Appendix E

Heat Pipe Performance Uncertainty Analyses

McCoy, D. C., "Milliken Station Heat Pipe Air Heater Performance Uncertainty Analysis," CONSOL R&D Report to NYSEG, New York State Electric & Gas Corporation, Binghamton, New York, June 1995.

Maskew, J. T., "Milliken Station Heat Pipe Air Heater Performance Uncertainty Analysis of "Totally Corrected Gas Temperature Leaving The Air Heater", CONSOL R&D Report to NYSEG, New York State Electric & Gas Corporation, Binghamton, New York, April 1996.

MILLIKEN STATION HEAT PIPE AIR HEATER PERFORMANCE UNCERTAINTY ANALYSIS

Prepared By

CONSOL Inc.
Research and Development
4000 Brownsville Road
Library, Pennsylvania 15129-9566

Principal Investigators
D. C. McCoy
R. A. Bilonick

Prepared For

New York State Electric & Gas Corporation
Corporate Drive
Kirkwood Industrial Park
P.O. Box 5534
Binghamton, New York 13902-5224

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Milliken Station Heat Pipe Air Heater Performance Uncertainty Analysis

This report documents the heat pipe performance uncertainty analyses done by CONSOL R&D. The uncertainty analyses were requested by ABB Air Preheater Inc., ABB API, and New York State Electric & Gas Corporation, NYSEG, as part of the performance testing program. The results indicate that for the two areas of most concern, i.e., the flue gas outlet temperature measurement and the percent air leakage, the measurement errors will be small. For the heat pipe operating at the design outlet temperature of 253°F, the measured outlet temperature uncertainty is likely to be less than about 2.6°F. The air leak uncertainty is likely to be less than 1.6 wt %.

Uncertainty Calculations ABB API requested that overall uncertainty analyses be calculated for:

- 1. Weighted average temperature for each traverse plane
- 2. Air and gas flows
- 3. Air-to-gas leakage rate.

The analysis is to develop performance test tolerance criteria which can be agreed to by NYSEG and ABB API.

The uncertainty analysis is a method of estimating the potential error in a result caused by errors in measured parameters. Errors fall into two catagories, bias or fixed errors and random errors. Bias errors remain constant during a test and cannot be reduced by repeated measurement of a parameter. However, if the cause of the bias is known, the bias can sometimes be accounted for and eliminated. Instrument signal off set is one type of bias error which can be eliminated by calibration.

Random errors are errors which can be reduced by repeated measurement. Measurement fluctuations due to changes in personnel, environmental fluctuations, instrument noise etc. represent types of random errors.

The ASME procedure for calculating uncertainty recommends that sources and levels of bias and random errors be identified.⁽¹⁾ These errors are propagated separately through the calculation procedure to the final result. The error propagation is calculated by Taylor Series expansion of the result function. In general, if $r = f(x_1,...x_i,....x_n)$ then the error statistics, S_r , for bias and random errors are each calculated separately by applying:⁽²⁾

$$S_{r} = \left(\sum_{i,j=1}^{n} \frac{\partial f}{\partial x_{i}} \frac{\partial f}{\partial x_{j}} \sigma_{x_{j}} \sigma_{x_{j}}\right)^{1/2}$$
(1)

$$\frac{\partial f}{\partial x_i}, \frac{\partial f}{\partial x_j}$$
 = Partial Derivatives of f With Respect to x_i and x_j

 $\sigma_{x_i}, \sigma_{x_j} = Error Standard Deviations$

When parameters are independent only the i=j terms are significant. The cross product terms $i\neq j$ are zero. However, when parameters are not independent (i.e. are linked or correlated) the cross product terms must be considered. An example would be the use of a single thermocouple to measure all temperatures in a traverse plane. The bias associated with the measurements is the same for all points, therefore, there is a 1:1 correlation. Here the cross product terms must be evaluated to obtain the proper bias error statistic.

Depending upon the desired range of coverage (level of confidence) the uncertainty is calculated by:

$$U = (B^2 + (tS)^2)^{1/2}$$
 (2)

Where:

U = Uncertainty Interval

B = Overall Bias Error Statistic

S = Overall Random Error Statistic

t = Percentile Point For Student t Distribution

Normally t is selected for 95% coverage. If the random error standard deviations for the primary measurements can be taken to represent the result of a large number of repeated measurements, then t is 1.96 or for simplicity assumed to be 2.0.

Temperature Traverse Uncertainty Calculations The following is a calculation example for uncertainty calculations. Except for the secondary air inlet temperature, which will be obtained by a straight average of 4 thermocouples, all flue gas and air inlet/outlet temperatures will be obtained by pitot/temperature traverses of the ductwork. The average temperatures will be calculated using the formula:

$$T_{avg} = \frac{\sum_{i=1}^{n} A_i V_i \rho_i T_i}{\sum_{i=1}^{n} A_i V_i \rho_i}$$
(3)

 A_i = Cross Section i Area, ft^2

i = Traverse Point Number

 T_i = Temperature in Center of Area A_i , ${}^{\circ}F$

 $V_i = Gas \ Velocity \ in \ Area \ A_i, fps$

 ρ_i = Gas Density in Area A_i , lb/ft^3

The gas velocity in each area section, A_i is obtained by:

$$V_i = 85.49CP_i \left(\frac{DP_iT_i}{P_{st}M_i}\right)^{1/2} \tag{4}$$

Where:

CP; = Pitot Tube Flow Rate Coefficient, Dimensionless

DP_i = Velocity Head In Area A_i, In. WC

P_{si} = Static Pressure In Area A_i, In. Hg Absolute

 $M_i = Gas \ Mol \ Wt. \ In \ Area \ A_i, \ lbs/lb-mol$

and the gas density by:

$$\rho_i = \frac{0.04578 M_i P_{si}}{T_i} \tag{5}$$

Combining Equations 3, 4, and 5 gives:

$$T_{avg} = \frac{\sum_{i=1}^{n} CP_{i}A_{i}(DP_{i}M_{i}P_{si}T_{i})^{1/2}}{\sum_{i=1}^{n} CP_{i}A_{i}\left(\frac{DP_{i}M_{i}P_{si}}{T_{i}}\right)^{1/2}}$$
(6)

To obtain sensitivities for the uncertainty calculations, Equation 6 is differentiated with respect to each variable. If we let the SUM1 equal the denominator of Equation 6 and SUM2 the numerator, then the derivatives are:

$$\frac{\partial T_{avg}}{\partial A_i} = \frac{CP_i SUMI (DP_i M_i P_{si} T_i)^{1/2} - CP_i SUM2 \left(\frac{DP_i M_i P_{si}}{T_i}\right)^{1/2}}{SUMI^2}$$
(7)

$$\frac{\partial T_{avg}}{\partial CP_i} = \frac{A_i SUMI (DP_i M_i P_{si} T_i)^{1/2} - A_i SUM2 \left(\frac{DP_i M_i P_{si}}{T_i}\right)^{1/2}}{SUMI^2}$$
(8)

$$\frac{\partial T_{avg}}{\partial DP_{i}} = \frac{A_{i}CP_{i}SUMI(M_{i}P_{si}T_{i})^{1/2}DP_{i}^{-1/2} - A_{i}CP_{i}SUM2\left(\frac{M_{i}P_{si}}{T_{i}}\right)^{1/2}DP_{i}^{-1/2}}{2SUM1^{2}}$$
(9)

$$\frac{\partial T_{avg}}{\partial M_{i}} = \frac{A_{i}CP_{i}SUMI(DP_{i}P_{si}T_{i})^{1/2}M_{i}^{-1/2} - A_{i}CP_{i}SUM2\left(\frac{DP_{i}P_{si}}{T_{i}}\right)^{1/2}M_{i}^{-1/2}}{2SUM1^{2}}$$
(10)

$$\frac{\partial T_{avg}}{\partial P_{si}} = \frac{A_i C P_i S U M I (D P_i M_i T_i)^{1/2} P_{si}^{-1/2} - A_i C P_i S U M 2 \left(\frac{D P_i M_i}{T_i}\right)^{1/2} P_{si}^{-1/2}}{2 S U M I^2}$$
(11)

$$\frac{\partial T_{avg}}{\partial T_i} = \frac{A_i C P_i S U M I (D P_i M_i P_{si})^{1/2} T_i^{-1/2} + A_i C P_i S U M 2 (D P_i M_i P_{si})^{1/2} T_i^{-3/2}}{2 S U M I^2}$$
(12)

To evaluate Equation 1 we must now determine the biases and precision indices (random errors) associated with the measurements. These errors are determined from experiments, literature sources, and experience. Errors and sources are presented in Table 1. Most of the errors were taken from literature sources or were based on experience. The likely bias and sampling errors for the coal

Table 1

Summary of Bias Limits and Precision Indices For Uncertainty Calculations

Parameter	Bias Limit	Random Error (Precision) (1 Standard Deviation)	Comments
Dimensions			
Width	0.5" (0.042')	0.5" (0.042')	Assumed.
Length	0.5" (0.042')	0.5" (0.042')	Assumed.
Temperature	1% of °F Reading	1/2% of deg F Reading	Bias - Typical for Type K TC's; Actual Insturment Accuracy Is 0.1% Of Reading +/- 0.8 deg F; Precision - Typical Error Based on Experience (From ASME PTC 4.1).
Pressure			
Barometric	0.04" Hg	0.04" Hg	Calibrated Aneroid Barometer Readability.
Static	0.05" WC	0.05" WC (0.0037" Hg)	Water Manometer with 0.1" Scale, Readable to 0.05".
Velocity Head, DP	2% of Avg Reading	0.00005" WC	Bias - Instrument Design Specifications;
			Precision or Random Error - 1/2 Insturment Resolution.
Pitot Factor, CP	0.01	0.0	Calibration Accuracy.
Coal Analysis			
Moisture, Mf	3.9% of Mf	(0.20+0.012*Mf)/(2*1.414)	Bias - Assumed Same As For Ash;
			Precision - ASTM Analysis Repeatability.
С	3.9% of C	(0.64)/(2*1.414)	Bias - Assumed Same As For Ash;
			Precision - ASTM Analysis Repeatability.
Н	3.9% of H	(0.16)/(2*1.414)	Bias - Assumed Same As For Ash;
			Precision - ASTM Analysis Repeatability.
N	3.9% of N	(0.11)/(2*1.414)	Bias - Assumed Same As For Ash;
			Precision - ASTM Analysis Repeatability.
S	1.9% of S	(0.06+0.035*S)/(2*1.414)	Bias - From Washability Data;
		, , , ,	Precision - ASTM Analysis Repeatability
Ash	3.9% of Ash	(0.07+0.02*Ash)/(2*1.414)	Bias - From Washability Data;
		(**************************************	Precision - ASTM Analysis Repeatability.
Carbon In Ash	25% of Ash Carbon	10% of Ash Carbon	Bias - From Unit 2 LOI Data; Precision - Assumed.
Coal Rate, Wfe	5.0% of Wfe	0.25% of Wfe	Bias - Assumed; Precision - Typical Value for Calibrated Scales Based on Experience (Form PCT 4.1).
Gas Analyses			
O2	0.05% Absolute	0.05% Absolute	Bias - Cal. Gas Spec.; Precision - Low O2 Calibration.
CO	20 ppm (0.002%)	10 ppm (0.001%)	Insturment Design Specification.
CO2	0.1% Absolute	3% of Measurement	Bias - Burette Scale Division Readability; Precision - Orsat Error Based on Experience (From PCT 4.1).
Air Moisture	10% of Humidity	20% of Humidity	Bias - Estimate Based on 1 deg F Error In Measured T; Precision - Estimate Based on 2 deg F Error In Wet Bulb.
MW			
Flue Gas	0.05	0.07	Bias & Precision - Uncertainty Analysis Results Based On Composition Bias Limits and Precision Indices for Coal, Ash, and Flue Gas.
Air	0.025	0.05	Bias & Precision - Uncertainty Analysis Results Based On Bias and Precision Errors for Air Humidity.

sulfur and ash analyses were determined from coal washability data based on a method by $Gy^{(3)}$ and illustrated in Bilonick. The method requires ash and sulfur measurements for various size and density fractions. This information was taken from the results of a coal washability study on coal from CONSOL's Bailey Mine which was performed on January 16, 1993. The coal top-size was assumed to be 3/4 inch to be consistant with the Milliken Station sample size. The calculations were performed for sample sizes of 1 lb and 4 lbs. Data were not available to calculate bias errors for the coal moisture (m_f), C, H, and N; so as a conservative estimate, the bias error for these components was assumed to be the same as for the ash. Also to be conservative, large bias errors were assumed for the refuse carbon (carbon in the ash relative 25%) analysis and for the coal feed rate (relative 5%).

Equation 1 can now be evaluated using the biases and random errors listed in Table 1, and Equations 7 to 12 to calculate sensitivitives. A spreadsheet program was developed. The results of this program were later checked using the MAPLETM relational math computer program. The results of the two programs were essentially identical; indicating that the explicit partial derivatives used in the spreadsheet program were properly evaluated.

The results of the average temperature uncertainty calculations are presented in Appendix A. Bias and random errors in each traverse plane (primary air inlet/outlet, secondary air inlet/outlet, and flue gas inlet/outlet) are included. The traverse bias evaluation includes cross product terms for measured parameters (i.e. T_i with T_j , A_i with A_j , DP_i with DP_j , etc., where $i \neq j$). This accounts for the use of the same equipment to obtain measurements for each point in a traverse. Normally, only one thermocouple will be used for all temperature measurements in a traverse plane; one pressure transducer for all velocity head measurements; one gas analyzer for all gas compositions etc. Therefore, the bias errors associated with the readings are correlated 1:1 for each traverse point. Cross product terms between parameters, such as between temperature and gas composition, or temperature and velocity head, are not included since these parameters are independent of each other.

Table 2 summarizes the uncertainty analysis results for the average flue gas and air stream temperatures around the heat pipe. The major contribution to the uncertainties in the average inlet/outlet temperatures is the bias error of the temperature measuring system. Bias and random errors in the other measured parameters do not contribute to the uncertainty. For the calculations, the bias error is assumed to be 1% of the thermocouple reading in °F. This is based on typical errors cited in the literature. The uncertainty analysis indicates that the estimate of the average flue gas outlet temperature will be only about ± 2.6 °F for 95% coverage if the heat pipe operates at the design 253 °F outlet. To reduce this error further, the temperature measuring equipment will be calibrated before testing against a National Institute of Standards and Technology (NIST) traceable thermocouple and potentiometer. The calibration will cover the expected operating range for heat pipe testing.

The input data shown in Appendix A Tables A-1 through A-12 are dummy values for design case conditions. Except for an assumed temperature spacial bias, input data values are constant for each parameter (i.e. A_i, CP_i, DP_i, M_i, Ps_i). A comparison of Tables A-1 with A-13 and A-7 with A-14

Uncerta	inty Estima	Table 2	ge Duct T	emperature	s
	Based o	n Multi-Poin	t Traverse	s	
Location	No. of Traverse Points	Operating Temp. °F	Bias Error °F	Random Error °F	Uncertainty °F (1)
Primary Air Inlet	12	80	0.80	0.12	0.84
Primary Air Outlet	20	644	6.44	0.74	6.61
			· · · · · · · · · · · · · · · · · · ·		
Secondary Air Inlet	4	80	0.80	0.20	0.89
Secondary Air Outlet	24	616	6.16	0.70	6.32
Flue Gas Inlet	20	680	6.81	0.81	6.99
Flue Gas Outlet	24	253	2.53	0.35	2.63
(1) Calculated by Equ	uation 2.				

shows the effect of non-uniform input data on the bias and precision errors respectively. For the weighted averages, the weighting does not significantly affect the overall bias and precision errors of the average result. Because the weighting terms are in the numerator and denominator of the result function and the errors tend to cancel. This shows that use of actual data will have little effect on the estimated uncertainties.

Primary Air Flow Rate Uncertainty Calculations The proposed heat pipe performance test procedure requires direct measurement of the primary air flows exiting each air heater. The flow rates will be determined using the following equation:

$$W_{air} = 14088CP \sum_{i=1}^{n} A_{i} \left(\frac{P_{st} M_{i} DP_{i}}{T_{i}} \right)^{1/2}$$
 (13)

Since terms A_i , CP, P_{si} , and M_i will be essentially constant for each traverse point, single values can be used for these parameters and Equation 13 can be simplified to:

$$W_{air} = 14088 \cdot A \cdot CP \cdot (P_s M)^{1/2} \sum_{i=1}^{n} \left(\frac{DP_i}{T_i}\right)^{1/2}$$
 (14)

 $A_i = Cross Section i Area, ft^2$

CP = Pitot Tube Flow Coefficient, Dimensionless

DP, = Velocity Head in Center of Area A, in. WC

i = Traverse Point Number

 $M_i = Air Mol Weight (wet) in Area A_i, lbs/mol$

P_{si} = Static Pressure in Duct, in. Hg

 T_i = Temperature in Center of Area A_i , ${}^{\circ}R$

W_{air} = Primary Air Outlet Flow, lb/hr

For test purposes, it is assumed that the primary air inlet flow is equal to the measured outlet flow. However, for the uncertainty evaluation presented here, Equation 14 was evaluated for both the inlet and outlet flows. The inlet flow is through a rectangular duct (3.28'x17.5') while the outlet flow is through a 4' diameter round duct. For these calculations the Maple relational math computer program was used. The program listings and calculated results are presented in Appendices B-1 to B-4.

Table 3 summarizes the 95% coverage uncertainty estimates. The uncertainties for the inlet and outlet primary air flow rates should not exceed about 7% and 5%, respectively. These are conservative results, the actual uncertainty may well be less. In Appendix B the individual contributions due to errors associated with the air humidity, pitot factor, velocity head, temperature, pressure, and traverse area are listed. The largest contributors to the air flow rate uncertainties are the bias and random errors associated with flow area terms. Throughout this analysis, a 1/2" standard deviation was assumed for length, width, and diameter terms associated with the incremental traverse areas. This assumption, when propogated through the incremental area calculations, results in relatively large, conservative, standard deviations for the calculated bias and random errors associated with the traverse areas.

Realistic average pitot velocity heads were assumed for the uncertainty calculations. The slight difference in the inlet and outlet flow rates is a consequence of not adjusting the velocity heads exactly to achieve identical flow rates. This has no effect on the calculated uncertainties.

			Table	3			
	Uncer	rtainty Est	imates for	Primary A	ir Streams	S	
		<u>Bias</u>	<u>Error</u>	Randor	n Error	<u>Uncer</u> 95% Ir	
Stream	Value lbs/hr	Abs lbs/hr	Rel %	Abs lbs/hr	Rel %	Abs lbs/hr	Rel %
Air In	62300	2060	3.31	1820	2.93	4190	6.72
Air Out	62500	1640	2.61	1300	2.08	3075	4.92

<u>Flue Gas Flow Rate Uncertainty Calculations</u> The flue gas flow to each heat pipe is determined in the following manner:

- (1) The inlet flue gas ducts to each heat pipe are pitot tube traversed to obtain temperature, velocity, and gas composition data.
- (2) Carbon flow rates as SCFH CO₂ to each heat pipe are calculated from the pitot data.
- (3) The carbon burn split to each heat pipe is calculated from the CO₂ flow rates (needed since flue gas flow is calculated as lbs gas/lb AF coal).
- (4) Average inlet flue gas compositions to each heat pipe (i.e. \overline{CO} , \overline{CO}_2 , and \overline{O}_2) are calculated from pitot probe gas analysis data).
- (5) The combustion air rate required to produce the flue gas to each heat pipe is calculated from the coal analysis, ambient air moisture, and dry flue gas analyses.
- (6) The flue gas moisture content is calculated from the coal analysis and calculated combustion air rate.
- (7) The flue gas rate is then calculated from the coal analysis, average dry gas analysis, flue gas moisture content, coal feed rate, and carbon burn split.

The above procedure is discussed below and appropriate equations presented. Outlet flue gas flows are calculated in the same fashion.

The CO₂ flow rates at standard conditions to each heat pipe are calculated from gas analyse, temperature, static pressure, and velocity traverse data by:

$$FA_{CO_2} = 53,488 \sum_{i=1}^{20} A_{FGIi} CP \left(\frac{DP_i P_{si}}{T_i M_i} \right)^{1/2} (1 - M_{FGIi}) CO_{2i}$$
 (15)

and

$$FB_{CO_2} = 53,488 \sum_{i=1}^{20} A_{FGIi} CP \left(\frac{DP_i P_{si}}{T_i M_i} \right)^{1/2} (1 - M_{FGIi}) CO_{2i}$$
 (16)

 A_{FGIi} = Flue Gas Inlet Duct Area For Traverse Point i, ft^2

 CO_{2i} = CO_2 Concentration In Area A_{FGIi} , Vol %

CP = Pitot Tube Flow Coefficient, Dimensionless

 DP_i = Velocity Head In Area A_{FGIi} , in. WC

 FA_{CO_2} , $FB_{CO_2} = CO_2$ Flow To "A" & "B" Heat Pipes Respectively, SCFH

i = Traverse Point Number

M_i = Flue Gas Mol Weight (wet) In Area A_{FGli}, lbs/mol

M_{FGIi} = Flue Gas Moisture In Area A_{FGIi}, Mol Fraction

P_{si} = Duct Static Pressure In Area A_{FGIi}, in. Hg

 T_i = Temperature In Area A_{EGI} , ${}^{\circ}R$

The flow split is then determined by:

$$SA = \frac{FA_{CO_2}}{(FA_{CO_2} + FB_{CO_2})} \tag{17}$$

$$SB = 1.0 - SA \tag{18}$$

Where:

SA = Flow Split To "A" Side Air Heater, Fraction

SB = Flow Split To "B" Side Air Heater, Fraction

For the uncertainty calculations, the assumption is made that 90% of the fly ash goes overhead in the boiler and that the bottom ash has one-third the carbon level of the overhead. The carbon in the refuse is therefore:

$$C_{R} = \frac{A \times OVHD \times C_{a}}{1 - C_{a}} + \frac{A \times (1.0 - OVHD) \times \frac{C_{a}}{3}}{1.0 - \frac{C_{a}}{3}}$$
(19)

$$C_h = C - C_R \tag{20}$$

A = Coal Ash Content, lbs/lb As Fired (AF) Coal

C = Coal Carbon Content, lbs/lb AF Coal

 C_a = Carbon In Fly Ash, lbs/lb

C_b = Coal Carbon Burned, lbs/lb AF Coal

OVHD = Fraction Fly Ash To Overhead, (0.9 For Calculations)

The average dry gas compositions to each heat pipe are determined by:

$$\overline{CO} = \frac{\sum_{i=1}^{20} A_{FGIi} \left(\frac{DP_i P_{si}}{M_i T_i} \right)^{1/2} (1 - M_{FGIi}) CO_i}{\sum_{i=1}^{n} A_{FGIi} \left(\frac{DP_i P_{si}}{M_i T_i} \right)^{1/2} (1 - M_{FGIi})}$$
(21)

$$\overline{CO_2} = \frac{\sum_{i=1}^{20} A_{FGIi} \left(\frac{DP_i P_{si}}{M_i T_i}\right)^{1/2} (1 - M_{FGIi}) CO_{2i}}{\sum_{i=1}^{n} A_{FGIi} \left(\frac{DP_i P_{si}}{M_i T_i}\right)^{1/2} (1 - M_{FGIi})}$$
(22)

$$\overline{O_2} = \frac{\sum_{i=1}^{20} A_{FGIi} \left(\frac{DP_i P_{si}}{M_i T_i} \right)^{1/2} (1 - M_{FGIi}) O_{2i}}{\sum_{i=1}^{n} A_{FGIi} \left(\frac{DP_i P_{si}}{M_i T_i} \right)^{1/2} (1 - M_{FGIi})}$$
(23)

The flue gas moisture mol fraction, M_{FGIi}, and the wet mol weight, M_i, are:

$$M_{FGIi} = \frac{0.055506K_{4i}}{0.055506K_{4i} + 100K_{3i}} \tag{24}$$

$$M_{i} = \frac{18.016K_{4i} + K_{3i}(288.08CO_{2i} + 71.70O_{2i} + 50481)}{K_{4i} + 1801.6K_{3i}}$$
 (25)

$$K_{3i} = \frac{C_b + \frac{12.01S}{32.07}}{12.01(CO_{2i} + CO_i)}$$
 (26)

$$K_{4i} = 8.936H + Wma \left[\frac{28.02(100 - CO_i - CO_{2i} - O_{2i})K_{3i} - N}{0.7685} \right] + m_f$$
 (27)

and:

H = Coal Hydrogen, lbs/lb AF Coal

 K_{3i} = Constant Equivalent To mols Flue Gas /lb AF Coal/100

 K_{4i} = Flue Gas Moisture In Area A_{FGIi} , lbs/lb AF Coal

 m_f = Coal Moisture, lbs/lb AF Coal

N = Coal Nitrogen, lbs/lb AF Coal

S = Coal Sulfur, lbs/lb AF Coal

Wma = Air Humidity, lbs/lb Bone Dry Air

CO; = Flue Gas Carbon Monoxide Level In Area A_{FGI}, Vol %

 CO_{2i} = Flue Gas Carbon Dioxide Level In Area A_{FGIi} , Vol %

O2i = Flue Gas Oxygen Level In Area AFGIi, Vol %

To obtain the average flue gas moisture, \overline{M}_{FGI} , Equations 26, 27, and 24 are evaluated replacing CO_i , CO_{2i} , and O_{2i} with \overline{CO} , \overline{CO}_2 , and \overline{O}_2 . Once average values are obtained for the flue gas composition, the amount of combustion air and the moisture in the flue gases are calculated by:

$$W_{AI} = \frac{\frac{28.02(100 - \overline{CO} - \overline{CO}_2 - \overline{O}_2)}{12.01(\overline{CO} + \overline{CO}_2)} \left(C_b + \frac{12.01S}{32.07}\right) - N}{0.7685}$$
(28)

and

$$W_{MGI} = 8.936H + (Wma \times W_{AI}) + m_f$$
 (29)

Where:

W_{AI} = Combustion Air Requirement, lbs/lb AF Coal

 W_{MGI} = Inlet Flue Gas Moisture, lbs/lb AF Coal

The flue gas inlet rate can be calculated using Equation (30):

$$W_{GI} = \frac{\left(44.01\overline{CO_2} + 32.02\overline{O_2} + 28.01\overline{CO} + 28.02\overline{N_2}\right)\left(C_b + \frac{12.01S}{32.07}\right)}{12.01(\overline{CO} + \overline{CO_2})} + W_{MGI}$$
(30)

Where:

 $\overline{N_2}$ = Flue Gas Average Nitrogen Level (100 - \overline{CO} - $\overline{CO_2}$ - $\overline{O_2}$), Dry Vol %

 W_{GI} = Flue Gas Inlet Rate (Wet), lbs/lb AF Coal

In a sumilar fashion, the outlet flue gas rate from each heat pipe is calculated. The Power Test Code⁽⁵⁾ (para. 5.4) recommends that the flue gas rates be calculated from the fuel analysis and flue gas composition as shown above. The method yields the pounds of flue gas produced per pound of as-fired fuel. The total flue gas rate is then determined from the product of this calculation and the measured fuel feed rate. Rates in lbs/hr to and from the "A" side heat pipe are:

$$W_{TFGL} = W_{Gl} \times W_{fe} \times SA \tag{31}$$

$$W_{TFGO} = W_{GO} \times W_{fe} \times SA \tag{32}$$

 W_{GI} = Flue Gas Inlet Rate Based On "A" Side Conditions, lbs/lb AF Coal

 W_{GO} = Flue Gas Outlet Rate Based On "A" Side Conditions, lbs/lb AF Coal

W_{fe} = As Fired Coal Rate, lbs/hr

SA = Flue Gas Flow Split To "A" Side, Fraction

Based on the above, the flue gas flow rate calculation is complicated, involving several steps and depending upon a large number of variables. To expidite the uncertainty calculations, the Maple relational math computer program was used. The program input is the series of equations leading to the desired final result. The program then generates a single equation from the series of equations. The single equation is differentiated to obtain the sensitivities. Parameter variances are then separately propogated to obtain the result term bias and random errors. Additionally, for the bias calculations, the program is set up to include covarances for dependent variables.

The computer outputs for the flue gas flow rate uncertainty estimates are presented in Appendices C through H. The reader is cautioned that some printouts contain extraneous calculations which are not needed for the calculation of the specific result shown. For example, the primary air flow and air leak results are shown in the flue gas inlet flow bias error calculation (Appendix G-1). These calculations are superfluous to the flue gas rate calculation. The reason is that program files were copied and modified to suit specific calculation needs. Frequently, not all unrelated calculations were eliminated from a modified file. The reader should be aware that only lines with a right facing carrot (>) are executed by the program. Otherwise, the statement is assumed to be a comment by the program. On some print outs comments have been "penciled in" to help with interpertation.

Some problems exceeded the memory of the PC used (i.e. > 40 Megabytes RAM and 60 Megabytes virtual memory). Examples are the bias and random error calculations for average dry gas compositions where pitot traverses contain more than about 10 or 12 data points. The problem was overcome by extrapolating program results for a small number of traverse points. The bias errors were found to be independent of the number of traverse points and the random errors varied inversely with the square root of the number of data points (a result expected based on the statistics of averaging several measurements⁽¹⁾).

To reduce the complexity of calculating flue gas flow rate bias and random errors, the bias and random errors for the average dry gas compositions were first calculated and then used via error propogation. This was done because of machine memory limitations as mensioned above. Appendix C-1 contains the bias error associated with the average \overline{CO}_2 concentration at the inlet of a heat pipe, based on pitot traverses. Two calculations are presented for 2 point and 4 point traverse data. The results show that the bias is independent of the number of traverse points and is equal to the input bias shown in Table 1. Therefore, the biases for \overline{CO} and \overline{O}_2 are the same as shown in Table 1.

The random errors associated with the calculation of the average inlet dry flue gas compositions are shown in Appendices D-1 through D-3, and for the outlet compositions in Appendices E-1 through E-3. Appendix D-1 shows the random error associated with the calculation of the inlet dry CO₂ concentration for 8 point and 12 point traverses. Direct calculation of the results for 20 point traverses was not possible because of computer memory limitations. However, as shown in the D-1 Appendix results, extrapolation of the 8 point and 12 point travese results to 20 point, gives the same result.

Appendices F-1 and F-2 present the bias and random errors respectively for the flue gas inlet flows. Appendices G-1 through G-4 are the bias and random error calculations for the flue gas outlet flows. Two cases are presented. Case 1 is for zero air leak into the flue gas, Case 2 is for nominal air leak of 6.9 wt %. Appendices H-1 and H-2 show the bias and random errors associated with the estimate of the flue gas flow split between the heat pipes. The split calculation is included here since it is needed to properly estimate the absolute flow rate to each heat pipe (see Equation 31).

The results of the flue gas flow rate uncertainty calculations are summarized in Table 4. For the flue gas inlet flows, conditions were selected which provided approximately the design flue gas rate of 750,000 lb/hr to each heat pipe. For the flow split calculation, conditions were selected which provided different gas compositions to each heat pipe and approximately a 50/50 gas split between the two heat pipes. The results indicate that the uncertainty in the flue gas flows is less than 6.5% relative and the uncertainty in the flow split is less than 1 % relative.

	Lincont		Table 4		Dotos		
		•		r Flue Flow tween Heat			
		Bias Er	<u>ror</u>	Random	<u>Error</u>	<u>Uncert</u> 95% In	
Stream	Value lbs/hr	Abs lbs/hr	Rel %	Abs lbs/hr	Rel %	Abs lbs/hr	Rel %
Flue Gas In	754,800	47,400	6.28	5,680	0.75	48,700	6.46
Flue Gas Out No Leak	754,800	47,200	6.25	3,460	0.46	47,700	6.32
Flue Gas Out With Leak	806,592	50,458	6.26	3,708	0.46	51,000	6.32
Flow Split to 'A' Side (SA)	51.7%	0.2214%	0.43	0.2175%	0.49	0.49%	0.94
\	<u> </u>	Acres Carrier Carrier			L		1

<u>Secondary Air Flow Rate Uncertainty Calculations</u> The primary air flows from the heat pipes will be measured by pitot traverses of the outlet ducts. The secondary air rates will be calculated

from a heat balances around the heat pipes. For either heat pipe the secondary air rate is determined by the following equation:

$$W_{SAI} = \frac{W_{FGI}[C_{PFG}(T_{FGI} - T_{FGO}) - (AL)C_{PAL}(T_{FGO} - T_{ALI})] - W_{PAO}C_{PPA}(T_{PAO} - T_{PAI})}{C_{PSA}(T_{SAO} - T_{SAI})}$$
(33)

Where:

AL = Fraction Air Leakage, Pounds Air Leak Per Pound Entering
Flue Gas

 C_{PAL} = Leaked Air Specific Heat From T_{ALI} To T_{FGO} , Btu/Lb- $^{\circ}F$

 C_{PFG} = Flue Gas Specific Heat From T_{FGI} To T_{FGO} , Btu/lb- $^{\circ}F$

 C_{PPA} = Primary Air Specific Heat From T_{PAI} To T_{PAO} , Btu/lb- $^{\circ}F$

 C_{PSA} = Secondary Air Specific Heat From T_{SAI} To T_{SAO} , Btu/lb- $^{\circ}F$

W_{FGI} = Flue Gas Flow In, lb/lb A.F. Coal

 W_{PAO} = Primary Air Flow In, lb/lb A.F. Coal

 W_{SAI} = Secondary Air Flow In, lb/lb A.F. Coal

 T_{FGI} , T_{FGO} = Flue Gas In, Out Temperature Respectively, ${}^{\circ}F$

 T_{PAI} , T_{PAO} = Primary Air In, Out Temperature Respectively, °F

 T_{SAP} , T_{SAO} = Secondary Air In, Out Temperature Respectively, ${}^{\circ}F$

 T_{ALI} = Air Leak In Temperature (Same As T_{SAI}), °F

Bias and random error calculations for the secondary air flows are shown in Appendices I-1 through I-4. Appendices I-1 and I-2 are for a zero leak case while Appendices I-3 and I-4 are for a 6.9 wt % leak case. Table 5 summarizes the results.

Comparing Tables 3, 4, and Table 5 shows that the relative uncertainty in the secondary air rate is somewhat less than for the primary air inlet and the flue gas inlet and outlet rates.

<u>Air Leak Uncertainty Calculations</u> The leak from air side to the flue gas side within the air heater is calculated from the difference between the inlet and outlet flue gas flow rates by:

$$AL' = \frac{W_{GO} - W_{GI}}{W_{GI}} \times 100 \tag{34}$$

Equation 34 represents the air leak as a weight percentage of the inlet flue gas flow rate.

	•	.	Table 5		D1 D		
l	Incertainty	Estimates	for Seco	ondary Air	Flow R	lates	
		Bias E	rror	Random	<u>Error</u>	<u>Uncerta</u> 95% Int	
Stream	Value lbs/hr	Abs lbs/hr	Rel %	Abs lbs/hr	Rel %	Abs lbs/hr	Rel %
2nd Air In/Out (Zero Air Leak Case)	573,700	28,800	5.02	3,890	0.68	29,900	5.20
2nd Air In/Out (6.9 wt % Air Leak)	557,400	28,000	5.02	3,830	0.69	29,000	5.21
, , , , , , , , , , , , , , , , , , , ,							

The uncertainty in the air leak calculation is summarized in Table 6. Calculations are presented in Appendices J-1 to J-4 for a zero leak case and a case with air leak. For the zero leak case, the inlet and outlet dry flue gas O_2 concentrations were both assumed to be 3.8 vol %. For the air leak case, a 5.0 vol % average outlet O_2 concentration was assumed. This resulted in a 6.9 wt % calculated air leak. The 95 % coverage uncertainties are similar for the two cases, i.e., 1.56 wt % for zero leak, and 1.73 wt % for 6.9 wt % air leak. Since the heat pipe air heaters are designed for zero air leak, the 6.9 w. % leak case indicates a significant mechanical failure. This level of air leakage should be readily detected since the difference between inlet and outlet average O_2 levels is 1.2 vol. % (i.e., 5.0% - 3.8%) and the accuracy of the oxygen analyzer is 0.05 vol. % absolute.

The air leak uncertainties upon first inspection appear to be rather large. The relative uncertainty for the zero leak case is infinity (or not defined) and is +25% for the 6.9 wt % leak case. However, the absolute uncertainties actually translate into relatively small differences between inlet and outlet average O_2 concentrations i.e., 0.29 and 0.32 vol. % for the no leak and with leak cases, respectively. Again, this level of difference should be readily identified by inlet/outlet traverses and oxygen analyzer readings.

Establishing that an absolute zero air leak is achieved will be time consuming and expensive since a large number of tests would likely be required. Based on the uncertainty results, one would expect that for a zero leak rate, the test results would vary between ±1.56 wt %. Therefore, CONSOL

proposes that a zero leak be considered demonstrated if the calculated leak rate (after correction for sootblower seal and vent valve leaks) is 1.6 wt % or less for two full load boiler tests.

		7	Cable 6				
	Unc	ertainty Es	stimate 1	for Air Le	ak		
		Bias E	<u>rror</u>	Randon	n Error	<u>Uncer</u> 95% II	
Case	Value wt %	Abs wt %	Rel %	Abs wt %	Rel %	Abs wt %	Rel %
Zero Air Leak	0.0	0.020	ND	0.782	ND	1.56	ND
Air Leak Case	6.87	0.058	0.85	0.866	12.60	1.73	25.21
ND Not De	efined						

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Appendix A Bias and Random Error Calculations Air and Flue Gas Stream Temperatures

Table A-1

Blas Error Calculation — Primary Air Inlet

Milliken Heat Pipe Air Preheater

	Averege Value	Sigma Absolute	Sigma Relative						•											
Duct Size																				
Width, It	3.26	0.042	1.27%																	
Length, ft	17.5	0.042	0.24%																	
	12																			
Widthwise	2																			
Longthwise	6																			
Sector Width, ft	1.64	0.042																		
Sector Length, ft	2.92	0.042																		
A, Sector Area ft^2	4.78	0.139	2.91%																	
T, deg F	80	0.800	1.00%																	
T, deg R	540	0.800																		
Special Blas, deg F	10		2.00	deg F/Length	Increment S	pacial Blas			1											
DP, In WC	0.005069	0.0001	2.00%	•																
M, lb/mol	26.65	0.025	0.09%	•																
Amb Pres, In. Hg	29.50																			
Duct Pres, In. WC	48.00																			
Ps, in. Hg Absolute	31.23	0.040	0.13%	•																
CP, Pitot Fact	0.84	0.0100	1.19%																	
Nominal Vel, fps	3.96	ACFM=	13631	SCFM= 1	13702	lb/hr= 6	2500													
110111111111111111111111111111111111111											Derivatives, d	T_ 1,10					(dTa/dX*8	iame) ^ 2		
			Deta					·~ ·	dTa/dTI	dTa/AI			dYa/dMi d	Ta/dPai	d/dTI*STI	d/dAI*SAI	a/acpi*scpi		d/dMi*SM	d/dPei*SPe
Point	A	CPI	DPI	M	Pal	Ti	(1)	(2)	8.41E-02	-8.73E-02	-4.97E-01 -4			6.7E-03	4.53E-03	1.48E-04	2.47E-05	1.74E-05	3.28E-08	7.21E-08
1	4.78	0.84		28.85	31.23	535.0	0.371	198.6		-6.73E-02 -5.22E-02	-2.97E-01 -2			4.0E-03	4.49E-03	5.30E-05	8.84E-06	6.24E-06	1.17E-08	2.58E-08
2	4.78	0.84		26.85	31.23	537.0	0.371	199.0	8.38E-02	-5.22E-02	-2.87E-01 -2			1.3E-03	4.46E-03	5.78E-06	9.65E-07	6.81E-07	1.28E-09	2.82E-09
3	4.78	0.84		26.85	31.23	539.0	0.370	199.4	8.35E-02	-1.72E-02 1.76E-02	1.00E-01 8.3		1.46E-03		4.43E-03	6.02E-06	1.00E-06	7.08E-07	1.33E-09	2.93E-09
4	4.78	0.84	0.005089	26.85	31.23	541.0	0.369	199.7	8.32E-02		2.98E-01 2.4				4.40E-03	5.32E-05	8.87E-06	6.26E-06	1.18E-08	2.59E-08
5	4.78	0.84	0.005089	26.85	31.23	543.0	0.309	200.1	8.29E-02	5.23E-02	2.95E-01 2.4 4.95E-01 4.				4.36E-03	1.47E-04	2.45E-05	1.73E-05	3.24E-08	7.14E-08
6	4.78	0.84	0.005069	28.85	31.23	545.0	0.368	200.5	8.26E-02	8.69E-02			-7.2E-03		4.53E-03	1.48E-04	2.47E-05	1.74E-05	3.26E-08	7.21E-08
7	4.78	0.84	0.005069	26.85	31.23	535.0	0.371	198.6	8.41E-02	-8.73E-02	-4.97E-01 -4				4.49E-03	5.30E-05	8.84E-06	6.24E-06	1.17E-08	2.58E-08
8	4.78	0.84	0.005069	28.85	31.23	537.0	0.371	199.0	8.38E-02	-5.22E-02	-2.97E-01 -2			4.0E-03	4.46E-03	5.78E-06	9.65E-07	8.81E-07	1.28E-09	2.82E-09
9	4.78	0.84	0.005069	28.85	31.23	539.0	0.370	199.4	8.35E-02	-1.72E-02	-9.82E-02 -8		-1.4E-03			6.02E-06	1.00E-06	7.08E-07	1.33E-09	2.93E-09
10	4.78	0.84	0.005069	28.85	31.23	541.0	0.369	199.7	8.32E-02	1.76E-02	1.00E-01 8.				4.43E-03		8.87E-08	6.26E-06	1.18E-08	2.59E-08
11	4.78	0.84	0.005069	28.85	31.23	543.0	0.369	200.1	8.29E-02	5.23E-02	2.98E-01 2.				4.40E-03	5.32E-05		1.73E-05	3.24E-08	7.14E-08
12	4.78	0.84	0.005069	28.85	31.23	545.0	0.368	200.5	8.26E-02	8.69E-02	4.95E-01 4.	10E+01	7.20E-03 (5.65E-03	4.36E-03	1.47E-04	2.45E-05	1./3E-05 DP	3.24E-06	7.14E-06 Ps
•-			ure - Simple	Average		540.00	Sum1	Sum2							T	A	CP		2.81E-23	-8.27E-24
			ure Weighte			539.99	4.434	2394.6				(Contribution	ne (3)	6.40E-01	8.47E-20	-8.47E-21	-2.03E-20	2.81E-23 0.64	-0.2/E-24
(1) AI*CPI(DPI*MI*P	a/Tn ≏o.5																Total Sk			A C
(2) AI*CPI(DPI*MI*P																	Tavg Sk	<u>şma</u>	0.80	deg r

⁽²⁾ AI*CPI(DPI*MI*PaI*TI) ~ 0.5

⁽³⁾ Contributions Include Cross Product Terms

Table A-1 (Continued) Cross Product Terms

d/dTi*d/dT	i*STi*STi										
	4.51E-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03	4.53E-03	4.51E-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03
4.51E-03		4.48E-03	4.46E-03	4.44E-03	4.43E-03	4.51E-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03	4.43E-03
4.49E-03	4.48E-03		4.44E-03	4.43E-03	4.41E-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03	4.43E-03	4.41E-03
	4.46E-03			4.41E-03	4.40E-03	4.48E-03	4.46E-03	4.44E-03	4.43E-03	4.41E-03	4.40E-03
4 46F-03	4 44F-03	4.43E-03	4.41E-03		4.38E-03	4.46E-03	4.44E-03	4.43E-03	4.41E-03	4.40E-03	4.38E-03
4 44F-03	4.43E-03	4.41E-03	4.40E-03	4.38E-03		4.44E-03	4.43E-03	4.41E-03	4.40E-03	4.38E-03	4.36E-03
4 53F-03	4.51E-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03		4.51E-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03
4 51F-03	4.49E-03	4.48E-03	4.46E-03	4.44E-03	4.43E-03	4.51E-03		4.48E-03	4.46E-03	4.44E-03	4.43E-03
4 49F-03	4.48F-03	4.46E-03	4.44E-03	4.43E-03	4.41E-03	4.49E-03	4.48E-03		4.44E-03	4.43E-03	4.41E-03
4 48F-03	4.46E-03	4.44E-03	4.43E-03	4.41E-03	4.40E-03	4.48E-03	4.46E-03	4.44E-03		4.41E-03	4.40E-03
4 46F-03	4.44E-03	4.43E-03	4.41E-03	4.40E-03	4.38E-03	4.46E-03	4.44E-03	4.43E-03	4.41E-03		4.38E-03
4.44F-03	4.43E-03	4.41E-03	4.40E-03	4.38E-03	4.36E-03	4.44E-03	4.43E-03	4.41E-03	4.40E-03	4.38E-03	
4.93E-02	4.91E-02	4.90E-02	4.88E-02	4.86E-02	4.85E-02	4.93E-02	4.91E-02	4.90E-02	4.88E-02	4.86E-02	4.85E-02
d/dDPi*d/d	IDPj*SDPi*	SDPj									
	1.04E-05	3.45E-06	-3.52E-06	-1.05E-05	-1.74E-05	1.74E-05	1.04E-05	3.45E-06	-3.52E-06	-1.05E-05	-1.74E-05
1.04E-05		2.06E-06	-2.10E-06	-6.25E-06	-1.04E-05	1.04E-05	6.24E-06	2.06E-06	-2.10E-06	-6.25E-06	-1.04E-05
3.45E-06	2.06E-06		-6.94E-07	-2.06E-06	-3.43E-06	3.45E-06	2.06E-06	6.81E-07	-6.94E-07	-2.06E-06	-3.43E-06
-3.52E-06	-2.10E-06	-6.94E-07		2.11E-06	3.50E-06	-3.52E-06	-2.10E-06	-6.94E-07	7.08E-07	2.11E-06	3.50E-06
-1.05E-05	-6.25E-06	-2.06E-06	2.11E-06		1.04E-05	-1.05E - 05	-6.25E-06	-2.06E-06	2.11E-06	6.26E-06	1.04E-05
-1 74F-05	-1 04F-05	-3.43F-06	3.50E-06	1.04E-05		-1.74E-05	-1.04E-05	-3.43E-06	3.50E-06	1.04E-05	1.73E-05
1.74E-05	1.04E-05	3.45E-06	-3.52E-06	-1.05E-05	-1.74E-05		1.04E-05	3.45E-06	-3.52E-06	-1.05E-05	-1.74E-05
1.04E-05	6.24E-06	2.06E-06	-2.10E-06	-6.25E-06	-1.04E-05	1.04E-05		2.06E-06	-2.10E-06	-6.25E-06	-1.04E-05
3.45E-06	2.06E-06	6.81E-07	-6.94E-07	-2.06E-06	-3.43E-06	3.45E-06	2.06E-06		-6.94E-07	-2.06E-06	-3.43E-06
-3 52F-06	-2 10F-06	-6.94F-07	7.08E-07	2.11E-06	3.50E-06	-3.52E-06	-2.10E-06	-6.94E-07		2.11E-06	3.50E-06
-1 05F-05	-6.25F-06	-2.06E-06	2.11E-06	6.26E-06	1.04E-05	-1.05E-05	-6.25E-06	-2.06E-06	2.11E-06		1.04E-05
-1.74E-05	-1.04E-05	-3.43E-06	3.50E-06	1.04E-05	1.73E-05	-1.74E-05	-1.04E-05	-3.43E-06	3.50E-06	1.04E-05	
-1.74E-05	-6.24E-06	-6.81E-07	-7.08E-07	-6.26E-06	-1.73E-05	-1.74E-05	-6.24E-06	-6.81E-07	-7.08E-07	-6.26E-06	-1.73E-05
d/dMi*d/d	Mj*SMi*SM	i									
	1.96E-08	6.47E-09	-6.60E-09	-1.96E-08	-3.26E-08	3.28E-08	1.96E-08	6.47E-09	-6.60E-09	-1.96E-08	-3.26E-08
1 96F-08		3 87F-09	-3.95E-09	-1.17E-08	-1.95E-08	1.96E-08	1.17E-08	3.87E-09	-3.95E-09	-1.17E-08	-1.95E-08
6.47F-09	3.87F-09		-1.30F-09	-3.88E-09	-6.44E-09	6.47E-09	3.87E-09	1.28E-09	-1.30E-09	-3.88E-09	-6.44E-09
-6.60E-09	-3.95E-09	-1.30E-09		3.95E-09	6.57E-09	-6.60E-09	-3.95E-09	-1.30E-09	1.33E-09	3.95E-09	6.57E-09
-1.96E-08	-1.17E-08	-3.88E-09	3.95E-09		1.95E-08	-1.96E-08	-1.17E-08	-3.88E-09	3.95E-09	1.18೬-08	1.95೬-08
-3.26E-08	-1.95E-08	-6.44E-09	6.57E-09	1.95E-08		-3.26E-08	-1.95E-08	-6.44E-09	6.57E-09	1.95E-08	3.24E-08
3.28E-08	1.96E-08	6.47E-09	-6.60E-09	-1.96E-08	-3.26E-08		1.96E-08	6.47E-09	-6.60E-09	-1.96E-08	-3.26E-08
1 96F-08	1 17F-08	3.87F-09	-3 95F-09	-1.17E-08	-1.95E-08	1.96E-08		3.87E-09	-3.95E-09	-1.17E-08	-1.95E-08
6 47F-09	3 87F-09	1.28E-09	-1.30E-09	-3.88E-09	-6.44E-09	6.47E-09	3.87E-09		-1.30E-09	-3.88E-09	-6.44E-09
-6 60F-09	-3 95F-09	-1.30E-09	1.33E-09	3.95E-09	6.57E-09	-6.60E-09	-3.95E-09	-1.30E-09		3.95E-09	6.57E-09
-1 96F-08	-1 17F-08	-3 88F-09	3.95E-09	1.18E-08	1.95E-08	-1.96E-08	-1.17E-08	-3.88E-09	3.95E-09		1.95E-08
-3.26E-08	-1.95E-08	-6.44E-09	6.57E-09	1.95E-08	3.24E-08	-3.26E-08	-1.95E-08	-6.44E-09	6.57E-09	1.95E-08	
-3.28E-08	-1.17E-08	-1.28E-09	-1.33E-09	-1.18E-08	-3.24E-08	-3.28E-08	-1.17E-08	-1.28E-09	-1.33E-09	-1.18E-08	-3.24E-08

Table A-1 (Continued) Cross Product Terms

d/dPsi*d/dP	ei*SDei*S	Dei									
d/di Si d/di	4 31F-08	1 43F-08	-1 45F-08	-4 32F-08	-7 18F-08	7.21F-08	4.31E-08	1 43F-08	-1 45F-08	-4 32F-08	-7.18F-08
4.31E-08	4.01E-00	8 52F-09	-8 69F-09	-2 58F-08	-4 29F-08	4.31F-08	2.58F-08	8.52F-09	-8 69F-09	-2 58F-08	-4 29F-08
1.43E-08	8 52F-00	0.02L-03	-2.87F-09	-8 54F-09	-1 42F-08	1.43F-08	8.52F-09	2.82F-09	-2 87F-09	-8 54F-09	-1 42F-08
-1.45E-08 -	9 60E 00	.2 87E-00	-2.07 L-00	8 71E-09	1.42E 00	-1.45E-08	-8 69F-09	-2.87F-09	2 93F-09	8 71F-09	1.45F-08
-4.32E-08 -	2 505 00	9.54E.00	9.71E-00	0.7 12-03	4.30E-08	-4.32F-08	-2 58E-08	-8 54F-09	8 71F-09	2.59E-08	4.30E-08
-4.32E-08 -	4 20E 00	1 425 09	1.7 TE-09	4.30E-08	4.50L-00	-7.02E-00	-4.20E-08	-1 42F-08	1.45E_08	4 30F-08	7.14E-08
7.100-00 -	4.29E-00	1 425 08	1.45E-08	4.30E-08	-7 18E-08	-7.10L-00	4 31F-08	1.42E-00	-1.45E-08	-4 32F-08	-7.14E-08
7.21E-08 4.31E-08	4.31E-00	0.505.00	9 60E 00	2.52E-00	4 20E 08	4 31E 08	4.51L-00	8.52E-00	-8 60E-00	-2.52E-08	-1.10E-00
4.31E-08 1.43E-08	2.50E-00	2 925 00	2 975 00	9.54E.00	-1.29E-08	1.43E-08	8 52E-00	0.52L-05	-2.87E-09	-8.54E-00	-1.23E-08
-1.45E-08 -	0.02E-09	2.025-09	2.07 E-09	9.74E-09	1.426-00	1.45E-00	9.60E.00	2 875 00	-2.07 L-03	9.71E.00	1 455 00
-1.45E-08 -	-8.69E-09	-2.87E-U9	2.93E-09	2.505.09	1.43E-00	4 22E 08	-0.09E-09	-8.54E-00	8 71E-00	6.7 TE-09	1.43E-00
-4.32E-08 - -7.18E-08 -	-2.58E-U8	-8.54E-09	0./ IE-U9	4.30E.00	7.30E-00	7 105 00	4 20E 09	1 425 09	1.455.09	4 20E 09	4.300-00
-7.18E-08 -	-4.29E-08	-1.42E-U0	1.43E-00	4.30⊑-00	7.146-00	-7.10E-U0	-4.29E-00	-1.426-00	1.43E-00	4.30⊑-00	
-7.21E-08 -	2.58E-08	-2.82E-09	-2.93E-09	-2.59E-08	-7.14E-08	-7.21E-08	-2.58E-08	-2.82E-09	-2.93E-09	-2.59E-08	-7.14E-08
d/dCPi*d/d0	CPi*SCPi*	SCPi									
	1.48E-05	4.88E-06	-4.98E-06	-1.48E-05	-2.46E-05	2.47E-05	1.48E-05	4.88E-06	-4.98E-06	-1.48E-05	-2.46E-05
1.48F-05		2.92E-06	-2.98E-06	-8.86E-06	-1.47E-05	1.48E-05	8.84E-06	2.92E-06	-2.98E-06	-8.86E-06	-1.47E-05
4 88F-06	2.92F-06		-9.84E-07	-2.93E-06	-4.86E-06	4.88E-06	2.92E-06	9.65E-07	-9.84E-07	-2.93E-06	-4.86E-06
-4 98F-06	-2 98F-06	-9.84E-07		2.98E-06	4.96E-06	-4.98E-06	-2.98E-06	-9.84E-07	1.00E-06	2.98E-06	4.96E-06
-4.98E-06 -1.48E-05	-8 86F-06	-2.93F-06	2.98E-06		1.47E-05	-1.48E-05	-8.86E-06	-2.93E-06	2.98E-06	8.87E-06	1.47E-05
-2 46F-05	-1 47F-05	-4.86F-06	4.96E-06	1.47E-05		-2.46E-05	-1.47E-05	-4.86E-06	4.96E-06	1.47E-05	2.45E-05
2.47F-05	1 48F-05	4 88F-06	-4 98F-06	-1 48F-05	-2.46F-05		1.48E-05	4.88E-06	-4.98E-06	-1.48E-05	-2.46E-05
1.48E-05	8 84F-06	2 92F-06	-2 98F-06	-8.86E-06	-1.47E-05	1.48E-05	2.92E-06	2.92E-06	-2.98E-06	-8.86E-06	-1.47E-05
4 88F-06	2 92F-06	9.65F-07	-9.84F-07	-2.93E-06	-4.86E-06	4.88E-06	2.92E-06		-9.84E-07	-2.93E-06	-4.86E-06
-4.98E-06	-2 98F-06	-9.84F-07	1.00F-06	2.98E-06	4.96E-06	-4.98E-06	-2.98E-06	-9.84E-07		2.98E-06	4.96E-06
-1.48E-05	-8 86F-06	-2 93F-06	2 98F-06	8.87F-06	1.47E-05	-1.48E-05	-8.86E-06	-2.93E-06	2.98E-06		1.47E-05
-2.46E-05	-1.47E-05	-4.86E-06	4.96E-06	1.47E-05	2.45E-05	-2.46E-05	-1.47E-05	-4.86E-06	4.96E-06	1.47E-05	
-2.47E-05	-8.84E-06	-9.65E-07	-1.00E-06	-8.87E-06	-2.45E-05	-2.47E-05	-8.84E-06	-9.65E-07	-1.00E-06	-8.87E-06	-2.45E-05
d/dAi*d/dA	j*SAi*SAj										4.455.04
	8.86E-05	2.93E-05	-2.99E-05	-8.88E-05	-1.47E-04	1.48E-04	8.86E-05	2.93E-05	-2.99E-05	-8.88E-05	-1.47E-04
8.86E-05		1.75E-05	-1.79E-05	-5.31E-05	-8.82E-05	8.86E-05	5.30E-05	1./5E-05	-1./9E-05	-5.31E-05	-8.82E-05
2.93E-05	1.75E-05		-5.90E-06	-1.75E-05	-2.91E-05	2.93E-05	1.75E-05	5.78E-06	-5.90E-06	-1.75E-05	-2.91E-05
-2.99E-05	-1.79E-05	-5.90E-06		1.79E-05	2.97E-05	-2.99E-05	-1.79E-05	-5.90E-06	6.02E-06	1.79E-05	2.97E-05
-8.88E-05	-5.31E-05	-1.75E-05	1.79E-05		8.84E-05	-8.88E-05	-5.31E-05	-1.75E-05	1.79E-05	5.32E-05	8.84E-05
-1.47E-04	-8.82E-05	-2.91E-05	2.97E-05	8.84E-05		-1.47E-04	-8.82E-05	-2.91E-05	2.97E-05	8.84E-05	1.47E-04
1.48E-04	8.86E-05	2.93E-05	-2.99E-05	-8.88E-05	-1.47E-04		8.86E-05	2.93E-05	-2.99E-05	-8.88E-05	-1.47E-04
8.86E-05	5.30E-05	1.75E-05	-1.79E-05	-5.31E-05	-8.82E-05	8.86E-05		1.75E-05	-1.79E-05	-5.31E-05	-8.82E-05
2.93E-05	1.75E-05	5.78E-06	-5.90E-06	-1.75E-05	-2.91E-05	2.93E-05	1.75E-05		-5.90E-06	-1.75E-05	-2.91E-05
-2.99E-05	-1.79E-05	-5.90E-06	6.02E-06	1.79E-05	2.97E-05	-2.99E-05	-1.79E-05	-5.90E-06		1.79E-05	2.97E-05
-8.88E-05	-5.31E-05	-1.75E-05	1.79E-05	5.32E-05	8.84E-05	-8.88E-05	-5.31E-05	-1.75E-05	1.79E-05		8.84E-05
-1.47E-04	-8.82E-05	-2.91E-05	2.97E-05	8.84E-05	1.47E-04	-1.47E-04	-8.82E-05	-2.91E-05	2.97E-05	8.84E-05	
-1.48E-04	-5.30E-05	-5.78E-06	-6.02E-06	-5.32E-05	-1.47E-04	-1.48E-04	-5.30E-05	-5.78E-06	-6.02E-06	-5.32E-05	-1.47E-04

Table A-2
Bias Error Calculation — Primary Air Outlet
Milliken Heat Pipe Air Preheater

	Average Value	Sigma Absolute R	Sigma elativo																	
uct Size																				
Dia. ft	4	0.042	1.04%																	
angth, ft																				
F of Points	20																			
Dia. #1	10																			
Dia. #2	10																			
N, Sector Area ft^2	0.63	0.013	2.06%																	
deg F	644	6.440	1.00%																	
deg R	1104	6.440	0.58%																	
imp Blas, deg F	100		11.11	deg F/Leng	th incremen	t Special B	Hes													
P, In WC	0.2171	0.0043	2.00%							,										
, ib/mol	26.65	0.025	0.09%															•		
no Pres, In. Hg	29.50																			
uct Pres, in. WC	44.50																			
s, in. Hg Absolute	31.11	0.040	0.13%																	
P, Pitot Fact	0.84	0.0100	1.19%																	
ominal Vel, fps	37.11	ACFM= 2	7982	SCFM=	13702	lb/hr=	62500													
		Input Del	la								Derivatives						(dTe/dX°8			
Point	Ai	CPI	DPI	Mi	Pai	TI	(1)	(2)	dTa/dTl	dTa/dAl	dTa/dCPI	dTa/dDPI	dTa/dMi	dTa/dPal	d/dTi*STi	d/dAI*SAI	d/dCPI*SCPI			d/dPsi*SPsi
1	0.63	0.84	0.2171	26.85	31.11	1054.0	0.227	239.2	5.236E-02		-3.02E+00		-4.39E-02		1.14E-01	2.79E-03	9.10E-04	6.42E-04	1.21E-06	2.68E-06 1.59E-06
2	0.63	0.84	0.2171	26.85	31.11	1065.1	0.226	240.4		-3.11E+00	-2.33E+00		-3.39E-02		1.11E-01	1.66E-03	5.42E-04	3.82E-04	7.18E-07	7.97E-07
3	0.63	0.84	0.2171	28.85	31.11	1076.2	0.225	241.7	5.13E-02		-1.65E+00		-2.40E-02		1.00E-01	8.30E-04	2.71E-04	1.91E-04	3.59E-07	
4	0.63	0.84	0.2171	26.85	31.11	1087.3	0.223	242.9		-1.30E+00		-1.88E+00	-1.41E-02		1.07E-01	2.89E-04	9.44E-05	6.66E-05 6.52E-06	1.25E-07 1.22E-08	2.78E-07 2.72E-08
5	0.63	0.84	0.2171	26.85	31.11	1098.4	0.222	244.2	5.02E-02	-4.06E-01	-3.04E-01	-5.88E-01	-4.42E-03	-4.10E-03	1.05E-01	2.83E-05	9.23E-06		1.89E-08	3.75E-08
6	0.63	0.84	0.2171	26.85	31.11	1109.6	0.221	245.4	4.97E-02	4.77E-01	3.57E-01	6.91E-01	5.20E-03	4.82E-03	1.03E-01	3.91E-05	1.28E-05	9.00E-06 7.22E-05	1.09E-08	3.73E-08 3.01E-07
7	0 63	0.84	0.2171	28.85	31.11	1120.7	0.220	246.6	4.92E-02	1.35E+00	1.01E+00		1.47E-02		1.01E-01	3.13E-04	1.02E-04		3.65E-07	8.10E-07
8	0.63	0.84	0.2171	28.85	31.11	1131.8	0.219	247.8	4.88E-02		1.66E+00		2.42E-02		9.86E-02	8.44E-04	2.75E-04 5.30E-04	1.94E-04 3.74E-04	7.02E-07	1.56E-06
•	0.63	0.84	0.2171	28.85	31.11	1142.9	0.218	249.1		3.08E+00	2.30E+00		3.35E-02		9.67E-02 9.48E-02	1.62E-03 2.64E-03	8.63E-04	8.09E-04	1.14E-06	2.54E-06
10	0.63	0.84	0.2171	28.85	31.11	1154.0	0.217	250.3		3.93E+00			4.28E-02 -4.39E-02		1.14E-01	2.79E-03	9.10E-04	6.42E-04	1.21E-06	2.68E-06
11	0 63	0.84	0.2171	26.85	31.11	1054.0	0.227	239.2		-4.03E+00 -3.11E+00			-3.39E-02		1.11E-01	1.00E-03	5.42E-04	3.82E-04	7.18E-07	1.50E-06
12	0.63	0.84	0.2171	28.85	31.11	1065.1	0.226	240.4					-3.39E-02		1.09E-01	8.30E-04	2.71E-04	1.91E-04	3.50E-07	7.97E-07
13	0.63	0.84	0.2171	28.85	31.11	1076.2	0.225 0.223	241.7 242.9	5.13E-02 5.07E-02		-1.05E+00 -9.72E-01		-1.41E-02		1.07E-01	2.89E-04	9.44E-05	0.66E-05	1.25E-07	2.78E-07
14	0 63	0.84	0.2171	28.85	31.11	1087.3		244.2	5.07E-02 5.02E-02		-3.04E-01	-5.88E-01	-4.42E-03		1.05E-01	2.83E-05	9.23E-00	6.52E-06	1.22E-08	2.72E-08
15	0.63	0.84	0.2171	26.65	31.11	1098.4	0.222 0.221	245.4	4.97E-02	4.77E-01	3.57E-01	6.91E-01	5.20E-03	4.82E-03	1.03E-01	3.91E-05	1.28E-05	9.00E-06	1.09E-08	3.75E-08
16	0.63	0.84	0.2171	28.85	31.11	1109.6		245.4	4.97E-02 4.92E-02				1.47E-02		1.01E-01	3.13E-04	1.02E-04	7.22E-05	1.36E-07	3.01E-07
17	0.63	0.84	0.2171	26.85	31.11	1120.7 1131.8	0.220 0.219	240.0	4.88E-02		1.88E+00		2.42E-02		9.86E-02	8.44E-04	2.75E-04	1.84E-04	3.65E-07	8.10E-07
18	0.63	0.84	0.2171	28.85	31.11		0.219	247.8		3.08E+00			3.35E-02		9.67E-02	1.02E-03	5.30E-04	3.74E-04	7.02E-07	1.56E-08
10	0.63	0.84	0.2171	26.85	31.11	1142.0	0.218	250.3		3.928E+00			4.28E-02		9.48E-02	2.64E-03	8.63E-04	6.09E-04	1.14E-06	2.54E-08
20	0.63	0.84	0.2171	26.85	31.11	1154.0		Sum2	4.702-02	J.#20L. 700	2.072700	J.00L 7 00	7,202.02	J. 77 L VL	T	A.04E.00	CP	DP	M	Pe
		Temperature	•	-		1104.0 1103.5	8um1 4.436	4895.0						Contributions (3)	4.15E+01	1.02E-18	1.76E-19	-5.69E-19	-1.0E-21	1.85E-22
I) Alacoliogia (ac.)	TI 00 F	Temperature	weight	n verege		1103.3	4.430	4093.0									Total Sig		41.51	
i) Ai*CPI(DPI*MI*Pal/ 2) Ai*CPI(DPI*MI*Pal*	•																Tavg Sig		6.44	deg F

³⁾ Contributions Include Cross Product Terms

Table A-2 (Continued) Cross Product Terms

1/12-01 1/12												1125.21	1.145.01	4.405.01	4 00E C1	1.00E.01	1.07E-01	1.06E-01	1.05E-01	1.04E
111E-01 1.0E-01 0.0E-01 0.0E		1.12E-01	1.11E-01	1.10E-01																1.04E
100-01 1			1.10E-01																	1.026
100E-01 100E				1.08E-01																1.01E
108E-01 107E-01 108E-01 108E				_	1.08E-01															9.96E
108E-01 108E-01 108E-01 108E-01 108E-01 109E-01 109E					- - •	1.04E-01														9.86E
108E01 1							1.02E-01													9.768
108E-01 108E							0.055.00	9.95E-02				.,								9.676
108E-01 108E								0.705.00	9.76E-02											9.588
1.14E-01 1.12E-01 1.11E-01 1.10E-01 1.00E-01									0.585.03	9.30E-02										9.486
1.112-01 1.116-01 1.006-01 1.0										1.045-01	1.046-01									1.04
11E-01 1.0E-01 1.0E-											1 12F-01	1.126-01							–	1.03
1/16_01 1/08												1 10F-01	1.102 01							1.026
1.09E-01 1.0													1.08F-01	1.002 01						1.01E
1.08E-01 1.07E-01 1.08E-01														1.06E-01						9.96
1.07E-01 1.06E-01 1.0															1.04E-01		1.02E-01	1.01E-01	9.96E-02	9.86
1.06E-01 1.06E-01 1.04E-01 1.03E-01 1.02E-01 1.01E-01 9.98E-02 9.88E-02 9.78E-02															1.03E-01	1.02E-01		9.95E-02	9.86E-02	9.76
1.05E-01 1.04E-01 1.03E-01 1.02E-01 1.01E-01 9.96E-02 9.86E-02 9.76E-02 9.76E-02 9.87E-02 9.8														1.03E-01	1.02E-01	1.01E-01	9.95E-02		9.76E-02	9.67
1.04E-01 1.03E-01 1.02E-01 1.0											1.05E-01	1.04E-01	1.03E-01	1.02E-01	1.01E-01	9.96E-02	9.86E-02	9.76E-02		9.58
204E+00 2.02E+00 2.00E+00 1.98E+00 1.98E+00 1.94E+00 1.92E+00 1.91E+00 1.92E+00 1.92										9.48E-02	1.04E-01	1.03E-01	1.02E-01	1.01E-01	9.96E-02	9.86E-02	9.76E-02	9.67E-02	9.58E-02	
4.96E-04 3.50E-04 2.70E-04 1.60E-04 4.99E-05 -5.9E-05 -1.7E-04 -2.7E-04 -3.8E-04 4.89E-04 3.82E-04 2.70E-04 1.60E-04 4.99E-05 -5.9E-05 -1.66E-04 -2.73E-04 -3.78E-04 -2.7E-04 -3.8E-04 4.89E-04 3.82E-04 2.70E-04 1.60E-04 4.99E-05 -5.9E-05 -1.66E-04 -2.73E-04 -2.87E-04 -2.87E-04 -2.7E-04 -3.8E-04 4.89E-04 3.82E-04 2.70E-04 1.91E-04 1.13E-04 3.53E-05 -4.1E-05 -1.18E-04 -2.87E-04 -2.87E-04 -2.7E-04 -3.8E-04 2.70E-04 1.91E-04 1.13E-04 1.91E-04 1.13E-04 1.91E-05 -2.4E-05 -6.9E-05 -1.18E-04 -1.9E-04 -2.0TE-04	dDPJ*8DPI				0.435.06	305.05	0.05.04	255.04	4.05.04	A 25C 04	6.42E.04	4 08F-04	3 50E-04	2.07F-04	6.47F-05	-7 8F-05	-2 15F-04	-3 53F-04	-4 90F-04	-8.25
3.50E-04 2.70E-04 1.00E-04 1.13E-04 3.53E-05 -1.18E-04 1.99E-04 -2.70E-04 1.00E-04 1.13E-04 3.53E-05 -2.4E-05 -	_	4.96E-04																		-4.82
2.07E-04 1.60E-04 1.13E-04 2.08E-05 2.08E-05 2.08E-05 -2.4E-05 -3.6E-05 -3.6E-05 -3.6E-05 -4.9E-05 -5.80E-05 -5.80E-05 -2.15E-04 -1.7E-04 -1.8E-04 -2.0E-04 1.18E-04 -1.8E-04 -2.0E-04 1.18E-04 -1.8E-04 -2.0E-04 1.18E-04 -1.8E-04 -2.0E-04 1.8E-04 1.8E-05 -2.2E-05 -7.6E-05 1.8E-04 1.9E-04 1.8E-04			2.70E-04																	-3.41
6 47E-05			4 405 04	1.136-04															-1.58E-04	-2.01
-7.60E-05 -5.9E-05 -4.1E-05 -2.4E-05 -7.7E-06 2.55E-05 4.18E-05 -5.80E-05 7.40E-05 -5.87E-05 -4.15E-05 -2.45E-05 -7.68E-06 9.00E-06 9.00E-				2 08 E .05	2.000-03														-4.93E-05	-6.30
-2.15E-04 -1.7E-04 -1.2E-04 -6.9E-05 -2.2E-05 2.55E-05 1.18E-04 1.64E-04 2.10E-04 -1.18E-04 -1.18E-04 -6.94E-05 -2.17E-05 2.55E-05 7.22E-05 1.18E-04 1.64E-04 2.69E-04 -2.73E-04 -1.93E-04 -1.14E-04 -3.58E-05 4.18E-05 1.18E-04 1.94E-04 2.69E-04 -3.58E-04 -2.77E-04 -1.9E-04 -1.16E-04 -3.6E-05 1.18E-04 1.94E-04 2.69E-04 -3.78E-04 -2.78E-04 -3.78E-04 -2.67E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04 -3.74E-04 -3.58E-04 -3.4E-04 -3.4E-04 -3.58E-04 -2.0E-04 -3.6E-04					-7 7E-08	-7.7E-00								-2.45E-05		9.00E-06	2.55E-05	4.18E-05	5.80E-05	7.40
3.53E-04 -2.7E-04 -1.9E-04 -1.1E-04 -3.6E-05 4.18E-05 1.18E-04 -2.69E-04 -3.8E-04 -2.73E-04 -1.9E-04 -1.14E-04 -3.58E-05 4.18E-05 1.18E-04 1.9E-04 -2.69E-04 -3.8E-04 -2.75E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04 -4.90E-04 -3.76E-04 -3.78E-04 -2.67E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04 -3.74E-04 -3.74E				-		2 55F-05	2.502-00							-6.94E-05	-2.17E-05	2.55E-05	7.22E-05	1.18E-04	1.64E-04	2.10
-4.90E-04 -3.8E-04 -2.7E-04 -1.8E-04 -4.9E-05 5.80E-05 1.64E-04 2.69E-04 4.77E-04 -4.90E-04 -3.78E-04 -2.67E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04 3.74E-04 -8.25E-04 -4.80E-04 3.4E-04 -2.01E-04 -6.30E-05 7.40E-05 2.10E-04 3.4E-04 4.77E-04 6.42E-04 4.96E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.2E-04 -3.53E-04 -4.90E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.15E-04 -3.53E-04 -4.90E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -7.6E-05 -2.15E-04 -3.53E-04 -4.90E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.15E-04 -3.53E-04 -4.90E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -7.6E							1.18E-04			3.44E-04	-3.53E-04	-2.73E-04	-1.93E-04	-1.14E-04	-3.56E-05	4.18E-05	1.18E-04	1.94E-04	2.69E-04	3.44
-8 25E-04 -4.8E-04 -3.4E-04 -2.0E-04 -6.3E-05 7.40E-05 2.10E-04 3.4E-04 4.77E-04 6.42E-04 4.96E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.2E-04 -3.5E-04 -4.9E-04 -8.25E-04 -4.96E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.15E-04 -3.53E-04 -4.90E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.15E-04 -3.53E-04 -4.90E-04		-						2.69E-04		4.77E-04	-4.90E-04	-3.78E-04	-2.67E-04	-1.58E-04	-4.93E-05	5.80E-05	1.64E-04	2.69E-04	3.74E-04	4.77
6.42E-04 4.96E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.2E-04 -3.53E-04 -4.90E-04 -6.25E-04 4.96E-04 3.50E-04 2.07E-04 6.47E-05 -7.6E-05 -2.15E-04 -3.53E-04 -4.90E-04									4.77E-04		-6.25E-04	-4.82E-04	-3.41E-04	-2.01E-04	-6.30E-05	7.40E-05	2.10E-04	3.44E-04	4.77E-04	6.09
								-3.5E-04	-4.9E-04	-6.25E-04		4.96E-04	3.50E-04	2.07E-04	6.47E-05	-7.6E-05	-2.15E-04	-3.53E-04	-4.90E-04	-6.25
4 96E-04 3.82E-04 2.70E-04 1.60E-04 4.99E-05 -5.9E-05 -1.76E-04 -2.73E-04 -3.8E-04 -4.82E-04 4.98E-04 2.70E-04 1.60E-04 4.99E-05 -5.9E-05 -1.66E-04 -2.73E-04 -3.78E-04			_				-1.7E-04	-2.7E-04	-3.8E-04	-4.82E-04	4.98E-04		2.70E-04	1.60E-04	4.99E-05	-5.9E-05	-1.66E-04	-2.73E-04	-3.78E-04	-4.82
3.50E-04 2.70E-04 1.91E-04 1.19E-04 3.53E-05 -4.1E-05 -1.2E-04 -1.92E-04 -2.67E-04 3.50E-04 2.70E-04 1.13E-04 3.53E-05 -4.1E-05 -1.18E-04 -1.93E-04 -2.67E-04				1.13E-04	3.53E-05	-4.1E-05	-1.2E-04	-1.9E-04	-2.7E-04	-3.41E-04	3.50E-04	2.70E-04		1.13E-04	3.53E-05	-4.1E-05	-1.18E-04	-1.93E-04	-2.67E-04	-3.41
207E-04 1.60E-04 1.13E-04 6.66E-05 2.08E-05 -2.4E-05 -6.9E-05 -1.1E-04 -1.6E-04 -2.01E-04 2.07E-04 1.60E-04 1.13E-04 2.08E-05 -2.4E-05 -6.94E-05 -1.14E-04 -1.58E-04							-6.9E-05	-1.1E-04	-1.6E-04	-2.01E-04	2.07E-04	1.60E-04	1.13E-04		2.08E-05	-2.4E-05	-6.94E-05	-1.14E-04	-1.58E-04	-2.01
6.47E-05 4.99E-05 3.53E-05 2.08E-05 6.52E-06 -7.7E-06 -2.2E-05 -3.66E-05 -4.9E-05 -6.30E-05 6.47E-05 4.99E-05 3.53E-05 2.08E-05 -7.7E-06 -2.17E-05 -3.56E-05 -4.93E-05	6.47E-05	4.99E-05	3.53E-05	2.08E-05	6.52E-06	-7.7E-06	-2.2E-05	-3.6E-05	-4.9E-05	-6.30E-05	6.47E-05	4.99E-05	3.53E-05	2.08E-05		-7.7E-06	-2.17E-05	-3.56E-05		-6.30
-7.60E-05 -5.9E-05 -4.1E-05 -2.4E-05 -7.7E-08 9.00E-08 2.55E-05 4.18E-05 5.80E-05 7.40E-05 -7.60E-05 -5.87E-05 -4.15E-05 -2.45E-05 -7.66E-06 2.55E-05 4.18E-05 5.80E-05							2.55E-05	4.18E-05	5.80E-05	7.40E-05	-7.60E-05	-5.87E-05	-4.15E-05	-2.45E-05	-7.66E-06		2.55E-05	4.18E-05	5.80E-05	7.40
1 18EA 1845A	-2.15E-04	-1.7E-04	-1.2E-04	-6.9E-05	-2.2E-05	2.55E-05	7.22E-05	1.18E-04	1.64E-04	2.10E-04	-2.15E-04	-1.66E-04	-1.18E-04	-6.94E-05				1.18E-04		2.10
	-3.53E-04	-2.7E-04				4.18E-05	1.18E-04	1.94E-04	2.69E-04	3.44E-04	-3.53E-04	-2.73E-04	-1.93E-04	-1.14E-04			1.18E-04		2.69E-04	3.44
3 53E-04 -2.7E-04 -1.9E-04 -1.1E-04 -3.6E-05 4.18E-05 1.18E-04 1.94E-04 2.69E-04 3.44E-04 -3.53E-04 -2.73E-04 -1.14E-04 -3.56E-05 4.18E-05 1.18E-04 2.69E-04 2.69E-04										4.77E-04	-4.90E-04	-3.78E-04	-2.67E-04	-1.58E-04	-4.93E-05	5.80E-05	1.64E-04	2.69E-04		4.77
-3 53E-04 -2.7E-04 -1.9E-04 -1.1E-04 -3.6E-05 4.18E-05 1.18E-04 1.94E-04 2.69E-04 3.44E-04 -3.53E-04 -2.73E-04 -1.93E-04 -1.14E-04 -3.56E-05 4.18E-05 1.18E-04 2.69E-04	-4.90E-04	-J.OE-U4					1.046.04													
-3 53E-04 -2.7E-04 -1.9E-04 -1.1E-04 -3.6E-05 4.18E-05 1.18E-04 1.94E-04 2.69E-04 3.44E-04 -3.53E-04 -2.73E-04 -1.93E-04 -1.14E-04 -3.56E-05 4.18E-05 1.18E-04 2.69E-04 -4.90E-04 -3.8E-04 -2.7E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04 3.74E-04 4.77E-04 4.90E-04 -3.78E-04 -2.67E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04 3.74E-04 4.77E-04 4.90E-04 3.78E-04 -2.67E-04 -1.58E-04 -2.67E-04 -1.58E-05 3.74E-04 3.74E-04 3.77E-04 4.77E-04 4.77										6.09E-04	-8.25E-04	-4.82E-04	-3.41E-04	-2.01E-04	-6.30E-05	7.40E-05	2.10E-04	3.44E-04	4.77E-04	
-3.53E-04 -2.7E-04 -1.9E-04 -1.1E-04 -3.6E-05 4.18E-05 1.18E-04 1.9E-04 2.69E-04 3.44E-04 -3.53E-04 -2.73E-04 -1.93E-04 -1.14E-04 -3.56E-05 4.18E-05 1.18E-04 2.69E-04 -4.90E-04 -3.8E-04 -2.7E-04 -1.6E-04 -4.9E-05 5.80E-05 1.64E-04 2.69E-04 4.77E-04 -4.90E-04 -3.78E-04 -2.87E-04 -1.58E-04 -4.93E-05 5.80E-05 1.64E-04 2.69E-04										6.09E-04	-8.25E-04	-4.82E-04	-3.41E-04	-2.01E-04	-8.30E-05	7.40E-05	2.10E-04	3.44E-04	4.77E-04	-6.098

Table A-2 (Continued) Cross Product Terms

	9.30E-07	6.58E-07	3.88E-07	1.21E-07	-1.4E-07	-4.0E-07	-6.6E-07	-9.2E-07	-1.17E-06	1.21E-06	9.30E-07	6.58E-07	3.88E-07	1.21E-07	-1.4E-07	-4.04E-07	-6.63E-07	-9.20E-07 -7.10E-07	
9.30E-07		5.08E-07	3.00E-07	9.37E-08	-1.1E-07	-3.1E-07	-5.1E-07	-7.1E-07	-9.06E-07	9.30E-07	7.18E-07	5.08E-07	3.00E-07	9.37E-08	-1.1E-07	-3.12E-07	-5.12E-07		•
6.58E-07	5.08E-07			6.63E-08	-7.8E-08	-2.2E-07	-3.6E-07	-5.0E-07	-6.40E-07	6.58E-07	5.08E-07	3.59E-07	2.12E-07		-7.8E-08	-2.21E-07	-3.62E-07	-5.02E-07	•
	3.00E-07	2.12E-07		3.91E-08	-4.6E-08	-1.3E-07	-2.1E-07	-3.0E-07	-3.78E-07	3.88E-07	3.00E-07	2.12E-07	1.25E-07	3.91E-08	-4.6E-08	-1.30E-07	-2.14E-07	-2.96E-07	•
	9.37E-08		3.91E-08		-1.4E-08	-4.1E-08	-6.7E-08	-9.3E-08	-1.18E-07	1.21E-07	9.37E-08	6.63E-08	3.91E-08		-1.4E-08	-4.07E-08	-6.68E-08	-9.26E-08	
		-7.8E-08	-4.6E-08	-1.4E-08			7.85E-08	1.09E-07	1.39E-07	-1.43E-07	-1.10E-07	-7.79E-08	-4.60E-08	-1.44E-08	1.69E-08	4.79E-08	7.85E-08	1.09E-07	
-4.04E-07		-2.2E-07			4.79E-08		2.22E-07	3.08E-07	3.94E-07	-4.04E-07	-3.12E-07	-2.21E-07	-1.30E-07	-4.07E-08	4.79E-08	1.36E-07	2.22E-07	3.08E-07	
-8.63E-07		-3.6E-07			7.85E-08	2.22E-07		5.06E-07	6.46E-07	-6.63E-07	-5.12E-07	-3.62E-07	-2.14E-07	-6.68E-08	7.85E-08	2.22E-07	3.65E-07	5.08E-07	
	-	-5.0E-07			1.09E-07	3.08E-07	5.06E-07		8.95E-07	-9.20E-07	-7.10E-07	-5.02E-07	-2.96E-07	-9.26E-08	1.09E-07	3.08E-07	5.06E-07	7.02E-07	
-1.17E-06	-9.1E-07			-1.2E-07	1.39E-07	3.94E-07	6.46E-07	8.95E-07		-1.17E-06	-9.06E-07	-6.40E-07	-3.78E-07	-1.18E-07		3.94E-07	6.46E-07	8.95E-07	
				1.21E-07			-6.6E-07	-9.2E-07	-1.17E-06		9.30E-07	6.58E-07	3.88E-07	1.21E-07	-1.4E-07	-4.04E-07	-6.63E-07	-9.20E-07	•
	7.18E-07			9.37E-08	-1.1E-07	-3.1E-07	-5.1E-07	-7.1E-07	-9.06E-07	9.30E-07		5.08E-07	3.00E-07	9.37E-08	-1.1E-07	-3.12E-07	-5.12E-07	-7.10E-07	•
				6.63E-08	-7.8E-08	-2.2E-07	-3.6E-07	-5.0E-07	-6.40E-07	6.58E-07	5.08E-07		2.12E-07	6.63E-08	-7.8E-08	-2.21E-07	-3.62E-07	-5.02E-07	-
	3.00E-07				-4.6E-08	-1.3E-07	-2.1E-07	-3.0E-07	-3.78E-07	3.88E-07	3.00E-07	2.12E-07		3.91E-08	-4.6E-08	-1.30E-07	-2.14E-07	-2.96E-07	-
	9.37E-08			1.22E-08	-1.4E-08	-4.1E-08	-6.7E-08	-9.3E-08	-1.18E-07	1.21E-07	9.37E-08	6.63E-08	3.91E-08		-1.4E-08	-4.07E-08	-6.68E-08	-9.26E-08	-
-1.43E-07		-7.8E-08	-4.6E-08		1.69E-08	4.79E-08	7.85E-08	1.09E-07	1.39E-07	-1.43E-07	-1.10E-07	-7.79E-08	-4.60E-08	-1.44E-08		4.79E-08	7.85E-08	1.09E-07	
-4.04E-07		-2.2E-07	-1.3E-07	-4.1E-08	4.79E-08	1.36E-07	2.22E-07	3.08E-07	3.94E-07	-4.04E-07	-3.12E-07	-2.21E-07	-1.30E-07	-4.07E-08	4.79E-08		2.22E-07	3.08E-07	
-6.63E-07		-3.6E-07	-2.1E-07	-6.7E-08	7.85E-08	2.22E-07	3.65E-07	5.06E-07	6.46E-07	-6.63E-07	-5.12E-07	-3.62E-07	-2.14E-07	-6.68E-08	7.85E-08	2.22E-07		5.06E-07	
-9.20E-07		-5.0E-07		-9.3E-08	1.09E-07	3.08E-07	5.06E-07	7.02E-07	8.95E-07	-0.20E-07	-7.10E-07	-5.02E-07	-2.96E-07	-9.26E-08	1.09E-07	3.08E-07	5.08E-07		
-1.17E-06	-9.1E-07	-6.4E-07	-3.8E-07	-1.2E-07	1.39E-07	3.94E-07	6.46E-07	8.95E-07	1.14E-06	-1.17E-06	-9.06E-07	-6.40E-07	-3.78E-07	-1.18E-07	1.39E-07	3.94E-07	6.46E-07	8.95E-07	
	7.05.07	0.05.07	4.05.07	4.05.00	4 7E 08	-1 4F-07	-3.6E-07	-7.0E-07	-1.14E-08	-1.21E-06	-7.18E-07	-3.59E-07	-1.25E-07	-1.22E-08	-1.7E-08	-1.36E-07	-3.65E-07	-7.02E-07	-
		-3.6E-U/	-1.3E-07	-1.25-06	-1./2-06	1,42 01	0.02 0.												
	*8Ps]							-2.0E-08	-2.61E-06	2.68E-06	2.07E-06	1.46E-08	8.62E-07	2.70E-07	-3.2E-07	-8.98E-07	-1.47E-06	-2.04E-06	
	8P] 2.07E-06	1.46E-06	8.62E-07	2.70E-07 2.08E-07	-3.2E-07	-9.0E-07	-1.5E-06			2.68E-06 2.07E-06	2.07E-06 1.59E-06	1.13E-06	6.65E-07	2.08E-07	-2.4E-07	-8.93E-07	-1.14E-06	-1.58E-06	
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2 07E-08 1.46E-08 8.62E-07 2.70E-07 -3.17E-07 -8.98E-07 -2.04E-08 -2.61E-06 2.68E-06 2.07E-08 1.46E-08 8.62E-07 -2.70E-07 -3.17E-07 -8.98E-07 -1.47E-06	2.07E-06 6.65E-07 2.08E-07 -2.4E-07 -6.9E-07 -1.1E-06 -1.6E-06 2.07E-06 1.59E-06 1.13E-06 6.65E-07 2.08E-07 -2.4E-07 -6.9E-07	1.46E-08 1.13E-08 4.71E-07 1.47E-07 -1.7E-07 -4.9E-07 -1.1E-08 1.46E-06 1.13E-06 7.97E-07 4.71E-07 -1.7E-07 -4.9E-07 -8.0E-07 -1.1E-08	8.62E-07 6.65E-07 4.71E-07 8.69E-08 -1.0E-07 -4.7E-07 -6.6E-07 -8.62E-07 4.71E-07 2.78E-07 8.69E-08 -1.0E-07 -4.7E-07	2.70E-07 2.08E-07 1.47E-07 8.69E-08 -3.2E-08 -9.0E-08 -1.5E-07 2.70E-07 2.70E-07 2.08E-07 1.47E-07 8.69E-08 2.72E-08 -3.2E-08 -3.2E-08	-3.2E-07 -2.4E-07 -1.7E-07 -1.0E-07 -3.2E-08 1.08E-07 1.74E-07 -3.2E-07 -3.2E-07 -1.0E-07 -3.2E-08 3.75E-08 1.08E-07 1.74E-07	-9.0E-07 -6.9E-07 -4.9E-07 -2.9E-07 -9.0E-08 1.08E-07 -8.9E-07 -8.9E-07 -4.9E-07 -9.0E-08 1.06E-07 3.01E-07 4.94E-07	-1.5E-06 -1.1E-08 -8.0E-07 -4.7E-07 -1.5E-07 1.74E-07 4.94E-07 1.12E-06 -1.5E-06 -1.1E-06 -8.0E-07 -4.7E-07 1.74E-07 4.94E-07 8.10E-07	-2.0E-08 -1.6E-08 -1.1E-08 -6.6E-07 -2.1E-07 2.42E-07 1.12E-08 1.99E-08 -2.0E-08 -1.6E-08 -1.1E-08 -2.1E-07 -2.1E-07 2.42E-07 6.85E-07 1.12E-08	-2.61E-06 -2.01E-06 -1.42E-06 -8.39E-07 -2.63E-07 3.09E-07 1.43E-06 1.99E-06 -2.61E-06 -2.01E-06 -1.42E-08 -8.39E-07 -2.63E-07 -3.09E-07 8.74E-07	2.07E-06 1.46E-08 8.62E-07 2.70E-07 -3.17E-07 -1.47E-08 -2.04E-08 2.07E-06 1.46E-08 8.62E-07 -3.17E-07 -8.98E-07 -1.47E-08 -2.04E-08	1.59E-08 1.13E-08 6.65E-07 2.08E-07 -2.45E-07 -6.93E-07 -1.14E-08 -2.01E-08 2.07E-06 1.13E-08 6.65E-07 -2.08E-07 -2.45E-07 -4.93E-07 -1.14E-08 -1.58E-08	1.13E-08 7.97E-07 4.71E-07 1.47E-07 -1.73E-07 -4.90E-07 -8.04E-07 -1.11E-08 1.48E-08 1.13E-08 4.71E-07 -1.47E-07 -1.73E-07 -4.90E-07 -8.04E-07	6.65E-07 4.71E-07 2.78E-07 8.69E-08 -1.02E-07 -2.89E-07 -4.74E-07 -6.58E-07 8.62E-07 6.65E-07 4.71E-07 8.69E-08 -1.02E-07 -2.89E-07 -4.74E-07	2.08E-07 1.47E-07 8.69E-08 2.72E-08 -3.19E-08 -9.04E-08 -1.48E-07 -2.06E-07 2.70E-07 2.08E-07 1.47E-07 8.69E-08 -9.04E-08 -1.48E-07	-2.4E-07 -1.7E-07 -1.0E-07 -3.2E-08 3.75E-08 1.06E-07 1.74E-07 2.42E-07 -3.09E-07 -3.2E-07 -1.7E-07 -1.0E-07 -3.2E-08 1.06E-07 1.74E-07 2.42E-07	-6.93E-07 -4.90E-07 -2.89E-07 -9.04E-08 1.08E-07 3.01E-07 4.94E-07 6.85E-07 -6.93E-07 -4.90E-07 -2.89E-07 -9.04E-08 1.06E-07	-1.14E-08 -8.04E-07 -4.74E-07 -1.48E-07 1.74E-07 8.10E-07 1.12E-08 1.43E-08 -1.47E-08 -1.14E-08 -8.04E-07 1.74E-07 4.94E-07	-1.58E-08 -1.11E-08 -6.58E-07 -2.08E-07 2.42E-07 6.85E-06 1.58E-06 1.99E-08 -2.04E-06 -1.158E-06 -1.11E-08 -6.58E-07 -2.08E-07	

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Table A-2 (Continued) Cross Product Terms

8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 -2.79E-03 2.79E-03 2.15E-03 1.52E-03 8.98E-04	-2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03 -2.15E-03 1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.5E-04 -7.2E-03 -1.6E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03 1.52E-03 1.17E-03 8.30E-04 4.90E-04 1.53E-04	8.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04 -6.8E-04 8.98E-04 6.93E-04 4.90E-04 2.89E-04	2.17E-04 1.53E-04 9.04E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.17E-04 1.53E-04 9.04E-05 2.83E-05 -9.4E-05 -1.5E-04 -2.1E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04 -3.3E-04 -2.5E-04 -1.8E-04 -1.1E-04	5.14E-04 7.13E-04 9.10E-04 -9.3E-04 -7.2E-04 -5.1E-04 -9.4E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04	1.17E-03 1.49E-03 -1.5E-03 -1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 8.44E-04 1.17E-03	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.1E-03 -1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 1.62E-03	-2.71E-03 -2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 9.10E-04 1.49E-03 2.07E-03 -2.71E-03 -2.09E-03 -1.48E-03 -8.74E-04 9.10E-04 1.49E-03 2.07E-03 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 2.07E-03	2.79E-03 2.15E-03 1.52E-03 8.98E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.71E-03 2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 -2.13E-03 -2.13E-03	2.15E-03 1.86E-03 1.17E-03 6.93E-04 2.17E-04 -7.21E-04 -1.18E-03 -2.09E-03 2.15E-03 1.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03 -2.09E-03	1.52E-03 1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -1.16E-03 1.52E-03 1.7E-03 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -5.10E-04 -1.16E-03 -1.16E-03	8.98E-04 6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 6.93E-04 4.90E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04 -4.94E-04	2.81E-04 2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-04 -2.14E-04 2.17E-04 2.17E-04 1.53E-04 9.04E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04 -2.14E-04	1.11E-04 1.82E-04 2.52E-04 3.21E-04 -3.3E-04 -2.5E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04	-9.35E-04 -7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 9.10E-04 -9.35E-04 -7.21E-04 -5.10E-04 -9.41E-05 1.11E-04 5.14E-04 7.13E-04 9.35E-04	-1.53E-03 -1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03 -1.53E-03 -1.53E-03 -1.54E-04 1.82E-04 5.14E-04 1.82E-04 5.14E-04	-2.13E-03 -1.84E-03 -1.18E-03 -0.85E-04 -2.14E-04 2.52E-04 7.13E-03 1.82E-03 2.07E-03 -1.18E-03 -1.18E-03 -1.18E-03 -1.18E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03	-2.71E -2.09E -1.48E -8.74E -2.73E 3.21E 9.10E 2.07E 2.64E -2.71E -2.09E -1.48E -8.74E -2.73E 3.21E 9.10E 1.49E 2.07E
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.71E-03 2.79E-03 2.15E-03 1.52E-03 8.98E-04 -3.30E-04 -9.35E-04 -1.53E-03	6.93E-04 2.17E-04 -2.5E-04 -1.2E-03 -1.6E-03 -2.1E-03 2.15E-03 1.66E-03 1.17E-03 6.93E-04 -2.5E-04 -7.2E-04 -1.2E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03 1.52E-03 1.17E-03 8.30E-04 4.90E-04 -1.8E-04 -5.1E-04 -8.4E-04	8.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -6.8E-04 -8.7E-04 6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04	2.17E-04 1.53E-04 9.04E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.17E-04 1.53E-04 9.04E-05 -9.4E-05 -1.5E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 -1.11E-04 1.82E-04 2.52E-04 -3.3E-04 -2.5E-04 -1.8E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 -7.13E-04 -9.3E-04 -7.2E-04 -5.1E-04 -9.4E-05 1.11E-04 3.13E-04 5.14E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03 -1.5E-03 -1.2E-03 -8.4E-04 -4.9E-04 1.82E-04 5.14E-04 8.44E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.1E-03 -1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 -2.07E-03 -2.09E-03 -1.48E-03 -8.74E-04 9.10E-04 1.49E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-03 -2.13E-03 -2.71E-03 2.15E-03 1.52E-03 8.98E-04 -3.30E-04 -9.35E-04 -1.53E-03	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -2.09E-03 2.15E-03 1.17E-03 6.93E-04 -2.55E-04 -7.21E-04 -1.18E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04 -1.16E-03 -1.48E-03 1.52E-03 1.17E-03 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 8.98E-04 6.93E-04 4.90E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.73E-04 2.81E-04 2.17E-04 1.53E-04 9.04E-05 -3.32E-05 -9.41E-05 -1.54E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04 -3.3E-04 -2.5E-04 -1.8E-04 -3.3E-05 1.11E-04 1.82E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 -7.13E-04 -9.35E-04 -7.21E-04 -5.10E-04 -9.41E-05 1.11E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 5.14E-04 8.44E-04 1.17E-03 1.49E-03 -1.53E-03 -1.18E-03 -8.37E-04 -1.54E-04 1.82E-04 5.14E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-03 1.62E-03 2.07E-03 -2.13E-03 -1.64E-03 -1.16E-03 -8.85E-04 -2.14E-04 2.52E-04 7.13E-04	-2.09E -1.48E -8.74E -2.73E 3.21E 9.10E 1.49E -2.07E -2.09E -1.48E -8.74E -2.73E 3.21E 9.10E 1.49E
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.71E-03 2.79E-03 2.15E-03 1.52E-03 8.98E-04 2.81E-04 -9.35E-04	6.93E-04 2.17E-04 -2.5E-04 -1.2E-03 -1.6E-03 -2.15E-03 1.66E-03 1.17E-03 6.93E-04 -2.5E-04 -7.2E-04	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.52E-03 1.52E-03 1.17E-03 8.30E-04 4.90E-04 -1.68E-04 -5.1E-04	8.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -6.8E-04 -8.7E-04 8.98E-04 4.90E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04	2.17E-04 1.53E-04 9.04E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.81E-04 2.15E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 -1.11E-04 1.82E-04 2.52E-04 -3.3E-04 -2.5E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04 -9.3E-04 -7.2E-04 -5.1E-04 -9.4E-05 1.11E-04 3.13E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03 -1.5E-03 -1.2E-03 -8.4E-04 -4.9E-04 1.82E-04 5.14E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.1E-03 -1.6E-03 -1.2E-03 -1.2E-04 2.52E-04 7.13E-04	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 -2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 9.10E-04	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 -2.71E-03 2.15E-03 1.52E-03 8.98E-04 -3.30E-04 -9.35E-04	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -2.09E-03 2.15E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04 -1.18E-03 1.52E-03 1.17E-03 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -8.74E-04 8.98E-04 4.90E-04 9.04E-05 -1.06E-04 -3.01E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04 2.81E-04 2.17E-04 1.53E-04 9.04E-05 -3.32E-05 -9.41E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04 -3.3E-04 -2.5E-04 -1.1E-04 -3.3E-05	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 -7.13E-04 -9.35E-04 -7.21E-04 -3.01E-04 -9.41E-05 1.11E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 5.14E-04 5.14E-04 1.17E-03 1.49E-03 -1.53E-03 -1.18E-03 -8.37E-04 -4.94E-04 1.82E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-03 1.62E-03 2.07E-03 -2.13E-03 -1.64E-03 -1.16E-03 -8.85E-04 -2.14E-04 2.52E-04 7.13E-04	-2.09E -1.48E -8.74E -2.73E 3.21E 9.10E 2.07E 2.64E -2.71E -2.09E -1.48E -8.74E -2.73E 3.21E-9.10E
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.71E-03 2.79E-03 2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03 2.15E-03 1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.5E-04	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03 1.52E-03 1.17E-03 8.30E-04 4.90E-04 -1.6E-04	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -6.8E-04 -6.98E-04 6.98E-04 4.90E-04 4.90E-04 9.04E-05 -1.1E-04	2.17E-04 1.53E-04 9.04E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.81E-04 2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.3E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04 -3.3E-04 -2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04 -9.3E-04 -7.2E-04 -5.1E-04 -9.4E-05 1.11E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 -1.5E-03 -1.2E-03 -8.4E-04 -4.9E-04 1.82E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.1E-03 -1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 2.07E-03 -2.71E-03 -2.09E-03 -1.48E-03 -8.74E-04 3.21E-04	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-03 -2.13E-03 -2.71E-03 2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03 -2.09E-03 2.15E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -1.80E-04 -1.16E-03 -1.48E-03 1.52E-03 1.17E-03 4.90E-04 1.53E-04 -1.80E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04 -8.74E-04 8.98E-04 6.93E-04 4.90E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -9.41E-05 -1.54E-04 -2.14E-04 -2.73E-04 2.81E-04 2.17E-04 1.53E-04 9.04E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 -2.52E-04 -3.3E-04 -2.5E-04 -1.1E-04 -3.3E-05	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04 -9.10E-04 -7.21E-04 -5.10E-04 -9.41E-05	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 5.14E-04 5.14E-04 1.17E-03 1.49E-03 -1.53E-03 -1.18E-03 -8.37E-04 -4.94E-04 1.82E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 1.17E-03 1.62E-03 2.07E-03 -2.13E-03 -1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04	-2.09E -1.48E -8.74E -2.73E 9.10E 1.49E 2.07E 2.67E -2.71E -2.09E -1.48E -8.74E -2.73E
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1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -1.53E-03 -2.13E-03 -2.71E-03 2.79E-03 2.15E-03 1.52E-03	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03 -2.1E-03 1.66E-03 1.17E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03 1.52E-03 1.17E-03 8.30E-04	8.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04 -6.8E-04 -8.7E-04 8.98E-04 4.90E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.81E-04 2.17E-04 1.53E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04 -2.5E-04 -1.8E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04 9.10E-04 -9.3E-04 -7.2E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03 -1.5E-03 -1.2E-03 -8.4E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.07E-03 -2.1E-03 -1.6E-03 -1.2E-03	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 2.07E-03 -2.71E-03 -2.09E-03 -1.48E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.71E-03 2.15E-03 1.52E-03	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -2.09E-03 2.15E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -1.16E-03 -1.48E-03 1.52E-03 1.17E-03	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04 -8.74E-04 6.93E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04 2.81E-04 2.17E-04 1.53E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04 -3.3E-04 -1.8E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04 -9.35E-04 -7.21E-04 -5.10E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 8.44E-04 1.17E-03 1.49E-03 -1.53E-03 -1.18E-03 -8.37E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03 1.62E-03 2.07E-03 -1.16E-03 -1.16E-03	-2.096 -1.486 -8.746 -2.736 3.216 9.106 1.496 2.076 2.646 -2.716 -2.096 -1.486
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 2.79E-03 2.15E-03	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03 -2.1E-03 1.66E-03	4.90E-04 1.53E-04 -1.8E-04 1-5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03 1.52E-03	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04 -6.8E-04 -8.7E-04 6.93E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.81E-04 2.17E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04 -3.3E-04 -2.5E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04 9.10E-04 -9.3E-04 -7.2E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03 -1.5E-03 -1.2E-03	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.07E-03 -2.1E-03 -1.6E-03	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 2.07E-03 -2.71E-03 -2.09E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 2.15E-03	1.86E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03 -2.09E-03 2.15E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04 -1.16E-03 -1.48E-03 1.52E-03	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04 -8.74E-04 6.93E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04 2.81E-04 2.17E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04 -3.3E-04 -2.5E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04 9.10E-04 -9.35E-04 -7.21E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 8.44E-04 1.17E-03 1.49E-03 -1.53E-03 -1.18E-03	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03 1.62E-03 2.07E-03 -2.13E-03 -1.64E-03	-2.09 -1.48 -8.74 -2.73 3.21 9.10 1.49 2.07 2.64 -2.71 -2.09
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 -2.71E-03 2.79E-03	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03 -2.1E-03 2.15E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03 1.52E-03	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04 -6.8E-04 -8.7E-04 8.98E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05 -1.5E-04 -2.1E-04 2.81E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04 -3.3E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04 9.10E-04 -9.3E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03 -1.5E-03	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03 -2.07E-03 -2.1E-03	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 2.07E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 -2.71E-03	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03 -2.09E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04 -1.16E-03 -1.48E-03 1.52E-03	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04 8.74E-04 8.98E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04 2.81E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04 -3.3E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04 9.10E-04 -9.35E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 8.44E-04 1.17E-03 1.49E-03 -1.53E-03	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03 1.62E-03 2.07E-03 -2.13E-03	-2.09 -1.48 -8.74 -2.73 3.21 9.10 1.49 2.07 2.64 -2.71
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03 -2.71E-03	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03 -2.1E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03 -1.5E-03	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04 -6.8E-04 -8.7E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05 -1.5E-04 -2.1E-04 -2.7E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04 9.10E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04 1.17E-03 1.49E-03	-1.6E-03 -1.2E-03 -6.6E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03 2.07E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03 -2.09E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04 -1.16E-03 -1.48E-03	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04 -8.74E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04 -2.73E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04 3.21E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04 9.10E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 8.44E-04 1.17E-03 1.49E-03	-1.84E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03 1.62E-03 2.07E-03	-2.09 -1.48 -8.74 -2.73 3.21 9.10 1.49 2.07 2.64
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03 -1.6E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04 -1.2E-03	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04 -6.8E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05 -1.5E-04 -2.1E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04 2.52E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04 7.13E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04 1.17E-03	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03 -2.13E-03	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03 -1.64E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04 -1.16E-03	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04 -6.85E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04 -2.14E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04 2.52E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04 7.13E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 8.44E-04 1.17E-03	-1.84E-03 -1.16E-03 -8.85E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03 1.82E-03	-2.09 -1.48 -8.74 -2.73 3.21 9.10 1.49 2.07
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04 -1.2E-03	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04 -8.4E-04	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04 -4.9E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05 -1.5E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 1.11E-04 1.82E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04 5.14E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04 5.14E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04 1.49E-03	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04 -1.53E-03	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04 -1.18E-03	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04 -8.37E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04 -4.94E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05 -1.54E-04	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04 1.82E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04 5.14E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04 8.44E-04	-1.84E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-04 1.17E-03	-2.06 -1.46 -8.74 -2.73 3.21 9.10
1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04	6.93E-04 2.17E-04 -2.5E-04 -7.2E-04	4.90E-04 1.53E-04 -1.8E-04 -5.1E-04	6.93E-04 4.90E-04 9.04E-05 -1.1E-04 -3.0E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05 -9.4E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05 1.11E-04	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04 7.13E-04	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04 9.10E-04	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04 -9.35E-04	1.86E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04 -7.21E-04	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04 -5.10E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04 -3.01E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05 -9.41E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05 1.11E-04	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04 3.13E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04 5.14E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04 7.13E-04	-2.0(-1.4(-8.7- -2.7) -2.7(3.2)
1.52E-03 8.98E-04 2.81E-04 -3.30E-04	6.93E-04 2.17E-04 -2.5E-04	4.90E-04 1.53E-04 -1.8E-04	6.93E-04 4.90E-04 9.04E-05 -1.1E-04	2.17E-04 1.53E-04 9.04E-05 -3.3E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04 1.82E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04 2.52E-04	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04 3.21E-04	2.15E-03 1.52E-03 8.98E-04 2.81E-04 -3.30E-04	1.66E-03 1.17E-03 6.93E-04 2.17E-04 -2.55E-04	1.17E-03 8.30E-04 4.90E-04 1.53E-04 -1.80E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05 -1.06E-04	2.17E-04 1.53E-04 9.04E-05 2.83E-05 -3.32E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05 3.91E-05	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05 1.11E-04	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04 1.82E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04 2.52E-04	-2.00 -1.40 -8.74 -2.75 -2.75
1.52E-03 8.98E-04 2.81E-04	6.93E-04 2.17E-04	4.90E-04 1.53E-04	6.93E-04 4.90E-04 9.04E-05	2.17E-04 1.53E-04 9.04E-05	-2.5E-04 -1.8E-04 -1.1E-04	-7.2E-04 -5.1E-04 -3.0E-04 -9.4E-05	-1.2E-03 -8.4E-04 -4.9E-04 -1.5E-04	-1.6E-03 -1.2E-03 -6.8E-04 -2.1E-04	-2.09E-03 -1.48E-03 -8.74E-04 -2.73E-04	2.15E-03 1.52E-03 8.98E-04 2.81E-04	1.66E-03 1.17E-03 6.93E-04 2.17E-04	1.17E-03 8.30E-04 4.90E-04 1.53E-04	6.93E-04 4.90E-04 2.89E-04 9.04E-05	2.17E-04 1.53E-04 9.04E-05 2.83E-05	-2.5E-04 -1.8E-04 -1.1E-04 -3.3E-05	-7.21E-04 -5.10E-04 -3.01E-04 -9.41E-05	-1.18E-03 -8.37E-04 -4.94E-04 -1.54E-04	-1.64E-03 -1.16E-03 -6.85E-04 -2.14E-04	-2.00 -1.40 -8.7- -2.75
1.52E-03 8.98E-04	6.93E-04	4.90E-04	6.93E-04 4.90E-04	2.17E-04 1.53E-04	-2.5E-04 -1.8E-04 -1.1E-04	-7.2E-04 -5.1E-04 -3.0E-04	-1.2E-03 -8.4E-04 -4.9E-04	-1.6E-03 -1.2E-03 -6.8E-04	-2.09E-03 -1.48E-03 -8.74E-04	2.15E-03 1.52E-03 8.98E-04	1.66E-03 1.17E-03 6.93E-04	1.17E-03 8.30E-04 4.90E-04	6.93E-04 4.90E-04 2.89E-04	2.17E-04 1.53E-04 9.04E-05	-2.5E-04 -1.8E-04 -1.1E-04	-7.21E-04 -5.10E-04 -3.01E-04	-1.18E-03 -8.37E-04 -4.94E-04	-1.64E-03 -1.16E-03 -6.85E-04	-2.00 -1.40 -8.7
1.52E-03			6.93E-04	2.17E-04 1.53E-04	-2.5E-04 -1.8E-04	-7.2E-04 -5.1E-04	-1.2E-03 -8.4E-04	-1.6E-03 -1.2E-03	-2.09E-03 -1.48E-03	2.15E-03 1.52E-03	1.66E-03 1.17E-03	1.17E-03 8.30E-04	6.93E-04 4.90E-04	2.17E-04 1.53E-04	-2.5E-04 -1.8E-04	-7.21E-04 -5.10E-04	-1.18E-03 -8.37E-04	-1.64E-03 -1.16E-03	-2.00 -1.4
		1.17E-03	6.93E-04	2.17E-04	-2.5E-04	-7.2E-04	-1.2E-03	-1.6E-03	-2.09E-03	2.15E-03	1.66E-03	1.17E-03	6.93E-04	2.17E-04	-2.5E-04	-7.21E-04	-1.18E-03	-1.64E-03	-2.0
																-9.35E-04	-1.53E-03	-2.13E-03	-2.7
	2.15E-03	1.52E 03	8.98E-04	2 81F-04	-3.3E-04														
dAj*8Al*8A	<u> </u>																		
10E-04	-5.4E-04	-2.7E-04	-9.4E-05	-9.2E-06	-1.3E-05	-1.0E-04	-2.8E-04	-5.3E-04	-8.63E-04	-9.10E-04	-5.42E-04	-2.71E-04	-9.44E-05	-9.23E-06	-1.3E-05	-1.02E-04	-2.75E-04	-5.30E-04	-8.63
-8.86E-04	-6.8E-04	-4.8E-04	-2.9E-04	-8.9E-05	1.05E-04	2.97E-04	4.87E-04	6.76E-04	8.63E-04	-8.86E-04	-6.84E-04	-4.84E-04	-2.85E-04	-8.92E-05	1.05E-04	2.97E-04	4.87E-04	6.76E-04	
-6.94E-04	-5.4E-04	-3.8E-04	-2.2E-04	-7.0E-05	8.22E-05	2.33E-04	3.82E-04	5.30E-04	6.76E-04	-8.94E-04	-5.36E-04	-3.79E-04	-2.24E-04	-6.99E-05	8.22E-05	2.33E-04	3.82E-04		6.7
-5.01E-04	-3.9E-04	-2.7E-04	-1.6E-04	-5.0E-05	5.93E-05	1.68E-04	2.75E-04	3.82E-04	4.87E-04	-5.01E-04	-3.86E-04	-2.73E-04	-1.61E-04	-5.04E-05	5.93E-05	1.68E-04		3.82E-04	4.8
-3.05E-04	-2.4E-04	-1.7E-04	-9.8E-05	-3.1E-05	3.61E-05	1.02E-04	1.68E-04	2.33E-04	2.97E-04	-3.05E-04	-2.36E-04	-1.67E-04	-9.83E-05	-3.07E-05	3.61E-05		1.68E-04	2.33E-04	2.9
-1.08E-04	-8.3E-05	-5.9E-05	-3.5E-05	-1.1E-05	1.28E-05	3.61E-05	5.93E-05	8.22E-05	1.05E-04	-1.08E-04	-8.31E-05	-5.88E-05	-3.47E-05	-1.09E-05		3.61E-05	5.93E-05	8.22E-05	1.0
		5.00E-05	2.95E-05	9.23E-06	-1.1E-05	-3.1E-05	-5.0E-05	-7.0E-05	-8.92E-05	9.17E-05	7.07E-05	5.00E-05	2.95E-05		-1.1E-05	-3.07E-05	-5.04E-05	-8.99E-05	-8.9
	2.26E-04		9.44E-05		-3.5E-05	-9.8E-05	-1.6E-04	-2.2E-04	-2.85E-04	2.93E-04	2.26E-04	1.60E-04	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		-3.5E-05	-9.83E-05	-1.61E-04	-2.24E-04	-2.8
4.97E-04		2.71E-04			-5.9E-05	-1.7E-04	-2.7E-04	-3.8E-04	-4.84E-04	4.97E-04	3.83E-04	0.002.01	1.60E-04	5.00E-05	-5.9E-05	-1.67E-04	-2.73E-04	-3.79E-04	-4.8
				7.07E-05		-2.4E-04	-3.9E-04	-5.4E-04	-6.84E-04	7.02E-04		3.83E-04	2.28E-04	7.07E-05	-8.3E-05	-2.36E-04	-3.86E-04	-5.36E-04	-6.8
						-3.1E-04	-5.0E-04	-6.9E-04	-8.86E-04	0.002 04	7.02E-04	4.97E-04	2.93E-04	9.17E-05	-1.1E-04	-3.05E-04	-5.01E-04	-6.94E-04	-8.8
-8.86E-04		-4.8E-04	-2.9E-04					8 78F-04	002 04	-8.86E-04	-6.84E-04	-4.84E-04	-2.85E-04	-8.92E-05		2.97E-04	4.87E-04	6.76E-04	8.6
-6.94E-04		-3.8E-04					3.82F-04	0.012.04	6.76E-04		-5.36E-04	-3.79E-04	-2.24E-04	-6.99E-05		2.33E-04	3.82E-04	5.30E-04	6.7
-5.01E-04		-2.7E-04	-1.6E-04		5.93E-05	1 88F-04	1.002-04	3.82E-04	4.87E-04	-5.01E-04	-3.86E-04	-2.73E-04	-1.61E-04	-5.04E-05		1.68E-04	2.75E-04	3.82E-04	4.8
-1.08E-04 -3.05E-04		-5.8E-05	-9.8E-05	-3.1E-05	2 61 E 05	3.012-05		2.33E-04	2.97E-04	-3.05E-04	-2.36E-04	-1.67E-04	-9.83E-05	-1.00E-05		1.02E-04	1.68E-04	8.22E-05 2.33E-04	2.9
		5.00E-05		-1.1E-05	-1.15-05	-3.1E-05	-5.0E-05 5.93E-05		1.05E-04	9.17E-05 -1.08E-04	-8.31E-05	-5.88E-05	-3.47E-05	9.23E-06 -1.09E-05		-3.07E-05 3.61E-05	-5.04E-05 5.93E-05	-6.99E-05	-8.9 1.0
			• • • • • • •	2.905-00	-3.5E-05	-9.8E-05	-1.6E-04		-2.85E-04 -8.92E-05	2.93E-04 9.17E-05	2.26E-04 7.07E-05	1.60E-04 5.00E-05	9.44E-05 2.95E-05	2.95E-05 9.23E-06	-3.5E-05 -1.1E-05	-9.83E-05 -3.07E-05	-1.61E-04	-2.24E-04	-2.8
9.17E-05			1.60E-04	5.00E-05	-5.9E-05	-1.7E-04	-2.7E-04	-3.8E-04	-4.84E-04	4.97E-04	3.83E-04	2.71E-04	1.60E-04	5.00E-05	-5.9E-05	-1.67E-04	-2.73E-04	-3.79E-04	-4.8
2.93E-04 9.17E-05		3.83E-04	2.26E-04		-8.3E-05	-2.4E-04	-3.9E-04		-6.84E-04	7.02E-04	5.42E-04	3.83E-04	2.26E-04		-8.3E-05	-2.36E-04	-3.86E-04	-5.36E-04	-6.8
9.17E-05			2.03L-U-	9.17E-05	-1.1E-04	-3.1E-04	-5.0E-04	-6.9E-04	-8.86E-04	9.10E-04	7.02E-04	4.97E-04	2.93E-04	9.17E-05	-1.1E-04	-3.05E-04	-5.01E-04	-6.94E-04	-8.8

Table A-3 Bias Error Calculation -- Secondary Air Inlet Milliken Heat Pipe Air Preheater

# of Points	4		
T, deg F	80	0.800	1.00%
T, deg R	540	0.800	0.15%

	Input Da	ta	Derivatives	(0	iTa/dX*Sigma) ^ 2 (1)		Cross Pro	duct Terms	
_	Point	TI	dTa/DTI		dTa/dTi		d/dTi*d/d	Tj*STI*STJ	
	1	1 80.0			4.00E-02		4.00E-02	4.00E-02	4.00E-02
	2	80.0	0.25		4.00E-02	4.00E-02		4.00E-02	4.00E-02
	3	80.0	0.25		4.00E-02	4.00E-02	4.00E-02		4.00E-02
	4	80.0	0.25		4.00E-02	4.00E-02	4.00E-02	4.00E-02	
				Totals	1.60E-01	1.20E-01	1.20E-01	1.20E-01	1.20E-01

	Т	
Contributions (2)	6.40E-01	
Total Sigma ^ 2	0.64	
Tavg Sigma	0.80	deg F

⁽¹⁾ Ta = (T1 + T2 + T3 + T4)/4

⁽²⁾ Contributions Include Cross Product Terms

Table A-4 **Bias Error Calculation -- Secondary Air Outlet** Milliken Heat Pipe Air Preheater

	Average	Sigma	Sigma				
	Value	Absolute	Relative				
uct Size							
Molth, It	•	0.042	0.46%				
Length, ft	•	0 042	0.89%				
# of Points	24						
Mothwise	6						
.engthwise	4						
Sector Width, ft	1.50	0.042	2.78%				
Sector Length, ft	1.50	0.042	2.78%				
4, Sector Area ft^2	2.25	0.088	3.93%				
deg F	616	6.160	1.00%				
deg R	1076	6.160	0.57%				
ımp Bias, deg F	100		33.33	deg F/Length I	ncrement	Special Bio	18
P, In WC	0.972035	0.0194	2.00%				
, lb/mol	26.85	0.025	0.09%				
mb Pres, In. Hg	29.50						
uct Pres, In. WC	5.60						
s, in. Hg Absolute	29.70	0.040	0.14%				
P, Pitot Fact	0.84	0.0100	1.19%				
ominal Vel, fps	79.34	ACFM=	257051	SCFM= 12	3321	lb/hr=	562500

			Input D	ela								Derivative	e, dTa/dX					(dTe/dX*8	igma) ^ 2		
	Point	Ai	CPi	DPI	MI	Pel	Ti	(1)	(2)	dTa/dTi	dTa/dAl	dTa/dCPi	dTa/dDPl	dTa/dMi	dTa/dPai	d/dTI*STI	d/dAi*SAi	d/dCPI*SCPI	d/dDPI*SDPI	d/dMi*SMI	d/dPei*SPei
	1	2 25	0 84	0.9720	28.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	7.24E-02	6.84E-03	6.26E-04	4.43E-04	8.32E-07	2.03E-06
	2	2.25	0.84	0.0720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	6.79E-02	6.98E-04	6.41E-05	4.52E-05	8.49E-08	2.07E-07
	3	2 25	0.84	0.9720	26.65	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	6.38E-02	7.90E-04	7.26E-05	5.12E-05	9.61E-06	2.34E-07
	4	2.25	0.84	0.9720	26.65	29.70	1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	6.01E-02	6.56E-03	6.03E-04	4.25E-04	7.98E-07	1.94E-06
	5	2.25	0.84	0.9720	26.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.85E-02	-3.54E-02	7.24E-02	6.84E-03	6.28E-04	4.43E-04	8.32E-07	2.03E-06
	6	2.25	0.84	0.9720	28.85	29.70	1050.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	6.79E-02	6.98E-04	8.41E-05	4.52E-05	8.49E-08	2.07E-07
	7	2.25	0.84	0.9720	26.85	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	6.38E-02	7.90E-04	7.26E-05	5.12E-05	9.61E-08	2.34E-07
	8	2.25	0.84	0.9720	28.85	29.70	1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	6.01E-02	6.56E-03	6.03E-04	4.25E-04	7.98E-07	1.94E-06
	•	2.25	0.84	0.9720	28.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	7.24E-02	6.84E-03	6.26E-04	4.43E-04	8.32E-07	2.03E-06
	10	2.25	0.84	0.9720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	6.79E-02	6.98E-04	6.41E-05	4.52E-05	8.49E-08	2.07E-07
	11	2.25	0.84	0.9720	26.85	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	6.38E-02	7.90E-04	7.26E-05	5.12E-05	9.61E-08	2.34E-07
	12	2.25	0.84	0.9720	28.85	29.70	1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	6.01E-02	6.56E-03	6.03E-04	4.25E-04	7.98E-07	1.94E-06
	13	2.25	0.84	0.9720	26.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	7.24E-02	6.84E-03	6.28E-04	4.43E-04	8.32E-07	2.03E-06
	14	2.25	0.84	0.9720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	6.79E-02	6.98E-04	6.41E-05	4.52E-05	8.49E-08	2.07E-07
	15	2.25	0.84	0.9720	28.85	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	6.38E-02	7.90E-04	7.26E-05	5.12E-05	9.61E-08	2.34E-07
	16	2.25	0.84	0.9720	26.85	29.70	1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	6.01E-02	6.56E-03	6.03E-04	4.25E-04	7.96E-07	1.94E-08
	17	2.25	0.84	0.9720	26.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	7.24E-02	6.84E-03	6.28E-04	4.43E-04	8.32E-07	2.03E-06
	18	2.25	0.84	0.9720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	6.79E-02	6.98E-04	6.41E-05	4.52E-05	8.49E-08	2.07E-07
	19	2.25	0.84	0.9720	26.85	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	6.38E-02	7.90E-04	7.26E-05	5.12E-05	9.61E-08	2.34E-07
	20	2.25	0.84	0.9720	28.85	29.70	1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	6.01E-02	6.56E-03	6.03E-04	4.25E-04	7.98E-07	1.94E-06
	21	2.25	0.84	0.9720	26.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	7.24E-02	6.84E-03	6.28E-04	4.43E-04	8.32E-07	2.03E-06
	22	2.25	0.84	0.9720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	6.79E-02	6.98E-04	6.41E-05	4.52E-05	8.49E-08	2.07E-07
	23	2.25	0.84	0.9720	26.85	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	6.38E-02	7.90E-04	7.26E-05	5.12E-05	9.61E-06	2.34E-07
	24	2.25	0.84	0.9720	28.85	29.70	1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	6.01E-02	6.56E-03	6.03E-04	4.25E-04	7.98E-07	1.94E-08
			Temperature	- Simple Av	erage		1076.0	SUM1	SUM2							T	A	CP	DP	M	Pe
			Temperature	- Weighted	Average		1075.4	39.927	42936.0						Contributions (3)	3.80E+01	7.81E-18	3.74E-18	4.88E-19	-4.76E-22	6.99E-21
) Al*CPI(DPI	•Mi•Pəl/Ti)	^0.5																Total Sign	na ^ 2	37.99	
) Al*CPI(DPI	*Mi*Pei*Ti)	^0.5																Tavg Sign	14	6.16	deg F
) Camedhada																					

⁾ Al*CPI(DPI*MI*Pal*TI) ^ 0.5

⁾ Contributions Include Cross Product Terms

Table A-4 (Continued)

Cross Product Terms

d/dTI*d/dTJ*STI*STJ	1												4 4 1 7 7 7	4 405 00	4 40F A2	7 04E 60	7.01E.02	6.80E-02	6.60E-02	7 24F-02	7.01E-02	6.60E-02	6.60E-02
		6 80E-02	6.60E-02	7.24E-02	7.01E-02	6.60E-02	6.60E-02	7.24E-02	7.01E-02	8.80E-02	8.60E-02	7.24E-02	7.01E-02	0.00E-02	6.60E-02	7.245-02	4.01E-02	6.58E-02	6.30E-02		6.79E-02		
7.01E-02		6.58E-02	- AAE AA	7 ALE A2	4 70F A2	# SAF_O2	4 30F.A2	7.01F-02	6 79E-02	6 58E-02	6.39E-02	7.01E-02	6.79E-02	0.38E-UZ	0.3VC-U4	7.016-02	0.700-02	6.38E-02	6.19E-02		6.58E-02		
	6.58E-02			4 40E 00	A EAE AS	4 28E 02	8 10E-02	A ANE INC	4 SAF-02	6 38E-02	6.10E-02	6.80E-02	6.56E-02	6.36E-02	6.1VC-UZ	0.0UC-UZ	0.30C-UZ	6.38E-02 6.19E-02	6.01E-02		6.39E-02		
	6.30E-02			6.60E-02	6.39E-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02	6.01E-02	0.0UE-U2	7.04E-02	6.60E-02	6.60E-02		7.01E-02		
7.24E-02	7.01E-02	6.80E-02	6.60E-02		7.01E-02	6.80E-02	6.60E-02	7.24E-02	7.01E-02	6.80E-02	6.60E-02	7.24E-02	7.01E-02	6.50E-02	6.60E-02	7.24E-02	7.01E-02	6.58E-02	8.30E-02		6.79E-02		
				7.01E-02		6.58E-02	6.30E-02	7.01E-02	6.79E-02	6.58E-02	6.3 9 E-02	7.01E-02	6.79E-02	6.56E-02	6.39E-02	7.01E-02	6.79E-02	6.38E-02	8.19E-02		6.58E-02		
8 80E-02	6.58E-02	6.38E-02	6.19E-02	6.80E-02	6.58E-02		6.19E-02	6.80E-02	8.58E-02	6.38E-02	6.19E-02	6.60E-02	6.58E-02	6.36E-02	6.19E-02	8.80E-02	9.56E-02		6.01E-02		6.39E-02		
6 60F-02	6.30E-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02		6.60E-02	6.30E-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02	6.01E-02	6.60E-02	6.30E-02	6.19E-02	8.80E-02		7.01E-02		
7 24F.02	7.01F-02	6 80E-02	6.60E-02	7.24E-02	7.01E-02	6.80E-02	6.00E-02			6.80E-02	6.60E-02	7.24E-02	7.01E-02	6.80E-02	6.60E-02	7.24E-02	7.01E-02	6.80E-02	•		6.79E-02		
7.01E.02	6 70F-02	4 5AF-02	4.30E-02	7.01E-02	6.79E-02	6.58E-02	6.30E-02	7.01E-02			6.30E-02	7.01E-02	6.79E-02	6.58E-02	6.30E-02	7.01E-02	6.79E-02	6.58E-02	6.30E-02		6.58E-02		
# #0E-02	4 5AF-02	6 38F-02	4.19E-02	6.80E-02	6.58E-02	6.38E-02	6.19E-02	6.80E-02	6.58E-02						8.19E-02			6.38E-02	6.19E-02		6.30E-02		
4 ANE 02	4 30E 02	4 10F.02	# 01F-02	6 60E-02	6.39E-02	6.19E-02	8.01E-02	8.60E-02	6.39E-02	6.19E-02					6.01E-02			6.19E-02	6.01E-02				
7.045.02	3 A1E A2	4 ANE-02	4 AOF -02	7 24F-02	7.01E-02	6.80E-02	6.60E-02	7.24E-02	7.01E-02	6.80E-02	6.80E-02				8.60E-02			6.80E-02	8.60E-02		7.01E-02		
7.045.00	# 70E 00	4 54E 02	4 30E.02	7.01F-02	6 70F-02	6 58F-02	6.39E-02	7.01E-02	6.79E-02	6.58E-02	6.39E-02	7.01E-02			6.39E-02			6.58E-02	6.39E-02		6.79E-02		
a aoc oo	4 4 4 5 02	4 34E 03	# 10E.02	# MAE-02	6 58F-02	6 38F-02	6.19E-02	8.80E-02	6.58E-02	6.38E-02	6.19E-02	6.80E-02	6.58E-02		6.19E-02			6.38E-02	6.19E-02		6.58E-02		
		4 405 00	4 A+E A2	A 40E 02	■ 30E-02	A 10F.02	6 01F-02	6 60F-02	6.39E-02	8.19E-02	6.01E-02	0.0UE-U2	0.3VE-U2	0.19E-UZ		6.60E-02		6.19E-02	6.01E-02		6.39E-02		
3 2 5 6 2 2	7 445 44	4 AAE AA	4 40E 02	7 24E-02	7.01F.02	6 80F-02	6 60F-02	7.24E-02	7.01E-02	8.80E-02	6.60E-02	7.24E-02	7.01E-02	0.80C-02	0.000.02		7.01E-02	6.80E-02	6.60E-02		7.01E-02		
			4 30E 00	7 A 1 E A2	4 70E 02	A SAF_A2	# 30E-U3	7 01F-02	6.79E-02	6.58E-02	6.39E-02	7.01E-02	0./9E-U2	0.30E-UZ	0.386-02	7.01E-02		6.58E-02	6.30E-02		6.79E-02		
		4 04E 00	4 405 02	4 AOE 02	A SAE-O2	A SAF-02	8 10F-02	6 80F-02	8.58E-02	8.38E-02	6.19E-02	6.80E-02	0.505-02	0.30E-U2	9. ISC-U2	0.000	9.50E-02		6.19E-02		6.58E-02		
			4 445 44	4 40E 02	# 20E 02	# 10E-02	A DIF-DO	A ANE-NO	6 30F-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	0.19E-U2	0.U1C-U2	0.0UC-UZ	0.30C-U2	6.19E-02		6.60E-02			
	* * * * * * * * *	A BOE OO	4 4AE AA	7 04E 00	7.01E.02	A BOE-DO	A AOF-O2	7 24F-02	7.01E-02	6.80E-02	6.60E-02	7.24E-02	7.01E-02	0.8UE-U2	0.0UE-02	1.29E-02	7.01E-02	6.80E-02	8.60E-02			6.80E-02	
				7 A4E A4	4 70E 02	# ENE-DO	# 30E-02	7 01F-02	6 79F-02	6.58E-02	6.39E-02	7.01E-02	0./VE-U2	0.30E-U∠	0.39C-U2	7.01E-02	0.786-02	6.58E-02	6.39E-02			6.58E-02	
			- 405 00	4 4AE A2	# KAE 02	4 3AE-02	# 10F_02	& MAF-02	A 5AF-02	6.38E-02	6.19E-02	6.80E-02	6.38E-U2	0.305-02	0.196-02	0.DUC~UZ	♥.30L~02	6.38E-02	6.19E-02		6.58E-02		6.19E-02
6 60E-02	6 30E-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02	6.01E-02	6.60E-02	6.3 0E -02	6.19E-02	6.01E-02	6.60E-02	6.39E-02	6.19E-02	6.01E-02	8.60E-02	6.39E-02	6.19E-02	
																					4.545.00		4.455.00
1 60E ± 00	1 54F + 00	1 49F+0	0 145F+00	1.59E+00	1.54E+00	1.49E+00	1.45E+00	1.59E+00	1.54E+00	1.49E+00	1.45E+00	1.59E+00) 1.54E+00	1.49E+00	1.45E+00	1.50E+00	1.54E+00	1.49E+00	1.45E+00	1,50E+00	1.54E+00	1.495 +00	1.436 +00
1.596 + 00	1.546.700) 1.48E TO	0 1.402 704	, ,,,,,,,																			
AJADBI*AJA DBI*S DI	PI-SOPI																				1 10 01	465 64	4.35.04
d/dDPI*d/dDPJ*SDF	PI*SDPJ	-1 5E-04	-4.3E-04	4.43E-04	1.42E-04	-1.5E-04	-4.3E-04	4.43E-04	1.42E-04	-1.5E-04	-4.3E-04	4.43E-04	1.42E-04	-1.5E-04	-4.3E-04	4.43E-04	1.42E-04	-1.51E-04	-4.34E-04			-1.5E-04	
	1.42E-04	-1.5E-04	1 45 04	1.42E-04	4 50F-05	-4 AF-05	-1 4F-04	1.42E-04	4.52E-05	-4.8E-05	-1.4E-04	1.42E-04	4.52E-05	-4.6E-05	-4.3E-04 -1.4E-04	1.422-04	4.522-05	-4.81E-05	-1.39E-04	1.42E-04	4.52E-05	-4.8E-05	-1.4E-04
1.42E-04	1.42E-04	-4.8E-05	1 45 04	1.42E-04	4.52E-05	-4.8E-05	-1.4E-04	1.42E-04	4.52E-05	-4.8E-05 5.12E-05	-1.4E-04 1.48E-04	1.42E-04 -1.5E-04	4.52E-05 -4.8E-05	-4.8E-05	-1.4E-04 1.48E-04	-1.5E-04	4.52E-05	-4.81E-05 5.12E-05	-1.39E-04 1.48E-04	1.42E-04 -1.5E-04	4.52E-05 -4.81E-05	-4.8E-05 5.12E-05	-1.4E-04 1.48E-04
1.42E-04 -1.51E-04	1.42E-04 -4.8E-05	-4.8E-05	-1.4E-04 1.48E-04	1.42E-04	4.52E-05 -4.8E-05	-4.8E-05 5.12E-05	-1.4E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04	-1.48E-04 1.48E-04 4.25E-04	-1.5E-04 -4.3E-04	-4.8E-05 -1.4E-04	-4.81E-05 5.12E-05 1.48E-04	-1.39E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.81E-05 -1.39E-04	-4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04
1.42E-04 -1.51E-04 -4.34E-04	1.42E-04 -4.8E-05 -1.4E-04	-4.8E-05	-1.4E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04	-1.5E-04 -4.3E-04 4.43E-04	-4.8E-05 -1.4E-04 1.42E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04	-1.30E-04 1.48E-04 4.25E-04 -4.34E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04
1.42E-04 -1.51E-04 -4 34E-04 4 43E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1,42E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05	-1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04	4.52E-05 -4.61E-05 -1.39E-04 1.42E-04 4.52E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04
1.42£-04 -1.51£-04 -4.34£-04 4.43£-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.8E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05	-1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04
1.42E-04 -1.51E-04 -4.34E-04 4.43E-04 1.42E-04 -1.51E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05	-1.4E-04 1.48E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04	-1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04	-4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04	-1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05 -1.39E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04
1.42E-04 -1.51E-04 -4.34E-04 4.43E-04 -1.51E-04 -4.34E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04	-4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04	-1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04 1.48E-04 4.25E-04 -4.34E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05 -1.39E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04
1.42E-04 -1.51E-04 -4.34E-04 -4.43E-04 -1.51E-04 -4.34E-04 -4.34E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04	-4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 4.43E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04	4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05	-1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04
1.42E-04 -1.51E-04 -4.34E-04 -4.43E-04 -1.42E-04 -4.34E-04 -4.34E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-06	-4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 +1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -1.5E-04 -4.3E-04 1.42E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 1.48E-04	-1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04	4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05	-1.39E-04 1.48E-04 4.25E-04 -4.34E-04 -1.39E-04 1.48E-04 4.25E-04 -4.34E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04	4.52E-05 -4.61E-05 -1.39E-04 1.42E-04 4.52E-05 -4.61E-05 -1.39E-04 1.42E-04 4.52E-05 -4.61E-05	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04
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1.42E-04 -1.51E-04 -4.34E-04 -1.42E-04 -1.51E-04 -4.34E-04 -1.51E-04	1.42E-04 -4.8E-05 -1.4E-04 -4.8E-05 -4.8E-05 -1.4E-04	-4.8E-05 -1.48E-04 -4.8E-05 -1.2E-05 -1.48E-04 -4.8E-05 -1.5E-04 -4.8E-05 -5.12E-05 -4.8E-06 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-06 -1.48E-06 -1.5E-06	-1.4E-04 1.48E-04 -4.3E-04	1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.526-05 -4.8E-05 -1.4E-04 1.426-04 -4.8E-05 -1.4E-04 1.426-04 4.526-05 -4.8E-04 1.426-04 4.526-05 -4.8E-04 1.426-04 4.526-05 -4.8E-04 1.426-04 4.526-05	4.8E-05 5.12E-05 1.48E-04 4.8E-05 1.48E-04 4.8E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05	-1.4E-04 1.48E-04 4.3E-04 -1.4E-04 1.48E-04 -1.4E-04 1.48E-04 4.3E-04 -1.4E-04 4.3E-04 -1.4E-04 -1.4E-04 4.3E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.52:-05 -1.4E-04 1.42:-04 4.52:-05 -4.8E-05 -1.4E-04 1.42:-04 1.42:-04 1.42:-04 1.42:-04 1.42:-04 4.52:-05 -1.4E-04 1.42:-04 4.52:-05 -1.4E-04 1.42:-04 4.52:-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -1.5E-05 5.12E-05	-1.4E-04 1.48E-04 4.2SE-04 -1.4E-04 1.48E-04 4.3E-04 -1.4E-04 1.48E-04 4.3E-04 -1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 1.42E-04 4.3E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	4.8E-06 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04	4.8E-04 5.12E-05 1.48E-04 -1.5E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05	1.48-04 1.48-04 4.25-04 4.38-04 1.48-04 1.48-04 4.25-04 4.38-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04	1.42E-04 4.3E-04 4.3E-04 4.3E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.5E-04 4.3E-04 1.5E-04 1.5E-04	4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.5E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05	-1.39E-04 1.48E-04 4.25E-04 -1.39E-04 1.48E-04 -1.39E-04 -1.39E-04 1.48E-04 -1.39E-04 4.25E-04 4.34E-04 -1.39E-04 1.48E-04 -1.39E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 -1.5E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -1.39E-04 1.42E-04 4.52E-05 -1.39E-04 1.42E-04 -4.81E-05	-4.8E-05 5.12E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 -4.3E-04 -1.4E-04 1.48E-04 -1.4E-04 1.48E-04 -1.4E-04 1.4SE-04 -1.4E-04 1.4SE-04 -1.4E-04 1.4SE-04 -1.4E-04 1.4SE-04 -1.4E-04 1.4SE-04 -1.4E-04
1.42E-04 -1.51E-04 -4.34E-04 -1.42E-04 -1.51E-04 -4.34E-04 -1.51E-04	1.42E-04 -4.8E-05 -1.4E-04 -4.8E-05 -4.8E-05 -1.4E-04	-4.8E-05 -1.48E-04 -4.8E-05 -1.2E-05 -1.48E-04 -4.8E-05 -1.5E-04 -4.8E-05 -5.12E-05 -4.8E-06 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 -4.8E-05 -1.5E-06	-1.4E-04 1.48E-04 -4.3E-04	1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.526-05 -4.8E-05 -1.4E-04 1.426-04 -4.8E-05 -1.4E-04 1.426-04 4.526-05 -4.8E-04 1.426-04 4.526-05 -4.8E-04 1.426-04 4.526-05 -4.8E-04 1.426-04 4.526-05	4.8E-05 5.12E-05 1.48E-04 4.8E-05 1.48E-04 4.8E-05 5.12E-05 1.48E-04 4.8E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05	-1.4E-04 1.48E-04 4.3E-04 -1.4E-04 1.48E-04 -1.4E-04 1.48E-04 4.3E-04 -1.4E-04 4.3E-04 -1.4E-04 -1.4E-04 4.3E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.52:-05 -1.4E-04 1.42:-04 4.52:-05 -4.8E-05 -1.4E-04 1.42:-04 1.42:-04 1.42:-04 1.42:-04 1.42:-04 4.52:-05 -1.4E-04 1.42:-04 4.52:-05 -1.4E-04 1.42:-04 4.52:-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -1.5E-05 5.12E-05	-1.4E-04 1.48E-04 4.2SE-04 -1.4E-04 1.48E-04 4.3E-04 -1.4E-04 1.48E-04 4.3E-04 -1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 1.42E-04 4.3E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	4.8E-06 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04 4.52E-05 -1.4E-04	4.8E-04 5.12E-05 1.48E-04 -1.5E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05	1.48-04 1.48-04 4.25-04 4.38-04 1.48-04 1.48-04 4.25-04 4.38-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04 1.48-04	1.42E-04 4.3E-04 4.3E-04 4.3E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.5E-04 4.3E-04 1.5E-04 1.5E-04	4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.5E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -4.81E-05 5.12E-05 1.48E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05	-1.39E-04 1.48E-04 4.25E-04 -1.39E-04 1.48E-04 -1.39E-04 -1.39E-04 1.48E-04 -1.39E-04 4.25E-04 4.34E-04 -1.39E-04 1.48E-04 -1.39E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.52E-05 -4.81E-05 -1.39E-04 1.52E-05 -4.81E-05 -1.39E-04 1.52E-05 -4.81E-05 -1.39E-04 1.42E-04	-4.8E-05 5.12E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04
1.42E-04 -1.51E-04 -4.34E-04 -1.42E-04 -1.42E-04 -1.51E-04 -4.34E-04 -4.34E-04 -1.51E-04 -4.34E-04 -4.34E-04 -1.51E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	-4.8E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 -4.3E-04	1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.43E-04	4.526-05 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -1.	-1.4E-04 1.48E-04 -1.3E-04 -1.4E-04 1.48E-04 -1.4E-04 1.48E-04 -1.3E-04 -1.	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04 1.3E-04 1.3E-04 1.42E-04 -1.3E-04 4.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05	-1.4E-04 1.48E-04 4.2SE-04 -1.4E-04 1.48E-04 4.2SE-04 -1.4E-04 1.48E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 1.48E-04 -1.5E-05 1.48E-04 -1.5E-05 1.48E-04 -1.5E-05 5.12E-05 1.48E-04 -1.5E-05	1.48E-04 4.25E-04 4.3E-04 1.48E-04 4.25E-04 4.3E-04 1.48E-04 4.3E-04 1.48E-04 1.48E-04 1.48E-04 1.48E-04 1.48E-04 4.3E-04 1.48E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	1.42E-04 4.3E-04 4.3E-04 4.43E-04 1.42E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04	-1.39E-04 1.48E-04 4.23E-04 -1.39E-04 1.48E-04 4.23E-04 -1.39E-04 1.48E-04 4.23E-04 4.23E-04 1.48E-04 4.34E-04 -1.39E-04 1.48E-04 -1.39E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 -4.81E-05 -1.39E-04 -4.81E-05 -1.39E-04	-4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04
1.42E-04 -1.51E-04 -4.34E-04 -1.42E-04 -1.42E-04 -1.51E-04 -4.34E-04 -4.34E-04 -1.51E-04 -4.34E-04 -4.34E-04 -1.51E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	-4.8E-05 1.48E-04 -1.5E-04	-1.4E-04 1.48E-04 -4.3E-04	1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.43E-04	4.526-05 -4.8E-05 -1.4E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -1.	-1.4E-04 1.48E-04 -1.3E-04 -1.4E-04 1.48E-04 -1.4E-04 1.48E-04 -1.3E-04 -1.	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 -4.3E-04 1.3E-04 1.3E-04 1.42E-04 -1.3E-04 4.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	-4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -4.8E-05 5.12E-06 1.48E-04 -1.5E-04 -4.8E-05 1.48E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05 5.12E-05	-1.4E-04 1.48E-04 4.2SE-04 -1.4E-04 1.48E-04 4.2SE-04 -1.4E-04 1.48E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 4.43E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 4.3E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04	4.8E-05 5.12E-05 1.48E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 1.48E-04 -1.5E-05 1.48E-04 -1.5E-05 1.48E-04 -1.5E-05 5.12E-05 1.48E-04 -1.5E-05	1.48E-04 4.25E-04 4.3E-04 1.48E-04 4.25E-04 4.3E-04 1.48E-04 4.3E-04 1.48E-04 1.48E-04 1.48E-04 1.48E-04 1.48E-04 4.3E-04 1.48E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	1.42E-04 4.3E-04 4.3E-04 4.43E-04 1.42E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4.8E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 4.52E-05 -1.4E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	-4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05 1.48E-04 -1.51E-04 -4.81E-05 1.48E-04 -1.51E-04 -4.81E-05 1.48E-04 -1.51E-04 -4.81E-05 5.12E-05	-1.39E-04 1.48E-04 4.23E-04 -1.39E-04 1.48E-04 4.23E-04 -1.39E-04 1.48E-04 4.23E-04 4.23E-04 1.48E-04 4.34E-04 -1.39E-04 1.48E-04 -1.39E-04 1.48E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04	4.52E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.42E-05 -4.81E-05 -1.39E-04 1.52E-05 -4.81E-05 -1.39E-04 1.42E-04 4.52E-05 -4.81E-05 -1.39E-04 1.42E-04 -4.81E-05 -1.39E-04 -4.81E-05 -1.39E-04	-4.8E-05 5.12E-05 1.48E-04	-1.4E-04 1.48E-04 4.25E-04 -4.3E-04 -1.4E-04 1.48E-04 4.25E-04 -4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04

COMMERCIAL SECTION

Table A-4 (Continued)

Cross Product Terms

MI-SMI-S		0.45.63	4 15 63	A AGE AS	2.66E-07	A AP AT	A 45 A4	A AA- A4	A AAF AS	A AP AS	A 4P AS	A AAP A4	A AAF AS	A 4P 45	A - P A 4	- A A A P A A							
2 445 07	2 000-07																	-2.83E-07	-8.15E-07			-2 8E-07	
2 66E-07	0 OF 00				8.49E-08													-9.03E-08	-2.60E-07			-9.0E-08	
	-0.0E-08				-9.0E-06													9.61E-06	2.77E-07		-9.03E-08		
		2.77E-07		-8.1E-0/	-2.6E-07													2.77E-07	7.98E-07		-2.60E-07		
		-2.8E-07			2.006-07										-8.1E-07			-2.83E-07	-8.15E-07			-2.8E-07	
		-9.0E-08				-9.0E-08									-2.8E-07			-9.03E-08	-2.60E-07			-9.0E-08	
				-2.8E-07			2.77E-07								2.77E-07			9.01E-08	2.77E-07		-9.03E-08	9.61E-06	2.7
					-2.6E-07			-8.1E-07							7.98E-07			2.77E-07	7.98E-07		-2.60E-07	2.77E-07	7.9
	_				2.66E-07										-8.1E-07			-2.83E-07	-8.15E-07		2.00E-07	-2.8E-07	-8
					8.49E-08					-9.0E-06					-2. 6 E-07			-9.03E-08	-2.60€-07			-9.0E-08	_
					-9.0E-08						2.77E-07				2.77E-07			9.61E-08	2.77E-07	·2.8E-07	-0.03E-08	9.61E-08	2.7
					-2.6E-07							-8.1E-07			7.98E-07			2.77E-07	7.98E-07	-8.1E-07	-2.60E-07	2.77E-07	7.8
					2.66E-07								2.66E-07		-8.1E-07			-2.83E-07	-8.15E-07	8.32E-07	2.66E-07	-2.8E-07	-8
					8.49E-08									-9.0E-08	-2.8E-07	2.66E-07	8.49E-08	-9.03E-08	-2.60E-07	2.66E-07	8.49E-08	-9.0E-08	-2
					-9.0E-08										2.77E-07	-2.8E-07	-9.0E-08	9.61E-08	2.77E-07	-2.8E-07	-9.03E-08	9.61E-08	2.7
					-2.0E-07											-8.1E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.60E-07	2.77E-07	7.0
8.32E-07	2.66E-07	-2.8E-07	-8.1E-07	8.32E-07	2.00E-07	-2.8E-07	-8.1E-07	8.32E-07	2.86E-07	-2.8E-07	-8.1E-07	8.32E-07	2.66E-07	-2.8E-07	-8.1E-07		2.66E-07	-2.83E-07	-8.15E-07	8.32E-07	2.66E-07	-2.8E-07	-0
2.86E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07		-9.03E-08	-2.60E-07	2.86E-07	8.49E-08	-9.0E-08	-2
·2.83E-07	-9.0E-08	9.61E-06	2.77E-07	-2.8E-07	-9.0E-08	9.61E-08	2.77E-07	-2.8E-07	-9.0E-08	9.61E-06	2.77E-07	-2.8E-07	-9.0E-08	9.61E-08	2.77E-07	-2.8E-07	-9.0E-06		2.77E-07	-2.8E-07	-9.03E-08	9.61E-08	2.
-8.15E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.8E-07	2.77E-07	7.98E-07	-8.1E-07	-2.6E-07	2.77E-07		-8.1E-07	-2.80E-07		
8.32E-07	2.66E-07	-2.8E-07	-8.1E-07	8.32E-07	2.66E-07	-2.8E-07	-8.1E-07	8.32E-07	2.66E-07	-2.8E-07	-8.1E-07	8.32E-07	2.86E-07	-2.8E-07	-8.1E-07	8.32E-07	2.66E-07	-2.83E-07	-8.15E-07		2.88E-07	-2.8E-07	-
2.66E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07	8.49E-08	-9.0E-06	-2.6E-07	2.86E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07	8.49E-08	-9.0E-08	-2.6E-07	2.66E-07	8.49E-08	-9.03E-08	-2.60E-07	2.86E-07		-9.0E-08	
-2.83E-07	-9.0E-08	9.61E-06	2.77E-07	-2.8E-07	-9.0E-08	9.61E-08	2.77E-07	-2.8E-07	-9.0E-08	9.61E-08	2.77E-07	-2.8E-07	-9.0E-08	9.61E-08	2.77E-07	-2.8E-07	-9.0E-08	9.61E-06	2.77E-07	-2.8E-07	-0.03E-08		2.
-8.15E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.6E-07	2.77E-07	7. 98 E-07	-8.1E-07	-2. 6E- 07	2.77E-07	7.98E-07	-8.1E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.6E-07	2.77E-07	7.98E-07	-8.1E-07	-2.60E-07	2.77E-07	_
-8.32E-07	-8.5E-08	-9.6E-08	-8.0E-07	-8.3E-07	-8.5E-06	-9.6E-08	-8.0E-07	-8.3E-07	-8.5E-08	-9.6E-06	-8.0E-07	-8.3E-07	-8.5E-08	-9.6E-08	-8.0E-07	-8.3E-07	-8.5E-08	-9.61E-08	-7.96E-07	-8.3E-07	-8.49E-08	-9.6E-08	-6
		-9.6E-08	-8.0E-07	-8.3E-07	-8.5E-08	-9.6E-08	-8.0E-07	-8.3E-07	-8.5E-08	-9.6E-06	-8.0E-07	-8.3E-07	-8.5E-08	-9.8E-08	-8.0E-07	-8.3E-07	-8.5E-08	-9.61E-08	-7.98E-07	-8.3E-07	-8.49E-08	-9.6E-08	-8
-8.32E-07 dPa *SPal	·SP4																						
dPaj*SPal	·SP4	-8.9E-07	-2.0E-06	2.03E-06	6.47E-07	-6.9E-07	-2.0E-06	2.03E-06	6.47E-07	-8.9E-07	-2.0E-00	2.03E-06	6.47E-07	-8.9E-07	-2.0E-06	2.03E-06	6.47E-07	-6.89E-07	-1.98E-06	2.03E-08	6.47E-07	-8.9E-07	-2
6.47E-07	*SPa 6.47E-07	-8.9E-07	-2.0E-06 -6.3E-07	2.03E-06 6.47E-07	6.47E-07 2.07E-07	-6.9E-07 -2.2E-07	-2.0E-06 -6.3E-07	2.03E-06 6.47E-07	6.47E-07 2.07E-07	-6.9E-07 -2.2E-07	-2.0E-00 -8.3E-07	2.03E-06 6.47E-07	6.47E-07 2.07E-07	-8.9E-07 -2.2E-07	-2.0E-06 -6.3E-07	2.03E-06 6.47E-07	6.47E-07 2.07E-07	-8.89E-07 -2.20E-07	-1.98E-06 -6.34E-07	2.03E-06 6.47E-07	6.47E-07 2.07E-07	-8.9E-07 -2.2E-07	-2
1 Paj*SPal * 6.47E-07 -6.69E-07	SPaj 6.47E-07 -2.2E-07	-8.9E-07 -2.2E-07	-2.0E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07	6.47E-07 2.07E-07 -2.2E-07	-6.9E-07 -2.2E-07 2.34E-07	-2.0E-06 -6.3E-07 6.75E-07	2.03E-06 6.47E-07 -6.9E-07	6.47E-07 2.07E-07 -2.2E-07	-8.9E-07 -2.2E-07 2.34E-07	-2.0E-06 -6.3E-07 6.75E-07	2.03E-06 6.47E-07 -6.9E-07	6.47E-07 2.07E-07 -2.2E-07	-8.9E-07 -2.2E-07 2.34E-07	-2.0E-06 -6.3E-07 6.75E-07	2.03E-06 6.47E-07 -6.9E-07	6.47E-07 2.07E-07 -2.2E-07	-8.89E-07 -2.20E-07 2.34E-07	-1.98E-06 -6.34E-07 6.75E-07	2.03E-06 6.47E-07 -6.9E-07	6.47E-07 2.07E-07 -2.20E-07	-8.9E-07 -2.2E-07 2.34E-07	-6 6.1
6.47E-07 -6.89E-07 -1.98E-06	•SPa 6.47E-07 -2.2E-07 -6.3E-07	-6.9E-07 -2.2E-07 6.75E-07	-2.0E-06 -6.3E-07 6.75E-07	2.03E-06 6.47E-07 -6.9E-07	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07	-6.9E-07 -2.2E-07 2.34E-07 6.75E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07	-6.9E-07 -2.2E-07 2.34E-07 6.75E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07	-8.89E-07 -2.20E-07 2.34E-07 6.75E-07	-1.98E-06 -6.34E-07 6.75E-07 1.94E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.20E-07 -6.34E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07	-6 6. 1.1
6.47E-07 -6.89E-07 -1.98E-06 2.03E-06	-SPa 6.47E-07 -2.2E-07 -6.3E-07 6.47E-07	-6.9E-07 -2.2E-07 6.75E-07 -6.9E-07	-2.0E-06 -6.3E-07 6.76E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07	-6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07	-6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -8.9E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07	-0.89E-07 -2.20E-07 2.34E-07 6.75E-07 -0.69E-07	-1.98E-06 -6.34E-07 6.75E-07 1.94E-06 -1.96E-06	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06	6.47E-07 2.07E-07 -2.20E-07 -6.34E-07 6.47E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07	-6 6. 1.:
6.47E-07 -6.89E-07 -1.98E-08 2.03E-06 6.47E-07	*SPa 6.47E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07	-6.9E-07 -2.2E-07 6.75E-07 -6.9E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 -2.0E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 6.47E-07	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07	-6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -8.9E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07	-8.89E-07 -2.20E-07 2.34E-07 6.75E-07 -8.89E-07 -2.20E-07	-1.98E-06 -6.34E-07 6.75E-07 1.94E-06 -1.98E-06 -6.34E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07	6.47E-07 2.07E-07 -2.20E-07 -6.34E-07 6.47E-07 2.07E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07	-2 -6 -2 -6
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47e4*\$Pai* 6 47E-07 -6.89E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07	*SPa 6.47E-07 -2.2E-07 -6.3E-07 6.3E-07 6.3E-07 6.3E-07 6.3E-07 6.3E-07 6.47E-07 2.0TE-07 -2.2E-07 -6.3E-07 6.47E-07 -2.2E-07 -6.3E-07 6.47E-07 -2.2E-07	-6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06	2.03E-06 6.47E-07 -8.9E-07 -2.0E-08 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 8.47E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -2.2E-07	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -6.3E-07 1.94E-06 -6.3E-07 6.75E-07	2.03E-06 8.47E-07 -6.9E-07 -2.0E-08 2.03E-06 8.47E-07 -2.0E-08 6.47E-07 -2.0E-08 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07	-8.9E-07 -2.2E-07 -2.2E-07 -6.75E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07	-2.0E-06 -8.3E-07 6.75E-07 1.94E-06 -2.0E-06 -8.3E-07 1.94E-06 -2.0E-06 -8.3E-07 1.94E-06 -2.0E-06 -8.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-08 2.03E-06 6.47E-07 -2.0E-08 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -8.9E-07 -2.0E-06 6.47E-07 -8.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -4.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.3E-07 6.3E-07 6.47E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 6.47E-07 2.07E-07 -2.2E-07 -2.2E-07 -2.2E-07	-8.9E-07 -2.2E-07 2.34E-07 -8.9E-07 -2.2E-07 2.3E-07 -8.9E-07 -2.2E-07 6.75E-07 -8.9E-07 -2.2E-07 2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07 6.75E-07 -2.0E-06 -6.3E-07 1.94E-06 -6.3E-07 1.94E-06 -6.3E-07 1.94E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 -2.0E-06 6.47E-07 -2.0E-06 -3.0E-07 -2.0E-06 -3.0E-07 -3.0E-07 -3.0E-06 -4.9E-07 -4.9E-07	6.47E-07 2.07E-07 -2.2E-07 -4.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.47E-07 2.07E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.47E-07 2.07E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07	-6.89E-07 -2.20E-07 -2.34E-07 -6.89E-07 -2.20E-07 -2.34E-07 -6.89E-07 -2.20E-07 -2.34E-07 -6.89E-07 -2.20E-07 -6.89E-07 -2.20E-07 -6.89E-07 -2.20E-07 -6.89E-07 -6.89E-07 -6.89E-07 -6.89E-07	-1.98E-06 -6.34E-07 6.75E-07 1.94E-08 -1.98E-08 -1.98E-08 -1.98E-08 -3.4E-07 1.94E-08 -1.98E-08 -1.98E-08 -1.98E-08 -1.98E-07 1.94E-08 -1.98E-08 -1.98E-07 -1.98E-08 -1.98E-08 -1.98E-08 -1.98E-08 -1.98E-08 -1.98E-08	2.03E-06 6.47E-07 -6.9E-07 -2.0E-08 6.47E-07 -6.9E-07 -2.0E-08 2.03E-06 6.47E-07 -2.0E-08 6.47E-07 -2.0E-08 6.47E-07 -6.9E-07 -2.0E-08 6.47E-07 -6.9E-07 -2.0E-08 6.47E-07	6.47E-07 2.07E-07 -2.20E-07 -6.34E-07 6.47E-07 2.07E-07 -6.34E-07 6.47E-07 -2.20E-07 -6.34E-07 6.47E-07 -2.20E-07 -2.20E-07 -3.34E-07 6.47E-07 -2.20E-07 -3.34E-07 6.34E-07 6.34E-07	-6.9E-07 -2.2E-07 -2.3E-07 -6.9E-07 -2.2E-07 -2.3E-07 -6.9E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.3E-07 -6.9E-07 -2.2E-07 -2.3E-07 -2.3E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07	-22 -66.7 1.6 -22 -6.7 1.6 -22 -6.7 1.6 -2.7 1.6 -2.7 -6.7 1.9 -2.7 -6.7
47e4*\$Pai* 6 47E-07 -6.89E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 2 03E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07 -1.96E-06 6 47E-07	*SPa 6.47E-07 -2.2E-07 -6.3E-07 6.3E-07 6.3E-07 6.3E-07 6.3E-07 6.3E-07 6.47E-07 2.0TE-07 -2.2E-07 -6.3E-07 6.47E-07 -2.2E-07 -6.3E-07 6.47E-07 -2.2E-07	-6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06	2.03E-06 6.47E-07 -8.9E-07 -2.0E-08 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 8.47E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 -2.2E-07 -6.3E-07 -2.2E-07 -2.2E-07 -6.3E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -3.3E-07 -2.2E-07 -3.3E-07 -2.2E-07 -3.3E-07 -3.	-8.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -2.0E-06 -6.3E-07 1.94E-06 -6.3E-07 1.94E-06 -6.3E-07 6.75E-07	2.03E-06 8.47E-07 -6.9E-07 -2.0E-08 2.03E-06 8.47E-07 -2.0E-08 6.47E-07 -2.0E-08 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07 -6.3E-07 6.47E-07 2.07E-07 -2.2E-07	-8.9E-07 -2.2E-07 -2.2E-07 -6.75E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07 -6.9E-07 -2.2E-07	-2.0E-06 -8.3E-07 6.75E-07 1.94E-06 -2.0E-06 -8.3E-07 1.94E-06 -2.0E-06 -8.3E-07 1.94E-06 -2.0E-06 -8.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07 1.94E-06 -0.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-08 2.03E-06 6.47E-07 -2.0E-08 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -8.9E-07 -2.0E-06 6.47E-07 -8.9E-07 -2.0E-06	6.47E-07 2.07E-07 -2.2E-07 -4.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.3E-07 6.3E-07 6.47E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 6.47E-07 2.07E-07 -2.2E-07 -2.2E-07 -2.2E-07	-8.9E-07 -2.2E-07 2.34E-07 -8.9E-07 -2.2E-07 2.3E-07 -8.9E-07 -2.2E-07 6.75E-07 -8.9E-07 -2.2E-07 2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07	-2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07 6.75E-07 1.94E-06 -2.0E-06 -6.3E-07 6.75E-07 -2.0E-06 -6.3E-07 1.94E-06 -6.3E-07 1.94E-06 -6.3E-07 1.94E-06 -6.3E-07	2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07 -6.9E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 6.47E-07 -2.0E-06 -2.0E-06 6.47E-07 -2.0E-06 -3.0E-07 -2.0E-06 -3.0E-07 -3.0E-07 -3.0E-06 -4.9E-07 -4.9E-07	6.47E-07 2.07E-07 -2.2E-07 -4.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.47E-07 2.07E-07 6.47E-07 2.07E-07 -2.2E-07 6.3E-07 6.47E-07 2.07E-07 -2.2E-07 6.47E-07 2.07E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07 -2.2E-07	-6.69E-07 -2.20E-07 -2.34E-07 -6.59E-07 -6.89E-07 -2.34E-07 -6.75E-07 -6.89E-07 -2.20E-07 -2.34E-07 -6.75E-07 -6.89E-07 -6.89E-07 -6.89E-07 -6.89E-07 -6.89E-07 -6.90E-07	-1.98E-06 -6.34E-07 6.78E-07 1.94E-08 -1.96E-08 -6.34E-07 6.78E-07 1.94E-06 -6.34E-07 6.78E-07 1.94E-08 -6.34E-07 6.78E-07 -1.98E-08	2.03E-06 6.47E-07 -0.9E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 2.03E-06 6.47E-07 -2.0E-06 8.47E-07 -2.0E-06 8.47E-07 -4.9E-07	6.47E-07 2.07E-07 -2.20E-07 -6.34E-07 6.47E-07 -2.20E-07 -6.34E-07 6.47E-07 -2.20E-07 -6.47E-07 2.07E-07 -2.20E-07 -6.47E-07 2.07E-07 -2.20E-07 -6.34E-07 6.47E-07 -2.20E-07 -6.34E-07 6.34E-07	-6.9E-07 -2.2E-07 2.34E-07 -6.9E-07 -2.2E-07 2.34E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 6.75E-07 -6.9E-07 -2.2E-07 2.34E-07 -6.9E-07 -2.2E-07	-22 -6.7 1.6 -2 -6.7 1.6 -2 -6.7 1.9 -2 -6.7 1.9 -2 -6.7

Table A-4 (Continued)

Cross Product Terms

dCP SCPI	O O O F O A	2 15 04	A SE AA	A SAF-OA	201F-04	2 1E 04	-8.2E-04	6.26E-04	2.01E-04	-2.1E-04	6.2E-04	8.28E-04	2.01E-04	-2.1E-04	-0.2E-04	6.28E-04	2.01E-04	-2.13E-04	-8.15E-04		2.01E-04		
2 01E-04	2012-04		0 OF 04	2015 04	A 41E.05	A AF-OS	-2 OF-04	201F-04	8.41E-05	-8.8E-00	-2.0E-04	2.0 IE-04	0.4 IE-00	-U.UL-V	-2.02-04	2.012 01	U. 1 1 E UU	-6.82E-05	-1.97E-04		6.41E-05		
-		-0.0L-00	2.00E-04	0 1E 04	4 45 06	7 24F-05	2 00F.04	.2 1F.04	-A AF-06	7.26E-05	2.09E-04	-2.1E-04	-0.5E-UD	7.20C-US	2.00E-04	-2.10-04	-0.6E-00	7.26E-05	2.09E-04		-8.82E-05		
-2.13E-04			2.002	A 05 04	2 OF 04	2 AGE A4	# U3E-U4	A OF A	-2 OF-04	2.09E-04	6.03E-04	-6.2E-04	-2.0E-04	2.09E-04	0.U3E-U4	-0.22-04	-2.00-04	2.09E-04	6.03E-04		-1.97E-04		
-6.15E-04			- 05 04	-0.2L-04	2015.04	2 1E 04	A 2E-04	8 28F-04	201F-04	-2.1E-04	-8.2E-04	6.26E-04	2.01E-04	-2.1E-04	-8.22-04	0.20E-04	2.01E-04	-2.13E-04	-8.15E-04		2.01E-04		
6.26E-04					2.016-04	4.45.05	-2.0E-04	201E-04	6.41F-05	-8 AF-05	-2 0E-04	2.01E-04	6.41E-05	-6.8E-05	-2.0E-04	2.01E-04	6.41E-05	-6.82E-05	-1.97E-04	2.01E-04	6.41E-05		
201E-04	6.41E-05	-8.8E-05	-2.0E-04	2.01E-04		-0.0C-UO	-2.0E-04	215.04	# #E-05	7 26F-05	2.09E-04	-2 1E-04	-6.8E-05	7.26E-05	2.09E-04	-2.1E-04	-6.8E-05	7.26E-05	2.09E-04	-2.1E-04	-6.82E-05		
-2.13E-04	-6.8E-05	7.26E-05	2.09E-04	-2.1E-04	-0.8E-05		2.000	# 05 04	205.04	2.00E.04	6.03E-04	-6 2E-04	-2.0E-04	2.09E-04	6.03E-04	-8.2E-04	-2.0E-04	2.09E-04	6.03E-04	-8.2E-04	-1.97E-04	2.09E-04	6.03E
-6.15E-04	-2.0E-04	2.09E-04	6.03E-04	-8.2E-04	-2.0E-04	2.09E-04		-9.2E-V4	0.015.04	2.15.04	-8.2E-04	6 26F-04	201F-04	-2.1E-04	-8.2E-04	6.26E-04	2.01E-04	-2.13E-04	-6.15E-04	6.26E-04	2.01E-04	-2.1E-04	-6.2E
6.26E-04	2.01E-04	-2.1E-04	-6.2E-04	6.26E-04	2.01E-04	-2.1E-04	-6.22-04		2.01E-04	-2.1E-04	-2.0E-04	2015.04	445.05	-A AF-05	-2 OF-04	201F-04	6.41E-05	-6.82E-05	-1.97E-04	2.01E-04	6.41E-05	-6.8E-05	-2.0E
201E-04	6 41E-05	-6.8E-05	-2.0E-04	2.01E-04	6.41E-05	-8.8E-05	-2.0E-04	2.01E-04		-0.8E-US	•2.0E-04	-2.1E-04	# #E-05	7 20F-05	2 00F-04	.2 1F-04	-8.8E-05	7.26E-06	2.09E-04	-2.1E-04	-8.82E-05	7.26E-06	2.09E
-2.13E-04	-0 8E-05	7.26E-06	2.09E-04	-2.1E-04	-8.8E-05	7.26E-06	2.09E-04	-2.1E-04	-6.8E-US	0.005.04	2.000-04		-2.0E-04					2.09E-04	6.03E-04	-8.2E-04	-1.97E-04	2.09E-04	0.038
-8.15E-04	-2.0E-04	2.00E-04	6.03E-04	-0.2E-04	-2.0E-04	2.09E-04	6.03E-04	-0.2E-04	-2.0E-04	2.002-04			2.01E-04					-2.13E-04	-8.15E-04		2.01E-04	-2.1E-04	-6.2
4 045 04	0.015.04	215.04	-A 2€-∩4	4 28F-04	2.01E-04	-2.1E-04	-6.2E-04	6.28E-04	2.01E-04	-2.1E-04	-6.2E-04		2.016-04		-2.0E-04			-6.82E-05	-1.97E-04		6.41E-05	-6.8E-05	-2.06
	A OF	A AC AS	205.04	2 01F-04	8 41F-05	-A AF-05	-2.0E-04	2.01E-04	6.41E-05	-6.6E-05	-2.0E-04	2.01E-04		-0.0E-UO	2.09E-04			7.26E-05	2.09E-04		-6.82E-05		
	4 4E AE	7 045 05	2 AGE A4	-2 1F-04	-A AF-05	7 26F-05	2.09E-04	-2.1E-04	-8.8E-03	1.20E-U0	2.00C-04	-2. IC-U4	-6.8E-05		2.096-04			2.09E-04	6.03E-04		-1.97E-04		
	005.04	0.006.04	4 025 04	A 26.04	-2 OF -04	2 00F-04	6 03E-04	-8.2E-04	-2.0E-04	2.00E-04	9.U3E-U4	49.25-04	-2.00-04	2.09E-04		-0.25-04	-2.0E-04		-8.15E-04		2.01E-04		
		0.45.04	# 25 A4	4 24E-04	201F-04	-2 1F-04	-8 2E-04	6.28E-04	2.01E-04	-2.1E-04	-6.2E-04	8.25E-04	2.016-04	-2.1E-04	-6.2E-04		2.01E-04	-2.13E-04			6.41E-05		
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-2.13E-04	-8.8E-05	7.282-05	2.00E-04	-2.1E-04	-0.0E-04	2.00E.04	6.03E-04	-A 2F-04	-2 0F-04	2.00E-04	6.03E-04	-6.2E-04	-2.0E-04	2.09E-04	6.03E-04	-6.2E-04	-2.0E-04	2.09E-04	6.03E-04	-6.2E-04	-1.97E-04	2.09E-04	
-8.28E-04	-6.4E-05	-7.3E-05	-6.0E-04	-6.3E-04	-6.4E-05	-7.3E-05	-6.0E-04	-6.3E-04	-6.4E-05	-7.3E-05	-6.0E-04	-6.3E-04	-8.4E-05	-7.3E-05	-8.0E-04	-8.3E-04	-8.4E-05	-7.26E-05	-6.03E-04	-6.3E-04	-6.41E-05	-7.3E-05	-6.0
AAI-SAI-SA	2 18E-03	-2.3E-03	-8.7E-03	6.84E-03	2.18E-03	-2.3E-03	-6.7E-03	6.84E-03	2.18E-03	-2.3E-03	-6.7E-03	6.84E-03	2.18E-03	-2.3E-03	-6.7E-03	6.84E-03	2.18E-03	-2.32E-03	-6.70E-03		2.18E-03	-2.3E-03 -7.4E-04	
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		.7 4F-04	-2.1E-03	2.18E-03	5.90E-U4	-7.4E-04	-2.1E-03	2.18E-03	0.BOL-0-7	·/ .4C-04	·2. IL-03	2.18E-03	0.90E-04	-7.4E-04									
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	-7.4E-04		2.26E-03	2 25 02	-7.4E-04	7.90E-04	2.28E-03	-2.3E-03	-7.4E-04	7.90E-04 2.26E-03	2.28E-03 6.56E-03	-2.3E-03 -6.7E-03	-7.4E-04 -2.1E-03	7.90E-04 2.28E-03	6.56E-03	-2.3E-03	-2.1E-03	2.26E-03	8.56E-03	-2.3E-03 -6.7E-03	-7.43E-04 -2.14E-03	7.90E-04 2.26E-03	2.25 6.56
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-6 70E-03 6 84E-03 2.18E-03 -2 32E-03 -6.70E-03 6.84E-03 -2.32E-03 -5.70E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03	2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03	2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -6.7E-03	-2.3E-03 -6.7E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 6.7E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.98E-04	7.90E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04	2.26E-03 6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -5.0E-03 -6.7E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03	-7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.99E-04	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 2.20E-03 -2.3E-03 -7.4E-04	2.26E-03 6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 6.56E-03 -5.7E-03 -2.1E-03 -2.1E-03	2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03	7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03	6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.56E-03 -6.7E-03 -2.1E-03	-2.32-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.16E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04 2.28E-03 -2.32E-03	6.56E-03 -6.70E-03 -2.14E-03 2.26E-03 -6.70E-03 -2.14E-03 2.26E-03 -6.70E-03 -7.0E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 6.84E-03	-7.43E-04 -2.14E-03 2.18E-03 6.98E-04 -7.43E-03 2.18E-03 6.98E-04 -7.43E-04 -2.14E-03 2.18E-03 6.98E-04 -7.43E-04	7.90E-04 2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 7.90E-04 7.90E-04	2.2 6.5 -6. -2. 2.2 6.5 -6. -2. 2.2 6.5 -6.
-6.70E-03 6.84E-03 2.18E-03 -2.32E-03 -6.70E-03 6.84E-03 -2.32E-03 6.84E-03 2.18E-03 -2.32E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04	2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04	2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03	-2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 8.84E-03 -2.3E-03 8.84E-03 2.18E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04	2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 2.26E-03 -6.7E-03 -2.1E-03 -2.1E-03 2.26E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 6.84E-03 -2.3E-03	-7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04	2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03	2.18E-03 -2.3E-03 -6.7E-03 8.84E-03 -2.3E-03 -6.7E-03 8.84E-03 -2.3E-03 -6.7E-03	-7.4E-04 -7.4E-03 -2.18E-03 6.96E-04 -7.4E-03 2.18E-03 6.96E-04 -7.4E-04 -2.1E-03 2.18E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04	6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.56E-03 -6.7E-03 -2.1E-03	-2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04	2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04	6.56E-03 -6.70E-03 -2.14E-03 2.26E-03 6.56E-03 -6.70E-03 2.14E-03 2.56E-03 -6.70E-03 -2.14E-03 2.26E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 2.18E-03	-7.43E-04 -2.14E-03 2.18E-03 6.98E-04 -7.43E-04 -2.14E-03 2.18E-03 6.98E-04 -7.43E-04 -2.14E-03 6.98E-04	7.90E-04 2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 7.90E-04 7.90E-04	2.20 6.56 -6.1 2.2 6.56 -6.1 -2.2 6.5 -6.1 -2.2
-6 70E-03 6.84E-03 2.18E-03 -2 32E-03 -6.70E-03 6.84E-03 -2.32E-03 -6.70E-03 6.84E-03 2.18E-03 -2.32E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 2.18E-03 6.98E-04 -7.4E-04	2.28E-03 -2.3E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04	2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03	-2.3E-03 -6.7E-03 2.18E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 2.18E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03	2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 -6.7E-03 -2.1E-03 -2.28E-03 6.56E-03	-2.3E-03 -6.7E-03 8.84E-03 -2.3E-03 -6.7E-03 2.18E-03 -6.7E-03 6.84E-03 2.18E-03 -6.7E-03	-7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-03 -2.3E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.26E-03	2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 2.28E-03 2.28E-03 6.56E-03	2.18E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03	6.98E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 2.26E-03	6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 6.56E-03 -6.7E-03 -2.1E-03 2.26E-03	-2.32-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 2.16E-03 -2.3E-03 -6.7E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 2.18E-03 6.98E-04 -7.4E-04	2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04	6.56E-03 -6.70E-03 -2.14E-03 2.26E-03 6.56E-03 -6.70E-03 2.14E-03 2.56E-03 -6.70E-03 -2.14E-03 2.26E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.84E-03 2.18E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -2.3E-03 -2.3E-03	-7.43E-04 -2.14E-03 2.18E-03 -9.08E-04 -7.43E-04 -2.14E-03 2.18E-03 -7.43E-04 -2.14E-03 2.10E-03 6.90E-04 -7.43E-04 -7.43E-04 -2.14E-03	7.90E-04 2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 7.90E-04 7.90E-04	2.20 6.56 -6.1 2.20 6.56 -6.1 -2.2 2.22 6.55 -6.5
-6 70E-03 6 84E-03 2.18E-03 -2 32E-03 6.70E-03 6.84E-03 -2.32E-03 -6.70E-03 2.18E-03 -2.32E-03 -6.70E-03 -2.32E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03	2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03	2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 -6.7E-03 -2.1E-03 2.26E-03 6.56E-03	-2.3E-03 -6.7E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-04 -2.1E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03	2.28E-03 6.56E-03 -2.1E-03 2.26E-03 -8.7E-03 -2.1E-03 2.26E-03 6.56E-03 -2.1E-03 2.26E-03 6.56E-03	-2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -5.7E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03	-7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03	2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 -6.7E-03	2.18E-03 -2.3E-03 -8.7E-03 -8.84E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -2.3E-03 -2.3E-03 -6.7E-03 -6.7E-03 -6.7E-03	7.4E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.99E-04 -7.4E-04 -2.1E-03 2.18E-03	2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -2.3E-03 -7.4E-04	6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 2.28E-03 6.56E-03 -6.7E-03 2.28E-03	-2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 6.84E-03 2.10E-03 -2.3E-03 -2.7E-03	7.4E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-04 -2.1E-03 2.18E-03	2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04 2.28E-03	6.56E-03 -6.70E-03 -2.14E-03 2.28E-03 -6.70E-03 -2.14E-03 2.28E-03 -6.70E-03 -2.14E-03 2.26E-03 -6.56E-03 -6.70E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.84E-03 2.18E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -2.3E-03 -2.3E-03	-7.43E-04 -2.14E-03 2.18E-03 6.96E-04 -7.43E-04 -2.14E-03 2.18E-03 6.96E-04 -2.14E-03 2.18E-03 6.96E-04 -7.43E-04 -7.43E-04 -2.14E-03 2.18E-03 2.18E-03	7.90E-04 2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03	2.21 6.56 -6.1 -2.2 6.56 -6.1 -2.2 2.22 6.55 -6.5
-6 70E-03 6 84E-03 2.18E-03 -2 32E-03 6.70E-03 6.84E-03 -2.32E-03 -6.70E-03 2.18E-03 -2.32E-03 -6.70E-03 -2.32E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-03 6.98E-04 -7.4E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -2.3E-03 -2.3E-03	2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -2.7E-03 2.28E-03 6.56E-03	-2.3E-03 -6.7E-03 -2.3E-03 -6.7E-03 -6.8E-03 -2.3E-03 -6.7E-03 -6.7E-03 -2.3E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.26E-03 -2.3E-03 -2.3E-03	2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -5.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -6.7E-03	-2.3E-03 -6.7E-03 0.84E-03 2.18E-03 -2.3E-03 -2.7E-03 0.84E-03 2.18E-03 -2.7E-03 0.84E-03 2.18E-03 -2.7E-03 0.84E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.16E-03 -7.4E-04 -2.1E-03 2.16E-03 -7.4E-04 -2.1E-03 2.18E-03 2.18E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04	2.26E-03 6.56E-03 -6.7E-03 -2.1E-03 2.26E-03 6.56E-03 -2.1E-03 2.26E-03 -2.1E-03 2.26E-03 6.56E-03 -2.1E-03 2.26E-03	2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03	7.4E-04 -2.1E-03 2.18E-03 6.99E-04 -7.4E-04 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03	7,46-04 7,90E-04 2,28E-03 -7,4E-04 7,90E-04 2,28E-03 -7,4E-04 2,28E-03 -2,3E-03 -7,4E-04 2,28E-03 -7,4E-04	6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03	-2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -7.7E-03	2.18E-03 6.98E-04 -7.4E-04 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -7.43E-04 7.90E-04 2.26E-03 -2.32E-03 -2.32E-03	8.58E-03 -8.70E-03 -2.14E-03 2.29E-03 -6.56E-03 -6.70E-03 -2.14E-03 2.28E-03 -6.70E-03 -2.14E-03 2.26E-03 -6.70E-03 -6.70E-03	-2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -0.7E-03 6.84E-03 2.18E-03 -3.26-03 -6.7E-03 6.84E-03	-7.43E-04 -2.14E-03 2.18E-03 6.96E-04 -7.43E-04 -2.14E-03 2.18E-03 6.96E-04 -2.14E-03 2.18E-03 6.96E-04 -7.43E-04 -7.43E-04 -2.14E-03 2.18E-03 2.18E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04	2.26 6.56 -6.7 2.26 6.56 -6.7 -2. 2.26 6.56 -6.7 -2.
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-6 70E-03 6 84E-03 2.18E-03 -2.32E-03 -6.70E-03 6 84E-03 2.18E-03 2.18E-03 -2.32E-03 -6.70E-03 6.84E-03 2.18E-03 2.32E-03 -2.32E-03 -2.32E-03 -2.32E-03 -2.32E-03 -2.32E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-03 2.18E-03 6.98E-04	2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04	2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03	-2.3E-03 -0.7E-03 2.18E-03 -2.2E-03 -6.7E-03 2.18E-03 -2.2E-03 -6.7E-03 2.18E-03 -2.2E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03	-7.4E-04 -2.18E-03 -7.4E-04 -2.18E-03 -7.4E-04 -2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 -7.4E-04 -2.1E-03 -7.4E-04 -2.1E-03 -7.4E-04	7.90E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04	2.28E-03 6.56E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.56E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.26E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03	-2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03	7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -7.4E-04 -7.4E-04 -7.4E-04 -7.4E-04 -7.4E-04 -7.4E-04 -7.4E-04 -7.4E-04	7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04	2.28E-03 6.56E-03 -0.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -2.28E-03 -2.28E-03 -2.28E-03	2.18E-03 -2.3E-03 -2.4E-03 2.18E-03 -2.3E-03 -6.7E-03 6.4E-03 2.18E-03 -2.3E-03 -6.7E-03 6.4E-03 2.18E-03 -2.3E-03 6.7E-03 6.4E-03 2.18E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03	5.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03 6.98E-04 -2.1E-03 6.98E-04 -2.1E-03 6.98E-04 -2.1E-03 6.98E-04	7,80E-04 2,28E-03 7,4E-04 7,90E-04 2,28E-03 -2,3E-03 -7,4E-04 7,90E-03 2,28E-03 -2,3E-03 -7,4E-04 2,28E-03 -2,3E-03 -7,4E-04 2,28E-03 -2,3E-03 -7,4E-04 2,28E-03 -2,3E-03 -7,4E-04 2,28E-03	2.88E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 -2.28E-03 -6.7E-03 -2.28E-03 -6.7E-03 -2.28E-03 -6.7E-03 -2.28E-03	-2.3E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -6.7E-03 -7.2.3E-03 -7.3.3E-03 -7.3.	-7.4E-04 -7.4E-04 -7.4E-04 -7.4E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-03	2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 2.28E-03 -2.32E-03 -7.43E-04 7.90E-04 7.90E-04 7.90E-04 2.26E-03 -2.32E-03 -7.43E-04	6.56E-03 -6.70E-03 2.28E-03 6.56E-03 -6.70E-03 2.28E-03 -6.70E-03 -2.14E-03 2.28E-03 -6.70E-03 -2.14E-03 2.28E-03 -2.14E-03 2.28E-03	-2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -0.7E-03 2.16E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03 -2.3E-03	-7.43E-04 -2.14E-03 2.18E-03 6.96E-04 -7.43E-04 -2.14E-03 6.96E-04 -7.43E-04 -2.14E-03 2.18E-03 6.96E-04 -7.43E-04 -2.14E-03 2.18E-03 2.18E-03	7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04 7.90E-04 2.28E-03 -2.3E-03 -7.4E-04	2.26 6.56 -6.7 -2.1 2.26 6.56 -6.7 -2.1 2.26 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -2.1 -2.22 6.56 -6.7 -6.7 -6.7 -6.7 -6.7 -6.7 -6.7 -6.
-6 70E-03 6 84E-03 2 18E-03 -2 32E-03 -6 70E-03 6 84E-03 -2 32E-03 -6 70E-03 6 84E-03 2 18E-03 2 32E-03 -6 70E-03 6 84E-03 2 18E-03 2 32E-03 -6 70E-03 6 84E-03 2 32E-03 -6 70E-03 6 84E-03 2 32E-03 -6 70E-03	-2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 2.18E-03 6.98E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03 2.18E-03 6.98E-04 -2.1E-03	2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03	2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -6.7E-03 2.28E-03 6.56E-03 -6.7E-03 2.28E-03 6.56E-03 -6.7E-	-2.3E-03 -0.7E-03 -2.3E-03 -0.7E-03 -6.8E-03 -2.3E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03 -0.7E-03	-7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03	7.90E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.28E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03	2.28E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 -2.1E-03 2.28E-03 6.5E-03 -2.1E-03 2.28E-03 6.5E-03 -6.7E-03 2.28E-03 6.5E-03 -6.7E-03 2.26E-03 6.5E-03 -6.7E-03 2.26E-03 6.5E-03	-2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -2.3E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 -6.7E-03 6.84E-03 -6.7E-03	-7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03	7.00E-04 2.28E-03 -7.4E-04 7.00E-04 2.28E-03 -7.4E-04 2.28E-03 -7.4E-04 7.00E-04 2.28E-03 -7.4E-04 7.00E-04 2.28E-03 -7.4E-04 7.00E-04 2.28E-03 -7.4E-04 7.00E-04 2.28E-03	2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03 -2.1E-03 2.28E-03 6.56E-03	2.18E-03 -2.3E-03 -6.7E-03 6.84E-03 2.18E-03 -6.7E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 6.8E-03 -2.3E-03 -6.7E-03 6.8E-03 -2.3E-03 -6.7E-03 6.8E-03 -2.3E-03 -6.7E-03 -6.7E-03 -6.7E-03	7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-03 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03 2.18E-04 -7.4E-04 -2.1E-03	7,80E-04 2,28E-03 -7,4E-04 7,90E-04 2,28E-03 -7,4E-04 7,90E-04 2,28E-03 -7,4E-04 7,90E-04 2,28E-03 -7,4E-04 7,90E-04 2,28E-03 -7,4E-04 7,90E-04 2,28E-03	2.8E-03 6.56E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-03 -2.1E-03 2.28E-03 -6.7E-0	-8.7E-03 6.84E-03 2.18E-03 -2.3E-03 6.84E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03 2.18E-03 -2.3E-03 -6.7E-03	-7.4E-04 -7.4E-03 6.98E-04 -7.4E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 2.18E-03 6.98E-04 -7.4E-04 -2.1E-03 6.98E-04 -7.4E-04 -2.1E-03	2.28E-03 -2.32E-03 -7.43E-04 2.28E-03 -2.32E-03 -7.43E-04 2.28E-03 -2.32E-03 -7.43E-04 2.28E-03 -7.43E-04 2.28E-03 -2.32E-03 -7.43E-04 -7.90E-04	6.56E-03 -6.70E-03 -2.14E-03 -6.56E-03 -6.70E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -2.14E-03 -6.56E-03	-2.3E-03 -6.7E-03 6.84E-03 -2.3E-03 -6.7E-03 2.16E-03 -2.3E-03 -6.7E-03 2.16E-03 -2.3E-03 -6.7E-03 2.16E-03 -2.3E-03 -6.7E-03 -2.3E-03 -6.7E-03	-7.43E-04 -2.14E-03 2.18E-04 -7.43E-04 -2.14E-03 2.18E-03 -7.43E-04 -2.14E-03 2.18E-03 2.18E-03 2.18E-03 -7.43E-04	7.90E-04 2.26E-03 -2.3E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04 7.90E-04 2.26E-03 -7.4E-04	2.265 6.566 6.76 2.16 2.266 6.566 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.506 6.77 6.2.11 2.266

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Table A-5 Bias Error Calculation -- Flue Gas Inlet Milliken Heat Pipe Air Preheater

	Average	Sigma	Sigma																		
	Value	Absolute	Relative																		
uct Size																					
Mdth, ft	5.5	0.042	0.76%)																	
Length, ft	14.5	0.042	0.29%	•																	
# of Points	20																				
Mdthwise	4																				
Longthwise	6																				
Sector Width, ft	1.38	0.042	3.03%	•																	
Sector Length, ft	2.90	0.042	1.44%	•																	
A, Sector Area ft^2	3.90	0.134	3.35%																		
deg F	680	6.800	1.00%																		
deg R	1140	6.800	0.60%																		
emp Blas, deg F	100	*			th increment	Special Blu	10														
P. In WC	0.82631	0.0166	2.00%																		
, lb/mol	29.71	0.050	0.17%																		
mb Pres, In. Hg	29.50	0.000	• • • • • • • • • • • • • • • • • • • •																		
uct Pres, In. WC	-7.50																				
s, in. Hg Absolute	29.23	0.040	0.14%																		
P, Pitot Fact	0.84	0.0100	1.19%																		
ominal Vel, tos	74.88		358315	SCFM=	150660	lb/hr=	750001														
Citation ver, ipe	, 4.55	7,01 m-		•••••		,															
		Input I	Data								Darivativ	es, dTa/dX						(dTa/dX°8	lame) ^ 2		
Point	Al	Cpl	DPI	Mi	Pal	Ti	(1)	(2)	dTa/dTl	dTa/dAl			dTa/dMI	dTa/dPei		dTI*STI	d/dAl*SAl	d/dCPI*SCPI		d/dMI*SMI	d/dPai*SPai
rom	3.99	0.84	0.82831	29.71	29.23	1090.0	2.721	2965.9	5.51E-02				-9.7E-02	-9.9E-02		.40E-01	3.77E-02	4.75E-03	3.35E-03	2.37E-05	1.58E-05
2	3.99	0.84	0.82831	29.71	29.23	1115.0	2.690	2999.7	5.38E-02				-7.4E-02	-7.6E-02		.34E-01	2.20E-02	2.78E-03	1.96E-03	1.39E-05	9.25E-06
-					29.23	1140.0	2.001	3033.1	5.26E-02							.26E-01	1.08E-02				
3	3.90	0.84 0.84	0.82831	29.71 29.71	29.23	1165.0	2.632	3066.2						-3.1E-02		.23E-01	3.62E-03	1.36E-03	9.58E-04	6.78E-06	4.52E-06
:	3.90		0.82831															4.56E-04	3.22E-04	2.28E-06	1.52E-06
3	3.99	0.84	0.82831	29.71	29.23	1190.0	2.604	3098.9	5.04E-02				-8.7E-03	-8.9E-03		.18E-01	3.04E-04	3.83E-05	2.70E-05	1.91E-07	1.27E-07
•	3.99	0.84	0.82631	29.71	29.23	1215.0	2.577	3131.3	4.94E-02				1.22E-02			.13E-01	5.96E-04	7.51E-05	5.30E-05	3.75E-07	2.50E-07
7	3.99	0.84	0.82831	29.71	29.23	1240.0	2.551	3163.4	4.84E-02			1.18E+00				.08E-01	4.26E-03	5.39E-04	3.80E-04	2.69E-06	1.79E-08
8	3.99	0.84	0.82631	29.71	29.23	1265.0	2.526	3195.1	4.74E-02		3.75E+00					.04E-01	1.11E-02	1.40E-03	9.91E-04	7.01E-06	4.68E-06
9	3 99	0.84	0.82631	29.71	29.23	1290.0	2.501	3226.5	4.65E-02			2.61E+00				.00E-01	2.10E-02	2.65E-03	1.87E-03	1.32E-05	8.82E-06
10	3.99	0.84	0.82831	29.71	29.23	1315.0	2.477	3257.6	4.57E-02			3.30E+00				.64E-02	3.37E-02	4.25E-03	3.00E-03	2.12E-05	1.42E-05
11	3.99	0.84	0.82831	29.71	29.23	1090.0	2.721	2965.9	5.51E-02		-8.9E+00			-		.40E-01	3.77E-02	4.75E-03	3.35E-03	2.37E-05	1.58E-05
12	3.99	0.84	0.82831	29.71	29.23	1115.0	2.690	2999.7	5.38E-02		-5.3E+00			-7.6E-02		.34E-01	2.20E-02	2.78E-03	1.96E-03	1.39E-05	9.25E-06
13	3.99	0.84	0.82831	29.71	29.23	1140.0	2.661	3033.1	5.26E-02	-7.8E-01	-3.7E+00	-1.9E+00	-5.2E-02	-5.3E-02	1	.28E-01	1.06E-02	1.36E-03	9.58E-04	6.78E-06	4.52E-06
14	3.99	0.84	0.82631	29.71	29.23	1165.0	2.632	3066.2	5.15E-02	-4.5E-01	-2.1E+00	-1.1E+00	-3.0E-02	-3.1E-02	1	.23E-01	3.62E-03	4.56E-04	3.22E-04	2.26E-06	1.52E-06
15	3.99	0.84	0.82831	29.71	29.23	1190.0	2.604	3098.9	5.04E-02	-1.3E-01	-6.2E-01	-3.1E-01	-8.7E-03	-8.9E-03	1	.18E-01	3.04E-04	3.83E-05	2.70E-05	1.91E-07	1.27E-07
16	3.99	0.84	0.82831	29.71	29.23	1215.0	2.577	3131.3	4.94E-02	1.83E-01	8.66E-01	4.39E-01	1.22E-02	1.24E-02	1	.13E-01	5.96E-04	7.51E-05	5.30E-05	3.75E-07	2.50E-07
17	3.99	0.84	0.82831	29.71	29.23	1240.0	2.551	3163.4	4.84E-02	4.89E-01	2.32E+00	1.18E+00	3.28E-02	3.34E-02	1	.08E-01	4.26E-03	5.39E-04	3.80E-04	2.69E-06	1.79E-06
18	3.99	0.84	0.82831	29.71	29.23	1265.0	2.526	3195.1	4.74E-02	7.89E-01	3.75E+00	1.90E+00	5.30E-02	5.38E-02	1	.04E-01	1.11E-02	1.40E-03	9.91E-04	7.01E-06	4.68E-06
19	3.99	0.84	0.82831	29.71	29.23	1290.0	2.501	3226.5	4.65E-02	1.08E+00	5.15E+00	2.61E+00	7.27E-02	7.39E-02	- 1	.00E-01	2.10E-02	2.65E-03	1.67E-03	1.32E-05	8.82E-06
20	3.99	0.84	0.82831	29.71	29.23	1315.0	2.477	3257.6	4.57E-02	1.37E+00	6.52E+00	3.30E+00	9.21E-02	9.36E-02	9	.64E-02	3.37E-02	4.25E-03	3.00E-03	2.12E-05	1.42E-05
		Temperatu	ıre Simple	Average		1202.5	SUM1	SUM2								T	A	CP	DP	M	Pe
		•	re Weight	-		1200.4	51.881	62275.2					Contribution	ons (3)	4.	64E+01	-2.17E-17	6.37E-18	1.07E-18	2.75E-20	2.62E-20
i) Al*CPi(DPi*Mi*Pal	/TI) ^ 0.5	•	•	•										• •				Total Sign		46.41	
) Al*CPI(DPI*MI*Pal	*Ti) ^ 0.5																	Tavg Sign			deg F
•																			_		

Table A-5 (Continued) Cross Product Terms

TJ*8TI*8TJ																			
<u> </u>	1.37E-01	1.34E-01	1.31E-01			1.23E-01								1.28E-01	1.26E-01	1.23E-01	1.21E-01	1.19E-01	- 1
1.37E-01		1.31E-01				1.20E-01							1.28E-01			1.20E-01	1.18E-01	1.16E-01	
1.34E-01	1.31E-01		1.25E-01			1.18E-01						1.28E-01	1.25E-01	1.23E-01		1.18E-01	1.15E-01	1.13E-01	
1.31E-01	1.28E-01	1.25E-01		1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.09E-01	1.31E-01	1.28E-01	1.25E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	
1.28E-01	1.26E-01	1.23E-01	1.20E-01		1.15E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.28E-01	1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.08E-01	
1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01		1.10E-01	1.08E-01	1.06E-01	1.04E-01	1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.10E-01	1.08E-01	1.06E-01	
1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.10E-01		1.06E-01	1.04E-01	1.02E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.10E-01	1.08E-01	1.06E-01	1.04E-01	
1.21E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.08E-01	1.08E-01		1.02E-01	1.00E-01	1.21E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.04E-01	1.02E-01	
1.19E-01	1.16E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.04E-01	1.02E-01		9.83E-02	1.19E-01	1.16E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.04E-01	1.02E-01	1.00E-01	
						1.02E-01				1.16E-01	1.14E-01	1.11E-01	1.09E-01	1.06E-01	1.04E-01	1.02E-01	1.00E-01	9.83E-02	
1.40E-01	1.37E-01	1.34E-01	1.31E-01	1.28E-01	1.26E-01	1.23E-01	1.21E-01	1.19E-01	1.16E-01		1.37E-01	1.34E-01	1.31E-01	1.28E-01	1.26E-01	1.23E-01	1.21E-01	1.19E-01	
1.37E-01	1.34E-01	1.31E-01	1.28E-01	1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.16E-01	1.14E-01	1.37E-01		1.31E-01	1.28E-01	1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.16E-01	
1.34E-01	1.31E-01	1.28E-01	1.25E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.34E-01	1.31E-01		1.25E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	
1.31E-01	1.28E-01	1.25E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.09E-01	1.31E-01	1.28E-01	1.25E-01		1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	
1.28E-01	1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.28E-01	1.26E-01	1.23E-01	1.20E-01		1.15E-01	1.13E-01	1.11E-01	1.08E-01	
1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01	1.13E-01	1.10E-01	1.08E-01	1.06E-01	1.04E-01	1.26E-01	1.23E-01	1.20E-01	1.18E-01	1.15E-01		1.10E-01	1.08E-01	1.06E-01	
						1.08E-01								1.13E-01	1.10E-01		1.06E-01	1.04E-01	
1.21E-01						1.06E-01								1.11E-01		1.06E-01		1.02E-01	
1.19E-01	1.16E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.04E-01	1.02E-01	1.00E-01	9.83E-02	1.19E-01	1.16E-01	1.13E-01	1.11E-01	1.08E-01	1.06E-01	1.04E-01	1.02E-01		
1.16E-01	1.14E-01	1.11E-01	1.09E-01	1.06E-01	1.04E-01	1.02E-01	1.00E-01	9.83E-02	9.64E-02	1.16E-01	1.14E-01	1.11E-01	1.09E-01	1.06E-01	1.04E-01	1.02E-01	1.00E-01	9.83E-02	
				0.005.00	0.175.00	0.125.00	0.00E±00	2 08E±00	2 02F±00	241F+00	2 38F±00	231F±00	2.26E+00	2 22F+00	2.17E+00	2.13F±00	2.09E+00	2.06E+00	2
2.41E+00		2.31E+00	2.26E+00	2.222+00	2.172+00	2.132700	2.092700	2.002.700	2.022 1 00		2.002 100	2.012100		2.22		2.102.100		2.002,00	
2.41E+00 dDPJ*8DPI	*8DP			3.01E-04	-4.2E-04			-2.5E-03		·	2.56E-03				-4.2E-04	-1.13E-03	-1.82E-03	-2.50E-03	
	*8DP	1.79E-03	1.04E-03				-1.8E-03		-3.2E-03	3.35E-03		1.79E-03	1.04E-03	3.01E-04					
dDPJ*8DPI 2.56E-03	*8DP	1.79E-03	1.04E-03 7.94E-04	3.01E-04	-4.2E-04	-1.1E-03	-1.8E-03 -1.4E-03	-2.5E-03 -1.9E-03	-3.2E-03 -2.4E-03	3.35E-03 2.56E-03	2.56E-03	1.79E-03 1.37E-03	1.04E-03 7.94E-04	3.01E-04 2.30E-04	-4.2E-04	-1.13E-03	-1.82E-03	-2.50E-03	<u> </u>
dDPj*8DPl 2.56E-03 1.79E-03	1*8DP] 2.56E-03 1.37E-03	1.79E-03 1.37E-03	1.04E-03 7.94E-04	3.01E-04 2.30E-04 1.61E-04	-4.2E-04 -3.2E-04	-1.1E-03 -8.6E-04	-1.8E-03 -1.4E-03 -9.7E-04	-2.5E-03 -1.9E-03	-3.2E-03 -2.4E-03 -1.7E-03	3.35E-03 2.56E-03 1.79E-03	2.56E-03 1.96E-03	1.79E-03 1.37E-03 9.58E-04	1.04E-03 7.94E-04 5.55E-04	3.01E-04 2.30E-04 1.61E-04	-4.2E-04 -3.2E-04	-1.13E-03 -8.63E-04	-1.82E-03 -1.39E-03	-2.50E-03 -1.91E-03	
dDPJ*8DPI 2.56E-03 1.79E-03 1.04E-03	2.56E-03	1.79E-03 1.37E-03 5.55E-04	1.04E-03 7.94E-04 5.55E-04	3.01E-04 2.30E-04 1.61E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04	-1.1E-03 -8.6E-04 -6.0E-04 -3.5E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04	-2.5E-03 -1.9E-03 -1.3E-03	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04	3.35E-03 2.56E-03 1.79E-03 1.04E-03	2.56E-03 1.96E-03 1.37E-03	1.79E-03 1.37E-03 9.58E-04 5.55E-04	1.04E-03 7.94E-04 5.55E-04 3.22E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05	-4.2E-04 -3.2E-04 -2.3E-04	-1.13E-03 -8.63E-04 -6.03E-04	-1.82E-03 -1.39E-03 -9.74E-04	-2.50E-03 -1.91E-03 -1.34E-03	- - -
dDPJ*8DPI 2.56E-03 1.79E-03 1.04E-03	2.56E-03 1.37E-03 7.94E-04	1.79E-03 1.37E-03 5.55E-04	1.04E-03 7.94E-04 5.55E-04 9.32E-05	3.01E-04 2.30E-04 1.61E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04	-1.1E-03 -8.6E-04 -6.0E-04 -3.5E-04 -1.0E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04	-2.5E-03 -1.9E-03 -1.3E-03 -7.8E-04 -2.2E-04	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04	3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04	1.79E-03 1.37E-03 9.58E-04 5.55E-04	1.04E-03 7.94E-04 5.55E-04 3.22E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04	-1.13E-03 -8.63E-04 -6.03E-04 -3.50E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.84E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04	
2.56E-03 1.79E-03 1.04E-03 3.01E-04	1.37E-03 7.94E-04 2.30E-04	1.79E-03 1.37E-03 5.55E-04 1.61E-04	1.04E-03 7.94E-04 5.55E-04 9.32E-05	3.01E-04 2.30E-04 1.61E-04 9.32E-05	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04	-1.1E-03 -8.6E-04 -6.0E-04 -3.5E-04 -1.0E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04 -1.6E-04 2.29E-04	-2.5E-03 -1.9E-03 -1.3E-03 -7.8E-04 -2.2E-04 3.15E-04	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 3.98E-04	3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04	1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04	1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05	3.01E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05 -3.8E-05	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05	-1.13E-03 -8.63E-04 -6.03E-04 -3.50E-04 -1.01E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.84E-04 -1.64E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04	
2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04	2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04	1.79E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04	1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05	-1.1E-03 -8.6E-04 -6.0E-04 -3.5E-04 -1.0E-04 1.42E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04 -1.6E-04 2.29E-04	-2.5E-03 -1.9E-03 -1.3E-03 -7.8E-04 -2.2E-04 3.15E-04 8.43E-04	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 3.98E-04 1.07E-03	3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04	1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04 -2.3E-04	1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05 -1.3E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 5.30E-05	-1.13E-03 -8.63E-04 -6.03E-04 -3.50E-04 -1.01E-04 1.42E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 -1.64E-04 2.29E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 3.15E-04	- - - -
2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03	2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04	1.79E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -6.0E-04	1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04 -3.5E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.6E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 1.42E-04 2.29E-04	-1.1E-03 -8.6E-04 -6.0E-04 -3.5E-04 -1.0E-04 1.42E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04 -1.6E-04 2.29E-04 6.14E-04	-2.5E-03 -1.9E-03 -1.3E-03 -7.8E-04 -2.2E-04 3.15E-04 8.43E-04	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 3.98E-04 1.07E-03 1.72E-03	3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -1.8E-03	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04	1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04 -2.3E-04 -8.0E-04	1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05 -1.3E-04 -3.5E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -1.6E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 5.30E-05 1.42E-04	-1.13E-03 -8.63E-04 -6.03E-04 -3.50E-04 -1.01E-04 1.42E-04 3.80E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 -1.64E-04 2.29E-04 6.14E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 3.15E-04 8.43E-04	
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2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03 -1.82E-03 3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03 -1.82E-03 -2.50E-03	2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 -2.4E-03 2.56E-03 1.96E-03 1.97E-03 7.94E-04 2.30E-04 -3.2E-04 -3.2E-04 -1.4E-03 -1.9E-03	1.79E-03 1.37E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -8.0E-04 -1.3E-03 1.79E-03 1.37E-03 9.58E-04 1.61E-04 -2.3E-04 -6.0E-04 -9.7E-04 -1.3E-03	1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04 -5.6E-04 -7.8E-04 1.04E-03 7.94E-04 9.32E-04 9.32E-04 9.32E-04 -1.3E-04 -5.6E-04 -5.6E-04 -7.8E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.8E-04 -2.2E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -1.6E-04 -1.6E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 1.42E-04 2.29E-04 -4.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 5.30E-05 1.42E-04 2.29E-04	-1.1E-03 -8.6E-04 -6.0E-04 -1.0E-04 1.42E-04 6.14E-04 8.43E-04 -1.0E-04 -3.5E-04 -1.0E-04 1.42E-04 3.6E-04 6.14E-04 8.43E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04 -1.6E-04 2.29E-04 6.14E-03 -1.36E-03 -1.4E-03 -9.7E-04 -1.6E-04 2.29E-04 6.14E-04 9.91E-04 1.36E-03	-2.5E-03 -1.9E-03 -1.3E-04 -2.2E-04 3.15E-04 8.43E-04 1.36E-03 -2.5E-03 -1.9E-03 -1.3E-04 -2.2E-04 3.15E-04 1.36E-03 1.36E-03 1.36E-03	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 1.07E-03 1.72E-03 -3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 1.07E-03 1.72E-03 2.37E-03	3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -2.5E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -1.8E-03 -2.5E-03	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 -1.9E-03	1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04 -2.3E-04 -1.3E-03 1.79E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -9.7E-04 -1.3E-03	1.04E-03 7.94E-04 3.22E-04 9.32E-05 -1.3E-04 -3.5E-04 -7.8E-04 1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04 -3.5E-04	3.01E-04 2.30E-04 1.81E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -2.2E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.6E-04 -1.6E-04 -2.2E-04	-4.2E-04 -3.2E-04 -3.2E-04 -1.3E-04 -3.8E-05 5.30E-05 1.42E-04 -2.29E-04 -3.2E-04 -3.2E-04 -3.2E-04 -3.8E-05 1.42E-04 2.29E-04 -3.8E-05	-1.13E-03 -8.63E-04 -8.03E-04 -1.01E-04 1.42E-04 3.80E-04 6.14E-04 8.43E-04 -6.03E-04 -1.01E-04 1.42E-04 6.14E-04 8.43E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 -1.64E-04 8.14E-04 9.91E-04 1.36E-03 -1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 2.29E-04 6.14E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 3.15E-04 8.43E-04 1.36E-03 2.37E-03 -2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 8.43E-04 1.36E-03	
2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03 -1.82E-03 3.17E-03 3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03 -1.82E-03	2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 -2.4E-03 2.56E-03 1.96E-03 1.97E-03 7.94E-04 2.30E-04 -3.2E-04 -3.2E-04 -1.4E-03 -1.9E-03	1.79E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -8.0E-04 -1.3E-03 1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04 -2.3E-04 -6.0E-04 -9.7E-04	1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04 -5.6E-04 -7.8E-04 1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05 -1.3E-04 -5.6E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.8E-04 -2.2E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -1.6E-04 -1.6E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 1.42E-04 2.29E-04 -4.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 5.30E-05 1.42E-04 2.29E-04	-1.1E-03 -8.6E-04 -6.0E-04 -3.5E-04 -1.0E-04 1.42E-04 6.14E-04 8.43E-04 -6.0E-04 -3.5E-04 -1.0E-04 1.42E-04 3.80E-04 6.14E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04 -1.6E-04 2.29E-04 6.14E-03 -1.72E-03 -1.4E-03 -9.7E-04 -1.6E-04 2.29E-04 6.14E-04 9.91E-04 1.36E-03	-2.5E-03 -1.9E-03 -1.3E-04 -2.2E-04 3.15E-04 8.43E-04 1.36E-03 -2.5E-03 -1.9E-03 -1.3E-04 -2.2E-04 3.15E-04 1.36E-03 1.36E-03 1.36E-03	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 1.07E-03 1.72E-03 -3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 1.07E-03 1.72E-03 2.37E-03	3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -2.5E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -1.8E-03 -2.5E-03	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -1.4E-03 -1.9E-03 -2.4E-03 2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03	1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04 -2.3E-04 -9.7E-04 -1.3E-03 1.79E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -9.7E-04 -1.3E-03	1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05 -1.3E-04 -5.6E-04 -7.8E-04 1.04E-03 7.94E-04 5.55E-04	3.01E-04 2.30E-04 1.81E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -2.2E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.6E-04 -1.6E-04 -2.2E-04	-4.2E-04 -3.2E-04 -3.2E-04 -1.3E-04 -3.8E-05 5.30E-05 1.42E-04 2.29E-04 -3.15E-04 -3.2E-04 -2.3E-04 -3.8E-05 1.42E-04 2.29E-04	-1.13E-03 -8.63E-04 -8.03E-04 -3.50E-04 -1.01E-04 1.42E-04 3.80E-04 1.07E-03 -1.13E-03 -8.63E-04 -3.50E-04 -1.01E-04 1.42E-04 6.14E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 -1.64E-04 2.29E-04 6.14E-04 1.36E-03 -1.72E-03 -1.39E-03 -9.74E-04 -1.64E-04 6.14E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 8.43E-04 1.36E-03 1.87E-03 -2.50E-03 -1.91E-03 -1.75E-04 -2.25E-04 3.15E-04 8.43E-04	
2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03 -1.82E-03 -2.50E-03 3.35E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.21E-04 -1.13E-03 -1.82E-03 -2.50E-03 -3.17E-03	1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 -1.9E-03 2.56E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 -1.9E-03 -2.4E-03	1.79E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -6.0E-04 -9.7E-04 -1.3E-03 1.79E-03 1.37E-03 9.58E-04 1.61E-04 -2.3E-04 -6.0E-04 -9.7E-03 -1.7E-03	1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04 -3.5E-04 -5.6E-04 -7.8E-04 1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05 -1.3E-04 -5.6E-04 -7.8E-04 -9.8E-04	3.01E-04 2.30E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.8E-04 -2.2E-04 2.30E-04 1.61E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -2.2E-04 -2.8E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 1.42E-04 3.15E-04 -3.2E-04 -3.2E-04 -3.8E-05 5.30E-05 1.42E-04 2.29E-04 3.15E-04 3.98E-04	-1.1E-03 -8.6E-04 -6.0E-04 -1.0E-04 1.42E-04 6.14E-04 8.43E-04 -1.0E-04 -3.5E-04 -1.0E-04 1.42E-04 3.6E-04 6.14E-04 8.43E-04	-1.8E-03 -1.4E-03 -9.7E-04 -5.6E-04 -1.8E-04 2.29E-04 6.14E-04 1.36E-03 -1.8E-03 -1.4E-03 -9.7E-04 -1.6E-04 2.29E-04 6.14E-04 9.91E-04 1.36E-03 1.72E-03	-2.5E-03 -1.9E-03 -1.3E-04 -2.2E-04 3.15E-04 8.43E-04 1.36E-03 -2.5E-03 -1.9E-03 -1.3E-04 8.43E-04 1.36E-03 1.3E-04 8.43E-04 1.36E-03 1.87E-03 2.37E-03	-3.2E-03 -2.4E-03 -1.7E-03 -9.8E-04 -2.8E-04 1.07E-03 1.72E-03 2.37E-03 -2.4E-03 -1.7E-03 -9.8E-04 1.07E-03 1.72E-03 2.37E-03 1.72E-03 2.37E-03	3.35E-03 2.58E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -2.5E-03 2.56E-03 1.79E-03 1.04E-03 3.01E-04 -4.2E-04 -1.1E-03 -1.8E-03 -2.5E-03	2.56E-03 1.96E-03 1.37E-03 7.94E-04 2.30E-04 -3.2E-04 -8.6E-04 -1.4E-03 -1.9E-03 2.56E-03 1.37E-03 7.94E-04 -3.2E-04 -1.4E-03 -1.9E-03 -2.4E-03	1.79E-03 1.37E-03 9.58E-04 5.55E-04 1.61E-04 -2.3E-04 -1.7E-03 1.37E-03 5.55E-04 1.61E-04 -2.3E-04 -1.3E-03 -1.7E-03	1.04E-03 7.94E-04 5.55E-04 3.22E-04 9.32E-05 -1.3E-04 -5.6E-04 -7.8E-04 1.04E-03 7.94E-04 5.55E-04 9.32E-05 -1.3E-04 -7.8E-04 -7.8E-04	3.01E-04 2.30E-04 9.32E-05 2.70E-05 -3.8E-05 -1.0E-04 -2.2E-04 -2.8E-04 1.61E-04 9.32E-05 -3.8E-05 -1.0E-04 -1.6E-04 -2.2E-04	-4.2E-04 -3.2E-04 -2.3E-04 -1.3E-04 -3.8E-05 5.30E-05 1.42E-04 3.98E-04 -3.2E-04 -3.2E-04 -3.8E-05 1.42E-04 2.3E-04 3.88E-05	-1.13E-03 -8.63E-04 -8.03E-04 -1.01E-04 1.42E-04 3.80E-04 6.14E-04 8.43E-04 -6.03E-04 -1.01E-04 1.42E-04 6.14E-04 8.43E-04	-1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 -1.64E-04 8.14E-04 9.91E-04 1.36E-03 -1.82E-03 -1.39E-03 -9.74E-04 -5.64E-04 2.29E-04 6.14E-04	-2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 3.15E-04 8.43E-04 1.36E-03 2.37E-03 -2.50E-03 -1.91E-03 -1.34E-03 -7.75E-04 -2.25E-04 8.43E-04 1.36E-03	

Table A-5 (Continued) Cross Product Terms

	1.81E-05					-8.0E-06		-1.8E-05					7.35E-06		-3.0E-06	-7.99E-06	-1.29E-05	-1.77E-05	-2.24E
1.81E-05		9.70E-06	5.62E-06	1.63E-06	-2.3E-06	-6.1E-06	-9.9E-06	-1.4E-05	-1.7E-05	1.81E-05	1.39E-05	9.70E-06	5.62E-06	1.63E-06	-2.3E-06	-6.11E-06	-9.86E-06	-1.35E-05	-1.72E
.27E-05	9.70E-06		3.93E-06	1.14E-06	-1.6E-06		-6.9E-06	-9.5E-06					3.93E-06		-1.6E-06	-4.27E-06	-6.90E-06	-9.47E-08	-1.20E
_	5.62E-06			6.60E-07	-9.2E-07		-4.0E-06						2.28E-06		-9.2E-07	-2.48E-06	-4.00E-08	-5.49E-06	-6.95E
	1.63E-06				-2.7E-07		-1.2E-06						6.60E-07	1.91E-07	-2.7E-07	-7.17E-07	-1.16E-06	-1.59E-06	-2.01E
	-2.3E-06			-2.7E-07		1.00E-06	1.62E-06					-1.6E-06		-2.7E-07		1.00E-06	1.62E-06	2.23E-06	2.82E
	-6.1E-06			-7.2E-07			4.34E-06	5.97E-06				-4.3E-06	-2.5E-06	-7.2E-07	1.00E-06	2.69E-06	4.34E-08	5.97E-06	7.56E
9E-05				-1.2E-06				9.63E-06	1.22E-05			-6.9E-06	-4.0E-06	-1.2E-06	1.62E-06	4.34E-08	7.01E-06	9.63E-06	1.22
	-1.4E-05						9.63E-06		1.68E-05	-1.8E-05		-9.5E-06	-5.5E-06	-1.6E-06	2.23E-06	5.97E-06	9.63E-06	1.32E-05	1.66
24E-05							1.22E-05			-2.2E-05	-1.7E-05	-1.2E-05	-7.0E-06	-2.0E-06	2.82E-06	7.58E-08	1.22E-05	1.68E-05	2.12
			7.35E-06				-1.3E-05				1.81E-05		7.35E-06		-3.0E-06	-7.99E-08	-1.29E-05	-1.77E-05	-2.2
			5.62E-06				-9.9E-06			1.81E-05		9.70E-06	5.62E-06	1.63E-06	-2.3E-06	-8.11E-06	-9.86E-06	-1.35E-05	-1.72
.27E-05	9.70E-06	6.78E-06	3.93E-06	1.14E-06	-1.6E-06	-4.3E-06	-6.9E-06	-9.5E-06	-1.2E-05	1.27E-05	9.70E-08		3.93E-06	1.14E-06	-1.8E-08	-4.27E-06	-6.90E-06	-9.47E-06	-1.20
.35E-08	5.62E-06	3.93E-06	2.28E-06	6.60E-07	-9.2E-07	-2.5E-06	-4.0E-06	-5.5E-06			5.62E-06			6.60E-07	-9.2E-07	-2.48E-06	-4.00E-06	-5.49E-06	-6.95
.13E-06	1.63E-06	1.14E-06	6.60E-07					-1.6E-08			1.63E-06	1.14E-06	6.60E-07		-2.7E-07	-7.17E-07	-1.16E-06	-1.59E-06	-2.01
98E-06	-2.3E-06	-1.6E-06					1.62E-06				-2.3E-06	-1.6E-06	-9.2E-07	-2.7E-07		1.00E-06	1.62E-06	2.23E-06	2.82
.99E-06	-6.1E-06	-4.3E-06					4.34E-06					-4.3E-06	-2.5E-06	-7.2E-07	1.00E-06		4.34E-06	5.97E-06	7.5
.29E-05		-6.9E-06	-4.0E-06				7.01E-06					-6.9E-06	-4.0E-06	-1.2E-06	1.62E-06	4.34E-06		9.63E-06	1.2
.77E-05	-1.4E-05	-9.5E-06	-5.5E-06				9.63E-06					-9.5E-06	-5.5E-06	-1.6E-06	2.23E-06	5.97E-08	9.63E-06		1.6
1.24E-05	-1.7E-05	-1.2E-05	-7.0E-06	-2.0E-06	2.82E-06	7.56E-06	1.22E-06	1.68E-05	2.12E-05	-2.2E-05	-1.7E-05	-1.2E-05	-7.0E-06	-2.0E-06	2.82E-08	7.56E-06	1.22E-05	1.68E-05	
.37E-05	-1.4E-05	-6.8E-06	-2.3E-06	-1.9E-07	-3.7E-07	-2.7E-06	-7.0E-06	-1.3E-05	-2.1E-05	-2.4E-05	-1.4E-05	-6.8E-06	-2.3E-06	-1.9E-07	-3.7E-07	-2.69E-06	-7.01E-06	-1.32E-05	-2.12
Paj*8Pal*	8Paj																		
Paj*8Pai*			4.90E-06	1.42E-06	-2.0E-06	-5.3E-06	-8.6E-06	-1.2E-05					4.90E-06		-2.0E-06	-5.33E-06	-8.60E-06	-1.18E-05	-1.5
Paj*8Pal*			4.90E-06 3.75E-06	1.42E-06 1.09E-08	-2.0E-06 -1.5E-06	-5.3E-06							4.90E-06 3.75E-06		-2.0E-06 -1.5E-06	-5.33E-06 -4.07E-06	-8.60E-06 -8.58E-06	-1.18E-05 -9.03E-06	
Paj*8Pai* 1.21E-05 8.46E-06	1.21E-05 6.47E-06	6.47E-06	4.90E-06 3.75E-06	1.42E-06 1.09E-06 7.59E-07	-2.0E-06 -1.5E-06 -1.1E-06	-5.3E-06 -4.1E-06 -2.8E-06	-8.6E-06 -6.6E-06 -4.6E-06	-1.2E-05 -9.0E-06 -6.3E-06	-1.1E-05 -8.0E-06	1.21E-05 8.46E-06	9.25E-06 6.47E-06	6.47E-06 4.52E-06	3.75E-06 2.62E-06	1.09E-06 7.59E-07					-1.1
Paj*8Pai* 1.21E-05 8.46E-06 4.90E-06	1.21E-05 6.47E-06 3.75E-06	6.47E-06 2.62E-06	4.90E-06 3.75E-06 2.62E-06	1.42E-06 1.09E-06 7.59E-07	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06	-1.1E-05 -8.0E-06 -4.6E-06	1.21E-05 8.46E-06 4.90E-08	9.25E-06 6.47E-06 3.75E-06	6.47E-06 4.52E-06 2.62E-06	3.75E-06 2.62E-06 1.52E-06	1.09E-06 7.59E-07 4.40E-07	-1.5E-06	-4.07E-06	-6.58E-06	-9.03E-06	-1.1 -8.0
Paj*8Pai* 1.21E-05 8.46E-06 4.90E-06 1.42E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06	6.47E-08 2.62E-08 7.59E-07	4.90E-06 3.75E-06 2.62E-06 4.40E-07	1.42E-06 1.09E-06 7.59E-07 4.40E-07	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06	1.21E-05 8.46E-06 4.90E-06 1.42E-06	9.25E-06 6.47E-06 3.75E-06 1.09E-06	6.47E-06 4.52E-06 2.62E-06	3.75E-06 2.62E-06	1.09E-06 7.59E-07 4.40E-07	-1.5E-06 -1.1E-06	-4.07E-06 -2.85E-06	-6.58E-06 -4.60E-06	-9.03E-06 -6.32E-06	-1.1- -8.00 -4.6-
Paj*8Pal* 1.21E-05 8.46E-06 4.90E-06 1.42E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06	4.90E-06 3.75E-06 2.62E-06 4.40E-07	1.42E-06 1.09E-08 7.59E-07 4.40E-07	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07 1.08E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.88E-06	1.21E-05 8.46E-06 4.90E-06 1.42E-06 -2.0E-06	9.25E-06 6.47E-06 3.75E-06 1.09E-06	6.47E-06 4.52E-06 2.62E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07	1.09E-06 7.59E-07 4.40E-07	-1.5E-06 -1.1E-08 -6.2E-07 -1.8E-07	-4.07E-06 -2.85E-06 -1.65E-08	-6.58E-06 -4.60E-06 -2.66E-06	-9.03E-06 -6.32E-06 -3.66E-06	-1.1- -8.00 -4.6- -1.3-
Paj*8Paj* 1.21E-05 8.46E-06 4.90E-06 1.42E-06 1.99E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06	4.90E-08 3.75E-08 2.62E-08 4.40E-07 -6.2E-07 -1.7E-08	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07	-2.0E-08 -1.5E-08 -1.1E-08 -8.2E-07 -1.8E-07	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07 1.08E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06 3.98E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.88E-06 5.04E-08	1.21E-05 8.46E-06 4.90E-06 1.42E-06 -2.0E-06 -5.3E-06	9.25E-06 6.47E-06 3.75E-06 1.09E-06	6.47E-06 4.52E-06 2.62E-06 7.59E-07	3.75E-06 2.62E-06 1.52E-06 4.40E-07	1.09E-06 7.59E-07 4.40E-07 1.27E-07	-1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 2.50E-07	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07	-9.03E-06 -6.32E-06 -3.66E-06 -1.06E-06	-1.1 -8.0 -4.6 -1.3 1.8
Paj*8Pai* 1.21E-05 8.46E-06 4.90E-06 1.42E-06 1.99E-06 5.33E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06	4.90E-08 3.75E-08 2.62E-08 4.40E-07 -6.2E-07 -1.7E-08 -2.7E-08	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07 -7.7E-07	-2.0E-08 -1.5E-08 -1.1E-08 -8.2E-07 -1.8E-07 6.70E-07 1.08E-08	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07	-8.6E-08 -6.6E-08 -4.6E-08 -2.7E-08 -7.7E-07 1.08E-08 2.90E-08	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.86E-06 5.04E-06 8.14E-06	1.21E-05 8.46E-06 4.90E-06 1.42E-06 -2.0E-06 -5.3E-06 -8.6E-06	9.25E-06 6.47E-06 3.75E-06 1.09E-06 -1.5E-06	6.47E-06 4.52E-06 2.62E-06 7.59E-07 -1.1E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07	1.09E-06 7.59E-07 4.40E-07 1.27E-07 -1.8E-07	-1.5E-08 -1.1E-08 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07 6.70E-07	-8.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06	-9.03E-06 -6.32E-06 -3.66E-06 -1.06E-06 1.49E-06	-1.1- -8.00 -4.6- -1.3- 1.80 5.0-
Paj*8Pai* 1.21E-05 8.46E-06 4.90E-06 1.42E-06 1.99E-06 5.33E-06 8.60E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06	4.90E-08 3.75E-08 2.62E-08 4.40E-07 -6.2E-07 -1.7E-08 -2.7E-08	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07	-2.0E-08 -1.5E-08 -1.1E-08 -8.2E-07 -1.8E-07 6.70E-07 1.08E-08	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07	-8.6E-08 -6.6E-08 -4.6E-08 -2.7E-08 -7.7E-07 1.08E-08 2.90E-08	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06 3.98E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.86E-06 5.04E-06 8.14E-06	1.21E-05 8.46E-06 4.90E-06 1.42E-06 -2.0E-06 -5.3E-06	9.25E-06 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06	6.47E-06 4.52E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06	1.09E-06 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -7.7E-07	-1.5E-08 -1.1E-08 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07 6.70E-07 1.79E-06	-8.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06	-9.03E-06 -6.32E-06 -3.66E-06 -1.06E-06 1.49E-06 3.98E-06	-1.1 -8.0 -4.6 -1.3 1.8 5.0 8.1
Paj*8Pai* 1.21E-05 8.46E-06 4.90E-06 1.42E-08 1.99E-06 5.33E-06 8.60E-08 1.18E-05	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06 -6.3E-06	4.90E-06 3.75E-06 2.62E-08 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -3.7E-08	1.42E-06 1.09E-06 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07 -7.7E-07 -1.1E-08	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 6.70E-07 1.08E-06 1.49E-08	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 2.90E-06 3.98E-08	-8.6E-08 -6.6E-08 -4.6E-08 -2.7E-08 -7.7E-07 1.08E-08 2.90E-08	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-08 6.42E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.86E-06 5.04E-06 8.14E-06	1.21E-05 8.46E-06 4.90E-06 1.42E-06 -2.0E-06 -5.3E-06 -8.6E-06 -1.2E-05	9.25E-08 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06	6.47E-06 4.52E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-08	1.09E-06 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -7.7E-07	-1.5E-08 -1.1E-08 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07 1.08E-08	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-08	-9.03E-06 -6.32E-06 -3.66E-06 -1.08E-06 1.49E-06 3.98E-06 6.42E-06	-1.1 -8.0 -4.6 -1.3 1.8 5.0 8.1
Paj*8Paj* 1.21E-05 8.46E-08 4.90E-08 1.42E-08 1.99E-08 5.33E-08 8.60E-08 1.18E-05 1.50E-05	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-08 -1.1E-05	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06 -8.3E-06 -8.0E-06	4.90E-06 3.75E-06 2.62E-08 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -3.7E-08	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07 -7.7E-07 -1.1E-08 -1.3E-08	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 6.70E-07 1.08E-06 1.49E-06 1.88E-06	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 2.90E-06 3.98E-08	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07 1.08E-06 2.90E-06 6.42E-08 8.14E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-08 6.42E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.86E-08 5.04E-06 8.14E-06 1.12E-05	1.21E-05 8.46E-06 4.90E-06 1.42E-06 -2.0E-06 -5.3E-06 -8.6E-06 -1.2E-05	9.25E-06 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05	6.47E-06 4.52E-08 2.62E-06 7.59E-07 -1.1E-08 -2.8E-06 -4.6E-06 -6.3E-06 -8.0E-06	3.75E-08 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -3.7E-06	1.09E-06 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -7.7E-07 -1.1E-06 -1.3E-06	-1.5E-06 -1.1E-08 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07 1.08E-06 1.49E-06	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06 3.98E-06	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-08 6.42E-06	-9.03E-06 -6.32E-06 -3.66E-06 -1.06E-06 1.49E-06 3.98E-06 6.42E-06 8.82E-06	-1.1 -8.0 -4.8 -1.3 1.8 5.0 8.1 1.1 1.4
Paj*8Pai* 1.21E-05 8.46E-08 4.90E-08 1.42E-08 1.99E-08 5.33E-06 8.60E-08 1.18E-05 1.50E-05 1.58E-05	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05 1.21E-05	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06 -6.3E-06 -8.0E-06 8.46E-06	4.90E-06 3.75E-06 2.62E-08 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-08 -3.7E-08 -4.6E-08	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07 -7.7E-07 -1.1E-08 -1.3E-08 1.42E-08	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 6.70E-07 1.08E-06 1.49E-06 -2.0E-06	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-08 -4.8E-07 6.70E-07 2.90E-06 3.98E-08 5.04E-08	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07 1.08E-06 2.90E-06 6.42E-06 8.14E-06 -8.6E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 -1.49E-06 3.98E-06 6.42E-06	-1.1E-05 -8.0E-06 -4.6E-06 -1.3E-06 1.86E-08 5.04E-06 8.14E-06 1.12E-05	1.21E-05 8.46E-06 4.90E-08 1.42E-06 -2.0E-06 -5.3E-06 -8.6E-06 -1.2E-05 -1.5E-05	9.25E-06 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05	6.47E-06 4.52E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-08 -6.3E-06 -8.0E-06 8.46E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -3.7E-06 -4.6E-06	1.09E-06 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -7.7E-07 -1.1E-06 -1.3E-06 1.42E-06	-1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07 1.08E-08 1.49E-06 1.88E-06	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06 3.98E-06 5.04E-06	-6.58E-06 -4.60E-08 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-06 6.42E-06 8.14E-06	-9.03E-06 -6.32E-06 -3.66E-06 -1.06E-06 1.49E-06 3.98E-06 6.42E-06 8.82E-06 1.12E-05	-1.1/ -8.0/ -4.6 -1.3 -1.8/ 5.0- 8.1/ 1.1/ 1.4/ -1.5/
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Pel*8Pel* 1.21E-05 8.46E-08 4.90E-08 1.42E-08 1.99E-08 5.33E-08 8.60E-08 1.158E-05 1.21E-05 8.46E-08 4.90E-08 1.42E-08 1.99E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05 9.25E-06 6.47E-06 3.75E-06 -1.5E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06 -6.3E-06 -8.0E-06 -8.46E-06 4.52E-06 4.52E-06 7.59E-07	4.90E-06 3.75E-08 2.62E-08 4.40E-07 -6.2E-07 -1.7E-08 -2.7E-08 -4.6E-08 4.90E-08 2.62E-08 1.52E-08 4.40E-07 -6.2E-07	1.42E-06 1.09E-06 7.59E-07 4.40E-07 -1.8E-07 -7.7E-07 -1.1E-08 -1.3E-06 1.49E-06 7.59E-07 4.40E-07 -1.27E-07	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 6.70E-07 1.08E-08 1.49E-08 1.88E-06 -2.0E-08 -1.5E-06 -1.1E-08 -6.2E-07 -1.8E-07 2.50E-07	-5.3E-06 -4.1E-06 -2.8E-08 -1.7E-06 -4.8E-07 6.70E-07 2.90E-06 3.98E-08 -5.3E-06 -4.1E-06 -4.8E-07 6.70E-07	-8.6E-06 -6.6E-06 -4.6E-08 -2.7E-06 -7.7E-07 1.08E-06 2.90E-06 6.42E-06 8.14E-06 -8.6E-06 -4.6E-06 -4.6E-06 -7.7E-07	-1.2E-05 -9.0E-06 -6.3E-08 -3.7E-06 -1.1E-06 1.49E-06 3.98E-08 6.42E-06 -1.2E-05 -9.0E-06 -6.3E-06 -1.1E-06 1.49E-08	-1.1E-05 -8.0E-08 -4.8E-08 -1.3E-06 1.88E-08 5.04E-06 1.12E-05 -1.5E-05 -1.1E-05 -8.0E-08 -4.6E-06 1.88E-06	1.21E-05 8.48E-08 4.90E-08 1.42E-08 -2.0E-08 -5.3E-06 -8.6E-08 -1.2E-05 -1.5E-05 1.21E-05 8.46E-08 4.90E-08 1.42E-08	9.25E-06 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -9.0E-06 -1.1E-05 1.21E-05 6.47E-06 3.75E-06 1.09E-06	6.47E-06 4.52E-08 2.62E-08 7.59E-07 -1.1E-08 -2.8E-08 -4.6E-08 -8.0E-08 8.46E-08 6.47E-08 2.62E-06 7.59E-07	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -3.7E-06 -4.6E-06 4.90E-06 3.75E-06 2.62E-06	1.09E-08 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -7.7E-07 -1.1E-08 -1.3E-08 1.42E-06 1.09E-08 7.59E-07 4.40E-07	-1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 2.50E-07 6.70E-06 1.49E-06 1.88E-06 -2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07	-4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06 3.98E-06 5.04E-06 -5.33E-06 -4.07E-06 -2.85E-06 -1.65E-06 -4.78E-07	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-06 6.42E-06 8.14E-06 -8.60E-06 -6.58E-06 -2.68E-06 -7.72E-07 1.08E-06	-9.03E-08 -6.32E-08 -3.66E-08 -1.06E-08 1.49E-06 1.49E-06 6.42E-06 8.82E-06 1.12E-05 -1.18E-05 -9.03E-08 -6.32E-06 -3.66E-08 -1.06E-06 1.49E-06	-1.14 -8.00 -4.64 -1.34 1.88 5.04 1.12 -1.50 -1.14 -8.00 -4.64 -1.34
Pal*8Pal* 1.21E-05 8.46E-08 4.90E-08 1.42E-08 1.99E-08 8.60E-08 1.18E-05 1.50E-05 1.51E-05 8.46E-08 4.90E-08 1.42E-08 1.99E-06 5.33E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05 9.25E-06 6.47E-06 3.75E-06 -1.5E-06	6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -4.6E-06 -6.3E-06 -8.0E-06 8.46E-06 6.47E-06 4.52E-06 7.59E-07 -1.1E-06	4.90E-06 3.75E-08 2.62E-08 4.40E-07 -6.2E-07 -1.7E-08 -2.7E-08 -4.6E-08 4.90E-08 2.62E-08 1.52E-08 4.40E-07 -6.2E-07	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -7.7E-07 -1.1E-08 -1.3E-08 1.42E-08 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 6.70E-07 1.08E-06 1.49E-06 -2.0E-06 -1.5E-06 -1.1E-06 -1.1E-07 -1.8E-07 -1.8E-07 -1.8E-07	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 2.90E-06 3.98E-08 -5.3E-06 -4.1E-08 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 1.79E-08	-8.6E-06 -6.6E-06 -4.6E-08 -2.7E-06 -7.7E-07 1.08E-06 2.90E-06 6.42E-06 8.14E-06 -8.6E-06 -4.6E-06 -4.6E-06 -7.7E-07 1.08E-08	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06 3.98E-06 6.42E-05 -1.2E-05 -9.0E-06 -6.3E-06 -1.1E-06 1.49E-06 3.98E-06	-1.1E-05 -8.0E-06 -4.8E-06 -1.3E-06 1.88E-08 5.04E-08 1.12E-05 -1.5E-05 -1.1E-05 -8.0E-08 -4.6E-08 1.88E-06 5.04E-06	1.21E-05 8.48E-08 4.90E-06 1.42E-08 -2.0E-08 -5.3E-08 -1.2E-05 -1.5E-05 1.21E-05 8.48E-08 4.90E-08 1.42E-08 -2.0E-08 -5.3E-08	9.25E-06 6.47E-08 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -9.0E-08 -1.1E-05 1.21E-05 6.47E-06 3.75E-06 -1.5E-06	6.47E-06 4.52E-08 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06 -6.3E-06 -8.0E-06 6.47E-06 2.62E-06 7.59E-07 -1.1E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -3.7E-06 -4.6E-08 4.90E-06 3.75E-06 2.62E-06	1.09E-08 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -1.1E-08 -1.3E-08 1.42E-08 1.09E-08 7.59E-07 4.40E-07	-1.5E-08 -1.1E-08 -6.2E-07 -1.8E-07 2.50E-07 6.70E-08 1.49E-08 1.88E-08 -2.0E-06 -1.5E-08 -1.1E-06 -6.2E-07 -1.8E-07	-4.07E-06 -2.85E-06 -1.85E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06 3.98E-06 -5.33E-06 -4.07E-06 -2.85E-06 -1.85E-06 -4.78E-07	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-06 6.42E-06 8.14E-06 -8.60E-06 -4.60E-06 -2.66E-06 -7.72E-07	-9.03E-08 -6.32E-08 -3.66E-06 -1.06E-06 1.49E-06 3.98E-06 6.42E-06 1.12E-05 -1.18E-05 -9.03E-06 -3.66E-06 1.49E-06 3.98E-06	-1.14 -8.00 -4.64 -1.34 1.88 5.04 8.14 1.12 -1.50 -1.14 -8.00 -4.64 -1.34 1.88 5.04
1.21E-05 8.46E-06 4.90E-06 1.42E-06 -1.99E-06 -5.33E-06 8.60E-08 -1.18E-05 -1.50E-05 1.58E-05 1.21E-05 8.46E-06 4.90E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05 1.21E-05 9.25E-06 6.47E-06 3.75E-06 -1.5E-06 -4.1E-06 -6.6E-06	6.47E-06 2.62E-08 7.59E-07 -1.1E-08 -4.6E-08 -6.3E-08 -8.0E-08 6.47E-08 4.52E-08 2.62E-08 7.59E-07 -1.1E-08 -2.8E-08	4.90E-06 3.75E-08 2.62E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-08 -3.7E-06 4.90E-08 3.75E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -7.7E-07 -1.1E-06 -1.3E-08 1.42E-08 1.09E-06 7.59E-07 4.40E-07 -1.8E-07 -1.8E-07 -4.8E-07 -7.7E-07	-2.0E-06 -1.5E-06 -1.1E-06 -8.2E-07 -1.8E-07 6.70E-07 1.08E-06 1.49E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07	-5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 2.90E-06 3.98E-06 -5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 1.79E-06 2.90E-06	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07 1.08E-06 2.90E-06 6.42E-06 -8.6E-06 -4.6E-06 -4.6E-06 -7.7E-07 1.08E-06 2.90E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06 3.98E-06 6.42E-05 -9.0E-06 -3.7E-06 -1.1E-06 -1.1E-06 1.49E-06 3.98E-06 6.42E-06	-1.1E-05 -8.0E-06 -4.8E-06 -1.3E-06 1.88E-06 5.04E-08 1.12E-05 -1.5E-05 -1.1E-05 -8.0E-06 -4.6E-08 -1.3E-06 1.88E-06 5.04E-06 8.14E-06	1.21E-05 8.48E-08 4.90E-06 1.42E-06 -2.0E-08 -5.3E-06 -1.2E-05 -1.5E-05 1.21E-05 8.48E-08 4.90E-08 1.42E-06 -2.0E-06 -5.3E-06 -8.6E-08	9.25E-06 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05 1.21E-05 6.47E-06 3.75E-06 -1.5E-06 -4.1E-06	6.47E-06 4.52E-08 2.62E-06 7.59E-07 -1.1E-06 -4.6E-08 -6.3E-06 -6.3E-06 8.46E-06 6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -4.6E-06 4.90E-06 3.75E-06 2.62E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06	1.09E-08 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -1.1E-08 -1.3E-08 1.42E-08 1.09E-08 7.59E-07 4.40E-07	-1.5E-08 -1.1E-06 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07 1.08E-06 1.49E-08 1.88E-06 -2.0E-06 -1.5E-08 -1.1E-08 -1.2E-07 -1.8E-07	-4.07E-06 -2.85E-06 -1.85E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06 3.98E-06 -5.33E-06 -4.07E-06 -2.85E-06 -4.78E-07 6.70E-07	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-06 -8.60E-06 -8.60E-06 -2.66E-06 -7.72E-07 1.08E-06	-9.03E-08 -6.32E-08 -3.66E-08 -1.06E-08 1.49E-06 1.49E-06 6.42E-06 8.82E-06 1.12E-05 -1.18E-05 -9.03E-08 -6.32E-06 -3.66E-08 -1.06E-06 1.49E-06	-1.50 -1.14 -8.00 -4.64 -1.34 1.88 5.04 8.14 1.12 -1.50 -4.64 -1.34 1.88 5.04 8.14 1.12
1.21E-05 8.46E-08 4.90E-08 1.42E-06 1.99E-08 5.33E-06 8.60E-05 1.21E-05 8.46E-06 4.90E-08 1.42E-06 1.59E-05 1.59E-05 1.42E-06 1.59E-06 1.59E-06	1.21E-05 6.47E-06 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06 -1.1E-05 1.21E-05 9.25E-06 6.47E-06 3.75E-06 -1.5E-06 -4.1E-06 -6.6E-06	6.47E-06 2.62E-08 7.59E-07 -1.1E-08 -2.8E-08 -4.6E-08 -8.3E-08 6.47E-08 4.52E-08 2.62E-08 7.59E-07 -1.1E-08 -2.8E-08 -4.6E-08 -6.3E-08	4.90E-08 3.75E-08 2.62E-08 4.40E-07 -6.2E-07 -1.7E-06 -3.7E-08 -4.6E-08 4.90E-08 3.75E-08 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-08 -3.7E-08	1.42E-06 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -7.7E-07 -1.1E-08 1.42E-06 1.09E-08 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -7.7E-07	-2.0E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 1.08E-06 1.49E-06 -1.5E-06 -1.1E-06 -6.2E-07 -1.8E-07 -1.08E-06 1.08E-06 1.08E-06	-5.3E-06 -4.1E-06 -4.8E-07 6.70E-07 2.90E-06 5.98E-06 -5.3E-06 -4.1E-06 -2.8E-06 -1.7E-06 -4.8E-07 6.70E-07 1.79E-08 2.90E-08	-8.6E-06 -6.6E-06 -4.6E-06 -2.7E-06 -7.7E-07 1.08E-06 2.90E-06 6.42E-06 -8.6E-06 -4.6E-06 -7.7E-07 1.08E-06 2.90E-06 4.68E-06	-1.2E-05 -9.0E-06 -6.3E-06 -3.7E-06 -1.1E-06 1.49E-06 3.98E-06 6.42E-05 -9.0E-06 -6.3E-06 -1.1E-06 -1.1E-06 1.49E-08 3.98E-06 6.42E-06 8.82E-06	-1.1E-05 -8.0E-08 -4.6E-08 -1.3E-06 1.86E-06 5.04E-06 6.14E-06 1.12E-05 -1.5E-05 -1.1E-05 -4.0E-06 -1.3E-06 5.04E-06 8.14E-06 8.14E-06	1.21E-05 8.46E-08 4.90E-08 1.42E-08 -2.0E-08 -5.3E-08 -1.2E-05 -1.5E-05 1.21E-05 8.46E-08 4.90E-08 1.42E-08 -2.0E-08 -5.3E-08 -8.6E-08 -1.2E-05	9.25E-06 6.47E-08 3.75E-06 1.09E-06 -1.5E-06 -4.1E-06 -9.0E-06 -1.1E-05 1.21E-05 6.47E-06 1.09E-06 -1.5E-06 -4.1E-06 -6.6E-06 -9.0E-06	6.47E-06 4.52E-08 2.62E-06 7.59E-07 -1.1E-06 -2.8E-08 -4.6E-08 -6.3E-06 8.46E-06 6.47E-06 2.62E-06 7.59E-07 -1.1E-06 -2.8E-06 -4.6E-06	3.75E-06 2.62E-06 1.52E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06 -4.6E-06 4.90E-06 3.75E-06 2.62E-06 4.40E-07 -6.2E-07 -1.7E-06 -2.7E-06	1.09E-08 7.59E-07 4.40E-07 1.27E-07 -1.8E-07 -4.8E-07 -1.1E-08 -1.3E-08 1.42E-08 1.09E-08 7.59E-07 4.40E-07 -1.8E-07 -4.8E-07 -7.7E-07	-1.5E-08 -1.1E-06 -6.2E-07 -1.8E-07 2.50E-07 6.70E-07 1.08E-06 1.49E-08 1.88E-06 -2.0E-06 -1.5E-08 -1.1E-08 -1.2E-07 -1.8E-07	-4.07E-06 -2.85E-06 -1.85E-06 -4.78E-07 6.70E-07 1.79E-06 2.90E-06 3.98E-06 -5.33E-06 -4.07E-06 -2.85E-06 -1.85E-06 -4.78E-07	-6.58E-06 -4.60E-06 -2.66E-06 -7.72E-07 1.08E-06 2.90E-06 4.68E-06 6.42E-06 8.14E-06 -8.60E-06 -6.58E-06 -2.68E-06 -7.72E-07 1.08E-06	-9.03E-08 -6.32E-08 -3.66E-06 -1.06E-06 1.49E-06 3.98E-06 6.42E-06 1.12E-05 -1.18E-05 -9.03E-06 -3.66E-06 1.49E-06 3.98E-06	-1.14 -8.00 -4.64 -1.34 1.88 5.04 8.14 1.12 -1.50 -1.14 -8.00 -4.64 -1.34 1.88 5.04

Table A-5 (Continued) Cross Product Terms

	3.63E-03	2.54E-03	1.47E-03	4.26E-04	-8.0E-04	-1.6E-03	-2.6E-03	-3.5E-03		4.75E-03	3.63E-03			4.26E-04		-1.60E-03	-2.58E-03	-3.54E-03	-4.4 -3.4
3.63E-03		1.94E-03	1.12E-03	3.26E-04	-4.6E-04	-1.2E-03	-2.0E-03	-2.7E-03			2.78E-03	1.94E-03			-4.6E-04	-1.22E-03	-1.97E-03	-2.71E-03	
2.54E-03	1.94E-03		7.87E-04	2.28E-04	-3.2E-04	-8.6E-04	-1.4E-03	-1.9E-03			1.94E-03	1.36E-03			-3.2E-04	-8.55E-04	-1.38E-03	-1.90E-03	-2.
	1.12E-03	7.87E-04		1.32E-04	-1.8E-04	-5.0E-04	-8.0E-04	-1.1E-03				7.87E-04			-1.8E-04	-4.96E-04	-8.00E-04	-1.10E-03	-1.3
		2.28E-04	1.32E-04		-5.4E-05	-1.4E-04	-2.3E-04	-3.2E-04	-4.0E-04	4.26E-04	3.26E-04	2.28E-04	1.32E-04		-5.4E-05	-1.44E-04	-2.32E-04	-3.18E-04	-4.
-5.97E-04	-4.6E-04	-3.2E-04	-1.8E-04	-5.4E-05		2.01E-04	3.25E-04	4.48E-04	5.65E-04	-6.0E-04	-4.8E-04	-3.2E-04	-1.8E-04		7.51E-05	2.01E-04	3.25E-04	4.48E-04	5.
-1.60E-03	-1.2E-03	-8.6E-04	-5.0E-04	-1.4E-04	2.01E-04		8.70E-04	1.19E-03	1.51E-03	-1.6E-03	-1.2E-03	-8.6E-04	-5.0E-04	-1.4E-04	2.01E-04	5.39E-04	8.70E-04	1.19E-03	1
-2 58E-03	-2.0E-03	-1.4E-03	-8.0E-04	-2.3E-04	3.25E-04	8.70E-04		1.93E-03	2.44E-03	-2.6E-03	-2.0E-03	-1.4E-03	-8.0E-04	-2.3E-04		8.70E-04	1.40E-03	1.93E-03	2
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-5.97E-04	-4.6E-04		-1.8E-04	-5.4E-05	7.51E-05	2.01E-04	3.25E-04	4.46E-04	5.65E-04	-6.0E-04	-4.6E-04	-3.2E-04	-1.8E-04	-5.4E-05		2.01E-04	3.25E-04	4.46E-04	5
-1.60E-03	-1.2E-03	-8.6E-04	-5.0E-04	-1.4E-04	2.01E-04	5.39E-04	8.70E-04	1.19E-03	1.51E-03	-1.6E-03	-1.2E-03	-8.6E-04	-5.0E-04	-1.4E-04	2.01 E-04		8.70E-04	1.19E-03	1
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-4.49E-03	-3.4E-03		-1.4E-03	-4.0E-04	5.65E-04	1.51E-03	2.44E-03	3.35E-03	4.25E-03	-4.5E-03	-3.4E-03	-2.4E-03	-1.4E-03	-4.0E-04	5.65E-04	1.51E-03	2.44E-03	3.35E-03	
-4.75E-03	-2.8E-03	-1.4E-03	-4.6E-04	-3.8E-05	-7.5E-05	-5.4E-04	-1.4E-03	-2.6E-03	-4.2E-03	-4.7E-03	-2.8E-03	-1.4E-03	-4.6E-04	-3.8E-05	-7.5E-05	-5.39E-04	-1.40E-03	-2.65E-03	-4.
J*8AI*8A		2 01E-02	1.17E-02	3.38E-03	-4.7E-03	-1.3E-02	-2.0E-02	-2.8E-02				2.01E-02			-4.7E-03	-1.27E-02	-2.05E-02	-2.81E-02	
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2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02 -2.81E-02	2.88E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -8.7E-03	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 6.90E-03 9.48E-03	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03	-2.2E-02 -1.5E-02 -8.7E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02 -2.8E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 -1.9E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 6.90E-03 1.11E-02 1.53E-02 1.94E-02	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.68E-02	-2 -1 -3 -4 1 1
2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02 -2.81E-02 -3.56E-02	2.88E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 -1.9E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -8.7E-03 -1.1E-02	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 9.48E-03 1.20E-02	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.53E-02 1.94E-02	-2.2E-02 -1.5E-02 -8.7E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 2.66E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02 -2.8E-02 -3.6E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02 -1.27E-02	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 1.11E-02 1.53E-02 1.94E-02 -2.05E-02	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.68E-02 -2.81E-02	-2 -1 -3 -3 -3 -3
2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02 -2.81E-02 -3.56E-02 3.77E-02	2.88E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 -1.9E-02 2.01E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -8.7E-03 -1.1E-02 1.17E-02	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03 3.38E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03 -4.7E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 9.48E-03 1.20E-02 -1.3E-02	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.53E-02 1.94E-02 -2.0E-02	-2.2E-02 -1.5E-02 -8.7E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02 2.66E-02 -2.8E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 2.66E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02 -2.8E-02 -3.6E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 -1.9E-02 2.01E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03 3.38E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03 -4.7E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02 -1.27E-02 -9.70E-03	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 6.90E-03 1.11E-02 1.53E-02 -2.05E-02 -1.57E-02	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.66E-02 -2.81E-02 -2.15E-02	-2 -1 -3 -4 1 1 -3 -3 -3
2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02 -2.81E-02 -3.56E-02 3.77E-02 2.88E-02	2.88E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02 2.20E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 -1.9E-02 2.01E-02 1.54E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -8.7E-03 -1.1E-02 1.17E-02 8.93E-03	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03 -4.7E-03 -3.6E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 9.48E-03 1.20E-02 -1.3E-02	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.53E-02 1.94E-02 -2.0E-02 -1.6E-02	-2.2E-02 -1.5E-02 -8.7E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02 2.66E-02 -2.8E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 2.66E-02 -3.6E-02 -2.7E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02 -2.8E-02 -3.6E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 2.01E-02 1.54E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02 1.17E-02 8.93E-03	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03 3.38E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 3.54E-03 -4.7E-03 -3.6E-03 -2.5E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 9.48E-03 9.48E-03 -1.20E-02 -1.27E-02 -9.70E-03 -6.79E-03	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 6.90E-03 1.11E-02 1.53E-02 1.94E-02 -2.05E-02 -1.57E-02 -1.10E-02	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.68E-02 -2.81E-02 -1.50E-02	-2 -1 -3 -3 -4 1 1 2 -3 -4 -4 -4 -4
2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02 -2.81E-02 -3.56E-02 2.88E-02 2.88E-02	2.88E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02 2.20E-02 1.54E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 -1.9E-02 2.01E-02 1.54E-02 1.08E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02 1.17E-02 8.93E-03 6.24E-03	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03 3.38E-03 2.59E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03 -4.7E-03 -3.6E-03 -2.5E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 9.48E-03 1.20E-02 -1.3E-02 -9.7E-03	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.53E-02 1.94E-02 -2.0E-02 -1.6E-02 -1.1E-02	-2.2E-02 -1.5E-02 -8.7E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02 -2.66E-02 -2.8E-02 -2.2E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 2.66E-02 -3.6E-02 -2.7E-02 -1.9E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02 -2.8E-02 -3.6E-02 2.88E-02 2.01E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -1.1E-02 -1.5E-02 -1.9E-02 2.01E-02 1.54E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02 1.17E-02 8.93E-03	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 3.38E-03 2.59E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 3.54E-03 -4.7E-03 -3.6E-03 -2.5E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02 -1.27E-02 -9.70E-03	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 8.90E-03 1.11E-02 1.53E-02 1.94E-02 -2.05E-02 -1.57E-02 -1.10E-02 -6.35E-03	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.68E-02 -2.81E-02 -1.50E-02 -8.72E-03	-2 -1 -3 -3 -4 1 2 -3 -2 -1
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2.88E-02 2.01E-02 1.17E-02 3.38E-03 -1.27E-02 -2.05E-02 -3.56E-02 3.77E-02 2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02	2.88E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02 2.20E-02 1.54E-02 8.93E-03 -3.6E-03 -9.7E-03 -1.6E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -1.1E-02 -1.5E-02 -1.9E-02 2.01E-02 1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -8.7E-03 -1.1E-02 1.17E-02 8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -2.5E-03 -3.2E-03 3.38E-03 2.59E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 -4.7E-03 -3.6E-03 -2.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03	-9.7E-03 -6.8E-03 -3.9E-03 1.1E-03 1.60E-03 9.48E-03 1.20E-02 -1.3E-02 -9.7E-03 -6.8E-03 -1.1E-03 1.60E-03 4.28E-03 6.90E-03	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.53E-02 -1.94E-02 -2.0E-02 -1.1E-02 -6.3E-03 1.8E-03 2.58E-03 6.90E-03 1.11E-02	-2.2E-02 -1.5E-02 -8.7E-03 3.54E-03 9.48E-03 1.53E-02 2.66E-02 -2.8E-02 -2.2E-02 -1.5E-02 -2.5E-03 3.54E-03 9.48E-03 1.53E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 2.66E-02 -3.6E-02 -2.7E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -1.7E-03 -1.3E-02 -2.0E-02 2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02 1.54E-02 8.93E-03 -3.6E-03 -9.7E-03 -1.6E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.9E-02 2.01E-02 1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -3.9E-03 -6.3E-03 -1.1E-02 1.17E-02 8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -2.5E-03 3.38E-03 2.59E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 3.54E-03 -4.7E-03 -3.6E-03 -2.5E-03 -4.3E-04 1.60E-03 2.58E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02 -1.27E-02 -9.70E-03 -3.93E-03 -1.14E-03 1.60E-03	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 6.90E-03 1.11E-02 1.53E-02 -1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.81E-02 -2.81E-02 -1.50E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03	-22 -11 -13 -3 -3 -2 -1 -1 -1 11 11
2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -2.05E-02 -2.81E-02 -3.56E-02 3.77E-02 2.01E-02 1.17E-02 3.38E-03 -4.74E-03 -1.27E-02 -2.05E-02 -2.05E-02	2.88E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 2.88E-02 2.20E-02 1.54E-02 8.93E-03 -9.7E-03 -1.6E-02 -2.2E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -1.1E-02 -1.5E-02 -1.9E-02 1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -8.7E-03 -1.1E-02 1.17E-02 8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -8.7E-03	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 3.38E-03 2.59E-03 1.81E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 -4.7E-03 -3.6E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 3.54E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 9.48E-03 1.20E-02 -1.3E-02 -9.7E-03 -6.8E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.53E-02 -1.6E-02 -1.1E-02 -6.3E-03 2.58E-03 6.90E-03 1.11E-02	-2.2E-02 -1.5E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02 2.66E-02 -2.8E-02 -1.5E-02 -8.7E-03 -2.5E-03 9.48E-03 1.53E-02 2.10E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 -3.6E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 2.66E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -1.7E-02 -2.0E-02 -2.8E-02 2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02	2.20E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 2.88E-02 1.54E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 2.01E-02 1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -3.9E-03 -8.7E-03 -1.1E-02 1.17E-02 8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -8.7E-03	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -2.5E-03 3.38E-03 2.59E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -1.8E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 -4.7E-03 -3.6E-03 -2.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02 -1.27E-02 -9.70E-03 -3.93E-03 -1.14E-03 1.60E-03	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 6.90E-03 1.11E-02 1.53E-02 -1.57E-02 -1.10E-02 -6.35E-03 1.84E-03 2.58E-03 6.90E-03	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.81E-02 -2.81E-02 -1.50E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03	-3 -2 -1 -1 -3 4 1 1 2 2 -1 -1 -3 -4 1 1 -1 2 2 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1
2.88E-02 2.01E-02 1.17E-02 3.38E-03 -1.27E-02 -2.05E-02 -2.81E-02 -3.56E-02 3.77E-02 2.01E-02 3.38E-03 -1.27E-02 -2.05E-02 -2.05E-02 -2.05E-02 -2.05E-02 -2.05E-02	2.88E-02 8.93E-03 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02 2.88E-02 2.59E-03 -3.6E-03 -9.7E-03 -1.6E-02 -2.2E-02	1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02 1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -6.8E-03 -1.1E-02 -1.5E-02	8.93E-03 6.24E-03 1.05E-03 -1.5E-03 -8.7E-03 -8.7E-03 -1.1F-02 8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -8.7E-03 -1.1E-02	2.59E-03 1.81E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 3.38E-03 2.59E-03 1.81E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 -4.7E-03 -3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03	-9.7E-03 -6.8E-03 -3.9E-03 -1.1E-03 1.60E-03 9.48E-03 1.20E-02 -9.7E-03 -6.8E-03 -3.9E-03 1.60E-03 4.28E-03 9.48E-03 1.20E-02	-1.6E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 8.90E-03 1.53E-02 -1.94E-02 -1.1E-02 -6.3E-03 -1.8E-03 2.58E-03 6.90E-03 1.11E-02 1.53E-02	-2.2E-02 -1.5E-02 -8.7E-03 -2.5E-03 3.54E-03 9.48E-03 1.53E-02 -2.8E-02 -2.2E-02 -1.5E-02 -8.7E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 2.66E-02	-2.7E-02 -1.9E-02 -1.1E-02 -3.2E-03 1.48E-03 1.94E-02 2.66E-02 -3.6E-02 -1.9E-02 -1.1E-02 -3.2E-03 4.48E-03 1.20E-02 1.94E-02 2.66E-02 3.37E-02	2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.8E-02 -3.8E-02 2.88E-02 2.01E-02 1.17E-02 3.38E-03 -4.7E-03 -1.3E-02 -2.0E-02 -2.8E-02	2.20E-02 1.54E-02 8.93E-03 -3.6E-03 -1.6E-02 -2.2E-02 -2.7E-02 2.88E-02 1.54E-02 8.93E-03 -3.6E-03 -1.6E-02 -2.7E-02 -2.7E-02	1.54E-02 1.08E-02 6.24E-03 1.81E-03 -2.5E-03 -1.1E-02 -1.5E-02 -1.54E-02 6.24E-03 1.81E-03 -2.5E-03 -1.1E-02 -1.5E-02	8.93E-03 6.24E-03 3.62E-03 1.05E-03 -1.5E-03 -3.9E-03 -6.3E-03 -1.1E-02 1.17E-02 8.93E-03 6.24E-03 1.05E-03 -3.9E-03 -6.3E-03 -8.7E-03 -1.1E-02	2.59E-03 1.81E-03 1.05E-03 3.04E-04 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 3.38E-03 2.59E-03 1.05E-03 -4.3E-04 -1.1E-03 -1.8E-03 -2.5E-03 -3.2E-03	-3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 5.96E-04 1.60E-03 2.58E-03 -4.7E-03 -3.6E-03 -2.5E-03 -1.5E-03 -4.3E-04 1.60E-03 2.58E-03 3.54E-03 4.48E-03	-9.70E-03 -6.79E-03 -3.93E-03 -1.14E-03 1.60E-03 4.28E-03 6.90E-03 9.48E-03 1.20E-02 -1.27E-02 -9.70E-03 -3.93E-03 1.40E-03 6.90E-03 9.48E-03	-1.57E-02 -1.10E-02 -6.35E-03 -1.84E-03 2.58E-03 1.11E-02 1.53E-02 1.53E-02 -1.57E-02 -1.10E-02 -6.35E-03 1.84E-03 2.58E-03 6.90E-03	-2.15E-02 -1.50E-02 -8.72E-03 -2.53E-03 3.54E-03 9.48E-03 1.53E-02 2.10E-02 -2.81E-02 -1.50E-02 -8.72E-03 3.54E-03 9.48E-03 1.53E-02	-22 -11 -13 -3 -3 -3 -3 -3 -4 -1 11 11 11 11 11 11 11 11 11 11 11 11

Table A-6 Bias Error Calculation -- Flue Gas Outlet Milliken Heat Pipe Air Preheater

	Average Value	Sigma Absolute	Sigma Boletine				
ct Size	7805	ADOMAN	71010410				
fidth, ft	2.5	0.042	1.67%				
angth, ft	34	0.042	0.12%				
• .		0.046	0.12.4				
of Points	24						
fidthwise	2						
ang thwise	12						
ector Width, it	1.25	0.042	3.33%				
ector Length, ft	2.63	0.042	1.47%				
, Sector Area ft^2	3.54	0.129	3.64%				
deg F	253	2.530	1.00%				
deg R	713	2.530	0.35%				
mp Bias, deg F	100		9.09	deg F/Len	th incremer	nt Special Bi	48
, in WC	0.45802	0.0092	2.00%				
V, Ib/mol	29.71	0.050	0.17%				
nb Pres, In. Hg	29.50						
ct Pres, In. WC	-11.00						
a Pres, in. Hg	29.10	0.040	0.14%				
ot Fact, Cp	0.84	0.0100	1.19%				
minal Vel, fpe	44.13	ACFM=	225078	SCFM=	159869	ib/hr=	750003

			Input D	ala								Derivative	, dTs/dX					(dTa/dX°8	gma) ^ 2		
	Point	Al	CPI	DPI	Mi	Pai	Ti	(1)	(2)	dTa/dTi	dTa/dAl	dTa/dCPI	dTa/dDPI	dTa/dMl	dTa/dPal	d/dTi*STi	d/dAI*SAI	d/dCPI*SCPI	d/dDPI*SDPI	d/dMi*SMi	d/dPai*SPai
	1	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524.4	4.25E-02	-1.6E-01	-0.8E-01	-6.2E-01	-9.6E-03	-9.8E-03	1.16E-02	4.32E-04	4.62E-05	3.26E-05	2.31E-07	1.55E-07
	2	3.54	0.64	0.4580	29.71	29.10	672.1	2.264	1534.8	4.19E-02	-5.3E-02	-2.2E-01	-2.0E-01	-3.1E-03	-3.2E-03	1.13E-02	4.63E-05	4.95E-06	3.49E-06	2.47E-08	1.06E-08
	3	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545.2	4.14E-02	5.42E-02	2.28E-01	2.10E-01	3.23E-03	3.30E-03	1.10E-02	4.89E-05	5.22E-06	3.68E-06	2.81E-08	1.75E-08
	4	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555.5	4.08E-02	1.80E-01	6.73E-01	8.17E-01	9.52E-03	9.72E-03	1.07E-02	4.25E-04	4.53E-05	3.20E-05	2.27E-07	1.52E-07
	5	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524.4	4.25E-02	-1.6E-01	-6.8E-01	-8.2E-01	-9.6E-03	-9.8E-03	1.16E-02	4.32E-04	4.62E-05	3.26E-05	2.31E-07	1.55E-07
	6	3.54	0.84	0.4580	29.71	29.10	672.1	2.284	1534.8	4.19E-02	-5.3E-02	-2.2E-01	-2.0E-01	-3.1E-03	-3.2E-03	1.13E-02	4.63E-05	4.95E-06	3.49E-06	2.47E-08	1.66E-08
	7	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545.2	4.14E-02	5.42E-02	2.28E-01	2.10E-01	3.23E-03	3.30E-03	1.10E-02	4.89E-05	5.22E-06	3.68E-06	2.81E-08	1.75E-08
	8	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555.5	4.08E-02	1.80E-01	6.73E-01	6.17E-01	9.52E-03	9.72E-03	1.07E-02	4.25E-04	4.53E-05	3.20E-05	2.27E-07	1.52E-07
	9	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524.4	4.25E-02	-1.6E-01	-8.8E-01	-6.2E-01	-9.6E-03	-9.8E-03	1.16E-02	4.32E-04	4.62E-05	3.26E-05	2.31E-07	1.55E-07
	10	3.54	0.84	0.4580	29.71	29.10	672.1	2.264	1534.8	4.19E-02	-5.3E-02	-2.2E-01	-2.0E-01	-3.1E-03	-3.2E-03	1.13E-02	4.63E-05	4.95E-06	3.49E-06	2.47E-08	1.66E-08
	11	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545.2	4.14E-02	5.42E-02	2.28E-01	2.10E-01	3.23E-03	3.30E-03	1.10E-02	4.89E-05	5.22E-06	3.68E-06	2.61E-08	1.75E-08
	12	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555.5	4.08E-02	1.60E-01	6.73E-01	6.17E-01	9.52E-03	9.72E-03	1.07E-02	4.25E-04	4.53E-05	3.20E-05	2.27E-07	1.52E-07
	13	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524.4	4.25E-02	-1.6E-01	-6.8E-01	-6.2E-01	-9.6E-03	-9.8E-03	1.16E-02	4.32E-04	4.62E-05	3.26E-05	2.31E-07	1.55E-07
	14	3.54	0.84	0.4580	29.71	29.10	672.1	2.264	1534.8	4.19E-02	-5.3E-02	-2.2E-01	-2.0E-01	-3.1E-03	-3.2E-03	1.13E-02	4.63E-05	4.95E-06	3.49E-06	2.47E-08	1.66E-08
	15	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545.2	4.14E-02	5.42E-02	2.28E-01	2.10E-01	3.23E-03	3.30E-03	1.10E-02	4.89E-05	5.22E-06	3.68E-06	2.61E-06	1.75E-08
	16	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555.5	4.08E-02	1.60E-01	6.73E-01	6.17E-01	9.52E-03	9.72E-03	1.07E-02	4.25E-04	4.53E-05	3.20E-05	2.27E-07	1.52E-07
	17	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524.4	4.25E-02	-1.6E-01	-6.8E-01	-6.2E-01	-9.6E-03	-9.8E-03	1.16E-02	4.32E-04	4.62E-05	3.26E-05	2.31E-07	1.55E-07
	18	3.54	0.84	0.4580	29.71	29.10	672.1	2.284	1534.8	4.19E-02	-5.3E-02	-2.2E-01	-2.0E-01	-3.1E-03	-3.2E-03	1.13E-02	4.63E-05	4.95E-06	3.49E-06	2.47E-08	1.86E-08
	19	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545.2	4.14E-02	5.42E-02	2.26E-01	2.10E-01	3.23E-03	3.30E-03	1.10E-02	4.89E-05	5.22E-06	3.68E-06	2.61E-08	1.75E-08
	20	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555.5	4.08E-02	1.60E-01	6.73E-01	6.17E-01	9.52E-03	9.72E-03	1.07E-02	4.25E-04	4.53E-05	3.20E-05	2.27E-07	1.52E-07
	21	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524.4	4.25E-02	-1.6E-01	-6.8E-01	-6.2E-01	-9.6E-03	-9.8E-03	1.16E-02	4.32E-04	4.62E-05	3.26E-05	2.31E-07	1.55E-07
	22	3.54	0.84	0.4580	29.71	29.10	672.1	2.264	1534.8	4.19E-02	-5.3E-02	-2.2E-01	-2.0E-01	-3.1E-03	-3.2E-03	1.13E-02	4.63E-05	4.95E-06	3.49E-06	2.47E-08	1.66E-06
	23	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545.2	4.14E-02	5.42E-02	2.28E-01	2.10E-01	3.23E-03	3.30E-03	1.10E-02	4.89E-05	5.22E-06	3.68E-06	2.61E-06	1.75E-08
	24	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555.5	4.08E-02	1.60E-01	6.73E-01	6.17E-01	9.52E-03	9.72E-03	1.07E-02	4.25E-04	4.53E-05	3.20E-05	2.27E-07	1.52E-07
		1	Temperature	- Simple A	verage			SUM1	SUM2							Т	A	CP	DP	M	Pe
		1	Temperature	Weighted	Average			54.628	36959.4						Contributions (3)	6.40E+00	-9.76E-19	-2.24E-10	1.52E-19	3.57E-22	-3.18E-22
Ai*CPI(DP	i*Mi*Pal/Ti)	^0.5																Total Sign	na^2	6.40	

2.53 deg F

Tavg Sigma

⁾ Al*CPI(DPI*MI*Pai*TI) ^ 0.5

Contributions Include Cross Product Terms

Table A-6 (Continued) Cross Product Terms

146 0 1 116 0	TRETTERT																							
1.166	111-811-811	7 4 AF AA	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02					
1160 1160			E 00	1 10E 02	1.145.02	1 13F-02	1 11F-02	1 10F-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02	1.14E-02	1.136-02	1.116-02	1.106-02								
1162 11				4 04E 02	1 12E 02	1 11F.02	1 10F-02	1 0AF-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02								
1462 1162					1 11E-02	1 10F-02	1 0AF-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.0/E-02								
1.11.602 1.11.602						1 14F-02	1 13F-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02								
11-62 11-6	1 14E-02	1.13E-02	1.11E-02	1.10E-02			1.11F-02	1.10F-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02								
11-16-22 11-16-22	1 13F-02	1 11F-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02		1.08E-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02								
1.14-62 1.14			4 A4E AG	4 AZE AZ	4 44E A2	1 10E.02	1 0AF-02		1.11E-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.07E-02								
		4 445 00	4 43E AA	4 44E A2	1 145.02	1 14F-02	1 13F-02	1.11F-02		1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02								
11-16-02 11-16-02	1.100-02	1.135-02	1.11E-02	1 10F-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02	1.14E-02		1.11E-02	1.10E-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02								
11662 1166	1 135 02 1	1 11E-02	1 10F-02	1 00F-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02		1.08E-02	1.136-02	1.116-02	1.106-02	1.006-02								
114602 1	4 44E 00	1 105 02	1 04E-02	1 07F-02	1 11F-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02													
1.11.602 1.11.602	4 145 02	1 146.02	1 13F.02	1 11F-02	1.10F-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02			1.13E-02	1.11E-02								
1116-02 1106-02 1006-02 1106-0	4 44E 00	1 12E 02	1 11E-02	1 10F-02	1 14F-02	1 13F-02	1.11E-02	1.10E-02	1.14E-02	1.13E-02	1.11E-02	1.106-02	1.14E-02			1.10E-02	1.14E-02							
1116-02 11	4 42E 00	4 44E 02	1 10E 02	1.08F-02	1 13F-02	1 11F-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02		1.08E-02	1.13E-02	1.11E-02	1.10E-02					
1146-02 1146-0	4 4 4 E 00	4 405 02	1 AME A2	1 07E-02	1 11F-02	1 10F-02	1 0AF-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.006-02		1.11E-02	1.10E-02						
1.16-22 1.16-2			1 12E 02	1 11E 02	1 18F-02	1 14F-02	1 13F-02	1.11F-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.146-02	1.13E-02	1.11E-02		1.14E-02						
1116-02 1.106-02 1.006-02 1.116-02 1.106-02 1	4 4 4 5 00	4 425 02	4 445 03	1 10E-02	1 14F-02	1 13F-02	1 11F-02	1.10E-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02	1.146-02	1.136-02	1.116-02	1.106-02	1.14E-02		1.11E-02					
1.116-02 1.1	4 405 00	4 44E AA	4 405 02	1 AME A2	1 13E-02	1 11F-02	1 10F-02	1 08E-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.116-02	1.106-02	1.00E-UZ	1.13E-02	1.11E-02						
116-02 11			4 045 00	4 ATE AT	1 11E A2	1 10E-02	1 08F-02	1 07F-02	1 11F-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.106-02	1.066-02	1.0/E-02	1.11E-02	1.10E-02	1.08E-02	1	1.11E-02			
1.18-02 1.116-02 1.106-02 1.11	1.11E-02	1.106-02	1.005-02	1.076-02	1.115-02	1.14E-02	1.13F-02	1.11F-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02	1.11E-02	1.16E-02	1.14E-02	1.13E-02					
1.11E-02 1.11E-02 1.00E-02 1.00E-02 1.00E-02 1.10E-02 1.00E-02 1.10E-02 1.00E-02 1.0	4 4 4 5 4 4	4 44E 64	4 44E 02	1 10E 02	1 14F-02	1 13F-02	1 11F-02	1.10E-02	1.14E-02	1.13E-02	1.11E-02	1.10E-02	1.146-02	1.13E-02	1.116-02	1.106-02	1.14E-02	1.13E-02	1.11E-02					
1.11E-02 1.06-02 1.06-02 1.01E-02 1.11E-02 1.10E-02 1.06-02 1.01E-02 1.01E-03 1.01E-	1.14E-02	1.135-02	1.116-02	1.10E-02	1.175-02	1.15E-02	1 10F-02	1.08F-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02	1.10E-02	1.08E-02	1.13E-02	1.11E-02	1.10E-02					1.
2816-01 237E-01 2316-0	1.13E-02	1.11E-02	1.106-02	1.00E-02	1.13E-02	1 10F-02	1.0AF-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	1.07E-02	1.11E-02	1.10E-02	1.08E-02	2
241E-01 257E-01 254E-01 251E-01 251E-0																		-		2515 24		0.575.04	0 £ 4 E 01	
107EOS	2.61E-01	2.57E-01	2.54E-01	2.51E-01	2.61E-01	2.57E-01	2.54E-01	2.51E-01	2.61E-01	2.57E-01	2.54E-01	2.51E-01	2.61E-01	2.57E-01	2.54E-01	2.51E-01	2.612-01	2.5/E-01	2.54E-01	2.312-01	2.012-01	2.372-01	2.012-01	
107E-05																								
1.10E-05																								
1.10E-05 3.48E-00 1.00E-05 1.1E-05 1.00E-05 3.2E-05 1.1E-05 1.00E-05 3.2E-05 3.2E-05 1.1E-05 1.00E-05 3.2E-05 1.1E-05 1.0	d/dDPj*SDP	1.07F.05	-1 1F-05	-3.28-05	3.26E-05	1.07E-05	-1.1E-05	-3.2E-05	3.26E-05	1.07E-05	-1.1E-05	-3.2E-05	3.26E-05	1.07E-05	-1.1E-05	-3.2E-05								
3 2E 66		1.07E-05	-1.1E-05	1 15 05	1.07F.06	3.49F-06	-3 6F-06	-1.1E-05	1.07E-05	3.49E-06	-3.6E-06	-1.1E-05	1.07E-05	3.49E-06	-3.0E-00	-1.1E-03	1.07E-05	3.49E-06	-3.59E-06	-1.06E-05	1.07E-05	3.49E-06	-3.6E-06	•
10Fe0 346-00 366-00 10Fe0 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00 1.16-00 3.66-00	1.07E-05	1.07E-05	-1.1E-05 -3.6E-06	1 15 05	1.07E-05	3.49E-06	-3.6E-06	-1.1E-05 1.09E-05	1.07E-05	3.49E-06 -3.6E-06	-3.6E-06 3.68E-06	-1.1E-05 1.09E-05	1.07E-05 -1.1E-05	3.49E-06 -3.6E-06	-3.6E-06	1.09E-05	1.07E-05 -1.10E-05	3.49E-06 -3.59E-06	-3.59E-06 3.68E-06	-1.06E-05 1.09E-05	1.07E-05 -1.1E-05	3.49E-06 -3.59E-06	-3.6E-06 3.68E-06	3 - 3 1
107E-05 348E-06 3.8E-06 1.07E-05 3.8E-06 1.07E-05 3.8E-06 1.07E-05 3.48E-06 3.8E-06	1.07E-05 -1.10E-05	1.07E-05 -3.6E-06	-3.6E-06	-1.1E-05 1.09E-05	1.07E-05 -1.1E-05	3.49E-06 -3.6E-06	-3.6E-06 3.66E-06	-1.1E-05 1.09E-05 3.20E-05	1.07E-05 -1.1E-05 -3.2E-05	3.49E-06 -3.6E-06 -1.1E-05	-3.6E-06 3.68E-06 1.09E-05	-1.1E-05 1.09E-05 3.20E-05	1.07E-05 -1.1E-05 -3.2E-05	3.49E-06 -3.6E-06 -1.1E-05	3.68E-06 1.09E-05	1.09E-05 3.20E-05	1.07E-05 -1.10E-05	3.49E-06 -3.59E-06	-3.59E-06 3.68E-06 1.09E-05	-1.06E-05 1.09E-05 3.20E-05	1.07E-05 -1.1E-05 -3.2E-05	3.49E-06 -3.59E-06 -1.06E-05	-3.6E-06 3.66E-06 1.09E-05	3 - 3 1 5 3
1.10E-05 3.8E-00 1.0E-05 3.2E-05 1.1E-05 1.0E-05 3.2E-05 1.0E-05 1.0E-05 1.0E-05 3.2E-05 1.0E-05 1.0E-	1.07E-05 -1.10E-05 -3 23E-05	1.07E-05 -3.6E-06 -1.1E-05	-3.6E-06	-1.1E-05 1.09E-05	1.07E-05 -1.1E-05 -3.2E-05	3.49E-06 -3.6E-06	-3.6E-06 3.66E-06 1.09E-05	-1.1E-05 1.09E-05 3.20E-05	1.07E-05 -1.1E-05 -3.2E-05 3.26E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05	-1.1E-05 1.09E-05 3.20E-05 -3.2E-05	-1.1E-05 -3.2E-05 3.26E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	3.68E-06 1.09E-05 -1.1E-05	1.09E-05 3.20E-05 -3.2E-05	1.07E-05 -1.10E-05 -3.23E-05	3.49E-06 -3.59E-06 -1.06E-05	-3.59E-06 3.68E-06 1.09E-05	-1.06E-05 1.09E-05 3.20E-05 -3.23E-05	1.07E-05 -1.1E-05 -3.2E-05 3.26E-05	3.49E-06 -3.59E-06 -1.06E-05 1.07E-05	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05	3 1
3 2E-05	1.07E-05 -1.10E-05 -3.23E-05 3.26E-05	1.07E-05 -3.6E-06 -1.1E-05 1.07E-05	-3.6E-06 1.09E-05 -1.1E-05	-1.1E-05 1.09E-05 -3.2E-05	1.07E-05 -1.1E-05 -3.2E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	-3.6E-06 3.66E-06 1.09E-05	-1.1E-05 1.09E-05 3.20E-05	1.07E-05 -1.1E-05 -3.2E-05 3.26E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05	-1.1E-05 1.09E-05 3.20E-05 -3.2E-05	-1.1E-05 -3.2E-05 3.26E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	3.68E-06 1.09E-05 -1.1E-05	1.09E-05 3.20E-05 -3.2E-05	1.07E-05 -1.10E-05 -3.23E-05 3.26E-05	3.49E-06 -3.59E-06 -1.06E-05 1.07E-05	-3.59E-06 3.68E-06 1.09E-05 -1.10E-05	-1.08E-05 1.09E-05 3.20E-05 -3.23E-05 -1.06E-05	1.07E-05 -1.1E-05 -3.2E-05 3.28E-05 1.07E-05	3.49E-06 -3.59E-06 -1.06E-05 1.07E-05 3.49E-06	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05 -3.6E-06	3 - 3 3 3 -
3 28E-05	1.07E-05 -1.10E-05 -3.23E-05 3.26E-05 1.07E-05	1.07E-05 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06	-3.6E-06 1.09E-05 -1.1E-05 -3.6E-06	-1.1E-05 1.09E-05 -3.2E-05 -1.1E-05	1.07E-05 -1.1E-05 -3.2E-05 1.07E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	-3.6E-06 3.66E-06 1.09E-05 -1.1E-05 -3.6E-06	-1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05	1.07E-05 -1.1E-05 -3.2E-05 3.26E-05 1.07E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05 -3.6E-06	-1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05	1.07E-05 -1.1E-05 -3.2E-05 3.26E-05 1.07E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06	3.68E-06 1.09E-05 -1.1E-05 -3.6E-06	1.09E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05	1.07E-05 -1.10E-05 -3.23E-05 3.26E-05 1.07E-05	3.49E-06 -3.59E-06 -1.06E-05 1.07E-05 3.49E-06	-3.59E-06 3.68E-06 1.09E-05 -1.10E-05 -3.59E-06	-1.08E-05 1.09E-05 3.20E-05 -3.23E-05 -1.06E-05	1.07E-05 -1.1E-05 -3.2E-05 3.28E-05 1.07E-05	3.49E-06 -3.59E-06 -1.06E-05 1.07E-05 3.49E-06 -3.59E-06	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05 -3.6E-06 3.66E-06	3 1 3 3 3 -
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3.7E-06 3.7E-06 3.7E-06 3.7E-06 3.7E-06 3.7E-06 3.7E-06 3.7E-06 3.28E-05 3.48E-08 3.86E-08 3.20E-05 3.3E-05 3.48E-08 3.8E-05 3.48E-08 3.8E-05 3.48E-08 3.8E-05	1.07E-05 -1.10E-05 -3.21E-05 -3.20E-05 -1.10E-05 -3.22E-05 -3.22E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -3.23E-05 -3.26E-05	1.07E-05 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 1.07E-05 3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 3.49E-06 -3.6E-06 -1.1E-05 3.49E-06 -3.6E-06 -1.1E-05	-3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 3.66E-06 -1.1E-05 -3.6E-06 3.66E-06 -1.1E-05 -3.6E-06 3.66E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06	-1.1E-05 1.00E-05 -3.2E-03 -1.1E-05 1.00E-05 -3.2E-05 -1.1E-05 -1.2E-05 -1.1E-05 -1.2E-05 -1.1E-05 -1.2E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05	1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 3.28E-05 1.07E-05 -1.1E-0 3.28E-05 1.07E-05 -1.1E-05 3.28E-05 1.07E-05 -1.2E-05 3.28E-05 1.07E-05 -1.2E-05 3.28E-05	3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 -3.6E-00 -1.1E-05 1.07E-05 3.49E-00 -3.6E-00 1.07E-05 3.49E-00 -3.6E-00 1.07E-05 3.49E-00 -3.6E-00 1.07E-05 3.49E-00 -3.6E-00 -3.6E-00 -3.6E-00	-3.08-00 3.08-00 3.08-00 -1.16-05 -1.16-05 -3.08-00 1.008-05 -1.16-05 -3.08-00 1.008-05 -1.16-05 -3.08-00 1.008-05 -1.16-05 -3.08-00 1.008-05 -1.16-05 -3.08-00 1.008-05 -1.16-05 -3.08-00 1.008-05 -1.16-05 -3.08-00 -1.08-05 -1.16-05 -3.08-00 -1.08-05 -1.16-05 -3.08-00 -1.08-05 -1.18-05 -3.08-00	-1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05	1.07E-05 -1.1E-05 3.26E-05 1.07E-05 -1.1E-05 -3.26E-05 1.07E-05 -1.1E-05 3.26E-05 1.07E-05 -1.1E-05 3.26E-05 1.07E-05 -1.1E-05 3.26E-05 1.07E-05 -1.1E-05 3.26E-05 1.07E-05	3.49E-06 -3.6E-06 1.07E-05 3.49E-06 -3.6E-06 1.07E-05 1.07E-05 1.07E-05 3.49E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 3.49E-06 -1.1E-05 3.49E-06 -1.1E-05 3.49E-06	-3.8E-06 3.88E-06 1.09E-05 -1.1E-05 -3.8E-06 3.88E-06 1.09E-05 -1.1E-05 -3.8E-06 1.09E-05 -1.1E-05 -3.8E-06 1.09E-05 -1.1E-05 -3.8E-06 1.09E-05 -1.1E-05 -3.8E-06 1.09E-05 -3.8E-06 3.86E-06 3.86E-06 3.86E-06 3.86E-06 3.86E-06	-1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.00E-05 -3.2E-05 -1.1E-05 3.20E-05 -3.2E-05 -1.1E-05 3.20E-05 -3.2E-05 -1.1E-05 3.20E-05 -1.2E-05 -1.	1.07E-05 -1.1E-05 3.20E-05 1.07E-05 -1.1E-05 3.20E-05 1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05	3.49E-00 -1.1E-05 1.07E-05 3.49E-00 -1.1E-05 1.07E-05 1.07E-05 1.07E-05 1.07E-05 1.07E-05 1.07E-05 1.07E-05 1.1E-05 1.07E-05 1.1E-05 1.07E-05 1.07E-05 1.07E-05	-3.62-06 3.68E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05	-1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 3.2E-05 -1.1E-05 1.09E-05 3.2E-05 -1.1E-05	1.07E-05 -1.10E-05 -3.23E-05 -1.10E-05 -1.10E-05 -3.23E-05 -3.23E-05 -1.10E-05 -3.23E-05 -3.23E-05 -1.10E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -1.10E-05 -3.23E-05 -1.10E-05 -1.10E-05 -1.10E-05 -1.10E-05 -1.10E-05 -1.10E-05	3.49E-08 -3.59E-08 1.07E-05 3.49E-00 -3.59E-08 -1.06E-05 1.07E-05 3.49E-08 -3.59E-08 -1.06E-05 1.07E-05 3.59E-00 -1.06E-05 1.07E-05 -3.59E-00 -1.06E-05 1.07E-05	-3.59E-06 3.68E-06 1.09E-05 -1.10E-05 -3.59E-06 3.68E-06 1.09E-05 -1.10E-05 -3.59E-06 1.09E-05 -1.10E-05 -3.59E-06 1.09E-05 -1.10E-05 -3.59E-06 3.68E-06 1.09E-05 -1.10E-05 -3.59E-06 3.68E-06	-1.06E-05 1.00E-05 3.20E-05 -3.22E-05 -1.00E-05 1.00E-05 -3.22E-05 -1.00E-05 1.00E-05 -3.22E-05 -1.00E-05 -3.22E-05 -1.00E-05 1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05	1.07E-05 -1.1E-05 -3.2E-05 3.20E-05 1.07E-05 -1.1E-05 -3.2E-05 3.20E-05 1.07E-05 -1.1E-05 -3.2E-05 3.20E-05 1.07E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05	3.49E-06 -3.59E-06 -1.00E-05 -3.59E-06 -1.00E-05 -1.00E-05 -3.59E-06 -3.59E-06 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05 -1.00E-05	-3.6E-06 3.68E-06 1.09E-05 -1.1E-05 -3.6E-06 3.66E-06 1.1E-05 -3.6E-06 3.66E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -1.1E-05 -3.6E-06 1.09E-05 -3.6E-06	3 3 4 3 3 3 4 3 3 3 4 3 3 3 4 3 3 4 3 3 4 3 3 4 3 3 4 3 4 3 3 4 3
	1.07E-05 -1.10E-05 -3.23E-05 -3.20E-05 -1.10E-05 -3.20E-05 -3.20E-05 -1.10E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05 -3.23E-05	1.07E-05 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05	-3.6E-06 -1.1E-05 -3.6E-06 -3.6E-06 -3.6E-06 -3.6E-06 -3.6E-06 -3.6E-06 -1.1E-05 -3.6E-06 1.00E-05 -1.1E-05 -3.6E-06 1.00E-05 -1.1E-05 -3.6E-00 1.00E-05 -1.1E-05 -3.6E-00 1.00E-05 -3.6E-00 1.00E-05 -3.6E-00 1.00E-05 -3.6E-00 1.00E-05	-1.1E-05 1.00E-05 -1.2E-05 -1.1E-05 1.00E-05 -1.2E-05 -1.1E-05 1.00E-05 -1.2E-05 -1.1E-05 -1.2E-05 -1.	1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 3.28E-05 1.07E-05 -1.1E-05 -3.2E-05 3.28E-05 1.07E-05 -1.1E-05 -3.2E-05 3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -1.1E-05 -3.2E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05 -1.1E-05	3.49E-06 -3.6E-06 -1.1E-05 -1.1E-05 -1.1E-05 1.07E-05 3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-00 -1.1E-05 1.07E-05 3.49E-00 -1.1E-05 1.07E-05 3.49E-00 -1.1E-05 1.07E-05 3.49E-00 -1.1E-05	-3.6E-06 3.68E-06 -1.1E-05 -1.1E-05 -3.6E-06 1.00E-05 -1.1E-05	-1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 3.20E-05 -3.2E-05 -1.1E-05 3.20E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05	1.07E-05 -1.1E-05 3.26E-06 1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 1.07E-05 -1.1E-05 -3.2E-05 3.26E-05 1.07E-05 -3.2E-05 3.26E-05 1.07E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05	3.49E-06 -3.6E-06 1.07E-05 3.49E-06 -3.6E-06 -3.6E-06 1.07E-05 1.07E-05 3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06 -3.6E-06 -1.1E-05 1.07E-05 3.49E-06 -3.6E-06 -1.1E-05 1.07E-05	-3.6E-06 3.88E-06 1.09E-05 -1.1E-05 -3.8E-06 1.09E-05 -1.1E-05 -3.8E-06 1.09E-05 -1.1E-05 -3.8E-06 1.00E-05	-1.1E-05 1.09E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 3.20E-05 -3.2E-05	1.07E-05 -1.1E-05 -3.26E-05 1.07E-05 -3.26E-05 1.07E-05 -3.26E-05 1.07E-05 -1.1E-05 -3.26E-05 1.07E-05 -1.1E-05 -3.26E-05 1.07E-05 -1.1E-05 -3.26E-05 1.07E-05 -1.1E-05 -3.26E-05	3.49E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 1.07E-05 3.49E-06 -1.1E-05 1.07E-05 -3.6E-06 -1.1E-05 1.07E-05 -3.6E-06 -1.1E-05 1.07E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05 -3.6E-06 -1.1E-05	-3.62-06 1.09E-05 -1.1E-05 -3.06-06 1.09E-05 -1.1E-05 -3.62-06 1.09E-05 -1.1E-05 -3.6E-00 1.09E-05 -1.1E-05	-1.1E-05 1.09E-05 3.20E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -1.1E-05 1.09E-05 3.20E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05 -3.2E-05	1.07E-05 -1.10E-05 -3.23E-05 -1.0E-05 -1.10E-05 -1.10E-05 -3.23E-05 -1.10E-05 -3.23E-05 -1.23E-05 -1.23E-05 -1.10E-05 -3.23E-05	3.49E-08 -3.59E-08 -1.00E-05 1.07E-05 3.49E-00 -1.00E-05 1.07E-05 3.49E-00 -1.00E-05 1.07E-05 -1.00E-05 1.07E-05 -1.00E-05 1.07E-05 -1.00E-05 1.07E-05 -1.00E-05 1.07E-06 -1.00E-05 1.07E-06 -1.00E-05 1.07E-06 -1.00E-05	-3.59E-08 3.68E-08 1.09E-05 -1.10E-05 -3.56E-08 3.68E-08 1.09E-05 -1.10E-05 -3.56E-00 1.09E-05 -1.10E-05 -3.59E-00 1.09E-05 -1.10E-05 -3.59E-00 1.09E-05 -1.10E-05 -3.59E-00 3.68E-00 1.09E-05	-1.08E-05 1.09E-05 3.20E-05 -3.22E-05 -1.08E-05 1.09E-05 -3.22E-06 -3.22E-05 -3.22E-05 -3.22E-05 -1.08E-05 -3.22E-05 -3.22E-05 -3.22E-05 -3.22E-05 -3.22E-05 -3.22E-05 -3.22E-05 -3.22E-05 -3.23E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05 -1.09E-05	1.07E-05 -1.1E-05 -3.2E-05 -3.2E-05 -1.07E-05 -1.1E-05 -3.2E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05 -1.1E-05 -3.2E-05	3.49E-06 3.59E-06 -1.00E-05 3.49E-06 -1.00E-05 3.49E-06 -1.00E-05 3.49E-06 -1.00E-05 3.49E-06 -1.00E-05 3.49E-06 -3.59E-06 -1.00E-05 1.07E-05 3.49E-06 -3.59E-06 -1.00E-05 -1.00E-05	-3.6E-06 3.68E-06 1.09E-05 -3.6E-06 3.6E-06	33 -13 1.03 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3 3.3

Table A-6 (Continued)

Cross Product Terms

MI-SMI-SM	SSE OA	.7 AF OA	-2 3E-07	2.31E-07	7.55E-08	-7.8E-08	-2.3E-07	2.31E-07	7.55E-08	-7.8E-08	-2.3E-07	2.31E-07	7.55E-08	7 8E-08	-2.3E-07	2.31E-07	7.55E-08	-7.76E-08	-2.20E-07 2.31		7.55E-08		
7.55E-08		.2 SE.0A	-7 5F-08	7 55F-08	2 47E-08	-2 5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.54E-08	-7.48E-08 7.55	-	2.47E-08		
7.76E-08	.2 5E-08	2.02.00	7.60E-08	-7.8E-08	-2.5E-08	2.61E-06	7.69E-08	-7.8E-08	-2.5E-08	2.61E-08	7.69E-08	-7.8E-08	-2.5E-08	2.61E-08	7. 691. -08	-7.76E-08	-2.54E-08	2.61E-08	7.69E-08 -7.8		2.54E-08		
2.29E-07				-2.3E-07	-7.5E-08	7.69E-08	2.27E-07	-2.3E-07	-7.5E-06	7.69E-08	2.27E-07	-2.3E-07	-7.5E-08	7.69E-08	2.27E-07	-2.29E-07	-7.48E-08	7.89E-08	2.27E-07 -2.3		7.48E-08		
2.31E-07 7					7.55E-08	-7.8E-08	-2.3E-07	2.31E-07	7.55E-06	-7.8E-08	-2.3E-07	2.31E-07	7.55E-08	-7.8E-08	-2.3E-07	2.31E-07	7.55E-08	-7.76E-08	-2.29E-07 2.31		7.55E-08		
7.55E-08 2				7.55E-08		-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.54E-08	-7.48E-08 7.55		2.47E-08		
7.76E-06					-2.5E-08		7.69E-08	-7.8E-08	-2.5E-08	2.61E-08	7.69E-08	-7.8E-08	-2.5E-08	2.61E-08	7.69E-08	-7.76E-08	-2.54E-08	2.61E-06	7.69E-08 -7.8		2.54E-08		
2.29E-07								-2.3E-07	-7.5E-08	7.69E-06	2.27E-07	-2.3E-07	-7.5E-08	7.69E-08	2.27E-07	-2.29E-07	-7.48E-08	7.60E-08	2.27E-07 -2.3		7.48E-08		
2.31E-07 7	7 55E-08	-7 AF-0A	-2 3E-07	2 31F-07	7 55E-08	-7.8E-08	-2.3E-07		7.55E-08	-7.8E-08	·2.3E-07	2.31E-07	7.55E-08	-7.8E-08	-2.3E-07	2.31E-07	7.55E-06	-7.78E-08	-2.29E-07 2.31		7.55E-08		
7.55E-08 2	2.47E.04	-2 SE.04	.7 SE.OA	7.55F-08	2 47E-08	-2 5E-08	-7.5E-08	7.55E-06		-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.54E-08	-7.48E-08 7.55	SE-08 2	2.47E-08	-2.5E-08	-7.5
7.76E-08	245.04	2.05.04	7 605-06	.7 AF-0A	-2.5F-08	2.61E-08	7.60E-08	-7.8E-08	-2.5E-08		7.89E-08	-7.8E-08	-2.5E-08	2.61E-08	7.69E-08	-7.76E-08	-2.54E-06	2.61E-08	7.69E-06 -7.8	BE-08 -	2.54E-08	2.61E-08	7.6
-2 29E-07	.7 SE.04	7 AGE -04	2 27F-07	-2 3F-07	-7.5E-08	7.89E-08	2.27E-07	-2.3E-07	-7.5E-08	7.69E-08		-2.3E-07	-7.5E-08	7.69E-08	2.27E-07	-2.29E-07	-7.48E-08	7.00E-08	2.27E-07 -2.3	3E-07 -7	7.48E-08	7.60E-08	2.2
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7.55E-08 2	1.33E-08	2.65.04	7.65.04	7.55E.04	2.47E-08	-2.5E-08	-7 5F-08	7.55E-08	2.47E-08	-2.5E-08	-7.5E-08	7.55E-08		-2.5E-08	-7.5E-08	7.55E-08	2.47E-08	-2.54E-08	-7.48E-08 7.55	5E-08 :	2.47E-08	-2.5E-08	•7.
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-7.76E-06 -2.29E-07	-2.3E-U0	2.015-00	0.035.07	2 35 07	7.55.04	7.60E.08	2 27E-07	-2 3E-07	-7.5F-0A	7 60F-08	2.27E-07	-2.3E-07	-7.5E-08	7.69E-08		-2.29E-07	-7.48E-08	7.69E-06	2.27E-07 -2.3	3E-07 -	7.48E-08	7.89E-08	2.2
-2.29E-07 2.31E-07	-7.36-08	7.00E-00	2.2/6-0/	·2.3E-07	7.55-00	7.000-00	2.85.07	2 115.07	7.55E-04	-7 AF-0A	-2 3F-07	2 31F-07	7.55E-08	-7 AF-08	-2.3E-07		7.55E-08	-7.76E-06	-2.29E-07 2.31	1E-07	7.55E-08	-7.8E-08	-2.
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7.55E-00 7 -7.76E-08	2.47E-08	-2.5E-08	-7.5E-06	7.556-08	2.4/6-00	-2.3E-06	7.0E-00	7.000-00	2.476-00	2.55.00	7 AOF 08	-7 AF-0A	-2 SE-04	2.61F-0A	7 60F-08	-7.76E-08	-2.54E-08		7.69E-08 -7.8		2.54E-08	2.61E-08	7.6
-7.76E-08 -2.29E-07	-2.5E-08	2.61E-08	7.69E-08	-7.8E-08	-2.56-06	2.81E-00	0.075.07	-7.0E-00	7.65.04	7.00E.08	2 275.07	-7.0E-00	-7 SE-04	7 60F-08	2 27F-07	-2.29E-07	-7.48E-08	7.60E-08			7.48E-08	7.69E-08	2.3
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-7.76E-06 -2.29E-07	-2.5E-08	2.61E-08	7.69E-08	-7.8E-08	-2.5E-06	2.016-06	7.000-00	-7.0E-00	7.55-00	2.01E-00	2.00E-00	2 25-07	-7 SE-08	7 AOF-08	2 27F-07	-2.29E-07	-7.48E-08	7.60E-08	2.27E-07 -2.3		7.48E-08	7.69E-08	
-2.31E-07	-2.5E-08	-2.6E-08	-2.3E-07	-2.3E-07	-2.5E-08	-2.6E-08	-2.3E-07	-2.3E-07	-2.5E-08	-2.6E-08	-2.3E-07	-2.3E-07	-2.5E-08	-2.6E-08	-2.3E-07	-2.31E-07	-2.47E-08	-2.61E-08	-2.27E-07 -2.3	3E-07 -:	2.47E-08	-2.6E-08	-2
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5 08E-08 5 22E-00 -1.54E-07 1 55E-07 5 08E-08 -5 22E-00 -1.54E-07 1.55E-07 5 08E-08 -5 22E-08 -1.54E-07 1 55E-07 5 08E-08 -5 22E-08 -1.54E-07 1 55E-07 -5 22E-08 -1.54E-07 1 55E-07	-1.7E-08 -5.0E-08 5.0E-08 5.0E-08 -1.7E-08 -5.0E-08 -1.7E-08 -5.0E-08 1.6E-08 -1.7E-08 -5.0E-08 1.6E-08 1.6E-08 1.6E-08 1.6E-08 1.6E-08	-1.7E-08 -5.2E-08 -1.7E-08 1.75E-08 -5.2E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08 -1.7E-08	-1.5E-07 -5.0E-08 5.17E-08 -1.5E-07 -5.0E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08	1.55E-07 5.08E-08 -5.2E-08 -1.5E-07 5.08E-08 -5.2E-08 -1.5E-07 1.55E-07 5.08E-08 -5.2E-08 -1.5E-07 1.55E-07 5.08E-08 -5.2E-08 -1.5E-07 1.55E-07 5.08E-08 -1.5E-07 5.08E-08 -1.5E-07	1.06E-06 -1.7E-08 -5.0E-06 -1.7E-08 -5.0E-06 -1.7E-08 -5.0E-06 -1.7E-06 -1.7E-06 -5.0E-06 -5.0E-06 -5.0E-06 -5.0E-06 -5.0E-06 -5.0E-06 -5.0E-06 -5.0E-06 -5.0E-06 -1.7E-08	-1.7E-06 1.75E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 1.75E-08 5.17E-08 1.75E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.2E-08 1.75E-08 5.2E-08 5.17E-08	-5.0E-06 5.17E-06 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08	1.55E-07 5.08E-08 -5.2E-08 1.55E-07 5.08E-08 -1.5E-07 5.08E-08 -1.5E-07 1.55E-07 5.08E-08 -1.5E-07 1.55E-07 5.08E-08 -1.5E-07 1.55E-07 5.08E-08 -1.5E-07	1.06E-08 -1.7E-08 5.0E-08 1.0E-08 -1.7E-08 5.0E-08 -1.7E-08 -5.0E-08 1.0E-08 -1.7E-08 5.0E-08 1.0E-08 1.0E-08 5.0E-08	-1.7E-08 1.75E-08 5.17E-08 -5.2E-08 -1.7E-08 1.7E-08 -5.2E-08 -1.7E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08 5.17E-08	-1.5E-07 -5.0E-08 5.17E-08 5.15E-07 -1.5E-07 -5.0E-08 5.17E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08	1.55E-07 5.08E-08 -1.5E-07 1.55E-07 1.55E-07 1.55E-07 1.55E-07 5.08E-08 -1.5E-07 1.55E-07 1.55E-07 1.55E-07 1.55E-07 1.55E-07 1.55E-07 1.55E-07 1.55E-07	5.08E-08 1.06E-08 -1.7E-08 5.0E-08 1.06E-08 -1.7E-08 5.0E-08 1.06E-08 -1.7E-08 5.0E-08 5.0E-08 1.06E-08 -1.7E-08 5.0E-08 1.06E-08 1.06E-08 1.06E-08 1.06E-08	-5.2E-08 -1.7E-08 5.17E-08 5.17E-08 -5.2E-08 -1.7E-08 5.2E-08 -1.7E-08 5.2E-08 -1.7E-08 5.2E-08 -1.7E-08 5.2E-08 -1.7E-08 5.2E-08 -1.7E-08 5.2E-08 -1.7E-08 5.17E-08	-1.5E-07 -5.0E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 1.52E-07 -1.5E-07 -5.0E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08 1.52E-07 -1.5E-07 -5.0E-08 5.17E-08	5.08E-08 -5.22E-08 -1.54E-07 1.55E-07 5.08E-08 -5.22E-08 -1.55E-07 5.08E-08 -5.22E-08 -1.54E-07 5.08E-08 -5.22E-08 -1.54E-07 5.08E-08 -5.22E-08 -1.54E-07 5.08E-08	1.66E-08 -1.71E-08 -5.03E-08 5.06E-08 1.66E-08 -1.71E-08 -5.03E-08 1.66E-08 1.66E-08 1.66E-08 1.71E-08 -5.03E-08 1.71E-08 -5.03E-08 1.71E-08 -5.03E-08	-1.71E-08 1.75E-08 5.17E-08 -5.22E-08 -1.71E-08 5.12E-08 -1.71E-08 -5.22E-08 -1.71E-08 -5.22E-08 -1.71E-08 -5.22E-08 -1.71E-08 -5.22E-08 -1.71E-08	-5.03E-06 5.06 5.17E-06 -5.2 1.52E-07 -1.5 5.03E-06 5.06 5.17E-06 -5.2 1.52E-07 -1.5 1.52E-07 -1.5 5.03E-08 5.03	8E-08 2E-08 2E-08 5E-07 5E-07 6E-08 2E-08 5E-07 6E-08 5E-07	1.66E-08 1.71E-08 5.03E-08 5.03E-08 5.03E-08 1.66E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08 5.03E-08	-1.7E-08 1.75E-08 5.17E-08 -1.7E-08 1.75E-08 5.17E-08 -1.7E-08 -1.7E-08 -1.7E-08 5.2E-08 -1.7E-08 5.17E-08 5.17E-08 -1.7E-08 1.75E-08 5.17E-08 -1.7E-08	-5 -5 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -1 -5 -5 -1 -5 -5 -1 -5 -5 -1 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -5 -1 -5 -5 -5 -1 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5

Table A-6 (Continued)

Cross Product Terms

/dCP*d/dCPj*SCPi	*SCPI													105.05	4.65.05	4.62E-05	1.51E-05	-1.55E-05	-4.58E-05	4.62E-05	1.51E-05	-1 6E-05	-4 6E-05
	1.51E-05	-1.6E-05	-4.6E-05	4.62E-05	1.51E-05	-1.8E-05	-4.6E-05	4.62E-05	1.51E-05	1.6E-05	-4.6E-05	4.82E-05	1.51E-05	-1.0E-05	4.00-00	1.51E-05	4.95E-06	-5.08E-06	-1.50E-05		4.95E-06		
1.51E-05		-5.1E-06	1.5E-05	1.51E-05	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05	4.95E-08	-3.15-00	-1.3E-05	-1.55E-05	-5.08E-06	5.22E-06	1.54E-05		-5.08E-06		
-1.55E-05	-5.1E-06		1.54E-05	-1.6E-05	-5.1E-06	5.22E-06	1.54E-05	-1.6E-05	-5.1E-06	5.22E-06	1.54E-05	-1.6E-05	-5.1E-06	3.22E-06	1.54E-05	-1.55E-05	-1.50E-05	1.54E-05	4.53E-05		-1.50E-05		
-4 58E-06		1.54E-05		-4.6E-05	-1.5E-05	1.54E-05	4.53E-05	-4.6E-05	-1.5E-05	1.54E-05	4.53E-05	-4.6E-05	-1.5E-05	1.54E-05	4.035-00	4.82E-05	1.51E-05	-1.55E-05	-4.58E-05		1.51E-05		
4.62E-05	1.51E-05	-1.6E-05	-4.6E-05		1.51E-05	-1.6E-05	-4.6E-05	4.62E-05	1.51E-05	-1.6E-05	-4.6E-05	4.62£-05	1.51E-05	-1.0E-05	4.05-05	1.51E-05	4.95E-06	-5.08E-08	-1.50E-05		4.95E-08		
1 51E-05	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05		-5.1E-06	-1.5E-05	1.51E-05	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05	4.85E-00	-3.1E-06	-1.3E-03	-1.55E-05	-5.08E-06	5.22E-00	1.54E-05		-5.08E-06		
-1.55E-05	-5.1E-06	5.22E-06	1.54E-05	-1.6E-05	-5.1E-06		1.54E-05	-1.6E-05	-5.1E-06	5.22E-06	1.54E-05	1.6E-05	-5.1E-06	5.22E-UG	1.546-05	-1.55E-05	-1.50E-05	1.54E-05	4.53E-05		-1.50E-05		
-4 50E-05	-1.5E-05	1.54E-05	4.53E-05	-4.6E-05	-1.5E-05	1.54E-06		-4.6E-05	-1.5E-05	1.54E-05	4.53E-05	-4.6E-05	-1.5E-05	1.54E-05	4.536-00		1.51E-05	-1.55E-05	-4.58E-05		1.51E-05		
4 82F-05	1.51F-05	-1.6E-06	-4.6E-06	4.62E-05	1.51E-05	-1.6E-06	-4.6E-05		1.51E-05			4.62E-05				4.62E-05	1.51E-05 4.95E-06	-5.08E-08	-1.50E-05		4.95E-06		
1.51E-05	4 95F-06	-5.1E-06	-1.5E-06	1.51E-06	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05		-5.1E-06		1.51E-05				1.51E-05	-5.08E-06	5.22E-06	1.54E-05		-5.08E-06		
1 655.05	4 1F-04	5 22F-06	1.54E-05	-1.8E-06	-5.1E-06	5.22E-06	1.54E-05	-1.6E-05	-5.1E-06		1.54E-05	-1.6E-05				-1.55E-05	-5.06E-05	1.54E-05	4.53E-05		-1.50E-05		
4 4 4 E 04	1 15.04	1 54F.06	4 53F-05	-4 BE-05	-1.5E-05	1.54E-05	4.53E-05	-4.6E-05	-1.5E-05	1.54E-05		-4.6E-05	-1.5E-05			-4.58E-05	1.51E-05	-1.55E-05	4.58E-05			-1.6E-05	
4 505 05	4 4 4 5 04	-1 AF-04	-4 8F-06	4 82F-05	1.51E-05	-1.6E-05	-4.6E-05	4.62E-05	1.51E-05	-1.6E-05	-4.6E-05	_	1.51E-05			4.62E-05	1.51E-05 4.95E-06	-1.35E-05 -5.08E-06	-1.50E-05		4.95E-06		
	4 055 04	5 1E-08	-1 SE-05	1.51F-05	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05	4.95E-06	-5.1E-06	-1.5E-05	1.51E-05		-5.1E-06		1.51E-05	-5.08E-06	5.22E-06	1.54E-05		-5.08E-08		
		E ONE NA	4 K4E AK	1 4E-06	-5 1F-06	5 22F-06	1 54F-05	-1.6E-05	-5.1E-06	5.22E-00	1.54E-05	-1.6E-US	-5.1E-06		1.54E-05	-1.55E-05 -4.58E-05	-3.08E-06	1.54E-05	4.53E-05		-1.50E-05		
		4 E .C AE	4 5 3 C AS	4 4E 06	-1 5F-05	1 54F-05	4 53F-05	-4 6E-05	-1.5E-05	1.54E-03	4.53E-05	-4.0E-UD	· 1.3E-03	1.54E-05		-4.566-05	1.51E-05	-1.55E-05	4.58E-05			-1.8E-05	
		4 45 46	4 aC 05	A AGE OF	1 SIE AS	-1 AF-AS	-4 AF-05	4 82E-05	1.51E-05	-1.6E-05	-4.6E-03	4.622-00	1.515-05	·1.0E-U3	-4.6E-05		1.31E-05	-1.55E-05 -5.08E-06	-1.50E-05		4.95E-06		
		F 45 00	4 4 C A4	4 K 1 C AS	4 05E-08	-5 1F-06	-1 5F-05	1 51F-05	4.95E-06	-5.1E-08	-1.5E-05	1.51E-03	4.90E-00	-3.1E-U0	·1.5E-05	1.51E-05	5 00E 08	-5.06E-06	1.54E-05		-5.08E-06		
		E 00E 04	4 E 4E 05	1 45 06	-5 1F-OR	5 22F-06	1.54F-05	-1.8E-05	-5.1E-06	5.22E-00	1.54E-U0	-1.6C-US	-3.1E-U0	3.22E-00	1.046-00	-1.55E-05	-5.08E-06	1.54E-05	1.54E-05	-4.8E-05	-1.50E-05		
		4 E 4E AE	4 5 3 E NS	4 45.05	-1 SE-05	1 54F-05	4 53E-05	-4.8E-05	-1.5E-05	1.54E-05	4.53E-00	-4.0E-UD	•1.3E-03	1.346-03	4.33E-00	-4.58E-05	-1.50E-05	-1.55E-05	-4.58E-05	-4.02-00		-1.6E-05	
		4 45 45	4 aC AE	A BOE OS	1 51E-05	-1 AF-05	-4 8F-05	4.82E-05	1.51E-05	-1.6E-05	-4.6E-05	4.02E-05	1.51E-05	-1.02-00	-4.0E-US	4.62E-05 1.51E-05	1.51E-05 4.95E-06	-1.55E-05 -5.08E-06	-1.50E-05	1.51F-05	1.512-00	-5.1E-06	
		E 4E 04	4 KE 04	4 61E 06	4 DAF_DA	-5 1F-06	-1 5F-05	1.51E-05	4.95E-06	-5.1L-06	-1.5E-00	1.51E-U5	4.90E-00	-3.1E-00	- 1.0E-03	-1.55E-05	-5.08E-06	5.22E-06	1.54E-05		-5.08E-06	0.12.00	1.54E-05
			4 5 45 65	4 AE AS	5 1E-04	€ 22€_08	1 84F-05	-1 6F-05	-5.1E-08	5.22E-05	1.54E-05	-1.0E-US	-3.1E-U0	3.225.40	1.346-03	-1.55E-05	-1.50E-05	1.54E-05	4.53E-05		-1.50E-05	1.54E-05	
-4.58E-05	-1.5E-05	1.54E-05	1.54E-05 4.53E-05	-4.6E-05	-1.5E-05	1.54E-05	4.53E-05	-4.6E-05	-1.5E-05	1.54E-05	4.53E-05	-4.8E-05	-1.5E-05	1.54E-05	4,535-05	-4.58E-05	-1.50E-05	1.045-00	4.552-00	7.02-00	1.552 55	1.012 00	
																4 005 05	-4.95E-06	-5.22E-06	-4.53E-05	-4 8F-05	-4.95E-06	-5 2E-06	-4.5E-05
-4.62E-05	-4.9E-06	-5.2E-06	-4.5E-05	-4.6E-05	-4.9E-06	-5.2E-06	-4.5E-05	-4.6E-05	-4.9E-06	-5.2E-06	-4.5E-05	-4.6E-05	-4.9E-06	-5.2E-06	-4.5E-05	-4.62E-05	-4.95E-00	-0.222-00	-1.33E-03	-4,0L-00	4.502.00		
1/Ap*d/dAj*SAl*SA	1										4 25 64	4 495 64	1.425.04	-1.5E-04	4 3F.04	4 32F-04	1.42F-04	-1.45E-04	-4.29E-04	4.32E-04	1.42E-04	-1.5E-04	-4.3E-04
1/Ap*d/dAj*SAI*SA		-1.5E-04	-4.3E-04	4.32E-04	1.42E-04	-1.5E-04	-4.3E-04	4.32E-04	1.42E-04	-1.5E-04	-4.3E-04	4.32E-04	1.42E-04	-1.5E-04	-4.3E-04	4.32E-04	1.42E-04 4.63E-05	-1.45E-04 -4.76E-05	-4.29E-04 -1.40E-04			-1.5E-04 -4.8E-05	-4.3E-04 -1.4E-04
1/Ap*d/dAj*\$Al*\$A		-1.5E-04 -4.8E-05	1 45 04	1 425 04	4 83F-05	-4 AF-05	-1 4F-04	1.42E-04	4.63E-05	-4.8E-05	-1.4E-04	1.42E-04	4.63E-05	-4.8E-05	-1.4E-04	1.42E-04	4.63E-05	-4.76E-05	-4.29E-04 -1.40E-04 1.44E-04	1.42E-04	4.63E-05		-1.4E-04
1.42E-04	1.42E-04 -4.8E-05	-4.8E-05	1 45 04	1.42E-04	4.63E-05	-4.8E-05	-1.4E-04	1.42E-04 -1.5E-04	4.63E-05 -4.8E-05	-4.8E-05 4.89E-05	-1.4E-04 1.44E-04	1.42E-04 -1.5E-04	4.63E-05 -4.8E-05	-4.8E-05 4.89E-05	-1.4E-04 1.44E-04	1.42E-04 -1.45E-04	4.63E-05 -4.76E-05	-4.76E-05 4.69E-05	-1.40E-04	1.42E-04 -1.5E-04	4.63E-05	-4.8E-05 4.89E-05	-1.4E-04 1.44E-04
1.42E-04 -1.45E-04 -4.29E-04	1.42E-04 -4.8E-05 -1.4E-04	-4.8E-05 1.44E-04	-1.4E-04 1.44E-04	1.42E-04	4.63E-05 -4.8E-05	-4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.6E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.8E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.45E-04 -4.29E-04	4.63E-05 -4.76E-05 -1.40E-04	-4.78E-05 4.89E-05 1.44E-04	-1.40E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.76E-05 -1.40E-04	-4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04
1.42E-04 -1.45E-04 -4.29E-04 4.32E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 -4.3E-04	1,42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.8E-05	-4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04	-4.76E-05 4.89E-05 1.44E-04 -1.45E-04	-1.40E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04	4.83E-05 -4.78E-05 -1.40E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 1.42E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04	1,42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.6E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04	4.63E-05 -4.6E-05 -1.4E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05	-4.76E-05 4.69E-05 1.44E-04 -1.45E-04 -4.76E-05	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04	4.83E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04
1.42E-04 -1.45E-04 -4.29E-04 -4.32E-04 -1.42E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -4.8E-05	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04 -1.45E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05	-4.76E-05 4.89E-05 1.44E-04 -1.45E-04 -4.76E-05 4.89E-05	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04	4.83E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04
1.42E-04 -1.45E-04 -4.29E-04 -1.42E-04 -1.45E-04 -4.29E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05 -1.4E-04	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 -1.5E-04 -4.3E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04 -1.45E-04 -4.29E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04	-4.76E-05 4.89E-05 1.44E-04 -1.45E-04 -4.76E-05 4.89E-05 1.44E-04	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04	4.83E-05 -4.78E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -4.20E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 4.32E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.6E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04 4.32E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04 -1.45E-04 -4.29E-04 4.32E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04	-4.76E-05 4.89E-05 1.44E-04 -1.45E-04 -4.76E-05 4.89E-05	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04 4.32E-04	4.83E-05 -4.78E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -4.20E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -1.5E-04 -4.3E-04 4.32E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05	-4.76E-05 4.69E-05 1.44E-04 -1.45E-04 -4.76E-05 4.69E-05 1.44E-04 -1.45E-04 -4.76E-05	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04 1.44E-04 4.25E-04 -4.29E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04	4.83E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -4.20E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04 4.83E-05 -4.8E-05	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 4.32E-04 -1.5E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.69E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 -4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 1.42E-04 -1.5E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -4.8E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 1.44E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04 -1.45E-04 -4.29E-04 4.32E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04	-4.76E-05 4.89E-05 1.44E-04 -1.45E-04 -4.76E-05 4.89E-05 1.44E-04 -1.45E-04	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04	4.83E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04
1.42E-04 -1 45E-04 -4 29E-04 -4 32E-04 -1 42E-04 -4 29E-04 -4 32E-04 -1 42E-04 -1 43E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 4.83E-05 -4.8E-05	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 -4.3E-04 1.44E-04 4.25E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 1.42E-04 -1.5E-04 -4.3E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 -1.5E-04 -4.3E-04 4.32E-04 -1.5E-04 -4.3E-04	4.63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05 -1.4E-04 1.42E-04 4.63E-05 -4.6E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04	1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 1.42E-04 -1.45E-04 -4.29E-04 4.32E-04 -1.45E-04	4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05 -1.40E-04 1.42E-04 4.63E-05 -4.76E-05	-4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -4.70E-05 4.89E-05	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 4.32E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04	4.83E-05 -4.76E-05 -1.40E-04 1.42E-04 4.83E-05 -4.76E-05 -1.40E-04 1.42E-04 4.83E-05 -4.76E-05 -1.40E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04
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1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -1.45E-04 -4.20E-04 -1.45E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-05 4.89E-05 1.44E-04 -1.5E-05 4.8E-05 1.44E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2SE-04 -1.3E-04 1.4E-04 4.2SE-04 4.3E-04 1.4E-04 4.2SE-04 4.3E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -4.3E-04 -1.5E-04 -4.3E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.5E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-05 4.89E-05 1.44E-04 -1.5E-05 4.89E-05 1.44E-04 -1.5E-04 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 -1.4E-04 1.4E-04 4.25E-04 -1.4E-04 4.25E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -4.3E-04 -4.3E-04 -4.3E-04	4.63E-05 -4.8E-05 -1.4E-04 4.63E-05 -4.8E-05 -1.4E-04 -4.8E-05 -1.4E-04 4.63E-05 -1.4E-04 4.63E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 -1.4E-04 -4.8E-05 -1.4E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 4.25E-04 -1.4E-04 -1.4E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	1.42E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 1.42E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4,63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-05 -1.4E-04 4.63E-05 -1.4E-04 1.42E-04 4.6E-05 -1.4E-04 1.42E-04 4.6E-05	4.88E-05 4.89E-05 1.5E-04 -1.5E-04 -4.8E-05 4.89E-05 1.4E-04 -4.8E-05 4.89E-05 1.4E-04 -4.8E-05 1.4E-04 -4.8E-05	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.4E-04 4.2SE-04 -4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 -1.4E-04 -1.4E-04	1.42E-04 -1.45E-04 -4.20E-04 -1.32E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.20E-04 -1.20E-04 -1.20E-04 -1.45E-04 -1.45E-04 -1.45E-04	4.63E-05 -1.76E-05 -1.40E-04 1.42E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.40E-04 1.42E-04	-4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -4.78E-05 4.89E-05 4.89E-05 4.89E-05 1.44E-04 -1.78E-05 1.45E-04 -1.78E-05 1.44E-04	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 -4.3E-04	4.63E-05 -1.76E-05 -1.40E-04 1.42E-05 -1.76E-05 -1.76E-05 -1.76E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.76E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.42E-04 4.63E-05	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.89E-05 1.44E-04 -4.89E-05 1.44E-04 -1.5E-04 -4.89E-05 4.89E-05 4.89E-05 4.89E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -1.45E-04 -4.20E-04 -1.45E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.08E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05	-4.8E-05 4.88E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 -1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04	4.03E-05 -4.8E-05 -1.4E-04 4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 -1.4E-	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -4.8E-05 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 -1.4E-04 1.4E-04 4.3E-04 -1.4E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04	1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 1.42E-04 1.5E-04 4.3E-04 1.42E-04	4,63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 1.4E-04 -1.5E-04 -4.8E-05 4.89E-05 1.4E-04 -4.8E-05 4.89E-05 1.4E-04 -1.5E-04 -4.8E-05 1.4E-04 -1.5E-04 -4.8E-05 1.4E-04	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 4.25E-04 -1.3E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -1.25E-04 -1.32E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04	4.83E-05 -1.76E-05 -1.40E-04 4.83E-05 -1.76E-05 -1.40E-04 4.83E-05 -1.40E-04 1.42E-04 4.83E-05 -1.40E-04 1.42E-04 4.83E-05 -1.40E-04	4.78E-05 4.89E-05 1.44E-04 4.79E-05 4.89E-05 1.44E-04 4.78E-05 1.45E-04 4.78E-05 1.44E-04 1.45E-04 4.78E-05 1.44E-04 4.78E-05	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -1.3E-04 1.42E-04 -1.5E-04 -1.3E-04 1.3E-04 1.3E-04 1.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4.63E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-05 4.89E-05 1.4E-04 -1.5E-05 4.89E-05 1.4E-04 -1.5E-04 4.89E-05 1.4E-04 -1.5E-04 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 1.4E-04 1.44E-04 4.3E-04 -1.4E-04 1.44E-04 4.3E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.20E-04 -1.45E-04	1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04	-4.8E-05 -1.4E-04 -1.5E-04 -4.8E-05 -4.8E-05 -4.8E-05 -4.8E-05 -4.8E-04 -4.8E-05 -4.8E-05 -4.8E-05 -4.8E-04 -4.8E-04 -4.8E-05 -4.8E-04 -4.8E-04 -4.8E-04 -4.8E-05	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 -1.3E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 4.83E-05 -4.8E-05 -1.4E-04 4.83E-05 -1.4E-04 4.83E-05 -1.4E-04 4.83E-05 -4.8E-05 -4.8E-05 -4.8E-05	-4.8E-05 4.88E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -4.8E-05 -1.4E-04 4.03E-05 -4.8E-05 -1.4E-04 -4.03E-05 -4.8E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 -4.8E-05	-1,4E-04 1,44E-04 -1,3E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04 -1,4E-04	1.42E-04 4.3E-04 4.32E-04 1.42E-04 1.5E-04 4.32E-04 1.42E-04 1.5E-04 4.3E-04 1.42E-04 1.5E-04 4.32E-04 1.42E-04 1.5E-04 4.32E-04 1.42E-04 1.5E-04	4,63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05 -4.8E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -4.8E-05 -1.4E-04 4.63E-05 -4.8E-05 -4.8E-05	4.88E-05 4.89E-06 1.44E-04 -1.5E-04 4.89E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.4E-04 4.25E-04 -4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04	4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.03E-05 -1.76E-05 -1.40E-04 1.42E-04 -1.40E-04 -1.40E-04	-1.78E-05 4.89E-05 1.44E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04	-1.40E-04 1.41E-04 4.29E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 1.40E-04 1.40E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 -4.3E-04	4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-05 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.83E-05 -1.76E-05 -1.40E-04 1.42E-04 4.83E-05 -1.40E-04 1.42E-04 4.83E-05 -1.40E-04	-4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.5E-04 -4.8E-05 4.80E-05 1.5E-04 -4.8E-05 4.80E-04 1.5E-04 -4.8E-05 4.80E-05 1.44E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 -1.4E-04 1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -4.20E-04 -1.45E-04	1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-05 -1.4E-04 1.42E-05 -1.4E-04 1.42E-05 -1.4E-04	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.8E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-05 -1.4E-04 -1.5E-05 -1.4E-04	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.3E-04 -1.4E-04 1.4E-04 4.3E-04 1.4E-04 4.3E-04 1.4E-04 4.3E-04 1.4E-04 4.3E-04	1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 4.83E-05 -1.4E-04 4.83E-05 -1.4E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -4.8E-05 4.89E-05 1.44E-04 -4.8E-05 4.89E-05 1.44E-04 -4.8E-05 4.89E-05 1.44E-04 -4.8E-05 1.45E-04 -4.8E-05 1.45E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.	4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 -1.4E-04 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 4.89E-05 1.44E-04 -1.5E-04	-1,4E-04 1,44E-04 -4,3E-04 -1,4E-04 1,4E-04 1,4E-04 -1,4E	1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.5E-04 4.32E-04	4,63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -4.8E-05 -4.8E-05 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-05 -1.4E-05 -1.4E-05 -1.4E-05	4.88E-05 4.89E-05 1.5E-04 -1.5E-04 -4.8E-05 4.89E-05 1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.4E-04	-1.4E-04 1.44E-04 -4.3E-04 -1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.20E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.20E-04 -1.20E-04	4.83E-05 -1.76E-05 -1.40E-04 4.83E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.76E-05 -1.76E-05 -1.76E-05 -1.76E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04 1.42E-04	-4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-05 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.83E-05 -1.76E-05 -1.40E-04 1.42E-04 4.83E-05 -1.40E-04 1.42E-04 4.83E-05 -1.40E-04	-4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.5E-04 -4.8E-05 4.80E-04 -1.5E-04 -4.8E-05 4.80E-04 -1.5E-04 -4.8E-05 4.80E-04 -1.5E-04 -4.8E-05 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 4.25E-04 -4.3E-04 -1.4E-04 4.25E-04 -4.3E-04 -1.4E-04 4.25E-04 -4.3E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -4.20E-04 -1.45E-04	1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.88E-05 1.44E-04 -4.8E-05 4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 4.3E-04 -1.4E-04 4.3E-04 -1.4E-04 4.3E-04 -1.4E-04	1.42E-04 -1.5E-04 -1.3E-04 -1.5E-04 -1.3E-04 -1.3E-04 -1.5E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 1.42E-04 4.8E-05 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-05 -1.4E-04 1.42E-05 -1.4E-04 1.42E-05	-4.8E-05 4.08E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.3E-04 -1.4E-04 1.4E-04 -1.4E-04 -1.4E-04 4.3E-04 -1.4E-04 4.3E-04 -1.4E-04 1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.3E-04 -1.3E-04 -1.3E-04	1.42E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.03E-05 -4.8E-04 1.4E-04 1.42E-04 4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-06 -1.4E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-06 -1.4E-04 -1.5E-04	-1,4E-04 1,44E-04 4,25E-04 -1,4E-04 1,44E-04 4,3E-04 -1,4E-04 1,44E-04 4,25E-04 -1,4E-04 4,25E-04 -1,4E-04 1,44E-04 4,25E-04 -1,4E-04 1,44	1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.3E-04 1.42E-04 -1.5E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4,63E-05 -4.8E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 -4.6E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04	4.8E-05 4.89E-05 1.4E-04 4.8E-05 1.4E-04 1.5E-04 1.5E-04 1.5E-04 1.5E-04 1.5E-04 1.4E-04 1.5E-05 1.44E-04 1.5E-05 1.44E-04 1.5E-05 1.44E-04 1.5E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 4.25E-04 -1.3E-04 1.4E-04 4.25E-04 -1.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.20E-04 1.42E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04 1.42E-04 -1.45E-04 -1.29E-04	4.63E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04 4.76E-05 -1.40E-04 4.63E-05	4.78E-05 4.89E-05 1.44E-04 4.78E-05 4.89E-05 1.45E-04 4.78E-05 4.89E-05 1.45E-04 4.78E-05 4.89E-05 1.45E-04 4.78E-05 1.45E-04 4.78E-05 1.45E-04 4.78E-05	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 1.44E-04 4.25E-04 1.40E-04 1.40E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 1.42E-04	-4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.5E-04 -4.8E-05 4.80E-04 -1.5E-04 -4.8E-05 4.80E-04 -1.5E-04 -4.8E-05 4.80E-04 -1.5E-04 -4.8E-05 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.32E-04 -1.45E-04 -4.20E-04 -1.45E-04	1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 4.83E-05	-4.8E-05 -1.4E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -4.8E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04	-4.8E-05 4.88E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.2SE-04 -1.3E-04 -1.4E-04 1.4E-04 -1.4E-04 -1.3E-04 -1.3E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04	1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 1.42E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 -1.5E-04	-1,4E-04 1,44E-04 -4,3E-04 -1,4E-04	1.42E-04 4.32E-04 4.32E-04 1.42E-04 1.5E-04 4.32E-04 1.42E-04 1.5E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4,63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04	4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04 1.42E-04 -4.76E-05 -1.40E-04 1.42E-04 -4.76E-05 -1.40E-04 1.42E-04 -4.76E-05 -1.40E-04 1.42E-04	-1.78E-05 4.89E-05 1.44E-04 -1.45E-04	-1.40E-04 1.44E-04 4.25E-04 -4.29E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 4.25E-04 -1.40E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 1.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.42E-04 1.5E-04	4.63E-05 -1.70E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.70E-05 -1.40E-04 1.42E-04 4.63E-05 -1.70E-05 -1.40E-04 1.42E-04 4.63E-05	-4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 1.4E-04 1.4E-04 4.25E-04 -4.3E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04
1.42E-04 -1.45E-04 -4.20E-04 -4.20E-04 -1.45E-04 -4.20E-04	1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 4.83E-05	-4.8E-05 -1.4E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04	4.83E-05 -4.8E-05 -1.4E-04 1.42E-04 -4.8E-05 -4.8E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04 1.42E-04 4.03E-05 -4.8E-04	-4.8E-05 4.88E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.2SE-04 -1.3E-04 -1.4E-04 1.4E-04 -1.4E-04 -1.3E-04 -1.3E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04 -1.4E-04	1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 1.42E-04 -1.5E-04 4.32E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 1.42E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04 4.03E-05 -1.4E-04	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 -1.5E-04	-1,4E-04 1,44E-04 -4,3E-04 -1,4E-04	1.42E-04 4.32E-04 4.32E-04 1.42E-04 1.5E-04 4.32E-04 1.42E-04 1.5E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04 4.3E-04	4,63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04	-4.8E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.20E-04 1.42E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04 1.42E-04 -1.45E-04 -1.29E-04	4.63E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.76E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04 4.76E-05 -1.40E-04 4.63E-05	4.78E-05 4.89E-05 1.44E-04 4.78E-05 4.89E-05 1.45E-04 4.78E-05 4.89E-05 1.45E-04 4.78E-05 4.89E-05 1.45E-04 4.78E-05 1.45E-04 4.78E-05 1.45E-04 4.78E-05	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 1.44E-04 4.25E-04 1.40E-04 1.40E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 4.63E-05 -1.40E-04 1.42E-04	-4.8E-05 4.80E-05 1.44E-04 -4.8E-05 4.80E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05 1.44E-04 -1.5E-04 -4.80E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04 1.44E-04
1.42E-04 -1.45E-04	1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04 4.8E-05 4.80E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04	1.42E-04 -1.5E-04 -1.3E-04	4.83E-05 -4.8E-05 -1.4E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04	-4.8E-05 4.00E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.2SE-04 -1.4E-04 1.44E-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 -1.4E-05 -1.4E-04 -1.4E-05 -1.4E-06 -1.4E-	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04	1.425-04 4.325-04 4.325-04 1.425-04 1.325-04 4.325-04 4.325-04 1.425-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04	4,63E-05 -1,4E-04 1,42E-04 4,63E-05 -1,4E-04 1,42E-04 4,03E-05 -1,4E-04 1,42E-04 -4,6E-05 -1,4E-04 1,42E-04 4,63E-05 -1,4E-04 1,42E-04 4,63E-05 -1,4E-04 4,63E-05 -1,4E-04 4,63E-05 -1,4E-04	4.8E-05 4.89E-05 1.4E-04 -1.5E-04 -1.5E-05 1.44E-04 -1.5E-05 4.89E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.29E-04	4.83E-05 -1.76E-05 -1.40E-04 4.83E-05 -1.40E-04 1.42E-04 4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04	-1.78E-05 4.89E-05 1.44E-04 -1.45E-04 -4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.29E-04 -1.40E-04 1.44E-04 4.25E-04 4.25E-04 -1.40E-04 1.44E-04 1.44E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.63E-05 -1.40E-04 1.42E-04	-4.8E-05 4.8E-05 1.4E-04 -1.5E-04 -4.8E-05 4.8E-05 1.4E-04 -4.8E-05 1.4E-04 -4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 1.4E-04 -4.8E-05 1.4E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04
1.42E-04 -1.45E-04	1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04	-4.8E-05 1.44E-04 -1.5E-04 4.8E-05 4.80E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 1.44E-04 -1.5E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 -1.4E-04 1.4E-04 1.4E-04 4.2E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.5E-04 -1.3E-04	4.83E-05 -4.8E-05 -1.4E-04 -4.8E-05 -1.4E-04 1.42E-04 4.83E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04 1.42E-04 4.63E-05 -1.4E-04	-4.8E-05 4.00E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04	-1.4E-04 1.44E-04 4.2SE-04 -1.4E-04 1.44E-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04 4.2SE-04 -1.4E-04	1.42E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.5E-04 -4.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04 -1.3E-04	4.03E-05 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 -4.8E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 1.42E-04 4.03E-05 -1.4E-04 -1.4E-05 -1.4E-04 -1.4E-05 -1.4E-06 -1.4E-	-4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -4.8E-05 4.89E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-05 -1.4E-04 -1.5E-05 -1.4E-04 -1.5E-05 -1.4E-04 -1.5E-05 -1.4E-04	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04 -1.4E-04 4.25E-04	1.425-04 4.325-04 4.325-04 1.425-04 1.325-04 4.325-04 4.325-04 1.425-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04 4.325-04	4,63E-05 -1,4E-04 1,42E-04 4,63E-05 -1,4E-04 1,42E-04 4,03E-05 -1,4E-04 1,42E-04 -4,6E-05 -1,4E-04 1,42E-04 4,63E-05 -1,4E-04 1,42E-04 4,63E-05 -1,4E-04 4,63E-05 -1,4E-04 4,63E-05 -1,4E-04	4.8E-05 4.89E-05 1.4E-04 -1.5E-04 -1.5E-05 1.44E-04 -1.5E-05 4.89E-05 1.44E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	-1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.3E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04	1.42E-04 -1.45E-04 -4.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.29E-04 -1.45E-04 -1.29E-04	4.83E-05 -1.76E-05 -1.40E-04 4.83E-05 -1.40E-04 1.42E-04 4.63E-05 -1.76E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04 1.42E-04 4.76E-05 -1.40E-04	-1.78E-05 4.89E-05 1.44E-04 -1.45E-04 -4.78E-05 4.89E-05 1.44E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04 -1.45E-04	-1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.25E-04 -1.40E-04 1.44E-04 4.29E-04 -1.40E-04 1.44E-04 4.25E-04 4.25E-04 -1.40E-04 1.44E-04 1.44E-04 1.44E-04	1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -4.3E-04 1.42E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04 -1.5E-04	4.63E-05 -1.70E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.40E-04 1.42E-04 4.63E-05 -1.70E-05 -1.40E-04 1.42E-04 4.63E-05 -1.70E-05 -1.40E-04 1.42E-04 4.63E-05	-4.8E-05 4.8E-05 1.4E-04 -1.5E-04 -4.8E-05 4.8E-05 1.4E-04 -4.8E-05 1.4E-04 -4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 4.8E-05 1.4E-04 -4.8E-05 1.4E-04	-1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.44E-04 4.25E-04 -1.4E-04 1.44E-04 4.25E-04 -4.3E-04 -1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04 1.4E-04

Table A-7 Random Error Calculation -- Primary Air Inlet Milliken Heat Pipe Air Preheater

	Average	Sigma	Sigma		
	Value	Absolute	Relative		
Duct Size					
Width, R	3.26	0.042	1.27%		
Length, ft	17.5	0.042	0.24%		
# of Points	12				
Widthwise	2				
Lengthwise	•				•
Sector Width, It	1.64	0.042	2.54%		
Sector Length, ft	2.92	0.042	1.43%		
A, Sector Area ft^2	4.78	0.139	2.91%		
T, deg F	80	0.400	0.50%		
T, deg R	540	0.400	0.07%		
Temp Bias, deg F	10		2.00 d	eg F/Length Increme	nt Spacial Blas
DP, in WC	0.005060	0.00005	0.99%		
M, lb/mol	26.85	0.050	0.17%		
Amb Pres, in. Hg	29.50				
Duct Pres, in. WC	48.00				
Ps, in. Hg Absolute	31.23	0.040	0.13%		
CP, Pitot Fact	0.84	0.0000	0.00%		
Nominal Vel, fps	3.96	ACFM=	13631	SCFM= 13702	lb/hr= 6250

			Input C	ala								Derivative	, dTa/dX					(dTe/dX°8	lgma) ^ 2		
•	Point	Al	CPI	DPI	Mi	Pal	TI	(1)	(2)	dTa/dTi	dTa/Ai	dTa/CPI	dTa/dDPi	dTa/dMi	dTe/dPei	d/dTI*STI	d/dAI*SAI	d/dCPI*SCPI	d/dDPi*SDPI	d/dMi*SMi	d/dPai*SPa
	1	4.78	0.84	0.0051	26.65	31.23	535.0	0.371	198.6	8.41E-02	-8.7E-02	-5.0E-01	-4.1E+01	-7.2E-03	-6.7E-03	1.13E-03	1.48E-04	0.00E+00	4.24E-06	1.31E-07	7.21E-08
	2	4.78	0.84	0.0051	26.65	31.23	537.0	0.371	199.0	8.38E-02	-5.2E-02	-3.0E-01	-2.5E+01	-4.3E-03	-4.0E-03	1.12E-03	5.30E-05	0.00E+00	1.52E-06	4.00E-08	2.58E-08
	3	4.78	0.84	0.0051	26.65	31.23	539.0	0.370	199.4	8.35E-02	-1.7E-02	-9.8E-02	-8.1E+00	-1.4E-03	-1.3E-03	1.12E-03	5.78E-08	0.00E+00	1.66E-07	5.11E-09	2.82E-09
	4	4.78	0.84	0.0051	26.65	31.23	541.0	0.369	199.7	8.32E-02	1.76E-02	1.00E-01	8.30E+00	1.46E-03	1.35E-03	1.11E-03	6.02E-06	0.00E+00	1.72E-07	5.32E-09	2.93E-09
	5	4.78	0.84	0.0051	26.85	31.23	543.0	0.369	200.1	8.29E-02	5.23E-02	2.98E-01	2.47E+01	4.34E-03	4.01E-03	1.10E-03	5.32E-05	0.00E+00	1.52E-06	4.70E-08	2.50E-08
	6	4.78	0.84	0.0051	26.65	31.23	545.0	0.368	200.5	8.26E-02	8.69E-02	4.95E-01	4.10E+01	7.20E-03	6.65E-03	1.09E-03	1.47E-04	0.00E+00	4.20E-06	1.30E-07	7.14E-08
	7	4.78	0.84	0.0051	26.65	31.23	535.0	0.371	198.6	8.41E-02	-8.7E-02	-5.0E-01	-4.1E+01	-7.2E-03	-6.7E-03	1.13E-03	1.48E-04	0.00E+00	4.24E-06	1.31E-07	7.21E-08
	8	4.78	0.84	0.0051	26.65	31.23	537.0	0.371	199.0	8.38E-02	-5.2E-02	-3.0E-01	-2.5E+01	-4.3E-03	-4.0E-03	1.12E-03	5.30E-05	0.00E+00	1.52E-06	4.69E-08	2.58E-08
	9	4.78	0.84	0.0051	26.65	31.23	539.0	0.370	199.4	8.35E-02	-1.7E-02	-9.8E-02	-8.1E+00	-1.4E-03	-1.3E-03	1.12E-03	5.78E-06	0.00E+00	1.66E-07	5.11E-09	2.82E-09
	10	4.78	0.84	0.0051	26.85	31.23	541.0	0.369	199.7	8.32E-02	1.76E-02	1.00E-01	8.30E+00	1.46E-03	1.35E-03	1.11E-03	6.02E-06	0.00E+00	1.72E-07	5.32E-09	2.93E-09
	11	4.78	0.84	0.0051	26.85	31.23	543.0	0.369	200.1	8.29E-02	5.23E-02	2.98E-01	2.47E+01	4.34E-03	4.01E-03	1.10E-03	5.32E-05	0.00E+00	1.52E-06	4.70E-08	2.50E-08
	12	4.78	0.84	0.0051	26.85	31.23	545.0	0.368	200.5	8.26E-02	8.69E-02	4.95E-01	4.10E+01	7.20E-03	6.65E-03	1.09E-03	1.47E-04	0.00E+00	4.20E-06	1.30E-07	7.14E-06
								SUM1	8UM2							T	A	Ср	DP	M	P•
								4.434	2394.6					Contribution	one	1.33E-02	8.26E-04	0.00E+00	2.36E-05	7.30E-07	4.02E-07
(1) Al*CPI(D)Pi*Mi*Pal/Ti) *	0.5																Total Sig	ma^2	0.01	
(2) AI°CPI(D	Pi-Mi-ba-ti)	^ 0. 5																Tavg Sig	ma	0.12	deg F

⁽²⁾ AI*CPI(DPI*MI*PaI*TI) * 0.5

Table A-8

Random Error Calculation — Primary Air Outlet

Milliken Heat Pipe Air Preheater

	Average Value	Sigma Absolute	Sigma Relative																	
Duct Size																				
Dia. It	4	0.042	1.04%																	
Length, ft																				
ø of Points	20																			
Dia. #1	10																			
Dia. #2	10																			
A, Sector Area ft ^ 2	, 0.63	0.013	2.08%																	
T, deg F	644	3.220	0.50%																	
T, deg R	1104	3.220	0.29%																	
Temp Bias, deg F	100			deg F/Leng	th increment	Special Bla	•													
DP, in WC	0.2171	0.0043	2.00%																	
M, lb/mol	26.85	0.025	0.09%																	
Amb Pres, in. Hg	29.50																			
Duct Pres, in. WC	44.50																			
Ps, in. Hg Absolute	31.11	0.040	0.13%																	
CP, Pliot Fact	0.84	0.0000	0.00%				~~~													
Nominal Vel, tps	37.11	ACFM=	27982	SCFM=	13/02	lb/hr= 6	2200													
		Input [Dela								Derivatives,	dTa/dX					(dTa/dX°S			
Point	Ai	CPI	DPI	Mi	Pal	Ti	(1)	(2)	dTa/dTl	dTa/dAl	dTa/dCPI	dTa/dDPI	dTa/dMi	dTa/dPel	d/dTI*STI	d/dAl*SAl	d/dCPI*SCPI		_,	d/dPsi*SPsi
1	0.63	0.84	0.2171	26.85	31.11	1054.0	0.227	239.2	5.24E-02	-4.03E+00	-3.02E+00	-5.84E+00	-4.39E-02	-4.07E-02	2.84E-02	2.79E-03	0.00E+00	6.42E-04	1.21E-06	2.68E-06
2	0.63	0.84	0.2171	28.85	31.11	1065.1	0.226	240.4	5.18E-02	-3.11E+00	-2.33E+00	-4.50E+00	-3.39E-02	-3.14E-02	2.78E-02	1.66E-03	0.00E+00	3.82E-04	7.18E-07	1.59E-06
3	0.63	0 84	0.2171	26.85	31.11	1076.2	0.225	241.7	5.13E-02	-2.20E+00	-1.65E+00	-3.18E+00	-2.40E-02	-2.22E-02	2.73E-02	8.30E-04	0.00E+00	1.91E-04	3.50E-07	7.97E-07
4	0.63	0.84	0.2171	28.85	31.11	1087.3	0.223	242.9	5.07E-02	-1.30E+00	-9.72E-01	-1.88E+00	-1.41E-02	-1.31E-02	2.87E-02	2.89E-04	0.00E+00	6.66E-05	1.25E-07	2.78E-07
5	0 63	0.84	0.2171	26.85	31.11	1098.4	0.222	244.2	5.02E-02	-4.06E-01	-3.04E-01	-5.88E-01	-4.42E-03	-4.10E-03	2.62E-02	2.83E-05	0.00E+00	6.52E-06	1.22E-08	2.72E-08
	0.63	0.84	0.2171	28.85	31.11	1109.6	0.221	245.4	4.97E-02	4.77E-01	3.57E-01	8.91E-01	5.20E-03	4.82E-03	2.56E-02	3.91E-05	0.00E+00	9.00E-06	1.69E-08	3.75E-08
7	0.63	0.84	0.2171	26.85	31.11	1120.7	0.220	246.6	4.92E-02	1.35E+00	1.01E+00		1.47E-02	1.37E-02	2.51E-02	3.13E-04	0.00E+00	7.22E-05	1.36E-07	3.01E-07
8	0.63	0.84	0.2171	28.85	31.11	1131.8	0.219	247.8	4.88E-02	2.22E+00	1.66E+00		2.42E-02	2.24E-02	2.46E-02	8.44E-04	0.00E+00	1.94E-04	3.65E-07	8.10E-07
9	0.63	0.84	0.2171	28.85	31.11	1142.9	0.218	249.1	4.83E-02	3.08E+00	2.30E+00		3.35E-02	3.11E-02	2.42E-02	1.62E-03	0.00E+00	3.74E-04	7.02E-07	1.56E-06
10	0.63	0.84	0.2171	28.85	31.11	1154.0	0.217	250.3	4.78E-02	3.93E+00	2.94E+00		4.28E-02	3.97E-02	2.37E-02	2.64E-03	0.00E+00	6.09E-04	1.14E-06	2.54E-06
11	0.63	0.84	0.2171	28.85	31.11	1054.0	0.227	239.2	5.24E-02				-4.39E-02	-4.07E-02	2.84E-02	2.79E-03	0.00E+00	6.42E-04	1.21E-06	2.88E-06 1.59E-06
12	0.63	0.84	0.2171	26.85	31.11	1065.1	0.226	240.4	5.18E-02				-3.39E-02	-3.14E-02	2.78E-02	1.66E-03	0.00E+00	3.82E-04	7.18E-07 3.5 0 E-07	7.97E-07
13	0.63	0.84	0.2171	26.85	31.11	1076.2	0.225	241.7	5.13E-02		-1.65E+00		-2.40E-02		2.73E-02	8.30E-04	0.00E+00	1.91E-04 6.66E-05	3.30E-07 1.25E-07	2.78E-07
14	0.63	0.84	0.2171	26.85	31.11	1087.3	0.223	242.9	5.07E-02	-1.30E+00	-9.72E-01	-1.88E+00	-1.41E-02	-1.31E-02	2.67E-02	2.89E-04	0.00E+00			2.72E-08
15	0.63	0.84	0.2171	28.85	31.11	1098.4	0.222	244.2			-3.04E-01	-5.88E-01	-4.42E-03	-4.10E-03	2.62E-02	2.83E-05	0.00E+00	6.52E-06 9.00E-06	1.22E-08 1.89E-08	3.75E-08
16	0.63	0.84	0.2171	28.85	31.11	1109.6	0.221	245.4			3.57E-01	6.91E-01	5.20E-03	4.82E-03	2.56E-02	3.91E-05	0.00E+00			
17	0.63	0.84	0.2171	28.85	31.11	1120.7	0.220	246.6	4.92E-02		1.01E+00		1.47E-02	1.37E-02	2.51E-02	3.13E-04	0.00E+00	7.22E-05	1.36E-07	3.01E-07 8.10E-07
16	0.63	0.84	0.2171	28.85	31.11	1131.8	0.219	247.8	4.88E-02		1.66E+00		2.42E-02	2.24E-02	2.46E-02	8.44E-04	0.00€+00	1.94E-04	3.65E-07	
19	0.63	0.84	0.2171	28.85	31.11	1142.9	0.218	249.1	4.83E-02		2.30E+00		3.35E-02	3.11E-02	2.42E-02	1.62E-03	0.00E+00	3.74E-04	7.02E-07	1.56E-06
20	0.63	0.84	0.2171	26.85	31.11	1154.0	0.217	250.3	4.78E-02	3.93E+00	2.94E+00	5.68E+00	4.26E-02	3.97E-02	2.37E-02	2.64E-03	0.00E+00	6.09E-04	1.14E-06	2.54E-06
		Temperatu	ure Simple	Average		1104.0	Sum 1	Sum2							T	A	CP	DP * coc co	M 0.505.00	Pa nuccos
		Temperati	ure Weight	ed Average	ı	1103.5	4.436	4895.0						Contributions (3)	5.19E-01	2.21E-02	0.00E+00	5.09E-03	9.56E-06	2.12E-05
(1) Ai°CPI(DPI°MI°Pa	i/TI) ^ 0.5	•															Total Sig		0.55	d E
(2) Al*CPI(DPI*MI*P																	Tavg Sig	ma.	0.74	deg r

⁽²⁾ Ai°CPi(DPi°Mi°Pai°Ti) ^ 0.5

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⁽³⁾ Contributions Include Cross Product Terms

Table A-9
Random Error Calculation -- Secondary Air Inlet
Milliken Heat Pipe Air Preheater

# of Points	4		
T, deg F	80	0.400	0.50%
T, deg R	540	0.400	0.07%

	Input Dat	a	Derivatives	(ď	Ta/dX*Sigma) ^ 2	(1)
-	Point	TI	dTa/DTI		dTa/dTl	
	1	80.0	0.25		1.00E-02	
	2	80.0	0.25		1.00E-02	
	3	80.0	0.25		1.00E-02	
	4	80.0	0.25		1.00E-02	
				Totals	4.00E-02	

	τ	
Contributions (2)	4.00E-02	
Total Sigma ^ 2	0.04	
Tavg Sigma	0.20	deg F

⁽¹⁾ Ta = (T1 + T2 + T3 + T4)/4

⁽²⁾ Temperature Is Only Term Contributing -- Simple Average.

Table A-10 Random Error Calculation -- Secondary Air Outlet Milliken Heat Pipe Air Preheater

			•																	
	Value	Absolute	Relative																	
ict Size																				
	•	0.042	0.46%																	
Main, R		0.042	0.00%																	
.angth, ft	-	0.042	0.00.0																	
r of Points	24																			
Multiwise	6																			
.engthwise	4																			
jector Width, ft	1.50	0.042	2.78%																	
	1.50	0.042	2.78%																	
iector Length, ft		0.068	3.83%																	
I, Sector Area ft^2	2.25																			
deg F	616	3.060	0.50%																	
deg R	1076	3.080	0.29%																	
king Bias, deg F	100		33.33	deg F/Lengt	th increment i	Special Blee														
P, in WC	0.972035	0.00005	0.01%																	
	28.85	0.060	0.17%																	
, lb/mol		0.000	•																	
mb Pres, In. Hg	29.50																			
uct Pres, in. WC	5.60																			
s, in. Hg Absolute	29.70	0.040	0.14%																	
P. Pliot Fact	0.84	0.0000	0.00%																	
•	79.34	ACFM=	257051	SCFM=	123321	lb/hr=	582500													
ominal Vel, fps																	(dTa/dX+8i			
											Derivatives	, dTa/dX							4444465441	d/dPai*SPai
		Input				ŢI	(1)	(2)	dTa/dTI	dTa/dAl	dTa/dCPI	dTa/dDPI	dTa/dMi	dTa/dPal	d/dTI*STI	d/dAI*SAI	d/dCPI*SCPI	d/dDPI*SDPI		
Point	Al	CPI	DPI	Mi	Pal			1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1 00E+00	-3.65E-02	-3.54E-02	1.81E-02	0.84E-03	0.00E+00	2.93E-09	3.33E-06	2 03E -06
1	2.25	0.64	0.9720	26.65	29.70	1026.0	1.703					-3.46E-01	-1.17E-02	-1.13E-02	1.70E-02	8.98E-04	0.00E+00	2.99E-10	3.40E-07	2.07E-07
2	2.25	0.84	0.9720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02					1.20E-02	1.59E-02	7.90E-04	0.00E+00	3.39E-10	3.84E-07	2.34E-07
3		0.84		28.85	29.70	1092.7	1.650	1803.1	4.10E-02	3.18E-01		3.68E-01	1.24E-02			6.56E-03	0.00E+00	2.81E-09	3.19E-06	1.94E-08
3		0.84		26.85	29.70	1126.0	1.626	1830.4	3.98E-02	9.18E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	1.50E-02				3.33E-06	2.03E-06
•	2.25				29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	1.81E-02	6.84E-03	0.00E+00	2.93E-09		
5	2.25	0.84		28.85			1.076	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	1.70E-02	6.98E-04	0.00E+00	2.99E-10	3.40E-07	2.07E-07
•	2.25	0.84	0.9720	26.65	29.70	1059.3			4.10E-02			3.68E-01	1.24E-02	1.20E-02	1.59E-02	7.90E-04	0.00E+00	3.39E-10	3.84E-07	2.34E-07
7	2.25	0.84	0.9720	26.85	29.70	1092.7	1.650	1803.1					3.57E-02	3.47E-02	1.50E-02	6.56E-03	0.00E+00	2.81E-09	3.19E-06	1.94E-06
	2.25	0.84	0.9720	26.85	29.70	1126.0	1.626	1830.4			2.45E+00				1.81E-02	6.84E-03	0.00E+00	2.93E-09	3.33E-06	2.03E-06
9				28.85	29.70	1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00					6.98E-04	0.00E+00	2.99E-10	3.40E-07	2.07E-07
-				26.85	29.70	1059.3	1.676	1/75.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02		1.70E-02		0.00E+00	3.39E-10	3.84E-07	2.34E-07
10				28.85		1092.7	1.650	1803.1	4.10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	1.50E-02	7.90E-04				1.94E-06
11						1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02	3.47E-02	1.50E-02	6.56E-03	0.00€+00	2.81E-09	3.19E-06	
12	2 2.25	0.84	0.9720	26.85	29.70				4.37E-02		-2.51E+00		-3.65E-02	-3.54E-02	1.81E-02	6.84E-03	0.00E+00	2.93E-09	3.33E-06	2.03E-06
13	3 2.25	0.84	0.9720	28.85	29.70	1026.0	1.703	1747.2						-1,13E-02	1.70E-02	6.98E-04	0.00E+00	2.99E-10	3.40E-07	2.07E-07
14		0.84	0.9720	26.85	29.70	1059.3	1.676	1775.4	4.23E-02						1.59E-02	7.90E-04	0.00E+00	3.39E-10	3.84E-07	2.34E-07
				28.85	29.70	1092.7	1.650	1803.1	4.10E-02		8.52E-01	3.68E-01					0.00E+00	2.81E-09	3.19E-06	1.94E-06
1:				26.85		1126.0	1.626	1830.4	3.98E-02	9.16E-01	2.45E+00	1.06E+00	3.57E-02		1.50E-02	6.56E-03			3.33E-06	2.03E-06
10			-			1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00	-1.08E+00	-3.65E-02	-3.54E-02	1.81E-02	6.84E-03	0.00E+00	2.93E-09		
17	7 2.25			28.85				1775.4	4.23E-02					-1.13E-02	1.70E-02	6.98E-04	0.00E+00	2.99E-10	3.40E-07	2.07E-07
10	8 2.25	0.84	0.9720	28.85		1059.3	1.676			•		3.68E-01	1.24E-02	1.20E-02	1.59E-02	7.90E-04	0.00E+00	3.39E-10	3.84E-07	2.34E-07
11	9 2.25	0.6	4 0.9720	28.85	29.70	1092.7	1.650	1803.1	4.10E-02						1.50E-02	8.56E-03	0.00E+00	2.81E-09	3.19E-06	1.94E-08
2			4 0.9720	28.85	29.70	1126.0	1.626	1830.4	3.98E-02		2.45E+00					8.84E-03	0.00E+00	2.93E-09	3.33E-06	2.03E-06
						1026.0	1.703	1747.2	4.37E-02	-9.36E-01	-2.51E+00				1.81E-02			2.99E-10	3.40E-07	2.07E-07
2						1059.3	1.676	1775.4	4.23E-02	-2.99E-01	-8.01E-01	-3.46E-01	-1.17E-02	-1.13E-02	1.70E-02	6.98E-04	0.00E+00	-		
2	2 2.25						1.650	1803.1	4 10E-02	3.18E-01	8.52E-01	3.68E-01	1.24E-02	1.20E-02	1.50E-02	7.90E-04	0.00E+00	3.39E-10	3.84E-07	2.34E-07
2	3 2.25	5 0.8	4 0.9720	26.65	29.70	1092.7	1.030	1003.1	7,702.02	0.105.01	0.455+00			3.47E-02	1.50E-02	6.56E-03	0.00E+00	2.81E-09	3.19E-06	1.94E-06

1830.4 3.98E-02 9.18E-01 2.45E+00 1.08E+00 3.57E-02 3.47E-02

Contributions

1126.0

29.70

1.626

SUM1

30.927

SUM2

42936.0

2.65E-05

6.56E-03

A

8.93E-02

1.50E-02

T

3.96E-01

СР

0.00E+00

Total Sigme ^ 2

Tavg Sigma

3.83E-08

4.35E-05

0.49

0.70 deg F

⁽¹⁾ AI*CPI(DPI*MI*Pai/TI) * 0.5

⁽²⁾ AI*CPI(DPI*MI*PaI*TI) ~ 0.5

Table A-11
Random Error Calculation -- Flue Gas Inlet
Milliken Heat Pipe Air Preheater

	Average	Sigme	Bigma																	
. 61:	Value	Absolute	Relative																	
ict Size	5.5	0.042	0.70%																	
vidih, R		0.042	0.29%																	
angth, ft	14.5	0.046	U.22 ~																	
r of Points	20																			
Vidthwise	4																			
ang thwise	5																			
iector Width, R	1.36	0.042																		
iector Length, R	2.90	0.042																		
i, Sector Area R^2	3.99	0.134	3.35%																	
deg F	660	3.400	0.50%							•										
deg R	1140	3.400	0.30%		_															
mp Bias, deg F	100			deg F/Leng	th Increment 8	ipacial Blas														
, in WC	0.82631	0.00005	0.01%																	
, lb/mol	29.71	0.070	0.24%																	
nb Pres, In. Hg	29.50																			
act Pres, In. WC	-7.50																			
i, in. Hg Absolute	29.23	0.040	0.14%																	
P. Pinot Fact	0.84	0.0000	0.00%																	
aminal Vel, tos	74.88	ACFM=	358315	SCFM=	150660	lb/hr=	750001													
																	(dTa/dX°SI	amel ^ 2		
		Input	Deta					•			Derivatives		dTa/dMi	dTa/dPal	d/dTI*STI	d/dAl*SAl		d/dDPI*SDPI	d/dMI*SMI	d/dPsi*SPsi
Point	Al	CPI	DPI	MI	Pel	Ti	(1)	(2)	dTa/dTi	dTa/dAl	dTa/dCPI		-4.25E-02	-4.32E-02	3.18E-02	7.19E-03	0.00E+00	5.82E-09	8.87E-06	3.02E-06
1	3 90	0.84	0.8263	29.71	29.23	1090	2.721	2966	5.23E-02	-6.34E-01		-1.53E+00	-2.08E-02	-2.11E-02	3.02E-02	1.72E-03	0.00€+00	1.30E-00	2.12E-06	7.21E-07
. 2	3 99	0.84	0.8283	29.71	29.23	1115	2.690	3000	5.11E-02	-3.10E-01	-1.47E+00				2.89E-02	8.48E-07	0.00E+00	6.85E-13	1.04E-09	3.55E-10
3	3 00	0 84	0.8283	29.71	29.23	1140	2.661	3033	5.00E-02	6.88E-03	3.26E-02		4.61E-04	4.60E-04		1.79E-03	0.00E+00	1.45E-09	2.21E-06	7.53E-07
4	3 90	0.84	0.8283	29.71	29.23	1165	2.632	3066	4.89E-02	3.17E-01			2.13E-02	2.18E-02	2.76E-02			5.57E-09	8.49E-06	2.89E-06
5	3.99	0.84	0.8263	29.71	29.23	1190	2.604	3099	4.79E-02		2.94E+00		4.16E-02	4.23E-02	2.65E-02	8.88E-03	0.00E+00 0.00E+00	5.82E-09	8.87E-08	3.02E-06
6	3.99	0.84	0.8263	29.71	29.23	1090	2.721	2966	5.23E-02		-3.01E+00				3.16E-02	7.19E-03		1.39E-09	2.12E-08	7.21E-07
7	3 90	0.84	0.8263	29.71	29.23	1115	2.600	3000	5.11E-02	-3.10E-01	-1.47E+00		-2.08E-02		3.02E-02	1.72E-03	0.00E+00			3.55E-10
	3.90	0.84	0.8263	29.71	29.23	1140	2.061	3033	5.00E-02	6.88E-03				4.60E-04	2.80E-02	8.46E-07	0.00E+00	6.85E-13	1.04E-09	7.53E-07
•		0.84	0.8263	29.71	29.23	1165	2.632	3066	4.89E-02	3.17E-01		7.63E-01	2.13E-02	2.16E-02	2.76E-02	1.79E-03	0.00E+00	1.45E-09	2.21E-06	
10		0.84		29.71	29.23	1190	2.604	3099	4.79E-02	6.20E-01		1.49E+00	4.16E-02	4.23E-02	2.65E-02	6.88E-03	0.00E+00	5.57E-09	8.49E-06	2.89E-06
11		0.84		29.71	29.23	1090	2.721	2966	5.23E-02		-3.01E+00			-4.32E-02	3.16E-02	7.19E-03	0.00E+00	5.82E-09	8.87E-06	3.02E-06
12		0.84		29.71	29.23	1115	2.890	3000	5.11E-02	-3.10E-01	-1.47E+00	-7.46E-01	-2.08E-02		3.02E-02	1.72E-03	0.00E+00	1.39E-09	2.12E-06	7.21E-07
13		0.84		29.71	29.23	1140	2.661	3033	5.00E-02	8.88E-03	3.26E-02	1.66E-02		4.69E-04	2.89E-02	8.46E-07	0.00E+00	0.85E-13	1.04E-09	3.55E-10
14		0.84		29.71	29.23	1165	2.632	3066	4.89E-02	3.17E-01	1.50E+00	7.63E-01	2.13E-02	2.16E-02	2.76E-02	1.79E-03	0.00E+00	1.45E-09	2.21E-06	7.53E-07
15		0.84		29.71	29.23	1190	2.804	3099	4.79E-02	6.20E-01	2.94E+00	1.49E+00	4.16E-02	4.23E-02	2.65E-02	6.88E-03	0.00E+00	5.57E-09	8.49E-06	2.89E-06
10				29.71	29.23	1090	2.721	2966	5.23E-02	-6.34E-01	-3.01E+00	-1.53E+00	-4.25E-02	-4.32E-02	3.16E-02	7.19E-03	0.00E+00	5.82E-09	8.87E-06	3.02E-08
10				29.71	29.23	1115	2.690	3000	5.11E-02	-3.10E-01	-1.47E+00	-7.46E-01	-2.08E-02	-2.11E-02	3.02E-02	1.72E-03	0.00E+00	1.39E-09	2.12E-06	7.21E-07
				29.71	29.23	1140	2.661	3033	5.00E-02	6.88E-03	3.26E-02	1.66E-02	4.61E-04	4.69E-04	2.89E-02	8.48E-07	0.00E+00	6.85E-13	1.04E-08	3.55E-10
16				29.71	29.23	1165	2.632	3066	4.89E-02	3.17E-01	1.50E+00	7.63E-01	2.13E-02	2.16E-02	2.76E-02	1.79E-03	0.00E+00	1.45E-09	2.21E-06	7.53E-07
19				29.71	29.23	1190	2.604	3000	4.79E-02		2.94E+00	1.49E+00	4.16E-02	4.23E-02	2.65E-02	8.68E-03	0.00E+00	5.57E-09	8.49E-06	2.89E-06
20	3.90	0.84	0.8283	<i>a</i> ./1	دن . جع		8UM1	SUM2							т	A	CP	DP	M	Pe
							53.232	60655					Contributio	ene	5.79E-01	7.03E-02	0.00E+00	5.69E-08	8.68E-05	2.95E-05
																	Total Sign	ma^2	0.65	
I) AI*CPI(DPI*MI*Pa	(i i) ~ U.5																Tavg Sign	me	0.81	deg F

²⁾ AI-CPI(DPI-MI-Pal-TI) -0.5

Table A-12 Random Error Calculation -- Flue Gas Outlet Milliken Heat Pipe Air Preheater

	Average Value	Sigma Absolute	Sigme Ficialiyo				
Duct Size							
Width, R	2.5	0.042	1.67%				
Length, R	34	0.042	0.12%				
ø of Points	24						
Widthwise	2						
Langthwise	12						
Sector Width, R	1.25	0.042	3.33%				
Sector Length, ft	2.63	0.042	1.47%				
A, Sector Area R^2	3.54	0.129	3.64%				
T, deg F	253	1.265	0.50%				
T, deg R	713	1.265	0.18%				
Temp Bias, deg F	100		9.09	leg F/Leng	th Incremer	nt Special Bis	18
DP, in WC	0.45802	0.00005	0.01%				
M, lb/mol	29.71	0.070	0.24%				
Amb Pres, In. Hg	29.50						
Duct Pres, in. WC	-11.00						
Ps, In. Hg Absolute	29.10	0.040	0.14%				
	0.84	0.0000	0.00%				
CP, Pitot Fact Nominal Vel, Ips	44.13	ACFM=	225078	SCFM=	150000	ib/w=	750003

Nominal Vel, I	P 8	44.13	ACFM=	22016	SCFM=	3000		••													
•												Derivative	s, dTs/dX					(dTa/dX°8)			1110 100
			Input D					443	(2)	dTa/dTi	dTa/dAl	dTa/dCPI	dTa/dDPI	dTa/dMi	dTa/dPal	d/dTI*STI	d/dAI*SAI	d/dCPI*SCPI			d/dPai*SPai
	Point	Ai	CPI	DPI	MI	Pal	TI	(1)	1524	4.48E-02		-2.53E+00		-3.58E-02	-3.66E-02	3.21E-03	6.02E-03	0.00E+00	1.35E-08	6.29E-06	2.16E-06
	1	3 54	0.64	0.4580	29.71	29.10	663.0	2.299	1535		-	-2.05E+00			-2.96E-02	3.12E-03	3.95E-03	0.00E+00	8.86E-09	4.13E-06	1.42E-08
	2	3.54	0.84	0.4580	29.71	29.10	672.1	2.264	1545			-1.58E+00			-2.26E-02	3.04E-03	2.33E-03	0.00E+00	5.24E-09	2.44E-06	8.37E-07
	3	3.54	0.64	0.4580	29.71	29.10	681.2	2.268	1555	4.30E-02		-1.11E+00				2.96E-03	1.15E-03	0.00E+00	2.59E-09	1.21E-06	4.14E-07
	4	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1566	4.24E-02		-8.48E-01			-9.35E-03	2.88E-03	3.93E-04	0.00E+00	8.82E-10	4.11E-07	1.41E-07
	5	3.54	0.84	0.4580	29.71	29.10	600.4	2.230		4.19E-02		1.92E-01			-2.77E-03	2.81E-03	3.44E-05	0.00E+00	7.72E-11	3.60E-08	1.23E-08
	6	3.54	0.84	0.4580	29.71	29.10	708.5	2.224	1576	4.14E-02			• • • • • • • • • • • • • • • • • • • •		3.73E-03	2.74E-03	6.27E-05	0.00E+00	1.41E-10	6.56E-08	2.25E-08
	7	3.54	0.64	0.4580	29.71	29.10	717.5	2.210	1586	4.08E-02	1.87E-01			9.95E-03	1.02E-02	2.87E-03	4.64E-04	0.00E+00	1.04E-09	4.85E-07	1.66E-07
	۵	3.54	0.84	0.4580	29.71	29.10	726.6	2.196	1596	4.03E-02			1.05E+00	1.62E-02	1.65E-02	2.60E-03	1.22E-03	0.00E+00	2.75E-09	1.26E-06	4.30E-07
		3 54	0.84	0.4580	29.71	29.10	735.7	2.183	1606	3.98E-02		1.58E+00		2.23E-02	2.26E-02	2.54E-03	2.33E-03	0.00E+00	5.23E-09	2.43E-06	8.35E-07
	10	3.54	0.84	0.4580	29.71	29.10	744.8	2.169	1616 1625	3.94E-02			1.84E+00	2.83E-02	2.89E-02	2.48E-03	3.77E-03	0.00E+00	8.45E-09	3.94E-06	1.35E-06
	11	3.54	0.84	0.4580	29.71	29.10	753.9	2.156	1635	3.69E-02		2.43E+00			3.51E-02	2.42E-03	5.53E-03	0.00E+00	1.24E-08	5.78E-06	1.98E-08
	12	3.54	0.84	0.4580	29.71	29.10	763.0	2.143		4.48E-02		-2.53E+00			-3.66E-02	3.21E-03	6.02E-03	0.00E+00	1.35E-08	8.29E-06	2.16E-06
	13	3.54	0.84	0.4580	29.71	29.10	663.0	2.299	1524 1535	4.42E-02		-2.05E+00				3.12E-03	3.95E-03	0.00E+00	8.86E-09	4.13E-06	1.42E-06
	14	3.54	0.84	0.4580	29.71	29.10	672.1	2.264		4.38E-02		1 -1.58E+00				3.04E-03	2.33E-03	0.00E+00	5.24E-09	2.44E-06	8.37E-07
	15	3.54	0.84	0.4580	29.71	29.10	681.2	2.268	1545	4.30E-02		1 -1.11E+00				2.96E-03	1.15E-03	0.00E+00	2.50E-09	1.21E-06	4.14E-07
	16	3.54	0.84	0.4580	29.71	29.10	690.3	2.253	1555	4.30E-02 4.24E-02		1 -6.48E-01				2.88E-03	3.93E-04	0.00E+00	8.82E-10	4.11E-07	1.41E-07
	17	3.54	0.84	0.4580	29.71	29.10	609.4	2.239	1500	4.19E-02		2 -1.92E-01			-2.77E-03	2.81E-03	3.44E-05	0.00E+00	7.72E-11	3.60E-08	1.23E-08
	18	3.54	0.84	0.4580	29.71	29.10	708.5	2.224	1576	4.14E-02	-					2.74E-03	6.27E-05	0.00E+00	1.41E-10	8.56E-08	2.25E-08
	19	3.54	0.84	0.4580	29.71	29.10	717.5	2.210	1586	4.14E-02 4.08E-02					1.02E-02	2.67E-03	4.64E-04	0.00E+00	1.04E-09	4.85E-07	1.66E-07
	20	3.54	0.84	0.4560	29.71	29.10	726.6	2.196	1596	4.03E-02		1 1.14E+00			1.65E-02	2.60E-03	1.22E-03	0.00E+00	2.75E-09	1.26E-06	4.30E-07
	21	3.54	0.84	0.4580	29.71	29.10	735.7	2.183	1606	3.98E-02		1 1.58E+00				2.54E-03	2.33E-03	0.00E+00	5.23E-09	2.43E-06	8.35E-07
	22	3.54	0.84	0.4580	29.71	29.10	744.8	2.109	1616	3.96E-02		1 2.01E+00				2.48E-03	3.77E-03	0.00E+00	8.45E-09	3.94E-06	1.35E-06
	23	3.54	0.84	0.4580	29.71	29.10	753.9	2.156	1626				2.23E+00			2.42E-03	5.53E-03	0.00E+00	1.24E-08	5.78E-06	1.98E-06
	24	3.54	0.84	0.4580	29.71	29.10	763.0	2.143	1635	3.69E-02	5.76E-0	2.432.700	2.202.100			T	A	CP	ĐP	M	P•
								SUM1	SUM2					Contributi	one	6.694E-02	5.450E-02	0.000E+00	1.223E-07	5.698E-05	1.955E-05
								53.251	37931									Total Sign	ma^2	0.12	
																		Tava Slo	ma.	0.35	dea F

⁽¹⁾ Al*CPI(DPV*MI*Pal/TI) ~ 0.5

⁽²⁾ Al-CPI(DPI-MI-Pal-TI) ~ 0.5

Table A-13 Bias Error Calculation -- Primary Air Inlet (Randomized Input Data Assumed) Milliken Heat Pipe Air Preheater

	VAC A																			
	Value	Absolute	Relative																	
uct Size																				
Width, ft	3.26	0.042																		
Longth, R	17.5	0.042	0.24%																	
ø of Points	12																			
Widthwise	2																			
Longthwise	•																			
Sector Width, ft	1.64	0.042																		
Sector Length, R	2.92	0.042	1.43%																	
A, Sector Area ft^2	4.78	0.138	2.91%																	
, deg F	80	0.800	1.00%																	
, deg R	540	0.800																		
ipacial Blas, deg F	10			deg F/Leng	th increment	Special Bia	•													
IP, In WC	0.005069	0.0001																		
i, lb/mol	26.85	0.025	0.00%																	
umb Pres, In. Hg	29.50																			
Juct Pres, In. WC	48.00																			
le, in. Hg Absolute	31.23	0.040						•												
CP, Pilot Fact	0.84	0.0100																		
tominal Vel, tps	3.96	ACFM=	13631	SCFM=	13702	lb/hr=	1200													
											Derivative	a. dTa/dX					(dTa/dX*8)	gme) ^ 2		
		Inpu	l Dela (1)					(4)	dTa/dTl	dTe/Al	dTa/CPI	dTa/dDPI	dTa/dMI	dTa/dPal	d/dYI*STI	d/dAI*SAI	d/dCPI*SCPI	d/dDPI*SDPI	d/dMi*SMi	d/dPm*SPs
Point	ı Al	CPI (2)	DPI	MI	Pal	TI	(3)	59.4	3.06E-02			-1.66E+02		-2.81E-03	5.98E-04	2.51E-05	4.03E-06	2.84E-04	5.66E-09	1.27E-08
1	4.69	0.84		26	30.00	535.0	0.111	92.4	4.73E-02		-	-8.23E+01		-2.69E-03	1.43E-03	2.19E-05	3.95E-06	6.96E-05	5.17E-09	1.17E-08
2	4.97	0.84		29	31.00	537.0	0.172	99.7	5.07E-02			-2.56E+01		-1.22E-03	1.65E-03	5.73E-06	8.82E-07	6.76E-06	1.41E-09	2.40E-09
3	4.54	0.64		26	32.00	539.0	0.185 0.188	101.6	5.14E-02			5.83E+00		3.94E-04	1.89E-03	5.86E-07	7.92E-08	3.49E-07	1.52E-10	2.51E-10
•	4.31	0.84		24	30.00	541.0	0.188	145.2	7.30E-02			3.55E+01		3.22E-03	3.41E-03	2.26E-05	4.60E-06	1.30E-05	6.46E-09	1.67E-08
:	5.26	0.84		26	28.00	543.0	0.289	157.8	7.89E-02		4.21E-01		5.89E-03	5.70E-03	3.99E-03	1.06E-04	1.77E-05	3.47E-05	2.17E-08	5.24E-08
	4.78	0.64		30		545.0	0.230	123.0	6.33E-02			-3.44E+01	-5.45E-03	-5.81E-03	2.56E-03	2.87E-04	1.72E-05	1.22E-05	1.86E-08	5.45E-08
1	7 2.67	0.84		32		535.0	0.320	171.9	8.80E-02				-5.35E-03	-5.35E-03	4.95E-03	1.28E-04	1.37E-05	6.17E-06	1.79E-08	4.62E-06
(3 83	0.84		29	29.00	537.0	0.507	273.3	1.39E-01			-1.41E+01		-3.82E-03	1.24E-02	2.70E-05	6.48E-06	2.03E-06	9.12E-09	2.35E-08
•	5.74	0.84		26		539.0	0.652	352.7	1.78E-01	1.37E-02		4.05E+00		1.32E-03	2.04E-02	3.50E-06	9.54E-07	1.68E-07	1.25E-09	2.83E-09
10		0.64		29		541.0	0.652	242.1	1.22E-01	6.26E-02		1.69E+01		5.18E-03	9.50E-03	7.66E-05	1.26E-05	2.95E-06	2.09E-08	4.33E-06
1	1 4.78	0.84		26		543.0		154.8	7.75E-02			4.26E+01		5.78E-03	3.84E-03	1.42E-04	1.71E-05	1.88E-05	1.98E-08	5.39E-08
1:	2 4.07	0.84	4 0.0041	31	30.00	545.0	0.264		7.73E-02	U.WE-V2	7.136-01	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	2.272 00		T	A	CP	DP	M	Ps
							Sum1	Sum2							# 40E 04	5 08E 05	-1.05E-20	3 48F-04	8 90E-11	1.92E-11

3.652

1974.0

-1.05E-20

Total Sigma ^ 2

Tavg Sigma

5.08E-05

6.40E-01

Contributions (5)

3.48E-04

8.90E-11

0.64

0.80 deg F

1.92E-11

⁽¹⁾ No Attempt Made to Make Average of Randomized Individual Terms Equal to Input Average Values.

⁽²⁾ Not Varied Since Same Pitot Tube Used For All Measurements.

⁽³⁾ AI*CPI(DPI*MI*Pai/TI) ^ 0.5

⁽⁴⁾ AI*CPI(DPI*MI*PaI*TI) *0.5

⁽⁵⁾ Contributions include Cross Product Terms

Table A-13 (Continued) Cross Product Terms

```
d/dTi*d/dTj*STi*STj
                9.25E-04 9.92E-04 1.01E-03 1.43E-03 1.54E-03 1.24E-03 1.72E-03 2.72E-03 3.49E-03 2.38E-03 1.52E-03
                         1.53E-03 1.56E-03 2.21E-03 2.39E-03 1.92E-03 2.66E-03 4.21E-03 5.40E-03 3.69E-03 2.35E-03
       9.25E-04
                                   1.67E-03 2.37E-03 2.56E-03 2.05E-03 2.86E-03 4.51E-03 5.79E-03 3.95E-03 2.51E-03
       9.92E-04 1.53E-03
                                            2.40E-03 2.60E-03 2.08E-03 2.89E-03 4.58E-03 5.87E-03 4.01E-03 2.55E-03
       1.01E-03 1.56E-03 1.67E-03
                                                  3.69E-03 2.96E-03 4.11E-03 6.50E-03 8.34E-03 5.70E-03 3.62E-03
       1.43E-03 2.21E-03 2.37E-03 2.40E-03
                                                              3.20E-03 4.44E-03 7.02E-03 9.01E-03 6.15E-03 3.91E-03
       1.54E-03 2.39E-03 2.56E-03 2.60E-03 3.69E-03
                                                                        3.56E-03 5.63E-03 7.23E-03 4.93E-03 3.14E-03
       1.24E-03 1.92E-03 2.05E-03 2.08E-03 2.96E-03 3.20E-03
       1.72E-03 2.66E-03 2.86E-03 2.89E-03 4.11E-03 4.44E-03 3.56E-03
                                                                                  7.83E-03 1.00E-02 6.86E-03 4.36E-03
       2.72E-03 4.21E-03 4.51E-03 4.58E-03 6.50E-03 7.02E-03 5.63E-03 7.83E-03
                                                                                           1.59E-02 1.08E-02 6.89E-03
       3.49E-03 5.40E-03 5.79E-03 5.87E-03 8.34E-03 9.01E-03 7.23E-03 1.00E-02 1.59E-02
                                                                                                    1.39E-02 8.85E-03
       2.38E-03 3.69E-03 3.95E-03 4.01E-03 5.70E-03 6.15E-03 4.93E-03 6.86E-03 1.08E-02 1.39E-02
                                                                                                             6.04E-03
       1.52E-03 2.35E-03 2.51E-03 2.55E-03 3.62E-03 3.91E-03 3.14E-03 4.36E-03 6.89E-03 8.85E-03 6.04E-03
                2.88E-02 3.08E-02 3.12E-02 4.33E-02 4.65E-02 3.79E-02 5.13E-02 7.66E-02 9.38E-02 6.85E-02 4.57E-02
d/dDPi*d/dDPj*SDPi*SDPj
                 1.41E-04 4.38E-05 -9.96E-06 -6.07E-05 -9.93E-05 5.88E-05 4.19E-05 2.40E-05 -6.91E-06 -2.89E-05 -7.31E-05
                          2.17E-05 -4.93E-06 -3.01E-05 -4.92E-05 2.91E-05 2.07E-05 1.19E-05 -3.42E-06 -1.43E-05 -3.62E-05
        1.41E-04
                           -1.54E-06 -9.36E-06 -1.53E-05 9.07E-06 6.46E-06 3.71E-06 -1.07E-06 -4.46E-06 -1.13E-05
        4.38E-05 2.17E-05
                                             2.13E-06 3.48E-06 -2.06E-06 -1.47E-06 -8.43E-07 2.42E-07 1.01E-06 2.56E-06
       -9.96E-06 -4.93E-06 -1.54E-06
                                                  2.12E-05 -1.26E-05 -8.94E-06 -5.14E-06 1.48E-06 6.18E-06 1.56E-05
       -6.07E-05 -3.01E-05 -9.36E-06 2.13E-06
                                                             -2.05E-05 -1.46E-05 -8.40E-06 2.42E-06 1.01E-05 2.55E-05
       -9.93E-05 -4.92E-05 -1.53E-05 3.48E-06 2.12E-05
                                                                    8.66E-06 4.97E-06 -1.43E-06 -5.99E-06 -1.51E-05
        5.88E-05 2.91E-05 9.07E-06 -2.06E-06 -1.26E-05 -2.05E-05
        4.19E-05 2.07E-05 6.46E-06 -1.47E-06 -8.94E-06 -1.46E-05 8.66E-06
                                                                                  3.54E-06 -1.02E-06 -4.26E-06 -1.08E-05
                                                                                        -5.85E-07 -2.45E-06 -6.18E-06
        2.40E-05 1.19E-05 3.71E-06 -8.43E-07 -5.14E-06 -8.40E-06 4.97E-06 3.54E-06
       -6.91E-06 -3.42E-06 -1.07E-06 2.42E-07 1.48E-06 2.42E-06 -1.43E-06 -1.02E-06 -5.85E-07
                                                                                              7.04E-07 1.78E-06
       -2.89E-05 -1.43E-05 -4.46E-06 1.01E-06 6.18E-06 1.01E-05 -5.99E-06 -4.26E-06 -2.45E-06 7.04E-07
       -7.31E-05 -3.62E-05 -1.13E-05 2.56E-06 1.56E-05 2.55E-05 -1.51E-05 -1.08E-05 -6.18E-06 1.78E-06 7.44E-06
                 8.60E-05 4.17E-05 -1.14E-05 -8.01E-05 -1.45E-04 5.29E-05 4.01E-05 2.46E-05 -7.82E-06 -3.49E-05 -9.97E-05
    3.02E-05
 d/dMi*d/dMj*SMi*SMj
                  5.41E-09 2.82E-09 -9.26E-10 -6.05E-09 -1.11E-08 1.03E-08 1.01E-08 7.18E-09 -2.66E-09 -1.09E-08 -1.05E-08
                           2.70E-09 -8.86E-10 -5.78E-09 -1.06E-08 9.80E-09 9.63E-09 6.87E-09 -2.54E-09 -1.04E-08 -1.01E-08
         5.41E-09
                                   -4.62E-10 -3.01E-09 -5.52E-09 5.11E-09 5.02E-09 3.58E-09 -1.33E-09 -5.42E-09 -5.25E-09
        2.82E-09 2.70E-09
                                       9.90E-10 1.81E-09 -1.68E-09 -1.65E-09 -1.18E-09 4.35E-10 1.78E-09 1.72E-09
        -9.26E-10 -8.86E-10 -4.62E-10
                                                      1.18E-08 -1.10E-08 -1.08E-08 -7.68E-09 2.84E-09 1.16E-08 1.12E-08
        -6.05E-09 -5.78E-09 -3.01E-09 9.90E-10
                                                             -2.01E-08 -1.97E-08 -1.41E-08 5.21E-09 2.13E-08 2.06E-08
        -1.11E-08 -1.06E-08 -5.52E-09 1.81E-09 1.18E-08
                                                                        1.82E-08 1.30E-08 -4.82E-09 -1.97E-08 -1.91E-08
         1.03E-08 9.80E-09 5.11E-09 -1.68E-09 -1.10E-08 -2.01E-08
                                                                                 1.28E-08 -4.73E-09 -1.93E-08 -1.87E-08
         1.01E-08 9.63E-09 5.02E-09 -1.65E-09 -1.08E-08 -1.97E-08 1.82E-08
                                                                                        -3.38E-09 -1.38E-08 -1.34E-08
         7.18E-09 6.87E-09 3.58E-09 -1.18E-09 -7.68E-09 -1.41E-08 1.30E-08 1.28E-08
                                                                                                      5.11E-09 4.95E-09
        -2.66E-09 -2.54E-09 -1.33E-09 4.35E-10 2.84E-09 5.21E-09 -4.82E-09 -4.73E-09 -3.38E-09
        -1.09E-08 -1.04E-08 -5.42E-09 1.78E-09 1.16E-08 2.13E-08 -1.97E-08 -1.93E-08 -1.38E-08 5.11E-09
                                                                                                               2.02E-08
        -1.05E-08 -1.01E-08 -5.25E-09 1.72E-09 1.12E-08 2.06E-08 -1.91E-08 -1.87E-08 -1.34E-08 4.95E-09 2.02E-08
     -6.37E-09 -5.85E-09 -1.76E-09 -3.54E-11 -5.70E-09 -2.03E-08 -1.99E-08 -1.92E-08 -1.00E-08 -9.17E-10 -1.95E-08 -1.83E-08
```

Table A-13 (Continued) Cross Product Terms

```
d/dPsi*d/dPsj*SPsi*SPsj
                 1.22E-08 5.52E-09 -1.79E-09 -1.46E-08 -2.58E-08 2.63E-08 2.43E-08 1.73E-08 -6.00E-09 -2.35E-08 -2.62E-08
                          5.29E-09 -1.71E-09 -1.40E-08 -2.48E-08 2.52E-08 2.32E-08 1.66E-08 -5.75E-09 -2.25E-08 -2.51E-08
       5.52E-09 5.29E-09 -7.75E-10 -6.32E-09 -1.12E-08 1.14E-08 1.05E-08 7.51E-09 -2.60E-09 -1.02E-08 -1.14E-08
                                             2.04E-09 3.62E-09 -3.70E-09 -3.40E-09 -2.43E-09 8.41E-10 3.29E-09 3.68E-09
       -1.79E-09 -1.71E-09 -7.75E-10
                                                      2.96E-08 -3.02E-08 -2.78E-08 -1.98E-08 6.87E-09 2.69E-08 3.00E-08
       -1.46E-08 -1.40E-08 -6.32E-09 2.04E-09
                                                             -5.35E-08 -4.92E-08 -3.51E-08 1.22E-08 4.76E-08 5.32E-08
       -2.58E-08 -2.48E-08 -1.12E-08 3.62E-09 2.96E-08
                                                                     5.02E-08 3.58E-08 -1.24E-08 -4.86E-08 -5.42E-08
       2.63E-08 2.52E-08 1.14E-08 -3.70E-09 -3.02E-08 -5.35E-08
       2.43E-08 2.32E-08 1.05E-08 -3.40E-09 -2.78E-08 -4.92E-08 5.02E-08
                                                                                   3.30E-08 -1.14E-08 -4.47E-08 -4.99E-08
                                                                                          -8.15E-09 -3.19E-08 -3.56E-08
       1.73E-08 1.66E-08 7.51E-09 -2.43E-09 -1.98E-08 -3.51E-08 3.58E-08 3.30E-08
       -6.00E-09 -5.75E-09 -2.60E-09 8.41E-10 6.87E-09 1.22E-08 -1.24E-08 -1.14E-08 -8.15E-09
                                                                                                      1.11E-08 1.23E-08
       -2.35E-08 -2.25E-08 -1.02E-08 3.29E-09 2.69E-08 4.76E-08 -4.86E-08 -4.47E-08 -3.19E-08 1.11E-08
                                                                                                               4.83E-08
       -2.62E-08 -2.51E-08 -1.14E-08 3.68E-09 3.00E-08 5.32E-08 -5.42E-08 -4.99E-08 -3.56E-08 1.23E-08 4.83E-08
                -1.12E-08 -2.18E-09 -3.20E-10 -1.73E-08 -5.35E-08 -5.35E-08 -4.53E-08 -2.29E-08 -3.06E-09 -4.42E-08 -5.50E-08
    -1.22E-08
d/dCPi*d/dCPj*SCPi*SCPj
                 3.99E-06 1.86E-06 -5.65E-07 -4.30E-06 -8.44E-06 8.33E-06 7.41E-06 5.11E-06 -1.96E-06 -7.17E-06 -8.29E-06
                           1.84E-06 -5.59E-07 -4.26E-06 -8.36E-06 8.25E-06 7.34E-06 5.06E-06 -1.94E-06 -7.10E-06 -8.21E-06
        3.99E-06
                                  -2.61E-07 -1.99E-06 -3.91E-06 3.86E-06 3.43E-06 2.36E-06 -9.07E-07 -3.32E-06 -3.84E-06
        1.86E-06 1.84E-06
                                              6.03E-07 1.18E-06 -1.17E-06 -1.04E-06 -7.17E-07 2.75E-07 1.01E-06 1.16E-06
       -5.65E-07 -5.59E-07 -2.61E-07
                                                       9.02E-06 -8.90E-06 -7.92E-06 -5.46E-06 2.09E-06 7.66E-06 8.85E-06
       -4.30E-06 -4.26E-06 -1.99E-06 6.03E-07
                                                         -1.75E-05 -1.56E-05 -1.07E-05 4.11E-06 1.50E-05 1.74E-05
       -8.44E-06 -8.36E-06 -3.91E-06 1.18E-06 9.02E-06
                                                                          8.33E-06 8.25E-06 3.86E-06 -1.17E-06 -8.90E-06 -1.75E-05
                                                                                   9.41E-06 -3.61E-06 -1.32E-05 -1.53E-05
        7.41E-06 7.34E-06 3.43E-06 -1.04E-06 -7.92E-06 -1.56E-05 1.53E-05
                                                                                          -2.49E-06 -9.10E-06 -1.05E-05
        5.11E-06 5.06E-06 2.36E-06 -7.17E-07 -5.46E-06 -1.07E-05 1.06E-05 9.41E-06
       -1.96E-06 -1.94E-06 -9.07E-07 2.75E-07 2.09E-06 4.11E-06 -4.06E-06 -3.61E-06 -2.49E-06
                                                                                                       3.49E-06 4.03E-06
       -7.17E-06 -7.10E-06 -3.32E-06 1.01E-06 7.66E-06 1.50E-05 -1.48E-05 -1.32E-05 -9.10E-06 3.49E-06
                                                                                                                1.48E-05
       -8.29E-06 -8.21E-06 -3.84E-06 1.16E-06 8.85E-06 1.74E-05 -1.72E-05 -1.53E-05 -1.05E-05 4.03E-06 1.48E-05
                 -3.95E-06 -8.62E-07 -7.92E-08 -4.60E-06 -1.77E-05 -1.72E-05 -1.37E-05 -6.48E-06 -9.54E-07 -1.28E-05 -1.71E-05
 d/dAi*d/dAj*SAi*SAj
                  2.34E-05 1.20E-05 -3.84E-06 -2.39E-05 -5.16E-05 8.49E-05 5.67E-05 2.60E-05 -9.59E-06 -4.39E-05 -5.96E-05
                           1.12E-05 -3.58E-06 -2.23E-05 -4.82E-05 7.93E-05 5.29E-05 2.43E-05 -8.95E-06 -4.09E-05 -5.56E-05
                                   -1.83E-06 -1.14E-05 -2.47E-05 4.06E-05 2.71E-05 1.24E-05 -4.58E-06 -2.10E-05 -2.85E-05
        1.20E-05 1.12E-05
                                              3.65E-06 7.89E-06 -1.30E-05 -8.66E-06 -3.98E-06 1.46E-06 6.70E-06 9.11E-06
        -3.84E-06 -3.58E-06 -1.83E-06
                                                        4.92E-05 -8.09E-05 -5.40E-05 -2.48E-05 9.13E-06 4.18E-05 5.68E-05
        -2.39E-05 -2.23E-05 -1.14E-05 3.65E-06
                                                            -1.75E-04 -1.17E-04 -5.35E-05 1.97E-05 9.02E-05 1.23E-04
        -5.16E-05 -4.82E-05 -2.47E-05 7.89E-06 4.92E-05
                                                                           1.92E-04 8.80E-05 -3.24E-05 -1.48E-04 -2.02E-04
         8.49E-05 7.93E-05 4.06E-05 -1.30E-05 -8.09E-05 -1.75E-04
                                                                                    5.88E-05 -2.16E-05 -9.90E-05 -1.35E-04
         5.67E-05 5.29E-05 2.71E-05 -8.66E-06 -5.40E-05 -1.17E-04 1.92E-04
         2.60E-05 2.43E-05 1.24E-05 -3.98E-06 -2.48E-05 -5.35E-05 8.80E-05 5.88E-05
                                                                                       -9.94E-06 -4.55E-05 -6.18E-05
        -9.59E-06 -8.95E-06 -4.58E-06 1.46E-06 9.13E-06 1.97E-05 -3.24E-05 -2.16E-05 -9.94E-06
                                                                                                       1.67E-05 2.28E-05
        -4.39E-05 -4.09E-05 -2.10E-05 6.70E-06 4.18E-05 9.02E-05 -1.48E-04 -9.90E-05 -4.55E-05 1.67E-05
                                                                                                                 1.04E-04
        -5.96E-05 -5.56E-05 -2.85E-05 9.11E-06 5.68E-05 1.23E-04 -2.02E-04 -1.35E-04 -6.18E-05 2.28E-05 1.04E-04
                  1.15E-05 1.13E-05 -6.04E-06 -5.68E-05 -1.80E-04 -1.66E-04 -4.73E-05 1.00E-05 -1.73E-05 -1.39E-04 -2.26E-04
```

1.06E-05

Table A-14 Random Error Calculation -- Primary Air Inlet (Randomized Input Data Assumed) Milliken Heat Pipe Air Preheater

	Average	Sigma	Sigma																	
	Value	Absolute	Relative																	
Duct Size																				
Width, ft	3.26	0.042	1.27%																	
Longth, ft	17.5	0.042	0.24%																	
# of Points	12																			
Widthwise	2																			
Longthwise	•																			
Sector Width, ft	1.64	0.042	2.54%																	
Sector Length, R	2.92	0.042	1.43%																	
A, Sector Area # 2	4.78	0.139	2.91%																	
T, deg F	80	0.400	0.50%																	
T, deg R	540	0.400	0.07%																	
Temp Blas, deg F	10			deg F/Leng#	h Increment	Special Bles														
DP, In WC	0.005069	0.00005	0.99%							•										
M, lb/mol	26.85	0.050	0.17%																	
Amb Pres, In. Hg	29.50																			
Duct Pres, In. WC	48.00																			
Ps, in. Hg Absolute	31.23	0.040	0.13%																	
CP, Pitol Faci	0.84	0.0000	0.00%																	
Nominal Vel, Ips	3.96	ACFM=	13631	SCFM=	13702	lb/hr= (32500													
											Derivative	. dTa/dX					(dTa/dX°8)			
			Data (1)		0.1	Ti	(3)	(4)	dTa/dTI	dTa/Al	dTe/CPI	dTa/dDPI	dTa/dMi	dTa/dPal	d/dTi*STi	d/dAI*SAI	d/dCPI*SCPI	d/dDPI*SDPI		d/dPai*SPa
Poin		CPI (2)	DPI	MI	Pel	535.0	0.111	59.4	3.06E-02	-3.6E-02	-2.0E-01	-1.7E+02	-3.0E-03	-2.8E-03	1.50E-04	2.51E-05	0.00E+00	8.91E-05	2.26E-08	1.27E-08
	1 4.60	0.84	0.0005	26	30.00	537.0	0.172	92.4	4.73E-02	-3.4E-02	-2.0E-01	-8.2E+01	-2.9E-03	-2.7E-03	3.58E-04	2.19E-05	0.00E+00	1.69E-05	2.07E-08	1.17E-08
	2 497	0.84	0.0010	29	31.00	539.0	0.185	99.7	5.07E-02	-1.7E-02	-9.3E-02	-2.6E+01	-1.5E-03	-1.2E-03	4.11E-04	5.73E-06	0.00E+00	1.64E-06	5.63E-00	2.40E-09
;	3 4.54	0.84	0.0015	26	32.00 30.00	541.0	0.188	101.6	5.14E-02	5.49E-03		5.83E+00	4.93E-04	3.94E-04	4.23E-04	5.88E-07	0.00E+00	8.50E-08	6.07E-10	2.51E-10
	4 4.31	0.84	0.0020	24		543.0	0.267	145.2	7.30E-02			3.55E+01	3.22E-03	3.22E-03	8.54E-04	2.28E-05	0.00E+00	3.15E-06	2.59E-06	1.67E-08
	5 5.26	0.84	0.0025	26	28.00	545.0	0.269	157.8	7.89E-02	7.39E-02	4.21E-01	5.81E+01	5.89E-03	5.70E-03	9.97E-04	1.06E-04	0.00E+00	8.44E-08	8.68E-06	5.24E-08
	6 4.78	0.84	0.0030	30	31.00	535.0	0.230	123.0	6.33E-02	-1.2E-01	-4.2E-01	-3.4E+01	-5.5E-03	-5.8E-03	6.41E-04	2.87E-04	0.00E+00	2.96E-06	7.43E-08	5.45E-08
	7 2.67	0.84	0.0051	32	30.00	537.0	0.320	171.0	8.80E-02	-8.1E-02	-3.7E-01	-2.4E+01	-5.4E-03	-5.4E-03	1.24E-03	1.26E-04	0.00E+00	1.50E-06	7.16E-08	4.82E-08
	8 3.83	0.84	0.0063	29	29.00	539.0	0.507	273.3	1.39E-01	-3.7E-02	-2.5E-01	-1.4E+01	-3.8E-03	-3.8E-03	3.09E-03	2.70E-05	0.00E+00	4.94E-07	3.65E-06	2.35E-08
	9 5.74	0.84	0.0076	26	26.00	541.0	0.652	352.7	1.78E-01	1.37E-02	9.77E-02	4.05E+00	1.41E-03	1.32E-03	5.09E-03	3.66E-06	0.00E+00	4.09E-08	5.00E-09	2.83E-09
1	0 5.98	0.84	0.0101	29	31.00	541.0 543.0	0.446	242.1	1.22E-01	6.28E-02		1.69E+01	5.78E-03	5.18E-03	2.37E-03	7.66E-05	0.00E+00	7.18E-07	8.34E-08	4.33E-08
1	1 4.78	0.84	0.0089	26	29.00		0.264	154.8	7.76E-02	8.53E-02		4.26E+01	5.60E-03	5.78E-03	9.60E-04	1.42E-04	0.00E+00	4.57E-06	7.83E-08	5.30E-08
1	2 4.07	0.84	0.0041	31	30.00	545.0	8UM1	8UM2	,., JL-V&	J.J.J. VE					T	A	Ср	DP	M	Pe
							3.652	1974.0					Contributio	MS	1.66E-02	8.48E-04	0.00E+00	1.10E-04	5.11E-07	3.21E-07
							3.032	,574.0									Total Sign	na ^ 2	0.02	
(1) No Attempt Made	to Make Avera	ge of Rand	omized indiv	idual													Tavg Sigi	ne.	0.13	deg F

⁽¹⁾ No Attempt Made to Make Average of Randomized individual Terms Equal to Input Average Values.

⁽²⁾ Not Varied Since Same Pitot Tube Used For All Measurements.

⁽³⁾ AI*CPI(DPI*MI*Pal/TI) * 0.5

⁽⁴⁾ AI*CPI(DPI*MI*PaI*TI) ~ 0.5

Appendix B-1 Bias Calculation Primary Air In

```
Error Propagation Calculations, Part B, PAFA
 Set no. of sample points
> n := 12;
                                      n := 12
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for I to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
   make_array :=
       proc(var,n)
       local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
            for j to n do
                for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
            od:
            varcovar
       end
   #4
```

#13 m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1); 28.97 Wma + 28.97 1.608015098 Wma+1 1:='1'; i := iPRIMARY AIR FLOW - A' SIDE OF PAFA := 14088.2 apa CP sqrt(PSpa m) sum((DPpa[i] Tpa[i]) (1/2), l=1..n); DPpa₂ $PAFA := 14088.2 \ apa \ CP \ \frac{PSpa (28.97 \ Wma + 28.97)}{1.608015098 \ Wma + 1}$ Tpa₂ DPpa₄ DPpa₃ DPpa₅ Tpa₄ DPpa DPpa Tpa 11 Tpa PRIMAIN AIR FLOW - 8 5/DE

PAFB := 14088.2 apa CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); PAFB := 14088.2 apa CP $\frac{PSpa (28.97 \text{ Wma} + 28.97)}{1.608015098 \text{ Wma} + 1}$

$+ \sqrt{\frac{DPpa_3}{Tpa_3}} + \sqrt{\frac{DPpa_4}{Tpa_4}} + \sqrt{\frac{DPpa_5}{Tpa_5}} + \sqrt{\frac{DPpa_6}{Tpa_6}} + \sqrt{\frac{DPpa_7}{Tpa_7}} + \sqrt{\frac{DPpa_8}{Tpa_8}} + \sqrt{\frac{DPpa_8}{Tpa_8}$	DPpa Tpa
$+ \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}}$	
> sigmaPAFACP := sqrt(Diff(PAFA,CP)^2*varCP):	
> sigmaPAFACP := value("):	
> sigmaPAFAapa := sqrt(Diff(PAFA,apa)^2*varapa):	
> sigmaPAFAapa := value("):	
> sigmaPAFAPSpa := sqrt(Diff(PAFA,PSpa)^2*varPSpa):	
> slgmaPAFAPSpa := value("):	
> sigmaPAFAWma := sqrt(Diff(PAFA,Wma)^2*varWma):	
> sigmaPAFAWma := value("):	
> sigmaPAFADPpa := sqrt(sum(sum(
> Diff(PAFA,DPpa[i])*Diff(PAFA,DPpa[j])*varDPpa[i,j]	
> ,j=1n),i=1n)):	
> sigmaPAFADPpa := value("):	
> sigmaPAFATpa := sqrt(sum(sum(
> Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[i,j]	
> ,j=1n),i=1n)):	
> sigmaPAFATpa := value("):	



var:=[.6400 .6400 .6400 .6400 .6400 .6400]	.6400 .6400	.6400	.6400	.6400	.6400	.6400
varTpa := make_array(var,n);		raouar				
	varTpa := vai	COVUI				
Results		******	*****	*****	***	

evalf(PAFA);	62313.288	46 15	14/1	FU	,w	
evalf(sigmaPAFA);	2062.4363	194	BIA	5		
evalf(100*sigmaPAFA/PAFA);	3.3097858	34	BIAS	CONT	21847	ous
,						
evalf(sigmaPAFAWma);	23.812991	155				
evalf(sigmaPAFACP);	741.82486	527				
>						
evalf(sigmaPAFADPpa);	623.1328	828				
> evalf(sigmaPAFATpa);	46.15799	166				
> evalf(sigmaPAFAPSpa);	39,90604					
> evalf(sigmaPAFAapa);	1819.548			()		
*************		*****	*****	******	++++	
> l := 'l';		•				
#13 A(L	i := : T• Vma*28.97/18.0					
	m := 28.745	70417				
#14						

> PAFA := 14	088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
	PAFA := 62313.28846
> PAFB := 14	088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
	PAFB := 62313.28846
i>	

...! .. در)

L

sigmaPAFA := sqrt(Diff(PAFA,CP)^2*varCP+ Diff(PAFA,apa)^2*varapa + Diff(PAFA,PSpa)^2*varPSpa + Diff(PAFA,Wma)^2*varWma + sum(sum(Diff(PAFA,DPpa[i])*Diff(PAFA,DPpa[j])*varDPpa[i,j] + Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[i,]] ,j=1..n),i=1..n)): sigmaPAFA := value("): Constants Averages and Variances from Part A Pitot Coefficient CP := 0.84;CP := .84 $varCP := (0.01)^2;$ varCP := .0001Pressure for primary air PSpa := 31.23; PSpa := 31.23 $varPSpa := (0.04)^2;$ varPSpa := .0016 Moisture (air) · Wma := 0.013; wma:=.013 varWma := (.1*Wma)^2; varWma:=.169 10⁻⁵

AREA INCREMENT Area for primary air > apa := 4.78; apa := 4.78> varapa := (.0292*apa)^2; varapa := .01948145978 HE AN w.c. VELOCITY > v := .005069; v := .005069> DPpa := array([seq(v,l=1..n)]); $DPpa := [.005069 \ .005069 \ .005069 \ .005069 \ .005069 \ .005069 \ .005069 \ .005069$.005069 .005069 .005069 .005069] > u := (0.02*v)^2; $u := .102779044 \quad 10^{-7}$ > var := array([seq(u,i=1..n)]); $var := \begin{bmatrix} .102779044 & 10^{-7} \end{bmatrix}$.102779044 10^{-7} .102779044 10^{-7} .102779044 10^{-7} $.102779044 \ 10^{-7} \ .102779044 \ 10^{-7} \ .102779044 \ 10^{-7}$.102779044 10^{-7} .102779044 10^{-7} .102779044 10^{-7} .102779044 10^{-7} > varDPpa := make_array(var,n); varDPpa:=varcovar INLET TEMPERATURE OF > v := 540; v := 540> Tpa := array([seq(v,l=1..n)]); $Tpa := [540 \quad 540 \quad 540]$ > u := (0.01*(v - 460))^2; u := .6400> var := array([seq(u,i=1..n)]);



Appendix B-2 Random Error Calculation Primary Air In

```
Random Error Propagation Calculations, Part B, PAFA in
Set no. of sample points
> n := 12;
                                          n := 12
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i=j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi;
> od
> od;
> varcovar;
> end;
   Warning, 'varcovar' is implicitly declared local
   Warning, 'j' is implicitly declared local Warning, 'i' is implicitly declared local
   make_array :=
        proc(var,n)
        local varcovar, j, i;
             varcovar := array(1 .. n,1 .. n);
             for j to n do
```

```
if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
              ođ
          od;
          varcovar
     end
#13
m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
                                   28.97 Wma + 28.97
                                  1.608015098 Wma+1
· 1 := 'l':
                                       i := i
                                                                          HEAT PIPE
                                 FLOW
          PRIMARY
                         AIR
PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                      DPpa<sub>2</sub>
                                                            DPpa.
                             PSpa (28.97 Wma + 28.97)
                                                                      Tpa<sub>2</sub>
                                                            Tpa
                                                    DPpa<sub>7</sub>
                    DPpa
                                                     Tpa
                                                                           Tpa
```

for i to n do

DPpa 12 DPpa 10 DPpa. 70 SIDE DRIMARI PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ PAFB := 14088.2 apa CP Tpa₂ DPpa₆ DPpa₄ DPpa₇ DPpa₅ DPpa, Tpa₆ Tpa Tpa, DPpa DPpa DPpa Tpa Tpa Tpa 10 > sigmaPAFACP := sqrt(Diff(PAFA,CP)^2*varCP): > sigmaPAFACP := value("): > sigmaPAFAapa := sqrt(Diff(PAFA,apa)^2*varapa): > sigmaPAFAapa := value("): > sigmaPAFAPSpa := sqrt(Diff(PAFA,PSpa)^2*varPSpa): > sigmaPAFAPSpa := value("): > sigmaPAFAWma := sqrt(Diff(PAFA,Wma)^2*varWma): > sigmaPAFAWma := value("): > sigmaPAFADPpa := sqrt(sum(sum(> Diff(PAFA,DPpa[i])*Diff(PAFA,DPpa[j])*varDPpa[i,j] > ,j=1..n),i=1..n)): > sigmaPAFADPpa := value("):

> sigmaPAFATpa := sqrt(sum(sum(
Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[i,j]
> ,j=1n),i=1n)):
> sigmaPAFATpa := value("):
> sigmaPAFA := sqrt(
> Diff(PAFA,CP)^2*varCP +
> Diff(PAFA,apa)^2*varapa +
> Diff(PAFA,PSpa)^2*varPSpa +
> Diff(PAFA,Wma)^2*varWma +
> sum(sum(
> Diff(PAFA,DPpa[i])*Diff(PAFA,DPpa[j])*varDPpa[i,j] +
> Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[l,j]
> ,j=1n),i=1n)):
> sigmaPAFA := value("):
Constants
Pitot Coefficient re
> CP := 0.84; CP := .84
> varCP := 0^2; varCP := 0
IV
Area - Primary Air Gut re
> apa := 4.78; apa := 4.78

```
> varapa := (0.0292*apa)^2;
                                      varapa := .01948145978
                           IN
  Primary Air Pressure Out re
> PSpa := 31.23;
                                            PSpa := 31.23
> varPSpa := (0.04)^2;
                                          varPSpa := .0016
  Moisture (air) re
> Wma := 0.013;
                                             Wma := .013
> varWma := (.2*Wma)^2;
                                        varWma:=.676 10<sup>-5</sup>
   Velocity Head re
 > v := 0.005069;
                                             v := .005069
> DPpa := array([seq(v,i=1..n)]);
                                                                      .005069 .005069 .00506
     DPpa := [.005069 \ .005069 \ .005069 \ .005069]
       .005069 .005069 .005069 .005069]
> u := (0.00005)^2;
                                             u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
       var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
         .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup>
 > varDPpa := make_array(var,n);
                                       varDPpa:= varcovar
    Temperature Primary Air In re
 > v := 540;
                                                v := 540
 > Tpa := array([seq(v,i=1..n)]);
          Tpa := [540 \quad 540 \quad 540]
 > u := (0.005*(v-460))^2;
                                              u := .160000
 > var := array([seq(u,i=1..n)]);
```

var:=[.160000 .160000 .1		160000 .	160000	.160000	.160000
.160000 .160000 .160000	.160000]				
> varTpa := make_array(var,n);	varTpa:= varco	war			
	varipa := varco				
Results					
***********************	******	******	******	****	
> evalf(PAFA);	(0010 00016	li ai			-
	62313.28846	15/HR	Fω	U RATE	
> evalf(sigmaPAFA);	1022 701070	. Q 441 No	M ER	200	
W4004-I	1822.781079				
> evalf(100*sigmaPAFA/PAFA);	2.925188389	CON	NTQIB	a Tion	•
	2.923188389		}		
>			ļ		
> evalf(sigmaPAFAWma);					
	47.62598310				
> evalf(sigmaPAFACP);					
	0				
>					
> evalf(sigmaPAFADPpa);					
evantsignial At Abi pay,	88.71718747				
> evalf(sigmaPAFATpa);					
	6.662332196				
					····
> evalf(sigmaPAFAPSpa);					
	39.90604447				
> evalf(sigmaPAFAapa);			· /		
	1819.548024		U/		
************************	++++++++++++	******	******	****	
> i := 'i';					
>1:=1;	i := i				
	11				
#13 AIR MW.					
> m := (Wma * 28.97+28.97)/((Wr	ma*28.97/18.016)+	1);			
	m := 28.7457041	7			
#14					

$>$ PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);				
PAFA := 62313.28846				
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);				
PAFB := 62313.28846				
>				

Appendix B-3 Bias Calculation Primary Air Out

```
Error Propagation Calculations, Part B, PAFA out
 Set no. of sample points
> n := 20;
                                      n := 20
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
           varcovar
       end
  #4
```

#13

· m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);

$$m := \frac{28.97 \text{ Wma} + 28.97}{1.608015098 \text{ Wma} + 1}$$

· I := 'i';

$$i := i$$

#14 PLIMACY AIR FLOW FROM 'A' SIDE OF HEAT PIAGE
PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i])*\(1/2\),i=1..n);

$$\begin{split} & \text{PAFA} \coloneqq 14088.2 \ \ \, \text{apa} \ \ \, \text{CP} \, \, \frac{PSpa \, \left(28.97 \, \text{ Wma} + 28.97\right)}{1.608015098 \, \text{ Wma} + 1} \, \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} + \begin{array}{c} DPpa_2 \\ Tpa_2 \end{array} \right) \\ & + \sqrt{\frac{DPpa_3}{Tpa_3}} + \sqrt{\frac{DPpa_4}{Tpa_4}} + \sqrt{\frac{DPpa_5}{Tpa_5}} + \sqrt{\frac{DPpa_6}{Tpa_6}} + \sqrt{\frac{DPpa_7}{Tpa_7}} + \sqrt{\frac{DPpa_8}{Tpa_8}} + \sqrt{\frac{DPpa_9}{Tpa_9}} \\ & + \sqrt{\frac{DPpa_10}{Tpa_{10}}} + \sqrt{\frac{DPpa_11}{Tpa_{11}}} + \sqrt{\frac{DPpa_12}{Tpa_{12}}} + \sqrt{\frac{DPpa_13}{Tpa_{13}}} + \sqrt{\frac{DPpa_14}{Tpa_{14}}} + \sqrt{\frac{DPpa_15}{Tpa_{15}}} \\ & + \sqrt{\frac{DPpa_16}{Tpa_16}} + \sqrt{\frac{DPpa_17}{Tpa_17}} + \sqrt{\frac{DPpa_18}{Tpa_{18}}} + \sqrt{\frac{DPpa_19}{Tpa_19}} + \sqrt{\frac{DPpa_20}{Tpa_20}} \\ & + \sqrt{\frac{DPpa_20}{Tpa_20}} \end{array} \end{split}$$

PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$PAFB := 14088.2 \ apa \ CP \sqrt{\frac{PSpa \ (28.97 \ kma + 28.97)}{1.608015098 \ kma + 1}} \left(\sqrt{\frac{DPpa \ }{Tpa \ }_{1}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{2}} \right) + \sqrt{\frac{DPpa \ }{Tpa \ }_{3}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{4}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{4}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{5}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{6}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{7}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{7}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{8}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{8}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{9}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{10}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{11}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{11}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{12}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{13}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{14}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{15}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{15}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{16}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{17}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{17}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{18}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{19}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{20}} + \sqrt{\frac{DPpa \ }{Tpa \ }_{$$

> sigmaPAFATpa := sqrt(sum(sum(
> Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[i,j]
> ,j=1n),i=1n)):
> sigmaPAFATpa := value("):
> sigmaPAFA := sqrt(
> Diff(PAFA,CP)^2*varCP +
> Diff(PAFA,apa)^2*varapa +
> Diff(PAFA,PSpa)^2*varPSpa +
> Diff(PAFA,Wma)^2*varWma +
> sum(sum(
> Diff(PAFA,DPpa[i])*Diff(PAFA,DPpa[j])*varDPpa[i,j] +
> Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[i,j]
> ,j=1n),i=1n)):
> sigmaPAFA := value("):
Constants
Pitot Coefficient
> CP := 0.84;
<i>CP</i> := .84 > varCP := 0.01^2;
varCP := .0001
Area - Primary Air Out AREA INCREMENT
> apa := 0.63; apa := .63
> varapa := (0.0208*apa)^2;
varapa:=.000171714816

```
Primary Air Pressure Out
> PSpa := 31.11;
                                PSpa := 31.11
> varPSpa := (0.04)^2;
                               varPSpa := .0016
 Moisture (air)
> Wma := 0.013;
                                  Wma := .013
> varWma := (.1*Wma)^2;
                             varWma := .169 	ext{ } 10^{-5}
 Velocity Head re
> v := 0.2171;
                                  v := .2171
> DPpa := array([seq(v,i=1..n)]);
     DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
      .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171]
> u := (0.02*v)^2;
                               u := .000018852964
> var := array([seq(u,i=1..n)]);
     var := [.000018852964 \quad .000018852964 \quad .000018852964 \quad .000018852964
                                  .000018852964
                                               .000018852964
                                                             .000018852964
      .000018852964 .000018852964
                                                             .000018852964
      .000018852964
                    .000018852964
                                  .000018852964
                                               .000018852964
      .000018852964 .000018852964
                                  .000018852964 .000018852964
                                                             .000018852964
      .000018852964]
> varDPpa := make_array(var,n);
                             varDPpa:=varcovar
  Temperature Primary Air Out re
> v := 1104;
                                   v := 1104
> Tpa := array([seq(v,i=1..n)]);
     > u := (0.01*(v-460))^2;
                                 u := 41.4736
```

var := array([seq(u,i=1n)]);			
var:=[41.4736 41.4736 41.4			
41.4736 41.4736 41.4736		41.4736	41.4736 41.4736
41.4736 41.4736 41.4736	41.4736]		
varTpa := make_array(var,n);			
ι	arTpa:=varco	var	
Results			
MDAEA)	***************************************		
evalf(PAFA);	62529.82254	16/4/L	FWW
evalf(sigmaPAFA);		1	4
	1634.685119	16/HR	BURS
evalf(100*sigmaPAFA/PAFA);		Cor	UTRIBUTIONS .
	2.614248774		
evalf(sigmaPAFAWma);			
	23.89573991		
evalf(sigmaPAFACP);			
ovantoigina. / ii / ie i /,	744.4026492		
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
evalf(sigmaPAFADPpa);			
	625.2982312		
evalf(sigmaPAFATpa);			
	182.3786497		
evalf(sigmaPAFAPSpa);			
	40.19917875		
evalf(sigmaPAFAapa);			
	1300.620309		V
******	*****	******	******
· I := 'I';			
	<u>i := i</u>		
#13			
m := (Wma * 28.97+28.97)/((Wm	a*28.97/18.016)+	1);	
	m:= 28.7457041	7	

.

#14	
> PAFA := 1408	38.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
	PAFA := 62529.82254
DAER :- 1/06	38.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
7 FAFD 1400	PAFB := 62529.82254

Appendix B-4 Random Error Calculation Primary Air Out

```
Random Error Propagation Calculations, Part B, PAFA out
 Set no. of sample points
> n := 20;
                                       n := 20
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i=j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi;
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
```

7 7 7

```
for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
              ođ
          od:
          varcovar
     end
#13
m := (Wma * 28.97 + 28.97)/((Wma*28.97/18.016) + 1);
                                   28.97 Wma + 28.97
                                  1.608015098 Wma + 1
l := 'i';
                                       i := i
       PRIMHRUI
                            FURN FROM
                                                `H·
                                                       SIDE OF HEAT
                     AID.
PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                       DPpa<sub>2</sub>
                                                            DPpa
                             PSpa (28.97 Wma + 28.97)
  PAFA := 14088.2 apa CP
                                                                        Tpa<sub>2</sub>
                                1.608015098 Wma+1
                                                             Tpa
                              DPpa<sub>5</sub>
                                                                DPpa<sub>8</sub>
                                                                            DPpa<sub>9</sub>
                   DPpa .
                                          DPpa,
                                                     DPpa_
                                                     Tpa
                                                                             Tpag
```

```
DPpa
15
                                                 DPpa
13
                                                              DPpa
                       DPpa
11
                                    DPpa
12
                10
                                                                            Tpa<sub>15</sub>
           Tpa
                        Tpa
                                     Tpa
                                                  Tpa
                                                               Tpa
                                                              DPpa<sub>20</sub>
          DPpa
                       DPpa
                                    DPpa
                                                  DPpa
                             17
                                          18
                                                       19
                16
                                    Tpa 18
                                                               Tpa<sub>20</sub>
                        Tpa
                                                  Tpa
           Tpa.
                                  FROM
                                            31
                    FLOW
                                                     SIDE
           A 1/2
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                             DPpa<sub>2</sub>
                                 PSpa (28.97 Wma + 28.97)
    PAFB := 14088.2 apa CP
                                                                             Tpa<sub>2</sub>
                                    1.608015098 Wma+1
                                                                  Tpa.
                                  DPpa<sub>5</sub>
                                              DPpa<sub>6</sub>
                                                                      DPpa<sub>8</sub>
          DPpa<sub>3</sub>
                                                          DPpa<sub>7</sub>
                      DPpa
                                                                                  DPpa
                                              Tpa<sub>6</sub>
                                                                      Tpa<sub>8</sub>
                                  Tpa 5
                                                                                  Tpa
                                                           Tpa
           Tpa3
                       Tpa
                                                               DPpa
          DPpa
                       DPpa
                                    DPpa
                                                 DPpa
                                                                            DPpa
                       Tpa
                                    Tpa
                                                                           Tpa<sub>15</sub>
                                                  Tpa
                                                               Tpa
           Tpa
                                                 DPpa<sub>19</sub>
                                                              DPpa<sub>20</sub>
          DPpa
                                    DPpa
                       DPpa.
                             17
                                          18
                16
                                                               7pa<sub>20</sub>
          Tpa
16
                                                 Tpa 19
                       Tpa
17
                                     Tpa.
> sigmaPAFACP := sqrt(Diff(PAFA,CP)^2*varCP):
> sigmaPAFACP := value("):
> sigmaPAFAapa := sqrt(Diff(PAFA,apa)^2*varapa):
> sigmaPAFAapa := value("):
> sigmaPAFAPSpa := sqrt(Diff(PAFA,PSpa)^2*varPSpa):
> sigmaPAFAPSpa := value("):
> sigmaPAFAWma := sqrt(Diff(PAFA,Wma)^2*varWma):
> sigmaPAFAWma := value("):
```

5

DPpa

> sigmaPAFADPpa := sqrt(sum(sum(
> Diff(PAFA,DPpa[i])*Diff(PAFA,DPpa[j])*varDPpa[i,j]
> ,j=1n),i=1n)):
> sigmaPAFADPpa := value("):
> sigmaPAFATpa := sqrt(sum(sum(
> Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[i,j]
> ,j=1n),i=1n)):
> sigmaPAFATpa := value("):
> sigmaPAFA := sqrt(
> Diff(PAFA,CP)^2*varCP +
> Diff(PAFA,apa)^2*varapa +
> Diff(PAFA,PSpa)^2*varPSpa +
> Diff(PAFA,Wma)^2*varWma +
> sum(sum(
> Ditt(PAFA,DPpa[i])*Ditt(PAFA,DPpa[j])*varDPpa[i,j] +
> Diff(PAFA,Tpa[i])*Diff(PAFA,Tpa[j])*varTpa[l,j]
> ,j=1n),i=1n)):
> sigmaPAFA := value("):
Constants
Pitot Coefficient re > CP := 0.84;

```
CP := .84
> varCP := 0^2;
                                                                                                                               varCP := 0
     Area - Primary Air Out re
> apa := 0.63;
                                                                                                                                  apa := .63
> varapa := (0.0208*apa)^2;
                                                                                                          varapa := .000171714816
       Primary Air Pressure Out re
  > PSpa := 31.11;
                                                                                                                             PSpa := 31.11
 > varPSpa := (0.04)^2;
                                                                                                                      varPSpa := .0016
        Moisture (air) re
 > Wma := 0.013;
                                                                                                                                 Wma := .013
 > varWma := (.2*Wma)^2;
                                                                                                                 varWma := .676 \cdot 10^{-5}
        Velocity Head re
 > v := 0.2171;
                                                                                                                                   v := .2171
 > DPpa := array([seq(v,i=1..n)]);
                     DPpa := [.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
                          .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
 > u := (0.00005)^2;
                                                                                                                              u := .25 \ 10^{-8}
  > var := array([seq(u,i=1..n)]);
               var := [.25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8}
                    .25 	ext{ } 10^{-8} 	ext{ } 
                    .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup>]
  > varDPpa := make_array(var,n);
                                                                                                                varDPpa:= varcovar
```

	l'emperature F	runary A	ar Out r	<u>e</u>							
> \	/ := 1104;				v:= 1	104					
			4 \2\-		V .= 1	104					
>	Γpa := array(
	Tpa := [1]			1104					1104	1104	1104
		104 1104		1104	1104	1104	1104	1104]			
> t	ı := (0.005*(v	-460))^2;	i		:= 10.3	40 100					
			- 131a	u	.= 10.3	08400					
> \	/ar := array([s				(0.400	10.27	0.400	10.2604	20 10	2 (0 4 0 (`
	var:=[10.3							10.36840		368400	
	10.368400			368400		8400			.368400		68400
	10.368400			568400	10.36	8400	10.3684	100 10	.368400	10.3	68400
> ۱	/arTpa := ma	ke_array	(var,n);								
	·····			varT	pa := v	arcov	/ar				
<u></u>	Results									<u> </u>	
_	valf(PAFA);									-	
> 6	vali(PAFA);				2520.0	2264	15/1/4	. .	ه دید	4.TE	
		. = . \		C	12529.8	2234	19/14	FL	SW E	RIC	
> 6	evalf(sigmaP	AFA);		1	302.27	9372	BANI	om 1	ERRO	r_	
	valf(100*sign	naPAFA	/PAFA):					OWTR	BUTO	0NS	
			, ,	2	.08265	3235	C		124 11		
 >									1		
									1		
> e	valf(sigmaP	AFAWma	a);						1		
			••	4	7.7914	7982			1		
	valf(sigmaP	AFACP):					· · · · · · · · · · · · · · · · · · ·		 		
	(5				0				1		
									 		
> e	valf(sigmaP	AFADPp	a);								
		-		1	.61009	8270		- 1			
> e	valf(sigmaP	AFATpa)	:								·
_			,	2	0.3905	5286		- 1			
	valf(sigmaP	AFAPSna	a):					1			
		Al ope	-,,	Á	0.1991	7875		V			
				4	ひ. 1フプ1	1013					

1300.620309	

> i := 'i';	
i := i	
#13	
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);	
m := 28.74570417	
#14	
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1	n);
PAFA := 62529.82254	
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1	n);
PAFB := 62529.82254	
>	



Appendix C-1 Bias Error Calculation Inlet Flue Gas Average CO₂ Concentration

```
Error Propagation Calculations, Part A, CO2i
  Set no. of sample points
> n := 2;
                                       n := 2
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
          varcovar := array(1 .. n,1 .. n);
           for j to n do
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
           oď;
           varcovar
```

> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)

```
> Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{OUHD^{Ca}}/(1-Ca) + (A^{(1-OUHD)^{Ca}})/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*C02[x]+71.70*02[x]+50480.8))/(K4+1801.6)
 end
> sigmaCO2avei := sqrt(
 Diff(CO2avel,A)^2*varA +
 Diff(CO2avel,OUHD)^2*varOUHD +
 Diff(CO2avel,Ca)^2*varCa +
  Diff(CO2avel,C)^2*varC +
> Diff(CO2avel,S)^2*varS +
  Diff(CO2avel,H)^2*varH +
  Diff(CO2avel,Wma)^2*varWma +
 Diff(CO2avei,N)^2*varN +
> Diff(CO2avel,Mf)^2*varMf +
'> sum(sum(
> Diff(CO2avei,DPi[i])*Diff(CO2avei,DPi[i])*varDPi[i,i] +
> Diff(CO2avel,Ti[i])*Diff(CO2avel,Ti[i])*varTi[i,i] +
> Diff(CO2avel,COi[i])*Diff(CO2avel,COi[j])*varCOi[i,j] +
> Diff(CO2avei,CO2i[i])*Diff(CO2avei,CO2i[i])*varCO2i[i,j] +
> Diff(CO2avei,O2i[i])*Diff(CO2avei,O2i[j])*varO2i[i,j]
> .i=1..n).i=1..n)):
> sigmaCO2avei := value("):
```

Constants	
Constants	
Coal Feed Rate (lbs/hr)	
> Wfe := 115839;	
> 116 := 115055,	115920
	Wfe:=115839
> varWfe := (0.05*Wfe)^2;	
	varWfe:=.3354668480 10 ⁸
	Valities in the second of the
Area (square ft)	
> Areai := 3.99;	
> Area: = 3.59,	2.00
	Areai := 3.99
> varAreal := (0.0335*Areal)*	2;
	varAreai := .01786633223
> Areao := 3.54;	
	Areao := 3.54
> varAreao := (0.0364*Areao)^2:
> 141711040 14 (0.000 1 7 H 0.10	varAreao:=.01660386874
	Valai eao .= .0100000011
Pitot Coefficient	
> CP := 0.84;	
> CP := 0.04;	CP:= .84
	CP := .84
> varCP := (0.01)^2;	
	varCP:=.0001
Pressure in Area	
> PSi := 29.23;	# Community
•	PSi := 29.23

> varPSi := (0.04)^2;
varPSi := .0016
> PSo := 29.1;
PSo := 29.1
> varPSo := (0.04)^2;
varPSo := .0016
Velocity Head
> v := .45802; v := .45802
> DPo := array([seq(v,i=1n)]); DPo := [.45802 .45802]
> $u := (.02^{\circ}v)^{\circ}2;$ u := .00008391292816
> var := array([seq(u,i=1n)]); var := [.00008391292816
> varDPo := make_array(var,n);
varDPo := varcovar
> v := .82831;
v:=.82831
> DPi := array([seq(v,i=1n)]);
DPi := allay([Seq(4, 1-117])), $DPi := [.8283182831]$
> u := (.02*v)^2;
$v := (.02 \text{ V})^{-2}$; v := .0002744389824
> var := array([seq(u,i=1n)]);
var := [.0002744389824 .0002744389824]
> varDPi := make_array(var,n);
> Value: = make_array(var,n), varDPi := varcovar
valuri valcoval
Temperature (R)
> v := 713;
v := 713
> To := array([seq(v,l=1n)]);
To:=[713 713]
> u := (0.01*(v-460))^2;
u := 6.4009

> var := array([seq(u,l=1n)]);		
,((,),),	var := [6.4009	6.40091
> varTo := make_array(var,n);		
	varTo:= var	rcovar
> v := 1140;		
	v:= 114	0
> Ti:= array([seq(v,i=1n)]);		
	Ti := [1140	1140]
> u := (0.01°(v-460))^2;		
	u := 46.24	000
> var := array([seq(u,i=1n)]);		
	var:=[46.2400	46.2400]
> varTi := make_array(var,n);		
	varTi := var	covar
Moisture in Ash > Mf := 0.06;		
> WII .=0.00,	MF := .06	:
> varMf := (0.039*Mf)^2;	MI := .00)
- vaimi .= (0.005 Mil) 2,		
	varMf := .5475	6 10 ⁻³
Ash		
> A := 0.0619;		
× 7. = 0.0013,	A := .0619	1
> varA := (0.039*A)^2;	A .= .0013	
(5.555 7,7 2,		
	varA := .5827878	81 10 3
Overhead		
> OUHD := 0.9;		
·	OUHD := .9	,
> varOUHD := (0.1*OUHD)^2;		
	varOUHD := .(0081
Carbon		
> C := 0.7381;		
	C := .7381	
> varC := (0.039°C)^2;		

	varC:= .()())82	286280388
Hydrogen		
> H := 0.0482;		
	H := .04	82
> varH := (0.039°H)^2;		
v	rarH:=.35336	4804 10 ⁻⁵
Nitrogen		
> N := 0.0135;		Commission of the second graph is also than
	N:- 01	25
> varN := (0.039*N)^2;	N:=.01	33
> variv := (0.039 N)~2;		
ı	varN:=.27720	225 10 ⁻⁶
Sulfur		
> S := 0.0123;		
	S := .01	23
> varS := (0.019*S)^2;		
• •		7
	vars:=.54615	569 10-7
CO2		
> v := 14.145;		
	v:= 14.1	45
> CO2o := array([seq(v,l=1n)]);		
CC	020 := [14.145	14.145]
> u := 0.1^2;		
·	u := .01	
> var := array([seq(u,l=1n)]);		
vai := airay([304(a,i=1ii)]),		011
	var:=[.01	.01]
> varCO2o := make_array(var,n);		
v	arCO2o:= va	rcovar
> v := 15.2148;		
	v := 15.214	48
CO2i := array([seq(v,i=1n)]);		
C02	i := [15.2148	15.21481
· u := (0.1)^2;		1
•	u := .01	
	u .= .01	

> var := array([seq(u,l=1n)]);			
> var := array([sed(a,i=1/]))	var:=[.01	.01}	
> varCO2i := make_array(var,n);			
	varCO2i:= va	rcovar	
O2			
> v := 5;			
	v:= 5		
> O2o := array([seq(v,l=1n)]);	0216	61	
	020:= 5	5]	
> u := (0.05)^2;	u := .002	ς.	
	u .= .002	,	
> var := array([seq(u,i=1n)]);	var:=[.0025	.0025]	
> varO2o := make_array(var,n);	Var [.0025		
> Val O20 .= Illake_allay(val,ii),	var02o := va	covar	
> v := 3.8;			
•	v := 3.8		
> O2i := array([seq(v,i=1n)]);			
	02i := [3.8]	3.8]	
> u := (0.05)^2;			
	u := .002	5	
> var := array([seq(u,l=1n)]);			
	var := [.0025	.0025]	
> varO2i := make_array(var,n);			
	varO2i:= va	ccovar	
Molsture (air)			
> Wma := 0.013;			
, <u>.</u>	Wma := .(13	
> varWma := (.1*Wma)^2;			
, , ,	varWma:=.l	9 10-5	
	7 CL 1111CC .— . I		
CO			
> v := 0.005;			
	v:=:0	5	
> COo := array([seq(v,i=1n)]);			

	COo := [.005 .005]
> u := (0.002)^2;	
	$u := .4 \cdot 10^{-5}$
> var := array([seq(u,i=1n)]);	
	$var := [.4 \ 10^{-5} \ .4 \ 10^{-5}]$
wasCOs make assaulters a	
> varCOo := make_array(var,n	varCOo:= varcovar
	varcovar
> v := 0.005;	
	v := .005
> COi := array([seq(v,i=1n)]);	
	COi:=[.005 .005]
> u := (0.002)^2;	
• • • • • • • • • • • • • • • • • • •	u := .4 10 ⁻⁵
	u.=.4 10
> var := array([seq(u,l=1n)]);	ا د دا
	$var := [.4 \ 10^{-5} \ .4 \ 10^{-5}]$
> varCOl := make_array(var,n);
	varCOi:= varcovar
Carbon in Ash	
> Ca := 0.0486;	Co. 1- 0.196
(0.0510-)40	Ca := .0486
> varCa := (0.25°Ca)^2;	
	varCa := .000147622500
Results	
:	
eval(sigmaO2avei);	
> eval(CO2avei);	15.21480000
	13.21400000
> eval(sigmaCO2avei);	.1000000000
> eval(100*slgmaCO2avei/CC	.6572547782
	.03/234//02

```
Error Propagation Calculations, Part A, CO2i
 Set no. of sample points
> n := 4:
                                       n := 4
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for | to n do
> for I to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od:
> varcovar:
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
       local varcovar, j, i;
           varcovar := array(1 .. n, 1 .. n);
           for j to n do
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
           od:
           varcovar
       end
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
```

```
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936*H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MTG :=
  proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cri
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*:
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 + + Wma^*((28.02^*(100-CO[x]-CO2[x]-O2[x])^*K3-N)/0.7685) + Mf;
> M := (18.016°K4+K3°(288.08°CO2[x]+71.70°O2[x]+50480.8))/(K4+1801.6°K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma* (36.46063760*(100-CO[x]-CO2[x]-O2[x]) *K3-1.301236174*N)+Mf
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
  end
> CO2avel := sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf)))^(1/
> 2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*CO2i[i],l=1..n)/sum((DPi[i
> \( \tau(\text{I,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf}) \) \( \tau(\text{I/2})^*(\text{1-MFG(i,A,OUHD,C}) \)
> a,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1..n):
> sigmaCO2avel := sqrt(
> Diff(CO2avel,A)^2*varA +
> Diff(CO2avei,OUHD)^2*varOUHD +
> Diff(CO2avel,Ca)^2*varCa +
> Diff(CO2avei,C)^2*varC +
> Diff(CO2avel,S)^2*varS +
> Diff(CO2avei,H)^2*varH +
> Diff(CO2avei,Wma)^2*varWma +
> Diff(CO2avei,N)^2*varN +
> Diff(CO2avei,Mf)^2*varMf +
> sum(sum(
> Diff(CO2avei,DPi[i])*Diff(CO2avei,DPi[j])*varDPi[i,j] +
```

> Diff(CO2avel,Ti[i])*Diff(CO2avel,Ti[j])*varTi[i,j] +
> Diff(CO2avel,COi[i])*Diff(CO2avel,COi[j])*varCOi[i,j] +
> Diff(CO2avel,CO2i[i])*Diff(CO2avel,CO2i[j])*varCO2i[i,j] +
> Diff(CO2avel,O2i[i])*Diff(CO2avel,O2i[j])*varO2i[i,j]
> , =1n),l=1n)):
> sigmaCO2avei := value("):
Constants
Constants
Coal Feed Rate (lbs/hr)
> Wfe := 115839;
Wfe := 115839
> varWfe := (0.05*Wfe)^2;
varWfe:=.3354668480 10 ⁸
Area (square ft)
> Areai := 3.99;
Areai:=3.99
> varAreai := (0.0335*Areai)^2;
varAreai := .01786633223
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874
Pitot Coefficient
> CP := 0.84;
CP := .84
> varCP := (0.01)^2; varCP := .0001
Pressure in Area

> PSi := 29.23;

	PSi := 29.23		
rarPSI := (0.04)^2;	varPSi := .0016		
PSo := 29.1;	PSo := 29.1		
varPSo := (0.04)^2;	varPSo:=.0016		
Velocity Head			
v := .45802;	v:=.45802		
DPo := array([seq(v,l=1n)]); DPo :=	[.45802 .45802 .45802	.45802]	
> u := (.02*v)^2;	u := .00008391292816		
<pre>var := array([seq(u,i=1n)]); var := [.00008391292816</pre>	.00008391292816 .0000	8391292816	.00008391292816]
> var := array([seq(u,l=1n)]); var := [.00008391292816 > varDPo := make_array(var,r	.000037127		.00008391292816]
var := [.00008391292816); varDPo:=varcova		.00008391292816]
<pre>var := [.00008391292816 > varDPo := make_array(var,r > v := .82831;</pre>	varDPo := varcova v:= .82831	r	.00008391292816]
<pre>var := [.00008391292816 > varDPo := make_array(var,r > v := .82831;</pre>	varDPo := varcova v:= .82831	r 31 .82831]	.00008391292816]
<pre>var := [.00008391292816 > varDPo := make_array(var,r) > v := .82831; > DPi := array([seq(v,i=1n)])</pre>	v:=.82831 v:=.82831 =[.82831 .82831 .8283 u:=.000274438982 ; 4 .0002744389824 .000	r 31 .82831]	.00008391292816]
<pre>var := [.00008391292816 > varDPo := make_array(var,r > v := .82831; > DPi := array([seq(v,l=1n)])</pre>	v:=.82831 v:=.82831 =[.82831 .82831 .8283 u:=.000274438982 ; 4 .0002744389824 .000	31 .82831] 4 2744389824	
<pre>var := [.00008391292816 > varDPo := make_array(var,r > v := .82831; > DPi := array([seq(v,l=1n)])</pre>	v:=.82831 ; =[.82831 .82831 .8283 u:=.000274438982 ; 4 .0002744389824 .000	31 .82831] 4 2744389824	
<pre>var := [.00008391292816 > varDPo := make_array(var,r) > v := .82831; > DPi := array([seq(v,i=1n)])</pre>	v:=.82831 ; =[.82831 .82831 .8283 u:=.000274438982 ; 4 .0002744389824 .000	31 .82831] 4 2744389824	

·	
u := 6.4009	
> var := array([seq(u,i=1n)]); var := [6.4009 6.4009 6.4009 6.4009]	
> varTo := make_array(var,n); varTo := varcovar	
> v := 1140; v := 1140	
> Ti:= array([seq(v,i=1n)]);	
> u := (0.01°(v-460))^2; u := 46.2400	
> var := array([seq(u,i=1n)]); var := [46.2400	
> varTi := make_array(var,n); varTi := varcovar	
Moisture in Ash	
> M1 := 0.06; Mf := .06	
> varMf := (0.039°Mf)^2; varMf := .54756 10 ⁻⁵	
Ash > A := 0.0619; A := .0619	
> varA := (0.039*A)^2; varA := .582787881 10 ⁻⁵	
Overhead	
> OUHD := 0.9;	
> varOUHD := (0.1*OUHD)^2; varOUHD := .0081	
Carbon $> C := 0.7381;$ $C := .7381$	

WarC := .0008286280388 Hydrogen H := 0.0482; H := .0482	> varC := (0.039°C)^2;
H := 0.0482; h := 0.0482; varH := (0.039*H)^2; Nitrogen N := 0.0135; varN := (0.039*N)^2; varN := 27720225 10 ⁻⁶ Sulfur S := 0.0123; S := 0.0123; VarS := .5461569 10 ⁻⁷ CO2 VarS := .5461569 10 ⁻⁷ CO2 V := 14.145; CO20 := array([seq(v,l=1n])); CO20 := [14.145 14.145 14.145 14.145] V u := 0.1^2; u := .01 Var := array([seq(u,l=1n])); var := array([seq(u,l=1n])); varCO20 := make_array(var,n); varCO20 := varcovar V := 15.2148; CO2i := [15.2148 15.2148 15.2148 15.2148 15.2148]	
H := 0.0482; h := 0.0482; varH := (0.039*H)^2; Nitrogen N := 0.0135; varN := (0.039*N)^2; varN := 27720225 10 ⁻⁶ Sulfur S := 0.0123; S := 0.0123; VarS := .5461569 10 ⁻⁷ CO2 VarS := .5461569 10 ⁻⁷ CO2 V := 14.145; CO20 := array([seq(v,l=1n])); CO20 := [14.145 14.145 14.145 14.145] V u := 0.1^2; u := .01 Var := array([seq(u,l=1n])); var := array([seq(u,l=1n])); varCO20 := make_array(var,n); varCO20 := varcovar V := 15.2148; CO2i := [15.2148 15.2148 15.2148 15.2148 15.2148]	
# := .0482 varH := (0.039*H)^2; varH := .353364804 10 ⁻⁵ Nitrogen N := 0.0135; varN := (0.039*N)^2; varN := .27720225 10 ⁻⁶ Sulfur S := .0123 varS := .5461569 10 ⁻⁷ CO2 v := 14.145; v := 14.145 CO20 := array([seq(v,l=1n)]); co20 := [14.145 14.145 14.145 14.145] varCO20 := make_array(var,n); varCO20 := warcovar v := 15.2148; v := 15.2148 CO21 := [15.2148 15.2148 15.2148 15.2148]	
Nitrogen Nitrogen	
Nitrogen N:= .0135; N:= .0135 varN:= .27720225 10 ⁻⁶ Sulfur S:= .0.0123; S:= .0.0123; VarS:= .5461569 10 ⁻⁷ CO2 varS:= .5461569 10 ⁻⁷ CO2 v:= 14.145; CO20:= [14.145 14.145 14.145 14.145] var:= [.01 .01 .01 .01] varCO20:= warCO20:= warCoVar varCO20:= array([seq(u,l=1n)]); varCO20:= warCoVar varCO20:= array([seq(v,l=1n)]); varCO20:= warCoVar vi= 15.2148; CO2i:= array([seq(v,l=1n)]); cO2i:= [15.2148 15.2148 15.2148 15.2148]	
Nitrogen N := 0.0135; N := 0.0135; VarN := (0.039*N)^2; VarN := 27720225 10 ⁻⁶ Sulfur S := 0.0123; S := 0.0123; VarS := .5461569 10 ⁻⁷ CO2 V := 14.145; CO20 := array([seq(v,l=1n)]); CO20 := [14.145 14.145 14.145 14.145] V := 0.1^2; Var := 0.1	_
> N := 0.0135; > varN := (0.039*N)^2; varN := .27720225	varH:= .353364804 10 ⁻⁵
> N := 0.0135; > varN := (0.039*N)^2; varN := .27720225	
N:=.0135 varN:=.27720225 10 ⁻⁶ Sulfur S:=.0123; s:=.0123 varS:=.5461569 10 ⁻⁷ CO2 v:=14.145; v:=14.145 CO20:=[14.145 14.145 14.145 14.145] vuice 0.1^2; u:=.01 var:=[.01 .01 .01 .01] varCO20:=varcovar vice 15.2148; v:=15.2148 CO2i:=[15.2148 15.2148 15.2148 15.2148]	Nitrogen
<pre>varN := (0.039*N)^2; varN := .27720225 10⁻⁶ Sulfur > S := 0.0123; varS := .5461569 10⁻⁷ CO2 > v := 14.145; v := 14.145 CO20 := array([seq(v,l=1n)]); co20 := [14.145 14.145 14.145 14.145] var := array([seq(u,l=1n)]); var := array([seq(u,l=1n)]); var := array([seq(u,l=1n)]); var := 15.2148; v := 15.2148 > CO2i := array([seq(v,l=1n)]); co2i := [15.2148 15.2148 15.2148 15.2148]</pre>	> N := 0.0135;
<pre>varN := .27720225 10⁻⁶ Sulfur > S := 0.0123;</pre>	N:= .0135
Sulfur > S := 0.0123;	> varN := (0.039*N)^2;
S:= 0.0123; > varS:= (0.019*S)^2; varS:= .5461569 10^{-7} CO2 v := 14.145; v := 14.145 CO20:= [14.145 14.145 14.145 14.145 > u := 0.1^2; u := .01 > var := array([seq(u,i=1n)]); var := [.01	varN:= .27720225 10 ⁻⁶
S:= 0.0123; > varS:= (0.019*S)^2; varS:= .5461569 10^{-7} CO2 v := 14.145; v := 14.145 CO20:= [14.145 14.145 14.145 14.145 > u := 0.1^2; u := .01 > var := array([seq(u,i=1n)]); var := [.01	
S:=.0123 > varS:= (0.019°S)^2; varS:= .5461569 10 ⁻⁷ CO2 > v := 14.145; v:= 14.145 > CO2o := array([seq(v,l=1n)]); co2o := [14.145	Sulfur
<pre>varS := (0.019*S)^2; varS := .5461569 10⁻⁷ CO2 > v := 14.145;</pre>	> S := 0.0123;
<pre>vars:=.5461569 10⁻⁷ CO2 > v := 14.145;</pre>	S := .0123
CO2 > v := 14.145; v := 14.145 CO2o := array([seq(v,l=1n)]); CO2o := [14.145	> varS := (0.019*S)^2;
CO2 > v := 14.145; v := 14.145 CO2o := array([seq(v,l=1n)]); CO2o := [14.145	vars:=.5461569 10 ⁻⁷
> v := 14.145; v := 14.145 > CO2o := array([seq(v,i=1n)]); CO2o := [14.145	
<pre>v:= 14.145 > CO2o := array([seq(v,l=1n)]);</pre>	CO2
> CO2o := array([seq(v,l=1n)]);	> v := 14.145;
<pre>co2o:=[14.145 14.145 14.145 14.145] > u := 0.1^2;</pre>	v := 14.145
> u := 0.1^2; var := array([seq(u,l=1n)]); var := [.01	> CO2o := array([seq(v,l=1n)]);
<pre>u := .01 > var := array([seq(u,i=1n)]);</pre>	CO2o := [14.145
> var := array([seq(u,i=1n)]);	> u := 0.1^2;
<pre>var:=[.01 .01 .01 .01] > varCO2o := make_array(var,n);</pre>	u := .01
> varCO2o := make_array(var,n);	> var := array([seq(u,i=1n)]);
<pre>varC02o := varcovar > v := 15.2148; v := 15.2148 > CO2i := array([seq(v,l=1n)]);</pre>	var:=[.01 .01 .01 .01]
<pre>varC02o := varcovar > v := 15.2148; v := 15.2148 > CO2i := array([seq(v,l=1n)]);</pre>	> varCO2o := make_array(var,n);
v := 15.2148 > CO2i := array([seq(v,l=1n)]); CO2i := [15.2148	
v := 15.2148 > CO2i := array([seq(v,l=1n)]); CO2i := [15.2148	
> CO2i := array([seq(v,l=1n)]); CO2i := [15.2148	> v := 15.2148;
CO2i := [15.2148 15.2148 15.2148	v := 15.2148
CO2i := [15.2148 15.2148 15.2148	> CO2i := array([seq(v,i=1n)]);
> u := (0.1)^2;	
	> u := (0.1)^2;

```
u := .01
> var := array([seq(u,i=1..n)]);
                               var := [.01 .01 .01 .01]
> varCO2i := make_array(var,n);
                                  varCO2i := varcovar
  02
> v := 5;
                                          v := 5
> O2o := array([seq(v,i=1..n)]);
                                   020 := [5 \ 5 \ 5 \ 5]
> u := (0.05)^2;
                                        u := .0025
> var := array([seq(u,i=1..n)]);
                           var:=[.0025 .0025 .0025 .0025]
> varO2o := make_array(var,n);
                                  var02o:= varcovar
> v := 3.8;
                                         v := 3.8
> O2i := array([seq(v,i=1..n)]);
                                02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                         u := .0025
> var := array([seq(u,i=1..n)]);
                           var := [.0025 \ .0025 \ .0025 \ .0025]
> varO2i := make_array(var,n);
                                  var02i := varcovar
  Moisture (air)
> Wma := 0.013;
                                        Wma := .013
> varWma := (.1*Wma)^2;
                                   varWma:=.169 10<sup>-5</sup>
  co
> v := 0.005;
                                         v := .005
```

.005] -5 .4 l
r
r
.005]
-5 .4 1
r
00

Appendix D-1 Random Error Calculation Inlet Flue Gas Average CO₂ Concentration

```
Random Error Propagation Calculations, Part A, CO2i
Set no. of sample points
> n := 8;
                                       n := 8
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for I to n do
> for j to n do
> if i = j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'i' is implicitly declared local
  Warning, 'j' is implicitly declared local
   make_array :=
       local varcovar, i, j;
            varcovar := array(1 .. n,1 .. n);
            for i to n do
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end;
  Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 M :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      M := (18.016 + K4 + K3 + (288.08 + CO2[x] + 71.70 + O2[x] + 50480.8)) / (K4 + 1801.6 + K3)
 and
```

```
for j to n do
                    if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                    else varcovar[i,j] := 0
                    fi
               ođ
           od;
           varcovar
       and
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{OUHD^{Ca}}/(1-Ca) + (A^{(1-OUHD)^{Ca}})/(1-Ca/3)
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr,Cb,K3,K4,MFG;
      Cx := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*L
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

> a,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),I=1n): > sigmaCO2avel := sqrt(> Diff(CO2avel,A)^2°varA +
> Diff(CO2avel,A)^2*varA +
> Diff(CO2avel,OUHD)^2*varOUHD +
> Diff(CO2avel,Ca)^2*varCa +
> Diff(CO2avel,C)^2*varC +
> Diff(CO2avel,S)^2*varS +
> Diff(CO2avei,H)^2*varH +
> Diff(CO2avel,Wma)^2*varWma +
> Diff(CO2avel,N)^2*varN +
> Diff(CO2avel,Mf)^2*varMf +
> sum(
> Diff(CO2avei,DPi[i])*Diff(CO2avei,DPi[i])*varDPi[i,i] +
> Diff(CO2avel,Ti[i])*Diff(CO2avel,Ti[i])*varTi[i,i] +
> Diff(CO2avel,COi[i])*Diff(CO2avel,COi[i])*varCOi[i,i] +
> Diff(CO2avel,CO2i[i])*Diff(CO2avel,CO2i[i])*varCO2i[i,i] +
> Diff(CO2avei,O2i[i])*Diff(CO2avei,O2i[i])*varO2i[i,i]
> ,i=1n)):
> sigmaCO2avei := value("):

Constants	
Coal Feed Rate (lbs/hr) re	
> Wfe := 115839;	
	Wfe:= 115839
> varWfe := (0.0025*Wfe)^2;	
y van 1110 v = (ora v m. ,	varWfe:= 83866.71200
Area (square ft) re	
> Areal := 3.99;	
	Areai := 3.99
> varAreal := (0.0335*Areal)^2;	
va	arAreai := .01786633223
> Areao := 3.54;	
	Areao := 3.54
> varAreao := (0.0364*Areao)^2;	
V	arAreao:=.01660386874

```
tot Coefficient re
P := 0.84;
                                       CP := .84
arCP := 0^2;
                                      varCP := 0
essure Ambient or Barometric re
Si := 29.23;
                                     PSi := 29.23
arPSi := (0.04)^2;
                                   varPSi := .0016
So := 29.1;
                                      PSo := 29.1
rPSo := (0.04)^2;
                                   varPSo := .0016
elocity Head DP re
:= .45802;
                                      v := .45802
Po := array([seq(v,i=1..n)]);
    DPo := [.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802]
:= .00005^2;
                                    u := .25 \cdot 10^{-8}
ir := array([seq(u,i=1..n)]);
var:=
 .25 \cdot 10^{-8} .25 \cdot 10^{-8}
rDPo := make_array(var,n);
                                varDPo := varcovar
:= .82831;
                                      v := .82831
Pi := array([seq(v,i=1..n)]);
    DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831]
:= .00005^2;
```

```
u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
    var:=
      .25 \cdot 10^{-8} .25 \cdot 10^{-8}
> varDPi := make_array(var,n);
                                     varDPi := varcovar
  Temperature (R) re
> v := 713;
                                            v := 713
> To := array([seq(v,i=1..n)]);
                     To := [713 \quad 713 \quad 713 \quad 713 \quad 713 \quad 713 \quad 713]
> u := (.005*(v-460))^2;
                                          u := 1.600225
> var := array([seq(u,i=1..n)]);
    var := [
      1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225
> varTo := make_array(var,n);
                                     varTo:= varcovar
> v := 1140;
                                           v := 1140
> Ti:= array([seg(v,i=1..n)]);
                 Ti := [1140 \ 1140 \ 1140 \ 1140 \ 1140 \ 1140 \ 1140 \ 1140]
> u := (.005*(v-460))^2;
                                         u := 11.560000
> var := array([seq(u,i=1..n)]);
         var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
          11.560000 11.560000]
> varTi := make_array(var,n);
                                     varTi := varcovar
  Moisture in Ash re
> Mf :=0.06;
                                           Mf := .06
```



	varMf:=.005368101168	
Ash re		
A := 0.0619;		
	A := .0619	
varA := ((0.07+0.02*A)/(2*1.414))^2;	
· ((o.o. · · / / / / / / / / /	varA := .0006345482144	
Overhead re		
OUHD := 0.9;		
	<i>OUHD</i> := .9	
varOUHD := (0.1*OUHD)	1^2.	
781 COID (0.1 COID)	varOUHD := .0081	
Carbon re		
C := 0.7381;		
0 0001,	C := .7381	
varC := (0.64/(2*1.414))^		
varc := (0.04/(2 1.414))"	varC:= .05121546706	
	Varc := :03121340700	
Hydrogen re		
H := 0.0482;	0.402	
	H := .0482	
varH := (0.16/(2*1.414))^		
	varH:=.003200966692	
Nitrogen re		
N := 0.0135;		
	N:= .0135	
varN := (0.11/(2*1.414))^	2;	
	varN:=.001512956913	
Sulfur re		
S := 0.0123;		
	S := .0123	
varS := ((0.06+0.035*S)/	(2*1.414))^2;	
•	vars := .(x)004566185652	
CO2 re		

```
> v := 14.145;
                                       v := 14.145
> CO20 := array([seq(v,i=1..n)]);
       CO2o := [14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145]
> u := (0.03*v)^2;
                                     u := .1800729225
> var := array([seq(u,i=1..n)]);
        var:=[.1800729225 .1800729225 .1800729225 .1800729225 .1800729225
          .1800729225 .1800729225 .1800729225]
> varCO2o := make_array(var,n);
                                 varCO2o := varcovar
> v := 15.2148;
                                       v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
   CO2i := [15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148]
> u := (0.03^{\circ}v)^{2};
                                     u := .2083411251
> var := array([seq(u,i=1..n)]);
        var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251
          .2083411251 .2083411251 .2083411251]
> varCO2i := make_array(var,n);
                                 varCO2i := varcovar
 O<sub>2</sub> re
> v := 5;
                                          v := 5
> O2o := array([seq(v,i=1..n)]);
                            020:=[5 5 5 5 5 5 5 5]
> u := (0.05)^2;
                                        u := .0025
> var := array([seq(u,i=1..n)]);
            var := [.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
> varO2o := make_array(var,n);
                                  var02o:= varcovar
> v := 3.8;
                                         v := 3.8
```

```
O2i := array([seq(v,i=1..n)]);
                  02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8]
u := (0.05)^2;
                                      u := .0025
var := array([seq(u,i=1..n)]);
          var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
varO2i := make_array(var,n);
                                var02i := varcovar
Moisture (air) re
Wma := 0.013;
                                     Wma := .013
varWma := (.2*Wma)^2;
                                varWma := .676 	ext{ } 10^{-5}
СО ге
v := 0.005;
                                       v := .005
COo := array([seq(v,i=1..n)]);
              u := (0.001)^2;
                                     u := .1 \cdot 10^{-5}
var := array([seq(u,i=1..n)]);
 var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
varCOo := make_array(var,n);
                                varCOo := varcovar
v := 0.005;
                                       v := .005
COi := array([seq(v,i=1..n)]);
               u := (0.001)^2;
                                     u := .1 \cdot 10^{-5}
var := array([seq(u,i=1..n)]);
  var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
varCOi := make_array(var,n);
                                 varCOi := varcovar
```

Carbon in Ash re						
> Ca := 0.0486;						
	Ca := .0486					
> varCa := (0.1*Ca)^2;						
	Ca := .000023	6196				
Results						
eval(O2aveo);						
eval(sigmaO2aveo);						
eval(CO2aveo);						
eval(sigmaCO2aveo);						
eval(COaveo);						
eval(sigmaCOaveo);						
eval(O2avei);						
eval(02avei);						
evan(sigmaOzaver),						
> eval(CO2avel);						
, cva.(002avo.),	15.21479999					
> eval(sigmaCO2avei);	13.21477777					
> evai(sigmacOzaver);	17122222	f > 4		. 180	4	
	.1613773238	101	15: 13	X V 1/13	= 0.10 Los	,
> eval(100*sigmaCO2avei/CO2avei);						
	1.060660172					
eval(COavei);						
eval(sigmaCOavei);						
>						



```
Random Error Propagation Calculations, Part A, CO2i
Set no. of sample points
n := 12;
                                     n := 12
procedure for creating variance-covariance matrix
make array := proc(var,n)
varcovar := array(1..n,1..n);
or i to n do
lor i to n do
if i = j then
varcovar[i,]] := sqrt(var[i]*var[j])
else
 varcovar[i,j] := 0
od
od:
varcovar:
end:
Warning, 'varcovar' is implicitly declared local
Warning, 'i' is implicitly declared local
Warning, 'j' is implicitly declared local
make_array :=
     proc(var,n)
     local varcovar, i, j;
         varcovar := array(1 .. n,1 .. n);
         for i to n do
```

```
if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                  else varcovar[i,j] := 0
                  fi
              ođ
          od;
          varcovar
      end
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 + + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'MFG' is implicitly declared local
 MFG :=
 proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 local Cr,Cb,K3,K4,MFG;
     Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
     K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
 end
 #6
• M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
· Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

for j to n do

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma°((28.02°(100-CO[x]-CO2[x]-O2[x])°K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
  end
> CO2avei := sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/
> 2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*CO2i[i],i=1..n)/sum((DPi[i
> \(Ti[i]^M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)^(1-MFG(i,A,OUHD,C
> a,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1..n):
> sigmaCO2avei := sqrt(
> Diff(CO2avei,A)^2*varA +
> Diff(CO2avei,OUHD)^2*varOUHD +
> Diff(CO2avel,Ca)^2*varCa +
```

```
> Diff(CO2avel,C)^2*varC +
> Diff(CO2avei,S)^2*varS +
> Diff(CO2avei,H)^2*varH +
> Diff(CO2avel,Wma)^2*varWma +
> Diff(CO2avei,N)^2*varN +
> Diff(CO2avei,Mf)^2*varMf +
> sum(
> Diff(CO2avel,DPi[i])*Diff(CO2avel,DPi[i])*varDPi[i,i] +
> Diff(CO2avei,Ti[i])*Diff(CO2avei,Ti[i])*varTi[i,i] +
> Diff(CO2avei,COi[i])*Diff(CO2avei,COi[i])*varCOi[i,i] +
> Diff(CO2avel,CO2i[i])*Diff(CO2avei,CO2i[i])*varCO2i[i,i] +
   Diff(CO2avei,O2i[i])*Diff(CO2avei,O2i[i])*varO2i[i,i]
> ,i=1..n)):
> sigmaCO2avei := value("):
  Constants
  Coal Feed Rate (lbs/hr) re
> Wfe := 115839:
                                     Wfe := 115839
> varWfe := (0.0025*Wfe)^2;
                                 varWfe := 83866.71200
  Area (square ft) re
> Areal := 3.99;
                                     Areai := 3.99
> varAreai := (0.0335*Areai)^2;
                               varAreai := .01786633223
> Areao := 3.54;
                                     Areao := 3.54
> varAreao := (0.0364*Areao)^2;
                               varAreao := .01660386874
```

```
Pitot Coefficient re
 > CP := 0.84;
                                                                                                                                           CP := .84
 > varCP := 0^2;
                                                                                                                                        varCP := 0
         Pressure Ambient or Barometric re
 > PSi := 29.23;
                                                                                                                                      PSi := 29.23
 > varPSi := (0.04)^2;
                                                                                                                               varPSi := .0016
 > PSo := 29.1;
                                                                                                                                      PSo := 29.1
 > varPSo := (0.04)^2;
                                                                                                                              varPSo := .0016
        Velocity Head DP re
 > v := .45802:
                                                                                                                                      v := .45802
 > DPo := array([seq(v,i=1..n)]);
                   DPo := [.45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .4
                       .45802 .45802 .45802]
 > u := .00005^2;
                                                                                                                                 u := .25 \cdot 10^{-8}
 > var := array([seq(u,i=1..n)]);
                     var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
                          .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
 > varDPo := make array(var,n);
                                                                                                                   varDPo:=varcovar
 > v := .82831;
                                                                                                                                      v := .82831
> DPi := array([seq(v,i=1..n)]);
                  DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
                       .82831 .82831 .828311
> u := .00005^2:
```

```
u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
     var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
      .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
> varDPi := make_array(var,n);
                             varDPi := varcovar
  Temperature (R) re
> v := 713;
                                   v := 713
> To := array([seq(v,i=1..n)]);
       > u := (.005*(v-460))^2;
                                u := 1.600225
> var := array([seq(u,i=1..n)]);
     1.600225 1.600225 1.600225 1.600225 1.600225]
> varTo := make_array(var,n);
                             varTo:= varcovar
> v := 1140;
                                  v := 1140
> Ti:= array([seq(v,i=1..n)]);
    Ti :=
     > u := (.005*(v-460))^2;
                                u := 11.560000
> var := array([seq(u,i=1..n)]);
       var := [11.56(XXX) - 11.56(XXX) - 11.56(XXX) - 11.56(XXX) - 11.56(XXX) - 11.56(XXX)
        11.560000 11.560000 11.560000 11.560000 11.560000 1
> varTi := make_array(var,n);
                             varTi := varcovar
 Moisture in Ash re
> Mf := 0.06;
                                  Mf := .06
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;
                           varMf := .00001058319613
```

	
Ash re	
> A := 0.0619;	
A := .0619	
> varA := ((0.07+0.02*A*100)/(2*1.414*100))^2;	
$varA := .4696223261 \cdot 10^{-6}$	
Overhead re	
> OUHD := 0.9;	
<i>OUHD</i> := .9	
> varOUHD := (0.1*OUHD)^2;	
<i>varOUHD</i> := .0081	
Carbon re	
> C := 0.7381;	
C:=.7381	
> varC := (0.64/(2*1.414*100))^2;	
varC := .5121546706 10 ⁻⁵	
Valc .= .5121340700 10	
Hydrogen re	
> H := 0.0482;	
H:= .0482	
> varH := (0.16/(2*1.414*100))^2;	
varH := .3200966692 10 ⁻⁶	
Nitrogen re	
> N := 0.0135;	
N:= .0135	
> varN := (0.11/(2*1.414*100))^2;	
varN:=.1512956913 10 ⁻⁶	
Sulfur re	
> S := 0.0123;	*
S := .0123	
> varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;	
vars:=.1327813813 10 ⁻⁶	
CO2	
CO2 re	

> v := 14.145;v := 14.145> CO20 := array([seq(v,i=1..n)]); 14.145 14.145 14.145] > u := (0.03°v)^2; u := .1800729225> var := array([seq(u,i=1..n)]); $var := \{.1800729225 \ .180072925 \ .180072925 \ .180072925 \ .180072925 \ .180072925 \ .180072925 \ .180072925 \$.1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .18007292 .18007292251 > varCO2o := make_array(var,n); varCO2o := varcovar > v := 15.2148; v := 15.2148> CO2i := array([seq(v,i=1..n)]); $CO2i := [15.2148 \quad 15.2148 \quad 15.21$ 15.2148 15.2148 15.2148 15.2148] > u := (0.03*v)^2; u := .2083411251> var := array([seq(u,i=1..n)]); $var := [.2083411251 \ .2083411251 \ .2083411251 \ .2083411251 \ .2083411251$.2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .208341125 .2083411251] > varCO2i := make_array(var,n); varCO2i := varcovar O2 re > V := 5; v := 5> O2o := array([seq(v,i=1..n)]); $> u := (0.05)^2;$ u := .0025> var := array([seq(u,i=1..n)]); $var := [.0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025$

.0025 .0025]

```
> varO2o := make_array(var,n);
                                                                                                                varO2o:= varcovar
 > v := 3.8;
                                                                                                                                      v := 3.8
 > O2i := array([seq(v,i=1..n)]);
                                     02i := [3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.
 > u := (0.05)^2;
                                                                                                                                   u := .0025
 > var := array([seq(u,i=1..n)]);
                       var := [.0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025
                            .0025 .0025]
 > varO2i := make_array(var,n);
                                                                                                              var02i := varcovar
      Moisture (air) re
> Wma := 0.013;
                                                                                                                                Wma := .013
> varWma := (.2*Wma)^2;
                                                                                                                varWma:=.676 10<sup>-5</sup>
      CO re
 > v := 0.005;
                                                                                                                                    v := .005
> COo := array([seq(v,i=1..n)]);
               COO := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
> u := (0.001)^2;
                                                                                                                             u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
                \textit{var} := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
                    .1 10-5 .1 10-5 .1 10-5 .1 10-5
> varCOo := make_array(var,n);
                                                                                                              varC0o:= varcovar
> v := 0.005:
                                                                                                                                    v := .005
> COi := array([seq(v,l=1..n)]);
```

COI:=[.005 .005 .005 .005 .005 .005 .005 .005	105
> u := (0.001)^2;	
$u := .1 \cdot 10^{-5}$	
> var := array([seq(u,i=1n)]);	
$var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 \end{bmatrix}$	145
	10
.1 10 ⁻⁵ .1 10 ⁻⁵ .1 10 ⁻⁵ .1 10 ⁻⁵]	
> varCOi := make_array(var,n);	
varCOi := varcovar	
Carbon in Ash re	
> Ca := 0.0486; Ca := .0486	
> varCa := (0.1°Ca)^2;	
varCa := .0000236196	
Val Ca0000250170	
Results	
eval(O2aveo);	
eval(sigmaO2aveo);	
eval(CO2aveo);	
eval(sigmaCO2aveo);	
eval(COaveo);	
eval(sigmaCOaveo);	
eval(O2avei);	
eval(sigmaO2avei);	
> eval(CO2avel);	
15.21479999	
> aval/sigmaCO2avai):	
.1317640331 FOL H: 20 y (1/20 = 0.1028L)	
> eval(100*sigmaCO2avei/CO2avei);	
,	
eval(COavei);	
eval(sigmaCOavei);	

Appendix D-2 Random Error Calculation Inlet Flue Gas Average CO Concentration

```
Random Error Propagation Calculations, Part A, COi
  Set no. of sample points
> n := 8;
                                        n := 8
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i = j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
          varcovar := array(1 .. n,1 .. n);
```

for j to n do

```
for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
               od
          od;
          varcovar
 #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{OUHD^{Ca}}/(1-Ca) + (A^{(1-OUHD)^{Ca}})/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01^{\circ}S/32.07)/(12.01^{\circ}(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02°(100-CO[x]-CO2[x]-O2[x])°K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936*H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
        8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
  end
> COavei := sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2
> *(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*COi[i],I=1..n)/sum((DPi[i]/(
> Ti[i]*M(I,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2I,N,Mf)))^(1/2)*(1-MFG(I,A,OUHD,Ca,
> C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1..n):
> sigmaCOavei := sqrt(
> Diff(COavei,A)^2*varA +
> Diff(COavei,OUHD)^2*varOUHD +
> Diff(COavei,Ca)^2*varCa +
> Diff(COavei,C)^2*varC +
> Diff(COavei,S)^2*varS +
> Diff(COavei,H)^2*varH +
```

> Diff(COavei,Wma)^2*varWma +
> Diff(COavei,N)^2*varN +
> Diff(COavel,Mf)^2*varMf +
> sum(
> Diff(COavel,DPi[i])*Diff(COavel,DPi[i])*varDPi[i,i] +
> Diff(COavel,Ti[i])*Diff(COavei,Ti[i])*varTi[i,i] +
> Diff(COavel,COi[i])*Diff(COavel,COi[i])*varCOi[i,i] +
> Diff(COavel,CO2i[i])*Diff(COavel,CO2i[i])*varCO2i[i,i] +
> Diff(COavel,O2i[i])*Diff(COavel,O2i[i])*varO2i[i,i]
> ,l=1n)):
> sigmaCOavei := value("):
Constants
Coal Feed Rate (lbs/hr) re
> Wfe := 115839;
Wfe := 115839
> varWfe := (0.0025*Wfe)^2;
varWfe:= 83866.71200
Area (square ft) re
> Areal := 3.99;
Areai := 3.99
> varAreai := (0.0335*Areai)^2;
varAreai := (0.0555 Areai) 2,
VarArea1 .= .01760033223
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874
VALLE ONC 1

```
Pitot Coefficient re
 > CP := 0.84;
                                                                                                                                                  CP := .84
 > varCP := 0^2;
                                                                                                                                              varCP := 0
        Pressure Ambient or Barometric re
  > PSi := 29.23;
                                                                                                                                             PSi := 29.23
> varPSi := (0.04)^2;
                                                                                                                                       varPSi := .0016
 > PSo := 29.1;
                                                                                                                                               PSo := 29.1
  > varPSo := (0.04)^2;
                                                                                                                                        varPSo := .0016
        Velocity Head DP re
  > v := .45802;
                                                                                                                                                 v := .45802
  > DPo := array([seq(v,i=1..n)]);
                                 DPo:=[.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802]
    > u := .00005^2;
                                                                                                                                            u := .25 \cdot 10^{-8}
    > var := array([seq(u,l=1..n)]);
                 var:=
                       .25 	ext{ } 10^{-8} 	ext{ } 
    > varDPo := make_array(var,n);
                                                                                                                              varDPo := varcovar
    > v := .82831;
                                                                                                                                                  v := .82831
    > DPi := array([seq(v,i=1..n)]);
                                 DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831]
    > u := .00005^2;
```

```
u := .25 \cdot 10^{-8}
> var := array([seq(u,l=1..n)]);
    var:=
     .25 \ 10^{-8} .25 \ 10^{-8} .25 \ 10^{-8} .25 \ 10^{-8} .25 \ 10^{-8} .25 \ 10^{-8} .25 \ 10^{-8}
> varDPi := make_array(var,n);
                               varDPi := varcovar
  Temperature (R) re
> v := 713;
                                      v := 713
> To := array([seq(v,i=1..n)]);
                  To := [713 \ 713 \ 713 \ 713 \ 713 \ 713 \ 713 \ 713]
> u := (.005*(v-460))^2;
                                   u := 1.600225
> var := array([seq(u,l=1..n)]);
   var := [
     1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225
> varTo := make_array(var,n);
                                varTo:= varcovar
> v := 1140;
                                     v := 1140
> Ti:= array([seq(v,i=1..n)]);
              > u := (.005*(v-460))^2;
                                   u := 11.560000
> var := array([seq(u,i=1..n)]);
       var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
         11.560000 11.5600001
> varTi := make_array(var,n);
                                varTi := varcovar
  Moisture in Ash re
> Mf :=0.06;
                                     Mf := .06
```

> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;	
varMf := .00001058319613	
Ash re	
> A := 0.0619;	
A := .0619	
> varA := ((0.07+0.02*A*100)/(2*1.414*100))^2;	
varA := .4696223261 10 ⁻⁶	
Overhead re > OUHD := 0.9;	
OUHD := .9	
> varOUHD := (0.1*OUHD)^2;	
varOUHD:=.0081	
Carbon re	
> C := 0.7381;	
C:=.7381	
> varC := (0.64/(2*1.414*100))^2;	
$varC := .5121546706 \ 10^{-5}$	
Hydrogen re	
> H := 0.0482;	
H := .0482	
> varH := (0.16/(2*1.414*100))^2;	
$varH := .3200966692 \cdot 10^{-6}$	
VaIIIJ_007000072 10	
Nitrogen re	
> N := 0.0135;	
N:= .0135	
> varN := (0.11/(2*1.414*100))^2;	
varN:=.1512956913 10 ⁻⁶	
Sulfur re	
> S := 0.0123;	
S := 0.0123	
> varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;	
**	
vars:=.1327813813 10 ⁻⁶	

```
CO2 re
 > v := 14.145;
                                                                                                                      v := 14.145
 > CO2o := array([seq(v,i=1..n)]);
                       CO2o := \{14.145 \quad 14.145 \}
 > u := (0.03°v)^2:
                                                                                                             u := .1800729225
 > var := array([seq(u,l=1..n)]);
                         var:=[.1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                             .1800729225 .1800729225 .1800729225]
 > varCO2o := make_array(var,n);
                                                                                                   varCO2o := varcovar
 > v := 15.2148;
                                                                                                                   v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
          CO2i := \{15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \}
> u := (0.03^{\circ}v)^{2};
                                                                                                             u := .2083411251
> var := array([seq(u,i=1..n)]);
                         var := [.2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .208411251 .208411251 .2084111251 .2084111251 .2084111251 .2084111251 .208411125
                             .2083411251 .2083411251 .2083411251]
> varCO2i := make_array(var,n);
                                                                                                  varC02i := varcovar
      O<sub>2</sub> re
 > v := 5;
                                                                                                                            v := 5
 > O2o := array([seq(v,i=1..n)]);
                                                                                  020 := [5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5]
 > u := (0.05)^2;
                                                                                                                      u := .0025
> var := array([seq(u,i=1..n)]);
                                     var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025]
 > varO2o := make_array(var,n);
                                                                                                     var02o:= varcovar
```

```
> v := 3.8;
                                            v := 3.8
> O2i := array([seq(v,i=1..n)]);
                       02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                           u := .0025
> var := array([seq(u,i=1..n)]);
             var := [.0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025]
> varO2i := make_array(var,n);
                                     var02i := varcovar
  Moisture (air) re
> Wma := 0.013:
                                          Wma := .013
> varWma := (.2*Wma)^2;
                                     varWma := .676 \cdot 10^{-5}
  CO re
> v := 0.005;
                                           v := .005
> COo := array([seq(v,i=1..n)]);
                  > u := (0.001)^2;
                                         u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
   var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
> varCOo := make_array(var,n);
                                    varCOo:= varcovar
> v := 0.005;
                                           v := .005
> COi := array([seq(v,i=1..n)]);
                  COi := [.005 .005 .005 .005 .005 .005 .005]
> u := (0.001)^2;
                                         u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
   var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
```

ニング

<pre>> varCOi := make_array(var,n);</pre>			
	varCOi := varcov	ar	
Carbon in Ash re			
> Ca := 0.0486;			
, , , , , , , , , , , , , , , , , , , ,	Ca := .0486		
> varCa := (0.1*Ca)^2;			
·	varCa:=.00002361	96	
			
Results			
eval(O2aveo);	· · · · · · · · · · · · · · · · · · ·		
eval(sigmaO2aveo);			
eval(CO2aveo);			
eval(sigmaCO2aveo);			
eval(COaveo);			
eval(sigmaCOaveo);			
eval(O2avei);			
eval(sigmaO2avei);	· · · · · · · · · · · · · · · · · · ·		
eval(CO2avei);		· · · · · · · · · · · · · · · · · · ·	
eval(sigmaCO2avei);			
> eval(COavei);			
	.004999999996		
> eval(sigmaCOavei);			
	.0003535533905	FOR N: 15	X 1 = 0000224
> eval(100*sigmaCOavel/COavel			
	7.071067816	•	
>			
•			

Appendix D-3 Random Error Calculation Inlet Flue Gas Average O_2 Concentration

```
Random Error Propagation Calculations, Part A, O2i
 Set no. of sample points
> n := 8;
                                        n := 8
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i = j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
       proc(var,n)
       local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
```

```
for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
                   fi
              od
          od;
          varcovar
      end
  #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{OUHD^{Ca}}/(1-Ca) + (A^{(1-OUHD)^{Ca}})/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100°K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 M :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr.Cb, K3, K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+1
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K]
 end
> O2avei := sum((DPi[i]/(Tl[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)
> *(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*O2i[i],l=1..n)/sum((DPI[i]/(T
> i[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,
> S.COI.CO2I,H,Wma,O2I,N,Mf)),i=1..n):
> sigmaO2avei := sqrt(
> Diff(O2avei,A)^2*varA +
```

>	sigmaO2avei := value("):
>	,i=1n)):
>	Diff(O2avel,O2i[i])*Diff(O2avel,O2i[i])*varO2i[i,i]
>	Diff(O2avel,CO2i[i])*Diff(O2avel,CO2i[i])*varCO2i[i,i] +
>	Diff(O2avel,COi[i])*Diff(O2avel,COi[i])*varCOi[i,i] +
>	Diff(O2avel,Ti[i])*Diff(O2avel,Ti[i])*varTi[i,i] +
>	Diff(O2avel,DPi[i])*Diff(O2avel,DPi[i])*varDPi[i,i] +
>	sum(
>	Diff(O2avel,Mf)^2*varMf +
>	Diff(O2avel,N)^2*varN +
>	Diff(O2avel,Wma)^2*varWma +
>	Diff(O2avei,H)^2*varH +
>	Diff(O2avel,S)^2*varS +
>	Diff(O2avei,C)^2*varC +
>	Diff(O2avel,Ca)^2*varCa +
>	Diff(O2avei,OUHD)^2*varOUHD +

.

Wfe:= 115839	
2;	
varWfe := 83866.71200	
Areai := 3.99	
i)^2;	
varAreai := .01786633223	
Areao := 3.54	
ao)^2;	
varAreao:=.01660386874	
	<pre>Wfe := 115839 2; varWfe := 83866.71200 Areai := 3.99 i)^2; varAreai := .01786633223 Areao := 3.54 ao)^2;</pre>

```
Pitot Coefficient re
> CP := 0.84;
                                            CP := .84
> varCP := 0^2;
                                           varCP := 0
  Pressure Ambient or Barometric re
> PSi := 29.23;
                                          PSi := 29.23
> varPSi := (0.04)^2;
                                        varPSi := .0016
> PSo := 29.1:
                                           PSo := 29.1
> varPSo := (0.04)^2;
                                        varPSo := .0016
  Velocity Head DP re
> v := .45802;
                                           v := .45802
> DPo := array([seq(v,i=1..n)]);
         DPo := [.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802]
> u := .00005^2;
                                          u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
    var:=
      .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8}
> varDPo := make_array(var,n);
                                     varDPo := varcovar
> v := .82831;
                                           v := .82831
> DPI := array([seq(v,i=1..n)]);
         DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831]
> u := .00005^2;
```

```
u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
    var:=
      .25 \cdot 10^{-8} .25 \cdot 10^{-8}
> varDPi := make_array(var,n);
                                    varDPi := varcovar
  Temperature (R) re
> v := 713;
                                           v := 713
> To := array([seq(v,i=1..n)]);
                     To:=[713 713 713 713 713 713 713 713]
> u := (.005*(v-460))^2;
                                        u := 1.600225
> var := array([seq(u,i=1..n)]);
    var:=[
     1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225
> varTo := make_array(var,n);
                                     varTo:= varcovar
> v := 1140;
                                          v := 1140
> Ti:= array([seq(v,i=1..n)]);
                Ti := [1140 \ 1140 \ 1140 \ 1140 \ 1140 \ 1140 \ 1140 \ 1140]
> u := (.005*(v-460))^2;
                                        u := 11.560000
> var := array([seq(u,l=1..n)]);
        var := [11.560000 \ 11.560000 \ 11.560000 \ 11.560000 \ 11.560000 \ 11.560000]
          11.560000 11.560000]
> varTi := make_array(var,n);
                                    varTi := varcovar
  Moisture in Ash re
> Mf := 0.06;
                                          Mf := .06
```

	varMf := .00001058319613
Ash re	
> A := 0.0619;	
	A := .0619
> varA := ((0.07+0.02*	A*100)/(2*1.414*100))^2;
	varA:=.4696223261 10 ⁻⁶
Overhead re	
> OUHD := 0.9;	
	OUHD := .9
> varOUHD := (0.1*OU	JHD)^2;
•	varOUHD:=.0081
Carbon re	
> C := 0.7381;	
	C := .7381
> varC := (0.64/(2*1.41	4*100))^2;
	varC:=.5121546706 10 ⁻⁵
	Varc5121540700 10
Hydrogen re	
> H := 0.0482;	
, , , = 0.0 .02,	H := .0482
> varH := (0.16/(2*1.41	
> vaiii .= \0.10/(2 1.41)	
	varH:=.3200966692 10 ⁻⁶
Nitrogen re	
> N := 0.0135;	
	N := .0135
> varN := (0.11/(2*1.41	4*100))^2;
	varN:=.1512956913 10 ⁻⁶
Sulfur re	
> S := 0.0123;	
	S := .0123
> varS := ((0.06+0.035	'S*100)/(2*1.414*100))^2;
•••	vars:=.1327813813 10 ⁻⁶
	Vars := .132/613613 10

CO2 re	
> v := 14.145;	
v := 14.145	
> CO2o := array([seq(v,i=1n)]);	14145 141451
CO2o := [14.145	14.145 14.145]
> u := (0.03*v)^2;	
u := .1800729225	
> var := array([seq(u,i=1n)]);	
var:=[.1800729225 .1800729225 .1800729225 .1800729	225 .1800729225
.1800729225 .1800729225 .1800729225]	
> varCO2o := make_array(var,n);	
varCO2o := varcovar	
> v := 15.2148;	
v := 15.2148	
> CO2i := array([seq(v,i=1n)]);	
$CO2i := [15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148$	3 15.2148 15.21-
> u := (0.03°v)^2;	
u := .2083411251	
> var := array([seq(u,l=1n)]);	
var:=[.2083411251 .2083411251 .2083411251 .2083411	251 .2083411251
.2083411251 .2083411251 .2083411251]	
> varCO2l := make_array(var,n);	
varCO2i := varcovar	
O2 re	
> V := 5;	
v := 5	
> O2o := array([seq(v,l=1n)]);	
020:=[5 5 5 5 5 5 5 5]	
> u := (0.05)^2;	
u := .0025	
> var := array([seq(u,i=1n)]);	
	025 .00251
> varO2o := make array(var,n);	,
> varO20 := make_dray(var,n), varO20 := varcovar	
Val 020 Val COVal	

```
> v := 3.8;
                                              v := 3.8
> O2i := array([seq(v,i=1..n)]);
                        02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                             u := .0025
> var := array([seq(u,i=1..n)]);
              var := [.0025 .0025
                                       .0025 .0025 .0025 .0025 .0025 .0025]
> varO2l := make_array(var,n);
                                      var02i := varcovar
  Moisture (air) re
> Wma := 0.013;
                                            Wma := .013
> varWma := (.2*Wma)^2;
                                      varWma := .676 	ext{ } 10^{-5}
 CO re
> v := 0.005;
                                             v := .005
> COo := array([seq(v,i=1..n)]);
                   COo := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
> u := (0.001)^2;
                                           u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
    var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
> varCOo := make_array(var,n);
                                      varCOo:= varcovar
> ∀ := 0.005;
                                             v := .005
> COi := array([seq(v,l=1..n)]);
                   COi := \{.005, .005, .005, .005, .005, .005, .005, .005\}
> u := (0.001)^2;
                                           u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
    var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
```

varCOi := make_array(var,n);		
v	arCOi:=varcova	r
Control in Ash as		
Carbon in Ash re Ca := 0.0486;		
Ca := 0.0486;		
	Ca := .0486	
varCa := (0.1°Ca)^2;		
v	arCa:=.000023619	6
Results		
eval(O2aveo);		
eval(sigmaO2aveo);		
	A	
eval(CO2aveo);	4	**************************************
eval(sigmaCO2aveo);		
eval(COaveo);		
eval(sigmaCOaveo);		· · · · · · · · · · · · · · · · · · ·
eval(O2avei);		
	3.800000000	
eval(sigmaO2avei);		
	.01767766953	FOR N: 23 . 017678 x 13
eval(100*sigmaO2avei/O2avei);		= 0.0118
,,	.4652018297	0.07718
	.4032010277	
eval(CO2avei);		
eval(cOzavei); eval(sigmaCO2avei);		
Craiting Coarety,		
eval(COavei);		
eval(sigmaCOavei);		

Appendix E-1 Random Error Calculation Outlet Flue Gas Average CO₂ Concentration

```
Random Error Propagation Calculations, Part A, CO2o
  Set no. of sample points
> n := 8;
                                        n := 8
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i = j then
> varcovar[i,i] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi
> od
> od;
> varcovar;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
```

```
for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
                   fi
              ođ
          od:
          varcovar
      end
 #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
           'K4' is implicitly declared local
 Warning, 'MFG' is implicitly declared local
 MOFG :=
 proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016 \text{ K}4 + \text{K}3^{\circ}(288.08 \text{ CO}2[x] + 71.70 \text{ O}2[x] + 50480.8))/(\text{K}4 + 1801.6 \text{ K}3)
> end;
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 M :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr.Cb.K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
 end
> CO2aveo := sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))
> ^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*CO2o[i],i=1..n)/su
> m((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG-
> i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)),i=1..n):
> sigmaCO2aveo := sgrt(
> Diff(CO2aveo,A)^2*varA +
> Diff(CO2aveo,OUHD)^2*varOUHD +
> Diff(CO2aveo,Ca)^2*varCa +
> Diff(CO2aveo,C)^2*varC +
> Diff(CO2aveo,S)^2*varS +
```



Diff(CO2aveo,H)^2*varH +
Diff(CO2aveo,Wma)^2*varWma +
Diff(CO2aveo,N)^2*varN +
Diff(CO2aveo,Mf)^2*varMf +
Din(40-1170), 1 va
sum(
Diff(CO2aveo,DPo[i])*Diff(CO2aveo,DPo[i])*varDPo[i,i] +
Diff(CO2aveo,To[i])*Diff(CO2aveo,To[i])*varTo[i,l] +
Diff(CO2aveo,COo[i])*Diff(CO2aveo,COo[i])*varCOo[i,i] +
Diff(CO2aveo,CO2o[i])*Diff(CO2aveo,CO2o[i])*varCO2o[i,i] +
Diff(CO2aveo,O2o[i])*Diff(CO2aveo,O2o[i])*varO2o[i,i]
i=1n)):
. (1)
sigmaCO2aveo := value("):
Constants
Coal Feed Rate (lbs/hr) re
Wfe := 115839;
Wfe:= 115839
/arWfe := (0.0025*Wfe)^2;
varWfe:= 83866.71200
Area (square ft) re
Areai := 3.99;
Areai := 3.99
varAreai := (0.0335*Areai)^2;
varAreai := .01786633223
A 2.54.
Areao := 3.54;
Areao := 3.54

```
> varAreao := (0.0364*Areao)^2;
                                 varAreao := .01660386874
 Pitot Coefficient re
> CP := 0.84;
                                          CP := .84
> varCP := 0^2;
                                         varCP := 0
  Pressure Ambient or Barometric re
> PSI := 29.23;
                                        PSi := 29.23
> varPSi := (0.04)^2;
                                      varPSi := .0016
> PSo := 29.1;
                                         PSo := 29.1
> varPSo := (0.04)^2;
                                      varPSo := .0016
  Velocity Head DP re
> v := .45802;
                                         v := .45802
> DPo := array([seq(v,i=1..n)]);
         DPo := [.45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802]
> u := .00005^2;
                                        u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
    var:=
      .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
> varDPo := make_array(var,n);
                                    varDPo:= varcovar
> v := .82831;
                                         v := .82831
> DPi := array([seq(v,i=1..n)]);
         DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831]
```

:= .00005^2;	> varMf :=
u := .25 10 ⁻⁸	> varion
ır := array([seq(u,i=1n)]);	
var :=	Ash re
.25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}	> A := 0.0
	> varA :=
rDPi := make_array(var,n);	
varDPi := varcovar	
, /D)	Overhea
:= 713;	> OUHD :
v = 713	
) := array([seq(v,i=1n)]);	> varOUH
To:=[713 713 713 713 713 713 713 713]	
:= (.005*(v-460))^2;	Carbon
u := 1.600225	> C := 0.7
ır := array([seq(u,i=1n)]);	700
var := [> varC :=
1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
1	
arTo := make_array(var,n);	Hydroge
varTo := varcovar	> H := 0.0
:= 1140;	> varH :=
v := 1140	
:= array([seq(v,i=1n)]);	
Ti := [1140 1140 1140 1140 1140 1140 1140 114	Nitroger
:= (.005*(v-460))^2;	> N := 0.0
u := 11.560000	
ar := array([seq(u,i=1n)]);	> varN :=
var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000	
11.560000 11.560000]	
arTi := make_array(var,n);	Sulfur > S := 0.0
varTi := varcovar	> 5 := 0.0
loisture in Ash re	> varS :=
If :=0.06;	

	Mf := .06
> varMf := ((0.2+0.12*Mf)/(2*1.4	14))^2;
	varMf := .(X)5368101168
Ash re	
> A := 0.0619;	A := .0619
> varA := ((0.07+0.02*A)/(2*1.4	
> VarA := ((0.07+0.02 A)(2 1.4	varA := .0006345482144
Overhead re	
> OUHD := 0.9;	
	OUHD := .9
> varOUHD := (0.1*OUHD)^2;	
•	varOUHD := .0081
Carbon re	
> C := 0.7381;	
	C := .7381
> varC := (0.64/(2*1.414))^2;	
	varC := .05121546706
Hydrogen re	
> H := 0.0482;	0492
	H := .0482
> varH := (0.16/(2*1.414))^2;	002000044402
	varH:= .003200966692
Nitrogen re > N := 0.0135;	
> 14 .= 0.0133,	N := .0135
- MarN (0.11//241.414\\A2+	
> varN := (0.11/(2*1.414))^2;	varN:= .001512956913
	Valiv001312230213
Sulfur re	
> S := 0.0123;	
, C	s := .0123
> varS := ((0.06+0.035*S)/(2*1.	414))^2:
> 4410 .= ((0.0010.000 Op(z 1.	vars := .(XXX4566185652

v := 14.145;				_				
		1	z := 14.14	5				
CO2o := array([se	q(v,i=1n)])	;						
CO2o := [14.1		14.145	14.145	14.145	14.145	14.145	14.	145]
u := (0.03°v)^2;								
		u :=	: .1800729	9225				
var := array([seq(u,i=1n)]);							
var:=[.180	0729225 .1	80072922	.1800	729225	.180072	9225 .	18007	29225
	5 .1800729		00729225					
varCO2o := make	_array(var,ı	1);						
		varC0	20 := va	rcovar				
v := 15.2148;			. 1601	40				
			r := 15.21	48				
CO2i := array([se				15014	0 1631	40 15	2148	15.2148
CO2i := [15.2148	15.2148	15.2148	15.2148	15.214	8 15.21	48 13.	2140	13.2140
u := (0.03*v)^2;								
		u ::	208341 =	1251				
var := array([seq(u,i=1n)]);						00024	11261
var:=[.208	3411251 .2			3411251	.20834	11251 .	20834	11251
var:=[.208	u,i=1n)]); 3411251 .2 51 .2083411		51 .2083)8341125		.208341	11251 .	20834	11251
var:=[.208 .208341125	3411251 .2 51 .2083411	1251 .20			.208341	11251 .	20834	11251
var:=[.208 .208341125	3411251 .2 51 .2083411	1251 .20 1);		1]		11251 .	20834	11251
var:=[.208 .208341125	3411251 .2 51 .2083411	1251 .20 1);	08341125	1]			20834	11251
var := [.208	3411251 .2 51 .2083411	1251 .20 1);	08341125	1]			20834	11251
var := [.208	3411251 .2 51 .2083411	1251 .20 1);	08341125 02i := va	1]			20834	11251
var := [.208	3411251 .2 51 .2083411 _array(var,r	1251 .20 n); varCC	08341125	1]			20834	11251
var := [.208	3411251 .2 51 .2083411 _array(var,r	1251 .20 n); varCo	08341125 02i := va v := 5	l]			20834	11251
.208341125 varCO2i := make O2 re v := 5; O2o := array([sec	3411251 .2 51 .2083411 _array(var,r	1251 .20 n); varCo	08341125 02i := va	l]			20834	11251
var := [.208	3411251 .2 51 .2083411 _array(var,r	1251 .20 n); varCo	08341125 02i := va v := 5 5 5 5	1] arcovar			20834	11251
var := [.208 .208341125 varCO2i := make	3411251 .2 51 .2083411 _array(var,r q(v,i=1n)]);	1251 .20 n); varCo	08341125 02i := va v := 5	1] arcovar			20834	11251
var := [.208 .208341125 varCO2i := make O2 re · v := 5; · O2o := array([sec	3411251 .2 51 .2083411 _array(var,r q(v,i=1n)]); 02	1251 .20 n); varco i o := 5	08341125 02i := va v := 5 5 5 5 u := .002	5 5 25	5 5]			
var := [.208 .208341125 varCO2i := make O2 re · v := 5; · O2o := array([sec · u := (0.05)^2; · var := array([seq var :=	(u,i=1n)]); [.0025 .00	1251 .20 a); varCC : : : : : : : : : : : : :	08341125 02i := va v := 5 5 5 5 u := .002	1] arcovar	5 5]		.0025]	
var := [.208 .208341125 varCO2i := make O2 re · v := 5; · O2o := array([sec	(u,i=1n)]); [.0025 .00	1251 .20 a); varCo : : : : : : : : : : : : :	08341125 02i := va v := 5 5 5 5 u := .002	5 5 .0025	5 5]			

```
> v := 3.8;
                                               v := 3.8
> O2i := array([seq(v,i=1..n)]);
                        02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                              u := .0025
> var := array([seq(u,i=1..n)]);
              var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
> varO2i := make_array(var,n);
                                       var02i := varcovar
   Moisture (air) re
> Wma := 0.013;
                                              Wma := .013
 > varWma := (.2*Wma)^2;
                                        varWma := .676 \cdot 10^{-5}
   CO re
 > v := 0.005;
                                               v := .005
 > COo := array([seq(v,i=1..n)]);
                    COO := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
 > u := (0.001)^2;
                                             u := .1 \cdot 10^{-5}
 > var := array([seq(u,i=1..n)]);
     var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
 > varCOo := make_array(var,n);
                                        varCOo:= varcovar
 > v := 0.005;
                                                v := .005
 > COi := array([seq(v,i=1..n)]);
                     COi := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
 > u := (0.001)^2;
                                              u := .1 \cdot 10^{-5}
 > var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
```

arCOi := make_array(var,n);			
	varCOi := varcov	ar	
arbon in Ash re			
a := 0.0486;			
	Ca := .0486		
arCa := (0.1*Ca)^2;			
	varCa := .00002361	96	
		· · · · · · · · · · · · · · · · · · ·	
esults			
val(CO2aveo);			
· · · · · · · · · · · · · · · · · · ·	14.14500000		
val(sigmaCO2aveo);		······································	_
	.1500303812	FOR No 24	XV= .0866
val(100*sigmaCO2aveo/CO2a	aveo):		
	1.060660171		

Appendix E-2 Random Error Calculation Outlet Flue Gas Average CO Concentration

```
Random Error Propagation Calculations, Part A, COo
  Set no. of sample points
> n := 8;
                                        n := 8
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if I = J then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi
> od
> od;
> varcovar;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
```

```
for i to n do
                  if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                  else varcovar[i,j] := 0
                  fi
              ođ
          od;
          VARCOVAR
      end
 #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
       MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
  #6
 > M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 > Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
       K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*:
       M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
   end
> COaveo := sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))
```

> (1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*COo[i],i=1..n/sum(> DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A

> OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)),i=1..n):

> sigmaCOaveo := value("):
> sigmaCOaveo := sqrt(
> Diff(COaveo,A)*Diff(COaveo,A)*varA +
> Diff(COaveo,OUHD)*Diff(COaveo,OUHD)*varOUHD +
> Diff(COaveo,Ca)*Diff(COaveo,Ca)*varCa +
> Diff(COaveo,C)*Diff(COaveo,C)*varC +
> Diff(COaveo,S)*Diff(COaveo,S)*varS +
> Diff(COaveo,H)*Diff(COaveo,H)*varH +
> Diff(COaveo,Wma)*Diff(COaveo,Wma)*varWma +
> Diff(COaveo,N)*Diff(COaveo,N)*varN +
> Diff(COaveo,Mf)*Diff(COaveo,Mf)*varMf +
> sum(
> Diff(COaveo,DPo[i])*Diff(COaveo,DPo[i])*varDPo[i,i] +
> Diff(COaveo,To[i])*Diff(COaveo,To[i])*varTo[i,i] +
> Diff(COaveo,COo[i])*Diff(COaveo,COo[i])*varCOo[i,i] +
> Diff(COaveo,CO2o[i])*Diff(COaveo,CO2o[i])*varCO2o[i,i] +
> Diff(COaveo,O2o[i])*Diff(COaveo,O2o[i])*varO2o[i,i]
> ,i=1n)):

Constants		
Coal Feed Rate (lbs/hr) re		
> Wfe := 115839;		
, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Wfe:=115839	
> varWfe := (0.0025*Wfe)^2		
•	varWfe:= 83866.71200	
Area (square ft) re		
> Areal := 3.99;		
	Areai := 3.99	
> varAreal := (0.0335*Areal)	^2;	
•	varAreai := .01786633223	
> Areao := 3.54;		
	Areao := 3.54	
> varAreao := (0.0364*Area	o)^2;	
,	varAreao:=.01660386874	

```
Pitot Coefficient re
> CP := 0.84;
                                             CP := .84
> varCP := 0^2;
                                            varCP := 0
  Pressure Ambient or Barometric re
> PSi := 29.23;
                                           PSi := 29.23
> varPSi := (0.04)^2;
                                         varPSi := .0016
> PSo := 29.1;
                                            PSo := 29.1
> varPSo := (0.04)^2;
                                          varPSo := .0016
   Velocity Head DP re
> v := .45802;
                                             v := .45802
> DPo := array([seq(v,i=1..n)]);
         DPo := [.45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802]
> u := .00005^2;
                                           u := .25 \ 10^{-8}
 > var := array([seq(u,i=1..n)]);
     var:=
       .25 \cdot 10^{-8} .25 \cdot 10^{-8}
 > varDPo := make_array(var,n);
                                       varDPo := varcovar
 > v := .82831;
                                             v := .82831
 > DPi := array([seq(v,i=1..n)]);
          DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831]
 > u := .00005^2;
```

```
u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
   var:=
     .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
> varDPi := make_array(var,n);
                               varDPi := varcovar
  Temperature (R) re
> v := 713;
                                      v := 713
> To := array([seq(v,i=1..n)]);
                  To:=[713 713 713 713 713 713 713 713]
> u := (.005*(v-460))^2;
                                    u := 1.600225
> var := array([seq(u,i=1..n)]);
    var:=[
     1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.6002
> varTo := make_array(var,n);
                                 varTo := varcovar
 > v := 1140;
                                      v := 1140
> Ti:= array([seq(v,i=1..n)]);
               > u := (.005*(v-460))^2;
                                   u := 11.560000
 > var := array([seq(u,i=1..n)]);
        var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
         11.560000 11.560000]
 > varTi := make_array(var,n);
                                 varTi := varcovar
   Moisture in Ash re
 > Mf :=0.06;
                                      Mf := .06
```

<pre>varMf := ((0.2+0.12*</pre>	Mf*100)/(2*1.414*100))^2;	
	varMf:=.00001058319613	
Ash re		
A := 0.0619;	0.440	
	A := .0619	
varA := ((0.07+0.02	*A*100)/(2*1.414*100))^2;	
	varA:=.4696223261 10 ⁻⁶	
Overhead re		
OUHD := 0.9;		
•	<i>OUHD</i> := .9	
varOUHD := (0.1°O	UHD)^2:	
	varOUHD := .0081	
Carbon re		
C := 0.7381;		
•	C := .7381	
varC := (0.64/(2*1.4	14*100\\^2:	
1410:- (0.0 1/2 111	**	
	varC:=.5121546706 10 ⁻⁵	
Hydrogen re		
H := 0.0482;	0.400	
	н := .0482	
varH := (0.16/(2*1.4	14*100))^2;	
	varH:=.3200966692 10 ⁻⁶	
Nitrogen re		
N := 0.0135;		
	N:= .0135	
varN := (0.11/(2*1.4	14*100))^2;	
	_	
	varN:=.1512956913 10 ⁻⁶	
Sulfur re		
> S := 0.0123;	a. 0102	
	s:=.0123	·····
varS := ((0.06+0.03)	5*S*100)/(2*1.414*100))^2;	
	varS:=.1327813813 10 ⁻⁶	

```
CO<sub>2</sub> re
> v := 14.145;
                                        v := 14.145
> CO20 := array([seq(v,i=1..n)]);
       CO20 := [14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145 \quad 14.145]
> u := (0.03*v)^2;
                                      u := .1800729225
> var := array([seq(u,i=1..n)]);
        var:=[.1800729225 .1800729225 .1800729225 .1800729225 .1800729225
          .1800729225 .1800729225 .1800729225]
> varCO2o := make_array(var,n);
                                  varCO2o:= varcovar
> v := 15.2148;
                                        v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
   CO2i := [15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148
> u := (0.03°v)^2;
                                      u := .2083411251
> var := array([seq(u,i=1..n)]);
        var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251
          .2083411251 .2083411251 .2083411251]
> varCO2i := make_array(var,n);
                                  varCO2i := varcovar
  O<sub>2</sub> re
> v := 5;
                                           v := 5
> O2o := array([seq(v,l=1..n)]);
                             020 := [5 \ 5 \ 5 \ 5 \ 5 \ 5 \ 5]
> u := (0.05)^2;
                                         u := .0025
> var := array([seq(u,i=1..n)]);
             var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
> varO2o := make_array(var,n);
                                   var02o:= varcovar
```

```
> v := 3.8;
                                             v := 3.8
> O2i := array([seq(v,i=1..n)]);
                       02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                            u := .0025
> var := array([seq(u,l=1..n)]);
             var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
> varO2i := make array(var,n);
                                     varO2i := varcovar
  Moisture (air) re
> Wma := 0.013;
                                           Wma := .013
> varWma := (.2*Wma)^2;
                                      varWma := .676 \cdot 10^{-5}
  CO re
> v := 0.005;
                                            v := .005
> COo := array([seq(v,i=1..n)]);
                  COo := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
> u := (0.001)^2;
                                          u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
    var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
> varCOo := make_array(var,n);
                                     varCOo:= varcovar
 > V := 0.005;
                                             v := .005
 > COi := array([seq(v,i=1..n)]);
                   > u := (0.001)^2;
                                           u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
     var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
```

> varCOi := make_array(var,n)	;
	varCOi:=varcovar
Carbon in Ash re	
> Ca := 0.0486;	0.104
	Ca := .0486
> varCa := (0.1°Ca)^2;	
	varCa := .(XXX)236196
Results	
eval(O2aveo);	
eval(sigmaO2aveo);	
eval(CO2aveo);	
eval(sigmaCO2aveo);	
> eval(COaveo);	
	.005000000001
> eval(sigmaCOaveo);	
	.0003535533905 FOR N=14 x 1 : . COOLOH
> eval(100*sigmaCOaveo/COa	iveo);
	7.071067809
eval(O2avei);	
eval(sigmaO2avei);	
В ,	
eval(CO2avei);	
eval(sigmaCO2avei);	
eval(COavei);	
eval(sigmaCOavei);	
>	

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Appendix E-3 Random Error Calculation Outlet Flue Gas Average O_2 Concentration

```
Random Error Propagation Calculations, Part A, O2o
  Set no. of sample points
> n := 8;
                                       n := 8
procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i = j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fl
> od
> od;
> varcovar;
> end:
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
       proc(var,n)
       local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
```

```
for i to n do
                  if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                  else varcovar[i,j] := 0
                  fi
              ođ
          od;
          varcovar
      end
  #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,MI)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MOFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016°K4+K3°(288.08°CO2[x]+71.70°O2[x]+50480.8))/(K4+1801.6°K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
  end
  O2aveonum := sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,A
 1)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*O2o[i],l=1..n);
    02aveonum:= DPo
     160.9909760 H+18.01600000 %17+18.01600000 Mf
                                    8.9360000000 H + \%17 + Mf
     05550621670
                  .4960035524 H + .05550621670 %17 + .05550621670 Mf + 100.
```

ت حی آ

$$\%12 := 12.01000000 \quad Co2o_3 + 12.01000000 \quad Coo_3$$

$$\%13 := \\ Wma \left(36.46063760 \frac{\left(100. - 1. Coo_3 - 1. Co2o_3 - 1. O2o_3 \right) \%2}{\%12} - 1.301236174 \right) \\ \%14 := 12.01000000 \quad Co2o_2 + 12.01000000 \quad Coo_2$$

$$\%15 := \\ Wma \left(36.46063760 \frac{\left(100. - 1. Coo_2 - 1. Co2o_2 - 1. O2o_2 \right) \%2}{\%14} - 1.301236174 \right) \\ \%16 := 12.01000000 \quad Co2o_1 + 12.01000000 \quad Coo_1$$

$$\%17 := \\ Wma \left(36.46063760 \frac{\left(100. - 1. Coo_1 - 1. Co2o_1 - 1. O2o_1 \right) \%2}{\%16} - 1.301236174 \right) \\ > O2aveoden := sum((DPo[i]/(To[i]^*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,f)))^{-1.00}(1/2)^*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,f)),i=1..n):$$

$$O2aveo := O2aveonum/O2aveoden:$$

$$O2avei := sum((DPi[i]/(Ti[i]^*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^{-1.00}(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))^{-1.00}(1-MFG(i,A,OUHD,Ca,C,S,C$$

UHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO H,Wma,O2i,N,Mf)),i=1..n): #7

CO2aveo := sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-Mf (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)) *CO2o[i], i=1..n)/sum((DPo[i]/(To[i])) + (DPo[i]/(To[i])) + (DPo[i]/(To[i]/(To[i])) + (DPo[i]/(To[i]/(To[i])) + (DPo[i]/(To[iM(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C COo,CO2o,H,Wma,O2o,N,Mf)),i=1..n):

CO2avei := $A, OUHD, Ca, C, S, COi, CO2i, H, Wma, O2i, N, Mf) *CO2i[i], i=1...n \\ / sum((DPi[i]/(Ti[i]*M(i...)) + (DPi[i]/(Ti[i]) + (DPi[i]/(Ti[i])$ OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,C

> ,l=1n)):
> sigmaO2aveo := value("):
> sigmaO2aveo := sqrt(
> Diff(O2aveo,A)^2°varA +
> Diff(O2aveo,OUHD)^2*varOUHD +
> Diff(O2aveo,Ca)^2*varCa +
> Diff(O2aveo,C)^2*varC +
> Diff(O2aveo,S)^2*varS +
> Diff(O2aveo,H)^2*varH +
> Diff(O2aveo,Wma)^2*varWma +
> Diff(O2aveo,N)^2*varN +
> Diff(O2aveo,Mf)^2*varMf +
> sum(
> Diff(O2aveo,DPo[i])*Diff(O2aveo,DPo[i])*varDPo[i,l] +
> Diff(O2aveo,To[i])*Diff(O2aveo,To[i])*varTo[i,l] +
> Diff(O2aveo,COo[i])*Diff(O2aveo,COo[i])*varCOo[i,i] +
> Diff(O2aveo,CO2o[i])*Diff(O2aveo,CO2o[i])*varCO2o[i,i] +
> Diff(O2aveo,O2o[i])*Diff(O2aveo,O2o[i])*varO2o[i,i]

Constants
Coal Feed Rate (lbs/hr) re
> Wfe := 115839;
Wfe:= 115839
> varWfe := (0.0025*Wfe)^2;
varWfe:= 83866.71200
Area (square ft) re
> Areal := 3.99;
Areai := 3.99
> varAreal := (0.0335*Areai)^2;
varAreai := .01786633223
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874
Pitot Coefficient re
> CP := 0.84;
CP := .84
> varCP := 0^2;
varCP := 0

```
Pressure Ambient or Barometric re
> PSi := 29.23;
                                            PSi := 29.23
> varPSi := (0.04)^2;
                                          varPSi := .0016
> PSo := 29.1;
                                             PSo := 29.1
> varPSo := (0.04)^2;
                                          varPSo := .0016
   Velocity Head DP re
> v := .45802;
                                              v := .45802
 > DPo := array([seq(v,i=1..n)]);
          DPo:=[.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802]
 > u := .00005^2;
                                            u := .25 \cdot 10^{-8}
 > var := array([seq(u,l=1..n)]);
      var:=
       .25 \cdot 10^{-8} .25 \cdot 10^{-8}
 > varDPo := make_array(var,n);
                                        varDPo:= varcovar
  > v := .82831;
                                               v := .82831
 > DPI := array([seq(v,l=1..n)]);
           DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831]
  > u := .00005^2:
                                             u := .25 \cdot 10^{-8}
  > var := array([seq(u,i=1..n)]);
       vas:=
         .25 \cdot 10^{-8} .25 \cdot 10^{-8}
   > varDPI := make_array(var,n);
```

```
varDPi := varcovar
 Temperature (R) re
> v := 713;
                                    v := 713
> To := array([seq(v,i=1..n)]);
                 To:=[713 713 713 713 713 713 713 713]
> u := (0.005*(v-460))^2;
                                  u := 1.600225
> var := array([seq(u,i=1..n)]);
   var:=[
     1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.6002
> varTo := make_array(var,n);
                               varTo:= varcovar
> v := 1140;
                                    v := 1140
> Ti:= array([seq(v,i=1..n)]);
              > u := (0.005*(v-460))^2;
                                  u := 11.560000
 > var := array([seq(u,i=1..n)]);
       var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
         11.560000 11.560000]
 > varTi := make_array(var,n);
                               varTi := varcovar
   Moisture in Ash re
 > Mf :=0.06;
                                     ME := .06
 > varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;
                             varMf := .00001058319613
   Ash re
 > A := 0.0619;
                                     A := .0619
 > varA := (( 0.07+0.02*A*100)/(2*1.414*100))^2;
```

C:=.7381 varC := (0.64/(2*1.414*100))^2; varC:=.5121546706 10 ⁻⁵ Hydrogen re H:= 0.0482; H:=.0482 varH := (0.16/(2*1.414*100))^2; varH:=.3200966692 10 ⁻⁶ Nitrogen re N:= 0.0135; N:=.0135 varN := (0.11/(2*1.414*100))^2; varN:=.1512956913 10 ⁻⁶ Sulfur re S:= 0.0123; S:=.0123 varS:=.0123 varS:=.1327813813 10 ⁻⁶ CO2 re v:= 14.145; v:= 14.145	varA := .4696223261 10 ⁻⁶		
OUHD := 0.9; VarOUHD := (0.1*OUHD)^2; VarOUHD := .0081 Carbon re C := 0.7381; C := .7381 VarC := (0.64/(2*1.414*100))^2; VarC := .5121546706 10 ⁻⁵ Hydrogen re H := 0.0482; H := .0482 VarH := (0.16/(2*1.414*100))^2; VarH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 VarN := (0.11/(2*1.414*100))^2; VarN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 VarS := .((0.06+0.035*S*100)/(2*1.414*100))^2; VarS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; V := 14.145	Overhood we		
VarOUHD := (0.1*OUHD)^2; VarOUHD := .0081 Carbon re C := 0.7381; C := .7381 VarC := (0.64/(2*1.414*100))^2; VarC := .5121546706 10^-5 Hydrogen re H := 0.0482; H := .0482 VarH := (0.16/(2*1.414*100))^2; VarH := .3200966692 10^-6 Nitrogen re N := 0.0135; N := .0135 VarN := (0.11/(2*1.414*100))^2; VarN := (0.11/(2*1.414*100))^2; VarN := .1512956913 10^-6 Sulfur re S := 0.0123; S := .0123 VarS := .1327813813 10^-6 CO2 re V := 14.145; V := 14.145			
VarOUHD := (0.1*OUHD)^2; VarOUHD := .0081 Carbon re C := 0.7381; C := .7381 VarC := (0.64/(2*1.414*100))^2; VarC := .5121546706 10^5 Hydrogen re H := 0.0482; H := .0482 VarH := (0.16/(2*1.414*100))^2; VarH := .3200966692 10^6 Nitrogen re N := 0.0135; N := .0135 VarN := (0.11/(2*1.414*100))^2; VarN := .1512956913 10^6 Sulfur re S := 0.0123; S := .0123 VarS := ((0.06+0.035*S*100)/(2*1.414*100))^2; VarS := .1327813813 10^6 CO2 re V := 14.145; V := 14.145			
Carbon re C := 0.7381; C:= .7381 varC := (0.64/(2*1.414*100))^2; varC := .5121546706 10.5 Hydrogen re H := 0.0482; H:= .0482 varH := (0.16/(2*1.414*100))^2; varH := .3200966692 10.6 Nitrogen re N := 0.0135; N:= .0135 varN := (0.11/(2*1.414*100))^2; varN:= .1512956913 10.6 Sulfur re S := 0.0123; S:= .0123 varS := .1327813813 10.6 CO2 re V := 14.145; v:= 14.145			
Carbon re C := 0.7381; C := 0.7381 varC := (0.64/(2*1.414*100))^2; varC := .5121546706 10 ⁻⁵ Hydrogen re H := 0.0482; H := .0482 varH := (0.16/(2*1.414*100))^2; varH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 varN := (0.11/(2*1.414*100))^2; varN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; V := 14.145	> varOUHD := (0.1*OUHD)^2;		
C := 0.7381; C := .7381 varC := (0.64/(2*1.414*100))^2; varC := .5121546706 10 ⁻⁵ Hydrogen re H := 0.0482; H := .0482 varH := (0.16/(2*1.414*100))^2; varH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 varN := (0.11/(2*1.414*100))^2; varN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := .((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re v := 14.145; v := 14.145	<i>varOUHD</i> := .0081		
C := 0.7381; C := .7381 varC := (0.64/(2*1.414*100))^2; varC := .5121546706 10 ⁻⁵ Hydrogen re H := 0.0482; H := .0482 varH := (0.16/(2*1.414*100))^2; varH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 varN := (0.11/(2*1.414*100))^2; varN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := .((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re v := 14.145; v := 14.145			
C:=.7381 varC := (0.64/(2*1.414*100))^2; varC:=.5121546706 10 ⁻⁵ Hydrogen re H:= 0.0482; H:=.0482 varH := (0.16/(2*1.414*100))^2; varH:=.3200966692 10 ⁻⁶ Nitrogen re N:= 0.0135; N:=.0135 varN := (0.11/(2*1.414*100))^2; varN:=.1512956913 10 ⁻⁶ Sulfur re S:= 0.0123; S:=.0123 varS:=.0123 varS:=.1327813813 10 ⁻⁶ CO2 re v:= 14.145; v:= 14.145	Carbon re		
<pre>varC := (0.64/(2*1.414*100))^2;</pre>	> C := 0.7381;		
VarC := .5121546706 10 ⁻⁵ Hydrogen re H := 0.0482; H := .0482 VarH := (0.16/(2*1.414*100))^2; VarH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 VarN := (0.11/(2*1.414*100))^2; VarN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 VarS := .((0.06+0.035*S*100)/(2*1.414*100))^2; VarS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; V := 14.145	c := .7381		
VarC := .5121546706 10 ⁻⁵ Hydrogen re H := 0.0482; H := .0482 VarH := (0.16/(2*1.414*100))^2; VarH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 VarN := (0.11/(2*1.414*100))^2; VarN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 VarS := .((0.06+0.035*S*100)/(2*1.414*100))^2; VarS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; V := 14.145	> varC := (0.64//2*1.414*100)\^2:		
Hydrogen re H := 0.0482; H := .0482 varH := (0.16/(2*1.414*100))^2; varH := .3200966692 10 ⁻⁶ Nitrogen re N := 0.0135; N := .0135 varN := (0.11/(2*1.414*100))^2; varN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; V := 14.145	_		
H:= 0.0482; varH:= (0.16/(2*1.414*100))^2; varH:= .3200966692 10 ⁻⁶ Nitrogen re N:= 0.0135; N:= .0135 varN:= (0.11/(2*1.414*100))^2; varN:= .1512956913 10 ⁻⁶ Sulfur re S:= 0.0123; S:= .0123 varS:= .((0.06+0.035*S*100)/(2*1.414*100))^2; varS:= .1327813813 10 ⁻⁶ CO2 re V:= 14.145;	varC := .5121546706 10 ⁻³		
H:= 0.0482; VarH:= (0.16/(2*1.414*100))^2; VarH:= .3200966692 10 ⁻⁶ Nitrogen re N:= 0.0135; N:= 0.0135 VarN:= (0.11/(2*1.414*100))^2; VarN:= .1512956913 10 ⁻⁶ Sulfur re S:= 0.0123; S:= .0123 VarS:= .((0.06+0.035*S*100)/(2*1.414*100))^2; VarS:= .1327813813 10 ⁻⁶ CO2 re V:= 14.145; V:= 14.145			
<pre>H:=.0482 varH:= (0.16/(2*1.414*100))^2; varH:=.3200966692 10⁻⁶ Nitrogen re N:= 0.0135; N:= 0.0135 varN:= (0.11/(2*1.414*100))^2; varN:=.1512956913 10⁻⁶ Sulfur re S:= 0.0123; S:=.0123 varS:= ((0.06+0.035*S*100)/(2*1.414*100))^2; varS:=.1327813813 10⁻⁶ CO2 re V:= 14.145;</pre>			
<pre>varH := (0.16/(2*1.414*100))^2;</pre>	> H := 0.0482;		
<pre>VarH:= .3200966692 10⁻⁶ Nitrogen re N:= 0.0135;</pre>	H := .0482		
<pre>VarH:= .3200966692 10⁻⁶ Nitrogen re N:= 0.0135;</pre>	> varH := (0.16/(2*1.414*100))^2:		
Nitrogen re N := 0.0135; varN := (0.11/(2*1.414*100))^2; varN:= .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; v := 14.145			
N := 0.0135; varN := (0.11/(2*1.414*100))^2; varN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; v := 14.145	varH := .3200966692 10 °		
N := 0.0135; varN := (0.11/(2*1.414*100))^2; varN := .1512956913 10 ⁻⁶ Sulfur re S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; v := 14.145			
N:=.0135 varN:= (0.11/(2*1.414*100))^2; varN:=.1512956913 10 ⁻⁶ Sulfur re S:= 0.0123; S:=.0123 varS:= ((0.06+0.035*S*100)/(2*1.414*100))^2; varS:=.1327813813 10 ⁻⁶ CO2 re V:= 14.145; v:= 14.145			
<pre>varN := (0.11/(2*1.414*100))^2;</pre>	> N := 0.0135;		
<pre>varN:=.1512956913 10⁻⁶ Sulfur re S:= 0.0123;</pre>	N:=.0135		
<pre>varN:=.1512956913 10⁻⁶ Sulfur re S:= 0.0123;</pre>	> varN := (0.11/(2*1.414*100))^2;		
Sulfur re S := 0.0123; S := .0123 varS := ((0.06+0.035°S°100)/(2°1.414°100))^2; varS := .1327813813 10 ⁻⁶ CO2 re V := 14.145; v := 14.145			
S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re v := 14.145; v := 14.145	VarN:= .1512950913 10		
S := 0.0123; S := .0123 varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re v := 14.145; v := 14.145			
S:=.0123 varS:= ((0.06+0.035*S*100)/(2*1.414*100))^2; varS:=.1327813813 10 ⁻⁶ CO2 re v:= 14.145; v:= 14.145			
varS := ((0.06+0.035*S*100)/(2*1.414*100))^2; varS := .1327813813 10 ⁻⁶ CO2 re v := 14.145; v := 14.145			
<pre>varS := .1327813813 10⁻⁶ CO2 re v := 14.145; v := 14.145</pre>			
CO2 re v := 14.145; v := 14.145	> varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;		
CO2 re v := 14.145; v := 14.145	varg:- 1327813813 10-6		
v := 14.145; v := 14.145	Vars .= .132/013013 10		
v := 14.145; v := 14.145	004		
v := 14.145			
	•		
0000			
CO20 := array([seq(v,l=1n)]);	> CO2o := array([seq(v,i=1n)]);		
CO2o:=[14.145	CO2o:=[14.145		
u := (0.03°v)^2;	> u := (0.03°v)^2;		

```
u := .1800729225
> var := array([seq(u,i=1..n)]);
                               var:=[.1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                                     .1800729225 .1800729225 .18007292251
 > varCO2o := make_array(var,n);
                                                                                                                            varCO2o:=varcovar
> v := 15.2148;
                                                                                                                                                 v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
            CO2i := [15.2148 \quad 15.2148 \quad 15.21
> u := (0.03*v)^2;
                                                                                                                                        u := .2083411251
> var := array([seq(u,i=1..n)]);
                               var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251
                                     .2083411251 .2083411251 .2083411251]
> varCO2l := make_array(var,n);
                                                                                                                            varCO2i := varcovar
        O<sub>2</sub> re
 > v := 5;
                                                                                                                                                           v := 5
> O2o := array([seq(v,i=1..n)]);
                                                                                                        020:=[5 5 5 5 5 5 5 5]
> u := (0.05)^2;
                                                                                                                                                    u := .0025
> var := array([seq(u,i=1..n)]);
                                               var := [.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
> varO2o := make_array(var,n);
                                                                                                                              var02o := varcovar
> v := 3.8;
                                                                                                                                                        v := 3.8
> O2i := array([seq(v,i=1..n)]);
                                                                               02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                                                                                                                                    u := .0025
> var := array([seq(u,i=1..n)]);
```

```
var := [.0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025]
> varO2i := make_array(var,n);
                                    var02i := varcovar
  Moisture (air) re
> Wma := 0.013;
                                          Wma := .013
> varWma := (.2*Wma)^2;
                                     varWma := .676 	ext{ } 10^{-5}
  CO re
> v := 0.005;
                                           v := .005
> COo := array([seq(v,l=1..n)]);
                  COo := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
> u := (0.001)^2;
                                         u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
   var := [.1 \ 10^{-5} \ .1 \ 10^{-5} \ .1 \ 10^{-5} \ .1 \ 10^{-5} \ .1 \ 10^{-5} \ .1 \ 10^{-5} ]
> varCOo := make array(var,n);
                                    varCOo:= varcovar
> v := 0.005;
                                            v := .005
> COi := array([seq(v,i=1..n)]);
                  COi := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005]
> u := (0.001)^2;
                                         u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
    var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
> varCOi := make_array(var,n);
                                    varCOi := varcovar
  Carbon in Ash re
> Ca := 0.0486;
                                          Ca := .0486
> varCa := (0.1*Ca)^2;
```

varCa:=.(NXX))236196		
Results		
> eval(O2aveo);		
	5.0000000001	
> eval(sigmaO2aveo);		FO2 N: 17
	.01767766953	.01767767 × V = 001021'=
> eval(100*sigmaO2aveo/O2aveo);		
	.3535533905	
eval(CO2aveo);		

Appendix F-1 Bias Error Calculation Flue Gas Inlet Flow

>
Error Propagation Calculations, Part B, TFluegasINa
Error Propagation Calculations, 1 art B, 11 inchasiva
Set no. of sample points
> n := 2;
n := 2
procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1n,1n);
> for j to n do
> for i to n do
> varcovar[l,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end;
Warning, 'varcovar' is implicitly declared local
Warning, 'j' is implicitly declared local
Warning, 'i' is implicitly declared local
make_array :=
proc(var,n)
local varcovar, j, i;
<pre>varcovar := array(1 n,1 n);</pre>
for j to n do
for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
od;
varcovar
end
#4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)

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O

```
> Cr := (A^{OUHD^{Ca}}/(1-Ca) + (A^{(1-OUHD)^{Ca}})/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
 Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MIFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr.Cb.K3.K4.MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr:
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  ⇔nd
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936*H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016 \text{ K}4 + \text{K}3^{\circ}(288.08 \text{ CO2}[x] + 71.70 \text{ O2}[x] + 50480.8))/(\text{K}4 + 1801.6 \text{ K}3)
> end;
  Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr:
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
  #13
> m := (Wma * 28.97 + 28.97)/((Wma*28.97/18.016) + 1);
                                    28.97 Wma + 28.97
                                   1.608015098 Wma + 1
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                       DPpa<sub>2</sub>
                                                             DPpa
                                                                        Tpa<sub>2</sub>
                                                             Tpa
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                       DPpa_2
                                                                        Tpa<sub>2</sub>
                                                             Tpa.
 #17
> FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
> ma.O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C
> O2i[i]/100,i=1..n):
  #18
> FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C
```

> O2i[i]/100,i=1..n): #19 > SA := FA/(FA+FB); $SA := \frac{1}{2}$ #20 > SB := FB/(FA+FB); $SB := \frac{1}{2}$ #21 > WPAIA := PAFA/(Wfe*SA); DPpa DPpa PSpa (28.97 Wma + 28.97) Tpa₂ Tpa WPAIA := 28176.4 · > WPAIB := PAFB/(Wfe*SB); DPpa₂ PSpa (28.97 Wma + 28.97) Tpa Tpa WPAIB := 28176.4 -Wfe > Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3); $Cr := \frac{A \text{ OUHD } Ca}{1 - Ca} + \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca}$ > Cb := C - Cr; Cb := $C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca}$

> WAI := (28.02*(100-CO2avel-COavel-O2avel)/(12.01*(CO2avel+COavel))*(Cb+(12.0

WAi := 36.46063760 (100 - CO2avei - COavei - O2avei)

> 1/32.07)*S)-N)/0.7685;

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2avei + 12.01 \quad COavei) - 1.301236174 \quad N$$

#24 > WMGi := 8.936*H + (Wma*WAi)+Mf;

WMGi := 8.936
$$H + Wma$$
 $\left(36.46063760\right) (100 - CO2avei - COavei - O2avei)$

$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2avei + 12.01 COavei) - 1.301236174 N + Mf

#25

> WGpl := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02*(100-CO2avei-COavei-COavei-COavei))/(12.01*(CO2avei+COavei))*(Cb+(12.01/32.07)*S));

WGpi:=(15.99 CO2avei+4.00 O2avei-.01 COavei+2802.00)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 CO2avei+12.01 COavei)$$

#26

> WGi := WGpi + WMGi;

$$WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2avei + 12.01 COavei) + 8.936 H + Wma 36.46063760

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S \right) / ($$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C

> b + (12.01/32.07)*S)-N)/0.7685;

$$WAo := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right)$$

12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936 H + Wma
$$\left(36.46063760 \ (100 - CO2aveo - COaveo - O2aveo) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right)$$

12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf

#29

> WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C

> Oaveo-O2aveo)y(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

$$WGpo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2aveo + 12.01 COaveo)

#30

> WGo := WGpo + WMGo;

$$\begin{pmatrix}
C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} & \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 & S
\end{pmatrix} (1 - \frac{1}{3} Ca)$$

12.01
$$CO2aveo + 12.01 COaveo) + 8.936 H + Wma$$
 $\left(36.46063760\right)$ $\left(100 - CO2aveo - COaveo - O2aveo\right)$ $\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 $CO2aveo + 12.01 COaveo) - 1.301236174 N\right) + Mf$$

> AL := ((WGo-WGI)/WGI)*100;
AL :=
$$100 \left(\frac{(15.99 \ Co2aveo + 4.00 \ O2aveo - .01 \ Coaveo + 2802.00) \%1}{12.01 \ Co2aveo + 12.01 \ Coaveo} + Wma \left(36.46063760 \frac{(100 - Co2aveo - Coaveo - O2aveo) \%1}{12.01 \ Co2aveo + 12.01 \ Coaveo} - 1.301236174 \ Label{eq:main_control_coaveo} \right)$$

$$-\frac{(15.99\ CO2avei+4.00\ O2avei-.01\ COavei+2802.00)\ \%1}{\%2} - Wma \left(36.46063760\ \frac{(100-CO2avei-COavei-02avei)\ \%1}{\%2} - 1.301236174\ \hbar$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%2 := 12.01 CO2avei + 12.01 COavei

#32

> TFluegaslNa := WGi*Wfe*SA;

$$TFluegasINa := \frac{1}{2} \left((15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left(100 - CO2avei - COavei - O2avei \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei) - 1.301236174 \ N + Mf \right) \ Wfe$$

- > sigmaTFluegaslNa := sqrt(
- > Diff(TFluegaslNa,CO2avel)^2*varCO2avel +
- > Diff(TFluegaslNa,COavei)^2*varCOavel +
- > Diff(TFluegaslNa,O2avei)^2*varO2avei +
- > Diff(TFluegaslNa,Wfe)^2*varWfe +
- > Diff(TFluegasINa, Areai)^2*varAreai +
- > Diff(TFluegaslNa,CP)^2*varCP +
- > Diff(TFluegaslNa,PSi)^2*varPSi +
- > Diff(TFluegaslNa,A)^2*varA +
- > Diff(TFluegasINa,OUHD)^2*varOUHD +
- > Diff(TFluegasiNa,Ca)^2*varCa +
- > Diff(TFluegasINa,C)*Diff(TFluegasINa,C)*varC +
- > Diff(TFluegaslNa,S)*Diff(TFluegaslNa,S)*varS +
- > Diff(TFluegaslNa,H)*Diff(TFluegaslNa,H)*varH +
- > Diff(TFluegaslNa,Wma)*Diff(TFluegaslNa,Wma)*varWma +

> Diff(Triuegasina,n)*Diff(Triuegasina,n)*Varn +		
> Diff(TFluegasINa,Mf)*Diff(TFluegasINa,Mf)*varMf +		
> sum(sum(
> Diff(TFluegaslNa,DPi[i])*Diff(TFluegaslNa,DPl[j])*varDPi[i,j] +		
> Diff(TFluegaslNa,Ti[i])*Diff(TFluegaslNa,Ti[j])*varTi[i,j] +		
> Diff(TFluegaslNa,COi[i])*Diff(TFluegaslNa,COi[j])*varCOi[i,j] +		
> Diff(TFluegasINa,CO2i[i])*Diff(TFluegasINa,CO2i[j])*varCO2i[i,j] +		
> Diff(TFluegaslNa,O2i[i])*Diff(TFluegaslNa,O2l[j])*varO2i[i,J]		
> ,j=1n),i=1n)):		
> sigmaTFluegasiNa := value("):		
Constants		
Commit		
Averages and Variances from Part A		
> CO2avel := 15.2148;		
CO2avei := 15.2148		
> varCO2avei := .1^2;		
varCO2avei:=.01		
> COavel := .005;		
COavei := .005		
> varCOavel := .002^2;		
varCOavei:=.4 10 ⁻⁵		
> O2avei := 3.8;		
O2avei := 3.8		
> varO2avel := .05^2;		
var02avei := .0025		
> CO2aveo := 14.145;		
CO2aveo := 14.145		
> varCO2aveo := .1^2;		

varCO2aveo := .01
> COaveo := .005;
COaveo := .005
> varCOaveo := .002^2;
_
varCOaveo := .4 10 ⁻⁵
> O2aveo := 5;
02aveo := 5
> varO2aveo := .05^2;
var02aveo := .0025
Coal Feed Rate (lbs/hr)
> Wfe := 115839;
Wfe:= 115839
> varWfe := (0.05*Wfe)^2;
varWfe:=.3354668480 10 ⁸
Area (square ft)
> Areal := 3.99;
Areai := 3.99
> varAreai := (0.0335*Areai)^2;
varAreai := .01786633223
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874
Valification01000000011
Pitot Coefficient
> CP := 0.84;
CP:=.84
> varCP := (0.01)^2;
varCP := (0.01)-2,
Val.et .= .0001
Pressure in Area
> PSI := 29.23;
PSi := 29.23
> varPSI := (0.04)^2;
> varPSi := (0.04)"2; varPSi := .0016
VALEST 163 IBV

```
> PSo := 29.1;
                                       PSo := 29.1
> varPSo := (0.04)^2;
                                    varPSo := .0016
  Pressue for primary air
> PSpa := 31.11;
                                     PSpa := 31.11
> varPSpa := (0.04)^2;
                                   varPSpa := .0016
  Velocity Head
> v := .45802;
                                       v := .45802
> DPo := array([seq(v,i=1..n)]);
                                DPo := [.45802 .45802]
> u := (.02*v)^2;
                                  u := .00008391292816
> var := array([seq(u,i=1..n)]);
                      var := \{.00008391292816 .00008391292816\}
> varDPo := make_array(var,n);
                                 varDPo:= varcovar
> v := .82831;
                                       v := .82831
> DPi := array([seq(v,i=1..n)]);
                                DPi := [.82831 .82831]
> u := (.02*v)^2;
                                  u := .0002744389824
> var := array([seq(u,i=1..n)]);
                        var := [.0002744389824 \ .0002744389824]
> varDPi := make_array(var,n);
                                 varDPi := varcovar
  Temperature (R)
> v := 713;
                                        v := 713
```

~ / / / 4 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		
> To := array([seq(v,i=1n)]);	m (312	7121
	To := [713	/13]
> u := (0.01*(v-460))^2;		
	u := 6.40	09
> var := array([seq(u,i=1n)]);		
	var:=[6.4009	6.4009]
> varTo := make_array(var,n);		
	varTo:= var	covar
> v := 1140;		
	v:= 114	0
> Ti:= array([seq(v,i=1n)]);		
7.1. 1. 7 7.2. 7.2. 7.2. 7.2. 7.2. 7.2. 7.2. 7.2.	Ti := [1140	1140]
> u := (0.01*(v-460))^2;		
/ u.= (c.c. (c. c.c.), _,	u := 46.24	100
> var := array([seq(u,i=1n)]);	4 40.24	
> var .= array([seq(u,i=11/]),		46.2400]
	var:=[46.2400	40.2400]
<pre>> varTl := make_array(var,n);</pre>		
	varTi:=var	covar
Maiatura in Cool		
Moisture in Coal > Mf :=0.06;		
/ IIII .20.00,	Mf := .00	6
	M1 .= .00	U
> varMf := (0.039°Mf)^2;		
	varMf := .5475	56 10 ⁻⁵
Ash		
> A := 0.0619;		
	A := .061	9
> varA := (0.039*A)^2;		
	varA := .5827878	881 10-5
	Vair5027070	001 10
Overhead		
> OUHD := 0.9;		**************************************
· •	OUHD := .	.9
> varOUHD := (0.1*OUHD)^2;		
> val Collip .= (0.1 Collip) 2,	varOUHD:=	0081
	VALOUND :=	

```
Carbon
> C := 0.7381;
                                         C := .7381
> varC := (0.039°C)^2;
                                  varC:=.0008286280388
  Hydrogen
> H := 0.0482;
                                         H := .0482
> varH := (0.039*H)^2;
                                 varH := .353364804 \cdot 10^{-5}
  Nitrogen
> N := 0.0135;
                                         N := .0135
> varN := (0.039*N)^2;
                                  varN := .27720225 \cdot 10^{-6}
  Sulfur
> S := 0.0123;
                                         s := .0123
> varS := (0.019*S)^2;
                                  varS:=.5461569 10<sup>-7</sup>
  CO2
> v := 14.145;
                                        v := 14.145
> CO2o := array([seq(v,i=1..n)]);
                                CO20 := [14.145 14.145]
> u := (0.1)^2;
                                         u := .01
> var := array([seq(u,i=1..n)]);
                                    var := [.01 .01]
> varCO2o := make_array(var,n);
                                 varCO2o:= varcovar
> v := 15.2148;
                                       v := 15.2148
```

> CO2i := array([seq(v,l=1n)]);	-0: (150140	16 21 40 1
	02i := [15.2148	15.2148]
> u := (0.1)^2;		
	u := .01	
> var := array([seq(u,i=1n)]);		
	var:=[.01	.01]
> varCO2i := make_array(var,n);		
	varCO2i:=va	rcovar
O2		
> v := 5;		
	v:= 5	
> O2o := array([seq(v,l=1n)]);		
	020 := [5	5)
> u := (0.05)^2;		
•	u := .002	25
> var := array([seq(u,i=1n)]);		
	var:=[.0025	.0025]
> varO2o := make_array(var,n);		
	var020 := var	rcovar
> v := 3.8;		
	v := 3.8	
> O2i := array([seq(v,i=1n)]);		
7.4	02i := [3.8]	3.8]
> u := (0.05)^2;	·····	
, a. (, -,	ս := .002	25
> var := array([seq(u,i=1n)]);		
	var:=[.0025	.0025]
> varO2l := make_array(var,n);		
> var ozr .= mako_array(var,);	var02i := vai	rcovar
	Valori - var	
Moisture (air)		
> Wma := 0.013;		
	Wma := .0	113
> varWma := (.1*Wma)^2;		
>		χο 10-5
	varWma:=.16	א וט -

!
CO
> v := 0.005;
v := .005
> COo := array([seq(v,l=1n)]);
$COo := \{.005 .005\}$
> u := (0.002)^2;
$u := .4 \cdot 10^{-5}$
> var := array([seq(u,l=1n)]);
$var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}$
> varCOo := make_array(var,n);
varCOo := varcovar
> v := 0.005;
v := .005
> COI := array([seq(v,i=1n)]);
1
Coi := [.005 .005]
> u := (0.002)^2;
$u := .4 \cdot 10^{-5}$
> var := array([seq(u,l=1n)]);
$var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}$
> varCOi := make_array(var,n);
varCOi := varcovar
Carbon in Ash
> Ca := 0.0486;
Ca := .0486
> varCa := (0.25°Ca)^2;
varCa:=.000147622500
Area for primary air
> apa := .63;
apa := .63
> varapa := (.013)^2;
varapa := .000169
* one organ 1007 02
> v := .2171;
v:=.2171,
V ,= .41/1

> DPpa := array([seq(v,i=1n)]);	;	
	DPpa := [.2171	.2171]
> u := 0.02*v;		
	u := .0043	42
> var := array([seq(u,i=1n)]);		
	var:=[.004342	.004342]
> varDPpa := make_array(var,n);	
	varDPpa:= va	rcovar
> v := 1104;		
	v:= 110	4
> Tpa := array([seq(v,l=1n)]);		
	Tpa := [1104	1104]
> u := 0.01*(v - 460);	-	
	u := 6.4	4
> var := array([seq(u,i=1n)]);		
	var:=[6.44	6.44]
<pre>> varTpa := make_array(var,n);</pre>		
	varTpa:= va	rcovar
Results		
	***********	********
> eval(TFluegasiNa);		
> 01a.(11.aogaoa),	754792.21	00
> eval(sigmaTFluegasINa);		
·	47382.149	935
> eval(100*sigmaTFluegaslNa/		
> 01ai(100 0.ga.) 1a0gao	6.2775090	058
*******************	**********	*******
Recalculate Other Results		
> i := 'l';		
	i := i	
#13	·	C). 4).
> m := (Wma * 28.97+28.97)/((W		
	m := 28.7457	70417

>	45.24.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.
	Error Propagation Calculations, Part B, TFluegasINa
	Set no. of sample points
> r	n := 20;
	n := 20
	procedure for creating variance-covariance matrix
	make_array := proc(var,n)
> \	varcovar := array(1n,1n);
> f	or j to n do
> 1	or I to n do
> V	varcovar[i,j] := sqrt(var[i]*var[j])
> 0	od
> 0	od;
> V	rarcovar;
> e	nd;
	Varning, 'varcovar' is implicitly declared local
W	arning, 'j' is implicitly declared local
W	arning, 'i' is implicitly declared local
n	ake_array :=
	proc(var,n)
	local varcovar, j, i;
	<pre>varcovar := array(1 n,1 n);</pre>
	for j to n do
	for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) o
	od;
	Varcovar
	end

> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)



```
> Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma°((28.02°(100-CO[x]-CO2[x]-O2[x])°K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100 K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
Warning, 'M' is implicitly declared local
M :=
proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
local Cr,Cb,K3,K4,M;
         Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
         Cb := C-Cr;
         K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
         K4 :=
           8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x])*K3-1.301236174*L
         M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
end
#5
O2aveo :=
sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG
(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*M(
 ,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,CO
0,CO20,H,Wma,O20,N,Mf),i=1..n);
O2avei :=
sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,
A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*O2i[i],i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,O
UHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i
H,Wma,O2i,N,Mf), i=1..n;
CO2aveo :=
sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG
(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*CO2o[i],i=1..n)/sum((DPo[i]/(To[i]*
M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,
COo,CO2o,H,Wma,O2o,N,Mf), i=1..n;
 CO2avei :=
sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,N,Mf))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,Mf))^{(1/2)*(1-MFG(i,A,C,B,C),H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,
A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*CO2i[i],i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A.
OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO
2i,H,Wma,O2i,N,Mf)),i=1..n);
 #8
 COaveo :=
sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG
(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*COo[i],i=1..n)/sum((DPo[i]/(To[i]*Mt
i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,CO
```

o,CO2o,H,Wma,O2o,N,Mf), i=1..n;

COavei :=

sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*COi[i],i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1..n);

#13

> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);

$$m := \frac{28.97 \text{ Wma} + 28.97}{1.608015098 \text{ Wma} + 1}$$

#14

> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} \text{PAFA} &:= 14088.2 \ \text{apa} \ CP \ \sqrt{\frac{PSpa \ (28.97 \ \text{Wma} + 28.97)}{1.608015098 \ \text{Wma} + 1}} \ \left(\sqrt{\frac{DPpa}{Tpa}_1} + \sqrt{\frac{DPpa}{2}} \right. \\ &+ \sqrt{\frac{DPpa}{3}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{5}} + \sqrt{\frac{DPpa}{6}} + \sqrt{\frac{DPpa}{6}} + \sqrt{\frac{DPpa}{7}} + \sqrt{\frac{DPpa}{8}} + \sqrt{\frac{DPpa}{8}} + \sqrt{\frac{DPpa}{9}} \right. \\ &+ \sqrt{\frac{DPpa}{10}} + \sqrt{\frac{DPpa}{10}} + \sqrt{\frac{DPpa}{11}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{13}} + \sqrt{\frac{DPpa}{14}} + \sqrt{\frac{DPpa}{15}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{$$

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i])Tpa[i])^(1/2),i=1..n);

$$\begin{split} \text{PAFB} &:= 14088.2 \quad \text{apa} \quad \text{CP} \quad \sqrt{\frac{PSpa^{-}(28.97 \quad \text{Wma} + 28.97)}{1.608015098 \quad \text{Wma} + 1}} \left(\int \frac{DPpa_{1}}{Tpa_{1}} + \int \frac{DPpa_{2}}{Tpa_{2}} + \int \frac{DPpa_{2}}{Tpa_{2}} + \int \frac{DPpa_{3}}{Tpa_{3}} + \int \frac{DPpa_{4}}{Tpa_{4}} + \int \frac{DPpa_{5}}{Tpa_{5}} + \int \frac{DPpa_{6}}{Tpa_{6}} + \int \frac{DPpa_{7}}{Tpa_{7}} + \int \frac{DPpa_{8}}{Tpa_{8}} + \int \frac{DPpa_{9}}{Tpa_{9}} + \int \frac{DPpa_{10}}{Tpa_{10}} + \int \frac{DPpa_{11}}{Tpa_{11}} + \int \frac{DPpa_{12}}{Tpa_{12}} + \int \frac{DPpa_{13}}{Tpa_{13}} + \int \frac{DPpa_{14}}{Tpa_{14}} + \int \frac{DPpa_{15}}{Tpa_{15}} + \int \frac{DPpa_{1$$

$$+ \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}}$$

#17

> FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

#18

> FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

#19

> SA := FA/(FA+FB);

$$SA := \frac{1}{2}$$

#20

> SB := FB/(FA+FB);

$$SB := \frac{1}{2}$$

#21

> WPAIA := PAFA/(Wfe*SA);

$$\begin{split} & \textit{WPAIA} := 28176.4 \ \textit{apa} \ \textit{CP} \ \frac{PSpa \ (28.97 \ \textit{Wma} + 28.97)}{1.608015098 \ \textit{Wma} + 1} \ \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} \right) + \begin{array}{c} DPpa_2 \\ Tpa_2 \end{array} \\ & + \begin{array}{c} DPpa_3 \\ Tpa_3 \end{array} + \begin{array}{c} DPpa_4 \\ Tpa_4 \end{array} + \begin{array}{c} DPpa_5 \\ Tpa_5 \end{array} + \begin{array}{c} DPpa_6 \\ Tpa_6 \end{array} + \begin{array}{c} DPpa_7 \\ Tpa_7 \end{array} + \begin{array}{c} DPpa_8 \\ Tpa_8 \end{array} + \begin{array}{c} DPpa_8 \\ Tpa_8 \end{array} + \begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} \\ & + \begin{array}{c} DPpa_1 \\ Tpa_{10} \end{array} + \begin{array}{c} DPpa_{11} \\ Tpa_{11} \end{array} + \begin{array}{c} DPpa_{12} \\ Tpa_{12} \end{array} + \begin{array}{c} DPpa_{13} \\ Tpa_{13} \end{array} + \begin{array}{c} DPpa_{14} \\ Tpa_{14} \end{array} + \begin{array}{c} DPpa_{15} \\ Tpa_{15} \end{array} \\ & + \begin{array}{c} DPpa_{16} \\ Tpa_{16} \end{array} + \begin{array}{c} DPpa_{17} \\ Tpa_{17} \end{array} + \begin{array}{c} DPpa_{18} \\ Tpa_{18} \end{array} + \begin{array}{c} DPpa_{19} \\ Tpa_{19} \end{array} + \begin{array}{c} DPpa_{20} \\ Tpa_{20} \end{array} \right) / \textit{Wfe} \end{split}$$

#22

> WPAIB := PAFB/(Wfe*SB);

$$\begin{split} & \text{WPAIB} := 28176.4 \ \ \, \text{apa} \ \ \, \text{CP} \ \, \frac{PSpa \ \, (28.97 \ \, \text{Wma} + 28.97)}{1.608015098 \ \, \text{Wma} + 1} \left(\begin{array}{c} \hline DPpa \\ \hline Tpa \\ \end{array} \right) + \sqrt{\frac{DPpa \\ 1}{Tpa }_{1}} + \sqrt{\frac{DPpa \\ 4}{Tpa }_{2}} \\ & + \sqrt{\frac{DPpa \\ 4}{Tpa }_{3}} + \sqrt{\frac{DPpa \\ 4}{Tpa }_{4}} + \sqrt{\frac{DPpa \\ 5}{Tpa }_{5}} + \sqrt{\frac{DPpa \\ 6}{Tpa }_{6}} + \sqrt{\frac{DPpa \\ 7}{Tpa }_{7}} + \sqrt{\frac{DPpa \\ 8}{Tpa }_{8}} + \sqrt{\frac{DPpa \\ 9}{Tpa }_{9}} \\ & + \sqrt{\frac{DPpa \\ 10}{Tpa }_{10}} + \sqrt{\frac{DPpa \\ 11}{Tpa }_{11}} + \sqrt{\frac{DPpa \\ 12}{Tpa }_{12}} + \sqrt{\frac{DPpa \\ 13}{Tpa }_{13}} + \sqrt{\frac{DPpa \\ 14}{Tpa }_{14}} + \sqrt{\frac{DPpa \\ 15}{Tpa }_{15}} \\ & + \sqrt{\frac{DPpa \\ 16}{Tpa }_{16}} + \sqrt{\frac{DPpa \\ 17}{Tpa }_{17}} + \sqrt{\frac{DPpa \\ 18}{Tpa }_{18}} + \sqrt{\frac{DPpa \\ 19}{Tpa }_{19}} + \sqrt{\frac{DPpa \\ 20}{Tpa }_{20}} / \text{Wfe} \end{split}$$

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \ OUHD \ Ca}{1 - Ca} + \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> Cb := C - Cr;

Cb :=
$$C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca}$$

> WAi := (28.02*(100-CO2avei-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.0

> 1/32.07)*S}-N)/0.7685;

WAi := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N$$

#24

> WMGi := 8.936*H + (Wma*WAi)+Mf;

$$WMGi := 8.936 \ H + Wma$$
 $36.46063760 \ (100 - CO2avei - COavei - O2avei)$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N + Mf$$

#25

> WGpi := ((44.01°CO2avei+32.02°O2avei+28.01°COavei+28.02°(100-CO2avei-COa > ei-O2avei))/(12.01*(CO2avei+COavei))*(Cb+(12.01/32.07)*S));

$$WGpi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ Coavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei)$$

WGI := WGpI + WMGI;

WGi := (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (1 - \frac{1}{3} Ca)$$

12.01
$$CO2avei + 12.01 COavei) + 8.936 H + Wma$$
 36.46063760

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right)/($$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*((

> b + (12.01/32.07)*S)-N)/0.7685;

WAO := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} - \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (1 - \frac{1}{3} Ca)$$

S n

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2aveo - COaveo - O2aveo) \right)$

$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / (12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf$$

#29

- > WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C
- > Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

WGpo := (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2aveo + 12.01 COaveo)

#30

> WGo := WGpo + WMGo;

$$WGo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2aveo + 12.01 COaveo) + 8.936 H + Wma 36.46063760

$$\left(100 - CO2aveo - COaveo - O2aveo\right) \\
\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (Ca) \\$$

#31

> AL := ((WGo-WGi)/WGi)*100;

AL := $100 \left(\frac{(15.99 \ Co2aveo + 4.00 \ O2aveo - .01 \ Coaveo + 2802.00) \ \%1}{12.01 \ Co2aveo + 12.01 \ Coaveo} \right) + Wma \left(36.46063760 \frac{(100 - Co2aveo - Coaveo - O2aveo) \ \%1}{12.01 \ Co2aveo + 12.01 \ Coaveo} \right) - 1.301236174 : - \frac{(15.99 \ Co2avei + 4.00 \ O2avei - .01 \ Coavei + 2802.00) \ \%1}{\%2}$ $- Wma \left(36.46063760 \frac{(100 - Co2avei - Coavei - O2avei) \ \%1}{\%2} \right) - 1.301236174 : - \frac{1}{3} \left(\frac{(15.99 \ Co2avei + 4.00 \ O2avei - .01 \ Coavei + 2802.00) \ \%1}{\%2} + 8.936 \ H$ $+ Wma \left(36.46063760 \frac{(100 - Co2avei - Coavei - O2avei) \ \%1}{\%2} \right) - 1.301236174 : - \frac{1}{3} \left(\frac{1}{3} \right) - \frac{1}{3} \left($

$$TF1uegasINa := \frac{1}{2} \left((15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802 \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left(100 - CO2avei - COavei - O2avei \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{2} \ Ca} + .3744932959 \ S \right) / ($$

12.01 CO2avei + 12.01 COavei) - 1.301236174 N + Mf

TFluegasINb := WGi*Wfe*SB;
#33
TFluegasOUTa := WGo*Wfe*SA;
TFluegasOUTb := WGo*Wfe*SB;
B. C.
> sigmaTFluegasiNa := sqrt(
> Diff(TFluegasINa,CO2avei)^2*varCO2avel +
> Diff(TFluegasiNa,COavel)^2*varCOavel +
> Diff(TFluegaslNa,O2avel)^2*varO2avel +
> Diff(TFluegasiNa,Wfe)^2*varWfe +
> Diff(TFluegasiNa,Areal)^2*varAreal +
> Diff(TFluegaslNa,CP)^2*varCP +
> Diff(TFluegaslNa,PSi)^2*varPSi +
> Diff(TFluegaslNa,A)^2*varA +
> Diff(TFluegasiNa,OUHD)^2*varOUHD +
> Diff(TFluegasiNa,Ca)^2*varCa +
> Diff(TFluegasINa,C)*Diff(TFluegasINa,C)*varC +
> Diff(TFluegasINa,S)*Diff(TFluegasINa,S)*varS +
> Dlff(TFluegaslNa,H)*Dlff(TFluegaslNa,H)*varH +
> Diff(TFluegaslNa,Wma)*Diff(TFluegaslNa,Wma)*varWma +
> Diff(TFluegasINa,N)*Diff(TFluegasINa,N)*varN +
> Diff(TFluegasINa,Mf)*Diff(TFluegasINa,Mf)*varMf +
> sum(sum(
> Diff(TFluegaslNa,DPl[i])*Diff(TFluegaslNa,DPl[j])*varDPl[i,j] +

>	Diff(TFluegaslNa,Ti[i])*Diff(TFluegaslNa,Ti[j])*varTi[i,j] +
>	Diff(TFluegaslNa,COi[i])*Diff(TFluegaslNa,COi[j])*varCOi[i,j] +
>	Diff(TFluegaslNa,CO2i[i])*Diff(TFluegaslNa,CO2i[j])*varCO2i[i,]] +
>	Diff(TFluegaslNa,O2i[i])*Diff(TFluegaslNa,O2i[j])*varO2i[i,j]
>	,j=1n),i=1n)):
>	sigmaTFluegasINa := value("):

Constants		
Averages and Variances fron	ı Part A	
CO2avel := 15.2148;		
	CO2avei := 15.2148	
varCO2avei := .1^2;		
	varCO2avei := .01	
> COavel := .005;		
•	COavei := .005	
> varCOavel := .002^2;		
•	varCOavei := .4 10 ⁻⁵	
020001 . 2.9.	varcoaver.=.4 10	
> O2avei := 3.8;	02avei := 3.8	
00	02ave1 3.6	
> varO2avei := .05^2;	var02avei := .0025	
	Val 02 a Ve1 . = .0023	
> CO2aveo := 14.145;		
> 002av00 .= 14.140,	CO2aveo := 14.145	_
> varCO2aveo := .1^2;		
> va. 002av00 .= 2,	varCO2aveo:=.01	
> COaveo := .004;		
200400121011	COaveo := .004	
> varCOaveo := .002^2;		
> vai 0 0 a voi . = . 0 0 1 2,	4 10-5	
	varCOaveo := .4 10 ⁻⁵	
> O2aveo := 5;		
	02aveo := 5	
> varO2aveo := .05^2;	2000	
	var02aveo := .0025	

Coal Feed Rate (lbs/hr)		
Wfe := 115839;		
	Wfe:= 115839	
varWfe := (0.05*Wfe)^2;		
Val Wie .= (0.05 Wie) 2,	8	
	varWfe:=.3354668480 10 ⁸	
Area (square ft)		
• Areai := 3.99;	2.00	
	Areai := 3.99	
varAreai := (0.0335*Areai)		
	varAreai := .01786633223	
> Areao := 3.54;		
MICOU 3.34,	Areao := 3.54	
varAreao := (0.0364*Areac	o)^2;	
•	varAreao:= 01660386874	
Pitot Coefficient		
> CP := 0.84;		
	CP := .84	
> varCP := (0.01)^2;		
	varCP:=.0001	
Pressure in Area		
> PSi := 29.23;		
Ĺ	PSi := 29.23	
> varPSi := (0.04)^2;		
	varPSi := .0016	
> PSo := 29.1;		
· ·	PSo := 29.1	
> varPSo := (0.04)^2;		
> va. 1 00 != (0.0 !, =,	varPSo := .0016	
Pressue for primary air		
> PSpa := 31.11;		
· · - p-· · · · · · · · · · · · · · · ·	PSpa := 31.11	
> varPSpa := (0.04)^2;		
> 14.1. Opu .= (0.04) 2;	varPSpa := .0016	
	varropa	



```
Velocity Head
> v := .45802;
                                       v := .45802
> DPo := array([seq(v,i=1..n)]);
    DPo := [.45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802 \quad .45802
                                                            .45802 .45802 .45802
      .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
      .45802]
> u := (.02°v)^2;
                                  u := .00008391292816
> var := array([seq(u,i=1..n)]);
      var:=[.00008391292816 .00008391292816 .00008391292816 .00008391292816
        .00008391292816 \quad .00008391292816 \quad .00008391292816 \quad .00008391292816
        .00008391292816 \quad .00008391292816 \quad .00008391292816 \quad .00008391292816
                                                             .00008391292816
        .00008391292816 .00008391292816 .00008391292816
        .00008391292816 \quad .00008391292816 \quad .00008391292816 \quad .00008391292816]
> varDPo := make_array(var,n);
                                  varDPo := varcovar
> v := .82831;
                                       v := .82831
> DPi := array([seq(v,i=1..n)]);
    DPi:=[.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
      .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
      .828311
> u := (.02°v)^2;
                                   u := .0002744389824
> var := array([seq(u,i=1..n)]);
         var:=[.0002744389824 .0002744389824 .0002744389824 .0002744389824
          .0002744389824 .0002744389824 .0002744389824 .0002744389824
                                                            .0002744389824
                           .0002744389824
                                            .0002744389824
          .0002744389824
          .0002744389824 .0002744389824
                                            .0002744389824 .0002744389824
          .0002744389824 .0002744389824 .0002744389824 .0002744389824]
> varDPi := make_array(var,n);
                                  varDPi := varcovar
  Temperature (R)
> v := 713;
```

v := 713	
> To := array([seq(v,i=1n)]);	
To:=[713 713 713 713 713 713 713 713 713 713	, 7
713 713 713 713 713 713	
> u := (0.01*(v-460))^2;	
u := 6.4009	
> var := array([seq(u,i=1n)]);	
var:=[6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.	
6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009	6.40
6.4009]	
> varTo := make_array(var,n);	
varTo := varcovar	
> v := 1140;	
v := 1140, v := 1140	
> Ti:= array([seq(v,i=1n)]);	
1	1140
1140 1140 1140 1140 1140 1140 1140 1140	
> u := (0.01*(v-460))^2;	
u := 46.2400	
> var := array([seq(u,i=1n)]);	
var:=[46.2400 46.2400	5.240
46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400	
46.2400 46.2400 46.2400 46.2400]	
> varTi := make_array(var,n);	
varTi := varcovar	
Moisture in Coal	
> Mf :=0.06;	
Mf := .06	
$> varMf := (0.039*Mf)^2;$	
$varMf := .54756 \cdot 10^{-5}$	
Ash	
> A := 0.0619;	
A := .0619	
> varA := (0.039*A)^2;	
varA:=.582787881 10 ⁻⁵	

Overhead							
> OUHD := 0.9;							
		OUHD	:= .9				
> varOUHD := (0.1*OUHD)^2;		***********					
, (a. co., 2, 2,	17	arOUHD	0081				
		around	0001				
Carbon							
> C := 0.7381;							
		C := .7	381				
> varC := (0.039*C)^2;							
	var	3000. =: 0	32862803	88			
Hydrogen							
> H := 0.0482;							
		H := .0	482				
> varH := (0.039°H)^2;							
, carrier (erece try 2,				5			
	varH	:= .3533	64804 1	0-2			
Nitrogen							
> N := 0.0135;							
		N := .0	135				
> varN := (0.039*N)^2;							
		. 2771	20225 10	6			
	varn	V := .2//2	20223 10	<u>' </u>			
0.16							
Sulfur							
> S := 0.0123;							_
		S := .0	123				
> varS := (0.019*S)^2;							
	var.	s:= .546	1569 10	-7			
CO2							
> v := 14.145;							
		v:= 14	145				
0000	N .	V 14	.143				
> CO2o := array([seq(v,l=1n)]							
CO20:=[14.145 14.145 1	4 1 4 5	14.145	14.145	14.145	14.145	14.145	14.145
CO20 := [14.145							
•	4.145 14.145	14.145	14.145	14.145	14.145	14.145	14.14

```
> u := (0.1)^2;
                                                                                                                                        u := .01
> var := array([seq(u,i=1..n)]);
                 var := [.01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01 \ .01
                     [10. 10. 10. 10. 10.
> varCO2o := make_array(var,n);
                                                                                                               varCO2o := varcovar
> v := 15.2148;
                                                                                                                                 v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
               CO2i := [15.2148 \quad 15.2148 \quad 15.21
                   15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
                    15.2148 15.2148 15.2148 15.2148]
> u := (0.1)^2;
                                                                                                                                        u := .01
> var := array([seq(u,i=1..n)]);
                 [10. 10. 10. 10. 10.
> varCO2i := make_array(var,n);
                                                                                                               varCO2i := varcovar
      02
> v := 5;
                                                                                                                                          v := 5
> O2o := array([seq(v,i=1..n)]);
                          > u := (0.05)^2;
                                                                                                                                    u := .0025
> var := array([seq(u,i=1..n)]);
                                                                                                                                                                      .0025 .0025 .0025 .0025 .0025
                      var := [.0025 .0025 .0025 .0025 .0025
                           .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 ]
> varO2o := make_array(var,n);
                                                                                                                 var02o := varcovar
> v := 3.8;
                                                                                                                                        v := 3.8
> O2i := array([seq(v,i=1..n)]);
```



```
0.2i := 13.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3.8 - 3
                              3.8 3.8 3.8 3.8 3.8]
 > u := (0.05)^2;
                                                                                                                                                                                    u := .0025
 > var := array([seq(u,i=1..n)]);
                               var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                                                                                                                                                                               .0025 .0025 .0025
                                     .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                                                                                                                  .0025 .0025 .0025 .0025]
 > varO2i := make_array(var,n);
                                                                                                                                                          var02i := varcovar
           Moisture (air)
 > Wma := 0.013;
                                                                                                                                                                                 Wma := .013
> varWma := (.1*Wma)^2;
                                                                                                                                                           varWma:=.169 10<sup>-5</sup>
        CO
> v := 0.005:
                                                                                                                                                                                       v := .005
> COo := array([seq(v,i=1..n)]);
                           COO := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005
                                   .005 .005 .005 .005 .005
                                                                                                                                                                       .005 .005 .005]
> u := (0.002)^2;
                                                                                                                                                                             u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
                       var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
                             .4 \cdot 10^{-5} .4 \cdot 10^{-5}
                              .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
 > varCOo := make_array(var,n);
                                                                                                                                                         varCOo:= varcovar
 > v := 0.005;
                                                                                                                                                                                       v := .005
> COi := array([seq(v,i=1..n)]);
                             COi := [.005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .0
                                   > u := (0.002)^2;
```

```
u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
       .4 \cdot 10^{-5} .4 \cdot 10^{-5}
        .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
> varCOi := make array(var,n);
                                      varCOi := varcovar
  Carbon in Ash
> Ca := 0.0486;
                                            Ca := .0486
> varCa := (0.25*Ca)^2;
                                     varCa := .000147622500
  Area for primary air
> apa := .63;
                                             apa := .63
> varapa := (.013)^2;
                                                                         DR NOT 451.
                .0204 x 044
                                        varapa := .000169
> v := .2171;
                                             v := .2171
> DPpa := array([seq(v,i=1..n)]);
       DPpa := [.2171 \ .2171 \ .2171 \ .2171 \ .2171 \ .2171 \ .2171 \ .2171 \ .2171 \ .2171 \ .2171
        .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
> u := 0.02^{\circ}v;
                                           u := .004342
> varDPpa := array([seq(u,i=1..n)]);
        varDPpa := [.004342 .004342 .004342 .004342 .004342 .004342 .004342 ]
          .004342 .004342 .004342 .004342 .004342 .004342 .004342 .004342
          .004342 .004342 .004342 .004342 .004342]
> varDPpa := make_array(var,n);
                                     varDPpa := varcovar
> v := 1104:
                                             v := 1104
> Tpa := array([seq(v,i=1..n)]);
```

(V)

_

			1104	1104					1104	1104 1104		1104	1104
			1104	1104	110	4 110	4 11	04	1104	1104	<u></u>		
> u :	= 0.01*(V - 40	u),			u :=	6.44						
> va	:= arra	y([sec	q(u,i=1.	.n)]);									
	var:=	[6.44	6.44	6.44	6.44					4 6.4	4 6.4	4 6.44	6.44
			6.44			6.44	6.44	6.44]				
> va	Tpa :=	make	_array(var,n)									
					vai	Tpa:=	varo	cova	<u>r</u>				
Re	sults												
	<u> </u>											*****	***
**		*****		*****	****	*****							
> e v	al(TFlue	gasır	va);			75479	2.210	0					
> AV	al(sigm	aTFlu	egasIN	a):									
- ••				••		4738	2.1493	14					
> ev	al(100°s	sigma	TFlueg	aslNa	/TFlue	gasIN	a);						
							50905						
**	*****	*****	*****	*****	****	*****	****	****	****	*****			
	al(TFlue	easIN	h):										
ev	al(sigma	TFlue	gaslNb)	;									
			100 \										
	al(TFlue al(sigma			(a):									
	m(signia	11140	6000.										
ev	al(TFlue	gasOl	JTb);										
<u>ev</u>	al(sigma	TFlue	gasOUT	ГЬ);									
R	ecalculat	e Oth	er Resu	lts									
>1:	= 'i';					i	:= i						
#	13												
> m	:= (Wn	na * 28	3.97+28	.97)/((Wma*	28.97/	18.01	6)+1)	;				
						m := 28	.7457	0417		. 			
#	14 AFA :=	14099	2ºena	CP's	art(PS	pa°m\	'sum	((DPi	oa[iV	rpa(II	^(1/2),	i=1n);	

Appendix F-2 Random Error Calculation Flue Gas Inlet Flow

```
Random Error Propagation Calculations, Part B, TFluegasINa
 Set no. of sample points
> n := 20;
                                       n := 20
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for I to n do
> if i=j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi;
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      local varcovar, j, i;
          varcovar := array(1 .. n,1 .. n);
           for j to n do
```

```
for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
                   fi
              ođ
          oda
          varcovar
      end
  #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-02[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> M := (18.016 \text{ K}4 + \text{K}3 \text{ (}288.08 \text{ CO2[x]} + 71.70 \text{ O2[x]} + 50480.8))/(\text{K}4 + 1801.6 \text{ K}3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
 M :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
        8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)
      M := (18.016*K4+K3*(288.08*C02[x]+71.70*02[x]+50480.8))/(K4+1801.6*
 and
 #13
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1):
                                      28.97 Wma + 28.97
                                     1.608015098 Wma + 1
  #14
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                           DPpa,
                                PSpa (28.97 Wma + 28.97)
                                                                Tpa
                                                                            Tpa_
                                            DPpa 6
                                                                   DPpa<sub>8</sub>
                                DPpa<sub>5</sub>
                                                                               DPpa
                                                        DPpa_
```



$$+ \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}} + \sqrt{\frac{DPpa_{13}}{Tpa_{13}}} + \sqrt{\frac{DPpa_{14}}{Tpa_{14}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} + \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}}$$

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} \text{PAFB} &:= 14088.2 \ \text{apa} \ CP \ \sqrt{\frac{PSpa}{1.608015098} \ \text{Wma} + 1} \ \left(\begin{array}{c} DPpa_1 \\ \hline Tpa_1 \end{array} \right) + \begin{array}{c} DPpa_2 \\ \hline Tpa_2 \end{array} \\ + \\ \sqrt{\frac{DPpa_3}{Tpa_3}} + \begin{array}{c} DPpa_4 \\ \hline Tpa_4 \end{array} + \begin{array}{c} DPpa_5 \\ \hline Tpa_5 \end{array} + \begin{array}{c} DPpa_6 \\ \hline Tpa_6 \end{array} + \begin{array}{c} DPpa_7 \\ \hline Tpa_7 \end{array} + \begin{array}{c} DPpa_8 \\ \hline Tpa_8 \end{array} + \begin{array}{c} DPpa_9 \\ \hline Tpa_9 \end{array} \\ + \\ \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \begin{array}{c} DPpa_{11} \\ \hline Tpa_{11} \end{array} + \begin{array}{c} DPpa_{12} \\ \hline Tpa_{12} \end{array} + \begin{array}{c} DPpa_{13} \\ \hline Tpa_{13} \end{array} + \begin{array}{c} DPpa_{14} \\ \hline Tpa_{14} \end{array} + \begin{array}{c} DPpa_{15} \\ \hline Tpa_{15} \end{array} \\ + \\ \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \begin{array}{c} DPpa_{17} \\ \hline Tpa_{17} \end{array} + \begin{array}{c} DPpa_{18} \\ \hline Tpa_{18} \end{array} + \begin{array}{c} DPpa_{19} \\ \hline Tpa_{19} \end{array} + \begin{array}{c} DPpa_{20} \\ \hline Tpa_{20} \end{array} \end{split}$$

#17

- > FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(I,A,OUHD,Ca,C,S,COI,CO2I,H,W
- > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C
- > O2i[l]/100,l=1..n):

#18

- > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
- > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(I,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C
- > O2i[i]/100,i=1..n):

#19

> SA := FA/(FA+FB);

$$SA := \frac{1}{2}$$

#20

> SB := FB/(FA+FB);

$$SB := \frac{1}{2}$$

#21 > WPAIA := PAFA/(Wfe*SA);

#22 > WPAIB := PAFB/(Wfe*SB);

$$\begin{split} \textit{WPAIB} &:= 28176.4 \ \textit{apa} \ \textit{CP} \ \sqrt{\frac{\textit{PSpa} \ (28.97 \ \textit{Wma} + 28.97)}{1.608015098 \ \textit{Wma} + 1}} \ \left(\sqrt{\frac{\textit{DPpa}_1}{\textit{Tpa}_1}} + \sqrt{\frac{\textit{DPpa}_2}{\textit{Tpa}_2}} \right. \\ &+ \sqrt{\frac{\textit{DPpa}_3}{\textit{Tpa}_3}} + \sqrt{\frac{\textit{DPpa}_4}{\textit{Tpa}_4}} + \sqrt{\frac{\textit{DPpa}_5}{\textit{Tpa}_5}} + \sqrt{\frac{\textit{DPpa}_6}{\textit{Tpa}_6}} + \sqrt{\frac{\textit{DPpa}_7}{\textit{Tpa}_7}} + \sqrt{\frac{\textit{DPpa}_8}{\textit{Tpa}_8}} + \sqrt{\frac{\textit{DPpa}_1}{\textit{Tpa}_4}} \right. \\ &+ \sqrt{\frac{\textit{DPpa}_{10}}{\textit{Tpa}_{10}}} + \sqrt{\frac{\textit{DPpa}_{11}}{\textit{Tpa}_{11}}} + \sqrt{\frac{\textit{DPpa}_{12}}{\textit{Tpa}_{12}}} + \sqrt{\frac{\textit{DPpa}_{13}}{\textit{Tpa}_{13}}} + \sqrt{\frac{\textit{DPpa}_{14}}{\textit{Tpa}_{14}}} + \sqrt{\frac{\textit{DPpa}_{15}}{\textit{Tpa}_{15}}} \\ &+ \sqrt{\frac{\textit{DPpa}_{16}}{\textit{Tpa}_{16}}} + \sqrt{\frac{\textit{DPpa}_{17}}{\textit{Tpa}_{17}}} + \sqrt{\frac{\textit{DPpa}_{18}}{\textit{Tpa}_{18}}} + \sqrt{\frac{\textit{DPpa}_{19}}{\textit{Tpa}_{19}}} + \sqrt{\frac{\textit{DPpa}_{20}}{\textit{Tpa}_{20}}} / \textit{Wfe} \end{split}$$

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \ OUHD \ Ca}{1 - Ca} + \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> Cb := C - Cr;

$$Cb := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> WAI := (28.02*(100-CO2avel-COavel-O2avel)/(12.01*(CO2avel+COavel))*(Cb+(12.0 > 1/32.07)*S)-Ny0.7685;

WAi := 36.46063760 (100 -
$$CO2avei - COavei - O2avei$$
)
$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 CO2avei + 12.01 COavei) - 1.301236174 N$$

#24

> WMGi := 8.936*H + (Wma*WAi)+Mf;

WMGi := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2avei - COavei - O2avei)\right)$ $\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($

12.01 CO2avei + 12.01 COavei) - 1.301236174 N + Mf

#25

> WGpl := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02*(100-CO2avei-COav > el-O2avei))/(12.01*(CO2avei+COavei))*(Cb+(12.01/32.07)*S));

WGpi := (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2avei + 12.01 COavei)

#26

> WGi := WGpi + WMGi;

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S \right) / (1 - \frac{1}{3} \quad Ca)$$

$$12.01 \quad CO2avei + 12.01 \quad COavei) + 8.936 \quad H + Wma \quad \left(36.46063760 \right)$$

$$\left(100 - CO2avei - COavei - O2avei \right)$$

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S \right) / (1 - \frac{1}{3} \quad Ca)$$

$$12.01 \quad CO2avei + 12.01 \quad COavei) - 1.301236174 \quad N \right) + Mf$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAo := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (1 - \frac{1}{3} \quad Ca)$$
12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

$$WMGo := 8.936 \ H + Wma \left(36.46063760 \ (100 - CO2aveo - COaveo - O2aveo) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N + Mf$$

#29

> WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

 $WGpo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2aveo + 12.01 \quad COaveo)$$

> WGo := WGpo + WMGo;

$$WGo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / (12.01 \ CO2aveo + 12.01 \ COaveo) + 8.936 \ H + Wma \left(36.46063760 \right) / (100 - CO2aveo - COaveo - O2aveo)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / (12.01 \ CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N) + Mf$$

> AL := ((WGo-WGi)/WGi)*100;

AL :=
$$100 \left(\frac{(15.99\ CO2aveo + 4.00\ O2aveo - .01\ COaveo + 2802.00)\ \%1}{12.01\ CO2aveo + 12.01\ COaveo} + \frac{12.01\ CO2aveo + 12.01\ COaveo}{12.01\ CO2aveo - O2aveo)\ \%1} - 1.301236174\ N \right)$$

$$\frac{(15.99\ CO2avei + 4.00\ O2avei - .01\ COavei + 2802.00)\ \%1}{\%2} - \frac{1.301236174\ N}{\%2}$$

$$- \text{Wind} \left(\frac{36.46063760}{36.46063760} \frac{(100) - CO2avei - COavei - O2avei)\ \%1}{\%2} - 1.301236174\ N \right)$$

$$\left(\frac{(15.99\ CO2avei + 4.00\ O2avei - .01\ COavei + 2802.00)\ \%1}{\%2} + 8.936\ H \right)$$

$$+ \text{Wina} \left(\frac{36.46063760}{36.46063760} \frac{(100 - CO2avei - COavei - O2avei)\ \%1}{\%2} - 1.301236174\ N \right)$$

$$+ \text{Mf} \right)$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%2 := 12.01 CO2avei + 12.01 COavei

#32

> TFluegasINa := WGi*Wfe*SA;

TFluegasINa := WGi*Wte*SA;

$$TFluegasINa := \frac{1}{2} \left((15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 28(02.00) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left((100 - CO2avei - COavei - O2avei) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei) - 1.301236174 \ N + Mf \right) Wfe$$

> sigmaTFluegasiNa := sqrt(

- Diff(TFluegaslNa,CO2avel)^2*varCO2avel +
- Diff(TFluegaslNa,COavei)^2*varCOavei +
- > Diff(TFluegasINTa,O2avei)^2*varO2avei +
- > Diff(TFluegaslNa,Wfe)^2*varWfe +
- > Diff(TFluegaslNa,Areai)^2*varAreai +
- Diff(TFluegaslNa,CP)^2*varCP +
- > Diff(TFluegasINa,PSi)^2*varPSi +
- > Diff(TFluegaslNa,A)^2*varA +

> Diff(TFluegasINa,OUHD)^2*varOUHD +
> Diff(TFluegaslNa,Ca)^2*varCa +
> Diff(TFluegaslNa,C)*Diff(TFluegaslNa,C)*varC +
> Diff(TFluegaslNa,S)*Diff(TFluegaslNa,S)*varS +
> Diff(TFluegasINa,H)*Diff(TFluegasINa,H)*varH +
> Diff(TFluegasINa,Wma)*Diff(TFluegasINa,Wma)*varWma +
> Diff(TFluegasINa,N)*Diff(TFluegasINa,N)*varN +
> Diff(TFluegasINa,Mf)*Diff(TFluegasINa,Mf)*varMf +
> sum(
> Diff(TFluegasINa,DPl[i])*Diff(TFluegasINa,DPl[i])*varDPl[i,i] +
> Diff(TFluegaslNa,Ti[i])*Diff(TFluegaslNa,Ti[i])*varTi[i,i] +
> Diff(TFluegaslNa,COi[i])*Diff(TFluegaslNa,COi[i])*varCOI[i,i] +
> Diff(TFluegaslNa,CO2i[i])*Diff(TFluegaslNa,CO2i[i])*varCO2i[l,i] +
> Diff(TFluegaslNa,O2i[i])*Diff(TFluegaslNa,O2i[i])*varO2i[i,i]
> ,l=1n)):
> sigmaTFluegasiNa := value("):
Constants
Averages and Random Error Variances (Copied from Part A function of sample size n > CO2avel := 15.2148;
CO2avei := 15.2148
> varCO2avel := .102^2; varCO2avei := .010404
> COavei := .005; COavei := .005
> varCOavel := .0002^2;

	varCOavei:=.4 10 ⁻⁷
> O2avei := 3.8;	
	02avei:=3.8
> varO2avei := .01118^2;	
	varO2avei := .0001249924
> CO2aveo := 14.145;	
	CO2aveo := 14.145
> varCO2aveo := .0866^2;	
	varCO2aveo := .00749956
> COaveo := .005;	
,	COaveo := .005
> varCOaveo := .000204^2;	
	varCOaveo:= 41616 10 ⁻⁷
	Valcoaveo := :41010 10
> O2aveo := 5;	02aveo := 5
	02ave0 3
> varO2aveo := .010206^2;	000104162426
	var02aveo := .000104162436
S. A. Francisco	Proposition
Constants for Random Error	Propagation
Coal Feed Rate (lbs/hr) re	
> Wfe := 115839;	
,	Wfe:=115839
> varWfe := (0.0025*Wfe)^2;	
, ,	varWfe:= 83866.71200
Area (square ft) re	
> Areal := 3.99;	
	Areai:-3.99
> varAreal := (0.0335*Areai)	^2;
•	varAreai := .01786633223
> Areao := 3.54;	
	Areao:=3.54
> varAreao := (0.0364*Area	o)^2;
•	varAreao := .01660386874



```
Pitot Coefficient re
> CP := 0.84;
                                                                                                                                         CP := .84
> varCP := (0)^2;
                                                                                                                                     varCP := 0
     Pressure Ambient or Barometric re
> PSi := 29.23;
                                                                                                                                  PSi := 29.23
> varPSi := (0.04)^2;
                                                                                                                            varPSi := .0016
> PSo := 29.1;
                                                                                                                                    PSo := 29.1
> varPSo := (0.04)^2;
                                                                                                                            varPSo := .0016
      Pressue for primary air
> PSpa := 31.11;
                                                                                                                                PSpa := 31.11
> varPSpa := (0.04)^2;
                                                                                                                          varPSpa := .0016
       Velocity Head DP re
> v := .45802;
                                                                                                                                     v := .45802
> DPo := array([seq(v,i=1..n)]);
              PPO := \{.45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .45802, .458
                   .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
                    .458021
> u := .00005^2;
                                                                                                                                u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
            var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
                  .25 \cdot 10^{-8} .25 \cdot 10^{-8}
                  .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8}
> varDPo := make_array(var,n);
```

```
varDPo := varcovar
> v := .82831;
                                                                                                              v := .82831
> DPi := array([seq(v,i=1..n)]);
            ppi := [.82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831
                 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
                .82831]
> u := .00005^2;
                                                                                                          u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
          var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
               .25 10<sup>-8</sup> .25 10<sup>-8</sup>
               .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8}
 > varDPi := make array(var,n);
                                                                                               varDPi := varcovar
 > v := .2171;
                                                                                                                v := .2171
 > DPpa := array([seq(v,i=1..n)]);
                 DPpa := \{.2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171, .2171
                      .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
> u := (0.00005)^2;
                                                                                                           u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
           var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
               .25 \cdot 10^{-8} .25 \cdot 10^{-8}
               .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8} \cdot .25 \cdot 10^{-8}
 > varDPpa := make_array(var,n);
                                                                                             varDPpa := varcovar
 > v := 1104;
                                                                                                                 v := 1104
 > Tpa := array([seq(v,i=1..n)]);
```

1104	1104 1	104 1104	1104	1104	1104	1104	110-	41	
> u := (0.005°(v - 460))	^2;	·····						······································
			u :-	= 10.36	8400				
> var := array([seq(u,i	=1n)]);	***************************************						
var:=[10	0.368400	10.36840	0 10.36	8400	10.36	8400 1	0.368	3400 10	.368400
10.36840	0 10.36	8400 10.3	368400	10.368	400	10.3684	00	10.368400	10.36840
10.36840	0 10.36	8400 10.3	368400	10.368	400	10.3684	00	10.368400	10.36840
> varTpa := m	ake_arra	ay(var,n);							
			varTp	a := va	rcov	ar			
Temperature	(D) =0								
> v := 713;	(R) IE								
× · · - · · · · · · · · · · · · · · · ·			,	v:=71	2				
> To := array([seg(v l=	1 n\}\·		V /1					
To := [713	•••		713 713	3 713	713	713	713	713 7	13 713 7
713 713		713 713	7131	,,,	, 13	, ,,,	713	113 1	13 /13 /
> u := (0.005*(\	/-460))^:								
(0.000	,	-,	11 :=	= 1.600	225				
> var := array([sea(u.l=	:1n)]):		1.000					·
var:=[1.60			.600225	1.600	225	1.60022	5 1	.600225	1.600225
1.600225	1.60022				1.6002		0022		
1.600225	1.60022	5 1.60022			.6002			1.000	1.000
> varTo := mak	e array	(var.n):							
		(,,,	varTo	:= var	cova	r			
> v := 1140;									
			v	:= 114	0				
> Ti:= array([se	q(v,i=1.	.n)]);							
Ti := []]	40 1140	1140	1140 11	40 11	40	1140 1	140	1140 1	140 1140
1140	1140 11	40 1140	1140	1140	1140	1140	1140]	
u := (0.005*(v	-460))^2								
			u :=	11.560	000				
var := array([seq(u,i=	1n)]);							
var:=[11.		11.560000	11.560	000 1	1.560	000 11	.5600	00 11.5	60000
11.560000	11.560	000 11.56	00000 1	1.5600	00 1	1.56000	0 11	.560000	11.560000
11.560000			50000 1	1.5600	00 1	1.56000	0 11	.560000	11.560000
· varTi := make	_array(\	/ar,n);							
			varTi:	= var	cova	r			

!	
Moisture in Ash re	
> Mf :=0.06;	
Mf := .06	
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;	
varMf := .00001058319613	
Vaimi := .00001036319613	
Ash	
Ash re > A := 0.0619;	
·	
A := .0619	
> varA := ((0.07+0.02*A*100)/(2*1.414*100))^2;	
$varA := .4696223261 \cdot 10^{-6}$	
Val 1.10/02/2001 10	
Overhead re	
> OUHD := 0.9;	
OUHD := .9	
> varOUHD := (0.1*OUHD)^2;	
varOUHD:=.0081	
Carbon re	
> C := 0.7381;	
C := .7381	
> varC := (0.64/(2*1.414*100))^2;	
· · · · · · · · · · · · · · · · · · ·	
varC := .5121546706 10 ⁻⁵	
Hydrogen re	
> H := 0.0482;	
H := .0482	
> varH := (0.16/(2*1.414*100))^2;	
$varH := .3200966692 \cdot 10^{-6}$	
Varii (# ,5200)900092 1()	
NP.	
Nitrogen re	
• N := 0.0135;	
N:=.0135	
varN := (0.11/(2*1.414*100))^2;	
varN:=.1512956913 10 ⁻⁶	
VALIT1312/30/13 10	
Sulfur re	



```
> S := 0.0123;
                                      S := .0123
> varS := ((0.06+0.035*S*100)(2*1.414*100))^2:
                              vars := .1327813813 \cdot 10^{-6}
  CO<sub>2</sub> re
> v := 14.145;
                                     v := 14.145
> CO2o := array([seq(v,i=1..n)]);
    14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145
      14.1451
> u := (0.03°v)^2;
                                   u := .1800729225
> var := array([seq(u,l=1..n)]);
     var := [.1800729225 \ .1800729225 \ .1800729225 \ .1800729225 \ .1800729225
      .1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
      .1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
      .1800729225 .1800729225 .18007292251
> varCO2o := make array(var,n);
                                varCO2o := varcovar
> v := 15.2148;
                                     v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
    CO2i := [15.2148 \quad 15.2148 \quad 15.2148
      15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
      15.2148 15.2148 15.2148 15.21481
> u := (0.03°v)^2;
                                  u := .2083411251
> var := array([seq(u,i=1..n)]);
    var := [.2083411251 \ .2083411251 \ .2083411251 \ .2083411251 \ .2083411251
      .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
      .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
      .2083411251 .2083411251 .20834112511
> varCO2i := make_array(var,n);
                               varCO2i := varcovar
```

```
O2 re
 > v := 5;
                                                                                                                    v := 5
 > O2o := array([seq(v,i=1..n)]);
                       > u := (0.05)^2;
                                                                                                               u := .0025
 > var := array([seq(u,i=1..n)]);
                    var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                            .0025
                                                                                                                                                                                  .0025 .00251
                        .0025 .0025 .0025 .0025 .0025
                                                                                                                        .0025
                                                                                                                                                                .0025
 > varO2o := make_array(var,n);
                                                                                              var02o := varcovar
 > v := 3.8;
                                                                                                                 v := 3.8
 > O2i := array([seq(v,i=1..n)]);
               02i := [3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8
                  3.8 3.8 3.8 3.8 3.8]
 > u := (0.05)^2;
                                                                                                               u := .0025
 > var := array([seq(u,i=1..n)]);
                    var := [.0025 \ .0025 \ .0025 \ .0025 \ .0025 \ .0025
                                                                                                                                                            .0025 .0025 .0025 .0025
                        .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
 > varO2i := make_array(var,n);
                                                                                              var02i := varcovar
      Moisture (air) re
> Wma := 0.013:
                                                                                                             Wma := .013
 > varWma := (.2*Wma)^2;
                                                                                               varWma:=.676 10<sup>-5</sup>
      CO re
 > v := 0.005:
                                                                                                               v := .005
 > COo := array([seq(v,i=1..n)]);
                 COO := \{.005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .005, .0
                     .005 .005 .005 .005
                                                                                                        .005 .005 .0051
```

```
> u := (0.001)^2;
                                              u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
        .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
        .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
> varCOo := make_array(var,n);
                                         varCOo:= varcovar
> v := 0.005;
                                                 v := .005
> COi := array([seq(v,i=1..n)]);
       COi := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005
         > u := (0.001)^2;
                                              u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
       .1 \cdot 10^{-5} .1 \cdot 10^{-5}
        .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
> varCOi := make_array(var,n);
                                        varCOi := varcovar
  Carbon in Ash re
> Ca := 0.0486;
                                               Ca := .0486
> varCa := (0.1*Ca)^2;
                                        varCa:=.0000236196
  Area for Primary Air re
> apa := 0.63;
                                               apa := .63
> varapa := (0.0208*apa)^2;
                                       varapa := .000171714816
```

Results
> evalf(TFluegaslNa);
754792.2100
> evalf(sigmaTFluegasINa);
5676.235856
> evalf(100*sigmaTFluegasiNa/TFluegasiNa);
.7520262903



Appendix G-1 Bias Error Calculation Flue Gas Outlet Flow -- Zero Leak Case

```
Error Propagation Calculations, Part B, TFluegasOUTa -- Zero Leakage
 Set no. of sample points
> n := 24;
                                      n := 24
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
  end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
       proc(var,n)
       local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
                for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
           oá;
           varcovar
 > 1:IFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
```

```
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  ುವರ
 #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 + Wma'((28.02'(100-CO[x]-CO2[x]-O2[x]) K3-N)/0.7685) + Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
 M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr.Cb.K3.K4.M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
 and
 #13
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
                                     28.97 Wma + 28.97
                                    1.608015098 Wma + 1
 #14
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                         DPpa<sub>2</sub>
                                                               DPpa
   PAFA := 14088.2 apa CP
                                  1.608015098 Wma + 1
                                                               Tpa
                                                                          Tpa
         DPpa<sub>3</sub>
                                DPpa<sub>5</sub>
                     DPpa
                                            DPpa
                                                       DPpa
                                                                   DPpa
                                                                               DPpa.
                                                                   Tpa8
          Tpa3
                     Tpa
                                 Tpa
                                                        Tpa
                                                                               Tpa
                                            Tpa
         DPpa
                      DPpa
                                  DPpa
                                               DPpa
                                                            DPpa
                                                                        DPpa
                                  Tpa
                                                                        Tpa 15
          Tpa
                      Tpa,
                                                Tpa
                                                            Tpa.
                                                    13
                                                           \overline{DPpa}_{20}
         DPpa
                     DPpa.
                                  DPpa
                                               DPpa
                                                                        DPpa.
                                        81
                                                    19
                     Tpa
17
                                  Tpa 18
                                                           7pa<sub>20</sub>
                                               Tpa
                                                                        Tpa 21
          Tpa
              16
                     DPpa<sub>23</sub>
        DPpa<sub>22</sub>
                                  DPpa<sub>24</sub>
                                  Tpa<sub>24</sub>
                     Tpa<sub>23</sub>
         Tpa<sub>22</sub>
```

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} & \text{PAFB} \coloneqq 14088.2 \ \ \, \text{apa} \ \ \, CP \, \, \sqrt{\frac{PSpa \, (28.97 \, \text{Wma} + 28.97)}{1.608015098 \, \text{Wma} + 1}} \, \left(\sqrt{\frac{DPpa}{Tpa}_1} + \sqrt{\frac{DPpa}{2}} \right. \\ & + \sqrt{\frac{DPpa}{3}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{5}} + \sqrt{\frac{DPpa}{5}} + \sqrt{\frac{DPpa}{6}} + \sqrt{\frac{DPpa}{7}} + \sqrt{\frac{DPpa}{7}} + \sqrt{\frac{DPpa}{8}} + \sqrt{\frac{DPpa}{9}} \\ & + \sqrt{\frac{DPpa}{10}} + \sqrt{\frac{DPpa}{11}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{13}} + \sqrt{\frac{DPpa}{14}} + \sqrt{\frac{DPpa}{15}} + \sqrt{\frac{DPpa}{15}} \\ & + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} + \sqrt{\frac{DPpa}{21}} + \sqrt{\frac{DPpa}{21}} \\ & + \sqrt{\frac{DPpa}{22}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{22}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{$$

> FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPI[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

#18

> FB := 5348840°Areai°CP°sqrt(PSi)°sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=t..n):

#19

> SA := FA/(FA+FB);

 $SA := \frac{1}{2}$

#20

> SB := FB/(FA+FB);

 $SB := \frac{1}{2}$

#21

> WPAIA := PAFA/(Wfe*SA);

$$\begin{split} & \text{WPAIA} \coloneqq 28176.4 \text{ apa } CP \quad \boxed{\frac{PSpa\ (28.97\ \text{Wma} + 28.97)}{1.608015098\ \text{Wma} + 1}} \quad \left(\begin{array}{c} DPpa \\ Tpa \\ \end{array} \right) + \\ & \begin{array}{c} DPpa \\ Tpa \\ Tpa \\ Tpa \\ \end{array} \right) + \\ \begin{array}{c} DPpa \\ Tpa \\ T$$

#22 > WPAIB := PAFB/(Wfe*SB);

$$\begin{split} \text{WPAIB} &:= 28176.4 \text{ apa } \text{CP} \sqrt{\frac{PSpa \ (28.97 \ \text{Wma} + 28.97)}{1.608015098 \ \text{Wma} + 1}} \left(\sqrt{\frac{DPpa}{Tpa}_1} + \sqrt{\frac{DPpa}{2}} \right. \\ &+ \sqrt{\frac{DPpa}{3}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{5}} + \sqrt{\frac{DPpa}{6}} + \sqrt{\frac{DPpa}{6}} + \sqrt{\frac{DPpa}{7}} + \sqrt{\frac{DPpa}{8}} + \sqrt{\frac{DPpa}{8}} + \sqrt{\frac{DPpa}{7}} \right. \\ &+ \sqrt{\frac{DPpa}{10}} + \sqrt{\frac{DPpa}{11}} + \sqrt{\frac{DPpa}{11}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{13}} + \sqrt{\frac{DPpa}{14}} + \sqrt{\frac{DPpa}{15}} \\ &+ \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} + \sqrt{\frac{DPpa}{20}} + \sqrt{\frac{DPpa}{21}} \\ &+ \sqrt{\frac{DPpa}{22}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} / \text{Wfe} \end{split}$$

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \ OUHD \ Ca}{1 - Ca} + \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> Cb := C - Cr;

$$Cb := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{2} \ Ca}$$

> WAi := (28.02*(100-CO2avei-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.0 > 1/32.07)*S)-Ny0.7685;

WAi := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 \text{ N}$$

#24

> WMGi := 8.936*H + (Wma*WAi)+Mf;

WMGi := 8.936
$$H + Wma \left(36.46063760 \ (100 - CO2avei - COavei - O2avei) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) (12.01 \ CO2avei + 12.01 \ COavei) - 1.301236174 \ N + Mf$$

#25

> WGpi := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02*(100-CO2avei-COav

> ei-O2avei) \((12.01 \((CO2avei + COavel \) \((Cb + (12.01/32.07) \((S) \) \);

$$WGpi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} - \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2avei + 12.01 COavei)

#26

> WGi := WGpi + WMGi;

$$WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2avei + 12.01 \quad COavei) + 8.936 \quad H + Wma \quad (36.46063760)$$

$$\left(100 - CO2avei - COavei - O2avei\right) \left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2avei + 12.01 \quad COavei) - 1.301236174 \quad N\right) + Mf$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAo := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}) - 1.301236174 \text{ N}$$

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 \ (100) - CO2aveo - COaveo - O2aveo \right)$ $\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($
12.01 $CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N + Mf$

#29

> WGpo := ((44.01°CO2aveo+32.02°O2aveo+28.01°COaveo+28.02°(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

WGpo:=(15.99 CO2aveo+4.00 O2aveo-.01 COaveo+2802.00)

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2aveo + 12.01 \quad COaveo)$$

> WGo := WGpo + WMGo;

Gpo + WMGo;
WGo := (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 CO2aveo + 12.01 COaveo) + 8.936 H + Wma (36.46063760)
(100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N) + Mf$$$$

#31

> AL := ((WGo-WGi)/WGi)*100;

$$AL := 100 \left(\frac{(15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00) \ \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} + \frac{12.01 \ CO2aveo - COaveo - O2aveo) \ \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} - \frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} - \frac{(15.99 \ CO2avei + 4.00 \ O2avei - COavei - O2avei) \ \%1}{\%2} - 1.301236174 \ N \right)$$

$$\left(\frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} + 8.936 \ H \right)$$

$$+ Wma \left(36.46063760 \ \frac{(100 - CO2avei - COavei - O2avei) \ \%1}{\%2} - 1.301236174 \ N \right)$$

$$+ Mf$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%2 := 12.01 CO2avei + 12.01 COavei

#33

> TFluegasOUTa := WGo*Wfe*SA;

TF1uegasOUTa :=
$$\frac{1}{2}$$
 (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 28(02.00))

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$
12.01 CO2aveo + 12.01 COaveo) + 8.936 H + Wma (36.46063760)

$$\left(100 - CO2aveo - COaveo - O2aveo\right) \left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf | Wfe

- sigmaTFluegasOUTa := sqrt(
- > Diff(TFluegasOUTa,CO2avei)^2*varCO2avei +
- > Diff(TFluegasOUTa,COavei)^2*varCOavei +
- > Diff(TFluegasOUTa,O2avei)^2*varO2avel +
- > Diff(TFluegasOUTa,Wfe)^2*varWfe +
- > Diff(TFluegasOUTa,Areai)^2*varAreai +
- > Diff(TFluegasOUTa,CP)^2*varCP +
- > Diff(TFluegasOUTa,PSi)^2*varPSi +
- > Diff(TFluegasOUTa,A)^2*varA +

(N

. _3

> sigmaTFluegasOUTa := value(");

$$sigmaTFluegasOUTa := \left(\frac{1}{2} \frac{\%4 \%1}{\%2} + 4.4680000000 H\right)$$

$$+\frac{1}{2}$$
 Wma $\left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N\right) + \frac{1}{2} Mf\right)^2$ varWfe $+\frac{1}{4}$

$$\frac{\%4\left(-\frac{OUHD\ Ca}{1-Ca} - \frac{1}{3} \frac{(1-OUHD)\ Ca}{1-\frac{1}{3}\ Ca}\right)}{42}$$

 $\frac{\text{Wma } \%3 \left(-\frac{OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{(1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} \right)^{2}}{\%2} + 36.46063760 \frac{\%2}{4 \left(-\frac{A \ Ca}{1 - Ca} + \frac{1}{3} \frac{A \ Ca}{1 - \frac{1}{3} \ Ca} \right)}{\| -\frac{1}{3} \ Ca}$

$$+36.46063760 \frac{\text{Wma } \%3 \left(-\frac{A Ca}{1-Ca} + \frac{1}{3} \frac{A Ca}{1-\frac{1}{3} Ca}\right)^{2}}{\%2} \text{Wfe}^{2} \text{ varOUHD} + \frac{1}{4}$$

$$\frac{\%4\left(-\frac{A \text{ OUHD}}{1-Ca} - \frac{A \text{ OUHD } Ca}{\left(1-Ca\right)^2} - \frac{1}{3} \frac{A \left(1-OUHD\right)}{1-\frac{1}{3} Ca} - \frac{1}{9} \frac{A \left(1-OUHD\right) Ca}{\left(1-\frac{1}{3} Ca\right)^2}\right)}{\left(1-\frac{1}{3} Ca\right)^2}$$

36.46063760 Wma %3

$$\left(-\frac{A \text{ OUHD}}{1-Ca} - \frac{A \text{ OUHD } Ca}{\left(1-Ca\right)^2} - \frac{1}{3} \frac{A \left(1-OUHD\right)}{1-\frac{1}{3} Ca} - \frac{1}{9} \frac{A \left(1-OUHD\right) Ca}{\left(1-\frac{1}{3} Ca\right)^2}\right) / (\%2)$$

Wfe²
$$varCa + \frac{1}{4} \left(\frac{\%4}{\%2} + 36.46063760 \frac{Wma \%3}{\%2} \right)^2 Wfe^2 varC$$

$$+\frac{1}{4}\left(.3744932959 \frac{\%4}{\%2} + 13.65426435 \frac{\text{Wma } \%3}{\%2}\right)^2 \text{Wfe}^2 \text{ vars}$$

+19.96302400 Wfe² varH

$$+ \frac{1}{4} \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 \text{ N} \right)^2 \text{ Wfe}^2 \text{ varWma}$$

$$+ .4233038951 \text{ Wma}^2 \text{ Wfe}^2 \text{ varN} + \frac{1}{4} \text{ Wfe}^2 \text{ varMf}$$

$$\%1 := C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD) Ca}}{1 - \frac{1}{3} \text{ Ca}} + .3744932959 \text{ S}$$

$$\%2 := 12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}$$

$$\%3 := 100 - \text{CO2aveo} - \text{COaveo} - \text{O2aveo}$$

$$\%4 := 15.99 \text{ CO2aveo} + 4.00 \text{ O2aveo} - .01 \text{ COaveo} + 2802.00$$

$$\text{Constants}$$

$$\text{Averages and Variances from Part A}$$

$$\text{CO2avei} := 15.2148;$$

$$\text{cO2avei} := 15.2148$$

$$\text{varCO2avei} := .01$$

$$\text{COavei} := .005;$$

$$\text{varCOavei} := .005$$

$$\text{varCOavei} := .38;$$

$$\text{O2avei} := 3.8;$$

$$\text{O2avei} := 3.8;$$

$$\text{O2avei} := 3.8;$$

$$\text{O2avei} := .0025$$

$$\text{CO2aveo} := 15.2148;$$

$$\text{CO2aveo} := 15.2148;$$

> varCO2aveo := .1^2;

varCO2aveo := .01
> COaveo := .005;
COaveo := .005
> varCOaveo := .002^2;
•
varCOaveo := .4 10 ⁻⁵
> O2aveo := 3.8;
O2aveo := 3.8
> varO2aveo := .05^2;
<i>var02aveo</i> := .0025
Coal Feed Rate (lbs/hr)
> Wfe := 115839;
Wfe:=115839
> varWfe := (0.05*Wfe)^2;
varWfe:=.3354668480 10 ⁸
Valwie, -, 91wib
Area (square ft)
> Areal := 3.99;
Areai := 3.99
> varAreal := (0.0335*Areal)^2; varAreal := .01786633223
VarArea1 := .01760033223
Avenue 1 - 2 541
> Areao := 3.54; Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874
Did A Co. (Gisland
Pitot Coefficient > CP := 0.84;
CP := 0.04;
> varCP := (0.01)^2;
varCP:= .0001
Description Ages
Pressure in Area > PSi := 29.23;
PSi := 29.23
> varPSI := (0.04)^2;
varPSi := .0016

```
> PSo := 29.1;
                                      PSo := 29.1
> varPSo := (0.04)^2;
                                    varPSo := .0016
  Pressue for primary air
> PSpa := 31.11;
                                     PSpa := 31.11
> varPSpa := (0.04)^2;
                                   varPSpa := .0016
  Velocity Head
> v := .45802;
                                      v := .45802
> DPo := array([seq(v,i=1..n)]);
     DPo := [.45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802 \ .45802
      .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
      .45802 .45802 .45802 .45802 .45802]
> u := (.02*v)^2;
                                 u := .00008391292816
> var := array([seq(u,i=1..n)]);
      var:=[.00008391292816 .00008391292816 .00008391292816 .00008391292816
        .00008391292816 .00008391292816 .00008391292816 .00008391292816
        .00008391292816
                         .00008391292816 .00008391292816
                                                            .00008391292816
        .00008391292816
                         .00008391292816 .00008391292816 .00008391292816
        .00008391292816 .00008391292816 .00008391292816
                                                           .00008391292816
        .00008391292816 .00008391292816 .00008391292816 .00008391292816
> varDPo := make_array(var,n);
                                 varDPo:= varcovar
> v := .82831;
                                      v := .82831
> DPi := array([seq(v,i=1..n)]);
     DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
      .82831 .82831 .82831 .82831
                                     .82831 .82831 .82831 .82831 .82831 .82831
      .82831 .82831 .82831 .82831
                                     .828311
> U := (.02°V)^2;
```

u := .0002744389824> var := array([seq(u,i=1..n)]); var := [.0002744389824 .0002744389824 .0002744389824 .0002744389824].0002744389824] > varDPi := make_array(var,n); varDPi := varcovar Temperature (R) > v := 713; v := 713> To := array([seq(v,i=1..n)]); $To := \{713 \ 713$ 713 713 713 713 713 713 713 713 713 7131 > u := (0.01*(v-460))^2; u := 6.4009> var := array([seq(u,i=1..n)]); $var := [6.4009 \ 6.4009 \ 6.4009 \ 6.4009 \ 6.4009 \ 6.4009 \ 6.4009 \ 6.4009 \ 6.4009$ 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009] varTo := make_array(var,n); varTo := varcovar > v := 1140; v := 1140> Ti:= array([seq(v,i=1..n)]); 11401 > u := (0.01*(v-460))^2; u := 46.2400> var := array([seq(u,i=1..n)]); var:=[46.2400 46.24001 > varTI := make_array(var,n);



	varTi:=varcovar
Moisture in Coal	
> Mf :=0.06;	
	Mf := .06
> varMf := (0.039°Mf)^2;	
> var := (0.000, =,	54754 10-5
	varMf:=.54756 10 ⁻⁵
Ash	
> A := 0.0619;	- 0/10
	A := .0619
> varA := (0.039*A)^2;	
	varA := .582787881 10 ⁻⁵
Overhead	
> OUHD := 0.9;	
> 00/15 != 0.0,	<i>оинр</i> := .9
> varOUHD := (0.1*OUHD)^2;	
> varound := (0.1 00Hb) 2,	varOUHD := .0081
	Val OURD := .0001
Carbon	
> C := 0.7381;	C:= .7381
	C .= .7361
> varC := (0.039*C)^2;	
	varC:=.0008286280388
Hydrogen	
> H := 0.0482;	
	H := .0482
> varH := (0.039°H)^2;	
•	varH:=.353364804 10 ⁻⁵
	Vain333304864 10
Niles	
Nitrogen > N := 0.0135;	
> 14 := 0.0135;	N:= .0135
	CC1U VI
> varN := (0.039*N)^2;	
- (a (a	,
(0.000 1.7 =1	varN:= .27720225 10 ⁻⁶

Sulfur	
S := 0.0123;	
s:=.0123	
> varS := (0.019°S)^2;	
vars:=.5461569 10 ⁻⁷	
CO2	
> v := 14.145;	
v := 14.145	
> CO20 := array([seq(v,l=1n)]);	115
CO20:=[14.145	.14.1 1.14:
	1.17
14.145 14.145 14.145 14.145 14.145]	
> u := (0.1)^2; u := .01	
> var := array([seq(u,l=1n)]); var := [.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.0:
.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	
> varCO2o := make_array(var,n);	
varCO20 := make_andy(var,n), varCO20 := varcovar	
> v := 15.2148;	
v := 15.2148	
> CO2i := array([seq(v,i=1n)]);	
$CO2i := [15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148$	214
15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148	
15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148]	
> u := (0.1)^2;	
u := .01	
> var := array([seq(u,l=1n)]);	
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.().
.01 .01 .01 .01 .01 .01 .01 .00 . 10.	
> varCO2i := make_array(var,n);	
varCO2i := varcovar	
02	
> v := 5 ; v := 5	
v J	

```
> O2o := array([seq(v,i=1..n)]);
    020 :=
     > u := (0.05)^2;
                                    u := .0025
> var := array([seq(u,i=1..n)]);
     var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
       .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
       .0025 .0025 .0025}
> varO2o := make_array(var,n);
                              var02o := varcovar
> v := 3.8;
                                     v := 3.8
> O2i := array([seq(v,i=1..n)]);
    02i := [3.8 \quad 3.8 \quad 3.8
      3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8
> u := (0.05)^2;
                                    u := .0025
> var := array([seq(u,i=1..n)]);
      var := [.0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                        .0025 .0025 .0025
       .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
       .0025 .0025 .0025]
> varO2i := make_array(var,n);
                               varO2i := varcovar
  Moisture (air)
> Wma := 0.013;
                                   Wma := .013
> varWma := (.1*Wma)^2;
                               varWma := .169 \cdot 10^{-5}
  CO
 > v := 0.004;
                                     v := .004
 > COo := array([seq(v,i=1..n)]);
                                                        .004 .004
                                             .004
                                                   .004
                                  .004
                                       .004
      .004 .004 .004 .0041
                                  .004 .004 .004
        004 .004 .004 .004
                             .004
```

```
> u := (0.002)^2;
                                               u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
        .4 10<sup>-5</sup> .4 10<sup>-5</sup> .4 10<sup>-5</sup> .4 10<sup>-5</sup> .4 10<sup>-5</sup> .4 10<sup>-5</sup>
        .4 \cdot 10^{-5} .4 \cdot 10^{-5}
> varCOo := make array(var,n);
                                          varCOo := varcovar
> v := 0.005;
                                                  v := .005
> COi := array([seq(v,i=1..n)]);
                                                                            .005 .005 .005 .005
        .005
                                                                            .005 .005 .005}
                                              .005
                                                      .005 .005
                                                                     .005
                                      .005
          .005 .005 .005
 > u := (0.002)^2;
                                                u := .4 \cdot 10^{-5}
 > var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
        .4 \cdot 10^{-5} .4 \cdot 10^{-5}
        .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
 varCOi := make_array(var,n);
                                          varCOi := varcovar
   Carbon in Ash
 > Ca := 0.0486;
                                                 Ca := .0486
 > varCa := (0.25*Ca)^2;
                                          varCa := .000147622500
   Area for primary air
 > apa := .63;
                                                  apa := .63
 > varapa := (.013)^2;
                                             varapa := .000169
```

> v := .2171;

					v:=	.2171						
DPpa := a	array([se	=i,v)pe	1n)]);									
DPpa	:= [.217	.217	1 .217	71 .2	171 .	2171	.2171	.217		-		2171
.217					71 .	2171	.2171	.217	.217	1 .21	71 .	2171
.217	1 .2171	.217	1]									
u := 0.02	'v;				u:=.0	00434:	2					
varDPpa	·- array	/Isen/	u l=1. r	1)1):								
· Valurpa	DPpa:=	1 00434	12 00	4342	.0043	42 .0	004342	.004	342 .0	04342	.004	1342
)04342	.0043		04342		4342	.00434		342 .	00434	12
•		X)4342	.0043		04342		4342	.00434	2 .004	342 .	00434	12
)4342 .\)4342]	JU4 J42	.0045									
varDPpa >	•	27721	//var n	١٠								
> varuppa	:= man	3_ama	y (v a 1 , 1 1)Pna:	= var	cova	<u>r</u>				
> v := 1104	l:											
	-,				v:=	- 1104						
> Tpa := a	rrav([se	a(v.i=1	n)]);									
To a	:=[1104	1104	1104	1104	110	4 11	04 1	104 1	104 1	104 1	104	1104
110		1104		1104	110)4 1	104 1	104 1	104 1	104 1	104	1104
110		•••										
> u := 0.01	•	11.										
> u := 0.01	(0 - 40)	٠,,			u :	= 6.44						
> var := ar	raulica	1/11 i-1	n)]):									
> vai .= ai	:= [6.44	6 44	6 44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44
	4 6.44			6.44	6.44	6.44	6.44	6.44	6.44	6.44	6.44	
> varTpa												
> varīpa	= make	_aii ay	(vai, ii)		·Toa:	= var	cova	r				
Results												
*****	******	*****	*****	****	*****	****	*****	*****	+++++	*****	****	
> eval(TF	luegasC)UTa);										
					7547	192.21	00					
> eval(sig	maTFlu	egasC	UTa);									
						76.462						
> eval(10	0*sigma	TFlue	gasOU	Ta/TF	luega	sOUT	a);					
					6.25	02582	.77					
	*****	+++++	*****	****	****	++++	+++++	*****	*****	*****	****	***

· i := 'l';	i := i
#13	**************************************
m := (Wma * 28.97+28.97)/((Wi	ma*28.97/18.010)+1);
	m := 28.74570417
#14	//DD(I)//DD-(I)//(I/2) i-1 n):
> PAFA := 14088.2*apa*CP*sqrt	(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
	PAFA := 75035.78706
DAFD . 44000 2*2n2*CP*sort	i(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
> PAFB := 14000.2 apa Cr 3410	PAFB := 75035.78706
	FALD 13033.10.00
#17	
EA . E248840 Areal CP'sort	(PSI)*sum((DPi[i]/(M(I,A,OUHD,Ca,C,S,COI,CO2I,H,V MFG(I,A,OUHD,Ca,C,S,COI,CO2I,H,Wma,O2I,N,Mf))*(
> O2i[i]/100,i=1n):	
#18 5348840*Areai*CP*sqrt	(PSI)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COI,CO2i,H,V
ma.Q2i.N.Mf)*Ti[i]))^(1/2)*(1-N	MFG(i,A,OUHD,Ca,C,S,COI,CO2I,H,Wma,O2i,N,Mf))
> O2i[i]/100,i=1n):	
#19	
> SA := FA/(FA+FB);	
	SA := .5(X)00(X)00000
#20	
> SB := FB/(FA+FB);	C000000000
	SB := .50000000000
#21	
> WPAIA := PAFA/(Wfe*SA);	
•	WPAIA := 1.295518557
#22	
WPAIR := PAFB/(Wfe*SB):	

	WPAIB := 1.295518557
423	
#23 > Cr := (A*OUHD*CaV/1-C	(a) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
י ואנשט שווטט אן ב. וט כ	Cr := .002947741741
> Cb := C - Cr;	
, co .= 0 · oi,	Cb := .7351522583
WALL (20 02*/100-CO2	avei-COavei-O2avei)(12.01*(CO2avel+COavei))*(Cb+(12.0
> WAI := (28.02 (100-002 > 1/32.07)*S)-N)/0.7685;	aver-coaver-ozavery(12.51 (Gozaver-Gozaver-
> 1/32.07	WAi := 11.93169660
#24	
> WMGI := 8.936*H + (Wm	na*WAi)+Mf;
	WMGi := .6458272558
#25	
> WGpi := ((44.01°CO2ave	el+32.02*O2avel+28.01*COavel+28.02*(100-CO2avel-COav
> ei-O2avei))/(12.01*(CO2	avei+COavei))*(Cb+(12.01/32.07)*S));
	WGpi := 12.38591870
#26	
> WGi := WGpi + WMGi;	
	WGi := 13.03174596
#27	
> WAo :=(((28.02*(100-C) > b + (12.01/32.07)*S)-N)/	O2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C 0.7685:
	WAo := 11.93169660
#28	
> WMGo := 8.936°H + (Wr	ma*WAo) + Mf;
	WMGo := .6458272558
#29	
> WGpo := ((44.01°CO2a)	veo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C
> Oaveo-O2aveo))/(12.01	*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));
	WGpo := 12.38591870
#30	
> WGo := WGoo + WMGo	D:

WGo := 13.03174596

#31	
AL := ((WGo-WGi)/WGi)*100;	
AL := 0	
#32	
TFluegasINa := WGi*Wfe*SA;	
TFluegasINb := WGi*Wfe*SB;	
#33	
> TFluegasOUTa := WGo*Wfe*SA;	
TFluegasOUTa := 754792.2100	
TFluegasOUTb := WGo*Wfe*SB;	

Appendix G-2 Random Error Calculation Flue Gas Outlet Flow -- Zero Leak Case

```
Random Error Propagation Calculations, Part B, TFluegasOUTa Zero Leak
  Set no. of sample points
> n := 24;
                                       n := 24
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i=j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi;
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
          varcovar := array(1 .. n,1 .. n);
           for j to n do
                                                                5
```

```
for i to n do
                    if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                    else varcovar[i,j] := 0
                    fi
               ođ
           od;
           VARCOVAR
       end
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100°K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
       K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
       MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> C_{1} := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
```

```
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> M := (18.016 \text{ K}4 + \text{K}3^{\circ}(288.08 \text{ CO2}[x] + 71.70 \text{ O2}[x] + 50480.8))/(\text{K}4 + 1801.6 \text{ K}3)
> end:
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 M :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr, Cb, K3, K4, M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr:
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016 * K4 + K3 * (288.08 * CO2[x] + 71.70 * O2[x] + 50480.8))/(K4 + 1801.6)
 O2aveo :=
 sum((DPo[i]/(To[i]+M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)+(1-MFG
 (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mc
 ,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,CO
 0,CO20,H,Wma,O20,N,Mf),i=1..n);
 O2avei :=
 A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*O2i[i],i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,O
 UHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,
 H,Wma,O2i,N,Mf)),i=1..n);
 #7
 CO2aveo :=
 sum((DPo[i]/(To[i]+M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)+(1-MFG
 (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*CO2o[i],i=1..n)/sum((DPo[i]/(To[i]*
 M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S.
 COo,CO2o,H,Wma,O2o,N,Mf), i=1..n;
```

> Cb := C - Cr:



CO2avei :=

sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*CO2i[i],i=1...n)/sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1..n);

#8

COaveo :=

sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*COo[i],i=1..n)/sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)),i=1..n);

COavei :=

sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*COi[i],i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1..n);

#13

> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);

$$m := \frac{28.97 \text{ Wma} + 28.97}{1.608015098 \text{ Wma} + 1}$$

#14

> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),l=1..n);

$$\begin{split} & \text{PAFA} := 14088.2 \quad \text{apa} \quad CP \quad \sqrt{\frac{PSpa \; (28.97 \; \text{Wma} + 28.97)}{1.608015098 \; \text{Wma} + 1}} \; \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} \right) + \begin{array}{c} DPpa_2 \\ Tpa_2 \end{array} \\ & + \\ \sqrt{\frac{DPpa_3}{Tpa_3}} + \begin{array}{c} DPpa_4 \\ Tpa_4 \end{array} + \begin{array}{c} DPpa_5 \\ Tpa_5 \end{array} + \begin{array}{c} DPpa_6 \\ Tpa_6 \end{array} + \begin{array}{c} DPpa_7 \\ Tpa_7 \end{array} + \begin{array}{c} DPpa_8 \\ Tpa_8 \end{array} + \begin{array}{c} DPpa_9 \\ Tpa_9 \end{array} \\ & + \\ \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \begin{array}{c} DPpa_{11} \\ Tpa_{11} \end{array} + \begin{array}{c} DPpa_{12} \\ Tpa_{12} \end{array} + \begin{array}{c} DPpa_{13} \\ Tpa_{13} \end{array} + \begin{array}{c} DPpa_{14} \\ Tpa_{14} \end{array} + \begin{array}{c} DPpa_{15} \\ Tpa_{15} \end{array} \\ & + \\ \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \begin{array}{c} DPpa_{17} \\ Tpa_{17} \end{array} + \begin{array}{c} DPpa_{18} \\ Tpa_{18} \end{array} + \begin{array}{c} DPpa_{19} \\ Tpa_{19} \end{array} + \begin{array}{c} DPpa_{20} \\ Tpa_{20} \end{array} + \begin{array}{c} DPpa_{21} \\ Tpa_{21} \end{array} \\ & + \\ \sqrt{\frac{DPpa_{22}}{Tpa_{22}}} + \begin{array}{c} DPpa_{23} \\ Tpa_{23} \end{array} + \begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \end{split}$$

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ DPpa PSpa (28.97 Wma + 28.97) PAFB := 14088.2 apa CP Tpa₂ 1.608015098 Wma + 1 Tpa DPpa₈ DPpa₃ DPpa₅ DPpa DPpa DPpa. DPpa_ 6 Tpa3 Tpa₅ Tpa Tpa₈ Tpa Tpa Tpa DPpa 10 DPpaDPpa DPpa DPpa DPpa Tpa₁₅ Tpa 10 Tpa Tpa Tpa. Tpa 12 13 DPpa₂₁ DPpa DPpa. DPpa, DPpa. DPpa 18 16 Tpa 18 Tpa₂₁ Tpa 17 Tpa 16 Tpa. Tpa DPpa₂₂ DPpa₂₃ DPpa₂₄

#17

> FA := 5348840*Areal*CP*sqrt(PSI)*sum((DPi[i]/(M(I,A,OUHD,Ca,C,S,COi,CO2i,H,W

Tpa₂₄

Tpa₂₃

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C |> O2i[i]/100,l=1..n):

#18

- > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COI,CO2i,H,W
- > ma,O2i,N,Mf)*Tl[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C
- > O2i[i]/100,l=1..n):

Tpa₂₂

#19

> SA := FA/(FA+FB);

$$SA := \frac{1}{2}$$

#20

> SB := FB/(FA+FB);

$$SB := \frac{1}{2}$$

$$\begin{split} & \text{WPAIA} := 28176.4 \ \text{apa} \ \text{CP} \ \frac{PSpa \ (28.97 \ \text{Wma} + 28.97)}{1.608015098 \ \text{Wma} + 1} \ \left(\begin{array}{c} \overline{DPpa}_1 \\ \overline{Tpa}_1 \end{array} + \begin{array}{c} \overline{DPpa}_2 \\ \overline{Tpa}_2 \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_3 \\ \overline{Tpa}_3 \end{array} + \begin{array}{c} \overline{DPpa}_4 \\ \overline{Tpa}_4 \end{array} + \begin{array}{c} \overline{DPpa}_5 \\ \overline{Tpa}_5 \end{array} + \begin{array}{c} \overline{DPpa}_6 \\ \overline{Tpa}_6 \end{array} + \begin{array}{c} \overline{DPpa}_7 \\ \overline{Tpa}_7 \end{array} + \begin{array}{c} \overline{DPpa}_8 \\ \overline{Tpa}_8 \end{array} + \begin{array}{c} \overline{DPpa}_9 \\ \overline{Tpa}_9 \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{10} \\ \overline{Tpa}_{10} \end{array} + \begin{array}{c} \overline{DPpa}_{11} \\ \overline{Tpa}_{11} \end{array} + \begin{array}{c} \overline{DPpa}_{12} \\ \overline{Tpa}_{12} \end{array} + \begin{array}{c} \overline{DPpa}_{13} \\ \overline{Tpa}_{13} \end{array} + \begin{array}{c} \overline{DPpa}_{14} \\ \overline{Tpa}_{14} \end{array} + \begin{array}{c} \overline{DPpa}_{15} \\ \overline{Tpa}_{15} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{16} \\ \overline{Tpa}_{16} \end{array} + \begin{array}{c} \overline{DPpa}_{17} \\ \overline{Tpa}_{17} \end{array} + \begin{array}{c} \overline{DPpa}_{18} \\ \overline{Tpa}_{18} \end{array} + \begin{array}{c} \overline{DPpa}_{19} \\ \overline{Tpa}_{19} \end{array} + \begin{array}{c} \overline{DPpa}_{20} \\ \overline{Tpa}_{20} \end{array} + \begin{array}{c} \overline{DPpa}_{21} \\ \overline{Tpa}_{21} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{22} \\ \overline{Tpa}_{22} \end{array} + \begin{array}{c} \overline{DPpa}_{23} \\ \overline{Tpa}_{23} \end{array} + \begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{22} \\ \overline{Tpa}_{22} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{23} \\ \overline{Tpa}_{23} \end{array} + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{22} \\ \overline{Tpa}_{22} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{22} \\ \overline{Tpa}_{23} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{23} \\ \overline{Tpa}_{23} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{22} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{23} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) + \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right) \\ & \left(\begin{array}{c} \overline{DPpa}_{24} \\ \overline{Tpa}_{24} \end{array} \right)$$

> WPAIB := PAFB/(Wfe*SB);

$$\begin{aligned} & \text{WPAIB} := 28176.4 \ \ \, \text{apa} \ \ \, \text{CP} \ \, \frac{PSpa \ \, (28.97 \ \, \text{Wma} + 28.97)}{1.608015098 \ \, \text{Wma} + 1} \left(\begin{array}{c} DPpa \\ Tpa \\ \end{array} \right) + \left(\begin{array}{c} DPpa \\ Tpa \\ Tpa \\ \end{array} \right) + \left(\begin{array}{c$$

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \quad OUHD \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

> Cb := C - Cr;

$$Cb := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> WAI := (28.02*(100-CO2avei-COavel-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.0 > 1/32.07)*S-N)0.7685;

WAI := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N$$

#24

> WMGI := 8.936*H + (Wma*WAI)+Mf;

WMGi := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2avei - COavei - O2avei)\right)$ $\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) (12.01 CO2avei + 12.01 COavei) - 1.301236174 N + Mf$

#25

> WGpl := ((44.01°CO2avel+32.02°O2avel+28.01°COavel+28.02°(100-CO2avel-COavel-O2avel))/(12.01°(CO2avel+COavel))*(Cb+(12.01/32.07)*S));

WGpi := (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00)
$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 CO2avei + 12.01 COavei)$$

#26

> WGi := WGpi + WMGi;

 $WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) + 8.936 \text{ } H + \text{Wma} \left(36.46063760 \right)$$

$$(100 - \text{CO2avei} - \text{COavei} - \text{O2avei})$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N \right) + \text{Mf}$$

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAo := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 - 1$$

12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2aveo - COaveo - O2aveo) \right)$ $\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($ 12.01 $CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf$

#29

> WGpo := ((44.01°CO2aveo+32.02°O2aveo+28.01°COaveo+28.02°(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

WGpo := (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2aveo + 12.01 \quad COaveo)$$

#30 > WGo := WGpo + WMGo; WGo:=(15.99 CO2aveo+4.00 O2aveo-.01 COaveo+2802.00) $\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($ 12.01 CO2aveo + 12.01 COaveo) + 8.936 H + Wma | 36.46063760 (100 - CO2aveo - COaveo - O2aveo) $\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($ 12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf

$$\%1 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S$$

%2:=12.01 CO2avei+12.01 COavei

#33

> TFluegasOUTa := WGo*Wfe*SA;

TF1uegasOUTa :=
$$\frac{1}{2}$$
 (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$
12.01 CO2aveo + 12.01 COaveo) + 8.936 H + Wma (36.46063760)

$$\left(\frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$

12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf Wfe

- > sigmaTFluegasOUTa := sqrt(
- > Diff(TFluegasOUTa,CO2avei)^2*varCO2avei +
- > Diff(TFluegasOUTa,COavei)^2*varCOavei +
- > Diff(TFluegasOUTa,O2avel)^2*varO2avel +
- > Diff(TFluegasOUTa,Wfe)^2*varWfe +
- > Diff(TFluegasOUTa,Areai)^2*varAreai +
- > Diff(TFluegasOUTa,CP)^2*varCP +
- > Diff(TFluegasOUTa,PSi)^2*varPSi +
- > Diff(TFluegasOUTa,A)^2*varA +

> Diff(TFluegasOUTa,OUHD)^2*varOUHD +
> Diff(TFluegasOUTa,Ca)^2*varCa +
> Diff(TFluegasOUTa,C)*Diff(TFluegasOUTa,C)*varC +
> Diff(TFluegasOUTa,S)*Diff(TFluegasOUTa,S)*varS +
> Diff(TFluegasOUTa,H)*Diff(TFluegasOUTa,H)*varH +
> Diff(TFluegasOUTa,Wma)*Diff(TFluegasOUTa,Wma)*varWma +
> Diff(TFluegasOUTa,N)*Diff(TFluegasOUTa,N)*varN +
> Diff(TFluegasOUTa,Mf)*Diff(TFluegasOUTa,Mf)*varMf +
> sum(
> Diff(TFluegasOUTa,DPi[i])*Diff(TFluegasOUTa,DPi[i])*varDPi[i,i] +
Diff(TFluegasOUTa,Ti[i])*Diff(TFluegasOUTa,Ti[i])*varTi[i,i] +
> Diff(TFluegasOUTa,COi[i])*Diff(TFluegasOUTa,COi[i])*varCOi[i,i] +
> Diff(TFluegasOUTa,CO2i[i])*Diff(TFluegasOUTa,CO2i[i])*varCO2i[i,i] +
> Diff(TFluegasOUTa,O2i[i])*Diff(TFluegasOUTa,O2i[i])*varO2i[i,i]
> ,i=1n)):
> sigmaTFluegasOUTa := value("):
Constants
Averages and Random Error Variances (Copied from Part A function of sample size
> CO2avel := 15.2148;
CO2avei := 15.2148
> varCO2avei := .102^2; varCO2avei := .010404
> COavel := .005;
COavei := .005;

> varCOavel := .0002^2;
<i>varCOavei</i> := .4 10 ⁻⁷
> O2avel := 3.8;
O2avei := 3.8
> varO2avel := .01118^2;
varO2avei := .0001249924
200
> CO2aveo := 15.2148; CO2aveo := 15.2148
> varCO2aveo := .0866^2;
varCO2aveo := .00749956
> COaveo := .005;
COaveo := .005
> varCOaveo := .000204^2;
varCOaveo := .41616 10 ⁻⁷
> O2aveo := 3.8;
02aveo := 3.8
> varO2aveo := .010206^2;
varO2aveo := .000104162436
Val 024VC0 ,- 1000101102 150
Constants for Random Error Propagation
Colomina for removin across stopping
Coal Feed Rate (lbs/hr) re
> Wfe := 115839;
Wfe := 115839
> varWfe := (0.0025*Wfe)^2;
varWfe:= 83866.71200
Area (square ft) re
> Areal := 3.99;
Areai := 3.99
> varAreal := (0.0335*Areal)^2;
varAreai := .01786633223
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874

Pitot Coefficient re
> CP := 0.84;
<i>CP</i> := .84
> varCP := (0)^2;
varCP:=0
vaicru
Pressure Ambient or Barometric re
> PSi := 29.23;
PSi := 29.23
> varPSi := (0.04)^2;
<i>varPSi</i> := .0016
> PSo := 29.1;
<i>PSo</i> := 29.1
> varPSo := (0.04)^2;
varPSo := .0016
VarPSO .= .0010
Pressue for primary air
> PSpa := 31.11;
<i>PSpa</i> := 31.11
> varPSpa := (0.04)^2;
varPSpa:=.0016
>
Velocity Head DP re
> v := .45802;
v := .45802
> DPo := array([seq(v,i=1n)]);
DPo := [.45802 .45802
.45802 .45
.45802 .45802 .45802 .45802 .45802]
> u := .00005^2;
$u := .25 \cdot 10^{-8}$
> var := array([seq(u,i=1n)]);
$var := [.25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8}$
.25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
$.25 \cdot 10^{-8}$

```
.25 10-8
        > varDPo := make_array(var,n);
                                                                                                                                                             varDPo := varcovar
        > v := .82831;
                                                                                                                                                                                     v := .82831
        > DPi := array([seq(v,l=1..n)]);
                          DPi := \{.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82881 .828831 .828831 .828831 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82
                                  .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
                                  .82831 .82831 .82831 .82831 .82831]
        > u := .00005^2;
                                                                                                                                                                              u := .25 \cdot 10^{-8}
       > var := array([seq(u,l=1..n)]);
                        var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
                              .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup>
                              .25 \cdot 10^{-8} .25 \cdot 10^{-8}
                               .25 10-8
      > varDPI := make_array(var,n);
                                                                                                                                                           varDPi := varcovar
      >
/ > v := .2171;
                                                                                                                                                                                       v := .2171
     > DPpa := array([seq(v,i=1..n)]);
                                  DPpa := [.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .
                                        .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
                                        .2171 .2171 .2171]
      > u := (0.00005)^2;
                                                                                                                                                                              u := .25 \cdot 10^{-8}
     > var := array([seq(u,i=1..n)]);
                       var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
                              .25 \cdot 10^{-8} .25 \cdot 10^{-8}
                               .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
                               .25 10-8
     > varDPpa := make array(var.n);
```

```
varDPpa := varcovar
> v := 1104;
                            v := 1104
 > Tpa := array([seq(v,i=1..n)]);
     Tpa:=[1104 1104 1104 1104 1104 1104 1104
      1104 1104 1104 1104 1104
                            1104 1104
                                     1104
                                         1104
      1104]
 > u := (0.005*(v - 460))^2;
                           u := 10.368400
 > var := array([seq(u,i=1..n)]);
    10.368400 10.368400 10.368400 10.368400
                                     10.368400
     10.368400 10.368400 10.368400 10.368400 10.368400 10.368400 10.368400
     10.368400 10.368400 10.368400 10.3684001
 varTpa := make array(var,n);
                        varTpa := varcovar
  Temperature (R) re
 > v := 713;
                             v := 713
 > To := array([seq(v,i=1..n)]);
    u := (0.005*(v-460))^2;
                           u := 1.600225
 > var := array([seq(u,i=1..n)]);
   var:=[1.600225    1.600225    1.600225    1.600225    1.600225    1.600225    1.600225
     1.600225 1.600225 1.600225 1.600225 1.600225
                                       1.600225 1.600225
     1.6002251
 > varTo := make_array(var,n);
                         varTo := varcovar
/ > v := 1140;
                            v := 1140
 > Ti:= array([seq(v,i=1..n)]);
```

```
11401
> u := (0.005*(v-460))^2;
                                     u := 11.560000
> var := array([seq(u,i=1..n)]);
     var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
      11.560000 11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
      11.560000 11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
      11.560000 11.560000 11.560000 11.560000]
> varTi := make_array(var,n);
                                  varTi := varcovar
  Moisture in Ash re
> Mf := 0.06;
                                       Mf := .06
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;
                               varMf := .00001058319613
  Ash re
> A := 0.0619;
                                       A := .0619
> varA := (( 0.07+0.02*A*100)/(2*1.414*100))^2;
                               varA := .4696223261 \cdot 10^{-6}
  Overhead re
> OUHD := 0.9;
                                      OUHD := .9
> varOUHD := (0.1*OUHD)^2;
                                   varOUHD := .0081
  Carbon re
> C := 0.7381:
                                       C := .7381
> varC := (0.64/(2*1.414*100))^2;
                               varC:= .5121546706 10<sup>-5</sup>
  Hydrogen re
> H := 0.0482;
                                       H := .0482
> varH := (0.16/(2*1.414*100))^2;
```

```
varH:=.3200966692 10<sup>-6</sup>
       Nitrogen re
> N := 0.0135;
                                                                                                                                    N := .0135
> varN := (0.11/(2*1.414*100))^2;
                                                                                                          varN:=.1512956913 10<sup>-6</sup>
       Sulfur re
 > S := 0.0123;
                                                                                                                                     S := .0123
> varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;
                                                                                                          vars := .1327813813 \cdot 10^{-6}
       CO<sub>2</sub> re
 > v := 14.145;
                                                                                                                                   v := 14.145
 > CO2o := array([seq(v,i=1..n)]);
               CO20 := [14.145 \quad 14.145 \quad 1
                    14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145
                    14.145 14.145 14.145 14.145 14.145)
 > u := (0.03*v)^2;
                                                                                                                          u := .1800729225
 > var := array([seq(u,i=1..n)]);
                 var:=[.1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                     .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                     .1800729225 .1800729225 .1800729225
                                                                                                                                                                                                       .1800729225 .1800729225
                                                                                                                                                          .1800729225
                     .1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                     .18007292251
> varCO2o := make_array(var,n);
                                                                                                               varCO2o := varcovar
 > v := 15.2148;
                                                                                                                                 v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
                CO2i := [15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148 \ 15.2148
                    15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
                    15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
```

```
> u := (0.03^{\circ}v)^{2};
                                  u := .2083411251
> var := array([seq(u,i=1..n)]);
    var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251
      .2083411251 .2083411251 .2083411251 .2083411251
                                                         .2083411251 .2083411251
                                                         .2083411251 .2083411251
                                            .2083411251
      .2083411251 .2083411251 .2083411251
      .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
      .2083411251]
> varCO2i := make_array(var,n);
                               varCO2i := varcovar
  O<sub>2</sub> re
> v := 5:
                                       v := 5
> O2o := array([seq(v,i=1..n)]);
     020:=
      > u := (0.05)^2;
                                      u := .0025
> var := array([seq(u,i=1..n)]);
      var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
        .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
        .0025 .0025 .0025]
 > varO2o := make_array(var,n);
                                 varO2o := varcovar
 > v := 3.8;
                                       v := 3.8
 > O2i := array([seq(v,i=1..n)]);
     02i := [3.8 \quad 3.8 \quad 3.8
       3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8
 > u := (0.05)^2;
                                      u := .0025
 > var := array([seq(u,i=1..n)]);
                                                            .0025 .0025 .0025
       var:=[.0025 .0025 .0025 .0025 .0025 .0025
        .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                             .0025 .0025 .0025
        .0025 .0025 .0025]
> varO2i := make_array(var,n);
```

```
var02i := varcovar
   Moisture (air) re
 > Wma := 0.013;
                                               wma := .013
 > varWma := (.2*Wma)^2;
                                         varWma := .676 10<sup>-5</sup>
   CO re
 > v := 0.004:
                                                 v := .004
 > COo := array([seq(v,i=1..n)]);
                                                                                 .004 .004 .004
        COo:=[.004 .004 .004 .004 .004 .004 .004
                                                    .004 .004 .004 .004 .004 .004 .
          .004 .004 .004 .004 .004
                                              .004
  > u := (0.001)^2:
                                               u := .1 \cdot 10^{-5}
 > var := array([seq(u,i=1..n)]);
       \mathbf{var} := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
        .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
         .1 10-5 .1 10-5 .1 10-5 .1 10-5 .1 10-5 .1 10-5 .1 10-5
  > varCOo := make array(var,n);
                                          varCOo := varcovar
> v := 0.005;
                                                 v := .005
  > COi := array([seq(v,i=1..n)]);
                                                                          .005 .005 .005 .005
                                      .005 .005 .005 .005
         COi := \{.005 .005 .005 .005\}
                                      .005 .005 .005 .005
  > u := (0.001)^2;
                                               u := .1 \cdot 10^{-5}
 > var := array([seq(u,i=1..n)]);
        var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
         .1 \cdot 10^{-5} .1 \cdot 10^{-5}
         .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5}
  > varCOi := make_array(var,n);
```

varCOi := varcovar

· C	arbon in Ash re
> C	a := 0.0486;
	Ca := .0486
> V	arCa := (0.1*Ca)^2;
- •	varCa := .0000236196
A	rea for Primary Air re
> a	pa := 0.63;
	apa := .63
	arapa := (0.0208°apa)^2;
	varapa := .000171714816
 	
R	tesults
*	++++++++++++++++++++++++++++++++++++++
> 8	valf(TFluegasOUTa);
:	754792.2100
> €	valf(sigmaTFluegasOUTa);
	3463.473784
-	ovalf(100*sigmaTFluegasOUTa/TFluegasOUTa);
> 6	.4588645376
1	٥/در۴۵۵۵۵۰
•	*****

Appendix G-3 Bias Error Calculation Flue Gas Outlet Flow -- With Leak Case

```
Error Propagation Calculations, Part B, TFluegas Na out
  Set no. of sample points
> n := 24;
                                      n := 24
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end:
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
           od;
           varcovar
       end
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
```

```
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01°S/32.07)/(12.01°(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
           'Cb' is implicitly declared local
  Warning,
  Warning, 'K3' is implicitly declared local
           'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MOTG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
   local Cr,Cb,K3,K4,MFG;
       Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
       K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
        8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
       MFG := .05550621670*K4/(.05550621670*K4+100*K3)
   end
   #6
 > M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 > Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
 > Cb := C - Cr;
 > K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
 > K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
 > M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
  > end;
    Warning, 'Cr' is implicitly declared local
    Warning, 'Cb' is implicitly declared local
    Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
Warning, 'M' is implicitly declared local
 M :=
 proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma*(36.46063760*(100-co[x]-co2[x]-02[x])*K3-1.301236174*N
      K4 :=
      M := (18.016*K4+K3*(288.08*C02[x]+71.70*02[x]+50480.8))/(K4+1801.6)
 and
 #13
 · m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
                                       28.97 Wma + 28.97
                                      1.608015098 Wma + 1
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
  #14
                                                                              DPpa,
                                                                   DPpa
                                 PSpa (28.97 Wma + 28.97)
    PAFA := 14088.2 apa CP
                                                                               Tpa
                                                                   Tpa.
                                     1.608015098 Wma + 1
                                                                       DPpa<sub>8</sub>
                                   DPpa<sub>5</sub>
                                                                                    DPpa
                                                           DPpa<sub>1</sub>
          DPpa<sub>3</sub>
                                               DPpa.
                       DPpa_{4}
                                                                        Tpa<sub>8</sub>
                                                                                    Tpa.
                                                            Tpa
                                                Tpa
           Tpa3
                                    Tpa
                        Tpa
                                                                             DPpa
                                                                DPpa
          DPpa
                                                   DPpa.
                                     DPpa
                        DPpa
                                                         13
                                      Tpa
                                                                              Tpa
                                                                 Tpa.
                                                    Tpa
                         Tpa
            Tpa.
                                                        13
                             11
                10
                                                                DPpa<sub>20</sub>
                                                                             DPpa<sub>21</sub>
                                                   DPpa<sub>19</sub>
                                     DPpa<sub>18</sub>
                        DPpa
17
           DPpa
                                                                              Tpa<sub>21</sub>
                                                                Tpa<sub>20</sub>
                                      Tpa 18
                         Tpa
17
                                                    Tpa.
            Tpa
                        DPpa<sub>23</sub>
                                     DPpa<sub>24</sub>
           DPpa<sub>22</sub>
                                      Tpa<sub>24</sub>
                         Tpa<sub>23</sub>
            Tpa<sub>22</sub>
```

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} & PAFB := 14088.2 \ apa \ CP \ \sqrt{\frac{PSpa \ (28.97 \ Wma + 28.97)}{1.608015098 \ Wma + 1}} \ \left(\sqrt{\frac{DPpa}{Tpa}_{1}} + \sqrt{\frac{DPpa}{2}} \right. \\ & + \sqrt{\frac{DPpa}{3}} \left. + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{4}} + \sqrt{\frac{DPpa}{5}} \right. + \sqrt{\frac{DPpa}{6}} + \sqrt{\frac{DPpa}{7}} \left. + \sqrt{\frac{DPpa}{7}} + \sqrt{\frac{DPpa}{8}} + \sqrt{\frac{DPpa}{7}} \right. \\ & + \sqrt{\frac{DPpa}{10}} + \sqrt{\frac{DPpa}{11}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{12}} + \sqrt{\frac{DPpa}{13}} + \sqrt{\frac{DPpa}{13}} + \sqrt{\frac{DPpa}{14}} + \sqrt{\frac{DPpa}{15}} \\ & + \sqrt{\frac{DPpa}{16}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{17}} + \sqrt{\frac{DPpa}{18}} + \sqrt{\frac{DPpa}{19}} + \sqrt{\frac{DPpa}{20}} + \sqrt{\frac{DPpa}{21}} \\ & + \sqrt{\frac{DPpa}{22}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{22}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{22}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{23}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}} \\ & + \sqrt{\frac{DPpa}{24}} + \sqrt{\frac{DPpa}{24}}$$

- > FA := 5348840*Areal*CP*sqrt(PSi)*sum((DPi[i]/(M(I,A,OUHD,Ca,C,S,COI,CO2i,H,W
- > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C
- > O2i[i]/100,i=1..n):

#18

- > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
- > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C
- > O2i[i]/100,l=1..n):

#19

> SA := FA/(FA+FB);

$$SA := \frac{1}{2}$$

#20

> SB := FB/(FA+FB):

$$SB := \frac{1}{2}$$

#21

> WPAIA := PAFA/(Wfe*SA);

$$\begin{split} & \text{WPAIA} := 28176.4 \ \ \, \text{apa} \ \ \, \text{CP} \ \, \sqrt{\frac{PSpa \ \, (28.97 \ \, \text{Wina} + 28.97)}{1.608015098 \ \, \text{Wma} + 1}} \left(\begin{array}{c} DPpa_1 \\ \hline Tpa_1 \end{array} + \begin{array}{c} DPpa_2 \\ \hline Tpa_1 \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_3 \\ \hline Tpa_3 \end{array} + \begin{array}{c} DPpa_4 \\ \hline Tpa_4 \end{array} + \begin{array}{c} DPpa_5 \\ \hline Tpa_5 \end{array} + \begin{array}{c} DPpa_6 \\ \hline Tpa_6 \end{array} + \begin{array}{c} DPpa_7 \\ \hline Tpa_7 \end{array} + \begin{array}{c} DPpa_8 \\ \hline Tpa_8 \end{array} + \begin{array}{c} DPpa_8 \\ \hline Tpa_4 \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{10} \\ \hline Tpa_{10} \end{array} \right) + \left(\begin{array}{c} DPpa_{11} \\ \hline Tpa_{11} \end{array} + \begin{array}{c} DPpa_{12} \\ \hline Tpa_{12} \end{array} + \left(\begin{array}{c} DPpa_{13} \\ \hline Tpa_{13} \end{array} \right) + \begin{array}{c} DPpa_{14} \\ \hline Tpa_{14} \end{array} + \left(\begin{array}{c} DPpa_{15} \\ \hline Tpa_{15} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{16} \\ \hline Tpa_{16} \end{array} \right) + \left(\begin{array}{c} DPpa_{17} \\ \hline Tpa_{17} \end{array} + \left(\begin{array}{c} DPpa_{18} \\ \hline Tpa_{18} \end{array} \right) + \left(\begin{array}{c} DPpa_{19} \\ \hline Tpa_{19} \end{array} \right) + \left(\begin{array}{c} DPpa_{20} \\ \hline Tpa_{20} \end{array} \right) + \left(\begin{array}{c} DPpa_{21} \\ \hline Tpa_{21} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ \hline Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ \hline Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ \hline Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ \hline Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ \hline Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ \hline Tpa_{22} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{23} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right) \\ & \left(\begin{array}{c} DPpa_{24} \\ \hline Tpa_{24} \end{array} \right)$$

#22 WPAIB := PAFB/(Wfe*SB); DPpa₂ DPpa. PSpa (28.97 Wma + 28.97) WPAIB := 28176.4 apa CP 1.608015098 Wma+1 Tpa_{γ} Тра DPpa₅ DPpa DPpa DPpa. DPpa_ DPpa DPpa_{_} Tpa8 Tpa Tpa Tpa Tpa Tpa Tpā DPpa DPpa 12 DPpa DPpa. DPpa. DPpa 10 13 14 15 Tpa 10 Tpa Tpa 12 Tpa 13 Tpa 14 Tpa₁₅ DPpa 18 DPpa 16 DPpa 17 DPpa 19 DPpa₂₁ DPpa₂₀ $\overline{Tp}_{a_{20}}$ 77)a21 Tpa Tpa Tpa Tpa. 18 DPpa₂₄ DPpa₂₂ DPpa₂₃ /Wfe Tpa₂₄ Tpa₂₂ Tpa₂₃

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \quad OUHD \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

b := C - Cr;

Cb :=
$$C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca}$$

Al := (28.02*(100-CO2avel-COavel-O2avel)(12.01*(CO2avel+COavel))*(Cb+(12.0 32.07)*S)-N)/0.7685;

WAi := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (1 - \frac{1}{3} Ca)$$

12.01 CO2avei + 12.01 COavei) - 1.301236174 N

 $MGi := 8.936^{\circ}H + (Wma^{\circ}WAi) + Mf;$

WMGi := 8.936
$$H + Wma \left(36.46063760 \ (100 - CO2avei - COavei - O2avei) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

12.01 CO2avei + 12.01 COavei) - 1.301236174 N + Mf

Gpi := ((44.01°CO2avei+32.02°O2avei+28.01°COavei+28.02°(100-CO2avei-COavei-COavei))/(12.01°(CO2avei+COavei))*(Cb+(12.01/32.07)°S));

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2avei + 12.01 COavei)

Gi := WGpi + WMGi;

 $WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) (6)$$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei} + 8.936 \text{ } H + \text{Wma} \left(36.46063760 \right)$$

$$(100 - \text{CO2avei} - \text{COavei} - \text{O2avei} \right)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) (6)$$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei} - 1.301236174 N \right) + Mf$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C

> b + (12.01/32.07)*S)-N)/0.7685;

WAO := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}) - 1.301236174 N$$

#28

> WMGo := 8.936 H + (Wma WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2aveo - COaveo - O2aveo) \right)$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 s \right) / (12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}) - 1.301236174 N + Mf$$

#29

> WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

WGpo := (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (12.01 \quad CO2aveo + 12.01 \quad COaveo)$$

WGo := WGpo + WMGo;

$$WGo := (15.99 \ Co2aveo + 4.00 \ O2aveo - .01 \ Coaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ Co2aveo + 12.01 \ Coaveo) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left(100 - Co2aveo - Coaveo - O2aveo\right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ Co2aveo + 12.01 \ Coaveo) - 1.301236174 \ N + Mf$$

AL := ((WGo-WGi)/WGi)*100;

$$AL := 100 \left(\frac{(15.99\ Co2aveo + 4.00\ O2aveo - .01\ Coaveo + 2802.00)\ \%1}{12.01\ Co2aveo + 12.01\ Coaveo} + Wma \left(36.46063760 \frac{(100 - Co2aveo - Coaveo - O2aveo)\ \%1}{12.01\ Co2aveo + 12.01\ Coaveo} - 1.301236174\ N \right) - \frac{(15.99\ Co2avei + 4.00\ O2avei - .01\ Coavei + 2802.00)\ \%1}{\%2} - 1.301236174\ N \right) - \frac{(100 - Co2avei - Coavei - O2avei)\ \%1}{\%2} - 1.301236174\ N \right) - \frac{(15.99\ Co2avei + 4.00\ O2avei - .01\ Coavei + 2802.00)\ \%1}{\%2} + 8.936\ H + Wma \left(36.46063760 \frac{(100 - Co2avei - Coavei - O2avei)\ \%1}{\%2} - 1.301236174\ N \right) + Mf \right)$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%2 := 12.01 CO2avei + 12.01 COavei

#33

> TFluegasOUTa := WGo*Wfe*SA;

uegasOUTa := WGo*Wie*SA;

$$TFluegasOUTa := \frac{1}{2} \left((15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / (12.01 \ CO2aveo + 12.01 \ COaveo) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S \right) ($$

$$12.01 \quad CO2aveo + 12.01 \quad COaveo) - 1.301236174 \quad N + Mf \quad Wfe$$

- > sigmaTFluegasOUTa := sqrt(
- > Diff(TFluegasOUTa,CO2avei)^2*varCO2avei +
- > Diff(TFluegasOUTa,COavei)^2*varCOavei +
- > Diff(TFluegasOUTa,O2avei)^2*varO2avei +
- > Diff(TFluegasOUTa,Wfe)^2*varWfe +
- > Diff(TFluegasOUTa, Areai)^2*varAreai +
- > Diff(TFluegasOUTa,CP)^2*varCP +
- > Diff(TFluegasOUTa,PSi)^2*varPSi +
- > Diff(TFluegasOUTa,A)^2*varA +

ff(TFluegasOUTa,OUHD)^2*varOUHD +

ff(TFluegasOUTa,Ca)^2*varCa +

ff(TFluegasOUTa,C)*Diff(TFluegasOUTa,C)*varC +

ff(TFluegasOUTa,S)*Diff(TFluegasOUTa,S)*varS +

ff(TFluegasOUTa,H)*Diff(TFluegasOUTa,H)*varH +

ff(TFluegasOUTa,Wma)*Diff(TFluegasOUTa,Wma)*varWma +

ff(TFluegasOUTa,N)*Diff(TFluegasOUTa,N)*varN +

ff(TFluegasOUTa,Mf)*Diff(TFluegasOUTa,Mf)*varMf +

ım(sum(

ff(TFluegasOUTa,DPi[i])*Diff(TFluegasOUTa,DPi[j])*varDPi[i,j] +

ff(TFluegasOUTa,Ti[i])*Diff(TFluegasOUTa,Ti[j])*varTi[i,j] +

iff(TFluegasOUTa,COi[i])*Diff(TFluegasOUTa,COi[j])*varCOi[i,j] +

iff(TFluegasOUTa,CO2i[i])*Diff(TFluegasOUTa,CO2i[j])*varCO2i[i,j] +

iff(TFluegasOUTa,O2i[i])*Diff(TFluegasOUTa,O2i[j])*varO2i[i,]]

1..n),i=1..n)):

jmaTFluegasOUTa := value(");

$$+\frac{1}{2}$$
 Nma $\left(36.46063760 \frac{\%3\%1}{\%2} - 1.301236174 N\right) + \frac{1}{2} Mf\right)^2$ varWfe $+\frac{1}{4}$

$$\%4 \left(-\frac{OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{(1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} \right)$$

$$\frac{\text{Wma \%3} \left(-\frac{OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{(1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} \right)^{2}}{\$ + 36.46063760}$$

$$\frac{+36.46063760}{\$ 2}$$

$$\frac{4 \left(-\frac{A \ Ca}{1 - Ca} + \frac{1}{3} \frac{A \ Ca}{1 - \frac{1}{3} \ Ca} \right)}{\$ 2}$$

$$\frac{4 \left(-\frac{A \ Ca}{1 - Ca} + \frac{1}{3} \frac{A \ Ca}{1 - \frac{1}{3} \ Ca} \right)}{\$ 2}$$

$$\frac{\%4 \left(-\frac{A \text{ OUHD}}{1 - Ca} - \frac{A \text{ OUHD } Ca}{\left(1 - Ca\right)^2} - \frac{1}{3} \frac{A \left(1 - \text{OUHD}\right)}{1 - \frac{1}{3} Ca} - \frac{1}{9} \frac{A \left(1 - \text{OUHD}\right) Ca}{\left(1 - \frac{1}{3} Ca\right)^2} \right) + \frac{\%2}{\left(1 - \frac{1}{3} Ca\right)^2} + \frac{\%2}{\left(1$$

36.46063760 Wma %3

$$\left(-\frac{A \text{ OUHD}}{1-Ca} - \frac{A \text{ OUHD } Ca}{(1-Ca)^2} - \frac{1}{3} \frac{A (1-OUHD)}{1-\frac{1}{3} Ca} - \frac{1}{9} \frac{A (1-OUHD) Ca}{\left(1-\frac{1}{3} Ca\right)^2}\right) / (\%2)\right)$$

$$Wfe^2 \text{ } varCa + \frac{1}{4} \left(\frac{\%4}{\%2} + 36.46063760 \frac{\text{Wma \%3}}{\%2}\right)^2 \text{ } Wfe^2 \text{ } varC$$

$$+ \frac{1}{4} \left(.3744932959 \frac{\%4}{\%2} + 13.65426435 \frac{\text{Wma \%3}}{\%2}\right)^2 \text{ } Wfe^2 \text{ } varS$$

+19.96302400 Wfe² varH

CO2aveo := 14.145

O2aveo := 14.145;

arCO2aveo := .1^2;

varCO2aveo := .01	
> COaveo := .005;	
COaveo := .005,	
> varCOaveo := .002^2;	
_	
varCOaveo := .4 10 ⁻⁵	
> O2aveo := 5;	
02aveo := 5	
> varO2aveo := .05^2;	
var02aveo := .0025	
Coal Feed Rate (lbs/hr)	
> Wfe := 115839; Wfe := 115839	
> varWfe := (0.05°Wfe)^2;	
varWfe := .3354668480 10 ⁸	
Area (square ft)	
> Areal := 3.99;	
Areai := 3.99	
> varAreal := (0.0335*Areal)^2;	
varAreai := .01786633223	
> Areao := 3.54;	
Areao := 3.54	
> varAreao := (0.0364*Areao)^2;	
varAreao := .01660386874	
Pitot Coefficient	
> CP := 0.84;	
CP := .84	
> varCP := (0.01)^2;	
varCP := .0001	
Pressure in Area	
> PSI := 29.23;	
PSi := 29.23	
> varPSi := (0.04)^2;	
varPSi := .0016	

```
u := .0002744389824
o := 29.1;
                                                                                 > var := array([seq(u,i=1..n)]);
                             PSo := 29.1
                                                                                         var:=[.0002744389824 .0002744389824 .0002744389824 .0002744389824
PSo := (0.04)^2:
                                                                                          .0002744389824 .0002744389824
                                                                                                                       .0002744389824
                                                                                                                                      .0002744389824
                           varPSo := .0016
                                                                                          .0002744389824 .0002744389824
                                                                                                                        .0002744389824
                                                                                                                                      .0002744389824
                                                                                          .0002744389824
                                                                                                        .0002744389824
                                                                                                                       .0002744389824
                                                                                                                                      .0002744389824
isue for primary air
                                                                                          .0002744389824 .0002744389824
                                                                                                                       .0002744389824
                                                                                                                                      .0002744389824
)a := 31.11;
                                                                                          .0002744389824 .0002744389824 .0002744389824 .0002744389824]
                            PSpa := 31.11
                                                                                 > varDPi := make_array(var,n);
PSpa := (0.04)^2;
                                                                                                               varDPi := varcovar
                          varPSpa := .0016
                                                                                   Temperature (R)
                                                                                > v := 713;
city Head
                                                                                                                     v := 713
.45802;
                                                                                > To := array([seq(v,i=1..n)]);
                             v := .45802
                                                                                    := array([seq(v,i=1..n)]);
                                                                                      713 713 713 713 713 713 713 713 713 713]
Po := [.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
                                                                                > u := (0.01*(v-460))^2;
45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
                                                                                                                   u := 6.4009
45802 .45802 .45802 .45802 .45802]
                                                                                > var := array([seq(u,i=1..n)]);
(.02°v)^2;
                                                                                    var := [6.4009 6.4009 6.4009 6.4009 6.4009 6.4009
                                                                                                                                      6.4009
                                                                                                                                             6.4009
                                                                                                                                                    6.4009
                        u := .00008391292816
                                                                                     6.4009 6.4009 6.4009 6.4009
                                                                                                                  6.4009
                                                                                                                         6.4009 6.4009 6.4009 6.4009 6.4009
= array([seq(u,i=1..n)]);
                                                                                     6.4009 6.4009 6.4009 6.4009 6.4009]
var:=[.00008391292816 .00008391292816 .00008391292816 .00008391292816
                                                                                > varTo := make array(var.n):
 .00008391292816 .00008391292816 .00008391292816
                                                .00008391292816
 .00008391292816 .00008391292816 .00008391292816
                                                                                                               varTo := varcovar
                                                .00008391292816
 .00008391292816 \quad .00008391292816 \quad .00008391292816
                                                .00008391292816
                                                                                > v := 1140;
 .00008391292816 \quad .00008391292816 \quad .00008391292816 \quad .00008391292816
 .00008391292816 \quad .00008391292816 \quad .00008391292816 \quad .00008391292816]
                                                                                                                    v := 1140
                                                                                > Ti:= array([seq(v,i=1..n)]);
Po := make_array(var,n);
                                                                                     varDPo:= varcovar
                                                                                      1140]
82831:
                                                                                > u := (0.01*(v-460))^2:
                            v := .82831
                                                                                                                  u := 46.2400
= array([seq(v,i=1..n)]);
                                                                                > var := array([seq(u,i=1..n)]);
i := [.82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831 \ .82831
                                                              .82831
                                                                                    var:=[46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400
32831 .82831 .82831 .82831
                            .82831 .82831 .82831 .82831 .82831 .82831
                                                                                     46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400
32831 .82831 .82831 .82831 .82831]
                                                                                     46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400 46.2400]
.02*v)^2;
                                                                                > varTi := make_array(var,n);
```

	varTi := varcovar
	V41121
loisture in Coal	
Nf :=0.06;	
	Mf := .06
arMf := (0.039*Mf)^2;	
•	varMf:=.54756 10 ⁻⁵
\sh	
A := 0.0619;	
	A := .0619
varA := (0.039*A)^2;	
(, ,	varA:=.582787881 10 ⁻⁵
	Vala30270700. 10
Overhead	
OUHD := 0.9;	
-	OUHD := .9
varOUHD := (0.1*OUHD)^2;	
Valoutib i= (ett date)	varOUHD:=.0081
Carbon	
C := 0.7381;	
	C:= .7381
varC := (0.039*C)^2;	
vui o .= (0.000 -/ -/	varC := .0008286280388
Hydrogen	
H := 0.0482;	
	H:=.0482
varH := (0.039°H)^2;	
• •	varH:=.353364804 10 ⁻⁵
	Vain55550-1001 - 10
Nitrogen	
N := 0.0135;	
-	N:=.0135
varN := (0.039*N)^2;	
• •	varN:=.27720225 10 ⁻⁶

S := 0.0123;							
3 .2 0.0120,		s:= .0	123				
varS := (0.019*S)^2;							
	var	s := .546	1569 10	₎ -7			
CO2							
v := 14.145;		v := 1	1145				
		V := 14	1.143				
CO20 := array([seq(v,l=1.	n)]);		14 146	14.145	14 145	14 145	14.145
CO20 := [14.145 14.145	14.145	14.145	14.143	14.145	14.145	14.145	14.14
14.145 14.145 14.14	-) 14.143	14.143	•=	
14.145 14.145 14.14	5 14.145	14.145	<u> </u>				
u := (0.1)^2;		u:=	01				
	121:	u	.01				
var := array([seq(u,i=1n	/))) ;	01 0	1 01	.01 .01	.01 .01	.01 .0	01 .0
var:=[.01 .01 .01	.01 .01	.01 .01 10. 10	.011	.01 .01			
.01 .01 .01 .01 .		.01	.011				
> varCO2o := make_array(var,n);						
		-CO2o :=	varco	var			
> v := 15.2148;			5.2148				
		V := 1	5.2146				
> CO2i := array([seq(v,i=1	n)]);		0.40 1	5.2148 I	5 2 1 4 8	15 2148	15 214
CO2i := [15.2148 15.2]	.148 15.21	148 15		15.2148		15.2148	
15.2148 15.2148 15		.2148			15.2148		
15.2148 15.2148 15	5.2148 15.	.2148	5.2148	15.2146	13.2140	13.2140	,,
> u := (0.1)^2;			0.1				
		u :					
			01				
> var := array([seq(u,i=1	n)]);					. 01	01 6
> var := array([seq(u,l=1 var := [.01 .01 .01	n)]); .01 .01		10. 10	.01 .01	.01 .0	1 .01	.01 .0
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.01 .01			.01 .01	.01 .0	.01	0. 10.
var := [.01 .01 .01]	.01 .01 .01 .01 (var,n);	.01 .0	01 .01		.01 .0	10. 1	.01 .0
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.01 .01 .01 .01 (var,n);	.01 .0	10. 10		.01 .0	1 .01	.01 .00
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.01 .01 .01 .01 (var,n);	.01 .0	01 .01		.01 .0	1 .01	.01 .0
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.01 .01 .01 .01 (var,n);	.01 .0	01 .01		.01 .0	.01	.01 .0
var := [.01 .01 .01 .01 .01 .01 .01 .01 .01 .01	.01 .01 .01 .01 (var,n);	.01 .0 rCO2i:	01 .01		.01 .0	.01	.01 .0

```
120 := array([seq(v,i=1..n)]);
                                                                                                                                                                                            > u := (0.002)^2;
  020 :=
                                                                                                                                                                                                                                                                          u := .4 \cdot 10^{-5}
    > var := array([seq(u,i=1..n)]);
:= (0.05)^2;
                                                                                                                                                                                                      var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
                                                                         u := .0025
                                                                                                                                                                                                         .4 \cdot 10^{-5} .4 \cdot 10^{-5}
ar := array([seq(u,i=1..n)]);
                                                                                                                                                                                                          .4 \cdot 10^{-5} \quad .4 \cdot 10^{-5}
     var := [.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                      .0025 .0025
        .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                                                                             > varCOo := make_array(var,n);
        .0025 .0025 .0025]
                                                                                                                                                                                                                                                                 varCOo := varcovar
arO2o := make_array(var,n);
                                                            var02o := varcovar
                                                                                                                                                                                             > v := 0.005;
                                                                                                                                                                                                                                                                              v := .005
:= 3.8;
                                                                                                                                                                                            > COi := array([seq(v,i=1..n)]);
                                                                          v := 3.8
                                                                                                                                                                                                         COi := [.005 .005 .005 .005 .005 .005]
                                                                                                                                                                                                                                                                                               .005 .005
                                                                                                                                                                                                                                                                                                                       .005 .005 .005 .005
2i := array([seq(v,i=1..n)]);
                                                                                                                                                                                                                                                                       .005 .005 .005 .005 .005 .005 .005
                                                                                                                                                                                                           .005 .005 .005 .005
   02i := \{3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.
                                                                                                                                                                                             > u := (0.002)^2;
     3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8
                                                                                                                                                                                                                                                                          u := .4 \cdot 10^{-5}
:= (0.05)^2;
                                                                                                                                                                                            > var := array([seq(u,i=1..n)]);
                                                                        u := .0025
                                                                                                                                                                                                      var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
ir := array([seq(u,i=1..n)]);
                                                                                                                                                                                                         .4 \cdot 10^{-5} .4 \cdot 10^{-5}
    var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
   .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                                                                                          .4 \cdot 10^{-5} \quad .4 \cdot 10^{-5}
       .0025 .0025 .0025]
                                                                                                                                                                                             > varCOi := make_array(var,n);
irO2i := make_array(var,n);
                                                                                                                                                                                                                                                                 varCOi := varcovar
                                                            var02i := varcovar
                                                                                                                                                                                                Carbon in Ash
oisture (air)
                                                                                                                                                                                             > Ca := 0.0486;
ma := 0.013:
                                                                                                                                                                                                                                                                            Ca := .0486
                                                                      Wma := .013
                                                                                                                                                                                             > varCa := (0.25°Ca)^2;
rWma := (.1*Wma)^2;
                                                                                                                                                                                                                                                               varCa := .000147622500
                                                            varWma := .169 \cdot 10^{-5}
                                                                                                                                                                                               Area for primary air
                                                                                                                                                                                             > apa := .63;
= 0.004:
                                                                                                                                                                                                                                                                            apa := .63
                                                                        v := .004
                                                                                                                                                                                             > varapa := (.013)^2;
Do := array([seq(v,i=1..n)]);
                                                                                                                                                                                                                                                                    varapa := .000169
   COo := [.004 \ .004 \ .004 \ .004 \ .004 \ .004]
                                                                                           .004
                                                                                                       .004
                                                                                                                    .004
                                                                                                                               .004
                                                                                                                                             .004
      .004 .004 .004 .004 .004
                                                                 .004 .004
                                                                                          .004
                                                                                                      .004
                                                                                                                  .004 .004 .0041
                                                                                                                                                                                             > v := .2171;
```

v := .2171
DPpa := array([seq(v,i=1n)]);
DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
.2171 .2171 .2171]
u := 0.02°v;
u := .004342
varDPpa := array([seq(u,i=1n)]);
varDPpa:=[.004342 .004342 .004342 .004342 .004342 .004342 .004342
.004342 .004342 .004342 .004342 .004342 .004342 .004342 .004342
.004342 .004342 .004342 .004342 .004342 .004342 .004342 .004342 .004342 .
varDPpa := make_array(var,n);
varDPpa := varcovar
v := 1104;
ν := 1104
Tpa := array([seq(v,i=1n)]);
Tpa:=[1104 1104 1104 1104 1104 1104 1104 1104
1104 1104 1104 1104 1104 1104 1104 1104
1104]
u := 0.01*(v - 460);
u := 6.44
var := array([seq(u,i=1n)]);
var:=[6.44 6.44 6.44 6.44 6.44 6.44 6.44 6.44
6.44 6.44 6.44 6.44 6.44 6.44 6.44 6.44
varTpa := make_array(var,n);
varTpa:=varcovar
Results

eval(TFluegasINa);
eval(sigmaTFluegasINa);
eval(100*sigmaTFluegasINa/TFluegasINa);

eval(TFluegaslNb);
eval(sigmaTFluegasINb);

> eval(TFluegasOUTa);
806591.6480
> eval(sigmaTFluegasOUTa);
50458.32200
> eval(100*sigmaTFluegasOUTa/TFluegasOUTa);
6.255745658

eval(TFluegasOUTb);
eval(sigmaTFluegasOUTb);
Recalculate Other Results
Recalculate Office Acquis
> l := 'l';
i:=i
#13
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
m := 28.74570417
H - A
#14 > PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
PAFA := 14000.2 apa CF sqrt(FSpa iii) suin((DFpa[ij) fpa[ij) (112),i=1ii),
PAPA .= 13033.76700
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
PAFB := 75035.78706
1711 5 - 13055.70700
#17
> FA := 5348840*Areal*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,V
> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*(
> O2 [i]/100,l=1n):
#18
> FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,V
> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(I,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*(
> O2i[i]/100,i=1n):
#19

SA := FA/(FA+FB);	SA := .5000000000
20	
B := FB/(FA+FB);	
	SB := .5000000000
21	
VPAIA := PAFA/(Wfe*SA);	
	WPAIA := 1.295518557
22	
VPAIB := PAFB/(Wie*SB);	WPAIB := 1.295518557
	WPAIB := 1.293310331
23	(A)(4 O)(1)(2)(4 Co)(2).
r := (A*OUHD*Ca)/(1-Ca)	+ (A*(1-OUHD)*Ca/3)/(1-Ca/3);
	Cr := .002947741741
b := C - Cr;	
	Cb := .7351522583
NAI := (28.02*(100-CO2ave 1/32.07)*S)-N)/0.7685;	el-COavel-O2avel)/(12.01*(CO2avel+COavel))*(Cb+(12.
	WAi := 11.93169660
WMGI := 8.936*H + (Wma*)	WAi)+Mf;
•	WMGi := .6458272558
125	
WGpi := ((44.01*CO2avei+	32.02*O2avel+28.01*COavel+28.02*(100-CO2avel-COavel
H-02avel)y(12.01-(CO2av	ei+COavel))*(Cb+(12.01/32.07)*S));
	WGp1 := 12.38591870
¥26	
WGi := WGpi + WMGi;	wGi := 13.03174596
	WG1 .= 13.03174390
#27	
	aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(

	WAo := 12.81444703
#28	
> WMGo := 8.936*H + (Wma*	WAo) + Mf;
	WMGo := .6573030114
#29	
> WGpo := ((44.01*CO2aveo	+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C O2aveo+COaveo))*(Cb+(12.01/32.07)*S));
	WGpo := 13.26877798
#30	
> WGo := WGpo + WMGo;	
	WGo := 13.92608099
#31	
> AL := ((WGo-WGi)/WGi)*10)0;
	AL := 6.862741437
#32	
TFluegasINa := WGi*Wfe*S	A;
TFluegasINb := WGi*Wfe*S	B;
#33	
> TFluegasOUTa := WGo*W	fe*SA;
_	TF1uegas0UTa := 806591.6480
TFluegasOUTb := WGo*Wf	e*SB;

Appendix G-4 Random Error Calculation Flue Gas Outlet Flow -- With Leak Case

```
Random Error Propagation Calculations, Part B, TFluegasOUTa
  Set no. of sample points
> n := 24;
                                       n := 24
  procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> if i=j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fi;
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
```

```
for i to n do
                  if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                  else varcovar[i,j] := 0
                  fi
              ođ
          odi
          varcovar
      and
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936*H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
       Cb := C-Cr;
       R3 := (Cb+.3764932959°S)/(12.01°CO2[x]+12.01°CO[x]);
        8.9364H+Wmm (36.46063760*(100-co[x]-co2[x]-02[x])*K3-1.301236174°N)+M8
       MFG := .05550621670"K4/(.05550621670"K4+100"K3)
   and
 > M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 > Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma°((28.02°(100-CO[x]-CO2[x]-O2[x])°K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
 Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
 M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr.Cb, K3, K4, M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236176*N
      M : = (18.0164K6+K34(288.084CO2[x]+71.704O2[x]+50480.8 ))/(K6+1861.6
  and
```

#13

> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);

28.97 Wma + 28.97 1.608015098 Wma + 1

#14

> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} & \text{PAFA} \coloneqq 14088.2 \ \ \, \text{apa} \ \ \, \text{CP} \, \, \frac{\text{PSpa} \, \, (28.97 \, \, \text{Wma} + 28.97)}{1.608015098 \, \, \text{Wma} + 1} \, \, \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} \right) + \begin{array}{c} DPpa_2 \\ Tpa_2 \end{array} \\ & + \left(\begin{array}{c} DPpa_3 \\ Tpa_3 \end{array} \right) + \left(\begin{array}{c} DPpa_4 \\ Tpa_4 \end{array} \right) + \left(\begin{array}{c} DPpa_5 \\ Tpa_5 \end{array} \right) + \left(\begin{array}{c} DPpa_6 \\ Tpa_6 \end{array} \right) + \left(\begin{array}{c} DPpa_7 \\ Tpa_7 \end{array} \right) + \left(\begin{array}{c} DPpa_8 \\ Tpa_8 \end{array} \right) + \left(\begin{array}{c} DPpa_9 \\ Tpa_9 \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{10} \\ Tpa_{10} \end{array} \right) + \left(\begin{array}{c} DPpa_{11} \\ Tpa_{11} \end{array} \right) + \left(\begin{array}{c} DPpa_{12} \\ Tpa_{12} \end{array} \right) + \left(\begin{array}{c} DPpa_{13} \\ Tpa_{13} \end{array} \right) + \left(\begin{array}{c} DPpa_{14} \\ Tpa_{14} \end{array} \right) + \left(\begin{array}{c} DPpa_{15} \\ Tpa_{15} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{16} \\ Tpa_{16} \end{array} \right) + \left(\begin{array}{c} DPpa_{17} \\ Tpa_{17} \end{array} \right) + \left(\begin{array}{c} DPpa_{18} \\ Tpa_{18} \end{array} \right) + \left(\begin{array}{c} DPpa_{19} \\ Tpa_{19} \end{array} \right) + \left(\begin{array}{c} DPpa_{20} \\ Tpa_{20} \end{array} \right) + \left(\begin{array}{c} DPpa_{21} \\ Tpa_{21} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{15} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{22} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{15} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{23} \\ Tpa_{23} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{15} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right) \\ & + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{22} \end{array} \right) + \left(\begin{array}{c} DPpa_{24} \\ Tpa_{24} \end{array} \right)$$

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ DPpa PAFB := 14088.2 apa CP Tpa₂ 1.608015098 Wma+1 Tpa DPpa₆ DPpa₈ DPpa₇ DPpa₄ DPpa DPpa₅ DPpa₃ Tpa 6 Tpa 8 Tpa₄ $\overline{Tp}a_3$ Tpa Tpa Tpa₅ DPpa 15 DPpa 10 DPpa DPpa DPpa DPpa 12 14 Tpa₁₅ Tpa 10 Tpa Tpa Tpa Tpa 12 DPpa₂₁ DPpa₁₉ DPpa₂₀ DPpa 16 DPpa DPpa 17 Tpa 18 Tpa₂₀ Tpa 21 Tpa 16 Тра 17 Tpa 19 DPpa₂₄ DPpa₂₂ DPpa₂₃ Tpa₂₃ Tpa₂₄ Tpa₂₂ #17 > FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C > O2i[i]/100,i=1..n): #18 > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W > ma,O2I,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2I,H,Wma,O2i,N,Mf))*C > O2i[i]/100,i=1..n): #19

> SA := FA/(FA+FB);

 $SA := \frac{1}{2}$ #20

> SB := FB/(FA+FB);

 $SB := \frac{1}{2}$

> WPAIA := PAFA/(Wfe*SA);

$$\begin{aligned} & \text{WPAIA} := 28176.4 & \text{apa } CP \int \frac{PSpa}{1.608015098} \frac{(28.97 \text{ Wma} + 28.97)}{\text{Ima}_1} \left(\int \frac{DPpa}{1} + \int \frac{DPpa}{2} \right) \\ & + \int \frac{DPpa}{3} + \int \frac{DPpa}{4} + \int \frac{DPpa}{4} + \int \frac{DPpa}{5} + \int \frac{DPpa}{6} + \int \frac{DPpa}{7} + \int \frac{DPpa}{7} + \int \frac{DPpa}{8} + \int \frac{DPpa}{7} + \int \frac{DPpa}{8} + \int \frac{DPpa}{7} + \int \frac{DPpa}{10} + \int \frac{DPpa}{10} + \int \frac{DPpa}{10} + \int \frac{DPpa}{11} + \int \frac{DPpa}{12} + \int \frac{DPpa}{12} + \int \frac{DPpa}{13} + \int \frac{DPpa}{13} + \int \frac{DPpa}{14} + \int \frac{DPpa}{15} + \int \frac{DPpa}{15} + \int \frac{DPpa}{16} + \int \frac{DPpa}{16} + \int \frac{DPpa}{16} + \int \frac{DPpa}{17} + \int \frac{DPpa}{18} + \int \frac{DPpa}{19} + \int \frac{DPpa}{19} + \int \frac{DPpa}{20} + \int \frac{DPpa}{21} + \int \frac{DPpa}{22} + \int \frac{DPpa}{22} + \int \frac{DPpa}{23} + \int \frac{DPpa}{24} + \int \frac{DPpa}{24}$$

#22

> WPAIB := PAFB/(Wfe*SB);

$$\begin{split} \text{WPAIB} &:= \text{PAFB}(\text{Wie-Sb}); \\ \text{WPAIB} &:= 28176.4 \ \text{apa} \ \text{CP} \ \, \frac{PSpa \ \, (28.97 \ \, \text{Wma} + 28.97)}{1.608015098 \ \, \text{Wma} + 1} \left(\begin{array}{c} \frac{DPpa_1}{Tpa_1} + \sqrt{\frac{DPpa_2}{Tpa_2}} \\ \frac{DPpa_3}{Tpa_3} + \sqrt{\frac{DPpa_4}{Tpa_4}} + \sqrt{\frac{DPpa_5}{Tpa_5}} + \sqrt{\frac{DPpa_6}{Tpa_6}} + \sqrt{\frac{DPpa_7}{Tpa_7}} + \sqrt{\frac{DPpa_8}{Tpa_8}} + \sqrt{\frac{DPpa_9}{Tpa_9}} \\ + \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}} + \sqrt{\frac{DPpa_{13}}{Tpa_{13}}} + \sqrt{\frac{DPpa_{14}}{Tpa_{14}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} \\ + \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}} + \sqrt{\frac{DPpa_{21}}{Tpa_{21}}} \\ + \sqrt{\frac{DPpa_{22}}{Tpa_{22}}} + \sqrt{\frac{DPpa_{23}}{Tpa_{23}}} + \sqrt{\frac{DPpa_{24}}{Tpa_{24}}} \\ \end{pmatrix} \text{Wfe} \end{split}$$

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \quad OUHD \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

> Cb := C - Cr;

Cb :=
$$C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca}$$

> WAI := (28.02*(100-CO2avei-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.0

> 1/32.07)*S)-N)/0.7685;

WAi := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 s\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N$$

#24

> WMGI := 8.936*H + (Wma*WAI)+Mf;

WMGi := 8.936 H + Wma
$$\left(36.46063760 \ (100 - CO2avei - COavei - O2avei) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{2} \ Ca} + .3744932959 \ S \right)$$

#25

> WGpi := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02*(100-CO2avei-COavei-COavei+28.02*(100-CO2avei-COavei-Coa > ei-O2avei))/(12.01*(CO2avei+COavei))*(Cb+(12.01/32.07)*S));

WGpi := (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) (6)$$

12.01 CO2avei + 12.01 COavei)

#26

> WGi := WGpi + WMGi;

WGi := (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) + 8.936 \text{ } H + \text{Wma} \left(36.46063760\right) / (100 - CO2avei - COavei - O2avei) / (100 - CO2avei + 12.01 COavei) - 1.301236174 N) + Mf$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAO := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (1 - \frac{1}{3} Ca)$$

12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2aveo - COaveo - O2aveo) \right)$

$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$
12.01 $CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf$

#29

> WGpo := ((44.01°CO2aveo+32.02°O2aveo+28.01°COaveo+28.02°(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

WGpo := (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$
12.01 CO2aveo + 12.01 COaveo)

#30

+ Mf

> WGo := WGpo + WMGo;

$$WGo := WGpo + WMGo;$$

$$WGo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ CO2aveo + 12.01 \ COaveo) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N + Mf$$

> AL := ((WGo-WGi)/WGi)*100; $AL := 100 \left(\frac{(15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ CO}{(15.99 \ CO2aveo + 2802.00)} \right) \%1$ + Wma $\left(36.46063760 \frac{(100 - CO2aveo - COaveo - O2aveo) \%1}{12.01 CO2aveo + 12.01 COaveo} - 1.301236174 III$ (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00) %1 $- \text{Wma} \left(36.46063760 \frac{(100) - CO2avei - COavei - O2avei) \% 1}{\% 2} - 1.301236174 \right)$ $\left(\frac{(15.99 \ CO2avei + 4.00) \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} + 8.936 \ H$ + Wtma $\left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174 \right)$

$$\%1 := C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S$$

%2 := 12.01 CO2avei + 12.01 COavei

#33

> TFluegasOUTa := WGo*Wfe*SA;

TF1uegasOUTa :=
$$\frac{1}{2}$$
 (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$
12.01 CO2aveo + 12.01 COaveo) + 8.936 H + Wma (36.46063760)

$$\left(100 - CO2aveo - COaveo - O2aveo \right)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$
12.01 CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf Wfe

- > sigmaTFluegasOUTa := sqrt(
- > Diff(TFluegasOUTa,CO2avel)^2*varCO2avel +
- > Diff(TFluegasOUTa,COavel)^2*varCOavel +
- > Diff(TFluegasOUTa,O2avel)^2*varO2avel +
- > Diff(TFluegasOUTa,Wfe)^2*varWfe +
- > Diff(TFluegasOUTa,Areai)^2*varAreai +
- > Diff(TFluegasOUTa,CP)^2*varCP +
- > Diff(TFluegasOUTa,PSi)^2*varPSi +
- > Diff(TFluegasOUTa,A)^2*varA +

> Diff(TFluegasOUTa,OUHD)^2*varOUHD +
> Diff(TFluegasOUTa,Ca)^2*varCa +
> Diff(TFluegasOUTa,C)*Diff(TFluegasOUTa,C)*varC +
> Diff(TFluegasOUTa,S)*Diff(TFluegasOUTa,S)*varS +
> Diff(TFluegasOUTa,H)*Diff(TFluegasOUTa,H)*varH +
> Diff(TFluegasOUTa,Wma)*Diff(TFluegasOUTa,Wma)*varWma +
> Diff(TFluegasOUTa,N)*Diff(TFluegasOUTa,N)*varN +
> Diff(TFluegasOUTa,Mf)*Diff(TFluegasOUTa,Mf)*varMf +
> sum(
> Dlff(TFluegasOUTa,DPl[i])*Diff(TFluegasOUTa,DPl[i])*varDPl[i,i] +
> Diff(TFluegasOUTa,Ti[i])*Diff(TFluegasOUTa,Ti[i])*varTi[i,i] +
> Diff(TFluegasOUTa,COi[i])*Diff(TFluegasOUTa,COi[i])*varCOi[i,i] +
> Dlff(TFluegasOUTa,CO2i[i])*Diff(TFluegasOUTa,CO2i[i])*varCO2i[i,i] +
> Diff(TFluegasOUTa,O2i[i])*Diff(TFluegasOUTa,O2i[i])*varO2i[i,i]
> ,i=1n)):
> sigmaTFluegasOUTa := value("):
Constants
Averages and Random Error Variances (Copied from Part A function of sample size n
> CO2avel := 15.2148;
CO2avei := 15.2148
> varCO2avei := .102^2;
varCO2avei := .010404
> COavel := .005;
COavei := MS

> varCOavei := .0002^2;
varC0avei:=.4 10 ⁻⁷
> O2avel := 3.8;
02avei := 3.8
> varO2avei := .01118^2;
varO2avei := .0001249924
> CO2aveo := 14.145;
CO2aveo := 14.145
> varCO2aveo := .0866^2;
varCO2aveo := .00749956
> COaveo := .005;
COaveo := .005
> varCOaveo := .000204^2;
varCOaveo := .41616 10 ⁻⁷
> O2aveo := 5;
02aveo := 5
> varO2aveo := .010206^2;
varO2aveo := .000104162436
Constants for Random Error Propagation
Coal Feed Rate (lbs/hr) re
> Wfe := 115839;
Wfe := 115839
> varWfe := (0.0025*Wfe)^2;
varWfe:=83866.71200
Area (square ft) re
> Areal := 3.99;
Areai := 3.99
> varAreai := (0.0335*Areai)^2;
varAreai := .01786633223
A 2 C 4
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364°Areao)^2; varAreao := .01660386874

Pitot Coefficient re
CP := 0.84;
CP:=.84
varCP := (0)^2;
varCP:=0
Pressure Ambient or Barometric re
PSI := 29.23;
<i>PSi</i> := 29.23
varPSi := (0.04)^2;
varPSi := .0016
PSo := 29.1;
PSo := 29.1
varPSo := (0.04)^2;
varPSo := .0016
Pressue for primary air
PSpa := 31.11;
PSpa := 31.11
varPSpa := (0.04)^2;
varPSpa := .0016
Velocity Head DP re
v := .45802;
v:=.45802
DPo := array([seq(v,i=1n)]);
DPo := [.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
.45802 .45802 .45802 .45802 .45802]
u := .00005^2;
·
u := .25 10 ⁻⁸
var := array([seq(u,i=1n)]);
$var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}$
$.25 \cdot 10^{-8} .25 \cdot 10^{-8$

```
.25 10<sup>-8</sup>
    > varDPo := make_array(var,n);
                                                                                                     varDPo := varcovar
    > v := .82831:
                                                                                                                    v := .82831
   > DPi := array([seq(v,i=1..n)]);
               DPi := [.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .828831 .828831 .828831 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82881 .82
                   .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
                    .82831 .82831 .82831 .82831 .82831]
   > u := .00005^2:
                                                                                                               u := .25 \cdot 10^{-8}
  > var := array([seq(u,i=1..n)]);
             var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
                 .25 \cdot 10^{-8} .25 \cdot 10^{-8}
                 .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
                 .25 10-8]
 > varDPi := make_array(var,n);
                                                                                                 varDPi := varcovar
 > v := .2171:
                                                                                                                  v := .2171
 > DPpa := array([seq(v,i=1..n)]);
                 DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
                     .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
                     .2171 .2171 .2171]
> u := (0.00005)^2;
                                                                                                            u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
          var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
              .25 \cdot 10^{-8} .25 \cdot 10^{-8}
              .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
               .25 10-8
> varDPpa := make_array(var,n);
```

```
varDPpa:=varcovar
 > v := 1104:
                             v := 1104
 > Tpa := array([seq(v,i=1..n)]);
     1104]
 > u := (0.005*(v - 460))^2:
                           u := 10.368400
> var := array([seq(u,i=1..n)]);
    10.368400 10.368400 10.368400 10.368400
                                            10.368400
                                    10.368400
     10.368400 10.368400 10.368400 10.368400 10.368400
                                            10.368400 10.368400
     10.368400 10.368400 10.368400 10.3684001
> varTpa := make_array(var,n);
                        varTpa := varcovar
  Temperature (R) re
> v := 713:
                            v := 713
> To := array([seq(v,i=1..n)]);
   713 713 713 713 713 713 713 713 713 713
> u := (0.005*(v-460))^2;
                          u := 1.600225
> var := array([seq(u,i=1..n)]);
  var:=[1.600225    1.600225    1.600225    1.600225    1.600225    1.600225    1.600225
   1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225
   1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225
    1.6002251
> varTo := make array(var.n):
                       varīo := varcovar
> v := 1140;
                           v := 1140
> Ti:= array([seq(v,i=1..n)]);
```

```
11401
> u := (0.005*(v-460))^2;
                                    u := 11.560000
> var := array([seq(u,i=1..n)]);
     var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
       11.560000 11.560000 11.560000 11.560000 11.560000 11.560000
       11,560000 11,560000 11,560000 11,560000 11,560000 11,560000 11,560000
       11.560000 11.560000 11.560000 11.560000]
> varTi := make_array(var,n);
                                 varTi := varcovar
  Moisture in Ash re
> Mf := 0.06;
                                      MF := .06
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;
                              varMf := .00001058319613
  Ash re
> A := 0.0619:
                                      A := .0619
> varA := ((0.07+0.02*A*100)/(2*1.414*100))^2;
                               varA := .4696223261 \cdot 10^{-6}
  Overhead re
> OUHD := 0.9;
                                      OUHD := .9
> varOUHD := (0.1*OUHD)^2;
                                  varOUHD := .0081
  Carbon re
> C := 0.7381;
                                      C := .7381
> varC := (0.64/(2*1.414*100))^2;
                              varC := .5121546706 \ 10^{-5}
  Hydrogen re
> H := 0.0482;
                                      H := .0482
> varH := (0.16/(2*1.414*100))^2;
```

```
varH:=.3200966692 10<sup>-6</sup>
         Nitrogen re
  > N := 0.0135;
                                                                                                                                      N := .0135
 > varN := (0.11/(2*1.414*100))^2;
                                                                                                           varN:=.1512956913 10<sup>-6</sup>
        Sulfur re
 > S := 0.0123;
                                                                                                                                      S := .0123
 > varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;
                                                                                                           vars := .1327813813 \cdot 10^{-6}
        CO<sub>2</sub> re
 > v := 14.145:
                                                                                                                                   v := 14.145
 > CO20 := array([seq(v,i=1..n)]);
               CO2o := [14.145 \quad 14.145 \quad 1
                    14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145
                    14.145 14.145 14.145 14.145 14.145]
  > u := (0.03*v)^2;
                                                                                                                          u := .1800729225
> var := array([seq(u,i=1..n)]);
                var:=[.1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                    .1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                    .1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                    .1800729225 .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
                    .18007292251
> varCO2o := make array(var.n);
                                                                                                               varCO2o:= varcovar
> v := 15.2148:
                                                                                                                                v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
               CO2i := [15.2148 \quad 15.2148 \quad 15.2148 \quad 15.2148 \quad 15.2148 \quad 15.2148
                                                                                                                                                                                                                                 15.2148 15.2143
                    15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
                    15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.21481
```

Or

ري ر

```
> u := (0.03^{\circ}v)^{2};
                                                                                          u := .2083411251
 > var := array([seg(u,i=1..n)]);
             var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251
                .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
                .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
                .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
                .20834112511
 > varCO2i := make_array(var,n);
                                                                                 varCO2i := varcovar
      O<sub>2</sub> re
 > v := 5;
                                                                                                      \mathbf{v} := 5
> O2o := array([seq(v,l=1..n)]);
           020 :=
              > u := (0.05)^2;
                                                                                                  u := .0025
> var := array([seq(u,i=1..n)]);
                var := [.0025 \ .0025 \ .0025 \ .0025 \ .0025
                                                                                                                                                                             .0025
                                                                                                                                                                                            .0025
                                                                                                                        .0025 .0025
                                                                                                                                                           .0025
                   .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                                                                                                                                           .0025 .0025 .0025
                   .0025 .0025 .00251
> varO2o := make_array(var,n);
                                                                                  var02o := varcovar
> v := 3.8;
                                                                                                    v := 3.8
> O2l := array([seq(v,l=1..n)]);
             02i := \{3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.
               > u := (0.05)^2;
                                                                                                u := .0025
> var := array([seg(u,i=1..n)]);
               var := [.0025 .0025 .0025 .0025 .0025
                                                                                                                        .0025
                                                                                                                                         .0025
                                                                                                                                                           .0025
                                                                                                                                                                                              .0025
                   .0025 \quad .0025
                                                                                                                                                                           .0025 .0025
                   .0025 .0025 .00251
> varO2i := make_array(var,n);
```

```
var02i := varcovar
   Moisture (air) re
> Wma := 0.013;
                                                 Wma := .013
> varWma := (.2*Wma)^2;
                                           varWma:=.676 10<sup>-5</sup>
  CO re
> v := 0.004;
                                                  v := .004
> COo := array([seq(v,i=1..n)]);
       .004
                                                                                    .004 .004 .004
         .004 .004 .004 .004 .004
                                              .004 .004 .004 .004 .004 .004 .0041
> u := (0.001)^2;
                                                u := .1 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
      var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
       .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
        .1 \cdot 10^{-5} \cdot .1 \cdot 10^{-5}
> varCOo := make_array(var,n);
                                          varCOo:= varcovar
> v := 0.005;
                                                  v := .005
> COi := array([seq(v,l=1..n)]);
       COi := [.005 .005 .005]
                                      .005
                                              .005 .005 .005
                                                                    .005 .005
                                                                                   .005 .005 .005
         .005 .005 .005 .005
                                             .005 .005 .005 .005 .005 .005 .005
> u := (0.001)^2;
                                               u := .1 \cdot 10^{-5}
> var := arrav([seq(u,i=1..n)]):
     var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
       .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
       .1 \cdot 10^{-5} \cdot .1 \cdot 10^{-5}
> varCOi := make array(var,n):
```

varCOi := varcovar

Carbon in Ash re	····
> Ca := 0.0486;	
Ca := .0486	
> varCa := (0.1*Ca)^2;	
varCa := .0000236196	
Area for Primary Air re	
> apa := 0.63;	
apa := .63	
> varapa := (0.0208*apa)^2;	
varapa:=.000171714816	
Results	
***************************************	******
> evalf(TFluegasOUTa);	
806591.6480	
> evalf(sigmaTFluegasOUTa);	
3707.782816	
> evalf(100*sigmaTFluegasOUTa/TFluegasOUTa);	
.4596852478	
***************************************	******
>	

Appendix H-1 Bias Error Calculation Inlet Flue Gas Flow Split

```
Error Propagation Calculations, Part B, Split A (SA)
  Set no. of sample points
> n := 2;
                                       n := 2
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
           for j to n do
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
          ođ:
           varcovar
      end
```

> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)

```
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01°S/32.07)/(12.01°(CO2[x] + CO[x]));
> K4 := 8.936'H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100°K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02°(100-CO[x]-CO2[x]-O2[x])°K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
```

```
Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 M :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
 local Cr,Cb,K3,K4,M;
                                   Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
                                     Cb := C-Cr;
                                   K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
                                     K4 :=
                                             8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
                                     M := (18.016*K4+K3*(288.08*C02[x]+71.70*02[x]+50480.8))/(K4+1801.6)
 end
  O2aveo :=
sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)*(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{\land}(1/2)^{\bullet}(1-MFG,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))
 (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i],i=1..n)/sum((DPo[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf))*O2o[i]/(To[i]*Mf)
    ,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,CO
  o,CO2o,H,Wma,O2o,N,Mf)),i=1..n);
     O2avei :=
  sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),CO2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2i,H,Wma,O2
    A, OUHD, Ca, C, S, COi, CO2i, H, Wma, O2i, N, Mf)) *O2i[i], i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,O))) *O2i[i], i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,O)))) *O2i[i]/(DPi[i]/(Ti[i]*M(i,A,O)))) *O2i[i]/(DPi[i]/(Ti[i]*M(i,A,O))) *O2i[i]/(DPi[i]/(Ti[i]*M(i,A,O))) *O2i[i]/(DPi[i]/(Ti[i]*M(i,A,O))) *O2i[i]/(DPi[i]/(Ti[i]*M(i,A,O)))) *O2i[i]/(DPi[i]/(Ti[i]*M(i,A,O))) *O2i[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi[i]/(DPi
    H,Wma,O2i,N,Mf)),i=1..n);
     CO2aveo :=
  sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{(1/2)*(1-MFG)}
    (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)) * CO2o[i],i=1..n)/sum((DPo[i]/(To[i]*)) * (DPo[i]/(To[i]*)) * (DPo[i]/(To[i]*) * (DPo[i]/(To[i]*)) * (DPo[i]/(To[i]/(To[i]*)) * (DPo[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(To[i]/(
    M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S.
     COo,CO2o,H,Wma,O2o,N,Mf)),i=1..n);
     CO2avei :=
    sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,R),Mf)})^{(1/2)*(1-MFG(i,R),Mf)})^{(1/2)*(1-MFG(i,R),Mf)})^{(1/2)*(1-MFG(i,R),Mf)})^{(1/2)*(1-MFG(i,R),Mf)}
    A, OUHD, Ca, C, S, COi, CO2i, H, Wma, O2i, N, Mf)) * CO2i[i], i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A...)))) * CO2i[i]/(Ti[i]*M(i,A...))) * CO2i[i]/(Ti[i]*M(i,A...)) * CO2i[i]/(Ti[i]*M(i,A...))) * CO2i[i]/(Ti[i]*M(i,A...)) * CO2i[i]/(Ti[i]*M(i,A...))) * CO2i[i]/(Ti[i]*M(i,A...)) *
     OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO
     2i,H,Wma,O2i,N,Mf),i=1..n);
     #8
     COaveo :=
    sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^{(1/2)*(1-MFG)}
    (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*COo[i],i=1..n)/sum((DPo[i]/(To[i]*\Min (DPo[i]/(To[i])))*COo[i],i=1..n)/sum((DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i]/(To[i]))*(DPo[i
    i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,CO
     o,CO2o,H,Wma,O2o,N,Mf)),i=1..n);
```

COavei := $sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^{(1/2)*(1-MFG(i,A,C),CO2i,H,Wma,O2i,Mf)))^{(1/2)*(1-MFG(i,A,C),CO2i,H,Wma,O2i,H,$ A, OUHD, Ca, C, S, COi, CO2i, H, Wma, O2i, N, Mf)) * COi[i], i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,Oi))) * COi[i]/(Ti[i]*M(i,A,Oi)) * COi[i]UHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i, H.Wma,O2i,N,Mf), i=1..n; #13 > m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1); 28.97 Wma + 28.97 1.608015098 Wma + 1 #14 > PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ Tpa₂ Tpa > PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ Tpa₂ #17 > FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2I,H,W > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C > O2i[i]/100,l=1..n): CALCULATION EXPEDIENT -- USED LEAR CASE FLUE GAS OUTLET COMPOSITIONS FOR GAS COMPOSITION TO B' SIDE HEAT PIPE. THIS JUST PROVIDES #18 A SECOND GAS COMPOSITION FOR CALCULATING A FLOW SPLIT. > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPI[i]/(M(I,A,OUHD,Ca,C,S,COo,CO2o,H, > Wma,O2o,N,Mf)*TI[I]))^(1/2)*(1-MFG(I,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,M > f))*CO2o[i]/100,i=1..n): #19 > SA := FA/(FA+FB); $SA := 5348840 \text{ Areai } CP \sqrt{PSi} \mid .010000000000 \mid DPi$

$$\begin{cases} CO2i_1 + .01000000000 & DPi_2 & 8.936000000 & H + \%7 + ME + 1801.600000 & \frac{\%2}{\%6} \end{pmatrix} / \\ & \left(160.9909760 & H + 18.01600000 & \%7 + 18.01600000 & ME \\ & + \frac{\%2 & \left(288.0800000 & CO2i_2 + 71.70000000 & O2i_2 + 50480.80000 \right)}{\%6} \right) Ti_2 \right)^{1/2} \\ & - .05550621670 & \frac{8.936000000 & H + \%7 + ME}{.4960035524 & H + .05550621670 & \%7 + .05550621670 & ME + 100. & \frac{\%2}{\%6} \\ \\ & CO2i_2 \right) + 5348840 & Areai & CP & \sqrt{PSi} & 0.10000000000 & DPi_1 \\ & \left(8.936000000 & H + \%5 + ME + 1801.600000 & \frac{\%2}{\%4} \right) / \left(\left(160.9909760 & H + 18.01600000 & ME + \frac{\%2}{3} \left(288.0800000 & CO2o_1 + 71.70000000 & O2o_1 + 50480.80000 \right) \right) Ti_1 \right)^{1/2} \\ & + \frac{8.936000000 & H + \%5 + ME}{.4960035524 & H + .05550621670 & \%5 + .05550621670 & ME + 100. & \frac{\%2}{\%4} \\ & CO2o_1 + .010000000000 & DPi_2 & \left(8.936000000 & H + \%3 + ME + 1801.600000 & \frac{\%2}{\%4} \right) / \left(160.9909760 & H + 18.01600000 & \%3 + 18.01600000 & ME \\ & + \frac{\%2}{3} & \left(288.0800000 & CO2o_2 + 71.70000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.0800000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \\ & + \frac{\%2}{3} & \left(288.0800000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50480.80000 \right) \right) Ti_2 \right)^{1/2} \\ & + \frac{\%2}{3} & \left(288.08000000 & CO2o_2 + 71.700000000 & O2o_2 + 50$$

 $SB := 5348840 \text{ Areai } CP \sqrt{PSi} \mid .010000000000 \mid DPi_1$ $\left(8.936000000 \ H + \%5 + ME + 1801.600000 \ \frac{\%2}{\%4}\right) / \left(160.9909760 \ H\right)$ + 18.01600000 %5 + 18.01600000 ME 8.9360000000 H + %5 + ME-.05550621670 - $.4960035524 \ \ \textit{H} + .05550621670 \ \ \%5 + .05550621670 \ \ \textit{Mf} + 100.$ $CO20_1 + .01000000000 \left[DPi_2 \left(8.936000000 \ H + \%3 + Mf + 1801.600000 \ \frac{\%2}{\%1} \right) \right]$ 160.9909760 H+18.01600000 %3+18.01600000 ME $\frac{\%2\left(288.0800000 \ co2o_{2} + 71.70000000 \ o2o_{2} + 50480.80000\right)}{\alpha_{11}}\right) \ Ti_{2}}$ -.05550621670 -.4960035524 H + .05550621670 %3 + .05550621670 ME + 100. $\frac{\%2}{\%1}$ $\left(8.936000000 \ H + \%9 + MF + 1801.600000 \ \frac{\%2}{\%8}\right) / \left[\left(160.9909760 \ H\right)^{-1}\right]$ +18.01600000 %9 + 18.01600000 Mf $\frac{\%2\left(288.0800000 \ co2i_1 + 71.700000000 \ o2i_1 + 50480.80000\right)}{\%8}\right) \ Ti_1 \bigg) \bigg)^{1/2} \bigg(1.$

8.9360000000 H + %9 + ME- .05550621670 -.4960035524 H + .05550621670 %9 + .05550621670 ME + 100. $CO2i_1 + .010000000000 \left[DPi_2 \left(8.936000000 \ H + \%7 + Mf + 1801.600000 \ \frac{\%2}{\%6} \right) \right]$ 160.9909760 H + 18.01600000 %7 + 18.01600000 Mf $\frac{-\frac{\%2\left(288.0800000\ co2i_2+71.700000000\ o2i_2+50480.80000\right)}{\%6}\right)}{}$ 8.9360000000 H + %7 + ME-.05550621670 -.4960035524 H+.05550621670 %7+.05550621670 Mf+100. $\frac{\%2}{\%6}$ $CO2i_2 + 5348840 \text{ Areai } CP \sqrt{PSi} \ 0.010000000000 \ DPi_1$ $\left(8.936000000 \ H + \%5 + ME + 1801.600000 \ \frac{\%2}{\%4}\right) / \left(\left(160.9909760 \ H\right)^{1/2}\right)$ +18.01600000 %5 +18.01600000 Mf $\frac{\%2\left(288.0800000 \ CO2o_1 + 71.700000000 \ O2o_1 + 50480.80000\right)}{\%4}\right) Ti_1\right)^{1/2} \left(1.$ -.05550621670 .4960035524 H + .05550621670 %5 + .05550621670 Mf + 100. $\frac{\%2}{\%1}$ $\left| \begin{array}{c} CO2o_{1} + .01000000000 \\ \end{array} \right| \left| \begin{array}{c} DPi_{2} \\ \end{array} \left(8.936000000 \\ \end{array} \right. H + \%3 + Mf + 1801.600000 \\ \left. \frac{\%2}{\%1} \right) \right|$ 160.9909760 H + 18.016000000 %3 + 18.016000000 ME

$$+ \frac{ \%2 \left(288.0800000 \ Co2o_2 + 71.70000000 \ o2o_2 + 50480.80000\right)}{ \%1} \right) Ti_2 \right)^{1/2} \left(1. - 0.5550621670 \ \frac{ 8.936000000 \ H + \%3 + ME}{ .4960035524 \ H + .05550621670 \ \%3 + .05550621670 \ ME + 100. \ \frac{\%2}{\%1} \right) Co2o_2 \right)^{1/2} \left(1. - \frac{ A \ OUHD \ Ca}{ 1. - 1. \ Ca} - .3333333333 \ \frac{A \ (1. - 1. \ OUHD) \ Ca}{ 1. - 33333333333 \ Ca} + .3744932959 \ S \right)^{1/2} \left(1. - \frac{ A \ OUHD \ Ca}{ 1. - 1. \ Ca} - .3333333333 \ \frac{A \ (1. - 1. \ OUHD) \ Ca}{ 1. - .33333333333 \ Ca} + .3744932959 \ S \right)^{1/2} \left(1. - \frac{ A \ OUHD \ Ca}{ 1. - 1. \ Ca} - .33333333333 \ \frac{A \ (1. - 1. \ OUHD) \ Ca}{ 1. - .33333333333 \ Ca} + .3744932959 \ S \right)^{1/2} \left(1. - \frac{ A \ OUHD \ Ca}{ 1. - 1. \ Ca} - .33333333333 \ \frac{A \ (1. - 1. \ OUHD) \ Ca}{ 1. - .333333333333 \ Ca} + .3744932959 \ S \right)^{1/2} \left(1. - \frac{ A \ OUHD \ Ca}{ 1. - 1. \ Co2o_2 - 1. \ O2o_2 \right)^{1/2} \left(1. - \frac{ 1. \ O2o_2 - 1. \ O2o_2 \right)^{1/2} \left(1. - \frac{ 1. \ O2o_2 - 1. \$$

> sigmaSA := sqrt(
> Diff(SA,CO2avei)^2*varCO2avei +
> Diff(SA,COavel)^2*varCOavel +
> Diff(SA,O2avel)^2*varO2avel +
> Diff(SA,CO2aveo)^2*varCO2aveo +
> Diff(SA,COaveo)^2*varCOaveo +
> Diff(SA,O2aveo)^2*varO2aveo +
> Diff(SA,Wfe)^2*varWfe +
> Diff(SA,Areal)^2*varAreal +
> Diff(SA,CP)^2°varCP +
> Diff(SA,PSI)^2*varPSi +
> Diff(SA,A)^2*varA +
> Diff(SA,OUHD)^2*varOUHD +
> Diff(SA,Ca)^2*varCa +
> Diff(SA,C)*Diff(SA,C)*varC +
> Diff(SA,S)*Diff(SA,S)*varS +
> Diff(SA,H)*Diff(SA,H)*varH +
> Diff(SA,Wma)*Diff(SA,Wma)*varWma +
> Diff(SA,N)*Diff(SA,N)*varN +
> Diff(SA,Mf)*Diff(SA,Mf)*varMf +
> sum(sum(
> Diff(SA,DPi[i])*Diff(SA,DPi[j])*varDPi[i,j] +
> Diff(SA,Ti[i])*Diff(SA,Ti[j])*varTi[i,j] +

> Diff(SA,COo[i])*Diff(SA,COo[j])*varCOo[i,j] +
> Diff(SA,CO2o[i])*Diff(SA,CO2o[j])*varCO2o[i,j] +
> Diff(SA,O2o[i])*Diff(SA,O2o[j])*varO2o[i,j] +
> Diff(SA,COi[i])*Diff(SA,COi[j])*varCOi[i,j] +
> Diff(SA,CO2[[i])*Diff(SA,CO2[[j])*varCO2i[i,]] +
> Diff(SA,O2i[i])*Diff(SA,O2i[j])*varO2i[i,]]
> ,[=1n),l=1n)):
> sigmaSA := value("):
Constants
Averages and Variances from Part A
> CO2avel := 15.2148;
CO2avei := 15.2148
> varCO2avel := .1^2;
varCO2avei := .01
> COavei := .005; COavei := .005
> varCOavei := .002^2;
varCOavei:=.4 10 ⁻⁵
> O2avei := 3.8;
02avei := 3.8
> varO2avel := .05^2;
var02avei := .0025
> CO2aveo := 14.145; CO2aveo := 14.145
> varCO2aveo := .1^2;
> VarCO2aveo := .1^2; varCO2aveo := .01
> COaveo := .005; COaveo := .005

> varCOaveo := .002^2;	
varCOaveo:=.4 10 ⁻⁵	
> O2aveo := 5;	
02aveo := 5	
> varO2aveo := .05^2;	
var02aveo := .0025	
C. In. J. D. A. (B. A.)	
Coal Feed Rate (lbs/hr) > Wfe := 115839;	
> Wie := 113639; Wfe := 115839	
> varWfe := (0.05*Wfe)^2;	
varWfe:=.3354668480 10 ⁸	
Area (square ft)	
> Areal := 3.99;	
Areai := 3.99	
> varAreal := (0.0335*Areal)^2;	
varAreai := .01786633223	
> Areao := 3.54;	
Areao := 3.54	
> varAreao := (0.0364*Areao)^2;	
varAreao := .01660386874	
Pilat Coofficient	
Pitot Coefficient > CP := 0.84;	***************************************
CP := .84	
> varCP := (0.01)^2;	
varCP := (0.01) ² 2,	
Valueww1	
Pressure in Area	
> PSi := 29.23;	
PSi := 29.23	
> varPSi := (0.04)^2;	
varPSi := .0016	
> PSo := 29.1;	
PSo := 29.1	·

> varPSo := (0.04)^2;	
varPSo:=	.0016
Pressue for primary air	
> PSpa := 31.11; PSpa := 3	1.11
> varPSpa := (0.04)^2; varPSpa :=	0016
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	.0010
Velocity Head	
> v := .45802;	
v := .458	02
> DPo := array([seq(v,l=1n)]);	
DPo := [.45802	.45802]
> u := (.02°v)^2;	
u := .00008391	292816
> var := array([seq(u,l=1n)]);	000000000000000000000000000000000000000
var := [.00008391292816	.00008391292816]
> varDPo := make_array(var,n);	
varDPo := va	rcovar
> v := .82831;	
v := .828	31
> DPI := array([seq(v,i=1n)]);	
DPi := [.82831	.82831}
> u := (.02*v)^2;	
u := .0002744	389824
> var := array([seq(u,i=1n)]);	
var:=[.0002744389824	.0002744389824}
> varDPl := make_array(var,n);	
varDPi := va.	rcovar
Temperature (R)	
> v := 713;	
v := 713	3
> To := array([seq(v,l=1n)]);	
To := [713	713)
> u := (0.01°(v-460))^2;	

	u := 6.400)9
> var := array([seq(u,i=1n)]);		
	var := [6.4009	6.4009]
> varTo := make_array(var,n);		
	varTo:= var	covar
> v := 1140;		
	v:= 114	0
> Ti:= array([seq(v,i=1n)]);		
	Ti := [1140	1140]
> u := (0.01*(v-460))^2;		
	u := 46.24	100
> var := array([seq(u,l=1n)]);		
	var:=[46.2400	46.2400]
<pre>> varTi := make_array(var,n);</pre>		
	varTi := var	covar
Moisture in Coal		
> Mf :=0.06;	Mf := .0	4
	MI .= .0	0
> varMf := (0.039*Mf)^2;		•
	varMf := .547.	56 10 ⁻³
Ash		
> A := 0.0619;	. 061	0
	A := .061	9
> varA := (0.039*A)^2;		•
	varA:=.582787	881 10 ⁻⁵
Overhead	·····	
> OUHD := 0.9;		0
	OUHD :=	.9
> varOUHD := (0.1*OUHD)^2;		000
	varOUHD:=	.0081
Corbon		
Carbon > C := 0.7381;		
~ · · · · · · · · · · · · · · · · · · ·	C:=.738	11
	C:=./36) i

> varC := (0.039°C)^2;
varC:= .0008286280388
Hydrogen
> H := 0.0482;
H := .0482
> varH := (0.039°H)^2;
varH:= .353364804 10 ⁻⁵
Varn.=.333304404 10
Nitrogen
> N := 0.0135;
N:=.0135
> varN := (0.039*N)^2;
$varN := .27720225 \cdot 10^{-6}$
Varn:=.27/20223 10
Culfus
Sulfur > S := 0.0123;
S := .0123
> varS := (0.019*S)^2;
•
varS:= .5461569 10 ⁻⁷
CO2
> V := 14.145;
v := 14.145
> CO2o := array([seq(v,l=1n)]);
CO2o := [14.145
> u := (0.1)^2;
u := .01
> var := array([seq(u,i=1n)]);
var:=[.01 .01]
> varCO2o := make_array(var,n);
varCO2o := varcovar
> v := 15.2148;
v := 15.2148
> CO2i := array([seq(v,i=1n)]);
CO2i := [15.2148 15.2148]
> u := (0.1)^2;

	u := .01	l
> var := array([seq(u,i=1n)]);		
	var:=[.01	.01]
> varCO2i := make_array(var,n);		
	varCO2i := va	arcovar
O2 > V := 5;		
> v := 5;	v:= 5	
> O2o := array([seq(v,i=1n)]);		
> 020 := u.vay([004(0],= vv _{jj}),	020 := [5	5]
> u := (0.05)^2;		
2 4 (2000) 2,	u := .002	25
> var := array([seq(u,i=1n)]);		
	var:=[.0025	.0025]
> varO2o := make_array(var,n);		
	var02o := va	rcovar
> v := 3.8;		
	v := 3.8	8
> O2i := array([seq(v,i=1n)]);		
	02i := [3.8	3.8]
> u := (0.05)^2;		
	u := .002	25
> var := array([seq(u,l=1n)]);		
	var := [.0025	.0025]
> varO2i := make_array(var,n);		
	var02i := va	arcovar
No. 1-Acres (n.l.)		
Moisture (air) > Wma := 0.013;		
> Willa .= 0.010,	Wma := .0	013
> varWma := (.1*Wma)^2;		
> var vviia .= (.1 vviia) 2,	varWma:=.10	69 10 ⁻⁵
	74271114	
CO		
> v := 0.005;		
	v := .00	05

```
> COo := array([seq(v,i=1..n)]);
                                      COo := [.005 .005]
> u := (0.002)^2;
                                          u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
                                   var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
> varCOo := make_array(var,n);
                                     varCOo:= varcovar
> v := 0.005;
                                            v := .005
> COi := array([seq(v,i=1..n)]);
                                      COi := [.005 .005]
> u := (0.002)^2;
                                          u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
                                   var := [.4 \ 10^{-5} \ .4 \ 10^{-5}]
> varCOi := make_array(var,n);
                                     varCOi := varcovar
  Carbon in Ash
> Ca := 0.0486;
                                           Ca := .0486
> varCa := (0.25*Ca)^2;
                                    varCa := .000147622500
  Area for primary air
> apa := .63;
                                           apa := .63
> varapa := (.013)^2;
                                       varapa := .000169
> v := .2171;
                                           v := .2171
> DPpa := array([seq(v,i=1..n)]);
                                    DPpa := {.2171 .2171}
> u := 0.02*v;
```

u := .004.542	
> varDPpa := array([seq(u,i=1n)]);	
varDPpa := [.004342	
> varDPpa := make_array(var,n);	
varDPpa:= varcovar	
> v := 1104;	
v := 1104	
> Tpa := array([seq(v,i=1n)]);	
Tpa := [1104 1104]	
> u := 0.01*(v - 460);	
u := 6.44	
> var := array([seq(u,i=1n)]);	
var:=[6.44 6.44]	
> varTpa := make_array(var,n);	
varTpa:= varcovar	
Results	

> eval(SA);	
.5168579433	
> eval(sigmaSA);	
.002214263857	
> eval(100*sigmaSA/SA);	
.4284085958	

eval(TFluegasINb);	
eval(sigmaTFluegasINb);	
eval(TFluegasOUTa);	
eval(sigmaTFluegasOUTa);	
out/TElugge OUTh)	
eval(TFluegasOUTb); eval(sigmaTFluegasOUTb);	
CTAI(SIGNATE INCGASOUTU);	
Recalculate Other Results	
1 - 11 -	

Appendix H-2 Random Error Calculation Inlet Flue Gas Flow Split

>
>
C. L. Leting Port P. Colit A (CA)
Random Error Propagation Calculations, Part B, Split A (SA)
Cat no of cample points
Set no. of sample points > n := 4;
n:=4
h of a conting verience coverience matrix
procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1n,1n);
> for j to n do
> for i to n do
> if i=j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,]] := 0
> fi;
> od
> od;
> varcovar;
> end;
Warning, 'varcovar' is implicitly declared local
Warning, 'j' is implicitly declared local
Warning, 'i' is implicitly declared local
- '
proc(var,n)
local varcovar, j, i;
<pre>varcovar := array(1 n,1 n);</pre>
for d to p do

```
for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
                   fi
               ođ
           od:
           varcovar
      and
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
 Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'MFG' is implicitly declared local
 MFG :=
 proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
 and
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016 \text{ K4+K3}(288.08 \text{ CO2}[x]+71.70 \text{ O2}[x]+50480.8))/(K4+1801.6 \text{ K3})
> end;
  Warning, 'Cr' is implicitly declared local
 Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'M' is implicitly declared local
 M :=
 proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*
 end
 #5
 O2aveo :=
 sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG
 (i,A,OUHD,Ca,C.S,COo,CO2o,H,Wma,O2o,N,Mf)+O2ofil,i=1..n)/sum((DPofil/(Tofil+M(i
 ,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,CO
 0,CO20,H,Wma,O20,N,Mf),i=1..n);
 O2avei :=
 sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,
 A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*O2i[i],i=1..n)/sum((DPi[i]/(Ti[i]*M(i,A,O
 UHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,
 H,Wma,O2i,N,Mf), i=1..n;
 #7
 CO2aveo :=
 sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG
 (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*CO2o[i],i=1..n)/sum((DPo[i]/(To[i]*
 M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,
 COo,CO2o,H,Wma,O2o,N,Mf),i=1..n);
```

CO2avei :=

2i,H,Wma,O2i,N,Mf)),i=1..n);

#8

COaveo :=

Sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG (i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf))*COo[i],i=1..n)/sum((DPo[i]/(To[i]*M(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,Mf)),i=1..n);

COavei :=

Sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*COi[i],i=1...n)/sum((DPi[i]/(Ti[i]*M(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf)),i=1...n);

#13

> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);

$$m := \frac{28.97 \text{ Wma} + 28.97}{1.608015098 \text{ Wma} + 1}$$

#14

> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$PAFA := 14088.2 \quad apa \quad CP \quad \frac{PSpa \quad (28.97 \quad Wma + 28.97)}{1.608015098 \quad Wma + 1}$$

$$\left(\int \frac{DPpa_1}{Tpa_1} + \int \frac{DPpa_2}{Tpa_2} + \int \frac{DPpa_3}{Tpa_3} + \int \frac{DPpa_4}{Tpa_4} \right)$$

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$PAFB := 14088.2 \quad apa \quad CP \quad \boxed{\frac{PSpa \quad (28.97 \quad Wma + 28.97)}{1.608015098 \quad Wma + 1}}$$

$$\left(\sqrt{\frac{DPpa_{1}}{Tpa_{1}}} + \sqrt{\frac{DPpa_{2}}{Tpa_{2}}} + \sqrt{\frac{DPpa_{3}}{Tpa_{3}}} + \sqrt{\frac{DPpa_{4}}{Tpa_{4}}} \right)$$

#17

> FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

A SECOND GES COMPOSITION FOR CALCULATING A FLOW SPLIT. #18 > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPI[i]/(M(I,A,OUHD,Ca,C,S,COo,CO2o,H, > Wma,O2o,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COo,CO2o,H,Wma,O2o,N,M > f))*CO2o[i]/100,l=1..n): #19 SA := FA/(FA+FB); $SA := 5348840 \text{ Areai } CP \sqrt{PSi} \ | .010000000000$ + 18.01600000 %17 + 18.01600000 Mf %16 8.9360000000 H + %17 + ME.05550621670 .4960035524 H + .05550621670 %17 + .05550621670 Mf + 100. $DPi_2 = 8.9360000000 H + \%15 + Mf + 1801.6000000$ 160.9909760 H + 18.01600000 %15 + 18.01600000 Mf8.9360000000 H + %15 + ME.05550621670 .4960035524 H + .05550621670 %15 + .05550621670 Mf + 100.

CALCHINTION EXPEDIENT -- USED LEAK CASE FLUE GAS OUTLET COMP.

FUL SHS COMPOSITION TO 'B' SIDE HEAT PIPE.

THIS JUST PIL

$$\begin{array}{c} .05550621670 \\ \hline & .05550621670 \\ \hline & .0960035524 \\ \hline & .05550621670 \\ \hline & .055506$$

e W

$$\%6 := 12.01000000 \ co2o_2 + 12.01000000 \ coo_2$$

$$\%7 := \\ \text{Wma} \left(36.46063760 \frac{\left(100. - 1. \ coo_2 - 1. \ co2o_2 - 1. \ o2o_2 \right) \%2}{\%6} - 1.301236174 \ N \right)$$

$$\%8 := 12.01000000 \ co2o_1 + 12.01000000 \ coo_1$$

$$\%9 := \\ \text{Wma} \left(36.46063760 \frac{\left(100. - 1. \ coo_1 - 1. \ co2o_1 - 1. \ o2o_1 \right) \%2}{\%8} - 1.301236174 \ N \right)$$

$$\%10 := 12.01000000 \ co2i_4 + 12.01000000 \ coi_4$$

$$\%11 := \\ \text{Wma} \left(36.46063760 \frac{\left(100. - 1. \ coi_4 - 1. \ co2i_4 - 1. \ o2i_4 \right) \%2}{\%10} - 1.301236174 \ N \right)$$

$$\%12 := 12.01000000 \ co2i_3 + 12.01000000 \ coi_3$$

$$\%13 := \\ \text{Wma} \left(36.46063760 \frac{\left(100. - 1. \ coi_3 - 1. \ co2i_3 - 1. \ o2i_3 \right) \%2}{\%12} - 1.301236174 \ N \right)$$

$$\%14 := 12.01000000 \ co2i_2 + 12.01000000 \ coi_2$$

$$\%15 := \\ \text{Wma} \left(36.46063760 \frac{\left(100. - 1. \ coi_2 - 1. \ co2i_2 - 1. \ o2i_2 \right) \%2}{\%14} - 1.301236174 \ N \right)$$

$$\%16 := 12.01000000 \ co2i_1 + 12.01000000 \ coi_1$$

$$\%17 := \\ \text{Wma} \left(36.46063760 \frac{\left(100. - 1. \ coi_1 - 1. \ co2i_1 - 1. \ o2i_1 \right) \%2}{\%16} - 1.301236174 \ N \right)$$

#20 SB := FB/(FA+FB);

$$-.05550621670 \frac{8.936000000 H + \%5 + ME}{.4960035524 H + .05550621670 \%5 + .05550621670 ME + 100. \frac{\%2}{\%4}}$$

$$\begin{vmatrix} CO2o_3 + .010000000000 & DPi_4 & 8.936000000 H + \%3 + ME + 1801.600000 \frac{\%2}{\%1} \end{vmatrix} / \begin{pmatrix} 160.9909760 H + 18.01600000 \%3 + 18.01600000 ME \\ + \frac{\%2}{\%1} & \frac{(288.08000000 CO2o_4 + 71.700000000 O2o_4 + 50480.80000)}{\%1} & Ti_4 \end{pmatrix} ^{1/2} \begin{pmatrix} 1. \\ -.05550621670 & \frac{8.936000000 H + \%3 + ME}{.4960035524 H + .05550621670 \%3 + .05550621670 ME + 100. \frac{\%2}{\%1}} \\ \begin{pmatrix} 8.936000000 H + \%17 + ME + 1801.600000 \frac{\%2}{\%16} \end{pmatrix} / \begin{pmatrix} 160.9909760 H \\ + 18.01600000 \%17 + 18.01600000 ME \\ + \frac{\%2}{\%16} & \frac{(288.0800000 Co2i_1 + 71.70000000 O2i_1 + 50480.80000)}{\%16} & Ti_1 \end{pmatrix} ^{1/2} \begin{pmatrix} 1. \\ -.05550621670 & \frac{8.936000000 H + \%17 + ME}{.4960035524 H + .05550621670 \%17 + .05550621670 ME + 100. \frac{\%2}{\%16}} \\ \end{pmatrix} & CO2i_1 + .010000000000 & DPi_2 & \frac{8.936000000 H + \%17 + ME}{.936000000 H + \%17 + ME} & \frac{\%2}{\%16} \\ \end{pmatrix} \begin{pmatrix} 160.9909760 H + 18.01600000 \%15 + 18.01600000 ME \end{pmatrix}$$

$$+ \frac{\%2 \left(288.0800000 \cdot CO2i_{2} + 71.700000000 \cdot O2i_{2} + 50480.800000\right)}{\%14} \right) Ti_{2} \right)^{1/2} \left(1. - \frac{\%14}{\%14}\right)^{1/2} \left(1. - \frac{\%2}{\%14}\right)^{1/2} \left(1. - \frac{\$.9360000000 \cdot H + \%15 + Mf}{A960035524 \cdot H + .05550621670 \cdot \%15 + .05550621670 \cdot Mf + 100.} \right) Ti_{2} \left(1. - \frac{\%2}{\%14}\right)^{1/2} \left(1. - \frac{\%2$$

 $\%8 := 12.01000000 \ CO2o_1 + 12.01000000 \ COo_1$

%9 :=
$$Wma \left(36.46063760 \frac{\left(100. - 1. COo_1 - 1. CO2o_1 - 1. O2o_1 \right) \%2}{\%8} - 1.301236174 N \right)$$

 $\%10 := 12.01000000 \ \textit{CO2i}_{4} + 12.01000000 \ \textit{COi}_{4}$

%11:=
Wma
$$\left(36.46063760 \frac{\left(100. - 1. COi_4 - 1. CO2i_4 - 1. O2i_4 \right) \%2}{\%10} - 1.301236174 N \right)$$

 $\%12 := 12.01000000 \ CO2i_3 + 12.01000000 \ COi_3$

%13:=
Wma
$$\left(36.46063760 \frac{\left(100. - 1. \ COi_3 - 1. \ CO2i_3 - 1. \ O2i_3 \right) \%2}{\%12} - 1.301236174 \ N \right)$$

 $\%14 := 12.01000000 \ CO2i_2 + 12.01000000 \ COi_2$

%15 :=
$$W_{\text{ma}} \left(36.46063760 \frac{\left(100. - 1. \ COi_2 - 1. \ CO2i_2 - 1. \ O2i_2 \right) \%2}{\%14} - 1.301236174 \ N \right)$$

 $\%16 := 12.01000000 \ CO2i_1 + 12.01000000 \ COi_1$

%17 := Wma
$$\left(36.46063760 \frac{\left(100.-1. COi_1-1. CO2i_1-1. O2i_1\right) \%2}{\%16} - 1.301236174 N\right)$$

- > sigmaSA := sqrt(
- > Diff(SA,CO2avei)^2*varCO2avei +
- > Diff(SA,COavei)^2*varCOavei +
- > Diff(SA,O2avei)^2*varO2avei +

> Diff(SA,CO2aveo)^2*varCO2aveo + > Diff(SA,COaveo)^2*varCOaveo + > Diff(SA,O2aveo)^2*varO2aveo + > Diff(SA,Wfe)^2*varWfe + > Diff(SA,Areai)^2*varAreai + > Diff(SA,CP)^2*varCP + > Diff(SA,PSI)^2*varPSI + > Diff(SA,A)^2*varA + Diff(SA,OUHD)^2*varOUHD + Diff(SA,Ca)^2*varCa + > Diff(SA,C)*Diff(SA,C)*varC + Diff(SA,S)*Diff(SA,S)*varS + Diff(SA,H)*Diff(SA,H)*varH + Diff(SA,Wma)*Diff(SA,Wma)*varWma + > Diff(SA,N)*Diff(SA,N)*varN + Diff(SA,Mf)*Diff(SA,Mf)*varMf + > sum(> Diff(SA,DPi[i])*Diff(SA,DPi[i])*varDPi[i,i] + > Diff(SA,Ti[i])*Diff(SA,Ti[i])*varTi[i,i] + > Diff(SA,COi[i])*Diff(SA,COi[i])*varCOi[i,i] + > Diff(SA,CO2i[i])*Diff(SA,CO2i[i])*varCO2i[i,i] + > Diff(SA,O2i[i])*Diff(SA,O2i[i])*varO2i[i,i] + > Diff(SA,COo[i])*Diff(SA,COo[i])*varCOo[i,i] + > Diff(SA,CO2o[i])*Diff(SA,CO2o[i])*varCO2o[i,i] +

> Diff(SA,O2o[i])*Diff(SA,O2o[i])*varO2o[i,i]	
> ,i=1n)):	
> sigmaSA := value("):	
Constants	
Averages and Random Error Variances (Copie	ed from Part A function of sample size n)
> CO2avel := 15.2148;	15.0140
CO2avei:	= 15.2148
> varCO2avei := .102^2;	6 :- 010404
> COavei := .005;	1010404
COavei	:= .005
> varCOavel := .0002^2;	
varC0avei	:= 4 10 ⁻⁷
> O2avel := 3.8;	
O2avei	:= 3.8
> varO2avei := .01118^2;	
var02avei:=	.0001249924
> CO2aveo := 14.145;	14.46
CO2aveo : > varCO2aveo := .0866^2;	= 14.145
varCO2aveo .= .0000~2,	= ()0749956
> COaveo := .005;	
COaveo	:= .005
> varCOaveo := .000204^2;	
varCOaveo:=	41616 10 ⁻⁷
> O2aveo := 5;	
02avec	o := 5
> varO2aveo := .010206^2;	
var02aveo := .	000104162436
Control to David	
Constants for Random Error Propagation	

Coal Feed Rate (lbs/hr) > Wfe := 115839;	
× 1110 := 110003,	116 115920
	Wfe:=115839
> varWfe := (0.0025*Wfe	e)^2;
	varWfe:=83866.71200
Area (square ft) re	
> Areai := 3.99;	
	Areai := 3.99
> varAreal := (0.0335*Ai	real)^2:
•	varAreai := .01786633223
	V42712 C4101700033223
> Areao := 3.54;	
	B
	Areao := 3.54
> varAreao := (0.0364*A	reao)^2;
	varAreao := .01660386874
Pitot Coefficient re	
> CP := 0.84;	
	CP := .84
> varCP := (0)^2;	
(3) =	varCP:=0
	V41C10
Pressure Ambient or Ba	romatria ro
> PSI := 29.23;	iometric re
2	ng: 20.22
- warDC1 - /2.04\40	PSi := 29.23
> varPSI := (0.04)^2;	
***	varPSi := .0016
> PSo := 29.1;	
	<i>PSo</i> := 29.1
> varPSo := (0.04)^2;	
(, -,	varPSo:=.0016
	Valt 500010
Pressue for prime-rain	
Pressue for primary air > PSpa := 31.11;	
/ ι υμα .= 31.11,	PSpa := 31.11

```
varPSpa := .0016
Velocity Head DP re
v := .45802;
                                         v := .45802
DPo := array([seq(v,i=1..n)]);
                        DPo := [.45802 .45802 .45802 .45802]
u := .00005^2;
                                       u := .25 \cdot 10^{-8}
var := array([seq(u,i=1..n)]);
                   var := [.25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8}]
varDPo := make_array(var,n);
                                   varDPo := varcovar
v := .82831;
                                        v := .82831
DPi := array([seq(v,i=1..n)]);
                        DPi := [.82831 .82831 .82831]
u := .00005^2;
                                       u := .25 \cdot 10^{-8}
var := array([seq(u,i=1..n)]);
                   var := [.25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8}]
varDPi := make_array(var,n);
                                   varDPi := varcovar
v := .2171;
                                         v := .2171
DPpa := array([seq(v,i=1..n)]);
                          DPpa := [.2171 .2171 .2171 .2171]
u := (0.00005)^2;
                                       u := .25 \cdot 10^{-8}
varDPpa := array([seq(u,i=1..n)]);
                 varDPpa := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
v := 1104:
```

```
v := 1104
> Tpa := array([seq(v,i=1..n)]);
                           Tpa := [1104 1104 1104 1104]
> u := (0.005*(v - 460))^2;
                                     u := 10.368400
> varTpa := array([seq(u,i=1..n)]);
                varTpa:=[10.368400 10.368400 10.368400 10.368400]
  Temperature (R) re
> v := 713;
                                        v := 713
> To := array([seq(v,i=1..n)]);
                              To := [713 713 713 713]
> u := (0.005*(v-460))^2;
                                      u := 1.600225
> var := array([seq(u,i=1..n)]);
                    var := [1.600225   1.600225   1.600225   1.600225]
> varTo := make array(var,n);
                                  varTo := varcovar
> v := 1140;
                                        v := 1140
> Ti:= array([seq(v,i=1..n)]);
                            Ti := [1140 1140 1140 1140]
> u := (0.005^{\circ}(v-460))^2;
                                     u := 11.560000
> var := array([seq(u,i=1..n)]);
                  var:=[11.560000 11.560000 11.560000 11.560000]
> varTi := make_array(var,n);
                                  varTi := varcovar
  Moisture in Ash re
> Mf := 0.06;
                                        Mf := .06
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;
                                varMf := .00001058319613
  Ash re
> A := 0.0619;
```

A := .0619	
varA := ((0.07+0.02*A*100)/(2*1.414*100))^2;	
varA := .4696223261 10 ⁻⁶	
10211-1150225201-10	
Overhead re	
OUHD := 0.9;	
<i>OUHD</i> := .9	
varOUHD := (0.1*OUHD)^2;	
varOUHD := .0081	
Carbon re	
C := 0.7381;	
C:=.7381	
varC := (0.64/(2*1.414*100))^2;	
varC:=.5121546706 10 ⁻⁵	
Hydrogen re	
H := 0.0482;	,
H:=.0482	
varH := (0.16/(2*1.414*100))^2;	
$varH := .3200966692 \cdot 10^{-6}$	
With the last of t	
Nitrogen re	······································
N := 0.0135;	
N:= .0135	
varN := (0.11/(2*1.414*100))^2;	
varN:=.1512956913 10 ⁻⁶	•
Sulfur re	
S := 0.0123;	•
S := .0123	
varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;	
$vars := .1327813813 \cdot 10^{-6}$	
CO2 re	
v := 14.145;	
v := 14.145	
CO2o := array([seq(v,i=1n)]);	

```
> u := (0.03°v)^2;
                                   u := .1800729225
> var := array([seq(u,i=1..n)]);
             var := [.1800729225 .1800729225 .1800729225 ]
> varCO2o := make_array(var,n);
                                varCO2o := varcovar
> v := 15.2148;
                                      v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
                     CO2i := [15.2148 \quad 15.2148 \quad 15.2148 \quad 15.2148]
> u := (0.03*v)^2;
                                   u := .2083411251
> var := array([seq(u,i=1..n)]);
             var := [.2083411251 .2083411251 .2083411251 .2083411251]
> varCO2i := make_array(var,n);
                                varCO2i := varcovar
  02 ге
> v := 5;
                                        v := 5
> O2o := array([seq(v,i=1..n)]);
                                 020 := [5 \ 5 \ 5]
> u := (0.05)^2;
                                       u := .0025
> var := array([seq(u,i=1..n)]);
                          var := [.0025 \ .0025 \ .0025 \ .0025]
> varO2o := make_array(var,n);
                                var02o:= varcovar
> v := 3.8;
                                       v := 3.8
> O2i := array([seq(v,i=1..n)]);
                              02i := [3.8 \quad 3.8 \quad 3.8 \quad 3.8]
> u := (0.05)^2;
                                      u := .0025
> var := array([seq(u,i=1..n)]);
```

var:=[.0025 .0025 .0025 .0025]	
> varO2i := make_array(var,n);	
var02i := varcovar	Area
Midwedia	> apa :
Moisture (air) re > Wma := 0.013:	
Wma := .013	> vara
> varWma := (.2*Wma)^2;	
varWma:=.676 10 ⁻⁵	
CO re	
> v := 0.005;	Resul
v := .005	
> COo := array([seq(v,i=1n)]);	
COo:=[.005 .005 .005]	> cvan
> u := (0.001)^2;	> eval(s
$u := .1 \cdot 10^{-5}$	
> var := array([seq(u,i=1n)]);	> eval(1
$var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}$	
> varCOo := make_array(var,n);	****
varCOo:= varcovar	>
· v := 0.005;	
v:=.005	
· COi := array([seq(v,i=1n)]);	·
COi:=[.005 .005 .005]	
· u := (0.001)^2;	
$u := .1 \cdot 10^{-5}$	
var := array([seq(u,i=1n)]);	
$var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}$	
varCOi := make_array(var,n);	
varCOi := varcovar	
Carbon in Ash re	
Ca := 0.0486;	
Ca := .0486 varCa := (0.1°Ca)^2;	
(o., Oa) 2,	

	varCa := .()()()()23(5196	
Area for Primary Air re			
> apa := 0.63;			
	apa := .63		
> varapa := (0.0208*apa)^2;			
	varapa := .0001717	14816	
Results			
> evalf(SA);	*********	******	******
ovan(SA),	£1/0570422		
eval(sigmaSA);	.5168579433		
evai(sigiliasA);	00404440000	A 4	03.13.7 - 100
eval(100*sigmaSA/SA);	.004864108802	¥ √ y	= 0.002175 - FOR
eval(100 signlasA/SA);			
	.9410920089		
	*******	******	******
>			

Appendix I-1 Bias Error Calculation Secondary Air Inlet Flow -- Zero Leak Case

```
Error Propagation Calculations, Part B, Secondary Airflow Wsai with No Leakage
> MFG := proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2 + CO));
> K4 := 8.936*H + Wma*((28.02*(100-CO-CO2-O2)*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
     proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
     local Cr.Cb.K3,K4,MFG;
         Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
         K3 := (Cb+.3744932959*S)/(12.01*CO2+12.01*CO);
         K4 := 8.936*H+Wma*(36.46063760*(100-CO-CO2-O2)*K3-1.301236174*h
         MFG := .05550621670*K4/(.05550621670*K4+100*K3)
> Mfg := MFG(A,OUHD,Ca,C,S,COavei,CO2avei,H,Wma,O2avei,N,Mf);
   Mfg := .05550621670 \mid 8.936 \mid H
     + Wma \left(36.46063760\right) \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei}
     + Mf / (.4960035524 H + .05550621670
```

```
Whaa \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N\right)
     \%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S
> p1 := CO2avei*(6.214*t2+(10.396/1000)*t2^2/2-(3.545/1000000)*t2^3/3-(6.214*t1+(1
> 0.396/1000)*t1^2/2-(3.545/1000000)*t1^3/3));
    p1 := CO2avei (6.214 t2 + .005198000000 t2^2 - .1181666667 10^{-5} t2^3 - 6.214 t1
      -.005198000000 \pm 1^2 + .1181666667 \times 10^{-5} \pm 1^3
> p2 := COavei*(6.420*t2+(1.665/1000)*t2^2/2-(0.196/1000000)*t2^3/3-(6.420*t1+(1.66
> 5/1000)*t1^2/2-(0.196/1000000)*t1^3/3));
    p2 := COavei \left( 6.420 \ t2 + .0008325000000 \ t2^2 - .6533333333 \ 10^{-7} \ t2^3 - 6.420 \ t1 \right)
      -0008325000000 	 t1^2 + .6533333333 	 10^{-7} 	 t1^3
> p3 := O2avei*(6.148*t2+(3.102/1000)*t2^2/2-(0.923/1000000)*t2^3/3-(6.148*t1+(3.10
> 2/1000)*t1^2/2-(0.923/1000000)*t1^3/3));
    p3 := 02avei (6.148 t2 + .001551000000 t2^2 - .3076666666 <math>10^{-6} t2^3 - 6.148 t1
       -.001551000000 	 t1^2 + .3076666666 	 10^{-6} 	 t1^3
> N2avei := 100 - CO2avei - COavel - O2avel;
                      N2avei := 100 - COavei - CO2avei - O2avei
> p4 := N2ayei*(6.524*t2+(1,250/1000)*t2^2/2-(0.001/1000000)*t2^3/3-(6.524*t1+(1.25
> 0/1000)*t1^2/2-(0.001/1000000)*t1^3/3));
       p4 := (100 - COavei - CO2avei - O2avei) (6.524 t2 + .0006250000000 t2^2)
         -.3333333333 \cdot 10^{-9} t2^3 - 6.524 t1 - .0006250000000 t1^2
         +.33333333333310^{-9} t1<sup>3</sup>
```

> p5 := Mfg*(7.256*t2+(2.298/1000)*t2^2/2+(0.283/1000000)*t2^3/3-(7.256*t1+(2.298/1 > 000)*t1^2/2+(0.283/1000000)*t1^3/3));

 $p5 := .05550621670 \left(8.936 \ H \right) \\ + Wma \left(36.46063760 \frac{(100 - Coavei - Co2avei - O2avei) \%1}{12.01 \ Co2avei + 12.01 \ Coavei} - 1.301236174 \ E \\ + Mf \right) \left(7.256 \ t2 + .001149000000 \ t2^2 + .9433333332 \ 10^{-7} \ t2^3 - 7.256 \ t1 \\ - .001149000000 \ t1^2 - .9433333332 \ 10^{-7} \ t1^3 \right) / \left(.4960035524 \ H + .05550621670 \right) \\ Wma \left(36.46063760 \frac{(100 - Coavei - Co2avei - O2avei) \%1}{12.01 \ Co2avei + 12.01 \ Coavei} - 1.301236174 \ N \right) \\ + .05550621670 \ Mf + 100 \frac{\%1}{12.01 \ Co2avei + 12.01 \ Coavei} \right) \\ \%1 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S$

 $Cpfg := \frac{1}{100} \left(\frac{8.936 \ H + \%4 + Mf}{1.005550621670} \frac{8.936 \ H + \%4 + Mf}{1.005550621670} \frac{8.936 \ H + \%4 + Mf}{1.005550621670 \ \%4 + .05550621670 \ \%4 + .05550621670 \ Mf + 100 \ \%2}{\%1} \right) \left(CO2avei \left(6.214 \ t2 + .005198000000 \ t2^2 - .1181666667 \ 10^{-5} \ t2^3 - 6.214 \ t1 \right) - .005198000000 \ t1^2 + .1181666667 \ 10^{-5} \ t1^3 \right) + Coavei \left(6.420 \ t2 + .0008325000000 \ t2^2 - .6533333333 \ 10^{-7} \ t2^3 - 6.420 \ t1 - .0008325000000 \ t1^2 + .65333333333 \ 10^{-7} \ t1^3 \right) + O2avei \left(6.148 \ t2 + .001551000000 \ t2^2 - .30766666666 \ 10^{-6} \ t2^3 - 6.148 \ t1 - .001551000000 \ t1^2 + .30766666666 \ 10^{-6} \ t2^3 - 6.524 \ t1 - .00062500000000 \ t1^2 + .3333333333 \ 10^{-9} \ t2^3 - 6.524 \ t1 - .00062500000000 \ t1^2 + .3333333333 \ 10^{-9} \ t1^3 \right) + 5.550621670$ $(8.936 \ H + \%4 + Mf) \left(7.256 \ t2 + .0011490000000 \ t2^2 + .94333333332 \ 10^{-7} \ t1^3 \right) / \left(\frac{10^{-7} \ t2^3}{10^{-7} \ t2^3} \right) + \frac{10^{-7} \ t2^3}{10^{-7} \ t2^3} \right) + \frac{10^{-7} \ t2^3}{10^{-7} \ t2^3} \right) + \frac{10^{-7} \ t2^3}{10^{-7} \ t2^3}$

 $.4960035524 \ H + .05550621670 \ \%4 + .05550621670 \ Mf + 100 \ \frac{\%2}{\%1} \bigg) \bigg/ (t2 - t1)$

%1 := 12.01 CO2avei + 12.01 COavei

$$\%2 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S$$

%3 := 100 - COavei - CO2avei - O2avei

%4 := Wma
$$\left(36.46063760 \frac{\%3 \%2}{\%1} - 1.301236174 N\right)$$

> p3 := 21*(6.148*t4+(3.102/1000)*t4^2/2-(0.923/1000000)*t4^3/3-(6.148*t3+(3.102/10 > 00)*t3^2/2-(0.923/1000000)*t3^3/3));

 $p3 := 129.108 \ t4 + .03257100000 \ t4^2 - .6460999999 \ 10^{-5} \ t4^3 - 129.108 \ t3$ - .03257100000 \ \tau_3^2 + .6460999999 \ 10^{-5} \ \tau_3^3

> p4 := 79*(6.524*t4+(1.250/1000)*t4^2/2-(0.001/1000000)*t4^3/3-(6.524*t3+(1.250/10 > 00)*t3^2/2-(0.001/1000000)*t3^3/3));

 $p4 := 515.396 \ t4 + .04937500000 \ t4^2 - .2633333333 \ 10^{-7} \ t4^3 - 515.396 \ t3$ - .04937500000 \ \tau^2 + .2633333333 \ 10^{-7} \ \tau^3

> amp := ((28.97*Wma*100)/18.015)/(28.97*Wma/18.015 +1);

amp :=
$$160.8104357 \frac{Wma}{1.608104357 Wma + 1}$$

> p5 := amp*(7.256*t4+(2.298/1000)*t4^2/2+(0.283/1000000)*t4^3/3-(7.256*t3+(2.298/ > 1000)*t3^2/2+(0.283/1000000)*t3^3/3));

p5 := 160.8104357 Wma $\left(7.256 \text{ } \pm 4 + .001149000000 \text{ } \pm 4^2 + .9433333332 \text{ } 10^{-7} \text{ } \pm 4^3 - .7.256 \text{ } \pm 3 - .001149000000 \text{ } \pm 3^2 - .9433333332 \text{ } 10^{-7} \text{ } \pm 3^3 \right) / (1.608104357 \text{ Wma} + 1)$

> Cpal := $(1/(t4-t3))^*(((100-Mfg)/100)^*(p3+p4)+p5)/100;$

$$Cpa1 := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 H \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 N \right) \right)$$

 $\begin{aligned} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \bigg(36.46063760 \ \frac{(100 - \mathit{Coavei} - \mathit{Co2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} - 1.301236174 \ \mathit{N} \bigg) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \bigg(644.504 \ \mathit{t4} \\ &+ .08194600000 \ \mathit{t4}^2 - .6487333332 \ 10^{-5} \ \mathit{t4}^3 - 644.504 \ \mathit{t3} - .08194600000 \ \mathit{t3}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t3}^3 \bigg) + 160.8104357 \ \mathit{Wma} \bigg(7.256 \ \mathit{t4} + .001149000000 \ \mathit{t4}^2 \\ &+ .9433333332 \ 10^{-7} \ \mathit{t4}^3 - 7.256 \ \mathit{t3} - .0011490000000 \ \mathit{t3}^2 - .9433333332 \ 10^{-7} \ \mathit{t3}^3 \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg/ (\mathit{t4} - \mathit{t3}) \end{aligned}$

 $\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$

> p3 := 21*(6.148*t8+(3.102/1000)*t8^2/2-(0.923/1000000)*t8^3/3-(6.148*t7+(3.102/10 > 00)*t7^2/2-(0.923/1000000)*t7^3/3));

p3 := 129.108
$$t8 + .03257100000$$
 $t8^2 - .6460999999$ 10^{-5} $t8^3 - 129.108$ $t7$ $- .03257100000$ $t7^2 + .6460999999$ 10^{-5} $t7^3$

> p4 := 79*(6.524*t8+(1.250/1000)*t8^2/2-(0.001/1000000)*t8^3/3-(6.524*t7+(1.250/10 > 00)*t7^2/2-(0.001/1000000)*t7^3/3));

$$p4 := 515.396 \ t8 + .04937500000 \ t8^2 - .2633333333 \ 10^{-7} \ t8^3 - 515.396 \ t7$$

- .04937500000 \ $t7^2 + .2633333333 \ 10^{-7} \ t7^3$

> p5 := amp*(7.256*t8+(2.298/1000)*t8^2/2+(0.283/1000000)*t8^3/3-(7.256*t7+(2.298/ > 1000)*t7^2/2+(0.283/1000000)*t7^3/3));

p5 :=
$$160.8104357$$
 Wma $(7.256 \pm 8 \pm .0011490000000 \pm 8^2 \pm .9433333332 \pm 10^{-7} \pm 8^3 \pm 7.256 \pm 7.001149000000 \pm 7^2 - .9433333332 \pm 10^{-7} \pm 7^3)/(1.608104357 \text{ Wma} + 1.008104357 \text{ Wma})/(1.608104357 \text{ Wma})/(1$

> Cpsa := (1/(t8-t7))*(((100-Mfg)/100)*(p3+p4)+p5)/100;

$$Cpsa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \text{ H} \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ \text{N} \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ & \mathit{Wina} \bigg(36.46063760 \ \frac{(100 - \mathit{Coavei} - \mathit{Co2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} - 1.301236174 \ \mathit{N} \bigg) \\ & + .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \bigg(644.504 \ \mathit{t8} \\ & + .08194600000 \ \mathit{t8}^2 - .6487333332 \ 10^{-5} \ \mathit{t8}^3 - 644.504 \ \mathit{t7} - .08194600000 \ \mathit{t7}^2 \\ & + .6487333332 \ 10^{-5} \ \mathit{t7}^3 \bigg) + 160.8104357 \ \mathit{Wina} \bigg(7.256 \ \mathit{t8} + .001149000000 \ \mathit{t8}^2 \\ & + .9433333332 \ 10^{-7} \ \mathit{t8}^3 - 7.256 \ \mathit{t7} - .0011490000000 \ \mathit{t7}^2 - .9433333332 \ 10^{-7} \ \mathit{t7}^3 \\ \bigg) \bigg/ (1.608104357 \ \mathit{Wina} + 1) \bigg/ (\mathit{t8} - \mathit{t7}) \\ & \%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{3} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> p3 := 21*(6.148*t6+(3.102/1000)*t6^2/2-(0.923/1000000)*t6^3/3-(6.148*t5+(3.102/10

> 00)*t5^2/2-(0.923/1000000)*t5^3/3));

$$p_3 := 129.108 \ t6 + .03257100000 \ t6^2 - .6460999999 \ 10^{-5} \ t6^3 - 129.108 \ t5$$

- .03257100000 \ \tau5^2 + .6460999999 \ 10^{-5} \ \tau5^3

> p4 := 79*(6.524*t6+(1.250/1000)*t6^2/2-(0.001/1000000)*t6^3/3-(6.524*t5+(1.250/10 > 00)*t5^2/2-(0.001/1000000)*t5^3/3));

$$p4 := 515.396 \ t6 + .04937500000 \ t6^2 - .2633333333 \ 10^{-7} \ t6^3 - 515.396 \ t5$$

- .04937500000 \ \tau5^2 + .2633333333 \ 10^{-7} \ \tau5^3

> p5 := amp*(7.256*t6+(2.298/1000)*t6^2/2+(0.283/1000000)*t6^3/3-(7.256*t5+(2.298/ > 1000)*t5^2/2+(0.283/1000000)*t5^3/3));

p5 := 160.8104357 Wma
$$(7.256 \ \text{t}6 + .0011490000000 \ \text{t}6^2 + .9433333332 \ 10^{-7} \ \text{t}6^3$$

-7.256 t5 - .001149000000 t5² - .9433333332 10^{-7} t5³)/(1.608104357 Wma + 1)

> Cppa := $(1/(t6-t5))^{\circ}(((100-Mfg)/100)^{\circ}(p3+p4)+p5)/100;$

$$Cppa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \ H \right) + Wma \left(36.46063760 \ \frac{(100 - Coavei - Co2avei - O2avei) \%1}{12.01 \ Co2avei + 12.01 \ Coavei} - 1.301236174 \ N \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \left(36.46063760 \ \frac{(100 - \mathit{Coavei} - \mathit{Co2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} - 1.301236174 \ \mathit{N} \right) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t6} \right. \\ &+ .081946000000 \ \mathit{t6}^2 - .6487333332 \ 10^{-5} \ \mathit{t6}^3 - 644.504 \ \mathit{t5} - .081946000000 \ \mathit{t5}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t5}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t6} + .0011490000000 \ \mathit{t6}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t6}^3 - 7.256 \ \mathit{t5} - .0011490000000 \ \mathit{t5}^2 - .9433333332 \ 10^{-7} \ \mathit{t5}^5 \\ \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg) \bigg/ (\mathit{t6} - \mathit{t5}) \\ \%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{3} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

Wsal := (Wfgi*(Cpfg*(Tfgi-Tfgo) - AL*Cpal*(Tfgo-Tsal)) - Wpai*Cppa*(Tpao-Tsal))/ (Cpsa*(Tsao-Tsal)*Wfe*SA); Wsai := 100 $\left(\text{Wfgi } \left(\frac{1}{100} \left(\left(1 - .05550621670 \frac{8.936 \ H + \%4 + Mf}{\%5} \right) \left(CO2avei \right) \right) \right)$ 6.214 $\pm 2 \pm .005198000000$ $\pm 2^2 \pm .1181666667$ $\pm 10^{-5}$ $\pm 2^3 \pm 6.214$ ± 1 $-.005198000000 t1^2 + .1181666667 10^{-5} t1^3 + COavei (6.420 t2)$ $\pm .0008325000000 \ \epsilon 2^2 - .6533333333 \ 10^{-7} \ \epsilon 2^3 - 6.420 \ \epsilon 1 - .0008325000000 \ \epsilon 1^2$ $+.6533333333 \cdot 10^{-7} t1^{3} + O2avei (6.148 t2 + .001551000000 t2^{2})$ $-.3076666666 \cdot 10^{-6} \cdot \epsilon 2^3 - 6.148 \cdot \epsilon 1 -.001551000000 \cdot \epsilon 1^2 +.3076666666 \cdot 10^{-6} \cdot \epsilon 1^{-3}$)+%3 (6.524 ± 2 + .00062500000000 $\pm 2^2$ - .3333333333 $\pm 10^{-9}$ $\pm 2^3$ - 6.524 ± 1 $(8.936 \ H + \%4 + Mf) \left(7.256 \ t2 + .001149000000 \ t2^2 + .9433333332 \ 10^{-7} \ t2^3\right)$ $-7.256 \text{ t1} - .001149000000 \text{ t1}^2 - .9433333332 \text{ 10}^{-7} \text{ t1}^3)/(\%5)$ (Tfgi - Tfgo $/(t2-t1) - \frac{1}{100}$ AL $\left(\frac{1}{100}\left(100 - .05550621670 \frac{8.936 \ H + \%4 + MF}{\%5}\right)\left(644.504 \ t\right)$ $\pm .08194600000$ $\pm 4^2 - .6487333332$ 10^{-5} $\pm 4^3 - 644.504$ $\pm 3 - .08194600000$ $\pm 3^2$

$$\begin{array}{l} + .6487333332 \ 10^{-5} \ t3^3 + 160.8104357 \ \text{Wma} \ \left(7.256 \ t4 + .001149000000 \ t4^2 \right. \\ + .9433333332 \ 10^{-7} \ t4^3 - 7.256 \ t3 - .001149000000 \ t3^2 - .9433333332 \ 10^{-7} \ t3^3 \\)/(1.608104357 \ \text{Wma} + 1) \ (TEgo - Tsai)/(t4 - t3) \ - \frac{1}{100} \ \text{Wpai} \ \left(\frac{1}{100} \right. \\ \left(100 - .05550621670 \ \frac{8.936}{5} \ H + \%4 + Mf}{\%5} \right) \left(644.504 \ t6 + .08194600000 \ t6^2 \right. \\ - .6487333332 \ 10^{-5} \ t6^3 - 644.504 \ t5 - .08194600000 \ t5^2 \\ + .6487333332 \ 10^{-5} \ t5^3 \right) + 160.8104357 \ \text{Wma} \ \left(7.256 \ t6 + .001149000000 \ t6^2 \right. \\ + .9433333332 \ 10^{-7} \ t6^3 - 7.256 \ t5 - .001149000000 \ t5^2 - .9433333332 \ 10^{-7} \ t5^3 \\)/(1.608104357 \ \text{Wma} + 1) \ (Tpao - Tsai)/(t6 - t5) \ (t8 - t7) / \left(\left(\frac{1}{100} \right) \right) \\ \left(100 - .05550621670 \ \frac{8.936}{\%5} \ H + \%4 + Mf}{\%5} \right) \left(644.504 \ t8 + .08194600000 \ t8^2 \right. \\ - .6487333332 \ 10^{-5} \ t8^3 - 644.504 \ t7 - .08194600000 \ t7^2 \\ + .6487333332 \ 10^{-5} \ t8^3 - 644.504 \ t7 - .08194600000 \ t7^2 \\ + .9433333332 \ 10^{-5} \ t8^3 - 7.256 \ t7 - .001149000000 \ t7^2 - .9433333332 \ 10^{-7} \ t7^3 \\)/(1.608104357 \ \text{Wma} + 1) \right) \ (Tsao - Tsai) \ \text{Wfe} \ SA \right) \\ \%1 := 12.01 \ CO2avei + 12.01 \ COavei \\ \%2 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ ca} + .3744932959 \ S \\ \%3 := 100 - Coavei - CO2avei - O2avei \\ \%4 := \text{Wma} \ \left(36.46063760 \ \frac{\%3}{\%1} - 1.301236174 \ \text{N} \right) \\ \%5 := .4960035524 \ \text{H} + .05550621670 \ \%4 + .05550621670 \ \text{Mf} + 100 \ \frac{\%2}{\%1} \right.$$

> Diff(Wsai,SA)^2*varSA +

> Diff(Wsai,CO2avei)^2*varCO2avei +

> Diff(Wsai,COavei)^2*varCOavel +
> Diff(Wsal,O2avel)^2*varO2avel +
> Diff(Wsai,Wfe)^2*varWfe +
> Diff(Wsai,A)^2*varA +
> Diff(Wsai,OUHD)^2*varOUHD +
> Diff(Wsai,Ca)^2*varCa +
> Diff(Wsal,C)*Diff(Wsal,C)*varC +
> Diff(Wsal,S)*Diff(Wsal,S)*varS +
> Diff(Wsal,H)*Diff(Wsal,H)*varH +
> Diff(Wsal,Wma)*Diff(Wsal,Wma)*varWma +
> Diff(Wsai,N)*Diff(Wsai,N)*varN +
> Diff(Wsal,Mf)*Diff(Wsal,Mf)*varMf
>):
> sigmaWsal := value("):
Constants
SA - Split A
> SA := 0.5168;
SA := .5168
> varSA := 0.002214^2;
$varsA := .4901796 \ 10^{-5}$
>
Weight of Flue Gas in
> Wfgl := 754952;
Wfgi := 754952
> varWfgi := 47382^2;
> vai trigi 41 302 2,

	varWfgi:=2245053924	
Weight of Primary Air in		·
Weight of Primary Air in > Wpai := 62530;		
> wpar := 62550;	Wpai := 62530	
	wpa1 .= 02330	
> varWpal := 1635^2;		
	varWpai:=2673225	
Air Leakage fraction		
> AL := .0;	0	
	AL := 0	
> varAL := .00058^2;		
	varAL:=.3364 10 ⁻⁶	
> Tfgi := 680;		
	Tfgi := 680	
> varTfgl := (0.01°Tfgl)^2;		
> varrigi .= (0.01 11gi) 2,	varTfgi := 46.2400	
	Valify1 := 40.2400	
> t2 := (Tfgi +460)/1.8;		
	£2 := 633.3333334	
>		
> Tfgo := 253;		
> 1.go .= 250,	Tfgo := 253	
	1190 255	
> varTfgo := (0.01*Tfgo)^2;	T.C. (4000)	
	varTfgo := 6.4009	
> t1 := (Tfgo+460)/1.8;		
	t1 := 396.1111112	
>		
> Tall := 80;		
> 1811 := 50;	m. 1 ' 90	
	Tali := 80	
> varTali := (0.01°Tali)^2;		
	varTali:=.6400	
> t3 := (Tali+460)/1.8;		
	t3 := 300.0000001	
> t4 := t1;		
•	£4:=396.1111112	
> Tpai := 80;		

	<i>Tpai</i> := 80	
> varTpai := (0.01*Tpai)^2;		
	varTpai := .6400	
> t5 := (Tpai+460)/1.8;		
	£5 := 300.0000001	
> Tpao := 644;		
	Tpao := 644	
> varTpao := (0.01*Tpao)^2;		
	varTpao := 41.4736	
> t6 := (Tpao+460)/1.8;		
	<i>t6</i> := 613.3333334	
> Tsal := 80;		
	Tsai := 80	
> varTsai := (0.01*Tsai)^2;		
	varTsai := .6400	
> t7 := (Tsai+460)/1.8;		
	£7:=300.0000001	
> Tsao := 616;		
	Tsao := 616	
> varTsao := (0.01*Tsao)^2;		
	varTsao:=37.9456	
> t8 := (Tsao+460)/1.8;		
	t8:=597.777778	
Averages and Variances from P. > CO2avei := 15.2148;	art A	
> CO2aver .= 15.2140,	CO2avei := 15.2148	
> varCO2avel := .1^2;	CO2ave1 15.2146	
> varcozaver .2 .1 · 2,	varCO2avei := .01	
COpyri - 005	Varcozaver .= .01	
> COavei := .005;	000mi = 005	
> varCOavel := .002^2;	COavei := .005	
> varCOaver := .002*2;	5	
	varCOavei:=.4 10 ⁻⁵	
> O2avei := 3.8;		
	O2avei := 3.8	
> varO2avel := .05^2;		

	var02avei:=.0025
Coal Feed Rate (lbs/hr)	
> Wfe := 115839;	
	Wfe:=115839
> varWfe := (0.05*Wfe)^2;	
	varWfe:=.3354668480 10 ⁸
	/arwie .= .3534008480 10
Moisture in Coal	
> Mf :=0.06;	
/ IIII .=0.00,	Mf := .06
> varMf := (0.039*Mf)^2;	
> varmi .= (0.059 wii) 2,	
	varMf := .54756 10 ⁻⁵
Ash	
> A := 0.0619;	- 0410
	A := .0619
> varA := (0.039*A)^2;	
	varA := .582787881 10 ⁻⁵
Overhead	
> OUHD := 0.9;	
,	<i>OUHD</i> := .9
> varOUHD := (0.1*OUHD)^2;	
> varound := (0:: 00::2) =;	varOUHD := .0081
Carbon	
> C := 0.7381;	
, , , , , , , , , , , , , , , , , , , ,	C := .7381
> varC := (0.039°C)^2;	
y vai 0 := (0.000 0) 1;	varC := .0008286280388
Hydrogen	
> H := 0.0482;	
old ldaj	H := .0482
> varH := (0.039°H)^2;	
> vaiii .= (0.033 ii) 2,	252254224 1255
	varH:= .353364804 10 ⁻⁵

N := .0135
27720225 10-6
varN:=.27720225 10 ⁻⁶
S := .0123
varS:=.5461569 10 ⁻⁷
Vals3401307 10
Wma := .013
wina .= .015
varWma:=.169 10 ⁻⁵
Ca := .0486
varCa := .000147622500
Varca .= .000147022300

.08136935946
.00130733740
(A) 0 P (A
7.769387922
7.151727411
7.316810251
7.305185745
C+1 CD1 CDC.1

Wsai in lb/lb of AF Coal		
evalf(Wsal);		
	9.583839808	
evalf(sigmaWsai);		
	.4815015354	
> evalf(100*sigmaWsai/Wsai	;	
	5.024098326	
> evalf(Wsai*SA*Wfe);		
	573742.2744	
> evalf(sigmaWsai*SA*Wfe);		
	28825.37601	
>		
>		

ì

Appendix I-2 Random Error Calculation Secondary Air Inlet Flow -- Zero Leak Case

```
Random Error Propagation Calculations, Part B, Secondary Airflow Wsai without
  Leakage
> MFG := proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3):
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2 + CO)):
> K4 := 8.936*H + Wma*((28.02*(100-CO-CO2-O2)*K3-N)/0.7685)+Mf:
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
     proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
     local Cr,Cb,K3,K4,MFG;
         Cr := \lambda * OUHD * Ca/(1-Ca) + 1/3*\lambda * (1-OUHD) * Ca/(1-1/3*Ca);
         Cb := C-Cr;
         K3 := (Cb+.3744932959*S)/(12.01*CO2+12.01*CO);
         K4 := 8.936*H+Wma*(36.46063760*(100-CO-CO2-O2)*K3-1.301236174*N
         MFG := .05550621670*K4/(.05550621670*K4+100*K3)
     end
> Mfg := MFG(A,OUHD,Ca,C,S,COavei,CO2avei,H,Wma,O2avei,N,Mf);
   Mfg := .05550621670 \ 8.936 \ H
    + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174\right)
```

```
+ ME / (.4960035524 H + .05550621670
      Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N\right)
       +.05550621670 \text{ Mf} + 100 \frac{\pi}{12.01 \text{ Co2avei} + 12.01 \text{ Coavei}}
    \%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S
> p1 := CO2avei*(6.214*t2+(10.396/1000)*t2^2/2-(3.545/1000000)*t2^3/3-(6.214*t1+(1
> 0.396/1000)*t1^2/2-(3.545/1000000)*t1^3/3));
    p1:= CO2avei (6.214 t2 + .005198000000 t2^2 - .1181666667 10^{-5} t2^3 - 6.214 t1
       > p2 := COavei*(6.420*t2+(1.665/1000)*t2^2/2-(0.196/1000000)*t2^3/3-(6.420*t1+(1.66
> 5/1000)*t1^2/2-(0.196/1000000)*t1^3/3));
    p2 := COavei \left( 6.420 \text{ } t2 + .0008325000000 \text{ } t2^2 - .6533333333 \text{ } 10^{-7} \text{ } t2^3 - 6.420 \text{ } t1 \right)
       -.0008325000000 \quad \epsilon 1^2 + .6533333333 \quad 10^{-7} \quad \epsilon 1^3
> p3 := O2avei*(6.148*t2+(3.102/1000)*t2^2/2-(0.923/1000000)*t2^3/3-(6.148*t1+(3.10
> 2/1000)*t1^2/2-(0.923/1000000)*t1^3/3));
     p3 := 02 avei (6.148 \text{ t}2 + .001551000000 \text{ t}2^2 - .3076666666 \text{ }10^{-6} \text{ t}2^3 - 6.148 \text{ t}1
       > N2avei := 100 - CO2avei - COavei - O2avei;
                        N2avei := 100 - COavei - CO2avei - O2avei
> p4 := N2avei*(6.524*t2+(1.250/1000)*t2^2/2-(0.001/1000000)*t2^3/3-(6.524*t1+(1.25
> 0/1000)*t1^2/2-(0.001/1000000)*t1^3/3));
       p4 := (100 - Coavei - Co2avei - O2avei) (6.524 t2 + .00062500000000 t2^2)
          -.3333333333 \cdot 10^{-9} t2^3 - 6.524 t1 - .0006250000000 t1^2
          +.3333333333310^{-9} t1^{3}
```

> p5 := Mifg*(7.256*t2+(2.298/1000)*t2^2/2+(0.283/1000000)*t2^3/3-(7.256*t1+(2.298/1

```
+ Wma \left(36.46063760 \frac{(100 - Coavei - Co2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ E
       + Mf (7.256 t2 + .001149000000 \ t2^2 + .9433333332 \ 10^{-7} \ t2^3 - 7.256 \ t1
       -.001149000000 \ \ t1^2 -.9433333332 \ \ 10^{-7} \ \ t1^3 \bigg) \bigg/ \bigg(.4960035524 \ \ H + .05550621670
       Wma \left(36.46063760 \frac{(100 - Coavei - Co2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N\right)
       +.05550621670 Mf + 100 12.01 CO2avei + 12.01 COavei
    \%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S
> Cpfg := (1/(t2-t1))^*(((1-Mfg))^*(p1+p2+p3+p4)+100^*p5)/100;
    Cpfg := \frac{\cdot}{100}
       1 - .05550621670
                              .4960035524 H+.05550621670 %4+.05550621670 Mf+100 \frac{\%2}{(1)}
         (co2avei (6.214 t2 + .005198000000 t2^2 - .1181666667 10^{-5} t2^3 - 6.214 t1)
       -.005198000000 	ext{ t1}^2 + .1181666667 	ext{ 10}^{-5} 	ext{ t1}^3) + Coavei (6.420 	ext{ t2})
       +.0008325000000 \pm 2^2 -.6533333333 10^{-7} \pm 2^3 -6.420 \pm 1 -.0008325000000 \pm 1^2
       +.6533333333 \cdot 10^{-7} t1^{3} + 02avei (6.148 t2 + .001551000000) t2^{2}
       -.3076666666 \cdot 10^{-6} \quad \pm 2^{3} - 6.148 \quad \pm 1 -.001551000000 \quad \pm 1^{2} +.3076666666 \quad 10^{-6} \quad \pm 1^{3}
      )+%3 (6.524 \pm 2 + .00062500000000 \pm 2^2 - .33333333333 \times 10^{-9} \pm 2^3 - 6.524 \pm 1
       -.0006250000000 \pm 1^2 + .3333333333 \pm 10^{-9} \pm 1^3) + 5.550621670
      (8.936 \text{ H} + \%4 + \text{Mf}) \left(7.256 \text{ t}2 + .001149000000 \text{ t}2^2 + .9433333332 \text{ }10^{-7} \text{ t}2^3\right)
      -7.256 \ t1 - .001149000000 \ t1^2 - .9433333332 \ 10^{-7} \ t1^3)/(
```

000)*t1^2/2+(0.283/1000000)*t1^3/3));

p5 := .05550621670 | 8.936 H

.4960035524
$$H + .05550621670$$
 %4 + .05550621670 $Mf + 100$ $\frac{\%2}{\%1}$) $/(t2 - t1)$

%1 := 12.01 CO2avei + 12.01 COavei

$$\%2 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%3 := 100 - COavei - CO2avei - O2avei

%4 := Wma
$$\left(36.46063760 \frac{\%3 \%2}{\%1} - 1.301236174 N\right)$$

> p3 := 21*(6.148*t4+(3.102/1000)*t4^2/2-(0.923/1000000)*t4^3/3-(6.148*t3+(3.102/10 > 00)*t3^2/2-(0.923/1000000)*t3^3/3));

$$p3 := 129.108 \ t4 + .03257100000 \ t4^2 - .6460999999 \ 10^{-5} \ t4^3 - 129.108 \ t3$$

- .03257100000 \ \tau_3^2 + .6460999999 \ 10^{-5} \ \tau_3^3

> p4 := 79*(6.524*t4+(1.250/1000)*t4^2/2-(0.001/1000000)*t4^3/3-(6.524*t3+(1.250/10 > 00)*t3^2/2-(0.001/1000000)*t3^3/3));

$$p4 := 515.396 \ t4 + .04937500000 \ t4^2 - .2633333333 \ 10^{-7} \ t4^3 - 515.396 \ t3$$

- .04937500000 \ \tau^2 + .2633333333 \ 10^{-7} \ \tau^3

> amp := ((28.97*Wma*100)/18.015)/(28.97*Wma/18.015 +1);

$$amp := 160.8104357 \frac{Wma}{1.608104357 Wma + 1}$$

> p5 := amp*(7.256*t4+(2.298/1000)*t4^2/2+(0.283/1000000)*t4^3/3-(7.256*t3+(2.298/ > 1000)*t3^2/2+(0.283/1000000)*t3^3/3));

p5 :=
$$160.8104357$$
 Wma $(7.256 \ t4 + .0011490000000 \ t4^2 + .9433333332 \ 10^{-7} \ t4^3$
 $-7.256 \ t3 - .0011490000000 \ t3^2 - .9433333332 \ 10^{-7} \ t3^3)/(1.608104357 \ Wma + 1)$

> Cpal := (1/(t4-t3))*(((100-Mfg)/100)*(p3+p4)+p5)/100;

$$Cpa1 := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \text{ H} \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \left(36.46063760 \ \frac{(100 - \mathit{coavei} - \mathit{co2avei} - \mathit{o2avei}) \ \%1}{12.01 \ \mathit{co2avei} + 12.01 \ \mathit{coavei}} - 1.301236174 \ \mathit{N} \right) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{co2avei} + 12.01 \ \mathit{coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t4} \right. \\ &+ .08194600000 \ \mathit{t4}^2 - .6487333332 \ 10^{-5} \ \mathit{t4}^3 - 644.504 \ \mathit{t3} - .08194600000 \ \mathit{t3}^2 \right. \\ &+ .6487333332 \cdot 10^{-5} \ \mathit{t3}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t4} + .0011490000000 \ \mathit{t4}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t4}^3 - 7.256 \ \mathit{t3} - .0011490000000 \ \mathit{t3}^2 - .9433333332 \ 10^{-7} \ \mathit{t3} \bigg. \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg/ (\mathit{t4} - \mathit{t3}) \\ &\% 1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{2} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> p3 := 21*(6.148*t8+(3.102/1000)*t8^2/2-(0.923/1000000)*t8^3/3-(6.148*t7+(3.102/10 > 00)*t7^2/2-(0.923/1000000)*t7^3/3));

$$p3 := 129.108 \ t8 + .03257100000 \ t8^2 - .6460999999 \ 10^{-5} \ t8^3 - 129.108 \ t7$$

- .03257100000 \ \tau^2 + .6460999999 \ 10^{-5} \ \tau^3

> p4 := 79*(6.524*t8+(1.250/1000)*t8^2/2-(0.001/1000000)*t8^3/3-(6.524*t7+(1.250/10 > 00)*t7^2/2-(0.001/1000000)*t7^3/3));

> p5 := amp*(7.256*t8+(2.298/1000)*t8^2/2+(0.283/1000000)*t8^3/3-(7.256*t7+(2.298/ > 1000)*t7^2/2+(0.283/1000000)*t7^3/3));

$$p5 := 160.8104357 \text{ Wma} \left(7.256 \text{ } \pm 8 + .0011490000000 \text{ } \pm 8^2 + .9433333332 \text{ } 10^{-7} \text{ } \pm 8^3 \right)$$

-7.256 \psi t7 - .0011490000000 \psi t7^2 - .9433333332 \quad 10^{-7} \psi t7^3 \right)/(1.608104357 \quad \text{Wma} + 1

> Cpsa := (1/(t8-t7))*(((100-Mfg)/100)*(p3+p4)+p5)/100;

$$Cpsa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \ H \right) + Wma \left(36.46063760 \ \frac{(100 - Coavei - Co2avei - O2avei) \%1}{12.01 \ Co2avei + 12.01 \ Coavei} - 1.301236174 \ N \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \left(36.46063760 \ \frac{(100 - \mathit{COavei} - \mathit{CO2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{COavei}} - 1.301236174 \ \mathit{N} \right) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t8} \right. \\ &+ .081946000000 \ \mathit{t8}^2 - .6487333332 \ 10^{-5} \ \mathit{t8}^3 - 644.504 \ \mathit{t7} - .081946000000 \ \mathit{t7}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t7}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t8} + .0011490000000 \ \mathit{t8}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t8}^3 - 7.256 \ \mathit{t7} - .0011490000000 \ \mathit{t7}^2 - .9433333332 \ 10^{-7} \ \mathit{t7}^3 \\ \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg) \bigg/ (\mathit{t8} - \mathit{t7}) \\ \%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{3} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> p3 := 21*(6.148*t6+(3.102/1000)*t6^2/2-(0.923/1000000)*t6^3/3-(6.148*t5+(3.102/10 > 00)*t5^2/2-(0.923/1000000)*t5^3/3));

$$p3 := 129.108 \ t6 + .03257100000 \ t6^2 - .6460999999 \ 10^{-5} \ t6^3 - 129.108 \ t5$$

- .03257100000 \ \tau5^2 + .6460999999 \ 10^{-5} \ \tau5^3

> p4 := 79*(6.524*t6+(1.250/1000)*t6^2/2-(0.001/1000000)*t6^3/3-(6.524*t5+(1.250/10 > 00)*t5^2/2-(0.001/1000000)*t5^3/3));

$$p4 := 515.396 \ t6 + .04937500000 \ t6^2 - .2633333333 \ 10^{-7} \ t6^3 - 515.396 \ t5$$

- .04937500000 \ \tau5^2 + .2633333333 \ 10^{-7} \ \tau5^3

> p5 := amp*(7.256*t6+(2.298/1000)*t6^2/2+(0.283/1000000)*t6^3/3-(7.256*t5+(2.298/2000)*t5^2/2+(0.283/1000000)*t5^3/3));

p5 := 160.8104357 Wma
$$(7.256 \ \text{t}6 + .0011490000000 \ \text{t}6^2 + .9433333332 \ 10^{-7} \ \text{t}6^3$$

-7.256 t5 - .001149000000 t5² - .9433333332 $10^{-7} \ \text{t}5^3)/(1.608104357 \ \text{Wma} + 1)$

> Cppa := $(1/(t6-t5))^*(((100-Mfg)/100)^*(p3+p4)+p5)/100;$

$$Cppa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \text{ H} \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 CO2avei + 12.01 COavei} - 1.301236174 \text{ N} \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \left(36.46063760 \ \frac{(100 - \mathit{Coavei} - \mathit{Co2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} - 1.301236174 \ \mathit{N} \right) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t6} \right. \\ &+ .08194600000 \ \mathit{t6}^2 - .6487333332 \ 10^{-5} \ \mathit{t6}^3 - 644.504 \ \mathit{t5} - .08194600000 \ \mathit{t5}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t5}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t6} + .001149000000 \ \mathit{t6}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t6}^3 - 7.256 \ \mathit{t5} - .001149000000 \ \mathit{t5}^2 - .9433333332 \ 10^{-7} \ \mathit{t5} \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg) \bigg/ (\mathit{t6} - \mathit{t5}) \\ \%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{3} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

```
+.6487333332 \cdot 10^{-5} t3^{3} + 160.8104357 Wma (7.256 t4 +.001149000000 t4<sup>2</sup>
                   +.9433333332 \cdot 10^{-7} \cdot t4^3 - 7.256 \cdot t3 - .001149000000 \cdot t3^2 - .9433333332 \cdot 10^{-7} \cdot t3^3
                  /(1.608104357 \text{ Wma} + 1) (Tfgo - Tsai)/(t4 - t3) - \frac{1}{100} \text{ Wpai} \left(\frac{1}{100}\right)
                  \left(100 - .05550621670 \frac{8.936 \ H + \%4 + ME}{\%5}\right) \left(644.504 \ \text{t}6 + .08194600000 \ \text{t}6^2\right)
                   -.6487333332 \cdot 10^{-5} \cdot \epsilon 6^3 - 644.504 \cdot \epsilon 5 - .08194600000 \cdot \epsilon 5^2
                  +.6487333332 \cdot 10^{-5} \cdot t5^{3} + 160.8104357 Wma (7.256 \cdot t6 + .001149000000 \cdot t6^{2}
                   +9433333332 \cdot 10^{-7} \cdot 
                  /((1.608104357 \text{ Wma} + 1)) (Tpao - Tsai)/(t6 - t5)) (t8 - t7) / ((\frac{1}{100}))
                    \left(100 - .05550621670 \frac{8.936 \ H + \%4 + ME}{\%5}\right) \left(644.504 \ \text{tb} + .08194600000 \ \text{tb}^2\right)
                   -.6487333332 \cdot 10^{-5} t8^{3} - 644.504 t7 - .08194600000 t7^{2}
                  +.6487333332 \cdot 10^{-5} \cdot \epsilon 7^{3} + 160.8104357 Wma (7.256 \cdot \epsilon 8 + .001149000000 \cdot \epsilon 8^{2}
                   +.9433333332 \cdot 10^{-7} \cdot t8^3 - 7.256 \cdot t7 - .001149000000 \cdot t7^2 - .9433333332 \cdot 10^{-7} \cdot t7^3
                 )/(1.608104357 Wma+1) (Tsao-Tsai) Wfe SA
              %1:=12.01 CO2avei + 12.01 COavei
           \%2 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S
             %3 := 100 - COavei - CO2avei - O2avei
             \%4 := Wma \left( 36.46063760 - \frac{\%3 \%2}{\%1} - 1.301236174 N \right)
             %5 := .4960035524 H + .05550621670 %4 + .05550621670 ME + 100 \frac{\%2}{\alpha.1}
> sigmaWsai := sqrt(
```

> Diff(Wsai,SA)^2*varSA +

> Diff(Wsai,CO2avei)^2*varCO2avei +

Dim(Wsai,COavei)^2-varcOavei +
Diff(Wsal,O2avel)^2*varO2avel +
Diff(Wsai,Wfe)^2*varWfe +
Diff(Wsai,A)^2*varA +
Diff(Wsai,OUHD)^2*varOUHD +
Diff(Wsai,Ca)^2*varCa +
Diff(Wsai,C)*Diff(Wsai,C)*varC +
Diff(Wsal,S)*Diff(Wsal,S)*varS +
Diff(Wsai,H)*Dlff(Wsai,H)*varH +
Diff(Wsai,Wma)*Diff(Wsai,Wma)*varWma +
Diff(Wsal,N)*Diff(Wsal,N)*varN +
Diff(Wsal,Mf)*Diff(Wsal,Mf)*varMf
:
sigmaWsai := value("):
Constants
SA - Split A
SA := 0.5168;
SA := .5168
varSA := 0.002175^2;
varSA := 0.002175^2;
varSA := 0.002175^2;
varSA := 0.002175^2; varSA := .4730625 10 ⁻⁵
varSA := 0.002175^2; varSA := .4730625 10 ⁻⁵ Weight of Flue Gas in
varSA := 0.002175^2; varSA := .4730625 10 ⁻⁵ Weight of Flue Gas in Wfgl := 754952;

	varWfgi := 32216976	
Weight of Primary Air in		
> Wpai := 62530;		
·	Wpai := 62530	
> varWpai := 1823^2;		
•	varWpai:=3323329	
Air Leakage fraction		
> AL := .0;		
	AL := 0	
> varAL := .00866^2;		
	varAL := .0000749956	
> Tfgi := 680;		<u></u>
	Tfgi := 680	
> varTfgl := (0.0012*Tfgl)^2;		
	varTfgi := .66585600	
> t2 := (Tfgi +460)/1.8;		
, , ,	t2 := 633.33333334	
>		
> Tfgo := 253;		
	Tfgo := 253	
> varTfgo := (0.0035*Tfgo)^2;		
	varTfgo:=.78411025	
> t1 := (Tfgo+460)/1.8;		
	t1:=396.1111112	
>		
> Tali := 80;		
•	Tali := 80	
> varTali := (0.0012*Tali)^2;		
, , , ,	varTali:=.00921600	
> t3 := (Tali+460)/1.8;		
• •	t3 := 300.0000001	
> t4 := t1;		
•	t4:=396.1111112	
> Tpai := 80;		

Tpai := 80
> varTpal := (0.0012*Tpai)^2;
varTpai := .00921600
> t5 := (Tpai+460)/1.8;
£5 := 300.0000001
> Tpao := 644;
Tpao := 644
> varTpao := (0.0074*Tpao)^2;
varTpao:=22.71094336
> t6 := (Tpao+460)/1.8;
<i>t6</i> := 613.3333334
> Tsal := 80;
Tsai := 80
> varTsal := (0.002*Tsai)^2;
varTsai := .025600
> t7 := (Tsal+460)/1.8; £7 := 300,0000001
E7 := 300.0000001
> Tsao := 616;
Tsao := 616
> varTsao := (0.007*Tsao)^2;
varTsao := 18.593344
> t8 := (Tsao+460)/1.8;
£8 := 597.777778
Averages and Variances from Part A
> CO2avei := 15.2148; CO2avei := 15.2148
> varCO2avel := .10206^2;
varCO2avei := .10206 2;
> COavel := .005;
COavei := .005
> varCOavel := .00022^2;
_
varCOavei := .484 10 ⁻⁷
> O2avei := 3.8;
02avei := 3.8
> varO2avei := .01118^2;

var02avei:=.0001249924	
Coal Feed Rate (lbs/hr)	
> Wfe := 115839;	
Wfe:= 115839	
> varWfe := (0.0025°Wfe)^2;	
varWfe := 83866.71200	
Moisture in Coal	
> Mf :=0.06;	
Mf := .06	
> varMf := ((0.2+.012*Mf*100)/(100*2*1.414))^2;	
varMf:= .9250793742 10 ⁻⁶	
Ash re	
> A := 0.0619;	
•	
A:=.0619	
> varA := ((0.07+0.02*A*100)/(100*2*1.414))^2;	
varA := .4696223261 10 ⁻⁶	
Overhead?	
> OUHD := 0.9;	
OUHD := .9	····
> varOUHD := (0.1*OUHD)^2;	
varOUHD := .0081	
Carbon	
> C := 0.7381;	
c:=.7381	
> varC := (0.64/(100°2°1.414))^2;	
varC:= .5121546706 10 ⁻⁵	
Underson	
Hydrogen > H := 0.0482;	
H:= .0482	
H := .0482 > varH := (0.16/(100*2*1.414))^2;	
· · · · · · · · · · · · · · · · · · ·	
varH:= .3200966692 10 ⁻⁶	

Nitrogen	
> N := 0.0135;	
	N := .0135
> varN := (0.11/(100*2*1.414)))^2;
i	varN:=.1512956913 10 ⁻⁶
	VALIT 1312/30/13 10
Sulfur re	
> S := 0.0123;	
	S := .0123
> varS := ((0.06+.035*S*100)/	/(100*2*1.414))^2;
	vars:=.1327813813 10 ⁻⁶
	VALS1527013013 10
Moisture (air) re	
> Wma := 0.013;	
	Wma := .013
> varWma := (.2*Wma)^2;	
	varWma:=.676 10 ⁻⁵
	V41 Mild
Carbon in Ash re	
> Ca := 0.0486;	
İ	Ca := .0486
> varCa := (0.10*Ca)^2;	
	varCa := .000023619600
Results	
**********	*************
> evalf(Mfg);	
	.08136935946
> evalf(Cpfg);	
	7.769387922
> evalf(Cpal);	
• • •	7.151727411
> evalf(Cppa);	
	7.316810251
> evalf(Cpsa);	
• • •	7.305185745



Wsai in lb/lb of AF Coal	
WSm III IB/IB Of AT Com	
evalf(Wsai);	
•	9.583839808
evalf(slgmaWsai);	
• •	.06491445524
> evalf(100*sigmaWsai/Wsai);	
, ,	.6773324319
> evalf(Wsai*SA*Wfe);	
•	573742.2744
evalf(sigmaWsai*SA*Wfe);	
	3886.142500
>	

********	********

;

:

Appendix I-3
Bias Error Calculation
Secondary Air Inlet Flow -- With Leak Case

```
Error Propagation Calculations, Part B, Secondary Airflow Wsai with Leakage
> MFG := proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2 + CO));
> K4 := 8.936*H + Wma*((28.02*(100-CO-CO2-O2)*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100°K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MOFG :=
     proc(A,OUHD, Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
     local Cr,Cb,K3,K4,MFG;
          Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
         Cb := C-Cr;
         K3 := (Cb+.3744932959*S)/(12.01*CO2+12.01*CO);
          K4 := 8.936*H+Wma*(36.46063760*(100-CO-CO2-O2)*K3-1.301236174*N
         MFG := .05550621670*K4/(.05550621670*K4+100*K3)
     end
> Mfg := MFG(A,OUHD,Ca,C,S,COavei,CO2avei,H,Wma,O2avei,N,Mf);
   Mfg := .05550621670 \mid 8.936 \text{ H}
     + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei}\right)
                                                                   - 1.301236174
     + Mf / .4960035524 H + .05550621670
```

```
Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N\right)
      \%1 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{2} \ Ca} + .3744932959 \ S
> p1 := CO2avel*(6.214*12+(10.396/1000)*12^2/2-(3.545/1000000)*12^3/3-(6.214*11+(1
> 0.396/1000)*t1^2/2-(3.545/1000000)*t1^3/3));
    p1:= CO2avei (6.214 t2 + .0051980000000 t2^2 - .1181666667 10^{-5} <math>t2^3 - 6.214 t1
      -0.05198000000 	 t1^2 + .1181666667 	 10^{-5} 	 t1^3
> p2 := COavel*(6.420*t2+(1.665/1000)*t2^2/2-(0.196/1000000)*t2^3/3-(6.420*t1+(1.66
> 5/1000)*t1^2/2-(0.196/1000000)*t1^3/3));
    p2 := COavei \left( 6.420 \ t2 + .0008325000000 \ t2^2 - .6533333333 \ 10^{-7} \ t2^3 - 6.420 \ t1 \right)
      -.0008325000000 	 t1^2 + .6533333333 	 10^{-7} 	 t1^3
> p3 := O2avei*(6.148*t2+(3.102/1000)*t2^2/2-(0.923/1000000)*t2^3/3-(6.148*t1+(3.10
> 2/1000)*t1^2/2-(0.923/1000000)*t1^3/3));
    p3 := 02avei \left( 6.148 \ t2 + .001551000000 \ t2^2 - .3076666666 \ 10^{-6} \ t2^3 - 6.148 \ t1 \right)
       -.0015510000000 \pm 1^2 + .3076666666 \times 10^{-6} \pm 1^3
> N2avei := 100 - CO2avei - COavei - O2avei;
                       N2avei := 100 - COavei - CO2avei - O2avei
> p4 := N2avei*(6.524*t2+(1.250/1000)*t2^2/2-(0.001/1000000)*t2^3/3-(6.524*t1+(1.25
> 0/1000)^{1}^{2/2}(0.001/1000000)^{1}^{3/3};
        p4 := (100 - COavei - CO2avei - O2avei) (6.524 t2 + .0006250000000 t2^2)
          -3333333333110^{-9} t2^3 - 6.524 t1 - .0006250000000 t1^2
          +.33333333333310^{-9} t1^{3}
> p5 := Mfg*(7.256*t2+(2.298/1000)*t2^2/2+(0.283/1000000)*t2^3/3-(7.256*t1+(2.298/1
```

> 000)*t1^2/2+(0.283/1000000)*t1^3/3));

 $p5 := .05550621670 \left(8.936 \ H \right) \\ + Wma \left(36.46063760 \ \frac{(100 - COavei - CO2avei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ E \\ + Mf \right) \left(7.256 \ t2 + .001149000000 \ t2^2 + .9433333332 \ 10^{-7} \ t2^3 - 7.256 \ t1 \\ - .001149000000 \ t1^2 - .94333333332 \ 10^{-7} \ t1^3 \right) / \left(.4960035524 \ H + .05550621670 \right) \\ Wma \left(36.46063760 \ \frac{(100 - COavei - CO2avei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N \right) \\ + .05550621670 \ Mf + 100 \ \frac{\%1}{12.01 \ CO2avei + 12.01 \ COavei} \right) \\ \%1 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S$

> Cpfg := $(1/(12-11))^*(((1-Mfg))^*(p1+p2+p3+p4)+100^*p5)/100$; $cpfg := \frac{1}{100} \left(\frac{8.936 \ H + \%4 + Mf}{4.960035524 \ H + .05550621670 \ \%4 + .05550621670 \ Mf + 100 \ \frac{\%2}{\%1}} \right) \left(co2avei \left(6.214 \ t2 + .005198000000 \ t2^2 - .1181666667 \ 10^{-5} \ t2^3 - 6.214 \ t1 \right) \right) \left(co2avei \left(6.214 \ t2 + .005198000000 \ t2^2 - .1181666667 \ 10^{-5} \ t2^3 - 6.214 \ t1 \right) \right) \left(co2avei \left(6.214 \ t2 + .0051980000000 \ t2^2 - .1181666667 \ 10^{-5} \ t2^3 - 6.214 \ t1 \right) \right) \left(co2avei \left(6.214 \ t2 + .0051980000000 \ t2^2 - .1181666667 \ 10^{-5} \ t2^3 - 6.214 \ t1 \right) \right) + coavei \left(6.420 \ t2 + .00083250000000 \ t2^2 + .65333333333 \ 10^{-7} \ t2^3 - 6.420 \ t1 - .00083250000000 \ t2^2 + .30766666666 \ 10^{-6} \ t2^3 - 6.148 \ t1 - .0015510000000 \ t2^2 + .30766666666 \ 10^{-6} \ t1^3 \right) \right) + \%3 \left(6.524 \ t2 + .000625000000000 \ t2^2 + .33333333333 \ 10^{-9} \ t2^3 - 6.524 \ t1 \right) - .000625000000000 \ t2^2 + .33333333333 \ 10^{-9} \ t1^3 \right) + 5.550621670$ $(8.936 \ H + \%4 + Mf) \left(7.256 \ t2 + .0011490000000 \ t2^2 + .94333333332 \ 10^{-7} \ t2^3 \right)$ $-7.256 \ t1 - .0011490000000 \ t1^2 - .94333333333 \ 10^{-7} \ t1^3 \right) / \left(co2avei \left(c.214 \ b.214 \ b$

$$.4960035524 \ H + .05550621670 \ \%4 + .05550621670 \ MF + 100 \ \frac{\%2}{\%1} \bigg) \bigg) / (\ \epsilon 2 - \epsilon 1)$$

%1:=12.01 CO2avei + 12.01 COavei

$$\%2 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S$$

%3 := 100 - COavei - CO2avei - O2avei

%4 := Wma
$$\left(36.46063760 \frac{\%3 \%2}{\%1} - 1.301236174 N\right)$$

> p3 := 21*(6.148*t4+(3.102/1000)*t4^2/2-(0.923/1000000)*t4^3/3-(6.148*t3+(3.102/10 > 00)*t3^2/2-(0.923/1000000)*t3^3/3));

$$p_3 := 129.108 \ t_4 + .03257100000 \ t_4^2 - .6460999999 \ 10^{-5} \ t_4^3 - 129.108 \ t_3^2 - .03257100000 \ t_3^2 + .6460999999 \ 10^{-5} \ t_3^3$$

> p4 := 79*(6.524*t4+(1.250/1000)*t4^2/2-(0.001/1000000)*t4^3/3-(6.524*t3+(1.250/10 > 00)*t3^2/2-(0.001/1000000)*t3^3/3));

$$p4 := 515.396 \quad t4 + .04937500000 \quad t4^2 - .2633333333 \quad 10^{-7} \quad t4^3 - 515.396 \quad t3$$

- .04937500000 \quad t3^2 + .2633333333 \quad 10^{-7} \quad t3^3

> amp := ((28.97*Wma*100)/18.015)/(28.97*Wma/18.015 +1);

$$amp := 160.8104357 \frac{Wma}{1.608104357 Wma + 1}$$

> p5 := amp*(7.256*t4+(2.298/1000)*t4^2/2+(0.283/1000000)*t4^3/3-(7.256*t3+(2.298/ > 1000)*t3^2/2+(0.283/1000000)*t3^3/3));

p5 :=
$$160.8104357$$
 Wma $(7.256 \pm 4 + .001149000000 \pm 4^2 + .9433333332 \pm 10^{-7} \pm 4^3 - .7.256 \pm 3 - .0011490000000 \pm 3^2 - .9433333332 \pm 10^{-7} \pm 3^3)/(1.608104357 \text{ Wma} + 1)$

> Cpal := $(1/(t4-t3))^*(((100-Mfg)/100)^*(p3+p4)+p5)/100;$

$$Cpa1 := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \ H \right) + Wma \left(36.46063760 \ \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ N \right)$$

 $\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$

> p3 := 21°(6.148°t8+(3.102/1000)°t8^2/2-(0.923/1000000)°t8^3/3-(6.148°t7+(3.102/10)
> 00)°t7^2/2-(0.923/1000000)°t7^3/3));

$$p3 := 129.108 \ t8 + .03257100000 \ t8^2 - .6460999999 \ 10^{-5} \ t8^3 - 129.108 \ t7$$

- .03257100000 \ $t7^2 + .6460999999 \ 10^{-5} \ t7^3$

> p4 := 79*(6.524*t8+(1.250/1000)*t8^2/2-(0.001/1000000)*t8^3/3-(6.524*t7+(1.250/10)
> 00)*t7^2/2-(0.001/1000000)*t7^3/3));

$$p4 := 515.396 \ t8 + .04937500000 \ t8^2 - .2633333333 \ 10^{-7} \ t8^3 - 515.396 \ t7$$
$$- .04937500000 \ t7^2 + .2633333333 \ 10^{-7} \ t7^3$$

> p5 := amp*(7.256*t8+(2.298/1000)*t8^2/2+(0.283/1000000)*t8^3/3-(7.256*t7+(2.298 > 1000)*t7^2/2+(0.283/1000000)*t7^3/3));

p5 := 160.8104357 Wma
$$(7.256 \text{ } \text{t8} + .001149000000 \text{ } \text{t8}^2 + .9433333332 \text{ } 10^{-7} \text{ } \text{t8}^3 -7.256 \text{ } \text{t7} - .001149000000 \text{ } \text{t7}^2 - .9433333332 \text{ } 10^{-7} \text{ } \text{t7}^3)/(1.608104357 \text{ } \text{Wma} + .001149000000 \text{ } \text{t7}^2 - .9433333332 \text{ } 10^{-7} \text{ } \text{t7}^3)$$

> Cpsa := (1/(t8-t7))*(((100-Mfg)/100)*(p3+p4)+p5)/100;

$$Cpsa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \text{ H} \right) \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ & \mathit{Wma} \left(36.46063760 \ \frac{(100 - \mathit{Coavei} - \mathit{Co2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} - 1.301236174 \ \mathit{N} \right) \\ & + .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t8} \right. \\ & + .08194600000 \ \mathit{t8}^2 - .6487333332 \ 10^{-5} \ \mathit{t8}^3 - 644.504 \ \mathit{t7} - .08194600000 \ \mathit{t7}^2 \\ & + .6487333332 \ 10^{-5} \ \mathit{t7}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t8} + .001149000000 \ \mathit{t8}^2 \right. \\ & + .9433333332 \ 10^{-7} \ \mathit{t8}^3 - 7.256 \ \mathit{t7} - .001149000000 \ \mathit{t7}^2 - .9433333332 \ 10^{-7} \ \mathit{t7}^3 \\ & \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg) \bigg/ (\mathit{t8} - \mathit{t7}) \\ & \%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{3} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> p3 := 21*(6.148*t6+(3.102/1000)*t6^2/2-(0.923/1000000)*t6^3/3-(6.148*t5+(3.102/10 > 00)*t5^2/2-(0.923/1000000)*t5^3/3));

 $p3 := 129.108 \quad t6 + .03257100000 \quad t6^{2} - .6460999999 \quad 10^{-5} \quad t6^{3} - 129.108 \quad t5$ $- .03257100000 \quad t5^{2} + .6460999999 \quad 10^{-5} \quad t5^{3}$

> p4 := 79*(6.524*t6+(1.250/1000)*t6^2/2-(0.001/1000000)*t6^3/3-(6.524*t5+(1.250/10 > 00)*t5^2/2-(0.001/1000000)*t5^3/3));

p4 := 515.396 t6 + .04937500000 $t6^2 - .2633333333$ 10^{-7} $t6^3 - 515.396$ t5 - .04937500000 $t5^2 + .2633333333$ 10^{-7} $t5^3$

> p5 := amp*(7.256*t6+(2.298/1000)*t6^2/2+(0.283/1000000)*t6^3/3-(7.256*t5+(2.298/ > 1000)*t5^2/2+(0.283/1000000)*t5^3/3));

p5 := 160.8104357 Wma $(7.256 \ t6 + .0011490000000 \ t6^2 + .9433333332 \ 10^{-7} \ t6^3 - 7.256 \ t5 - .0011490000000 \ t5^2 - .9433333332 \ 10^{-7} \ t5^3)/(1.608104357 \ Wma + 1)$

> Cppa := (1/(t6-t5))*(((100-Mfg)/100)*(p3+p4)+p5)/100;

$$Cppa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 H \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 CO2avei + 12.01 CO2avei} - 1.301236174 N \right) \right)$$

$$\begin{split} &+ \mathit{ME} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \left(36.46063760 \ \frac{(100 - \mathit{COavei} - \mathit{CO2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{COavei}} - 1.301236174 \ \mathit{N} \right) \\ &+ .05550621670 \ \mathit{ME} + 100 \ \frac{\%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{COavei}} \bigg) \bigg) \left(644.504 \ \mathit{t6} \right. \\ &+ .08194600000 \ \mathit{t6}^2 - .6487333332 \ 10^{-5} \ \mathit{t6}^3 - 644.504 \ \mathit{t5} - .08194600000 \ \mathit{t5}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t5}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t6} + .0011490000000 \ \mathit{t6}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t6}^3 - 7.256 \ \mathit{t5} - .0011490000000 \ \mathit{t5}^2 - .9433333332 \ 10^{-7} \ \mathit{t5} \\ \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg) \bigg/ (\mathit{t6} - \mathit{t5}) \\ \%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{2} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> Wsal := (Wfgl*(Cpfg*(Tfgl-Tfgo) - AL*Cpal*(Tfgo-Tsal)) - Wpal*Cppa*(Tpao-Tsal))/ > (Cpsa*(Tsao-Tsal)*Wfe*SA);

2000

 $+.6487333332 \cdot 10^{-5} \cdot t3^{3}$ $+ 160.8104357 \cdot Wma \left(7.256 \cdot t4 + .0011490000000\right) \cdot t4^{2}$ $+.943333332 \cdot 10^{-7} \cdot t4^3 - 7.256 \cdot t3 - .001149000000 \cdot t3^2 - .9433333332 \cdot 10^{-7} \cdot t3^3$ $/((1.608104357 \text{ Wma} + 1)) (Tfgo - Tsai)/(t4 - t3)) - \frac{1}{100} \text{ Wpai} \left(\frac{1}{100}\right)$ $\left(100 - .05550621670 \frac{8.936 \ H + \%4 + Mf}{\%5}\right) \left(644.504 \ t6 + .08194600000 \ t6^{2}\right)$ $-.6487333332 \cdot 10^{-5} \cdot t6^{3} - 644.504 \cdot t5 - .08194600000 \cdot t5^{2}$ $+.6487333332 \cdot 10^{-5} \cdot t5^{3}$ + 160.8104357 Wma (7.256 $t6+.0011490000000 \cdot t6^{2}$ $+.9433333332 \cdot 10^{-7} \cdot t6^3 - 7.256 \cdot t5 - .001149000000 \cdot t5^2 - .9433333332 \cdot 10^{-7} \cdot t5^3$ /(1.608104357 Wma + 1) (Tpao - Tsai)/(t6 - t5) (t8 - t7) / $((\frac{1}{100})$ $\left(100 - .05550621670 \frac{8.936 \ H + \%4 + Mf}{\%5}\right) \left(644.504 \ t8 + .08194600000 \ t8^{2}\right)$ $-.6487333332 ext{ } 10^{-5} ext{ } t8^3 - 644.504 ext{ } t7 - .08194600000 ext{ } t7^2$ $+.6487333332 \cdot 10^{-5} \cdot t7^{3}$ + 160.8104357 Wma $(7.256 \cdot t8 + .001149000000 \cdot t8^{2})$ $+.943333332 \cdot 10^{-7} \cdot \epsilon 8^3 - 7.256 \cdot \epsilon 7 - .001149000000 \cdot \epsilon 7^2 - .9433333332 \cdot 10^{-7} \cdot \epsilon 7^3$)/(1.608104357 Wma+1)) (Tsao-Tsai) Wfe SA) %1 := 12.01 CO2avei + 12.01 COavei $\%2 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S$ %3 := 100 - COavei - CO2avei - O2avei $\%4 := Wma \left(36.46063760 - \frac{\%3 \%2}{\%1} - 1.301236174 N \right)$ %5 := .4960035524 H + .05550621670 %4 + .05550621670 Mf + 100 $\frac{\%2}{\%1}$

> sigmaWsai := sqrt(

> Diff(Wsai,SA)^2*varSA +

> Diff(Wsai,CO2avei)^2*varCO2avei +

>	Diff(Wsal,COavei)^2*varCOavei +
>	Diff(Wsal,O2avei)^2*varO2avei +
>	Diff(Wsai,Wfe)^2*varWfe +
>	Diff(Wsal,A)^2*varA +
>	Diff(Wsal,OUHD)^2*varOUHD +
>	Diff(Wsai,Ca)^2*varCa +
>	Diff(Wsai,C)*Diff(Wsai,C)*varC +
>	Diff(Wsai,S)*Diff(Wsai,S)*varS +
>	Diff(Wsal,H)*Diff(Wsal,H)*varH +
>	Diff(Wsal,Wma)*Diff(Wsal,Wma)*varWma +
>	Diff(Wsal,N)*Diff(Wsal,N)*varN +
>	Diff(Wsal,Mf)*Diff(Wsal,Mf)*varMf
>):
>	sigmaWsal := value("):
_	Constants
	SA - Split A
>	SA := 0.5168; SA := .5168
>	varSA := 0.002214^2;
	varSA:=.4901796 10 ⁻⁵
>	
_	Weight of Flue Gas in
>	Wfgi := 754952;
	Wfgi := 754952
>	varWfgl := 47382^2;

	varWfgi := 2245053924	
Weight of Primary Air in		
> Wpai := 62530;		
	Wpai := 62530	
> varWpal := 1635^2;		
:	varWpai := 2673225	
	varipat	
Air Leakage fraction		
> AL := .0687;		
) AL .= .0007,	AL := .0687	
> varAL := .00058^2;		
·	$varAL := .3364 \cdot 10^{-6}$	
> Tfgl := 680;		
	Tfgi := 680	
> varTfgi := (0.01*Tfgi)^2;		
y variigi .= (0.01 1191) 2,	varTfgi := 46.2400	
	Val 11g1 40.2400	
> t2 := (Tfgi +460)/1.8;	- (00 0000004	
	t2 := 633.3333334	
>		
> Tfgo := 253;		
	Tfgo := 253	
> varTfgo := (0.01*Tfgo)^2;		
> variigo .= (0.01 1190/ 2,	varTfgo := 6.4009	
	val11g0 ,= 0.4007	
> t1 := (Tfgo+460)/1.8;	- 00/111110	
	t1 := 396.1111112	
>		
> Tali := 80;		*
•	Tali := 80	
> varTali := (0.01*Tali)^2;		
> varian := (0:01 1an, =,	varTali:=.6400	
40 - CT-II - 4CO\/4 9-	¥44 444 4 1 10 100	
> t3 := (Tali+460)/1.8;	2 200 000000	
	£3 := 3(X).0(X)00001	
> t4 := t1;		
	£4 := 396.1111112	
> Tpal := 80;		

	Tpai := 80
> varTpai := (0.01*Tpai)^2;	
, carried to	varTpai := .6400
> t5 := (Tpal+460)/1.8;	
) (5 .= (. pa 100)	£5 := 300.0000001
> Tpao := 644;	
> 1µao .= 044,	Tpao := 644
T (0.01) (7.00) (0.00)	
> varTpao := (0.01°Tpao)^2;	varTpao := 41.4736
	Val 1pao .= 41.4750
> t6 := (Tpao+460)/1.8;	. 6. (12.222224
	t6 := 613.3333334
> Tsal := 80;	Tsai := 80
	TS41 .= 60
> varTsai := (0.01*Tsai)^2;	
	varTsai := .6400
> t7 := (Tsal+460)/1.8;	
	£7 := 300.0000001
> Tsao := 616;	
	Tsao := 616
> varTsao := (0.01*Tsao)^2;	
	varTsao:=37.9456
> t8 := (Tsao+460)/1.8;	
•	£8 := 597.7777778
Averages and Variances from I	Part A
> CO2avei := 15.2148;	
	CO2avei := 15.2148
> varCO2avel := .1^2;	
	varCO2avei := .01
> COavei := .005;	
,	COavei := .005
> varCOavel := .002^2;	
y vai 00a10 = 100 = -,	varCOavei:=.4 10 ⁻⁵
	varcuavei:=.4 10
> O2avel := 3.8;	
	02avei := 3.8
> varO2avei := .05^2;	

	var02avei := .0025	
Coal Feed Rate (lbs/hr)		
> Wfe := 115839;	Wfe:= 115839	
	Wre := 113639	
> varWfe := (0.05*Wfe)^2;	Q	
,	varWfe:=.3354668480 10 ⁸	
Moisture in Coal		
> Mf :=0.06;	Mf := .06	
	M100	
> varMf := (0.039*Mf)^2;	5	
	varMf:= .54756 10 ⁻⁵	
Ash		
A := 0.0619;	A:=.0619	
	A := .0019	
> varA := (0.039*A)^2;	\$	
	varA:=.582787881 10 ⁻⁵	
Overhead		
> OUHD := 0.9;		
	OUHD := .9	
> varOUHD := (0.1*OUHD)^2;		
	varOUHD:=.0081	
Carbon		
> C := 0.7381;	C := .7.381	
	C (4 ,7361	
> varC := (0.039°C)^2;	- 0000204200200	
	varC := .0008286280388	
Hydrogen > H := 0.0482;		
> П .= U.U4U2,	H := .0482	
> varH := (0.039*H)^2;	252264204 10-5	
	varH:=.353364804 10 ⁻⁵	

Nitrogen	
> N := 0.0135;	
	N := .0135
> varN := (0.039*N)^2;	
- va.iv .= (0.000 iv) 2,	,
	varN:= .27720225 10 ⁻⁶
Sulfur	
> S := 0.0123;	
	S:=.0123
> varS := (0.019*S)^2;	
(, , , , , , , , , , , , , , , , , , ,	7
	vars:=.5461569 10 ⁻⁷
Moisture (air)	
> Wma := 0.013;	
	Wma := .013
> varWma := (.1*Wma)^2;	
	5
	varWma:=.169 10 ⁻⁵
Carbon in Ash	
Ca := 0.0486;	
	Ca := .0486
varCa := (0.25*Ca)^2;	
	varCa := .000147622500
Results	
****************	***********
evalf(Mfg);	
,	.08136935946
evalf(Cpfg);	
oran(opig),	7.76227022
14/0	7.769387922
evalf(Cpai);	
	7.151727411
evalf(Cppa);	
	7.316810251
evalf(Cpsa);	
(7 205195745
N. S.	7.305185745

Wsai in lb/lb of AF Coal		
> evalf(Wsai);		
	9.310086250	
> evalf(sigmaWsai);		
	.4677796756	
> evalf(100*sigmaWsai/Wsai);		
· -	5.024439764	
> evalf(Wsal*SA*Wfe);		
	557353.8547	
> evalf(sigmaWsal*SA*Wfe);		
	28003.90871	
>		
******************		*****

Appendix I-4
Random Error Calculation
Secondary Air Inlet Flow -- With Leak Case

```
Random Error Propagation Calculations, Part B, Secondary Airflow Wsai with Leakage
> MFG := proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2 + CO));
> K4 := 8.936*H + Wma*((28.02*(100-CO-CO2-O2)*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MPG :=
     proc(A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
     local Cr.Cb.K3.K4.MFG:
          Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
         Cb := C-Cr;
         K3 := (Cb+.3744932959*S)/(12.01*C02+12.01*C0);
         K4 := 8.936*H+Wma*(36.46063760*(100-C0-C02-02)*K3-1.301236174*L
         MFG := .05550621670*K4/(.05550621670*K4+100*K3)
     and
> Mfq:= MFG(A,OUHD,Ca,C,S,COavei,CO2avei,H,Wma,O2avei,N,Mf);
   MEG := .05550621670 \mid 8.936 \mid H
     + nma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei}\right)
                                                                   - 1.301236174
     + Mf / (.4960035524 H + .05550621670
```

```
Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 CO2avei + 12.01 COavei} - 1.301236174 N\right)
              +.05550621670 \text{ Mf} + 100 \frac{701}{12.01 \text{ CO2avei} + 12.01 \text{ COavei}}
         \%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S
> p1 := CO2avei*(6.214*t2+(10.396/1000)*t2^2/2-(3.545/1000000)*t2^3/3-(6.214*t1+(1
> 0.396/1000)*t1^2/2-(3.545/1000000)*t1^3/3));
          p1 := CO2avei (6.214 t2 + .005198000000 t2^2 - .1181666667 10^{-5} t2^3 - 6.214 t1
                -.005198000000 	 t1^2 + .1181666667 	 10^{-5} 	 t1^3
> p2 := COavei*(6.420*t2+(1.665/1000)*t2^2/2-(0.196/1000000)*t2^3/3-(6.420*t1+(1.66
> 5/1000)*t1^2/2-(0.196/1000000)*t1^3/3));
           p2 := COavei \left( 6.420 \text{ } t2 + .0008325000000 \text{ } t2^2 - .6533333333 \text{ } 10^{-7} \text{ } t2^3 - 6.420 \text{ } t1 \right)
                -.0008325000000 \ \epsilon 1^2 + .6533333333 \ 10^{-7} \ \epsilon 1^3
> p3 := O2avei*(6.148*t2+(3.102/1000)*t2^2/2-(0.923/1000000)*t2^3/3-(6.148*t1+(3.10
> 2/1000)*t1^2/2-(0.923/1000000)*t1^3/3));
            p3 := 02avei (6.148 t2 + .001551000000 t2^2 - .3076666666 10^{-6} t2^3 - 6.148 t1
                  -.001551000000 \ \epsilon 1^2 +.3076666666 \ 10^{-6} \ \epsilon 1^3
 > N2avei := 100 - CO2avei - COavei - O2avei;
                                                         N2avei := 100 - COavei - CO2avei - O2avei
 > p4 := N2avei*(6.524*t2+(1.250/1000)*t2^2/2-(0.001/1000000)*t2^3/3-(6.524*t1+(1.25
 > 0/1000)*t1^2/2-(0.001/1000000)*t1^3/3));
                    p4 := (100 - COavei - CO2avei - O2avei) (6.524 t2 + .0006250000000 t2^2)
                         -.3333333333 	ext{ 10}^{-9} 	ext{ } 	                         +.3333333333310^{-9} t1^{3}
```

> p5 := Mfg*(7.256*t2+(2.298/1000)*t2^2/2+(0.283/1000000)*t2^3/3-(7.256*t1+(2.298/1

> 000)*t1^2/2+(0.283/1000000)*t1^3/3));

p5 := .05550621670 $\left(8.936 \ H \right)$ $+ \ \textit{Wma} \left(36.46063760 \ \frac{(100 - \textit{COavei} - \textit{CO2avei} - \textit{O2avei}) \ \%1}{12.01 \ \textit{CO2avei} + 12.01 \ \textit{COavei}} - 1.301236174 \ \vdots \right)$ + Mf (7.256 t2 + .001149000000 $t2^2 + .9433333332$ 10^{-7} $t2^3 - 7.256$ t1 $-.001149000000 \ \epsilon 1^2 -.9433333332 \ 10^{-7} \ \epsilon 1^3 \bigg) \bigg/ \bigg(.4960035524 \ H + .05550621670 \bigg) \bigg)$ Wma (36.46063760 (100 - COavei - CO2avei - O2avei) %1 - 1.301236174 N) $+.05550621670 \text{ MF} + 100 \frac{\%1}{12.01 \text{ CO2avei} + 12.01 \text{ Coavei}}$ $\%1 := C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S$ $> Cpfg := (1/(t2-t1))^*(((1-Mfg))^*(p1+p2+p3+p4)+100*p5)/100;$ $Cpfg := \frac{1}{100}$ 1 - .05550621670 -.4960035524 H+.05550621670 %4+.05550621670 Mf+100 $\frac{\%}{G}$ $(co2avei (6.214 t2 + .005198000000 t2^2 - .1181666667 10^{-5} t2^3 - 6.214 t_{-})$ $-.005198000000 t1^2 + .1181666667 10^{-5} t1^3 + Coavei (6.420 t2)$ $\pm .0008325000000$ $\pm 2^2 - .65333333333$ 10^{-7} $\pm 2^3 - 6.420$ $\pm 1 - .0008325000000$ $\pm 1^2$ $+.6533333333310^{-7}$ $t1^3$) + 02avei (6.148 t2+.001551000000 $t2^2$ $-.3076666666 ext{ } 10^{-6} ext{ } t2^3 - 6.148 ext{ } t1 -.001551000000 ext{ } t1^2 +.3076666666 ext{ } 10^{-6} ext{ } t2^3 - 6.148 ext{ } t1 -.001551000000 ext{ } t2^3 +.30766666666 ext{ } 10^{-6} ext{ } t2^3 - 6.148 ext{ } t1 -.001551000000 ext{ } t2^3 +.30766666666 ext{ } 10^{-6} ext{ } t2^3 - 6.148 ex$)+ %3 $(6.524 \ \text{t2} + .0006250000000 \ \text{t2}^2 - .3333333333 \ 10^{-9} \ \text{t2}^3 - 6.524 \ \text{t1}$ $(8.936 \text{ H} + \%4 + \text{ME}) \left(7.256 \text{ t2} + .001149000000 \text{ t2}^2 + .9433333332 \text{ 10}^{-7} \text{ t2}^3\right)$ -7.256 t1 -.001149000000 t1² -.9433333332 10^{-7} t1³)/(

 $.4960035524 \ \ H + .05550621670 \ \ \%4 + .05550621670 \ \ Mf + 100 \ \ \frac{\%2}{\%1} \bigg) \bigg| / (t2 - t1)$

%1 := 12.01 CO2avei + 12.01 COavei

$$\%2 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%3 := 100 - COavei - CO2avei - O2avei

%4 := Wma
$$\left(36.46063760 \frac{\%3 \%2}{\%1} - 1.301236174 N\right)$$

> p3 := 21*(6.148*t4+(3.102/1000)*t4^2/2-(0.923/1000000)*t4^3/3-(6.148*t3+(3.102/10 > 00)*t3^2/2-(0.923/1000000)*t3^3/3));

$$p_3 := 129.108 \ t_4 + .03257100000 \ t_4^2 - .6460999999 \ 10^{-5} \ t_4^3 - 129.108 \ t_3^2 - .03257100000 \ t_3^2 + .6460999999 \ 10^{-5} \ t_3^3$$

> p4 := 79*(6.524*t4+(1.250/1000)*t4^2/2-(0.001/1000000)*t4^3/3-(6.524*t3+(1.250/10 > 00)*t3^2/2-(0.001/1000000)*t3^3/3));

$$p4 := 515.396 \ t4 + .04937500000 \ t4^2 - .2633333333 \ 10^{-7} \ t4^3 - 515.396 \ t3$$

- .04937500000 \ \tau_3^2 + .2633333333 \ \ 10^{-7} \ \tau_3^3

> amp := ((28.97*Wma*100)/18.015)/(28.97*Wma/18.015 +1);

$$amp := 160.8104357 \frac{Wma}{1.608104357 Wma + 1}$$

> p5 := amp*(7.256*t4+(2.298/1000)*t4^2/2+(0.283/1000000)*t4^3/3-(7.256*t3+(2.298/ > 1000)*t3^2/2+(0.283/1000000)*t3^3/3));

$$p5 := 160.8104357 \text{ Wma} \left(7.256 \text{ } \text{c4} + .001149000000 \text{ } \text{c4}^2 + .9433333332 \text{ } 10^{-7} \text{ } \text{c4}^3 - .7.256 \text{ } \text{c3} - .001149000000 \text{ } \text{c3}^2 - .9433333332 \text{ } 10^{-7} \text{ } \text{c3}^3 \right) / (1.608104357 \text{ Wma} + 1)$$

> Cpal := $(1/(t4-t3))^*(((100-Mfg)/100)^*(p3+p4)+p5)/100;$

$$Cpa1 := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 H \right) + Wma \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 CO2avei + 12.01 COavei} - 1.301236174 N \right) \right)$$

$$\begin{aligned} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \bigg(36.46063760 \ \frac{(100 - \mathit{Coavei} - \mathit{Co2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} - 1.301236174 \ \mathit{N} \bigg) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{Co2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \bigg(644.504 \ \mathit{t4} \\ &+ .08194600000 \ \mathit{t4}^2 - .6487333332 \ 10^{-5} \ \mathit{t4}^3 - 644.504 \ \mathit{t3} - .08194600000 \ \mathit{t3}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t3}^3 \bigg) + 160.8104357 \ \mathit{Wma} \bigg(7.256 \ \mathit{t4} + .001149000000 \ \mathit{t4}^2 \\ &+ .9433333332 \ 10^{-7} \ \mathit{t4}^3 - 7.256 \ \mathit{t3} - .0011490000000 \ \mathit{t3}^2 - .9433333332 \ 10^{-7} \ \mathit{t3} \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg/ (\mathit{t4} - \mathit{t3}) \\ &\%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{2} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{aligned}$$

> p3 := 21*(6.148*t8+(3.102/1000)*t8^2/2-(0.923/1000000)*t8^3/3-(6.148*t7+(3.102/10 > 00)*t7^2/2-(0.923/1000000)*t7^3/3));

p4 := 79*(6.524*t8+(1.250/1000)*t8^2/2-(0.001/1000000)*t8^3/3-(6.524*t7+(1.250/10 > 00)*t7^2/2-(0.001/1000000)*t7^3/3));

$$p4 := 515.396 \ t8 + .04937500000 \ t8^2 - .2633333333 \ 10^{-7} \ t8^3 - 515.396 \ t7$$

- 04937500000 $t7^2 + 2633333333 \ 10^{-7} \ t7^3$

 $> p5 := amp*(7.256*t8+(2.298/1000)*t8^2/2+(0.283/1000000)*t8^3/3-(7.256*t7+(2.298/2) > 1000)*t7^2/2+(0.283/1000000)*t7^3/3));$

p5 := 160.8104357 Wma
$$(7.256 \ \epsilon 8 + .0011490000000 \ \epsilon 8^2 + .9433333332 \ 10^{-7} \ \epsilon 8^3$$

-7.256 $\epsilon 7 - .0011490000000 \ \epsilon 7^2 - .9433333332 \ 10^{-7} \ \epsilon 7^3)/(1.608104357 \ Wma + 1)$

> Cpsa := (1/(t8-t7))*(((100-Mfg)/100)*(p3+p4)+p5)/100;

$$Cpsa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \ H \right) + Wma \left(36.46063760 \ \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \ Partial Properties of the control of the contro$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \bigg(36.46063760 \ \frac{(100 - \mathit{COavei} - \mathit{CO2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{COavei}} - 1.301236174 \ \mathit{N} \bigg) \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t8} \right. \\ &+ .08194600000 \ \mathit{t8}^2 - .6487333332 \ 10^{-5} \ \mathit{t8}^3 - 644.504 \ \mathit{t7} - .08194600000 \ \mathit{t7}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t7}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t8} + .001149000000 \ \mathit{t8}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t8}^3 - 7.256 \ \mathit{t7} - .0011490000000 \ \mathit{t7}^2 - .9433333332 \ 10^{-7} \ \mathit{t7}^3 \\ &\Big) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg/ (\mathit{t8} - \mathit{t7}) \\ &\%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{3} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> p3 := 21*(6.148*t6+(3.102/1000)*t6^2/2-(0.923/1000000)*t6^3/3-(6.148*t5+(3.102/10 > 00)*t5^2/2-(0.923/1000000)*t5^3/3));

$$p3 := 129.108 \ b6 + .03257100000 \ b6^2 - .6460999999 \ 10^{-5} \ b6^3 - 129.108 \ b5$$

- .03257100000 \ b5^2 + .6460999999 \ 10^{-5} \ b5^3

> p4 := 79*(6.524*t6+(1.250/1000)*t6^2/2-(0.001/1000000)*t6^3/3-(6.524*t5+(1.250/10 > 00)*t5^2/2-(0.001/1000000)*t5^3/3));

$$p4 := 515.396 \ t6 + .04937500000 \ t6^2 - .2633333333 \ 10^{-7} \ t6^3 - 515.396 \ t5$$

- .04937500000 \ \tau5^2 + .2633333333 \ 10^{-7} \ \tau5^3

> p5 := amp*(7.256*t6+(2.298/1000)*t6^2/2+(0.283/1000000)*t6^3/3-(7.256*t5+(2.298/ > 1000)*t5^2/2+(0.283/1000000)*t5^3/3));

p5 := 160.8104357 Wma
$$(7.256 \ \text{t}6 + .0011490000000) \ \text{t}6^2 + .9433333332 \ 10^{-7} \ \text{t}6^3$$

-7.256 t5 - .001149000000 t5² - .9433333332 $10^{-7} \ \text{t}5^3)/(1.608104357 \ \text{Wma} + 1)$

> Cppa := $(1/(t6-t5))^*(((100-Mfg)/100)^*(p3+p4)+p5)/100;$

$$Cppa := \frac{1}{100} \left(\frac{1}{100} \left(100 - .05550621670 \left(8.936 \text{ H} \right) + W_{100} \left(36.46063760 \frac{(100 - COavei - CO2avei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \text{ N} \right) \right)$$

$$\begin{split} &+ \mathit{Mf} \bigg) \bigg/ \bigg(.4960035524 \ \mathit{H} + .05550621670 \\ &\mathit{Wma} \bigg(36.46063760 \ \frac{(100 - \mathit{COavei} - \mathit{CO2avei} - \mathit{O2avei}) \ \%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{COavei}} - 1.301236174 \ \mathit{N} \, , \\ &+ .05550621670 \ \mathit{Mf} + 100 \ \frac{\%1}{12.01 \ \mathit{CO2avei} + 12.01 \ \mathit{Coavei}} \bigg) \bigg) \left(644.504 \ \mathit{t6} \right. \\ &+ .08194600000 \ \mathit{t6}^2 - .6487333332 \ 10^{-5} \ \mathit{t6}^3 - 644.504 \ \mathit{t5} - .08194600000 \ \mathit{t5}^2 \\ &+ .6487333332 \ 10^{-5} \ \mathit{t5}^3 \bigg) + 160.8104357 \ \mathit{Wma} \left(7.256 \ \mathit{t6} + .0011490000000 \ \mathit{t6}^2 \right. \\ &+ .9433333332 \ 10^{-7} \ \mathit{t6}^3 - 7.256 \ \mathit{t5} - .0011490000000 \ \mathit{t5}^2 - .9433333332 \ 10^{-7} \ \mathit{t5} \bigg) \bigg/ (1.608104357 \ \mathit{Wma} + 1) \bigg/ (\mathit{t6} - \mathit{t5}) \\ &\%1 := C - \frac{A \ \mathit{OUHD} \ \mathit{Ca}}{1 - \mathit{Ca}} - \frac{1}{3} \ \frac{A \ (1 - \mathit{OUHD}) \ \mathit{Ca}}{1 - \frac{1}{2} \ \mathit{Ca}} + .3744932959 \ \mathit{S} \end{split}$$

> Wsal := (Wfgl*(Cpfg*(Tfgi-Tfgo) - AL*Cpal*(Tfgo-Tsai)) - Wpai*Cppa*(Tpao-Tsai))
> (Cpsa*(Tsao-Tsai)*Wfe*SA);

```
 + .6487333332 \  \, 10^{-5} \  \, t3^3) + 160.8104357 \  \, \text{Wma} \left( 7.256 \  \, t4 + .001149000000 \  \, t4^2 \right. \\ + .94333333332 \  \, 10^{-7} \  \, t4^3 - 7.256 \  \, t3 - .001149000000 \  \, t3^2 - .94333333332 \  \, 10^{-7} \  \, t3^3 \\ ) / (1.608104357 \  \, \text{Wma} + 1) \right) (Tfgo - Tsai) / (t4 - t3) - \frac{1}{100} \  \, \text{Wpai} \left( \frac{1}{100} \right. \right. \\ \left( 100 - .05550621670 \  \, \frac{8.936 \  \, H + \%4 + Mf}{\%5} \right) \left( 644.504 \  \, t6 + .08194600000 \  \, t6^2 \right. \\ - .6487333332 \  \, 10^{-5} \  \, t6^3 - 644.504 \  \, t5 - .08194600000 \  \, t5^2 \\ + .6487333332 \  \, 10^{-5} \  \, t5^3 \right) + 160.8104357 \  \, \text{Wma} \left( 7.256 \  \, t6 + .001149000000 \  \, t6^2 \right. \\ + .9433333332 \  \, 10^{-7} \  \, t6^3 - 7.256 \  \, t5 - .0011490000000 \  \, t5^2 - .9433333332 \  \, 10^{-7} \  \, t5^3 \\ ) / (1.608104357 \  \, \text{Wma} + 1) \right) (Tpao - Tsai) / (t6 - t5) \right) (t8 - t7) / \left( \left( \frac{1}{100} \right. \right) \right. \\ \left( 100 - .05550621670 \  \, \frac{8.936 \  \, H + \%4 + Mf}{\%5} \right) \left( 644.504 \  \, t8 + .08194600000 \  \, t8^2 \right. \\ - .6487333332 \  \, 10^{-5} \  \, t8^3 - 644.504 \  \, t7 - .081946000000 \  \, t7^2 \right. \\ \left. + .64873333332 \  \, 10^{-5} \  \, t7^3 \right) + 160.8104357 \  \, \text{Wma} \left( 7.256 \  \, t8 + .0011490000000 \  \, t8^2 \right. \\ \left. + .94333333332 \  \, 10^{-7} \  \, t8^3 - 7.256 \  \, t7 - .0011490000000 \  \, t7^2 - .94333333332 \  \, 10^{-7} \  \, t7^3 \right. \\ \left. / (1.608104357 \  \, \text{Wma} + 1) \right) \left( Tsao - Tsai) \  \, \text{Wfe} \  \, SA \right)
```

%1 := 12.01 CO2avei + 12.01 COavei

$$\%2 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%3 := 100 - COavei - CO2avei - O2avei

%4 :=
$$Wma$$
 $\left(36.46063760 \frac{\%3 \%2}{\%1} - 1.301236174 N\right)$

$$\%5 := .4960035524 \ H + .05550621670 \ \%4 + .05550621670 \ MF + 100 \ \frac{\%2}{\%1}$$

> sigmaWsal := sqrt(

> Diff(Wsal,SA)^2*varSA +

> Diff(Wsai,CO2avei)^2*varCO2avei +

> Diff(wsai,Coavei)"2 varcoavei +
> Diff(Wsai,O2avei)^2*varO2avei +
> Diff(Wsai,Wfe)^2*varWfe +
> Diff(Wsai,A)^2*varA +
> Diff(Wsai,OUHD)^2*varOUHD +
> Diff(Wsal,Ca)^2*varCa +
> Diff(Wsai,C)*Diff(Wsai,C)*varC +
> Diff(Wsai,S)*Diff(Wsai,S)*varS +
> Diff(Wsal,H)*Diff(Wsal,H)*varH +
> Diff(Wsal,Wma)*Diff(Wsai,Wma)*varWma +
> Diff(Wsal,N)*Diff(Wsal,N)*varN +
> Diff(Wsai,Mf)*Diff(Wsai,Mf)*varMf
>):
> sigmaWsai := value("):
Constants
SA - Split A
> SA := 0.5168;
SA := .5168
> varSA := 0.002175^2;
$varsA := .4730625 \cdot 10^{-5}$
>
Weight of Flue Gas in
> Wfgi := 754952;
Wfgi := 754952
> varWfgi := 5676^2;

	varWfgi:=32216976	
Weight of Primary Air in		
> Wpai := 62530;		
•	Wpai := 62530	
> varWpai := 1823^2;		
, (2.0)	varWpai := 3323329	
Air Leakage fraction		
> AL := .0687;		
• • • • • • • • • • • • • • • • • • • •	AL := .0687	
> varAL := .00866^2;		
y vai AL .= .00000 2,	varAL := .0000749956	
	Valab. 2.0000147750	
> Tfgi := 680;		
> 11gi := 000;	m6~i :- 690	
	Tfgi := 680	
> varTfgi := (0.0012*Tfgi)^2;		
	varTfgi := .66585600	
> t2 := (Tfgi +460)/1.8;		
	t2 := 633.33333334	
>		
		A
> Tfgo := 253;		
	Tfgo := 253	
> varTfgo := (0.0035*Tfgo)^2;		
	varTfgo := .78411025	
> t1 := (Tfgo+460)/1.8;		
> (1 .= (11g0+400)/1.0,	t1:=396.1111112	
	C1 .= 370.1111112	
>		
> Tall := 80;		
> 1aii .= 00,	Tali:=80	
77 11 (0.00404T-11)A0-	121100	
> varīali := (0.0012*Tali)^2;	- 11 00001600	
	varTali:=.00921600	
> t3 := (Tali+460)/1.8;		
	t3 := 300.0000001	
> t4 := t1;		
	t4 := 396.1111112	
> Tpai := 80;		
Loui		

1 1	<i>Tpai</i> := 80	
> varTpai := (0.0012*Tpai)^2)-	
	varTpai := .00921600	
> t5 := (Tpai+460)/1.8;		
• • • • • •	t5 := 300.000001	
> Tpao := 644;		
•	Tpao := 644	
> varTpao := (0.0074*Tpao)	^2:	
,	varTpao := 22.71094336	
> t6 := (Tpao+460)/1.8;		
	t6 := 613.3333334	
> Tsal := 80;		
	Tsai := 80	
> varTsai := (0.002*Tsai)^2;		
	varTsai := .025600	
> t7 := (Tsal+460)/1.8;		
	t7 := 300.0000001	
> Tsao := 616;		
1	<i>Tsao</i> := 616	
> varTsao := (0.007*Tsao)^2).	
	varTsao := 18.593344	
> 18 := (Tsao+460)/1.8;		
	t8 := 597.777778	
Averages and Variances from	n Part A	
> CO2avei := 15.2148;		
	CO2avei := 15.2148	
> varCO2avel := .10206^2;		
	varCO2avei := .0104162436	
> COavel := .005;		
	COavei := .005	
> varCOavei := .00022^2;		
* *	varCOavei:=.484 10 ⁻⁷	
> O2avei := 3.8;		
	<i>02avei</i> := 3.8	
> varO2avei := .01118^2;		
		\sim

va	r02avei := .0001249924
Coal Feed Rate (lbs/hr)	
> Wfe := 115839;	
•	Wfe:=115839
> varWfe := (0.0025*Wfe)^2;	
	varWfe:= 83866.71200
Moisture in Coal	
> Mf := 0.06;	
> M1 :=0.00,	Mf := .06
> varMf := ((0.2+.012°Mf*100)/(100	
va	rMf:=.9250793742 10 ⁻⁶
Ach ro	
Ash re > A := 0.0619;	
7 A .= 0.0019,	A := .0619
> varA := ((0.07+0.02*A*100)/(100	_
Vá	arA:=.4696223261 10 ⁻⁶
Overhead ?	
> OUHD := 0.9;	
	OUHD := .9
> varOUHD := (0.1*OUHD)^2;	
> varound := (0.1 Ound) 2,	varOUHD := .0081
	Val COND .= .0081
Carbon	
> C := 0.7381;	
<i>y</i> c .= 0.7501,	c:=.7381
0 (0 04//4004044 444)\\00	C , - , , , , , , , , , , , , , , , , ,
> varC := (0.64/(100*2*1.414))^2;	¢
V	arC:=.5121546706 10 ⁻⁵
Undrogen	
Hydrogen > H := 0.0482;	
> 11 .= U.U402,	H := .0482
> varH := (0.16/(100*2*1.414))^2;	
	arH:=.3200966692 10 ⁻⁶
V	wass

Nitrogen	
N := 0.0135;	
	N:=.0135
varN := (0.11/(100*2*1.414))	^2;
• •	varN:=.1512956913 10 ⁻⁶
	Valv.=.1312930913 10
C. If.	
Sulfur re S := 0.0123;	
· S := 0.0123,	S := .0123
varS := ((0.06+.035*S*100)/(·
	varS:=.1327813813 10 ⁻⁶
Moisture (air) re	
→ Wma := 0.013;	
	Wma := .013
varWma := (.2*Wma)^2;	
· · · · · · · · · · · · · · · · · · ·	5
	varWma:=.676 10 ⁻⁵
Carbon in Ash re	
Ca := 0.0486;	
	Ca := .0486
varCa := (0.10*Ca)^2;	
	varCa := .000023619600
Results	
********	***********
evalf(Mfg);	
	.08136935946
evalf(Cpfg);	
	7.769387922
evalf(Cpal);	
	7.151727411
> evalf(Cppa);	
evantoppa),	7 2169 10251
	7.316810251
> evalf(Cpsa);	3 205 10 5 3 15
	7.305185745

Wsai in lb/lb of AF Coal	
> evalf(Wsai);	<u></u>
	9.310086250
> evalf(sigmaWsai);	
	.06394430072
> evalf(100*sigmaWsal/Wsai);	
	.6868282313
> evalf(Wsai*SA*Wfe);	All
•	557353.8547
> evalf(sigmaWsai*SA*Wfe);	
	3828.063622
>	
***************************************	***************************************
>	

Appendix J-1 Bias Error Calculation Air Leak Calculation -- Zero Leak Case

```
Error Propagation Calculations, Part B, AL
 Set no. of sample points
> n := 20;
                                      n := 20
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for j to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end;
 Warning, 'varcovar' is implicitly declared local
 Warning, 'j' is implicitly declared local
 Warning, 'i' is implicitly declared local
 make_array :=
      proc(var,n)
      local varcovar, j, i;
          varcovar := array(1 .. n,1 .. n);
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
          od;
          varcovar
      end
```

> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)

```
> Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca) + (A^{\circ}(1-OUHD)^{\circ}Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
       Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
       Cb := C-Cr;
       K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       K4 :=
        8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
       MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A^*OUHD^*Ca)/(1-Ca) + (A^*(1-OUHD)^*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936^{\circ}H + Wma^{\circ}((28.02^{\circ}(100-CO[x]-CO2[x]-O2[x])^{\circ}K3-N)/0.7685)+Mf;
> M := (18.016 \text{ K}4 + \text{K}3^{\circ}(288.08 \text{ CO2}[x] + 71.70 \text{ O2}[x] + 50480.8))/(\text{K}4 + 1801.6 \text{ K}3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
```

> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);

$$m := \frac{28.97 \text{ Wma} + 28.97}{1.608015098 \text{ Wma} + 1}$$

> i := 'i';

i := i

#14

> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} & \text{PAFA} := 14088.2 \quad apa \quad CP \quad \sqrt{\frac{PSpa \quad (28.97 \quad Wma + 28.97)}{1.608015098 \quad Wma + 1}} \left(\begin{array}{c} DPpa_1 \\ \hline Tpa_1 \\ \end{array} \right) + \sqrt{\frac{DPpa_2}{Tpa_1}} \\ & + \sqrt{\frac{DPpa_3}{Tpa_3}} + \sqrt{\frac{DPpa_4}{Tpa_4}} + \sqrt{\frac{DPpa_5}{Tpa_5}} + \sqrt{\frac{DPpa_6}{Tpa_6}} + \sqrt{\frac{DPpa_7}{Tpa_7}} + \sqrt{\frac{DPpa_8}{Tpa_8}} + \sqrt{\frac{DPpa_9}{Tpa_9}} \\ & + \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}} + \sqrt{\frac{DPpa_{13}}{Tpa_{13}}} + \sqrt{\frac{DPpa_{14}}{Tpa_{14}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} \\ & + \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}} \\ & + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}} \\ \end{split}$$

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} PAFB &:= 14088.2 \ apa \ CP \ \sqrt{\frac{PSpa \ (28.97 \ Wma + 28.97)}{1.608015098 \ Wma + 1}} \ \left(\begin{array}{c} DPpa \\ \hline Tpa \\ \hline Tpa \\ \end{array} \right) + \sqrt{\frac{DPpa _{2}}{Tpa _{2}}} \\ &+ \sqrt{\frac{DPpa _{3}}{Tpa _{3}}} + \sqrt{\frac{DPpa _{4}}{Tpa _{4}}} + \sqrt{\frac{DPpa _{5}}{Tpa _{5}}} + \sqrt{\frac{DPpa _{6}}{Tpa _{6}}} + \sqrt{\frac{DPpa _{7}}{Tpa _{7}}} + \sqrt{\frac{DPpa _{8}}{Tpa _{8}}} + \sqrt{\frac{DPpa _{9}}{Tpa _{9}}} \\ &+ \sqrt{\frac{DPpa _{10}}{Tpa _{10}}} + \sqrt{\frac{DPpa _{11}}{Tpa _{11}}} + \sqrt{\frac{DPpa _{12}}{Tpa _{12}}} + \sqrt{\frac{DPpa _{13}}{Tpa _{13}}} + \sqrt{\frac{DPpa _{14}}{Tpa _{14}}} + \sqrt{\frac{DPpa _{15}}{Tpa _{15}}} \end{split}$$

$$+ \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}}$$

#17

> FA := 5348840*Areai*CP*sqrt(PSI)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,V

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*(

> O2i[i]/100,i=1..n):

#18

> FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,V

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(I,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*(

> O2i[i]/100,i=1..n):

#19

> SA := FA/(FA+FB);

 $SA := \frac{1}{2}$

#20

> SB := FB/(FA+FB);

 $SB := \frac{1}{2}$

#21

> WPAIA := PAFA/(Wfe*SA);

$$\begin{split} & \text{WPAIA} := 28176.4 \ \ \, \text{apa} \ \ \, \text{CP} \ \, \frac{PSpa \ \, (28.97 \ \, \text{Wma} + 28.97)}{1.608015098 \ \, \text{Wma} + 1} \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} \right) + \frac{DPpa_2}{Tpa_2} \\ & + \sqrt{\frac{DPpa_3}{Tpa_3}} + \sqrt{\frac{DPpa_4}{Tpa_4}} + \sqrt{\frac{DPpa_5}{Tpa_5}} + \sqrt{\frac{DPpa_6}{Tpa_6}} + \sqrt{\frac{DPpa_6}{Tpa_7}} + \sqrt{\frac{DPpa_8}{Tpa_7}} + \sqrt{\frac{DPpa_8}{Tpa_8}} + \sqrt{\frac{DPpa_1}{Tpa_1}} \\ & + \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}} + \sqrt{\frac{DPpa_{13}}{Tpa_{13}}} + \sqrt{\frac{DPpa_{14}}{Tpa_{14}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} \\ & + \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}} / \text{Wfe} \end{split}$$

> WPAIB := PAFB/(Wfe*SB);

$$\begin{split} & \textit{WPAIB} \coloneqq 28176.4 \text{ apa } \textit{CP} \int \frac{\textit{PSpa} \; (28.97 \; \textit{Wma} + 28.97)}{1.608015098 \; \textit{Wma} + 1} \left(\int \frac{\textit{DPpa}_1}{\textit{Tpa}_1} + \int \frac{\textit{DPpa}_2}{\textit{Tpa}_2} \right. \\ & + \int \frac{\textit{DPpa}_3}{\textit{Tpa}_3} + \int \frac{\textit{DPpa}_4}{\textit{Tpa}_4} + \int \frac{\textit{DPpa}_5}{\textit{Tpa}_5} + \int \frac{\textit{DPpa}_6}{\textit{Tpa}_6} + \int \frac{\textit{DPpa}_7}{\textit{Tpa}_7} + \int \frac{\textit{DPpa}_8}{\textit{Tpa}_8} + \int \frac{\textit{DPpa}_9}{\textit{Tpa}_9} \\ & + \int \frac{\textit{DPpa}_{10}}{\textit{Tpa}_{10}} + \int \frac{\textit{DPpa}_{11}}{\textit{Tpa}_{11}} + \int \frac{\textit{DPpa}_{12}}{\textit{Tpa}_{12}} + \int \frac{\textit{DPpa}_{13}}{\textit{Tpa}_{13}} + \int \frac{\textit{DPpa}_{14}}{\textit{Tpa}_{14}} + \int \frac{\textit{DPpa}_{15}}{\textit{Tpa}_{15}} \\ & + \int \frac{\textit{DPpa}_{16}}{\textit{Tpa}_{16}} + \int \frac{\textit{DPpa}_{17}}{\textit{Tpa}_{17}} + \int \frac{\textit{DPpa}_{18}}{\textit{Tpa}_{18}} + \int \frac{\textit{DPpa}_{19}}{\textit{Tpa}_{19}} + \int \frac{\textit{DPpa}_{20}}{\textit{Tpa}_{20}} \right) \textit{Wfe} \end{split}$$

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \quad OUHD \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

> Cb := C - Cr;

$$Cb := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> WAI := (28.02*(100-CO2avel-COavel-O2avel)/(12.01*(CO2avel+COavel))*(Cb+(12.0 > 1/32.07)*S)-N)/0.7685;

WAI := 36.46063760 (100 -
$$CO2avei - COavei - O2avei$$
)
$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2avei + 12.01 COavei) - 1.301236174 N

#24

> WMGi := 8.936*H + (Wma*WAi)+Mf;

WMGi :=
$$8.936\ H + Wma$$
 $\left\{36.46063760\ (100 - CO2avei - COavei - O2avei)\right\}$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N + Mf$$

#25

> WGpi := ((44.01°CO2avei+32.02°O2avei+28.01°COavei+28.02°(100-CO2avei-C0 > ei-O2avei))/(12.01°(CO2avei+COavei))°(Cb+(12.01/32.07)°S));

WGpi:=(15.99 CO2avei+4.00 O2avei-.01 COavei+2802.00)
$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2avei + 12.01 COavei)

#26

WGi := WGpi + WMGi;

$$WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2avei + 12.01 COavei) + 8.936 H + Wma 36.46063760

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / ($$

12.01 CO2avei + 12.01 COavei) - 1.301236174 N + Mf

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo))) > b + (12.01/32.07)*S)-N)/0.7685;

WAO := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (1 - \frac{1}{3} Ca)$$

638

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2aveo - COaveo - O2aveo)\right)$ $\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) ($ 12.01 $CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N\right) + Mf$

#29

> WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

$$WGpo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2aveo + 12.01 COaveo)

#30

> WGo := WGpo + WMGo:

$$WGo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / (10.01 \ CO2aveo + 12.01 \ COaveo) + 8.936 \ H + Wma \ (36.46063760)$$

$$\left(100 - CO2aveo - COaveo - O2aveo\right) \\
\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (6)$$

> AL := ((WGo-WGi)/WGi)*100; $AL := 100 \left\{ \frac{(15.99 \ CO2aveo + 4.00) \ O2aveo - .01 \ COaveo + 2802.00) \% 1 \right\}$ 12.01 CO2aveo + 12.01 COaveo + Wma (36.46063760 (100 - CO2aveo - COaveo - O2aveo) %1 - 1.301236174 12.01 CO2aveo + 12.01 COaveo (15.99 CO2avei + 4.00) O2avei - .01 COavei + 2802.00) %1 - Wma $\left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174\right)$ $\frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} + 8.936 \ H$ + Wma $\left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174\right)$ + Mf $\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S$ %2 := 12.01 CO2avei + 12.01 COavei #32 > TFluegasINa := WGi*Wfe*SA: TFluegasINa:= $\frac{1}{2} \int (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$ $\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S\right) / ($ 12.01 CO2avei + 12.01 COavei) + 8.936 H + Wma 36.46063760

 $\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S\right) / ($

61

TFluegasINb := WGi*Wfe*SB;

#33

TFluegasOUTa := WGo*Wfe*SA;

TFluegasOUTb := WGo*Wfe*SB;

> sigmaALCO2avel := sqrt(Diff(AL,CO2avei)^2*varCO2avei):

> sigmaALCO2avei := value(");

$$sigmaALCO2avei := \left(100 \right) \\ -15.99 \frac{\%1}{\%2} + 12.01 \frac{\%4 \%1}{\%2^2} - Wma \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \%1}{\%2^2} \right) \\ \frac{\%4 \%1}{\%2} + 8.936 H + Wma \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N \right) + Mf \\ -100 \left(\frac{(15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00) \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} + Wma \left(36.46063760 \frac{(100 - CO2aveo - COaveo - O2aveo) \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} - 1.301236174 N \right) \\ -\frac{\%4 \%1}{\%2} - Wma \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N \right) \right) \\ \left(15.99 \frac{\%1}{\%2} - 12.01 \frac{\%4 \%1}{\%2^2} + Wma \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \%1}{\%2^2} \right) \right) \\ / \left(\frac{\%4 \%1}{\%2} + 8.936 \ H + Wma \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N \right) + Mf \right)^2 \right) \\ varCO2avei \right)$$

$$\%1 := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S$$

$$\%2 := 12.01 \ CO2avei + 12.01 \ COavei$$

$$\%3 := 100 - CO2avei - COavei - O2avei$$

$$\%4 := 15.99 \ CO2avei + 4.00 \ O2avei - .01 \ Coavei + 2802.00$$

$$> sigmaALCOavei := sqrt(Diff(AL,COavei)^2 \ varCOavei):$$

$$> sigmaALCO2avei := sqrt(Diff(AL,CO2avei)^2 \ varCO2avei):$$

$$> sigmaALCO2avei := value("):$$

$$> sigmaALCO2aveo := sqrt(Diff(AL,CO2aveo)^2 \ varCO2aveo):$$

$$> sigmaALCO2aveo := sqrt(Diff(AL,CO2aveo)^2 \ varCO2aveo):$$

$$> sigmaALCO2aveo := \sqrt{10000} \left(\left(15.99 \frac{\%1}{\%2} \right) - 12.01 \frac{(15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00) \ \%1}{\%2} + iwhna$$

$$= \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{(100 - CO2aveo - COaveo - O2aveo) \ \%1}{\%2} \right)$$

$$= varCO2aveo / \left(\frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ Coavei + 2802.00) \ \%1}{12.01 \ CO2avei + 12.01 \ Coavei} - 1.301236174 \right)$$

$$= 48.936 \ H + iwina \left(36.46063760 \frac{(100 - CO2avei - Coavei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right)$$

$$= 48.936 \ H + iwina \left(36.46063760 \frac{(100 - CO2avei - Coavei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right)$$

$$= 48.936 \ H + iwina \left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right)$$

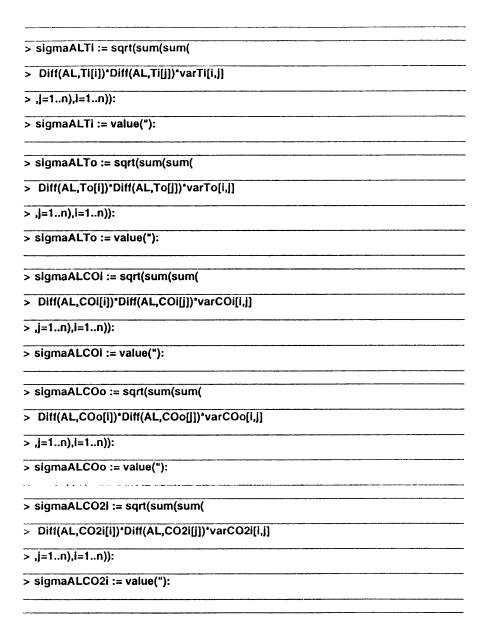
$$= 48.936 \ H + iwina \left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right)$$

$$= 48.936 \ H + iwina \left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right)$$

$$= 6.60 \ H + iwina \left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \ \%1}{12.01 \ CO2avei + 12.01 \ COavei} + 12.01 \ COavei + 12.$$

> sigmaALCOaveo := sqrt(Diff(AL,COaveo)^2*varCOaveo):
> sigmaALCOaveo := value("):
> sigmaALO2aveo := sqrt(Diff(AL,O2aveo)^2*varO2aveo):
> sigmaALO2aveo := value("):
> covarALCO2avelo := 2*Diff(AL,CO2avei)*Diff(AL,CO2aveo)*sqrt(varCO2avei)*sqrt > (varCO2aveo):
> covarALCO2aveio := value("):
> sigmaALAreai := sqrt(Diff(AL,Areai)^2*varAreai):
> sigmaALAreai := value("):
> sigmaALAreao := sqrt(Diff(AL,Areao)^2*varAreao):
> sigmaALAreao := value("):
> sigmaALCP := sqrt(Diff(AL,CP)^2*varCP):
> sigmaALCP := value("):
> sigmaALPSi := sqrt(Diff(AL,PSi)^2*varPSI):
> sigmaALPSi := value("):
> sigmaALPSo := sqrt(Diff(AL,PSo)^2*varPSo):
> sigmaALPSo := value("):
> sigmaALA := sqrt(Diff(AL,A)^2*varA):
> sigmaALA := value("):
> slgmaALOUHD := sqrt(Diff(AL,OUHD)^2*varOUHD):
> sigmaALOUHD := value("):
> sigmaALCa := sqrt(Diff(AL,Ca)^2*varCa):
> sigmaALCa := value("):
> sigmaALC := sqrt(Diff(AL,C)*Diff(AL,C)*varC):

```
> sigmaALC := value("):
 > sigmaALS := sqrt(Diff(AL,S)*Diff(AL,S)*varS):
 > sigmaALS := value("):
 > sigmaALH := sqrt(Diff(AL,H)*Diff(AL,H)*varH):
 > sigmaALH := value("):
 > sigmaALWma := sqrt(Diff(AL,Wma)*Diff(AL,Wma)*varWma):
 > sigmaALWma := value("):
> sigmaALN := sqrt(Diff(AL,N)*Diff(AL,N)*varN):
 > sigmaALN := value("):
 > sigmaALMf := sqrt(Diff(AL,Mf)*Diff(AL,Mf)*varMf):
> sigmaALMf := value("):
> sigmaALWfe := sqrt(Diff(AL,Wfe)^2*varWfe):
> sigmaALWfe := value("):
> sigmaALWma := sqrt(Diff(AL,Wma)*Diff(AL,Wma)*varWma):
> sigmaALWma := value("):
> sigmaALDPi := sqrt(sum(sum(
> Diff(AL,DPi[i])*Diff(AL,DPi[j])*varDPi[i,j]
> ,j=1..n),i=1..n)):
> sigmaALDPi := value("):
> sigmaALDPo := sqrt(sum(sum(
> Diff(AL,DPo[i])*Diff(AL,DPo[j])*varDPo[i,j]
> ,j=1..n),i=1..n)):
> sigmaALDPo := value("):
```



> sigmaALCO2o := sqrt(sum(sum(> Diff(AL,CO2o[i])*Diff(AL,CO2o[j])*varCO2o[i,j] > ,j=1..n),i=1..n)): > sigmaALCO2o := value("): > sigmaALO2i := sqrt(sum(sum(> Diff(AL,O2i[i])*Diff(AL,O2i[j])*varO2i[i,j] > ,j=1..n),i=1..n)): > sigmaALO2i := value("): sigmaALO2o := sqrt(sum(sum(> Diff(AL,O2o[i])*Diff(AL,O2o[j])*varO2o[i,j] > ,j=1..n),i=1..n)): > sigmaALO2o := value("): sigmaAL := sqrt(> Diff(AL,CO2avei)^2*varCO2avei + > Diff(AL,COavei)^2*varCOavei + > Diff(AL,O2avei)^2*varO2avel + Diff(AL,CO2aveo)^2*varCO2aveo + > Diff(AL,COaveo)^2*varCOaveo + > Diff(AL,O2aveo)^2*varO2aveo + > 2*Diff(AL,CO2avei)*Diff(AL,CO2aveo)*sqrt(varCO2avei)*sqrt(varCO2aveo) + > Diff(AL,Wfe)^2*varWfe + > Diff(AL,Areai)^2*varAreai +

> Diff(AL,Areao)^2*varAreao +
> Diff(AL,CP)^2*varCP +
> Diff(AL,PSi)^2*varPSi +
> Diff(AL,PSo)^2*varPSo +
> Diff(AL,A)^2*varA +
> Diff(AL,OUHD)^2*varOUHD +
> Diff(AL,Ca)^2*varCa +
> Diff(AL,C)*Diff(AL,C)*varC +
> Diff(AL,S)*Diff(AL,S)*varS +
> Diff(AL,H)*Diff(AL,H)*varH +
> Diff(AL,Wma)*Diff(AL,Wma)*varWma +
> Diff(AL,N)*Diff(AL,N)*varN +
> Diff(AL,Mf)*Diff(AL,Mf)*varMf +
> sum(sum(
> Diff(AL,DPi[i])*Diff(AL,DPi[j])*varDPi[i,J] +
> Diff(AL,Ti[i])*Diff(AL,Ti[j])*varTi[i,]] +
> Diff(AL,COI[i])*Diff(AL,COI[j])*varCOI[i,j] +
> Diff(AL,CO2i[i])*Diff(AL,CO2i[j])*varCO2i[i,j] +
> Diff(AL,O2i[i])*Diff(AL,O2i[j])*varO2i[i,j] +
> Diff(AL,DPo[i])*Diff(AL,DPo[j])*varDPo[i,j] +
> Diff(AL,To[i])*Diff(AL,To[j])*varTo[i,j] +
> Diff(AL,COo[i])*Diff(AL,COo[j])*varCOo[i,j] +
> Diff(AL,CO2o[i])*Diff(AL,CO2o[j])*varCO2o[l,j] +
> Diff(AL,O2o[i])*Diff(AL,O2o[j])*varO2o[l,j]

> ,j=1..n),i=1..n)): > sigmaAL := value("); $\frac{\%9 \%15}{\%7} + 36.46063760 \frac{\text{Wma} \%8 \%15}{\%7} - \frac{\%5 \%15}{\%2} - 36.46063760 \frac{\text{Wma} \%3 \%1}{\%2}$ $\sqrt{(\%6) - 100} = \frac{\%10 \left(\frac{\%5 \%15}{\%2} + 36.46063760 \frac{\text{Wma} \%3 \%15}{\%2} \right)^{2}} \text{varA} + \left(100 \right)^{2}$ $\frac{\%9\ \%14}{\%7} + 36.46063760\ \frac{\text{Wma}\ \%8\ \%14}{\%7} - \frac{\%5\ \%14}{\%2} - 36.46063760\ \frac{\text{Wma}\ \%3\ \%1}{\%2}$ $-100 \frac{\%10 \left(15.99 \frac{\%1}{\%2} - 12.01 \frac{\%5 \%1}{\%2^2} + \%11\right)}{\%...2}$ $\left(15.99 \frac{\%1}{\%7} - 12.01 \frac{\%9 \%1}{\%7^2} + \%12\right) \sqrt{varCO2avei} \sqrt{varCO2aveo}/(\%6) + \left(16.99 \frac{\%1}{\%7} - 12.01 \frac{\%9 \%1}{\%7} + \%12\right)$ $\frac{\%9\ \%13}{\%7} + 36.46063760 \frac{\text{Wina}\ \%8\ \%13}{\%7} - \frac{\%5\ \%13}{\%2} - 36.46063760 \frac{\text{Wina}\ \%3\ \%1}{\%2}$

$$\frac{\frac{\%}{\%7} + 36.46063760}{\frac{\%}{\%7} + 36.46063760} \frac{\frac{kma}{\%7} - \frac{\%}{\%2} - 36.46063760}{\frac{\%}{\%2}} \frac{\frac{kma}{\%3}}{\frac{\%}{2}}$$

$$-100 \frac{\%10 \left(\frac{\%}{\%2} + 36.46063760 \frac{kma}{\%2} - \frac{\%}{\%2}\right)^{2} varc + \left(100 \left(.3744932959 \frac{\%}{\%7} + 13.65426435 \frac{kma}{\%7} - .3744932959 \frac{\%}{\%2} - 13.65426435 \frac{kma}{\%2}\right)/(\%6)$$

$$-100 \frac{\%10 \left(.3744932959 \frac{\%}{\%2} + 13.65426435 \frac{kma}{\%2} - \frac{\%}{32}\right)^{2} vars}{\%6^{2}}$$

$$+798520.9600 \frac{\%10^{2} varH}{\%6^{4}} + \left(100 \frac{36.46063760 \frac{\%}{\%7} - 36.46063760 \frac{\%}{\%2} - 100 \frac{\%10}{\%6^{2}} - 100 \frac{\%10}{\%6^{2}}\right)^{2} varWma}$$

$$+10000 \frac{\left(4.00 \frac{\%1}{\%7} - 36.46063760 \frac{kma}{\%2} - 100 \frac{\%}{\%6^{2}}\right)^{2} varO2aveo}{\%6^{2}} + \left(100 \frac{\%10 \left(4.00 \frac{\%1}{\%2} - 36.46063760 \frac{kma}{\%2} - 100 \frac{\%10}{\%2}\right)^{2} varO2aveo}{\%6^{2}}$$

$$+10000 \frac{\left(15.99 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC02aveo}{\%6^{2}} + 10000 \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^{2}} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7} + \%12\right)^{2} varC0aveo}{\%6^{2}} + \frac{\left(-01 \frac{\%1}{\%7} - 12.01 \frac{\%1}{\%7} - \frac{\%12}{\%7} + \frac{\%12}{\%7} + \frac{\%12}{\%7} + \frac{\%12}{\%7} + \frac{\%12}{\%7} + \frac{\%12}{\%7} + \frac{\%12}$$

$$\frac{15.99}{\frac{\%1}{\%2}} + 12.01 \frac{\frac{\%3}{\%2}}{\frac{\%2}{2}} - \%11$$

$$\frac{\%10}{100} \left(\frac{15.99}{\frac{\%1}{\%2}} - 12.01 \frac{\frac{\%5}{\%1}}{\frac{\%2}{2}} + \%11 \right) \frac{2}{\%6}$$

$$\frac{.01}{\frac{\%1}{\%2}} + 12.01 \frac{\frac{\%5}{\%1}}{\frac{\%6}{2}} - \%11$$

$$\frac{.01}{\frac{\%1}{\%2}} + 12.01 \frac{\frac{\%5}{\%1}}{\frac{\%6}{2}} - \%11$$

$$\frac{\%6}{\frac{\%6}{2}} - \frac{100}{\frac{\%6}{2}} - \frac{12.01}{\frac{\%6}{3}} + \frac{\%11}{\frac{\%2}{2}} + \%11 \right) \frac{2}{\sqrt{6}}$$

$$\frac{\%10}{\frac{\%6}{2}} - \frac{12.01}{\frac{\%6}{3}} - \frac{\%5}{\frac{\%1}{2}} + \%11 \right) \frac{1}{\sqrt{2}}$$

$$\frac{112}{\sqrt{6}}$$

$$\%1 := C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A \text{ (1 - OUHD) Ca}}{1 - \frac{1}{3} \text{ Ca}} + .3744932959 \text{ S}$$

$$\%2 := 12.01 \text{ CO2avei} + 12.01 \text{ COavei}$$

$$\%3 := 100 - \text{CO2avei} - \text{COavei} - \text{O2avei}$$

$$\%3 := 15.99 \text{ CO2avei} + 4.00 \text{ O2avei} - .01 \text{ COavei} + 2802.00$$

$$\%5 := 15.99 \text{ CO2aveo} + 12.01 \text{ COaveo}$$

$$\%6 := \frac{\%5}{\%2} + 8.936 \text{ } H + \text{ wma } \%4 + \text{ Mf}$$

$$\%7 := 12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}$$

$$\%8 := 100 - \text{CO2aveo} + 12.01 \text{ COaveo}$$

$$\%8 := 100 - \text{CO2aveo} + 12.01 \text{ COaveo}$$

$$\%8 := 15.99 \text{ CO2aveo} + 4.00 \text{ O2aveo} - .01 \text{ COaveo} + 2802.00}$$

$$\%10 := \frac{15.99 \text{ CO2aveo} + 4.00 \text{ O2aveo} - .01 \text{ COaveo} + 2802.00}$$

$$\frac{\%9 \%1}{\%7} + \text{Wma} \left(36.46063760 \frac{\%8 \%1}{\%7} - 1.301236174 N\right) - \frac{\%5 \%1}{\%2} - \text{Wma} \%4$$

$$\%11 := \text{Wma} \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \%1}{\%2^2}\right)$$

$$\%12 := \text{Wma} \left(-36.46063760 \frac{\%1}{\%7} - 437.8922576 \frac{\%8 \%1}{\%7^2}\right)$$

$$\%13 := -\frac{A \text{ OUHD}}{1 - \text{Ca}} - \frac{A \text{ OUHD Ca}}{(1 - \text{Ca})^2} - \frac{1}{3} \frac{A (1 - \text{ OUHD})}{1 - \frac{1}{3} \text{ Ca}} - \frac{1}{9} \frac{A (1 - \text{ OUHD}) \text{ Ca}}{\left(1 - \frac{1}{3} \text{ Ca}\right)^2}$$

$$\%14 := -\frac{A \text{ Ca}}{1 - \text{Ca}} + \frac{1}{3} \frac{A \text{ Ca}}{1 - \frac{1}{3} \text{ Ca}}$$

$$\%15 := -\frac{\text{OUHD Ca}}{1 - \text{Ca}} - \frac{1}{3} \frac{(1 - \text{ OUHD}) \text{ Ca}}{1 - \frac{1}{3} \text{ Ca}}$$

Constants		
Averages and Variances from	a Part A	
> CO2avei := 15.2148;		
	CO2avei := 15.2148	
> varCO2avei := .1^2;		
	varCO2avei := .01	
> COavel := .005;		
, , , , , , , , , , , , , , , , , , , ,	COavei := .005	
> varCOavei := .002^2;		
, va. o cavo= .== =,	varCOavei:=.4 10 ⁻⁵	
	varcoavei := .4 10	
> O2avei := 3.8;		
	02avei := 3.8	
> varO2avei := .05^2;		
	var02avei := .0025	
> CO2aveo := 15.2148;		
	CO2aveo := 15.2148	
> varCO2aveo := .1^2;		
	varCO2aveo := .01	

,

COaveo := .005	
> varCOaveo := .002^2;	
varCOaveo = 4 10 ⁻⁵	
O2aveo := 3.8;	
02aveo := 3.8	
> varO2aveo := .05^2;	
var02aveo := .0025	
Coal Feed Rate (lbs/hr) > Wfe := 115839;	
Wfe := 113033,	
> varWfe := (0.05*Wfe)^2;	
varWfe:=.3354668480 10 ⁸	
Area (square ft)	
> Areal := 3.99;	
Areai := 3.99	
> varAreai := (0.0335*Areai)^2;	
varAreai := .01786633223	
> Areao := 3.54;	
Areao := 3.54	
> varAreao := (0.0364*Areao)^2;	
varAreao := .01660386874	
Pitot Coefficient > CP := 0.84;	
CP := .84	
> varCP := (0.01)^2;	
varCP := .0001	
Pressure in Area	
> PSi := 29.23;	
PSi := 29.23	
> varPSi := (0.04)^2;	
varPSi := .(M)16	
> PSo := 29.1;	

	PSo := 29.1
varPSo := (0.04)	'2;
•	varPSo := .0016
Pressue for primar	y air
PSpa := 31.11;	PSpa := 31.11
varPSpa := (0.04	
Vai 1 Spa (0.01	varPSpa := .0016
•	
Velocity Head v := .45802;	
V := .456UZ;	v := .45802
DPo := array([se	
DPo := 1.45802	.45802 .45802 .45802 .45802 .45802 .45802 .45802 .458
.45802 .4580	02 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .4
.45802]	
• u := (.02*v)^2;	
•	u := .000008391292816
var := array([sec	լ(u,i=1n)]);
var:=[.0000	00008391292816 .000008391292816 .00008391292816 .000083912928
.000083912	
.000083912	
.000083912	92816 .00008391292816 .00008391292816 .00008391292816
.000083912	92816 .00008391292816 .00008391292816 .00008391292816]
> varDPo := make	_array(var,n);
	varDPo:= varcovar
20004	
> v := .82831;	v := .82831
DD://o	
> DPi := array([se	.82831 .828831 .828831 .828831 .828831 .828831 .828831 .828831 .828831 .828831 .828831 .828831 .828831 .828
	.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .8
.82831 .828 .828311	31 .82831 .82831 .82831 .82831 .82831 .82831
> u := (.02*v)^2;	
> u (.∪≥ ∀) ∠,	u := .0(X)2744389824
> var := array([se	
	00)2744389824 .000)2744389824 .000)2744389824 .000)274438982-

.0002744389824	.0002744389824	.(XXX)2744389824	.0002744389824
.0002744389824	.0002744389824	.0002744389824	.0002744389824
.0002744389824	.(00)2744389824	.0002744389824	.0002744389824
.0002744389824	.0002744389824	.0002744389824	.0002744389824]
varDPi := make_array(\	/ar,n);		
,,	varDPi:	= varcovar	
Temperature (R)			
v := 713;			
•	v	:= 713	
To := array([seq(v,l=1	.n)]);		
To:=[713 713 713	713 713 713	713 713 713	713 713 713 713 713
713 713 713 713			
u := (0.01*(v-460))^2;			
	u:	= 6.4009	
var := [6.4009 6.400 6.4009 6.4009 6.4	1009 6.4009 6.40	009 6.4009 6.40	009 6.4009 6.4009 6.4009
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\forall 1	var,n);		
6.4009 6.4009 6.4 6.4009]	var,n);	:= varcovar	009 6.4009 6.4009 6.4009
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\	var,n);		009 6.4009 6.4009 6.400
6.4009 6.4009 6.4 6.4009]	var,n); varTo	:= varcovar	
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\ > v := 1140;	var,n); varTo v		009 6.4009 6.4009 6.4009
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\ > v := 1140; > Ti:= array([seq(v,i=1	var,n); varTo v v	:= varcovar ::= 1140	0.4009 0.4009 0.400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo) > v := 1140; > Ti:= array([seq(v,l=1 Ti := [1140 1140	var,n); varTo varTo v n)]);	:= varcovar ::= 1140	1140 1140 1140 1140
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\frac{1}{2}) > v := 1140; > Ti:= array([seq(v,l=1 Ti := [1140 1140 1140 1140 1140 1140 1140 114	var,n); varTo varTo v n)]);	:= varcovar ::= 1140	1140 1140 1140 1140
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo) > v := 1140; > Ti:= array([seq(v,l=1 Ti := [1140 1140	var,n); varTo varTo v n)]); 1140 1140 11 40 1140 1140	:= varcovar ::= 1140	1140 1140 1140 1140
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo) > v := 1140; > Ti:= array([seq(v,i=1 Ti := [1140 1140 1140 1140 1140 1140 1140 114	var,n); varTo varTo varTo 1,0)]); 1140 1140 1140 1140 1140 1140 1140 114	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400	1140 1140 1140 1140 0 1140]
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo) > v := 1140; > Ti:= array([seq(v,i=1 Ti := [1140 1140 1140 1140 1140 1140 1140 114	var,n); varTo varTo varTo 1,0)]); 1140 1140 1140 1140 1140 1140 1140 114	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400	1140 1140 1140 1140 0 1140]
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\(\begin{array}{c}\) = 1140; > V := 1140; > Ti := \([\text{1140} \] 1140 \] 1140 \] \(\text{140} \] 1140 1140 \(\text{2} \text{3} \text{4} \text{2} \text{4} \text{6} \text{6} \text{4} \text{6} \text{6} \text{4} \text{6} \text{6} \text{4} \text{6} \te	var,n); varTo v	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\(\begin{array}{c}\) = 1140; > V := 1140; > Ti := [1140	var,n); varTo v	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400 0 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo := make_array(varTo := make_array(varTo := 1140; > Ti := [1140	var,n); varTo	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400 0 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(\(\begin{array}{c}\) = 1140; > V := 1140; > Ti := [1140	var,n); varTo var,n);	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400 0 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo := make_array(varTo := make_array(varTo := 1140; > Ti := [1140	var,n); varTo var,n);	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400 0 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(v) > v := 1140; > Ti:= array([seq(v,l=1	var,n); varTo var,n);	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400 0 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400
6.4009 6.4009 6.4 6.4009] > varTo := make_array(varTo := make_array(varTo := make_array(varTo := 1140; > Ti := [1140	var,n); varTo	:= varcovar := 1140 140 1140 1140 1140 1140 1140 = 46.2400 46.2400 46.2400 0 46.2400 46.2400	1140 1140 1140 1140 0 1140] 46.2400 46.2400 46.2400

> varMf := (0.039*Mf)^2;	
•	varMf := .54756 10 ⁻⁵
Ash	
ASII A := 0.0619;	
A .2 0.0013,	A := .0619
4 0 02014\02:	
varA := (0.039*A)^2;	5
	varA:=.582787881 10 ⁻⁵
Overhead	
OUHD := 0.9;	
	OUHD := .9
> varOUHD := (0.1*OUHD)^2;	
	varOUHD:=.0081
Carbon	
> C := 0.7381;	
	c := .7381
> varC := (0.039°C)^2;	
1	varC:=.0008286280388
Hydrogen	
> H := 0.0482;	
	H := .0482
> varH := (0.039*H)^2;	
y vairi := (0.000 ti) =;	varH:=.353364804 10 ⁻⁵
<u></u>	VarH := .353304804 10
Nitrogen	
> N := 0.0135;	N: 0135
	N:= .0135
> varN := (0.039*N)^2;	,
	varN:= .27720225 10 ⁻⁶
Sulfur	
> S := 0.0123;	
•	s := .0123
> varS := (0.019*S)^2;	
> 1410.7 (0.010 0/ -1	T. 5161560 10-7
	vars:=.5461569 10 ⁻⁷

001													
CO2 > v := 14.145;													
> V := 14.140;				v	= 14	.145							
> CO2o := array	ulisen	√ i=1 :	1)]):										
CO20 := arra; CO20 := [14	/([364 145	14 145	14 14	5 14.1	145	14.145	14.	145	14.14	15	14.145	14.	145
14.145						14.14		.145	14.1	45	14.145	14	1.145
14.1451	1.115		•										
> u := (0.1)^2;													
> u .= (0.1) =,				1	u := .	01							
> var := array([sealu	.i=1n)));										
var:=[.01	.01	.01 .0	01 .0	10.1	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01 .01	.01												
> varCO20 := n	nake_	array(v	ar,n);										
		-		arCO2	o :=	varco	var						
> v := 15.2148;						•••							
				v	:= 15	.2148							
> CO2i := array	/([seq	(v,i=1r	1)]);						c 0 1 4		E 2140	15	214
CO2i := [1:			18 15	.2148	15.2	148	5.214		5.2148		5.2148		. 2140
15.2148	15.214	48 15.2				5.2148	15.2	148	15.21	48	15.214	0	
15.2148	15.214	48 15.2	148	15.2148	3]								
> u := (0.1)^2;													
					u :=	.01							
> var := array(01	01	Δ1	Δ1	.01	.01	.01
var:=[.0				10. 10	.0	1 .01	.01	.01	.01	.01	.01	.01	.01
			01]										
> varCO2i := n	nake_	array(va			o								
				/arco.	21 :=	varco							
-01													
$\frac{O2}{> v := 5;}$													
> v := 5,					v:	= 5							
> O2o := array	ulisen	ı(v.i=1. ı	າ)]):										
020 = array	, (1304 : [5 - 5	5 5 5	5 5	5 5	5	5 5	5 :	5 5	5 .	5 5	5 5	5 5]
> u := (0.05)^2													
> u .= (0.05) 7	-,				u :=	.0025							
> var := array	((sen	/u.i=1. n)]);										
yai .= aiiay	(LOOY)	.0025	.0025	.002	5 .0	ж25 .	0025	.00	25 .(0025	.0025	5 .0	025
vai		.,,,,,,,											

.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 . > varO2o := make_array(var,n); var02o:= varcovar > v := 3.8; v := 3.8> O2i := array([seq(v,i=1..n)]); $02i := [3.8 \quad 3.8 \quad 3.$ 3.8 3.8 3.8 3.8 3.8] > u := (0.05)^2; u := .0025> var := array([seq(u,i=1..n)]); var:=[.0025 .0025] > varO2i := make_array(var,n); var02i := varcovar Moisture (air) > Wma := 0.013; Wma := .013> varWma := (.1*Wma)^2; varWma:=.169 10⁻⁵ CO > v := 0.005;v := .005> COo := array([seq(v,i=1..n)]); $COo := \{.005, .0$ > u := (0.002)^2; $u := .4 \cdot 10^{-5}$ > var := array([seq(u,i=1..n)]); $var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}$ $.4 \cdot 10^{-5}$ $.4 \cdot 10^{-5}$ $.4 \cdot 10^{-5}$ $.4 \cdot 10^{-5}$ > varCOo := make_array(var,n); varCOo:= varcovar



```
> v := 0.005;
                                          v := .005
> COi := array([seq(v,i=1..n)]);
      COi := [.005 .005 .005 .005]
                                       .005 .005 .005 .005 .005
                                       .005 .005 .005]
> u := (0.002)^2;
                                        u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
     var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
      .4 \cdot 10^{-5}        .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
> varCOi := make_array(var,n);
                                   varCOi := varcovar
  Carbon in Ash
> Ca := 0.0486;
                                         Ca := .0486
> varCa := (0.25*Ca)^2;
                                  varCa := .000147622500
 Area for primary air
> apa := .63;
                                         apa := .63
> varapa := (.0208*apa)^2;
                                 varapa:=.000171714816
> v := .2171;
                                         v := .2171
> DPpa := array([seq(v,i=1..n)]);
      DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
       .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
> u := (0.02*v)^2;
                                     u := .000018852964
> varDPPA := array([seq(u,i=1..n)]);
      varDPPA := [.(XXX)18852964 .0XXX)18852964 .000018852964 .0XXX)18852964
       .000018852964 .000018852964 .000018852964 .000018852964 .000018852964
```

.000018852964 .0000	18852964 .000)018852964	.000018852964	.00001885297
.000018852964 .0000	18852964 .000	018852964	.000018852964	.00001885296
.000018852964}				
> v := 1104;				
		= 1104		
> Tpa := array([seq(v,i=1n)				
• •	104 1104 11	04 1104	1104 1104 11	04 1104 110
	104 1104 11	.04 1104	1104 1104]	
> u := (0.01*(v - 460))^2;				
	u :=	41.4736		
<pre>> varTpa := array([seq(u,i=1</pre>	n)]);			
varTpa:=[41.4736	41.4736 41.4	736 41.473	36 41.4736 41.	4736 41.4736
41.4736 41.4736 4	41.4736 41.47	36 41.473	6 41.4736 41.4	736 41.4736
41.4736 41.4736 4	41.4736 41.47	36 41.473	6]	
Results	· · · · · · · · · · · · · · · · · · ·			
*****************	******	*******	***********	****
> evalf(AL);		-		
AN LEAK	.329963	34610 10 ⁻⁷	\approx 0	
> evalf(sigmaAL);				
BIAS	.0195	2759709	%	
> evalf(100*sigmaAL/AL);	- 			
	50191	08942 10 ⁸	105 6 11 1	-10 1 1-
> evalf(sigmaALWfe);		38942 10	NOT SIGNIF	
> evali(sigmaALWie);		0	WHE !	20
		0		
> evalf(sigmaALWma);				
	.392743	3122 10 ⁻¹⁰	1	
> evalf(sigmaALCO2avei);				
•	.584	1239251		
> evalf(sigmaALCOavei);				
	.0126	7624739		
> evalf(sigmaALO2avei);				
(.0054	75063689		
> evalf(sigmaALCO2aveo);	.,,,,,,			
z diantoiginaneoozavco),	59.1	1239248		
> evalf(sigmaALCOaveo);	.704			
> evan(sigmaALCOaveo);				

	.01267624739	
> evalf(sigmaALO2aveo);	005.150.0000	
	.005475063692	
> evalf(covarALCO2avelo);		
	6824015194	
> evalf(sigmaALAreai);		
	0	
> evalf(sigmaALAreao);		
	0	
> evalf(sigmaALCP);		
, -	0	
> evalf(slgmaALPSi);		
	0	
> evalf(sigmaALPSo);		
	0	
> evalf(sigmaALA);		
,	.4879213086 10 ⁻¹¹	
	,4679213080 10	
> evalf(sigmaALOUHD);	11	
	.4893902538 10 ⁻¹¹	
> evalf(slgmaALCa);		
	.1154095607 10 ⁻¹⁰	
> evalf(sigmaALC);		
> evan(sigmaxco),	1000051012 10-8	
	.1832051013 10 ⁻⁸	
> evalf(sigmaALS);		
	.3774725272 10 ⁻¹¹	
> evalf(sigmaALH);		
	.4253221987 10 ⁻¹⁰	
	.72.77221707	
> evalf(sigmaALN);	-13	
	.2255075574 10 ⁻¹³	
> evalf(sigmaALMf);		
	.5924873774 10 ⁻¹¹	
> evalf(sigmaALDPi);		
> crantoidine rec. N	0	
> evalf(sigmaALTi);		
> evalitalyillantill,	0	

> evalf(sigmaALCOi);
0
> evalf(sigmaALCO2i);
0
> evalf(sigmaALO2i);
()
> evalf(sigmaALDPo);
Ú
> evalf(sigmaALTo);
()
> evalf(sigmaALCOo);
0
> evalf(sigmaALCO2o);
0
> evalf(sigmaALO2o);
()

> := 'I';
i := i
#13
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
m := 28.74570417
#14 > PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
PAFA := 62529.82254
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
PAFB := 62529.82254
#17
> FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H, > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))
> O2I[i]/100,i=1n):
410

	ırt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W I-MFG(i,A,OUHD,Ca,C,S,COi,CO2I,H,Wma,O2i,N,Mf))*(
> O2i[i]/100,i=1n):	· = (,, ,, = = ,, = , = ,, = , = ,, = ,
#19	
> SA := FA/(FA+FB);	
	SA := .50000000000
#20	
> SB := FB/(FA+FB);	
	SB := .50XX00XXXXX
#21	
> WPAIA := PAFA/(Wfe*SA);	
	WPAIA := 1.079598797
#22	
> WPAIB := PAFB/(Wfe*SB);	
	WPAIB := 1.079598797
#23	
> Cr := (A*OUHD*Ca)/(1-Ca) +	
	Cr := .002947741741
> Cb := C - Cr;	
	Cb := .7351522583
> WAI := (28.02*(100-CO2ave > 1/32.07)*S)-N)/0.7685;	I-COavei-O2avei)/(12.01*(CO2aveI+COavei))*(Cb+(12.0
	WAi := 11.93169660
#24	
> WMGi := 8.936*H + (Wma*W	/Al)+Mf;
	WMGi := .6458272558
#25	
	2.02*O2avei+28.01*COavei+28.02*(100-CO2avel-COav i+COavei))*(Cb+(12.01/32.07)*S));
	WGpi := 12.38591870
#26	
> WGi := WGni + WMGi:	

	WGi := 13.03174596
#27	
WAo :=(((28.02*(100-CO2a	aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*
> b + (12.01/32.07)*S)-N)/0.76	685;
	WAO := 11.93169660
#28	
WMGo := 8.936*H + (Wma*	WAo) + Mf:
•	WMGo := .6458272558
#29	
WGpo := ((44.01 CO2aveo-	+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo
Oaveo-O2aveo))/(12.01*(C0	O2aveo+COaveo))*(Cb+(12.01/32.07)*S));
	WGpo := 12.38591870
#30	
WGo := WGpo + WMGo;	
	WGo := 13.03174596
#31	
	10;
	AL := 0
AL := ((WGo-WGi)/WGI)*10	
AL := ((WGo-WGi)/WGI)*10	AL := 0
AL := ((WGo-WGi)/WGI)*10	AL := 0
AL := ((WGo-WGi)/WGI)*10	AL := 0
AL := ((WGo-WGi)/WGI)*10	AL := 0 6A; TFluegasINa := 754792.21(X)
#32 TFluegasINa := WGi*Wfe*S	AL := 0 6A; TFluegasINa := 754792.21(X)
#32 TFluegasINa := WGi*Wfe*SI #33	AL := 0 GA; TFluegasINa := 754792.21(X) B;
#32 • TFluegasINb := WGi*Wfe*SI	AL := 0 GA; TFluegasINa := 754792.21(X) B; *SA;
#32 FILLE THUE THUE THUE THUE THUE THUE THUE THU	AL := 0 GA; TFluegasINa := 754792.21(X) B; *SA;

Appendix J-2
Random Error Calculation
Air Leak Calculation -- Zero Leak Case

>	
Random Error Propagation Calculations, Part B, AL (zero leakage, n n=24 for flue gas out)	=20 for flue gas in
n=24 for fine gas out)	
Set no. of sample points	
Set no. of sample points > n := 20;	
n := 20	
procedure for creating variance-covariance matrix	
> make_array := proc(var,n)	
> varcovar := array(1n,1n);	
> for j to n do	
> for I to n do	
> if I = j then	
> varcovar[i,j] := sqrt(var[i]*var[j])	
> else	
> varcovar[i,j] := 0	
> fl;	
> od	
> od;	
> varcovar;	
> end; Warning, 'varcovar' is implicitly declared local Warning, 'j' is implicitly declared local Warning, 'i' is implicitly declared local	
make_array :=	
proc(var,n)	
<pre>local varcovar,j,i; varcovar := array(1 n,1 n);</pre>	6
ASICOASE := STIGA(T W. * **)	0

```
for j to n do
               for i to n do
                    if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
                   fi
           od;
           Varcovar
       end
  #4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936 H + Wma'((28.02'(100-CO[x]-CO2[x]-O2[x])K3-N)(0.7685)+Mf:
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end;
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MPG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 : 25
       8.935°% \mae (35.46063760°(100-CO[x]-CO2[x]-02[x]) *K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  ond
 #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936*H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
        8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6)
  end
 #13
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
                                   28.97 Wma + 28.97
                                  1.608015098 Wma + 1
 #14
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                    DPpa<sub>2</sub>
                                                          DPpa
                                1.608015098 Wma + 1
                                                           Tpa
                                                                     Tpa
                                                   DPpa<sub>7</sub>
                              DPpa.
                                                              DPpa
                                         DPpa,
                                                                         DPpa
                                                                         Tpa
                                                               Tpa,
```

$$+ \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}} + \sqrt{\frac{DPpa_{13}}{Tpa_{13}}} + \sqrt{\frac{DPpa_{14}}{Tpa_{14}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} + \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}}$$

> PAFB := 14088.2°apa°CP°sqrt(PSpa°m)°sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} \text{PAFB} &:= 14088.2 \ \text{apa} \ CP \ \sqrt{\frac{PSpa}{1.608015098} \ \text{Wma} + 28.97)}{1.608015098} \ \text{Wma} + 1} \ \left(\begin{array}{c} \frac{DPpa}{1} \\ Tpa_1 \end{array} \right) + \begin{array}{c} \frac{DPpa}{2} \\ Tpa_2 \end{array} \\ + \left(\begin{array}{c} \frac{DPpa}{3} \\ Tpa_3 \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{4} \\ Tpa_4 \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{5} \\ Tpa_5 \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{6} \\ Tpa_6 \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{7} \\ Tpa_7 \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{8} \\ Tpa_8 \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{9} \\ Tpa_9 \end{array} \right) \\ + \left(\begin{array}{c} \frac{DPpa}{10} \\ Tpa_{10} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{11} \\ Tpa_{11} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{12} \\ Tpa_{12} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{13} \\ Tpa_{13} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{14} \\ Tpa_{14} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{15} \\ Tpa_{15} \end{array} \right) \\ + \left(\begin{array}{c} \frac{DPpa}{16} \\ Tpa_{16} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{17} \\ Tpa_{17} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{18} \\ Tpa_{18} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{19} \\ Tpa_{19} \end{array} \right) + \left(\begin{array}{c} \frac{DPpa}{20} \\ Tpa_{20} \end{array} \right) \\ \end{array}$$

#17

- > FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
- > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C
- > O2i[i]/100,i=1..n):

#18

- > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
- > ma,O2I,N,Mf)*Ti[I]))^(1/2)*(1-MFG(I,A,OUHD,Ca,C,S,COI,CO2I,H,Wma,O2I,N,Mf))*C
- > O2i[i]/100,i=1..n):

#19

> SA := FA/(FA+FB);

$$SA := \frac{1}{2}$$

#20

> SB := FB/(FA+FB);

$$SB := \frac{1}{2}$$

#21

> WPAIA := PAFA/(Wfe*SA);

$$\begin{split} \textit{WPAIA} &:= 28176.4 \ \textit{apa} \ \textit{CP} \ \, \frac{\textit{PSpa} \ \, (28.97 \ \, \textit{Wma} + 28.97)}{1.608015098 \ \, \textit{Wma} + 1} \left(\begin{array}{c} \boxed{DPpa}_1 \\ \hline Tpa_1 \end{array} \right) + \begin{array}{c} \boxed{DPpa}_2 \\ \hline Tpa_2 \end{array} \\ & + \begin{array}{c} \boxed{DPpa}_3 \\ \hline Tpa_3 \end{array} + \begin{array}{c} \boxed{DPpa}_4 \\ \hline Tpa_4 \end{array} \right) + \begin{array}{c} \boxed{DPpa}_5 \\ \hline Tpa_5 \end{array} + \begin{array}{c} \boxed{DPpa}_6 \\ \hline Tpa_6 \end{array} \right) + \begin{array}{c} \boxed{DPpa}_7 \\ \hline Tpa_7 \end{array} + \begin{array}{c} \boxed{DPpa}_8 \\ \hline Tpa_8 \end{array} + \begin{array}{c} \boxed{DPpa}_9 \\ \hline Tpa_6 \end{array} \\ & + \begin{array}{c} \boxed{DPpa}_10 \\ \hline Tpa_{10} \end{array} + \begin{array}{c} \boxed{DPpa}_{11} \\ \hline Tpa_{11} \end{array} + \begin{array}{c} \boxed{DPpa}_{12} \\ \hline Tpa_{12} \end{array} + \begin{array}{c} \boxed{DPpa}_{13} \\ \hline Tpa_{13} \end{array} + \begin{array}{c} \boxed{DPpa}_{14} \\ \hline Tpa_{14} \end{array} + \begin{array}{c} \boxed{DPpa}_{15} \\ \hline Tpa_{15} \end{array} \\ & + \begin{array}{c} \boxed{DPpa}_{16} \\ \hline Tpa_{16} \end{array} + \begin{array}{c} \boxed{DPpa}_{17} \\ \hline Tpa_{17} \end{array} + \begin{array}{c} \boxed{DPpa}_{18} \\ \hline Tpa_{18} \end{array} + \begin{array}{c} \boxed{DPpa}_{19} \\ \hline Tpa_{19} \end{array} + \begin{array}{c} \boxed{DPpa}_{20} \\ \hline Tpa_{20} \end{array} \right) / \textit{Wfe} \end{split}$$

#22

> WPAIB := PAFB/(Wfe*SB);

$$\begin{split} \textit{WPAIB} &:= 28176.4 \ \textit{apa} \ \textit{CP} \ \sqrt{\frac{\textit{PSpa} \ (28.97 \ \textit{Wma} + 28.97)}{1.608015098 \ \textit{Wma} + 1}} \ \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} + \begin{array}{c} DPpa_2 \\ Tpa_2 \end{array} \right) \\ + \sqrt{\frac{\textit{DPpa}_3}{\textit{Tpa}_3}} + \sqrt{\frac{\textit{DPpa}_4}{\textit{Tpa}_4}} + \sqrt{\frac{\textit{DPpa}_5}{\textit{Tpa}_5}} + \begin{array}{c} DPpa_6 \\ Tpa_6 \end{array} + \sqrt{\frac{\textit{DPpa}_7}{\textit{Tpa}_7}} + \sqrt{\frac{\textit{DPpa}_8}{\textit{Tpa}_8}} + \sqrt{\frac{\textit{DPpa}_8}{\textit{Tpa}_4}} \\ + \sqrt{\frac{\textit{DPpa}_{10}}{\textit{Tpa}_{10}}} + \sqrt{\frac{\textit{DPpa}_{11}}{\textit{Tpa}_{11}}} + \sqrt{\frac{\textit{DPpa}_{12}}{\textit{Tpa}_{12}}} + \sqrt{\frac{\textit{DPpa}_{13}}{\textit{Tpa}_{13}}} + \sqrt{\frac{\textit{DPpa}_{14}}{\textit{Tpa}_{14}}} + \sqrt{\frac{\textit{DPpa}_{15}}{\textit{Tpa}_{15}}} \\ + \sqrt{\frac{\textit{DPpa}_{16}}{\textit{Tpa}_{16}}} + \sqrt{\frac{\textit{DPpa}_{17}}{\textit{Tpa}_{17}}} + \sqrt{\frac{\textit{DPpa}_{18}}{\textit{Tpa}_{18}}} + \sqrt{\frac{\textit{DPpa}_{19}}{\textit{Tpa}_{19}}} + \sqrt{\frac{\textit{DPpa}_{20}}{\textit{Tpa}_{20}}} / \textit{Wfe} \end{split}$$

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \quad OUHD \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

> Cb := C - Cr;

Cb :=
$$C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{2} \ Ca}$$

> WAI := (28.02*(100-CO2avel-COavel-O2avel)/(12.01*(CO2avel+COavel))*(Cb+(12.0 > 1/32.07)*S)-N)/0.7685;

WAi := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 \text{ N}$$

#24

> WMGi := 8.936*H + (Wma*WAi)+Mf;

WMGi := 8.936
$$H + Wma$$
 $\left(36.46063760 \ (100 - CO2avei - COavei - O2avei) \right)$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$
12.01 $CO2avei + 12.01 \ COavei) - 1.301236174 \ N + Mf$

#25

> WGpi := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02`(100-CO2avei-COav

> ei-O2avei))/(12.01*(CO2avel+COavei))*(Cb+(12.01/32.07)*S));

$$WGpi := (15.99 \ CO2avei + 4.00) \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2avei + 12.01 COavei)

#26

> WGi := WGpi + WMGi;

$$WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) + 8.936 \text{ } H + \text{Wma} \left(36.46063760\right)$$

$$(100 - \text{CO2avei} - \text{COavei} - \text{O2avei})$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 \text{ N} + \text{Mf}$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAo := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / (12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}) - 1.301236174 N$$

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

$$WMGo := 8.936 \ H + Wma \left(36.46063760 \ (100 - CO2aveo - COaveo - O2aveo) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N + Mf$$

#29

- > WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C
- > Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

WGpo := (15.99 CO2aveo + 4.00) O2aveo - .01 COaveo + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2aveo} + 12.01 \text{ COaveo})$$

> WGo := WGpo + WMGo;

$$\begin{aligned} & \text{Gpo + WMGo;} \\ & \text{WGo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)} \\ & \left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / (\\ & 12.01 \ CO2aveo + 12.01 \ COaveo) + 8.936 \ H + Wma \ \left(36.46063760 \right) \\ & \left(100 - CO2aveo - COaveo - O2aveo \right) \\ & \left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / (\\ & 12.01 \ CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N \right) + Mf \end{aligned}$$

#31

> AL := ((WGo-WGi)/WGi)*100;

L:= ((WGo-WGI) WGI) 100,
AL:=
$$100 \left(\frac{(15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ Coaveo + 2802.00) \%1}{12.01 \ CO2aveo + 12.01 \ Coaveo} - 1.301236174 \ N \right)$$
+ Wma $\left(36.46063760 \frac{(100 - CO2aveo - COaveo - O2aveo) \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} - 1.301236174 \ N \right)$
- Wma $\left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174 \ N \right)$

$$\left(\frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \%1}{\%2} + 8.936 \ H \right)$$
+ Wma $\left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174 \ N \right)$
+ Wf

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%2:=12.01 CO2avei + 12.01 COavei

#32

> TFluegaslNa := WGi*Wfe*SA;

TFluegasINa := WGi*Wfe*SA;

$$TFluegasINa := \frac{1}{2} \left((15.99 \ Co2avei + 4.00 \ O2avei - .01 \ Coavei + 2802.00) \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ Co2avei + 12.01 \ Coavei) + 8.936 \ H + Wma \left(36.46063760 \right)$$

$$\left(100 - Co2avei - Coavei - O2avei \right)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S \right) / ($$

$$12.01 \ Co2avei + 12.01 \ Coavei) - 1.301236174 \ N + Mf \right) Wfe$$

- > sigmaAL := sqrt(
- > Diff(AL,CO2avei)^2*varCO2avel +
- > Diff(AL,COavei)^2*varCOavel +
- > Diff(AL,O2avel)^2*varO2avel +
- > Diff(AL,CO2aveo)^2*varCO2aveo +
- > Diff(AL,COaveo)^2*varCOaveo +
- > Diff(AL,O2aveo)^2*varO2aveo +
- Diff(AL,A)^2*varA +
- > Diff(AL,OUHD)^2*varOUHD +

>):

> sigmaAL := value(");

$$sigmaAL := \left(100 \frac{-15.99 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2^2} - \%14}{\%6} \right)^{2} varco2avei + \left(100 \frac{\%1 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2^2} + \%14}{\%6} \right)^{2} varco2avei + \left(100 \frac{\%1 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2^2} - \%14}{\%6} \right)^{2} varco2avei + \left(100 \frac{\%10 \left(-.01 \frac{\%1}{\%2} - 12.01 \frac{\%5 \%1}{\%2^2} + \%14}{\%6} \right)^{2} varcoavei + \left(100 \frac{-4.00 \frac{\%1}{\%2} + 36.46063760 \frac{\text{Wma \%1}}{\%2}}{\%6} \right)^{2} varco2avei + 10000}$$

$$\begin{bmatrix} 15.99 & \frac{\%1}{\%7} - 12.01 & \frac{\%.9 & \%1}{\%7^2} + \text{Wina} & \left(-36.46063760 & \frac{\%1}{\%7} - 437.8922576 & \frac{\%.8 & \%1}{\%7^2} \right) \\ 2 & varco2aveo / \%6^2 + 10000 \\ \begin{bmatrix} -.01 & \frac{\%1}{\%7} - 12.01 & \frac{\%9 & \%1}{\%7^2} + \text{Wina} & \left(-36.46063760 & \frac{\%1}{\%7} - 437.8922576 & \frac{\%.8 & \%1}{\%7^2} \right) \\ varco2aveo / \%6^2 + 10000 & \underbrace{ \begin{pmatrix} 4.00 & \frac{\%1}{\%7} - 36.46063760 & \frac{\text{Wina} & \%1}{\%7} \\ \%6^2 \end{pmatrix}^2 & varo2aveo \\ \%6^2 \\ \end{bmatrix} \\ | 100 & \underbrace{ \begin{pmatrix} \frac{\%9 & \%13}{\%7} + 36.46063760 & \frac{\text{Wina} & \%8 & \%13}{\%2} - \frac{\%5 & \%13}{\%2} - 36.46063760 & \frac{\text{Wina} & \%3 & \%1}{\%2} \\ \end{bmatrix}^2 & varA + \left(\frac{100}{\%7} \right) \\ | \frac{\%9 & \%12}{\%7} + 36.46063760 & \frac{\text{Wina} & \%8 & \%12}{\%7} - \frac{\%5 & \%12}{\%2} - 36.46063760 & \frac{\text{Wina} & \%3 & \%1}{\%2} \\ | | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%5 & \%12}{\%2} + 36.46063760 & \frac{\text{Wina} & \%3 & \%12}{\%2} \\ \frac{\%9 & \%11}{\%7} + 36.46063760 & \frac{\text{Wina} & \%8 & \%11}{\%7} - \frac{\%5 & \%11}{\%2} - 36.46063760 & \frac{\text{Wina} & \%3 & \%1}{\%2} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%5 & \%12}{\%2} + 36.46063760 & \frac{\text{Wina} & \%3 & \%12}{\%2} \\ \frac{\%9 & \%11}{\%7} + 36.46063760 & \frac{\text{Wina} & \%8 & \%11}{\%7} - \frac{\%5 & \%11}{\%2} - 36.46063760 & \frac{\text{Wina} & \%3 & \%1}{\%2} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%6} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%6} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%5 & \%11}{\%2} + 36.40063760 & \frac{\text{Wina} & \%3 & \%11}{\%2} \right)^2}_{\%7} \\ | /(\%6) - 100 & \underbrace{ \begin{pmatrix} \%10 & \left(\frac{\%10 & \%10 & \%$$



$$-100) \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma \%3}}{\%2}\right)^{2}}{\%6^{2}} varC + \left(100 \left(.3744932959 \frac{\%9}{\%7} + 13.65426435 \frac{\text{Wma \%3}}{\%7} - .3744932959 \frac{\%5}{\%2} - 13.65426435 \frac{\text{Wma \%3}}{\%2}\right)/(\%6)$$

$$-100 \frac{\%10 \left(.3744932959 \frac{\%5}{\%2} + 13.65426435 \frac{\text{Wma \%3}}{\%2}\right)}{\%6^{2}}\right)^{2} varS$$

$$+798520.9600 \frac{\%10^{2} varH}{\%6^{4}} + \left(100 \frac{36.46063760 \frac{\%8 \%1}{\%7} - 36.46063760 \frac{\%3 \%1}{\%2} - 100 \frac{\%10 \%4}{\%6^{2}}\right)^{2} varWma$$

$$+16932.15581 \frac{\%10^{2} \text{Wma}^{2} varN}{\%6^{4}} + 10000 \frac{\%10^{2} varMf}{\%6^{4}}\right)^{1/2}$$

$$\%1 := C - \frac{A \text{ OUHD Ca}}{1 - \text{Ca}} - \frac{1}{3} \frac{A (1 - \text{ OUHD) Ca}}{1 - \frac{1}{2} \text{ Ca}} + .3744932959 \text{ S}$$

%2:=12.01 CO2avei+12.01 COavei

%3 := 100 - CO2avei - COavei - O2avei

$$\%4 := 36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N$$

%5 := 15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00

$$\%6 := \frac{\%5 \%1}{\%2} + 8.936 H + Wma \%4 + Mf$$

%7 := 12.01 CO2aveo + 12.01 COaveo

%6 := 1(%) - CO2aveo - COaveo - O2aveo

%9:=15.99 CO2aveo+4.00 O2aveo-.01 COaveo+2802.00

$$\%10 := \frac{\%9 \%1}{\%7} + W_{\text{ma}} \left(36.46063760 \frac{\%8 \%1}{\%7} - 1.301236174 N \right) - \frac{\%5 \%1}{\%2} - W_{\text{ma}} \%4$$

$$\%11 := -\frac{A \text{ OUHD}}{1 - Ca} - \frac{A \text{ OUHD } Ca}{\left(1 - Ca \right)^2} - \frac{1}{3} \frac{A \text{ } (1 - \text{ OUHD})}{1 - \frac{1}{3} \text{ } Ca} - \frac{1}{9} \frac{A \text{ } (1 - \text{ OUHD}) \text{ } Ca}{\left(1 - \frac{1}{3} \text{ } Ca \right)^2}$$

$$\%12 := -\frac{A \text{ } Ca}{1 - Ca} + \frac{1}{3} \frac{A \text{ } Ca}{1 - \frac{1}{3} \text{ } Ca}$$

$$\%13 := -\frac{OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{(1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

$$\%14 := Wma \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \ \%1}{\%2^2} \right)$$

> sigmaALCO2avel := sqrt(Diff(AL,CO2avel)^2*varCO2avel):

> sigmaALCO2avei := value("):

> sigmaALCOavei := sqrt(Diff(AL,COavel)^2*varCOavei):

> sigmaALCOavei := value("):

> sigmaALO2avei := sqrt(Diff(AL,O2avei)^2'varO2avei):

> sigmaALO2avei := value("):

> slgmaALCO2aveo := sqrt(Diff(AL,CO2aveo)^2*varCO2aveo):

> sigmaALCO2aveo := value("):

> sigmaALCOaveo := sqrt(Diff(AL,COaveo)^2*varCOaveo):

> sigmaALCOaveo := value("):

> sigmaALO2aveo := sqrt(Diff(AL,O2aveo)^2*varO2aveo):

> sigmaALO2aveo := value("):

> sigmaALA := sqr(Diff(AL,A)^2°varA):

-	
>	sigmaALA := value("):
>	sigmaALOUHD := sqrt(Diff(AL,OUHD)^2*varOUHD):
>	sigmaALOUHD := value("):
>	sigmaALCa := sqrt(Diff(AL,Ca)^2*varCa):
>	sigmaALCa := value("):
>	sigmaALC := sqrt(Diff(AL,C)^2*varC):
>	sigmaALC := value("):
>	sigmaALS := sqrt(Diff(AL,S)^2*varS):
>	sigmaALS := value("):
>	sigmaALH := sqrt(Diff(AL,H)^2*varH):
>	sigmaALH := value("):
>	sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma):
>	sigmaALWma := value("):
>	sigmaALN := sqrt(Diff(AL,N)^2*varN):
>	sigmaALN := value("):
> :	sigmaALMf := sqrt(Diff(AL,Mf)^2*varMf):
> :	sigmaALMf := value("):
(Constants
	versues and Dandom Press Verinas Core Broad (200 ' 240)
<u> </u>	verages and Random Error Variances from Part A (n=20 for in, n=24 for out) CO2avei := 15.2148;
_ (
	CO2avei := 15.2148
> V	arCO2avel := .102^2;
	varCO2avei := .010404
> C	Coavel := .005:

	COavei := .005
> varCOavel := .0002^2;	
	varCOavei:=.4 10 ⁻⁷
> O2avei := 3.8;	
	O2avei := 3.8
> varO2avei := .01118^2;	
	varO2avei := .0001249924
> CO2aveo := 15.2148;	
	CO2aveo := 15.2148
> varCO2aveo := .0866^2;	
	varCO2aveo := .00749956
> COaveo := .005;	
•	COaveo := .005
> varCOaveo := .000204^2;	
•	
000	varCOaveo:=.41616 10 ⁻⁷
> O2aveo := 3.8;	
	02aveo := 3.8
> varO2aveo := .010206^2;	
	var02aveo := .000104162436
0.15.15.41.5	
Coal Feed Rate (lbs/hr) re > Wfe := 115839;	
> Wie .= 113039,	45 . 115020
	Wfe:=115839
> varWfe := (0.0025*Wfe)^2;	
	varWfe:= 83866.71200
Area (square ft) re	
> Areal := 3.99;	
•	Areai := 3.99
> varAreal := (0.0335*Areai)^	
(0.0000 7.100.7	varAreai := .01786633223
	Valifical 1- 101700033223
> Areao := 3.54;	
•	Areao:= 3.54
> varAreao := (0.0364*Areao)	
(0.000, 0.000)	varAreao:=.()166()386874
	701712 000 1- 101000300077



	fficient re
> CP := 0.8	14; CP := .84
> varCP :=	· · ·
	varCP:=0
	A. L. A. D
Pressure > PSi := 29	Ambient or Barometric re
> P31 .= 23	PSi := 29.23
DCI .	
> varPSi :=	varPSi := .0016
	V41101,-1.000
> PSo := 2	9.1.
- 1 00 . - 2	PSo := 29.1
> varPSo	= (0.04)^2;
<i>y</i> 1a ii 00 .	varPSo := .0016
Pressue f	or primary air
> PSpa :=	
•	PSpa := 31.11
> varPSpa	:= (0.04)^2;
•	varPSpa := .0016
>	
	Head DP re
> v := .458	v:= .45802
> DPo := 8	array([seq(v,i=1n)]); = [.45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
DPo :=	13802 .45
.4580	
> u := .00	
	u := .25 10 ⁻⁸
> var := a	rray([seq(u,l=1n)]);
var'=	$\left[.25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \ .25 \ 10^{-8} \right]$
var	10^{-8} .25 10^{-8}
.25	10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
> varDPo	:= make_array(var,n);

```
varDPo := varcovar
> v := .82831;
                                               v := .82831
> DPi := array([seq(v,i=1..n)]);
     DPi:=[.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
       .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
       .82831]
> u := .00005^2;
                                              u := .25 \cdot 10^{-8}
> var := array([seq(u,i=1..n)]);
    var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
      .25 \cdot 10^{-8}       .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
> varDPI := make_array(var,n);
                                         varDPi := varcovar
   Area for primary air
 > apa := .63;
                                                apa := .63
 > varapa := (.0208*apa)^2;
                                        varapa:=.000171714816
> v := .2171;
                                                 v := .2171
 > DPpa := array([seq(v,i=1..n)]);
        DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
         .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
> u := (0.00005)^2;
                                               u := .25 \cdot 10^{-8}
> varDPpa := array([seq(u,i=1..n)]);
     varDPpa := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
       .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
        .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
```

> v := 1104;		
	v :=	1104
	[seq(v,i=1n)]);	
Tpa :=		
1104	<u>104 1104 1104 1104 1104 </u>	1104 1104 1104]
> u := (0.005°	••	
	u := 10.3	368400
	ay([seq(u,l=1n)]);	
-	[10.368400 10.368400 10.368	
10.3684	141000100 101000100 10101	68400 10.368400 10.368400 10.368400
10.3684	10.368400 10.368400 10.36	68400 10.368400 10.368400 10.368400
.		
Temperature > v := 713;	K) re	
/ V .~ / 13,		712
To arrow	v:='	/13
	eq(v,l=1n)]);	
•		13 713 713 713 713 713 71
713 71	713 713 713 713]	
> u := (.005*(\	••	2000
	u := 1.6	00225
	seq(u,i=1n)]);	
•		600225 1.600225 1.600225 1.600225
1.600225	1.600225 1.600225 1.600225	1.600225 1.600225 1.600225 1.60022
1.600225	1.600225 1.600225 1.600225	1.600225]
varTo := ma	a_array(var,n);	
	varTo := v	arcovar
4446		
v := 1140;		
	v := 1	140
· Ti:= array([s		
•	0 1140 1140 1140 1140	1140 1140 1140 1140 1140 1140
1140	140 1140 1140 1140 1140	1140 1140 1140]
· u := (.005*(v	60))^2;	
	u := 11.5	60000
var := array	eq(u,i=1n)]);	
•	60000 11.560000 11.560000	11.560000 11.560000 11.560000
var:=[1]		11.500000 11.500000 11.500000
	11.560000 11.560000 11.56	

> varTi := make_array(var,n);	
varTi := varcovar	
Moisture in Ash re	
> Mf :=0.06;	
M£ := .06	
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;	
varMf := .(XXXX)1058319613	
Ash re	
> A := 0.0619;	
A := .0619	
> varA := ((0.07+0.02*A*100)/(2*1.414*100))^2;	
varA := .4696223261 10 ⁻⁶	
Val 4070225201 10	
Overhead re	
> OUHD := 0.9;	
OUHD := .9	
> varOUHD := (0.1*OUHD)^2;	
varOUHD:=.0081	
Carbon re	
> C := 0.7381;	
C:=.7381	
> varC := (0.64/(2*1.414*100))^2;	
varC := .5121546706 10 ⁻⁵	
VAIC .= .5121540700 10	
Hydrogen re	
> H := 0.0482;	
H := .0.182	
> varH := (0.16/(2*1.414*100))^2;	
i de la companya de	
varH:= .3200966692 10 ⁻⁶	
Nitrogen re	
> N := 0.0135;	
N:= .0135	
> varN := (0.11/(2*1.414*100))^2;	
• • • • • • • • • • • • • • • • • • • •	
varN:=.1512956913 10 ⁻⁶	

Sulfur re	
> S := 0.0123;	
S := .0123	
> varS := ((0.06+0.035*S*100)/(2*1.414*100))^2;	
varS:=.1327813813 10 ⁻⁶	
CO2 re	
> v := 15.2148;	
v := 15.2148	
> CO2o := array([seq(v,i=1n)]);	
	.2148
15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148	
15.2148 15.2148 15.2148 15.2148]	
> u := (0.03*v)^2;	
u := .2083411251	
> var := array([seq(u,l=1n)]);	
var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251	
.2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .208341	
.2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .208341	1251
.2083411251 .2083411251 .2083411251]	
> varCO2o := make_array(var,n);	
varCO2o := varcovar	
> v := 15.2148;	
v := 15.2148	
> CO2i := array([seq(v,i=1n)]);	
CO21:-[15.2140 15.2140	.2148
15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148	
15.2148 15.2148 15.2148 15.2148]	
> u := (0.03°v)^2;	
u := .2083411251	
> var := array([seq(u,i=1n)]);	
var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251	
.2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .208341	
.2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .208341	11251
.2083411251 .2083411251 .2083411251]	
> varCO2l := make_array(var,n);	

Valebal Valebal	
02 re	
> v := 3.8;	
v := 3.8	
> O2o := array([seq(v,i=1n)]);	
020 := [3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8	3.8 3
3.8 3.8 3.8 3.8 3.8]	
> u := (0.05)^2;	
u := .0025	
> var := array([seq(u,i=1n)]);	
var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025	.0025
.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025	ļ
> varO2o := make_array(var,n);	
var02o:= varcovar	
> v := 3.8;	
v := 3.8	
> O2i := array([seq(v,i=1n)]);	
02i:=[3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8	3.8 3
3.8 3.8 3.8 3.8 3.8]	
> u := (0.05)^2;	
u := .0025	
> var := array([seq(u,i=1n)]);	
var := [.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025	.0025
.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025	İ
> varO2i := make_array(var,n);	
var02i := varcovar	
Moisture (air) re	
> Wma := 0.013;	
Wma := .013	
> varWma := (.2*Wma)^2;	
varWma:=.676 10 ⁻⁵	
CO re	
> v := 0.005;	
v := .005	

varCO2i := varcovar

> COo := array([se	q(v,i=	:1n)])	:								
coo := [.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005	.005
.005 .005						.005]					
> u := (0.001)^2;											
				u :=	.1 10	5					
> var := array([seq	(u,l=1	n)]);								_	
var:=[.1 10											1 10-5
.1 10 ⁻⁵ .1	10-5	.1 10	·5 .1	10 ⁻⁵	.1 10	⁻⁵ .1	10 ⁻⁵	.1 10) ⁻⁵ .1	10-5	
.1 10 ⁻⁵ .1	10-5	.1 10	·5 .1	10-5							
> varCOo := make											
			va	rCOo:	= var	covar					
> v := 0.005;											
> V .= 0.005,				v	:= .005						
> COi := array([se	q(v,i=	1n)]);									
coi := [.005				.005	.005	.005	.005	.005	.005	.005	.005
.005 .005	.005	.005	.005	.005	.005	.005]					
> u := (0.001)^2;											
				u :=	.1 10	-5					
> var := array([sec											
var:=[.1 10											
.1 10 ⁻⁵ .1	10-5	.1 10	-5 .1	10-5	.1 10) ⁻⁵ .1	10 ⁻⁵	.1 10	o ⁻⁵ .:	l 10 ⁻⁵	
.1 10 ⁻⁵ .1				-	•						
> varCOi := make											
	•	•		rCOi	:= var	covar					
Carbon in Ash re	<u> </u>										
> Ca := 0.0486;				Ca	:= .048	6					
> varCa := (0.1*Ca)^2:										
> (a. 6a. - (6. 6. 6.	, -,		vā	rCa:	= .0000	236196					
	****	****	****		*****	*****	****	*****	****	****	
Results											

> eval(AL);	
	.3299634610 10 ⁻⁷ % LEAK
> eval(sigmaAL);	
	.7815861141 BANDOM ERROR
> eval(100*sigmaAL/AL);	
	.2368705043 10 ¹⁰
	COWTRIBUTIONS
> evalf(sigmaALCO2avei);	1
	.5958064036
> evalf(sigmaALCOavei);	
	.001267624739
> evalf(sigmaALO2avel);	
	.001224224241
> evalf(sigmaALCO2aveo);	5050512100
	.5058513189
> evalf(sigmaALCOaveo);	0012020772224
	.001292977234
> evalf(sigmaALO2aveo);	001117570000
	.001117570000
> evalf(sigmaALA);	-11
	.1385060987 10 ⁻¹¹
> evalf(sigmaALOUHD);	
	.4893902538 10 ⁻¹¹
> evalf(sigmaALCa);	
	.4616382430 10 ⁻¹¹
> evalf(sigmaALC);	
	.1440317769 10 ⁻⁹
	.1440317709 10
> evalf(slgmaALS);	
	.5885660774 10 ⁻¹¹
> evalf(sigmaALH);	
	.1280109093 10 ⁻¹⁰
> evalf(sigmaALWma);	
	.7854866245 10 ⁻¹⁰
> evalf(sigmaALN);	W
>(o-g	

RANDOM ERROR CONTRIBUTION

			1
	.1666003868 10 ⁻¹	3	
> evalf(sigmaALMf);			
	.8237049338 10 ⁻¹	il v	V
**************	*******	+++++++++	******
> i := 'i';			
	i := i		
#13			
> m := (Wma * 28.97+28.97)/	((Wma*28.97/18.016)+1) ;	
	m := 28.74570417	<u> </u>	
#14			
> PAFA := 14088.2*apa*CP*s	sqrt(PSpa*m)*sum((DP	'pa[i]/Tpa[i])^	(1/2),i=1n);
	PAFA := 62529.822	254	
> PAFB := 14088.2*apa*CP*s	eart/PSnatm)tsum//DP	na[i]/Tna[i])^	(1/2).l=1n):
> PAFB := 14000.2 apa CF :	PAFB := 62529.822)54	(),,
	FAFB .= 02329.022		
#17			
> FA := 5348840*Areai*CP*s	qrt(PSi)*sum((DPi[i]/(N	I(I,A,OUHD,C	a,C,S,COI,CO2I,H,W
> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C	;,S,COI,CO2I,I	H,Wma,O2i,N,Mi)) C
> O2i[i]/100,i=1n):			
#18 > FB := 5348840*Areal*CP*s	(DCi)toum//DDi(i)//A	MA OUHD C	a C S COI CO2I H W
> FB := 5348840"Areal"CP \$ > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(ւզու(բեռ) suni(քեղերև (1-MFG(i.A.OUHD.Ca.C	.s.coi.co2i.	H,Wma,O2I,N,Mf))*C
> O2i[i]/100,i=1n):	(, m. a(i, i, a a i a i a i a i a i a i a i a i		, , , , , ,
#19			
> SA := FA/(FA+FB);			
,	SA := .5000000000	00	
#20			
> SB := FB/(FA+FB);	SB	(10)	
#21			
> WPAIA := PAFA/(Wie*SA)	0	-	

	WPAIA:=1.079598797
#22	
WPAIB := PAFB/(Wfe*SB);	
	WPAIB:=1.079598797
#23	
$Cr := (A^{\circ}OUHD^{\circ}Ca)/(1-Ca)$	+ (A^(1-OUHD)^Ca/3)/(1-Ca/3);
0 (oo.,_ ou,_ ou,_	Cr := .(0)2947741741
Cb := C - Cr;	
CD := C - CI,	Cb := .7351522583
· WAI := (28.02"(100-CO2ave · 1/32.07)*S)-N)/0.7685;	ei-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.
, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	WAi := 11.93169660
#24	
WMGI := 8.936*H + (Wma*\	WAI)+Mf;
	WMGi := .6458272558
#25	
WGni := (/44 01*CO2avei+	32.02*O2avel+28.01*COavel+28.02*(100-CO2avel-COa
el-O2avei)V(12.01*(CO2ave	ei+COavei))*(Cb+(12.01/32.07)*S));
C, 024/01/7(12101 (0024)	WGpi := 12.38591870
	700
#26	
WGI := WGpi + WMGi;	
,	WGi := 13.03174596
#27	
> WAo :=(((28.02*(100-CO26 > b + (12.01/32.07)*S)-N)/0.7	aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(685:
D + (12.01/02.01/ 0/ 11/ 01.	WAo := 11.93169660
	MAO 11.73107/MA
#28	
> WMGo := 8.936*H + (Wma	*WAo) + Mf;
	WMGo := .6458272558
H20	
#29	0+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-
- Open-Open-N/(12 01*/C	(O2aveo+COaveo))*(Cb+(12.01/32.07)*S));
> Cavec-Czavecjy(12.01 (C	WGpo := 12.38591870
	WGDO. → 12.303710/U

#30		
> WGo := WGpo + WMG	0;	
	WGo := 13.03174596	
#31		
> AL := ((WGo-WGi)/WG	i)*100;	
	AL := 0	
#32		**************************************
> TFluegasiNa := WGi*W	/fe*SA;	
	TF1uegasINa := 754792.2100	
>		

Appendix J-3 Bias Error Calculation Air Leak Calculation -- With Leak Case

```
Error Propagation Calculations, Part B, AL (nonzero leak)
 Set no. of sample points
> n := 20;
                                       n := 20
 procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1..n,1..n);
> for i to n do
> for i to n do
> varcovar[i,j] := sqrt(var[i]*var[j])
> od
> od;
> varcovar;
> end;
  Warning, 'varcovar' is implicitly declared local
  Warning, 'j' is implicitly declared local
  Warning, 'i' is implicitly declared local
  make_array :=
      proc(var,n)
      local varcovar, j, i;
           varcovar := array(1 .. n,1 .. n);
               for i to n do varcovar[i,j] := sqrt(var[i]*var[j]) od
           ođ;
           varcovar
      end
```

#4
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)

```
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'MFG' is implicitly declared local
  MFG :=
  proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  end
   #6
 > M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
 > Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
 > Cb := C - Cr;
 > K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
 > K4 := 8.936°H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
 > M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
 > end;
   Warning, 'Cr' is implicitly declared local
   Warning, 'Cb' is implicitly declared local
   Warning, 'K3' is implicitly declared local
```

> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1); 28.97 Wma + 28.97 1.608015098 Wma + 1 > 1 := '1'; i := i#14 > PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ DPpa, PSpa (28.97 Wma + 28.97)PAFA := 14088.2 apa CP 1.608015098 Wma + 1 Tpa Tpa DPpa₅ DPpa₈ DPpa₉ DPpa₃ DPpa DPpa DPpa 6 Tpa8 Tpa Tpa₉ Tpa₅ Tpa Tpa Tpa DPpa DPpa DPpa DPpa DPpa DPpa 12 15 Tpa Tpa Tpa Tpa Tpa Tpa 12 DPpa 17 DPpa 19 DPpa₂₀ DPpa DPpa 18 Tpa 16 Tpa 17 Tpa 18 Tpa 19 Tpa 20 > PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n); DPpa₂ DPpa PSpa (28.97 Wma + 28.97)PAFB := 14088.2 apa CP 1.608015098 Wma + 1 Tpa_2 Tpa, DPpa₇ DPpa₉ DPpa₅ DPpa₆ DPpa₃ DPpa DPpa Tpa₅ Tpa₈ Tpa Tpa_ Tpa Tpa Tpa, DPpa 15 DPpa DPpa DPpa DPpa DPpa Tpa 15 Tpa₁₃ Tpa

Tpa

#13

DPpa 18 DPpa 19 DPpa 20 DPpa 16 DPpa 17 Tpa 20 Tpa 18 Tpa Tpa Tpa 16 #17 > FA := 5348840*Areal*CP*sqrt(PSI)*sum((DPi[I]/(M(I,A,OUHD,Ca,C,S,COI,CO2i,H,V. > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*(O2i[i]/100,i=1..n): > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,V > O2i[i]/100,i=1..n): #19 SA := FA/(FA+FB); $SA := \frac{1}{2}$ #20 SB := FB/(FA+FB); $SB := \frac{1}{2}$ #21 > WPAIA := PAFA/(Wfe*SA); DPpa₂ DPpa PSpa (28.97 Wma + 28.97)WPAIA := 28176.4 apa CP Tpa₂ 1.608015098 Wma + 1 Tpa DPpa₈ DPpa₄ DPpa₇ DFpa DPpa₅ DPpa₆ DPpa_ Tpa₅ Tpa8 Tpa3 Tpa₇ Tpa Tpa₄ Tpa DPpa₁₅ DPpa 10 DPpa DPpa

DPpa

Tpa ||

DPpa 17

Tpa 17

Tpa 10

DPpa 16

Tpa

DPpa 12

Tpa 12

DPpa 18

Tpa 18

Tpa₁₃

DPpa 19

Tpa

Tpa

DPpa₂₀

Tpa 20

Tpa₁₅

6

/Wfe

> WPAIB := PAFB/(Wfe*SB);

$$\begin{split} &\textit{WPAIB} := 28176.4 \;\; \textit{apa} \;\; \textit{CP} \;\; \frac{\textit{PSpa} \;\; (28.97 \;\; \textit{Wma} + 28.97)}{1.608015098 \;\; \textit{Wma} + 1} \;\; \left(\begin{array}{c} \frac{\textit{DPpa}_1}{\textit{Tpa}_1} + \frac{\textit{DPpa}_2}{\textit{Tpa}_2} \\ + \sqrt{\frac{\textit{DPpa}_3}{\textit{Tpa}_3}} + \sqrt{\frac{\textit{DPpa}_4}{\textit{Tpa}_4}} + \sqrt{\frac{\textit{DPpa}_5}{\textit{Tpa}_5}} + \sqrt{\frac{\textit{DPpa}_6}{\textit{Tpa}_6}} + \sqrt{\frac{\textit{DPpa}_7}{\textit{Tpa}_7}} + \sqrt{\frac{\textit{DPpa}_8}{\textit{Tpa}_8}} + \sqrt{\frac{\textit{DPpa}_9}{\textit{Tpa}_9}} \\ + \sqrt{\frac{\textit{DPpa}_{10}}{\textit{Tpa}_{10}}} + \sqrt{\frac{\textit{DPpa}_{11}}{\textit{Tpa}_{11}}} + \sqrt{\frac{\textit{DPpa}_{12}}{\textit{Tpa}_{12}}} + \sqrt{\frac{\textit{DPpa}_{13}}{\textit{Tpa}_{13}}} + \sqrt{\frac{\textit{DPpa}_{14}}{\textit{Tpa}_{14}}} + \sqrt{\frac{\textit{DPpa}_{15}}{\textit{Tpa}_{15}}} \\ + \sqrt{\frac{\textit{DPpa}_{16}}{\textit{Tpa}_{16}}} + \sqrt{\frac{\textit{DPpa}_{17}}{\textit{Tpa}_{17}}} + \sqrt{\frac{\textit{DPpa}_{18}}{\textit{Tpa}_{18}}} + \sqrt{\frac{\textit{DPpa}_{19}}{\textit{Tpa}_{19}}} + \sqrt{\frac{\textit{DPpa}_20}{\textit{Tpa}_{20}}} / \textit{Wfe} \end{split}$$

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \quad OUHD \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

> Cb := C - Cr;

$$Cb := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> WAI := (28.02*(100-CO2avei-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.0

> 1/32.07)*S)-N)/0.7685;

WAI := 36.46063760 (100 - CO2avei - COavei - O2avei)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N$$

#24

> WMGi := 8.936*H + (Wma*WAi)+Mf;

$$WMGi := 8.936 \ H + Wma$$
 $36.46063760 \ (100 - CO2avei - COavei - O2avei)$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N) + Mf$$

#25

> WGpi := ((44.01*CO2avei+32.02*O2avei+28.01*COavel+28.02*(100-CO2avei-COavel-COAvel-C > el-O2avei))/(12.01*(CO2avei+COavel))*(Cb+(12.01/32.07)*S));

$$WGpi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ CO2avei + 12.01 \ COavei)$$

#26

> WGi := WGpi + WMGi;

WGi:=
$$(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$\left(100 - CO2avei - COavei - O2avei\right) \\
\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (1 - O2avei - O2avei)$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAo := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

6 6

 Q_{-}

#28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 \right) (100 - CO2aveo - COaveo - O2aveo)$

$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) \text{ Ca}}{1 - \frac{1}{3} \text{ Ca}} + .3744932959 \text{ S} \right) ($$
12.01 $CO2aveo + 12.01 \text{ COaveo}) - 1.301236174 \text{ N} + Mf$

#29

> WGpo := ((44.01°CO2aveo+32.02°O2aveo+28.01°COaveo+28.02°(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / ($$

12.01 CO2aveo + 12.01 COaveo)

#30

> WGo := WGpo + WMGo;

$$WGo := (15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{2} \ Ca} + .3744932959 \ S\right) / ($$

$$\left(100 - CO2aveo - COaveo - O2aveo\right) \\
\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) (1 - \frac{1}{3} Ca)$$

> AL := ((WGo-WGi)/WGi)*100; $(15.99 \ CO2aveo + 4.00) \ O2aveo - .01 \ COaveo + 2802.00) \%1$ AL := 10012.01 CO2aveo + 12.01 COaveo + Wma $\left(36.46063760 \frac{(100) - CO2aveo - COaveo - O2aveo)}{12.01 \cdot CO2aveo - COaveo - O2aveo}\right) \frac{\%1}{12.01 \cdot CO2aveo - COaveo - O2aveo} - 1.301236174 \text{ P.}$ 12.01 CO2aveo + 12.01 COaveo (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00) %1 $-W_{\text{ma}} \left(36.46063760 - \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174 \right)$ $\left(\frac{\text{(15.99 Co2avei+4.(M) O2avei-.01 Coavei+28()2.(M)) \%1}}{\text{\%2}} + 8.936 \text{ H}\right)$ + Wma $\left(36.46063760 \frac{(100 - CO2avei - COavei - O2avei) \%1}{\%2} - 1.301236174 \right)$ $\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S$ %2 := 12.01 CO2avei + 12.01 COavei TFluegasiNa := WGi*Wfe*SA; TFluegas INa := $\frac{1}{2}$ (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00) $\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{2} \quad Ca} + .3744932959 \quad S\right) / ($ 12.01 CO2avei + 12.01 COavei) + 8.936 H + Wma 36.46063760 $\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S\right) / ($

TFluegasINb := WGi*Wfe*SB;

#33

TFluegasOUTa := WGo*Wfe*SA;

TFluegasOUTb := WGo*Wfe*SB;

> sigmaALCO2avei := sqrt(Diff(AL,CO2avei)^2*varCO2avei):

> sigmaALCO2avei := value(");

$$sigmaALCO2avei := \left(100 \right) \\ -15.99 \frac{\%1}{\%2} + 12.01 \frac{\%4 \%1}{\%2^2} - wma \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \%1}{\%2^2} \right) \\ \frac{\%4 \%1}{\%2} + 8.936 H + wma \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N \right) + Mf \\ -100 \left(\frac{(15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00) \%1}{12.01 CO2aveo + 12.01 COaveo} \right) \\ + wma \left(36.46063760 \frac{(100 - CO2aveo - COaveo - O2aveo) \%1}{12.01 CO2aveo + 12.01 COaveo} - 1.301236174 N \right) \\ -\frac{\%4 \%1}{\%2} - wma \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N \right) \\ \left(15.99 \frac{\%1}{\%2} - 12.01 \frac{\%4 \%1}{\%2^2} + wma \left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \%1}{\%2^2} \right) \right) \\ / \left(\frac{\%4 \%1}{\%2} + 8.936 H + wma \left(36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 N \right) + Mf \right)^2 \\ varco2avei \right)$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

$$\%2 := 12.01 \text{ CO2avei} + 12.01 \text{ COavei}$$

$$\%3 := 100 - \text{CO2avei} - \text{COavei} - \text{O2avei}$$

%4:=15.99 CO2avei+4.00 O2avei-01 COavei+2802.00

- > sigmaALCOavei := sqrt(Diff(AL,COavei)^2*varCOavei):
- > sigmaALCOavel := value("):
- > sigmaALO2avel := sqrt(Diff(AL,O2avei)^2*varO2avei):
- > sigmaALO2avel := value("):
- > sigmaALCO2aveo := sqrt(Diff(AL,CO2aveo)^2*varCO2aveo):
- > sigmaALCO2aveo := value(");

$$sigmaALCO2aveo := \sqrt{10000} \left(15.99 \frac{\%1}{\%2} - 12.01 \frac{(15.99 CO2aveo + 4.00) O2aveo - .01 COaveo + 2802.00) \%1}{\%2^2} + Wma$$

$$+ W_{ma} \left(36.46063760 \right) \frac{(100 - CO2avei - COavei - O2avei) \%1}{12.01 \ CO2avei + 12.01 \ COavei} - 1.301236174 \right)$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{2} Ca} + .3744932959 S$$

%2 := 12.01 CO2aveo + 12.01 COaveo

```
> sigmaALCOaveo := sqrt(Diff(AL,COaveo)^2*varCOaveo):
> sigmaALCOaveo := value("):
> sigmaALO2aveo := sqrt(Diff(AL,O2aveo)^2*varO2aveo):
> sigmaALO2aveo := value("):
> covarALCO2avelo := 2*Diff(AL,CO2avei)*Diff(AL,CO2aveo)*sqrt(varCO2avei)*sqrt
> (varCO2aveo):
> covarALCO2avelo := value("):
> sigmaALAreal := sqrt(Diff(AL,Areal)^2*varAreal):
> sigmaALAreai := value("):
> sigmaALAreao := sqrt(Diff(AL,Areao)^2*varAreao):
> sigmaALAreao := value("):
> sigmaALCP := sqrt(Diff(AL,CP)^2*varCP):
> sigmaALCP := value("):
> sigmaALPSi := sqrt(Diff(AL,PSi)^2*varPSi):
> sigmaALPSi := value("):
> sigmaALPSo := sgrt(Diff(AL,PSo)^2*varPSo):
> sigmaALPSo := value("):
> sigmaALA := sqrt(Diff(AL,A)^2*varA):
> sigmaALA := value("):
> sigmaALOUHD := sgrt(Diff(AL,OUHD)^2*varOUHD):
> sigmaALOUHD := value("):
> sigmaALCa := sqrt(Diff(AL,Ca)^2*varCa):
> sigmaALCa := value("):
> sigmaALC := sqrt(Diff(AL,C)*Diff(AL,C)*varC):
```

```
> sigmaALC := value("):
> sigmaALS := sqrt(Diff(AL,S)*Diff(AL,S)*varS):
> sigmaALS := value("):
> sigmaALH := sqrt(Diff(AL,H)*Diff(AL,H)*varH):
> sigmaALH := value("):
> sigmaALWma := sqrt(Diff(AL,Wma)*Diff(AL,Wma)*varWma):
> sigmaALWma := value("):
> sigmaALN := sgrt(Diff(AL,N)*Diff(AL,N)*varN):
> sigmaALN := value("):
> sigmaALMf := sqrt(Diff(AL,Mf)*Diff(AL,Mf)*varMf):
> sigmaALMf := value("):
> sigmaALWfe := sqrt(Diff(AL,Wfe)^2*varWfe):
> sigmaALWfe := value("):
> sigmaALWma := sqrt(Diff(AL,Wma)*Diff(AL,Wma)*varWma):
> sigmaALWma := value("):
> sigmaALDPi := sqrt(sum(sum(
> Diff(AL,DPi[i])*Diff(AL,DPi[j])*varDPi[i,j]
> ,j=1..n),i=1..n)):
> sigmaALDPi := value("):
> sigmaALDPo := sqrt(sum(sum(
> Diff(AL,DPo[i])*Diff(AL,DPo[j])*varDPo[i,j]
> ,j=1..n),i=1..n)):
> sigmaALDPo := value("):
```

> sigmaALTi := sqrt(sum(sum(
> Diff(AL,Ti[i])*Diff(AL,Ti[j])*varTi[i,j]
> ,j=1n),i=1n)):
> sigmaALTi :≖ value("):
> sigmaALTo := sqrt(sum(sum(
> Diff(AL,To[i])*Diff(AL,To[j])*varTo[i,j]
> ,j=1n),i=1n)):
> sigmaALTo := value("):
> sigmaALCOi := sqrt(sum(sum(
> Diff(AL,COi[i])*Diff(AL,COi[j])*varCOi[l,j]
> ,j=1n),i=1n)):
> sigmaALCOi := value("):
> sigmaALCOo := sqrt(sum(sum(
> Diff(AL,COo[i])*Diff(AL,COo[j])*varCOo[i,j]
> ,j=1n),i=1n)):
> sigmaALCOo := value("):
> sigmaALCO2i := sqrt(sum(sum(
> Diff(AL,CO2i[i])*Diff(AL,CO2i[j])*varCO2i[i,j]
> ,j=1n),i=1n)):
> sigmaALCO2i := value("):

> sigmaALCO2o := sqrt(sum(sum(> Diff(AL,CO2o[i])*Diff(AL,CO2o[j])*varCO2o[i,j] > ,j=1..n),i=1..n)): > sigmaALCO2o := value("): > sigmaALO2i := sqrt(sum(sum(> Diff(AL,O2|[i])*Diff(AL,O2|[j])*varO2|[i,j] > ,j=1..n),i=1..n)): > sigmaALO2i := value("): > sigmaALO2o := sqrt(sum(sum(> Diff(AL,O2o[i])*Diff(AL,O2o[j])*varO2o[i,j] > ,j=1..n),i=1..n)): > sigmaALO2o := value("): > sigmaAL := sqrt(> Diff(AL,CO2avei)^2*varCO2avei + > Diff(AL,COavei)^2*varCOavel + > Diff(AL,O2avei)^2*varO2avel + > Diff(AL,CO2aveo)^2*varCO2aveo + > Diff(AL,COaveo)^2*varCOaveo + > Diff(AL,O2aveo)^2*varO2aveo + > 2*Diff(AL,CO2avei)*Diff(AL,CO2aveo)*sqrt(varCO2avei)*sqrt(varCO2aveo) + > Diff(AL,Wfe)^2*varWfe + > Diff(AL,Areai)^2*varAreai +

> Diff(AL,Areao)^2*varAreao +
> Diff(AL,CP)^2*varCP +
> Diff(AL,PSi)^2*varPSi +
> Diff(AL,PSo)^2*varPSo +
> Diff(AL,A)^2°varA +
> Diff(AL,OUHD)^2*varOUHD +
> Diff(AL,Ca)^2*varCa +
> Diff(AL,C)*Diff(AL,C)*varC +
> Diff(AL,S)*Diff(AL,S)*varS +
> Diff(AL,H)*Diff(AL,H)*varH +
> Diff(AL,Wma)*Diff(AL,Wma)*varWma +
> Diff(AL,N)*Diff(AL,N)*varN +
> Diff(AL,Mf)*Diff(AL,Mf)*varMf +
> sum(sum(
> Diff(AL,DPi[i])*Diff(AL,DPi[j])*varDPi[i,j] +
> Diff(AL,Ti[i])*Diff(AL,Ti[j])*varTi[i,j] +
> Diff(AL,COi[i])*Diff(AL,COi[j])*varCOi[i,J] +
> Diff(AL,CO2i[i])*Diff(AL,CO2i[j])*varCO2i[i,j] +
> Diff(AL,O2i[i])*Diff(AL,O2i[j])*varO2i[i,j] +
> Diff(AL,DPo[i])*Diff(AL,DPo[j])*varDPo[i,j] +
> Diff(AL,To[i])*Diff(AL,To[j])*varTo[i,j] +
> Diff(AL,COo[I])*Diff(AL,COo[j])*varCOo[i,j] +
> Diff(AL,CO2o[i])*Diff(AL,CO2o[j])*varCO2o[i,j] +
> Diff(AL,O2o[i])*Diff(AL,O2o[j])*varO2o[i,j]

> ,j=1..n),i=1..n)):
> sigmaAL := value(");

$$sigmaAL := \left(100 \frac{.01 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2^2} - \%11 \frac{}{\%6} \right)^2 varCOavei + \left(\frac{\%12}{\%2} + 36.46063760 \frac{\text{Wma \%1}}{\%2} \right)^2 varCOavei + \left(\frac{-4.00 \frac{\%1}{\%2} + 36.46063760 \frac{\text{Wma \%1}}{\%2}}{\%6} \right)^2 varCOavei + \left(\frac{15.99 \frac{\%1}{\%7} - 12.01 \frac{\%10 \%1}{\%7^2} + \%9 \right)^2 varCOavei + \frac{\left(15.99 \frac{\%1}{\%7} - 12.01 \frac{\%10 \%1}{\%7^2} + \%9 \right)^2 varCOaveo + 10000 \frac{\left(-.01 \frac{\%1}{\%7} - 12.01 \frac{\%10 \%1}{\%7^2} + \%9 \right)^2 varCOaveo + 10000 \frac{\left(4.00 \frac{\%1}{\%7} - 36.46063760 \frac{\text{Wma \%1}}{\%7^2} \right)^2 varCOaveo + 10000 \frac{\left(4.00 \frac{\%1}{\%7} - 36.46063760 \frac{\text{Wma \%1}}{\%7} \right)^2 varCOaveo + 10000 \frac{\left(4.00 \frac{\%1}{\%7} - 36.46063760 \frac{\text{Wma \%1}}{\%7} \right)^2 varCOaveo + 10000 \frac{\left(4.00 \frac{\%1}{\%7} - 36.46063760 \frac{\text{Wma \%1}}{\%7} \right)^2 varCOaveo + 10000 \frac{\left(4.00 \frac{\%1}{\%7} + 12.01 \frac{\%5 \%1}{\%2} - \%11 \frac{\%6}{\%6} \right)^2 varCOaveo + 10000 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2} - \%11 + 10000 \frac{\%6}{\%6}$$

$$\frac{\%12}{\%2} \left(\frac{\%5 \%14}{\%2} + 36.46063760 \frac{\text{Wma} \%3 \%14}{\%2} \right)^{2} \text{ varA} + \left(100 \right) \left(\frac{\%6^{2}}{\%2} + 36.46063760 \frac{\text{Wma} \%8 \%13}{\%7} - \frac{\%5 \%13}{\%2} \right)^{2} \text{ varA} + \left(100 \right) \left(\frac{\%10 \%13}{\%7} + 36.46063760 \frac{\text{Wma} \%8 \%13}{\%2} \right)^{2} (\%6)$$

$$= \frac{\%12}{100} \left(\frac{\%5 \%13}{\%2} + 36.46063760 \frac{\text{Wma} \%3 \%13}{\%2} \right)^{2} (\%6)$$

$$= \frac{15.99 \%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2} - \%11$$

$$= \frac{\%6^{2}}{100} - \frac{\%10 \%1}{\%2} + \frac{\%5 \%1}{\%2} - 12.01 \frac{\%5 \%1}{\%2^{2}} + \%11 \right)$$

$$= \frac{\%12}{100} \left(\frac{\%10 \%1}{\%2} + \frac{\%9}{\%2} \right) \sqrt{\text{varCO2avei}} \sqrt{\text{varCO2aveo}} / (\%6)$$

$$\%12 = C - \frac{A \text{ OUHD Ca}}{1 - \text{Ca}} - \frac{1}{3} \frac{A (1 - \text{OUHD}) \text{ Ca}}{1 - \frac{1}{3} \text{ ca}} + .3744932959 \text{ S}$$

$$\%2 := 12.01 \text{ CO2avei} + 12.01 \text{ COavei}$$

$$\%3 := 100 - \text{CO2avei} - \text{COavei} - \text{O2avei}$$

$$\%4 := 36.46063760 \frac{\%3 \%1}{\%2} - 1.301236174 \text{ N}$$

$$\%5 := 15.99 \text{ CO2avei} + 4.00 \text{ O2avei} - .01 \text{ COavei} + 2802.00$$

$$\%6 := \frac{\%5 \%1}{\%2} + 8.936 \text{ H} + \text{Wma} \%4 + \text{Mf}$$

%7 := 12.01 CO2aveo + 12.01 COaveo

%8 := 100 - CO2aveo - COaveo - O2aveo

$$\%9 := Wma \left(-36.46063760 \frac{\%1}{\%7} - 437.8922576 \frac{\%8 \%1}{\%7^2} \right)$$

%10:=15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00

$$\%11 := \text{Wma} \left(-36.46063760 \ \frac{\%1}{\%2} - 437.8922576 \ \frac{\%3 \ \%1}{\%2^2} \right)$$

$$\frac{\%10 \%1}{\%7} + Wma \left(36.46063760 \frac{\%8 \%1}{\%7} - 1.301236174 N\right) - \frac{\%5 \%1}{\%2} - Wma \%4$$

$$\%13 := -\frac{A \quad Ca}{1 - Ca} + \frac{1}{3} \quad \frac{A \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

$$\%14 := -\frac{OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{(1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

$$\%15 := -\frac{A \text{ OUHD}}{1 - Ca} - \frac{A \text{ OUHD } Ca}{\left(1 - Ca\right)^2} - \frac{1}{3} \frac{A \left(1 - OUHD\right)}{1 - \frac{1}{3} Ca} - \frac{1}{9} \frac{A \left(1 - OUHD\right) Ca}{\left(1 - \frac{1}{3} Ca\right)^2}$$

Constants

Averages and Variances from Part A

> CO2avei := 15.2148;

CO2avei := 15.2148

> varCO2avel := .1^2;

varCO2avei := .01

> COavel := .005;

COavei := .005

> varCOavei := .002^2;

varCOavei := .4 10⁻⁵

> O2avei := 3.8;

02avei := 3.8

> varO2avei := .05^2;

var02avei := .0025

> CO2aveo := 14.145;

CO2aveo := 14.145

> varCO2aveo := .1^2;		
	varCO2aveo := .01	
> COaveo := .004;		
	COaveo := .004	
> varCOaveo := .002^2;		
14.0041001102 2,	varCOaveo := .4 10 ⁻⁵	
> O2aveo := 5;	Varcuaveo := .4 10	
> Ozaveo := 5;		
	02aveo := 5	
> varO2aveo := .05^2;		
	var02aveo:=.0025	
Coal Feed Rate (lbs/hr)		
> Wfe := 115839;		
	Wfe:= 115839	
<pre>varWfe := (0.05*Wfe)^2;</pre>		
	varWfe:=.3354668480 10 ⁸	
	Valwie337400480 10	
Area (square ft)		
> Areal := 3.99;		•
	Areai := 3.99	
varAreal := (0.0335*Area	1)^2:	
	varAreai:=.01786633223	
~		
> Areao := 3.54;		
	Areao := 3.54	
varAreao := (0.0364*Area	10)^2;	
·	varAreao := .01660386874	
Pitot Coefficient		
· CP := 0.84;		
	CP := .84	
varCP := (0.01)^2;		
•	varCP := .0001	
H-77 1-76 1-76 1-76 1-76 1-76 1-76 1-76 1-76 1-76 1-76 1-76 1-76 1-76		

varPSI := (0.04)^2;	varPSi	:= .0016	
PSo := 29.1;	PSo:=	= 29.1	
varPSo := (0.04)^2;	varPSo	:= .0016	
Pressue for primary air			
PSpa := 31.11;	PSpa:	= 31.11	
varPSpa := (0.04)^2;	varPSpa	a := .0016	
•			
Velocity Head			
v := .45802;	v := .	.45802	
> DPo := array([seq(v,i=	02 45902 45802	45802 .45802	.45802 .45802 .45802
DB0 1 45802 458	02 .45802 .45802 5802 .45802 .4580	.45802 .45802 02 .45802 .45802	45002 4500
DPo := [.45802	02 .45802 .45802 5802 .45802 .4580	.45802 .45802 92 .45802 .45802 98391292816	.43002 ,15002
$DPo := [.45802 .4580]$ $.45802 .45802 .45802$ $.45802]$ > $u := (.02^{\circ}v)^{\circ}2;$ > $var := array([seq(u,i=)])$	02 .45802 .45802 5802 .45802 .4580 u := .0000	08391292816	.45802 .45802 .4580
DPo := [.45802 .458 .45802 .45802 .4: .45802] > u := (.02*v)^2; > var := array([seq(u,i= var := [.00008391]	02 .45802 .45802 5802 .45802 .4580 u := .0000 1n)]); 292816 .0000839129	08391292816	.45802 .45802 .4580 .45802 .45802 .4580 .2816 .00008391292816
DPo := [.45802 .45804 .45802 .45802 .45802] > u := (.02*v)^2; > var := array([seq(u,i=var := [.00008391292816	02 .45802 .45802 5802 .45802 .4580 u := .0000 1n)]); 292816 .0000839129 .00008391292816	08391292816	.45802 .45802 .4580 .45802 .45802 .4580 .92816 .00008391292816 .00008391292816 .00008391292816
DPo := [.45802 .45804 .45802 .45802 .45802] > u := (.02*v)^2; > var := array([seq(u,l=var := [.00008391292816 .00008391292816	02 .45802 .45802 5802 .45802 .4580 u := .00000 1n)]); 292816 .0000839129 .00008391292816 .00008391292816	08391292816 02816 .0000839129 .00008391292816	.45802 .45802 .4580 .45802 .45802 .4580 .02816 .00008391292816 .00008391292816 .00008391292816
DPo := [.45802 .45802 .45802 .45802] > u := (.02*v)^2; > var := array([seq(u,l=: var := [.00008391292816 .00008391292816 .00008391292816	02 .45802 .45802 5802 .45802 .4580 u := .0000 1n)]); 292816 .0000839129 .00008391292816 .00008391292816 .00008391292816	08391292816 000008391292816 000008391292816 000008391292816	.45802 .45802 .4580 .45802 .45802 .4580 .92816 .00008391292816 .00008391292816 .00008391292816
DPo := [.45802 .458 .45802 .45802 .4: .45802] > u := (.02*v)^2; > var := array([seq(u,i= var := [.000083912 .00008391292816 .00008391292816 .00008391292816	02 .45802 .45802 5802 .45802 .4580 u := .0000 1n)]); 292816 .0000839129 .00008391292816 .00008391292816 .00008391292816 .00008391292816	08391292816 02816 .0000839129 .00008391292816 .00008391292816 .00008391292816 .00008391292816 .00008391292816	.45802 .45802 .4580 .45802 .45802 .4580 .02816 .00008391292816 .00008391292816 .00008391292816
DPo := [.45802 .45802 .45802 .45802] > u := (.02*v)^2; > var := array([seq(u,l=: var := [.00008391292816 .00008391292816 .00008391292816	02 .45802 .45802 5802 .45802 .4580 u := .0000 1n)]); 292816 .0000839129 .00008391292816 .00008391292816 .00008391292816 .00008391292816	08391292816 000008391292816 000008391292816 000008391292816 000008391292816	.45802 .45802 .4580 .45802 .45802 .4580 .02816 .00008391292816 .00008391292816 .00008391292816
DPo := [.45802 .458 .45802 .45802 .4: .45802] > u := (.02*v)^2; > var := array([seq(u,i= var := [.000083912 .00008391292816 .00008391292816 .00008391292816	02 .45802 .45802 5802 .45802 .4580 u := .00000 1n)]); 292816 .0000839129 .00008391292816 .00008391292816 .00008391292816 .00008391292816 .00008391292816 .00008391292816	08391292816 02816 .0000839129 .00008391292816 .00008391292816 .00008391292816 .00008391292816 .00008391292816	.45802 .45802 .4580 .45802 .45802 .4580 .02816 .00008391292816 .00008391292816 .00008391292816

.828311 > u := (.02*v)^2; u := .0002744389824> var := array([seq(u,i=1..n)]); var:=[.0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .0002744389824 .(XX)2744389824 .(XX)2744389824 .(XX)2744389824 .(XX)2744389824] > varDPl := make_array(var,n); varDPi := varcovar Temperature (R) > v := 713; v := 713> To := array([seq(v,l=1..n)]); 713 713 713 713 713 713] > u := (0.01*(v-460))^2; u := 6.4009> var := array([seq(u,i=1..n)]); $var := [6.4009 \quad 6.4009 \quad 6.$ 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.4009 6.400 6.4009] > varTo := make_array(var,n); varTo := varcovar > v := 1140;v := 1140> Ti:= array([seq(v,l=1..n)]); $\mathtt{Ti} := [1140 \quad 1140 > u := (0.01*(v-460))^2; u := 46.2400> var := array([seq(u,i=1..n)]); var:=[46.2400 46.2400]

> varTi := make_array(var,n);	
	varTi := varcovar
Moisture in Coal	
> Mf :=0.06;	
> IMI .=0.00,	Mf := .06
> varMf := (0.039*Mf)^2;	112
> varmi := (0.039 mi)*2,	5
	varMf:=.54756 10 ⁻⁵
Ash	
> A := 0.0619;	A := .0619
	A := .0019
> varA := (0.039*A)^2;	•
	varA := .582787881 10 ⁻⁵
Overhead	
> OUHD := 0.9;	_
	OUHD := .9
> varOUHD := (0.1*OUHD)^2;	
	varOUHD := .0()81
Carbon	
> C := 0.7381;	
	C := .7381
> varC := (0.039°C)^2;	
	varC := .0008286280388
Hydrogen	
> H := 0.0482;	v.= 0482
	H := .0482
> varH := (0.039*H)^2;	•
	varH := .353364804 10 ⁻⁵
Nitrogen	
> N := 0.0135;	0.05
	N:= .0135
> varN := (0.039*N)^2;	
	$varN := .27720225 \cdot 10^{-6}$

Sulfur
> S := 0.0123;
S := .0123
> varS := (0.019°S)^2;
vars:= .5461569 10 ⁻⁷
CO2
> v := 14.145;
v:= 14.145
> CO2o := array([seq(v,i=1n)]);
CO20 := [14.145
14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14
14.145]
> u := (0.1)^2;
u := .01
> var := array([seq(u,i=1n)]);
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01
.01 .01 .01 .01 .01]
> varCO2o := make_array(var,n);
varCO2o := varcovar
> v := 15.2148;
v := 15.2148
> CO2i := array([seq(v,i=1n)]);
CO2i := [15.2148 15.21
15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
15.2148 15.2148 15.2148 15.2148]
> u := (0.1)^2;
u := .01
> var := array([seq(u,l=1n)]);
var:=[.01 .01 .01 .01 .01 .01 .01 .01 .01 .01
.01 .01 .01 .01 .01
> varCO2i := make_array(var,n);
varCO2i := varcovar
02
> v := 5;
v:=5

```
> O2o := array([seq(v,i=1..n)]);
                        > u := (0.05)^2;
                                                                                                              u := .0025
   > var := array([seq(u,i=1..n)]);
                     var:=[.0025 .0025 .0025 .0025 .0025
                                                                                                                                       .0025 .0025 .0025 .0025 .0025
                         .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
   > varO2o := make_array(var,n);
                                                                                              var02o := varcovar
  > v := 3.8:
                                                                                                                v := 3.8
  > O2i := array([seq(v,i=1..n)]);
               O2i := [3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8 \ 3.8
                   3.8 3.8 3.8 3.8 3.8]
  > u := (0.05)^2;
                                                                                                             u := .0025
  > var := array([seq(u,i=1..n)]);
                   var := \{.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0
                                                                                                                                      .0025 .0025
                                                                                                                                                                             .0025 .0025 .0025
                       .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 ]
 > varO2i := make_array(var,n);
                                                                                            var02i := varcovar
       Moisture (air)
  > Wma := 0.013;
                                                                                                          Wma := .013
> varWma := (.1*Wma)^2;
                                                                                              varWma := .169 10<sup>-5</sup>
     CO
> v := 0.005;
                                                                                                             v := .005
> COo := array([seq(v,l=1..n)]);
                Coo := [.005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005 \ .005
                    > u := (0.002)^2:
                                                                                                       u := .4 \cdot 10^{-5}
> var := array([seq(u,i=1..n)]);
```

```
var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
        .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
        .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
 > varCOo := make_array(var,n);
                                        varCOo:= varcovar
 > v := 0.005;
                                               v := .005
 > COI := array([seq(v,i=1..n)]);
        > u := (0.002)^2:
                                             u := .4 \cdot 10^{-5}
> var := array([seq(u,l=1..n)]);
      var := \begin{bmatrix} .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} & .4 & 10^{-5} \end{bmatrix}
        .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5} .4 \cdot 10^{-5}
        .4 \cdot 10^{-5} \cdot .4 \cdot 10^{-5} \cdot .4 \cdot 10^{-5} \cdot .4 \cdot 10^{-5}
> varCOi := make array(var.n);
                                       varCOi := varcovar
  Carbon in Ash
> Ca := 0.0486:
                                              Ca := .0486
> varCa := (0.25°Ca)^2;
                                      varCa := .000147622500
  Area for primary air
> apa := .63;
                                              apa := .63
> varapa := (.0208*apa)^2:
                                     varapa := .000171714816
> v := .2171;
                                              v := .2171
> DPpa := array([seq(v,i=1..n)]);
```

DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171

د در

> u := (0.02*v)^2; u := .000018852964 > varDPPA := array([seq(u,i=1n)]); varDPPA := (000018852964
u := .000018852964 > varDPPA := array([seq(u,i=1n)]);
1,000010052041 000010052044 000010052064 000018852064
varDPPA:=[.000018852964 .000018852964 .000018852964 .000018852964
.000018852964 .000018852964 .000018852964 .000018852964 .000018852964
.000018852964 .000018852964 .000018852964 .000018852964 .000018852964
.000018852964 .000018852964 .000018852964 .000018852964 .000018852964
.(XXX)18852964]
4104.
> v := 1104; v := 1104
> Tpa := array([seq(v,i=1n)]);
Tpa:=[1104 1104 1104 1104 1104 1104 1104 1104
1104 1104 1104 1104 1104 1104 1104 1104
> u := (0.01*(v - 460))^2;
u := 41.4736
> varTpa := array([seq(u,i=1n)]);
varTpa:=[41.4736 41.4736 41.4736 41.4736 41.4736 41.4736 41.4736
41.4736 41.4736 41.4736 41.4736 41.4736 41.4736 41.4736
41.4736 41.4736 41.4736 41.4736]
Results
> evalf(AL); 6.870044252 LEAK %
> evalf(sigmaAL); .05846028139 6/45 7/0
> evalf(100*sigmaAL/AL);
.8509447573 RELATIVE ERROR
> evalf(sigmaALWfe); 0 CONTRIBUTIONS
> evalf(sigmaALWma); .0006394708566
> evalf(sigmaALCO2avel);
.6242534970
> evalf(sigmaALCOavei);
.01354711120

> evalf(sigmaALO2avei);		
	.005851202990	1
> evalf(sigmaALCO2aveo);		
	.6768855565	
> evalf(sigmaALCOaveo);		
	.01460668871	
> evalf(sigmaALO2aveo);		
	.005889417936	
> evalf(covarALCO2aveio);		
•	8450963514	1
> evalf(sigmaALAreai);		
	0	1
> evalf(sigmaALAreao);		
	0	
> evalf(sigmaALCP);		
	0	1
> evalf(sigmaALPSi);		
	0	
> evalf(sigmaALPSo);		
, ,	0	
> evalf(sigmaALA);		
	.00004018356526	
> evalf(sigmaALOUHD);		
	.00006740663400	
> evalf(sigmaALCa);		
	.0002704368469	
> evalf(sigmaALC);		
	.01006176701	
> evalf(sigmaALS);		
	.00003059125007	
> evalf(sigmaALH);		
,,	.008855472416	
> evalf(sigmaALN);		
	.4695207444 10 ⁻⁵	
	.407J2U/444 IU	
> evalf(sigmaALMf);	(V)1222505520	
	.001233595529	
> evalf(sigmaALDPi);		(V

_	
> evalf(sigmaALTi);	
0	
> evalf(sigmaALCOi);	
0	
> evalf(sigmaALCO2i);	
0	
> evalf(sigmaALO2i);	
0	
> evalf(sigmaALDPo);	
0	
> evalf(sigmaALTo);	
0	
> evalf(sigmaALCOo);	
0	
> evalf(sigmaALCO2o);	
0	
> evalf(sigmaALO2o);	
0	****
> i := 'i';	
<i>i</i> :=	: i
#13	
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.	
m := 28.74	1570417
44.4	
#14 > PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*su	m((DPna(i)/Tna(i))^(1/2) i=1 n):
PAFA := 62.	
Intr.— uz	
> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*su	m((DPpa[i]/Tpa[i])^(1/2),i=1n);
PAFB := 62:	
#17	
> FA := 5348840*Areai*CP*sgrt(PSi)*sum((D	Pifi1/(M(I.A.OUHD.Ca.C.S.COI.CO2I.H.W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

0

#18 > FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COI,CO2i,H,V > ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COi,CO2i,H,Wma,O2i,N,Mf))*(> O2i[i]/100,i=1..n): #19 > SA := FA/(FA+FB); SA := .5000000000000#20 > SB := FB/(FA+FB); SB := .50000000000> WPAIA := PAFA/(Wfe*SA); WPAIA := 1.079598797 > WPAIB := PAFB/(Wfe*SB); WPAIB := 1.079598797#23 > Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3); Cr := .002947741741> Cb := C - Cr; Cb := .7351522583 > WAI := (28.02*(100-CO2avei-COavel-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei))*(Coavei+COavei)*(Coavei+COavei)*(Coavei+COavei)*(Coavei+COavei+COavei)*(Coavei+COavei > 1/32.07)*S)-N)/0.7685; WAi := 11.93169660#24 > WMGi := 8.936*H + (Wma*WAi)+Mf; WMGi := .6458272558#25

> WGpi := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02*(100-CO2avei-COavei-COavei-O2avei))/(12.01*(CO2avei+COavei))*(Cb+(12.01/32.07)*S));

	WGpi := 12.38591870
437	
#26	
> WGi := WGpi + WMGi;	10.02194507
	WGi := 13.03174596
#27	
> WAo :=(((28.02*(100-CO2a* > b + (12.01/32.07)*S)-N)/0.76	veo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C 85;
	WAO := 12.81551267
#28	
> WMGo := 8.936*H + (Wma*\	NAo) + Mf;
	WMGo := .6573168647
#29	
	32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C
	D2aveo+COaveo))*(Cb+(12.01/32.07)*S));
) Caveo-Ozavoo, p(. z.o. (Co	WGpo := 13.26971581
	wGp0 .= 13.20771381
#30	
> WGo := WGpo + WMGo;	
	WGo := 13.92703267
#31	
> AL := ((WGo-WGI)/WGI)*100	0:
, ,	AL := 6.870044219
#32 > TFluegaslNa := WGi*Wfe*S	Δ.
-	TF1uegasINa:=754792.2100
TFluegasINb := WGi*Wfe*SI);
#33	
TFluegasOUTa := WGo*Wfe*	
TFluegasOUTb := WGo*Wfe	*SB;

Appendix J-4 Random Error Calculation Air Leak Calculation -- With Leak Case

>
>
Random Error Propagation Calculations, Part B, AL (nonzero leakage, n=20 for flue ga
in, n=24 for flue gas out)
Set no. of sample points
> n := 20;
n := 20
procedure for creating variance-covariance matrix
> make_array := proc(var,n)
> varcovar := array(1n,1n);
> for j to n do
> for i to n do
> If i = j then
> varcovar[i,j] := sqrt(var[i]*var[j])
> else
> varcovar[i,j] := 0
> fl;
> od
> od;
> varcovar;
> end:
Warning, 'varcovar' is implicitly declared local
Warning, 'j' is implicitly declared local
Warning, 'i' is implicitly declared local
make_array :=
proc(var,n)
local varcovar, j, i;
varcovar := array(1 n,1 n);

```
for i to n do
               for i to n do
                   if i = j then varcovar[i,j] := sqrt(var[i]*var[j])
                   else varcovar[i,j] := 0
                   £i
               ođ
          od:
          varcovar
      end
> MFG := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
> Cb := C - Cr;
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
> K4 := 8.936°H + Wma*((28.02°(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> MFG := (K4/18.016)/((K4/18.016)+100*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
 Warning, 'K3' is implicitly declared local
 Warning, 'K4' is implicitly declared local
 Warning, 'MFG' is implicitly declared local
 MFG :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,MFG;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*CO2[x]+12.01*CO[x]);
      K4 :=
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N)+Mf
      MFG := .05550621670*K4/(.05550621670*K4+100*K3)
  and
  #6
> M := proc(x,A,OUHD,Ca,C,S,CO,CO2,H,Wma,O2,N,Mf)
> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);
```

```
> Cb := C - Cr:
> K3 := (Cb+12.01*S/32.07)/(12.01*(CO2[x] + CO[x]));
'> K4 := 8.936*H + Wma*((28.02*(100-CO[x]-CO2[x]-O2[x])*K3-N)/0.7685)+Mf;
> M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*K3)
> end:
  Warning, 'Cr' is implicitly declared local
  Warning, 'Cb' is implicitly declared local
  Warning, 'K3' is implicitly declared local
  Warning, 'K4' is implicitly declared local
  Warning, 'M' is implicitly declared local
  M :=
  proc(x, A, OUHD, Ca, C, S, CO, CO2, H, Wma, O2, N, Mf)
  local Cr,Cb,K3,K4,M;
      Cr := A*OUHD*Ca/(1-Ca)+1/3*A*(1-OUHD)*Ca/(1-1/3*Ca);
      Cb := C-Cr;
      K3 := (Cb+.3744932959*S)/(12.01*C02[x]+12.01*C0[x]);
       8.936*H+Wma*(36.46063760*(100-CO[x]-CO2[x]-O2[x])*K3-1.301236174*N
      M := (18.016*K4+K3*(288.08*CO2[x]+71.70*O2[x]+50480.8))/(K4+1801.6*
  end
  #13
> m := (Wma * 28.97+28.97)/((Wma*28.97/18.016)+1);
                                    28.97 Wma + 28.97
                                   1 608015098 Wma + 1
  #14
> PAFA := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);
                                                                       DPpa<sub>2</sub>
                                                             DPpa
                              PSpa (28.97 Wma + 28.97)
    PAFA := 14088.2 apa CP
                                 1.608015098 Wma + 1
                                                                        Tpa
                                                             Tpa
                               DPpa<sub>5</sub>
         DPpa<sub>3</sub>
                                                                 DPpa
                                                                            DPpa.
                                                      DPpa_
                    DPpa
                                           DPpa.
                                Tpa<sub>5</sub>
                                           Tpa
                                                      Tpa
                                                                 Tpa
                                                                            Tpa,
                     Tpa
          Tpa,
                                                                     DPpa 15
                                                          DPpa
                                  DPpa
                                              DPpa.
         DPpa
                     DPpa
                                       12
                                                                       Tpa
                      Tpa
                                  Tpa
                                              Tpa
                                                           Tpa
          Tpa.
                                                         DPpa<sub>20</sub>
                                             DPpa<sub>19</sub>
         DPpa
                     DPpa
                                  DPpa.
                                       18
               16
                                                          7pa<sub>20</sub>
                                  Tpa 18
                                              Tpa 19
                      Tpa
          Tpa
                          17
```

> PAFB := 14088.2*apa*CP*sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1..n);

$$\begin{split} & \text{PAFB} := 14088.2 \ \ \, \text{apa} \ \ \, \text{CP} \, \, \sqrt{\frac{PSpa}{1.608015098} \, \frac{(28.97 \, \text{Wma} + 28.97)}{\text{Ima}_1 + 1}} \, \left(\begin{array}{c} DPpa_1 \\ Tpa_1 \end{array} \right) + \begin{array}{c} DPpa_2 \\ Tpa_2 \end{array} \\ & + \begin{array}{c} DPpa_3 \\ Tpa_3 \end{array} + \begin{array}{c} DPpa_4 \\ Tpa_4 \end{array} + \begin{array}{c} DPpa_5 \\ Tpa_5 \end{array} + \begin{array}{c} DPpa_6 \\ Tpa_6 \end{array} + \begin{array}{c} DPpa_7 \\ Tpa_7 \end{array} + \begin{array}{c} DPpa_8 \\ Tpa_8 \end{array} + \begin{array}{c} DPpa_9 \\ Tpa_9 \end{array} \\ & + \begin{array}{c} DPpa_10 \\ Tpa_{10} \end{array} + \begin{array}{c} DPpa_{11} \\ Tpa_{11} \end{array} + \begin{array}{c} DPpa_{12} \\ Tpa_{12} \end{array} + \begin{array}{c} DPpa_{13} \\ Tpa_{13} \end{array} + \begin{array}{c} DPpa_{14} \\ Tpa_{14} \end{array} + \begin{array}{c} DPpa_{15} \\ Tpa_{15} \end{array} \\ & + \begin{array}{c} DPpa_{16} \\ Tpa_{16} \end{array} + \begin{array}{c} DPpa_{17} \\ Tpa_{17} \end{array} + \begin{array}{c} DPpa_{18} \\ Tpa_{18} \end{array} + \begin{array}{c} DPpa_{19} \\ Tpa_{19} \end{array} + \begin{array}{c} DPpa_{20} \\ Tpa_{20} \end{array} \end{split}$$

#17

> FA := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

#18

> FB := 5348840*Areai*CP*sqrt(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W

> ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C

> O2i[i]/100,i=1..n):

#19

> SA := FA/(FA+FB);

$$SA := \frac{1}{2}$$

#20

> SB := FB/(FA+FB);

$$SB := \frac{1}{2}$$

#21

> WPAIA := PAFA/(Wfe*SA);

WPAIA := 28176.4 apa CP
$$\frac{PSpa (28.97 \text{ Wma} + 28.97)}{1.608015098 \text{ Wma} + 1} \left(\sqrt{\frac{DPpa_1}{Tpa_1}} + \sqrt{\frac{DPpa_2}{Tpa_2}} \right)$$

$$+ \sqrt{\frac{DPpa_{3}}{Tpa_{3}}} + \sqrt{\frac{DPpa_{4}}{Tpa_{4}}} + \sqrt{\frac{DPpa_{5}}{Tpa_{5}}} + \sqrt{\frac{DPpa_{6}}{Tpa_{6}}} + \sqrt{\frac{DPpa_{7}}{Tpa_{7}}} + \sqrt{\frac{DPpa_{8}}{Tpa_{8}}} + \sqrt{\frac{DPpa_{8}}{Tpa_{8}}} + \sqrt{\frac{DPpa_{10}}{Tpa_{10}}} + \sqrt{\frac{DPpa_{11}}{Tpa_{11}}} + \sqrt{\frac{DPpa_{12}}{Tpa_{12}}} + \sqrt{\frac{DPpa_{13}}{Tpa_{13}}} + \sqrt{\frac{DPpa_{14}}{Tpa_{14}}} + \sqrt{\frac{DPpa_{15}}{Tpa_{15}}} + \sqrt{\frac{DPpa_{16}}{Tpa_{16}}} + \sqrt{\frac{DPpa_{17}}{Tpa_{17}}} + \sqrt{\frac{DPpa_{18}}{Tpa_{18}}} + \sqrt{\frac{DPpa_{19}}{Tpa_{19}}} + \sqrt{\frac{DPpa_{20}}{Tpa_{20}}} / \text{Wfe}$$

#22

> WPAIB := PAFB/(Wfe*SB);

#23

> Cr := (A*OUHD*Ca)/(1-Ca) + (A*(1-OUHD)*Ca/3)/(1-Ca/3);

$$Cr := \frac{A \text{ OUHD } Ca}{1 - Ca} + \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca}$$

> Cb := C - Cr;

$$Cb := C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

> WAi := (28.02*(100-CO2avei-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei))*(Cb+(12.01*(CO2avei+COavei)))*(Cb+(12.01*(COavei)))*(Cb+(12.01*(COavei)))*(Cb+(12.01*(COavei)))*(Cb+(12.01*(COavei)))*(Cb+(12.01*(COavei)))*(Cb+(12.01*(Coavei)))*(Cb+(12.01*(Coavei)))*(Cb+(12.01*(Coavei)))*(Cb+(12.01*(Coavei)))*(Cb+(12.01*(Coavei)))*(Cb+(12.01*(Coavei)))*

> 1/32.07)*S)-N)/0.7685;

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N$$

#24

> WMGI := 8.936*H + (Wma*WAi)+Mf;

WMGi := 8.936 H + Wma
$$\left(36.46063760 (100 - CO2avei - COavei - O2avei)\right)$$

$$\left(C - \frac{A \text{ OUHD Ca}}{1 - Ca} - \frac{1}{3} \cdot \frac{(1 - OUHD) \text{ Ca}}{1 - \frac{1}{3} \text{ Ca}} + .3744932959 \text{ S}\right) / (12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 \text{ N} + Mf$$

#25

> WGpi := ((44.01*CO2avei+32.02*O2avei+28.01*COavei+28.02*(100-CO2avei-COav

> el-O2avei))/(12.01*(CO2avel+COavei))*(Cb+(12.01/32.07)*S));

$$WGpi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2avei + 12.01 COavei)

#26

> WGi := WGpi + WMGi;

$$WGi := (15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \ \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

12.01 CO2avei + 12.01 COavei) + 8.936 H + Wma 36.46063760

$$\left(C - \frac{A \quad OUHD \quad Ca}{1 - Ca} - \frac{1}{3} \quad \frac{A \quad (1 - OUHD) \quad Ca}{1 - \frac{1}{3} \quad Ca} + .3744932959 \quad S\right) / (100 - CO2avei - COavei - O2avei)$$

#27

> WAo :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C > b + (12.01/32.07)*S)-N)/0.7685;

WAO := 36.46063760 (100 - CO2aveo - COaveo - O2aveo)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / (12.01 \text{ CO2aveo} + 12.01 \text{ COaveo}) - 1.301236174 \text{ N}$$

±28

> WMGo := 8.936*H + (Wma*WAo) + Mf;

WMGo := 8.936
$$H + Wma$$
 $\left(36.46063760 (100 - CO2aveo - COaveo - O2aveo) \right)$

$$\left(C - \frac{A OUHD Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$
12.01 $CO2aveo + 12.01 COaveo) - 1.301236174 N + Mf$

#20

> WGpo := ((44.01*CO2aveo+32.02*O2aveo+28.01*COaveo+28.02*(100-CO2aveo-C

> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));

$$WGpo := (15.99 \ Co2aveo + 4.00 \ O2aveo - .01 \ Coaveo + 2802.00)$$

$$\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / ($$

$$12.01 \ Co2aveo + 12.01 \ Coaveo)$$

#30

> WGo := WGpo + WMGo;

WGo := (15.99 CO2aveo + 4.00 O2aveo - .01 COaveo + 2802.00)
$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / ($$



12.01
$$CO2aveo + 12.01$$
 $COaveo) + 8.936$ $H + Wma$ $\left(36.46063760\right)$ $\left(100 - CO2aveo - COaveo - O2aveo\right)$ $\left(C - \frac{A \ OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{A \ (1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca} + .3744932959 \ S\right) / (12.01 \ CO2aveo + 12.01 \ COaveo) - 1.301236174 \ N + Mf$

#31 > AL := ((WGo-WGi)/WGi)*100;

L:= ((WGo-WGI)/WGI)-100;
AL:=
$$100 \left(\frac{(15.99 \ CO2aveo + 4.00 \ O2aveo - .01 \ COaveo + 2802.00) \ \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} + \frac{(100 - CO2aveo - COaveo - O2aveo) \ \%1}{12.01 \ CO2aveo + 12.01 \ COaveo} - \frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} - \frac{(100 - CO2avei - COavei - O2avei) \ \%1}{\%2} - \frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} + \frac{(15.99 \ CO2avei + 4.00 \ O2avei - .01 \ COavei + 2802.00) \ \%1}{\%2} + \frac{8.936 \ H}{\%2} + \frac{1.301236174 \ N}{\%2} + \frac{1.301236174$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

%2 := 12.01 CO2avei + 12.01 COavei

#32

> TFluegaslNa := WGi*Wfe*SA;

TFluegasINa :=
$$\frac{1}{2}$$
 (15.99 CO2avei + 4.00 O2avei - .01 COavei + 2802.00)

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / (1 - \frac{1}{3} Ca)$$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) + 8.936 \text{ } H + \text{Wma} \left(36.46063760 \right)$$

$$\left(100 - \text{CO2avei} - \text{COavei} - \text{O2avei} \right)$$

$$\left(C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - \text{OUHD}) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S \right) / (1 - \frac{1}{3} Ca)$$

$$12.01 \text{ CO2avei} + 12.01 \text{ COavei}) - 1.301236174 N + Mf$$

$$\text{Wfe}$$

TFluegasINb := WGi*Wfe*SB;

#33
TFluegasOUTa := WGo*Wfe*SA;
TFluegasOUTb := WGo*Wfe*SB;

> sigmaAL := sqrt(

> Diff(AL,CO2avei)^2*varCO2avei +

> Diff(AL,COavei)^2*varCOavel +

> Diff(AL,O2avei)^2*varO2avei +

> Diff(AL,CO2aveo)^2*varCO2aveo +

> Diff(AL,COaveo)^2*varCOaveo +

> Diff(AL,O2aveo)^2*varO2aveo +

> Diff(AL,A)^2*varA +

> Diff(AL,OUHD)^2*varOUHD +

> Diff(AL,Ca)^2*varCa +

> Diff(AL,C)^2*varC +

> Diff(AL,S)^2*varS +

> Diff(AL,H)^2°varH +

> Diff(AL,N)^2*varN +

>):

> sigmaAL := value(");
$$sigmaAL := \left(100 \frac{.15.99 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2^2} - \%14}{\%6} \right)$$

$$-100 \frac{\%10 \left(15.99 \frac{\%1}{\%2} - 12.01 \frac{\%5 \%1}{\%2^2} + \%14 \right)}{\%6}$$

$$varco2avei + \left(\frac{.01 \frac{\%1}{\%2} + 12.01 \frac{\%5 \%1}{\%2^2} - \%14}{\%6} \right)$$

$$-100 \frac{\%10 \left(-.01 \frac{\%1}{\%2} - 12.01 \frac{\%5 \%1}{\%2^2} + \%14 \right)}{\%6}$$

$$-100 \frac{-4.00 \frac{\%1}{\%2} + 36.46063760 \frac{\text{Wma \%1}}{\%2}}{\%6}$$

$$-100 \frac{\%10 \left(4.00 \frac{\%1}{\%2} - 36.46063760 \frac{\text{Wma \%1}}{\%2} \right)}{\%6}$$

$$varco2avei + \left(15.99 \frac{\%1}{\%7} - 12.01 \frac{\%9 \%1}{\%7^2} + \text{Wma} \left(-36.46063760 \frac{\%1}{\%7} - 437.8922576 \frac{\%8 \%1}{\%7^2} \right) \right)$$

$$2 \text{varco2aveo} / \%6^2 + 10000$$

$$\left[-.01 \frac{\%1}{\%7} - 12.01 \frac{\%9}{\%7^2} + \text{Wma} \left(-36.46063760 \frac{\%1}{\%7} - 437.8922576 \frac{\%8}{\%7^2} \frac{\%1}{1} \right) \right]$$

$$varCOaveo / \%6^2 + 10000 \frac{\left(4.00 \frac{\%1}{\%7} - 36.46063760 \frac{\text{Wma}}{\%7} - 36.46063760 \frac{\text{Wma}}{\%7} \right)^2 \text{ varO2aveo} }{\%6^2}$$

$$100 \left(\frac{\%9}{\%9} \frac{\%13}{\%7} + 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%8}{\%7} - \frac{\%5}{\%2} \frac{\%13}{32} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)$$

$$\sqrt{(\%6) - 100} \frac{\%10 \left(\frac{\%5}{\%2} \frac{\%13}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2 \text{ varA} + \left(100 \right) }{\%6^2}$$

$$\sqrt{(\%6) - 100} \frac{\%10 \left(\frac{\%5}{\%2} \frac{\%12}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2} \frac{\%12}{36.46063760} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right) }{\%6^2}$$

$$\sqrt{(\%6) - 100} \frac{\%10 \left(\frac{\%5}{\%2} \frac{\%12}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2 \text{ varOUHD} + \left(1 \right) }{\%6^5}$$

$$\sqrt{(\%6) - 100} \frac{\%10 \left(\frac{\%5}{\%2} \frac{\%11}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2 \text{ varCa} + \left(\frac{\%9}{\%7} + 36.46063760 \frac{\text{Wma}}{\%7} \frac{\%8}{\%7} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$\sqrt{(\%6) - 100} \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%7} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%7} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%7} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%7} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%7} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%3}{\%2} \right)^2$$

$$- 100 \frac{\%10 \left(\frac{\%5}{\%2} + 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2} - 36.46063760 \frac{\text{Wma}}{\%2} - \frac{\%5}{\%2}$$

$$-100 \frac{\%10 \left(.3744932959 \frac{\%5}{\%2} + 13.65426435 \frac{\text{Wma } \%3}{\%2}\right)^{2}}{\%6^{2}} \text{ vars}$$

$$+798520.9600 \frac{\%10^2 \text{ varH}}{\%6^4} +$$

$$\left(100 \frac{36.46063760 \frac{\%8 \%1}{\%7} - 36.46063760 \frac{\%3 \%1}{\%2}}{\%6} - 100 \frac{\%10 \%4}{\%6^2}\right)^2 \text{ varWma}$$

$$+16932.15581 \frac{\%10^2 \text{ Wma}^2 \text{ varN}}{\%6^4} + 10000 \frac{\%10^2 \text{ varMf}}{\%6^4}$$

$$\%1 := C - \frac{A \text{ OUHD } Ca}{1 - Ca} - \frac{1}{3} \frac{A (1 - OUHD) Ca}{1 - \frac{1}{3} Ca} + .3744932959 S$$

$$%4 := 36.46063760 \frac{%3 \%i}{\%2} - 1.301236174 N$$

$$\%6 := \frac{\%5 \%1}{\%2} + 8.936 H + Wma \%4 + Mf$$

$$\%10 := \frac{\%9 \%1}{\%7} + \text{Wma} \left(36.46063760 \frac{\%8 \%1}{\%7} - 1.301236174 \text{ N} \right) - \frac{\%5 \%1}{\%2} - \text{Wma} \%4$$

$$\%11 := -\frac{A \text{ OUHD}}{1 - Ca} - \frac{A \text{ OUHD Ca}}{\left(1 - Ca\right)^2} - \frac{1}{3} \frac{A \left(1 - \text{OUHD}\right)}{1 - \frac{1}{3} Ca} - \frac{1}{9} \frac{A \left(1 - \text{OUHD}\right) Ca}{\left(1 - \frac{1}{3} Ca\right)^2}$$

$$\%12 := -\frac{A \quad Ca}{1 - Ca} + \frac{1}{3} \frac{A \quad Ca}{1 - \frac{1}{3} \quad Ca}$$

$$\%13 := -\frac{OUHD \ Ca}{1 - Ca} - \frac{1}{3} \frac{(1 - OUHD) \ Ca}{1 - \frac{1}{3} \ Ca}$$

%14 := Wma
$$\left(-36.46063760 \frac{\%1}{\%2} - 437.8922576 \frac{\%3 \%1}{\%2^2} \right)$$

> sigmaALCO2avei := sqrt(Diff(AL,CO2avei)^2*varCO2avei):

> sigmaALCO2avei := value("):

> sigmaALCOavel := sqrt(Diff(AL,COavel)^2*varCOavel):

> sigmaALCOavei := value("):

> sigmaALO2avei := sqrt(Diff(AL,O2avel)^2*varO2avel):

> sigmaALO2avei := value("):

> sigmaALCO2aveo := sqrt(Diff(AL,CO2aveo)^2*varCO2aveo):

> sigmaALCO2aveo := value("):

> sigmaALCOaveo := sqrt(Diff(AL,COaveo)^2*varCOaveo):

> sigmaALCOaveo := value("):

> sigmaALO2aveo := sqrt(Diff(AL,O2aveo)^2*varO2aveo):

> sigmaALO2aveo := value("):

> sigmaALA := sqrt(Diff(AL,A)^2*varA):

> sigmaALA := value("):

> sigmaALOUHD := sqrt(Diff(AL,OUHD)^2*varOUHD):

<pre>> sigmaALOUHD := value("): > sigmaALCa := sqrt(Diff(AL,Ca)^2*varCa): > sigmaALC := sqrt(Diff(AL,C)^2*varC): > sigmaALC := sqrt(Diff(AL,C)^2*varC): > sigmaALC := value("): > sigmaALS := sqrt(Diff(AL,S)^2*varS): > sigmaALS := value("): > sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := sqrt(Diff(AL,N)^2*varN): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := sqrt(Diff(AL,Mf)^2*varMf):</pre>
<pre>> sigmaALCa := value("): > sigmaALC := sqrt(Diff(AL,C)^2*varC): > sigmaALC := value("): > sigmaALS := sqrt(Diff(AL,S)^2*varS): > sigmaALS := value("): > sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := value("): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALWma := value("): > sigmaALWma := value("):</pre>
<pre>> sigmaALC := sqrt(Diff(AL,C)^2*varC): > sigmaALC := value("): > sigmaALS := sqrt(Diff(AL,S)^2*varS): > sigmaALS := value("): > sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := value("): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):</pre>
<pre>> sigmaALC := value(*): > sigmaALS := sqrt(Diff(AL,S)^2*varS): > sigmaALS := value(*): > sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := value(*): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value(*): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value(*):</pre>
<pre>> sigmaALS := sqrt(Diff(AL,S)^2*varS): > sigmaALS := value("): > sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := value("): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):</pre>
<pre>> sigmaALS := value("): > sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := value("): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):</pre>
> sigmaALH := sqrt(Diff(AL,H)^2*varH): > sigmaALH := value("): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):
<pre>> sigmaALH := value("): > sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):</pre>
<pre>> sigmaALWma := sqrt(Diff(AL,Wma)^2*varWma): > sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):</pre>
<pre>> sigmaALWma := value("): > sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):</pre>
> sigmaALN := sqrt(Diff(AL,N)^2*varN): > sigmaALN := value("):
> sigmaALN := value("):
> sigmaALMf := sqrt(Diff(AL,Mf)^2"varM1):
> sigmaALMf := value("):
Constants
Averages and Random Error Variances from Part A (n=20 for in, n=24 for out)
> CO2avei := 15.2148; CO2avei := 15.2148
> varCO2avei := .102^2;
> COavei := .005;
COavei := .005;
> varCOavel := .0002^2;
varCOavei:=.4 10 ⁻⁷
> O2avei := 3.8; 02avei := 3.8
> varO2avei := 01118^2:
> varO2avei := .01118^2; varO2avei := .0001249924
> varO2avei := .01118^2;

> varCO2aveo := .0866^2;
varCO2aveo := .00749956
> COaveo := .004;
C0aveo := .0()4
> varCOaveo := .000204^2;
varCOaveo := .41616 10 ⁻⁷
> O2aveo := 5;
02aveo := 5
> varO2aveo := .010206^2;
var02aveo := .000104162436
Coal Feed Rate (lbs/hr) re
> Wfe := 115839;
Wfe:= 115839
> varWfe := (0.0025*Wfe)^2;
varWfe:=83866.71200
Area (square ft) re
> Areai := 3.99; Areai := 3.99
> varAreal := (0.0335*Areal)^2; varAreal := .01786633223
VaIAI eal01760033223
> Areao := 3.54;
Areao := 3.54
> varAreao := (0.0364*Areao)^2;
varAreao := .01660386874
Pitot Coefficient re
> CP := 0.84;
CP := .84
> varCP := (0)^2;
varCP := 0
Pressure Ambient or Barometric re
> PSi := 29.23;
PSi := 29.23
> varPSi := (0.04)^2;
varPSi := .0016

```
> PSo := 29.1;
                                              PSo := 29.1
> varPSo := (0.04)^2;
                                           varPSo := .0016
   Pressue for primary air
> PSpa := 31.11;
                                             PSpa := 31.11
> varPSpa := (0.04)^2;
                                          varPSpa := .0016
   Velocity Head DP re
> v := .45802;
                                               v := .45802
> DPo := array([seq(v,i=1..n)]);
      DPo := [.45802 \quad .45802        .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802 .45802
       .458021
 > u := .00005^2;
                                             u := .25 \cdot 10^{-8}
 > var := array([seq(u,i=1..n)]);
     var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
       .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
       .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup>
 > varDPo := make_array(var,n);
                                         varDPo:= varcovar
 > v := .82831;
                                               v := .82831
 > DPi := array([seq(v,i=1..n)]);
      DPi:=[.82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
        .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831 .82831
         .82831]
  > u := .00005^2;
                                              u := .25 \cdot 10^{-8}
```

```
> var := array([seq(u,i=1..n)]);
    var := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
     .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8} .25 \cdot 10^{-8}
      .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup> .25 10<sup>-8</sup>
> varDPi := make_array(var,n);
                                      varDPi := varcovar
  Area for primary air
> apa := .63;
                                            apa := .63
> varapa := (.0208*apa)^2;
                                    varapa := .000171714816
> v := .2171:
                                             v := .2171
> DPpa := array([seq(v,i=1..n)]);
       DPpa:=[.2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
         .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171 .2171
  u := (0.00005)^2:
                                           u := .25 \cdot 10^{-8}
 > varDPpa := array([seq(u,i=1..n)]);
     varDPpa := \begin{bmatrix} .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} & .25 & 10^{-8} \end{bmatrix}
       .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8} .25 10^{-8}
       25 \cdot 10^{-8} .25 \cdot 10^{-8}
 > v := 1104;
                                              v := 1104
 > Tpa := array([seq(v,i=1..n)]);
        > u := (0.005*(v - 460))^2;
                                           u := 10.368400
 > varTpa := array([seq(u,i=1..n)]);
```

10.368400 10.368400 10.368400 10.368400 10.368400 10.368400 10.368400

10.368400 10.368400 10.368400 10.368400 10.368400 10.368400 10.	368400]
Temperature (R) re	
· v := 713;	
v := 713	
• To := array([seq(v,l=1n)]);	
To:=[713 713 713 713 713 713 713 713 713 713	13 713
713 713 713 713 713 713]	
> u := (.005*(v-460))^2;	
u := 1.600225	
• var := array([seq(u,i=1n)]);	2225
Var := [1.000223 1.0000223 1.0000223 1.0000223 1.0000223 1.0000223 1.000000000000000000000000000000000000	0225
1.600225 1.600225 1.600225 1.600225 1.600225 1.600225 1.600225	1.60022
1.600225 1.600225 1.600225 1.600225 1.600225]	
varTo := make_array(var,n);	
varTo:= varcovar	
v := 1140;	
v := 1140	
Ti:= array([seq(v,i=1n)]);	
Ti := [1140 1140 1140 1140 1140 1140 1140 114	1140
1140 1140 1140 1140 1140 1140 1140 1140	
> u := (.005°(v-460))^2;	
u := 11.560000	
> var := array([seq(u,i=1n)]);	
var:=[11.560000 11.560000 11.560000 11.560000 11.560000 11.560000	0
11.560000 11.560000 11.560000 11.560000 11.560000 11.560000 11.	560000
11.560000 11.560000 11.560000 11.560000 11.560000 11.560000 11.	560000]
> varTi := make_array(var,n);	
varTi := varcovar	
Moisture in Ash re	
> Mf :=0.06;	
Mf := .06	
> varMf := ((0.2+0.12*Mf*100)/(2*1.414*100))^2;	
varMf := .000001058319613	
Ash re	
> A := 0.0619;	

	A := .0619	
varA := ((0.07+0.02*A*	100)/(2*1.414*100))^2;	
	varA:=.4696223261 10 ⁻⁶	
Overhead re		
> OUHD := 0.9;		
	<i>OUHD</i> := .9	
> varOUHD := (0.1*OUH	D)^2;	
•	varOUHD := .0081	
Carbon re		
> C := 0.7381;		
	C := .7381	
> varC := (0.64/(2*1.414*	100))^2;	
• •	varC := .5121546706 10 ⁻⁵	
	Valc5121540700 10	
Undragen re		
Hydrogen re > H := 0.0482;		
> 11 .= 0.0 1 02,	H := .0482	
> varH := (0.16/(2*1.414*		
> vain := (0.10/2 1.414		
	varH := .3200966692 10 ⁻⁶	
Nitrogen re		
> N := 0.0135;	0125	
	N := .0135	
> varN := (0.11/(2*1.414*		
	varN:=.1512956913 10 ⁻⁶	
Sulfur re		
> S := 0.0123;		
	s := .0123	
> varS := ((0.06+0.035*S	*100)/(2*1.41 4 *100))^2;	
	vars:=.1327813813 10 ⁻⁶	
	V415 152/015015 10	
CO2 re		
> v := 14.145;		
=	14 145	
	v := 14.145	

```
14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145 14.145
     14.145]
> u := (0.03*v)^2;
                               u := .1800729225
> var := array([seq(u,i=1..n)]);
   var := [.1800729225 \ .1800729225 \ .1800729225 \ .1800729225 \ .1800729225
     .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
     .1800729225 .1800729225 .1800729225 .1800729225 .1800729225
     .1800729225 .1800729225 .1800729225]
> varCO2o := make_array(var,n);
                            varCO2o := varcovar
> v := 15.2148;
                                v := 15.2148
> CO2i := array([seq(v,i=1..n)]);
   CO2i := [15.2148 \quad 15.2148      15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148 15.2148
     15.2148 15.2148 15.2148 15.2148]
> u := (0.03°v)^2:
                               u := .2083411251
> var := array([seq(u,l=1..n)]);
    var:=[.2083411251 .2083411251 .2083411251 .2083411251 .2083411251
     .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
     .2083411251 .2083411251 .2083411251 .2083411251 .2083411251 .2083411251
     .2083411251 .2083411251 .2083411251]
> varCO2i := make_array(var,n);
                            varCO2i := varcovar
  O2 re
> ∀ := 5;
                                   v := 5
> O20 := array([seq(v,i=1..n)]);
       > u := (0.05)^2;
                                  u := .0025
> var := array([seq(u,i=1..n)]);
                                           .0025 .0025 .0025 .0025 .0025
      var:=[.0025 .0025 .0025 .0025 .0025
                                                       .0025 .0025]
       .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
```

```
> varO2o := make_array(var,n);
                                                                                                                                              var02o:= varcovar
> v := 3.8:
                                                                                                                                                                              v := 3.8
> O2i := array([seq(v,i=1..n)]);
                     02i := [3.8 \quad 3.8                            3.8 3.8 3.8 3.8 3.8]
> u := (0.05)^2;
                                                                                                                                                                           u := .0025
> var := array([seq(u,i=1..n)]);
                            var:=[.0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025
                                   .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025 .0025]
 > varO2i := make_array(var,n);
                                                                                                                                                 varO2i := varcovar
          Moisture (air) re
   > Wma := 0.013;
                                                                                                                                                                       Wma := .013
          varWma := (.2*Wma)^2;
                                                                                                                                                   varWma:=.676 10<sup>-5</sup>
         CO re
   > v := 0.005;
                                                                                                                                                                             v := .005
   > COo := array([seq(v,i=1..n)]);
                                                                                                                                       COo := [.005 .005]
                                                                                                              .005
                                                                                                                                                                .005 .005 .005]
                                   .005 .005 .005
                                                                                                           .005
                                                                                                                                      .005
    > u := (0.001)^2;
                                                                                                                                                                     u := .1 \cdot 10^{-5}
   > var := array([seq(u,i=1..n)]);
                        var := \begin{bmatrix} .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} & .1 & 10^{-5} \end{bmatrix}
                              .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5} .1 \cdot 10^{-5}
                              .1 10<sup>-5</sup> .1 10<sup>-5</sup> .1 10<sup>-5</sup>
    > varCOo := make_array(var,n);
                                                                                                                                                   varCOo:= varcovar
```

> v := 0.005;		v:	= .005						
> COI := array([seq(v,l=1n)]);									
COi := [.005 .005 .005]	.005	.005	.005	.005	.005	.005	.005	.005	.005
.005 .005 .005 .005	.005	.005	.005	.005]					
> u := (0.001)^2;									
> u = (every - 1		u :=	.1 10	5					
> var := array([seq(u,i=1n)]);					_			_	-
$\frac{10^{-5}}{10^{-5}}$.1 10	-5 .I	10-5	.1 10	.1 ⁻⁵	10-5	.1 1	0-3 .	1 10-3
.1 10 ⁻⁵ .1 10 ⁻⁵ .1 10	·5 .1	10 ⁻⁵	.1 10) ⁻⁵ .l	10 ⁻⁵	.1 10) ⁻⁵ .1	1 10-5	
.1 10 ⁻⁵ .1 10 ⁻⁵ .1 10	.1	10-5							
> varCOl := make_array(var,n)									
		rC0i	= var	covar					
									
Carbon in Ash re									
> Ca := 0.0486;		Ca	:= .048	6					
> varCa := (0.1°Ca)^2;									
,	Vā	rCa:	= .0000	236196	<u> </u>				
Results									
> eval(AL);		6.81	700442	52					
		0.0	700112						
> eval(sigmaAL);		.86	548594	56					
> eval(100*sigmaAL/AL);									
		12.	597967	55					
		· · · · · ·							
> evalf(sigmaALCO2avei);		.63	673856	669					
> evalf(sigmaALCOavei);							 '		
> oranjoignmme ==/		.001	354711	120					
> evalf(sigmaALO2avei);									
		100.	308328	3988					
> evalf(sigmaALCO2aveo);									

	.5861828919
evalf(sigmaALCOaveo);	
	.001489882249
evalf(sigmaALO2aveo);	
	.001202147989
evalf(sigmaALA);	
	.00001140689853
evalf(sigmaALOUHD);	
·	.00006740663400
evalf(sigmaALCa);	
	.0001081747388
evalf(sigmaALC);	
	.0007910337493
<pre>> evalf(sigmaALS);</pre>	2200 15(005(152
	.00004769876152
evalf(sigmaALH);	20244524444
	.002665266661
> evalf(sigmaALWma);	20100001012
	.001278941713
> evalf(sigmaALN);	
	.3468723555 10 ⁻⁵
> evalf(sigmaALMf);	
, orange same	.001715004846
> l := 'l';	
	i := i
#13 > m := (Wma * 28.97+28.97)/	///Wma*28 97/18 016)+1):
> m := (Wma - 28.9/+28.9/)/	m := 28.74570417
	an 20.7 1370
#14	
> PAFA := 14088.2*apa*CP*	sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
Situation transmission of	PAFA := 62529.82254
> PAFB := 14088.2*apa*CP*	sqrt(PSpa*m)*sum((DPpa[i]/Tpa[i])^(1/2),i=1n);
•	PAFB := 62529.82254

#17	WARRANT & OTHER CO.C. S. CO. CO.S. H.W.
FA := 5348840*Areai*CP*sqrl	t(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-l	MFG(i,A,OUHD,Ca,C,S,COI,CO2i,H,Wma,O2i,N,Mf))*C
O2i[i]/100,i=1n):	
#18	WE STRUMM A CHUR Co C C COI CO2I H W
FB := 5348840*Areal*CP*sqr	t(PSi)*sum((DPi[i]/(M(i,A,OUHD,Ca,C,S,COi,CO2i,H,W
- ma,O2i,N,Mf)*Ti[i]))^(1/2)*(1-	MFG(I,A,OUHD,Ca,C,S,COI,CO2I,H,Wma,O2I,N,Mf))*C
> O2i[i]/100,i=1n):	
410	
#19	
SA := FA/(FA+FB);	SA := .5000000000
	SA300000000
#20	
#20 > SB := FB/(FA+FB);	
> 3D := FD/(1 AT1 D);	SB := .50000000000
	-, ac
#21	
> WPAIA := PAFA/(Wfe*SA);	. 070500707
	WPAIA := 1.079598797
#22	
> WPAIB := PAFB/(Wfe*SB);	
	WPAIB:= 1.079598797
#23	
> Cr := (A*OUHD*Ca)/(1-Ca) +	(A*(1-OUHD)*Ca/3)/(1-Ca/3);
•	Cr := .002947741741
> Cb := C - Cr;	
) CB := 0	Cb := .7351522583
	-COavei-O2avei)/(12.01*(CO2avei+COavei))*(Cb+(12.
> WAI := (28.02-(100-CO2avei	-COaver-Ozavery(12.51 (OOZaver) Coaver-Ozavery
> 1/32.07)*S)-N)/0.7685;	WAi := 11.93169660
	WA1 := 11.93109000
43.1	
#24	(Ai)+Mf:
#24 > WMGi := 8.936*H + (Wma*W	'Ai)+Mf; WMGi := .6458272558

#25
> WGpi := ((44.01°CO2avei+32.02°O2avel+28.01°COavei+28.02°(100-CO2avei-COav
> ei-O2avei))/(12.01*(CO2avei+COavei))*(Cb+(12.01/32.07)*S));
WGpi := 12.38591870
#26
> WGi := WGpi + WMGi;
WGi := 13.03174596
WG1 15.05174370
NA.
#27 > WAO :=(((28.02*(100-CO2aveo-COaveo-O2aveo))/(12.01*(CO2aveo+COaveo)))*(C
> b + (12.01/32.07)*S)-N)/0.7685;
\Rightarrow B + (12.01/32.07) 3 <i>F</i> (4)0.7003, $WAO := 12.81551267$
WAO := 12.81331207
#28
> WMGo := 8.936°H + (Wma°WAo) + Mf;
WMGo := .6573168647
#29
> WGpo := ((44.01°CO2aveo+32.02°O2aveo+28.01°COaveo+28.02°(100-CO2aveo-C
> Oaveo-O2aveo))/(12.01*(CO2aveo+COaveo))*(Cb+(12.01/32.07)*S));
WGpo := 13.26971581
#30
> WGo := WGpo + WMGo;
WGo := 13.92703267
#31
> AL := ((WGo-WGi)/WGi)*100;
AL := 6.870044219
422
#32 > TFluegasINa := WGi*Wfe*SA;
TFluegasiNa := 754792.2100
TFluegaslNb := WGi*Wfe*SB;
#33
TFluegasOUTa := WGo*Wfe*SA;
TFluegasOUTb := WGo*Wfe*SB;
>

MILLIKEN STATION HEAT PIPE AIR HEATER PERFORMANCE UNCERTAINTY ANALYSIS OF "TOTALLY CORRECTED GAS TEMPERATURE LEAVING THE AIR HEATER"

Prepared by

CONSOL Inc.
Research and Development
4000 Brownsville Road
Library, Pennsylvania 15129-9566

Principal Investigator
J. T. Maskew

Prepared For

New York State Electric & Gas Corporation
Corporate Drive
Kirkwood Industrial Park
P.O. Box 5224
Binghamton, New York 13902-5224

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Milliken Station Heat Pipe Air Heater Performance Uncertainty Analysis of "Totally Corrected Gas Temperature Leaving the Air Heater"

This report documents the uncertainty analysis of the "totally corrected gas temperature leaving the air heater" as specified in the ASME performance code. The analysis was requested by ABB Air Preheater Inc. (ABB API) and New York State Electric & Gas Corporation (NYSEG) in support of the performance testing of the Milliken Station heat pipe air heater. This analysis estimates the uncertainty of the final, corrected gas outlet temperature for the flue gas leaving the primary air side as ± 4.75 °F. For the flue gas leaving the secondary air side, the uncertainty is ± 4.8 °F. The uncertainty for the combined flue gas stream is ± 4.4 °F.

This following report discusses the procedures used and the sources of the values used in this calculation.

UNCERTAINTY CALCULATIONS

During a conference call with CONSOL R&D, held on March 5, 1996, ABB API raised additional questions concerning the measurements required to evaluate the performance of their heat pipe air heater. Specifically CONSOL was asked to extend their previously published analysis, Milliken Station Heat Pipe Air Heater Performance Uncertainty Analysis, McCoy, D. C. and Bilonick, R. A., June 1995. NYSEG agreed to extend the previous analysis to evaluate the uncertainty in the calculation of the totally corrected outlet temperature of the flue gas. Specifically, Equation 7.12 of the Air Heaters — Supplement to Performance Test Code for Steam Generating Units, PTC 4.1; ASME PTC 4.3 -- 1974 will serve as the basis for this analysis. This analysis completes the uncertainty estimates for the heat pipe air heater performance testing.

A procedure similar to that detailed in the previous report (McCoy, 1995) was used to estimate these errors. Briefly, two categories of errors are present in measured values: biases (or fixed) errors and random errors. Biases are associated with the measuring equipment and cannot be minimized by repeat measurements. However, since many calculations present in the ASME performance code involve differences and ratios, the biases tend to compensate for one another. Random errors on the other hand are reduced by repeat measurements. For purposes of this analysis, only a single final evaluation was assumed. Repeating the test will reduce the random error portion of the uncertainty analysis estimated by this study.

Both error types propagate through the performance code calculations. The two types of errors are propagated separately with the final bias and random errors combined to yield the uncertainty in the result. In the previous study, partial derivatives of the function with respect to each parameter were determined. The errors are then propagated by a Taylor Series expansion of these derivatives.

The following formula was used to propagate the errors:

$$S_r = \left[\sum_{\substack{i=1\\j=1}}^n \frac{\partial f}{\partial x_i} \cdot \frac{\partial f}{\partial x_j} \cdot \sigma_{x_i} \cdot \sigma_{x_j} \right]^{\frac{1}{2}}$$
 (1)

where

 $\frac{\partial f}{\partial x_i}$ = Partial derivative of the function f with respect to x_i ,

 $\frac{\partial f}{\partial x_j}$ = Partial derivative of the function f with respect to x_j ,

 σ_{x} = Error in i, and

 $\sigma_{x_i} = \text{Error in } j$.

However, the applicability of Equation 1 to nonlinear equations is limited. Its estimate can become inaccurate for highly nonlinear equations. Then, the following equation should be used:

$$S_r = \left[\sum_{\substack{i=1\\j=1}}^n \frac{\Delta f}{\Delta x_i} \cdot \frac{\Delta f}{\Delta x_j} \cdot \sigma_{x_i} \cdot \sigma_{x_j} \right]^{\frac{1}{2}}$$
 (2)

where

 $\frac{\Delta f}{\Delta x}$ = Incremental change in the function f with respect to x_i , and

 $\frac{\Delta f}{\Delta x_i}$ = Incremental change in the function f with respect to x_j .

Of course, in the limit, as Δ approaches zero, this equation is identical to Equation 1. The difference is that Equation 2 is a numerical approach to solving the uncertainty analysis. Carl James (James, 1995) used a similar procedure to evaluate the uncertainty in the design of a cross-flow heat exchanger.

Equation 2 approximates the actual function f surface as a linear segment parallel to the true functional relationship. Equation 1 is generally a more accurate estimate of the error limit for linear equations. For independent parameters, only the i = j terms are non-zero. This is true for both relationships. Equation 1 will be evaluated initially. This was the equation used in the previous study. (McCoy, 1995.)

After evaluating the bias and random errors for the function separately, the uncertainty is calculated by:

$$U = [B^2 + (t \cdot S)^2]^{\frac{1}{2}}$$
 (3)

where

U =Uncertainty interval,

B = Overall bias error statistic,

S = Overall random error statistic, and

t = Appropriate Student t value.

For 95% significance, the value of Student t is approximately two.

CORRECTED FLUE GAS OUTLET TEMPERATURE

The totally corrected flue gas outlet temperature, $t_{G15 \delta Total}$, shown in the ASME guide as Equation 7.12, is:

$$t_{GIS \,\delta_{Total}} = t_{GIS \,\delta_A} + t_{GIS \,\delta_G} + t_{GIS \,\delta_{XR}} + t_{GIS \,\delta_{K}} - 3 \cdot t_{GIS}$$
 (4)

where

 $t_{GI5 \delta_A}$ = Flue gas temperature leaving the air heater corrected for the deviation from design of the entering air temperature, °F,

 $t_{G15 \ \delta_G}$ = Flue gas temperature leaving the air heater corrected for deviation from design of the entering flue gas temperature, °F,

 $t_{G15 \delta_{XR}}$ = Flue gas temperature leaving the air heater corrected for deviation from design of the X-ratio, °F,

 $t_{G15 \ \delta_{\bullet}}$ = Flue gas temperature leaving the air heater corrected for deviation from design of the entering gas flow, °F, and

 t_{GIS} = Measured flue gas temperature leaving the air heater, °F.

The ASME Performance Test Codes provide definitions for two of the temperature corrections. The other corrections, $t_{GI5\ \delta XR}$ and $t_{GI5\ \delta E}$, are unique to the design of an air heater. ABB API supplied the X-ratio and gas flow correction factors for their heat pipe air heater.

For the flue gas temperature leaving the air heater corrected for deviation from the design entering air temperature, $t_{GIS \Delta A}$, this temperature correction is:

$$t_{GI5 \ \delta_A} = \frac{t_{A8D} \cdot (t_{GI4} - t_{GI5}) + t_{GI4} \cdot (t_{GI5} - t_{A8})}{(t_{GI4} - t_{A8})}$$
 (5)

where

 t_{A8D} = Design air temperature entering the air heater, °F,

 t_{Gl4} = Measured flue gas temperature entering the air heater, °F,

 t_{GIS} = Measured flue gas temperature leaving the air heater, °F, and

 t_{A8} = Measured air temperature entering the air heater, °F.

Similarly, the correction of the flue gas temperature leaving the air heater, $t_{G15 \& G}$, for deviation from the design entering flue gas temperature, is:

$$t_{GI5 \delta_G} = \frac{t_{GI4D} \cdot (t_{GI5} - t_{A8}) + t_{A8} \cdot (t_{GI4} - t_{GI5})}{(t_{GI4} - t_{A8})}$$
(6)

where

 t_{GAD} = Design flue gas temperature entering the air heater, °F,

 t_{GI4} = Measured flue gas temperature entering the air heater, °F,

 t_{GIS} = Measured flue gas temperature leaving the air heater, °F, and

 t_{A8} = Measured air temperature entering the air heater, °F.

The correction factors to the flue gas temperature for the deviation from the design X-ratio, $t_{GI5\ \delta XR}$, and for the deviation from the design entering gas flow, $t_{GI5\ \delta E}$, are obtained from performance equations developed by ABB API. Equipment specific correlation factors for these equations were provided graphically as functions of the X-ratio and the inlet flue gas flow. ABB API provided individual performance equations and plots for the primary air section and for the secondary air section of the air heater.

To be applicable to ASME Equation 7.12 -- Equation 4, above -- the performance equations must be rewritten in terms of the deviation from the original or design conditions rather than predicting the behavior at the current conditions. This requires calculation of the deviation from design conditions. The resulting delta is added to the current flue gas temperature leaving the air heater. This corrects for the deviation from design X-ratio and entering gas flow. The method will be discussed in detail below.

From the correction factor plots provided by ABB API, CONSOL derived mathematical correlations over the range of interest. ABB API's performance equation combined the correction parameters, X-ratio and flue gas flow, into a single equation for each section of the heat pipe. The individual correction factors for Equation 4 were derived by varying one parameter at a time in the performance equation, holding the other constant at the design conditions. In this fashion, separate correction factors were derived for the deviation from design X-ratio and for flue gas flow.

PRIMARY AIR SIDE

For the primary air side of the air heater, ABB API provided the following performance equation to NYSEG (Larkin, 1995). This performance equation combined the effects for the deviation from the design X-ratio, $t_{GI4\ \delta XR}$, with that for the entering flue gas flow, $t_{GI5\ \delta G}$, into a single equation. This equation predicts the no-leak gas temperature specific to the Milliken air heater, $t_{PGI5\ Performance}^{NL}$ and is:

$$t_{PG15\ Performance}^{NL} = t_{G14} \cdot \left[1 - 0.6177 \cdot f_{pg} \cdot f_{px}\right] + t_{A8} \cdot 0.6177 \cdot f_{pg} \cdot f_{px}$$
 (7)

where

 f_{pg} = Primary gas flow parameter, and

 f_{px} = X-ratio parameter for the primary gas flow.

At an air side effectiveness, E_{pa} , above a specified limiting value, this relationship changes. The air side effectiveness is defined as:

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$$E_{pa} = \frac{\left(t_{PA9} - t_{A8}\right)}{\left(t_{GI4} - t_{A8}\right)} \tag{8}$$

For the primary air side of the heat pipe air heater, this limit is 0.9492. Above this value of the air side effectiveness, the air side effectiveness is fixed at 0.9492, and the primary-side flue gas X-ratio correction factor becomes:

$$f_{px} = \frac{\left[E_{po} \cdot X_{p}\right]}{\left[0.6177 \cdot f_{pg}\right]} = \frac{\left[0.9492 \cdot X_{p}\right]}{\left[0.6177 \cdot f_{pg}\right]}$$
(9)

where

 $X_p = X$ -ratio for the primary-side.

The air heater appears to be operating below this limit. Therefore, the uncertainty estimation will be conducted only on the correlations developed for the ABB API plotted curves.

The functional relationship for the parameter associated with deviations in the primary flue gas flow from the design value, f_{pg} , is:

$$f_{pg} \approx 1.063795 - 0.0003486 \cdot F_{PFG}$$
 (10)

where

 F_{PFG} = Primary-side flue gas flow, 1,000 lb/hr.

Similarly, for the X-ratio, the parameter, f_{px} , is:

$$f_{px} \approx -0.20011 + 2.506607 \cdot X_P - 1.01786 \cdot X_P^2$$
 (11)

The X-ratio for the primary air side, X_P , is:

$$X_{P} = \frac{\left(t_{GI4} - t_{PGI5}^{NL}\right)}{\left(t_{PA9} - t_{A8}\right)} \tag{12}$$

where

 t_{PA9} = Measured primary air temperature leaving the air heater, °F.

$$\frac{\partial t_{PGIS \, \delta_{Total}}}{\partial t_{GI4}} = \frac{t_{A8D} + \left(t_{PGIS} - t_{A8}\right)}{\left(t_{GI4} - t_{A8}\right)} - \frac{t_{A8D} \cdot \left(t_{GI4} - t_{PGIS}\right) + t_{GI4} \cdot \left(t_{PGIS} - t_{A8}\right)}{\left(t_{GI4} - t_{A8}\right)^{2}} + \frac{t_{A8}}{\left(t_{GI4} - t_{A8}\right)} - \frac{t_{GI4D} \cdot \left(t_{PGIS} - t_{A8}\right) + t_{A8} \cdot \left(t_{GI4} - t_{PGIS}\right)}{\left(t_{GI4} - t_{A8}\right)^{2}} + \left\{ - t_{GI4D} \cdot \left[- 0.6177 \cdot f_{P8D} \cdot \left(\frac{2.506607}{\left(t_{PA9} - t_{A8}\right)} - 1.01786 \cdot (2) \cdot \right) \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PGIS} - t_{AB}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PGIS} - t_{AB}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2) \cdot \right] - t_{A8D} \cdot \left[\frac{\left(t_{PA9} - t_{A8}\right)^{2}}{\left(t_{PA9} - t_{A8}\right)^{2}} - 1.01786 \cdot (2$$

This simplifies to yield:

$$\frac{\partial t_{PGI5} \, \delta_{Total}}{\partial t_{GI4}} = \frac{t_{A8D} + t_{PGI5}}{\left(t_{GI4} - t_{A8}\right)} - \frac{\left(t_{A8D} + t_{A8}\right) \cdot \left(t_{GI4} - t_{PGI5}\right) + \left(t_{GI4D} + t_{GI4}\right) \cdot \left(t_{PGI5} - t_{A8}\right)}{\left(t_{GI4} - t_{A8}\right)^{2}} + \left\{ \left(t_{GI4D} - t_{A8D}\right) \cdot 0.6177 \cdot f_{P8D} \cdot \left(\frac{2.506607}{\left(t_{PA9} - t_{A8}\right)}\right) - 1.01786 \cdot (2) \cdot \left(\frac{\left(t_{CI4} - t_{PGI5} - \left(\frac{A_{\mathcal{Q}}}{100}\right) \cdot \left(t_{PGI5} - t_{Amb}\right)\right)}{\left(t_{PA9} - t_{A8}\right)^{2}} \right] \right\}$$

Differentiating Equation 20 with respect to the primary-side flue gas outlet temperature, \$\frac{1}{2015}\$, yields:

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$$\frac{\partial t_{PGIS} \, \delta_{Pool}}{\partial t_{PGIS}} = \frac{-t_{A8D} + t_{GIA}}{\left(t_{GIA} - t_{A8}\right)} + \frac{t_{GIAD} - t_{A8}}{\left(t_{GIA} - t_{A8}\right)} + \left\{1 - t_{GIAD} \cdot \left[-0.6177 \cdot f_{PgD} \cdot \frac{c_{PA}}{c_{PG}} \right] - 2.506607 \cdot \left[1 + \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{PA}}{c_{PG}}\right] + 1.01786 \cdot (2) \cdot \left[1 + \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{PA}}{c_{PG}}\right] \right] - \left[\frac{t_{GIA} - t_{PGIS} - \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{PA}}{c_{PG}} \cdot \left(t_{PGIS} - t_{Amb}\right) - \frac{c_{PA}}{c_{PG}}\right]}{\left(t_{PA9} - t_{A8}\right)^{2}}\right] - t_{A8D} \cdot \left[0.6177 \cdot f_{PgD} \cdot \left(1 + \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{PA}}{c_{PG}}\right] \cdot \left(t_{PA9} - t_{A8}\right) - \frac{c_{PA}}{c_{PG}}\right] + 1.01786 \cdot (2) \cdot \left(1 + \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{PA}}{c_{PG}}\right] - \frac{c_{PA}}{c_{PG}}\right] - \frac{c_{PA}}{c_{PG}} \cdot \left[\frac{c_{PA}}{c_{PG}} \cdot \left(t_{PGIS} - t_{Amb}\right) - \frac{c_{PA}}{c_{PG}}\right] - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}}\right] + c_{PGIS} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}}\right] + c_{PGIS} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}}}{c_{PG}}\right] + c_{PGIS} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}}}{c_{PG}}\right] + c_{PGIS} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c_{PG}}}{c_{PG}} - \frac{c_{PA}}{c_{PG}} - \frac{c_{PA}}{c$$

This is simplified to:

$$\frac{\partial t_{PGI5} \, \delta_{Total}}{\partial t_{PGI5}} = + \frac{\left(t_{GI4D} + t_{GI4}\right) - \left(t_{A8D} + t_{A8}\right)}{\left(t_{GI4} - t_{A8}\right)} + \left\{\left(t_{GI4D} - t_{A8D}\right) \cdot \left[0.6177 \cdot f_{pgD}\right] \cdot \left[\frac{c_{pA}}{100}\right] \cdot \left[\frac{c_{pA}}{c_{pG}}\right] + 1.01786 \cdot (2) \cdot \left(1 + \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{pA}}{c_{pG}}\right]\right) \cdot \left[\frac{c_{pA}}{c_{pG}}\right] \cdot \left[\frac{c_{pA}$$

Differentiating Equation 20 with respect to the air temperature leaving the primary-side of the air heater, t_{PA9} , yields the following equation:

$$\frac{\partial t_{PGIS} \, \delta_{Tool}}{\partial t_{PAG}} = 0 + 0 + \left\{ -t_{GI4D} \cdot \left[-0.6177 \cdot f_{PgD} \cdot \left(t_{PGIS} - \frac{A_{g}}{100} \right) \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right\} + 1.01786 \cdot (2) \cdot \left[\frac{\left(t_{GI4} - t_{PGIS} - \left[\frac{A_{g}}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right]^{2}}{\left(t_{PAG} - t_{AB} \right)^{3}} \right] \right\} + 1.01786 \cdot (2) \cdot \left[\frac{\left(t_{GI4} - t_{PGIS} - \left[\frac{A_{g}}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right]^{2}}{\left(t_{PAG} - t_{AB} \right)^{3}} \right] \right] + 1.01786 \cdot (2) \cdot \left[\frac{\left(t_{GI4} - t_{PGIS} - \left[\frac{A_{g}}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right]^{2}}{\left(t_{PAG} - t_{AB} \right)^{3}} \right] \right\} + \{0\} + 0$$

which when rearranged and simplified yields:

$$\frac{\partial t_{PGI5 \ \delta_{Total}}}{\partial t_{PA9}} = \left(t_{GI5D} - t_{A8D}\right) \cdot \left[0.6177 \cdot f_{pgD} \cdot \left(t_{PGI5} - \frac{A_{\mathcal{Q}}}{100}\right) \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGI5} - t_{Amb}\right)\right] + 1.01786 \cdot (2) \cdot \left[\frac{\left(t_{GI4} - t_{PGI5} - \left[\frac{A_{\mathcal{Q}}}{100}\right] \cdot \left[\frac{c_{pA}}{c_{pG}}\right] \cdot \left(t_{PGI5} - t_{Amb}\right)\right]}{\left(t_{PA9} - t_{A8}\right)^{3}}\right]$$

Differentiating Equation 20 with respect to the primary flue gas flow, F_{PA} , yields:

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$$\frac{\partial t_{PGI5 \, \delta_{Total}}}{\partial F_{PFG}} = 0 + 0 + \{0\} + \{-t_{GI4D} \cdot [0.6177 \cdot (0.0003486) \cdot f_{pxD}] + t_{A8D} \cdot [0.6177 \cdot (0.0003486) \cdot f_{pxD}]\} + 0$$
(29)

The final parameter is the percent leak, $A_{\mathcal{L}}$. Differentiating with respect to percent leak yields:

$$\frac{\partial t_{PGIS} \, b_{Towl}}{\partial A_{gl}} = 0 + 0 + \left\{ -t_{GI4D} \cdot \left[-0.6177 \cdot f_{PSD} \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right. \\
\left. \left(-2.506607 \cdot \left[\frac{\left[\left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right] \right. \\
\left. + 1.01786 \cdot (2) \cdot \left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \cdot \left. \left[\frac{\left(t_{PGIS} - t_{PGIS} - t_{Amb} \right) \cdot \left(t_{PA9} - t_{A8} \right)^{2} \right] \right] \right. \\
\left. - t_{ASD} \cdot \left[0.6177 \cdot f_{PSD} \cdot \left(\left(\frac{1}{100} \right) \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right. \\
\left. + 1.01786 \cdot (2) \cdot \left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right. \\
\left. \left. \left(t_{CI4} - t_{PGIS} - \left[\frac{A_{gl}}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right. \right. \\
\left. \left. \left[\frac{\left(t_{CI4} - t_{PGIS} - \left[\frac{A_{gl}}{100} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right] \right. \\
\left. + \left. \left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right] \right. \\
\left. + \left. \left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right. \right\} + \left. \left. \left(0 \right) + 0 \right. \right.$$

This can be simplified as follows:

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$$\frac{\partial t_{PGIS} \, \delta_{Total}}{\partial A_{\mathcal{Q}}} = \left(t_{GI4D} - t_{A8D} \right) \cdot \left[0.6177 \cdot f_{PgD} \cdot \left(\frac{1}{100} \right) \cdot \left[\frac{c_{pA}}{c_{pG}} \cdot \left(t_{PGIS} - t_{Amb} \right) \right] \right. \\
+ 1.01786 \cdot (2) \cdot \left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \cdot \left[\frac{\left(t_{GI4} - t_{FGIS} - \left[\frac{A_{\mathcal{Q}}}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{FGIS} - t_{Amb} \right) \right] \right] \\
+ \left[\frac{1}{100} \right] \cdot \left[\frac{c_{pA}}{c_{pG}} \right] \cdot \left(t_{PGIS} - t_{Amb} \right) \right]$$

The equations presented above were used to propagate the errors presented in the previous work. (McCoy, 1995.) Unfortunately the nonlinearity of the equations results in an erroneous forecast. This can be seen in the table below.

Table I

Error Calculation Using Partial Differentiation

	Paramet	er Error, %	Corresponding PropagationError , %	
Parameter	Bias Error	Random Error	Bias Error Random Erro	
Air Temperature @ Inlet	1.00	0.15	1.96	0.29
Flue Gas Temperature @ Inlet	1.00	0.12	0.41	0.05
Primary-Side Flue Gas Temperature @ Outlet	1.00	0.11	0.16	0.02
Primary Air Temperature @ Outlet	1.00	0.11	0.51	0.06
Primary-Side Flue Gas Flow	6.25	0.46	0.81	0.06
Air Leak Into Primary-Side Flue Gas	0.85	12.60	0.38	5.64

The error forecast for the random portion of the air leak into the primary-side flue gas, the highlighted cell, is 6%, which corresponds to an uncertainty of approximately 34 °F. The effect of the entire 6 percent air leak on the results predicted by Equation 16, the X-ratio correction factor, is less than 2.5 °F. Therefore, it appears that Equation 20 is too nonlinear to be used to propagate the estimate of the errors rigorously via the partial differentiation technique.

Equation 2 was used to estimate the errors using the method detailed below. (Box, G. E. P., 1978.)

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The function for the total corrected flue gas outlet temperature, $t_{G15\ \delta Total}$, can be approximated as a set of linear segments in the region of interest to yield:

$$t_{GIS \ \delta_{Total}} \approx \Theta_0 + \sum_{i=1}^n \ \Theta_i \cdot x_i$$
 (32)

where

 Θ_0 = Constant evaluated at center point for all parameters, and

 Θ_i = Constants for each x_i .

These constants, Θ_i , are linear approximations of the actual function evaluated at the midpoint. The variance of this function is:

$$S_r = \sum_{i=1}^n \Theta_i^2 \cdot \sigma_i^2 + \sum_{\substack{j=1\\j=1\\i\neq j}}^n \Theta_i \cdot \Theta_j \cdot \sigma_i \cdot \sigma_j$$
(33)

which, if the parameters are uncorrelated or independent, reduces to:

$$S_r = \sum_{i=1}^n \Theta_i^2 \cdot \sigma_i^2 \tag{34}$$

The function f is evaluated at two points, α and β , about the center point for each parameter. These points are equal distances from the center point x_i . The distance is three σ_i . The constant is then defined as:

$$\Theta_i = \frac{f_\alpha - f_\beta}{6 \cdot \sigma_i} \tag{35}$$

The following example shows the propagation of the bias for the entering air temperature through Equation 20. The entering air temperature is varied while all other parameters are held constant. The function, Equation 20, is evaluated for changes in this parameter, x_i , as shown below.

	Value of Parameter	Value of Function	Difference	Θ_{ι}
$x_i + 3 \cdot \sigma$	103.00	312.31	-0.436	
\boldsymbol{x}_i	100.00	312.74		-0.143
$x_i - 3 \cdot \sigma$	97.00	313.17	-0.422	

The results shown above are typical for the parameters presented in Table II. As shown, the difference values, in the fourth column, are very similar. This demonstrates that over the range of $\pm 3 \bullet \sigma$ the linear approximation is valid. The results of these calculations will be discussed below. Reducing the range did not affect the values of Θ_i .

SECONDARY AIR

For the secondary air side of the heat pipe air heater, ABB API provided the following equation:

$$t_{SG15\ Performance}^{NL} = t_{G14} \cdot [1 - 0.7265 \cdot f_{sg} \cdot f_{sx}] + t_{SA8} \cdot 0.7265 \cdot f_{sg} \cdot f_{sx}$$
 (36)

where

 $t_{SG15\ Performance}^{NL}$ = Temperature of the flue gas leaving the air heater at test conditions corrected for the air leak, i. e., the no-leak temperature,

 f_{sg} = Secondary-side flue gas flow correction factor,

 f_{sx} = X-ratio correction factor for secondary-side flue gas flow, and

 t_{SA8} = Measured secondary-side air temperature entering the air heater, °F.

The derived functional relationship for the correction factor with respect to deviations in the secondary-side flue gas flow from its design value, f_{sg} , is:

$$f_{sg} \approx 1.088958 - 0.00006725 \cdot F_{SFG}$$
 (37)

where

 F_{SFG} = Secondary-side flue gas flow, 1,000 lb/hr.

Similarly, the X-ratio correction factor, f_{xx} , is:

$$f_{xx} \approx -0.16969 + 2.119151 \cdot X_S - 0.83539 \cdot X_S^2$$
 (38)

with the X-ratio for the secondary air side, X_s , defined as:

$$X_{S} = \frac{\left(t_{G14} - t_{SG15}^{NL}\right)}{\left(t_{SA9} - t_{SA8}\right)}$$
(39)

where

 t_{S49} = Measured secondary-side air temperature leaving the air heater, ${}^{\circ}F$.

For the secondary-side of the air heater, the leak can be neglected and thus:

$$t_{SG15} = t_{SG15}^{NL} \tag{40}$$

As discussed for the primary-side of the air heater, the above equations are performance equations. Converting these equations to the required correction equations required by the ASME Equation 7.12 produce the following equations. For the deviation from design X-ratio, $t_{SGIS\ \delta XR}$, this is:

$$t_{SGIS} \delta_{XR} = t_{SGIS} + \left\| t_{SGISD} - t_{GI4D} \cdot \left[1 - 0.7265 \cdot f_{sgD} \cdot \left\{ - 0.16969 + 2.119151 \cdot \left[\frac{\left(t_{GI4} - t_{SGIS} \right)}{\left(t_{SA9} - t_{SA8} \right)} \right] - 0.83539 \cdot \left[\frac{\left(t_{GI4} - t_{SGIS} \right)}{\left(t_{SA9} - t_{SA8} \right)} \right]^{2} \right\} \right] - t_{A8D} \cdot \left[0.7265 \cdot f_{sgD} \cdot \left\{ - 0.16969 + 2.119151 \cdot \left[\frac{\left(t_{GI4} - t_{SGIS} \right)}{\left(t_{SA9} - t_{SA8} \right)} \right] - 0.83539 \cdot \left[\frac{\left(t_{GI4} - t_{SGIS} \right)}{\left(t_{SA9} - t_{SA8} \right)} \right]^{2} \right\} \right] \right\|$$

and for the deviation from design entering gas flow, this equation is:

$$t_{SGIS} \delta_{\epsilon} = t_{SGIS} + \|t_{SGISD} - t_{GI4D} \cdot [1 - 0.7265 \cdot \{1.088958 - 0.00006725 \cdot F_{SFG}\} \cdot f_{sxD}]$$

$$- t_{A8D} \cdot 0.7265 \cdot \{1.088958 - 0.00006725 \cdot F_{SFG}\} \cdot f_{sxD}] \|$$
(42)

As with the primary air side, a break exists in this relationship. For a secondary air side effectiveness, E_{sa} , greater than 0.9300, the following relationship applies:

$$f_{sx} = \frac{\left[E_{sa} \cdot X_{s}\right]}{\left[0.7265 \cdot f_{sg}\right]} = \frac{\left[0.930 \cdot X_{s}\right]}{\left[0.7265 \cdot f_{sg}\right]}$$
(43)

The functional relationship for the secondary-side totally corrected flue gas temperature becomes:

$$t_{SGIS} \ b_{Total} = \frac{t_{A8D} \cdot (t_{GI4} - t_{SGIS}) + t_{GI4} \cdot (t_{SGIS} - t_{SA8})}{(t_{GI4} - t_{SA8})} + \frac{t_{GI4D} \cdot (t_{SGIS} - t_{SA8}) + t_{SA8} \cdot (t_{GI4} - t_{SGIS})}{(t_{GI4} - t_{SA8})}$$

$$+ \left\{ t_{SGIS} + \right\| t_{SGISD} - t_{GI4D} \cdot \left[1 - 0.7265 \cdot f_{SgD} \cdot \left[\frac{(t_{GI4} - t_{SGIS})}{(t_{SA9} - t_{SA8})} \right] - 0.83539 \cdot \left[\frac{(t_{GI4} - t_{SGIS})}{(t_{SA9} - t_{SA8})} \right]^{2} \right) \right]$$

$$- t_{A8D} \cdot \left[0.7265 \cdot f_{SgD} \cdot \left(-0.16969 + 2.119151 \cdot \left[\frac{(t_{GI4} - t_{SGIS})}{(t_{SA9} - t_{SA8})} \right] \right] \right]$$

$$- 0.83539 \cdot \left[\frac{(t_{GI4} - t_{SGIS})}{(t_{SA9} - t_{SA8})} \right]^{2} \right] \right] \right\} + \left\{ t_{SGISD} - t_{GI4D} \cdot \left[1 - 0.7265 \cdot \left\{ 1.088958 - 0.00006725 \cdot F_{PFG} \right\} \cdot f_{SSD} \right] - t_{A8D} \cdot 0.7265 \cdot \left\{ 1.088958 - 0.00006725 \cdot F_{PFG} \right\} \right\}$$

$$\cdot f_{SSD} \right] \right\} - 3 \cdot t_{SGIS}$$

These equations can be differentiated, similar to those of the primary-side, and simplified to yield the following equations.

Differentiating Equation 44 with respect to the inlet air temperature yields:

$$\frac{\partial t_{SGIS} \, \delta_{Total}}{\partial t_{SA8}} = \frac{-t_{GI4D} - t_{SGIS}}{\left(t_{GI4} - t_{SA8}\right)} + \frac{\left(t_{GI4D} + t_{GI4}\right) \cdot \left(t_{SGIS} - t_{SA8}\right) + \left(t_{SA8} + t_{A8D}\right) \cdot \left(t_{GI4} - t_{SGIS}\right)}{\left(t_{GI4} - t_{SA8}\right)^{2}} + \left(t_{GI4D} - t_{A8D}\right) \cdot \left\| 0.7265 \cdot f_{SgD} \cdot \left(t_{GI4} - t_{SGIS}\right) - 0.83539 \cdot \left(2\right) \cdot \left[\frac{\left(t_{GI4} - t_{SGIS}\right)^{2}}{\left(t_{SA9} - t_{SA8}\right)^{3}}\right] \right) \right\|$$

With respect to the inlet gas temperature, t_{GI4} , the result simplifies to:

$$\frac{\partial t_{SGIS} \, \delta_{Total}}{\partial t_{GI4}} = \frac{t_{A8D} + t_{SGIS}}{\left(t_{GI4} - t_{SA8}\right)} - \frac{\left(t_{A8D} + t_{SA8}\right) \cdot \left(t_{GI4} - t_{SGIS}\right) + \left(t_{GI4D} + t_{GI4}\right) \cdot \left(t_{SGIS} - t_{SA8}\right)}{\left(t_{GI4} - t_{SA8}\right)^{2}} + \left(t_{GI4D} - t_{A8D}\right) \cdot \left\|0.7265 \cdot f_{SgD}\right.$$

$$\left(\frac{2.119151}{\left(t_{SA9} - t_{SA8}\right)} - 0.83539 \cdot \left(2\right) \cdot \left[\frac{\left(t_{GI4} - t_{SGIS}\right)}{\left(t_{SA9} - t_{SA8}\right)^{2}}\right]\right) \right\|$$

Differentiating Equation 44 with respect to the flue gas outlet temperature, t_{SGI5} , and simplifying yields:

$$\frac{\partial t_{SG15 \ \delta_{Total}}}{\partial t_{SG15}} = \frac{\left(t_{G14D} + t_{G14}\right) - \left(t_{A8D} + t_{SA8}\right)}{\left(t_{G14} - t_{SA8}\right)} + \left\{1 + \left(t_{G14D} - t_{A8D}\right) \cdot \|0.7265 \cdot f_{sgD}\right\} \cdot \left(1 - \frac{2.119151}{\left(t_{SA9} - t_{SA8}\right)} + 0.83539 \cdot (2) \cdot \left[\frac{\left(t_{G14} - t_{SG15}\right)}{\left(t_{SA9} - t_{SA8}\right)^{2}}\right]\right) \right\} + \left\{1\right\} - 3$$

Differentiating with respect to the secondary-side outlet air temperature, t_{SA9} , this simplifies to:

$$\frac{\partial t_{SG15 \ \delta_{Total}}}{\partial t_{SA9}} = \left(t_{G14D} - t_{A8D}\right) \cdot \| 0.7265 \cdot f_{sgD} \cdot \left(-2.119151 \cdot \left[\frac{\left(t_{G14} - t_{SG15}\right)}{\left(t_{SA9} - t_{SA8}\right)^{2}} \right] + 0.83539 \cdot (2) \cdot \left[\frac{\left(t_{G14} - t_{SG15}\right)^{2}}{\left(t_{SA9} - t_{SA8}\right)^{3}} \right] \right) \|$$
(48)

With respect to the secondary flue gas flow, $\,F_{\rm SA}$, this partial differentiation simplifies to:

$$\frac{\partial t_{SGI5} \, \delta_{Total}}{\partial F_{SFG}} = -\left(t_{GI4D} - t_{A8D}\right) \cdot \left[0.7265 \cdot (0.00006725) \cdot f_{sxD}\right]$$

$$\tag{49}$$

Besides the rigorous method presented above, the delta method, Equation 2, was also used to propagate the errors. Since the delta estimate resulted in a slightly larger error, it was used.

RESULTS

The resulting differentials were summed by the method presented in Equation 2 to provide the bias and the random errors for the "totally corrected flue gas temperatures leaving the primary and secondary sides of the heat pipe air heater." The parameters as shown in Table II were used to estimate the uncertainties. Table II also contains the bias and random error results of the initial study. As discussed, these error values were used in this study. These were combined via Equation 3 to produce the uncertainty in the "totally corrected flue gas exit temperature." These results are shown below in Table III.

Table II

Parameter Values and Associated Errors

Parameter	Unit	Value	Bias Error	Random Error
Air Temperature @ Primary Inlet	°F	100	1.00	0.15
Air Temperature @ Secondary Inlet	°F	80	0.80	0.12
Air Temperature @ Primary Outlet	°F	644	6.44	0.74
Air Temperature @ Secondary Outlet	°F	616	6.16	0.70
	***************************************	××××××××××××××××××××××××××××××××××××××	******	
Flue Gas Temperature @ Inlet	°F	680	6.81	0.81
Flue Gas Temperature @ Primary Outlet	°F	285	2.85	0.35
Flue Gas Temperature @ Secondary Outlet	°F	244	2.44	0.35
	**********	*******		
Design Air Temperature @ Inlet	°F	80	\bowtie	*************************************
Design Flue Gas Temperature @ Inlet	°F	680		
	***********	***********	<u> </u>	XXXXXXXXXXX
Primary-Side Flue Gas Flow	1,000 lb/hr	157.00	9.82	0.72
Secondary-Side Flue Gas Flow	1,000 lb/hr	1342.60	83.96	6.16
Air Leak into Primary-Side Flue Gas Flow	Percent	6.0	0.05	0.77

Table III

Uncertainty Estimates for Totally Corrected Primary and Secondary Flue Gas Outlet Temperatures

			Random		
Parameter	Unit	Bias Error	Ептог	Uncertainty	
Primary Outlet	°F	4.57	0.66	±4.75	
Secondary Outlet	°F	4.69	0.50	±4.80	

EXTENDING UNCERTAINTY TO THE FINAL FLUE GAS TEMPERATURE

The uncertainties estimated above may be extended to the bulk temperature of the combined flue gas stream. Since an equipment specific correction factor for the combined primary and secondary heat pipe air heaters is not available, the ASME equation cannot be used. That is, a correction for the $t_{G15\ \delta XR}$ and $t_{G15\ \delta C}$ factors for the combined flue gas flow is required for Equation 7.12 of the ASME air heater performance code. Therefore, the errors must be propagated through the algebraic summation of primary and secondary flue gas temperatures leaving the air heater, t_{PG15} and t_{SG15} , respectively. This equation is:

$$t_{Final} = \frac{t_{PG15 \ \delta_{Total}} \cdot F_{PFG} + t_{SG15 \ \delta_{Total}} \cdot F_{SFG}}{F_{PFG} + F_{SFG}}$$
 (50)

where

 t_{Final} = Temperature of the combined flue gas leaving the air heater.

Equation 49 is partially differentiated as discussed above to yield the following four equations:

$$\frac{\partial t_{Final}}{\partial t_{PGIS} \, \delta_{Total}} = \frac{F_{PFG}}{F_{PFG} + F_{SFG}} \tag{51}$$

$$\frac{\partial t_{Final}}{\partial t_{SGI5} \, \delta_{Total}} = \frac{F_{SFG}}{F_{PFG} + F_{SFG}} \tag{52}$$

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$$\frac{\partial t_{Final}}{\partial F_{PFG}} = \frac{t_{PGI5 \, \delta_{Total}}}{F_{PFG} + F_{SFG}} - \frac{t_{PGI5 \, \delta_{Total}} \cdot F_{PFG} + t_{SGI5 \, \delta_{Total}} \cdot F_{SFG}}{F_{PFG} + F_{SFG}}$$
(53)

and:

$$\frac{\partial t_{Final}}{\partial F_{SFG}} = \frac{t_{SGI5 \, \delta_{Total}}}{F_{PFG} + F_{SFG}} - \frac{t_{PGI5 \, \delta_{Total}} \cdot F_{PFG} + t_{SGI5 \, \delta_{Total}} \cdot F_{SFG}}{\left(F_{PFG} + F_{SFG}\right)^2}$$
(54)

As with the primary and secondary flue gas temperatures leaving the air heater, the bias and random errors are propagated individually and summed as shown in Equations 1 and 3. The values and errors for the temperatures and flue gas rates are the results calculated previously, as listed in Table III. The results of propagating the errors through these partial differentials, Equations 50 through 53, are listed below in Table IV.

Table IV

Uncertainty Estimates in the Combined Flue Gas Temperature

			Random	
Parameter	Unit	Bias Error	Error	Uncertainty
Combined Flue Gas Temperature	°F	4.27	0.46	±4.36

Uncertainty in the temperature of the combined flue gas is in the same range as the uncertainty in the primary and secondary flue gas temperatures. The uncertainty in the combined flue gas flow is estimated to be ± 4.4 °F. This is less than that of the primary and secondary-side exit flue gas temperatures due to the nature of the error propagation calculations. The uncertainty of the flue gas temperatures leaving the heat pipe air heater is ± 4.75 °F for the flue gas leaving the primary air side of the air heater and ± 4.80 °F for that leaving the secondary air side, as shown in Table III.

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