# FLOW-CALC Version 1.0
# Users' Manual

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# 1.0 Introduction to FLOW-CALC

The FLOW-CALC Data Entry and EDR Generation Software is a tool for stack testers to enter flow Relative Accuracy Test Audit (RATA) measurement data (Methods 2, 2F, 2G, and 2H) and calculate flow RATA results, print out test results, and electronically export flow RATA data to quarterly Electronic Data Reports (EDRs). EPA's Clean Air Markets Division (CAMD) developed the software to improve data quality and to ease the entry of large amounts of flow RATA measurement data into the EDR ASCII format.

The software is designed to work in conjunction with EPA's Monitoring Data Checking (MDC) software. MDC is a tool that allows regulated industry and State agencies to enter, analyze, and print electronic monitoring plan, certification and quality assurance data (including RATAs) in the format required by the Acid Rain and $NO_x$ Budget Programs. The FLOW-CALC software performs many of the data checks performed by MDC on flow RATA data. RATA data exported from FLOW-CALC can be imported to the MDC software for additional checks for consistency with the facilities' electronic monitoring plan data. However, it is not necessary for MDC version 3.3 to be installed on the computer containing FLOW-CALC.

The software performs five basic tasks:

| | |
|---|---|
| Data Entry | Entry of probe calibration, reference method measurement, and continuous emission monitor data; |
| Calculations | Calculation of reference method and RATA results; |
| Evaluation | Evaluation of data to identify potential errors and inconsistencies (checks are similar to those in EPA's Monitoring Data Checking (MDC) software); |
| Printing | Printing of the data in easy-to-read report formats; |
| Export | Export of data into EDR v2.1 formatted ASCII files. |

# 2.0 Using Windows

The FLOW-CALC software allows you to have several windows open simultaneously. The Windows Menu will contain a list of the currently opened windows. You may then select from that list in order to move between open windows.

Use your mouse to size or move windows on your screen so that you can see related information on more than one screen simultaneously.

When a Window is active, but minimized, the menu option will be disabled. Go to the Windows Menu option to maximize the window and enable the menu option.

## 2.1 Edit Menu

The Edit Menu gives you access to the standard Windows editing functions, including:

Cut Removes currently highlighted data and places the data in a buffer from which you may paste the data [CTRL-X].

Copy Copies currently highlighted data and places the data in a buffer from which the user may paste the data [CTRL-C].

Paste Pastes the currently buffered data at the current cursor location [CTRL-V].

In addition, the Edit Menu provides access to data entry screens that are used to add and edit data for the basic entities of the FLOW-CALC Software:

Probe Information The Probe Information option allows you to add and edit probe calibration data for selected probes.

RATAs The RATAs option allows you to add and edit the measurement data required for a selected flow RATA.

## 2.2 Browse and Select Windows

FLOW-CALC contains standard browse and select windows to add data or access data that have already been entered.

Add Button Displays a blank data entry screen for the initial data entry of RATA or Probe data. To save the data entry for the record click on the <Exit> button to receive a save prompt. The record will then appear in the appropriate browse list(s).

Edit Button Click on the <Edit> button on the browse list after highlighting the record to edit the record. When you save the record, the changes will appear in the list. You may also double click or press [Enter] on a highlighted record to access a data entry screen.

Copy Ref. Method Data This button copies all of the RATA reference method test data from the highlighted RATA to a new RATA, and may be used if the same reference method results are used in RATAs for a primary monitor and its back-up monitor.

Delete Button Deletes the entire RATA or Probe record.

Print Button Generates a RATA report that can be viewed, printed or saved in electronic format.

Close Button Closes the browse and select window.

### 2.3 Keyboard Navigation of Screens and Fields

The program provides hot keys which allow the user to navigate the screens, fields, and pull down menus using the keyboard instead of a mouse. Hot keys are identified by an underlined letter in a window's menu bars or buttons.
For example the initial screen that appears when opening the program contains the following hot keys on the menu bar at the top of the screen:

File
Edit
Reports
Utilities
Window
Help

The pull down menu for each can be accessed through the keyboard by pressing the <Alt> key and the underlined letter key simultaneously. After accessing the pull down menu in this manner, subsequent menu items that appear can by accessed by simply pressing the underlined key.

Screen buttons all have an underlined hot key except for the <Delete> Button. All screen buttons can be activated by pressing the <Alt> key simultaneously with the underlined letter key displayed on the button label. For example the <Add> button can be activated by pressing the <Alt> key and letter <A> key simultaneously. The <Delete> button can be accessed from the keyboard by pressing the <Delete>key.

### 2.4 Data Entry Features

The Probe and RATA data entry screens make use of tabular forms to enter and display calibration, operating level, run level, and point level data. To navigate the data fields:

Tab — The [Tab] key can be used to move from field to field in a window. The data tables can also be entered by using the [Tab] key from the last data entry field prior to the table. This will locate the cursor in the correct location for data entry. The [Tab] key can also be used to move the cursor from column to column (left to right) in a data table row.

Enter — Pressing the [Enter] key moves the cursor from field to field in a window or from column to column within a table row (from left to right).

Up/Down Arrow — The up and down arrow keys can be used to navigate from field to field in a window, between rows in a column of a data table, and is used to access a new blank table row.

Mouse Cursor — The mouse cursor can be used to move between fields and table fields, but can not be used to access a new blank row in a data table.

Also, the cursor will automatically tab to the next data field once the maximum number of characters allowed in a field is reached. For example the differential pressure field format in the point data tables is F4.3. Once you enter three numbers after the decimal place, the next character entered will automatically be entered in the next field column.

### 2.5 Using Table Look-ups

Many of the fields in this program can only be filled in by using look-up tables provided with the program. "Table look-ups" are used to ensure that data are entered consistently and accurately and to reduce data entry time. If you are in a field that requires entry of an item from a look-up table, you can access the table by clicking on the field or table look-up button (the down arrow) to the right of the field. You can also press [ALT-down arrow] to expand the complete list. Side arrow keys will scroll through the list. Press [Enter] to make a selection.

## 3.0 Evaluation Features

The FLOW-CALC Software evaluates the data entered based on many criteria. These error checks assure that the data exported meet all specifications, and are ready to be submitted to EPA.

To evaluate the entered data, select the <Evaluate> button located in the first RATA data entry window. The <Evaluate> button generates a complete RATA Error Report. You may also generate an evaluation report form the Reports Menu.

Many evaluation errors listed on the RATA Error Report are associated with an error code which can be used to look-up the exact requirements associated with the error. Understanding the check will help you to identify the type of error and correct it before submitting data to the appropriate agency. On the report, look up the specifications using the listed error codes which are indexed by code in this help file.

There are three types of errors: basic errors, warnings, and informational messages.

Basic Errors — Basic errors prevent the software form calculating relative accuracy and/or the bias adjustment factor.

Warnings — Warnings do not prevent these calculations, but indicate errors in the data that should be corrected.

Informational Messages — Messages which begin with the word "Attention" do not indicate errors, but unusual conditions in the data that may or may not require changes to the data.

For a detailed list of the evaluation criteria and resulting error messages, see Evaluation Criteria For Relative Accuracy Tests.

## 4.0 Print Features

RATA test reports and evaluation reports can be accessed from the Reports Menu at the top of the screen. The menu allows you to select the type of report, and is followed by a window for selecting the desired RATA (multiple RATAs can also be selected). Reports are viewed and printed from a Print Preview window. To view the report click on the scroll bars on the bottom and side of the print preview window. Move from page to page by clicking on the page icon on the upper right of the preview window. Note that the number of pages and the current page is displayed on the print preview title bar. When you are ready to print, click on the appropriate button to print the entire report or selected pages of the report. The report will be sent to your currently active printer, as defined in your Windows Print Manager.

If a printed report is not formatted correctly, check to determine if the printer identified in your User Profile as the "Selected Printer" is the currently active printer. If not, change the "Selected Printer" and try again.

To save the report in RTF format click on the <Save As> button at the top of the Print Preview Window. You will then be prompted for a file name and location to save the file using a standard File Save Window.

## 5.0 Export Features

To Export a RATA in EDR ASCII format:

1. From the File Menu, select "Export Data to EDR File."

2. Select one or more of the RATAs from the RATA Selection Window. Highlight the RATA or RATAs you want to export by using a single right mouse click and then click the <Export> button. You can also double click on a single RATA to export it.

3. After the above selections have been completed, the software processes the data into EDR v2.1 ASCII format and displays it in the Print Preview window. You may choose to print the file or to export the file. If you chose to export, you will be prompted to provide a file name and location to save the exported file using a standard File Save Window.

# 6.0 FLOW-CALC Screens

## 6.1 Probe Information Data Entry Screen

Probe calibration data for flow reference method probes are entered in the Probe Information Screen. To add a probe or edit existing probe calibration data select "Probe Information" from the "Edit" pull down menu at the top of the window.

Select the <Add> button to display a blank data entry screen for the initial data entry of Probe data. To save the data entry for the record click on the <Exit> button to receive a save prompt. The record will then appear in the appropriate browse list(s).

To select a probe record from a browse list to edit, highlight it (click on it once) and double click or press [Enter] on the highlighted record to access a data entry screen. You may also click on the <Edit> button on the browse list after highlighting the record to edit the record. When you save the record, the changes will appear in the list.

**Data Entry Fields for a Flow Method Probe**

Probe ID — Report the permanent identification number engraved (or otherwise marked) on the probe.

Calibration Velocity — This is an optional field. This field is used when a probe is calibrated at more than one range of velocities. Enter the wind tunnel velocity or range of velocities at which the probe was calibrated. For example, enter "60-90 fps." There is no format for this entry.

Probe Type — A look-up table provides six different probe types used in flow reference methods:

| | |
|---|---|
| S | Type S (manual) |
| AS | Type S (automated) |
| P | Prandtl |
| DA | Prism-shaped 3-D Pitot (without thermocouple) |
| DAT | Prism-shaped 3-D Pitot (with thermocouple) |
| SPH | Spherical 3-D Probe |

Calibration Date — The date corresponding to the calibration data.

Side of Probe — This field will appear for only type S pitot tubes. It identifies the side (A or B) corresponding to the calibration coefficient Cp.

Calibration Coefficient — This field will appear on the screen for non-3D probes. Enter the calibration coefficient for the probe, or probe side (for a type S pitot tube).

F2 at Pitch Angle 0 — For a 3-D probe enter the F2 at pitch angle 0. This is the calibration coefficient for the probe when used for Method 2G runs.

**Buttons**

Method 2F Data — This button will take you to the 2F Probe Calibration Data Screen.

Exit — This button closes the calibration screen for a specific probe, and returns you to the probe selection window.

### 6.2 2F Probe Calibration Data Screen

Method 2F wind tunnel calibration data for a 3-dimensional probe are entered on this screen. Based on the data the system will generate a F1-Pitch Angle Polynomial and a Pitch Angle-F2 Polynomial.

**Calibration Data Tab -- Data Entry Fields**

Pitch Angle — Enter the pitch angles used in the wind tunnel calibration of the 3-D probe. Include a negative sign if the pitch angle is negative.

F1 — Enter the F1 value determined at the corresponding pitch angle. Include a negative sign if F1 is negative.

F2 — Enter the F2 value determined at the corresponding pitch angle.

**Polynomial Tab -- Fields Updated by the System (Display Only)**

F1-Pitch Angle and Pitch Angle-F2 Polynomials — The F1-Pitch Angle and Pitch Angle-F2 Polynomials are generated by the system based on the inputted calibration data. The system uses a curve fitting algorithm for generating the polynomials. The algorithum first determines the linear equations that best fit the calibration data points, and the sums of the squares of the residuals at each point. The residual is the difference between the actual y value and the y value derived from the equation. Subsequently higher order polynomials (beginning with a $2^{nd}$ order polynomial) are fitted to the curve, each tested against the linear equations, until the sums of the squares value of the polynomials are equal to or less than 10% of the value for the linear equations, or until a 5th order polynomial is fitted to the curve. A 5th order polynomial is the maximum order polynomial that is used. This is to prevent large oscillations between the fitted data points that can occur with higher order polynomials.

### 6.3 RATA Data Entry Screens

RATA data is entered and calculation results presented in a series of windows accessed in the following order:

Main RATA Data Entry Screen

This first window, RATA Data Entry, is used to enter information on the plant, unit, monitoring system, and the stack. It is also used to enter the operating level, the reference method, and information on the test location for each operating level tested. Overall RATA test results calculated by the system are also presented on this screen.

Run Data for Operating Level

The Run Data for Operating Level screen is used to enter the run number, date, time, CEM value, gross unit load, and run status for each run of a RATA performed at one operating level. This window also allows the selection of a default wall effect adjustment factor for applicable flow RATAs, and displays operating level RATA results calculated by the system.

Supporting Data for Run

The Supporting Data for Run window is used to enter data for each individual run. The top part of the window includes data entry fields for run measurement data: barometric pressure, stack pressure, percent $CO_2$, $O_2$, and $H_2O$. The table in the bottom portion of the window is used to enter point measurement data: point pressures, temperature, and yaw angle. The system calculates and displays F1, F2, and pitch angle for 2F run points, point velocities for method 2F, 2G, and 2H runs, Wall Effects Adjustment Factor (WAF) for 2H runs, and average run velocity and run flow.

Wall Effects Data for Run

The Wall Effects Data for Run screen for each run is divided into 9 separate tabs, 2 each for each of the 4 Measurement Ports (or Method 1 wall points), and a $d_{rem}$ Calculation folder. Point and run data are entered only into the Port Measurements folder for each measurement port or wall point, and system calculated results are presented in the Port Calculations folder.

To enter measurement data for a RATA, select "RATA" from the "Edit" pull down menu. This will take you to the first RATA Data Entry window. Select the <Add> button to display a blank data entry screen for the initial data entry of RATA data. To save the data entry for the record click on the <Exit> button to receive a save prompt. The record will then appear in the appropriate browse list(s).

To select a RATA record from a browse list to edit, highlight it (click on it once) and double click or press [Enter] on the highlighted record to access a data entry screen. You may also

click on the <Edit> button on the browse list after highlighting the record to edit the record. When you save the record, the changes will appear in the list.

Data entry fields in the window are identified by the white background. Fields in the window which are updated by the software have a dark background.

### 6.3.1 Main RATA Data Entry Screen

The first window, RATA Data Entry, is used to enter information on the plant, unit, monitoring system, and the stack. It is also used to enter the operating level, the reference method, and information on the test location for each operating level tested. Overall RATA test results calculated by the system are also presented on this screen.

**RATA Data Entry Fields**

| | |
|---|---|
| ORIS Code | Enter the ORIS code here. This is the plant ID used by the Acid Rain and $NO_x$ Budget Programs. It is an essential identifier if this RATA is to be exported to an EDR. |
| Plant Name | Enter the plant name here. This field is optional, and is for display purposes only. |
| City/State | Enter the city and state in which the plant is located. This field is optional, and is for display purposes only. |
| Company Name | Enter the name of the plant owner or operator here. This field is optional, and is for display purposes only. |
| Unit/Stack ID | Enter the unit/stack ID. This unit/stack ID must correspond with the ID in the facility's monitoring plan, and is an essential identifier if this RATA is to be exported to an EDR. |
| Monitoring System ID | Please note that the monitoring system ID is an essential identifier in the EDR. Relative accuracy tests are reported in the EDR only on a system basis. The monitoring system ID must match the monitoring system ID in EDR RT 510 in the monitoring plan. A monitoring system ID must contain three alpha-numeric characters. |
| Parameter | Select the pollutant or parameter measured by the Monitoring System from the table look-up. For a flow RATA select "FLOW." This field can not be edited once the data have been saved. |
| Test Number | For each set of relative accuracy runs which comprise a single-load relative accuracy test, or for all runs associated with all load levels of a multi-load level flow RATA, assign and report a unique test number for the set of test records. |

For example, assign the test number "1" to a normal load relative accuracy test for a flow system at a peaking unit. If this test is aborted or fails and a new test subsequently passed, assign the test number "2" to the successful second test. For test number "2" there will be a minimum of nine runs.

For a multi-load flow RATA (e.g., a 3-load RATA which is performed at low, mid and high load levels) assign a test number "1" to all the low, mid and high level runs for this test which represent the results for each load level. The test number links together the 3-load levels as a single "test." The test number and operating level are used to distinguish each set of load-specific runs within the 3-load flow RATA.

You may use the same test number (e.g., "1") for RATAs of different monitoring systems in the same calendar quarter.

You may reuse the test number for the same monitoring system, provided that the tests are performed and reported in different quarters and files.

Reason for the RATA — A table look-up provides reasons for performing the RATA. Please select one of the following:

Diagnostic Test
Grace Period QA Test
Grace Period QA and Diagnostic Test
Initial Certification
QA Test
QA and Diagnostic Test
Recertification
Recertification and Grace Period QA Test
Recertification and QA Test

Circular Stack — If the stack is circular enter "Y," otherwise enter "N." Method 2H is only applicable to circular stacks.

Interior Stack Type — A table look-up provides two stack types (this is in reference to the interior stack wall). The stack is either of the brick and mortar interior stack wall type, or the non brick and mortar interior stack wall type. This information is used to determine an appropriate default wall effects adjustment factor (WAF).

Operating Level — Report the load level at which the relative accuracy test occurred, (i.e., at low, mid or high load levels). The letter "N" in the table look-up is now reserved exclusively for single load RATAs at peaking units

and bypass stacks, for which the entire operating range is considered normal. For all other RATAs, only the letters "L," "M," and "H" are to be used to indicate the operating level.

Reference Method

Select the reference method(s) from the table look-up choices below. (You should select one of the first methods listed below (2, 2F, 2G) if you decide to use a default wall effects factor from Method 2H without performing Method 2H measurements.) The reference method selected cannot be edited once data are entered in associated run level entry screens.

| | |
|---|---|
| 2 | Method 2 |
| 2F | Method 2F |
| 2G | Method 2G |
| 2, 2H | Method 2, With Method 2H Measurements |
| 2F, 2H | Method 2F, With Method 2H Measurements |
| 2G, 2H | Method 2G, With Method 2H Measurements |

Those familiar with MDC should note that these identifiers for the reference methods are different from those reported in EDR RTs 611 and RTs 614. This program will generate the appropriate EDR reference method identifiers in the ASCII text export file.

Load Indicator

Indicate which load level being tested is normal. The table look-up provides three choices. The normal load level(s) for each unit or stack is defined in EDR RT 536 of the monitoring plan.

| | |
|---|---|
| N | Normal Load |
| S | Second Most Used Load, but not Normal |
| O | Other |

Stack Dimension

If you have identified a circular stack, the program will offer three options for the stack dimension at the test location:

Area
Circumference
Diameter

If the stack is not circular, you are required to provide the stack area, which is the only option allowed by the program for non-circular stacks.

Stack Size/Units

Provide the stack area, circumference, or diameter, measurement as described above, as well as the units of measurement.

**RATA Data Entry Screen Buttons**

| | |
|---|---|
| Run Data Button | This button is used to access the Run Data Entry window to enter summary data for each RATA run at the load level. |
| Evaluate Button | The system will evaluate the RATA data, and provide error and informational messages if necessary. |
| Delete Level Button | This button will delete operating level at the cursor, and all associated run and point data. |
| Exit Button | The exit button closes the window, prompts you to the save the data if changes were made, and returns you to the browse and select window. |

**Fields Updated by Software (Display Only)**

The following fields in the window are entered by the program, and will change as subsequent run and point data are entered.

| | |
|---|---|
| End Date | The date on which the last run ended as defined in the RATA Run Level data entry screen. |
| End Time | The time at which the last run ended as defined in the RATA Run Level data entry screen. |
| Units of Measure | The units of measure based on the parameter and reference method. It is standard cubic feet per hour (scfh) for a flow RATA. |
| Result | The Result of the test based on the calculated Relative Accuracy. If the test meets the standard specification in 40 CFR Part 75, Appendix A, Section 3.3, the test result will be "PASS." If the test fails the standard specification, the result will be "FAIL." |
| Calculated RA | The Relative Accuracy (RA) as calculated internally by the system. The calculation is performed per Equation A-10 in 40 CFR Part 75, Appendix A. For a multi-level RATA the relative accuracy shown will be the highest relative accuracy determined at a normal operating level. |
| Calculated BAF | The Bias Adjustment Factor (BAF) as determined internally by the system per the procedures in 40 CFR Part 75, Appendix A, Section 7.6.5. |
| No. of Load Levels | The software displays the number of load levels that have been entered for the RATA. |

### 6.3.2 Run Data for Operating Level

The Run Data for Operating Level screen is used to enter the run number, date, time, CEM value, gross unit load, and run status, for each run of a RATA performed at one operating level. This window also allows the selection of a default wall effect adjustment factor for applicable flow RATAs and displays operating level RATA results.

From this window the tester can proceed to the run level data entry window by clicking the <Point> button to enter run and point data. Data must be entered in the Start Date and Start Time fields to access the run level data entry screen for a run.

**Run Data for Operating Level Entry Fields**

Tester — This field is used to identify the testing company or individual responsible for the test. This field is optional, and is for display purposes only.

Use Default WAF — Select "Y" if you wish to use a default wall effects adjustment factor to adjust the reference method flow results for wall effects per Method 2H in 40 CFR Part 60, Appendix A. This field will not appear if the use of a default WAF is not applicable (see 40 CFR Part 60, Appendix A, Method 2H, Section 1.0).

Start and End Date/Time — Report the start and end date and time for each individual run. Run times must not overlap. The run start and end date will be filled automatically for subsequent runs based on the first date entered.

CEMS Value — Report the measured value from the monitoring system being tested in the appropriate units for the run. Report these values to the same precision as is required for hourly data in the EDR (to the nearest 1000 scfh for a flow RATA).

Gross Unit Load — Report the average gross unit load in megawatts or steam load for each run used for this load level.

Run Status — Report whether the run data were used to determine relative accuracy using one of the following codes:

0 Run Not Used in RATA Calculation
1 Run Used in RATA Calculation
9 Test Aborted

2H Run? — This field will appear on the screen only if Method 2H is indicated as a reference method for this RATA level. Identify "Y" for each run in which Method 2H measurements are made. Identify "N" for each run

that does not include Method 2H measurements. This field can not be edited from "Y" to "N" once Method 2H data have been entered for the run.

**Run Data Buttons**

Point Data Button — This button takes you to the point data entry screen for the run. If a previous run has been entered, you will be asked if you wish to copy the point ID, port ID, and probe ID from the previous run to the new run. This feature saves time if you are conducting the next run in the same point order and with the same probe as the previous run.

Delete Last Row Button — This button will delete the last run entered and all associated point and run data.

Save Button — This button saves the data that have been entered in the window. It is recommended that you save frequently to prevent data loss.

Close Button — The close button closes the window, prompts you to the save the data if changes were made, and returns you to the previous window.

**Fields Updated by Software (Display Only)**

End Date/Time — The end date and time that the last run for this level ended, as determined from runs entered on this screen.

Avg. Gross Unit Load — The average of the gross unit loads reported for each run as calculated internally by the software.

Mean CEMS Value — The mean of the run CEMS values as calculated by the software from the run CEMS entered in this window.

Mean RM Value — The mean of the run reference method results for this operating level calculated by the software.

Mean Difference — The arithmetic mean of the differences (÷) between the run reference method value and CEMS value for this operating level calculated by the system per equation A-7, in 40 CFR Part 75, Appendix A.

Standard Deviation — The software calculates the standard deviation of the data set per equation A-8, in 40 CFR Part 75, Appendix A.

Confidence Coefficient — The software calculates the confidence coefficient (one-tailed), cc, of a data set per the equation A-9, and the procedures in 40 CFR Part 75, Appendix A, Section 7.3.3.

T-Value — The software selects the T-Value ($t_{0.025}$) used in the confidence coefficient calculation based on Table 7-1 in 40 CFR Part 75, Appendix A, Section 7.3.3.

Calculated WAF for All Runs — The calculated Wall Effects Adjustment Factor (WAF) used for all runs at this load level based on the WAF determined by the system for at least one Method 2H run, or the average of the calculated WAFs determined from multiple Method 2H runs. If the calculated WAF is less than the minimum WAF allowed by Method 2H, the system will substitute the minimum WAF allowed (0.9700 for a full wall effects traverse or 0.9800 for a partial wall effects traverse) for the calculated value (see 40 CFR Part 60, Appendix A, Method 2H, Sections 12.6.1 and 12.6.2).

Default WAF — The appropriate default Wall Effects Adjustment Factor (WAF) is displayed, if you have chosen to use a default WAF. The default WAF is chosen based on 40 CFR Part 60, Appendix A, Method 2H, Section 2.2.2.

Result — The Result of the test for this operating level based on the calculated Relative Accuracy. If the test meets the standard specification in 40 CFR Part 75, Appendix A, Section 3.3, the test result will be "PASS." If the test fails the specification, the result will be "FAIL."

RA — The Relative Accuracy (RA) for this level as calculated internally by the software. The calculation is performed per Equation A-10 in 40 CFR Part 75, Appendix A.

BAF — The Bias Adjustment Factor (BAF) is determined for the RATA level per the procedures in 40 CFR Part 75, Appendix A, Section 7.6.5.

Run Number — The system will enter run numbers sequentially beginning with run number 1.

Reference Method Value — The software displays the Reference Method value calculated by the system for each run.

### 6.3.3 Supporting Data for Run

The Supporting Data for Run window is used to enter data for each individual run. The top part of the window includes data entry fields for run measurement data: barometric pressure, stack pressure, percent $CO_2$, $O_2$, and $H_2O$. The table in the bottom portion of the window is used to enter point measurement data: point pressures, temperature, and yaw angle. The system calculates and displays F1, F2, and pitch angle for 2F run points, point velocities for method 2F,

2G, and 2H runs, Wall Effects Adjustment Factor (WAF) for 2H runs, and average run velocity and run flow. The Supporting Data for Run screen also provides access to a Method 2H Run Data screen. The Supporting Data for Run screen itself is accessed from the Point Data button on the previous Run Data for Operating Level screen.

**Supporting Data for Run Entry Fields**

To save time the first three fields (Number of Traverse Points, Pressure Measurement Device, CO2/02 Method) may be copied from one run to the next using the Point Button in the previous Run Data for Operating Level window.

Number of Traverse Points — Enter the number of Method 1 traverse points.

Pressure Measurement Device — Select the type of pressure measurement device employed in the run from the table look-up box:

MN Fluid Manometer
MG Mechanical Pressure Gauge (e.g., magnehelic gauge)
ET Electronic Manometer or Electronic Pressure Transducer

CO2/O2 Method — Identify the $CO_2/O_2$ Reference Method used from the table look-up box:

Method 3
Method 3A

Barometric Pressure (in. Hg) — Enter the barometric pressure, in inches of mercury, for the test run.

Static Pressure (in. $H_20$) — Enter the stack static pressure ($P_g$), in inches of water, for the run. If $P_g$ is negative, include the minus sign.

%CO2 (dry) — Enter the dry-basis $\%CO_2$ in the stack gas for the test run.

%O2 (dry) — Enter the dry-basis $\%O_2$ in the stack gas for the test run.

%Moisture — Enter the stack gas moisture percentage for the test run.

The following fields are entered in the point data table for each point of the run. To save time, the first three fields in the table (Point ID, Port ID, Probe ID) can be copied from one run to the next using the Point Button in the previous Run Data for Operating Level window.

Point ID — Assign a unique three digit alphanumeric designation to each of the Method 1 traverse points. Maintain the same point numbering scheme throughout the RATA.

Port ID — The Port ID field will appear in the window only for runs using Method 2H. Assign a Port ID from the table look-up (A, B, C, or D). If there are only two physical stack ports, and you are performing a Method 2H run, you will need to designate 2 additional measurement ports corresponding to the Method 1 wall points which are not adjacent to the test ports. See Figure 2H-1 in 40 CFR Part 60, Appendix A, Method 2H.

Probe ID — Select from the table look-up the identification number engraved (or otherwise marked) on the probe (as well as probe side or calibration velocity range if appropriate) being used to measure velocity at the traverse point. The software will use the most recent calibration data for this probe ID in subsequent velocity calculations. Once selected, the program will autofill the other points with the same probe ID.

P1 - P2 — Report the sight-weighted or integrated average velocity pressure (P1 - P2 or ? P depending on probe type), in inches of $H_20$, recorded at the Method 1 traverse point.

P4 - P5 — This field will appear on the screen for a Method 2F test. Report the sight-weighted or integrated average pitch angle pressure (P4 - P5) in inches of $H_20$ recorded at the Method 1 traverse point.

Stack Temperature — Report the stack temperature measured at the traverse point in degrees Fahrenheit.

Yaw Angle — This field will appear on the screen for a Method 2F or 2G test. Report the measured yaw angle at the traverse point. If the yaw angle is negative, be sure to include a minus sign.

Near Wall? — This field will appear on the screen if the run includes Method 2H measurements for wall effects. Identify the Method 1 traverse point closest to the wall at each port. There should be four in total. If the stack only has two ports see the previous Port ID discussion.

**Supporting Data Buttons**

Delete Point Button — This button will delete the point row.

Method 2H

Data Button — This button will appear on the screen if Method 2H has been identified as a reference method for the RATA. Clicking on this button opens the Method 2H Data Screen.

Save Button — As in other screens this button will save the entered contents of the screen. You should save frequently to prevent data loss.

Close Button — This button will close the screen, prompt you to save the data, and return you to the previous screen.

**Fields Updated by System (Display Only)**

Molecular Wt. (dry) — The Dry Molecular Weight ($M_d$) is calculated by the software using the $CO_2$ and $O_2$ content of the stack gas entered by the tester. The calculation is performed using Equation 3-1, in 40 CFR Part 60, Appendix A, Method 3.

Molecular Wt. (wet) — The Wet Molecular Weight ($M_s$) is calculated by the software using the moisture content of the stack gas entered by the tester, and the dry molecular weight calculated by the software. The calculation is performed using Equation 2-6, in 40 CFR Part 60, Appendix A, Method 2.

Mean Temp. (F) — The average temperature is calculated by the software from the temperatures entered for each traverse point.

Run Velocity Unadjusted for Wall Effects — The Average Run Velocity (ft/sec) is calculated by the software from the software calculated point velocities, except for Method 2 test runs without Method 2H measurements. For the Method 2 test runs (unless different probes are used during the run) the average run velocity is calculated based on the average of the square of the point differential pressures, and the average of the point temperatures (Equation 2-7 in 40 CFR Part 60, Appendix A, Method 2).

Run Traverse Type — This field indicates whether a full or partial Method 2H traverse was performed. The field only appears for Method 2H runs.

Stack Flow (Unadjusted for Wall Effects) — The Average Wet Stack Flow (scfh) is calculated by the software using Equation 2F-10, in 40 CFR Part 60, Appendix A, Method 2F.

Run Velocity (Accounting for Wall Effects) — The Average Run Velocity accounting for Wall Effects (ft/sec) is calculated by the software for Method 2H runs. It equals the average

of the calculated point velocities, including the replacement velocities for near wall points.

WAF for the Run — The Wall Effects Adjustment Factor (WAF) is calculated by the system using Equation 2H-19 of 40 CFR Part 60, Appendix A, Method 2H.

The following fields in the point data table are generated by the system for each point in the run.

Cp — This field is generated for Method 2 run traverse points. The software uses the most recent calibration coefficient (Cp)for a type S or Prandtl probe.

Cp/F2 — This field is generated for Method 2G run traverse points. The software uses the most recent calibration coefficient (Cp for a type S and Prandtl probe or F2 at pitch angle 0 for a 3-D probe) for that probe ID that has been entered in the Probe Data window.

F2 — This field is generated for Method 2F run traverse points. The software determines F2 from the Pitch Angle/F2 polynomial generated from the most recent calibration data for that probe ID.

Pitch Angle — This field is generated for Method 2F run traverse points. The software determines Pitch Angle from the F1/Pitch Angle polynomial generated from the most recent calibration data for that probe ID.

Velocity — The Actual Point Velocity (ft/sec) is calculated by the software using the equation appropriate for Method 2, 2F, or 2G, in 40 CFR Part 60, Appendix A. While the software calculates point velocities for Method 2 runs, it only uses those velocities in conjunction with a Method 2H run.

Replacement Velocity — The Replacement Velocity (ft/sec) is generated by the software for Method 2H runs. The replacement velocity is calculated using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Sections 12.4.1 through 12.4.8.

### 6.3.4 Wall Effects Data for Run

The Wall Effects Data for Run screen is divided into 9 separate tabs, 2 each for each of the 4 Measurement Ports (or Method 1 wall points), and a $d_{rem}$ Calculation folder. Data are entered only into the Port Measurements folder for each measurement port or wall point.

If your stack has only 2 actual physical measurement ports, you will need to designate 2 additional measurement ports corresponding to the Method 1 wall points which are not adjacent to the test ports. See Figure 2H-1 in 40 CFR Part 60, Appendix A, Method 2H.

Save Button — As on other screens this button will save the entered contents of the screen. You should save frequently to prevent data loss.

Close Button — Closes the screen, prompts you to save if there are changes, and returns to the prior screen.

### 6.3.4.1 $d_{rem}$ Calculation

The $d_{rem}$ Calculation tab is the first tab displayed in the Wall Effects Data for Run window. This tab displays the $d_{last}$ and $d_{rem}$ wall effects point locations for a complete wall effects traverse. The $d_{rem}$ wall point location for a partial traverse is displayed in the Port Calculations folders in the Actual $d_{rem}$ field. It is displayed for a partial traverse after entering a wall effects point location in the Port Measurement folder. $d_{rem}$ for a partial traverse will vary depending on the location of the wall effects points.

**Fields Updated by Software (Display Only)**

$d_b$ (in) — The software determines the Distance from the Wall for the Interior Boundary ($d_b$) of a Method 1 Exterior Equal-Area Sector using Equation 2H-4 in 40 CFR Part 60, Appendix A, Method 2H. Also see 40 CFR Part 60, Appendix A, Method 2H, Table 2H-1.

$d_{last}$ (in) — The software determines the Distance from the Wall of the Last 1-inch Incremented Wall Effects Traverse Point ($d_{last}$) for a complete wall effects traverse using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 8.2.3.

$d_{rem}$ (in) — The software determines the Distance from the Wall of the Centroid of the Area Between $d_{last}$ and the Interior Edge of the Method 1 Exterior Equal Area Sector ($d_b$) using Equations 2H-1 or 2H-2 in 40 CFR Part 60, Appendix A, Method 2H.

### 6.3.4.2 Port (A, B, C, D) Measurements

There is one tab (window) to enter Method 2H data for each port or Method 1 traverse wall point. To save time, the first three point fields in the point table (Distance, Point ID, Probe ID) can be copied from one port measurement folder to the next.

**Wall Effects Point Data Entry**

Traverse Type — Select the type of wall effects traverse from the table look-up:

Complete
Partial

Distance (in.) — Enter the distance from the wall in inches for the wall effects traverse point.

Point ID — Assign a unique three digit alphanumeric designation to each of the wall effects traverse points. Maintain the same point numbering scheme throughout the RATA.

Probe ID — Select from the table look-up the identification number engraved (or otherwise marked) on the probe (as well as probe side or calibration velocity range if appropriate) being used to measure velocity at the traverse point. The software will use the most recent calibration data for this probe ID in subsequent velocity calculations.

P1 - P2 — Enter the sight-weighted or integrated average velocity pressure (P1 - P2 or ? P depending on probe type), in inches of $H_20$, recorded at the Method 1 traverse point.

P4 - P5 — This field will appear on the screen for a Method 2F test. Enter the sight-weighted or integrated average pitch angle pressure (P4 - P5) in inches of $H_20$ recorded at the wall effects point.

Stack Temp. (F) — Enter the stack temperature measured at the wall effects point in degrees Fahrenheit.

Yaw Angle — This field will appear on the screen for a Method 2F or 2G test. Report the measured yaw angle at the wall effects traverse point. If the yaw angle is negative, be sure to include a minus sign.

Delete Point Button — This button will delete the point row at the cursor.

**Fields Updated by Software (Display Only)**

No. of Measurement Points — The software counts the number of wall effects traverse points entered for the measurement port.

Cp — This field is generated for Method 2 run traverse points. The software uses the most recent calibration coefficient (Cp) for a type S or Prandtl probe.

F2 or Cp — This field is generated for Method 2G run traverse points. The software uses the most recent calibration coefficient (Cp for a type S and Prandtl probe or F2 at pitch angle 0 for a 3-D probe) for that probe ID that has been entered in the Probe Data window.

F2 — This field is generated for Method 2F run wall effects traverse points. The software determines F2 from the F2/Pitch Angle polynomial generated from the most recent calibration data for that probe ID.

Pitch Angle — This field is generated for Method 2F run wall effects traverse points. The software determines Pitch Angle from the F1/Pitch Angle polynomial generated from the most recent calibration data for that probe ID.

Velocity — The Actual Wall Effects Point Velocity (ft/sec) is calculated by the software using the equation appropriate for Method 2, 2F, or 2G in 40 CFR Part 60, Appendix A.

#### 6.3.4.3 Port (A, B, C, D) Calculations

**Fields Updated by Software (Display Only)**

Actual $d_{rem}$ (in) — The software calculates $d_{rem}$ in inches from the entered data per Equations 2H-1 or 2H-2, in 40 CFR Part 60, Appendix A, Method 2H.

Replacement Velocity — The Replacement Velocity (ft/sec) for the Method 1 equal area sector closest to the wall is calculated by the software using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Sections 12.4.1 through 12.4.8.

Distance (in) — Distance from the wall as entered on the Port Measurements tab.

Velocity — The Actual Wall Effects Point Velocity (ft/sec) is calculated by the software using the equation appropriate for Method 2, 2F, or 2G in 40 CFR Part 60, Appendix A.

$V_{-dec}$ (d) — The software calculates the Average Velocity for each Sector (decay velocity) using Equation 2H-7 in 40 CFR Part 60, Appendix A, Method 2H.

Col.(D) — The software calculates an intermediate value, Column D, for the Area(d) calculation using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 12.4.2.

Col.(E) — The software calculates an intermediate value, Column E, for the Area(d) calculation using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 12.4.2.

| | |
|---|---|
| Area(d) | The Cross Sectional Area of the Subsector is calculated by the software by subtracting the Column E value from the Column D value (Equation 2H-8 in 40 CFR Part 60, Appendix A, Method 2H.) |
| Flow(d) | The software calculates the Volumetric Flow through each cross sectional area using Equation 2H-9 in 40 CFR Part 60, Appendix A, Method 2H. |
| Velocity $d_{rem}$ | The value for $V_{drem}$ is determined using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 12.4.6. |
| Area $d_{rem}$ | The $A_{drem}$ cross sectional area is determined by the software using the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 12.4.5. |
| Total Flow (d) | The software calculates the Volumetric Flow for all subsectors located between the wall and $d_{last}$ using Equation 2H-10 in 40 CFR Part 60, Appendix A, Method 2H. |
| Flow $d_{rem}$ | The software calculates the $d_{rem}$ Volumetric Flow using the procedures in Section 12.4.6 in 40 CFR Part 60, Appendix A, Method 2H. |
| Total Flow | The software calculates the Total Volumetric Flow for the Method 1 equal area sector closest to the wall using Equation 2H-14 in 40 CFR Part 60, Appendix A, Method 2H. |

# 7.0 Utilities

The FLOW-CALC software provides several utilities to keep the system and the data current. These features allow you to modify the system to suit your environment and preferences. The following items are accessed from the Utilities Menu:

Reindex the Database
Select Printer
Printer Maintenance
Look-Up Table Maintenance
Move Operating Level to Another Flow RATA

## 7.1 Reindex the Database

This option allows you to recreate or recover indexes to the database which are corrupted by a computer or network failure. Use this option if you notice erratic behavior or error messages following a hardware event or network failure. If you report a problem to the technical support

person, you may be asked to reindex the databases. You may only perform this task if you are the only user in the system.

### 7.2 Select Printer

The Select Printer option allows you to select the printer to use from a printer look-up table. The Printer Maintenance option allows you to add a printer to the look-up table.

### 7.3 Printer Maintenance

The Printer Maintenance option enables you to change the printer definitions supported by the FLOW-CALC Software. You can add, edit, or delete printer definitions by navigating the sorted list of printer names.

Navigate the list with the scroll bar, or use the following key combinations:

| | |
|---|---|
| Up/Down Arrow | Scroll the list |
| Left/Right Arrow, Tab | Scroll the controls |
| Shift-Home/End | Top/bottom of the list |
| PgUp/PgDn | Jump to the next section of the list |
| Any letter | Jump to the first printer starting with that letter |

**Adding a Printer**

Click on the <Insert> button to add a new printer to the list. Define the graphics type field from a drop down list of generic values. Use the standard navigation keys to select a value. Press [Tab] or click to move to the definition page frames. Click on the left tab page labeled "Initialization" to enter printer control codes for printer job control and page formatting. Click on the right tab page labeled "Fonts" to define the control codes for proportional fonts sizes, style and character enhancements. Or use [ALT-I] to switch to the Initialization codes page and [ALT-F] to switch to the Fonts codes page.

The control codes for a printer are technical specifications with which most users are not familiar. These codes are decimal values separated by commas and are usually contained in the printer manual. If you are uncertain about the correct values, consult your computer support staff or printer documentation for information on filling out Printer Definitions. Once you have entered the codes and selected the printer, print a sample report to verify that the codes are entered and operating correctly.

**Changing a Printer Definition**

Highlight a printer using the mouse or arrow keys and press [Enter] or click on the <Edit> button to modify the printer definitions.

**Deleting a Printer**

Highlight a printer using the mouse or arrow keys and click on the <Delete> button to delete the record. The software will prompt you to confirm this action with a Yes/No question.

## 7.4 Look-Up Table Maintenance

This option allows you to add, delete or change the look-up tables which are used by the software to verify the content of fields which are limited to specific codes. For some fields, you may review the codes but not change them. It is recommended that you only change look-up table entries at the direction of EPA.

To review the list of look-up tables, select the All Tables option from the Table Maintenance Menu. The Current Table option is only available when you are on a data entry screen and press [CTRL-T] from the field associated with the look-up value.

Use the highlight bar or mouse to select a Table Look-up Category. Double click or press [Enter] to select the category. A list of all the values associated with the category appear for your review. If the category has been defined as a category for user edit, you may add, delete or edit the look-up values as follows.

**Adding a Table Entry**

To add an entry to a table, click on the <Add> button. A Table Entry Screen will appear. Fill in the fields of this screen as follows:

| | |
|---|---|
| Field #1 (Code or Value) | Following the numbering or code assignment conventions on the previous list, enter new, unique numbers or characters for the new table entry. Note that when you access the table during data entry, this code will not appear on the screen. |
| Field #2 (Label or Description) | Enter the name of the new table entry. This is the value that will appear in the selection list in alphabetical order on the data entry screen. |

Click on the <Save> button to save your changes; click on <Cancel> to abandon your changes.

**Editing a Table Entry**

To edit a table entry, highlight it and double click or press [Enter]. Note that all code values must be unique.

Click on the <Save> button to save your changes; <Cancel> to abandon your changes.

**Deleting a Table Entry**

To delete a table entry, highlight it and click on the <Delete> button. You will be asked to confirm the deletion.

### 7.5 Move Operating Level to Another Flow RATA

This option allows you to move one operating level of a multi-load flow RATA to another flow RATA. You may need to use this utility if you have failed or aborted one level of a multi-load RATA, but passed one or more levels of the RATA. Under certain circumstances, you will only need to retest at the failed operating level. (See 40 CFR Part 75, Appendix B, Section 2.3.2(f).) Since you must report the failed RATA, you should begin a new test for the retest, and then use this utility to move the operating levels that passed in the old test to the new test.

Before moving the level, you should already have added the new test, and filled in the ORIS Code, Unit/Stack ID, and Monitoring System ID.

To move a level, use the highlight bar or the mouse to select the level that you wish to move, and then double click or press <Continue>. A list of possible destination RATAs will then appear. Use the highlight bar or the mouse to select the destination RATA, and then double click or press <Move>.

## 8.0 Calculations

Calculations are performed using the procedures and equations in the appropriate Reference Methods in 40 CFR Part 60, Appendix A, and the RATA procedures and calculations in 40 CFR Part 75, Appendix A. The methods and procedures can be accessed by clicking on the links below:

40 CFR Part 60, Appendix A: Method 2
Method 2F
Method 2G
Method 2H
Method 3

40 CFR Part 75, Appendix A: Section 7

**Rounding**

The software performs calculations using calculated intermediate values that are not rounded, except in the following cases:

1. The flow reference method values are first rounded to the nearest 1000 scfh prior to performing the relative accuracy calculations. The rounded flow reference method values are displayed on the Run Data screen.

2. The stack area used in stack flow calculations is calculated based on the reported stack diameter in feet, or the stack diameter in feet back-calculated from the reported stack area, circumference, or stack diameter (if the diameter is reported in inches). The resulting calculated area used in the flow calculation is rounded to 2 decimal places. The calculated area is rounded to 2 decimal points in order to match the MDC program routine for checking flow calculations.

3. For Method 2F, the F2 value and pitch angle determined from the probe calibration data polynomials are rounded to 3 decimal places and 1 decimal place respectively.

4. For Method 2H, the Method 1 wall point replacement velocities, which are used to determine the Wall Adjustment Factor (WAF), are rounded to 2 decimal places. The velocities determined at the Method 2H wall effects traverse points are also rounded to 2 decimal places. The rounding to 2 decimal places is performed to match the EDR format and MDC program routine for checking the RATA results.

# Appendix A: FLOW-CALC Error Messages

FLOW-1

You designated one of the operating levels of a multi-load RATA as "N." The only valid operating levels for a multi-load RATA are H, L, or M. You should only report an operating level of "N" for single-load RATAs conducted at peaking units. The BAF for this RATA cannot be determined.

FLOW-2

Warning: The test period for this RATA extended for more than 720 clock hours. This test may not meet the requirement that the test period for a multi-load RATA be completed within 720 unit or stack operating hours.

FLOW-3

Your reference method value indicates that you intend to perform Method 2H calculations, but you indicated that the stack is not circular. You can only perform Method 2H calculations at a circular stack.

FLOW-4

You did not report the Stack Area at the test port for [key]. You must report the stack area at the test port when conducting a RATA at a non-circular stack.

FLOW-5

The stack or duct diameter for [key] is less than 3.3 feet. A minimum stack or duct diameter of 3.3 feet is required when Method 2H is used for a flow RATA.

FLOW-6

Warning: [key] was less than five minutes. Each run must be at least five minutes in duration.

FLOW-7

Warning: The measured CEMS value for [key] was not rounded to the nearest 1000 scfh.
FLOW-8

Warning: The Traverse Point ID for [key] is invalid. All Traverse Point IDs must consist of three alpha-numeric characters.

FLOW-9A

The Probe ID identified in [key] could not be found in the probe information table.

FLOW-9B

Warning: The Calibration Test Date for the probe used at [key] was more than one year before the date of this run.

FLOW-10

The F2 VALUE and the PITCH ANGLE OF FLOW for [key] cannot be determined, either because you reported an invalid pressure measurement or because the Method 2F polynomials for the probe were missing or invalid.

FLOW-11

The point velocity calculated for [key] exceeded the maximum allowable value in the EDR. Therefore, the velocity and stack flow for this run was not calculated.

FLOW-12A

The number of traverse points reported for [key] was inconsistent with the actual number of Method1 traverse points at which measurements were conducted.

FLOW-12B

The number of traverse points for [key] is less than 16. A minimum of 16 traverse points is required for a flow RATA run in which Method 2H is used to calculate a wall effects adjustment factor.

FLOW-13

The traverse point data for [key] contain duplicate Method 1 Traverse Point IDs.

FLOW-14A

You reported more than one probe type at the Method 1 traverse points for [key]. The same type of probe must be used for all traverse points associated with a run.

FLOW-14B

The probe type used for [key] is not appropriate for a Method 2F flow RATA. Only probe types "DA," "DAT," or "SPH" may be used for Method 2F RATAs.

FLOW-14C

The probe type used for [key] is not appropriate for a Method 2G flow RATA. Only probe types "S," "AS," "DA," "DAT," or "SPH" may be used for Method 2G RATAs.

FLOW-14D

The probe type used for [key] is not appropriate for a regular Method 2 flow RATA. Only probe types "S," "AS," or "P" may be used for Method 2 RATAs.

FLOW-15A

Attention: More than one probe was used to determine the stack flow for [key]. Therefore, instead of following the usual Method 2 calculation procedure, the stack flow was calculated by averaging the individual velocities at each of the Method 1 traverse points for the run.

FLOW-15B

The average velocity for [key] is less than 20.0 ft/sec. A minimum velocity of 20.0 ft/sec is required to use Method 2F for a flow RATA.

FLOW-15C

Warning: The run velocity calculated for [key] exceeded the expected maximum value of 200 feet per second.

FLOW-16A

The run velocity calculated for [key] exceeded the maximum allowable value in the EDR. Therefore, the stack flow for this run was not calculated.

FLOW-16B

Warning: The run velocity calculated for [key] exceeded the expected maximum value of 200 feet per second.

FLOW-17A

The reference method value calculated for [key] exceeded the maximum allowable value in the EDR.

FLOW-17B

Warning: The stack flow calculated for [key] exceeded the expected maximum value of 200 million scfh.

FLOW-18

You identified [key] as a run to be used in the calculation of a wall effects adjustment factor (WAF), but you did not identify exterior method 1 traverse points as "near wall points" at each of the four stack test ports. Method 2H measurements must be performed at all four stack test ports in order to calculate a WAF.

FLOW-19A

You reported more than one probe type at the Method 2H wall effects measurement points for [key]. The same type of probe must be used at all Method2H points used to calculate a replacement velocity.

FLOW-19B

The probe type used for [key] is not appropriate for a Method 2F flow RATA. Only probe types "DA," "DAT," or "SPH" may be used for Method 2F RATAs.

FLOW-19C

The probe type used for [key] is not appropriate for a Method 2G flow RATA. Only probe types "S," "AS," "DA," "DAT," or "SPH" may be used for Method 2G RATAs.

FLOW-19D

The probe type used for [key] is not appropriate for a regular Method 2 flow RATA. Only probe types "S," "AS," or "P" may be used for Method 2 RATAs.

FLOW-20

You conducted more than one Method 2H measurement at the same distance from wall for [key].

FLOW-21A

You indicated that you performed Method 2H measurements for [key] but you did not conduct measurements at the minimum of two points.

FLOW-21B

You did not perform a valid full Method 2H traverse for [key], either because you did not perform measurements at the d-last and d-rem point(s), or because your d-last and d-rem measurements were conducted at incorrect distances.

FLOW-21C

You did not perform a valid partial Method 2H traverse for [key], either because you did not conduct a measurement at the d-rem point, or the d-rem measurement was conducted at an incorrect distance.

FLOW-22

You indicated that you performed a full Method 2H traverse for [key], but you did not conduct measurements at all the required points.

FLOW-23

You reported more than one probe type at the Method 1 and Method 2H traverse points for [key]. The same type of probe must be used for all traverse points associated with a run.

FLOW-24

Attention: Both "full" and "partial" traverses were used to calculate a wall effects adjustment factor for [key]. Therefore, it is assumed that a partial wall effects traverse was performed in calculating the WAF.

FLOW-25A

You reported that a flow RATA was performed using method 2H calculations for [key], but you did not identify runs for the purpose of calculating a wall effects adjustment factor (WAF). When using these methods, you must identify at least one run for the purpose of calculating a WAF. If you intend to use a default WAF, and not perform any wall effects measurements, you must remove Method 2H from the REFERENCE METHOD field, and enter Y in the USE DEFAULT WAF? field on the run data screen.

FLOW-25B

The number of equal area sectors at the runs used to calculate a wall effects adjustment factor (WAF) for [key] were not the same. All runs used to calculate a WAF must have the same number of equal area sectors.

FLOW-25C

Attention: You have not indicated the use of a default wall effects adjustment factor for [key], even though the default WAF is less than the WAF calculated for this operating level.

FLOW-26

Attention: You have indicated the use of a default wall effects adjustment factor for [key], even though the default WAF is greater than the WAF calculated for this operating level.

FLOW-27

Attention: The calculated wall effects adjustment factor (WAF) was not applied in the calculation of stack flow for [key], because the number of traverse points at the test port for the run was greater than the number of traverse points for the run(s) used to calculate the WAF.

FLOW-28

The relative accuracy for [key] was not calculated because of the errors listed above.

FLOW-29A

Warning: You did not designate the operating level as a 'normal' load. Single-load RATAs must be performed at the normal operating level.

FLOW-29B

You did not designate at least one operating level as a "normal" load, or you did not designate two operating levels as either a "normal" or "second most frequently used" load. A multi-load RATA must be performed at the two most frequently used load levels. The BAF for this RATA cannot be determined.

FLOW-29C

Warning: You did not designate at least one operating level as a "normal" load, or you did not designate two operating levels as either a "normal" or "second most frequently used" load. A multi-load RATA must be performed at the two most frequently used load levels.

FLOW-30A

Warning: The average gross unit load for Operating Level H is lower than the average gross unit load for another level in this RATA. This may indicate that you have not assigned the correct operating levels to this RATA.

FLOW-30B

Warning: The average gross unit load for Operating Level M is lower than the average gross unit load for Operating Level L. This may indicate that you have not assigned the correct operating levels to this RATA.

GEN-1

This RATA contains an invalid Monitoring System ID. The Monitoring System ID must consist of three alpha-numeric characters. This RATA cannot be exported until you have corrected this problem.

GEN-2

The Test Number is not unique for this monitoring system and the calendar quarter in which this RATA was completed. The test number may be assigned a different value when the RATA is exported.

GEN-3

Attention: One or more run records contain a run status of '9' which indicates that the test has been aborted. This test is treated as an aborted RATA and was not evaluated further.

GEN-4

One or more runs have overlapping run times.

GEN-5A

The Run Start Time for [key] is invalid. The hour must be 00 - 23, and the minutes must be 00 - 59.

GEN-5B

The Run End Time for [key] is invalid. The hour must be 00 - 23, and the minutes must be 00 - 59.

GEN-6

The Run End Date/Time was not later than the Run Start Date/Time. These data are invalid.

GEN-7

There are more than three run records for [key] with a run status of '0', which indicates runs excluded from the data analysis. Only three runs may be excluded from a RATA at each operating level.

GEN-8

There are fewer than nine run records for [key] with a run status of '1'. A minimum of nine runs are required for each complete operating level RATA.

GEN-9

There are duplicate, missing or non-sequential run numbers for [key], where the RATA run records are time ordered by run start date and time.

GEN-10

Warning: The test period for this RATA extended for more than 168 clock hours. This test may not meet the requirement that the test period for each single-load RATA be completed within 168 unit or stack operating hours.

GEN-11

Warning: The relative accuracy recorded for [key] is 99.99, which is the maximum value allowed in the EDR. This value, however, may be less than the actual calculated value.

# Appendix B: Evaluation Criteria for Relative Accuracy Tests

**Requirement Number:** FLOW-1

**Requirement Name:** Invalid Operating Level

**Purpose:** To identify multi-load Flow RATAs which have an invalid operating level

**Function:** For a multi-load Flow RATA,

Locate an operating level with a value of "N."

If found,

print error message: "You designated one of the operating levels of a multi-load RATA as "N." The only valid operating levels for a multi-load RATA are H, L, or M. You should only report an operating level of "N" for single-load RATAs conducted at peaking units. The BAF for this RATA cannot be determined."

**Requirement Number:** FLOW-2

**Requirement Name:** Check for Multi-Load Flow RATA Duration

**Purpose:** To identify multiple load flow RATAs that span more than 30 days

**Function:** For each multiple-load flow RATA, sort all RTs 610 for all load levels by run start date and time.

If the latest valid Run End Date and Time is more than 720 clock hours after the earliest Run Start Date and Time,

> print error message: "Warning: The test period for this RATA extended for more than 720 clock hours. This test may not meet the requirement that the test period for a multi-load RATA be completed within 720 unit or stack operating hours."

**Comments:** Perform only if all dates and times are valid and all run numbers are non-blank.

**Requirement Number:** FLOW-3

**Requirement Name:** Stack Not Circular for Method 2H RATA

**Purpose:** To identify Method 2H Flow RATAs which are performed at a non-circular stack

**Function:** For each operating level of a Flow RATA,

If the Reference Method Used contains the code "2H" and the circular stack indicator is not equal to "Y,"

print error message: "Your reference method value indicates that you intend to perform Method 2H calculations, but you indicated that the stack is not circular. You can only perform Method 2H calculations at a circular stack."

**Requirement Number:** FLOW-4

**Requirement Name:** Invalid Stack Dimension for Non-Circular Stack

**Purpose:** To identify invalid stack size measurements for Flow RATAs which are performed at a non-circular stack

**Function:** For each operating level of a Flow RATA,

If the Stack Dimension is not equal to "Area" and the circular stack indicator is not equal to "Y,"

print error message: "You did not report the Stack Area at the test port for [key]. You must report the stack area at the test port when conducting a RATA at a non-circular stack."

**Requirement Number:** FLOW-5

**Requirement Name:** Stack Diameter Too Small for Method 2H RATA

**Purpose:** To identify Method 2H Flow RATAs which performed at a location in the stack where the diameter is less than 3.3 feet

**Function:** For each operating level of a Flow RATA,

If the Reference Method Used contains the code "2H,"

If the Stack Diameter at the Test Location is less than 3.3 feet or 39.6 inches, or the Stack Circumference at the Test Location is less than 10.4 feet or 124.5 inches, or the Stack Area at the Test Location is less than 8.6 square feet or 1231.7 square inches,

print error message: "The stack or duct diameter for [key] is less than 3.3 feet. A minimum stack or duct diameter of 3.3 feet is required when Method 2H is used for a flow RATA."

**Requirement Number:** FLOW-6

**Requirement Name:** Flow Run Length Check

**Purpose:** To determine flow run length compliance with Part 75

**Function:** For each run of a Flow RATA with a run status equal to "1,"

calculate the duration of the run from the run start date and time and the run end date and time.

If the duration is < 5 minutes,

print error message: "Warning: [key] was less than five minutes. Each run must be at least five minutes in duration."

**Comments:** Perform check if GEN-5A, GEN-5B, and GEN-6 have been passed.

**Requirement Number:** FLOW-7

**Requirement Name:** Check for Proper Rounding of Flow RATA CEM Values

**Purpose:** To determine if measured values for flow were rounded to nearest 1000

**Function:** For each run of a Flow RATA with a run status equal to "1,"

If the measured CEM value is not rounded to the nearest 1,000 scfh,

print error message: "Warning: The measured CEMS value for [key] was not rounded to the nearest 1000 scfh."

**Requirement Number:** FLOW-8

**Requirement Name:** Traverse Point ID Format Check

**Purpose:** Check for three-character traverse point IDs

**Function:** For each Method 1 traverse point in a Flow RATA,

If the Point ID does not contain 3 non-blank characters,

print error message: "Warning: The Traverse Point ID for [key] is invalid. All Traverse Point IDs must consist of three alpha-numeric characters."

**Requirement Number:** FLOW-9A and 9B

**Requirement Name:** Probe Calibration Test Date Check

**Purpose:** Check for valid probe calibration test date

**Function:** For each Method 1 traverse point and Method 2H wall point in a Flow RATA,

(a) Locate all records in the probe calibration table with the same Probe ID, Probe Side, and Range of Velocities as the probe used at the point and with a Calibration Test Date no later than the Run Start Date.

If not found (a),

print error message A: "The Probe ID identified in [key] could not be found in the probe information table."

If found (a)

If the Calibration Test Date in the record with the most recent Calibration Test Date is more than one year earlier than the Run Start Date,

print error message B: "Warning: The Calibration Test Date for the probe used at [key] was more than one year before the date of this run. Probes are to be recalibrated within 12 months of its first field use after its most recent calibration, or after 10 field tests, whichever occurs later."

**Comments:** One error message per probe per run.

**Requirement Number:** FLOW-10

**Requirement Name:** Calculation of Method 2F Probe Calibration Values

**Purpose:** To calculate the F2 and Pitch Angle values in Method 2F RATAs

**Function:** For each Method 1 traverse point and Method 2H wall point in a Method 2F Flow RATA,

(a) Locate the most recent record in the probe calibration table with the same Probe ID, Probe Side, and Range of Velocities as the probe used at the point and with a Calibration Test Date no later than the Run Start Date.

If found (a), and both Method 2F equations in the probe calibration record are valid,

Calculate F2 and Pitch Angle using the Method 2F equations and the P1P2 Differential Pressure and the P4P5 Pressure readings, and round the results to three decimal places.

If not found (a), or either of the Method 2F equations is missing or invalid, or if the absolute value of the calculated F2 value is greater than or equal to 10, or if the absolute value of the calculated Pitch Angle value is greater than 90,

print error message: "The F2 VALUE and the PITCH ANGLE OF FLOW for [key] cannot be determined, either because you reported an invalid pressure measurement or because the Method 2F polynomials for the probe were missing or invalid."

Otherwise,

Store the calculated F2 and Pitch Angle values for use in FLOW-11.

**Comments:** Do not perform if Probe ID is blank or the P1P2 Differential Pressure is zero.

**Requirement Number:** FLOW-11

**Requirement Name:** Calculation of Point Velocity

**Purpose:** To ensure that point velocities do not exceed the maximum allowable or expected values

**Function:** For each Method 1 traverse point and Method 2H wall point in a Flow RATA,

If the Percent $CO_2$, Percent $O_2$, Percent Moisture, Barometric Pressure, or Stack Static Pressure for the run is not within the valid range of values, or if the P1-P2 Differential Pressure, Stack Temperature, or Yaw Angle (for Methods 2F and 2G) for the point is not within the valid range of values (see table, page B-12),

exit this check.

If the Probe ID for the point is blank, or if the point failed FLOW-10 (for Method 2F RATAs) or if the Probe Calibration Coefficient or F2 Value (for Method 2 and 2G RATAs) for the point is not within the valid range of values,

exit this check.

Otherwise, calculate the dry molecular weight using Method 3 or 3A, as appropriate, and then calculate the wet molecular weight using Equation 2-6 in 40 CFR Part 60, Appendix A, Method 2.

If the wet molecular weight is less than 25 or greater than 35,

exit this check.

Otherwise, calculate the point velocity according 40 CFR Part 60, Appendix A, Sections 12.1 and 12.2 of Methods 2F or 2G, as appropriate.

If the point velocity is greater than 999.99 fps,

print error message: "The point velocity calculated for [key] exceeded the maximum allowable value in the EDR. Therefore, the

velocity and stack flow for this run was not calculated." Exit this check.

Otherwise,

Store the Method 1 traverse point velocity for use in FLOW-15. Round the Method 2H wall point velocity to two decimal places and store the value for use in FLOW-22.

**FLOW-11 Range Checks**
**(FLOW-CALC Version 1.0)**

| Record Type and Parameter | Field | Range Check |
|---|---|---|
| Supporting Run Data (Flow) | Barometric Pressure | 20 to 35 |
| | Static Pressure | -10 to 10 |
| | Percent $CO_2$ | 0.1 to 20 |
| | Percent $O_2$ | 0.1 to 22 |
| | Percent Moisture | 0.1 to 75 |
| Traverse Point (Flow) | P1-P2 Differential Pressure | <0> |
| | Stack Temperature | 0 to 1000 |
| | Yaw Angle | -90 to 90 |
| Method 2H Point (Flow) | Distance from Wall | must be an integer value between 1 and 12 or must be $d_{rem}$ |
| | P1-P2 Differential Pressure | <0> |
| | Stack Temperature | 0 to 1000 |
| | Yaw Angle | -90 to 90 |

**Requirement Number:** FLOW-12A and 12B

**Requirement Name:** Number of Traverse Points Check

**Purpose:** Check for a valid number of traverse points, and calculate the number of equal area sectors for the run.

**Function:** For each run of a Flow RATA,

Count the number of Method 1 traverse points at which measurements were conducted.

If this number does not equal the value in the Number of Traverse Points field,

print error message A: "The number of traverse points reported for [key] was inconsistent with the actual number of Method1 traverse points at which measurements were conducted." Exit this check.

If the value in the Number of Traverse Points field is greater than or equal to 12 but less than 16, and this is a Method 2H RATA and the 2H Run indicator for the run is equal to "Y,"

print error message B: "The number of traverse points for [key] is less than 16. A minimum of 16 traverse points is required for a flow RATA run in which Method 2H is used to calculate a wall effects adjustment factor." Exit this check.

Calculate the number of equal area sectors used in the run by dividing the Number of Traverse Points for the run by 4 and rounding up to the nearest integer. Store this value for use in FLOW-25.

**Comments:** Do not perform FLOW-12A if the value in the Number of Traverse Points field is equal to zero.

**Requirement Number:** FLOW-13

**Requirement Name:** Duplicate Traverse Points Check

**Purpose:** To identify and eliminate duplicate Method 1 traverse points

**Function:** For each run of a Flow RATA,

If the set of Method 1 traverse points contains any records with the same Traverse Point ID,

print error message: "The traverse point data for [key] contain duplicate Method 1 Traverse Point IDs."

**Comments:** One error message per run.

**Requirement Number:** FLOW-14A, 14B, 14C, and 14D

**Requirement Name:** Probe Type Check

**Purpose:** To verify the proper probe type for the corresponding flow reference method

**Function:** For each run of a Flow RATA,

(a) Locate the first Method 1 traverse point associated with the run.

If not found (a),

exit this check.

(b) Locate the most recent record in the probe calibration table with the same Probe ID, Probe Side, and Range of Velocities as the probe used at the traverse point and with a Calibration Test Date no later than the Run Start Date.

`

If not found (b), or if the Probe Type in this record is blank,

(c) Locate the next Method 1 traverse point associated with the run.

If found (c),

Repeat step (b).

If not found (b), or if the Probe Type in this record is blank, repeat step (c).

If not found (c),

exit this check.

If found (b), and the Probe Type in this record is not blank,

Store the Probe Type in this record as the probe type for the run for use below and in FLOW-23.

If the probe used in any other Method 1 traverse point for the run is different than the probe used to determine the probe type for the run,

Locate the most recent record in the probe calibration table with the same Probe ID, Probe Side, and Range of Velocities as the probe used at the traverse point and with a Calibration Test Date no later than the Run Start Date.

If found, and the Probe Type in this record is not equal to the probe type for the run,

> print error message A: "You reported more than one probe type at the Method 1 traverse points for [key]. The same type of probe must be used for all traverse points associated with a run." Exit this check.

If this is a Method 2F RATA, and the probe type for the run is not equal to "DA," "DAT," or "SPH,"

> print error message B: "The probe type used for [key] is not appropriate for a Method 2F flow RATA. Only probe types "DA," "DAT," or "SPH" may be used for Method 2F RATAs."

If this is a Method 2G RATA, and the probe type for the run is not equal to "S," "AS," "DA," "DAT," or "SPH,"

> print error message C: "The probe type used for [key] is not appropriate for a Method 2G flow RATA. Only probe types "S," "AS," "DA," "DAT," or "SPH" may be used for Method 2G RATAs."

If this is a Method 2 RATA, and the probe type for the run is not equal to "S," "AS" or "P,"

> print error message D: "The probe type used for [key] is not appropriate for a regular Method 2 flow RATA. Only probe types "S," "AS," or "P" may be used for Method 2 RATAs."

**Requirement Number:** FLOW-15A, 15B, and 15C

**Requirement Name:** Calculation of Run Velocity Based on Point Velocities

**Purpose:** To calculate run velocity for Method 2F, 2G, 2H, and special Method 2 runs.

**Function:** For each run of a of a Flow RATA,

If the point velocity for any Method 1 traverse point in the run was not calculated in FLOW-11, or if any traverse point failed check FLOW-11, or if the run failed checks FLOW-12A, FLOW-13, FLOW-14A, FLOW-14B, FLOW-14C, or FLOW-14D,

exit this check.

If the reference method for the operating level is "2" or "2,2H" and the 2H Run indicator for the run is not equal to "Y,"

Count the number of different probes used at all the Method 1 traverse points in the run.

If the number of probes used in the run is equal to 1,

This is an ordinary Method 2 run. Proceed to check FLOW-16.

If the number of probes used in the run is greater than 1,

print error message A: "Attention: More than one probe was used to determine the stack flow for [key]. Therefore, instead of following the usual Method 2 calculation procedure, the stack flow was calculated by averaging the individual velocities at each of the Method 1 traverse points for the run."

If the reference method for the operating level contains the value "2F" or "2G," or if the 2H Run indicator for the run is equal to "Y," or if the number of probes used in the is greater than 1,

Calculate the run velocity by averaging the point velocities.

If the calculated velocity is less than 20 fps and the reference method for the operating level contains the value "2F,"

print error message B: "The average velocity for [key] is less than 20.0 ft/sec. A minimum velocity of 20.0 ft/sec is required to use Method 2F for a flow RATA."

Otherwise,

Store the run velocity for use in FLOW-17 and FLOW-24.

If the calculated velocity is greater than 200 fps,

print error message C: "Warning: The run velocity calculated for [key] exceeded the expected maximum value of 200 feet per second."

**Requirement Number:** FLOW-16A and 16B

**Requirement Name:** Calculation of Run Velocity for Ordinary Method 2 Run

**Purpose:** To calculate run velocity for ordinary Method 2 runs

**Function:** For each ordinary Method 2 run of a of a Flow RATA,

Calculate the run velocity according to Equation 2-7 in 40 CFR Part 60, Appendix A, Method 2.

If the calculated run velocity is greater than 999.99 fps,

print error message A: "The run velocity calculated for [key] exceeded the maximum allowable value in the EDR. Therefore, the stack flow for this run was not calculated."

Otherwise,

Store the run velocity for use in FLOW-17.

If the calculated run velocity is greater than 200 fps,

print error message B: "Warning: The run velocity calculated for [key] exceeded the expected maximum value of 200 feet per second."

**Comments:** See check FLOW-15 for criteria for an "ordinary Method 2 run."

**Requirement Number:** FLOW-17A and 17B

**Requirement Name:** Calculation of Stack Flow (Unadjusted for Wall Effects)

**Purpose:** To calculate stack flow (unadjusted for wall effects).

**Function:** For each run of a of a Flow RATA,

If the run velocity was not calculated in FLOW-15 or FLOW-16, or if the run failed checks FLOW-15B or FLOW-16A,

exit this check.

If the Stack Dimension or the Stack Size Units of Measure for the operating level is blank, or if the Stack Size at Test Location is less than or equal to zero, or if the operating level failed check FLOW-4,

exit this check.

Otherwise,

Calculate the Stack Diameter Equivalent in square feet using the Stack Dimension, Stack Size at Test Location, and Stack Size Units of Measure, and round the resulting value to two decimal places.

Calculate the stack area at the test location using the stack diameter equivalent calculated above.

Calculate the stack flow (unadjusted for wall effects) according to Equation 2F-10, in 40 CFR Part 60, Appendix A, Method 2F.

If the calculated stack flow rounded to the nearest 1000 scfh is greater than 999,999,999 scfh,

print error message A: "The reference method value calculated for [key] exceeded the maximum allowable value in the EDR."

Otherwise,

Store the stack flow (unadjusted for wall effects) for use in FLOW-27.

If the calculated stack flow is greater than 200,000,000 scfh,

> print error message B: "Warning: The stack flow calculated for [key] exceeded the expected maximum value of 200 million scfh."

**Requirement Number:** FLOW-18

**Requirement Name:** Wall Point Completeness Check

**Purpose:** To ensure that each wall point of a Method 2H run is properly identified.

**Function:** For each run of a Method 2H Flow RATA with a 2H Run indicator equal to "Y,"

(a) Locate a Method 1 traverse point with a Wall Point indicator equal to "Y" and a Port ID equal to "A."

If found (a),

(b) Locate a Method 1 traverse point with a Wall Point indicator equal to "Y" and a Port ID equal to "B."

If found (b),

Locate a Method 1 traverse point with a Wall Point indicator equal to "Y" and a Port ID equal to "C."

If found (c),

Locate a Method 1 traverse point with a Wall Point indicator equal to "Y" and a Port ID equal to "D."

If found (d),

Count the number of Method 1 traverse points with a Wall Point indicator equal to "Y."

If found (a) and found (b) and found (c) and found (d) and the number of traverse points identified as wall points is equal to 4,

exit this check.

Otherwise,

print error message: "You identified [key] as a run to be used in the calculation of a wall effects adjustment factor (WAF), but you did not identify exterior method 1 traverse points as "near wall points" at each of the four stack test ports. Method 2H measurements must be performed at all four stack test ports in order to calculate a WAF."

**Requirement Number:** FLOW-19A, 19B, 19C, and 19D

**Requirement Name:** Method 2H Probe Type Check

**Purpose:** To verify that the same probe type was used to measure all the Method 2H wall points at a port,

**Function:** For each port in a Method 2H run of a Flow RATA,

(a) Locate the first Method 2H wall point associated with the port.

If not found (a),

exit this check.

(b) Locate the most recent record in the probe calibration table with the same Probe ID, Probe Side, and Range of Velocities as the probe used at the wall point and with a Calibration Test Date no later than the Run Start Date.

If not found (b), or if the Probe Type in this record is blank,

(c) Locate the next Method 2H wall point associated with the port.

If found (c),

Repeat step (b).

If not found (b), or if the Probe Type in this record is blank, repeat step (c).

If not found (c),

exit this check.

If found (b), and the Probe Type in this record is not blank,

Store the Probe Type in this record as the probe type for the port for use below and in FLOW-23.

If the probe used in any other Method 2H wall point for the port is different that the probe used to determine the probe type for the port,

Locate the most recent record in the probe calibration table with the same Probe ID, Probe Side, and Range of Velocities as the probe used at the wall point and with a Calibration Test Date no later than the Run Start Date.

If found, and the Probe Type in this record is not equal to the probe type for the port,

> print error message A: "You reported more than one probe type at the Method 2H wall effects measurement points for [key]. The same type of probe must be used at all Method2H points used to calculate a replacement velocity." Exit this check.

If this is a Method 2F RATA, and the probe type for the run is not equal to "DA," "DAT," or "SPH,"

> print error message B: "The probe type used for [key] is not appropriate for a Method 2F flow RATA. Only probe types "DA," "DAT," or "SPH" may be used for Method 2F RATAs."

If this is a Method 2G RATA, and the probe type for the run is not equal to "S," "AS," "DA," "DAT," or "SPH,"

> print error message C: "The probe type used for [key] is not appropriate for a Method 2G flow RATA. Only probe types "S," "AS," "DA," "DAT," or "SPH" may be used for Method 2G RATAs."

If this is a Method 2 RATA, and the probe type for the run is not equal to "S," "AS" or "P,"

> print error message D: "The probe type used for [key] is not appropriate for a regular Method 2 flow RATA. Only probe types "S," "AS," or "P" may be used for Method 2 RATAs."

**Requirement Number:** FLOW-20

**Requirement Name:** Duplicate Traverse Points Check

**Purpose:** To identify and eliminate duplicate Method 2H wall points

**Function:** For each port in a Method 2H run of a Flow RATA,

If the set of Method 2H wall points contains any records with the same Distance from the Wall,

print error message: "You conducted more than one Method 2H measurement at the same distance from wall for [key]."

**Comments:** One error message per port.

**Requirement Number:** FLOW-21A, 21B, and 21C

**Requirement Name:** $d_{rem}$ Measurement Check

**Purpose:** To determine whether a Method 2H wall point measurement was conducted at $d_{rem}$

**Function:** For each port in a Method 2H run of a Flow RATA,

If the operating level failed FLOW-3 or FLOW-5 or if the run failed FLOW-12B,

exit this check.

Count the number of Method 2H wall points at the port.

If the number is less than 2,

print error message A: "You indicated that you performed Method 2H measurements for [key] but you did not conduct measurements at the minimum of two points." Exit this check.

Locate the Method 2H Wall Point at the port with the second-to-highest Distance from the Wall.

If the Traverse Type for the port is equal to "Full Traverse,"

Calculate $d_{rem}$ and $d_{last}$ according to the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 8.2.3. and Equations 2H-1 or 2H-2, and round the results to one decimal place.

Locate the Method 2H Wall Point at the port with the highest Distance from the Wall.

If the Distance from the Wall in this record is equal to $d_{rem}$, and the Distance from the Wall in the next-to-highest record is equal to $d_{last}$,

Store $d_{rem}$ and $d_{last}$ as calculated above for use in FLOW-22, and exit this check.

If the Distance from the Wall in this record is equal to $d_{last}$, and difference between the Distance

from the Wall in this record and the unrounded $d_{rem}$ calculated above is less than or equal to .25,

Store the Distance from the Wall in this record as both $d_{rem}$ and $d_{last}$ for use in FLOW-22 and exit this check.

Otherwise,

print error message B: "You did not perform a valid full Method 2H traverse for [key], either because you did not perform measurements at the d-last and d-rem point(s), or because your d-last and d-rem measurements were conducted at incorrect distances."

If the Traverse Type for the port is equal to "Partial Traverse,"

Assuming that the Distance from the Wall in this record is $d_{last}$, calculate $d_{rem}$ according to the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 8.2.2, and Equations 2H-1 or 2H-2, and round the results to one decimal place.

Locate the Method 2H Wall Point at the port with the highest Distance from the Wall.

If the calculated $d_{rem}$ is equal to the Distance from the Wall in this record,

Store the Distance from the Wall in the previous record as $d_{last}$ and the Distance from the Wall in this record as $d_{rem}$ for use in FLOW-22, and exit this check.

Otherwise,

Assuming that the Distance from the Wall in this record is $d_{last}$, calculate $d_{rem}$ according to the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 8.2.2 and Equation 2H-1 or 2H-2.

If the difference between the calculated $d_{rem}$ and the Distance from the Wall in this record is less than or equal to .25,

Store the Distance from the Wall in this record as both $d_{last}$ and $d_{rem}$ for use in FLOW-22, and exit this check.

Otherwise,

print error message C: "You did not perform a valid partial Method 2H traverse for [key], either because you did not conduct a measurement at the d-rem point, or the d-rem measurement was conducted at an incorrect distance."

**Comments:** Do not perform if the Stack Dimension or Stack Size Units of Measure is blank or if the Stack Size at Test Port is not greater than zero.

**Requirement Number:** FLOW-22

**Requirement Name:** Calculation of Replacement Velocities

**Purpose:** To verify that a valid Method 2H traverse was conducted at each port and to calculate the replacement velocity

**Function:** For each port in a Method 2H run of a Flow RATA,

If the traverse type for the port is blank or if $d_{rem}$ was not calculated in FLOW-21,

exit this check.

If the Traverse Type for the port is equal to "Full Traverse,"

(a) Locate the Method 2H wall point at the port with the lowest Distance from the Wall.

If the value is less than or equal to 4,

(b) Locate the Method 2H wall point at the port with the next highest Distance from the Wall.

If the Distance from the Wall for this point is equal to $d_{rem}$,

exit this check.

If the Distance from the Wall for this point is one greater than the Distance from the Wall at the previous point,

return to step (b).

Otherwise,

print error message: "You indicated that you performed a full Method 2H traverse for [key], but you did not conduct measurements at all the required points." Exit this check.

If the port failed FLOW-19A, FLOW-19B, FLOW-19C, FLOW-19D, FLOW-20, FLOW-21A, FLOW-21B,

FLOW-21C, or the above check, or if the velocity at any Method 2H wall point for the port was not calculated in FLOW-11, or if any associated point failed FLOW-11, or if the Distance from the Wall for associated any point is not among the value range of values,

exit this check.

Otherwise,

calculate the replacement velocity according to the procedures in 40 CFR Part 60, Appendix A, Method 2H, Section 12.4. Round the resulting value to two decimal places.

**Requirement Number:** FLOW-23

**Requirement Name:** Method 1/Method 2H Probe Type Consistency Check

**Purpose:** To verify that the same probe type was used at all the Method 1 traverse and Method 2H wall points for a Method 2H run.

**Function:** For each Method 2H run of a Flow RATA,

If the probe type for the run determined in FLOW-14 and all the probe types for the port determined in FLOW-19 associated with the run are the same,

exit this check.

Otherwise,

print error message: "You reported more than one probe type at the Method 1 and Method 2H traverse points for [key]. The same type of probe must be used for all traverse points associated with a run."

**Comments:** Do not perform this check if the run failed FLOW-14A, FLOW-14B, FLOW-14C, or FLOW-14D, or if any port associated with the run failed FLOW-19A, FLOW-19B, FLOW-19C, or FLOW-19D.

**Requirement Number:** FLOW-24

**Requirement Name:** Calculation of the Wall Effects Adjustment Factor for the Run

**Purpose:** To calculate the Wall Effects Adjustment Factor (WAF) and to determine the traverse type for the run

**Function:** For each Method 2H run of a Flow RATA,

If the run velocity was not calculated in FLOW-15, or the run failed FLOW-15A, FLOW-18, or FLOW-23, or the replacement velocities were not calculated in FLOW-23 at all four ports,

proceed to step 2.

1. Calculate the wall effects adjustment factor for the run according to Equation 2H-19 in 40 CFR Part 60, Appendix A, Method 2H. Store this value for use in FLOW-25.

2. Determine the traverse type for the run as follows:

Locate the traverse type at all ports of the run.

If all the traverse types are equal to "Full Traverse,"

store "Full Traverse" as the traverse type for the run for use in FLOW-25.

If all the traverse types are equal to "Partial Traverse,"

store "Partial Traverse" as the traverse type for the run for use in FLOW-25.

Otherwise,

store "Partial Traverse" as the traverse type for the run for use in FLOW-25, and

print error message: "Attention: Both "full" and "partial" traverses were used to calculate a wall effects adjustment factor for [key]. Therefore, it is assumed that a partial wall effects traverse was performed in calculating the WAF."

Comment: Ignore any Traverse Type that is blank in step 2.

**Requirement Number:** FLOW-25A, 25B, and 25C

**Requirement Name:** Calculation of the Wall Effects Adjustment Factor for the Operating Level

**Purpose:** To calculate the Wall Effects Adjustment Factor (WAF) for the operating level

**Function:** For each operating level of a Flow RATA with a Reference Method Used containing a value of "2H,"

Count the number of runs with a Run Status Flag equal to "1" and a 2H Run indicator equal to "Y,"

If the number of used Method 2H runs is equal to zero,

print error message A: "You reported that a flow RATA was performed using method 2H calculations for [key], but you did not identify runs for the purpose of calculating a wall effects adjustment factor (WAF). When using these methods, you must identify at least one run for the purpose of calculating a WAF. If you intend to use a default WAF, and not perform any wall effects measurements, you must remove Method 2H from the REFERENCE METHOD field, and enter Y in the USE DEFAULT WAF? field on the run data screen." Exit this check.

If the Calculated WAF for the Run was not calculated in FLOW-24 for all Method 2H runs in the operating level,

exit this check.

Retrieve the number of equal area sectors used in the run that was calculated in FLOW-12 for all Method 2H runs with a Run Status Flag equal to "1,"

If more than one Method 2H run was used to calculate the WAF, and the Number of Equal Area Sectors used in these runs were not all equal,

print error message B: "The number of equal area sectors at the runs used to calculate a wall effects adjustment factor (WAF) for [key] were not the same.

All runs used to calculate a WAF must have the same number of equal area sectors." Exit this check.

Otherwise, store this value as the Number of Equal Area Sectors Used to Calculate the WAF for use in FLOW-27.

Determine the Calculated WAF for the Operating Level by averaging the Calculated WAF for each Method 2H run with the following exception. If the Calculated WAF for any run is less than .97 and the traverse type for the run as determined in FLOW-24 was a "Full Traverse," replace the Calculated WAF for the run with .97. If the Calculated WAF for any run is less than .98 and the traverse type for the run as determined in FLOW-24 was a "Partial Traverse," replace the Calculated WAF for the run with .98.

Store the Calculated WAF for the operating level for use in FLOW-26 and FLOW-27.

If the Calculated WAF for the operating level is greater than .9900 and the Number of Traverse Points for all runs in the operating level is less than or equal to 16,

If the Calculated WAF for the operating level is greater than .9950 or the Stack Interior Wall Type is equal to "Brick and mortar,"

print error message C: "Attention: You have not indicated the use of a default wall effects adjustment factor for [key], even though the default WAF is less than the WAF calculated for this operating level."

**Requirement Number:** FLOW-26

**Requirement Name:** Determination of the Default Wall Effects Adjustment Factor

**Purpose:** To determine the Default Wall Effects Adjustment Factor (WAF) to be applied to each run in the operating level

**Function:** For each operating level of a Flow RATA with a Use Default WAF indicator equal to "Y,"

If the Stack Interior Wall Type is blank,

exit this check.

If the Stack Interior Wall Type is equal to "Brick and mortar,"

Store .9900 as the Default WAF.

If the Stack Interior Wall Type is equal to "Other than brick and mortar,"

Store .9950 as the Default WAF.

If a Calculated WAF for the operating level was calculated in FLOW-25 and is less than the Default WAF calculated above,

print error message: "Attention: You have indicated the use of a default wall effects adjustment factor for [key], even though the default WAF is greater than the WAF calculated for this operating level."

**Comments:** The software does not allow the user to enter a Use Default WAF indicator if the operating level is not eligible to use a default WAF. The operating level is eligible to use a default WAF only if the stack is circular, the stack diameter at the test location is greater than or equal to 3.3 feet, and there are no more than 16 traverse points at all runs of the operating level.

**Requirement Number:** FLOW-27

**Requirement Name:** Calculation of the Reference Method Value for the Run

**Purpose:** To calculate the reference method value for the run

**Function:** For each run of a Flow RATA,

If the Stack Flow (unadjusted for wall effects) was not calculated in FLOW-17,

exit this check.

If the Reference Method Used of the operating level associated with the run does not contain a value of "2H," and if the Use Default WAF indicator of the operating level associated with the run is not equal to "Y,"

Calculate the Reference Method Value by rounding the Stack Flow (unadjusted for wall effects) calculated in FLOW-17 to the nearest 1000 scfh.

If the Reference Method Used of the operating level associated with the run contains a value of "2H," and the Calculated WAF for the operating level was not calculated in FLOW-25,

exit this check.

If the Use Default WAF indicator of the operating level associated with the run is equal to "Y,"

If the Stack Interior Wall Type is blank,

exit this check.

Otherwise, calculate the Reference Method Value by multiplying the Stack Flow (unadjusted for wall effects) calculated in FLOW-17 by the Default WAF determined in FLOW-26, and rounding the resulting value to the nearest 1000 scfh.

If the Reference Method Used of the operating level associated with the run contains a value of "2H,"

If the number of equal area sectors used in the run (which was calculated in FLOW-12) is less than or equal to the Number of Equal Area Sectors Used to Calculate the WAF (which was determined in FLOW-25),

Calculate the Reference Method Value by multiplying the Stack Flow (unadjusted for wall effects) calculated in FLOW-17 by the Calculated WAF for the operating level calculated in FLOW-25, and rounding the resulting value to the nearest 1000 scfh.

Otherwise,

Calculate the Reference Method Value by rounding the Stack Flow (unadjusted for wall effects) calculated in FLOW-17 to the nearest 1000 scfh, and,

print error message: "Attention: The calculated wall effects adjustment factor (WAF) was not applied in the calculation of stack flow for [key], because the number of traverse points at the test port for the run was greater than the number of traverse points for the run(s) used to calculate the WAF."

**Requirement Number:** FLOW-28

**Requirement Name:** Calculation of the Results for the Operating Level

**Purpose:** To calculate the relative accuracy and bias adjustment factor (BAF) for the operating level

**Function:** For each operating level of a Flow RATA,

If the reference method value was not calculated in FLOW-27 for any run in the operating level with a run status flag equal to "1," or if the operating level failed GEN-4, GEN-5A, GEN-5B, GEN-6, GEN-7, GEN-8, or GEN-9,

Store the result for this operating level as "INVALID."

Print error message: "The relative accuracy for [key] was not calculated because of the errors listed above." Exit this check.

Calculate the relative accuracy according to Equation A-10 in 40 CFR Part 75, Appendix A.

If the relative accuracy is greater than 99.99,

Store the result for this operating level as "FAIL." Store the relative accuracy as 99.99 for use in FLOW-29. Do not perform a bias test.

If the relative accuracy is greater than 10.0,

Store the result for this operating level as "FAIL." Store the relative accuracy for use in FLOW-29. Do not perform a bias test.

If the relative accuracy is less than or equal to 10.0,

Store the result for this operating level as "PASS." Store the relative accuracy for use in FLOW-29.

Perform the bias test according to the procedures in 40 CFR Part 75, Appendix A, Section 7.6.5.

Store the bias adjustment factor for use in FLOW-29.

**Requirement Number:** FLOW-29A, 29B, and 29C

**Requirement Name:** Calculation of the Results of the RATA

**Purpose:** To calculate the relative accuracy and the bias adjustment factor (BAF) for the RATA

**Function:** If the RATA is a single-load test,

The result, relative accuracy, and bias adjustment factor for the test is the same as the result, relative accuracy, and bias adjustment factor for the operating level determined in RATA-28.

If the Load Indicator for the operating level is not equal to "N" or blank,

print error message A: "Warning: You did not designate the operating level as a 'normal' load. Single-load RATAs must be performed at the normal operating level."

If the RATA is a multiple-load test and the results of all the operating levels determined in RATA-28 is equal to "PASS,"

Store the result of the test as "PASS." The relative accuracy of the test is the highest relative accuracy of all the operating levels.

If all operating levels passed the bias test,

The bias adjustment factor for the test is 1.

Otherwise,

Count the number of operating levels with a Load Indicator equal to "N." Count the number of operating levels with a Load Indicator equal to "S."

If the number of operating levels with a Load Indicator equal to "N" is equal to zero, or the number of operating levels with a Load Indicator equal to "N" and "S" are not equal to two,

print error message B: "You did not designate at least one operating level as a "normal" load, or you did not designate two operating levels as either a "normal" or "second most frequently used" load. A multi-load RATA must be performed at the two most frequently used load levels. The BAF for this RATA cannot be determined." Exit this check.

If all the operating levels with a Load Indicator equal to "N" passed the bias test,

The bias adjustment factor for the test is 1.

Otherwise,

The bias adjustment factor for the test is the highest bias adjustment factor of all the operating levels with a Load Indicator equal to "N" and "S."

If the RATA is a multiple-load test and the result of any operating level determined in RATA-28 is equal to "INVALID,"

Store the result of the test as "INVALID." There is no relative accuracy or bias adjustment factor for the test.

If the RATA is a multiple-load test and the result of any operating level determined in RATA-28 is equal to "FAIL" and there were no operating levels with a result of "INVALID,"

Store the result of the test as "FAIL." The relative accuracy of the test is the highest relative accuracy of all the operating levels. There is not bias adjustment factor for the test.

If the RATA is a multiple-load test, and the result of the test is "FAIL" or "INVALID," or if all operating levels passed the bias test,

Count the number of operating levels with a Load Indicator equal to "N." Count the number of operating levels with a Load Indicator equal to "S."

If the number of operating levels with a Load Indicator equal to "N" is equal to zero, or the number of operating levels with a Load Indicator equal to "N" and "S" are not equal to two,

print error message C: "Warning: You did not designate at least one operating level as a "normal" load, or you did not designate two operating levels as either a "normal" or "second most frequently used" load. A multi-load RATA must be performed at the two most frequently used load levels."

**Requirement Number:** FLOW-30A and 30B

**Requirement Name:** Operating Load Level Consistency Check

**Purpose:** To determine if the average gross unit load for each operating level in a multi-load RATA is consistent with the operating level indicator

**Function:** For each multi-load RATA,

Calculate the average gross unit load for each operating level by averaging the gross unit load for each run with a run status flag equal to "1."

If the RATA has a high operating level, and the average gross unit load for that operating level is less than the average gross unit load for the mid operating level or the low operating level,

print error message A: "Warning: The average gross unit load for Operating Level H is lower than the average gross unit load for another level in this RATA. This may indicate that you have not assigned the correct operating levels to this RATA."

If the RATA has a mid operating level, and the average gross unit load for that operating level is less than the average gross unit load for the low operating level,

print error message B: "Warning: The average gross unit load for Operating Level M is lower than the average gross unit load for Operating Level L. This may indicate that you have not assigned the correct operating levels to this RATA."

**Requirement Number:** GEN-1

**Requirement Name:** Invalid Monitoring System ID

**Purpose:** To identify an invalid Monitoring System ID

**Function:** If the Monitoring System ID is less than 3 characters long or if the Monitoring System ID contains an embedded space,

> print error message: "This RATA contains an invalid Monitoring System ID. The Monitoring System ID must consist of three alpha-numeric characters. This RATA cannot be exported until you have corrected this problem."

**Comments:** Do not perform if Monitoring System ID is blank.

**Requirement Number:** GEN-2

**Requirement Name:** Unique Key Check

**Purpose:** To identify RATAs with duplicate keys

**Function:** Locate another RATA which has the same ORIS Code, Unit/Stack ID, Monitoring System ID, and Test Number as the current RATA, and which ended in the same calendar quarter as the current RATA.

If found,

> print error message: "The Test Number is not unique for this monitoring system and the calendar quarter in which this RATA was completed. The test number may be assigned a different value when the RATA is exported."

**Requirement Number:** GEN-3

**Requirement Name:** Identification of Aborted Test

**Purpose:** To identify RATAs which have been reported as aborted tests

**Function:** If any run record contains a run status equal to "9,"

> print error message: "Attention: One or more run records contain a run status of '9' which indicates that the test has been aborted. This test is treated as an aborted RATA and was not evaluated further."

Store the result as "Aborted" and discontinue further checks for this test.

**Requirement Number:** GEN-4

**Requirement Name:** Check for Simultaneous or Concurrent Runs

**Purpose:** To identify RATAs which contain simultaneous or concurrent runs

**Function:** Sort all run records in the RATA according to Run Start Date and Time.

If the Run Start Date/Time for any run is earlier than the Run End Date/Time of the previous run record,

print error message: "One or more runs have overlapping run times."

**Comments:** Perform only if dates and times are valid.

**Requirement Number:** GEN-5A and 5B

**Requirement Name:** Run Start and End Time Validation

**Purpose:** To identify runs which have improperly formatted times

**Function:** For each run,

If the hour in the first two characters of the Run Start Time is not 00 - 23 or if the minute in the last two characters is not 00 - 59,

print error message A: "The Run Start Time for [key] is invalid. The hour must be 00 - 23, and the minutes must be 00 - 59."

If the hour in the first two characters of the Run End Time is not 00 - 23 or if the minute in the last two characters is not 00 - 59,

print error message B: "The Run End Time for [key] is invalid. The hour must be 00 - 23, and the minutes must be 00 - 59."

**Comments:** One error message per time field.

**Requirement Number:** GEN-6

**Requirement Name:** Inconsistent Run Date/Times

**Purpose:** To identify runs which have inconsistent start and end date/times

**Function:** For each run,

Compare the start date and time and the end date and time.

If the Start Date/Time $\geq$ End Date/Time,

print error message: "The Run End Date/Time was not later than the Run Start Date/Time. These data are invalid."

**Comments:** Perform only if all dates and times are valid.

**Requirement Number:** GEN-7

**Requirement Name:** Check for Number of Excluded Runs

**Purpose:** To identify RATAs which have more than 3 runs excluded

**Function:** For each operating level,

Count the number of run records which contain a run status equal to "0." If the number is greater than 3,

print error message: "There are more than three run records for [key] with a run status of '0', which indicates runs excluded from the data analysis. Only three runs may be excluded from a RATA at each operating level."

**Requirement Number:** GEN-8

**Requirement Name:** Check for Number of Included Runs

**Purpose:** To identify RATAs which have fewer than 9 runs

**Function:** For each operating level,

Count the number of run records which contain a run status equal to "1." If the number is less than 9,

print error message: "There are fewer than nine run records for [key] with a run status of '1'. A minimum of nine runs are required for each complete operating level RATA."

**Requirement Number:** GEN-9

**Requirement Name:** Check for Out-of-sequence or Missing Runs

**Purpose:** To identify RATAs which contain out-of-sequence or missing runs

**Function:** For each operating level,

Sort all runs in run start date and time order.

If any run number in the set is a duplicate, missing or not in sequential order,

print error message: "There are duplicate, missing or non-sequential run numbers for [key], where the RATA run records are time ordered by run start date and time."

**Comments:** Perform only if all dates and times are valid and all run numbers are non-blank.

**Requirement Number:** GEN-10

**Requirement Name:** Check for RATA Duration

**Purpose:** To identify single-load RATAs which span more than seven calendar days

**Function:** For each single load RATA sort RTs 610 by run start date and time.

If the latest valid Run End Date and Time is more than 168 clock hours after the earliest Run Start Date and Time,

> print error message: "Warning: The test period for this RATA extended for more than 168 clock hours. This test may not meet the requirement that the test period for each single-load RATA be completed within 168 unit or stack operating hours."

**Comments:** Perform only if all dates and times are valid and all run numbers are non-blank.

**Requirement Number:** GEN-11

**Requirement Name:** Check for Maximum Relative Accuracy

**Purpose:** To determine if the relative accuracy exceeds the maximum allowable value

**Function:** If the Relative Accuracy calculated for the RATA is greater than 99.99,

> print error message: "Warning: The relative accuracy recorded for [key] is 99.99, which is the maximum value allowed in the EDR. This value, however, may be less than the actual calculated value."