Appendix D.
Example Calculation -- Run BY-201

This example calculation is based on run BY-201, which was a test of scraper loading emissions conducted at the North Central Kansas Technical College. The test was conducted on September 15, 1999, began at 12:49 p.m. and ended at 13:31 p.m. However, the test was halted at 13:05 p.m. because of poor winds. It was then restarted again at 13:21 p.m. and finished accordingly at 13:31 p.m. Thus, the test duration was 26 minutes. The average temperature during the test was 75 F and the barometric pressure was 28.80 in Hg [information taken from Run Sheet]. During the test, there were 34 scraper passes [information taken from vehicle log].

The following table shows the filter net weights calculated for the 2, 4.5 and 7m cyclone samplers:

Sampler Location	(Note 1) Filter No.	(Note 2) Tare weight (mg)	(Note 2) Final weight (mg)	Net Weight (mg)	(Note 3) Blank–corrected net weight (mg)
Cyclone 40 cfm 2 m DW	9982019	4411.50	4469.50	58.00	56.86
Cyclone 40 cfm 4.5 m DW	9982018	4404.05	4435.85	31.80	30.66
Cyclone 40 cfm 7 m DW	9982017	4408.05	4415.15	7.10	5.96

Notes
1. Information taken Field Filter Log.
2. Information taken from filter weigh books.
3. The blank-corrected net weights are based on an average blank value of –1.14 mg. Blank filter statistics are contained in Appendix C, which presents spreadsheets for the BY runs.

The following table illustrates how the sampling flow rates are determined using the look-up tables.

Sampler Location	VFC ID	(Note 1) Filter Pressure (in H20)	Filter Pressure (in Hg)	(Note 2) P_o/P_a	(Note 3) Flow rate (acfm)	PM-10 Concentration (ug/m^3)
Cyclone 40 cfm 2 m DW	75	24.10	1.77	0.939	40.82	1892
Cyclone 40 cfm 4.5 m DW	70	22.90	1.68	0.942	40.57	1026
Cyclone 40 cfm 7 m DW	67	24.00	1.76	0.939	41.01	197

Notes:
1. Average of pressures shown on Run Sheet.
2. Value represents 1 – (filter pressure/barometric pressure). For example, for 2 m sampler, 0.939 = 1-(1.77/28.80).
3. Flow rate determined from Look Up table using previous column and ambient temperature. Look Up table for 2m unit attached.

As shown in Appendix C, the upwind PM-10 concentration is 11 ug/m3 and the following plume sampling data are obtained:

Sampler Location	PM-10 Concentration (ug/m3)	(Note 1) Net PM-10 Concentration (ug/m3)	(Note 2) Mean Wind Speed (mph)	(Note 3) Net PM-10 Exposure (mg/cm2)
Cyclone 40 cfm 2 m DW	1892	1881	2.48	0.3253
Cyclone 40 cfm 4.5 m DW	1026	1015	3.01	0.2131
Cyclone 40 cfm 7 m DW	197	186	3.29	0.0428

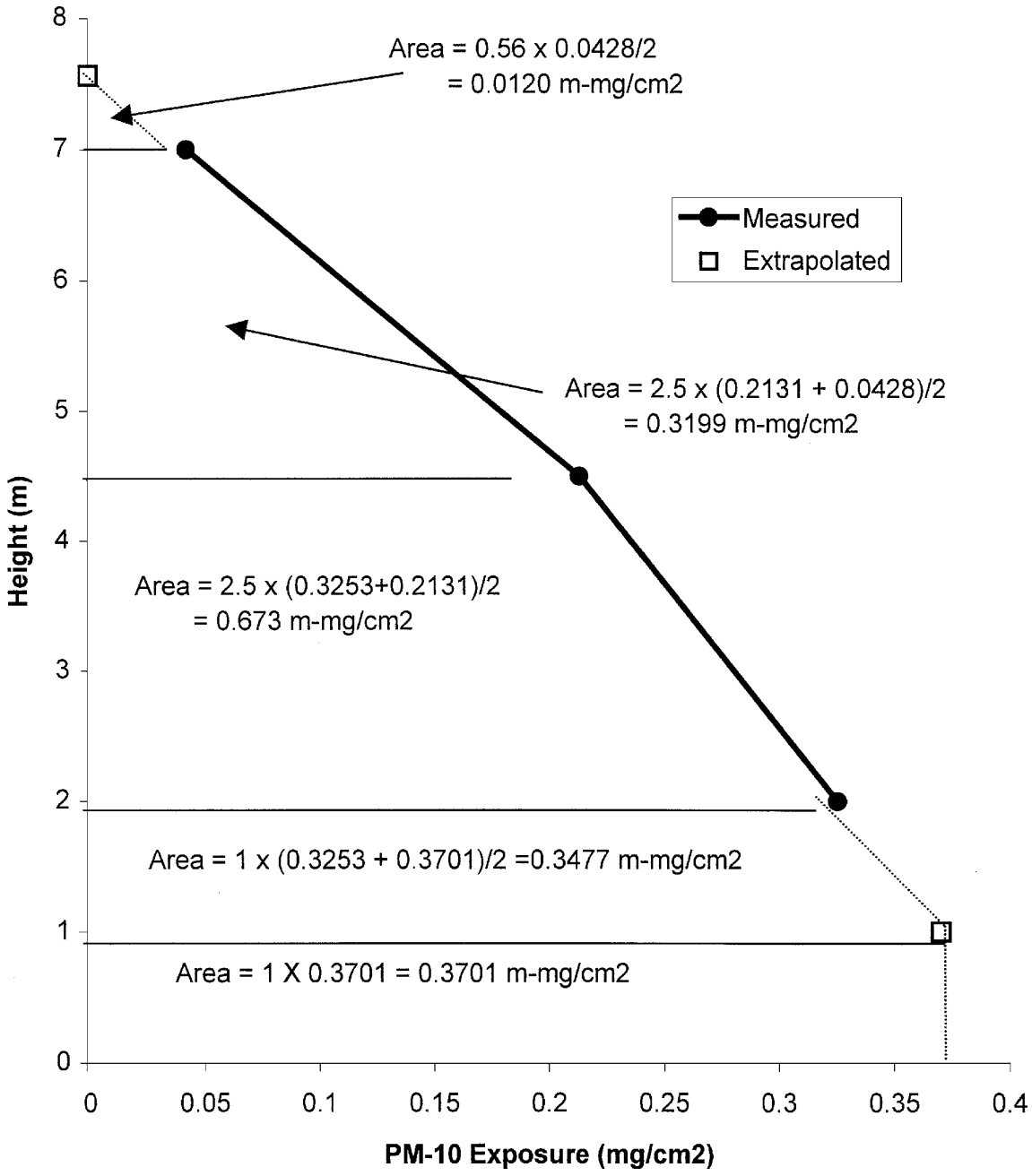
Notes
1. Upwind concentration values presented in Appendix F.
2. Average of 5-min average wind speeds recorded during test. Value at 4.5 m interpolated using the logarithmic profile described in Section 2.4 of the report.
3. Exposure represents product of wind speed, concentration, and test duration. See Section 2.4 of the report.

As discussed in Section 2.4, a numerical integration scheme is used to determine the integrated exposure and emission factor.
Extrapolation of the 4.5 and 7 m net concentrations to a value of zero leads to an estimated plume height of H = 7.56 m. The attached figure plots the exposure values and shows how the trapezoidal rule is applied to obtain the intrgrated exposure value:

$$A = 0.3701 + 0.3477 + 0.673 + 0.3199 + 0.0120$$
$$= 1.723 \text{ m-mg/cm}^2$$
$$= 61.1 \text{ lb/mi}$$

The emission factor e is found by dividing the integrated exposure by the number of scraper passes:

$$e = 61.1 / 34 \text{ vehicles}$$
$$= 1.80 \text{ lb/veh-mi}$$


Area = 0.56 x 0.0428/2
= 0.0120 m-mg/cm2
Measured
Extrapolated
Area = 2.5 x (0.2131 + 0.0428)/2
= 0.3199 m-mg/cm2
Area = 2.5 x (0.3253+0.2131)/2
= 0.673 m-mg/cm2
Area = 1 x (0.3253 + 0.3701)/2 =0.3477 m-mg/cm2
Area = 1 X 0.3701 = 0.3701 m-mg/cm2
Height (m)
PM-10 Exposure (mg/cm2)
0
1
2
3
4
5
6
7
8
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4

UNCONTROLLED

MIDWEST RESEARCH INSTITUTE
Fugitive Emission Testing
Run Sheet

8Y-201

Run No(s). Beloit
MRI Project No. 104813.1.002.03

Date 9-15-99
Recorded by GM + NEP

Site NCKTC @ Scott city uncontrolled test

Temperature d 75 @ 1248 @ Barometric pressure 28.8 @ 1245 @
w 59 → Temp
Baro Press

Sampler	Sampler Location	Sampler ID	*Start Time	*Stop Time	Back Plate Pressure (in H_2O)	Filter/B.P. Pressure (in. H_2O)	Nozzle/ Time
Partisol	not run						
Cyc/Imp						@ @	/ /
Cyc/Imp						@ @	/ /
Wedding						@ @	
Partisol			N. A.				
Cyc/Imp	4.5 aa	8585	1250 1350	1305 restart @1321	0.57	0.57 NEP @	/ /
Cyc/Imp	2m	98-5	1250 1350	1305	0.60	0.60 NEP @	/ /
Cyclone	7m	67	1249 1349			23.7 @ 1257 @ 1327	/ /
Cyclone	4.5	70				22.9 @ 1257 @	/ /
Cyclone	2m **	75				24.1 @ 1257 @	/ /
Wedding			1250 1350		13:31	24.2 @ 1250 @ 1507 NEP	

NO UPWINDS RUN

Comments

201 on East Tower 202 on West Tower

all Stand 30° E of South —

0.58 98-6
0.57 8585
0.58 98-7
0.60 98-5

* initial start @ 1249 - 1250 (all)
stop @ 1305 (all) - shut down because of poor winds
restart @ 1321 (all)
stop @ 1331 (cyclones only) - cyclone impactors are left running
stop cyclone impactors + wedding @ 15:07 (cyclones only shut down) + wedding

** Pressure Umbilical on #3 not working — need to read

UNCONTROLLED

MIDWEST RESEARCH INSTITUTE
Fugitive Emission Testing
Vehicle Log

BY-201, 202

Site: Beloit Run 201

Project No. 104813.1.002.03

Date 9-15-99

Recorded by DG

Road Location ______

Sampling Start Time 1250 Stop Time ______

Counter Start Count 1250 Stop Count ______

1305 shut down BY201 202 restart 1321

off @1327

doing other work then refill now 2 min. to cont.

Vehicle Type *	Vehicle Wt.	Axles / Wheels	1	2	3	4	5	6	7	8	9	10	Total
613 Scraper		2/4	𝍸	𝍸	IIII	𝍸	I						
621 Scraper		2/4	𝍸	IIII	𝍸								
		/											
		/											

Count +

Comments: 1254 tower 202 start 5-613's 3-621's not included w/run 201

Site Sketch: WIND ~~OOE~~ to E @ 1303

UNCONTROLLED

Midwest Research Institute

Fugitive Emission Testing

Field Filter Log

Site: Beloit
Project No. 104813.1.002.03 BY-201

Date 9-14-99
Recorded by DG

Sampling Array ID	Sampler Type/Height	Filter Type	Filter ID	Checks/Date Unloaded		Comments
U-1	Partisol	47mm Teflon	9985002	✓	9-15	Used as blank
U-2	Cyc/Imp 2m	8x10 quartz	9982011			BY 401
		4x5 glass fiber S-3	9988014			"
		4x5 glass fiber S-2	9988015			"
		4x5 glass fiber S-1	9988016			"
U-3	Cyc/Imp 4.5m	8x10 quartz	9982012			"
		4x5 glass fiber S-3	9988017			"
		4x5 glass fiber S-2	9988018			"
		4x5 glass fiber S-1	9988019			"
U-4	Wedding 2m	8x10 quartz	9982015	✓	9-15	Blank
D-1	Cyc/Imp 2m	8x10 quartz	9982013	✓	9-15	
		4x5 glass fiber S-3	9988020	✓	9-15	
		4x5 glass fiber S-2	9988021	✓	9-15	
		4x5 glass fiber S-1	9988022	✓	9-15	
D-2	Cyc/Imp 4.5m	8x10 quartz	9982014	✓	9-15	
		4x5 glass fiber S-3	9988023	✓	9-15	
		4x5 glass fiber S-2	9988024	✓	9-15	
		4x5 glass fiber S-1	9988025	✓	9-15	
D-3	Cyclone 7m	8x10 quartz	9982017	✓	9-15	
	Cyclone 4.5m	8x10 quartz	9982018	✓	9-15	
	Cyclone 2m	8x10 quartz	9982019	✓	9-15	
D-4	Wedding 2m	8x10 quartz	9982016	✓	9-15	

UNCONTROLLED

TARE

Filter Analysis Log

	First Weigh			Audit (1)					Audit (2)			
Filter No.	Weight (mg)	By	Date	Weight (mg)	Δ (mg)	Meets QC?	By	Date	Weight (mg)	Meets QC?	By	Date
9982001	~~4388.80~~	DH	9-9-99	4386.00	0.40	yes	CK	9.10.99				
002	4392.20			4391.80	0.40							
* 003	~~4359.10~~	DH		4359.10	0.10							
004	4391.35			4390.60	0.75							
005	4390.60			4390.25	0.35							
006	4376.95			4376.25	0.70							
007	4386.20			4386.00	0.20							
008	4387.70			4387.35	0.35							
009	4384.45			4384.25	0.20							
010	4364.40			4364.15	0.25							
011	4373.70			4373.20	0.50							
012	4394.90			4395.00	0.10							
013	4378.05			4378.00	0.05							
014	4408.85			4408.70	0.15							
015	4401.05			4400.65	0.40							
016	4404.00			4403.70	0.30							
017	4408.05			4407.85	0.20							
018	4404.05			4403.80	0.25							
019	4411.50			4411.25	0.25							
020	~~4420.15~~	DH	NO FILTER									
021	4420.15	DH	9-9-99	4419.85	0.30	yes	CK	9.10.99				
022	4389.25			4389.20	0.05							
023	4354.05			4353.65	0.40							
024	4420.45			4420.20	0.25							
025	4379.50			4378.85	0.65							
026	4399.10			4398.80	0.30							
027	4379.05			4378.70	0.35							
028	4416.05			4415.80	0.25							
029	4385.50			4386.00	0.50							
030	4406.00			4405.75	0.75							
031	4400.70			4400.35	0.35							
032	4379.75			~~4460~~ *	0.30							

Comments:

* 9982001 4385.60 9-9-99
003 4359.20 9-9-99

Figure 3. Filter Analysis Log

* 4379.45

MRI-QAU\MRI-8403 FORMS.DOC

UNCONTROLLED

FINAL

0 ^ 10 GMH

Filter Analysis Log

Filter No.	First Weigh Weight (mg)	By	Date	Audit (1) Weight (mg)	Δ (mg)	Meets QC?	By	Date	Audit (2) Weight (mg)	Meets QC?	By	Date
9982001	4386.55	AY	9-27-99									
002	4392.80											
003	4359.55											
004	4391.90			4391.40	0.50	YES	DA	9-28-99				
005	NO FILTER											
006	4376.60											
007	4386.95											
008	4390.15											
009	4385.15											
010	4365.05											
011	4376.85											
012	4397.05											
013	4406.65			4406.25	0.40	YES	DA	9-28-99				
014	4422.35			4422.15	0.20	YES	DA	9-28-99				
015	4403.15											
016	4474.85											
017	4415.15											
018	4435.85											
019	4469.50			4468.90	0.60	YES	DA	9-28-99				
020	NO FILTER											
021	4426.90			4426.75	0.15	YES	DA	9-28-99				
022	4400.45											
023	4384.25											
024	4421.75											
025	4381.35											
026	4400.75											
027	4380.60			4380.10	0.50	YES	DA	9-28-99				
028	4417.90											
029	4387.80											
030	4407.60			4407.40	0.20	YES	DA	9-28-99				
031	4405.80			4405.50	0.30	YES	DA	9-28-99				
032	4386.70											

Comments:

Figure 3. Filter Analysis Log

UNCONTROLLED

LOOKUP TABLE FOR ASI/GMW VFC S/N P01575 Calibrated 07/23/1992

TEMPERATURE °F Flow rate ft3/min (actual)

Po/Pa	48	52	56	60	64	68	72	76	80	84	88	92	96	Po/Pa
0.930	39.48	39.61	39.75	39.89	40.03	40.16	40.30	40.43	40.57	40.70	40.84	40.97	41.10	0.930
0.931	39.52	39.66	39.80	39.93	40.07	40.21	40.34	40.48	40.61	40.75	40.88	41.02	41.15	0.931
0.932	39.57	39.70	39.84	39.98	40.12	40.25	40.39	40.52	40.66	40.79	40.93	41.06	41.20	0.932
0.933	39.61	39.75	39.89	40.02	40.16	40.30	40.43	40.57	40.71	40.84	40.97	41.11	41.24	0.933
0.934	39.65	39.79	39.93	40.07	40.21	40.34	40.48	40.62	40.75	40.89	41.02	41.15	41.29	0.934
0.935	39.70	39.84	39.98	40.12	40.25	40.39	40.53	40.66	40.80	40.93	41.07	41.20	41.33	0.935
0.936	39.74	39.88	40.02	40.16	40.30	40.44	40.57	40.71	40.84	40.98	41.11	41.25	41.38	0.936
0.937	39.79	39.93	40.07	40.21	40.34	40.48	40.62	40.75	40.89	41.02	41.16	41.29	41.43	0.937
0.938	39.83	39.97	40.11	40.25	40.39	40.53	40.66	40.80	40.94	41.07	41.21	41.34	41.47	0.938
0.939	39.88	40.02	40.16	40.30	40.43	40.57	40.71	40.85	40.98	41.12	41.25	41.39	41.52	0.939
0.940	39.92	40.06	40.20	40.34	40.48	40.62	40.75	40.89	41.03	41.16	41.30	41.43	41.57	0.940
0.941	39.97	40.11	40.25	40.39	40.52	40.66	40.80	40.94	41.07	41.21	41.34	41.48	41.61	0.941
0.942	40.01	40.15	40.29	40.43	40.57	40.71	40.85	40.98	41.12	41.26	41.39	41.53	41.66	0.942
0.943	40.06	40.20	40.34	40.48	40.62	40.75	40.89	41.03	41.17	41.30	41.44	41.57	41.71	0.943
0.944	40.10	40.24	40.38	40.52	40.66	40.80	40.94	41.07	41.21	41.35	41.48	41.62	41.75	0.944
0.945	40.15	40.29	40.43	40.57	40.71	40.84	40.98	41.12	41.26	41.39	41.53	41.67	41.80	0.945
0.946	40.19	40.33	40.47	40.61	40.75	40.89	41.03	41.17	41.30	41.44	41.58	41.71	41.85	0.946
0.947	40.24	40.38	40.52	40.66	40.80	40.94	41.07	41.21	41.35	41.49	41.62	41.76	41.89	0.947
0.948	40.28	40.42	40.56	40.70	40.84	40.98	41.12	41.26	41.39	41.53	41.67	41.80	41.94	0.948
0.949	40.33	40.47	40.61	40.75	40.89	41.03	41.17	41.30	41.44	41.58	41.71	41.85	41.99	0.949
0.950	40.37	40.51	40.65	40.79	40.93	41.07	41.21	41.35	41.49	41.62	41.76	41.90	42.03	0.950
0.951	40.41	40.56	40.70	40.84	40.98	41.12	41.26	41.39	41.53	41.67	41.81	41.94	42.08	0.951
0.952	40.46	40.60	40.74	40.88	41.02	41.16	41.30	41.44	41.58	41.72	41.85	41.99	42.13	0.952
0.953	40.50	40.65	40.79	40.93	41.07	41.21	41.35	41.49	41.62	41.76	41.90	42.04	42.17	0.953
0.954	40.55	40.69	40.83	40.97	41.11	41.25	41.39	41.53	41.67	41.81	41.95	42.08	42.22	0.954
0.955	40.59	40.74	40.88	41.02	41.16	41.30	41.44	41.58	41.72	41.85	41.99	42.13	42.27	0.955
0.956	40.64	40.78	40.92	41.06	41.20	41.35	41.48	41.62	41.76	41.90	42.04	42.18	42.31	0.956
0.957	40.68	40.83	40.97	41.11	41.25	41.39	41.53	41.67	41.81	41.95	42.08	42.22	42.36	0.957
0.958	40.73	40.87	41.01	41.15	41.30	41.44	41.58	41.72	41.85	41.99	42.13	42.27	42.41	0.958
0.959	40.77	40.92	41.06	41.20	41.34	41.48	41.62	41.76	41.90	42.04	42.18	42.32	42.45	0.959
0.960	40.82	40.96	41.10	41.24	41.39	41.53	41.67	41.81	41.95	42.09	42.22	42.36	42.50	0.960
0.961	40.86	41.01	41.15	41.29	41.43	41.57	41.71	41.85	41.99	42.13	42.27	42.41	42.55	0.961
0.962	40.91	41.05	41.19	41.34	41.48	41.62	41.76	41.90	42.04	42.18	42.32	42.45	42.59	0.962
0.963	40.95	41.10	41.24	41.38	41.52	41.66	41.80	41.94	42.08	42.22	42.36	42.50	42.64	0.963
0.964	41.00	41.14	41.28	41.43	41.57	41.71	41.85	41.99	42.13	42.27	42.41	42.55	42.69	0.964
0.965	41.04	41.18	41.33	41.47	41.61	41.75	41.90	42.04	42.18	42.32	42.46	42.59	42.73	0.965
0.966	41.09	41.23	41.37	41.52	41.66	41.80	41.94	42.08	42.22	42.36	42.50	42.64	42.78	0.966
0.967	41.13	41.27	41.42	41.56	41.70	41.85	41.99	42.13	42.27	42.41	42.55	42.69	42.83	0.967
0.968	41.18	41.32	41.46	41.61	41.75	41.89	42.03	42.17	42.31	42.45	42.59	42.73	42.87	0.968
0.969	41.22	41.36	41.51	41.65	41.79	41.94	42.08	42.22	42.36	42.50	42.64	42.78	42.92	0.969
0.970	41.26	41.41	41.55	41.70	41.84	41.98	42.12	42.27	42.41	42.55	42.69	42.83	42.97	0.970
0.971	41.31	41.45	41.60	41.74	41.89	42.03	42.17	42.31	42.45	42.59	42.73	42.87	43.01	0.971
0.972	41.35	41.50	41.64	41.79	41.93	42.07	42.22	42.36	42.50	42.64	42.78	42.92	43.06	0.972
0.973	41.40	41.54	41.69	41.83	41.98	42.12	42.26	42.40	42.54	42.69	42.83	42.97	43.10	0.973
0.974	41.44	41.59	41.73	41.88	42.02	42.16	42.31	42.45	42.59	42.73	42.87	43.01	43.15	0.974
0.975	41.49	41.63	41.78	41.92	42.07	42.21	42.35	42.50	42.64	42.78	42.92	43.06	43.20	0.975
0.976	41.53	41.68	41.82	41.97	42.11	42.26	42.40	42.54	42.68	42.82	42.96	43.11	43.24	0.976
0.977	41.58	41.72	41.87	42.01	42.16	42.30	42.44	42.59	42.73	42.87	43.01	43.15	43.29	0.977
0.978	41.62	41.77	41.91	42.06	42.20	42.35	42.49	42.63	42.78	42.92	43.06	43.20	43.34	0.978
0.979	41.67	41.81	41.96	42.10	42.25	42.39	42.54	42.68	42.82	42.96	43.10	43.24	43.38	0.979

$$\text{Flow Rate } (@\ 75°F) = (75-72)\left(\frac{40.85-40.71}{76-72}\right) + 40.71 = 40.82\ \frac{ft^3}{min}$$