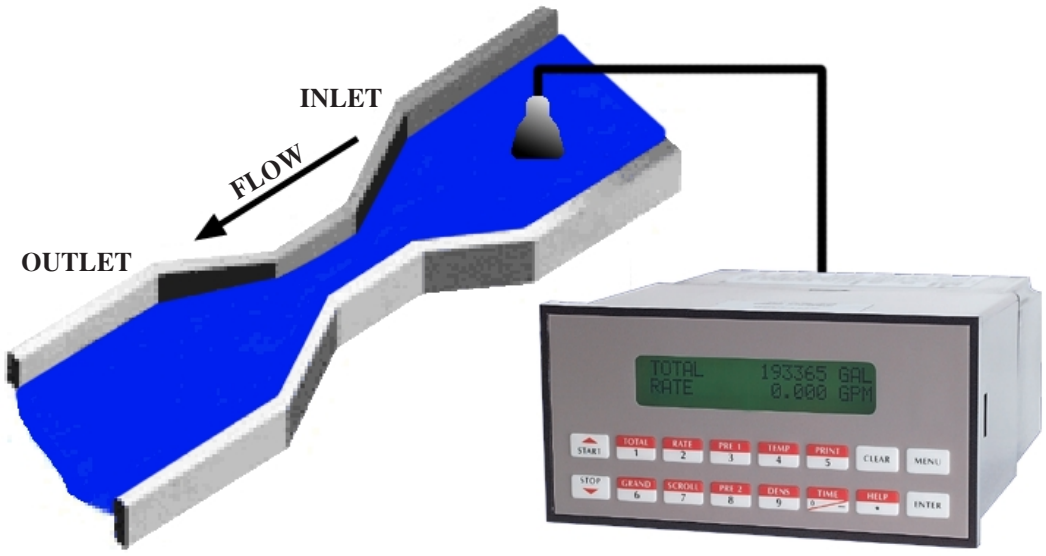
Open Channel Flow Measurement using Flumes

Open Channel Flow Measurement Application
Using Flume System and Electronic Flow Computer (SUPERtrol-I)

General

The common method of measuring flow through an open channel is to measure the height or HEAD of the liquid as it passes over an obstruction (a flume or weir) in the channel. For any open channel that is free flowing through a specific controlled metering structure, there is a specific relationship between inlet height of inlet water and the flow rate. Whenever a given inlet height occurs, there will always be the corresponding flow. Therefore, if you know the flow corresponding to each inlet height, you can construct an inlet height-to-flow relationship. The water level or "Head" is accurately measured using a level sensor.

The height or level sensor outputs an electrical signal that corresponds with the height of the liquid. This signal indirectly relates to the flow rate. This relationship can be entered into the SUPERtrol-I Flow Computer using the 16 Point Linearization Table feature. The flow rate is then summed over time to display total flow.



The SUPERtrol-I can be used to measure open channel flow using flumes. We use the 16 point linearization table to convert the input level readings into their corresponding flow rates. An Excel spread sheet is available as an aid to help construct the linearization table. This spreadsheet can be sent upon request or downloaded from the KEP website at:
http://www.kep.com/catalog/flow/tutorials/flume16/flume16point.xls

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REQUIRED CUSTOMER INFORMATION:
Flumes come with documentation that shows the head in inches at the flume and the corresponding flow rates. This sheet is required for each application. Details on the level sensor span and signal type that will be used are also required. See the example on the following page.

SETUP TABLE:
Below is the "flume16point.xls" application aid in the form of a spreadsheet. This will help to construct the SUPERtrol-I 16 point table. The spreadsheet is dimensionless so that it can be applied to any application regardless of the signal type, level units, or flow rate units required.

In the actual spreadsheet table there are areas in blue where you enter information and there are areas in green that represent the resulting 16 point linearization table that is created.

FLUME LINEARIZATION EXAMPLE:
Example: Signal: 4-20mA corresponding to 0-28.15", nominal flowrate: 0 -10000 GPM (for the sample flume)

Zero Signal	4
FS Sig	20
Zero Level	0
FS Level	28.15
Zero Flow	0
FS Flow	10000

Act Head	Normalized Input	Appar. Flow	Act Flow	CF Factor	Signal In
1	0.03552	355.23979	58	0.1633	4.568
1.75	0.06217	621.66963	139	0.2236	4.995
3.5	0.12433	1243.33925	405	0.3257	5.989
5.25	0.18650	1865.00888	759	0.4070	6.984
7	0.24867	2486.67851	1180	0.4745	7.979
8.75	0.31083	3108.34813	1659	0.5337	8.973
10.5	0.37300	3730.01776	2195	0.5885	9.968
12.25	0.43517	4351.68739	2781	0.6391	10.963
14	0.49734	4973.35702	3404	0.6844	11.957
15.75	0.55950	5595.02664	4092	0.7314	12.952
17.5	0.62167	6216.69627	4812	0.7740	13.947
19.25	0.68384	6838.36590	5569	0.8144	14.941
21	0.74600	7460.03552	6373	0.8543	15.936
22.75	0.80817	8081.70515	7207	0.8918	16.931
24.5	0.87034	8703.37478	8075	0.9278	17.925
28.15	1.00000	10000.00000	10000	1.0000	20.000

TO USE THIS TABLE:
1. Begin by selecting 16 evenly spaced points from the flumes discharge table (see following page).
2. Enter the signal zero and span coming from the level transmitter (i.e.:4-20mA)
3. Enter the zero level and full scale level for the flume that correspond to the above span(i.e.:0-28.15")
4. Enter the flow rates that correspond to the zero level and full scale level for the flume(i.e.:0-10000 GPM)
5. Enter the Actual Head (level) and Actual Flow as 16 points in ascending order of level
6. The table will be computed for you. You will be entering into the SUPERtrol-I:
   a. Setup the units of flow and time base
   b. Select the signal type coming from the level transmitter in the flow menus and also LinTbl
   c. Set in the 16 point table of Apparent Flow and Correction Factor
   d. Set in the Flow Low Scale and Flow Full Scale corresponding to the Zero Flow and FS Flow for the flume
7. Setup other features on the SUPERtrol-I as you normally would.
8. The SUPERtrol-I will now be configured for use.

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EXAMPLE

Discharge From an Eighteen Inch Parshall Flume

HEAD (INCHES)	FLOW (MMGD)	(GPM)
1.00	0.08	58
1.25	0.12	85
1.50	0.16	112
1.75	0.20	139
2.00	0.25	172
2.25	0.30	206
2.50	0.33	232
2.75	0.40	279
3.00	0.45	320
3.25	0.52	361
3.50	0.58	405
3.75	0.65	451
4.00	0.72	500
4.25	0.79	546
4.50	0.86	596
4.75	0.93	648
5.00	1.01	701
5.25	1.09	759
5.50	1.18	817
5.75	1.26	875
6.00	1.34	933
6.25	1.43	991
6.50	1.51	1050
6.75	1.61	1115
7.00	1.70	1180
7.25	1.79	1245
7.50	1.89	1311
7.75	1.95	1354
8.00	2.06	1432
8.25	2.17	1510
8.50	2.29	1588
8.75	2.39	1659
9.00	2.49	1730
9.25	2.60	1806
9.50	2.71	1882
9.75	2.82	1958
10.00	2.93	2035
10.25	3.05	2115
10.50	3.16	2195
10.75	3.28	2275
11.00	3.39	2356
11.25	3.51	2437
11.50	3.63	2523
11.75	3.76	2609
12.00	3.88	2695
12.25	4.01	2781
12.50	4.13	2870
12.75	4.26	2958
13.00	4.39	3047
13.25	4.52	3135
13.50	4.63	3217
13.75	4.75	3298
14.00	4.90	3404
14.25	5.05	3507
14.50	5.19	3603
14.75	5.33	3700
15.00	5.47	3796
15.25	5.61	3894
15.50	5.75	3993
15.75	5.89	4092
16.00	6.04	4191
16.25	6.18	4295
16.50	6.33	4398
16.75	6.48	4501
17.00	6.63	4605
17.25	6.76	4708
17.50	6.93	4812
17.75	7.08	4915
18.00	7.24	5026
18.25	7.39	5135
18.50	7.55	5243
18.75	7.71	5352
19.00	7.86	5450
19.25	8.02	5569
19.50	8.18	5683
19.75	8.35	5798
20.00	8.51	5912
20.25	8.68	6026
20.50	8.84	6140
20.75	9.01	6255
21.00	9.18	6373
21.25	9.35	6491
21.50	9.52	6609
21.75	9.69	6727
22.00	9.86	6845
22.25	10.03	6964
22.50	10.20	7085
22.75	9.69	6727
23.00	10.55	7328
23.25	10.73	7449
23.50	10.90	7571
23.75	11.08	7695
24.00	11.26	7821
24.25	11.46	7948
24.50	11.63	8075
24.75	11.81	8208
25.00	11.99	8328
28.15	14.49	10000

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