DISCHARGE THROUGH FREE FLOW ORIFICES

Head	Diameter of Orifice (Inches)									
In.	3/4	1	1-3/8	1-1/2	1-3/4	2	2-1/2	3	3-1/2	4
					Flow in GPM					
0.4	1.24									
0.5	1.39	2.49								
0.6	1.52	2.73								
0.7	1.64	2.94	5.71							
0.8	1.75	3.15	6.11	7.19						
0.9	1.86	3.34	6.48	7.63	10.34					
1.0	1.96	3.52	6.83	8.04	10.90					
1.1	2.06	3.69	7.16	8.43	11.43	14.8				
1.2	2.15	3.86	7.48	8.80	11.94	15.5				
1.3	2.23	4.01	7.78	9.17	12.43	16.1	24.8			
1.4	2.32	4.16	8.08	9.51	12.90	16.7	25.8			
1.5	2.40	4.31	8.36	9.84	13.35	17.3	26.7			
1.6	2.48	4.45	8.63	10.17	13.79	17.9	27.5	38.7		
1.7	2.55	4.59	8.90	10.48	14.21	18.4	28.4	39.9		
1.8	2.63	4.72	9.16	10.78	14.62	19.0	29.2	41.1		
1.9	2.70	4.85	9.41	11.08	15.03	19.5	30.0	42.2	57.5	
2.0	2.77	4.98	9.66	11.37	15.42	20.0	30.8	43.3	59.0	
2.1	2.84	5.10	9.89	11.65	15.80	20.5	31.5	44.4	60.5	
2.2	2.91	5.22	10.13	11.92	16.17	21.0	32.3	45.4	61.9	
2.3	2.97	5.34	10.35	12.19	16.53	21.4	33.0	46.4	63.3	82.5
2.4	3.04	5.45	10.54	12.45	16.89	21.9	33.7	47.4	64.6	84.3
2.5	3.10	5.57	10.79	12.71	17.23	22.3	34.4	48.4	65.9	86.0
2.6	3.16	5.68	11.01	12.96	17.58	22.8	35.1	49.4	67.2	87.6
2.7	3.22	5.79	11.22	13.21	17.91	23.2	35.8	50.3	68.5	89.3
2.8	3.28	5.89	11.42	13.45	18.24	23.7	36.4	51.2	69.8	91.0
2.9	3.34	5.99	11.63	13.69	18.56	24.1	37.1	52.1	71.0	92.6
3.0	3.40	6.09	11.82	13.92	18.88	24.5	37.7	53.0	72.2	94.2
3.1	3.45	6.19	12.02	14.15	19.19	24.9	38.3	53.9	73.4	95.7
3.2	3.50	6.29	12.21	14.38	19.50	25.3	38.9	54.8	74.6	97.2
3.3	3.56	6.39	12.40	14.60	19.88	25.7	39.5	55.6	75.7	98.7
3.4	3.61	6.49	12.59	14.82	20.17	26.1	40.1	56.5	76.8	100.1
3.5	3.67	6.59	12.77	15.04	20.47	26.4	40.7	57.3	77.8	101.6
3.6	3.72	6.68	12.95	15.25	20.75	26.8	41.3	58.1	78.9	103.1
3.7	3.77	6.77	13.13	15.46	21.04	27.2	41.9	58.9	80.0	104.6
3.8	3.82	6.86	13.31	15.67	21.33	27.6	42.4	59.7	81.1	106.0
3.9	3.87	6.95	13.48	15.87	21.61	27.9	43.0	60.5	82.2	107.4
4.0	3.92	7.04	13.65	16.08	21.88	28.3	43.5	61.3	83.2	108.7
4.1			13.82	16.28	22.15	28.6	44.1	62.0	84.2	110.0
4.2			13.99	16.47	22.42	29.0	44.6	62.8	85.3	111.4
4.3			14.16	16.67	22.69	29.3	45.1	63.5	86.3	112.7
4.4			14.32	16.86	22.95	29.7	45.6	64.2	87.3	114.0
4.5			14.48	17.05	23.21	30.0	46.2	65.0	88.3	115.3
4.6			14.64	17.24	23.47	30.3	46.7	65.7	89.3	116.6
4.7			14.80	17.43	23.72	30.7	47.2	66.4	90.2	117.9
4.8			14.96	17.61	23.97	31.0	47.7	67.1	91.1	119.2
4.9			15.11	17.79	24.22	31.3	48.2	67.8	92.1	120.4

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DISCHARGE THROUGH SUBMERGED FLOW ORIFICES

Head	Diameter of Orifice (Inches)									
In.	3/4	1	1-3/8	1-1/2	1-3/4	2	2-1/2	3	3-1/2	4
					Flow in GPM					
0.3	1.00	1.80	3.58	4.26	5.80	7.6	11.7	16.8	22.8	29.8
0.4	1.15	2.07	4.14	4.92	6.70	8.7	13.5	19.4	26.4	34.6
0.5	1.29	2.32	4.62	5.50	7.49	9.8	15.1	21.7	29.5	38.4
0.6	1.41	2.55	5.07	6.03	8.20	10.7	16.6	23.7	32.3	42.2
0.7	1.52	2.75	5.47	6.51	8.86	11.6	17.9	25.6	34.9	45.6
0.8	1.63	2.94	5.85	6.96	9.47	12.3	19.1	27.4	37.2	48.6
0.9	1.73	3.12	6.20	7.38	10.05	13.1	20.3	29.1	39.6	51.6
1.0	1.82	3.29	6.54	7.78	10.60	13.8	21.4	30.6	41.7	54.5
1.1	1.91	3.45	6.86	8.16	11.11	14.5	22.4	32.1	43.7	57.1
1.2	2.00	3.60	7.16	8.53	11.60	15.1	23.4	33.6	45.6	59.6
1.3	2.08	3.75	7.46	8.87	12.08	15.7	24.3	34.9	47.5	62.0
1.4	2.16	3.89	7.74	9.21	12.53	16.3	25.2	36.2	49.2	64.3
1.5	2.23	4.03	8.01	9.53	12.97	16.9	26.2	37.5	51.1	66.7
1.6	2.30	4.16	8.27	9.84	13.40	17.5	27.0	38.7	52.7	68.8
1.7	2.37	4.29	8.53	10.15	13.81	18.0	27.8	39.9	54.3	70.9
1.8	2.44	4.41	8.77	10.44	14.21	18.5	28.6	41.1	55.9	72.9
1.9	2.51	4.53	9.02	10.73	14.60	19.0	29.4	42.2	57.5	75.0
2.0	2.58	4.65	9.25	11.01	14.98	19.5	30.2	43.3	59.0	76.9
2.1	2.64	4.76	9.48	11.28	15.35	20.0	30.9	44.4	60.5	78.[illegible]
2.2	2.70	4.88	9.70	11.54	15.71	20.4	31.7	45.4	61.9	80.[illegible]
2.3	2.76	4.99	9.92	11.80	16.06	20.9	32.3	46.4	63.3	82.5
2.4	2.82	5.09	10.13	12.06	16.41	21.3	33.0	47.4	64.6	84.3
2.5	2.88	5.20	10.34	12.31	16.74	21.8	33.6	48.4	65.9	86.0
2.6	2.94	5.30	10.55	12.55	17.08	22.2	34.3	49.4	67.2	87.6
2.7	3.00	5.40	10.75	12.79	17.40	22.7	35.0	50.3	68.5	89.3
2.8	3.05	5.50	10.94	13.02	17.72	23.1	35.7	51.2	69.8	91.0
2.9	3.10	5.60	11.14	13.25	18.03	23.5	36.3	52.1	71.0	92.6
3.0	3.15	5.69	11.33	13.48	18.34	23.9	37.0	53.0	72.2	94.2
3.1	3.20	5.79	11.52	13.70	18.65	24.3	37.6	53.9	73.4	95.7
3.2	3.25	5.88	11.70	13.92	18.94	24.7	38.2	54.8	74.6	97.2
3.3	3.30	5.97	11.88	14.14	19.24	25.1	38.7	55.6	75.7	98.7
3.4	3.35	6.06	12.06	14.35	19.53	25.4	39.3	56.5	76.8	100.1
3.5	3.40	6.15	12.24	14.56	19.81	25.8	39.9	57.3	77.8	101.6
3.6	3.45	6.24	12.41	14.77	20.10	26.2	40.5	58.1	78.9	103.1
3.7	3.50	6.32	12.58	14.97	20.38	26.5	41.1	58.9	80.0	104.6
3.8	3.54	6.41	12.75	15.17	20.65	26.9	41.6	59.7	81.1	106.0
3.9	3.59	6.49	12.92	15.37	20.92	27.3	42.2	60.5	82.2	107.4
4.0	3.64	6.57	13.08	15.57	21.19	27.6	42.7	61.3	83.2	108.7
4.1			13.24	15.76	21.45	27.9	43.2	62.0	84.2	110.0
4.2			13.40	15.95	21.71	28.3	43.7	62.8	85.3	111.4
4.3			13.56	16.14	21.97	28.6	44.2	63.5	86.3	112.7
4.4			13.72	16.33	22.22	28.9	44.7	64.2	87.3	114.0
4.5			13.87	16.51	22.47	29.3	45.2	65.0	88.3	115.
4.6			14.03	16.69	22.72	29.6	45.7	65.7	89.3	116.6
4.7			14.18	16.87	22.97	29.9	46.2	66.4	90.2	117.9
4.8			14.33	17.05	23.21	30.2	46.7	67.1	91.1	119.2
4.9			14.48	17.23	23.45	30.5	47.2	67.8	92.1	120.4

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NOTES ON INSTALLATION AND USE OF ORIFICE PLATES FOR FURROW FLOW MEASUREMENT

1. Install plates as nearly perpendicular to the direction of flow as can be done by "eye".

2. Install plates so the orifice opening will be at least one inch from the furrow boundary (bottom and sides). If the furrow silts up near the bottom of the opening during operation, clean it out and wait for the flow to restabilize before making a measurement.

3. Install plates so the downstream water surface will be below the bottom of the orifice opening for free flow conditions or so the downstream water surface will be above the top of the opening for submerged flow conditions.

4. Use extreme care in making head measurements. They must be precise. A hook gage usually should be used. Remember, for free flow conditions, the effective head is the water surface elevation above the exact center of the orifice opening. If measurements are to be made from a selected point on the top edge of the orifice plate, it will be necessary to determine the vertical distance between this reference point and the center of the orifice opening.

5. Store and handle orifice plates so as to protect the edges of the orifice openings. Measurement errors will be introduced if the edges of the openings become battered or rounded.

Reference: Research Report No. 323, "Orifice Plates for Furrow Flow Measurement", by A. R. Robinson, Agricultural Research Service, Fort Collins, Colorado, December 1959.

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