



RBC Flume 13.17.04

User manual

Contents

1. Introduction.....	1
2. The flumes of Eijkelkamp Soil & Water	1
3. Principles of discharge-measuring flumes	3
4. Selection and location of the flume	4
5. Measurements using the flume	5
6. Maintenance and measuring problems	5

Appendices

Appendix 1: References	6
Appendix 2: RBC Flume 13.17.04 Data	7
Appendix 3: Explanation of program output for computed rating table	8
Appendix 4-5 Data from computer program FLUME.....	9
Appendix 4: Rating table RBC flume 13.17.04.....	9
Appendix 5: Discharge graph	13

1. Introduction

For the management of irrigation systems it is important that the quantity of water flowing through canals can be measured accurately. In the field of irrigation this is called discharge (flow rate). Discharge is the amount of water flowing through a canal at a certain place at a certain time. The flow rate is usually expressed in litres per second or cubic meters per hour.

The flow rate data are used for the design and monitoring of irrigation canals. This allows for the design of an efficient water distribution system in which a surplus or waste of water is avoided as much as possible. The flow rate is measured frequently in particular at canal splitting or separation structures. At section level it is important to know the flow rate in order to determine whether the crop receives sufficient water.

These operating instructions give brief information on how to use the RBC flume. For detailed information on flumes is referred to literature as listed in appendix 1.

2. The flumes of Eijkelkamp Soil & Water

Flumes are designed in different types and sizes. Eijkelkamp Soil & Water offers a trapezium shaped RBC (Clemmens et al. 1984) flume for four flow rate ranges (0.16 - 9.0; 0.93 - 50; 1.55 - 86 and 2.0 - 145 l/s). Compared to the WSC and the Parshall flumes the RBC flume is the most accurate. Compared to other shapes, the trapezium shaped flumes have two more important advantages:

- Accurate for a wide range of flow rates;
- Fits better in canals which often are trapezium shaped by design (more reliable flow pattern upstream of the flume and inside the flume).

Meet the difference

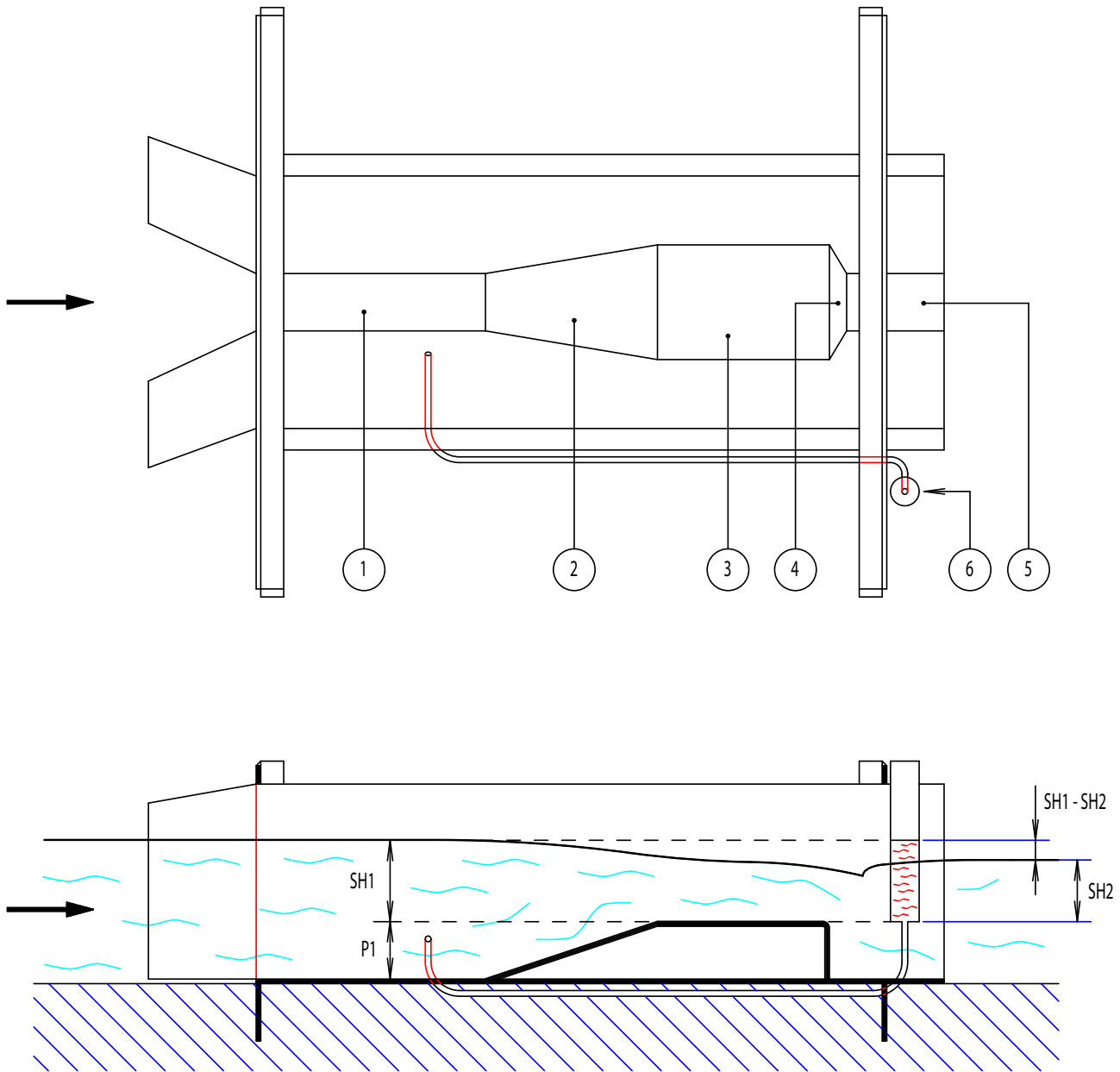


Fig. 1. Top view (above) and side view of the flow profile in the RBC flume.

The RBC flumes are designed mainly for use in furrows or other small earthen canals. All flumes can be equipped with a data logger and a pressure sensor. This allows for automatic measuring (or activation), storage and reading.

3. Principles of discharge-measuring flumes

For field measurement of the flow rate in small, usually earthen, irrigation canals, discharge-measuring flumes can be applied. Discharge-measuring flumes for small canals usually are compact and easy to use and transport.

A discharge-measuring flume is illustrated in figure 1 and consists of:

1. Approach section.
2. A converging section in which the speed of the water increases.
3. A throat section, a sill where the speed is increased further.
4. The throat section discharges into a diverging outlet where the flow rate is reduced to its original value. The Eijkelkamp flume has an abrupt transition: the diverging section has a length of 0 cm.
5. A tail water section where the water level is controlled by flow downstream.
6. A measuring tube (stilling well).

In figure 1, the mechanism of a discharge-measuring flume is illustrated:

Water enters the approach section of the flume (1) as indicated by the arrow. The converging section (2) causes an increase of the flow rate in the flume. This flow rate is further increased in the throat section (3). The diverging section (4) of the Eijkelkamp flume has a length of 0 cm, so the water drops immediately to its original value.

The increase of the flow rate causes a reduction of the water level in the tail water section (5), and results in a drop in water stage (SH1 - SH2) inside of the flume. By constructing a flume in this way, the theoretical preconditions are realised allowing the flow rate to be determined by only measuring the water level (SH1) in the flume.

The water level is measured using a stilling well, which has its inlet upstream of the flume. The measured water level is referenced to the sill level (P1).

The sill-referenced water level is converted to discharge or flow rate, using tables or graphs.

The relation between water level SH1 and flow rate (specific to the 13.17.04 Eijkelkamp RBC flume) is given in appendices 4 and 5.

Data in this table and graph are determined using the computer program FLUME (1993), which is developed for assisting in the design and calibration of flumes. For instance, FLUME gives information on the required head loss needed to create optimal measuring conditions.

It can also be used for predicting the flow rate through the flume.

An explanation of the output parameters of the FLUME software is given in appendix 3.

If an automated flume is used, and data are already stored in (spreadsheet importable) files, it is much more convenient to calculate the flow rate instead of using tables or graphs.

Based on the regression line of the graph in appendix 5, the following equation is used for the

13.17.04 Eijkelkamp flume
(formula for the operating range SH = 46 (Q = 5.212) till SH = 311 (Q = 145.344):

$$Q = 0.000000516 \cdot (SH1)^3 + 0.00092 \cdot (SH1)^2 + 0.0433 \cdot (SH1) - 0.33211$$

With Q (discharge) in litres per second
and SH1 (sill referenced water level) in millimeter.

4. Selection and location of the flume

Selection

Before starting discharge measurements the best type of flume for the chosen application has to be selected. Usually, from a point of view of economy as well as accuracy, the smallest possible type of flume is selected for the flow rate measurement in a canal. As a general rule this is a flume with a top width of approximately $\frac{1}{3}$ or $\frac{1}{2}$ times the width of the canal. As no flow rate measurements are possible without a water-level head, a flume must be used which allows the passage of the 'estimated' flow and which provides the required sill-referenced head. The following table can be used as an indication of the discharge capacity of the flume and the required sill-referenced head.

flume type (art. no)	minimum flow (l/s)	maximum flow (l/s)	required head (SH1 - SH2) (mm)
13.17.02	0.16	9.0	20
13.17.04	0.93	50.0	40
13.17.06	1.55	86.0	50
13.17.08	2.00	145.0	60

In addition of the type of flume, also the type of data registration has to be selected: manually versus automatically.

In case of an automated flume, the sill-referenced water level is recorded using a very accurate pressure sensor connected to a data logger.

Advantages of automatic registration over a manual determination of the flow rate are:

- Maximum and minimum values are recorded in relation to time, from which the response rate of the discharge can be deduced.
- Average discharge rates as well as the cumulative discharge are accurately determined by continuous recording.
- Automatically recording flow rates is less time consuming and is very convenient in remote areas.
- High flow rates during rain periods can selectively be recorded.

Location

The flume is placed in the centre of the flow with the stilling well located at the end of the tail water section. The supply flow should preferably be straight and without any head over a substantial distance (a distance of 10 times the average channel width).

The channel bed in the approach section to a certain extent must not be porous because:

- a. all the water must flow through the flume in order to obtain reliable measurements.
- b. the flume can be undercut and will subside by erosion.

Erosion of the supply channels must be limited in order to prevent pollution or blockage of the flume. The flume must be installed level in vertical as well as in horizontal direction in order to avoid that the flow profile (and thus the measurements) is influenced. If the flume is not installed level in the longitudinal direction then this can easily yield a measuring error of 3%. The vertical direction yields a less important error (approximately 0.5%). Placing the flume upright in the vertical direction of flow of the water can be realised by holding the upstream side of the flume parallel to the water surface. In the longitudinal direction a level can be used.

Both sides of the flume must be sealed (filled up with earth) to prevent water from flowing along side of it. The effluent water must be able to run off unobstructedly and should not hinder the influent water. The flume should not be placed at a depth at which it disappears under the water level (submerged condition). Installing the flume too shallow is not a real problem as the water will soon accumulate in front of the flume (damming up) and an equilibrium water level will soon establish itself.



In case of an automated flume, the pressure sensor protrudes from under the flume. This should be taken into account when installing the flume in order to avoid damaging the sensor. The complete stilling well can be demounted as to facilitate installation. The data logger is placed on a separate mounting base which allows to read the data logger without having to stand in the canal.

5. Measurements using the flume

After the flume is placed into the canal, the conditions as described in chapter 4 are met and the water level in the flume has become in equilibrium with the new situation, discharge measurements can be started. As already described, using the Eijkelkamp RBC flume, only the sill-referenced water level has to be measured to determine discharge.

The water level in the approach section of a flume can be measured in several ways:

- ☐ Graduation fitted on the side of the approach section.
- ☐ Level measurement via surface level measurement (for instance ultrasonic).
- ☐ Level measurement applying a stilling well.

In the Eijkelkamp RBC flumes, the stilling well is used for measuring the water level without the need to measure inside the flume itself and disturbing the level in the process (wave action caused by current and wind). The still also dampens water level fluctuations caused by longitudinal flowing water in the flume. The passage towards the stilling well is provided in the wall of the approach section under the sill height. In order to avoid blocking by debris or sediment, the opening is located slightly raised from the bottom of the flume. After the water level has been measured in the stilling well and referenced to the sill height, the discharge is determined, either by using the table in appendix 4, the discharge graph in appendix 5 or the formula in chapter 3.

The frequency of measurements, or the time interval between successive measurements, completely depends on the user wished application of the flume.

If one wants to make a continuous registration of the discharge rate of a natural stream, it is important to carry out measurements at the same points of time, as to minimise the effect of natural daily discharge fluctuations. If one wants to determine maximum discharge rates after heavy rainfall, the frequency of measurements will be low during dry periods, but very high during splash rains.

6. Maintenance and measuring problems

Inside the flume and the stilling well pollution in the form of sediment, waste, algal growth, weeds etc. may accumulate in time. For this reason the flume and in particular the stilling well and the supply must be checked for pollution frequently. In case of blockage of the supply towards the measuring opening this line can be blown through. In case of measuring problems with the automated flume the pressure sensor should be handled with care. The sensor can only sustain limited over pressure. By slackening the lower ring of the stilling well the sensor can be demounted for cleaning.

To prevent damage of the sensor this must be removed when temperature drops below zero.

If the flume is not working properly, or if there is any doubt regarding the flow profile or the installation, the necessary flow profile can be obtained by raising the entire flow a small amount. Or if that is not feasible, the same result may be obtained by lowering and cleaning the canal for a short distance downstream so that the water may flow freely away below the flume.

Appendix 1: References

Bos, M.G. (editor). 1989. Discharge Measurement Structures . Third revised version. ILRI Publication no. 20. The Netherlands.

Bos, M.G. and J.A. Replogle. 1984. Flow Measuring Flumes for Open Channel Systems. A Wiley-Interscience Publication. John Wiley & Sons. New York.

Bos, M.G. (editor). 1976. Discharge Measurement Structures. Published in co-operation with ILRI and Wageningen Agricultural University, Department of Hydraulics and Irrigation. Publication no. 161.

Clemmens, A.J., M.J. Bos and J.A. Replogle. 1993. FLUME Design and Calibration of Long-Throated Measuring Flumes. Version 3. ILRI Publication no. 54. The Netherlands. Including 1 HD disk.

Eijkelkamp. Operating Instructions 13.17.10.06 Flume Software.

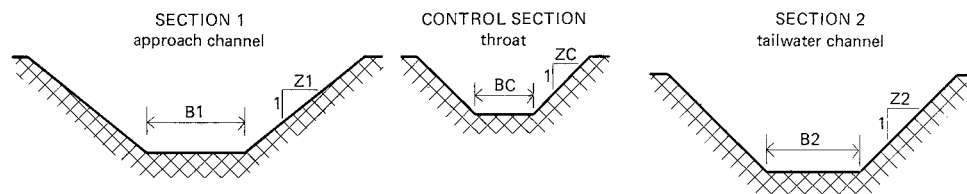
Withers, B. and S. Vipont. 1988. Irrigation: Design and Practice. BT Batsford Limited. London.

Appendix 2:

RBC Flume 13.17.04

Data

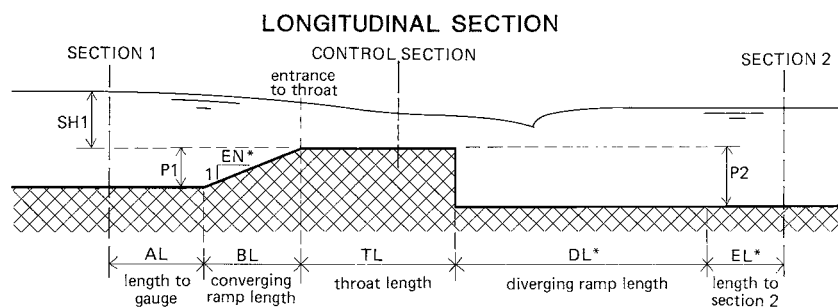
CROSS SECTIONS



Cross section data:

Approach channel, simple trapezoid:	Bottom width	B1	=	.100 m
	Side slope	Z1	=	.490 : 1
Throat section, simple trapezoid:	Bottom width	BC	=	.200 m
	Side slope	ZC	=	.490 : 1
Tailwater channel, simple trapezoid:	Bottom width	B2	=	.100 m
	Side slope	Z2	=	.490 : 1

Longitudinal section data:



SH1	=	Sill-referenced head		
AL	=	Distance between converging ramp and gauging station	=	0.100 m
BL	=	Converging ramp length	=	0.300 m
TL	=	Throat length	=	0.300 m
P1	=	Sill height relative to approach channel	=	0.100 m
P2	=	Sill height relative to tail water channel	=	0.100 m
EN*	=	Converging transition ratio (hor./vert.)	=	3.000:1
DL*	=	Diverging ramp length	=	0
EL*	=	Length to section 2	=	2.500 m
SH2	=	Sill-referenced head in tail water section		
SH1-SH2	=	Head loss		
RK	=	Absolute roughness height of material	=	0.0002 m

An * indicates that these data are not specified by the user

Appendix 3: Explanation of program output for computed rating table

Column	Value	Description
1	SH1 = h_1	The sill-referenced head. This is the head measured at the gauging station for determining discharge.
2	Q	The predicted flow rate for the given h_1 .
3*	FR1 = Fr_1	The Froude number of the flow in the approach channel. This value should be less than 0.5 in all cases and less than 0.45 when the approach conditions are not totally smooth.
4	H1/TL = H_1/L	The ratio of energy head to throat length. The head, h_1 , over which rating can be reliably computed is limited to $0.075 < H_1/L < 0.75$
5	CD = C_d	Discharge coefficient, the ratio between actual and ideal flow.
6	CV = C_v	The velocity coefficient which is computed for reference purposes only. It is the ratio between flow based on energy head, H_1 , and water depth h_1
7	DH = Dh	This is the required energy loss across the flume, $H_2 - H_1$. This may differ from the required difference in water levels, $Dh = h_2 - h_1$
8	Y2 = y_2	This is the maximum flow depth in the tail water channel for which there is no influence of this depth on the Q - h_1 relationship, $y_2 = h_2 + p_2$
9	ML	This is the modular limit defined in terms of the ratio of downstream to upstream energy heads, H_2/H_1 , at the limit between modular and nonmodular flow. Modular flow exists when the Q - h_1 relationship is not affected by the flow in the tail water channel.

* = the Froude number F1 at the gauging station is defined as:

$$Fr_1 = \frac{v_1}{\sqrt{gA_1/B_1}}$$

with:

v_1	=	the average flow velocity at the gauging station
g	=	the acceleration due to gravity
A_1	=	the cross sectional area perpendicular to the flow
B_1	=	the water surface width at the gauging station.

The Froude number gives an indication for the expected turbulence. When there is a rapid change in depth of flow from a low to a high stage, the water level will rise abruptly, creating a hydraulic jump, visible through its turbulence. The higher the Froude number, the higher the turbulence.

To obtain a relatively smooth water surface for which the elevation can be determined accurately, the Froude number should not exceed 0.5.

For channels with high sediment loads, the Froude number should be kept high in order to prevent sedimentation.

Appendix 4-5 Data from computer program FLUME

Appendix 4: Rating table RBC flume 13.17.04

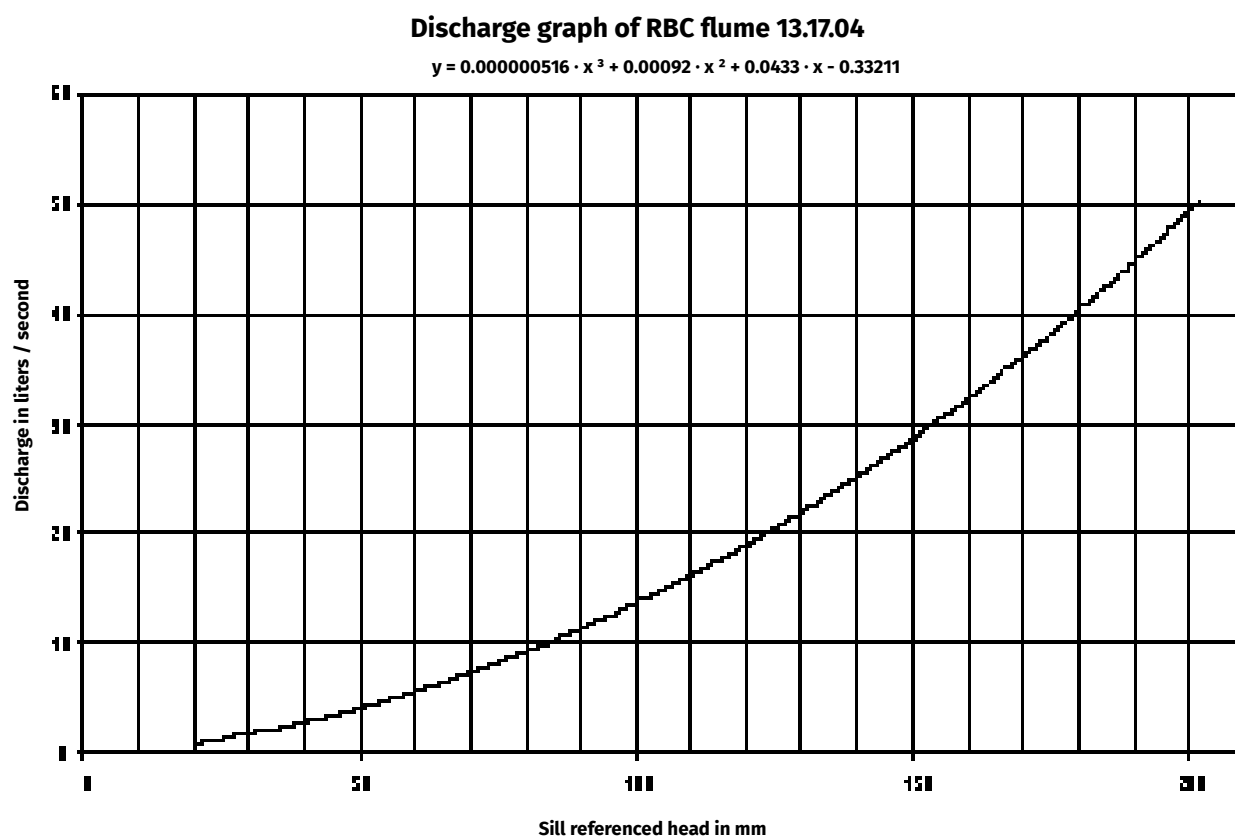
SILL REFER. HEAD	FLOW RATE	FROUDE NO.		DISH. COEFF.	VELOC. COEFF.	REQ'D HEAD LOSS	MAX. T-WATER DEPTH	MODULAR LIMIT
SHI MM	Q LIT/SEC	FR1	H1/TL	CD	CV	DH MM	Y2 MM	
12.0	0.403	0.026	0.040	0.8769	1.004	4.3	107.6	0.642
13.0	0.460	0.029	0.043	0.8868	1.004	4.6	108.3	0.650
14.0	0.520	0.032	0.047	0.8953	1.005	4.8	109.1	0.658
15.0	0.583	0.036	0.050	0.9027	1.006	5.0	109.9	0.665
16.0	0.649	0.039	0.054	0.9090	1.006	5.3	110.6	0.672
17.0	0.716	0.042	0.057	0.9146	1.007	5.5	111.4	0.679
18.0	0.787	0.046	0.060	0.9196	1.008	5.7	112.2	0.685
19.0	0.859	0.049	0.064	0.9240	1.009	5.9	113.0	0.691
20.0	0.934	0.053	0.067	0.9279	1.010	6.1	113.8	0.697
21.0	1.012	0.056	0.070	0.9314	1.011	6.3	114.6	0.703
22.0	1.091	0.060	0.074	0.9346	1.012	6.5	115.4	0.708
23.0	1.173	0.064	0.077	0.9376	1.013	6.6	116.2	0.713
24.0	1.257	0.067	0.081	0.9404	1.014	6.8	117.1	0.718
25.0	1.343	0.071	0.084	0.9428	1.015	7.0	117.9	0.723
26.0	1.432	0.074	0.088	0.9450	1.016	7.1	118.7	0.728
27.0	1.523	0.078	0.091	0.9470	1.017	7.3	119.6	0.733
28.0	1.615	0.081	0.094	0.9489	1.018	7.4	120.4	0.737
29.0	1.710	0.085	0.098	0.9507	1.019	7.6	121.3	0.741
30.0	1.807	0.089	0.101	0.9523	1.020	7.7	122.1	0.746
31.0	1.907	0.092	0.105	0.9537	1.021	7.9	123.0	0.750
32.0	2.008	0.096	0.108	0.9552	1.022	8.0	123.8	0.754
33.0	2.111	0.099	0.112	0.9565	1.023	8.1	124.7	0.758
34.0	2.217	0.103	0.115	0.9578	1.024	8.2	125.6	0.761
35.0	2.325	0.107	0.119	0.9590	1.025	8.4	126.5	0.765
36.0	2.434	0.110	0.122	0.9601	1.027	8.5	127.3	0.769
37.0	2.546	0.114	0.126	0.9612	1.028	8.6	128.2	0.772
38.0	2.660	0.117	0.129	0.9624	1.029	8.7	129.1	0.776
39.0	2.776	0.121	0.132	0.9633	1.030	8.8	130.0	0.779
40.0	2.894	0.124	0.136	0.9642	1.031	8.9	130.9	0.782
41.0	3.014	0.128	0.139	0.9650	1.032	9.0	131.8	0.785
42.0	3.136	0.131	0.143	0.9658	1.034	9.1	132.7	0.788
43.0	3.260	0.135	0.147	0.9664	1.035	9.2	133.6	0.791
44.0	3.386	0.138	0.150	0.9672	1.036	9.3	134.5	0.794
45.0	3.514	0.141	0.154	0.9680	1.037	9.3	135.4	0.797
46.0	3.645	0.145	0.157	0.9687	1.039	9.4	136.3	0.800
47.0	3.777	0.148	0.161	0.9694	1.040	9.5	137.2	0.803
48.0	3.911	0.152	0.164	0.9699	1.041	9.6	138.1	0.805
49.0	4.047	0.155	0.168	0.9704	1.042	9.7	139.0	0.808
50.0	4.186	0.158	0.171	0.9711	1.044	9.7	139.9	0.811
51.0	4.326	0.162	0.175	0.9717	1.045	9.8	140.8	0.813
52.0	4.469	0.165	0.178	0.9722	1.046	9.9	141.8	0.816
53.0	4.613	0.168	0.182	0.9728	1.047	9.9	142.7	0.818
54.0	4.760	0.171	0.185	0.9733	1.049	10.0	143.6	0.820
55.0	4.908	0.175	0.189	0.9737	1.050	10.1	144.5	0.823
56.0	5.059	0.178	0.193	0.9742	1.051	10.1	145.5	0.825
57.0	5.211	0.181	0.196	0.9746	1.052	10.2	146.4	0.827
58.0	5.366	0.184	0.200	0.9751	1.054	10.2	147.3	0.829

SILL REFER. HEAD	FLOW RATE	FROUDE NO.		DISH. COEFF.	VELOC. COEFF.	REQ'D HEAD LOSS	MAX. T-WATER DEPTH	MODULAR LIMIT
SHI MM	Q LIT/SEC	FR1	H1/TL	CD	CV	DH MM	Y2 MM	
59.0	5.522	0.187	0.203	0.9755	1.055	10.3	148.3	0.831
60.0	5.681	0.191	0.207	0.9759	1.056	10.3	149.2	0.833
61.0	5.842	0.194	0.211	0.9763	1.058	10.4	150.1	0.835
62.0	6.005	0.197	0.214	0.9766	1.059	10.4	151.1	0.837
63.0	6.169	0.200	0.218	0.9770	1.060	10.5	152.0	0.839
64.0	6.336	0.203	0.221	0.9774	1.061	10.5	152.9	0.841
65.0	6.505	0.206	0.225	0.9777	1.063	10.6	153.9	0.843
66.0	6.676	0.209	0.229	0.9781	1.064	10.6	154.8	0.845
67.0	6.849	0.212	0.232	0.9784	1.065	10.7	155.8	0.847
68.0	7.024	0.215	0.236	0.9787	1.067	10.7	156.7	0.849
69.0	7.201	0.218	0.240	0.9790	1.068	10.8	157.6	0.850
70.0	7.380	0.221	0.243	0.9793	1.069	10.8	158.6	0.852
71.0	7.561	0.224	0.247	0.9796	1.070	10.8	159.5	0.854
72.0	7.745	0.227	0.251	0.9799	1.072	10.9	160.5	0.855
73.0	7.930	0.230	0.254	0.9802	1.073	10.9	161.4	0.857
74.0	8.117	0.233	0.258	0.9804	1.074	10.9	162.4	0.859
75.0	8.307	0.236	0.262	0.9807	1.076	11.0	163.4	0.860
76.0	8.498	0.239	0.265	0.9810	1.077	11.0	164.3	0.862
77.0	8.692	0.242	0.269	0.9812	1.078	11.0	165.3	0.863
78.0	8.887	0.244	0.273	0.9815	1.079	11.1	166.2	0.865
79.0	9.085	0.247	0.276	0.9817	1.081	11.1	167.1	0.866
80.0	9.285	0.250	0.280	0.9819	1.082	11.1	168.1	0.868
81.0	9.486	0.253	0.284	0.9822	1.083	11.1	169.0	0.869
82.0	9.690	0.256	0.287	0.9824	1.084	11.2	170.0	0.870
83.0	9.896	0.258	0.291	0.9826	1.086	11.2	171.0	0.872
84.0	10.104	0.261	0.295	0.9829	1.087	11.2	171.9	0.873
85.0	10.314	0.264	0.298	0.9831	1.088	11.3	172.9	0.874
86.0	10.527	0.266	0.302	0.9833	1.090	11.3	173.8	0.876
87.0	10.741	0.269	0.306	0.9835	1.091	11.3	174.8	0.877
88.0	10.957	0.272	0.310	0.9837	1.092	11.3	175.7	0.878
89.0	11.176	0.274	0.313	0.9839	1.093	11.3	176.7	0.879
90.0	11.396	0.277	0.317	0.9841	1.095	11.4	177.7	0.881
91.0	11.619	0.280	0.321	0.9843	1.096	11.4	178.6	0.882
92.0	11.844	0.282	0.325	0.9845	1.097	11.4	179.6	0.883
93.0	12.071	0.285	0.328	0.9847	1.098	11.4	180.6	0.884
94.0	12.300	0.287	0.332	0.9848	1.100	11.4	181.5	0.885
95.0	12.531	0.290	0.336	0.9850	1.101	11.5	182.5	0.886
96.0	12.762	0.292	0.339	0.9851	1.102	11.5	183.4	0.887
97.0	12.998	0.295	0.343	0.9853	1.103	11.5	184.4	0.888
98.0	13.235	0.297	0.347	0.9854	1.105	11.5	185.4	0.890
99.0	13.477	0.300	0.351	0.9857	1.106	11.5	186.3	0.891
100.0	13.719	0.302	0.355	0.9859	1.107	11.5	187.3	0.892
101.0	13.962	0.305	0.358	0.9859	1.108	11.5	188.3	0.893
102.0	14.208	0.307	0.362	0.9861	1.110	11.6	189.2	0.894
103.0	14.457	0.310	0.366	0.9863	1.111	11.6	190.2	0.895
104.0	14.707	0.312	0.370	0.9864	1.112	11.6	191.2	0.896
105.0	14.959	0.315	0.373	0.9866	1.113	11.6	192.1	0.897
106.0	15.212	0.317	0.377	0.9866	1.114	11.6	193.1	0.897
107.0	15.469	0.319	0.381	0.9868	1.116	11.6	194.0	0.898

SILL REFER. HEAD	FLOW RATE	FROUDE NO.		DISH. COEFF.	VELOC. COEFF.	REQ'D HEAD LOSS	MAX. T-WATER DEPTH	MODULAR LIMIT
SHI MM	Q LIT/SEC	FR1	H1/TL	CD	CV	DH MM	Y2 MM	
108.0	15.727	0.322	0.385	0.9870	1.117	11.6	195.0	0.899
109.0	15.989	0.324	0.389	0.9871	1.118	11.6	196.0	0.900
110.0	16.252	0.326	0.392	0.9873	1.119	11.6	196.9	0.901
111.0	16.517	0.329	0.396	0.9875	1.120	11.7	197.9	0.902
112.0	16.785	0.331	0.400	0.9876	1.122	11.7	198.9	0.903
113.0	17.054	0.333	0.404	0.9878	1.123	11.7	199.8	0.904
114.0	17.326	0.335	0.408	0.9879	1.124	11.7	200.8	0.904
115.0	17.600	0.338	0.411	0.9881	1.125	11.7	201.8	0.905
116.0	17.877	0.340	0.415	0.9882	1.126	11.7	202.8	0.906
117.0	18.155	0.342	0.419	0.9884	1.128	11.7	203.7	0.907
118.0	18.436	0.344	0.423	0.9885	1.129	11.7	204.7	0.908
119.0	18.719	0.347	0.427	0.9886	1.130	11.7	205.7	0.909
120.0	19.004	0.349	0.431	0.9888	1.131	11.7	206.6	0.909
121.0	19.291	0.351	0.434	0.9889	1.132	11.7	207.6	0.910
122.0	19.581	0.353	0.438	0.9891	1.134	11.7	208.6	0.911
123.0	19.872	0.355	0.442	0.9892	1.135	11.7	209.5	0.912
124.0	20.166	0.357	0.446	0.9893	1.136	11.7	210.5	0.912
125.0	20.462	0.360	0.450	0.9895	1.137	11.8	211.6	0.913
126.0	20.763	0.362	0.454	0.9897	1.138	11.8	212.6	0.914
127.0	21.063	0.364	0.457	0.9898	1.139	11.8	213.5	0.914
128.0	21.364	0.366	0.461	0.9899	1.141	11.8	214.5	0.915
129.0	21.669	0.368	0.465	0.9901	1.142	11.8	215.5	0.916
130.0	21.976	0.370	0.469	0.9902	1.143	11.8	216.5	0.916
131.0	22.285	0.372	0.473	0.9903	1.144	11.8	217.4	0.917
132.0	22.597	0.374	0.477	0.9904	1.145	11.8	218.4	0.918
133.0	22.911	0.376	0.481	0.9905	1.146	11.8	219.4	0.918
134.0	23.227	0.378	0.484	0.9906	1.147	11.8	220.4	0.919
135.0	23.546	0.380	0.488	0.9908	1.149	11.8	221.3	0.920
136.0	23.866	0.382	0.492	0.9909	1.150	11.8	222.3	0.920
137.0	24.189	0.384	0.496	0.9910	1.151	11.8	223.3	0.921
138.0	24.516	0.386	0.500	0.9912	1.152	11.8	224.3	0.921
139.0	24.844	0.388	0.504	0.9913	1.153	11.8	225.2	0.922
140.0	25.174	0.390	0.508	0.9914	1.154	11.8	226.2	0.923
141.0	25.506	0.392	0.512	0.9915	1.155	11.8	227.2	0.923
142.0	25.840	0.394	0.516	0.9916	1.157	11.8	228.2	0.924
143.0	26.174	0.396	0.519	0.9916	1.158	11.8	229.2	0.924
144.0	26.513	0.398	0.523	0.9917	1.159	11.8	230.1	0.925
145.0	26.854	0.400	0.527	0.9918	1.160	11.8	231.1	0.925
146.0	27.198	0.401	0.531	0.9920	1.161	11.8	232.1	0.926
147.0	27.544	0.403	0.535	0.9921	1.162	11.8	233.1	0.926
148.0	27.892	0.405	0.539	0.9922	1.163	11.8	234.0	0.927
149.0	28.242	0.407	0.543	0.9923	1.164	11.8	235.0	0.928
150.0	28.595	0.409	0.547	0.9924	1.165	11.8	236.0	0.928
151.0	28.950	0.411	0.551	0.9925	1.166	11.8	237.0	0.929
152.0	29.307	0.412	0.555	0.9927	1.168	11.8	238.0	0.929
153.0	29.666	0.414	0.558	0.9928	1.169	11.8	238.9	0.930
154.0	30.028	0.416	0.562	0.9928	1.170	11.8	239.9	0.930
155.0	30.392	0.418	0.566	0.9930	1.171	11.8	240.9	0.931
156.0	30.759	0.420	0.570	0.9932	1.172	11.8	241.9	0.931

SILL REFER. HEAD	FLOW RATE	FROUDE NO.		DISH. COEFF.	VELOC. COEFF.	REQ'D HEAD LOSS	MAX. T-WATER DEPTH	MODULAR LIMIT
SHI MM	Q LIT/SEC	FR1	H1/TL	CD	CV	DH MM	Y2 MM	
157.0	31.128	0.421	0.574	0.9933	1.173	11.8	242.8	0.932
158.0	31.499	0.423	0.578	0.9934	1.174	11.8	243.8	0.932
159.0	31.873	0.425	0.582	0.9935	1.175	11.8	244.8	0.933
160.0	32.249	0.427	0.586	0.9937	1.176	11.8	245.8	0.933
161.0	32.627	0.428	0.590	0.9938	1.177	11.8	246.8	0.933
162.0	33.007	0.430	0.594	0.9939	1.178	11.8	247.7	0.934
163.0	33.390	0.432	0.598	0.9939	1.179	11.8	248.7	0.934
164.0	33.776	0.434	0.602	0.9940	1.180	11.8	249.7	0.935
165.0	34.163	0.435	0.606	0.9941	1.181	11.8	250.7	0.935
166.0	34.553	0.437	0.610	0.9942	1.182	11.8	251.7	0.936
167.0	34.946	0.439	0.613	0.9943	1.184	11.8	252.6	0.936
168.0	35.340	0.440	0.617	0.9944	1.185	11.8	253.6	0.937
169.0	35.738	0.442	0.621	0.9945	1.186	11.7	254.6	0.937
170.0	36.137	0.444	0.625	0.9946	1.187	11.7	255.6	0.937
171.0	36.539	0.445	0.629	0.9947	1.188	11.7	256.6	0.938
172.0	36.943	0.447	0.633	0.9948	1.189	11.7	257.5	0.938
173.0	37.350	0.448	0.637	0.9949	1.190	11.7	258.5	0.939
174.0	37.759	0.450	0.641	0.9951	1.191	11.7	259.5	0.939
175.0	38.171	0.452	0.645	0.9952	1.192	11.7	260.5	0.939
176.0	38.584	0.453	0.649	0.9953	1.193	11.7	261.5	0.940
177.0	39.001	0.455	0.653	0.9954	1.194	11.7	262.4	0.940
178.0	39.419	0.456	0.657	0.9955	1.195	11.7	263.4	0.941
179.0	39.841	0.458	0.661	0.9956	1.196	11.7	264.4	0.941
180.0	40.264	0.460	0.665	0.9957	1.197	11.7	265.4	0.941
181.0	40.690	0.461	0.669	0.9958	1.198	11.7	266.3	0.942
182.0	41.118	0.463	0.673	0.9959	1.199	11.7	267.3	0.942
183.0	41.549	0.464	0.677	0.9960	1.200	11.7	268.3	0.942
184.0	41.982	0.466	0.681	0.9961	1.201	11.7	269.3	0.943
185.0	42.418	0.467	0.685	0.9962	1.202	11.7	270.4	0.943
186.0	42.856	0.469	0.689	0.9963	1.203	11.7	271.4	0.943
187.0	43.297	0.470	0.693	0.9964	1.204	11.7	272.4	0.944
188.0	43.740	0.472	0.697	0.9966	1.205	11.7	273.4	0.944
189.0	44.185	0.473	0.701	0.9965	1.206	11.7	274.4	0.944
190.0	44.633	0.475	0.705	0.9966	1.207	11.7	275.4	0.945
191.0	45.083	0.476	0.709	0.9967	1.208	11.7	276.4	0.945
192.0	45.536	0.478	0.713	0.9968	1.209	11.7	277.3	0.945
193.0	45.991	0.479	0.717	0.9969	1.210	11.7	278.3	0.946
194.0	46.451	0.481	0.721	0.9970	1.211	11.7	279.3	0.946
195.0	46.911	0.482	0.725	0.9971	1.212	11.6	280.3	0.946
196.0	47.374	0.484	0.729	0.9972	1.213	11.6	281.3	0.947
197.0	47.839	0.485	0.733	0.9973	1.214	11.6	282.3	0.947
198.0	48.306	0.487	0.737	0.9974	1.215	11.6	283.3	0.947
199.0	48.777	0.488	0.741	0.9975	1.216	11.6	284.2	0.948
200.0	49.249	0.489	0.745	0.9976	1.217	11.6	285.2	0.948
201.0	49.724	0.491	0.749	0.9977	1.218	11.6	286.2	0.948
202.0	50.201	0.492	0.753	0.9978	1.219	11.6	287.2	0.949

Appendix 5: Discharge graph



Nothing in this publication may be reproduced and/or made public by means of print, photocopy, microfilm or any other means without previous written permission from Eijkelkamp Soil & Water.

Technical data can be amended without prior notification.

Eijkelkamp Soil & Water is not responsible for (personal) damage due to (improper) use of the product.

Eijkelkamp Soil & Water is interested in your reactions and remarks about its products and operating instructions.