Sewer manhole PP bottom segment DN 1000 for extension from typified concrete cylindrical units

with Parshall flume P1, P2, P3,

labelling **MD-Q / y/ p / o / k / na /koš**

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- Certification record for Parshall flume type TCM 142/95-2075 , issued by the Czech Metrology Institute
- Appendix No.1 2075/95/1 from January 2009 extending the certification for Parshall flumes P3 with connection to pipes DN 300
- Parshall flume is supplied with the Initial calibration according Czech Metrology Law

Sewer manhole PP bottom segment DN 1000 with Parshall flume serves after completing of the whole manhole for the flow measurements in free surface conditions in the range from 0,3 to 35 l/s depending on the type of applied flowmeter. PP bottom segment with Parshall flume is designed as permanent shuttering for consequent extension concrete units DN 1000. Moreover bed configuration can be adjusted for the application of the automatic sampler.

Water discharge is measured by the Parshall flume, which is built in the bottom segment and smoothly connected into the inflow and outflow pipe (transition pipe stretch is significantly prolonged compared to the installations into the commonly used concrete manholes). Size of the Parshall flume to be used is ruled by the range of discharges as follows:

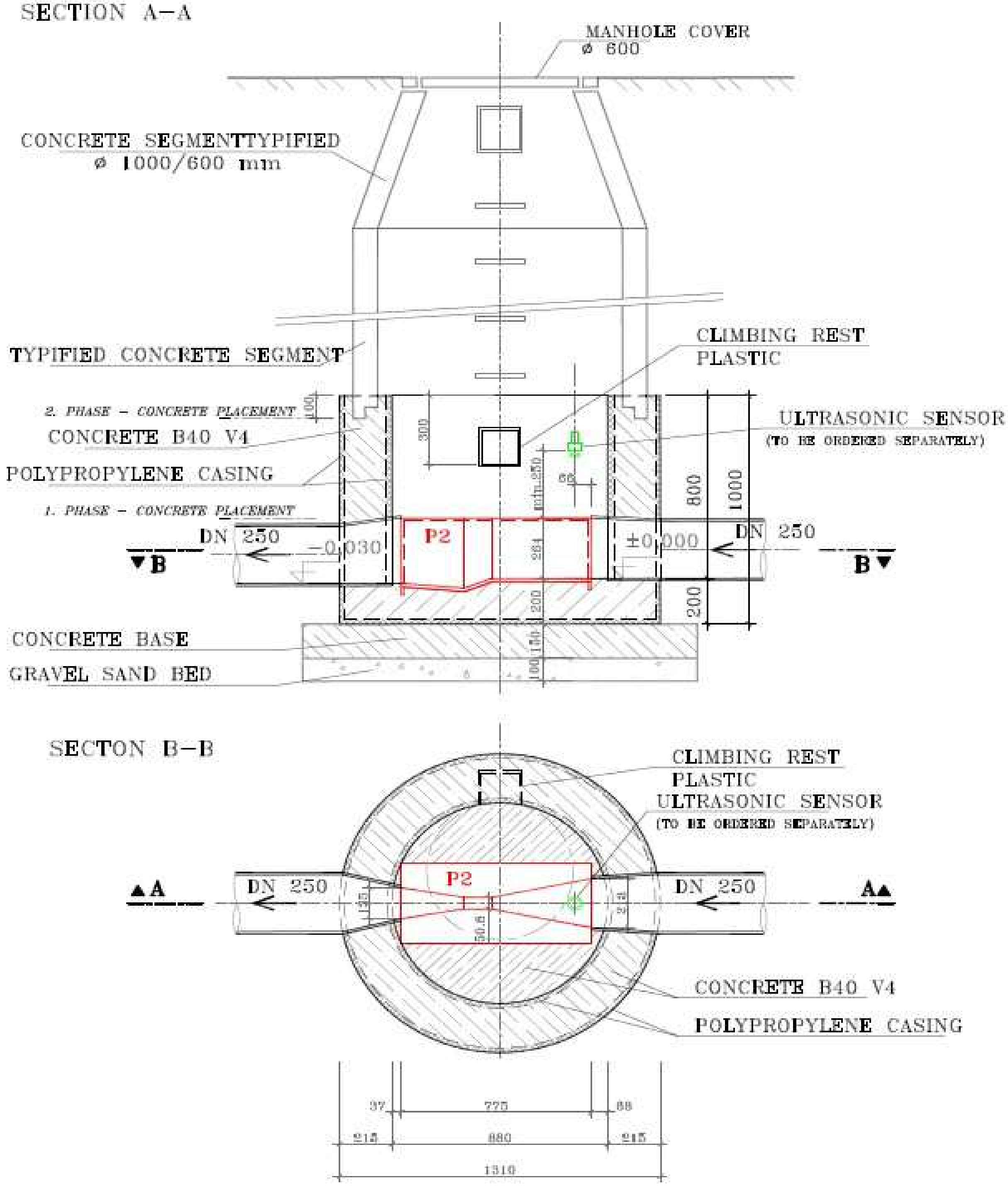
Parshall flume	**Flow (l/s)**		**Type of water**
	Qmin	Qmax	
Parshall flume P1	0,26	6,2	Mechanically treated
Parshall flume P2	0,52	15,1	Raw sewage
Parshall flume P3	0,78	35	Raw sewage
For steepler slopes of sewers the shortened version of flume can be used - - ***Montana***			

Water flowing into the flume is forced by continuous channel narrowing over short distance forming a bottleneck and by a subsequent increased slope of the bottom to pass from subcritical flow over a critical depth to supercritical flow. Thanks to this transition from one regime to another, water flow can be measured from the water depth in certain distance before the neck. In the flume axis, levels of water are measured usually by an ultrasonic sensor. Exaxt vertical positioning of the Parshal flume in the bottom segment and the the way of connection (slopes, pipe diameters) of the manhole to the ingoing and outgoing pipes should be settled by the hydraulic calculation and the manhole documentation is part of the project of the sewer.

Water discharge is evaluated and archived electronically. Electronic processor unit, which is not part of the delivery, translates the water level data in flow data and generates record of total flow volume and the cumulative value of time of operation. More expensive units can provide electronic archiving of flow values in time (flow hydrogram), and if needed also send the data in wireless manner to the internet server or directly to remote PC, mobile etc. The batteries for the water level sensor should provide usually 12V, DC and for processor unit, located separately cca 20 VA. Some units can use the bareries with solar panel.

The equipment described above meets metrological standards of EU. The Czech Certifications are acknowledged in the countries which have a contract with The Czech Metrological Institute. The equipment was tested as a source of data for billing purposes as well as for water flow balancing.

SEWER MANHOLE BOTTOM SEGMENT DN1000–POLYPROPYLENE WITH FLOWMETER – PARSHALL FLUME P2



NOTE: PRECISE VERTICAL SETTING OF PARSHALL FLUME IN THE MANHOLE SHALL BE DETERMINED BY HYDRAULIC CALCULATION BY PARS aqua s.r.o.

2. Advantages

Presented sewer manhole bottom segment makes it possible in opposition to standard manhole solutions:

- More efficient water surface stabilization a and consequently minimizing of the measurement error of the whole system as a result from the prolonged transition stretch from circular to rectangle profile
- Significant simplification of design and construction, and thus providing high precision and stability of measurement as a result of prefabrication
- Adjustability of the cross-section for the application of the automatic sampler and possibility of strainer flushing

Parshal flume is hydraulic measurement device. Its broad applicability is mainly due to the following features:

a) local losses are low (3-4 times lower compared to the weirs)
b) relatively not sensitive to the uneven flow velocity distribution across the flow profile
c) can be effectively used also when submerged by backwater
d) flow velocity is high enough to avoid sedimentation
e) non-diluted solids can easily pass through the flume and do not influence the quality of measurement
f) high range of measured discharge and precision
g) long life expectancy

3. Technical parameters

3.1. Manhole.

The sewer manhole bottom is made out of polyproplyene. The construction consists of the double casing, which forms the cylindrical unit. The space between the casings is to be filled with concrete B 40 V 4 after placing the manhole bottom on the concrete base. The concrete placing is to be arranged per partes. As the first step the bottom part is filled up to the level of the upper desk of Parshall flume. After the bottom concrete gets stiff as the next step concrete is placed between the casing by 20 cm layers up to cca 10 cm bellow the upper edge. After the concrete stiffening at least on the 60 procent of the final strength the space between the casing is filled up with concrete B 40 V 4 to the very edge and into the liquid concrete the typified cylindrical concrete segment DN 1000 is laid. This is the way, how both the watertight connection and required static qualities of the manhole are reached. The manhole is finished from the typified cylindrical concrete segments according to the requirements of the producer. Reinforcement is not included in the standard version - is applied only in case of either deep manholes in water-logged sand conditions or mechanically highly stressed manhole locations.Concreting is realized in wheather temperatu 5^0C to 20^0 C

Manhole bottom segments are produced as tailor-made on the basis of specification of the designer. The standard design version for P2 is shown in the figure above. The main production parameters are shown in the following table and the labelling rules are as follows:

MANHOLE TYPE LABELLING

MD-Q / y / p / o / k / na / strainer /

Parameter for the manhole labeling		Options
y	Type of Parshall flume	…P1…P2…P3
p	Diameter and material of inlet	e.g.…DN 300 Bocker
o	Diameter and material of outlet	e.g …DN 400 PVC
k	The vertical distance between IN and OUT pipes	e.g …50 mm /see Picture/
na	Distance between Parshall bottom and the inlet pipe bottom	e.g …25 mm /see Picture/
strainer	Chamber for inlet unit of sampler with strainer	YES … NO

3.2. Parshal flume

Standard consumption curves Q = f(h) are given in the following table, for non-typical setting of the sensor or dimensions of the flume we provide recalculation of the curve. The final consumption curve of the Parshall flume is shown in the protocol "Original calibration of the Parshall flume" at the end of this leaflet.

<u>Extended uncertainty of measurement</u>

Parshall flume flowmeter was tested by the Czech Metrology Institute and by decree No. 2075/95/1 from 1. june 1995 (validity periodically prolonged) obtained certification TCM 142/95-2075 with stated maximum measurement error ±1.5 % of the actual flow.
Implementation of the Parshall flume P3 into the manhole DN1000 with connection to pipe DN 300 was certified by the Czech Metrology Institute in Brno in January 2009, with stated maximum measurement error ± 5 % of the actual flow.
Extended uncertainty of measurement of Parshall flume P1, P2 and P3 in the manhole DN 1000 vary from 2% to 5 % (depended on uncertainity of the throat, of parameter C of flow, of influence of pipe connection - uncertainity of depth was minimalized). Final extended uncertainity on probability 95% of measurement (.. with real uncertainity of the head) depend on the quality of the head evaluation unit and so can be greater.

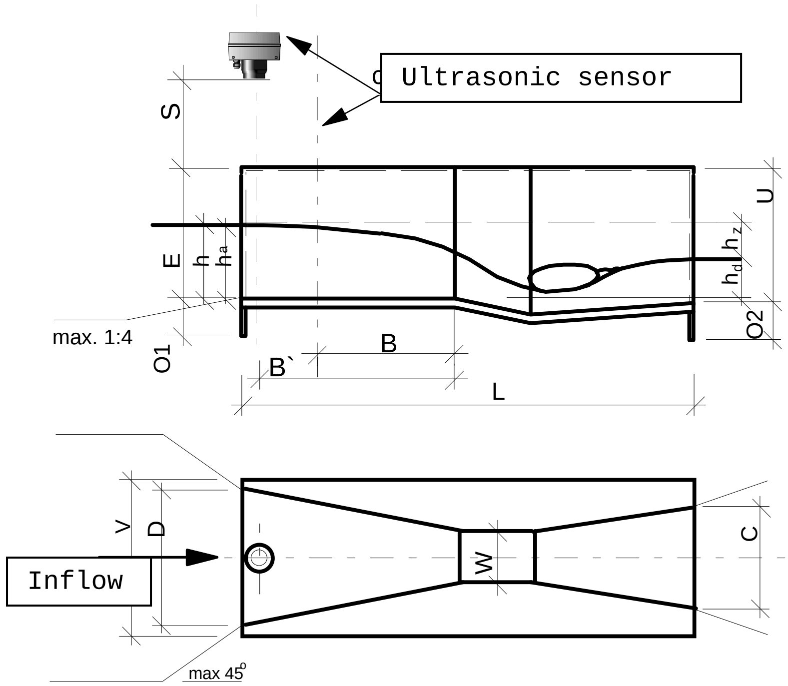
Notice: values of the extended uncertainty of the measurement are calculated for the deviations in the water level measurement ± 0,5% and include both the deviations of the parameters of the consumption curve C and the deviation in dimension of the throat of the flume

	P1	P2	P3
Q_{min}	0,26	0,52	0,78
Q_{max}	6,22	15,1	35
a	0,0609	0,120	0,178
b	1,552	1,553	1,555
B`	30	34	39
m	9	10.6	19.1
W	2.54	5.08	7.62
B`	30.0	34.0	39.0
C	9.29	13.49	17.80
D	16.75	21.35	25.88
E	23	26.4	46.7
L	63.5	77.5	91.5
O1	2,8	4,2	5,7
O2	4,6	6,4	8,2
S	20	20	20
U	24.8	28.6	49.2
V	30.7	35.35	39.9

Legend

m ……weight of flume (kg)
h_d/h… maximal ratio of backwater influence (-)
h ….. ..water depth measured at the distance B´ in front of the neck (m)
h_d ……water depth behind the flume-measured from the level of inflow (m)
W,B´,…V…..dimensions of flume (see Fig.) (cm)
Q…….discharge (m^3/s)

Consumption curve : $\boxed{Q = a * h^b}$



Design of Parshall flume

There must be subcritical flow in the whole range of flows in the inflow (Froud number should be less than 0,5) and simultaneously should not be lowered to extent leading to unappropriate sedimentation in the channel (moderate extent of sedimentation taking place within cca 10 m long stretch in front of the channel (flume) causes no operational problems and sediment are during increased inflow washed away on regular basis). The flow regime must be calm, vortex and wave free – the distribution of velocities must be uniform. In the outflow the conditions should be in principle backwater free, so as the ratio of backwater influence is lower then 0,5 .

Description of the hydraulic calculation as well as the design of length of the obstacle free stretch of pipe (uniform profile and slope, no change in direction of flow) in front of the flume and the dimensions of the channel are described on our web pages **www.pars-aqua.cz.** When needed we are prepared to send the templates of projects of flumes (Autocad drawing or paper documentation) and make the check hydraulic calculations, based on specific manhole location data, free of charge.

4. Operational aspects of the use of the manhole with the Parshall flume

4.1. Parshall flume

Parshall flume is deigned for the flow measurements. Although it is temperature-resistant, the water in the flume is not allowed to freeze up. The maximum water temperature is 80 degrees Celsius. The flumes resist anorganic salt and acid solutions, alkaline solutions without too strong oxidation properties, and a majority of organic solvents. As far as the operational maintenance is concerned, the flume requires regular removal of debris with bigger dimension that 0,8xW, as the maximum size of debris, which are able to freely pass the flume, is cca 0,8 x W (80 % of the throttling), and once-a-year cleanups of the flume surface from a biological film. For greater quantities of rough material the checking and cleaning should be carried out when required.

4.2. Manhole

Manhole, equipped with the Parshall flume, serves for flow measurements in sewers and channels with free water surface in non freezing conditions. Before entering the manhole, appropriate ventilation should be secured and the detection on dangerous gases should be carried out by specialized equipment.

5. Assembling of manhole

- Manhole is placed with using crane (short crane cables should be avoided) on the concrete base (declination from horizontal level at maximum 5 mm/1000mm, flatness at maximum 2 mm). Foundation surface is on the level 20 cm bellow the level of inflow into the measurement manhole, with the exception of the non-typical manhole construction.
- Inflow and outflow sockets are tightly fastened to the sewer pipes. The arrangement of the connections is ruled by the material of the pipes and is individually designed.

Concrete placing will be carried out as follows:

- ▪ The space around the Parshall flume and between the casing is filled up with concrete B40 V4 to the level of the upper desk of Parshall flume.
- ▪ After the bottom concrete gets stiff as the next step concrete is placed between the casing by 20 cm layers up to cca 10 cm bellow the upper edge of casing
- ▪ After the concrete stiffening at least on the 60 procent of the final strength the space between the casing is filled up to the very edge and into the liquid concrete the typified cylindrical concrete segment DN 1000 is laid
- ▪ The manhole is finished from the typified cylindrical concrete segments according to the requirements of the producer.
- ▪ The connection of the sleeves and pipes is fixed with concrete B40 V 4 in the 1 m length both on the inflow and outflow sides

- After the concrete and ground placing the ultrasonic sensor for water level measurements can be installed (not part of delivery). Cable bushing is carried out by means of IP 66. In case sensor is placed in the distance B´ in front of throttling neck, the front baffle of the Parshall flume should be cut out. The recommended location of the processor unit is the distant dispatcher room.

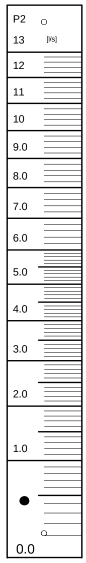
6. Evaluation of flow

The following types of equipment are usually used to convert water level data in the measurement profile into the flow data:

a) mechanical device without a data recorder,

b) electronic device with the data recording

Mechanical converter



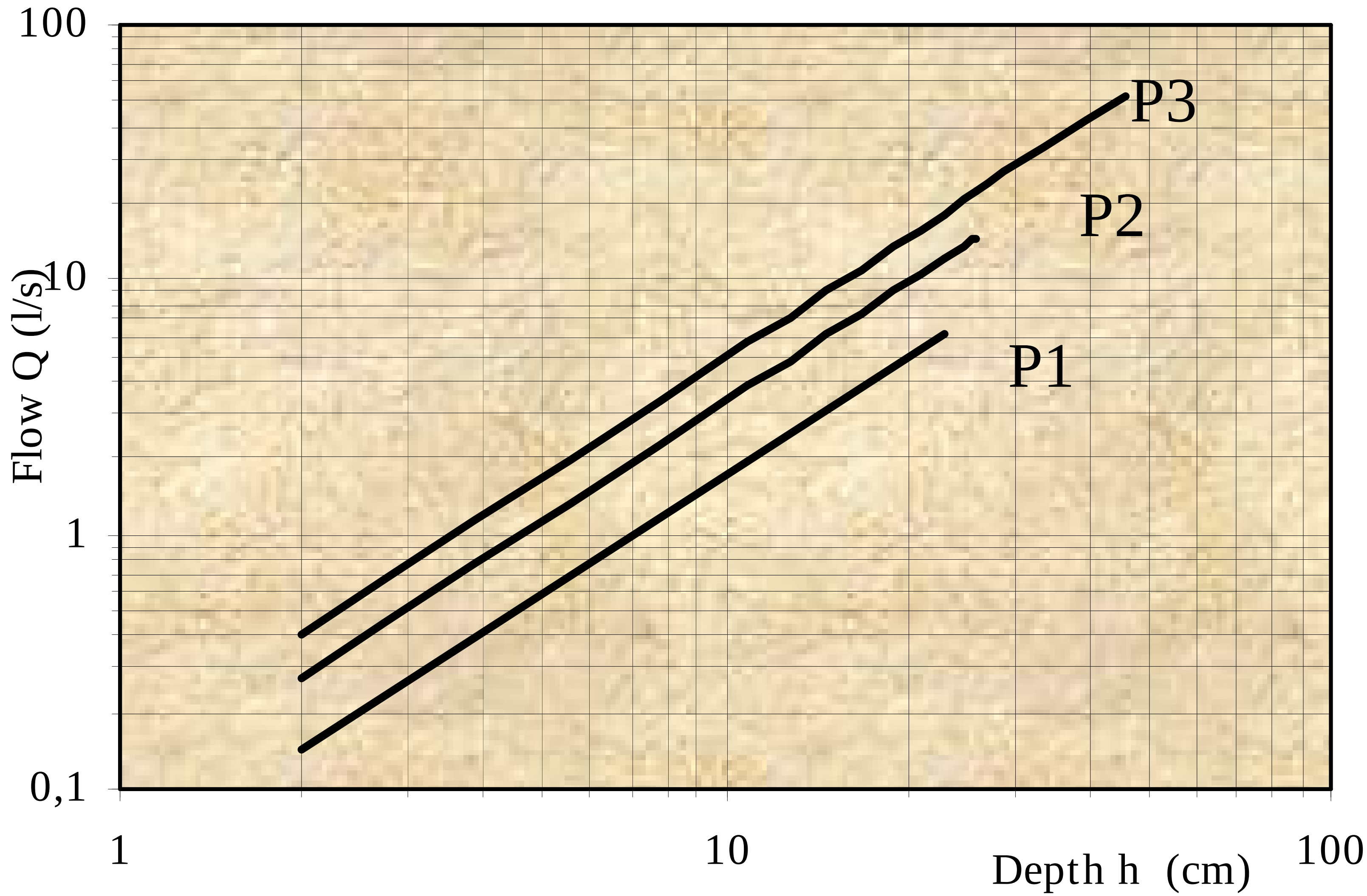
Parshall flume can be equipped with brass ruler, which enables the direct reading of the flow values. This equipment serves only for quick and simple checking of the function of the electronic converter/processor.

Electronic converter/processor

The electronic converter is in principal a microprocessor-based evaluation unit. Some types of equipment have evaluation unit integrated as a part of sensor and so the data can be read and checked directly in the manhole. The sensor with an ultrasonic transmitter/receiver is placed in the flume axis in the profile B´ . The sensor is positioned usually 20 cm above the maximum water level (in each case the producer information about the work range of the sensor should be taken into consideration) . Display of the converter/processor shows the values of the water level, actual flow, total flow volume and the cumulative value of time of operation. More expensive units can provide electronic archiving of flow values in time (flow hydrogram), and if needed also send the data to the internet server or directly to remote PC or provide statistical analysis, controlling of pumps, alarms, dosing units, controlling of small treatment plants etc. The electronic converter/processor is usually located in the separated covered places (max distance from the sensor is ruled by the type of equipment – see Appendix) or is included in the sensor body. Some units enable wireless transmission. The units need electricity connection 220 V AC (20 VA), alternatively 10 to 40 V DC (20VA) or AC – depending on the producer of the unit.

The converter/processor is not part of the Parshall flume and has to be ordered separately.

Consumtion Curve



Calibration List for Parshalll flume

Parshall flume No. …………………..

according Czech Metrology Law No.505/91 Sb.

Custumer :

Place of usage :

Measurement device : Parshall flume P……… No.………………

Function and parameters : Parshall flume is measurement tool used for determination of water discharge in free surface flow conditions, e.g. in the channels, partly filled pipes, creeks or other streams). Water coming into the flume is forced by special arrangement of changing cross- section and changes in slope to pass over a critical depth during the transition from subcritical to supercritical flow regime. Due to the transition from one regime to another, water discharge can be calculated from the measured water depth before the neck. Water depth is measured in defined distance B´ in front of the throttling. Flow discharge is calculated using the exact mathematical formula $Q = a * h^b$. The calibration result is setting of 2 parameters **a** and **b.**

Sort of measurement device : working measurement device

Calibration method: comparison of geometrical parameters of the flume with Certification TCM 142/95-2075, approved by the Czech Metrology Institute

Used measuring devices and its calibrations :

- steel ruler, length 60 cm , readings 0,5 mm, deviation 0,1 mm Tajima
  Certification List ČMI č. 6033-KL-D156-04 2013
- ruler No. č. 90124, length 60 cm , readings 0,1 mm, deviation 0,02 mm
  Certification List ČMI Brno č. 6033-KL-D158-04 from 2013

<u>Calibration Results :</u>

Dimensions and other geometrical parameters meets the standard given by Certification TCM 142/95-2075, approved by the Czech Metrology Institute

Evaluated throat width **W = cm**

Consumption curve :

Q = * h [m^3/s, m],

h……(m), depth measured at the distance cm in front of the throttling

Q…… (m^3/s) discharge,

Extended uncertainity of measurement :

Extended uncertainty of measurement of Parshall flume P1, P2 and P3 in the manhole DN 1000 vary from 2% to 5 % (depended on uncertainity of the throat, of parameter C of flow, of influence of pipe connection - for uncertainity of head 0,5% minimalized). Final extended uncertainity on probability 95% of measurement (.. with real uncertainity of the head) depend on the quality of the head evaluation unit and so can be greater.

Notice: values of the extended uncertainty of the measurement are calculated for the deviations in the water level measurement 0,5% and include both the deviations of the parameters of the consumption curve C and the deviation in dimension of the throat of the flume

. Calculations of deviations are made according EAL-R2 a ČSN ISO 3354, ČSN ISO 9826 a ČSN ISO 5168.

Calibration executed by : Ing. Jan Vršecký, Csc , tel. + 420 736 686 159
Pars aqua Ltd, Strojírenská 260, 155 21 Praha 5

Date:

ČESKÝ METROLOGICKÝ INSTITUT
Okružní 31 638 00 Brno

ROZHODNUTÍ
O SCHVÁLENÍ TYPU MĚŘIDLA
č. 2075/95/1

Na žádost fy PARS-Ing. Jan Vršecký CSc., U Mrázovky, Praha 5, Český metrologický institut, podle zákona o metrologii, č. 505/1990 Sb., § 6, 7

s c h v a l u j e

typ měřidla: průtokoměr Parschalův žlab,
výrobce: PARS-Ing. Jan Vršecký CSc., Praha, ČR,
jako pracovní měřidlo
ve smyslu odst.c) § 3 zákona o metrologii č. 505/1990 Sb., při dodržení technických údajů a podmínek uvedených v příloze tohoto rozhodnutí.

Měřidlu se přiděluje úřední značka schválení typu

TCM 142/95 - 2075

Odůvodnění:
Uvedené měřidlo splňuje metrologické požadavky a potvrzuje parametry zařízení udané v technicko - dodacích podmínkách, jak bylo zjištěno odbornou technickou zkouškou, provedenou Českým metrologickým institutem.

Poučení o odvolání:
Proti tomuto rozhodnutí lze podat u Úřadu pro technickou normalizaci, metrologii a státní zkušebnictví rozklad do 15 dnů ode dne jeho oznámení

Příloha
je nedílnou součástí tohoto rozhodnutí. Obsahuje základní technické údaje a metrologické parametry měřidla a má celkem 4 strany protokolu a 2 technické přílohy.

ČESKÝ METROLOGICKÝ INSTITUT
BRNO
-3-

RNDr. Pavel K l e n o v s k ý
ředitel ČMI

Brno, 1. června 1995