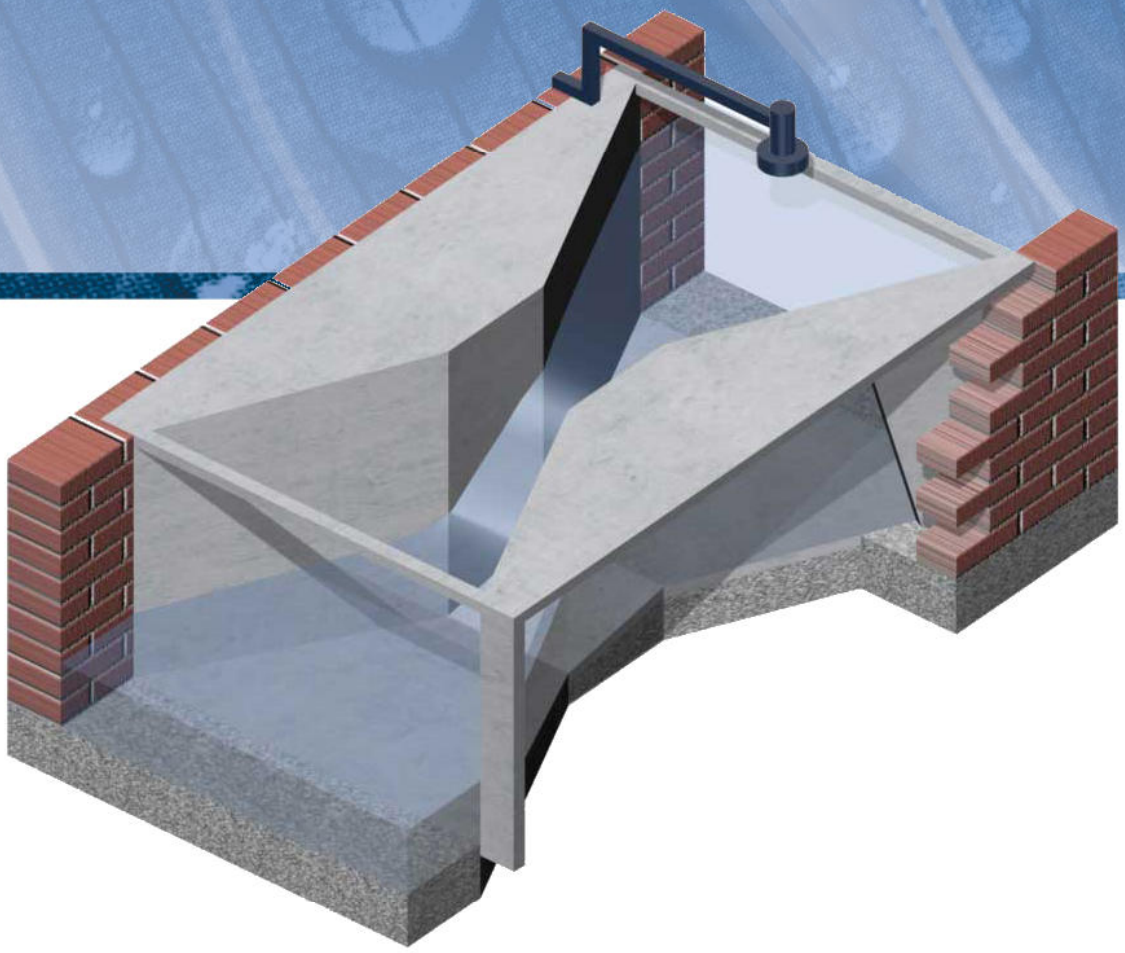
Parshall Flume User Guide



arkon flow systems

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1. Introduction

The Parshall flume is a measuring device of the volume flow rate with a wide variety of use. It can be installed in a stream, drainage, irrigation canal, reservoir outlet, sewer system, waste-water treatment plant, etc. Its broad applicability is mainly due to these advantages:

· small energy losses (3-4 times smaller than in a weirs),

· high insensitivity to velocity distribution profile at the inflow ,

· ability to withstand high degrees of submergence (up to 0,7),

· velocity of flow through the flume is sufficiently rapid to prevent suspended solids sedimentation ,

· minimal maintenance costs, long lifetime

· broad range of flow measurements

· the deviations is in the range from 3,8 % to 2,2% for minimum and maximum of flow on the level of probability 95 %

2. Functions

Water coming into the flume is forced by a bottleneck and by a subsequent bottom dip to pass over a critical depth where it goes from river-speed motion into rapidsspeed motion. Thanks to this transition from one regime to another, water flow can be measured from the water levels before the neck. Water levels are scanned either inside the gauge shaft, which is part of the Parshall flume, or inside the axis of the 0inflow part of the flume. Inside the shaft, levels are gauged by a float linked by mechanical transmission with a flow meter, or by the sensor of an electronic flowmeter. In the flume axis, levels are scanned by an ultrasonic sensor. The electronic flowmeter converts data about flume water depths to flow rates and volumes. Standard Parshall flume is produced without gauge schaft.

New electronic evaluations units provide: data storing, statistic data treat and other calculations. Data can be sent to internet servers or directly to the computers as well as to the mobile phones. Some of the units can control the waste water treatment plant technology or control the valves or chlorine dosage pumps and etc.

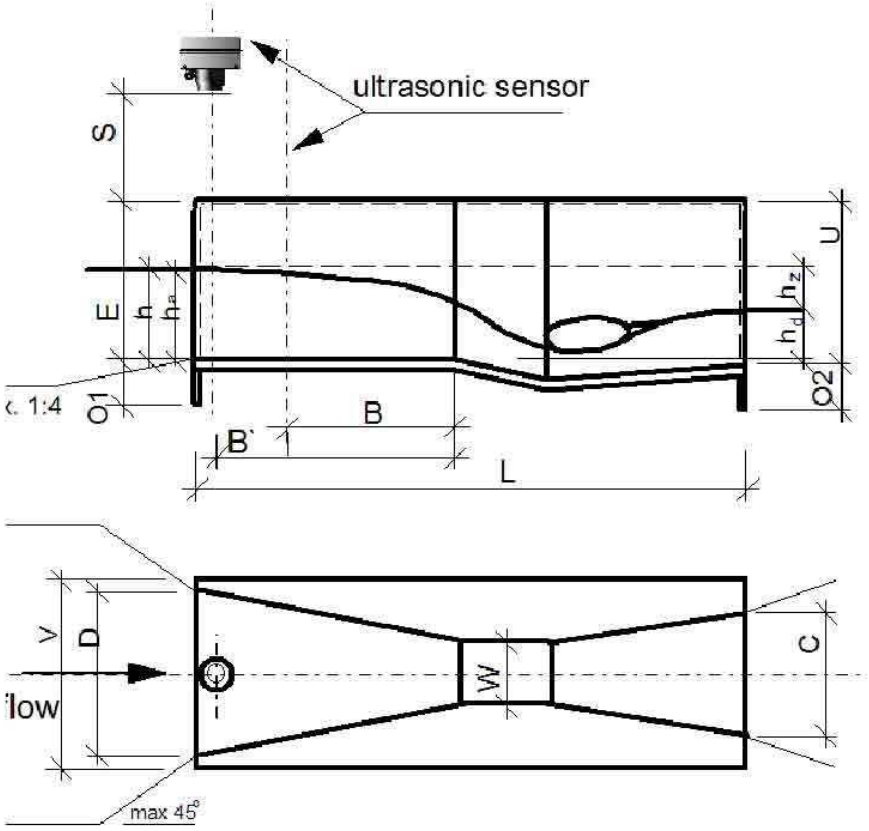
The measuring equipment meets metrological standards of EU. The Czech Certifications are acknowledged in the countries which have a contract with The Czech Metrological Institute.

3. Technical parameters of the flume

The Parshall flume is made of polypropylene. Exact dimensions and weights of individual flumes, which are mandatory for designers, are listed in Table 1. Water flows are calculated (equatation 1) according depth of water in the measuring profile. Measuring profile is ussually used at the distance B in front of the throat according ISO standards. Better results are obtained at the distance B´ where the slope of the surface is significantly lower and so performance of ultrasonic senzors is more stabile with higher precision. Parameters in the table are given for profile B´. The flumes are calibrated to within a 1.5 % error- probability 67 % (Czech Metrology Institute, June 1, 1995 as „TCM 142/95-2075“). Parameter Z in the table is the deviation with probability 95 % for minimim and maximum of flow. Enclosed there is Czech certificate for each flume where the discharge equatation is changed according real dimensions and so the deviation is in the range from 3,8 % to 2,2 % for minimim and maximum of flow.

Discharge equatation :

Q = a * hb ....flow (m3/s,m) **/1/**
h ....depth of water in B´ profile (m)



		P1	P2	P3	P4	P5	P6	P7	P8	P9
Q_{min}		0,26	0,52	0,78	1,52	2,25	2,91	4,4	5,8	8,7
Q_{max}		6,22	15,1	54,6	168	368	598	898	1211	1841
a		0,0609	0,1197	0,1784	0,354	0,521	0,675	1.015	1,368	2,081
b		1,552	1,553	1,555	1,558	1,558	1,556	1,560	1,564	1,569
Z %	Qmin	5,4	4,1	4,1	4,1	3,8	3,8	3,6	3,6	3,5
	Qmax	4,8	3,6	3,6	3,6	3,2	3,2	3,1	3,1	3,0
h_d/h_a		0,6					0,7			
m		9	10.6	19.1	49.0	81.0	146	183	231	252
W		2.54	5.08	7.62	15.24	22.86	30.48	45.70	61.00	91.4
B`		30.0	34.0	39.0	53.0	75.0	120.0	130.0	135.0	150.0
C		9.29	13.49	17.80	39.4	38.1	61.0	76.2	91.44	121.9
D		16.75	21.35	25.88	39.69	57.47	84.46	102.6	120.7	157.2
E		23	26.4	46.7	62.0	80	92.5	92.5	92.5	92.5
L		63.5	77.5	91.5	152.4	162.6	286.7	294.3	301.9	316.9
O1		2,8	4,2	5,7	11,5	11,5	10			
O2		4,6	6,4	8,2	19,1	19,1	17,6			
S		20	20	20	20	20	20	20	20	20
U		24.8	28.6	49.2	69.6	87.6	100.1	100.1	100.1	100.1
V		30.7	35.35	39.9	54.0	80	100	120	140	180

Legenda
m ……weight of flume (kg)
hd/h…..ratio of water submergance (-)
h …… ..water depth measured at the distance B´ in front of the throat (m)
hd ……water depth behind the flume (m)
W……windth of the throat (cm)
B´ až V…..dimensions of flume (see pic.) (cm)
Z ….deviation (probability 95 %) for Qmin ,Qmax (-)
Q…….flow water (m3/s)

4. Installation

Right conditions at the inflow and at the outflow pipe determine its proper function. At the inflow should be river- speed motion conditions. Inserted Parshall flume raises water level and lowers speed motion. Velocity has to be high enough to prevent sedimentation of suspended solids. The placement of Parshall flume for creek-speed motion has to be hydraulically calculated (realize free of charge Arkon Flow Systems).

The streaming in front of flume should be smooth, free of whirls and undulation, to provide a well balanced speed distribution profile. For these reasons, the flume should be installed at a safe distance from the end of a curve (at least 12 W), or for the drop wall at least 30 W (depends on the depth and on the schape of floor).

In the case, when inflow channel or pipe is wider then parshall flume, then side walls should be narowed at maximum at a 45-degree angle to axis and at a 15-degree angle to the bottom (see Pic. 1) to provide sufficient linkage between flume and trough (for greater sizes than P4 are recommended lower angles).

If the trough is being widened, side walls should be extended at an angle no greater than 10 degrees (this is the case the trough is narrower than the Parshall flume). Streaming in trough can be additionally stabilized with lengthwise partitions (special screens) or floats.

At the outflow end, sufficient outflow conditions must be secured to prevent excessive submergence (maximum submergence ratio is listed in Tab. 1 – parameter hd/ha). Discharge equatation has to be adjusted if those values are exceeded !

Since correct functioning of the Parshall flume depends on correct hydraulic design of the track and on proper mounting, the job should be assigned to a specialist.

The Parshall flume is made as a prefabricate from polyprophylene and is installed on the spot in accordance with the design. The flume is designed to allow very easy installation, which proceeds simply by setting the flume in concrete on the spot.

Concrete manhole is constracted on the site at the first . The bottom of the manhole is deeper, so that Parshall flume could be simple inserted and adjusted in the direct place. The dip in the manhole is defferent for different sizes of Parshall flume (see table)

Parshall flume	P1	P2	P3	P4	P5	P6	P7	P8	P9
Depth of dip (cm)	10	10	10	15	30	40	40	40	40

Remark : depth of the dip is the distance between tho bottom of inlet pipe and the bottom of the manhole

The concreting should be done by three stages :

· parshall flume is fixed in predicted level and perfectly level (the flumeś bottom in front of parshall flumeś throat has to be in horizontal level). For sizes up to P4 is convinient to spread the layer of concrete drought) and place the flume to this layer

· after 24 hours finish the concreating of the bottom

· than the walls of inlet and outle connections are constructed

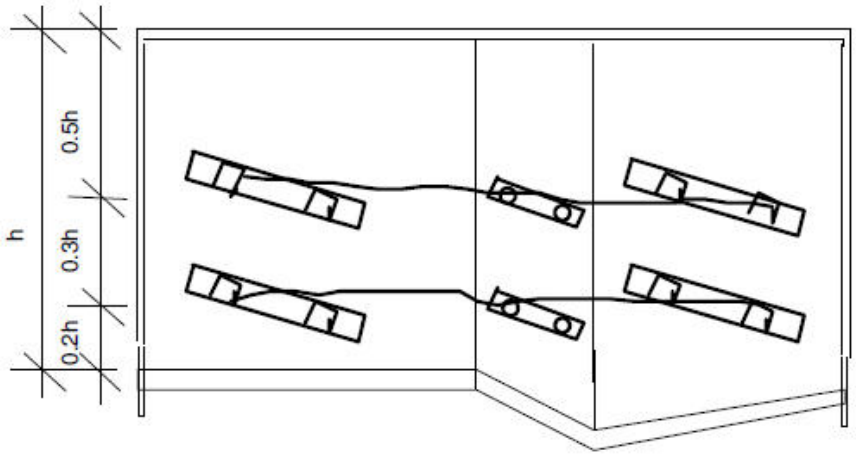
Remarks :

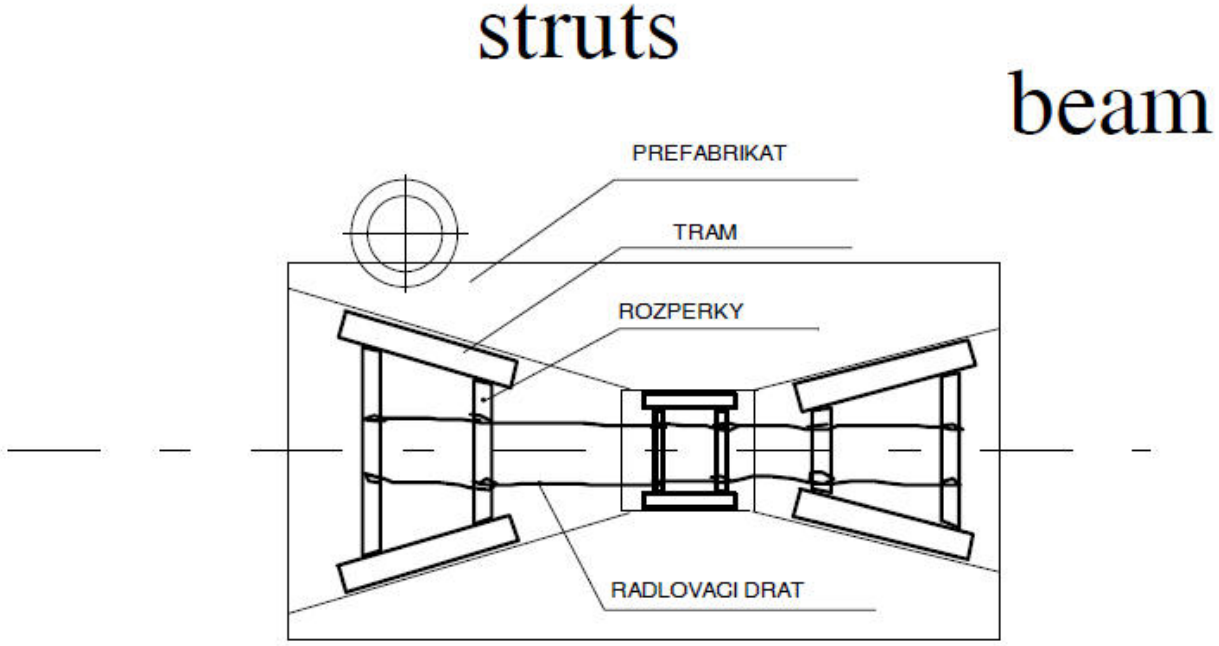
· concrete vibration is not recommended

· Parshall flumes P1 P2 and P3 need no inside casing (reinforcement)

· greater flumes than P4 should be reinforced with internal casing before concreting to prevent distortion see Pic.3). Inside casing should not be overstressed, so as not to bulge the prefabricate.
· Cocreting can be done within the range of temperature from 5oC to 15o C

The Parshall flume can be used in the manhole , without roofing. The banks must be sloped to allow comfortable access for flume cleaning or manual flow measurements. Parshall flumes P1, P2, P3, and modified P4 (Montana flume) may be installed directly in man holes. The mounting and hydraulic calculations should be performed with utmost caution in such cases, and therefore we advise you to consult our firm about these variants.





5. Operational conditions

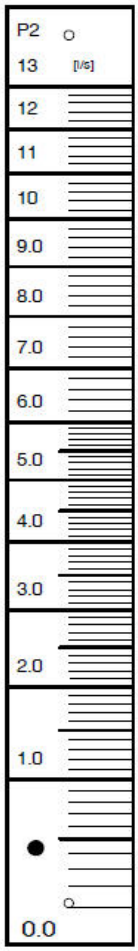
The Parshall flume is designed to measure the flow of water and, consequently, although it is temperature-resistant, the water in the flume must not be allowed to freeze up. The maximum water temperature is 80 degrees Celsius. The flumes resist anorganic salt and acid solutions, alcaline solutions without too strong oxidizing properties, and a majority of organic solvents. As far as operational maintenance is concerned, the flume requires once-a-year cleanups of itś surface and of the float shaft and of the connecting pipe between shaft and flume.

The maximum size of derbits which are able freely pass the flume is calculated as 0,8 x W (80 % of the throat). For greater quantities of unsolved substances, screens should be adjusted.

Parshall flume flow rating

The following types of flowmeters are usually used to convert water-depth data in the gauge profile:

a) mechanical device without a data recorder,
b) electronic device with an ultrasonic surface scanner



Mechanical flowmeter

Parshall flume can be equipped with brass ruler with cutings to the metal plate. This equipment serve only for actual flow readings and simple checking of the electronic flowmeter function. Brass ruler hs to be ordered separately

Electronic flowmeter

The electronic flowmeter is a device which consists of a scanning probe and a microprocessor-based evaluation unit. The scanning probe with an ultrasonic transmitter/receiver is placed in the flume axis in the profile B´ . The sensor is positioned above maximum water surface (vary from 20 cm to 60 cm). The probe has to be cleaned within six months from incrustations and other impurities. The evaluation unit is usually separated and placed at the building. Some equipment has evaluation unit as a part of sensor and so the data is displayed in the manhole. Each producer has its own regulations and conditions for instalation . Nowadays flowmeters are offered in many variants (data storing, statistic data treat and other calculations, wireless data transfer to internet servers or directly to the computers as well as to the mobile phones, control of the waste water treatment plant technology or control the valves or chlorine dosage pumps and etc. The flowmeter is not part of the Parshall flume and has to be ordered separately.

6. Calibration

Parshall flume	**Calibration Certificate No:**
	According Czech metrology law 505/91 Sb., ISO 3455

Costumer:

Place of usage:

Measure tool: water-flowmeter Parshall flume P… No….

Function and parameters : Parshall flume is measure tool used for determination of water flow volume in the channels with an open surface (e.g. in the channels, tubes, partly filled pipelines, creeks or other treams). Water coming into the flume is forced by a bottleneck and by a subsequent bottom dip to pass over a critical depth where it goes from river-speed motion into rapids-speed motion. Due to this transition from one regime to another, water flow can be measured from the water depth before the neck. Water depth is measured in a certain distance B´ in front of the throat . Volume of flow is calculated using the exact mathematical formulae Q = a * hb . Parameters a, b is the matter of this calibration list.

Sort of measure tool: working instrument

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

Used mesuring devices and its calibrations:

 steel roller Tajima, lenth 60 cm , readings 0,5 mm, deviation 0,1 mm Certification List ČMI č. 6033-KL-D156-04 from 4. march 2004
 roller No. č.90124, lenth 60cm, readings 0,1mm, deviation 0,02mm
Certification List ČMI Brno č. 6033-KL-D158-04 , 4. march 2004

Calibration Results for Parshall flume No…… :

Dimensions and all geometrical parameters meets the standard given in Certification of Czech Metrology Institute TCM 142/95-2075.

Average throat wideness W = cm
Consumtion curve: Q = * h [m3/s, m],
The range of calibration: Qmax = Qmin =

h……(m), depth at the distance cm in front of the throat
Q…...(m3/s) volume of flow,

Calibration uncetainity: less than 2 %

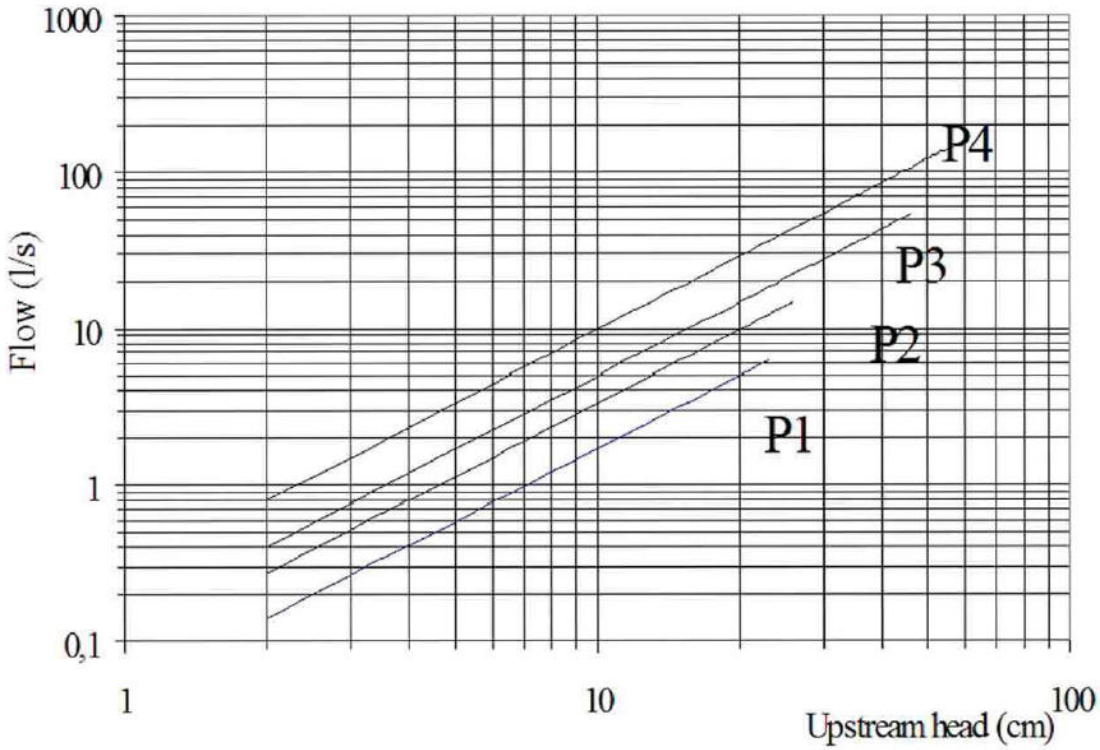
Deviation of measurement:
The deviations of measurement results are in the range from 3,8 % to 2,2% for minimum and maximum of flow on the probability level 95 %, calculations of deviations are made according EAL-R2 a ČSN ISO 3354, ČSN ISO 9826, ČSN ISO 1438-1 a ČSN ISO 5168.

Calibration executed by: Ing. Jan Vršecký, Csc , tel. + 420 736 686 159

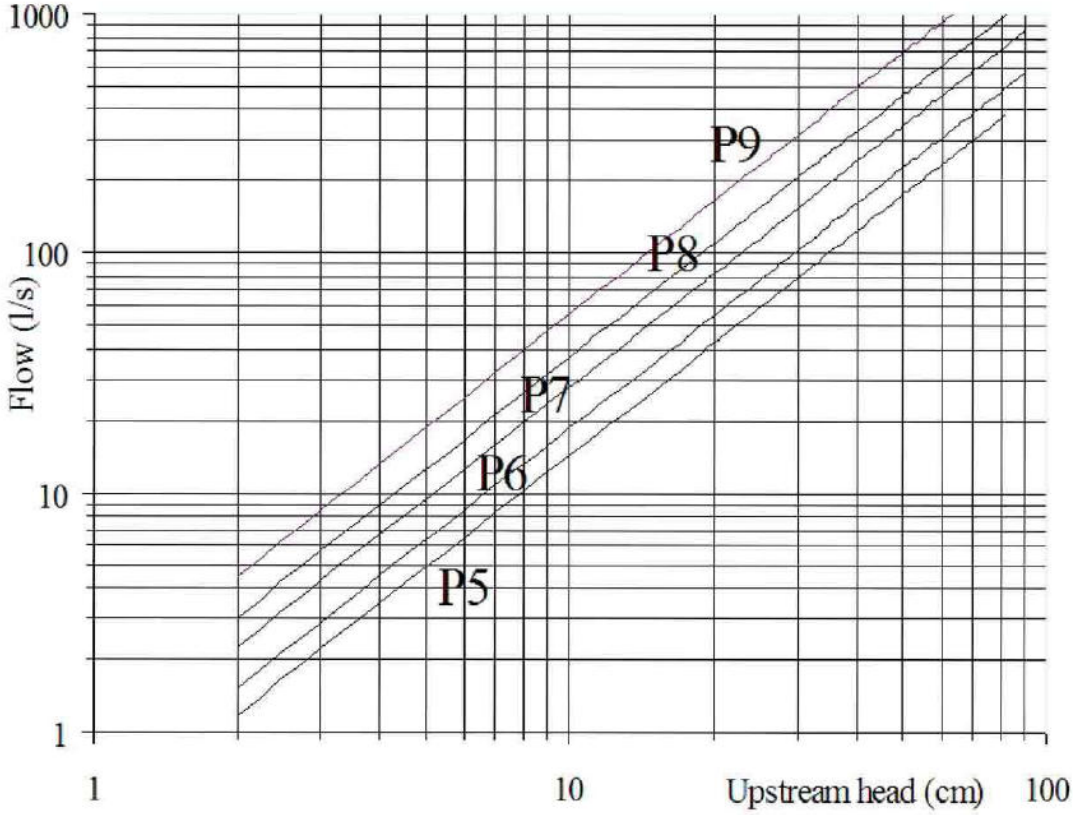
Date:

Remark:
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.

Consumtion curves



Consumtion curves



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

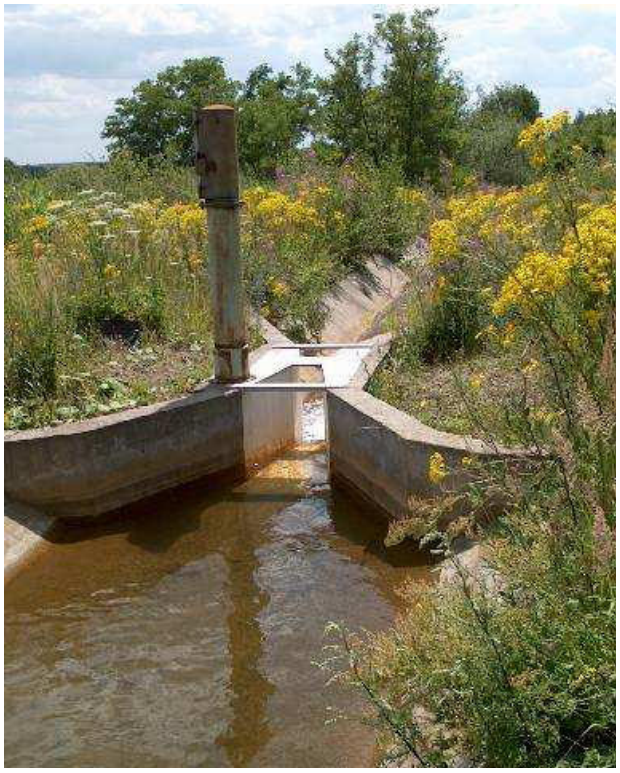
Příloha
je nedílnou součástí tohoto rozhodnutí. Obsahuje základní technické údaje a metrologické parametry měřidla a má celkem 4 strany protokolu a 2 technické přílohy.

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

Brno, 1. června 1995

7. Applications

Arkon Parshall Flumes is a primary flow device with a wide range of applications, for measuring open channel flow. It can be used for flow measurement in creeks, irrigation and/or drainage channels, sewer outfalls and waste water treatment plants.



8. Appendix

8.1. Certification

- Measurement instrument type TCM 142/95-2075 from 1995 , certificated by the Czech Metrology Institute.
- Certification TaZUS 090-013151 , No. 90-130148 from 16.5.2005, static construction approved.
- Calibration list for each measurement manhole.
- Certification of water tightness DIN 4034.

Meets metrological standards of EU. The Czech Certifications are acknowledged in the countries wich have a contract with The Czech Metrological Institute.

8.2. Warranty

The warranty conditions are covered by Arkon Flow Systems, s.r.o. Terms & Conditions of Sale and by Arkon Flow Systems, s.r.o Return Regulations and Warranty Conditions. The Arkon Flow Systems, s.r.o Terms & Conditions of Sale and the Arkon Flow Systems, s.r.o Return Regulations and Warranty Conditions are an integral part of the Resellers contract and of any Order Confirmation. Please see your Resellers contract or www.arkon.co.uk; Support section. The Warranty sheet is part of the Packing note of any new goods sent. For the claim or return procedure, please consult our web site www.arkon.co.uk or call the Arkon Flow Systems, s.r.o sales office.

Arkon Flow Systems provides Parshall flumes with a warranty period of two years from delivery date.

8.3. Contact

Technical support: support@arkon.co.uk
Windows life messenger: support@arkon.co.uk

Sales office: office@arkon.co.uk

Office hours:
8:30 – 18:00 (GMT+1)

Direct technical support:
8:00 – 17:00 (GMT+1)