

Application of Ultrasonic Meter Box for Open Channel in Western Area in China

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working principle Features & benefits Tests in factory & field

Application

Background:

In the past decades, with vigorous development of China's economy, National Water Resource Strategy has been put on unprecedented level

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- Agricultural water reservation (农业节水)、improvement of the efficiency and productivity of agricultural water(提高水资源利用效率)、improvement of the management efficiency of water resource (提高水资源调配能力), accurate measurement of water volume is the precondition前提是对水量的准确计量
- In the vast Western area of China, affected by geological factors, the variation in flow directions is complex, sediment concentration is heavy, types of channels are varied, to have accurate volume measurement is difficult.
 To eliminate the affection on measurement accuracy in the field, box-shaped ultrasonic flow meter is designed

A box-shaped flow meter for open channel provides measurement accuracy on site even in turbulent and channel sediment condition.

Working Principle 工作原理:

- > The working principle of **discharge流量** is velocity-area method流速面积法: Instantaneous flow = mean velocity * cross sectional area
- The working principle of velocity流速 is ultrasonic transit time method超声波时差法 It employs ultrasonic time-difference technology to determine velocity by measuring the transmit time taken for the pulses travelling between transducers.
- Wetted cross-sectional area过流面积 in the box

Interior width of the box * water depth (not water level) inside the box

Box-shaped Ultrasonic Flow Meter for Open Channel



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Box-shaped Ultrasonic Flow Meter for Open Channel

Features & Benefits 特点及优势:

> Box-shaped cube provides a stable section area稳定断面 for measurement

Meter box is made in aluminum or stainless steel with or without entry flame depends on mounting options. It provides a relatively stable space for ultrasonic transit-time system to compute velocity and the meter to determine the distribution area.

> Accurate flow measurement with multiple cross-path交叉多声道 velocity

8 – 24 pairs of transducers (according to the size of the box) in a interleaved cross way交叉错层 to map the vertical velocity profile of distribution area, enables the product to be resistant to swirl, or other unstable flow condition.

> Automatic sediment height identification淤积高度自动识别

The interleaved cross transducers with no more than 5cm spacing for each path not only provide good sampling of vertical velocity profile, but also helps to determine the sediment height in the box. This function secures the measurement accuracy in the field where sedimentation in the channel is heavy.



Box-shaped Ultrasonic Flow Meter for Open Channel

Features & Benefits 特点及优势:

➢ Triple water level survey 三水位测量

Meter box employs electric water gauge (on one side panel), ultrasonic water level sensor (on the top panel) and transducers (on both side panels) to determine water level in the box. The water depth is computed according to optimized water level data. This feature provides the true section area no matter the meter box is submerged or partially full.

> Integrated design makes it easy to install and almost maintenance-free 一体化设计

Meter box takes all-in-one design concept, the mainboard is integrated inside the top of the box. It is also possible to have battery powered meter box version with lithium cell and RTU integrated in the box. No incompatibilities' problems.

No moving parts within the box, very low head lost, can be square or rectangle basing on the needs on field. Meter box can be mounted to existing head wall, control gate, or slide into provided grooves in channel. It makes the installation at very low cost.



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National verification of measurement accuracy in the laboratory

Group Standard T/CIDA 0007-2021 Box-shaped Ultrasonic Flow Meter for Open Channels, which was published on June 2021, and came into force on July 2021 in China.

Flow measurement accuracy of Beijing Huashui Metering' s UPM-X400 received the official test report from National Test Center for Equipment of Irrigation and Drainage on January 2022.

1/CIDA 0007-2021		-	水利部灌排	分各检测	中心
箱式超声波阻渠流量计		Nation	al Test Center for Equip	ment of Irrigation	and Drain
相互なにという大加重り			测试	报告	
1 范围	水利部灌排设备检测中心		TEST	REPORT	
本标准规定了相式组产该明果流量计时不请相定义,标记、技术要求,性能指标要求,试服方法,检验规则和标志,包装,运输和贮存的要求。	A . LANE IN A MI PROVA I				
本标准适用于箱式超声波明束流量计,也适用于测箱和闸门连接在一起所组成的测控一体化系统	National Test Center for Equipment of Irrigation and Drainage	编号 (NO.): B	3XC202201	<u>+</u> 	<u>+2页第</u>
(以下同称 固拉形疣) 以及开版式回用等。		Product Name	箱式超声波明渠流量计	Model/Type	0.032~0.24
2. 网络亚马用女社 下列文件中的内容通过文力的现在作引用风肉或水中流送不可见的条款。其中,注目期的引用文件, 仅其目期对应的版本法用:24元期, r4行期间对用文件,其它真存在,(Chur(在的推改句)法用于本标准。	测试报告	委托单位 Inspected Body	北京华水仪表系统有限公 司	委托单位地址 Address of Inspected Body	北京市朝 15 号东侧 255 室
GB 4208-2017 第先時較多度(P代码) GB/T 14173-2708 米化片水面 12時間第1日時時、現金市場時間	TEST REPORT	生产单位	河北华水仪表仪器有限公	测试项目	共9項()
	(A)	Manufacturer 抽样单位 Sampling Body	可水利部瀨排设备检测中心	Test Item 送样单位 Client	北京华水住公司
3 水脈和冠文	编号(NO.): BXC202201	抽样日期 Sampling Date	2021年12月30日	抽样地点 Sampling Site	河北华水县公司生产和
JJF 1001-1554、11年 1001 - 5071 - #22年5月2月25年時大田和田文明明子本大学。 3.1	产品名称: 新式超声波明果流量计	样品数量 Sampling Quantity	2 台	抽样基数 Sampling Base	50 台
oom uw measuring same 一种用于影漫板水口成整度较小的原理上进行流量测量的新式设备。测量需定用箱体、喇叭口、	Product Name	到样日期 Receipt Date	2021年12月30日	样品等级 Sampling Crade	2.0 级
法被运动可能、通用部步发展行用 汽车集中 有效 电力 计重要规则 学发带或制度有效 电 也可能 立于测量能化之计变化,我们都直接成为形式。 也可力得意 军民族制度的状况。 3.2 建设测量关系 the those to also the set of th	要托单位。 北京华水仪表系统有限公司 Inspected Body	样品特性和状态 Sample Character & Condition	样品正常,无破损	林品编号/生产日期 Sample Serial No./Manufactured Date	HS1152113 HS1152113 2021 年 12
3.3 稿体长度 the length of Link 谜 区 切	极振央别: 安代朗试 Kind of Test	测试依据 Test Criterion	《箱式超声波明集流量计》	T/CIDA 0007-2021	
圆箱出厂时标称的箱体沿道向长度。 3、4	检验中心公章:	测试结论 Test Conclusion	合格。(详见续页)	保设会	1
喇叭口 Haring intel 为使进入测箱的水流平顺,在测箱的水流进口端四周加设的一种导流板,导流板在测箱沿水流方	Seal of Test Center	备注 Note	/	新日本	14
同时如此无形动物。 3.5 使量度图 Theorenter range 由最小心镜是希腊大规模所能定的温润。在该组图内能式相严说明累流量计的风镜则能误是符合相 应用能管理的原本。 3.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6 2.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3	报告发送日期:2022年)月22日 Date of Report	主检: 文r Tested by: プロ (月27日	通潮 申核: み Audited by: み ヨーフーン 年 月 7]	H HAPP	世 被求负责人) 年(月)

利部灌打 Test Center for E	非 duipu	 Lanent	各检测中心 of Irrigation and Drainage	
测	试	报	告	

	利号提格	CX-400 × 400 × 458.	
箱式超声波明梁流量计	Model/Type	0.032~0.240-2.0	
业育化业校事系统有限公	委托单位地址	北京市朝阳区百子湾路	
司	Address of	15 号东侧 3 号楼 2 层	
nl	Inspected Body	255 室	
河北华水仪表仪器有限公	测试项目	世の間(満町特別)	
司	Test Item	96 3 MI (14 76 96 94 7	
-Landerson and its of an and its of	送样单位	北京华水仪表系统有限	
小村部租押就會位割中心	Client	公司	
and the second second	抽样地点	河北华水仪表仪器有限	
2021年12月30日	Sampling Site	公司生产基地	
2 台	油杆盖奴	50 台	
1000	Sampling Base	7439559	
	样品等级	224	
2021年12月30日	Sampling Crade	2.0 10	
	样品编号/生产日期		
and the particular of the later	Sample Serial	HS11521120035/	
杆品止带,无敏颈	No./Manufactured	HS11521120064/	
	Date	2021 34-12 /3	
A ANY JAP ANY MACRO- HILL OF THE ALL ALL M	T/CIDA 0002 2021	<i>.</i>	
《相关规则》 使为分配用 计》	T/CIDA 0007-2021		
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合恰。(研光狭贝)	操设备	the second se	
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	E TOTAL A		
	 都式園声波明葉就量計 北京中水伐東系統有限公司 四北平水伐東久銀有限公 水和感謝排送条校園中心 2021年12月30日 2位 2位 2位 2位 2位 4価元常, 无磁鏡 (備汽和岸級明集流量計) 合格、(研見練刀) 	招式超声波明葉進士: <mark>双号規格 </mark>	

National Test Center for Equipment of Irrigation and Drainage

检验报告

TEST REPORT 共2页 第2页 委托单位:北京华水仪表系统有限公司 品名称: 箱式超声波明渠流

k计	规格型号:	CX-400×400×4
	试验日期:	2021-12-30

序号 Serial No.	检验项目 Test Item	技术指标 Technical Requirement	检验结果 Test Result	单项判定 Judgement
1	测箱规格尺寸及 其极限偏差(mm)	孔口高度和孔口宽度及其允许偏差 应为400±2	400+0.5	合格
2	测箱内侧板平面 度(1.5mm/m)	湖箱内侧板的平面度应小于 1.5	0.7	合格
3	测量误差 要求(%)	最大允许误差: 高等级要求为 ±2.0, 基本要求为±5.0, 宽限要 求为±7.0	1.39	合格,符合 高等级要求
4	重复性试验(%)	重复性试验: 高等级要求为 ±1.0, 基本要求为±1.5, 宽限要 求为±2.5	0.7%	合格,符合 高等级要求
5	水位变幅误差试 验(%)	在非满箱流情况下,流量测量的最 大允许误差为±5.0	-1.20%	合格
6	扰动试验(%)	在扰动情况下,流量测量的最大允 许误差为±7.0	-6.17%	合格
7	水位(mm)	设置在测箱内的水位测量装置的测量误差应在±2.5 的范围内	+0.56 -1.00	合格
8	起测水深(%)	起週水深和生产厂家声称值的误差 应在±5的范围内	9设在之	合格
9	电池工作寿命	应能连续工作 30 天以上	41.6 天	合格
备注: / Note:			撤销起	1

Box-shaped Ultrasonic Flow Meter for Open Channe World Water

Testing methodology and equipment 测试方法及设备

The test was conducted by reference meter method. The water goes through reference meters, water tanks, and tested meter box in a closed loop. Press "start" on the interface of host computer software, the computer starts to read the flow rate data from tested meter box and reference meter. Press "finish "to terminate the test,

the software shows the accumulated volume data of tested meter box and reference meter, and the measurement uncertainty.

The test equipment is consist of host computer control desk, surge tank, water storage tanks, pumping station, frequency inverters, reference meters, flow regulating valves, pressure regulating valves, standard steel open channel etc.

The tested box meter is fixed on the frame in the steel open channel, which is 1.5m wide, 1.5m high, and 12m long.





Box-shaped Ultrasonic Flow Meter for Open Channel World Water

Field testing under canal sediment condition 渠道淤积工况下的现场比测

The field test methodology is to use a rotating current meter to determine the cross-section velocity, and multiplies the distribution area to get the flow rate as reference data. The distribution area is determined by water gauge and the known width of the canal. The accuracy is to be assessed by the cumulative flow rate of meter box through the testing period, to the reference flow rate.

The rotating current meter method is well designed under hydraulic principle and widely applied through China. This field testing is conducted under 《Specifications for water measurement of irrigation canal system》GB/T 21303-2017 and 《Code for measurement of fluid flow in open Channels》GB50179-2015.

Equipment↩	Code⊲	Description ↩
Huashui meter box↩	UPM-X1000↩ ⁻	1000 (width) mm*1000(height)mm, 20 pairs
		of transducers arranged in cross-split level↩
Rotating current meter↩	LS25-3A<⊐	verification certificate within validity period,
		applicable water depth > 16cm, velocity \geq
		0.05m/s↩
Remote terminal unit & meter	TL12↩	4G communication, solar power supply↩
box display⊲		



Box-shaped Ultrasonic Flow Meter for Open Channe World Water Congress



Table 6.3.1.1 Testing data record of meter box under free flow condition				
Date: 25 th March, 2021			Weather: Clear 17℃	
Site: Tuanjie villa	ge, Lailou town, Shay	/a county, Xinjing Uyg	ur Autonomous Regio	on
Recorder: Hu hui	tao		Record date: 25 th M	/larch, 2021
		Meter measured sedimentation		
Hand measured s	edimentation height:	190mm	height: 221mm	
No	Instantaneous	Mater level (rem)	Cumulative flow	Collect time
NO.	flow rate (m ³ /h)	water ievei (mm)	rate (m ³)	
1	417.29	652	658	12:21
2	417.22	645	665	12:22
3	415.93	641	672	12:23
4	412.65	641	679	12:24
5	410.05	641	686	12:25
6	405.20	641	693	12:26
7	383.91	640	699	12:27
8	363.12	638	705	12:28
9	357.90	634	711	12:29
10	340.40	629	717	12:30
11	323.44	626	723	12:31
12	309.28	623	728	12:32
13	291.46	618	733	12:33
Average flow	verage flow Average flow rate=SUM (instantaneous flow rate1:			ow rate1:
rate (m³/s)	0.104	instantaneous flow rate13)/13/3600		



Table 6.3.1.2 Error% comparing under free flow condition↩				
Flow rate calculated by	Average flow rate			
rotating current meter	measured by meter box	error%↩		
method (m³ /s)⊲	(m³ /s)↩			
0.102↩	0.104↩	1.9%↩		
Error = (meter box avg flow – rotating current meter flow)/ rotating current flow*100% ←				

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Testing items & results 测试项目及比测结果

Table 6.3.2.1 Testing data record of meter box under downstream damming condition↩				
Date: 25 th March, 2021↩			Weather: Clear 17℃<-	
Site: Tuanjie village, Lailou town, Shaya county, Xinjing Uygur Autonomous Region⊲				
Recorder: Hu huitao⊲			Record date: 25 th March, 2021⊲	
Hand measured sedimentation height: 190mm		Meter measured sedimentation height: 221mm⊲		
Instantaneous flow		Cumulative flow	Collect time⊲	
NU.	rate (m³ /h)↩		rate (m³)↩	
1↩	285.72↩	711↩	1408↩	15:39↩
2↩⊐	286.57↩	713↩	1413↩	15:40↩
3↩	287.36↩	717↩	1417↩	15:41↩
4↩	283.92↩	720↩	1422↩┘	15:42↩
5↩□	288.02↩	721↩	1427↩	15:43↩
6↩□	289.89↩	721↩	1432↩┘	15:44↩
7↩	287.54	723↩	1436↩	15:45↩
8↩□	283.41↩	725↩	1441↩	15:46↩
9↩□	288.25↩	726↩	1446↩	15:47↩
10↩	286.91↩	728↩	1451↩	15:48↩
11↩	289.61↩	730↩	1455↩	15:49↩
Average flow rate (m³ /s)	Average flow0.079Average flow rate=SUM (instantaneous flow rate1: instantaneous flow rate11)/11/3600			
Table 6.3.2.2 Error% comparing under downstream damming condition⊲				

Table 6.5.2.2 Error % comparing under downstream damming condition				
Flow rate calculated by	Average flow rate			
rotating current	measured by meter	error%↩		
meter method (m³/s)↩	box (m³/s)↩			
0.077<⊐	0.079↩	2.5%←ੋ		
Error = (meter box avg flow – rotating current meter flow)/ rotating current flow*100%				





Box-shaped Ultrasonic Flow Meter for Open Channel



As a newly developed device of flow rate measurement for open channel, meter box has be widely and successfully applied to irrigation districts in China. It has been approved that automatic sediment height identification function and triple water level survey helped to secure the accuracy in real world.

The accuracy of meter box field testing









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Thank you for your attention!

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