Badger Meter Europa GmbH

UFX

Handheld ultrasonic flow meter

USER MANUAL

October 2013

UF_DYN_UFX_BA _02_1310

1. Basic safety recommendations

Before installing or using this product, please read this instruction manual thoroughly.
Only qualified personnel should install and/or repair this product. If a fault appears, contact your distributor.

Installation
Do not place any unit on an unstable surface that may allow it to fall.
Never place the units above a radiator or heating unit.
Route all cabling away from potential hazards.
Isolate from the mains before removing any covers.

Power connection
Use only the type of power source suitable for electronic equipment. If in doubt, contact your distributor. Ensure that any power cables are of a sufficiently high current rating.
All units must be earthed to eliminate risk of electric shock.
Failure to properly earth a unit may cause damage to that unit or data stored within it.

Protection class
The device has protection class IP54 and needs to be protected against dripping water, water, oils, etc.

Setup & operation
Adjust only those controls that are covered by the operating instructions. Improper adjustment of other controls may result in damage, incorrect operation or loss of data.

Cleaning
Switch off all units and isolate from mains before cleaning.
Clean using a damp cloth. Do not use liquid or aerosol cleaners.

Repair of faults
Disconnect all units from power supply and have it repaired by a qualified service person if any of the following occurs:

- If any power cord or plug is damaged or frayed
- If a unit does not operate normally when operating instructions are followed
- If a unit exposed to rain/water or if any liquid has been spilled into it
- If a unit has been dropped or damaged
- If a unit shows a change in performance, indicating a need for service.

⚠ WARNING

Failure to adhere to these safety instructions may result in damage to the product or serious bodily injury.

RoHs
Our products are RoHs compliant.

Battery disposal
The batteries contained in our products need to be disposed of as per your local legislation acc. to EU directive 2006/66/EG.

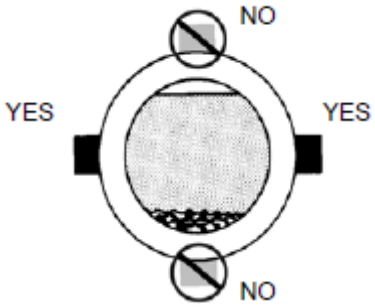
2. Quick-start instructions

This manual contains detailed operating instructions for the UFX instrument. The following condensed instructions are provided to assist an experienced operator in basic operation of the instrument. If the operator is unfamiliar with this type of instrument, refer to the detailed explanations in chapter 5 “controls and terminology”.

Step 1: Select a sensor mounting location at least 10 pipe diameters downstream and 5 diameters upstream of flow disturbances (i.e. elbows, tees, valves, etc.)

Step 1

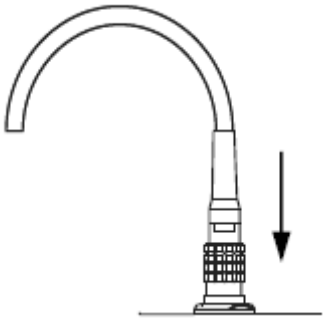
Step 2: On horizontal pipe, choose a sensor mounting location approximately 90 degrees from the top of the pipe.



Step 2

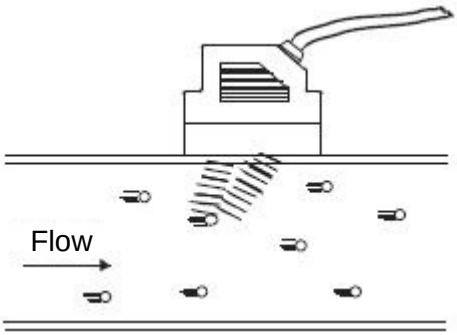
Step 3: Remove rust, scale and paint from the sensor mounting location. Clean to bare metal. Plastic pipes do not require preparation.

Step 4: Plug the sensor plug into the sensor jack.



Step 4

Step 5: Apply approximately 3 mm [$^1/_8$ inch] silicone grease to the sensor face. Place the sensor face on the prepared area of pipe. Hold the sensor parallel to the pipe with the cable pointing downstream of the flow direction.



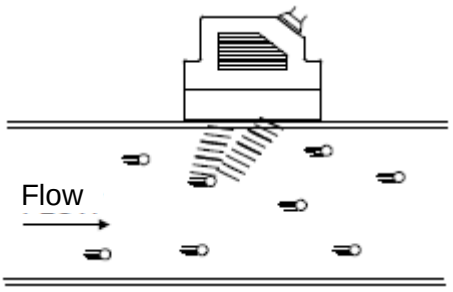
Step 6: Press the ON/OFF key. Wait at least 30 seconds before recording a reading. The UFX will automatically turn itself off after 3 minutes.

Step 7: Change units of measure by pressing the FT/SEC - M/SEC key.

3. Introduction and operating theory

Series UFX phase shift flow meters feature advanced trans-phase measuring technology, providing accurate and reliable flow velocity assessments in closed piping systems. The UFX utilizes a non-invasive sensor which is handheld or strapped to the outside of a pipe. Within seconds, the large 18 mm [0.7 inch] LCD provides stable readings in either ft/s (feet per second) or m/s (meters per second). This product is designed to operate on metal, plastic or rubber pipes containing liquids with greater than 100 ppm of suspended solids or entrained gases that act as reflectors.

Phase shift flow meters utilize two piezoelectric crystals contained within one sensor to transmit ultrasonic sound energy into the fluid stream and receive reflected sound from reflectors (suspended solids or entrained gases) within the liquid. See figure below. In accordance with the theories of Christian Johann Doppler (circa 1842), if the liquid is moving (and therefore carrying the reflectors with it) and oscillating energy is imposed on the moving reflector, the reflected energy's frequency of oscillation will be altered with respect to the transmitted frequency. The magnitude of frequency change is directly proportional to the velocity of the reflector.



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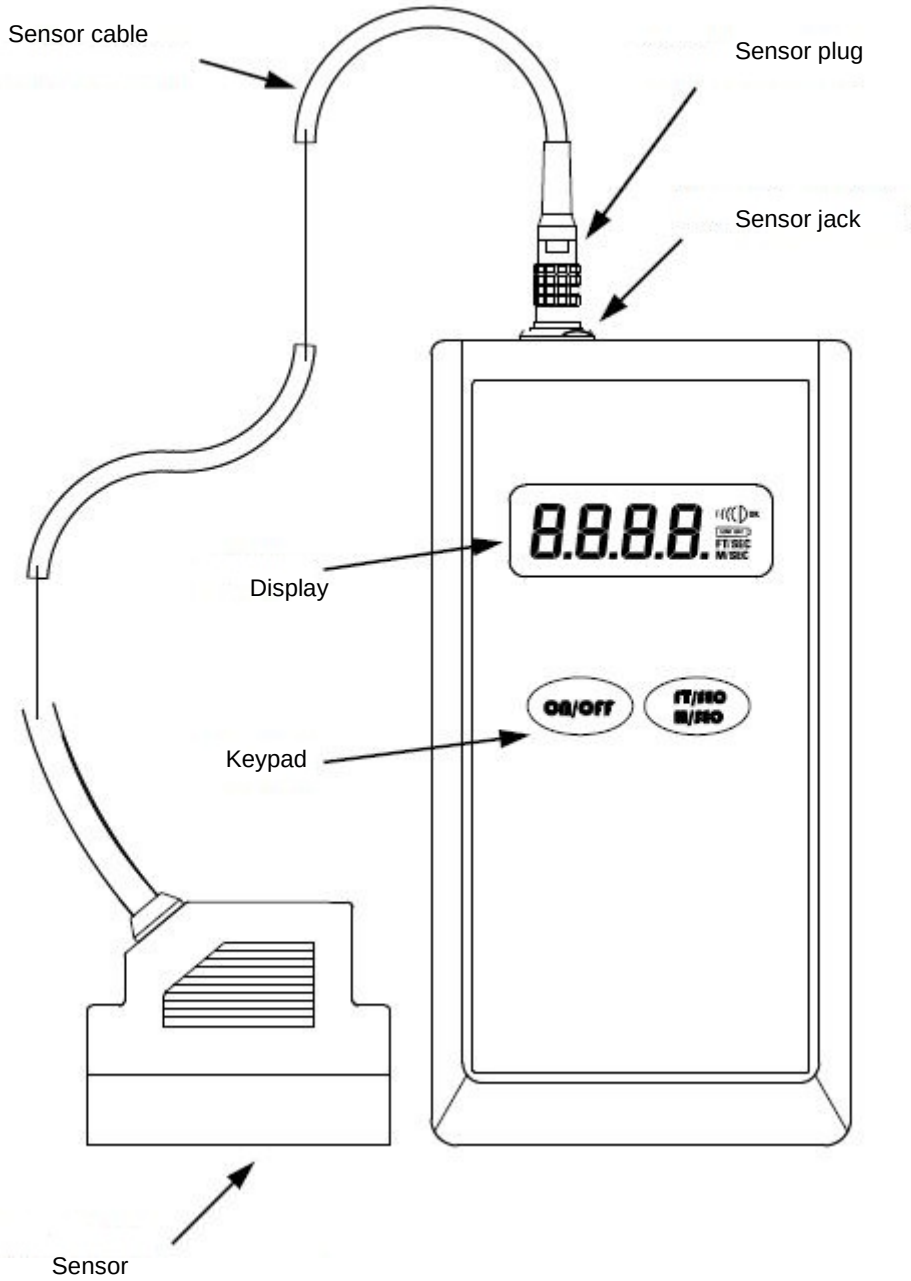
4. Technical data

Description	Specification
Power	Four AA alkaline cells provide over 30 hours of operation
Flow range	0.10 to 9.00 m/s [0.30 to 30.00 ft/s]
Temperature	Electronics: -20 °C to +60 °C [-28 °F to +140 °F] Sensor: -40 °C to +80 °C [-40 °F to +180 °F]
Enclosure rating	NEMA 12X, splash resistant
Accuracy	±2% full scale
Sensor mount	Handheld (clamp-on), utilize acoustic couplant such as DOW 111

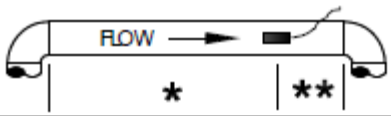
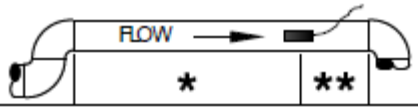
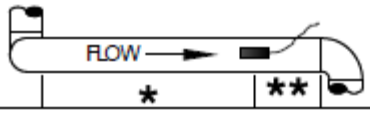
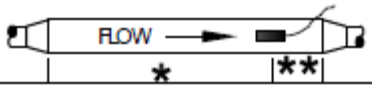
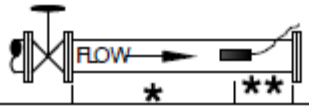
5. Controls and terminology



Note: The UFX battery compartment is located on the back of the enclosure. Remove the two upper screws to gain access to the battery compartment.

5.1 Sensor location

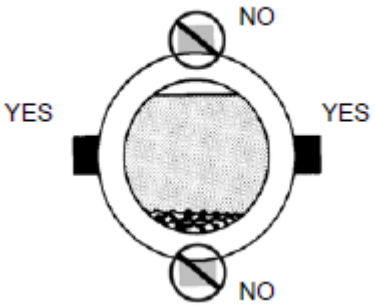
Selecting the proper location for taking a flow measurement is the single most critical step in the operational procedure. The sensor utilized by the UFX flow meter contains two piezoelectric crystals for transmitting and receiving ultrasonic signals through the wall of a pipe. Select a sensor location with adequate straight runs (without flow disturbances) of pipe, both upstream and downstream, to achieve stable and accurate readings. Examples of common piping configurations and the recommended minimum upstream and downstream pipe lengths are included in table below.

	Upstream dimensions	Downstream dimensions
Piping configuration and sensor position	Pipe diameter	Pipe diameter
	*	**
	9	3
	14	3
	24	4
	8	3
	8	3
	24	4

Note: If adequate straight plumbing cannot be provided, the UFX will operate repeatable, but will most likely not achieve ideal accuracy.

5.2 Mounting locations on the pipe

If the sensor is applied to horizontal pipe, choose a mounting position at approximately 3 o'clock or 9 o'clock, assuming 12 o'clock to be to top of the pipe. These positions typically provide optimum acoustic penetration into the moving liquid. As illustrated in figure below, placement at the top or bottom of the pipe can result in poor sound penetration due to air pockets (on the top of the pipe) or sediment (at the bottom of the pipe). If the sensor is applied to vertical pipe, orientation does not matter.



5.3 Pipe preparation

Before the sensor face can be coupled to a pipe surface, an area slightly larger than the flat surface of the sensor must be cleaned to bare metal on the pipe. Remove all scale rust and paint. Thoroughly dry and clean the mounting surface.

Note: For plastic pipes, such as PVC or PVDF, pipe preparation is typically not required.

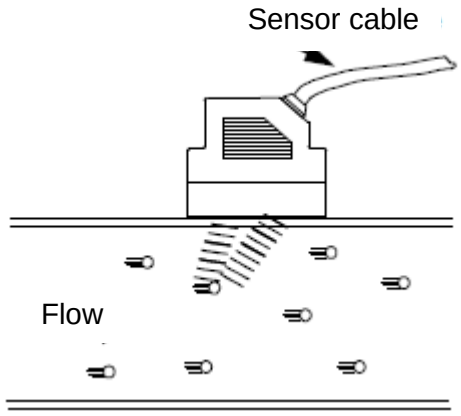
5.4 Connecting the sensor

Connect the sensor plug into the sensor jack. The connection is polarized, so alignment of the keyway is necessary.

Note: The splash-resistant environmental seal is provided only when the sensor plug is secured into the sensor jack. It is advisable to make this connection before entering an area where the UFX may be dropped into or splashed with liquid.

5.5 Applying the sensor

To ensure an acoustically conductive path between the sensor face and the prepared pipe surface, a coupling compound is employed. Enclosed with the UFX flow meter is a tube of Dow Corning 111 silicone based grease. This grease is adequate for the majority of installations. If an alternate grease is utilized, the grease must be specified not to flow at the temperature of the pipe surface or the ambient conditions.
Apply an even layer of grease, sensor cable approximately 1/8" (3 mm) thick to the flat surface of the sensor. Place the sensor on the prepared area of the pipe, with the cable pointing downstream. See figure below. Align the sensor with the pipe, ensuring that it is parallel with the pipe wall. Apply only enough pressure to hold the sensor in place. If no reading is shown, perform a “rub test” by rubbing thumb across the dry sensor head. The zeros should display a low flow reading. See Troubleshooting Guide for further recommendations.



5.6 Optaining a reading

Press the ON/OFF key on the keypad. On power up, the UFX performs internal diagnostics and starts the ultrasonic transmitter. The display will read Hold for approximately 5 seconds during this time. If the sensor is properly mounted to a pipe containing flowing liquid with at least 100 ppm of 100 micron or larger particles or entrained gases, the display will begin to indicate velocity. The default units of measure are FPS (feet per second). The response time of the UFX is approximately 10 seconds to obtain a reading. Adequate signal strength is obtained when the OK icon appears in the upper right corner of the display. See figure below. Readings taken without this icon present may be erroneous. It is recommended that survey readings of at least 30 seconds be taken to ensure reading stability.

The UFX can be turned off by pressing the ON/OFF key on the keypad, or the unit will automatically turn off after approximately 3 minutes of operation.

5.7 Changing units of measure

Toggle between ft/s (feet per second) and m/s (meters per second) by depressing the FT/SEC M/SEC key on the keypad.

5.8 Conversion from velocity to volume

The velocity readings taken from the UFX can be readily converted to volumetric flow rate measurements such as gal/min (gallons per minute) or l/m (liters per minute). Refer to the "Liquid velocity" to volume conversions chart" in chapter 7 for conversions of schedule 40 pipe sizes. If the pipe size is not located in this chart, use the following equations:

- For conversion to LPM (pipe I.D. in millimeters):
  l/m = m/s x 0.047 x I.D.^{2}
- For conversion to GPM (pipe I.D. in inches):
  gal/min = ft/s x 2.448 x I.D.^{2}

5.9 Low battery indication

When the power supply batteries become drained to a level of 4 volts, the LOW BAT icon will illuminate on the right-hand side of the display. Typical alkaline batteries will provide about 2 hours of operation after the LOW BAT icon turns on. The flow meter will no longer operate when battery voltage is less than 3.5 volts. At 3.5 volts and lower, an Err1 will be displayed and then unit will shut off.

Replace the batteries by removing the two screws located on the upper portion of the enclosure back. Install four fresh AA alkaline batteries following the polarity indicated within the battery compartment and replace the battery cover. A fresh set of alkaline batteries will provide approximately 30 hours of service. Use of carbon-based batteries is not recommended.

Do not allow discharged batteries to remain in the UFX during storage. Discharged batteries can leak and may cause severe damage to the internal circuits of the UFX. **Damage caused by leaking batteries will not be covered under the manufacturer's warranty.**

5.10 Display test

The UFX contains software to verify operation of the individual LCD segments. To run the display test, turn the UFX off. Press and hold the ft/s - m/s key, then press the ON/OFF key. Release both keys and verify that all segments illustrated in figure of chapter 5.6 "Optaining a reading", illuminate. The UFX firmware version number (FX.XX) is displayed at the end of the test.

6. Troubleshooting guide

Unit does not turn “ON” when ON/OFF key is pressed	Verify that batteries are installed and contain a charge.
“Err1” is indicated	The batteries must be replaced.
No display readings are obtained and no “OK” icon is observed	• Poor acoustic coupling to pipe. Apply silicone grease to sensor. • Ensure pipe is full of a flowing liquid. • If the pipe has a plastic liner, move the sensor to another location. The liner may contain an air void. • Non-working sensor. Rub sensor head with thumb for reading. • Liquid contains less than 3% total suspended solids. • Move sensor closer to a source of flow disturbance (i.e. an elbow, pump outlet or Control valve).
Dashes appear on display	Liquid velocity is greater than 9 m/s (30 ft/s).
Readings are obtained, but the “OK” icon does not turn on.	Signal strength is low. Flow readings may be erroneous. Move the sensor closer to a source of hydraulic disturbance.
Erroneous readings	• Sensor mounted incorrectly. • Another local ultrasonic instrument is operating at approximately the same frequency as the UFX. • Excessive pipe vibration. • Very viscous (thick) liquids will cause the unit to read lower than actual flow. • The pipe is not completely full of liquid.

7. Liquid velocity to volume conversion chart

Dynasonics®		ft/s to gal/m cross-reference (schedule 40)							
Nom. Pipe size	**I.D. inch**	**1**	**1½**	**2**	**2½**	**3**	**3½**	**4**	**4½**
1	1.05	2.6989	4.4084	5.3978	6.7473	8.097	9.4462	10.796	12.145
1¼	1.38	4.662	6.9929	9.3239	11.655	13.99	16.317	18.648	20.979
1½	1.61	6.3454	9.5182	12.691	15.864	19.04	22.209	25.382	28.555
2	2.07	10.489	15.734	20.979	26.224	31.47	36.713	41.958	47.202
2½	2.47	14.935	22.402	29.87	37.337	44.8	52.272	59.74	67.207
3	3.07	23.072	34.608	46.144	57.68	69.22	80.752	92.288	103.82
3½	3.55	30.851	46.276	61.702	77.127	92.55	107.98	123.4	138.83
4	4.03	39.758	59.636	79.515	99.394	119.3	139.15	159.03	178.91
5	5.05	62.43	93.645	124.86	156.07	187.3	218.5	249.72	280.93
6	6.06	89.899	134.85	179.8	224.75	269.7	314.65	359.6	404.55
8	7.98	155.89	233.83	311.78	389.72	467.7	545.61	623.56	701.5
10	10.02	245.78	368.67	491.56	614.45	737.3	860.23	983.12	1106
12	11.94	348.99	523.49	697.99	872.49	1047	1221.5	1396	1570.5
14	13.13	422.03	633.04	844.05	1055.1	1266	1477.1	1688.1	1899.1
16	15	550.8	826.2	1101.6	1377	1652	1927.8	2203.2	2478.6
18	16.88	697.52	1046.3	1395	1743.8	2093	2441.3	2790.1	3138.8

	ft/s to gal/m cross- reference (schedule 40)								
Nom. Pipe size	**5**	**5½**	**6**	**6½**	**7**	**7½**	**8**	**8½**	**9**
1	13.49	14.844	16.19	17.54	18.89	20.24	21.59	22.941	24.29
1¼	23.31	25.641	27.97	30.3	32.63	34.96	37.3	39.627	41.958
1½	31.73	34.9	38.07	41.25	44.42	47.59	50.76	53.936	57.109
2	52.45	57.692	62.94	68.18	73.43	78.67	83.92	89.16	94.405
2½	74.67	82.142	89.61	97.08	104.5	112	119.5	126.95	134.41
3	115,4	126.9	138.4	150	161.5	173	184.6	196.11	207.65
3½	154.3	169.68	185.1	200.5	216	231.4	246.8	262.23	277.66
4	198.8	218.67	238.5	258.4	278.3	298.2	318.1	337.94	357.82
5	312.1	343.36	374.6	405.8	437	468.2	499.4	530.65	561.87
6	449.5	494.45	539.4	584.3	629.3	674.2	719.2	764.14	809.09
8	779.4	857.39	935.3	1013	1091	1169	1247	1325.1	1403
10	1229	1351.8	1475	1598	1720	1843	1966	2089.1	2212
12	1745	1919.5	2094	2268	2443	2617	2792	2966.5	3141
14	2110	2321.1	2532	2743	2954	3165	3376	3587.2	3798.2
16	2754	3029.4	3305	3580	3856	4131	4406	4681.8	4957.2
18	3488	3836.3	4185	4534	4883	5231	5580	5928.9	6277.7

8. Return of goods for repair

Please copy, fill in and sign hereafter harmlessness declaration and enclose it for any return of goods you may send back for repair.

No repair will be performed prior to receiving the harmlessness declaration duly filled and signed.

Harmlessness declaration

To : _____

Attn. : _____

From : _____

Dept. : _____

Please note that no repair will be performed prior to receiving of this declaration duly signed by you!

Please send all parts clean from medium and inform us about possible medium wastes remaining in the part. For this purpose, please use this form. A security specification sheet of the medium must accompany this declaration in the following cases: Toxical, dangerous or objectionable media, or media belonging to any dangerous materials class. We inform you that uncleaned parts lead to additional costs. Extra clean costs will be charged to you.

Declaration

We herewith confirm that the part(s) sent for repair has/have been cleaned and is/are free of any liquid and/or solid wastes of the medium and/or cleaning medium: Any eventually remaining wastes are:

❍ harmless

❍ dangerous, toxic, etc. – Security specifications are attached

Signature of person in charge: _____

Name of the person in charge in capital letters: _____

Date: _____

Company stamp: _____

Hotline

Tel: +49-7025-9208-0
Fax: +49-7025-9208-15
E-Mail: badger@badgermeter.de

Badger Meter Europa GmbH
Subsidiary of Badger Meter, Inc.

Nürtinger Strasse 76
72639 Neuffen (Germany)
E-Mail: badger@badgermeter.de
www.badgermeter.de