SBWI

THE OPEN INDUSTRY STANDARD FOR
INDUCTIVE METER READING PADS

Issue One

8/8/2000

Uncontrolled Copy

Contents

1 Introduction

1.1 The Society of British Water Industries (SBWI)

The Society of British Water Industries was formed in 1986 to represent the interests of UK manufacturers and contractors who supply the Water Supply Industry.

Its main aim is to monitor developments within the industry, provide a forum for communication with Government, Regulators and other industry bodies, encourage and develop liaison with the water suppliers and to keep members informed on issues that may affect their operations.

The Society is recognised and respected throughout the industry.

1.2 The SBWI Metering Group

The SBWI Metering Group was established in December 1998 as a sub-group within the Pipeline Equipment Section, now the Contractors and Suppliers Technical Section. The aim of the group is to advance the common interests of all stakeholders in the UK water metering industry by promoting:

- Open standards, product interchangeability and innovation
- Process and practice improvement and
- Long term planning in the water metering industry

The members of the SBWI Metering Group are:

- ABB Kent Meters

- Invensys Metering Systems and
- Schlumberger Water Metering

1.3 Urgent need for a pad standard

With over 1.5 million households expected to opt for an internal meter installation over the next five years, the need for a standard remote reading pad has never been greater.

Although the benefits of inductive meter reading are widely understood, some water companies have been reluctant to invest in manufacturer's proprietary systems because they did not want to commit themselves to one meter supplier for the life of the reading equipment.

This new standard for an interchangeable device will allow all industry participants – suppliers and utilities alike – to benefit from an open systems approach to meter reading.

Interchangeability of meters, pads and reading probes will enable water companies to enjoy the fruits of competition in metering product supply long after the original meter reading system has been installed.

1.4 Relationship with other standards-making channels

The SBWI Metering Group's members support the development of national, European and international standards. However, the group also recognises an industry need for fast track development of open standards or technical agreements in areas where technology progress and market growth outpace the conventional standards-making processes.

1.5 How to obtain copies of this standard

Requests for copies of this standard or for more information should be made to the Metering Group, Society of British Water Industries, 38 Holly Walk, Leamington Spa, Warwicks CV32 4LY.

1.6 Document control

This open standard will be available in both uncontrolled and controlled formats.

The uncontrolled version will be made available free-of-charge on the SBWI web-site: www.sbwi.co.uk. This version will be maintained in-line with the current issue but any downloaded copies will be uncontrolled.

The SBWI Metering Group will manage the controlled version with administrative support from the staff at Leamington Spa. The procedures for managing document control will be in accordance with BS EN ISO 9000. A small charge will be made for controlled copies to cover the administration costs.

2 Scope

This standard applies to inductive meter-reading pads for use with encoded and electronic meters in the UK Water Industry. Both wall-mounted and pit lid-mounted versions are covered.

3 Objectives of the open industry standard initiative

- To develop a simple, low cost, pad design standard that will function efficiently and reliably with all the major encoded meters and inductive reading probes

· To build-in features that eliminate the risk of wiring errors in installation.

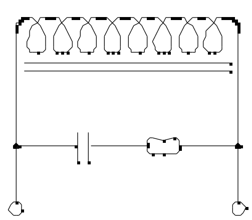
· To leave scope for future innovation in encoded meter functionality.

4 Pad design requirements

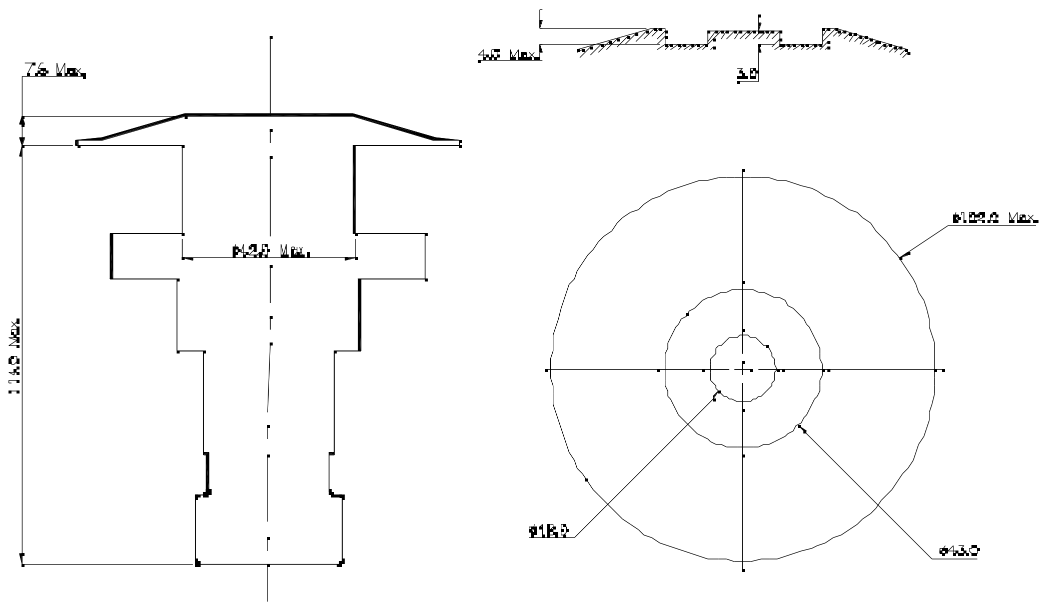
The pad design shall conform to the outlines given in 4.1 and 4.4, and the detail design requirements shown in 4.2 and 4.3.

4.1 Design outline – introductory schematic

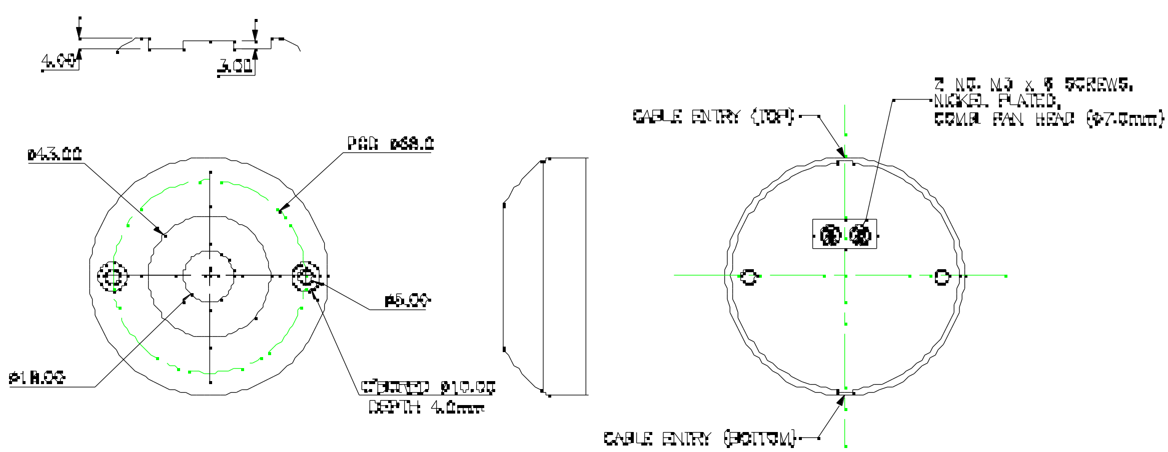
The capacitor and resistor shall be in series and form a parallel circuit across the coil and ferrite, as shown in the schematic diagram below.



4.2 Design detail – pit-pad version



4.3 Design detail – wall-pad version



4.4 Location of components within housing

The coil, ferrite core, electronic components and screw terminals shall be fully contained and potted within a moulded housing.

5 Pad performance requirements

A sample batch of five pads shall be selected at random from a population that is representative and typical of normal volume production. Each of the five pads shall be subjected to the following performance tests. The pads must perform within the specified limits irrespective of rotational alignment. The respective test methods and test equipment requirements are listed in Appendices A, B and C.

5.1 D.C. resistance across pad terminals (R)

The d.c. resistance across the pad terminals shall be 8.6Ω s +/- 0.2Ω.

5.2 Resonant frequency of pad

The resonant frequency of the pad when measured at the terminals shall be 25.5 kHz +/- 1.5 kHz.

5.3 Quality factor

The quality factor is defined as the ratio between the voltage at the Resonant Frequency and the 3db voltage points (3db equates to 0.707 of $V_{Resonance}$).

The quality factor shall be 4 +/- 0.2.

5.4 Voltage transfer - standard load

The voltage transfer ratio at the resonant frequency +/- 4 kHz shall be 2.3 +/- 0.3.

5.5 Voltage transfer - no load

The voltage transfer ratio at the resonant frequency shall be 5.25 +/- 0.75.

The voltage transfer ratio at the resonant frequency +/- 4 kHz shall be 3.5 +/- 0.75.

5.6 Phase Alignment – standard load

The phase lag of the pad under test shall be 90 degrees +/- 10 degrees.

The phase lag at 10 kHz shall be between 0 and 5 degrees.

5.7 Water exposure and immersion

Wall-pads shall meet the requirements 5.1 to 5.6 after exposure to water in accordance with specification BS EN 60947 – 1 1999 Annex C (clause 6 of IEC 60529), IP44.

Pit-pads shall meet the other requirements 5.1 to 5.6 after immersion in water at a depth of 1m for a period of 24 hours in accordance with specification BS EN 60947 – 1 1999 Annex C (clause 6 of IEC 60529), IP68.

5.8 Cold impact

Wall-pads shall meet the requirements 5.1 to 5.7 after exposure to cold impact in accordance with Appendix A8.1.

Pit-pads shall meet the requirements 5.1.1 to 5.1.7 after exposure to cold impact in accordance with Appendix A8.2.

There shall be no evidence of fracture in the outer casing of the pads after the cold

6 Installation guidance

6.1 Location of wall-pads

A wall-pad shall be fixed to a convenient vertical surface on the metered property, near the public highway and such that it:

- Will not expose meter readers and/or pedestrians to any health or safety hazard.
- Is readily accessible to meter readers without customer assistance or contact.
- Is ideally at a height of 1.3m from the ground.
- Is away from routes of rainwater drainage and dampness.
- Is away from drainpipes and other structures that might impede access.
- Is fitted in accordance with the IEE Wiring Regulations 16th Edition.

6.2 Location of pit-pads

A pit-pad shall be fitted to a meter box cover with a suitable clearance hole.

6.3 Fixings for wall-pads

Wall-pads shall be fixed using two suitable M4 screws (not countersunk) in combination with appropriate fixing plugs for the chosen surface, in accordance with the manufacturers' instructions.

6.4 Cable installation

The cable shall be connected to the meter and pad in accordance with the manufacturer's instructions and the IEE Wiring Regulations 16th Edition.

The minimum length of cable run shall be 1m.

The maximum length of cable run shall be 100m.

7 Conditions of use

7.1 Reading probe operating frequencies

This standard ensures that conforming pads operate over a range of frequencies from 10 to 30 kHz. This range covers the popular types of reading probe in use at the time this open industry standard was developed.

7.2 Contact and misalignment with reading probes

To optimise reading performance, the probe shall be in full contact with pad and the central axes of the probe and pad shall be aligned.

Appendix A - Test methods

A.1 d.c. resistance across pad terminals

Measure d.c. resistance directly across the pad terminals using a resistance meter (or multi-meter) to an uncertainty of less than 0.01Ω.

A.2 Resonant frequency of pad

Apply a signal generator having an output impedance of 50R to pad terminals via a series 10kΩ, 0.1% non-inductive resistor. Set the signal generator to provide a 1 +/- 0.01 Vrms sinewave output. Ensure the output amplitude of the signal generator does not vary by more than 0.1% over the frequency range 10kHz to 30kHz.

Attach an RMS volt-meter directly to pad terminals. Adjust the signal generator frequency until a maximum value is obtained on the volt-meter (F –Resonance). Note both the frequency and the output voltage. Measure the voltage to an uncertainty of less than 0.01V and the frequency to an uncertainty of less than 0.01kHz.

A.3 Quality factor (Q)

This is a measure of the "width" of resonance. Using the procedure in A.2, re-establish the RMS value at resonance. Determine the frequency points 3db either side of resonance. These are defined as the frequencies at which the voltage is 0.707 of the value at resonance. To calculate the 3db bandwidth, subtract the lower frequency from the upper frequency. The value for Q is then defined as the resonant frequency divided by the frequency bandwidth, $Q = F_{Resonance} / F_{3dB\ Bandwidth}$.

A.4 Voltage transfer - standard load.

Connect the Standard Test Nozzle (see Appendix C) directly to the output of the signal generator. Connect a 3.3kΩ 0.1% non-inductive resistor across the pad terminals. Connect the RMS volt-meter to the pad terminals. Set the signal generator to give an output of 1 +/-0.01 Vrms when connected to the nozzle.

Position the Standard Test Nozzle so that it is axially aligned and in full contact with the pad under test. Establish the new resonant frequency of the nozzle/pad combination. This is achieved by adjusting the signal generator frequency until a maximum reading is obtained on the volt-meter. This new resonance will be higher than that obtained in A2.

Record both the resonant frequency and RMS voltage.

The transfer ratio is the output voltage divided by the 1Vrms input voltage at resonance. Repeat the above measurements with the signal generator set to the resonant frequency +4kHz, and at the resonant frequency –4kHz.

A.5 Voltage transfer – no load.

Repeat the procedure in A.4, but without the 3.3kΩ load resistor.

A.6 Phase alignment – standard load.

Connect the equipment as in A.4. Using a dual trace oscilloscope, connect the first probe to the output of the signal generator, and the second probe to the output of the pad under test. With the signal generator set to 10kHz, measure the time delay between input waveform and the output waveform. If the signals are approximately 180 degrees out of phase, swap the connections to the pad under test. The signals should now be approximately in phase. Measure the time difference (Δt) between the input waveform and the output waveform. The phase difference (ΔPhase) is calculated using the formula:

$$\Delta Phase = 360\Delta t / t_{iw}$$

Where t_{iw} = The period of the input waveform (100μsec at 10kHz).

Record ΔPhase for 10kHz testing.

Adjust the signal generator to the resonant frequency determined in A.4. Perform the same measurements for time difference (Δt) and input waveform period (t_{iw}) as above (noting that the latter will have changed from 100μsec), and repeat the ΔPhase calculation.

Record ΔPhase for the resonant frequency determined in A.4.

A.7 Cold impact testing of wall-pads

One wall-pad sample shall be tested according to the following procedure.

The wall-pad sample shall be mounted on one side of a standard house brick in accordance with the manufacturer's instructions.

The wall-pad and brick assembly shall be stabilised at a temperature of –25^{o}C (+/-3^{o}C) for a period of at least 4 hours and the following test shall take place within 60 seconds of removal from the cold environment.

The wall-pad and brick assembly shall be placed on a flat, rigid, horizontal surface with the pad facing upwards. A round steel ball having a mass of 1kg (+/-5g) shall be dropped freely from a height of at least 1m via a suitable guide tube, directly onto the central axis (+/- 5mm) of the exposed surface of the wall-pad.

A.8 Impact testing of pit-pads

One pit-pad sample shall be tested according to the following procedure.

The pit-pad sample shall be mounted within a typical meter box cover in accordance with the manufacturer's instructions.

The pit-pad and meter box cover assembly shall be stabilised at a temperature of –25^{o}C (+/-3^{o}C) for a period of at least 4 hours and the following test shall take place within 60 seconds of removal from the cold environment.

The pit-pad and meter box cover assembly shall be placed on a suitable flat, rigid, horizontal surface with the pad facing upwards such that the rear protrusion of the pad is in free space. A steel ball having a mass of 1kg (+/-5g) shall be dropped freely from a height of at least 2m via a suitable guide tube, directly onto the central axis (+/-5mm) of the exposed surface of the pad.

Appendix B – Test equipment

B.1 Standard test load

The standard test load shall be a non-inductive resistor 3.3kΩ 0.1% 15ppm 0.25W.

B.2 Signal generator

The signal generator shall have an output impedance of 50Ω with fine frequency control and an uncertainty of less than 100Hz at 25kHz and resolution of 100Hz.

B.3 Oscilloscope

An oscilloscope with two channel inputs and a bandwidth of greater than 20MHz shall be used to take test measurements. The test probes must have input impedance of 10M Ω.

B.4 Resistance meter

The resistance meter shall be non-inductive. It shall have a 0.01Ω resolution and an uncertainty of less than 0.01Ω.

B.5 RMS voltmeter

The voltmeter shall be a true RMS Voltmeter with an uncertainty of less than 0.01Vrms and a resolution of 10 to 30 kHz.

B.6 Source resistor

The source resistor shall be non-inductive with a value of 10kΩ 0.1% 15ppm 0.25W.

B.7 Calibration

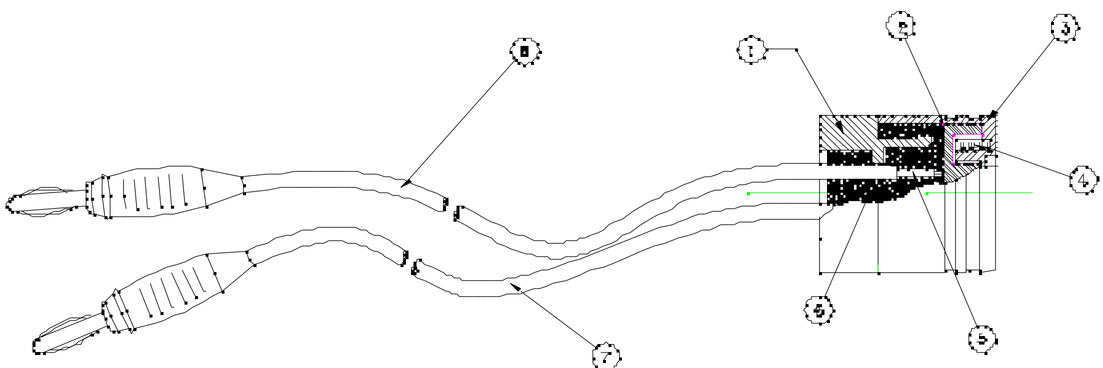
All test and measuring equipment used to examine products against this standard shall be correctly calibrated and all such calibration shall be traceable to national measurement standards. The frequency of calibration shall be appropriate to the specific item of equipment. Documentation shall be maintained to show when, where and how each item of equipment was last calibrated, by whom and when re-calibration is due.

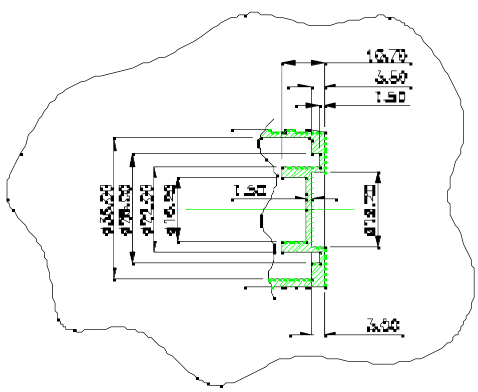
Appendix C - Standard Test Nozzle

C.1 General Assembly

The Standard Test Nozzle is a coil winding and ferrite component housed in a plastic sub-assembly. A pair of screw terminals allows for connection to the signal generator and for the monitoring of signals.

The general assembly of the Standard Test Nozzle is shown below.

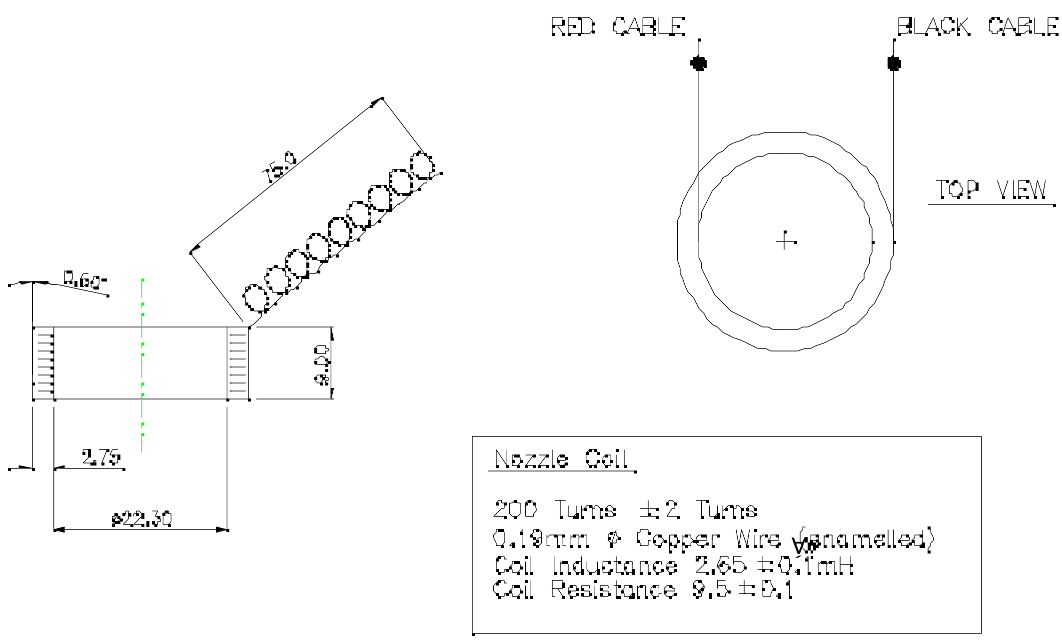




PART No.	DESCRIPTION
1	NOZZLE INSERT
2	FERRITE
3	NOZZLE
4	COIL
5	HEATSHRINK
6	POTTING COMPOUND
7	0.5m CABLE (RED)
8	0.5m CABLE (BLACK)

C.2 Coil Specification

The parameters of the coil are specified below:



C.3 Ferrite Component

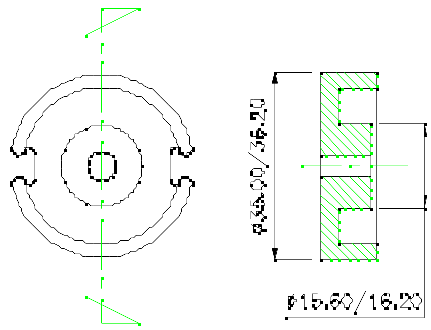
The parameters of the ferrite component are specified below:

Phillips Soft Ferrite

P Core (IEC 133)

Core type:	P36/22
Core material:	3C85
Gap type:	Asymmetrical (1.1mm)
A_L Value (nH):	250
	(P36/22 – 3C85 – A 250)

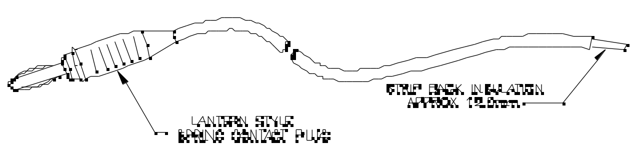
The dimensions of the ferrite component are shown below.



C.4 Silicone test leads

The parameters for the silicone test leads used with the Standard Test Nozzle are shown below:

Type:	Low voltage 4mm silicone test lead terminated at one end with a lantern-style spring contact plug.
Rating:	10A
Length:	0.5m
Colour:	One black, one red
Suggested supplier:	RS Components Part No. 488-416



C.5 Procurement of Standard Test Nozzles

An approved batch of Standard Test Nozzles shall be held by the SBWI and made available for hire or purchase to applicants for the purpose of product development and examination.