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USERS' MANUAL

JACKOUT PRESSURE CELL

VIBRATING WIRE TYPE

MODEL EPS-30V-J

Doc. # WI 6002.35 R03 | May 2019

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1 INTRODUCTION

The rheology of soil/rock formations is a complex function of soil/rock type, stress history, shear and normal stress levels, boundary and drainage conditions and many other environmental effects. The accurate assessment of stress in foundation soil/rock formations and their changes caused by construction and loading is important for good engineering design. In any instrumentation scheme for geo-technical or geo-structural study associated with large civil engineering structures like tall buildings, dams, underground tunnels etc., measurement of stress plays a very important part. Encardio-rite manufactures a range of instruments for the measurement of stress, including sensors, readout unit and data logger.

The study of stress fall into two basic categories:

- Measurement of total stress at a point within a soil mass/mass concrete/foundation rock.
- Measurement of contact stress against the face of a structural element like a diaphragm wall.

The development of a range of vibrating wire pressure cells introduced a reliable and fast method of taking stress readings electrically. The cable is carried from the pressure cell to the read out unit or data logger and is protected against any possible damage during construction to give all around reliable data.

Encardio-rite jackout pressure cell is the electrical sensor of choice as frequency output of vibrating wire sensor is almost immune to external noise, it is able to tolerate wet wiring conditions common in geotechnical applications and is capable of transmission of signals to long distances. It has applications in measurement of stresses in soil, concrete mass, soil concrete interface or foundation rock including:

- Measurement of total soil pressure on back side of a slurry or diaphragm wall.
- Total stress on and within liners of underground excavations as input to improve design and construction practices.
- Magnitude, orientation and distribution of principal stresses within embankments and dams as input to improve design and construction practices
- Total stress for studying soil/structure interaction behaviour

In this manual, the use of the jack-out pressure cell to measure the total soil pressure on the backside of a slurry wall is described. For other applications, the user is expected to modify the installation procedure according to his needs and requirement.

The Encardio-rite jack-out pressure cell basically consists of a flexible, circular flat capsule, constructed from two stainless steel discs welded around the periphery and connected to a specially designed Encardio-rite vibrating wire pressure transducer. The whole system is fluid filled. The vibrating wire pressure transducer incorporates the latest vibrating wire technology to provide remote digital readout.

This user's manual covers description of the vibrating wire jack-out pressure cell with its connected accessories, the operating principle, the installation procedure, method of taking observations and recording the data from the sensor.

1.1 Conventions used in this manual

WARNING! Warning messages calls attention to a procedure or practice, that if not properly followed could possibly cause personal injury.

CAUTION: Caution messages calls attention to a procedure or practice, that if not properly followed may result in loss of data or damage to equipment.

NOTE: Note contains important information and is set off from regular text to draw the users' attention.

1.2 How to use this manual

This users' manual is intended to provide sufficient information for making optimum use of jackout pressure cell in your application. This users' manual covers description of the stress cell with its connected accessories, the installation procedure and maintenance of the sensor, method of taking observations and recording data from the sensor.

NOTE: The installation personnel must have a background of good installation practices and knowledge of the fundamentals of geotechnics. Novices may find it very difficult to carry on installation work. The intricacies involved in installation are such that even if a single essential but apparently minor requirement is ignored or overlooked, the most reliable of instruments will be rendered useless.

A lot of effort has been made in preparing this instruction manual. However the best of instruction manuals cannot provide for each and every condition in the field that may affect the performance of the sensor. Also, blindly following the instruction manual will not guarantee success. Sometimes, depending upon field conditions, installation personnel will have to consciously depart from the written text and use their knowledge and common sense to find the solution to a particular problem.

To make this manual more useful, we invite your valuable comments and suggestions regarding any additions or enhancements. We also request you to please let us know of any errors that you may find while going through this manual.

This users' manual is intended to provide you with sufficient information for making optimum use of vibrating wire stress cell in your applications.

To make this manual more useful we invite your valuable comments and suggestions regarding any additions or enhancements. We also request you to please let us know of any errors that you may find while going through this manual.

The manual is divided into a number of sections. Each section contains a specific type of information.

The list given below tells you where to look for in this manual if you need some specific information.

For an insight into the jack-out pressure cell: See § 2 'Vibrating wire jack-out pressure cell'.

For complete operating procedure of Vibrating Wire readout unit EDI-54V: See Doc. # WI 6002.112'

For essential tools and accessories: See § 3 'Tools and accessories required for installation'.

For installation of jack-out pressure cells: See *§* 4 'Installation procedure'.

For temperature measurement by thermistor: See § 5 'Thermistor - temperature resistance correlation'.

For trouble shooting: See § 6.3 'Trouble shooting'.

2 VIBRATING WIRE JACK-OUT PRESSURE CELL

2.1 Introduction

The Encardio-rite jack-out pressure cell is also called total pressure cell or total stress cell. It measures stress in soil or pressure of soil on structures. Cells will respond not only to soil pressure but also to ground water pressure or to pore water pressure; hence the term total pressure or total stress. A simultaneous measurement of pore water pressure (ρ), using a piezometer, is necessary to separate the effective stress (σ) from the total stress (σ_t) as defined by Terzaghi's principle of effective stress:

$$\sigma_t = \sigma + \rho$$

These parameters coupled with the soil strength characteristics will determine soil behaviour under load.

2.2 General description

2.2.1 Flat stress capsule

The flat pressure capsule is 14 mm thick and has a diameter of either 200 mm or 125 mm. It is constructed from two stainless steel plates welded together around the periphery so as to leave a narrow space between them. This space is completely filled with de-aired fluid and connected hydraulically to a pressure sensor. The sensor has an all welded construction such that space confining the hydraulic fluid is entirely metal, not requiring 'O' rings that tend to trap air and reduce cell stiffness. The hydraulic fluid is de-aired which materially improves fluid stiffness and performance of cell.

2.2.2 Pressure sensor

The pressure sensor constitutes of a vibrating wire and coil magnet assembly enclosed in a stainless steel body which is electron beam welded to the diaphragm. This results in a vacuum of 1/1000 Torr inside the sensor making it completely immune to the effect of any ingress of water. As the pressure sensor is of stainless steel construction, it is not affected by normal chemical corrosion at locations in which it is used. The pressure sensor normally employed is the Encardio-rite pore pressure meter model EPP-30/36V that is available in several different pressure ranges (3, 5, 10, 20, 35, 50 & 100 kg/cm^2).

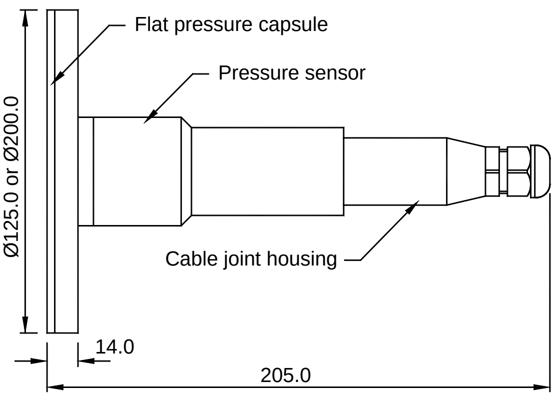

Figure 2.4 - layout

A tripolar plasma surge arrestor inside the transducer housing protects the vibrating wire pluck and read coils from electrical transients such as may be induced by direct or indirect lightning strikes.

A thermistor is provided to monitor temperature.

2.2.3 Cable connection

Leads from coil magnet are terminated on a glass to metal seal that is integrally electron beam welded to stainless steel body of pressure sensor. The two pins marked red and black are connected to coil magnet. The other two pins are connected to a thermistor for measurement of temperature. Cable joint housing and cable gland is provided for cable connection. Cable is attached to sensor in a sealed, water-resistant manner. For concrete pressure cell located inside a concrete block, cable may be armoured and provided with strain relief at cell to reduce likelihood of pull-out. For cable jointing, refer to Users Manual 6002.11.

2.2.4 Support plate

A support plate (figure 2.5) will normally be required for the flat pressure capsule, during installation. A typical assembly of jack out pressure cell in a diaphragm wall is shown in figure 2.6.

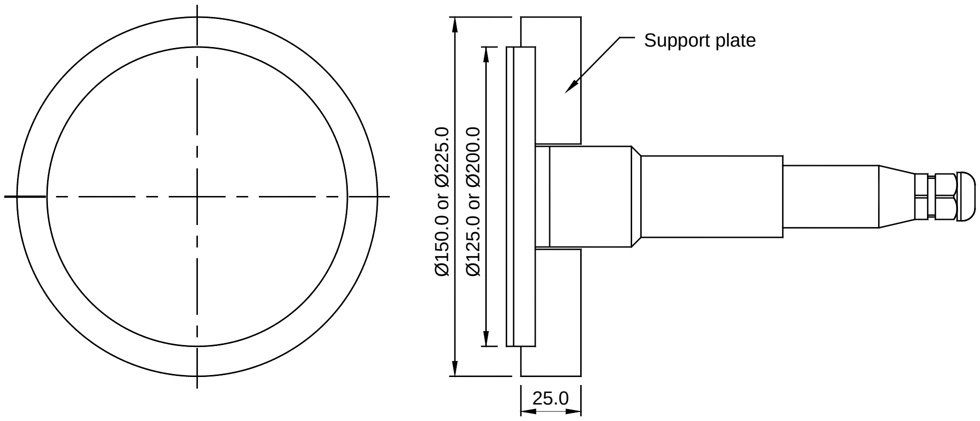

Figure 2.5 – jack-out pressure cell with support plate (dimensions in mm)

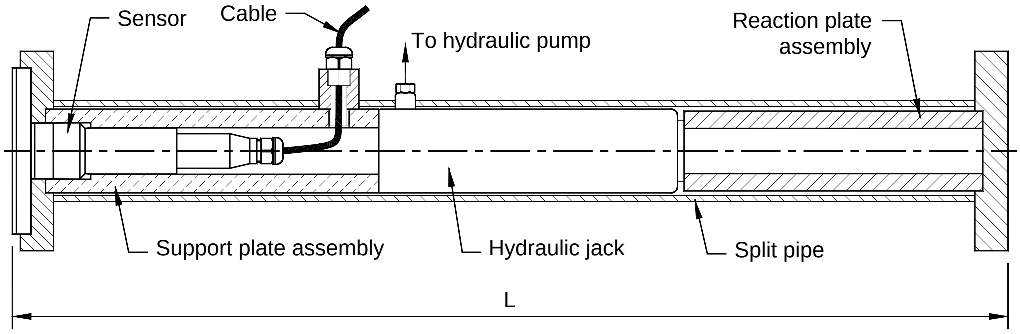

Figure 2.6 - typical assembly of jack out pressure cell in a diaphragm wall

2.3 Operating principle

Pressure sensor of a vibrating wire stress cell consists of a magnetic, high tensile strength stretched wire, one end of which is anchored and the other end fixed to a circular diaphragm. The diaphragm deflects in some proportion to applied pressure. Any change in pressure, deflects diaphragm proportionally affecting tension in stretched wire and in turns frequency of vibration The stress is proportional to the square of the frequency and the read out unit is able to display this directly in engineering units.

The wire is plucked by a coil magnet. Proportionate to the tension in the wire, it resonates at a frequency 'f'', which can be determined as follows:

$$\mathbf{f = [\sigma g/\rho]^{1/2}/2l \ \ Hz}$$

where, σ = tension of wire in kg/cm^2
g = 980 cm/sec^2
ρ = density of wire in kg/cm^3
l = length of wire in cm

The length of the wire in the stress cell being 5.5 cm, the formula can be reduced to:

$$\mathbf{f = 32\ [\sigma]^{1/2} \ \ Hz}$$

The resonant frequency with which the wire vibrates, induces an alternating current in the coil magnet. This is read by the read out unit.

2.4 On interpreting data

2.4.1 Jack-out pressure cell described here is of the hydraulic type. Two flat plates are electron beam welded together at the periphery and are separated by a small gap filled with hydraulic fluid. The soil pressure acts to squeeze the plate in contact with the soil against the second plate thus building up a pressure on the fluid. Depending upon compressibility and stiffness of soil and where it is used, it may generally give a reading somewhat different from the actual stress.

2.4.2 The plate in contact with soil being thin relative to its lateral extent, is quite flexible. However, please note that there is some supporting effect of the welded periphery at center of the plate that may affect the reading.

2.4.3 It should also be kept in mind that factors like inherent variability of soil properties give rise to varying soil stresses at different locations and it may be difficult to get a good sample of the mean stress from a limited number of cell locations. Also, response of cell to its immediate surroundings depends very largely on how closely the soil mass immediately around the cell has the same stiffness or compressibility or the same degree of compaction as the undisturbed soil mass. Installation methods will need to pay particular attention to this detail.

2.4.4 Any closed hydraulic system is sensitive to temperature effects. The stress cell when embedded between the soil an concrete acts like a closed hydraulic system. Any change in temperature of the surrounding soil or concrete therefore gives an unauthentic or false reading, the magnitude of which depends upon the elasticity of the surrounding material and the relative coefficient of expansions of the materials in contact & the filled fluid inside the stress cell. In some cases this effect may be high enough to cause permanent damage to the pressure transducer and should be considered in determining the capacity of the sensor ordered. A thermistor is incorporated in each sensor to assist in determining temperature compensation factors that may be calculated by closely observing the in-situ stress cell performance.

2.5 Taking readings with the model EDI-54V vibrating wire indicator

The model EDI-54V vibrating wire indicator (figure 2.6 (a)) is a microprocessor-based read-out unit for use with Encardio-rite's range of vibrating wire sensors. It can display the measured frequency in terms of time period, frequency, frequency squared or the value of measured parameter directly in proper engineering units. It uses a smartphone with Android OS as readout having a large display with a capacitive touch screen which makes it easy to read the VW sensor.

Fig 2.6 (a) – Vibrating wire indicator

The EDI-54V vibrating wire indicator can store calibration coefficients from 10,000 vibrating wire sensors so that the value of the measured parameter from these sensors can be shown directly in proper engineering units. For transducers with built-in interchangeable thermistor, it can also display the temperature of the transducer directly in degree Centigrade.

The vibrating wire indicator has an internal non-volatile memory with sufficient capacity to store about 525,000 readings from any of the programmed sensors. Each reading is stamped with the date and time the measurement was taken.

Refer instruction manual WI-6002.112 of model EDI-54V for entering the transducer calibration coefficients. The gage factor of the model EPS-30VJ Jackout Pressure Cell is given in the test certificate provided with every supply. The initial reading IR will be the actual reading in digits from the pressure cell after it is embedded and properly set in concrete.

An internal 6 V 4 Ah rechargeable sealed maintenance-free battery is used to provide power to the vibrating wire indicator. A battery charger is provided to charge the internal battery which operates from 90 V to 270 V AC 50 or 60 Hz V AC mains. A fully discharged battery takes around 6 hours to get fully charged. The indicator uses a smartphone as a readout that has its own internal sealed rechargeable Li-ion maintenance battery as a power source. A separate battery charger/adapter unit for the smartphone, operating from universal AC mains supply is supplied with each EDI-54V indicator unit.

The EDI-54V vibrating wire indicator is housed in an impact resistant plastic moulded housing with weatherproof connectors for making connections to the vibrating wire transducer and the battery charger.

3 TOOLS & ACCESSORIES REQUIRED FOR INSTALLATION

The following tools and accessories are required for proper cable jointing and installation of the stress cell (also refer user's manual on cable jointing - 6002.11):

- Soldering iron 25 watt
- Rosin 63/37 solder wire RF-3C, 30 swg
- Thread sealant (Loctite 577 or equivalent)
- Cable jointing compound (MS 853 and hardener MSH 283 - Mahendra Engineering & Chemical Products Ltd. or equivalent). For alternatives, refer to note on page 3-4 of Encardio-rite user's manual "cable jointing of sensors" 6002.11)
- Acetone (commercial)
- Spanner 20/22 and 26/28
- Hacksaw with 150 mm blade
- Cable Cutter
- Wire Stripper
- Pliers 160 mm
- Pouring funnel
- Stainless steel rod 5 mm ϕ x 150 mm length
- Spatula
- Rotary tin cutter
- Fixture for jointing upto three jack-out pressure cells (refer figure 3.1)
- Tooth brush
- Cloth for cleaning (lintless)
- Multimeter 3½ digits
- EDI-54V vibrating wire indicator

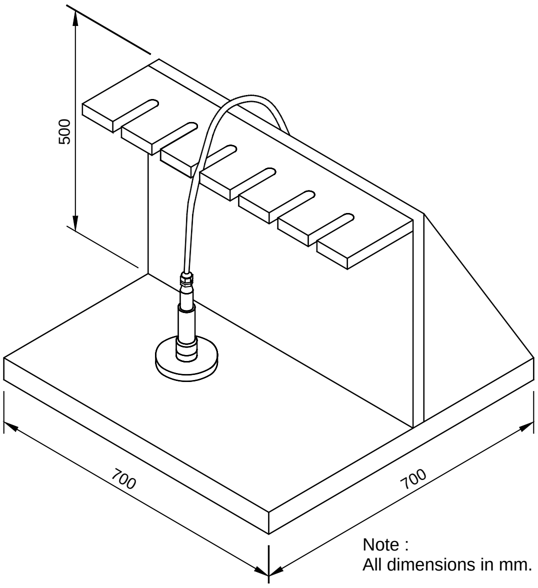

Figure 3.1 – cable jointing fixture (all dimensions in mm

4 INSTALLATION PROCEDURE

4.1 Preparation of the sensor before installation:

4.1.1 Remove the cable joint housing from the cable end of the sensor. This gives access to the four pin terminal. Two of the terminals are marked with red and black colors. These are internally wired to the coil of the magnet assembly inside the sensor. The other two terminals are internally wired to a thermistor provided for temperature correlation/measurement. Clean the terminals with a toothbrush.

CAUTION: Do not use any acetone for cleaning as it may damage the glass to metal seal.

4.1.2 Check the working of the sensor as follows:

- The coil resistance measured by a digital multimeter between the red and black pins, should lie between 120-150 Ohm. Note the room temperature with any thermometer. Determine the resistance of the thermistor at the room temperature from thermistor temperature chart in § 5. This resistance should be equal to that between pins marked green and white. For example, in case the temperature is 25ºC, this resistance would be 3,000 Ohm.
- The resistance between any lead and the protective armour should be > 500 M Ohm.
- Connect the sensor to Encardio-rite model EDI-54V portable readout unit and switch it on. The display will show something like:

```
Freq: 2629.8 Hz
```

where the actual figure will vary depending on the transducer connected to the indicator.

For the jackout pressure cell, the initial reading (offset) in frequency should lie between 2,250 and 2,750 Hz. This initial reading on the portable readout unit should be stable.

A crude but simple and very effective method of checking whether the sensor is responding to changes in pressure is as follows:

- Connect the sensor to the portable digital readout unit.
- Press the diaphragm with the thumb and verify that the reading on the indicator decreases.
- This change in reading ensures that the deformation produced by the pressure of the thumb on the diaphragm is transmitted to the vibrating wire sensing element.

4.1.3 Connect the required length of cable to the sensor as described in the operating manual on cable jointing - doc. # WI 6002.11.

NOTE: The cable should always be unreeled by turning the cable drum so that the cable is laid out on the flooring. Cables should never by unreeled by pulling on the cable itself as the internal conductors can get damaged from excessive strain.

Under no circumstances should the cable be unwound from any one side of the drum. This can happen, for example, when the cable drum is kept on its side and the cable is taken out without rolling the drum.

4.1.4 Check the working of the sensor again following the procedure described above in § 4.1.2.

NOTE: Remember to add the cable resistance when checking the resistance between the leads after the cable jointing. For the model CS 0401 cable, the resistance is 26 Ohm/km and for the model CS 0406 cable, the resistance is 48 Ohm/km. (multiply by 2 for both leads). In case any other cable is used, make the necessary addition in the resistance value.

4.1.5 Cable should be marked with permanent markers every 5 m by the use of stainless steel tags tied by stainless steel wire and stamped with appropriate earth pressure cell numbers. Alternatively, plastic tabs may also be used. Temporary identification can be done by writing the serial number of the sensor, its code number and the location at which it is installed, on a strip of paper, placing the strip on the cable and covering it with a transparent plastic adhesive tape. Permanent identification is necessary to prevent errors in making proper connections in the junction box and to ensure correct splicing if cable is cut or broken.

CAUTION: The single most important factor leading to loss of worthwhile data from sensors is losing track of identification of cable ends. Proper identification and marking of cables is generally taken most casually. Care should also be taken to put an identification tag at point where cable comes out of structure such that cable identity is not lost if cable gets accidentally cut.

NOTE: Cables may be spliced without affecting the sensor reading; nevertheless splicing should be avoided wherever possible. If necessary, use special cable jointing kits available from Encardio-rite.

4.2 Installation of jack-out pressure cell in a diaphragm or slurry wall

Installing the jack-out pressure cell requires skill and expertise. In case effective stress is to be determined, a pore pressure meter must be installed close by.

NOTE: The jack-out pressure cell measures the total stress. In case effective stress is to be measured a pore pressure meter must be installed close by.

The jack-out pressure cell is designed to measure the total pressure in a cast-in-place concrete structure such as a diaphragm or slurry wall. The cell is normally placed with the flat surfaces vertical and will therefore measure horizontal stress in a direction perpendicular to the diaphragm of the cell. A hydraulic jack is used to keep the cell in firm contact with the soil during the process of concreting. It is for this reason that it is known as a jack-out pressure cell.

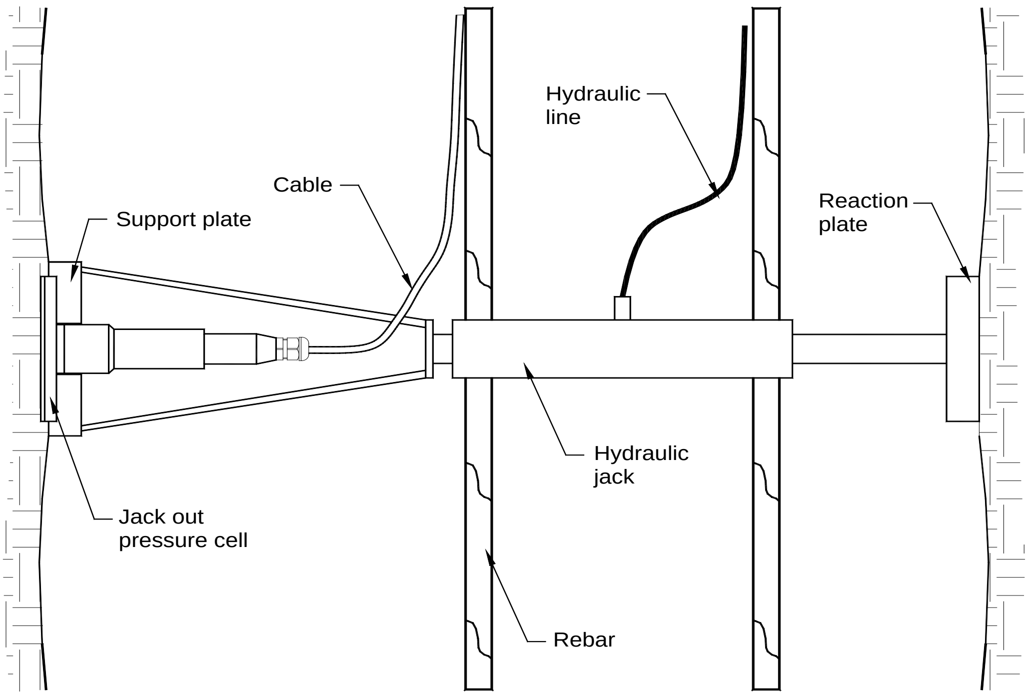

Figure 4.1 – Jackout pressure cell installation in reinforcing cage with rigid steel support plate, double-acting hydraulic jack and a reaction plate

Jack-out pressure cell is installed at the required location in the reinforcing cage together with a rigid steel support plate, a double-acting hydraulic jack and a reaction plate. Refer to figure 4.1. The purpose of the support plate is to prevent any distortion of the cell by providing a buffer between the jack and the cell.

Cable from sensor and hydraulic pressure pipe from the jack-out pressure cell are firmly secured with the reinforced bars forming the cage. They should be adequately protected. The cage is lowered into the diaphragm/slurry trench. Position the cell and the reaction plate in contact with the soil.

NOTE: Record initial reading and temperature with EDI-54V for permanent record, when cell is placed in position and is about to be covered with concrete. This will form the zero reading for the stress cell. Note the barometric pressure at time of taking the initial reading.

Activate the jack and lock it. To prevent any concrete from entering between the soil and the sensitive face of the cell, make sure that the hydraulic pressure exerted by the jack is more than the pressure head at cell location of the poured concrete.

Fill the trench with concrete through a tremie pipe.

The above instructions for installation are only a guideline. Depending upon site conditions, the actual installation procedure to be used should be determined by the project authorities.

4.3 Sample test certificate

TEST CERTIFICATE

DWT Traceable to standard no.: NPL /3373/05/20/2002

Customer:	………………………………		
P.O.No.:	………………………………		
Instrument:	Jack out pressure cell	**Date:**	....
Serial number:	2539	**Temperature:**	31°C
Capacity:	35 kg/cm²	**Atm. pressure:**	1.016 kg/cm²

Pressure transducer calibration data

Input pressure kg/cm²	Observed value Up1 (Digit)	Down (Digit)	Up2 (Digit)	Average (Digit)	End Point Fit (kg/cm²)
0.00	6683.9	6683.9	6683.9	6684	0.000
7.00	6319.3	6319.3	6319.3	6319	7.071
14.00	5957.6	5957.6	5957.6	5958	14.089
21.00	5596.7	5596.7	5596.7	5597	21.088
28.00	5236.5	5238.8	5236.5	5236	28.077
35.00	4879.5	4879.5	4879.5	4880	35.000

Error (%FS) 0.25

Digit: $f^2 \times 10E-3$

Pressure transducer gage factor: 1.940E-02 kg/cm²/digit

Thermal factor: -0.008 kg/cm²/°C

Jackout pressure cell calibration data

Cell constant (multiplier): 1.034

Linear gage factor: 2.006E-02 kg/cm²/digit

Pin configuration/wiring code:

Red & black: Signal

Green & white: Thermistor

Checked by

Tested by

5 TEMPERATURE MEASUREMENT

5.1 Thermistor - temperature resistance correlation

Thermistor type Dale 1C3001-B3 or equivalent

Temperature resistance equation

$$T = 1/[A + B(LnR) + C(LnR)^3] - 273.2\ ^oC$$

T = temperature in ^oC

LnR = Natural log of thermistor resistance

A = 1.4051×10^{-3}

B = 2.369×10^{-4}

C = 1.019×10^{-7}

Ohm	Temp. ^oC	Ohm	Temp. ^oC	Ohm	Temp. ^oC
201.1k	-50	16.60K	-10	2417	+30
187.3K	-49	15.72K	-9	2317	31
174.5K	-48	14.90K	-8	2221	32
162.7K	-47	14.12K	-7	2130	33
151.7K	-46	13.39k	-6	2042	34
141.6K	-45	12.70K	-5	1959	35
132.2K	-44	12.05K	-4	1880	36
123.5K	-43	11.44K	-3	1805	37
115.4K	-12	10.86K	-2	1733	38
107.9K	-41	10.31K	-1	1664	39
101.0K	-40	9796	0	1598	40
94.48K	-39	9310	+1	1535	41
88.46K	-38	8851	2	1475	42
82.87K	-37	8417	3	1418	43
77.66K	-36	8006	4	1363	44
72.81K	-35	7618	5	1310	45
68.30K	-34	7252	6	1260	46
64.09K	-33	6905	7	1212	47
60.17K	-32	6576	8	1167	48
56.51K	-31	6265	9	1123	49
53.10K	-30	5971	10	1081	50
49.91K	-29	5692	11	1040	51
46.94K	-28	5427	12	1002	52
44.16K	-27	5177	13	965.0	53
41.56k	-26	4939	14	929.6	54
39.13K	-25	4714	15	895.8	55
36.86K	-24	4500	16	863.3	56
34.73K	-23	4297	17	832.2	57
32.74K	-22	4105	18	802.3	58
30.87K	-21	3922	19	773.7	59
29.13K	-20	3748	20	746.3	60
27.49K	-19	3583	21	719.9	61
25.95K	-18	3426	22	694.7	62
24.51K	-17	3277	23	670.4	63
23.16K	-16	3135	24	647.1	64
21.89K	-15	3000	25	624.7	65
20.70K	-14	2872	26	603.3	66
19.58K	-13	2750	27	582.6	67
18.52K	-12	2633	28	562.8	68

17.53K	-11	2523	29	525.4	70

5.2 Measurement of temperature

Thermistor for temperature measurement is incorporated in the sensor. The thermistor gives a varying resistance output related to the temperature (see § 5.1). The thermistor is connected between the green and white leads. The resistance can be measured with an Ohmmeter. The cable resistance may be subtracted from the Ohmmeter reading to get the correct thermistor resistance. However the effect is small and is usually ignored.

The Encardio-rite model EDI-54V read-out unit gives the temperature from the thermistor reading directly in engineering units.

5.3 Temperature correction

A pressure-temperature variation correlation factor (k) is provided in the test certificate for the pressure sensor of jackout pressure cell. In case correction for temperature effect is required in cell, use following equation:

$P_{correction}$ = K (current temperature - initial temperature)

The temperature correction value is added to the pressure value read from the EDI-54V read-out.

The effect of the temperature coefficient of expansion of concrete on the stress cell is almost impossible to determine. Temperature effect caused by mismatch between the temperature coefficient of cell and surrounded soil and concrete is not quantifiable and hence no correction factor for this effect is supplied. If required, user may conduct his own tests under controlled conditions. Please once read again § 2.4.4 in this connection.

6 OTHER CONSIDERATIONS/TROUBLE SHOOTING

6.1 Barometric pressure correction

The pressure transducer used in the Encardio-rite vibrating wire jackout pressure cell is evacuated and hermetically sealed and will respond to barometric pressure fluctuation. In fact all jackout pressure cells will respond to barometric pressure fluctuations unless they are manufactured in the gage pressure version and a capillary tube is provided in the cable which opens into the atmosphere.

Since the magnitude of barometric pressure fluctuations is of the order of +/-0.03 kg/cm^2, correction is generally not required. If a correction for these fluctuations is required then it is necessary to record the barometric pressure at the time of taking the reading. The initial barometric pressure corresponding to the zero reading at the time of installation is to be considered (refer to second note in § 4.2). The correction can be made by using the following equation:

$P_{correction}$ = (initial barometric pressure - current barometric pressure)

The pressure correction value is added to the pressure value read from the EDI-54V read-out.

6.2 Pressure conversion table

The test certificate gives the calibration coefficients suitable for reading in kg/cm^2. To convert the output to other engineering units, multiply the reading obtained from the model EDI-54V read-out unit in by the conversion factor given below:

bar	0.981
atm.	0.968
mm Hg	735.6
" Hg	28.96
psi	14.22
" H_2O	393.7
'H_2O	32.81
m H_2O	10
Newton/cm^2	9.807
kPa	98.07
mPa	0.098

6.3 Trouble shooting

Jackout pressure cell is embedded in soil and concrete. Once installed, the cell is usually inaccessible and remedial action is limited. Maintenance and trouble shooting is consequently confined to periodic checks of cable connection and functioning of the read-out unit. Refer the following list of problems and possible solutions should problems arise. For any additional help, consult the factory.

6.3.1 Symptom: pressure cell reading unstable

- Check the insulation resistance. The resistance between any lead and the protective armour should be > 500 M Ohm. If not, cut a meter or so from the end of cable and check again.

- Does the read-out work with another jackout pressure cell? If not, the read-out may have a low battery or be malfunctioning. Consult the manual of the readout unit for charging or trouble shooting instructions.
- Use another read-out unit to take the reading.
- Check if there a source of electrical noise nearby? General sources of electrical noise are motors, generators, transformers, arc welders and antennas. If so the problem could be reduced by shielding from the electrical noise.

6.3.2 Symptom: pressure cell fails to read

- The cable may be cut or crushed? Check the nominal resistance between the two gage leads using an Ohm meter. It should be within 120 - 150 Ohm. The correct value is given in the concrete pressure cell test certificate. Please add the cable resistance when checking. For the model CS 0401 cable, the resistance is 26 Ohm/km and for the model CS 0406 cable, the resistance is 48 Ohm/km. (multiply by 2 for both leads). In case any other cable is used, make the necessary addition in the resistance value. If the resistance reads infinite or a very high value, a cut in the cable is suspected. If the resistance reads very low (<100 Ohm), a short in the cable is likely.
- Does the read-out work with another jackout pressure cell? If not, the read-out may have a low battery or be malfunctioning. Consult the manual of the readout unit for charging or trouble shooting instructions.
- Use another read-out unit to take the reading.