NOVARENT
LOCATION ET VENTE DE MATÉRIEL DE MESURE

DISPLACEMENT SENSOR

VIBRATING WIRE TYPE

MODEL EDE-VXX

www.novarent.fr
0973791595
contact@novarent.fr

TABLE OF CONTENTS

1 INTRODUCTION 1

1.1 Types manufactured 1

1.2 Conventions used in this manual 1

1.3 How to use this manual 2

2 VIBRATING WIRE DISPLACEMENT SENSOR 3

2.1 Operating principle 3

2.2 General Description 3

2.2.1 Encardio-rite model EDE-VXX-WP 4

2.2.2 Encardio-rite model EDE-VXX-RC 4

2.2.3 Encardio-rite model EDE-VXX-SC 4

2.3 Wiring 4

2.4 Taking readings with model EDI-54V vibrating wire indicator/logger 5

2.5 Sample test certificate 6

3 CHECKING OF SENSOR AND INSTALLATION 7

3.1 Checking sensor before installation 7

3.2 Lightning protection 7

3.3 General precautions in cable installation 8

3.4 Initial reading 8

3.5 Installation 8

3.5.1 Encardio-rite model EDJ-40V vibrating wire crack/joint meter 9

4 THERMISTOR - TEMPERATURE RESISTANCE CORRELATION 10

4.1 Thermistor - temperature resistance correlation 10

4.2 Measurement of temperature 11

4.3 Temperature correction 11

5 TROUBLE SHOOTING 12

5.1 Symptom: displacement sensor reading unstable 12

5.2 Symptom: displacement sensor fails to read 12

6 WARRANTY 13

1 INTRODUCTION

The Encardio-rite model EDE-VXX linear displacement transducer incorporates a vibrating wire sensor. It converts mechanical displacement to an electrical frequency output. This frequency output can be read or logged by Encardio-rite model EDI-54V remote digital readout unit or Encardio-rite model EDAS-10 data acquisition system.

The model EDE-VXX vibrating wire displacement transducer is used in geotechnical and structural engineering applications where either it is difficult to take direct mechanical readings due to inaccessibility or online data needs to be logged at a remote location. Some uses are:

- to monitor rock mass or concrete displacement in single or multipoint borehole extensometers.
- to monitor soil displacement in soil extensometers.
- to monitor surface cracks in structures and rock mass (use Encardio-rite model EDJ-40V vibrating wire crack/joint meter).
- to monitor two or three axis displacement in joints of mass concrete (for uniaxial displacement use Encardio-rite model EDJ-50V vibrating wire joint meter).

Vibrating wire displacement sensors have an advantage over conventional transducers like LVDT as the former gives frequency, rather than a voltage, as output signal. The frequency signal can be transmitted over long distances without any change in value caused by variations in cable resistance which can arise from water penetration, temperature fluctuations, contact resistance or leakage to ground.

This factor, coupled with excellent zero stability and rugged design makes the model EDE-VXX displacement transducer preferable for long-term measurements in adverse environments.

1.1 Types manufactured

Encardio-rite manufactures vibrating wire displacement sensors in three configurations:

- EDE-VXX-WP: This is a water proof version and can withstand a water pressure upto 1 MPa equivalent to 100 m of water column. It finds applications in areas exposed to water pressure.
- EDE-VXX-RC: This has a cable coming out centrally from the back. It is for splash proof applications but will withstand a water pressure of 0.2 MPa. It is mostly used in applications like borehole extensometers and soil extensometers.
- EDE-VXX-SC: It has M6 threads centrally on both ends of the sensor and so has a cable coming out eccentrically from the back The sensor is suitable for applications upto a water pressure upto 0.4 MPa. It is mostly used in crack meters and biaxial/ triaxial joint meters.

1.2 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.

1.3 How to use this manual

The users' manual is intended to provide sufficient information for making optimum use of vibrating wire displacement sensors for different applications.

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

NOTE: 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 the 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 gone in preparing this instruction manual. However the best of instruction manuals cannot provide for each and every condition in the field, which may affect performance of the instrument. Also, blindly following the instruction manual will not guarantee success. Sometimes, depending upon field conditions, the 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.

NOTE: This sensor is normally used to monitor site conditions and will record any change, even though minor that may affect behaviour of the structure being monitored. Some of these factors amongst others, are, seasonal weather changes, temperature, rain, barometric pressure, earthquakes, nearby landslides, traffic, construction activity around site including blasting, tides near sea coasts, fill levels, excavation, sequence of construction and changes in personnel etc. These factors must always be observed and recorded as they help in correlating data later on and also may give an early warning of potential danger or problems.

The manual is divided into a number of sections, each section containing a specific type of information. The list given below tells you where to look for in this manual if you need some specific information. It is however recommended that you read the manual from the beginning to the end to get a thorough grasp of the subject. You will find a lot of unexpected information in the sections you feel you may skip.

For description of vibrating wire displacement sensor manufactured by Encardio-rite: See § 2 "Vibrating wire displacement sensor*"*.

For test certificate: See § 3 "Sample test certificate".

For installation: See § 4 "Checking of sensor and installation".

For installation of crack/joint meter: See § 4.5.1 "Checking of sensor and installation".

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

For temperature effect: See § 5 "Thermistor - temperature resistance correlation ".

For trouble shooting: See § 6 "Trouble shooting ".

For Warranty: See § 7 "Warranty ".

2 VIBRATING WIRE DISPLACEMENT SENSOR

2.1 Operating principle

Vibrating wire displacement sensor basically consists of a magnetic, high tensile strength stretched wire, one end of which is anchored and other end fixed to a shaft through a precision coil spring that deflects in some proportion to displacement. Any change in position of shaft, deflects the spring proportionally and this in turn affects tension in the stretched wire. Thus any change in displacement, directly affects tension in the wire and thus frequency of vibration.

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

$f = [\sigma g/\rho]^{1/2}/ 2l$ 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 displacement sensor is 5.5 cm. Consequently 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. The displacement is proportional to square of frequency and the readout unit is able to display this directly in engineering units.

2.2 General Description

The sensor body is of stainless steel construction. It has a shaft with M6 x 10 threads at the exposed end. For monitoring displacement in any application, the shaft slides inside the sensor body with respect to the latter. The shaft should never be rotated inside the sensor body as this will damage the transducer.

CAUTION: Never rotate shaft inside sensor body as this will damage the transducer. The shaft end is provided with an alignment pin that sits inside an alignment slot on sensor body. Always displace shaft axially while checking or installing sensor.

Each sensor is provided with a thermistor for monitoring temperature. Normally, no correction due to temperature induced frequency changes is required. However, if it is necessary to make these corrections, refer to data on zero shift due to temperature changes provided in test report (see § 3).

The displacement sensor is manufactured in various capacities. The three sensors EDE-VXX-WP, EDE-VXX-RC and EDE-VXX-SC are shown in the adjacent photograph.

WP
(water proof)

SC
(side cable)

RC
(rear cable)

Dimensional details of the various types of vibrating wire displacement sensors manufactured are as follows:

2.2.1 Encardio-rite model EDE-VXX-WP

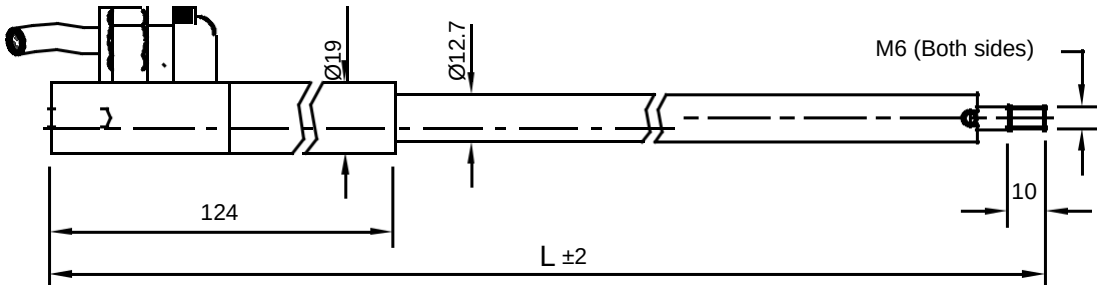


Figure 2.1 – Water proof sensor to withstand a water pressure upto 100 m of water column with M6 threads on both sides for mounting

2.2.2 Encardio-rite model EDE-VXX-RC

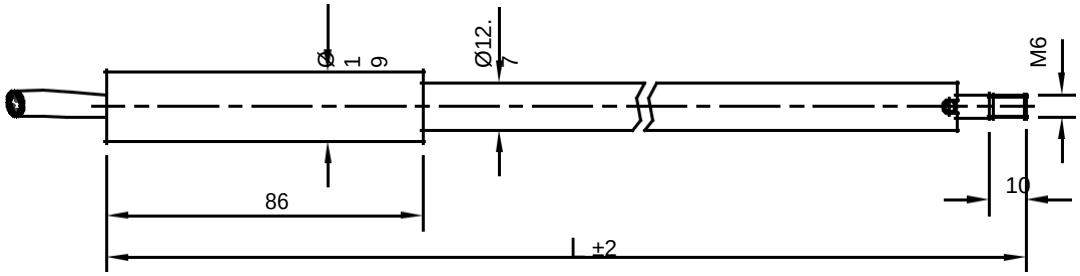


Figure 2.2 – Sensor for splash proof applications with M6 x 10 threads on shaft. In applications like borehole extensometer, the sensor body is clamped on Φ 19

2.2.3 Encardio-rite model EDE-VXX-SC

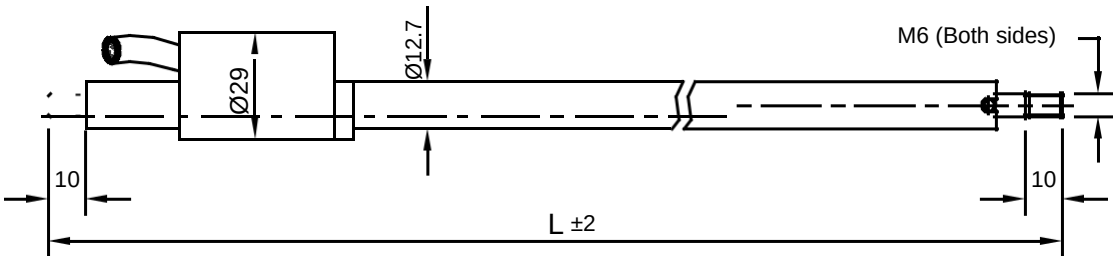


Figure 2.3 – Water proof sensor to withstand a water pressure upto 40 m of water column with M6 threads on both sides for mounting

Displacement mm	L mm		
	EDE-VXX-WP	EDE-VXX-RC	EDE-VXX-SC
15	X	X	207
25	260	222	222
50	330	292	292
100	460	422	422
150	590	552	X

2.3 Wiring

The sensor is provided with an integral 1 m long φ 4 mm four core PVC sheathed cable with cores in red, black, green and white. Red and black cores are for frequency signal while green and white are for temperature monitoring through a thermistor. In case specially ordered, PU sheathed cable can be provided.

2.4 Taking readings with model EDI-54V vibrating wire indicator/logger

The model EDI-54V vibrating wire indicator (figure 2.3) 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 2.3 (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 EDE-VXX displacement sensor is given in the test certificate provided with every supply. The initial reading IR will be the actual reading in digits from the displacement sensor after it is installed and properly fixed.

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.

2.5 Sample test certificate

TEST CERTIFICATE

Instrument : Vibrating wire displacement sensor
Serial number : xxxxxxx Date : 07.04.2018
Capacity : 50 mm Temperature : 28°C

Input Displacement (mm)	Observed value Up1 (Digit)	Up2 (Digit)	Average (Digit)	End Point Fit (mm)	Poly Fit (mm)
0.00	2261.3	2250.4	2250.4	2255.9	0.00	0.00
10.00	3515.5	3489.3	3503.2	3509.4	10.10	10.01
20.00	4761.3	4736.0	4750.6	4755.9	20.15	20.01
30.00	5997.7	5977.4	5989.9	5993.8	30.13	29.99
40.00	7233.3	7215.3	7226.5	7229.9	40.09	40.00
50.00	8459.3	8459.3	8458.9	8459.1	50.00	50.00
				Error (%FS)	0.30	0.02

Digit : f ²/1000
Linear gage factor (G) : 8.0603E-03 mm/digit
Thermal factor (K) : 0.011 mm/°C
Polynomial constants :
A= 1.5269E-08 B= 7.8979E-03 C= -1.7899E+01

Displacement "D" is calculated with the following equation:
Linear : D(mm) =G(R1-R0)-K(T1-T0)
Polynomial : D(mm) = A(R1)² + B(R1) + C -K(T1-T0)-D0
R1 = current reading & R0 is initial reading in digit.
D0 = Initial reading in mm

Zero reference (initial position) in the field must be established by recording the initial reading R0 (digit) along with temperature T0 (°C) just after installation.

Note : Zero displacement reading given in above calibration chart is taken at around 3 mm from mechanical zero, i.e. slider fully in

Pin configuration/wiring code: Red & black: Signal Green & white: Thermistor

CAUTION: Never rotate shaft of displacement sensor in respect to the outside body. This will permanently damage the sensor. During checking pull or push shaft only axially. A pin has been provided at end of displacement sensor that sits flush in a groove in sensor body.

3 CHECKING OF SENSOR AND INSTALLATION

3.1 Checking sensor before installation

The cable from the sensor is four wired 1 m long. Red and black cores are for frequency signal while green and white are for temperature monitoring through a thermistor.

Check the working of the sensor as follows:

- The coil resistance measured by the digital multimeter should lie between 130-180 Ohm. Determine resistance at the room temperature from thermistor temperature resistance chart in § 5. This resistance should be equal to that between the green and white wires. For example, in case the room temperature is 25$_o$C, 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 the Encardio-rite model EDI-54V portable readout unit and switch it on. The display will show something like:

  `Freq:  2230.8 Hz`

  where the actual figure will vary depending on the transducer connected to the indicator. This initial reading on the portable readout unit should be stable.
- A crude but a simple and very effective method of checking whether the displacement sensor is responding to changes in displacement is as follows:

  Shift the read-out unit display to the engineering unit mode. Using a scale, extend the displacement sensor by about 5 mm. The reading in the digital readout unit should change by around 5 mm. The change in reading ensures that the deformation produced by the displacement is transmitted to the vibrating wire sensing element.

CAUTION: The displacement sensor is a delicate and sensitive instrument. It should be handled with care. Twisting or applying too much force on the shaft with respect to the sensor body may result in a zero shift or even permanent damage. Always displace shaft axially while checking or installing sensor.

The shaft end is provided with an alignment pin that sits inside an alignment slot on sensor body. When not in use or while tightening sensor against a shaft mounting object, keep the pin engaged inside the slot to prevent any damage to the sensor by rotation of sensor against shaft body.

3.2 Lightning protection

Lightning during thunderstorms can induce short spikes of sufficiently high electrical energy in the wires connecting the vibrating wire sensor to the readout instrument that can damage the coils in the sensor assembly. Some measure of lightning protection for the vibrating wire sensor is recommended if the sensor is mounted in the field or in open areas and connected to the readout instrument through long wires. However, these protection schemes will not protect the sensor against direct or near direct lightning strikes. Lightning protection is generally not required if the connecting wire is very short, say only a few meters in length, or both the sensor and the vibrating wire indicator is used inside a shielded structure, e.g. a building.

The EDE-VXX vibrating wire strain gage is not available with any integral lightning protection component. If lightning protection is desired one of the following options may be used:

- Surge arrestors like Gas Discharge Tubes (GDT) or TransZorbs (registered trademark of General Semiconductor Industries) may be fixed to the sensor cable as near to the sensor as possible and epoxy potted in place. The ground conductor would have to be connected to an earthing stake or the steel structure itself.
- If the vibrating wire displacement sensor is mounted close to a junction box or a multiplexer, the surge arrestor component can be mounted in the junction box or the multiplexer box itself. Encardio-rite can provide junction boxes and multiplexers with lightning protection installed as an option (specify while ordering).
- Lightning arrestor boards and enclosures are available from Encardio-rite, which can be installed at the exit point of the structure being monitored. Consult the factory for additional information on these or alternate lightning protection schemes.

3.3 General precautions in cable installation

Unless otherwise specified, each sensor is provided with 1 m cable attached. Cable may be extended without affecting sensor reading or its long term performance. Always ensure a waterproof joint of appropriate strength.

The procedure for laying of cables differs with individual installations. The cable should be routed in such a way so as to minimize the possibility of damage due to moving equipment, debris or other causes. In general:

- Protect cable from damage by angular and sharp particles of material in which it is embedded.
- In earth/rock embankments and backfill, cable must be protected from stretching due to differential compaction of embankment. Cable must also be protected from damage by compaction equipment.

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 the cables is generally taken most casually. Care should be taken to put an identification tag at the point where the cable comes out of the structure such that cable identity is not lost if the cable gets cut or damaged. Route the cable properly to the location where readings have to be taken, taking care that it is suitably protected. Gage and lead wires must be protected from mechanical damage and from water.

Take care to keep cables as far away as possible from sources of electrical interference such as power lines, welding equipment, motors, generators and transformers etc. To avoid picking up noise, cables should never be buried or run along with AC power lines as this will cause problems in obtaining stable data.

3.4 Initial reading

Always carefully record initial displacement reading along with temperature at time of installation to serve as a reference for determining subsequent deformation.

3.5 Installation

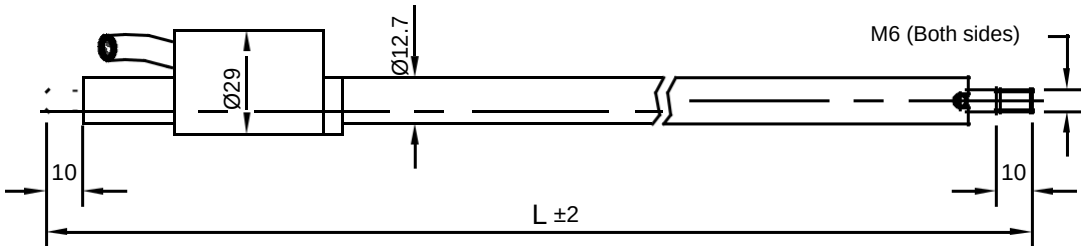
4.2.1 For using vibrating wire displacement sensor in borehole extensometer, refer to instruction manual doc. # WI 6002.79 model EDS-70V borehole extensometer system (bhe) with vibrating wire sensors.

4.2.2 For using vibrating wire displacement sensor in soil extensometer, refer to method statement MS 0407 EDS- 92 soil extensometer.

4.2.3 For using vibrating wire displacement sensor for monitoring of cracks or joint openings on the surface, refer to figures in § 4.5.1.

3.5.1 Encardio-rite model EDJ-40V vibrating wire crack/joint meter

Displacement sensor for Crack meter



Mounting details for Crack meter

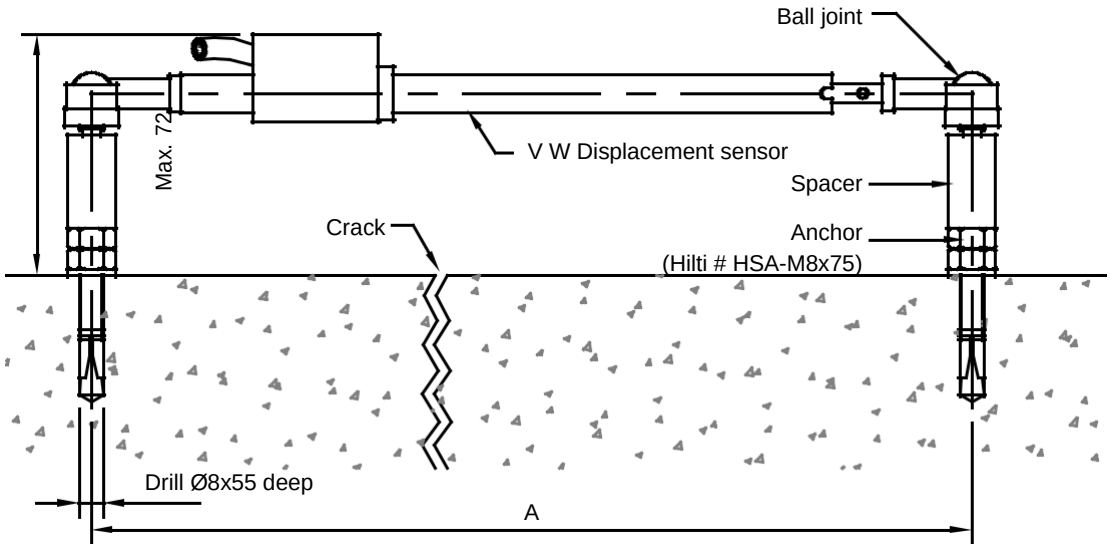


Figure 4.1 – Crack/joint meter mounting details

Range mm	L mm	A mm (half open position)
15	207	~ 255
25	222	~ 275
50	292	~ 357

4 THERMISTOR - TEMPERATURE RESISTANCE CORRELATION

4.1 Thermistor - temperature resistance correlation

Thermistor type Dale 1C3001-B3

Temperature resistance equation

$T = 1/[A + B(LnR) + C(LnR)_3] - 273.2\ ^oC$

where T = temperature in ^oC
LnR = Natural log of thermistor resistance
A $=1.4051 \times 10^{-3}$
B $=2.369 \times 10^{-4}$
C $=1.019 \times 10^{-7}$

Ohm	Temp. ^{o} C	Ohm	Temp. ^{o} C	Ohm	Temp. ^{o} C
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

4.2 Measurement of temperature

Thermistor for temperature measurement is incorporated in each displacement sensor. The thermistor gives a varying resistance output related to the temperature (see § 5). The thermistor is connected between the green and white leads. The resistance can be measured with an Ohm meter. The cable resistance may be subtracted from the Ohm meter 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.

4.3 Temperature correction

Each vibrating wire displacement sensor is relatively insensitive to temperature variations within certain limits and often the effect of temperature can be ignored. However in case a 'displacement - temperature variation' correlation is required, correction for the temperature effect on the sensor can be made by making use of the temperature zero shift factor (K) provided in the test certificate (see § 2.5) and substituting it in the following equation:

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

The temperature correction value is subtracted from the displacement reading from the EDI-54V read-out.

5 TROUBLE SHOOTING

The displacement sensor is installed during construction of the structure. 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 to the following list of problems and possible solutions should problems arise. For any additional help, consult the factory.

5.1 Symptom: displacement sensor 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 displacement sensor? 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 is 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.

5.2 Symptom: displacement sensor 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 130 - 180 Ohm. The correct value is given in the test certificate. Please add the cable resistance when checking. 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 displacement sensor? 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.

6 WARRANTY

The Company warrants its products against defective workmanship or material for a period of 12 months from date of receipt or 13 months from date of dispatch from the factory, whichever is earlier. The warranty is however void in case the product shows evidence of being tampered with or shows evidence of damage due to excessive heat, moisture, corrosion, vibration or improper use, application, specifications or other operating conditions not in control of Encardio-Rite. The warranty is limited to free repair/replacement of the product/parts with manufacturing defects only and does not cover products/parts worn out due to normal wear and tear or damaged due to mishandling or improper installation. This includes fuses and batteries

If any of the products does not function or functions improperly, it should be returned freight prepaid to the factory for our evaluation. In case it is found defective, it will be replaced/repaired free of cost.

A range of technical/scientific instruments are manufactured by Encardio-rite, the improper use of which is potentially dangerous. Only qualified personnel should install or use the instruments. Installation personnel must have a background of good installation practices as 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.

The warranty is limited to as stated herein. Encardio-rite is not responsible for any consequential damages experienced by the user. There are no other warranties, expressed or implied, including but not limited to the implied warranties of merchantability and of fitness for a particular purpose. Encardio-rite is not responsible for any direct, indirect, incidental, special or consequential damage or loss caused to other equipment or people that the purchaser may experience as a result of installation or use of the product. The buyer's sole remedy for any breach of this agreement or any warranty by Encardio-rite shall not exceed the purchase price paid by the purchaser to Encardio-rite. Under no circumstances will Encardio-rite reimburse the claimant for loss incurred in removing and/or reinstalling equipment.

A lot of effort has been made and precaution for accuracy taken in preparing instruction manuals and software. However best of instruction manuals and software cannot provide for each and every condition in field that may affect performance of the product. Encardio-rite neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damage or loss that results from use of Encardio-rite products in accordance with the information contained in the manuals or software.

Products described in Encardio-rite's catalogs are subject to modification and improvement as dictated by subsequent developments. Encardio-rite reserves the right to modify, change or improve products, to discontinue them or to add new ones without notice.