INSTRUCTION MANUAL

VIBRATING WIRE TYPE
TEMPERATURE METER MODEL SME -2100

SENSORS & MEASUREMENTS ENTERPRISES
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VIBRATING WIRE TEMPERATURE METER

1. Introduction:

The SME model 2100 vibrating wire temperature meter is used for the measurement of internal temperature in concrete structures, soil or water. With the SME read out unit model 2460-P digital indicator, it provides a resolution of better than 0.1°C.

1.1 Purpose

Temperature is generally measured in concrete structures to determine:

- Temperature gradients.
- Temperature corrections for other measurements.

The study and measurement of temperature in concrete structures has the following main purposes:

- One of the greatest factor which causes stress in mass concrete is changes arising due to temperature variations. Other major factors which causes stress in mass concrete is the procedure adopted during construction and the stress caused due to the weight of the concrete itself. For analyzing the development of thermal stress and for control of artificial cooling, it is necessary to monitor the temperature variation of concrete during construction. To do this, the temperature should be accurately measured at many points in the structure, in the water and in the air. Sufficient number of sensors should be embedded to get a correct picture of temperature distribution at various points in the structure. In a large concrete dam, a typical scheme would be to place a temperature probe every 15-20 m along the cross-section and every 10 m along the elevation. For smaller dams, the spacing may be reduced.
- Temperature probes placed in the upstream face of the dam, evaluate the reservoir temperature as it varies throughout the year. This is much easier than dropping a thermometer in the reservoir every now and then to take observations.
- During operation of a concrete dam, the seasonal changes in the environment, play havoc as far as development of thermal stresses in the structure is concerned. The effect is more pronounced on the downstream side. A few temperature sensors should be placed near and in the downstream face of the concrete dam to evaluate the rapid daily and weekly fluctuation in temperature.

1.2 Features

SME vibrating wire sensors have the following features:

- Rugged, water proof & of stainless steel construction for high reliability.
- Excellent linearity & hysteresis.
- Vibrating wire technology assures long-term stability, quick and easy readout.
- Weather proof enclosure conforming to IP 68.
- Readily adoptable to data loggers.

1.3 Applications

The SME vibrating wire temperature meter is the temperature sensor of choice as its frequency output is unaffected by the to external noise, it is able to tolerate wet wiring common in geotechnical applications and it is capable of transmission of signals to long distances. Some of the applications of the temperature meter are listed.

- For verifying design assumptions that will promote safer and economical design and construction.
- Temperature rise during process of curing of concrete.
- Soil and rock temperatures near liquid gas storage tanks and ground freezing operations.
- Water temperatures in reservoirs and bore holes.
- Interpretation of temperature related stress and volume changes in dams.
- Study of temperature effect on other installed instruments.

2. Vibrating wire temperature meter

1.4 Operating principle

The vibrating wire temperature meter is designed on the principle that dissimilar metals have different linear coefficient of expansion with temperature variation. The temperature basically consists of a magnetic, high tensile strength stretched wire, the two ends of which are fixed to any dissimilar metal in a manner that any change in temperature directly affects the tension in the wire and thus its natural frequency of vibration.The dissimilar metal, in SME temp. meter, is brass. As the temperature signal is converted into frequency by the vibrating wire, the same readout unit as is used for other vibrating wire sensors, can also be used for monitoring of the temperature.

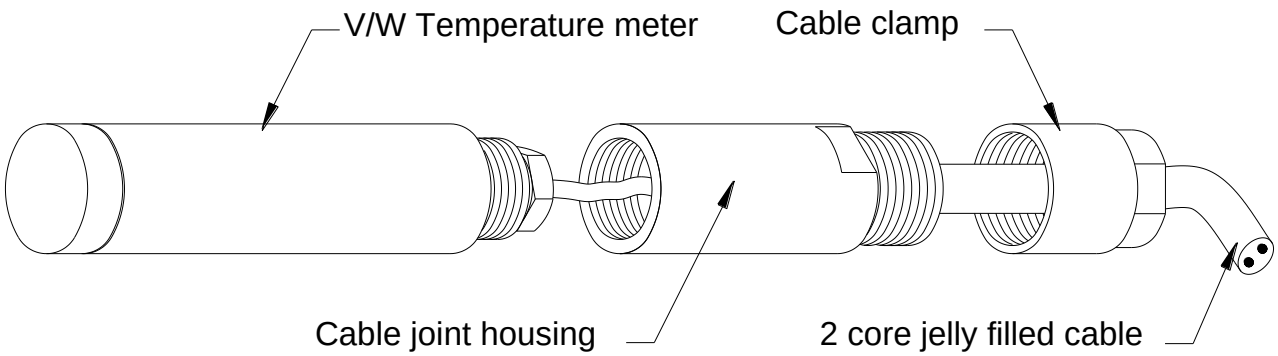
The wire is plucked by a coil magnet. The change in temperature is sensed by the specially built SME vibrating wire sensor and this signal is converted into frequency signal which is then transmitted to the readout unit model SME 2460-P.

For calibration, the time period , frequency or frequency square is measured at 0°C and 100°C. The difference in frequency is taken for calculating the K constant for that sensor.

The frequency which is proportional to the temperature and tension of wire is sensed by the readout unit and display the data in degree centigrade. Each sensor is programmed for its sl. no., K factor, I value etc.

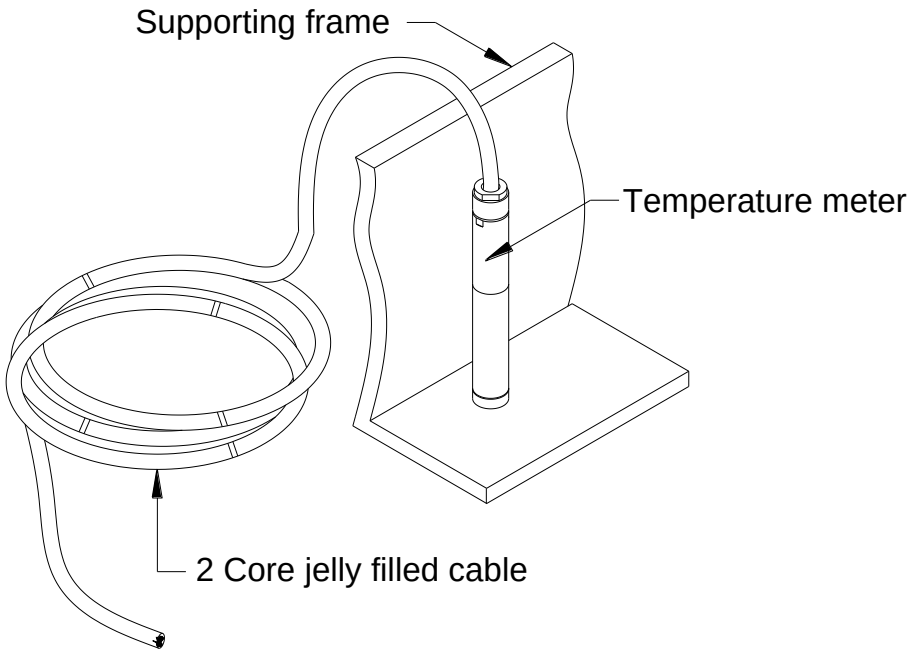
3. Installation Procedure

a) Cut and dress the 2 core cable of about 60 mm for jointing the sensor with jelly filled cable.
b) Check the working of sensor with readout unit model SME 2460-P. The frequency at room temperature should be stable.
c) Connect the required length of 2 core jelly filled armored cable with sensor as per the procedure laid down in the cable jointing manual.
d) Check the working of the sensor again and the frequency should be stable.
e) Attached the cable identification tags punching the sl.no. or T1,T2 etc. made of stainless steel sheet at every 5 or 10 meter interval to jelly filled cable.



4. Tools & accessories required for cable jointing and installation

4.1 Cable jointing compound of Mahendra Engineering & Chemical Products Ltd.
4.2 Soldering iron 25 watt.
4.3 Solder wire with rosin.
4.4 Hacksaw with 150mm blade.
4.5 Cable cutter.
4.6 Adjustable spanner.
4.7 Pliers 160mm.
4.8 Wire stripper
4.9 Surgical blade
4.10 S.S. rod dia 5mm and 150mm length.
4.11 Acetone (commercial)
4.12 Cloth for cleaning.
4.13 Tin cutter.
4.14 Wooden fixture for supporting the sensors.
4.15 Readout unit model SME 2460-P.



CABLE JOINTING FIGURE

Installing the temperature meter:

Installing of the temperature meter in the embankment of concrete dams and other structures is a fairly simple operation. No special orientation of the temperature meter is necessary. It can be directly placed on the concrete surface. The only care necessary is that any sharp points on the concrete surface do not damage the connecting cable.

a) Place some sand/gravel to form a plain surface in the concrete dam or the structure.
b) In case of a concrete dam or structure, pour concrete by a hand shovel to embed the sensor to a depth of around 0.5 m before commencing normal operation.

5. Cable laying in concrete dams and structures

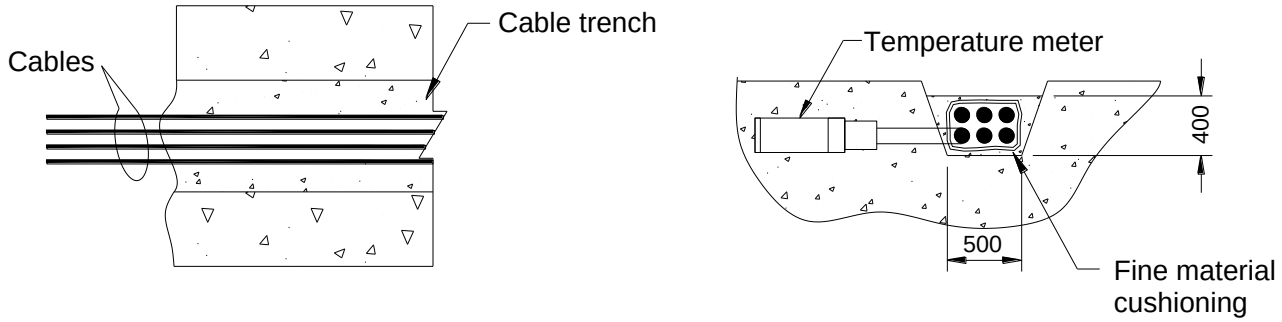
Very careful and skilled cabling is required in installation of the temperature meter as the sensor/cable joint and a large part of the cable is permanently embedded and no future access is available for any maintenance and corrective action.

As access galleries are available in concrete dams, the cable from the sensors is first routed to the gallery. These cables may be terminated in junction boxes inside the gallery. The data from the various sensors can then be taken or logged from the junction boxes with the help of a readout unit or data logger. Alternatively, if required, the signals from the junction boxes may be carried through multi core cables to any observation room outside the dam structure.

In a concrete dam, a number of temperature meters along with other sensors are installed at selected elevations at different cross sections. Cables from these sensors have to be taken to junction boxes to be mounted inside cross galleries. The gallery may be above or below the elevation at which the sensors are to be installed. As a general practice, all the cables from sensors at any particular elevation are routed to a vertical shaft on the upstream side of the dam. The cables are then lowered or lifted through the vertical shaft to the gallery.

At any cross section, the filling of the dam is allowed to continue to an elevation of around 25 cm higher than where the sensors are to be mounted, leaving 0.5 m X 0.5 m X 25 cm deep trenches at the positions where the sensors are to be placed. Larger trench may be left in case the temperature mater is to be installed along with other sensors, specially the strain rosette and the no stress strain meter which require more space. In case the latter are to be mounted along with the temperature meter.

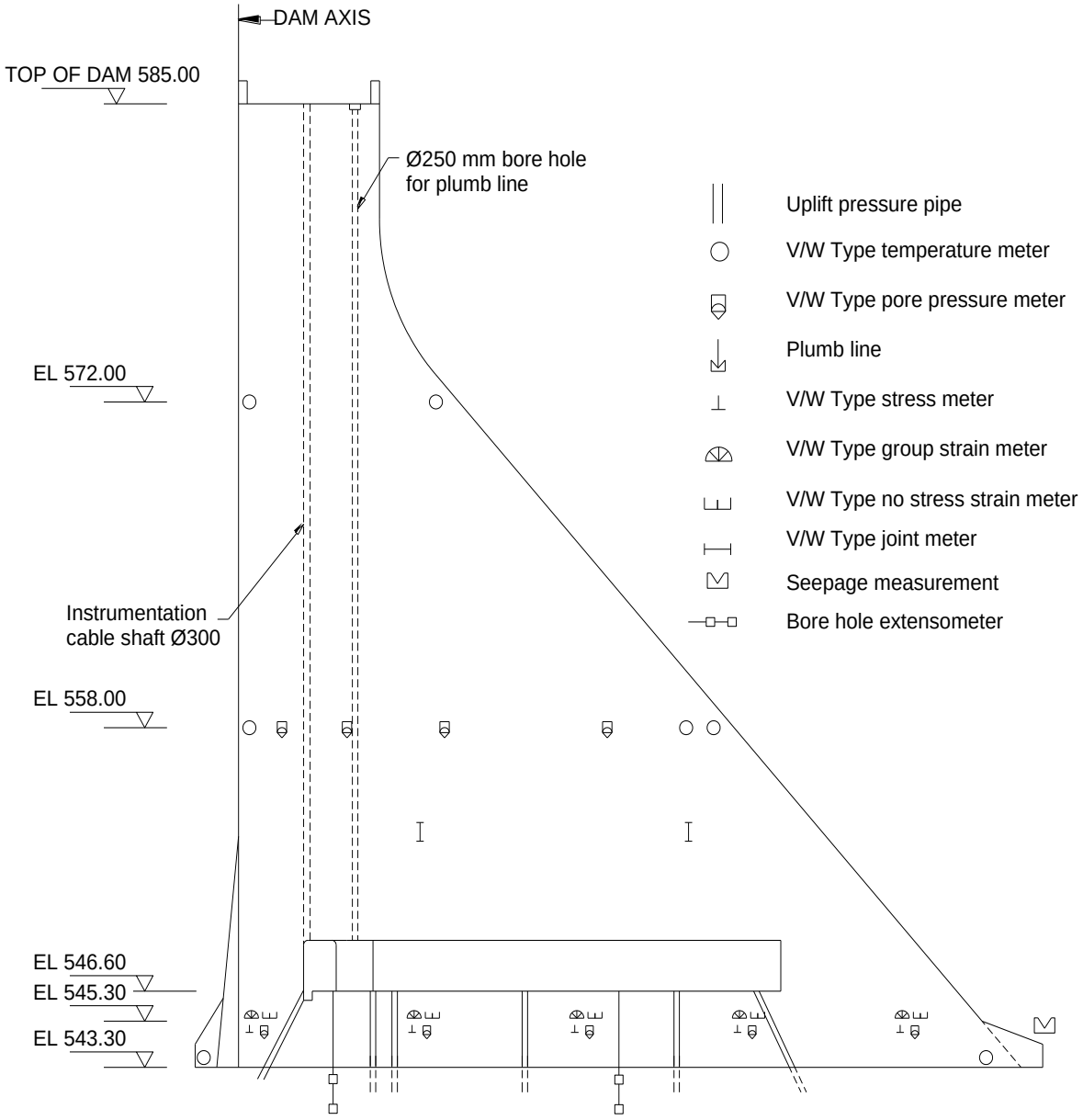
The cable from the sensors should be routed through a carefully marked channel trench ending into the vertical shaft and running parallel to the line of the sensors. The depth and width of the channel trench depends upon the number of cables the trench has to carry. In case all the cables at an elevation fit in one row, the depth of the channel can be around 10 cm. If more than one row is required to lay all the cables, the depth should be increased by 10 cm per row. Before laying the cables, the channel trench should be properly cleaned and leveled. Any sharp rocks or objects should be removed to prevent the cable from accidentally getting damaged. The center distance between successive cables should be kept at a distance of 25 mm with the help of the wooden cable spacer and cable rake provided. To take care of settlement effects and temperature effects during concrete setting, the cable should be zig zagged by providing a uniformly distributed slack of around 0.5 m in a 15 m length of each cable. After laying the cable in any row, it should be covered with concrete by a hand shovel to a depth of around 10 cm and allowed to set. This is necessary to prevent any accidental damage to the cables.



Method of cable routing

Precaution must be taken that the cables are properly tagged, onward from the point from which they come out of the dam or concrete structure into the vertical shaft.

CAUTION: All cables should be property identified by tagging them every 5 m or closer, onwards from the point from which they come out of the dam body into the vertical shaft. The tag should be of anon-corrosive material like stainless steel or plastics.



INSTALLATION OF TEMPERATURE METERS IN DAM

6. Observation Sheet

Model SME 2460-P Readout Unit

Sl. #	Date	Sensor no. Location E.L.	Sensor no. Location E.L.	Sensor no. Location E.L.	Sensor no. Location E.L.
		Temperature °C	Temperature °C	Temperature °C	Temperature °C
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					

6.1. Frequency of observation

There is no fixed rule on frequency of taking readings. Temperature readings should be taken every two hours after the concrete is poured, to determine the effect of heat of hydration. After that it may be taken every day during construction and at 15 days intervals thereafter. To determine diurnal effect, the readings may be taken once in the day and again at night. The frequency of taking readings may be reduced as the temperature stabilizes.

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