INSTRUCTION MANUAL

VIBRATING WIRE TYPE LOAD CELLS

SENSORS & MEASUREMENTS ENTERPRISES
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Instruction Manual of SME make
Vibrating Wire Type Base Support/Anchor Bolt Load Cell

General Specification:-

		Anchor Bolt Load Cell	Base Support Load Cell
Model	-	SME 2240	SME 2260
Capacity	-	10 to 200 ton	10 to 200 ton
No. of gages	-	3, 4 or 6	3, 4 or 6
Accuracy	-	Better than 1% (Standard)	Better than 1% (Standard)
Operating temp.	-	-20^0C to 70^0C	-20^0C to 70^0C
Material	-	Element stainless steel	Element stainless steel
Sensitivity	-	0.1%fs	0.1%fs

Description:-

The SME make base support/anchor bolt load cells are available in three, four or six, wire gauge technique. All the three, four or six wire are mounted vertically at an angle of 120°, 90° or 60° on the periphery of the loading axis .This technique minimizes the eccentric loading effect to a great extent. As in the underground mines, underground cavity or in tunnel it is difficult to get the perfectly parallel surface to mount the load cell. In such locations multi gage system is most suitable to measure accurate load measurement under difficult site conditions. Anchor bolt load cells Model 2240 are used to measure load on anchors or on tie rod etc. whereas Model SME 2260 i.e. base support load cells are used to measure loads under the roof supports in coal mines, in the steel ribs in tunnel lining at crown, spring level and at the rib supports or any other location in construction for compressive load measurement. The basic design difference in these two types is the anchor bolt load cell has a hole at the centre for mounting over the anchor bolt where as base support load cells which are used directly under the roof with some temporary support as in case of coal mines where the load cells are generally used with the high set proble/pit proble/wooden support and the load coming on load cell is not vertical and also not possible to load equally on the axis of the load cell. Here load cell model SME 2260 are designed with a base plate at the bottom and a top plate with top button assembly which provides a small self alignment facility for simplifing the installation. In these application the average of loads on multi gage system measures the actual load very accurately.

Working Principle :-

Load cell works on vibrating wire principle. In vibrating wire sensors the basic principle is that it has a special steel wire of known length which is rigidly fixed between two points and a permanent eletro-magnet is placed at a fixed distance near centre of wire, when this magnet is given a magnetic pulse through some source like readout model SME 2460-P wire starts vibrating to its natural frequency depending upon its length.
This frequency is read and displayed by readout unit The same can also be displayed in terms of time period, square of frequency or with little programming directly in engineering unit of required parameter.

The sensors basically works on tension or compression modes which increases or decreases the length of wire. This change in length of wire makes change in frequency also. As the square of frequency is proportional to change in length, the same is calibrated for range of any sensor. In load cell where load is not uniformly distributed on all body of the element due to eccentric loading, a multi wire system is preferred to get accurate load by averaging the load on different wires. Here each wire works as an individual sensor for load measurement at that portion and the average gives the accurate load.

Installation Procedure of base support / roof support load cell in coal mines with the high set probe / pit probe / wooden probe.

Please note that as in a simple vibrating wire sensor, it will have only two core cable where as in multi wire system it will have one core each for each wire gage

plus one common core for one sensor i.e. a three vibrating wire load cell will be supplied with a four core cable. Generally black color lead is a common lead whereas green, yellow and red will be gage wire leads.
Before actual installation starts it is always recommended to make initial check for proper working of the load cell you are going to install.

It is always recomended to install the load cell below the support by making surface plane & rigid to get the better result. However load cell can be installed over the probe also if the bottom is having water /mud etc.
Select the hydraulic prop leak proof or wooden prop strong so that leakage or compression should not take place after load is applied.

Now put the load cell under the steel probe/wooden support/ hydraulic probe keeping top plate and button plate assembly vertical to roof and install in position between roof and floor. Apply the pressure on steel/wooden/hydraulic probe by conventional method up to the 1 / 2 ton. Care should be taken to minimize eccentric loading and this can be adjusted best possible by checking and controlling the load distribution seeing the load on readout unit. This can be done by forcing the load cell little inward the side showing less load .

Now take the frequency of all the three wire with the help of readout unit. For this connect the readout model SME 2460-P with load cell as follows:

Connect common black lead of load cell with crocodile clip having black lead and connect red crocodile clip with green lead of load cell. This way you have connected first gage wire of load cell to readout . Now switch on the indicator and put the readout in frequency mode and note down the frequency. Please check here that the data should be stable within ± 1.0Hz

Now remove red lead of load cell and replace it with yellow and note down frequency of second gage wire as above and finally note down frequency of third gage wire

by replacing yellow with red lead of load cell . Please note that black lead of load cell will remain and always be kept intact with black of readout unit.
In case you find that data is not stable within said limits, replace the load cell with another correct one which falls in limit .

Installation Procedure of roof bolt /anchor bolt load cell in coal mines with the roof bolt:-

a. Grout the roof bolt/ anchor bolt at the correct location in the roof leaving the the threaded end of rock /roof bolt about 120 mm to 130 mm out from the roof surface as shown in the installation drawing.
b. After roof bolt grouting become hard the load cell installation can be started.
c. Place the spacer plates on the top & bottom of load cell and insurt complete load cell in the anchor bolt/o of bolt as shown in the installation figure.
d. Hand tight the anchor bolt (nut).
e. Now connect the readout unit and take the initial frequency (I value) of each wire and note it down.
f. Program the readout unit as described below for each wire of load cell.
g. Go in measure mode of readout unit and see the load in each gage wire.
h. Start tightening of roof bolt (Nut) with the help of suitable spanner till the readout unit shows nearly 2/3 ton of load from each gage wire.(average load).This load is called setting load and should be considered as zero.
i. Now the installation of this load cell is over and the reading should be taken as & when required by subtracting the setting load from present load.

Programming of Readout unit:-

Note:- It ia always recommended that programming of load cell to be done after 20 or 24 hours from the installation time, it is because the load on load cell will stabilized due to compression in

the wooden prop or some leakage may take place in the hydraulic prop. Due to above reason you may get some negative data from the load cells.

Now program the readout unit following Readout Instruction manual with the help of Load cells test report.

1) Press the APPEND button display will ask ID. no. of load cell. Let the sl. no. of load cell is 265. Then the sl. no. of different gage wire during programming will be 2651 for green i.e. for first gage and similarly, 2652 and 2653 will be indicative for yellow and red i.e. second and third gage respectively . Feed the ID no. and enter.
2) Display will ask K. Factor. Feed the K. factor in 6 digits as given in test report and enter. Display will ask unit.
3) Feed the unit 03 (for Ton) and enter. Display will ask I Value (Frequency).
4) Feed the I value (Frequency) in 4 digits taken after installation of load cell and press enter. Display will ask sign.
5) Feed the sign 01 and enter.
6) Display will ask NEXT/END. Press next button. Display will again ask ID no of load cell. Feed the next sl.no. of load cell and other parameters as asked by the readout unit.

Similarly program the third wire of load cell with above method and press END button when it is asking NEXT/END.

After completion of programming you can see the data s in engg. unit of individual gage wire. For this, connect the common black lead of indicator to black lead and red lead of indicator to green of load cell and proceed as under.

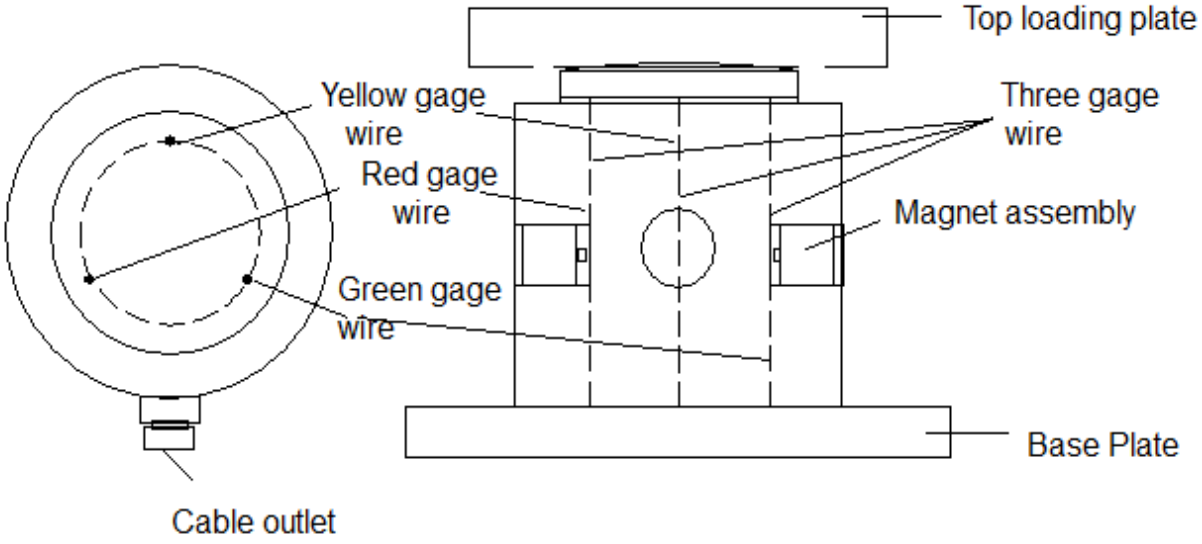
1) Press the MEAS.button display will ask ID.no. feed the sl.no. of load cell say here as 2651 and enter. Readout unit will display the data in Ton. Note down 2) Change the lead from green to yellow and press MEAS. The display will ask ID.no. Feed the sl.no of load cell i.e.2652 and enter. Readout will display the data in ton note this data and press enter.
3) Change the lead again from yellow to red and press MEAS. The display will ask ID.no. Feed the sl.no of load cell as 2653 & enter. Readout will display the data in ton . Note this data and press enter.
4) Add all these three datas and divide by three, You will get average i.e. actual load showing by the load cell which may be nearly zero.

Recording of data's:-

Now every day you can take the load cell data by above method. Some examples are given below for your reference.

1. The data noted between:-
Black & Green (2651) say 2.34 Ton
Black & Yellow (2652) say 2.85 Ton
Black & Red (2653) say 2.17 Ton
Actual load on load cell will be average of these three i.e. 2.34+2.85+2.17/ 3 = 2.45 Ton

Now if next data is taken after few days ,we find
Black & Green (2651) say 7.82 Ton
Black & Yellow (2652) say 10.15 Ton
Black & Red (2653) say 5.42 Ton
Load on load cell at that time will be average of these three i.e.7.82+10.85+5.42 / 3 = 8.03 Ton



Detail of three gage wire load cell

Re-installation of load cell from present location to new location.

It is required to shift the load cell from present location to new location to monitor the load coming at new location.

1) Re-install the load cell under steel probe or wooden probe or hydraulic probe by giving the initial load of 1/2 ton and as per the instructions given in the manual.
2) Measure the I value (Frequency) of each wire and note down.
3) This new I value to be modified by replacing the old I value already entered in the program of this load cell.
4) For modification of this I value press the read button the display will indicate first ID no. of the load cell programmed . Press the enter button it will indicate K factor. Press the enter button it will indicate unit . Press the enter button it will indicate I value. Press enter button it will indicate sign . Press the enter button the indicator will display sign again. Now you have to see next load cell programming data. Press NEXT button you will get next ID no.of load cell. Go on pressing enter button then next button till you get the desired load cell no. which is to be modified.
5) After getting the desired load cell no. go on pressing the enter button till you get I value display. This I value to be entered in place of old I value. Feed that I value and enter. The sign value will come .Press enter and then press NEXT.
6) Now you will get next ID no. of load cell .Go on pressing the enter till the I value appears on the display. Feed the new I value and enter. Similarly, modify the frequency of third wire with the method described above.
7) By modifying the frequency in all the three wire of load cell you can take the data in engg. unit by going into measure mode.

Note :- Each load cell I value (Frequency) to be modified if the load cell is re-installed .

IMPORTANT NOTE:-
The data of load cell can be calculated by taking the frequency of each wire ,if the readout unit is showing not programmed with the help of following formula:-

$(F1^2 - F2^2)$ K. Fact. in 5 digit given in test report $X\ 10^{-9}$
Whereas F1 is initial frequency noted after installation of load cell and F2 is present frequency .
Example:-
F1 Green = 2526
Yellow = 2532
Red = 2503

= 7561/3

Average F1 = 2520

F2 Green = 2526
Yellow = 2532
Red = 2503

= 7424/3

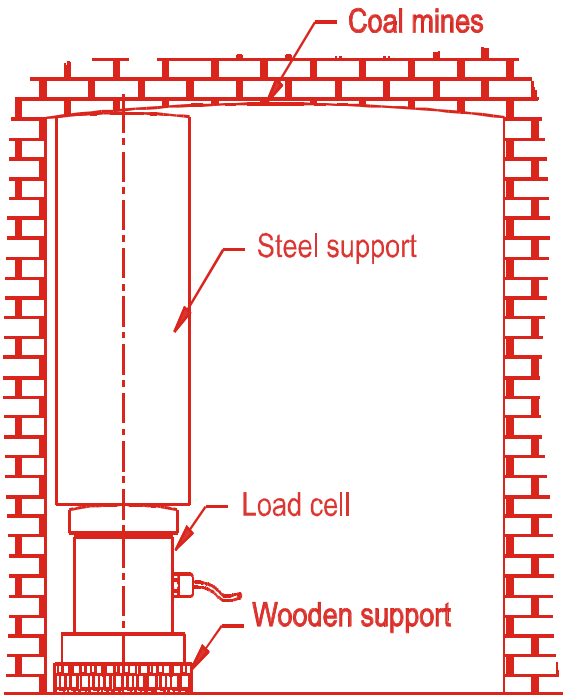
Average F2 = 2474.6 or = 2475

Now F1 $(2520)^2$ = 6350400

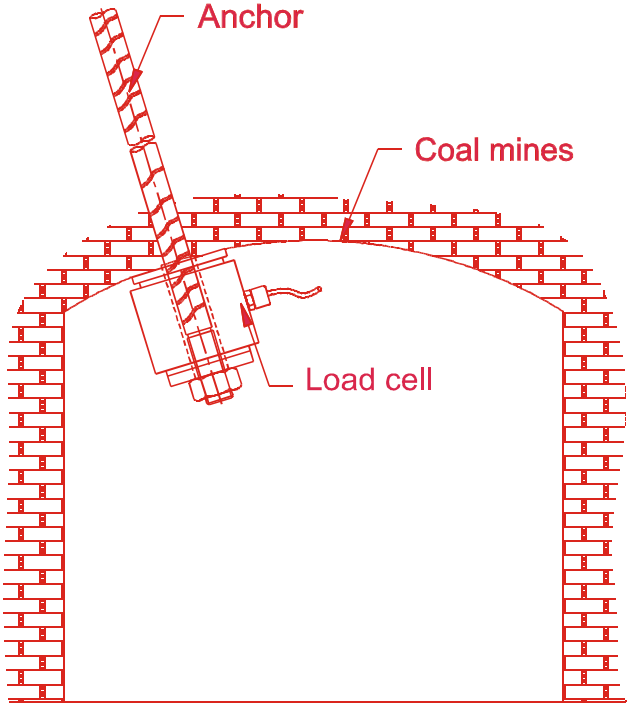
F2 $(2475)^2$ = 6125625

$(F1^2 - F2^2)$ = 6350400 - 6125625 = 224775 X 13098 X 10^{-9} = 2.94 Ton.

This 2.94 Ton is the average load coming on load cell.
So with the help of above method you can find out the load by taking the frequency if, readout is showing programming problem.



Installation figure of base support load cell



Installation figure of anchor bolt load cell

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