Vibrating Wire Concrete Stress Cell
User Manual

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Section 1 : Foreword

It is essential that the equipment covered by this manual is both installed and operated by competent and suitably qualified personnel. They must **READ AND UNDERSTAND** the procedures outlined in this manual before attempting installation or operation of the equipment on site. Failure to do this may result in degraded performance and reduced reliability.

All systems are designed to operate consistently under normal field conditions. Although the components are relatively robust for such sensitivity they will not survive mishandling or neglect.

WARNING: **Treat all items with respect and handle with care**

Obviously these techniques can only serve as a general guide and will require modification to suit particular circumstances on site. If difficulties are encountered time will usually be saved by contacting Soil Instruments at the earliest opportunity.

Section 2 : Introduction

The cell consists of a rectangular flat jack formed from two sheets of steel welded around the periphery and filled with oil or mercury. The cell is connected to a vibrating wire pressure transducer by a short length of stainless steel tubing forming a closed fluid system. The cell also incorporates a compensating tube which allows adjustment of initial cell volume to offset concrete shrinkage by progressively crimping the tube from its welded end using the crimping tool provided. See sketch page 7.

The cells are designed for measurements in shotcrete, concrete and rock. They are usually employed in shotcrete and concrete tunnel linings to measure radial, circumferential and axial pressures. Cells may be used to monitor stress changes in the rock walls of underground works, in which case slots are machined by diamond wheel sawing or line drilling, the cell being embedded in cement mortar within the slot.

NOTE: It is important that persons installing mercury filled pressure cells should thoroughly acquaint themselves with the health hazards associated with mercury and take due precautions to protect themselves. Details of mercury regulations, handling procedures and emergency action are available from Soil Instruments in a separate information pack.

Section 3 : Installation

Proper installation of a total pressure cell is most important if correct readings are to be obtained. Ideally the material immediately adjacent to the cell should be identical to that in the general area under investigation.

3.01 Installation in Shotcrete/Concrete Lined Tunnels

All cells placed at a shotcrete/concrete-rock interface **MUST** be bedded on a pad of mortar, to ensure that the stress is applied to the cell reasonably uniformly. Where the installation is in the invert of the tunnel the cell may be bedded directly onto a wet mortar pad. At other positions around the tunnel it will be necessary to cast the mortar pad first using suitable form work before placing the cell on the prepared pad. The cell is then attached to the prepared mortar pad by suitable masonry pins and/or resin mortar prior to embedment.

Cells placed wholly within the concrete structure can be cast in place with the concrete by attaching them to the form work but **CARE** must be taken to avoid damaging the cells.

The cell compensating tube can be **CAREFULLY** bent to the required position beneath the form work and protected by greased paper. Use wire tied to the underside of the shuttering to facilitate location. When the shuttering is removed ensure that the wires are cut to free the compensating tube.

3.02 Installation in Rock

For installation into rock it is recommended that cell is installed in a slot. This slot can be line drilled (use a 50mm diameter drill bit at 40mm centres with a template) or machined with a diamond wheel saw. After the cell is placed the slot must be grouted up with the cell properly supported by spacers e.g. small pre-cast mortar blocks.

If the slot is down hole, grouting is easily carried out by tremie pipe ensuring that these are sufficient to grout all parts of the slot. The pipes should be raised slowly to keep pace with the filling operations taking care not to trap air.

If the slot is uphill than the cell must be suitably supported by the spacers before constructing a temporary grout retaining form work over the slot. Connecting cable, compensating tube and grouting pipe must all pass through this form work and all of the resulting holes must be properly sealed. As well as the grout injection pipe, placed at the mouth of the slot it will be necessary to place small air bleed pipes to the top of the slot.

To withdraw the air bleed pipes it will be necessary to pump grout through the injection pipe until a return flow is flowing from all of the bleed pipes. These can then be slowly removed one at a time ensuring that the grout flow is maintained and that the resulting hole is immediately plugged. Ensure the grout has cured before removing the retaining form work.

3.03 Compensation for Shrinkage

Shotcrete/concrete or grout surrounding the cell is likely to shrink on curing. This will result in loss of contact between cell body and surrounding surfaces. To restore this contact, it is important to inflate the pan by supplying it with fluid from the compensating tube.

After installation when sufficient time for curing of shotcrete/concrete or filling resin/grout has elapsed, the cell surfaces will need inflating to make contact with surrounding material. Mercury/oil is forced into the pan by crimping the tube from the welded end. This operation requires extreme care to avoid over compensation which will reduce the working range of the cell.

Compensation by crimping is carried out by the following simple steps:

Step 1 Connect the vibrating wire pressure transducer to a Vibrating Wire readout.

Step 2 Using the crimping tool, start flattening the compensating tube from the sealed end. Monitor the transducer reading continuously while crimping of compensating tube advances.

Step 3 With the onset of an increase in the value of the incremental reading stop the crimping. The cell pan plates are now in contact with concrete face and further crimping of the tube will increase the reading at a fast rate.

Step 4 To avoid over compensation final crimping is done very slowly to achieve a pre-determined initial zero reading. Allow the cell to settle down and take initial installed reading.

NOTE: **Volume of mercury/oil displaced from compensating tube into the cell may be calculated from the length of the crimped tube. This can be used to evaluate shrinkage and quality of concrete at various cell locations on a site.**

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DECLARATION OF CONFORMITY

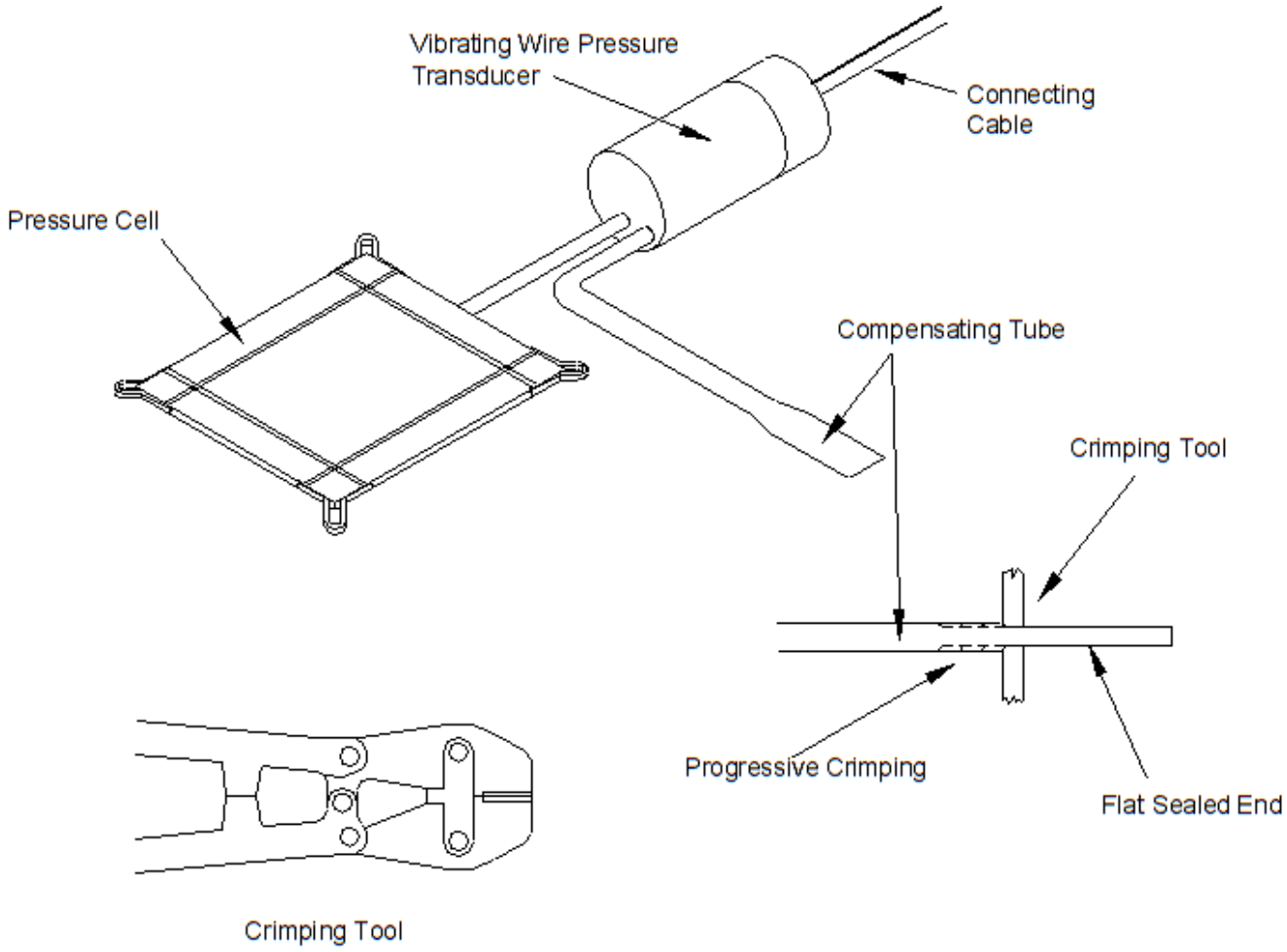
WITH

COUNCIL DIRECTIVE 73/23/EEC as Amended by 93/68/EEC

Date of Issue:	12th October 2006	
DoC Ref.:	Soil/CE/LVD/WW/06	
Directive:	72/23/EEC Low Voltage Directive as amended by 93/68/EEC	
Conforming Apparatus:	All Vibrating Wire Instruments Manufactured by Soil Instruments Ltd – see pages 3-10 of Technical File	
Manufacturer:	**Soil Instruments Ltd**	
Responsible Person:	Chris Rasmussen Soil Instruments Ltd Bell Lane, Uckfield, East Sussex, TN22 1QL	
Standards Referenced:	Annex I of Directive	1.a, 1.b, 1.d, 2.a, 2.b, 2.c, 2.d, 3.a, 3.b & 3.c
Technical File:	Soil Instruments Ltd – EU Low Voltage Directive 73/23/EEC as amended 93/68/EEC Technical Documentation. Issue 1 – October 2006 – Vibrating Wire Instruments	

We hereby certify that the apparatus described above, conforms with the protection requirements of 72/23/EEC Low Voltage Directive as amended by 93/68/EEC on the approximation of the laws of the Member States relating to Low Voltage Equipment.

Signed: 	
Signatory: Chris Rasmussen Technical Director	



Pressure Cell Compensation