Effective protection for weighbridge load cells

Weighbridges, often outdoors and in exposed locations, are very susceptible to damage from lightning. Nearby lightning activity can cause devastating transient overvoltages on weighbridge signal lines, destroying load cells, amplifiers and displays - resulting in costly system downtime.

The Furse ESP LDC is specifically designed to provide load cells, amplifiers and displays, with effective protection against damaging transient overvoltages caused by lightning.

Furse ESP LDC for:
- Load cells
- Weighbridges
- Railway weighbridges
- Process and batch weighing
- Weighing silos

The Furse ESP LDC can be used on either 4 or 6 wire systems and, with a simple adjustment, on either 15 or 30 volt systems.

Furse ESP LDC provides effective protection by reducing the transient overvoltage 'let-through' to weighing equipment, to a low and harmless level – without degrading or impairing the system's normal operation.

Furse ESP LDC
- Low 'let-through' voltage
- Protection between all conductors
- Low in-line resistance
- Suits most applications
- Easy to install

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1. INTRODUCTION
Weighbridges can be damaged not only by transient overvoltages (the secondary effects of lightning) but also, because of their often exposed locations, by direct lightning strikes. Complete protection against direct strikes cannot be guaranteed. However, by following the guidance in this Application Note, the incidence of damage will be greatly reduced.

Most cases of weighbridge damage are caused by the secondary effects of lightning. Correct use of Furse ESP transient overvoltage protection and where necessary good earthing and bonding practices, will eliminate the risk of transient overvoltage damage.

1.1 Typical weighbridge installation
A weighbridge consists of a platform on a foundation. The platform sits on load cells (typically 4 or 6 in number) which measure weight. The load cells sit on the metal foundation plate. Weight signals from each load cell are transmitted to an indication unit housed in a nearby building.

2. APPLYING TRANSIENT OVERVOLTAGE PROTECTION
2.1 Load cell protection
Weighbridge load cells are most commonly configured in one of two ways.

CASE A - Where load cells are individually wired back to the indication unit building, one ESP LDC protector should be installed close to each load cell.

CASE B - Alternatively load cells may be wired to a common junction box on the weighbridge, from where a single 4 or 6 wire cable is connected to the indication unit building. All load cells can be protected by a single ESP LDC protector, provided:

i) The weighbridge deck is constructed from metal which is either continuous or cross-bonded (see 3.2 iii).

ii) The load cell to junction box wiring is in bonded metal conduit (see 3.1 (c)).

If this is not so, as with concrete weighbridges, then individual protectors should be installed for each load cell - as in Case A. If the junction box does not common the cables, then individual protectors will again be required - as in Case A.

2.2 Indication unit protection
All incoming signal lines should be protected on the input side of the indication unit.

- Where data transmission to the indication unit is by a single 4 or 6 core cable, a single Furse ESP LDC is required.
- If data transmission to the indication unit is by (a) individual cables from each load cell, or (b) multicore cable containing individual cables from each load cell, then one Furse ESP LDC is required per load cell.

2.3 Wiring of load cell protectors
The Furse ESP LDC can be used on either 4 wire or 6 wire load cells and can be configured for use on 12/15 volt or 24/30 volt load cells. There are two cable screen connections on a Furse ESP LDC, enabling the bonding practice dictated by the load cell manufacturer to be followed:

- The 'earthed screen' allows the cable screen to be directly connected to earth,
- The 'isolated screen' leaves the cable screen unearthed and only connects it to earth during transient activity.

2.4 Protection of mains power supply
The indication unit should also be protected against transient overvoltages on the mains power supply. Typically a mains wire-in protector (ESP 240/415 or ESP 120/208) will be installed at the distribution board feeding the indication unit. On smaller installations, a plug-in protector (such as the Micro Conditioner) may be more suitable. Product datasheets are available on request.

2.5 Other protection
Lightning can affect other pieces of equipment connected to power or data lines which are routed outside. Details of protectors for other applications, such as telephone lines, are available from Furse.

3 EARTHING AND BONDING REQUIREMENTS
Unless good earthing and bonding practices are followed, the effectiveness of the Furse ESP LDC against transient overvoltages, will be severely reduced. In the event of a lightning strike directly to the weighbridge, good earthing and bonding will reduce the possibility of damage.
3.1 Overview of weighbridge earthing and bonding

A. The weighbridge should be properly earthed. Earth rods should be installed close to each load cell. (See 3.2 i & ii).
B. The weighbridge should be bonded to the main earth bar in the indication unit building. Furse TC030 copper tape can be used for this purpose.
C. Wherever possible, all wiring on the weighbridge should be enclosed in metal conduit. Both ends of the metal conduit(s) should be bonded to the metalwork of the weighbridge - a metal conduit saddle clip may be used for this purpose. (See 3.2 iii).

![Diagram of weighbridge earthing](image)

1. The cable run between the weighbridge and indication unit building, should be in a metal conduit or duct. This should be bonded to the metal of the weighbridge at one end and the main earth bar in the indication unit building at the other.
2. All Furse ESP LDC protectors should be properly earthed. Units installed on the weighbridge should be earthed to adjacent (earthed) metalwork. Units installed in the indication unit building should be connected to the building's main earth bar. Detailed guidance on the installation of Furse ESP LDC is contained in the installation instructions supplied with each unit.
3. Where other Furse ESP transient overvoltage protectors are in use, these should also be properly earthed. Where the power supply is protected with a wire-in protector at the power distribution board, the protector should be properly connected to the main earth bar. Similarly, Lightning Barriers for data communication and telephone lines should be connected to the main earth bar.

3.2 Detail of weighbridge earthing

i) Installation of earth rods

Earth rods should be installed close to each load cell. Each should have a measured earth resistance of less than 10 ohms multiplied by the number of earth rods/load cells. Since most weighbridges have 4 or 6 load cells, the earth resistance should either be less than 40 ohms or less than 60 ohms respectively.

Furse RB205 earth rods joined with Furse CG270 couplers, should be driven into the ground until the required resistance is achieved. A Furse ST200 driving stud should be attached to the rod via a Furse CG270 coupler, during driving. NB: Care should be taken to ensure that the spacing between rods is not less than their length.

ii) Weighbridge to earth rod connection

The base of the weighbridge can be connected to each earth rod with a length of Furse TC030 copper tape. The copper tape can be connected to the earth rod using a Furse CR105 clamp. (It is recommended that underground joints are protected using Furse TD005 denso tape). The rod installation can be covered and housed within a Furse PT205 earth pit. At the other end the copper tape can, in most cases, simply be drilled and joined to the foundation plate - making use of the existing bolts.

The foundation plate should be connected to the weighbridge platform with a flexible link - this should be installed close to, but not touching, the load cell. The flexible link can be joined to the foundation plate at the same point as the copper tape and making use of the same bolts. The other end of the flexible tape is simply bolted to the weighbridge platform, Furse produce a 200mm flexible link (Furse BN505) and a 400mm flexible link (Furse BN510).

All the connections to the weighbridge platform and foundation plate should be made using Furse CM005 inhibitor compound.

iii) Other bonding requirements

- The Furse ESP LDC protector should be earthed to the adjacent continuous metalwork of the weighbridge.
- The ends of all metal conduits should be securely bonded using a metal conduit saddle clip.
- If the surface of the weighbridge is metal sections it should be made electrically continuous with at least two well spaced bridging links across any joints.
- These bridging links can be made out of Furse TC030 copper tape drilled at each end and fixed by bolts.

Details of materials for earthing and bonding are contained within the Furse Earthing and Lightning Protection catalogue. Technical guidance is contained in the Furse Consultants Handbook.
ESP LDC

EFFECTIVE PROTECTION
Furse ESP LDC provides effective protection by restricting the 'let-through' voltage below equipment damage levels. On 15 volt signal lines the maximum transient overvoltage 'let-through' the ESP LDC will be just 25 volts. When configured for 30 volt signal lines the maximum transient overvoltage 'let-through' the ESP LDC is just 43 volts.

TOTAL PROTECTION
Furse ESP LDC provides effective protection between all conductors.

LOW IN-LINE RESISTANCE
This performance is achieved without introducing excessive resistance into the line. The low in-line resistance of ESP LDC allows effective protection without signal degradation and reduced signalling distance.

Performance specification
Maximum working voltage 1 15V or 30V* 1
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Peak 'let-through' voltage 1 line to line/earth 25V when rated for 15V lines 43V when rated for 30V lines earth to isolated screen <600V
Line resistance 3 2.2Ω
Bandwidth (50Ω system) 10 MHz

1 Working voltage at less than 10mA leakage
2 Peak transient 'let-through' voltage 2 10% (50V/10/700μs test to BS 6651:1992 Appendix C, Category C - High and C(T)T(T) IX K7)
3 Insertion resistance in each line ± 10%
* Maximum working voltage can be increased from 15V to 30V with the removal of the link connector.

Technical data
Rated discharge current 10kA (8/20μs) BS 6651:1992*
Response time less than 10 nano seconds
Maximum running current 300mA
Working temperature -25°C to +70°C
Connections 1.5mm² stranded
Cable glands accommodate 6-12mm diameter cable
Earthing Mo stud
Outer enclosure Polycarbonate, rated to IP67
Dimension (mm) L* W D
170 80 68
Fixing centres 150 x 60mm M4 clearance

VERSATILE
The Furse ESP LDC has been designed to provide weightbridges and load cells with effective protection and will suit most applications. Furse ESP LDC can be used on:
- 4 or 6 wire signal lines
- Circuits with either an earthed or isolated screen
- Systems with a working voltage of up to 15 volts or, with the removal of the link connector, up to 30 volts
- With an IP67 enclosure, for dirty, wet environments

Interior of Furse ESP LDC shown connected to a 6 wire circuit with an isolated screen. The ESP LDC can be used on circuits with a working voltage of up to 15 volts, or with the removal of the red link connector on circuits up to 30 volts.

EASY INSTALLATION
Furse ESP LDC is designed for easy installation:
- Install in series
- Holes for flat mounting
- Substantial earth termination
- Ready boxed in its own IP67 enclosure
- Straightforward and comprehensive installation instructions

After installation of Furse ESP LDC, weighing measurement systems will need to be re-certified and may require recalibration.

Connection schematic

W. J. Furse & Co. Ltd.
Electronic Systems Protection Division,
Wilford Road, Nottingham NG2 1EB.
Tel: (0115) 986 3471. Fax: (0115) 986 0538.