RDP Customer Document

Technical Manual

GENERAL LOAD CELL APPLICATION NOTES

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Affirmed by Declaration of Conformity

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Index

Introduction

This document contains information regarding the installation of various load cells supplied by RDP Electronics.

Section 1 contains information for model 31 load cells up to and including 1000g capacity.

Section 2 contains information for model 31 load cells with capacities greater than 1000g, and other load cell types.

IT IS VERY IMPORTANT THAT THE CORRECT INSTRUCTIONS ARE FOLLOWED, AS INCORRECT INSTALLATION COULD CAUSE IRREPARABLE DAMAGE TO THE LOAD CELL.

SECTION 1 – MODEL 31 LOAD CELLS UP TO 1000G

These instructions apply to low capacity Model 31 cells (up to and including 1000 g capacity). For higher capacities refer to Section 2.

The Model 31 load cells require some care in handling and installation to avoid permanent damage to the load cell.

1. The low capacity Model 31 load cell is shipped with the active threaded stud removed. The active threaded stud has threads on both ends and should be finger-tightened into the load cell body.

2. The threaded stud on the base of the load cell is machined as an integral part of the load cell. The base can be threaded into the customer's part by grasping the main body of the load cell, rotating the load cell and cable assembly until finger-tight.

3. Caution should be used when attaching the active threaded stud to the customer's fixture. The customer's fixture should not be threaded below the shoulder at the bottom of the active threaded stud. The customer's fixture should not be tightened more than 8 in.lbs (0.9Nm), which is about finger-tight. No tools should be used in assembling these parts.

4. The tension or compression force to be measured must be applied as much as possible in a vertical direction along the centre line of the mounting studs.

5. Bending moment or torsion forces in excess of 3 in.lbs (0.35Nm) could cause permanent damage to the load cell.

The low capacity Model 31 load cell is available with optional mechanical overload stops for both tension and compression. The mechanical stops will usually protect the load cell from forces in the tension and compression direction; however, the load cell may be damaged by either a bending moment or excessive torque during installation. The optional mechanical overload stops will not protect the cell from bending moments or applying excessive torque to the threads. The most obvious result of damage to the load cell is the residual unbalance of the strain gauge bridge. The strain gauge bridge is balanced at the factory to within two per cent of the full rated output in millivolts. The addition of the customer's fixture will change the zero balance depending upon the weight of the fixture. Excessive unbalance can be attributed to damage resulting from excess torque or bending moment.

The low capacity Model 31 load cell has two welded stainless steel diaphragms on the top and bottom side of the active element to protect the load cell from the effects of off-axis loading. For example, a 100% full-scale load applied at 90 degrees to the base of the active stud would create a maximum error of only 2%. A 100% full scale bending moment load applied at 90 degrees to the vertical axis of the load cell and 50mm above the surface of the load cell would create a maximum error of only 3%.

The above specifications are to be used as guidelines only and the loads specified are static loads. Damage may occur from shock loads or dynamic loads that never exceed the above limits. Each application is different and we recommend the use of the mechanical overload stop options as much as possible to avoid unintentional overload damage.

SECTION 2 - GENERAL LOAD CELL APPLICATION NOTES

Please read these notes carefully before attempting to install a load cell

REMEMBER, although load cells may look extremely rugged, they contain delicate sensing devices and can be very easily damaged by misuse rendering the unit unserviceable or subject to an expensive repair

1. **DO NOT** allow the load cell to swing by its cable.
2. **DO NOT** allow a load cell to drop onto the floor.
3. **Low rating load cells** can be easily damaged by squeezing between fingers. Always handle these devices with extreme care as they can easily be overloaded
4. **NEVER** hammer a load cell into place. Shock loads can permanently damage some units
5. **NEVER** exceed the specified input voltage rating when energizing a load cell. Over voltage will overheat the strain gauges and cause them to burn out
6. **DO NOT** apply excessive torque between the centre and outer diameters of the cell. See below.
7 **ENSURE**, wherever possible, that the cell cannot be overloaded,
8 **BEWARE** of shock loadings. These can be very high and, although of short duration, can easily cause permanent damage.
9 **ENSURE** the surface to which a load cell is to be attached is flat within 0.0002" (i.e. 2 parts in ten thousand) and that the surface finish is better then 16 micro-inch.
10 **For Flat Load Cells**, use a good quality steel for the base, having a minimum hardness of Rockwell C30 (B105). In order to avoid distortion and consequent errors, ensure the mounting plate thickness is at least 1.5 times the cell height.
11 **ENSURE** loadings are only applied axially to a cell otherwise errors will occur.
12 **ENSURE** no extraneous torque and/or bending loads are applied to a cell as these can easily overload and destroy it.
13 In any event, the sum of all forces applied to a cell must **NEVER** total to a figure in excess of the cell rating. (refer to cell data sheet for details).
14 When a radiused load button is used for compression loadings, the load must be applied via a hardened flat surface. **DO NOT** attempt to shape the loading surface to match the load button.
15 It is often difficult to mount sub-miniature cells and generally is achieved with external clamping or adhesives.
Care should be taken to ensure that adhesive is not present between the loading surfaces, and if clamps are used they should be confined to the side wall area and never allowed to clamp the central loading section. Failure to fix a cell correctly will result in a poor performance and a loss of accuracy.

The following information relates primarily to low profile cells such as the universal Model 41 or the compression-only Model 43. It will help determine the correct torque tightening values for centre and hold down bolts.

It is most important to appreciate that a load cell cannot withstand unlimited torque on the sensing structure of the cell. Please, therefore, take this fact into account when tightening central connecting bolts. Do not allow the torque to be transmitted into the load cell body.

Hold-Down Bolts

For universal cells it is important that the cell outer ring in contact with the mounting surface remains fully located during tensile and compressive loading. If this is not ensured, then non-linearity may result.

As most load cell mounting bases are manufactured from softer materials than the heat treated load cell, the inter-surface pressure should be kept high. As a general rule, load cells should whenever possible be evenly bolted down with a load equivalent to twice the cell rating. This can usually be easily achieved with the smaller capacity cells.

The table below provides details of the maximum recommended torques for standard 12.9 grade steel metric cap screws lubricated on the thread and under the head with a molybdenum based grease.

When the x 2 factor can be applied, the required tightening load/bolt can be calculated from:

$$P = \frac{Load\ Cell\ Rating \times 2}{Number\ of\ Bolts}$$

This then gives the pre-tension in each bolt and the torque required to induce this tension can then be determined by the empirically derived equation;

T = KDP

where : T = the tightening torque in Nm
D = nominal bolt diameter in mm
P = pre-tension in kN
K = the torque coefficient

Assume K = 0.17 for standard alloy steel bolts lubricated with molybdenum based grease.

Obviously care must be taken to ensure that the bolts are not over-stressed and generally should not be loaded beyond 75% of their maximum yield value. This may influence the choice of bolt type and/or base material.

The following table is provided as a helpful guide.

The large diameter centre bolt should also be pre-tensioned to the full cell rating if the cell is to be used in tension and compression**. This can best be achieved by simply applying full-scale tensile load and then tightening down the locking nut with a small amount of torque**. This will ensure that the thru-bolt cannot move in the threads in normal universal operation. If in doubt, please consult our Technical Department.

EG. CHARACTERISTICS FOR STD. 12.9K GRADE ALLOY STEEL METRIC CAP SCREWS

Nom Size	Min Tensile Strength kN	Recommended Max Torque Nm	Approx Tension Induced kN
M1.4	1.18	0.22	0.66
M1.6	1.52	0.29	0.90
M2.0	2.46	0.66	1.43
M2.5	4.02	1.3	2.4
M3	5.98	2.4	3.5
M4	10.49	4	6.0
M5	16.99	11	10
M6	24	18	14
M8	44	43	26
M10	69	83	40
M12	100	120	58
M14	137	215	80
M16	188	310	108
M18	230	430	134
M20	293	560	170
M24	422	950	246

* Data for threads M4 to M24 based on bolt grade 12.9k. Other bolt grades will have significantly lower values.