

# Load Cells

## Applications

- Monitoring loads in tie-backs and rock bolts in the walls of excavations
- Monitoring long-term loads in concrete dam tie-downs
- Monitoring loads in steel arch tunnel supports
- Monitoring loads in cross lot struts
- Measurement of loads during pile testing
- Confirmation of hydraulic jack loads



● Model 3000 Load Cells with the Model GK-501 Readout Box.



● Model GK-403 Readout Box for use with the Model 4900 Load Cells.



● Model 4900 Vibrating Wire Load Cells.

## Operating Principle

The Geokon Model 4900 Load Cell consists of a cylinder of high strength steel with 3-6 vibrating wire strain sensors arranged to measure the compression of the cylinder under load. The cylindrical shape allows the load cell to be used with tie-backs and rock bolts.

The readings from the individual sensors are averaged and used in conjunction with a calibration factor, supplied with the load cell, to calculate the applied loads.

The Model 3000 has the same annular design but uses electrical resistance strain gages cemented to the outside of the annulus and connected together in a Wheatstone Bridge Circuit so that there is a single mV/V output. Remote sensing techniques are used to minimize cable effects.

## Advantages and Limitations

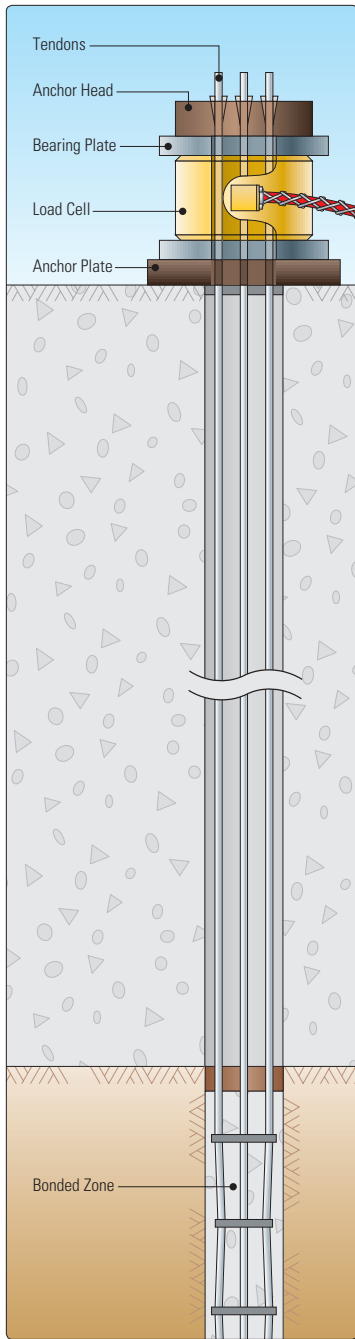
Vibrating wire load cells provide excellent long-term stability and can be used with long cables without adversely affecting the output frequency. They are waterproof and have low temperature coefficients. Vibrating

wire load cells have also been used successfully in high radiation environments.

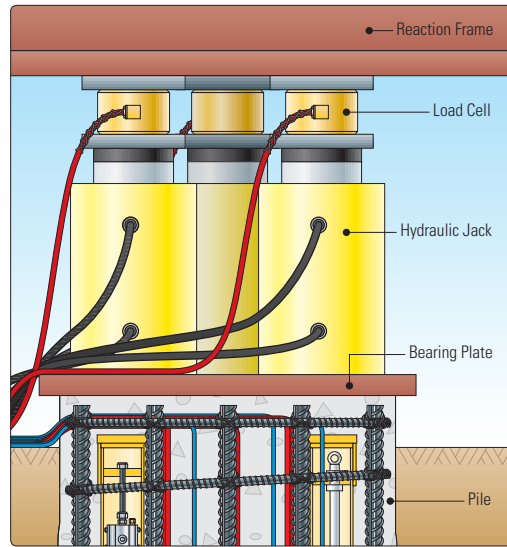
Eccentric loading is accounted for by averaging the readings from all the strain sensors.

Vibrating wire load cells are not able to measure dynamic loading and, although they are easily datalogged, the multiplicity of sensors requires a corresponding number of channels of the multiplexer. For dynamic applications it may be preferable to use the Model 3000 Load Cells.

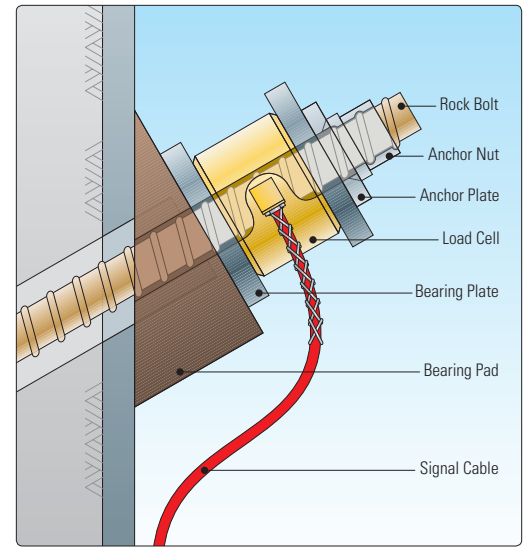
The calibration of annular shaped load cells is very dependent on the end loading conditions, i.e. on the flatness and thickness of the bearing surfaces and on any mismatch in size between the load cell and the hydraulic ram which could cause bearing plates to bend. Calibration variations of as much as 15% have been observed. For best accuracy, calibrations should be performed while duplicating or simulating actual field conditions.



● Model 4900 used in concrete dam tie-down.



● Load cells used in pile test.



● Load cell used to monitor performance of tie-back in excavation.

### System Components

Signals from the load cell are transmitted to the readout location by means of a multi-conductor shielded cable, which may be armored for extra protection. Kellems grips prevent the cable from being pulled from the load cell. Larger size load cells are supplied with lifting lugs.

Readout of the Model 4900 Load Cells is by Model GK-401, GK-403 or Micro-10 Datalogger. Manual readout can be facilitated using a multi-channel switch box connected to the end of the cable. In the case of the GK-403 Readout Box, there is the option to use the Model GK-403-5 multiplexer which allows the GK-403 to automatically scan through all the vibrating wire sensors, average the readings, apply the calibration constant and display the load in engineering units. Readout of the Model 3000 Load Cells is by means of the Model GK-501 Readout Box.

To minimize eccentric and uneven loading, the use of the thick machined-flat bearing plates and centralizer bushings (where necessary) are recommended.

Bearing plates should be machined flat and large enough to totally cover the load bearing surface of the load cell. The thickness is related to the load cell/hydraulic jack

size mismatch: the greater the size disparity the thicker the bearing plate. Typical thickness ranges from 25 to 75 mm.

If the size of the tie-back or rock bolt is more than 30 mm smaller than the internal diameter of the load cell, then centralizer bushings are recommended.

### Technical Specifications

|                                   | 3000  | 4900           |
|-----------------------------------|---|----------------|
| Load Ranges <sup>1</sup>          | 450, 900, 1300, 1800, 2200, 2600, 3600, 4500, 5400, 6800, 9000, 11000, 13500 kN |                |
| Over Range <sup>2</sup>           | 150% F.S.   | 150% F.S.      |
| Resolution <sup>3</sup>           | 0.025% F.S.   | 0.025% F.S.    |
| Calibration Accuracy <sup>4</sup> | 0.25% F.S.  | 0.25% F.S.     |
| Output                            | 1.5 to 2.5 mV/V @ F.S.  | 1200-2800 Hz   |
| Temperature Range                 | -20°C to +80°C  | -20°C to +80°C |
| Internal Diameters <sup>1</sup>   | solid, 25, 50, 75, 100, 125, 150, 200, 250 mm                                   |                |
| Cables                            | Multi-conductor shielded pairs with PVC outer jacket                            |                |

<sup>1</sup>Other ranges and diameters available on request.  
Calibrations that exceed Geokon's NIST traceable capacity of approximately 4500 kN are subcontracted to an accredited testing laboratory.

<sup>2</sup>With no calibration shift.

<sup>3</sup>Approximate.

<sup>4</sup>System accuracy depends on end loading conditions.



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