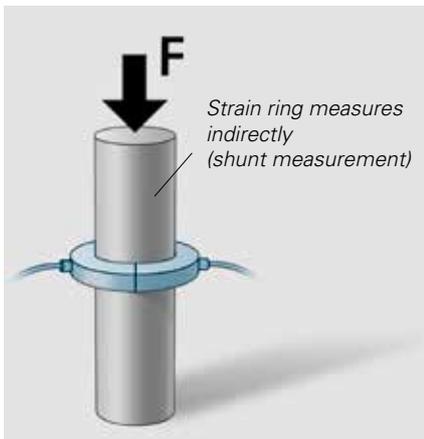


Overview of applications for STRAIN-MATE™ and other surface strain sensors



### Axial Load in Cylinder

Calibrated measurement with strain ring type DSRC. The applied force can be directly calculated by the following formula:

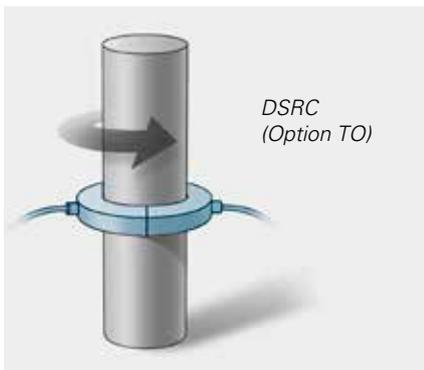
$$F = A \times E \times \epsilon$$

A = Cross section [mm<sup>2</sup>]  
 E = E-Modulus [N/mm<sup>2</sup>]  
 ε = Strain Δ l/l

The entire force passes through the cylinder and is measured with two pressed-on strain gages. The more accurate the Young's modulus is known the more precise the force can be measured.

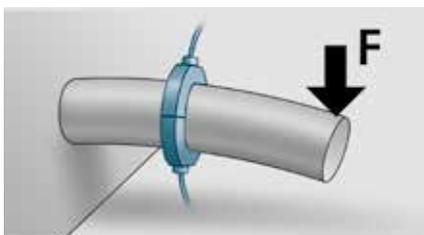
### Elastic modulus E

Steel	210'000 N/mm <sup>2</sup>	Titan	105'000 N/mm <sup>2</sup>
Aluminum	70'500 N/mm <sup>2</sup>	Copper	120'000 N/mm <sup>2</sup>



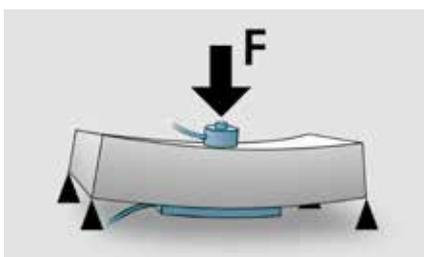
### Torsion

Torsion measurement is easy with the strain ring type DSRC/Option TO. Strain rings with option TO can be connected to standard sensopress amplifiers. For rotating torque measurements the strain ring may be connected to a commercially available telemetry system.



### Bending on a Cylinder

The strain ring type DSRC used in a 1/2-bridge arrangement directly measures the axial load compensated bending strain.



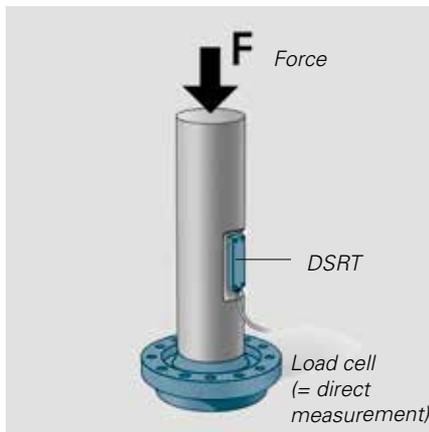
### Bending on Beams or Cross Heads

Bending measurements on beams with strain link type DSRT.



## Force Measurement

Load cells measure the force directly. The advantage is that the force can be directly recorded in kN. Alternatively, the indirect (or shunt) force measurement with strain sensors offers the advantage that there is no need to install a load cell into the load flow. In addition the strain sensors cannot be overloaded. On the other hand, it is necessary to calibrate the measuring chain. The indirect measurement always guarantees excellent repeatability.

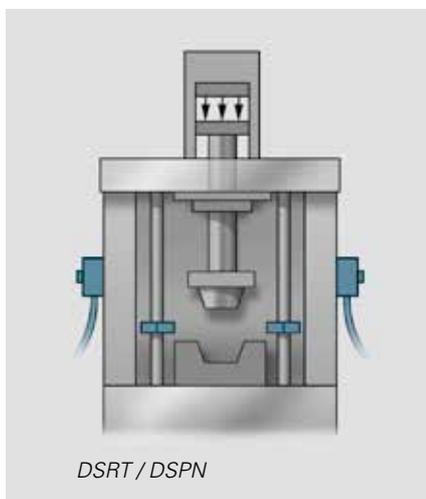


### Indirect Force Measurement

Indirect force measurement can be done with asymmetrically attached strain sensors. The surface strain can contain a superimposed bending component. For a given set up, this component remains proportional to the force. Process monitoring can be performed with or without calibration.

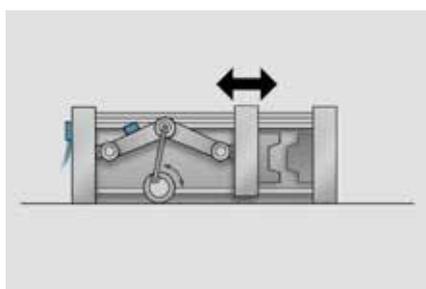
Application:

- Strain link DSRT for standard applications



### Hydraulic Presses

The load distribution on a hydraulic frame press is measured with two strain sensors. To determine the magnitude of the force, a pressure sensor may be used to measure the hydraulic pressure in the cylinder. For accurate measurements, the system must be calibrated with a load cell installed in the load flow. The load cell for instance, can be temporarily put in place of the tool.



### Mechanical Presses

On presses with a mechanical clamping mechanism, the force can be measured indirectly on the toggle mechanism or on one of the plates.

Using sensors with sufficiently high resolution (DSPN), allows one to measure the clamping force and at the same time detect a potential collision. For instance, a collision can be caused by a part not completely removed. With such a high resolution sensor, it is possible to implement a tool protection system on production machinery.