Load Measurement Made Easy

SPC4™ load indicating fastener technology allows installation of a bolted assembly with confidence. Users can monitor the clamp load of any SPC4™ bolted joint whether static or dynamic, by attaching an indicator datum disc located on the end of the fastener and reading the value with a user friendly mechanical indicator.

Gauge that easily snaps on and off SPC4 bolt end for accurate load readings

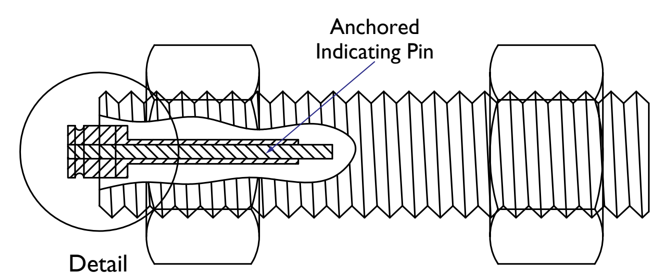
Reading bolt load on SPC4 bolt with gauge

Integrity of a bolted joint is jeopardized when fasteners lose their tension. This loss of clamping force begins even during assembly due to elastic interactions and joint relaxation. Self-loosening continues when the joint is put in service due to vibrations, temperature changes, shock, etc. The SPC4™ joint allows the end-user to retighten only the bolts or studs that have lost their clamp load, resulting in a tremendous saving of maintenance time, money, and replacement parts.

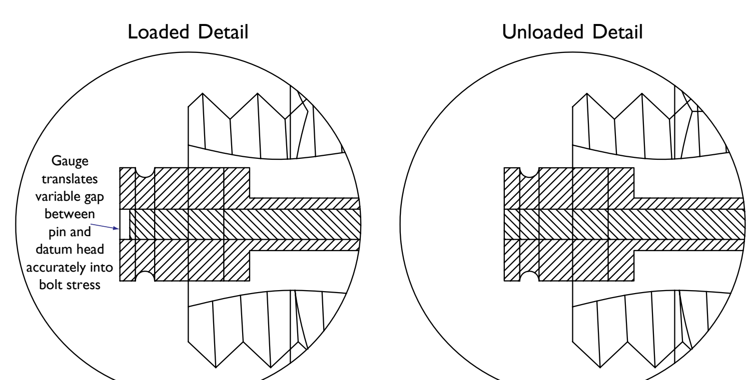
Lamons SPC4 Technology

A fastener is modified by machining a small hole into the head. Minimal modifications to the bolt assures basic bolt design integrity. A gage pin is inserted into the hole and secured at the bottom. A datum disk is fitted on the top of the bolt head and forms a flat surface with the top of the gauge pin when the bolt is unloaded. When the bolt is tightened, it elongates and the gauge pin is drawn into the bolt away from the datum disk surface. This indicator is calibrated to detect the differential space between the indicating pin and datum head. The differential space is translated into a gauge reading that precisely indicates the fastener's loading, related to ultimate yield strength.

The benefits of this concept allow the fastener to be loaded many times as long as the stress remains in the elastic range, meeting the criteria of **ASTM F2482**. An accurate assessment of loading can also be obtained after the joint has been put into service.



Lamons SPC4 Load Indicating Fastener



Common Bolt Issues

There are two variables in any bolted joint design that continually plague the industry. Achieving accurate preload and maintaining this preload are the most common issues associated with problematic flanges and bolted joints. Some of the better flange tightening procedures that exist incorporate torque as the preferred method for attempting to establish accurate preload. While it can be a knowledged that torque is a reliable indicator of bolt stress, it should be realized that there are a number of factors that heavily impact the accuracy of this tightening method.

- Torque wrenches must be calibrated regularly. These tools are often fragile and sensitive to loss of accuracy if dropped or handled improperly.
- Operators often loosely interpret the "click" of a torque wrench and overturn the fastener. The speed at which the operator turns the wrench will affect accuracy of targeted bolt load.
- Torque wrenches are often long leverage devices which makes this impractical in compact situations where an operator cannot turn the tool.
- Friction in the entire joint and all mating surfaces will be the most significant deterrent to accuracy. Friction is not accounted for in the twisting force of torque and will result in greater bolt scatter and inaccuracy.

These problems with torque have long been recognized and there have been several solutions offered by bolting and hardware manufacturers to gauge bolt stress more accurately. The more successful technologies measure the change in length of a fastener and compare the length in an unloaded state and to that of a loaded state. Using Hooke's Law of elasticity one can accurately relate stress in a fastener with the elongation of that component.

Traditional torque method

Mathematically, Hooke's law states:

$$F = -kx$$

where

x is the displacement of the end of the spring from its equilibrium position (in SI units: "m");

F is the restoring force exerted by the material (in SI units: "N" or "$kgms^{-2}$"); and k is the force constant (or spring constant) (in SI units: "$N \bullet m^{-1}$" or "kgs^{-2}").

When this holds, the behavior is said to be linear. If shown on a graph, the line should show a direct variation. There is a negative sign on the right hand side of the equation because the restoring force always acts in the opposite direction of the displacement (for example, when a spring is stretched to the left, it pulls back to the right).

Relative to Bolting and Fastener materials, Hooke's law would be applicable for these materials throughout its elastic range (below their yield strength).

This linear relationship described in Hooke's law creates a scenario where a user can very accurately monitor bolt extension and directly relate this to the stress in the fastener.

Historical methods for measuring this change in length include:

- Physical measurement of the change in length with a gauge
  - » Physical measurements require the ends of the fasteners to be polished and parallel. Any contamination or damage to the end of the measurement surface will cause faulty readings.
  - » Compact space restrictions will often limit the use of measurement equipment around piping systems.
- Ultrasonics utilizes the measurement of the transit time of an ultrasonic signal over the length of the fastener.
  - » Ultrasonics require electronic equipment to be taken in the field and records of specific fastener data have to be stored in order to relate initial readings with future readings. Wiring and associating previous records with the correct fastener can be inconvenient and difficult.
  - » This equipment is sensitive to temperature changes and must be calibrated often to account for this variable.

Physical Measurement of Fastener

Ultrasonic Measurement of a Fastener

A New Dimension to Bolting Technology is Here

For a minimal investment, the SPC4™ offers maximum joint integrity with optimum performance. The ability to monitor stud load after assembly is a key **ASTM F2482** feature and something very unique to this SPC4™ technology.

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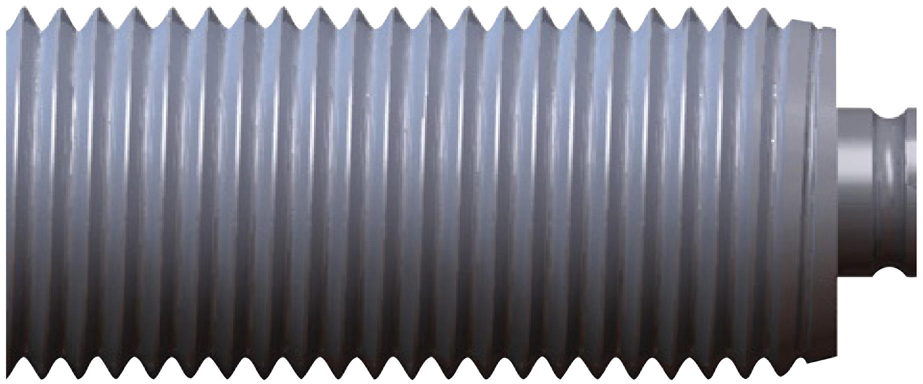

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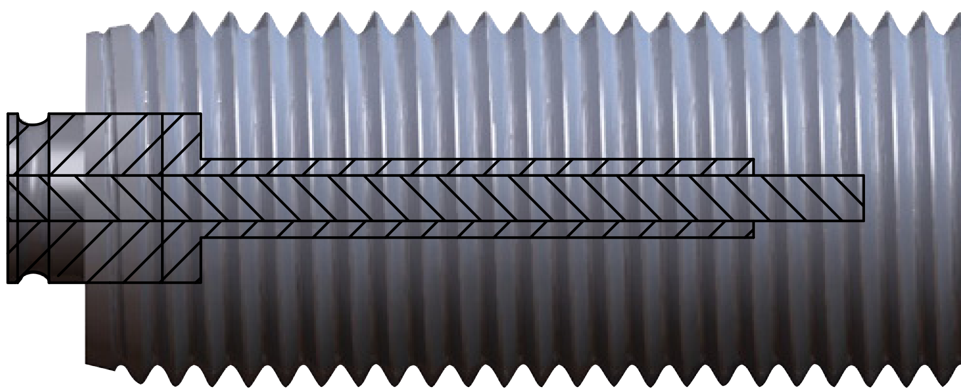

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