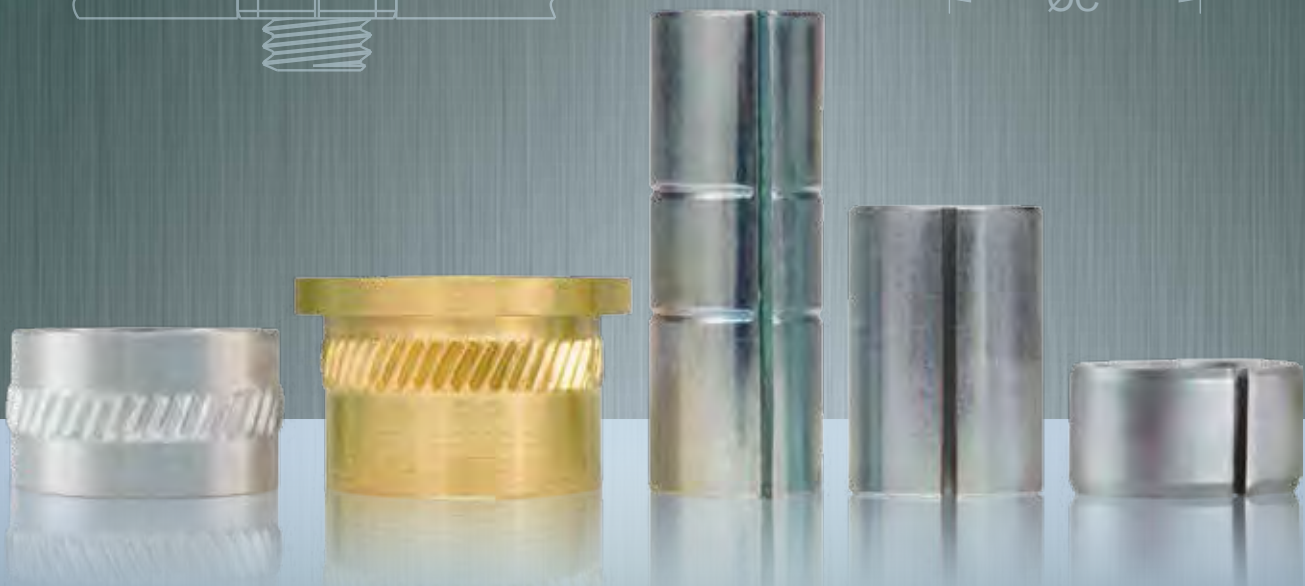
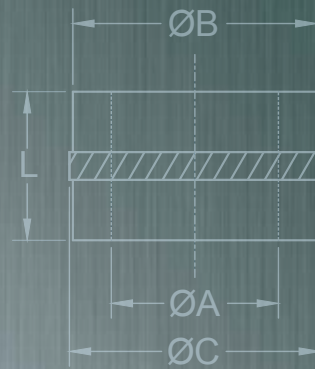
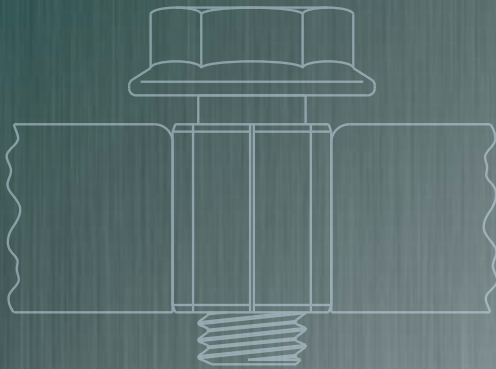


SPIROL[®]

COMPRESSION LIMITERS

$$A_P = \frac{\pi \times (\varnothing_2^2 - \varnothing_1^2)}{4}$$





The Function of a Compression Limiter

The primary function of a Compression Limiter is to provide and maintain joint integrity of a plastic assembly. Compression Limiters are designed to protect the plastic components of an assembly from the compressive loads generated by the tightening of bolts, thereby assuring continued integrity of the bolted connection.

In practice, the Compression Limiter should be slightly shorter than the thickness of the plastic host. As the bolt is tightened the plastic compresses and the stress in the plastic increases until the head of the bolt, or washer if one is used, comes into contact with the Compression Limiter. Thereafter, the Compression Limiter and plastic will compress at the same, although greatly reduced, rate. The Compression Limiter will absorb additional clamping loads without further significant compression or increased stress in the plastic material.

A properly designed bolted joint must meet the following criteria:

- The head of the bolt, or washer if one is used, should always seat against both the plastic host and the Compression Limiter under load. This will prevent deterioration of the bolted joint resulting from diminished clamping load due to plastic creep.
- The rated proof load of the Compression Limiter should be equal to or greater than the proof load of the bolt to assure that the Compression Limiter will not yield prior to the bolt under excessive clamping loads.
- The mating component that the Compression Limiter seats against should be strong enough to withstand the localized compressive stresses generated by the clamping force.
- The clearance between the maximum bolt diameter and the minimum installed inside diameter of the Compression Limiter should be sufficient to compensate for normal misalignment.

Standard **SPIROL® COMPRESSION LIMITERS** meet these criteria.

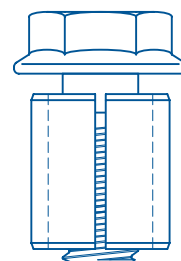
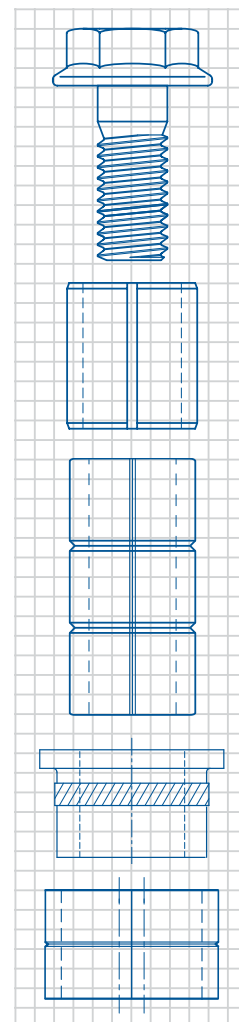
Application Engineering Support

It is imperative that the proper Compression Limiter be designed into each application based on the specific requirements for that assembly, and that the plastic host be designed appropriately to ensure that bolted joint integrity is maintained throughout the life of the assembly.

Each application has unique considerations such as:

- The specific plastic type in which the Compression Limiter will be used
- Columnar strength requirements
- Corrosion resistance requirements
- Temperature requirements
- Installation method

This catalog provides useful information regarding design guidelines and specifications for assemblies that use Compression Limiters. In addition, SPIROL's Application Engineers will partner with your design team to determine the most appropriate Compression Limiter for your specific application.



Contact **SPIROL** for design assistance:
www.spirol.com/s/cmpldesign/

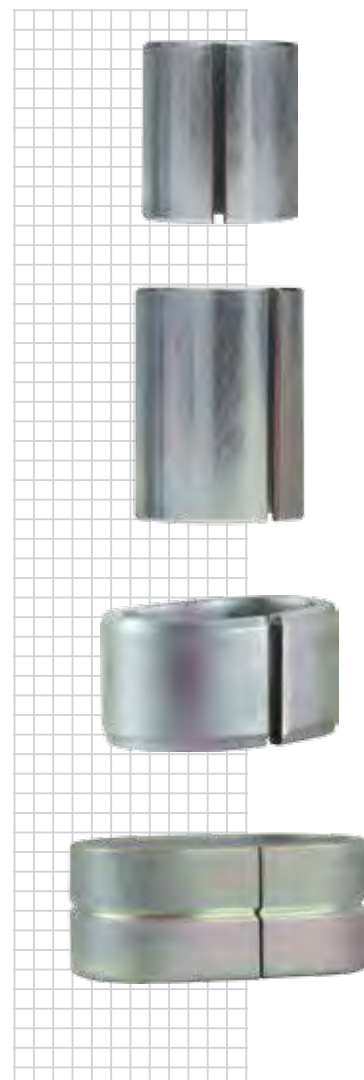
SPIROL® **SPIROL'S** **Compression Limiters**

SPIROL offers a range of both roll formed and machined Compression Limiters including split seam, molded in, oval and solid wall designs. All roll formed Compression Limiters are zinc plated and have a supplementary coating of trivalent passivation and an organic sealant for corrosion resistance. This finish provides 144 hours to white corrosion, and 384 hours to red corrosion when salt spray tested in accordance with ASTM B117. Machined Limiters are manufactured from aluminum and brass, both of which have inherent corrosion resistant properties and thus do not require supplementary finishing. Each series of Compression Limiter is designed to meet specific proof loads and accommodate a variety of installation methods.

The clearance between the bolt and the inside diameter of the installed Compression Limiter is adequate to meet normal misalignment. The Compression Limiter's length should be designed to ensure it will bottom out against the surface under the bolt's head and mating component. The appropriate length and length tolerance is application dependent. While the standard tolerance is sufficient to meet most needs, verification is recommended. SPIROL's Applications Engineers are available to assist in this process. If it is determined that a special Compression Limiter is required, then a documented recommendation will be provided.

The following details the unique features for each standard series:

- **Series CL200 Split Seam:** The Series CL200 Compression Limiter is produced from high carbon steel and intended for post-mold installation. The spring force generated during installation provides self-retention in the assembly. The flexible diameter accommodates wide hole tolerances, yet the gap is designed to be less than the material thickness, therefore they will not interlock in the free state. The CL200's are rated for use up to ISO Class 8.8/ Grade 5 bolts. If the application requires it, the CL200 can be heat treated (to order) for use up to ISO Class 12.9/Grade 8 bolts. When applications can be designed around the Series CL200 standard range, this series offers the lowest total installed cost.
- **Series CL350 Split Seam:** Similar to the Series CL200 Compression Limiter, the CL350's were designed with a thicker wall for increased bearing surface when clamped against soft mating materials. Generous bolt clearance also aids in positional alignment when multiple Compression Limiters are used in an assembly. The CL350 is rated for use up to ISO Class 10.9 bolts.
- **Series CL400 Oval Press-In:** Produced from high carbon steel, the oval Series CL400 accommodates up to 2.25mm extra clearance on one axis, providing additional flexibility over round Compression Limiters for centerline and stack-up tolerancing. Similar to the CL200 and CL350, this split-seam oval Limiter is roll-formed, and it is spring tension that provides positive retention in the hole. The roll-forming manufacturing method yields substantial cost savings over machined products with similar features and characteristics. The CL400 is rated for use up to ISO Class 8.8 bolts.
- **Series CL460 Oval Molded-In:** The CL460 Series is similar to the oval Series CL400, but produced with a butted-seam so as to prevent plastic from entering the inner diameter during the molding process. This series also accommodates up to 2.25mm extra clearance on one axis. The CL460 is rated for use up to ISO Class 8.8 bolts.



SPIROL® SPIROL'S Compression Limiters



- **Series CL500 Molded-In:** The Series CL500 is produced from low carbon steel with a butted seam to prevent plastic from entering the inner diameter of the Compression Limiter during the molding process. This also provides an anti-rotation feature once in the assembly. The radial grooves provide axial retention. The CL500 is rated for use up to ISO Class 8.8/Grade 5 bolts.
- **Series CL600 Aluminum:** The Series CL600 is machined from 2024 aluminum as this grade provides the best combination of strength, corrosion resistance, machineability and cost. Additional advantages of aluminum are that it is lightweight (1/3 the weight of brass), it is 40% stronger than brass, and it is lead free. These Limiters can be molded in or pressed into the assembly. The precision machined ID tolerance allows proper seating on the core pin when molding into the assembly. When pressed into the assembly, they are designed with a pilot that allows the part to stand freely in the hole prior to completing the installation. Once installed, the knurl provides excellent retention within the hole. The CL600 is rated for use up to ISO Class 10.9/Grade 8 bolts.
- **Series CL601 Headed Aluminum:** The CL601 headed aluminum Compression Limiter is the same as the CL600, with the addition of a head. The head provides extra bearing surface on the mating component when a flanged bolt or a washer is not used.
- **Series CL800 Brass:** The Series CL800 is machined from 360 brass. Similar to the CL600, the CL800 can be molded in or pressed into an assembly. The applications for SPIROL's brass and aluminum Compression Limiters are very similar, however to accommodate the same class/grade bolt, the brass Limiters have a larger wall thickness due to the material's lower yield strength. While this increases the size and weight of the Limiter as compared to the CL600, the thicker wall does provide more bearing surface for the mating component. The most common reason a designer may choose the CL800 is for those applications that require a shift away from aluminum on the galvanic series chart to make the Limiter more noble. The CL800 is rated for use up to ISO Class 10.9/Grade 8 bolts.
- **Series CL801 Headed Brass:** The CL801 headed brass Compression Limiters are the same as the CL800 with the addition of a head. Similar to the CL601, the head provides extra bearing surface on the mating component when a flanged bolt or a washer is not used.

| STANDARD MATERIALS | |
|-----------------------|--|
| Type | Grade |
| A - Aluminum | ASTM B211 2024 ISO AlCu4Mg1 |
| B - High Carbon Steel | UNS G10700/G10740 CS67S (1.1231) / CS75S (1.1248) |
| E - Brass | UNS C36000 EN 12164 CW603N CuZn36Pb3 |
| F - Low Carbon Steel | UNS G10060/G10100 EN10139 DC04 (1.0338) / DC01 (1.0330) |

SPIROL® Design Considerations

Recommended Loading

The integrity of a bolted joint requires that all of the components in the load path be capable of sustaining for indefinite periods, under all environmental conditions, the fastening load initially applied. To do this, all components must be designed for a specific stress, and the fastener being used must be tightened to an appropriate level so as not to exceed the yield point (elastic limit) of any of the components. The reason that metal Compression Limiters are required is because plastic always exhibits stress and strain relaxation under even modest loads. When determining bolted joint characteristics, the following considerations should be evaluated:

- What type of load is really required? For example, does a given plastic flange really need a Class 12.9 cap screw to hold it in place?
- What are the strengths of the components in the joint?
- What will the Compression Limiter be seated against? If it is aluminum or plastic, then that may be the limiting feature.
- Is the bolt being threaded into an Insert? If so, is there adequate thread strength and contact area on the Insert to fully support the Compression Limiter?
- What torque should the bolt be tightened to? **SPIROL** recommends that the bolt load be 25% to 75% of proof load. Less than 25% and you risk not generating enough frictional retention within the threads. More than 75% and there is a chance, due to assembly variations, that the proof load of the bolt may be exceeded.
- How does torque relate to bolt load? Torque and actual clamping load are very dependant on materials and conditions. The theoretical formula provided on page 17 is only for reference. Actual torque applied must be determined by the end user and is dependant on a variety of factors such as materials and coatings of all the components in the joint as well as the method of applying the torque.

Recommended Tightening Torque

The integrity of the bolted joint requires that none of the components, including the bolt, be stressed beyond the elastic limit. SPIROL recommends a clamping load not to exceed 75% of the proof load of the bolt. The recommended torque values to produce this clamping load are provided on pages 16 and 17.

Determination of Compression Limiter Length

Proper length specifications of both the Compression Limiter and the plastic component are crucial to the proper performance of the bolted joint. The recommended maximum length of the Compression Limiter is the minimum thickness of the plastic component. This assures that when the proper load is applied to the bolt two critical conditions will be met:

- The bolt will be in contact with the Compression Limiter, eliminating the possibility of creep.
- The plastic host will always have a small amount of compression applied.

The amount of compression on the plastic host will be at most the combined thickness and length tolerances of the two components and the amount of compressive deflection on the Compression Limiter. In reality, with good SPC and production controls, the actual compression will be much less.

Load Rating

SPIROL rates our Compression Limiters by matching the load required to compress the Limiter 2.5% of its nominal length to the clamp load of the nominal sized fastener. See Table 1.

| Compression Limiter Series | Bolt Rating | |
|----------------------------|-------------|-------|
| | Class | Grade |
| CL200 | 8.8 | 5 |
| CL350 | 10.9 | — |
| CL400 | 8.8 | — |
| CL460 | 8.8 | — |
| CL500 | 8.8 | 5 |
| CL600 / CL601 | 10.9 | 8 |
| CL800 / CL801 | 10.9 | 8 |

Table 1

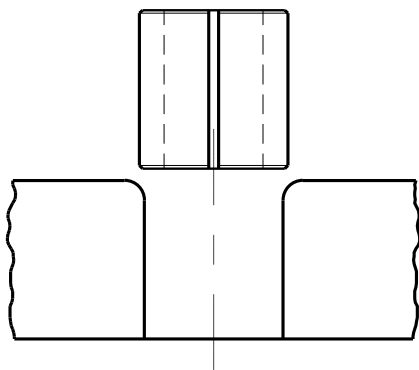
Compression Limiters are rated by the load required to compress the Limiter to a defined, safe distance that meets the requirements of:

- Maintaining integrity of the Limiter, preventing rupturing or excessive swelling.
- Maintaining the integrity of the plastic host by keeping any localized compressive strains within generally accepted, safe limits.
- Maintaining the load of the fastener by preventing stress relaxation, thereby assuring the continued integrity of the bolted connection.

For all engineered thermoplastic materials used in durable manufactured products, allowing 3%-5% maximum compression has been determined to be a safe, conservative limit. Most plastics are perfectly safe being compressed 5%-7%; many even further. Plastics have the characteristic that they will very quickly exhibit stress relaxation in the areas of high compression eliminating the potential of stress cracking and allowing the Compression Limiter to take the fastener load.

Hole Design

Although the split seam Compression Limiters have a broken edge, this is kept to a minimum in order to maintain the maximum bearing surface area. Accordingly, it is recommended that a radius be molded as a lead-in to the hole in the plastic component to facilitate insertion. This radius is not necessary for solid Compression Limiters as the pilot is smaller than the hole. When a draft angle is required, the hole should taper within the recommended hole size for the length of the Compression Limiter.



Mating Component Material

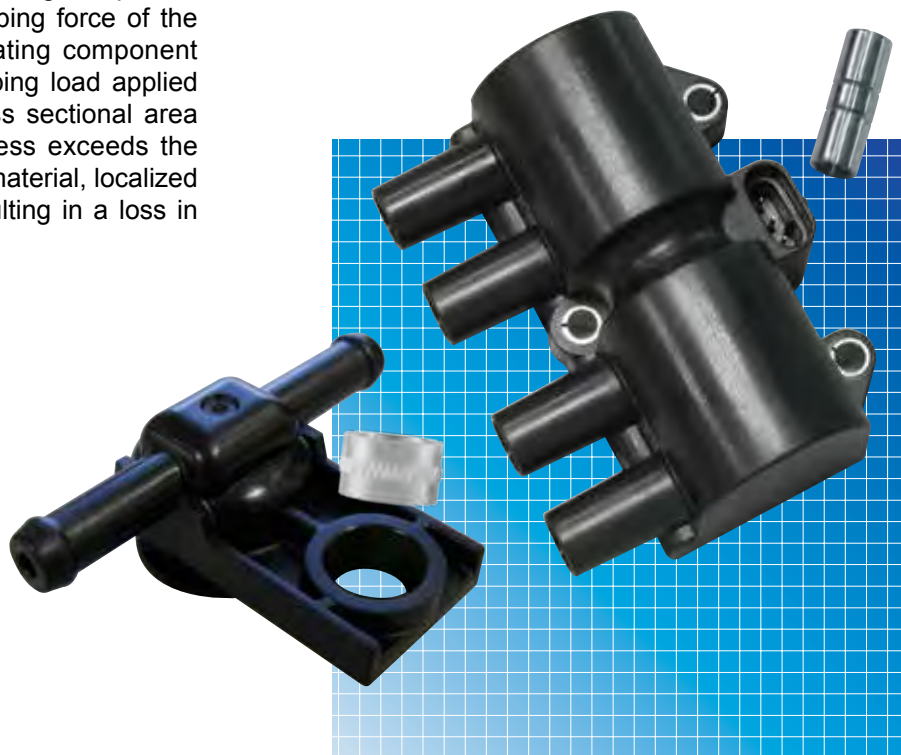
The clamping load of the bolt is transferred to the mating component through the Compression Limiter. It must be evaluated whether the material of the mating component is strong enough to withstand the clamping force of the bolt. The stress imparted onto the mating component can be calculated by dividing the clamping load applied to the Compression Limiter by the cross sectional area of the Compression Limiter. If this stress exceeds the yield strength of the mating component material, localized permanent deformation may occur, resulting in a loss in clamping load.

Cost-Effective Fastener Selection

Designers should be prudent about not choosing a bolt class that is too strong for the application and ensuring that the proper tightening torque is applied during the assembly process. A higher bolt class requires a stronger Compression Limiter and potentially stronger mating material. Each adds to the total cost of the assembly. When increased bearing surface at the mating junction is required, Designers should consider selecting either a flange head bolt or including a washer rather than investing in a headed Compression Limiter. In this situation, there is a trade-off between cost and ease of assembly. Flanged bolts and washers cost much less than the added expense of a headed Compression Limiter. In addition, non-headed Compression Limiters are easier to feed.

Selecting the Most Cost-Effective Compression Limiter

Each standard series of Compression Limiters will affect the overall cost of the assembly in different ways. SPIROL Engineering will assist in the determination of which type of Compression Limiter is best suited to meet the performance and installation requirements that results in the lowest total cost of the assembly.



SPIROL® Design Guidelines

Allowable Compression of the Plastic Component

For most commonly used molded plastics, it is difficult to determine a specific maximum amount that they can be compressed in a short period of time. There are too many variables involved to make a specific calculation. Such features as the specific plastic, filler, mold design, wall thickness, and stress concentrations all impact the durability of the plastic. As a general guideline, 3%-5% compression of thermoplastic materials is reasonable. Over a short period of time the plastic will usually exhibit stress relaxation, thereby alleviating the compressive load on the plastic and allowing the Compression Limiter to maintain joint integrity. Stated in **formula (1)** below:

$$(1) \quad \delta_p = T_{\max} - L_{\min} + \delta_c$$

Where δ_p should typically be less than 5% of T_{\max}

Where:

- δ_p = Required deflection of the plastic component, in units of length.
- T_{\max} = Maximum thickness of the plastic component, in units of length.
- L_{\min} = Minimum length of the Compression Limiter, in units of length.
- δ_c = Deflection of the Compression Limiter under load, in units of length.

Deflection of the Compression Limiter

Deflection of the Compression Limiter under bolt load can be calculated using **formula (2)** below:

$$(2) \quad \delta_c = \frac{F_B \times L_c}{A_c \times E_c}$$

Where:

- δ_c = Deflection of the Compression Limiter under load, in units of length.
- F_B = Compressive force generated by the bolt or fastener, in units of force.
- L_c = Nominal length of the Compression Limiter, in units of length.
- A_c = Cross sectional area of the Compression Limiter, in units of area.
- E_c = Modulus of Elasticity (Young's Modulus) of the material of the Compression Limiter, in units of force per area. **See Table 2.**

Force to Seat the Bolt on the Compression Limiter

It is important to always assure that the bolt is seated securely against the Compression Limiter. While proportionally plastic is much more compressible than the Compression Limiter, in the initial assembled state the plastic will be nominally thicker than the length of the Compression Limiter. With the use of flanged bolts or large washers, significant surface area of the plastic can be put under compression, generating high loads. Therefore, it is necessary to calculate the capability of the bolt to compress the plastic and seat against the Compression Limiter in the worst case scenario. **Formula (3)** shows how to calculate the force required to seat the bolt.

$$(3) \quad F_B = \frac{(T_{\max} - L_{\min}) \times E_p \times A_p}{T_{\max}}$$

$$\text{Where } A_p = \frac{\pi \times (\phi_2^2 - \phi_1^2)}{4}$$

Where:

- F_B = Compressive force generated by the bolt or fastener, in units of force.
- T_{\max} = Maximum thickness of the plastic component, in units of length.
- L_{\min} = Minimum length of the Compression Limiter, in units of length.
- E_p = Modulus of Elasticity (Young's Modulus) of the plastic component, in units of force per area.
- A_p = Area of the plastic component being placed in compression by the bolt, in units of area.
- ϕ_1 = Minimum hole diameter of the plastic component, in units of length.
- ϕ_2 = Maximum diameter of the portion of the bolt or washer that will be in contact with the plastic, in units of length.

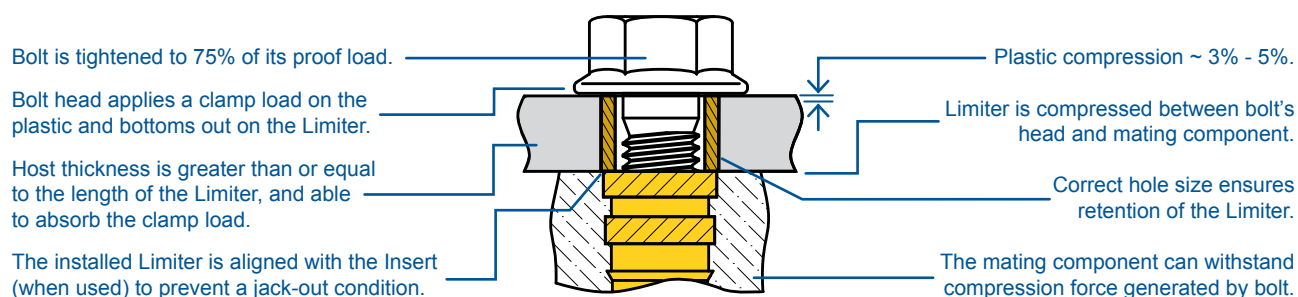
The resultant F_B should be in the range of 75% or less of the proof load of the selected bolt, thereby assuring that sufficient compression is applied to the Compression Limiter after the plastic stress has relaxed.

| Material | psi | MPa |
|--------------|------------|---------|
| Carbon Steel | 30,000,000 | 206,000 |
| Aluminum | 10,000,000 | 69,000 |
| Brass | 14,100,000 | 97,000 |

Table 2 - Modulus of Elasticity for Common Materials

Note: Compressive strain is an estimated value. Factors such as the rigidity of the plastic host, material, length to diameter ratio of the Compression Limiter, wall thickness, material type, and level of work hardening all affect the actual strain in the Limiter under actual compressive loads in the application. For assistance on determining the most appropriate Compression Limiter for your assembly, please contact SPIROL for complimentary Application Engineering support.

Ideal Bolted Joint

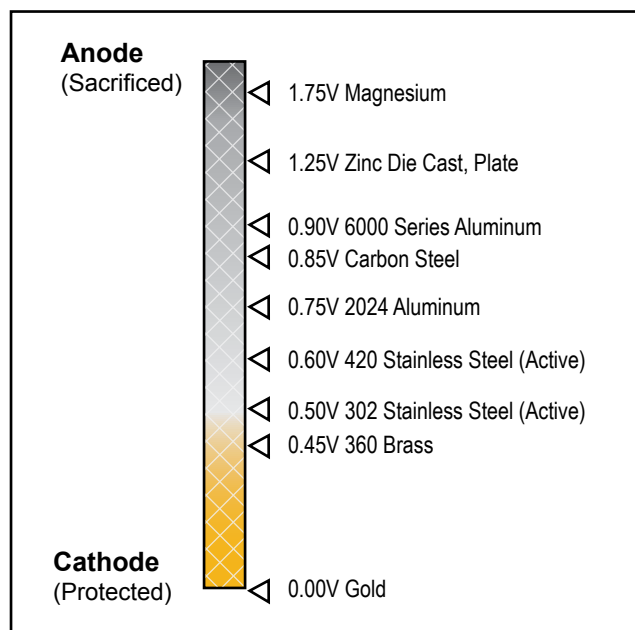


The following design guidelines should be considered when a Compression Limiter is used to ensure its effectiveness in the plastic assembly:

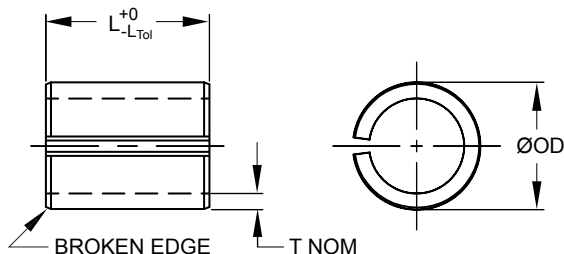
- The length of the Compression Limiter should be equal to or slightly less than the host thickness such that there is a small amount of plastic compression after the bolt is torqued. If the plastic is not compressed, the host may move about the Limiter.
- The bearing surface beneath the bolt's head or washer must extend over the Compression Limiter to contact the plastic component to avoid plastic creep and ensure bolted joint integrity over the life of the assembly. Methods that can be used to achieve this include the use of a flanged bolt, washer or headed Compression Limiter. A washer may be preferred in lower volume and or/non-serviced applications. In higher volume, automated and/or serviceable applications, a non-headed Compression Limiter with a flanged bolt is the easiest to assemble and provides the lowest total cost.
- The amount of material compressed under the bolt's head varies depending on the application's loading and plastic properties. This area of compression must be large enough to withstand forces attempting to pull the assembly apart, yet small enough to allow sufficient plastic compression so that the Compression Limiter contacts both the bolt and the mating component.
- For any given bolt size and class/grade, the recommended clamp load is 25%-75% of the proof load. (Reference pages 16 and 17)
- It is imperative that the component mating against the Compression Limiter can withstand the compression force generated by the bolt.
- When using an Insert in the mating component, it is essential for the Compression Limiter to be in contact with the face of the Insert to avoid pulling the Insert out of the plastic assembly (jack-out). The Insert must also be able to withstand the load generated by the bolt.

Galvanic compatibility of the materials within the assembly should be considered when an electrolyte is present. Theoretically, galvanic corrosion can be prevented by use of similar metals on the anodic scale and separating dissimilar metals by use of electrical insulators. In reality, protection is difficult to achieve as it is difficult to always use similar metals or provide complete protection from the elements. It is important to consider other measures to minimize the effect of galvanic corrosion. The following factors should be considered:

- Protect the metallic parts from the environment. Without an electrolyte, galvanic corrosion cannot occur.
- Avoid combinations of dissimilar metals that are far apart on the anodic index. For harsh environments such as outdoor use, materials should be within 0.15V, and in warehouses and other uncontrolled indoor environments materials should be within 0.25V. In temperature and humidity controlled environments, materials can be as far apart as 0.50V.
- Avoid small anodes and large cathodes as this increases the corrosion rate of the anode.



STANDARD SPLIT SEAM COMPRESSION LIMITERS SERIES CL200



MATERIAL

B High Carbon Steel

FINISH

T Trivalent Zinc Plated

DIMENSIONAL DATA

| Metric | | | | | |
|-------------------|--------------------|------------------|------------------|-------------|-------------------------|
| Nominal Bolt Size | Min. ØID Installed | Wall Thickness T | L _{Tol} | ØOD | Recommended Ø Hole Size |
| M4 | 4.65 | 0.85 | 0.15 | 6.65/6.75 | 6.50/6.60 |
| M5 | 5.65 | 1.00 | 0.15 | 7.95/8.10 | 7.80/7.90 |
| M6 | 6.65 | 1.10 | 0.15 | 9.15/9.33 | 9.00/9.10 |
| M8 | 8.65 | 1.50 | 0.20 | 11.90/12.20 | 11.75/11.85 |
| M10 | 10.60 | 1.85 | 0.25 | 14.65/15.07 | 14.50/14.60 |

| Inch | | | | | |
|-------------------|--------------------|------------------|------------------|-----------|-------------------------|
| Nominal Bolt Size | Min. ØID Installed | Wall Thickness T | L _{Tol} | ØOD | Recommended Ø Hole Size |
| #8 | .188 | .032 | .006 | .265/.269 | .259/.263 |
| #10 | .215 | .038 | .006 | .305/.311 | .299/.303 |
| 1/4 | .275 | .043 | .006 | .374/.381 | .368/.372 |
| 5/16 | .338 | .059 | .008 | .468/.480 | .462/.466 |
| 3/8 | .396 | .073 | .010 | .558/.574 | .552/.556 |

| Metric | | | | | |
|-------------------|---|---|---|---|----|
| Nominal Bolt Size | 4 | 5 | 6 | 8 | 10 |
| Standard Lengths | 8 | | | | |
| 10 | | | | | |
| 12 | | | | | |
| 15 | | | | | |
| 20 | | | | | |
| 25 | | | | | |
| 30 | | | | | |

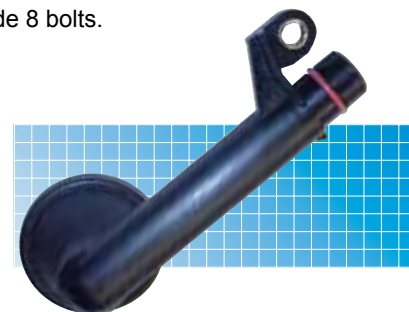
| Inch | | | | | |
|-------------------|------|-----|-----|------|-----|
| Nominal Bolt Size | #8 | #10 | 1/4 | 5/16 | 3/8 |
| Standard Lengths | .312 | | | | |
| .375 | | | | | |
| .500 | | | | | |
| .625 | | | | | |
| .750 | | | | | |
| 1.000 | | | | | |
| 1.250 | | | | | |

- All dimensions apply prior to plating.
- CL200 rated for use up to ISO Class 8.8/Grade 5 bolts.
- Heat treated versions available to order for use up to ISO Class 12.9/Grade 8 bolts.
- Special lengths and sizes available upon request.

SPIROL® Split Seam Compression Limiters

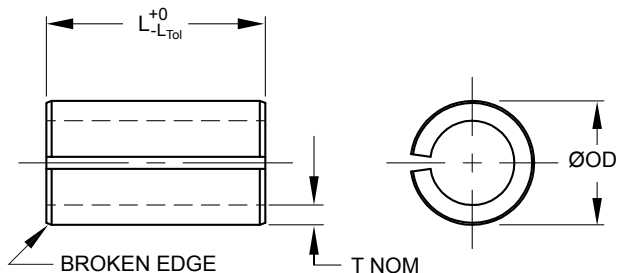
can be installed with **SPIROL** installation equipment or simply pressed in.

To Order: CMPL, Nominal Bolt Diameter, Length, Material, Finish, Series
Example: CMPL 10 X 12 BT CL200



STANDARD SPLIT SEAM COMPRESSION LIMITERS

SERIES CL350



MATERIAL

B High Carbon Steel

FINISH

T Trivalent Zinc Plated

DIMENSIONAL DATA

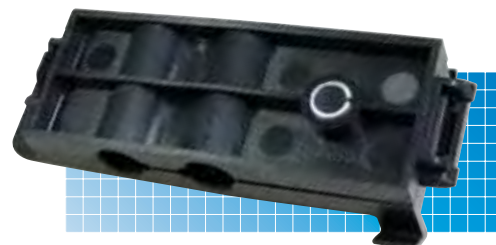
| Metric | | | | | |
|-------------------|--------------------|------------------|------------------|-------------|-------------------------|
| Nominal Bolt Size | Min. ØID Installed | Wall Thickness T | L _{Tol} | ØOD | Recommended Ø Hole Size |
| M6 | 6.8 | 1.50 | 0.15 | 10.08/10.28 | 9.95/10.05 |
| M8 | 8.8 | 2.00 | 0.20 | 13.25/13.52 | 13.05/13.20 |

| Nominal Bolt Size ➤ | | 6 | 8 |
|---------------------|----|---|---|
| Standard Lengths | 10 | | |
| | 12 | | |
| | 15 | | |
| | 20 | | |
| | 25 | | |

- All dimensions apply prior to plating.
- CL350 rated for use up to ISO Class 10.9 bolts.
- Special lengths and inch sizes available upon request.

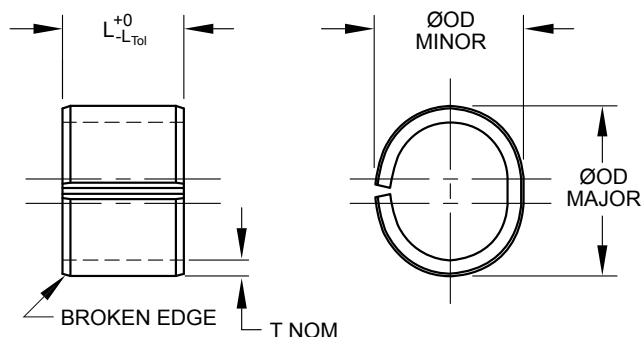
SPIROL® Standard Split Seam

Compression Limiters can be installed with **SPIROL** installation equipment or simply pressed in.



To Order: CMPL, Nominal Bolt Diameter, Length, Material, Finish, Series
Example: CMPL 6 X 15 BT CL350

STANDARD OVAL SPLIT SEAM COMPRESSION LIMITERS SERIES CL400



MATERIAL

B High Carbon Steel

FINISH

T Trivalent Zinc Plated

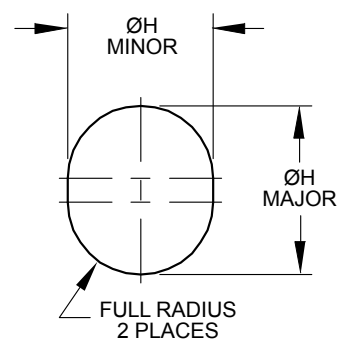
DIMENSIONAL DATA

| Metric | | | | | | | |
|-------------------|--------------------|--------|------------------|-------------|-------------|------------------------------------|-------------|
| Nominal Bolt Size | Min. ØID Installed | T Ref. | L _{Tol} | ØOD Major | ØOD Minor | Recommended Ø Hole Size H Major | H Minor |
| M6 | 6.8 | 1.10 | 0.15 | 11.45/11.70 | 9.40/9.60 | 11.55/11.70 | 9.20/9.30 |
| M8 | 8.8 | 1.50 | 0.20 | 14.30/14.60 | 12.25/12.50 | 14.45/14.60 | 12.05/12.15 |

| Nominal Bolt Size ➤ | | 6 | 8 |
|---------------------|----|---|---|
| Standard Lengths | 8 | | |
| | 10 | | |
| | 12 | | |
| | 15 | | |
| | 20 | | |

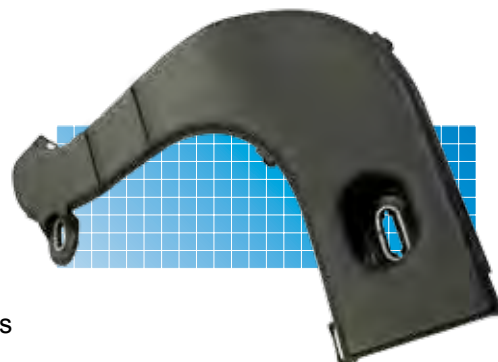
- All dimensions apply prior to plating.
- CL400 rated for use up to ISO Class 8.8 bolts.
- Special lengths and inch sizes available upon request.

HOLE SPECIFICATIONS



SPIROL® Standard Oval Split Seam

Compression Limiters can be installed with **SPIROL** installation equipment or simply pressed in.

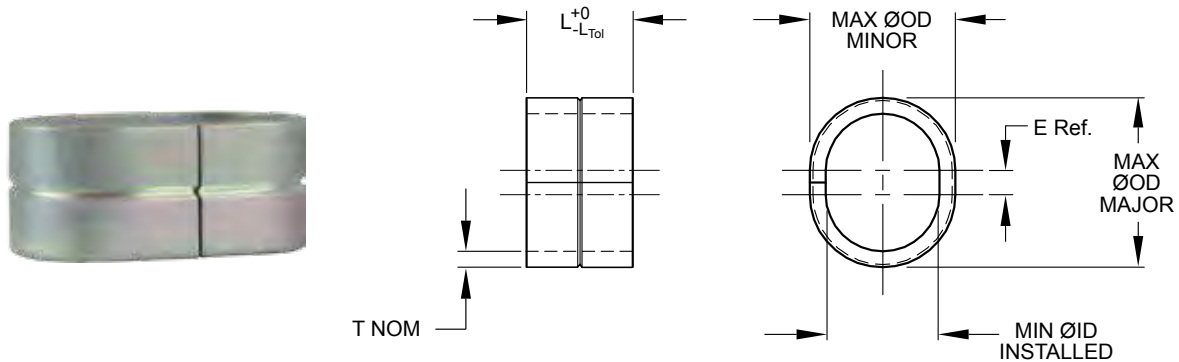


To Order: CMPL, Nominal Bolt Diameter, Length, Material, Finish, Series
Example: CMPL 6 X 12 BT CL400



Compression Limiter Specifications

STANDARD OVAL MOLDED-IN COMPRESSION LIMITERS SERIES CL460



MATERIAL

B High Carbon Steel

FINISH

T Trivalent Zinc Plated

DIMENSIONAL DATA

| Metric | | | | | | |
|-------------------|---------------------------------|--------|--------|-----------|-----------------------------|-----------------------------|
| Nominal Bolt Size | Min. $\varnothing ID$ Installed | T Ref. | E Ref. | L_{Tol} | Max. $\varnothing OD$ Major | Max. $\varnothing OD$ Minor |
| M6 | 6.8 | 1.10 | 2.25 | 0.15 | 11.65 | 9.40 |
| M8 | 8.8 | 1.50 | 2.25 | 0.20 | 14.50 | 12.25 |

| Nominal Bolt Size ➤ | | 6 | 8 |
|---------------------|----|---|---|
| Standard Lengths | 6 | | |
| | 8 | | |
| | 10 | | |
| | 12 | | |
| | 15 | | |

- All dimensions apply prior to plating.
- CL460 rated for use up to ISO Class 8.8 bolts.
- Special lengths and inch sizes available upon request.

SPIROL® Standard Oval Molded-In Compression Limiters

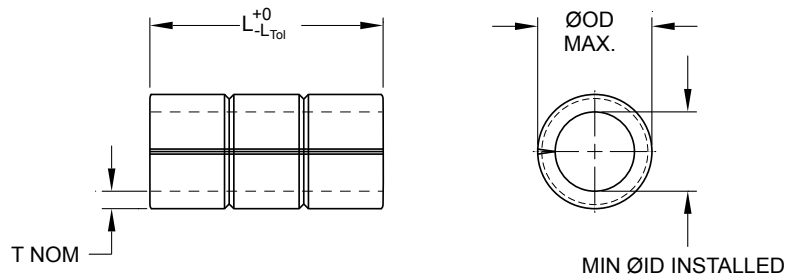
can be molded in using industry standard core pins.



To Order: CMPL, Nominal Bolt Diameter, Length, Material, Finish, Series
Example: CMPL 8 X 10 BT CL460

STANDARD MOLDED-IN COMPRESSION LIMITERS

SERIES CL500



Parts less than 20mm (.750") long will have a single groove.

MATERIAL

F Low Carbon Steel

FINISH

T Trivalent Zinc Plated

DIMENSIONAL DATA

| Metric | | | | |
|-------------------|--------------------|------------------|------------------|----------|
| Nominal Bolt Size | Min. ØID Installed | Wall Thickness T | L _{Tol} | ØOD Max. |
| M6 | 6.8 | 1.50 | 0.15 | 10.25 |
| M8 | 8.8 | 2.00 | 0.20 | 13.25 |

| Inch | | | | |
|-------------------|--------------------|------------------|------------------|----------|
| Nominal Bolt Size | Min. ØID Installed | Wall Thickness T | L _{Tol} | ØOD Max. |
| #10 | .221 | .043 | .006 | .323 |
| 1/4 | .281 | .059 | .006 | .417 |
| 5/16 | .344 | .078 | .008 | .518 |

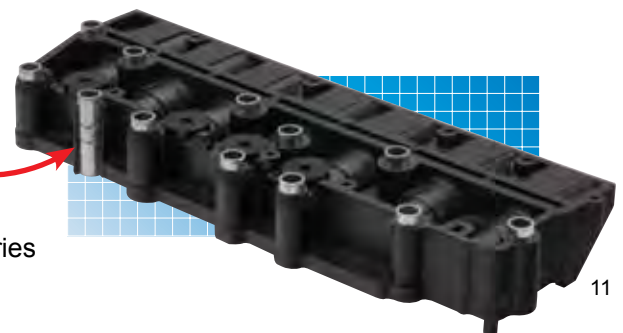
| Metric | | |
|-------------------|----|----|
| Nominal Bolt Size | 6 | 8 |
| Standard Lengths | 10 | 12 |
| | 15 | 20 |
| | 25 | |

| Inch | | | |
|-------------------|------|------|-------|
| Nominal Bolt Size | #10 | 1/4 | 5/16 |
| Standard Lengths | .312 | .375 | .500 |
| | .625 | .750 | 1.000 |

- All dimensions apply prior to plating.
- CL500 rated for use up to ISO Class 8.8/Grade 5 bolts.
- Special lengths and sizes available upon request.

SPIROL® Standard Molded-In Compression Limiters can be molded in using industry standard core pins.

Plastic removed to show Compression Limiter.

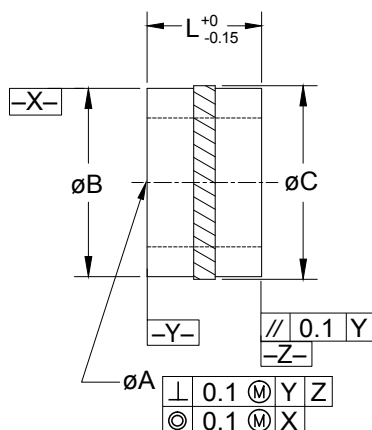


To Order: CMPL, Nominal Bolt Size x Length, Material, Finish, Series
Example: CMPL 6 X 20 FT CL500

STANDARD ALUMINUM COMPRESSION LIMITERS - METRIC

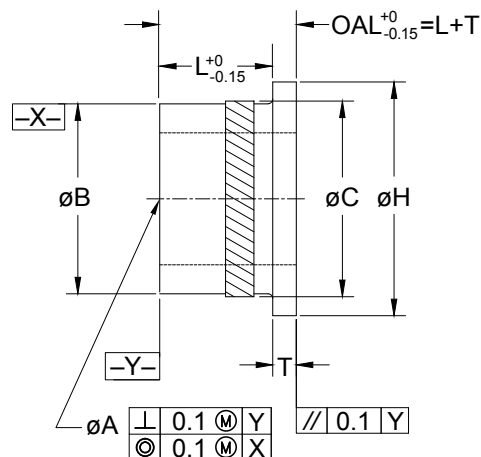
SERIES CL600

Knurled



SERIES CL601

Headed



MATERIAL

A Aluminum

FINISH

K Plain

DIMENSIONAL DATA

| Metric | | | | | | |
|-------------------|-----------|-------------|---------|-------------|--------|-------------------------|
| Nominal Bolt Size | ØA | ØB | ØC Ref. | ØH | T Ref. | Recommended Ø Hole Size |
| M3 | 4.05/4.15 | 5.42/5.58 | 5.78 | 7.35/7.60 | 1.00 | 5.60/5.70 |
| M4 | 5.05/5.15 | 6.95/7.11 | 7.32 | 8.95/9.20 | 1.00 | 7.13/7.23 |
| M5 | 6.05/6.15 | 8.47/8.63 | 8.82 | 10.55/10.80 | 1.00 | 8.64/8.74 |
| M6 | 7.05/7.15 | 10.00/10.16 | 10.38 | 12.15/12.40 | 1.25 | 10.18/10.28 |
| M8 | 9.05/9.15 | 13.36/13.52 | 13.72 | 15.35/15.60 | 1.25 | 13.53/13.63 |

| Metric | | | | | |
|-------------------|---|---|---|---|---|
| Nominal Bolt Size | 3 | 4 | 5 | 6 | 8 |
| Standard Length | 3 | 4 | 5 | 6 | 8 |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 8 | | | | | |

- CL600 / CL601 rated for use up to ISO Class 10.9 bolts.
- The knurl will always be larger than the maximum hole.
- Special lengths available upon request.

SPIROL® Knurled CL600 and CL601

Compression Limiters are perfect for press-in and molded-in applications.

To Order: CMPL, Nominal Bolt Size x Length, Material, Finish, Series

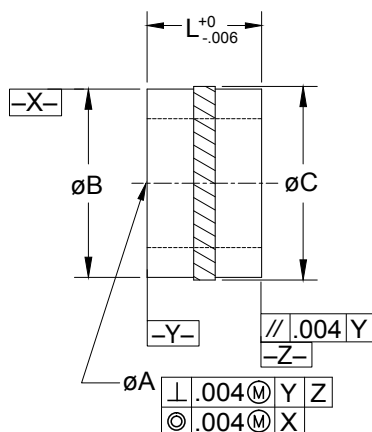
Example: CMPL 6 X 8 AK CL600



STANDARD ALUMINUM COMPRESSION LIMITERS - INCH

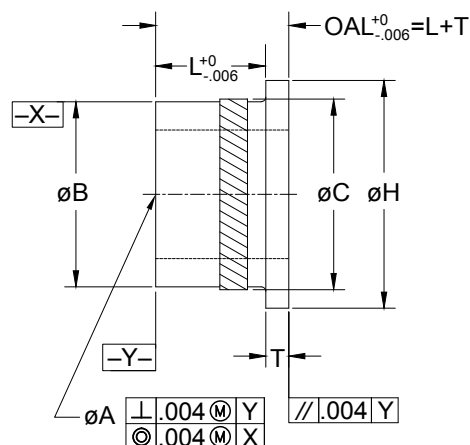
SERIES CL600

Knurled



SERIES CL601

Headed



MATERIAL

A Aluminum

FINISH

K Plain

DIMENSIONAL DATA

| Inch | | | | | | |
|-------------------|-----------|-----------|---------|-----------|--------|-------------------------|
| Nominal Bolt Size | ØA | ØB | ØC Ref. | ØH | T Ref. | Recommended Ø Hole Size |
| #4 | .159/.163 | .213/.219 | .228 | .289/.299 | .039 | .221/.224 |
| #6 | .179/.183 | .249/.255 | .263 | .321/.331 | .039 | .256/.259 |
| #8 | .199/.203 | .274/.280 | .288 | .352/.362 | .039 | .281/.284 |
| #10 | .238/.242 | .334/.340 | .347 | .415/.425 | .039 | .341/.344 |
| 1/4 | .277/.281 | .394/.400 | .409 | .478/.488 | .049 | .401/.404 |
| 5/16 | .356/.360 | .526/.532 | .540 | .604/.614 | .049 | .533/.536 |

| Inch | | | | | | | |
|---------------------|------|----|----|----|-----|-----|------|
| Nominal Bolt Size ➤ | | #4 | #6 | #8 | #10 | 1/4 | 5/16 |
| Standard Length | .125 | | | | | | |
| | .156 | | | | | | |
| | .187 | | | | | | |
| | .250 | | | | | | |
| | .312 | | | | | | |

- CL600 / CL601 rated for use up to SAE Grade 8 bolts.
- The knurl will always be larger than the maximum hole.
- Special lengths available upon request.

SPIROL® Knurled CL600 and CL601

Compression Limiters are perfect for press-in and molded-in applications.

To Order: CMPL, Nominal Bolt Size x Length, Material, Finish, Series

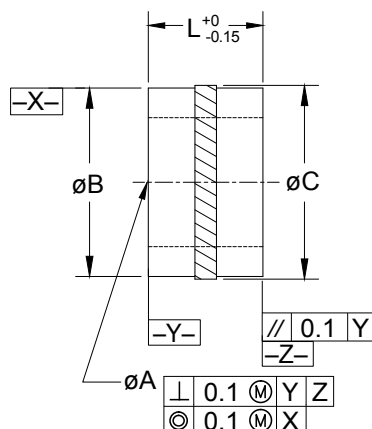
Example: CMPL .250 X .312 AK CL601



STANDARD BRASS COMPRESSION LIMITERS - METRIC

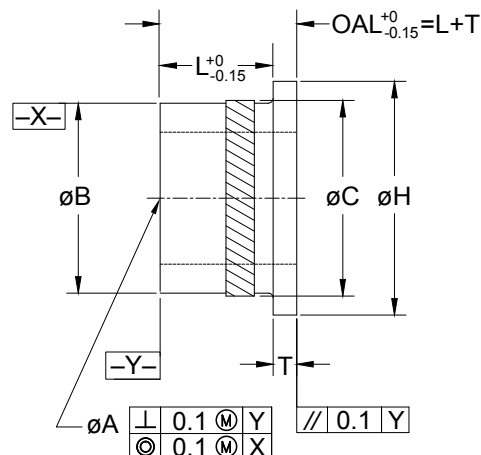
SERIES CL800

Knurled



SERIES CL801

Headed



MATERIAL

E Brass

FINISH

K Plain

DIMENSIONAL DATA

| Metric | | | | | | |
|-------------------|-----------|-------------|---------|-------------|--------|-------------------------|
| Nominal Bolt Size | ØA | ØB | ØC Ref. | ØH | T Ref. | Recommended Ø Hole Size |
| M3 | 4.05/4.15 | 6.03/6.19 | 6.40 | 7.75/8.00 | 1.00 | 6.20/6.30 |
| M4 | 5.05/5.15 | 7.56/7.72 | 7.92 | 9.35/9.60 | 1.00 | 7.74/7.84 |
| M5 | 6.05/6.15 | 9.09/9.25 | 9.45 | 10.95/11.20 | 1.00 | 9.27/9.37 |
| M6 | 7.05/7.15 | 10.92/11.08 | 11.29 | 13.35/13.60 | 1.25 | 11.10/11.20 |
| M8 | 9.05/9.15 | 14.58/14.74 | 14.96 | 17.35/17.60 | 1.25 | 14.76/14.86 |

| Metric | | | | | |
|-------------------|---|---|---|---|---|
| Nominal Bolt Size | 3 | 4 | 5 | 6 | 8 |
| Standard Length | 3 | 4 | 5 | 6 | 8 |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |
| 8 | | | | | |

- CL800 / CL801 rated for use up to ISO Class 10.9 bolts.
- The knurl will always be larger than the maximum hole.
- Special lengths available upon request.

SPIROL® Knurled CL800 and CL801

Compression Limiters are perfect for press-in and molded-in applications.

To Order: CMPL, Nominal Bolt Size x Length, Material, Finish, Series

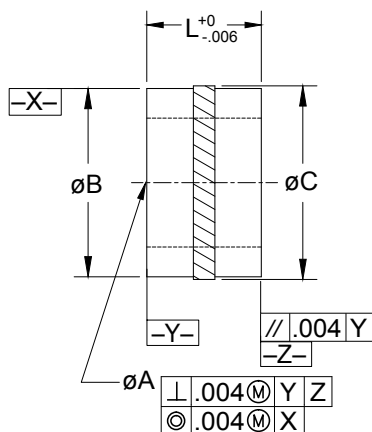
Example: CMPL 5 X 6 EK CL800



STANDARD BRASS COMPRESSION LIMITERS - INCH

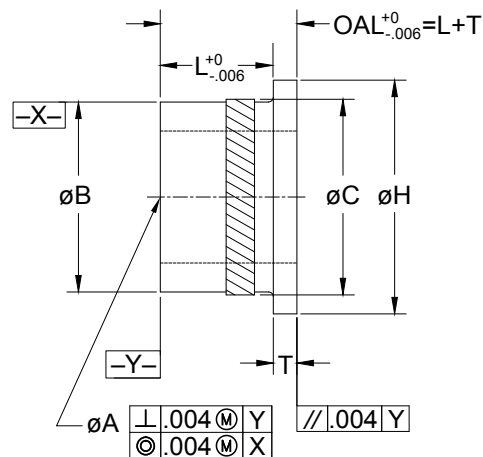
SERIES CL800

Knurled



SERIES CL801

Headed



MATERIAL

E Brass

FINISH

K Plain

DIMENSIONAL DATA

| Inch | | | | | | |
|-------------------|-----------|-----------|---------|-----------|--------|-------------------------|
| Nominal Bolt Size | ØA | ØB | ØC Ref. | ØH | T Ref. | Recommended Ø Hole Size |
| #4 | .159/.163 | .238/.244 | .252 | .305/.315 | .039 | .245/.248 |
| #6 | .179/.183 | .262/.268 | .276 | .336/.346 | .039 | .269/.272 |
| #8 | .199/.203 | .298/.304 | .312 | .367/.377 | .039 | .305/.308 |
| #10 | .238/.242 | .358/.364 | .372 | .430/.440 | .039 | .365/.368 |
| 1/4 | .277/.281 | .430/.436 | .445 | .524/.534 | .049 | .437/.440 |
| 5/16 | .356/.360 | .574/.580 | .589 | .680/.690 | .049 | .581/.584 |

| Inch | | | | | | | |
|---------------------|------|----|----|----|-----|-----|------|
| Nominal Bolt Size ➤ | | #4 | #6 | #8 | #10 | 1/4 | 5/16 |
| Standard Length | .125 | | | | | | |
| | .156 | | | | | | |
| | .187 | | | | | | |
| | .250 | | | | | | |
| | .312 | | | | | | |

- CL800 / CL801 rated for use up to SAE Grade 8 bolts.
- The knurl will always be larger than the maximum hole.
- Special lengths available upon request.

SPIROL® Knurled CL800 and CL801

Compression Limiters are perfect for press-in and molded-in applications.



To Order: CMPL, Nominal Bolt Size x Length, Material, Finish, Series

Example: CMPL .250 X .312 EK CL801

SPIROL® Bolt Specifications

| Common Inch Bolts per SAE J429 | | | | | | |
|--------------------------------|----------------------|-------|----------------------|-------|----------------------|-------|
| Threads | Grade 2 Loads (lbs.) | | Grade 5 Loads (lbs.) | | Grade 8 Loads (lbs.) | |
| Coarse | Proof | Clamp | Proof | Clamp | Proof | Clamp |
| #4-40 | 330 | 250 | 510 | 380 | 720 | 540 |
| #6-32 | 500 | 375 | 770 | 580 | 1,090 | 820 |
| #8-32 | 770 | 575 | 1,190 | 895 | 1,680 | 1,260 |
| #10-24 | 960 | 720 | 1,480 | 1,110 | 2,100 | 1,575 |
| 1/4-20 | 1,750 | 1,310 | 2,700 | 2,025 | 3,800 | 2,850 |
| 5/16-18 | 2,900 | 2,200 | 4,450 | 3,340 | 6,300 | 4,725 |
| 3/8-16 | 4,250 | 3,200 | 6,600 | 4,950 | 9,300 | 7,000 |

| Common Inch Bolts per SAE J429 | | | | | | |
|--------------------------------|----------------------|-------|----------------------|-------|----------------------|-------|
| Threads | Grade 2 Loads (lbs.) | | Grade 5 Loads (lbs.) | | Grade 8 Loads (lbs.) | |
| Fine | Proof | Clamp | Proof | Clamp | Proof | Clamp |
| #4-48 | 360 | 270 | 560 | 420 | 790 | 600 |
| #6-40 | 550 | 410 | 860 | 645 | 1,210 | 910 |
| #8-36 | 800 | 600 | 1,250 | 940 | 1,760 | 1,320 |
| #10-32 | 1,100 | 825 | 1,700 | 1,275 | 2,400 | 1,800 |
| 1/4-28 | 2,000 | 1,500 | 3,100 | 2,325 | 4,350 | 3,260 |
| 5/16-24 | 3,200 | 2,400 | 4,900 | 3,675 | 6,950 | 5,210 |
| 3/8-24 | 4,800 | 3,600 | 7,450 | 5,600 | 10,500 | 7,900 |

| Common Metric Bolts per ISO 898 | | | | | | | | |
|---------------------------------|---------------------|--------|---------------------|--------|----------------------|--------|----------------------|--------|
| Threads | Class 5.8 Loads (N) | | Class 8.8 Loads (N) | | Class 10.9 Loads (N) | | Class 12.9 Loads (N) | |
| | Proof | Clamp | Proof | Clamp | Proof | Clamp | Proof | Clamp |
| M3 | 1,910 | 1,430 | 2,920 | 2,190 | 4,180 | 3,140 | 4,880 | 3,660 |
| M3.5 | 2,580 | 1,940 | 3,940 | 2,960 | 5,630 | 4,220 | 6,580 | 4,940 |
| M4 | 3,340 | 2,500 | 5,100 | 3,850 | 7,290 | 5,450 | 8,520 | 6,400 |
| M5 | 5,400 | 4,050 | 8,230 | 6,150 | 11,800 | 8,850 | 13,800 | 10,350 |
| M6 | 7,640 | 5,750 | 11,600 | 8,700 | 16,700 | 12,550 | 19,500 | 14,650 |
| M8 X 1 | 14,900 | 11,200 | 22,700 | 17,000 | 32,500 | 24,400 | 38,000 | 28,500 |
| M8 X 1.25 | 13,900 | 10,400 | 21,200 | 15,900 | 30,400 | 22,800 | 35,500 | 26,600 |
| M10 X 1 | 24,500 | 18,400 | 37,400 | 28,100 | 53,500 | 40,100 | 62,700 | 47,000 |
| M10 X 1.25 | 23,300 | 17,500 | 35,500 | 26,600 | 50,800 | 38,100 | 59,400 | 44,600 |
| M10 X 1.5 | 22,000 | 16,500 | 33,700 | 25,300 | 48,100 | 36,100 | 56,300 | 42,200 |
| M12 X 1.25 | 35,000 | 26,300 | 53,400 | 40,100 | 76,400 | 57,300 | 89,300 | 67,000 |
| M12 X 1.5 | 33,500 | 25,100 | 51,100 | 38,300 | 73,100 | 54,800 | 85,500 | 64,100 |
| M12 X 1.75 | 32,000 | 24,000 | 48,900 | 36,700 | 70,000 | 52,500 | 81,800 | 61,400 |

Notes:

- Proof loads are per SAE J429 and ISO 898 respectively.
- Shaded inch sizes are not directly covered by SAE J429, but are calculated appropriately.
- Clamp load is approximately 75% proof load. **SPIROL** strongly recommends not to exceed 75% of proof load. If the bolt is torqued all the way to proof, the bolt will fail.

Standard Fastener Rated Yield (Proof) Strengths

| | |
|----------------|-------------|
| SAE Grade 5 | 85,000 psi |
| SAE Grade 8 | 120,000 psi |
| ISO Class 5.8 | 380 MPa |
| ISO Class 8.8 | 580 MPa |
| ISO Class 10.9 | 830 MPa |
| ISO Class 12.9 | 970 MPa |

SPIROL® Torque Specifications

Typical tightening torque values to achieve recommended **Clamping Loads** are based on the following formula:

$$T = K \times D \times P$$

Where:

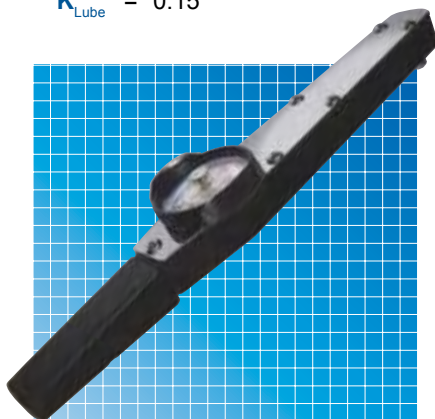
K = torque-friction coefficient

D = nominal bolt diameter

P = bolt clamping load

K_{Dry} = 0.2

K_{Lube} = 0.15



| Common Inch Bolts per SAE J429 | | | | | | |
|--------------------------------|----------------|-------|----------------|-------|----------------|-------|
| Threads | Grade 2 Torque | | Grade 5 Torque | | Grade 8 Torque | |
| Coarse | Dry | Lube | Dry | Lube | Dry | Lube |
| #4-40 | 5.6 | 4.2 | 8.5 | 6.4 | 12.1 | 9.1 |
| #6-32 | 10.4 | 7.8 | 16.0 | 12.0 | 22.6 | 17.0 |
| #8-32 | 18.9 | 14.1 | 29.4 | 22.0 | 41.3 | 31.0 |
| #10-24 | 27.4 | 20.5 | 42.2 | 31.6 | 60.0 | 45.0 |
| 1/4-20 | 65.5 | 49.0 | 101.0 | 76.0 | 143.0 | 107.0 |
| 5/16-18 | 138.0 | 103.0 | 209.0 | 157.0 | 295.0 | 221.0 |
| 3/8-16 | 240.0 | 180.0 | 371.0 | 278.0 | 525.0 | 394.0 |

| Common Inch Bolts per SAE J429 | | | | | | |
|--------------------------------|----------------|-------|----------------|-------|----------------|-------|
| Threads | Grade 2 Torque | | Grade 5 Torque | | Grade 8 Torque | |
| Fine | Dry | Lube | Dry | Lube | Dry | Lube |
| #4-48 | 6.0 | 4.5 | 9.4 | 7.1 | 13.4 | 10.1 |
| #6-40 | 11.3 | 8.5 | 17.8 | 13.4 | 25.1 | 18.8 |
| #8-36 | 19.7 | 14.8 | 30.8 | 23.1 | 43.3 | 32.5 |
| #10-32 | 31.4 | 23.5 | 48.5 | 36.3 | 68.5 | 51.5 |
| 1/4-28 | 75.0 | 56.5 | 116.0 | 87.0 | 163.0 | 122.0 |
| 5/16-24 | 150.0 | 113.0 | 230.0 | 172.0 | 326.0 | 244.0 |
| 3/8-24 | 270.0 | 202.0 | 420.0 | 315.0 | 593.0 | 444.0 |

| Common Metric Bolts per ISO 898 | | | | | | | | |
|---------------------------------|------------------|------|------------------|------|-------------------|-------|-------------------|-------|
| Threads | Class 5.8 Torque | | Class 8.8 Torque | | Class 10.9 Torque | | Class 12.9 Torque | |
| | Dry | Lube | Dry | Lube | Dry | Lube | Dry | Lube |
| M3 | 0.9 | 0.6 | 1.3 | 1.0 | 1.9 | 1.4 | 2.2 | 1.6 |
| M3.5 | 1.4 | 1.0 | 2.1 | 1.6 | 3.0 | 2.2 | 3.5 | 2.6 |
| M4 | 2.0 | 1.5 | 3.1 | 2.3 | 4.4 | 3.3 | 5.1 | 3.8 |
| M5 | 4.0 | 3.0 | 6.2 | 4.6 | 8.8 | 6.6 | 10.3 | 7.8 |
| M6 | 6.9 | 5.2 | 10.4 | 7.8 | 15.1 | 11.3 | 17.6 | 13.2 |
| M8 X 1 | 17.9 | 13.4 | 27.2 | 20.4 | 39.0 | 29.3 | 45.6 | 34.2 |
| M8 X 1.25 | 16.6 | 12.5 | 25.4 | 19.1 | 36.5 | 27.4 | 42.6 | 31.9 |
| M10 X 1 | 36.8 | 27.6 | 56.2 | 42.1 | 80.2 | 60.2 | 94.0 | 70.5 |
| M10 X 1.25 | 35.0 | 26.3 | 53.2 | 39.9 | 76.2 | 57.2 | 89.2 | 66.9 |
| M10 X 1.5 | 33.0 | 24.8 | 50.6 | 38.0 | 72.2 | 54.2 | 84.4 | 63.3 |
| M12 X 1.25 | 63.1 | 47.3 | 96.2 | 72.2 | 137.5 | 103.1 | 160.8 | 120.6 |
| M12 X 1.5 | 60.2 | 45.2 | 91.9 | 68.9 | 131.5 | 98.6 | 153.8 | 115.4 |
| M12 X 1.75 | 57.6 | 43.2 | 88.1 | 66.1 | 126.0 | 94.5 | 147.4 | 110.5 |

Notes:

- Shaded inch sizes are not directly covered by SAE J429, but are calculated appropriately.
- Torque for inch threads are in•lbs.
- Torque for metric threads are N•m.
- Torque values shown are for clamp load.
- Actual loads developed by a specified torque value can vary by ±25%.



**Innovative fastening solutions.
Lower assembly costs.**



Please refer to www.SPIROL.com for current specifications and standard product offerings.

SPIROL Application Engineers will review your application needs and work with you to recommend the optimum solution. One way to start the process is to visit our **Optimal Application Engineering** portal at **SPIROL.com**.

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