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General Products

Electrical & Mechanical Connections

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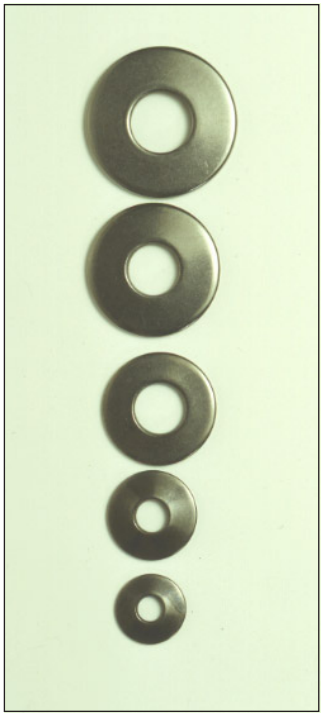
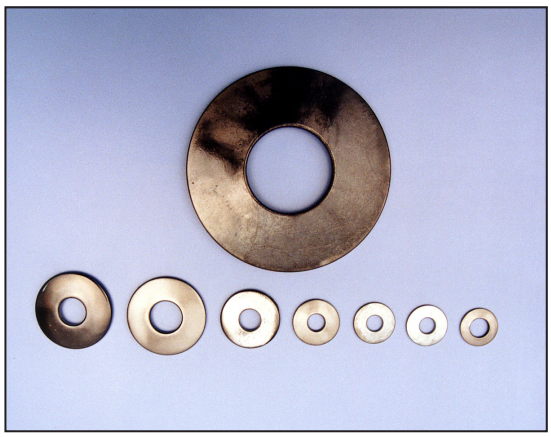
**All pages begin with an GP - EM (GENERAL PRODUCTS, Electrical & Mechanical Connections) prefix*

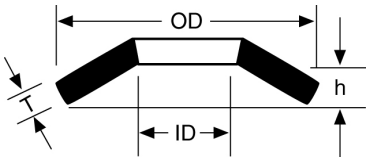
Ph:(+61) 07 3826 6000 Fax:(+61) 07 3826 6066 Email:sales@thew.com.au Website: www.thew.com.au
45 Enterprise Street Cleveland (PO Box 1796 Cleveland DC) Queensland 4163 Australia

Electrical & Mechanical Connections

Belleville Spring Washers







Made by Solon Manufacturing Co

Description:

Alloy/Carbon Steel Belleville - AISI 1074 High Carbon Steel (ASTM A684)

Operating temperature range: - 40° to 180° C. For indoor/outdoor service, electrical and mechanical applications. Fully magnetic finish. Mechanically zinc plated, .0005" thick with a clear chromate dip. (ASTM B695, class 12, Type I) Type II available on request. Where plating is not desired, a scale free, oiled finish can be supplied.

Typical Applications For Solon Alloy High Carbon Belleville Springs:

Off Highway Equipment	Torque Limiters
Seismic Damping	Fail Safe Brakes
Small Engines	Structural Members

17-7PH Stainless Steel Belleville Springs

Type 17-7PH Stainless Steel (ASTM A693)

Operating temperature range: - 240° to 290° C. For indoor/outdoor service and corrosive atmospheres. Not recommended for chloride and fluoride applications. Suitable for cryogenic applications. Highly magnetic. Finish: Scale free, or if desired, a sulfamate nickel plating from .0003" to .0005" thick in accordance with AMS 2424D can be supplied.

Typical application for Solon 17-7PH Belleville Spring:

Pole Line Hardware	Electrical Bus Bar
Circuit Breakers	Substations
Valve Live Loading	Pipe Hold Downs

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Electrical & Mechanical Connections

Belleville Spring Washers

301 Stainless Steel Belleville Springs

Type 301 Stainless Steel (ASTM A666)

Operating temperature range: -240° to 290° C. For indoor/outdoor service and corrosive atmospheres. Slightly magnetic. Finish: Scale free and deburred.

Typical Applications For Solon 301SS Belleville Springs:

- Pole Line Hardware
- Circuit Breakers
- Valve Live Loading
- Electrical Bus Bar
- Substations
- Pipe Hold Downs

510 Phosphor Bronze Belleville Springs

510 Phosphor Bronze (ASTM B103)

Operating temperature range: -240° to 290° C. For use with copper bus and silicon bronze bolts and nuts. Also for non-magnetic requirements and good electrical conductivity. Non-magnetic. Finish: Scale free and deburred.

Typical Applications For Solon 510PB Belleville Springs:

- Electrical Bus Bar
- Circuit Breakers
- Switchgear
- Pole Line Hardware
- Substations

Inconel 718 Nickel Alloy Belleville Springs

Inconel 718 Nickel Alloy (ASTM B637)

Operating temperature range: 240° to 590° C. For high temperature service in corrosive atmospheres. Indoor/outdoor service. Non-magnetic. Finish: Scale-free and deburred.

1) After initial loading – parts are not preset

2) Height = as received height

3) Torque (ft. lbs.) = .2 x Bolt Dia. X Load ÷ 12

Typical Applications For Solon Inconel 718 Belleville Springs:

- Heat Exchangers
- Marine Applications
- Electrical Bus Bar
- Coastal Substations

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Electrical & Mechanical Connections

Belleville Springs - Application Notes

Belleville spring, disc spring, conical compression washer are all names for the same type of spring (Figure 1). A Belleville spring is a conical shaped disc that will deflect (flatten) at a given rate. This spring rate is usually very high, allowing the spring to produce very large loads in a very small space.

Belleville springs are used in a variety of applications where high spring loads are required. They are particularly useful where vibration, differential thermal expansion, relaxation, and bolt creep are problems.

Belleville springs can be stacked in four different ways (Figure 2).

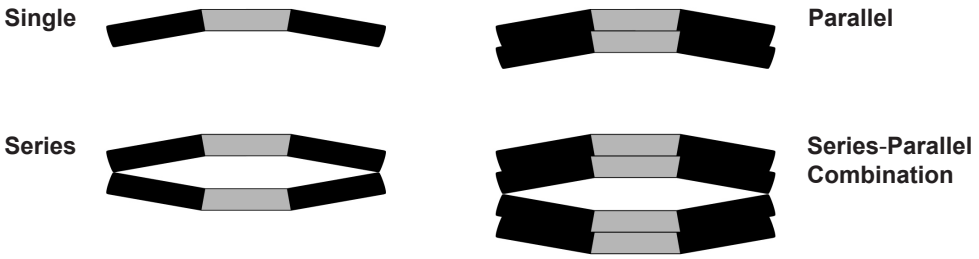

Figure 2

A single Belleville spring has a specific load and deflection. Belleville springs in stacked arrangements provide increased load and/or deflection. Two springs in parallel doubles the load at the deflection of one spring. Two springs in series doubles the deflection at the nominated load of one spring. (Figure 3)

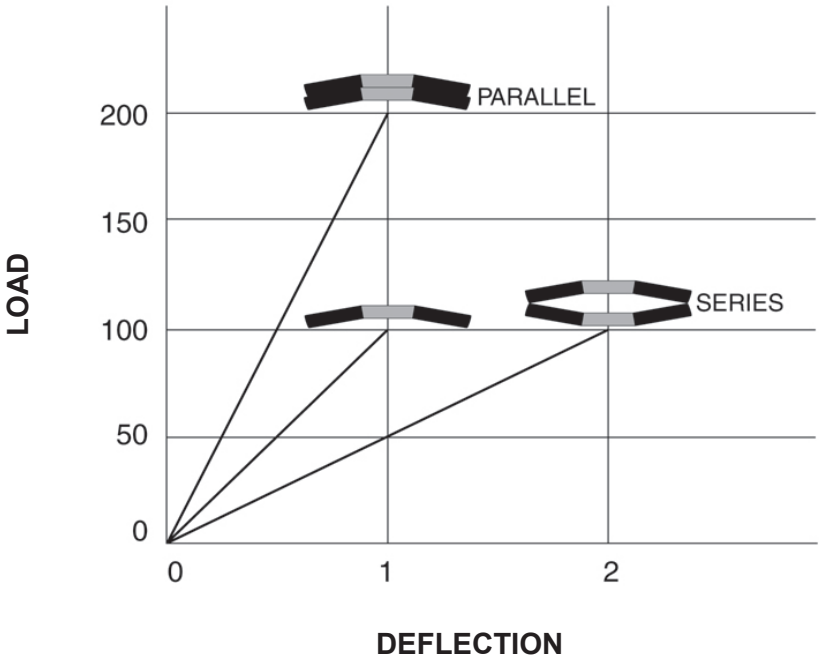

Figure 3

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Electrical & Mechanical Connections

Belleville Springs - Application Notes

Installation:

Belleville springs must be utilised correctly in order to maximise their benefit. There are several important points when using Belleville springs.

A. Be sure that the bolts are long enough to account for the thickness of the Belleville.

B. The OD of the spring should contact the surface of the joint. The ID should contact the bolt head or nut.

C. If a tensioner is used to preload the bolts, the Bellevilles must be on the opposite side of the joint.

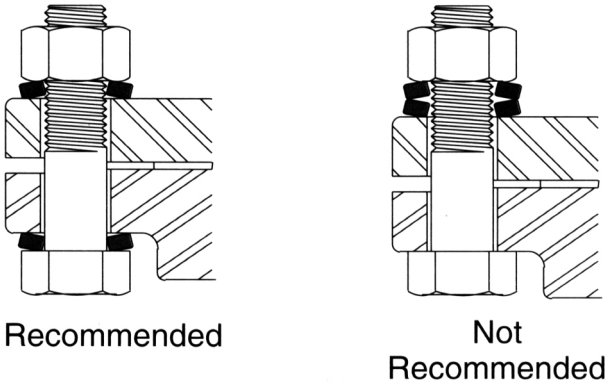

Figure 4

Figure 4 shows examples of the proper and improper way to install two Belleville springs in series.

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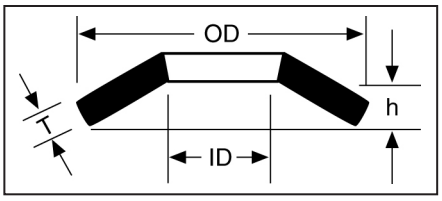
Pipe Flange Connections

Flange Washers



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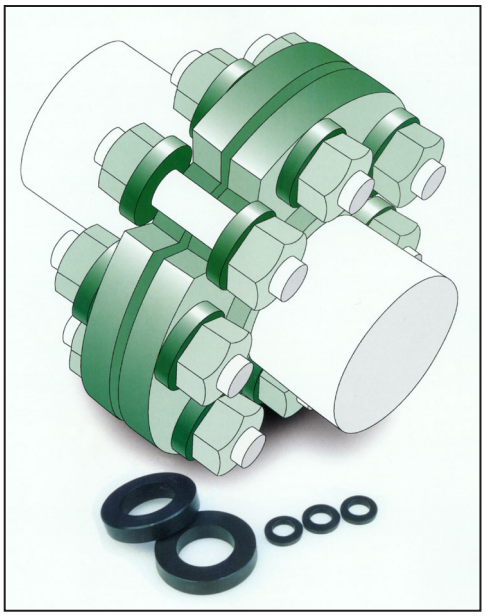

17-7PH Stainless Steel Flange Washer

Type 17-7PH Stainless Steel (ASTM A693)

Operating temperature range: -240° to 290° C. For indoor/outdoor service and corrosive atmospheres. Not recommended for chloride and fluoride applications. Suitable for cryogenic applications. Highly magnetic. Finish: Scale free, or if desired, a Sulfamate Nickel plating from .0003" to .0005" thick in accordance with AMS 2424D can be supplied.

Solon Flange Washers Prevent Bolt Tension Loss Due To:

- Differential Thermal Expansion
- Packing & Gasket Relaxation
- High Temperature Bolt Creep
- Vibration

Metric 17-7PH Stainless Flange Washers

17-7PH Stainless Steel (ASTM A693)

Operating temperature range: -240° to 290° C. For indoor/outdoor service and corrosive atmospheres. Not recommended for chloride and fluoride applications. Suitable for Cryogenic applications. Highly magnetic. Finish: Scale free, or if desired, a Sulfamate Nickel plating form .0003" to .0005" thick in accordance with AMS 2424D can be supplied.

H-13 Tool Steel Flange Washers

H-13 Tool Steel (ASTM A681)

Operating temperature range: -120° to 540° C. For indoor/outdoor high temperature service. Available only in Solon Flange Washers. Fully magnetic. Finish: Machined and lightly oiled.

Metric Inconel 718 Nickel Alloy Flange Washers

Inconel 718 Nickel Alloy (ASTM B637)

Operating temperature range: 240° to 590° C. For high temperature service in corrosive atmospheres. Indoor/outdoor service. Non-magnetic. Finish: Scale free deburred.

Application and Technical Assistance Available on Request.

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Pipe Flange Connections

Flange Washers - Application Notes

Solon Flange Washers are specifically tempered for flange connections. Solon Flange Washers must be installed correctly to maximise their benefits. There are several important points to remember when installing them.

A. Be sure that the bolts or studs are long enough to account for the thickness of the flange washer.

B. The OD of the flange washer should contact the flange joint and the ID of the flange washer should contact the bolt head or nut. (Figure 1)

If the crown of the flange washer is allowed to extend into the bolt hole, then its loading characteristics will be altered. The same is true for a nut that contacts the spring's bottom surface. Since deflections are relatively small, it can be difficult for the installer to see which side is up. Solon's H-13 Tool Steel Flange Washers are chamfered at the top of the OD to help the installer to identify the spring's top surface.

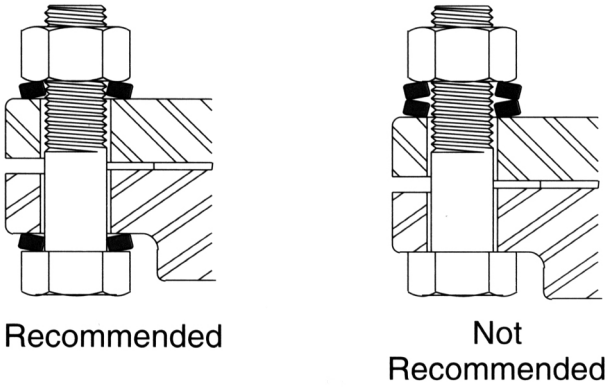

Figure 1

C. If a tensioner is used to preload the bolts, then the flange washer must be on the opposite side of the joint.

D. Flat washers are not normally required for the flange washer's bearing surface. Soft flange materials, such as aluminium, may warrant the use of hardened flat washers to prevent the Bellevilles from embedding in the material.

E. If they are properly applied, flange washers may be reused. Since Belleville springs are highly stressed parts, they should not be reinstalled if corrosion pitting is observed on the surface. If cracking occurs, it may be necessary to specify a different material or coating. Contact Thew & McCann's engineering staff for assistance.

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Pipe Flange Connections

Flange Washers - Application Notes

Live Loading with Solon Flange Washers

It is estimated that 50% to 80% of all flange leaks are caused by insufficient bolt preload. Typically, the bolts are all tightened to a nominated preload. At this original load the bolt has a certain amount of stretch and the gasket yields (takes a set). At start-up, the process fluid heats up the flange and gasket causing them to expand more than the bolts. This leads to an increase in gasket stress causing more yielding. As the bolt temperature rises, preload may fall substantially. This is because the bolt stretch is insufficient to “make up” for what is lost when the gasket yields. For example, if the bolt stretch was .005” and the gasket yield is .005”, then all of the original preload will be lost.

Solon Flange Washers are effective because they add deflection to the fastening system. This is known as “Live Loading”. Flange washers are Belleville springs that are typically very elastic compared to the bolts they are used with. The increase in elasticity leads to dramatically less loss of preload when join components yield. Using the previous example, if the joint employed two flange washers with .025” of deflection each, then preload would fall by only 9% rather than 100%.

Examples of candidates for live loading using flange washers are:

A. Flanges where failure could cause a safety problem.

B. Joints that see large temperature fluctuations.

C. The length to diameter ratio of the bolt is less than three.

D. One or more of the flange components are subject to yielding such as gasket creep, bolt creep, vibration, or elastic interaction.

E. The flange has a history of maintenance problems.

Live loading will not correct all flange leaks. However, maintaining more of the original preload will significantly reduce the risk of failure. It has been shown through various studies by a number of petrochemical companies, that the use of flange washers has a positive overall impact of the performance of a live loaded flange joint.

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Surface Plating

Silver Plating Powder

Description:

Cool Amp silver plating powder is suitable for surface plating properly prepared copper, brass or bronze surfaces. A plating thickness of approximately 0.0025mm is applied to the surface. Reduces contact resistance, reduces power losses and overheating on outdoor and indoor electrical bolted connections such as busbars, cable and transformer terminals. Instructions for proper preparation of surface and application are included.

Weight: 100g (net)

Code: COOLAMP

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