# Useful Facts
## ABOUT STAINLESS STEEL

### CONDITIONS WHICH FAVOUR USE OF STAINLESS STEEL

- Corrosive Environment.
- Very low (cryogenic) temperatures prevent brittleness.
- High temperatures – prevent scale, maintain strength.
- High strength vs. mass.
- Hygienic conditions required – easily cleaned.
- Aesthetic appearance – no rust, thus no paint necessary.
- No contamination – prevents catalytic reactions.
- Discharge slideability from hoppers.
- Wet abrasion resistance.
- Non-magnetic properties of austenitic grades.

### KEY CONSIDERATIONS IN WORKING STAINLESS STEELS

- Know the material:
  Knowledge improves decision making, avoids problems and saves costs.
- Know the grade of material:
  Correct material selection is vital – risk taking is costly.
- Know the design:
  Good design ensures savings for fabricator and user.
- Know surface finishes:
  Good finishes perform well, look good and promote sales.
- Know your supplier.
- Apply good housekeeping:
  Good housekeeping saves rectification costs.
- Apply accurate identification:
  Lost identity can prove costly.
- Apply production planning:
  Planning saves costs and promotes quality.

### OTHER FACTORS

**Thermal conductivity**

All stainless steels have a much lower conductivity than that of carbon (mild) steel (plain chromium grades approximately 1/3 and austenitic grades approximately 1/4). This must be borne in mind for any operation which involves high temperature, eg effects during welding (control of heat input), longer times required for heating to attain a uniform temperature for hot working.

**Expansion coefficient**

Plain chromium grades have an expansion coefficient similar to carbon (mild) steels, but that of the austenitic grades is about 1½ times higher. The combination of high expansion and low thermal conductivity means that precautions must be taken to avoid adverse effects, eg during welding use low heat input, dissipate heat by use of copper backing bars and use adequate jigging. This factor must also be considered in components which use a mixture of materials, eg a heat exchanger with a mild steel shell and austenitic grade tubes.

**Passive film/passivity**

Stainless steels rely on a very thin surface passive film for their corrosion resistance. It is vital to maintain and preserve the integrity of the passive film.

- Avoid mechanical damage and contamination.
- Repair any affected areas – eg high temperature scale adjacent to a weld, mechanically damaged or ground areas, contaminated areas – by passivation only or by both pickling and passivation.
- Ensure a constant and sufficient availability of oxygen at the surface of the stainless steel.

**Galling/pick-up/seizing**

Stainless steels have a tendency to gall, pick-up or seize. To avoid this take precautions, such as:

- for surfaces experiencing relative motion - minimise the load, ensure no heat build up, keep free of grit or contaminants, use lubricants or surface coatings.
- on threaded components the threads must have a high degree of surface finish, components should have an intermediate to free fit, avoid over-torque and contamination of the threads.

*Information obtained from the Australian Stainless Steel Development Association.*

# STAINLESS STEEL
# Threaded Fittings

## STAINLESS STEEL THREADED FITTINGS

For many years Stainless Steel low pressure screwed fittings have been generally manufactured to dimensions of cast (ANSI B16.3) Malleable Iron, and Wrought Steel (BS 1740) Fitting standards. These standards have governed the majority of regularly available Stainless Steel products in Australia. Castings have been largely supplied in accordance with ASTM A351 (CF8M usually).

High pressure fittings on the other hand, have been manufactured to Forged (ASME B16.11) standards covering both Socketweld and Threaded fittings.

The stainless steel industry however, has recognised there are **problems with the supply of low pressure fittings**, particularly from substantial overseas manufacturing centres, where cast fittings are dimensionally manufactured to American standards (ANSI B16.3 and B16.14), designed to be threaded with National Pipe Taper threads, in accordance with ANSI B1.20.1. These cast fittings are subsequently threaded to **"R" for male taper** and **"Rp" for female parallel**, as described in Australian Standard AS1722.1 Part 1, (commonly known as BSPT and BSPP respectively), or G series for female threads, in accordance with AS1722.2 Part 2, (commonly known as Gas threads).

In practice R threaded male and Rp threaded female fittings which have been dimensionally manufactured to an American standard, have proven to seal, provided threads are cut to adequate depths.

However male castings produced to American standards, have insufficient length to produce a thread in full compliance with the R series specification. In addition, if female cast fittings are machined with a G series thread and connected to a male R threaded fitting, conflict will occur, and it is likely that inadequate sealing will result.

Problems with threaded fittings are not however restricted to just low pressure fittings, as high pressure threaded fittings (Class 3000 and 6000), threaded in accordance with the NPT standard, have been found to be failing in two areas, namely:

1. *Non compliance to the thread standard by not meeting the essential elements of* ***thread form.***
2. ***Insufficient thread engagement*** *of mating male and female threads, although still remaining in accordance with the standard. This could lead to fitting blow-out at moderate to high pressure.*

## R SERIES (BSP) THREADED FITTINGS

The most common pipe threads produced on screwed fittings available in Australia are the R series which are used across a broad range of industries, the G series predominantly in the hydraulics industry and the NPT series which are extensively used in the petrochemical industry.

The R series and G series threads are commonly referred to in the industry as BSP (British Standard Pipe) threads. The use of such a common term as BSP, has given rise to the mismatching of the two thread standards.

R series are Sealing Pipe Threads of the Whitworth Form as in AS1722.1 Part 1. The basic thread form has a 55 degree flank angle (**see Figure 1**) and the number of pitch per inch, depends upon the size of pipe to be threaded. To effect a seal the threads are to be connected by either of the following two methods:

a. *An R (external male taper pipe thread) screwed together with an Rc (internal female taper pipe thread), see* ***Figure 2****. The cone tapers on both threads are 1 in 16 on diameter, which equates to 1 degree 47 minutes.*

b. *An R (external male taper pipe thread) screwed together with an Rp (internal female parallel pipe thread), see* ***Figure 3****.*

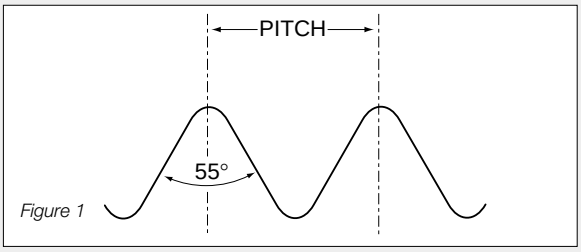


Figure 1

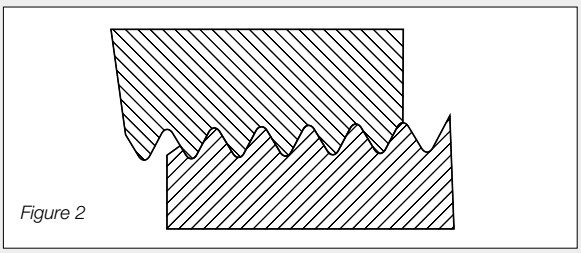


Figure 2

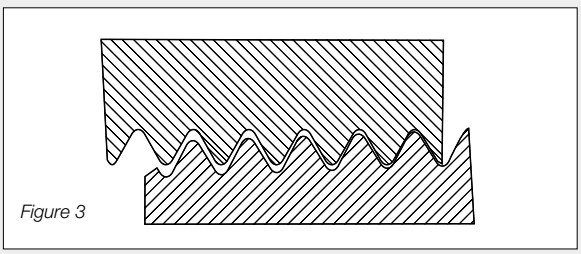


Figure 3

The matching of these threads, with the use of a jointing medium (ie. Teflon thread tape) is sufficient to effect a seal between the mating parts.

It should be noted that the connection between a male taper and a female parallel pipe thread, theoretically would only make contact at one single point, but owing to the elasticity of the material, they will, in practice, have sealing contact on approximately one and a half turns. It is recommended that this method of jointing be limited to moderate pressures, whilst for higher pressures the use of **taper on taper** threads is recommended.

**G series are Fastening Pipe Threads** of the Whitworth Form as in AS1722.2 Part 2. Again the basic thread form and pitch are common to the R series, but that is where the similarity ends. A seal is not achieved by the threads and another means of sealing must be introduced (ie. Gasket or O-Ring). Both the male and female threads are parallel, the female having a positive tolerance and the male having a negative tolerance on the basic diameters, thus producing clearance between the two, (**see Figure 4**).

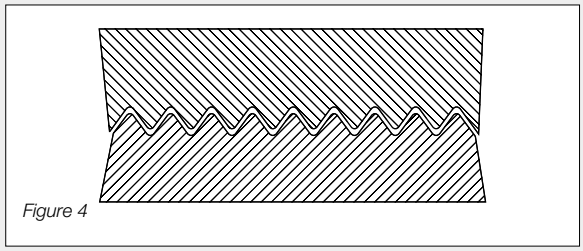


*Figure 4*

This combination of threads is used extensively in the hydraulics industry and with the correct selection of an appropriate seal material or seal form for the application, high pressures can be maintained.

## EQUIVALENT INTERNATIONAL STANDARDS

| **Australian Standard AS1722.1 Part 1** | **Australian Standard AS1722.2 Part 2** |
|---|---|
| British Standard institution BS 21 | British Standard Institution BS 2779 |
| International Organisation for Standards ISO 7 | International Organisation for Standards ISO 228 |
| Deutsche Industrie-Norm DIN 2999 | Deutsche Industrie-Norm DIN 259 |

## NPT THREADED FITTINGS

National Pipe Taper (NPT) threads are manufactured in accordance with ANSI/ASME B1.20.1 where the basic thread form has a 60 degree flank angle and the number of pitch per inch is dependent on the pipe size to be threaded. Again the cone taper on male and female threads is 1 in 16 on diameter or 1 degree 47 minutes, with the flank angle being perpendicular to the centreline axis. The thread form is sharper in appearance than the Whitworth form, and incorporates the use of a truncation (flat), rather than a radius on the roots and crests of the thread, (**see Figure 5**).

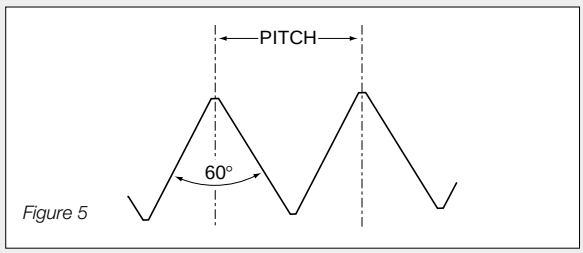



*Figure 5*

The NPT male and female threads are designed to seal on the flanks of the thread form, (**see Figure 6**), but with the combination of various tolerances in the form, some crushing of the crests or roots may occur, thus it is recommended that a thread sealant or lubricant be used. This will assist in the sealing and also prevent the thread from galling which is a common problem in the 300 series stainless steels. This combination of threads is used extensively in applications with high pressures, of 3000 psi and above.

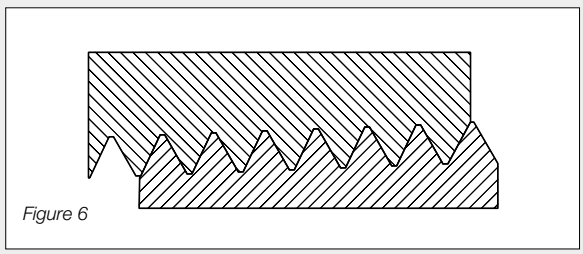


*Figure 6*

STAINLESS STEEL

# Threaded Fittings

### COMMON TERMS USED WITH THREADS

LO = Overall length of thread

LU = Length of useful thread or effective thread length

LF = Length of complete full thread form

LG = Gauge length or hand tight engagement

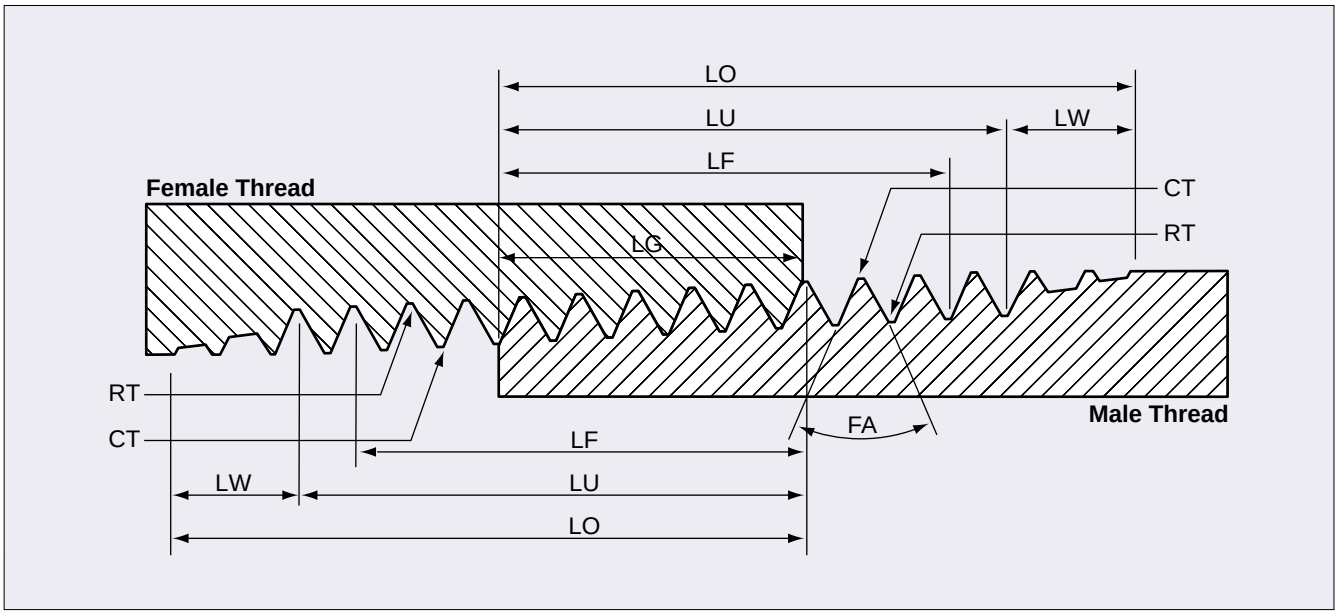
LW = Length of washout thread or vanish threads

CT = Crest of thread

RT = Root of thread

FA = Flank angle

For further information refer to the appropriate standard.




## COMMON PROBLEMS ENCOUNTERED IN THE USE OF THREADS

**Problem: Mismatching of Standards**

Pipe sizes ½" and ¾" have the same pitch and cone taper angle on R and NPT series threads and may appear to screw together without any mismatch. Please remember the two series of threads are **completely different** in all other respects, and it is recom-mended that the mixing of the two thread standards **does not** occur.

**Problem: Joining of an R series male thread with G series female thread**

The two thread standards are independent of each other, so while the two threads may appear to connect together without any mismatch, problems may occur with:

a) The male thread may screw into the female thread further than designed, thus having a potential to leak.

b) The beginning of the male thread interferes with the end of the female thread. This is a common problem encountered with valves that are screwed with G series threads. Usually the female thread length is insufficient to accommodate the male thread.

**Problem: American standard castings with R series threads**

Fittings originally cast to the American Standards ANSI B16.3 and B16.14 that are designed to be machined with an NPT thread, but are subsequently machined with an R series thread. The length of the fitting as cast is found to be too short, to produce an R series thread to its correct length.

**Problem: R series threads locking up in the wash out part of the thread**

This is easy to check, male thread should have two to three threads exposed after hand tight engagement with a female thread, this is to allow the joint to be wrench tightened.

**Problem: Rp thread machined or tapped oversize**

The male thread engages too deeply and lock up could occur in the wash out of the thread, or the front face of the male fitting could foul with the end of the female thread.

**Problem: Insufficient thread engagement**

NPT male and female threads manufactured to maximum and minimum tolerance respectively, the amount of engagement could be limited to as little as one turn. Fitting blow-out may occur with the introduction of high pressure.

**Problem: Incorrect thread form**

NPT threads machined with the incorrect thread form, thus the possibility of leakage or thread blow out.

## THE SOLUTION

Prochem Pipeline Products is Australia's leading manufacturer of stainless steel threaded fittings, with all fittings manufactured in complete accordance with the various International fitting standards, under the strict control of a Quality Assurance System certified to ISO 9001 by Lloyd's.

All of the problems as detailed within, have been identified, and indeed rectified, by Prochem, with industry Australia wide gaining the benefits of our local expertise.

If you have concerns about fitting problems you may be experiencing or in fact you require a particular fitting product to meet your special application, then please do not hesitate to contact your nearest Prochem office.

**At Prochem, we have the quality of product and service, the experience and the expertise, to provide the solutions to your fitting problems, and we are only too pleased to assist in any way we can: *that's the Prochem advantage.***