Thread Systems

A thread system is a set of various thread designations which represent different thread sizes to define the thread geometry for example:

Thread Series	Designations
Metric	M
Unified	UNC, UNF, UNS, UN, UNR
National Taper Pipe	NPT
Aeronautical Taper Pipe	ANPT
British Standard Whitworth	BSW

There are only two major screw thread systems that are used today:

1. The ISO Metric Screw Thread System
2. The Unified Screw Thread System

In countries other than the United States and Canada, the ISO Metric Screw Thread System is primarily used today. Unlike, most other countries the United States and Canada still use the Unified (Inch) Thread System. However, both are moving over to the ISO Metric System. It is estimated that approximately 60% of screw threads in use in the United States are still inch based.

Other thread designations such as BSW, BSF, BA, etc. are also still in use today but are mostly produced in the capacity of a replacement part.

Threads are manufactured by cold forming, cold rolling, hot forming, cold rolling or by the cut-thread process. The most common manufacturing method for standard fasteners up to 1" or 25mm is the cold forming or cold rolling process whereby both the head and the thread are produced with the material in the cold state. The threads over this size are produced by the hot forging process, however, the threads are still cold rolled when size permits. Cut threads are produced mainly to satisfy special requirements – such as low volume replacement parts and larger fasteners over 1" or M25.

ISO Metric Thread Designation

ISO Metric threads are designated by the letter M followed by the values of the nominal diameter and of the pitch expressed in millimeters; separated by the sign "x" for example M2 x .4.

The metric coarse threads do not need to have the pitch specified. When there is not a pitch listed it indicates that the thread is a coarse thread series not a fine thread series, for example, M12 (Coarse pitch 1.5mm). In all other cases, the thread pitch needs to be specified, for example, M14 x 1.5.

Unified Thread System Designation (Inch System)

Unified form thread designations are represented by abbreviations such as UNC (unified coarse), UNF (unified fine), UNEF (unified extra fine), UNS (unified special) and UN (unified constant pitch), with the thread major diameter preceding the designation for example, 9/16" UNC, 9/16" UNF.

Threads in the UNC, UNF & UNEF designations have a fixed number of threads per inch (tpi) for a special diameter. For example, 5/16" UNC has 18 tpi, 5/16" UNF has 24 tpi, and 5/16" UNEF has 32 tpi.

UNC	**Unified National Coarse-** is the most commonly used and preferred thread for general purpose inch gaging. Because of the inherent coarse pitch, the threads are deeper than fine threads and are easier to assemble without cross threading.
UNF	**Unified National Fine-** threads have a slightly higher breaking load capacity than UNC threads because of the lesser thread depth and a larger tensile stress area for gages of the same identical material and diameter. The smaller lead angle allows for fine adjustment where needed.
UNS	**Unified Special-** threads need to have the tpi specified; however the number of tpi for a specific diameter is limited. Example, within ½" diameter size, the tpi allowed are: ½" – 12 UNS, ½" – 14 UNS, ½" – 18 UNS, ½" – 24 UNS and ½" – 27 UNS.
UN	**Unified Constant Pitch-** series threads with 4, 6, 8, 12, 16, 20, 28 & 32 threads per inch, offer a wide range of diameter-pitch combinations for those applications where the standard UNC, UNF, UNEF and UNS are not suitable.
UNJC & UNJF	Are similar to UNC and UNF threads in both external and internal thread forms except that the external thread has a much larger root radius than the corresponding UNC, UNF threads and the radius is mandatory and must be inspected. The addition of the root radius increases the tensile stress area of the thread, thus making it stronger and also helps reduce the stress concentration factor in the threaded section.
UNR	**Unified Round-** is an external rolled unified form thread in all respects except that the root radius must be rounded but not mandatory inspected. Almost all externally threaded fastener manufacturers produce UNR rolled threads rather than plain unified form threads.

Thread Fit

Thread fit is a measure of the tension or laxity between a male and the corresponding female thread. Classes of thread fit are specific combinations of tolerances and allowances that are applied to male and female threads.

From a plating point of view, tolerances/allowances applying to threads are important because they provide a measure of the maximum thickness of corrosion resistant coatings that can be used in the thread assembly.

Unified Thread System Fit

The allowances/tolerances (class) for external Unified Threads are designated by the letter 'A' preceded by a number for example, class 1A, 2A, or 3A. The internal Unified Threads are designated by the letter 'B' preceded by a number for example, 1B, 2B, or 3B. Therefore a 1A thread ring gage fits a 1A thread set plug.

Metric Thread System Fit

According to ISO 965, two tolerance classes of thread fits are recommended. For example, 6g thread ring gage, 6H thread plug gage.

Note: A metric tolerance class 6g ring and 6H plug is suitable for use where a Unified class 2A Ring and 2B thread plug was previously used on a thread for comparison basis.

Comparison – Coarse vs. Fine Threads

Coarse Threads offer the following advantages for most applications:

- Easier and faster assembly of components with less chance of cross threading.
- Minor damage to threads during handling and shipping are less likely to affect assembly.
- Less prone to stripping when fastened into lower strength materials.
- Thicker platings possible because of relatively larger thread allowances and therefore less likely to seize in corrosion prone applications.
- Better fatigue resistance because of less concentration of stress at thread root radius.

Fine Threads on the other hand offer:

- Higher strengths in tension because of larger tensile stress area.
- Shorter thread depth allows threading in thin wall applications.
- Fine threads allow more precise adjustment because of smaller helix angle.
- Where length of engagement is limited, fine threads provide greater strength.
- Fine threads are easier to tap in harder materials.