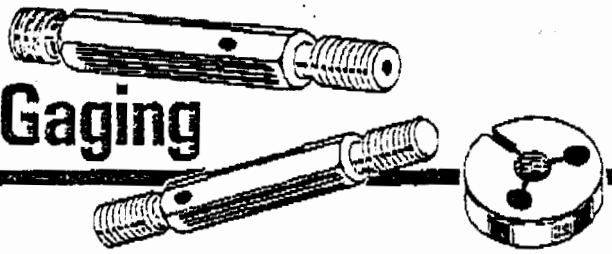


NPTF (DRYSEAL) TAPER PIPE GAGES

Dryseal pipe threads are generally used in more critical applications then NPT and therefore a greater variety of gages and/or measuring equipment is used to more adequately check size, taper and thread form. NPT product threads and gages are covered by our Technical Bulletin, "NPT Taper Pipe Thread Gages", which may be consulted for basic taper pipe gaging principles and to make comparisons to NPTF.

NPTF (National Pipe Taper Fuel) threads have the same taper (3/4" per foot) and 60° thread angle as NPT but differ significantly in the crest and root truncation requirements. Closer control of all elements is necessary for a satisfactory "dryseal" assembly of mating parts. This control starts with selection of the proper threading tools specifically made to produce an NPTF profile.

Figure #1 illustrates the normal product thread condition wherein the crests (major diameter of external threads and minor diameter of internal threads) are sharper than the roots of the mating parts.

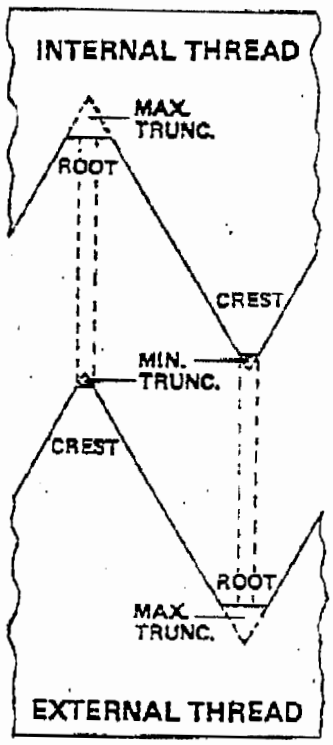
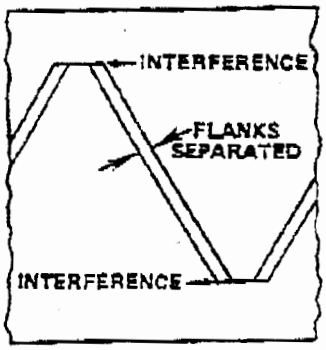


Figure #1

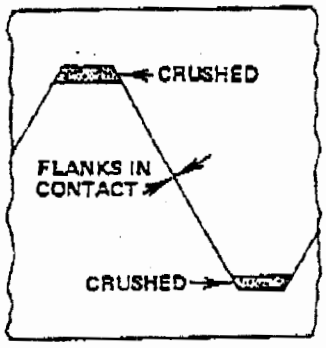
Figure #2 illustrates that when the NPTF parts are assembled hand-tight there normally will be contact or interference at crest and root first while the thread flanks are still separated.

Figure #3 illustrates the results when mating parts are brought to a wrench-tight condition. Now the sharper crests are crushed into the opposing roots while the thread flanks are drawn together. Thus there is complete mating profile making a leak-proof connection without the necessity of a sealing compound. Hence the term "dryseal" is used. (There are applications particularly where high pressures are involved when a sealant may still be applied.)



CREST & ROOT INTERFERENCE (HAND TIGHT)

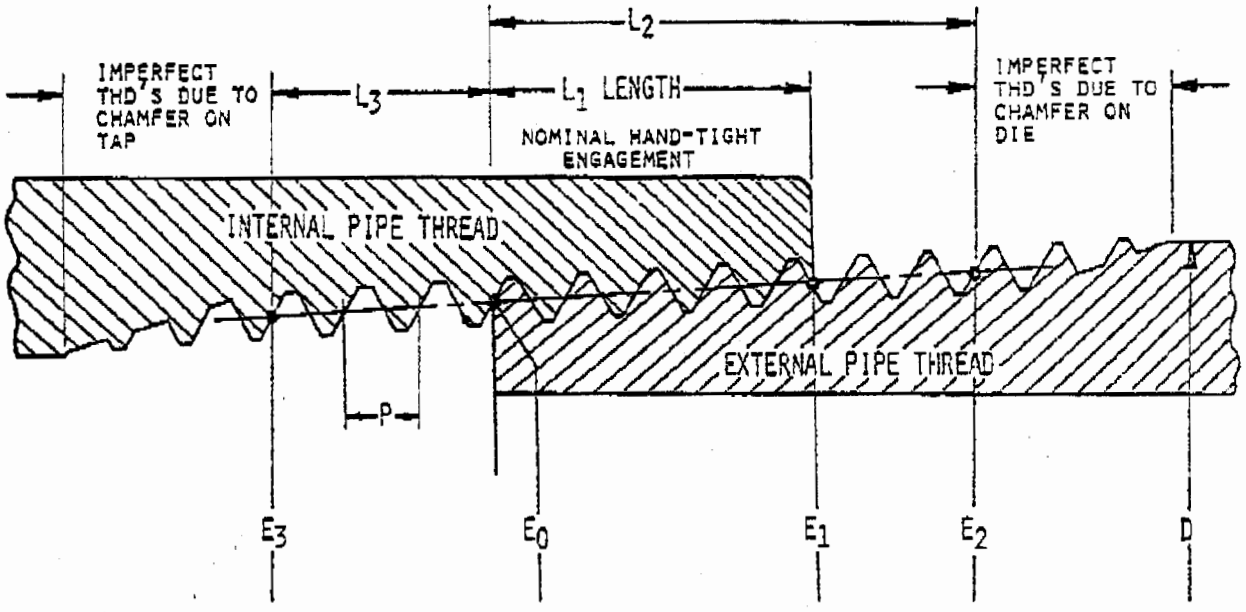
Figure #2



CRESTS & ROOTS CRUSHED (WRENCH TIGHT)

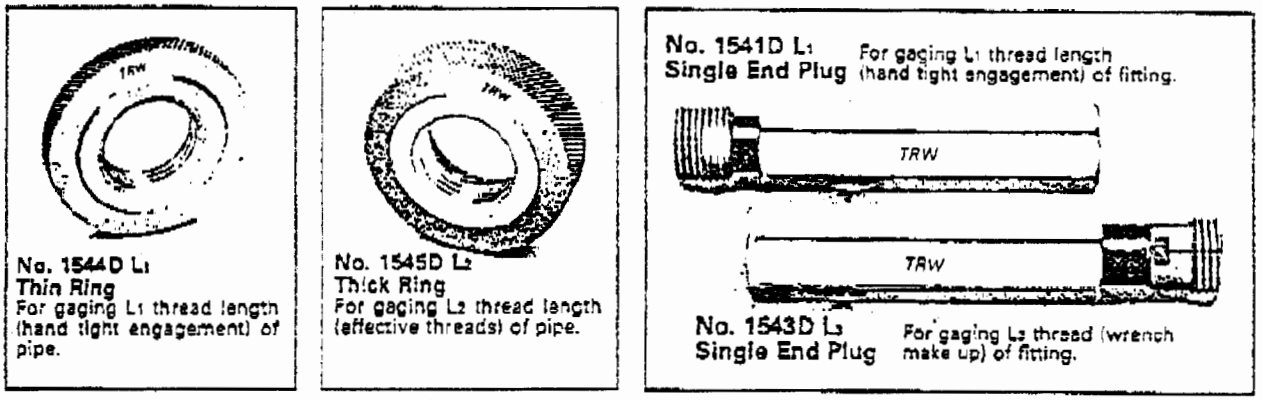
Figure #3

Technical Bulletin, NPT Taper Pipe Thread Gages, defines the L-1 basic hand-tight engagement on NPT product threads. This same L-1 length applies to NPTF threads. It is the theoretical length of assembly (hand-tight) if both parts had perfect thr form and taper and were exactly at the nominal size. The following diagram and Table show standard L-1 lengths for pipe thread sizes up to 2" and also other leng. dimensions known as L-2 and L-3. Because of allowable tolerances on both parts the actual length of assembly often uses threads in these other sections and particularly so when drawn together wrench-tight. The full L-2 and L-3 threads should have satisfactory size and profile to permit this assembly and therefore additional thread gages are used. Figure #4 shows the four thread gages required for checking NPTF parts.



NOM. SIZE	PITCH P	INCREASE IN DIAMETER PER THREAD	L-1 LENGTH	L-2 LENGTH	L-3 LENGTH	PD AT E_3	PD AT E_0	PD AT E_1	PD AT E_2	NOMINAL DIAMETER PIPE D
1/16-27	.03704	.00231	.160	.2611	.1111	.26424	.27118	.28118	.28750	.312
1/8-27	.03704	.00231	.1615	.2639	.1111	.35656	.36351	.37360	.38000	.405
1/4-18	.05556	.00347	.2278	.4018	.1667	.46697	.47739	.49163	.50250	.540
3/8-18	.05556	.00347	.240	.4078	.1667	.60160	.61201	.62701	.63750	.675
1/2-14	.07143	.00446	.320	.5337	.2143	.74503	.75843	.77843	.79179	.840
3/4-14	.07143	.00446	.339	.5457	.2143	.95429	.96768	.98887	1.00179	1.050
1"-11½	.08696	.00543	.400	.6828	.2609	1.19733	1.21363	1.23863	1.25630	1.
1¼-11½	.08696	.00543	.420	.7068	.2609	1.54083	1.55713	1.58338	1.60130	1.
1½-11½	.08696	.00543	.420	.7235	.2609	1.77978	1.79609	1.82234	1.84130	1.900
2-11½	.08696	.00543	.436	.7565	.2609	2.25272	2.26902	2.29627	2.31630	2.375

Figure #4

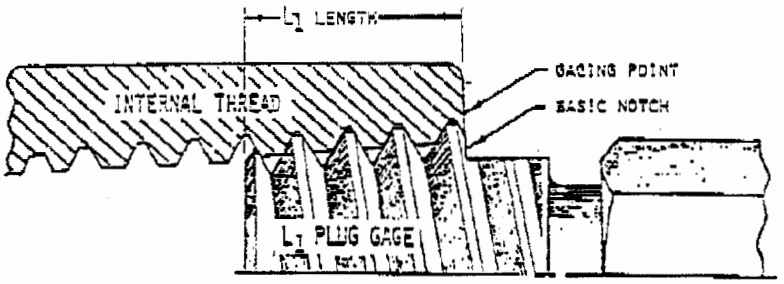


The ANSI B1.20.5-1978 standard (and corresponding FED-STD H28/8) have established two classes of NPTF product threads. On class 1 threads the acceptability is determined by the coordinated use of L-1 and L-3 thread plug gages for internal product threads and L-1 and L-2 thread ring gages for external product threads. Crest and root truncations are generally considered adequately controlled by the tooling used to produce the product threads. Class 2 NPTF requirements are described later.

GAGING INTERNAL THREADS

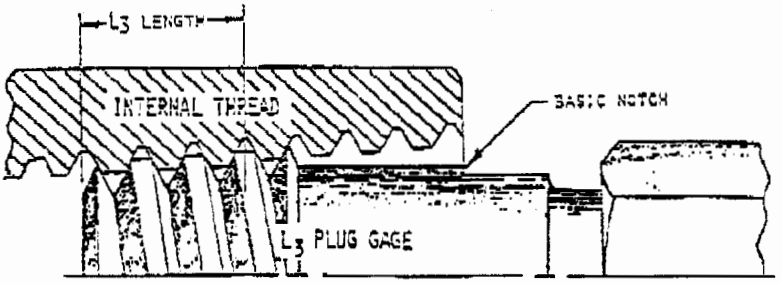
The L-1 taper pipe thread plug gage is used first. This gage has a notch at a distance of L-1 from its small end. The pitch diameter at the notch is equal to the E_1 dimension in the Table. This gage is turned "hand-tight" into the product and the notch must then be flush with the large end of the internal thread within a tolerence of plus or minus one turn. (See Figure #5) It also must be noted on each part as to the approximate position within these maximum and minimum limits the gaging point stopped.

Figure #5



After removing the L-1 gage the L-3 taper pipe thread plug gage is fully engaged into the part. This gage checks threads in the L-3 section (beyond those checked by the L-1 gage). Threads on this gage near the large end have been removed but the basic notch is at the same theoretical position as the notch on the L-1 gage. See Figure #6

Figure #6



10/2

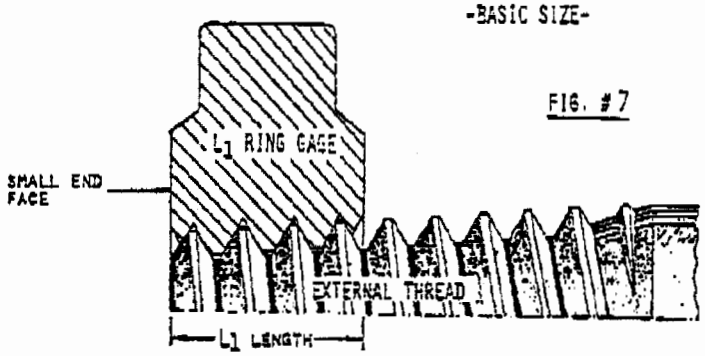
This notch must stop within plus or minus 1/2 turn of the same position found in using the L-1 gage on that particular part. The L-3 gage thus checks the assembleabil: and functional size of threads in the L-3 region, and the correlation of results with th L-1 gage provides an indication of excessive steep or shallow taper deviations in the product thread.

GAGING EXTERNAL THREADS

The L-1 taper pipe thread ring gage is used first. This gage has a pitch diameter at small end equal to the E_o dimension in the table and a thickness equal to the L-1 length. When this ring gage is turned hand-tight onto the external pipe thread the small end faces of each must be flush within a tolerance of plus or minus one turn. See Figure #7

GAGING NPTF EXTERNAL THREADS
-BASIC SIZE-

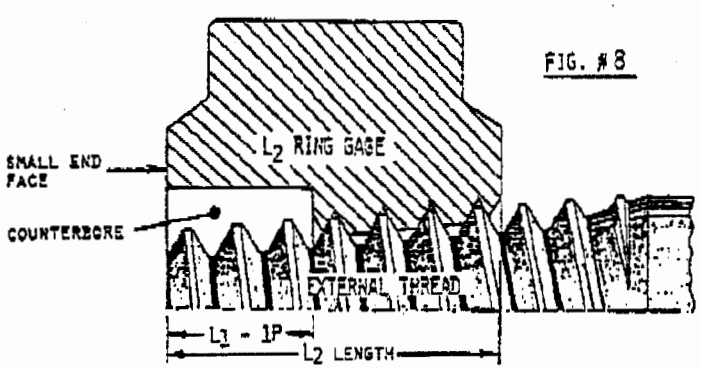
FIG. #7



Again, the appropriate position within these limits must be noted on each part.

The L-2 taper pipe thread ring gage is then used. The small end of this gage must correlate within plus or minus 1/2 turn of the same position as noted when the L-1 ring was used on that same part. The L-2 ring has a thickness equal to the standard L-2 thread length per the table, but threads near the small end of the gage are omitted. See Figure #8.

FIG. #8



This gage checks the assembleability and functional size of threads further up on the pipe beyond those checked by the L-1 ring. The coordinated use of both L-1 and L-2 thread rings also gives an indication of taper deviations.

CLASS 2 NPTF PRODUCT THREADS

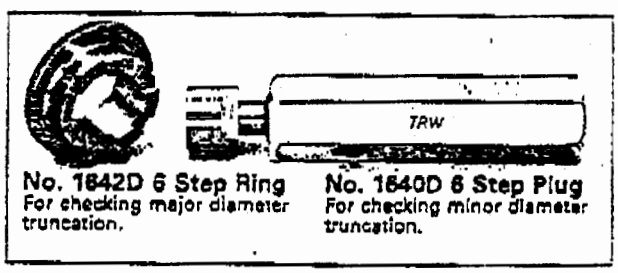
For class 2 NPTF threads the use of L-1, L-2 and L-3 thread gages is still required for acceptability, but beyond that the measurement or gaging of crests and roots is also required. Direct measurements or optical projection (on a sampling basis) of the truncations or equivalent widths of flat is generally considered more accurate and is the referee method in the event of a dispute. (For internal threads this would involve sectioning or making a cast.)

Crest and root truncation gages are used as alternate methods. The 6 step plain taper plug and ring gages provide a rapid, simplified method of checking crest truncations and we will discuss their usage.

The six step root truncation gages are not as common. They have threads with 50° included angles made to clear the 60° product thread flanks and contact only at the roots of the product threads. Gaging results would be affected by the inaccuracy of flank angles, lead, and taper also by dirt, chips and surface imperfections.

Figure #9 shows 6 step plain taper plug and ring gages for checking crests. These should be considered as having 3 pairs of steps. One pair marked MN and MNt is used to check a "minimum" size part. Another pair marked B and Bt is used to check a "basic" size part. The third pair marked MX and MXt is used to check a "maximum" size part. Only one pair of steps is used on a given part and the particular pair chosen is established by the use of the L-1 gage. In other words, the L-1 gage must segregate each part into a minimum or basic or maximum thread size category. The 6 step plain taper gage then checks truncation in relation to the thread size.

Figure #9

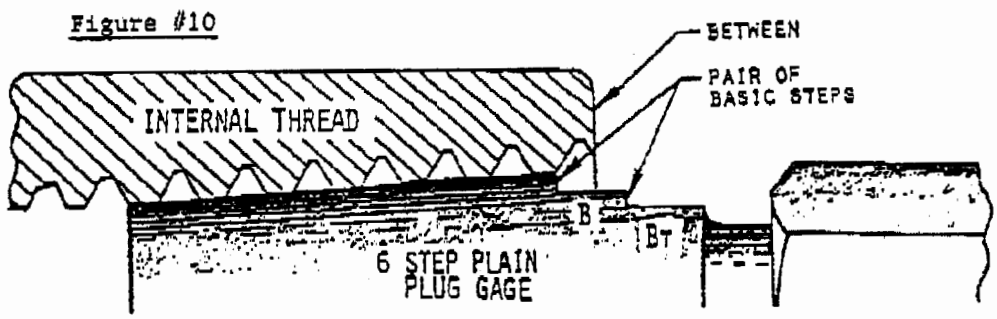


SYMBOLS

B = Basic Thread Size at Minimum Truncation
BT = Basic Thread Size at Maximum Truncation
MN = Minimum Thread Size at Minimum Truncation
MNT = Minimum Thread Size at Maximum Truncation
MX = Maximum Thread Size at Minimum Truncation
MXT = Maximum Thread Size at Maximum Truncation

Figure #10 illustrates an internal threaded part which has been determined by the L-1 thread plug gage to be closest to a "basic" thread size. Therefore, the large end face must fall between the B and Bt steps of the 6 step plain taper plug gage which you will note checks minor diameter truncation.

Figure #10

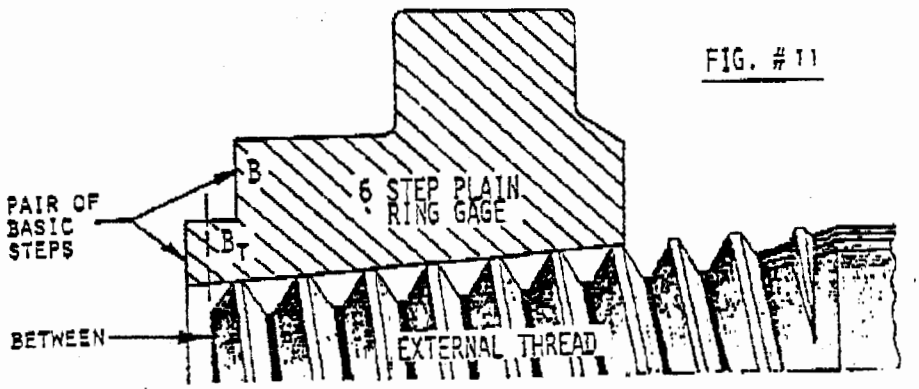


NOTE: In many cases threading problems or leakage of a dryseal assembly are traced to selection of an incorrect drill size or to incorrect use of a taper reamer prior to tapping. Taper reaming is not necessarily beneficial, but when reamers are used they must always leave metal to be removed by the minor diameter of the tap. Thus if the tap is made properly and maintains its form in usage it is expected to generate the correct full NPTF profile for threads at least through the L-1 length section. Greenfield has an Engineering Bulletin, "Hole Preparation For NPT, NPTF and ANPT Internal Pipe Threads" available on request.

Figure #11 shows a 6 step plain taper ring gage checking the crest (major diameter) of an external thread. The small end face of the part falls within the B and Bt steps as this part was judged by the L-1 thread ring gage to be within the "basic" thread size category.

Root truncation gages also have 3 pairs of steps which would be used in the same manner as plain taper gages, i.e. coordinating with the size category established by the L-1 thread gage.

FIG. #11



EXTRA STEP GAGES

Pipe thread gages most commonly used have one basic notch on the L-1 and L-3 plugs and basic L-1 or L-2 thickness on the rings. These are the most economical but 3-step or 4-step thread gages do have some advantages.

3-step thread gages have 2 extra notches or gaging faces (at plus 1 turn and minus 1 turn) to provide an easier means of sighting the minimum and maximum product size limits 4-step thread gages not only define the extreme minimum and maximum limits but create between the steps 3 equally spaced "zones" of tolerance. (Minimum, basic, and maximum) Each "zone" is actually 2/3 of a pitch in length and thus the total product tolerance is still 2 pitches in length (plus or minus 1 pitch). The 4 steps on the L-1 gages in particular make it easier to establish the size category for coordination with one of the 3 pairs of steps on the plain taper gages.

Greenfield has an Engineering Bulletin which provides more details in the designs of 4 step thread taper gages and 6 step plain taper gages, or this information can be obtained directly from the ANSI B1.20.5 document available from ASME, United Engineering Center, 345 E. 47th Street, New York City, NY.

Single step L-1 and L-3 thread plug gages carried in stock can be converted to 3-step or 4-step design quite economically. Single step (basic Length) L-1 and L-2 threa ring gages carried in stock however cannot be converted and therefore 3-step and 4-step rings are much more costly.

Internal threaded parts having a deep chamfer or recess often require a corresponding change in the gaging point to the bottom of the chamfer or recess. An alternate method of checking such parts is the "turns engagement method" described below.

TURNS ENGAGEMENT METHOD

Another gaging technique described in H-28 and ANSI documents is called the "turns engagement" method. In this method the thread plug or thread ring gage is fully assembled into or onto the product thread and then the exact number of turns and decimal part thereof is counted as the gage is removed until it becomes disengaged. The documents list the "basic" number of turns for L-1, L-2, and L-3 gages in each pipe size. The product limits are still plus or minus 1 turn from the "basic" turns, and there is still a correlation required between the results of L-1 versus L-2 or L-3 gaging of plus or minus 1/2 turn. The "turns engagement" method is particularly useful if the gaging point on the product is not an accurate or perpendicular face.

The NPT Technical Bulletin P-1 on NPT Taper Pipe Thread Gages contains additional comments relating to tightness or torque in using pipe thread gages. Greenfield can also supply information on master pipe gages for verifying functional size and wear on working pipe gages. Information on various styles of pipe taps (interrupted thread, "easy start", "high hook", "spiral flute", etc.) and other threading tools can also be supplied.

The Technical Bulletin, P-3, NPSF, NPSI And FTF-SAE Short Gages deals with short dryseal pipe threads.

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