API Ballot id # 5993
SC5 TGTGC

Work Item	3065—6th Edition Development
Type of Distribution [Ballot (vote and comment), Comment-only, Recirculation (comment resolution), Re-ballot, etc.]	Initial ballot (voting and commenting)
Revision Key	NA—The document is an overhaul from previous-to-current styling, along with a great deal many updates, it is not practical to show it using Track Changes; *a thorough, detailed reading is highly suggested*.

Work Item Charge: Make the 5B1 the "how to" for thread gauging API 5B connections, with detailed drawings, illustrations and the necessary formulas and tables (with examples).

Ballot Rationale: The current edition (5th) was published in October 1999. It is outdated from current gauging practices and needs realignment with the current edition of Spec 5B.

NOTE See the ballot email notification for additional information regarding this ballot.

Gauging and Inspection of Casing, Tubing, and Line Pipe Threads

API RECOMMENDED PRACTICE 5B1
SIXTH EDITION, [MONTH] [YEAR]

The *Special Notes*, *Foreword*, and *Contents* will be generated by API during the page proof stage before publication.

Introduction

The American Petroleum Institute was established in 1919 by partnership between industry executives and the U.S. Federal Government. Prior to then, companies did not have much experience working together. But after the difficulties faced during World War I with the handling and transfer of petroleum supplies for the war effort, they agreed to work with the government to address those challenging issues.

Among the founding cornerstones of API was the creation of industry standards. With numerous areas of interest in industry to have standards developed, the first publication for manufacturing pipe (line pipe, drill pipe, casing and tubing), including threading, was API No. 5, *Specifications for Steel and Iron Pipe for Oil Country Tubular Goods*, October 20th 1924.

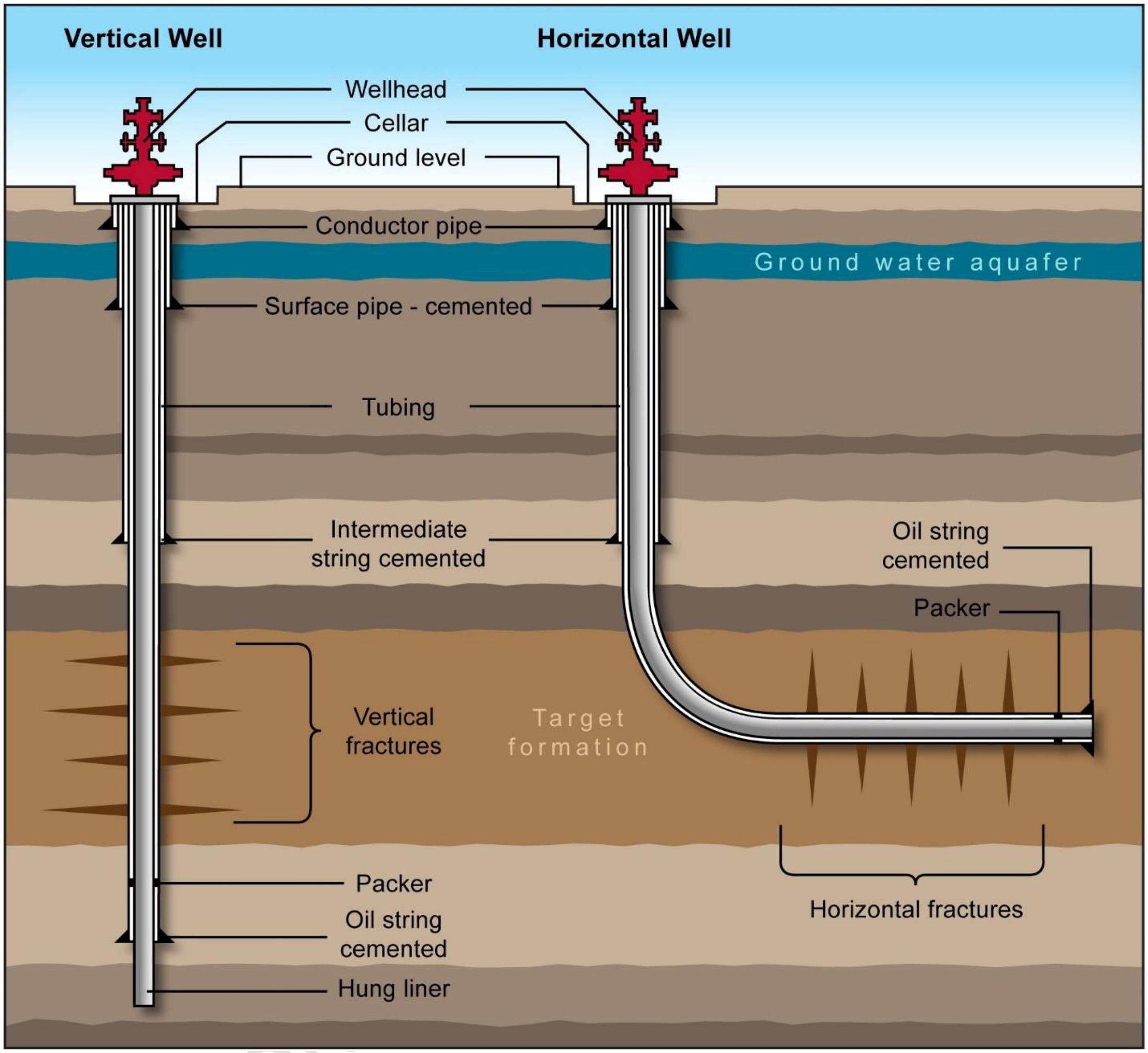
Since then, pipe (and their threaded connections among many other features) were able to follow common standards for manufacturers to conform with. This began allowing for desirable attributes, such as product consistency, interchangeability and so forth, to be achieved. As the standards progressed over time, pipe threads were required to follow API 5B for casing and tubing products according to API 5CT and line pipe according to API 5L, and API 7-2 for drill pipe and drill stem elements according to API 5DP and API 7-1, respectively. Regardless of thread-type, all API threaded connections are required to be inspected for conformance with their applicable design specification.

The ability of pipe to perform properly depends very much on the end connection. Each connection must withstand various pressures and the forces associated with tension, collapse, and torsion; also, the connection design, along with accurate machining, provide the required strength and resistance to leakage for the specific application for which they are designed. Thus, all API threaded connections are designed to perform three primary functions:

- Act as a mechanical fastener to connect pipe
- Provide leak resistance under pressure
- Maintain integrity under load

The API 5B1 standard provides the guidance and instruction on inspection techniques and equipment, in addition to the training material and insights necessary to ensure that threads are dimensionally accurate. Any individual conducting these inspections needs to have appropriate knowledge and be adequately trained in the thread gauging concepts (classroom) and practical experience (hands-on). Every pipe connection is intended to have capability of being able to withstand internal and external pressure without leakage. Inspection of the threaded pipe ends will determine if the design specification is met.

The threads competency of design and the quality of manufacturing enables pipe to achieve the desired functions for which it will serve. Whether its casing and drill pipe used for drilling the wells, tubing used in the completion and production of wells, or line pipe used for the gathering and processing and transportation and distribution of petroleum, the level of importance in having standards for pipe is well recognized. This understanding is essential to the success of communities, businesses, and nations around the world. See Figure 1 for a highly-generalized, non-exhaustive illustration of a well's components and configurations.



The descriptions below are general, intended to depict the concept, and not to be considered exhaustive.

- — Conductor casing: Prevent drilling fluid from broaching, causing surface erosion.
- — Surface casing: Protect fresh water zones, support wellhead installation.
- — Intermediate casing: Maintain wellbore stability, isolate formations.
- — Production casing/liner tie-back: Secure pay zone, allow for tubing installation.

Figure 1—Simple Example Well Diagrams

Gauging and Inspection of Casing, Tubing, and Line Pipe Threads

1 Scope

The scope of this standard is limited to inspection of API casing, tubing, and line pipe connections, including when applied to other products. This standard also applies to unused product.

It is not expected that threaded connections will gauge within specified tolerances after coating or plating is applied or after being made-up power-tight. However, the basic techniques of gauge usage apply to any threads for which the thread element specifications are known. Specifically, this standard is designed to be used with the latest edition of API 5B. It does not duplicate the dimensional tables contained in API 5B. Instead, it provides instruction in inspection techniques appropriate to comparing the dimension of the product with specified dimensions and tolerances for that product. In any case where there is conflict between this standard and API 5B, it is intended that API 5B takes precedence.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any errata or addenda) applies.

API Specification 5B, *Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads*

API Specification 5CT, *Casing and Tubing*

API Specification 5L, *Line Pipe*

API Specification Q1, *Quality Management System Requirements for Manufacturing Organizations for the Petroleum and Natural Gas Industry*

3 Terms, Definitions, Symbols, and Abbreviations

3.1 Definitions

For the purposes of this standard, the following terms and definitions apply.

3.1.1
addendum
The distance from the crest cone to the pitch cone, normal to the axis of the thread.

3.1.2
basic size
The theoretical size from which all variations are measured.

3.1.3
calibration
Comparison of an instrument with, or the adjustment of an instrument to, a known reference(s) standard that is often traceable to a national institute.

NOTE The U.S. National Institute of Standards and Technology (NIST) is a national institute.

3.1.4
chamfer
The beveled surface where the thread form starts.

3.1.5
continuity of thread
A thread that meets the thread form and angle requirements throughout the perfect thread length.

3.1.6
crest
The top of the thread.

3.1.7
crest cone
The imaginary cone which passes over the crest of the thread.

3.1.8
dial indicator
A measurement instrument in which small displacements of a spindle or lever are magnified by mechanical means to a pointer rotating in front of a circular dial having a graduated scale; it provides a dial display similar to a clock face with clock hands; the hands point to graduations in a circular scale on the dial which represents the distance of the probe tip from a zero setting.

3.1.9
digital indicator
A measurement instrument in which small displacements of a spindle or lever are magnified by electrical means to a digital numeric display located in the case or on an external device which represents the distance of the probe tip from a zero setting.

3.1.10
external thread (pin)
A thread on the external surface of a pipe or any external surface.

3.1.11
flank (side)
The surface of the thread which connects the crest with the root.

3.1.12
flank angle
The angle between the individual flanks and a line perpendicular to the axis of the thread measured in an axial plane.

NOTE A flank angle of a symmetrical thread is commonly termed the half-angle of the thread.

3.1.13
hand-tight
Threaded connection that has been made-up by hand without the aid of tongs or other mechanical devices.

3.1.14
height
The distance between the root and crest of the thread measured normal (perpendicular) to the thread axis.

3.1.15
imperfect thread length
The buttress threads located beyond the L_7 plane (away from the pipe ends).

3.1.16
included angle
The angle between the flanks of the threads measured in an axial plane.

3.1.17
internal thread (box)
Thread on the internal surface of a coupling, pipe, or accessory.

3.1.18
last scratch
vanish point
The last visible evidence of the continuous machined root as it stops or runs-out.

3.1.19
lead
The distance parallel to the thread axis from a point on a thread turn and the corresponding point on the next turn (i.e. the axial displacement of a point following a helix, one turn around the thread axis).

3.1.20
load flank
pressure flank
The flank of the pipe thread facing away from the open end of the pipe; the flank of the coupling or box thread facing away from the open end of the coupling; the 3° flank on buttress thread.

NOTE See Figures 2 through 5.

3.1.21
major diameter
The crest diameter of the external thread and the root diameter of the internal thread.

3.1.22
minor diameter
The root diameter of the external thread and the crest diameter of the internal thread.

3.1.23
non-full-crested threads
black-crested threads
flat threads
Threads that are not fully-crested.

NOTE Threads that are not fully-crested because the original mill surface has not been removed have historically been and continue to be referred to as "black-crested threads".

3.1.24
null point
The point where the indicating pointer needle stops and begins to return to its point of origin at either the greatest distance between two points or the shortest distance between two points dependent on the dimensional attribute being measured.

3.1.25
ovality
The difference between the maximum and minimum diameter measurements.

3.1.26
perfect thread length
PTL
The last perfect thread location on external threads is L_4–g for tubing and line pipe, L_7 for buttress, and last scratch (last thread groove) -0.625 in. for casing round threads; the last perfect thread location on internal threads is J+1p measured from the physical center of the coupling or from the small end of the box for integral joint tubing.

3.1.27
pitch
The axial distance between corresponding points on successive threads.

NOTE In a single start thread, pitch is equivalent to lead.

3.1.28
pitch cone
pitch line
The imaginary cone of such apex angle and location of its vertex and axis that its surface would pass through a taper thread in such a manner as to make the axially measured widths of the thread ridge and thread groove equal.

3.1.29
pitch diameter
On a taper thread, the pitch diameter at a given position on the thread axis is the diameter of the pitch cone at that position; on buttress threads, the pitch diameter is midway between the major and minor diameter.

3.1.30
recess
The counter-bored section at the face end of the internal thread on line pipe and round threads.

NOTE The recess facilitates stabbing the threads.

3.1.31
root
The bottom of the thread.

3.1.32
run-out (buttress threads)
Intersection of the thread root cone and the pipe outside diameter.

3.1.33
stab flank
front flank
leading flank
The flank of the pipe thread facing the near open end of the pipe; the flank of the coupling thread facing the open end of the coupling.

NOTE See Figures 2 through 5.

3.1.34
standardization
The adjustment of measurement instrument using an appropriate reference standard, to obtain or establish a known and reproducible response.

3.1.35
standoff
The distance between faces of gauges or between gauges and product reference planes when mated.

3.1.36
taper
The change in the pitch diameter of the thread along the thread axis is expressed as inches per foot or inches per inch of thread length.

3.1.37
thread axis
The axis of the pitch cone, the longitudinal central line through the threads.

NOTE In the basic thread design, all length measurements are related to the thread axis.

3.1.38
thread form
The form of thread is the thread profile along the thread axis for a length of one pitch.

3.1.39
threads per inch
TPI
The specified number of threads in one inch of thread length.

3.1.40
tolerance
The permissible deviation from the specified value.

3.2 Symbols

A hand-tight standoff thread turns

A_1 length of pin face to base of triangle

d calculated inside diameter

D specified outside diameter for pipe

g length of imperfect threads from the nominal thread length (L_4) for tubing, line pipe, and buttress

J distance from end of pipe to center of coupling, power-tight make-up

L_1 length from end of pipe to hand-tight plane

L_4 total length of threads (end of pipe to vanish point)

L_7 BC perfect thread length

L_c minimum length full-crest threads

M length of face of coupling to hand-tight plane

N actual coupling length

N_L minimum coupling length

P stand-off between the reference master plug face and reference master ring at small end

P_1 stand-off between the reference master plug face to the working ring gauge at small end

p pitch

S stand-off between reference master ring face and reference master plug shoulder at large end

S_1 stand-off between working plug gauge shoulder and reference master ring face at large end

t specified wall thickness

π (pi) constant equal to 3.1416

3.3 Abbreviations

BC buttress casing thread

EU external upset tubing connection

IJ integral-joint tubing connection

LC long threaded casing connection

LP line pipe

NU non-upset tubing connection

PTL perfect thread length

Rd round threads

SC short-threaded casing connection

TECL thread element control length

TPF taper per foot

TPI threads per inch

VTI visual thread inspection

4 Capabilities, Limitations, and Repeatability of Results

4.1 Capabilities

The ability of pipe to perform properly depends on the physical integrity of the pipe body and connections. Threads at each end of the pipe provide a means of joining the pipe segments together with many possible configurations. However, they all have two functions in common: to resist leakage and tensile failures.

This standard provides guidance and instruction on the correct use of thread inspection techniques and equipment to assure dimensionally accurate connections. The inspector carries a heavy responsibility; this responsibility can be discharged properly only if the inspector is adequately trained. This standard also provides the training material and insight necessary to perform an adequate inspection of pipe connections.

Inspecting the threaded ends of pipe determines if the manufactured product is in conformance with the design. Pipe is inspected at the manufacturer's facility prior to shipment; additionally, the pipe may be inspected at the pipe yard and/or job site. The manufacturer's inspection is not normally an inspection of each individual connection; instead, it is normally an inspection of a statistically designed sample based on manufacturer's experience. The field inspection generally is an inspection of each threaded end. The scope of the field inspection varies based on the owner's desires and the inherent constraints of field inspection.

4.2 Limitations

When performing field inspections, including receiving inspections of new product, the following should be considered:

a) Coatings or platings are applied to threads for the purposes of anti-galling during make-up, anti-corrosion while in storage, and/or as an aid to sealing for leak resistance,

b) Materials for coatings and platings include metallic phosphates (zinc, manganese, etc.)and metals (copper, tin, zinc, etc.), and

c) The coating or plating interferes with the gauging of threads.

Considering the limitations, discretion should be used when interpreting the results of gauging of coated threads.

As a result of the applied stresses, gauging of assembled (made-up) threaded components (i.e. field-end of coupling) can result in the components not conforming to the specified values (i.e. taper, thread crest diameter).

4.3 Repeatability of Results

Thread inspection and dimensional measurement processes inherently produce some variability of results.

Some of the factors attributable to this variability are as follows:

— permissible options in the selection of practices for use in the inspection of specific attributes,

— permissible options in the selection of reference standards,

— variations in the mechanical and electronic designs used by each equipment manufacturer of thread inspection equipment, and/or

— lack of exact repeatability within the performance capability of a single thread inspection equipment set-up.

5 Quality Assurance

5.1 General

The threader or entity performing inspection shall implement and maintain a quality management program or system in accordance with API Q1.

5.2 Standardization and Operating Procedures

The standardization procedures vary with the different types of equipment. The written procedure should include the detailed steps describing the techniques to verify proper operation of measuring devices, setting standard to be used, required setting location and tolerances. The frequency, range, accuracy, and the procedure for calibration, verification of accuracy, control features and documentation should be included. It should be noted that some gauges, i.e. taper gauges, do not require setting standards. Procedures should include a statement that all equipment and materials employed for testing and examination are used within the design limits established by the equipment manufacturer.

5.3 Equipment Description

The equipment used to conduct the inspection should be described in sufficient detail to demonstrate that it meets the requirements of API 5B.

6 Qualification of Inspection Personnel

6.1 General

The qualification requirements of inspection personnel is the responsibility of the employer. Candidates for qualification should have the experience required by the company's quality management system.

Re-qualification requirements should be defined by the company's quality management system, which may include frequency and providing evidence of continuing satisfactory technical performance.

Further guidance on development of training, examination, and qualification of inspectors can be found in ASNT SNT-TC-1A.

6.2 Training Programs

All qualified personnel should have completed a documented training program given by the company or an outside entity.

The program should include the following:

a) principles of each applicable inspection method,

b) procedures for each applicable inspection method, including standardization and operation of inspection equipment, and

c) relevant sections of the applicable industry standards.

6.3 Examinations

Examinations may be given by the company or by an outside agent.

All inspection personnel should have completed the below examinations:

a) written examinations addressing the general and specific principles that are applicable to thread inspection, inspection procedures, and appropriate API standards,

b) hands-on or operating examination that includes apparatus assembly, standardization, inspection techniques, operating procedures, interpretation of results and report preparation, and

c) annual vision examination to verify ability, with natural or corrected vision, to read J-2 letters on a Jaeger number 2 test chart at a distance of 12 in. to 15 in.; equivalent tests such as the ability to perceive a Titmus number 8 target, a Snellen fraction 20/25 (0.8), or vision examinations with optical apparatus administered by a qualified medical practitioner are also acceptable.

7 General Inspection Method Descriptions and Capability Requirements

7.1 General

The thread inspection equipment and instruments shall be calibrated in accordance with the company's quality management system and shall align with API Q1 and API 5B requirements.

7.2 Equipment

7.2.1 Precision gauges and devices

Precision gauges and devices may consist of various adjustable and non-adjustable styles, including: micrometer, Vernier, dial, digital, or fixed limit.

7.2.2 Non-adjustable length- and diameter-measuring devices

Length- and diameter-measuring devices may consist of steel rules, steel length or diameter measuring tapes and other non-adjustable measuring devices.

Accuracy verification shall be defined in the company's quality management system.

7.3 Illumination

7.3.1 External surface illumination

7.3.1.1 Direct daylight

Direct daylight conditions do not require a check for surface illumination.

7.3.1.2 Night and enclosed-facility illumination

The visible light intensity at the surfaces being inspected shall be a minimum of 100 fc (1076 lx).

Illumination verification in enclosed, fixed-location facilities shall be in accordance with the company's quality management system. The check shall be recorded in a log with the date, the reading, and the initials of the person who performed the check. This record should be available.

For a temporary set-up (night, covered area, or indoors), proper illumination shall be verified at the beginning of the job to assure that portable lighting is directed effectively at the surfaces being inspected. Illumination shall be checked during the job whenever lighting fixtures change position or intensity relative to the surfaces being inspected.

7.3.2 Internal surface illumination

7.3.2.1 Mirrors for illumination

The reflecting surface shall be a non-tinted mirror that provides a non-distorted image. The reflecting surface shall be flat and clean.

7.3.2.2 Portable lights

A portable light producing an intensity greater than 100 fc (1076 lx) at the inspection distance may be used for illumination of inside surfaces.

7.4 Light Meters

The light meter used to verify visible illumination shall be calibrated in accordance with the company's quality management system; however, intervals between light meter calibration shall not exceed one year.

8 API Threaded Connections

8.1 General

API threaded connections are interference fit tapered threads. Threads, as applied to tubular connections, are used to mechanically hold two pieces of pipe together in axial alignment. A threaded connection consists of two members: a pipe or pin member and a coupling or box member.

The externally threaded member is called the pipe or pin member. The internally threaded member is called the coupling or box member. Two pin members are connected by means of a coupling, which is a short segment of pipe slightly larger in diameter than the pipe but threaded internally from each end (see Figure 2). The pins may be the same thickness as the pipe body (non-upset) or thicker than the pipe body (upset).

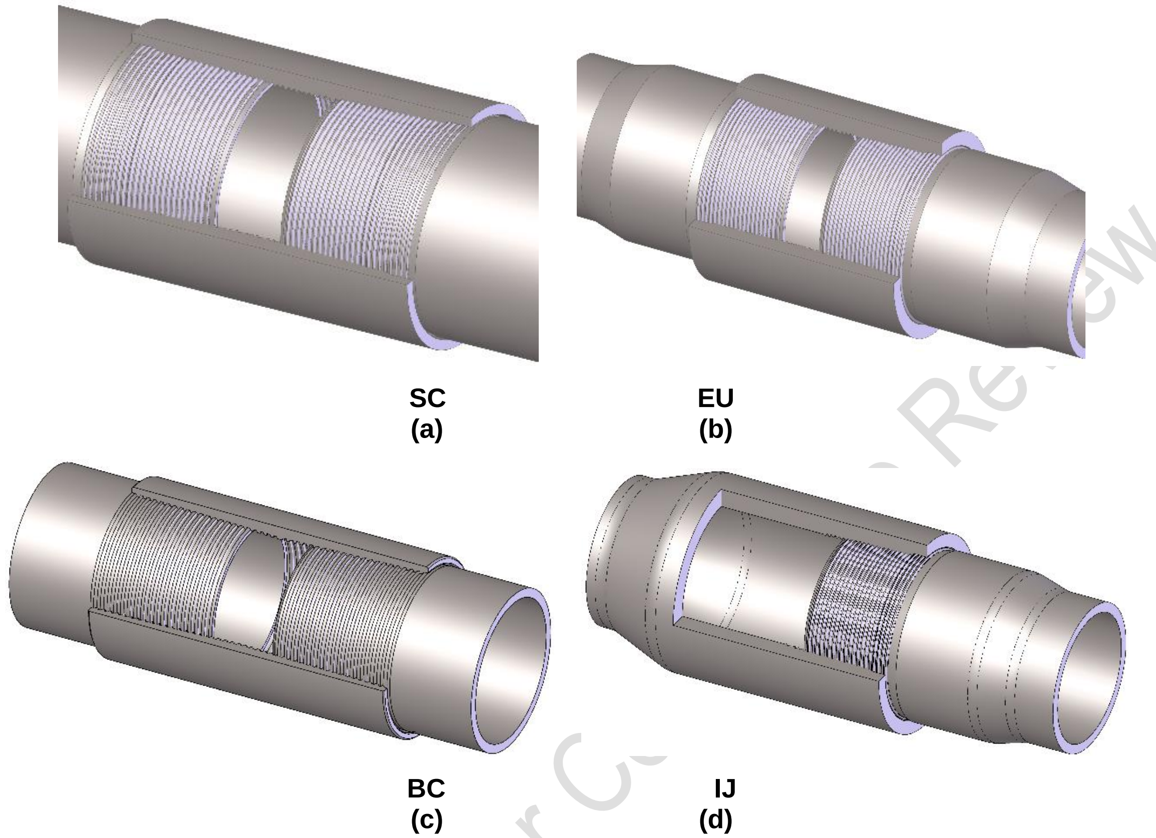


Figure 2—Examples of Pipe Couplings and Make-up

API tubular good specifications cover three styles of threads: line pipe threads (see Figure 3), round threads (see Figure 4), and buttress threads (see Figures 5 and 6).

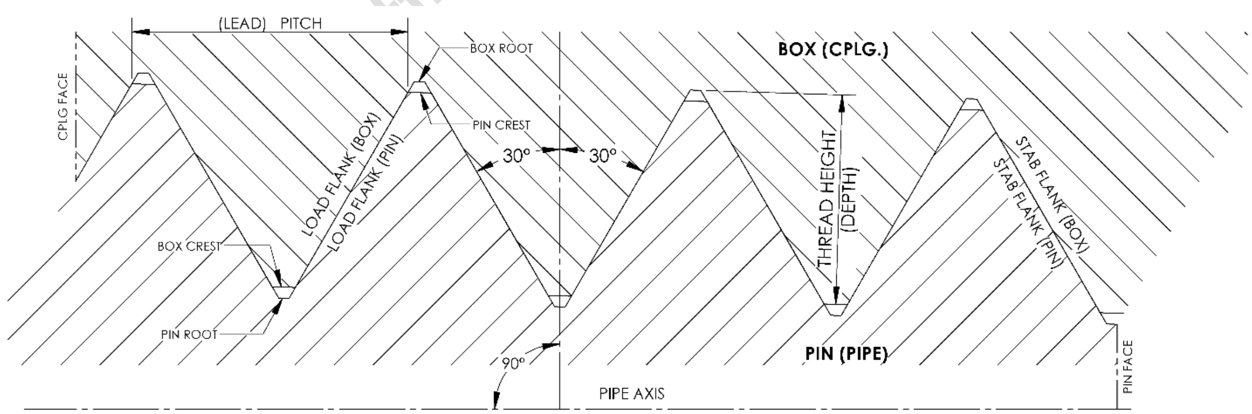


Figure 3—Line Pipe Thread Configuration

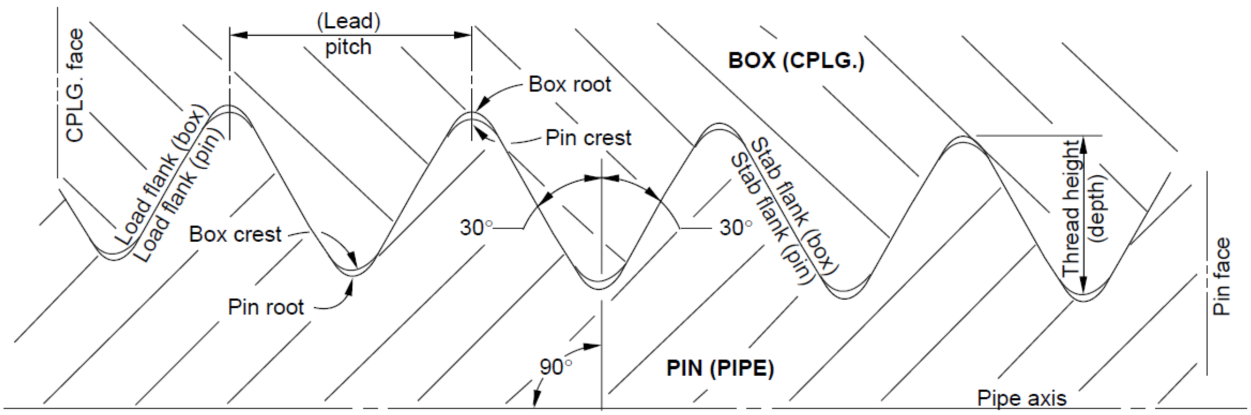


Figure 4—Round Thread Casing and Tubing Thread Configuration

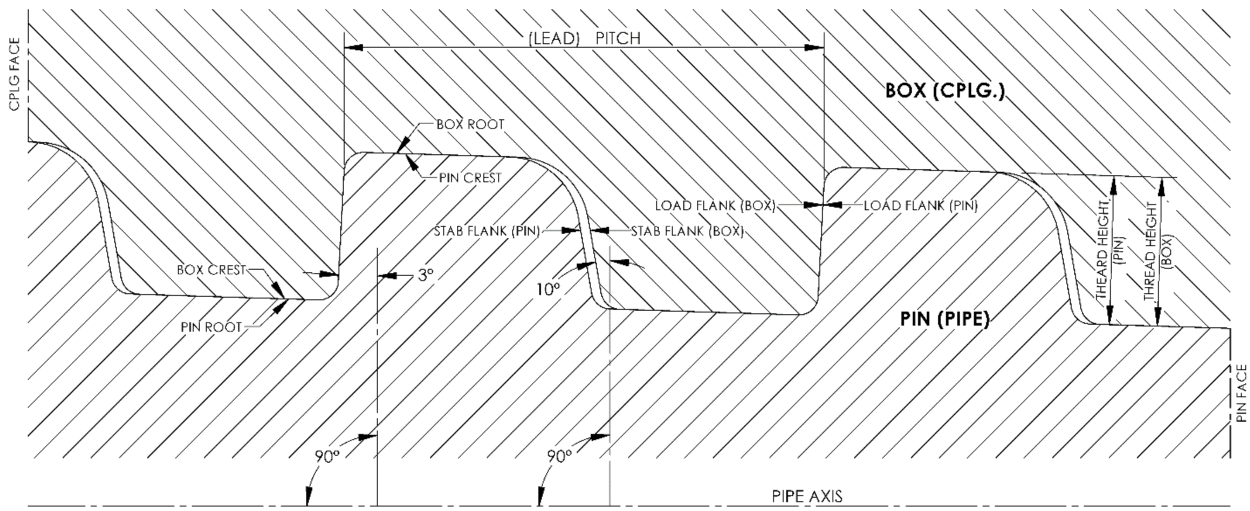


Figure 5—Buttress Thread Configuration for 13$^3/_8$ in. OD and smaller Casing

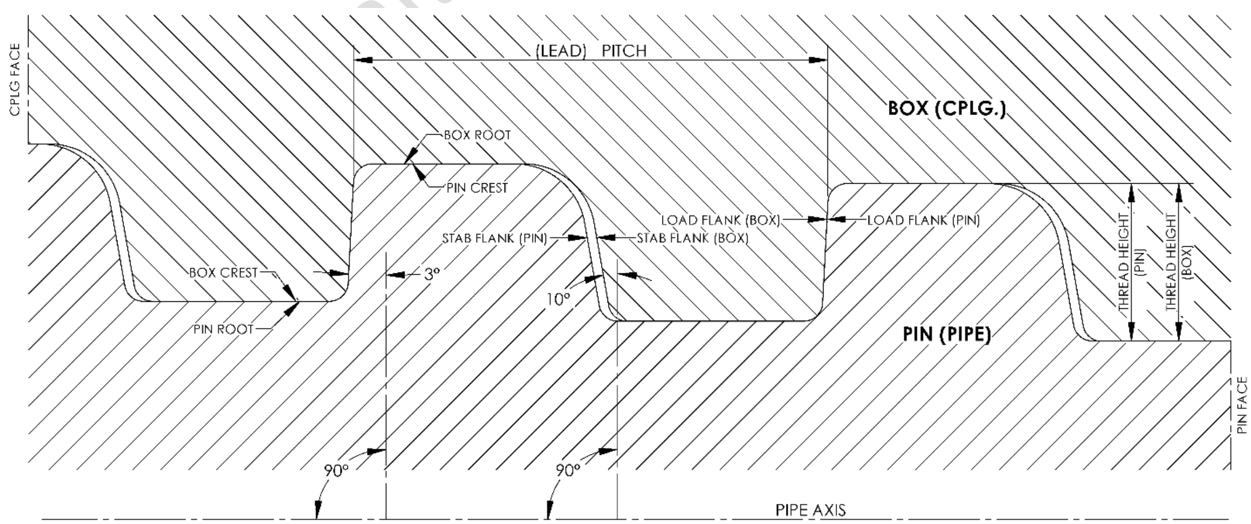


Figure 6—Buttress Thread Configuration for 16 in. OD and larger Casing

All API threaded and coupled casing and line pipe are non-upset. Tubing is manufactured non-upset (NU), external upset (EU), or integral joint (IJ). API EU tubing is upset on both ends. API IJ tubing may be upset on pin end and is upset on box end. The approximate internal diameter of the pipe ends is equal to that of the pipe body.

On a threaded connection, the stab flank of a thread is the radial surface facing the nearest end of the pipe or nearest open end of the coupling/box body (Figures 3 through 6). The load or back flank is the radial surface facing away from the nearest end of the pipe or nearest open end of the coupling/box body. The top and bottom of a thread are designated as crest and root, respectively (Figures 3 through 6). On a external thread (pin), the crest is located on the major diameter of a thread and the root is located the minor diameter. On an internal thread (coupling/box), the root is located on the major diameter, and the crest is located on the minor diameter (Figures 3 through 6).

8.2 Line Pipe Thread

The line pipe thread is a 60° Vee-type thread with the included angle between flanks being 60° (Figure 3). The crests and roots are truncated on a cone parallel with the taper. The stab and load flanks are interference-bearing surfaces when the connection is properly made-up, with clearance between the crests and roots.

8.3 Round Tubing and Casing Threads

The round tubing and casing thread is essentially the same thread form as used on line pipe except that the thread crests and roots are truncated with a radius (Figure 4). The stab and load flanks are interference-bearing surfaces when the connection is properly made-up (Figure 7), with clearance between the crests and roots.

8.4 Buttress Casing Thread

Buttress casing threads have flat thread crests and roots. For sizes $4^1/_2$ in. to $13^3/_8$ in., the roots and crests are parallel to the thread taper. For sizes 16 in. to 20 in., the thread crests and roots are parallel to the pipe axis. The load flanks and the box crest to pin root and/or the box root to pin crest are interference-bearing surfaces when the connection is properly made-up, with clearance between the stab flanks and potentially the box crest to pin root or the box root to pin crest. The crest, root, and flanks have potential to be interference-bearing surfaces.

8.5 Locations of First and Last Perfect Threads

8.5.1 First Perfect Thread Location

The first perfect thread location is the thread nearest the chamfer on the pin or the face of the coupling with a root having a full-crest on both sides.

8.5.2 Last Perfect Thread Location

The last perfect thread location on external threads shall be L_4–g for tubing and line pipe, and L_7 for buttress. See Tables A.3, A.4, and A.5 for L_4-g, and Table A.6 for L_7. The last perfect thread location is not dependent on the thread having a full-crest at this location.

For casing round threads, the distance from the end of the pipe to the last perfect thread (last scratch – 0.625 in.) is called the thread element control length (TECL). The last perfect thread location on internal threads is J+1p measured from the physical center of the coupling or from the small end of the box for integral joint tubing. The generally accepted practice is to use N_L/2–(J+1p). In case of dispute, actual coupling length (N) is used in lieu of N_L. Short threaded couplings are manufactured to accommodate all weights; always use J equal to 0.500 in. when calculating PTL.

NOTE When inspecting seal-ring groove couplings, see Annex C for requirements.

9 Visual Inspection

9.1 Visual Thread Inspection (VTI)

9.1.1 General

Visual thread inspection is a procedure for identifying thread imperfections (see API 5T1 for a listing of common imperfections). This inspection applies to exposed internal and external threads. Visually evident manufacturing imperfections or mechanical damage to the threads are detected by this inspection. Visual thread inspection also includes an overview of the threads for normal configuration.

NOTE Guidance for the detection and possible causes for deviations from normal configurations is provided in B.3.

9.1.2 Detection and Evaluation Tools

Imperfections may be detected during visual inspection. Graduated scales shall have a minimum of $^{1}/_{32}$ in. increments. Other tools may be used to detect, evaluate, or quantify the magnitude of the imperfections found, including but not limited to the following.

a) A linear measuring device or template of known accuracy (see Figure 8).

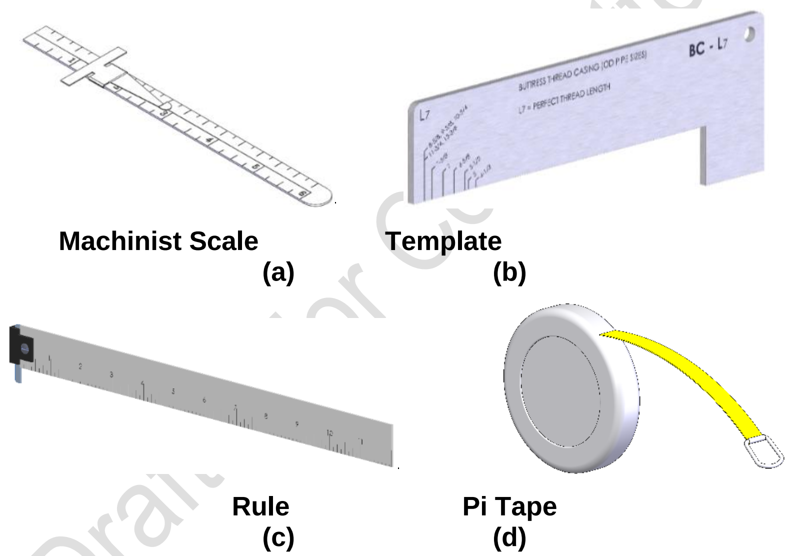


Figure 8—Examples of Linear Measurement Devices

b) A mirror for inspection of load flanks and roots of internal threads; a thread pick for detection of steps (see Figure 9).

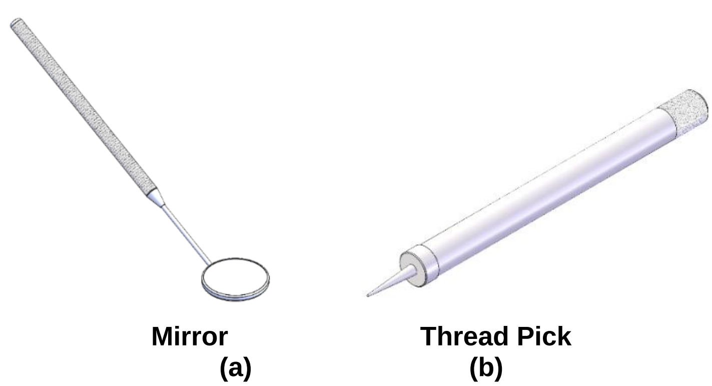


Figure 9—Example of Mirror and Thread Pick

c) A flexible measuring tape for measuring circumferential distance.

d) A profile template (see B.1 for details).

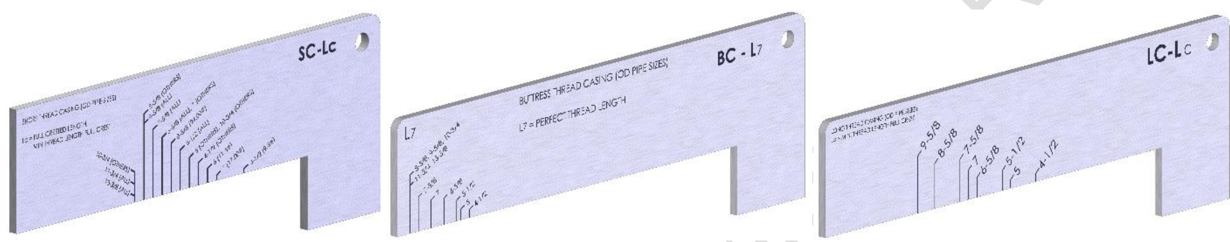
9.1.3 Cleaning

All threads, and other machined surfaces, shall be cleaned and free from debris, tears, or burrs that may affect inspection accuracy.

9.1.4 Thread Inspection Areas

9.1.4.1 L_c Length, Perfect Thread Length (PTL)

A linear measuring device or template shall be used to determine if imperfections fall within the L_c length of external threads and PTL of internal threads in accordance with Tables A.1 through A.6 (see Figure 10).



(a) (b) (c)

Figure 10—Examples of Length Templates

9.1.4.2 Thread Acceptance Classification

Imperfections located in the L_c area of external threads or PTL of the internal threads have different criteria for acceptance and rejection than those outside these regions. Measurements are used to determine if imperfections are in the L_c or box PTL.

9.1.5 Thread Examination

9.1.5.1 External Threads

Visual examination of the external threads shall include the face, chamfer, L_c, and non-L_c area.

9.1.5.2 Internal Threads

Visual examination of the internal threads shall include the counter bore, PTL, and threaded area beyond the PTL. Seal-ring grooves shall be inspected for imperfections on each side of the groove.

9.2 Visual Inspection of External Threads

9.2.1 Good judgment and discretion should be used in examination of exposed threads. Some surface irregularities will not affect the joint strength or the pressure sealing performance, unless they are large enough to act as a leak channel; the thread flanks in the L_c area of round threads and line pipe threads are the critical sealing elements. It should be considered that thread crests of round threads and line pipe threads do not engage the roots of the threads of the mating piece. Therefore, minor chatter, tears, cuts or other surface irregularities on the crest or roots of round threads may not be cause for rejection.

9.2.2 Some surface roughness may be beneficial to proper make-up by holding thread compound in place as the thread is engaged during make-up.

9.2.3 Superficial scratches, minor dings, and surface irregularities on threads are occasionally encountered and may not necessarily be detrimental. Because of the difficulty in defining superficial scratches, minor dings, and surface irregularities, and because of the degree to which they can affect thread performance, no blanket waiver of such imperfections can be established.

9.2.4 For inspections performed by a third-party agency, repair of threads, and other repairs stated in API 5B (section/content for *visual inspection*) should only be performed by agreement with the customer.

9.2.5 Arc burns and quench cracks are defects anywhere in the threaded areas.

9.2.6 Tables A.1 through A.6 may be used to determine the length of specific thread areas (e.g., L_c and L_4), but in case of dispute API 5B governs. The vanishing point (L_4) and full-crested thread length (L_c) are shown in Figure 11.

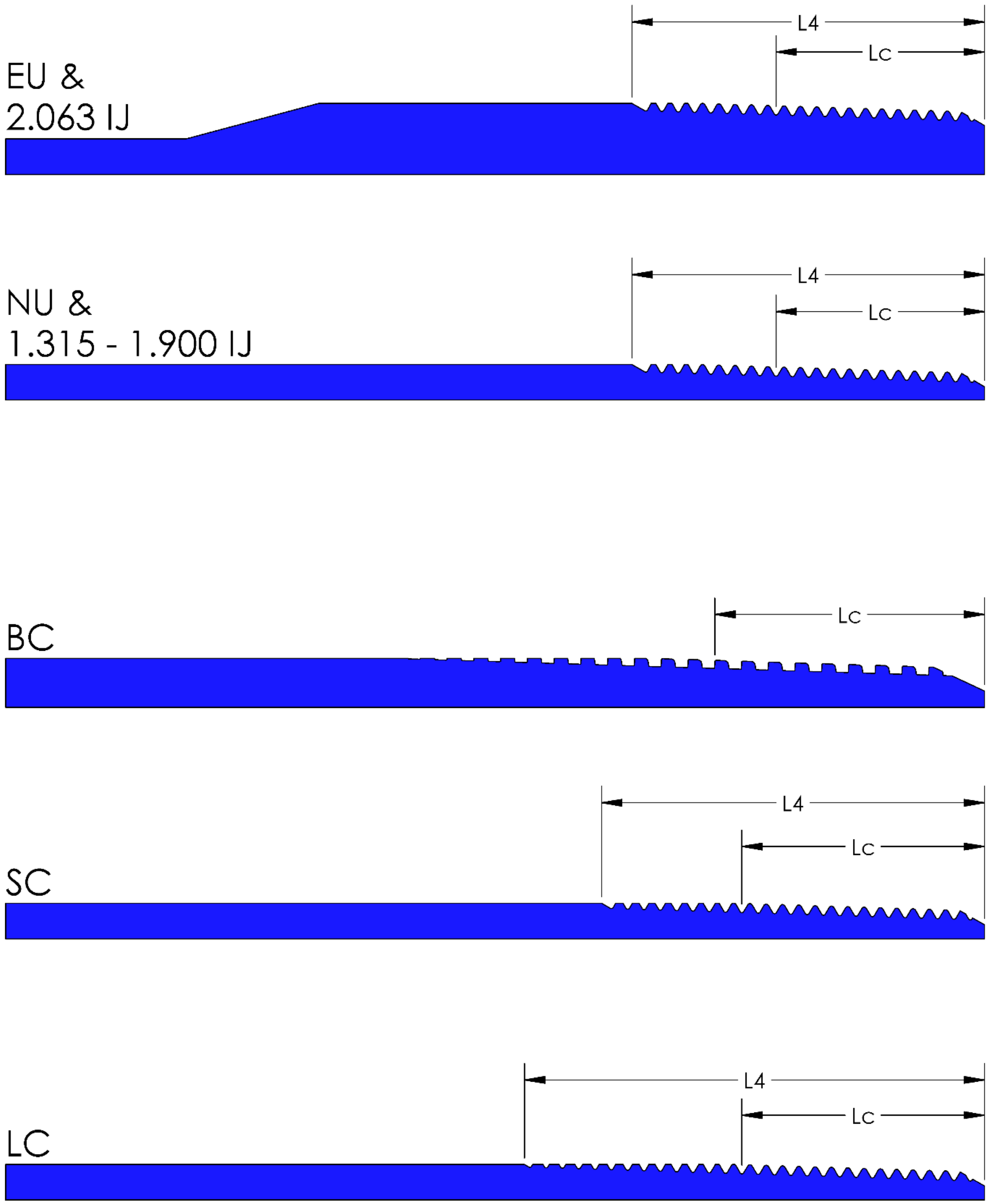


Figure 11—Vanishing Points and Full-Crested Thread Lengths

9.2.7 Non-L_c Area

9.2.7.1 Imperfections between the length, L_c, and vanish point are permissible, if their depth does not extend below the root cone of the thread; or extend beyond 12 $^1/_2$ % of specified pipe wall thickness (measured from the projected pipe surface), whichever is greater. Refer to Figure 12 and Figure 13.

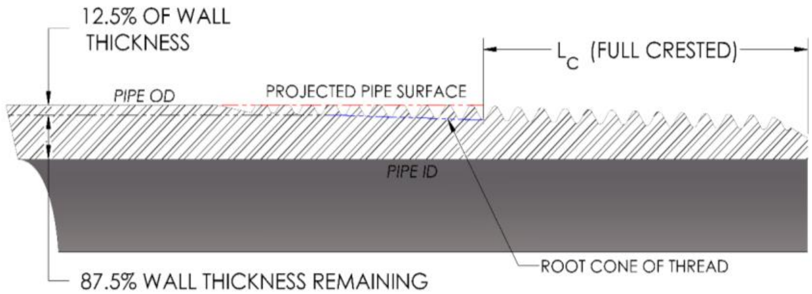


Figure 12—Projected Pipe Surface on Round Threads

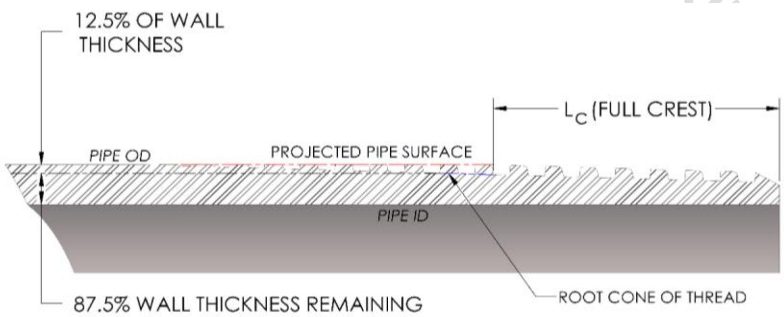


Figure 13—Projected Pipe Surface on Buttress Threads

9.2.7.2 As a guide, the most critical consideration is to ensure that there are no detectable protrusions, including burrs, on the threads that can peel off the protective coating on the coupling threads or score mating surfaces. Burrs or detectable protrusions may be removed, or connection shall be rejected according to API 5B.

9.2.8 L_c Area

9.2.8.1 If there are any visible imperfections, then each shall be verified that they do not break the continuity of the threads. For a listing of common imperfections, reference API 5T1.

9.2.8.2 There shall be verification of no detectable protrusions, including burrs, on the threads that can peel off the protective coating on the coupling threads or score mating surfaces. Burrs or detectable protrusions may be removed, or the connection shall be rejected in accordance with API 5B.

9.2.8.3 On round threads, all threads within the L_c area shall be verified to have full-crests around the entire circumference.

9.2.8.4 For buttress casing, no more than two threads showing the original outside surface of the pipe on their crests or no single crest exceeds 25 % of the pipe circumference shall be verified. Buttress thread with black-crested threads exceeding either condition shall be rejected. Maximum circumferential length of black-crested threads shall be calculated using Equation (1) and should be measured with a flexible measuring tape:

$$\text{Maximum circumferential length of black-crested threads} = \pi \times D / 4 \quad (1)$$

where

π(pi) is a constant 3.1416

D specified outside diameter for pipe

9.2.8.5 Minor pitting and thread discoloration may also be encountered and may not necessarily be detrimental. As a guide to acceptance, most critical considerations are that any corrosion products protruding above the surface of the threads be removed and that no leak path exists. Filing or grinding to remove pits is not permitted.

9.2.9 Chamfer Area of Externally Threaded Ends

9.2.9.1 The OD chamfer shall be verified it is present for a full 360° circumference (see Figure 14). In addition, chamfer angle requirements of API 5B shall be verified. For round nose, see 9.2.10.3 for requirements.

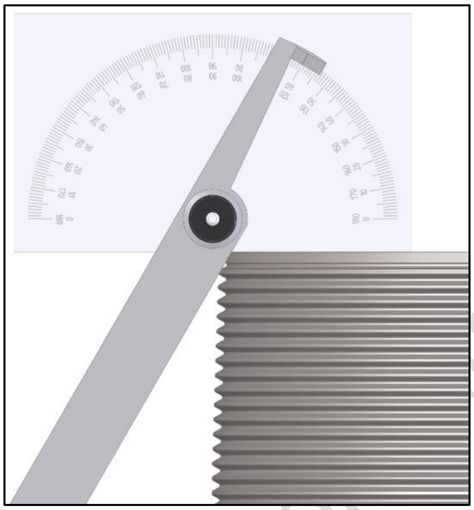


Figure 14—Example of Protractor used on Chamfer

9.2.9.2 The thread root run-out on the OD chamfer shall be verified, but not on the face of the pipe. See Figure 15 for an example of how the thread root can run-out on the face of the part.

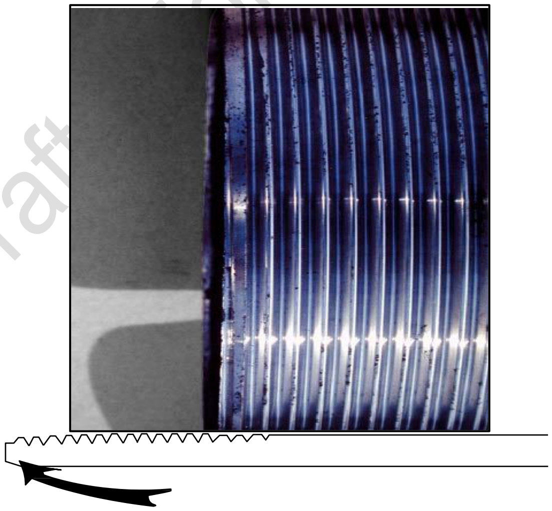


Figure 15—Thread Root Run-out on Face

9.2.9.3 The OD chamfer shall be verified that it does not produce a knife-edge (razor-edge) on the face of the pipe. See Figure 16 for illustrated example.

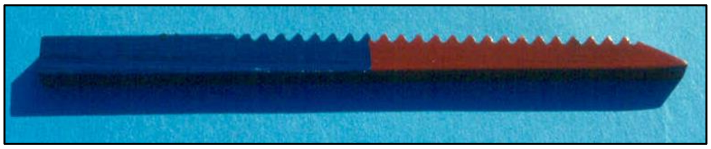


Figure 16—Knife-Edge (Razor-Edge) on the Pipe Face

9.2.9.4 The starting threads shall be verified to have no burrs. Burrs or detectable protrusions may be removed, or connection shall be rejected in accordance with API 5B.

9.2.9.5 If a false starting thread is present, then it shall be verified that it does not extend into the true starting thread.

9.2.9.6 If dents or mashes are present, then it shall be verified that they do not cause out-of-tolerance thread dimensions nor protrusions on surface that could score mating surfaces. A profile template may aid to identify such protrusions.

9.2.10 Face of Externally Threaded Ends

9.2.10.1 The pipe face shall be fully machined and the pipe end shall be verified to be free of any burrs. Burrs or detectable protrusions may be removed, or connection shall be rejected in accordance with API 5CT.

9.2.10.2 If dents or mashes are present, then it shall be verified that they do not cause out-of-tolerance thread dimensions.

9.2.10.3 Optional Rounded Nose (Round or Bullet Nose) External Upset Tubing

In lieu of a chamfer with sharp corners on threaded ends, a modified “round” or “bullet-nose” end may be supplied. The modified end shall be rounded, and the radius transition shall be smooth with no sharp corners, burrs, or slivers on the inside-wall or outside-wall chamfer surfaces (see Figure 17). Burrs or slivers may be removed, or connection shall be rejected in accordance with API 5CT.

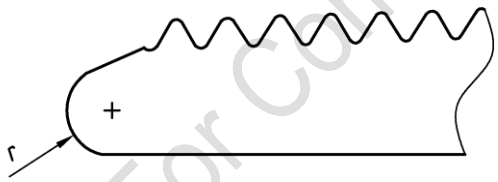


Figure 17—Round Nose

9.2.11 Make-up Triangle Location

9.2.11.1 Buttress Thread

The make-up triangle apex and base shall be present on the externally threaded end, prior to coupling make-up. For measurement, reference 12.4.

9.2.11.2 Round Thread

The presence of the make-up triangle on the external threaded end of each length of 16 in., 18 $^{5}/_{8}$ in., and 20 in. round thread casing shall be verified.

9.3 Visual Inspection of Internal Threads

9.3.1 PTL Area of Internal Threads

9.3.1.1 If there are any visible imperfections, then it shall be verified that they do not break the continuity of the threads. For a listing of common imperfections, reference API 5T1.

9.3.1.2 There shall be verification of no detectable protrusions, including burrs. Burrs may be removed, or connection shall be rejected in accordance with API 5B.

9.3.1.3 All threads within the PTL area shall be verified to have full-crests around the entire circumference.

9.3.2 Threads Beyond the PTL Area of Internal Threads

For couplings, it shall be verified that threads extend into the center of the coupling. For integral joint, it shall be verified that threads extend for 0.500 in. beyond the end of the PTL.

9.3.3 Box Face and Counterbore

9.3.3.1 The pipe face shall be fully machined and it shall be verified that there are no burrs. Burrs or detectable protrusions may be removed, or connection shall be rejected in accordance with API 5CT.

9.3.3.2 If dents or mashes are present, then it shall be verified that they do not cause counterbore diameter reduction nor out-of-tolerance connection dimensions.

NOTE Thread root helical scratches on the counterbore may indicate incorrect counterbore diameter, counterbore misalignment, or thread misalignment.

9.3.3.3 On buttress thread, the root of the coupling thread shall be verified that it both starts within the area of the ID chamfer and extends to the center of the coupling.

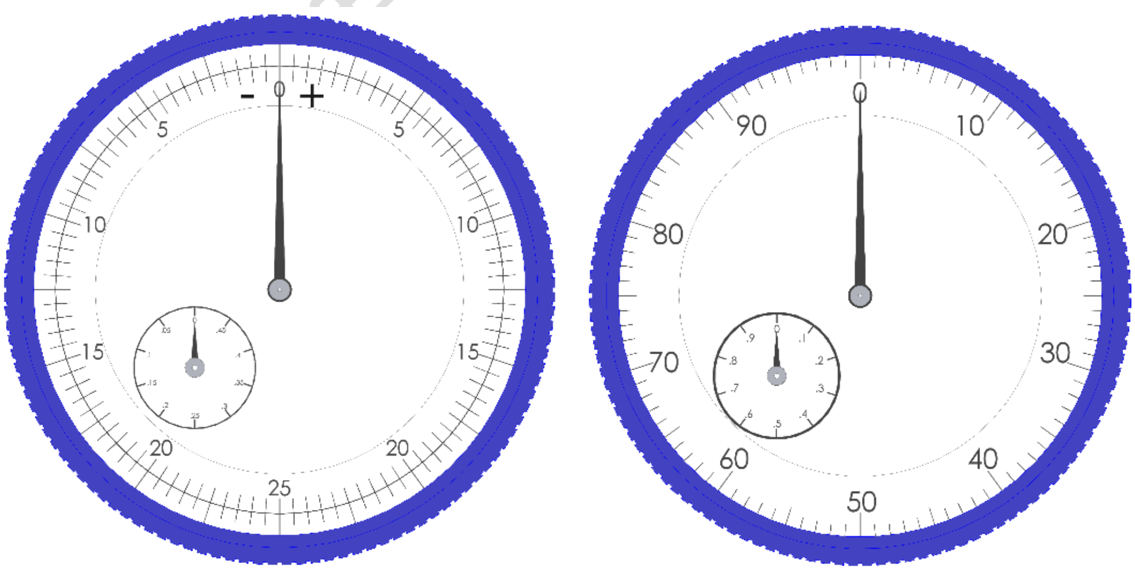
9.3.4 Seal-Ring Groove

When the coupling has seal-ring grooves, it shall be verified that there are no burrs that are loose nor can become loose and fold into the thread form or seal-ring groove. The use of a pick tool or go/no-go block may be used to aid with the inspection. Burrs may be removed, or connection shall be rejected in accordance with API 5CT.

10 Care of Inspection Gauges

10.1 General

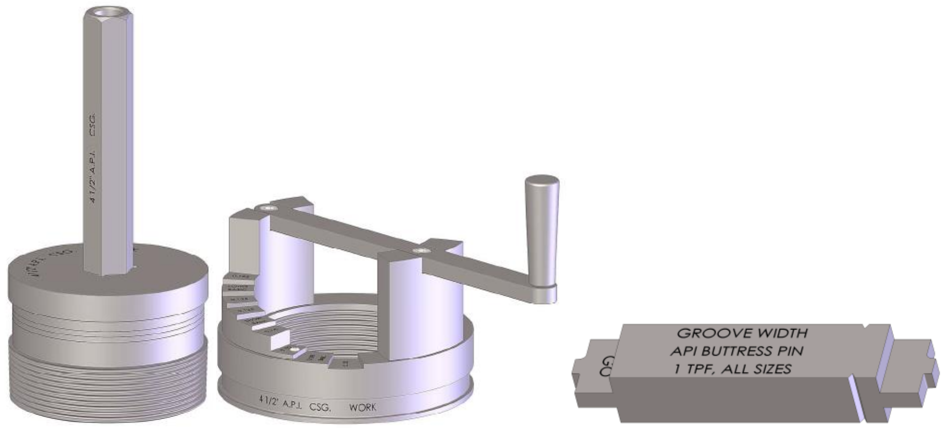
Gauges used for the inspection of tubular goods are delicate and subject to damage if mishandled. Extreme care and cleanliness shall be observed in the storage, handling, standardization, verification, and use of thread element gauges. Two types of gauges are used for thread inspection: indicator (dial or digital) gauges and fixed gauges. Dial indicator gauges are provided with a dial indicator (see Figure 18) that when placed on the thread shall read within a certain range if the element is within specification. The fixed gauge (see Figure 19) is a rigid gauge that is screwed or applied onto the thread.



Balanced
(a)

Continuous
(b)

Figure 18—Dial Indicator-type Gauges



Plug (a) **Ring (b)** **Groove (c)**

Figure 19—Fixed Limit Gauges

10.2 Storage

All gauges should be stored to prevent damage or deterioration (see Figure 20).

Figure 20—Gauge Storage Example

10.3 Handling and Use

The following are applicable to the handling and use of gauges.

a. Gauges, including indicators, should be handled with care.

b. Prior to use, gauges should be cleaned and visually inspected for damage.

c. Foreign matter entering gauge working mechanisms or abrading gauge surfaces may cause deterioration; all surfaces being inspected shall be clean when fitting the gauge to that surface.

d. Temperature differences of the gauge, standard, and product being inspected can affect measurement accuracy; Sufficient time should be allowed for gauges and standards to acclimate.

e. Gauges should be gently placed on the product to be inspected.

f. Gauges should not remain on the product while the gauge is unattended.

11 Calibration and Standardization of Indicators and Fixed Gauges

11.1 Calibration Status

The instrument shall be verified that it is within the current calibration interval. This process includes determining the accuracy of indicators. In case of ring and plug gauges, calibration permits determining whether the standoff between the working gauge and the master gauge has not changed, or if a change has occurred that the amount of change is then known. Calibration normally is not performed in the field or at the inspection table since the measuring equipment is precise and subject to deterioration outside of a laboratory environment.

11.2 Standardization

Standardization is the process of determining if the gauge is accurate at the intended reading and adjusting if necessary. Gauges should be standardized at the beginning of each inspection and the standardization verified any time an out-of-spec thread element is found and after every 25 pieces inspected. In accordance with API 5B, additional calibration and subsequent standardization shall be performed if the gauge has been dropped, bumped, or applied roughly to the product. Re-standardization shall include verification of gauge accuracy, contact point condition, fully intact, and tight. Standardization should be verified at the end of a shift or order.

After an unacceptable standardization check, the element measured by the gauge that failed standardization shall be re-inspected on all connections inspected since the most recent acceptable standardization.

12 Thread Inspection Measurement Accuracy

12.1 General

Accurate gauging can only be performed prior to thread coating. Correct thread element limits and/or tolerances and dimensions necessary for proper gauging are contained in API 5B. The thread is properly machined if all thread elements are within spec and the fixed gauge standoff is within spec. Inspection of the threaded connection shall consist of verifying the dimensions of the following thread elements and features for round, buttress, and line pipe threads:

a) thread length (except buttress threads),

b) make-up triangle or mark,

c) thread taper,

d) thread run-out (buttress only)

e) thread lead,

f) thread height,

g) thread addendum (round threads only),

h) thread form,

i) thread tooth thickness or thread groove width (buttress only),

j) coupling thread alignment,

k) thread crest diameter (8-round and buttress only),

l) thread ovality (8-round and buttress only),

m) standoff, and

n) coupling powertight make-up position.

See B.10 for examples of documentation of thread inspection results.

12.2 Inspection Procedure

Thread elements for all threads, except line pipe threads finer than 11 $^{1}/_{2}$ threads per inch, shall be subject to inspection in accordance with this section. See Figure 21 for length location references.

For the gauging of external or internal threads, measurements shall be made at the first and last perfect threads where full-crested threads exist. Measurements are continued in intervals as follows:

a) 1 in. intervals for products with more than 1 in. between the first and last perfect threads,

b) $^{1}/_{2}$ in. intervals for products with 1 in. to $^{1}/_{2}$ in. between the first and last perfect threads, or

c) intervals consisting of 4 threads for products with 11 $^{1}/_{2}$ threads per inch.

All threads shall be clean before inspection and the imperfect starting thread should be de-burred before inspection. A longitudinal line may be drawn on the pin end threads using a felt tipped marker or similar marking device that passes through the last tool mark to facilitate thread length measurements (see Figure 22). Inspection intervals may be marked along the longitudinal line starting with the first perfect thread (pin end). The last inspection interval shall coincide with the last perfect thread, or an overlapping interval shall be provided; an overlapping interval is provided by starting at the last perfect thread and marking toward end of the pin until the new interval overlaps the previously marked interval (Figure 22).

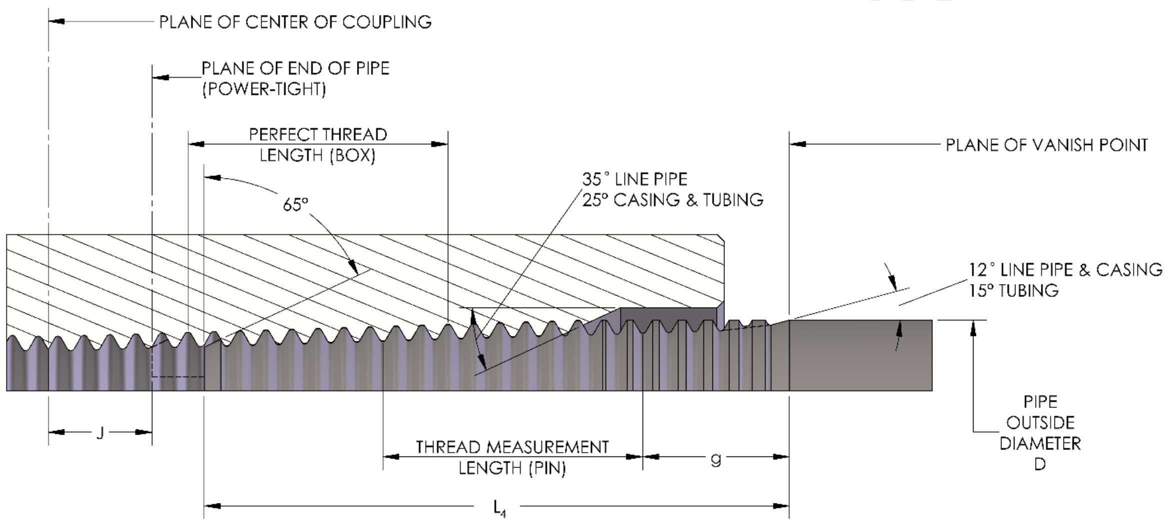


Figure 21—Example of Length Locations

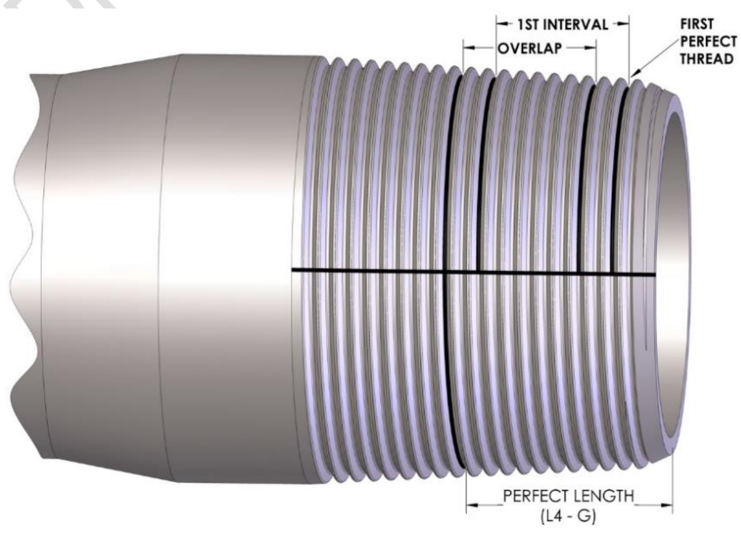


Figure 22—Example of Intervals–External Thread

12.3 Total Thread Length for Round Thread and Line Pipe Thread

A linear measuring device or template should be used for measuring total thread length. The measuring device shall be aligned to the thread axis (not the crest cone).

For round thread pins, the total thread length, the L_4 dimension (Tables A.1 through A.4) shall be measured from the pipe face to the vanish point (the last visible evidence of the continuous machined root as it stops or runs-out; Figure 11).

For integral joint box, the minimum total thread length shall not be less than L_4 + J, according to API 5B.

12.4 Make-up Triangle Mark for External Threads Only

12.4.1 Round Thread

For round thread sizes 16 in., $18^5/_8$ in., and 20 in. in Grades H40, J55, and K55, a make-up triangle shall be applied unless otherwise specified on the purchase order; the make-up triangle may be replaced with a transverse white paint band. For round threads, the make-up triangle ($L_4 + {}^1/_{16}$ in.) shall be measured parallel to the pipe axis from the end of pipe to the base of the make-up triangle. A linear measuring device or template should be used. The measuring device shall be aligned to the thread axis (not the crest cone).

12.4.2 Buttress Thread

For buttress casing, a make-up triangle shall be applied unless otherwise specified on the purchase order, the make-up triangle may be replaced with a transverse white paint band. For buttress threads, the make-up triangle (A_1, see Table A.6) shall be measured parallel to the pipe axis from the end of pipe to the base of the make-up triangle. A linear measuring device or template should be used. The measuring device shall be aligned to the thread axis (not the crest cone), as shown in Figure 23.

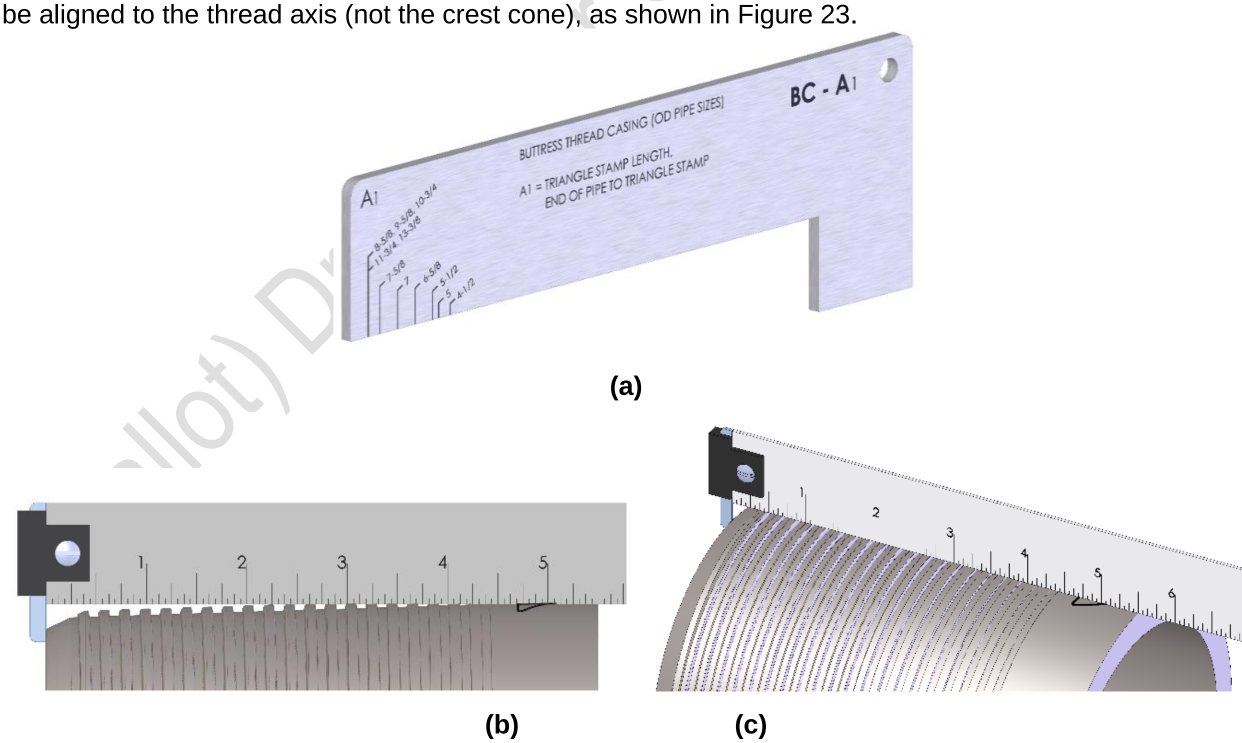


Figure 23— Make-up Triangle Measurement Parallel to Thread Axis

12.5 Taper

12.5.1 Taper Calipers with Dial Indicators

Taper calipers are provided with a continuous-dial-type indicator. The gauge contact points shall be fitted with contact points of diameter as listed in Table 1. These contact points are ball-type. The point diameter should be verified. Two contact points are provided–a fixed point and a movable point (see Figure 23).

The following types of calipers are available for inspecting thread taper:

— an external taper caliper (Figure 24) with an arm that adjusts to the appropriate pipe OD, or

— depending on the caliper-type, the internal taper caliper is (1) adjusted to fit the coupling by installing extensions (see Figure 25) on the indicator shaft, or (2) for sizes $4^1/_2$ in. and smaller, by sliding the arm to the corresponding coupling size (see Figure 26).

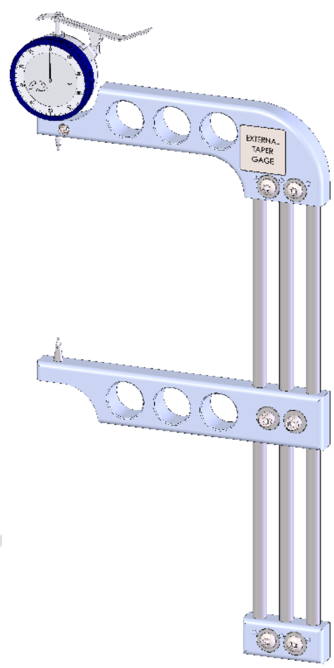


Figure 24—External Thread Taper Caliper

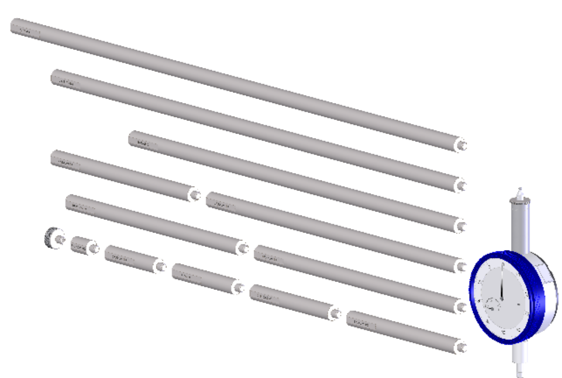


Figure 25—Internal Taper Caliper (Rod-style) for 4-1/2 in. OD and larger with Gauge Extensions

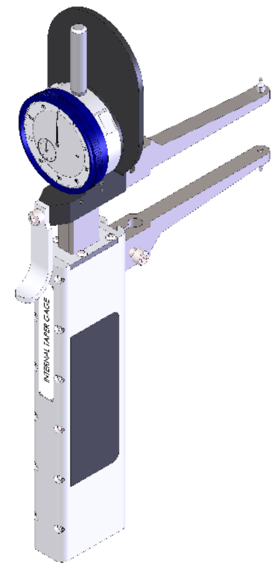


Figure 26—Internal Thread Taper Caliper (Plunger-style)

Table 1—Contact Point Dimensions for Taper Calipers

1	2	3
Threads per inch	**Thread Form**	**Contact Point Diameter** in.
8	Round	0.072
8	Line Pipe	0.072
10	Round	0.057
$11^1/_2$	Line Pipe	0.050
5	Buttress	0.090 [a]
[a] This is the only value that differs from the similar information in Table 2 for lead gauges.		

12.5.2 External Threads

12.5.2.1 Adjusting the Taper Caliper

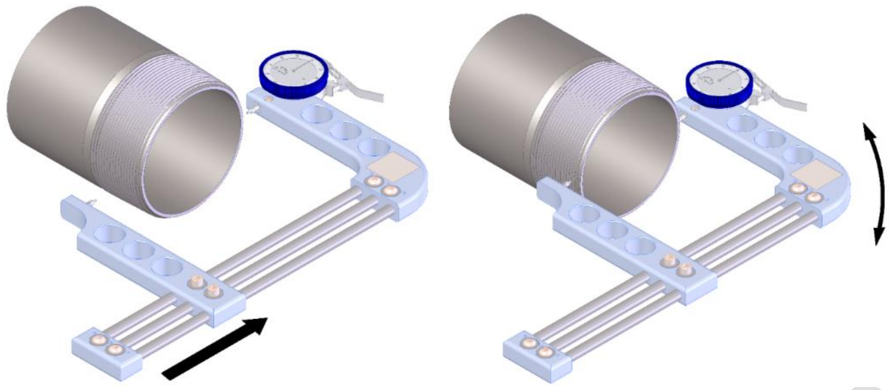
Taper calipers shall be adjusted on the pin. For round threads, the caliper shall be verified that the opening of the arms will allow the gauge to fit over the first and last perfect thread and the dial reading at the first and last perfect thread are relatively centered on the full-dial travel. For buttress threads, the caliper shall be verified that the opening of the arms will allow the gauge to fit over the first and into the imperfect thread area. Refer to Figure 26 for adjustment.

Threads may be marked with intervals as discussed in the inspection procedure (see 12.2 and Figure 22);.

The first perfect thread location is the thread nearest the chamfer on the pin with a root having a full-crest on both sides.

The last perfect thread location on external threads is L_4–g for tubing and line pipe, and L_7 for buttress. See Tables A.3, A.4, and A.5 for L_4-g, and Table A.6 for L_7. The last perfect thread location is not dependent on the thread having a full-crest at this location.

For casing round threads, the distance from the end of the pipe to the last perfect thread (last scratch – 0.625 in.) is called the thread element control length (TECL).



(a) (b)

Figure 26—Initial Positioning and Adjusting for Travel and Indicator Tension

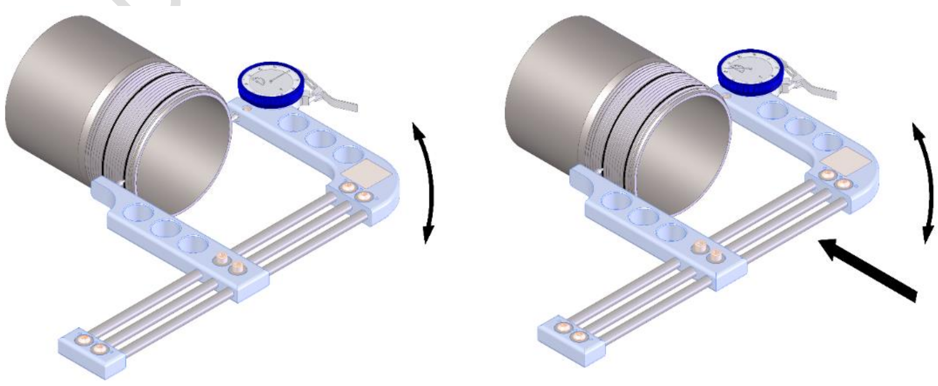
12.5.2.2 Applying the Taper Caliper

The ball point on the fixed end of the gauge shall be placed in the groove at the first perfect thread position and the ball point on the plunger in the groove diametrically opposite (in a helical path). The fixed point shall be held firmly within the thread groove while the movable point is oscillated through an arc within the groove. The dial pointer indicator shall be adjusted to read zero at the maximum reading; this adjustment is made by loosening the thumb screw and rotating the dial until a zero reading is indicated (see Figure 27).

Successive measurements at the same radial position relative to the axis of the thread shall then be taken at the required intervals for the full length of the perfect threads. An example of these motions is in Figure 27. The difference between successive measurements shall be the taper in that interval of threads.

The taper in the last interval of perfect threads shall be measured and may include an overlap interval from previous measurement. If the last interval of perfect threads is less than the specified measurement interval (1 in. or $^{1}/_{2}$ in.), the ball point on the fixed end of the gauge should be placed in the thread groove of one measurement interval from the last perfect thread and the indicator set to zero. The overlap interval ends at the last perfect thread.

For external buttress threads, taper measurements shall continue into the imperfect thread area as far as thread flanks and contact size permits. If the measurement that includes both perfect and imperfect threads (if there is one) does not meet the perfect thread requirements, then another measurement shall be done at the last perfect thread. The taper caliper shall be zeroed at 1 in. towards pin face from the last perfect thread, then measured at last perfect thread.



Zeroing the indicator **First Measurement of Taper**

(a) (b)

Figure 27—Sequence of Performing Taper Measurements

12.5.3 Internal Threads

12.5.3.1 Adjusting the Plunger-style Gauge

The gauge shall be adjusted on the internal thread. The caliper shall be verified that the opening of the arms will allow the gauge to fit in the first and last perfect thread and the dial reading at the first and last perfect thread are relatively centered on the full-dial travel.

The internal threads may be marked with intervals as discussed in 12.2.

The first perfect thread is the thread nearest the coupling/box face with a root having a full-crest on both sides. See Figure 28.

The last perfect thread location on internal threads is J+1p, and shall be measured from the physical center of the coupling or from the small end of the box for integral joint tubing (L_4 + J). For couplings, the generally accepted practice is to use $N_L/2$–(J+1p). In case of dispute, actual coupling length (N) shall be used in lieu of N_L. Short-threaded couplings are manufactured to accommodate all weights; J equal to 0.500 in. shall be used when calculating PTL.

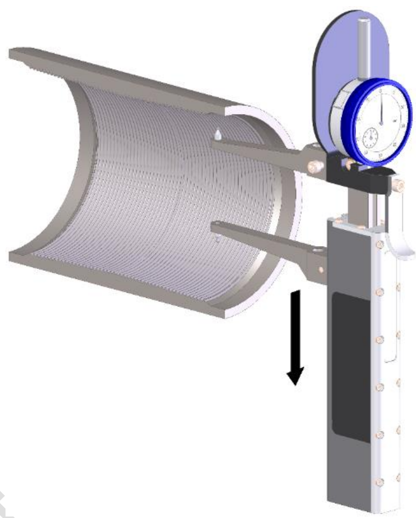


Figure 28—Adjust Taper Caliper on Part-Internal

12.5.3.2 Adjusting the Rod-style Taper Gauge

The rod-style internal taper gauge for couplings $4^1/_2$ in. OD and larger shall be adjusted by installing the appropriate fixed gauge extensions for the respective size (Figure 24) of the product being measured.

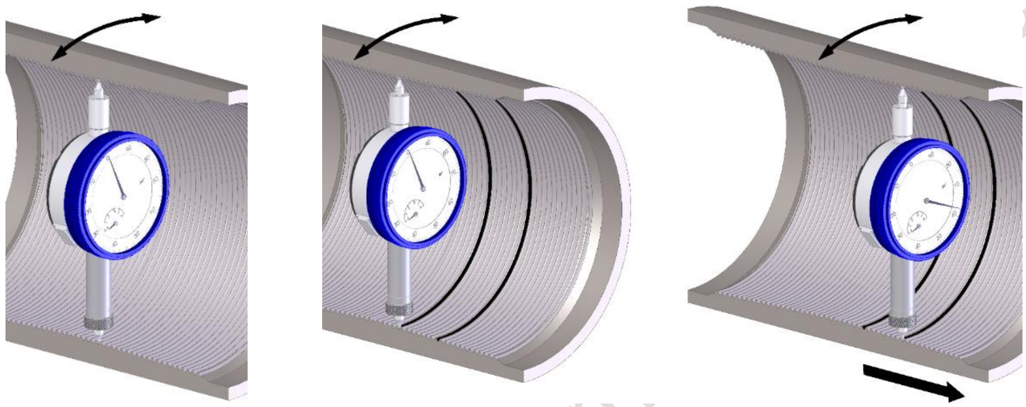
12.5.3.3 Applying the Taper Gauge

To ensure that the fixed contact stays on a straight line, a longitudinal line shall be marked across the crests of the threads. The internal taper gauge shall be inserted into the last perfect thread of the coupling, or integral joint box, so the movable contact point (short end) is at the top and the fixed contact point (large end) is at the bottom (Figure 29) and on the longitudinal line. The last perfect threads are located at five threads from the center of the coupling for 8-round, six threads from the center of the coupling for 10-round, or six threads from the small end of the IJ box. For buttress, the last perfect thread is located at the physical center of the coupling minus 0.700 in. For line pipe, the last perfect thread is located at J+1p from the physical center of the coupling, and reference API 5B for J. The fixed point shall be held firmly in position, the pivoted point oscillated through a small arc, and the dial indicator set so that the zero position coincides with the maximum indication (null point). Figure 29 and Figure 30 depict the proper movements used for rod and plunger gauge-styles.

Successive measurements at the same radial position relative to the axis of the thread shall then be taken at the required intervals for the full length of the perfect threads. The difference between successive measurements shall be the taper in that interval of threads.

The taper in the last interval of perfect threads shall be measured and may include an overlap interval from previous measurement. If the last interval of perfect threads is less than the specified measurement interval (1 in. or $^1/_2$ in.), the ball point on the fixed end of the gauge should be placed in the thread groove of one measurement interval from the last perfect thread and the indicator set to zero. The overlap interval ends at the last perfect thread.

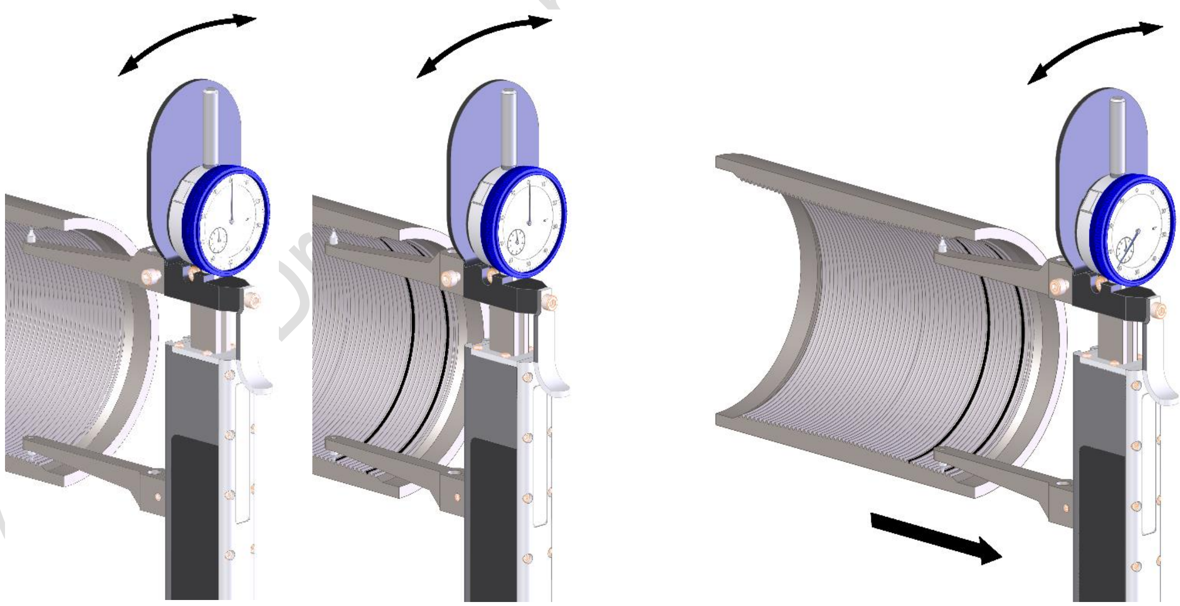
Depending on indicator gauge-type, taper may be measured by starting at the first or last perfect thread.



Starting Location Zeroing the indicator First Measurement of Taper

(a) (b) (c)

Figure 29—Internal Taper Gauge (Rod-style) for 4$^1/_2$ in. OD and larger Pipe



Starting Location Zeroing the indicator First Measurement of Taper

(a) (b) (c)

Figure 30—Internal Taper Gauge (Plunger-style)

12.6 Thread Run-out (Buttress Only)

12.6.1 General

The purpose of measuring the run-out is to verify that the thread root cone angle does not increase before the apex of the make-up triangle or reaching the pipe outside diameter.

12.6.2 Gauge

The run-out gauge is a three-point gauge having two fixed points and one movable point attached to a balanced-dial indicator (Figure 31).

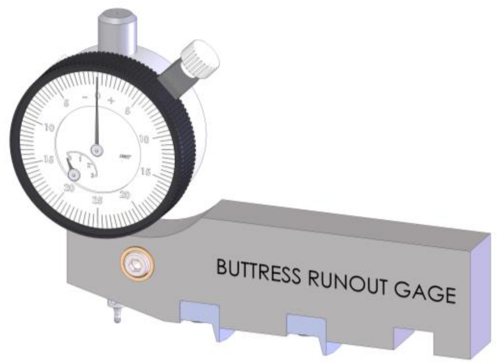


Figure 31—Buttress Thread Run-out Gauge

The run-out gauge indicator shall be set to zero using a flat surface as a setting standard for size 13$^{3}/_{8}$ in. and smaller casing (see Figure 32). For size 16 in. and larger casing, the run-out gauge indicator shall be set to zero using the perfect thread roots as a setting standard (see Figure 33). These perfect thread roots shall be checked for acceptable taper prior to setting the run-out gauge. If the indicator does not read zero, the dial shall be adjusted to read zero. The gauge zero shall be verified after adjustment.

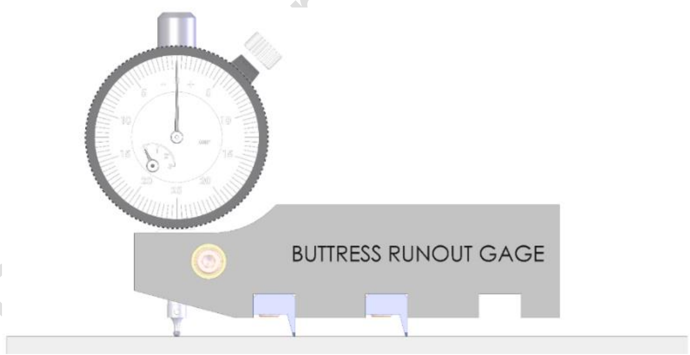


Figure 32—Zero on Flat Surface for $^{3}/_{4}$-inchTPF

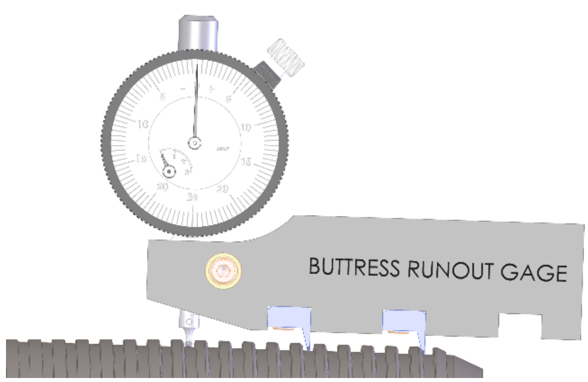


Figure 33—Zero on Perfect Thread Length for 1-inch TPF

12.6.3 Applying the Gauge

Thread measurement location depends on where the thread runs-out. Two possible thread run-out conditions can occur, either:

a) Thread run-out before the apex of the make-up triangle (nearer to the pipe end) – if the thread terminates before the apex of the make-up triangle (Table A.6), the movable pointer shall be placed in the last thread groove 90° prior to the thread termination and the gauge traversed clockwise until the pointer exits the thread groove and rides on the pipe surface; or

b) Thread run-out at or beyond the apex of the make-up triangle – if the thread terminates at or beyond the apex, the movable pointer shall be placed in the thread groove 90° prior to the thread groove located at A_1 + 0.375 in. (apex) and traverse the gauge clockwise until the pointer reaches the make-up triangle apex (see Figure 34).

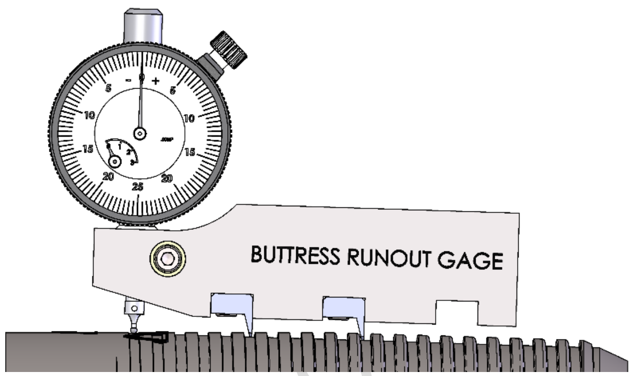


Figure 34—Run-out Measurement when Threads Terminate Beyond Apex of Make-up Triangle

12.7 Lead

12.7.1 General

Because lead is such a short distance (one thread), lead error shall be measured over intervals of multiple threads.

For the gauging of external or internal threads, lead measurements shall be made starting at either the first perfect thread and continuing to the last perfect thread or the last perfect thread and continuing to the first perfect thread. Measurement intervals may require an overlap of the thread measuring interval. At no time shall lead measurements be taken with a contact point beyond the last perfect thread location.

If the distance from the first or last perfect thread is:

a. greater than 1 inch, then 1-inch measurement intervals shall be used,

b. $^1/_2$ inch to 1 inch, then $^1/_2$-inch measurement intervals shall be used, or

c. for 11 $^1/_2$ threads per inch, then a 4-thread measurement interval shall be used.

12.7.2 Gauges

Several types of gauges are available (see Figure 35). The gauge shall be standardized by applying the gauge to the lead setting standard (see Figure 36). Prior to adjusting the lead gauge, the contact point diameter shall be verified. The contact point dimensions are listed in Table 2. Points not within tolerance shall be replaced. Two contact points are provided: a fixed point and a movable point (Figure 37). Pull-style lead gauges should be used on buttress threads.

Figure 35—Example Lead Gauge

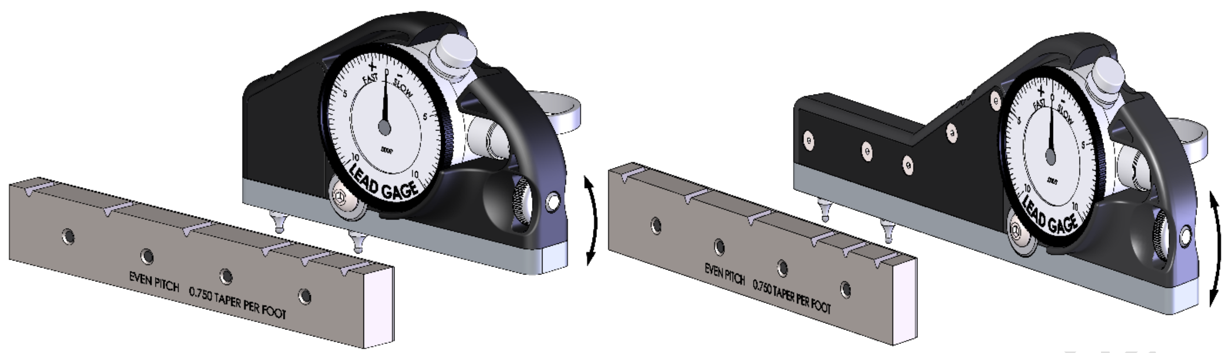
Figure 36—Lead Setting Standard

Table 2—Contact Point Dimensions for Lead Gauge

1	2	3
Threads per inch (TPI)	**Thread Form**	**Contact Point Diameter**
		in.
8	Round	0.072
8	Line Pipe	0.072
10	Round	0.057
$11^1/_2$	Line Pipe	0.050
5	Buttress	0.062 [a]
[a] This is the only value that differs from the similar information in Table 1 for taper calipers.		

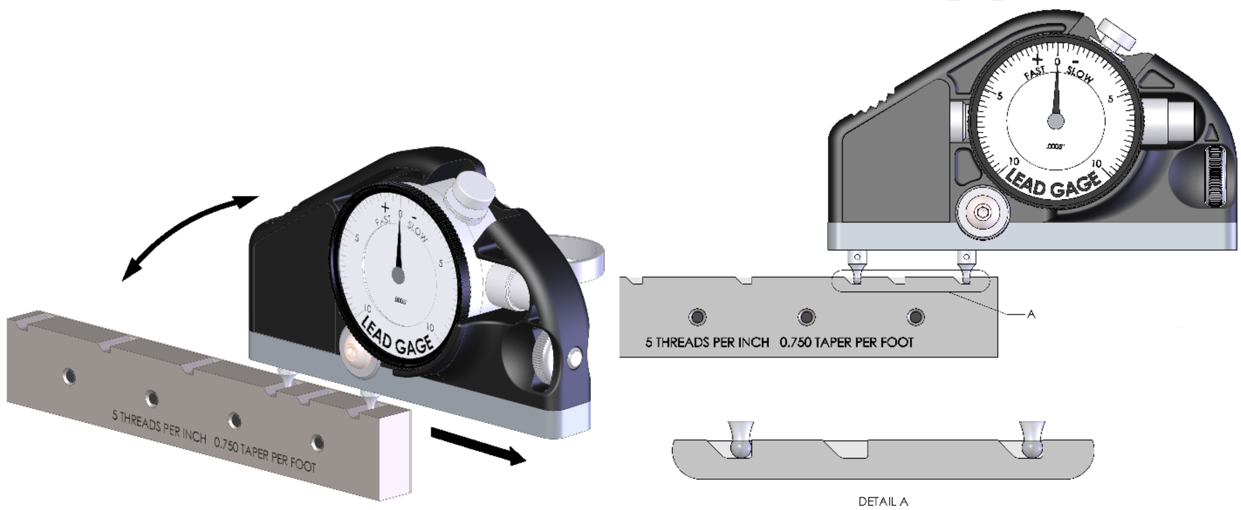
12.7.3 Adjusting the Gauge

The fixed gauge point shall be placed in a groove on the standard with the movable point in the appropriate increment groove. For line pipe with $11^1/_2$ threads per inch, a 4-thread lead-setting standard shall be used. The gauge should be pivoted in a small arc about the fixed point on either side of the groove (see Figure 37 and Figure 38). The lead gauge indicator shall register zero when applied to the setting standard. An adjustment is necessary if the gauge does not register zero. The gauge should be removed from the standard and reapplied to confirm correctness of the adjustment.



(a) **(b)**

Figure 37—Lead Setting Standard with External/Internal Lead Gauge Applied–Round Threads



(a) **(b)**

Figure 38—Lead Setting Standard with Lead Gauge Applied–Buttress Threads

12.7.4 Applying the Gauge to the product

12.7.4.1 Per inch Measurement

The gauge shall be used in the same fashion for inspecting external and internal threads. The gauge shall be properly adjusted prior to applying the gauge to the product. The length of the threads from the first perfect thread through the last perfect thread shall be inspected.

The first perfect thread location is the thread nearest the chamfer on the pin or face of the coupling with a root having a full-crest on both sides.

The last perfect thread location on external threads is L_4–g for tubing and line pipe, L_7 for buttress casing, and last scratch (last thread groove) -0.625 in. for round thread casing. For round thread casing, the distance from the end of the pipe to the last perfect thread is called the thread element control length, or TECL (see Figure 39).

The last perfect thread location on internal threads is J+1p, and shall be measured from the physical center of the coupling or from the small end of the box for integral joint tubing.

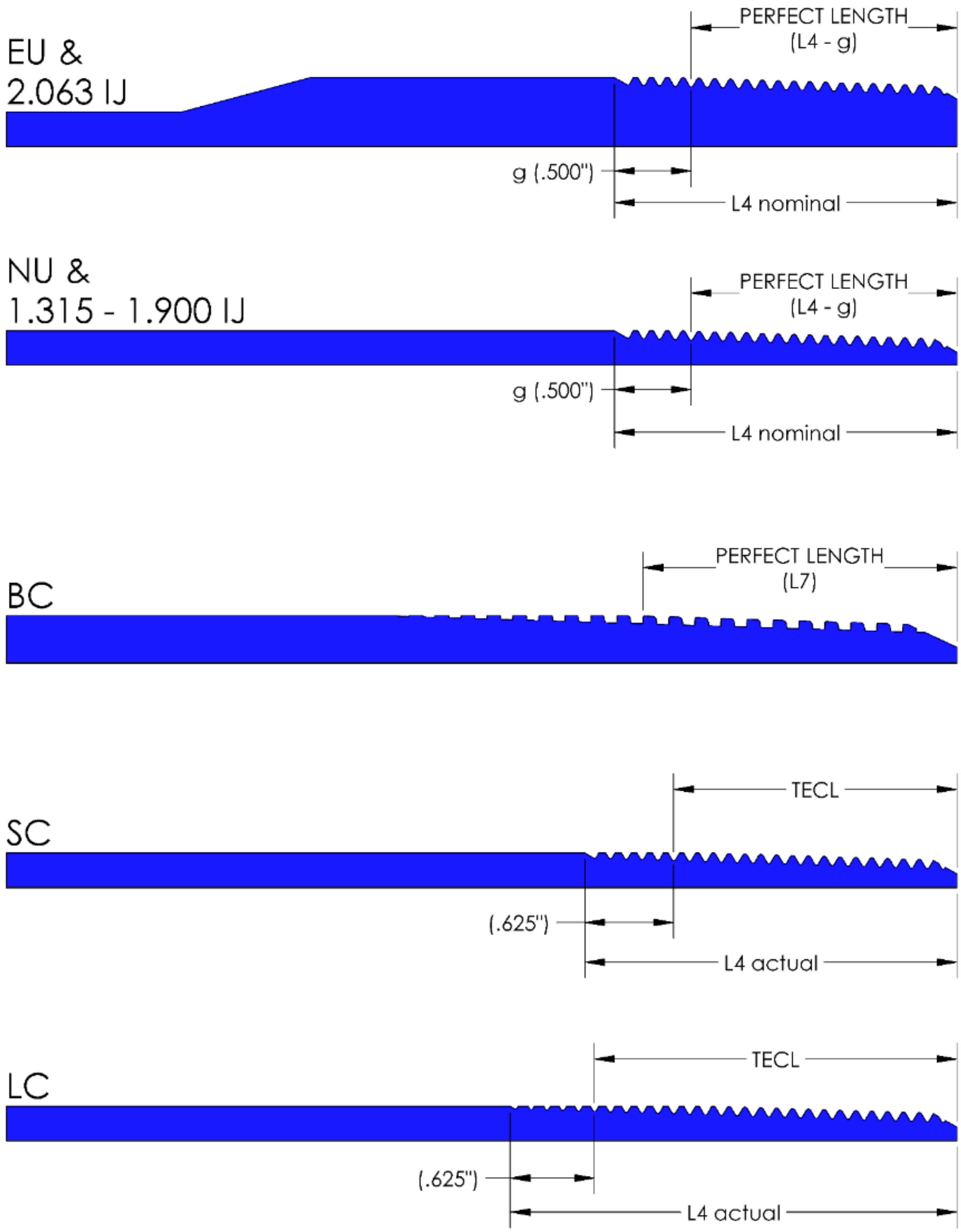
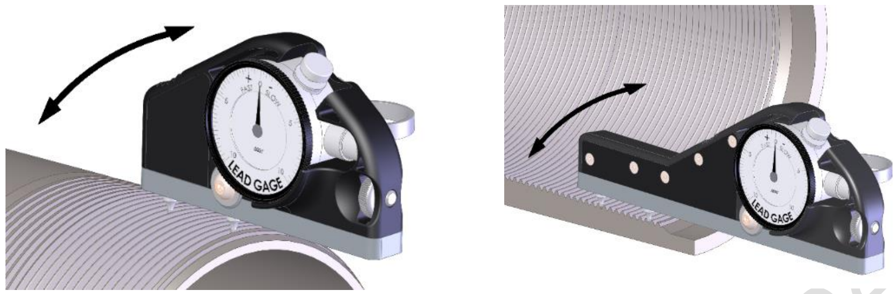


Figure 39—Perfect Length and TECL

The fixed gauge point shall be placed on the line in the first full thread groove near the small diameter of the thread (Figure 22). With the movable point in the thread groove (see Figure 40), the gauge should be pivoted in a small arc about the fixed point on either side of the longitudinal line. The maximum deviation from zero in either the fast (+) or slow (–) direction represents the error in lead.



(a) **(b)**

Figure 40—Lead Gauge on Round Threads

For inspection purposes, the coupling full-crested thread length extends from the first perfect thread (third thread root from end of recess) to the J+1 thread length (fifth thread and sixth thread from coupling center for 8-round and 10-round, respectively; Tables A.1 through A.6).

For buttress, both internal and external threads, the gauge shall be applied so that the contact points simultaneously touch the root and the 3° flank of the threads with light pressure to the load flank as shown in Figure 41.

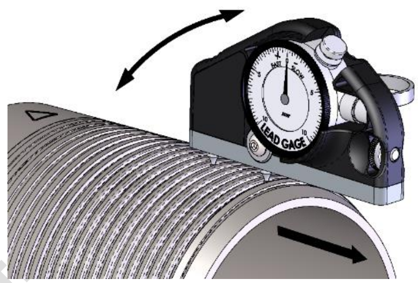
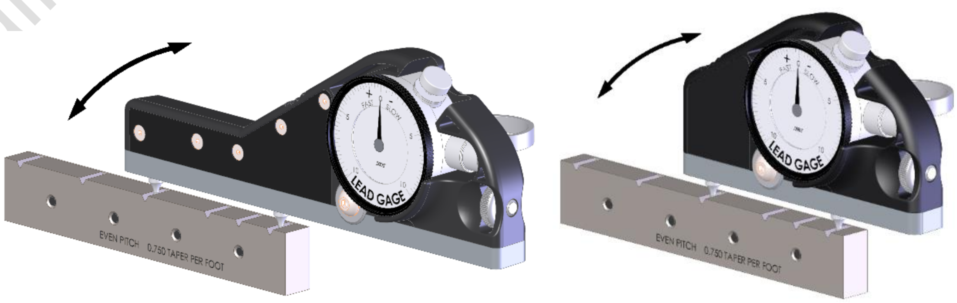


Figure 41—Lead Gauge on Buttress Threads

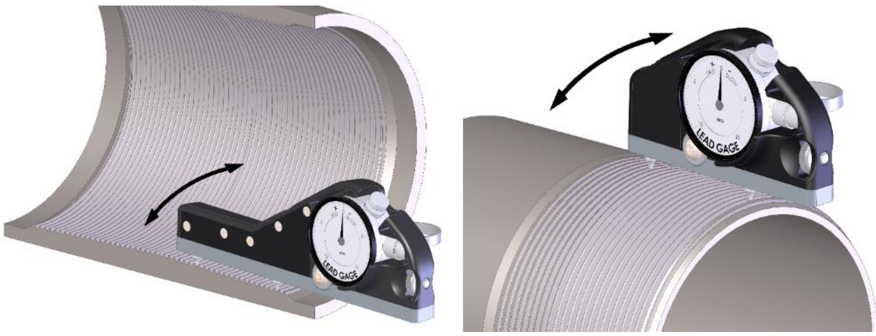
12.7.4.2 Cumulative Lead Measurement

Cumulative lead shall be measured between the first and last perfect threads over an interval (in excess of 1 inch) which is the largest multiple of $^1/_2$ inch for round threads or 1 inch for buttress (Tables A.1 through A.6). The lead gauge shall be applied to the product as for the 1 in. interval, i.e., the fixed point shall be placed in the first full groove at the end of the thread. The movable point shall be placed on the longitudinal line in the groove appropriate to the distance between gauge points. Refer to Figure 42 and Figure 43.



(a) **(b)**

Figure 42—Setting of Cumulative Lead Gauges



(a) **(b)**

Figure 43—Cumulative Lead Gauges on Product

12.7.4.3 Lead Measurements in Couplings with Seal-Rings

When a seal-ring groove is present in a coupling, lead measurements shall be taken with all contact points placed where full thread forms are on each side of the contact points. The partial threads adjacent to the groove shall be avoided when measuring any thread element.

12.8 Thread Height

12.8.1 General

Thread height (depth) is the measurement of the distance from the thread root to the thread crest normal to the thread axis using either a balanced-type indicator or a continuous reading dial-type (Figure 17). Balanced-dial-type gauges establish the difference (error) between the setting standard notch depth and the thread height being inspected. The balanced-dial-type gauge can be recognized by the equal "plus" and "minus" divisions on each side of zero on the dial indicator. A continuous-reading dial-type gauge measures the distance from the thread crest to the thread root for thread height.

12.8.2 Round Thread and Line Pipe Gauges

Two types of thread height gauges are used for round and line pipe threads: external/internal gauges (see Figure 44) and internal gauges (see Figure 45). Straight-anvil-type height gauge shall be used for external/internal round threads.

Figure 44—Thread Height Gauge for Internal / External Threads–Balanced Indicator

Figure 45—Thread Height Gauge for Internal Threads

The contact points for thread height gauges for line pipe and round threads shall be conical in shape with a maximum included angle of 50° and shall not contact the thread flank. The gauge shall be standardized by applying the gauge to setting standards appropriate for the product to be inspected.

12.8.3 Buttress Thread Gauge

Buttress threads shall be measured with gauges registering error in thread height in 0.0005 in. (see Figure 46). A straight-anvil-type external/internal height gauge shall be used for buttress pin and coupling threads 13 $^{3}/_{8}$ in. OD and smaller casing. A step-anvil-type external/internal height gauge shall be used for buttress pin and coupling threads casing larger than 13 $^{3}/_{8}$ in. OD.

Figure 46—Example Thread Height Gauge for Internal / External Buttress Threads

12.8.4 Adjusting the Gauge

The standardization of the gauge shall be verified by placing the gauge on the setting standard with the contact point within the U-notch and contacting the bottom of the notch (see Figure 47 and 49). The dial indicator should register the value appropriate to the thread configuration being inspected (see Table 3). The thumb screw should be loosened, and the dial revolved until the indicator registers the value appropriate to the thread configuration being inspected. The gauge should be rechecked on the setting standard after the dial thumb screw is tightened.

Additionally, round thread contact point wear should be verified by applying the gauge to the Vee block (see Figure 48). The dial indicator shall read within ±0.0005 in. of the appropriate thread depth, i.e., 0.071 in. for 8-round and 0.056 in. for 10-round.

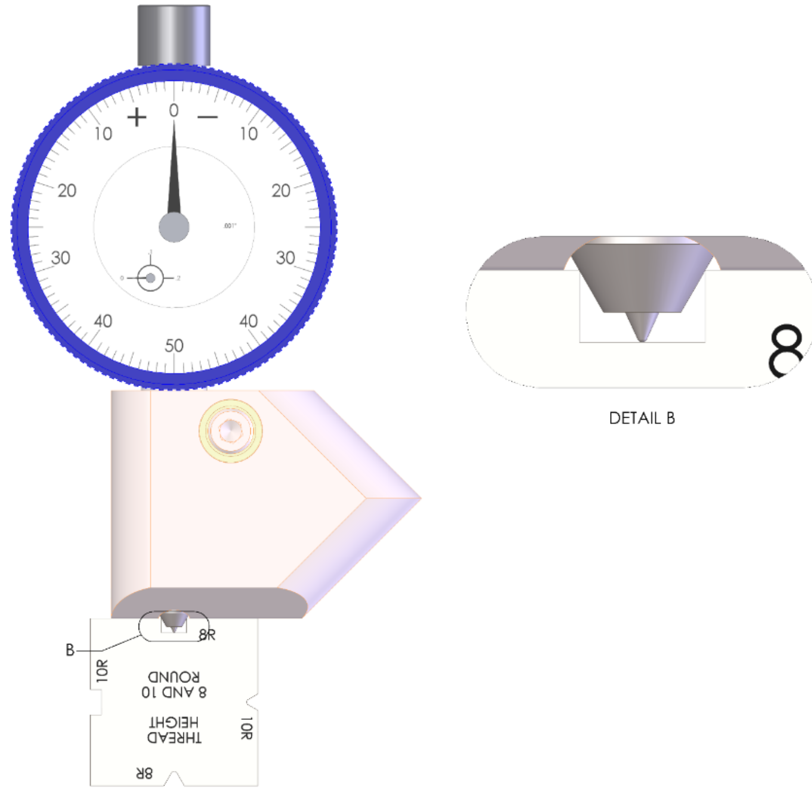


Figure 47—Height Gauge (Balanced-type) Applied to Setting Standard–U-notch

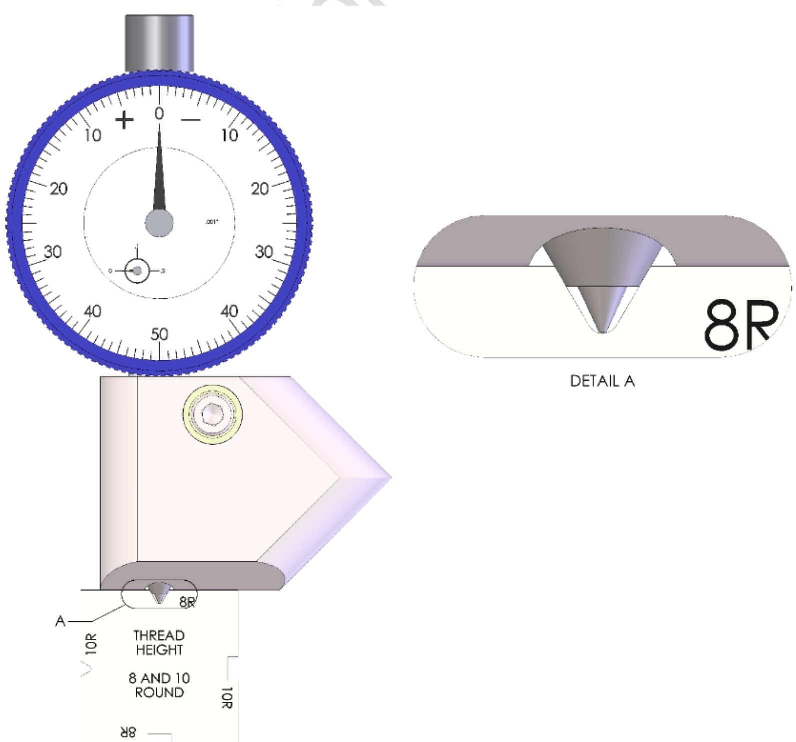
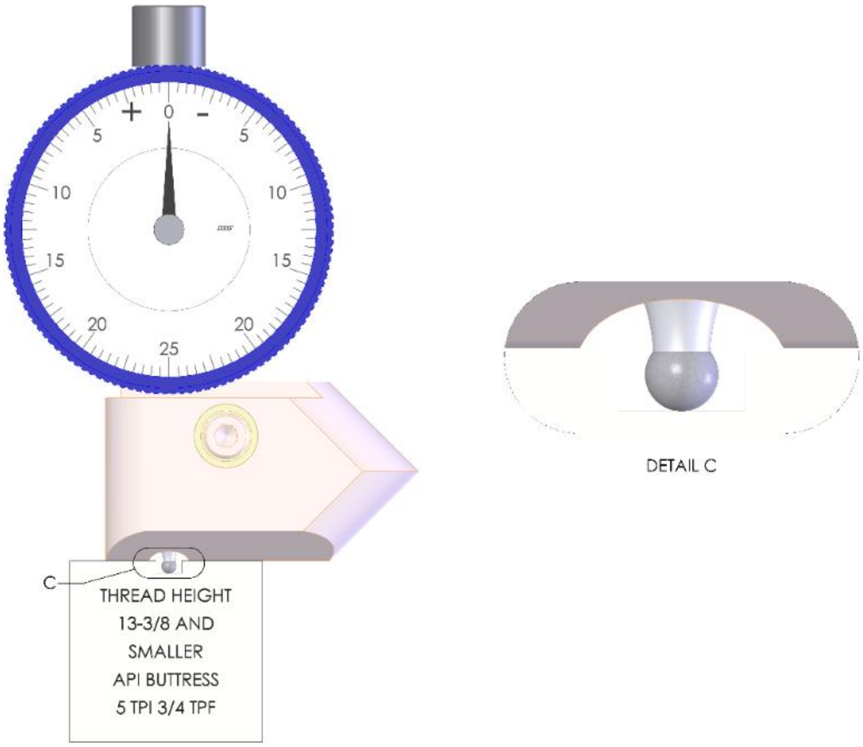
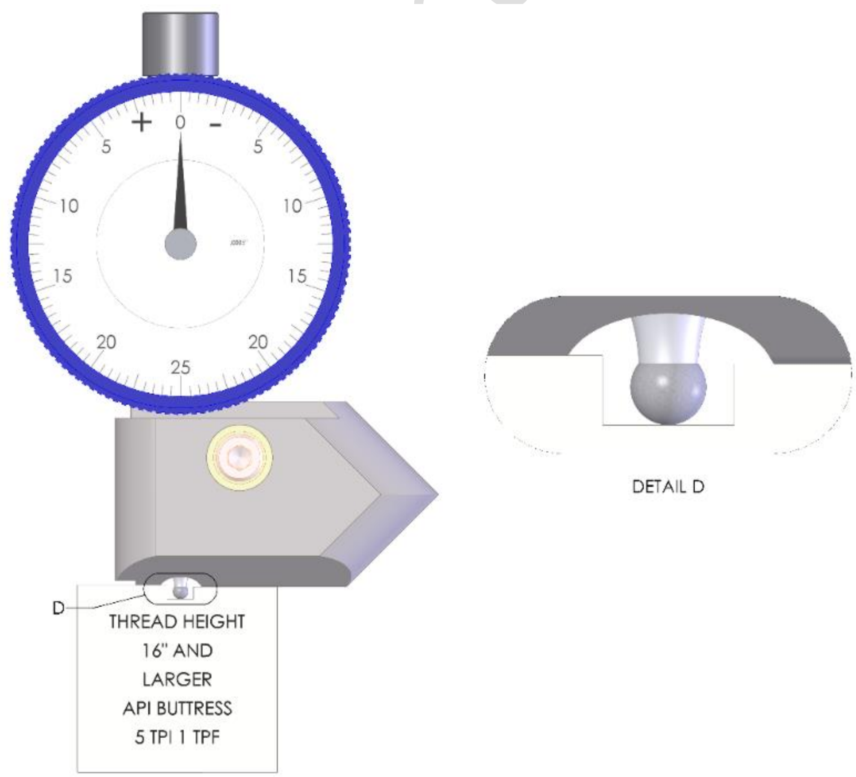


Figure 48—Height Gauge (Balanced-type) Applied to Setting Standard–Vee Block



(a)



(b)

Figure 49—Height Gauge Applied to Setting Standard (Balanced-type)–Buttress

Table 3—Thread Height for Various Thread Forms

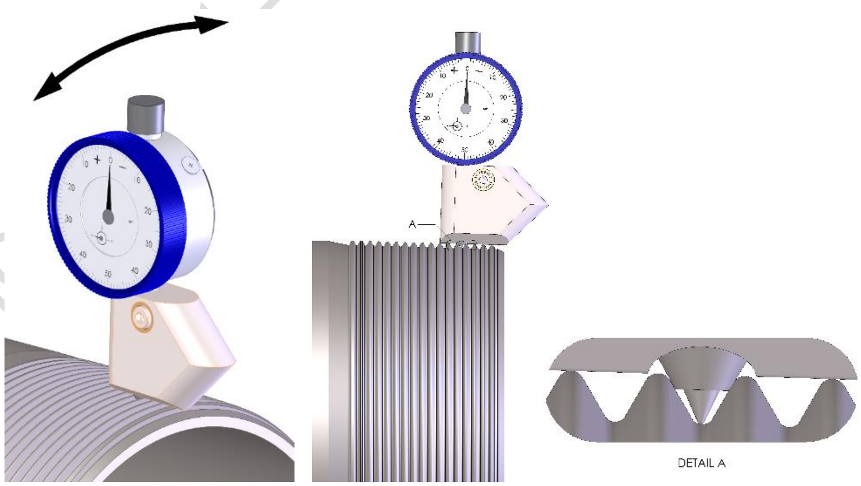
1	2
Thread Form	**Nominal**
	in.
Casing and Tubing (8-round)	0.071
Tubing (10-round)	0.056
Line Pipe ($11^{1}/_{2}$ V)	0.066
Line Pipe (8 V)	0.095
Buttress	0.062
NOTE Calculated dimensions are specified in API 5B.	

12.8.5 Applying the Gauge to the Product

The accuracy of the determination of thread height depends on the anvil resting on top of full-crested threads. The first few threads may be slightly truncated. Care shall be taken to make thread height measurements at a location that has full-crested threads on both sides of the thread root for the anvil to rest upon.

The last perfect thread location on external threads is L_4–g for tubing and line pipe, L_7 for buttress and last scratch (last thread groove), -0.625 in. for casing round threads. For casing, the distance from the end of the pipe to the last perfect thread is called the thread element control length, or TECL. The last perfect thread location on internal threads is J+1p, and shall be measured from the physical center of the coupling or from the small end of the box for integral joint tubing.

Thread height gauge contact point shall be placed (see Figure 50) in the thread groove and anvil of the gauge resting on top of full-crested threads. The anvil shall be held in firm contact with the thread crests. The gauge shall be aligned with the axis of threads by rocking the gauge about the longitudinal axis of the anvil (see Figure 51). The thread height is indicated correctly when the dial indicator stops moving near the center of the rocking motion–the null point.



(a) **(b)**

Figure 50—Thread Height Gauge Applied to Product–External

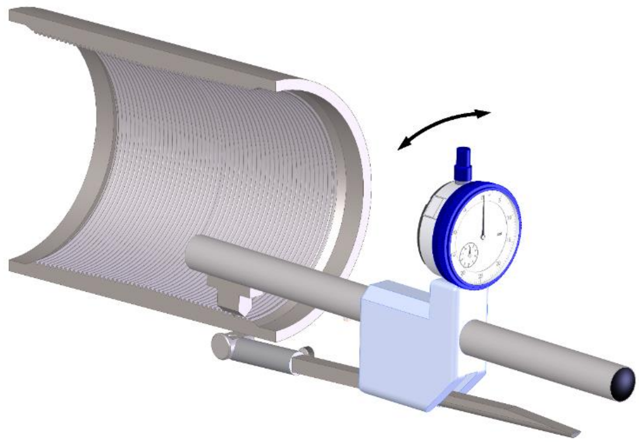


Figure 51—Thread Height Gauge Applied to Product–Internal

The dial indicator reads the actual thread height (Table 3) at the null point if a continuous-dial-type gauge is used; or the dial indicator reads the error in the thread height at the null point if a balanced-dial-type gauge is used.

Verification of thread height shall be performed at the first and last perfect threads and at intervals in between as specified in 12.2 (Figure 20). For inspection purposes, the coupling full-crested threads extend from the first perfect thread to the J+1p thread length (fifth threads and sixth threads from coupling center for 8-round and 10-round, respectively, or small end of the box for integral joint tubing; Figure 22). For buttress, the last perfect thread is located at the physical center of the coupling minus 0.700 in. For line pipe, use J+1p from the physical center of the coupling, and reference API 5B for J. The anvil of the thread height gauge shall be placed firmly to the full-crested threads. Caution should be used when attempting to obtain accurate height measurements of the first and last perfect threads since the anvil may rest on non-full-crested threads.

12.9 Thread Addendum

12.9.1 General

Thread addendum shall be measured using a balanced-type indicator. Balanced-dial-type gauges establish the difference (error) between the setting standard notch depth and the thread addendum being inspected. The balanced-dial-type gauge can be recognized by the equal "plus" and "minus" divisions on each side of zero on the dial indicator (see Figure 52).

Figure 52—Example of Addendum Gauge–Balanced Indicator

Two types of thread addendum gauges are used for round threads: external/internal gauges (Figure 44) and internal gauges (Figure 45). A straight-anvil-type addendum gauge shall be used for external/internal round threads. For internal threads, an external addendum gauge (i.e. preferred) should be used, size permitting.

All thread addendum gauges for round threads shall be equipped with 0.072 in. contact points for 8-round and with 0.057 in. contact points for 10-round. The accuracy of each type of gauge shall be verified by use of setting standards appropriate for the product to be inspected.

The standardization of the gauge shall be verified by placing the gauge on the setting standard with the contact point within the U-notch and contacting the bottom of the notch (see Figure 53). The thumb screw should be loosened, and the dial revolved until the indicator registers the value appropriate to the thread configuration being inspected. The gauge should be rechecked on the setting standard after the dial thumb screw is tightened. Contact point wear should be verified by applying the gauge to the Vee block (see Figure 54). The dial indicator shall read within ±0.0005 in. of the U-notch zero. A contact point not meeting this requirement shall be replaced.

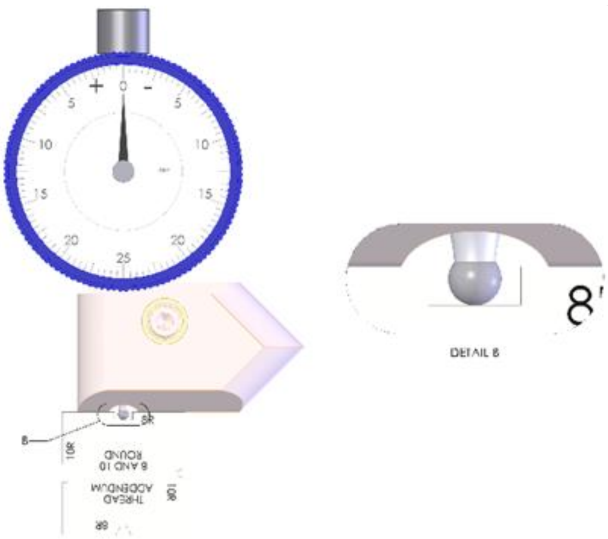


Figure 53—Addendum Gauge (Balanced-type) Applied to Setting Standard–U-notch

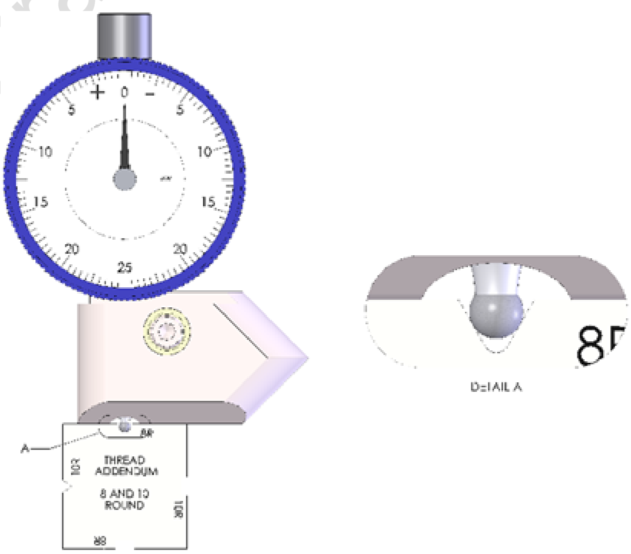


Figure 54—Addendum Gauge (Balanced-type) Applied to Setting Standard–Vee block

12.9.2 Applying the Gauge to the Product

The accuracy of the determination of thread addendum depends on the anvil resting on top of full-crested threads. The first few threads may be slightly truncated. Care shall be taken to make thread addendum measurements at a location that has full-crested threads on both sides of the thread root for the anvil to rest upon.

The last perfect thread location on external threads is L_4–g for tubing and last scratch (last thread groove) -0.625 in. for casing round threads. For casing, the distance from the end of the pipe to the last perfect thread is called the thread element control length, or TECL. The last perfect thread location on internal threads is J+1p, and shall be measured from the physical center of the coupling or from the small end of the box for integral joint tubing.

The contact point of the thread addendum gauge (see Figure 55) shall be placed in the thread groove and anvil of the gauge resting on top of full-crested threads. The anvil shall be held in firm contact with the thread crests. The gauge shall be aligned with the axis of threads by rocking the gauge about the longitudinal axis of the anvil (see Figure 56). The thread addendum is indicated correctly when the dial indicator stops moving near the center of the rocking motion–the null point. The dial indicator reads the error in the thread addendum at the null point.

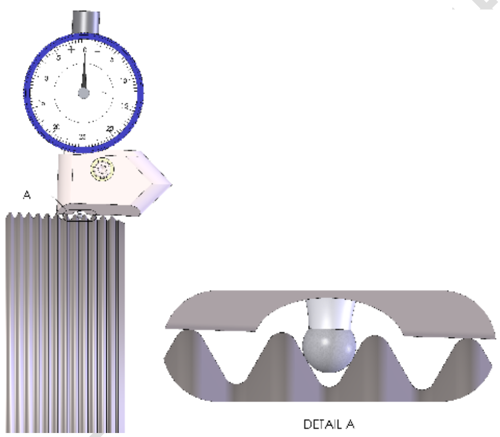


Figure 55—Addendum Gauge Applied to Product

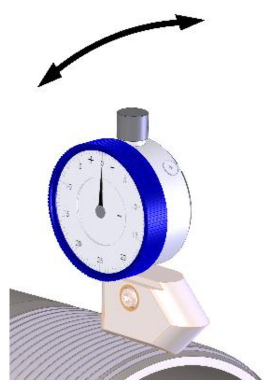


Figure 56—Addendum Gauge Applied to Product and Rotated

Verification of thread addendum should be performed at the first and last full-crested threads within the perfect threads and at intervals as specified in 12.2 (Figure 22). For inspection purposes, the coupling full-crested threads extend from the first perfect thread to the J+1p thread length (fifth threads and sixth threads from coupling center; Figure 21). The anvil of the thread addendum gauge shall be placed firmly to the full-crested threads. Caution should be used when attempting to obtain accurate addendum measurements of the first and last perfect threads since the anvil may rest on non-full-crested threads.

12.10 Angle and Thread Form Measurement

12.10.1 General

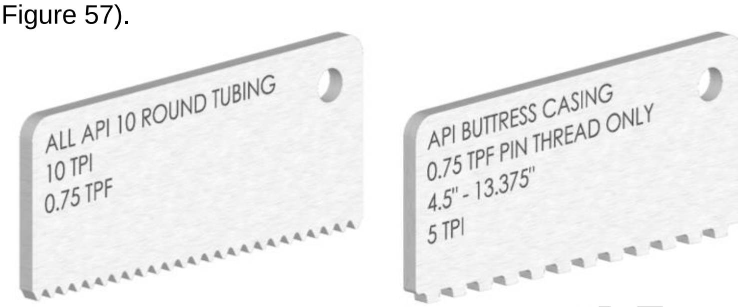
The following criteria are applicable to thread angle and form.

— For 60° threads, the flank angles are half angles of the thread and therefore equal.

— For buttress threads, the stab flanks are 10° and the load flanks are 3°.

— The form of thread is the thread profile along the thread axis for a length of one pitch.

Thread profile templates can be used as reference to check threads but are not used for actual measurements (see Figure 57).



(a) **(b)**

Figure 57—Examples of Thread Profile Templates

12.10.2 Angle and Form Measurement (Profile Projector or Equivalent)

Thread form shall be assessed with an optical comparator/profile projector or equivalent form assessment device. A thread form master overlay, physical or digital, of known accuracy shall be used. Thread angles shall be measured with an optical comparator/profile projector or equivalent precision angle measuring device. Equivalent methods may include (but are not limited to) threads that are measured with a laser measurement system with demonstrated accuracy, optical measurement system with demonstrated accuracy, or a properly calibrated precision thread contour measuring machine (see Figure 58).

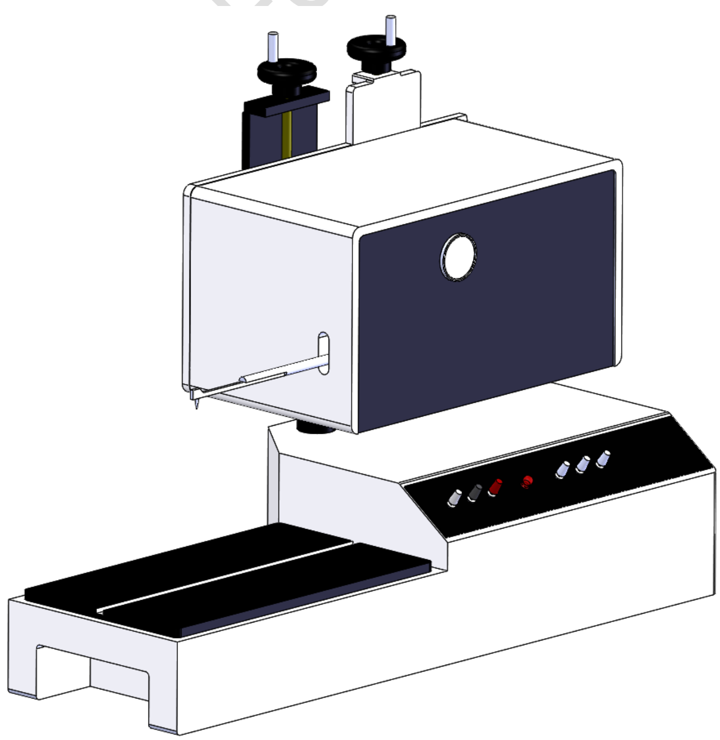


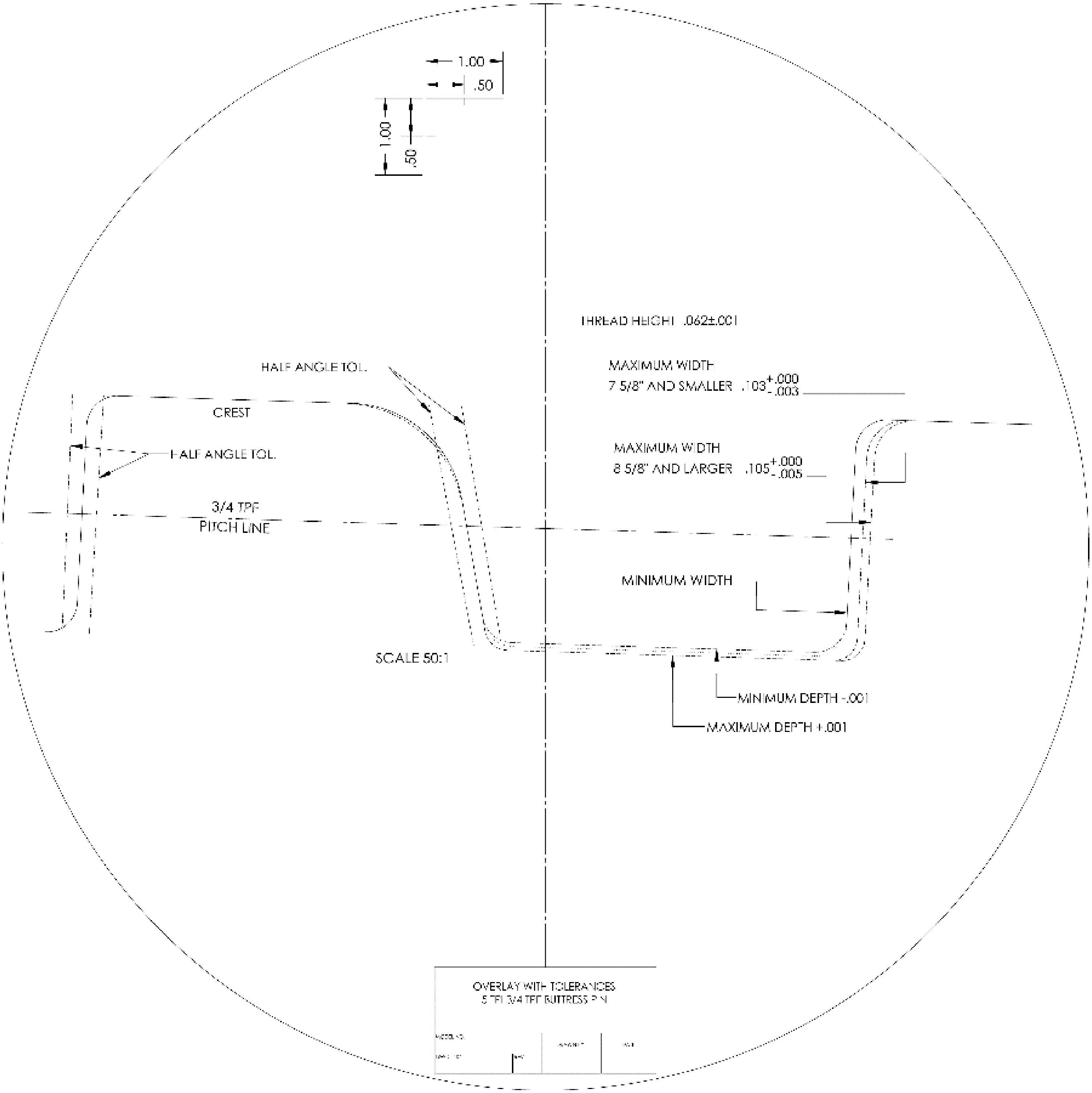
Figure 58—Example of Contour Tracer

12.10.3 Optical Comparator/Profile Tracer/Equivalent Technologies

The angles of the thread shall be verified and assured that the complete thread form is within tolerance by a product overlay, or reference standard.

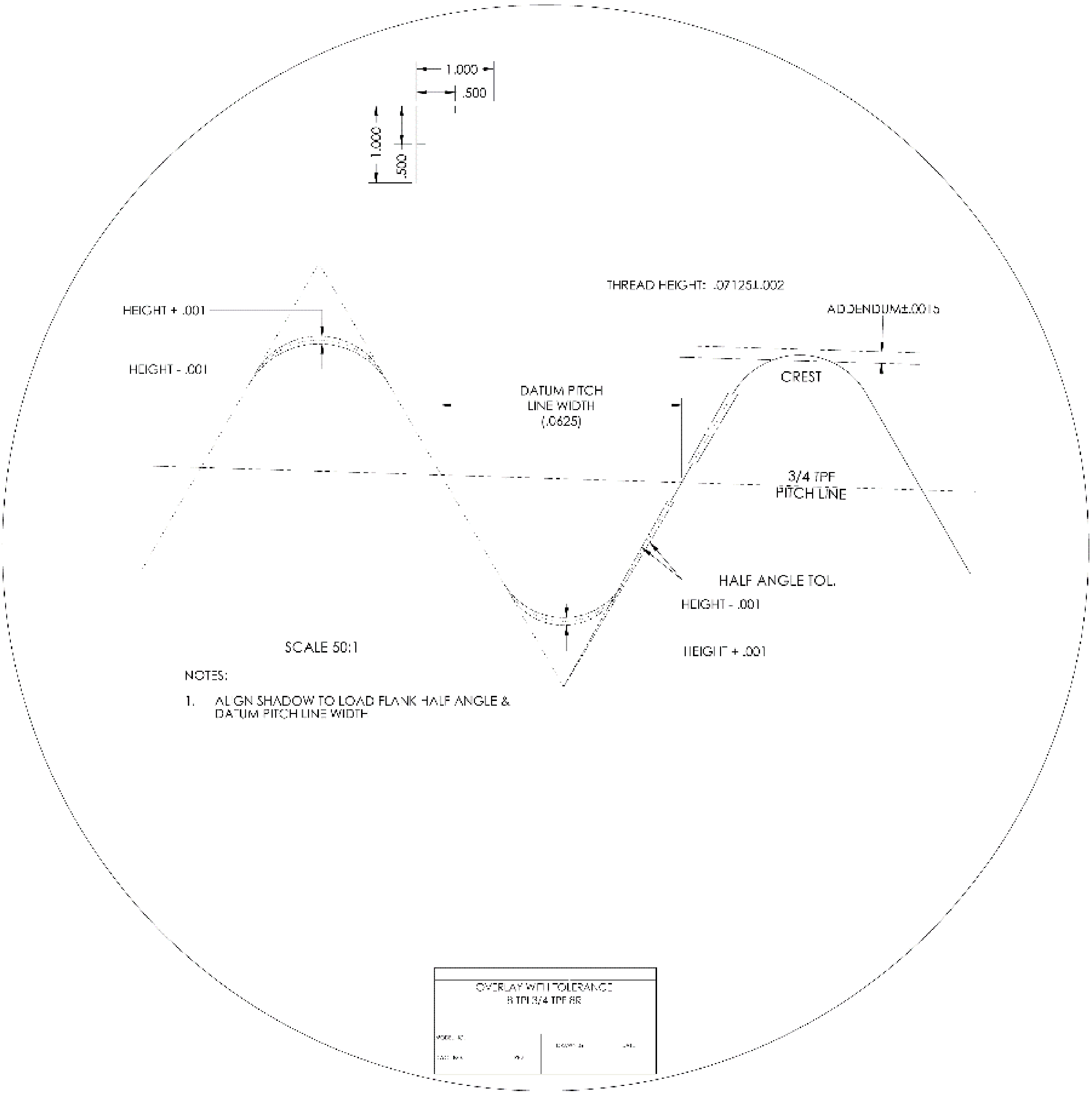
When using the optical comparator or profile tracer, the projection or tracing of the full form threads shall be compared to the product overlay. All radii, thread height, thread widths, and flank angles shall touch in any manner or be within the tolerance lines for the external and internal threads. Refer to B.6 and B.7 for information and guidance on using product overlays, and the examples in Figure 59.

When using other measurement technologies, the manufacturer recommendations shall be referenced.



(a)

Figure 59—Examples of Product Thread Form Overlays with Tolerance Bands



(b)

Figure 59—Examples of Product Thread Form Overlays with Tolerance Bands

12.10.4 Thread Contour Microscope

Thread forms and angles can be examined by the thread contour microscope. These microscopes are manufactured by several companies with each style having a different configuration and operation. Therefore, no attempt is made here to describe the operation of the microscope. Instead, refer to the manufacturer’s supplied instructions.

The thread contour microscope shall be used to examine flank angles or thread forms of external thread. The microscope shall be fitted to the thread in accordance with the manufacturer’s instructions, a thread form template shall be installed and adjusted to conform to the thread being inspected, and any error is then read on the scale provided. To use the microscope for internal threads, the threads shall be replicated (e.g. using material such as plaster of paris, etc.) and then viewed in the microscope as a negative image of the product thread.

12.11 Buttress Tooth Thickness/Width Gauge

12.11.1 General

A buttress tooth thickness/width gauge is used for checking the actual tooth thickness (amount of shave) of both external and internal buttress casing threads near the pitch line. The contact points on gauges having anvils contacting the thread crests (see Figure 60) shall be 0.087 in. diameter (truncated 0.023 in.) and gauges using contact points that touch the root (see Figure 61) shall have 0.062 in. contact points.

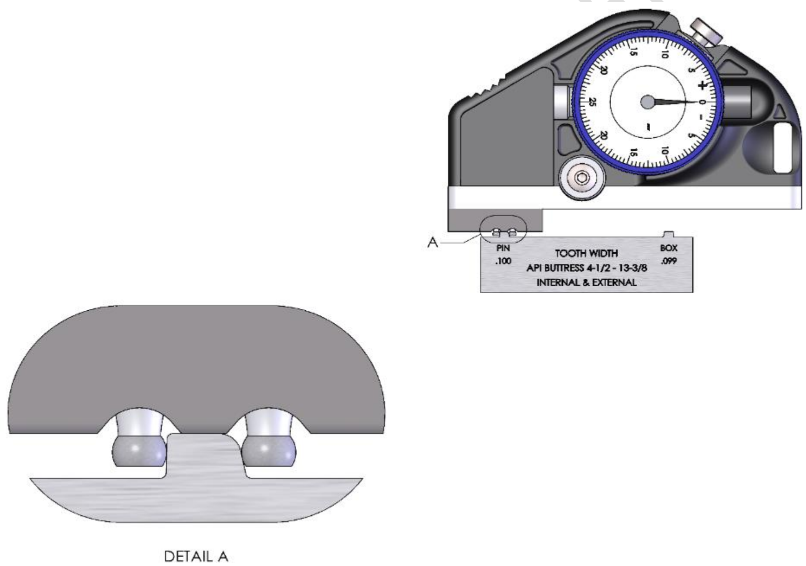


Figure 60—Buttress Tooth Thickness/Width Gauge (Measured from Thread Crest)

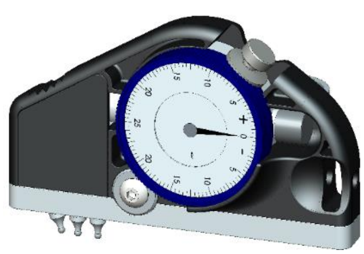
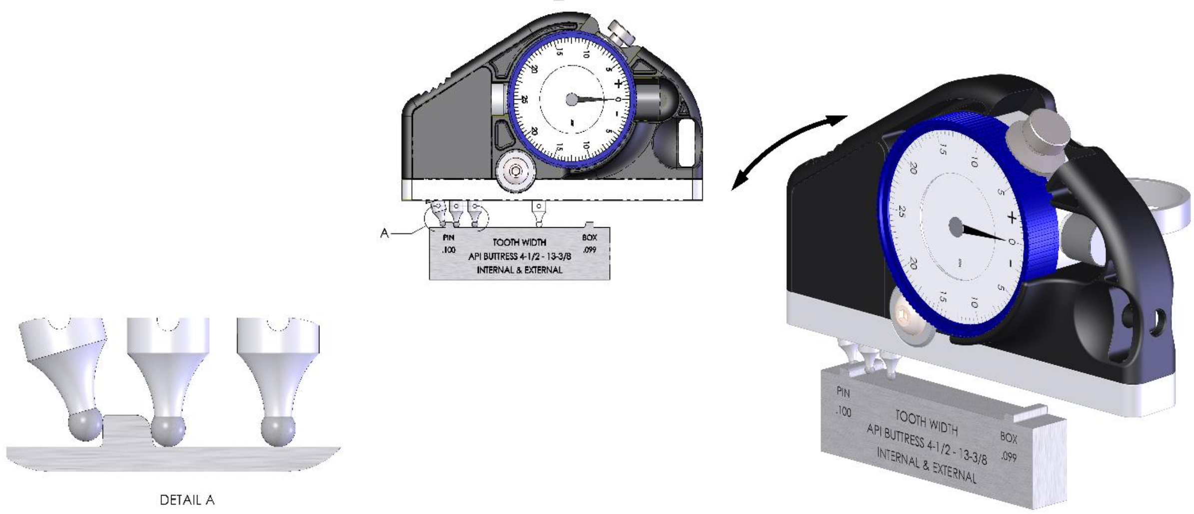


Figure 61—Buttress Tooth Thickness/Width Gauge (Measured from Thread Root)

Before use, the dial indicator shall be adjusted to zero using a setting standard (Figure 61 and 62). The gauge contact points shall be placed over the thread tooth on the setting standard and aligned with the setting standard axis. For gauges with three contact points, the third contact point shall also be resting on the standard. The gauge should be pivoted in a small arc about the fixed contact point on either side of the tooth to determine the null point. The indicator shall be set to zero at the null point. The gauge should be removed from the standard and reapplied to confirm correctness of the adjustment.

The tolerance in the *Buttress Casing Thread Dimension Table* in API 5B shall apply when using a 0.100 in. tooth standard for both the external and internal threads. The box tooth width is 0.099 in. so when set on the 0.100 in. standard and applied to the box thread the gauge reads minus 0.001 in. The tolerances in the buttress figures are applied minus 0.001 in. starting point for internal threads to calculate the tolerances in the API 5B. If the setting standard used to adjust for internal threads is 0.099 in., the tolerances in the buttress casing thread form and dimension figures in API 5B apply without adjustment. Other tooth width setting standards may be used; however, acceptable readings shall be adjusted accordingly.

Figure 61—Example of Root Tooth Thickness Standards



(a) **(b)**

Figure 62—Setting Single Dial Buttress Form Gauge and Standards

12.11.2 Procedure

After the gauge is properly verified against the setting standard, the contact points of the gauge shall be placed over a full-crested thread within the perfect thread length. With the gauge properly applied, the gauge shall be pivoted on a fixed contact through a small arc (see Figures 63 to 65). The null point shall be taken as the reading. Refer to B.4 for guidance on measuring tooth thickness.

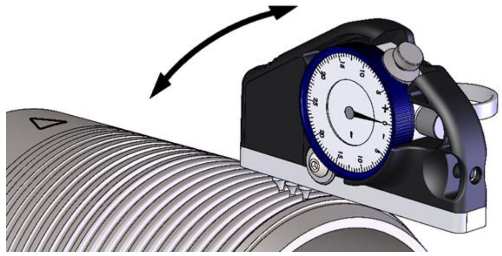
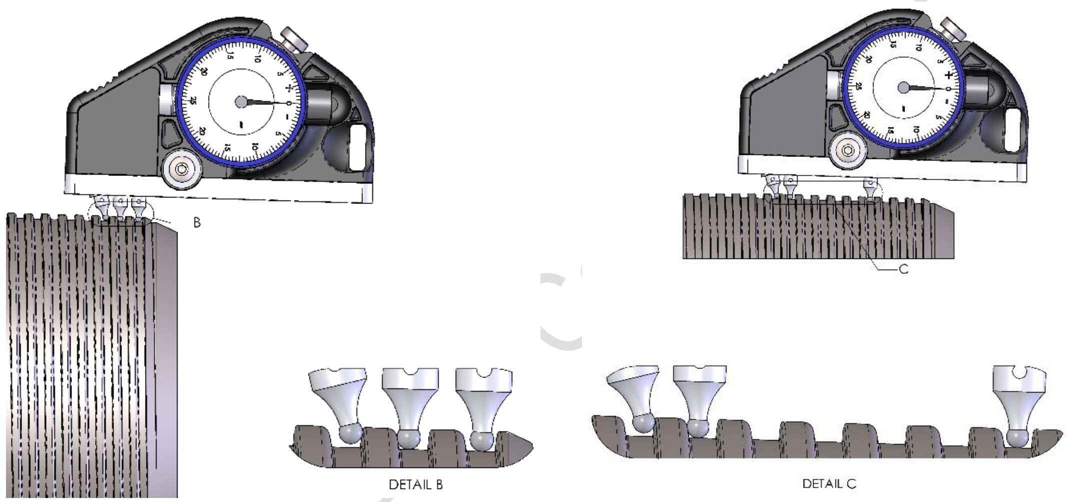
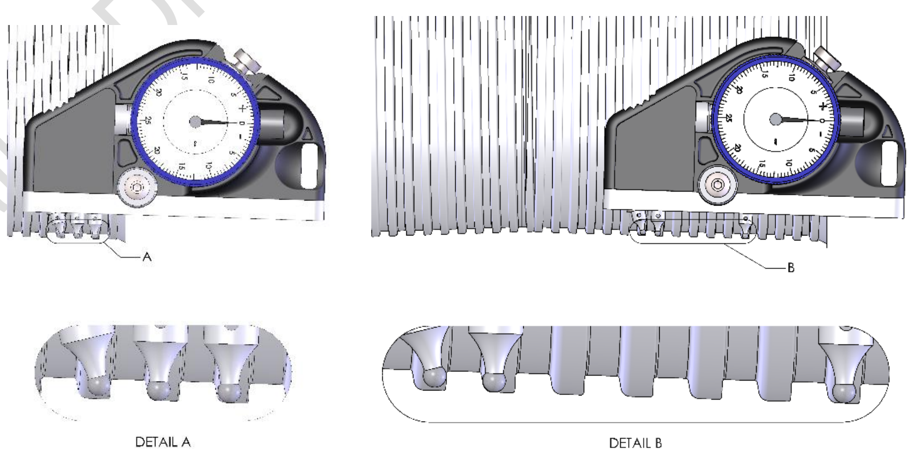


Figure 63—Tooth Thickness Measurement on External Product



Short Spacing (a) **Long Spacing (b)**

Figure 64—Example Tooth Thickness Measurement on Product–Short and Long Spaced



Short Spacing (a) **Long Spacing (b)**

Figure 65—Tooth Thickness Measurement on Internal Product–Short and Long Spaced

12.11.3 Buttress Groove Width Gauge

Conformance of external and internal thread widths may be verified using buttress groove width gauge (Go-No-Go gauge; see Figures 66 to 68). The No-Go end of the gauge shall be inserted into a full-depth thread groove on the longitudinal inspection line; contact between the gauge and the thread root bottom shall not occur. The Go-end of the gauge shall be inserted into the full-depth thread groove on the longitudinal inspection line; contact between the gauge and the thread root bottom shall occur.

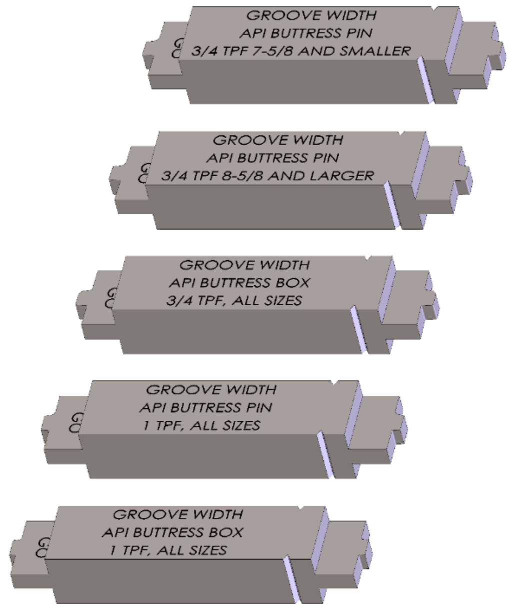


Figure 66—Examples of Groove Width Go/No-Go Gauges

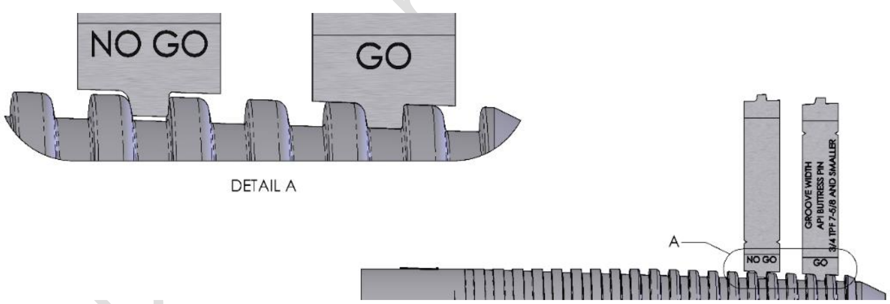


Figure 67—Go/No-Go Gauges Applied to External Product

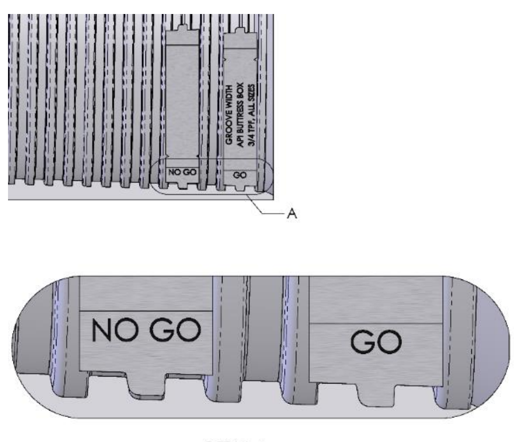


Figure 68—Go/No-Go Gauges Applied to Internal Product

12.12 Coupling Thread Alignment

A coupling's thread alignment shall be measured from the angular deviation of one or both coupling-thread cones to each other.

The intent of the coupling alignment gauge is to quantify the amount of misalignment between the two threaded cones of a coupling (see Figure 69). The contact sizes shall be appropriately selected to ride on the pitch line of the thread. See API 5B for correct contact size for each product. Line pipe, round thread casing and tubing shall be the same as those as shown for the lead gauge in Table 2. Ball point diameter of 0.100 in. truncated 0.030 in. shall be used for buttress casing threads. The more severe the misalignment, the further the thread axis of each crest cone will be out of parallel.

The difference in spacing of the fixed and moveable points on the gauge shall be measured by moving the gauge around a complete arc along the thread helix. For easier operation of the ball contact-style coupling alignment gauge, a cradle with rollers can be used to hold the gauge in-place and rotate the coupling while observing the total indicator reading on the dial. After obtaining this linear differential around the coupling, see B.6.2 which contains a chart (Tables B.2 thru B.6) to correlate maximum sweep values to permissible angular misalignment using the equations as defined in API 5B. Also refer to B.6.3 for alternative method for checking coupling alignment on couplings that have been faced and threaded in the same chucking.

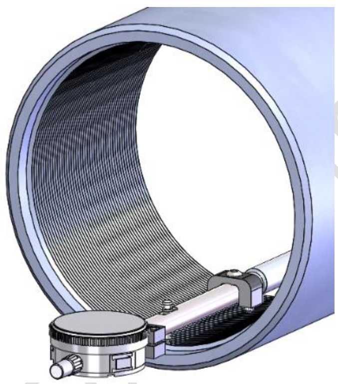


Figure 69—Example of Angular Misalignment Gauge on Product

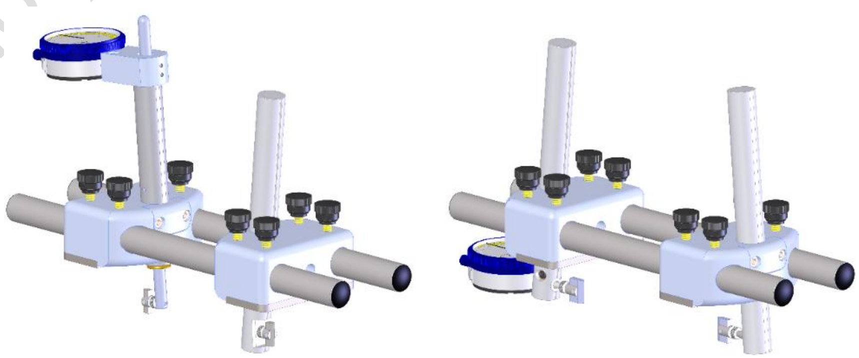
12.13 Crest Diameter

12.13.1 General

The major diameter of an external thread or the minor diameter of an internal thread.

12.13.2 Thread Crest Diameter Gauge Requirements

Thread diameter gauges may be of a particular type (mechanical, dial indicator, optical, laser, or equivalent) that are capable of thread crest diameter measurements or thread pitch diameter measurements with a demonstrated measurement precision of 0.001 in. or better (see Figure 70).



(a) **(b)**

Figure 70—Examples of Crest Diameter and Thread Ovality Gauges

12.13.3 Setting the gauge

The thread crest diameter gauge shall be set-up and standardized properly for the appropriate thread size and type, based on requirements in API 5B (L_{10}, C_{10}, M_{12} and C_{12}), compensated for gauge and standard design configuration (Annex B.5.4). Refer to Figures 71 to 73.

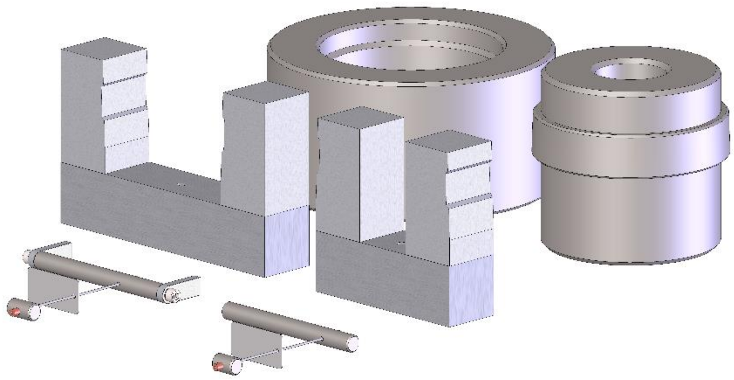
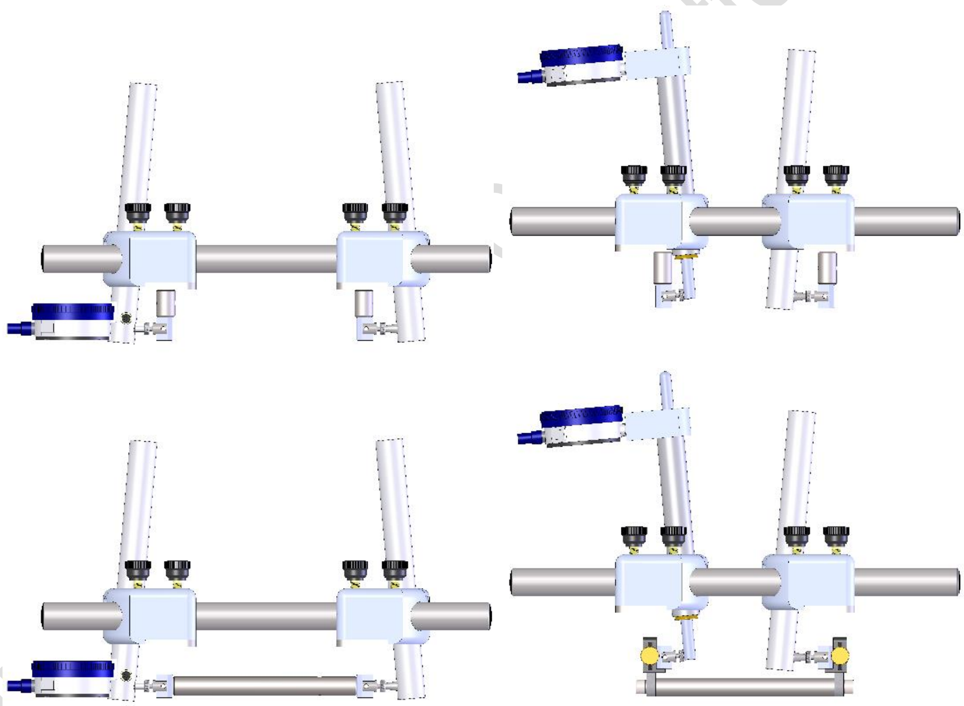


Figure 71—Examples of Internal and External Setting Standards



(a) **(b)**

Figure 72— Setting Crest Diameter Gauges on Rod-style Standards

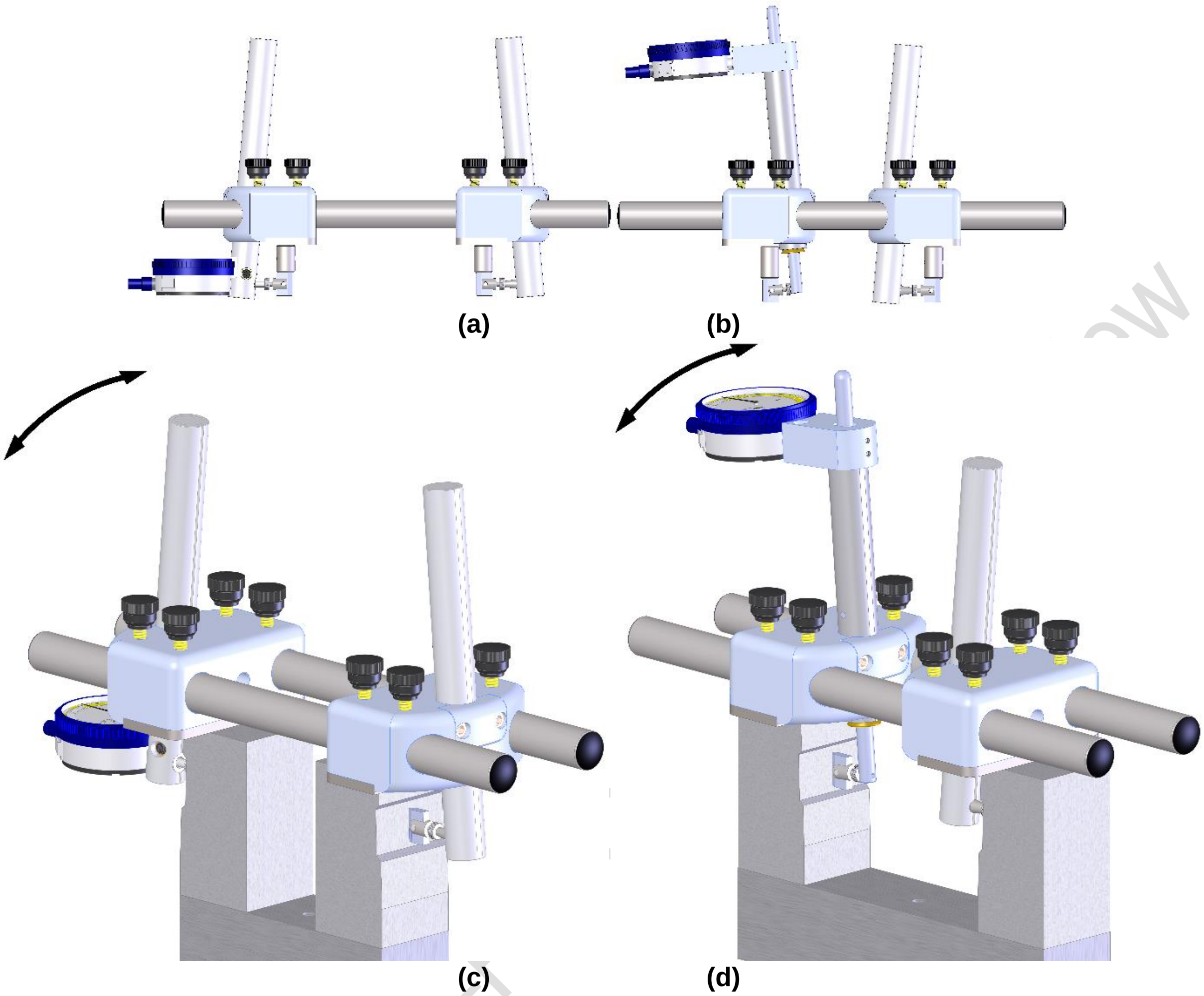


Figure 73—Setting Crest Diameter Gauges on Frame-style Standards

12.14 Thread Crest Diameter and Thread Ovality Measurement

When applying the gauge, the contact pads shall be in contact with the end of the product and the contact shoes diametrically opposing on the thread cone. The moveable contact shoe shall be oscillated through the maximum needle deflection, while holding the fixed contact shoe in a stationary position. The null point shall be taken as the reading. The indication reading may be positive (+) or negative (-) in relation to the "0" point. The correct portion of the dial face shall be used (internal or external) depending on the connection being measured. The revolution indicator shall read the same value as when it was standardized. The measurements shall be repeated in close intervals 180° around the circumference of the part to obtain the maximum and minimum readings (Figures 74 and 75). The average crest diameter and the ovality shall be determined using Equation (2) and Equation (3) and calculation examples below, respectively. Maximum ovality shall not exceed requirements in Table A.8.

$$\text{Average crest diameter (C.D.)} = (\text{maximum reading} + \text{minimum reading}) / 2 \qquad (2)$$

$$\text{Ovality} = \text{maximum reading} - \text{minimum reading} \qquad (3)$$

Example 1—Thread Crest Diameter Average (Equation 2)

NOTEThread crest diameter is the crest cone's average diameter at a given distance from the pipe's end.

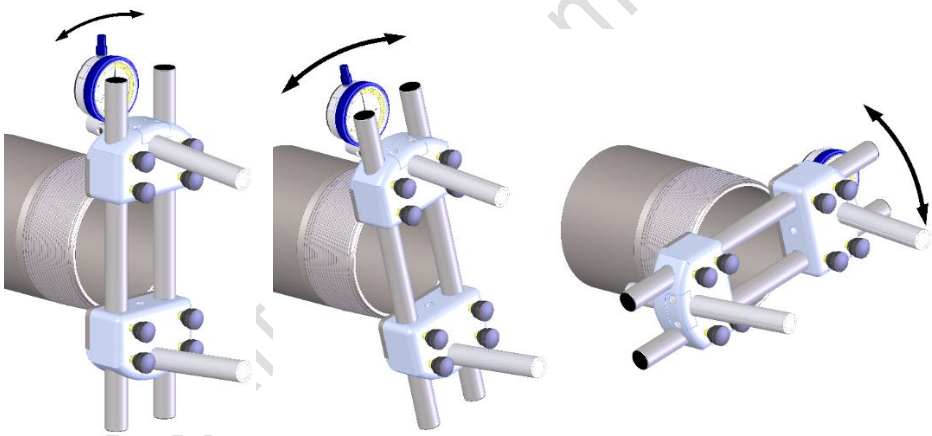
Actual Readings		Calculation	Next Step	Average C.D. Calculation Results (in.)
Plus (+)	Plus (+)	Add	Divide (÷) by 2	(+0.002) + (+0.004) = +0.006 / 2 = +0.003
Minus (-)	Minus (-)	Add	Divide (÷) by 2	(-0.002) + (-0.004) = -0.006 / 2 = -0.003
Minus (-)	Plus (+)	Subtract	Divide (÷) by 2	(+0.002) + (-0.004) = -0.002 / 2 = -0.001
Plus (+)	Minus (-)	Subtract	Divide (÷) by 2	(-0.002) + (+0.004) = +0.002 / 2 = +0.001

Example 2—Thread Ovality (Equation 3)

NOTE 1 Thread ovality is the difference between the largest and smallest crest diameter measurements.

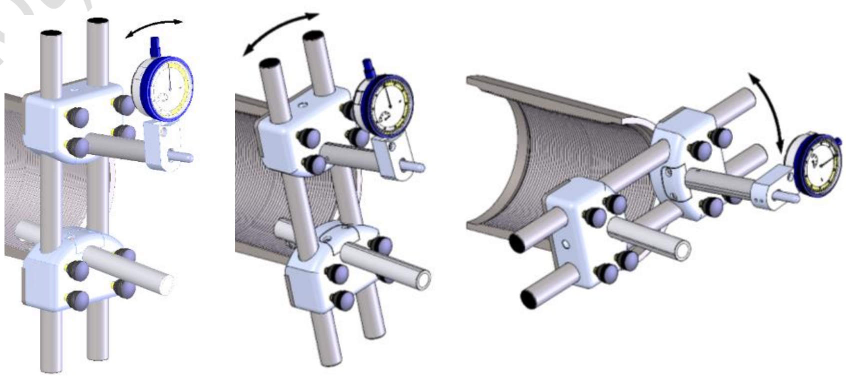
NOTE 2 The sum of the thread ovality is not intended to display a plus (+) or minus (-) symbol.

Actual Readings		Calculation	Ovality Calculation Results (in.)
Plus (+)	Plus (+)	Subtract	(+0.002) – (+0.004) = 0.002
Minus (-)	Minus (-)	Subtract	(-0.002) – (-0.004) = 0.002
Plus (+)	Minus (-)	Add	(+0.002) + (-0.004) = 0.006
Minus (-)	Plus (+)	Add	(-0.002) + (+0.004) = 0.006



(a) (b) (c)

Figure 74—Application of Thread Crest Diameter Gauges on External Product



(a) (b) (c)

Figure 75—Application of Thread Crest Diameter Gauges on Internal Product

12.15 Standoff

12.15.1 General

Standoff shall be measured as the axial distance between the end of the external thread or internal thread and the standoff position to the ring or plug gauge (see Figure 76). There are two levels of ring and plug gauges used for measuring standoff: working gauges and certified master gauges. Working gauges are applied to the piece being inspected; certified master gauges are used to verify the accuracy of the working gauges (certified as specified in API 5B). Inspection is generally made using a working gauge unless a dispute arises; at which time the certified master gauge may be used to resolve the dispute.

The use of master gauges in checking product threads should be minimized. Such use should be confined to cases of dispute which cannot be settled by rechecking the working gauge against the master. Good care should be exercised when the master size gauge is assembled on a product thread.

Ring gauges for 8-round threads are made to verify standoff of short-thread; however, additional step-type rings are available to verify long-thread standoff. If step-type rings are not available, measurement compensation can be made. To verify long-thread standoff without step-type rings, refer to Table A.9.

Plug gauges for 8-round threads are made to verify standoff on both short- and long-thread without compensation.

(a) (b) (c)

Figure 76—Examples of Standoff Measurement Using Various Depth Micrometers

12.15.2 External Threads—Ring Gauge

The ring gauge shall be used by screwing the ring gauge hand-tight onto the external thread to be inspected. In the final tightening, the gauge should be screwed onto the external thread (by one person) with a slow steady pull until it stops advancing, no additional force shall be used. A short casing thread gauge may be used to inspect a casing long thread; however, the external thread will extend beyond the gauge point; then, tolerance shall be measured from this new gauge point.

To obtain correct standoff on sizes 16 in. and larger buttress casing thread gauges, the gauges should be advanced axially with back pressure in direction of arrows so that all clearance is removed between the load flanks of threads.

Standoff adjustments shall be made based on ovality by Equation (4), according to API 5B; see Table A.10.

$$\text{Maximum SO} = \text{standoff tolerance} + [\text{OV} / (\text{taper} \times 2)] \tag{4}$$

where

OV is thread ovality as measured out of the machine in inches;

SO is maximum allowable standoff as measured out of the machine and includes standoff tolerance plus standoff due to the effect of thread ovality (in.);

standoff tolerance is from API 5B; and

taper is the specified thread taper (in./in.).

The thread standoff is increased due to the thread ovality. This is shown in Table A.10.

NOTE Minimum standoff values are unaffected.

To use of a short-casing thread ring gauge on a long thread, the distance the pin extends beyond the gauge end shall be determined. To use flush gauges and template-type gauges, a steel scale, calipers, or templates on which the extensions and +/- tolerances are marked shall be used. Step gauges are provided with two sets of tolerance steps: one for long thread inspection and another for short thread inspection.

The distance the long pin extends beyond the short ring gauge shall be determined from Equation (5):

$$\text{Distance} = L_1\ (\text{long}) - L_1\ (\text{short}) - P_1 \quad (5)$$

where

L_1 (long) is the length from the end of long pin to the hand-tight plane

L_1 (short) is the length from the end of the short pin to the hand-tight plane

P_1 is the standoff between the short working ring gauge and certified master plug gauge (see Figure 79)

Values of (L_1 (long) – L_1 (short)) have been determined and tabulated in Table A.9; this table is intended to provide users with the information necessary to gauge all available casing pipe with round threads using the working ring gauge defined within API 5B. It may be preferable to use gauges designed specifically for their application such as LTC, but not required.

EXAMPLE

Accurate inspection may be affected by any thread finish other than as machined. Some ring gauges are flush-type where the end of the external thread is flush with the end of the gauge when the thread size is at zero tolerance (see Figure 77). Other ring gauges are fitted with step plates extending beyond the gauge proper. The zero tolerance is equivalent to the end of the pipe being flush with the middle step (see Figure 78). The first step on either side of the middle step represents the tolerance. Old-style ring gauges were provided with a template. The template was marked with zero and the plus and minus tolerances (see Figure 79).

Figure 77—Flush-type Ring Gauge

Figure 78—Ring Gauge with Step Plate

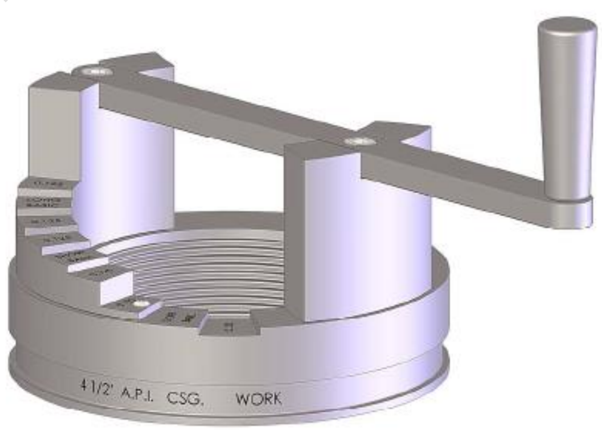
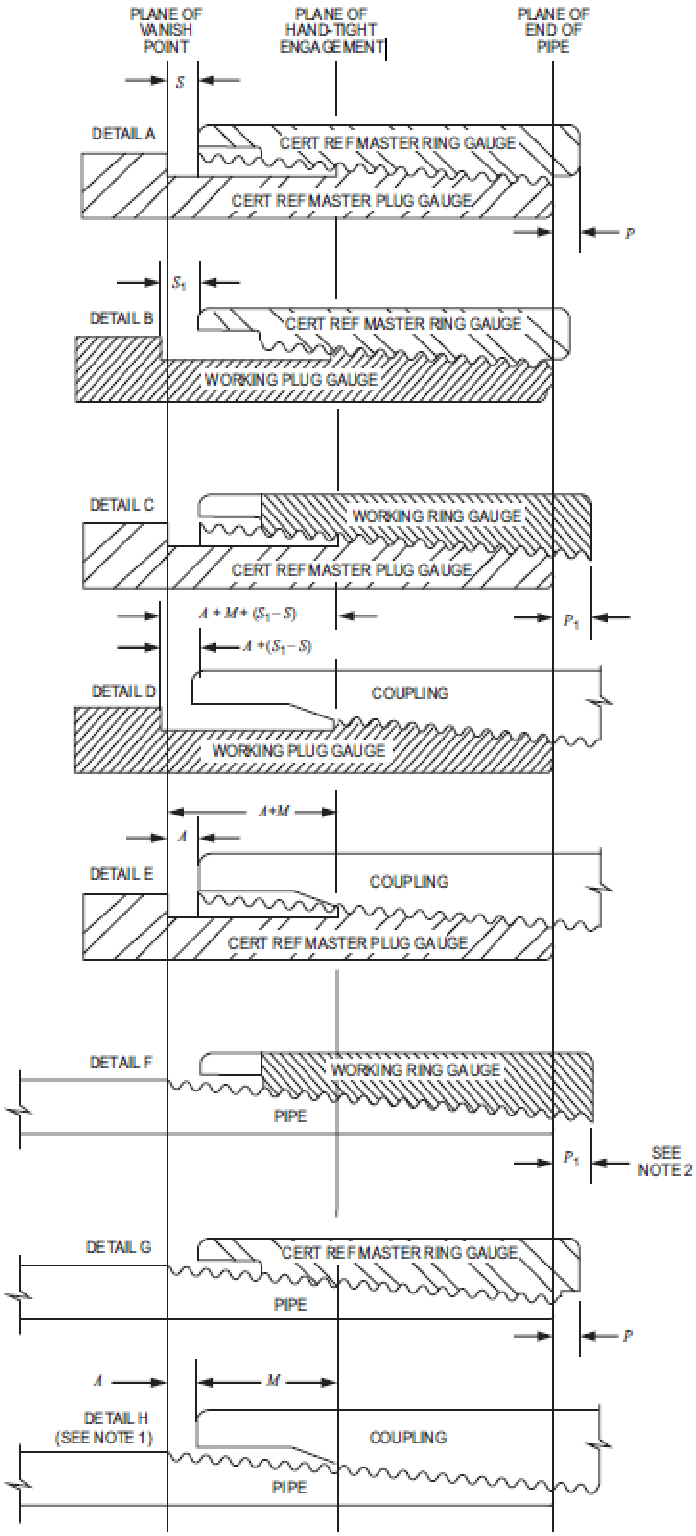


Figure 79—Step-type Ring Gauge



NOTE 1 Detail H is a nominal design illustration and the tolerances given in *Standoff Tolerances Table* of API 5B are not applicable to the standoff of coupling on pipe.

NOTE 2 When checking long thread casing with short thread ring gauges, the end of the pipe will extend beyond the small end of the ring gauge by an amount equal to ($L_{1\ long}$ - $L_{1\ short}$) - P_1.

Figure 80—Standoff of Master Gauge, Working Gauge and Pipe and Coupling

12.15.3 Internal Threads—Plug Gauge

When a seal-ring groove has been cut in a coupling, accurate gauging may not be possible because of interference from the yielded featheredge fade-out where the threads enter and leave the seal-ring groove. Plug gauge readings can be taken before cutting the seal-ring or after removing the yielded featheredge fade-out. The method used to remove the featheredge fade-out shall not damage the remaining threads. Accurate inspection may be affected by any thread finish other than as machined.

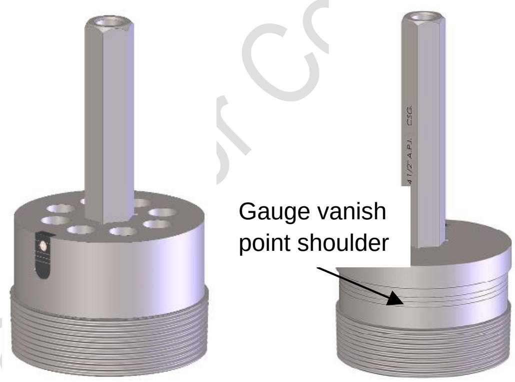
Standoff adjustments are allowed based on ovality; refer to Table A.11.

EXAMPLE—The plug gauge is used by screwing the plug gauge hand-tight into the internal thread to be inspected. In the final tightening, the gauge is screwed into the internal thread (preferably by one person) with a slow steady pull until it stops advancing, no additional force is to be used.

To obtain correct standoff on sizes ≥ 16 in. buttress casing thread gauges, the gauges should be advanced axially with back pressure in direction of arrows to remove all clearance between the load flanks of threads.

As described below, plug gauges are commonly made in two styles: insert lines and shoulder type.

- The insert lines-style gauges are provided with an insert containing three lines representing the tolerance and the basic size and a fourth line representing the vanish point (see Figure 81).
- The shoulder-type gauge may be provided with three lines where the middle represents the basic size; the tolerance lines are indicated from the middle line by lines ahead and behind the basic line (see Figure 81). Shoulder style gauges without standoff lines can be used to inspect standoff by measuring from the gauge vanish point shoulder to the coupling face using a scale or caliper, or by using a standoff template from the back shoulder of the plug to the coupling face (see Figure 82).



Insert-style (a) **Shoulder-style (b)**

Figure 81—Insert and Shoulder Style Standoff Plug Gauges

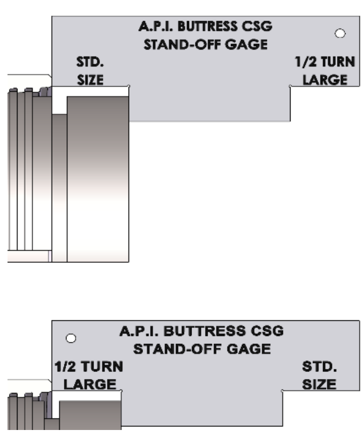


Figure 82—Template-style Plug Gauge

12.16 Coupling Power-tight Make-up Position

12.16.1 General

The purpose of this measurement is to detect if couplings have been properly made-up power-tight to the correct position. In addition, the verification can identify other errors, including:

— make-up of LC coupling onto SC pin,

— make-up of SC coupling onto LC pin, and

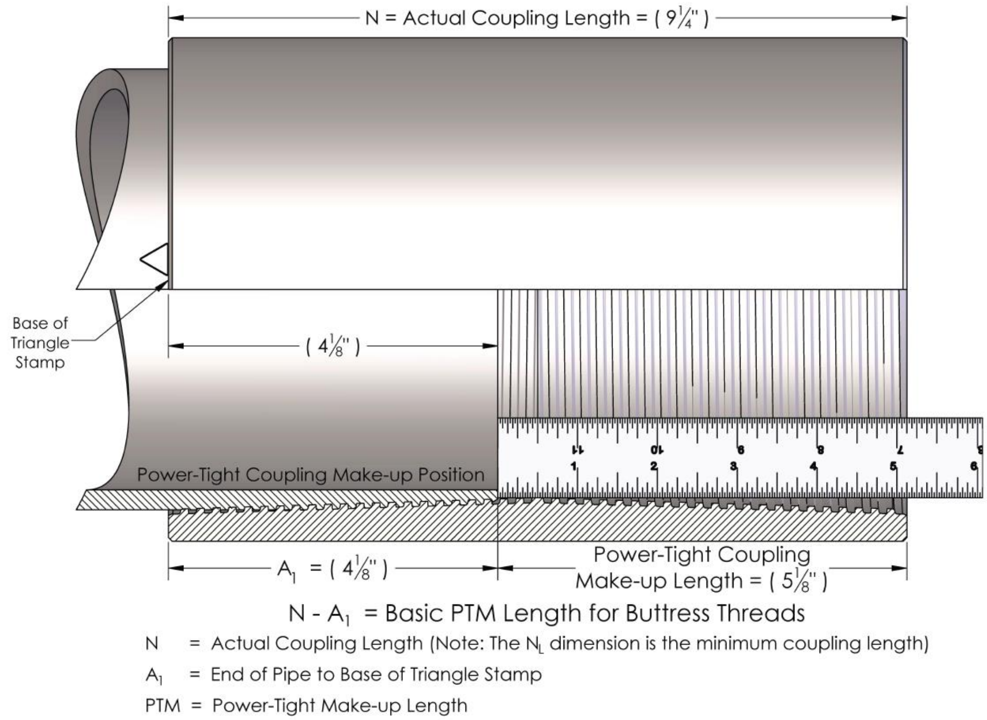
— possible improper make-up.

12.16.2 Buttress Thread

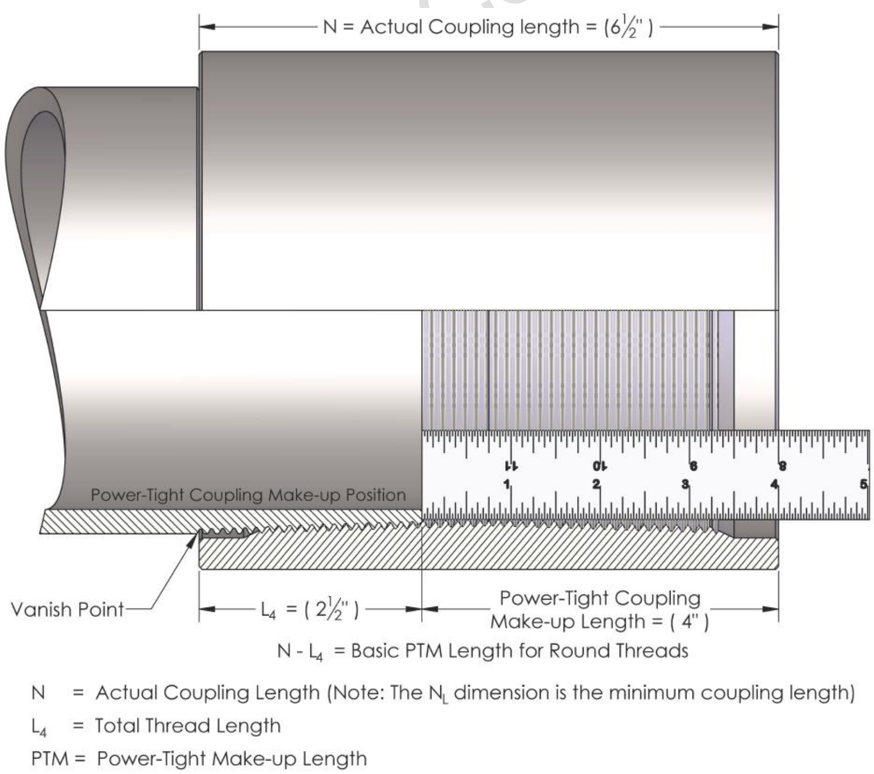
The distance $N - A_1$ shall be determined, where N is the actual measured coupling length. This is the nominal position of the end of the pin in the coupling. This distance ($N - A_1$) should be within 1-turn short of the base of the triangle stamp and the apex of the triangle stamp. Measure the distance from the end of the coupling to the end of the pin inside the coupling. If the measured distance is outside of API 5B tolerances, the connection shall be rejected. Figure 83 shows an example where the coupling length is equal to the minimum (NL) and the pin is made-up exactly to the base of the triangle. The coupling length and final position will vary in field conditions.

12.16.3 Round Thread

For all sizes, the distance $N - L_4$ shall be determined, where N is the actual measured coupling length. The distance from the end of the coupling to the end of the pin inside the coupling shall be measured. This is the nominal position of the end of the pin in the coupling. Although the powertight position is not defined in API 5B, it has been an industry practice to accept ± 2-turns or ± 3-turns from the nominal powertight position $= L_1 + M + (A \times P)$, respectively, for 8-round and 10-round connections. Therefore, if the measured distance is different from the nominal distance by more than $\pm 2P$ for 8-round and $\pm 3P$ for 10-round, the condition should be reported for disposition. Figure 83 shows an example where the coupling length is equal to the minimum (NL) and the pin is made-up exactly to the vanish point. The coupling length and final position will vary in field conditions.



Buttress Casing (BC) 5 ½ in.
(a)



Short-threaded Casing (SC) 5 in. 11.50 lb/ft
(b)

Figure 83—Examples of Coupling Power-tight Make-up Position Measurement

Annex A
(normative)

Thread Dimensional Data Tables

Table A.1—Casing Short Thread Dimensions

1	2	3	4	5	6	7
OD Size	Nominal Weight	Total Thread Length	Min. Length Full-Crest Thread	Min. Coupling Length	J Dimension	Box
		L_4	L_c	NL [a]		PTL
in.	lbs/ft	in.	in.	in.	in.	in.
4 1/2	9.5	2.000	0.875	6 1/4	1.125	2.500
4 1/2	Others	2.625	1.500	6 1/4	0.500	2.500
5	11.5	2.500	1.375	6 1/2	0.750	2.625
5	Others	2.750	1.625	6 1/2	0.500	2.625
5 1/2	All	2.875	1.750	6 3/4	0.500	2.750
6 5/8	All	3.125	2.000	7 1/4	0.500	3.000
7	17	2.375	1.250	7 1/4	1.250	3.000
7	Others	3.125	2.000	7 1/4	0.500	3.000
7 5/8	All	3.250	2.125	7 1/2	0.500	3.125
8 5/8	24	3.000	1.875	7 3/4	0.875	3.250
8 5/8	Others	3.375	2.250	7 3/4	0.500	3.250
9 5/8	All	3.375	2.250	7 3/4	0.500	3.250
10 3/4	32.75	2.750	1.625	8	1.250	3.375
10 3/4	Others	3.500	2.375	8	0.500	3.375
11 3/4	All	3.500	2.375	8	0.500	3.375
13 3/8	All	3.500	2.375	8	0.500	3.375
16	All	4.000	2.875	9	0.500	3.875
18 5/8	87.5	4.000	2.875	9	0.500	3.875
20	All	4.000	2.875	9	0.500	3.875

[a] Refer to API 5CT for casing and tubing.

Table A.2—Casing Long Thread Dimensions

1	2	3	4	5	6
OD Size	Total Thread Length	Minimum Length Full-Crest Thread	Minimum Coupling Length	J Dimension	Box
	L_4	L_c	NL [a]		PTL
in.	in.	in.	in.	in.	in.
4 1/2	3.000	1.875	7	0.500	2.875
5	3.375	2.250	7 3/4	0.500	3.250
5 1/2	3.500	2.375	8	0.500	3.375
6 5/8	3.875	2.750	8 3/4	0.500	3.750
7	4.000	2.875	9	0.500	3.875
7 5/8	4.125	3.000	9 1/4	0.500	4.000
8 5/8	4.500	3.375	10	0.500	4.375
9 5/8	4.750	3.625	10 1/2	0.500	4.625
20	5.250	4.125	11 1/2	0.500	5.125

[a] Refer to API 5CT for casing and tubing.

Table A.3—Non-Upset Thread Dimensions

1	2	3	4	5	6	7
OD Size	Total Thread Length	Minimum Length Full-Crest Thread	Minimum Coupling Length	J Dimension	L_4-g	Box
	L_4	L_c	NL [a]			PTL
in.	in.	in.	in.	in.	in.	in.
1.050	1.094	0.300	3 3/16	0.500	0.594	0.994
1.315	1.125	0.300	3 1/4	0.500	0.625	1.025
1.660	1.250	0.350	3 1/2	0.500	0.750	1.150
1.900	1.375	0.475	3 3/4	0.500	0.875	1.275
2 3/8	1.625	0.725	4 1/4	0.500	1.125	1.525
2 7/8	2.063	1.163	5 1/8	0.500	1.563	1.963
3 1/2	2.313	1.413	5 5/8	0.500	1.813	2.213
4	2.375	1.375	5 3/4	0.500	1.875	2.250
4 1/2	2.563	1.563	6 1/8	0.500	2.063	2.438

[a] Refer to API 5CT for casing and tubing.

Table A.4—External Upset Thread Dimensions

1	2	3	4	5	6	7
OD Size	Total Thread Length	Minimum Length Full-Crest Thread	Minimum Coupling Length	J Dimension	L_4-g	Box
	L_4	L_c	NL [a]			PTL
in.	in.	in.	in.	in.	in.	in.
1.050	1.125	0.300	3 1/4	0.500	0.625	1.025
1.315	1.250	0.350	3 1/2	0.500	0.750	1.150
1.660	1.375	0.475	3 3/4	0.500	0.875	1.275
1.900	1.438	0.538	3 7/8	0.500	0.938	1.338
2 3/8	1.938	0.938	4 7/8	0.500	1.438	1.813
2 7/8	2.125	1.125	5 1/4	0.500	1.625	2.000
3 1/2	2.375	1.375	5 3/4	0.500	1.875	2.250
4	2.500	1.500	6	0.500	2.000	2.375
4 1/2	2.625	1.625	6 1/4	0.500	2.125	2.500

[a] Refer to API 5CT for casing and tubing.

Table A.5—Line Pipe Thread Dimensions

1	2	3	4	5	6	7
Nominal Size	**Threads per inch (TPI)**	**Total Thread Length**	**Minimum Length Full-Crest Thread**	**L_4–g**	**Minimum Coupling Length**	**J Dimension**
		L_4	L_c		**NL**	
in.	**—**	**in.**	**in.**	**in.**	**in.**	**in.**
1/8	27	0.3924	—	—	1 1/16	0.1389
1/4	18	0.5946	—	—	1 5/8	0.2179
3/8	18	0.6006	—	—	1 5/8	0.2119
1/2	14	0.7815	—	—	2 1/8	0.2810
3/4	14	0.7935	—	—	2 1/8	0.2690
1	11 1/2	0.9845	0.3325	0.4845	2 5/8	0.3280
1 1/4	11 1/2	1.0085	0.3565	0.5085	2 3/4	0.3665
1 1/2	11 1/2	1.0252	0.3732	0.5252	2 3/4	0.3498
2	11 1/2	1.0582	0.4062	0.5582	2 7/8	0.3793
2 1/2	8	1.5712	0.6342	1.0712	4 1/8	0.4913
3	8	1.6337	0.6967	1.1337	4 1/4	0.4913
3 1/2	8	1.6837	0.7467	1.1837	4 3/8	0.5038
4	8	1.7337	0.7967	1.2337	4 1/2	0.5163
5	8	1.8400	0.9030	1.3400	4 5/8	0.4725
6	8	1.9462	1.0092	1.4462	4 7/8	0.4913
8	8	2.1462	1.2092	1.6462	5 1/4	0.4788
10	8	2.3587	1.4217	1.8587	5 3/4	0.5163
12	8	2.5587	1.6217	2.0587	6 1/8	0.5038
14 OD	8	2.6837	1.7467	2.1837	6 3/8	0.5038
16 OD	8	2.8837	1.9467	2.3837	6 3/4	0.4913
18 OD	8	3.0837	2.1467	2.5837	7 1/8	0.4788
20 OD	8	3.2837	2.3467	2.7837	7 5/8	0.5288

Table A.6—Buttress Thread Casing Dimensions

1	2	3	4	5	6	7
OD Size	Total Thread Length	Minimum Length Full-Crest Thread	Minimum Length Perfect Threads	Length End of Pipe to Triangle Stamp	Minimum Coupling Length	J Dimension
	L_4	L_c	L_7	A_1	NL	
in.	in.	in.	in.	in.	in.	in.
4 1/2	3.6375	1.2535	1.6535	3 15/16	8 7/8	0.500
5	3.7625	1.3785	1.7785	4 1/16	9 1/8	0.500
5 1/2	3.8250	1.4410	1.8410	4 1/8	9 1/4	0.500
6 5/8	4.0125	1.6285	2.0285	4 5/16	9 5/8	0.500
7	4.2000	1.8160	2.2160	4 1/2	10	0.500
7 5/8	4.3875	2.0035	2.4035	4 11/16	10 3/8	0.500
8 5/8	4.5125	2.1285	2.5285	4 13/16	10 5/8	0.500
9 5/8	4.5125	2.1285	2.5285	4 13/16	10 5/8	0.500
10 3/4	4.5125	2.1285	2.5285	4 13/16	10 5/8	0.500
11 3/4	4.5125	2.1285	2.5285	4 13/16	10 5/8	0.500
13 3/8	4.5125	2.1285	2.5285	4 13/16	10 5/8	0.500
16	4.6125	2.7245	3.1245	4 13/16	10 5/8	0.500
18 5/8	4.6125	2.7245	3.1245	4 13/16	10 5/8	0.500
20	4.6125	2.7245	3.1245	4 13/16	10 5/8	0.500

Table A.7—Integral-Joint Thread Dimensions

1	2	3	4	5	6
OD Size	Total Thread Length	Minimum Length Full-Crest Thread	Minimum Box Length	J Dimension	Box
	L_4	L_c			PTL
in.	in.	in.	in.	in.	in.
1.315	1.125	0.025	1.625	0.500	1.025
1.660	1.250	0.350	1.750	0.500	1.150
1.900	1.375	0.475	1.875	0.500	1.275
2.063	1.438	0.538	1.938	0.500	1.338

Table A.8—Maximum Thread Ovality

1	2	3	4
Pipe OD	**Specified Wall Thickness**	**Ovality Multiplier**	**Max Thread Ovality**
	t	**OM**	
in.	**in.**	**—**	**in.**
2.875	> 0.144	0.003	0.009
	≤ 0.144	0.004	0.012
3.5	> 0.175	0.003	0.011
	≤ 0.175	0.004	0.014
4.5	> 0.225	0.003	0.014
	≤ 0.225	0.004	0.018
5	> 0.250	0.003	0.015
	≤ 0.250	0.004	0.02
5.5	> 0.275	0.003	0.017
	≤ 0.275	0.004	0.022
6.625	> 0.331	0.003	0.02
	≤ 0.331	0.004	0.027
7	> 0.350	0.003	0.021
	≤ 0.350	0.004	0.028
7.625	> 0.381	0.003	0.023
	≤ 0.381	0.004	0.031
8.625	> 0.431	0.003	0.026
	≤ 0.431	0.004	0.035
9.625	> 0.481	0.003	0.029
	≤ 0.481	0.004	0.039
10.75	> 0.538	0.003	0.032
	≤ 0.538	0.004	0.043
11.75	> 0.588	0.003	0.035
	≤ 0.588	0.004	0.047
13.375	> 0.669	0.003	0.04
	≤ 0.669	0.004	0.054
16	> 0.800	0.003	0.048
	≤ 0.800	0.004	0.064
18.625	> 0.931	0.003	0.056
	≤ 0.931	0.004	0.075
20	> 1.000	0.003	0.06
	≤ 1.000	0.004	0.08

Table A.9—Casing Long-thread L_1–Short-thread L_1

1	2	3	4	5	6
Size Designation	**Nominal Weight Thread and Coupling**	**Length: End of Pipe to Hand-Tight Plane**	**Pitch Diameter at Hand-Tight Plane**	**Nominal Ring Gauge Standoff**	**Standoff or Stand-in**
D		***L_1***	***E_1***		
in.	**lb/ft**	**in.**	**in.**	**in.**	**—**
4 1/2	Short 9.50	0.921	4.40337	P_1	—
4 1/2	Short Others	1.546	4.40337	0.625 - P_1	Stand-in
4 1/2	Long	1.921	4.40337	1.000 - P_1	Stand-in
5	Short 11.50	1.421	4.90337	P_1 + 0.250	Standoff
5	Short Others	1.671	4.90337	P1	—
5	Long	2.296	4.90337	0.625 - P_1	Stand-in
5 1/2	Short All	1.796	5.40337	P_1	—
5 1/2	Long	2.421	5.40337	P_1 + 0.625	Stand-in
6 5/8	Short All	2.046	6.52837	P_1	—
6 5/8	Long	2.796	6.52837	0.750 - P_1	Stand-in
7	Short 17.00	1.296	6.90337	P_1 + 0.750	Standoff
7	Short Others	2.046	6.90337	P_1	—
7	Long	2.921	6.90337	0.875 - P_1	Stand-in
7 5/8	Short All	2.104	7.52418	P_1	—
7 5/8	Long	2.979	7.52418	0.875 - P_1	Stand-in
8 5/8	Short 24.00	1.854	8.52418	P_1 + 0.375	Standoff
8 5/8	Short Others	2.229	8.52418	P1	—
8 5/8	Long	3.354	8.52418	1.125 - P_1	Stand-in
9 5/8	Short All	2.229	9.52418	P_1	—
9 5/8	Long	3.604	9.52418	1.375 - P_1	Stand-in
10 3/4	Short 32.75	1.604	10.64918	P_1 + 0.750	Standoff
10 3/4	Short Others	2.354	10.64918	P_1	—
11 3/4	Short All	2.354	11.64918	P_1	—
13 3/8	Short All	2.354	13.27418	P_1	—
16	Short All	2.854	15.89918	P_1	—
18 5/8	Short 87.50	2.854	18.52418	P_1	—
20	Short All	2.854	19.89918	P_1	—
20	Long	4.104	19.89918	1.250 - P_1	Stand-in

Table A.10—Maximum Standoff Allowed for Pins

1	2	3	4
Thread Ovality	**8-round**	**3/4-in. Buttress**	**1-in. Buttress**
in.	**in.**	**in.**	**in.**
0.001	0.133	0.108	0.106
0.002	0.141	0.116	0.112
0.003	0.149	0.124	0.118
0.004	0.157	0.132	0.124
0.005	0.165	0.140	0.130
0.006	0.173	0.148	0.136
0.007	0.181	0.156	0.142
0.008	0.189	0.164	0.148
0.009	0.197	0.172	0.154
0.010	0.205	0.180	0.160
0.011	0.213	0.188	0.166
0.012	0.221	0.196	0.172
0.013	0.229	0.204	0.178
0.014	0.237	0.212	0.184
0.015	0.245	0.220	0.190
0.016	0.253	0.228	0.196
0.017	0.261	0.236	0.202
0.018	0.269	0.244	0.208
0.019	0.277	0.252	0.214
0.020	0.285	0.260	0.220
0.021	0.293	0.268	0.226
0.022	0.301	0.276	0.232
0.023	0.309	0.284	0.238
0.024	0.317	0.292	0.244
0.025	0.325	0.300	0.250
0.026	0.333	0.308	0.256
0.027	0.341	0.316	0.262
0.028	0.349	0.324	0.268
0.029	0.357	0.332	0.274
0.030	0.365	0.340	0.280
0.031	0.373	0.348	0.286
0.032	0.381	0.356	0.292
0.033	0.389	0.364	0.298
0.034	0.397	0.372	0.304
0.035	0.405	0.380	0.310
0.036	0.413	0.388	0.316
0.037	0.421	0.396	0.322
0.038	0.429	0.404	0.328
0.039	0.437	0.412	0.334
0.040	0.445	0.420	0.340

1	2	3	4
Thread Ovality	**8-round**	**$^3/_4$-in. Buttress**	**1-in. Buttress**
in.	**in.**	**in.**	**in.**
0.041	0.453	0.428	0.346
0.042	0.461	0.436	0.352
0.043	0.469	0.444	0.358
0.044	0.477	0.452	0.364
0.045	0.485	0.460	0.370
0.046	0.493	0.468	0.376
0.047	0.501	0.476	0.382
0.048	0.509	0.484	0.388
0.049	0.517	0.492	0.394
0.050	0.525	0.500	0.400
0.051	0.533	0.508	0.406
0.052	0.541	0.516	0.412
0.053	0.549	0.524	0.418
0.054	0.557	0.532	0.424
0.055	0.565	refer to 1 in. taper	0.430
0.056	0.573	refer to 1 in. taper	0.436
0.057	0.581	refer to 1 in. taper	0.442
0.058	0.589	refer to 1 in. taper	0.448
0.059	0.597	refer to 1 in. taper	0.454
0.060	0.605	refer to 1 in. taper	0.460
0.061	0.613	refer to 1 in. taper	0.466
0.062	0.621	refer to 1 in. taper	0.472
0.063	0.629	refer to 1 in. taper	0.478
0.064	0.637	refer to 1 in. taper	0.484
0.065	0.645	refer to 1 in. taper	0.490
0.066	0.653	refer to 1 in. taper	0.496
0.067	0.661	refer to 1 in. taper	0.502
0.068	0.669	refer to 1 in. taper	0.508
0.069	0.677	refer to 1 in. taper	0.514
0.070	0.685	refer to 1 in. taper	0.520
0.071	0.693	refer to 1 in. taper	0.526
0.072	0.701	refer to 1 in. taper	0.532
0.073	0.709	refer to 1 in. taper	0.538
0.074	0.717	refer to 1 in. taper	0.544
0.075	0.725	refer to 1 in. taper	0.550
0.076	0.733	refer to 1 in. taper	0.556
0.077	0.741	refer to 1 in. taper	0.562
0.078	0.749	refer to 1 in. taper	0.568
0.079	0.757	refer to 1 in. taper	0.574
0.080	0.765	refer to 1 in. taper	0.580

Table A.11— Maximum Standoff Allowed for Couplings

1	2	3	4	5	6	7	8
Thread Ovality	**8-Round**	**8-Round**	**8-Round**	**8-Round**	**Buttress**	**Buttress**	**Buttress**
					$4^1/_2$ in.	**5–$13^3/_8$ in.**	**16–20 in.**
	A = 2 turns	**A = 3 turns**	**A = $3^1/_2$ turns**	**A = 4 turns**	**A = $^1/_2$ turn**	**A = 1 turn**	**A = $^7/_8$ turn**
in.	**in.**	**in.**	**in.**	**in.**	**in.**	**in.**	**in.**
0.001	0.383	0.508	0.571	0.633	0.108	0.208	0.181
0.002	0.391	0.516	0.579	0.641	0.116	0.216	0.187
0.003	0.399	0.524	0.587	0.649	0.124	0.224	0.193
0.004	0.407	0.532	0.595	0.657	0.132	0.232	0.199
0.005	0.415	0.540	0.603	0.665	0.140	0.240	0.205
0.006	0.423	0.548	0.611	0.673	0.148	0.248	0.211
0.007	0.431	0.556	0.619	0.681	0.156	0.256	0.217
0.008	0.439	0.564	0.627	0.689	0.164	0.264	0.223
0.009	0.447	0.572	0.635	0.697	0.172	0.272	0.229
0.010	0.455	0.580	0.643	0.705	0.180	0.280	0.235
0.011	0.463	0.588	0.651	0.713	0.188	0.288	0.241
0.012	0.471	0.596	0.659	0.721	0.196	0.296	0.247
0.013	0.479	0.604	0.667	0.729	0.204	0.304	0.253
0.014	0.487	0.612	0.675	0.737	0.212	0.312	0.259
0.015	—	0.620	0.683	0.745	0.220	0.320	0.265
0.016	—	0.628	0.691	0.753	0.228	0.328	0.271
0.017	—	0.636	0.699	0.761	0.236	0.336	0.277
0.018	—	0.644	0.707	0.769	0.244	0.344	0.283
0.019	—	0.652	0.715	0.777	—	0.352	0.289
0.020	—	0.660	0.723	0.785	—	0.360	0.295
0.021	—	0.668	0.731	0.793	—	0.368	0.301
0.022	—	0.676	0.739	0.801	—	0.376	0.307
0.023	—	0.684	0.747	0.809	—	0.384	0.313
0.024	—	0.692	0.755	0.817	—	0.392	0.319
0.025	—	0.700	0.763	0.825	—	0.400	0.325
0.026	—	0.708	0.771	0.833	—	0.408	0.331
0.027	—	0.716	0.779	0.841	—	0.416	0.337
0.028	—	0.724	0.787	0.849	—	0.424	0.343
0.029	—	—	0.795	0.857	—	0.432	0.349
0.030	—	—	0.803	0.865	—	0.440	0.355
0.031	—	—	0.811	0.873	—	0.448	0.361

1	2	3	4	5	6	7	8
Thread Ovality	**8-Round**	**8-Round**	**8-Round**	**8-Round**	**Buttress**	**Buttress**	**Buttress**
					4 1/2 in.	**5–13 3/8 in.**	**16–20 in.**
	A = 2 turns	**A = 3 turns**	**A = 3 1/2 turns**	**A = 4 turns**	**A = 1/2 turn**	**A = 1 turn**	**A = 7/8 turn**
in.	**in.**	**in.**	**in.**	**in.**	**in.**	**in.**	**in.**
0.032	—	—	0.819	0.881	—	0.456	0.367
0.033	—	—	0.827	0.889	—	0.464	0.373
0.034	—	—	0.835	0.897	—	0.472	0.379
0.035	—	—	0.843	0.905	—	0.480	0.385
0.036	—	—	0.851	0.913	—	0.488	0.391
0.037	—	—	0.859	0.921	—	0.496	0.397
0.038	—	—	0.867	0.929	—	0.504	0.403
0.039	—	—	0.875	0.937	—	0.512	0.409
0.040	—	—	0.883	0.945	—	0.520	0.415
0.041	—	—	0.891	0.953	—	0.528	0.421
0.042	—	—	0.899	0.961	—	0.536	0.427
0.043	—	—	0.907	0.969	—	0.544	0.433
0.044	—	—	0.915	0.977	—	0.552	0.439
0.045	—	—	0.923	0.985	—	0.560	0.445
0.046	—	—	0.931	0.993	—	0.568	0.451
0.047	—	—	0.939	1.001	—	0.576	0.457
0.048	—	—	0.947	1.009	—	0.584	0.463
0.049	—	—	0.955	1.017	—	0.592	0.469
0.050	—	—	0.963	1.025	—	0.600	0.475
0.051	—	—	0.971	1.033	—	0.608	0.481
0.052	—	—	0.979	1.041	—	0.616	0.487
0.053	—	—	0.987	1.049	—	0.624	0.493
0.054	—	—	0.995	1.057	—	0.632	0.499
0.055	—	—	1.003	1.065	—	refer to 1 in. taper	0.505
0.056	—	—	1.011	1.073	—	refer to 1 in. taper	0.511
0.057	—	—	1.019	1.081	—	refer to 1 in. taper	0.517
0.058	—	—	1.027	1.089	—	refer to 1 in. taper	0.523
0.059	—	—	1.035	1.097	—	refer to 1 in. taper	0.529
0.060	—	—	1.043	1.105	—	refer to 1 in. taper	0.535
0.061	—	—	1.051	1.113	—	refer to 1 in. taper	0.541
0.062	—	—	1.059	1.121	—	refer to 1 in. taper	0.547
0.063	—	—	1.067	1.129	—	refer to 1 in. taper	0.553

1	2	3	4	5	6	7	8
Thread Ovality	**8-Round**	**8-Round**	**8-Round**	**8-Round**	**Buttress**	**Buttress**	**Buttress**
					4 1/2 in.	**5–13 3/8 in.**	**16–20 in.**
	A = 2 turns	**A = 3 turns**	**A = 3 1/2 turns**	**A = 4 turns**	**A = 1/2 turn**	**A = 1 turn**	**A = 7/8 turn**
in.	**in.**	**in.**	**in.**	**in.**	**in.**	**in.**	**in.**
0.064	—	—	1.075	1.137	—	refer to 1 in. taper	0.559
0.065	—	—	1.083	1.145	—	refer to 1 in. taper	0.565
0.066	—	—	1.091	1.153	—	refer to 1 in. taper	0.571
0.067	—	—	1.099	1.161	—	refer to 1 in. taper	0.577
0.068	—	—	1.107	1.169	—	refer to 1 in. taper	0.583
0.069	—	—	1.115	1.177	—	refer to 1 in. taper	0.589
0.070	—	—	1.123	1.185	—	refer to 1 in. taper	0.595
0.071	—	—	1.131	1.193	—	refer to 1 in. taper	0.601
0.072	—	—	1.139	1.201	—	refer to 1 in. taper	0.607
0.073	—	—	1.147	1.209	—	refer to 1 in. taper	0.613
0.074	—	—	1.155	1.217	—	refer to 1 in. taper	0.619
0.075	—	—	1.163	1.225	—	refer to 1 in. taper	0.625
0.076	—	—	1.171	1.233	—	refer to 1 in. taper	0.631
0.077	—	—	1.179	1.241	—	refer to 1 in. taper	0.637
0.078	—	—	1.187	1.249	—	refer to 1 in. taper	0.643
0.079	—	—	1.195	1.257	—	refer to 1 in. taper	0.649
0.080	—	—	1.203	1.265	—	refer to 1 in. taper	0.655

Annex B
(informative)

Gauging Practice Information and Guidance

B.1 Procedure for Thread Profile Template Use

The thread profile template is a precision-hardened manufactured thread tooth form used as an aid for the visual detection of thread form imperfections. See Figure B.1 for examples.

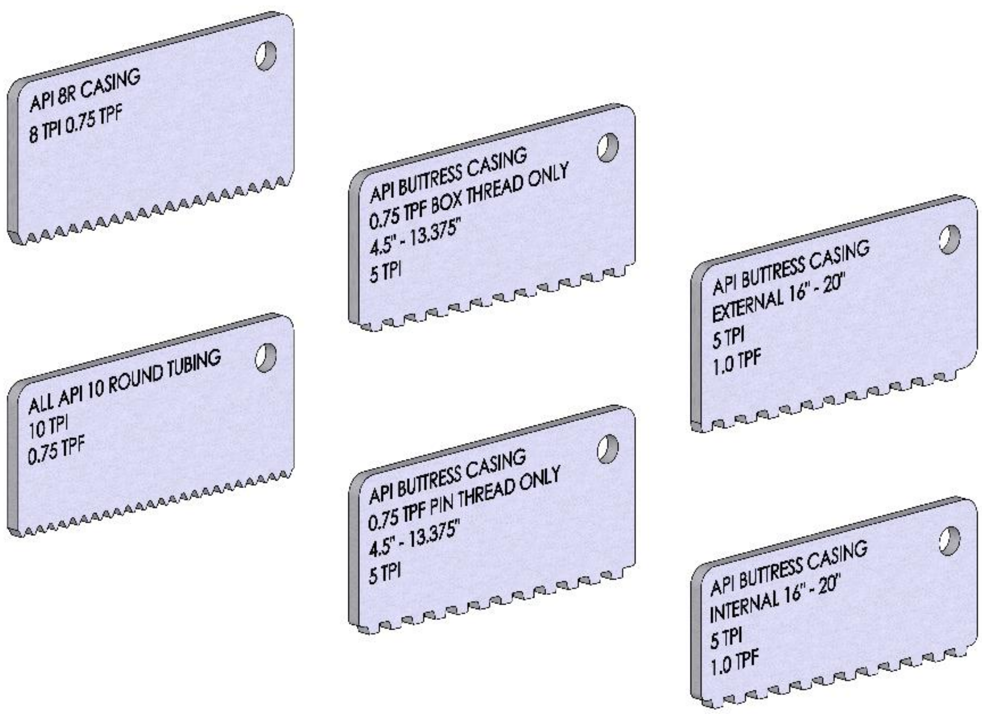
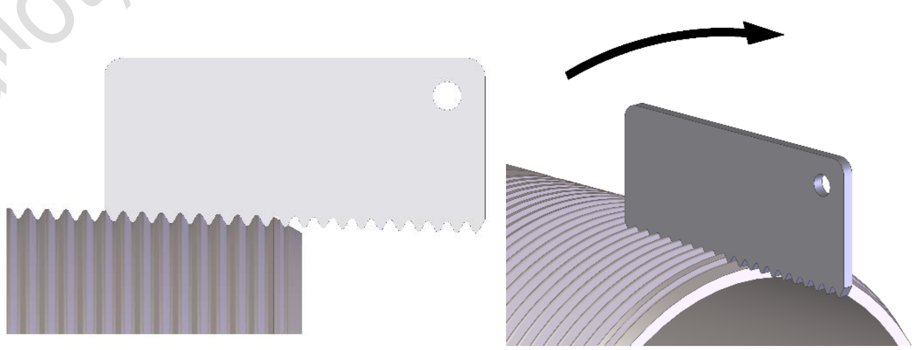


Figure B.1—Examples of Thread Profile Templates

The template shall be placed in the perfect thread area. The template teeth should fit in the pin or box threads without lateral movement or interference (ride-up on flank threads). Such indications of imperfect fit may indicate a problem in the thread form. Rejection of the thread should not be made until the thread pitch, taper, thread height, flank angle, and/or thread profile as measured with a thread comparator or other thread form measurement device has verified the condition. See Figure B.2 for an example.



(a) **(b)**

Figure B.2—Example of Thread Profile Template on Product

B.2 Sequence of Using Ring/Plug Gauges

The sequence below should be used with ring/plug gauges.

1) Ensure the correct gauge for the connection to be inspected is used and is within calibration and the proper standoff values for that gauge are known, using Equation B.1:

$$\text{Plug Gauge Standoff to Coupling} = (A \times p) + (S_1 - S) \quad \text{(B.1)}$$

where

A = nominal hand-tight standoff, # of thread turns according to API 5B

p = nominal pitch of the thread

S = actual mating standoff of master plug to master ring

S_1 = actual standoff of work plug to master ring

Standoff tolerance is according to API 5B

Ring gauge standoff to Pin = P_1 value as found on the work ring certification. Standoff tolerance according to API 5B.

Example 1—<u>4 1/2 8-Round Casing</u>

S = 0.3620

S_1 = 0.3630

A = 3-turns

$(A \times p) + (S_1 - S) = (3 \times 0.1250) + (0.3630 - 0.3620) = 0.3750 + 0.001 = 0.3760$

Example 2—<u>9 5/8 Buttress Casing</u>

S = 0.1990

S_1 = 0.1950

A = 1-turn

$(A \times p) + (S_1 - S) = (1 \times 0.2000) + (0.1950 - 0.1990) = 0.200 + (-0.004) = 0.1960$

2) Clean both the product and the gauge to remove any dirt, chips, or other debris.

3) Visually inspect the gauge for dings, cracks, broken threads, or any other defects which could adversely affect proper gauging or damage the gauge or the product to be gauged.

4) A light lubricant may be used to help thread engagement between the gauge and product and help prevent galling. Take precaution not to use a lubricant that leaves a residue or film, such as common spray lubricants.

5) Take care when applying the gauge to the product to ensure the two pieces are not banged together or cross-threaded. Thread the gauge onto/into the product until it stops hand-tight. Because the hand-tight position is unknown when initially applying the gauge, the gauge often stops with some amount of force when it gets to that point. It is good practice to back the gauge off approximately 1/4-turn and then slowly advance it until it stops without the use of force; this method provides more consistency in standoff measurements.

B.3 Visual Inspection Observations

Visual inspection starts with an overview of the threads for conformance with the normal configuration. These observed conditions are shown below in Table B.1 and are not necessarily cause of rejection. Deviations from the normal configurations, such as those shown in Table B.1, should be investigated to determine source of the deviation and if the cause is sufficient to warrant rejection of the connection.

Table B.1—Examples of Visual Observations and Evaluations

1	2	3
Observation	**Common Causes**	**Evaluations**
Uniform shoulder all around behind the pin threads on round threads	— Pipe OD oversize — Thread diameter undersized — Thread length is too short — Taper too slow	— Measure pipe diameter — Measure thread crest diameter — Measure thread length — Measure taper
Shoulder on one side behind the pin threads on round threads	Angular or axial thread to pipe misalignment	Check for non-full-crested threads in the L_C length
Shoulder on two sides behind the pin threads on round threads	Pipe or thread ovality	Measure thread ovality
Interrupted starting thread	— Chamfer angular or axial misaligned with pipe axis — Chamfer misaligned with thread axis — Thread ovality — Chamfer out-of-roundness	— Measure chamfer angle — Measure thread ovality
Pin face width varies around the circumference	— Threads cut off axis from the chamfer — Pipe eccentricity	— Measure ovality — Measure wall thickness behind threads
Black crested threads not near the L_C length on buttress	— Pipe OD oversize — Thread diameter undersized	— Measure pipe diameter — Measure thread crest diameter
Black crested threads length extends on opposite sides	Pipe or thread ovality	Measure thread ovality
For power-tight make-up connections, face of Internal thread not about a $^1/_2$ in. from the center the coupling	Improper make-up	Measure power-tight make-up
Ghost threads on the coupling counterbore	— Axial or angular misalignment — Thread ovality — Tooling variance/misalignment — Loose gibbs on the lathe — Improperly chucked part — Couplings threaded when chucked on non-turned surfaces — Shavings not being blown out of the chuck when flipping coupling to cut opposite end	— Measure alignment — Measure ovality

B.4 Use of Buttress Tooth Thickness/Width Gauge

The steps below should be used gauging tooth thickness/width.

1) Set-up the gauge with contact points appropriate for either “datum from crest” or “datum from root” measurements. Ensure that the measurement method is clearly noted in procedures/training available to inspectors.

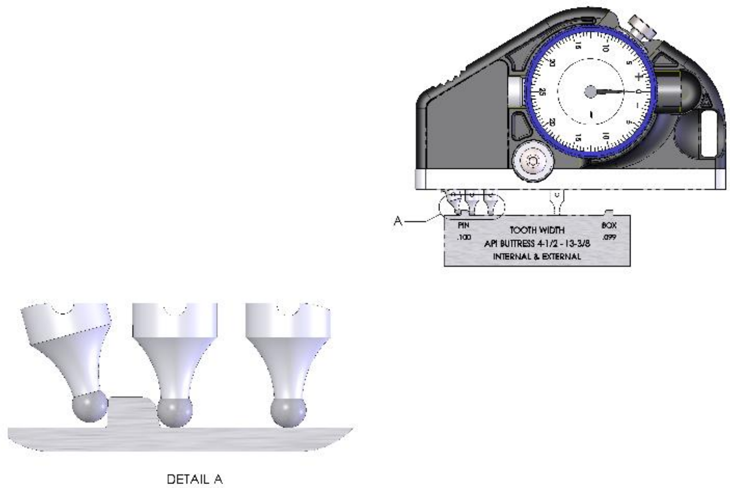
2) Before issuing the gauge to be used, verify the spring action of the movable contact point to ensure that it freely returns to the position nearest to the fixed point. This can be checked by zeroing the dial, carefully moving the spring-loaded contact point, slowly allow the contact point to return to its starting position under its own spring tension and ensuring that the dial returns to zero.

3) Verify alignment of the three contact points. If contact points are not aligned, the gauge may not be able to correctly measure the tooth width due to the angle of approach into the threads.

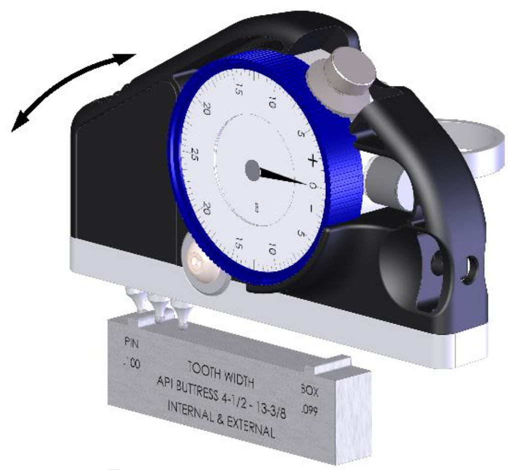
4) Checking tooth thickness/width on box threads/couplings, it may be required to use a gauge with a dial offset several inches from the location of the contact points, similar to an internal thread lead gauge, in order to read the dial when checking threads further into the box/coupling. Use care to ensure that the contact points are properly seated in the threads to make a measurement.

5) Obtain the appropriate setting standard for box or pin threads. When placing the gauge onto the setting standard, the alignment of the contact points can be checked by ensuring that the minimum value is read when the third contact point, which is not in contact with the tooth being measured, is centered in the longitudinal axis of the setting standard (axis perpendicular to the tooth).

6) When measuring threads on the production part, ensure that a minimum tooth thickness/width value can be achieved when gently oscillating the gauge around the location where the contact points are contacting the thread being measured. If the reading suddenly increases, it is likely that the third fixed point is interfering with another thread and pulling the gauge away from the thread being measured; this causes the spring loaded tip to be moved by pulling the datum contact point away from the other side of the thread being measured, and not relative to the thread being measured.

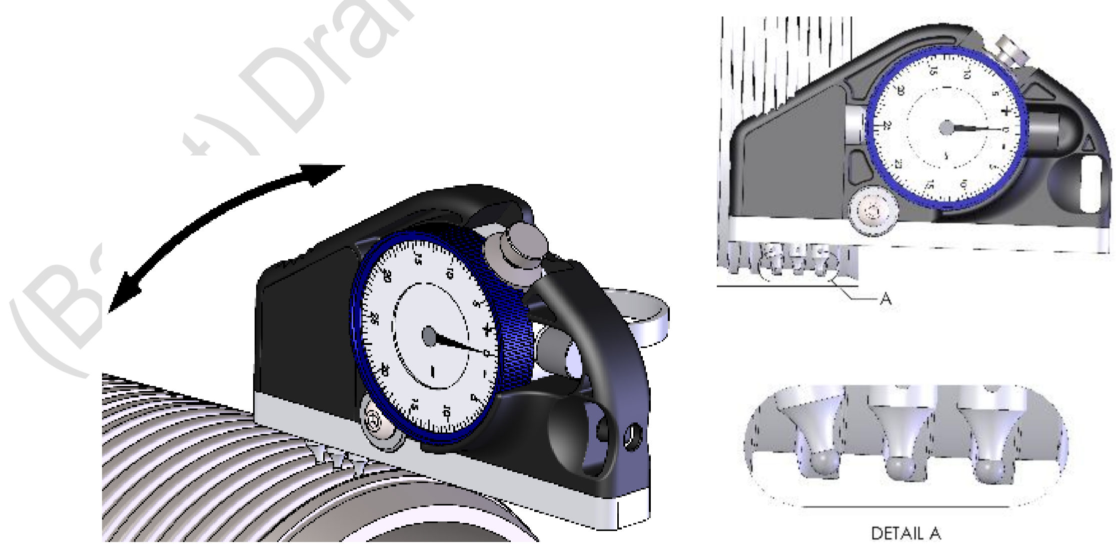


(a)



(b)

Figure B.3—Example Tooth Thickness Measurement Set-up

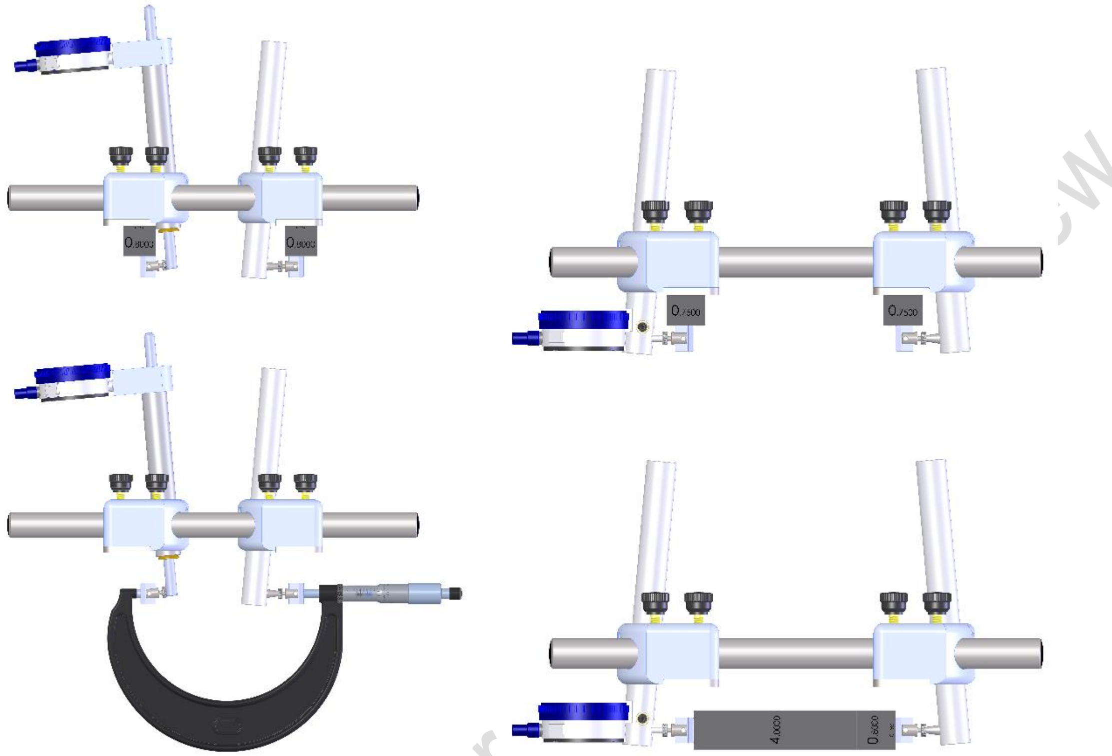


(a) **(b)**

Figure B.4—Example Tooth Thickness Measurement on Product

B.5 Alternate Setting Methods for Crest Diameter and Ovality

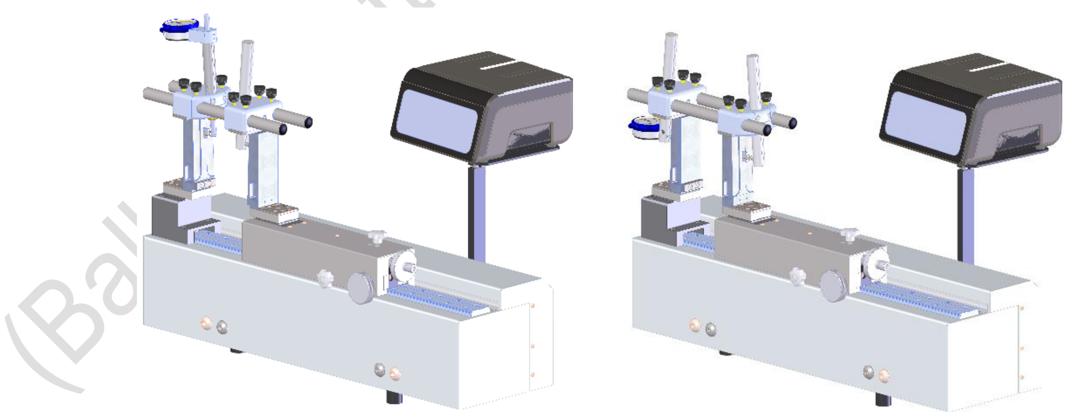
B.5.1 Combination of Outside Diameter Micrometers and Gauge Block Stack-Ups



(a) **(b)**

Figure B.5—Example of Setting Gauges

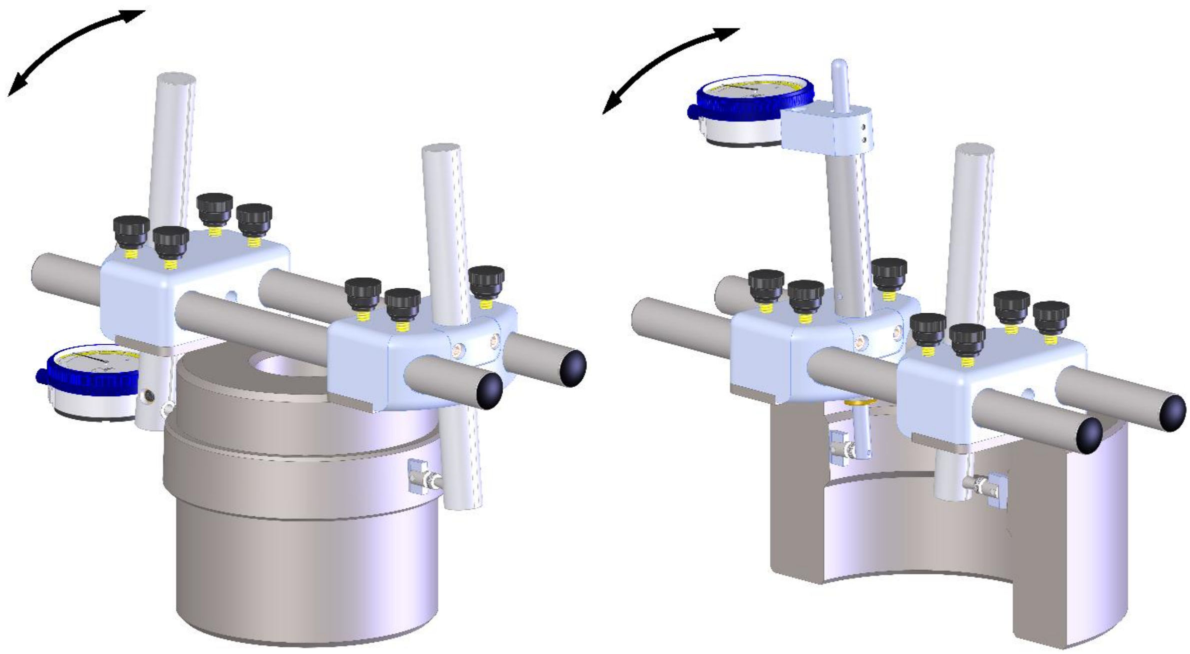
B.5.2 Industrial Linear Measurement Device



(a) **(b)**

Figure B.6—Example of Setting Gauges using an Industrial device

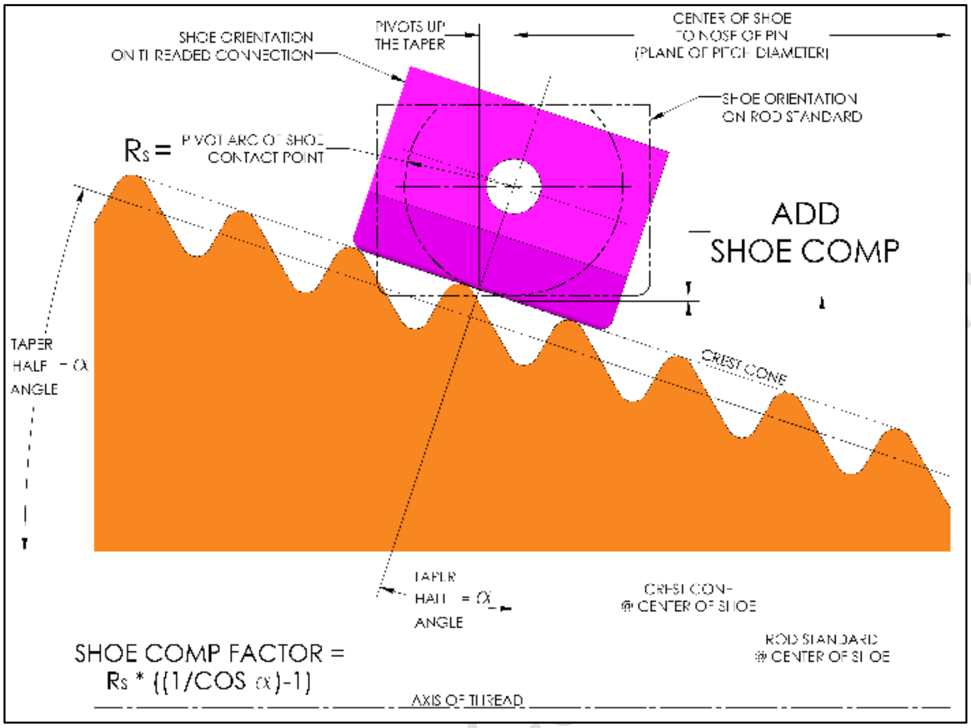
B.5.3 Roundness Simulated Standards



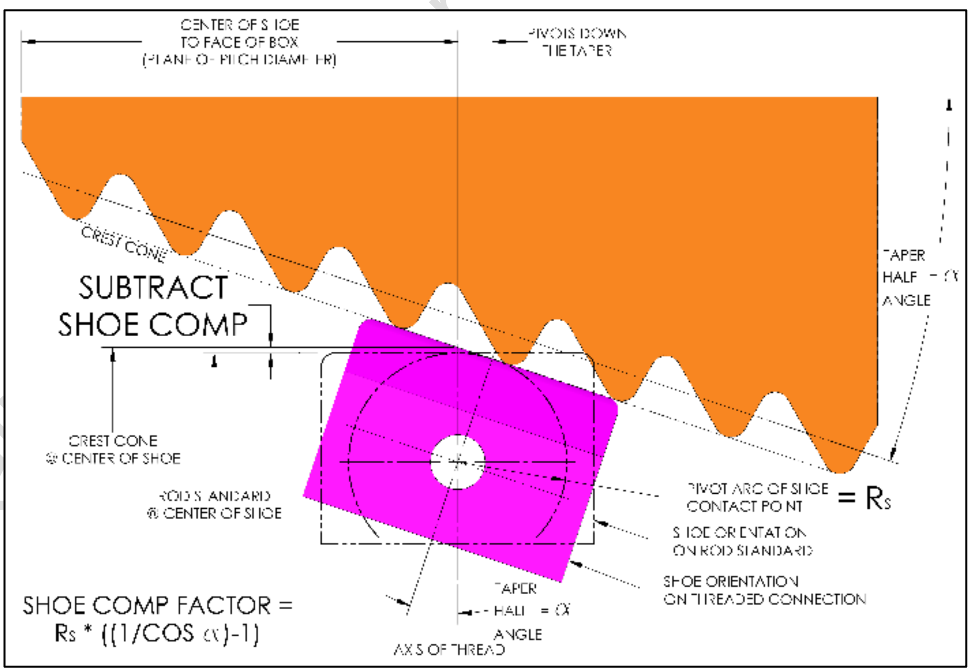
(a) (b)

Figure B.7—Example of Gauges on Round Standards

B.5.4 Calculation of Crest Diameter and Ovality Setting Dimensions at Nominal Taper including Shoe Compensation



(a)



(b)

Figure B.8—Illustration of Shoe Pivot Compensation (with Taper and Features exaggerated)

B.6 Alternate Method for Inspecting Coupling Alignment

B.6.1 General

The following imperfections are typically visible or more easily observed and measured, that can often accompany parts with misalignment; these include, but may not be limited to:

- observation of thread cross-over imperfection on one side of the J area, but not on the other side,
- thread root helical scratches on the counterbore,
- variance in the over-all length around the circumference,
- non-clean-up of the bearing face can indicate length variance, which in turn can indicate thread cone misalignment,
- tooling variance/misalignment during the cutting process,
- loose gibbs on the lathe,
- improperly chucked part,
- couplings threaded when chucked on non-turned surfaces,
- shavings not being blown out of the chuck when flipping the coupling to cut the opposite side of threads, and/or
- variation in bearing face thickness around the circumference.

Generally, it isn't necessary to check coupling alignment on every part. There are two simple techniques to better identify couplings with potential misalignment; see B.6.2 and B.6.3 below.

B.6.2 First Method

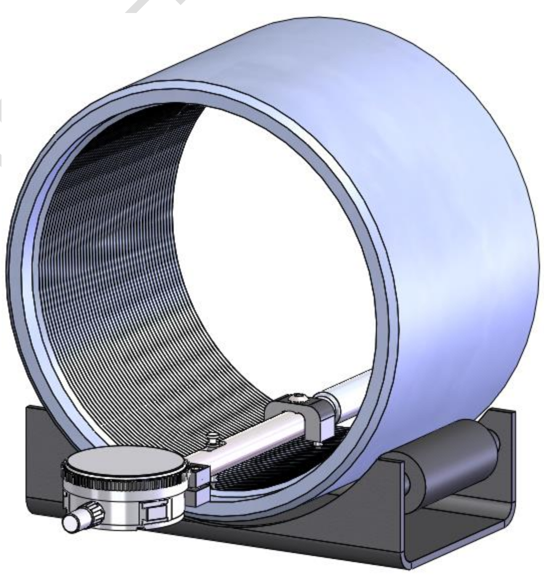


Figure B.9—Example of Coupling Alignment Gauge Being Used

Table B.2—Maximum Sweep Values, EU

1	2
EU Coupling Size	**Maximum Sweep Value**
in.	**in.**
1.315	0.004
1.660	0.006
1.900	0.006
2⅜	0.008
2⅞	0.009
3½	0.011
4	0.013
4½	0.014

Table B.3—Maximum Sweep Values, NU

1	2
NU Coupling Size	**Maximum Sweep Value**
in.	**in.**
2⅜	0.007
2⅞	0.009
3½	0.011
4	0.012
4½	0.014

Table B.4—Maximum Sweep Values, LC

1	2
LC Coupling Size	**Maximum Sweep Value**
in.	**in.**
4½	0.014
5	0.015
5½	0.017
6⅝	0.020
7	0.021
7⅝	0.023
8⅝	0.026
9⅝	0.029
20	0.061

Table B.5—Maximum Sweep Values, SC

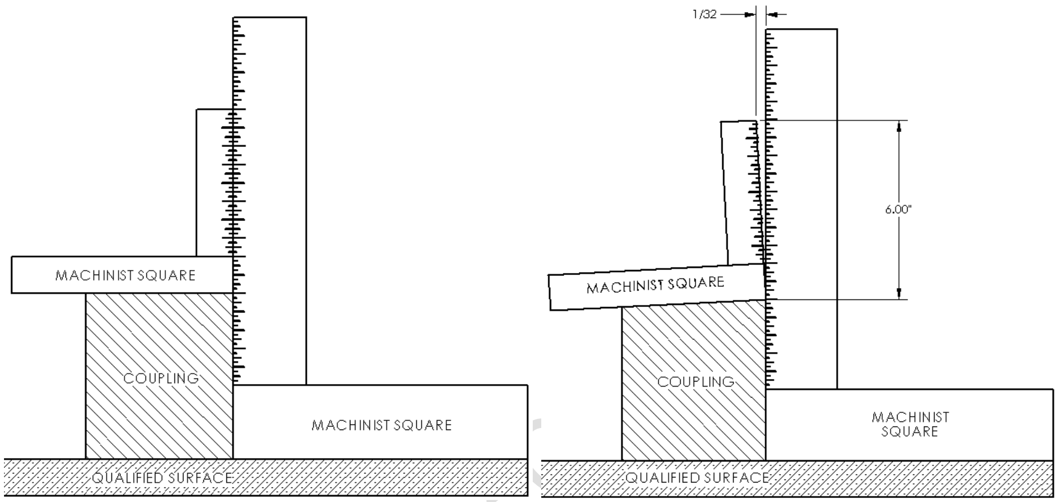
1	2
SC Coupling Size	**Maximum Sweep Value**
in.	**in.**
4½	0.014
5	0.015
5½	0.017
6⅝	0.020
7	0.021
7⅝	0.023
8⅝	0.026
9⅝	0.029
10¾	0.033
11¾	0.036
13⅜	0.041
16	0.049
18⅝	0.057
20	0.062

Table B.6—Maximum Sweep Values, BC

1	2
BC Coupling Sizes	**Maximum Sweep Value**
in.	**in.**
4½	0.014
5	0.015
5½	0.017
6⅝	0.020
7	0.021
7⅝	0.023
8⅝	0.026
9⅝	0.029
10¾	0.033
11¾	0.036
13⅜	0.041
16	0.049
18⅝	0.058
20	0.062

B.6.3 Second Method

When parts have been faced and threaded in the same chucking, an alternate Go/No-Go method is available to inspect coupling misalignment. This can be done by first positioning the coupling on a qualified flat surface, such as a granite surface plate, and then placing a non-adjustable machinist square (minimum length of coupling length + 6 in.) against the OD of the coupling. Next, a 2nd 6-in. non-adjustable machinist square would be placed on top of the bearing face of the coupling and sliding it against the 1st non-adjustable machinist square as seen in the Figure B.10. If there is any misalignment, there will be a gap at the top of the 2nd non-adjustable machinist square. After that, the coupling is rotated to maximize the gap; if a $^{1}/_{32}$ in. (i.e. 0.01875 in.) feeler gauge fits inside the gap at 6 inches from the bearing face, the alignment is out-of-tolerance.



(a) (b)

Figure B.10—Example of Non-Adjustable Machinist Square Method

B.7 Optical Comparator/Profile Projector Guidance Using Toleranced Overlays

Good practices when using overlays involve "calibrating the operator/inspector's eye". One way to accomplish this is to practice inspecting a gauge pin of known size utilizing the alignment guidelines below.

The operator should compare the measured size derived from the following procedure to the actual known size of the gauge pin. Practicing this technique will ensure more accurate and consistent results when measuring product. The inspector should align to one side of the datum line on the overlay, and they shall then stay consistent when traversing the table to measure other features. The center of a shadow-line should not be used to measure features.

(a) (b)

Figure B.11—Calibrating Inspector's Eye with Known Gauge Pin

Accurately inspecting thread form using a mold or shadow graph starts with the following foundations:

— a reputable piece of equipment (such as a profile projector / optical comparator),

— a thread product overlay with tolerance bands, and

— a proven reliable procedure.

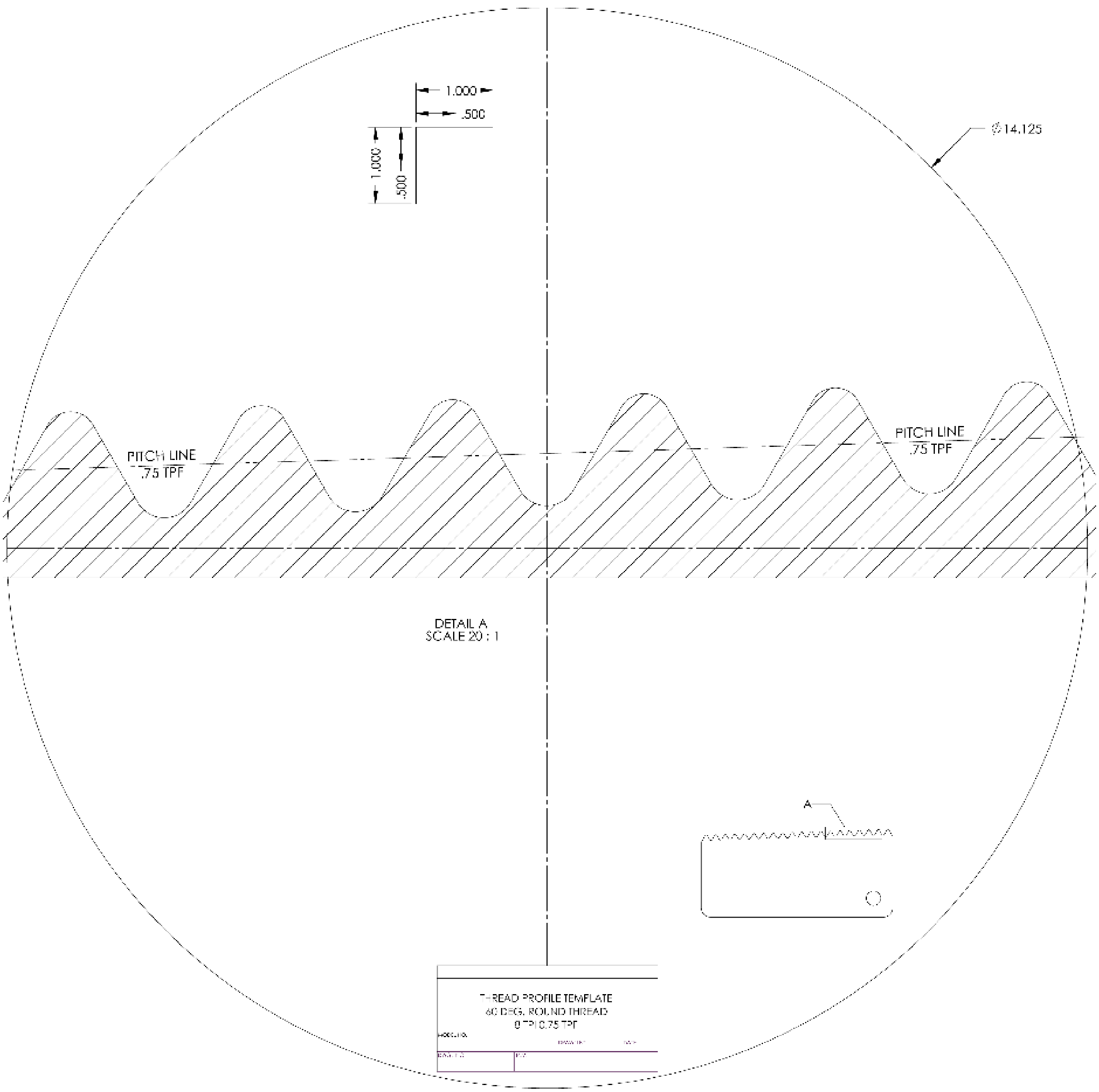
The appropriate overlay should be selected with a 20X, or whenever possible a 50X, magnification level with an overall size that's matched to maximize the available footprint of the optical comparator's screen. The inspector shall be able to fully identify the respective features and attributes of the thread form. After properly aligning the overlay, each feature shall fit within the tolerance band on the overlay to be considered in-spec.

Best practice when using overlays involves aligning to a straight feature to act as a starting datum, such as the pitch line or a flank angle. Once the shadow/projection is aligned to a proper datum on the overlay, the operator/inspector can traverse the table up or down, left or right to measure specific features or ensure features of the shadow projection lie within tolerance bands. Inaccurate results can be a common occurrence when overlays are aligned improperly to features other than a proper datum.

Figure B.12—Consistent Feature Alignment on Optical Comparator

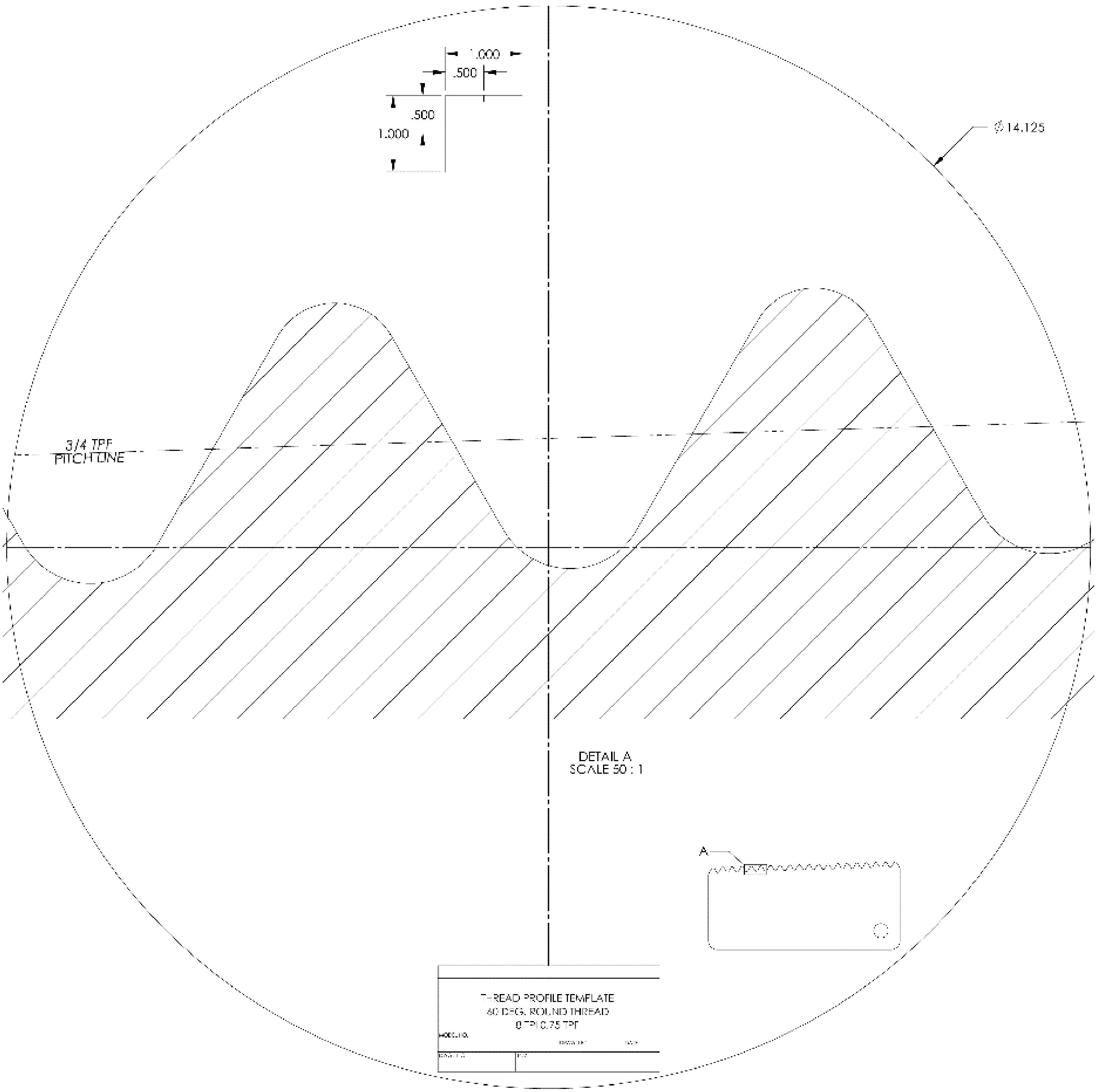
B.8 Verification of Profile Templates using an Overlay

A thread profile template is a visual aid for inspecting the thread form, looking for gross lead error, and detecting burrs or damage to the threads. While a thread profile template does not quantify or measure a thread, it is a useful visual aid. If large form errors are observed or detected, best practice is to investigate further with individual attribute gauges or use of an optical comparator or contour tracer. Industry standard profile templates are manufactured to nominal product dimensions, at manufacturer's tolerances. The verification of a profile template is accomplished utilizing an optical comparator and the respective overlay. General practice involves utilizing a pass or fail method, meaning no dimensional measurements are taken. The profile either fits the overlay or does not on a pure pass or fail basis.



(a)

Figure B.13—Examples of Thread Form Overlays



(b)

Figure B.13—Examples of Thread Form Overlays

B.9 Common Mathematical Equations and Relationships

B.9.1 Pitch

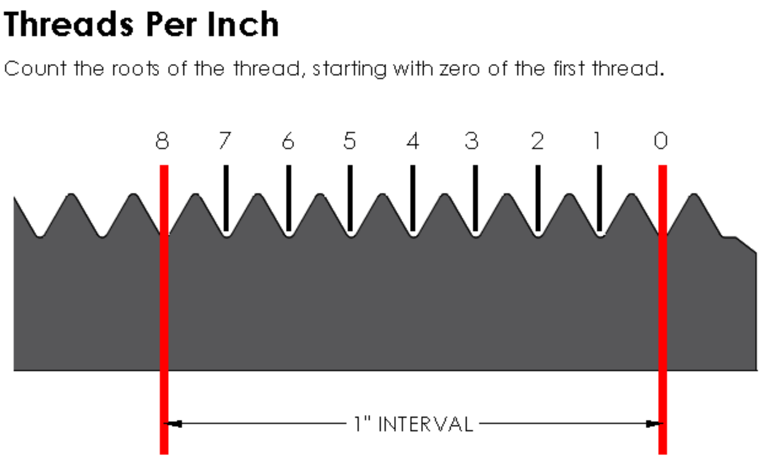


Figure B.14—Illustration of Pitch

B.9.2 Taper

Below are examples on how to calculate taper.

Example 1—3/4 inch TPF

0.750 in	~~1 ft~~	= **0.0625 in. per in.**
~~1 ft~~	12 in	

Example 2—1 inch TPF

1 in	~~1 ft~~	= **0.0833 in. per in.**
~~1 ft~~	12 in	

Example 3—3/4 inch TPF, 8 TPI

0.750 in	~~1 ft~~	~~1 in~~	= **0.0078 in. per thread**
~~1 ft~~	12 ~~in~~	8 Threads	

B.9.3 Effect of Lead Error or Coating Thickness on Fit

Figure B.15 and the examples below show how fit is affected by lead error or coating thickness.

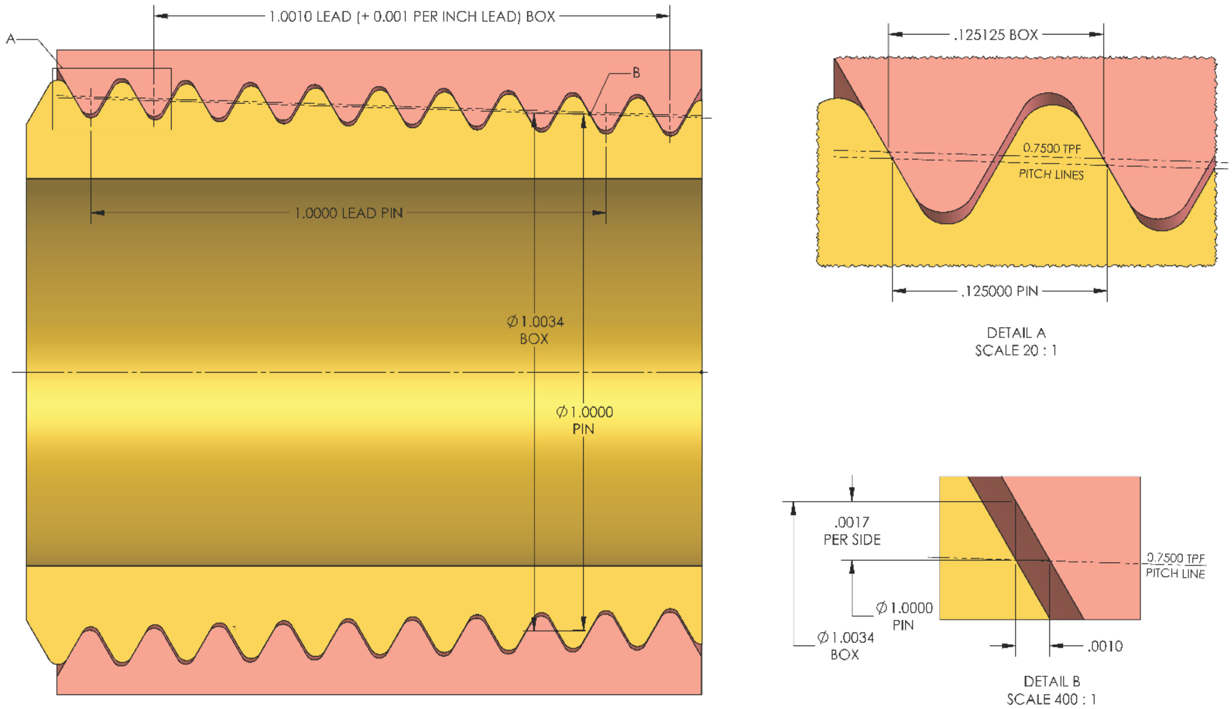


Figure B.15—Example of Effect from Lead Error

Example—Effect from Lead Error

$$\Delta \textbf{ Functional Size} = \frac{\textbf{Lead Error x 2}}{\textbf{TAN}\left(\alpha/2\right)}$$

α = Angle of Thread

$$\text{Ex.:} \quad \frac{0.001 \times 2}{\text{TAN}\left(60/2\right)} = 0.0034''$$

B.9.4 Stand-off to Pitch Diameter Correlation

Example—Effect on Stand-off

R = 12/TPF

R = Standoff to Pitch Diameter Ratio
TPF = Taper Per Foot

Example: 3/4 TPF

R = 12/0.750 (3/4 in) in/ft.
R = 16 to 1

B.10 Example Inspection Reports

The following figures – Figures B.16 to B.21 – are merely examples for illustration purposes only. They are not to be considered exclusive or exhaustive in nature. API makes no warranties, express or implied for reliance on or any omissions from the information contained in this document.

Commentary NOTES as shown for Figure B.17.

1 Correlating reference section in this document.

2 Example of use of white space to capture gauge contact ball size.

3 Use thread height setting block number.

4 Use tooth width gauge number on setting block number, measured from root of thread.

5 Use GO/NO-GO buttress groove width gauge number.

6 Thread-form 5-pitch and ¾ in. TPF; 1 in. TPF for 16 in. to 20 in.

7 Use appropriate thread overlay.

8 To set thread crest diameter gauges, use: length to gauge plane (L_{10}), setting diameter (C_{10}).

9 Ovality is measured while part is in a free state, see API 5B.

10 If present, ovality may require adjustments to standoff requirements; for adjustments, see API 5B.

11 For max allowable standoff, see API 5B.

12 ID length on accessories is equal to L_C min.

13 Example of gauging frequency less than 100 %.

14 Example of element not checked at threading.

15 Visual may also be used for manufacturer-assigned codes for reject causes (e.g. BCT = black crusted thread).

Commentary NOTES as shown for Figure B.21.

1 Correlating reference section in this document.

2 Example of use of white space to capture gauge contact ball size.

3 Use thread height setting block number.

4 Use thread addendum setting block.

5 To set thread crest diameter gauges, use: length to gauge plane (L_{10}), setting diameter (C_{10}).

6 Thread-form 8-pitch and ¾ in. TPF.

7 Use appropriate thread overlay.

8 To set thread crest diameter gauges, use: length to gauge plane (M_{12}), setting diameter (C_{12}).

9 Ovality is measured while part is in a free state, see API 5B

10 If present, ovality may require adjustments to standoff requirements; for adjustments, see API 5B.

11 For max allowable standoff, see API 5B.

12 Example of gauging frequency less than 100 %.

13 Example of element not checked at threading.

14 Visual may also be used for manufacturer-assigned codes for reject causes (e.g. BCT = black crusted thread).

BUTTRESS THREAD CASING (BC) PIN

W/O #:		Customer:		Thread Size:		Weight:		Type:	
Dwg# / Rev.:		Machine #:		Inspector:		Wall Thickness:		Thread Spec:	
Date:		Operator:		Shift:		Units:			

API 5B1 Section Ref.		NA												NA			NA
Joint Number	Visual	Major Diameter	Perfect Thread Taper	Imperfect Thread Taper	Thread Lead	Cum. Lead	Thread Height	Tooth Thickness	Groove Width	Thread Profile	Thread Crest Diameter	Ovality	Max Allowable Standoff Tolerance	Measured Standoff Value	A_1 Triangle Stamp	Run-Out	I.D. "d"
Side (M / F) (Mill / Field)	L7	0.000	0.000	0.000	+0.000	+0.000	0.000	+0.000	OK	OK	+0.000	0.000			0.000	+0.000	0.000
	Lc	Max	0.000	0.000	-0.000	-0.000	0.000	-0.000	Reject	Reject	-0.000	Max			0.000	-0.000	0.000
																	A
																	C
																	C
																	E
																	S
																	S
																	O
																	R
																	Y

Figures B.16—Example Inspection Template: Buttress Thread Casing (BC) Pin

BUTTRESS THREAD CASING (BC) PIN

W/O #:	WO 5B1EX1	Customer:	Perfect Pipe Inc.	Thread Size:	7-5/8"	Weight:	29.7#	Type:	BC
Dwg# / Rev.:		Machine #:	1	Inspector:	JD	Wall Thickness:	0.357#	Thread Spec:	API 5B & API 5CT Latest Editions
Date:	2019/09/27	Operator:	JS	Shift:	3	Units:	UCS		

API 5B1 Section Ref.	5.2	NA	8.5.2	8.5.2	8.7	8.7.3.2	8.8.2	8.11	8.11.2	8.10.1	8.14	8.14	8.15.1	NA	8.4.2	8.6	NA
Joint Number	Visual	Major Diameter	Perfect Thread Taper	Imperfect Thread Taper	Thread Lead	Cum. Lead	Thread Height	Tooth Thickness	Groove Width	Thread Profile	Thread Crest Diameter	Ovality	Max Allowable Standoff Tolerance	Measured Standoff Value	A_1 Triangle Stamp	Run-Out	I.D. "d"
			0.090	0.090	0.062	0.062		0.087							Caliper	0.057	
Side (M / F) (Mill / Field)	2.4035	—	0.066	0.067	+0.002	+0.004	+0.001	+0.000	OK	OK	+0.0060	0.023	—	—	4.718	+0.005	0.000
	2.0035	Max	0.061	0.061	-0.002	-0.004	-0.001	-0.003	Reject	Reject	-0.0020	Max	—	-0.000	4.657	-0.005	0.000
1-M	OK	—	0.064	0.064	+0.0005	+0.0005	0.000	-0.002	OK	MOLD	+0.001	0.004	0.132	+0.028	4.710	-0.001	A
2-M	OK	—	0.063	0.064	+0.0005	+0.0005	0.000	-0.002	OK	OK	+0.001	0.014	0.212	+0.030	4.703	-0.002	C
3-M	OK	—	0.064	0.064	+0.0005	+0.0005	0.000	-0.002	OK	OK	+0.001	0.002	0.116	+0.050	4.678	-0.001	C
4-M	OK	—	0.064	0.064	+0.0005	+0.0005	0.000	-0.0015	OK	OK	+0.0015	0.005	0.14	+0.042	4.704	-0.002	E
5-M	OK	—	0.064	0.064	+0.0005	+0.0005	0.000	-0.002	OK	OK	+0.001	0.004	0.132	+0.046	4.665	-0.002	S
6-M	OK	—	0.062	0.063	—	—	—	—	—	—	—	—	—	—	—	—	S
7-M	OK	—	—	—	+0.0005	+.0005	—	—	—	—	—	—	—	—	—	—	O
8-M	OK	—	—	—	—	—	0.000	0.000	—	—	—	—	—	—	—	—	R
9-M	OK	—	—	—	—	—	—	—	OK	OK	—	—	—	—	—	—	Y
10-M	OK	—	—	—	—	—	—	—	—	—	+0.001	0.002	0.116	+0.044	—	—	—
11-M	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	4.689	—	—
12-M	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-0.0015	—
13-M	OK	—	0.062	0.062	—	—	—	—	—	—	—	—	—	—	—	—	—
14-M	BCT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure B.17—Example Inspection (with Commentary Notes): Buttress Thread Casing (BC) Pin

NOTE 1 · NOTE 2 · NOTE 3 · NOTE 4 · NOTE 5 · NOTES 6 & 7 · NOTES 8 & 9 · NOTES 9 & 10 · NOTE 10 · NOTE 11 · NOTE 12 · NOTE 13 · NOTE 14 · NOTE 15

LONG THREAD CASING (LC) PIN																
W/O #:			Customer:			Thread Size:				Weight:			Type:			
Dwg# / Rev.:			Machine #:			Inspector:				Wall Thickness:			Thread Spec:			
Date:			Operator:			Shift:				Units:						
API 5B1 Section Ref.		NA										NA				
Joint Number	Visual	Major Diameter	Thread Taper	Thread Lead	Cum. Lead	Thread Height	Thread Addendum	Thread Profile	Thread Crest Diameter	Ovality	Max Allowable Standoff Tolerance	Measured Standoff Value	Total Length	Full-Crested Thread Length	Chamfer Diameter	I.D. "d"
																0.000
Side (M / F) (Mill / Field)		0.000	0.000	+0.000	+0.000	0.000	+0.000	OK	+0.000	0.000			0.000	0.000	OK	0.000
		Max	0.000	-0.000	-0.000	0.000	-0.000	Reject	-0.000	Max			0.000	Min	Reject	0.000
																A
																C
																C
																E
																S
																S
																O
																R
																Y

Figure B.18—Example Inspection Template: Long Thread Casing (LC) Pin

BUTTRESS THREAD CASING (BC) BOX																
W/O #:			Customer:			Thread Size:			Weight:				Type:			
Dwg# / Rev.:			Machine #:			Inspector:			Wall Thickness:				Thread Spec:			
Date:			Operator:			Shift:			Units:							
API 5B1 Section Ref.		NA										NA				
Joint Number	Visual	OD	Thread Lead	Cum. Lead	Thread Height	Tooth Thickness	Groove Width	Thread Profile	Thread Crest Diameter	Ovality	Max Allowable Standoff Tolerance	Measured Standoff Value	Counter-bore Diameter	Bearing Face	Coupling Length	Coupling Thread Alignment
Side (A/B)		0.000	+0.000	+0.000	0.000	+0.000	OK	OK	+0.000	0.000			0.000	0.000	0.000	0.000
		0.000	-0.000	-0.000	0.000	-0.000	Reject	Reject	-0.000	Max			0.000	Min	Max	Max

Figure B.19—Example Inspection Template: Buttress Thread Casing (BC) Box

LONG THREAD CASING (LC) BOX

W/O #:		Customer:		Thread Size:		Weight:		Type:	
Dwg# / Rev.:		Machine #:		Inspector:		Wall Thickness:		Thread Spec:	
Date:		Operator:		Shift:		Units:			

API 5B1 Section Ref.		NA										NA	NA	NA	NA	NA	NA
Joint Number	Visual	OD	Thread Taper	Thread Lead	Cum. Lead	Thread Height	Thread Addendum	Thread Profile	Thread Crest Diameter	Ovality	Max Allowable Standoff Tolerance	Measured Standoff Value	Recess Diameter	Recess Depth	Bearing Face	Coupling Length	Coupling Thread Alignment
Side (A/B)		0.000	+0.000	+0.000	+0.000	0.000	+0.000	OK	+0.000	0.000			0.000	0.000	0.000	0.000	0.000
		0.000	-0.000	-0.000	-0.000	0.000	-0.000	Reject	-0.000	Max			0.000	0.000	Min	Max	Max

Figure B.20—Example Inspection Template: Long Thread Casing (LC) Box

NOTE 1
NOTE 2
NOTE 3
NOTE 4
NOTE 5
NOTES 6 & 7
NOTES 8 & 9
NOTES 9 & 10
NOTE 10
NOTE 11
NOTE 12
NOTE 13
NOTE 14

LONG THREAD CASING (LC) BOX

W/O #:	WO 5B1EX1	Customer:	Perfect Pipe Inc.	Thread Size:	7-5/8"	Weight:	29.7#	Type:	BC
Dwg# / Rev.:		Machine #:	1	Inspector:	JD	Wall Thickness:	0.357#	Thread Spec:	API 5B & API 5CT Latest Editions
Date:	2019/09/27	Operator:	JS	Shift:	3	Units:	UCS		

API 5B1 Section Ref.	9.2	NA	12.5	12.7	12.7.3.2	12.8.2	12.11	12.10.0	12.14	12.14	12.15.2	NA	NA	NA	NA	NA	NA
Joint Number	Visual	OD	Thread Taper	Thread Lead	Cum. Lead	Thread Height	Thread Addendum	Thread Profile	Thread Crest Diameter	Ovality	Max Allowable Standoff Tolerance	Measured Standoff Value	Recess Diameter	Recess Depth	Bearing Face	Coupling Length	Coupling Thread Alignment
			0.072	0.072	0.072		0.072										
Side (A/B)	—	8.585	0.0677	+0.003	+0.006	0.0732	+0.0015	OK	+0.008	0.0305		—	7.812	0.434	0.2188	9.250	0.031
	—	8.415	0.0599	-0.003	-0.006	0.0693	-0.0015	Reject	-0.008	Max	—	—	7.781	0.433	Min	Max	Max
1-A	OK	—	—	—	—	—	—	Mold	—	—	—	—	—	—	—	—	—
1-B	OK	—	—	—	—	—	—	OK	—	—	—	—	—	—	—	—	—
2-A	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2-B	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3-A	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3-B	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4-A	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4-B	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5-A	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5-B	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6-A	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6-B	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7-A	OK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7-B	BCT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Figure B.21—Example Inspection (with Commentary Notes): Long Thread Casing (LC) Box

Annex C
(informative)

Seal-Ring Groove Relative Depth and Concentricity Gauging

A thread height gauge with a flat-type tip shall be used. With the anvil of the gauge resting on the thread crests and the penetrant in the seal-ring groove against the side nearest the center of the coupling, radial depths from the thread crests to the seal-ring groove bottom shall be read on selected increments over the circumference of the groove (see Figures C.1 and C.2). The anvil shall not be placed near featheredge fade-outs. If the maximum differences in indicated reading exceed 0.020 inches, the coupling is rejected. Alternate contact tip configurations are shown in Figure 61.

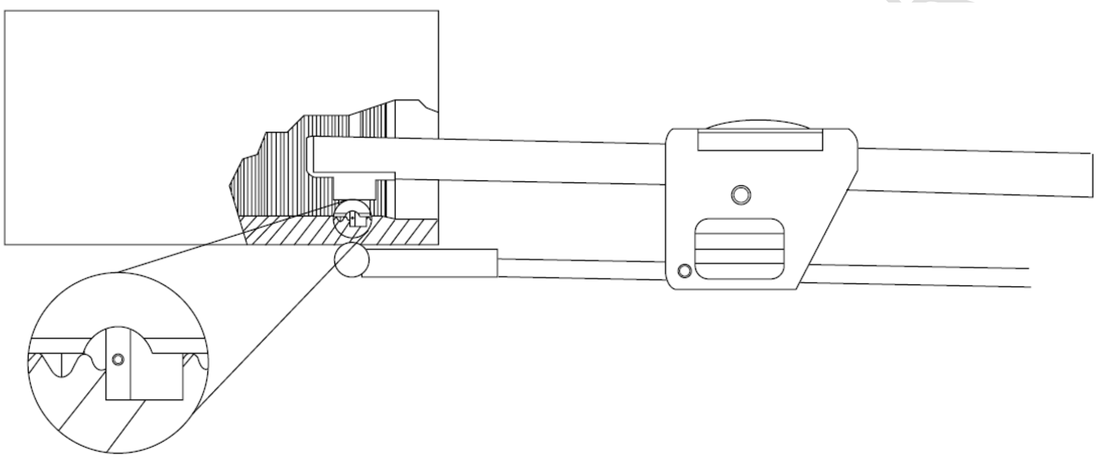


Figure C.1—Gauging of Tubing Coupling Grooves

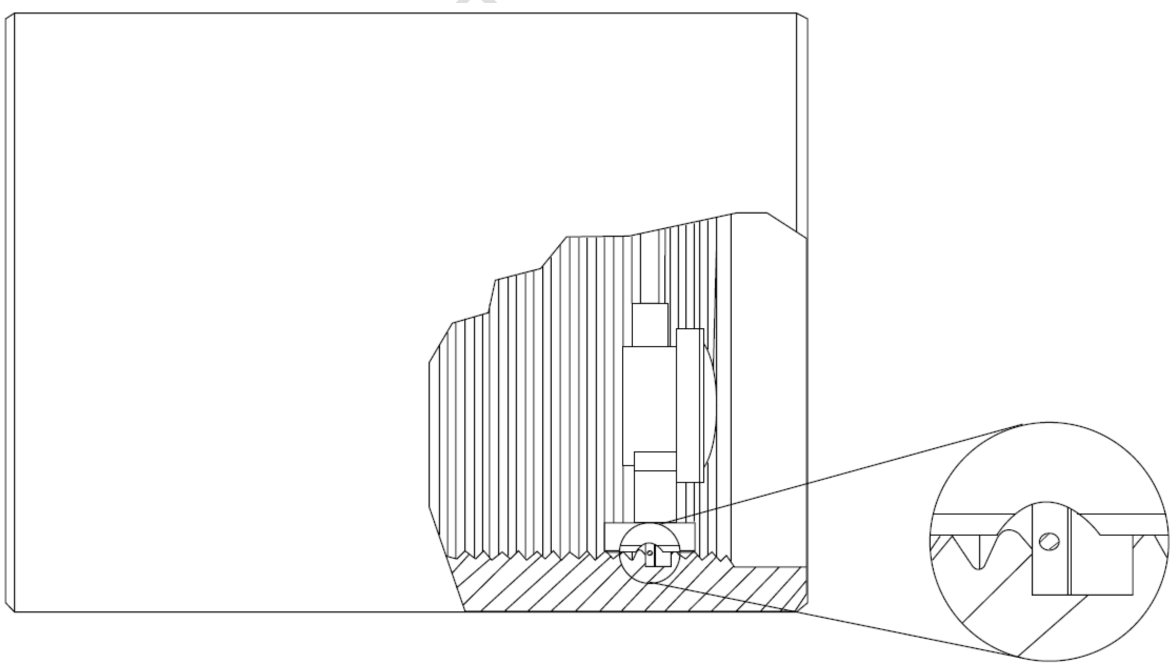


Figure C.2—Gauging of Casing Coupling Grooves

Bibliography

[1] API Bulletin 5T1, *Imperfection and Defect Terminology*

[2] API Recommended Practice 5A5, *Field Inspection of New Casing, Tubing, and Plain-end Drill Pipe*

[3] ASNT SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*