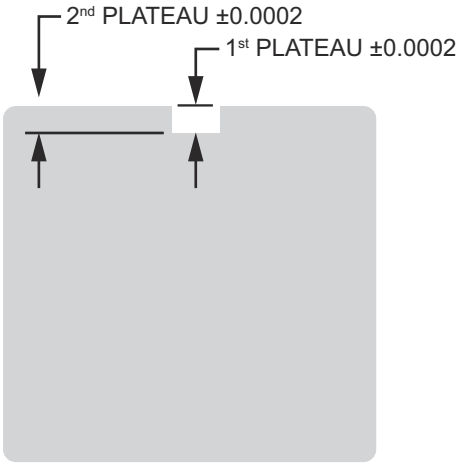


Figure 37—Buttress Height Gauge Setting Standard (1 in. TPF Buttress Thread Height Standard)

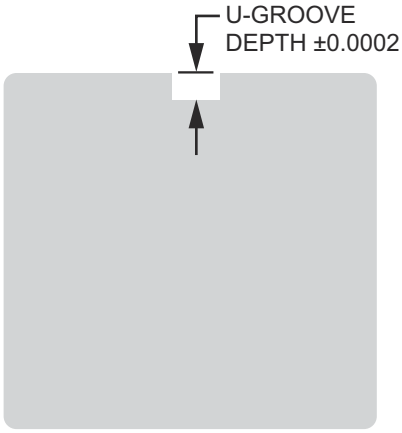


Figure 38—Round Thread Height Gauge Setting Standard ($^3/_4$ in. TPF Buttress Thread Height Standard)

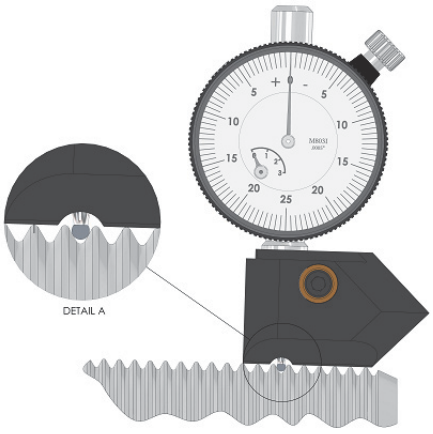


Figure 39—External Addendum Gauge on Pin Threads (Round Thread Addendum Gauge)

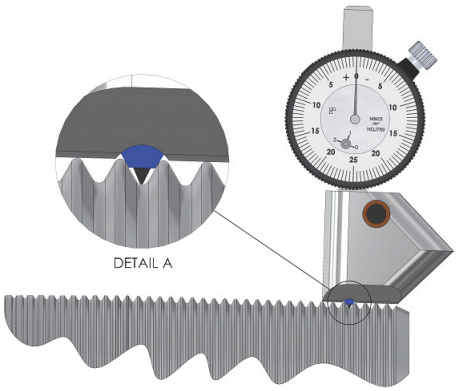


Figure 40—External Thread Height Gauge on Pin Threads (Round Thread Height Gauge)

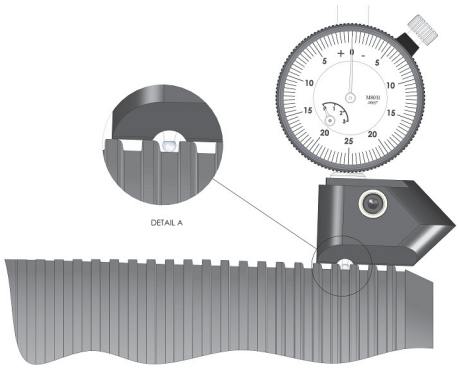


Figure 41—External Thread Height Gauge on Pin Threads (Buttress Thread Height Gauge)

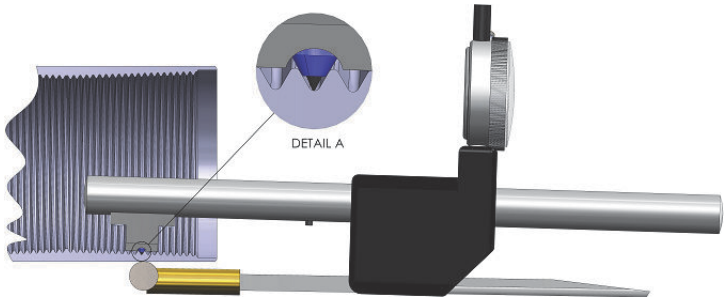


Figure 42—Internal Thread Height Gauge on Coupling Threads (Round Thread Height Gauge)

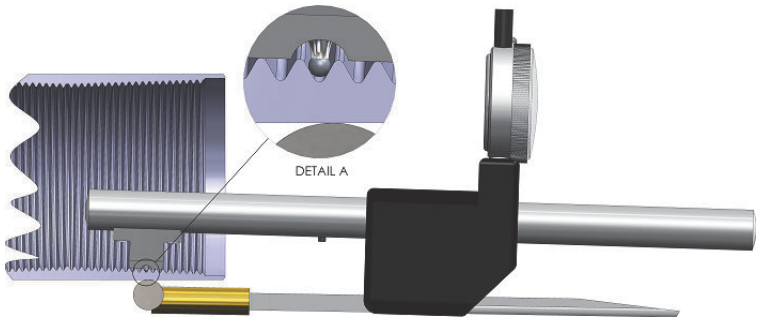


Figure 43—Internal Addendum Gauge on Coupling Threads (Round Thread Addendum Gauge)

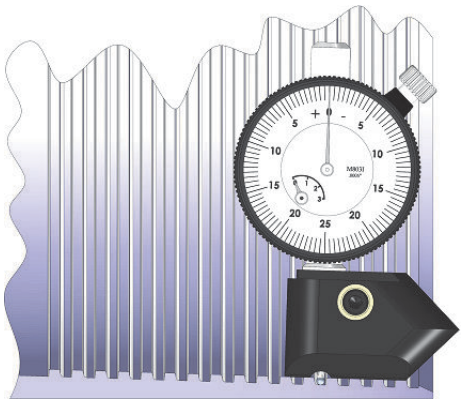


Figure 44—Internal Thread Height Gauge on Coupling Threads (Buttress Thread Height Gauge)

5.6 Angle and Thread Form Measurement

5.6.1 General

The following criteria are applicable to thread angle and form.

— For 60-degree threads, the flank angles are half angles of the thread and therefore equal. For buttress threads, the leading flanks are 10 degrees and the following flanks are 3 degrees.

— The form of thread is its profile in an axial plane for a length of one pitch.

5.6.2 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 is required. 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.

5.6.3 Procedure

The angles of the uncoated thread shall be verified and assured that the complete thread form is within tolerance

5.6.4 Requirements

For 60-degree threads, thread form requirements include the limitations imposed by the requirements on height of thread, thread addendum, and included angle or individual flank angles. For buttress threads, the thread form shall conform to the basic dimensions within the tolerances of Figure 2 and Figure 3 including the requirements of thread height, included flank angles, tooth thickness, or groove width. The following are examples of acceptable methods of measuring tooth thickness: Single dial gauge, optical comparator, contour measuring machine, or cast molds. The quality of workmanship required for acceptance under these specifications automatically prohibits the presence of such defects in thread form as torn threads, shaved threads, broken threads, and distorted threads that fall outside thread form requirements. Such imperfections may be detected, while at the same time measuring flank angles. Angular, as well as linear, assessments of the defects shall be determined by comparing the thread profile image with that of a toleranced thread overlay (Figure 45 and Figure 46) or by direct measurement.

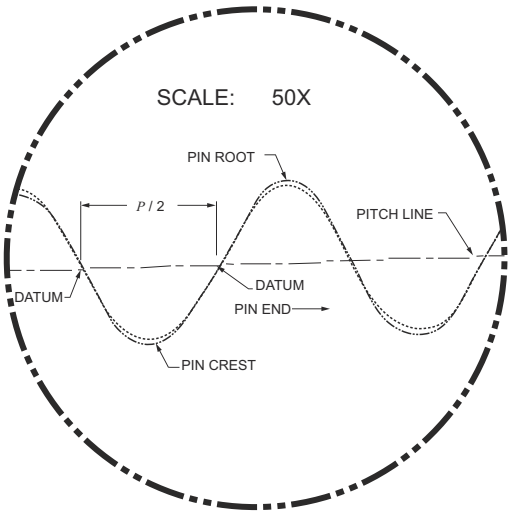


Figure 45—External Thread Form Overlays for 8 Round Threads

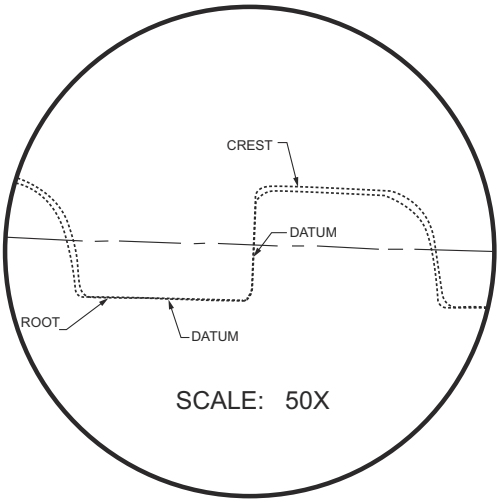


Figure 46—External Thread Form Overlays for Buttress Threads

5.7 Single Dial Buttress Thread Form Gauge

5.7.1 General

This 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 for the form gauge shall be ball pointers of 0.087 in. (22.1 mm) diameter truncated 0.023 in. (0.58 mm). Before use, the dial indicator shall be adjusted to zero using a setting standard.

5.7.2 Procedure

After the gauge is properly verified against the setting standard, place the point of the gauge in the thread groove starting at the small diameter. With the anvil of the gauge contacting the thread root or crests (always over full crested threads), pivot the gauge on the rounded anvil edge through a small arc. Ensure that base is in a line parallel to the thread axis. Take the reading at the point where the indicator hand reaches the maximum indication (which may be the highest position). Check the remaining threads in the required intervals in the same axis line clock position (last perfect thread). If the threads have imperfect crests, shift to the last threads having a full crest.

Buttress thread form gauge tolerances from zero setting are illustrated in Figure 47 and Figure 48, and a Go-no/Go-fixed limit gauge as shown in Figure 49.

With the anvil contacting shown in Figure 48, contacting the thread crests or the contacts shown in Figure 47, contacting the root.

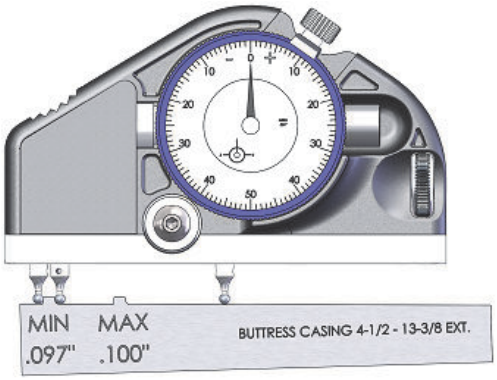


Figure 47—Buttress Tooth Width Gauge (Measured from Thread Root)

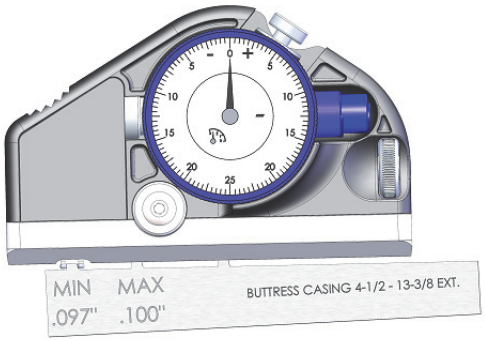


Figure 48—Buttress Tooth Width Gauge (Measured from Thread Crest)

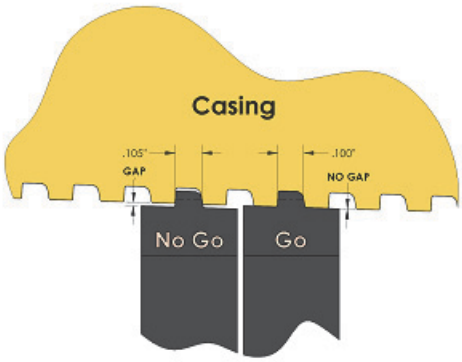


Figure 49—Buttress Groove Width Gauge

5.8 Coupling Thread Alignment

5.8.1 General

The opposing coupling-thread cones are aligned through the bore.

5.8.2 Equipment

Concentricity and alignment of coupling threads may be measured with the following types of equipment:

a) Figure 50 is an example of equipment capable of measuring for concentricity and alignment of coupling threads. Concentricity and alignment tests for coupling threads (see Section 4) are made by screwing the coupling onto the threaded test mandrel which has been centered on the lathe type spindle, then screwing into the other end of the coupling a threaded plug provided with an axial extension of 1 ft (304.8 mm) and a disc attached as shown. While the assembly is rotated, concentricity of the coupling threads can be determined by means of a dial gauge bearing radially against the OD of the disc next to the coupling face (as shown). Angular misalignment can be determined by means of a dial gauge bearing radially against the plug extension or axially against the side of the disc which is parallel to the coupling face.

b) Figure 51 is an example of a coupling-thread alignment gauge. The contact points utilized on thread alignment gauges of this type shall be as follows:

1) Line pipe, round thread casing and tubing shall be the same as those as shown in 5.4.2 for the lead gauge.

2) Ball point diameter of 0.100 in. (2.54 mm) truncated 0.030 in. (0.76 mm) shall be used for buttress casing threads.

i) The ball points shall be inserted in the thread grooves an equal distance on either side of the J area but not less than $2J + 2$ thread turns apart parallel along the centerline axis of the coupling as shown in Figure 52 and Figure 53.

ii) The ball points shall then be rotated one turn while positioned in the thread grooves.

The maximum sweep of the dial gauge indicator (space between the maximum and minimum indications) shall not exceed the amount determined by:

$$R = EA/240 \quad (2)$$

where

A is the maximum allowable misalignment in 20 ft (6.1 m) (see 4.10);

E is the pitch diameter of the coupling where the contact points on the gauge are located. This shall be calculated for the coupling being inspected, and

R is the maximum permissible sweep of the dial gauge indicator.

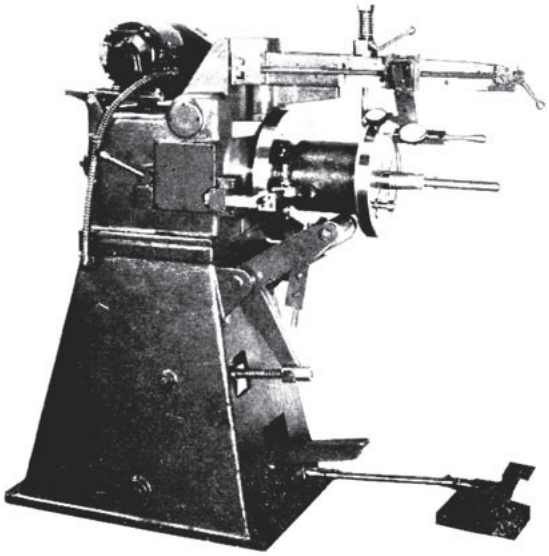


Figure 50—Equipment for Measuring Coupling Alignment and Concentricity

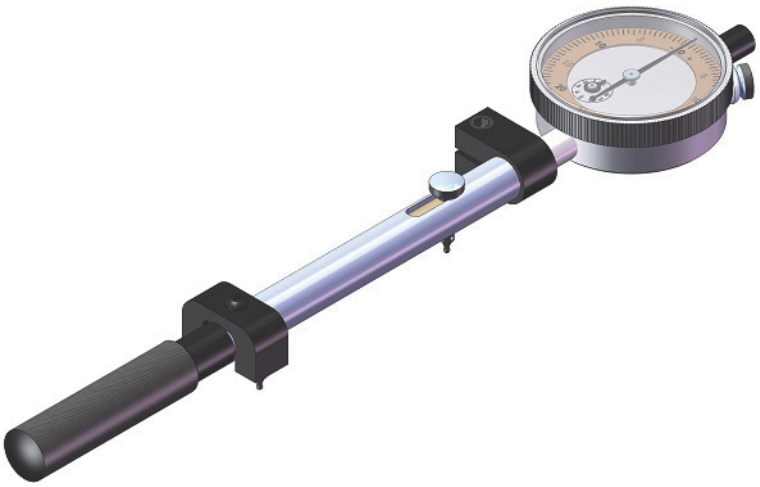


Figure 51—Coupling Alignment Gauge

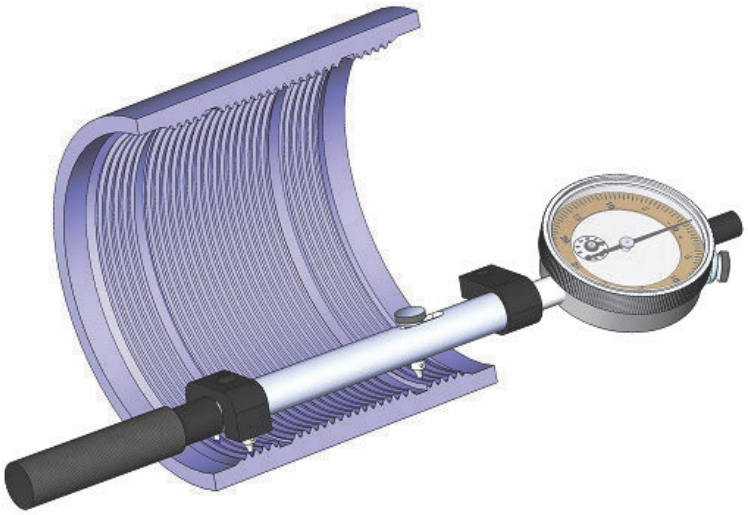


Figure 52—Coupling Alignment Inspection

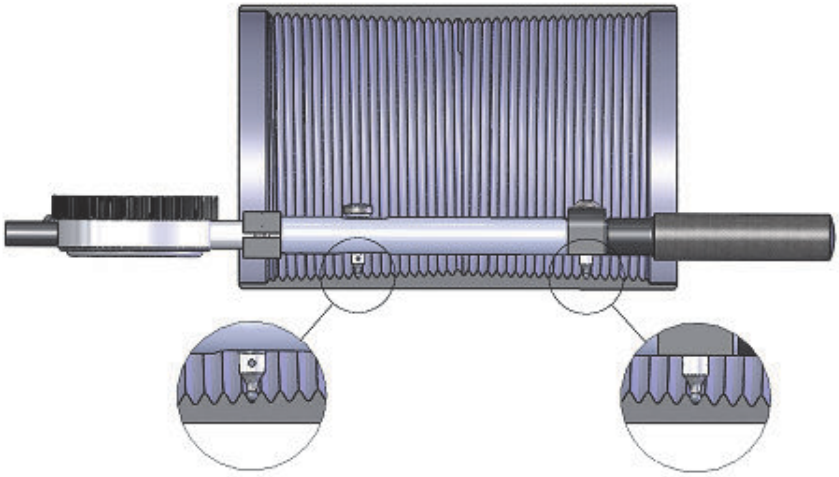


Figure 53—Coupling Alignment Inspection (Detail)

5.9 Calibration of Instruments and Dial Gauges

5.9.1 Use a lead-gauge calibrator to verify calibration of lead gauges through the entire range of scale for total lengths of threads up to 4 in. (101.60 mm). It is essential that calibrators of this type utilize a precision screw micrometer reading in increments of 0.0001 in. (0.003 mm). Determine the amount of movement of the micrometer screw [reading the micrometer to 0.0001 in. (0.003 mm)] necessary to indicate an error of 0.001 in. (0.03 mm) by the lead gauge for each 0.001 in. (0.03 mm) of the lead gauge scale. From these determinations, prepare a table of accumulative error for the entire scale range of the lead gauge.

5.9.2 The accuracy of lead gauge standard templates, height gauge check blocks and crest cone standards should be verified in an approximately 68 °F (20°C) environment by a means that assures a measurement precision no greater than 25 % of the allowable tolerance for the dimension being measured. The required distances between notches on the lead gauge standard template are compensated for measurement parallel to the taper cone and are given in Table 19 and 5.4.3. The groove dimensions for height check blocks are given in Table 21 and Table 22, and 5.5.4.

5.9.3 Calibrate dial gauges by a method with a resolution of 0.0001 in. (0.003 mm). Following are some examples of acceptable calibration instruments:

— toolmaker's microscope

— universal measuring microscope

— precision screw micrometer reading in increments of 0.0001 in. (0.003 mm)

— precision gauge blocks

— precision linear-measuring machine

5.9.4 Dial gauges shall be tested for accuracy on repeated readings and also of measuring intervals, over the full dial scale. The accuracy of repeated readings shall be within 0.0002 in. (0.005 mm). The accuracy of interval measurements shall be within the following values as shown in Table 24:

Table 24—Dial Gauge Error Check

Dial Range in. (mm)	Max Error in. (mm)
1.0000 (25.400)	0.0010 (0.025)
0.5000 (12.700)	0.0010 (0.025)
0.1000 (2.540)	0.0005 (0.013)
0.0200 (0.508)	0.0002 (0.005)

5.9.5 Frequency of Calibration

Verify calibration of dial gauges at frequent intervals throughout the entire range of plunger travel when received, and after they have been dropped, subjected to unusual shocks, or other conditions which might affect the accuracy of precision measuring instruments. Intervals shall be no less than once per year or more often as required by internal quality management systems. However, if the dial gauge is not used in the 1-year period, calibration is not required until subsequent future usage.

6 Diameter, Ovality, and Size Gauging Practice

6.1 Line Pipe, Round Thread Casing and Tubing, and Buttress Thread Casing

6.1.1 Coverage

All threads covered by this section shall comply with the gauging requirements specified herein. Accordingly, a manufacturer who produces products using the threads covered by this Specification shall have access to setting standards for thread diameter gauges and shall have access to master size gauges for each size and type of thread produced. Setting standards for thread crest diameter gauges conform to the requirements of Section 7. Master size gauges consists of a plug and mating ring conforming to the requirements of Section 7 and certified as required in Section 8.

Gauges made under API 5A, 5AX, or 5L prior to 1962 may be used provided proper allowance is made for deviations from the requirements of Section 5. See 6.1.15 regarding line pipe gauges made prior to 1940.

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.

6.1.2 Gauge Requirements

The manufacturer of product threads shall also provide working gauges for the measurement of crest diameter, addendum, ovality, and size, conforming to the requirements of 7.1.2 for use in gauging the product threads, and shall maintain each working gauge in such condition as to ensure that product threads, gauged as required herein, are acceptable under this specification. The manufacturer shall establish and document a program of measuring the wear on each gauge and setting standard(s) used in the production of API threads. Included in this program shall be detailed procedures for the measurement of wear, and the criteria of rejection that will result in the complete decommissioning of gauges, or setting standards from future use, or a combination thereof. The results of each required measurement shall be documented. The records of procedures used and measurements made, shall be maintained for not less than three years following the last usage of each gauge. The manufacturer shall also establish and document a frequency for inspecting product threads with working gauges based on the controls of the specific manufacturing process.

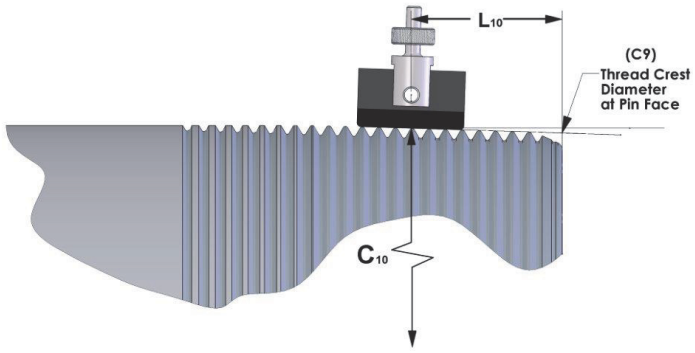
6.1.3 Crest Diameter Locations

For product threads in this specification that require measurement of crest diameter, the location of the crest diameter on pins (the major cone) is defined as the diameter of the crest cone C_{10} at the L_{10} length and on couplings (the minor cone) is defined as the diameter of the crest cone C_{12} at the M_{12} length. On buttress casing pipe, as many as two threads within the L_c length may be showing the original outside surface of the pipe on their crests for a circumferential distance not exceeding 25 % of the pipe circumference. Because these black-crested threads may extend into the L_{10} gauging length, measurements shall be made with a minimum of 50 % of the measuring shoe located on full-crested threads. For crest diameter measurements made at locations other than L_{10} length and M_{12} length, corresponding setting values shall be appropriately adjusted.

Gauge systems in existence prior to the 16th edition of API 5B may be utilized. Crest diameter measurements may be made at locations other than L_{10} length and M_{12} length if the corresponding setting values are appropriately adjusted using nominal taper; setting standards shall also comply with the marking and tolerancing requirements in 7.1.11. In case of dispute, acceptance or rejection shall be made with measurements at L_{10} and M_{12} lengths, provided the gauge shoes ride on full-crested threads.

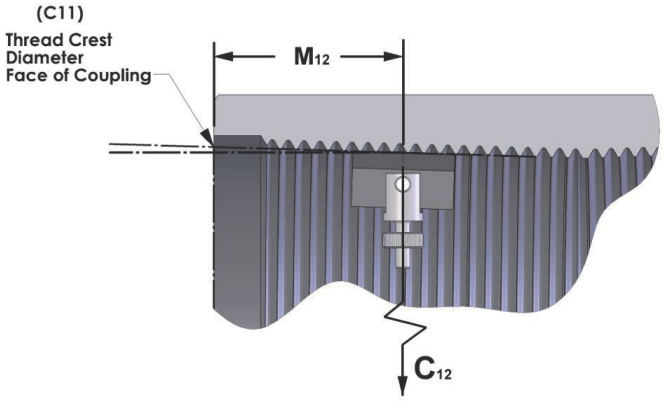
6.1.4 Thread Diameter Gauge Requirements

Thread diameter gauges, conforming to the requirements of Section 7 and certified as required in Section 8, may be of a particular type (mechanical, dial indicator, optical, laser or equivalent) capable of thread crest diameter measurements, or thread pitch diameter measurements at the L_{10} or M_{12} planes, or both, with a demonstrated measurement precision of 0.001 in. (0.0254 mm) or better. See Figure 54 and Figure 55 for an illustration of the gauge's location.



NOTE For specific gauging system setup and use, see appropriate manufacturing requirements.

Figure 54—External Thread Crest Diameter Gauge Location



NOTE For specific gauging system setup and use, see appropriate manufacturing requirements.

Figure 55—Internal Thread Crest Diameter Gauge Location