Specification for Rotary Drill Stem Elements

API SPECIFICATION 7
THIRTY-NINTH EDITION, DECEMBER 1997

EFFECTIVE DATE: JUNE 1, 1998

American Petroleum Institute

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Specification for Rotary Drill Stem Elements

1 Scope

1.1 COVERAGE

This specification covers requirements on drill-stem members (except drill pipe), including threaded connections, gauging practice, and master gauges therefor. A typical drill-stem assembly is shown in Figure 1. Also included, as appendices, are recommended practices on care and use of regional master, reference master, and working gauges.

1.2 MATERIAL REQUIREMENTS

Where material requirements are not otherwise specified, material for equipment supplied to this specification may vary depending on the application but shall comply with the manufacturer's written specifications. Manufacturer specifications shall define:

a. Chemical composition limits.
b. Heat treatment conditions.
c. Mechanical property limits:
   1. Tensile strength.
   2. Yield strength.
   3. Elongation.
   4. Hardness.

2 References

API

RP 5A3	*Thread Compounds for Casing, Tubing, and Line Pipe*
RP 7A1	*Testing of Thread Compound for Rotary Shouldered Connections*
RP 7G	*Drill Stem Design and Operating Limits*
Spec 5D	*Drill Pipe*
Spec 7	*Rotary Drill Stem Elements*, 32nd Edition
Spec 8A	*Drilling and Production Hoisting Equipment*
Spec 8C	*Drilling and Production Hoisting Equipment (PSL 1 and PSL 2)*

ASME[1]

Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"

ASNT[2]

RP SNT-TC-1A Recommended Practice No. SNT-TC-1A

ASTM[3]

A262	*Practice E*
A370	*Test Methods and Definitions for Mechanical Testing of Steel Products*
A434	*Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered*
E8	*Tension Testing of Metallic Materials*
E10	*Test Method for Brinell Hardness of Metallic Materials*
E23	*Notched Bar Impact Testing of Metallic Materials*
E114	*Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method*
E214	*Immersed Ultrasonic Examination by the Reflection Method Using Pulsed Longitudinal Waves*
E1001	*Detection and Evaluation of Discontinuities by the Immersed Pulse-Echo Ultrasonic Method Using Longitudinal Waves*

3 Definitions

For the purposes of this specification, the following definitions apply:

3.1 bevel diameter: The outer diameter of the contact face of the rotary shouldered connection.

3.2 bit sub: A sub, usually with 2 box connections, that is used to connect the bit to the drill stem.

3.3 box connection: A threaded connection on Oil Country Tubular Goods (OCTG) that has internal (female) threads.

3.4 calibration system: A documented system of gauge calibration and control.

3.5 cold working: Plastic deformation of metal at a temperature low enough to insure or cause permanent strain.

3.6 decarburization: The loss of carbon from the surface of a ferrous alloy as a result of heating in a medium that reacts with the carbon at the surface.

3.7 drift: A gauge used to check minimum ID of loops, flowlines, nipples, tubing, casing, drill pipe, and drill collars.

3.8 drill collar: Thick-walled pipe to provide stiffness and concentration of weight at the bit.

3.9 drill pipe: A length of tube, usually steel, to which special threaded connections called tool joints are attached.

[1]American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017.
[2]American Society for Nondestructive Testing, Inc., 1711 Arlingate Lane, Columbus, Ohio 43228.
[3]American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428.

3.10 forging: (1) Plastically deforming metal, usually hot, into desired shapes with compressive force, with or without dies. (2) A shaped metal part formed by the forging method.

3.11 full depth thread: A thread in which the thread root lies on the minor cone of an external thread or lies on the major cone of an internal thread.

3.12 gauge point: An imaginary plane, in the pin threads, perpendicular to the thread axis, in which the pitch diameter equals the value in Column 5 of Table 25.

3.13 kelly: The square or hexagonal shaped steel pipe connecting the swivel to the drill pipe. The kelly moves through the rotary table and transmits torque to the drill string.

3.14 kelly saver sub: A short substitute that is made up onto the bottom of the kelly to protect the pin end of the kelly from wear during make-up and break-out operations.

3.15 last engaged thread: The last thread on pin engaged with the box.

3.16 L_{BT}**:** Length of threads in the box measured from the make-up shoulder to the intersection of the non-pressure flank and crest of the last thread with full thread depth.

3.17 lower kelly valve (kelly cock): An essentially full-opening valve installed immediately below the kelly, with outside diameter equal to the tool joint outside diameter. Valve can be closed to remove the kelly under pressure and can be stripped in the hole for snubbing operations.

3.18 make-up shoulder: The sealing shoulder on a rotary shouldered connection.

3.19 non-pressure flank: The thread flank on which no axial load is induced from make-up of the connection or from tensile load on the drill stem member. On the pin, it is the thread flank farthest from the make-up shoulder. On the box, it is the thread flank closest to the make-up shoulder.

3.20 pin end: The external (male) threads of a threaded connection.

3.21 pitch cone: An imaginary cone whose diameter at any point is equal to the pitch diameter of the thread at the same point.

3.22 pitch diameter: The diameter at which the distance across the threads is equal to the distance between the threads.

3.23 quenched and tempered: Quench hardening—hardening a ferrous alloy by austenitizing and then cooling rapidly enough that some or all of the austenite transforms to martensite.

Tempering—reheating a quenched-hardened or normalized ferrous alloy to a temperature below the transformation range and then cooling at any rate desired.

3.24 reference dimension: Dimension that is a result of two or more other dimensions.

3.25 rotary shouldered connection: A connection used on drill string elements, which has coarse, tapered threads and sealing shoulders.

3.26 stress-relief feature: A modification performed on rotary shouldered connections that removes the unengaged threads of the pin or box. This process makes the joint more flexible and reduces the likelihood of fatigue cracking in this highly stressed area.

3.27 swivel: Device at top of the drill stem that permits simultaneous circulation and rotation.

3.28 tensile strength: The maximum tensile stress that a material is capable of sustaining. Tensile strength is calculated from the maximum load during a tension test carried to rupture and the original cross-sectional area of the specimen.

3.29 test pressure: A pressure above working pressure used to demonstrate structural integrity of a pressure vessel.

3.30 thread form: The thread profile in an axial plane for a length of one pitch.

3.31 tolerance: The amount of variation permitted.

3.32 tool joint: A heavy coupling element for drill pipe having coarse, tapered threads and sealing shoulders designed to sustain the weight of the drill stem, withstand the strain of repeated make-up and break-out, resist fatigue, resist additional make-up during drilling, and provide a leak-proof seal. The male section (pin) is attached to one end of a length of drill pipe and the female section (box) is attached to the other end. Tool joints may be welded to the drill pipe, screwed onto the pipe, or a combination of screwed on and welded.

3.33 upper kelly valve (kelly cock): A valve immediately above the kelly that can be closed to confine pressures inside the drill stem.

3.34 working gauges: Gauges used for gauging product threads.

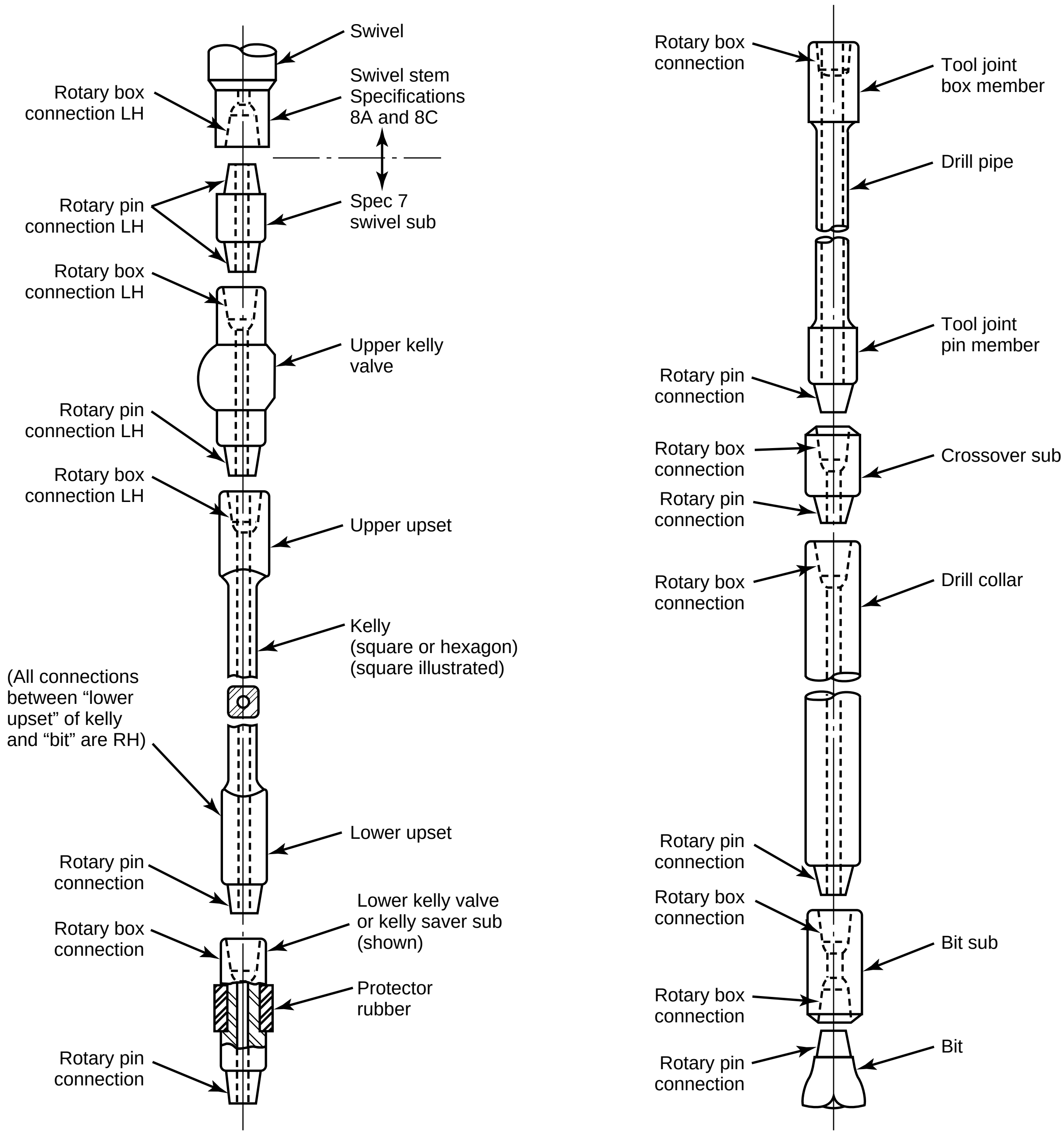
3.35 working pressure: The pressure to which a particular piece of equipment is subjected during normal operations.

3.36 working temperature: The temperature to which a particular piece of equipment is subjected during normal operations.

4 Upper and Lower Kelly Valves

4.1 GENERAL

This specification specifies the minimum design, material, and inspection requirements for both upper and lower kelly valves. It applies to valves of all sizes with rated working pressures of 5,000 through 15,000 psi (34.5 through 103.4 MPa) applied in normal service conditions (not H_2S service). Rated working temperatures are 14°F (–10°C) and above.



Note: Requirements on the swivel are included in API Specifications 8A and 8C.

Figure 1—Typical Drill-Stem Assembly

4.2 DESIGN CRITERIA

The manufacturer shall document the design criteria and analysis for each type of valve produced under the auspices of this specification. The minimum design yield safety factor shall be 1.0 times the test pressure in Table 1.

4.2.1 Material Requirements

For material requirements, see 1.2.

Note: Mechanical properties shall be determined by tests on cylindrical tensile specimens conforming to the requirements of ASTM A370, 0.2 percent offset method.

4.2.2 Impact Strength

Three longitudinal impact test specimens per heat/heat treatment lot shall be taken. The average impact values of the three specimens shall be no less than 30 ft-lbs (41 J) with no single value below 23 ft-lbs (31 J) when tested at 14°F (–10°C).

Note: Testing will be in accordance with the requirements of ASTM A370 and ASTM E23, Charpy V-Notch method.

4.3 CONNECTIONS

For both upper and lower kelly valves, connections shall be of the size and type shown in Section 5 and Tables 3 and 4 unless otherwise stated on the purchase order. When such connections are employed, the corresponding bevel diameters specified for such connections shall be used.

Connections shall be non-destructively inspected by the wet magnetic particle method for both transverse and longitudinal defects in accordance with the ASME *Boiler & Pressure Vessel Code*, Section 5, Sub-section A, Article 7, and Sub-section B, Article 25. The examination shall be performed in accordance with a written procedure, which shall be made available to the purchaser on request.

4.4 INSPECTION AND TESTING

Manufacturer shall maintain and provide on request to the purchaser documentation of inspection (dimensional, visual, and nondestructive) and hydrostatic testing.

4.5 HYDROSTATIC TESTING

Hydrostatic testing shall be conducted to the pressures shown in Table 1.

Table 1—Hydrostatic Testing Pressures

Minimum Pressure Working Rating		Maximum Hydrostatic Shell Test Pressure	
psi	MPa	psi	MPa
5,000	34.5	10,000	68.9
10,000	68.9	15,000	103.4
15,000	103.4	22,500	155.1

4.5.1 Hydrostatic Shell Testing

Each valve body shall be tested to the hydrostatic test pressure by the following method. The test shall be conducted in three parts:

a. Initial pressure holding period of three minutes.
b. Reduction of pressure to zero.
c. Final pressure holding period of not less than 10 minutes.

Note: Testing shall be conducted with the valve in the half closed position. During the pressure holding period, timing will start when pressure stabilization is achieved. During this period no detectable pressure drop or leakage may occur.

4.5.2 Seat Test

The seat test will be conducted to the maximum rated working pressure with the valve in the closed position. Pressure will be applied to the functional lower end of the valve (normally the pin end). Test period will be for a minimum of five minutes with no detectable leakage or drop in pressure.

4.6 MARKING

Kelly valves manufactured in conformance with this specification shall be die-stamped using a low stress steel stamp as follows:

a. Manufacturer's name or mark, "Spec 7," unique serial number, and maximum rated working pressure to be applied in milled recess.
b. Connection size and style to be applied on OD surface adjacent to connection.
c. Indication of rotation direction required to position valve in closed position on OD surface adjacent to valve operating mechanism.

5 Square and Hexagon Kellys

5.1 SIZE, TYPE, AND DIMENSIONS

Kellys shall be either square or hexagon and conform to the sizes and dimensions in Tables 2 and 3 and Figures 2 and 3.

5.2 DIMENSIONAL GAUGING

5.2.1 Drive Section

The drive section of all kellys shall be gauged for dimensional accuracy, using a sleeve gauge conforming to Table 4 and Figure 4.

5.2.2 Bore

All kelly bores shall be gauged with a drift mandrel 10 feet (3.05 meters) long minimum. The drift mandrel shall have a minimum diameter equal to the specified bore of the kelly (standard or optional) minus $^1/_8$ inch (3.2 millimeters).

5.3 CONNECTIONS

Kellys shall be furnished with box and pin connections in the sizes and styles stipulated in Tables 2 and 3 and shall conform with the requirements of Section 10.

Note: For the lower end of $4^1/_4$ and $5^1/_4$ square kellys and for the lower end of $5^1/_4$ and 6 hexagonal kellys, two sizes and styles of connections are standard. Also, for the $5^1/_4$ hexagonal kellys, a standard inside diameter (bore) and optional bore are provided (see Table 3).

5.4 SQUARE FORGED KELLYS

Square forged kellys shall be manufactured such that the decarburized surface layer is removed in the zones defined by the radiuses joining the drive section to the upper and lower upsets and extending a minimum of $^1/_8$ inch (3.2 millimeters) beyond the tangency points of the radiuses.

5.5 MECHANICAL PROPERTIES

The mechanical properties of kellys, as manufactured, shall comply with the requirements of Table 5. These properties shall be verified by performing a tensile test on one specimen (with properties representative of the end product) from each heat and bar size from that heat.

5.6 MARKING

Kellys manufactured in conformance with this specification shall be die-stamped on the OD of the upper upset with the manufacturer's name or identifying mark, "Spec 7," and the size and style of the upper connection. The lower upset shall be die-stamped on the OD with size and style of the lower connection. Numbered connections (NC) shall be stamped with both the NC and IF designations as shown in Tables 2 and 3.

Following is an example: A $4^1/_4$ square kelly with a $6^5/_8$ REG left-hand upper box connection shall be marked:

On upper upset:

A B Co (or mark) SPEC 7 $6^5/_8$ REG LH

On lower pin:

NC50 ($4^1/_2$ IF)

(Text continued on page 9.)

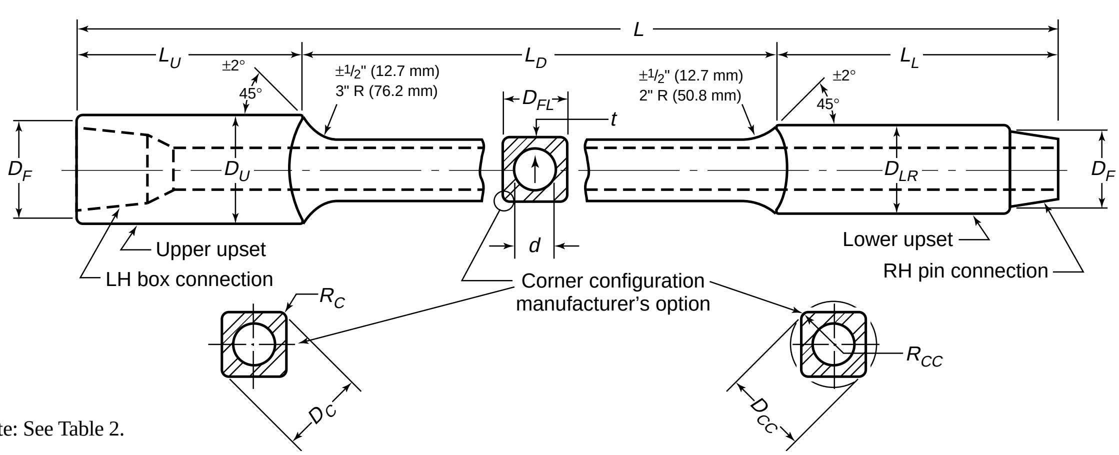
Table 2—Square Kellys

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
											Upper Box Connection											
	Length of Drive Section feet		Length Overall feet		Drive Section						Size and Style LH		Outside Diameter		Bevel Diameter			Lower Pin Connection				
Kelly Size ([a])	Standard ([b]) L_D	Optional ([b]) L_D	Standard ([c]) L	Optional ([c]) L	Across Flats ([d]) D_{FL}	Across Corners ([e]) D_C	Across Corners ([f]) D_{CC}	Radius ([g]) R_C	Radius ([l]) R_{CC}	Min. Wall Ecc. Bore t	Standard	Optional	Standard ([h]) D_U	Optional ([h]) D_U	Length ([i]) L_U	Standard ([j]) D_F	Optional ([j]) D_F	Size and Style	Outside Diameter ([h]) D_{LR}	Length ([i]) L_L	Bevel Diameter ([j]) D_F	Inside Diameter ([k]) d
2 1/2	37	—	40	—	2 1/2	3 9/32	3.250	5/16	1 5/8	0.450	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC26 (2 3/8 IF)	3 3/8	20	3 17/64	1 1/4
3	37	—	40	—	3	3 15/16	3.875	3/8	1 15/16	0.450	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC31 (2 7/8 IF)	4 1/8	20	3 61/64	1 3/4
3 1/2	37	—	40	—	3 1/2	4 17/32	4.437	1/2	2 7/32	0.450	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC38 (3 1/2 IF)	4 3/4	20	4 37/64	2 1/4
4 1/4	37	51	40	54	4 1/4	5 9/16	5.500	1/2	2 3/4	0.475	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC46 (4 IF)[m]	6 1/4	20	5 23/32	2 13/16
																		NC50 (4 1/2 IF)[m]	6 3/8	20	6 1/16	2 13/16
5 1/4	37	51	40	54	5 1/4	6 29/32	6.750	5/8	3 3/8	0.625	6 5/8 REG		7 3/4	—	16	7 21/64		5 1/2 FH[m]	7	20	6 23/32	3 1/4
																		NC56[m]	7	20	6 47/64	3 1/4

Notes:

1. See Figure 2.
2. All dimensions are in inches except lengths of drive section and lengths overall, which are given in feet. See Appendix M for metric table.

[a]Size of square kellys is the same as the dimension D_{FL} across flats (distance between opposite faces) as given in Column 6.
[b]Tolerance on L_D, +6, –5.
[c]Tolerance on L, +6, –0.
[d]Tolerances on D_{FL}, sizes 2 1/2 to 3 1/2 incl.: +5/64, –0.; sizes 4 1/4 and 5 1/4: + 3/32, –0. See 5.2 for sleeve-gauge test.
[e]Tolerance on D_C, sizes 2 1/2, 3, and 3 1/2: +1/8, –0; sizes 4 1/4 and 5 1/4: +5/32, –0.
[f]Tolerance on D_{CC}, +0.000, –0.015.
[g]Tolerance on R_C, all sizes, ±1/16.
[h]Tolerance on D_U and D_{LR}, all sizes, ±1/32.
[i]Tolerance on L_U and L_L, all sizes, +2 1/2, –0.
[j]Tolerance on D_F, all sizes, ±1/64.
[k]Tolerance on d, all sizes, +1/16, –0. See 5.2 for drift-mandrel test.
[l]Reference dimension only.
[m]See Note, 5.3.



Note: See Table 2.

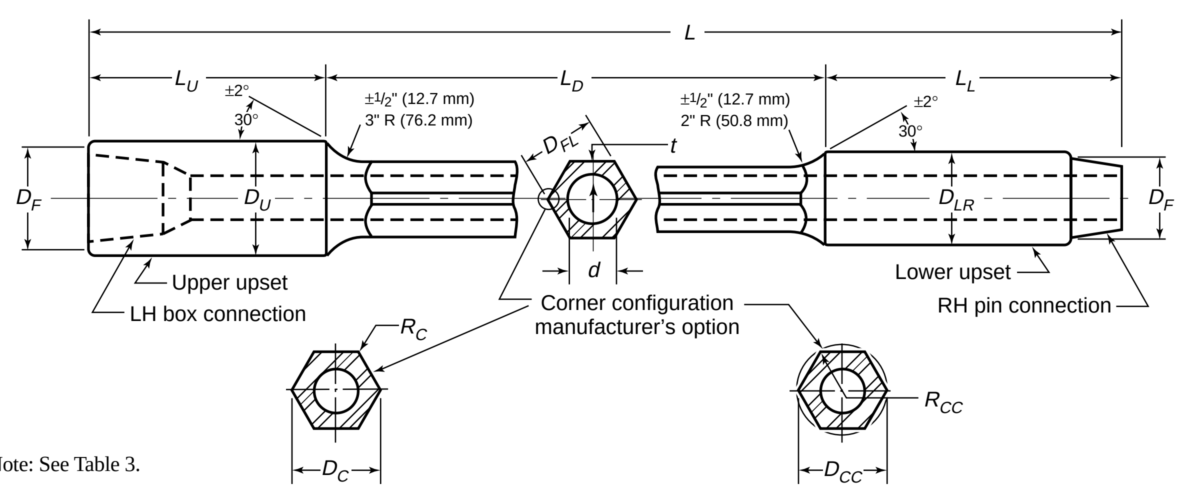
Figure 2—Square Kellys

Table 3—Hexagon Kellys

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
											Upper Box Connection											
	Length of Drive Section feet		Length Overall feet		Drive Section						Size and Style LH		Outside Diameter		Bevel Diameter			Lower Pin Connection				
Kelly Size	Standard	Optional	Standard	Optional	Across Flats	Across Corners	Across Corners	Radius	Radius	Min. Wall Ecc. Bore	Standard	Optional	Standard	Optional	Length	Standard	Optional	Size and Style	Outside Diameter	Length	Bevel Diameter	Inside Diameter
(a)	(b)	(b)	(c)	(c)	(d)	(e)	(f)	(e)	(j)				(e)	(e)	(g)	(h)	(h)		(e)	(g)	(h)	(i)
	L_D	L_D	L	L	D_{FL}	D_C	D_{CC}	R_C	R_{CC}	t			D_U	D_U	L_U	D_F	D_F		D_{LR}	L_L	D_F	d
3	37	—	40	—	3	3 3/8	3.375	1/4	1 11/16	0.475	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC26 (2 3/8 IF)	3 3/8	20	3 17/64	1 1/4
3 1/2	37	—	40	—	3 1/2	3 31/32	3.937	1/4	1 31/32	0.525	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC31 (2 7/8 IF)	4 1/8	20	3 61/64	1 3/4
4 1/4	37	51	40	54	4 1/4	4 13/16	4.781	5/16	2 25/64	0.625	6 5/8 REG	4 1/2 REG	7 3/4	5 3/4	16	7 21/64	5 19/64	NC38 (3 1/2 IF)	4 3/4	20	4 37/64	2 1/4
5 1/4	37	51	40	54	5 1/4	5 31/32	5.900	3/8	2 61/64	0.625	6 5/8 REG	—	7 3/4	—	16	7 21/64	—	NC46 (4 IF)[k]	6 1/4	20	5 23/32	3[k]
																		NC50 (4 1/2 IF)[k]	6 3/8	20	6 1/16	3 1/4[k]
6	37	51	40	54	6	6 13/16	6.812	3/8	3 13/32	0.625	6 5/8 REG	—	7 3/4	—	16	7 21/64	—	5 1/2 FH[k]	7	20	6 23/32	3 1/2
																		NC56[k]	7	20	6 47/64	3 1/2

Notes:
1. See Figure 3.
2. All dimensions are in inches except lengths of drive section and lengths overall, which are given in feet. See Appendix M for metric table.

[a]Size of hexagon kellys is the same as dimensions D_{FL} across flats (distance between opposite faces) as given in Column 6.
[b]Tolerance on L_D, +6, –5.
[c]Tolerance on L, +6, –0.
[d]Tolerance on D_{FL}, all sizes, +1/32, –0; see 5.2 for sleeve-gauge test.
[e]Tolerance on D_U, D_{LR}, and R_C, all sizes, ±1/32.
[f]Tolerance on D_{CC}, +0.000, –0.015.
[g]Tolerance on L_U and L_L, all sizes, +2 1/2, –0.
[h]Tolerance on D_F, ±1/64.
[i]Tolerance on d, all sizes, +1/16, –0; see 5.2 for drift-mandrel test.
[j]Reference dimension only.
[k]For 5 1/4 hexagon kellys a bore of 2 13/16 shall be optional. See Note 5.3.



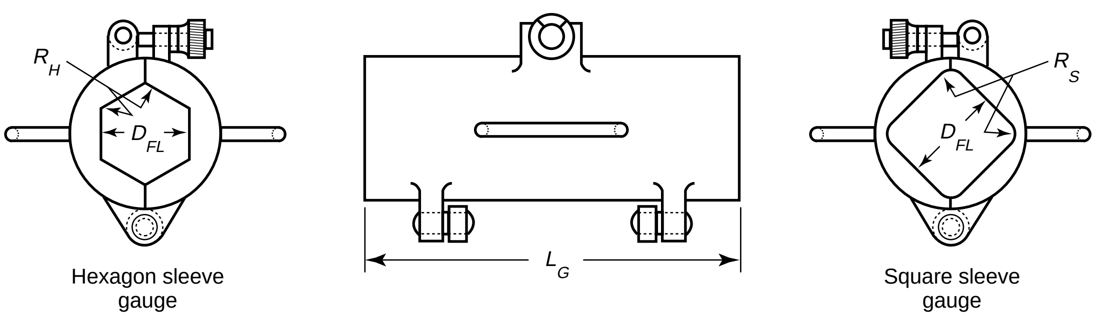
Note: See Table 3.

Figure 3—Hexagon Kellys

Table 4—Kelly Sleeve Gauge

Kelly Size	Min. Length of Gauge L_G	Distance Across Flats: Square D_{FL}	Distance Across Flats: Hexagon D_{FL}	Max. Fillet Radius: Square R_S	Max. Fillet Radius: Hexagon R_H
$2^1/_2$	10	2.594	—	$^1/_4$	—
3	10	3.094	3.036	$^5/_{16}$	$^3/_{16}$
$3^1/_2$	10	3.594	3.536	$^7/_{16}$	$^3/_{16}$
$4^1/_4$	12	4.375	4.286	$^7/_{16}$	$^1/_4$
$5^1/_4$	12	5.375	5.286	$^9/_{16}$	$^5/_{16}$
6	12	—	6.036	—	$^5/_{16}$

Notes:
1. See Figure 4.
2. All dimensions are in inches. See Appendix M for metric table.
3. Tolerance on D_{FL}, all sizes, +0.005, –0.000.
4. Tolerance on nominal included angles between flats ±0°, 30'.



Note: See Table 4.

Figure 4—Sleeve Gauge for Kellys

Table 5—Mechanical Properties and Tests New Kellys (All Sizes)

Lower Upset OD	Lower Upset Minimum Yield Strength psi	Lower Upset Minimum Tensile Strength psi	Minimum Elongation, Percent	Minimum Brinell Hardness BHN
$3^3/_8$ - $6^7/_8$	110,000	140,000	13	285
7	100,000	135,000	13	285

Notes:
1. Mechanical properties shall be determined by tests on cylindrical tensile specimens conforming to the requirements of current ASTM A370, 0.2 percent offset method, 0.500 inch diameter specimens preferred, 0.350 inch and 0.250 inch diameter specimens alternative for thin sections.
2. Tensile specimens from kelly should be taken from the lower upset in a longitudinal direction, having the centerline of the tensile specimen 1 inch from the outside surface or midwall, whichever is less.
3. Tensile testing is not necessary or practical on the upper upset. A minimum Brinell hardness number of 285 shall be prima facie evidence of satisfactory mechanical properties. The hardness test shall be made on the OD of the upper upset using Brinell hardness (Rockwell-C acceptable alternative) test methods in compliance with current ASTM A370 requirements.

6 Tool Joints

6.1 TOOL JOINT SIZE AND STYLE

Tool joints shall be of the weld-on type and shall be produced in the sizes and styles shown in Table 7.

6.2 MECHANICAL PROPERTIES

The mechanical properties of tool joints, as manufactured, shall not be lower than the minimum values shown in Table 6.

6.2.1 The nondestructive method for verifying tool joint mechanical properties shall be optional with the manufacturer.

6.2.2 Destructive determination of mechanical properties of the pin shall be done according to the latest edition of ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products.* Specimen parameters are as follows:

a. Specimens shall be taken from the location shown in Figure 5.
b. Specimens shall be taken parallel with the axis of the tool joint.
c. The test shall be conducted on a 0.500 inch (12.7 millimeter) diameter round specimen using the 0.2 percent offset method.

If the pin section at the specified location is not sufficient to secure a tensile specimen of 0.500 inch (12.7 millimeter) diameter, a 0.350 inch (8.9 millimeter) or 0.250 inch (6.4 millimeter) diameter specimen may be used.

If the pin section at the specified location is not sufficient to secure a tensile specimen of 0.250 inch (6.4 millimeter) diameter [1.00 inch (25 millimeter) gauge length] or larger, a minimum Brinell hardness number of 285 shall be prima facie evidence of satisfactory mechanical properties. The hardness test shall be made at the location shown in Figure 5.

6.2.3 Destructive determination of mechanical properties by tensile testing is not necessary or practical on box connections. A minimum Brinell hardness number of 285 shall be prima facie evidence of satisfactory mechanical properties. The hardness test shall be made at the location shown in Figure 5.

6.3 DIMENSIONAL REQUIREMENTS

Tool joints shall conform to the dimensions specified in Table 7. Paragraphs 6.3.1, 6.3.2, and 6.3.3 are exceptions to these dimensions.

6.3.1 Outside Diameter (OD) and Inside Diameter (ID)

The *D* and *d* (OD and ID) dimensions shown in Table 7 make the tool joint to drill pipe torsional strength ratio approximately 0.8 or greater.

Table 6—Mechanical Properties of New Tool Joints at Locations Shown in Figure 5 (All Sizes)

Minimum Yield Strength		Minimum Tensile Strength			
psi	N/mm²	psi	N/mm²	Minimum Elongation Percent	Box Minimum Brinell Hardness
120,000	827.4	140,000	965.3	13	285

Other OD and ID tool joints are acceptable when the drill string design is based on tensile strength requirements rather than on torsional strength requirements such as in combination strings or tapered strings.

The *d* dimension shown in Table 7 does not apply to boxes. Box inside diameters shall be optional.

6.3.2 Tong Space and Lengths

The L_{PB}, pin tong space, and L_B, box tong space, listed in Table 7 are minimums and may be increased.

The L_P, total length tool joint pin, and *L*, combined length of pin and box listed in Table 7, will increase as the pin tong space and box tong space are increased.

6.3.3 Elevator Upset

The D_{PE}, D_{SE}, and D_{TE}, diameter of pin at elevator upset and diameter of box at elevator upset, apply to finished drill pipe assemblies after the tool joint is welded to pipe.

6.4 TOOL JOINT/DRILL PIPE WELD ZONE REQUIREMENTS

6.4.1 Definitions

Note: These definitions apply to Section 6.4 only.

6.4.1.1 lot: A group of pipe to tool joint welds that are produced in a single continuous or interrupted production run using a single qualified procedure (WPS and WPQ). Lot quantities serve as the basis for production weld testing frequency.

6.4.1.2 procedure qualification record (PQR): The written documentation that a specific WPS meets the requirements of this specification. The record of the welding data used to weld a test joint and the test results from specimens taken from the test weld joint.

6.4.1.3 variable, essential: That variable parameter in which a change affects the mechanical properties of the weld joint. Changes in essential variables require requalification of the WPS.

6.4.1.4 variable, nonessential: That variable parameter in which a change may be made in the WPS without requalification.

(Text continued on page 12.)

Table 7—Tool Joint Dimensions For Grades E75, X95, G105, and S135 Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Drill Pipe			Tool Joint									
Tool Joint Designation[a]	Size and Style	Nom. Wt.[b] lb/ft	Grade	Outside Dia. of Pin and Box ±1/32 D	Inside Dia. of Pin[c] +1/64 –1/32 d	Bevel Dia. of Pin and Box Shoulder ±1/64 D_F	Total Length Tool Joint Pin +1/4 –3/8 L_P	Pin Tong Space ±1/4 L_{PB}	Box Tong Space ±1/4 L_B	Combined Length of Pin and Box ±1/2 L	Dia. of Pin at Elevator Upset Max. D_{PE}	Dia. of Box at Elevator Upset Max. D_{TE}	Torsional Ratio, Pin to Drill Pipe
NC26 (2 3/8 IF)	2 3/8 EU	6.65	E75	3 3/8	1 3/4	3 17/64	10	7	8	15	2 9/16	2 9/16	1.10
			X95	3 3/8	1 3/4	3 17/64	10	7	8	15	2 9/16	2 9/16	0.87
			G105	3 3/8	1 3/4	3 17/64	10	7	8	15	2 9/16	2 9/16	0.79
NC31 (2 7/8 IF)	2 7/8 EU	10.40	E75	4 1/8	2 1/8	3 61/64	10 1/2	7	9	16	3 3/16	3 3/16	1.03
			X95	4 1/8	2	3 61/64	10 1/2	7	9	16	3 3/16	3 3/16	0.90
			G105	4 1/8	2	3 61/64	10 1/2	7	9	16	3 3/16	3 3/16	0.82
			S135	4 3/8	1 5/8	3 61/64	10 1/2	7	9	16	3 3/16	3 3/16	0.82
NC38[d]	3 1/2 EU	9.50	E75	4 3/4	3	4 37/64	11 1/2[d]	8	10 1/2	18 1/2	3 7/8	3 7/8	0.91
NC38 (3 1/2 IF)	3 1/2 EU	13.30	E75	4 3/4	2 11/16	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.98
			X95	5	2 9/16	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.87
			G105	5	2 7/16	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.86
			S135	5	2 1/8	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.80
		15.50	E75	5	2 9/16	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.97
			X95	5	2 7/16	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.83
			G105	5	2 1/8	4 37/64	12	8	10 1/2	18 1/2	3 7/8	3 7/8	0.90
NC40 (4 FH)	3 1/2 EU	15.50	S135	5 1/2	2 1/4	5 1/64	11 1/2	7	10	17	3 7/8	3 7/8	0.87
	4 IU	14.00	E75	5 1/4	2 13/16	5 1/64	11 1/2	7	10	17	4 3/16	4 3/16	1.01
			X95	5 1/4	2 11/16	5 1/64	11 1/2	7	10	17	4 3/16	4 3/16	0.86
			G105	5 1/2	2 7/16	5 1/64	11 1/2	7	10	17	4 3/16	4 3/16	0.93
			S135	5 1/2	2	5 1/64	11 1/2	7	10	17	4 3/16	4 3/16	0.87
NC46 (4 IF)	4 EU	14.00	E75	6	3 1/4	5 23/32	11 1/2	7	10	17	4 1/2	4 1/2	1.43
			X95	6	3 1/4	5 23/32	11 1/2	7	10	17	4 1/2	4 1/2	1.13
			G105	6	3 1/4	5 23/32	11 1/2	7	10	17	4 1/2	4 1/2	1.02
			S135	6	3	5 23/32	11 1/2	7	10	17	4 1/2	4 1/2	0.94
	4 1/2 IU	13.75	E75	6	3 3/8	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	1.20
	4 1/2 IEU	16.60	E75	6 1/4	3 1/4	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	1.09
			X95	6 1/4	3	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	1.01
			G105	6 1/4	3	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	0.91
			S135	6 1/4	2 3/4	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	0.81
	4 1/2 IEU	20.00	E75	6 1/4	3	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	1.07
			X95	6 1/4	2 3/4	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	0.96
			G105	6 1/4	2 1/2	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	0.96
			S135	6 1/4	2 1/4	5 23/32	11 1/2	7	10	17	4 11/16	4 11/16	0.81
NC50 (4 1/2 IF)	4 1/2 EU	13.75	E75	6 5/8	3 7/8	6 1/16	11 1/2	7	10	17	5	5	1.32
	4 1/2 EU	16.60	E75	6 5/8	3 3/4	6 1/16	11 1/2	7	10	17	5	5	1.23
			X95	6 5/8	3 3/4	6 1/16	11 1/2	7	10	17	5	5	0.97
			G105	6 5/8	3 3/4	6 1/16	11 1/2	7	10	17	5	5	0.88
			S135	6 5/8	3 1/2	6 1/16	11 1/2	7	10	17	5	5	0.81

Notes:
1. See Figure 6.
2. All dimensions are in inches. See Appendix M for metric table.
3. Neck diameters (D_{PE} and D_{TE}) and inside diameters (d) of tool joints prior to welding are at manufacturer's option. The above table specifies dimensions after final machining of the assembly.
4. Appendix I contains dimensions of obsolescent connections and for square elevator shoulders.

[a]The tool joint designation indicates the size and style of the applicable connection.
[b]Nominal weights, threads and couplings are shown for the purpose of identification in ordering.
[c]The inside diameter does not apply to box members, which are optional with the manufacturer.
[d]Length of pin thread reduced to 3 1/2 inches (1/2 inch short) to accommodate 3 inch ID.

Table 7—Tool Joint Dimensions For Grades E75, X95, G105, and S135 Drill Pipe (Continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Drill Pipe			Tool Joint									
Tool Joint Designation[a]	Size and Style	Nom. Wt.[b] lb/ft	Grade	Outside Dia. of Pin and Box ±1/32 D	Inside Dia. of Pin[c] +1/64 –1/32 d	Bevel Dia. of Pin and Box Shoulder ±1/64 D_F	Total Length Tool Joint Pin +1/4 –3/8 L_P	Pin Tong Space ±1/4 L_{PB}	Box Tong Space ±1/4 L_B	Combined Length of Pin and Box ±1/2 L	Dia. of Pin at Elevator Upset Max. D_{PE}	Dia. of Box at Elevator Upset Max. D_{TE}	Torsional Ratio, Pin to Drill Pipe
	4 1/2 EU	20.00	E75	6 5/8	3 5/8	6 1/16	11 1/2	7	10	17	5	5	1.02
			X95	6 5/8	3 1/2	6 1/16	11 1/2	7	10	17	5	5	0.96
			G105	6 5/8	3 1/2	6 1/16	11 1/2	7	10	17	5	5	0.86
			S135	6 5/8	3	6 1/16	11 1/2	7	10	17	5	5	0.87
	5 IEU	19.50	E75	6 5/8	3 3/4	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.92
			X95	6 5/8	3 1/2	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.86
			G105	6 5/8	3 1/4	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.89
			S135	6 5/8	2 3/4	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.86
	5 IEU	25.60	E75	6 5/8	3 1/2	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.86
			X95	6 5/8	3	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.86
			G105	6 5/8	2 3/4	6 1/16	11 1/2	7	10	17	5 1/8	5 1/8	0.87
5 1/2 FH	5 IEU	19.50	E75	7	3 3/4	6 23/32	13	8	10	18	5 1/8	5 1/8	1.53
			X95	7	3 3/4	6 23/32	13	8	10	18	5 1/8	5 1/8	1.21
			G105	7	3 3/4	6 23/32	13	8	10	18	5 1/8	5 1/8	1.09
			S135	7 1/4	3 1/2	6 23/32	13	8	10	18	5 1/8	5 1/8	0.98
	5 IEU	25.60	E75	7	3 1/2	6 23/32	13	8	10	18	5 1/8	5 1/8	1.21
			X95	7	3 1/2	6 23/32	13	8	10	18	5 1/8	5 1/8	0.95
			G105	7 1/4	3 1/2	6 23/32	13	8	10	18	5 1/8	5 1/8	0.99
			S135	7 1/4	3 1/4	6 23/32	13	8	10	18	5 1/8	5 1/8	0.83
	5 1/2 IEU	21.90	E75	7	4	6 23/32	13	8	10	18	5 11/16	5 11/16	1.11
			X95	7	3 3/4	6 23/32	13	8	10	18	5 11/16	5 11/16	0.98
			G105	7 1/4	3 1/2	6 23/32	13	8	10	18	5 11/16	5 11/16	1.02
			S135	7 1/2	3	7 3/32	13	8	10	18	5 11/16	5 11/16	0.96
	5 1/2 IEU	24.70	E75	7	4	6 23/32	13	8	10	18	5 11/16	5 11/16	0.99
			X95	7 1/4	3 1/2	6 23/32	13	8	10	18	5 11/16	5 11/16	1.01
			G105	7 1/4	3 1/2	6 23/32	13	8	10	18	5 11/16	5 11/16	0.92
			S135	7 1/2	3	7 3/32	13	8	10	18	5 11/16	5 11/16	0.86
6 5/8 FH	6 5/8 IEU	25.20	E75	8	5	7 45/64	13	8	11	19	6 15/16	6 15/16	1.04
			X95	8	5	7 45/64	13	8	11	19	6 15/16	6 15/16	0.82
			G105	8 1/4	4 3/4	7 45/64	13	8	11	19	6 15/16	6 15/16	0.87
			S135	8 1/2	4 1/4	7 45/64	13	8	11	19	6 15/16	6 15/16	0.86
	6 5/8 IEU	27.70	E75	8	5	7 45/64	13	8	11	19	6 15/16	6 15/16	0.96
			X95	8 1/4	4 3/4	7 45/64	13	8	11	19	6 15/16	6 15/16	0.89
			G105	8 1/4	4 3/4	7 45/64	13	8	11	19	6 15/16	6 15/16	0.81
			S135	8 1/2	4 1/4	7 45/64	13	8	11	19	6 15/16	6 15/16	0.80

Notes:
1. See Figure 6.
2. All dimensions are in inches. See Appendix M for metric table.
3. Neck diameters (D_{PE} and D_{TE}) and inside diameters (d) of tool joints prior to welding are at manufacturer's option. The above table specifies dimensions after final machining of the assembly.
4. Appendix I contains dimensions of obsolescent connections and for square elevator shoulders.

[a]The tool joint designation indicates the size and style of the applicable connection.
[b]Nominal weights, threads and couplings are shown for the purpose of identification in ordering.
[c]The inside diameter does not apply to box members, which are optional with the manufacturer.
[d]Length of pin thread reduced to 3 1/2 inches (1/2 inch short) to accommodate 3 inch ID.

6.4.1.5 welder performance qualification (WPQ): The written documentation that a welding machine operator has demonstrated the capability to use the WPS to produce a weld joint meeting the requirements of this specification.

6.4.1.6 welding procedure specification (WPS): The written procedure prepared to proved direction for making production welds to the requirements of this specification. It must include all essential and nonessential variables for welding of tool joints to drill pipe. A WPS applies to all those welds of which each member has the same specified dimensions and chemistry that are grouped according to a documented procedure which will ensure a predictable response to weld zone heat treatment for a particular grade.

6.4.2 Welding Requirements

The manufacturer shall develop and qualify a welding procedure (WPS and PQR) for welding of tool joints to drill pipe. The WPS shall identify the essential and nonessential variables. The PQR shall include the results of all mechanical tests listed in 6.4.5. All lots shall be welded in accordance with a qualified procedure (WPS and PQR). The manufacturer shall qualify welding machine operators to a specific WPQ for each WPS utilized by the operators.

6.4.3 Heat Treatment

6.4.3.1 The weld zone shall be austenitized, cooled below the transformation temperature and tempered at 1,100°F (593°C) minimum. The weld zone shall be heat treated from the OD to the ID and from the weld line to beyond where the flow lines of the tool joint and pipe material change direction as a result of the welding process.

6.4.3.2 Specimens used for destructive testing (i.e., tensile, impact) shall also be used to determine compliance with the requirements of 6.4.3.1.

A longitudinal section sufficient in length to include the entire Heat Affected Zone (HAZ) from heat treatment shall be suitably prepared and etched to determine the location of the HAZ in relation to the weld line and transverse grain flow. This etched section shall be used to ensure that the tensile specimen (see 6.4.5.2) includes the full HAZ from heat treatment within the gauge length.

6.4.4 Process Controls—Surface Hardness

Each weld zone shall be hardness tested at three places 120 degrees apart, ±15 degrees, in the HAZ from heat treatment, around outside surface. The hardness testing method is optional with the manufacturer. The hardness of the weld zone HAZ from heat treatment shall not exceed 37 HRC.

6.4.5 Mechanical Testing

Note: See Appendix A Supplementary Requirements.

6.4.5.1 One set of mechanical tests shall be conducted per lot or 400 welds, whichever is less.

6.4.5.2 Weld zone yield strengths shall be determined by tests on cylindrical tensile specimens taken from the location in Figure 7 conforming to the requirements of the latest edition of ASTM A370, 0.2 percent offset method. 0.500 inch diameter specimens are preferred, 0.350 inch and 0.250 inch diameter specimens are suitable alternatives for thin sections.

The product of the yield strength of the tensile specimen and the cross-sectional area of the weld zone shall be greater than the product of the specified minimum yield strength of the drill pipe times the cross-sectional area of the drill pipe based on the dimensions specified for the outside and inside diameter in API Specification 5D. The method for calculating the cross-sectional area of the weld zone shall be:

$$A_w = 0.7854\,(D^2 - d^2)$$

Where:

D = minimum allowable outside diameter specified by manufacturer.

d = maximum allowable inside diameter specified by manufacturer.

6.4.5.3 Charpy V-notch Type A impact tests conforming to the latest edition of ASTM A370 shall be conducted on three specimens removed longitudinally from the axis of the pipe with the notch oriented radially as shown in Figure 8. Full size 10 millimeter x 10 millimeter specimens shall be used whenever possible. A test shall consist of three longitudinal specimens. The center of the notch in the specimen shall be located on the weld interface. For subsize specimen impact strength requirements see Table 8.

The average value for the three specimens shall not be less than 12 ft-lbs. The minimum value for any single specimen shall not be less than 10 ft-lbs.

The test temperature shall be 70°F, ±5°F. (21°C,-2.8°C) Tests conducted at lower temperatures that meet the test requirements stated above are acceptable.

6.4.5.4 Transverse side bend tests, in accordance with the ASME *Boiler and Pressure Vessel Code,* Section IX, paragraphs QW-161.1 and QW-162.1, shall be performed on two specimens removed from the weld zone of the test piece. The weld zone shall be centered in longitudinal specimens. Test specimen shall be full wall thickness, approximately $^3/_8$ inch wide, and the length shall be 6 inches minimum.

Table 8—Subsize Specimen Impact Strength Requirements

Specimen Size mm x mm		Percent of Requirements Specified in 6.4.5.3
10	10	100
10	7.5	80

The weld zone shall be completely within the bend portion of the specimen after bending. One specimen shall be bent in each direction (clockwise and counterclockwise) relative to the pipe axis.

The guided-bend specimens shall have no open defects in the weld zone exceeding $^1/_8$ inch, measured in any direction on the convex surface of the specimen after bending. Cracks occurring on the corners of the specimen during testing shall not be considered unless there is definite evidence that they result from inclusions or other internal defects.

6.4.5.5 Through-wall hardness tests of the HAZ from heat treatment shall be taken as shown in Figure 9. The hardness values shall not exceed 37 HRC. A hardness value is the average of three Rockwell-C readings taken at 0.100 inch to 0.250 inch from the outside surface and inside surface on the pipe and tool joint sides of the weld line. Hardness readings shall be within the portion of the HAZ that was reaustenitized.

6.4.6 Retest of Weld Zones

6.4.6.1 Surface Hardness Retest

All welds with a hardness value that exceeds 37 HRC shall be retested or rejected. For any hardness value that exceeds 37 HRC, one more hardness value shall be taken in the immediate area.

If the new hardness value does not exceed 37 HRC, the new hardness value will be accepted. If the new hardness value exceeds 37 HRC, the weld shall be rejected.

The manufacturer may elect to reprocess the weld in accordance with a qualified procedure and test the weld in accordance with 6.4.4.

6.4.6.2 Through-Wall Hardness Retest

Any weld test pieces with a hardness value that exceeds 37 HRC shall be retested or the lot represented by the test piece shall be rejected. For any test piece with a hardness value that exceeds 37 HRC, the test surface may be reground and retested in accordance with 6.4.5.5.

If the retest hardness values do not exceed 37 HRC, the hardness values will be accepted. If any retest hardness value exceeds 37 HRC, the lot of welds represented by the test piece shall be rejected.

The manufacturer may elect to reprocess the entire lot in accordance with a qualified procedure and test mechanical properties in accordance with 6.4.4 and 6.4.5.

6.4.6.3 Tensile Retest

If a tensile test specimen representing a lot of welds fails to conform to the specified requirements, the manufacturer may elect to retest the same weld test piece. If the retest specimen conforms to the tensile requirements, all of the welds in the lot shall be accepted. If the retest specimen fails to meet the tensile requirements, the lot shall be rejected.

The manufacturer may elect to reprocess the entire lot in accordance with a qualified procedure and retest mechanical properties in accordance with 6.4.4 and 6.4.5.

6.4.6.4 Impact Retest

If the average absorbed energy value for a set of specimens representing a lot is below the specified minimum average absorbed energy requirement, or if one value is below the minimum value, a retest of three additional specimens may be made from the same weld test piece. The average absorbed impact energy value and the minimum absorbed energy value of the retest specimens shall equal or exceed the specified absorbed energy requirements or the lot shall be rejected.

The manufacturer may elect to reprocess the entire lot in accordance with a qualified procedure and retest mechanical properties in accordance with 6.4.4 and 6.4.5.

6.4.6.5 Guided Transverse Side Bend Retest

If one or both of the guided-bend specimens fail to conform to the specified requirements, the manufacturer may elect to test two additional specimens from the same weld test piece. If both the retest specimens meet the specified requirements, the lot shall be accepted. If one or both of the retest specimens fail to meet the specified requirements, the lot shall be rejected.

The manufacturer may elect to reprocess the entire lot in accordance with a qualified procedure and retest mechanical properties in accordance with 6.4.4 and 6.4.5.

6.4.7 Visual Inspection

Each finished drill pipe upset, weld zone, and tool joint assembly shall be visually inspected and free of sharp corners or abrupt changes of section. The internal finished drill pipe assembly shall permit a 90 degree hook-type tool to be pulled through the upset and weld zone without hang-up.

6.4.8 Alignment Inspection

The maximum misalignment between the longitudinal axis of the drill pipe and the welded-on tool joint, as measured from the outside diameter of the drill pipe and the large diameter of the tool joint, shall not exceed 0.156 inches total indicator reading of parallel misalignment and shall not exceed 0.008 inches per inch of angular misalignment for $4^1/_2$-inch pipe and larger and 0.010 inches per inch for pipe smaller than $4^1/_2$ inches.

6.4.9 Wet Fluorescent Magnetic Particle Inspection

The entire outside surface of the weld zone shall be wet fluorescent magnetic particle inspected for transverse defects. All imperfections revealed shall be considered defects.

Defects may be removed by grinding, provided the remaining wall thickness is not less than the manufacturer's minimum weld zone wall thickness requirement. All grinding shall be blended smooth.

Defects that are not removed shall be cause for rejection.

6.4.10 Ultrasonic Inspection

Each weld zone shall be ultrasonically inspected over the circumference with the beam directed toward the weld.

Shear wave/angle beam ultrasonic equipment capable of continuous and uninterrupted inspection of the entire weld zone shall be used. The inspection shall be applied in accordance with the manufacturer's documented procedure. The transducer shall be square 2.25 MHz frequency attached to a 45 degree, ±5 degree, Lucite wedge.

Any reflection greater than the calibration reference reflector shall be cause for rejection of the weld zone.

A reference standard shall be used to demonstrate the effectiveness of the inspection equipment and procedures at least once every working turn. The equipment shall be adjusted to produce a well defined indication when the reference standard is scanned in a manner simulating the inspection of the product. The reference standard shall be manufactured from a sound section of drill pipe assembly stock with the same specific diameter and wall thickness as the product being inspected. The reference standard may be of any convenient length as determined by the manufacturer. The reference standard shall contain a through-drilled hole as specified in Figure 10.

6.4.11 NDT Personnel Certification

A program for certification of NDT personnel shall be developed by the manufacturer. The latest edition of the American Society for Nondestructive Testing *Recommended Practice No. SNT-TC-1A* shall be used as a guideline.

The administration of the NDT personnel certification program shall be the responsibility of the manufacturer.

6.5 CONNECTIONS

Connections shall conform to the applicable requirements of Section 10. Right-hand threads shall be considered standard. Left-hand threads conforming to the specifications herein shall be acceptable.

6.6 MARKING

6.6.1 Tool joint tong space shall be die stamped with the following:

a. Manufacturer's name or mark.
b. "Spec 7."
c. Tool joint designation as shown in column 1 of Table 7.

6.6.2 Tool joint pin base shall be die stamped with the marking shown in Figure 11. The marking shall be done for identification of drill stem components by the company that attaches the tool joint to the drill pipe.

6.6.3 Additional marks applied by the manufacturer, such as tool joint part number, quality control inspector designators or manufacturing process designators, are acceptable.

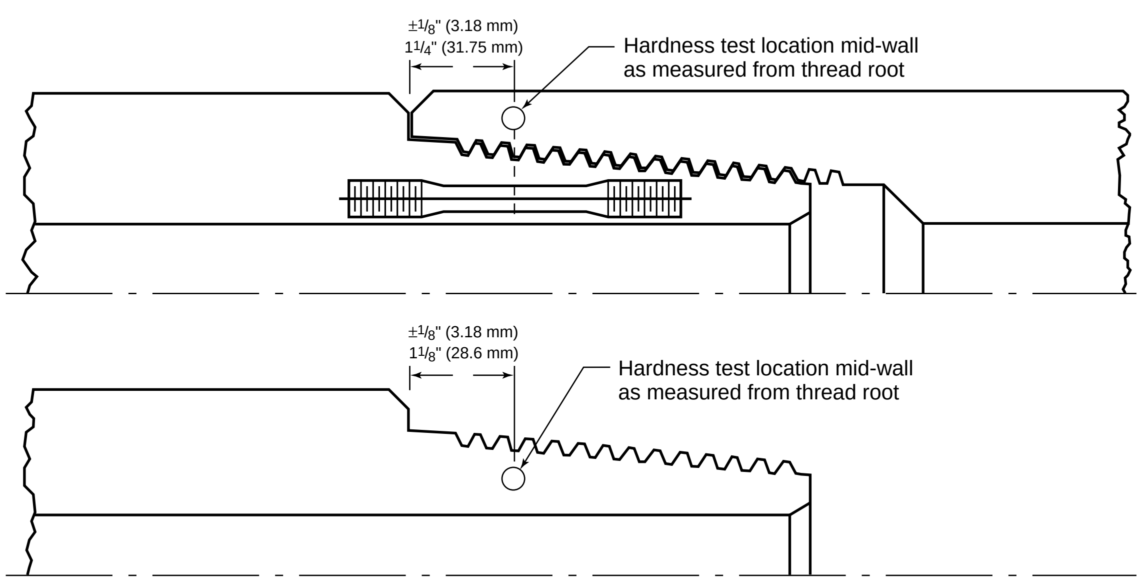
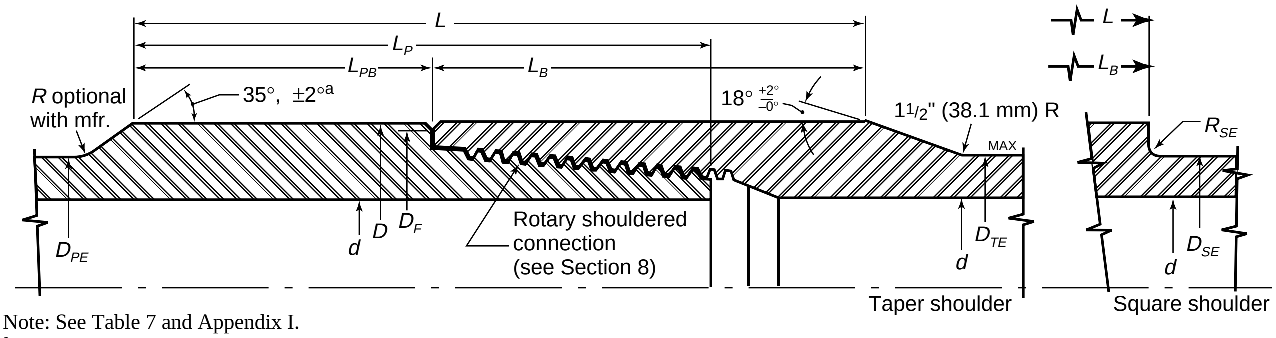


Figure 5—Tensile Specimen and Hardness Test Location



Note: See Table 7 and Appendix I.
[a]18°, +2° –0°, by agreement on the order.

Figure 6—Tool Joint, Taper Shoulder, and Square Shoulder

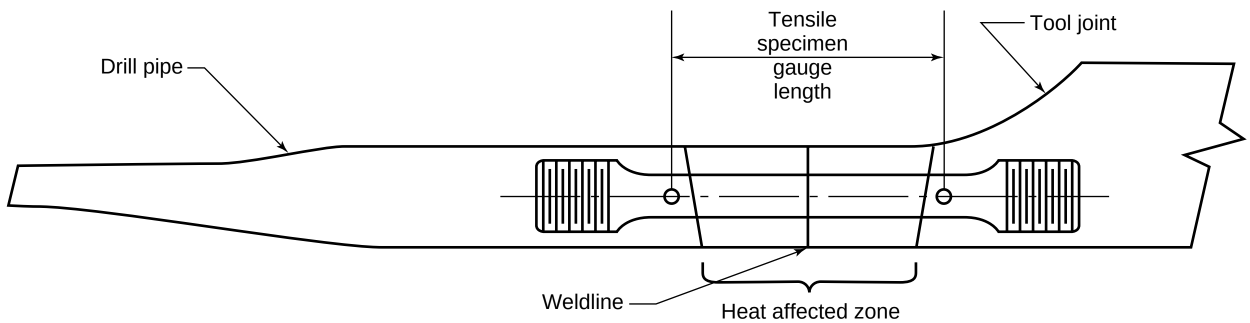


Figure 7—Tensile Test Specimen Location

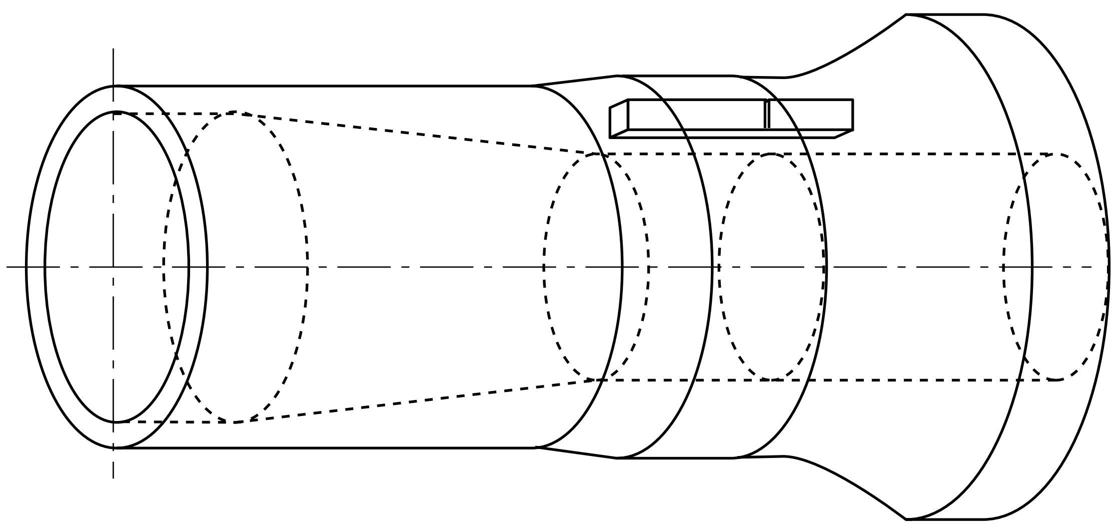
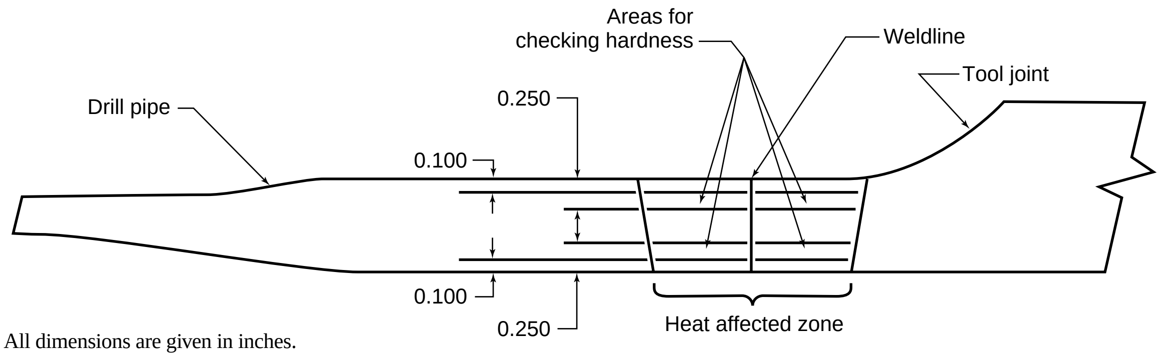
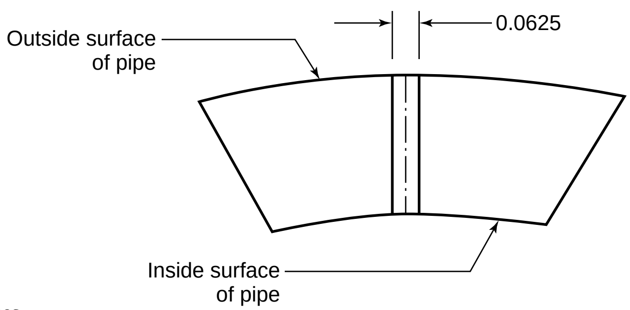


Figure 8—Impact Test Specimen Location and Orientation



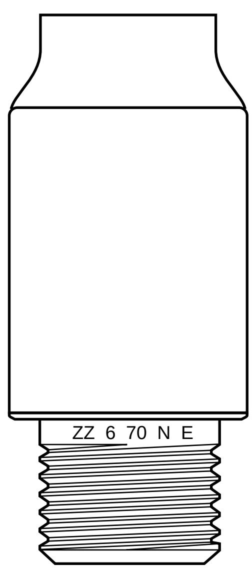
Note: All dimensions are given in inches.

Figure 9—Hardness Test Locations



Note: All dimensions are given in inches.

Figure 10—Reference Standard



Sample markings at base of pin

1	2	3	4	5
ZZ	6	70	N	E

1 Tool Joint Manufacturer's Symbol:
ZZ Company (fictional for example only)

2 Month Welded:
6—June

3 Year Welded:
70—1970

4 Pipe Manufacturer's Symbol:
N—United States Steel Company

5 Drill Pipe Grade:
E—Grade E75 drill pipe

Note: Tool joint manufacturer's symbol, month welded, year welded, pipe manufacturer, and drill pipe grade symbol shall be stenciled at the base of the pin as shown above. Pipe manufacturer symbol and drill pipe grade symbol applied shall be as represented by manufacturer. Supplier, owner, or user shall be indicated on documents such as mill certification papers or purchase orders.

Figure 11—Sample Markings at Base of Pin

7 Drill-Stem Subs

7.1 CLASS AND TYPE

Drill-stem subs shall be furnished in the classes and types shown in Table 9 and Figure; 12 and 14.

7.2 TYPES A & B DIMENSIONS

7.2.1 Connections, Bevel Diameters, and Outside Diameters

The connection sizes, styles and bevel diameters (D_F) and the outside diameters (D or D_R) shall conform to the applicable sizes, styles, dimensions, and tolerances specified in Tables 2 and 3 when connecting to kellys, Table 7 when connecting to tool joints, Table 13 when connecting to drill collars, and Tables 21, 22, and 24 when connecting to bits.

7.2.2 Inside Diameters

The inside diameter (d) and tolerances shall be equal to the inside diameter specified for the applicable connecting member with the smaller size and style connection.

7.2.3 Inside Bevel Diameter

The inside bevel diameter (d_B) of the pin shall be equal to $^1/_8$, $+^1/_{16}$, –0 inches (3.2, +1.6, –0 millimeters) larger than the inside diameter specified for the corresponding connecting member.

7.2.4 Length

Lengths and tolerances shall be as shown in Figure 12.

7.2.5 Float Valve Recess for Bit Subs

Dimensional data on boring out bit subs for installation of float valve assemblies are shown in Table 12 and Figure 13.

7.3 TYPE C (SWIVEL SUB) DIMENSIONS

7.3.1 Connections, Bevel Diameters, and Outside Diameters

The swivel sub shall have pin up and pin down (both left hand) rotary shouldered connections. The lower connection size, style, and bevel diameter (D_F) shall conform to the applicable sizes, styles, dimensions, and tolerances specified in Tables 2 and 3 for upper kelly box connections. The upper connection shall be the size and style of the swivel stem box connection, i.e., $4^1/_2$, $6^5/_8$, $7^5/_8$ API Regular. The sub's outside diameter and tolerances shall conform to the larger of either the kelly upper box connection or the swivel stem box connection outside diameter.

7.3.2 Inside Diameter

The maximum inside diameter (d) shall be the largest diameter allowed for the upper kelly connection specified in Table 2 or 3. In the case of step bored subs in which the bore through the upper pin is larger than the bore through the lower pin, the upper pin bore shall not be so large as to cause the upper pin to have lower tensile strength or torsional strength than the lower pin as calculated per the current edition of API Recommended Practice 7G.

7.3.3 Inside Bevel Diameter

The inside bevel diameter (d_B) shall be $^1/_4$, $\pm^1/_{16}$ inch (6.4, ±1.6 millimeter) larger than the bore.

7.3.4 Length

The minimum tong space allowable shall be 8 inches (203.2 millimeters).

7.4 TYPE D (LIFT SUB) DIMENSIONS

7.4.1 Pipe Diameter and Upper Lift Diameter

The pipe diameter (D_p) shall conform to applicable drill pipe size. Corresponding upper lift diameters (D_L) for tapered shoulders are specified in Table 11.

7.4.2 Connections, Bevel Diameters, and Outside Diameters

The connection sizes, styles, bevel diameters (D_F), and outside diameter (D) shall conform to the applicable sizes, styles, dimensions, and tolerances specified in Table 13.

7.4.3 Inside Diameter

The maximum inside diameter (d) shall be the largest diameter allowed for the lightest applicable pipe size listed in Table 7.

7.4.4 Length

Lengths and tolerances shall be as shown in Figure 14 (dimensions in inches).

7.5 MATERIAL MECHANICAL PROPERTIES

The mechanical properties of all subs shall conform to the material requirements of drill collars as specified in Section 8. The surface hardness of the as-manufactured diameter (D_R) of type B subs shall be measured per the current edition of ASTM A370 and shall conform to the requirements listed in Table 10.

7.6 CONNECTION STRESS RELIEF FEATURE

Stress relief features are optional on Type A and B subs and mandatory on $4^1/_2$ API REG and larger Type C subs. Type D subs are not affected. Connection stress relief feature dimensions and tolerance shall conform to the dimensions and tolerances listed in Section 8, Drill Collars, and are applicable to connections on Type A, B, and C subs shown in Table 9.

7.7 COLD WORKING ON THREAD ROOTS

Cold working of thread roots is optional. See Section 8 for details.

7.8 MARKING

Subs manufactured in conformance to this specification shall be marked with the manufacturer's name or identification mark, "Spec 7," the inside diameter and the size and style of the connection at each end. The markings shall be die stamped on a marking recess located on the *D* diameter of the sub. The marking identifying the size and style of connection shall be placed on that end of the recess closer to the connection to which it applies.

Following are two examples:

a. A sub with $4^1/_2$-inch REGULAR LH box connection on each end and with a $2^1/_4$-inch inside diameter shall be marked as follows:

A B Co (or mark)		SPEC 7
$4^1/_2$ REG LH	$2^1/_4$	$4^1/_2$ REG LH

b. A sub with NC 31 pin connection on one end and NC 46 box connection on the other end and with a 2-inch inside diameter shall be marked as follows:

A B Co (or mark)		SPEC 7
NC 31	2	NC 46

Table 9—Drill-Stem Subs

1	2	3	4
Type	Class	Upper Connection to Assemble With	Lower Connection to Assemble With
A or B	Kelly Sub	Kelly	Tool Joint
"	Tool Joint Sub	Tool Joint	Tool Joint
"	Crossover Sub	Tool Joint	Drill Collar
"	Drill Collar Sub	Drill Collar	Drill Collar
"	Bit Sub	Drill Collar	Bit
C	Swivel Sub	Swivel Stem	Kelly
D	Lift Sub	Elevator	Drill Collar

Table 10—Mechanical Properties and Test New Steel Drill-Stem Subs

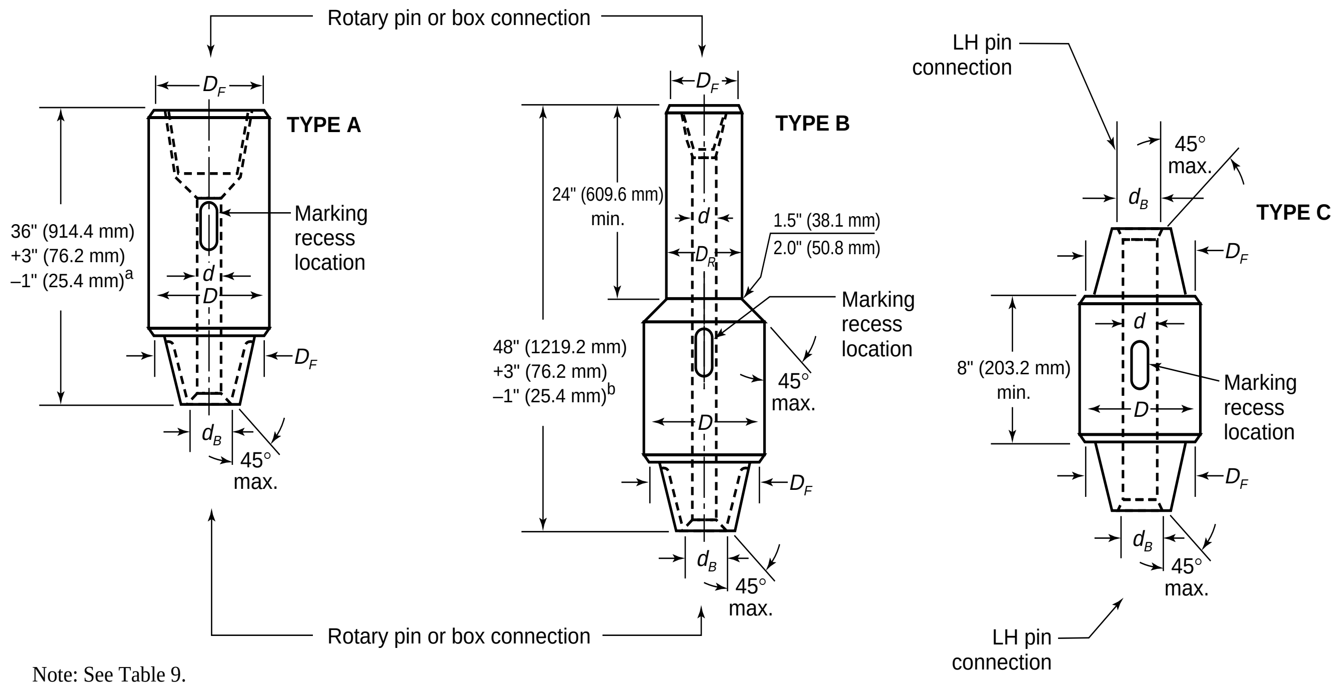
1	2
Sub OD and Type (Size)	Minimum Surface Hardness (BHN) 3000 kg 10 mm
D_R Type B	
$3^1/_8$ in. (79.4 mm) through $6^7/_8$ in. (175 mm)	285
7 in. (178 mm) through 10 in. (254 mm)	277

Table 11—Dimensional Data for Lift Sub Upper Lift Diameters

Diameter of Drill Pipe D_P	Diameter of Taper Shoulder ($+^1/_8$, –0) D_L
$2^3/_8$	$3^3/_8$
$2^7/_8$	$4^1/_8$
$3^1/_2$	$4^3/_4$
4	6
$4^1/_2$	$6^1/_4$
5	$6^1/_2$
$5^1/_2$	7
$6^5/_8$	8

Note: All dimensions are in inches.

(Text continued on page 21.)

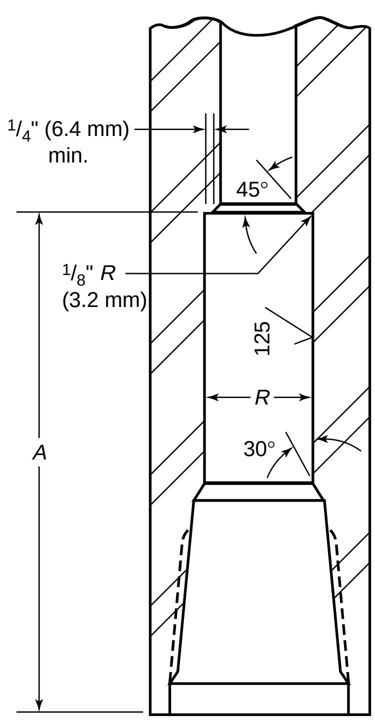


Note: See Table 9.

[a]If type A is a double box or double pin sub, the overall length is 36" (914.4 mm).

[b]If type B is a double box or double pin sub, the overall length is 48" (1219.2 mm).

Figure 12—Drill-Stem Subs



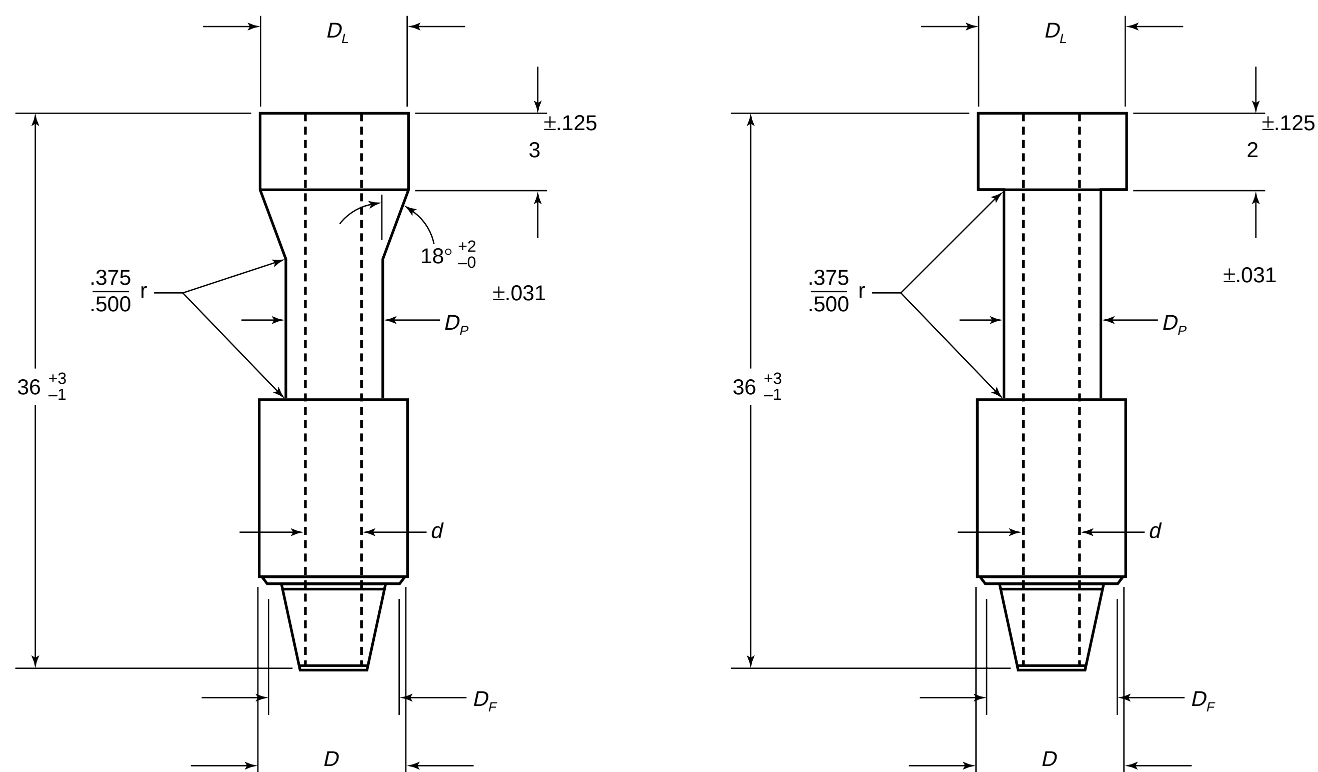
Notes:
1. If this diameter is the same as or smaller than bore, then disregard.
2. If bore is larger than R-1/2 inch (12.7 millimeters), then use 1/8 inch (3.2 millimeters) minimum.
3. The ID of drill collar or sub and ID of bit pin must be small enough to hold valve assembly.
4. $A = L$ (length of valve assembly) + length of tool pin joint + 1/4 inch (6.4 millimeters).
5. See Table 12.

Figure 13—Float Valve Recess in Bit Subs

Table 12—Float Valve Recess in Bit Subs

Diameter of Valve Assembly	Diameter of Float Recess	Length of Valve Assembly	API Reg. Bit Box		Other Popular Connections	
D	*R*, $+^{1}/_{64}$ –0 (*D*, $+^{1}/_{32}$)	*L*	Size	*A*, $\pm^{1}/_{16}$	Size	*A*, $\pm^{1}/_{16}$
$1^{21}/_{32}$	$1^{11}/_{16}$	$5^{7}/_{8}$	$2^{3}/_{8}$	$9^{1}/_{8}$	NC23	$9^{1}/_{8}$
$1^{29}/_{32}$	$1^{15}/_{16}$	$6^{1}/_{4}$	$2^{7}/_{8}$	10	$2^{3}/_{8}$ IF	$9^{1}/_{2}$
$2^{13}/_{32}$	$2^{7}/_{16}$	$6^{1}/_{2}$	$3^{1}/_{2}$	$10^{1}/_{2}$	$2^{7}/_{8}$ IF	$10^{1}/_{4}$
$2^{13}/_{16}$	$2^{27}/_{32}$	10	—	—	$3^{1}/_{2}$ FH	14
$3^{1}/_{8}$	$3^{5}/_{32}$	10	—	—	$3^{1}/_{2}$ IF	$14^{1}/_{4}$
$3^{15}/_{32}$	$3^{1}/_{2}$	$8^{5}/_{16}$	$4^{1}/_{2}$	$12^{13}/_{16}$	NC44	$13^{1}/_{16}$
$3^{21}/_{32}$	$3^{11}/_{16}$	12	—	—	4 IF	$13^{1}/_{4}$
$3^{7}/_{8}$	$3^{29}/_{32}$	$9^{3}/_{4}$	$5^{1}/_{2}$	$14^{3}/_{4}$	$4^{1}/_{2}$ IF	$14^{1}/_{2}$
$4^{25}/_{32}$	$4^{13}/_{16}$	$11^{3}/_{4}$	$6^{5}/_{8}$	17	$5^{1}/_{2}$ IF	17
—	—	—	$7^{5}/_{8}$	$17^{1}/_{4}$	$5^{1}/_{2}$ FH	17
—	—	—	$8^{5}/_{8}$	$17^{3}/_{8}$	NC61	$17^{1}/_{4}$
$5^{11}/_{16}$	$5^{23}/_{32}$	$14^{5}/_{8}$	$8^{5}/_{8}$	$20^{1}/_{4}$	$6^{5}/_{8}$ IF	$19^{7}/_{8}$

Note: All dimensions in inches. See Appendix M for metric table.



Notes:
1. See Table 9.
2. All dimensions in inches.

Figure 14—Lift Subs (Type D)

8 Drill Collars

8.1 GENERAL

8.1.1 Size

Drill collars shall be furnished in the sizes and dimensions shown in Table 13 and OD tolerances as specified in 8.1.4.

8.1.2 Bores

All drill collar bores shall be gauged with a drift mandrel 10 feet (3.05 meters) long minimum. The drift mandrel shall have a minimum diameter equal to the bore diameter *d* (see Table 13) minus $^1/_8$ inch (3.2 millimeters).

8.1.3 Connections

Drill collars shall be furnished with box and pin connections in the sizes and styles stipulated in Table 13 and shall conform with the requirements of Section 10.

8.1.4 OD Tolerances

8.1.4.1 Outside Diameter

The outside diameter shall comply with the tolerances of Table 14.

8.1.4.2 Surface Finish

The minimum external surface finish shall be hot rolled mill finished. Workmanship shall comply with current ASTM A434. Surface imperfection removal shall comply with Table 15.

8.1.4.3 Straightness

The external surface of drill collars shall not deviate from a straight line extending from end to end of the drill collar when placed adjacent to the surface by more than $^1/_{160}$ inch per foot (0.52 millimeters per meter) of drill collar.

For example: On a 30-foot (9.14-meter) long drill collar, the maximum deviation from a straight line is 30 x $^1/_{160}$ = $^3/_{16}$ inch (4.76 millimeters).

8.1.5 Connection Stress-Relief Features

Stress relief features are optional. Stress relief features shall conform to the dimensions shown in Table 16 and Figure 16 or Table 16 and Figure 17 (alternate box stress relief feature).

Note 1: Laboratory fatigue tests and tests under actual service conditions have demonstrated the beneficial effects of stress-relief contours at the pin shoulder and at the base of the box thread. It is recommended that, where fatigue failures at point of high stress are a problem, stress-relief features be provided, and that such surfaces as well as the roots of the threads be cold worked after gauging to API specifications. Gauge standoff will change after cold working of threads. Cold working of API gauged connections may result in connections that do not fall within API gauge standoff. This will not affect the interchangeability of connections and will improve connection performance. It is therefore permissible for a connection to be marked if it meets the API specification before cold working. In such event, the connection shall also be stamped with a circle enclosing "CW" to indicate cold working after gauging. The mark shall be located on the connection as follows:

Pin connection—at the end of the pin
Box connection—in box counterbore

Note 2: The boreback stress-relief feature is the recommended relief feature for box connections. However, the box relief groove shown in Figure 17 has been shown to provide beneficial effects also. It is included as an alternate to the boreback design.

8.1.6 Low Torque Feature

The faces and counterbores of 8$^5/_8$ regular connections shall conform to the dimensions shown in Figure 18 when machined on drill collars larger than 10$^1/_2$ inch (266.7 millimeter) OD.

Note: Stress relief features will cause a slight reduction in the tensile strength and section modulus of the connection. However, under most conditions this reduction in cross-sectional area is more than offset by the reduction in fatigue failures. When unusually high loads are expected, calculations of the effect should be made.

8.2 STANDARD STEEL DRILL COLLARS

8.2.1 Mechanical Properties

The mechanical properties of standard steel drill collars, as manufactured, shall comply with requirements of Table 17.

These properties shall be verified by performing a tensile test on one specimen (with properties representative of end product) from each heat and bar size from that heat.

In addition, a hardness test shall be performed on each drill collar as prima facie evidence of conformance.

8.2.2 Marking

Standard steel drill collars conforming to this specification shall be die stamped on the drill collar OD with the manufacturer's name or identifying mark, "Spec 7," outside diameter, bore, and connection designation. NC style connections and FH and IF sizes in parentheses in column 1 of Table 13 are identical if made with the V-0.038R thread form. The examples below illustrate these marking requirements:

a. A 6$^1/_4$-inch collar with 2$^{13}/_{16}$-inch bore and NC46 connections shall be stamped:

A B Co (or mark)

NC46-62 (4IF) 2$^{13}/_{16}$ SPEC 7

The same markings apply to a collar of the same dimensions, but ordered with 4IF connections, if the connections are made with the V-0.038R thread form.

b. An 8$^1/_4$-inch collar with 2$^{13}/_{16}$-inch bore and 6$^5/_8$ REG connections shall be stamped:

A B Co (or mark)

8$^1/_4$ 2$^{13}/_{16}$ 6$^5/_8$ REG SPEC 7

Table 13—Drill Collars

1	2	3	4	5	6
Drill Collar Number[a]	Outside Diameter D[b]	Bore, $+\frac{1}{16}$ –0 d	Length, ft. ±6 in. L[d]	Bevel Diameter, $\pm\frac{1}{64}$ D_F	Reference Bending Strength Ratio[e]
NC23-31	$3\frac{1}{8}$	$1\frac{1}{4}$	30	3	2.57:1
NC26-35 ($2\frac{3}{8}$ IF)	$3\frac{1}{2}$	$1\frac{1}{2}$	30	$3\frac{17}{64}$	2.42:1
NC31-41 ($2\frac{7}{8}$ IF)	$4\frac{1}{8}$	2	30 or 31	$3\frac{61}{64}$	2.43:1
NC35-47	$4\frac{3}{4}$	2	30 or 31	$4\frac{33}{64}$	2.58:1
NC38-50 ($3\frac{1}{2}$ IF)	5	$2\frac{1}{4}$	30 or 31	$4\frac{49}{64}$	2.38:1
NC44-60	6	$2\frac{1}{4}$	30 or 31	$5\frac{11}{16}$	2.49:1
NC44-60	6	$2\frac{13}{16}$	30 or 31	$5\frac{11}{16}$	2.84:1
NC44-62	$6\frac{1}{4}$	$2\frac{1}{4}$	30 or 31	$5\frac{7}{8}$	2.91:1
NC46-62 (4 IF)	$6\frac{1}{4}$	$2\frac{13}{16}$	30 or 31	$5\frac{29}{32}$	2.63:1
NC46-65 (4 IF)	$6\frac{1}{2}$	$2\frac{1}{4}$	30 or 31	$6\frac{3}{32}$	2.76:1
NC46-65 (4 IF)	$6\frac{1}{2}$	$2\frac{13}{16}$	30 or 31	$6\frac{3}{32}$	3.05:1
NC46-67 (4 IF)	$6\frac{3}{4}$	$2\frac{1}{4}$	30 or 31	$6\frac{9}{32}$	3.18:1
NC50-70 ($4\frac{1}{2}$ IF)	7	$2\frac{1}{4}$	30 or 31	$6\frac{31}{64}$	2.54:1
NC50-70 ($4\frac{1}{2}$ IF)	7	$2\frac{13}{16}$	30 or 31	$6\frac{31}{64}$	2.73:1
NC50-72 ($4\frac{1}{2}$ IF)	$7\frac{1}{4}$	$2\frac{13}{16}$	30 or 31	$6\frac{43}{64}$	3.12:1
NC56-77	$7\frac{3}{4}$	$2\frac{13}{16}$	30 or 31	$7\frac{19}{64}$	2.70:1
NC56-80	8	$2\frac{13}{16}$	30 or 31	$7\frac{31}{64}$	3.02:1
$6\frac{5}{8}$ REG	$8\frac{1}{4}$	$2\frac{13}{16}$	30 or 31	$7\frac{45}{64}$	2.93:1
NC61-90	9	$2\frac{13}{16}$	30 or 31	$8\frac{3}{8}$	3.17:1
$7\frac{5}{8}$ REG	$9\frac{1}{2}$	3	30 or 31	$8\frac{13}{16}$	2.81:1
NC70-97	$9\frac{3}{4}$	3	30 or 31	$9\frac{5}{32}$	2.57:1
NC70-100	10	3	30 or 31	$9\frac{11}{32}$	2.81:1
$8\frac{5}{8}$ REG[c]	11	3	30 or 31	$10\frac{1}{2}$	2.84:1

Notes:
1. See Figure 15.
2. All dimensions are in inches unless otherwise specified. See Appendix M for metric table.

[a]The drill collar number consists of two parts separated by a hyphen. The first part is the connection number in the NC style. The second part, consisting of 2 (or 3) digits, indicates the drill collar outside diameter in units and tenths of inches. The connections shown in parentheses in the first column are not part of the drill collar number; they indicate interchangeability of drill collars made with the standard (NC) connections as shown. If the connections shown in parentheses in the first column are made with V-0.038R thread form, the connections and drill collars are identical with those in the NC style. Drill collars with $8\frac{1}{4}$, $9\frac{1}{2}$, and 11 inch outside diameters are shown with $6\frac{5}{8}$, $7\frac{5}{8}$, and $8\frac{5}{8}$ REG connections, since there are no NC connections in the recommended bending strength ratio range.

[b]See Table 14 for tolerances.

[c]See Figure 17 and Table 16 for dimensions.

[d]See 8.3.2 for nonmagnetic drill collar tolerances.

[e]Stress relief features are disregarded in the calculation of the bending strength ratio.

Table 14—Drill Collar OD Tolerances

1	2		3	4	
	Size Tolerance Inclusive				
	Over			Out-of-Roundness[a]	
Size: Outside Diameter	in.	mm	Under	in.	mm
Over $2\frac{1}{2}$ to $3\frac{1}{2}$ inclusive	$\frac{3}{64}$	1.19	0	0.035	0.89
Over $3\frac{1}{2}$ to $4\frac{1}{2}$ inclusive	$\frac{1}{16}$	1.59	0	0.046	1.17
Over $4\frac{1}{2}$ to $5\frac{1}{2}$ inclusive	$\frac{5}{64}$	1.98	0	0.058	1.47
Over $5\frac{1}{2}$ to $6\frac{1}{2}$ inclusive	$\frac{1}{8}$	3.18	0	0.070	1.78
Over $6\frac{1}{2}$ to $8\frac{1}{4}$ inclusive	$\frac{5}{32}$	3.97	0	0.085	2.16
Over $8\frac{1}{4}$ to $9\frac{1}{2}$ inclusive	$\frac{3}{16}$	4.76	0	0.100	2.54
Over $9\frac{1}{2}$	$\frac{1}{4}$	6.35	0	0.120	3.05

[a]Out-of-roundness is the difference between the maximum and minimum diameters of the bar, measured at the same cross-section, and does not include surface finish tolerances outlined in 8.1.4.2.

8.3 NONMAGNETIC DRILL COLLARS

8.3.1 Dimensional Features

Nonmagnetic drill collars shall be furnished with dimensional features conforming to those stated in 8.1.1, Size; 8.1.2, Bores; 8.1.3, Connections; 8.1.4, OD Tolerances; and 8.1.5, Stress-Relief Features, with 8.3.1.1 through 8.3.1.3 listed as exceptions:

8.3.1.1 Length Tolerance

The length tolerance for nonmagnetic drill collars shall be +6, –0 inches (+152.4, –0 millimeters).

8.3.1.2 Bore Eccentricity

The maximum bore eccentricity shall be 0.094 inches (2.39 millimeters) at the collar ends. The center eccentricity shall not exceed 0.250 inches (6.35 millimeters).

Note: The purpose of the eccentricity specification in the center of a nonmagnetic collar is to ensure reasonably accurate alignment of a survey instrument with the collar axis. Eccentricity in the center does not have a significant effect on the torsional or tensile strength of the collar.

8.3.1.3 Connections

In addition to the connections and outside diameter combinations noted in 8.1.3 and Tables 13 and 19, nonmagnetic drill collars may be produced as bottom hole drill collars having an API Regular box connection at the lower end. These connections shall conform with the requirements of Section 10. The drill collar OD ranges with applicable lower box connection sizes are shown in Table 18.

8.3.2 Material Requirements

Each nonmagnetic drill collar shall be tested and certified as meeting the following minimum requirements for mechanical properties, magnetic properties, corrosion resistance properties, and soundness of material as measured by ultrasonic techniques.

8.3.2.1 Mechanical Properties

The minimum required mechanical properties are shown in Table 20.

Outside surface hardness shall be measured per the current edition of ASTM E10 for information only. Correlation between hardness and material strength is not reliable.

8.3.2.2 Magnetic Properties

8.3.2.2.1 Relative Magnetic Permeability Measurements

Drill collars shall have a relative magnetic permeability less than 1.010. Each certification of relative magnetic permeability shall identify the test method. The manufacturer shall also state whether tests have been performed on individual collars or on a sample that qualifies a product lot. One lot is defined as all material with the same form from the same heat processed at one time through all steps of manufacture.

8.3.2.2.2 Field Gradient Measurement

The magnetic field in the bore of new drill collars shall have a maximum deviation from a uniform magnetic field not exceeding ±0.05 microtesla. This shall be measured with a magnetoscope and differential field probe having its magnetometers oriented in the axial direction of the collar. A strip chart record showing differential field along the entire bore of the collar shall be part of the certification of each collar.

8.3.2.3 Corrosion Resistance Requirements (for Austenitic Steel Collars of 12 Percent Chromium or More)

Austenitic stainless steel collars are subject to cracking due to conjoint action of tensile stress and certain specific corrodents. This phenomenon is called stress corrosion cracking.

Resistance to intergranular corrosion shall be demonstrated by subjecting material from each collar to the current edition of the corrosion test ASTM A262 Practice E. At the discretion of each supplier, the test specimen may have an axial orientation, in which case it shall be taken from within 0.5 inch (12.7 millimeters) of the bore surface, or it may have a tangential orientation, in which case its midpoint shall be from within 0.5 inch (12.7 millimeters) of the bore surface.

Under some environmental circumstances, steels may be subject to transgranular stress corrosion cracking. Tendencies with different compositions vary but additional resistance may be provided by surface treatments that lead to compressive residual stress.

8.3.2.4 Ultrasonic Evaluation

Drill collar bodies shall be inspected ultrasonically full length over the circumference of the body. Inspection before boring is acceptable. However, reinspection must follow boring in areas that contained any rejectable defect indications (specified in Items d and e) within the material that is to be bored out. Alternately, complete inspection after boring is acceptable.

The current editions of ASTM E114 (direct contact method), ASTM E214, and/or ASTM E1001 (immersion method) provide procedures for establishing examination techniques. The following further defines a satisfactory NDE procedure:

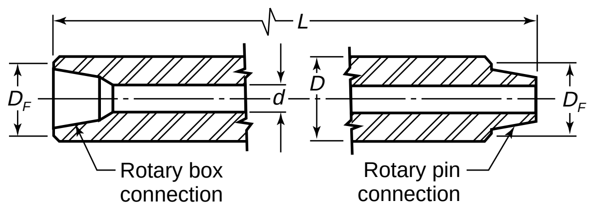
a. A sound section of the drill collar body shall be used as the calibration standard.

b. For the direct contact method, transducer size shall be 1 to $1^1/_8$ inches (25.4 to 28.6 millimeters) diameter.

c. 1 to 5 MHz transducers are acceptable.

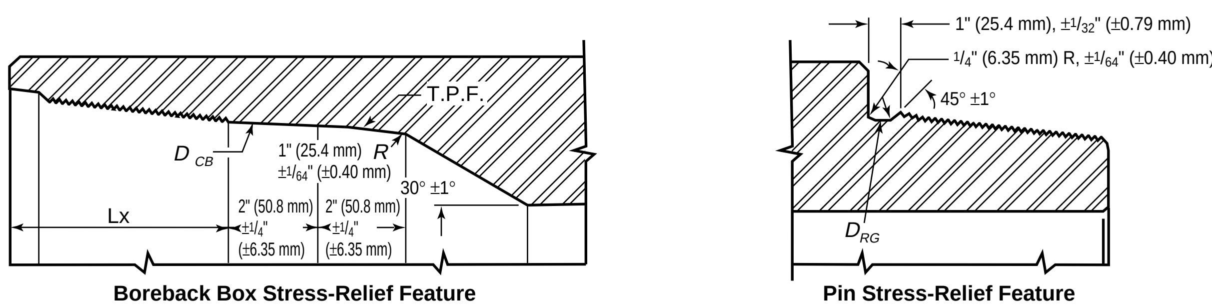
Table 15—Drill Collar Surface Imperfection Removal

1	2	
	Maximum Stock Removal From Surface	
Size: Outside Diameter	in.	mm
Over 2$^1/_2$ to 3$^1/_2$ inclusive	0.072	1.83
Over 3$^1/_2$ to 4$^1/_2$ inclusive	0.090	2.29
Over 4$^1/_2$ to 5$^1/_2$ inclusive	0.110	2.79
Over 5$^1/_2$ to 6$^1/_2$ inclusive	0.125	3.18
Over 6$^1/_2$ to 8$^1/_4$ inclusive	0.155	3.94
Over 8$^1/_4$ to 9$^1/_2$ inclusive	0.203	5.16
Over 9$^1/_2$	0.480	12.19



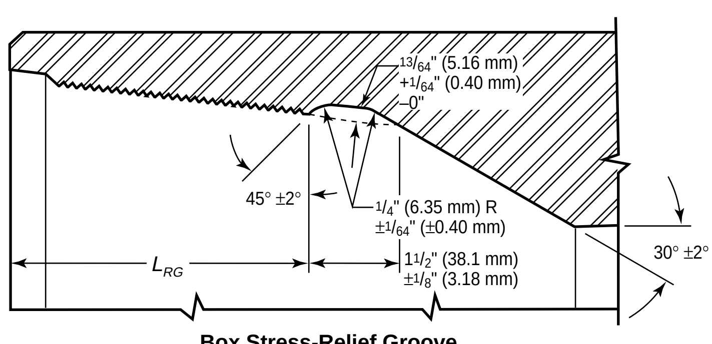
Note: See Table 13.

Figure 15—Drill Collars



Note: See Table 16.

Figure 16—Connection Stress-Relief Features



Note: See Table 16.

Figure 17—Alternate Box Stress-Relief Feature

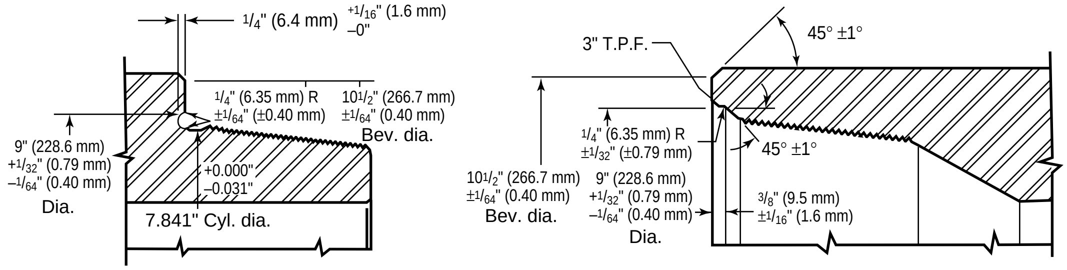


Figure 18—Low Torque Feature for $8^{5}/_{8}$ Regular Connections Machined on ODs Larger Than $10^{1}/_{2}$ Inches (266.7 Millimeters) Excluding Bit Boxes

d. A defect indication greater than 5 percent of the calibration back reflection shall cause rejection of the drill collar.

e. A drill collar containing an area in which the back reflection height is less than or equal to 50 percent of the calibration back reflection is subject to rejection unless the supplier establishes that the loss of back reflection is due to large grains, surface condition, or lack of parallelism between the scanning and reflecting surfaces.

8.3.3 Marking

Nonmagnetic drill collars conforming to this specification shall be die stamped with the manufacturer's name or identifying mark, "Spec 7," nonmagnetic identification, manufacturer's serial number, outside diameter, and bore. The example below illustrates these marking requirements. Locations of the markings and the application of additional markings shall be specified by the manufacturer. Following is an example:

An $8^{1}/_{4}$-inch collar, with $2^{13}/_{16}$-inch bore, manufactured by A B Company shall be stamped:

A B Co (or mark)

$8^{1}/_{4}$ $2^{13}/_{16}$ NMDC $6^{5}/_{8}$ REG SPEC 7

Table 16—Stress-Relief Features for Drill Collar Connections

1	2	3	4	5	6
Number or Size and Style of Connection[a]	Length Shoulder Face to Last Thread Scratch of Box Member in., $\pm^{1}/_{16}$ in. L_X	Diameter of Cylinder Area of Box Member in., $+^{1}/_{64}$ –0 in. D_{CB}	Taper of Area Behind Cylinder Area of Box Member in./ft., $\pm^{1}/_{4}$ in./ft. T.P.F.	Diameter of Pin Member at Groove in., +0 –.031 in. D_{RG}	Length Shoulder Face to Groove of Box Member in., +0 $-^{1}/_{8}$ in. L_{RG}
NC35	$3^{1}/_{4}$	$3^{15}/_{64}$	2	3.231	$3^{3}/_{8}$
NC38 ($3^{1}/_{2}$ IF)	$3^{1}/_{2}$	$3^{15}/_{32}$	2	3.508	$3^{5}/_{8}$
NC40 (4 FH)	4	$3^{21}/_{32}$	2	3.772	$4^{1}/_{8}$
NC44	4	4	2	4.117	$4^{1}/_{8}$
NC46 (4 IF)	4	$4^{13}/_{64}$	2	4.326	$4^{1}/_{8}$
NC50 ($4^{1}/_{2}$ IF)	4	$4^{5}/_{8}$	2	4.742	$4^{1}/_{8}$
NC56	$4^{1}/_{2}$	$4^{51}/_{64}$	3	5.277	$4^{5}/_{8}$
NC61	5	$5^{15}/_{64}$	3	5.839	$5^{1}/_{8}$
NC70	$5^{1}/_{2}$	$5^{63}/_{64}$	3	6.714	$5^{5}/_{8}$
NC77	6	$6^{35}/_{64}$	3	7.402	$6^{1}/_{8}$
$4^{1}/_{2}$ REG	$3^{3}/_{4}$	$3^{23}/_{32}$	3	4.013	$3^{7}/_{8}$
$4^{1}/_{2}$ FH	$3^{1}/_{2}$	$3^{61}/_{64}$	3	4.180	$3^{5}/_{8}$
$5^{1}/_{2}$ REG	$4^{1}/_{4}$	$4^{1}/_{2}$	3	4.869	$4^{3}/_{8}$
$6^{5}/_{8}$ REG	$4^{1}/_{2}$	$5^{9}/_{32}$	2	5.417	$4^{5}/_{8}$
$7^{5}/_{8}$ REG	$4^{3}/_{4}$	$5^{55}/_{64}$	3	6.349	$4^{7}/_{8}$
$8^{5}/_{8}$ REG	$4^{7}/_{8}$	$6^{25}/_{32}$	3	7.301	5

Notes:
1. See Figures 16 and 17.
2. See Appendix M for metric table.
[a]Connections NC23, NC26 ($2^{3}/_{8}$ IF), and NC31 ($2^{7}/_{8}$ IF) do not have sufficient metal to accommodate stress-relief features.

Table 17—Mechanical Properties and Tests New Standard Steel Drill Collars

1	2		3		4	5
	Minimum Yield Strength		Minimum Tensile Strength			
Drill Collar OD Range inches	psi	N/mm²	psi	N/mm²	Elongation, Minimum, With Gauge Length Four Times Diameter, percent	Minimum Brinell Hardness
$3^{1}/_{8}$ through $6^{7}/_{8}$	110,000	758	140,000	965	13	285
7 through 11	100,000	689	135,000	931	13	285

Notes:

1. Tensile properties shall be determined by tests on cylindrical specimens conforming to the requirements of the current ASTM A370, 0.2 percent offset method.
2. Tensile specimens from drill collars shall be taken within 3 feet (0.9 meters) of the end of the drill collar in a longitudinal direction, having the centerline of the tensile specimen 1 inch (25 millimeters) from the outside surface or midwall, whichever is closer to the outside surface.
3. Hardness test shall be on OD of drill collar using Brinell Hardness (Rockwell-C acceptable alternative) test methods in compliance with current ASTM A370 requirements.

Table 18—Connections for Bottom Hole Drill Collars

		Bevel Diameter	
Size: Outside Diameter	Bottom Box Connection	in. $\pm^{1}/_{64}$	mm ±0.40
$4^{1}/_{8}$ to $4^{1}/_{2}$ inclusive	$2^{7}/_{8}$ REG	$3^{39}/_{64}$	91.68
$4^{3}/_{4}$ to 5 inclusive	$3^{1}/_{2}$ REG	$4^{7}/_{64}$	104.38
6 to 7 inclusive	$4^{1}/_{2}$ REG	$5^{21}/_{64}$	135.33
7 to $7^{1}/_{4}$ inclusive	$5^{1}/_{2}$ REG	$6^{1}/_{2}$	165.10
$7^{3}/_{4}$ to 9 inclusive	$6^{5}/_{8}$ REG	$7^{23}/_{64}$	186.93
$9^{1}/_{2}$ to 10 inclusive	$7^{5}/_{8}$ REG	$8^{15}/_{32}$	215.11
11 inclusive	$8^{5}/_{8}$ REG	$9^{35}/_{64}$	242.49

Table 19—Additional Nonmagnetic Drill Collars

1	2		3		4		5		6
	Outside Diameter		Bore		Length ft, m		Bevel Diameter		
					L		D_F		
Drill Collar Number	*D* in.	mm	$+^{1}/_{16}$ –0 in.	+1.6 –0 mm	+6 –0 in.	+152.4 –0 mm	$\pm^{1}/_{64}$ in.	±0.4 mm	Ref. Bending Strength Ratio
NC 50-67 ($4^{1}/_{2}$ IF)	$6^{3}/_{4}$	171.5	$2^{13}/_{16}$	71.4	30 or 31	9.14 or 9.45	$6^{9}/_{32}$	159.5	2.37:1[a]

Note: See Figure 15 and Table 13.

[a]The NC 50-67 ($4^{1}/_{2}$ IF) with $2^{3}/_{16}$ ID has a bending strength ratio of 2.37:1, which is more pin strong than is normally acceptable for standard steel collars but has proven to be acceptable for nonmagnetic drill collars.

Table 20—Mechanical Properties and Tests, New Nonmagnetic Drill Collars

	Stainless Steels					Beryllium Copper				
Drill Collar OD Range, inches	Minimum Yield Strength		Minimum Tensile Strength		Minimum Elongation, percent	Minimum Yield Strength		Minimum Tensile Strength		Minimum Elongation, percent
	psi	N/mm²	psi	N/mm²		psi	N/mm²	psi	N/mm²	
$3^{1}/_{2}$ through $6^{7}/_{8}$	110,000	758	120,000	827	18	110,000	758	140,000	965	12
7 through 11	100,000	689	110,000	758	20	100,000	689	135,000	931	13

Notes:

1. Tensile properties shall be determined by tests on cylindrical specimens with gauge length four times diameter conforming to the requirements of the current edition of ASTM E 8, 0.2 percent offset method.
2. Tensile specimens shall be taken from excess material within 3 feet (0.9 meters) of the end of the drill collar and, at the manufacturer's option, may be oriented in either the longitudinal or transverse direction. The specimen's orientation shall be reported. The midpoint of the specimen gauge section shall be, at minimum, one inch (25 millimeters) beneath the outside surface, or at midwall, whichever position is closer to the outside surface.

9 Drilling and Coring Bits

9.1 ROLLER BITS AND BLADE DRAG BITS

9.1.1 Size

Roller bits shall be furnished in sizes as specified on the purchase order. See Recommended Practice 7G for commonly used sizes for roller bits. Blade drag bits shall be furnished in the sizes specified on the purchase order.

9.1.2 Tolerances

The gauge diameter of the cutting edge of the bit shall conform to the size designation, within the following tolerances:

Size of Bit	Tolerance	
in.	in.	mm
$3^3/_8$ to $13^3/_4$, inclusive	$+^1/_{32}$ –0	+0.80 –0
14 to $17^1/_2$, inclusive	$+^1/_{16}$ –0	+1.59 –0
$17^5/_8$ and larger	$+^3/_{32}$ –0	+2.38 –0

9.1.3 Connections

Roller bits shall be furnished with the size and style of pin connection shown in Table 21. Blade drag bits shall be furnished with the size and style of connection shown in Table 22, and shall be pin or box.

9.1.4 Marking

Bits shall be die stamped in some location other than the make-up shoulder with the manufacturer's name or identification mark, the bit size, "Spec 7," and the size and style of connection. Following is an example:

A $7^7/_8$ bit with $4^1/_2$-inch REG rotary connection shall be stamped as follows:

A B Co (or mark) $7^7/_8$ SPEC 7 $4^1/_2$ REG

9.2 DIAMOND DRILLING BITS, DIAMOND CORE BITS, AND POLYCRYSTALLINE DIAMOND COMPACT (PDC) BITS

9.2.1 Diamond Bit Tolerances

Diamond drilling bits, diamond core bits, and polycrystalline diamond compact (PDC) bits shall be subject to the OD tolerances shown in Table 23.

9.2.2 Diamond Drilling Bit and PDC Connections

Diamond drilling bits and PDC bits shall be furnished with the size and style pin connections shown in Table 24. All connection threads shall be right hand.

9.2.3 Diamond Bit and PDC Bit Gauging

All diamond and PDC bits will have the outer diameter inspected using the following dimensional guidelines for ring gauges.

9.2.3.1 Gauge Specification

"Go" and "No Go" gauges should be fabricated as shown in Figure 19 and as described below:

a. "Go" and "No Go" gauges should be rings fabricated from 1-inch steel with ODs equal to nominal bit sizes plus $1^1/_2$ inches (38.1 millimeters).
b. "Go" gauge ID should equal nominal bit size plus 0.002 inch (0.051 millimeter) clearance with a tolerance of +0.003, –0 inch (+0.076, –0 millimeter).
c. "No Go" gauge ID should equal minimum bit size (nominal less maximum negative tolerance) minus 0.002 inch interference with a tolerance of +0, –0.003 inch (+0, –0.076 millimeter).

9.2.3.2 Gauging Practice

The "Go" and "No Go" gauges should be used as follows:

a. If acceptable, the product bit should enter the "Go" gauge (product not too large).
b. If acceptable, the product bit should not enter the "No Go" gauge (product not too small).
c. Both the "Go" and "No Go" gauges should be within 20°F (11°C) of the same temperature as the bit or corehead for accurate measurement.

9.2.4 Marking

Diamond drilling bits, diamond core bits, and PDC bits shall be marked as follows:

a. Diamond drilling bits and PDC bits shall be permanently and legibly identified in some location other than the make-up shoulder with the manufacturer's name or identification mark, the bit size, "Spec 7," and the size and type of connection.
Following is an example:
A $7^1/_2$ bit with $4^1/_2$-inch REG rotary connection shall be stamped as follows:

A B Co (or mark) $7^1/_2$ SPEC 7 $4^1/_2$ REG

b. Diamond core bits shall be permanently and legibly identified on some location other than the make-up shoulder with the manufacturer's name or identification mark and "Spec 7" as follows:

A B Co (or mark) SPEC 7

Because of its proprietary nature, the connection on diamond core bits will not be shown. The marking "Spec 7" shall indicate that other dimensional requirements have been met.

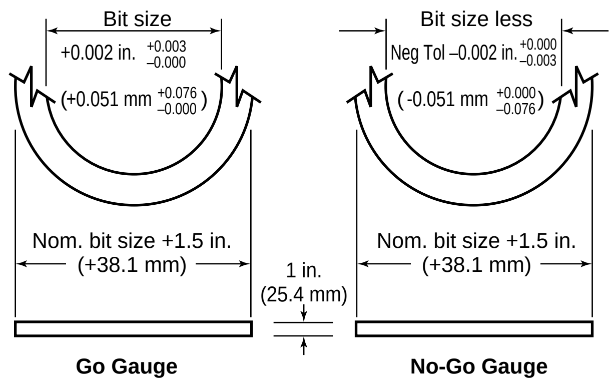


Figure 19—Diamond Bit and PDC Bit Gauge Dimensions

Table 21—Roller Bit Connections

1	2	3		4	
Size of Bit inches	Size and Style of Rotary Pin Connection	Bit Sub Bevel Diameter[a]		Bit Bevel Diameter[a]	
		inches ±$^{1}/_{64}$	millimeters ±0.40	inches ±$^{1}/_{64}$	millimeters ±0.40
$3^{3}/_{4}$ to $4^{1}/_{2}$ inclusive	$2^{3}/_{8}$ REG	$3^{3}/_{64}$	77.39	$3^{5}/_{64}$	78.18
$4^{5}/_{8}$ to 5 inclusive	$2^{7}/_{8}$ REG	$3^{39}/_{64}$	91.68	$3^{41}/_{64}$	93.66
$5^{1}/_{8}$ to $7^{3}/_{8}$ inclusive	$3^{1}/_{2}$ REG	$4^{7}/_{64}$	104.38	$4^{9}/_{64}$	105.17
$7^{1}/_{2}$ to $9^{3}/_{8}$ inclusive	$4^{1}/_{2}$ REG	$5^{21}/_{64}$	135. 33	$5^{23}/_{64}$	136.13
$9^{1}/_{2}$ to $14^{3}/_{8}$ inclusive	$6^{5}/_{8}$ REG	$7^{23}/_{64}$	186.93	$7^{25}/_{64}$	187.72
$14^{1}/_{2}$ to $18^{1}/_{2}$ inclusive	$6^{5}/_{8}$ REG or $7^{5}/_{8}$ REG	$7^{23}/_{64}$ or $8^{15}/_{32}$	186.93 or 215.11	$7^{25}/_{64}$ or $8^{1}/_{2}$	187.72 or 215.90
$18^{5}/_{8}$ to 26 inclusive	$7^{5}/_{8}$ REG or $8^{5}/_{8}$ REG	$8^{15}/_{32}$ or $9^{35}/_{64}$	215.11 or 242.49	$8^{1}/_{2}$ or $9^{37}/_{64}$	215.90 or 243.28
27 and larger	$8^{5}/_{8}$ REG	$9^{35}/_{64}$	242.49	$9^{37}/_{64}$	243.28

[a]Bevel diameter is the outer diameter of the contact face of the rotary shouldered connection.

Table 22—Blade Drag Bit Connections

1	2	3		4	
Size of Bit inches	Size and Style of Rotary Connection	Bit Sub Bevel Diameter[a]		Bit Bevel Diameter[a]	
		inches ±$^{1}/_{64}$	millimeters ±0.40	inches ±$^{1}/_{64}$	millimeters ±0.40
$3^{3}/_{4}$ to $4^{1}/_{2}$ inclusive	$2^{3}/_{8}$ REG, pin or box	$3^{3}/_{64}$	77.39	$3^{5}/_{64}$	78.18
$4^{5}/_{8}$ to 5 inclusive	$2^{7}/_{8}$ REG, pin or box	$3^{39}/_{64}$	91.68	$3^{41}/_{64}$	93.66
$5^{1}/_{8}$ to $7^{3}/_{8}$ inclusive	$3^{1}/_{2}$ REG, pin or box	$4^{7}/_{64}$	104.38	$4^{9}/_{64}$	105.17
$7^{1}/_{2}$ to $8^{1}/_{2}$ inclusive	$4^{1}/_{2}$ REG, pin or box	$5^{21}/_{64}$	135.33	$5^{23}/_{64}$	136.13
$8^{5}/_{8}$ to $9^{7}/_{8}$ inclusive	$5^{1}/_{2}$ REG, pin or box	$6^{1}/_{2}$	165.10	$6^{17}/_{32}$	165.89
larger than $9^{7}/_{8}$	$6^{5}/_{8}$ REG, pin or box	$7^{23}/_{64}$	186.93	$7^{25}/_{64}$	187.72

[a]Bevel diameter is the outer diameter of the contact face of the rotary shouldered connection.

Table 23—Diamond Drilling, Diamond Core, and PDC Bit Tolerances

1	2	
	OD Tolerance[a]	
Bit Size, OD inches	inches	millimeters
$6^3/_4$ and smaller	+0 –0.015	+0 –0.38
$6^{25}/_{32}$ to 9 inclusive	+0 –0.020	+0 –0.51
$9^1/_{32}$ to $13^3/_4$ inclusive	+0 –0.030	+0 –0.76
$13^{25}/_{32}$ to $17^1/_2$ inclusive	+0 –0.045	+0 –1.14
$17^{17}/_{32}$ and larger	+0 –0.063	+0 –1.60

[a]It is recognized that certain applications may warrant the manufacture of PDC bits to tolerances other than those shown in Table 23. When manufactured, such bits are considered outside the scope of this specification.

Table 24—Diamond Drilling Bit and PDC Bit Connections

1	2	3		4	
Size of Bit inches	Size and Style of Rotary Pin Connection	Bit Sub Bevel Diameter[a]		Bit Bevel Diameter[a]	
		inches $\pm^1/_{64}$	millimeters ±0.40	inches $\pm^1/_{64}$	millimeters ±0.40
$3^{11}/_{16}$ to $4^1/_2$ inclusive	$2^3/_8$ REG	$3^3/_{64}$	77.39	$3^5/_{64}$	78.18
$4^{17}/_{32}$ to 5 inclusive	$2^7/_8$ REG	$3^{39}/_{64}$	91.68	$3^{41}/_{64}$	93.66
$5^1/_{32}$ to $7^3/_8$ inclusive	$3^1/_2$ REG	$4^7/_{64}$	104.38	$4^9/_{64}$	105.17
$7^{13}/_{32}$ to $9^3/_8$ inclusive	$4^1/_2$ REG	$5^{21}/_{64}$	135.33	$5^{23}/_{64}$	136.13
$9^{13}/_{32}$ to $14^1/_2$ inclusive	$6^5/_8$ REG	$7^{23}/_{64}$	186.93	$7^{25}/_{64}$	187.72
$14^9/_{16}$ to $18^1/_2$ inclusive	$6^5/_8$ REG or $7^5/_8$ REG	$7^{23}/_{64}$ or $8^{15}/_{32}$	186.93 or 215.11	$7^{25}/_{64}$ or $8^1/_2$	187.72 or 215.90
$18^9/_{16}$ and larger	$7^5/_8$ REG or $8^5/_8$ REG	$8^{15}/_{32}$ or $9^{35}/_{64}$	215.11 or 242.49	$8^1/_2$ or $9^{37}/_{64}$	218.90 or 243.28

[a]Bevel diameter is the outer diameter of the contact face of the rotary shouldered connection.

10 Rotary Shouldered Connections

10.1 SIZE AND STYLE

Rotary shouldered connections shall be furnished in the sizes and styles shown in Table 25.

10.2 DIMENSIONS

Dimensions of rotary shouldered connections shall conform to Tables 25 and 26.

The dimensions shown in Tables 25 and 26 that have no specified tolerance shall be considered reference dimensions. Deviations from these dimensions are not cause for rejection.

10.2.1 Shoulder contact faces of rotary shouldered connections shall be square with the thread axis within 0.002 inches (0.05 millimeters).

10.2.2 Shoulder contact faces of rotary shouldered connections shall be flat within 0.002 inches (0.05 millimeters).

10.2.3 Threads of rotary shouldered connections shall be produced with standoff tolerances as specified in Section 11 of this specification.

10.2.4 Thread axes of rotary shouldered connections, except on bits, shall not deviate from the design axes of the product by an angle greater than 0 degrees, 3 minutes, 26 seconds (0.001 inch per inch [0.03 millimeters per millimeter] of projected axis). The design axis shall be assumed to intersect the thread axis at the plane of the joint shoulder.

10.2.5 The lead tolerance of rotary shouldered connections is as follows:

a. ±0.0015 inches per inch (±0.0038 millimeters per millimeter) for any inch (millimeter) between the first and last full depth threads.

b. b. ±0.0045 inches (±0.114 millimeters) between the first and last full depth threads, or the sum of 0.001 inches (0.025 millimeters) for each inch (mm) between the first and last full depth threads, whichever is greater.

10.2.6 The taper tolerance of rotary shouldered connections is as follows:

a. Pin thread: +0.030, –0.000 inches per foot (+2.50, –0.00 millimeters per meter) average taper between the first and last full depth threads.

b. Box thread: +0.000, –0.030 inches per foot (+0.00, –2.50 millimeters per meter) average taper between the first and last full depth threads.

Appendix G of this specification contains descriptions of suitable tools for determining taper.

10.2.7 Pin base diameter dimensional requirements are as follows:

a. Drill collars shall conform to the dimension D_{LF}, Column 7 of Table 25, and shall have a 0.062 inch (1.59 millimeter) radius at the pin base as shown in Figure 20 except when stress-relief grooves are used.

b. The D_{LF} dimension, Column 7 of Table 25, and the radius at the pin base as shown in Figure 20 are optional for all drill stem elements except drill collars.

10.3 EQUIVALENT CONNECTIONS

The number connections and their equivalent connections are as follows:

Number Connection	Equivalent Connection
NC26	$2^3/_8$ IF
NC31	$2^7/_8$ IF
NC38	$3^1/_2$ IF
NC40	4 FH
NC46	4 IF
NC50	$4^1/_2$ IF

The number in the Connection Number, Column 1 of Table 25, is the pitch diameter of the pin thread at the gauge point rounded to units and tenths of inches.

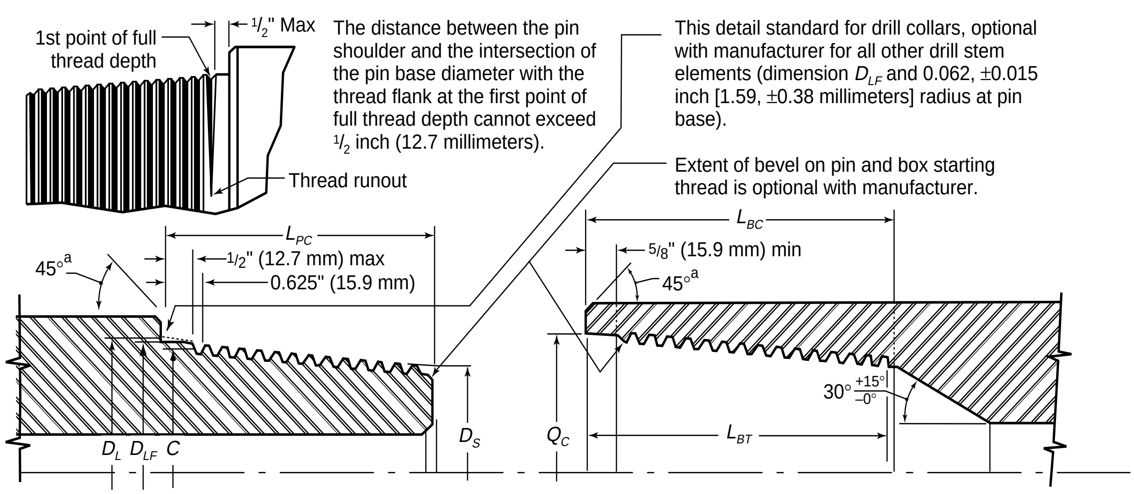
Table 25—Product Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12
Connection Number or Size	Thread Form	Threads Per Inch	Taper, Inches Per Foot on Diameter	Pitch Diameter of Thread at Gauge Point C	Large Diameter of Pin D_L	Diameter of Flat on Pin $\pm\frac{1}{64}$ D_{LF}	Small Diameter of Pin D_S	Length of pin[a] $+0\ -\frac{1}{8}$ L_{PC}	Minimum Length of Box Threads[b] L_{BT}	Depth of Box $+\frac{3}{8}\ -0$ L_{BC}	Box Counter-bore $+\frac{1}{32}\ -\frac{1}{64}$ Q_C
					Number (NC) Style						
NC23	V-0.038R	4	2	2.35500	2.563	2.437	2.063	3	$3\frac{1}{8}$	$3\frac{5}{8}$	$2\frac{5}{8}$
NC26	V-0.038R	4	2	2.66800	2.876	2.750	2.376	3	$3\frac{1}{8}$	$3\frac{5}{8}$	$2\frac{15}{16}$
NC31	V-0.038R	4	2	3.18300	3.391	3.266	2.808	$3\frac{1}{2}$	$3\frac{5}{8}$	$4\frac{1}{8}$	$3\frac{29}{64}$
NC35	V-0.038R	4	2	3.53100	3.739	3.625	3.114	$3\frac{3}{4}$	$3\frac{7}{8}$	$4\frac{3}{8}$	$3\frac{13}{16}$
NC38	V-0.038R	4	2	3.80800	4.016	3.891	3.349	4	$4\frac{1}{8}$	$4\frac{5}{8}$	$4\frac{5}{64}$
NC40	V-0.038R	4	2	4.07200	4.280	4.156	3.530	$4\frac{1}{2}$	$4\frac{5}{8}$	$5\frac{1}{8}$	$4\frac{11}{32}$
NC44	V-0.038R	4	2	4.41700	4.625	4.499	3.875	$4\frac{1}{2}$	$4\frac{5}{8}$	$5\frac{1}{8}$	$4\frac{11}{16}$
NC46	V-0.038R	4	2	4.62600	4.834	4.709	4.084	$4\frac{1}{2}$	$4\frac{5}{8}$	$5\frac{1}{8}$	$4\frac{29}{32}$
NC50	V-0.038R	4	2	5.04170	5.250	5.135	4.500	$4\frac{1}{2}$	$4\frac{5}{8}$	$5\frac{1}{8}$	$5\frac{5}{16}$
NC56	V-0.038R	4	3	5.61600	5.876	5.703	4.626	5	$5\frac{1}{8}$	$5\frac{5}{8}$	$5\frac{15}{16}$
NC61	V-0.038R	4	3	6.17800	6.438	6.266	5.063	$5\frac{1}{2}$	$5\frac{5}{8}$	$6\frac{1}{8}$	$6\frac{1}{2}$
NC70	V-0.038R	4	3	7.05300	7.313	7.141	5.813	6	$6\frac{1}{8}$	$6\frac{5}{8}$	$7\frac{3}{8}$
NC77	V-0.038R	4	3	7.74100	8.000	7.828	6.376	$6\frac{1}{2}$	$6\frac{5}{8}$	$7\frac{1}{8}$	$8\frac{1}{16}$
					Regular (REG) Style						
$2\frac{3}{8}$ REG	V-0.040	5	3	2.36537	2.625	2.515	1.875	3	$3\frac{1}{8}$	$3\frac{5}{8}$	$2\frac{11}{16}$
$2\frac{7}{8}$ REG	V-0.040	5	3	2.74037	3.000	2.890	2.125	$3\frac{1}{2}$	$3\frac{5}{8}$	$4\frac{1}{8}$	$3\frac{1}{16}$
$3\frac{1}{2}$ REG	V-0.040	5	3	3.23987	3.500	3.390	2.562	$3\frac{3}{4}$	$3\frac{7}{8}$	$4\frac{3}{8}$	$3\frac{9}{16}$
$4\frac{1}{2}$ REG	V-0.040	5	3	4.36487	4.625	4.515	3.562	$4\frac{1}{4}$	$4\frac{3}{8}$	$4\frac{7}{8}$	$4\frac{11}{16}$
$5\frac{1}{2}$ REG	V-0.050	4	3	5.23402	5.520	5.410	4.333	$4\frac{3}{4}$	$4\frac{7}{8}$	$5\frac{3}{8}$	$5\frac{37}{64}$
$6\frac{5}{8}$ REG	V-0.050	4	2	5.75780	5.992	5.882	5.159	5	$5\frac{1}{8}$	$5\frac{5}{8}$	$6\frac{1}{16}$
$7\frac{5}{8}$ REG	V-0.050	4	3	6.71453	7.000	6.890	5.688	$5\frac{1}{4}$	$5\frac{3}{8}$	$5\frac{7}{8}$	$7\frac{3}{32}$
$8\frac{5}{8}$ REG	V-0.050	4	3	7.66658	7.952	7.840	6.608	$5\frac{3}{8}$	$5\frac{1}{2}$	6	$8\frac{3}{64}$
					Full-Hole (FH) Style						
$5\frac{1}{2}$ FH	V-0.050	4	2	5.59100	5.825	—	4.992	5	$5\frac{1}{8}$	$5\frac{5}{8}$	$5\frac{29}{32}$
$6\frac{5}{8}$ FH	V-0.050	4	2	6.51960	6.753	—	5.920	5	$5\frac{1}{8}$	$5\frac{5}{8}$	$6\frac{27}{32}$

Notes:
1. See Figure 20.
2. All dimensions are in inches unless otherwise specified. See Appendix M for metric table.

[a]For rolling cone drill bits only, the tolerance is $+0, -\frac{3}{16}$.

[b]L_{BT} is the length of threads in the box measured from the make-up shoulder to the intersection of the non-pressure flank and crest of the last thread with full thread depth.



Note: See Table 25.

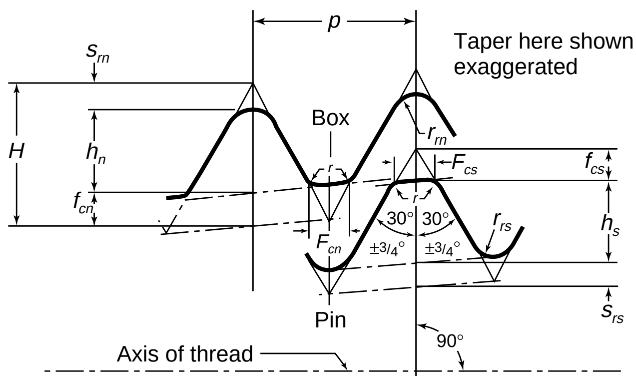
[a]For drill bits only, the allowable bevel angle is 45° to 70°.

Figure 20—Rotary Shouldered Connections

Table 26—Product Thread Dimensions Rotary Shouldered Connections

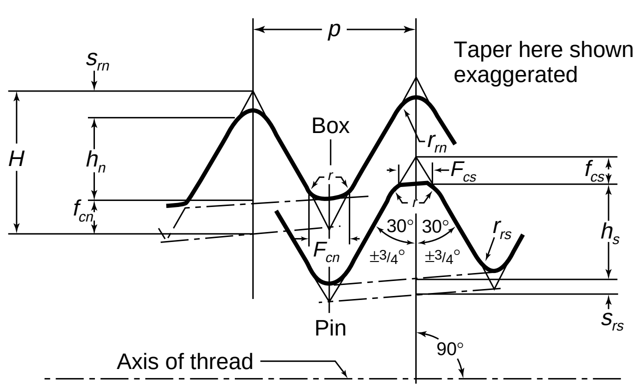
1	2	3	4	5	6	7	8	9	10
						Width of Flat			
Thread Form	Taper in./ft.	Reference Thread Height, Not Truncation H	Reference Thread Height, Truncated $h_n = h_s$	Reference Root Truncation $s_{rn} = s_{rs}$ $f_{rn} = f_{rs}$	Reference Crest Truncation $f_{cn} = f_{cs}$	Crest $F_{cn} = F_{cs}$	Root $F_{rn} = F_{rs}$	Root Radius $r_{rn} = r_{rs}$	Radius at Thread Corners Form r ±0.008
V-0.038R	2	0.216005	0.121844	0.038000	0.056161	0.065	—	0.038	0.015
V-0.038R	3	0.215379	0.121381	0.038000	0.055998	0.065	—	0.038	0.015
V-0.040	3	0.172303	0.117842	0.020000	0.034461	0.040	—	0.020	0.015
V-0.050	3	0.215379	0.147303	0.025000	0.043076	0.050	—	0.025	0.015
V-0.050	2	0.216005	0.147804	0.025000	0.043201	0.050	—	0.025	0.015

Notes:
1. See Figures 21 and 22.
2. All dimensions are in inches unless otherwise specified. See Appendix M for metric table.



Note: See Table 26.

Figure 21—V-0.038R Product Thread Form



Note: See Table 26.

Figure 22—V-0.040 and V-0.050 Product Thread Form

11 Gauging Practice, Rotary Shouldered Connections

11.1 REFERENCE MASTER GAUGES

All threads on rotary shouldered connections shall comply with the gauging practice requirements specified herein. Accordingly, any manufacturer who desires to produce drill stem members utilizing API rotary shouldered connections conforming to this specification must own or have access to calibrated API reference master gauges, consisting of individual reference master plug(s) and mating reference master ring gauge(s), conforming to the requirements of Section 12 and certified as required in Section 13.

Note 1: The use of reference master gauges in checking product threads should be minimized. Such use should be confined to cases of dispute that cannot be settled by rechecking the working gauges against the reference master. Good care should be exercised when the reference master gauge is assembled on a product thread.

Note 2: It is not necessary that authority to use the API monogram be procured in order to purchase API reference master gauges, but the purchaser of such gauges must comply with all the stipulations on calibration and retest as given in this specification.

Note 3: It is not necessary that a manufacturer own all possible sizes of rotary reference master gauges, even though he may own or have access to hardened and ground working gauges. It is therefore permissible that a registered reference master may be borrowed in order to assure the dimensional integrity of these working gauges, so long as the reference master meets the requirements specified in Sections 12 and 13. Furthermore, the borrower must be able to show documentation and traceability as required in 11.5.

11.2 WORKING GAUGES

The manufacturer must own or have access to working gauges for use in gauging product threads, and shall maintain all working gauges in such condition as to ensure that product threads, gauged as required herein, are acceptable under this specification. (See Appendix D for recommended practice for care and use of working gauges.)

11.3 GAUGE RELATIONSHIP

The relationship between reference master gauges, working gauges, and product threads shall be as shown in Figure 23, wherein the certified reference master plug gauge is shown as the standard and the certified reference master ring gauge as the transfer standard. The standoff value, S, of certified reference master gauges is the distance from the plane of the rotary shoulder on the plug to the plane of the gauge point on the ring. The certified reference master ring gauge is used to establish the standoff value, S_1, of the working plug gauge. The certified reference master plug gauge is used to establish the standoff value, S_2, of the working ring gauge. S_1 and S_2 are measured values that the working gauges stand off from their certified reference master gauges and may be greater or less than S.

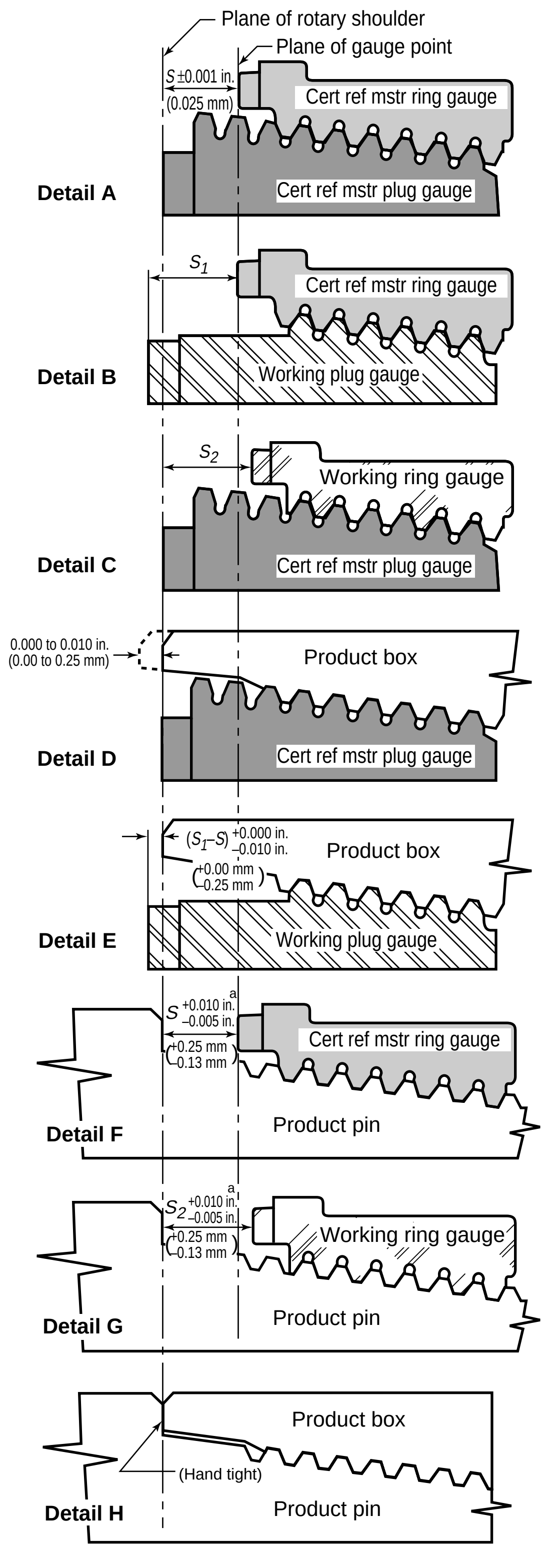
Note: The mating standoff of the reference master ring against the reference master plug gauge as marked on the ring gauge is intended primarily as the basis for establishing the limits of wear or secular change in the gauges. Deviation from this initial S value should be taken into account in establishing working gauge standoff value.

11.4 STANDOFF TOLERANCES

Tolerances on standoff values shall be as specified in Figure 23. These tolerances shall apply after the connection is finish machined and before any antigalling and/or cold working surface treatment is applied to the pin or box connection. Change in gauge standoff after the application of the surface treatment may cause the standoff to exceed the API limits specified for the connection and does not constitute a cause for rejection. It is therefore permissible for a connection to be marked with the API monogram if it meets the API specification before the application of the surface treatment.

11.5 CALIBRATION SYSTEM

Owners and users of API reference master and working gauges shall establish and document a system of gauge calibration and control. Records shall be maintained that show conformance of gauges to the design and calibration requirements of Sections 12 and 13. The calibration system shall establish the frequency of retest in conformance with 12.10. Records of calibration shall show the last calibration date, identity of the individual who performed the calibration, and the calibration history. When reference master gauges are not on the site of the gauge user, copies of the reference master gauges' certificate of certification, per Section 13, shall be maintained at the user site.



Notes:
1. Detail A at 68°F, ±2°F (20°C, ±1.1°C).
2. Details B through H at ambient temperature.
[a]For drill bits only, the tolerance is +0.010, –0.031 in. (+0.25, –0.79 mm).

Figure 23—Rotary Shouldered Connection Gauging Practice

12 Gauge Specification, Rotary Shouldered Connections

12.1 GRAND AND REGIONAL MASTER GAUGES

Grand and regional master gauges shall conform to the dimensions specified in Tables 27 and 28, Figures 24 and 26, and to the tolerances specified in Table 30. These tolerances were established by the National Institute of Standards and Technology. Prior to use, all regional master gauges shall be certified as required in 13.1.

12.2 REFERENCE MASTER GAUGES

Reference master gauges shall conform to the dimensions specified in Tables 27 and 28, Figures 24 and 26, and to the tolerances specified in Table 29. Prior to use, all reference master gauges shall be certified as required in 13.1.

12.3 WORKING GAUGES

Working gauges shall conform to the dimensions specified in Tables 27 and 28, Figures 25 (see notes) and 26, and to the tolerances specified in Table 31. All working plug gauges manufactured per Figure 25 shall have the unused threads removed from the large end. To assure removal of the unused threads, the start of the first thread on the large end of the working plug shall be located within the limits of 1.080 to 1.120 inches (27.43 to 28.45 millimeters) from the surface used to determine standoff.

Note 1: Working plug gauges made prior to June 30, 1987 conform to Figure 24.

Note 2: Working plug gauges made between June 30, 1987 and June 30, 1990 may conform to either Figure 24 or 25.

Note 3: Working plug gauges made after June 30, 1990 shall conform to Figure 25 only.

Note 4: Working plug gauges made per Figure 24, as stated in Notes 1 and 2, may be used without being modified to conform to Figure 25 providing it can be demonstrated through the use of comparators, over wire measurements, or other means that the working plug gauge will produce a product within specification.

Note 5: Working plug gauges made per Figure 24 may be modified to conform to Figure 25.

12.4 GENERAL DESIGN

All plug and ring gauges shall be hardened and ground. Hardness shall be within the limits of Rockwell C60-C63 or equivalent hardness on a superficial scale. Threads on NC, IF, and FH gauges shall be right-hand. Threads for REG gauges can be specified as right-hand or left-hand. Imperfect threads at the ends of plug and ring gauges shall be reduced to a blunt start. Gauges shall be furnished with fitting plates as illustrated in Figures 24 and 25.

12.5 LEAD

The lead of plug and ring gauges shall be measured parallel to the thread axis along the pitch line, over the full threaded length, omitting one full thread from each end. The lead error between any two threads shall not exceed the tolerance specified in Tables 29, 30, or 31. These dimensions shall be measured or checked on laboratory instruments to certify the accuracy shown in Tables 27, 28, 29, 30, and 31.

12.6 TAPER

The included taper shall be measured on the diameter along the pitch line over the full threaded length, omitting one full thread from each end. The taper determined as above, and computed to the length, L_{rg}, Figures 24 and 25, shall conform to the basic taper within the tolerance specified in Tables 29, 30, or 31. Also, on both plug and ring gauges, the included taper of the pitch diameter cone over any interval of length, not exceeding the full threaded length less one full thread at each end, shall lie within the zone defined by the tolerance for taper specified in Tables 29, 30, and 31. These dimensions shall be measured or checked on laboratory instruments to certify the accuracy shown in Tables 27, 28, 29, 30, and 31.

12.7 ROOT FORM

The roots of gauge threads shall be sharp with a radius of truncation not to exceed 0.010 inch (0.25 millimeter), or undercut to a maximum width equivalent to the basic root truncation values given in Table 28. The undercut shall be of such depth as to clear the basic sharp thread; otherwise, the shape of the undercut is not important.

12.8 INITIAL STANDOFF

New and reconditioned plug and ring gauges shall conform to the mating standoff dimensions specified in Table 27, the interchange standoff dimensions listed below, and the tolerances specified in Tables 29, 30, or 31. The interchange standoff for plug and ring gauges against grand, regional, and reference master gauges shall conform to the following limits:

a. Regional masters against grand masters:
   1. Minimum standoff 0.621 inch (15.77 millimeters).
   2. Maximum standoff 0.629 inch (15.98 millimeters).
b. Reference masters against regional or grand masters:
   1. Minimum standoff 0.621 inch (15.77 millimeters).
   2. Maximum standoff 0.629 inch (15.98 millimeters).
c. Working gauges against reference masters:
   1. Minimum standoff 0.621 inch (15.77 millimeters).
   2. Maximum standoff 0.629 inch (15.98 millimeters).

Note: The requirements for interchange standoff place a restriction on the magnitude of the thread-element errors that may be present in gauges that meet both the mating and interchange standoff requirements. If the errors in one or more thread elements are at or near the maximum limits allowed by

Tables 29, 30, or 31, then the errors on other thread elements must be well within the limits to compensate. Differences in lead in mated gauges are partially or completely compensated by difference in taper.

12.9 MISCELLANEOUS ELEMENTS

Diameter of fitting plate, dimensions L_{pg}, L_{rg}, D_R, and Q (see Table 27), shall conform to the dimensions and tolerances (see Tables 29, 30, and 31) given.

12.10 PERIODIC RETEST

Plug and ring gauges shall be periodically retested according to the schedule below to ensure the gauges remain within the standoff limits specified in 12.11.

12.10.1 Regional and reference master gauges shall be retested for mating and interchange standoff at least once each seven years, and certified on a certificate of retest as being acceptable for further use. The certificate of retest shall also report the mating and interchange standoff of the gauges. Regional master gauges shall be retested against grand master gauges at the National Institute of Standards and Technology. Reference master gauges shall be retested against certified regional master gauges at one of the testing agencies listed in Appendix F or against the grand master gauges at the National Institute of Standards and Technology.

12.10.2 Working gauges shall be retested periodically for mating and interchange standoff against certified reference masters. The frequency at which working gauges should be retested depends entirely upon the amount of use. Frequency of retest shall ensure that mating and interchange standoff is maintained within the requirements of 12.11. A calibration system as specified in 11.5 shall be used to establish frequency of retest.

12.11 RETEST STANDOFF

Mating and interchange standoff of plug and ring gauges on periodic retest shall conform to the following limits:

a. Regional masters:
   1. Minimum standoff 0.621 inch (15.77 millimeters).
   2. Maximum standoff 0.629 inch (15.98 millimeters).

b. Reference masters:
   1. Minimum standoff 0.621 inch (15.77 millimeters).
   2. Maximum standoff 0.629 inch (15.98 millimeters).

c. Working gauges:
   1. Minimum standoff 0.621 inch (15.77 millimeters).
   2. Maximum standoff 0.629 inch (15.98 millimeters).

A pair of plug and ring gauges that have been tested as prescribed in 12.8 shall conform to the following wear limit tolerances from the originally established mating and interchange values. Any gauges not conforming to these wear limit tolerances shall be reconditioned and/or replaced.

	Axial Tolerance
Regional masters	+0.0005 inch (0.127 millimeters) –0.0013 inch (0.330 millimeters)
Reference masters	+0.0005 inch (0.127 millimeters) –0.0023 inch (0.584 millimeters)
Working gauges	+0.0005 inch (0.127 millimeters) –0.0023 inch (0.584 millimeters)

12.12 RECONDITIONING

Plug and ring gauges reported as in nonconformance with the standoff requirements of 12.8 or 12.11, or as otherwise unsuitable for further use, shall be removed from service. Regional master, reference master, and working gauges found to be in nonconformance may be reconditioned. Reconditioned regional master and reconditioned reference master gauges shall be resubmitted for initial certification per the requirements of Section 13 before they are returned to service. Reconditioned working gauges shall be inspected for compliance with the requirements of 12.8.

12.13 MARKING

Plug and ring gauges shall be permanently marked by the gauge manufacturer with the markings given below. Plug gauges should preferably be marked on the body, although marking on the handle is acceptable on gauges in small sizes or when the handle is integral with the body. Any markings considered necessary by the gauge maker may be added. Plug gauges and ring gauges shall be marked as required in items a through g as follows:

a. API Monogram—certified regional master and certified reference master gauges only.

b. Size or number of gauge, as given in Column 1, Table 27.

c. Style of connection as follows:
   1. NC ROTARY.
   2. REG ROTARY.
   3. REG LH ROTARY.
   4. FH ROTARY.
   5. IF ROTARY.

d. Gauge registration number—The gauge registration number is issued by the gauge manufacturer as authorized by API. This applies only to regional and reference masters.

e. Name or identifying mark of gauge maker—The name or identifying mark of the gauge maker shall be placed on both plug and ring gauge.

f. Date of certification—The date of certification shall be marked on all regional and reference master gauges. In recertifying reconditioned gauges, the previous certification date shall be replaced with the date of recertification. Dates of retest, as required by 12.10, shall not be marked on reference master or working gauges.

Table 27—Gauge Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Size	Thread Form	Threads Per Inch	Taper in./ft. on Dia.	Pitch Dia. at .625 Gauge Point[a]	Major Dia. at .625 Gauge Point[a]	Minor Dia. at .625 Gauge Point[a]	Pitch Dia. at 1.375 Gauge Point[a]	Total Length Plug Gauge L_{pg}	Dia. of Plug Fitting Plate	Total Length Plug Gauge L_{rg}	Outside Dia. of Ring Gauge D_R	Dia. of Counter-bore Q	Mating Standoff S
						Number (NC) Style Gauges							
NC23	V-0.038R	4	2	2.35500	2.44868	2.26132	2.23000	3	2.056	$2^{3}/_{8}$	$3^{7}/_{8}$	2.521	0.625
NC26 ($2^{3}/_{8}$ IF)	V-0.038R	4	2	2.66800	2.76168	2.57432	2.54300	3	2.369	$2^{3}/_{8}$	$4^{3}/_{16}$	2.834	0.625
NC31 ($2^{7}/_{8}$ IF)	V-0.038R	4	2	3.18300	3.27668	3.08932	3.05800	$3^{1}/_{2}$	2.884	$2^{7}/_{8}$	$5^{1}/_{8}$	3.349	0.625
NC35	V-0.038R	4	2	3.53100	3.62468	3.43732	3.40600	$3^{3}/_{4}$	3.232	$3^{1}/_{8}$	$5^{1}/_{4}$	3.697	0.625
NC38 ($3^{1}/_{2}$ IF)	V-0.038R	4	2	3.80800	3.90168	3.71432	3.68300	4	3.509	$3^{3}/_{8}$	$5^{5}/_{8}$	3.974	0.625
NC40 (4 FH)	V-0.038R	4	2	4.07200	4.16568	3.97832	3.94700	$4^{1}/_{2}$	3.773	$3^{7}/_{8}$	$5^{7}/_{8}$	4.239	0.625
NC44	V-0.038R	4	2	4.41700	4.51068	4.32332	4.29200	$4^{1}/_{2}$	4.118	$3^{7}/_{8}$	$6^{3}/_{8}$	4.583	0.625
NC46 (4 IF)	V-0.038R	4	2	4.62600	4.71968	4.53232	4.50100	$4^{1}/_{2}$	4.327	$3^{7}/_{8}$	$6^{1}/_{2}$	4.792	0.625
NC50 ($4^{1}/_{2}$ IF)	V-0.038R	4	2	5.04170	5.13538	4.94802	4.91670	$4^{1}/_{2}$	4.743	$3^{7}/_{8}$	$7^{1}/_{8}$	5.208	0.625
NC56	V-0.038R	4	3	5.61600	5.70938	5.52262	5.42850	5	5.318	$4^{3}/_{8}$	$7^{7}/_{8}$	5.782	0.625
NC61	V-0.038R	4	3	6.17800	6.27138	6.08462	5.99050	$5^{1}/_{2}$	5.880	$4^{7}/_{8}$	$8^{1}/_{2}$	6.344	0.625
NC70	V-0.038R	4	3	7.05300	7.14638	6.95962	6.86550	6	6.755	$5^{3}/_{8}$	$9^{3}/_{8}$	7.219	0.625
NC77	V-0.038R	4	3	7.74100	7.83438	7.64762	7.55350	$6^{1}/_{2}$	7.443	$5^{7}/_{8}$	$10^{1}/_{4}$	7.907	0.625
						Regular (REG) Style Gauges							
$2^{3}/_{8}$ REG	V-0.040	5	3	2.36537	2.45875	2.27199	2.17787	3	2.131	$2^{3}/_{8}$	$3^{3}/_{4}$	2.531	0.625
$2^{7}/_{8}$ REG	V-0.040	5	3	2.74037	2.83375	2.64699	2.55287	$3^{1}/_{2}$	2.506	$2^{7}/_{8}$	$4^{1}/_{4}$	2.906	0.625
$3^{1}/_{2}$ REG	V-0.040	5	3	3.23987	3.33325	3.14649	3.05237	$3^{3}/_{4}$	3.005	$3^{1}/_{8}$	5	3.406	0.625
$4^{1}/_{2}$ REG	V-0.040	5	3	4.36487	4.45825	4.27149	4.17737	$4^{1}/_{4}$	4.130	$3^{5}/_{8}$	$6^{1}/_{4}$	4.531	0.625
$5^{1}/_{2}$ REG	V-0.050	4	3	5.23402	5.35324	5.11479	5.04652	$4^{3}/_{4}$	4.956	$4^{1}/_{8}$	$7^{1}/_{2}$	5.427	0.625
$6^{5}/_{8}$ REG	V-0.050	4	2	5.75780	5.87740	5.63820	5.63280	5	5.448	$4^{3}/_{8}$	$8^{1}/_{4}$	5.949	0.625
$7^{5}/_{8}$ REG	V-0.050	4	3	6.71453	6.83375	6.59531	6.52703	$5^{1}/_{4}$	6.421	$4^{5}/_{8}$	$9^{1}/_{2}$	6.906	0.625
$8^{5}/_{8}$ REG	V-0.050	4	3	7.66658	7.78580	7.54735	7.47908	$5^{3}/_{8}$	7.373	$4^{3}/_{4}$	$10^{3}/_{4}$	7.858	0.625
						Full-Hole (FH) Style Gauges							
$5^{1}/_{2}$ FH	V-0.050	4	2	5.59100	5.71060	5.47140	5.46600	5	5.292	$4^{3}/_{8}$	$7^{3}/_{4}$	5.784	0.625
$6^{5}/_{8}$ FH	V-0.050	4	2	6.51960	6.63920	6.40000	6.39460	5	6.210	$4^{3}/_{8}$	9	6.711	0.625

Notes:
1. See Appendix J for dimensions of obsolescent connections shown in parentheses in this table.
2. See Figures 24 and 25.
3. All dimensions in inches at 68°F, ±2°F. See Appendix M for metric table.
2. Gauges are the same for numbered connections (NC) and obsolescent connections when shown on the same line.
[a]The values in Columns 5 and 6 apply only to grand, regional, and reference master plug gauges. The values in Column 8 apply only to working plug gauges. The values in Column 7 apply only to ring gauges.

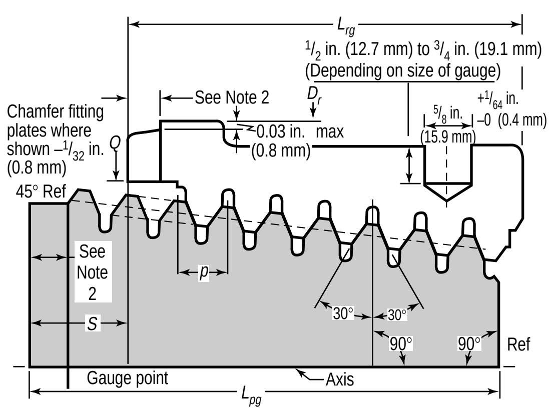


Figure 24—Grand Regional and Reference Master Thread Gauges Rotary Shouldered Connections. All Sizes and Styles

Notes for Figures 24 and 25:
1. See Table 27.
2. The thickness of fitting plate shall be 0.375 inch (9.53 millimeter) maximum for all gauge sizes $5^{1}/_{2}$ and NC50 and smaller, and 0.437 inch (11.10 millimeter) maximum for all gauge sizes $6^{5}/_{8}$ and NC56 and larger.
3. Working gauges made prior to June 30, 1990 may conform to Figure 24 and are acceptable providing they meet all other requirements of 12.3.

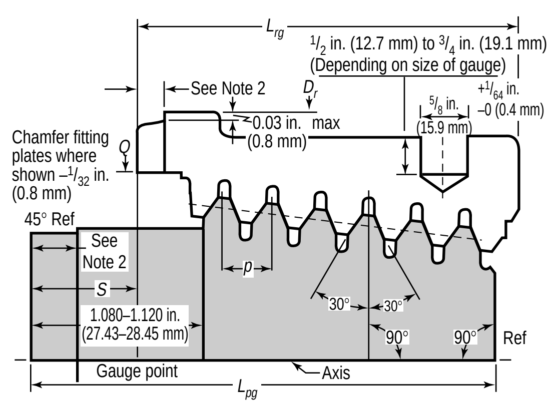


Figure 25—Working Thread Gauges[3] Rotary Shouldered Connection All Sizes and Styles

g. Mating standoff—The initial mating standoff of reference master gauges and working gauges shall be marked on the ring gauge only. Mating standoff values determined by periodic retest as specified in 12.10 shall not be marked on reference master or working gauges.

Following are examples:

A certified regional master or a reference master NC56 rotary gauge shall be marked as follows:

A B Co (or mark) NC56 Rotary
Registration Number
Date of Certification
Mating Standoff

An NC56 working gauge shall be marked as follows:

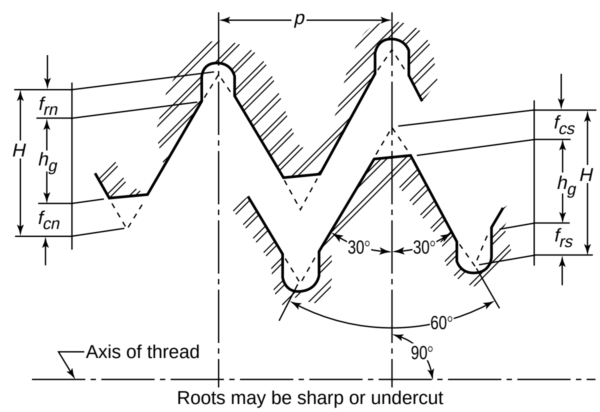
A B Co (or mark) NC56 Rotary Spec 7
Mating Standoff

A certified regional master or a certified reference master $4^{1}/_{2}$ Reg. rotary gauge shall be marked as follows:

A B Co (or mark) $4^{1}/_{2}$ Reg. Rotary
Registration Number
Date of Certification
Mating Standoff

A certified regional master or a certified reference master NC38 rotary gauge which is interchangeable with a $3^{1}/_{2}$ IF rotary gauge shall be marked as follows:

A B Co (or mark) NC38 ($3^{1}/_{2}$ IF) Rotary
Registration Number
Date of Certification
Mating Standoff



Note: See Tables 28, 29, 30, and 31.

Figure 26—Gauge Thread Form

Table 28—Gauge Thread Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10
Form of Thread	Number of Threads Per Inch (Reference)	Pitch p	Taper Inches Per Foot on Diameter	Reference Thread Height, Not Truncated H	Thread Height, Truncated h_g	Root Truncation Maximum f_{rs}	Root Truncation Maximum f_{rn}	Crest Truncation f_{cs}	Crest Truncation f_{cn}
V-0.038R	4	0.2500	2	0.216005	0.101459[a]	0.053385	0.053385	0.061161	0.061161
V-0.038R	4	0.2500	3	0.215379	0.100996[a]	0.053385	0.053385	0.060998	0.060998
V-0.040	5	0.2000	3	0.172303	0.093383	0.039460	0.039460	0.039460	0.039460
V-0.050	4	0.2500	3	0.215379	0.119219	0.048080	0.048080	0.048080	0.048080
V-0.050	4	0.2500	2	0.216005	0.119605	0.048200	0.048200	0.048200	0.048200

Notes:
1. In computing thread height and truncation, account has been taken of the effect of taper in reducing thread height for a given pitch, as compared with values for the same pitch on a cylinder.
2. See Tables 29, 30, and 31 for tolerances on columns 3, 4, 6, 9, and 10.
3. See Figure 26.
4. All dimensions in inches at 68°F, ±2°F. See Appendix M for metric table.
[a]The h_g dimension for V-0.038R thread form (Column 6) cannot be used to compute major and minor diameters from the pitch diameters given in Tables 28 and 29, because the crest and root transactions are not equal.

Table 29—Tolerances On Reference Master Gauge Dimensions

Plug Gauge		Ring Gauge	
Element	Tolerance	Element	Tolerance
Pitch diameter at gauge point[a]:		Minor diameter at gauge point	±0.002
Sizes $6^{5}/_{8}$ and NC50 and smaller	±0.0004	Lead[b]:	
Sizes $7^{5}/_{8}$ and NC56 and larger	±0.0005	Sizes $2^{3}/_{8}$ through $5^{1}/_{2}$ and NC23 through NC50	±0.0006
Major diameter at gauge point	±0.002	Sizes $6^{5}/_{8}$ and NC56 and larger	±0.0007
Diameter of fitting plate	±0.015	Taper[c,d]:	
Lead[b]:		L_{rg} $3^{1}/_{2}$ and shorter	–0.0004 –0.0012
Sizes $6^{5}/_{8}$ and NC50 and smaller	±0.0004	L_{rg} $3^{5}/_{8}$ through 4	–0.0004 –0.0014
Sizes $7^{5}/_{8}$ and NC56 and larger	±0.0005	L_{rg} $4^{1}/_{8}$ through $4^{1}/_{2}$	–0.0004 –0.0016
Taper[c]:		L_{rg} $4^{5}/_{8}$ through 5	–0.0004 –0.0018
L_{rg} $3^{1}/_{2}$ and shorter	+0.0004 –0.0000	L_{rg} $5^{1}/_{8}$ through $5^{1}/_{2}$	–0.0004 –0.0020
L_{rg} $3^{5}/_{8}$ through 4	+0.0005 –0.0000	L_{rg} $5^{5}/_{8}$ through 6	–0.0004 –0.0022
L_{rg} $4^{1}/_{8}$ through $4^{1}/_{2}$	+0.0006 –0.0000	Half angle of thread	±15 min
L_{rg} $4^{5}/_{8}$ through 5	+0.0007 –0.0000	Length L_{rg}	$\pm^{3}/_{32}$
L_{rg} $5^{1}/_{8}$ through $5^{1}/_{2}$	+0.0008 –0.0000	Crest truncation:	
L_{rg} $5^{5}/_{8}$ through 6	+0.0009 –0.0000	Sizes $6^{5}/_{8}$ and NC 50 and smaller	±0.00120
Half angle of thread	±7 min	Sizes $7^{5}/_{8}$ and NC 56 and larger	±0.00125
Length L_{pg}	$\pm^{3}/_{32}$	Outside diameter D_R	$\pm^{1}/_{64}$
Crest truncation:		Diameter of counterbore Q	±0.015
Sizes $6^{5}/_{8}$ and NC 50 and smaller	±0.00120	Mating standoff S	±0.001
Sizes $7^{5}/_{8}$ and NC 56 and larger	±0.00125		

Notes:
1. See Figure 24.
2. All dimensions in inches at 68°F, ±2°F. See Appendix M for metric table.

[a]Helix angle correction shall be disregarded in pitch diameter determinations.
[b]Maximum allowable error in lead between any two threads whether adjacent or separated by any amount not exceeding the full length of thread less one full thread at each end.
[c]L_{rg} values are listed in Table 27, Column 10.
[d]The pitch cone of the ring gauge is provided with a minus taper in order to minimize variations in interchange standoff due to lead errors.

Table 30—Tolerances On Grand and Regional Master Gauge Dimensions

Plug Gauge		Ring Gauge	
Element	Tolerance	Element	Tolerance
Pitch diameter at gauge point[a]	±0.0002	Minor diameter at gauge point	±0.002
Lead[b]:		Lead[b]:	
Sizes $2^{3}/_{8}$ to $3^{1}/_{2}$, inclusive	±0.0002	Sizes $2^{3}/_{8}$ to $3^{1}/_{2}$, inclusive	±0.0003
Sizes 4 to $8^{5}/_{8}$, inclusive	±0.0003	Sizes 4 to $8^{5}/_{8}$, inclusive	±0.0004
Taper[c]	+0.0004 +0.0001	Taper[c,d]	–0.0006 –0.0012
Half angle of thread (minutes)	±5	Half angle of thread (minutes)	±10
Length L_{pg}	$\pm^{3}/_{32}$	Length L_{rg}	±3/32
Crest truncation	±0.00112	Crest truncation	±0.0011
		Outside Diameter D_R	$\pm^{1}/_{64}$
		Diameter of counterbore Q	±0.015
		Mating standoff S	±0.001

Notes:
1. See Figure 24.
2. All dimensions in inches at 68°F, ±2°F. See Appendix M for metric table.

[a]Helix angle correction shall be disregarded in pitch diameter determinations.
[b]Maximum allowable error in lead between any two threads whether adjacent or separated by any amount not exceeding the full length of thread less one full thread at each end.
[c]L_{rg} values are listed in Table 27, Column 10.
[d]The pitch cone of the ring gauge is provided with a minus taper in order to minimize variations in interchange standoff due to lead errors.

Table 31—Tolerance On Working Gauge Dimensions

Plug Gauge		Ring Gauge	
Element	Tolerance	Element	Tolerance
Pitch diameter at gauge point[a]:		Minor diameter at gauge point	±0.002
Sizes $6^5/_8$ and NC50 and smaller	±0.0004	Lead[b]:	
Sizes $7^5/_8$ and NC56 and larger	±0.0005	Sizes $2^3/_8$ through $5^1/_2$ and NC23 through NC50	±0.0006
Major diameter at gauge point	±0.002	Sizes $6^5/_8$ and NC56 and larger	±0.0007
Diameter of fitting plate	±0.015	Taper[c,d]:	
Lead[b]:		L_{rg} $3^1/_2$ and shorter	–0.0004 –0.0014
Sizes $6^5/_8$ and NC50 and smaller	±0.0004	L_{rg} $3^5/_8$ through 4	–0.0004 –0.0016
Sizes $7^5/_8$ and NC56 and larger	±0.0005	L_{rg} $4^1/_8$ through $4^1/_2$	–0.0004 –0.0018
Taper[c]:		L_{rg} $4^5/_8$ through 5	–0.0004 –0.0020
L_{rg} $3^1/_2$ and shorter	+0.0006 –0.0000	L_{rg} $5^1/_8$ through $5^1/_2$	–0.0004 –0.0022
L_{rg} $3^5/_8$ through 4	+0.0007 –0.0000	L_{rg} $5^5/_8$ through 6	–0.0004 –0.0024
L_{rg} $4^1/_8$ through $4^1/_2$	+0.0008 –0.0000	Half angle of thread	±15 min
L_{rg} $4^5/_8$ through 5	+0.0009 –0.0000	Length L_{rg}	$\pm^3/_{32}$
L_{rg} $5^1/_8$ through $5^1/_2$	+0.0010 –0.0000	Crest truncation:	
L_{rg} $5^5/_8$ through 6	+0.0011 –0.0000	Sizes $6^5/_8$ and NC 50 and smaller	±0.00120
Half angle of thread	±7 min	Sizes $7^5/_8$ and NC 56 and larger	±0.00125
Length L_{pg}	$\pm^3/_{32}$	Outside diameter D_R	$\pm^1/_{64}$
Crest truncation:		Diameter of counterbore Q	±0.015
Sizes $6^5/_8$ and NC 50 and smaller	±0.00120	Mating standoff S	±0.001
Sizes $7^5/_8$ and NC 56 and larger	±0.00125		

Notes:
1. See Figure 25.
2. All dimensions in inches at 68°F, ±2°F. See Appendix M for metric table.
[a]Helix angle correction shall be disregarded in pitch diameter determinations.
[b]Maximum allowable error in lead between any two threads whether adjacent or separated by any amount not exceeding the full length of thread less one full thread at each end.
[c]L_{rg} values are listed in Table 27, Column 10.
[d]The pitch cone of the ring gauge is provided with a minus taper in order to minimize variations in interchange standoff due to lead errors.

13 Gauge Certification, Rotary Shouldered Connections

13.1 CERTIFICATION AGENCIES

New and reconditioned regional master and reference master gauges shall be submitted for certification as to the accuracy of all essential elements as required in 12.1 and 12.2. The National Institute of Standards and Technology shall be the certifying agency for all regional master gauges.

New and reconditioned reference master gauges shall be submitted to one of the following agencies for certification:

a. National Institute of Standards and Technology, Washington, D.C., U.S.A.
b. National Physical Laboratory, Teddington, England.
c. National Research Laboratory of Metrology, Ibaraki, Japan.
d. National Measurement Laboratory, Lindfield, N.S.W., Australia.
e. Instituto Nacional de Tecnologia Industrial, Buenos Aires, Argentina.
f. National Institute of Metrology, Beijing, People's Republic of China.

Note: Application to become an API Gauge Certification Agency is open to any metrology laboratory capable of demonstrating compliance with API policy and specified requirements. Interested parties shall notify the API Exploration & Production Department at 1220 L Street, NW, Washington, D.C. 20005. Appendix E of this specification outlines certification agency requirements.

13.2 GENERAL REQUIREMENTS

Regional master and reference master gauges shall be certified in complete sets, e.g., a reference master plug and a reference master ring. A single gauge may be certified only if accompanied by a previously certified mating gauge. When a previously certified mating gauge is used, the certificate of certification shall be furnished to the certifying agency as proof of the accuracy of the mating gauge.

All gauges submitted for certification shall be permanently marked with its API registration number at the time of submittal.

13.3 CERTIFICATION

The gauge manufacturer shall select one of the agencies listed in 13.1 to inspect new and reconditioned regional master and reference master gauges for conformance to the requirements of Section 12. For each set of gauges that complies with all requirements, the gauge manufacturer shall obtain a certificate from the certifying agency as evidence of the gauge accuracy. The certificate shall contain the following information:

a. Name of certifying agency.
b. Signature of inspector.
c. Date of certification.
d. API registration number of each gauge.
e. Mating standoff measurement.
f. Interchange standoff measurement.
g. Statement of compliance to 13.7.
h. Statement of compliance to Section 12.

The gauge manufacturer shall instruct the certifying agency to send a copy of the certificate of certification to the API Washington Office.

13.4 INTERCHANGE STANDOFF

All new and reconditioned reference master gauges shall be submitted to one of the agencies referenced in 13.5 or 13.6 for determination of interchange standoff against grand or regional master gauges, as required in 12.8.

13.5 GRAND MASTER GAUGES

One grand master gauge in each size and style of connection is deposited with the National Institute of Standards and Technology, Washington, D.C. These grand master gauges are used to check the interchange standoff of both regional master gauges and reference master gauges. Only regional master and reference master gauges manufactured by an API licensed gauge manufacturer shall be checked with the grand master gauges.

Note: Grand and regional master gauges shall not be used to inspect used working gauges.

13.6 REGIONAL MASTER GAUGES

Appendix E lists the agencies that have on deposit, in available sizes and styles, regional master gauges. These regional master gauges are used to check the interchange standoff of reference master gauges. Only reference master gauges manufactured by an API licensed gauge manufacturer shall be checked with the regional master gauges.

Note: Grand and regional master gauges shall not be used to inspect used working gauges.

13.7 DETERMINATION OF STANDOFF

Mating and interchange standoff (see Figures 23 and 24) shall be determined as follows:

a. During the test all pieces entering into the measurement shall be at a uniform temperature of 68°F, ±2°F (20°C, ±1.1°C).
b. Gauges shall be free of visible evidence of contaminates before mating. A thin film of medicinal mineral oil shall be wiped on the threads with clean chamois skin or bristle brush.
c. The pair shall be mated hand tight without spinning into place, and complete register shall be accomplished with the torque hammer specified for each size (see Figure 27).

Table of Weights

2-lb. (0.908 kg) weight for gauges in sizes $2^{3}/_{8}$ and $2^{7}/_{8}$ and NC23, NC26, and NC31.

3-lb. (1.362 kg) weight for gauges in sizes $3^{1}/_{2}$ and 4 and NC35, NC38, NC40, NC44, NC46, and NC50.

4-lb. (1.816 kg) weight for gauges in sizes $5^{1}/_{2}$ and $6^{5}/_{8}$ and NC56 and NC61.

5-lb. (2.270 kg) weight for gauges in size $7^{5}/_{8}$ and NC70.

6-lb. (2.724 kg) weight for gauges in size $8^{5}/_{8}$ and NC77.

Note: See 11.7.3.

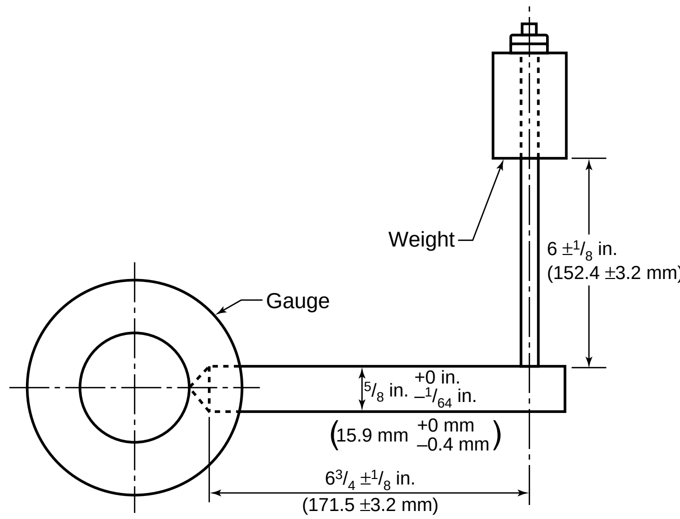


Figure 27—Torque Hammer

d. The number of torque hammer blows is unimportant. Sufficient number should be made so that continued hammering will not move the ring relative to the plug. When testing, the plug gauge should be rigidly held, preferably in a vise mounted on a rigid work bench. When so held, 12 torque hammer blows should be sufficient to make complete register.

13.8 STANDOFF REPORT

If the gauge conforms to the interchange standoff limits specified in 12.8 or 12.10, the gauge manufacturer or reconditioner shall obtain, from the certifying agency, a report showing both the mating and interchange standoff values. The manufacturer or reconditioner shall provide a copy of the report to the API Washington Office.

13.9 MARKING

All sets of regional or reference master gauges found to be in full conformance with the requirements of Section 12 shall have the plug gauge only permanently marked with the name or identification mark of the certifying agency.

14 Connection Marking

When used on products or applications not covered by this specification, any rotary connection that conforms to the threading and gauging stipulations given herein may, at the manufacturer's option, be identified by stamping or stenciling the product adjacent to such thread with the manufacturer's name or mark, "Spec 7," and the size and style of connection. The connection marking may be applied to products that are not covered by API specifications. For example, an NC46 connection may be marked:

A B Co (or mark) SPEC 7 NC46 THD

15 Inspection and Rejection

When stated on the purchase order, the provisions of Appendix N shall apply.

APPENDIX A—SUPPLEMENTARY REQUIREMENTS

By agreement between the purchaser and the manufacturer and when specified on the purchase order, the following supplementary requirements for the tool joint/drill pipe weld zone shall apply:

A.1 SR1—Frequency of Testing

One set of mechanical tests shall be conducted per lot or 200 welds, whichever is less.

A.2 SR2—Charpy V-Notch Type A Impact Tests

The test temperature shall be –4°F, ± 5°(-20°C, ± 2.8°C).

A.3 SR3—Minimum Values

The minimum average value for the three specimens shall not be less than 20 foot-pounds. The minimum value for any single specimen shall not be less than 17 foot-pounds.

APPENDIX B—INSTRUCTIONS FOR CARE AND USE OF API REGIONAL MASTER GAUGES

B.1 The gauging surfaces of regional master gauges should be protected with a coating of petrolatum brushed into the threads. In cold weather it is advisable to heat the petrolatum slightly so that it will flow easily. If gauges are not used for a period of six months, the gauges should be thoroughly cleaned and a fresh coating of petrolatum applied. (A neutral oil is effective in protecting gauges for only a short period of time, a few days to two weeks depending on atmospheric conditions. In warm weather an oil will flow off the surface much faster than in cold weather. Eventually dust particles settling on an oil-protected gauge will penetrate the gauge surface and cause small rust spots. Since the custodian may not know when the regional masters will be used again upon completing the check of standoff of a set of reference master gauges against the regional masters, the use of petrolatum as protection is advised in all cases.)

B.2 Gauges should be stored unassembled in a well controlled temperature environment. When gauges are stored with plug and ring assembled with or without a protective coating, there is a tendency for electrolytic corrosion to develop, appearing as a discoloration of the surfaces in contact. If left assembled for a long period, the surfaces may actually rust together. The ideal storage arrangement for regional master gauges is a case or cupboard with wood shelves provided with a door with lock and key to prevent unauthorized use of the gauges. Shelves should be partitioned with wood spacers to provide a separate compartment for each size plug gauge. This prevents damage to thread surfaces in storing. Compartments for rings are not required, but rings should not be stacked. Shelving should be covered with waxed paper to protect end surfaces of plugs and rings.

B.3 In the determination of standoff values, both regional master and reference master gauges should be thoroughly cleaned before assembly. This can be done most efficiently by immersing the gauges (plug or ring) in a suitable solvent and brushing the thread surfaces with a stiff brush. After cleaning, the reference gauges should be inspected for damaged threads, rust, etc. Gauges with burns or rough threads that may damage the regional master gauges should not be assembled with those gauges. With regard to discoloration on the thread surfaces, the custodian must use his judgment. The coefficient of friction between smooth and bright steel surfaces is less than between rough and discolored surfaces. It is apparent that the friction factor enters into the determination of standoff values. A gummy oil deposit on the gauge seriously adds to the friction. It is inadvisable to determine standoff on gauges with such a deposit.

B.4 For standoff determination the thread surfaces of the gauges should be completely, but lightly, covered with medicinal mineral oil. Excess oil should be avoided since the excess would have to flow out of the ends of the gauge and if trapped may affect the standoff value.

B.5 In the assembling operation, the plug gauge should be held rigidly in a vise. The vise should be of a heavy type and firmly fastened to a rigid bench. This is of importance as standoff values, especially on the larger sizes, may be affected by the rigidity of the holding device. In using the hammer, the lever arm should be approximately horizontal (see Figure 27). Standoff should be measured at four points around the fitting plates, avoiding contact with any raised points caused by the stamping of serial numbers on the plates. The mean of the four readings should be taken as the standoff value to be reported.

APPENDIX C—INSTRUCTIONS FOR SHIPMENT OF REFERENCE MASTER GAUGES

C.1 Reference master gauges should ordinarily remain in good condition for years if properly cared for and used only for the purpose intended, namely, the checking of working gauges with smooth, clean threads. If the gauges become dirty, they should be cleaned by the gauge owner before shipment to the custodian for standoff determinations.

C.2 Oily deposits or discolorations may sometimes be removed with a pointed, soft wood stick. To do this, the gauge (plug or ring) should be chucked in a lathe and rotated slowly while the stick is pressed into the thread with equal bearing on both flanks. A large portion of such deposits can usually be removed by this method, but it may sometimes be necessary to charge the stick with oil and a fine grade of emery. A coarse or quick cutting abrasive should not be used.

Note: A fine grade of emery flour, such as No. 12 Washington Mills, is recommended for this purpose.

C.3 Burrs or small scored places on the threads may be stoned with a fine grade of stone. The stoning of scored places extending all the way around the gauge is not approved as the accuracy of the gauges may be seriously affected by extensive stoning. For severe cases of pitting or scoring, regrinding by the gauge maker is advisable.

C.4 After reconditioning, the gauge must be cleaned thoroughly.

C.5 After drying, the plug and ring gauge should be thoroughly covered with medicinal mineral oil, assembled in mating pairs, then wrapped in oil paper.

C.6 Each mating pair of gauges should be boxed separately for shipment, using waste or similar packing.

C.7 Shipping boxes should be securely made and the material should be heavy enough to prevent damage to the gauges during shipment; 2 inch (50.8 millimeter) material is recommended. If gauges are received by the custodian in boxes inadequate for return shipment, the custodian will repair or replace the shipping containers, and add cost to the inspection fee. The gauges should be held rigidly in place in the box by a follower block with a hole through the middle that fits the handle of the plug gauge snugly. This follower block should be fastened with wood screws through the outside of the box.

C.8 The tops of the shipping boxes should be screwed on, not nailed, with the return address affixed securely on the reverse side, so that the top can be reversed by the custodian for return shipment to the owner.

C.9 All carriage charges must be prepaid. Shipment to custodians should preferably be by express, which is faster in transit and delivery. When returning gauges, custodians will ship collect. Owners should indicate to the custodian whether gauges are to be returned by freight or express.

C.10 Custodians are not permitted to assemble grand or original master gauges with reference master gauges that have dirty or damaged threads. If cleaning is required, other than that required to remove the protective coating, the testing agency will charge for the extra work. If the gauge is rusted or scored to the extent as to require reconditioning, the gauge owner will be so notified. Failure to recondition such gauges will be considered justification for cancellation of the gauges' status as authorized reference master gauges.

C.11 Owners of gauges that are to be transported by ship from outside the United States to the National Institute of Standards and Technology (NIST) for test must make prior arrangements with a customs broker either in the country of origin or in the United States for entry of the gauges into the United States, with or without bond as may be necessary, and prepaid transportation to and from the ports of entry and exit. Entry in bond is required for gauges made outside the United States, whereas gauges made in the United States may be entered without bond. If arrangements are made with a broker in the country of origin, that broker should, in turn, have a customs broker in or near the port of entry arrange for entry of the gauges and prepaid transportation to the National Institute of Standards and Technology, Gaithersburg, MD.

C.12 An alternative method of shipment that eliminates the need for services of a customs broker is by air freight to NIST via Dulles International Airport, Washington D.C. When shipments are made by this method, NIST will pick up the gauges at the airport, arrange for entry in bond when necessary, and after test obtain release from bond if required and deliver the gauges to the airport for return shipment. The gauges will be returned collect with transportation charges payable at destination.

C.13 Transportation by air is much more expensive than by ship but the difference is largely offset by customs broker's charges. An added advantage of air transportation is the very great decrease in the time the gauges are away from the owner's factory.

C.14 The agencies' charges for tests will be billed separately from those of a customs broker. Prepayment of all charges for tests is required.

APPENDIX D—RECOMMENDED PRACTICE FOR CARE AND USE OF WORKING GAUGES

D.1 A reduction in mating standoff of used working gauges is not serious, providing the wear on thread elements has been uniform and that correction in gauging standoff, as shown by comparison with the reference masters, is applied when gauging product threads.

D.2 Because of their extreme accuracy, gauges represent a considerable investment. They should be handled with care. A gauge that is abused or allowed to deteriorate quickly loses its value for gauging purposes.

D.3 Gauges should be kept free from dirt and grit. It is important that a suitable place be provided for storage. It is advisable that plug and ring gauges be stored separately and not made up in pairs. They should be coated with a good grade of slushing oil when not in use.

D.4 Before use, the gauges should be examined for burrs on the thread. Burrs or other rough spots should be removed with a medium fine stone or with a fine file. Gauges should be given a periodic visual examination for pick-up of slivers on the gauging surfaces. Those observed should be removed with a fine file or stone.

D.5 In gauging product threads, the gauges should be handled with care. Clean both the gauge and the product thoroughly before assembling. A light film of thin oil will protect the gauge when in use and increase the life of the gauge. Dry surfaces, when set up under pressure, have a tendency to seize and pick up metal. Such spots will cause inaccuracies in gauging if not removed. Gauges should be set up firmly on the product. A rod about 6 inches (152.4 millimeters) long may be used for this purpose. Loose gauging produces loose joints.

APPENDIX E—API GAUGE CERTIFICATION AGENCY REQUIREMENTS

All API Gauge Certification Agency applicants shall be required to demonstrate measurement capability in the following areas:

a. Facility environment.
b. Inspection equipment.
c. Standards and calibration.
d. Personnel qualifications.
e. Organizational structure.
f. Documentation.
g. Storage and handling.

APPENDIX F—API GRAND AND REGIONAL MASTER ROTARY CONNECTION GAUGES JANUARY 1, 1994

Table F-1—Numbered Connections

	NC26	NC31	NC35	NC38	NC40	NC44	NC46	NC50	NC56	NC61	NC70
	Gauge Registration Number										
Grand Master Gauges											
National Institute of Standards and Technology, Washington D.C., U.S.A.	4401	4402	7000	4403	3005	7001	4404	4405	7002	7003	7004
Regional Master Gauges											
Chengdu Measuring & Cutting Tool Works, Chengdu, Peoples Republic of China	—	—	—	7831	—	—	—	7832	—	—	—
Instituto Nacional de Tecnologia Industrial, Buenos Aires, Argentina	7012	7013	—	7014	8082	—	7015	7016	—	—	—
Lone Star Gauge & Calibration, Houston, TX, U.S.A.	—	—	—	10400	—	—	—	10395	—	—	—
National Institute of Metrology, Beijing, Peoples Republic of China	7834	7835	7836	7837	7838	7839	7840	7841	7842	7843	7844
National Physical Laboratory, Teddington, England	4407	4408	7008	4409	3017	7009	4410	4411	7010	7011	—
National Research Laboratory of Metrology, Ibaraki, Japan	—	4420	—	4421	—	—	—	4422	—	—	—
Oil Country Tubular Goods Inspection Laboratory, Baoji, Peoples Republic of China	1706	—	1707	1708	1709	1710	10602	—	1711	1712	1713

Table F-2—Regular Right-Hand (REG)

	Size							
	$2^3/_8$	$2^7/_8$	$3^1/_2$	$4^1/_2$	$5^1/_2$	$6^5/_8$	$7^5/_8$	$8^5/_8$
	Gauge Registration Number							
Grand Master Gauges								
National Institute of Standards and Technology, Washington, D.C., U.S.A.	1101	1102	1103	1104	1105	1700	1142	1701
Regional Master Gauges								
Instituto Nacional de Tecnologia Industrial, Buenos Aires, Argentina	1148	1149	1150	6501	6502	6503	6504	—
Lone Star Gauge & Calibration, Houston, TX, U.S.A.	1122	1123	1124	1125	1126	1127	—	1128
National Physical Laboratory, Teddington, England	1129	1130	1131	1132	1133	1134	1146	1147
National Research Laboratory of Metrology, Ibaraki, Japan	—	—	—	1143	1144	1145	—	—
National Measurement Laboratory, Lindfield, N.S.W., Australia	—	6022	6023	6024	—	6025	—	—
Oil Country Tubular Goods Inspection Laboratory, Baoji, People's Republic of China	1714	1731	1715	—	1716	1717	1718	1719

Table F-3—Regular Left-Hand (REG LH)

	Size							
	$2^{3}/_{8}$	$2^{7}/_{8}$	$3^{1}/_{2}$	$4^{1}/_{2}$	$5^{1}/_{2}$	$6^{5}/_{8}$	$7^{5}/_{8}$	$8^{5}/_{8}$
	Gauge Registration Number							
Grand Master Gauges								
National Institute of Standards and Technology, Washington, D.C., U.S.A.	1751	1752	1753	1754	1755	1756	1779	1757
Regional Master Gauges								
Lone Star Gauge & Calibration, Houston, TX, U.S.A.	1758	1759	1760	1761	1762	1763	—	1764
National Physical Laboratory, Teddington, England	1771	1772	1773	1774	1775	1776	—	—
National Measurement Laboratory, Lindfield, N.S.W., Australia	—	—	—	1916	—	—	—	—
Oil Country Tubular Goods Inspection Laboratory, Baoji, Peoples Republic of China	1724	1725	1726	—	1727	1728	1729	1730

Table F-4—Full-Hole Right-Hand (FH)

	Size				
	$3^{1}/_{2}$	4	$4^{1}/_{2}$	$5^{1}/_{2}$	$6^{5}/_{8}$
	Gauge Registration Number				
Grand Master Gauges					
National Institute of Standards and Technology, Washington, D.C., U.S.A.	3001	3005	3002	3003	3004
Regional Master Gauges					
Chengdu Measuring & Cutting Tool Works, Chengdu, People's Republic of China	—	—	—	7833	—
Instituto Nacional de Tecnologia Industrial, Buenos Aires, Argentina			3031	3032	—
National Physical Laboratory, Teddington, England	3016	3017	3018	3019	3020
National Research Laboratory of Metrology, Ibaraki, Japan	3027	—	3028	3030	—
National Measurement Laboratory, Lindfield, N.S.W., Australia	—	—	3228	—	—
National Institute of Metrology, Beijing, People's Republic of China	—	—	—	7845	—
Oil Country Tubular Goods Inspection Laboratory, Baoji, People's Republic of China	1720	—	1721	—	1722

Table F-5—Internal-Flush Right-Hand (IF)

	Size					
	$2^{3}/_{8}$	$2^{7}/_{8}$	$3^{1}/_{2}$	4	$4^{1}/_{2}$	$5^{1}/_{2}$
	Gauge Registration Number					
Grand Master Gauges						
National Institute of Standards and Technology, Washington, D.C., U.S.A.	4401	4402	4403	4404	4405	4406
Regional Master Gauges						
Instituto Nacional de Tecnologia Industrial, Buenos Aires, Argentina	7012	7013	7014	7015	7016	—
Lone Star Gauge & Calibration, Houston, TX, U.S.A.	—	—	10400	—	10305	—
National Institute of Metrology, Beijing, People's Republic of China	—	—	—	—	—	7846
National Physical Laboratory, Teddington, England	4407	4408	4409	4410	4411	4412
National Research Laboratory of Metrology, Ibaraki, Japan	—	4420	4421	—	4422	4423
Oil Country Tubular Good Inspection Laboratory, Baoji, People's Republic of China	—	—	—	—	—	1723

APPENDIX G—RECOMMENDED THREAD COMPOUNDS FOR ROTARY SHOULDERED CONNECTIONS

Note: It is recommended that the label of all containers of thread compound for use on tool joints include the metallic content, by weight, and the range of recommended temperatures.

G.1 General

Since rotary shouldered connections are subjected to high torsional loads in service, it is important that thread compounds be used that will provide adequate protection against galling and prevent excessive make-up. Excessive make-up usually results in damage in the form of stretched or broken pins and/or swelled boxes. API Recommended Practice 7A1, *Recommended Practice for Testing of Thread Compound for Rotary Shouldered Connections*, provides recommendations for testing the frictional performance of thread compounds for rotary shouldered connections. The following paragraphs give recommendations for thread compounds for use on API rotary shouldered connections. While there may be other compounds that will perform equally well, the compounds discussed below have proven satisfactory.

G.1.1 THREAD COMPOUNDS FOR TOOL JOINTS

Zinc base compounds have proven successful for use on rotary shouldered connections on tool joints. The compound should contain 40 percent to 60 percent by weight of finely powdered metallic zinc, and not more than 0.3 percent active sulfur.

G.1.2 THREAD COMPOUNDS FOR DRILL COLLARS

Lead base or zinc base compounds have proven successful for use on rotary shouldered connections on drill collars. The compound should contain a minimum of 60 percent by weight of finely powdered metallic lead or 40 percent to 60 percent by weight of finely powdered metallic zinc, and not more than 0.3 percent active sulfur.

G.1.3 THREAD COMPOUNDS FOR DRILLING AND CORING BITS

Zinc base compounds have proven successful for use on rotary shouldered connections on drilling and coring bits. The compound should contain 40 percent to 60 percent by weight of finely powdered metallic zinc, and not more than 0.3 percent sulfur.

G.2 Caution

Thread compounds may contain hazardous materials. Consult the product Material Safety Data Sheet for further information. Mark, store, report and dispose of thread compound containers and waste materials in accordance with applicable regulations. Thread compounds made according to API Bulletin 5A3 will produce excess make-up and are not recommended for use on rotary shouldered connections.

APPENDIX H—RECOMMENDED PRACTICE FOR GAUGING NEW ROTARY SHOULDERED CONNECTIONS

H.1 Foreword

This recommended practice is published as an aid in the procurement and use of satisfactory instruments for determining lead and taper of the threaded elements of new rotary shouldered connections. Other instruments and methods may be and are used to control manufacturing operations. This recommended practice is not intended in any way to restrict the use of any instrument or method to control manufacturing operations, but in case of dispute, acceptance and rejection of the product shall be governed by the use of instruments for determining lead and taper described in this recommended practice. (See 12.4 and 12.5 of this specification.)

H.2 Precautions

H.2.1 TEMPERATURE

All instruments shall be exposed to the same temperature conditions as the product to be inspected, for a time sufficient to eliminate any temperature difference.

H.2.2 CARE OF INSTRUMENTS

The instruments described herein are precision instruments and shall be handled in a careful and intelligent manner, commensurate with the maintenance of the high accuracy and precision required for inspection under this recommended practice. If any instrument is inadvertently dropped or severely shocked, it should not be used for inspection purposes until its accuracy has been reestablished.

H.2.3 CLEANING THE THREADS

All threads shall be cleaned thoroughly before gauging. If the gauging is made after shipment, the thread compound shall be removed with a brush having stiff bristles, using a suitable solvent.

H.3 Taper Measurement

H.3.1 DEFINITION

For rotary shouldered connection threads, taper shall be defined as the increase in the pitch diameter of the thread, in inches per foot (millimeter per meter) of thread. On all threads, taper tolerances are expressed in terms of inches per foot (millimeter per meter) of threads and taper errors must be determined accordingly. The measurements are made for suitable interval lengths and the observed errors should be calculated to the inches per foot (millimeter per meter) basis.

H.3.2 GAUGE CONTACTS

Contact points of taper gauges shall be of the ball-point type and shall preferably be made of tungsten carbide or tantalum carbide. The dimensions of the ball-point contacts shall be such that they contact the thread flanks rather than the minor cone. The commonly used ball-points meeting flank contact requirements are shown in Table H-1.

H.3.3 EXTERNAL TAPER CALIPER

The taper of external threads can be measured with a dial-gauge caliper as illustrated in Figure H-1.

Note: A caliper having a maximum capacity less than twice the size of the thread should be used to ensure accurate measurements.

H.3.4 PROCEDURE FOR EXTERNAL THREADS

With the adjustable arm of the caliper set to the size of the external thread under test, the fixed contact shall be placed in position at the first perfect thread and the contact on the plunger located in the same thread, 180 degrees opposite. The fixed contact shall be held firmly in position, the plunger contact oscillated through a small arc, and the dial gauge set so that the zero position coincides with the maximum indication. Successive measurements at the same radial position relative to the axis of the thread shall then be taken at suitable intervals for the full length of perfect threads. A line scribed on the thread crests parallel to the thread axis can be used to align the fixed contact for maintaining the same radial position. The difference between successive measurements shall be the taper in that interval of threads.

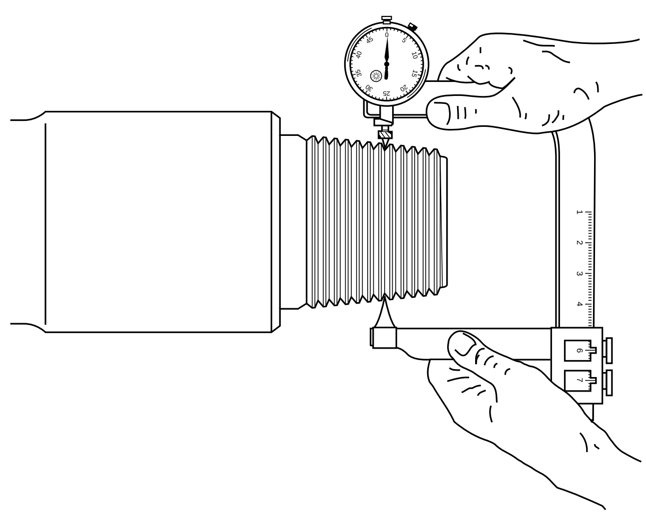


Figure H-1—External Taper Measurement

Table H-1—Compensated Thread Lengths and Ball Point Diameters for Measurements Parallel to the Taper Cone

1	2	3	4	5	6	7
Thread Form	Taper, inches/foot	Number Threads Per Inch	Pitch, inches	Thread Length (Parallel to Thread Axis), inches	Compensated Length (Parallel to Taper Cone), inches	Ball Point Diameter, inches
V-0.038R	2.00	4	0.25000	1	1.00347	0.14400
V-0.038R	3.00	4	0.25000	1	1.00778	0.14400
V-0.040	3.00	5	0.20000	1	1.00778	0.11500
V-0.050	3.00	4	0.25000	1	1.00778	0.14400
V-0.050	2.00	4	0.25000	1	1.00347	0.14400
V-0.065	2.00	4	0.25000	1	1.00347	0.14400
V-0.076	1.50	4	0.25000	1	1.00195	0.14400
H-90	2.00	$3^1/_2$	0.28571	2	2.00694	0.20203
H-90	3.00	$3^1/_2$	0.28571	2	2.01556	0.20203
SL-H90	1.25	3	0.33333	1	1.00136	0.23570

Notes:
1. Although only taper and lead measurements are recommended in this appendix, these ballpoint diameters would also apply to contour microscope contact points for measuring thread angle or checking thread form if desired, except that the contacts for the V-0.040 thread form should be truncated to clear the bottom of the thread. If thread height is measured, the height gauge contact points should be conical in shape, with a 50° included angle and a 0.002 inch radius at the tip of the cone.
2. See Appendix M for metric table.

H.3.5 INTERNAL TAPER CALIPER

The taper of internal threads can be measured with an internal taper caliper as illustrated in Figure H-2.

H.3.6 PROCEDURE FOR INTERNAL THREADS

With the adjustable arm of the caliper set to accommodate the size of thread to be inspected, the contact on the fixed arm of the caliper shall be placed in the first full depth thread position and the contact on the movable arm of the caliper in position in the same thread, 180 degrees opposite. The fixed contact shall be held firmly in position, the movable contact oscillated through a small arc, and the dial gauge set so that the zero position coincides with the maximum indication. Similarly, successive measurements, at the same radial position relative to the axis of the thread, shall then be taken at suitable intervals for the length of perfect threads. A line scribed on the thread crests parallel to the thread axis can be used to align the fixed contact for maintaining the same radial position. The difference between successive measurements shall be the taper in that interval of threads.

H.4 Lead Measurement

H.4.1 DEFINITION

Lead shall be defined as the distance from a point on a thread turn to a corresponding point on the next thread turn, measured parallel to the thread axis. Lead tolerances are expressed in terms of *per inch* of threads and *cumulative* and lead errors must be determined accordingly. For interval measurements over lengths other than one inch (25.40 millimeters) the observed errors should be calculated to the per-inch basis. For cumulative measurements, observed errors represent the cumulative errors.

H.4.2 GAUGE CONTACT POINTS

The contact points of lead gauges shall be of the ball-point type and shall preferably be made of tungsten carbide or tantalum carbide. The dimensions of the contact points shall be such that they contact the thread flanks rather than the minor cone. The commonly used ball-points meeting this requirement have diameters shown in Table H-1.

H.4.3 LEAD GAUGES

The lead of external threads may be gauged with a lead gauge of the type illustrated in Figure H-3. The lead of internal threads may be gauged with a lead gauge of the type illustrated in Figure H-4. Lead gauges shall be so constructed that the measuring mechanism is under strain when the indicator hand is adjusted to zero by means of the standard template (see Figure H-5). The standard templates shall be so constructed as to compensate for the error in measuring lead parallel to the taper cone instead of parallel to the thread axis, according to the values shown in Table H-1. The distance between any two adjacent notches of the template shall be accurate within a tolerance of ±0.0001 inch (0.003 millimeter), and between any two nonadjacent notches within a tolerance of ±0.0002 inch (0.005 millimeter).

H.4.4 ADJUSTMENT OF GAUGES

Before use, the movable ball-point shall be set to provide a distance between points equal to the interval of threads to be gauged and the dial gauge indicator set to zero position when the gauge is applied to the standard template. If the gauge does not register zero, the lock screw on the arm should be loosened, the gauge adjusted to zero by means of the adjusting screw, and the lock screw tightened. This adjustment should be repeated until the gauge registers zero when applied to the template under the procedure described in H.4.5.

H.4.5 PROCEDURE

The ball points of the gauge shall be placed in the proper thread grooves and the gauge shall be pivoted upon the fixed ball point through a small arc on either side of the correct line of measurement. The minimum fast or maximum slow reading shall be the error in lead.

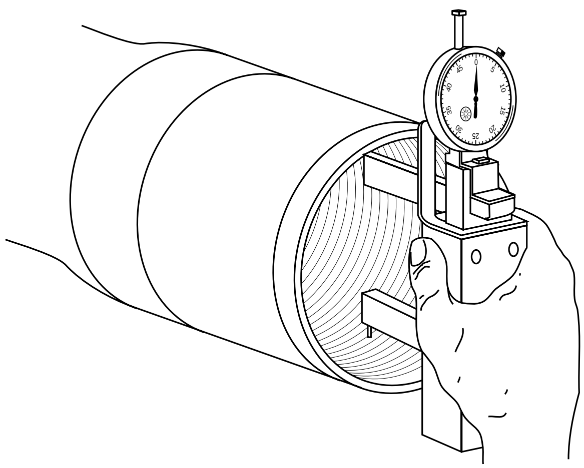


Figure H-2—Internal Taper Measurement

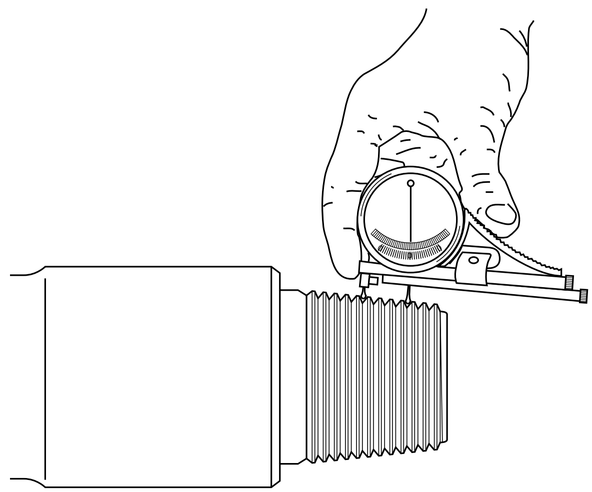


Figure H-3—External Lead Measurement

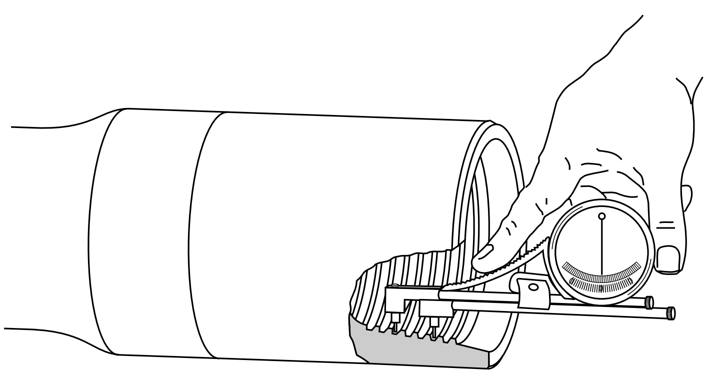


Figure H-4—Internal Lead Measurement

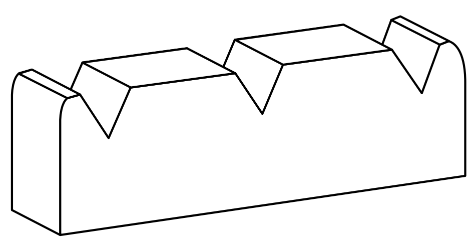


Figure H-5—Standard Lead Template

APPENDIX I—OBSOLESCENT TOOL JOINTS

Table I-1—Obsolescent Tool Joints With Taper Shoulder and Square Shoulder

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Tool Joint											Shoulder		
											Taper	Square	
Tool Joint Designation[a]	Drill Pipe Size and Style	Drill Pipe Nominal Weight[b] lb./ft.	Outside Dia. of Pin and Box $\pm^1/_{32}$	Inside Dia. of Pin and Box[c] $+^1/_{64}$ $-^1/_{32}$	Dia. of Pin at Elevator Upset Max	Bevel Dia. of Pin and Box Shoulder $\pm^1/_{64}$	Total Length Tool Joint Pin $+^1/_4$ $-^3/_8$	Pin Tong Space $\pm^1/_4$	Box Tong Space $\pm^1/_4$	Combined Length of Pin and Box $\pm^1/_2$	Dia. of Box at Elevator Upset Max.	Dia. of Box at Elevator Upset Max.	Radius of Elevator Neck $\pm^1/_{64}$
			D	d	D_{PE}	D_F	L_P	L_{PB}	L_B	L	D_{TE}	D_{SE}	R_{SE}
Obsolescent Connections (To be removed from the standards at a later date) Full-Hole (FH) Style													
$3^1/_2$ FH[e]	$3^1/_2$ IU	13.30	$4^5/_8$	$2^1/_8$	$3^{11}/_{16}$	$4^{31}/_{64}$	$10^3/_4$	7	$9^1/_2$	$16^1/_2$	$3^{11}/_{16}$	$3^5/_8$	$^3/_{16}$
$3^1/_2$ FH[e]	$3^1/_2$ IU	15.50	$4^5/_8$	$2^1/_8$	$3^{11}/_{16}$	$4^{31}/_{64}$	$10^3/_4$	7	$9^1/_2$	$16^1/_2$	$3^{11}/_{16}$	$3^5/_8$	$^3/_{16}$
4 FH (NC40)	4 IU	14.00	$5^1/_4$	$2^{13}/_{16}$	$4^3/_{16}$	$5^1/_{64}$	$11^1/_2$	7	10	17	$4^3/_{16}$	$4^1/_8$	$^1/_4$
$4^1/_2$ FH	$4^1/_2$ IU	16.60	$5^3/_4$	3	$4^{11}/_{16}$	$5^{17}/_{32}$	11	7	10	17	$4^{11}/_{16}$	$4^5/_8$	$^1/_4$
$4^1/_2$ FH	$4^1/_2$ IEU	20.00	$5^3/_4$	3	$4^{11}/_{16}$	$5^{17}/_{32}$	11	7	10	17	$4^{11}/_{16}$	$4^5/_8$	$^1/_4$
$5^1/_2$ FH[f]	$5^1/_2$ IEU	21.90	7	4	$5^{11}/_{16}$	$6^{23}/_{32}$	13	8	10	18	$5^{11}/_{16}$	$5^{11}/_{16}$	$^1/_4$
$5^1/_2$ FH[f]	$5^1/_2$ IEU	24.70	7	4	$5^{11}/_{16}$	$6^{23}/_{32}$	13	8	10	18	$5^{11}/_{16}$	$5^{11}/_{16}$	$^1/_4$
Internal-Flush (IF) Style													
$2^3/_8$ IF (NC26)	$2^3/_8$ EU	6.65	$3^3/_8$	$1^3/_4$	$2^9/_{16}$	$3^{17}/_{64}$	9	6	7	13	$2^9/_{16}$	—	—
$2^7/_8$ IF (NC31)	$2^7/_8$ EU	10.40	$4^1/_8$	$2^1/_8$	$3^3/_{16}$	$3^{61}/_{64}$	$9^1/_2$	6	8	14	$3^3/_{16}$	$3^3/_{16}$	$^3/_{16}$
$3^1/_2$ IF (NC38)	$3^1/_2$ EU	13.30	$4^3/_4$	$2^{11}/_{16}$	$3^7/_8$	$4^{37}/_{64}$	11	7	$9^1/_2$	$16^1/_2$	$3^7/_8$	$3^7/_8$	$^3/_{16}$
$3^1/_2$ IF (NC38)	$3^1/_2$ EU	15.50	5	$2^{11}/_{16}$	$3^7/_8$	$4^{37}/_{64}$	11	7	$9^1/_2$	$16^1/_2$	$3^7/_8$	$3^7/_8$	$^3/_{16}$
4 IF (NC46)	4 EU	14.00	$5^3/_4$	$3^1/_4$	$4^1/_2$	$5^{17}/_{32}$	$11^1/_2$	7	10	17	$4^1/_2$	$4^1/_2$	$^1/_4$
$4^1/_2$ IF (NC50)	$4^1/_2$ EU	16.60	Std $6^1/_8$	$3^3/_4$	5	$6^1/_{16}$ ($5^{59}/_{64}$)	$11^1/_2$	7	10	17	5	5	$^1/_4$
$4^1/_2$ IF (NC50)	$4^1/_2$ EU	16.60	Opt $6^1/_4$	$3^3/_4$	5	$6^1/_{16}$ ($5^{59}/_{64}$)	$11^1/_2$	7	10	17	5	5	$^1/_4$
$4^1/_2$ IF (NC50)[d]	5 IEU	19.50	Std $6^3/_8$	$3^3/_4$	$5^1/_8$	$6^1/_{16}$ ($5^{59}/_{64}$)	$11^1/_2$	7	10	17	$5^1/_8$	$5^1/_8$	$^1/_4$
$4^1/_2$ IF (NC50)[d]	5 IEU	19.50	Opt $6^1/_2$	$3^1/_2$	$5^1/_8$	$6^1/_{16}$ ($5^{59}/_{64}$)	$11^1/_2$	7	10	17	$5^1/_8$	$5^1/_8$	$^1/_4$

Notes:
1. See Figure 6.
2. All dimensions are in inches. See Appendix M for metric table.
3. Neck diameters (D_{PE}, D_{TE}, and D_{SE}) and inside diameters *(d)* of tool joints prior to welding are at manufacturer's option. The above table specifies the finished dimensions after final machining of the assembly.
4. See Table 7 for dimensions for numbered connections (NC).
5. Bevel diameter shown in parentheses was optional with the manufacturer until June 1986, at which time $6^1/_{16}$ became standard. *CAUTION TO USER*—As a result of this option, precaution is advised to make sure mating NC50 connections have the same bevel diameter.

[a]The tool-joint designation (Column 1) indicates the size and style of the applicable connection. Those in parentheses are not a part of the size designation for the number style connections. They indicate interchangeability of these tool joints when welded to the same size, style, and weight of drill pipe. See Special Note in Table J-1.

[b]Nominal weights, threads, and coupling (Column 3) are shown for the purpose of identification in ordering.

[c]The bore dimensions (Column 5) do not apply to the bores of box members of REG tool joints, which are optional with the manufacturer.

[d]NC50 ($4^1/_2$ IF) joint with $6^3/_8$- and $6^1/_2$-inch OD is used on 5-inch IEU drill pipe to produce an assembly variously known as 5-inch Extra-Hole and 5-inch Semi-Internal Flush.

[e]The inside diameter (Column 5) of the $3^1/_2$ FH tool joint was changed from $2^7/_{16}$ to $2^1/_8$ inch in Appendix H of the May 1979, Thirty-Second Edition of Specification 7.

[f]In 1979, the $5^1/_2$ FH tool joints were reinstated as full standard in Table 7. The dimensions were retained here primarily so that Appendix I could continue to be the single reference for square shoulder dimensions (See Figure 6).

APPENDIX J—OBSOLESCENT ROTARY SHOULDERED CONNECTIONS

Table J-1—Product Dimensions for Obsolescent Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12
Connection Number or Size	Thread Form	Threads Per Inch	Taper, inches per foot on dia.	Pitch Dia. of Thread at Gauge Point	Large Dia. of Pin	Dia of Flat on Pin[b] $\pm^1/_{64}$	Small Dia. of Pin	Length of Pin $+0\ -^1/_8$	Minimum Length of Box Threads[c]	Depth of Box[c] $+^3/_8\ -0$	Box Counterbore $+^1/_{32}\ -^1/_{64}$
				C	D_L	D_{LF}	D_S	L_{PC}	L_{BT}	L_{BC}	Q_C
Obsolescent Product Dimensions Full-Hole (FH) Style											
$3^1/_2$ FH	V-0.040	5	3	3.73400	3.994	—	3.056	$3^3/_4$	$3^7/_8$	$4^3/_8$	$4^3/_{64}$
4 FH[a]	V-0.065	4	2	4.07200	4.280	4.156	3.530	$4^1/_2$	$4^5/_8$	$5^1/_8$	$4^{11}/_{32}$
$4^1/_2$ FH	V-0.040	5	3	4.53200	4.792	—	3.792	4	$4^1/_8$	$4^5/_8$	$4^7/_8$
Internal-Flush (IF) Style											
$2^3/_8$ IF[a]	V-0.065	4	2	2.66800	2.876	2.750	2.376	3	$3^1/_8$	$3^5/_8$	$2^{15}/_{16}$
$2^7/_8$ IF[a]	V-0.065	4	2	3.18300	3.391	3.266	2.808	$3^1/_2$	$3^5/_8$	$4^1/_8$	$3^{29}/_{64}$
$3^1/_2$ IF[a]	V-0.065	4	2	3.80800	4.016	3.891	3.349	4	$4^1/_8$	$4^5/_8$	$4^5/_{64}$
4 IF[a]	V-0.065	4	2	4.62600	4.834	4.709	4.084	$4^1/_2$	$4^5/_8$	$5^1/_8$	$4^{29}/_{32}$
$4^1/_2$ IF[a]	V-0.065	4	2	5.04170	5.250	5.135	4.500	$4^1/_2$	$4^5/_8$	$5^1/_8$	$5^5/_{16}$
$5^1/_2$ IF	V-0.065	4	2	6.18900	6.397	—	5.564	5	$5^1/_8$	$5^5/_8$	$6^{29}/_{64}$

Notes:
1. See Table 25 for dimensions for numbered connections (NC).
2. See Figure 20.
3. All dimensions are in inches. See Appendix M for metric table.

[a]Connections in the number (NC) style are interchangeable with connections having the same pitch diameter in the FH and IF styles. See 10.3.
[b]Dimension D_{LF} and the 0.062-inch radius at the pin base (See Figure 20) are standard for drill collars and optional with the manufacturer for other drill stem elements.
[c]L_{BT} is the length of threads in the box measured from the make-up shoulder to the intersection of the non-pressure flank and crest of the last thread with full thread depth.

Special Note:

At the 1964 meeting of the API Committee on Drilling and Servicing Equipment, a new series of rotary shouldered connections was adopted (as tentative) in order to improve the service performance of drill collars and tool joints. At the 1968 meeting of the Committee, 11 of the 13 sizes in this new style were advanced to standard.

In this new style of connections, the size designation is a two-digit number indicating the pitch diameter of the pin member at the gauge point and the style is referred to as the number style, or numbered connection. These numbered connections employ a V thread form having a 0.065-inch flat crest and a 0.038-inch rounded root. This form is designated as the V-0.038R form. This V-0.038R form mates with the V-0.065 form that is employed on all API internal-flush (IF) connections and on the API 4-inch full-hole (4 FH) connection. All API IF and FH connections are now considered obsolescent and appear in Appendixes I, J, and K of this specification.

Of these new numbered connections, five sizes have the same pitch diameter, taper, pitch, and length of thread as the corresponding size in the IF style and one corresponds to the 4FH connection. Further, these six connections in the number style can be gauged with the same gauging practice and with the same gauges required for the equivalent connections. See 10.3.

APPENDIX K—OBSOLESCENT ROTARY SHOULDERED CONNECTIONS

Table K-1—Gauge Dimensions for Obsolescent Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Size	Thread Form	Threads Per Inch	Taper, in./ft. on dia.	Pitch Dia. at .625 Gauge Point[a]	Major Dia. at .625 Gauge Point[a]	Minor Dia. at .625 Gauge Point[a]	Pitch Dia. at 1.375[a]	Total Length Plug Gauge L_p	Dia. of Plug Fitting Plate	Total Length Ring Gauge L_R	Outside Dia. of Ring Gauge D_R	Dia. of Counter-bore Q	Mating Standoff S
Obsolescent Gauge Dimensions Full-Hole (FH) Style Gauges													
$3\frac{1}{2}$ FH	V-0.040	5	3	3.73400	3.82738	3.64062	3.54650	$3\frac{3}{4}$	3.499	$3\frac{1}{8}$	$5\frac{1}{2}$	3.900	0.625
4 FH (NC40)	V-0.065	4	2	4.07200	4.16568	3.97832	3.94700	$4\frac{1}{2}$	3.773	$3\frac{7}{8}$	$5\frac{7}{8}$	4.239	0.625
$4\frac{1}{2}$ FH	V-0.040	5	3	4.53200	4.62538	4.43862	4.34450	4	4.297	$3\frac{3}{8}$	$6\frac{1}{2}$	4.698	0.625
Internal-Flush (IF) Style Gauges													
$2\frac{3}{8}$ IF (NC26)	V-0.065	4	2	2.66800	2.76168	2.57432	2.54300	3	2.369	$2\frac{3}{8}$	$4\frac{3}{16}$	2.834	0.625
$2\frac{7}{8}$ IF (NC31)	V-0.065	4	2	3.18300	3.27668	3.08932	3.05800	$3\frac{1}{2}$	2.884	$2\frac{7}{8}$	$5\frac{1}{8}$	3.349	0.625
$3\frac{1}{2}$ IF (NC38)	V-0.065	4	2	3.80800	3.90168	3.71432	3.68300	4	3.509	$3\frac{3}{8}$	$5\frac{5}{8}$	3.974	0.625
4 IF (NC46)	V-0.065	4	2	4.62600	4.71968	4.53232	4.50100	$4\frac{1}{2}$	4.327	$3\frac{7}{8}$	$6\frac{1}{2}$	4.792	0.625
$4\frac{1}{2}$ IF (NC50)	V-0.065	4	2	5.04170	5.13538	4.94802	4.91670	$4\frac{1}{2}$	4.743	$3\frac{7}{8}$	$7\frac{1}{8}$	5.208	0.625
$5\frac{1}{2}$ IF	V-0.065	4	2	6.18900	6.28268	6.09532	6.06400	5	5.890	$4\frac{3}{8}$	$8\frac{3}{8}$	6.355	0.625

Notes:
1. See Table 27 for dimensions for numbered connections (NC).
2. Gauges are the same for numbered connections (NC) and obsolescent connections when shown on the same line.
3. See Section 12 for gauge specifications.
4. See Figure 24.
5. All dimensions are in inches at 68°F. See Appendix M for metric table.

[a]The values in Column 5 and 6 apply only to plug gauges. The values in Columns 7 and 8 apply only to ring gauges.

APPENDIX L—USE OF API MONOGRAM

L.1 General

The following marking requirements apply to licensed manufacturers using the API monogram on products covered by this specification. In addition to the stated marking requirements, the products or products packaging shall also be marked with the date of manufacture (month and year) and the manufacturer's API license number. The license number shall be adjacent to the API monogram. The location of the date of manufacture shall be at the option of the licensee.

L.2 Kelly Valve Marking

Kelly valves produced in accordance with this specification shall be die stamped using a low stress steel stamp as follows:

a. Manufacturer's name or mark, the API monogram, date of manufacture, unique serial number, and maximum rated working pressure to be applied in milled recess.
b. Connection size and style to be applied on OD surface adjacent to connection.
c. Indication of rotation direction required to position valve in closed position on OD surface adjacent to valve operating mechanism.

L.3 Kelly Marking

Kellys manufactured in conformance to this specification shall be die stamped, on the upper upset, with the manufacturer's name or mark, the API monogram, date of manufacture, and the size and style of connection. The lower pin connection shall be die stamped as follows:

a. Numbered connections (NC), and those in the IF style if made with the V-0.038R thread form, shall be stamped with both the NC and IF designations.
b. IF style connections if made with the V-0.065 thread form, and the $5^{1}/_{2}$ FH connection, shall be stamped with those designations only.

Following is an example:

A $4^{1}/_{4}$ square kelly with a $6^{5}/_{8}$ REG left-hand upper box connection and $4^{1}/_{2}$ IF right-hand lower pin connection, shall be marked:

On upper upset:

A B Co (or mark) Mo-Yr

$6^{5}/_{8}$ REG LH

On lower pin:

$4^{1}/_{2}$ IF (if made with V-0.065 thread form)

NC50 ($4^{1}/_{2}$ IF) (if made with V-0.038 thread form)

L.4 Tool Joint Marking

Tool joints manufactured in conformance to this specification shall be die stamped around the outside diameter with the manufacturer's name or mark, the API monogram, date of manufacture, and the size and style of connection (size and style of tool joint). Interchangeable number connections (NC) as shown in Column 1, Table 7, and those in the IF and FH sizes (shown in parentheses) if made with the V-0.038R thread form, shall be stamped with the dual designations as shown. All other connections shall be stamped with the applicable single designations as shown in Column 1 for the NC, FH, and IF style tool joints.

Following are examples:

a. An NC38 tool joint that is interchangeable with a $3^{1}/_{2}$ IF joint, shall be stamped:

A B Co (or mark) Mo-Yr NC38 ($3^{1}/_{2}$ IF)

b. A $3^{1}/_{2}$ IF tool joint which is interchangeable with an NC38 tool joint, if made with a V-0.038R thread form shall be stamped as in item a.
c. A 3 $^{1}/_{2}$ IF tool joint made with V-0.065 thread form shall be stamped:

A B Co (or mark) Mo-Yr $3^{1}/_{2}$ IF

d. Data regarding the drill pipe shall be stenciled at the base of the pin by the tool joint manufacturer for identification of drill string components.

L.5 Sub Marking

Subs manufactured in conformance to this specification shall be marked with the manufacturer's name or mark, the API monogram, date of manufacture, the inside diameter and the size and style of connection at each end. The markings shall be die stamped on a marking recess located on the *D* diameter of the sub. The marking identifying the size and style of connection shall be placed on that end of the recess closer to the connection to which it applies.

Following are examples:

a. A sub with $4^{1}/_{2}$ REG LH box connection on each end and with a $2^{1}/_{4}$ inch inside diameter shall be marked as follows:

A B Co (or mark) Mo-Yr

4 $^{1}/_{2}$ REG LH 2 $^{1}/_{4}$ 4 $^{1}/_{2}$ REG LH

b. A sub with NC31 pin connection on one end and NC46 box connection on the other end shall be marked as follows:

A B Co (or mark) Mo-Yr

NC31 2 NC46

L.6 Drill Collar Marking

L.6.1 Standard steel drill collars conforming to this specification shall be die stamped on the drill collar OD with the manufacturer's name or mark, the API monogram, outside diameter, bore, and connection designation. NC style connections and FH and IF sizes in parentheses in Column 1 of Table 13 are identical if made with the V-0.038R thread form. The following examples illustrate these marking requirements:

a. A $6^{1}/_{4}$-inch collar with $2^{13}/_{16}$-inch bore and NC46 connections shall be stamped:

A B Co (or mark) Mo-Yr

NC46-62 (4 IF) $2^{13}/_{16}$

The same markings apply to a collar of the same dimensions, but ordered with 4 IF connections, if the connections are made with the V-0.038R thread form.

b. An $8^{1}/_{4}$-inch collar with $2^{13}/_{16}$-inch bore and $6^{5}/_{8}$ REG connections shall be stamped:

A B Co (or mark) Mo-Yr

$8^{1}/_{4}$ $2^{13}/_{16}$ $6^{5}/_{8}$ REG

L.6.2 Nonmagnetic drill collars conforming to this specification shall be die stamped with the manufacturer's name or mark, the API monogram, nonmagnetic identification, manufacturer's serial number, outside diameter, and bore. The following example illustrates these marking requirements. Locations of the markings and the application of additional markings shall be specified by the manufacturer.

Following is an example:

An $8^{1}/_{4}$-inch collar with $2^{13}/_{16}$ bore, manufactured by A B Company shall be stamped:

A B Co (or mark) Mo-Yr

$8^{1}/_{4}$ $2^{13}/_{16}$ NMDC $6^{5}/_{8}$ REG

L.7 Bit Marking

L.7.1 ROLLER AND BLADE DRAG BIT MARKING

Bits shall be die stamped with the manufacturer's name or mark, the bit size, the API monogram, date of manufacture, and the size and style of connection.

Following is an example:

A $7^{7}/_{8}$ bit with $4^{1}/_{2}$-inch regular rotary connection shall be stamped as follows:

A B Co (or mark) $7^{7}/_{8}$ Mo-Yr $4^{1}/_{2}$ REG

L.7.2 DIAMOND, CORE, AND PDC BIT MARKING

Diamond drilling bits, diamond core bits, and PDC bits shall be marked as follows:

a. Diamond drilling bits and PDC bits shall be die stamped with the manufacturer's name or mark, the API monogram, date of manufacture, and the size and style of connection.

Following is an example:

A $7^{1}/_{2}$ bit with $4^{1}/_{2}$-inch regular rotary connection shall be stamped as follows:

A B Co (or mark) $7^{1}/_{2}$ Mo-Yr $4^{1}/_{2}$ REG

b. Diamond core bits shall be die stamped with the manufacturer's name or identification mark, the API monogram, and date of manufacture, for example:

A B Co (or mark) Mo-Yr

Because of its proprietary nature, the connection on diamond core bits will not be shown. The API monogram shall indicate that other dimensional requirements have been met.

L.8 Rotary Shouldered Connection Marking

Rotary shouldered connections, when used on products or for applications not covered by this specification, but conforming to the threading and gauging stipulations of this specification, shall be identified by stamping or stenciling the product adjacent to the connection with the following:

a. Manufacturer's name or mark.

b. API Monogram and manufacturer's API lincense number with the letter THD directly adjacent to the Monogram.

c. Date of manufacture.

d. Size and style of connection.

The connection marking may be applied to products which are not covered by API specifications as long as the threading and gauging stipulations of this specification are met.

For example, an NC46 connection shall be marked:

A B Co (or mark) THD Mo-Yr NC46

The monogramming of rotary shouldered connections in accordance with this section does not assure that the product conforms to any material requirements found in this specification.

APPENDIX M—METRIC TABLES

The factors used for conversion of U.S. customary units to metric values are:

1 inch (in.)	= 25.4 millimeters (mm) exactly.
1 square inch (sq. in.)	= 645.16 square millimeters (mm^2) exactly.
1 foot (ft)	= 0.3048 meters (m) exactly.
1 pound (lb)	= 0.454 kilograms (kg).
1 pound per foot (lb/ft)	= 1.4895 kilograms per meter (kg/m).
1 pound per square inch (psi)	= 0.00689476 newtons per square millimeter (N/mm^2) for stress.
	= 0.00689476 megapascals (MPa) for pressure.
1 foot-pound (ft-lb)	= 1.355818 Joules (J) for impact energy.
	= 1.355818 newton-meters (N • m) for torque.

The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (°C):

$$°C = 5/9\ (°F–32)$$

Metric Table 2—Square Kellys

1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
												Upper Box Connection											
		Length of Drive Section feet		Length Overall feet		Drive Section						Size and Style LH		Outside Diameter		Bevel Diameter			Lower Pin Connection				
Kelly Size		Standard	Optional	Standard	Optional	Across Flats	Across Corners	Across Corners	Radius	Radius	Min. Wall Ecc. Bore	Standard	Optional	Standard	Optional	Length	Standard	Optional	Size and Style	Outside Diameter	Length	Bevel Diameter	Inside Diameter
([a])		([b])	([b])	([c])	([c])	([d])	([e])	([f])	([g])	([l])			([h])	([h])	([i])	([j])	([j])	([h])	([i])	([j])	([k])		
in.	mm	L_D	L_D	L	L	D_{FL}	D_C	D_{CC}	R_C	R_{CC}	t			D_U	D_U	L_U	D_F	D_F		D_{LR}	L_L	D_F	d
$2^1/_2$	63.5	11.28		12.19		63.5	83.3	82.55	7.9	41.3	11.43	$6^5/_8$ REG	$4^1/_2$ REG	196.9	146.1	406.4	186.1	134.5	NC26 ($2^3/_8$ IF)	85.7	508	82.9	31.8
3	76.2	11.28		12.19		76.2	100.0	98.43	9.5	49.2	11.43	$6^5/_8$ REG	$4^1/_2$ REG	196.9	146.1	406.4	186.1	134.5	NC31 ($2^7/_8$ IF)	104.8	508	100.4	44.5
$3^1/_2$	88.9	11.28		12.19		88.9	115.1	112.70	12.7	56.4	11.43	$6^5/_8$ REG	$4^1/_2$ REG	196.9	146.1	406.4	186.1	134.5	NC38 ($3^1/_2$ IF)	120.7	508	116.3	57.2
$4^1/_4$	108.0	11.28	15.54	12.19	16.46	108.0	141.3	139.70	12.7	69.9	12.07	$6^5/_8$ REG	$4^1/_2$ REG	196.9	146.1	406.4	186.1	134.5	NC46 (4 IF)[m]	158.8	508	145.3	71.4
																			NC50 ($4^1/_2$ IF)[m]	161.9	508	154.0	71.4
$5^1/_4$	133.4	11.28	15.54	12.19	16.46	133.4	175.4	171.45	15.9	85.7	15.88	$6^5/_8$ REG		196.9		406.4	186.1	134.5	$5^1/_2$ FH[m]	177.8	508	170.7	82.6
																			NC56[m]	177.8	508	171.1	82.6

Notes:
1. See Figure 2.
2. All dimensions in millimeters except lengths of drive section and lengths overall, which are given in meters.

[a]Size of square kellys is the same as the dimension D_{FL} across flats (distance between opposite faces) as given in Column 6.
[b]Tolerance on L_D, +152.4, –127.0.
[c]Tolerance on L, +152.4, –0.0.
[d]Tolerances on D_{FL}, sizes $2^1/_2$ to $3^1/_2$ incl.: +2.0, –0.; sizes $4^1/_4$ & $5^1/_4$: +2.4, –0.0. See 5.2 for sleeve-gauge test.
[e]Tolerance on D_C, sizes $2^1/_2$, 3, and $3^1/_2$: +3.2, –0.0; sizes $4^1/_4$ & $5^1/_4$: +4.0, –0.0.
[f]Tolerance on D_{CC}, +0.0, –0.38.
[g]Tolerance on R_C, all sizes, ±1.6.
[h]Tolerance on D_U and D_{LR}, all sizes, ±0.8.
[i]Tolerance on L_U and L_L, all sizes, +63.5, –0.0.
[j]Tolerance on D_F, all sizes, ±0.4.
[k]Tolerance on d, all sizes, +1.6, –0.0. See 5.2 for drift-mandrel test.
[l]Reference dimension only.
[m]See note, 5.3.

Metric Table 3—Hexagon Kellys

1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
												Upper Box Connection											
		Length of Drive Section feet		Length Overall feet		Drive Section						Size and Style, LH		Outside Diameter		Bevel Diameter			Lower Pin Connection				
Kelly Size		Standard	Optional	Standard	Optional	Across Flats	Across Corners	Across Corners	Radius	Radius	Min. Wall Ecc. Bore	Standard	Optional	Standard	Optional	Length	Standard	Optional	Size and Style	Outside Diameter	Length	Bevel Diameter	Inside Diameter
([a])		([b])	([b])	([c])	([c])	([d])	([e])	([f])	([e])	([j])				([e])	([e])	([g])	([h])	([h])		([e])	([g])	([h])	([i])
in.	mm	L_D	L_D	L	L	D_{FL}	D_C	D_{CC}	R_C	R_{CC}	t			D_U	D_U	L_U	D_F	D_F		D_{LR}	L_L	D_F	d
3	76.2	11.28		12.19		76.2	85.7	85.73	6.4	42.9	12.1	$6\frac{5}{8}$ REG	$4\frac{1}{2}$ REG	196.9	146.1	406.4	186.1	134.5	NC26 ($2\frac{3}{8}$ IF)	85.7	508	82.9	38.1
$3\frac{1}{2}$	88.9	11.28		12.19		88.9	100.8	100.00	6.4	50.0	13.3	$6\frac{5}{8}$ REG	$4\frac{1}{2}$ REG	196.9	146.1	406.4	186.1	134.5	NC31 ($2\frac{7}{8}$ IF)	104.8	508	100.4	44.5
$4\frac{1}{4}$	108.0	11.28	15.54	12.19	16.46	108.0	122.2	121.44	7.9	60.7	15.9	$6\frac{5}{8}$ REG	$4\frac{1}{2}$ REG	196.9	146.1	406.4	186.1	134.5	NC38 ($3\frac{1}{2}$ IF)	120.7	508	116.3	57.2
$5\frac{1}{4}$	133.4	11.28	15.54	12.19	16.46	133.4	151.6	149.86	9.5	75.0	15.9	$6\frac{5}{8}$ REG	—	196.9	—	406.4	186.1	—	NC46 (4 IF)[k]	158.8	508	145.3	76.2
																			NC50 ($4\frac{1}{2}$ IF)[k]	161.9	508	154.0	82.6
6	152.4	11.28	15.54	12.19	16.46	152.4	173.0	173.02	9.5	86.5	15.9	$6\frac{5}{8}$ REG	—	196.9	—	406.4	186.1	—	$5\frac{1}{2}$ FH[k]	177.8	508	170.7	88.9
																			NC56[k]	177.8	508	171.1	88.9

Notes:
1. See Figure 3.
2. All dimensions in millimeters, except lengths of drive section and lengths overall which are given in meters.

[a]Size of hexagon kellys is the same as dimensions D_{FL} across flats (distance between opposite faces) as given in Column 6.
[b]Tolerance on L_D, +152.4, –127.0.
[c]Tolerance on L, +152.4, –0.0.
[d]Tolerance on D_{FL}, all sizes, +0.8, –0.0; see 5.2 for sleeve-gauge test.
[e]Tolerance on D_U, D_{LR}, D_C, and R_C, all sizes, ±0.8.
[f]Tolerance on D_{CC}, +0.0, –0.38.
[g]Tolerance on L_U and L_L, all sizes, +63.5, –0.0.
[h]Tolerance on D_F, ±0.4.
[i]Tolerance on d, all sizes, +1.6, –0.0; see 5.2 for drift-mandrel test.
[j]Reference dimension only.
[k]For $5\frac{1}{4}$ (133.4 millimeters) hexagon kellys a bore of 71.4 millimeters shall be optional. See note, 5.3.

Metric Table 4—Kelly Sleeve Gauge

Kelly Size		Min. Length of Gauge	Distance Across Flats		Max. Fillet Radius	
			Square	Hexagon	Square	Hexagon
in.	mm	L_G	D_{FL}	D_{FL}	R_S	R_H
$2\frac{1}{2}$	63.5	254	65.9	—	6.4	—
3	76.2	254	78.6	77.1	7.9	4.8
$3\frac{1}{2}$	88.9	254	91.3	89.8	11.1	4.8
$4\frac{1}{4}$	108.0	304.8	111.1	108.9	11.1	6.4
$5\frac{1}{4}$	133.4	304.8	136.5	134.3	14.3	7.9
6	152.4	304.8	—	153.3	—	7.9

Notes:
1. See Figure 4.
2. All dimensions in millimeters.
3. Tolerance on D_{FL}, all sizes, +0.13, –0.000.
4. Tolerance on nominal included angles between flats ±0°, 30".

Metric Table 7—Tool Joint Dimensions for Grade E75, X95, G105, and S135 Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Drill Pipe			Tool Joint									
Tool Joint Designation[a]	Size and Style	Nom. Wt.[b] kg/m	Grade	Outside Dia. of Pin and Box ±0.8	Inside Dia. of Pin[c] +0.4 –0.8	Bevel Dia. of Pin and Box Shoulder ±0.4	Total Length Tool Joint Pin +6.4 –9.5	Pin Tong Space ±6.4	Box Tong Space ±6.4	Combined Length of Pin and Box ±12.7	Dia. of Pin at Elevator Upset Max.	Dia. of Box at Elevator Upset Max.	Torsional Ratio, Pin to Drill Pipe
				D	d	D_F	L_P	L_{PB}	L_B	L	D_{PB}	D_{TB}	
NC26 ($2^3/_8$ IF)	$2^3/_8$ EU	9.90	E75	85.7	44.45	82.95	254.0	177.8	203.2	381	65.09	65.09	1.10
				85.7	45.45	82.95	254.0	177.8	203.2	381	65.09	65.09	0.87
				85.7	45.45	82.95	254.0	177.8	203.2	381	65.09	65.09	0.79
NC31 ($2^7/_8$ IF)	$2^7/_8$ EU	15.49	E75	104.8	53.98	100.41	266.7	177.8	228.6	406.4	80.96	80.96	1.03
			X95	104.8	50.80	100.41	266.7	177.8	228.6	406.4	80.96	80.96	0.90
			G105	104.8	50.80	100.41	266.7	177.8	228.6	406.4	80.96	80.96	0.82
			S135	111.1	41.28	100.41	266.7	177.8	228.6	406.4	80.96	80.96	0.82
NC38[d]	$3^1/_2$ EU	14.15	E75	120.7	76.20	116.28	292.1[d]	203.2	266.7	469.9	98.43	98.43	0.91
NC38 ($3^1/_2$ IF)	$3^1/_2$ EU	19.81	E75	120.7	68.26	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.98
			X95	127.0	65.09	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.87
			G105	127.0	61.91	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.86
			S135	127.0	53.98	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.80
		23.09	E75	127.0	65.09	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.97
			X95	127.0	61.91	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.83
			G105	127.0	53.98	116.28	304.8	203.2	266.7	469.9	98.43	98.43	0.90
NC40 (4 FH)	$3^1/_2$ EU	23.09	S135	139.7	57.15	127.40	292.1	177.8	254.0	431.8	98.43	98.43	0.87
	4 IU	20.85	E75	133.4	71.44	127.40	292.1	177.8	254.0	431.8	106.36	106.36	1.01
			X95	133.4	68.26	127.40	292.1	177.8	254.0	431.8	106.36	106.36	0.86
			G105	139.7	61.91	127.40	292.1	177.8	254.0	431.8	106.36	106.36	0.93
			S135	139.7	50.80	127.40	292.1	177.8	254.0	431.8	106.36	106.36	0.87
NC46 (4 IF)	4 EU	20.85	E75	152.4	82.55	145.26	292.1	177.8	254.0	431.8	114.30	114.30	1.43
			X95	152.4	82.55	145.26	292.1	177.8	254.0	431.8	114.30	114.30	1.13
			G105	152.4	82.55	145.26	292.1	177.8	254.0	431.8	114.30	114.30	1.02
			S135	152.4	76.20	145.26	292.1	177.8	254.0	431.8	114.30	114.30	0.94
	$4^1/_2$ IU	20.48	E75	152.4	85.73	145.26	292.1	177.8	254.0	431.8	119.06	119.06	1.20
	$4^1/_2$ IEU	24.73	E75	158.8	82.55	145.26	292.1	177.8	254.0	431.8	119.06	119.06	1.09
			X95	158.8	76.20	145.26	292.1	177.8	254.0	431.8	119.06	119.06	1.01
			G105	158.8	76.20	145.26	292.1	177.8	254.0	431.8	119.06	119.06	0.91
			S135	158.8	69.85	145.26	292.1	177.8	254.0	431.8	119.06	119.06	0.81
	$4^1/_2$ IEU	29.79	E75	158.75	76.20	145.3	292.1	177.8	254.0	431.8	119.07	119.07	1.07
			X95	158.75	69.85	145.3	292.1	177.8	254.0	431.8	119.07	119.07	0.96
			G105	158.75	63.50	145.3	292.1	177.8	254.0	431.8	119.07	119.07	0.96
			S135	158.75	57.15	145.3	292.1	177.8	254.0	431.8	119.07	119.07	0.81
NC50 ($4^1/_2$ IF)	$4^1/_2$ EU	20.48	E75	168.28	98.43	154.0	292.1	177.8	254.0	431.8	127.00	127.00	1.32
	$4^1/_2$ EU	24.73	E75	168.28	95.25	154.0	292.1	177.8	254.0	431.8	127.00	127.00	1.23
			X95	168.28	95.25	154.0	292.1	177.8	254.0	431.8	127.00	127.00	0.97
			G105	168.28	95.25	154.0	292.1	177.8	254.0	431.8	127.00	127.00	0.88

Notes:
1. See Figure 6.
2. All dimensions are in millimeters.
3. Neck diameters (D_{pe} and D_{te}) and inside diameters (d) of tool joints prior to welding are at manufacturer's option. The above table specifies dimensions after final machining of the assembly.
4. Appendix I contains dimensions of obsolescent connections and for square elevator shoulders.

[a]The tool joint designation indicates the size and style of the applicable connection.
[b]Nominal weights, threads, and couplings are shown for the purpose of identification in ordering.
[c]The inside diameter does not apply to box members, which are optional with the manufacturer.
[d]Length of pin thread reduced to 88.9 mm (12.7 mm short) to accommodate 76.2 mm ID.

Metric Table 7—Tool Joint Dimensions for Grade E75, X95, G105, and S135 Drill Pipe (Continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Drill Pipe			Tool Joint									
Tool Joint Designation[a]	Size and Style	Nom. Wt.[b] kg/m	Grade	Outside Dia. of Pin and Box ±0.8	Inside Dia. of Pin[c] +0.4 –0.8	Bevel Dia. of Pin and Box Shoulder ±0.4	Total Length Tool Joint Pin +6.4 –9.5	Pin Tong Space ±6.4	Box Tong Space ±6.4	Combined Length of Pin and Box ±12.7	Dia. of Pin at Elevator Upset Max.	Dia. of Box at Elevator Upset Max.	Torsional Ratio, Pin to Drill Pipe
				D	d	D_F	L_P	L_{PB}	L_B	L	D_{PB}	D_{TB}	
			S135	168.28	88.90	154.0	292.1	177.8	254.0	431.8	127.00	127.00	0.81
	$4^{1}/_{2}$ EU	29.79	E75	168.28	92.08	154.0	292.1	177.8	254.0	431.8	127.00	127.00	1.02
			X95	168.28	88.90	154.0	292.1	177.8	254.0	431.8	127.00	127.00	0.96
			G105	168.28	88.90	154.0	292.1	177.8	254.0	431.8	127.00	127.00	0.86
			S135	168.28	76.20	154.0	292.1	177.8	254.0	431.8	127.00	127.00	0.87
	5 IEU	29.05	E75	168.28	95.25	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.92
			X95	168.28	88.90	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.86
			G105	168.28	82.55	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.89
			S135	168.28	69.85	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.86
	5 IEU	38.13	E75	168.28	88.90	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.86
			X75	168.28	76.20	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.86
			G105	168.28	69.85	154.0	292.1	177.8	254.0	431.8	130.18	130.18	0.87
$5^{1}/_{2}$ FH	5 IEU	29.05	E75	177.80	95.25	170.7	330.2	203.2	254.0	457.2	130.18	130.18	1.53
			X95	177.80	95.25	170.7	330.2	203.2	254.0	457.2	130.18	130.18	1.21
			G105	177.80	95.25	170.7	330.2	203.2	254.0	457.2	130.18	130.18	1.09
			S135	184.15	88.90	170.7	330.2	203.2	254.0	457.2	130.18	130.18	0.98
	5 IEU	38.13	E75	177.80	88.90	170.7	330.2	203.2	254.0	457.2	130.18	130.18	1.21
			X95	177.80	88.90	170.7	330.2	203.2	254.0	457.2	130.18	130.18	0.95
			G105	184.15	88.90	170.7	330.2	203.2	254.0	457.2	130.18	130.18	0.99
			S135	184.15	82.55	170.7	330.2	203.2	254.0	457.2	130.18	130.18	0.83
	$5^{1}/_{2}$ IEU	32.62	E75	177.80	101.60	170.7	330.2	203.2	254.0	457.2	144.46	144.46	1.11
			X95	177.80	95.25	170.7	330.2	203.2	254.0	457.2	144.46	144.46	0.98
			G105	184.15	88.90	170.7	330.2	203.2	254.0	457.2	144.46	144.46	1.02
			S135	190.50	76.20	180.2	330.2	203.2	254.0	457.2	144.46	144.46	0.96
	$5^{1}/_{2}$ IEU	36.79	E75	177.80	101.60	170.7	330.2	203.2	254.0	457.2	144.46	144.46	0.99
			X95	184.15	88.90	170.7	330.2	203.2	254.0	457.2	144.46	144.46	1.01
			G105	184.15	88.90	170.7	330.2	203.2	254.0	457.2	144.46	144.46	0.92
			S135	190.50	76.20	180.2	330.2	203.2	254.0	457.2	144.46	144.46	0.86
$6^{5}/_{8}$ FH	$6^{5}/_{8}$ IEU	37.54	E75	203.20	127.00	195.7	330.2	203.2	279.4	482.6	176.21	176.21	1.04
			X95	203.20	127.00	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.82
			G105	209.55	120.65	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.87
			S135	215.90	107.95	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.86
	$6^{5}/_{8}$ IEU	41.29	E75	203.20	127.00	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.96
			X95	209.55	120.65	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.89
			G105	209.55	120.65	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.81
			S135	215.90	107.95	195.7	330.2	203.2	279.4	482.6	176.21	176.21	0.80

Notes:
1. See Figure 6.
2. All dimensions are in millimeters.
3. Neck diameters (D_{pe} and D_{te}) and inside diameters (d) of tool joints prior to welding are at manufacturer's option. The above table specifies dimensions after final machining of the assembly.
4. Appendix I contains dimensions of obsolescent connections and for square elevator shoulders.

[a]The tool joint designation indicates the size and style of the applicable connection.
[b]Nominal weights, threads, and couplings are shown for the purpose of identification in ordering.
[c]The inside diameter does not apply to box members, which are optional with the manufacturer.
[d]Length of pin thread reduced to 88.9 mm (12.7 mm short) to accommodate 76.2 mm ID.

Metric Table 12—Float Valve Recess In Bit Subs

Diameter of Value Assembly *D*	Diameter Of Float Recess *R* +0.40 –0 (*D* plus 0.79)	Length of Value Assembly *L*	API Reg. Bit Box		Other Popular Connections	
			Size	*A* ±1.6	Size	*A* ±1.6
42.07	42.86	149.2	$2^{3}/_{8}$	231.8	NC23	231.8
48.42	49.21	158.8	$2^{7}/_{8}$	254.0	$2^{3}/_{8}$ IF	241.3
61.12	61.91	165.1	$3^{1}/_{2}$	266.7	$2^{7}/_{8}$ IF	260.4
71.44	72.23	254.0	—	—	$3^{1}/_{2}$ FH	355.6
79.38	80.17	254.0	—	—	$3^{1}/_{2}$ IF	362.0
88.11	88.90	211.4	$4^{1}/_{2}$	325.4	NC44	331.8
92.87	93.66	304.8	—	—	4 IF	336.6
98.43	99.22	247.6	$5^{1}/_{2}$	374.7	$4^{1}/_{2}$ IF	368.3
121.44	122.24	288.4	$6^{5}/_{8}$	431.8	$5^{1}/_{2}$ IF	431.8
—	—	—	$7^{5}/_{8}$	438.2	$5^{1}/_{2}$ FH	431.8
—	—	—	$8^{5}/_{8}$	441.3	NC61	438.2
144.46	145.26	371.5	$8^{5}/_{8}$	514.4	$6^{5}/_{8}$ IF	504.8

Note: All dimensions in millimeters.

Metric Table 13—Drill Collars

1	2		3	4	5	6
Drill Collar Number[a]	Outside Diameter D[b]		Bore +1.6 –0.0 *d*	Length m ±152.4 mm *L*[d]	Bevel Diameter ±0.4 D_F	Ref. Bending Strength Ratio[e]
	in.	mm				
NC23-31 (tentative)	$3^{1}/_{8}$	79.4	31.8	9.14	76.2	2.57:1
NC26-35 ($2^{3}/_{8}$ IF)	$3^{1}/_{2}$	88.9	38.1	9.14	82.9	2.42:1
NC31-41 ($2^{7}/_{8}$ IF)	$4^{1}/_{8}$	104.8	50.8	9.14 or 9.45	100.4	2.43:1
NC35-47	$4^{3}/_{4}$	120.7	50.8	9.14 or 9.45	114.7	2.58:1
NC38-50 ($3^{1}/_{2}$ IF)	5	127.0	57.2	9.14 or 9.45	121.0	2.38:1
NC44-60	6	152.4	57.2	9.14 or 9.45	144.5	2.49:1
NC44-60	6	152.4	71.4	9.14 or 9.45	144.5	2.84:1
NC44-62	$6^{1}/_{4}$	158.8	57.2	9.14 or 9.45	149.2	2.91:1
NC46-62 (4IF)	$6^{1}/_{4}$	158.8	71.4	9.14 or 9.45	150.0	2.63:1
NC46-65 (4IF)	$6^{1}/_{2}$	165.1	57.2	9.14 or 9.45	154.8	2.76:1
NC46-65 (4IF)	$6^{1}/_{2}$	165.1	71.4	9.14 or 9.45	154.8	3.05:1
NC46-67 (4IF)	$6^{3}/_{4}$	171.5	57.2	9.14 or 9.45	159.5	3.18:1
NC50-70 ($4^{1}/_{2}$ IF)	7	177.8	57.2	9.14 or 9.45	164.7	2.54:1
NC50-70 ($4^{1}/_{2}$ IF)	7	177.8	71.4	9.14 or 9.45	164.7	2.73:1
NC50-72 ($4^{1}/_{2}$ IF)	$7^{1}/_{4}$	184.2	71.4	9.14 or 9.45	169.5	3.12:1
NC56-77	$7^{3}/_{4}$	196.9	71.4	9.14 or 9.45	185.3	2.70:1
NC56-80	8	203.2	71.4	9.14 or 9.45	190.1	3.02:1
$6^{5}/_{8}$ REG	$8^{1}/_{4}$	209.6	71.4	9.14 or 9.45	195.7	2.93:1
NC61-90	9	228.6	71.4	9.14 or 9.45	212.7	3.17:1
$7^{5}/_{8}$ REG	$9^{1}/_{2}$	241.3	76.2	9.14 or 9.45	223.8	2.81:1
NC70-97	$9^{3}/_{4}$	247.7	76.2	9.14 or 9.45	232.6	2.57:1
NC70-100	10	254.0	76.2	9.14 or 9.45	237.3	2.81:1
$8^{5}/_{8}$ REG[c]	11	279.4	76.2	9.14 or 9.45	266.7	2.84:1

Notes:
1. See Figure 15.
2. All dimensions in millimeters unless otherwise specified.

[a]The drill collar number consists of two parts separated by a hyphen. The first part is the connection number in the NC style. The second part, consisting of 2 (or 3) digits, indicates the drill collar outside diameter in units and tenths of inches. The connections shown in parentheses in the first column are not a part of the drill collar number; they indicate interchangeability of drill collars made with the standard (NC) connections as shown. If the connections shown in parentheses in the first column are made with the V-0.038R (0.97 mm) thread form, (as provided in 8.4) the connections, and drill collars, are identical with those in the NC style. Drill collars with $8^{1}/_{4}$ inch (209.6 mm), $9^{1}/_{2}$ inch (241.3 mm) and 11 inch (279.4 mm) outside diameters are shown with a $6^{5}/_{8}$, $7^{5}/_{8}$, and $8^{5}/_{8}$ REG connections, since there are no NC connections in the recommended bending strength ratio range.
[b]See Table 14 for tolerances.
[c]See Figure 17 and Table 16 for dimensions.
[d]See 8.3.2 for nonmagnetic drill collar tolerances.
[e]Stress relief features are disregarded in the calculation of the bending strength ratio.

Metric Table 16—Stress-Relief Features for Drill-Collar Connections

1	2	3	4	5	6
Number or Size and Style of Connection[a]	Length Shoulder Face to Last Thread Scratch of Box Member mm, ±1.59 mm L_X	Diameter of Cylinder Area of Box Member mm, +0.40 –0.0 mm D_{cb}	Taper of Area Behind Cylinder Areas of Box Member mm/m ±20.83 mm/m T.P.M.	Diameter of Pin |Member at Groove mm, +0.0 –0.79 mm D_{RG}	Length Shoulder Face to Groove of Box Member mm, +0.0 –3.18 mm L_{rg}
NC35	82.6	82.15	166.67	82.15	85.73
NC38 (3$^1/_2$ IF)	88.9	88.11	166.67	89.30	92.08
NC40 (4 FH)	101.6	92.87	166.67	96.04	104.78
NC44	101.6	101.60	166.67	106.36	104.78
NC46 (4 IF)	101.6	106.76	166.67	109.93	104.78
NC50 (4$^1/_2$ IF)	101.6	117.48	166.67	120.65	104.78
NC56	114.3	121.84	250.00	134.54	117.48
NC61	127.0	132.95	250.00	148.83	130.18
NC70	139.7	152.00	250.00	171.05	142.88
NC77	152.4	166.29	250.00	188.52	155.58
4$^1/_2$ FH	88.9	96.44	250.00	106.76	92.08
5$^1/_2$ REG	108.0	114.30	250.00	123.43	111.13
6$^5/_8$ REG	114.3	134.14	166.67	137.72	117.48
7$^5/_8$ REG	120.7	148.83	250.00	162.72	123.83
8$^5/_8$ REG	123.8	172.24	250.00	185.34	127.00

Note: See Figures 16 and 17.
[a]Connections NC23, NC26 (2$^3/_8$ IF), and NC31 (2$^7/_8$ IF) do not have sufficient metal to accommodate stress-relief features.

Metric Table 25—Product Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12
Connection Number or Size	Thread Form	Threads Per 25.4 mm	Taper mm/m on Dia.	Pitch Dia. of Thread at Gauge Point C	Large Diameter of Pin D_L	Diameter of Flat on Pin D_{LF}	Small Diameter of Pin D_S	Length of Pin[a] +0 –3.18 L_{PC}	Minimum Length of Threads[b] L_{BT}	Depth of Box +9.53 –0.0 L_{BC}	Box Counterbore +0.79 –0.40 Q_C
					Number (NC) Style						
NC23	V-0.038R	4	166.67	59.817	65.10	61.90	52.4	76.20	79.38	92.08	66.68
NC20	V-0.038R	4	166.67	67.7672	73.05	69.85	60.35	76.20	79.38	92.08	74.61
NC31	V-0.038R	4	166.67	80.8482	86.13	82.96	71.32	88.90	92.08	104.78	87.71
NC35	V-0.038R	4	166.67	89.6874	94.97	92.08	79.10	95.25	98.43	111.13	96.84
NC38	V-0.038R	4	166.67	96.7232	102.01	98.83	85.06	101.60	104.78	117.48	103.58
NC40	V-0.038R	4	166.67	103.4288	108.71	105.56	89.66	114.30	117.48	130.18	110.33
NC44	V-0.038R	4	166.67	112.1918	117.48	114.27	98.43	114.30	117.48	130.18	119.06
NC46	V-0.038R	4	166.67	117.5004	122.78	119.61	103.73	114.30	117.48	130.18	124.62
NC50	V-0.038R	4	166.67	128.0592	133.35	130.43	114.30	114.30	117.48	130.18	134.94
NC56	V-0.038R	4	250.00	142.6464	149.25	114.86	117.50	127.00	130.18	142.88	150.81
NC61	V-0.038R	4	250.00	156.9212	163.53	159.16	128.60	139.70	142.88	155.58	165.1
NC70	V-0.038R	4	250.00	179.1462	185.75	181.38	147.65	152.40	155.58	168.28	187.33
NC77	V-0.038R	4	250.00	196.6214	203.2	198.83	161.95	165.10	168.28	180.98	204.79
					Regular (REG) Style						
2 3/8 REG	V-0.040	5	250.00	60.0804	66.68	63.88	47.63	76.20	79.38	92.08	68.26
2 7/8 REG	V-0.040	5	250.00	69.6054	76.20	73.41	53.98	88.90	92.08	104.78	77.79
3 1/2 REG	V-0.040	5	250.00	82.2927	88.90	86.11	65.07	95.25	98.43	111.13	90.49
4 1/2 REG	V-0.040	5	250.00	110.8677	117.48	114.68	90.47	107.95	111.13	123.83	119.06
5 1/2 REG	V-0.050	4	250.00	132.9441	140.21	137.41	110.06	120.65	123.83	136.53	141.68
6 5/8 REG	V-0.050	4	166.67	146.2481	152.20	149.40	131.04	127.00	130.18	142.88	153.99
7 5/8 REG	V-0.050	4	250.00	170.5491	177.80	175.01	144.48	133.35	136.53	149.23	184.15
8 5/8 REG	V-0.050	4	250.00	194.7311	201.98	199.14	167.84	136.53	139.70	152.40	204.39
					Full-Hole (FH) Style						
5 1/2 FH	V-0.050	4	166.67	142.0114	147.96	—	126.80	127.00	130.18	142.88	150.02
6 5/8 FH	V-0.050	4	166.67	165.5978	171.53	—	150.37	127.00	130.18	142.88	173.83

Notes:
1. See Figure 20.
2. All dimensions are in millimeters.

[a]For rolling cone drill bits only, the tolerance is +0.0 –2.8 mm.

[b]L_{BT} is the length of threads in the box measured from the make-up shoulder to the intersection of the non-pressure flank and crest of the last thread with full thread depth.

Metric Table 26—Product Thread Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10
						Width of Flat			
Thread Form	Taper mm/m	Reference Thread Height, Not Truncated H	Reference Thread Height, Truncated $h_n = h_s$	Reference Root Truncation $s_{rn} = s_{rs}$ $f_{rn} = f_{rs}$	Reference Crest Truncation $f_{cn} = f_{cs}$	Crest $F_{cn} = F_{cs}$	Root $F_{rn} = F_{rs}$	Root Radius $r_{rn} = r_{rs}$	Radius at Thread Corners r ±0.20 mm
V-0.038R	166.67	5.48653	3.09484	0.96520	1.42649	1.65	—	0.97	0.38
V-0.038R	250.00	5.47063	3.08308	0.96520	1.42235	1.65	—	0.97	0.38
V-0.040	250.00	4.37650	2.99319	0.50800	0.87531	1.02	—	0.51	0.38
V-0.050	250.00	5.47063	3.74150	0.63500	1.09413	1.27	—	0.64	0.38
V-0.050	166.67	5.48653	3.75422	0.63500	1.09731	1.27	—	0.64	0.38

Notes:
1. See Figures 21 and 22.
2. All dimensions in millimeters.

Metric Table 27—Gauge Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Size	Thread Form	Threads Per 25.4 mm	Taper mm/m on Dia.	Pitch Dia. at 15.88 Gauge Point[a]	Major Dia. at 15.88 Gauge Point[a]	Minor Dia. at 15.88 Gauge Point[a]	Pitch Dia. at 34.9 Gauge Point[a]	Total Length Plug Gauge L_{pg}	Dia. of Plug Fitting Plate	Total Length Ring Gauge L_{rg}	Outside Dia. of Ring Gauge D_R	Dia. of Counter-bore Q	Mating Standoff S
						Number (NC) Style Gauges							
NC23	V-0.038R	4	166.67	59.8170	62.1965	57.4375	56.6420	76.2	52.22	60.3	98.4	64.03	15.88
NC26 ($2^3/_8$ IF)	V-0.038R	4	166.67	67.7672	70.1467	65.3877	64.5922	76.2	60.17	60.3	106.4	71.98	15.88
NC31 ($2^7/_8$ IF)	V-0.038R	4	166.67	80.8482	83.2277	78.4687	77.6732	88.9	73.25	73.0	130.2	85.06	15.88
NC35	V-0.038R	4	166.67	89.6874	92.0669	87.3079	86.5124	95.3	82.09	79.4	133.4	93.90	15.88
NC38 ($3^1/_2$ IF)	V-0.038R	4	166.67	96.7232	99.1027	94.3437	93.5482	101.6	89.13	85.7	142.9	100.94	15.88
NC40 (4 FH)	V-0.038R	4	166.67	103.4288	105.8083	101.0493	100.2538	114.3	95.83	98.4	149.2	107.67	15.88
NC44	V-0.038R	4	166.67	112.1918	114.5713	109.8123	109.0163	114.3	104.60	98.4	161.9	116.41	15.88
NC46 (4 IF)	V-0.038R	4	166.67	117.5004	119.8799	115.1209	114.3254	114.3	109.91	98.4	165.1	121.72	15.88
NC50 ($4^1/_2$ IF)	V-0.038R	4	166.67	128.0592	130.4382	125.6797	124.8842	114.3	120.47	98.4	181.0	132.28	15.88
NC56	V-0.038R	4	250.00	142.6464	145.0183	140.2745	137.8339	127.0	135.08	111.1	200.0	146.86	15.88
NC61	V-0.038R	4	250.00	156.9212	159.2931	154.5493	152.1587	139.7	149.35	123.8	215.9	161.14	15.88
NC70	V-0.038R	4	250.00	179.1462	181.5181	176.7743	174.3837	152.4	171.58	136.5	238.1	183.36	15.88
NC77	V-0.038R	4	250.00	196.6214	198.9933	192.2495	191.8589	165.1	189.05	149.2	260.4	200.84	15.88
						Regular (REG) Style Gauges							
$2^3/_8$ REG	V-0.040	5	250.00	60.0804	62.4523	57.7085	55.3179	76.2	54.13	60.3	95.3	64.29	15.88
$2^7/_8$ REG	V-0.040	5	250.00	69.6054	71.9773	67.2335	64.8429	88.9	63.65	73.0	108.0	73.81	15.88
$3^1/_2$ REG	V-0.040	5	250.00	82.2927	84.6646	79.9209	77.5302	95.3	76.33	79.4	127.0	86.51	15.88
$4^1/_2$ REG	V-0.040	5	250.00	110.8677	113.2395	108.4958	106.1052	108.0	104.90	92.1	158.8	115.09	15.88
$5^1/_2$ REG	V-0.050	4	250.00	132.9441	135.9723	129.9157	128.1816	120.7	125.88	104.8	190.5	137.85	15.88
$6^5/_8$ REG	V-0.050	4	166.67	146.2481	149.2860	143.2103	143.0731	127.0	138.38	111.1	209.6	151.10	15.88
$7^5/_8$ REG	V-0.050	4	250.00	170.5491	173.5772	167.5209	165.7866	133.4	163.09	117.5	241.3	175.41	15.88
$8^5/_8$ REG	V-0.050	4	250.00	194.7311	197.7593	191.7027	187.9686	136.5	187.27	120.7	273.1	199.59	15.88
						Full-Hole (FH) Style Gauges							
$5^1/_2$ FH	V-0.050	4	166.67	142.0114	145.0492	138.9736	138.8364	127.0	134.42	111.1	196.9	146.91	15.88
$6^5/_8$ FH	V-0.050	4	166.67	165.5978	168.6357	162.5600	162.4228	127.0	157.73	111.1	228.6	170.46	15.88

Notes:
1. See Appendix K for dimensions of obsolescent connections shown in parentheses in this table.
2. Gauges are the same for numbered connections (NC) and obsolescent connections when shown on the same line.
3. See Figures 24 and 25.
4. All dimensions in millimeters at 20°C, ±1.1°C, unless otherwise specified.

[a]The values in Column 5 and 6 apply only to grand, regional, and reference master plug gauges. The values in Column 8 apply only to working plug gauges. The values in Column 7 apply only to ring gauges.

Metric Table 28—Gauge Thread Dimensions Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10
Form of Thread	Reference No. of Thread per 25.4 mm	Pitch p	Taper mm/m on Dia.	Reference Thread Height, Not Truncated H	Thread Height, Truncated h_g	Root Truncation Maximum f_{rs}	Root Truncation Maximum f_{rn}	Crest Truncation f_{cs}	Crest Truncation f_{cn}
V-0.038R	4	6.350	166.67	5.486527	2.577059[a]	1.355979	1.355979	1.553489	1.553489
V-0.038R	4	6.350	250.00	5.470627	2.565298[a]	1.355979	1.355979	1.549349	1.549349
V-0.040	5	5.080	250.00	4.376496	2.371928	1.002284	1.002284	1.002284	1.002284
V-0.050	4	6.350	250.00	5.470627	3.028163	1.221232	1.221232	1.221232	1.221232
V-0.050	4	6.350	166.67	5.486527	3.037967	1.224280	1.224280	1.224280	1.224280

Notes:
1. In computing thread height and truncation, account has been taken of the effect of taper in reducing thread height for a given pitch, as compared with values for the same pitch on a cylinder.
2. See Tables 29, 30, and 31 for tolerances on Columns 3, 4, 6, 9, and 10.
3. See Figure 26.
4. All dimensions in millimeters at 20°C, ±1.1°C.

[a]The h_g dimension for V-0.038R thread form (Column 6) cannot be used to compute major and minor diameters from the pitch diameters given in Tables 28 and 29, because the crest and root transactions are not equal.

Metric Table 29—Tolerances on Reference Master Gauge Dimensions

Plug Gauge Element	Plug Gauge Tolerance	Ring Gauge Element	Ring Gauge Tolerance
Pitch diameter at gauge point[a]:		Minor diameter at gauge point	±0.05
Sizes 6 5/8 and NC50 and smaller	±0.010	Lead[b]:	
Sizes 7 5/8 and NC56 and larger	±0.013	Sizes 2 3/8 through 5 1/2 and NC23 through NC50	±0.012
Major diameter at gauge point	±0.05	Sizes 6 5/8 and NC56 and larger	±0.018
Diameter of fitting plate	±0.38	Taper[c,d]:	
Lead[b]:		L_{rg} 3 1/2 and shorter	+0.010 –0.030
Sizes 6 5/8 and NC50 and smaller	±0.010	L_{rg} 3 5/8 through 4	+0.010 –0.036
Sizes 7 5/8 and NC56 and larger	±0.013	L_{rg} 4 1/8 through 4 1/2	+0.010 –0.041
Taper[c]:		L_{rg} 4 5/8 through 5	+0.010 –0.045
L_{rg} 3 1/2 and shorter	+0.010 –0.000	L_{rg} 5 1/8 through 5 1/2	+0.010 –0.051
L_{rg} 3 5/8 through 4	+0.013 –0.000	L_{rg} 5 5/8 through 6	+0.010 –0.056
L_{rg} 4 1/8 through 4 1/2	+0.015 –0.000	Half angle of thread	±15 min.
L_{rg} 4 5/8 through 5	+0.018 –0.000	Length L_{rg}	±0.8
L_{rg} 5 1/8 through 5 1/2	+0.020 –0.000	Crest truncation:	
L_{rg} 5 5/8 through 6	+0.023 –0.000	Sizes 6 5/8 and NC50 and smaller	±0.0305
Half angle of thread	±7 min.	Sizes 7 5/8 and NC56 and larger	±0.0318
Length L_{pg}	±2.4	Outside diameter D_R	±0.4
Crest truncation:		Diameter of counterbore Q	±0.38
Sizes 6 5/8 and NC50 and smaller	±0.0305	Mating standoff S	0.03
Sizes 7 5/8 and NC56 and larger	±0.0318		

Notes:
1. See Figure 24.
2. All dimensions in millimeters at 20°C, ±1.1°C.

[a]Helix angle correction shall be disregarded in pitch diameter determinations.
[b]Maximum allowable error in lead between any two threads whether adjacent or separated by any amount not exceeding the full length of thread less one full thread at each end.
[c]L_{rg} values are listed in Table 27, column 10.
[d]The pitch cone of the ring gauge is provided with a minus taper in order to minimize variations in interchange standoff due to lead errors.

Metric Table 30—Tolerances On Grand and Regional Master Gauge Dimensions

Plug Gauge		Ring Gauge	
Element	Tolerance	Element	Tolerance
Pitch diameter at gauge point[a]	±0.005	Minor diameter at gauge point	±0.05
Lead[b]:		Lead[b]:	
Sizes 2$^3/_8$ to 3$^1/_2$, inclusive	±0.005	Sizes 2$^3/_8$ to 3$^1/_2$, inclusive	±0.008
Sizes 4 to 8$^5/_8$, inclusive	±0.008	Sizes 4 to 8$^5/_8$, inclusive	±0.010
Taper[c]:	+0.010	Taper[c,d]	–0.015
	+0.003		–0.030
Half angle of thread (minutes)	±5	Half angle of thread (minutes)	±10
Length L_{pg}	±2.4	Length L_{rg}	±2.4
Crest truncation	±0.0284	Crest truncation	±0.028
		Outside diameter D_R	±0.4
		Diameter of counterbore Q	±0.38
		Mating standoff S	±0.03

Notes:
1. See Figure 24.
2. All dimensions in millimeters at 20°C, ±1.1°C.
[a]Helix angle correction shall be disregarded in pitch diameter determinations.
[b]Maximum allowable error in lead between any two threads whether adjacent or separated by any amount not exceeding the full length of thread less one full thread at each end.
[c]L_{rg} values are listed in Table 27, Column 10.
[d]The pitch cone of the ring gauge is provided with a minus taper in order to minimize variations in interchange standoff due to lead errors.

Metric Table 31—Tolerances On Working Gauge Dimensions

Plug Gauge		Ring Gauge	
Element	Tolerance	Element	Tolerance
Pitch diameter at gauge point[a]:		Minor diameter at gauge point	±0.05
Sizes 6$^5/_8$ and NC50 and smaller	±0.010	Lead[b]:	
Sizes 7$^5/_8$ and NC56 and larger	±0.013	Sizes 2$^3/_4$ through 5$^1/_2$ and NC23 through NC50	±0.015
Major diameter at gauge point	±0.05	Sizes 6$^5/_8$ and NC56 and larger	±0.018
Diameter of fitting plate	±0.38	Taper[c,d]:	
Lead[b]:		L_{rg} 3$^1/_2$ and shorter	–0.010 –0.036
Sizes 6$^5/_8$ and NC50 and smaller	±0.010	L_{rg} 3$^5/_8$ through 4	–0.010 –0.041
Sizes 7$^5/_8$ and NC56 and larger	±0.013	L_{rg} 4$^1/_8$ through 4$^1/_2$	–0.010 –0.046
Taper[c]:		L_{rg} 4$^5/_8$ through 5	–0.010 –0.051
L_{rg} 3$^1/_2$ and shorter	+0.015 –0.000	L_{rg} 5$^1/_8$ through 5$^1/_2$	–0.010 –0.056
L_{rg} 3$^5/_8$ through 4	+0.018 –0.000	L_{rg} 5$^5/_8$ through 6	–0.010 –0.061
L_{rg} 4$^1/_8$ through 4$^1/_2$	+0.020 –0.000	Half angle of thread	±15° min.
L_{rg} 4$^5/_8$ through 5	+0.023 –0.000	Length L_{rg}	±2.4
L_{rg} 5$^1/_8$ through 5$^1/_2$	+0.025 –0.000	Crest truncation:	
L_{rg} 5$^5/_8$ through 6	+0.028 –0.000	Sizes 6$^5/_8$ and NC50 and smaller	±0.0305
Half angle of thread	±7 min.	Sizes 7$^5/_8$ and NC56 and larger	±0.0318
Length L_{pg}	±2.4	Outside diameter D_R	±0.4
Crest truncation:		Diameter of counterbore Q	±0.38
Sizes 6$^5/_8$ and NC50 and smaller	±0.0305	Mating standoff S	±0.03
Sizes 7$^5/_8$ and NC56 and larger	±0.0318		

Notes:
1. See Figure 25.
2. All dimensions in millimeters at 20°C, ±1.1°C.
[a]Helix angle correction shall be disregarded in pitch diameter determinations.
[b]Maximum allowable error in lead between any two threads whether adjacent or separated by any amount not exceeding the full length of thread less one full thread at each end.
[c]L_{rg} values are listed in Table 27, Column 10.
[d]The pitch cone of the ring gauge is provided with a minus taper in order to minimize variations in interchange standoff due to lead errors.

Metric Table H-1—Compensated Thread Lengths and Ball Point Diameters for Measurements Parallel to the Taper Cone

1	2	3	4	5	6	7
Thread Form	Taper mm/m	Number Threads Per 25.4 mm	Pitch mm	Thread Length (Parallel to Thread Axis), mm	Compensated Length (Parallel to Taper Cone), mm	Ball Point Diameter mm
V-0.038R	166.67	4	6.350	25.4	25.48814	3.66
V-0.038R	250.00	4	6.350	25.4	25.59761	3.66
V-0.040	250.00	5	6.350	25.4	25.59761	2.92
V-0.050	250.00	4	6.350	25.4	25.59761	3.66
V-0.050	166.67	4	6.350	25.4	25.48814	3.66
V-0.065	166.67	4	6.350	25.4	25.48814	3.66
V-0.076	125.00	4	6.350	25.4	25.44953	3.66
H-90	166.67	$3^1/_2$	7.257	50.8	50.97628	5.1316
H-90	250.00	$3^1/_2$	7.257	50.8	51.19522	5.1316
SL-H90	104.17	3	8.467	25.4	25.43454	5.9868

Note: Although only taper and lead measurements are recommended in this appendix, these ballpoint diameters would also apply to contour microscope contact points for measuring thread angle or checking thread form if desired, except that the contacts for the V-0.040 thread form should be truncated to clear the bottom of the thread. If thread height is measured, the height gauge contact points should be conical in shape, with a 50 degree included angle and a 0.0508 millimeter radius at the tip of the cone.

Metric Table I-1—Obsolescent Tool Joints With Taper Shoulder and Square Shoulder

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Tool Joint											Shoulder		
											Taper	Square	
Tool Joint Designation[a]	Drill Pipe Size and Style	Drill Pipe Nom. Wt.[b] kg/m	Outside Dia. of Pin and Box ±0.8	Inside Dia. of Pin and Box[c] +0.4 –0.8	Dia. of Pin at Elevator Upset Max.	Bevel Dia. of Pin and Box Shoulder ±0.4	Total Length Tool Joint Pin +6.4 –9.5	Pin Tong Space ±6.4	Box Tong Space ±6.4	Combined Length of Pin and Box ±12.7	Dia. of Box at Elevator Upset Max.	Dia. of Box at Elevator Upset Max.	Radius of Elevator Neck ±0.4
			D	d	D_{PE}	D_F	L_P	L_{PB}	L_B	L	D_{TE}	D_{SE}	R_{SE}
Obsolescent Connections Full-Hole (FH) Style													
3 1/2 FH[e]	3 1/2 IU	19.81	117.5	54.0	93.7	113.9	273.1	177.8	241.3	419.1	93.7	92.1	4.8
3 1/2 FH[e]	3 1/2 IU	23.09	117.5	54.0	93.7	113.9	273.1	177.8	241.3	419.1	93.7	92.1	4.8
4 FH (NC40)	4 IU	20.85	133.4	71.4	106.4	127.4	292.1	177.8	254.0	431.8	106.4	104.8	6.4
4 1/2 FH	4 1/2 IU	24.73	146.1	76.2	119.1	140.5	279.4	117.8	254.0	431.8	119.1	117.5	6.4
4 1/2 FH	4 1/2 IEU	29.79	146.1	76.2	119.1	140.5	279.4	177.8	254.0	431.8	119.1	117.5	6.4
5 1/2 FH[f]	5 1/2 IEU	32.62	177.8	101.6	144.5	170.7	330.2	203.2	254.0	457.2	144.5	144.5	6.4
5 1/2 FH[f]	5 1/2 IEU	36.79	177.8	101.6	144.5	170.7	330.2	203.2	254.0	457.2	144.5	144.5	6.4
Internal-Flush (IF) Style													
2 3/8 IF (NC26)	2 3/8 EU	9.91	85.7	44.5	65.1	82.9	228.6	152.4	177.8	330.2	65.1	—	—
2 7/8 IF (NC31)	2 7/8 EU	15.49	104.8	54.0	81.0	100.4	241.3	152.4	203.2	355.6	81.0	81.0	4.8
3 1/2 IF (NC38)	3 1/2 EU	19.81	120.7	68.3	98.4	116.3	279.4	177.8	241.3	419.1	98.4	98.4	4.8
3 1/2 IF (NC38)	3 1/2 EU	23.09	127.0	68.3	98.4	116.3	279.4	177.8	241.3	419.1	98.4	98.4	4.8
4 IF (NC46)	4 EU	20.85	146.1	82.6	114.3	140.5	292.1	177.8	254.0	431.8	114.3	114.3	6.4
4 1/2 IF (NC50)	4 1/2 EU	24.73	Std 155.6	95.3	127.0	154.0 (150.4)	292.1	177.8	254.0	431.8	127.0	127.0	6.4
4 1/2 IF (NC50)	4 1/2 EU	24.73	Opt 158.8	95.3	127.0	154.0 (150.4)	292.1	177.8	254.0	431.8	127.0	127.0	6.4
4 1/2 IF (NC50)[d]	5 IEU	29.05	Std 161.9	95.3	130.2	154.0 (150.4)	292.1	177.8	254.0	431.8	130.2	130.2	6.4
4 1/2 IF (NC50)[d]	5 IEU	29.05	Opt 165.1	88.9	130.2	154.0 (150.4)	292.1	177.8	254.0	431.8	130.2	130.2	6.4

Notes:
1. See Figure 6.
2. All dimensions are in millimeters.
3. Neck diameters (D_{PE}, D_{TE}, and D_{SE}) and inside diameters (d) of tool joints prior to welding are at manufacturer's option. The above table specifies the finished dimensions after final machining of the assembly.
4. See Table 7 for dimensions for numbered connections (NC).
5. Bevel diameter shown in parentheses is optional with the manufacturer until June 1986, at which time 154.0 will be standard. CAUTION TO USER—As a result of this option precaution is advised to make sure mating NC50 connections have the same bevel diameter.

[a]The tool-joint designation (Column 1) indicates the size and style of the applicable connection. Those in parentheses are not a part of the size designation for the number style connections. They indicate interchangeability of these tool joints when welded to the same size, style, and weight of drill pipe. See Special Note.
[b]Nominal weights, threads, and coupling (Column 3) are shown for the purpose of identification in ordering.
[c]The bore dimensions (Column 5) do not apply to the bores of box members of REG tool joints, which are optional with the manufacturer.
[d]NC 50 (4 1/2 IF) joint with 161.9- and 165.1-mm OD is used on 5-inch IEU drill pipe to produce an assembly variously known as 5-inch Extra-Hole and 5-inch Semi-Internal Flush.
[e]The inside diameter (Column 5) of the 3 1/2 FH tool joint was changed from 61.9 to 54.0 mm in Appendix H of the May 1979, Thirty-Second Edition of Specification 7.
[f]In 1979, the 5 1/2 FH tool joints were reinstated as full standard in Table 4.2. The dimensions were retained here primarily so that Appendix I could continue to be the single reference for square shoulder dimensions (See Figure 6).

Metric Table J-1—Product Dimensions for Obsolescent Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12
Connection Number or Size	Thread Form	Threads Per 25.4 mm	Taper, mm/m on Dia.	Pitch Dia. of Thread at Gauge Point	Large Dia. of Pin	Dia. of Flat on Pin[b] ±0.4	Small Dia. of Pin	Length of Pin +0 –3.2	Minimum Length of Box Threads[c]	Depth of Box[c] +9.5 –0	Box Counterbore +0.8 –0.4
				C	D_L	D_{LF}	D_S	L_{PC}	L_{BT}	L_{BC}	Q_C
					Obsolescent Product Dimensions Full-Hole (FH) Style						
$3^{1}/_{2}$ FH	V-0.040	5	250.0	94.8436	101.45	—	77.62	95.3	98.4	111.1	102.8
4 FH[a]	V-0.065	4	166.7	103.4288	108.71	105.56	89.66	114.3	117.5	130.2	110.3
$4^{1}/_{2}$ FH	V-0.040	5	250.0	115.1128	121.72	—	96.32	101.6	104.8	117.5	123.8
					Internal-Flush (IF) Style						
$2^{3}/_{8}$ IF[a]	V-0.065	4	166.7	67.7672	73.05	69.85	60.35	76.2	79.4	92.1	74.6
$2^{7}/_{8}$ IF[a]	V-0.065	4	166.7	80.8482	86.13	82.96	71.32	88.9	92.1	104.8	87.7
$3^{1}/_{2}$ IF[a]	V-0.065	4	166.7	96.7232	102.01	98.83	85.06	101.6	104.8	117.5	103.6
4 IF[a]	V-0.065	4	166.7	117.5004	122.78	119.61	103.73	114.3	117.5	130.2	124.6
$4^{1}/_{2}$ IF[a]	V-0.065	4	166.7	128.0592	133.35	130.43	114.30	114.3	117.5	130.2	134.9
$5^{1}/_{2}$ IF	V-0.065	4	166.7	157.2006	162.48	—	141.33	127.0	130.2	142.9	163.9

Notes:
1. See Metric Table 25 for dimensions for numbered connections (NC).
2. See Figure 20.
3. All dimensions are in millimeters.

[a]Connections in the number (NC) style are interchangeable with connections having the same pitch diameter in the FH and IF styles. See 10.3.
[b]Dimension DLF and the 1.57 mm radius at the pin base (See Figure 20) are standard for drill collars and optional with the manufacturer for other drill stem elements.
[c]L_{BT} is the length of threads in the box measured from the make-up shoulder to the intersection of the non-pressure flank and crest of the last thread with full thread depth.

Metric Table K-1—Gauge Dimensions for Obsolescent Rotary Shouldered Connections

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Size	Thread Form	Threads Per 25.4 mm	Taper, mm/m on Dia.	Pitch Dia. at 15.88 Gauge Point[a]	Major Dia. at 15.88 Gauge Point[a]	Minor Dia. at 15.88 Gauge Point[a]	Pitch Dia. at 34.93[a]	Total Length Plug Gauge L_P	Dia. of Plug Fitting Plate	Total Length Ring Gauge L_R	Outside Dia. of Ring Gauge D_R	Dia. of Counter-bore Q	Mating Standoff S
						Obsolescent Gauge Dimensions Full-Hole (FH) Style Gauges							
$3^{1}/_{2}$ FH	V-0.040	5	250.00	94.8436	97.2155	92.4718	90.0811	95.3	88.87	79.4	139.7	99.06	15.88
4 FH (NC40)	V-0.065	4	166.67	103.4288	105.8083	101.0493	100.2538	114.3	95.83	98.4	149.2	107.67	15.88
$4^{1}/_{2}$ FH	V-0.040	5	250.00	115.1128	117.4847	112.7409	110.3503	101.6	109.14	85.7	165.1	119.33	15.88
						Internal-Flush (IF) Style Gauges							
$2^{3}/_{8}$ IF (NC26)	V-0.065	4	166.67	67.7672	70.1467	65.3877	64.5922	76.2	60.17	60.3	106.4	71.98	15.88
$2^{7}/_{8}$ IF (NC31)	V-0.065	4	166.67	80.8482	83.2277	78.4687	77.6732	88.9	73.25	73.0	130.2	85.06	15.88
$3^{1}/_{2}$ IF (NC38)	V-0.065	4	166.67	96.7232	99.1027	94.3437	93.5482	101.6	89.13	85.7	142.9	100.94	15.88
4 IF (NC46)	V-0.065	4	166.67	117.5004	119.8799	115.1209	114.3254	114.3	109.91	98.4	165.1	121.72	15.88
$4^{1}/_{2}$ IF (NC50)	V-0.065	4	166.67	128.0592	130.4387	125.6797	124.8842	114.3	120.47	98.4	181.0	132.28	15.88
$5^{1}/_{2}$ IF	V-0.065	4	166.67	157.2006	159.5801	154.8211	154.0256	127.0	149.61	111.1	212.7	161.42	15.88

Notes:
1. See Table 27 for dimensions for numbered connections (NC).
2. Gauges are the same for numbered connections (NC) and obsolescent connections when shown on the same line.
3. See Section 12 for gauge specifications.
4. See Figure 24.
5. All dimensions are in millimeters at 20°C.

[a]The values in Column 5 and 6 apply only to plug gauges. The values in Columns 7 and 8 apply only to ring gauges.

APPENDIX N—PURCHASER INSPECTION (OPTIONAL)

N.1 Inspection Notice

When the purchaser's inspector desires to witness the manufacture or testing of equipment, reasonable notice shall be given of the time at which manufacture and testing are to be done.

N.2 Inspection

While work on the contract of the purchaser is being performed, the purchaser's inspector shall have free entry at all times to all parts of the manufacturer's works that concern manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with operation of the works.

N.3 Rejection

Unless otherwise provided, material that shows defects on inspection or subsequent to acceptance at the manufacturer's works, or that proves defective when properly applied in service, may be rejected, and the manufacturer so notified. If tests that require the destruction of material are made, any product that is proven not to have met the requirements of the specification shall be rejected. Disposition of rejected product shall be a matter of agreement between the manufacturer and the purchaser.

N.4 Compliance

The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to satisfy himself of compliance by the manufacturer and may reject any material that does not comply with this specification.

N.5 Rotary Shouldered Connection

Acceptance of rotary shouldered connections shall be in accordance with this specification, which provides the opportunity to conduct detailed inspection of the connections in their as-machined condition. The surface conditions necessary for precise measurements will only be assured prior to subsequent further processing, doping, shipping, handling, storing, etc., which can alter the surfaces necessary for precision gauging.

Note: Connections should be visibly inspected for damage that may have occurred through this chain of events prior to putting the connections into service. Such damage is generally very minor and most often repairable well within the needs for good connection performance.

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