Date of Issue: April 20, 1998
Affected Publication: API Specification 7K, *Drilling Equipment*, Second Edition, February 1996, Effective: April 1, 1996

ERRATA

Page 14, Table 3:
The tolerances for the metric dimensions are as follows:

	Diameter of Extension	Keyway	
		Width	Depth
Size	A	B	C
	+0.000	+0.000	+15.24
	–0.025	–0.025	–0.000

Page 16, Section 9.5.4.a should read:
. . . . minimum impact toughness of 31 foot-pounds . . . .

Table 4, Change tolerances for dimension B_1 to read as follows:

B_1	
+0.000	+0.000
–0.030	–0.762

Page 17, Figure 6:
The dimensions 13 $^4/_{16}$" in the upper right view should read : 13 $^9/_{16}$". *The tolerances and the metric dimensions remain unchanged.*

The dimension reading 4° in the lower right view should read 4".

Page 21, Table 8:
The dimensions for 3 inch Rotary Vibrator and Drilling Hose were omitted. The dimensions, grades, and pressures for the 3 inch hose are identical to those for 3$^1/_2$ inch hose.

Page 31, Section 9.11.9.3, Taper:
The end of the 5th sentence should read: . . . length L_{TS}.

Page 32, Section 9.11.9.8, Initial Standoff:
Initial Standoff, The second sentence should read:
. . . 0.6739 ± 0.002 inch (17.117 ± 0.05 millimeter).

Page 35, Table 16, under Not-Go Gauges:
The dimension for Ring Length, L_N, for Taper Thread Number T2 should be $^{11}/_{16}$.

Page 43, Section C.2.3.b:
The sentence should read: . . . 10 cubic feet (0.283 cubic meters).

Page 51, Table E-6:
The dimension for Outside Diameter of Ring, D_R*, for Taper Thread Number T8 should be* 82.6.

Page 52, Table E-7:
The dimension for Truncated Major Diameter, B_{ST}*, for Taper Thread Number T17 should read* 113.162.

Specification for Drilling Equipment

API SPECIFICATION 7K
SECOND EDITION, FEBRUARY 1996

EFFECTIVE DATE: APRIL 1, 1996

American Petroleum Institute

Specification for Drilling Equipment

Exploration and Production Department

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FOREWORD

This specification is under the jurisdiction of the American Petroleum Institute (API) Committee on Drilling Standards' Suncommittee on Drilling and Servicing Equipment.

This specification was established to cover Drilling Equipment items formerly in Specification 7 that are nondrill stem and items formerly in Specification 8A/8C that are non-overhead equipment.

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Specification for Drilling Equipment

1 Scope

1.1 PURPOSE

The purpose of this specification is to provide standards for design, manufacture, and testing of new drilling equipment and replacement primary load carrying components.

Note: Refer to Section 9 to determine the specific paragraphs applicable to each type of equipment.

1.2 EQUIPMENT COVERED

This specification covers the following drilling equipment:

a. Rotary tables
b. Rotary bushings
c. Rotary slips
d. Rotary hose
e. Slush pump components
f. Drawworks components
g. Spiders not capable of use as elevators
h. Manual tongs
i. Safety clamps not used as hoisting devices
j. Power tongs

1.3 FUNCTIONAL AND OPERATIONAL REQUIREMENTS

Drilling equipment shall be designed, manufactured and tested such that it is in every respect fit for its intended purpose. The equipment shall safely transfer the load it is intended for. The equipment shall be designed for simple and safe operation.

1.4 SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall apply only when specified by the Purchaser in the contract or order. Appendix B gives a number of standardized supplementary requirements.

2 References

This specification includes by reference, either in total or in part, other API and industry standards. The edition effective at the date of purchase order or date of manufacture, whichever is earliest, shall apply.

Requirements of other standards included by reference in this specification are essential to the safety and interchangeability of the equipment produced.

2.1 STANDARDS

Other nationally or internationally recognized standards may be used provided it can be shown that they meet or exceed the requirements of the standards referenced herein.

Only those standards referenced herein are considered part of this specification. Documents (subtier) that are referenced by those standards are not considered part of this specification.

AGMA[1]

Std 211.01	*Surface Durability of Helical and Herringbone Gears*
Std 241.01	*Gear Materials - Steel*
Std 244.01	*Nodular Iron Gear Materials*
Std 424.01	*Standard Practice for the Rating of Helical and Herringbone Gearing for Oilfield Mud Pumps*

ANSI[2]

B1.1	*Unified Screw Threads*
B1.2	*Screw Thread Gages and Gaging for Unified Screw Threads*

ANSI/AWS[3]

D1.1	*Structural Welding Code*

API

Spec 5B	*Specification for Threading, Gauging and Thread Inspection of Casing, Tubing, and Line Pipe Threads*
Spec 7	*Specification for Rotary Drilling Equipment*
Spec 8A	*Specification for Drilling and Production Hoisting Equipment*

ASME[4]

V	*Non-Destructive Examination*
VIII	*Pressure Vessel Code*
IX	*Welding and Brazing Qualifications*

[1]American Gear Manufacturers Association, 1500 King Street, Suite 201, Alexandria, Virginia 22314.

[2]American National Standards Institute, 1430 Broadway, New York, New York 10018.

[3]American Welding Society, 550 N.W. LeJeune Road, Box 351040, Miami, Florida 33135.

[4]American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017-2392.

ASNT[5]

TC-1A	*Recommended Practice for Personnel Qualification and Certification in Non-Destructive Testing*

ASTM[6]

A370	*Standard Test Methods and Definitions for Mechanical Testing of Steel Products*
A488	*Recommended Practice for Qualification of Procedures and Personnel for the Welding of Steel Castings*
A668	*Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use*
A770	*Specification for Through Thickness Tension Testing of Steel Plates for Special Applications*
E4	*Load Verification of Testing Machines*
E125	*Reference Photographs for Magnetic Particle Indications on Ferrous Castings*
E165	*Practice for Liquid Penetrate Inspection Method*
E186	*Reference Radiographs for Heavy-Walled (2 to 4 1/2 inches—51 to 114 millimeters) Steel Castings*
E280	*Reference Radiographs for Heavy-Walled (4 1/2 to 12 inches—114 to 305 millimeters) Steel Castings*
E446	*Reference Radiographs for Steel Castings up to 2 inches (51 millimeters) in Thickness*
E709	*Practice for Magnetic Particle Examination*
BS 5781	*Measurement and Calibration Systems*

DOD[7]

MIL STD 120	*Gauge Inspection*
MIL STD 6875 F	*Heat Treatment of Steels—Aircraft Practice Process*

MSS[8]

SP-55	*Quality Standard for Steel Castings—Visual Method*

SAE[9]

AS 1260	*Equivalent Section of Certain Shapes to Round Bars*

[5]American Society for Nondestructive Testing, 4153 Arlingate Plaza, Box 28518, Columbus, Ohio 43228-0518.

[6]ASTM, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428.

[7]Department of Defense, Pentagon, Washington, DC 20301.

[8]Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia 22180.

[9]Society of Automotive Engineers, Two Pennsylvania Plaza, New York, New York 10001.

2.2 OTHER REFERENCES

IADC[10]	*Drilling Manual*

3 Definitions

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

3.1 critical area: Highly stressed regions on a primary load carrying component.

3.2 design load: A calculated load for the equipment that is the sum of the static and dynamic load that produces the maximum allowable stress in the equipment.

3.3 design safety factor: A safety factor to account for a certain safety margin between maximum allowable stress and the minimum specified yield strength of the material used.

3.4 design verification test: A test undertaken to validate the integrity of the design calculations used.

3.5 dynamic load: The load applied to the equipment due to acceleration/deceleration effects.

3.6 high stress:

$$\text{High Stress} \geq \frac{\text{Specified Min. Yield Strength}}{(1.33)\ (\text{Design Safety Factor})}$$

3.7 maximum allowable stress: The specified minimum yield strength divided by the design safety factor.

3.8 primary load: The load that arises within the equipment when the equipment is performing its primary design function.

3.9 primary load carrying components: Those components of the covered equipment through which the primary load is carried.

3.10 proof load test: A production load test undertaken to validate the load rating of the equipment.

3.11 rated load: The maximum operating load, both static and dynamic, to be applied to the covered equipment. The rated load is numerically equivalent to the design load.

3.12 rated speed: The rate of rotation, motion, or velocity as defined by the manufacturer.

3.13 repair: The removal of defects from castings or fabrication welds and refurbishment of the component or assembly by welding during the manufacturing process. Note that repair as referred to in this specification applies only to the manufacture of new equipment.

[10]International Association of Drilling Contractors, P.O. Box 4287, Houston, Texas 77210.

3.14 safe working load: Safe working load is equal to the design load reduced by the dynamic load.

3.15 size class: Represents the dimensional interchangeability of equipment specified herein.

3.16 special process: An operation that may change or affect the mechanical properties, including toughness, of the materials used in the equipment.

3.17 test unit: A prototype unit upon which a design verification test is conducted.

3.18 Within this specification **shall, should**, and **may** are defined as follows:

a. "Shall" is used to indicate that a provision is mandatory.
b. "Should" is used to indicate that a provision is not mandatory, but recommended as good practice.
c. "May" is used to indicate that a provision is optional.

3.19 equivalent round: A standard for comparing various shaped sections to round bars, in determining the response to hardening characteristics when heat treating low-alloy and martensitic corrosion-resistant steels.

3.20 metric conversions: Metric conversions of U.S. customary units are provided in parentheses throughout the text of this specification, for example, 6 inches (152.4 millimeters). Metric conversions of U.S. customary units are also included in all tables and figures. The factors used for conversion of U.S. customary units to metric values are given in Appendix F.

4 Design

4.1 DESIGN CONDITIONS

The equipment shall be designed to operate at −4°F (−20°C) unless otherwise specified in Section 9.

4.2 STRENGTH ANALYSIS

The equipment design analysis shall address excessive yielding, fatigue, or buckling as possible modes of failure.

4.2.1 The strength analysis shall be based on the elastic theory. Alternatively, ultimate strength (plastic) analysis may be used where justified by design documentation.

4.2.2 All forces that may govern the design shall be taken into account. For each cross section to be considered, the most unfavorable combination, position, and direction of forces shall be used.

4.2.3 Simplified assumptions regarding stress distribution and stress concentration may be used, provided that the assumptions are made in accordance with generally accepted practice, or in accordance with experience or tests.

4.2.4 In cases of equipment or components for which adequate methods of analysis do not exist, the capability shall be verified by tests. Refer to Section 5.

4.2.5 The fatigue analysis shall be based on a period of time of not less than 20 years.

4.2.6 The fatigue analysis shall be carried out according to generally accepted theories. A method that may be used is defined in the FEM Rules for the Design of Hoisting Appliances.

4.3 SIZE CLASS DESIGNATION

The size class designation for equipment shall represent dimensional interchangeability as required in Section 9.

4.4 RATING

4.4.1 Rotary tables, spiders, manual and power tongs furnished under this specification shall be rated in accordance with the requirements specified herein.

4.4.2 The static ratings for all bearings within the primary load path shall meet or exceed the rated load for the equipment.

4.4.3 Power and manual tongs shall be assigned Torque Ratings by the manufacturer for all configurations for which the tong is designed.

4.5 LOAD RATING BASIS

The Load Rating shall be based on (a) the Design Safety Factor as specified in 4.6, (b) the minimum specified yield strength of the material used in the primary load carrying components, and (c) the stress distribution as determined by design calculations and/or data developed in a design verification load test as specified in Section 5.

4.6 DESIGN SAFETY FACTOR

4.6.1 Design Safety Factor for spiders shall be established as follows:

Load Rating		
Tons	(MTonnes)	Design Safety Factor, SF_D
150	(136) and less	3.00
150–500	(136)–(454)	3.00 − 0.75(R − 150)/350
500	(454) and over	2.25

Where R = Load Rating in tons.

Note: Where R = Load Rating in MTonnes, the formula is 3.00 − 0.75 (R − 136)/318.

4.6.2 The minimum Design Safety Factor of structural components in the primary load path of rotary tables shall be 1.67.

4.6.3 The minimum Design Safety Factor for manual tongs, jaws, and snub line attachments of power tongs shall be established as follows:

Torque Rating, ft-lb (N•m)	Design Safety Factor, SF_D
30K(41K) and less	3.00
30K(41K) to 100K(136K)	3.00 − 0.75(R − 30K)/70K
100K(136K) and over	2.25

Where R = Torque Rating in ft-lbs.

Note: Where R = Torque Rating in N•m, the formula is 3.00 − 0.75(R − 41K)/95K.

4.7 SHEAR STRENGTH

For purposes of design calculations involving shear, the ratio of yield strength in shear-to-yield strength in tension shall be 0.58.

4.8 SPECIFIC EQUIPMENT

Refer to Section 9 for equipment-specific design requirements.

4.9 DESIGN DOCUMENTATION

Documentation of design shall include methods, assumptions, calculations, and design requirements. Design requirements shall include but not be limited to those criteria for size, test and operating pressures, material, environmental and API specification requirements, and other pertinent requirements upon which the design is to be based.

The requirements also apply to design change documentation.

5 Design Verification

5.1 GENERAL

To ensure the integrity of the design and supporting calculations, equipment shall be subject to design verification testing.

5.1.1 Design verification testing shall be performed in accordance with documented procedures.

5.1.2 Design verification testing shall be carried out or certified by personnel who are independent of those having direct responsibility for the design and manufacture of the product and are qualified to perform their task.

5.1.3 Design verification testing may consist of any of the listed tests when required by the specific equipment paragraphs of this specification.

a. Function Testing
b. Pressure Testing
c. Load Testing

5.2 DESIGN VERIFICATION FUNCTION TEST

5.2.1 Sampling of Test Units

One unit of each model of machine shall be subjected to function testing if the machine transmits force, motion, or energy by means of continued movement of the machine parts.

5.2.2 Test Procedure

The manufacturer shall establish a procedure documenting the duration, applied load, and speed of the test. For equipment designed for continuous operation, the test unit shall be operated at rated speed for a minimum of two hours. For equipment designed for intermittent or cyclical operation, the test unit shall be operated at rated speed and established duty cycles equivalent to two hours operation or ten duty cycles, whichever is greater, unless otherwise specified by Section 9.

5.2.3 Qualification

The unit must operate without noted loss of power. The temperature of the bearings and lubrication oil must be within acceptable limits as established by the design and documented in the test procedure.

5.3 DESIGN VERIFICATION PRESSURE TEST

5.3.1 Sampling of Test Units

Each design of pressure containing items or, as defined in Section 9, primary load carrying components, where the primary load is pressure, shall be hydrostatically tested for design verification. Hydraulic power transmission components are excluded from this test.

5.3.2 Test Procedure

The test pressure shall be 1.5 times the maximum rated operating pressure. Cold water, water with additives, or the fluid normally used in actual service shall be used as the test fluid. Tests shall be performed on the completed part or assembly before painting.

The hydrostatic test shall be applied for two cycles. Each cycle shall consist of four steps.

a. The primary pressure holding period.
b. The reduction of the test pressure to zero.
c. All external surfaces of the item being tested shall be thoroughly dried.
d. The secondary holding period.

The pressure holding period shall not start until the test pressure has been reached, and the equipment and pressure monitoring gauge isolated from the pressure source. The pressure holding period shall not be less than three minutes.

5.3.3 Qualification

After each test cycle the test item shall be carefully inspected for the absence of leakage or permanent deformation. Failure to meet this requirement or premature failure shall be the cause for a complete reassessment of the design followed by repetition of the test.

5.3.4 Individual Parts

Individual parts of the unit may be tested separately if the test fixture duplicates the loading conditions applicable to the part in the assembled unit.

5.4 DESIGN VERIFICATION LOAD TEST

5.4.1 Design Verification Load Test

When required by the specific equipment paragraphs of Section 9, equipment shall be subjected to a design verification load test.

5.4.2 Sampling of Test Units

To qualify design stress calculations applied to a family of units with an identical design concept but of varying sizes and ratings, the following options shall apply:

a. A minimum of three units of the design shall be subjected to design verification load testing. The test units shall be selected from the lower end, middle, and upper end of the load rating range.
b. Alternatively, the required number of test units can be established on the basis that each test unit also qualifies one load rating above and below that of the selected test unit. (This option would generally apply to limited product rating ranges.)

5.4.3 Test Procedure

The test procedure is as follows:

a. An assembled test unit shall be loaded to the maximum rated load. After this load has been released, the unit shall be checked for its intended design functions. The function of all of the equipment's parts shall not be impaired by this loading.
b. Strain gauges shall be applied to the test unit at all places where high stresses are anticipated, provided that the configuration of the unit permits such techniques. The use of finite element analysis, models, brittle lacquer, and so forth, is recommended to confirm the proper location of the strain gauges. Three element strain gauges are recommended in critical areas to permit determination of the shear stresses and to eliminate the need for exact orientation of the gauges.
c. The design verification test load to be applied to the test unit shall be determined as follows:
Design Verification Test Load = $0.8 \times R \times SF_D$, but not less than $2R$, where R is the maximum Load/Torque Rating and SF_D is the Design Safety Factor as defined in 3.3 and 4.6.
d. The test unit shall be loaded to the design verification test load. This test load should be applied incrementally, reading the strain gauge values and observing for evidence of yielding. The test unit may be loaded as many times as necessary to obtain adequate data.
e. The stress values computed from the strain gauge readings shall not exceed the values obtained from design calculations (based on the design verification test load) by more than the uncertainty of the testing apparatus specified in 5.4.6. Failure to meet this requirement or premature failure of any test unit shall be a cause for complete reassessment of the design followed by additional testing of an identical number of test units as originally required, including a test unit of the same load rating as the one that failed.
f. Upon completion of the design verification load test, the test unit shall be disassembled and the dimensions of each primary load carrying component checked for evidence of permanent deformation.
g. Individual parts of a test unit may be load tested separately if the holding fixtures duplicate the loading conditions applicable to the part in the assembled unit.

5.4.4 Determination of Load Rating

The load rating shall be determined from the results of the design verification load test and/or stress distribution calculations required by 5.1. The stresses at that rating shall not exceed the maximum allowable stress. Localized yielding shall be permitted at areas of contact. In a unit that has been design verification load tested, the critical permanent deformation determined by strain gauges or other suitable means shall not exceed 0.2 percent except in contact areas. If the stresses exceed the allowable values, the affected part or parts must be redesigned to obtain the desired rating. Stress distribution calculations may be used to load rate the equipment only if the stress values determined in the analysis are no less than the stresses observed during the design verification load test.

5.4.5 Alternative Design Verification Test Procedure and Rating

Destructive testing of the test unit may be used provided the yield and tensile strength of the material used in the equipment has been determined. This may be accomplished using tensile test specimens from the same heat and heat treatment lot as the parts represented and meeting the requirements of ASTM A370.

$$R = L_b \times \frac{YS_m}{TS_a \times SF_D}$$

Where:

L_b = Breaking Load, Tons

YS_m = Minimum Specified Yield Strength, ksi

TS_a = Actual Ultimate Tensile Strength, ksi

SF_D = Design Safety Factor (Reference 4.6)

R = Load Rating, Tons

Since this method of design qualification is not derived from stress calculations, qualification shall be limited to the specific model, size, and rating tested.

5.4.6 Design Verification Load Testing Apparatus

The loading apparatus used to duplicate the working load on the test unit shall be calibrated in accordance with ASTM E4 so as to ensure that the prescribed test load is obtained. For loads exceeding 400 tons (363 MTonnes) the load testing apparatus may be verified with calibration devices traceable to a Class A calibration device and having an uncertainty of less than 2.5 percent.

Test fixtures shall load the unit (or part) in the same manner as in actual service and with the same areas of contact on the load-bearing surface. All equipment used to load the unit (or part) shall be verified as to its capability to perform the test.

5.5 DESIGN CHANGES

When any change in design or manufacture is made that changes the calculated load rating, supportive design verification testing in conformance with this section shall be carried out. The manufacturer shall evaluate all changes in design or manufacture to determine whether the calculated load ratings are affected. This evaluation shall be documented.

5.6 RECORDS

All design verification records and supporting data shall be subject to the same controls as specified for design documentation in 11.1.

6 Materials Requirements

6.1 GENERAL

This section describes the various material qualifications, property, and processing requirements for primary load carrying and pressure containing components unless otherwise specified.

6.2 WRITTEN SPECIFICATIONS

All materials used in the manufacture of equipment covered by this specification shall conform to a written specification that meets or exceeds the design requirements.

6.3 MECHANICAL PROPERTIES

6.3.1 Impact Toughness

6.3.1.1 Impact testing shall be in accordance with ASTM A370.

6.3.1.2 When it is necessary for subsize impact test pieces to be used, the acceptance criteria shall be multiplied by the appropriate adjustment factor listed in Table 1. Subsize test pieces of width less than 5 millimeters are not permitted.

6.3.1.3 For design temperatures below –20°C supplementary impact toughness requirements may apply. See Appendix B, Supplementary Requirements SR2.

6.3.2 Through Thickness Properties

Where the design requires through thickness properties, materials shall be tested for reduction of area in the through thickness direction according to ASTM A770. The minimum reduction shall be 25 percent.

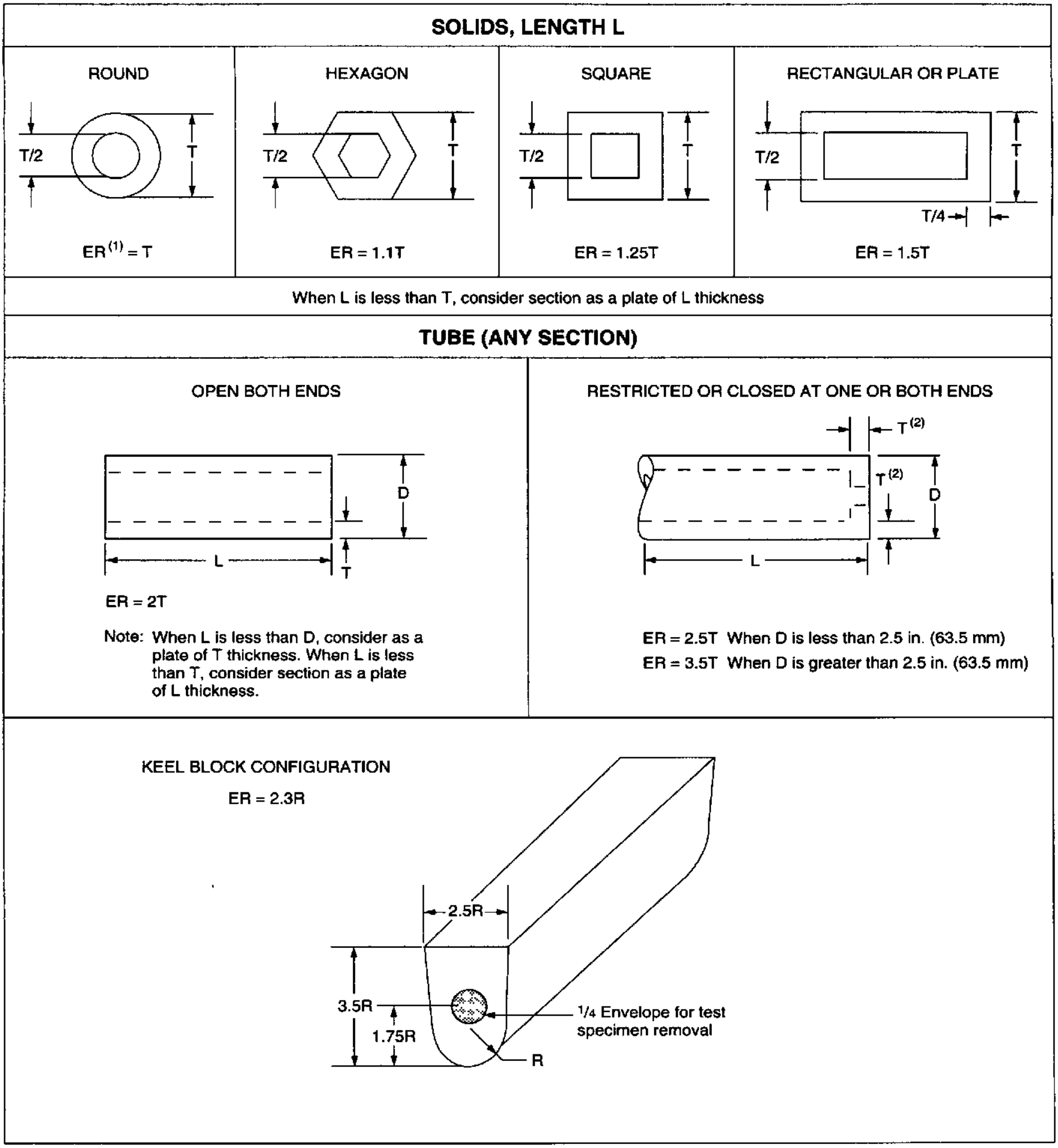
6.4 MATERIAL QUALIFICATION

The mechanical tests required by this specification shall be performed on qualification test coupons representing the heat and heat treatment lot used in the manufacture of the component. Tests shall be performed in accordance with the requirements of ASTM A370, or equivalent national standards, using material in the final heat treated condition. For the purposes of material qualification testing, stress relief following welding is not considered heat treatment. Material Qualification Tests may be performed before the stress relieving process provided that the stress relieving temperature is below that which changes the heat treatment condition.

The size of the qualification test coupon for a part shall be determined using the equivalent round (ER) method. Figure 1 illustrates the basic models for determining the ER of simple solid and hollowed parts. Any of the shapes shown may be used for the qualification test coupon. Figure 2 describes the steps for determining the governing ER for more

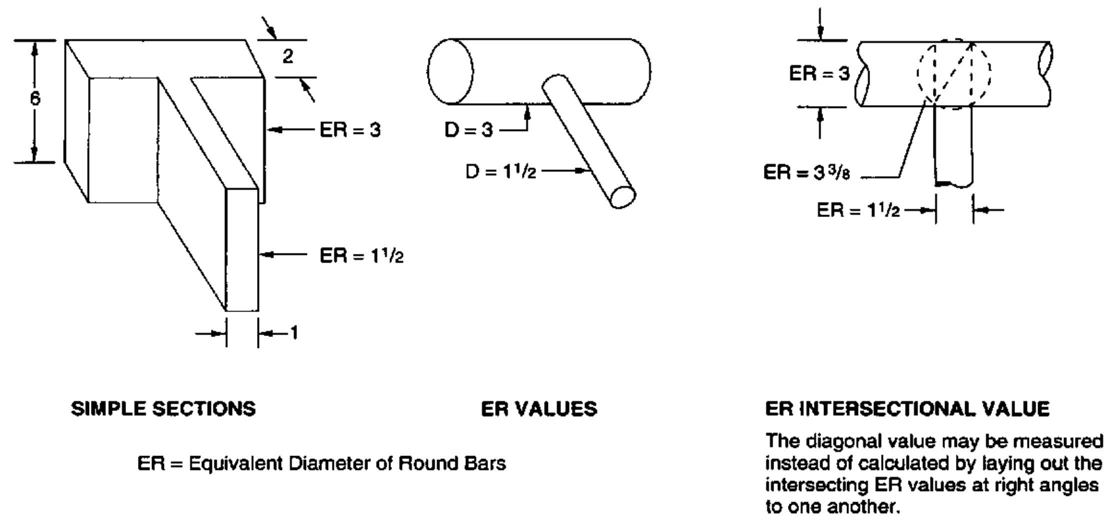
Table 1—Adjustment Factors for Subsize Impact Specimens

Specimen Dimensions mm × mm	Adjustment Factor
10.0 × 7.5	0.833
10.0 × 5.0	0.667



Notes: (1) ER = Equivalent Round
(2) Use maximum thickness for calculation

Figure 1—Equivalent Round Models



The following steps should be used in determining the governing equivalent round for complex sections.

1. Reduce the components to simple sections.
2. Convert simple sections to ER values. The ER value at an intersection is equivalent to a diagonal through the diameter of a circle which would circumscribe the ER area intersection, normal to the larger ER section, as shown in the upper right-hand sketch.
3. The maximum ER value, whether it is for a single component or an intersection, shall be taken as the ER of the complex section.

Figure 2—Equivalent Rounds for Complex Shapes

GIVEN:

ER = 2 ^{1}/2 inches
from Figure 1: ER = 2.3R

THEN:

R = ER/2.3 = 1.087 inches
1.75R = 1.75 × 1.087 = 1.902 inches
2.5R = 2.5 × 1.087 = 2.718 inches
3.5R = 3.5 × 1.087 = 3.805 inches

CONSTRUCT KEEL BLOCK

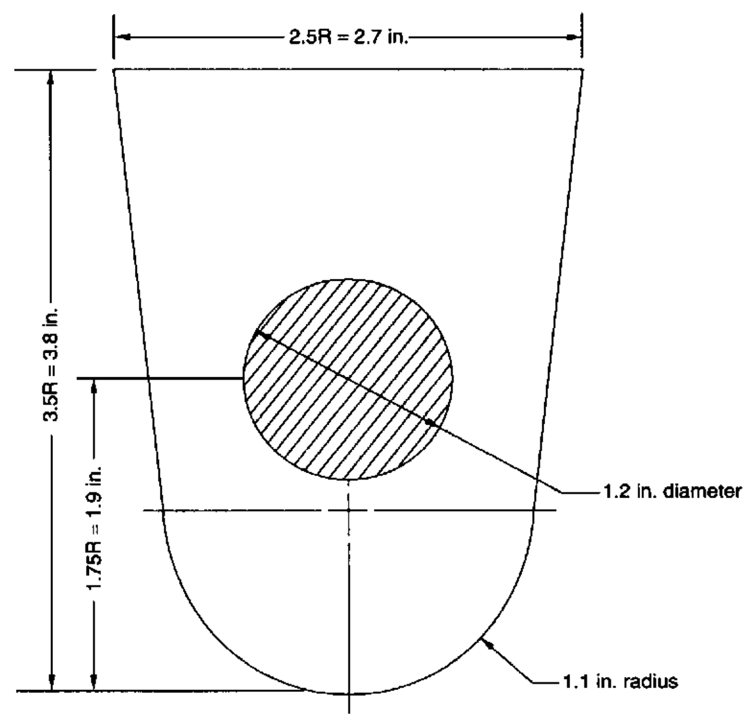


Figure 3—Development of Keel Block Dimensions

complex sections. The ER of a part shall be determined using the actual dimensions of the part in the "as heat treated" condition. The ER of the qualification test coupon shall be equal to or greater than the equivalent round dimensions of the part it qualifies, except that the ER is not required to exceed 5 inches. Figure 3 illustrates the procedure for determining the required dimensions of an ASTM A370 keel block.

Qualification test coupons may be integral with the components they represent or separate from the components or a sacrificial production part. In all cases test coupons shall be from the same heat as the components that they qualify, given the same working operations, and shall be heat treated with the components.

Test specimens shall be removed from integral or separate qualifications test coupons such that their longitudinal center line axis is wholly within the center core $^1/_4$ thickness envelope for a solid test coupon or within $^1/_8$ inch (3 millimeters) of the mid-thickness of the thickest section of a hollow test coupon. The gauge length on a tensile specimen or the notch of an impact specimen shall be at least $^1/_4$ thickness from the ends of the test coupon.

Test specimens taken from sacrificial production parts shall be removed from the center core $^1/_4$ thickness envelope location of the thickest section of the part.

6.5 MANUFACTURE

The manufacturing processes shall ensure repeatability in producing components that meet all the requirements of this specification.

All wrought materials shall be manufactured using processes that produce a wrought structure throughout the component.

All heat treatment operations shall be performed utilizing equipment qualified in accordance with the requirements specified by the manufacturer or processor. The loading of the material within heat treatment furnaces shall be such that the presence of any one part does not adversely affect the heat treating response of any other part within the heat treatment lot. The temperature and time requirements for heat treatment cycles shall be determined in accordance with the manufacturer's or processor's written specification. Actual heat treatment temperatures and times shall be recorded, and heat treatment records shall be traceable to relevant components.

Note: Appendix C of this specification provides recommendations for heat treating equipment qualifications.

6.6 CHEMICAL COMPOSITION

The material composition of each heat shall be analyzed for all elements specified in the manufacturer's written material specification.

7 Welding Requirements

7.1 GENERAL

This section describes requirements for the fabrication and repair welding of primary load carrying and pressure containing components, including attachment welds.

7.2 WELDING QUALIFICATION

All welding undertaken on components shall be performed using welding procedures that are qualified in accordance with ASME IX, AWS D1.1, and/or ASTM A488. This welding shall only be carried out by welders or welding operators who are qualified in accordance with the aforementioned standards.

Welding procedures for base materials that are not listed in the above standards shall be qualified individually or as a group based on weldability, tensile properties, or composition. Where the ductility of the parent metal is such as to render it incapable of meeting the bend test requirements of ASME IX, the bend test shall be conducted in the following manner: A bend bar comprised of parent metal heat treated to the ductility and strength requirements of the applicable specification shall be bent to failure. This side bend specimen shall then be capable of being bent to within 5 degrees of the angle thus determined.

7.3 WRITTEN DOCUMENTATION

Welding shall be performed in accordance with welding procedure specifications (WPS) written and qualified in accordance with the applicable standard. The WPS shall describe all the essential, nonessential, and supplementary essential (when required—see ASME Section IX) variables as listed in the applicable standard.

The procedure qualification record (PQR) shall record all essential and supplementary essential (when required) variables of the weld procedure used for the qualification tests. Both the WPS and the PQR shall be maintained as records in accordance with the requirements of Section 11 of this specification.

7.4 CONTROL OF CONSUMABLES

Welding consumables shall conform to American Welding Society (AWS) or consumable manufacturer's specifications.

The Manufacturer shall have a written procedure for storage and control of weld consumables. Materials of low hydrogen type shall be stored and used as recommended by the consumable manufacturer to retain their original low hydrogen properties.

7.5 WELD PROPERTIES

The mechanical properties of the weld, as determined by the procedure qualification test, shall at least meet the minimum specified mechanical properties required by the design. When impact testing is required for the base material, it shall also be a procedure qualification requirement. Results of testing in the weld and base material heat affected zone (HAZ) shall meet the minimum requirements of the base material. In the case of attachment welds, only the HAZ of material requiring impact testing shall meet the above requirements.

All weld testing shall be undertaken with the test weldment in the applicable post-weld heat treated condition.

7.6 POST-WELD HEAT TREATMENT

Post-weld heat treatment of components shall be in accordance with the applicable qualified welding procedure specification (WPS).

7.7 QUALITY CONTROL REQUIREMENTS

Requirements for quality control of welds shall be in accordance with Section 8 of this Specification.

7.8 SPECIFIC REQUIREMENTS—FABRICATION WELDS

Weld joint types and sizes shall meet the manufacturer's design requirements and shall be documented in the manufacturer's welding procedure specification.

7.9 SPECIFIC REQUIREMENTS—REPAIR WELDS

In addition to the requirements specified in 7.2 through 7.7, the following shall apply:

7.9.1 Access

There shall be adequate access to evaluate, remove, and inspect the nonconforming condition that is the cause of the repair.

7.9.2 Fusion

The selected welding procedure specification and the available access for repair shall be such as to ensure complete fusion with the base material.

7.9.3 Forgings and Castings

All repair welding shall be performed in accordance with the manufacturer's written welding procedure. Welding procedures shall be documented and shall be supplied at the purchaser's request.

Prior to any repair the manufacturer shall document the following criteria for permitted repairs:

- Defect type
- Defect size limits
- Definition of major/minor repairs

All excavations, prior to repair, and the subsequent weld repair shall meet the quality control requirements specified in Section 8 of the Specification.

7.9.4 Heat Treatment

The welding procedure specification used for qualifying a repair shall reflect the actual sequence of weld repair and heat treatment imparted to the repair item.

8 Quality Control

8.1 GENERAL

This section specifies the quality control requirements for equipment and materials used in primary load carrying components. All quality control work shall be controlled by the manufacturer's documented instructions, which shall include appropriate methodology, and quantitative and qualitative acceptance criteria.

Instructions for nondestructive examination (NDE) activities shall be detailed regarding the requirements of this specification and those of all applicable referenced specifications. All NDE instructions shall be approved by an ASNT TC-1A level III examiner, or an examiner qualified to an equivalent specification approved by the manufacturer.

The acceptance status of all equipment, parts, and materials shall be indicated either on the equipment, parts, or materials or in the records traceable to the equipment, parts, or materials.

8.2 QUALITY CONTROL PERSONNEL QUALIFICATIONS

8.2.1 NDE Personnel shall be qualified and/or certified in accordance with ASNT TC-1A, or an equivalent standard approved by the manufacturer.

8.2.2 Personnel performing visual inspection of welding operations and completed welds shall be qualified and certified as follows:

a. AWS certified welding inspector, or
b. AWS certified associate welding inspector, or
c. A welding inspector certified by the manufacturer's documented training program.

8.2.3 All personnel performing other quality control activities directly affecting material and product quality shall be qualified in accordance with the manufacturer's documented procedures.

8.3 MEASURING AND TESTING EQUIPMENT

Equipment used to inspect, test, or examine material or other equipment shall be identified, controlled, calibrated, and adjusted at specified intervals in accordance with documented manufacturer instructions, and consistent with a recognized industry standard (for example, MIL STD 120, BS 5781), to maintain the required level of accuracy.

8.4 QUALITY CONTROL FOR SPECIFIC EQUIPMENT AND COMPONENTS

The quality control requirements in the paragraphs of 8.4 apply to the critical areas of all primary load bearing and/or pressure containing equipment and components unless specified otherwise.

8.4.1 Chemical Analysis

Methods and acceptance criteria shall be in accordance with 6.6.

8.4.2 Tensile Testing

Methods and acceptance criteria shall be in accordance with 6.4.

8.4.3 Impact Testing

Methods and acceptance criteria shall be in accordance with 6.3 and 6.4.

8.4.4 Traceability

Components shall be traceable by heat and heat treatment lot identification.

Identification shall be maintained on materials and components through all stages of manufacturing and on the finished components or assembly. Manufacturer's documented traceability requirements shall include provisions for maintenance and replacement of identification marks and identification control records. Fasteners and pipe fittings shall be exempt from the traceability requirements, provided they are marked in accordance with a recognized industry standard.

8.4.5 Visual Examination

Components that do not qualify for full surface NDE shall be visually examined. Visual examination of castings shall meet the requirements of MSS SP-55. Examination of wrought material shall be in accordance with the manufacturer's documented procedures.

8.4.6 Surface NDE

All accessible surfaces of each finished component shall be inspected in accordance with this Section after final heat treatment and final machining operations.

If the equipment is subjected to a load test, the qualifying NDE shall be carried out after the load test. For materials susceptible to delayed cracking, as identified by the manufacturer, NDE shall be done a minimum 24 hours after the load testing. The equipment shall be disassembled for this inspection. Surface coating shall be removed prior to examination.

8.4.6.1 Method

Ferromagnetic materials shall be examined by the magnetic particle (MP) method in accordance with ASME Section V, Subsection A, Article 7, and Subsection B, Article 25, or ASTM E709. Machined surfaces shall be examined by the wet fluorescent method; other surfaces may be examined by the wet method.

Nonferromagnetic materials shall be examined by the liquid penetrant (LP) method in accordance with ASME Section V, Subsection A, Article 6, and Subsection B, Article 24, or ASTM E165.

When the use of prods cannot be avoided, all prod burn marks shall be removed by grinding and the affected areas rechecked by LP examination.

8.4.6.2 Definitions of Indications

The following definitions of indications should be used:

8.4.6.2.1 relevant indications: only those indications with major dimensions greater than 1/16 inch (1.6 millimeters) and associated with a surface rupture shall be considered relevant. Inherent indications not associated with a surface rupture (that is, magnetic permeability variations, nonmetallic stringers, and so forth) are considered nonrelevant. If magnetic particle indications greater than 1/16 inch (1.6 millimeters) are believed to be nonrelevant, they shall be examined by liquid penetrant surface NDE or removed and reinspected to prove their nonrelevancy.

8.4.6.2.2 linear indication: indication in which the length is equal to or greater than three times the width.

8.4.6.2.3 rounded indication: indication that is circular or elliptical with its length less than three times the width.

8.4.6.3 Acceptance Criteria

The acceptance criteria are as follows:

8.4.6.3.1 Castings

ASTM E125 shall be applied as a reference standard for the evaluation of magnetic particle indications on castings. The acceptance criteria shall be as specified in Table 2.

Table 2—Castings Indication Acceptance Criteria

		Maximum Permitted Degree	
Type	Discontinuity Descriptions	Critical Areas	Noncritical Areas
I	Hot tears, cracks	None	Degree 1
II	Shrinkage	Degree 2	Degree 2
III	Inclusions	Degree 2	Degree 2
IV	Internal chills, chaplets	Degree 1	Degree 1
V	Porosity	Degree 1	Degree 2

The manufacturer shall establish and maintain critical area drawings, identifying high stress areas, which shall be used in conjunction with this section. If critical areas are not identified then all surface areas of the component shall be considered critical.

8.4.6.3.2 Wrought Material

The following acceptance criteria apply for surface examination of wrought materials:

a. No relevant indications with a major dimension equal to or greater than $^{3}/_{16}$ inch (4.8 millimeters).
b. No more than ten relevant indications in any continuous 6-square-inch (39-square-centimeter) area.
c. No more than three relevant indications in a line separated by less than $^{1}/_{16}$ inch (1.6 millimeters) edge to edge.
d. No relevant indications in pressure sealing areas and stress relief features of thread joints.

8.4.7 Volumetric Nondestructive Examination of Castings

8.4.7.1 Method

Radiographic examination of castings shall be in accordance with ASME Section V, Subsection A, Article 2, and Subsection B, Article 22 with the restriction that fluorescent intensifying screens shall not be used.

Ultrasonic examination shall be in accordance with ASME Section V, Subsection A, Article 5, and Subsection B, Article 23. The component(s) shall be examined by the straight beam method in accordance with SA-609 of Article 23 and shall be supplemented by angle beam examination as in T-534.2 of Article 5 in areas where a back reflection cannot be maintained during the straight beam examination, or where the angle between the two surfaces of the component is more than 15 degrees.

8.4.7.2 Sampling

Primary load bearing castings shall be examined by volumetric NDE on the following sampling basis as a minimum:

a. All areas of initial or prototype castings shall be examined by ultrasonic or radiographic methods until the results of such examination indicate that a satisfactory production technique has been established.
b. Thereafter, one casting out of each production lot, or for production lots less than ten, one out of every ten production castings shall be volumetrically examined in all critical areas as identified on critical area drawings.
c. Should any casting show any indications outside the acceptance criteria as defined in 8.4.7.3, two more castings from that production lot as described above shall be examined by the same method(s) and should either of these two be found nonconforming, all castings of that batch shall be examined. If the two additional castings are acceptable, the remainder of the batch may be accepted and the initial nonconforming casting repaired or scrapped.

8.4.7.3 Acceptance Criteria

The acceptance criteria for volumetric nondestructive examination of castings are:

a. Radiography: The acceptance criteria for radiographic examination are based on the Standard Reference Radiographs of ASTM E446, ASTM E186, or ASTM E280, depending on the wall thickness being examined.

In all cases, cracks, hot tears, and inserts (defect types D, E, and F, respectively) are not permitted.

The remaining indication types shown in the reference radiographs shall meet Quality Level 2 in all critical areas and Quality Level 3 in noncritical areas. If critical area drawings are not available, all areas shall be classified as critical.

b. Ultrasonic Examination: The acceptance criteria for both straight beam and angle beam ultrasonic examination of castings are based on SA-609 in ASME Section V, Subsection B, Article 23, Quality Level 3.

8.4.8 Nondestructive Examination of Welds

8.4.8.1 General

When examination is required, essential welding variables and equipment shall be monitored and completed weldments (including a minimum of $^{1}/_{2}$ inch [12.7 millimeters] of surrounding base metal) and the entire accessible weld shall be examined in accordance with the methods and acceptance criteria of this section.

The NDE required by this section shall be carried out after final heat treatment.

8.4.8.2 Fabrication Welding

Fabrication welding shall be subject to the following criteria:

a. Visual Examination. All fabrication welds shall be visually examined in accordance with ASME V, Subsection A, Article 9.

- Undercuts shall not reduce the thickness in the affected area to below the design thickness, and shall be ground to blend smoothly with the surrounding material.
- Surface porosity and exposed slag are not permitted on or within $^{1}/_{8}$ inch (3 millimeters) of sealing surfaces.

b. Surface NDE. All primary load bearing and pressure containing welds and attachment welds to main load bearing and pressure containing components shall be examined as described in 8.4.6.1.

The following acceptance criteria shall apply:

- No relevant linear indication.
- No rounded indications greater than $^{1}/_{8}$ inch (3 millimeters) for welds whose depth is $^{5}/_{8}$ inch (17 millime-

ters) or less than $^3/_{16}$ inch (4.8 millimeters) for welds whose depth is greater than $^5/_8$ inch (16 millimeters).

- No more than three relevant indications in a line separated by less than $^1/_{16}$ inch (1.6 millimeters) edge to edge.

c. Volumetric NDE. Primary load bearing and pressure containing welds shall be examined by either ultrasonic or radiographic methods in accordance with ASME Section V, Subsection A, Article 5 and Article 2 respectively. This applies to full penetration welds only.

Acceptance criteria shall be in accordance with the requirements of ASME VIII, Div. I, UW-51 and Appendix 12 as appropriate.

8.4.8.3 Repair Welds

Repair welds shall be subject to the following criteria:

a. Weld Preparation Examination. All excavations for weld repairs shall be examined by the magnetic particle method and acceptance criteria as described in 8.4.8.2.
b. Repair Welds in Castings. All repair welds in castings shall be examined as described in 8.4.6.1. Acceptance criteria shall be identical to those for fabrication welds. (Refer to 8.4.8.2.)
c. Repair of Welds. NDE requirements for the repair of weld defects are identical to those for the original weld. (Refer to 8.4.8.2.)

8.5 DIMENSIONAL VERIFICATION

Verification of dimensions shall be carried out on a sample basis as defined and documented by the manufacturer.

All main load bearing and pressure sealing threads shall be gauged to the requirements of the relevant thread specification(s).

8.6 PROOF LOAD TESTING

When proof load testing is required, as indicated under the relevant equipment headings of Section 9, the following requirements shall apply:

a. Each production unit or primary load carrying component shall be load tested in accordance with the requirements of this Section.
b. The equipment shall be mounted in a test fixture capable of loading the equipment in the same manner as in actual service and with the same areas of contact on the load bearing surfaces. Rolling element bearings that would be damaged by the test may be replaced by a load transfer device.
c. A test load equal to 1.5 times the rated load shall be applied and held for a period of not less than 5 minutes.
d. Following the load test, the design functions of the equipment shall be checked, as applicable. Proper functioning of the equipment shall not be impaired by the load test.
e. Assembled equipment shall be subsequently stripped down to a level that will permit full surface NDE of all primary load bearing parts (excluding bearings).
f. All critical areas of the primary load bearing parts shall be subjected to magnetic particle examination in conformance with 8.4.6.1.

8.7 HYDROSTATIC TESTING

When hydrostatic testing of equipment is required under the relevant equipment headings of Section 9, the following general requirements shall apply:

8.7.1 The hydrostatic test shall be carried out in three steps:

a. The primary pressure-holding period.
b. The reduction of the pressure to zero.
c. The secondary pressure-holding period.

Both pressure-holding periods shall not be less than 3 minutes, the timing of which shall not start until the test pressure has been reached, the equipment and the pressure monitoring gauge have been isolated from the pressure source, and the external surfaces of the body members have been thoroughly dried.

8.7.2 Calibrated pressure gauges and recording equipment shall be used during testing. Recorder graphs shall be signed, dated, and made traceable to the equipment being tested.

Specific hydrostatic testing requirements are included under the relevant equipment headings of Section 9.

8.8 FUNCTIONAL TESTING

Specific functional testing requirements are included under the relevant equipment headings of Section 9.

9 Equipment

9.1 GENERAL

The requirements of Sections 4 through 8 apply to the primary load carrying components of the covered equipment unless specifically noted otherwise. It is the equipment designer's responsibility to determine the primary load path through the equipment and to define primary load carrying components.

WARNING: The operator of the equipment shall be responsible for the determination of the Safe Working Load for any operation.

WARNING: Use of the equipment covered by this specification at rated loads and temperatures less than −4°F (−20°C) is not recommended unless appropriate materials with the required toughness properties at lower design temperatures have been used for the equipment. (See Appendix B, SR2.)

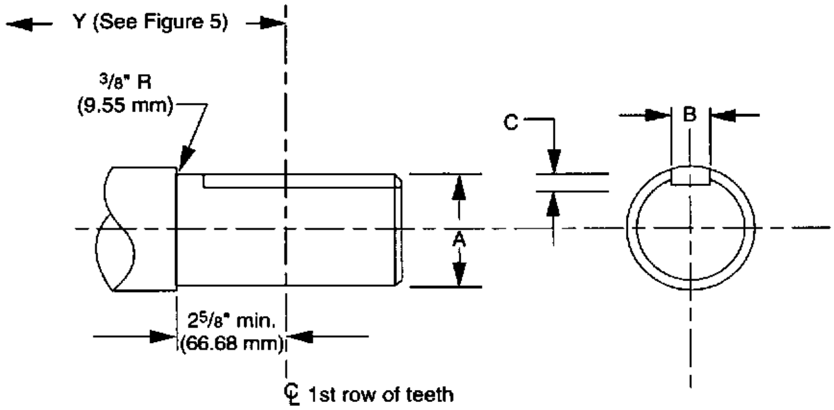


Figure 4—Rotary Table Pinion-Straight Shaft Extension
(See Table 3 for dimensions.)

WARNING: Design Safety Factor is intended as design criteria and shall not under any circumstances be construed as allowable working loads on the equipment in excess of those established under this specification.

WARNING: The maximum working stress associated with the Design Load shall not exceed the maximum allowable stress.

9.2 ROTARY TABLES

9.2.1 Primary Load

The primary load is the axial load through the center of the rotary table. Rotary torque is not taken as a primary load.

9.2.2 Static Load Rating

The static load rating, or primary load rating, for a rotary table shall be equal to or less than the static load capacity of the main bearing.

9.2.3 Operating Temperature

The operating temperature for rotary tables is 32°F (0°C).

Table 3—Rotary Table Pinion-Straight Shaft Extension
(See Figure 4.)

Size	Diameter of Extension +0.000 −0.001 A		Keyway Width +0.000 −0.001 B		Keyway Depth +0.600 −0.000 C	
No.	in.	mm	in.	mm	in.	mm
1	3.250	82.55	0.750	19.05	1/4	6.35
2	3.938	100.03	1.000	25.40	3/8	9.52
3	4.250	107.95	1.000	25.40	3/8	9.52
4	4.500	114.30	1.000	25.40	3/8	9.52
5	4.938	125.43	1.250	31.75	7/16	11.11

9.2.4 Rotary Table Pinion-Shaft Extension

Rotary tables, with straight pinion-shaft extensions, shall be furnished in the sizes shown in Table 3 and shall conform to the dimensions and tolerances shown in Table 3 and Figure 4. This paragraph does not preclude tapered or other straight rotary table pinion-shaft extensions as an alternative design.

9.2.5 Drive Sprocket

The distance Y between the center of the rotary table and the center of the first row of sprocket teeth (see Figure 5) shall be 53 1/4 inches (135.3 centimeters) for machines that will pass a 20-inch (50.8-centimeter) bit or larger and shall be 44 inches (111.8 centimeters) for machines that will not pass a 20-inch (50.8-centimeter) bit, except that, by agreement between the manufacturer and purchaser, the distance of 53 1/4 inches (135.3 centimeters) may be used on machines that will not pass a 20-inch (50.8-centimeter) bit. The distance Y shall be either 53 1/4 (135.3 centimeters) or 65 inches (165.1 centimeters) for the 49 1/2-inch (125.7-centimeter) rotary table opening. These distances may be stamped on the name plate (if used) attached to the rotary table.

9.2.6 Rotary Table Openings

Rotary tables for use with square drive master bushings shall conform to the requirements of Table 4 and Figure 6. Rotary tables for use with the four-pin drive master bushings shall conform to the requirements in Table 5 and Figure 7.

9.2.7 Demountable Rotary Table Sprockets

Demountable rotary table sprockets are shown in Table 6 and Figure 8. The sprockets, both single-strand and double-strand, have a common bolt circle.

9.2.8 The requirements of 4.2.5, 4.2.6, 5.4, 6.3.1, 8.4.3, 8.4.4, 8.4.6, and 8.4.7 shall not apply. For antifriction bearing design and manufacturing requirements, see 9.12.

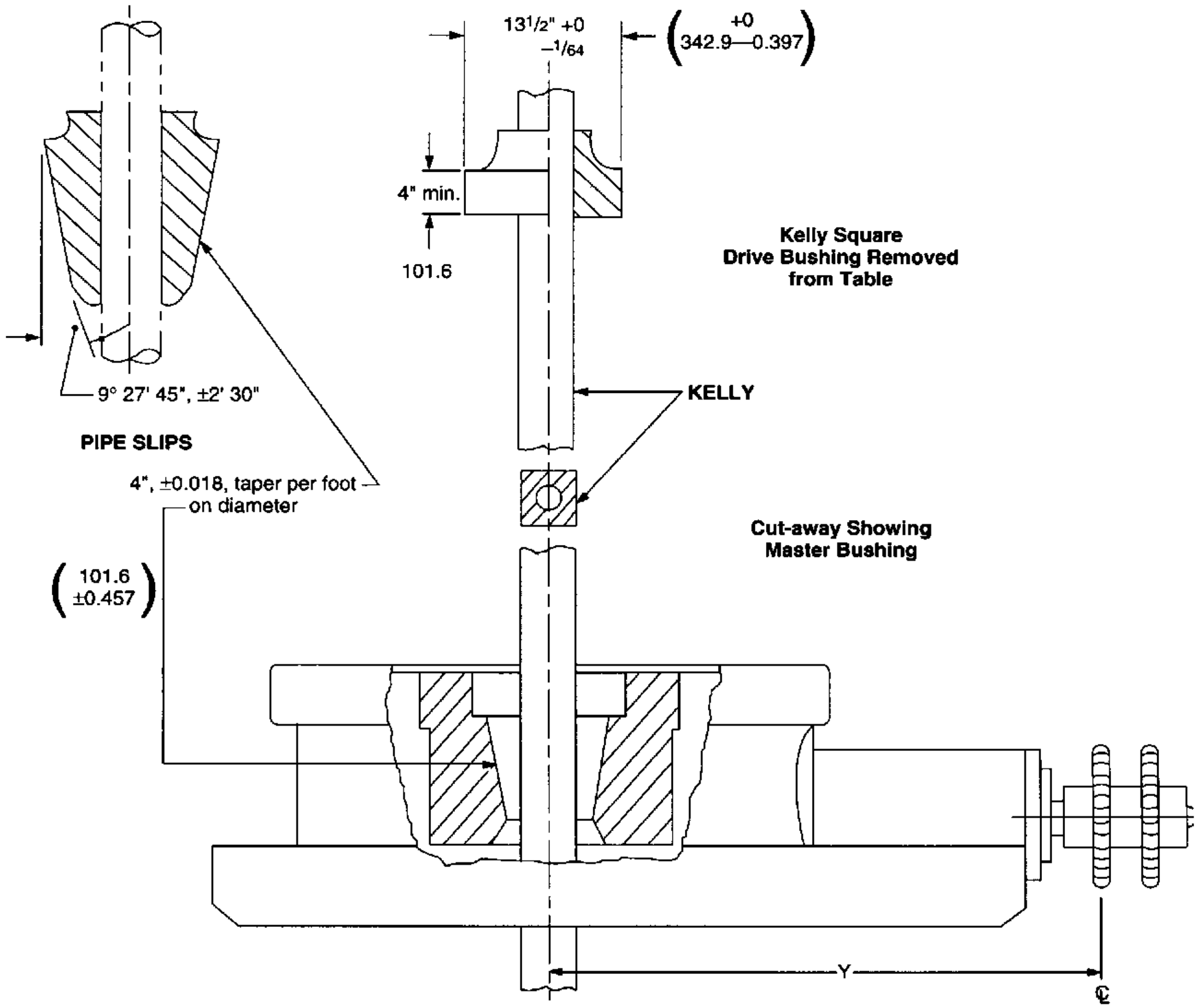


Figure 5—Rotary Table with Square Drive Bushings
(See 9.2.5 and 9.3.1.)

9.3 ROTARY BUSHINGS

9.3.1 Kelly Bushing

Kelly bushings are included for the purpose of dimensional interchangeability only and shall not be load rated. Square drive kelly bushing dimensions are shown in Figure 5.

Pin drive kelly bushing dimensions are shown in Figure 7.

9.3.2 Master Bushing

Master bushings are included for the purpose of dimensional interchangeability only and shall not be load rated. Square drive master bushings and rotary table square drive master bushings shall conform to the requirements of Table 4 and Figure 6. Dimensions for four-pin drive master bushings shall conform to the requirements in Table 5 and Figure 7.

9.3.3 Bushing Adapters

Bushing adapters are included for the purpose of dimensional interchangeability only and shall not be load rated. Bushing adapters are used to reduce the openings of rotary tables so that a smaller size master bushing may be used.

9.3.4 Requirements

The requirements of 8.4.4, 8.4.6, 8.4.7, and 8.4.8 shall not apply.

9.4 ROTARY SLIPS

9.4.1 Rotary slips shall have a taper of 4 inches per foot (33.333 centimeters per meter) on the diameter and other

Table 4—Rotary Table Opening and Square Drive Master Bushing
(See Figures 5 and 6.)

Nominal Table Size		Rotary Table Opening								Square Drive Master Bushing									
		A		B		C		D		A_1		B_1		C_1		D_1		Concen- tricity TIR	Concen- tricity TIR
		+0.015 −0.000	+0.381 −0.000	+0.030 −0.000	+0.762 −0.000			Max.	Max.	+0.000 −0.015	+0.000 −0.381	+0.000 −0.000	+0.030 −0.762			+0.250 −0.000	+6.350 −0.000		
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
17 1/2	444.50	17 1/2	444.500	18 1/6	461.963	5 1/4	133.35	1 3/4	44.45	17 7/16	442.913	18 1/8	460.375	5 1/4	133.35	1 3/4	44.45	1/32	0.794
20 1/2	520.70	20 1/2	520.700	21 1/16	538.163	5 1/4	133.35	1 3/4	44.45	20 7/16	519.113	21 1/8	536.575	5 1/4	133.35	1 3/4	44.45	1/32	0.794
27 1/2	696.50	27 1/2	696.500	28 1/16	715.963	5 1/4	133.35	1 3/4	44.45	27 7/16	696.913	28 1/16	—	5 1/4	133.35	1 1/4	44.45	1/32	0.794
37 1/2	952.50	37 1/2	952.500	—	—	—	—	—	—	37 7/16	950.913	—	—	—	—	—	—	—	—
49 1/2	1257.30	49 1/2	1257.300	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

suitable dimensions to permit operations in standard master bushings. Refer to 9.2.6 and Figure 5.

9.4.2 Load rating of rotary slips is not required.

9.4.3 The requirements of 8.4.4, 8.4.6, 8.4.7, and 8.4.8 shall not apply.

9.5 SPIDERS NOT CAPABLE OF USE AS ELEVATORS

9.5.1 Spider bodies furnished in conformance with this specification shall be marked with the manufacturer's name or mark and the rating.

9.5.2 Component Traceability

Primary load carrying components shall be uniquely marked as specified in 8.4.

9.5.3 Serialization

Each complete item of equipment shall be marked with a unique serial number that shall provide traceability to its manufacturing history.

9.5.4 Impact Toughness

The following impact toughness values apply to spider bodies:

a. Components with a specified minimum yield strength of at least 45,000 pounds per square inch (310 megapascals) shall be from materials possessing a minimum impact toughness of 25 foot-pounds (42 joules) at −4°F (−20°C).
b. Components with a specified yield strength of less than 45,000 pounds per square inch (310 megapascals), the −4°F (−20°C) minimum impact toughness shall be 20 foot-pounds (27 joules) with no individual value less than 15 foot-pounds (20 joules).

9.5.5 Design Verification Test

Design verification load test, as described in 5.4, shall apply.

9.5.6 Proof Load Test

Proof load testing, as described in 8.6, shall apply.

9.6 SAFETY CLAMPS NOT USED AS A HOISTING DEVICE

9.6.1 Load rating of safety clamps is not required.

9.6.2 The requirements of 8.4.4, 8.4.6, 8.4.7, and 8.4.8 shall not apply.

9.7 MANUAL TONGS

9.7.1 Product Marking

Manual tongs furnished in conformance with this specification shall be marked with the manufacturer's name or mark and the rated load.

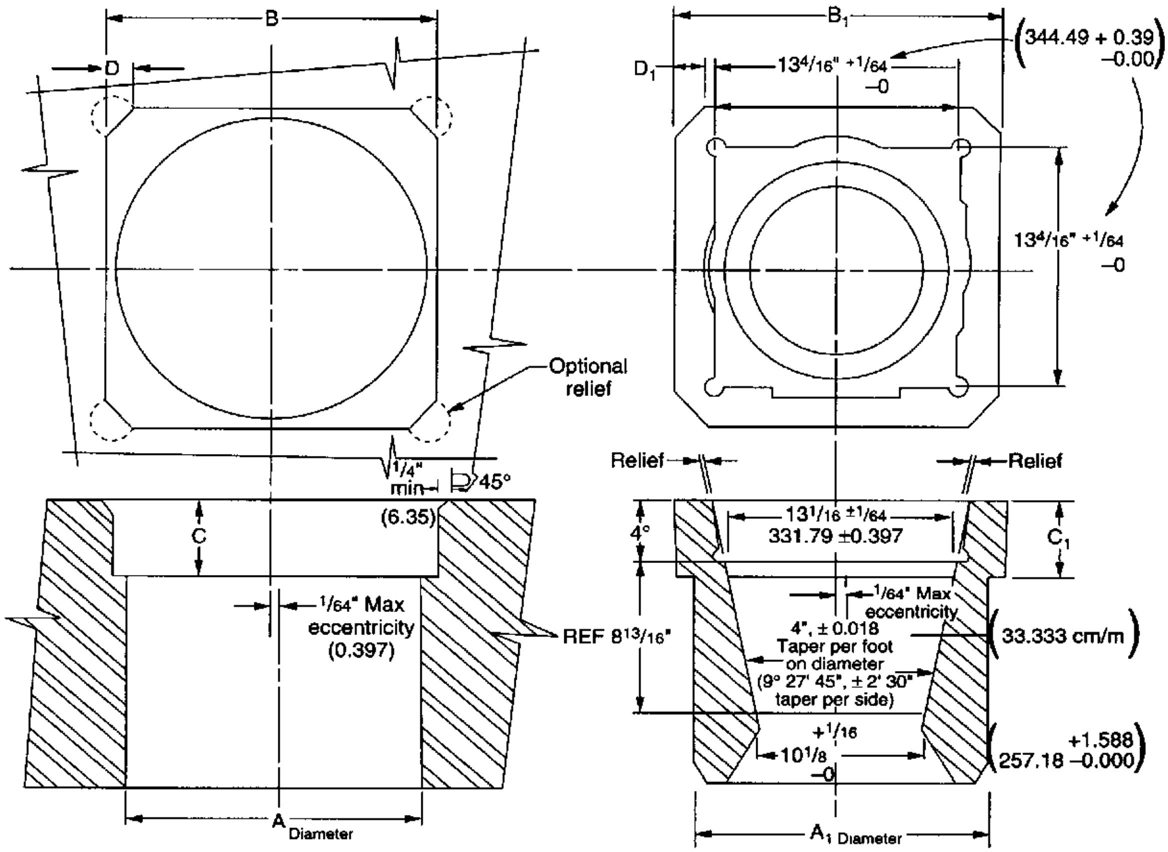


Figure 6—Rotary Table Opening and Square Drive Master Bushing
(See 9.2.6 and 9.3.2 and Table 4.)

9.7.2 Size Class Designation

The size class designation for manual tongs shall represent the diameter, or range of diameters, for which the tong is designed.

9.7.3 Impact Toughness

9.7.3.1 The following impact toughness values apply to primary load path components except hinge pins.

a. Components with a specified minimum yield strength of at least 45,000 pounds per square inch (310 megapascals) shall be from materials possessing a minimum impact toughness of 31 foot-pounds (42 joules) at −4°F (−20°C).

b. Components with a specified yield strength of less than 45,000 pounds per square inch (310 megapascals), the −4°F (−20°C) minimum impact toughness shall be 20 foot-pounds (27 joules) with no individual value less than 15 foot-pounds (20 joules).

Table 5—Four-Pin Drive Master Bushing and Kelly Bushing
(See Figure 7.)

Nominal Table Size		F		G		H		I		J		K	
		± 1/16	± 1.588	± 0.005	± 0.127			± 0.005	± 0.127	+ 1/16 −0	+ 1.588 −0	+ 1/16 −0	+ 1.588 −0
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
17 1/2	444.50	19	482.600	2.565	65.151	4 1/4	107.95	2.472	62.789	14 3/8	365.125	10 1/8	257.175
20 1/2	520.70	23	584.200	2.565	65.151	4 1/4	107.95	2.472	62.789	14 3/8	365.125	10 1/8	257.175
27 1/2	698.50	25 3/4	654.050	3.395	86.233	4 1/4	107.95	3.265	82.931	14 3/8	365.125	10 1/8	257.175
37 1/2	952.50	25 3/4	654.050	3.395	86.233	4 1/4	107.95	3.265	82.931	—		—	
49 1/2	1257.30	—		—		—		—		—		—	

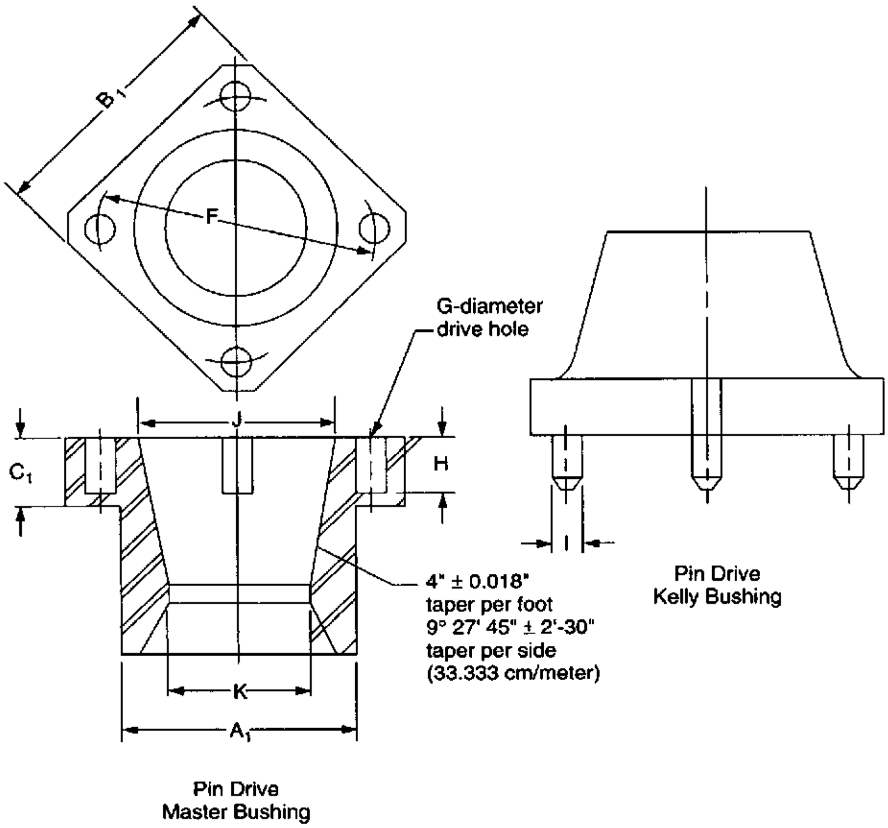


Figure 7—Pin Drive Master Bushing and Kelly Bushing
(See 9.2.6, 9.3.1, 9.3.2, and Table 5.)

9.7.3.2 Hinge pins shall have a minimum impact toughness of 11 foot-pounds (15 joules) at −4°F (−20°C).

9.7.4 Design verification load test, as described in 5.4, shall apply.

9.7.5 Proof load testing, as described in 8.6, shall apply. Jaw hinge pins of wrought material shall be exempt from this requirement.

9.8 POWER TONGS

9.8.1 Product Marking

Power tongs furnished in conformance with this specification shall be marked with the manufacturer's name or mark and size class.

9.8.2 Size Class Designation

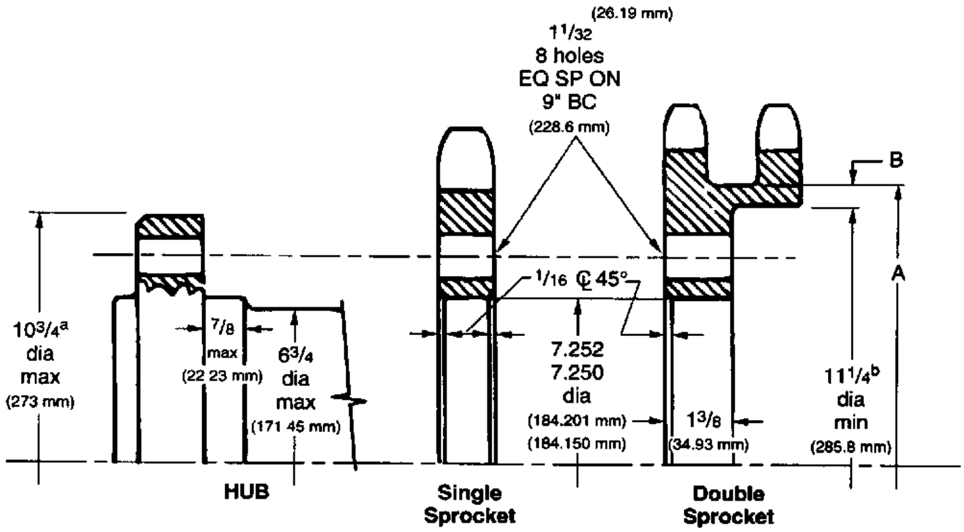
The size class designation for power tongs shall represent the diameter, or range of diameters, for which the tong is designed.

9.8.3 Requirements

The requirements of 4.2.5, 4.2.6, 5.3, 5.4, 6.3.1, 6.3.2, and Section 8 in its entirety shall not apply.

Table 6—Demountable Rotary Sprocket Data
(See 9.2.5 and 9.2.7.)

Sprocket Type	Teeth on Sprocket, Minimum	Sprocket Groove Diameter, Maximum A		Sprocket Thickness at Groove, Minimum B	
		in.	mm	in.	mm
$1^3/_4$P Single	23	—		—	
2P Single	21	—		—	
$2^1/_2$P Single	17	—		—	
$1^3/_4$P Double	25	$12^1/_{16}$	306.39	$^{13}/_{32}$	10.32
2P Double	22	$11^7/_8$	301.63	$^5/_{16}$	7.94
$2^1/_2$P Double	19	$12^7/_{16}$	315.91	$^{19}/_{32}$	15.08



a 10 3/4 in. (273 mm) is maximum hub diameter to allow for chain clearance.

b 11 1/4 in. (285.8 mm) counterbore dimension applies to sprockets with minimum number of teeth. This can be increased for sprockets with more than the minimum number of teeth to as much as the dimensions A minus B.

Figure 8—Demountable Rotary Sprocket
(See 9.2.7 and Table 6.)

9.8.4 Primary Load Path

The primary load path shall be considered to be the mechanical elements (exclusive of hydraulic power transmission components) through which the torque is applied or resisted.

9.9 DRAWWORKS COMPONENTS

9.9.1 Primary Load Path

The primary load path components for a drawworks shall be limited to those loaded by the fast line load when the main drum brake is engauged.

The operating temperature for drawworks is 32°F (0°C).

9.9.2 Requirements

The requirements of 4.2.5, 4.2.6, 5.4, 6.3.1, 8.4.3, 8.4.4, 8.4.6, and 8.4.7 shall not apply. For antifriction bearing design and manufacturing requirements, see 9.12.

9.9.3 Line-Shaft Extension for Cathead

9.9.3.1 Size and Dimensions

Line-shaft extensions for catheads shall be furnished in the sizes shown in Table 7, as specified on the purchase order, and shall conform to the dimensions and tolerances shown in Table 7 and Figure 9 unless the drawworks is furnished with integral catheads.

9.9.3.2 Marking

Line-shaft extensions for catheads manufactured in conformance with this specification shall be die stamped with the size number, as shown in Table 7, and the letters API, adjacent to the start of the taper, in letters 1/4 inch (6.4 millimeters) high.

9.10 ROTARY HOSE

9.10.1 Definitions

Rotary drilling hose is used as the flexible connector between the top of the standpipe and the swivel that allows for

Table 7—Line-Shaft Extensions for Catheads
(All dimensions in inches.
See Figure 9. See Appendix E for metric table.)

Size No.	Diam of Large End of Taper, +0.000 −0.001 A	Lgth. of Taper B	Keyway[a] Width, +0.000 −0.001 C	Keyway[a] Depth D	Retainer Threads Size E	Retainer Threads Depth F	Retainer Threads Chamfer G
1	4.331	6 1/2	1.000	48/64	1-8NC	1 3/4	1 3/8
2	4.562	7 1/4	1.250	7/8	1 1/2-6NC	1 3/4	2
3	5.000	7 1/4	1.250	7/8	1 1/2-6NC	2	2
4	5.500	7 1/4	1.250	7/8	1 1/2-6NC	2	2

a Straight length of keyway shall be not less than B minus 1/4 inch.

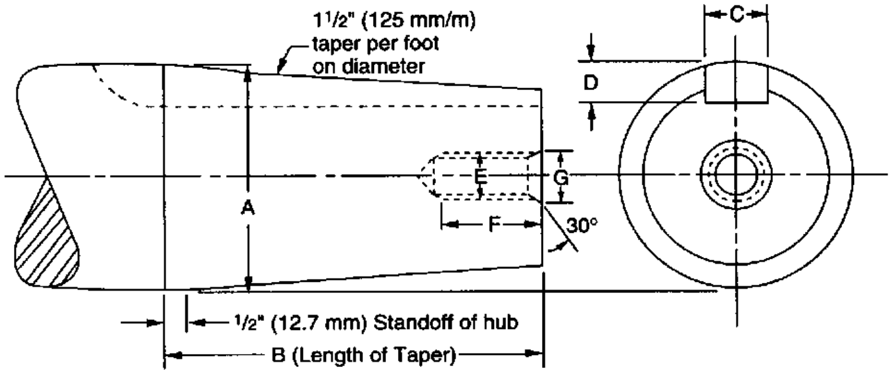


Figure 9—Line-Shaft Extension for Cathead
(See Table 7 for dimensions.)

vertical travel. It is usually used in lengths of 45 feet (13.7 meters) and over.

Rotary vibrator hoses are used as flexible connectors between the mud pump manifold and the standpipe manifold to accommodate alignment and isolate vibration. They are usually used in lengths of 30 feet (9.2 meters) and less.

9.10.2 Primary Load

The primary load for a rotary hose shall be taken as the internal pressure.

9.10.3 Requirements

The requirements of 4.2.5, 4.2.6, and all paragraphs of Sections 5, 6, 7, and 8 shall not apply.

9.10.4 Sizes

Rotary drilling hose and rotary vibrator hose shall be furnished in the sizes and lengths given in Table 8 as specified on the purchase order. Additional lengths of vibrator hose may be ordered, and lengths of drilling hose may be ordered in 5-foot increments.

9.10.5 Dimensions

Dimensions of rotary hose shall conform to the requirements of Table 8 and Figure 10, except as noted in 9.10.4.

9.10.6 Connections

Rotary hose assemblies shall be furnished with external connections threaded with line-pipe threads as specified in API Specification 5B: *API Specification for Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads.* The marking "Spec 7K" may be retained on the hose assemblies when other connections are applied, upon agreement of the user and the manufacturer, if the assembly is pressure tested in accordance with Table 8 with other connections in place.

9.10.7 Test Pressure

Each hose assembly shall be individually tested at the applicable pressure specified in Table 8 and held for a minimum period of 1 minute.

9.10.8 Working Pressure

The maximum working pressure of the hose assembly shall be that shown in Table 8. The surge pressures encountered in the system shall be included in the working pressure. The hose shall be designed to have a minimum burst pressure of at least 2-½ times the working pressure.

9.10.9 Marking

The hose assembly conforming to this specification shall be marked with Spec 7K, the working pressure, and the manufacturer's identification. Additionally, when the hose manufacturer does not install safety clamps, each hose end shall be marked (at the locations specified in Figure 10) with the notation "Attach Safety Clamp Here." Each length of hose shall have a longitudinal lay line of a different color than the hose cover. Markings, whether embossed or printed in distinctive colors, shall be vulcanized or similarly affixed into the hose cover.

9.11 SLUSH PUMP COMPONENTS

9.11.1 General

9.11.1.1 The primary load bearing components for a slush pump shall be defined as those containing the discharge pressure with the exception of expendable items and closure components, such as liners, pistons, piston rods, packing, packing glands, valves and seats, covers, heads, clamps, bushings, plugs, and fasteners.

9.11.1.2 The requirements of 4.2.5, 4.2.6, 5.4, 6.3.1, 8.4.3, 8.4.4, 8.4.6, and 8.4.7 shall not apply. For antifriction bearing design and manufacturing requirements, see 9.12.

Table 8—Rotary Vibrator and Drilling Hose Dimensions and Pressures

(See Appendix E for metric table.)

Size Inside Diam, in.	Standard Length, ft	Threads (Line Pipe Size, in.)		Working Pressure, psi					Test Pressure, psi				
D	*L*	*T*	Grade	Grade A	Grade B	Grade C	Grade D	Grade E	Grade A	Grade B	Grade C	Grade D	Grade E
2	35	$2^1/_2$	A,B	1500	2000	—	—	—	3000	4000	—	—	—
	40	$2^1/_2$	A,B,C	1500	2000	4000	—	—	3000	4000	8000	—	—
	10	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
	12	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
	15	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
$2^1/_2$	20	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
	30	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
	50	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
	55	3	A,B,C,D,E	1500	2000	4000	5000	7500	3000	4000	8000	10,000	15,000
	10	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	12	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	15	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	20	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
$3^1/_2$	30	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	55	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	60	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	70	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	75	4	C,D,E	—	—	4000	5000	7500	—	—	8000	10,000	15,000
	10	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	12	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	15	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	20	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
4	30	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	55	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	60	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	70	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—
	75	5	C,D	—	—	4000	5000	—	—	—	8000	10,000	—

9.11.1.3 Pressure rated items, as defined in 9.11.1.1, shall be pressure tested in production to 1.5 times the working pressure. Hydrostatic testing shall be performed in accordance with 8.7.1.

9.11.1.4 Cast components of the slush pump suction hydraulic circuit shall be hydrostatically tested in production to twice the manufacturer's rated suction pressure. The test procedure shall be the same as for discharge components described in 9.11.1.3.

9.11.2 Slush Pump Piston Rod and Piston Body Bore, Fluid End

See Recommended Practice 7L on slush pump nomenclature and maintenance of slush pump components.

9.11.2.1 Sizes and Dimensions

Fluid ends of slush pump piston rods and piston body bores shall be in accordance with Table 9 and Figures 11 and 12 for double acting pumps and Table 10 and Figure 13 for single acting pumps.

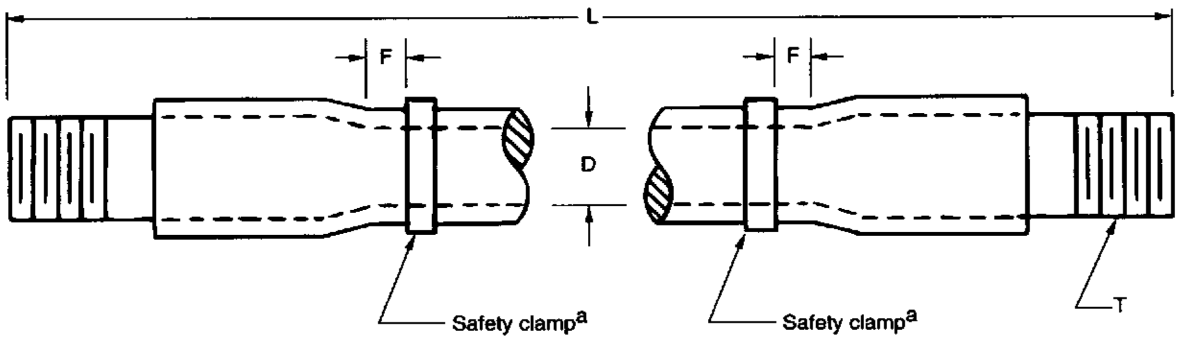


Figure 10—Rotary Vibrator and Drilling Hose Dimensions

F—For Rotary Hose, this dimension shall be 6 inches (152.4 millimeters) to 18 inches (457.2 millimeters) from the inboard end of the coupling. For Vibrator Hose, this dimension shall be 6 inches (152.4 millimeters) to 10 inches (254.0 millimeters) from the inboard end of the coupling.
[a]Hose manufacturers shall mark the hose with the notation "Attach Safety Clamp Here."

9.11.2.2 Threads

Threads on rod ends and in retainer nuts shall conform to the dimensions given in Tables 9 and 10 and shall be controlled by class X gauges conforming to the stipulations in ANSI B1.2. If supplementary production or working gauges are used, they shall be accurate copies of the master gauges.

9.11.2.3 Piston and Rod Shoulders

For 5 HP, 6 HP, and single acting pistons, shoulder faces M and N of pistons and rods shall be square to the center line within 0.001 inch (0.03 millimeters) total indicator reading (TIR). Piston shoulder face P shall be square to the center line within 0.005 inch (0.13 millimeters) TIR.

9.11.2.4 Marking

Marking shall be as follows:

a. Pistons, Double Acting. Pistons with a taper conforming to this specification shall be marked with the manufacturer's name or mark, Spec 7K, and the taper number. High pressure pistons number 5 HP and 6 HP are dimensionally

Table 9—Fluid End of Double Acting Slush Pump Piston Rods and Piston Body Bores
(All dimensions in inches.
See Figures 11 and 12. See Appendix E for metric table.)

		Piston Rod					Piston			Piston & Rod			
Piston & Rod Taper No.	Rod Diam Range[a] A	Length of Rod End, ±1/16 B	Major Diam Rod Taper, ±0.001 C	Length of Taper, ±1/16 D	Length of Perfect Thread, ±1/8 E	Diam of Thread Boss, +0, −1/16 F	Gauge Point Piston Diam, ±0.002 G[c]	Diam of Cylindrical Bore, ±1/64 H	Center of Piston J	Taper, In. Per Ft on Diam, ±0.002 K	Standoff S Min.	Standoff S Max.	Thread Designation
1	1–1 7/32	3 7/8	1.000	1 1/2	1 3/4	—	0.979	29/32	1 3/8	1.000	1/4	—	7/8-9UNC-2A
2	1 1/4–1 15/32	5 1/8	1.250	2 1/2	2 3/8	—	1.229	1 1/32	1 7/8	1.000	1/4	—	1-8UNC-2A
3	1 1/2–1 27/32	7 1/8	1.500	2 3/8	8 1/2	—	1.474	1 9/32	2 11/16	1.250	1/4	—	1 1/4-8UN-2A
4	1 7/8–2 7/32	8	1.875	4	3 1/2	—	1.854	1 9/16	2 15/16	1.000	1/4	—	1 1/2-8UN-2A
5	2 1/4–2 23/32	8 5/8	2.250	4	4 1/8	—	2.229	1 15/16	2 15/16	1.000	1/4	—	1 7/8-8UN-2A
6	2 3/4–2 31/32	9 1/8	2.750	4 1/2	4 1/8	—	2.279	2 3/8	2 15/16	1.000	1/4	—	2 1/4-8UN-2A
5HP[b]	2 3/4–3 1/2	8 5/8	2.225	3 3/4	4 3/8	1 11/16	2.229	1 15/16	2 11/16	1.000	0.041	0.113	1 7/8-8UN-2A
6HP	3–3 1/2	9 1/8	2.725	4 1/4	4 3/8	2 1/16	2.729	2 3/8	2 11/16	1.000	0.041	0.113	2 1/4-8UN-2A

[a] Selected diameter tolerances for API rod numbers 1 and 2: +0.010, −0.005 inch. For rod number 3 and larger; +0.010, −0.000 inch.
[b] Recomended as a substitute for API 6HP piston for reduced liner sizes only.
[c] Dimension G, column 8, relates to dimension S, min. only (column 12).

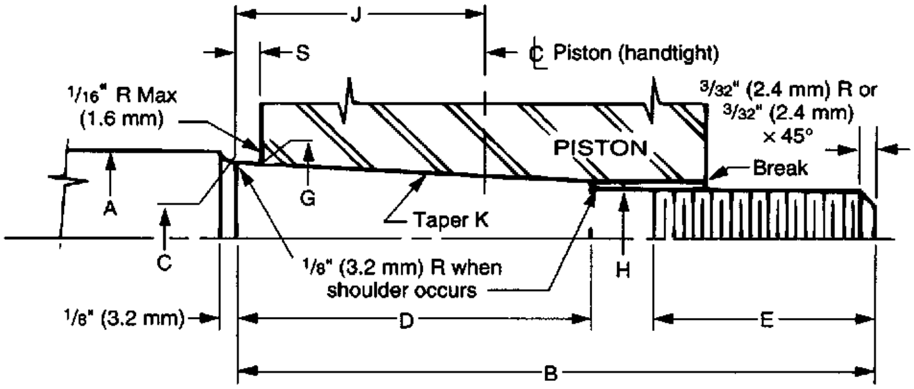
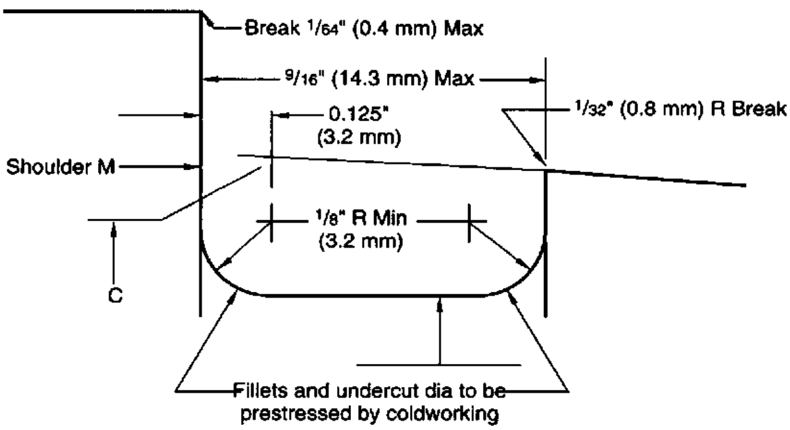


Figure 11—Tapers 1 Through 6



Undercut Detail

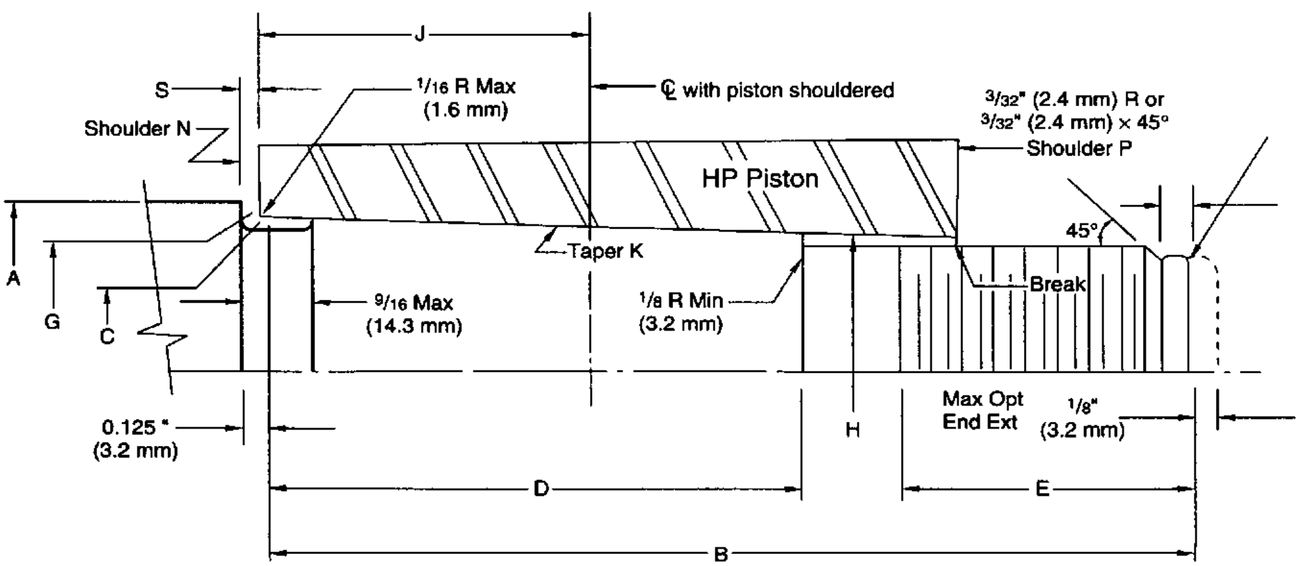


Figure 12—Tapers 5 HP and 6 HP

Table 10—Fluid End of Single Acting Slush Pump Piston Rods and Piston Body Bores
(All dimensions in inches.
See Figure 13. See Appendix E for metric table.)

		Piston Rod					
Piston and Rod Connection No.	Connection Diameter, Nominal	Rod Diameter, A	Length Rod End, $\pm^1/_{16}$ B	Start of Thread from Shoulder, maximum C	Shoulder Diameter, $\pm^1/_{64}$ D	Thread Designation	Piston Bore
SA-2	1	0.997–0.999	$4^3/_{16}$	$1^1/_2$	2	1-8UNC-2A	1.000–1.003
SA-4	$1^1/_2$	1.497–1.499	$5^7/_{16}$	$1^7/_8$	$3^1/_4$	$1^1/_2$-8UN-2A	1.500–1.503

interchangeable with pistons 5 and 6. It is permissible to stamp both tapers on shoulder P.

b. Pistons, Single Acting. Pistons with straight bores conforming to this specification shall be marked with the manufacturer's name or mark, Spec 7K and the connection number.

c. Rods, Double Acting. Piston rods conforming to this specification shall be marked with the manufacturer's name or mark, Spec 7K, and the taper number. The crosshead extension end of the piston rod shall be marked with Spec 7K and the taper thread number or the straight thread number from Table 11 or Table 12.

d. Rods, Single Acting. Piston rods conforming to this specification on the fluid end shall be marked with the manufacturer's name or mark, Spec 7K, and the connection number. If the crosshead extension end of the piston rod conforms to 9.11.3.1 or 9.11.3.2, this end shall be marked with Spec 7K and the taper thread number or the straight thread number from Table 11 or Table 12.

9.11.3 Slush Pump Crosshead, Crosshead Extension, and Piston Rod Connections—Tapered Thread Type

9.11.3.1 Sizes

Tapered thread type connections between crossheads, crosshead extensions, and piston rods shall be 8 TPI, Series UN, Class 2A-2B modified, in the sizes given in Table 11.

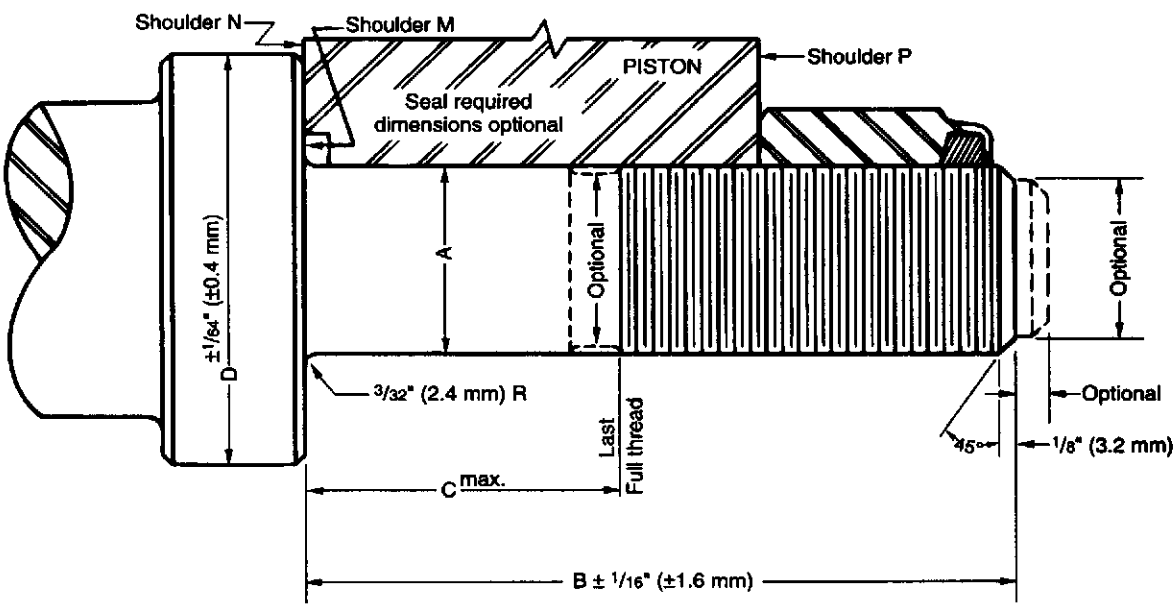


Figure 13—Fluid End of Single Acting Slush Pump Piston Rod and Piston Body Bore
(See Table 10.)

Table 11—Crosshead, Crosshead Extension, and Piston Rod Connections—Tapered Thread Type

(See Figure 14.)

Taper Thread Number	Nominal Size, A[a]		Length of Taper Thread, B		Length of Straight Thread, C		Locknut Thickness, D	
	in.	mm	in.	mm	in.	mm	in.	mm
T1	1	25.4	1 1/4	31.8	1	25.4	3/4	19.1
T2	1 1/8	28.6	1 13/32	35.7	1	25.4	3/4	19.1
T3	1 1/4	31.8	1 9/16	39.7	1	25.4	7/8	22.2
T4	1 3/8	34.9	1 23/32	43.7	1	25.4	7/8	22.2
T5	1 1/2	38.1	1 7/8	47.6	1 1/4	31.8	1	25.4
T6	1 5/8	41.3	2 1/32	51.6	1 1/4	31.8	1	25.4
T7	1 3/4	44.5	2 3/16	55.6	1 1/4	31.8	1 1/8	28.6
T8	1 7/8	47.6	2 11/32	59.5	1 1/4	31.8	1 1/8	28.6
T9	2	50.8	2 1/2	63.5	1 1/2	38.1	1 1/4	31.8
T10	2 1/4	57.2	2 13/16	71.4	1 1/2	38.1	1 3/8	34.9
T11	2 1/2	63.5	3 1/8	79.4	1 3/4	44.5	1 1/2	38.1
T12	2 3/4	69.9	3 7/16	87.3	1 3/4	44.5	1 5/8	41.3
T13	3	76.2	3 3/4	95.3	2	50.8	1 3/4	44.5
T14	3 1/4	82.6	4 1/16	103.2	2	50.8	1 7/8	47.6
T15	3 1/2	88.9	4 3/8	111.1	2 1/4	57.2	2	50.8
T16	4	101.6	5	127.0	2 1/4	57.2	2	50.8
T17	4 1/2	114.3	5 3/8	142.9	2 1/4	57.2	2	50.8
T18	5	127.0	6 1/4	158.8	2 1/4	57.2	2	50.8
T19	5 1/2	139.7	6 7/8	174.6	2 1/4	57.2	2	50.8
T20	6	152.4	7 1/2	190.5	2 1/4	57.2	2	50.8

[a]All threads are 8TPI, Series UN, Class 2A-2B modified.

Requirements for gauges and gauging practice are given in this section.

9.11.3.2 Thread Dimensions and Tolerances

Tapered thread type connections shall conform to dimensions given in Table 11, Figure 14, and Figure 15 and the following tolerances:

a. Taper. Tapered threads shall have a taper of 2 inches per foot (166.67 millimeters per meter) on pitch cone diameter with a tolerance of +0.000, −0.020 inch (+0, −0.51 millimeter) for internal threads and +0.020, −0.000 inch (+0.51 millimeter, −0) for external threads.

b. Concentricity. Threads shall be concentric with rod design axis. Angular misalignment of thread axis with rod design axis shall not exceed 0.0005 inch per inch of length.

c. Length. Total length of external threads = B + C; B = 1.25 A.

d. Perpendicularity. Face of internal thread member shall be perpendicular to thread axis within 0.001 inch per inch (0.001 millimeter per millimeter) of face diameter.

e. Lead. Lead tolerance shall be ± 0.0022 inch per inch (± 0.0022 millimeter per millimeter). Cumulative lead tolerance shall be ± 0.0022 inch (± 0.056 millimeter).

f. Thread Angle. Half angle tolerance of thread angle shall be ± 1 degree.

g. Truncation. Crest on both internal and external threads shall be truncated parallel to taper to produce a flat 0.030 inch (0.76 millimeter) wide. Root on both internal and external threads shall be truncated parallel to thread axis to produce a flat 0.015 inch (0.38 millimeter) wide. Root of internal threads may be truncated parallel to taper of thread at option of manufacturer. Straight threads truncated same as tapered threads.

h. Pitch Diameter. Pitch diameter and pitch diameter tolerance of straight threads shall be as designated in Table 4.1, ANSI B1.1.

Table 12—Crosshead, Crosshead Extension, and Piston Rod Connections—Straight Thread Type

(See Figure 17.)

Straight Thread Number	Nominal Size, A[a]		Length of Internal Thread, B		Length of External Thread, C		Locknut Thickness Min., D	
	in.	mm	in.	mm	in.	mm	in.	mm
S1	1	25.4	1 1/4	31.8	2 1/4	57.2	3/4	19.1
S2	1 1/8	28.6	1 13/32	35.7	2 13/32	61.1	3/4	19.1
S3	1 1/4	31.8	1 9/16	39.7	2 9/16	65.1	7/8	22.2
S4	1 3/8	34.9	1 23/32	43.7	2 23/32	69.1	7/8	22.2
S5	1 1/2	38.1	1 7/8	47.6	3 1/8	79.4	1	25.4
S6	1 5/8	41.3	2 1/32	51.6	3 9/32	83.3	1	25.4
S7	1 3/4	44.5	2 3/16	55.6	3 7/16	87.3	1 1/8	28.6
S8	1 7/8	47.6	2 11/32	59.5	3 19/32	91.3	1 1/8	28.6
S9	2	50.8	2 1/2	63.5	4	101.6	1 1/4	31.8
S10	2 1/4	57.2	2 13/16	71.4	4 5/16	109.5	1 3/8	34.9
S11	2 1/2	63.5	3 1/8	79.4	4 7/8	123.8	1 1/2	38.1
S12	2 3/4	69.9	3 7/16	87.3	5 3/16	131.8	1 5/8	41.3
S13	3	76.2	3 3/4	95.3	5 3/4	146.1	1 3/4	44.5
S14	3 1/4	82.6	4 1/16	103.2	6 1/16	154.0	1 7/8	47.6
S15	3 1/2	88.9	4 3/8	111.1	6 5/8	168.3	2	50.8
S16	4	101.6	5	127.0	7 1/4	184.2	2	50.8
S17	4 1/2	114.3	5 5/8	142.9	7 7/8	200.0	2	50.8
S18	5	127.0	6 1/4	158.8	8 1/2	215.9	2	50.8
S19	5 1/2	139.7	6 7/8	174.6	9 1/8	231.8	2	50.8
S20	6	152.4	7 1/2	190.5	9 3/4	247.7	2	50.8

[a]All threads are 8 TPI, Series UN, Class 2A-2B.

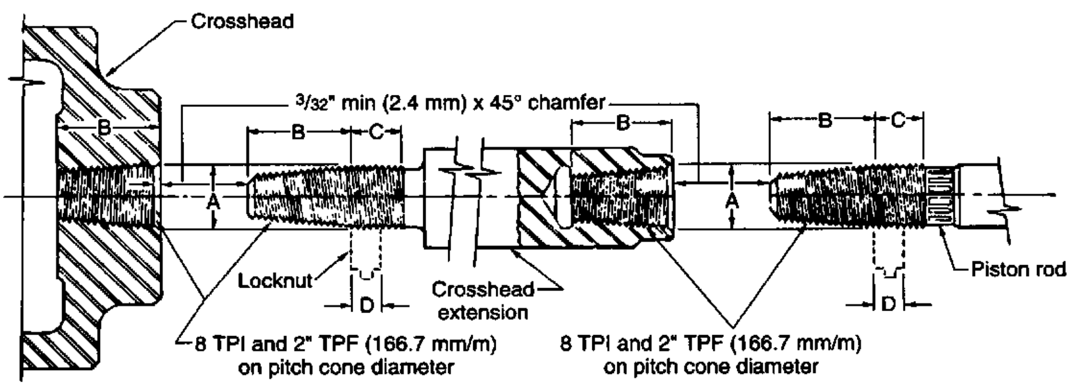


Figure 14—Crosshead, Crosshead Extension, and Piston Rod Connections—Tapered Thread Type

(See Table 11.)

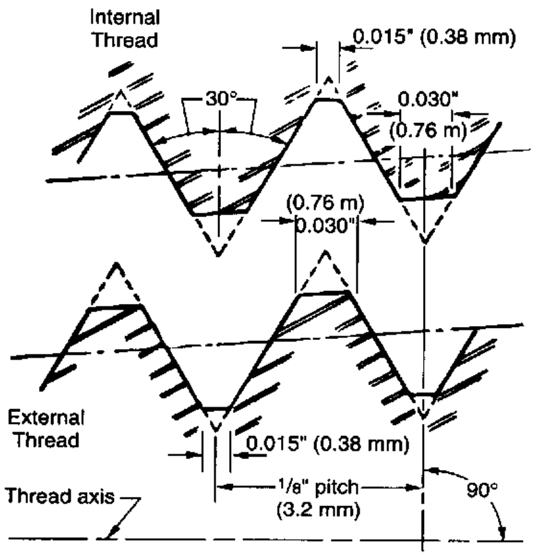


Figure 15—Tapered Thread Form
(See 9.11.3.2.)

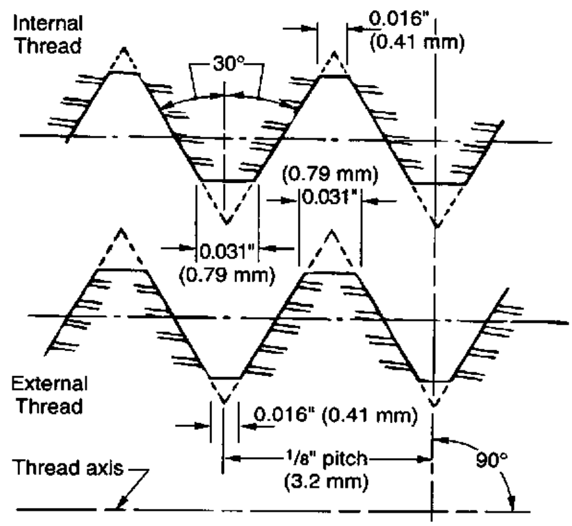


Figure 16—Straight Thread Form
(See 9.11.4.2.)

i. Standoff. In gauging tapered threads, standoff of product from plain and threads plug and ring gauges shall be maintained within a tolerance of ± 1/16 inch (1.6 millimeter).

CAUTION: Threads must not be damaged, as damage will cause misalignment and failure.

9.11.3.3 Locknuts

Crosshead extension and piston rod locknuts shall be furnished in accordance with 9.11.4.5.

9.11.4 Slush Pump Crosshead, Crosshead Extension, and Piston Rod Connections—Straight Thread Type

9.11.4.1 Sizes

Straight thread type connections between crossheads, crosshead extensions, and piston rods shall be 8 TPI, Series UN, Class 2A-2B modified, in the sizes given in Table 12.

9.11.4.2 Thread Dimensions and Tolerances

Straight thread type connections shall conform to the dimensions and tolerances given in Table 12, Figures 16 and 17, and ANSI B1.1, and shall be gauged in accordance with ANSI B1.2. The following requirements are also applicable:

a. Concentricity. Threads shall be concentric with rod design axis. Angular misalignment of thread axis with rod design axis shall not exceed 0.0005 inch per inch (0.0005 millimeter per millimeter) of length.

b. Length.

Internal: $B = 1.25\,A$

External: $C = B + D + 0.25$

c. Perpendicularity. Face of internal thread member shall be perpendicular to thread axis within 0.001 inch per inch (0.001 millimeter per millimeter) of face diameter.

9.11.4.3 Locknuts

Crosshead extension and piston rod locknuts shall be furnished in accordance with 9.11.4.4.

9.11.4.4 Locknuts—Figure

Crosshead extension and piston rod locknuts shall be furnished in accordance with Figure 18.

9.11.4.5 Taper Threads

Locknut threads for the taper type connection shall conform to the requirements of 9.11.3.2.

9.11.4.6 Threads

Locknut threads for the straight type connection shall conform to the requirements of 9.11.4.2.

9.11.5 Slush Pump Valve Pots

9.11.5.1 Sizes and Dimensions

Slush pump valve pots shall be furnished in the sizes and dimensions given in Table 13 and Figure 19 or as specified on the purchase order. API valve pots for caged valves shall provide a minimum G dimension. (See Table 13 for cage clearance.)

9.11.5.2 Spring Mounting Dimensions

Valve pot spring mounting dimensions shall conform to dimensions, L, M, and N in Figure 19 and Table 13.

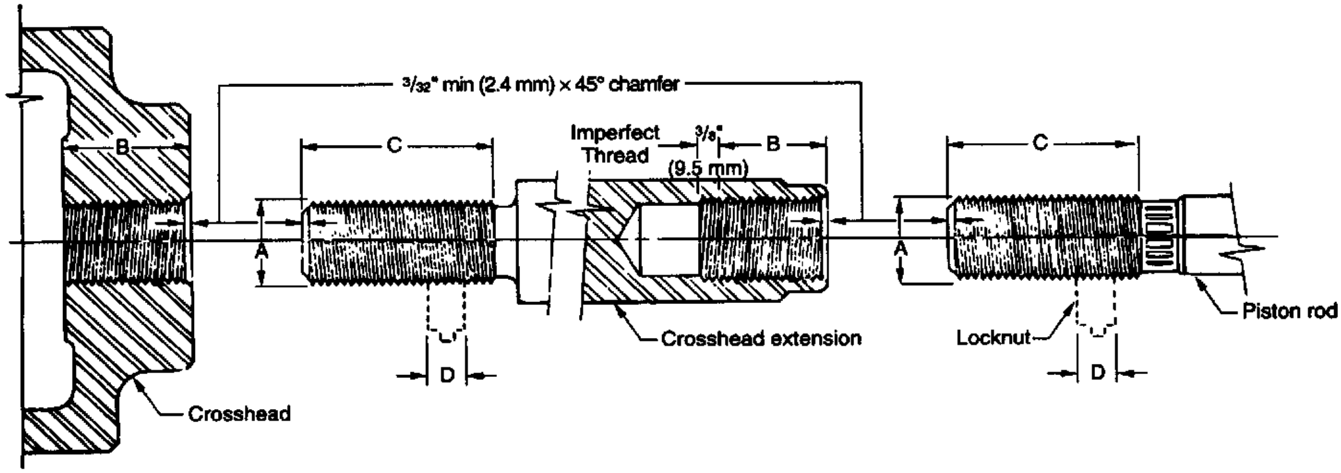


Figure 17—Crosshead, Crosshead Extension, and Piston Rod Connections—Straight Thread Type
(See Table 12.)

9.11.5.3 Marking

Slush pump valve pots furnished to this specification shall be marked with the manufacturer's name or mark, Spec 7K, and the valve pot size number. Markings shall be cast or die stamped on the fluid cylinder or applied to a plate securely affixed to the fluid cylinder. Markings shall be applied in a location visible after installation of the fluid cylinder on the pump and may be applied to either pot. For pumps having divided fluid ends, each section shall be marked.

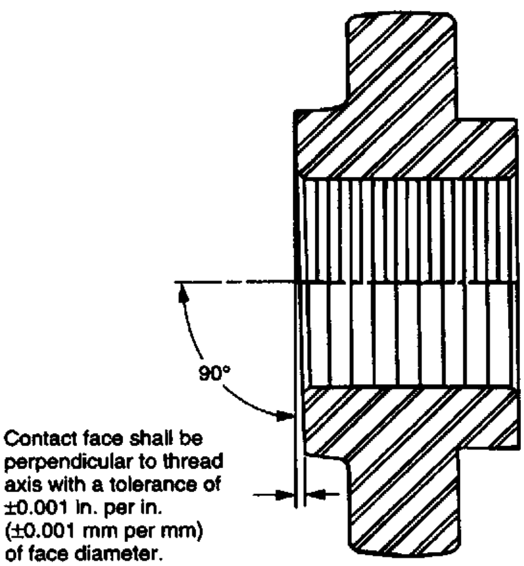


Figure 18—Crosshead Extension and Piston Rod Locknut

9.11.6 Slush Pump Pistons

9.11.6.1 Sizes and Dimensions

Slush pump pistons shall be bored to fit standard taper of piston rods as given in Figure 11 and Table 9. Piston outside diameters shall be suitable for use in liners or cylinders having increments of diameter change noted in Figure 20.

9.11.6.2 Marking

Pistons conforming to this specification shall be marked with the manufacturer's name or mark, Spec 7K, the corresponding API rod number, and standard bore. Markings shall be stamped in letters 1/8 inch (3.2 millimeters) high on the end face of piston core at the large end of piston-rod hole.

9.11.7 Slush Pump Liners

9.11.7.1 Liner Bores

Bores of slush pump liners 6 inches (152.4 millimeters) in diameter and larger shall be in 1/4-inch (6.4-millimeter) increments. Bores smaller than 6 inches (152.4 millimeters) in diameter shall be in 1/2-inch (12.7-millimeter) increments. Bore tolerances shall be as noted in Figure 20 or as specified on the purchase order.

9.11.7.2 Chamfer

The inside edge of the piston entering end of slush pump liners shall be chamfered as shown in Figure 20.

9.11.7.3 Marking

Slush pump liners conforming to this specification shall be marked with the manufacturer's name or mark, Spec 7K,

Table 13—Slush Pump Valve Pots
(All dimensions in inches.
See Figure 19 for explanation of dimensional symbols.
Dimensions for pot sizes 1, 2, and 3 are tentative.
See Appendix E for metric tables.)

Pot Size	Valve Pot Dimensions								Spring Mounting Dimensions		
	A	B	C	D	E	F	G	J	L	M	N
1[a]	2 7/8	2	1	3 1/4	Solid	1 3/4	Solid	2 1/4	1	2 1/2	2 1/2
2[a]	3 3/8	2	1 1/8	3 3/4	13/16	2 1/4	3 3/8	2 1/2	1 3/4	3	3 1/4
3[a]	3 7/8	2	1 1/4	4 1/4	13/16	2 1/4	3 3/4	2 5/8	1 3/4	3	3 1/2
4	4 3/8	2	1 3/8	4 3/4	13/16	2 3/4	4 1/8	2 3/4	2	3	3 3/4
5	5	2	1 1/2	5 3/8	1 5/16	3	4 7/8	3 1/8	2 3/4	3 3/4	4 1/4
5.5	5 3/8	2	1 5/8	5 3/4	1 5/16	3 1/4	5 1/4	3 3/8	2 3/4	3 3/4	4 1/2
6	5 5/8	2	1 3/4	6	1 5/16	3 1/4	5 1/4	3 3/8	2 3/4	3 3/4	4 1/2
7	6 1/4	2	2	6 5/8	1 5/16	3 1/2	5 5/8	3 3/4	2 3/4	3 3/4	4 3/4
8	7	2	2 1/4	7 3/8	1 5/16	3 3/4	6	3 7/8	2 3/4	3 3/4	5
9	7 3/4	2	2 1/2	8 1/8	1 5/16	4	6 3/8	4 1/8	2 3/4	3 3/4	5 1/4
10	8 1/2	2	2 7/8	8 7/8	1 5/16	4 1/4	6 3/4	4 7/8	2 3/4	3 3/4	5 1/2
11	9 1/2	2	3 1/4	9 7/8	1 5/16	4 1/2	7 1/8	5 3/8	2 3/4	3 3/4	5 3/4

[a] Dimensions for these pot sizes are tentative.

and the size (standard bore) of the liner. Markings shall be stamped in letters 1/8 inch (3.2 millimeters) high on the outer end of the liner.

9.11.8 Slush Pump Gear Ratings

9.11.8.1 Provisions

Gear ratings as given herein are derived from AGMA Std 424.01. Ratings are based on surface durability (which is independent of pitch). However, the gear manufacturer shall assume responsibility for selecting a pitch sufficiently coarse to provide adequate tooth strength.

9.11.8.2 Design

Gears shall be single reduction, either helical or herringbone. Gear materials are to be in accordance with AGMA Std 241.01. While field experience in the use of nodular iron as a gear material in slush pumps is limited, it does, to date, indicate this material can be used. Tentative use of nodular iron is permissible for gears only (not pinions), providing it is in accordance with AGMA Std 244.01. Use the steel hardness curves of Figure 21 to obtain K values. Any practical combination of tooth height, pressure angle, or helix angle may be used. However, American Gear Manufacturers Association standards are recommended. The slush pump manufacturer shall be responsible for adequate shafting and support to maintain proper align load.

9.11.8.3 Rating Formulas

The horsepower rating for surface durability shall be determined from the following formula:

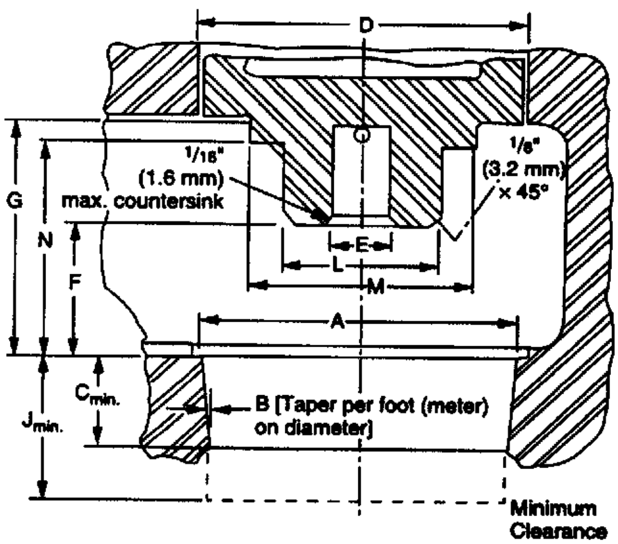


Figure 19—Slush Pump Valve Pot
(See Table 13 for dimensions.)

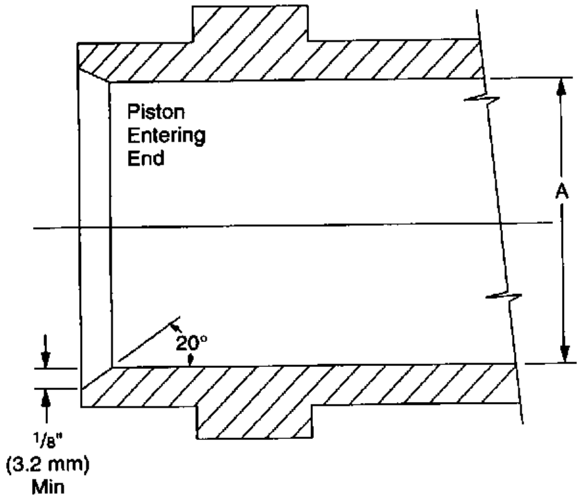


Figure 20—Slush Pump Liner

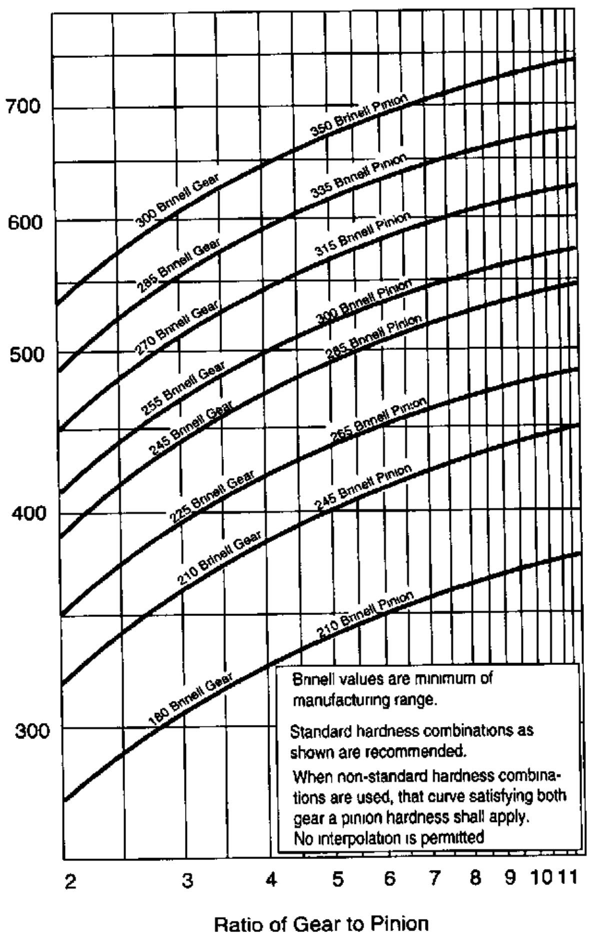


Figure 21—Variation of K_r Factor with Gear Ratio
(See 9.11.8.2.)

$$P = \frac{F_t K_r D_s}{F_r}$$

Where:

F_t = 0.65 *F*. Combined factor for face width and inbuilt factor. (Where *F* = face width in inches.)

F_r = Rating factor, see Figure 22.

K_r = Combined factor for materials, tooth form, and ratio, see Figure 21.

D_s = Combined factor for pinion rpm, pitch diameter, and velocity factor, using Figure 3 of AGMA Std 211.01: *Surface Durability of Helical and Herringbone Gears*, or the following formula:

$$D_s = \frac{D_p^2 C_v n}{126{,}000}$$

Where:

n = Pinion rpm.

D_p = Pinion pitch diameter, inches. With enlarged pinions, a value equal to outside diameter minus two standard addendums may be used.

$$C_v = \frac{78}{78 + \sqrt{v}}$$

v = Pitch line velocity in fpm (do not use enlarged value of D_p).

9.11.8.4 Name Plate Rating

The name plate rating of a slush pump shall not exceed the API rating of the gear.

9.11.9 Gauges and Gauging Practice for Slush Pump Components

The following gauges and gaging practices shall be observed:

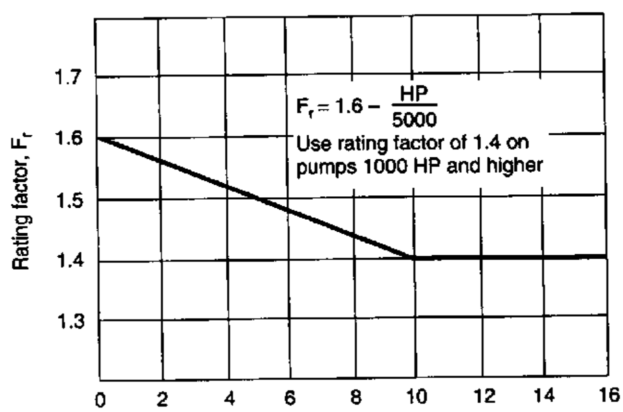


Figure 22—Gear Rating Chart for Mud Pumps
(See 9.11.8.3.)

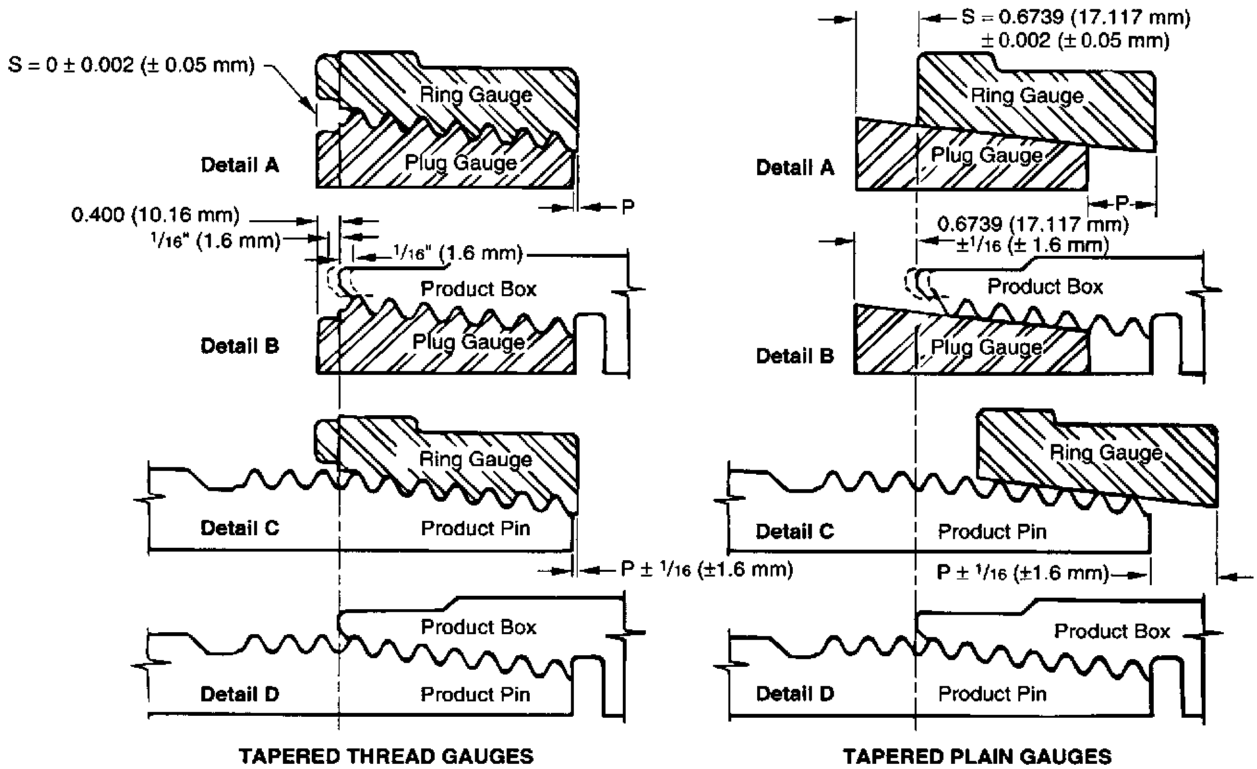


Figure 23—Gauging Practice for Crosshead, Crosshead Extension, and Piston Rod Connections—Tapered Thread Type

Note: The gauges for the straight portion of tapered thread crosshead, crosshead extension, and piston rod connection, should not be used for the straight thread crosshead, crosshead extension, and piston rod connections, because of the difference in length of engagement. Longer gauges are required for the straight thread connections.

9.11.9.1 Working Gauges

The manufacturer shall provide 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 specified herein, are acceptable under this specification. See Appendix C in API Specification 7 for recommended practice for care and use of working gauges. Working gauges shall be of such accuracy and construction as to ensure that the product threads conform to the requirements specified herein. The relationship between working gauges and product threads shall be as shown in Figure 23.

Note: The mating standoffs of the plain and threaded tapered ring gauges from the plug gauges are intended primarily as the basis for establishing the limits of wear or secular change in the gauges. Deviations from the initial S values should be taken into account in establishing working gauge standoff values.

9.11.9.2 Lead

The lead of thread 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 at each end. The lead error between any two threads shall not exceed the tolerances specified in Table 14 except that in the case of setting plugs, the tolerance applies to a length of thread equal to that in the mating ring gauge.

9.11.9.3 Taper

The included taper of tapered thread gauges shall be measured on the diameter along the pitch line over the full threaded length, omitting approximately one full thread at each end. The taper determined as above, and computed to the length L_{RT} (Table 15) shall conform to the basic taper within the tolerances specified in Table 14. The included taper of plain tapered plug and ring gauges shall be measured on the diameter over the full length, omitting approximately 1/16 inch (1.6 millimeter) of length at each end. The taper as determined above, and computed to the length L_{RP} (Table 15), shall conform to the basic taper within the tolerance specified in Table 14. The taper of straight thread setting plugs shall not exceed 0.00015 inch (0.0038 millimeter) over the length L_{RS}. The permissible taper shall be back taper (largest diameter at the entering end) and shall be confined within the pitch diameter limits.

Table 14—Tolerances on Gauge Dimensions

(All dimensions in inches at 68°F, except as otherwise indicated.)

TAPERED GAUGES (Threaded and Plain)

Plug Gauge		Ring Gauge	
Pitch diam at gauge point —	±0.0004	Minor diam at gauge point —	±0.002
Major diam at gauge point —	±0.002	Outside diam, D_R —	±0.015
Diam of plain plug at large end, D_{ep} —	±0.0004	Diam of counterbore, Q —	±0.015
Diam of fitting plate, D_p —	±0.015	Diam of fitting plate	±0.015

Taper and Lead (Plug Gauge)

Taper Thread Number	Taper[a] Threaded Plug	Taper[a] Plain Plug	Lead
T1–T15	+0.0004	±0.0002	±0.0004
T16–T18	+0.0005	±0.0003	±0.0005
T19–T20	+0.0007	±0.0004	±0.0007
Half-angle of thread —			± 7 min.
Length, L_{PT} and L_{PP} —			±0.002

Taper and Lead (Ring Gauge)

Taper Thread Number	Taper[a] Threaded Ring	Taper[a] Plain Ring	Lead
T1–T15	−0.0004 −0.0012	±0.0002	±0.0006
T16–T18	−0.0005 −0.0015	±0.0003	±0.0008
T19–T20	−0.0007 −0.0021	±0.0004	±0.0010
Half-angle of thread —			±15 min.
Length, L_{RT} and L_{RP} —			±0.002
Mating standoff —			±0.002

The ends of plug and ring gauges shall be square with the thread axis within a tolerance of 0.001 in.

[a] Tolerances for taper apply to the full gauge length.

STRAIGHT THREAD GAUGES

Tolerances for straight thread plug and ring gauges to gauge the straight thread portion of the tapered type connection of Section 15 shall be as specified in ANSI B1.2: *Gages and Gaging for Unified Screw Threads* for class W gauges.

Gauge design shall be as specified in Commercial Standard CS8, except where adequate length of engagement is not provided.

9.11.9.4 Fit

Go and not-go adjustable straight thread ring gauges shall be set to snug fit at full engagement on their mating plugs. An adjustable ring gauge may be set initially on either the full form or the truncated portion of the setting plug. When screwed onto the other portion of the setting plug there shall be only a slight change in fit, if any. If there is perceptible shake or play in the looser fit, the ring and, if necessary, the plug shall be reconditioned.

9.11.9.5 Root Form

The roots of tapered thread plug and ring gauges shall be approximately sharp with a radius not exceeding 0.010 inch (0.25 millimeter), or undercut to a maximum width equivalent to the basic root truncation given in Table 12. The undercut shall be substantially symmetrical with respect to the adjoining thread flanks and of such depth as to clear the basic sharp thread; otherwise, the shape of the undercut shall be optional with the gauge manufacturer.

9.11.9.6 Thread Roots

The thread roots of go thread plug and ring gauges, not-go thread plug and ring gauges, and setting thread plug gauges for the straight thread on the pin and the thread in the locknut shall be as specified in ANSI B1.2. See Tables 16, 17, and 18 and Figures 25, 26, and 27 for dimensional tolerances.

9.11.9.7 Pitch Diameter

In computing pitch diameter the effect of helix angle shall be disregarded.

9.11.9.8 Initial Standoff

The large ends of tapered thread gauges shall be flush within ±0.002 inch (0.05 millimeter). The standoff of plain tapered gauges shall be 0.6739 ±0.002 inch (0.05 millimeter).

Table 15—Tapered Thread and Plain Gauges[a]

(All dimensions in inches at 68°F.
See Figure 24. See Appendix E for metric table.)

			Tapered Thread Gauges[b]						Tapered Plain Gauges		
Taper Thread Number	Nom. Size	Outside Diam of Ring D_R	Pitch Diam at Gauge Point	Major Diam at Gauge Point	Minor Diam at Gauge Point	Diam of Fitting Plate D_P	Length of Plug & Ring L_{PT} & L_{RT}	Diam of Counter-bore Q	Diam of Plug at Large End D_{EP}	Diam of Ring at Large End D_{ER}	Length of Plug & Ring L_{PP} & L_{RP}
T1	1	2 3/8	0.86340	0.91956	0.80724	0.680	1.6500	1.146	0.96956	0.85724	1.2500
T2	1 1/8	2 1/2	0.98825	1.04441	0.93209	0.805	1.8062	1.271	1.09441	0.98209	1.4062
T3	1 1/4	2 5/8	1.11320	1.16936	1.05704	0.930	1.9625	1.396	1.21936	1.10704	1.5625
T4	1 3/8	2 3/4	1.23800	1.29416	1.18184	1.055	2.1188	1.521	1.34416	1.23184	1.7188
T5	1 1/2	2 7/8	1.36295	1.41911	1.30679	1.180	2.2750	1.646	1.46911	1.35679	1.8750
T6	1 5/8	3	1.48790	1.54406	1.43147	1.305	2.4312	1.771	1.59406	1.48174	2.0312
T7	1 3/4	3 1/8	1.61275	1.66891	1.55659	1.430	2.5875	1.896	1.71891	1.60659	2.1875
T8	1 7/8	3 1/4	1.73765	1.79381	1.68149	1.555	2.7438	2.021	1.84381	1.73149	2.3438
T9	2	3 3/8	1.86260	1.91876	1.80644	1.680	2.9000	2.146	1.96876	1.85644	2.5000
T10	2 1/4	3 5/8	2.11240	2.16856	2.05624	1.929	3.2125	2.395	2.21856	2.10624	2.8125
T11	2 1/2	3 7/8	2.36230	2.41846	2.30614	2.179	3.5250	2.645	2.46846	2.35614	3.1250
T12	2 3/4	4 3/8	2.61215	2.66831	2.55599	2.429	3.8375	2.895	2.71831	2.60599	3.4375
T13	3	4 7/8	2.86195	2.91811	2.80579	2.679	4.1500	3.145	2.96811	2.85579	3.7500
T14	3 1/4	5 1/8	3.11185	3.16801	3.05569	2.929	4.4625	3.395	3.21801	3.10569	4.0625
T15	3 1/2	5 3/8	3.36180	3.41796	3.30564	3.179	4.7750	3.645	3.46796	3.35564	4.3750
T16	4	5 7/8	3.86155	3.91771	3.80569	3.679	5.4000	4.145	3.96771	3.85539	5.0000
T17	4 1/2	6 3/8	4.36130	4.41746	4.30514	4.178	6.0250	4.644	4.46746	4.35514	5.6250
T18	5	6 7/8	4.86105	4.91721	4.80489	4.678	6.6500	5.144	4.96721	4.85489	6.2500
T19	5 1/2	7 3/8	5.36085	5.41701	5.30469	5.178	7.2750	5.644	5.46701	5.35469	6.8750
T20	6	7 7/8	5.86070	5.91686	5.80454	5.678	7.9000	6.144	5.96686	5.85454	7.5000

[a] Taper for all sizes is 2.0000 in. per ft on diameter.
[b] All threads are 8 TPI, Pitch = 0.1250 in.

9.11.9.9 Determination of Standoff

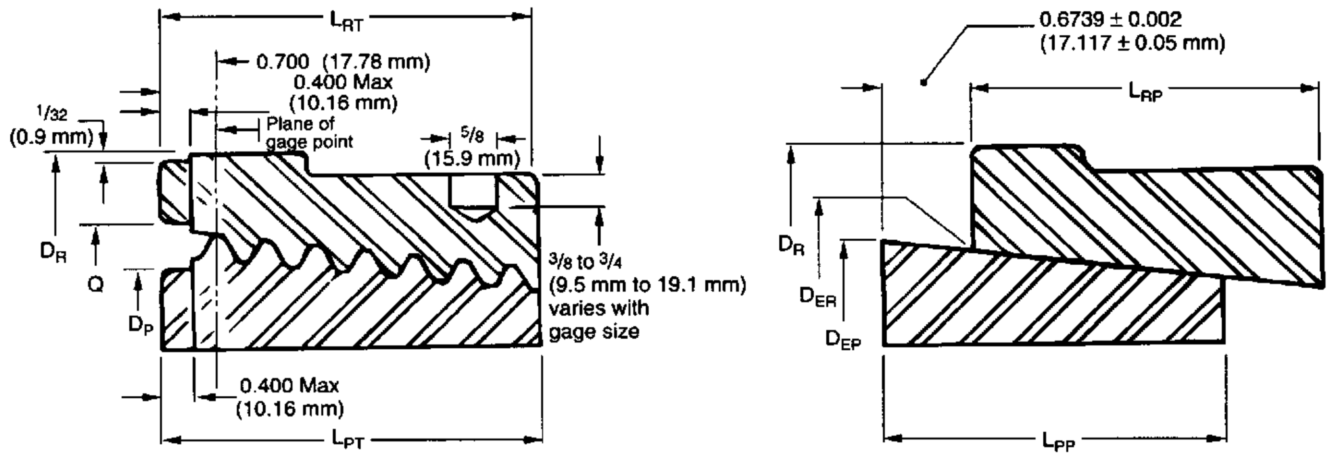
Mating standoff (see Figures 23 and 24) shall be determined as follows:

a. During the test all pieces entering into the measurement shall be at a uniform temperature near 68°F (20°C).
b. Gauges shall be benzol clean before mating and made up within a thin film of medicinal mineral oil[11] of a grade and viscosity equal to Nujol, Squibb's liquid petrolatum, and so forth, wiped on the threads with a clean chamois skin or bristle brush.

[11] *U.S. Pharmacopoeia* medicinal mineral oil.

c. The pair shall be mated hand tight without spinning into place, and complete register shall be accomplished with the torque hammer as shown in Figure 11.1 of Specification 7 using the following weights:

- For gauges T1–T9 use 1 pound (0.454 kilogram) weight.
- For gauges T10–T13 use 2 pounds (0.908 kilogram) weight.
- For gauges T14–T17 use 3 pounds (1.362 kilograms) weight.
- For gauges T18–T20 use 4 pounds (1.816 kilograms) weight.



TAPERED THREAD GAUGE

TAPERED PLAIN GAUGE

Figure 24—Tapered Thread and Plain Gauges
(See Table 15.)

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

9.11.9.10 Maintenance of Gauges

The maintenance of gauges within the specified limits shall be the responsibility of the gauge user. Tapered thread gauges shall be tested for standoff by the procedures listed herein, the interval between tests being dependent on use. A pair of tapered gauges may be considered safe for continued use provided the mating standoff does not differ from the original standoff by more than 0.005 inch (0.13 millimeter).

9.12 ANTIFRICTION BEARINGS

Antifriction bearings used as primary load path components shall be designed and manufactured in accordance with a recognized bearing industry code or standard. Antifriction bearings shall be exempt from the requirements of Sections 4, 5, 6, 7, and 8 of this specification.

10 Marking

10.1 Marking required in Sections 9 and 10 shall be low stress hard-die stamped or cast into components and shall be clearly visible and at least 3/8 inch (10 millimeters) high where the physical dimensions of the component will permit.

10.2 Equipment for which supplementary requirements apply shall be marked with the relevant "SR" numbers.

11 Documentation

11.1 GENERAL

Full records of any documentation referenced in this Specification shall be kept by the manufacturer for a period of ten years after the equipment has been manufactured and sold. Documentation shall be clear, legible, reproducible, retrievable, and protected from damage, deterioration, or loss.

All quality control records required by this Specification shall be signed and dated. Computer sorted records shall contain originator's personal code.

When requested by a purchaser of the equipment, authorities, or certifying agencies, the manufacturer shall make available all records and documentation for examination to demonstrate compliance with this Specification.

11.2 DOCUMENTATION TO BE KEPT BY THE MANUFACTURER

The following documentation shall be kept by the manufacturer:

a. Design documentation (refer to 4.9).
b. Design verification documentation (refer to Section 5).
c. Written specifications (refer to Sections 6, 7, and 8).
d. Qualification records such as:
- Weld Procedure Qualification Records.
- Welder Qualification Records.
- NDE Personnel Qualification Records.
- Measuring and Test Equipment Calibration Records.

e. Inspection and test records traceable to the equipment or components including:
- Material test reports covering the following tests, as applicable: chemical analysis, tensile tests, impact tests, and hardness tests.

Table 16—Pin Go and Not-Go Gauges[a] (for straight threaded portion of tapered thread connection)

(All dimensions in inches at 68°F. See Appendix E for metric table. See Figure 25.)

			Go Gauges					Not-Go Gauges				
Taper Thread Number	Nom. Size	Full Form Major Diam B_S	Truncated Major Diam B_{ST}	Pitch Diam E_S	Thread Length L_{TS}	Ring Length L_N	Ring Minor Diam K_N	Truncated Major Diam B_{ST}	Pitch Diam E_S	Thread Length L_{TS}	Ring Length L_N	Ring Minor Diam K_N
T1	1	0.9731	0.9560	0.9168	2 1/8	15/16	0.8605	0.9381	0.9100	1 1/2	11/16	0.8819
T2	1 1/8	1.0980	1.0809	1.0417	2 1/8	15/16	0.9854	1.0629	1.0348	1 1/2	1 1/16	1.0067
T3	1 1/4	1.2230	1.2059	1.1667	2 3/8	1 1/8	1.1104	1.1878	1.1597	1 5/8	3/4	1.1316
T4	1 3/8	1.3479	1.3308	1.2916	2 3/8	1 1/8	1.2353	1.3125	1.2844	1 5/8	3/4	1.2563
T5	1 1/2	1.4729	1.4558	1.4166	2 3/8	1 1/8	1.3603	1.4374	1.4093	1 5/8	3/4	1.3812
T6	1 5/8	1.5979	1.5808	1.5416	2 7/8	1 1/4	1.4853	1.5623	1.5342	1 7/8	13/16	1.5061
T7	1 3/4	1.7228	1.7057	1.6665	2 7/8	1 1/4	1.6102	1.6871	1.6590	1 7/8	13/16	1.6309
T8	1 7/8	1.8478	1.8307	1.7915	2 7/8	1 1/4	1.7352	1.8119	1.7838	1 7/8	13/16	1.7557
T9	2	1.9728	1.9557	1.9165	2 7/8	1 1/4	1.8602	1.9368	1.9087	1 7/8	13/16	1.8806
T10	2 1/4	2.2227	2.2056	2.1664	3	1 3/8	2.1101	2.1865	2.1584	2	7/8	2.1303
T11	2 1/2	2.4727	2.4556	2.4164	3 1/4	1 1/2	2.3601	2.4363	2.4082	2	7/8	2.3801
T12	2 3/4	2.7226	2.7055	2.6663	3 1/2	1 5/8	2.6100	2.6861	2.6580	2	7/8	2.6299
T13	3	2.9725	2.9554	2.9162	3 3/4	1 3/4	2.8599	2.9358	2.9077	2	7/8	2.8796
T14	3 1/4	3.2225	3.2054	3.1662	4	1 7/8	3.1099	3.1856	3.1575	2	15/16	3.1294
T15	3 1/2	3.4725	3.4554	3.4162	4 1/4	2	3.3599	3.4355	3.4074	2	15/16	3.3793
T16	4	3.9724	3.9553	3.9161	4 1/4	2	3.8598	3.9351	3.9070	2	15/16	3.8789
T17	4 1/2	4.4723	4.4552	4.4160	4 1/4	2	4.3597	4.4347	4.4066	2 1/8	1	4.3785
T18	5	4.9722	4.9551	4.9159	4 1/4	2	4.8596	4.9343	4.9062	2 1/8	1	4.8781
T19	5 1/2	5.4721	5.4550	5.4158	4 1/4	2	5.3595	5.4340	5.4059	2 1/8	1	5.3778
T20	6	5.9721	5.9550	5.9158	4 1/4	2	5.8595	5.9337	5.9056	2 1/8	1	5.8775

[a] All threads are 8 TPI. Pitch = 0.1250 in.

- NDE records covering the surface and/or volumetric NDE requirements of Section 8 of this Specification.
- Performance test records, including proof load testing records, hydrostatic pressure testing records, and functional testing records.
- Special Process Records.

Special process records include actual heat treatment time/temperature charts and weld repair records as described in Section 7. These records shall be traceable to the applicable components and shall be maintained by the manufacturer or by the party carrying out the special process if the work is subcontracted. In the latter case, the requirements of 11.1 shall equally apply to the subcontractor.

11.3 DOCUMENTATION TO BE DELIVERED WITH THE EQUIPMENT

The following documentation shall be delivered with the equipment:

a. The manufacturer's statement of compliance attesting to full compliance with the requirements of this Specification and any other requirements stipulated by the purchase order. The statement shall identify any noted deviations from the specified requirements.

b. Proof Load Test Record (as applicable).

c. Operations/Maintenance manuals, which shall include but not be limited to:

- Assembly drawings.
- List of components.
- Nominal capacities and ratings.
- Operating procedures.
- Recommended frequency of field inspection and preventive maintenance, methods, and acceptance criteria.
- Itemized spare parts (not applicable to single component equipment) and recommended stock levels.

A comprehensive data book can be specified by the purchaser by calling out supplementary requirement SR3 in the purchase order.

Table 17—Box Go and Not-Go Gauges[a] (for locknut)

(All dimensions in inches at 68°F. See Appendix E for metric table. See Figure 26.)

		Go Gauges			Not-Go Gauges		
Taper Thread Number	Nom. Size	Major Diam B_S	Pitch Diam E_S	Thread Length L_T	Major Diam B_S	Pitch Diam E_S	Thread Length L_T
T1	1	0.9751	0.9188	1	0.9557	0.9276	5/8
T2	1 1/8	1.1001	1.0438	1	1.0809	1.0528	5/8
T3	1 1/4	1.2251	1.1688	1 1/4	1.2061	1.1780	3/4
T4	1 3/8	1.3501	1.2938	1 1/4	1.3312	1.3031	3/4
T5	1 1/2	1.4751	1.4188	1 1/4	1.4564	1.4283	3/4
T6	1 5/8	1.6001	1.5438	1 1/4	1.5816	1.5535	7/8
T7	1 3/4	1.7251	1.6688	1 1/4	1.7067	1.6786	7/8
T8	1 7/8	1.8501	1.7938	1 1/4	1.8319	1.8038	7/8
T9	2	1.9751	1.9188	1 1/4	1.9570	1.9289	7/8
T10	2 1/4	2.2251	2.1688	1 3/8	2.2073	2.1792	7/8
T11	2 1/2	2.4751	2.4188	2	2.4575	2.4294	7/8
T12	2 3/4	2.7251	2.6688	2 1/8	2.7077	2.6796	1
T13	3	2.9751	2.9188	2 1/8	2.9580	2.9299	1
T14	3 1/4	3.2251	3.1688	2 1/4	3.2082	3.1801	1
T15	3 1/2	3.4751	3.4188	2 1/4	3.4584	3.4303	1
T16	4	3.9751	3.9188	2 1/4	3.9588	3.9307	1
T17	4 1/2	4.4751	4.4188	2 1/4	4.4591	4.4310	1
T18	5	4.9751	4.9188	2 1/4	4.9595	4.9314	1
T19	5 1/2	5.4751	5.4188	2 1/4	5.4598	5.4317	1
T20	6	5.9751	5.9188	2 1/4	5.9601	5.9320	1

[a]All threads are 8 TPI. Pitch = 0.1250 in.

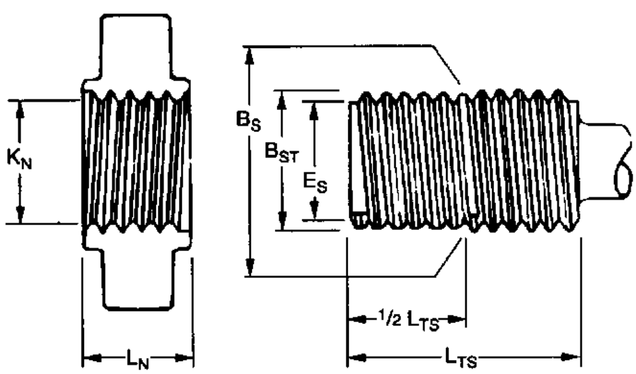


Figure 25—Pin Go and Not-Go Gauges
(for straight threaded portion of tapered thread connection)
(See Table 16.)

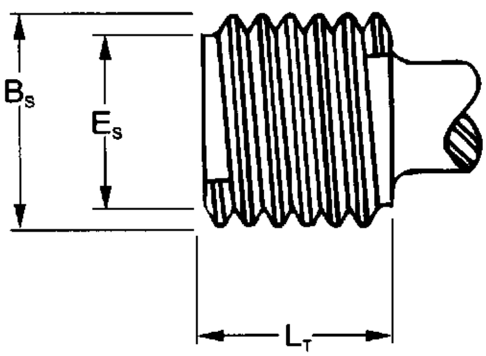


Figure 26—Box Go and Not-Go Gauges
(for locknut)
(See Table 17.)

Table 18—Gauge Thread Height Dimensions[a]
(All dimensions at 68°F (20°C).
See Figure 27.)

Thread Element	Tapered[b] Thread Gauges		Straight[c] Thread Gauges	
	in.	mm	in.	mm
f_{rn}, f_{cn}, f_{rs}, f_{cs}	0.02592	0.6584	0.02598	0.6599
h_g	0.05616	1.4265	0.05629	1.4298
H	0.10800	2.7432	0.10825	2.7495

[a] The effect of taper has been taken into account in computing thread height and truncation.

[b] Taper = 2.0000 in. per ft (166.67 mm per m) on diameter. Pitch = 0.1250 in. (3.175 mm).

[c] Pitch = 0.1250 in. (3.175 mm)

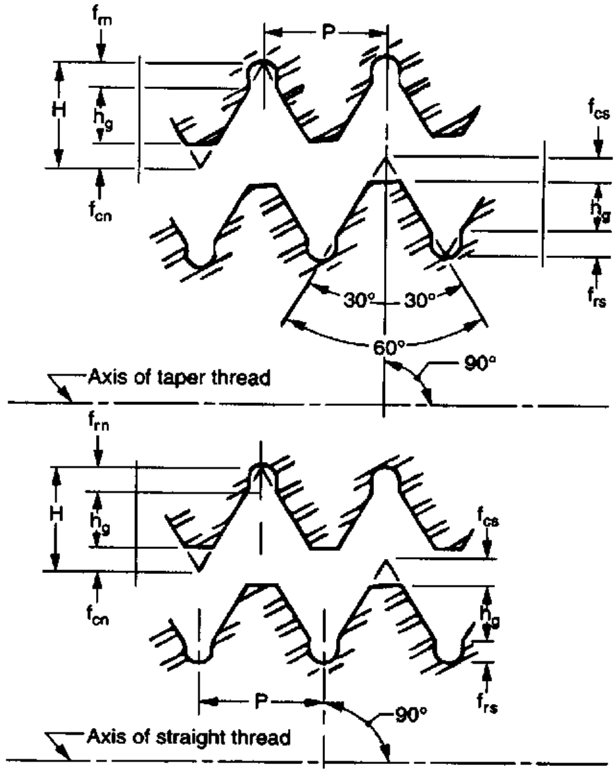


Figure 27—Gauge Thread Form
(See Table 18.)

APPENDIX A—USE OF API MONOGRAM

Products manufactured in conformance with this specification may be marked by the API license as specified hereinafter or as specified in the applicable section of this specification. Products to which the monogram is applied shall be marked per this appendix.

API licensees are authorized to use the API monogram only in conjunction with their API license number and the date of manufacture. The following is an example of an acceptable API monogram marking sequence:

7K XXXX ₯ Mo-Yr

This marking sequence shall be used in addition to all other marking requirements as specified in the applicable sections of this specification as follows: Marking requirements for "Spec 7K" shall be replaced by the API monogram marking sequence.

APPENDIX B—SUPPLEMENTARY REQUIREMENTS

B.0 Introduction

By agreement between the purchaser and manufacturer, and when specified in the purchase order, one or more of the following supplementary requirements shall apply.

B.1 SR1—Proof Load Testing

The equipment shall be load tested and subsequently examined in accordance with the requirements of 8.6 of this specification.

The equipment shall be marked "SR1" by means of low-stress hard-die stamping near the Load Rating identification.

B.2 SR2—Low Temperature Testing

Components shall be fabricated from materials possessing acceptable notch toughness at the specified minimum design temperature. The minimum average Charpy impact energy on three full-size test pieces shall be as specified in Section 9.

Impact testing shall be performed in accordance with the requirements of ASTM A370.

Each component shall be marked with SR2 to indicate that low temperature testing has been performed. Each component shall also be marked with the temperature in °C below zero to indicate the actual design and test temperature.

B.3 SR3—Data Book

When requested by the purchaser, records shall be prepared, gathered, and properly collated in a data book by the manufacturer. The data book shall at least include for each unit:

- Statement of compliance.
- Equipment designation/serial number.
- Assembly and critical area drawings.
- Nominal capacities and ratings.
- List of components.
- Traceability codes and systems (marking on parts/records on file).
- Steel grades.
- Heat treatment records.
- Material test reports.
- NDE records.
- Performance test records including functional hydrostatic and load testing certificates (when applicable).
- Supplementary requirements certificates as required.
- Welding procedure specifications and qualification records.

B.4 SR4—Additional Volumetric Examination of Castings

The requirements for SR4 shall be identical to the requirements for 8.4.7, except that all critical areas of each primary load bearing casting shall be examined.

B.5 SR5—Volumetric Examination of Wrought Material

The entire volume of primary load bearing wrought components shall be examined by the ultrasonic method. When examination of the "entire volume" is impossible due to geometric factors, such as radii at section changes, the maximum practical volume shall suffice.

Wrought components examined by the ultrasonic method shall meet the following acceptance criteria:

For both straight and angle beam examination, any discontinuity resulting in an indication that exceeds the calibration reference line shall be classed as a defect. Any indication interpreted as a crack or thermal ruptures shall also be considered a defect.

There shall be no multiple indications exceeding 50 percent of the reference distance amplitude curve. Multiple indications are defined as two or more indications (each exceeding 50 percent of the reference distance amplitude curve) within $^{1}/_{2}$ inch (12.7 millimeters) of each other in any direction.

APPENDIX C—HEAT TREATING EQUIPMENT

C.1 Temperature Tolerance

The temperature at any point in the working zone shall not vary by more than ± 25°F (± 14°C) from the furnace set point temperature after the furnace working zone has been brought up to temperature. Furnaces that are used for tempering, aging, and/or stress relieving shall not vary by more than ± 25°F (± 14°C) from the furnace set point temperature after the furnace working zone has been brought up to temperature.

C.2 Furnace Calibration

C.2.1 GENERAL

Heat treating of production parts shall be performed with heat treating equipment that has been calibrated and surveyed.

C.2.2 RECORDS

Records of furnace calibration and surveys shall be maintained for a period not less than two years.

C.2.3 BATCH TYPE FURNACE METHODS

a. A temperature survey within the furnace working zone(s) shall be performed on each furnace at the maximum and minimum temperatures for which each furnace is to be used.
b. A minimum of nine thermocouple test locations shall be used for all furnaces having a working zone greater than 10 cubic feet (0.283 cubic centimeters).
c. For each 125 cubic feet (3.539 cubic meters) of furnace working zone surveyed, at least one thermocouple test location shall be used up to a maximum of 60 thermocouples. See Figure C-1 for thermocouple locations.
d. For furnaces having a working zone less than 10 cubic feet (0.283 cubic meters) the temperature survey may be made with a minimum of three thermocouples located at the front, center, and rear, or at the top, center, and bottom of the furnace working zone.
e. After insertion of the temperature-sensing devices, readings shall be taken at least once every 3 minutes to determine when the temperature of the furnace working zone approaches the bottom of the temperature range being surveyed.
f. Once the furnace temperature has reached the set point temperature, the temperature of all test locations shall be recorded at 2-minute intervals maximum, for at least 10 minutes. Then readings shall be taken at 5-minute intervals maximum for sufficient time to determine the recurrent temperature pattern of the furnace working zone for at least 30 minutes.
g. Before the furnace set point temperature is reached, none of the temperature readings shall exceed the set point temperature by 25°F (14°C).
h. After the furnace control set point temperature is reached, no temperature readings shall exceed the limits specified. Each furnace shall be surveyed within one year prior to heat treating.
i. When a furnace is repaired or rebuilt, a new survey shall be required before heat treating.

C.2.4 CONTINUOUS TYPE FURNACE METHOD

Continuous heat treating furnaces shall be calibrated in accordance with procedures specified in Section 3 of MIL-H-6875F. Heat Treatment of Steels—Aircraft Practice Process.

C.3 Instruments

C.3.1 GENERAL

Automatic controlling and recording instruments shall be used. Thermocouples shall be located in the furnace working zone(s) and protected from furnace atmospheres by means of suitable protecting devices.

C.3.2 ACCURACY

The controlling and recording instruments used for the heat treatment processes shall possess an accuracy of ± 1 percent of their full scale range.

C.3.3 CALIBRATION

a. Temperature controlling and recording instruments shall be calibrated at least once every three months.
b. Equipment used to calibrate the production equipment shall possess an accuracy of ± 0.25 percent of full scale.

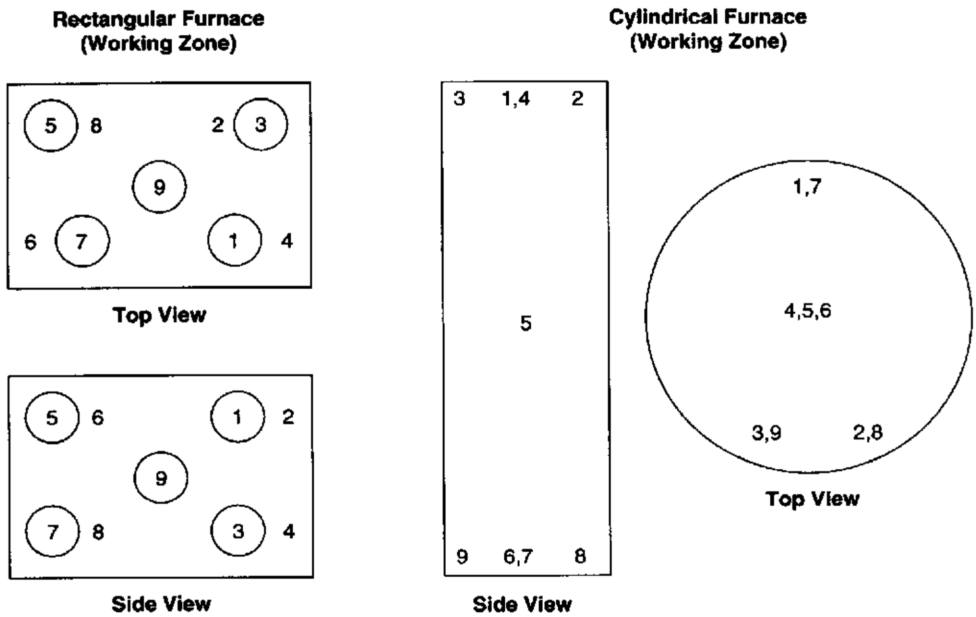


Figure C-1—Thermocouple Locations

APPENDIX D—LISTING OF PARAGRAPHS/SECTIONS IN API SPEC 7K THAT DO NOT APPLY TO CERTAIN EQUIPMENT

Note: This Appendix is for reference only and is not intended to preclude or replace the requirements in the individual sections of this specification.

	Sections				
Equipment	4	5	6	7	8
Rotary Tables	4.2.5	5.4	6.3.1		8.4.3
	4.2.6				8.4.4
					8.4.6
					8.4.7
Rotary Bushings					8.4.4
					8.4.6
					8.4.7
					8.4.8
Rotary Slips					8.4.4
					8.4.6
					8.4.7
					8.4.8
Spiders					
Safety Clamps					8.4.4
					8.4.6
					8.4.7
					8.4.8
Manual Tongs					
Power Tongs	4.2.5	5.3	6.3.1		Section
	4.2.6	5.4	6.3.2		8
Drawworks Components	4.2.5	5.4	6.3.1		8.4.3
	4.2.6				8.4.4
					8.4.6
					8.4.7
Rotary Hose	4.2.5	Section	Section	Section	Section
	4.2.6	5	6	7	8
Slush Pump Components	4.2.5	5.4	6.3.1		8.4.3
	4.2.6				8.4.4
					8.4.6
					8.4.7
Antifriction Bearings	Section	Section	Section	Section	Section
	4	5	6	7	8

APPENDIX E—METRIC CONVERSION TABLES

Table E-1—Line-Shaft Extensions for Catheads

(All dimensions in millimeters. See Figure 9.)

Size No.	Diam of Large End of Taper, +0.00 −0.03 A	Lgth. of Taper B	Keyway[a] Width, +0.00 −0.03 C	Keyway[a] Depth D	Retainer Threads Size E	Retainer Threads Depth F	Retainer Threads Chamfer G
1	100.01	165.1	25.40	17.9	1 -8NC	44.5	34.9
2	115.87	184.2	31.75	22.2	$1^1/_2$-6NC	44.5	50.8
3	127.00	184.2	31.75	22.2	$1^1/_2$-6NC	50.8	50.8
4	139.70	184.2	31.75	22.2	$1^1/_2$-6NC	50.8	50.8

[a] Straight length of keyway shall be not less than B minus 6.4 mm.

Table E-2—Rotary Vibrator and Drilling Hose Dimensions and Pressures

(See Figure 10.)

Size Inside Diam, in. D	Standard Length, L		Threads (Line Pipe Size) T			Working Pressure, MPa					Test Pressure, MPa				
	ft	m	in.	mm	Grade	Grade A	Grade B	Grade C	Grade D	Grade E	Grade A	Grade B	Grade C	Grade D	Grade E
2	35	10.67	$2^1/_2$	63.5	A,B	10.3	13.8	—	—	—	20.7	27.6	—	—	—
(50.8 mm)	40	12.19	$2^1/_2$	63.5	A,B,C	10.3	13.8	27.6	—	—	20.7	27.6	55.2	—	—
	10	3.05	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
	12	3.66	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
	15	4.57	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
$2^1/_2$	20	6.10	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
(63.5 mm)	30	9.14	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
	50	15.24	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
	55	16.76	3	76.2	A,B,C,D,E	10.3	13.8	27.6	34.5	51.7	20.7	27.6	55.2	68.9	103.4
	10	3.05	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	12	3.66	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	15	4.57	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	20	6.10	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
3	30	9.14	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
(76.2 mm)	55	16.76	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	60	18.29	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	70	21.34	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	75	22.86	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	10	3.05	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	12	3.66	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	15	4.57	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	20	6.10	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
$3^1/_2$	30	9.14	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
(88.9 mm)	55	16.76	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	60	18.29	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	70	21.34	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	75	22.86	4	101.6	C,D,E	—	—	27.6	34.5	51.7	—	—	55.2	68.9	103.4
	10	3.05	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
	12	3.66	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
	15	4.57	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
	20	6.10	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
4	30	9.14	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
(101.6 mm)	55	16.76	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
	60	18.29	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
	70	21.34	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—
	75	22.86	5	127.0	C,D	—	—	27.6	34.5	—	—	—	55.2	68.9	—

Table E-3—Fluid End of Double Acting Slush Pump Piston Rods and Piston Body Bores

(All dimensions in millimeters. See Figures 11 and 12.)

		Piston Rod				Piston							
Piston & Rod Taper No.	Rod Diam Range[a] A	Length of Rod End, ±1.6 B	Major Diam Rod Taper, ±0.03 C	Length of Taper, ±1.6 D	Length of Perfect Thread, ±3.2 E	Diam of Thread Boss, +0,–1.6 F	Gauge Point Piston Diam, ±0.05 G[c]	Diam of Cylindrical Bore, ±0.4 H	Center of Piston J	Piston & Rod Taper, mm Per m on Diam, ±0.05 K	Standoff S Min.	Standoff S Max.	Thread Designation
1	25.4–31.0	98.4	25.40	38.1	44.5	—	24.87	23.0	34.9	83.33	6.4	—	$^7/_8$-9UNC-2A
2	31.8–37.3	130.2	31.75	63.5	60.3	—	31.22	26.2	47.6	83.33	6.4	—	1-8UNC-2A
3	38.1–46.8	181.0	38.10	60.3	88.9	—	37.44	32.5	68.3	104.17	6.4	—	1 $^1/_4$-8UN-2A
4	47.6–56.4	203.2	47.63	101.6	88.9	—	47.09	39.7	74.6	83.33	6.4	—	1 $^1/_2$-8UN-2A
5	57.2–69.1	219.1	57.15	101.6	104.8	—	56.62	49.2	74.6	83.33	6.4	—	1 $^7/_8$-8UN-2A
6	69.9–75.4	231.8	69.85	114.3	104.8	—	69.32	60.3	74.6	83.33	6.4	—	2 $^1/_4$-8UN-2A
5HP[b]	69.9–88.9	219.1	57.15	95.3	111.1	42.9	56.62	49.2	68.3	83.33	1.04	2.87	1 $^7/_8$-8UN-2A
6HP	76.2–88.9	231.8	69.22	108.0	111.1	52.4	69.32	60.3	68.3	83.33	1.04	2.87	2 $^1/_4$-8UN-2A

[a]Selected diameter tolerances for API rod numbers 1 and 2: +0.25, −0.13 mm. For rod number 3 and larger; +0.25, −0.00 mm.
[b]Recomended as a substitute for API 6HP piston for reduced liner sizes only.
[c]Dimension G relates to dimension S, min. only.

Table E-4—Fluid End of Single Acting Slush Pump Piston Rods and Piston Body Bores

(All dimensions in millimeters. See Figure 13.)

			Piston Rod					
Piston and Rod Connection No.	Connection Diameter, Nominal in.	Connection Diameter, Nominal mm	Rod Diameter, A	Length Rod End, ±1.6 B	Start of Thread from Shoulder, Maximum C	Shoulder Diameter, ±0.4 D	Thread Designation	Piston Bore
SA-2	1	25.4	25.32–25.38	106.4	38.1	50.8	1-8UNC-2A	25.40–25.48
SA-4	1$^1/_2$	38.1	38.02–38.07	138.1	47.6	82.6	1$^1/_2$-8UN-2A	38.10–38.18

Table E-5—Slush Pump Valve Pots

(All dimensions in millimeters.
See Figure 19 for explanation of dimensional symbols.
Dimensions for pot sizes 1, 2, and 3 are tentative.)

Pot Size		Valve Pot Dimensions								Spring Mounting Dimensions		
in.	mm	A	B	C	D	E	F	G	J	L	M	N
1[a]	25.4	73.0	166.7	25.4	82.6	Solid	44.5	Solid	57.2	25.4	63.5	63.5
2[a]	50.8	85.7	166.7	28.6	95.3	20.6	57.2	85.7	63.5	44.5	76.2	82.6
3[a]	76.2	98.4	166.7	31.8	108.0	20.6	63.5	95.3	66.7	44.5	76.2	88.9
4	101.6	111.1	166.7	34.9	120.7	20.6	69.9	104.8	69.9	50.8	76.2	95.3
5	127.0	127.0	166.7	38.1	136.5	33.3	76.2	123.8	79.4	69.9	95.3	108.0
5.5	139.7	136.5	166.7	41.3	146.1	33.3	82.6	133.4	85.7	69.9	95.3	114.3
6	152.4	142.9	166.7	44.5	152.4	33.3	82.6	133.4	85.7	69.9	95.3	114.3
7	177.8	158.8	166.7	50.8	168.3	33.3	88.9	142.9	95.3	69.9	95.3	120.7
8	203.2	177.8	166.7	57.2	187.3	33.3	95.3	152.4	98.4	69.9	95.3	127.0
9	228.6	196.9	166.7	63.5	206.4	33.3	101.6	161.9	104.8	69.9	95.3	133.4
10	254.0	215.9	166.7	73.0	225.4	33.3	108.0	171.5	123.8	69.9	95.3	139.7
11	279.4	241.3	166.7	82.6	250.8	33.3	114.3	181.0	136.5	69.9	95.3	146.1

[a]Dimensions for these pot sizes are tentative.

Table E-6—Tapered Thread and Plain Gauges[a]

(All dimensions in millimeters at 20°C.
See Figure 24.)

			Tapered Thread Gauges[b]						Tapered Plain Gauges		
Taper Thread Number	Nom. Size	Outside Diam of Ring D_R	Pitch Diam at Gauge Point	Major Diam at Gauge Point	Minor Diam at Gauge Point	Diam of Fitting Plate D_P	Length of Plug & Ring L_{PT} & L_{RT}	Diam of Counter-bore Q	Diam of Plug at Large End D_{EP}	Diam of Ring at Large End D_{ER}	Length of Plug & Ring L_{PP} & L_{RP}
T1	1	60.3	21.9304	23.3578	20.5029	17.27	41.910	29.11	24.6275	21.7729	31.750
T2	1 1/8	63.5	25.1028	26.5278	23.6753	20.49	45.878	32.28	27.7978	24.9453	35.718
T3	1 1/4	66.7	28.2753	29.7028	26.8478	23.62	49.848	35.46	30.9728	28.1174	39.658
T4	1 3/8	69.9	31.4452	32.8727	30.0177	26.80	53.818	38.63	34.1427	31.2877	43.658
T5	1 1/2	73.0	34.6202	36.0451	33.1927	29.97	57.785	41.81	37.3151	34.4627	47.625
T6	1 5/8	76.2	37.7927	39.2201	36.3652	33.15	61.754	44.98	40.4901	37.6352	51.593
T7	1 3/4	79.4	40.9651	42.3901	39.5376	36.32	65.723	48.16	43.6601	40.8076	55.563
T8	1 7/8	32.6	44.1376	45.8625	42.7101	39.50	69.695	51.33	46.8325	43.9801	59.533
T9	2	85.7	47.31	48.7375	45.5826	42.67	73.660	54.51	50.0075	47.1526	63.500
T10	2 1/4	92.1	53.6550	55.6824	52.1310	49.00	81.598	60.83	56.3524	53.4975	71.438
T11	2 1/2	98.4	60.0064	61.4299	58.5799	55.35	89.535	67.18	62.6999	59.8449	79.875
T12	2 3/4	112.5	66.3499	67.7748	64.9224	61.70	97.473	73.53	69.0448	66.1924	87.313
T13	3	123.8	72.6948	74.1197	71.2673	68.05	105.410	79.88	75.3897	72.5373	92.250
T14	3 1/4	130.2	79.0423	80.4672	77.6148	74.40	113.348	86.23	81.7372	78.8848	103.188
T15	3 1/2	136.5	85.3897	80.8172	83.9622	80.75	121.285	92.58	88.0872	85.2322	111.128
T16	4	149.2	98.0846	99.5096	96.6572	93.45	137.160	105.28	100.7796	97.9272	127.000
T17	4 1/2	161.9	110.777	112.2045	109.3495	106.12	153.035	117.96	113.4745	110.5195	142.875
T18	5	174.6	123.4719	124.8969	122.0445	118.82	168.910	130.65	126.1669	123.3145	152.750
T19	5 1/2	187.3	136.1669	137.5918	134.7394	131.52	184.785	143.36	138.8618	136.0094	179.625
T20	6	200.0	148.8618	150.2893	147.4343	144.22	200.660	156.06	151.5593	143.7043	190.500

[a] Taper for all sizes is 166.67 millimeters per meter on diameter.
[b] All threads are 8 TPI. Pitch = 3.175 millimeters.

Table E-7—Pin Go and Not-Go Gauges[a]
(for straight threaded portion of tapered thread connection)

(See Figure 25.
All dimensions in millimeters at 20°C.)

			Go Gauges					Not-Go Gauges				
Taper Thread Number	Nom. Size	Full Form Major Diam B_S	Truncated Major Diam B_{ST}	Pitch Diam E_S	Thread Length L_{TS}	Ring Length L_N	Ring Minor Diam K_N	Truncated Major Diam B_{ST}	Pitch Diam E_S	Thread Length L_{TS}	Ring Length L_N	Ring Minor Diam K_N
T1	1	24.717	24.282	23.287	53.975	23.8	21.857	23.828	23.114	38.1	17.5	22.400
T2	1 1/8	27.889	27.455	26.459	53.975	23.8	25.029	26.998	26.284	38.1	17.5	25.570
T3	1 1/4	31.064	30.630	29.634	60.375	28.6	28.204	30.170	29.456	41.3	19.1	28.743
T4	1 3/8	34.237	33.802	32.807	60.375	28.6	31.377	33.338	32.624	41.3	19.1	31.910
T5	1 1/2	37.411	36.977	35.982	60.375	28.6	34.552	36.510	35.796	41.3	19.1	35.083
T6	1 5/8	40.587	40.152	39.157	73.025	31.8	37.727	39.682	38.969	47.6	20.6	38.252
T7	1 3/4	43.759	43.325	42.329	73.025	31.8	40.900	42.852	42.139	47.6	20.6	41.425
T8	1 7/8	46.934	46.500	45.504	73.025	31.8	44.074	46.022	45.309	47.6	20.6	44.595
T9	2	50.109	49.675	48.679	73.025	31.8	47.249	49.195	48.481	47.6	20.6	47.767
T10	2 1/4	56.457	56.022	55.027	76.200	34.9	53.597	55.538	54.823	50.8	22.2	54.110
T11	2 1/2	60.807	62.372	61.377	82.550	38.1	59.947	61.882	61.168	50.8	22.2	60.455
T12	2 3/4	69.154	68.720	67.000	88.100	41.3	66.294	68.227	67.513	50.8	22.2	66.800
T13	3	74.994	75.067	74.072	95.250	44.5	72.692	74.570	73.856	50.8	22.2	73.142
T14	3 1/4	81.851	81.417	80.422	101.600	47.6	78.992	80.914	80.201	50.8	23.8	79.437
T15	3 1/2	98.201	87.767	86.772	107.950	50.8	85.842	87.262	86.548	50.8	23.8	85.834
T16	4	100.299	100.465	99.469	107.950	50.8	95.039	99.952	99.238	50.8	23.8	98.524
T17	4 1/2	113.596	43.162	112.166	107.950	50.8	110.736	112.640	111.928	54.0	25.4	111.214
T18	5	126.294	125.860	124.864	107.950	50.8	123.434	125.331	124.618	54.0	25.4	123.904
T19	5 1/2	138.991	138.557	137.561	107.950	50.8	136.131	138.024	137.310	54.0	25.4	136.596
T20	6	151.691	151.257	150.261	107.950	50.8	148.831	150.716	150.002	54.0	25.4	149.289

[a] All threads are 8 TPI. Pitch = 3.175 millimeters.

Table E-8—Box Go and Not-Go Gauges[a] (for locknut)

(See Figure 26.
All dimensions in millimeters at 20°C.)

Taper Thread Number	Nom. Size	Go Gauges Major Diam B_S	Go Gauges Pitch Diam E_S	Go Gauges Thread Length L_T	Not-Go Gauges Major Diam B_S	Not-Go Gauges Pitch Diam E_S	Not-Go Gauges Thread Length L_T
T1	1	24.768	23.338	25.4	24.275	23.561	15.9
T2	1 1/8	27.940	26.513	25.4	27.455	26.741	15.9
T3	1 1/4	31.118	29.688	31.8	30.635	29.921	19.1
T4	1 3/8	34.293	32.863	31.8	33.813	33.099	19.1
T5	1 1/2	37.468	36.038	31.8	36.993	36.279	19.1
T6	1 5/8	40.643	39.213	31.8	40.173	39.459	22.2
T7	1 3/4	43.818	42.388	31.8	43.350	42.636	22.2
T8	1 7/8	46.993	46.563	31.8	46.530	45.817	22.2
T9	2	50.168	48.738	31.8	49.708	48.994	22.2
T10	2 1/4	56.518	55.088	34.9	56.065	55.352	22.2
T11	2 1/2	62.868	61.438	50.8	62.421	61.707	22.2
T12	2 3/4	69.218	67.788	54.0	68.776	68.062	25.4
T13	3	75.568	74.138	54.0	75.133	74.420	25.4
T14	3 1/4	81.918	80.488	57.2	81.488	80.775	25.4
T15	3 1/2	88.268	86.838	57.2	87.843	87.130	25.4
T16	4	100.968	99.538	57.2	100.554	99.840	25.4
T17	4 1/2	113.668	112.238	57.2	113.261	112.547	25.4
T18	5	126.368	124.938	57.2	125.971	125.258	25.4
T19	5 1/2	139 068	137.638	57.2	138.679	137.965	25.4
T20	6	151.768	150.338	57.2	151.387	150.673	25.4

[a]All threads are 8 TPI. Pitch = 3.175 millimeters

APPENDIX F—SI UNITS

Note: This appendix is not part of API Specification 7K.

The conversion of English units shall be made in accordance with ISO 31-3.

Table F-1—SI Units

Quantity	U.S. Customary Unit	SI Unit
Area	1 square inch (in.^{2})	645.16 square millimeters (mm^2) (exactly)
Flow rate	1 barrel per day (bbl/d)	0.158987 cubic meters per day (m^3/d)
	1 cubic foot per minute (ft^3/min)	0.02831685 cubic meters per minute (m^3/min) or 40.776192 cubic meters per day (m^3/d)
Force	1 pound-force (lbf)	4.448222 newtons (N)
Impact energy	1 foot pound-force (ft•lbf)	1.355818 Joules (J)
Length	1 inch (in.)	25.4 millimeters (mm) (exactly)
	1 foot (ft)	304.8 millimeters (mm) (exactly)
Mass	1 pound (lb)	0.45359237 kilograms (kg) (exactly)
Pressure	1 pound-force per square inch (lbf/in.^{2}) or 1 pound per square inch (psi) (Note: 1 bar = 10^5 Pa)	6894.757 pascals (Pa)
Strength or stress	1 pound-force per square inch (lbf/in.^{2})	6894.757 pascals (Pa)
Temperature	The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (°C):	°C = 5/9 (°F – 32)
Torque	1 inch pound-force (in•lbf)	0.112985 newton meters (N•m)
	1 foot pound-force (ft•lbf)	1.355818 newton meters (N•m)
Velocity	1 foot per second (ft/s)	0.3048 meters per second (m/s) (exactly)
Volume	1 cubic inch (in.^{3})	$16.387064 \cdot 10^{-3}$ cubic decimeters (dm^3) (exactly)
	1 cubic foot (ft^3)	0.0283168 cubic meters (m^3) or 28.3168 cubic decimeters (dm^3)
	1 gallon (U.S.)	0.0037854 cubic meters (m^3) or 3.7854 cubic decimeters (dm^3)
	1 barrel (U.S.)	0.158987 cubic meters (m^3) or 158.987 cubic decimeters (dm^3)

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