

Sucker Rods and Rod-related Products

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Introduction

This specification has been developed by users, purchasers, suppliers, and manufacturers and is intended for use in the petroleum and natural gas industry worldwide. This specification is intended to give requirements and information to all parties in the design, manufacture, and selection of thread form requirements, sucker rods, sinker bars, polished rods, couplings and sub-couplings, thread gauges, pumping tees, stuffing boxes, polished rod clamps, calibration of measuring equipment, standard methods of mechanical properties testing, and polished rod liners. Furthermore, this specification addresses the minimum requirements with which the manufacturer shall comply to claim conformity.

Attention is brought to users of this specification that requirements above those outlined in this specification can be required for individual applications. This specification is not intended to inhibit a manufacturer from offering or the user or purchaser from accepting alternative equipment or other engineering solutions. This can be particularly applicable where there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the manufacturer to identify any variations from this specification.

In this specification, U.S. customary (USC) units shall be the controlling units. International System (SI) units are included as reference only.

Sucker Rods and Rod-related Products

1 Scope

This specification provides the requirements and guidelines for the design of thread form requirements, steel sucker rods and pony rods, fiber reinforced plastic (FRP) sucker rods and pony rods, sinker bars, polished rods, couplings and sub-couplings, thread gauges, pumping tees, stuffing boxes, polished rod clamps, calibration of measuring equipment, standard methods of mechanical properties testing, and polished rod liners as defined herein for use in the sucker rod lift method for the petroleum and natural gas industry.

Normative Annexes B through K specify equipment requirements, normative Annexes L through M provide for the calibration of measuring equipment and mechanical properties testing requirements, and informative Annexes N through P provide illustrations for polished rod liners, representative examples of discontinuities, and a sucker rod pumping system.

The specification does not cover sucker rod guides, sucker rod rotators, shear tools, on-off tools, stabilizer bars, sealing elements used in stuffing boxes, or interface connections for stuffing boxes and pumping tees. Also, installation, operation and maintenance of these products are not included in this specification. However, API 11BR has information on operation and maintenance of these products.

Sucker rod pins manufactured to the maximum allowance for D_{SR} and R_{SR} prior to the 28th Edition can interfere with couplings manufactured to the minimum allowance for D_{F2} in prior editions. The 28th Edition resolves the interference between sucker rod pins and couplings. However, the potential for interference remains between couplings manufactured to the 28th Edition and sucker rod pins manufactured to prior editions or sucker rod pins manufactured to the 28th Edition and couplings manufactured to prior editions.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

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

API Recommended Practice 5B1, *Gauging and Inspection of Casing, Tubing, and Line Pipe Threads*

API Specification 6A, *Specification for Wellhead and Tree Equipment*

ASME B89.1.5 ¹, *Measurement of Plain External Diameters for Use as Master Discs or Cylindrical Plug Gages*

ASME B89.1.9, *Gage Blocks*

ASME B89.1.17, *Measurement of Thread Measuring Wires*

ASNT SNT-TC-1A ², *Personnel Qualification and Certification in Nondestructive Testing*

¹ ASME International, Two Park Avenue, New York, NY 10016-5990, www.asme.org.

² American Society for Nondestructive Testing, PO Box 28518, 1711 Arlingate Lane, Columbus, OH 43228, www.asnt.org.

ASTM A395/A395M³, *Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures*

ASTM A751, *Standard Test Methods and Practices for Chemical Analysis of Steel Products*

ASTM D2583, *Standard Test Method for Indention Hardness of Rigid Plastics by Means of a Barcol Impressor*

ASTM D2584, *Standard Test Method for Ignition Loss of Cured Reinforced Resins*

ASTM D4475, *Standard Test Method for Apparent Horizontal Shear Strength of Pultruded Reinforced Plastic Rods by the Short-Beam Method*

ASTM E83, *Standard Practice for Verification and Classification of Extensometer Systems*

ASTM E384, *Standard Test Method for Microindentation Hardness of Materials*

3 Terms and Definitions

For the purpose of this document the following terms and definitions apply. For quality-system-related terms used in this specification and not defined below, see API Q1.

3.1

batch lot processing

Material processed in a machine in defined quantities or volumes.

3.2

bend

A deviation from the theoretical central axis of a bar measured on the concave side.

NOTE Specific requirements for bends are found in applicable product annexes.

3.3

body

The length of the rod located between the upset transitions; see Figure C.1.

3.4

body holding pressure

The rated pressure the outer housing(s) of the stuffing box assembly or pumping tee is designed to contain.

3.5

bundle

A collection of sucker rods, pony rods, sinker bars, polished rods, etc., tied or wrapped up together without specific spacers.

3.6

cold rolled

A manufacturing process that involves forming bars or tubes of steel below the steel's recrystallization temperature.

³ ASTM International, PO Box C700, 100 Barr Harbor Drive, West Conshohocken, PA 19428, www.astm.org.

3.7**cold worked**

A special process requiring validation that is limited to cold drawing and die sizing but excludes all other processes.

3.8**continuous processing**

Material flowing steadily through the processing equipment in an undefined quantity or volume.

3.9**couplings**

Internally threaded components used to connect sucker rods, sinker bars, pony rods, or polished rods from the surface to the subsurface pump where both threads are of the same size and type.

3.10**crate**

An enclosed container used for transporting or storing product.

3.11**dent**

Local change in surface contour caused by mechanical impact but not accompanied by a loss of metal.

3.12**discontinuity**

Interruption in the normal physical structure or configuration such as cracks, laps, seams, pits, and laminations.

3.13**end shear crack**

Mill shear discontinuity that shows as a crack across the pin end face.

3.14**fiber reinforced plastic (FRP) sucker rod****pony rod**

Sucker rod or pony rod typically manufactured in three pieces and assembled by a process that provides connection of two metal end-fittings connected to a nonmetallic FRP rod body.

3.15**forging lap**

Discontinuity produced when two metal surfaces fold against each other without metallurgical bonding.

3.16**forging overfill**

Excessive metal stocking of the forging die resulting in a forging lap.

3.17**furnace lot**

Used for quality control purposes to identify when a partial amount of product is processed at a defined temperature and rate and is traceable to the original heat number of the product.

3.18**heat code**

Product identification marks that trace the specific chemical composition of the steel with respect to the material test report (MTR) from the steel mill, date of manufacture, and chemical composition of the grade of steel and heat number.

NOTE Also known as a manufacturer's heat code.

3.19**heat treatment**

The controlled heating and cooling of metals to alter their physical and mechanical properties without changing the product shape.

3.20**hot rolled****hot worked**

A manufacturing process that involves forming the steel at a high temperature [typically at temperatures over 1700 °F (926.7 °C)], which is above the steel's recrystallization temperature.

3.21**hydrocarbon removable coating**

A temporary coating used to provide atmospheric corrosion protection for products listed in the specification that is soluble in produced hydrocarbons.

3.22**independent calibration agency**

Organization providing calibration services that is independent of the manufacturer.

3.23**kink**

A deviation from the central axis of a bar measured on the concave side that is 0.125 in. (3.18 mm) or more as measured with a straight edge of 6 in. (152.4 mm) of length at the midpoint.

3.24**ksi**

Kilopound per square inch is a scale unit derived from pound per square inch (psi), equivalent to 1000 psi (6.895 MPa).

3.25**longitudinal**

Direction along the long axis of the rod that is parallel to the direction of maximum elongation in a worked material.

3.26**longitudinal discontinuity**

Discontinuity where the orientation of the long axis of the discontinuity is within $\pm 60^\circ$ from the longitudinal direction and is longer in the longitudinal direction than in the transverse direction.

3.27**material test report****MTR**

A certified document provided by a mill or processor for a specific melt of steel that states the date of manufacture, heat number, chemical composition, mechanical properties [e.g. yield strength, tensile strength, elongation, reduction of area (ROA), etc.], and hardness, as applicable.

3.28**micro-crack**

Crack undetectable by unaided visual inspection.

3.29**nick**

Local change in surface contour accompanied by a loss in metal caused by mechanical impact.

3.30**on-off tool**

Two-piece, reusable tool that provides a means of remotely connecting and disconnecting the sucker rods at or above the sucker rod pump.

3.31**operating working pressure**

The rated pressure the stuffing box assembly, with seal section and packing, or pumping tee is designed to contain.

3.32**out-of-round**

The difference between the maximum and minimum diameters of the bar, measured at the same cross-section.

3.33**out-of-square**

The difference in the two dimensions at the same cross-section of a square bar, each dimension being the distance between opposite sides.

3.34**pit**

A small, regular, or irregular crater or cavity in the surface of a material created by exposure to the environment or manufacturing processes.

3.35**polished rod**

Rod of standard length and diameter with a surface finish designed to facilitate a pressure seal in a stuffing box and to provide a mechanical link between equipment inside and outside the well.

3.36**polished rod clamp**

Device attached to the polished rod, which in conjunction with the pumping unit carrier bar secures a polished rod to the surface pumping unit.

3.37**polished rod liner**

A hard, spray metal, thin-walled tube that is installed with a pack off/seal over a polished rod and with a smooth outer surface to seal against the stuffing box internal packing/seal.

3.38**pony rod**

Sucker rod of reduced length used to place the pump at the desired depth in the well.

3.39**processor**

A supplier or company that transforms (metallurgically, dimensionally, etc.) product that will later be reprocessed by the manufacturer of equipment under this specification.

3.40**pull back**

Discontinuity in the spray metal coating where the coating does not extend to its intended surface coverage.

3.41**pumping tee**

Tubing fitting assembled to the top of a pumping well and below a stuffing box, designed to discharge production fluids through a side opening connected to a flow line.

3.42**qualified person**

Personnel with characteristics or abilities gained through training and/or experience as measured against established requirements, standards, or tests that enable the individual to perform a required function.

3.43**reference master gauge**

Gauge that is used for verification/calibration of working gauges.

3.44**rod guides**

Metallic or polymeric materials attached to the rod string to centralize the sucker rods and reduce sucker rod and tubing wear and/or reduce paraffin buildup.

3.45**rod pallet**

A strapped package of sucker rods, pony rods, and sinker bars with nonabrasive spacers to avoid metal-to-metal contact and bending during handling, transportation, or storing.

3.46**rod rotator**

Mechanical device that rotates the rod string to circumferentially distribute wear.

3.47**rod string**

Assembly of sucker rods, pony rods, polished rod, sinker bars, couplings, sub-couplings, and a polished rod clamp, as required, to actuate a subsurface rod pump.

3.48**rolled-in-scale**

Surface discontinuity caused by scale (metal oxide) formed during a previous heating that has not been removed prior to bar rolling or upset forging.

3.49**rolling lap**

Longitudinal surface discontinuity that can have the appearance of a seam, caused during rolling, fins, or sharp corners being folded over and then rolled into the bar surface without metallurgical bonding.

3.50**rolling overfill**

Raised ridges formed during bar rolling.

3.51**scab (sliver)**

Loose or torn segment of material or debris longitudinally rolled into the surface of the bar.

3.52**seam**

Longitudinal discontinuity that can be closed or open, but without metallurgical bonding, which can have the appearance of a straight line, scratch, or small longitudinal separation.

3.53**shake**

Perceptible movement of a ring gauge when rocked back and forth on the set plug.

3.54**shear tool**

Straight line pull safety joint release that provides a means of disconnecting the rod string from the pump below the tool.

3.55**sinker bar**

A steel rod of a specified length, normally in a larger diameter than the sucker rod, provided in standard sizes with externally threaded ends provided to add weight and stability to the rod string.

3.56**stabilizer bars**

Special pony rod with rod guides, normally used above the pump or between the sinker bars.

3.57**stuffing box**

Device with accessory sealing elements used in conjunction with the polished rod to facilitate sealing of the well bore.

3.58**sub-couplings**

Internally threaded components with polished rod threads used to connect polished rods, pony rods, sucker rods, or sinker bars to the subsurface pump, or to each other, where the threads on each end of the coupling are not of the same size.

3.59**sucker rod**

Steel or FRP rod of standard length and diameter with externally threaded ends, typically used for transmitting mechanical power to the subsurface pump.

3.60**sucker rod body**

The portion of the sucker rod or pony rod between the upset tapers.

3.61**sucker rod lift**

Artificial lift method that lifts fluids (oil, water, condensate, and/or gas) from a well with a sucker rod string and subsurface rod pump operating in a linear reciprocating mode.

3.62**thread flank**

The side of the thread between the crest and root of the thread.

3.63**thread rolling****thread forming processes**

Thread rolling and thread forming processes are manufacturing methods where threads are formed by cold pressing a shaped tool into the material to form the material into the desired shape.

NOTE A “rolling die” is used when an external (pin) thread is rolled while a “tap” is used to form internal (box) threads for couplings and sub-couplings. Cold forming threads by rolling or forming increases the yield strength and

hardness properties while wear resistance is increased and surface roughness is reduced since the threads are cold formed vs being cut.

3.64

transverse discontinuity

Discontinuity where the orientation of the long axis of the discontinuity is within $\pm 30^\circ$ from the transverse direction and is longer in the transverse direction than in the longitudinal direction.

3.65

underfill

Portion of the upset forging with a depression (typically insufficient metal) formed during forging.

3.66

upset transition

The end of the rod body where the rod diameter increases to the upset bead.

3.67

working gauge

Gauge used for direct measurement of product.

4 Variables, Acronyms, and Gauge List

4.1 Variables

Variables used within this specification are defined as follows.

A _{BC}	angle, box cone
A _{PC}	angle, pin cone
A _{TC}	angle, thread chamfer
B _{OR}	bar, out-of-roundness
D _{B1}	diameter, box thread major
D _{B2}	diameter, box thread minor
D _{BC}	diameter, box counterbore
D _{BP}	diameter, box thread pitch
D _{CS}	diameter, coupling and sub-coupling
D _{EF}	diameter, end fitting
D _{EN}	diameter, elevator neck
D _{F1}	diameter, contact face major
D _{F2}	diameter, contact face minor
D _{FE}	diameter, end fitting extension
D _{NL}	diameter, non-coated length (applies to polished rods with spray metal coating—only)

D _{P1}	diameter, pin thread major
D _{P2}	diameter, pin thread minor
D _{PP}	diameter, pin thread pitch
D _{PR}	diameter, polished rod
D _{PS}	diameter, pin shoulder
D _{RB}	diameter, rod body
D _{SB}	diameter, sinker bar
D _{SH}	diameter, pin shank
D _{SR}	diameter, stress relief
D _{TBC}	diameter, theoretical box cone
D _{TCB}	diameter, cone base
D _{UB}	diameter, upset bead
L _{BC}	length, box counterbore
L _{BD}	length, total depth of box
L _{BT}	length, perfect box thread
L _{BTM}	length, bottom portion of the polished rod
L _{CS}	length, coupling and sub-coupling
L _{EF}	length, end fitting
L _{EN}	length, elevator neck
L _{PF}	length, pin shoulder to the start of the wrench flat, including fillets
L _{PP}	length, total pin
L _{PR}	length, polished rod
L _{PS}	length, pin shoulder
L _{RD}	length, steel or FRP sucker rod and/or pony rod
L _{SB}	length, sinker bar
L _{SE}	length, pin shoulder to elevator neck
L _{SP}	length, steel or FRP sucker rod and/or pony rod pin
L _{SR}	length, stress relief

L _{SS}	length, seal section
L _{ST}	length, spray metal coating transition
L _{TBC}	length, theoretical box cone
L _{TCB}	length, to cone base
L _{TOP}	length, top portion of the polished rod that is non-spray metal coated
L _{TPC}	length, theoretical pin cone
L _{WF}	length, wrench flat
L _{WS}	length, wrench square
P _{F1}	parallelism, contact face
P _{PS}	parallelism, pin shoulder
R _{CS}	radius or chamfer, coupling and sub-coupling
R _{PS}	radius or chamfer, pin shoulder
R _{SH}	radius, pin shank
R _{SR}	radius, stress relief
R _{UB}	radius, upset bead
R _{UT}	radius, upset transition
S _{NT}	size, nominal thread
S _{P4}	standoff, P4 pin-cone ring gauge
T _{PRB}	threads, polished rod box
T _{PRP}	threads, polished rod pin
T _{SRB}	threads, sucker rod box
T _{SRP}	threads, sucker rod pin
W _{WF}	width, wrench flat
W _{WS}	width, wrench square

4.2 Acronyms

Acronym used within this specification are defined as follows.

AQL	acceptable quality level
BHN	Brinell Hardness

EU	external-upset
FRP	fiber reinforced plastic
HOF	halt of force
HNBR	hydrogenated nitrile butadiene rubber
HRC	Hardness Rockwell C-scale
HV ₂₀₀	Vickers Hardness
ID	inside diameter
ILAC MRA	International Laboratory Accreditation Cooperation Mutual Recognition Arrangement
MTR	material test report
NDE	nondestructive examination
NIST	National Institute of Standards and Technology
NU	non-upset
OD	outside diameter
PR	polished rod
R _a	average roughness
ROA	reduction of area
SR	sucker rod
TMME	testing, measuring, and monitoring equipment
UN	unified national
UNR	unified national rounded
UNS	Unified Numbering System (for steel grades)
UTM	ultimate tensile machine

4.3 Gauge List

Symbols used within the specification for gauges are defined as follows.

B2	gauge, go box-thread plug
B2B _s	diameter, major
B2D _f	diameter, plug collar
B2D _{tr}	diameter, thread relief

B2E _s	diameter, pitch
B2L _p	length, plug
B2L _s	length, thread
B3	gauge, box-cone ring
B3D _f	diameter, ring collar
B3D _{rc}	diameter, ring cone
B3K _s	diameter, minor
B3L _r	length, ring
B4	gauge, box-cone plug
B4B _s	diameter, major
B4D _f	diameter, plug collar
B4D _{pc}	diameter, plug cone at gauge point
B4D _{tr}	diameter, relief
B4E _s	diameter, pitch
B4L _{gp}	length, gauge point of cone
B4L _p	length, plug
B4L _s	length, thread
B6	gauge, no-go box-thread plug
B6B _s	diameter, major
B6E _s	diameter, pitch
B6L _s	length, thread
P1	gauge, go pin-thread truncated setting plug
P1B _s	diameter, full-form major
P1B _{st}	diameter, truncated major
P1D _f	diameter, plug collar
P1D _{tr}	diameter, thread relief
P1E _s	diameter, pitch
P1L _p	length, plug

P1L _s	length, thread
P1L _{st}	length, truncated portion
P2	gauge, go pin-thread ring
P2D _f	diameter, ring collar
P2D _q	diameter, counterbore
P2K _s	diameter, minor
P2L _f	length, ring
P3	gauge, pin-cone plug
P3B _s	diameter, major
P3D _f	diameter, plug collar
P3D _{pc}	diameter, plug cone at gauge point
P3D _{tr}	diameter, thread relief
P3E _s	diameter, pitch
P3L _{gp}	length, to gauge point of cone
P3L _p	length, plug
P3L _s	length, thread
P4	gauge, pin-cone ring
P4D _f	diameter, plug or ring collar
P4D _{rc}	diameter, ring cone
P4K _s	diameter, minor
P4L _r	length, ring
P5	gauge, no-go pin-thread truncated setting plug
P5B _s	diameter, full-form major
P5B _{st}	diameter, truncated major
P5E _s	diameter, pitch
P5L _s	length, thread
P5L _{st}	length, truncated portion
P6	gauge, no-go pin-thread ring

P6K _s	diameter, ring minor
P6L _r	length, ring
P7	gauge, go pin-thread truncated setting plug
P7B _s	diameter, full-form major
P7B _{st}	diameter, truncated major
P7D _f	diameter, plug or ring collar
P7D _{tr}	diameter, thread relief
P7E _s	diameter, pitch
P7L _p	length, plug
P7L _s	length, thread
P7L _{st}	length, truncated portion ($\frac{1}{2}$ of P7L _s)
P8	gauge, go pin-thread ring gauge
P8D _f	diameter, plug or ring collar
P8D _q	diameter, counterbore
P8K _s	diameter, minor
P8L _q	length, counterbore
P8L _r	length, ring

5 Functional Requirements

To order products that conform to this specification, the user or purchaser may determine the applicable well and environmental operational conditions, specify the requirements, and/or identify the supplier's or manufacturer's specific products. Additional detailed ordering information can be found in Annexes C through K and Annex N. Requirements may be conveyed to the manufacturer by means of the manufacturer's part number, data sheet, or other suitable documentation.

The following requirements may be specified as applicable:

- a) required fluid volume or loads to be applied to the products;
- b) material type and grade;
- c) well depth, pump size, tubing size, or other mechanical well parameters;
- d) well bore configuration (such as deviation, dog-legs, etc.);
- e) produced fluid chemical and physical composition, including produced solids (sand production, scale, etc.) to which the products are exposed during their full cycle;

- f) the selected surface drive system;
- g) pressure ratings, if applicable;
- h) bottom hole static temperature and pressure;
- i) planned chemical treatments; and
- j) bottom hole producing temperature and pressure.

6 Technical Requirements

6.1 General Requirements

Sucker rod pins manufactured to the maximum allowance for D_{SR} and R_{SR} prior to the 28th Edition can interfere with couplings manufactured to the minimum allowance for D_{F2} in prior editions. The 28th Edition resolves the interference between sucker rod pins and couplings. However, the potential for interference remains between couplings manufactured to the 28th Edition and sucker rod pins manufactured to prior editions or sucker rod pins manufactured to the 28th Edition and couplings manufactured to prior editions.

6.2 Design Requirements

6.2.1 Design Documentation

The design shall conform to the requirements of this specification. Design documentation shall as a minimum include drawings and, as applicable, assumptions, formulas, calculations, design requirements, testing, and acceptance criteria. Design documentation medium shall be clear, legible, reproducible, and retrievable. It shall include design verification, validation, reviews, and any necessary actions.

6.2.2 Design Review

Designs shall be reviewed and verified by a qualified person other than the person(s) who developed the original design to evaluate the ability of the design to meet requirements.

6.2.3 Design Verification

Design verification shall be performed to ensure that each product design meets the manufacturer's technical specifications.

6.2.4 Design Validation

Design validation shall be performed to ensure that the resulting product is capable of meeting the requirements for the specified application or intended use.

6.2.5 Design Changes

Design changes and changes to design documents that affect conformance to this specification shall require application of the same control features as those used to develop the original design.

6.3 Materials

6.3.1 General

The manufacturer shall have and conform to documented specifications for all materials used in products manufactured to this specification.

Cast bars or previously used rods shall not be used as bar stock for manufacturing sucker rods, pony rods, couplings, sinker bars, and/or polished rods.

6.3.2 Metals

6.3.2.1 General

Materials used for the manufacture of products made in accordance with this specification shall be as specified in the applicable annexes.

6.3.2.2 Material Test Report (MTR)

MTRs provided by the steel mill or processor for materials used to manufacture products with traceability requirements shall include the following.

- a) For materials that will be subsequently heat treated or cold worked: date of manufacture, heat number, and chemical composition.
- b) For materials that will be used as received and not subsequently heat treated or cold worked: date of manufacture, heat number, chemical composition, yield strength, ultimate tensile strength, elongation, reduction in area, and hardness, as applicable.

MTRs shall be maintained by the manufacturer for a period of at least five years. These records shall be available to the end user upon request.

6.3.3 Nonmetallic Materials for FRP Sucker Rods

The manufacturer shall develop specifications for nonmetallic materials and shall define those characteristics critical to the performance of the material.

7 Manufacturer Requirements

7.1 General

As a minimum, each of the following topics shall be addressed by the manufacturer.

7.2 Quality Control

7.2.1 General

To maintain accuracy, equipment used to measure, test, and gauge products manufactured in accordance with this specification shall be identified, controlled, inspected, calibrated, and adjusted, if necessary. This shall be performed at specified intervals in accordance with the manufacturer's specifications and the requirements of this specification.

Specific testing and inspecting criteria, including dimensional inspecting, and gauging, for each specific product are listed in the applicable annex.

Technologies for inspections with verifiable accuracies equal to or better than those listed in this specification may be applied with appropriate documentation approved by a qualified person.

7.2.2 Testing, Measuring, and Monitoring Equipment (TMME) (Except for Thread Gauges)

Owners and users of TMME shall establish and document a system of calibration and control. Records shall be maintained that show conformance of TMME to the design and calibration requirements. The calibration system shall establish the frequency of test. Records of calibration shall show the last calibration date, identity of the individual who performed the calibration, and calibration history.

Calibration standards used to calibrate TMME shall be checked and approved at a minimum of once a year by a national standards institute or an organization accredited by a signatory of the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA).

7.2.3 Thread Gauges

7.2.3.1 General

Owners and users of reference master and working gauges shall establish and document a system of gauge calibration and control. Records shall be maintained that show conformance of gauges to the design and calibration requirements of this specification. The calibration system shall establish the frequency of test in conformance with 7.2.3.2 through 7.2.3.4. Records of calibration shall show the last calibration date, identity of the individual who performed the calibration, and calibration history. When reference master gauges are not on the site of the gauge user, copies of the calibration certificate for the reference master gauges shall be maintained at the user site.

7.2.3.2 Plug and Ring Gauges

Plug and ring gauges shall be tested according to the schedule below to ensure compliance with specified limits.

7.2.3.3 Reference Master Gauges

Reference master gauges (P3, P4, B3, and B4) shall be tested for mating standoff at least once each seven years and certified on a Certificate of Retest as being acceptable for further use. The certificate of test shall also report the mating standoff of the gauges.

7.2.3.4 Working Gauges

Working gauges shall be tested periodically. The frequency at which working gauges should be tested depends entirely upon the amount of use. Guidance may be found in ILAC G24. Frequency of testing shall ensure that gauges are maintained within the requirements of this specification.

7.2.4 Personnel Qualifications

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

7.2.5 Product Acceptance

7.2.5.1 General

Products designed and manufactured in accordance with this specification shall conform to the requirements of the appropriate annexes of this specification. Records shall be maintained for a minimum of five years for all accepted finished products. When specified, nondestructive examinations (NDEs) shall

be performed and accepted per the manufacturer's documented specifications that include the acceptance criteria.

Dimensional inspection shall be performed by a qualified person to assure proper function and conformance with design criteria, specifications, and final component dimensions.

7.2.5.2 Frequency and Acceptance of Inspection

7.2.5.2.1 Batch Lot Processing

Unless otherwise stated in an annex, the frequency and acceptance of inspection of manufacturing lots for sucker rods, pony rods, sinker bars, and polished rods shall be in accordance with the acceptance criteria for the single sampling plan for normal inspection, General Inspection Level I, acceptable quality level (AQL) of 4.0 % ⁴, as specified in Table 1. More stringent inspection plans are acceptable.

Table 1—Single Sampling Plans for Normal Inspection, General Inspection Level I, AQL of 4 %

(1) Lot Size	(2) Sample Size	(3) Number of Parts, Accept Lot	(4) Out of Specification, Reject Lot ^a
2 to 8	2	0	1
9 to 15	2	0	1
16 to 25	3	0	1
26 to 50	5	0	1
51 to 90	5	0	1
91 to 150	8	1	2
151 to 280	13	1	2
281 to 500	20	2	3
501 to 1,200	32	3	4
1,201 to 3,200	50	5	6
3,201 to 10,000	80	7	8
10,001 to 35,000	125	10	11
35,001 to 150,000	200	14	15
150,001 to 500,000	315	21	22
>500,000	500	21	22

^a 100 % inspection (sort) of rejected parts is acceptable practice.

Unless otherwise stated in an annex, the frequency and acceptance of inspection of manufacturing lots for couplings, pumping tees, stuffing boxes, polished rod liners, and polished rod clamps shall be in accordance with the acceptance criteria for the single sampling plan for normal inspection, General Inspection Level II, AQL of 10.0 %, as specified in Table 2. More stringent inspection plans are acceptable.

⁴Tables 1 and 2 are based upon ANSI/ASQ Z1.4-2008 (R2013).

Table 2—Single Sampling Plans for Normal Inspection, General Inspection Level II, AQL of 10 %

Lot Size	Sample Size	Number of Parts, Accept Lot	Out of Specification, Reject Lot ^a
2 to 8	2	1	2
9 to 15	3	1	2
16 to 25	5	1	2
26 to 50	8	2	3
51 to 90	13	3	4
91 to 150	20	5	6
151 to 280	32	7	8
281 to 500	50	10	11
501 to 1,200	80	14	15
1,201 to 3,200	125	21	22
3,201 to 10,000	200	21	22
10,001 to 35,000	315	21	22
35,001 to 150,000	500	21	22
150,001 to 500,000	800	21	22
>500,000	1,250	21	22

^a 100 % inspection (sort) of rejected parts is acceptable practice.

Products shall be dimensionally inspected for conformance to the manufacturer's drawing and written specifications. The frequency of dimensional inspections for batch lot processing shall be accomplished according to the random sampling plans shown in Table 1 for sucker rods, pony rods, sinker bars, and polished rods or Table 2 for couplings, sub-couplings, pumping tees, stuffing boxes, polished rod liners, and polished rod clamps.

Acceptance criteria also may be based on continuous monitoring and statistical process control such as described in ANSI/ASQ Z1.4-2008 (R2013).

7.2.5.2.2 Continuous Processing

For continuous processing, a minimum of AQL 10 % (Table 2) of the produced parts shall be inspected. Processing of nonconforming items shall conform to 7.2.6. Parts manufactured prior to the nonconforming items shall be inspected back to the last acceptable part, and the nonconforming parts shall be dispositioned according to the manufacturer's documented procedures. Acceptance criteria may be based on continuous monitoring and statistical process control such as described in ANSI/ASQ Z1.4-2008 (R2013).

7.2.5.3 Threads

All connections shall conform to the gauging practices of this specification. Manufacturers that produce pumping tees and/or stuffing boxes shall conform to the additional requirements of API 5B, as these products require reference master gauges.

7.2.6 Manufacturing Nonconformances

The manufacturer shall establish and maintain documented procedures to ensure that product that does not conform to specified requirements is prevented from unintended use or installation. This control shall provide for identification, evaluation, segregation, and disposition of nonconforming assemblies or components.

The responsibility for review and authority for the disposition of nonconforming product shall be defined by the manufacturer. Nonconforming product shall be:

- a) reworked to meet the specified requirements or the specified requirements of another product;

- b) accepted without repair by concession of a manufacturer's qualified and authorized person, provided the concession is within the design acceptance criteria and at no time is this product allowed to violate the requirements of this specification; or
- c) rejected or scrapped.

Records of the nature of nonconformities and any subsequent actions taken, including concessions obtained, shall be maintained in accordance with manufacturer's documented procedures. These records shall be retained for a minimum of five years.

7.2.7 Coatings

Coatings shall be controlled by documented processing instructions, which have been approved by a qualified person. These instructions shall include acceptance criteria.

7.2.8 Heat Treating Furnace Instrumentation

Automatic controlling and recording instruments shall be used. Thermocouples shall be located in the furnace working zone(s). The controlling and recording instruments used for the heat treatment processes shall possess accuracy to within ± 1 % of their full-scale range. Temperature controlling and recording instruments shall be calibrated at least once every six months until a documented calibration history can be established. Calibration intervals shall then be established based on repeatability, degree of usage, and documented calibration history. Equipment used to calibrate the furnace equipment shall possess accuracy to within ± 0.25 % of full-scale range.

7.2.9 Nondestructive Examination (NDE)

When NDE is used, instructions shall be detailed in the manufacturer's documented procedures and conform to the requirements of this specification. All NDE instructions shall be approved by a Level III examiner qualified in accordance with an international or national standard such as ASNT SNT-TC-1A or ISO 9712.

Personnel performing NDE shall be qualified to at least Level II for evaluation and interpretation in accordance with an international or national standard such as ASNT SNT-TC-1A or ISO 9712. Any unacceptable indications shall be removed, repaired, and reexamined using the original NDE method.

In case discontinuities are detected by nonvisual NDE methods, the evaluation may be supplemented by visual examination and measurement to determine the size of the discontinuity at the option of the manufacturer.

7.2.10 Traceability

All products manufactured under this specification shall be traceable as required by the applicable annex. Traceability shall be in accordance with the manufacturer's documented procedures. Traceability is considered sufficient if the product meets the traceability requirements of this specification when it leaves the manufacturer's inventory.

7.3 Product Identification

All products manufactured under this specification shall be marked in accordance with the requirements detailed in the appropriate normative annex and the manufacturer's documented procedures.

7.4 Documentation

The manufacturer shall establish and maintain documented procedures to control documents and data required by this specification. These documents and data shall be clear, legible, reproducible, and retrievable. These documents and data shall be retained in facilities that provide an environment that prevents damage, deterioration, or loss. Documents and data may be in the form of any type of medium, such as hard copy or electronic media, and shall be retained for a minimum of five years from the date of manufacture.

7.5 Special Processes Requiring Validation

Heat treatment, spray metal coating, and NDE are special processes requiring validation for products covered by this specification.

Annex A

(informative)

Use of API Monogram by Licensees

The information in this annex has been intentionally removed.

See API Specification Q1, Annex A or the API website for information pertaining to the API Monogram Program and use of the API Monogram on applicable products.

Annex B

(normative)

Thread Form Requirements

B.1 General

The threaded portions of steel sucker rods and pony rods (Annex C), fiberglass reinforced plastic (FRP) sucker rods and pony rods (Annex D), sinker bars (Annex E), polished rods (Annex F), and sucker rod couplings, polished rod couplings, and sub-couplings (Annex G) shall conform to the thread form requirements in this annex.

The threaded portions of pumping tees (Annex I) and lower stuffing box bodies (Annex J) shall conform to the thread form requirements in API 5B and API 5B1. The manufacturer shall develop documented specifications for all other threaded components, if applicable, and shall define those characteristics critical to the performance of the assembled product.

The manufacturer shall develop documented specifications for all threaded components for polished rod liners (Annex N), if applicable, and shall define those characteristics critical to the performance of the assembled product.

The manufacturer shall develop documented specifications for all threaded components (e.g. bolts) for polished rod clamps (Annex K) and shall define those characteristics critical to the performance of the assembled product.

B.2 Thread Types

B.2.1 General

There are two thread types used for manufacturing products in Annex C through Annex G. These consist of:

- 1) sucker rod threads, pin and box, and
- 2) polished rod threads, pin and box.

All thread types for products in Annex C through Annex G shall be manufactured by thread rolling or thread forming. Thread rolling or thread forming shall occur after final heat treatment, spray metal coating, and other special processes that require validation (except for products in Annex F).

B.2.2 Sucker Rod Threads, Pin and Box

Sucker rod pin threads (T_{SRP}) shall be furnished on steel sucker rods and pony rods (Annex C), FRP sucker rods and pony rods (Annex D), sinker bars (Annex E), and on the upset pin-end of polished rods (Annex F). Sucker rod box threads (T_{SRB}) shall be furnished on sucker rod couplings (Annex G).

Sucker rod couplings, polished rod couplings, and sub-couplings (Annex G) can be used with sucker rod pin threads (T_{SRP}).

B.2.3 Polished Rod Threads, Pin and Box

Polished rod pin threads (T_{PRP}) shall be furnished on the non-upset (NU) end(s) of polished rods (Annex F) and available as an option on sinker bars (Annex E). Polished rod box threads (T_{PRB}) shall be furnished on polished rod couplings and sub-couplings (Annex G).

Polished rod couplings or sub-couplings (Annex G) can be used with polished rod pin threads (T_{PRP}) or sucker rod pin threads (T_{SRP}).

Sucker rod couplings shall not be used with polished rod pin threads. The thread minor diameter on the sucker rod coupling interferes with the minor diameter of the 9° pin cone preventing proper makeup and may result in failure of the sucker rod coupling or polished rod pin.

B.3 Thread Form Requirements

B.3.1 General

Sucker rod and polished rod threads are straight threads (see Figure B.1). The threaded portion shall be 10 threads per inch and are based on the unified thread form with Class 2A-2B tolerances and allowances, as defined in ANSI/ASME B1.1. The specific dimensional requirements and the required gauging (Annex H) shall be based on the actual dimensional requirements in this specification.

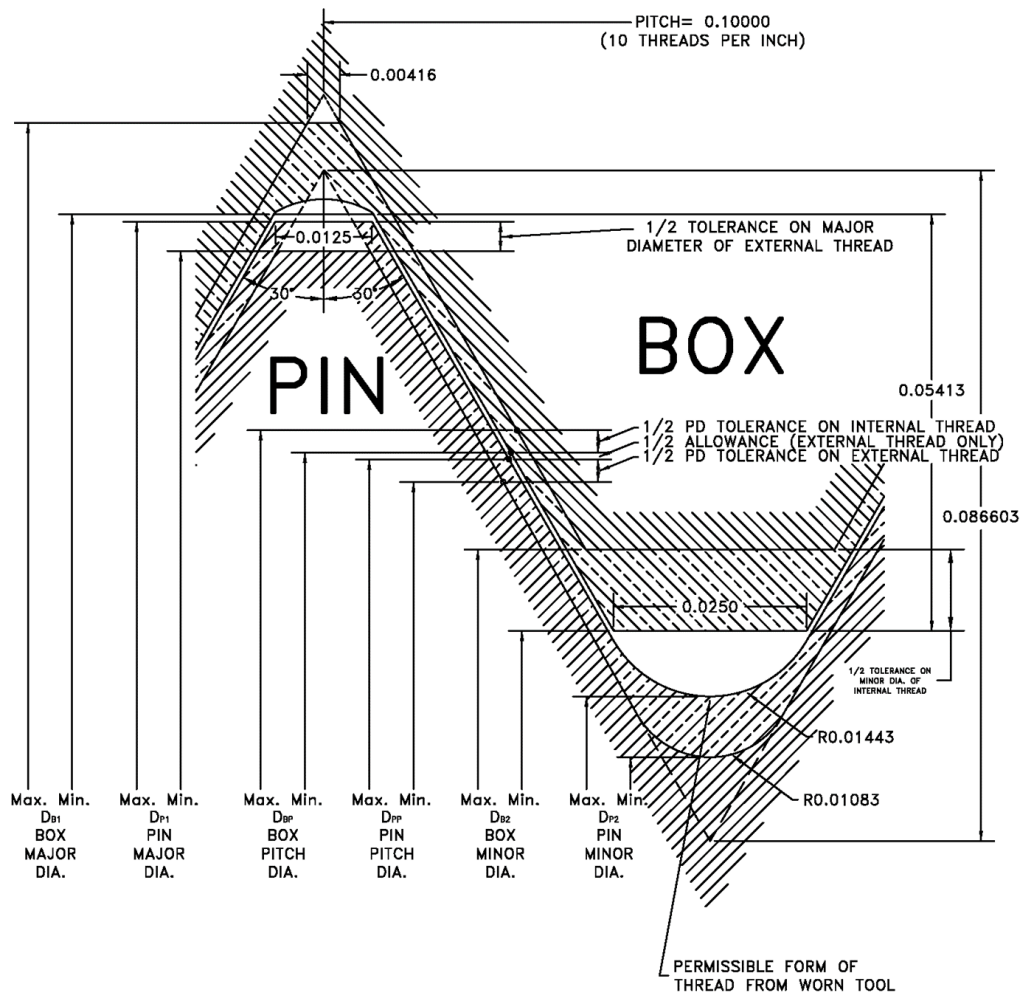


Figure B.1—Thread Form Illustration

B.3.2 Sucker Rod Pin Threads

Sucker rod pin threads (T_{SRP}) shall be furnished in the configuration shown in Figure B.2 and the nominal thread sizes (S_{NT}) in Table B.1. The design profile of the T_{SRP} is a special type of unified national rounded (UNR) thread with a rounded root contour as shown in Figure B.1.

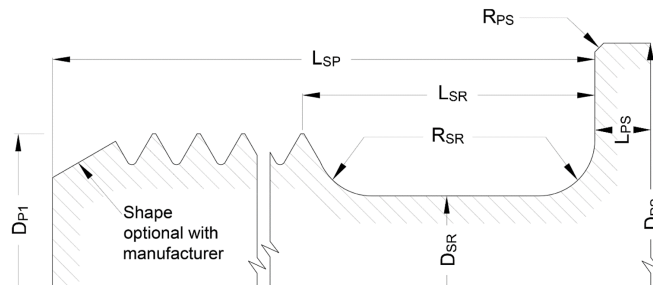
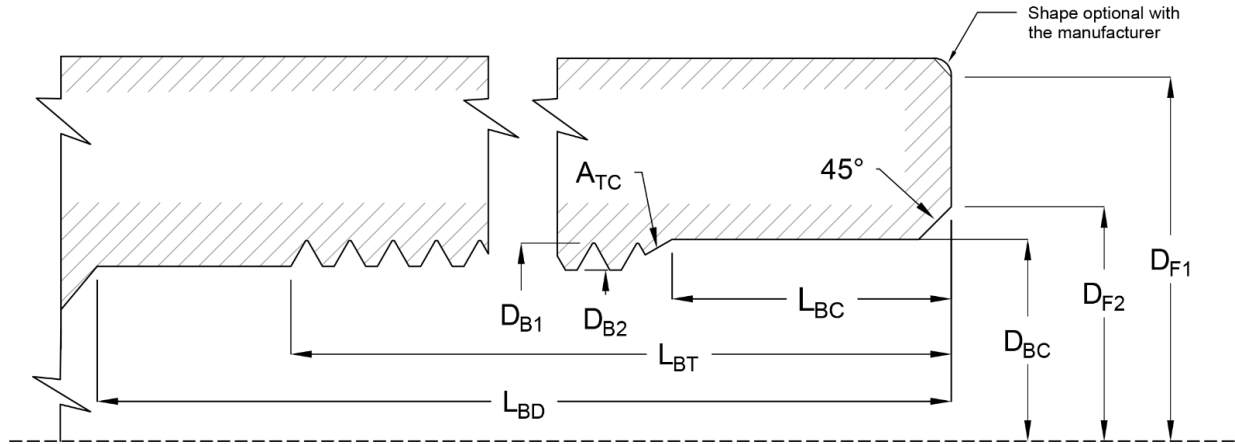
Figure B.2—Sucker Rod Pin with Sucker Rod Pin Thread (T_{SRP}) Illustration

Table B.1—Dimensions for Sucker Rod Pins with Sucker Rod Pin Threads (T_{SRP})

Dimensional Element ^a		Nominal Thread Size (S_{NT})				
		$\frac{5}{8} T_{SRP}$ in. (mm)	$\frac{3}{4} T_{SRP}$ in. (mm)	$\frac{7}{8} T_{SRP}$ in. (mm)	1 T_{SRP} in. (mm)	1 $\frac{1}{8} T_{SRP}$ in. (mm)
DP ₁ ^b Diameter, pin thread major	Maximum	0.9362 (23.779)	1.0611 (26.952)	1.1861 (30.127)	1.3735 (34.887)	1.5609 (39.647)
	Minimum	0.9233 (23.452)	1.0482 (26.624)	1.1732 (29.799)	1.3606 (34.559)	1.5480 (39.319)
DP ₂ ^b Diameter, pin thread minor	Maximum	0.8135 (20.663)	0.9384 (23.835)	1.0634 (27.010)	1.2508 (31.770)	1.4382 (36.530)
D _{PP} ^b Diameter, pin thread pitch	Maximum	0.8712 (22.128)	0.9962 (25.303)	1.1211 (28.476)	1.3085 (33.236)	1.4960 (37.998)
	Minimum	0.8654 (21.981)	0.9900 (25.146)	1.1150 (28.321)	1.3020 (33.071)	1.4892 (37.826)
D _{PS} Diameter, pin shoulder	Maximum	1.255 (31.88)	1.505 (38.23)	1.630 (41.40)	2.005 (50.93)	2.265 (57.53)
	Minimum	1.240 (31.62)	1.490 (37.85)	1.615 (41.02)	1.990 (50.55)	2.235 (56.77)
D _{SR} ^c Diameter, stress relief	Maximum	0.795 (20.19)	0.920 (23.37)	1.045 (26.54)	1.232 (31.29)	1.419 (36.04)
	Minimum	0.785 (19.94)	0.910 (23.11)	1.035 (26.29)	1.222 (31.04)	1.409 (35.79)
L _{PS} Length, pin shoulder	Minimum	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)
L _{SP} Length, sucker rod pin	Maximum	1.313 (33.34)	1.500 (38.10)	1.688 (42.86)	1.938 (49.21)	2.188 (55.56)
	Minimum	1.250 (31.75)	1.438 (36.51)	1.625 (41.28)	1.875 (47.63)	2.125 (53.98)
L _{SR} Length, stress relief	Maximum	0.547 (13.90)	0.625 (15.88)	0.703 (17.86)	0.828 (21.04)	0.906 (23.02)
	Minimum	0.516 (13.11)	0.594 (15.09)	0.672 (17.07)	0.797 (20.24)	0.875 (22.23)
R _{PS} ^d Radius or chamfer, pin shoulder	Maximum	0.031 (0.79)	0.031 (0.79)	0.031 (0.79)	0.063 (1.59)	0.063 (1.59)
R _{SR} Radius, stress relief	Maximum	0.141 (3.58)	0.141 (3.58)	0.141 (3.58)	0.141 (3.58)	0.141 (3.58)
	Minimum	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)
^a See Figure B.2. ^b See Figure B.1. ^c See 6.1. ^d The radius or chamfer shall not be sharp. Shape is optional with the manufacturer.						

B.3.3 Sucker Rod Box Threads

Sucker rod box threads (T_{SRB}) shall be furnished in the configuration shown in Figure B.3 and the nominal thread sizes (S_{NT}) in Table B.2. The design profile of the T_{SRB} is a special type of unified national (UN) thread having a flat root contour with a permissible round root contour beyond the $0.125 \times \text{pitch}$ ($0.125 p$) flat width to allow for crest wear. The hollow thread-crest from thread forming shall not be considered to be detrimental.

Figure B.3—Sucker Rod Coupling with Sucker Rod Box Thread (T_{SRB}) IllustrationTable B.2—Dimensions for Sucker Rod Couplings with Sucker Rod Box Threads (T_{SRB})

Dimensional Element ^a		Nominal Thread Size (S_{NT})				
		$5/8 T_{SRB}$ in. (mm)	$3/4 T_{SRB}$ in. (mm)	$7/8 T_{SRB}$ in. (mm)	1 T_{SRB} in. (mm)	1 $1/8 T_{SRB}$ in. (mm)
A_{TC} Angle, thread chamfer	Reference	30°	30°	30°	30°	30°
D_{B1} ^b Diameter, box thread major	Minimum	0.9380 (23.825)	1.0630 (27.000)	1.1880 (30.175)	1.3754 (34.935)	1.5630 (39.700)
D_{B2} ^b Diameter, box thread minor	Maximum	0.8510 (21.615)	0.9760 (24.790)	1.1010 (27.965)	1.2880 (32.715)	1.4760 (37.490)
	Minimum	0.8300 (21.082)	0.9550 (24.257)	1.0800 (27.432)	1.2670 (32.182)	1.4550 (36.957)
D_{BC} Diameter, box counterbore	Maximum	0.965 (24.51)	1.090 (27.69)	1.215 (30.86)	1.403 (35.64)	1.590 (40.39)
	Minimum	0.955 (24.26)	1.080 (27.43)	1.205 (30.61)	1.393 (35.38)	1.580 (40.13)
D_{BP} ^b Diameter, box thread pitch	Maximum	0.8806 (22.367)	1.0060 (25.552)	1.1310 (28.727)	1.3190 (33.503)	1.5068 (38.273)
	Minimum	0.8730 (22.174)	0.9980 (25.349)	1.1230 (28.524)	1.3105 (33.287)	1.4980 (38.049)
D_{F1} ^c Diameter, contact face major	Maximum	1.235 (31.37)	1.485 (37.72)	1.610 (40.89)	1.985 (50.42)	2.230 (56.64)
	Minimum	1.205 (30.61)	1.455 (36.96)	1.580 (40.13)	1.955 (49.66)	2.200 (55.88)
D_{F2} ^d Diameter, contact face minor	Maximum	1.110 (28.19)	1.235 (31.37)	1.360 (34.54)	1.547 (39.29)	1.734 (44.04)
	Minimum	1.080 (27.43)	1.205 (30.61)	1.330 (33.78)	1.517 (38.53)	1.704 (43.28)
L_{BC} Length, box counterbore	Maximum	0.500 (12.70)	0.500 (12.70)	0.500 (12.70)	0.500 (12.70)	0.500 (12.70)
	Minimum	0.438 (11.11)	0.438 (11.11)	0.438 (11.11)	0.438 (11.11)	0.438 (11.11)
L_{BD} ^e Length, total depth of box	Minimum	1.750 (44.45)	1.938 (49.23)	2.125 (53.98)	2.500 (63.50)	2.750 (69.85)

Dimensional Element ^a		Nominal Thread Size (S_{NT})				
		$\frac{5}{8} T_{SRB}$ in. (mm)	$\frac{3}{4} T_{SRB}$ in. (mm)	$\frac{7}{8} T_{SRB}$ in. (mm)	1 T_{SRB} in. (mm)	1 $\frac{1}{8} T_{SRB}$ in. (mm)
L_{BT} ^f Length, perfect box thread	Minimum	1.410 (35.81)	1.600 (40.64)	1.790 (45.47)	2.000 (50.80)	2.250 (57.15)

^a See Figure B.3.

^b See Figure B.1. Note that D_{B1} maximum is not specified.

^c D_{F1} diameter, contact face major maximum is not applicable to spray metal coated couplings and spray metal coated sub-couplings due to the allowable variation in coating thickness.

^d See 6.1.

^e For all sucker rod and polished rod couplings, the length of the total depth of box (L_{BD}) can only be achieved with a single bore through the coupling, eliminating the need for the L_{BD} dimension. For sub-couplings to achieve L_{BD} , the smaller thread bore shall meet the length of the perfect box thread (L_{BT}) dimension and possibly require a truncated tap for the larger thread bore to ensure the requirements of L_{BT} are met. In all cases, for the interface between two different size threads, the length of the threaded bore of the smaller size shall at a minimum be L_{BT} and tapped fully to depth to insure perfect thread form.

^f Length of the perfect box thread (L_{BT}) includes counterbore.

B.3.4 Polished Rod Pin Threads

Polished rod pin threads (T_{PRP}) shall be furnished in the configuration shown in Figure B.4 and the nominal thread sizes (S_{NT}) in Table B.3. The design profile of the T_{PRP} is a special type of UNR thread with a rounded root contour as shown in Figure B.1 with imperfect pin threads on the 9° taper as shown in Figure B.4. The 9° taper of the polished rod pin may not maintain the same height as the straight threaded portion. The 9° pin cone (A_{PC}) is critical for proper connection makeup. The start of angle A_{PC} is a reference point defined by the intersection of L_{TCB} and D_{TCB} dimensions and is blended into the thread root.

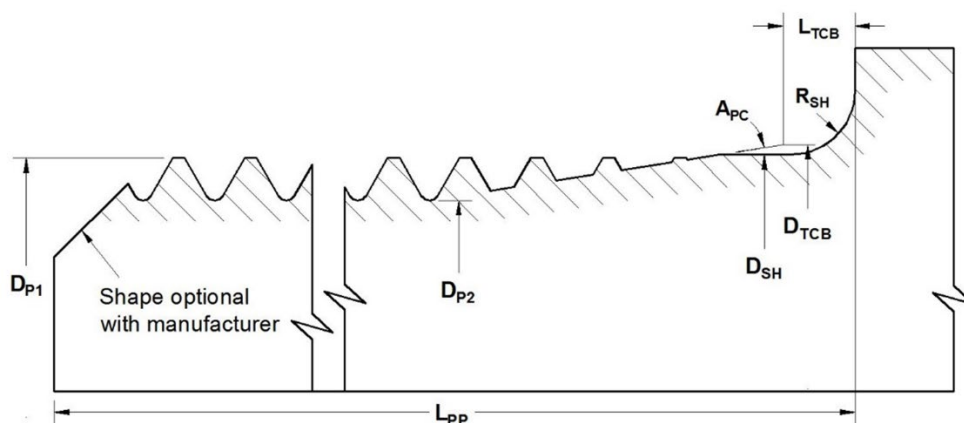


Figure B.4—Polished Rod Pin with Polished Rod Pin Thread (T_{PRP}) Illustration

Table B.3—Dimensions for Polished Rod Pins with Polished Rod Pin Threads (T_{PRP})

Dimensional Element ^a		Nominal Thread Size (S_{NT})				
		$5/8 T_{PRP}$	$3/4 T_{PRP}$	$7/8 T_{PRP}$	$1 T_{PRP}$	$1 1/8 T_{PRP}$
		in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
A_{PC} Angle, 9° pin cone	Maximum	9° 30'	9° 30'	9° 30'	9° 30'	9° 30'
	Minimum	9°	9°	9°	9°	9°
D_{TPC} Diameter, theoretical pin cone	Defined	0.9430 (23.952)	1.0680 (27.127)	1.1930 (30.302)	1.3805 (35.065)	1.5680 (39.827)
DP_1 ^b Diameter, pin thread major	Maximum	0.9362 (23.779)	1.0611 (26.952)	1.1861 (30.127)	1.3735 (34.887)	1.5609 (39.647)
	Minimum	0.9233 (23.452)	1.0482 (26.624)	1.1732 (29.799)	1.3606 (34.559)	1.5480 (39.319)
DP_2 ^b Diameter, pin thread minor	Maximum	0.8135 (20.663)	0.9384 (23.835)	1.0634 (27.010)	1.2508 (31.770)	1.4382 (36.530)
D_{PP} ^b Diameter, pin thread pitch	Maximum	0.8712 (22.128)	0.9962 (25.303)	1.1211 (28.476)	1.3085 (33.236)	1.4960 (37.998)
	Minimum	0.8654 (21.981)	0.9900 (25.146)	1.1150 (28.321)	1.3020 (33.071)	1.4892 (37.826)
D_{SH} Diameter, pin shank	Maximum	0.9362 (23.779)	1.0611 (26.952)	1.1861 (30.127)	1.3735 (34.887)	1.5609 (39.647)
	Minimum	0.9233 (23.452)	1.0482 (26.624)	1.1732 (29.799)	1.3606 (34.559)	1.5480 (39.319)
L_{TPC} Length, theoretical pin cone	Maximum	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)
	Minimum	0.225 (5.72)	0.225 (5.72)	0.225 (5.72)	0.225 (5.72)	0.225 (5.72)
L_{PP} Length, total pin	Maximum	1.300 (33.02)	1.490 (37.85)	1.680 (42.67)	1.890 (48.01)	2.140 (54.36)
	Minimum	1.239 (31.47)	1.429 (36.30)	1.619 (41.12)	1.829 (46.46)	2.079 (52.81)
R_{SH} Radius, pin shank	Maximum	0.094 (2.38)	0.094 (2.38)	0.094 (2.38)	0.094 (2.38)	0.094 (2.38)
SP_4 Standoff, P4 pin-cone ring gauge	Maximum	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)
	Minimum	0.225 (5.72)	0.225 (5.72)	0.225 (5.72)	0.225 (5.72)	0.225 (5.72)
^a Reference Figure B.4.						
^b See Figure B.1.						

B.3.5 Polished Rod Box Threads

Polished rod box threads (T_{PRB}) shall be furnished in the configuration shown in Figure B.5 and the nominal thread sizes (S_{NT}) in Table B.4. The counterbore depth and start of the threads are the only difference between T_{PRB} and sucker rod box threads (T_{SRB}). T_{PRB} have a shorter counterbore with the imperfect pin threads on the 9° box cone as the starting thread (see Figure B.5). The 9° box cone (A_{BC}) is critical for proper connection makeup. The start of angle A_{BC} is a reference point defined by the intersection of L_{TCB} and D_{TCB} dimensions. The design profile of the T_{PRB} is a special type of UN thread having a flat root contour with permissible round root contour beyond the $0.25 \times \text{pitch}$ ($0.25 p$) flat width to allow for crest wear. The hollow thread-crest from thread forming shall not be considered to be detrimental.

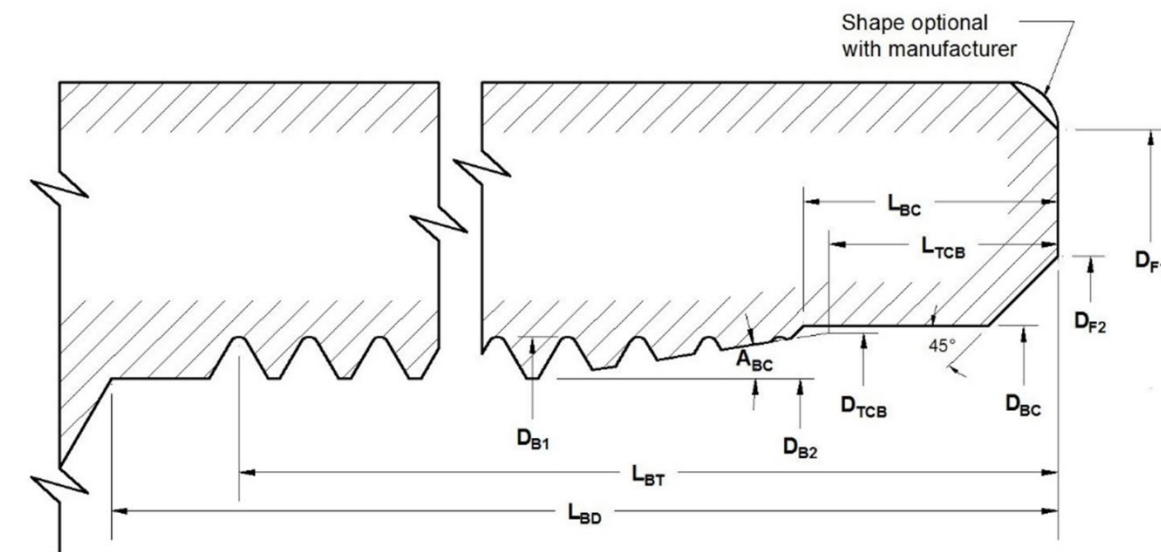


Figure B.5—Polished Rod Coupling or Sub-coupling with Polished Rod Box Thread (T_{PRB}) Illustration

Table B.4—Dimensions for Polished Rod Couplings or Sub-Couplings with Polished Rod Box Threads (T_{PRB})

Dimensional Element ^a		Nominal Thread Size (S_{NT})				
		$5/8 T_{PRB}$	$3/4 T_{PRB}$	$7/8 T_{PRB}$	$1 T_{PRB}$	$1 1/8 T_{PRB}$
		in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
A _{BC} Angle, box cone	Maximum	9°	9°	9°	9°	9°
	Minimum	8° 30'	8° 30'	8° 30'	8° 30'	8° 30'
D _{B1} ^b diameter, box thread major	Minimum	0.9380 (23.825)	1.0630 (27.000)	1.1880 (30.175)	1.3754 (34.935)	1.5630 (39.700)
D _{B2} ^b Diameter, box thread minor	Maximum	0.8510 (21.615)	0.9760 (24.790)	1.1010 (27.965)	1.2880 (32.715)	1.4760 (37.490)
	Minimum	0.8300 (21.082)	0.9550 (24.257)	1.0800 (27.432)	1.2670 (32.182)	1.4550 (36.957)
D _{BC} Diameter, box counterbore	Maximum	0.965 (24.51)	1.090 (27.69)	1.215 (30.86)	1.403 (35.64)	1.590 (40.39)
	Minimum	0.955 (24.26)	1.080 (27.43)	1.205 (30.61)	1.393 (35.38)	1.580 (40.13)
D _{BP} ^b Diameter, box thread pitch	Maximum	0.8806 (22.367)	1.0060 (25.552)	1.1310 (28.727)	1.3190 (33.503)	1.5068 (38.273)
	Minimum	0.8730 (22.174)	0.9980 (25.349)	1.1230 (28.524)	1.3105 (33.287)	1.4980 (38.049)
D _{TBC} Diameter, theoretical box cone	Theoretical	0.9430 (23.952)	1.0680 (27.127)	1.1930 (30.302)	1.3805 (35.065)	1.5680 (39.827)
D _{F1} ^c Diameter, contact face major	Maximum	1.235 (31.37)	1.485 (37.72)	1.610 (40.89)	1.985 (50.42)	2.230 (56.64)
	Minimum	1.205 (30.61)	1.455 (36.96)	1.580 (40.13)	1.955 (49.66)	2.200 (55.88)
D _{F2} ^d Diameter, contact face minor	Maximum	1.110 (28.19)	1.235 (31.37)	1.360 (34.54)	1.547 (39.29)	1.734 (44.04)
	Minimum	1.080 (27.43)	1.205 (30.61)	1.330 (33.78)	1.517 (38.53)	1.704 (43.28)

Dimensional Element ^a		Nominal Thread Size (S _{NT})				
		⁵ / ₈ T _{PRB}	³ / ₄ T _{PRB}	⁷ / ₈ T _{PRB}	1 T _{PRB}	1 ¹ / ₈ T _{PRB}
		in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
L _{BC} Length, box counterbore	Maximum	0.300 (7.62)	0.300 (7.62)	0.300 (7.62)	0.300 (7.62)	0.300 (7.62)
	Minimum	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)
L _{BD} ^e Length, total depth of box	Minimum	1.750 (44.45)	1.938 (49.23)	2.125 (53.98)	2.500 (63.50)	2.750 (69.85)
L _{BT} ^f Length, perfect box thread	Minimum	1.410 (35.81)	1.600 (40.64)	1.790 (45.47)	2.000 (50.80)	2.250 (57.15)
L _{TBC} Length, theoretical box cone	Maximum	0.200 (5.08)	0.200 (5.08)	0.200 (5.08)	0.200 (5.08)	0.200 (5.08)
	Minimum	0.175 (4.45)	0.175 (4.45)	0.175 (4.45)	0.175 (4.45)	0.175 (4.45)
^a See Figure B.5. ^b See Figure B.1. Note that D _{B1} maximum is not specified. ^c D _{F1} diameter, contact face major maximum is not applicable to spray metal coated couplings and spray metal coated sub-couplings due to the allowable variation in coating thickness. ^d See 6.1. ^e The length of the total depth of box (L _{BD}) is not applicable for couplings that are threaded the entire length with the same thread. For sub-couplings to achieve L _{BD} , the smaller thread bore shall meet the length of the perfect box thread (L _{BT}) dimension and possibly require a truncated tap for the larger thread bore to ensure the requirements of L _{BT} are met. In all cases, for the interface between two different size threads, the length of the threaded bore of the smaller size shall at a minimum be L _{BT} and tapped fully to depth to insure perfect thread form. ^f Length of the perfect box thread (L _{BT}) includes counterbore.						

B.4 Dimensional Inspection Requirements

B.4.1 General

Inspecting and testing shall be performed by qualified person(s) using the manufacturer's documented procedures. The methods of inspecting and testing shall be sufficient to comply with the requirements as defined below.

B.4.2 Inspection Racks and/or Tables

Support racks and/or tables for the inspection of all pin ends, couplings, and sub-couplings shall, as a minimum, be of a material that is non-damaging to the product. Dimensional requirements for the inspection racks and tables are provided in the product annexes.

B.4.3 Dimensional Inspection

Dimensional inspection of all thread types listed in B.2 shall be performed in accordance with Table B.5. Measurement of 9° pin and box cone shall be required setup as specified in Table B.6. If a nonconformance is found, the product shall be dispositioned in accordance with 7.2.6.

Table B.5—Dimensional Inspection

Check For	Typical Gauges or Measuring Instruments Used ^a	Procedure
D _{B1} Diameter, box major; minimum	B2 go box-thread gauge	Minimum—the B2 go box-thread plug gauge shall enter the product threads to the gauge shoulder.
D _{B2} Diameter, box minor; maximum and minimum	Micrometer, caliper, or go/no-go gauge	If measuring the box minor diameter (D _{B2}), the measurement result shall not be greater than the maximum specified value for D _{B2} or less than the minimum specified value for D _{B2} . If a go/no-go gauge is used, the go gauge shall enter D _{B2} the full length of the thread and the no-go gauge shall not enter D _{B2} .
D _{BC} Diameter, box counterbore; maximum and minimum	Micrometer, caliper, or go/no-go gauge	If measuring the box counterbore diameter (D _{BC}), the measurement result shall not be greater than the maximum specified value for D _{BC} or less than the minimum specified value for D _{BC} . If a go/no-go gauge is used, the go gauge shall enter the full length of D _{BC} and the no-go gauge shall not enter D _{BC} .
D _{BP} Diameter, box pitch	B2 go box-thread plug gauge and B6 no-go box-thread plug gauge	The B2 go box-thread plug gauge shall enter the product thread to the gauge shoulder, and the B6 no-go box-thread plug gauge shall not enter the product thread more than the third full turn of assembly.
D _{F1} Diameter, face major; maximum and minimum	Caliper or chamfer gauge	Measure the face major diameter (D _{F1}) from the intersection of the chamfer with the face on one side to the intersection of the chamfer with the face on the other side or from the tangency point of the radius with the face on one side to the tangency point of the radius with the face on the other side. The measurement result shall not be greater than the maximum specified value for D _{F1} or less than the minimum specified value for D _{F1} .
D _{F2} Diameter, face minor; maximum and minimum	Caliper or chamfer gauge	Measure the face minor diameter (D _{F2}) from the intersection of the chamfer with the face on one side to the intersection of the chamfer with the face on the other side. The measurement result shall not be greater than the maximum specified value for D _{F2} or less than the minimum specified value for D _{F2} .
D _{PS} Diameter, pin shoulder; maximum and minimum	Micrometer, caliper, or go/no-go gauge	If measuring the pin shoulder diameter (D _{PS}), the measurement result shall not be greater than the maximum specified value for D _{PS} or less than the minimum specified value for D _{PS} . If a go/no-go gauge is used, the go gauge shall enter the full length of D _{PS} and the no-go gauge shall not enter D _{PS} .
D _{SH} Diameter, pin shank; maximum and minimum	Micrometer, caliper, or go/no-go gauge	If measuring the pin shank diameter (D _{SH}), the measurement result shall not be greater than the maximum specified value for D _{SH} or less than the minimum specified value for D _{SH} . If a go/no-go gauge is used, the go gauge shall pass over the full length of D _{SH} .

Check For	Typical Gauges or Measuring Instruments Used ^a	Procedure
		and the no-go gauge shall not pass over any part of D_{SH} .
D_{SR} Diameter, stress relief; maximum and minimum	Micrometer, caliper, or go/no-go gauge	If measuring the stress relief diameter (D_{SR}), the measurement result shall not be greater than the maximum specified value for D_{SR} or less than the minimum specified value for D_{SR} . If a go/no-go gauge is used, the go gauge shall pass over the full length of D_{SR} and the no-go gauge shall not pass over any part of D_{SR} .
D_{P1} Diameter, pin thread major; maximum and minimum	Micrometer, caliper, or go/no-go gauge	If measuring the pin thread major diameter (D_{P1}), the measurement result shall not be greater than the maximum specified value for D_{P1} or less than the minimum specified value for D_{P1} . If a go/no-go gauge is used, the go gauge shall pass over the full length of D_{P1} and the no-go gauge shall not pass over any part of D_{P1} .
D_{P2} Diameter, pin minor; maximum	P8 go pin-thread ring gauge	The product threads shall enter the P8 go pin-thread ring gauge to the gauge shoulder.
D_{PP} Diameter, pin pitch; minimum and maximum	P8 go pin-thread ring gauge and P6 no-go pin-thread ring gauge	The product threads shall enter the P8 go pin-thread ring gauge to the gauge shoulder but shall not enter the P6 no-go pin-thread ring gauge more than the third full turn of assembly.
L_{BC} Length, box counterbore; maximum and minimum	Caliper or go/no-go gauge	If measuring the box counterbore length (L_{BC}), the measurement result shall not be greater than the maximum specified value for L_{BC} or less than the minimum specified value for L_{BC} . If a go/no-go gauge is used, the go gauge shall enter the full length of L_{BC} and the no-go gauge shall not enter L_{BC} .
L_{TCB} Length to box cone base; maximum and minimum	B4 box-cone plug gauge with calipers or B4 box-cone plug gauge with go/no-go gauges	Engage the B4 box-cone plug gauge hand-tight in the product thread. If using calipers, measure the standoff between the shoulder of the plug and the face of the box. The standoff shall not be greater than the maximum specified value for L_{TCB} or less than the minimum specified value for L_{TCB} . If using go/no-go gauges, the go gauge shall enter the gap between the shoulder of the plug and the face of the box and the no-go gauge shall not enter the gap.
L_{BD} ^b Length, total depth of box; minimum	B2 go box-thread plug gauge	The B2 go box-thread plug gauge shall enter the product threads to the gauge shoulder.
L_{BT} ^c Length, perfect box thread; minimum	B2 go box-thread plug gauge	The B2 go box-thread plug gauge shall enter the product threads to the gauge shoulder.
L_{TCB} Length to pin cone base; maximum and minimum	P4 pin-cone ring gauge with caliper or P4 pin-cone ring gauge with go/no-go gauge	Engage the P4 pin-cone ring gauge hand-tight on the product thread. If using calipers, measure the standoff between the face of the ring and the shoulder of the pin. The standoff shall not be greater than the maximum specified value for L_{TCB} or less than the minimum specified value for L_{TCB} . If using go/no-go gauges, the go gauge shall enter the gap between the face of the ring

Check For	Typical Gauges or Measuring Instruments Used ^a	Procedure
		and the shoulder of the pin and the no-go gauge shall not enter the gap.
L _{PP} Length, total pin; maximum and minimum	Caliper or go/no-go gauge	If measuring the total pin length (L _{PP}), the measurement result shall not be greater than the maximum specified value for L _{PP} or less than the minimum specified value for L _{PP} . If a go/no-go gauge is used, the go gauge, when contacting the pin shoulder, shall extend beyond the face of the pin and the no-go gauge, when contacting the pin shoulder, shall not extend beyond the face of the pin.
L _{PS} Length, pin shoulder; minimum	Caliper or go gauge	If measuring the pin shoulder length (L _{PS}), the measurement result shall not be less than the minimum specified value for L _{PS} . If a go gauge is used, the go gauge shall pass over the full length of L _{PP} .
L _{SP} Length, sucker rod pin; maximum and minimum	Caliper or go/no-go gauge	If measuring the sucker rod pin length (L _{SP}), the measurement result shall not be greater than the maximum specified value for L _{SP} or less than the minimum specified value for L _{SP} . If a go/no-go gauge is used, the go gauge, when contacting the pin shoulder, shall extend beyond the face of the pin and the no-go gauge, when contacting the pin shoulder, shall not extend beyond the face of the pin.
L _{SR} Length, stress relief; maximum and minimum	Caliper	Measure the length of the stress relief (L _{SR}) from the crest of the last full thread to the pin shoulder. The measurement result shall not be greater than the maximum specified value for L _{SR} or less than the minimum specified value for L _{SR} .
P _{F1} Parallelism, contact face; maximum	B2 go box-thread plug gauge and 0.002 in. (0.051 mm) flat feeler gauge	The B2 go box-thread plug gauge shall enter the product threads to the gauge shoulder. The 0.002 in. (0.051 mm) flat feeler gauge shall not enter, at any point, between the shoulder of the B2 go box-thread plug gauge and the product contact face major diameter.
P _{PS} Parallelism, pin shoulder; maximum	P8 go pin-thread ring gauge and 0.002 in. (0.051 mm) flat feeler gauge	The product threads shall enter the P8 go pin-thread ring gauge to gauge shoulder. The 0.002 in. (0.051 mm) flat feeler gauge shall not enter, at any point, between the shoulder of the P8 go pin-thread ring gauge and the product pin shoulder.
^a See 7.2.2. ^b For all sucker rod and polished rod couplings, the length of the total depth of box (L _{BD}) can only be achieved with a single bore through the coupling. For sub-couplings to achieve L _{TB} , the smaller thread bore shall meet the length of the perfect box thread (L _{BT}) dimension and possibly require a truncated tap for the larger thread bore to ensure the requirements of L _{BT} are met. In all cases, for the interface between two different size threads, the length of the threaded bore of the smaller size shall at a minimum be L _{BT} and tapped fully to depth to insure perfect thread form. ^c The length of perfect box thread (L _{BT}) includes the length of box counterbore (L _{BC}).		

Table B.6—Setup Validation

Check For	Gauge or Measuring Instrument	Procedure ^a
A_{PC} Angle, 9° pin cone; maximum and minimum	Tracer or optical comparator	Measure the 9° pin cone angle (A_{PC}). The measured value shall not be greater than the maximum specified value for A_{PC} or less than the minimum specified value for A_{PC} .
A_{BC} Angle, 9° box cone; maximum and minimum	Tracer or cast profile with optical comparator	Measure the 9° box cone angle (A_{BC}). The measure value shall not be greater than the maximum specified value for A_{BC} or less than the minimum specified value for A_{BC} .
^a These two dimensions (A_{PC} and A_{BC}) are typically only verified during manufacturing machine setup. Once the dimensions are validated, no further inspection of these attributes is necessary.		

B.4.4 Thread Alignment

B.4.4.1 General

Maximum parallel misalignment of axes of coupling or sub-coupling threads shall not exceed 0.020 in. (0.51 mm). Maximum angular misalignment shall not exceed 0.179° [$1^{15}/_{32}$ in. (11.91 mm) in 12 $1/2$ ft (3.81 m)]. Angular misalignment plus parallel misalignment shall not exceed 0.020 in. (0.508 mm).

B.4.4.2 Thread Alignment Test

Couplings manufactured by boring and threading-through from one end shall be exempt from thread alignment testing.

Thread alignment tests on couplings and sub-couplings shall be made by screwing the coupling or sub-coupling onto a threaded test mandrel that has been accurately centered in a lathe or live center, then screwing onto the other end of the coupling or sub-coupling into a lathe-turned piece that will provide a measured length of about 1.0 ft (0.3 m). Care shall be taken to make certain the coupling does not shoulder on either mandrel. A taper of $1/16$ in./ft (5.208 mm/m) on the mandrel thread is recommended.

The extent of parallel misalignment shall be determined by the use of a micrometer indicator on the turned piece of the outer end as the assembly is rotated.

B.4.5 Discontinuities

B.4.5.1 Surface Finish

Surface finish roughness of the machined surfaces of pin ends (except threads) shall not be greater than 125 μ in. (3.18 μ m) R_a unless otherwise specified in this specification.

The surface finish roughness for threads do not need to be measured. However, threads shall be visually acceptable and free from discontinuities.

B.4.5.2 Discontinuities

The thread form shall be complete over the length for perfect thread and shall not contain discontinuities such as tears, ruptures, shears, holes, or seams. Examples of some discontinuities are shown in Annex P.

Tapping marks in the counterbore of couplings and sub-couplings and the hollow thread-crest from thread forming shall not be considered detrimental to the product.

Annex C (normative)

Steel Sucker Rods and Pony Rods

C.1 General

Steel sucker rods and pony rods shall be manufactured and supplied in accordance with the requirements in this specification.

C.2 Design Requirements

C.2.1 General

The following general requirements shall be followed in the design of steel sucker rods and pony rods.

C.2.2 Dimensional Requirements

Steel sucker rods and pony rods shall be furnished in the configuration shown in Figure C.1, the dimensions in Table C.1, and the lengths in Table C.2 for customary lengths or Table C.3 for alternate lengths.

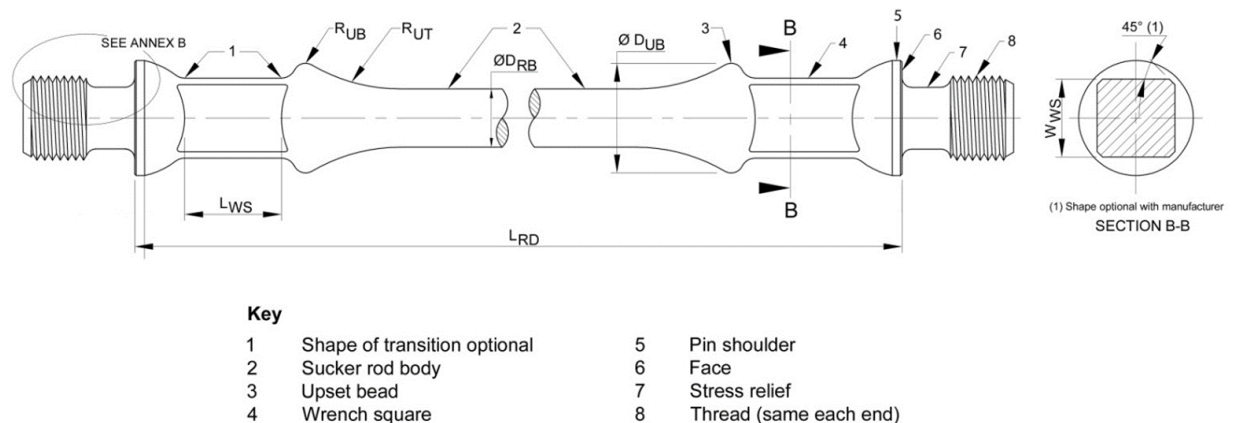


Figure C.1—Steel Sucker Rod and Pony Rod Illustration

C.2.3 Pin and Thread Type

The pin and thread type for steel sucker rods and pony rods shall conform to the configuration shown in Figure B.2 and the dimensions in Table B.1 for sucker rod pin threads (T_{SRP}). Steel sucker rods and pony rods shall be manufactured and supplied with the same nominal thread size (S_{NT}) on each end.

Table C.1—Dimensions for Steel Sucker Rods and Pony Rods

Dimensional Element ^b		Reference Size ^a				
		⁵ / ₈ in. in. (mm)	³ / ₄ in. in. (mm)	⁷ / ₈ in. in. (mm)	1 in. in. (mm)	1 ¹ / ₈ in. in. (mm)
S _{NT} ^c Size, nominal thread	Reference	⁵ / ₈ T _{SRP}	³ / ₄ T _{SRP}	⁷ / ₈ T _{SRP}	1 T _{SRP}	1 ¹ / ₈ T _{SRP}
D _{RB} Diameter, rod body	Maximum	0.632 (16.05)	0.758 (19.25)	0.883 (22.43)	1.009 (25.63)	1.135 (28.83)
	Minimum	0.611 (15.52)	0.734 (18.64)	0.859 (21.82)	0.982 (24.94)	1.105 (28.07)
B _{OR} Bar, out-of-roundness	Maximum	0.015 (0.38)	0.015 (0.38)	0.015 (0.38)	0.015 (0.38)	0.015 (0.38)
D _{UB} Diameter, upset bead	Maximum	1.224 (31.08)	1.411 (35.85)	1.505 (38.23)	1.911 (48.55)	2.193 (55.69)
	Minimum	1.094 (27.78)	1.281 (32.54)	1.375 (34.93)	1.719 (43.66)	2.000 (50.80)
L _{WS} ^d Length, wrench square	Minimum	1.250 (31.75)	1.250 (31.75)	1.250 (31.75)	1.500 (38.10)	1.625 (41.28)
R _{UB} ^e Radius, upset bead	Maximum	0.188 (4.76)	0.188 (4.76)	0.250 (6.35)	0.250 (6.35)	0.250 (6.35)
	Minimum	0.109 (2.78)	0.109 (2.78)	0.172 (4.37)	0.172 (4.37)	0.172 (4.37)
R _{UT} ^f Radius, upset transition	Maximum	2.000 (50.80)	2.375 (60.33)	2.750 (69.85)	3.125 (79.38)	3.500 (88.90)
	Minimum	1.750 (44.45)	2.125 (53.98)	2.500 (63.50)	2.875 (73.03)	3.250 (82.55)
W _{WS} ^g Width, wrench square	Maximum	0.906 (23.01)	1.031 (26.19)	1.031 (26.19)	1.344 (34.14)	1.531 (38.89)
	Minimum	0.844 (21.44)	0.969 (24.61)	0.969 (24.61)	1.282 (32.56)	1.469 (37.31)

^a Reference size is the nominal rod body diameter (D_{RB}).

^b See Figure C.1.

^c See Figure B.2.

^d Minimum length, exclusive of fillet.

^e Typically verified in forging die qualifications. The shape of the radius to the wrench square is optional with the manufacturer.

^f Typically verified in forging die qualifications.

^g Wrench square width (W_{WS}) for ⁷/₈ in. (22.23 mm) Grade HY sucker rods shall be a maximum 1.156 in. (29.36 mm) and a minimum 1.094 in. (27.79 mm).

Table C.2—Customary Lengths for Steel Sucker Rods and Pony Rods

Dimensional Element ^a	Standard Lengths		in. (mm)
L _{RD} ^b Length, sucker rod	25 ft	Maximum	298.00 (7569.2)
		Minimum	294.00 (7467.6)
	30 ft	Maximum	358.00 (9093.2)
		Minimum	354.00 (8991.6)
L _{RD} ^b Length, pony rod	2 ft	Maximum	22.00 (558.8)
		Minimum	18.00 (457.2)
	4 ft	Maximum	46.00 (1168.4)
		Minimum	42.00 (1066.8)
	6 ft	Maximum	70.00 (1778.0)
		Minimum	66.00 (1676.4)
	8 ft	Maximum	94.00 (2387.6)
		Minimum	90.00 (2286.0)
	10 ft	Maximum	118.00 (2997.2)
		Minimum	114.00 (2895.6)
	12 ft	Maximum	142.00 (3606.8)
		Minimum	138.00 (3505.2)

^a See Figure C.1.

^b Sucker rods and pony rods shall be measured from the contact face of the pin shoulder to the contact face of the pin shoulder.

Table C.3—Alternate Lengths for Steel Sucker Rods and Pony Rods

Dimensional Element ^a	Metric Lengths		in. (mm)
L _{RD} ^b Length, sucker rod	8.0 m	Maximum	313.00 (7949.2)
		Minimum	309.00 (7847.6)
	10.0 m	Maximum	391.70 (9949.2)
		Minimum	387.70 (9847.6)
L _{RD} ^b Length, pony rod	0.5 m	Maximum	17.70 (449.2)
		Minimum	13.70 (347.6)
	1.0 m	Maximum	37.40 (949.2)
		Minimum	33.40 (847.6)
	1.5 m	Maximum	57.10 (1449.2)
		Minimum	53.10 (1347.6)
	2.0 m	Maximum	76.70 (1949.2)
		Minimum	72.70 (1847.6)
	2.5 m	Maximum	96.40 (2449.2)
		Minimum	92.40 (2347.6)
	3.0 m	Maximum	116.10 (2949.2)
		Minimum	112.10 (2847.6)
	3.5 m	Maximum	135.80 (3449.2)
		Minimum	131.80 (3347.6)
	4.0 m	Maximum	155.50 (3949.2)
		Minimum	151.50 (3847.6)

^a See Figure C.1.

^b Sucker rods and pony rods shall be measured from the contact face of the pin shoulder to the contact face of the pin shoulder.

C.3 Material Requirements

C.3.1 Chemical Compositions and Analysis

Steel sucker rods and pony rods shall conform to the chemical composition requirements in Table C.4 for the grade specified. The chemical composition for each grade manufactured shall be detailed in the material specification of the manufacturer and shall be traceable to the MTR conforming to the requirements in 6.3.2.2.

An MTR conforming to the requirements of 6.3.2.2 is an acceptable means to comply with the requirement for a chemical analysis. When an MTR is not available, but the material is identified with a specific heat number, the manufacturer shall either reject the material or have a chemical analysis conducted on each heat number of steel in accordance with ASTM A751.

C.3.2 Mechanical Properties

After final heat treatment, steel sucker rods and pony rods shall conform to the mechanical property requirements in Table C.4 for the grade specified.

An MTR conforming to the requirements of 6.3.2.2 is an acceptable means to comply with the mechanical property testing requirements provided there has been no subsequent heat treatment, spray metal coating, or other special processes requiring validation. If special processes requiring validation occur, mechanical property testing shall be performed in accordance with Annex M in this specification. A minimum of two mechanical tests shall be performed on at least two rod bodies, one near the beginning and one near the end of each furnace lot, per heat number after final heat treatment.

If the manufacturer can document control of heat treatment processes by continuous monitoring and/or statistical process control, an acceptable alternate is a minimum of two mechanical tests performed on at least one rod body at the beginning of the furnace lot run once all parameters have been established. All rods in a furnace lot heat treated prior to establishing heat treatment parameters shall be reheat treated within the established parameters.

C.3.3 Color Codes

Steel sucker rods and pony rods shall conform to the color code requirements in Table C.4 for the grade specified.