STANDARD DS-1®

Drill Stem Inspection

STANDARD DS-1®

FIFTH EDITION | AUGUST 2020

1 2 3 4 5 6

VOLUME 3

BUREAU VERITAS 1828

BUREAU VERITAS

Standard DS-1®
Volume 3

Drill Stem Inspection

Fifth Edition
August 2020

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Drill Stem Inspection

Fifth Edition

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Bureau Veritas wishes to acknowledge the leadership and foresight of Tom H. Hill for conceptualizing Standard DS-1 and writing the First through Third Editions.

Bureau Veritas extends its deep appreciation to the Fifth Edition Sponsor Companies and to the individuals named below, whose technical input contributed significantly to the value of the standard.

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1. Introduction

Since 1992, Standard DS-1 has worked to prevent drill stem failures. It was first sponsored by members of the Drilling Engineers Association (DEA) and other parties as DEA Project 74. Originally an industry-standard set of inspection procedures for used drill pipe, the scope of the standard and its acceptance in the industry has grown dramatically through four previous editions.

This Fifth Edition of Standard DS-1 consists of six Volumes:

- Volume 1 covers the manufacture of various drill stem elements.
- Volume 2 provides resources and calculations to design and operate a drill string successfully.
- Volume 3—this book—gives inspection procedural control and acceptance criteria for generic components such as drill pipe, drill collars, HWDP, subs, etc.
- Volume 4 outlines a quality control structure for the maintenance processes of specialty tools.
- Volume 5 covers the inspection of new and used bits for oilfield drilling.
- Volume 6 provides the inspection procedures and acceptance criteria for used aluminum drill pipe.

1.1 Bureau Veritas and T H Hill

In March 2012, Bureau Veritas acquired T H Hill Associates, Inc. With the acquisition, the process of integrating T H Hill service lines and Standard DS-1 development work with Bureau Veritas's service portfolio was initiated. On September 1, 2016 the integration process was advanced by merging T H Hill Associates with Bureau Veritas's North America operating company (Bureau Veritas North America, Inc). This step has enabled expansion of the global footprint of Standard DS-1. It has also provided access to an extensive network of engineering support which helps to accelerate the technical content development efforts.

1.2 Coverage

In the Fifth Edition of Standard DS-1 (as was introduced in the Fourth Edition), inspection and qualification of drill string components is specified in Volumes 3 and 4. Volume 3 addresses the inspection of drill string equipment consisting of a single piece with no component pieces. Examples include drill pipe, drill collars, subs, and pup joints. Volume 4, first published with Fourth Edition, addresses drilling specialty tools, which are defined as a device that:

- can be run in a drill string or casing string and perform some function;
- is assembled from two or more components, and;
- is complete in itself with no additional equipment needed for its function except possibly some external power or pressure source.

Examples of drilling specialty tools include mud motors, MWD, LWD, underreamers, and safety valves.

1.3 Sponsorship

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Revisions and corrections of the DS-1 Standards are published from time to time. Before using the standard, be sure to contact us (see information above) or visit www.bvna.com/ds1standards to make sure you have the latest edition.

1.6 Significant Changes from DS-1 Fourth Edition

To assist the user in identifying changes between Standard DS-1 Fourth Edition and Fifth Edition, Table A.1 is provided (located in the Appendix). Table A.1 lists some of the new inspection procedures and methods added and some of the key changes made to the inspection procedures and methods previously covered in Fourth Edition and now continued in Fifth Edition. The goal is to familiarize DS-1 users with these changes. However it is not meant to be an exhaustive list that requires no further investigation. Table A.1 serves as a reference to be reviewed prior to examining the contents of Standard DS-1 Fifth Edition, Volume 3.

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This standard is not a training manual, nor should it be used by untrained or inexperienced personnel, or people who are not qualified in drilling engineering, threading technology, inspection technology, quality assurance, or applicable codes, standards, and procedures. This standard is not intended to meet the duties of employers to properly train and equip their employees in any of the above fields.

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Responsibility for compliance to any requirement of this standard can only be imposed by one user of this standard upon another user, by agreement between the two parties.

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2. Inspection Program

This and the following sections describe how to order an inspection of drill pipe under Volume 3 of Standard DS-1. For inspection of equipment using Volume 3, the customer is defined as the party on whose behalf the inspection is being conducted. If the components are being inspected for use in a well or wells, the customer is the organization at risk in the event of a failure. If the components are being inspected prior to returning them to stock for future rental, the customer is the company owning the components. In the first case, the customer will usually be represented by the designer, who will be most familiar with the loads and anticipated operating conditions, and therefore best qualified to set the inspection program and decide issues that arise during inspection.

2.1 Inspection Methods

Thirty six inspection methods are defined under the standard. Many of the methods are specific to certain component types, and the tools employed and procedures used in each method will vary widely. Table 2.2 lists all methods used under the Standard, and the purpose of each. Each of the methods listed in Table 2.2 is accompanied by a specific procedure. Unless a procedure is modified by the customer, the inspection company is required to follow it exactly.

2.2 Inspection Programs

The remaining sections of this chapter provide information on setting an inspection program using Volume 3. The inspection program is set by the customer and performed by the inspection company. An inspection program consists of four elements:

2.2.1 Equipment List

The customer must provide a complete list of the equipment to be inspected. The list must include joint count or footage required for each component, and a complete and accurate description of each component.

2.2.2 Methods to be Employed

The customer must provide precise guidelines on which of the available methods are to be used to inspect each component. This is usually accomplished by selecting from one of six inspection categories (discussed further below). However the customer is free to select any applicable methods he or she desires, and the procedural requirements accompanying the selected methods are still binding on the inspection company.

2.2.3 Acceptance Criteria in Effect

The customer must give the inspection company precise instructions about the attributes which must be met or exceeded in an acceptable component. For drill pipe, this is often done by specifying an inspection class. Attributes of other components cannot be assigned by specifying a class.

2.2.4 Frequency of Inspection

The usual practice has been to set inspection frequency on some arbitrary basis such as footage drilled or hours rotated. Such estimates are little better than wild guesses because they don't take into account how the components in question are loaded. Neither do they consider the probable failure modes. The recommended approach for setting inspection frequency is given in paragraph 2.12.

2.3 Conducting the Inspection Program

Once the customer sets the inspection program, the inspection organization is responsible for conducting it. (One exception is the Rig Floor Trip Inspection, which the rig crew may perform.) In the conduct of an inspection method, the inspection company is responsible for following the procedural requirements outlined in DS-1 Volume 3. The inspection company is also responsible for making the customer aware of any problems in achieving the desired acceptance criteria, and for working with the customer to resolve these problems.

2.4 Deviating from Procedural Requirements

The customer, having set the program in the first place, is free to alter any aspect of the process he or she desires. Customers are cautioned, however, that deviating from the procedures in Volume 3 may negatively impact the quality of the inspection and of the accepted products. The inspection company may not deviate from any requirement in Volume 3 of this standard without prior approval from the customer.

2.5 Specifying Applicable Methods

The customer may select any applicable set of methods from Table 2.2. However, to simplify the customer's choices and at the same time allow him or her to tailor the inspection program to the risks of the application, six service categories are established. These categories, and the recommended inspection programs that accompany them, are shown in Tables 2.3 and 2.4, and Figures 2.7 through 2.12.

2.5.1 Category 1

Category 1 inspections mainly search for damages to the component. This may apply to very shallow, very routine wells in well-developed areas. When drill stem failures occur, failure costs are so minimal that the cost of extensive inspection would not have been justified. It may also be applied as a higher-frequency "maintenance" inspection, attempting to find and fix problems in the drill stem before they lead to greater repair costs when a full, higher-category inspection is performed at the end of a campaign (for instance).

2.5.2 Category 2

Applies for routine drilling conditions where the established practice is to perform minimal inspection and the failure experience is low. May also be applied as a "maintenance" inspection to catch damages early.

2.5.3 Category 3

Designed for mid-range drilling conditions where a standard inspection program is justified. If a failure occurs, the risk of significant fishing cost or losing part of the hole is minimal. A minimum Category 3 inspection is required as a design constraint for Design Group 2.

2.5.4 Category 4

This category may be used when drilling conditions are more difficult than Category 3. Significant fishing costs or losing part of the hole are likely in the event of a drill stem failure.

2.5.5 Category 5

This category applies to severe drilling conditions. Several factors combine to make the cost of a possible failure very high. A minimum Category 5 inspection is required as a design constraint in Design Group 3.

2.5.6 Category HDLS

Owing to the increasing tensile loads carried by landing strings, especially in deep water, a sixth service category is included. This category is designated for heavy duty landing strings (HDLS). A heavy duty landing string consists of all components to be used in a casing landing operation from and including the casing running tool up to and including the top drive main shaft where any component in the load path is loaded beyond eighty-five percent of its rated tensile capacity (including the slip crushing capacity, if applicable). The customer is free to institute this category whenever he or she sees fit due to the severity of the operation and the high cost (monetary and otherwise) that would be associated with any type of failure.

2.6 Setting Acceptance Criteria

Once the inspection methods have been selected, the next step is to establish the applicable acceptance criteria. Unless working to a specific Design Group, the designer may set any set of acceptance criteria that meet the design constraints. Specifying a drill pipe class has long been the shorthand way most designers use to specify a complete set of acceptance criteria for drill pipe and associated connections. (A class designation does not apply to other components.) Five drill pipe classes are recognized in DS-1 Volume 3.

2.6.1 Class 1

This Class designation applies to new drill pipe and associated connections.

2.6.2 Ultra Class

The drill pipe tube and tool joint meet the requirements in Table 3.5.1. The tube is allowed to wear down to a minimum allowable Remaining Body Wall (RBW) of 90% of the nominal wall thickness. Tool joints are sized so that they are at least 80% as strong in torsion as the drill pipe tube they are connected to.

2.6.3 Premium Class

The drill pipe tube and tool joint meet the requirements in Table 3.5.1. The tube is allowed to wear down to a minimum allowable Remaining Body Wall (RBW) of 80% of the nominal wall thickness. Tool joints are sized so that they are at least 80% as strong in torsion as the drill pipe tube they are connected to.

2.6.4 Premium Class, Reduced TSR

Torsional Strength Ratio (TSR) is the ratio of tool joint to tube torsional strengths. Many new and Premium Class drill pipes have tool joint diameters that give a TSR of about 0.8, meaning that new and Premium Class tool joints are about 80 percent as strong in torsion as the tubes to which they are attached. Premium Class, Reduced TSR allows tool joint diameters that give TSRs of approximately 60 percent, while maintaining all other attributes of DS-1 Premium Class. This class was adopted in DS-1 Second Edition to recognize a long-standing industry practice of using smaller tool joint ODs in low torsion drilling to gain better fishing clearance in certain drill pipe/hole diameter situations. Pipe in this class will have identical load capacities as Premium Class pipe, except for torsional strength. Premium Class, Reduced TSR is not recognized by API.

2.6.5 Class 2

The drill pipe tube and tool joint meet the requirements in Table 3.5.1. The tube is allowed to wear down to a minimum allowable Remaining Body Wall (RBW) of 70% of the nominal wall thickness. Tool joints are sized so that they are at least 80% as strong in torsion as the drill pipe tube they are connected to.

2.6.6 Acceptance Criteria for Thick-Walled Drill Pipe

Acceptance of thick walled drill pipe is usually expressed by specifying the minimum acceptable remaining wall thickness. Typical limits placed on remaining wall are 80, 90, and 95 percent of new nominal. Classification criteria for TWDP is provided in Table 3.5.2.

2.6.7 Acceptance Criteria for Drill Collars

By specifying the acceptable Bending Strength Ratio (BSR) range, the designer establishes the dimensional requirements for drill collar connection OD and ID. BSR is discussed in Appendix A of this volume and Chapter 4 of Volume 2. BSR values for common connection types and sizes are listed for reference in Table 3.16. For convenience, the recommended ranges for BSR are repeated below.

Traditional Drill Collar OD	Recommended BSR Range	BSR Range
< 6 inches	2.25-2.75	1.8-2.5
6 to < 8 inches	2.25-2.75	2.25-2.75
≥ 8 inches	2.25-2.75	2.5-3.2

2.7 Drill Stem Inspection Order Form

A standard order form is provided at the end of this chapter. This form provides space to communicate instructions to the inspection company.

Example Problem 2.1, Ordering an Inspection:

The designer needs the following equipment inspected:

7000 ft, 5-inch, 19.50 ppf, grade S, NC50, R2 drill pipe
1000 ft, 3.5-inch, 13.30 ppf, grade S, HT38, R2 drill pipe
8000 ft, 3.5-inch, 13.30 ppf, grade S, NC38, R2 drill pipe
NC50 box x HT38 pin crossover
HT38 box x NC38 pin crossover

The designer has elected to solve certain shortcomings in her design by taking the following actions:

1. For the 3.5-inch drill pipe, tighten the minimum remaining wall tolerance from ≥ 80 percent of new nominal (Premium Class) to ≥ 82 percent. This will provide the additional tensile capacity needed at the surface to meet the overpull design constraint.
2. For the 3.5 inch section top, use 1000 feet of 3.5 inch, grade S drill pipe with HT38 connections in place of NC38 connections.
3. Replace the weak crossover at the 3.5 inch section top.

Crossover	Minimum Box OD (in)	Minimum Pin ID (in)
NC50 b × HT38 p	6 3/8	2 1/8
HT38 b × NC38 p	4 5/8	2 1/4

Order an inspection program on the drill string.

Solution:

The problem is solved in Figure 2.1 on the following page.

2.8 Inspection Frequency

In addressing the question of when to inspect, the designer should consider that the problem of scheduling re-inspection is both simpler and more difficult than using rules-of-thumb such as hours rotated or footage drilled. Simpler in that the dimensions governing overload failure are easily evaluated anytime the pipe is accessible on the rig. More difficult because the relationships that drive fatigue failure are far too complex to be handled with simple rules of thumb. In many cases, inspection will have been performed before the components are picked up. The question of how often to inspect thereafter must include considerations of how the components in question are used, and what is the expected failure mode.

2.9 Essential Objectives of Inspection

The technical details of drill string inspection processes may seem daunting to someone not familiar with the technology. Thus, it's very helpful to reduce inspection to its essential objectives. In most cases, setting aside issues of normal handling damage, the activities of the inspector are directed toward two principal objectives. If the designer focuses on these two objectives in scheduling a follow-up inspection, the designer's estimate will be much closer to the mark than is possible with any rule-of-thumb. The two inspection objectives are 1) To ensure that adequate load capacity exists in each component, and 2) To remove components that have fatigue cracks (or are at high risk for developing them). See Figure 2.2.

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INSPECTION ORDER FORM

Figure 2.1

Reference: ______ Page: 1 of 1 Issued to: ABC INSPECTION CO.

Date: ______ Date Equipment Needed: ______ Requesting Company: ______ Person: ______

Well/Rig Name: EXAMPLE WELL AFE #: ______ Phone: ______ Fax: ______ Email: ______

Instructions: 1) Specify equipment, 2) specify inspection programs, 3) specify acceptance criteria

Normal Weight and Thick-Walled Drill Pipe

Item #	Footage/ Count	Size	Nom Wt/ Wall	Grade	Connection	Range	Hardfacing Required?		Inspection Program			Acceptance Criteria		
							Yes	No	Category	Other	See Note:	Premium	Other	See Note:
1	7,000 FT	5	19.50	S	NC50	2		✓	3			✓		
2	1,000 FT	3 1/2	13.30	S	HT38	2		✓	3			✓	✓	NOTE 1
3	8,000 FT	3 1/2	13.30	S	NC38	2		✓	3			✓	✓	NOTE 1
4														

Other Components

Item #	Footage/ Count	Description	OD		ID	Connection	Hardfacing Required?		Boreback Box?		Stress Relief Pin?		Inspection Program			Acceptance Criteria
							Yes	No	Yes	No	Yes	No	Category	Other	Note	
5	20	DRILL COLLARS	4.75	x	2.25	NC38	✓		✓		✓		3			BSR 1.8 - 2.5
6	30	HWDP	3.5	x	2.25	NC38	✓		✓		✓		3			DS-1
7	1	CROSSOVER	6.5-4.75	x	3.25-2.25	NC50b x HT38p		✓		✓		✓	3	✓	NOTE 2	NOTE 3
8	1	CROSSOVER	4.75	x	2.125	HT38b x NC38p		✓		✓		✓	3	✓	NOTE 2	NOTE 4
9				x												
10				x												
11				x												
12				x												

Notes (attach extra notes as required)

Y ☑ N ☐ Is third-party supervision required?

Note 1: Items 2&3 shall have a minimum remaining wall thickness ≥ 82%

Note 2: Items 7 & 8 - Perform UT Wall Inspection in addition to Cat. 3. Min Wall ≥ 0.500 inch on both.

Note 3: Item 7 shall have a minimum box OD ≥ 6.375 inches, and minimum pin ID ≥ 2.125 inches.

Note 4: Item 8 shall have a minimum box OD ≥ 4.625 inches, and minimum pin ID ≥ 2.25 inches.

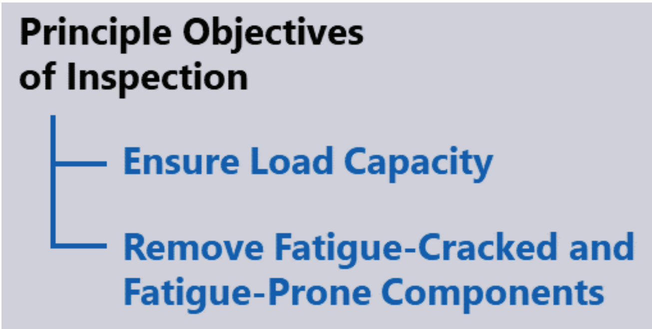


Figure 2.2 The two principal objectives of drill stem inspection. One is easily accomplished at the rig, the other requires special equipment and training.

2.10 Inspector's First Objective

The first objective of the inspector is to ensure that each component has the load capacity required of it. This concern almost always applies to drill pipe, which usually has lower load capacity than heavier BHA components and is also subject to higher loads. For a given drill pipe size and connection, load capacity is established by pipe grade, tube wall thickness, and connection OD and ID. If it can be presumed that the initial inspection got these issues correct, then during future use the designer need only be concerned about accumulated wear on tool joint boxes and drill pipe tubes (pin IDs rarely change due to wear). Most importantly, the two dimensions critical to load capacity that are affected by wear can be quickly and easily re-measured right on the rig at no cost in rig time. Since the designer can readily reconfirm these dimensions when the need arises, there will rarely be a need to schedule a full re-inspection on the basis of wear considerations alone. An exception to this rule will occur when a string is about to be used in some critical situation such as a Design Group 3 or HDLS application in which design factors and projected load factors approach unity.

2.11 Inspector's Second Objective

The inspector's second principal objective is to identify and set aside components that contain fatigue cracks, or that are at elevated risk for forming them. Finding fatigue cracks on drill pipe is an activity requiring special equipment, best done by trained specialists who are not working under production pressures. Thus, unless rig operations are to be suspended for several days, the designer should probably plan on transporting drill pipe to a location or facility where inspection can be efficiently done. A possible exception will be inspecting BHA connections for fatigue cracks, which can often be done efficiently at the rig, provided the inspector is allowed to work independently of rig-driven production pressure.

2.12 Considerations for Scheduling Re-Inspection

Given that the initial inspection was correctly done, the factors that should determine when re-inspection is needed are accumulated fatigue and accumulated wear.

2.12.1 Fatigue

Accumulated fatigue damage on drill pipe tubes should determine when to schedule a re-inspection for drill pipe fatigue cracks. The difficulty here is that fatigue damage can accumulate at vastly different rates in different parts of the string. This is illustrated in Figure 2.3. Here, a hole section is to be drilled from the tangent point to the section total depth. With the bit rotating at the tangent point, fatigue cycles begin accumulating on drill pipe that is within the build section. However, as drilling progresses, pipe moves from the build section into the straight tangent section, and from the straight section above the kickoff point into the build section. Also, if the tangent section is not horizontal, tension in the build section increases with each foot of new hole. This accelerates the rate at which damage accumulates on pipe in the build section. Figure 2.3 shows the accumulated damage when drilling the hole section is complete. While pipe immediately above TD

Figure 2.3 Fatigue damage will accumulate unevenly over the length of a drill string.

and in the straight section above the kickoff point have accumulated little or no damage, other sections, like the pipe at and immediately above the tangent point, will have significant damage. Other locations will have intermediate amounts of damage.

2.12.2 Load Capacity

Load capacity will be affected by wear on tool joints and tube bodies. Therefore, scheduling inspections for overload considerations should be done on the basis of cumulative wear.

2.13 Estimating Cumulative Fatigue Damage

To simplify the problem, the designer can separate the string into more than one section, then estimate accumulated fatigue damage on each, using Equation 2.1. Though this manual estimate will be very crude, it will be more useful for setting inspection frequency than any rule-of-thumb. The estimate is made by accumulating "damage points" on various sections of the drill string. Using this information, the designer can rotate component locations in the string to try to equalize damage, and schedule inspections based on the sum of accumulated damage points. The estimate takes into account average Curvature Index and number of cycles.

$$DP \equiv \frac{\text{Cycles} \cdot CI}{10^6} = \frac{60 \cdot CI \cdot RPM \cdot \text{Footage}}{ROP \cdot 10^6} \quad \text{.......... (2.1)}$$

Where:

DP = Fatigue "damage points" from one episode
CI = Average Curvature Index during episode
RPM = Average string rotation speed during episode (rev/min)
Footage = Footage drilled during episode (ft)
ROP = Average rate of penetration during episode (ft/hr)

2.14 Inspection Scheduling

Inspection for fatigue cracks will be indicated when total cumulative damage points for a section reach a predetermined threshold. Limited data is available to set these thresholds. However, based on the hind cast of several failure analyses, the recommended beginning estimate would be to inspect when total accumulated damage points reach 500 for "critical" applications. Less critical situations could be handled with higher limits on damage points, such as shown on the table below.

Drilling Conditions (Design Group)	**Inspection Trigger** (Cumulative Damage Points)
3	500
2	600
1	700

The designer should remember that this manual estimating method is very crude. However, it is an improvement over counting footage drilled or hours rotated, as it takes into account the relative severity of the drilling conditions. More accurate estimates can be obtained using a computer program designed for the task.

Example Problem 2.2, Scheduling Inspection for Fatigue Cracks:

The designer drills the hole section in Figure 2.3 from the tangent point to section TD in 10 ppg mud. He uses 5-inch, 19.50 ppf, grade S, Premium Class drill pipe. The wellbore kicks off at 3,000 feet and builds to 60 degree hole angle at a 3 degrees per 100 feet build rate. In this scenario, each joint of drill pipe that traverses the build section travels 2,000 feet within the build section where combined tension and bending are imposed while rotating. The joint of pipe that enters the build with the bit 2,000 feet from TD will experience the largest combined tension and bending while traversing the build section. Based on a torque and drag estimation, assume this 2,000 foot section experiences an average tension of 120,000 lb and is subjected to an average rotating speed of 120 RPM and an average ROP of 50 feet per hour. How many fatigue damage points accumulate on the drill pipe that reaches the tangent point when the bit reaches section TD?

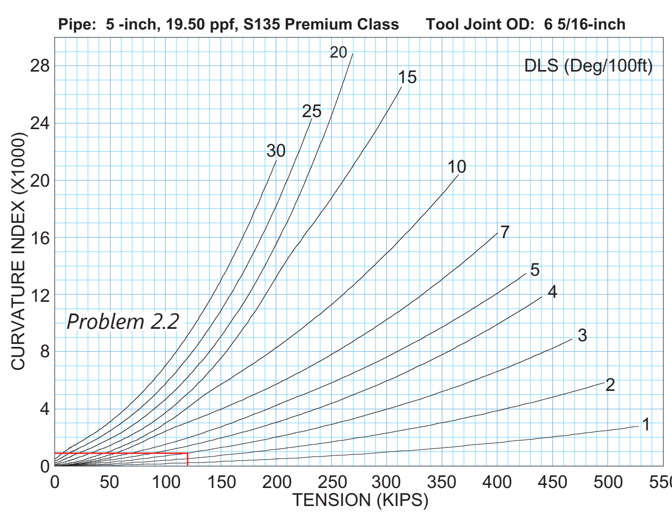


Figure 2.4 Curvature Index for 5-inch, 19.50 ppf, grade S, Premium Class drill pipe for example problem 2.2.

Solution:

From Figure 2.4, average Curvature Index in the subject pipe while it was in the build section was about 1,000. Applying Equation 2.1:

$$DP = \frac{60 \cdot 1000 \cdot 120 \cdot 2000}{50 \cdot 10^6} = 288 \text{ damage points.}$$

2.15 Manual vs Computer-Based Estimating

Estimating the degree of accumulated fatigue damage on drill string components can be done manually using the methods outlined above. However, computer programs are available at reasonable cost that will automate the estimating process and give more reliable answers. Even the manual process however, will yield much better estimates of cumulative wear and fatigue than traditional rules-of-thumb.

2.16 Estimating Loss of Load Capacity

Formulas are available to estimate the wear on a tool joint. However, these formulas are complex and estimates obtained from them will probably be crude. On the other hand, it's simple and economical to check the tool joint OD by setting OD calipers to the minimum allowable OD and using them as a no-go gauge on trips out of the hole. So a more effective measure would be to develop the habit of examining tool joints on trips. If those coming out of service under high side loads are still maintaining their dimensions, then others that were subject to less severe service could be assumed to be satisfactory.

2.17 Inspection Costs

Inspection cost will vary with Service Category. The following table gives rough relative cost ratios which may help in setting a program. These estimated ratios can fluctuate with market conditions and equipment availability. If an actual cost estimate is needed, it can be obtained from inspection companies in the region in question. The basic inspection program is DS-1 Category 3. The cost for other categories are expressed as multiples of Category 3 cost.

DS-1 Category	Approximate Cost Ratio
1	0.25
2	0.50
3	1.0
4	1.3
5	2.0
HDLS	6.0

2.18 Limitations of the Guidelines in this Standard

The standard inspection programs in Table 2.3 for service categories up through Category 5 cover most drilling applications. However, the user is cautioned that special material selection, inspection, and quality assurance programs that are beyond the scope of this standard will be required for very deep, very high pressure, and sour wells.

2.19 Inspection Using Metric Units

If measuring instruments with US customary units are not available for use during inspection, measuring instruments with metric units can be used, provided the calibration, standardization, and all other applicable requirements are met. The dimensions obtained shall be converted to the appropriate US customary units using Table 2.6 to determine acceptance of a component. The dimensional requirements and tolerances for verification of inspection apparatuses are also allowed to be measured using metric units and converted to the appropriate U. S. customary units. A reference table for conversion of fractions into equivalent decimal numbers is provided as Table 2.7.

2.20 Personnel Competency

The training, skill, and knowledge of the people performing the maintenance work covered by this standard is a critical factor in the likelihood of success. As such, every process performed under the guidance of this standard shall be performed by a competent individual.

2.20.1 Competency Standard

The inspection company shall develop a written Competency Standard, and a competent individual is someone who can demonstrate competency according to the written standard. The Competency Standard shall include:

- Skills: A list of skills that individuals will need for a given inspection task.
- Training: A classroom training program that imparts whatever knowledge is necessary for performing every listed skill to the individual. The training program shall document the training provided to each individual as well as the results of the testing provided to prove the individual has been successfully trained in each skill.
- Experience: Work that must be done to practice the skills needed under the supervision of a trainer or

instructor prior to the individual being certified as competent.

- Assessment: Provision for the individual to prove their ability to perform each skill. The assessment of each individual shall be performed by an assessor designated by the inspection company and the results of the assessment documented.

2.20.2 Vision Requirements

As a part of the Competency Standard, every individual performing inspection tasks in accordance with this standard shall meet the following requirements for visual acuity and color contrast:

- Near Vision Acuity: Inspectors shall demonstrate the ability in at least one eye to read a minimum of Jaeger Number 2 or equivalent type and size letter at twelve inches or greater distance on a standard Jaeger test chart. This test shall be given annually.

- Color Contrast: Inspectors shall demonstrate the ability to distinguish and differentiate contrast among colors used in the inspection methods to be performed. This test shall be given at each certification interval.

2.20.3 Qualification Certificates

Every person performing an inspection in accordance with this standard shall be able to demonstrate competency in the skills required according to the written Competency Standard. Upon demonstrating this competency, the inspection company shall create a Qualification Certificate as a record that the individual has met the applicable competency requirements. Each Qualification Certificate shall include:

- The individual's name

- The skill or skills for which the individual has demonstrated competency

- The signature of the Assessor that assessed the competency of the individual

- The date when the certificate was awarded

- The date of expiration of the certificate

2.20.4 Reassessment

A person must be reassessed for competency whenever any of the following occurs:

- The skill has not been performed in over one year

- The person changes employers

- At a minimum, every 5 years

For individuals performing inspection tasks, the Near Vision Acuity test described in 2.20.2 shall be given annually, at a minimum.

2.20.5 Records

The inspection company shall maintain the following records for all inspectors:

- Qualification Certificates as described in 2.20.3.

- Examination Records including examinations, grades, and vision examinations.

The records for each inspector shall be maintained for the duration of the inspector's employment with the company.

2.20.6 Customer Access

The customer or its authorized representative shall have access to the Competency Standard and all associated records for audit purposes. However, the Competency Standard is to be considered intellectual property and may not be copied or removed from the premises. Copies of the qualification certificates for each individual involved in the inspection of a tool provided to the customer may be retained by the customer or its authorized representative if desired.

2.21 Calibration Requirements

Instruments that are used to measure important parameters during the maintenance process shall be calibrated using standards traceable to the National Institute of Standards and Technology (NIST) or equivalent body. Unless otherwise indicated in this standard, the calibration frequency for all instruments shall be every six months.

The calibrated instrument shall have a tag or sticker affixed to it that shows the latest calibration date and the company and individual that performed the most recent calibration. If the tag or sticker is not present, the instrument's unique identification number shall be traceable to proof-of-calibration documents. The calibration of an instrument must be verifiable at the point of use.

A summary of the instrument calibrations required by this standard is given in Table 2.1.

2.22 Definitions

The following definitions apply under this standard.

Acceptance Criteria: A set of attributes, each of which must be met or exceeded in an inspected component for that component to be acceptable.

Customer: The entity on whose behalf the inspection is being conducted. If a component is being inspected prior to rental for use in a specific hole or holes, the customer is the owner of the hole(s). If the component is being inspected to go into inventory for later rental, the customer is the owner of the component.

Inspection: Examining a drill string component under the requirements of DS-1 Volume 3 to determine whether or not that component is acceptable under the stated acceptance criteria.

Inspection Class: A shorthand way of listing acceptance criteria on normal weight drill pipe tubes and connections. Five classes of accumulated wear and damage are recognized under this standard. They are "Class 1," "Ultra Class," "Premium Class," "Premium Class, Reduced TSR," and "Class 2." Class 1 refers to new pipe. Other class designations refer to acceptable levels of wear and

Table 2.1 Calibration Frequency

Device[1]	Calibration / Certification Frequency[2]	References
White Light Intensity Meter	6 months	3.4.2, 3.8.2, 3.9.2, 3.11.2, 3.15.2, 3.17.2, 3.19.2, 3.24.2, 3.25.2, 3.26.2, 3.27.2, 3.29.2, 3.37.2, 3.38.2
Caliper or Micrometer	6 months	3.5.2, 3.6.2, 3.31.2, 3.36.2
UT Wall Thickness Transducer Linearity	6 months	3.6.2, 3.33.2
Blacklight Intensity Meter	6 months	3.8.2, 3.9.2, 3.15.2, 3.17.2, 3.29.2
AC Yoke Capacity	6 months	3.8.2, 3.9.2, 3.19.2, 3.34.2
UT Flaw Detection Transducer Linearity	6 months	3.10.2, 3.16.2, 3.30.2
Lead Gage	6 months	3.11.2, 3.13.2, 3.14.2, 3.26.2, 3.27.2, 3.31.2
Internal Micrometer	6 months	3.13.2, 3.24.2, 3.28.3
ID Micrometer Setting Standard	6 months	3.13.2
Long-Stroke Depth Micrometer	6 months	3.13.2, 3.14.2
Depth Micrometer Setting Standards	6 months	3.13.2, 3.14.2
Extended-Jaw Caliper	6 months	3.13.2, 3.14.2
External & Internal Taper Gauge	6 months	3.31.2
Hydraulic Pressure Gauge	6 months	3.31.7
Pit Depth Gage	1 year	3.37.2, 3.38.2
Standard Lead Template	1 year	3.11.2, 3.13.2, 3.14.2, 3.26.2, 3.27.2, 3.31.2
Dry Film Thickness Gage	1 year	3.19.2
Thermometer	1 year	3.21.2, 3.22.2, 3.23.2
Field Brinell Hardness Tester	1 year	3.23.2
Magnetometer	1 year	3.34.2
Profile Gage	3 years	3.11.2, 3.13.2, 3.14.2, 3.26.2, 3.27.2, 3.38.2
Angle Gage	3 years	3.11.2, 3.27.2
10 lb Weight	3 years	3.8.2, 3.9.2, 3.19.2, 3.34.2
Ring & Plug Gages	Per API Spec 7-2	3.31.2

1. For any measuring device not listed, excluding steel or tape rulers, 6 month calibration frequency shall apply.
2. For any field inspection procedures for specialty connections, calibration frequency of equipment shall be per this standard or OEM requirements, whichever is shorter.

damage, as outlined in Table 3.5.1. The shorthand "Class" designation applies to only normal weight drill pipe.

Inspection Method: One of thirty six different processes for inspection outlined on Table 2.2 and governed by Volume 3 of this standard.

Inspection Procedure: A set of written steps, found in Volume 3 of this standard, that must be followed by the inspector to comply with this standard. Each of the specific methods in Table 2.2 has an accompanying procedure.

Inspection Program: A set of one or more inspection methods applied to a specified set of drill string components, and also the acceptance criteria the inspector will use to accept or reject each component.

Service Category: A shorthand way of expressing an inspection program. Six service categories are recognized here in DS-1 Volume 3.

Torsional Strength Ratio (TSR): On a joint of drill pipe, the ratio of tool joint to tube torsional strengths.

Trip Inspection: An inspection procedure conducted on the rig floor by rig crews. It consists of go/no-go checks of drill pipe tool joint dimensions, and ultrasonic measurement of drill pipe tube wall thickness.

2.23 History and Evolution of Used Drill Pipe Classes

The first industry-wide list of acceptance criteria for used drill pipe was written in API Recommended Practice 7G. Originally, RP7G established five classes, numbered 1 (new pipe) through 5 (junk). Later, a class called "Premium" was inserted between Class 1 and Class 2. Premium Class and Classes 2, 3, and 4 represent advancing stages of deterioration. Under this system, a pipe's classification is based upon a number of attributes. During inspection, each attribute is examined, and the pipe is placed at the highest class at which all required attributes are met or exceeded. When RP7G was first published, Class 3 and Class 4 pipe were considered usable in many circles, but now they are considered too worn for most needs. Today, even Class 2 drill pipe is rarely specified, and "Premium Class" has emerged as having the preferred minimum set of attributes for used drill pipe in most commercial transactions. "Premium Class, Reduced TSR" (Torsional Strength Ratio) was recognized as a separate class of pipe in the second edition of DS-1. Requirements for this class of pipe are identical to Premium Class, except that minimum tool joint dimensions result in a weaker than Premium Class torsional capacity. The class was recognized because a few drill pipe/tool joint combinations with undersized tool joint ODs (but Premium Class in every other respect) are still used widely. For these combinations, the industry seems to prefer a slimmer tool joint for fishing clearance, and is willing to accept a reduction in torsional capacity to gain the increased clearance. These tool joints are often manufactured with Class 2 dimensions, which wear reduces further. Since most people have routinely specified "Premium Class" for some time, the inspection community had for years used an informal, unregulated set of tool joint criteria to accept or reject these particular items, while more or less rigorously enforcing other requirements for Premium Class. To establish some control over this practice, DS-1 sponsors adopted a new class called "Premium Class, Reduced TSR" in the second edition of DS-1. Concerns later arose that Premium Class was not stringent enough for deepwater applications. Therefore, "Ultra Class" was created to provide acceptance criteria more stringent than that provided by Premium Class.

2.24 Fitness for Purpose

Historically, little interaction has occurred between designer and inspector, though this is in the process of change. Operators, the inspection industry, and the owners of drill pipe have long been settled in a routine centered around the "Premium Class" set of acceptance criteria. Drilling contracts and rental agreements for drill pipe often cite Premium Class as the minimum acceptable set of drill pipe attributes. Contractors, rental companies, and inspection companies stock inventories and inspect and reject around this benchmark. The drill string designer, knowing this to be the case, will generally check his or her design against the performance properties of Premium Class. Most references, like this one, build tables and curves giving performance properties built around pipe having Premium Class attributes, as if every piece of drill pipe in the world were worn to exactly 80 percent remaining wall thickness. There is nothing sacred about this long-ingrained habit. There will be times when good engineering and economy demand adjusting acceptance criteria from these essentially arbitrary values, to move toward providing pipe that will be fit for the intended application.

2.25 Adjusting Acceptance Criteria

Many criteria for acceptability in drill pipe have evolved over decades. They have become institutionalized in practice and in inspection industry standards, including this one. Some are directly related to performance, others loosely related, and a few hardly related at all. The designer should understand them, as they directly bear on the fitness of the drill string for an intended use. Whether or not to raise or lower them for a particular application, and the confidence that can be taken in the adjustment, will depend upon the attribute in question and the circumstances of the application. Chapter 5 covers these points in detail.

2.26 The Inspection Procedure is Critical

The designer will rarely be knowledgeable about the technical minutiae of inspecting a drill string, just as the inspector will rarely be able to design one. Yet the designer and his organization have much at stake in whether or not the drill string actually possesses the attributes called for. Stated another way, the designer and his organization have much at stake in whether or not the inspector accurately sorts the components being inspected. How well the inspector does his or her job will depend in large part on what procedure is followed during the inspection. Procedure sensitivity was well illustrated in a landmark study by Moyer and Dale.[1] These men used commercial inspection companies to examine several pieces of drill pipe and drill collars that were in various states of wear and fatigue. They did not materially interfere with the inspectors, but simply recorded their findings and plotted the probability that the inspectors would find the flaws they knew existed. In one facet of the study, Moyer and Dale evaluated the probability that inspection companies would find cracks in drill collar connections. The acceptance criteria allow no fatigue cracks in connections, no matter how small, so the test provided a good measure of commercial blacklight inspection. The result is shown in Figure 2.5. The test subjects had about a one in four chance of finding small cracks. Their chance of finding cracks increased to eight to nine in ten when the cracks were very large.

2.27 Procedure Affects Results

An interesting twist to the data in Figure 2.5 is this: the investigators used the same technique they were studying, blacklight inspection, to establish the existence of a crack, against which they evaluated commercial inspections. The investigators, however, examined the connections using the best available practices and under no production pressure. So Figure 2.5 does not evaluate the absolute quality of commercial blacklight inspection for finding cracks. In reality, it compares the relative quality of commercial blacklight inspection done at the time (data points) against blacklight inspection done properly by the investigators. Stated another way, the blacklight practices used by the investigators were 10-20% more likely to find very large cracks and four hundred percent more likely to find very small cracks than the commercial subjects. This "procedure sensitivity" is present in all nondestructive inspection. It is the reason mandatory inspection procedure control steps are written in Volume 3 of this Standard. Reference 1 also discusses the degree of "control" for an inspection process. This is illustrated in Figure 2.6. The acceptance criteria demanded, expressed in flaw size, is shown by the heavy black line. However, a real-world inspection will not be able to attain the ideal. Because of inspection uncertainty, some good material will be rejected, and some bad material accepted. Figure 2.6 (center) shows a real inspection sort that was run with a well-controlled procedure like the investigators in reference 1 used. A well-controlled inspection procedure can provide results that approximate (but can never match) the theoretical sort demanded by the acceptance criteria. As procedure control deteriorates, the results move further away from ideal, resulting in more acceptance of substandard material, and higher probability of downhole problems. This reality is especially problematic in drill string inspection, where inspections are priced on a "piece work" basis and often competitively bid by customers who may have little understanding of what they're purchasing. No matter how well qualified and motivated an inspection organization may be, these market pressures leave them no alternative but to "hurry" in order to make money. The resulting loss of procedure control, and the detrimental results on inspection

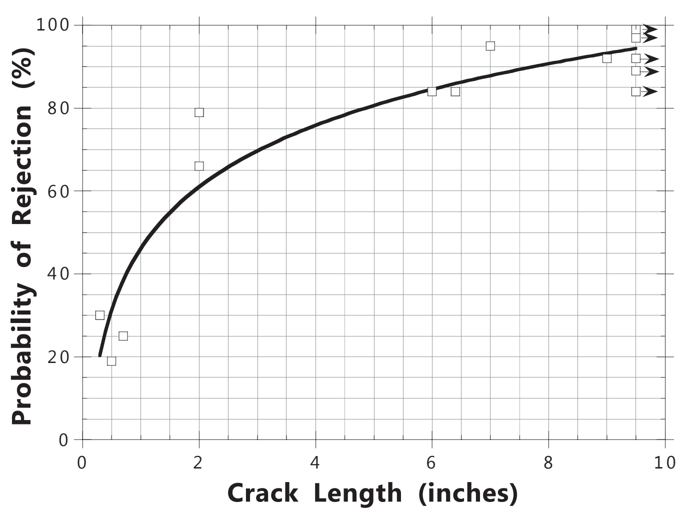


Figure 2.5 Probability of detecting a drill collar connection fatigue crack as a function of crack size. (from Reference 1)

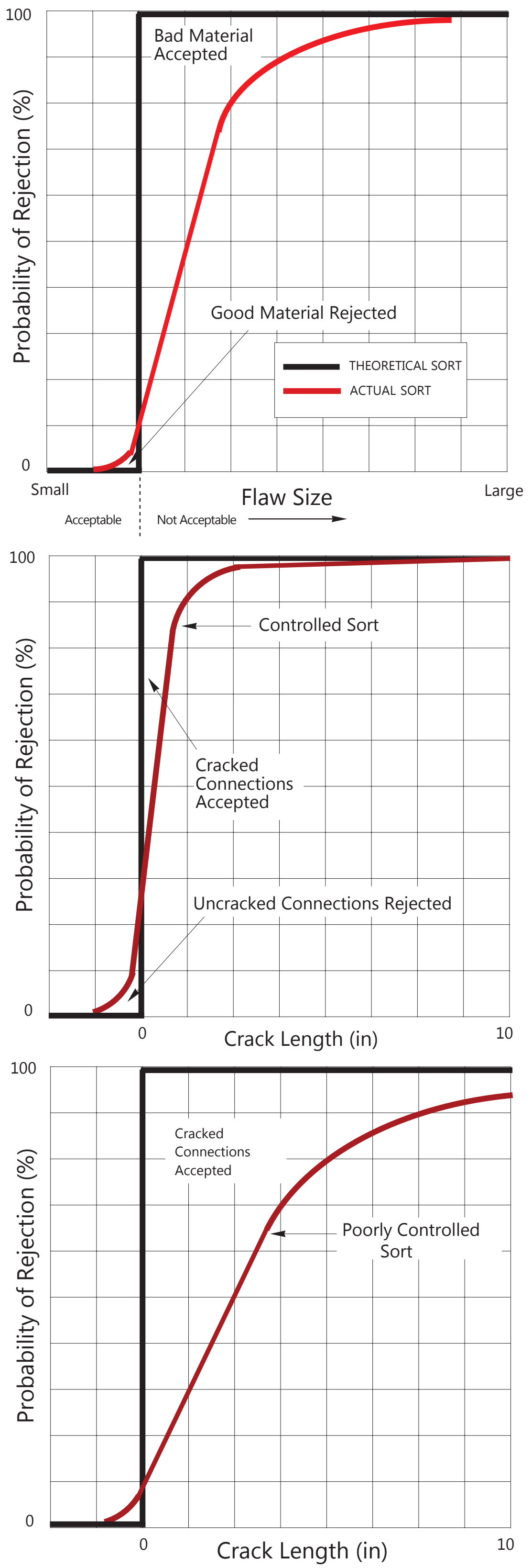


Figure 2.6 Real inspection can never attain the ideal sort demanded by the acceptance criteria in effect (top). However, a well controlled inspection procedure (center) more closely approximates the ideal than a poorly controlled procedure (bottom).

quality, far outweigh the few dollars the customer saves on inspection cost. Customers who focus only on minimizing inspection costs do not allow the inspection organization time to do a good job and still make money. Such customers are subverting their own interest, and share in the blame if the quality of the inspection they receive does not meet their expectations.

2.28 Frequently Asked Questions

DS-1 has become widely accepted as the standard for inspecting drill string components. Several questions are commonly asked about using the standard. These questions are answered here:

Q: What specific drill stem components are covered by DS-1 Volume 3 inspection procedures?

A: The Fifth Edition of Volume 3 of the standard covers used normal-weight drill pipe, thick-walled drill pipe, HWDP, workstring tubing, drill collars, pup joints, API and similar rotary-shouldered connections, a number of proprietary connections, kellys, subs, stabilizers, and single-piece fishing tools.

Q: Standard DS-1 Volume 3, Third Edition used to provide procedures for inspecting certain drilling specialty tools like jars, MWD/LWD, motors, etc. Can I continue to use DS-1 Volume 3, Fifth Edition for inspection of used drilling specialty tools?

A: No. Standard DS-1 Volume 3, Fifth Edition does not cover qualification of drilling specialty tools. Inspection and qualification of drilling specialty tools is now covered by Standard DS-1 Volume 4, Fifth Edition. However, since Standard DS-1 Volume 3, Third Edition previously covered qualification of certain drilling specialty tools, vendors of drilling specialty tools may be requested by their customers to follow requirements specified in Standard DS-1 Volume 3, Third Edition for Category 3-5 (or lower) for these tools. In this event, the vendor shall meet this request by following the requirements specified in Standard DS-1 Volume 4, Fifth Edition for tool Class A1.

Q: How does a DS-1 inspection differ from an API inspection?

A: Unfortunately, neither one of the two terms in this question has any precise meaning, so the question cannot be answered. The term "API inspection," although frequently used by people in the industry, has no precise meaning unless it is referenced to API RP7G-2 and an inspection classification is designated. Neither is the term "DS-1 inspection" meaningful unless it's accompanied by a specific Service Category (Number 1-5 or HDLS). See paragraph 2.5.

Q: Are DS-1 requirements more rigid than API RP7G-2 requirements for drill string inspection?

A: This question must be answered in four parts.

First, in terms of the drill pipe attributes required for a component to be accepted under Premium Class or Class 2 acceptance criteria, there is very little difference in the two standards. In fact, the majority of the DS-1 acceptance criteria were taken directly from API RP7G. However, API RP7G-2 does not provide Premium Class Reduced TSR acceptance criteria or dimensional acceptance criteria for proprietary connections. Also, API-RP7G-2 does not have Ultra Class as a possible acceptance criterion for Normal Weight Drill Pipe.

Second, in terms of method selection, DS-1 has six inspection categories while API RP7G-2 has three inspection classifications. There is no precise correlation between the inspection categories and classifications but the DS-1 Category 4 is similar to the API RP7G-2 Standard Level and the DS-1 Category 5 is similar to API RP7G-2 Moderate and Critical Levels.

Thirdly, DS-1 provides process controls on how an inspector must calibrate and use his or her equipment beyond the controls set in API RP7G-2.

Finally, DS-1 provides the tools to schedule inspections. For overload inspections, Procedure 3.33 Rig Floor Trip Inspection is provided. Since this inspection procedure can be implemented while tripping the drill string, the inspection can be performed as often as desired with minimal cost. For fatigue inspections, a process is provided to estimate fatigue damage based on its use. API RP7G-2 provides only the traditional recommendations of hours for setting inspection frequency which is inaccurate and inefficient.

Q: Can I use DS-1 Volume 3 for inspecting new drill stem components?

A: No. Volume 3 of the Standard applies only to used drill stem equipment. Its procedures are specifically geared to finding service-induced defects, and would not be effective for finding typical manufacturing flaws. For new drill pipe inspection, refer to Volume 1 of this standard. For gaging new tool joints and rotary shouldered connections, see API Specification 7-2.

Q: How do I order inspection under DS-1?

A: How to order inspection service is covered in detail earlier in this chapter.

Q: My inspection company tells me that it will cost more to do a DS-1 inspection than an API inspection. Is the extra expenditure justified?

A: This is the most frequent question that arises. It is best answered in the context of DS-1 Service Categories. When the sponsor committee first established DS-1 categories, the industry was using an informally defined program that many (but not all) inspection companies called a "Standard Rack Inspection." This "Standard Rack Inspection" (or its rough equivalent, since its meaning varied by company and location) was adopted by the sponsor committee as DS-1 Category 3. To give inspection buyers some flexibility while maintaining tight control over inspection processes, the sponsor committee also established Categories 1 and 2 (with fewer inspections than Category 3), and Categories 4-5 (with more inspections). If we suppose the speaker really means what was loosely called a "Standard Rack Inspection," then the cost of that inspection should be nearly identical to DS-1 Category 3. If it is significantly cheaper, then the inspection company is most likely omitting some process control step required in DS-1. Tightening to the DS-1 quality requirements would almost certainly be justified.

In more meaningful terms, the comparison could be phrased as "Standard Rack Inspection" vs "DS-1 Category 3 inspection." Unless the company is omitting some step required by DS-1 the cost should be the same. Of course, if the comparison were made with a DS-1 Category 4 or 5 inspection program, the latter should cost more. Conversely, a DS-1 Category 1 or 2 program should cost less. For more on inspection costs, see paragraph 2.17.

Q: My company has standardized on DS-1 Category 5 inspection program for all components, but inspection costs have increased. Are we doing the right thing?

A: Probably not. The cost of a Category 5 inspection is roughly twice that of the normal program represented by Category 3. Category 5 is intended for drill string components that are to be used in extremely adverse conditions where the potential cost of a failure is very large. Unless your drilling conditions and risk management policies dictate the utmost caution, Category 5 may not be justified.

Q: I would like to qualify my drill string by checking a sample. What percent of the string must I inspect to be sure that it is all acceptable?

A: You should not inspect your drill string by checking a sample. Unless the sample you choose is truly representative of the entire lot of components, and unless you have zero reject rate in your sample, you cannot be fully confident that every single component in the unchecked portion is acceptable. In a nutshell, if you need to do an inspection at all, you should apply it to all of the pipe in the lot. If you need to reduce inspection costs in low-risk situations, you might consider dropping to a lower service category.

Q: Under what conditions could spot sampling be considered good practice?

A: Spot sampling is useful if you wish to get a general feel for the condition of a lot of pipe, without qualifying every individual piece. For example, if you were concerned about the general condition of a string, you might use spot checking to decide whether to proceed with inspecting that string or to look for an entirely different string. The designer will probably use spot sampling when employing a trip inspection to evaluate cumulative wear on tool joints. In this event, he or she would only inspect those “spots” in the string that operated under higher side loads.

Q: All dimensions for procedural requirements and acceptance criteria in DS-1 Volume 3 are listed in US customary units. Am I allowed to perform an inspection using measuring instruments with metric units?

A: Yes. Dimensions used to verify procedural requirements (i.e. field reference standards) and to determine the acceptance of components are allowed to be measured using metric units and converted to the appropriate US customary units. The conversion factors that shall be used are listed in Table 2.6. See paragraph 2.19 for details.

References

1. Moyer, M.C., and Dale, B.A., "Sensitivity and Reliability of Commercial Drillstring Inspection Services", SPE 17661, Presented at the 1988 Offshore Southeast Asia Technology Conference, Singapore, Feb 2-5.

2. Taylor, Barry. N., & Thompson, Ambler. Guide for the Use of the International System of Units (SI) (Special Publication 811, 2008 ed.). Gaithersburg, MD: National Institute of Standards and Technology, 2008

Table 2.2 Inspection Methods Covered by this Standard

NAME OF METHOD:		APPLIED TO:	WHAT IS DONE:	WHAT IS BEING EVALUATED:
1	Visual Tube	Drill pipe & HWDP tubes	Full length visual examination of the inside and outside surfaces of used tubes	Straightness, mechanical or corrosion damage, debris such as scale or drilling mud
2	OD Gage Tube	Drill pipe tubes & workstring tubing	Full length mechanical gaging of the outside diameter of used drill pipe tubes	Diameter variations caused by excessive wear or mechanical damage, expansions caused by string shot, reductions caused by overpull
3	UT Wall Thickness	Drill pipe tubes & workstring tubing	Wall thickness is measured around one circumference of the tube using an ultrasonic thickness gage	Tube wall thickness below the specified acceptance limits, minimum cross-sectional area of the tube
4	Electromagnetic (EMI)	Drill pipe tubes & workstring tubing	Full length scanning (excluding external upsets) of drill pipe tube using the longitudinal field (transverse flaw) buggy type unit	Flaws such as fatigue cracks, corrosion pits, cuts, gouges, and other damage that exceeds the specified acceptance limits
5	Heat Checking Inspection	Box tool joints	Dry or wet fluorescent magnetic particle inspection	Heat checking (longitudinal surface flaws)
6	MPI Slip/Upset	Drill pipe, HWDP, or workstring slip and upset areas. HWDP center pad.	Examination of the external surface of drill pipe and HWDP upsets and slip areas, and HWDP center pad using the active-field AC yoke dry visible magnetic particle technique	Flaws such as fatigue cracks, corrosion pits, cuts, gouges, and other damage that exceed the specified acceptance limits
7	Ultrasonic (UT) Slip/Upset	Drill pipe, HWDP, or workstring slip and upset areas	Examination of Drill Pipe and HWDP upsets and slip areas using shear wave ultrasonic equipment	Flaws such as fatigue cracks, corrosion pits, cuts, gouges, and other damage that exceeds the specified acceptance limits
8	Visual Connection	Drill pipe tool joints, HWDP tool joints, and BHA connections	Visual examination of connections, shoulders, and tool joints and profile check of threads, measurement of box swell and pin lead, and check for shoulder flatness	Handling damage, indications of torsional damage, galling, washouts, fins, visibly non-flat shoulders, corrosion, weight/grade markings on tool joint and pin flat
9	Dimensional 1	Drill pipe tool joints	Measurement or Go-No-Go gaging of box OD, pin ID, shoulder width, and tong space	Torsional capacity of pin and box, torsional matching of tool joint and tube, adequate shoulder to support makeup stresses, adequate gripping space for tongs
10	Dimensional 2	Drill pipe tool joints	Dimensional 1 requirements plus measurement or Go-No-Go gaging of counterbore depth, box counterbore, pin flat length, and bevel diameter	Same as Dimensional 1, plus evidence of torsional damage, potential box thread engagement with pin flat, excessive shoulder width, sufficient seal area to avoid galling, non-flat shoulders
11	Dimensional 3	BHA connections, HWDP tool joints & upsets	Measurement or Go-No-Go gaging of box OD, pin ID, pin lead, bevel diameter, pin stress relief diameter and width, boreback cylinder diameter and thread length and HWDP center upset diameter	Torsional capacity of HWDP pin and box, drill collar BSR, evidence of torsional damage, excessive shoulder width, proper dimensions on stress relief features to reduce connection bending stresses, wear on HWDP center upset

Table 2.2 Inspection Methods Covered by this Standard (continued)

NAME OF METHOD:		APPLIED TO:	WHAT IS DONE:	WHAT IS BEING EVALUATED:
12	Blacklight Connection	BHA connections (mag only), HWDP tool joints, drill pipe tool joints, & workstring connections	Fluorescent wet magnetic particle inspection using active DC current	Fatigue cracks
13	UT Connection	HWDP tool joints BHA connections (all)	Compression wave pulse-echo ultrasonic inspection of connections	Fatigue cracks
14	Liquid Penetrant Inspection	Nonmagnetic BHA connections	Liquid penetrant inspection of connections and other surfaces	Fatigue cracks
15	Slip Groove	Drill collar slip grooves	Measurement of slip groove dimensions such as groove length and groove depth, and visual inspection of groove	Out-of-tolerance dimensions which could result in inadequate gripping of the collar
16	Wet Visible Contrast Inspection	Drill pipe or HWDP slip and upset areas. HWDP center pad	Examination of the external surface of drill pipe and HWDP upsets and slip areas, and HWDP center pad using wet visible contrast technique with an active AC or DC field	Flaws such as fatigue cracks, corrosion pits, cuts, gouges, and other damage that exceed the specified acceptance limits
17	Kelly Inspection	Kellys	Inspection of connections and body	Fatigue cracks, connection condition, wear patterns, straightness
18	Connection Phosphating	Newly machined or recut rotary-shouldered connections	Application of phosphating anti-galling treatment to connection surfaces	Proper application quality control
19	Hardbanding Reapplication	Tool joints, drill collars, and HWDP center pad	Application of hardbanding on used components	Proper application quality control
20	Tool Joint Rebuilding	Tool joints	Application of weld metal to rebuild tool joint (increase OD)	Proper application quality control
21	Stabilizer Inspection	Stabilizers	Blacklight and dimensional inspection of connections, blades, welds, and body	Fatigue cracks, connection condition, gage, neck length, weld cracks
22	Sub Inspection	Subs	Blacklight and dimensional inspection of connections and body	Fatigue cracks, connection condition, length, neck length, ID, other dimensions
23	Pup Joint 1 Inspection	Integral and welded pup joint	Visual and dimensional inspection	Mechanical, handling, corrosion, and operational damage. Check for fit-for-purpose
24	Pup Joint 2 Inspection	Integral and welded pup joint	Visual, dimensional, and flaw (crack) detection inspection	Fatigue cracks. Mechanical, handling, corrosion and operational damage. Check for fit-for-purpose
25	Shop Inspection of Fishing Tools	Fishing tools	Disassembly, inspection of connections, welds, internal parts, and body	Fatigue cracks on connections and outer case only. Dimensions on connections

Table 2.2 Inspection Methods Covered by this Standard (continued)

NAME OF METHOD:		APPLIED TO:	WHAT IS DONE:	WHAT IS BEING EVALUATED:
26	Residual Magnetic Particle Inspection Method	Ferromagnetic surfaces where active field inspection is not practical	Residual field magnetic particle inspection using either the Dry Visible or Wet Fluorescent Methods	Fatigue cracks, weld cracks, ID, OD
27	Full Length Ultrasonic Inspection (WT, TL, Obl)	Drill pipe tubes	Full length inspection of tube bodies with compressional wave (WT), transverse and longitudinal shear wave (TL), and oblique shear wave scans (Obl)	Flaws, such as cracks, cuts, gouges, and corrosion pits, and minimum wall thickness
28	Recutting and Gaging of RSC	BHA connections, HWDP tool joints, and drill pipe tool joints	Recutting, gaging, and marking of connections	Proper repair of connections
29	Traceability	Various heavy duty landing string components	Verification of component traceability	Component identity and traceability to source metallurgical test reports
30	Rig Floor Trip Inspection	Drill pipe and tool joints	Dimensional inspection of the tool joint OD and wall thickness measurement of the tube body	That the load capacity of the drill pipe has not been reduced by hole wear beyond desired limits
31	Demagnetization	Magnetized components	Measurement and reduction of residual magnetic fields	Residual magnetic fields
32	Post Inspection Marking	Drill stem components & workstring tubing	Post inspection marking of components	Proper marking and classification of inspected components
33	Drift Inspection	Workstring tubing	Drift mandrel passed through tubing	ID tool passage and presence of obstructions
34	Workstring Visual Tube	Workstring tubing	Full length visual examination of the inside and outside surfaces of used tubes	Straightness, mechanical or corrosion damage, debris such as scale or drilling mud
35	Workstring Visual Connection	Workstring tubing	Visual examination of connections and couplings and profile check of threads	Handling damage, indications of torsional damage, galling, washouts, fins, corrosion
36	Workstring Dimensional Connection Inspection	Workstring tubing connections	Measurement of coupling or box OD, pin ID, thread elements	Torsional capacity of connections, adequate threads to support makeup stresses

Table 2.3 Recommended Inspection Programs for Drill Pipe and Workstring Tubing

Component	Service Category 1	2	3	4	5 Note 2	HDLS
Tool Joint	Visual Connection	Visual Connection Dimensional 1	Visual Connection Dimensional 1	Visual Connection Dimensional 2	Visual Connection Dimensional 2 Blacklight Connection Heat Checking	Visual Connection Dimensional 2 Blacklight Connection Traceability Heat Checking
Drill Pipe Tube	Visual Tube	Visual Tube OD Gage UT Wall Thickness	Visual Tube OD Gage UT Wall Thickness EMI[1]	Visual Tube OD Gage UT Wall Thickness EMI[1] MPI Slip/Upset[3]	Visual Tube OD Gage EMI[1] MPI Slip/Upset[3] UT Slip/Upset UT Wall Thickness	Visual Tube OD Gage FLUT (WT/TL/Obl) MPI Slip/Upset[3] UT Slip/Upset Traceability
Workstring Connections	Workstring Visual Connection	Workstring Visual Connection Workstring Dimensional Connection	Workstring Visual Connection Workstring Dimensional Connection	Workstring Visual Connection Workstring Dimensional Connection	Workstring Visual Connection Workstring Dimensional Connection Blacklight Connection	-- -- --
Workstring Tubes	Workstring Visual Tube	Workstring Visual Tube OD Gage UT Wall Thickness Drift Testing	Workstring Visual Tube OD Gage UT Wall Thickness EMI Drift Testing	Workstring Visual Tube OD Gage UT Wall Thickness EMI MPI Slip/Upset Drift Testing	Workstring Visual Tube OD Gage UT Wall Thickness EMI MPI Slip/Upset UT Slip/Upset Drift Testing	-- -- -- -- -- -- --
Acceptance Criteria	Premium Class	Premium Class	Premium Class	Premium Class	Premium Class	Project Specific
Marking	Post-Inspection Marking	Post-Inspection Marking	Post-Inspection Marking	Post-Inspection Marking	Post-Inspection Marking	Post-Inspection Marking

Note 1: FLUT (WT/TL) is required for drill pipe in lieu of EMI when either the nominal wall thickness is greater than 0.500" or verification of wall thickness along the entire tube length is critical.

Note 2: For Category 5 Inspection: Blacklight Connection Inspection for fatigue cracks in drill pipe tool joints is relatively expensive when performed on large lots of drill pipe, and fatigue failures in drill pipe tool joints are rare. Users may consider omitting Blacklight Connection Inspection of drill pipe tool joints from the Category 5 inspection program unless tool joint fatigue cracks have occurred. Other Category 5 inspections are recommended. Blacklight Connection Inspection is still required on BHA components for Category 2 and higher.

Note 3: For ferromagnetic components, Wet Visible Contrast Inspection may be substituted for MPI Slip/Upset Area Inspection.

Table 2.4 Recommended Inspection Programs for Other Components

Component	Service Category 1	2	3 - 5	HDLS[2]
DC & HWDP Tool Joints	Visual Connection Slip Groove (if applicable)	Visual Connection Blacklight Connection[1] Slip Groove (if applicable) Heat Checking (HWDP only)	Visual Connection Blacklight Connection[1] Dimensional 3 Slip Groove (if applicable) Heat Checking (HWDP only)	--
HWDP Tubes	Visual Tube	Visual Tube	Visual Tube MPI Slip/Upset[3]	--
DC & HWDP Marking	Post-Inspection Marking	Post-Inspection Marking	Post-Inspection Marking	--
Subs, Stabilizers, Kellys	--	--	Sub, Stabilizer, or Kelly Inspection (as applicable)	Sub, Stabilizer, or Kelly Inspection (as applicable) Traceability
Fishing Tools	--	--	Shop Inspection of Fishing Tools	--
Pup Joints (Integral & Welded)	--	Pup Joint 1	Pup Joint 2	Pup Joint 2

Note 1: For nonmagnetic components, use UT Connection or Liquid Penetrant Connection for Blacklight Connection. UT Connection Inspection is recommended for nonmagnetic components.

Note 2: Inspect other HDLS components according to the manufacturers' and/or customers' requirements. Traceability inspection is also required.

Note 3: For ferromagnetic components, Wet Visible Contrast Inspection may be substituted for MPI Slip/Upset Area Inspection.

Table 2.5 Recommended Beginning Inspection Frequency

Component	Service Category (Also see requirements for the specific Design Group) 1	2-3	4-5	HDLS
Drill Pipe	When picked up	When picked up	Before each well	(see Note 2)
HWDP, Drill Collars, Subs, Stabilizers	When picked up & after each 250-400 rotating hours	When picked up & after each 150-300 rotating hours	When picked up & after each 150-250 rotating hours	Before each landing operation
Pup Joints (Integral & Welded)	--	When picked up	Before each well	Before each landing operation

Note 1: Setting inspection frequency guidelines applicable to all areas is impossible owing to the wide differences in drilling conditions that exist. The guidelines above should only serve as a starting point if no experience is available in the area in question. They should be adjusted based on experience and failure history.

Note 2: Inspect before each landing operation if previously used for any other operation, such as drilling or jarring, or loaded in tension beyond 90% of the tensile capacity. Otherwise, inspect prior to every third landing operation.

Table 2.6 Conversion Factors for Inspection

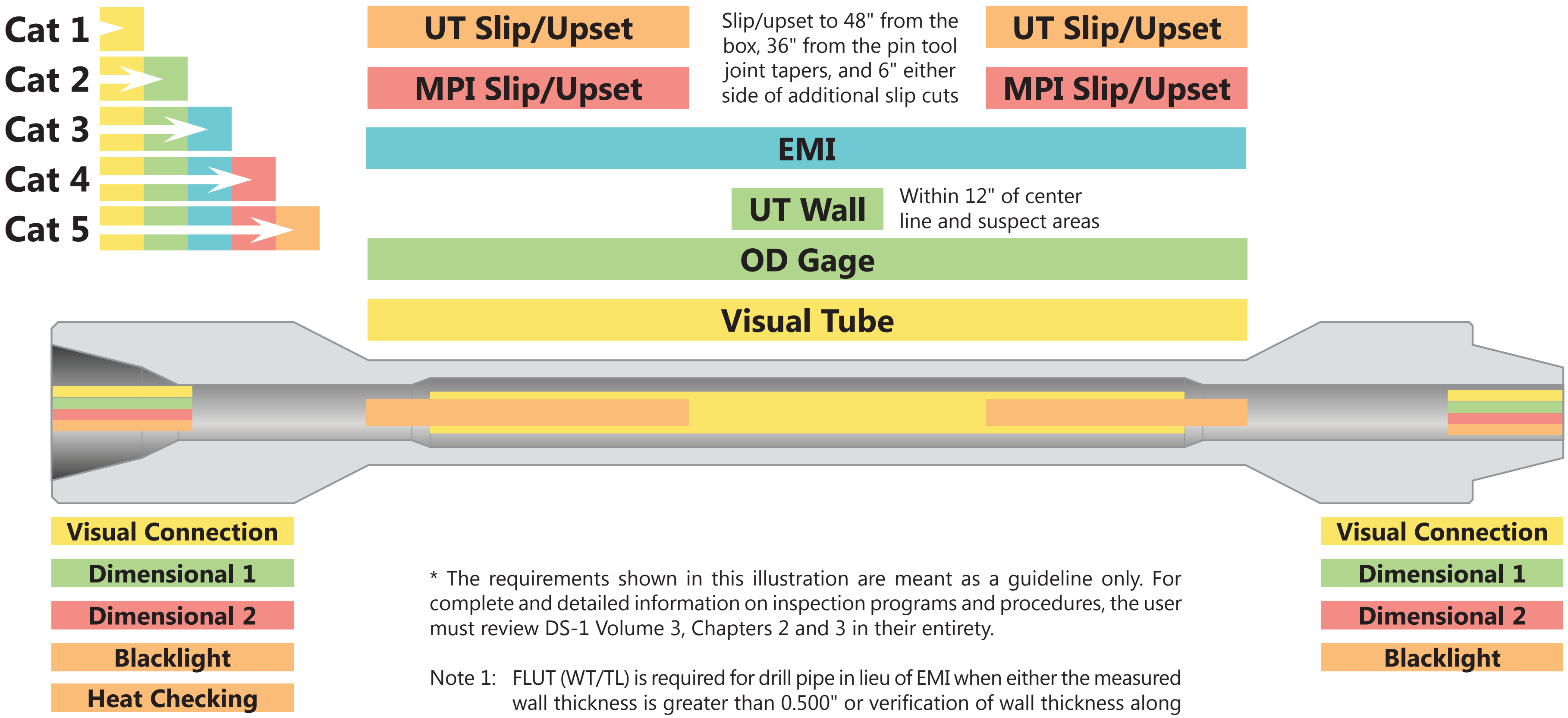
Attribute	Multiply SI Unit	By[Note1]	To Obtain US Customary Unit
Diameter/Thickness	millimeters (mm)	0.03937008	inch (in)
Length	meters (m)	3.280840	foot (ft)
Pressure/Strength	megapascal (MPa)	145.0377	pound per square inch (psi)
Torque	newton-meter (N-m)	0.7375621	foot-pound (ft-lb)
Temperature	Celsius (°C)	°C = (°F − 32) × $^5/_9$	Farenheit (°F)
Magnetic Field	tesla (T)	10^4	gauss (G)
Energy	joule (J)	0.7375621	foot-pound (ft-lb)
Illuminance	lux (lx)	0.09290304	foot-candle (fc)
Force/Load	newton (N)	0.2248089	pound force(lb_f)
Mass	kilogram (kg)	2.204622	pound (lb_m)
Speed	meter per second (m/s)	3.280840	feet per second (fps)
Density	kilograms per cubic meter (kg/m^3)	0.008345406	pounds per gallon (lb_m/gal or ppg)
Volume	liter (L)	0.2641720	gallon (gal)
Mass per unit length	kilogram per meter (kg/m)	0.6719688	pound per foot (ppf)
Area	square meter (m^2)	1550.003	square inch (in^2)
Rotary Speed	radians per second (rad/s)	9.549297	revolutions per minute (rpm)

Attribute	Multiply US Customary Unit	By[Note1]	To Obtain SI Unit
Diameter/Thickness	inch (in)	25.4	millimeters (mm)
Length	foot (ft)	0.3048	meters (m)
Pressure/Strength	pound per square inch (psi)	0.006894757	megapascal (MPa)
Torque	foot-pound (ft-lb)	1.355818	newton-meter (N-m)
Temperature	Fahrenheit (°F)	°F = °C × $^9/_5$ + 32	Celsius (°C)
Magnetic Field	gauss (G)	10^{-4}	tesla (T)
Energy	foot-pound (ft-lb)	1.355818	joules(J)
Illuminance	foot-candle (fc)	10.76391	lux (lx)
Force/Load	pound force(lb_f)	4.448222	newton (N)
Mass	pound (lb_m)	0.4535924	kilogram (kg)
Speed	feet per second (fps)	0.3048	meter per second (m/s)
Density	pounds per gallon (lb_m/gal or ppg)	119.8264	kilograms per cubic meter (kg/m^3)
Volume	gallon (gal)	3.785412	liter (L)
Mass per unit length	pound per foot (ppf)	1.488164	kilogram per meter (kg/m)
Area	square inch (in^2)	0.00064516	square meter (m^2)
Rotary Speed	revolutions per minute (rpm)	0.1047198	radians per second (rad/s)

Note 1: All conversion factors in the table above are in accordance to reference 2.

Table 2.7 Table of Fractions

Equivalent Decimal	Sixty-fourths 1/64	Thirty-seconds 1/32	Sixteenths 1/16	Eighths 1/8	Fourths 1/4	Halves 1/2
0.01563	1/64					
0.03125	2/64	1/32				
0.04688	3/64					
0.06250	4/64	2/32	1/16			
0.07813	5/64					
0.09375	6/64	3/32				
0.10938	7/64					
0.12500	8/64	4/32	2/16	1/8		
0.14063	9/64					
0.15625	10/64	5/32				
0.17188	11/64					
0.18750	12/64	6/32	3/16			
0.20313	13/64					
0.21875	14/64	7/32				
0.23438	15/64					
0.25000	16/64	8/32	4/16	2/8	1/4	
0.26563	17/64					
0.28125	18/64	9/32				
0.29688	19/64					
0.31250	20/64	10/32	5/16			
0.32813	21/64					
0.34375	22/64	11/32				
0.35938	23/64					
0.37500	24/64	12/32	6/16	3/8		
0.39063	25/64					
0.40625	26/64	13/32				
0.42188	27/64					
0.43750	28/64	14/32	7/16			
0.45313	29/64					
0.46875	30/64	15/32				
0.48438	31/64					
0.50000	32/64	16/32	8/16	4/8	2/4	1/2
0.51563	33/64					
0.53125	34/64	17/32				
0.54688	35/64					
0.56250	36/64	18/32	9/16			
0.57813	37/64					
0.59375	38/64	19/32				
0.60938	39/64					
0.62500	40/64	20/32	10/16	5/8		
0.64063	41/64					
0.65625	42/64	21/32				
0.67188	43/64					
0.68750	44/64	22/32	11/16			
0.70313	45/64					
0.71875	46/64	23/32				
0.73438	47/64					
0.75000	48/64	24/32	12/16	6/8	3/4	
0.76563	49/64					
0.78125	50/64	25/32				
0.79688	51/64					
0.81250	52/64	26/32	13/16			
0.82813	53/64					
0.84375	54/64	27/32				
0.85938	55/64					
0.87500	56/64	28/32	14/16	7/8		
0.89063	57/64					
0.90625	58/64	29/32				
0.92188	59/64					
0.93750	60/64	30/32	15/16			
0.95313	61/64					
0.96875	62/64	31/32				
0.98438	63/64					
1.00000	64/64	32/32	16/16	8/8	4/4	2/2

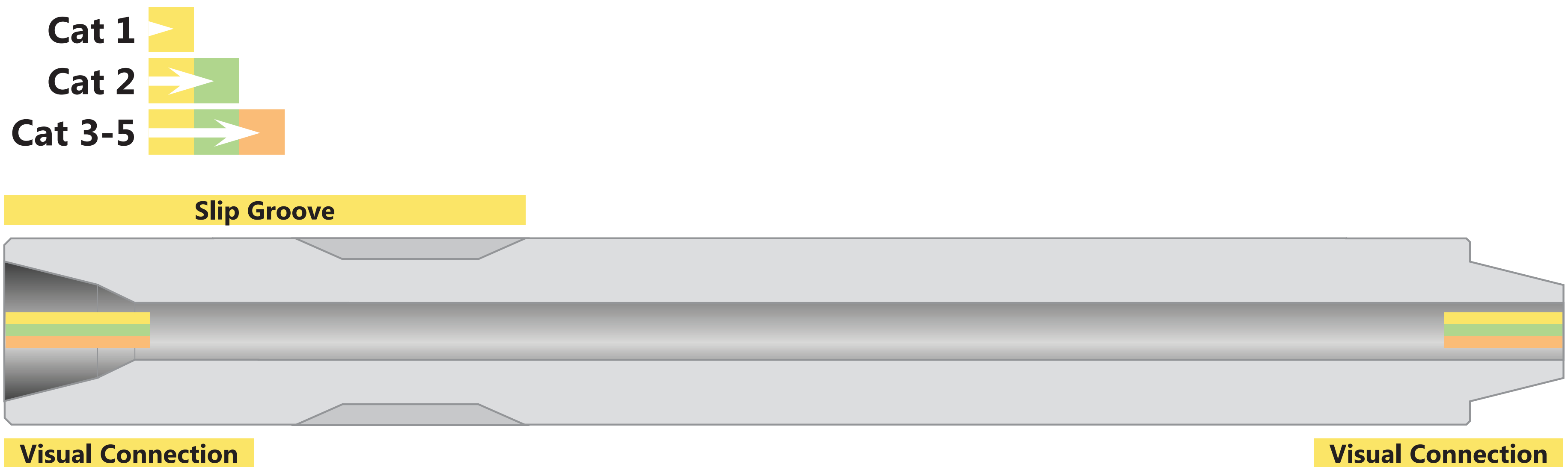


* The requirements shown in this illustration are meant as a guideline only. For complete and detailed information on inspection programs and procedures, the user must review DS-1 Volume 3, Chapters 2 and 3 in their entirety.

Note 1: FLUT (WT/TL) is required for drill pipe in lieu of EMI when either the measured wall thickness is greater than 0.500" or verification of wall thickness along the entire tube length is critical.

Note 2: For ferromagnetic components, Wet Visible Contrast Inspection may be substituted for MPI Slip/Upset Area Inspection.

Figure 2.7 Drill Pipe Inspection Program*

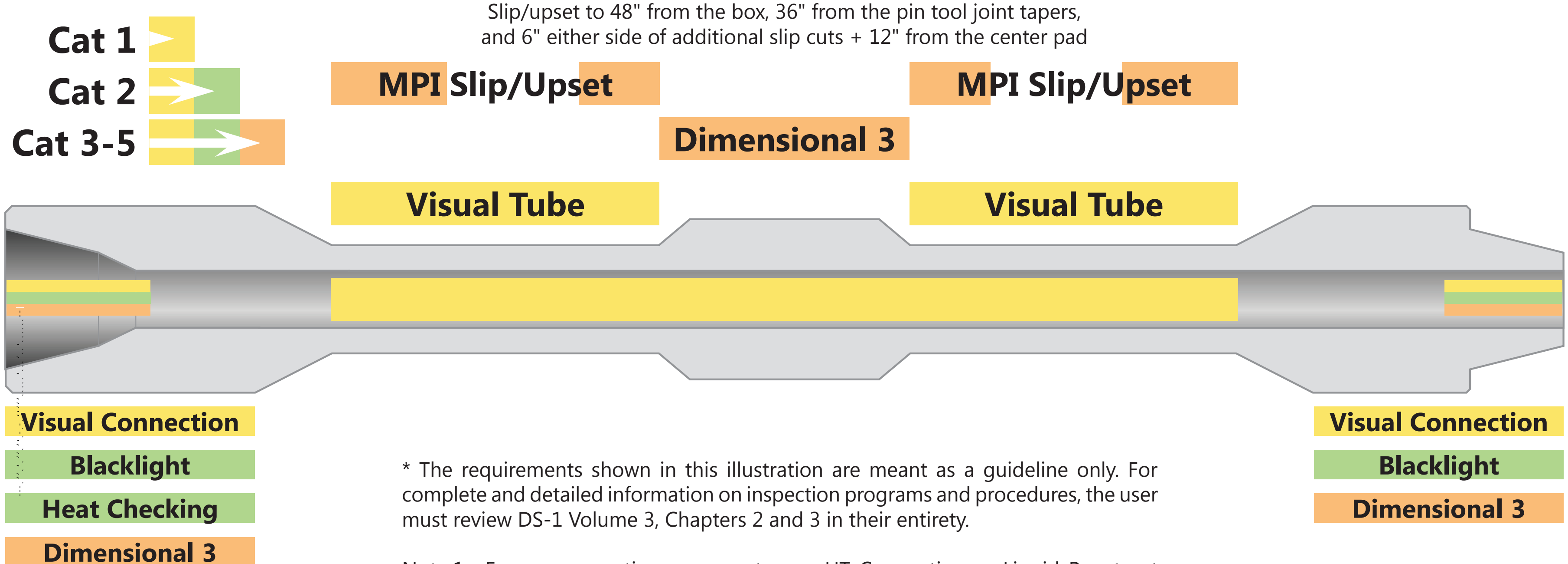


* The requirements shown in this illustration are meant as a guideline only. For complete and detailed information on inspection programs and procedures, the user must review DS-1 Volume 3, Chapters 2 and 3 in their entirety.

Note 1: For nonmagnetic components, use UT Connection or Liquid Penetrant Inspection (LPI) in lieu of Blacklight. UT is recommended for nonmagnetic components. If LPI is used the pin ID shall also be inspected.

Figure 2.8 Drill Collar Inspection Program*

Slip/upset to 48" from the box, 36" from the pin tool joint tapers,
and 6" either side of additional slip cuts + 12" from the center pad

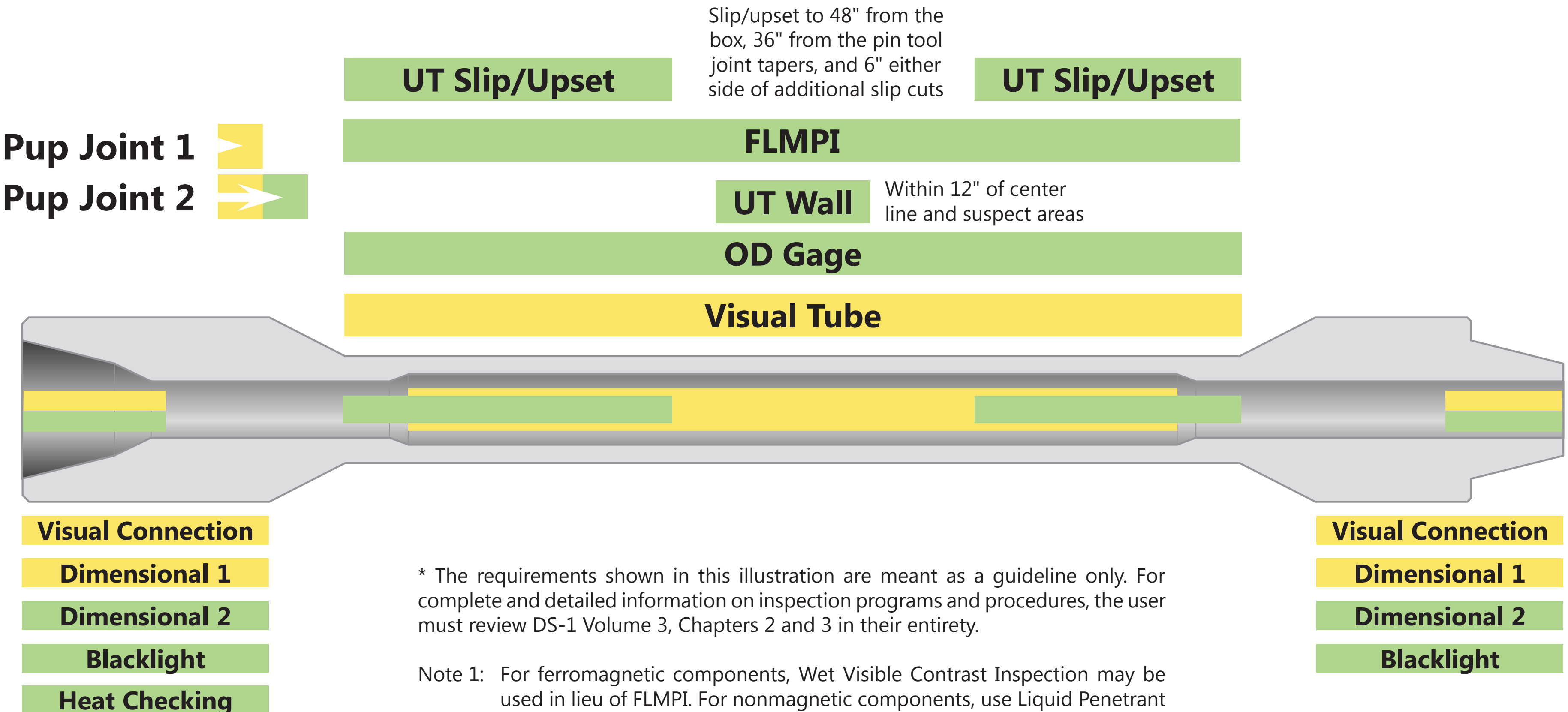


* The requirements shown in this illustration are meant as a guideline only. For complete and detailed information on inspection programs and procedures, the user must review DS-1 Volume 3, Chapters 2 and 3 in their entirety.

Note 1: For nonmagnetic components, use UT Connection or Liquid Penetrant Inspection (LPI) in lieu of Blacklight. UT is recommended for nonmagnetic components. If LPI is used the pin ID shall also be inspected.

Note 2: For ferromagnetic components, Wet Visible Contrast Inspection may be substituted for MPI Slip/Upset Area Inspection.

Figure 2.9 HWDP Inspection Program*

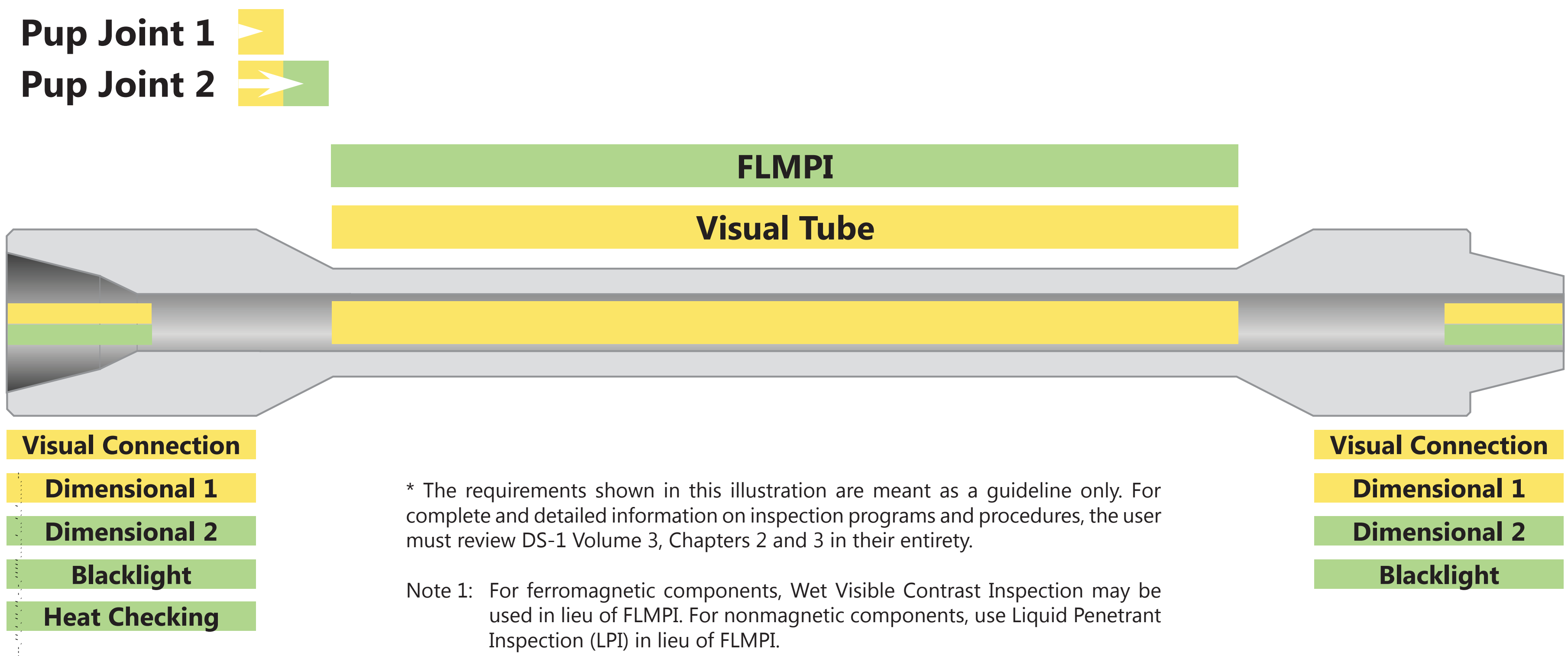


* The requirements shown in this illustration are meant as a guideline only. For complete and detailed information on inspection programs and procedures, the user must review DS-1 Volume 3, Chapters 2 and 3 in their entirety.

Note 1: For ferromagnetic components, Wet Visible Contrast Inspection may be used in lieu of FLMPI. For nonmagnetic components, use Liquid Penetrant Inspection (LPI) in lieu of FLMPI.

Note 2: For nonmagnetic components, use UT Connection or Liquid Penetrant Inspection (LPI) in lieu of Blacklight. If LPI is used, the pin ID shall also be inspected.

Figure 2.10 Welded Pup Joint Inspection Program*

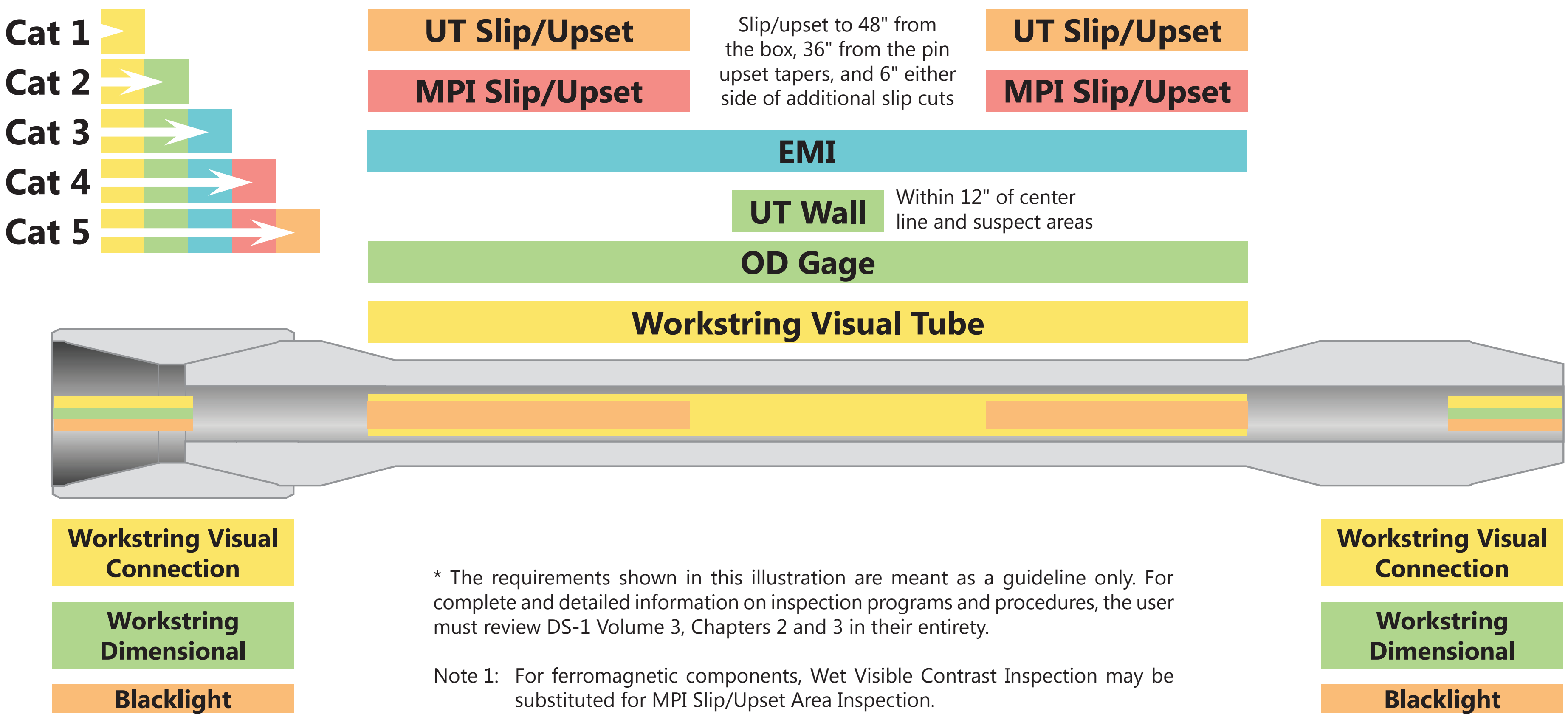


* The requirements shown in this illustration are meant as a guideline only. For complete and detailed information on inspection programs and procedures, the user must review DS-1 Volume 3, Chapters 2 and 3 in their entirety.

Note 1: For ferromagnetic components, Wet Visible Contrast Inspection may be used in lieu of FLMPI. For nonmagnetic components, use Liquid Penetrant Inspection (LPI) in lieu of FLMPI.

Note 2: For nonmagnetic components, use UT Connection or Liquid Penetrant Inspection (LPI) in lieu of Blacklight. If LPI is used, the pin ID shall also be inspected.

Figure 2.11 Integral Pup Joint Inspection Program*



* The requirements shown in this illustration are meant as a guideline only. For complete and detailed information on inspection programs and procedures, the user must review DS-1 Volume 3, Chapters 2 and 3 in their entirety.

Note 1: For ferromagnetic components, Wet Visible Contrast Inspection may be substituted for MPI Slip/Upset Area Inspection.

Figure 2.12 Workstring Tubing Inspection Program*

DS-1® Fifth Edition

INSPECTION ORDER FORM

Reference: ______________ Page: ______ of ______ Issued to: ______________________

Date: ____________________ Date Equipment Needed: __________ Requesting Company: _____________________ Person: ____________________________

Well/Rig Name: ________________________ AFE #: ______________________ Phone: _____________ Fax: ____________ Email: ____________________

Normal Weight and Thick-Walled Drill Pipe

Instructions: 1) Specify equipment, 2) specify inspection programs, 3) specify acceptance criteria

Item #	Footage/ Count	Size	Nom Wt/ Wall	Grade	Connection	Range	Hardfacing Required?		Inspection Program			Acceptance Criteria		
							Yes	No	Category	Other	See Note:	Premium	Other	See Note:
1														
2														
3														
4														

Other Components

Item #	Footage/ Count	Description	OD	ID	Connection	Hardfacing Required?		Boreback Box?		Stress Relief Pin?		Inspection Program			Acceptance Criteria
						Yes	No	Yes	No	Yes	No	Category	Other	Note	
5			×												
6			×												
7			×												
8			×												
9			×												
10			×												
11			×												
12			×												

Notes (attach extra notes as required)

Y ☐ N ☐ Is third-party supervision required?

3. Inspection Procedures

3.1 Contents

This chapter contains specific procedures covering the thirty six inspection methods in DS-1® Fifth Edition. The table of contents below gives procedure numbers and page numbers for locating a specific inspection procedure.

3.2 The Inspection Transaction

An inspection transaction begins when the customer orders a "DS-1 Inspection" of any category, and the inspection company accepts the order. It is understood by both parties in the transaction that the quality of the inspection and product provided will depend on the inspection procedure employed by the inspector. Therefore, the customer, in ordering the inspection, establishes the burden of compliance with the requirements of this section upon the inspection company. The inspection company, in accepting the order, accepts the responsibility for compliance. It is therefore understood by both parties that the inspection company will follow the requirements of this section exactly, unless instructed otherwise by the customer. The customer may alter any requirement herein as he or she sees fit, but should keep in mind that this may negatively affect the quality of the inspection or inspected product. Unless prior authorization is given by the customer, the inspection company may not alter any requirement herein.

3.3 Communication

The full benefit of proper inspection can only be realized in an atmosphere of good communication between the organizations and people who are buying and those who are conducting the inspection.

3.3.1 Ordering the Inspection

The customer is responsible for clearly outlining the inspection program, as discussed in Chapter 2. This entails a complete list of the items to be inspected, a selection of the methods to be employed, and the specific acceptance criteria to be applied by the inspector.

3.3.2 Conducting the Inspection

The organization conducting the inspection is responsible for conducting the inspection in compliance with the procedures in this section, except as these may be modified by the customer. The inspection organization is also responsible for clearly communicating to the customer the status of the inspection and the nature of any problems that may be occurring.

3.3.3 Ambiguous Terms

Ambiguous terms such as "DS-1 Inspection" (without a stated category), "Standard Inspection," "API Inspection," "RP7G Inspection" and others, are often used. These terms have no precise meanings. Their use can and does lead to misunderstanding because expectations were never clearly communicated and understood by both parties in the transaction. These and other ambiguous terms should be avoided.

3.4 Visual Tube Inspection

3.4.1 Scope

This procedure covers visual examination of the internal and external surfaces of drill pipe and HWDP tubes to determine general condition.

3.4.2 Inspection Apparatus

Paint marker, calibrated pit depth gage, ultrasonic thickness gage, a calibrated light meter to verify illumination, and a light capable of illuminating the entire accessible internal surface of the pipe are required. See section 2.21 for calibration requirements for the light intensity meter and pit depth gage. For examination of internal plastic coating (IPC) and specifically for examination of the internal upset run-out, a hinged mirror capable of extending into the pipe ID is required. Additionally, a wooden stick or a blunt putty knife or similar metal spatula is required to test the adhesion around areas of damaged internal plastic coating.

3.4.3 Preparation

a. All pipe shall be sequentially numbered.

b. The tube surfaces shall be clean so that the metal surface is visible and no surface particles larger than 1/8 inch in any dimension can be broken loose with a fingernail.

c. For examination of internal plastic coating, the internal surfaces of the pipe shall be free from drilling mud, chemical residues, dust, dirt, and other visible contaminants.

Note: For cleaning of pipe's internal surface, use of high pressure water jetting equipment is recommended. Other pipe cleaning methods may also be used. If high pressure water jetting equipment is used, it is recommended that the water pressure not exceed 15,000 psi, the water blast not be at a 90° angle to the coating surface, and a pencil point nozzle not be used. It is recommended that a commercially available 360° nozzle be used.

3.4.4 Procedure and Acceptance Criteria

a. The external surface shall be examined from upset-to-upset. Surface imperfections (including slip cuts, gouges, corrosion pits, etc) that penetrate the normal pipe surface shall be measured and the depth of the imperfection shall be subtracted from the average adjacent wall thickness to determine the remaining wall thickness under the imperfection. Surface imperfections that cause the remaining wall thickness under the imperfection to be less than the acceptance criteria listed in Table 3.5.1 for NWDP, 3.5.2 for TWDP, or 80% of the adjacent wall thickness for HWDP shall be cause for rejection. Additionally, round-bottomed surface imperfections (such as corrosion pits) with a depth greater than the acceptance criteria listed in the same tables are cause for rejection. Average adjacent wall thickness shall be determined by averaging the wall thickness readings from two opposite sides of the imperfection. Metal protruding above the normal surface may be removed to facilitate measuring the depth of penetration. Any visible cracks shall be cause for rejection.

(Note that material applied to the tube, metallic or otherwise, for the purposes of wear resistance does not constitute "raised metal" in this standard. If present, the wear material manufacturer should be contacted for specific inspection requirements.)

b. Cuts on the OD surface shall be measured and the depth of the cut compared to the average adjacent wall thickness (as measured above). "Cuts" are defined as surface imperfections caused by mechanical damage, including slip cuts and gouges. Cuts with a depth greater than the acceptance criteria listed in Table 3.5.1 for NWDP, 3.5.2 for TWDP, or 10% of the adjacent wall thickness for HWDP shall be cause for rejection.

c. Pipe with extensive raised metal in the slip area may be pulled out and laid aside without further inspection at the discretion of the inspection company and customer.

d. Pipe to be used for snubbing shall not have raised metal above the normal surface. Raised metal may be removed if permitted by the customer and the owner of the pipe.

e. The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:

- At the start of each inspection job
- When light fixtures change positions or intensity
- When there is a change in relative position of the inspected surface with respect to the light fixture
- When requested by the customer or its designated representative
- Upon completion of the inspection job.

The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

f. The illuminated ID surface shall be visually examined from each end. ID pitting shall not exceed 1/8 inch in depth as measured or visually estimated for Ultra and Premium Class NWDP, TWDP, or HWDP. For Class 2 NWDP, pitting shall not exceed 3/16 inch.

g. The tubes shall not be visibly crooked by more than 3 inches over the entire length of the tube or 0.5 inch in the first 5 feet from either end. In addition to all applicable inspection, all straightened pipes shall be inspected in the straightened tube section and 2 feet either side of the straightened section in accordance with procedure 3.9, Magnetic Particle Slip/Upset Inspection.

h. If internal plastic coating is present, the ID surface of internally coated pipe shall be evaluated in accordance with paragraph 3.4.5.

3.4.5 Evaluation of Internal Plastic Coating

a. The ID surface of internally coated pipe shall be examined for signs of deterioration of the internal plastic coating in the tube area (tube area includes the tube body and the internal transition area). The tool joint area shall also be examined if the optional tool joint criteria (3.4.5h) is specified by the customer. Figure 3.4.1 illustrates the tool joint and the tube area.

b. The overall drill pipe classification shall be based on the internal coating loss in the tube area (which includes tube body and transition area only). Internal coating loss in the tool joint (even if up to 100%) shall not cause downgrading of pipe. However, internal coating loss in the tool joint continuing or extending into the transition area shall be thoroughly evaluated for coating adhesion based on the guidelines provided in this procedure.

c. For the purposes of this procedure, internal coating loss is defined as total removal of the coating film down to base metal and does not refer to coating wear that does not reach metal substrate.

d. In order to determine fitness for purpose, the drill pipe shall be classified as ID Coating Reference Condition 1, 2, 3, or 4. The ID coating reference condition number shall be reported to the customer. Tubes with Coating Reference Condition 3 or 4 shall be rejected unless waived by the customer. Criteria for determining each Coating Reference Condition have been provided below in Table 3.1. Determination of condition number 1, 2, 3, or 4 shall be based on worst condition listed within the condition number column in Table 3.1. For example, if a particular drill pipe presents overall coating loss of less than 20% but shows delamination, then the drill pipe shall be classified as Condition 4.

e. Overall coating loss is based on the overall internal coating loss in the entire tube body and transition region (tube area). Localized internal coating loss is loss of coating in an area that includes the entire 360° internal surface area in any linear section of length 3 feet in tube area.

Table 3.1 Used Drill Pipe Internal Plastic Coating Evaluation

Condition	Condition 1	Condition 2	Condition 3	Condition 4
Overall Coating Loss in Tube Area Note 1	No visible coating loss; minor surface abrasion only	≤ 20%	> 20% and ≤ 35%	> 35%
Localized Coating Loss Note 2 *(coverage area includes the entire 360° internal surface area in any linear section of length 3 feet in tube area)*	No visible coating loss; minor surface abrasion only	≤ 25% in any tube area section of 3 linear feet	> 25% and < 50% in any tube area section of 3 linear feet	≥ 50% in any tube area section of 3 linear feet
Blistered Coating	No	No	No	Can be present
Delamination (peeling) Note 3	No Note 4	No Note 4	No Note 4	Can be present
Underfilm Corrosion Note 3	No	No	Can be present	Can be present

Notes:
1 The overall coating classification will be determined by the coating classification in the tube area (which includes tube body and transition area only). Coating showing signs of delamination shall be added to the lost coating to generate an accurate percentage of coating damage.
2 A borescope may be used to evaluate the coating condition more closely wherever necessary.
3 Underfilm corrosion and coating delamination can be determined with obvious peeling of the coating around areas of damage. To check the coating adhesion, a wooden stick or a blunt putty knife or metal spatula shall be used to gently prod the coating region. Loosely adhered coating shall be removed if undercreep is present.
4 No signs of delamination shall be visible even after pipe has been cleaned to meet requirements provided in paragraph 3.4.3.

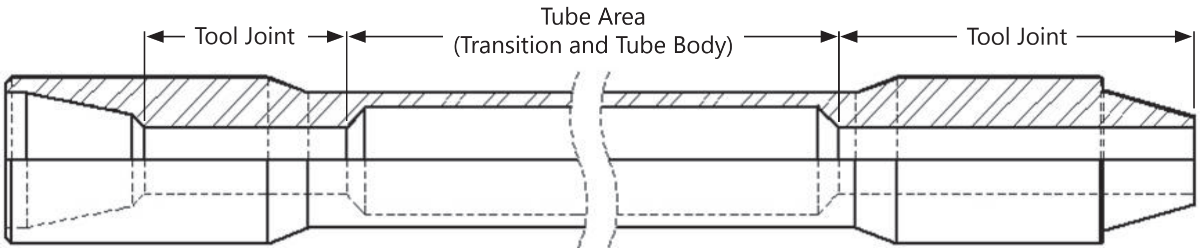


Figure 3.4.1 Drill Pipe Areas with Internal Plastic Coating (IPC)

All photos below courtesy of NOV Tuboscope

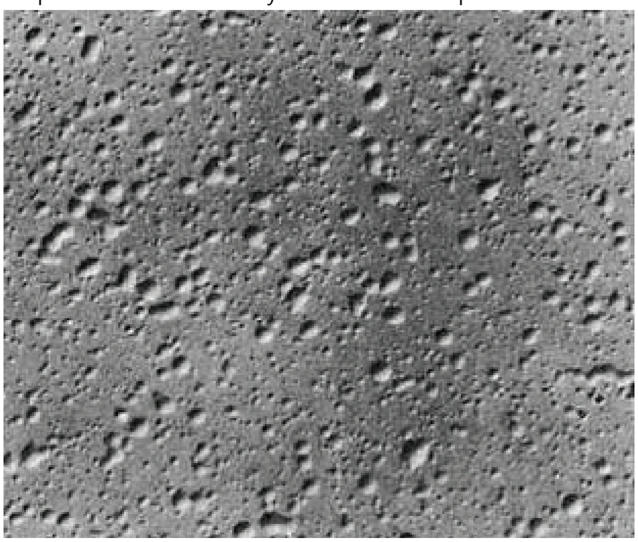


Figure 3.4.2 Blistered Coating.

Figure 3.4.3 Coating Delaminating (Peeling) away from an area of damage.

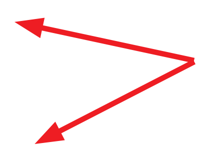


Figure 3.4.4 Wireline Cuts in coating.

Figure 3.4.5 Underfilm Corrosion where the coating film appears to be pushed up and corrosion is taking place under intact coating.

Figure 3.4.6
ID Coating Reference Condition 1 in the Upset Run-out. No visible damage.

Figure 3.4.7
ID Coating Reference Condition 1 Tube Body. No visible damage.

Figure 3.4.8
ID Coating Reference Condition 1 Tube Body. Internal camera view shows no visible coating damage down to steel substrate and no corrosion products.

Acceptable Residue on the coating surface (no rust or scale)

Figure 3.4.9
ID Coating Reference Condition 2 Internal Upset Run-out. Note the damage in the tool joint continuing or extending into the upset run-out. Surface corrosion without significant metal loss. Localized coating loss is less than 25% and overall coating loss is less than 20%.

Figure 3.4.10
ID Coating Reference Condition 2 Internal Upset Run-out. Note mechanical damage (wireline cut) extends into the upset run-out from the tool joint. Localized coating loss is less than 25% and overall coating loss is less than 20%.

Figure 3.4.11
ID Coating Reference Condition 2 Tube Body. Note pinhole areas of coating damage and minor indication of rust on the left.

Figure 3.4.12
ID Coating Reference Condition 2 Tube Body. Note isolated area of coating damage down to the metal substrate. Overall coating loss is less than 20%.

Figure 3.4.13
ID Coating Reference Condition 3 Tube Body. Note several areas of coating loss down to bare steel, there is no peeling of the coating in those areas. Localized coating loss is more than 25% but less than 50%. Overall coating loss is less than 35%.

Figure 3.4.14
ID Coating Reference Condition 3 Tube Body. Localized coating loss in tube area is more than 25% but less than 50%. Overall coating loss is less than 35%. Presence of surface corrosion but no signs of blistering or delamination. Coating loss in tool joint area is not to be included.

Figure 3.4.15 ID Coating Reference Condition 4. The presence of blisters indicates coating degradation which can be caused by excessive temperature, chemical exposure, and/or the coating reaching the end of its useful life.

Figure 3.4.16 ID Coating Reference Condition 4 Tube Body. Delamination of the coating in the tube body.

Figure 3.4.17 ID Coating Reference Condition 4 Tube Body. Note the loss of coating and presence of delamination.

f. Sample description of coating damage and defects such as wireline cuts, blistering, delamination, and underfilm corrosion are provided in Figures 3.4.2 through 3.4.5.

g. Sample pictures of drill pipe tube body and upset run-out illustrating ID Coating Reference Conditions 1, 2, 3, and 4 are provided in Figures 3.4.6 through 3.4.17.

h. Optional tool joint criteria: If specified by the customer, the ID surface of internally coated drill pipe shall be examined for signs of deterioration of the internal plastic coating in the tool joint area (see Figure 3.4.1). Blistered coating, delamination/peeling, or underfilm corrosion of the coating in the tool joint area shall be a cause for rejection of the drill pipe unless waived by the customer. If approved by the customer, the damaged coating may be removed entirely from the tool joint area.

3.5 OD Gage Tube Inspection

3.5.1 Scope

This procedure covers the full length mechanical gaging of the drill pipe or workstring tube for outside diameter variations.

3.5.2 Inspection Apparatus

a. Direct reading or go-no-go type gages may be used to locate areas of OD reduction. Gages must be capable of identifying the smallest permissible tube outside diameters.

b. Any electronic, dial, or Vernier device used to set or calibrate the OD gage shall itself have been calibrated. See section 2.21 for calibration requirements.

c. Fixed setting standards for field use shall be verified to ±0.002 inch accuracy using one of the devices above.

3.5.3 Preparation

a. All pipe shall be sequentially numbered.

b. The pipe OD surface shall be free from scale or heavy coatings exceeding 0.010 inch thickness.

3.5.4 Calibration

a. The OD gage calibration shall be verified at the applicable maximum and minimum OD values given in Table 3.6.1, 3.6.2, or 3.11.2, as applicable.

b. The gage calibration shall be verified:

- At the start of each inspection.
- After every 25 lengths.
- When the OD variance exceeds the acceptable limits.
- When the gage is suspected of having been damaged.
- At the completion of inspection.

c. If adjustments are required to the OD gage, all lengths gaged since last valid calibration check shall be regaged.

3.5.5 Procedure and Acceptance Criteria

a. The tube body shall be mechanically gaged from upset-to-upset by dragging the gage along the tube length while rotating the pipe and holding the gage perpendicular to the tube. The pipe shall roll at least one revolution for every 5 feet of length inspected.

b. Pipe with an OD reduction or increase exceeding the values in Table 3.6.1, 3.6.2, or 3.11.2, as applicable, shall be rejected.

3.6 Ultrasonic Wall Thickness Inspection

3.6.1 Scope

This procedure covers compression wave ultrasonic measurement of steel drill pipe or workstring tube wall thickness near the center of the tube and at points of obvious wear.

3.6.2 Inspection Apparatus and Calibration

a. The ultrasonic instrument shall be the pulse-echo type with digital display.

b. The transducer shall have separate transmit and receive elements. Any transducer worn to a degree that light is visible under its face when placed on the reference standard without couplant shall be replaced.

c. Linearity Calibration. The instrument shall have been calibrated for linearity over an interval of 0.100 inch to 2.000 inches after any repair of the instrument or at least every six months. See section 2.21 for calibration requirements.

d. The same type couplant shall be used for both calibration and gaging.

e. The field reference standard shall be of the same acoustic properties as the pipe being inspected and have at least two thicknesses that meet the following requirements:

- Thick Section = Nominal wall, +0.100, -0 inch.
- Thin Section = 70% of nominal wall, +0, -0.100 inch.

f. Minimum and maximum values of the thick and thin section of the field reference standard have been provided in Table 3.6.1, 3.6.2, or 3.11.2, as applicable.

g. The field reference standard shall be verified to be within ±0.002 inch of stated thicknesses by micrometer, or Vernier or dial caliper. See section 2.21 for calibration requirements for the verifying device.

h. After field calibration adjustments, the gage shall measure both thicknesses on the standard to ±0.001 inch accuracy.

i. Field calibration shall be verified at the following frequency:

- At the start of each inspection.
- After every 25 lengths.
- When a measurement indicates a rejectable piece.
- Each time the instrument is turned on.
- When the gage is suspected of having been damaged.
- When probe, cable, operator, or pipe weight are changed.
- Upon completion of each inspection job.

j. If previous field calibration accuracy cannot be verified, all areas tested since the last valid calibration shall be regaged after correcting the calibration.

3.6.3 Preparation

a. All pipe shall be sequentially numbered.

b. The external pipe surface where the readings are to be taken shall be cleaned to the bare surface.

3.6.4 Procedure

a. The parting line between the transmit and receive elements on the two-element transducer shall be held perpendicular to the longitudinal axis of the pipe.

b. After couplant application, thickness measurements shall be taken around the tube circumference in 1-inch maximum increments.

c. Readings shall be taken within one foot of the center on each tube. Additional readings may be taken in the same manner at any other areas selected by the inspector or customer representative.

d. The inspector shall scan the surface within a 1-inch radius of the lowest reading to confirm or modify that value. The lowest reading shall be recorded.

3.6.5 Acceptance Criteria

Pipe that does not meet the applicable requirements in Table 3.6.1, 3.6.2, or 3.11.2, as applicable, shall be rejected.

3.7 Electromagnetic Inspection (EMI)

3.7.1 Scope

This procedure covers the upset-to-upset scanning of steel drill pipe or workstring tubes for transverse and three-dimensional flaws using flux leakage detection equipment. Tube wall thickness may be monitored using gamma ray radiation, magnetic wall, or ultrasonic wall monitoring equipment after an agreement between the vendor and the customer. If wall monitoring equipment is used, requirements specified in this procedure shall be applicable.

3.7.2 Inspection Apparatus

Flux leakage units used for transverse flaw detection shall use a DC coil. The unit shall be designed to allow active longitudinal field inspection of the tube surface from upset-to-upset. The unit shall generate a permanent record of the pipe inspection and standardization.

3.7.3 Preparation

a. All pipe shall be sequentially numbered.

b. All surfaces from upset-to-upset shall be clean to a degree that the metal surfaces are visible and not sticky to the touch. Paint and clear lacquer coatings less than 0.010 inch thick are acceptable. Any condition interfering with detector ride on the pipe shall be corrected.

3.7.4 Flux Leakage Reference Standards

The reference standard for flux leakage transverse flaw detection units shall be a through-wall drilled hole standard prepared from a length of pipe of the same nominal diameter as the pipe to be inspected. The hole size shall be 1/16 inch, ±1/64 inch in diameter. The standard may have one hole for each detector, arranged in a spiral pattern. The Electromagnetic Inspection (EMI) drill-hole standard shall be recertified annually.

3.7.5 Standardization of Flux Leakage Equipment

a. The equipment shall be adjusted to produce a common reference amplitude (minimum 10 mm or a minimum of 40% of full digital screen height) from each detector when a hole is scanned. Signal to noise ratio shall be a minimum of 3 to 1.

b. After standardization adjustments are complete, the reference standard shall be dynamically scanned four times at the speed to be used for inspection with no changes in any settings.

   Each signal channel must produce indications of at least 80% of the reference amplitude established in 3.7.5a, with a minimum signal to noise ratio of 3 to 1.

c. The detectors shall be sized for the pipe being inspected and shall ride on the surface of the pipe without any visible gap.

d. The unit shall be restandardized according to the procedure in 3.7.5b:

   - At the start of each inspection job.
   - After each 50 lengths.
   - Each time the unit is turned on.
   - When mechanical or electronic changes or adjustments are made.
   - After each shift change.
   - Upon completion of the inspection job.

   Restandardization shall be performed prior to making adjustments to DC coil amperage. Automatic calibration functions must be turned off during restandardization.

e. If previous standardization accuracy cannot be verified, all pipe run since the last verified standardization shall be reinspected after correcting the standardization.

f. Standardization runs must appear in their proper sequence on the production logs.

3.7.6 Requirements for Wall Thickness Equipment

Wall monitoring equipment may be used after an agreement between the vendor and the customer. The following requirements for wall thickness reference standard and standardization of wall thickness equipment shall be applicable.

3.7.6.1 Wall Thickness Reference Standards

The wall thickness standard shall be made from a material with similar acoustic properties, same diameter, and same nominal wall thickness of the pipe being inspected. The standard shall have two known thicknesses within 80% to 100% of nominal wall thickness and shall differ by more than 5% of nominal wall thickness. The standard thicknesses shall be verified with a calibrated ultrasonic thickness gage or calibrated micrometer. See section 2.21 for calibration requirements.

3.7.6.2 Standardization of Wall Thickness Equipment

a. Using the reference standard defined in 3.7.6.1, the wall thickness unit standardization and re-standardization shall be verified at the same frequency as the flux leakage unit standardization. If any reference point has shifted by more than the equivalent of ±4% of the pipe nominal wall thickness, all lengths run since the last verified standardization shall be reinspected after correcting the standardization.

b. The linearity of the wall thickness unit shall be demonstrated by measuring the known wall thicknesses in dynamic mode and, if available, in static mode. The unit shall have a reference point representing the minimum acceptable wall thickness.

3.7.7 Inspection Procedure

a. The following information shall be recorded in the permanent record for each joint inspected:
   - Permanent serial number or metal-stamped identification number.
   - End from which scanning began (pin or box).
   - Marking of indications which are to be evaluated.

b. Each length shall be scanned from upset-to-upset. On buggy type EMI units, the inspection head shall be propelled into the near end tool joint with the detectors leading, then the head turned around and propelled the full length into the opposite tool joint. The inspection head may be backed onto the upset if it can be demonstrated during standardization that the system is of equal sensitivity while scanning in the forward and reverse direction and if the detectors are centrally located within the inspection head.

c. The rate of scanning for the EMI device during the inspection process:
   - Shall be constant throughout the entire tube length.
   - Shall be the same for production and standardization runs.
   - Shall be documented on the inspection report.

d. At the start of inspection, each indication exceeding 50% of the standardization reference level shall be marked until a minimum of 10 areas are marked.

e. Each marked area shall be proved-up using visual, mechanical measurements, magnetic particle (see 3.7.8), ultrasonic, or other techniques as required to identify, if possible, the type of imperfection, its depth, orientation, and proximity to the OD surface. (Restandardization shall be made based upon the results of prove-up if either the inspector or the customer representative judge that this is advisable.) The threshold level shall be established. A threshold level is the signal amplitude that warrants evaluation of all future indications on the pipe. The threshold level for the flux leakage unit shall not be greater than 80% of the reference level established in paragraph 3.7.5a. The threshold level for the thickness unit shall be the signal level representing 85% of new nominal wall thickness. The operator shall note any changes in signal response or pipe condition which may warrant adjustments and/or re-standardization. The threshold levels shall be recorded in the permanent inspection record.

f. On the remaining joints, prove-up is required when an indication is greater than the threshold set for flux leakage equipment. If wall monitoring equipment is utilized, prove-up is also required when an indication is less than the threshold set for the wall thickness equipment.

g. The results of the evaluation shall be recorded in a prove-up inspection report. Acceptance or rejection shall be clearly noted in the inspection report for each suspect location.

3.7.8 Wet Fluorescent or Dry Magnetic Particle Prove-Up Inspection

a. This prove-up method is acceptable only for prove-up of indications that break the OD surface on ferromagnetic pipe.

b. For the wet fluorescent and dry magnetic particle methods, the inspection apparatus, preparation, and procedure shall conform to the requirements in 3.9.2, 3.9.3, and 3.9.4a-d, respectively, except that the area to be cleaned and inspected shall include the suspect location and the surrounding area not less than six inches from the suspect location.

c. For the wet visible method, the inspection apparatus, preparation, and procedure shall conform to the requirements in 3.9.2, 3.9.3, and 3.9.4a-d, respectively, except as noted below and that the area to be cleaned and inspected shall include the suspect location and the surrounding area not less than six inches from the suspect location. The bath concentration shall be in the range of 1.2 to 2.4 mL of particles per 100 mL of bath, using a 100 mL centrifuge tube.

d. Magnetize with an AC yoke. Maintain a continuous active magnetic field during particle application.

3.7.9 Acceptance Criteria

a. Pipe with imperfections or wall thicknesses (if applicable) which do not meet the acceptance criteria specified in Tables 3.5.1, 3.5.2, or 3.11.1, as applicable, and 3.6.1, 3.6.2, or 3.11.2, as applicable, shall be rejected.

b. Areas in which flux leakage indications exceed threshold but no imperfection can be found shall be re-scanned. Repeatability of such an indication shall be cause for rejection.

(Note that material applied to the tube for the purposes of wear resistance will likely cause a variety of indications, such as dramatically reduced wall thickness (which is inaccurate) caused by a sudden change in material permeability. The inspector should confirm with the pipe owner whether the string has wear pads applied, and the wear pad material manufacturer should be contacted for specific inspection requirements, which may include different inspection methods and criteria for only that area.)

3.7.10 Records

Retention of strip charts and/or electronic data from all inspection and standardization runs shall be maintained by the inspection company for a minimum period of one year. These records shall be available for review to the customer or its designated representative upon request.

3.8 Heat Checking Inspection

3.8.1 Scope

This procedure covers examination of heat checking (longitudinal surface imperfections) on box tool joints from the shoulder to the intersection of the tube or upset OD and the 18° taper using the wet fluorescent magnetic particle technique or the dry magnetic particle technique.

3.8.2 Inspection Apparatus

3.8.2.1 General Apparatus

a. Required magnetic particle field indicators (MPFI) include a magnetic flux indicator strip or a magnetic penetrameter (pie gauge).

b. A calibrated AC yoke which has demonstrated the capacity to lift a ten pound weight within the last six months. The ten pound weight used for the lift test shall have been calibrated. See section 2.21 for calibration requirements. For AC yokes with adjustable poles:

- The maximum pole spacing during inspection shall not exceed the distance between the poles when all segments of the yoke are perpendicular to the grip.
- The minimum pole spacing during inspection shall be 2 inches.

c. Other equipment: If the inspection surfaces are to be inspected using a residual field with the approval from the customer, a capacitor discharge (C.D.) box may be used.

d. For dry particle inspection: The dry magnetic particles shall be of contrasting color to the inspection surface and shall be free from rust, grease, paint, dirt, and/or any other contaminants that may interfere with the particle characteristics.

3.8.2.2 Wet Fluorescent Magnetic Particle Technique

a. Particle Bath Mediums:

- Petroleum base mediums which exhibit natural fluorescence under blacklight shall not be used. Diesel fuel and gasoline are not acceptable.
- Water base mediums are acceptable if they wet the surface without visible gaps. If incomplete wetting occurs, additional cleaning, a new particle

bath, or the addition of more wetting agents may be necessary.

b. Blacklight Equipment: A blacklight source and a calibrated blacklight intensity meter are required. See section 2.21 for calibration requirements.

c. An ASTM centrifuge tube and stand are required.

d. A calibrated light meter to verify illumination. See section 2.21 for calibration requirements.

e. Booths or tarps shall be used to darken the area if necessary.

3.8.3 Preparation

a. Pipe shall be sequentially numbered.

b. Outside surface of the box tool joints from shoulder to the intersection of the tube or upset OD and the 18° taper shall be cleaned to a degree that the metal surfaces are visible. For dry powder inspection, the surfaces shall also be dry to the touch.

3.8.4 Procedure and Acceptance Criteria

a. The external surface defined in paragraph 3.8.1, excluding hardbanding, shall be inspected for longitudinal cracks using an AC yoke.

b. The magnetic field generated using the AC yoke shall be applied transverse to the tube and tool joint longitudinal axis, and it shall be continuously activated during particle application.

c. Inspection shall be performed using either the dry magnetic particle technique or the wet fluorescent magnetic particle technique.

d. Proper field strength and orientation are verified at the beginning of each shift using a MPFI as defined in paragraph 3.8.2.

e. For dry particle inspection: Apply the dry particles by spraying or dusting directly onto the inspection areas. The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:
   - At the start of each inspection job.
   - When light fixtures change positions or intensity.
   - When there is a change in relative position of the inspected surface with respect to the light fixture.
   - When requested by the customer or its designated representative.
   - Upon completion of the inspection job.

   The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

f. For wet fluorescent magnetic particle inspection:
   - Particle concentration shall range from 0.1 to 0.4 ml/100 ml when measured using an ASTM 100 ml centrifuge tube, with a minimum settling time of 30 minutes in water-based carriers or 1 hour in oil-based carriers.
   - Blacklight intensity shall be measured with an ultraviolet light meter each time the light is turned on, after every 8 hours of operation, and at the completion of the job. The minimum intensity shall be 1000 microwatts/cm^2 at fifteen inches from the light source or at the distance to be used for inspection, whichever is greater.
   - The intensity of ambient visible light, measured at the inspection surface, during wet fluorescent magnetic particle inspection, shall not exceed 2 foot-candles.

g. With the customer's approval, the surfaces may be inspected using a residual circular magnetic field, provided that the field strength and direction are verified on each box tool joint using a MPFI as defined in paragraph 3.8.2.

h. Each length shall be rolled to allow 360 degrees examination.

i. Heat checking cracks on the box tool joint surface, excluding hardbanding, are rejectable if any one of the following criteria are met:
   - Linear indications cover 30% or more of the tool joint surface's circumference or total area.
   - Any linear indication is equal to or greater than 1/8 inch in length.
   - Any linear indication is located within 1/2 inch of the bevel.

j. Grinding to remove cracks is not permitted.

3.9 MPI Slip/Upset Inspection

3.9.1 Scope

This procedure covers inspection of slip and upset external surfaces of used steel drill pipe or workstring tubing for transverse and three-dimensional flaws, using either the dry magnetic particle technique with an active AC field or the wet fluorescent magnetic particle technique with an active DC field. The area to be inspected covers the following:

- Tube close to pin: 36 inches on the tube side starting from the intersection of the 35° or 18° taper, as applicable, and the outside surface of the tube or upset on drill pipe, or from the upset on workstring tubing.

- Tube close to box: 48 inches on the tube side starting from the intersection of the 18° tool joint taper and the outside surface of the tube or upset on drill pipe, or from the upset or coupling on workstring tubing. If there are slip cuts beyond the 48 inches, then the area where the additional slip cuts are located, including 6 inches on either side of this location, shall also be inspected.

- HWDP center pad: If this method is applied to HWDP, the area also includes the first 12 inches of tube from the intersection of the transition radius and outside tube surface on either side of the center upset.

3.9.2 Inspection Apparatus

a. For dry powder inspection: The pipe surface shall be magnetized with an AC yoke or an AC coil. The dry magnetic particles shall be of contrasting color to the inspection surface and shall be free from rust, grease, paint, dirt, and/or any other contaminants that may interfere with the particle characteristics.

b. For wet fluorescent inspection:

- A DC coil, AC yoke, or AC coil may be used for magnetizing the pipe surface.
- Petroleum base mediums which exhibit natural fluorescence under blacklight shall not be used. Diesel fuel and gasoline are not acceptable.
- Water base mediums are acceptable if they wet the surface without visible gaps. If incomplete wetting occurs, additional cleaning, a new particle bath, or the addition of more wetting agents may be necessary.
- Other Equipment. A calibrated blacklight intensity meter, an ASTM centrifuge tube and stand, and a blacklight source are required. See section 2.21 for calibration requirements. If a DC coil is used for inspection, the coil shall have a rated capability to induce a longitudinal magnetic field of at least 1200 amp-turns per inch of connection OD.

c. If an AC yoke is used for either process, the capacity of the yoke to lift a ten pound weight shall have been demonstrated in the last six months. The ten pound weight used for the lift test shall have been calibrated. See section 2.21 for calibration requirements. For AC yokes with adjustable poles:

- The maximum pole spacing during inspection shall not exceed the distance between the poles when all segments of the yoke are perpendicular to the grip.
- The minimum pole spacing during inspection shall be 2 inches.

d. A calibrated light meter to verify illumination. See section 2.21 for calibration requirements.

e. Required magnetic particle field indicators (MPFI) include a pocket magnetometer and either a magnetic flux indicator strip or a magnetic penetrameter (pie gage).

3.9.3 Preparation

a. All pipe shall be sequentially numbered.

b. The pipe surfaces shall be clean to a degree that the metal surfaces are visible. For dry powder inspection, the surfaces shall also be dry to the touch.

c. Any raised metal that might affect dry-powder indications in the area to be inspected must be ground flush with the pipe surface or the pipe shall be rejected.

d. The environment in which the inspection is to be performed shall be conducive to high-quality inspection results. Weather, lighting, temperature, component placement, etc, shall be considered and accounted for or corrected prior to beginning the inspection.

3.9.4 Procedure and Acceptance Criteria

a. The external surface defined in paragraph 3.9.1 shall be inspected using a longitudinal field. Each length shall be rolled to allow 360 degree examination. The field shall be continuously activated during particle application.

b. The magnetic particle field indicator (MPFI) shall be used to verify proper field magnitude and orientation at the beginning of each shift.

c. For dry particle inspection: Apply the dry particles by spraying or dusting directly onto the inspection areas. The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:

- At the start of each inspection job.
- When light fixtures change positions or intensity.
- When there is a change in relative position of the inspected surface with respect to the light fixture.
- When requested by the customer or its designated representative.
- Upon completion of the inspection job.

The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

d. For wet fluorescent inspection:

- Particle concentration shall range from 0.1 to 0.4 ml/100 ml when measured using an ASTM 100 ml centrifuge tube, with a minimum settling time of 30 minutes in water-based carriers or 1 hour in oil-based carriers.
- Blacklight intensity shall be measured with an ultraviolet light meter each time the light is turned on, after every 8 hours of operation and at the completion of the job. The minimum intensity shall be 1000 microwatts/cm^2 at fifteen inches from the light source or at the distance to be used for inspection, whichever is greater.
- The intensity of ambient visible light, measured at the inspection surface, during wet fluorescent magnetic particle inspection, shall not exceed 2 foot-candles.

e. Areas with questionable indications shall be recleaned and reinspected.

f. Any crack is cause for rejection except that hairline cracks in hardfacing are acceptable so long as they do not extend into the base metal. Grinding to remove cracks is not permitted.

g. Other imperfections shall not exceed the specified limits given in Tables 3.5.1, 3.5.2, or 3.11.1, as applicable, and 3.6.1, 3.6.2, or 3.11.2, as applicable.

3.10 Ultrasonic (UT) Slip/Upset Area Inspection

3.10.1 Scope

This procedure covers the shear wave ultrasonic examination of used drill pipe and workstring tubing slip and upset areas. This method is used for the detection of transverse and three-dimensional flaws on the inside and outside surface of the tube. The area to be inspected covers the following:

- Tube close to pin: 36 inches on the tube side starting from the intersection of the 35° or 18° tool joint taper, as applicable, and the outside surface of the tube or upset on drill pipe, or from the upset on workstring tubing.

- Tube close to box: 48 inches on the tube side starting from the intersection of the 18° tool joint taper and the outside surface of the tube or upset on drill pipe, or from the upset on workstring tubing. If there are slip cuts beyond the 48 inches, then the area where the additional slip cuts are located, including 6 inches on either side of this location, shall also be inspected.

3.10.2 Inspection Apparatus

a. The ultrasonic instruments for both scanning and prove-up shall be the pulse-echo type with A-scan presentation and gain control increments no greater than 2 dB. The units shall include an audible and/or visible alarm or indicator.

b. Linearity Calibration. The instrument shall have been calibrated for linearity in accordance with ASTM E317 at least once every six months. See section 2.21 for calibration requirements.

c. The field reference standard for field standardization shall contain internal and external transverse notches meeting the following requirements:

- Depth = 5% of nominal wall, ±0.004 inch, with a minimum depth of 0.012 inch.
- Width = 0.040 inch max.
- Length = 1/2 inch max.

The ultrasonic notched standard shall be recertified annually.

d. The field reference standard shall be of similar acoustic properties as the pipe being inspected. The reference standard OD shall be the nominal OD of the pipe to be inspected with the larger of following tolerances applied:
   - +1%, -3% of the nominal OD of the pipe to be inspected, or
   - ±1/32 inch

   The reference standard wall thickness shall be within ±10% of the nominal wall thickness of the pipe to be inspected.

e. The same couplant type shall be used for both standardization and inspection.

f. The ultrasonic instrument for scanning shall generate a permanent record for inspection and standardization.

g. Transducers used in the scanning instruments shall have annual beam-profile reports in accordance with ASTM E1065 available for review.

3.10.3 Preparation

a. All pipe shall be sequentially numbered.

b. The surfaces identified in paragraph 3.10.1 shall be clean to a degree that the metal is visible and the surfaces are non-sticky to the touch.

c. Any raised metal that impedes transducer travel in the area to be inspected shall be ground flush with the pipe surface or the pipe shall be rejected.

3.10.4 Field Standardization

a. Shear wave skip position for standardization: The signal response from the ID reference notch shall be standardized using the first 1/2 skip or 1-1/2 skip position. The first 1-1/2 skip position may be used for thin wall material or if excessive noise is encountered at the first 1/2 skip position. The signal response from the OD reference notch shall be standardized using the first full skip position.

b. Reference level setting: Select an initial gain setting. Compare the signal response from the ID notch using the first 1/2 or 1-1/2 skip position (as required in 3.10.4a) to that of the OD notch using the first full skip position. Adjust the gain so that the lower signal response of either the ID notch or OD notch is a minimum of 60% full screen height (FSH).

c. Gate positioning: Maximize the response from the ID notch in the first 1/2 or 1-1/2 skip position (as required in 3.10.4a) and position the ID gate such that the indication is completely encompassed within the gate. Then, maximize the response from the OD notch in the first full skip position and position the OD gate such that the indication is completely encompassed within the gate.

d. The gate threshold shall be set to 6 dB less than the reference levels established in paragraph 3.10.4b. (See paragraph 3.10.5h for threshold adjustment guidelines.)

e. The unit shall be field standardized:
   - At the start of inspection.
   - After each 25 lengths.
   - Each time the instrument is turned on.
   - When the instrument or transducer are damaged.
   - When the transducer, cable, operator, or material to be inspected are changed.
   - When the accuracy of the last valid standardization is questionable.
   - Upon completion of the job.

f. All ends inspected since the last valid field standardization shall be reinspected when instrument adjustments of more than 2 dB are necessary to bring the responses from the reference standard notches back to reference level.

g. For prove-up, a distance amplitude correction (DAC) curve shall be established between the responses from the OD and ID reference standard notches.

3.10.5 Procedure

a. After standardization and surface preparation, a flow of couplant shall be established and the inspection head placed on the pipe a minimum of 36 inches from the intersection of the 35° or 18° taper, as applicable, and the outside surface of the tube or upset, or 48 inches from the intersection of the 18° tool joint taper and the outside surface of the tube or upset. For single probe hand scanning, the surface shall be continually wetted or a viscous couplant used which will keep sound coupled to the pipe.

b. The head or probe shall be scanned toward the end of the pipe. Scanning shall proceed over the upset and onto the tool joint taper until coupling is lost. Instrument gain may be increased for scanning.

c. The scanning procedure shall be repeated until 100% of the required surface has been inspected.

d. At reference level gain setting, indications that exceed the gate threshold level established in paragraph 3.10.4d shall be marked for prove-up.

e. All indications marked during the scanning operation shall be proved-up with a standardized unit as described in paragraph 3.10.4.

f. The reference level gain shall be used for prove-up of indications.

g. A borescope and magnetic particle inspection may also be used to prove-up indications.

h. The gate threshold may be adjusted if adequate prove-up confirms that indications found are proving irrelevant. A threshold level shall be established during prove-up that warrants evaluation of all future indications on the pipe. The gate threshold shall not be within 3 dB of the reference level established in paragraph 3.10.4b. The inspector should watch for changes in signal response that may warrant threshold adjustments and/or restandardization. The threshold levels shall be recorded on the inspection logs.

Note: For single probe hand scanning, the transducer travel must be maintained along the longitudinal axis of the pipe, ±5° and a minimum of 110% wall coverage must be achieved.

3.10.6 Acceptance Criteria

a. An inaccessible indication (one located where mechanical measurement cannot be made) with a signal amplitude which exceeds the DAC curve (with gain set at reference level) shall be cause for rejection.

b. A crack shall be cause for rejection regardless of the signal amplitude it produces.

c. Other imperfections shall not exceed the specified limits in Tables 3.5.1, 3.5.2, or 3.11.1, as applicable, and 3.6.1, 3.6.2, or 3.11.2, as applicable.

3.11 Visual Connection Inspection

3.11.1 Scope

This procedure covers visual examination of used rotary shouldered connections to determine the pipe grade; to evaluate the condition of the seal, threads, hardfacing, and bevel; and to look for evidence of box swell and pin stretch. On drill collars and other BHA components, visual examination of the connection stress relief features is also covered. Hardfacing requirements apply to tool joints, drill collars, and HWDP center upsets, as applicable.

3.11.2 Inspection Apparatus

A 12-inch metal rule graduated in 1/64 inch increments, a metal straightedge, a calibrated light meter to verify illumination, calibrated angle gages, a calibrated hardened and ground profile gage, and OD calipers are required. A calibrated lead gage and a calibrated standard lead template are also required. See section 2.21 for calibration requirements for the light intensity meter, angle gage, profile gage, lead gage, and standard lead template.

3.11.3 Preparation

a. All pipe shall be sequentially numbered.

b. Connections shall be clean so that no scale, mud, or lubricant can be wiped from the thread or shoulder surfaces with a clean rag.

3.11.4 Procedure and Acceptance Criteria

All connections shall meet the following requirements.

a. Weight/Grade Stencils: The grade and weight stencil shall be marked on either the pin milled slot or the pin neck in accordance with Figure 3.11.1. If marked in both locations, the markings on the pin neck must agree with those on the milled slot. If neither marking is present, or an alternate marking scheme that is approved by the user is not applied, the joint shall be rejected unless traceability to the grade and weight of the joint is achieved through the manufacturer's joint serial number.

b. Hardbanding: When present, hardfacing shall extend no more than 3/16 inch radially above the tool joint surface with no broken or missing areas larger than 1/8 inch across the major dimension. Hairline cracks in the hardfacing are permissible as long as the cracks do not extend into base metal. Protruding carbide chips or beads are not allowed, unless permitted by the end user. When conflicts arise between this specification and the hardbanding manufacturer's field inspection requirements, the hardbanding manufacturer's field inspection requirements shall apply.

c. Cracks: All connections and tool joint bodies shall be free of visible cracks and heat checking, except that hairline cracks in hardfacing are acceptable if they

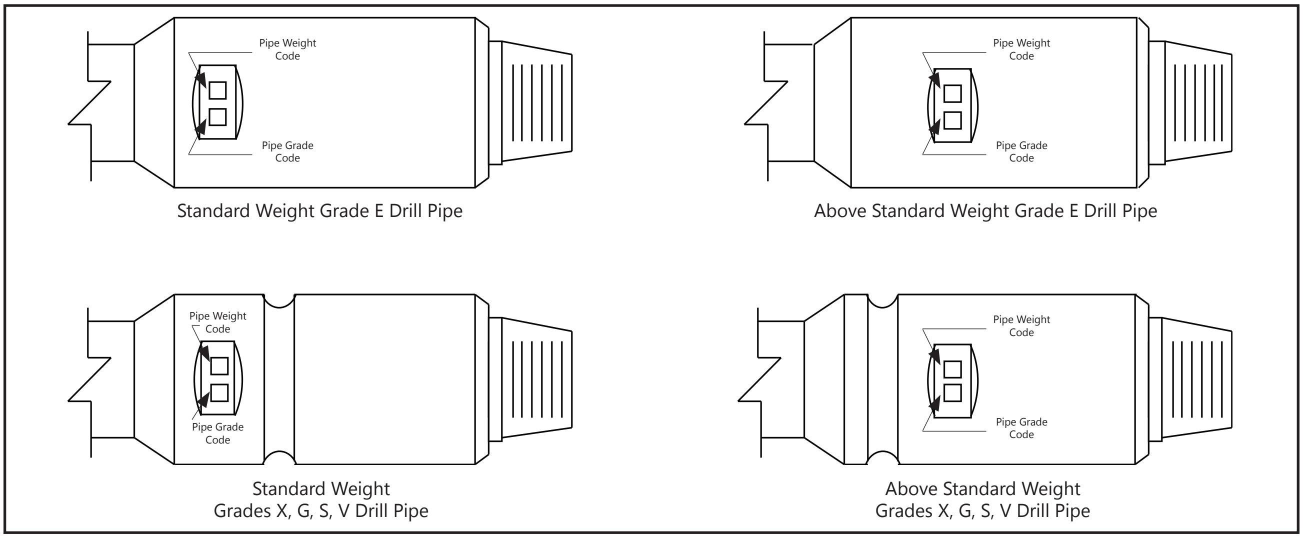
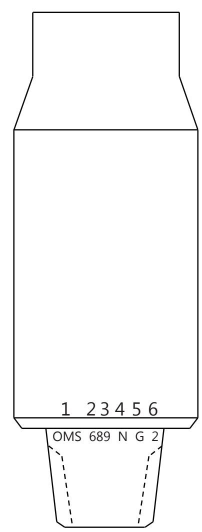


Figure 3.11.1a Marking system for normal weight drill pipe.

OD (in)	Nom. Wt. (lb/ft)	Weight Code
2-3/8	4.85	1
	6.65 (Standard)	2
2-7/8	6.85	1
	10.40 (Standard)	2
3-1/2	9.50	1
	13.30 (Standard)	2
	15.50	3
4	11.85	1
	14.00 (Standard)	2
	15.70	3
4-1/2	13.75	1
	16.60 (Standard)	2
	20.00	3
	22.82	4
	24.66	5
	25.50	6
5	16.25	1
	19.50 (Standard)	2
	25.60	3
5-1/2	19.20	1
	21.90 (Standard)	2
	24.70	3
5-7/8	23.40	2
	26.30	3
6-5/8	25.20 (Standard)	2
	27.70	3

Figure 3.11.1b Weight codes.

Mill/Processor	Symbol
Algoma	X
Dalmine	D
GrantPrideco	GP
Kawasaki	H
Nippon	I
NKK	K
Omsco	OMS
Reynolds Aluminum	RA
Seamless Tubes LTD	B
Siderca	SD
Sumitomo	S
Tamsa	T
Texas Steel Conversion	TSC
US Steel	N
Vallourec & Mannesmann	VM



Notes:

1 Tool Joint Mfg
2 Month of Weld
3 Year of Weld
4 Pipe Mfg
5 Pipe Grade
6 Pipe Weight Code

Example: Omsco tool joint, joined June 1989 on US Steel grade G standard weight pipe.

Figure 3.11.1d API pin neck marking system.

Grade	Grade Code
E-75	E
X-95	X
G-105	G
S-135	S
DS-140	Z*
V	V*

Figure 3.11.1c Grade codes.

*Z and V are to be used unless the manufacturer has a different marking indicating the grade.

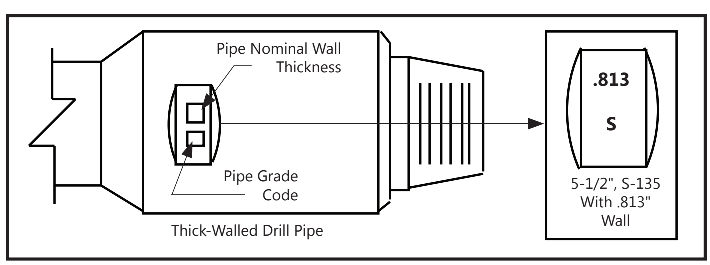


Figure 3.11.1e New marking system for thick-walled drill pipe.

do not extend into base metal. For non-magnetic connections, pay close attention to the thread roots at the back of the box and the boreback surface. These surfaces shall be free of cracks or crack-like indications. Grinding to remove cracks is not permissible.

d. The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:

- At the start of each inspection job.
- When light fixtures change positions or intensity.
- When there is a change in relative position of the inspected surface with respect to the light fixture.
- When requested by the customer or its designated representative.
- Upon completion of the inspection job.

The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

e. Air Wash: Air wash on the tool joint tapers (erosion caused by particle flow during air drilling, an example is shown in Figure 3.11.2) that covers more than 30% of the circumference of the tool joint taper shall be cause for rejection. Grinding to repair the air washed area is not permitted.

f. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces, including the end of the pin. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, the application of thread compound and protectors may be postponed until completion of the additional inspection.

3.11.5 API and Similar Non-Proprietary Connections

In addition to the requirements of paragraph 3.11.4, API and similar non-proprietary connections shall meet the following requirements.

3.11.5.1 Bevel Width

An approximate 45 degree OD bevel at least 1/32 inch wide shall be present for the full circumference on both pin and box.

3.11.5.2 Thread Root and Surface Pitting

This criteria covers tool joint (NWDP and TWDP) connections. See Figure 3.11.3 for the thread features considered.

a. Pin Connections: No pitting is allowed in the roots of any threads that are within 1-1/2 inches from the last scratch. Pitting is allowed in other thread roots, as well as all thread flanks and crests, as long as pitting does not occupy more than 1-1/2 inches in length along any thread helix, the pit depth does not exceed 1/32 inch, and the pit diameter does not exceed 1/8 inch.

b. Box Connections: Pitting on all thread surfaces shall not occupy more than 1-1/2 inches in length along any thread helix, the pit depth shall not exceed 1/32 inch, and the pit diameter shall not exceed 1/8 inch.

c. Locating the Last Scratch: Figure 3.11.4 shows an example API pin connection. The last scratch is created by the machining insert as it is slowly pulled

Figure 3.11.2 Example of rejectable air wash on tool joint taper.

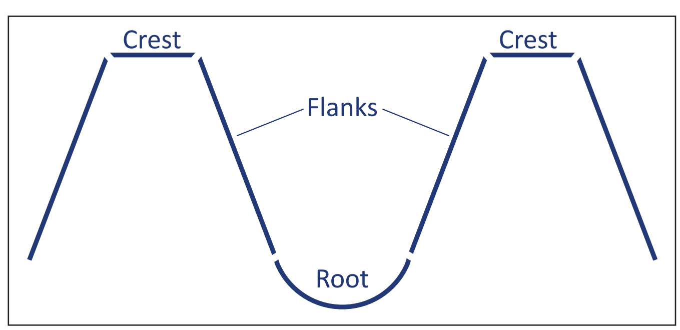


Figure 3.11.3 Parts of thread forms.

out, leaving an imperfect thread at the back of the connection. To locate the last scratch, rotate the connection until the last mark made by the machining insert is visible.

d. Measuring Required Distance: Measure 1-1/2 inches as shown in Figure 3.11.5. Threads on the connection follow the thread helix. Consequently, there will be areas where some of the thread root may fall within 1-1/2 inches while some of the thread root may theoretically be outside of 1-1/2 inches from the last scratch. In such cases, no pitting is allowed on that thread root even on the portions that may theoretically lie outside of 1-1/2 inches from the last scratch. This is evident in Figure 3.11.5 where line marked "no pitting allowed" is extended slightly beyond 1-1/2 inches (till the crest of the next thread) to cover the entire thread root.

3.11.5.3 BHA Connections with Stress Relief Features (SRF)

This criteria covers BHA connections with Stress Relief Features (SRF). No pitting is allowed in the roots of any threads that are within 1-1/2 inches from the last scratch. Pitting is allowed in other thread roots as long as the pitting does not occupy more than 1-1/2 inches in length along any thread helix, the pit depth does not exceed 1/32 inch, and the pit diameter does not exceed 1/8 inch. For pitting allowance on SRFs, see paragraph 3.11.5.4.

a. Locating the Last Scratch: Figure 3.11.6 shows an example API box connection with SRF (longitudinally split for clear view of internal geometry). The last scratch is created by the machining insert on the box connections with SRF due to machining of the boreback. The boreback creates truncated threads at the back of the box with gradually reducing height. The last thread eventually runs out at the boreback creating a last scratch. To locate the last scratch, rotate the connection until the last thread runout on the boreback is visible. Figure 3.11.7 shows an example API pin connection with SRF. The last scratch is created by the intersection of the machined radius of the SRF with the flank of the last thread. To locate the last scratch, rotate the connection until the mark made from machining the radius is visible as shown in Figure 3.11.7.

b. Measuring Required Distance: Measure 1-1/2 inches as shown in Figures 3.11.8 and 3.11.9. Threads on the connection follow thread helix. Consequently, there

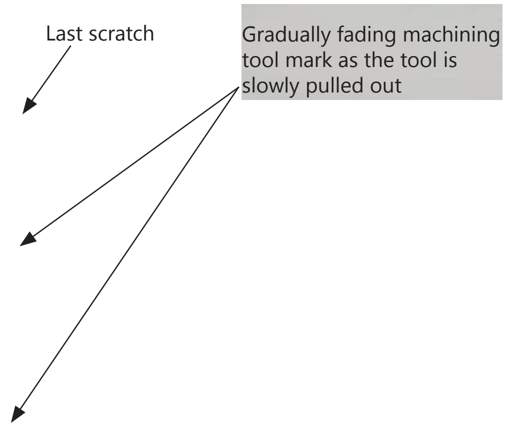


Figure 3.11.4 Identifying last scratch on drill pipe pin connection without SRF.

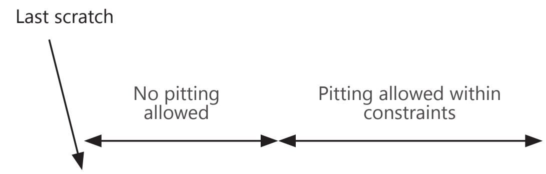


Figure 3.11.5 Measuring 1-1/2 inches from last scratch on drill pipe pin connection without SRF.

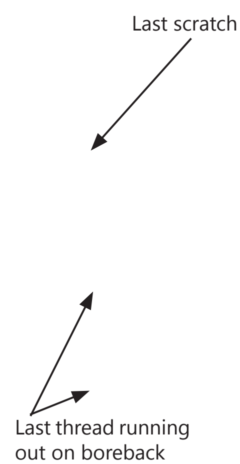


Figure 3.11.6 Locating the last scratch on BHA box connection with SRF.

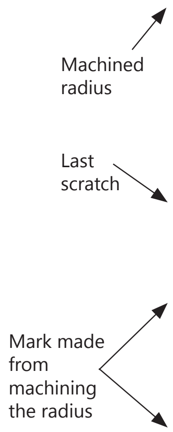


Figure 3.11.7 Locating the last scratch on BHA pin connection with SRF.

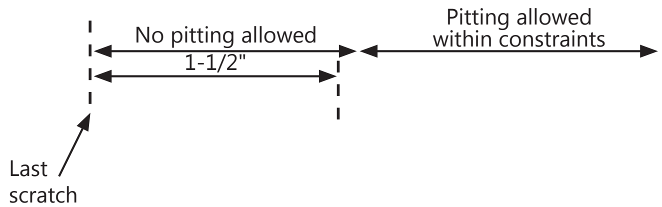


Figure 3.11.8 Measuring 1-1/2 inches from the last scratch on BHA box connection with SRF.

will be areas where some of the thread root may fall within 1-1/2 inches while some of the thread root may theoretically be outside of 1-1/2 inches from the last scratch. In such cases, no pitting is allowed on that thread root even on the portions that may theoretically lie outside of 1-1/2 inches from the last scratch. This is evident in Figure 3.11.8 and Figure 3.11.9 where line marked "no pitting allowed" is extended slightly beyond 1-1/2 inches (till the crest of the next thread) to cover the entire thread root.

3.11.5.4 BHA Connections Without SRF

This criteria covers BHA connections without SRFs. No pitting is allowed in the roots of any pin threads that are within 2 inches from the last scratch. Pitting is allowed in other pin thread roots and all box thread roots within constraints specified below. Pitting shall not occupy more than 1-1/2 inches in length along any thread helix, the pit depth shall not exceed 1/32 inch, and the pit diameter shall not exceed 1/8 inch.

a. Locating the Last Scratch: Refer to section 3.11.5.2c.

b. Measuring Required Distance: Measure 2 inches as shown in Figure 3.11.10. Threads on the connection follow thread helix. Consequently, there will be areas where some of the thread root may fall within 2 inches while some of the thread root may theoretically be outside of 2 inches from the last scratch. In such cases, no pitting is allowed on that thread root even on the portions that may theoretically lie outside of 2 inches from the last scratch. This is evident in Figure 3.11.10 where line marked "no pitting allowed" is extended

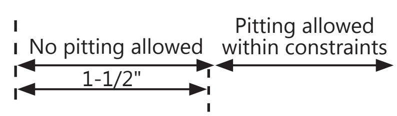


Figure 3.11.9 Measuring 1-1/2 inches from the last scratch on BHA pin connection with SRF.

Figure 3.11.10 Measuring 2 inches from the last scratch on BHA pin connection without SRF.

slightly beyond 2 inches (till the crest of the next thread) to cover the entire thread root.

3.11.5.5 Thread Surfaces

For thread root pitting criteria, see above. Other thread surfaces, such as thread crests, thread flanks, the box taper behind the last scratch with no stress-relief feature, and the area between the pin shoulder and the last scratch (i.e. pin-neck flats) with no stress-relief feature, shall be free of imperfections that appear to either penetrate below the thread root, occupy more than 1-1/2 inches in length along any thread helix, or exceed 1/16 inch in depth or 1/8 inch in diameter. Raised protrusions must be removed with a hand file or "soft" (nonmetallic) buffing wheel. The thread profile shall be checked after any buffing or filing of the threads.

3.11.5.6 Box Swell

A straightedge shall be placed along the longitudinal axis of the box tool joint. If a visible gap exists between the straightedge and the tool joint, the OD must be measured using calipers. Compare the OD at the bevel to the OD 2 inches, ±1/2 inch away from the bevel. If the OD at the bevel is greater by 1/32 inch or more, the connection shall be rejected.

3.11.5.7 Seal Surfaces

The seal surfaces shall be free of raised metal or corrosion deposits detected visually or by rubbing a metal scale or fingernail across the surface. Any pitting or interruptions of the seal surface that are estimated to exceed 1/32 inch in depth or occupy more than 20% of the seal width at any given location are rejectable. No filing of the seal shoulders is permissible.

3.11.5.8 Refacing

If refacing is necessary, only enough material to correct the damage shall be removed. Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected.

3.11.5.9 Pin Thread Profile

The profile gage shall mesh with the thread load and stab flanks so that no light is visible at any of the flanks or thread roots. Visible gaps estimated to be no greater than 1/16 inch on no more than two thread crests are permissible. Uniform flank wear estimated to be less than 0.010 inch is permissible. However, any visible gaps at the thread flanks will require pin lead measurement per paragraph 3.11.5.10 below. Two thread profile checks 90 degrees ±10 degrees apart shall be made on each connection.

3.11.5.10 Pin Lead

If the profile gage indicates that the pin is stretched, pin lead shall be measured over a 2-inch interval beginning at the first full-depth thread nearest the shoulder. Pin stretch shall not exceed 0.006 inch over the 2-inch length. Two lead checks 90 degrees ±10 degrees apart shall be made.

3.11.5.11 Stress Relief Surfaces of BHA Connections and HWDP Connections

Built up corrosion shall be removed from these surfaces with emery paper or flapper wheel to determine the surface condition. Pitting that is measured or visually estimated to be deeper than 1/32 inch or 1/8 inch in diameter shall be cause for rejection. Any stencil or stamp marking on a stress relief surface shall be cause for rejection.

Pitting in boreback cylinders: See Appendix, Paragraph A.4, for specific inspection requirements and repair guidelines.

3.11.5.12 Box Taper

The box taper at the back of the box shall be visually inspected. All inner diameter tapers originating from a box thread shall be at an angle of 45 degrees maximum from the centerline axis of the connection. No burr, lip, or edge greater than the allowable angle tolerance is acceptable.

Note: For subs and pup joints, if the taper angle at the back of the box is determined to be more than 35 degrees using an angle gage, the customer shall be advised and the inspection report shall document the findings.

3.11.5.13 Shoulder Squareness

If a 360 degree benchmark is present on the connection (either pin or box), the relative position of the seal surface to the benchmark shall be checked around the full circumference. If there is a variation in the distance between the benchmark and the seal surface (indicating a possible lack of alignment) that is visually estimated to exceed 1/64 inch, the connection shall be rejected.

3.11.5.14 Pitting in the Pin Inside Diameter (ID)

The entire pin ID for a length exceeding the threaded length shall be examined for pitting. Pitting that is measured or visually estimated to be deeper than 1/8 inch shall be cause for rejection. See Appendix, Paragraph A.5, for specific repair guidelines.

3.11.5.15 Shoulder Flatness

Box shoulder flatness shall be verified by placing a straightedge across a diameter of the tool joint face and rotating the straightedge at least 180 degrees along the plane of the shoulder. Any visible gaps shall be cause for rejection. The procedure shall be repeated on the pin with the straightedge placed across a chord of the shoulder surface. Any visible gaps between the straightedge and the shoulder surface shall be cause for rejection.

3.11.6 HI TORQUE™, eXtreme™ Torque, uXT™, eXtreme™ Torque-M, TurboTorque™, TurboTorque-M™, Grant Prideco Double Shoulder™, and uGPDS™

In addition to the requirements of paragraph 3.11.4, Grant Prideco HI TORQUE™ (HT), eXtreme™ Torque (XT), uXT™, eXtreme™ Torque-M (XT-M), TurboTorque™ (TT), TurboTorque-M™ (TT-M), Grant Prideco Double Shoulder™ (GPDS), and uGPDS™ connections shall meet the following requirements.

Note: Damages include, but are not limited to, the following conditions: galls, nicks, washes, fins, dents, scratches, pits, or cuts. This does not include discoloration or other superficial anomalies that alter the appearance only. When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread, make-up shoulder, and seal surfaces shall be cleaned sufficiently to allow for visual inspection. For XT™, uXT™, XT-M™, TT™, and TT-M™ the starting threads of the pin and box connections should be cleaned using a "soft wheel" or other buffing method.

b. Primary Shoulder (Seal): The seal surfaces shall be free of raised metal or corrosion deposits detected visually or by rubbing a metal scale or fingernail across the surface. Any pitting or interruptions of the seal surface that are estimated to exceed 1/32 inch in depth or cumulatively cover more than 1/3 of the radial width at any given location are rejectable. No filing of the seal shoulders is permissible. See Figure 3.11.11 for examples of acceptable and rejectable damages.

c. Secondary Shoulder (Mechanical Stop): The Secondary Shoulder is not a sealing surface. Damage to this surface is not critical unless the damage interferes with the make-up, driftability, or torque capacity of the connection. Dents, scratches, and cuts are not acceptable if they exceed 1 inch in length along the circumference or cause the connection to be rejected due to shortening of the shoulder-to-shoulder length. Any metal protrusion above the seal surface is not acceptable and shall be removed by filing, soft wheel, or other buffing method and protected by applying coating to the repaired areas. Connection length readings shall not be taken in damaged areas.

d. Refacing: For HT™, XT™, uXT™, TT™, GPDS™, and uGPDS™, if refacing is necessary, the distance from the primary shoulder to the secondary shoulder must be maintained as required in the Dimensional 2 Inspection. Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected.

Acceptable Damage	Rejectable Damage
$E_w + F_w \leq \frac{W}{3}$	$A_w > \frac{W}{3}$
$G_w + I_w \leq \frac{W}{3}$ (H_w is not loated at the same radial position as G_w and I_w, and is therefore not added to the total width at this location)	$B_w + C_w + D_w > \frac{W}{3}$

Figure 3.11.11 Acceptable and rejectable seal damage.

- GPMark™ Benchmark: After refacing repair, a minimum length of 1/16 inch (0.062 inch) shall remain on the box refacing benchmark, and 3/16 inch maximum (0.188 inch) shall remain on the pin refacing benchmark. Rethreading is required if excess material is removed. See Figure 3.11.12a.
- Xmark™ Benchmarks: After refacing repair, a visible step on the benchmark shall remain on the primary shoulder. The step is a necessary indicator that a benchmark is still present. Rethreading is required if there is no visible benchmark. See Figure 3.11.12b.

Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for Grant Prideco connections are acceptable. A minimum of four measurements shall be taken when using a portable field refacing unit. The variability of face flatness and squareness that is introduced should be monitored. If any measurement is found to be outside the drawing limits, the connection shall be rejected.

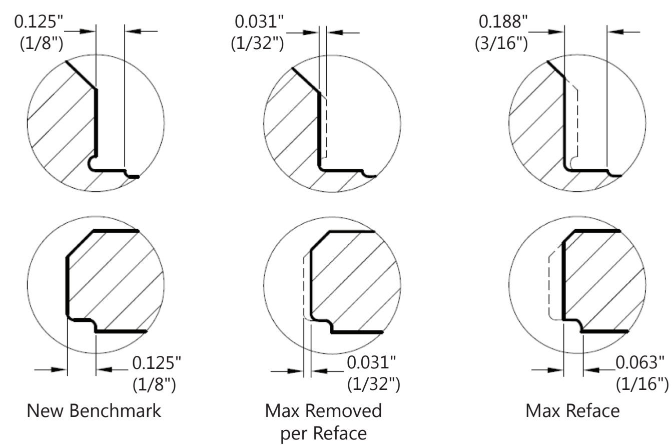


Figure 3.11.12a GPMark™ Benchmarks.

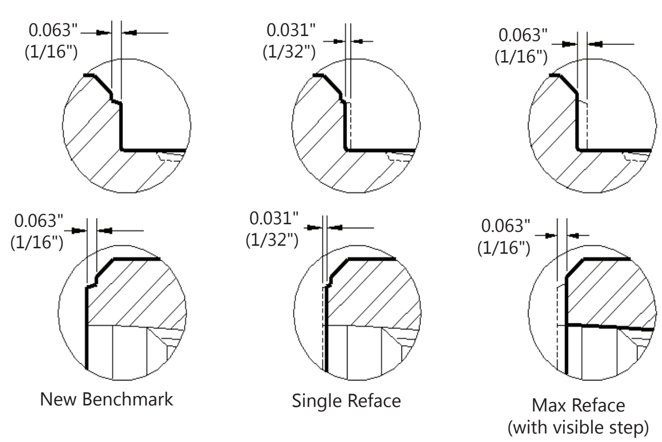


Figure 3.11.12b Xmark™ Benchmarks.

e. Threads: Thread flank surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter/width. For damage that is not round, the 1/8 inch requirement applies to the width of the damage, and shall not apply to the length of the damage along the circumference. See Figure 3.11.12c. Material that protrudes beyond the thread profile shall be removed using a round cornered triangle hand file or soft buffing wheel. Any damage in the thread roots located within the Pit Free Zone designated on the "Field Inspection Dimensions" drawing, latest revision, is not acceptable. For thread roots outside the designated Pit Free Zone, damage that exceeds 1/32 inch in depth or 1/8 inch in diameter is not acceptable and shall be repaired by rethreading.

   Note: For XT™, uXT™, XT-M™, TT™, and TT-M™ connections, the stab flank to crest radius of the starting 5 threads round off during break-in and normal operation. This condition is normal and does not affect the service of the connection. Thread flank surfaces that contain damage exceeding 1/16 inch in depth or 1/8 inch in diameter are acceptable in these first 5 starting threads.

f. Thread Profile: The thread profile shall be verified along the full length of complete threads in two locations at least 90 degrees apart. The profile gage shall mesh evenly in the threads and show normal contact. If the profile gage does not mesh evenly in the threads, lead measurements shall be taken.

g. Lead: For HT™, XT™, uXT™, XT-M™, GPDS™, and uGPDS™, if the profile gage indicates that thread

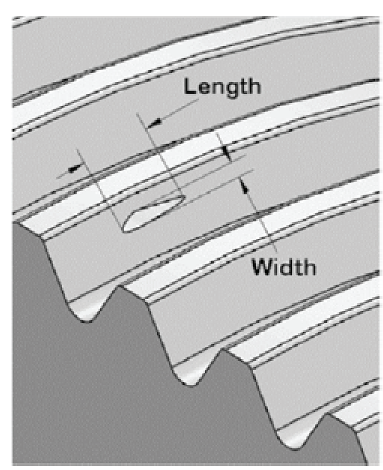


Figure 3.11.12c Dimensions of damage on thread flanks.

stretch has occurred, lead shall be measured over a 2-inch interval. Thread stretch shall not exceed 0.006 inch over the 2-inch length. Connections failing this inspection should be inspected for cracks and, if none are found, re-threaded.

For Grant Prideco TT™ and TT-M™, if the profile gage indicates that thread stretch has occurred, both thread leads shall be verified individually (in lead) and jointly (between leads). Connections failing the below inspections shall be inspected for cracks and if none are found, re-threaded.

Three Threads per Inch (3 TPI)
- *The first lead shall be measured over 6 threads (2 inch interval) and shall not exceed 0.006 inch.*
- *By advancing one thread, the second thread lead shall be measured over 6 threads (2 inch interval) and shall not exceed 0.006 inch.*
- *Joint thread leads shall be measured over a 5 threads (1-1/2 inch interval) and shall not exceed 0.005 inch.*

Three and a Half Threads per Inch (3.5 TPI)
- *The first lead shall be measured over 4 threads (1 inch interval) and shall not exceed 0.003 inch.*
- *By advancing one thread, the second thread lead shall be measured over 4 threads (1 inch interval) and shall not exceed 0.003 inch.*
- *Joint thread leads shall be measured over 7 threads (2 inch interval) and shall not exceed 0.006 inch.*

h. Coating: Threads and shoulders that are repaired by filing or refacing must be phosphate coated or copper sulfate coated.

i. Dimensional: Dimensional 2 (Section 3.13.5 or 3.13.6, as applicable) is required for drill pipe connections and Dimensional 3 (Section 3.14.5 or 3.14.6, as applicable) is required for HWDP, drill collar, and sub connections.

3.11.7 XT-M™ and TT-M™

In addition to the requirements of paragraph 3.11.6, Grant Prideco XT-M™ and TT-M™ connections shall meet the following requirements.

a. 15° Seal: The 15° metal-to-metal sealing surfaces are allowed to contain non-circumferential damage that is less than or equal to 1/32 inch in length, width, diameter, or depth. Multiple pits of this type are acceptable provided there is at least 1-inch circumferential separation between them. Circumferential lines or marks are acceptable in this surface provided they cannot be detected by rubbing a fingernail across the surface. The following "Pin Seal" and "Box Seal" diagrams (Figure 3.11.13) show areas of the seal that may contain damage exceeding that previously stated in this procedure. The area of the pin seal within 0.060 inch of the minor pin nose diameter is a not-contact surface and damage in this area does not affect sealing. The area on the pin seal within 0.060 inch of the major pin nose diameter may also contain damage or pitting. Damages and pitting within these two areas of the pin seal are permissible provided the balance of the pin seal contact surface area meets the requirements of this procedure. Similarly, the area on the box seal within 0.188 inch of the major box cylinder diameter contains the non-contact portion of the box seal and that portion of the seal that corresponds to the first 0.060 inch of the pin seal. Damage and pitting within this area of the box seal are permissible provided the balance of the box seal contact surface area meets the requirements of this section. Any metal protrusion above the seal surface is not acceptable. Filing is not permitted on any area of the radial metal-to-metal seal.

b. Refacing: The field refacing method addressed in 3.11.6d does not apply to the XT-M™ and TT-M™ connection, which require shop redressing in a licensed Grant Prideco facility.

3.11.8 Grant Prideco Express™, Grant Prideco EIS™, and Grant Prideco TM2™

The connections may be abbreviated as follows: Grant Prideco Express as VX™, Grant Prideco EIS as EIS™, and Grant Prideco TM2 as TM2™. In addition to the Visual Connection requirements of paragraph 3.11.4, VX™, EIS™, and TM2™ connections shall meet the following requirements.

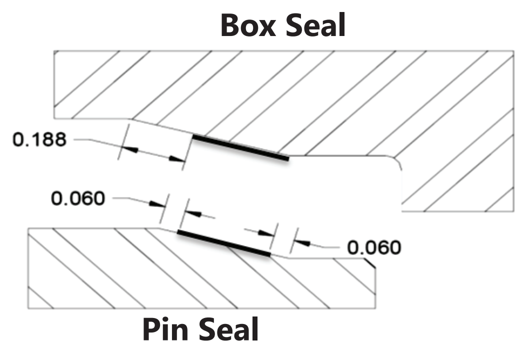


Figure 3.11.13 XT-M™ and TT-M™ box and pin seal surfaces.

Note: Connections manufactured as VAM CDS connections have been determined by Grant Prideco to be interchangeable with GPDS connections. As such, any CDS connections shall be inspected according to the procedures outlined for GPDS connections. When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread, make-up shoulder, and seal surfaces shall be cleaned sufficiently to allow for visual inspection.

b. Bevel Width: An approximate 45 degree OD bevel at least 1/32 inch wide shall be present for the full circumference on both pin and box.

c. Box Swell: A straightedge shall be placed along the longitudinal axis of the box tool joint. If a visible gap exists between the straightedge and the tool joint, the OD must be measured using calipers. Compare the OD at the bevel to the OD 2 inches, ±1/2 inch away from the bevel. If the OD at the bevel is greater by 1/32 inch or more, the connection shall be rejected.

d. Primary Shoulder (Seal): Any pitting, interruptions, galls, nicks, washes, fins, or other conditions on the seal surface that are estimated to exceed 1/32 inch in depth or occupy more that 30% of the seal width at any given location are rejectable. No filing of the seal shoulders is permissible.

e. Secondary Shoulder (Mechanical Stop): The secondary shoulder is not a seal. This shoulder must be free of raised metal or other imperfections that could prevent proper make-up, driftability, or cause galling. Secondary shoulder damage can be repaired with a hand file and should be used to remove protruding metal.

f. Refacing: If refacing is necessary, the distance from the primary shoulder to the secondary shoulder must be maintained as required in the Dimensional 2 Inspection. Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected.

g. Threads: Thread flank surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter. Thread roots shall be free of damage that extends below the thread root radius. Material that protrudes beyond the thread profile should be removed using a round cornered triangle hand file or soft buffing wheel.

h. Thread Profile: The thread profile shall be verified along the full length of complete threads in two locations at least 90 degrees apart. The profile gage should mesh evenly in the threads and show normal contact. If the profile gage does not mesh evenly in the threads, lead measurements shall be taken.

i. Lead: If the profile gage indicates that thread stretch has occurred, lead shall be measured over a 2-inch interval. Thread stretch shall not exceed 0.006 inch over the 2-inch length.

j. Coating: Threads and shoulders that are repaired by filing or refacing must be phosphate coated or copper sulfate coated.

3.11.9 Hydril Wedge Thread™

In addition to the requirements of paragraph 3.11.4, Hydril Wedge Thread™ (WT™) connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Out-Of-Roundness: Connections shall be visually evaluated for ovality. If a connection is identified as being out-of-round, the box counterbore diameters (D_1 and D_2) shall be measured and evaluated in accordance with step 3.13.8d of the Dimensional 2 procedure.

b. Thread Wear Indicator: The thread wear indicator shall be visually inspected for deformation and indications of contact with the box face. Pin connections exhibiting deformation on the wear indicator, scoring marks on the pin shoulder or burnish patterns on the pin shoulder shall be rejected. Box connections exhibiting scoring marks or burnish patterns on the box face shall be rejected.

c. OD Wear: WT™ connections shall be visually inspected for OD wear and rejected if the OD is worn below the bevel diameter for a total of 120 degrees of the circumference.

d. Thread Surfaces: Thread surfaces shall be free of pits or other imperfections that appear to exceed 1/16 inch in depth or 1/8 inch in diameter, that penetrate below the thread root, or that occupy more than 1-1/2 inches in length along any thread helix. Raised protrusions must be removed with a hand file or "soft" (nonmetallic) buffing wheel. The thread profile shall be checked after any buffing or filing of the threads.

e. Special Considerations:

- Hydril Wedge Thread™ does not seal on the pin shoulder or box face. Damage to these areas does not require mechanical refacing or rejection of the length.
- Thread surfaces shall be dressed with a file or hand grinder prior to inspection.
- Dents or mashed areas on the threads that can be hand dressed until the surface is even shall not be cause for rejection.
- Thread protrusions which can be hand dressed until the surface is even shall not be cause for rejection.
- Galling or scoring of the threads which can be hand dressed until the surface is even shall not be cause for rejection.

3.11.10 NK DSTJ™

In addition to the visual connection requirements in paragraph 3.11.4, NK DSTJ™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Seal Shoulder (Primary Make Up Shoulder): Galling, pitting, or any other damage to the seal that exceeds 1/32 inch in depth or occupies greater than 25% of the seal width at any given location of the circumference is cause for rejection. Field refacing of the sealing shoulder is not permitted. Sealing shoulders with damages within the refacing limits shall be identified with a green band around the box OD to be refaced in a NK DSTJ™ licensed machine shop. A red band around the box or pin tool joint is identified as the connections to be re-cut. All connections rejected by an inspection crew should be re-inspected by an inspection supervisor.

b. Traceability: It is necessary to check traceability by die stamping. If in case die-stamping "RF" is recognized on the connection, no more refacing can be performed. (Refacing is allowed only once on DSTJ™.)

c. Torque Stop Shoulder (TSS): The box TSS and pin TSS are not sealing shoulders but a mechanical stop. Light corrosion or indentations without protrusion are acceptable. Proud mechanical damages or other imperfections that could prevent proper make up or cause galling must be removed using a fine file.

d. Thread Surfaces: Pits, cuts, and gouges that cause slight depression in flanks and crests of the threads are acceptable as long as they do not occupy more than 1-1/2 inches in length along any thread helix. Pits, cuts, and gouges in thread roots are rejected if they are within two threads of the last engaged thread. Pits, cuts, and gouges that are roots of other threads shall not exceed 1/32 inch in depth. Raised protrusions must be removed with a hand file or "soft" (nonmetallic) buffing wheel. The thread profile shall be checked after any buffing or filing of the threads.

e. Thread Profile: The thread surfaces shall be visually inspected for evidence of galling or corrosion. Any galling of the threads which cannot be repaired by a hand file is cause for rejection. After any thread repair the thread profile shall be checked with a field profile gauge. The pin flat areas should be visually inspected for pitting that exceeds 1/32 inch in depth or any damage that would inhibit make-up. The box counterbore should also be free from any damage that would inhibit make-up.

f. Bevel: A visual check should be done on each connection to ensure a bevel of at least 1/16 inch width is present around the full circumference of the connection.

g. Profile Gauge: The threads of both pin and box connections shall be checked with a hardened and ground profile gauge for evidence of thread damage and thread stretch in at least three positions around the circumference. Threads which have stretch exceeding 0.006 inch in 2 inches shall be cause for rejection.

h. Box OD Swell: The box shall be examined for evidence of swelling. A straight edge shall be placed length ways along the longitudinal axis on the box surface. If a gap exists between the straight edge and the box outside surface, the outside surface shall be measured next to the bevel and compared to the OD two inches from the bevel. If the OD measured at the bevel is greater by 1/32 inch or more, the connection shall be rejected.

3.11.11 Hilong Interchangeable Double Shoulder (HLIDS™), Hilong Modified High-Torque (HLMT™), Hilong Super High-Torque (HLST™), and Hilong Improved Super High-Torque (HLIST™) Connections

In addition to the requirements of paragraph 3.11.4, HLIDS, HLMT, HLST, and HLIST connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread, make-up shoulder, and seal surfaces shall be cleaned sufficiently to allow for visual inspection. The starting threads of the pin and box connections should be cleaned using a "soft wheel" or other buffing method.

b. Primary Shoulder (Seal): Any pitting, interruptions, galls, nicks, washes, fins, or other conditions on the seal surface that are estimated to exceed 1/32 inch in depth or occupy more that 30% of the seal width at any given location are rejectable. No filing of the seal shoulders is permissible.

c. Secondary Shoulder (Mechanical Stop): The secondary shoulder is not a seal. This shoulder must be free of raised metal or other imperfections that could prevent proper make-up, driftability, or cause galling. Secondary shoulder damage can be repaired with a hand file which should be used to remove protruding metal.

d. Bevel Width: An approximate 45 degree OD bevel at least 1/32 inch wide shall be present for the full circumference on both pin and box.

e. Box Swell: A straightedge shall be placed along the longitudinal axis of the box tool joint. If a visible gap exists between the straightedge and the tool joint, the OD must be measured using calipers. Compare the OD at the bevel to the OD 2 inches, ±1/2 inch away from the bevel. If the OD at the bevel is greater by 1/32 inch or more, the connection shall be rejected.

f. Refacing: If refacing is necessary, the distance from the primary shoulder to the secondary shoulder must be maintained as required in the Dimensional 2 Inspection. Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected.

g. Threads: Thread flank surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter. Thread roots shall be free of damage that extends below the thread root radius. Material that protrudes beyond the thread profile should be removed using a round cornered triangle hand file or soft buffing wheel.

h. Thread Profile: The thread profile shall be verified along the full length of complete threads in two locations at least 90 degrees apart. The profile gage should mesh evenly in the threads and show normal contact. If the profile gage does not mesh evenly in the threads, lead measurements shall be taken.

i. Lead: If the profile gage indicates that thread stretch has occurred, lead shall be measured over a 2 inch interval. Thread stretch shall not exceed 0.006 inch over the 2 inch length.

j. Coating: Threads and shoulders that are repaired by filing or refacing must be phosphate coated or copper sulfate coated.

3.11.12 DP-Master DPM-DS, DPM-MT®, DPM-ST®, and DPM-HighTorque Series Connections

In addition to the requirements of paragraph 3.11.4, connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread and make-up shoulder surfaces shall be cleaned sufficiently to allow for visual inspection. The use of non-hydrocarbon based cleaning agents is recommended. Any build-up of corrosion should be removed by using "Scotch-brite®" or other buffing methods.

b. Primary Shoulder (Seal): The seal surface shall be free of galls, nicks, washes, fins, or other conditions that would affect its joint stability or pressure holding capacity. Damage that exceeds 1/32 inch in depth or crosses 30% of the radial width of the seal is rejectable. If the damage exceeds the acceptable limits, machine re-facing shall be used to repair the seal surface.

c. Secondary Shoulder (Mechanical Stop): The Secondary Shoulder is a mechanical stop and not a seal surface. Damage to this surface is not critical unless the damage interferes with the make-up, the ability to pass a drift through the ID, or the torque capacity of the connection. Dents, scratches, and cuts do not affect this surface. However, if the dents, scratches and cuts cause reduction in shoulder to shoulder length, then the connection shall be rejected. Metal loss due to fluid erosion is cause for rejection. Filing may be used to repair metal protrusions, which extend from the face. Connection length readings shall not be taken in damaged areas.

d. Thread Damage: Thread flank surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter. Thread roots shall be free of damage that extends below the radius. Thread crests shall be free of damage that would interfere with make-up. Material that protrudes beyond the thread profile should be removed using a round cornered triangle hand file or soft buffing wheel.

e. Refacing: The machine re-facing repair should only remove enough material to repair the damage. A maximum of 1/32 inch of material may be removed during each re-facing operation and a maximum of 1/16 inch may be removed from the connection before re-threading is required. Both the primary seal and the secondary shoulder shall be re-faced simultaneously to ensure that proper connection length is maintained.

f. Thread Profile: The thread profile shall be verified along the full length of complete threads in two locations at least 90 degrees apart. The profile gauge should mesh evenly in the threads and show normal contact. If the profile gage does not mesh in the threads, lead measurements shall be taken.

g. Thread Lead: The thread lead shall be verified if the profile gauge indicates that thread stretch has occurred. The thread lead shall be measured over a 2-inch interval and shall not exceed 0.006 inch. Connections failing this inspection should be inspected for cracks and if none are found, the connection shall be re-threaded.

h. Bare Metal Surface Treatment (Post Repair): Threads and shoulders on the pin and box connections shall be phosphate coated. Slightly worn coating is acceptable and can be repaired with a phosphate spray. Threads and shoulders that are repaired by filing or re-facing must be phosphate coated or coated using copper sulfate.

3.11.13 Grant Prideco Delta™ Connections

In addition to the requirements of paragraph 3.11.4, Grant Prideco Delta™ connections shall meet the following requirements.

Note: Damages include, but are not limited to, the following conditions: galls, nicks, washes, fins, dents, scratches, pits, or cuts. This does not include discoloration or other superficial anomalies that alter the appearance only. When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread, make-up shoulder, and seal surfaces shall be cleaned sufficiently to allow for visual inspection. The starting threads of the pin and box connections should be cleaned using a "soft wheel" or other buffing method.

b. Primary Shoulder (Seal): The seal surface shall be free of galls, nicks, washes, fins, or other conditions for which the damage exceeds 3/64 inch in depth, cumulatively covers more than 1/3 of the radial width of the seal surface, or raised metal protrudes above the seal surface (filing on the primary make-up shoulder is not permitted). See Figure 3.11.11 for examples of acceptable and rejectable damages.

c. Secondary Shoulder (Mechanical Stop): The Secondary Shoulder is not a sealing surface. Damage to this surface is not critical unless the damage interferes with the make-up, driftability, or torque capacity of the connection. Dents, scratches, and cuts do not affect this surface unless the damage around the circumference prevents the connection length from being accurately measured at two locations approximately 180 degrees apart or there is any raised metal protruding above the seal surface that cannot be removed by filing, soft wheel, or other buffing method. (Any repaired areas shall be protected by applying an acceptable coating.)

d. Refacing: Repair by refacing may only be used to attempt to repair shoulder damage less than or equal to 3/64 inch in depth, and/or connection length discrepancies that are less than 1/32 inch out of specification.

- As typical of the rotary shoulder connection reface process, a maximum of 1/32 inch of material may be removed from the primary make-up shoulder during each refacing operation, after which the joint shall be placed back into service prior to performing any additional refacing repair.

- The cumulative total material removal from the primary make-up shoulder for all refacing operations shall not exceed 3/32 inch before rethreading is required.
- Repair by refacing methods shall only remove sufficient material to repair the damage. However, when damage is less than 1/32 inch deep, all damage shall be removed from the primary make-up shoulder.
- After the maximum reface allowance is met, any remaining damage on the primary make-up shoulder shall not be deeper than 1/64 inch and shall meet all other requirements of this procedure.
- If the connection cannot be brought back within the acceptable limits outlined in this procedure without removing more than 1/32 inch of material from the primary shoulder, then rethreading shall be required.
- Both the primary make-up shoulder and secondary make-up shoulder shall be skimmed/machined during a refacing operation for all double shoulder connections.
- Machine refacing in a lathe is the preferred method.
- If the portable field refacing unit method is used, variability in the face flatness and squareness that is introduced shall be monitored by taking the connection length measurements in a minimum of four locations, equally spaced around the circumference. Each measurement shall be within the limits of the "Field Inspection Dimensions" drawing, latest revision.
- GPMark™ + Benchmark: After refacing repair, a minimum length of 1/16 inch (0.063 inch) shall remain on the box refacing benchmark, and 3/16 inch maximum (0.188 inch) shall remain on the pin refacing benchmark. Rethreading is required if excess material is removed. See Figure 3.11.14.
- Xmark™ + Benchmarks: After refacing repair, a visible step on the benchmark shall remain on the primary shoulder. The step is a necessary indicator that a benchmark is still present. Rethreading is required if there is no visible benchmark. See Figure 3.11.15.

e. Threads: Thread surfaces shall be free of any raised metal protruding above the thread surface that cannot be removed by filing, soft wheel, or other buffing method (filing is not permitted in the thread roots). Any repaired areas shall be protected by applying an acceptable coating. Thread flank surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter/width. For damage that is not round, the 1/8 inch requirement applies to the width of the damage, and shall not apply to the length of the damage along the circumference. See Figure 3.11.12c. Thread roots within the Pit Free Zone designated on the "Field Inspection Dimension" drawing, latest revision, shall be free of all damage. For thread roots outside of the designated Pit Free Zone, damage shall not exceeds 1/32 inch in depth or 1/8 inch in diameter.

f. Thread Profile: The thread profile shall be verified along the length of the full form threads in two locations at least 90 degrees apart. The profile gauge shall

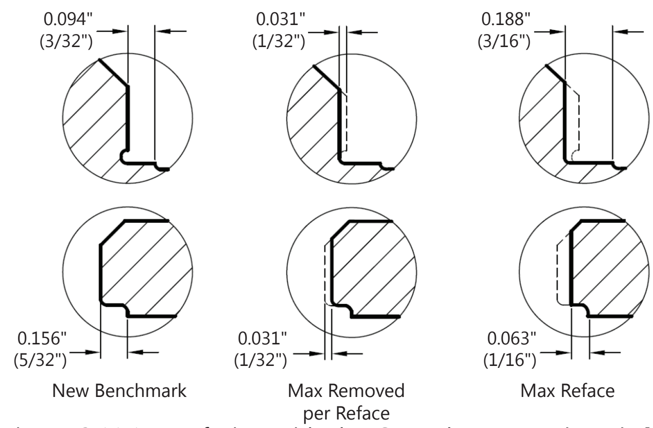


Figure 3.11.14 Refacing with the GPmark™ + Benchmark for Delta™ connections.

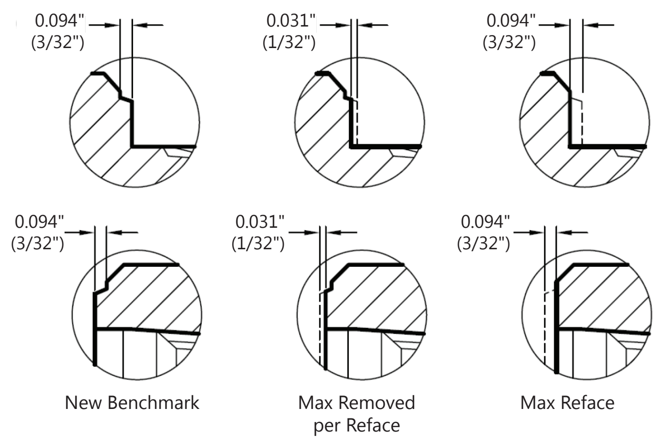


Figure 3.11.15 Refacing with the Xmark™ + Benchmark for Delta™ connections.

mesh evenly in the threads and show normal contact. If the profile gauge does not mesh in the threads, lead measurements shall be taken.

g. Lead: If the profile gage indicates that thread stretch has occurred, lead shall be measured over a 2-inch interval. Thread stretch shall not exceed 0.006 inch over the 2-inch length. Connections failing this inspection should be repaired by rethreading.

h. Coating: Threads and shoulders that are repaired by filing or refacing shall be protected by hot phosphate coating, or by using copper sulfate or other commercially available effective surface etchant products suitable for rotary shoulder connections. All rethreaded connections shall be protected by hot phosphate coating.

i. Dimensional: Dimensional 2 (Section 3.13.12) is required for drill pipe connections and Dimensional 3 (Section 3.14.8) is required for HWDP, drill collar, and sub connections.

3.11.14 Grant Prideco X-Force™

In addition to the Visual Connection requirements of paragraph 3.11.4, Grant Prideco X-Force™ (XF) connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread, make-up shoulder, and seal surfaces shall be cleaned sufficiently to allow for visual inspection.

b. Bevel Width: An approximate 45 degree OD bevel at least 1/32 inch wide shall be present for the full circumference on both pin and box.

c. Box Swell: A straightedge shall be placed along the longitudinal axis of the box tool joint. If a visible gap exists between the straightedge and the tool joint, the OD must be measured using calipers. Compare the OD at the bevel to the OD 2 inches, ±1/2 inch away from the bevel. If the OD at the bevel is greater by 1/32 inch or more, the connection shall be rejected.

d. Primary Shoulder (Seal): Any pitting, interruptions, galls, nicks, washes, fins, or other conditions on the seal surface that are estimated to exceed 1/32 inch in depth or occupy more that 30% of the seal width at any given location are rejectable. No filing of the seal shoulders is permissible.

e. Secondary Shoulder (Mechanical Stop): The secondary shoulder is not a seal. This shoulder must be free of raised metal or other imperfections that could prevent proper make-up, driftability, or cause galling. Secondary shoulder damage can be repaired with a hand file which should be used to remove protruding metal.

f. Refacing: If refacing is necessary, the distance from the primary shoulder to the secondary shoulder must be maintained as required in the Dimensional 2 Inspection. Shoulder refacing must be performed in a machine repair shop. Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected. Drill pipe machined with X-Force™ design have benchmark on pin and box external shoulders to check whether the connector can be re-faced or not. As shown in Figure 3.11.16, pin benchmark is a groove cut inside the external shoulder that has the same depth as allowed re-facing depth (1/16 inch). When the pin benchmark is no

0.0625" New

Figure 3.11.16 Pin end benchmark for X-Force™ connection.

0.125" New

Figure 3.11.17 Box end benchmark for X-Force™ connection.

longer visible, it means that the connection cannot be re-faced anymore. On the box end, as shown in Figure 3.11.17, the benchmark is a recess on the counter-bore diameter of the external shoulder. This benchmark has twice the depth of allowed re-facing depth. When box benchmark depth is equal to or smaller than 1/16 inch, the box connection cannot be re-faced anymore. Measurement of box benchmark depth is also an indicator of how much re-facing was already carried out on the box part.

g. Threads: Thread surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter or that occupy more than 1-1/2 inch in length along the thread helix. Thread roots shall be free of damage that extends below the thread root radius. Material that protrudes beyond the thread profile should be removed using a round cornered triangle hand file or soft buffing wheel.

h. Thread Profile: The thread profile shall be verified along the full length of complete threads in two locations at least 90 degrees apart. The profile gage should mesh evenly in the threads and show normal contact. If the profile gage does not mesh evenly in the threads, lead measurements shall be taken.

i. Lead: If the profile gage indicates that thread stretch has occurred, lead shall be measured over a 2-inch interval. Thread stretch shall not exceed 0.006 inch over the 2-inch length.

j. Coating: X-Force™ should always have a phosphate coating (Mn or Zn) on both the pin and box thread and shoulder areas. If this coating is slightly worn in some areas it is acceptable, however if the coating is removed completely or if re-facing has been carried out, the connector requires re-coating with phosphate or with a Molybdenum Disulfide (MoS_2) repair kit (like Molykote® spray products).

k. Box Counterbore: The box counterbore radius shall be free of any sharp edged defects caused by poor handling or stabbing. Such defects must be removed by grinding prior to re-using the connection.

3.11.15 Command CET™ Connections

In addition to the Visual Connection requirements of paragraph 3.11.4, Command CET connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Preparation: All thread and make-up shoulder surfaces shall be cleaned sufficiently so that no residue of any kind can be wiped from the thread or shoulder surfaces with a clean rag. For CET, the threads shall be cleaned using a "soft wheel" or other non-abrasive method on the crests (or other buffing method).

b. Primary Shoulder (Seal): The seal surface shall be free of raised metal, corrosion deposits, pitting, or interruptions that are estimated to exceed 1/32 inch in depth or occupy more than 50% of the seal width or 25% of the circumference at any given location, detected visually or by rubbing a metal scale or fingernail across the surface. Raised metal may be removed by light filing as long as existing seal surface is not impacted.

c. Secondary Shoulder (Mechanical Stop): The secondary shoulder is not a sealing surface. Damage to this surface is not critical unless the damage interferes with the make-up, driftability, or torque capacity of the connection. Dents, scratches, and cuts do not affect this surface unless they affect the primary shoulder to secondary shoulder length of the connection. Filing may be used to repair material protrusions, which extend from the face. Connection length readings shall not be taken in damaged areas.

d. Refacing: If refacing is necessary, the distance from the primary shoulder to the secondary shoulder must be maintained as required in this procedure.

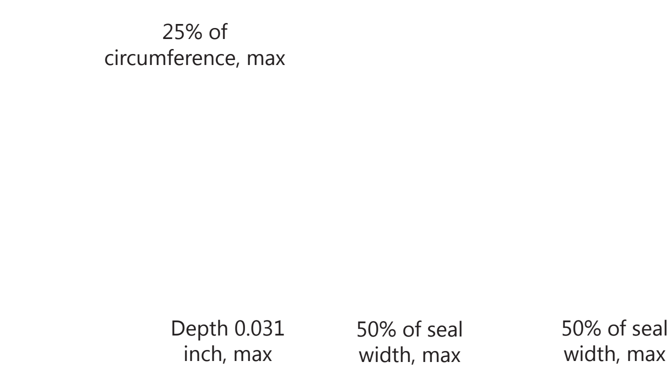


Figure 3.11.18 Acceptable and rejectable seal damage for CET.

- Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If the existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected.
- Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for CET connections are acceptable.
- During refacing, variability of face flatness and squareness may be introduced and shall be monitored. Check for squareness of the seal to the thread axis. Measure the recut seal face distance to the benchmark at two locations 90 degrees apart. If the difference is greater than 1/64 inch (0.016 inch) the connection shall be rethreaded.
- Connection lengths (pin and box) shall be verified after refacing is complete as per the criteria specified in 3.13.14g for boxes and 3.13.14j for pins.

e. Threads: Thread flank surfaces shall be free of damage that exceeds 1/16 inch in depth or 1/8 inch in diameter. Thread roots shall be free of damage that extends below the radius. Thread crests shall be free of damage that would interfere with make-up. Material that protrudes beyond the thread profile shall be removed using a round cornered triangle hand file or soft buffing wheel.

f. Thread Profile: A thread profile gauge shall be used to inspect the condition of the thread profile of both the pin and box for wear. The inspector shall look for visible light between the gauge and the thread flanks, roots, and crest. If the visible gap between the gauge and the thread crest is greater than 0.031 inch over 4 consecutive threads, or 0.060 inch over 2 consecutive threads, the connection shall be rejected. Visible gaps between the gauge and the thread flanks estimated to be more than 0.016 inch shall be cause for rejection. Any indication of stretching shall be evaluated by measuring the lead. All stretched pins shall be inspected for cracks.

g. Lead: If the thread profile gauge indicates that thread stretch has occurred, lead shall be measured over a 2-inch interval. Thread stretch shall not exceed 0.006 inch over the 2-inch length. Connections failing this inspection shall be inspected for cracks and, if none are found, rethreaded.

h. Box Swell: A straightedge shall be placed along the longitudinal axis of the box tool joint. If a visible gap exists between the straightedge and the tool joint, the OD must be measured using calipers. Compare the OD at the bevel to the OD 2 inches, ±1/2 inch away from the bevel. If the OD at the bevel is greater by 1/32 inch or more, the connection shall be rejected.

3.12 Dimensional 1 Inspection

3.12.1 Scope

This procedure covers the dimensional measurement of tool joint OD, ID, box shoulder width, tong space, and box swell for API and other similar, non-proprietary rotary shouldered connections. It is presumed that a Visual Connection Inspection will be performed in conjunction with this inspection. If the Visual Connection Inspection will not be performed, steps 3.11.4, 3.11.5.6, 3.11.5.9, and 3.11.5.10 shall be added to this procedure. Proprietary connections cannot be inspected using the Dimensional 1 procedure. Dimensional 2 shall apply for inspection of all proprietary connections.

3.12.2 Inspection Apparatus

A 12-inch metal rule graduated in 1/64 inch increments, a metal straightedge, and ID and OD calipers are required.

3.12.3 Preparation

a. All pipe shall be sequentially numbered.

b. The tool joints shall be clean so that nothing interferes with the measurement of any dimension.

3.12.4 Procedure and Acceptance Criteria

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured 3/8 inch ±1/8 inch from the shoulder. At least two measurements shall be taken spaced at intervals of 90 ±10 degrees. Box OD shall meet the requirements in Table 3.7.1, 3.7.26, or 3.8.1, as applicable.

b. Pin ID: The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch) and shall meet the requirements of Table 3.7.1, 3.7.26, or 3.8.1, as applicable.

c. Box Shoulder Width: The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore (excluding any ID bevel). The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.7.1, 3.7.26, or 3.8.1, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (excluding the OD bevel) shall meet the requirements of Table 3.7.1, 3.7.26, or 3.8.1, as applicable. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

e. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces as well as the end of the pin. Thread protectors shall be applied and secured using approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, the application of thread compound and protectors may be postponed until completion of the additional inspection.

3.13 Dimensional 2 Inspection

3.13.1 Scope

This procedure covers additional dimensional measurements beyond those required in Dimensional 1 inspection.

3.13.2 Inspection Apparatus

a. API and Similar Non-Proprietary Connections: A 12-inch metal rule graduated in 1/64 inch increments, a metal straightedge, a calibrated hardened and ground profile gage and ID and OD calipers are required. A calibrated lead gage and a calibrated standard lead template are also required. See section 2.21 for calibration requirements.

b. Grant Prideco HI TORQUE™, eXtreme™ Torque, uXT™, eXtreme™ Torque-M, TurboTorque™, TurboTorque-M™, Grant Prideco Double Shoulder™, uGPDS™, and Delta™ Connections: In addition to the requirements of paragraph 3.13.2a, a calibrated long stroke depth micrometer, a calibrated depth micrometer setting standards, and a calibrated extended jaw dial caliper are required. See section 2.21 for calibration requirements. A current field inspection drawing of the connection size to be inspected is recommended, which is available from Grant Prideco, their web site, or a licensed Grant Prideco machine shop. Dimensions provided in Tables 3.7.2–3.7.9, 3.7.13, and 3.8.2–3.8.7 are considered equivalent to the dimensions provided in Grant Prideco field inspection drawings at the time of this document's release. Responsibility for ensuring this document's dimensions are equivalent to Grant Prideco's latest revision field inspection drawing for the applicable connection remains with the inspector.

c. Grant Prideco VX™, EIS™, TM2™, and XF™ Connections: In addition to the requirements of paragraph 3.13.2a, a calibrated long stroke depth micrometer and calibrated depth micrometer setting standards are required. See section 2.21 for calibration requirements.

d. Hydril Wedge Thread™ Connections: In addition to the requirements of paragraph 3.13.2a, a calibrated ID micrometer and setting standard for the ID micrometer are also required. See section 2.21 for calibration requirements.

e. NK DSTJ™ and Hilong HLIDS, HLMT, HLST, and HLIST Connections: In addition to the requirements of paragraph 3.13.2a, a calibrated depth Vernier caliper is required. See section 2.21 for calibration requirements.

f. DP-Master DPM-DS, DPM-MT®, DPM-ST®, and DPM-HighTorque Series Connections: In addition to the requirements of paragraph 3.13.2a, a calibrated digital long stroke depth micrometer/gauge or Vernier gauge fitted with a wide depth base attachment is required. See section 2.21 for calibration requirements.

g. Command CET™ Connections: In addition to the requirements of 3.13.2a, a calibrated long stroke depth micrometer and calibrated setting standards for the depth micrometer are required. See section 2.21 for calibration requirements. A current field inspection dimension drawing and datasheet for the connection being inspected is also required, which is available from Command Tubular Products. The dimensions provided in Table 3.7.25 are considered equivalent to the dimensions provided in the field inspection dimensions drawings at the time of this document's release. The responsibility for ensuring this document's dimensions are equivalent to the latest field inspection dimensions drawings for the applicable connection remains with the inspector.

3.13.3 Preparation

a. All pipe shall be sequentially numbered.

b. The tool joints shall be clean so that nothing interferes with any measurement.

3.13.4 Procedure and Acceptance Criteria for API and Similar Non-Proprietary Connections

These features are illustrated in Figure 3.13.1. It is presumed that a Visual Connection Inspection will be performed in conjunction with this inspection. If the Visual Connection Inspection will not be performed, steps 3.11.4b-e, 3.11.5.6, 3.11.5.9, and 3.11.5.10 shall be added to this procedure.

a. Box Outside Diameter (OD): The OD of the tool joint box shall be measured 3/8 inch ±1/8 inch from the shoulder. At least two measurements shall be taken spaced at intervals of 90 ±10 degrees. Box OD shall meet the requirements in Table 3.7.1, 3.7.26, or 3.8.1, as applicable.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch) and shall meet the requirements of Table 3.7.1, 3.7.26, or 3.8.1, as applicable.

c. Box Shoulder Width: The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore (excluding any ID bevel). The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.7.1, 3.7.26, or 3.8.1, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (excluding the OD bevel) shall meet the requirements of Table 3.7.1, 3.7.26, or 3.8.1, as applicable. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

e. Box Counterbore Depth: The counterbore depth shall be measured (including any ID bevel). Counterbore depth shall not be less than 9/16 inch.

f. Box Counterbore Diameter: The box counterbore diameter shall be measured as near as possible to the shoulder (but excluding any ID bevel or rolled metal) at diameters 90 degrees ±10 degrees apart. Counterbore diameter shall not exceed the maximum counterbore dimension shown in Table 3.7.1, 3.7.26, or 3.8.1, as applicable.

g. Bevel Diameter: The bevel diameter on both the box and pin shall be within the minimum and maximum values given in Table 3.7.1, 3.7.26, or 3.8.1, as applicable.

h. Pin Neck Length: Pin neck length (the distance from the 90 degree pin shoulder to the intersection of the flank of the first full depth thread with the pin neck) shall be measured. Pin neck length shall not exceed 9/16 inch.

i. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free

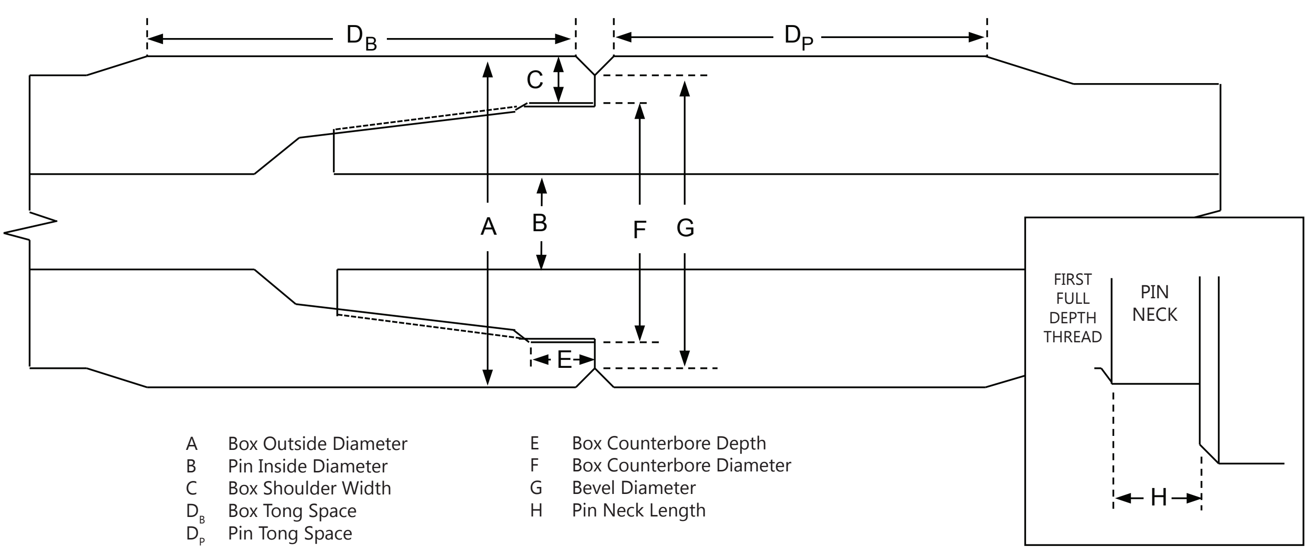


Figure 3.13.1 Tool joint dimensions for API and similar non-proprietary connections.

of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

3.13.5 Procedure and Acceptance Criteria for Grant Prideco HI TORQUE™, eXtreme™ Torque, uXT™, eXtreme™ Torque-M, TurboTorque™, and TurboTorque-M™ Connections

These features are illustrated in Figure 3.13.2. In addition to the Visual Connection requirements of 3.11.6 and 3.11.7, Grant Prideco™ HI TORQUE™, eXtreme™ Torque, uXT™, eXtreme™ Torque-M, TurboTorque™, and TurboTorque-M™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Box Outside Diameter (OD): For Grant Prideco HI TORQUE™ and eXtreme™ Torque-M connections, the OD of the tool joint box shall be measured at a distance of 2 inches ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.2, 3.7.4, or 3.8.2, as applicable.

For Grant Prideco™ eXtreme™ Torque and uXT™ sizes 43 and smaller (e.g. XT43), the OD of the tool joint box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. For sizes 46 and larger, the OD of the tool joint box shall be measured at a distance of 2 inches ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.3, 3.7.8, 3.8.3, or 3.8.6, as applicable.

For Grant Prideco™ TurboTorque™ and TurboTorque-M™ connections, the OD of the tool joint box shall be measured at a distance of 5/8 inch to 7/8 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.6–3.7.7 or 3.8.4–3.8.5, as applicable.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest to the shoulder (±1/4 inch) and referenced against the values in Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable. The pin ID is used to define other inspection dimensions.

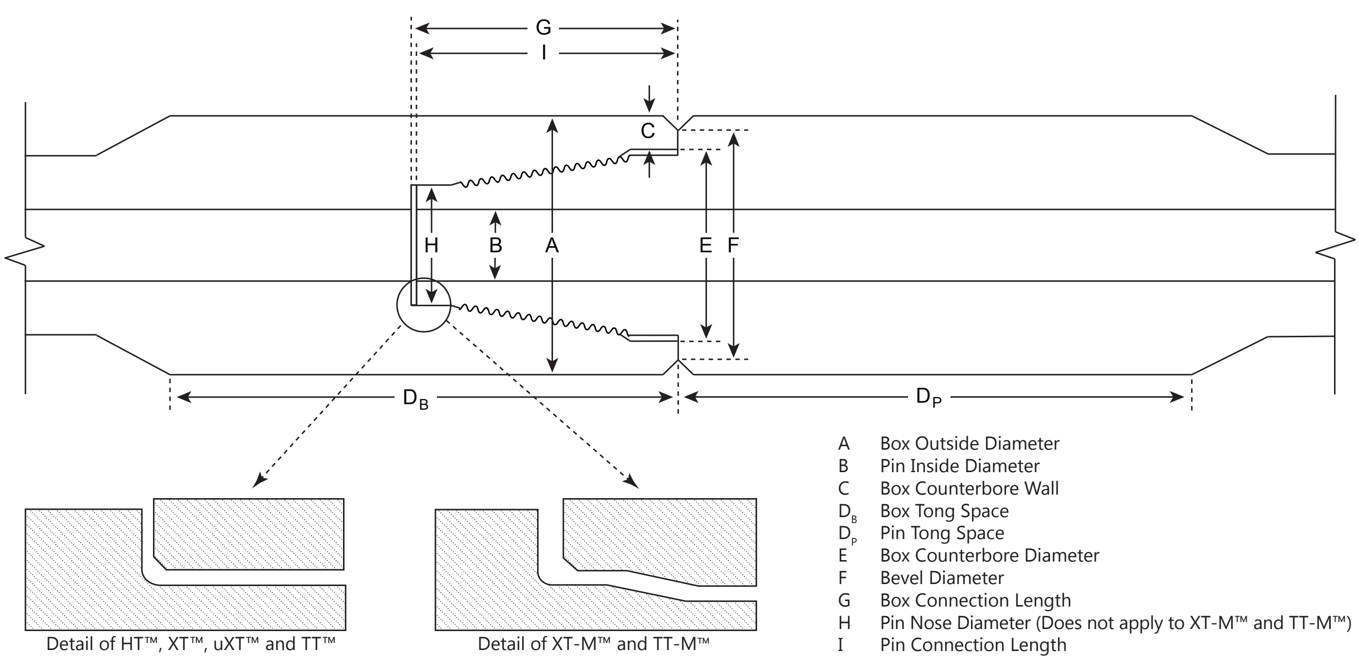


Figure 3.13.2 Tool joint dimensions for Grant Prideco HI TORQUE™, eXtreme™ Torque, uXT™, XT-M™, TurboTorque™, TurboTorque-M™, and Delta™ connections.

c. Box Counterbore (CBore) Wall Thickness: The box CBore wall thickness shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the wall thickness from this extension to the counterbore. The CBore wall thickness shall be measured at its point of minimum thickness. Any reading that does not meet the minimum CBore wall thickness requirement in Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable. If the diameter exceeds these limits, the connection shall be repaired by rethreading.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable. Refer to 3.13.5k for repair of connection length non-conformances.

h. Pin Nose Diameter: For HT™, XT™, uXT™, TT™ connections, the outside diameter of the pin nose shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.7.2, 3.7.3, 3.7.6, 3.7.8, 3.8.2, 3.8.3, 3.8.4, or 3.8.6, as applicable. Nonconforming connections shall be rethreaded. This dimension is not used to determine acceptance or rejection for XT-M™ or TT-M™ connections, but to test for pin nose swell and the need to verify connection length.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.2–3.7.4, 3.7.6–3.7.8, or 3.8.2–3.8.6, as applicable. Refer to 3.13.5k for repair of connection length non-conformances.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. Refacing: For HT™, XT™, uXT™, and TT™, in addition to torque shoulder damage, refacing may be required due to connection length discrepancies. Repair of connection length non-conformances may be accomplished as noted below.
   - If the box connection length exceeds the specified dimension, repair by refacing the primary shoulder.
   - If the box connection length is less than the specified dimension, repair by refacing the secondary shoulder.
   - If the pin connection length exceeds the specified dimension, repair by refacing the secondary shoulder (pin nose).
   - If the pin connection length is less than the specified dimension, repair by refacing the primary shoulder.
   - Connection lengths (pin and box) must be verified as per the criteria specified in this procedure.
   - Refacing limits are the same as for repair of damaged shoulders specified in 3.11.6.

   Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for Grant Prideco connections are acceptable. A minimum of four measurements shall be taken when using a portable field refacing unit. Variability of face flatness and squareness may be introduced and should be monitored. If any measurement is found to be outside the drawing limits, the connection shall be rejected.

The field refacing method addressed in this procedure does not apply to the XT-M™ and TT-M™ connection or any connection with radial interference metal-to-metal seals. Such connections require shop redressing in a licensed Grant Prideco facility.

1. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.13.6 Procedure and Acceptance Criteria for Grant Prideco™ Double Shoulder and uGPDS™ Connections

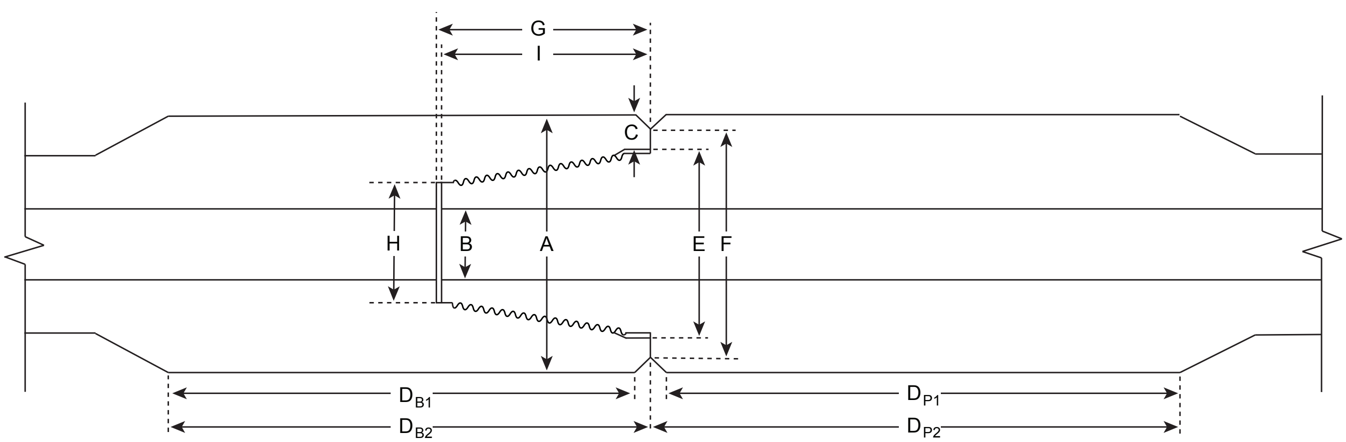
These features are illustrated in Figure 3.13.3. In addition to the Visual Connection requirements of 3.11.6, Grant Prideco™ Double Shoulder and uGPDS™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.5 or 3.7.9, as applicable.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest to the shoulder (±1/4 inch) and referenced against the values in Table 3.7.5 or 3.7.9, as applicable. The pin ID is used to define other inspection dimensions.

c. Box Shoulder Width (also referred to as Box Counterbore (CBore) Wall Thickness): The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore. The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width



A	Box Outside Diameter	D_{P2}	Pin Tong Space (GPDS & uGPDS)
B	Pin Inside Diameter	E	Box Counterbore Diameter
C	Box Shoulder Width	F	Bevel Diameter
D_{B1}	Box Tong Space	G	Box Connection Length
D_{B2}	Box Tong Space (GPDS & uGPDS)	H	Pin Nose Diameter
D_{P1}	Pin Tong Space	I	Pin Connection Length

Figure 3.13.3 Tool joint dimensions for Grant Prideco Double Shoulder™, uGPDS™, Express™, EIS™, TM2™, X-Force™, and Command CET™ connections.

requirement in Table 3.7.5 or 3.7.9, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.7.5 or 3.7.9, as applicable. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.7.5 or 3.7.9, as applicable. If the diameter exceeds these limits, the connection shall be repaired by rethreading.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.7.5 or 3.7.9, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.5 or 3.7.9, as applicable. Refer to 3.13.6k for repair of connection length non-conformances.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.7.5 or 3.7.9, as applicable.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.5 or 3.7.9, as applicable. Refer to 3.13.6k for repair of connection length non-conformances.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. Refacing: In addition to torque shoulder damage, refacing may be required due to connection length discrepancies. Repair of connection length non-conformances may be accomplished as noted below.

- If the box connection length exceeds the specified dimension, repair by refacing the primary shoulder.
- If the box connection length is less than the specified dimension, repair by refacing the secondary shoulder.
- If the pin connection length exceeds the specified dimension, repair by refacing the secondary shoulder (pin nose).
- If the pin connection length is less than the specified dimension, repair by refacing the primary shoulder.
- Connection lengths (pin and box) must be verified as per the criteria specified in this procedure.
- Refacing limits are the same as for repair of damaged shoulders specified in 3.11.6.

Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for Grant Prideco connections are acceptable. A minimum of four measurements shall be taken when using a portable field refacing unit. Variability in face flatness and squareness may be introduced and should be monitored. If any measurement is found to be outside the drawing limits, the connection shall be rejected.

l. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces, and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.13.7 Procedure and Acceptance Criteria for Grant Prideco Express™, Grant Prideco EIS™, and Grant Prideco TM2™ Connections

The connections may be abbreviated as follows: Grant Prideco Express as VX™, Grant Prideco EIS as EIS™, and Grant Prideco TM2 as TM2™. These features are illustrated in Figure 3.13.3. In addition to the Visual Connection requirements of 3.11.8, as applicable, VX, EIS, and TM2 connections shall meet the following requirements.

Note: Connections manufactured as VAM CDS connections have been determined by Grant Prideco to be interchangeable with GPDS connections. As such, any CDS connections shall be inspected according to the procedures outlined for GPDS connections. When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured 2 inches ±1/4 inch from the primary shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.10–3.7.12, as applicable.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch) and shall meet the requirements in Table 3.7.10–3.7.12, as applicable.

c. Box Shoulder Width: The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore. The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.7.10–3.7.12, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space shall meet the requirements of Table 3.7.10–3.7.12, as applicable. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured and shall meet the requirements shown in Table 3.7.10–3.7.12, as applicable.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.7.10–3.7.12, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.10–3.7.12, as applicable. If the connection length exceeds the specified criteria, repair may be made by refacing the primary shoulder. If the connection length is less than the specified criteria, refacing the secondary shoulder may be adequate to repair the connection. Refacing limits are the same as that performed for damaged shoulder faces.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured and shall meet the requirements shown in Table 3.7.10–3.7.12, as applicable.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.10–3.7.12, as applicable. If the connection length exceeds the specified criteria, repair may be made by refacing the secondary shoulder (pin nose). If the connection length is less than the specified criteria, refacing the primary shoulder may be adequate to repair the connection. Refacing limits are the same as that performed for damaged shoulder faces.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces, and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.13.8 Procedure and Acceptance Criteria for Hydril Wedge Thread™ Connections

These features are illustrated in Figure 3.13.4. In addition to the Visual Connection requirements of 3.11.9, Hydril WT™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured 2 inches ±1/4 inch from the shoulder. At least two measurements shall be taken spaced at intervals of 90 ±10 degrees. Box OD measurements are for reference data only.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch). Pin ID measurements are for reference data only.

c. Tong Space: Box and pin tong space (excluding the OD bevel) shall meet the requirements of Table 3.7.20. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

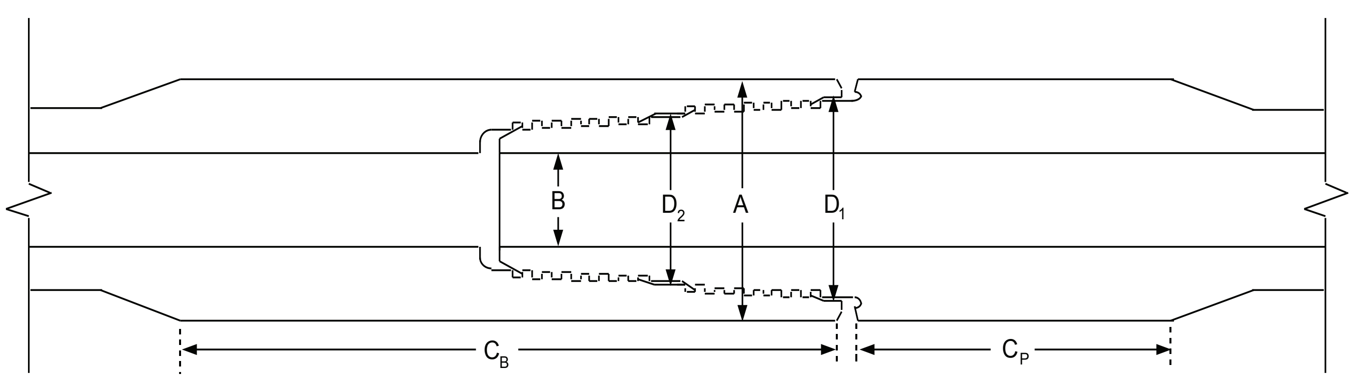
d. Box Counterbore Diameter: Measure the Cbore diameter at the face of the box, D_1, and the counterbore diameter immediately behind the large step thread, D_2. Measurements shall be taken at diameters 90 degrees ±10 degrees apart. Counterbore diameter shall not exceed the maximum Cbore dimension shown in Table 3.7.20.

e. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

3.13.9 Procedure and Acceptance Criteria for NK DSTJ™ Connections

These features are illustrated in Figure 3.13.5. In addition to the Visual Connection requirements in 3.11.10, NK DSTJ™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.



A Box Outside Diameter
B Pin Inside Diameter
C_B Box Tong Space
C_P Pin Tong Space
D_1 Box Counterbore Diameter at Box Face
D_2 Box Counterbore Diameter Behind Large Step Thread

Figure 3.13.4 Tool joint dimensions for Hydril Wedge Thread™ connections.

a. Box Outside Diameter (OD): The OD of the tool joint box shall be measured approximately 1 inch from the shoulder. At least two measurements shall be taken spaced at intervals of 90 ±10 degrees. Box OD shall meet the requirements in Table 3.7.15.

b. Pin Inside Diameter (ID): The pin ID shall be measured approximately 1 inch from the shoulder and shall meet the requirements of Table 3.7.15.

c. Box Shoulder Width: The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore (excluding any ID bevel). The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.7.15 shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (excluding the OD bevel) shall meet the requirements of Table 3.7.15. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

e. Box Counterbore Depth: The counterbore depth shall be measured (including any ID bevel). Counterbore depth shall not be less than 9/16 inch.

f. Box Counterbore Diameter: The box counterbore diameter shall be measured as near as possible to the shoulder (but excluding any ID bevel or rolled metal) at diameters 90 degrees ±10 degrees apart. Counterbore diameter shall not exceed the maximum counterbore dimension shown in Table 3.7.15.

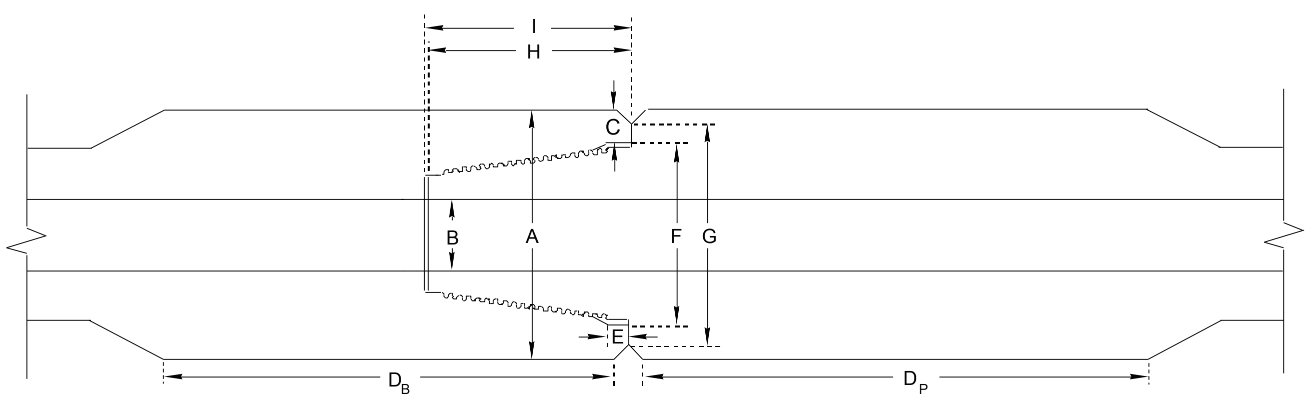
g. Bevel Diameter: The bevel diameter on both the box and pin shall be within the minimum and maximum values given in Table 3.7.15.

h. Pin Length: The length of the pin shall be measured using a depth micrometer and the data recorded on the inspection sheet.

i. Box Length (depth of box): The length of the box shall be measured using a depth micrometer and the data recorded on the inspection sheet. Both pin and box lengths shall meet the required min and max values in the table below.

Connection	Depth of Box		Length of Pin	
	Min	Max	Min	Max
DSTJ NC38	4.404	4.415	4.396	4.406
DSTJ NC40	4.915	4.927	4.907	4.918
DSTJ NC46	4.915	4.927	4.907	4.918
DSTJ NC50	4.915	4.927	4.907	4.918
DSTJ 5-1/2FH	5.427	5.439	5.419	5.430

j. Shoulder Flatness: Box shoulder flatness shall be verified by placing a straightedge across a diameter of the tool joint face and rotating the straightedge at least 180 degrees along the plane of the shoulder. Any visible gaps shall be cause for rejection. The procedure



A	Box Outside Diameter	E	Box Counterbore Depth
B	Pin Inside Diameter	F	Box Counterbore Diameter
C	Box Shoulder Width	G	Bevel Diameter
D_B	Box Tong Space	H	Pin Connection Length
D_P	Pin Tong Space	I	Box Connection Length

Figure 3.13.5 Tool joint dimensions for NK DSTJ™ connection.

shall be repeated on the pin with the straightedge placed across a chord of the shoulder surface. Any visible gaps between the straightedge and the shoulder surface shall be cause for rejection.

k. Thread Compound and Protectors: A good connection shall be well doped with specified compound and clean thread protectors that shall be installed wrench tight and sealed. Damaged or deformed thread protectors should not be installed. All connections re-threaded or re-faced shall be phosphate or copper plated. Manganese phosphate is preferable.

3.13.10 Procedure and Acceptance Criteria for Hilong Interchangeable Double Shoulder (HLIDS™), Hilong Modified High-Torque (HLMT™), Hilong Super High-Torque (HLST™), and Hilong Improved Super High-Torque (HLIST™) Connections

These features are illustrated in Figure 3.13.6. In addition to the Visual Connection requirements of 3.11.11, HLIDS, HLMT, HLST, and HLIST connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Box Outside Diameter (OD): The OD of the tool joint box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.16–3.7.19, as applicable.

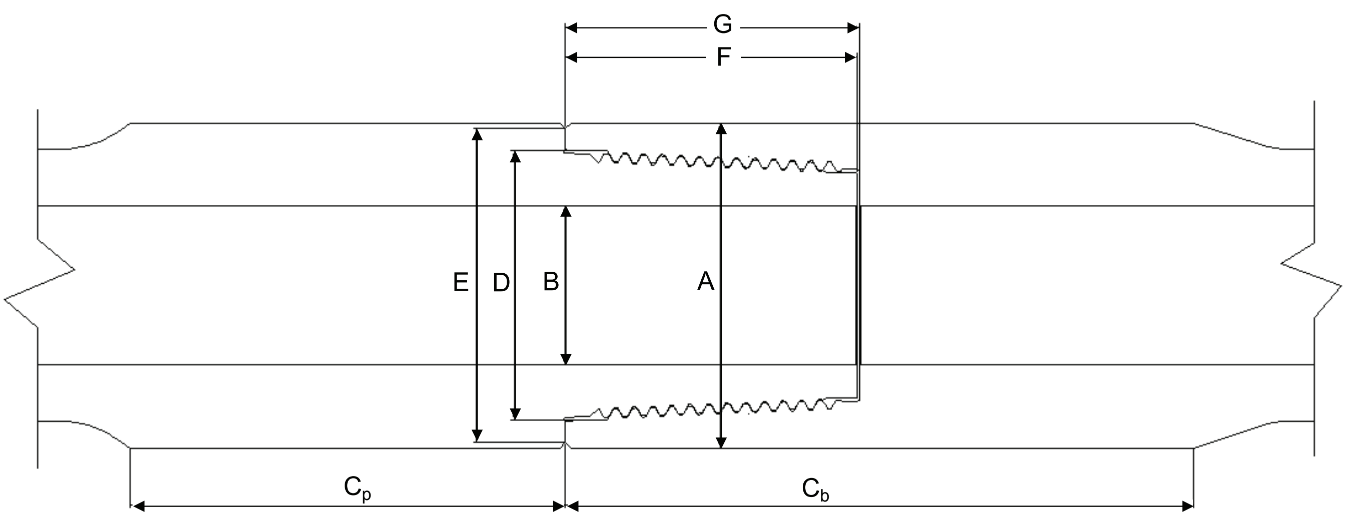
b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch) and shall meet the requirements in Table 3.7.16–3.7.19, as applicable.

c. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.7.16–3.7.19, as applicable. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

d. Box Counterbore Diameter: The box counterbore diameter shall be measured and shall meet the requirements shown in Table 3.7.16–3.7.19, as applicable.

e. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.7.16–3.7.19, as applicable.

f. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.16–3.7.19, as applicable. If the connection length exceeds the specified criteria,



A	Box Outside Diameter	D	Box Counterbore Diameter
B	Pin Inside Diameter	E	Bevel Diameter
C_b	Box Tong Space	F	Pin Connection Length
C_p	Pin Tong Space	G	Box Connection Length

Figure 3.13.6 Tool joint dimensions for Hilong HLIDS, HLMT, HLST, and HLIST connections.

repair may be made by refacing the secondary shoulder (pin nose). If the connection length is less than the specified criteria, refacing the primary shoulder may be adequate to repair the connection. Refacing limits are the same as for damaged shoulder faces.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.16–3.7.19, as applicable. If the connection length exceeds the specified criteria, repair may be made by refacing the primary shoulder. If the connection length is less than the specified criteria, refacing the secondary shoulder may be adequate to repair the connection. Refacing limits are the same as for damaged shoulder faces.

h. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

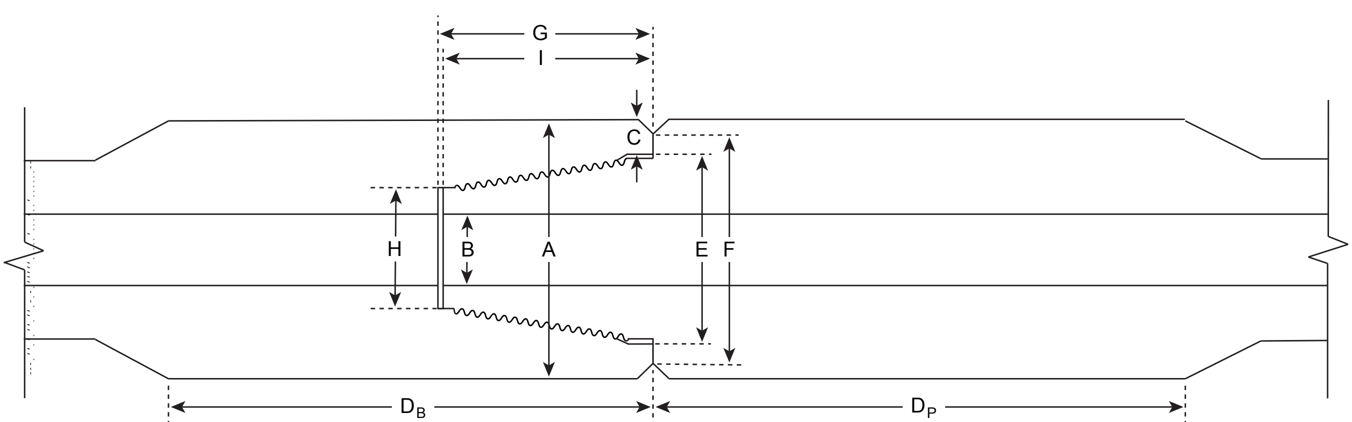
i. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.13.11 Procedure and Acceptance Criteria for DP-Master DPM-DS, DPM-MT®, DPM-ST®, and DPM-HighTorque Series Connections

These features are illustrated in Figure 3.13.7. In addition to the Visual Connection requirements of 3.11.12, connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Box Outside Diameter: The outside diameter of the box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. The box outer diameter must meet the requirements in Tables 3.7.21–3.7.24, as applicable.



A	Box Outside Diameter	E	Box Counterbore Diameter
B	Pin Inside Diameter	F	Bevel Diameter
C	Box Counterbore Wall	G	Box Connection Length
D_B	Box Tong Space	H	Pin Nose Diameter
D_P	Pin Tong Space	I	Pin Connection Length

Figure 3.13.7 Tool joint dimensions for DPM-DS, DPM-MT®, DPM-ST®, and DPM-HighTorque connections.

b. Pin Inside Diameter: Visually check the inside diameter for wear, erosion, or other conditions affecting the diameter. Measure the inside diameter with the calipers at any area of the inside-diameter increase and under the last thread nearest the shoulder (±1/4 inch). The pin inside diameter must meet the requirements in Tables 3.7.21–3.7.24, as applicable.

c. Minimum Counterbore Wall: The box counterbore wall thickness shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface and then measuring the wall thickness from this extension to the counterbore. The counterbore wall thickness shall be measured at its point of minimum thickness. The box counterbore wall thickness must meet the requirements in Tables 3.7.21–3.7.24, as applicable.

d. Tong Space: There is a minimum tong space (including the OD bevel) requirement of 6 inches for pins and a minimum box tong space equal to the connection length +1 inch or 8 inch minimum, whichever is greater. Tong space measurements on hardfaced components shall be made from the primary shoulder to edge of the hardfacing. The box and pin tong space must meet the requirements in Tables 3.7.21–3.7.24.

e. Box Counterbore Diameter: The inside diameter of the box counter bore shall be verified. The counterbore diameter has to be measured at two places approximately 90 degrees apart. The measurement is made from the projected intersection of the counter bore with the box face rather than to the internal bevel. Diameters shall not exceed the values listed in Tables 3.7.21–3.7.24, as applicable. Additionally, to test for box swell, the box counterbore diameter must not exceed the aforementioned requirements.

f. Bevel Diameter: Bevel diameter of the box and pin shall be verified to maintain adequate stresses in the connection after application of make-up torque. If the outside diameter is less than the bevel diameter, this bevel diameter is void and 1/32 inch × 45 degree taper becomes effective. The bevel diameter must meet the requirements in Tables 3.7.21–3.7.24, as applicable.

g. Box Connection Length: Measurements shall be taken using the digital depth micrometer/gauge or digital Vernier gauge fitted with a wide depth base attachment. The distance between the primary and secondary make-up shoulders shall be verified in two locations 180 degrees apart. (See Figure 3.13.8 for details.) Field re-facing is allowed but not recommended. Machine shop re-facing is preferred. Re-facing limits are the same as for repair of damaged shoulders. Both the primary seal and the secondary shoulder shall be re-faced simultaneously to ensure that proper connection length is maintained. The box connection length must meet the requirements in Tables 3.7.21–3.7.24, as applicable.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be verified. To test for pin nose swell, the pin nose diameter must meet the requirements in the Tables 3.7.21–3.7.24, as applicable.

i. Pin Connection Length: Measurements shall be taken using the digital depth micrometer/gauge or digital Vernier gauge fitted with a wide depth base attachment. The distance between the primary and secondary makeup shoulders shall be verified in two locations 180 degrees apart. (See Figure 3.13.9 for details.) Field re-facing is allowed but not recommended. Machine shop re-facing is preferred. Re-facing limits are the same as for repair of damaged shoulders. Both the primary seal and the secondary shoulder shall be re-faced simultaneously to ensure that proper connection length is maintained. The pin connection length must meet the requirements in Tables 3.7.21–3.7.24, as applicable.

j. Protecting Connection at Post Inspection: The connections shall be coated with storage compound after inspection to avoid corrosion unless the drill pipe is run immediately. Appropriate thread protectors that

Figure 3.13.8 Two methods of box connection length inspection.

Figure 3.13.9 Two methods of pin connection length inspection.

cover the whole connection shall be fitted to prevent accidental impacts from foreign objects.

k. Lathe Style Re-threading and Re-facing: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field inspection is completed. This operation shall be performed by a competent and approved repair facility.

3.13.12 Procedure and Acceptance Criteria for Grant Prideco™ Delta™ Connections

These features are illustrated in Figure 3.13.2. In addition to the Visual Connection requirements of 3.11.13, the Grant Prideco™ Delta™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Box Outside Diameter (OD): The OD of the tool joint box shall be measured at a distance 5/8 inch (±1/4 inch) from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.13 or 3.8.7, as applicable.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest to the shoulder (±1/4 inch) and referenced against the values in Table 3.7.13 or 3.8.7, as applicable. The pin ID is used to define other inspection dimensions.

c. Box Counterbore (CBore) Wall Thickness: The box CBore wall thickness shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the wall thickness from this extension to the counterbore. The CBore wall thickness shall be measured at its point of minimum thickness. Any reading that does not meet the minimum CBore wall thickness requirement in Table 3.7.13 or 3.8.7, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.7.13 or 3.8.7, as applicable. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured at two locations 90 degrees apart. The diameters shall meet the requirements in Table 3.7.13 or 3.8.7, as applicable. If the limits are exceeded, the connection shall be rethreaded.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.7.13 or 3.8.7, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. Measurements shall not be taken in areas where surface condition prevents accurate measurements. This distance shall meet the requirements of Table 3.7.13 or 3.8.7, as applicable. Refer to 3.13.12k for repair of connection length non-conformances.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.7.13 or 3.8.7, as applicable. If the diameter exceeds the specified limit, the connection shall be repaired by rethreading.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. Measurements shall not be taken in areas where surface condition prevents accurate measurements. This distance shall meet the requirements of Table 3.7.13 or 3.8.7, as applicable. Refer to 3.13.12k for repair of connection length non-conformances.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. Refacing: Repair by refacing may only be used to attempt to repair shoulder damage less than or equal to 3/64 inch in depth, and/or connection length discrepancies that are less than 1/32 inch out of specification.

- As is typical of the rotary shoulder connection reface process, a maximum of 1/32 inch of material may be removed from the primary make-up shoulder during each refacing operation, after which the joint shall be placed back into service prior to performing any additional refacing repair.
- The cumulative total material removal from the primary make-up shoulder for all refacing operations shall not exceed 3/32 inch before rethreading is required.
- Repair by refacing methods shall only remove sufficient material to repair the damage. However, when damage is less than 1/32 inch deep, all damage shall be removed from the primary make-up shoulder.
- After the maximum reface allowance is met, any remaining damage on the primary make-up shoulder shall not be deeper than 1/64 inch and shall meet all other requirements of this procedure.
- If the connection cannot be brought back within the acceptable limits outlined in this procedure without removing more than 1/32 inch of material from the primary shoulder, then rethreading shall be required.
- Both the primary make-up shoulder and secondary make-up shoulder shall be skimmed/machined during a refacing operation for all double shoulder connections.
- Machine refacing in a lathe is the preferred method.
- If the portable field refacing unit method is used, the variability in face flatness and squareness might be introduced and shall be monitored by taking the connection length measurements in a minimum of four locations, equally spaced around the circumference. Each measurement shall be within the limits of the "Field Inspection Dimensions" drawing, latest revision.
- GPMark™ + Benchmark: After refacing repair, a minimum length of 1/16 inch (0.063 inch) shall remain on the box refacing benchmark, and 3/16 inch maximum (0.188 inch) shall remain on the pin refacing benchmark. Rethreading is required if excess material is removed. See Figure 3.11.14.
- Xmark™ + Benchmarks: After refacing repair, a visible step on the benchmark shall remain on the primary shoulder. The step is a necessary indicator that a benchmark is still present. Rethreading is required if there is no visible benchmark. See Figure 3.11.15.

l. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.13.13 Procedure and Acceptance Criteria for Grant Prideco X-Force™ Connections

The connection may be abbreviated as XF™. These features are illustrated in Figure 3.13.3. In addition to the Visual Connection requirements of 3.11.14, XF™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured 2 inches ±1/4 inch from the primary shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.7.14.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch) and shall meet the requirements in Table 3.7.14.

c. Box Shoulder Width: The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore. The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.7.14 shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space shall meet the requirements of Table 3.7.14. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured and shall meet the requirements shown in Table 3.7.14. Since the box benchmark is a recess on the counter bore diameter of the external shoulder, be sure to measure the box end counter bore diameter and not the box benchmark diameter.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.7.14.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 90 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.14. If the connection length exceeds the specified criteria, repair may be made by refacing the primary shoulder. If the connection length is less than the specified criteria, refacing the secondary shoulder may be adequate to repair the connection. Refacing limits are the same as that performed for damaged shoulder faces. See Figure 3.13.10.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured and shall meet the requirements shown in Table 3.7.14.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 90 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.7.14. If the connection length exceeds the specified criteria, repair may be made by refacing the secondary shoulder (pin nose). If the connection length is less than the specified criteria, refacing the primary shoulder may be adequate to repair the connection. Refacing limits are the same as that performed for damaged shoulder faces. See Figure 3.13.11.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound (or a storage compound, if applicable) over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Only thread protectors specially designed for X-Force™ connectors may be used. These protectors cover the whole thread section and box counter bore. Sufficient grease should be applied to prevent the ingress of water into the connection. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may

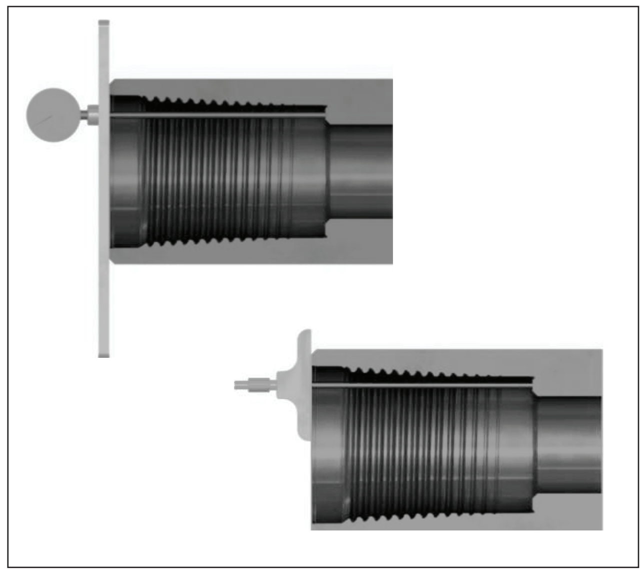


Figure 3.13.10 Two methods of box connection length inspection for XF™.

Figure 3.13.11 Two methods of pin connection length inspection for XF™.

be postponed until completion of the additional inspection.

k. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces, and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.13.14 Procedure and Acceptance Criteria for Command CET™ Connections

These features are illustrated in Figure 3.13.3. In addition to the Visual Connection requirements of 3.11.15, CET connections shall meet the following requirements.

NOTE: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Box Outside Diameter: The outside diameter of the box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum diameter shall meet the requirements Table 3.7.25.

b. Pin Inside Diameter: The pin ID shall be measured under the last thread nearest the secondary shoulder (±1/4 inch) and shall meet the requirements in Table 3.7.25.

c. Box Shoulder Width (also referred to as Box Counterbore (CBore) Wall Thickness): The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore. The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.7.25 shall cause the tool joint to be rejected.

d. Tong Space: The box and pin tong space shall be measured and shall meet the requirements of Table 3.7.25. Tong space shall be measured from the seal face to the closest edge of the hardbanding, if hardbanding is present. If there is no hardbanding then the tong space is measured from the seal face to the end of the tool joint.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured at two locations approximately 90 degrees apart. The diameters shall meet the requirements in Table 3.7.25. If the measurements are outside of the specified tolerance, the connection shall be rethreaded.

f. Bevel Diameter: Bevel diameter on both box and pin connections shall be measured and shall meet the requirements in Table 3.7.25.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be verified in 4 locations approximately 90 degrees apart. This distance shall be compared to the box length requirements in Table 3.7.25 to determine acceptance or rejection. If the connection length exceeds the specified dimension, repair may be made by re-facing the primary make-up shoulder. If the connection length is less than the specified dimension, re-facing the secondary make-up shoulder may be adequate to repair this condition. Re-facing limits are the same as for repair of damaged shoulders. Final connection length (after any repair) shall meet the requirements in Table 3.7.25.

h. Pin Cylinder Diameter: This is not required for Command Tubular Product connections.

i. Pin Nose Diameter: The outside diameter of the pin nose shall be measured at 2 locations 90 degrees apart and shall meet the requirements shown in Table 3.7.25. If the diameter exceeds the specified limit, the connection shall be repaired by rethreading.

j. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be verified in 4 locations approximately 90 degrees apart. This distance shall be compared to the requirement in Table 3.7.25 to determine acceptance or rejection. If the connection length exceeds the specified dimension, repair may be made by re-facing the secondary make-up shoulder (pin nose). If the connection length is less than the specified dimension, re-facing the primary make-up shoulder may be adequate to repair this condition. Re-facing limits are the same as for repair of damaged shoulders.

k. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection. If threads and shoulders are repaired by filing or refacing, an anti-galling treatment such as copper sulfate or phosphate coating shall be applied to the affected areas.

l. Refacing: In addition to torque shoulder damage, refacing may be required due to connection length discrepancies. If refacing is necessary, the distance from the primary shoulder to the secondary shoulder must be maintained as required in this procedure.

- Refacing limits are 1/32 inch on any one removal and 1/16 inch cumulatively. If the existing benchmarks indicate that the shoulder has been refaced beyond the maximum, the connection shall be rejected.
- Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for CET connections are acceptable.
- During refacing, variability of face flatness and squareness may be introduced and shall be monitored. Check for squareness of the seal to the thread axis. Measure the recut seal face distance to the benchmark at two locations 90 degrees apart. If the difference is greater than 1/64 inch (0.016 inch) the connection shall be rethreaded.
- Connection lengths (pin and box) shall be verified after refacing is complete as per the criteria specified in 3.13.14g for boxes and 3.13.14j for pins.

m. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.14 Dimensional 3 Inspection

3.14.1 Scope

This procedure covers the dimensional inspection of used rotary shouldered connections on drill collars, BHA components, and Heavy Weight Drill Pipe. The dimensions are illustrated in Figures 3.13.1-3.13.3, 3.14.1, and 3.14.2.

3.14.2 Inspection Apparatus

a. API and Similar Non-Proprietary Connections: A 12-inch metal rule graduated in 1/64 inch increments, a metal straightedge, a calibrated hardened and ground profile gage, and ID and OD calipers are required. A calibrated lead gage and a calibrated standard lead template are also required. See section 2.21 for calibration requirements.

b. Grant Prideco HI TORQUE™, eXtreme™ Torque, uXT™, XT-M™, Delta™, Grant Prideco Double Shoulder™, and uGPDS™ Connections: In addition to the requirements of paragraph 3.14.2a, a calibrated long stroke depth micrometer, depth micrometer setting standards and calibrated extended jaw dial caliper are required. See section 2.21 for calibration requirements. A current field inspection drawing of the connection size to be inspected is recommended, which is available from Grant Prideco, their web site or a licensed Grant Prideco machine shop. Dimensions provided in Tables 3.10.2–3.10.8 are considered equivalent to the dimensions provided in Grant Prideco field inspection drawings at the time of this document's release. Responsibility for ensuring this document's dimensions are equivalent to Grant Prideco's latest revision field inspection drawing for the applicable connection remains with the inspector.

c. Grant Prideco Express™ and Grant Prideco EIS™ Connections: In addition to the requirements of paragraph 3.14.2a, a calibrated long stroke depth micrometer and depth micrometer setting

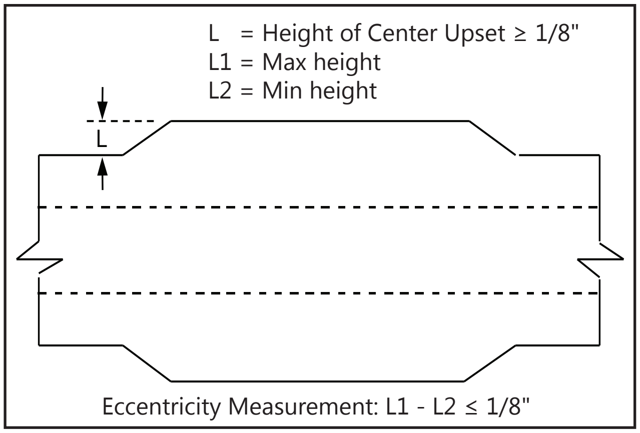


Figure 3.14.1 HWDP center upset.

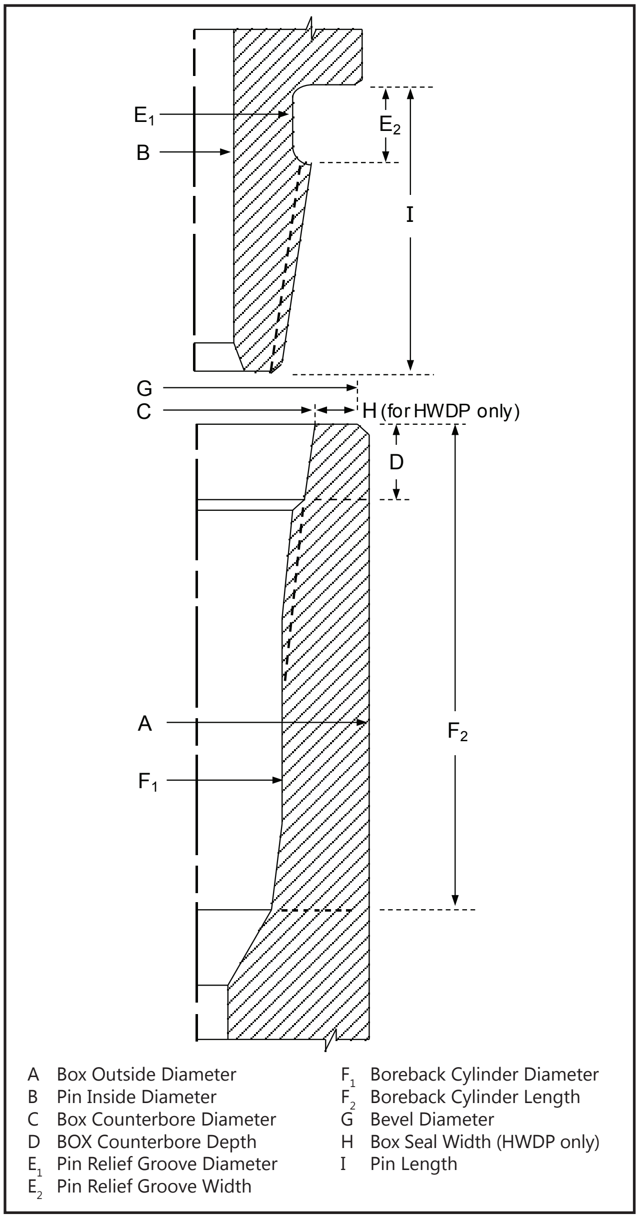


Figure 3.14.2 BHA connection dimensions. Connection shown with stress relief pin groove and boreback box.

standards are required. See section 2.21 for calibration requirements.

3.14.3 Preparation

a. All products shall be sequentially numbered. Serial numbers shall be recorded and documented on all reports.

b. Connections shall be clean so that no scale, mud, or lubricant can be wiped from the thread or shoulder surfaces with a clean rag.

3.14.4 Procedure and Acceptance Criteria for API and Similar Non-Proprietary Connections

It is presumed that a Visual Connection Inspection will be performed in conjunction with this inspection. If the Visual Connection Inspection will not be performed, steps 3.11.4b-e, 3.11.5.6, 3.11.5.9, and 3.11.5.10 shall be added to this procedure.

a. Box Outside Diameter (OD): The OD of the box connection shall be measured 4 inches, ±1/4 inch from the shoulder. At least two measurements shall be taken spaced at intervals of 90 ±10 degrees. For HWDP, the box OD shall meet the requirements of Table 3.10.1. For drill collars, the box OD (in combination with the pin ID) shall result in a BSR within the customer's specified range. Dimensions for commonly specified BSR ranges are given on Table 3.9. BSR values for various connection types and sizes are provided in Table 3.16.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder ±1/4 inch. For HWDP, the pin ID shall meet the requirements of Table 3.10.1. For drill collars, the pin ID (in combination with the box OD) shall result in a BSR within the customer's specified range. Dimensions for commonly specified BSR ranges are given on Table 3.9. BSR values for various connection types and sizes are provided in Table 3.16.

c. Box Counterbore Diameter: The box counterbore diameter shall be measured as near as possible to the shoulder (but excluding any ID bevel or rolled metal) at diameters 90 degrees ±10 degrees apart. Counterbore diameter shall not exceed the maximum counterbore dimension shown in Table 3.9 for drill collars and Table 3.10.1 for HWDP.

d. Box Counterbore Depth: The counterbore depth shall be measured (including any ID bevel) on drill collars.

Counterbore depth shall not be less than the value shown on Table 3.9.

e. Pin Stress Relief Groove: Unless waived by the customer, all API connections NC38 and larger that make up to BHA components shall be equipped with pin stress relief grooves or they shall be rejected. The diameter and width of the API pin stress relief groove shall be measured and shall meet the requirements of Table 3.9 for drill collars and Table 3.10.1 for HWDP. The pin stress relief groove length shall be measured from the connection shoulder to the first full thread by placing a metal rule on the thread taper and squared against the connection shoulder, as depicted in Figures 3.14.3, 3.14.4 and 3.14.5. "First full thread" is defined as the thread that is closest to the pin shoulder and reaches the same height and thread profile as the second thread. The location of the first full thread can be identified by rotating the profile gage until the absolute minimum amount of light is visible between the thread form and the profile gage.

f. Box Boreback: Unless waived by the customer, all API connections NC38 and larger that make up to BHA components shall be equipped with boreback boxes or they shall be rejected. The diameter and length of the boreback cylinder shall be measured and shall meet the requirements of Table 3.9 for drill collars or Table 3.10.1 for HWDP.

g. Bevel Diameter: The bevel diameter shall be measured on both pin and box and shall meet the requirements of Table 3.9 for drill collars and Table 3.10.1 for HWDP.

h. Box Seal Width: For HWDP, box seal width shall be measured at its smallest point and shall equal or exceed the minimum value in Table 3.10.1.

i. Pin Length: For connections with pin stress relief groove, the length of the connection pin shall be measured and shall meet the requirements of Table 3.9 or 3.10.1, as applicable.

j. Pin Neck Length: For connections without pin stress relief groove, pin neck length (the distance from the 90 degree pin shoulder to the intersection of the flank of the first full depth thread with the pin neck) shall be measured. Pin neck length shall not be greater than the counterbore depth minus 1/16 inch.

k. HWDP Center Upset: The height of the center upset shall be determined by placing a straightedge along

Figure 3.14.3 Thread not fully formed as seen with light showing between profile gage and thread.

Figure 3.14.4 Lay thread profile gage along thread taper and rotate around the thread form until absolute minimum light is visible between the profile gage and first thread. Thread is fully formed (First Full Thread).

Figure 3.14.5 Square scale at the point of the "First Full Thread" and take the measurement from the shoulder side of thread profile to pin shoulder.

the surface of the center upset above the HWDP tube body and measuring the height of the center upset. The eccentricity is determined by the difference between the minimum and maximum height of the center upset. The pipe shall be rejected if:

- The height of the center upset on HWDP is less than 1/8 inch or
- The eccentricity of the center upset is more than 1/8 inch.

l. Tong Space: HWDP box and pin tong space (excluding bevels) shall meet the requirements of Table 3.10.1. On hardfaced boxes and pins, the tong space measurement shall exclude the hardfacing. On spiral collars, box and pin tong space shall be measured between the shoulder bevels and the nearest diameter reduction. For drill collars, box tong space shall not be less than 10 inches, and pin tong space shall not be less than 7 inches.

m. Thread Compound and Protectors: All acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces, including the end of the pin. Thread protectors shall be applied and secured using approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of any debris.

3.14.5 Procedure and Acceptance Criteria for Grant Prideco HI TORQUE™, eXtreme™ Torque, uXT™, and eXtreme™ Torque-M Connections

In addition to the Visual Connection requirements of 3.11.6 and 3.11.7, Grant Prideco HI TORQUE™, eXtreme™ Torque, uXT™, and eXtreme™ Torque-M connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): For HT™ and XT-M™ connections, the OD of the tool joint box shall be measured at a distance of 2 inches ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.10.2 or 3.10.4, as applicable.

   For XT™ and uXT™ sizes 43 and smaller (e.g. XT43), the OD of the tool joint box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. For sizes 46 and larger, the OD of the tool joint box shall be measured at a distance of 2 inches ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.10.3 or 3.10.6, as applicable.

   Note: Connection box OD requirements are the same for HWDP and other BHA connections.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest to the shoulder (±1/4 inch) and referenced against the values in Table 3.10.2–3.10.4 or 3.10.6, as applicable. The pin ID is used to define other inspection dimensions.

c. Box Counterbore (CBore) Wall Thickness: The box CBore wall thickness shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the wall thickness from this extension to the counterbore. The CBore wall thickness shall be measured at its point of minimum thickness. Any reading that does not meet the minimum CBore wall thickness requirement in Table 3.10.2–3.10.4 or 3.10.6, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.10.2–3.10.4 or 3.10.6, as applicable. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.10.2–3.10.4 or 3.10.6, as applicable. If the diameter exceeds these limits, the connection shall be repaired by rethreading.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.10.2–3.10.4 or 3.10.6, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.10.2–3.10.4 or 3.10.6, as applicable. Refer to 3.14.5.1 for repair of connection length non-conformances.

h. Pin Nose Diameter: For HT™, XT™, and uXT™ connections, the outside diameter of the pin nose shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.10.2, 3.10.3, or 3.10.6, as applicable. Nonconforming connections shall be rethreaded. This dimension is not used to determine acceptance or rejection for XT-M™ connections, but to test for pin nose swell and the need to verify connection length.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.10.2–3.10.4 or 3.10.6, as applicable. Refer to 3.14.5.1 for repair of connection length non-conformances.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. HWDP Center Upset: The height of the center upset shall be determined by placing a straightedge along the surface of the center upset above the HWDP tube body and measuring the height of the center upset. The eccentricity is determined by the difference between the minimum and maximum height of the center upset. The pipe shall be rejected if:

- The height of the center upset on HWDP is less than 1/8 inch or
- The eccentricity of the center upset is more than 1/8 inch.

l. Refacing: For HT™, XT™, and uXT™, in addition to torque shoulder damage, refacing may be required due to connection length discrepancies. Repair of connection length non-conformances may be accomplished as noted below.

- If the box connection length exceeds the specified dimension, repair by refacing the primary shoulder.
- If the box connection length is less than the specified dimension, repair by refacing the secondary shoulder.
- If the pin connection length exceeds the specified dimension, repair by refacing the secondary shoulder (pin nose).
- If the pin connection length is less than the specified dimension, repair by refacing the primary shoulder.
- Connection lengths (pin and box) must be verified as per the criteria specified in this procedure.
- Refacing limits are the same as for repair of damaged shoulders specified in 3.11.6.

Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for Grant Prideco connections are acceptable. A minimum of four measurements shall be taken when using a portable field refacing unit. Variability in face flatness and squareness might be introduced and should be monitored. If any measurement is found to be outside the drawing limits, the connection shall be rejected.

The field refacing method addressed in this procedure does not apply to the XT-M™ connection or any connection with radial interference metal-to-metal seals. Such connections require shop redressing in a licensed Grant Prideco facility.

m. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.14.6 Procedure and Acceptance Criteria for Grant Prideco Double Shoulder™ and uGPDS™ Connections

In addition to the Visual Connection requirements of 3.11.6, Grant Prideco Double Shoulder™ and uGPDS™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured at a distance of 5/8 inch ±1/4 inch from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.10.5 or 3.10.7, as applicable. *(Note: Connection box OD requirements are the same for HWDP and other BHA connections.)*

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest to the shoulder (±1/4 inch) and referenced against the values in Table 3.10.5 or 3.10.7, as applicable. The pin ID is used to define other inspection dimensions.

c. Box Shoulder Width (also referred to as Box Counterbore (CBore) Wall Thickness): The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore. The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.10.5 or 3.10.7, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.10.5 or 3.10.7, as applicable. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured and shall meet the requirements shown in Table 3.10.5 or 3.10.7, as applicable. This dimension is not used to determine acceptance or rejection, but to test for box swell and the need to verify connection length.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.10.5 or 3.10.7, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.10.5 or 3.10.7, as applicable. Refer to 3.14.6.1 for repair of connection length non-conformances.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.10.5 or 3.10.7, as applicable.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.10.5 or 3.10.7, as applicable. Refer to 3.14.6.1 for repair of connection length non-conformances.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. HWDP Center Upset: The height of the center upset shall be determined by placing a straightedge along the surface of the center upset above the HWDP tube body and measuring the height of the center upset. The eccentricity is determined by the difference between the minimum and maximum height of the center upset. The pipe shall be rejected if:

- The height of the center upset on HWDP is less than 1/8 inch or
- The eccentricity of the center upset is more than 1/8 inch.

l. Refacing: In addition to torque shoulder damage, refacing may be required due to connection length discrepancies. Repair of connection length nonconformances may be accomplished as noted below.

  - If the box connection length exceeds the specified dimension, repair by refacing the primary shoulder.
  - If the box connection length is less than the specified dimension, repair by refacing the secondary shoulder.
  - If the pin connection length exceeds the specified dimension, repair by refacing the secondary shoulder (pin nose).
  - If the pin connection length is less than the specified dimension, repair by refacing the primary shoulder.
  - Connection lengths (pin and box) must be verified as per the criteria specified in this procedure.
  - Refacing limits are the same as for repair of damaged shoulders specified in 3.11.6.

  Machine refacing in a lathe is the preferred method. Portable field refacing units designed specifically for Grant Prideco connections are acceptable. A minimum of four measurements shall be taken when using a portable field refacing unit. Variability in face flatness and squareness might be introduced and should be monitored. If any measurement is found to be outside the drawing limits, the connection shall be rejected.

m. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces, and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.14.7 Procedure and Acceptance Criteria for Grant Prideco Express™ and EIS™

In addition to the Visual Connection requirements of 3.11.8, VX™ and EIS™ connections shall meet the following requirements.

Note: Connections manufactured as VAM CDS connections have been determined by Grant Prideco to be interchangeable with GPDS connections. As such, any CDS connections shall be inspected according to the procedures outlined for GPDS connections. When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured 2 inches ±1/4 inch from the primary shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.10.9 or 3.10.10, as applicable. (Note: Connection box OD requirements are the same for HWDP and other BHA connections.)

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest the shoulder (±1/4 inch) and shall meet the requirements in Table 3.10.9 or 3.10.10, as applicable.

c. Box Shoulder Width: The box shoulder width shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the shoulder thickness from this extension to the counterbore. The shoulder width shall be measured at its point of minimum thickness. Any reading that does not meet the minimum shoulder width requirement in Table 3.10.9 or 3.10.10, as applicable, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (excluding the OD bevel) shall meet the requirements of Table 3.10.9 or 3.10.10, as applicable. Tong space measurements on hardfaced components shall be made from the bevel to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured and shall meet the requirements shown in Table 3.10.9 or 3.10.10, as applicable.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.10.9 or 3.10.10, as applicable.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.10.9 or 3.10.10, as applicable. If the connection length exceeds the specified criteria, repair may be made by refacing the primary shoulder. If the connection length is less than the specified criteria, refacing the secondary shoulder may be adequate to repair the connection. Refacing limits are the same as that performed for damaged shoulder faces.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured and shall meet the requirements shown in Table 3.10.9 or 3.10.10, as applicable.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. This distance shall meet the requirements of Table 3.10.9 or 3.10.10, as applicable. If the connection length exceeds the specified criteria, repair may be made by refacing the secondary shoulder (pin nose). If the connection length is less than the specified criteria, refacing the primary shoulder may be adequate to repair the connection. Refacing limits are the same as that performed for damaged shoulder faces.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. HWDP Center Upset: The height of the center upset shall be determined by placing a straightedge along the surface of the center upset above the HWDP tube body and measuring the height of the center upset. The eccentricity is determined by the difference between the minimum and maximum height of the center upset. The pipe shall be rejected if:

- The height of the center upset on HWDP is less than 1/8 inch or
- The eccentricity of the center upset is more than 1/8 inch.

l. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces, and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.14.8 Procedure and Acceptance Criteria for Grant Prideco Delta™ Connections

In addition to the Visual Connection requirements of 3.11.13, Grant Prideco Delta™ connections shall meet the following requirements.

Note: When conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

a. Tool Joint Box Outside Diameter (OD): The OD of the tool joint box shall be measured at a distance 5/8 inch (±1/4 inch) from the primary make-up shoulder. Measurements shall be taken around the circumference to determine the minimum diameter. This minimum box diameter shall meet the requirements in Table 3.10.8.

b. Pin Inside Diameter (ID): The pin ID shall be measured under the last thread nearest to the shoulder (±1/4 inch) and referenced against the values in Table 3.10.8. The pin ID is used to define other inspection dimensions.

c. Box Shoulder Width (also referred to as Box Counterbore (CBore) Wall Thickness): The box

CBore wall thickness shall be measured by placing the straightedge longitudinally along the tool joint, extending past the shoulder surface, and then measuring the wall thickness from this extension to the counterbore. The CBore wall thickness shall be measured at its point of minimum thickness. Any reading that does not meet the minimum CBore wall thickness requirement in Table 3.10.8, shall cause the tool joint to be rejected.

d. Tong Space: Box and pin tong space (including the OD bevel) shall meet the requirements of Table 3.10.8. Tong space measurements on hardfaced components shall be made from the primary shoulder face to the edge of the hardfacing.

e. Box Counterbore Diameter: The box counterbore diameter shall be measured at two locations 90 degrees apart. The diameters shall meet the requirements in Table 3.10.8. If the limits are exceeded, the connection shall be rethreaded.

f. Bevel Diameter: The bevel diameter on both the box and pin shall be measured and shall meet the requirements shown in Table 3.10.8.

g. Box Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. Measurements shall not be taken in areas where surface condition prevents accurate measurements. This distance shall meet the requirements of Table 3.10.8. Refer to 3.14.8.1 for repair of connection length non-conformances.

h. Pin Nose Diameter: The outside diameter of the pin nose shall be measured at two locations 90 degrees apart and shall meet the requirements shown in Table 3.10.8. If the diameter exceeds the specified limit, the connection shall be repaired by rethreading.

i. Pin Connection Length: The distance between the primary and secondary make-up shoulders shall be measured in two locations, 180 degrees apart, and free from mechanical damage. Measurements shall not be taken in areas where surface condition prevents accurate measurements. This distance shall meet the requirements of Table 3.10.8. Refer to 3.14.8.1 for repair of connection length non-conformances.

j. Thread Compound and Protectors: Acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces including the end of the pin. A copper-based thread compound is recommended. Thread protectors shall be applied and secured with approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of debris. If additional inspection of the threads or shoulders will be performed prior to pipe movement, application of thread compound and protectors may be postponed until completion of the additional inspection.

k. HWDP Center Upset: The height of the center upset shall be determined by placing a straightedge along the surface of the center upset above the HWDP tube body and measuring the height of the center upset. The eccentricity is determined by the difference between the minimum and maximum height of the center upset. The pipe shall be rejected if:
   - The height of the center upset on HWDP is less than 1/8 inch or
   - The eccentricity of the center upset is more than 1/8 inch.

l. Refacing: Repair by refacing may only be used to attempt to repair shoulder damage less than or equal to 3/64 inch in depth, and/or connection length discrepancies that are less than 1/32 inch out of spec.
   - As is typical of the rotary shoulder connection reface process, a maximum of 1/32 inch of material may be removed from the primary make-up shoulder during each refacing operation, after which the joint shall be placed back into service prior to performing any additional refacing repair.
   - The cumulative total material removal from the primary make-up shoulder for all refacing operations shall not exceed 3/32 inch before rethreading is required.
   - Repair by refacing methods shall only remove sufficient material to repair the damage. However, when damage is less than 1/32 inch deep, all damage shall be removed from the primary make-up shoulder.
   - After the maximum reface allowance is met, any remaining damage on the primary make-up shoulder shall not be deeper than 1/64 inch and shall meet all other requirements of this procedure.
   - If the connection cannot be brought back within the acceptable limits outlined in this procedure

without removing more than 1/32 inch of material from the primary shoulder, then rethreading shall be required.

- Both the primary make-up shoulder and secondary make-up shoulder shall be skimmed/machined during a refacing operation for all double shoulder connections.
- Machine refacing in a lathe is the preferred method.
- If the portable field refacing unit method is used, variability in face flatness and squareness might be introduced and shall be monitored by taking the connection length measurements in a minimum of four locations, equally spaced around the circumference. Each measurement shall be within the limits of the "Field Inspection Dimensions" drawing, latest revision.
- GPMark™ + Benchmark: After refacing repair, a minimum length of 1/16 inch (0.063 inch) shall remain on the box refacing benchmark, and 3/16 inch maximum (0.188 inch) shall remain on the pin refacing benchmark. Rethreading is required if excess material is removed. See Figure 3.11.14.
- Xmark™ + Benchmarks: After refacing repair, a visible step on the benchmark shall remain on the primary shoulder. The step is a necessary indicator that a benchmark is still present. Rethreading is required if there is no visible benchmark. See Figure 3.11.15.

m. Rethreading: This method shall be used to repair connections that fail to meet the requirements stipulated in this inspection procedure after field repair is completed. Performance of this operation requires cropping the connection behind any fatigue crack. Complete removal of the thread profile is not necessary if the connection has no fatigue cracks and if sufficient material can be removed to comply with the NEW product requirements. In this case, the connection does not have to be "reblanked," however all torque shoulders, seal surfaces, and thread elements must be machined to 100% "bright metal." This is not necessary for cylindrical diameters. After rethreading, the connection must be phosphate coated. Copper sulfate is not an acceptable substitute for phosphate coating on rethreaded connections.

3.15 Blacklight Connection Inspection

3.15.1 Scope

This procedure covers examination of ferromagnetic connections for transverse surface flaws using the wet fluorescent magnetic particle (blacklight) technique.

3.15.2 Inspection Apparatus

a. Particle Bath Mediums:
   - Petroleum base mediums which exhibit natural fluorescence under blacklight shall not be used. Diesel fuel and gasoline are not acceptable.
   - Water base mediums are acceptable if they wet the surface without visible gaps. If incomplete wetting occurs, additional cleaning, a new particle bath, or the addition of more wetting agents may be necessary.

b. Blacklight Equipment: A blacklight source and a calibrated blacklight intensity meter are required. See section 2.21 for calibration requirements.

c. An ASTM centrifuge tube and stand are required.

d. Coil: A DC coil with a rated capability to induce a longitudinal magnetic field of at least 1200 amp-turns per inch of connection OD is required.

e. Required magnetic particle field indicators (MPFI) include a pocket magnetometer and either a magnetic flux indicator strip or a magnetic penetrameter (pie gauge).

f. A calibrated light meter to verify illumination. See section 2.21 for calibration requirements.

g. A mirror shall be used for examination of box thread roots. It may also be used for examination of pin ID.

h. Booths or tarps shall be used to darken the area if necessary.

3.15.3 Preparation

All surfaces to be inspected shall be cleaned such that no traces of grease, thread dope, corrosion products, or other contaminants are detected by wiping with a dry, unused white paper towel or tissue. Surfaces to be cleaned and inspected include the entire machined areas of both pin and box, including the entire pin ID from the pin tip to the pin shoulder, a minimum of 1 inch beyond the last thread in a non-stress relieved box, a minimum of 1 inch beyond the last scratch thread in a box with boreback stress relief feature, and the external surfaces of the box drill pipe tool joint from the shoulder to the taper. Internal plastic coating on the inside of pins need not be removed unless requested by the customer.

3.15.4 Procedure and Acceptance Criteria

a. Particle concentration shall range from 0.1 to 0.4 ml/100 ml when measured using an ASTM 100 ml centrifuge tube, with a minimum settling time of 30 minutes in water-based carriers or 1 hour in oil-based carriers.

b. Blacklight intensity shall be measured with an ultraviolet light meter each time the light is turned on, after every 8 hours of operation, and at the completion of the job. The minimum intensity shall be 1000 microwatts/cm^2 at fifteen inches from the light source or at the distance to be used for inspection, whichever is greater.

c. The intensity of ambient visible light, measured at the inspection surface, shall not exceed 2 foot-candles. The inspector shall allow time for his or her eyes to adjust properly to the low light level.

d. Determine the polarity of the existing magnetic field (if any) in each end of the test piece using the pocket magnetometer. Mark each end "+" (positive) or "-" (negative), whichever applies. The magnetizing coil shall be placed on the connection so as to reinforce (not oppose) any field already present. Magnetizing current activation and magnetic particle solution application shall be performed simultaneously. The solution shall be distributed over the area described in paragraph 3.15.3. The magnetizing current shall remain on for at least 2 seconds after the solution has been distributed before removing the field. The solution shall be agitated before each application.

   Note: For tools racked in close proximity, the solution shall be agitated within 3 minute intervals during application.

e. Proper field magnitude and orientation shall be verified under blacklight with either the magnetic flux indicator strip or the magnetic penetrameter placed on the internal surface of the connection while the solution is being applied and the power is activated. This shall be performed:

   - At the start of each inspection.
   - After every 25 connections.
   - Whenever the component diameter, thickness, or length changes.
   - When the inspector changes.
   - Any time the inspector or customer representative desires to confirm proper magnetization.
   - Upon completion of the inspection.

f. The inspection surfaces of each connection shall be examined under blacklight. Unless the pipe is vertical, each length shall be rolled to allow 360 degrees examination and to allow areas under solution "puddles" to be inspected. A mirror shall be used to examine box thread roots. Particular attention should be given to the last engaged thread roots of pin and box.

g. Any crack shall be cause for rejection. Grinding to remove cracks is not permitted, but areas with questionable indications may be recleaned with a nonmetallic and nonabrasive buffing wheel and reinspected. If the indication reappears, the connection shall be rejected. The repair of connections with cracks shall be conducted as per section 3.31.

h. Thread Compound and Protectors. All acceptable connections shall be thoroughly cleaned of all inspection materials and coated with an acceptable tool joint compound over all thread and shoulder surfaces, including the end of the pin. Thread protectors shall be applied and secured using approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of any debris.

3.16 UT Connection Inspection

3.16.1 Scope

This procedure covers examination of rotary shouldered connections for transverse flaws using the ultrasonic compression wave technique.

3.16.2 Inspection Apparatus

a. Ultrasonic instruments shall be the pulse-echo type with an A-scan presentation.

b. Linearity Calibration. See section 2.21 for calibration requirements for the instrument.

c. A wedge may be used to angle the transducer beam to the angle of the thread taper.

d. The same type couplant shall be used for both standardization and inspection. Thread compound shall not be used as couplant.

3.16.3 Preparation

a. The box shoulders and pin tips shall be clean to a degree that the entire metal surface is visible.

b. Contact surfaces with pits, gouges, or metal protrusions may hinder the inspection. Filing of the pin tip or refacing of the box shoulder may be necessary prior to inspection, provided dimensional tolerances are maintained.

3.16.4 Field Standardization

a. The ultrasonic unit shall be field standardized for distance and sensitivity using reference standards that are made from a material of similar acoustic properties as the part being tested.

b. Distance Reference Standard: The distance reference standard may be in any form which allows setup of the instrument to display a minimum distance equal to the pin length plus 1 inch.

c. Sensitivity Reference Standard

- Two sensitivity reference standards shall be used for standardization. One standard shall be all or part of a pin connection of the same connection type as the pin connection being tested. The other standard shall be all or part of a box connection of the same connection type as the box connection being tested.
- The sensitivity reference standard shall contain a transverse notch. The notch shall be placed in the standard in the last full thread groove closest to the shoulder on the pin and farthest from the shoulder on the box. The notch shall meet the following requirements.

  Depth = 0.080 inch ±0.005 inch
  Width = 0.040 inch max
  Length = 0.500 inch +0.500 inch, -0.125 inch

d. The distance and sensitivity reference standards may be incorporated into a single piece for convenience.

e. The reject control and electronic distance amplitude correction (DAC) shall be turned off for standardization and scanning.

f. Distance Standardization: The A-scan display shall be standardized so the horizontal baseline displays a distance equal to the pin length plus 1 inch minimum, plus 3 inches maximum.

g. Sensitivity Standardization: The signal amplitude produced by scanning the notch shall be adjusted to at least 80% full screen height (FSH) with a minimum signal to noise ratio of 3 to 1. This signal amplitude shall be used as the reference level for further inspection.

h. The unit shall be field standardized:

- At the start of inspection.
- After each 25 connections.
- Each time the instrument is turned on.
- When the instrument or transducer are suspected of having been damaged in any way.
- When the transducer, cable, operator, or material to be inspected are changed.
- When the validity of the last standardization is questionable.
- Upon completion of the inspection job.

i. All connections inspected since the last valid field standardization shall be reinspected when instrument signal amplitude adjustments of more than 2 dB are necessary during re-standardization.

3.16.5 Procedure and Acceptance Criteria

a. Couplant shall be distributed on the contact surfaces.

b. Gain may be increased above reference level for scanning.

c. Each connection shall be scanned a full 360 degrees. Scanning speed shall not exceed one inch per second.

d. Indications detected during scanning shall be evaluated at the standardization gain setting.

e. Indications that exceed the reference level shall be rejected without further evaluation.

f. Indications between 50-100% of the reference level shall receive Blacklight Connection Inspection (3.15) for ferromagnetic connections or Liquid Penetrant Inspection (3.17) for non-ferromagnetic connections, or the part shall be rejected. Any crack or crack-like indication shown by these methods is cause for rejection.

g. Thread Compound and Protectors: All acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces, including the end of the pin. Thread protectors shall be applied and secured using approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of any debris.

3.17 Liquid Penetrant Inspection

3.17.1 Scope

This procedure covers examination of the rotary shouldered connections and adjacent surfaces on non-magnetic BHA equipment for surface flaws. Visible water-washable, solvent-removable or fluorescent water-washable, self-developing penetrant techniques may be employed.

3.17.2 Inspection Apparatus

a. Penetrant and developer shall be from the same manufacturer. The labeling on the penetrant materials shall specify that the materials meet the sulfur and halogen requirements of ASTM E165.

b. Solvent-based (aqueous and non-aqueous) developers may be used for the visible techniques.

c. The quality of the penetrant materials and inspection procedure shall be verified by testing a cracked test piece. The test piece may be a Liquid Penetrant Comparator as described in Section V, ASME Boiler and Pressure Vessel Code or a quench cracked 3/8 inch thick block of 2024-T3 aluminum alloy plate.

d. A calibrated light meter is required to verify illumination. See section 2.21 for calibration requirements.

e. Blacklight Equipment. A blacklight source and a calibrated blacklight intensity meter are required. See section 2.21 for calibration requirements. Blacklight intensity shall be measured with an ultraviolet light meter each time the light is turned on, after every 8 hours of operation, and at the completion of the job. The minimum intensity shall be 1000 microwatts/cm^2 at fifteen inches from the light source or at the distance to be used for inspection, whichever is greater.

f. A mirror is required for examination of box threads and pin ID.

g. An intensive light source is required for the visible techniques which is capable of producing a visible light intensity of at least 50 foot-candles at the inspection surface.

3.17.3 Preparation

a. All surfaces to be inspected (including the test piece) shall be cleaned such that no traces of grease, thread dope, corrosion products, or other contaminants are detected by wiping with a dry, unused white paper towel or tissue. Surfaces to be cleaned and inspected include the entire machined areas of both pin and box, including the entire pin ID from the pin tip to the pin shoulder, a minimum of 1 inch beyond the last thread in a non-stress relieved box, and a minimum of 1 inch beyond the last scratch thread in a box with boreback stress relief feature. Internal surfaces on equipment with a pin ID 2 inches or smaller are exempt from being inspected. If any bleed-back of residue from imperfections is noted, the inspection area shall be recleaned.

b. Cleaning shall be accomplished by one of the following methods:
   - Steam or hot water and detergent
   - Mineral spirits
   - Commercial penetrant solvent

c. After cleaning, the inspection surface shall be dried to a degree that a dry, unused paper towel or tissue rubbed on the surface does not absorb any moisture. If other than commercial penetrant solvent is used, the surfaces shall receive final cleaning with acetone, methyl-ethyl ketone, or an equivalent solvent.

d. The same cleaning and process steps shall be performed on the connection and the test piece. The test piece temperature shall be within 5 degrees Fahrenheit of the temperature of the parts to be inspected.

3.17.4 Penetrant Application

a. The test piece shall be inspected before the component, under the same environmental conditions and with the same dwell times as the component. If the cracks in the test piece are not visible the inspection shall not be performed on the component. The cause of the failure must be corrected and the test piece successfully retested before proceeding.

b. The penetrant shall be applied over the areas identified in paragraph 3.17.3a.

c. A mirror shall be used to check for complete coverage on box threads.

d. The penetrant shall not be allowed to dry. Additional penetrant may be applied to prevent drying but the part shall be recleaned if the penetrant dries.

e. The dwell time (length of time the penetrant remains on the surface of the pipe) shall be a minimum of 10 minutes and a maximum of 60 minutes unless the penetrant manufacturer's recommendations are in conflict. If this is the case, the manufacturer's recommendation shall be used. For ambient temperatures between 40 degrees F and 50 degrees F, the dwell time shall be a minimum of 20 minutes. Penetrant testing shall not be performed if the ambient temperature or component temperature is less than 40 degrees F or greater than 125 degrees F.

3.17.5 Excess Penetrant Removal

a. Water Washable Systems: The excess penetrant shall be removed with a low pressure water spray or flow (maximum 40 psi). The part shall be air dried or dried by blotting with dry, lint-free cloths. If forced warm air is used for drying the part, the forced air temperature at the part surface shall not exceed 120 degrees F. Regulated air nozzles may be used for drying, but the air pressure shall be regulated to 25 psi or less. For fluorescent penetrant, to prevent over-washing, a blacklight shall be used and the spray terminated immediately after the background has been removed.

b. Visible Solvent Removable Systems: The part surface shall first be wiped with a dry, lint free cloth. Solvent shall then be sprayed on a similar cloth and the cloth used to remove the remaining surface penetrant. This step may have to be repeated. Finally, the part surface shall be wiped with a dry, lint free cloth. *Note: Solvent shall not be sprayed or otherwise applied directly to the test surface.*

c. An intensive light source capable of producing a visible light intensity of at least 50 foot-candles at the inspection surface, and a mirror shall be used to check for complete removal of excess penetrant from box threads and pin ID. Penetrant removal on all surfaces shall stop immediately after the penetrant is completely removed from those surfaces.

3.17.6 Developer Application

a. The developer shall be applied within five minutes after completion of the post-rinse drying operation.

b. The method of application of developer shall provide visually uniform coverage as thin as practical over the surface being examined.

c. The developing time shall be one half of the allowed penetrant dwell time, but not less than 7 nor more than 30 minutes.

3.17.7 Examination and Acceptance Criteria

a. Initial examination to detect gross imperfections and contamination on the surface shall be made within one minute after developer application. A blacklight shall be used during inspection using florescent penetrant.

b. Final examination shall be made after full developing time.

c. For visible penetrant: The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:

- At the start of each inspection job.
- When light fixtures change positions or intensity.
- When there is a change in relative position of the inspected surface with respect to the light fixture.
- When requested by the customer or its designated representative.
- Upon completion of the inspection job.

The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

d. For fluorescent penetrant: The intensity of ambient visible light, measured at the inspection surface, during fluorescent liquid penetrant inspection, shall not exceed 2 foot-candles.

e. All areas of interest shall be examined for cracks or crack-like indications. The last engaged thread roots of pins and boxes should receive particular attention. A mirror shall be used to inspect surfaces in the box.

f. Cracks: Any crack shall be cause for rejection. The repair of rotary shouldered connections with cracks shall be conducted as per section 3.31.

g. Indications: Parts with questionable indications shall be recleaned and reinspected. A repeatable indication shall be cause for rejection. Grinding or buffing of indications is prohibited.

h. After inspection, penetrant and developer shall be removed with water or solvent spray. With fluorescent penetrant, a blacklight shall be used to check for complete removal.

i. Thread Compound and Protectors: All acceptable connections shall be coated with an acceptable tool joint compound over all thread and shoulder surfaces, including the end of the pin. Thread protectors shall be applied and secured using 50 to 100 ft-lb of torque. The thread protectors shall be free of any debris.

3.18 Slip Groove Inspection

3.18.1 Scope

This procedure covers the dimensional verification of the drill collar OD and slip groove recess depth and length. Customer requirements shall prevail in all cases pertaining to final acceptance/rejection of slip grooves not meeting this procedure.

Note: In previous editions of Standard DS-1 elevator grooves were also considered in this procedure. Due to safety and compatibility concerns, API no longer supports the manufacture or use of traditional square-shouldered drill collar elevator grooves, and the DS-1 sponsor group agrees with this change. As such, there is no longer a DS-1 dimensional inspection for the drill collar elevator groove.

It is recognized that these products may still be in circulation, and this is acceptable as long as the groove is not used for lifting purposes. The crack-detection for all grooves, slip and elevator, in this procedure is still required.

3.18.2 Inspection Apparatus

A 12-inch metal rule graduated in 1/64 inch increments, a metal straightedge, and OD calipers are required.

3.18.3 Preparation

The groove areas shall be clean so that bare metal is visible over the entire groove surface.

3.18.4 Procedure and Acceptance Criteria

a. Dimensions shall be as shown in Figure 3.18.1.

b. Slip Groove Diameter: The slip groove diameter shall be measured approximately in the middle of the recess using OD calipers. Two diameter measurements shall be taken, approximately 90 degrees apart. The diameter shall meet the requirements below, where the diameter is calculated as:

Nominal Collar OD - 2 x Slip Recess
= Slip Recess Diameter (-1/16 inch, +0)

Collar OD (inch)	Slip Recess Depth (inch, +1/32, -0)
4 - 4-5/8	5/32
4-3/4 - 5-5/8	5/32
5-3/4 - 6-5/8	7/32
6-3/4 - 8-5/8	7/32
≥ 8-3/4	7/32

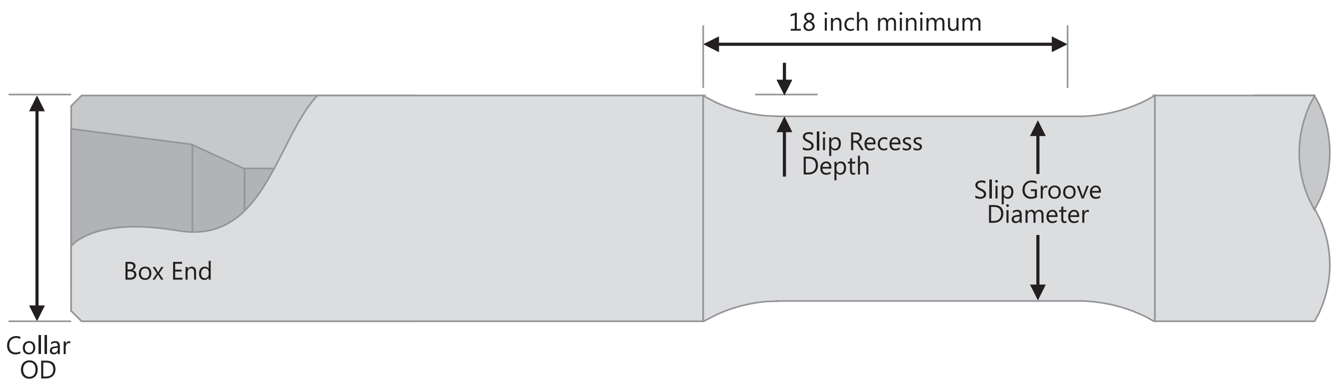


Figure 3.18.1 Drill collar slip grooves.

c. The entire outside surfaces of all grooves shall be inspected in accordance with procedure 3.9, MPI Slip/Upset Inspection. Particular attention should be paid to slip notches. Any crack shall be cause for rejection. If the material is non-magnetic, procedure 3.17, Liquid Penetrant Inspection, shall be substituted for Magnetic Particle Inspection.

3.19 Wet Visible Contrast Inspection

3.19.1 Scope

This procedure covers inspection of slip and upset external surfaces of used steel drill pipe or workstring tubing for transverse and three-dimensional flaws, using wet visible contrast technique with an active AC field or with an active DC field. The area to be inspected covers the following:

- Tube close to pin: 36 inches on the tube side starting from the intersection of the 35° or 18° taper, as applicable, and the outside surface of the tube or upset on drill pipe, or from the upset on workstring tubing.
- Tube close to box: 48 inches on the tube side starting from the intersection of the 18° tool joint taper and the outside surface of the tube or upset on drill pipe, or from the upset or coupling on workstring tubing. If there are slip cuts beyond the 48 inches, then the area where the additional slip cuts are located, including 6 inches on either side of this location, shall also be inspected.
- HWDP Center Pad: If this method is applied to HWDP, the area also includes the first 12 inches of tube from the intersection of the transition radius and outside tube surface on either side of the center upset.

3.19.2 Inspection Apparatus

a. Magnetic Particles: Magnetic particles shall be either black concentrate or red concentrate. The selection is based on securing the best possible contrast with the background when viewed in various kinds of light.

b. A white paint is required for contrast with the magnetic particles. The white contrast paint shall be non-magnetic and easily removable. White contrast paint and the testing media (black or red magnetic particle concentrate) shall be from the same manufacturer, or specified as compatible by the product manufacturer and used in accordance with the manufacturer's requirements.

c. A spray or a hand brush is required for application of the white contrast paint.

d. A DC coil or an AC yoke may be used for magnetizing the pipe surface.

e. If an AC yoke is used for inspection, the capacity of the yoke to lift a ten pound weight shall have been demonstrated in the last six months. The ten pound weight used for the lift test shall have been calibrated. See section 2.21 for calibration requirements. For AC yokes with adjustable poles:

- The maximum pole spacing during inspection shall not exceed the distance between the poles when all segments of the yoke are perpendicular to the grip.
- The minimum pole spacing during inspection shall be 2 inches.

See section 2.21 for calibration requirements for the yoke.

f. If a DC coil is used for inspection, the coil shall have a rated capability to induce a longitudinal magnetic field of at least 1200 amp-turns per inch of connection OD.

g. The suspension medium for the magnetic particles shall be either petroleum distillate or water. Water base mediums are acceptable if they wet the surface without visible gaps. If incomplete wetting occurs, additional cleaning, a new particle bath, or the addition of more wetting agents may be necessary.

h. A calibrated light meter to verify illumination. See section 2.21 for calibration requirements.

i. An ASTM centrifuge tube and stand are required.

j. Required magnetic particle field indicators (MPFI) include a pocket magnetometer and either a magnetic flux indicator strip or a magnetic penetrameter (pie gage).

k. A dry film thickness gage is required to measure the thickness of paint coating. See section 2.21 for calibration requirements. The calibration and operation for the thickness gage shall be such that the coating thickness can be determined within ±10% of its true thickness or to within ±0.0001 inch (±0.1 mil), whichever is greater.

3.19.3 Preparation

a. All pipe shall be sequentially numbered.

b. The pipe surfaces shall be clean to a degree that the metal surfaces are visible.

c. Paint and plated coatings on the pipe surface shall be removed from the area to be inspected.

3.19.4 Procedure and Acceptance Criteria

a. The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:

- At the start of each inspection job.
- When light fixtures change positions or intensity.
- When there is a change in relative position of the inspected surface with respect to the light fixture.
- When requested by the customer or its designated representative.
- Upon completion of the inspection job.

The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

b. Magnetic particle concentration shall range from 1.2 to 2.4 ml/100 ml when measured using an ASTM 100 ml centrifuge tube, with a minimum settling time of 30 minutes in water-based carriers or 1 hour in oil-based carriers. These requirements do not apply to pre-mixed bath available in aerosol containers.

c. If pre-mixed bath available in aerosol container is used for inspection, the inspection fluid shall spray freely from the container and the container shall be used only up to the shelf life date listed by the manufacturer on the container.

d. The external surface (all 360 degrees) defined in paragraph 3.19.1 shall be inspected using a longitudinal field as follows:

- White contrast paint shall be applied on the external surface which is to be inspected. Paint shall be applied using a spray or a hand brush. Paint coating thickness shall be verified on each joint after the paint is dry using the dry film thickness gage defined in paragraph 3.19.2k of this procedure. Paint coating shall be smooth and shall have a total thickness equal to or less than 0.002 inch (2 mil). White paint coating shall not be damaged during handling, until the inspection is complete.
- The magnetic particle field indicator (MPFI) defined in paragraph 3.19.2j shall be used to verify proper field magnitude and orientation at the beginning of each shift.
- Black or red colored magnetic particle solution shall be sprayed on the white contrast paint. The field shall be continuously activated during particle application. The magnetizing current shall remain on for at least 2 seconds after the solution has been distributed. The solution shall be agitated before each application.

e. Areas with questionable indications shall be re-cleaned and re-inspected.

f. Any crack is cause for rejection except that hairline cracks in hardfacing are acceptable so long as they do not extend into the base metal. Grinding to remove cracks is not permitted.

g. Other imperfections shall not exceed the specified limits given in Tables 3.5.1, 3.5.2, or 3.11.1, as applicable, and 3.6.1, 3.6.2, or 3.11.2, as applicable.

3.19.5 Post Cleaning

Post-inspection cleaning is necessary where magnetic particles could interfere with subsequent processing or with service requirements. Suitable post-inspection cleaning techniques shall be used which shall not interfere with subsequent requirements. The white coating paint applied during inspection shall be stripped from the pipe surface in order to facilitate post inspection markings.

3.20 Kelly Inspection

3.20.1 Scope

This procedure covers the inspection requirements and acceptance criteria for kellys.

3.20.2 Apparatus

The following equipment must be available for inspection: Machinist's protractor or equivalent, paint marker, pit gage, a light capable of illuminating the entire internal surface, metal scale, tape measure, flat file or disk grinder, braided cord at least 40 feet long, and precision straight edge.

3.20.3 Preparation

Record the kelly serial number and description. Reject the kelly if no serial number can be located unless the customer waives this requirement.

3.20.4 Saver Subs

Inspect saver subs, if any, in accordance with procedure 3.25, Sub Inspection.

3.20.5 Visual Connection Inspection

Inspect the kelly connections in accordance with procedure 3.11, Visual Connection Inspection, omitting sections 3.11.3a and 3.11.4a.

3.20.6 Dimensional Inspection-Upper Connection

On the upper kelly connection, do the following examination:

a. Box OD: Measure the tool joint box OD at a point 3/8 inch, ±1/8 inch from the shoulder. The box OD shall equal or exceed the value shown below.

b. Tong Space: Box and pin tong space (excluding the OD bevel) shall be at least 8 inches.

c. Box Swell: Measure the box counterbore in the plane nearest the shoulder, excluding any ID bevel. Two measurements shall be taken at diameters 90 degrees ±10 degrees apart. No counterbore diameter shall exceed the maximum counterbore dimension given below.

d. Bevel Diameter: The bevel diameter shall not exceed the value given below.

	Upper Kelly Connection	
Dimension	4 1/2 Reg	6 5/8 Reg
Min. Box OD (in)	5-21/32	7-21/32
Max. Bevel Diameter (in)	5-7/16	7-15/32
Max. Counterbore (in)	4-3/4	6-1/8

3.20.7 Dimensional Inspection-Lower Connection

Inspect the lower kelly connection in accordance with procedure 3.13, Dimensional 2 Inspection.

3.20.8 Blacklight Connection Inspection

Inspect both upper and lower connections in accordance with procedure 3.15, Blacklight Connection Inspection.

3.20.9 Straightness Inspection

Place the kelly on a set of racks with at least 3 support areas. Rotate the kelly 360 degrees and visually locate and note all questionable areas for straightness. Tightly stretch the braided cord from end to end from immediately behind each tool joint taper so that the cord covers each questionable location. Measure the maximum gap between the cord and kelly drive section. Reject the kelly for any of the following conditions:

a. A bend in the drive section that exceeds one inch over any three foot section.

b. A bend in the drive section greater than 1/16 inch over the two feet adjacent to each tool joint.

c. If it is visibly corkscrewed.

3.20.10 Drive Section Wear

The width and contact angle of the kelly drive section wear pattern indicates clearances between the kelly and drive bushing during previous use.

a. Wide wear patterns accompanied by low contact angles are optimum. They indicate that close clearances were maintained during past use.

b. High contact angles indicate that close clearances were not maintained during past use. Wider wear patterns at high contact angles indicate more wear has occurred at high clearances.

c. Narrow wear patterns accompanied by low contact angles indicate a kelly that is being operated with close clearances but on which wear patterns are not yet fully developed.

3.20.11 Drive Section Wear Limits

Measure the wear pattern contact angle at no less than six locations that appear representative of the general wear state of the kelly drive section. If the average contact angle exceeds the appropriate maximum angle below, notify the customer so that he or she can reduce operating clearances and maximize the remaining life of the kelly.

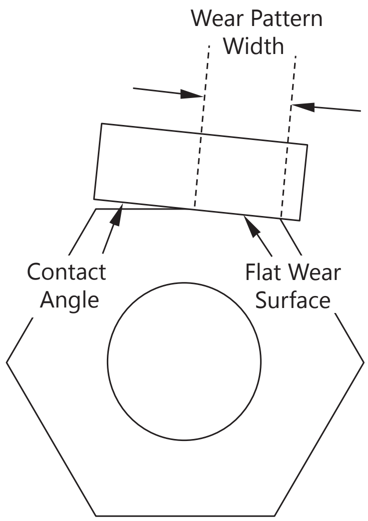


Figure 3.20.1 Kelly wear pattern and contact angle.

Maximum Contact Angle for Kelly Drive Sections

Kelly Size (inch)	Square Kelly (degrees)	Hexagonal Kelly (degrees)
2-1/2	17	-
3	16	12
3-1/2	15	11
4-1/4	14	10
5-1/4	13	9
6	-	8

3.20.12 Magnetic Particle Body Inspection

Inspect the outside surface of the tool from shoulder to shoulder in accordance with procedure 3.9, Magnetic Particle Inspection of Slip/Upset Areas. Any crack is cause for rejection.

3.20.13 Post-Inspection Requirements

Clean and dry the connections and thread protectors. Apply thread compound and apply thread protectors. Place a 2-inch wide white paint band around an acceptable tool. The paint band should be 12 inches ±2 inches from the box end. Using a permanent paint marker on the outer surface of the tool, write or stencil the words "DS-1 Kelly Inspection," the date, and the name of the company performing the inspection.

3.21 Connection Phosphating

3.21.1 Scope

This procedure covers the process control requirements for phosphating newly-machined or recut rotary-shouldered connections using zinc phosphate or manganese phosphate methods. This procedure is not required for connections that have only been refaced. Any required thread gauging must be completed prior to phosphating to ensure accurate measurements.

3.21.2 Apparatus

3.21.2.1 Phosphating Procedure Specification

A detailed, written procedure for treating the connections, using the specific phosphating product and equipment in place, must be available at the job site. This procedure, at a minimum, shall contain requirements for:

a. Solution Control: All variables about the phosphating solution that must be controlled and measured in order to ensure high-quality results. The specification shall, at a minimum, list acceptable ranges, measurement methods, and measurement intervals for the following:
   - Solution and Bath Temperature
   - Acid Concentration
   - Other key variables which require monitoring and control as stated by the manufacturer

b. Connection Preparation: The steps required to ensure the connection surfaces have been correctly prepared for phosphating, and any control methods used to ensure that the preparation has been satisfactorily completed. This preparation may be mechanical (e.g. bead blasting), chemical (e.g. detergent solutions), or both.

c. Phosphating Procedural Steps: Step-by-step instructions for treating the connections. The specification shall, at a minimum, include steps for:
   - Pre-rinsing (if necessary)
   - Exposure times
   - Nozzle arrangement and pressure (if spraying)
   - Post-treatment rinsing and passivation
   - Limits for time between process stages
   - Other key steps in the specified phosphating process

d. Acceptable and Rejectable Phosphating Results: A clear inspection procedure for evaluating the results of the phosphating treatment, including unambiguous details on acceptable and rejectable phosphate conditions.

e. System Quality Confirmation: Any periodic testing required to confirm that the phosphating system in place is giving acceptable, repeatable results. This may include instructions for phosphating, measuring, and recording the results from weight coupons. At a minimum, records for all solution tests and chemical additions and adjustments shall be maintained for a year.

3.21.2.2 Thermometer

A thermometer or temperature measuring device for measuring the temperature of the phosphating solution shall have been calibrated. See section 2.21 for calibration requirements.

3.21.3 Preparation

a. All pipe shall be sequentially numbered.

b. Any mechanical preparation (e.g. bead blasting) to the connection surfaces that is required by the phosphating procedure specification shall be performed according to the specification.

c. The thread and seal surfaces to be phosphated shall be cleaned according to the instructions provided in the phosphating procedure specification. Aqueous cleaning solutions shall be used to avoid leaving residual oil, wax, or other contaminants on the surface.

d. After the connections have been properly cleaned in preparation for phosphating, the thread and seal surfaces (and any baskets or handling equipment to be used in the phosphating process) shall be rinsed with fresh water. If an immersion rinse bath is used, the water used in this pre-rinse must be tested for purity periodically (at least daily). The phosphating procedure specification shall establish the parameters to be measured (pH, for example) and acceptable ranges for the rinse water.

e. After cleaning, the handling of the parts must be carefully performed to ensure that nothing contaminates the surfaces (e.g. dirty gloves or handling devices).

3.21.4 Procedure

a. Prior to phosphating, the solution temperature shall be checked to confirm that it is within the correct range given in the phosphating procedure specification.

b. The connections shall be phosphated according to the step-by-step instructions given in the phosphating procedure specification.

c. If a spraying application method is used, care must be taken to ensure complete, uniform coverage on all treated surfaces. Sprayer nozzles must be checked periodically (at least every shift) for blockage.

d. Care must be taken to ensure that the thread and seal surfaces to be phosphated do not touch each other or any other equipment while being treated.

e. Exposure times must be carefully monitored with a dedicated device (i.e. a stop watch or timer). The exposure time for the components phosphated must fall into the ranges specified by the phosphating procedure specification, but may be adjusted within those ranges to get optimum results.

f. After the appropriate exposure to the phosphating solution, the components must immediately be thoroughly rinsed with fresh water. The components must not be allowed to dry prior to rinsing. If an immersion rinse bath is used, the water used in this rinse must be tested for purity periodically (at least daily). The phosphating procedure specification shall establish the parameters to be measured (pH, for example) and acceptable ranges for the rinse water.

g. The components shall be dried, or allowed to dry, as required by the phosphating procedure specification.

3.21.5 Post-Treatment Inspection

a. All phosphated connections shall be 100% visually inspected.

b. The phosphate treatment must evenly cover all thread and seal surfaces. Any visible gaps or bare spots shall be cause for rejection.

c. The phosphated surfaces must have a uniform, fine crystalline texture and be uniformly light to dark gray. Blotches, streaking, any red color (rust blooms), or coarse crystals that can be brushed off with a rag shall be cause for rejection.

d. The phosphate coating must adhere well to all treated surfaces. If the adherence of the coating is questionable, a "rub test" can be performed by rubbing the surface with a pencil eraser with moderate pressure. If the phosphate coating rubs off, shows bare metal, or phosphate crystals transfer to the eraser, the coating is not adhering well and the component must be rejected. *(Note that the eraser or the phosphate may discolor during this test without any significant transfer of phosphate crystals. This is acceptable.)* Any flaking, bare spots, or blistering in the coating shall be cause for rejection.

e. Loose deposits or white powder on the phosphated surface generally indicates a problem with the phosphating process. A non-metallic brush shall be used to remove all such loose deposits from all phosphated surfaces. If the deposits cannot be removed with a non-metallic brush, or the phosphate coating underneath comes off, the component shall be rejected.

f. Acceptable connections shall be coated with an acceptable tool joint compound or storage compound over all thread and shoulder surfaces, including the end of the pin. Thread protectors shall be applied and secured using approximately 50 to 100 ft-lb of torque. The thread protectors shall be free of any debris.

3.22 Hardbanding Reapplication

3.22.1 Scope

This procedure covers the inspection of used components to be hardbanded (including but not limited to tool joints, HWDP center pads, drill collars, and workstring tubing) and the procedures required to ensure quality hardbanding reapplication.

3.22.2 Apparatus

3.22.2.1 Welding Procedure Specification (WPS)

The WPS for the specific hardbanding product being applied must be supplied by the hardbanding manufacturer, and a current copy must be available on site at the time of hardbanding application. The WPS, at a minimum, will provide requirements for:

a. Surface Preparation: Acceptable surface roughness, corrosion, cracking (found either through visual or non-destructive examination) or other conditions which will adversely impact hardbanding.

b. Preheat Temperature and Time: The temperature the component material is to be heated to, the time that temperature is to be maintained prior to applying the hardbanding, and the measurement methods for confirming that temperature.

c. Weld Variables: Acceptable ranges for the following:
    - Welding process (gas shielding, sub arc, open arc, etc)
    - Rotational speed
    - Flux voltage (range) requirements
    - Current ranges
    - Torch set-up (offset, angle, electrical stickout, standoff, etc)
    - Bead width
    - Oscillation rate
    - Gas selection
    - Other key variables which require monitoring and control as stated by the manufacturer

d. Interpass Temperature Ranges: Acceptable temperature ranges for the component material, the measurement methods, and measurement location.

e. Post-Heat Temperatures and Times: The temperature the component material must maintain after applying the hardbanding material, the length of time that temperature must be maintained, the cooling methods (air cooled, insulated, etc), and the measurement methods for determining temperatures.

f. Acceptable and Rejectable Crack Patterns: The requirements for visual examination after hardbanding the components and limits for cracking and other weld quality issues.

g. Procedure Qualification Records (PQR): A summary report of the metallurgical work done to prove that hardbanding application performed according to this WPS is acceptable in terms of bonding and quality. A recommended procedure for the PQR testing is given in DS-1 Volume 2.

h. Welder Performance Qualification (WPQ): The requirements necessary for each welder to prove that he or she is competent in using this WPS and is able to apply hardbanding of acceptable quality.

i. ID surface cooling: The WPS must specify if ID cooling for internal plastic coated drill pipe is required or if ID cooling should not be performed. If ID cooling is required per WPS, the WPS shall provide requirements for cooling media, flow rate, minimum and maximum coolant temperature, and other applicable operational variables, and the PQR shall address this.

3.22.2.2 Temperature Measurement

A 1,000 degrees F minimum temperature sensor or digital measuring device using a thermocouple that has been calibrated within the past year. See section 2.21 for calibration requirements.

3.22.2.3 Other Apparatus

A 12-inch metal rule graduated in 1/64-inch increments, a metal straightedge, and OD calipers are required, as well as any other equipment specified by the WPS.

3.22.3 Preparation

Caution: Some hardbanding products cannot be applied over other products because of chemical or mechanical incompatibility. Reapplication of new hardbanding over existing incompatible hardbanding can lead to problems like poor adhesion, excessive cracking, and poor performance. Examination of available documentation to determine the type or brand of any existing hardbanding already present on the component is recommended. If the existing hardbanding type cannot be determined, it is recommended that the existing hardbanding is removed to avoid hardbanding incompatibility problems.

a. All pipe shall be sequentially numbered.

b. A Visual Connection (procedure 3.11) and a Dimensional 1 Inspection (procedure 3.12) of all components shall be performed prior to hardbanding removal or reapplication to ensure that all components are fit for use.

c. Printed copies of the WPS shall be present. If any conflicts arise between this specification and the manufacturer's requirements, the manufacturer's requirements shall apply.

d. Thread lubricants or storage compounds shall be fully removed from all connections.

e. The weld surfaces must be prepared for hardbanding according to the WPS instructions. This may involve visual inspection, non-destructive examination, soft-metal welding, and/or machining to prepare the component.

3.22.4 Procedure

a. Any existing hardbanding shall be visually examined. If spalling, chipping, or voids greater than 1/16 inch in diameter are present in any existing hardbanding, the existing hardbanding shall be removed.

b. If existing hardbanding must be removed, an MPI Inspection (procedure 3.9) of the hardbanding area and 6 inches on either side shall be performed on the component OD surface after the existing hardbanding has been removed and the component has cooled to ambient temperature. The apparatus, preparation, and procedure requirements of paragraphs 3.9.2, 3.9.3, and 3.9.4 shall apply for the MPI inspection. Any cracks are cause for rejection.

c. The weld surface shall be visually examined. The area to be hardbanded shall have a bright metal finish and be free from all foreign matter such as rust, grease, oil, paint, or pipe coating.

d. The eccentricity of the weld surface shall be determined by measuring the OD at two locations 90° apart. The eccentricity of the weld surface (difference between the two OD measurements) shall not exceed 0.060 inch. The proud or raised section of an eccentric hardbanding application must be ground concentric (within 0.060 inch) prior to any attempted reapplication of the hardbanding material or the reapplication should only be applied to the lower side of the tool joint and feathered or tied into the initial application resulting in a symmetrical raised or proud application.

e. The component shall be preheated if required by the WPS and the preheat temperature monitored as required by the WPS. The preheat method shall be a "soaking" preheat whereby the component is uniformly heated throughout. Surface or spot heating using torches or other means is not allowed. During the preheat process, no carbon residue (soot) shall be permitted on the surfaces prior to hardbanding application.

f. After the component has reached the appropriate preheat temperature (as measured by the calibrated temperature sensor) and held at that temperature for the appropriate amount of time, the hardbanding shall be applied to the component as specified by the WPS. Weld parameters such as weld bead profile, weld quality (porosity, voids, blowholes, etc), and bead height shall be monitored during application and the welding parameters adjusted as necessary.

g. The temperature of the component's base material shall be monitored to ensure that the ranges specified in the WPS are maintained.

h. After hardbanding application is complete, the component shall be allowed to cool slowly using insulated cans or blankets according to the cooling schedule specified by the WPS. If required, the insulation shall not be removed until the component reaches a temperature of 300 degrees F, verified with a calibrated temperature sensor.

3.22.5 Post Welding Requirements

3.22.5.1 Weld Quality Inspection

The applied hardbanding shall be visually examined, checking the following:

a. Porosity, Voids, and Blowholes: Any voids or holes in the hardbanding greater than 1/16 inch in diameter are rejectable (see Figure 3.22.1). Chipping or flaking of the weld material is also cause for rejection.

b. Bead Profile: The weld bead profile shall be checked with a metal straightedge, and must be flat to slightly convex and consistent throughout the entire hardbanding. Concave profiles are cause for rejection. Weld bands that are significantly "humped" in the center may be repaired by grinding if practical (see Figure 3.22.2).

c. Tie-In: The weld bands must tie in with the parent metal and other bands consistently with no deep voids. Grooves or voids at tie-in locations (hardbanding band to parent material and between hardbanding weld bands) must be less than 1/8 inch wide and 1/16 inch deep. Small areas of poor tie-in may be repaired by spot welding before the component is cool, but repair welds shall not continue more than 45 degrees around the circumference of the component (see Figure 3.22.3).

d. Crack Patterns: Crack patterns in the finished hardbanding shall be examined and compared to the acceptable crack patterns specified by the WPS. Any crack patterns rejected by the manufacturer's specification or not addressed by the specification are cause for rejection.

3.22.5.2 Weld Geometry

The weld application geometry must meet the customer's specifications. Typically, the hardbanding can be either flush with the component OD or proud by 3/32 inch (±1/32 inch), measured twice 90 degrees apart. Any hardbanding on the 18 degree box taper must be flush to avoid damaging elevators (see Figure 3.22.4). Other acceptable and unacceptable features for some typical hardbanding products are illustrated in Figures 3.22.5 through 3.22.15.

3.22.5.3 Blacklight Inspection

The hardbanded component and the nearest connection to the applied hardbanding (if present) shall be inspected using the Blacklight Connection Inspection method (procedure 3.15). Any cracks or crack-like indications in the non-hardbanded areas are cause for rejection.

Figure 3.22.1 Voids and holes > 1/16" - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.2 Weld bead profile "humper" in middle of weld bead - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.3 Improper tie-in on 18° shoulder, repaired with single weld - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.4 Weld bead profile step on 18° shoulder - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.5 Weld profile at box tool joint taper - Acceptable. (Photo courtesy of Arnco)

Figure 3.22.6 “Stair-stepped” weld bead profile and not flush on 18° shoulder - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.7 Excessive porosity in worn layer - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.8 Flaking or chipping - Unacceptable. (Photo courtesy of Arnco)

Figure 3.22.9 Tuboscope TCS Titanium on used pipe - Acceptable. (Photo courtesy of Tuboscope)

Figure 3.22.10 Tuboscope TCS 8000 on used pipe - Acceptable. (Photo courtesy of Tuboscope)

Figure 3.22.11 Tungsten Carbide cracks - Acceptable. (Photo courtesy of Tuboscope)

Figure 3.22.12 PinnChrome X-38 - Acceptable. (Photo courtesy of Pinnacle)

Figure 3.22.13 MStar on used pipe - Acceptable. (Photo courtesy of Liquidmetal Coatings)

Figure 3.22.14 MStar on used pipe with excessive porosity - Unacceptable. (Photo courtesy of Liquidmetal Coatings)

Figure 3.22.15 Hardbanding (350XT) applied to a workstring tubing connection - Acceptable. (Photo courtesy of Arnco)

3.23 Tool Joint Rebuilding

3.23.1 Scope

This procedure covers the inspection of used tool joints to be rebuilt (by welding on the outside surfaces in order to increase the OD measurement) and the procedures required to ensure quality weld application.

3.23.2 Apparatus

3.23.2.1 Welding Procedure Specification (WPS)

A WPS must be created by a welding engineer for the specific weld operation being used, and a current copy must be available on site at the time of tool joint rebuilding. The WPS, at a minimum, will provide requirements for:

a. Surface Preparation: Acceptable surface roughness, corrosion, cracking (found either through visual or non-destructive examination), or other conditions which will adversely impact hardbanding.

b. Preheat Temperature and Time: The temperature the tool joint material is to be heated to, the time that temperature is to be maintained prior to weld application, and the measurement methods for confirming that temperature. This may also require water cooling on the ID of the tool joint if required by the WPS and qualified by the PQR.

c. Weld Variables: Acceptable ranges for all relevant welding parameters, including:
   - Rotation speed
   - Voltage and current ranges
   - Bead control

d. Interpass Temperature Ranges: Acceptable temperature ranges for the tool joint material between weld passes, measurement methods, and measurement locations. If water cooling is required, the coolant temperatures may also be specified.

e. Post-Weld Heat Temperatures and Times: The temperature the tool joint material must be heated to after welding, the length of time that temperature must be maintained, the cooling method (air cooled, insulated, etc), and the measurement methods for determining temperatures.

f. Post-Weld Inspection Requirements: The requirements for visual examination after welding the tool joint and limits for weld quality issues.

g. Procedure Qualification Records (PQR): A summary report of the metallurgical work done to prove that tool joint rebuilding performed according to this WPS is acceptable in terms of material bonding, strength, and quality.

h. Welder Performance Qualification (WPQ): The requirements necessary for each welder to prove that he or she is competent in using this WPS and is able to rebuild tool joints with acceptable quality.

3.23.2.2 Temperature Measurement

A 1,000 degrees F minimum temperature sensor or digital measuring device using a thermocouple that has been calibrated. See section 2.21 for calibration requirements.

3.23.2.3 Field Brinell Hardness Tester

A field Brinell hardness tester that has been calibrated. See section 2.21 for calibration requirements.

3.23.2.4 Other Equipment

A 12-inch metal rule graduated in 1/64-inch increments, a metal straightedge, and OD calipers are required. Any other equipment specified by the WPS is also required.

3.23.3 Preparation

a. All pipe shall be sequentially numbered and any original serial numbers recorded.

b. A Visual Tube Inspection (procedure 3.4), an OD Gage Tube Inspection (procedure 3.5), an Ultrasonic Wall Thickness Inspection (procedure 3.6), and an Electromagnetic Inspection (procedure 3.7), shall be performed on the drill pipe tubes prior to rebuilding to ensure that the tubes meet Premium Class requirements. Additional flaw detection inspections may also be used.

c. The tool joint ODs shall be measured as per section 3.12.4a. For the tool joints to be rebuilt, the following conditions must be met:
   - Tool joint OD must be greater than or equal to minimum Premium Class bevel diameter plus 1/16 inch.
   - The face of the box tool joint shall be a minimum of 5/32 inch.

d. The tool joint tong spaces shall be measured. There should be enough tong space to meet Premium Class requirements after applying (or re-applying) the desired length of hardbanding and recutting the connection. Build-up welding on the taper of the tool joint to extend the tong space is not allowed.

e. All hardbanding, whether flush or proud, must be removed prior to rebuilding the tool joints.

f. Inspect the tool joints in accordance with procedure 3.15, Blacklight Connection Inspection. Extend the coverage of blacklight connection inspection so that entire outside surface of the tool joint is examined. A tool joint with any cracks or crack-like indications is not allowed to be rebuilt.

g. Inspect the tool joints in accordance with procedure 3.8, Heat Checking Inspection. A tool joint with any cracks is not allowed to be rebuilt.

h. Printed copies of the WPS shall be present. If any conflicts arise between this specification and the welding engineer's requirements, the welding engineer's requirements shall apply.

i. Thread lubricants or storage compounds shall be fully removed from all connections.

j. The weld surfaces must be prepared according to the WPS instructions. This may involve visual inspection, non-destructive examination, and/or machining to prepare the component.

3.23.4 Procedure

a. The weld surface shall be visually examined. The area to be welded shall have a bright metal finish and be free from all foreign matter such as rust, grease, oil, paint, or pipe coating.

b. The tool joint shall be preheated and the preheat temperature monitored as required by the WPS. The preheat method shall be a "soaking" preheat whereby the component is uniformly heated throughout. Surface or spot heating using torches or other means is not allowed. During the preheat process, no carbon residue (soot) shall be permitted on the surfaces prior to weld application.

c. After the tool joint has reached the appropriate preheat temperature (as measured by the calibrated temperature sensor) and held at that temperature for the appropriate amount of time, the tool joint shall be welded as specified by the WPS. Weld parameters such as weld bead profile, weld quality (porosity, voids, blowholes, etc), and bead height shall be monitored during application and the welding parameters adjusted as necessary.

d. The temperature of the tool joint material and the coolant (if present) shall be monitored between weld passes to ensure that the ranges specified in the WPS are maintained.

e. After the tool joint has been built up to the proper dimensions (the final OD plus at least 1/8 inch for machining), the tool joint must be heat treated as prescribed in the WPS. The tool joint material temperatures reached shall be verified with a calibrated temperature sensor.

f. After the post-weld heat treatment is complete, the component shall be allowed to cool slowly using insulated cans or blankets according to the cooling schedule specified by the WPS. The insulation shall not be removed until the component reaches a temperature of 300 degrees F, verified with a calibrated temperature sensor.

3.23.5 Post Welding Requirements

3.23.5.1 Weld Quality Inspection

The welded material shall be visually examined, checking the following:

a. Porosity, Voids, and Blowholes: Any voids or holes in the weld material greater than 1/16 inch in diameter are rejectable. Chipping or flaking of the weld material is also cause for rejection.

b. Tie-In: The weld bands must tie in with the parent metal and other bands consistently with no deep voids. Grooves or voids at tie-in locations (weld band to parent material and between weld bands) must be less than 1/8 inch wide and 1/16 inch deep. Small areas of poor tie-in may be repaired by spot welding before the component is cool and prior to post-weld heat treatment, but repair welds shall not continue more than 45 degrees around the circumference of the component.

3.23.5.2 Weld Geometry

The weld geometry must meet the following and any other dimensional requirements specified in WPS. The weld shall be machined to a smooth surface with a consistent OD measurement and a smooth, accurate taper: 18 degrees (+2 degrees, -0 degree) on the box tool joint, 35 degrees (±2 degrees) on the pin. The transition radius between the tool joint taper and the tube body must be 1-1/2 inches, minimum.

3.23.5.3 Recut Connection

After any heat treatment the connections must be recut per the Shop Repair and Gaging of RSC method (procedure 3.31).

3.23.5.4 Blacklight Inspection

After the tool joint has been final machined, it shall be inspected using the Blacklight Connection Inspection method (procedure 3.15) covering both the newly-cut connection and the entire tool joint outside surface. Tool joints will also be inspected in accordance with procedure 3.8, Heat Checking Inspection. Any cracks or crack-like indications in the non-hardbanded areas are cause for rejection.

3.23.5.5 Hardness Testing

Brinell hardness testing shall be performed on every rebuilt tool joint, following the procedures outlined by the calibrated hardness test device. Hardness values must fall within the range of 285-341 BHN.

3.23.5.6 Marking

Acceptable tool joints shall be marked per the customer's specification. It is not necessary to retain the original serial numbers, but the pipe shall be numbered and records kept that allow traceability to the original serial numbers. An "RB" marking after the new serial number shall be used to signify that the tool joint has been rebuilt.

3.24 Stabilizer Inspection

3.24.1 Scope

This procedure covers the inspection requirements and acceptance criteria for stabilizers. Included are both ferromagnetic and nonmagnetic components.

3.24.2 Apparatus

The following equipment must be available for inspection: Paint marker, pit gage, metal scale, tape measure, a light capable of illuminating the entire internal surface, a calibrated light meter to verify illumination, a flat file or disk grinder, and stabilizer ring gage. An internal micrometer is also required. The ring gage thickness shall be 1/2 inch minimum and the gage width shall be 3/4 inch minimum. The gage inside diameter shall be the desired nominal blade diameter +0.005, -0 inch. The inside diameter of the ring gage shall be verified using internal micrometer. See section 2.21 for calibration requirements.

3.24.3 Preparation

Record the tool serial number and tool description. Reject the tool if no serial number can be located unless the customer waives this requirement.

3.24.4 Stress Relief Features Required

Unless waived by the customer, all end connections NC38 and larger on the stabilizer shall be equipped with pin stress relief grooves and boreback boxes. *(Note: Special-purpose stabilizers, like near bit stabilizers, do not require a boreback box when the box connection directly connects to the bit or the stabilizer requires inside diameters that do not accommodate a boreback box. When this occurs, specific dimensional acceptance criteria from the special stabilizer manufacturer shall apply.)*

3.24.5 Visual Connection Inspection

Inspect the connections, including midbody and sleeve connections on sleeve stabilizers, in accordance with procedure 3.11, Visual Connection Inspection, omitting sections 3.11.3a and 3.11.4a.

3.24.6 Dimensional Inspection

a. Inspect the connections in accordance with procedure 3.14, Dimensional 3 Inspection, using dimensions from Table 3.9 for acceptance, except in the case of near bit stabilizers. In this case, the dimensional requirements of Table 3.9 shall apply except with respect to the bevel diameter that is made up to the bit. Bit bevel diameters on near bit stabilizers shall comply with the ranges listed in paragraph 3.25.6d, Dimensional Inspection of Bit Subs.

b. Box OD and pin ID measurements shall result in a BSR within the customer's specified range for near bit stabilizers and other stabilizer connections that will join BHA components, except for connections that are made up to the bit or HWDP. Dimensions for commonly specified BSR ranges are given in Table 3.9. BSR values for various connections and sizes are provided in Table 3.16.

c. Measure stabilizer neck length on the upper connection (typically box). Neck length shall be as per table provided below. The minimum tong space on the lower connection (typically pin) shall be 7 inches or the tool shall be rejected.

Fishing Neck Length Requirements

Connection Outside Diameter (OD, inches)	Minimum Fishing Neck Length (inches)
OD ≤ 3 1/2	12
3 1/2 < OD ≤ 8	15
OD > 8	18

d. Crossover stabilizers shall have a minimum fishing neck length measured shoulder to taper as per table in paragraph 3.24.6c.

e. Float Bore Dimensions: On stabilizers equipped with float bores, the ID shall be free of flaws or pitting that will interfere with the valve's ability to seal. For box up float bores without stress relief features and for box down float bores, the float bore dimensions shall meet the dimensions given in Figure 3.25.2 and Table 3.12. If a baffle plate is to be used with the float valve the bore shall be visually inspected for the presence of a baffle recess as seen in Figure 3.25.3. If a baffle plate is to be used with a baffle plate recess (Figure 3.25.3), the baffle recess should be of sufficient depth to include the baffle plate and the float bore dimensions shall meet the dimensions given in Figure 3.25.3 and Table 3.12. If a baffle plate is to be used without a baffle plate recess (Figure 3.25.2) the float bore dimensions shall meet the dimensions given in Figure 3.25.2 and the float bore depth shall not exceed the bore depth listed in Table 3.12 plus the height of the baffle plate.

Note: If the Float Bore Diameter (R) and Connection Size do not match Table 3.12 values, calculate the Float Bore Depth (A) using Table 3.12.1.

3.24.7 Blacklight Inspection

Inspect the connections in accordance with procedure 3.15, Blacklight Connection Inspection. If the tool is nonmagnetic, substitute procedure 3.17, Liquid Penetrant Inspection for Blacklight Connection Inspection.

3.24.8 Visual Body Inspection

Visually examine the outside surface of the tool from shoulder to shoulder for mechanical damage. Any cut, gouge or similar imperfection deeper than 10% adjacent wall shall be rejected. Hardfacing material, if present, shall be visually examined for damages. Missing, chipped, or broken tungsten carbide tiles or inserts shall be cause for rejection unless waived by customer. Spalling and loss of matrix exceeding 1/16 inch in depth shall be rejected. For weld sections, any porosity, voids, and blowholes greater than 1/16 inch in diameter shall be a cause for rejection. In case of conflict with manufacturer's Weld Procedural Specification (WPS), manufacturer's WPS shall prevail.

3.24.9 Ring Gage Blade Inspection

Check the stabilizer blade diameter by sliding a ring gage over the length of the blades. The gage shall pass smoothly over the blades. Gaps between the gage and the blades shall not exceed 1/16 inch or the tool shall be rejected.

3.24.10 Magnetic Particle Body Inspection

Inspect the outside diameter from shoulder to shoulder (including the welds on welded blade stabilizers) in accordance with procedure 3.9, MPI Slip/Upset Inspection. (As an alternative to this step, the coverage area of the Blacklight Inspection from step 3.24.7 may be extended to cover the entire outside surface of the stabilizer.) Whichever procedure is used, the inspection of welds on welded blade stabilizers shall employ an AC yoke for magnetizing and shall be done twice, with the second field oriented perpendicular to the first. Any crack is cause for rejection, except that hairline cracks in the hardfacing are permissible if they do not extend into base metal which includes any welded and built-up sections. Any rejected cracks shall not be repaired or removed unless approved by the customer. If the stabilizer is nonmagnetic, procedure 3.17, Liquid Penetrant Inspection, shall be substituted for Magnetic Particle Inspection.

3.24.11 Post-Inspection Requirements

Clean and dry the connections and thread protectors. Apply thread compound and apply thread protectors. Mark an acceptable tool in accordance with the marking requirements specified for BHA components in procedure 3.35.

3.25 Sub Inspection

3.25.1 Scope

This procedure covers the inspection requirements and acceptance criteria for rotary drilling subs. Included are both ferromagnetic and nonmagnetic components.

3.25.2 Preparation

Record the tool serial number and description. Reject the tool if no serial number can be located unless the customer waives this requirement.

3.25.3 Apparatus

The following equipment must be available for inspection: Paint marker, pit gage, a light capable of illuminating the entire internal surface, a calibrated light meter to verify illumination, metal scale, tape measure, flat file or disk grinder. See section 2.21 for calibration requirements.

3.25.4 Stress Relief Features Required on BHA Subs

Bit subs and subs joining other BHA connections, with connections NC38 and larger, shall have pin stress relief grooves and boreback boxes or they shall be rejected. *(Note: Special-purpose subs, like bit subs, do not require a boreback box when the box connection directly connects to the bit or the subs require inside diameters that do not accommodate a boreback box. When this occurs, specific dimensional acceptance criteria from the special sub manufacturer shall apply. Special-purpose subs, like lift subs, do not require a stress relief groove.)*

3.25.5 Visual Connection Inspection

Inspect the connections in accordance with procedure 3.11, omitting sections 3.11.3a and 3.11.4a.

Note: For thread roots on lift subs, pitting is allowed on all threads as long as pitting does not occupy more than 1-1/2 inches in length along any thread helix or the pit depth does not exceed 1/32 inch or the pit diameter does not exceed 1/8 inch.

3.25.6 Dimensional Inspection

a. Inspect the connections of bit subs and subs that will join other BHA connections in accordance with procedure 3.14, Dimensional 3 Inspection, except that bevel diameter shall meet the requirements in steps b-d below, whichever applies, and the stress relief feature requirements shall be in accordance with paragraph 3.25.4. Box OD and pin ID measurements shall result in a BSR within the customer's specified range for bit subs and other sub connections that will join BHA components, except for connections made up to the bit or HWDP. Dimensions for commonly specified BSR ranges are given in Table 3.9. BSR values for various connection types and sizes are provided in Table 3.16.

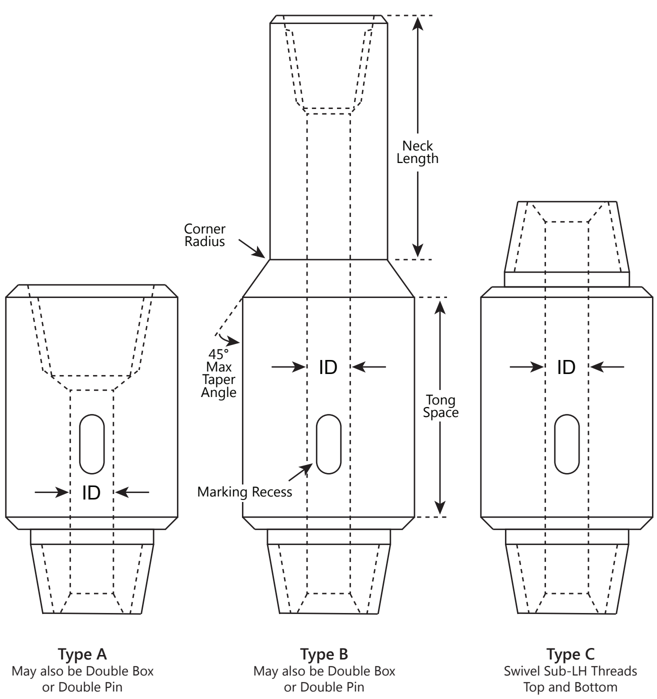


Figure 3.25.1 API drilling subs.

b. Bit subs and other sub connections that will join BHA components, except HWDP: Use bevel diameter from Table 3.9.

c. Sub connections joining HWDP: Use bevel diameters from Table 3.10.1–3.10.10, as applicable.

d. For bit sub connections joining bits: Use the following bevel diameter ranges.

	Bevel Diameter (in)	
Connection	Minimum	Maximum
2-3/8 Reg	3-1/32	3-1/16
2-7/8 Reg	3-19/32	3-5/8
3-1/2 Reg	4-3/32	4-1/8
4-1/2 Reg	5-5/16	5-11/32
6-5/8 Reg	7-11/32	7-3/8
7-5/8 Reg	8-29/64	8-31/64
8-5/8 Reg	9-17/32	9-9/16

e. Inspect the connections of subs that will join drill pipe connections or lower kelly connections in accordance with procedure 3.13, Dimensional 2 Inspection.

f. Tong space: Minimum tong space shall be 7 inches.

g. Inside Diameter: Subs with the same connection top and bottom shall have straight bores with inside diameter (ID) not greater than the ID of the largest pin to which the sub will be joined. Subs with different connections top and bottom may be equipped with step bores. In these subs, the torsional capacity of the pin with the larger ID may not be less than the torsional capacity of the connection on the other end of the sub.

h. Length: Measure overall length shoulder to shoulder. Measure neck length on type B subs. Subs shall meet the length requirements below or shall be rejected.

Type	Minimum Overall Length (in)	Minimum Neck Length (in)
A (box × box)	24	-
A (pin × pin)	12	-
A (box × pin)	16	-
B	see below	¶ 3.24.6c
C	8	-

For type B subs only: Minimum overall length requirement does not apply. The minimum fishing neck length is according to the requirements specified in paragraph 3.24.6c and the minimum tong space is 7 inches. The maximum OD taper angle shall not exceed 45 degrees.

Note: For box × pin Type B subs, the box side is considered the fishing side. For box × box, pin × pin, or subs run in the pin up configurations, the customer must specify the uphole connection to which the fishing neck applies.

i. Float bore dimensions: On subs equipped with float bores, the ID shall be free of flaws or pitting that will interfere with the valve's ability to seal. For box up float bores without stress relief features and for box down float bores, the float bore dimensions shall meet the dimensions given in Figure 3.25.2 and Table 3.12. If a baffle plate is to be used with the float valve, the bore shall be visually inspected for the presence of a baffle recess as seen in Figure 3.25.3. If a baffle plate is to be used with a baffle plate recess (Figure 3.25.3), the baffle recess should be of sufficient depth to include the baffle plate and the float bore dimensions shall meet the dimensions given in Figure 3.25.3 and Table 3.12. If a baffle plate is to be used without a baffle plate recess (Figure 3.25.2), the float bore dimensions shall meet the dimensions given in Figure 3.25.2 and the float bore depth shall not exceed the bore depth listed in Table 3.12 plus the height of the baffle plate.

Note: If the Float Bore Diameter (R) and Connection Size do not match Table 3.12 values, calculate the Float Bore Depth (A) using Table 3.12.1.

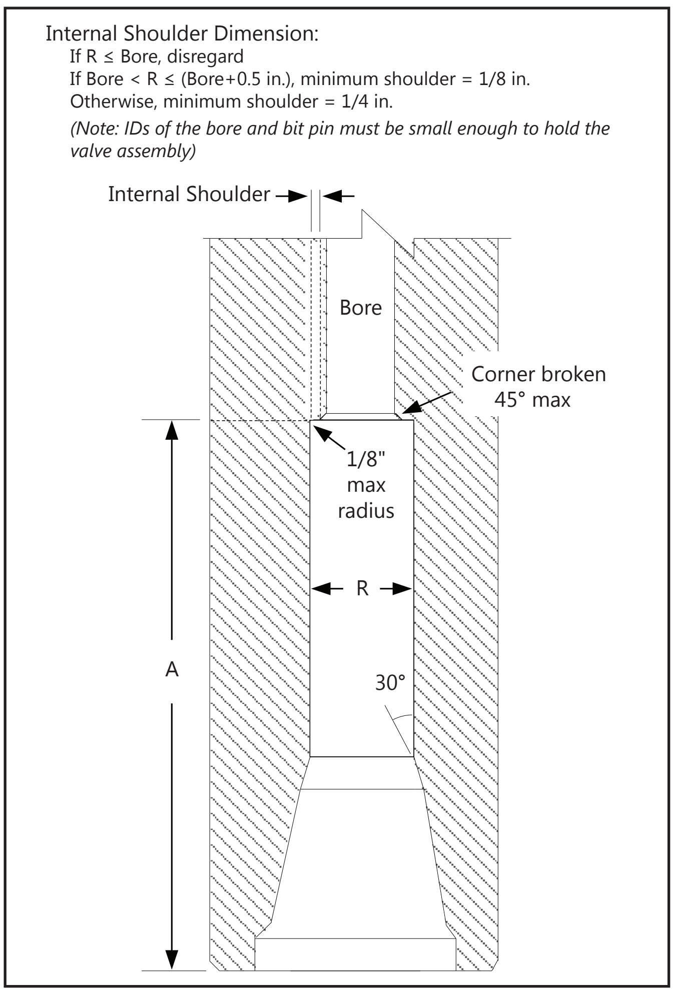


Figure 3.25.2 Float bore profile.

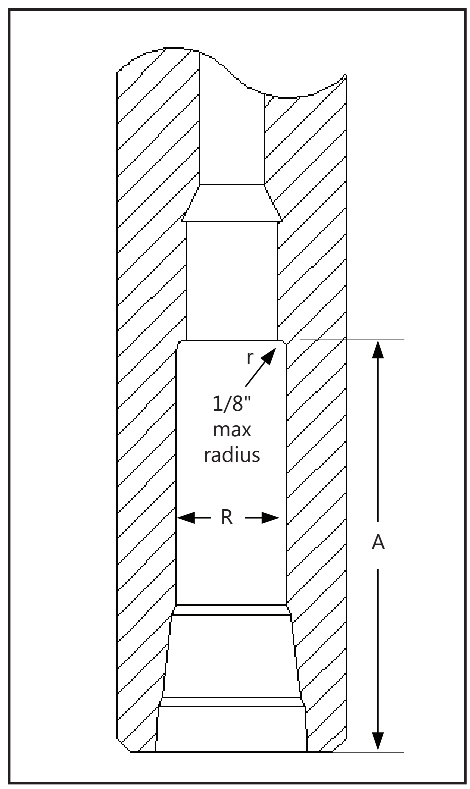


Figure 3.25.3 Float bore profile with baffle plate recess.

j. Lift sub dimensions: Lift subs for drilling equipment shall meet the dimensions shown in Figure 3.25.4 and the following (in inches):

D_P (±1/32)	D_L (+1/8, -0)	d (max)
2-3/8	3-1/2	1-49/64
2-7/8	4-1/4	2-9/64
3-1/2	5	2-45/64
4	6	3-17/64
4-1/2	6-1/4	3-49/64
5	6-1/2	3-49/64
5-1/2	7-1/4	4-1/64
5-7/8	7-9/16	4-17/64
6-5/8	8	5-1/64

Note: The taper angle is also allowed to be 90 degrees (a square-shouldered lift sub), but no other configurations are supported by this standard.

Other sizes of lift subs may be needed for specific operations, elevators, or pipe configurations. If the lift sub is to be rejected according to these requirements, the inspector should contact the end user to determine whether a waiver is necessary based on the expected operating conditions.

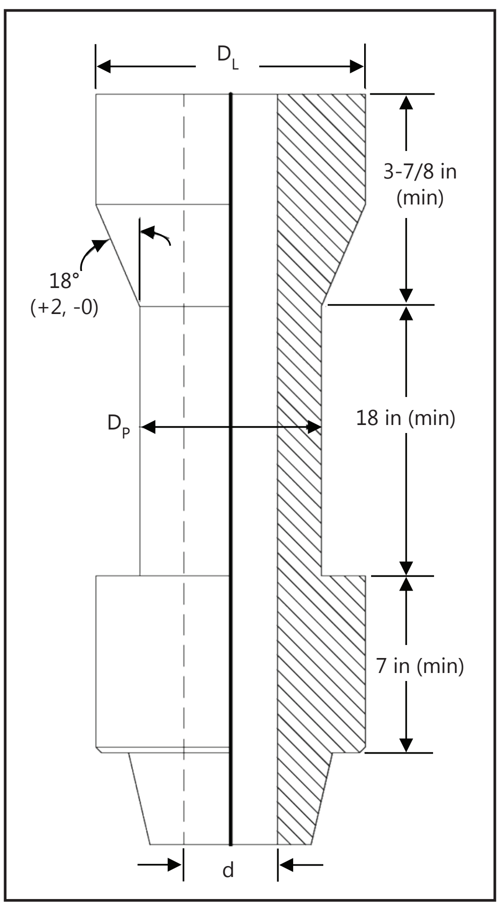


Figure 3.25.4 Lift sub dimensions.

3.25.7 Blacklight Connection Inspection

Inspect the end connections in accordance with procedure 3.15, Blacklight Connection Inspection. If the sub is nonmagnetic, substitute procedure 3.17, Liquid Penetrant Inspection, instead of Blacklight Connection Inspection.

3.25.8 Visual Body Inspection

a. Surface Condition: Visually examine the outside surface of the sub from shoulder to shoulder for mechanical damages. Any cut, gouge, or similar imperfection on the outside surface deeper than 10% of the adjacent wall shall be rejected. The outside and inside surfaces shall be clean so that the metal surface is visible and no surface particles larger than 1/8 inch in any dimension can be broken loose. Additionally, the inside diameter(s) of the sub shall be free of any obstruction or foreign objects.

b. Markings: The sub shall have a marking recess which shall show the manufacturer's name or mark, the words "SPEC 7-1," the upper and lower sub connections, and the inside diameter(s) of the sub. Information listed on the markings shall conform to the actual ID(s) and connections on the sub. (Subs which do not show these marks do not comply with API Specification 7-1.)

3.25.9 Magnetic Particle Body Inspection

Inspect the outside diameter from shoulder to shoulder in accordance with procedure 3.9, MPI Slip/Upset Inspection. Any crack shall be rejected. If the sub is manufactured from non-magnetic materials, procedure 3.17, Liquid Penetrant Inspection, shall be substituted for Magnetic Particle Inspection.

3.25.10 Post-Inspection Requirements

Clean and dry the connections and thread protectors. Apply thread compound and apply thread protectors. Mark an acceptable tool in accordance with the marking requirements specified for BHA components in procedure 3.35.

3.26 Pup Joint Inspection 1

3.26.1 Scope

This procedure covers Visual Tube inspection, Visual Connection inspection, and Dimensional 1 inspection of integral and welded pup joints.

3.26.2 Apparatus

The following equipment must be available:

a. Paint marker, pit depth gage, ultrasonic thickness gage, and a light capable of illuminating the entire accessible internal surface of the tool, calibrated angle gages, 12-inch metal rule graduated in 1/64 inch increments, a metal straight-edge, a calibrated hardened and ground profile gage, OD calipers, and ID calipers are required. See section 2.21 for calibration requirements.

b. A calibrated lead gage and a calibrated standard lead template are also required. See section 2.21 for calibration requirements.

c. A calibrated light meter to verify illumination is also required. See section 2.21 for calibration requirements.

d. Apparatus requirements for every inspection method referenced in this procedure shall be applicable in addition to the apparatus requirements specified above.

3.26.3 Preparation

a. All pup joints shall be sequentially numbered.

b. The tube surfaces shall be clean so that the metal surface is visible and no surface particles larger than 1/8 inch in any dimension can be broken loose with a fingernail.

c. The tool joints shall be clean so that nothing interferes with measurement of any dimension.

d. Connections shall be clean so that no scale, mud, or lubricant can be wiped from the thread or shoulder surfaces with a clean rag.

e. For integral pup joints, record the pup joint serial number. The joint shall be rejected if:

   - The serial number is not found, or
   - Traceability to the material properties (including documentation of yield strength, tensile strength, elongation, and impact strength) of the pup joint cannot be achieved through the serial number.

   The integral pup joint may be accepted if the above requirements are waived by the customer and the waiver is provided in writing.

f. For welded pup joints, the grade and weight stencil shall be marked on either the pin milled slot or the pin neck in accordance with Figure 3.11.1. If marked in both locations, the markings on the pin neck must agree with those on the milled slot. If neither marking is present, the joint shall be rejected unless traceability to the grade and weight of the joint is achieved through the manufacturer's joint serial number.

3.26.4 Visual Tube Inspection

Inspect the entire internal and external surface of the pup joint between the tool joint tapers in accordance with procedure 3.4, omitting steps 3.4.3a and 3.4.3b. Surface imperfections that cause the remaining wall thickness under the imperfection to be less than the acceptance criteria listed in Table 3.5.3, or cuts (as defined in 3.4.4b) that are deeper than the acceptance criteria listed in Table 3.5.3, shall be cause for rejection. ID pitting found during the visual examination shall not exceed 1/8 inch in depth as measured or visually estimated.

3.26.5 Visual Connection Inspection

Inspect the pup joint connections in accordance with procedure 3.11, omitting steps 3.11.3a, 3.11.3b, and 3.11.4a.

3.26.6 Dimensional Inspection

Inspect the pup joints in accordance with procedure 3.12 Dimensional 1 Inspection omitting step 3.12.3a. The acceptance criteria for tool joint OD, pin ID, box shoulder width, and tong space shall be determined by an agreement between the vendor and the customer.

3.26.7 Post-Inspection Requirements

Clean and dry the connections and thread protectors. Apply thread compound and thread protectors. Mark an acceptable integral or welded pup joint in accordance with the marking requirements specified for thick-walled drill pipe in procedure 3.35.

3.27 Pup Joint Inspection 2

3.27.1 Scope

This procedure covers the inspection requirements and acceptance criteria for welded and integral pup joints. The requirements listed in this procedure are more comprehensive than the requirements in Pup Joint Inspection 1.

3.27.2 Apparatus

The following equipment must be available:

a. Paint marker, pit depth gage, ultrasonic thickness gage, and a light capable of illuminating the entire accessible internal surface of the tool, calibrated angle gages, 12-inch metal rule graduated in 1/64 inch increments, a metal straight-edge, a calibrated hardened and ground profile gage, OD calipers and ID calipers are required. See section 2.21 for calibration requirements.

b. A calibrated lead gage and a calibrated standard lead template are also required. See section 2.21 for calibration requirements.

c. A calibrated light meter to verify illumination is also required. See section 2.21 for calibration requirements.

d. Apparatus requirements for every inspection method referenced in this procedure shall be applicable in addition to the apparatus requirements specified above.

3.27.3 Preparation

a. All pup joints shall be sequentially numbered.

b. The tube surfaces shall be clean so that the metal surface is visible and no surface particles larger than 1/8 inch in any dimension can be broken loose with a fingernail.

c. The tool joints shall be clean so that nothing interferes with measurement of any dimension.

d. Connections shall be clean so that no scale, mud, or lubricant can be wiped from the thread or shoulder surfaces with a clean rag.

e. For integral pup joints, record the pup joint serial number. The joint shall be rejected if:

- The serial number is not found, or
- Traceability to the material properties (including documentation of yield strength, tensile strength, elongation, and impact strength) of the pup joint cannot be achieved through the serial number.

The integral pup joint may be accepted if the above requirements are waived by the customer and the waiver is provided in writing.

f. For welded pup joints, the grade and weight stencil shall be marked on either the pin milled slot or the pin neck in accordance with Figure 3.11.1. If marked in both locations, the markings on the pin neck must agree with those on the milled slot. If neither marking is present, the joint shall be rejected unless traceability to the grade and weight of the joint is achieved through the manufacturer's joint serial number.

3.27.4 Procedure for Integral & Welded Pup Joints

3.27.4.1 Visual Tube Inspection

Inspect the entire internal and external surface of the pup joint between the tool joint tapers in accordance with procedure 3.4, omitting steps 3.4.3a and 3.4.3b. Surface imperfections that cause the remaining wall thickness under the imperfection to be less than the acceptance criteria listed in Table 3.5.3, or cuts (as defined in 3.4.4b) that are deeper than the acceptance criteria listed in Table 3.5.3, shall be cause for rejection. ID pitting found during the visual examination shall not exceed 1/8 inch in depth as measured or visually estimated.

3.27.4.2 Visual Connection Inspection

Inspect the pup joint connections in accordance with procedure 3.11, omitting steps 3.11.3a, 3.11.3b and 3.11.4a.

3.27.4.3 Dimensional Inspection

Inspect the pup joints in accordance with procedure 3.13, Dimensional 2 Inspection omitting step 3.13.3a. The acceptance criteria for tool joint OD, pin ID, box shoulder width, tong space, box counterbore diameter, and bevel diameter shall be determined by an agreement between the vendor and the customer.

3.27.4.4 Full Length Magnetic Particle Inspection (FLMPI)

This procedure covers inspection of the external surfaces of the pup joint tube in accordance with procedure 3.9, Magnetic Particle Inspection of Slip/Upset Areas. The inspection coverage includes the entire tube volume between the box and pin tool joint tapers. Any crack is cause for rejection. Grinding to remove cracks is not permitted. Other imperfections shall not exceed the specified limits given in Table 3.5.3. If the pup joint is nonmagnetic, procedure 3.17 Liquid Penetrant Inspection shall be substituted for Magnetic Particle Inspection.

3.27.4.5 Blacklight Connection Inspection

Inspect the pup joint connections in accordance with procedure 3.15, Blacklight Connection Inspection. If the pup joint is nonmagnetic, procedure 3.17, Liquid Penetrant Inspection shall be substituted for Magnetic Particle Inspection.

3.27.4.6 Heat Checking Inspection

Inspect the box tool joint of the pup joint in accordance with procedure 3.8, Heat Checking Inspection. If the pup joint is nonmagnetic, procedure 3.17, Liquid Penetrant Inspection shall be substituted for Magnetic Particle Inspection.

3.27.5 Additional Procedures for Welded Pup Joints Only

The following additional inspection procedures shall be performed for welded pup joints. The acceptance criteria and requirements for the additional inspection procedures shall be based on project specific criteria or the equivalent "class" of the welded pup joint specified by the customer.

3.27.5.1 OD Gage Tube Inspection

Inspect the entire length of the welded pup joint tube for outside diameter variations in accordance with procedure 3.5. Tubes with an OD reduction or increase exceeding the requirements specified in Table 3.5.3 shall be rejected.

3.27.5.2 Ultrasonic Wall Thickness Inspection

Inspect the tube of the welded pup joint near the center of the tube and at points of obvious wear in accordance with procedure 3.6, omitting step 3.6.3a. Tubes that do not meet the applicable requirements in Table 3.5.3 shall be rejected.

3.27.5.3 Ultrasonic Slip/Upset Area Inspection

Inspect the slip and upset areas of the welded pup joint in accordance with procedure 3.10, omitting step 3.10.3a.

3.27.6 Post-Inspection Requirements

Clean and dry the connections and thread protectors. Apply thread compound and thread protectors. Mark an acceptable integral or welded pup joint in accordance with the marking requirements specified for thick-walled drill pipe in procedure 3.35.

3.28 Shop Inspection of Fishing Tools

Foreword: In Standard DS-1, inspection and qualification of fishing tools is specified in both Volumes 3 and 4. Volume 3 addresses the inspection of fishing tools that consist of a single piece with no component pieces (except welded sections). Examples include washpipe, junk mills, etc. Volume 4, first published with fourth edition, addresses fishing tools that are assembled from two or more components or sub-tools. Examples of such fishing tools include overshots, spear pack-off, etc.

3.28.1 Scope and Objective

This procedure covers inspection requirements and acceptance criteria for fishing tools that consist of a single piece with no component pieces (except welded sections). The inspections outlined in this procedure are intended to help ensure structural soundness of the fishing tools. This procedure does not address functionality or wear resistance of the tools.

Compared to most other drill stem components covered by this standard, fishing tools are unique in several respects:

a. They come in a wide variety of geometric and mechanical configurations.

b. They often incorporate welded-on subcomponents and parts that are subject to very high operating stresses.

c. Welded and brazed hardsurfaced areas are quite common on fishing tools and subcomponents.

d. Tools are often developed for specialty applications and are not covered by industry-wide material or manufacturing standards.

Because of their nature, it is not possible to develop a simple written procedure that will foresee all configurations and answer all questions that might arise during fishing tool inspection. However, every effort has been made to make this procedure applicable to the widest variety of tools, and in most cases the procedure will adequately address the inspector's needs. If the instructions are clear, the inspector is required to follow them explicitly. However, because of the variety and complexity of fishing tools, the inspector may sometimes be faced with an accept/reject decision that is not clearly spelled out by this procedure. Should this occur, the inspector must advise the customer, giving the particulars of the situation, and the customer will decide whether or not the tool is acceptable for use.

3.28.2 Definitions

The following definitions will apply in this procedure.

3.28.2.1 Acceptance Criteria

The specific attributes or flaw severity which, if present, will render a fishing tool unfit for further use under this standard. Acceptance criteria are tightest in structural base metal and weld metal, and least tight in hardsurfacing metal. Acceptance criteria for non-structural base metal are intermediate between these two extremes.

3.28.2.2 Customer

The party on whose behalf the inspection is being conducted. When the fishing tool owner contracts an inspection company to inspect tools for the tool owner's inventory, the customer is the tool owner. If the tools are being inspected in anticipation of possible use in a specific hole or holes, the customer is the company owning the hole(s) in which the tools may be used.

3.28.2.3 End Connections

Connections that join a fishing tool to the drill string component(s) immediately above and below the tool.

3.28.2.4 Metals

Metals in this procedure are classified according to their use in a particular fishing tool. Five different classifications are recognized:

a. Base Metal (Structural): A portion of the tool which, if it fails, could result in string separation or loss of all or a significant part of a pinned-on or bolted-on component. Structural base metal specifically encompasses all metal meeting the following tests:

- All metal located inside a projection of an imaginary cylinder encircling the end connection or connections (Figure 3.28.1). If two end connections on a tool have different outside diameters, or if the tool has only one end connection and a body outside diameter that is different from the end connection outside diameter, two imaginary cylinders shall be projected to establish structural base metal (Figure 3.28.2).
- Portions of a tool or component that lie within two hole diameters of a hole, excluding hardsurface metal (Figure 3.28.3).
- Any other metal which, in the opinion of the inspector, meets the general definition for structural base metal above.

b. Base Metal (Non-Structural): Metal whose failure will not result in string separation or loss of all or a significant part of a component. Non-structural base metal specifically includes all metal meeting the following tests:

- A metallic component that is attached by welding to structural base metal (such as a blade on a welded-blade stabilizer or mill) but not including weld metal or hardsurface metal (Figure 3.28.2).
- Metal located outside a projection of a cylinder or cylinders encircling the end connection(s), unless such metal meets the requirements for structural base metal above (Figure 3.28.1).

c. Hardsurface Metal: Metal deposited on base metal by welding or brazing, and intended for the purpose of improving wear resistance or cutting ability of the fishing tool.

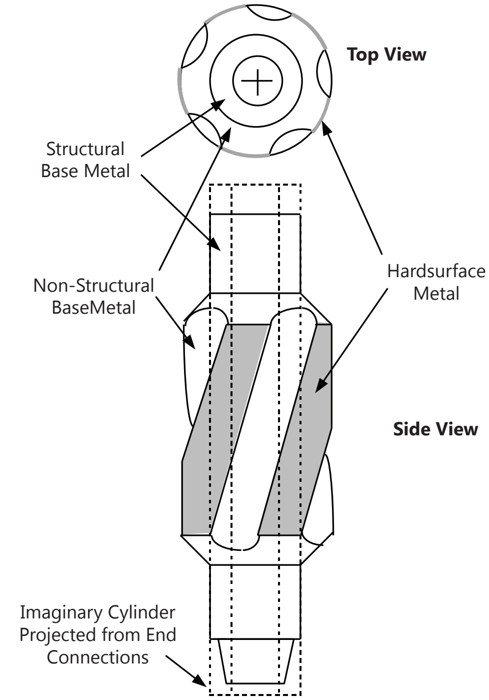


Figure 3.28.1 Metal classification on an example integral blade string mill.

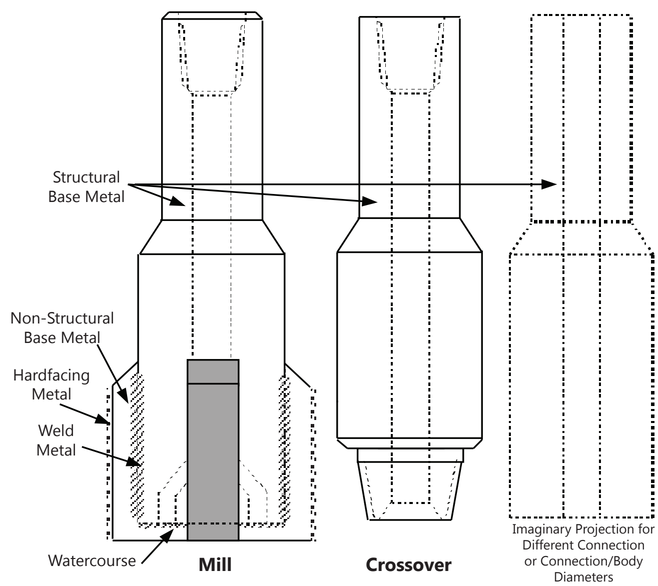


Figure 3.28.2 Metal classification on example tools.

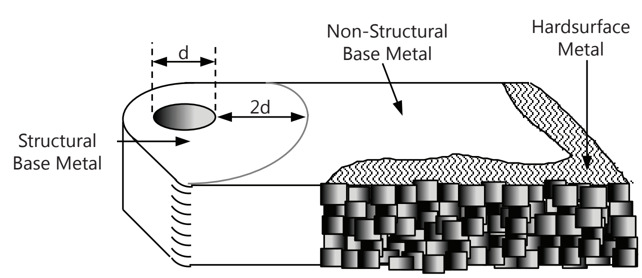


Figure 3.28.3 Metal classification on an example cutter blade.

d. Other Metal: Any metal that does not clearly meet one of the definitions for base metal, weld metal, or hardsurface metal.

e. Weld Metal: Metal deposited during a welding process for the purpose of attaching one component of a tool to another, not including hardsurface metal. Weld metal is primarily intended to provide structural support between two metallic components, neither of which is hardsurface metal (Figure 3.28.2).

3.28.2.5 Tap Wickers
Threads cut on fishing taps for the purpose of grasping the object being fished.

3.28.2.6 Strap Welding
The procedure of welding a strip or strips of metal across a connection to prevent inadvertent back out.

3.28.3 Apparatus
The following equipment must be available for inspection: Manufacturer's shop/assembly manual for the tool being inspected, paint marker, pit depth gage, OD ring gage, drift, a light capable of illuminating the entire internal surfaces of the tool and its subcomponents, metal scale, tape measure, and a flat file or disk grinder. A calibrated internal micrometer is also required. See section 2.21 for calibration requirements. The tools referenced in procedures 3.11, Visual Connection Inspection, 3.14, Dimensional 3 Inspection, 3.15, Blacklight Connection Inspection, and 3.9, MPI Slip/Upset Inspection are also required.

3.28.4 Preparation
Record the tool serial number and tool description. Reject the tool if no serial number can be located.

3.28.5 Cleaning
All surfaces to be inspected shall be clean, and all traces of thread dope and other foreign matter shall be completely removed from thread roots.

3.28.6 Stress Relief Features Required
End connections NC38 and larger on the tools so detailed in Table 3.2 shall be equipped with pin stress relief grooves and boreback boxes. Stress relief features are not required on end connections smaller than NC38.

3.28.7 Visual Connection Inspection

3.28.7.1 End Connections - Except on Washpipe
Inspect the end connections in accordance with procedure 3.11, omitting sections 3.11.3a and 3.11.4a. A number of fishing tools, such as taper taps, box taps, rope spears, impression blocks, and magnets, do not require a fluid seal at the shoulder. If it can be established with the customer that the fishing tool does not require a fluid seal, replace section 3.11.5.7 with the following section:

Non sealing shoulder: The shoulder surfaces shall be free of raised metal or corrosion deposits detected visually or by rubbing a metal scale or fingernail across the surface. Filing to remove raised metal is permitted.

3.28.7.2 Connections on Washpipe
Inspect these connections as follows:

a. Seal Surfaces: If the connection forms a pressure seal, the seal surfaces shall be free of raised metal or protruding corrosion deposits detected visually or by rubbing a metal scale or fingernail across the surface. Any pitting or interruptions of the seal surface that are estimated to exceed 1/32 inch in depth or occupy more than 20% of the seal width at any given location are cause for rejection. No filing of the seal surface is permitted.

b. Threads (excluding tap wickers): Thread surfaces shall be free of pits or other imperfections that appear to exceed 1/16 inch in depth or 1/8 inch in diameter, that penetrate below the thread root, or that occupy more than 1-1/2 inches in length along any thread helix. Raised protrusions may be removed with a hand file or "soft" (nonmetallic) buffing wheel. Metal removal below the plane of the thread surface is prohibited.

3.28.7.3 Tap Wickers
The wicker area of taps shall have no pulled or stripped threads within the catch area (as specified in the manufacturer's shop/assembly manual) and out to 2 inches on either side of the catch area. Wickers shall also be free of pits which appear to exceed 1/16 inch in depth or 1/8 inch in diameter, or which penetrate below the thread root, or which occupy more than 1-1/2 inches in length along any thread helix.

3.28.8 Dimensional 3 Connection Inspection
Inspect end connections of all tools (except washpipe end connections) in accordance with procedure 3.14, Dimensional 3 Inspection, using dimensions from Table 3.9 for acceptance. Tools which will connect with tools having bit bevel diameters shall have bevel diameters within the ranges listed in 3.25.6d.

3.28.9 Blacklight Connection Inspection
Inspect the end connections (including washpipe end connections) in accordance with procedure 3.15, Blacklight Connection Inspection.

Table 3.2 Stress Relief Features Required

Product Type	Boreback Box and Stress Relief Pins Required? (Yes/No)
Internal/External Cutter Tools	
Outside Cutter	No
Inside Cutter	No
Internal/External Engagement Tools	
Box Taps	No
Taper Taps	No
Overshots	No
Rope Spear	No
Spear Pack-Off	No
Casing and Tubing Spears	No
Mills and Shoes	
Rotary Shoes	No
Junk Mills	No
Pilot Mills	No
String and Watermelon Mills	Yes
Taper Mills	No
Packer Milling and Retrieving Tools	No
Junk Retrieval Tools	
Junk Baskets*	No
Internal Boot Baskets	No
Boot Baskets*	No
Washpipe Boot Baskets	No
Casing Repair Equipment	
Casing Patch	No
Wellbore Clean-up Tools	
Casing Scraper*	No
Casing Brush*	No
Casing Basket*	No
Magnet*	No
Circulating Tools*	No
Filters*	No
Jetting Tools*	No
Other Tools	
Key Seat Wiper	Yes
Casing Scraper*	No
Drilling Safety Joint*	No
Triple Connection Bushing	No
Washpipe Safety Joint	Yes
Rotary Subs*	No
Pony Collars	Yes
Drill Collars	Yes
Drill Pipe	No
Heavy Weight Drill Pipe	Yes
Fishing Magnets	No
Impression Blocks	No
Bumper Subs*	No
Jars*	No
Accelerators*	No
Knuckle Joints	No
Washpipe	No

Note: Stress relief feature requirements for tools not on this list shall be established or waived by the customer.

*Tools highlighted by an asterisk do not require stress relief features if they are (1) used exclusively for fishing or (2) used inside casing and not used in a rotary drilling application. However, if these tools are used for rotary drilling, stress relief features are required.

3.28.10 Visual/Dimensional Body Inspection

3.28.10.1 Cuts, Gouges, and Similar Flaws - Except on Wash Pipe

Refer to the manufacturer's shop/assembly manual to determine the manufacturer's recommended limits for cuts, gouges, and similar flaws. Examine the outside surfaces of the tool case, arms, cutters, and other components for mechanical damage. A cut, gouge, or similar flaw on structural base metal surfaces shall be cause for rejection of a component if the flaw:

a. Is deeper than 15% of the adjacent wall thickness for tubular components such as tool bodies.

b. Is deeper than 15% of the component thickness for solid components such as cutter arms. Thickness of a solid component is defined as the smallest distance between opposite surfaces, measured at the thinnest point (see Figure 3.28.4 for examples).

c. Is greater than 0.25 inch in depth for odd-shaped components.

d. Exceeds the limits given in the manufacturer's shop/assembly manual for the tool in question.

In cases where the flaw size exceeds the limits in a. through c. above, but does not exceed the specific limits allowed in the manufacturer's shop/assembly manual, or no flaw size limitation is listed in the manufacturer's shop/assembly manual, the manufacturer's engineering department may further evaluate and accept the flawed component, provided it does so in writing with reference to the specific flaw(s) in question. If the manufacturer's engineering department evaluates and accepts the flaw in writing, the tool shall be accepted, and the written acceptance shall become part of the inspection report to the customer. Otherwise, the part must be rejected.

3.28.10.2 Cuts, Gouges, and Similar Flaws on Wash Pipe

Body visual acceptance criteria for wash pipe is listed in Table 3.3.

3.28.10.3 Neck Length on Bottleneck Fishing Subs

Bottleneck crossover subs used exclusively for fishing shall have a minimum fishing neck length of 10 inches, measured from shoulder bevel to taper, and a minimum tong space of 7 inches (see Figure 3.28.5). This requirement applies only to bottleneck crossover subs, since some fishing tools are designed with shorter fishing necks and tong space.

Subs which will be used exclusively for rotary drilling shall meet the requirements of procedure 3.25, Sub Inspection.

3.28.10.4 Strap Welding

Tools that show evidence of having been strap welded shall be rejected unless this requirement is waived by the customer.

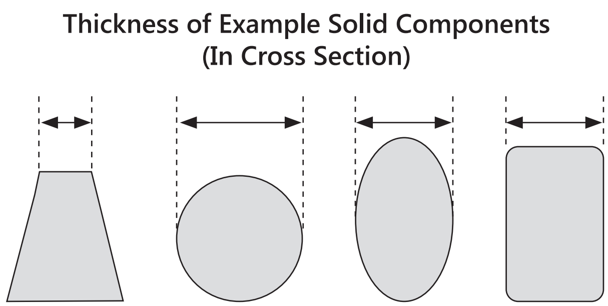


Figure 3.28.4 Measuring the "thickness" of a solid component. Measure the smaller cross-section dimension at the point where it is thinnest.

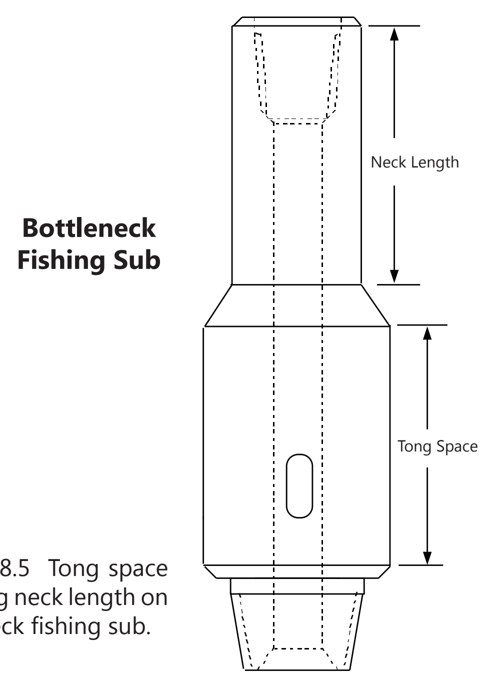


Figure 3.28.5 Tong space and fishing neck length on a bottleneck fishing sub.

3.28.11 Magnetic Particle Body Inspection

Inspect the ferromagnetic outside surfaces of tools and components, including weld areas and arms, in accordance with procedure 3.9, MPI Slip/Upset Inspection. The inspection should be performed with an AC yoke for magnetizing and shall be done twice, with the second field oriented perpendicular to the first. Non-ferromagnetic outside surfaces shall be inspected in accordance with procedure 3.17, Liquid Penetrant Inspection. Cracks shall be evaluated in accordance with paragraph 3.28.13.

Surfaces that cannot practically be magnetized with an AC yoke shall be inspected using a residual magnetic field applied in accordance with procedure 3.29, Residual Magnetic Particle Inspection Method.

3.28.12 Verifying Specified Critical Dimensions

The customer may have specific tool dimensions which are critical for the anticipated operation. These might include maximum outside diameter, minimum inside diameter, or other dimension. If so, the customer shall provide a list of tools and their respective critical dimensions and tolerances to the inspector for verification. Unless so notified, the inspector is not required to verify any dimensions other than those listed elsewhere in this procedure. If so notified, the inspector shall measure these dimensions as follows:

3.28.12.1 Outside Diameter (OD)

a. The OD of tools which have cylindrical machined surfaces shall be measured with spring calipers and a steel rule. At least two measurements shall be taken at 90 degrees ±10 degrees intervals, with the largest OD reported. Unless specified otherwise by the customer, the OD shall be the nominal tool OD +1/32 inch, -1/8 inch.

b. For tools whose ODs are not cylindrical machined surfaces, such as stabilizers and mills, the OD shall be measured using ring gages. Unless specified otherwise by the customer, the ring gage thickness shall be 1/2 inch minimum and the gage width shall be 3/4 inch minimum. The gage inside diameter shall be the desired nominal OD +0.005, -0 inch. The inside diameter of the ring gage shall be verified using internal micrometer specified in paragraph 3.28.3.

Table 3.3 Acceptance Criteria for Used Washpipe

Type of Imperfection	Location of Imperfection	Acceptance Criteria
Cuts, gouges, corrosion, erosion, and wear	All inside and outside surfaces except at the box connections	Remaining wall thickness ≥70% of new nominal.[1] Depth of imperfection ≤15% of adjacent wall thickness.[2]
Dents, mashes, slip area crushing or necking, stretching, and other diameter variations	Outside surface, except at box connection	Not more than 2% or 0.250 inch (whichever is smaller) reduction or increase from new nominal diameter.
Cuts, gouges, corrosion, erosion, wear, dents, and mashes	Box connection outside surface	See Note 3.
Fatigue cracks, cracks not originating in hardmetal or weld material, and cracks in base metal within two diameters of pin or bolt hole	Any	None allowed. Removal by grinding is not permitted.

[1] After subtracting the maximum depth of imperfection.

[2] Rejectable imperfections (defects) may be removed by grinding provided that wall thickness is not reduced below 70% of new nominal. Such grinding shall be faired into the outer contour of the pipe. The total longitudinal length of grinding in the slip area shall not exceed 1.5 inches.

[3] Transverse cuts or grooves exceeding 0.010 inches in depth or 0.5 inches in length are not permitted in the area over washpipe box threads. OD reductions in the box threaded area are limited to the smaller of 2% of nominal OD or the value calculated by the following formula:

(Min. OD) = (Nom. OD) - 0.125(Nom. WT)

Where:

Min. OD	=	Minimum outside diameter over box threads (inches)
Nom. OD	=	New nominal outside diameter of wash pipe (inches)
Nom. WT	=	New nominal wall thickness of wash pipe (inches)

The gage shall pass smoothly over arms or cutters. Gaps between the gage and arms/cutters/tool OD shall not exceed 1/16 inch or the tool shall be rejected.

3.28.12.2 Inside Diameter (ID)

The ID of tools shall be verified by passing a drift mandrel through the length of the tool. Unless specified otherwise by the customer, the drift mandrel shall have a minimum length of 18 inches and a diameter equal to the required minimum tool ID -0, +1/32 inch. *Note: Unless otherwise specified by the customer, the required minimum tool ID shall be the outside diameter of the largest device to be run through the fishing tool.*

3.28.12.3 Length

Unless specified otherwise by the customer, critical lengths shall be measured parallel to the axis of the tool. Specified critical lengths up to 12 inches shall be measured using a steel rule. Lengths greater than 12 inches shall be measured with a steel tape. Unless specified otherwise by the customer, the tolerances on critical lengths shall be ±1/16 inch for lengths less than or equal to 12 inches, and ±1/8 inch for lengths greater than 12 inches.

3.28.13 Acceptance Criteria for Cracks and Crack-Like Indications

3.28.13.1 Hardsurfaced Metal

Crack indications are acceptable in hardsurface metal provided that either crack width is no greater than 3/32 inch, or crack length does not exceed 0.25 inch.

3.28.13.2 Non-Structural Base Metal–Except in Cutter Knives

Crack indications in non-structural base metal are limited to those that originate in hardsurfaced regions and have a major dimension no more than 0.25 inch.

3.28.13.3 Non-Structural Base Metal–In Cutter Knives

Cracks in non-structural base metal in cutter knives must originate in hardsurface metal and may not be longer or deeper than 0.5 inch or 25% of the non-structural base metal thickness measured parallel to the crack. When measuring depth, measure from the outer surface of the hardsurface metal to the tip of the crack. If the hardsurface metal outer surface is irregular, measure from the point that will yield the largest crack.

3.28.13.4 Structural Base Metal

All cracks in structural base metal are cause for rejection except cracks originating from water courses in mills. Cracks originating from water courses in mills are acceptable up to a maximum crack length 0.5 inch, measured on its longest dimension.

3.28.13.5 Weld Metal and Other Metal

Cracks are not permitted in weld metal and other metal.

3.28.13.6 Indeterminate Metal

If the location of a crack is relevant to the acceptance or rejection of a component, but the type of metal surrounding the crack is in question, the inspector shall use the acceptance criteria for the more stringent location.

3.28.13.7 Reference Photographs

To assist the inspector, Figures 3.28.6 through 3.28.17 show examples of acceptable and rejectable conditions.

3.28.14 Repair of Cracks

Except for the exclusions below, cracks and crack-like indications which are cause for rejection may be repaired by welding provided that they are repaired in accordance with the tool owner's written weld procedure specification (WPS). These procedures and supporting documents such as procedure qualification reports (PQR) and welder performance qualification records (WPQ) shall be made available to the customer or his representative upon request. Cracks that may not be repaired by welding include:

- Any fatigue crack or any crack in base metal that does not originate in either weld metal or hardsurface metal.
- A crack in structural base metal that is within two diameters of a pin or bolt hole.

3.28.15 Removal of Non-Repairable Cracks

Cracks or crack-like indications that fall within the exclusions above are not repairable by welding. If practical, these cracks may be removed by cropping and the cropped end re-machined to a usable state. Grinding to remove these defects is not allowed.

3.28.16 Re-Inspection of Repaired Cracks

After repair or removal of rejectable cracks and crack-like indications, the repaired part must be reinspected to verify the defect is no longer present.

3.28.17 Post-Inspection Requirements

Clean and dry the connections and thread protectors. Apply thread compound and apply thread protectors. Mark an acceptable tool in accordance with the marking requirements specified for BHA components in procedure 3.35.

Photos courtesy of Weatherford International

Figure 3.28.6 Rejectable cracks in structural base metal (arrow). The cracked surface lies within the imaginary cylinder formed by the connection ODs.

Figure 3.28.7 A cutter blade. Cracks in structural base metal near the pin hole (left) are rejectable. The acceptable crack at right is in non-structural base metal, originates in hardsurface metal and is less than 0.5 inch deep.

Figure 3.28.8 Cracks on this mill are rejectable. The crack is not in structural base metal, but it does not originate in hardsurface metal. Crack depth is unknown.

Figure 3.28.9 This crack on a cutter blade is rejectable because it is in structural base metal (within two hole diameters of the pin hole).

Figure 3.28.10 Rejectable cracks in non structural base metal (arrows). The cracks are larger than permitted.

Figure 3.28.11 Acceptable cracks (less than 0.5 inch long) in non-structural base metal on a cutter knife.

Photos courtesy of Weatherford International

Figure 3.28.12 These cracks in structural base metal are acceptable because they originate in a watercourse and are smaller than the allowed length.

Figure 3.28.13 Cracks on this tool body are cause for rejecting the part, as they occur in structural base metal.

Figure 3.28.14 These cracks on a cutter blade are in structural base metal (within two hole diameters of the pin hole), and the component must be rejected.

Figure 3.28.15 Crack like indications in structural base metal on this WB pilot mill are cause for rejection, even though the indications may be due to poor weld practice.

Figure 3.28.16 Rejectable cracks in non-structural base metal. Cracks are longer than 0.25 inch.

Figure 3.28.17 Rejectable cracks in structural base metal (arrow). Failure at this point would result in loss of a significant part of the cutter blade.

3.29 Residual Magnetic Particle Inspection Method

3.29.1 Scope and Purpose

This procedure is intended only for inspection of ferromagnetic surfaces on which an active field cannot practically be used. The purpose of this procedure is to detect transverse, longitudinal, and oblique flaws using either the wet fluorescent residual magnetic particle technique or the dry visible residual magnetic particle technique.

3.29.2 Inspection Apparatus

3.29.2.1 General Apparatus

a. A direct current (DC) source and conductor are required to magnetize the inspection surfaces.

b. Required magnetic particle field indicators (MPFI) include a pocket magnetometer (Figure 3.29.1) and either a magnetic flux indicator strip or a magnetic penetrameter (pie gauge).

c. A mirror is required for examination of concealed surfaces.

d. A calibrated light meter to verify illumination. See section 2.21 for calibration requirements.

3.29.2.2 Wet Fluorescent Method

The following apparatus is required if the wet fluorescent method is used.

a. An ASTM centrifuge tube with stand.

b. Particle bath medium and fluorescent particles.

- Petroleum base mediums which exhibit natural fluorescence under blacklight shall not be used. Diesel fuel and gasoline are not acceptable.
- Water base mediums are acceptable if they wet the surface without visible gaps. If incomplete coverage occurs, additional cleaning, a new particle bath, or the addition of more wetting agents may be necessary.

c. A blacklight source and a calibrated blacklight intensity meter are required. See section 2.21 for calibration requirements.

d. A dark room, portable booth, or tarp shall be available to control the ambient light, if the inspection is performed during daylight hours.

3.29.2.3 Dry Visible Method

If the dry visible method is used, the dry magnetic particles shall be of contrasting color to the inspection surface and shall be free from rust, grease, paint, dirt, and/or other contaminants that may interfere with the particle characteristics.

3.29.3 Preparation

3.29.3.1 Cleaning

All surfaces to be inspected shall be clean to a degree that the metal surfaces are visible and free of contaminants (such as dirt, oil, grease, loose rust, sand, scale, and paint, that will restrict particle movement). Contaminants that are detectable by wiping with a dry, unused white paper towel or tissue on the surface shall be removed. For dry powder inspection, the surfaces shall also be dry to the touch.

3.29.3.2 Wet Fluorescent Method

If the wet magnetic particle method is used, verify particle concentration and blacklight intensity as follows:

a. Particle concentration test: Particle concentration shall range from 0.1 to 0.4 ml/100 ml when measured using a 100 ml ASTM centrifuge tube, using a minimum settling time of 30 minutes in water-based carriers or 1 hour in oil-based carriers. Repeat this test whenever the solution is diluted or particles are added. Agitate the solution thoroughly before each test.

b. Blacklight intensity test: Measure the blacklight intensity with an ultraviolet light meter. The minimum intensity shall be 1000 microwatts/cm^2 at fifteen inches from the light source or at the distance to be used for inspection, whichever is greater. Repeat this test each time the light is turned on, after every 8 hours of operation, and at the completion of the job.

c. The intensity of ambient visible light, measured at the inspection surface, shall not exceed 2 foot-candles.

Figure 3.29.1 A pocket magnetometer.

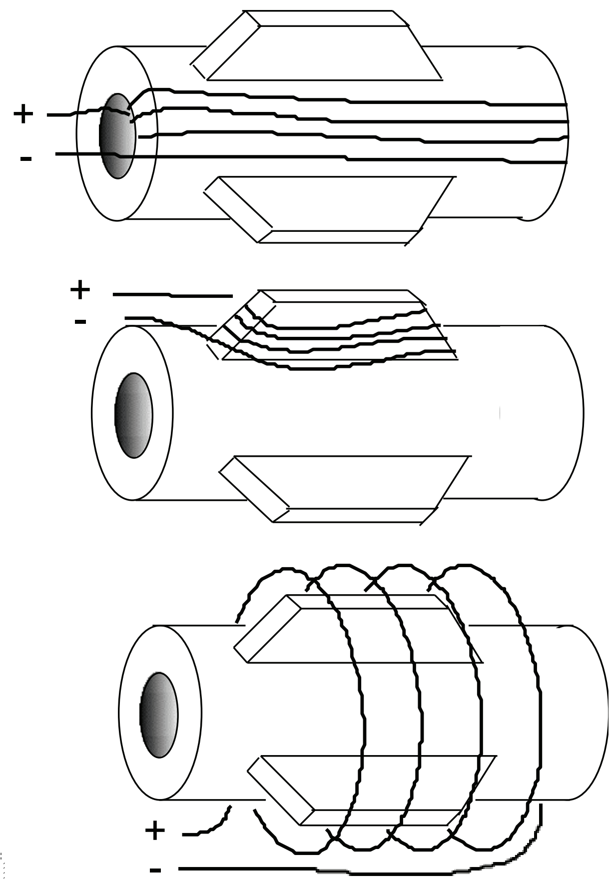


Figure 3.29.2 Some means of inducing magnetic fields: Circular field in a tool (top), transverse field in a protruding tool member (center), longitudinal field (bottom). Other means are acceptable so long as they leave an adequate residual field of the proper orientation.

3.29.3.3 Dry Particle Inspection

The minimum illumination level at the inspection surface shall be 50 foot-candles. Visual acuity requirements shall be per section 2.20.2. Light intensity level at the inspection surface must be verified:

- At the start of each inspection job.
- When light fixtures change positions or intensity.
- When there is a change in relative position of the inspected surface with respect to the light fixture.
- When requested by the customer or its designated representative.
- Upon completion of the inspection job.

The requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

3.29.4 Magnetizing the Component

Magnetizing a component shall be accomplished in the same manner, whether the wet fluorescent or dry visible method is used.

3.29.4.1 Check for Preexisting Fields

Check the inspection surfaces for the presence and direction of residual magnetic fields using a pocket magnetometer.

3.29.4.2 Induce First Field

If a residual field was detected in the previous step, wrap the magnetizing conductor in such a way as to reinforce the existing field and apply magnetizing current. (If no residual field is present in the part, it is generally preferable to wrap the conductors so that the first field will be aligned with the circular or transverse direction.) *The number of wraps, the amount of current, and the number of pulses required to induce a residual field of proper direction and adequate strength will vary with part size, part shape, and material properties.*

3.29.4.3 Verify First Field

Verify the residual magnetic field magnitude and orientation using either a magnetic flux indicator strip or a magnetic penetrameter. Verify the field in areas least likely to have been magnetized (such as areas furthest from the conductor and/or with the least favorable conductor orientation). If the proper field is not present on any inspection surface, re-magnetize the part using different current settings, more pulses, or relocated conductors. Recheck for the presence of the proper field before continuing. When using the wet fluorescent method, it may be necessary to use a booth or tarp to darken the area if the amount of ambient light prevents clear visibility of the artificial indications on a MPFI. If so, the area shall be darkened to the same degree for examination.

3.29.4.4 First Particle Application and Examination

a. Wet fluorescent particle application: Apply the wet fluorescent particle solution by spraying or flowing the solution over the inspection areas. Agitate the solution prior to use to ensure even particle distribution. After the application of the wet fluorescent solution, the inspection surface shall have a continuous and even film of solution.

b. Dry particle application: Apply the dry particles by spraying or dusting directly onto the inspection areas.

c. Examination: Pay particular attention to stress concentration areas (such as the base of stabilizer blades, thru-wall holes, grooves, and welds). Use a mirror to inspect areas where visibility is restricted.
   - Wet fluorescent examination: Examine the inspection surfaces under blacklight after the wet fluorescent particles have been applied. The inspector's eyes shall be allowed to adapt to the dark area for at least one minute prior to examining the part(s). Avoid contact between the portable booth or tarp and the surface being inspected. If particle bath puddles are evident in recess areas, the part shall be repositioned to allow the puddles to drain and then the areas shall be inspected.
   - Dry visible examination: Examine the inspection surfaces during dry particle application.

3.29.4.5 Induce Second Field

Wrap the conductors so as to induce a field perpendicular to the first field. If the inspection surface is irregularly shaped, achieving magnetic field orientations perpendicular to one another may prove difficult. However, the orientation of the second magnetic field shall be at least 60 degrees from the first.

3.29.4.6 Second Particle Application and Examination

Repeat steps 3.29.4.3 (field verification) and 3.29.4.4 (powder application and examination) with the second residual field in the part.

3.29.5 Acceptance Criteria

Acceptance criteria for cracks and crack-like indications are specific to the part being inspected. They are given in the individual equipment inspection procedures.

3.29.6 Post-Inspection Steps

Thoroughly remove all solution and dry powder from the part. Pay particular attention to threads and seals, as powder residue may cause corrosion damage in these areas if left unattended. Reapply thread compound and thread protectors if these were removed from the part in preparation for inspection.

3.30 Full Length Ultrasonic (FLUT WT/TL/Obl) Inspection

3.30.1 Scope

This procedure covers FLUT inspection of used drill pipe and work string tubing tubes (or other tubulars as applicable) for the detection of:

- Wall loss using compressive waves (WT)
- Transverse and longitudinal flaws using shear waves (TL)
- Oblique angled discontinuities using shear waves (Obl)

For externally-upset drill pipe and tubing, the inspection shall cover the entire tube volume between the external upsets. For drill pipe with internal upsets only, the inspection shall cover the entire tube volume between the box and pin tool joint tapers. For non-upset tubing, the inspection shall cover the entire tube volume between the connections (couplings and/or threaded areas). Any length of tube not covered by FLUT inspection when flaw detection is required (TL and/or Obl) shall be covered by Ultrasonic (UT) Slip/Upset Area Inspection (3.10).

Note: FLUT TL inspection may be substituted for UT Slip/Upset Area inspection if it can be determined that the FLUT scanning system can provide sufficient coverage in the slip/upset areas. The coverage of the scanning system shall be sufficient if it is determined that the notches detected on both outside diameter (OD) and inside diameter (ID) are outside the scanning head and the distances between the position of the scanning head while detecting the notches and the detected notches on both ID and OD are greater than:

- The distance between the scanning head and the intersection of the tool joint taper with the outside surface for drill pipe with internal upsets only.
- The distance between the scanning head and the connection (coupling and/or threaded areas) for non-upset tubing.
- The distance between the scanning head and the external upset for drill pipe or tubing with external upsets.
- The distance between the scanning head and the intersection of the transition radius with the outside surface for heavy-weight drill pipe with center upsets.

3.30.2 Inspection Apparatus

3.30.2.1 Ultrasonic Scanning System

An automated pulse-echo type ultrasonic scanning system is required. The unit must:

a. Be capable of detecting, marking, and reporting the locations of excessive tube wear, transverse-, longitudinal-, and oblique indications, as applicable.

The accuracy of the automated marking system shall be confirmed on known imperfections in the reference standard (see 3.30.2.2). The measured accuracy shall define the minimum area for prove-up inspection (see 3.30.6). FLUT units not equipped with automated marking systems are acceptable as long as the indications are manually marked.

b. Include an audible and/or visible alarm or indicator and a multi-channel data acquisition system with a sufficient response rate to capture and save to electronic media the activity of each array or orientation of transducers.

c. Inspect at a transducer frequency between 1 MHz and 5 MHz.

d. Include gain or attenuator controls that allow for adjustments in increments of 2 dB or less.

e. Be capable of monitoring the scanning helix and/or the rotational and line (carriage) speeds during field standardization and inspection. FLUT units not capable of directly monitoring the scanning helix are acceptable as long as the rotational and line speeds are monitored and physically verified.

f. Have been calibrated for linearity in accordance with ASTM E317 in the last six months and since any maintenance that would require recalibration. See section 2.21 for calibration requirements.

g. Not be any type of hand-held ultrasonic unit or manual scanning device.

h. Have annual beam-profile reports for each transducer available for review in accordance with ASTM E1065.

3.30.2.2 Reference Standards

A reference standard is required for field standardization. The reference standard shall be identified with a unique serial number and must:

a. Be prepared from a suitable length of pipe with an acoustic velocity similar to that of the pipe to be inspected. The reference standard's outside diameter (OD) shall be the nominal OD of the pipe to be inspected with the larger of the following tolerances applied:

- +1%, -3% of the nominal OD of the pipe to be inspected, or
- ±1/32 inch

The reference standard wall thickness shall be within ±10% of the nominal wall thickness of the pipe to be inspected.

b. Be free of indications that could interfere with calibration or standardization.

c. Contain two known wall thickness sections specified by the customer. If not specified, wall thickness sections shall be as follows:

- One wall thickness section between 70-80% of the nominal wall thickness.
- A second wall thickness section between 90-110% of nominal wall thickness.

The wall thickness sections shall be verified using an ultrasonic compression wave instrument that conforms to the requirements in 3.6.2.

d. If performing FLUT TL and/or Obl inspections, contain a minimum of two OD and two ID notches. Notch orientations, dimensions, and spacing shall be as follows:

- Orientations: For FLUT TL inspections, one longitudinal notch and one transverse notch shall be present on both the OD and ID surfaces (a total of four notches). For FLUT Obl inspections, three right-hand and three left hand oblique notches shall be present on both the OD and ID surfaces (a total of 12 notches). Oblique notches shall be oriented at 11, 22, and 45 degrees from the longitudinal axis of the pipe. The tolerance on notch orientation shall be ±2 degrees.
- Length: 0.500 inch max.
- Width: 0.040 inch max.
- Depth 5% of nominal wall, ±0.004 inch, with a minimum depth of 0.012 inch.
- Spacing: Notch separation shall be sufficient for the FLUT unit to clearly distinguish between each imperfection.

e. Have undergone ultrasonic notch verification. A notch verification certificate shall be available to the customer or customer's representative and reference the serial number of the reference standard. The reference standard shall be recertified annually.

3.30.2.3 Couplant

A liquid couplant, such as water, capable of conducting ultrasonic vibrations from the transducers into the pipe being inspected is required. The same couplant shall be used for both standardization and inspection.

3.30.2.4 Prove-Up Inspection Apparatus

a. Ultrasonic Inspection Apparatus: For prove-up of wall thickness and laminar indications, a compression-wave instrument is required and shall conform to the requirements in 3.6.2. For prove-up of indications that are not laminar in nature, such as seams, laps, cracks, porosity, and inclusions, a shear wave instrument is required and shall conform to the requirements in 3.10.2 and 3.10.4, with the distance amplitude correction (DAC) requirement in 3.30.6.2c replacing the DAC requirement in 3.10.4g.

b. Wet fluorescent or dry magnetic particle inspection apparatus shall conform to the requirements in 3.9.2.

c. Liquid penetrant inspection apparatus shall conform to the requirements in 3.17.2.

3.30.3 Preparation

a. All pipe shall be sequentially numbered.

b. The tube OD and ID surfaces shall be free of raised metal and contaminants such as dirt, cement, sand, oil, grease, and paint that will impede transducer travel, prevent proper shoe-ride, or alter the ultrasonic signal response.

c. Any raised metal shall be removed or ground flush with the pipe surface. Otherwise, the pipe shall be rejected.

3.30.4 Field Standardization

3.30.4.1 Transducer Orientation

a. Determine the proper scanning helix based on the effective transducer beam width that provides 100% volumetric inspection of the tube wall with a minimum of 10% overlap. The unit shall demonstrate the ability to maintain an accurate scanning helix or the overlap shall be increased to allow for the variance. If possible, verify the scanning helix by marking and measuring the axial translation during three consecutive helical periods and comparing the measurements to the theoretical axial translation.

b. Configure the transducer array to detect all notches in both the leading and trailing directions.

3.30.4.2 Static Standardization for WT

Adjust wall thickness compression wave transducers and the system to display the actual wall thickness while under the transducers within 0.005 inch.

3.30.4.3 Static Standardization for TL & Obl

a. Shear wave skip position for standardization: For each channel, the signal response from the ID reference notch shall be standardized using the first 1/2 skip or 1-1/2 skip position. The first 1-1/2 skip position may be used for thin wall material or if excessive noise is encountered at the first 1/2 skip position. For each channel, the signal response from the OD reference notch shall be standardized using the first full skip position.

b. First channel reference level setting: Select a single channel and insert the reference standard into the unit. Select a random gain setting. Without adjusting the random gain setting, compare the signal response from the ID notch using the first 1/2 or 1-1/2 skip position (as required in 3.30.4.3a) to that of the OD notch using the first full skip position. Adjust the gain so that the lower signal response of either the ID notch or the OD notch is a minimum of 80% of Full Screen Height (FSH).

c. First channel gate positioning: Maximize the response from the ID notch in the first 1/2 or 1-1/2 skip position (as required in 3.30.4.3a) and position the ID gate such that the indication is completely encompassed within the gate. Then, maximize the response from the OD notch in the first full skip position and position the OD gate such that the indication is completely encompassed within the gate.

d. Remaining channels: Set the reference levels and gate positions by repeating steps b and c for each channel.

3.30.4.4 TL & Obl Threshold Setting

a. Initial threshold setting: Set each gate threshold to 6 dB less than the corresponding reference level established in paragraph 3.30.4.3b.

b. Threshold adjustments: Adjust each gate threshold if adequate prove-up (3.30.6) confirms that indications found are proving irrelevant. A threshold level shall be established during prove-up that warrants evaluation of all future indications on the pipe. The gate threshold levels shall not be within 3 dB of the reference levels established in paragraph 3.30.4.3b. The operator should watch for changes in signal response or pipe condition that may warrant threshold adjustments and/or re-standardization. The threshold levels shall be recorded on the inspection logs.

3.30.4.5 WT Threshold Setting

Adjust the minimum threshold level of the wall thickness system such that the system generates an alert when the measured wall thickness is equal to or less than the specified minimum wall thickness plus 0.008 inch.

3.30.4.6 Dynamic Standardization

Scan the reference standard at production speed three times. The signal response amplitude from each reference standard notch as scanned in both directions shall exceed the applicable threshold on all three dynamic runs. The measured thickness of the reduced wall thickness section (as required in 3.30.2.2c) shall be within 0.005 inch of the actual wall thickness on all 3 dynamic runs.

3.30.4.7 Standardization Frequency

The unit shall be field standardized:

- At the start of inspection.
- After each 50 lengths or less.
- At least every 4 hours of continuous inspection.
- Each time the unit is turned on.
- When the instrument or a transducer is damaged.
- When the transducer, cable, operator, or material to be inspected is changed.
- When the accuracy of the last valid standardization is questionable.
- Upon completion of the job.

3.30.4.8 Invalid Standardization

If 3.30.4.6 is not met at any interval required by 3.30.4.7, all pipe inspected since the last valid field standardization shall be re-inspected.

3.30.5 Procedure

a. Record the serial number, OD, and wall thickness of the reference standard.

b. Distribute couplant on the contact surfaces throughout the standardization and inspection processes.

c. Limit the pipe rotational and line speeds during inspection to the speeds used for dynamic standardization.

d. The gain may be increased above reference level during scanning to increase the sensitivity.

e. All indications that exceed the threshold levels shall be marked and proved up using the methods presented in 3.30.6.

3.30.6 Prove-Up Methods

3.30.6.1 Prove-Up Inspection of WT Indications

a. Compression wave ultrasonic inspection shall apply for prove-up of low wall readings.

b. The inspection apparatus and standardization technique shall conform to the requirements in 3.30.2.4a.

c. The inspection area shall include the suspect location and the surrounding area as defined by the marking system accuracy in 3.30.2.1a, but not less than six inches from the suspect location.

d. Wall thickness readings shall be taken at a spacing not exceeding one reading per square inch in every direction.

3.30.6.2 Prove Up Inspection of TL & Obl Indications

a. Shear wave ultrasonic inspection shall apply for prove-up of all flaw indications.

b. The inspection apparatus and standardization technique shall conform to the requirements in 3.30.2.4a.

c. For shear wave inspection, a distance amplitude correction (DAC) curve shall be established between the responses from an ID reference standard notch on the first 1/2 skip and 1-1/2 skip positions of the shear wave as shown in Figure 3.30.1.

d. The inspection area shall include the suspect location and the surrounding area as defined by the marking

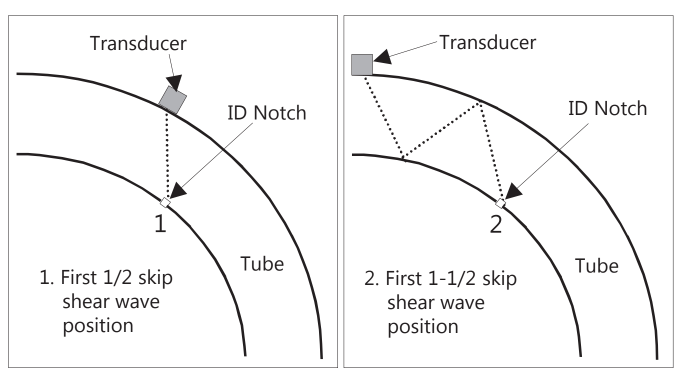


Figure 3.30.1 Shear wave skip positions for establishing a DAC curve.

system accuracy in 3.30.2.1a, but not less than six inches from the suspect location.

e. The transducer shall be moved in a zig-zag pattern within the inspection area to ensure full coverage.

3.30.6.3 Wet Fluorescent or Dry Magnetic Particle Prove-Up Inspection

a. This prove-up method is acceptable only for prove-up of indications that break the OD surface on ferromagnetic pipe.

b. For the wet fluorescent and dry magnetic particle methods, the inspection apparatus, preparation, and procedure shall conform to the requirements in 3.30.2.4b, 3.9.3, and 3.9.4a-d, respectively, except that the area to be cleaned and inspected shall include the suspect location and the surrounding area as defined by the marking system accuracy in 3.30.2.1a, but not less than six inches from the suspect location.

c. For the wet visible method, the inspection apparatus, preparation, and procedure shall conform to the requirements in 3.9.2, 3.9.3, and 3.9.4a-d, respectively, except as noted below and that the area to be cleaned and inspected shall include the suspect location and the surrounding area as defined by the marking system accuracy in 3.30.2.1a, but not less than six inches from the suspect location. The bath concentration shall be in the range of 1.2 to 2.4 mL of particles per 100 mL of bath, using a 100 mL centrifuge tube (with a 1.5 mL stem with 0.1 mL divisions).

d. Magnetize with an AC yoke. Maintain a continuous active magnetic field during particle application.

3.30.6.4 Liquid Penetrant Prove-Up Inspection

a. This method is acceptable only for prove-up of indications that break the OD surface.

b. The inspection apparatus, preparation, and procedure shall conform to the requirements in 3.30.2.4c, 3.17.3, and 3.17.4-7, respectively, except that the area to be cleaned and inspected shall include the suspect location and the surrounding area as defined by the marking system accuracy in 3.30.2.1a, but not less than six inches from the suspect location.

3.30.6.5 Prove-Up Results

The results of the prove-up inspection shall be recorded in a prove-up inspection report. Acceptance or rejection shall be clearly noted in the inspection report for each suspect location.

3.30.7 Acceptance Criteria

a. Any crack is cause for rejection. Grinding to remove cracks is not permitted.

b. Unless otherwise specified, the wall thickness in an area free of discontinuities that is equal to or greater than the minimum in Table 3.5.1, 3.5.2, or 3.11.1, as applicable, or 80% of the specified nominal wall is acceptable.

c. Unless otherwise specified, the remaining wall thickness in an area in which an indication has been removed that is equal to or greater than the minimum in Table 3.5.1, 3.5.2, or 3.11.1, as applicable, or 80% of the specified nominal wall is acceptable.

d. Unless otherwise specified, mid-wall and surface discontinuities with indication response levels equal to or greater than the 5% ID notch indication response level (3.10.4a) are rejectable.

3.30.8 Records

Retention of strip charts and/or electronic data from all inspection and standardization runs shall be maintained by the inspection company for a minimum period of one year. These records shall be available for review to the customer or its designated representative upon request.

3.31 Shop Repair and Gaging of RSC

3.31.1 Scope

This procedure covers the requirements for the repair and gaging of API rotary-shouldered connections (RSC). Repair and gaging of proprietary connections shall be performed according to the manufacturer's requirements, typically at a manufacturer-licensed facility.

3.31.2 Apparatus

The following equipment is required for:

3.31.2.1 Dimensional Verification Prior to Repair

a. 12-inch metal rule graduated in 1/64-inch increments

b. Tape measure

c. ID and OD calipers

3.31.2.2 Gaging of Recut RSC

a. Calibrated ring and plug gages meeting the requirements of API Specification 7-2 (latest edition). See section 2.21 for calibration requirements.

b. Dial caliper that has been calibrated within the past six months. See section 2.21 for calibration requirements.

c. Calibrated internal and external lead gages and a calibrated standard lead template. See section 2.21 for calibration requirements.

d. Calibrated internal and external taper gages. See section 2.21 for calibration requirements.

3.31.3 Preparation

3.31.3.1 Surface Preparation

Clean the connections and tool joints so that nothing interferes with any measurement.

3.31.3.2 Pin Neck Markings

Record all pin neck markings.

3.31.3.3 Dimensional Verification

Verify all tool joint dimensions that will be compromised as a result of the repair procedure to ensure the post-repair connection dimensions will meet API and DS-1 requirements.

a. If re-facing is proposed, verify that:

- The connection has not been refaced beyond the limits specified in 3.11.5.8.
- The tong space or fishing neck length, as applicable, will meet the minimum length requirement in Table 3.7.1, 3.7.26, or 3.8.1, as applicable, for drill pipe tool joints, section 3.14.4.1 for HWDP tool joints and drill collars, section 3.24.6 for stabilizers, and section 3.25.6 for subs.
- The pin stress relief groove will meet the requirement of Table 3.10.1 or 3.9, as applicable, for heavy weight drill pipe and bottom hole assembly connections.

b. If re-cutting is proposed, verify that:

- The tong space or fishing neck length, as applicable, will meet the minimum length requirement in Table 3.7.1, 3.7.26, or 3.8.1, as applicable, for drill pipe tool joints, section 3.14.4.1 for HWDP tool joints and drill collars, section 3.24.6 for stabilizers, and section 3.25.6 for subs.
- The pin stress relief groove will meet the requirement of Table 3.10.1 or 3.9, as applicable, for heavy weight drill pipe and bottom hole assembly connections.

3.31.4 Repair Guidelines

3.31.4.1 Fatigue Crack Removal

Crop all connections behind the fatigue crack. Fatigue cracks shall not be removed by grinding, re-cutting, chase-and-face, or any other repair operations.

3.31.4.2 Reface Depth

Verify that the depth of cut during a re-facing operation is not more than 1/32-inch.

3.31.4.3 Alignment

To ensure concentricity during the repair operation, verify that the total indicator reading (TIR) of angular misalignment between the thread axis and tool design axis does not exceed 0.001 inch per inch of projected axis. The design axis shall be assumed to intersect the thread axis at the plane of the tool joint shoulder.

3.31.4.4 Stress Relief Features (SRF)

Unless waived by the customer, machine pin stress relief grooves and boreback boxes on all BHA and HWDP end connections NC38 and larger. Boreback box dimensions shall be in accordance with the requirements of API Specification 7-2 (latest edition). Pin stress relief grooves shall be in accordance with the requirements of API Specification 7-2 (latest edition), except that the length shall be 3/4 inch (-1/32 inch, +9/32 inch).

Pitting in boreback cylinders: See Appendix, Paragraph A.4, for specific inspection requirements and repair guidelines.

3.31.4.5 Bevel Diameters

Machine bevel diameters in accordance with the requirements of API Specification 7-2 (latest edition) for collared BHA connections, and DS-1 Volume 1 for tool joints and HWDP connections. If the current outside diameter is less than that which will accommodate the API bevel, machine the bevel diameter in accordance with the requirements of Table 3.7.1, 3.7.26, or 3.8.1, as applicable, for tool joints, Table 3.9 for collared BHA connections, and Table 3.10.1 for HWDP connections.

3.31.4.6 Pitting in the Pin Inside Diameter (ID)

See Appendix, Paragraph A.5, for specific inspection requirements and repair guidelines. Repaired pin ID must meet the applicable requirements for maximum pin ID.

3.31.4.7 Refacing Benchmark

Unless waived by the customer, machine a cylinder benchmark (that is, a 360 degree refacing benchmark) in accordance with API Specification 7-2 (latest edition) on all recut connections except pins which require a stress relief groove.

3.31.5 Inspection and Gaging of Recut Connections

Recut connections shall be gaged in accordance with API Specification 7-2 (latest edition). Gaging shall take place after the connection is finished machined and before any anti-galling and/or cold working surface treatment is applied to the connection. The gaging process shall include the following measurements:

3.31.5.1 Thread Standoff

Measure the thread standoff using a ring or plug gage meeting the requirements in 3.31.2.2a. Gage care and use shall be in accordance with API Specification 7-2 (latest edition). After the gage has been firmly made up on the recut connection, measure the standoff using a dial caliper meeting the requirements in 3.31.2.2b. This measurement shall be taken at a minimum of four locations, 90 degrees apart. The measured standoff shall be within the limits set by API Specification 7-2 (latest edition).

3.31.5.2 Thread Lead

Measure the lead of the threads using a lead gage meeting the requirements in 3.31.2.2c. Gage care, adjustment, and use shall be in accordance with API Specification 7-2 (latest edition). The measured lead error shall be within the tolerance as follows:

a. ±0.0015 inch per inch for any inch between the first and last full depth threads.

b. ±0.0045 inch between the first and last full depth threads, or the sum of 0.001 inch for each inch between the first and last full depth threads, whichever is greater.

3.31.5.3 Thread Taper

Measure the taper of the threads using a taper caliper meeting the requirements in 3.31.2.2d. Caliper care, adjustment, and use shall be in accordance with API Specification 7-2 (latest edition). The measured taper error shall be within the tolerance as follows:

a. Pin threads: +0.030, -0.000 inch per foot average taper between the first and last full depth threads.

b. Box threads: +0.000, -0.030 inch per foot average taper between the first and last full depth threads.

3.31.5.4 Shoulder Condition

The shoulder contact face shall be:

a. Square with the thread axis: Compare the standoff values obtained in paragraph 3.31.5.1. The difference between any two standoff values 180 degrees apart shall be within 0.002 inch. This ensures that the shoulder contact face is square with the thread axis within the tolerance specified by API Specification 7-2 (latest edition).

b. Flat: Verify box shoulder flatness by placing a straightedge across a diameter of the shoulder contact face and rotating the straightedge at least 180 degrees along the plane of the shoulder. Verify pin shoulder flatness by placing a straightedge across a chord of the shoulder face and rotating the straightedge about the thread axis so that the entire shoulder face is examined. Gaps between the straightedge and the shoulder face shall not be greater than 0.002 inch as specified by API Specification 7-2 (latest edition).

3.31.6 Inspection and Gaging of Refaced Connections

All affected dimensions as a result of the re-facing procedure must be verified and shall meet the requirements of 3.13, Dimensional 2 Inspection, or 3.14, Dimensional 3 Inspection, as applicable.

If agreed upon between the customer and the refacing vendor, the refaced connections may be gaged using the following additional requirements:

3.31.6.1 Square Shoulder with the Thread Axis

Measure the thread standoff using a ring or plug gage meeting the requirements in 3.31.2.2a. Gage care and use shall be in accordance with API Specification 7-2 (latest edition). After the gage has been firmly made up on the refaced connection, measure the standoff using a dial caliper meeting the requirements in 3.31.2.2b. This measurement shall be taken at a minimum of four locations, 90 degrees apart. Compare the measured standoff values. The difference between any two standoff values 180 degrees apart shall be within 0.002 inch to ensure shoulder squareness.

Note: Limits for measured standoff specified by API Specification 7-2 (latest edition) are not applicable to refaced connections.

3.31.6.2 Flat Shoulder

Verify box shoulder flatness by placing a straightedge across a diameter of the shoulder contact face and rotating the straightedge at least 180 degrees along the plane of the shoulder. Verify pin shoulder flatness by placing a straightedge across a chord of the shoulder face and rotating the straightedge about the thread axis so that the entire shoulder face is examined. Gaps between the straightedge and the shoulder face shall not be greater than 0.002 inch as specified by API Specification 7-2 (latest edition).

3.31.7 Thread Root Cold Rolling

Cold rolling shall be performed on all new and re-cut BHA and HWDP API connections. This procedure shall not be used on stress relief grooves or external fillets of drill string connections. This procedure is based on the work in reference 1 and contributed by Shell Exploration and Production, who sponsored the work. The allowance for increase in cold rolling RPM is based on a later study carried out by Weatherford International and T H Hill Associates, Inc. Alternative procedures are permissible provided they have been specified or previously approved by the customer. In addition, shot peening may be used as an alternative to cold rolling for the following cases:

a. Nonmagnetic materials: Provided the procedure has been specified or previously approved by the customer.

b. Magnetic materials: Provided cold rolling equipment is not available and the procedure has been specified or previously approved by the customer.

3.31.7.1 Surface Preparation

The threads shall be cleaned to remove dirt and threading debris from machining operations. Surface scratches and imperfections visually estimated to be deeper than 0.002 inch are not allowed.

3.31.7.2 Equipment Requirements

A standard lathe for machining threads on rotary shouldered connections can be used for the rolling operation. The roller shall be mounted on an arm of sufficient length to treat the entire threaded part of the pin and box. The hydraulic cylinder mounted on the roller arm must be capable of producing a roller force in the range of 900 to 3375 pounds (see Table 3.4.1). The hydraulic cylinder shall be equipped with a pressure gauge that has been calibrated to an accuracy of ±5 percent in the past six months. See section 2.21 for calibration requirements. The hydraulic system must be equipped with an accumulator of sufficient capacity to maintain the required hydraulic pressure and corresponding roller force as the roller follows the taper along the length of the threads during the cold rolling process.

The roller shall meet the following requirements (see Figure 3.31.1):

- Recommended roller diameter (D_r) is 0.787 inch.
- The roller material shall be tool steel having a minimum hardness of 57 HRC. The roller edge shall be polished such that the maximum average surface roughness (R_a) is 16 μin.
- The roller flank angle (θ_r) shall be 5.0 degrees ±0.5 degrees less than the thread angle.
- The roller edge radius (r_r) shall be within 2% of that specified in Table 3.4.1 for each thread root radius.

3.31.7.3 Hydraulic Pressure Requirement

Refer to Table 3.4.1 and obtain the required roller force for the connection. Review the manufacturer's specifications for the hydraulic cylinder to obtain the piston diameter. Refer to Table 3.4.2 with the required roller force and the specified piston diameter to obtain the hydraulic pressure that is required to generate the specified roller force. If the hydraulic cylinder is not

Table 3.4.1 Roller Dimensions and Roller Force Requirements for Cold Rolling API Connections

Conn	Thread Form	Thread Root Radius (in)	Roller Dimensions (in) Dia (Dr)	Roller Dimensions (in) Edge Radius (r_r)	Required Roller Force (lb) Pin	Required Roller Force (lb) Box
			Number (NC) Style			
NC23	V-0.038R	0.038	0.787	0.042	1575	3375
NC26	V-0.038R	0.038	0.787	0.042	1800	3150
NC31	V-0.038R	0.038	0.787	0.042	1800	2925
NC35	V-0.038R	0.038	0.787	0.042	1800	2925
NC38	V-0.038R	0.038	0.787	0.042	1800	2925
NC40	V-0.038R	0.038	0.787	0.042	1800	2700
NC44	V-0.038R	0.038	0.787	0.042	1800	2700
NC46	V-0.038R	0.038	0.787	0.042	2025	2700
NC50	V-0.038R	0.038	0.787	0.042	2025	2700
NC56	V-0.038R	0.038	0.787	0.042	2025	2700
NC61	V-0.038R	0.038	0.787	0.042	2025	2475
NC70	V-0.038R	0.038	0.787	0.042	2025	2475
NC77	V-0.038R	0.038	0.787	0.042	2025	2475
			Regular (Reg) Style			
2 3/8	V-0.040	0.02	0.787	0.022	900	1800
2 7/8	V-0.040	0.02	0.787	0.022	900	1575
3 1/2	V-0.040	0.02	0.787	0.022	900	1575
4 1/2	V-0.040	0.02	0.787	0.022	900	1350
5 1/2	V-0.050	0.025	0.787	0.027	1350	1800
6 5/8	V-0.050	0.025	0.787	0.027	1350	1800
7 5/8	V-0.050	0.025	0.787	0.027	1350	1575
8 5/8	V-0.050	0.025	0.787	0.027	1350	1575
			Full Hole (FH) Style			
5 1/2 FH	V-0.050	0.025	0.787	0.027	1350	1800
6 5/8 FH	V-0.050	0.025	0.787	0.027	1350	1800

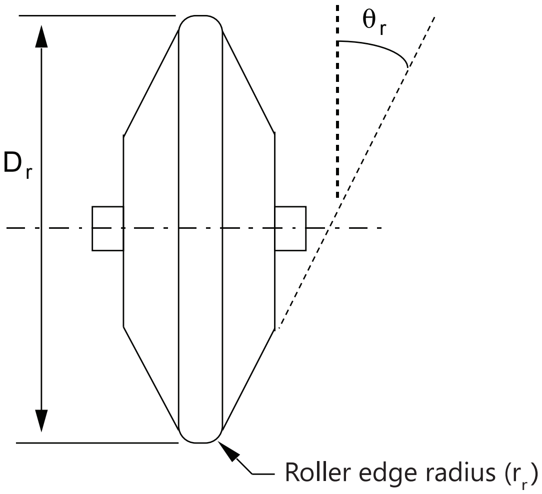


Figure 3.31.1 Roller Geometry.

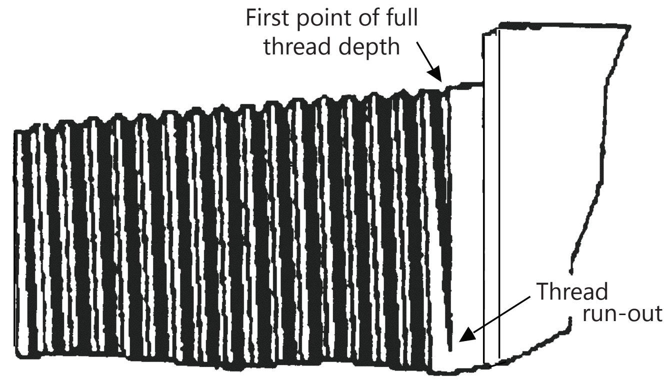


Figure 3.31.2 Pin thread run-out. Special care must be taken to ensure that full roller force is applied to the last machining marks in this area. The same consideration must be given to the box thread run-out.

Table 3.4.2 Required Hydraulic Pressure Given the Hydraulic Piston Diameter and the Required Roller Force for Cold Rolling API Connections

Hydraulic Piston Diameter (in)	Required Hydraulic Pressure (psi)									
1/2	17189	16043	14897	13751	12605	10313	9167	8021	6875	4584
5/8	11001	10267	9534	8801	8067	6600	5867	5134	4400	2934
3/4	7639	7130	6621	6112	5602	4584	4074	3565	3056	2037
7/8	5613	5238	4864	4490	4116	3368	2993	2619	2245	1497
1	4297	4011	3724	3438	3151	2578	2292	2005	1719	1146
1 1/8	3395	3169	2943	2716	2490	2037	1811	1584	1358	905
1 1/4	2750	2567	2384	2200	2017	1650	1467	1283	1100	733
1 3/8	2273	2121	1970	1818	1667	1364	1212	1061	909	606
1 1/2	1910	1783	1655	1528	1401	1146	1019	891	764	509
1 5/8	1627	1519	1410	1302	1193	976	868	759	651	434
1 3/4	1403	1310	1216	1123	1029	842	748	655	561	374
1 7/8	1222	1141	1059	978	896	733	652	570	489	326
2	1074	1003	931	859	788	645	573	501	430	286
2 1/8	952	888	825	761	698	571	508	444	381	254
2 1/4	849	792	736	679	622	509	453	396	340	226
2 3/8	762	711	660	609	559	457	406	356	305	203
2 1/2	688	642	596	550	504	413	367	321	275	183
2 5/8	624	582	540	499	457	374	333	291	249	166
2 3/4	568	530	492	455	417	341	303	265	227	152
2 7/8	520	485	451	416	381	312	277	243	208	139
3	477	446	414	382	350	286	255	223	191	127
3 1/8	440	411	381	352	323	264	235	205	176	117
3 1/4	407	380	353	325	298	244	217	190	163	108
3 3/8	377	352	327	302	277	226	201	176	151	101
3 1/2	351	327	304	281	257	210	187	164	140	94
3 5/8	327	305	283	262	240	196	174	153	131	87
3 3/4	306	285	265	244	224	183	163	143	122	81
3 7/8	286	267	248	229	210	172	153	134	114	76
4	269	251	233	215	161	161	143	125	107	72
Required Roller Force (lb)	3375	3150	2925	2700	2475	2025	1800	1575	1350	900

capable of reaching the required hydraulic pressure (obtained from Table 3.4.2), then it shall be replaced by an appropriately rated hydraulic cylinder.

3.31.7.4 Rolling Procedure

Rolling shall begin at either end of the threaded part. Position the roller at the thread run-out as seen in Figure 3.31.2 and gradually increase the hydraulic cylinder pressure until the required roller force is applied. Rotate the pipe at 1 RPM throughout the cold rolling process. For standard drill collar materials only, a rolling speed up to and including 15 RPM is allowed throughout the cold rolling process. Repeat the rolling procedure two additional times such that a minimum of three total passes are completed.

3.31.7.5 Post Cold Rolling Inspection

After the rolling process, the thread root shall show signs of plastic deformation. Use a 10x magnifying glass to check that the thread root has been plastically deformed as a result of the cold rolling process. Evidence of plastic deformation can normally be identified by a polished appearance at the thread root surface, as compared with the unpolished appearance of a thread root that has not been cold rolled. It is recommended that the root deformation be measured using a deep throat micrometer fitted with anvil tips. It is also recommended that the amount of root deformation be such that the post cold rolling thread height is a minimum of 0.004 inch greater than the thread height prior to the cold rolling process.

3.31.7.6 Marking

Cold rolled threads shall be marked by stamping the letters "CW" on the end face of the pin nose and/or on the counterbore at the end of the box.

3.31.8 Post Repair Requirements

3.31.8.1 Debris

All components with repaired connections shall be visually inspected from both ends of the component with the ID illuminated. No loose debris or metal shavings are allowed in the ID of the component. If found, the debris shall be cleaned out and the component ID re-inspected.

3.31.8.2 Anti-Galling Treatment

All recut steel connections shall be subjected to phosphating using zinc phosphate or manganese phosphate methods in accordance with the Connection Phosphating Procedure specified in section 3.21 of this volume. Copper sulfate coating is not an acceptable substitute for phosphating on recut connections. All recut connections made from material other than steel shall be subjected to a customer specified or previously approved anti-galling treatment.

3.31.8.3 Break-In

It is recommended that all recut connections should be made up three times at 60% of the minimum torsional yield of the connection. After final make-up, each connection shall be 100% visually inspected. If the vendor does not perform this break-in procedure, this must be communicated to the user in writing.

Note: Performing shop break-in of recut connections on certain components, like drill collars, may not be feasible due to the difficulty of handling full length components. Shops in certain locations may not have the capability to perform the recommended connection break-in.

3.31.8.4 Pin Neck Markings

Re-stamp all pin neck markings to match those recorded in 3.31.3.2.

3.31.8.5 Thread Compound and Protectors

Acceptable connections shall be coated with an API tool joint compound over all thread and shoulder surfaces as well as the end of the pin. Thread protectors shall be applied and secured using approximately 50 to 100 ft-lb of torque. The thread protectors shall be free debris. If additional inspection of the threads and shoulders will be performed prior to pipe movement, the application of thread compound and protectors may be postponed until the completion of the additional inspection.

3.32 Traceability

3.32.1 Scope

This procedure covers the traceability requirements for critical service drilling and landing equipment to ensure that each tool is uniquely identified, traceable to the mill certificate(s) and material test report(s), and manufactured from material that is in accordance with the customer defined material specification(s).

3.32.2 Apparatus

The equipment order form, material specification(s), mill certificate(s), material test report(s) and, as applicable, the serialization log(s), serialization cross-reference log(s), and bill(s) of materials are required.

3.32.3 Procedure

Figure 3.32.1 gives a systematic approach to equipment traceability verification.

3.32.4 Definitions

The following definitions apply under this procedure:

Equipment Order Form (EOF): A document prepared by the equipment supplier that provides the quantity and description of each tool required by the customer. This document will often be a rental or sales order depending on the nature of the transaction between the supplier and the customer.

Material Specification (MS): A document that specifies the chemistry and mechanical property requirements for a material from which a tool or assembly component is manufactured. The MS is defined by the customer for every applicable component. (Examples: API Specification 5DP, API Specification 7-1, and DS-1 Volume 1.)

Serialization Log (SL): A document that is prepared by the drill pipe manufacturer and links each drill pipe assembly serial number to the tube and tool joint heat numbers or codes. A SL is also known as a traceability log.

Serialization Cross-Reference Log (SCL): A document that is prepared by the equipment supplier and links the supplier's serial number to the manufacturer's original serial or heat number, which is traceable to the component's mill certificate and material test report.

Bill of Materials (BOM): A document prepared by the equipment supplier that lists the required components for an assembled tool. Each component shall have a unique part number on the BOM.

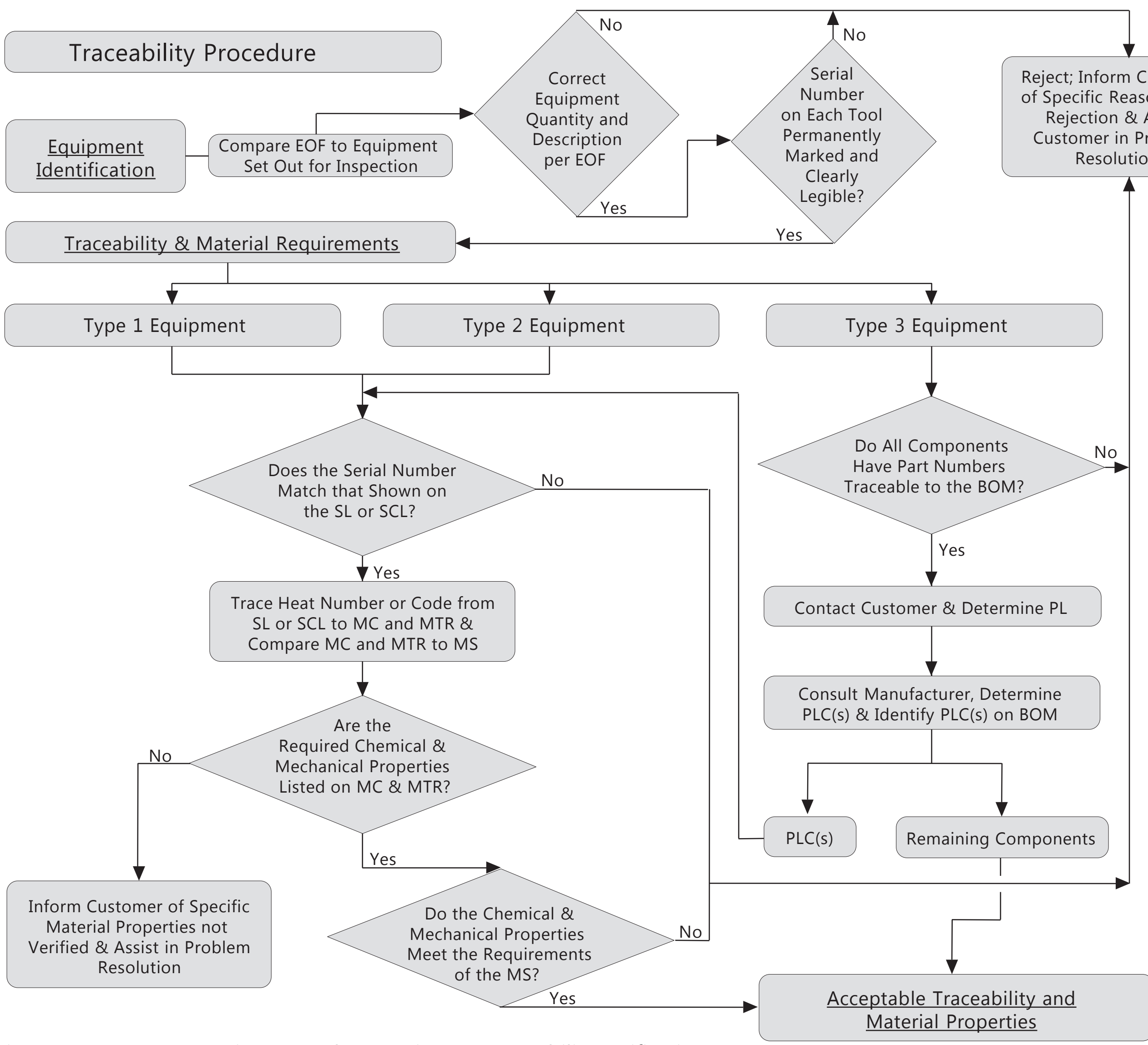


Figure 3.32.1 A systematic approach to equipment traceability verification.

Mill Certificate (MC): A document prepared by the stock material manufacturer that provides the chemical composition of the stock material from which a specific tool or component is manufactured. The MC shall list the stock material's heat number or heat code.

Material Test Report (MTR): A document prepared by the material testing facility that provides the mechanical properties of the stock material from which a specific tool or component is manufactured. The MTR shall list the stock material's heat number or heat code.

Primary Load (PL): The dominant load applied to a tool within a loading condition in which several loads may exist. The PL may be a tensile, compressive, torsional, or pressure load depending on the nature of the operation.

Primary Load-Bearing Component (PLC): An assembly component that is designed to support the primary load.

Type 1 Equipment: Drill pipe with weld-on tool joints.

Type 2 Equipment: Non-assembled tools manufactured from bar stock such as subs, integral pup joints, and drill collars.

Type 3 Equipment: Assembled tools such as safety valves, inside blowout preventers (IBOP), cement heads, circulation flow-back tools (CFT), diverter subs, and casing hanger running tools.

3.33 Rig Floor Trip Inspection

3.33.1 Scope

This procedure covers dimensional examination for drill pipe tube and tool joint wear on the rig floor. Measurements include tool joint OD and minimum body wall thickness near the center of the tube. This procedure is designed to be accomplished by rig crew members or by inspectors, and is only intended for segregating pipe that was originally acceptable but whose torsion and tension load capacity has been significantly reduced by downhole wear. Since minimizing rig time and rig-floor handling is a major objective, many steps that are routinely done by inspectors who are operating under no rig-driven production pressure will be omitted. To minimize handling, the procedure will normally be performed while tripping out of the hole. Furthermore, only pipe that has been operating under the most severe conditions will be examined, and if no excessive wear is found, the presumption will be made that pipe operating under less severe conditions will be acceptable without examination. Since only tool joint OD and tube wall thickness are generally affected by drilling wear, only these two attributes will be examined.

3.33.2 Inspection Apparatus

A calibrated ultrasonic wall thickness gage (see paragraph 3.6.2), viscous couplant capable of maintaining position on a vertical surface, OD calipers, and a 12-inch metal rule graduated in 1/64 inch increments will be required. See section 2.21 for calibration requirements.

3.33.3 Acceptance Criteria

The rig engineer, drill stem designer, or other responsible person will establish minimum acceptable wall thickness and minimum acceptable tool joint OD, based on his or her projection of future loads. (See DS-1 Fifth Edition, Volume 2, Chapter 3 for instructions on setting acceptance criteria.)

3.33.4 Components to be Examined

The rig engineer, drill stem designer, or other responsible person will also determine which components will be examined. This determination will usually be based upon which components have been operating under the highest side loads, the most abrasive conditions, and with the longest rotating times.

3.33.5 Inspection Procedure and Acceptance Criteria

a. Tool Joint Box Outside Diameter (OD): Set the OD caliper at the minimum acceptable value established above. As each subject component passes upward through the rotary, attempt to pass the caliper over each tool joint box, making at least two checks spaced at approximately 90 degrees. Any tool joint over which the calipers pass shall be rejected.

b. Ultrasonic Wall Thickness Measurement: Wall thickness measurement will require more time than tool joint checking. In the absence of significant tool joint wear or evidence of wall contact, it is unlikely that adjacent tubes will be significantly worn. Therefore, in the interest of saving rig time, the person who established the acceptance criteria and applicable components above may elect to forego checking tube wall thickness, based on the results of the tool joint inspection. The decision should be based on the following considerations:

   - Anticipated loads and load factors: If the future dominant loads and highest load factors are for the tensile case, more concern should be given to wall thickness. If the dominant loads and highest load factors are for torsion, less concern should be given to wall thickness if the pipe is equipped with standard rotary shouldered connections in standard sizes. If the pipe is equipped with high torsional capacity proprietary connections and torsional load factors are approaching the design constraint, more concern should be given to wall thickness.

- Extent of tool joint wear: If tool joint wear has been significant but not enough to cause rejection of the component, more concern should be given to wall thickness, especially if tool joints are hardbanded.
- Probability of wall contact: Wall contact is more likely in pipe that operates at high Curvature Indices (CI). Therefore, if pipe has been operating at high CI, more concern should be given to wall thickness measurement. (See DS-1 Fifth Edition, Volume 2, Chapter 4 for a discussion of Curvature Index.)

c. Should the responsible person elect to check tube wall thickness, the wall thickness of each applicable length of drill pipe shall be measured at the estimated center of the tube, as follows:

- If necessary, clean the area to be measured by wiping it with a rag. Apply couplant.
- After couplant application, take thickness measurements in at least four equally spaced locations around the tube circumference.
- Any reading that does not meet the minimum wall thickness requirement established above shall cause the length to be rejected.

3.33.6 Disposition of Rejects

Rejected lengths shall be removed from the drill string.

3.34 Demagnetization

3.34.1 Scope

This procedure covers the equipment and methods used for the measurement and reduction of residual magnetic fields in the longitudinal direction like those remaining after a component is inspected.

3.34.2 Inspection Apparatus

3.34.2.1 Magnetometer

Required magnetic particle field indicator (MPFI) includes an electronic magnetometer (gauss meter). Mechanical magnetometer may be used only if the user has established the equivalence to the electronic gauss meter. In case of dispute, the electronic gauss meter shall govern. The electronic or mechanical magnetometer, as applicable, shall have been calibrated. See section 2.21 for calibration requirements.

3.34.2.2 Demagnetization Equipment

Demagnetization equipment shall be one out of the following options:

a. An AC yoke which has demonstrated the capacity to lift a ten pound weight within the last six months. The ten pound weight used for the lift test shall have been calibrated. See section 2.21 for calibration requirements. For AC yokes with adjustable poles:

- The maximum pole spacing during inspection shall not exceed the distance between the poles when all segments of the yoke are perpendicular to the grip.
- The minimum pole spacing during inspection shall be 2 inches.

See section 2.21 for calibration requirements for the yoke.

b. An AC coil with 5,000 to 10,000 ampere turns. The frequency of the alternating current shall vary from 0.01 Hz to 100 Hz depending on the thickness of the material to be inspected. The relationship between AC line frequencies and penetration depth has been provided in Figure 3.34.1 as a guideline. The given relationship is based on the work in reference 2.

Note: The relationship between AC frequency and penetration depth (shown in Figure 3.34.1) has been provided as a guideline only. For effective demagnetization, the user must select the appropriate frequency based on the coercivity of the material.

c. DC demagnetization equipment capable of reversing the current while simultaneously reducing it in small increments. Starting current amperage shall be equal or greater than the amperage used for magnetizing and the current shall be reduced to either zero or very low amperage.

3.34.3 Procedure

3.34.3.1 Residual Magnetism Measurement

Component being checked shall be separated by at least 6 inches from other components in all directions. All measurements shall be taken with the gauss meter approximately 1 inch from the surface of the component. Measurements shall be taken at both ends and at 2-foot (±6 inches) increments along the longitudinal axis of components up to and including 10 feet in length. Components over 10 feet in length shall have measurements taken at both ends and at 5-foot (±6 inches) increments along the longitudinal axis. Additional readings may be taken at any other areas selected by the inspector or customer representative.

3.34.3.2 Demagnetization

One of the following techniques may be used to demagnetize components after inspection. The component must be subjected to a field equal or greater than that used to magnetize the part.

a. Demagnetization Using AC Yoke: AC yokes are effective demagnetizers for small or medium sized components.

- Small components are passed between the poles and slowly withdrawn while the AC yoke is still active. For AC yoke with adjustable legs, the space between the poles should be maintained as close to the component as possible.
- For larger components, the poles of the AC yoke are placed on the surface and the yoke is moved around as it is slowly withdrawn while it is still active.

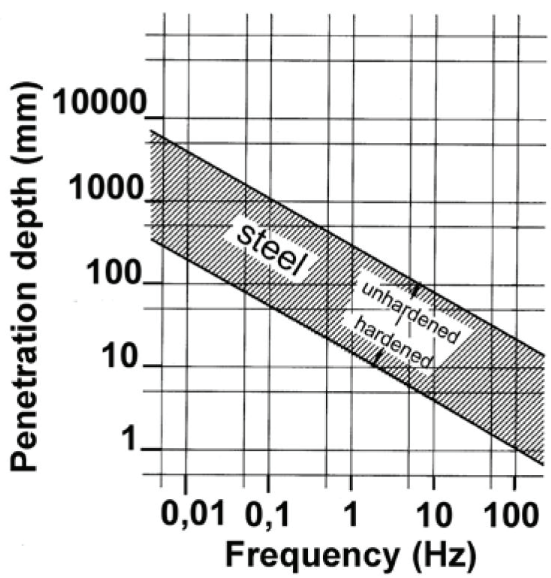


Figure 3.34.1 Penetration depth of eddy current. *(Courtesy of Vallon GmbH)*

b. Demagnetization Using AC Coil:

- Components are passed through the AC coil while it is activated and then slowly withdrawn from the field of the coil.
- Components must enter at a distance of 12 inches from the active coil and move through it steadily and slowly until the component is at least 36 inches beyond the coil.
- The above process is repeated as necessary until the residual field reaches an acceptable level.
- Demagnetization using an AC coil may also be achieved by placing the component within the coil and gradually reducing the magnetic field strength to a desired level.

c. Demagnetization Using DC Equipment: Demagnetization using DC equipment is recommended for larger components as an AC field lacks field penetration to remove internal residual magnetization.

- Starting current amperage shall be equal to or greater than the amperage used for magnetizing.
- Component is subjected to consecutive steps of reversed and reduced direct current magnetization until the desired level is achieved.
- Each step-down must last one second in order to allow the field in the part to reach a steady state.

3.34.4 Acceptance Criteria

The residual fields shall not exceed 3 gauss anywhere in the piece. Residual fields up to 10 gauss anywhere in the piece may be acceptable after an agreement between the vendor and the customer.

3.34.5 Post-Inspection Cleaning

Post-inspection cleaning is necessary where magnetic particles could interfere with subsequent processing or with service requirements. Suitable post-inspection cleaning techniques shall be used which shall not interfere with subsequent requirements.

3.35 Post-Inspection Marking

3.35.1 Scope

This procedure covers the post-inspection marking requirements of drill stem and workstring components. This procedure does not address marking of newly manufactured components.

3.35.2 Preparation

All foreign matter on the components that may prohibit the marking of the components shall be removed with suitable cleaning techniques.

3.35.3 Responsibility

An inspector shall mark a component meeting the applicable requirements only if he or she has inspected for and confirmed conformance of all the required attributes to the applicable acceptance criteria. Any crew member may also be directed to apply the appropriate descriptions, stencils, and paint bands if the components are inspected for and conform to all applicable requirements.

3.35.4 Marking Scheme

Two different marking schemes may be applied to denote the condition of the drill stem component. If a marking scheme is not specified, Scheme-B shall be applicable by default.

a. Scheme-A: Use this scheme when the inspection order specifies that the inspection of a particular component is to stop as soon as that component is rejected (see Figure 3.35.1). This scheme may only be applied to fully acceptable components and signifies that all parts of the component are acceptable to the applicable requirements. This is the normal scheme when the company ordering the inspection does not own the drill pipe or BHA component. No marking is required on the rejected material.

b. Scheme-B: Use this scheme when the inspection order specifies that the inspection is to continue until all specified inspections are completed (see Figure 3.35.2). This scheme denotes the condition of each part (tube and tool joints for drill pipe; or component body and connections for BHA component) individually and is the normal scheme when the owner of the pipe or BHA component orders the inspection.

3.35.5 Drill Pipe & Workstring Marking

This section applies to normal weight drill pipe, thick-walled drill pipe, heavy weight drill pipe, and workstring tubing.

3.35.5.1 Marking Requirements for Scheme-A

a. Tube: Location, number, and color of paint bands shall be as per Table 3.13.1 and Figure 3.35.1. The classification bands in Table 3.13.1 signify the classification of the entire assembly (tube and connections).

Example 1: If the drill pipe tube is acceptable as Class 2 and tool joints are acceptable as Premium Class, the marking requirement on the drill pipe tube shall be based on Class 2 requirements.

Example 2: If the drill pipe tube is acceptable as Premium Class and tool joints are acceptable as Class 2, the marking requirement on the drill pipe tube shall be based on Class 2 requirements.

Example 3: If the drill pipe tube is acceptable as Premium Class and tool joints are acceptable as Premium Class, the marking requirement on the drill pipe tube shall be based on Premium Class requirements.

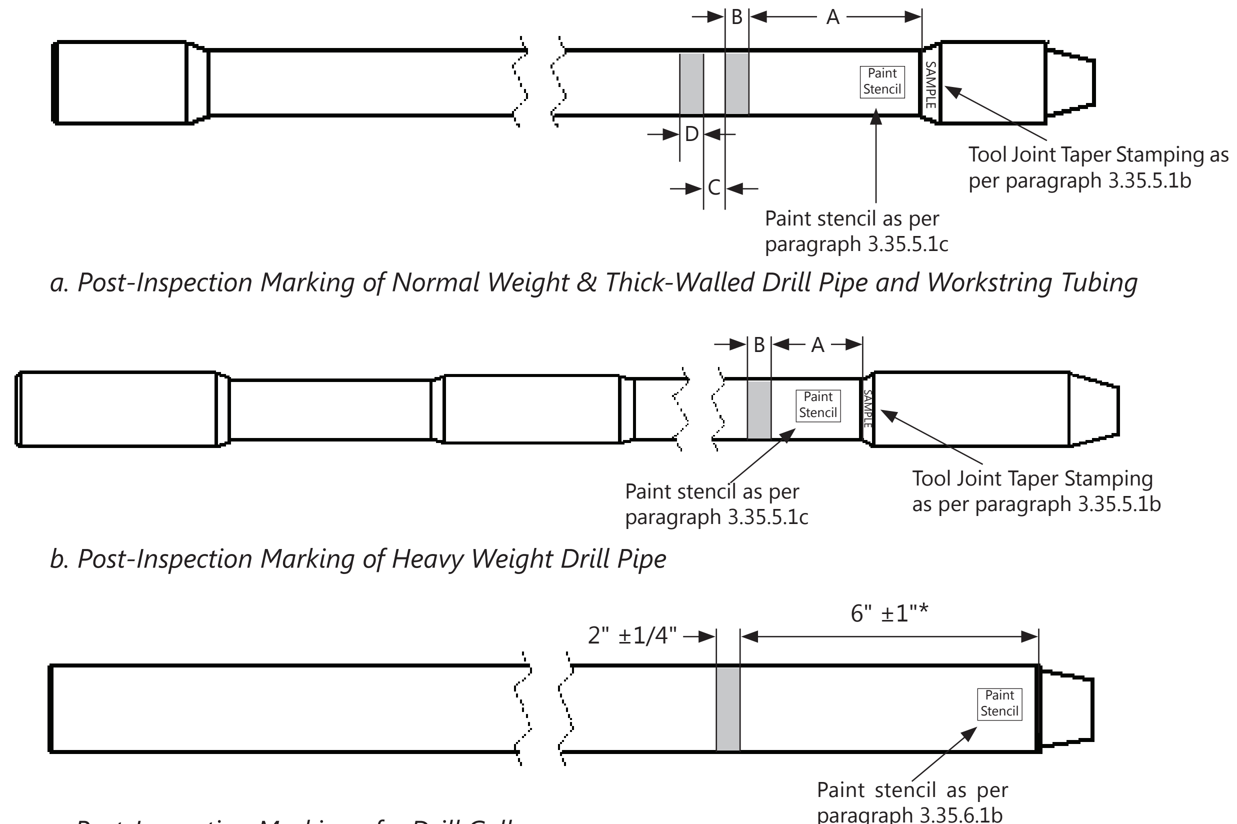
b. Tool Joint Taper Stamp: For drill pipe (not workstring tubing), if a serial number is stamped on the tool joint taper, it can be used in the inspection report for traceability. If a serial number is not found on the tool joint taper or if it is not used for traceability, the pipe owner shall be notified, and with the pipe owner's permission a unique sequence number shall be stamped on the 35° or 18° pin tool joint taper, as applicable, for traceability. Stamps shall not be larger than 3/8 inch.

c. Paint Stencil Marking: Using a permanent paint marking on the outer surface of the component, write or stencil the words "DS-1 CAT (followed by the number 1-5 or HDLS) Inspection," the date, and the name of the company performing the inspection. The letters "DS-1" and "CAT" followed by the number are the inspection company's certification that the inspection was performed in compliance with this standard for the service category indicated. Paint stencil marking shall be placed near the tube paint band for drill pipes. Lettering shall be at least 1 inch high. For thick-walled drill pipe, it is recommended that the markings include the minimum wall thickness used as the acceptance criteria.

3.35.5.2 Marking Requirements for Scheme-B

In addition to the marking requirements specified in section 3.35.5.1, the following requirements shall be applicable for Scheme-B:

a. Tube: All downgraded and rejected pipe shall have a 1-inch band around the tube in the defective area and the defective area shall be boxed in. Color of the band shall reflect the downgrade classification or



a. Post-Inspection Marking of Normal Weight & Thick-Walled Drill Pipe and Workstring Tubing

b. Post-Inspection Marking of Heavy Weight Drill Pipe

c. Post-Inspection Marking of a Drill Collar
*For box × box components, paint band shall be placed 12" ±2" from box shoulder.

Figure 3.35.1 Post-Inspection Marking Scheme-A of Drill Stem Components

rejection of the defect as per Table 3.13.1. Reason for downgrade or rejection shall be written next to the band with a permanent marker.

b. Connections: All connections that are not acceptable shall have a 1-inch band painted on the connection OD adjacent to the shoulder depending on the condition. Depending on connection condition, color of the paint band shall be per Table 3.13.2. The reason for rejection shall be written on the part next to the paint band with a permanent marker for all damaged connections. The markings shall be removed after repair.

3.35.6 BHA Component Marking

This section applies to drill collar and other BHA components.

3.35.6.1 Marking Requirements for Scheme-A

a. Component Body: Place a 2-inch wide (±1/4 inch) white paint band around an acceptable component. The paint band should be 6 inches ±1 inch from the pin shoulder. The paint band should be 12 inches ±2 inches from the box shoulder for box × box components.

b. Paint Stencil Marking on BHA Components: Using a permanent paint marker on the outer surface of the component, write or stencil the words "DS-1 CAT (followed by number 1-5) Inspection," the date, and the name of the company performing the inspection. The letters "DS-1" and "CAT" (followed by number) are the inspection company's certification that the inspection was performed in compliance with this standard for the service category indicated. The paint bands signify that all parts of the BHA component meet the indicated requirements. Paint stencil marking shall be placed as near as possible to the pin shoulder for BHA component. The paint stencil marking should be 6 inches ±1 inch from the box shoulder for box × box components.

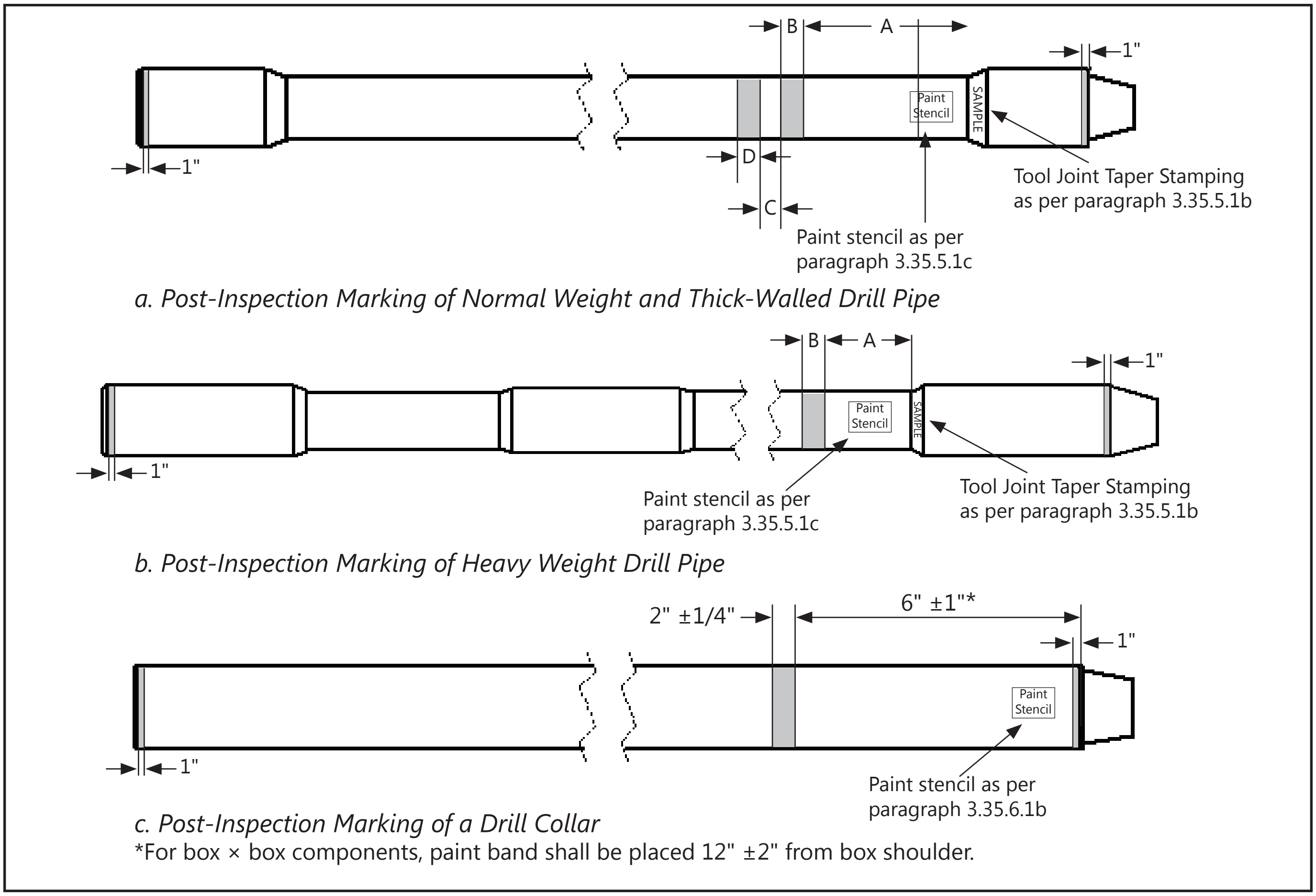


Figure 3.35.2 Post-Inspection marking Scheme-B of Drill Stem Components

3.35.6.2 Marking Requirements for Scheme-B

In addition to the marking requirements specified in section 3.35.6.1, the following requirements shall be applicable for Scheme-B:

a. Component Body: The rejected parts shall have a red band painted around the defective area and the reason for rejection shall be written on the part next to the red paint band with a permanent marker.

b. Connection: All connections that are not acceptable shall have a 1-inch band painted on the connection OD adjacent to the shoulder depending on the connection condition. Depending on connection condition, color of the paint band shall be as per Table 3.13.2. The reason for rejection shall be written on the part next to the paint band with a permanent marker for all damaged connections that require field repair or shop repair. The markings shall be removed after repair.

3.36 Drift Testing

3.36.1 Scope

This procedure covers the drifting of workstring tubing throughout its entire length to detect any reduction in the ID.

3.36.2 Inspection Apparatus

a. A drift mandrel shall be used to perform drift testing. The drift mandrel may be part of a rattler that is used for cleaning the internal surface of the tubing.

b. Any electronic, dial, or Vernier device used to verify the OD of the drift mandrel shall itself have been calibrated. See section 2.21 for calibration requirements. The measuring device shall also have flat contacts and be capable of measuring to a precision of 0.001 inch.

c. Fixed setting standards for field use shall be verified to an accuracy of ±0.002 inch using one of the devices listed in paragraph 3.36.2b.

3.36.3 Preparation

a. The drift mandrel shall be thoroughly clean and appropriate for use. The drift mandrel shall also be serialized with a unique identification number. It shall be visually inspected for any damages. The drift mandrel must have a constant OD and be continuous throughout its specified length. Disk and barbell-shaped mandrels shall not be used. The ends of the drift mandrel extending beyond the specified cylindrical portion shall be shaped to permit easy entry into the tubing.

b. When measuring the drift mandrel using a measuring device, the mandrel and measuring device shall be within 10 degrees F of each other after being stabilized for at least 30 minutes to ensure accurate measurement.

c. The cylindrical (measuring) portion of the drift mandrel shall be 42 inches long. If the drift mandrel is part of a fixed rattler, it is recommended that the length of the drift mandrel be at least 46 inches long to ensure that the tubing is being drifted per the requirements of this specification. The length of the drift cylinder shall be measured to the nearest 1/8 inch.

d. The OD of the drift mandrel shall be measured at a minimum of four locations: within 1 inch of both ends of the drift, within 2 inches of the middle of the drift, and 4 inches from the end that is most likely to wear. At least two measurements oriented 90 degrees apart shall be taken at each location to a precision of 0.001 inch. The drift cylinder diameter shall meet the requirements of Table 3.11.2. If the drift mandrel OD exceeds the allowed maximum, the drift shall be used only for acceptance but not rejection. If the drift mandrel OD does not meet the allowed minimum, then the mandrel shall be repaired or replaced before any further drifting is performed.

e. The drift mandrel OD shall be verified at minimum:

- At the start of each work order;
- After drifting 500 joints of tubing;
- At the end of every shift;
- When requested by the customer or a designated representative;
- At the end of each work order.

f. If the drift mandrel OD cannot be verified to meet the dimensional criteria of Table 3.11.2, all tubing drifted since the last valid verification shall be re-drifted after correcting the dimensional discrepancy.

g. The drift mandrel and the tubing shall be within 10 degrees F of one another when the drift passes through the ID of the tubing.

3.36.4 Procedure

Pass the drift mandrel through the entire length of each joint of tubing. The drift mandrel shall pass through the ID of the tubing freely using a reasonably-exerted force that does not exceed the weight of the drift mandrel. The drift should be inserted and removed carefully so that the threads are not damaged.

3.36.5 Acceptance Criteria

If the drift mandrel does not pass through the entire length of tubing, remove and clean the drift mandrel. Attempt the drift test again starting from the other end of the joint of tubing. If the drift mandrel does not pass through the entire length of the tubing on the second attempt, the component shall be rejected.

3.37 Workstring Visual Tube Inspection

3.37.1 Scope

This procedure covers visual examination of the internal and external surfaces of workstring tubes to determine general condition.

3.37.2 Inspection Apparatus

A paint marker, calibrated pit depth gage, calibrated white light intensity meter to verify illumination, and a light capable of illuminating the entire accessible internal surface are required. See section 2.21 for calibration requirements.

3.37.3 Preparation

a. All tubing shall be sequentially numbered.

b. The tubing body surface shall be cleaned so that the metal surface is visible and no surface particles larger than 1/8 inch in any dimension can be broken loose with a fingernail.

c. For examination of the ID, the internal surface in the inspected areas of the tubing shall be free from drilling mud, chemical residues, dust, dirt, and other visible contaminants.

Note: For cleaning of the tubing internal and external surfaces, it is recommended that a wire brush and/or rattler are used. Other pipe-cleaning methods may also be used.

3.37.4 Procedure and Acceptance Criteria

a. The minimum illumination level at the inspection surface shall be 50 foot-candles. The light intensity level at the inspection surface must be verified:

- At the start of each inspection;
- When light fixtures change positions or intensity;
- When there is a change in relative position of the inspected surface with respect to the light fixture;
- When requested by the customer or a designated representative;
- Upon completion of the inspection.

These requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface, all components inspected since the last light intensity level verification shall be re-inspected.

b. The external surface of the tubing shall be examined from end-to-end, not including the connections. Surface imperfections that penetrate the tubing body surface shall be marked and measured. Surface imperfections that do not meet the acceptance criteria of Table 3.11.1 shall be cause for rejection. The average adjacent wall thickness shall be determined by averaging the wall thickness readings from two opposite sides of the imperfection. Sample photos illustrating rejectable pitting on the OD are provided in Figure 3.37.1. Metal protruding above the surface may be removed to facilitate measuring the depth of penetration. Any visible cracks shall be cause for rejection.

c. The illuminated ID surface shall be visually examined up to at least 18 inches from either end. Identifiable rod wear shall be cause for rejection. An example of rod wear is included in Figure 3.37.2. ID pitting shall not exceed 1/8 inch as measured or visually estimated. If mill scale is found on either the OD or the ID, this is not cause for rejection. Sample photos of acceptable mill scale are included in Figure 3.37.3 and Figure 3.37.4. Corrosion scale, if present, shall be removed to facilitate the identification of pitting.

d. The ID surface of internally-coated pipe shall be examined for signs of deterioration of the Internal Plastic Coating (IPC). The tubing shall be classified as ID Coating Reference Condition 1, 2, 3, or 4 using the methods in section 3.4.5. Tubing with ID Coating Reference Condition 3 or 4 shall be rejected unless waived by the customer.

Figure 3.37.1 Rejectable pitting on the ODs of joints of tubing.

Figure 3.37.2 Rod wear on the ID of a joint of tubing.

Figure 3.37.3 Acceptable mill scale on the OD of a joint of tubing.

Figure 3.37.4 Acceptable mill scale on the ID of a joint of tubing.

e. The tubing shall not be visibly crooked by more than 3 inches over the entire length of the tube or 0.5 inch in the first 5 feet from either end. In addition to all applicable inspection, all straightened pipes shall be inspected in the straightened tube section and 2 feet either side of the straightened section in accordance with procedure 3.9, Magnetic Particle Inspection.

3.38 Workstring Visual Connection Inspection

3.38.1 Scope

This procedure covers visual examination of non-upset, externally-upset, and integral tubing connections to evaluate the condition of the connections.

3.38.2 Inspection Apparatus

A 12-inch metal ruler graduated in 1/64 inch increments, calibrated pit depth gage, calibrated API round thread profile gage, OD calipers, and calibrated white light intensity meter to verify illumination are required. See section 2.21 for calibration requirements.

3.38.3 Preparation

a. The minimum illumination level at the inspection surface shall be 50 foot-candles. The white light intensity level at the inspection surface shall be verified:

- At the start of each inspection;
- When light fixtures change positions or intensity;
- Where there is a change in relative position of the inspected surface with respect to the light fixture;
- When requested by the customer or a designated representative; and
- Upon completion of the inspection.

These requirements do not apply to direct sunlight conditions. If adjustments are required to the light intensity level at the inspection surface or if the light intensity is found to be less than 50 foot-candles when measured upon completion of the inspection, all components inspected since the most recent light intensity level verification shall be re-inspected.

b. All tubing shall be sequentially numbered.

c. Connections shall be clean so that no corrosion scale, mud, or lubricant can be wiped from the face of the connections or the thread surfaces with a clean rag.

3.38.4 Procedure & Acceptance Criteria for API Round Tubing Connections

a. Cracks: All connections shall be free of cracks. Grinding to remove cracks is not permitted.

b. Full-Height Threads: All threads within the L_c distance measured from the pin nose, except the thread closest to the pin nose, shall have full crests or the connection shall be rejected. All threads within the Perfect Thread Length (PTL) distance measured from the face of the box, except the thread closest to the face of the box, shall have full crests or the connection shall be rejected. The L_c and PTL distances are given in Table 3.11.3 and Table 3.11.4 as well as illustrated in Figure 3.38.1 and Figure 3.38.2.

c. Thread Profile: The thread profile gauge shall be used as a reference to check for major imperfections to the threads. Four thread profile checks 90 degrees ±10 degrees apart shall be made. Examples of acceptable

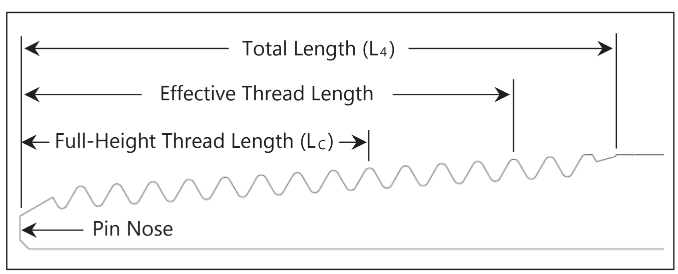


Figure 3.38.1 Thread dimensions of an API round thread pin.

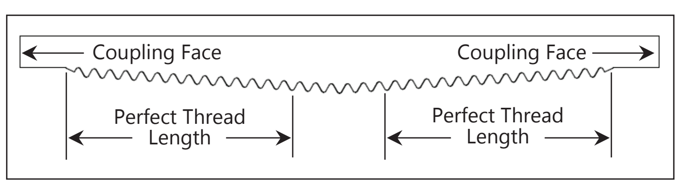


Figure 3.38.2 Thread dimensions of an API round thread coupling.

and rejectable thread conditions are shown in Figure 3.38.3–Figure 3.38.6.

d. Damages to Threads: All threads shall be free of raised metal, galling, missing threads, and pulled threads, or the connection shall be rejected. Thread surfaces shall be free of other imperfections or pitting that appears to occupy more than 1-1/2 inches in length along any thread helix, or exceed 1/32 inch in depth or 1/8 inch in diameter. Raised protrusions must be removed with a hand file or "soft" (nonmetallic) buffing wheel. The thread profile shall be checked after any buffing or cleaning of the threads using the thread profile gauge.

e. Box OD Imperfections: The depths of any pits, gouges, grip marks, or other imperfections on the OD of a box connection shall be measured using the pit depth gauge. If the result of subtracting the depth of the imperfection from the box OD is less than the minimum box OD given in Table 3.11.5, then the box connection shall be rejected. If a gouge has an adjacent metal protrusion, then the protrusion shall be removed prior to making a depth measurement.

f. Pin Nose Chamfer: A pin nose chamfer not present for a full (360 degree) circumference is cause for rejection. A thread root that runs out on the pin nose, a feather edge, or a knife edge (razor edge) is cause for rejection. Examples of these scenarios can be found in Figure 3.38.7, while a properly machined pin nose chamfer can be seen in Figure 3.38.1.

Figure 3.38.3 Acceptable thread condition.

Figure 3.38.4 Rejectable thread condition due to pitting.

Figure 3.38.5 Rejectable thread condition due to deformation.

Figure 3.38.6 Rejectable due to sharpened threads.

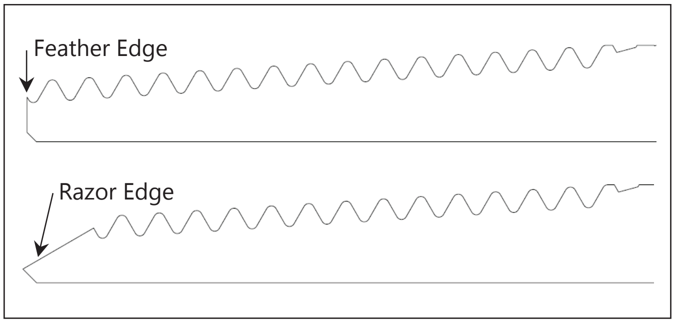


Figure 3.38.7 Improper pin nose geometry on API round thread pins.

3.38.5 Procedure and Acceptance Criteria for Shoulder-Sealing, Two-Step Connections

a. Cracks: All connections shall be free of cracks. Grinding to remove cracks is not permitted.

b. Sealing Surfaces: The sealing surfaces are defined in Figure 3.38.8 for the pin connection and Figure 3.38.9 for the box connection. All sealing surfaces shall be free of raised metal or corrosion deposits detected visually or by rubbing a metal scale or fingernail across the surface. Any pitting, scratches, dents, or other interruptions of the sealing surface that exceed 1/32 inch in depth or occupy more than 20% of the sealing width at any given location are rejectable.

c. Threads: Thread roots shall be free of all pitting or the connection shall be rejected and/or repaired. Thread surfaces shall be free of other imperfections that penetrate below the thread root, occupy more than one inch in length along any thread helix, or exceed 1/16 inch in depth or 1/8 inch in diameter.

d. Pin-Tip Shoulder: The pin-tip shoulder is defined in Figure 3.38.8 for the pin connection and Figure 3.38.9 for the box connection. The pin-tip shoulder shall not be rejected for damages unless the damage affects the adjacent sealing surface so that it prevents the connection from meeting the requirements in paragraph 3.38.5b.

e. Cylindrical Sections: The cylindrical sections (which are not seal areas) are defined in Figure 3.38.8 for the pin connection and Figure 3.38.9 for the box connection. The cylindrical sections shall not have damage that occupies more than 50% of any single cylindrical section width.

f. Any apparent plastic (permanent) deformation due to overtorque is cause for rejection.

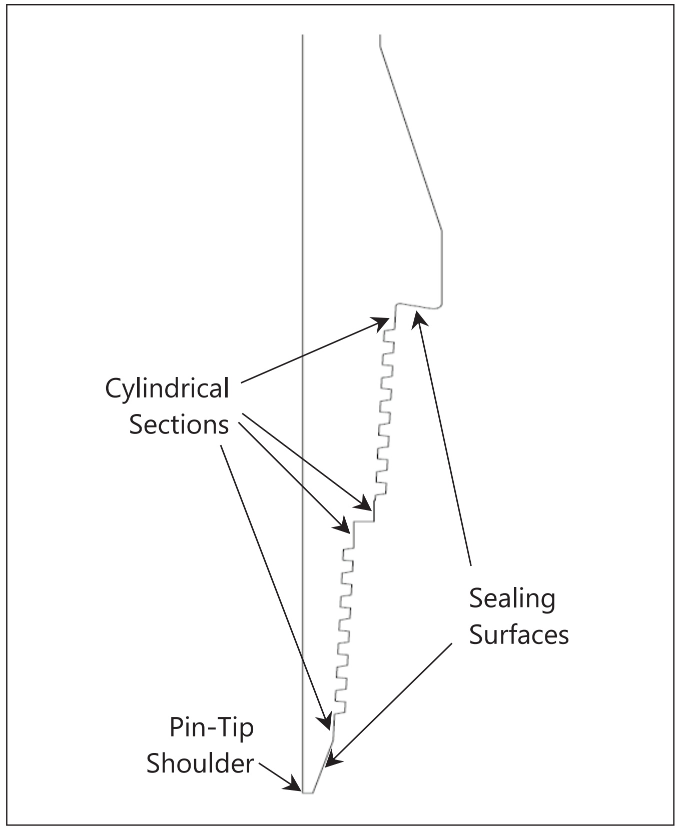


Figure 3.38.8 Shoulder-sealing, two-step pin.

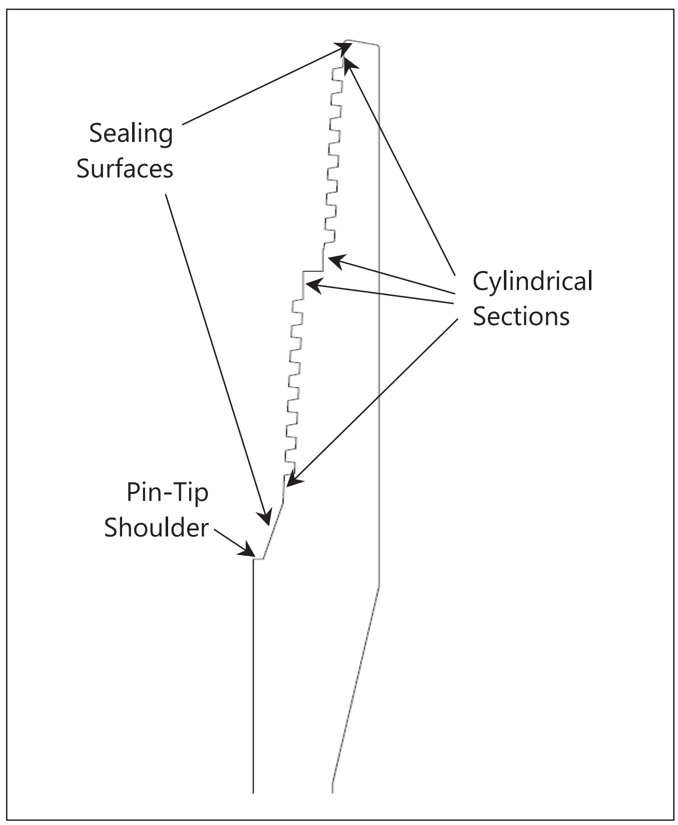


Figure 3.38.9 Shoulder-sealing, two-step box.

3.39 Workstring Dimensional Connection Inspection

3.39.1 Scope

This procedure covers the dimensional measurement of workstring tubing end connections.

3.39.2 Inspection Apparatus

A 12-inch steel rule graduated in 1/64 inch increments, a metal straightedge, and ID and OD calipers are required.

3.39.3 Preparation

a. All tubing shall be sequentially numbered.

b. Connections shall be clean so that nothing interferes with the measurements of any dimension.

3.39.4 Procedure and Acceptance Criteria for API Round Tubing Connections

a. Box OD: The OD of the box connection shall be measured 3/8 inch ±1/8 inch from the face of the box. At least two measurements shall be taken spaced at intervals of 90 degrees ±10 degrees. Box OD shall meet the requirements of Table 3.11.5.

b. Coupling Length: The coupling length shall be measured and meet the requirements of Table 3.11.5.

c. Pin Tip Standoff: For tubing with couplings, the mill end make-up position shall be checked by measuring the pin tip standoff (from the pin tip of the made-up connection to the face of the coupling on the mill-end side) with a steel rule. The pin tip standoff shall meet the requirements of Table 3.11.5.

3.39.5 Procedure and Acceptance Criteria for Shoulder-Sealing, Two-Step Connections

a. Box OD: The OD of the box connection shall be measured 3/8 inch ±1/8 inch from the face of the box. At least two measurements shall be taken spaced at intervals of 90 degrees ±10 degrees. The box OD shall meet the requirements of Table 3.11.6.

b. Pin ID: The pin ID shall be measured under the last thread furthest from the pin nose, and shall met the requirements of Table 3.11.6.

c. Pin Length: The pin length shall be measured and meet the requirements of Table 3.11.6.

References

1. The methodology is based on work by the University College of London and the Norwegian University of Science and Technology by order of Shell Internationale Exploration and Production B.V. and is further developed by Shell Internationale Exploration and Production B.V. The contributors were:
   A.C. Pols, Shell Internationale Exploration and Production B.V.
   W.J.G. Keultjes, Shell Internationale Exploration and Production B.V.
   J-M Savignat, Shell Internationale Exploration and Production B.V.
   L. van der Steen, Shell Internationale Exploration and Production B.V.
   F.P. Brennan, University College of London
   P.J. Haagensen, Norwegian University of Science and Technology

   The allowance for increase in cold rolling RPM is based on a later study carried out by Weatherford International and T H Hill Associates, Inc. The contributors from Weatherford International were:
   Khalid Imtiaz, Weatherford International
   Ismail Mohammed, Weatherford International
   Ahmed Moheb, Weatherford International

2. The relationship between AC frequency and the penetration depth for steel is based on the document "Degaussing – finished and semi-finished industrial products" by Vallon Gmbh.

Acknowledgement

Section 3.21 was contributed by Mr. Brian Williamson of Working Solutions, Inc.

The acceptance criteria for inspection of internal plastic coating is based on the internal plastic coating inspection procedure developed and provided by Mr. Robert Lauer of NOV Tuboscope.

Table 3.5.1 Classification of Used Normal Weight Drill Pipe Tubes and Tool Joints

	Condition	Ultra Class	Premium Class	Class 2
Tubes	Min Remaining Wall Thickness	≥ 90%	≥ 80%	≥ 70%[1]
	Cut Depth (slip cuts, gouges, etc)[2]	≤ 5% of avg adjacent wall[3]	≤ 10% of avg adjacent wall[3]	≤ 20% of avg adjacent wall[3]
	Round-Bottomed Imperfection Depth (pits, etc)	≤ 10% of avg adjacent wall[3]	Limited by wall thickness requirement	Limited by wall thickness requirement
	Diameter Reduction	≤ 2% of specified OD	≤ 3% of specified OD	≤ 4% of specified OD
	Diameter Increase	≤ 2% of specified OD	≤ 3% of specified OD	≤ 4% of specified OD
	Cracks	None	None	None
Tool Joints	Torsional Strength	≥ 80% of an Ultra Class tube	≥ 80% of a Premium Class tube	≥ 80% of a Class 2 tube
	Pin Stretch	≤ 0.006" in 2"	≤ 0.006" in 2"	≤ 0.006" in 2"
	Other Dimensions	As specified in Table 3.7.1–3.7.26	As specified in Table 3.7.1–3.7.26	As specified in Table 3.7.1–3.7.26
	Cracks	None	None	None

1 Minimum remaining wall thickness must be ≥ 80% under transverse cuts and gouges.
2 Surface imperfections include slip cuts, gouges, and corrosion pits. Surface imperfections may be removed by grinding provided the remaining wall is not reduced below the minimum remaining wall shown in this table.
3 Average adjacent wall is determined by averaging the wall thickness on each side of the imperfection adjacent to the deepest penetration.

Table 3.5.2 Classification of Used Thick-Walled Drill Pipe Tubes and Tool Joints

	Condition	95% Nom. Wall Class	90% Nom. Wall Class	80% Nom. Wall Class
Tubes	Min Remaining Wall Thickness	≥ 95%	≥ 90%	≥ 80%
	Cut Depth (slip cuts, gouges, etc)[2]	≤ 5% of avg adjacent wall[2]	≤ 10% of avg adjacent wall[2]	≤ 10% of avg adjacent wall[2]
	Round-Bottomed Imperfection Depth (pits, etc)	≤ 10% of avg adjacent wall[2]	Limited by wall thickness requirement	Limited by wall thickness requirement
	Diameter Reduction	≤ Nom. OD - [(2 • Min. wall) + Nom. ID]	≤ Nom. OD - [(2 • Min. wall) + Nom. ID]	≤ Nom. OD - [(2 • Min. wall) + Nom. ID]
	Diameter Increase	≤ 1% of specified OD	≤ 1% of specified OD	≤ 1% of specified OD
	Cracks	None	None	None
Tool Joints	Pin Stretch	≤ 0.006" in 2"	≤ 0.006" in 2"	≤ 0.006" in 2"
	Other Dimensions	As specified in Table 3.8.1–3.8.7	As specified in Table 3.8.1–3.8.7	As specified in Table 3.8.1–3.8.7
	Cracks	None	None	None

1 Surface imperfections include slip cuts, gouges, and corrosion pits. Surface imperfections may be removed by grinding provided the remaining wall is not reduced below the minimum remaining wall shown in this table.
2 Average adjacent wall is determined by averaging the wall thickness on each side of the imperfection adjacent to the deepest penetration.

Table 3.5.3 Criteria for Used Pup Joints

	Condition	Integral Pup Joints	Welded Pup Joints
Tubes	Min remaining wall thickness	Specified by customer	Specified by customer
	Cut Depth (slip cuts, gouges, etc)[2]	≤ 5% of avg adjacent wall[2]	≤ 10% of avg adjacent wall[2]
	Round-Bottomed Imperfection Depth (pits, etc)	≤ 10% of avg adjacent wall[2]	Limited by wall thickness
	Diameter Reduction	≤ Nom. OD - [(2•Min. wall) + Nom. ID]	≤ 3% of specified OD
	Diameter Increase	≤ 1% of specified OD	≤ 3% of specified OD
	Cracks	None	None
Tool Joints	Pin Stretch	≤ 0.006" in 2"	≤ 0.006" in 2"
	Other Dimensions	Specified by customer	Specified by customer
	Cracks	None	None

1 Surface imperfections include slip cuts, gouges, and corrosion pits. Surface imperfections may be removed by grinding provided the remaining wall is not reduced below the minimum remaining wall specified by the customer.

2 Average adjacent wall is determined by averaging the wall thickness on each side of the imperfection adjacent to the deepest penetration.

Table 3.6.1 Dimensional Acceptance Criteria for Used Normal Weight Drill Pipe Tubes

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
				Ultra Class			**Premium Class**			**Class 2**			**UT Field Reference Standard[1]**			
				Min Wall	**OD**		**Min Wall**	**OD**		**Min Wall**	**OD**		**Thick Section**		**Thin Section**	
Nom. OD (in)	**Nom. Weight (lb/ft)**	**Nom. ID (in)**	**Nom. Wall (in)**	**(90%) (in)**	**Min (in)**	**Max (in)**	**(80%) (in)**	**Min (in)**	**Max (in)**	**(70%) (in)**	**Min (in)**	**Max (in)**	**Min (in)**	**Max (in)**	**Min (in)**	**Max (in)**
2-3/8	4.85	1.995	0.190	0.171	2.328	2.423	0.152	2.304	2.446	0.133	2.280	2.470	0.190	0.290	0.033	0.133
	6.65	1.815	0.280	0.252			0.224			0.196			0.280	0.380	0.096	0.196
2-7/8	6.85	2.441	0.217	0.195	2.818	2.933	0.174	2.789	2.961	0.152	2.760	2.990	0.217	0.317	0.052	0.152
	10.40	2.151	0.362	0.326			0.290			0.253			0.362	0.462	0.153	0.253
3-1/2	9.50	2.992	0.254	0.229	3.430	3.570	0.203	3.395	3.605	0.178	3.360	3.640	0.254	0.354	0.078	0.178
	13.30	2.764	0.368	0.331			0.294			0.258			0.368	0.468	0.158	0.258
	15.50	2.602	0.449	0.404			0.359			0.314			0.449	0.549	0.214	0.314
4	11.85	3.476	0.262	0.236	3.920	4.080	0.210	3.880	4.120	0.183	3.840	4.160	0.262	0.362	0.083	0.183
	14.00	3.340	0.330	0.297			0.264			0.231			0.330	0.430	0.131	0.231
	15.70	3.240	0.380	0.342			0.304			0.266			0.380	0.480	0.166	0.266
4-1/2	13.75	3.958	0.271	0.244	4.410	4.590	0.217	4.365	4.635	0.190	4.320	4.680	0.271	0.371	0.090	0.190
	16.60	3.826	0.337	0.303			0.270			0.236			0.337	0.437	0.136	0.236
	20.00	3.640	0.430	0.387			0.344			0.301			0.430	0.530	0.201	0.301
	22.82	3.500	0.500	0.450			0.400			0.350			0.500	0.600	0.250	0.350
5	16.25	4.408	0.296	0.266	4.900	5.100	0.237	4.850	5.150	0.207	4.800	5.200	0.296	0.396	0.107	0.207
	19.50	4.276	0.362	0.326			0.290			0.253			0.362	0.462	0.153	0.253
	25.60	4.000	0.500	0.450			0.400			0.350			0.500	0.600	0.250	0.350
5-1/2	19.20	4.892	0.304	0.274	5.390	5.610	0.243	5.335	5.665	0.213	5.280	5.720	0.304	0.404	0.113	0.213
	21.90	4.778	0.361	0.325			0.289			0.253			0.361	0.461	0.153	0.253
	24.70	4.670	0.415	0.374			0.332			0.290			0.415	0.515	0.191	0.291
5-7/8	23.40	5.153	0.361	0.325	5.758	5.993	0.289	5.698	6.051	0.253	5.640	6.110	0.361	0.461	0.153	0.253
	26.30	5.045	0.415	0.374			0.332			0.290			0.415	0.515	0.191	0.291
6-5/8	25.20	5.965	0.330	0.297	6.493	6.758	0.264	6.426	6.824	0.231	6.360	6.890	0.330	0.430	0.131	0.231
	27.70	5.901	0.362	0.326			0.290			0.253			0.362	0.462	0.153	0.253

1 The requirements for the thick section and thin section of the Ultrasonic Field Reference Standard are according to the requirements given in section 3.6 of this volume.

Table 3.6.2 Dimensional Acceptance Criteria for Used Thick-Walled Drill Pipe Tubes

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			95% Nominal Wall Class			90% Nominal Wall Class			80% Nominal Wall Class			UT Field Reference Standard[1]			
				OD			OD			OD		Thick Section		Thin Section	
Nom. OD (in)	Nom. Wall (in)	Nom. ID (in)	Min Wall (in)	Min (in)	Max (in)	Min Wall (in)	Min (in)	Max (in)	Min Wall (in)	Min (in)	Max (in)	Min (in)	Max (in)	Min (in)	Max (in)
5	0.575	3.850	0.546	4.943	5.050	0.518	4.885	5.050	0.460	4.770	5.050	0.575	0.675	0.303	0.403
	0.625	3.750	0.594	4.938	5.050	0.563	4.875	5.050	0.500	4.750	5.050	0.625	0.725	0.338	0.438
	0.713	3.574	0.677	4.929	5.050	0.642	4.857	5.050	0.570	4.715	5.050	0.713	0.813	0.399	0.499
	0.750	3.500	0.713	4.925	5.050	0.675	4.850	5.050	0.600	4.700	5.050	0.750	0.850	0.425	0.525
5 1/2	0.500	4.500	0.475	5.450	5.555	0.450	5.400	5.555	0.400	5.300	5.555	0.500	0.600	0.250	0.350
	0.522	4.456	0.496	5.448	5.555	0.470	5.396	5.555	0.418	5.291	5.555	0.522	0.622	0.265	0.365
	0.750	4.000	0.713	5.425	5.555	0.675	5.350	5.555	0.600	5.200	5.555	0.750	0.850	0.425	0.525
	0.790	3.920	0.751	5.421	5.555	0.711	5.342	5.555	0.632	5.184	5.555	0.790	0.890	0.453	0.553
	0.813	3.875	0.772	5.419	5.555	0.731	5.338	5.555	0.650	5.175	5.555	0.813	0.913	0.469	0.569
5 7/8	0.500	4.875	0.475	5.825	5.934	0.450	5.775	5.934	0.400	5.675	5.934	0.500	0.600	0.250	0.350
	0.625	4.625	0.594	5.813	5.934	0.563	5.750	5.934	0.500	5.625	5.934	0.625	0.725	0.338	0.438
	0.675	4.525	0.641	5.808	5.934	0.608	5.740	5.934	0.540	5.605	5.934	0.675	0.775	0.373	0.473
	0.750	4.375	0.713	5.800	5.934	0.675	5.725	5.934	0.600	5.575	5.934	0.750	0.850	0.425	0.525
	0.813	4.249	0.772	5.794	5.934	0.732	5.712	5.934	0.650	5.550	5.934	0.813	0.913	0.469	0.569
6 5/8	0.415	5.795	0.394	6.584	6.691	0.374	6.542	6.691	0.332	6.459	6.691	0.415	0.515	0.191	0.291
	0.500	5.625	0.475	6.575	6.691	0.450	6.525	6.691	0.400	6.425	6.691	0.500	0.600	0.250	0.350
	0.522	5.581	0.496	6.573	6.691	0.470	6.521	6.691	0.418	6.416	6.691	0.522	0.622	0.265	0.365
	0.625	5.375	0.594	6.563	6.691	0.563	6.500	6.691	0.500	6.375	6.691	0.625	0.725	0.338	0.438
	0.640	5.345	0.608	6.561	6.691	0.576	6.497	6.691	0.512	6.369	6.691	0.640	0.740	0.348	0.448
	0.688	5.250	0.653	6.556	6.691	0.619	6.488	6.691	0.550	6.350	6.691	0.688	0.788	0.381	0.481
	0.750	5.125	0.713	6.550	6.691	0.675	6.475	6.691	0.600	6.325	6.691	0.750	0.850	0.425	0.525
	0.813	4.999	0.772	6.544	6.691	0.732	6.462	6.691	0.650	6.300	6.691	0.813	0.913	0.469	0.569

1 The requirements for the thick section and thin section of the Ultrasonic Field Reference Standard are according to the requirements given in section 3.6 of this volume.

Table 3.7.1 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

			Ultra Class				Premium Class				Class 2				Minimum Tong Space			
Nominal Size/Wt	Conn	Grade	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Pin	Box	Max Cbore	Max Bevel Diameter
2 3/8	2-3/8 PAC	E	2 13/16	1 13/32	2 43/64	11/64	2 25/32	1 3/8	2 21/32	9/64	2 23/32	1 19/32	2 5/8	7/64	4	4	2 15/32	2 23/32
6.65	2-3/8 SL H90	E	3 1/16	2 3/32	2 31/32	7/64	3 1/32	2 3/32	2 15/16	3/32	2 31/32	2 5/32	2 29/32	1/16	4	4 7/16	2 53/64	3 9/64
	2-3/8 OH SW	E	3 1/8	2 1/32	3 1/64	1/8	3 1/16	2 1/16	2 63/64	3/32	3 1/32	2 1/8	2 31/32	5/64	4	4	2 55/64	3 5/32
	NC26	E	3 7/32	2 1/16	3 9/64	7/64	3 3/16	2 3/32	3 7/64	5/64	3 5/32	2 5/32	3 3/32	1/16	4	4 5/8	3	3 9/32
	NC26	X	3 5/16	1 29/32	3 13/64	5/32	3 1/4	2	3 5/32	7/64	3 7/32	2 3/32	3 9/64	3/32	4	4 5/8	3	3 9/32
	NC26	G	3 11/32	1 27/32	3 7/32	11/64	3 9/32	1 15/16	3 3/16	1/8	3 1/4	2 1/32	3 5/32	7/64	4	4 5/8	3	3 9/32
2 7/8	2-7/8 OH LW	E	3 17/32	2 13/32	3 27/64	1/8	3 1/2	2 7/16	3 13/32	7/64	3 7/16	2 1/2	3 3/8	5/64	4	4 1/8	3 17/64	3 5/8
6.85	2-7/8 SL H90	E	3 17/32	2 9/16	3 27/64	7/64	3 1/2	2 19/32	3 13/32	3/32	3 7/16	2 5/8	3 3/8	1/16	4	4 9/16	3 19/64	3 59/64
	NC26	E	3 5/16	1 29/32	3 13/64	5/32	3 9/32	1 31/32	3 11/64	7/64	3 7/32	2 1/16	3 9/64	3/32	4	4 5/8	3	3 9/32
	NC31	E	3 23/32	2 19/32	3 21/32	7/64	3 11/16	2 17/32	3 5/8	5/64	3 21/32	2 11/16	3 39/64	1/16	4	5 1/8	3 33/64	3 31/32
	2-7/8 XH	E	3 21/32	2 1/2	3 37/64	7/64	3 5/8	2 9/16	3 35/64	1/16	3 9/16	2 5/8	3 33/64	3/64	4	5 5/8	3 27/64	4 3/64
	2-7/8 XH	X	3 3/4	2 3/8	3 5/8	5/32	3 11/16	2 15/32	3 19/32	7/64	3 5/8	2 9/16	3 9/16	5/64	4	5 5/8	3 27/64	4 3/64
	2-7/8 XH	G	3 25/32	2 5/16	3 41/64	11/64	3 23/32	2 13/32	3 39/64	1/8	3 11/16	2 1/2	3 37/64	3/32	4	5 5/8	3 27/64	4 3/64
2 7/8	2-7/8 SL H90	E	3 5/8	2 13/32	3 1/2	11/64	3 19/32	2 15/32	3 15/32	9/64	3 17/32	2 17/32	3 7/16	7/64	4	4 9/16	3 19/64	3 59/64
10.40	2-7/8 SL H90	X	3 3/4	2 1/4	3 9/16	7/32	3 11/16	2 5/16	3 17/32	3/16	3 5/8	2 13/32	3 31/64	5/32	4	4 9/16	3 19/64	3 59/64
	2-7/8 OH SW	E	3 21/32	2 3/16	3 33/64	13/64	3 19/32	2 9/32	3 15/32	5/32	3 9/16	2 3/8	3 7/16	7/64	4	4 1/2	3 17/64	3 5/8
	NC31	E	3 27/32	2 13/32	3 47/64	11/64	3 13/16	2 1/2	3 45/64	9/64	3 3/4	2 19/32	3 21/32	7/64	4	5 1/8	3 33/64	3 31/32
	NC31	X	3 31/32	2 1/4	3 51/64	7/32	3 29/32	2 5/16	3 3/4	3/16	3 27/32	2 7/16	3 23/32	5/32	4	5 1/8	3 33/64	3 31/32
	NC31	G	4	2 5/32	3 53/64	1/4	3 15/16	2 1/4	3 25/32	13/64	3 7/8	2 3/8	3 47/64	11/64	4	5 1/8	3 33/64	3 31/32
	NC31	S	4 5/32	1 27/32	3 59/64	21/64	4 1/16	2 1/32	3 55/64	17/64	4	2 13/16	3 13/16	15/64	4	5 1/8	3 33/64	3 31/32
	2-7/8 XH	E	3 25/32	2 5/16	3 21/32	11/64	3 23/32	2 13/32	3 39/64	9/64	3 21/32	2 1/2	3 37/64	7/64	4	5 5/8	3 27/64	4 3/64
3 1/2	NC31	E	4 3/32	2	3 7/8	9/32	4	2 1/8	3 53/64	15/64	3 15/16	2 9/32	3 25/32	13/64	4	5 1/8	3 33/64	3 31/32
13.30	3-1/2 H90	E	4 19/32	3 1/4	4 15/32	11/64	4 17/32	3 5/16	4 7/16	1/8	4 1/2	3 3/8	4 13/32	7/64	4	5 5/8	4 1/4	5
	3-1/2 H90	X	4 11/16	3 3/32	4 17/32	7/32	4 5/8	3 5/32	4 31/64	11/64	4 9/16	3 1/4	4 29/64	9/64	4	5 5/8	4 1/4	5
	3-1/2 XH	E	4 13/32	2 21/32	4 15/64	15/64	4 11/32	2 23/32	4 3/16	9/64	4 1/4	2 29/32	4 9/64	1/8	4	5 1/8	3 15/16	4 35/64
	3-1/2 XH	X	4 17/32	2 7/16	4 5/16	19/64	4 7/16	2 19/32	4 1/4	13/64	4 3/8	2 23/32	4 13/64	11/64	4	5 1/8	3 15/16	4 35/64
	3-1/2 XH	G	4 19/32	2 5/16	4 23/64	21/64	4 1/2	2 15/32	4 19/64	15/64	4 13/32	2 21/32	4 1/4	3/16	4	5 1/8	3 15/16	4 35/64
	3-1/2 SL H90	X	4 15/32	2 13/16	4 1/4	17/64	4 3/8	2 7/8	4 13/64	13/64	4 5/16	2 31/32	4 11/64	11/64	4	4 5/8	3 15/16	4 29/64
	NC38	E	4 9/16	2 31/32	4 13/32	13/64	4 1/2	3 1/16	4 23/64	11/64	4 7/16	3 1/8	4 21/64	9/64	4	5 5/8	4 9/64	4 19/32
	NC38	X	4 11/16	2 3/4	4 31/64	17/64	4 19/32	2 7/8	4 27/64	7/32	4 17/32	3	4 3/8	3/16	4	5 5/8	4 9/64	4 19/32
	NC38	G	4 3/4	2 21/32	4 33/64	19/64	4 21/32	2 25/32	4 15/32	1/4	4 19/32	2 7/8	4 27/64	7/32	4	5 5/8	4 9/64	4 19/32
	NC38	S	4 29/32	2 5/16	4 35/64	25/64	4 13/16	2 17/32	4 9/16	21/64	4 23/32	2 29/32	4 1/2	9/32	4	5 5/8	4 9/64	4 19/32
	NC40	S	5 3/32	2 25/32	4 27/32	11/32	5	2 29/32	4 25/32	9/32	4 29/32	3 1/16	4 23/32	15/64	4	6 1/8	4 13/32	5 1/32

Table 3.7.1 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

			Ultra Class				Premium Class				Class 2				Minimum Tong Space			
Nominal Size/Wt	Conn	Grade	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Pin	Box	Max Cbore	Max Bevel Diameter
3 1/2	NC38	E	4 5/8	2 7/8	4 7/16	15/64	4 17/32	2 31/32	4 25/64	3/16	4 15/32	3 3/32	4 23/64	5/32	4	5 5/8	4 9/64	4 19/32
15.50	NC38	X	4 3/4	2 5/8	4 17/32	5/16	4 21/32	2 25/32	4 15/32	1/4	4 19/32	2 29/32	4 27/64	7/32	4	5 5/8	4 9/64	4 19/32
	NC38	G	4 13/16	2 1/2	4 35/64	11/32	4 23/32	2 21/32	4 1/2	9/32	4 5/8	2 13/16	4 29/64	15/64	4	5 5/8	4 9/64	4 19/32
	NC38[1]	S	5	2 3/32	4 9/16	7/16	4 29/32	2 11/32	4 9/16	9/32	4 25/32	2 19/32	4 17/32	3/16	4	5 5/8	4 9/64	4 19/32
	NC40	G	5	2 15/16	4 25/32	19/64	4 15/16	3 1/16	4 47/64	1/4	4 27/32	3 3/16	4 43/64	13/64	4	6 1/8	4 13/32	5 1/32
	NC40	S	5 3/16	2 19/32	4 29/32	25/64	5 3/32	2 13/16	4 53/64	21/64	4 31/32	2 31/32	4 49/64	17/64	4	6 1/8	4 13/32	5 1/32
4	NC46	E	5 1/4	3 31/32	5 5/32	9/64	5 7/32	4 1/32	5 1/8	7/64	5 5/32	4 3/32	5 3/32	5/64	4	6 1/8	4 31/32	5 47/64
11.85	4 H90	E	4 15/16	3 11/16	4 13/16	5/32	4 7/8	3 23/32	4 25/32	7/64	4 27/32	3 25/32	4 49/64	3/32	4	5 7/8	4 5/8	5 9/32
4	NC40	E	4 7/8	3 5/32	4 45/64	15/64	4 13/16	3 1/4	4 43/64	3/16	4 3/4	3 11/32	4 5/8	5/32	4	6 1/8	4 13/32	5 1/32
14.00	NC40	X	5 1/32	2 29/32	4 51/64	5/16	4 15/16	3 1/16	4 47/64	1/4	4 27/32	3 3/16	4 11/16	13/64	4	6 1/8	4 13/32	5 1/32
	NC40	G	5 3/32	2 13/16	4 53/64	11/32	5	2 15/16	4 49/64	9/32	4 29/32	3 3/32	4 23/32	15/64	4	6 1/8	4 13/32	5 1/32
	NC40	S	5 9/32	2 13/32	4 61/64	7/16	5 11/64	2 39/64	4 57/64	3/8	5 1/16	2 13/16	4 53/64	5/16	4	6 1/8	4 13/32	5 1/32
	NC46	E	5 11/32	3 7/8	5 13/64	3/16	5 9/32	3 15/16	5 5/32	9/64	5 7/32	4 1/32	5 1/8	7/64	4	6 1/8	4 31/32	5 47/64
	NC46	X	5 7/16	3 23/32	5 17/64	15/64	5 3/8	3 13/16	5 15/64	3/16	5 5/16	3 15/16	5 11/64	5/32	4 1/32	6 1/8	4 31/32	5 47/64
	NC46	G	5 1/2	3 5/8	5 19/64	17/64	5 7/16	3 3/4	5 1/4	7/32	5 11/32	3 27/32	5 13/64	11/64	4 1/16	6 1/8	4 31/32	5 47/64
	NC46	S	5 21/32	3 3/8	5 13/32	11/32	5 9/16	3 1/2	5 11/32	9/32	5 1/2	3 21/32	5 19/64	1/4	4 11/64	6 1/8	4 31/32	5 47/64
	4 H90	E	5	3 19/32	4 55/64	3/16	4 15/16	3 21/32	4 53/64	9/64	4 7/8	3 23/32	4 25/32	7/64	4	5 7/8	4 5/8	5 9/32
	4 H90	X	5 1/8	3 7/16	4 15/16	1/4	5 1/32	3 1/2	4 57/64	3/16	4 31/32	3 19/32	4 27/32	5/32	4	5 7/8	4 5/8	5 9/32
	4 H90	G	5 5/32	3 11/32	4 31/32	17/64	5 3/32	3 7/16	4 59/64	7/32	5 1/32	3 15/32	4 7/8	3/16	4	5 7/8	4 5/8	5 9/32
	4 SH	E	4 17/32	2 7/16	4 5/16	19/64	4 7/16	2 19/32	4 1/4	15/64	4 3/8	2 23/32	4 13/64	13/64	4	5 1/8	3 15/16	4 35/64
4	NC40	E	4 15/16	3 1/16	4 47/64	17/64	4 7/8	3 1/8	4 11/16	7/32	4 25/32	3 9/32	4 41/64	11/64	4	6 1/8	4 13/32	5 1/32
15.70	NC40	X	5 3/32	2 13/16	4 53/64	11/32	5	2 31/32	4 49/64	9/32	4 29/32	3 3/32	4 23/32	15/64	4	6 1/8	4 13/32	5 1/32
	NC46	E	5 3/8	3 13/16	5 7/32	13/64	5 5/16	3 29/32	5 3/16	5/32	5 1/4	3 31/32	5 5/32	1/8	4	6 1/8	4 31/32	5 47/64
	NC46	X	5 1/2	3 5/8	5 19/64	17/64	5 7/16	3 3/4	5 1/4	7/32	5 11/32	3 27/32	5 13/64	11/64	4 1/16	6 1/8	4 31/32	5 47/64
	NC46	G	5 9/16	3 17/32	5 11/32	19/64	5 15/32	3 21/32	5 9/32	15/64	5 13/32	3 25/32	5 15/64	13/64	4 7/64	6 1/8	4 31/32	5 47/64
	NC46	S	5 3/4	3 1/4	5 29/64	25/64	5 21/32	3 13/32	5 25/64	21/64	5 17/32	3 9/16	5 21/64	17/64	4 15/64	6 1/8	4 31/32	5 47/64
	4 H90	E	5 1/32	3 17/32	4 57/64	13/64	4 31/32	3 19/32	4 27/32	5/32	4 29/32	3 21/32	4 13/16	1/8	4	5 7/8	4 5/8	5 9/32
	4 H90	X	5 5/32	3 11/32	4 31/32	17/64	5 3/32	3 7/16	4 59/64	7/32	5 1/32	3 17/32	4 7/8	3/16	4	5 7/8	4 5/8	5 9/32
	4 H90	G	5 7/32	3 1/4	5 1/64	19/64	5 5/32	3 11/32	4 61/64	1/4	5 1/16	3 15/32	4 29/32	13/64	4	5 7/8	4 5/8	5 9/32
4 1/2	NC46	E	5 15/32	3 11/16	5 9/32	1/4	5 13/32	3 25/32	5 15/64	13/64	5 11/32	3 7/8	5 13/64	11/64	4 3/64	6 1/8	4 31/32	5 47/64
16.60	NC46	X	5 5/8	3 15/32	5 3/8	21/64	5 17/32	3 19/32	5 21/64	17/64	5 7/16	3 23/32	5 17/64	7/32	4 5/32	6 1/8	4 31/32	5 47/64
	NC46	G	5 11/16	3 11/32	5 27/64	23/64	5 19/32	3 1/2	5 23/64	19/64	5 1/2	3 5/8	5 5/16	1/4	4 13/64	6 1/8	4 31/32	5 47/64
	NC46	S	5 29/32	2 31/32	5 35/64	15/32	5 25/32	3 5/32	5 31/64	25/64	5 21/32	3 3/8	5 13/32	21/64	4 11/32	6 1/8	4 31/32	5 47/64

Table 3.7.1 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

			Ultra Class				Premium Class				Class 2				Minimum Tong Space			
Nominal Size/Wt	Conn	Grade	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Pin	Box	Max Cbore	Max Bevel Diameter
4 1/2	4-1/2 H90	E	5 13/32	3 27/32	5 15/64	7/32	5 11/32	3 29/32	5 3/16	3/16	5 9/32	4	5 5/32	5/32	4	6 1/8	4 61/64	5 47/64
16.60	4-1/2 H90	X	5 17/32	3 21/32	5 5/16	19/64	5 15/32	3 3/4	5 17/64	1/4	5 3/8	3 27/32	5 7/32	13/64	4 3/32	6 1/8	4 61/64	5 47/64
	4-1/2 H90	G	5 19/32	3 9/16	5 23/64	21/64	5 1/2	3 21/32	5 19/64	17/64	5 7/16	3 25/32	5 1/4	15/64	4 1/8	6 1/8	4 61/64	5 47/64
	4-1/2 FH	E	5 7/16	3 17/32	5 17/64	1/4	5 3/8	3 5/8	5 7/32	13/64	5 9/32	3 23/32	5 11/64	5/32	4 1/64	5 5/8	4 15/16	5 47/64
	4-1/2 FH	X	5 19/32	3 9/32	5 23/64	21/64	5 1/2	3 13/32	5 5/16	17/64	5 13/32	3 9/16	5 1/4	7/32	4 1/8	5 5/8	4 15/16	5 47/64
	4-1/2 FH	G	5 21/32	3 5/32	5 13/32	23/64	5 9/16	3 21/32	5 11/32	19/64	5 15/32	3 15/32	5 19/64	1/4	4 11/64	5 5/8	4 15/16	5 47/64
	NC50	E	5 25/32	4 7/32	5 41/64	13/64	5 23/32	4 5/16	5 19/32	5/32	5 11/16	4 13/32	5 9/16	9/64	4 19/64	6 1/8	5 3/8	6 5/64
	NC50	X	5 15/16	4 1/32	5 23/32	9/32	5 27/32	4 5/32	5 43/64	7/32	5 25/32	4 1/4	5 5/8	3/16	4 25/64	6 1/8	5 3/8	6 5/64
	NC50	G	6	3 15/16	5 49/64	5/16	5 29/32	4 1/16	5 23/32	1/4	5 13/16	4 3/16	5 21/32	13/64	4 7/16	6 1/8	5 3/8	6 5/64
	NC50	S	6 5/32	3 21/32	5 7/8	25/64	6 1/16	3 13/16	5 13/16	21/64	5 31/32	3 31/32	5 3/4	9/32	4 35/64	6 1/8	5 3/8	6 5/64
4 1/2	NC46	E	5 9/16	3 17/32	5 11/32	19/64	5 1/2	3 5/8	5 19/64	1/4	5 13/32	3 3/4	5 1/4	13/64	4 7/64	6 1/8	4 31/32	5 47/64
20.00	NC46	X	5 3/4	3 1/4	5 29/64	25/64	5 21/32	3 13/32	5 25/64	21/64	5 9/16	3 9/16	5 21/64	9/32	4 15/64	6 1/8	4 31/32	5 47/64
	NC46	G	5 13/16	3 3/32	5 33/64	27/64	5 23/32	3 1/4	5 7/16	23/64	5 5/8	3 15/32	5 3/8	5/16	4 19/64	6 1/8	4 31/32	5 47/64
	NC46	S	6 1/16	2 19/32	5 21/32	35/64	5 59/64	2 7/8	5 37/64	15/32	5 51/64	3 1/8	5 31/64	13/32	4 7/16	6 1/8	4 31/32	5 27/32
	NC50	E	5 7/8	4 3/32	5 45/64	1/4	5 13/16	4 3/16	5 21/32	13/64	5 3/4	4 5/16	5 39/64	3/16	4 23/64	6 1/8	5 3/8	6 5/64
	NC50	X	6 1/32	3 7/8	5 51/64	21/64	5 15/16	4	5 47/64	17/64	5 7/8	4 1/8	5 11/16	15/64	4 29/64	6 1/8	5 3/8	6 5/64
	NC50	G	6 1/8	3 3/4	5 27/32	3/8	6 1/32	3 29/32	5 25/32	5/16	5 29/32	4 1/32	5 23/32	1/4	4 33/64	6 1/8	5 3/8	6 5/64
	NC50	S	6 5/16	3 3/8	5 31/32	15/32	6 7/32	3 19/32	5 57/64	13/32	6 3/32	3 25/32	5 13/16	11/32	4 21/32	6 1/8	5 3/8	6 5/64
	4-1/2 H90	E	5 1/2	3 23/32	5 19/64	17/64	5 13/32	3 25/32	5 15/64	7/32	5 11/32	3 7/8	5 13/64	3/16	4 1/16	6 1/8	4 61/64	5 47/64
	4-1/2 H90	X	5 21/32	3 15/32	5 25/64	11/32	5 9/16	3 9/16	5 21/64	19/64	5 15/32	3 23/32	5 9/32	1/4	4 5/32	6 1/8	4 61/64	5 47/64
	4-1/2 FH	E	5 9/16	3 11/32	5 11/32	5/16	5 15/32	3 1/2	5 9/32	1/4	5 3/8	3 5/8	5 15/64	13/64	4 3/32	5 5/8	4 15/16	5 47/64
	4-1/2 FH	X	5 23/32	3 1/32	5 29/64	25/64	5 5/8	3 7/32	5 3/8	21/64	5 17/32	3 3/8	5 5/16	9/32	4 13/64	5 5/8	4 15/16	5 47/64
5	NC50	E	5 31/32	4	5 47/64	19/64	5 7/8	4 3/32	5 11/16	15/64	5 13/16	4 7/32	5 41/64	13/64	4 13/32	6 1/8	5 3/8	6 5/64
19.50	NC50	X	6 1/8	3 3/4	5 27/32	3/8	6 1/32	3 7/8	5 25/32	5/16	5 15/16	4	5 23/32	17/64	4 33/64	6 1/8	5 3/8	6 5/64
	NC50	G	6 3/16	3 19/32	5 57/64	13/32	6 3/32	3 25/32	5 53/64	11/32	6	3 15/16	5 49/64	19/64	4 37/64	6 1/8	5 3/8	6 5/64
	NC50	S	6 7/16	3 3/16	6 1/32	17/32	6 5/16	3 13/32	5 61/64	29/64	6 3/16	3 5/8	5 7/8	25/64	4 23/32	6 1/8	5 3/8	6 5/64
	5 H90	X	5 15/16	3 3/4	5 43/64	23/64	5 27/32	3 27/32	5 5/8	19/64	5 3/4	3 21/32	5 9/16	1/4	4 25/64	6 3/8	5 15/64	6 1/8
	5 H90	G	6 1/32	3 5/8	5 23/32	25/64	5 29/32	3 3/4	5 21/32	21/64	5 13/16	3 7/8	5 19/32	9/32	4 7/16	6 3/8	5 15/64	6 1/8
	5 1/2 FH	E	6 7/16	4 11/16	6 17/64	15/64	6 23/64	4 25/32	6 7/32	3/16	6 5/16	4 27/32	6 11/64	5/32	4 49/64	6 5/8	5 31/32	6 5/16
	5 1/2 FH	X	6 19/32	4 1/2	6 11/32	5/16	6 31/64	4 39/64	6 19/64	1/4	6 13/32	4 23/32	6 1/4	13/64	4 55/64	6 5/8	5 31/32	6 7/16
	5 1/2 FH	G	6 21/32	4 3/8	6 25/64	11/32	6 35/64	4 33/64	6 21/64	9/32	6 15/32	4 5/8	6 9/32	15/64	4 29/32	6 5/8	5 31/32	6 1/2
	5 1/2 FH	S	6 27/32	4 1/16	6 33/64	7/16	6 3/4	4 1/4	6 29/64	3/8	6 5/8	4 13/32	6 3/8	5/16	5 3/64	6 5/8	5 31/32	6 47/64

Table 3.7.1 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

			Ultra Class				Premium Class				Class 2				Minimum Tong Space			
Nominal Size/Wt	Conn	Grade	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Pin	Box	Max Cbore	Max Bevel Diameter
5	5 1/2 FH	E	6 9/16	4 1/2	6 11/32	19/64	6 1/2	4 5/8	6 19/64	1/4	6 13/32	4 3/4	6 1/4	13/64	4 55/64	6 5/8	5 31/32	6 47/64
25.60	5 1/2 FH	X	6 3/4	4 7/32	6 29/64	25/64	6 21/32	4 3/8	6 25/64	21/64	6 9/16	4 17/32	6 21/64	9/32	4 63/64	6 5/8	5 31/32	6 47/64
	5 1/2 FH	G	6 27/32	4 3/32	6 33/64	7/16	6 23/32	4 9/32	6 7/16	23/64	6 5/8	4 7/16	6 3/8	5/16	5 3/64	6 5/8	5 31/32	6 47/64
	5 1/2 FH	S	7 1/16	3 21/32	6 43/64	35/64	6 15/16	3 29/32	6 37/64	15/32	6 13/16	4 1/8	6 31/64	13/32	5 13/64	6 5/8	5 31/32	6 47/64
	NC50	E	6 1/8	3 3/4	5 27/32	3/8	6 1/32	3 29/32	5 25/32	5/16	5 15/16	4 1/32	5 23/32	17/64	4 33/64	6 1/8	5 3/8	6 5/64
	NC50	X	6 5/16	3 13/32	5 31/32	15/32	6 7/32	3 9/16	5 57/64	13/32	6 3/32	3 25/32	5 13/16	11/32	4 21/32	6 1/8	5 3/8	6 5/64
	NC50	G	6 13/32	3 7/32	6 1/32	33/64	6 9/32	3 7/16	5 61/64	7/16	6 5/32	3 21/32	5 7/8	3/8	4 23/32	6 1/8	5 3/8	6 5/64
5 1/2	5 1/2 FH	E	6 9/16	4 1/2	6 11/32	19/64	6 15/32	4 5/8	6 9/32	15/64	6 13/32	4 3/4	6 15/64	13/64	4 55/64	6 5/8	5 31/32	6 47/64
21.90	5 1/2 FH	X	6 23/32	4 1/4	6 29/64	3/8	6 5/8	4 11/32	6 3/8	5/16	6 17/32	4 17/32	6 21/64	17/64	4 31/32	6 5/8	5 31/32	6 47/64
	5 1/2 FH	G	6 13/16	4 1/8	6 1/2	27/64	6 23/32	4 9/32	6 7/16	23/64	6 19/32	4 7/16	6 23/64	19/64	5 1/32	6 5/8	5 31/32	6 47/64
	5 1/2 FH	S	7 1/16	3 23/32	6 41/64	35/64	6 15/16	3 15/16	6 9/16	15/32	6 13/16	4 5/32	6 31/64	13/32	5 3/16	6 5/8	5 31/32	7 7/64
	5-1/2 H90	X	6 9/32	3 27/32	6	25/64	6 3/16	3 15/16	5 15/16	21/64	6 3/32	4 5/32	5 7/8	9/32	4 41/64	6 3/8	5 1/2	6 5/8
5 1/2	5 1/2 FH	E	6 5/8	4 13/32	6 25/64	21/64	6 9/16	4 17/32	6 21/64	9/32	6 15/32	4 11/16	6 9/32	15/64	4 29/32	6 5/8	5 31/32	6 47/64
24.70	5 1/2 FH	X	6 13/16	4 1/8	6 1/2	27/64	6 23/32	4 9/32	6 7/16	23/64	6 19/32	4 7/16	6 23/64	19/64	5 1/32	6 5/8	5 31/32	6 47/64
	5 1/2 FH	G	6 29/32	3 31/32	6 9/16	15/32	6 25/32	4 5/32	6 31/64	25/64	6 11/16	4 11/32	6 13/32	11/32	5 3/32	6 5/8	5 31/32	6 47/64
	5 1/2 FH	S	7 5/32	3 15/32	6 23/32	19/32	7 1/32	3 23/32	6 5/8	33/64	6 7/8	4	6 17/32	7/16	5 17/64	6 5/8	5 31/32	7 7/64
6 5/8	6 5/8 FH	E	7 17/32	5 7/16	7 19/64	5/16	7 7/16	5 15/32	7 15/64	1/4	7 3/8	5 9/16	7 3/16	7/32	5 37/64	6 5/8	6 29/32	7 23/32
25.20	6 5/8 FH	X	7 23/32	5 5/32	7 13/32	13/32	7 5/8	5 3/16	7 11/32	11/32	7 1/2	5 3/8	7 9/32	9/32	5 45/64	6 5/8	6 29/32	7 23/32
	6 5/8 FH	G	7 13/16	5 1/32	7 15/32	29/64	7 11/16	5 3/32	7 25/64	3/8	7 19/32	5 9/32	7 21/64	21/64	5 49/64	6 5/8	6 29/32	7 23/32
	6 5/8 FH	S	8 1/16	4 5/8	7 5/8	37/64	7 29/32	4 11/16	7 17/32	31/64	7 25/32	4 15/16	7 29/64	27/64	5 15/16	6 5/8	6 29/32	7 23/32
6 5/8	6 5/8 FH	E	7 19/32	5 11/32	7 21/64	11/32	7 1/2	5 3/8	7 9/32	9/32	7 13/32	5 1/2	7 7/32	15/64	5 5/8	6 5/8	6 29/32	7 23/32
27.70	6 5/8 FH	X	7 25/32	5 1/16	7 29/64	7/16	7 11/16	5 3/32	7 25/64	3/8	7 9/16	5 9/32	7 5/16	5/16	5 3/4	6 5/8	6 29/32	7 23/32
	6 5/8 FH	G	7 7/8	4 29/32	7 33/64	31/64	7 3/4	4 15/16	7 7/16	13/32	7 21/32	5 1/8	7 23/64	23/64	5 13/16	6 5/8	6 29/32	7 23/32
	6 5/8 FH	S	8 5/32	4 15/32	7 43/64	5/8	8	4 17/32	7 19/32	17/32	7 27/32	4 25/32	7 1/2	29/64	6	6 5/8	6 29/32	7 23/32

Note 1: 3-1/2", 15.50#, S135 drill pipe with NC38 connections is not covered in API Spec 5DP for new manufacturing due to the difficulty in meeting typical TSR requirements. API RP 7G-2 for inspection does have this combination, so those Premium and Class 2 values are given here. However, this pipe configuration is often manufactured with slim tool joints which may require the use of Premium Class - Reduced TSR criteria provided in Table 3.7.26.

Table 3.7.2 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco HI TORQUE™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8 6.65	HT 2 3/8 SLH90	G	1.688	2.969	0.094	6	8	3.141	2.984	4.438	4.429	2.263	2.216	2.789	2.727	4.448	4.443
		S	1.688	2.969	0.094	6	8	3.141	2.984	4.438	4.429	2.263	2.216	2.789	2.727	4.448	4.443
		V-150	1.563	2.969	0.094	6	8	3.141	2.984	4.438	4.429	2.263	2.216	2.789	2.727	4.448	4.443
	2 7/8 HT PAC	G	1.500	2.946	0.188	6	8	3.204	3.047	4.830	4.821	2.014	1.967	2.601	2.539	4.840	4.835
		S	1.500	2.972	0.188	6	8	3.204	3.047	4.830	4.821	2.014	1.967	2.601	2.539	4.840	4.835
	HT 26	G	1.688	3.133	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
		S	1.688	3.252	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
		V-150	1.563	3.257	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
2 7/8 6.85	2 3/8 HTSLH90	G	1.844	3.075	0.094	6	8	3.141	2.984	4.438	4.429	2.263	2.216	2.789	2.727	4.448	4.443
		S	1.844	3.231	0.094	6	8	3.141	2.984	4.438	4.429	2.263	2.216	2.789	2.727	4.448	4.443
		V-150	1.750	3.254	0.094	6	8	3.141	2.984	4.438	4.429	2.263	2.216	2.789	2.727	4.448	4.443
	2 7/8 HTPAC	G	1.500	2.987	0.188	6	8	3.204	3.047	4.830	4.821	2.014	1.967	2.601	2.539	4.840	4.835
		S	1.500	3.125	0.188	6	8	3.204	3.047	4.830	4.821	2.014	1.967	2.601	2.539	4.840	4.835
	HT 26	G	1.750	3.313	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
		S	1.750	3.375	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
		V-150	1.780	3.375	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
	HT 31	G	2.000	3.813	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		S	2.000	3.813	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		V-150	2.000	3.813	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
2 7/8 10.40	HT 26	G	1.750	3.375	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
		S	1.438	3.500	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
		V-150	1.313	3.638	0.188	6	8	[NOTE 5]	[NOTE 5]	5.165	5.156	2.156	2.109	2.969	2.907	5.173	5.168
	HT 31	G	2.000	3.813	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		S	2.000	3.864	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		V-150	2.000	3.939	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351

Table 3.7.2 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco HI TORQUE™

Nominal Size/Wt	Connection	Grade	Premium Class		Min CBore Wall	Minimum Tong Space[2]		Bevel Diameter[4]		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length	
			New ID[1]	Min OD[1]		Pin	Box	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3 1/2 9.50	HT 31	G	2.000	3.846	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		S	2.000	4.032	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		V-150	2.000	4.121	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
	HT 38	G	2.688	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		S	2.688	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		V-150	2.688	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
3 1/2 13.30	HT 31	G	2.000	4.038	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
		S	1.975	4.125	0.188	6	8	4.094	3.937	5.343	5.334	2.621	2.574	3.484	3.422	5.356	5.351
	HT 38	G	2.625	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		S	2.563	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		V-150	2.563	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
3 1/2 15.50	HT 38	G	2.500	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		S	2.500	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		V-150	2.313	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
4 14.00	HT 38	G	2.563	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		S	2.563	4.780	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		V-150	2.563	4.885	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
	HT 40	G	2.688	4.969	0.313	6	8	5.016	4.859	6.276	6.267	3.353	3.306	4.375	4.313	6.286	6.281
		S	2.688	4.969	0.313	6	8	5.016	4.859	6.276	6.267	3.353	3.306	4.375	4.313	6.286	6.281
		V-150	2.688	5.045	0.313	6	8	5.016	4.859	6.276	6.267	3.353	3.306	4.375	4.313	6.286	6.281
4 15.70	HT 38	G	2.563	4.704	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		S	2.563	4.877	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
		V-150	2.500	4.938	0.313	6	8	4.794	4.637	5.505	5.496	3.219	3.172	4.109	4.047	5.515	5.510
	HT 40	G	2.688	4.969	0.313	6	8	5.016	4.859	6.276	6.267	3.353	3.306	4.375	4.313	6.286	6.281
		S	2.688	5.038	0.313	6	8	5.016	4.859	6.276	6.267	3.353	3.306	4.375	4.313	6.286	6.281
		V-150	2.688	5.143	0.313	6	8	5.016	4.859	6.276	6.267	3.353	3.306	4.375	4.313	6.286	6.281

Table 3.7.2 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco HI TORQUE™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4 1/2 16.60	HT 50	G	3.688	5.938	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		S	3.563	5.938	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		V-150	3.438	5.938	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
4 1/2 20.00	HT 50	G	3.500	5.938	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		S	3.250	5.938	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
5 19.50	HT 50	G	3.500	5.938	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		S	3.500	5.967	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		V-150	3.500	6.086	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
5 25.60	HT 50	G	3.500	5.942	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		S	3.500	6.236	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
		V-150	3.500	6.250	0.313	6	8	6.281	6.124	6.159	6.150	4.344	4.298	5.344	5.282	6.169	6.164
5 1/2 21.90	HT 55	G	3.250	6.531	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		S	3.250	6.531	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		V-150	3.250	6.531	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
5 1/2 24.70	HT 55	G	3.250	6.531	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		S	3.250	6.531	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		V-150	3.250	6.571	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
5 7/8 23.40	HT 55	G	4.000	6.549	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		S	4.000	6.829	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		V-150	4.000	6.963	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
5 7/8 26.30	HT 55	G	4.000	6.663	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		S	4.000	6.967	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		V-150	4.000	7.000	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352

Table 3.7.2 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco HI TORQUE™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 7/8	HT 55	G	4.000	6.821	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
28.70		S	4.000	7.000	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		V-150	3.938	7.000	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
6 5/8	HT 65	G	5.000	7.469	0.313	6	8.509	7.704	7.547	7.500	7.491	5.613	5.566	6.875	6.813	7.509	7.504
25.20		S	5.000	7.694	0.313	6	8.509	7.704	7.547	7.500	7.491	5.613	5.566	6.875	6.813	7.509	7.504
		V-150	5.000	7.821	0.313	6	8.509	7.704	7.547	7.500	7.491	5.613	5.566	6.875	6.813	7.509	7.504
6 5/8	HT 65	G	5.000	7.506	0.313	6	8.509	7.704	7.547	7.500	7.491	5.613	5.566	6.875	6.813	7.509	7.504
27.70		S	5.000	7.785	0.313	6	8.509	7.704	7.547	7.500	7.491	5.613	5.566	6.875	6.813	7.509	7.504
		V-150	5.000	7.919	0.313	6	8.509	7.704	7.547	7.500	7.491	5.613	5.566	6.875	6.813	7.509	7.504

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
5 For HT26, bevel diameter varies with tool joint OD.
For OD = 3.375" or 3.438", bevel = 3.453" (max), 3.296" (min).
For OD = 3.5", bevel = 3.547" (max), 3.390" (min).
For OD = 3.625" or 3.565", bevel = 3.672" (max), 3.515" (min).

Table 3.7.3 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8	XT 24	G	1.500	3.000	0.188	6	8	3.141	2.984	3.219	3.210	2.114	2.067	2.655	2.593	3.222	3.217
6.65		S	1.500	3.000	0.188	6	8	3.141	2.984	3.219	3.210	2.114	2.067	2.655	2.593	3.222	3.217
		V-150	1.375	3.000	0.188	6	8	3.141	2.984	3.219	3.210	2.114	2.067	2.655	2.593	3.222	3.217
	XT 26	G	1.688	3.234	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
		S	1.688	3.234	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
		V-150	1.625	3.234	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
2 7/8	XT 26	G	1.688	3.234	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
6.85		S	1.688	3.234	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
		V-150	1.688	3.272	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
	XT 31	G	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
		S	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
		V-150	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
2 7/8	XT 26	G	1.688	3.257	0.188	6	8	3.360	3.203	3.125	3.116	2.356	2.309	2.893	2.831	3.128	3.123
10.40																	
	XT 31	G	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
		S	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
		V-150	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
3 1/2	XT 31	G	2.000	3.750	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
9.50		S	2.000	3.825	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
		V-150	2.000	3.918	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
	XT 38	G	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		S	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		V-150	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
3 1/2	XT 31	G	2.000	3.830	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
13.30		S	1.875	4.016	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
		V-150	1.750	4.084	0.188	6	8	4.016	3.859	4.000	3.991	2.787	2.740	3.404	3.342	4.003	3.998
	XT 38	G	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		S	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		V-150	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623

Table 3.7.3 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2	XT 34	G	2.000	4.045	0.188	6	8.0	4.266	4.109	4.156	4.147	3.110	3.063	3.700	3.638	4.159	4.154
15.50		S	2.000	4.181	0.188	6	8.0	4.266	4.109	4.156	4.147	3.110	3.063	3.700	3.638	4.159	4.154
		V-150	1.975	4.286	0.188	6	8.0	4.266	4.109	4.156	4.147	3.110	3.063	3.700	3.638	4.159	4.154
	XT 38	G	2.500	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		S	2.500	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		V-150	2.313	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
	XT 39	G	2.500	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		S	2.500	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		V-150	2.313	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
4	XT 38	G	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
14.00		S	2.563	4.574	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
		V-150	2.563	4.684	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.332	4.009	3.947	4.628	4.623
	XT 39	G	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		S	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		V-150	2.563	4.660	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
4	XT 39	G	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
15.70		S	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		V-150	2.563	4.767	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
	XT 40	G	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		S	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		V-150	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
4 1/2	XT 40	G	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
16.60		S	2.688	4.908	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		V-150	2.688	5.034	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
	XT 43	G	3.125	5.156	0.313	6	8	5.204	5.047	3.656	3.647	3.974	3.927	4.550	4.488	3.659	3.654
		S	3.125	5.156	0.313	6	8	5.204	5.047	3.656	3.647	3.974	3.927	4.550	4.488	3.659	3.654
		V-150	3.125	5.219	0.313	6	8	5.204	5.047	3.656	3.647	3.974	3.927	4.550	4.488	3.659	3.654

Table 3.7.3 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4 1/2 16.60	XT 46	G	3.250	5.734	0.313	6	8.510	6.075	5.918	7.500	7.491	4.368	4.321	5.133	5.071	7.510	7.505
		S	3.250	5.734	0.313	6	8.510	6.075	5.918	7.500	7.491	4.368	4.321	5.133	5.071	7.510	7.505
		V-150	3.250	5.734	0.313	6	8.510	6.075	5.918	7.500	7.491	4.368	4.321	5.133	5.071	7.510	7.505
	XT 50	G	3.688	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
		S	3.563	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
		V-150	3.438	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
5 19.50	XT 46	G	2.750	5.734	0.313	6	8.510	6.075	5.918	7.500	7.491	4.368	4.321	5.133	5.071	7.510	7.505
		S	2.750	5.734	0.313	6	8.510	6.075	5.918	7.500	7.491	4.368	4.321	5.133	5.071	7.510	7.505
		V-150	2.750	5.734	0.313	6	8.510	6.075	5.918	7.500	7.491	4.368	4.321	5.133	5.071	7.510	7.505
	XT 50	G	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
		S	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
		V-150	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
5 25.60	XT 50	G	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
		S	3.563	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
		V-150	3.375	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.790	4.743	5.471	5.409	7.310	7.305
5 1/2 21.90	XT 54	G	4.000	6.313	0.313	6	8.010	6.610	6.453	7.000	6.991	5.067	5.020	5.729	5.667	7.010	7.005
		S	4.000	6.313	0.313	6	8.010	6.610	6.453	7.000	6.991	5.067	5.020	5.729	5.667	7.010	7.005
		V-150	4.000	6.330	0.313	6	8.010	6.610	6.453	7.000	6.991	5.067	5.020	5.729	5.667	7.010	7.005
	XT 57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 1/2 24.70	XT 54	G	4.000	6.313	0.313	6	8.010	6.610	6.453	7.000	6.991	5.067	5.020	5.729	5.667	7.010	7.005
		S	4.000	6.331	0.313	6	8.010	6.610	6.453	7.000	6.991	5.067	5.020	5.729	5.667	7.010	7.005
		V-150	4.000	6.472	0.313	6	8.010	6.610	6.453	7.000	6.991	5.067	5.020	5.729	5.667	7.010	7.005
	XT 57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.188	6.565	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255

Table 3.7.3 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 7/8 23.40	XT 57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.250	6.655	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8 26.30	XT 57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	4.250	6.659	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.250	6.808	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
6 5/8 25.20	XT 65	G	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	6.121	6.074	6.846	6.784	8.260	8.255
		S	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	6.121	6.074	6.846	6.784	8.260	8.255
		V-150	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	6.121	6.074	6.846	6.784	8.260	8.255
6 5/8 27.70	XT 65	G	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	6.121	6.074	6.846	6.784	8.260	8.255
		S	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	6.121	6.074	6.846	6.784	8.260	8.255
		V-150	5.000	7.481	0.313	6	9.260	7.860	7.703	8.250	8.241	6.121	6.074	6.846	6.784	8.260	8.255
	XT 69	G	5.000	7.816	0.313	6	8.823	7.954	7.797	7.813	7.804	6.523	6.476	7.221	7.159	7.823	7.818
		S	5.000	7.816	0.313	6	8.823	7.954	7.797	7.813	7.804	6.523	6.476	7.221	7.159	7.823	7.818
		V-150	5.000	7.816	0.313	6	8.823	7.954	7.797	7.813	7.804	6.523	6.476	7.221	7.159	7.823	7.818

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.7.4 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque-M

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Ref.	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8 6.65	XT-M24	G	1.500	3.000	0.188	6	8	3.141	2.984	5.063	5.054	1.882	2.655	2.593	5.073	5.068
		S	1.500	3.051	0.188	6	8	3.141	2.984	5.063	5.054	1.882	2.655	2.593	5.073	5.068
		V-150	1.375	3.065	0.188	6	8	3.141	2.984	5.063	5.054	1.882	2.655	2.593	5.073	5.068
	XT-M26	G	1.688	3.238	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
		S	1.688	3.238	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
		V-150	1.563	3.238	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
2 7/8 6.85	XT-M26	G	1.750	3.238	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
		S	1.750	3.353	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
		V-150	1.750	3.375	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
2 7/8 10.40	XT-M26	G	1.688	3.381	0.188	6	8	3.360	3.203	5.000	4.991	2.124	2.893	2.831	5.010	5.005
3 1/2 9.50	XT-M38	G	2.563	4.478	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		S	2.563	4.478	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		V-150	2.563	4.478	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
3 1/2 13.30	XT-M38	G	2.563	4.478	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		S	2.563	4.496	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		V-150	2.563	4.585	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
3 1/2 15.50	XT-M38	G	2.500	4.478	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		S	2.500	4.566	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		V-150	2.313	4.581	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
	XT-M39	G	2.438	4.660	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
		S	2.438	4.660	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
		V-150	2.313	4.660	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
4 14.00	XT-M38	G	2.688	4.548	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
		S	2.688	4.750	0.250	6	8	4.704	4.547	6.500	6.491	3.146	4.009	3.947	6.510	6.505
	XT-M39	G	2.688	4.660	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
		S	2.688	4.753	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
		V-150	2.688	4.854	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255

Table 3.7.4 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque-M

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Ref.	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4	XT-M39	G	2.688	4.660	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
15.70		S	2.688	4.847	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
		V-150	2.688	4.875	0.250	6	8	4.927	4.770	6.250	6.241	3.360	4.191	4.129	6.260	6.255
	XT-M40	G	2.688	4.855	0.250	6	8	5.157	5.000	6.500	6.491	3.550	4.386	4.324	6.510	6.505
		S	2.688	4.860	0.250	6	8	5.157	5.000	6.500	6.491	3.550	4.386	4.324	6.510	6.505
		V-150	2.688	4.967	0.250	6	8	5.157	5.000	6.500	6.491	3.550	4.386	4.324	6.510	6.505
4 1/2	XT-M40	G	2.688	4.855	0.250	6	8	5.157	5.000	6.500	6.491	3.550	4.386	4.324	6.510	6.505
16.60		S	2.688	5.052	0.250	6	8	5.157	5.000	6.500	6.491	3.550	4.386	4.324	6.510	6.505
		V-150	2.688	5.172	0.250	6	8	5.157	5.000	6.500	6.491	3.550	4.386	4.324	6.510	6.505
	XT-M46	G	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
		S	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
		V-150	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
	XT-M50	G	3.625	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		S	3.563	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		V-150	3.438	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
4 1/2	XT-M46	G	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
20.00		S	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
		V-150	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
	XT-M50	G	3.500	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		S	3.250	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		V-150	3.125	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
5	XT-M46	G	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
19.50		S	3.000	5.719	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
		V-150	3.000	5.791	0.313	6	8.510	6.075	5.918	7.500	7.491	4.136	5.133	5.071	7.510	7.505
	XT-M50	G	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		S	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		V-150	3.750	6.106	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
5	XT-M50	G	3.750	6.065	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
25.60		S	3.563	6.153	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305
		V-150	3.375	6.200	0.313	6	8.310	6.459	6.302	7.300	7.291	4.558	5.471	5.409	7.310	7.305

Table 3.7.4 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque-M

			Premium Class		Min	Minimum		Bevel		Pin Connection		Pin Nose	Box Cbore		Box Connection	
Nominal			New	Min	CBore	Tong Space[2]		Diameter[4]		Length		Diameter	Diameter		Length	
Size/Wt	Connection	Grade	ID[1]	OD[1]	Wall	Pin	Box	Max	Min	Max	Min	Ref.	Max	Min	Max	Min
5 1/2	XT-M57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
21.90		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
		V-150	4.250	6.624	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
5 1/2	XT-M57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
24.70		S	4.250	6.625	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
		V-150	4.188	6.720	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
5 7/8	XT-M57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
23.40		S	4.250	6.673	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
		V-150	4.250	6.807	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
5 7/8	XT-M57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
26.30		S	4.250	6.811	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
		V-150	4.250	6.955	0.313	6	8.260	6.862	6.705	7.250	7.241	5.076	5.971	5.909	7.260	7.255
6 5/8	XT-M65	G	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	5.889	6.846	6.784	8.260	8.255
25.20		S	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	5.889	6.846	6.784	8.260	8.255
		V-150	5.000	7.537	0.313	6	9.260	7.860	7.703	8.250	8.241	5.889	6.846	6.784	8.260	8.255
6 5/8	XT-M65	G	5.000	7.441	0.313	6	9.260	7.860	7.703	8.250	8.241	5.889	6.846	6.784	8.260	8.255
27.70		S	5.000	7.500	0.313	6	9.260	7.860	7.703	8.250	8.241	5.889	6.846	6.784	8.260	8.255
		V-150	5.000	7.638	0.313	6	9.260	7.860	7.703	8.250	8.241	5.889	6.846	6.784	8.260	8.255

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.

2 Tong space excludes hardbanding.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.7.5 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Double Shoulder™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8	GPDS™ 26	G105	1.625	3.305	0.188	6.000	6.500	3.407	3.250	3.383	3.372	2.068	1.959	3.000	2.899	3.389	3.378
6.65		S135	1.625	3.305	0.188	6.000	6.500	3.407	3.250	3.383	3.372	2.068	1.959	3.000	2.899	3.389	3.378
		V150™	1.563	3.305	0.188	6.000	6.500	3.407	3.250	3.383	3.372	2.068	1.959	3.000	2.899	3.389	3.378
2 7/8	GPDS™ 31	G105	2.000	3.820	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
6.85		S135	2.000	3.820	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
		V150™	2.000	3.820	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
2 7/8	GPDS™ 31	G105	2.000	3.820	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
10.40		S135	2.000	3.859	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
		V150™	2.000	3.929	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
3 1/2	GPDS™ 31	G105	1.875	3.820	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
9.50		S135	1.875	3.969	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
		V150™	1.875	4.053	0.188	6.000	6.500	4.094	3.937	3.895	3.884	2.491	2.397	3.516	3.414	3.901	3.890
	GPDS™ 38	G105	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
		S135	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
		V150™	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
3 1/2	GPDS™ 38	G105	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
13.30		S135	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
		V150™	2.438	4.632	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
3 1/2	GPDS™ 38	G105	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
15.50		S135	2.438	4.642	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
		V150™	2.313	4.732	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.039	4.413	4.402
4	GPDS™ 40	G105	2.438	4.836	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
14.00		S135	2.438	4.836	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
		V150™	2.438	4.929	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915

Table 3.7.5 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Double Shoulder™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4	GPDS™ 40	G105	2.438	4.836	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
15.70		S135	2.438	4.922	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
		V150™	2.438	5.022	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
4 1/2	GPDS™ 42	G105	2.750	4.913	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
16.60		S135	2.750	5.145	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
		V150™	2.750	5.256	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
	GPDS™ 46	G105	3.000	5.523	0.313	6.000	6.500	5.860	5.703	4.918	4.907	3.772	3.662	4.969	4.859	4.927	4.915
		S135	3.000	5.523	0.313	6.000	6.500	5.860	5.703	4.918	4.907	3.772	3.662	4.969	4.859	4.927	4.915
		V150™	3.000	5.523	0.313	6.000	6.500	5.860	5.703	4.918	4.907	3.772	3.662	4.969	4.859	4.927	4.915
4 1/2	GPDS™ 46	G105	3.000	5.523	0.313	6.000	6.500	5.860	5.703	4.918	4.907	3.772	3.662	4.969	4.859	4.927	4.915
20.00		S135	3.000	5.586	0.313	6.000	6.500	5.860	5.703	4.918	4.907	3.772	3.662	4.969	4.859	4.927	4.915
		V150™	3.000	5.697	0.313	6.000	6.500	5.860	5.703	4.918	4.907	3.772	3.662	4.969	4.859	4.927	4.915
	GPDS™ 50	G105	3.000	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
		S135	3.000	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
		V150™	3.000	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
5	GPDS™ 50	G105	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
19.50		S135	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
		V150™	3.250	5.973	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
5	GPDS™ 50	G105	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
25.60		S135	3.250	6.115	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
		V150™	3.250	6.248	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.274	4.927	4.915
5 1/2	GPDS™ 55	G105	4.000	6.523	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
21.90		S135	4.000	6.611	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		V150™	4.000	6.722	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426

Table 3.7.5 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Double Shoulder™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2 24.70	GPDS™ 55	G105	4.000	6.523	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		S135	4.000	6.723	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		V150™	4.000	6.843	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
5 7/8 23.40	GPDS™ 55	G105	4.000	6.523	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		S135	4.000	6.767	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
6 5/8 25.20	GPDS™ 65	G105	5.000	7.461	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		S135	5.000	7.625	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		V150™	5.000	7.742	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
6 5/8 27.70	GPDS™ 65	G105	5.000	7.461	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		S135	5.000	7.709	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.

2 Tong space excludes hardbanding.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

5 For GPDS55, bevel diameter varies with tool joint OD.
For OD ≤ 7.375", bevel = 6.860" (max), 6.703" (min).
For OD ≥ 7.500", bevel = 7.235" (max), 7.078" (min).

Note: Connections manufactured as VAM CDS connections have been determined by Grant Prideco to be interchangeable with GPDS™ connections. As such, any CDS connections shall be inspected according to the procedures outlined for GPDS™ connections.

Table 3.7.6 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2 9.50	TurboTorque™ 380	G	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
		S-135	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
		V-150	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
3 1/2 13.30	TurboTorque™ 380	G	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
		S-135	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
		V-150	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
3 1/2 15.50	TurboTorque™ 380	G	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
		S-135	2.500	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
		V-150	2.313	4.477	0.250	6	8	4.681	4.524	4.688	4.683	3.435	3.388	4.008	3.946	4.691	4.686
4 14.00	TurboTorque™ 390	G	2.688	4.577	0.250	6	8	4.832	4.675	4.563	4.558	3.543	3.496	4.108	4.046	4.566	4.561
		S-135	2.688	4.577	0.250	6	8	4.832	4.675	4.563	4.558	3.543	3.496	4.108	4.046	4.566	4.561
		V-150	2.688	4.577	0.250	6	8	4.832	4.675	4.563	4.558	3.543	3.496	4.108	4.046	4.566	4.561
4 15.70	TurboTorque™ 390	G	2.688	4.577	0.250	6	8	4.832	4.675	4.563	4.558	3.543	3.496	4.108	4.046	4.566	4.561
		S-135	2.688	4.577	0.250	6	8	4.832	4.675	4.563	4.558	3.543	3.496	4.108	4.046	4.566	4.561
		V-150	2.688	4.642	0.250	6	8	4.832	4.675	4.563	4.558	3.543	3.496	4.108	4.046	4.566	4.561
4 1/2 16.60	TurboTorque™ 435	G	3.125	5.153	0.313	6	8	5.308	5.151	4.625	4.620	3.989	3.942	4.558	4.496	4.628	4.623
		S-135	3.125	5.153	0.313	6	8	5.308	5.151	4.625	4.620	3.989	3.942	4.558	4.496	4.628	4.623
		V-150	3.125	5.153	0.313	6	8	5.308	5.151	4.625	4.620	3.989	3.942	4.558	4.496	4.628	4.623
	TurboTorque™ 485	G	3.563	5.653	0.313	6	8	5.858	5.701	5.563	5.558	4.430	4.383	5.058	4.996	5.566	5.561
		S-135	3.563	5.653	0.313	6	8	5.858	5.701	5.563	5.558	4.430	4.383	5.058	4.996	5.566	5.561
		V-150	3.438	5.653	0.313	6	8	5.858	5.701	5.563	5.558	4.430	4.383	5.058	4.996	5.566	5.561
4 1/2 20.00	TurboTorque™ 485	G	3.500	5.653	0.313	6	8	5.858	5.701	5.563	5.558	4.430	4.383	5.058	4.996	5.566	5.561
		S-135	3.250	5.653	0.313	6	8	5.858	5.701	5.563	5.558	4.430	4.383	5.058	4.996	5.566	5.561
		V-150	3.125	5.653	0.313	6	8	5.858	5.701	5.563	5.558	4.430	4.383	5.058	4.996	5.566	5.561

Table 3.7.6 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 19.50	TurboTorque™ 500	G	3.500	5.815	0.313	6	8	6.117	5.960	5.313	5.308	4.499	4.452	5.220	5.158	5.316	5.311
		S-135	3.500	5.815	0.313	6	8	6.117	5.960	5.313	5.308	4.499	4.452	5.220	5.158	5.316	5.311
		V-150	3.500	5.815	0.313	6	8	6.117	5.960	5.313	5.308	4.499	4.452	5.220	5.158	5.316	5.311
	TurboTorque™ 525	G	3.875	6.065	0.313	6	8	6.317	6.160	5.750	5.745	4.712	4.665	5.470	5.408	5.753	5.748
		S-135	3.875	6.065	0.313	6	8	6.317	6.160	5.750	5.745	4.712	4.665	5.470	5.408	5.753	5.748
		V-150	3.875	6.065	0.313	6	8	6.317	6.160	5.750	5.745	4.712	4.665	5.470	5.408	5.753	5.748
5 25.60	TurboTorque™ 525	G	3.875	6.065	0.313	6	8	6.317	6.160	5.750	5.745	4.712	4.665	5.470	5.408	5.753	5.748
		S-135	3.563	6.065	0.313	6	8	6.317	6.160	5.750	5.745	4.712	4.665	5.470	5.408	5.753	5.748
		V-150	3.375	6.065	0.313	6	8	6.317	6.160	5.750	5.745	4.712	4.665	5.470	5.408	5.753	5.748
5 1/2 21.90	TurboTorque™ 550	G	4.250	6.315	0.313	6	8	6.510	6.353	4.750	4.745	5.046	4.999	5.720	5.658	4.753	4.748
		S-135	4.250	6.315	0.313	6	8	6.510	6.353	4.750	4.745	5.046	4.999	5.720	5.658	4.753	4.748
		V-150	4.250	6.315	0.313	6	8	6.510	6.353	4.750	4.745	5.046	4.999	5.720	5.658	4.753	4.748
	TurboTorque™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		S-135	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		V-150	4.375	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
5 1/2 24.70	TurboTorque™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		S-135	4.313	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		V-150	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
5 7/8 23.40	TurboTorque™ 575	G	4.125	6.565	0.313	6	8	6.897	6.740	5.375	5.370	5.244	5.197	5.970	5.908	5.378	5.373
		S-135	4.125	6.565	0.313	6	8	6.897	6.740	5.375	5.370	5.244	5.197	5.970	5.908	5.378	5.373
		V-150	4.125	6.565	0.313	6	8	6.897	6.740	5.375	5.370	5.244	5.197	5.970	5.908	5.378	5.373
	TurboTorque™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		S-135	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		V-150	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061

Table 3.7.6 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 7/8	TurboTorque™ 575	G	4.125	6.565	0.313	6	8	6.897	6.740	5.375	5.370	5.244	5.197	5.970	5.908	5.378	5.373
26.30		S-135	4.125	6.565	0.313	6	8	6.897	6.740	5.375	5.370	5.244	5.197	5.970	5.908	5.378	5.373
		V-150	4.125	6.576	0.313	6	8	6.897	6.740	5.375	5.370	5.244	5.197	5.970	5.908	5.378	5.373
	TurboTorque™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		S-135	4.500	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		V-150	4.500	6.787	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
6 5/8	TurboTorque™ 690[5]	G	5.500	7.790	0.313	6	8	8.093	7.936	5.438	5.433	6.231[6]	6.184[6]	7.195[6]	7.133[6]	5.443	5.438
27.70		S-135	5.500	7.790	0.313	6	8	8.093	7.936	5.438	5.433	6.231[6]	6.184[6]	7.195[6]	7.133[6]	5.443	5.438
		V-150	5.500	7.830	0.313	6	8	8.093	7.936	5.438	5.433	6.231[6]	6.184[6]	7.195[6]	7.133[6]	5.443	5.438

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
5 TurboTorque™ 690 has an internal shoulder gap tolerance of 0.002 inch - 0.008 inch.
6 1.25 inch taper per foot CBore.

Table 3.7.7 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque-M™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Ref.	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2	TurboTorque-M™ 380	G	2.688	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
9.50		S-135	2.688	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
		V-150	2.688	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
3 1/2	TurboTorque-M™ 380	G	2.625	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
13.30		S-135	2.625	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
		V-150	2.563	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
3 1/2	TurboTorque-M™ 380	G	2.500	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
15.50		S-135	2.500	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
		V-150	2.313	4.477	0.250	6	8	4.681	4.524	5.125	5.120	3.203	4.008	3.946	5.128	5.123
4	TurboTorque-M™ 390	G	2.688	4.577	0.250	6	8	4.832	4.675	5.000	4.995	3.311	4.108	4.046	5.003	4.998
14.00		S-135	2.688	4.600	0.250	6	8	4.832	4.675	5.000	4.995	3.311	4.108	4.046	5.003	4.998
		V-150	2.688	4.699	0.250	6	8	4.832	4.675	5.000	4.995	3.311	4.108	4.046	5.003	4.998
4	TurboTorque-M™ 390	G	2.688	4.577	0.250	6	8	4.832	4.675	5.000	4.995	3.311	4.108	4.046	5.003	4.998
15.70		S-135	2.688	4.692	0.250	6	8	4.832	4.675	5.000	4.995	3.311	4.108	4.046	5.003	4.998
		V-150	2.688	4.798	0.250	6	8	4.832	4.675	5.000	4.995	3.311	4.108	4.046	5.003	4.998
4 1/2	TurboTorque-M™ 435	G	3.125	5.153	0.313	6	8	5.308	5.151	5.063	5.058	3.757	4.558	4.496	5.066	5.061
16.60		S-135	3.125	5.153	0.313	6	8	5.308	5.151	5.063	5.058	3.757	4.558	4.496	5.066	5.061
		V-150	3.125	5.221	0.313	6	8	5.308	5.151	5.063	5.058	3.757	4.558	4.496	5.066	5.061
	TurboTorque-M™ 485	G	3.563	5.653	0.313	6	8	5.858	5.701	6.000	5.995	4.198	5.058	4.996	6.003	5.998
		S-135	3.563	5.653	0.313	6	8	5.858	5.701	6.000	5.995	4.198	5.058	4.996	6.003	5.998
		V-150	3.438	5.653	0.313	6	8	5.858	5.701	6.000	5.995	4.198	5.058	4.996	6.003	5.998
4 1/2	TurboTorque-M™ 485	G	3.500	5.653	0.313	6	8	5.858	5.701	6.000	5.995	4.198	5.058	4.996	6.003	5.998
20.00		S-135	3.250	5.653	0.313	6	8	5.858	5.701	6.000	5.995	4.198	5.058	4.996	6.003	5.998
		V-150	3.125	5.653	0.313	6	8	5.858	5.701	6.000	5.995	4.198	5.058	4.996	6.003	5.998

Table 3.7.7 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque-M™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Ref.	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 19.50	TurboTorque-M™ 500	G	3.500	5.815	0.313	6	8	6.117	5.960	5.750	5.745	4.267	5.220	5.158	5.755	5.750
		S-135	3.500	5.815	0.313	6	8	6.117	5.960	5.750	5.745	4.267	5.220	5.158	5.755	5.750
		V-150	3.500	5.827	0.313	6	8	6.117	5.960	5.750	5.745	4.267	5.220	5.158	5.755	5.750
	TurboTorque-M™ 525	G	3.875	6.065	0.313	6	8	6.317	6.160	6.188	6.183	4.480	5.470	5.408	6.193	6.188
		S-135	3.875	6.065	0.313	6	8	6.317	6.160	6.188	6.183	4.480	5.470	5.408	6.193	6.188
		V-150	3.875	6.084	0.313	6	8	6.317	6.160	6.188	6.183	4.480	5.470	5.408	6.193	6.188
5 25.60	TurboTorque-M™ 500	G	3.500	5.815	0.313	6	8	6.117	5.960	5.750	5.745	4.267	5.220	5.158	5.755	5.750
		S-135	3.500	5.970	0.313	6	8	6.117	5.960	5.750	5.745	4.267	5.220	5.158	5.755	5.750
		V-150	3.375	6.035	0.313	6	8	6.117	5.960	5.750	5.745	4.267	5.220	5.158	5.755	5.750
	TurboTorque-M™ 525	G	3.875	6.065	0.313	6	8	6.317	6.160	6.188	6.183	4.480	5.470	5.408	6.193	6.188
		S-135	3.563	6.065	0.313	6	8	6.317	6.160	6.188	6.183	4.480	5.470	5.408	6.193	6.188
		V-150	3.375	6.065	0.313	6	8	6.317	6.160	6.188	6.183	4.480	5.470	5.408	6.193	6.188
5 1/2 21.90	TurboTorque-M™ 550	G	4.250	6.315	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
		S-135	4.250	6.364	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
		V-150	4.250	6.479	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
	TurboTorque-M™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		S-135	4.500	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		V-150	4.375	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
5 1/2 24.70	TurboTorque-M™ 550	G	4.250	6.315	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
		S-135	4.250	6.480	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
		V-150	4.188	6.564	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
	TurboTorque-M™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		S-135	4.313	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		V-150	4.188	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
5 1/2 26.72	TurboTorque-M™ 585	G	4.375	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		S-135	4.063	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		V-150	3.875	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500

Table 3.7.7 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque-M™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Ref.	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 7/8 23.40	TurboTorque-M™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		S-135	4.500	6.697	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		V-150	4.500	6.817	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
5 7/8 26.30	TurboTorque-M™ 585	G	4.500	6.665	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		S-135	4.500	6.821	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		V-150	4.500	6.951	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.7.8 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco uXT™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2 9.50	uXT 38	G	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		S	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		V-150	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
3 1/2 13.30	uXT 38	G	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		S	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		V-150	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
3 1/2 15.50	uXT 38	G	2.500	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		S	2.500	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		V-150	2.313	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
4 14.00	uXT 38	G	2.563	4.478	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		S	2.563	4.496	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
		V-150	2.563	4.600	0.250	6	8	4.704	4.547	4.625	4.616	3.378	3.331	4.009	3.947	4.628	4.623
	uXT 39	G	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		S	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		V-150	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
4 15.70	uXT39	G	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		S	2.563	4.653	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
		V-150	2.563	4.679	0.250	6	8	4.927	4.770	4.500	4.491	3.578	3.531	4.183	4.121	4.503	4.498
	uXT40	G	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		S	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		V-150	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
4 1/2 16.60	uXT40	G	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		S	2.688	4.859	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
		V-150	2.688	4.938	0.250	6	8	5.157	5.000	4.500	4.491	3.782	3.735	4.386	4.324	4.503	4.498
	uXT43	G	2.875	5.156	0.313	6	8	5.204	5.047	3.656	3.647	3.974	3.927	4.550	4.488	3.659	3.654
		S	2.875	5.156	0.313	6	8	5.204	5.047	3.656	3.647	3.974	3.927	4.550	4.488	3.659	3.654
		V-150	2.875	5.156	0.313	6	8	5.204	5.047	3.656	3.647	3.974	3.927	4.550	4.488	3.659	3.654

Table 3.7.8 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco uXT™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2	uXT57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
21.90		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 1/2	uXT57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
24.70		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.188	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8	uXT57	G	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
23.40		S	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	4.250	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.7.9 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco uGPDS™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2 13.30	uGPDS 38	G	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.041	4.413	4.402
		S	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.041	4.413	4.402
		V-150	2.438	4.576	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.041	4.413	4.402
3 1/2 15.50	uGPDS 38	G	2.438	4.570	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.041	4.413	4.402
		S	2.438	4.585	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.041	4.413	4.402
		V-150	2.250	4.597	0.250	6.000	6.500	4.719	4.562	4.407	4.396	3.037	2.928	4.141	4.041	4.413	4.402
4 14.00	uGPDS 40	G	2.438	4.836	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
		S	2.438	4.836	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
		V-150	2.438	4.858	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
4 15.70	uGPDS 40	G	2.438	4.836	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
		S	2.438	4.851	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
		V-150	2.438	4.945	0.250	6.000	6.500	5.157	5.000	4.918	4.907	3.209	3.115	4.406	4.305	4.927	4.915
4 1/2 16.60	uGPDS 42	G	2.750	4.893	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
		S	2.750	5.067	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
		V-150	2.750	5.171	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
4 1/2 20.00	uGPDS 42	G	2.750	4.993	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
		S	2.750	5.242	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
		V-150	2.500	5.267	0.250	6.000	6.500	5.266	5.109	4.755	4.744	3.472	3.425	4.424	4.362	4.760	4.749
5 19.50	uGPDS 50	G	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.275	4.927	4.915
		S	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.275	4.927	4.915
		V-150	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.275	4.927	4.915
5 25.60	uGPDS 50	G	3.250	5.930	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.275	4.927	4.915
		S	3.250	6.027	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.275	4.927	4.915
		V-150	3.250	6.152	0.313	6.000	6.500	6.204	6.047	4.918	4.907	4.178	4.084	5.375	5.275	4.927	4.915

Table 3.7.9 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco uGPDS™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2 21.90	uGPDS 55	G	4.000	6.523	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		S	4.000	6.532	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		V-150	4.000	6.637	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
5 1/2 24.70	uGPDS 55	G	4.000	6.523	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		S	4.000	6.637	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
		V-150	4.000	6.751	0.313	6.000	6.500	[NOTE 5]	[NOTE 5]	5.431	5.420	4.616	4.522	5.969	5.850	5.437	5.426
6 5/8 25.20	uGPDS 65	G	5.000	7.461	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		S	5.000	7.542	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		V-150	5.000	7.652	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
6 5/8 27.70	uGPDS 65	G	5.000	7.461	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		S	5.000	7.621	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426
		V-150	5.000	7.737	0.313	6.000	6.500	7.844	7.687	5.431	5.420	5.553	5.443	6.906	6.778	5.437	5.426

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.

2 Tong space excludes hardbanding.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

5 For uGPDS55, bevel diameter varies with tool joint OD.
For OD ≤ 7.375", bevel = 6.860" (max), 6.703" (min).
For OD ≥ 7.500", bevel = 7.235" (max), 7.078" (min).

Table 3.7.10 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Express™

Nominal Size/Wt	Connection	Grade	Premium Class Max ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[3] Pin	Minimum Tong Space[3] Box	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 7/8 10.40	VX™ 24	G105	1.563	3.125	0.188	6	8	3.172	2.984	5.003	4.997	2.027	2.649	2.582	5.005	4.999
		S135	1.563	3.125	0.188	6	8	3.172	3.047	5.003	4.997	2.027	2.649	2.582	5.005	4.999
	VX™ 26	G105	1.563	3.250	0.188	6	8	3.516	3.172	5.253	5.247	2.242	2.887	2.82	5.254	5.248
		S135	1.563	3.375	0.188	6	8	3.516	3.203	5.253	5.247	2.242	2.887	2.82	5.254	5.248
3 1/2 13.30	VX™ 38	G105	2.813	4.375	0.188	6	8	4.734	4.297	6.004	5.996	3.288	4.005	3.938	6.007	5.999
4 14.00	VX™ 38	S135	2.500	4.500	0.188	6	8	4.734	4.297	6.004	5.996	3.288	4.005	3.938	6.007	5.999
	VX™ 39	G105	2.875	4.563	0.188	6	8	4.953	4.484	5.755	5.747	3.519	4.212	4.145	5.755	5.747
		S135	2.875	4.688	0.188	6	8	4.953	4.484	5.755	5.747	3.519	4.212	4.145	5.755	5.747
	VX™ 40	S135	3.063	4.969	0.250	6	8	5.234	4.891	6.254	6.247	3.735	4.476	4.409	6.254	6.247
4 15.70	VX™ 39	G105	2.875	4.563	0.188	6	8	4.953	4.484	5.755	5.747	3.519	4.212	4.145	5.755	5.747
		S135	2.813	4.719	0.188	6	8	4.953	4.484	5.755	5.747	3.519	4.212	4.145	5.755	5.747
4 1/2 16.60	VX™ 46	G105	3.813	5.625	0.250	6	8	5.953	5.547	6.755	6.747	4.368	5.157	5.090	6.754	6.746
		S135	3.563	5.625	0.250	6	8	5.953	5.547	6.755	6.747	4.368	5.157	5.090	6.754	6.746
4 1/2 20.00	VX™ 43	S135	3.063	5.031	0.250	6	8	5.391	4.953	6.253	6.245	3.825	4.566	4.499	6.254	6.248
	VX™ 46	G105	3.563	5.625	0.250	6	8	5.953	5.547	6.755	6.747	4.368	5.157	5.090	6.754	6.746
		S135	3.063	5.625	0.250	6	8	5.953	5.547	6.755	6.747	4.368	5.157	5.090	6.754	6.746
5 19.50	VX™ 50	G105	4.063	6.031	0.250	6	8.001	6.516	5.953	7.005	6.996	4.742	5.555	5.488	7.005	6.996
		S135	3.813	6.031	0.250	6	8.001	6.516	5.953	7.005	6.996	4.742	5.555	5.488	7.005	6.996
5 25.60	VX™ 50	G105	3.813	6.031	0.250	6	8.001	6.516	5.953	7.005	6.996	4.742	5.555	5.488	7.005	6.996

Table 3.7.10 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Express™

Nominal			Premium Class		Min	Minimum		Bevel		Pin Connection		Pin Nose	Box Cbore		Box Connection	
			Max	Min	CBore	Tong Space[2]		Diameter		Length		Diameter	Diameter		Length	
Size/Wt	Connection	Grade	ID[1]	OD[1]	Wall	Pin	Box	Max	Min	Max	Min	Max	Max	Min	Max	Min
5 1/2 **21.90**	VX™ 54	S135	4.063	6.219	0.250	6	8.379	6.859	6.141	6.381	6.370	4.996	5.749	5.682	6.384	6.373
	VX™ 57	G105	4.563	6.469	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
5 1/2 **24.70**	VX™ 54	S135	4.063	6.344	0.250	6	8.379	6.859	6.141	6.381	6.370	4.996	5.749	5.682	6.384	6.373
	VX™ 57	G105	4.563	6.469	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
		S135	4.313	6.531	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
5 7/8 **23.40** 0.361 wall	VX™ 57	G105	4.563	6.469	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
		S135	4.313	6.563	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
5 7/8 **26.30** 0.415 wall	VX™ 57	G105	4.563	6.563	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
		S135	4.313	6.688	0.313	6	8.003	6.922	6.391	7.006	6.997	5.177	5.990	5.923	7.006	6.997
6 5/8 **25.20**	VX™ 65	G105	5.563	7.500	0.313	6	8.375	7.922	7.422	7.379	7.371	6.166	7.016	6.949	7.379	7.371
		S135	5.563	7.625	0.313	6	8.375	7.922	7.422	7.379	7.371	6.166	7.016	6.949	7.379	7.371
6 5/8 **27.70**	VX™ 65	G105	5.563	7.500	0.313	6	8.375	7.922	7.422	7.379	7.371	6.166	7.016	6.949	7.379	7.371
		S135	5.313	7.531	0.313	6	8.375	7.922	7.422	7.379	7.371	6.166	7.016	6.949	7.379	7.371

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.11 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco EIS™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 7/8	NC26 Grant Prideco EIS™	G105	1.500	3.344	0.188	6.000	6.500	3.313	3.25	3.627	3.620	2.074	3.000	2.921	3.632	3.625
10.40		S135	1.500	3.511	0.188	6.000	6.500	3.313	3.281	3.627	3.620	2.074	3.000	2.921	3.632	3.625
	NC31 Grant Prideco EIS™	G105	2.000	3.797	0.188	6.000	6.500	4.000	3.906	4.127	4.120	2.531	3.516	3.414	4.132	4.125
		S135	2.000	3.827	0.188	6.000	6.500	4.000	3.906	4.127	4.120	2.531	3.516	3.414	4.132	4.125
3 1/2	NC38 Grant Prideco EIS™	G105	2.563	4.421	0.250	6.000	6.500	4.625	4.531	4.627	4.620	3.047	4.141	4.039	4.632	4.625
13.30		S135	2.563	4.569	0.250	6.000	6.500	4.625	4.531	4.627	4.620	3.047	4.141	4.039	4.632	4.625
3 1/2	NC38 Grant Prideco EIS™	G105	2.438	4.426	0.250	6.000	6.500	4.625	4.531	4.627	4.620	3.047	4.141	4.039	4.632	4.625
15.50		S135	2.438	4.602	0.250	6.000	6.500	4.625	4.531	4.627	4.620	3.047	4.141	4.039	4.632	4.625
4	NC38 Grant Prideco EIS™	G105	2.563	4.559	0.250	6.000	6.500	4.625	4.531	4.627	4.620	3.047	4.141	4.039	4.632	4.625
14.00		S135	2.438	4.698	0.250	6.000	6.500	4.625	4.531	4.627	4.620	3.047	4.141	4.039	4.632	4.625
	NC40 Grant Prideco EIS™	S135	2.688	4.9	0.250	6.000	6.500	5.063	4.813	5.127	5.120	3.227	4.406	4.305	5.132	5.125
4	NC40 Grant Prideco EIS™	S135	2.563	4.927	0.250	6.000	6.500	5.063	4.813	5.127	5.120	3.227	4.406	4.305	5.132	5.125
15.70																
4 1/2	NC46 Grant Prideco EIS™	G105	3.000	5.375	0.313	6.000	6.500	5.766	5.375	5.127	5.120	3.781	4.969	4.859	5.132	5.125
16.60		S135	3.000	5.375	0.313	6.000	6.500	5.766	5.375	5.127	5.120	3.781	4.969	4.859	5.132	5.125
	NC50 Grant Prideco EIS™	G105	3.500	5.782	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
		S135	3.500	5.782	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
4 1/2	NC46 Grant Prideco EIS™	G105	3.000	5.375	0.313	6.000	6.500	5.766	5.375	5.127	5.120	3.781	4.969	4.859	5.132	5.125
20.00		S135	3.000	5.528	0.313	6.000	6.500	5.766	5.375	5.127	5.120	3.781	4.969	4.859	5.132	5.125
	NC50 Grant Prideco EIS™	G105	3.500	5.782	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
		S135	3.500	5.815	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
5	NC50 Grant Prideco EIS™	G105	3.500	5.782	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
19.50		S135	3.500	5.92	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125

Table 3.7.11 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco EIS™

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5	NC50 Grant Prideco EIS™	G105	3.500	5.898	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
25.60		S135	3.250	6.045	0.313	6.000	6.500	6.109	5.781	5.127	5.120	4.197	5.375	5.274	5.132	5.125
5 1/2	5 1/2 FH Grant Prideco EIS™	G105	4.000	6.375	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
21.90		S135	4.000	6.555	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
5 1/2	5 1/2 FH Grant Prideco EIS™	G105	4.000	6.425	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
24.70		S135	3.750	6.543	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
5 7/8	5 1/2 FH Grant Prideco EIS™	G105	4.000	6.46	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
23.40		S135	3.750	6.586	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
5 7/8	5 1/2 FH Grant Prideco EIS™	S135	3.750	6.879	0.313	6.000	6.626	6.766	6.375	5.627	5.620	4.637	5.969	5.850	5.632	5.625
28.70																
6 5/8	6 5/8 FH Grant Prideco EIS™	G105	5.000	7.331	0.313	6.000	6.626	7.75	7.313	5.627	5.620	5.566	6.906	6.778	5.632	5.625
25.20		S135	4.750	7.423	0.313	6.000	6.626	7.75	7.313	5.627	5.620	5.566	6.906	6.778	5.632	5.625
6 5/8	6 5/8 FH Grant Prideco EIS™	G105	5.000	7.395	0.313	6.000	6.626	7.75	7.313	5.627	5.620	5.566	6.906	6.778	5.632	5.625
27.70		S135	4.750	7.504	0.313	6.000	6.626	7.75	7.313	5.627	5.620	5.566	6.906	6.778	5.632	5.625

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.7.12 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TM2™

Nominal Size/Wt	Connection	Grade	Premium Class Max ID[1]	Premium Class Min OD	Min CBore Wall	Minimum Tong Space Pin	Minimum Tong Space Box	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Cbore Diameter Max	Box Connection Length Max	Box Connection Length Min
6 5/8	TM2-6 5/8 FH	E	5.063	7.344	0.203	5.500	6.500	7.750	7.266	5.503	5.497	5.587	6.906	5.517	5.500
25.20		X	5.063	7.344	0.203	5.500	6.500	7.750	7.266	5.503	5.497	5.587	6.906	5.517	5.500
		G	5.063	7.344	0.203	5.500	6.500	7.750	7.266	5.503	5.497	5.587	6.906	5.517	5.500
		S	5.063	7.594	0.328	5.500	6.500	7.750	7.359	5.503	5.497	5.587	6.906	5.517	5.500
6 5/8	TM2-6 5/8 FH	E	5.063	7.344	0.203	5.500	6.500	7.750	7.266	5.503	5.497	5.587	6.906	5.517	5.500
27.70		X	5.063	7.344	0.203	5.500	6.500	7.750	7.266	5.503	5.497	5.587	6.906	5.517	5.500
		G	5.063	7.406	0.234	5.500	6.500	7.750	7.266	5.503	5.497	5.587	6.906	5.517	5.500
		S	4.813	7.531	0.297	5.500	6.500	7.750	7.297	5.503	5.497	5.587	6.906	5.517	5.500

1 For pipe where the ID has exceeded the maximum ID listed, the product is not necessarily rejectable. The recommended torque must be revalued by the manufacturer. The maximum ID is 1/16 inch over the New Nominal ID.

2 The sizes and designs listed do not reflect all of the acceptable designs. Other combinations of diameters, bevels, tong lengths, etc may be allowed by agreement between the manufacturer and original purchaser.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.13 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Delta™

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8 6.65	Delta 243	G	1.500	2.970	0.188	6	6.5	3.211	2.991	3.625	3.616	2.037	1.990	2.641	2.578	3.630	3.623
		S	1.500	2.970	0.188	6	6.5	3.211	2.991	3.625	3.616	2.037	1.990	2.641	2.578	3.630	3.623
		V-150	1.500	2.970	0.188	6	6.5	3.211	2.991	3.625	3.616	2.037	1.990	2.641	2.578	3.630	3.623
2 7/8 6.85	Delta 259	G	1.500	3.129	0.188	6	6.5	3.442	3.222	3.938	3.929	3.163	3.116	2.800	2.737	3.943	3.936
		S	1.500	3.129	0.188	6	6.5	3.442	3.222	3.938	3.929	3.163	3.116	2.800	2.737	3.943	3.936
		V-150	1.500	3.129	0.188	6	6.5	3.442	3.222	3.938	3.929	3.163	3.116	2.800	2.737	3.943	3.936
	Delta 321	G	2.000	3.756	0.188	6	6.5	4.164	3.944	4.313	4.304	2.751	2.704	3.427	3.364	4.318	4.311
		S	2.000	3.756	0.188	6	6.5	4.164	3.944	4.313	4.304	2.751	2.704	3.427	3.364	4.318	4.311
		V-150	2.000	3.756	0.188	6	6.5	4.164	3.944	4.313	4.304	2.751	2.704	3.427	3.364	4.318	4.311
2 7/8 10.40	Delta 259	G	1.500	3.129	0.188	6	6.5	3.442	3.222	3.938	3.929	3.163	3.116	2.800	2.737	3.943	3.936
		S	1.438	3.280	0.188	6	6.5	3.442	3.222	3.938	3.929	3.163	3.116	2.800	2.737	3.943	3.936
		V-150	1.250	3.302	0.188	6	6.5	3.442	3.222	3.938	3.929	3.163	3.116	2.800	2.737	3.943	3.936
	Delta 321	G	2.000	3.756	0.188	6	6.5	4.164	3.944	4.313	4.304	2.751	2.704	3.427	3.364	4.318	4.311
		S	2.000	3.756	0.188	6	6.5	4.164	3.944	4.313	4.304	2.751	2.704	3.427	3.364	4.318	4.311
		V-150	2.000	3.756	0.188	6	6.5	4.164	3.944	4.313	4.304	2.751	2.704	3.427	3.364	4.318	4.311
3 1/2 9.50	Delta 377	G	2.563	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
		S	2.563	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
		V-150	2.563	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
3 1/2 13.30	Delta 377	G	2.563	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
		S	2.563	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
		V-150	2.563	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
3 1/2 15.50	Delta 377	G	2.500	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
		S	2.500	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
		V-150	2.375	4.433	0.250	6	6.5	4.746	4.526	4.375	4.366	3.299	3.252	3.981	3.918	4.380	4.373
4 14.00	Delta 391	G	2.688	4.575	0.250	6	6.5	4.901	4.681	4.438	4.429	3.433	3.386	4.122	4.059	4.443	4.436
		S	2.688	4.575	0.250	6	6.5	4.901	4.681	4.438	4.429	3.433	3.386	4.122	4.059	4.443	4.436
		V-150	2.688	4.634	0.250	6	6.5	4.901	4.681	4.438	4.429	3.433	3.386	4.122	4.059	4.443	4.436
4 15.70	Delta 391	G	2.688	4.575	0.250	6	6.5	4.901	4.681	4.438	4.429	3.433	3.386	4.122	4.059	4.443	4.436
		S	2.688	4.626	0.250	6	6.5	4.901	4.681	4.438	4.429	3.433	3.386	4.122	4.059	4.443	4.436
		V-150	2.688	4.735	0.250	6	6.5	4.901	4.681	4.438	4.429	3.433	3.386	4.122	4.059	4.443	4.436

Table 3.7.13 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Delta™

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4 1/2 16.60	Delta 425	G	3.000	4.914	0.250	6	6.5	5.268	5.048	4.563	4.554	3.759	3.712	4.461	4.398	4.568	4.561
		S	3.000	4.983	0.250	6	6.5	5.268	5.048	4.563	4.554	3.759	3.712	4.461	4.398	4.568	4.561
		V-150	3.000	5.097	0.250	6	6.5	5.268	5.048	4.563	4.554	3.759	3.712	4.461	4.398	4.568	4.561
	Delta 494	G	3.250	5.737	0.313	6	6.5	6.202	5.982	5.625	5.616	4.346	4.299	5.158	5.095	5.630	5.623
		S	3.250	5.737	0.313	6	6.5	6.202	5.982	5.625	5.616	4.346	4.299	5.158	5.095	5.630	5.623
		V-150	3.250	5.737	0.313	6	6.5	6.202	5.982	5.625	5.616	4.346	4.299	5.158	5.095	5.630	5.623
4 1/2 20.00	Delta 425	G	3.000	4.914	0.250	6	6.5	5.268	5.048	4.563	4.554	3.759	3.712	4.461	4.398	4.568	4.561
		S	3.000	5.173	0.250	6	6.5	5.268	5.048	4.563	4.554	3.759	3.712	4.461	4.398	4.568	4.561
		V-150	2.875	5.232	0.250	6	6.5	5.268	5.048	4.563	4.554	3.759	3.712	4.461	4.398	4.568	4.561
	Delta 494	G	3.250	5.737	0.313	6	6.5	6.202	5.982	5.625	5.616	4.346	4.299	5.158	5.095	5.630	5.623
		S	3.250	5.737	0.313	6	6.5	6.202	5.982	5.625	5.616	4.346	4.299	5.158	5.095	5.630	5.623
		V-150	3.125	5.737	0.313	6	6.5	6.202	5.982	5.625	5.616	4.346	4.299	5.158	5.095	5.630	5.623
5 19.50	Delta 527	G	3.750	6.065	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
		S	3.750	6.065	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
		V-150	3.750	6.065	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
	Delta 544	G	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		S	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		V-150	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
5 25.60	Delta 527	G	3.750	6.065	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
		S	3.750	6.065	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
		V-150	3.750	6.135	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
5 1/2 21.90	Delta 544	G	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		S	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		V-150	4.000	6.243	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
	Delta 576	G	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
5 1/2 24.70	Delta 544	G	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		S	4.000	6.244	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		V-150	4.000	6.378	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
	Delta 576	G	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311

Table 3.7.13 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Delta™

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2 26.72	Delta 544	G	4.000	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		S	4.000	6.415	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		V-150	3.875	6.488	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
	Delta 576	G	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S	4.000	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	3.875	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
5 7/8 23.40	Delta 576	G	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	4.250	6.577	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
5 7/8 26.30	Delta 576	G	4.250	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S	4.250	6.580	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	4.250	6.721	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
6 5/8 25.20	Delta 663	G	5.000	7.427	0.313	6	6.627	7.936	7.716	5.625	5.616	6.036	5.989	6.848	6.785	5.630	5.623
		S	5.000	7.427	0.313	6	6.627	7.936	7.716	5.625	5.616	6.036	5.989	6.848	6.785	5.630	5.623
		V-150	5.000	7.427	0.313	6	6.627	7.936	7.716	5.625	5.616	6.036	5.989	6.848	6.785	5.630	5.623
6 5/8 27.70	Delta 663	G	5.000	7.427	0.313	6	6.627	7.936	7.716	5.625	5.616	6.036	5.989	6.848	6.785	5.630	5.623
		S	5.000	7.427	0.313	6	6.627	7.936	7.716	5.625	5.616	6.036	5.989	6.848	6.785	5.630	5.623
		V-150	5.000	7.427	0.313	6	6.627	7.936	7.716	5.625	5.616	6.036	5.989	6.848	6.785	5.630	5.623

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.

2 Tong space excludes hardbanding.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.7.14 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco X-Force™

Nominal Size/Wt	Connection	Grade	Premium Class		Min CBore	Minimum Tong Space		Bevel Diameter		Pin Connection Length		Pin Nose Diameter	Box Cbore Diameter		Box Connection Length	
			Max ID	Min OD	Wall	Pin	Box	Max	Min	Max	Min	Max	Max	Min	Max	Min
2 7/8 10.40	X-Force™ XF™ 24	G105	1.563	3.063	0.172	4	6	3.172	2.922	5.000	4.994	2.028	2.649	2.555	5.005	4.999
		S135	1.563	3.219	0.250	4	6	3.172	3.047	5.000	4.994	2.028	2.649	2.555	5.005	4.999
	X-Force™ XF™ 26	G105	1.563	3.219	0.141	4	6.250	3.516	3.141	5.250	5.244	2.242	2.887	2.793	5.254	5.248
		S135	1.563	3.281	0.172	4	6.250	3.516	3.141	5.250	5.244	2.242	2.887	2.793	5.254	5.248
	X-Force™ XF™ 31	G105	2.219	3.750	0.141	4	7.250	4.109	3.672	6.250	6.244	2.661	3.402	3.308	6.255	6.249
		S135	2.063	3.750	0.141	4	7.250	4.109	3.672	6.250	6.244	2.661	3.402	3.308	6.255	6.249
3 1/2 13.30	X-Force™ XF™ 38	G105	2.813	4.344	0.141	4	7	4.734	4.266	6.000	5.994	3.288	4.005	3.911	6.006	6.000
		S135	2.813	4.344	0.141	4	7	4.734	4.266	6.000	5.994	3.288	4.005	3.911	6.006	6.000
	X-Force™ XF™ 39	G105	2.875	4.563	0.141	4	6.75	4.953	4.484	5.750	5.744	3.519	4.212	4.118	5.755	5.749
		S135	2.750	4.563	0.141	4	6.75	4.953	4.484	5.750	5.744	3.519	4.212	4.118	5.755	5.749
3 1/2 15.50	X-Force™ XF™ 38	G105	2.750	4.344	0.141	4	7	4.734	4.266	6.000	5.994	3.288	4.005	3.911	6.006	6.000
	X-Force™ XF™ 39	G105	2.875	4.563	0.141	4	6.75	4.953	4.484	5.750	5.744	3.519	4.212	4.118	5.755	5.749
4 14.00	X-Force™ XF™ 38	S135	2.500	4.375	0.156	4	7	4.734	4.266	6.000	5.994	3.288	4.005	3.911	6.006	6.000
	X-Force™ XF™ 39	G105	2.875	4.563	0.141	4	6.75	4.953	4.484	5.750	5.744	3.519	4.212	4.118	5.755	5.749
		S135	2.875	4.563	0.141	4	6.75	4.953	4.484	5.750	5.744	3.519	4.212	4.118	5.755	5.749
	X-Force™ XF™ 40	G105	3.063	4.938	0.203	4	7.250	5.234	4.859	6.250	6.244	3.735	4.476	4.382	6.254	6.248
		S135	3.063	4.938	0.203	4	7.250	5.234	4.859	6.250	6.244	3.735	4.476	4.382	6.254	6.248
4 15.70	X-Force™ XF™ 38	S135	2.500	4.438	0.188	4	7	4.734	4.391	6.000	5.994	3.288	4.005	3.911	6.006	6.000
	X-Force™ XF™ 39	G105	2.875	4.688	0.203	4	6.75	4.953	4.609	5.750	5.744	3.519	4.212	4.118	5.755	5.749
		S135	2.813	4.594	0.156	4	6.75	4.953	4.609	5.750	5.744	3.519	4.212	4.118	5.755	5.749
	X-Force™ XF™ 40	G105	3.063	4.938	0.203	4	7.250	5.234	4.859	6.250	6.244	3.735	4.476	4.382	6.254	6.248
		S135	2.938	4.938	0.203	4	7.250	5.234	4.859	6.250	6.244	3.735	4.476	4.382	6.254	6.248

Table 3.7.14 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco X-Force™

Nominal Size/Wt	Connection	Grade	Premium Class Max ID	Premium Class Min OD	Min CBore Wall	Minimum Tong Space Pin	Minimum Tong Space Box	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4 1/2	X-Force™ XF™ 46	G105	3.813	5.625	0.203	4.375	7.75	5.953	5.547	6.750	6.744	4.368	5.157	5.063	6.754	6.748
16.60		S135	3.563	5.625	0.203	4.375	7.75	5.953	5.547	6.750	6.744	4.368	5.157	5.063	6.754	6.748
4 1/2	X-Force™ XF™ 43	S135	3.313	5.219	0.297	4	7.250	5.266	5.016	6.250	6.244	3.826	4.565	4.471	6.254	6.248
20.00																
	X-Force™ XF™ 46	G105	3.563	5.625	0.203	4.375	7.75	5.953	5.547	6.750	6.744	4.368	5.157	5.063	6.754	6.748
		S135	3.313	5.625	0.203	4.375	7.75	5.953	5.547	6.750	6.744	4.368	5.157	5.063	6.754	6.748
5	X-Force™ XF™ 50	G105	4.063	6.031	0.203	4.625	8	6.516	5.953	7.000	6.994	4.742	5.555	5.461	7.004	6.998
19.50		S135	3.813	6.031	0.203	4.625	8	6.516	5.953	7.000	6.994	4.742	5.555	5.461	7.004	6.998
		V150	3.813	6.031	0.203	4.625	8	6.516	5.953	7.000	6.994	4.742	5.555	5.461	7.004	6.998
5	X-Force™ XF™ 50	G105	3.813	6.031	0.203	4.625	8	6.516	5.953	7.000	6.994	4.742	5.555	5.461	7.004	6.998
25.60		S135	3.563	6.031	0.203	4.625	8	6.516	5.953	7.000	6.994	4.742	5.555	5.461	7.004	6.998
5 1/2	X-Force™ XF™ 54	S135	4.063	6.219	0.203	5.250	7.375	6.859	6.141	6.375	6.369	4.996	5.749	5.655	6.382	6.373
21.90																
	X-Force™ XF™ 57	G105	4.563	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
		S135	4.563	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
5 1/2	X-Force™ XF™ 54	S135	4.063	6.219	0.203	5.250	7.375	6.859	6.141	6.375	6.369	4.996	5.749	5.655	6.382	6.373
24.70																
	X-Force™ XF™ 57	G105	4.563	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
		S135	4.313	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
		V150	4.313	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
5 7/8	X-Force™ XF™ 57	G105	4.563	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
23.40		S135	4.313	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
5 7/8	X-Force™ XF™ 57	G105	4.563	6.469	0.203	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000
26.30		S135	4.313	6.500	7/32	5.250	8	6.922	6.391	7.000	6.994	5.177	5.990	5.896	7.006	7.000

Table 3.7.14 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco X-Force™

Nominal Size/Wt	Connection	Grade	Premium Class Max ID	Premium Class Min OD	Min CBore Wall	Minimum Tong Space Pin	Minimum Tong Space Box	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
6 5/8	X-Force™ XF™ 65	G105	5.563	7.469	0.203	5.500	8.375	7.922	7.391	7.375	7.369	6.167	7.016	6.922	7.378	7.372
25.20		S135	5.563	7.469	0.203	5.500	8.375	7.922	7.391	7.375	7.369	6.167	7.016	6.922	7.378	7.372
	X-Force™ XF™ 69	G105	5.938	7.813	0.203	5.500	8.125	8.203	7.734	7.125	7.119	6.538	7.363	7.269	7.127	7.121
		S135	5.813	7.813	0.203	5.500	8.125	8.203	7.734	7.125	7.119	6.538	7.363	7.269	7.127	7.121
6 5/8	X-Force™ XF™ 65	G105	5.563	7.469	0.203	5.500	8.375	7.922	7.391	7.375	7.369	6.167	7.016	6.922	7.378	7.372
27.70		S135	5.313	7.469	0.203	5.500	8.375	7.922	7.391	7.375	7.369	6.167	7.016	6.922	7.378	7.372
	X-Force™ XF™ 69	G105	5.938	7.813	0.203	5.500	8.125	8.203	7.734	7.125	7.119	6.538	7.363	7.269	7.127	7.121
		S135	5.688	7.813	0.203	5.500	8.125	8.203	7.734	7.125	7.119	6.538	7.363	7.269	7.127	7.121

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.15 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

NK DSTJ™

			Premium Class				Class 2				Minimum Tong Space			Max
Nominal Size/Wt	Conn	Grade	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Min OD	Max ID	Min Bevel Diameter	Min Shoulder Width	Pin	Box	Max Cbore	Bevel Diameter
3 1/2 13.30	DSTJ NC38	E	4 31/64	3 3/64	4 23/64	9/64	4 27/64	3 9/64	4 21/64	9/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC38	X	4 19/32	2 7/8	4 27/64	13/64	4 33/64	3	4 3/8	12/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC38	G	4 21/32	2 25/32	4 15/32	15/64	4 37/64	2 29/32	4 27/64	14/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC38	S	4 13/16	2 1/2	4 9/16	5/16	4 45/64	2 45/64	4 1/2	18/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC40	S	5	2 59/64	4 25/32	17/64	4 29/32	3 5/64	4 23/32	16/64	4	6 1/8	4 13/32	5 1/32
3 1/2 15.50	DSTJ NC38	E	4 17/32	2 31/32	4 25/64	11/64	4 15/32	3 1/16	4 23/64	11/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC38	X	4 21/32	2 25/32	4 15/32	15/64	4 37/64	2 29/32	4 27/64	14/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC38	G	4 23/32	2 43/64	4 1/2	17/64	4 5/8	2 53/64	4 29/64	16/64	4	5 5/8	4 9/64	4 19/32
	DSTJ NC40	G	4 59/64	3 1/16	4 47/64	15/64	4 53/64	3 13/64	4 43/64	14/64	4	6 1/8	4 13/32	5 1/32
	DSTJ NC40	S	5 5/64	2 51/64	4 53/64	5/16	4 31/32	2 63/64	4 49/64	18/64	4	6 1/8	4 13/32	5 1/32
4 11.85	DSTJ NC46	E	5 13/64	4 1/32	5 1/8	3/32	5 5/32	4 3/32	5 3/32	6/64	4	6 1/8	4 31/32	5 47/64
4 14.00	DSTJ NC40	E	4 13/16	3 15/64	4 43/64	11/64	4 47/64	3 11/32	4 5/8	11/64	4	6 1/8	4 13/32	5 1/32
	DSTJ NC40	X	4 59/64	3 1/16	4 47/64	15/64	4 27/32	3 3/16	4 11/16	14/64	4	6 1/8	4 13/32	5 1/32
	DSTJ NC40	G	4 63/64	2 61/64	4 49/64	17/64	4 29/32	3 5/64	4 23/32	16/64	4	6 1/8	4 13/32	5 1/32
	DSTJ NC40	S	5 11/64	2 39/64	4 57/64	23/64	5 1/16	2 13/16	4 53/64	21/64	4	6 1/8	4 13/32	5 1/8
	DSTJ NC46	E	5 17/64	3 61/64	5 5/32	1/8	5 7/32	4 1/64	5 1/8	8/64	4	6 1/8	4 31/32	5 47/64
	DSTJ NC46	X	5 3/8	3 51/64	5 15/64	11/64	5 19/64	3 29/32	5 11/64	11/64	4 1/32	6 1/8	4 31/32	5 47/64
	DSTJ NC46	G	5 27/64	3 47/64	5 1/4	13/64	5 11/32	3 27/32	5 13/64	12/64	4 1/16	6 1/8	4 31/32	5 47/64
	DSTJ NC46	S	5 9/16	3 33/64	5 11/32	17/64	5 31/64	3 41/64	5 19/64	17/64	4 11/64	6 1/8	4 31/32	5 47/64
4 15.70	DSTJ NC40	E	4 55/64	3 5/32	4 11/16	13/64	4 25/32	3 17/64	4 41/64	12/64	4	6 1/8	4 13/32	5 1/32
	DSTJ NC40	X	4 63/64	2 61/64	4 49/64	17/64	4 29/32	3 5/64	4 23/32	16/64	4	6 1/8	4 13/32	5 1/32
	DSTJ NC46	E	5 5/16	3 57/64	5 3/16	9/64	5 1/4	3 31/32	5 5/32	9/64	4	6 1/8	4 31/32	5 47/64
	DSTJ NC46	X	5 27/64	3 47/64	5 1/4	13/64	5 11/32	3 27/32	5 13/64	12/64	4 1/16	6 1/8	4 31/32	5 47/64
	DSTJ NC46	G	5 15/32	3 43/64	5 9/32	7/32	5 25/64	3 25/32	5 15/64	14/64	4 7/64	6 1/8	4 31/32	5 47/64
	DSTJ NC46	S	5 41/64	3 25/64	5 25/64	5/16	5 17/32	3 37/64	5 21/64	18/64	4 15/64	6 1/8	4 31/32	5 47/64

Table 3.7.15 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

NK DSTJ™

Nominal Size/Wt	Conn	Grade	Premium Class Min OD	Premium Class Max ID	Premium Class Min Bevel Diameter	Premium Class Min Shoulder Width	Class 2 Min OD	Class 2 Max ID	Class 2 Min Bevel Diameter	Class 2 Min Shoulder Width	Minimum Tong Space Pin	Minimum Tong Space Box	Max Cbore	Max Bevel Diameter
4 1/2	DSTJ NC46	E	5 25/64	3 25/32	5 15/64	3/16	5 21/64	3 55/64	5 13/64	12/64	4 3/64	6 1/8	4 31/32	5 47/64
16.60	DSTJ NC46	X	5 17/32	3 37/64	5 21/64	1/4	5 7/16	3 23/32	5 17/64	15/64	4 5/32	6 1/8	4 31/32	5 47/64
	DSTJ NC46	G	5 19/32	3 15/32	5 23/64	9/32	5 1/2	3 5/8	5 5/16	17/64	4 13/64	6 1/8	4 31/32	5 47/64
	DSTJ NC46	S	5 25/32	3 5/32	5 31/64	3/8	5 21/32	3 3/8	5 13/32	22/64	4 11/32	6 1/8	4 31/32	5 47/64
	DSTJ NC50	E	5 23/32	4 5/16	5 19/32	11/64	5 43/64	4 3/8	5 9/16	10/64	4 19/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	X	5 27/32	4 9/64	5 43/64	15/64	5 49/64	4 1/4	5 5/8	13/64	4 25/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	G	5 29/32	4 3/64	5 23/32	17/64	5 13/16	4 3/16	5 21/32	14/64	4 7/16	6 1/8	5 3/8	6 5/64
	DSTJ NC50	S	6 1/16	3 13/16	5 13/16	11/32	5 31/32	3 31/32	5 3/4	19/64	4 35/64	6 1/8	5 3/8	6 5/64
4 1/2	DSTJ NC46	E	5 31/64	3 41/64	5 19/64	17/64	5 13/32	3 3/4	5 1/4	14/64	4 7/64	6 1/8	4 31/32	5 47/64
20.00	DSTJ NC46	X	5 41/64	3 25/64	5 25/64	11/32	5 35/64	3 35/64	5 21/64	19/64	4 15/64	6 1/8	4 31/32	5 47/64
	DSTJ NC46	G	5 23/32	3 17/64	5 7/16	3/8	5 39/64	3 29/64	5 3/8	21/64	4 19/64	6 1/8	4 31/32	5 47/64
	DSTJ NC46	S	5 59/64	2 7/8	5 37/64	31/64	5 51/64	3 1/8	5 31/64	27/64	4 7/16	6 1/8	4 31/32	5 27/32
	DSTJ NC50	E	5 13/16	4 3/16	5 21/32	7/32	5 47/64	4 19/64	5 39/64	12/64	4 23/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	X	5 15/16	4 1/64	5 47/64	9/32	5 55/64	4 1/8	5 11/16	16/64	4 29/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	G	6 1/64	3 57/64	5 25/32	21/64	5 29/32	4 3/64	5 23/32	17/64	4 33/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	S	6 13/64	3 37/64	5 57/64	27/64	6 5/64	3 51/64	5 13/16	23/64	4 21/32	6 1/8	5 3/8	6 5/64
5	DSTJ NC50	E	5 7/8	4 3/32	5 11/16	1/4	5 51/64	4 13/64	5 41/64	14/64	4 13/32	6 1/8	5 3/8	6 5/64
19.50	DSTJ NC50	X	6 1/64	3 57/64	5 25/32	21/64	5 59/64	4 1/32	5 23/32	18/64	4 33/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	G	6 3/32	3 49/64	5 53/64	23/64	5 63/64	3 15/16	5 49/64	20/64	4 37/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	S	6 19/64	3 27/64	5 61/64	15/32	6 11/64	3 41/64	5 7/8	26/64	4 23/32	6 1/8	5 3/8	6 5/64
	DSTJ 5 1/2 FH	E	6 23/64	4 25/32	6 7/32	13/64	6 19/64	4 55/64	6 11/64	11/64	4 49/64	6 5/8	5 31/32	6 5/16
	DSTJ 5 1/2 FH	X	6 31/64	4 39/64	6 19/64	17/64	6 13/32	4 23/32	6 1/4	14/64	4 55/64	6 5/8	5 31/32	6 7/16
	DSTJ 5 1/2 FH	G	6 35/64	4 33/64	6 21/64	19/64	6 15/32	4 5/8	6 9/32	16/64	4 29/32	6 5/8	5 31/32	6 1/2
	DSTJ 5 1/2 FH	S	6 47/64	4 15/64	6 29/64	25/64	6 5/8	4 13/32	6 3/8	21/64	5 3/64	6 5/8	5 31/32	6 47/64
5	DSTJ 5 1/2 FH	E	6 31/64	4 39/64	6 19/64	17/64	6 13/32	4 23/32	6 1/4	14/64	4 55/64	6 5/8	5 31/32	6 47/64
25.60	DSTJ 5 1/2 FH	X	6 41/64	4 3/8	6 25/64	11/32	6 35/64	4 33/64	6 21/64	19/64	4 63/64	6 5/8	5 31/32	6 47/64
	DSTJ 5 1/2 FH	G	6 23/32	4 17/64	6 7/16	3/8	6 39/64	4 27/64	6 3/8	21/64	5 3/64	6 5/8	5 31/32	6 47/64
	DSTJ 5 1/2 FH	S	6 15/16	3 57/64	6 37/64	31/64	6 51/64	4 9/64	6 31/64	27/64	5 13/64	6 5/8	5 31/32	6 47/64
	DSTJ NC50	E	6 1/64	3 57/64	5 25/32	21/64	5 59/64	4 1/32	5 23/32	18/64	4 33/64	6 1/8	5 3/8	6 5/64
	DSTJ NC50	X	6 13/64	3 37/64	5 57/64	27/64	6 5/64	3 51/64	5 13/16	23/64	4 21/32	6 1/8	5 3/8	6 5/64
	DSTJ NC50	G	6 9/32	3 29/64	5 61/64	29/64	6 5/32	3 43/64	5 7/8	25/64	4 23/32	6 1/8	5 3/8	6 5/64

Table 3.7.15 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

NK DSTJ™

Nominal Size/Wt	Conn	Grade	Premium Class Min OD	Premium Class Max ID	Premium Class Min Bevel Diameter	Premium Class Min Shoulder Width	Class 2 Min OD	Class 2 Max ID	Class 2 Min Bevel Diameter	Class 2 Min Shoulder Width	Minimum Tong Space Pin	Minimum Tong Space Box	Max Cbore	Max Bevel Diameter
5 1/2	DSTJ 5 1/2 FH	E	6 15/32	4 5/8	6 9/32	1/4	6 25/64	4 47/64	6 15/64	14/64	4 55/64	6 5/8	5 31/32	6 47/64
21.90	DSTJ 5 1/2 FH	X	6 5/8	4 13/32	6 3/8	21/64	6 17/32	4 35/64	6 21/64	18/64	4 31/32	6 5/8	5 31/32	6 47/64
	DSTJ 5 1/2 FH	G	6 45/64	4 9/32	6 7/16	3/8	6 19/32	4 29/64	6 23/64	20/64	5 1/32	6 5/8	5 31/32	6 47/64
	DSTJ 5 1/2 FH	S	6 59/64	3 59/64	6 9/16	31/64	6 51/64	4 9/64	6 31/64	27/64	5 3/16	6 5/8	5 31/32	7 7/64
5 1/2	DSTJ 5 1/2 FH	E	6 35/64	4 33/64	6 21/64	19/64	6 29/64	4 21/32	6 9/32	16/64	4 29/32	6 5/8	5 31/32	6 47/64
24.70	DSTJ 5 1/2 FH	X	6 45/64	4 9/32	6 7/16	3/8	6 19/32	4 29/64	6 23/64	20/64	5 1/32	6 5/8	5 31/32	6 47/64
	DSTJ 5 1/2 FH	G	6 25/32	4 5/32	6 31/64	13/32	6 43/64	4 21/64	6 13/32	23/64	5 3/32	6 5/8	5 31/32	6 47/64
	DSTJ 5 1/2 FH	S	7 1/64	3 3/4	6 5/8	17/32	6 7/8	4	6 17/32	29/64	5 17/64	6 5/8	5 31/32	7 7/64

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply. Minimum OD's smaller than those listed in this table are acceptable if torque limitations are followed. Please contact the manufacturer for applicable charts for torque limitations.

Table 3.7.16 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLIDS

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8	HLIDS23	HL95SS	1.438	3.000	0.188	6.0	6.0	3.142	2.984	2.453	2.421	3.498	3.490	1.744	1.697	2.657	2.609	3.504	3.496
6.65 / IU		HL105SS	1.438	3.000	0.188	6.0	6.0	3.142	2.984	2.453	2.421	3.498	3.490	1.744	1.697	2.657	2.609	3.504	3.496
		G105 / HL105AS	1.438	3.000	0.188	6.0	6.0	3.142	2.984	2.453	2.421	3.498	3.490	1.744	1.697	2.657	2.609	3.504	3.496
		HL120S	1.438	3.000	0.188	6.0	6.0	3.142	2.984	2.453	2.421	3.498	3.490	1.744	1.697	2.657	2.609	3.504	3.496
		S135 / HL135AS	1.438	3.000	0.188	6.0	6.0	3.142	2.984	2.453	2.421	3.498	3.490	1.744	1.697	2.657	2.609	3.504	3.496
2 3/8	HLIDS26	HL95SS	1.750	3.313	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
6.65 / EU		HL105SS	1.750	3.313	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
		G105/HL105AS	1.750	3.313	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
		HL120S	1.750	3.313	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
		S135 / HL135AS	1.750	3.313	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
2 7/8	HLIDS26	HL95SS	1.688	3.438	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
10.40 / IU		HL105SS	1.625	3.469	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
		G105 / HL105AS	1.688	3.438	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
		HL120S	1.563	3.469	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
		S135 / HL135AS	1.469	3.531	0.188	6.0	6.0	3.407	3.250	2.766	2.734	3.384	3.376	2.066	2.034	2.969	2.922	3.390	3.382
2 7/8	HLIDS31	HL95SS	2.063	3.844	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
10.40 / EU		HL105SS	2.063	3.844	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
		G105 / HL105AS	2.063	3.844	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
		HL120S	2.063	3.844	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
		S135 / HL135AS	2.063	3.875	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
3 1/2	HLIDS31	HL95SS	2.094	4.031	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
13.30 / IU		HL105SS	2.000	4.094	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
		G105 / HL105AS	2.063	4.031	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
		HL120S	1.969	4.125	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
		S135 / HL135AS	1.813	4.156	0.188	6.0	6.0	4.095	3.937	3.282	3.250	3.894	3.886	2.496	2.465	3.485	3.437	3.900	3.892
3 1/2	HLIDS38	HL95SS	2.688	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
13.30 / EU		HL105SS	2.688	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		G105 / HL105AS	2.688	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		HL120S	2.688	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		S135 / HL135AS	2.688	4.656	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
3 1/2	HLIDS38	HL95SS	2.531	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
15.50 / EU		HL105SS	2.531	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		G105 / HL105AS	2.531	4.578	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		HL120S	2.531	4.594	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		S135 / HL135AS	2.531	4.688	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
4	HLIDS38	HL95SS	2.750	4.656	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
14.00 / IU		HL105SS	2.688	4.719	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		G105 / HL105AS	2.750	4.688	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		HL120S	2.656	4.750	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		S135 / HL135AS	2.563	4.781	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404
		V150	2.531	4.813	0.250	6.0	6.0	4.720	4.562	3.907	3.875	4.406	4.398	3.035	3.004	4.109	4.062	4.411	4.404

Table 3.7.16 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLIDS

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4	HLIDS40	HL95SS	2.813	4.906	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
14.00 / IU		HL105SS	2.813	4.906	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		G105 / HL105AS	2.813	4.906	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		HL120S	2.813	4.906	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		S135 / HL135AS	2.813	5.000	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		V150	2.813	5.031	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
4	HLIDS40	HL95SS	2.781	5.094	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
15.70 / IU		HL105SS	2.813	4.938	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		G105 / HL105AS	2.813	4.906	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		HL120S	2.813	4.969	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		S135 / HL135AS	2.813	5.063	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		V150	2.781	5.094	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
4 1/2	HLIDS40	HL95SS	2.813	5.000	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
16.60 / IEU		HL105SS	2.781	5.063	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		G105 / HL105AS	2.813	5.031	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		HL120S	2.750	5.094	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		S135 / HL135AS	2.625	5.188	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
		V150	2.594	5.188	0.281	6.0	6.0	5.157	5.000	4.172	4.140	4.917	4.909	3.216	3.184	4.375	4.328	4.923	4.915
	HLIDS46	HL95SS	3.375	5.469	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		HL105SS	3.375	5.469	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		G105 / HL105AS	3.375	5.469	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		HL120S	3.375	5.500	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		S135 / HL135AS	3.375	5.594	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		V150	3.375	5.625	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
4 1/2	HLIDS46	HL95SS	3.375	5.531	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
20.00 / IEU		HL105SS	3.375	5.594	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		G105 / HL105AS	3.375	5.531	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		HL120S	3.375	5.625	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		S135 / HL135AS	3.281	5.719	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
		V150	3.281	5.719	0.281	6.0	6.0	5.860	5.703	4.725	4.693	4.917	4.909	3.766	3.734	4.938	4.891	4.923	4.915
5	HLIDS50	HL95SS	3.781	5.938	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
19.50 / IEU		HL105SS	3.781	5.969	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		G105 / HL105AS	3.781	5.938	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		HL120S	3.781	6.000	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		S135 / HL135AS	3.750	6.094	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		V150	3.750	6.125	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
5	HLIDS50	HL95SS	3.781	6.063	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
25.60 / IEU		HL105SS	3.719	6.156	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		G105 / HL105AS	3.781	6.094	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		HL120S	3.656	6.156	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		S135 / HL135AS	3.531	6.250	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915
		V150	3.500	6.250	0.313	6.0	6.0	6.204	6.047	5.151	5.119	4.917	4.909	4.186	4.154	5.344	5.297	4.923	4.915

Table 3.7.16 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLIDS

Nominal			Premium Class		Min	Minimum		Bevel		Pin Cylinder		Pin Connection		Pin Nose		Box Cbore		Box Connection	
			Max	Min	Cbore	Tong Space[4]		Diameter[5]		Diameter		Length		Diameter		Diameter		Length	
Size/Wt	Conn	Grade[1]	ID[2]	OD[3]	Wall	Pin	Box	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
5 1/2	HLIDS5-1/2FH	HL95SS	4.219	6.531	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
21.90 / IEU		HL105SS	4.219	6.563	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		G105 / HL105AS	4.219	6.531	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		HL120S	4.219	6.594	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		S135 / HL135AS	4.219	6.719	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		V150	4.219	6.750	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
5 1/2	HLIDS5-1/2FH	HL95SS	4.219	6.563	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
24.70 / IEU		HL105SS	4.219	6.656	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		G105 / HL105AS	4.219	6.594	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		HL120S	4.219	6.719	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		S135 / HL135AS	4.156	6.781	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
		V150	4.125	6.813	0.313	6.0	6.0	6.860	6.703	5.731	5.699	5.429	5.421	4.626	4.594	5.938	5.891	5.435	5.427
6 5/8	HLIDS6-5/8FH	HL95SS	5.156	7.469	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
25.20 / IEU		HL105SS	5.156	7.531	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		G105 / HL105AS	5.156	7.469	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		HL120S	5.156	7.594	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		S135 / HL135AS	5.156	7.719	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		V150	5.156	7.719	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
6 5/8	HLIDS6-5/8FH	HL95SS	5.156	7.531	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
27.70 / IEU		HL105SS	5.156	7.625	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		G105 / HL105AS	5.156	7.531	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		HL120S	5.156	7.656	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		S135 / HL135AS	5.094	7.750	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427
		V150	5.063	7.781	0.313	6.0	6.0	7.845	7.687	6.659	6.627	5.429	5.421	5.508	5.476	6.875	6.828	5.435	5.427

1. HL105AS and HL135AS are Hilong proprietary grades for Antarctic Service drill pipe. HL95SS, HL105SS, and HL120S are Hilong proprietary grades for sour service drill pipe.
2. The maximum ID of Premium Class for most RSC types are based on the pin nose, pipe ID, and torsional capacity (TSR not less than 0.8).
3. The minimum OD of Premium Class is based on ID max and torsional capacity (TSR not less than 0.8). If the tool joint ID is smaller than ID max, the OD of Premium Class can be even smaller than stated above.
4. The minimium tong space excludes hardbanding which is from seal shoulder to the edge of hardbanding.
5. If the actual box OD is less than or equal to the specified bevel diameter plus 3/32 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
6. When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.17 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLMT

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8	HLMT2-3/8PAC	HL95SS	1.438	2.807	0.188	6.0	7.5	2.782	2.687	2.333	2.303	4.631	4.623	1.859	1.814	2.431	2.381	4.641	4.633
6.65 / IU		HL105SS	1.438	2.807	0.188	6.0	7.5	2.782	2.687	2.333	2.303	4.631	4.623	1.859	1.814	2.431	2.381	4.641	4.633
		G105 / HL105AS	1.438	2.807	0.188	6.0	7.5	2.782	2.687	2.333	2.303	4.631	4.623	1.859	1.814	2.431	2.381	4.641	4.633
2 7/8	HLMT2-7/8PAC	HL95SS	1.592	2.971	0.188	6.0	7.5	3.142	3.047	2.452	2.422	4.830	4.822	2.013	1.968	2.595	2.545	4.840	4.832
10.40 / IU		HL105SS	1.592	2.971	0.188	6.0	7.5	3.142	3.047	2.452	2.422	4.830	4.822	2.013	1.968	2.595	2.545	4.840	4.832
		G105 / HL105AS	1.592	2.971	0.188	6.0	7.5	3.142	3.047	2.452	2.422	4.830	4.822	2.013	1.968	2.595	2.545	4.840	4.832
3 1/2	HLMT38	HL95SS	2.688	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
13.30 / EU		HL105SS	2.688	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		G105 / HL105AS	2.688	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		HL120S	2.688	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		S135 / HL135AS	2.688	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		V150	2.688	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
3 1/2	HLMT38	HL95SS	2.531	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
15.50 / EU		HL105SS	2.531	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		G105 / HL105AS	2.531	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		HL120S	2.531	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		S135 / HL135AS	2.531	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		V150	2.531	4.603	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
4	HLMT38	HL95SS	2.781	4.625	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
14.00 / IU		HL105SS	2.781	4.656	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		G105 / HL105AS	2.781	4.625	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		HL120S	2.750	4.688	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		S135 / HL135AS	2.656	4.750	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
		V150	2.625	4.750	0.250	6.0	7.5	4.732	4.637	3.906	3.876	5.505	5.497	3.218	3.173	4.103	4.053	5.515	5.507
	HLMT40	HL95SS	2.932	4.932	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		HL105SS	2.932	4.932	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		G105 / HL105AS	2.932	4.932	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		HL120S	2.932	4.932	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		S135 / HL135AS	2.932	4.969	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		V150	2.932	5.000	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
4	HLMT40	HL95SS	2.932	4.932	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
15.70 / IU		HL105SS	2.932	4.938	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		G105 / HL105AS	2.932	4.932	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		HL120S	2.932	4.969	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		S135 / HL135AS	2.875	5.031	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
		V150	2.875	5.063	0.281	6.0	7.5	4.954	4.859	4.171	4.141	6.276	6.268	3.352	3.307	4.369	4.319	6.286	6.278
4 1/2	HLMT46	HL95SS	3.485	5.494	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
16.60 / IEU		HL105SS	3.485	5.494	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		G105 / HL105AS	3.485	5.494	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		HL120S	3.485	5.500	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		S135 / HL135AS	3.485	5.594	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		V150	3.469	5.594	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293

Table 3.7.17 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLMT

			Premium Class		Min	Minimum		Bevel		Pin Cylinder		Pin Connection		Pin Nose		Box Cbore		Box Connection	
Nominal			Max	Min	Cbore	Tong Space[4]		Diameter[5]		Diameter		Length		Diameter		Diameter		Length	
Size/Wt	Conn	Grade[1]	ID[2]	OD[3]	Wall	Pin	Box	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4 1/2	HLMT46	HL95SS	3.485	5.500	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
20.00 / IEU		HL105SS	3.485	5.594	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		G105 / HL105AS	3.485	5.531	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		HL120S	3.469	5.625	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		S135 / HL135AS	3.344	5.656	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
		V150	3.344	5.688	0.281	6.0	7.5	5.924	5.829	4.724	4.694	6.291	6.283	3.905	3.860	4.931	4.881	6.301	6.293
5	HLMT50	HL95SS	3.923	5.964	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
19.50 / IEU		HL105SS	3.923	5.969	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		G105 / HL105AS	3.923	5.964	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		HL120S	3.923	6.000	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		S135 / HL135AS	3.844	6.063	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		V150	3.813	6.063	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
5	HLMT50	HL95SS	3.875	6.031	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
25.60 / IEU		HL105SS	3.781	6.094	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		G105 / HL105AS	3.875	6.063	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		HL120S	3.750	6.125	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		S135 / HL135AS	3.625	6.188	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
		V150	3.594	6.219	0.313	6.0	7.5	6.219	6.124	5.150	5.120	6.159	6.151	4.343	4.298	5.338	5.288	6.169	6.161
5 1/2	HLMT5-1/2FH	HL95SS	4.281	6.557	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
21.90 / IEU		HL105SS	4.281	6.563	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		G105 / HL105AS	4.281	6.557	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		HL120S	4.281	6.594	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		S135 / HL135AS	4.281	6.719	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		V150	4.250	6.719	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
5 1/2	HLMT5-1/2FH	HL95SS	4.281	6.563	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
24.70 / IEU		HL105SS	4.281	6.656	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		G105 / HL105AS	4.281	6.563	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		HL120S	4.281	6.719	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		S135 / HL135AS	4.188	6.781	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349
		V150	4.156	6.781	0.313	6.0	8.5	6.952	6.857	5.730	5.700	7.347	7.339	4.712	4.667	5.931	5.881	7.357	7.349

1. HL105AS and HL135AS are Hilong proprietary grades for Antarctic Service drill pipe. HL95SS, HL105SS, and HL120S are Hilong proprietary grades for Sour Service drill pipe.
2. The maximum ID of Premium Class for most RSC types are based on the pin nose, pipe ID, and torsional capacity (TSR not less than 0.8).
3. The minimum OD of Premium Class is based on ID max and torsional capacity (TSR not less than 0.8). If the tool joint ID is smaller than ID max, the OD of Premium Class can be even smaller than stated above.
4. The minimium tong space exclude hardbanding which is from seal shoulder to the edge of hardbanding.
5. If the actual box OD is less than or equal to the specified bevel diameter plus 3/32 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
6. When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.18 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
2 3/8	HLST26	HL105SS	1.750	3.281	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
6.65 / EU		G105 / HL105AS	1.750	3.281	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
		HL120S	1.750	3.281	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
		S135 / HL135AS	1.750	3.281	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
2 7/8	HLST26	HL105SS	1.750	3.344	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
10.40 / IU		G105 / HL105AS	1.813	3.344	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
		HL120S	1.719	3.375	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
		S135 / HL135AS	1.625	3.438	0.188	6.0	6.0	3.449	3.291	2.784	2.753	3.504	3.496	2.268	2.236	2.903	2.856	3.508	3.500
2 7/8	HLST31	HL105SS	2.063	3.781	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
10.40 / EU		G105 / HL105AS	2.063	3.781	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
		HL120S	2.063	3.781	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
		S135 / HL135AS	2.063	3.781	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
3 1/2	HLST31	HL105SS	2.188	3.969	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
13.30 / IU		G105 / HL105AS	2.250	3.938	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
		HL120S	2.156	4.000	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
		S135 / HL135AS	2.031	4.031	0.188	6.0	6.0	4.047	3.890	3.307	3.276	4.000	3.992	2.780	2.748	3.435	3.388	4.006	3.998
3 1/2	HLST36	HL105SS	2.688	4.282	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
13.30 / EU		G105 / HL105AS	2.688	4.282	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		HL120S	2.688	4.313	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		S135 / HL135AS	2.688	4.406	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		V150	2.656	4.406	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
	HLST39	HL105SS	2.688	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		G105 / HL105AS	2.688	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		HL120S	2.688	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		S135 / HL135AS	2.688	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		V150	2.688	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
3 1/2	HLST36	HL105SS	2.531	4.282	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
15.50 / EU		G105 / HL105AS	2.531	4.282	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		HL120S	2.531	4.313	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		S135 / HL135AS	2.531	4.406	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		V150	2.531	4.438	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
	HLST39	HL105SS	2.531	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		G105 / HL105AS	2.531	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		HL120S	2.531	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		S135 / HL135AS	2.531	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		V150	2.531	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
4	HLST36	HL105SS	2.625	4.438	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
14.00 / IU		G105 / HL105AS	2.688	4.375	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		HL120S	2.594	4.438	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		S135 / HL135AS	2.469	4.500	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252
		V150	2.469	4.531	0.219	6.0	6.0	4.563	4.406	3.735	3.703	4.254	4.246	3.165	3.134	3.861	3.814	4.260	4.252

Table 3.7.18 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
	HLST39	HL105SS	3.063	4.688	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		G105 / HL105AS	3.094	4.648	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		HL120S	3.031	4.688	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		S135 / HL135AS	2.938	4.750	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		V150	2.938	4.750	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
4	HLST39	HL105SS	3.000	4.719	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
15.70 / IU		G105 / HL105AS	3.063	4.688	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		HL120S	2.969	4.750	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		S135 / HL135AS	2.875	4.781	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
		V150	2.844	4.813	0.250	6.0	6.0	4.921	4.756	4.053	4.022	4.504	4.496	3.492	3.461	4.179	4.132	4.508	4.500
4 1/2	HLST40	HL105SS	3.125	4.969	0.250	6.0	6.0	5.204	5.047	4.269	4.222	4.504	4.496	3.692	3.661	4.379	4.332	4.508	4.500
16.60 / IEU		G105 / HL105AS	3.188	4.906	0.250	6.0	6.0	5.204	5.047	4.269	4.222	4.504	4.496	3.692	3.661	4.379	4.332	4.508	4.500
		HL120S	3.094	4.969	0.250	6.0	6.0	5.204	5.047	4.269	4.222	4.504	4.496	3.692	3.661	4.379	4.332	4.508	4.500
		S135 / HL135AS	3.000	5.031	0.250	6.0	6.0	5.204	5.047	4.269	4.222	4.504	4.496	3.692	3.661	4.379	4.332	4.508	4.500
		V150	2.969	5.063	0.250	6.0	6.0	5.204	5.047	4.269	4.222	4.504	4.496	3.692	3.661	4.379	4.332	4.508	4.500
	HLST46	HL105SS	3.750	5.430	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		G105 / HL105AS	3.750	5.430	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		HL120S	3.750	5.438	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		S135 / HL135AS	3.750	5.531	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		V150	3.719	5.531	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
4 1/2	HLST46	HL105SS	3.563	5.438	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
20.00 / IEU		G105 / HL105AS	3.563	5.430	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		HL120S	3.563	5.469	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		S135 / HL135AS	3.563	5.594	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		V150	3.563	5.594	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
5	HLST46	HL105SS	3.656	5.594	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
19.50 / IEU		G105 / HL105AS	3.719	5.531	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		HL120S	3.625	5.625	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		S135 / HL135AS	3.500	5.688	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		V150	3.469	5.688	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
	HLST52	HL105SS	4.188	5.957	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		G105 / HL105AS	4.188	5.957	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		HL120S	4.188	5.969	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		S135 / HL135AS	4.188	6.063	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		V150	4.188	6.094	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004

Table 3.7.18 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5	HLST46	HL105SS	3.469	5.719	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
25.60 / IEU		G105 / HL105AS	3.531	5.656	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		HL120S	3.406	5.750	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		S135 / HL135AS	3.250	5.813	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
		V150	3.219	5.844	0.250	6.0	6.0	5.969	5.811	4.820	4.789	5.004	4.996	4.189	4.157	4.947	4.900	5.010	5.002
	HLST52	HL105SS	3.938	6.000	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		G105 / HL105AS	3.938	5.957	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		HL120S	3.938	6.031	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		S135 / HL135AS	3.938	6.156	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		V150	3.938	6.188	0.250	6.0	6.0	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
5 1/2	HLST52	HL105SS	4.219	6.125	0.250	6.0	6.5	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
21.90 / IEU		G105 / HL105AS	4.250	6.063	0.250	6.0	6.5	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		HL120S	4.156	6.156	0.250	6.0	6.5	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		S135 / HL135AS	4.063	6.219	0.250	6.0	6.5	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
		V150	4.031	6.219	0.250	6.0	6.5	6.449	6.291	5.368	5.336	5.004	4.996	4.750	4.718	5.488	5.441	5.012	5.004
	HLST54	HL105SS	4.500	6.385	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		G105 / HL105AS	4.563	6.385	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		HL120S	4.469	6.406	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		S135 / HL135AS	4.375	6.469	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		V150	4.375	6.500	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
	HLST57	HL105SS	4.688	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		G105 / HL105AS	4.688	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		HL120S	4.688	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		S135 / HL135AS	4.688	6.625	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		V150	4.688	6.656	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
5 1/2	HLST54	HL105SS	4.438	6.438	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
24.70 / IEU		G105 / HL105AS	4.500	6.406	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		HL120S	4.406	6.469	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		S135 / HL135AS	4.281	6.531	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
		V150	4.250	6.531	0.313	6.0	6.0	6.614	6.535	5.597	5.565	5.004	4.996	4.965	4.933	5.725	5.678	5.010	5.002
	HLST57	HL105SS	4.594	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		G105 / HL105AS	4.594	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		HL120S	4.594	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		S135 / HL135AS	4.594	6.688	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		V150	4.594	6.719	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504

Table 3.7.18 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 7/8	HLST57	HL105SS	4.719	6.625	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
23.40 / IEU		G105 / HL105AS	4.781	6.599	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		HL120S	4.688	6.656	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		S135 / HL135AS	4.594	6.750	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		V150	4.563	6.750	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
5 7/8	HLST57	HL105SS	4.656	6.719	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
26.30 / IEU		G105 / HL105AS	4.719	6.656	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		HL120S	4.594	6.719	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		S135 / HL135AS	4.500	6.813	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504
		V150	4.469	6.813	0.313	6.0	6.0	6.906	6.748	5.874	5.843	5.504	5.496	5.189	5.157	6.006	5.959	5.512	5.504

1. HL105AS and HL135AS are Hilong proprietary grades for Antarctic Service drill pipe. HL95SS, HL105SS, and HL120S are Hilong proprietary grades for Sour Service drill pipe.
2. The maximum ID of Premium Class for most RSC types are based on the pin nose, pipe ID, and torsional capacity (TSR not less than 0.8).
3. The minimum OD of Premium Class is based on ID max and torsional capacity (TSR not less than 0.8). If the tool joint ID is smaller than ID max, the OD of Premium Class can be even smaller than stated above.
4. The minimium tong space exclude hardbanding which is from seal shoulder to the edge of hardbanding.
5. If the actual box OD is less than or equal to the specified bevel diameter plus 3/32 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
6. When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.19 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLIST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2	HLIST38	HL95SS	2.688	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
13.30 / EU		HL105SS	2.688	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		G105 / HL105AS	2.688	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		HL120S	2.688	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		S135 / HL135AS	2.688	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		V150	2.688	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
3 1/2	HLIST38	HL95SS	2.531	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
15.50 / EU		HL105SS	2.531	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		G105 / HL105AS	2.531	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		HL120S	2.531	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		S135 / HL135AS	2.531	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		V150	2.531	4.509	0.250	6.0	7.0	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
	HLIST39	HL95SS	2.531	4.667	0.250	6.0	7.0	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		HL105SS	2.531	4.667	0.250	6.0	7.0	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		G105 / HL105AS	2.531	4.667	0.250	6.0	7.0	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		HL120S	2.531	4.667	0.250	6.0	7.0	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		S135 / HL135AS	2.531	4.667	0.250	6.0	7.0	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		V150	2.531	4.667	0.250	6.0	7.0	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
4	HLIST38	HL95SS	2.906	4.509	0.250	6.0	7.5	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
14.00 / IU		HL105SS	2.844	4.531	0.250	6.0	7.5	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		G105 / HL105AS	2.906	4.509	0.250	6.0	7.5	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		HL120S	2.813	4.531	0.250	6.0	7.5	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		S135 / HL135AS	2.719	4.594	0.250	6.0	7.5	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
		V150	2.719	4.625	0.250	6.0	7.5	4.673	4.548	3.890	3.860	4.625	4.617	3.368	3.337	4.009	3.962	4.628	4.623
	HLIST39	HL95SS	3.156	4.667	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		HL105SS	3.094	4.688	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		G105 / HL105AS	3.156	4.667	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		HL120S	3.063	4.667	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		S135 / HL135AS	3.000	4.719	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		V150	2.969	4.750	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
4	HLIST39	HL95SS	3.094	4.667	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
15.70 / IU		HL105SS	3.031	4.688	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		G105 / HL105AS	3.094	4.667	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		HL120S	3.000	4.719	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		S135 / HL135AS	2.938	4.781	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
		V150	2.906	4.781	0.250	6.0	7.5	4.896	4.771	4.072	4.042	4.500	4.492	3.568	3.537	4.167	4.120	4.503	4.498
4 1/2	HLIST46	HL95SS	3.750	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
16.60 / IEU		HL105SS	3.750	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		G105 / HL105AS	3.750	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		HL120S	3.750	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		S135 / HL135AS	3.750	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		V150	3.750	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505

Table 3.7.19 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLIST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
4 1/2	HLIST46	HL95SS	3.563	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
20.00 / IU		HL105SS	3.563	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		G105 / HL105AS	3.563	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		HL120S	3.563	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		S135 / HL135AS	3.563	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		V150	3.563	5.680	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
5	HLIST46	HL95SS	3.906	5.688	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
19.50 / IEU		HL105SS	3.844	5.750	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		G105 / HL105AS	3.906	5.688	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		HL120S	3.813	5.781	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		S135 / HL135AS	3.719	5.813	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
		V150	3.688	5.844	0.281	6.0	8.5	6.074	5.949	4.966	4.936	7.500	7.492	4.358	4.327	5.117	5.070	7.510	7.505
	HLIST50	HL95SS	4.188	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		HL105SS	4.188	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		G105 / HL105AS	4.188	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		HL120S	4.188	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		S135 / HL135AS	4.188	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		V150	4.188	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
5	HLIST50	HL95SS	3.938	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
25.60 / EU		HL105SS	3.938	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		G105 / HL105AS	3.938	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		HL120S	3.938	6.080	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		S135 / HL135AS	3.938	6.156	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
		V150	3.938	6.188	0.313	6.0	8.5	6.428	6.303	5.352	5.322	7.300	7.292	4.780	4.749	5.455	5.408	7.310	7.305
5 1/2	HLIST54	HL95SS	4.594	6.338	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
21.90 / IEU		HL105SS	4.531	6.338	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		G105 / HL105AS	4.594	6.338	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		HL120S	4.500	6.338	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		S135 / HL135AS	4.438	6.406	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		V150	4.406	6.406	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
	HLIST57	HL95SS	4.688	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		HL105SS	4.688	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		G105 / HL105AS	4.688	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		HL120S	4.688	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		S135 / HL135AS	4.688	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		V150	4.688	6.594	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
5 1/2	HLIST54	HL95SS	4.531	6.338	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
24.70 / IEU		HL105SS	4.469	6.375	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		G105 / HL105AS	4.531	6.338	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		HL120S	4.438	6.406	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		S135 / HL135AS	4.344	6.469	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005
		V150	4.313	6.469	0.313	6.0	8.5	6.579	6.454	5.610	5.580	7.000	6.992	5.057	5.026	5.713	5.666	7.010	7.005

Table 3.7.19 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hilong HLIST

Nominal Size/Wt	Conn	Grade[1]	Premium Class Max ID[2]	Premium Class Min OD[3]	Min Cbore Wall	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Bevel Diameter[5] Max	Bevel Diameter[5] Min	Pin Cylinder Diameter Max	Pin Cylinder Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2	HLIST57	HL95SS	4.594	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
24.70 / IEU		HL105SS	4.594	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		G105 / HL105AS	4.594	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		HL120S	4.594	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		S135 / HL135AS	4.594	6.625	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		V150	4.594	6.656	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
5 7/8	HLIST57	HL95SS	4.813	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
23.40 / IEU		HL105SS	4.750	6.594	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		G105 / HL105AS	4.813	6.580	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		HL120S	4.719	6.594	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		S135 / HL135AS	4.625	6.688	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		V150	4.594	6.688	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
5 7/8	HLIST57	HL95SS	4.750	6.594	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
26.30 / IEU		HL105SS	4.656	6.625	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		G105 / HL105AS	4.719	6.594	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		HL120S	4.625	6.656	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		S135 / HL135AS	4.531	6.750	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255
		V150	4.500	6.781	0.313	6.0	8.5	6.831	6.706	5.852	5.822	7.250	7.242	5.299	5.268	5.955	5.908	7.260	7.255

1. HL105AS and HL135AS are Hilong proprietary grades for Antarctic Service drill pipe. HL95SS, HL105SS, and HL120S are Hilong proprietary grades for Sour Service drill pipe.
2. The maximum ID of Premium Class is based on the pin nose, pipe ID, and torsional capacity (TSR not less than 0.8).
3. The minimum OD of Premium Class is based on ID max and torsional capacity (TSR not less than 0.8). If the tool joint ID is smaller than ID max, the OD of Premium Class can be even smaller than stated above.
4. The minimium tong space exclude hardbanding which is from seal shoulder to the edge of hardbanding.
5. If the actual box OD is less than or equal to the specified bevel diameter plus 3/32 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
6. When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.20 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hydril Wedge Thread™

Nominal Size/Wt.	Conn.	Grade	Nominal Tool Joint Box OD	Nominal Tool Joint Pin ID	Minimum Tong Space Pin	Minimum Tong Space Box	Box CBore Diameter - D1 Maximum	Box CBore Diameter - D2 Maximum
2 3/8 4.85	WT 14 S	X	3 1/4 - 3 3/8	1 15/16	4	5	3.090	NA
		G	3 1/4 - 3 3/8	1 15/16	4	5	3.090	NA
2 3/8 6.65	WT 14 S	X	3 1/4 - 3 3/8	1 3/4	4	5	3.090	NA
		G	3 1/4 - 3 3/8	1 3/4	4	5	3.090	NA
	WT 23	X	3 1/8	1 1/2	4	6 1/4	2.765	2.415
		G	3 1/8	1 1/2	4	6 1/4	2.765	2.415
	WT 26	X	3 3/8	1 3/4	4	6 1/4	2.980	2.630
		G	3 3/8	1 3/4	4	6 1/4	2.980	2.630
2 7/8 6.85	WT 14 S	X	3 1/4 - 3 3/8	1 31/32	4	5	3.090	NA
		G	3 1/4 - 3 3/8	1 31/32	4	5	3.090	NA
		S	3 1/4 - 3 3/8	1 31/32	4	5	3.090	NA
2 7/8 10.40	WT 14 S	X	3 1/4 - 3 3/8	1 31/32	4	5	3.090	NA
		G	3 1/4 - 3 3/8	1 31/32	4	5	3.090	NA
		S	3 1/4 - 3 3/8	1 31/32	4	5	3.090	NA
	WT 23	X	3 1/8	1 1/2	4	6 1/4	2.765	2.415
		G	3 1/8	1 1/2	4	6 1/4	2.765	2.415
		S	3 1/8	1 1/2	4	6 1/4	2.765	2.415
	WT 26	X	3 3/8	1 3/4	4	6 1/4	2.980	2.630
		G	3 3/8	1 3/4	4	6 1/4	2.980	2.630
		S	3 3/8	1 3/4	4	6 1/4	2.980	2.630
	WT 31	X	4 1/8	2	4	8 1/4	3.685	3.145
		G	4 1/8	2	4	8 1/4	3.685	3.145
		S	4 1/8	2	4	8 1/4	3.685	3.145
3 1/2 13.30	WT 14 S	X	3 9/16	1 31/32	4	5	3.090	NA
		G	3 9/16	1 31/32	4	5	3.090	NA
		S	3 9/16	1 31/32	4	5	3.090	NA
	WT 31	X	4 1/8	2	4	8 1/4	3.685	3.145
		G	4 1/8	2	4	8 1/4	3.685	3.145
		S	4 1/8	2	4	8 1/4	3.685	3.145
	WT 38	X	4 3/4 - 5	2 9/16	4	8 1/4	4.295	3.755
		G	4 3/4 - 5	2 9/16	4	8 1/4	4.295	3.755
		S	4 3/4 - 5	2 9/16	4	8 1/4	4.295	3.755
3 1/2 15.50	WT 31	X	4 1/8	2	4	8 1/4	3.685	3.145
		G	4 1/8	2	4	8 1/4	3.685	3.145
		S	4 1/8	2	4	8 1/4	3.685	3.145
	WT 38	X	4 3/4 - 5	2 1/2	4	8 1/4	4.295	3.755
		G	4 3/4 - 5	2 1/2	4	8 1/4	4.295	3.755
		S	4 3/4 - 5	2 1/2	4	8 1/4	4.295	3.755

Table 3.7.20 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hydril Wedge Thread™

Nominal Size/Wt.	Conn.	Grade	Nominal Tool Joint Box OD	Nominal Tool Joint Pin ID	Minimum Tong Space Pin	Minimum Tong Space Box	Box CBore Diameter - D1 Maximum	Box CBore Diameter - D2 Maximum
4 14.00 15.70 17.00	WT 31	X	4 1/8	2	4	8 1/4	3.685	3.145
		G	4 1/8	2	4	8 1/4	3.685	3.145
		S	4 1/8	2	4	8 1/4	3.685	3.145
	WT 38	X	4 3/4 - 5	2 9/16	4	8 1/4	4.295	3.755
		G	4 3/4 - 5	2 9/16	4	8 1/4	4.295	3.755
		S	4 3/4 - 5	2 9/16	4	8 1/4	4.295	3.755
	WT 39	X	5 - 5 1/8	2 13/16	4	8 1/4	4.510	3.970
		G	5 - 5 1/8	2 13/16	4	8 1/4	4.510	3.970
		S	5 - 5 1/8	2 13/16	4	8 1/4	4.510	3.970
	WT 40	X	5 1/2	5 1/8	4	8 1/4	4.820	4.280
		G	5 1/2	5 1/8	4	8 1/4	4.820	4.280
		S	5 1/2	5 1/8	4	8 1/4	4.820	4.280
4 1/2 16.60 20.00	WT 38	X	4 3/4	2 9/16	4	8 1/4	4.295	3.755
		G	4 3/4	2 9/16	4	8 1/4	4.295	3.755
		S	4 3/4	2 9/16	4	8 1/4	4.295	3.755
	WT 39	X	5 1/8	2 13/16	4	8 1/4	4.510	3.970
		G	5 1/8	2 13/16	4	8 1/4	4.510	3.970
		S	5 1/8	2 13/16	4	8 1/4	4.510	3.970
	WT 40	X	5 1/2	5 1/8	4	8 1/4	4.820	4.280
		G	5 1/2	5 1/8	4	8 1/4	4.820	4.280
		S	5 1/2	5 1/8	4	8 1/4	4.820	4.280
	WT 46	X	6 - 6 1/4	3 1/2	4 1/2	8 1/4	5.390	4.850
		G	6 - 6 1/4	3 1/2	4 1/2	8 1/4	5.390	4.850
		S	6 - 6 1/4	3 1/2	4 1/2	8 1/4	5.390	4.850
5 19.50 25.60	WT 39	X	5 1/8	2 13/16	4	8 1/4	4.510	3.970
		G	5 1/8	2 13/16	4	8 1/4	4.510	3.970
		S	5 1/8	2 13/16	4	8 1/4	4.510	3.970
	WT 40	X	5 3/8	5 1/8	4	8 1/4	4.820	4.280
		G	5 3/8	5 1/8	4	8 1/4	4.820	4.280
		S	5 3/8	5 1/8	4	8 1/4	4.820	4.280
	WT 46	X	6	3 1/2	4 1/2	8 1/4	5.390	4.850
		G	6	3 1/2	4 1/2	8 1/4	5.390	4.850
		S	6	3 1/2	4 1/2	8 1/4	5.390	4.850
	WT 50 (5 EU) 19.50	X	6 3/4 - 7	4	5 1/4	9	5.940	5.360
		G	6 3/4 - 7	4	5 1/4	9	5.940	5.360
		S	6 3/4 - 7	4	5 1/4	9	5.940	5.360
	WT 50 (5 EU) 25.60	X	6 3/4 - 7	3 7/8	5 1/4	9	5.940	5.360
		G	6 3/4 - 7	3 7/8	5 1/4	9	5.940	5.360
		S	6 3/4 - 7	3 7/8	5 1/4	9	5.940	5.360

Table 3.7.20 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Hydril Wedge Thread™

Nominal Size/Wt.	Conn.	Grade	Nominal Tool Joint Box OD	Nominal Tool Joint Pin ID	Minimum Tong Space Pin	Minimum Tong Space Box	Box CBore Diameter - D1 Maximum	Box CBore Diameter - D2 Maximum
5	WT 50	X	6 5/8	3 7/8	5 1/4	9	5.940	5.360
19.50	(5 IEU) 19.50	G	6 5/8	3 7/8	5 1/4	9	5.940	5.360
25.60		S	6 5/8	3 7/8	5 1/4	9	5.940	5.360
	WT 50	X	6 5/8	3 5/8	5 1/4	9	5.940	5.360
	(5 IEU) 25.60	G	6 5/8	3 5/8	5 1/4	9	5.940	5.360
		S	6 5/8	3 5/8	5 1/4	9	5.940	5.360
5 1/2	WT 46	X	5 7/8	3 1/2	4 1/2	8 1/4	5.390	4.850
21.90		G	5 7/8	3 1/2	4 1/2	8 1/4	5.390	4.850
24.70		S	5 7/8	3 1/2	4 1/2	8 1/4	5.390	4.850
	WT 50	X	6 3/4 - 7	4	5 1/4	9	5.940	5.360
	(IEU)	G	6 3/4 - 7	4	5 1/4	9	5.940	5.360
		S	6 3/4 - 7	4	5 1/4	9	5.940	5.360
	WT 54	X	7	4 3/8	5 1/4	9	6.180	5.600
		G	7	4 3/8	5 1/4	9	6.180	5.600
		S	7	4 3/8	5 1/4	9	6.180	5.600
	WT 56	X	7 - 7 1/4	4 5/8	5 1/2	9	6.430	5.850
	(EU)	G	7 - 7 1/4	4 5/8	5 1/2	9	6.430	5.850
		S	7 - 7 1/4	4 5/8	5 1/2	9	6.430	5.850
	WT 56	X	7 - 7 1/4	4 3/8	5 1/2	9	6.430	5.850
	(IEU)	G	7 - 7 1/4	4 3/8	5 1/2	9	6.430	5.850
		S	7 - 7 1/4	4 3/8	5 1/2	9	6.430	5.850
5 7/8	WT 54	X	7	4 3/8	5 1/4	9	6.180	5.600
23.40		G	7	4 3/8	5 1/4	9	6.180	5.600
27.00		S	7	4 3/8	5 1/4	9	6.180	5.600
	WT 56	X	7	4 5/8	5 1/2	9	6.430	5.850
		G	7	4 5/8	5 1/2	9	6.430	5.850
		S	7	4 5/8	5 1/2	9	6.430	5.850
6 5/8	WT 56	X	7	4 5/8	5 1/2	9	6.430	5.850
25.20		G	7	4 5/8	5 1/2	9	6.430	5.850
27.70		S	7	4 5/8	5 1/2	9	6.430	5.850
	WT 66	X	8	5 3/8	6	9	7.155	6.575
		G	8	5 3/8	6	9	7.155	6.575
		S	8	5 3/8	6	9	7.155	6.575

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.7.21 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-DS

Nominal Size/Wt	Conn	Grade	Premium Class Min OD[2]	Premium Class Max ID	Premium Class Min Cbore	Bevel Diameter Min	Bevel Diameter Max	Pin Connection Length Min	Pin Connection Length Max	Pin Nose Diameter Min	Pin Nose Diameter Max	Box Cbore Diameter Min	Box Cbore Diameter Max	Box Connection Length Min	Box Connection Length Max	Minimum Tong Space[3] Pin	Minimum Tong Space[3] Box
3 1/2	DPM-DS38	G105	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
13.30	DPM-DS38	S135	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
	DPM-DS38	DPM 140	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
	DPM-DS38	DPM 150	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
3 1/2	DPM-DS38	G105	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
15.50	DPM-DS38	S135	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
	DPM-DS38	DPM 140	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
	DPM-DS38	DPM 150	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
4	DPM-DS38	G105	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
14.00	DPM-DS38	S135	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
	DPM-DS38	DPM 140	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
	DPM-DS38	DPM 150	4.593	2.578	0.250	4.562	4.719	4.399	4.407	2.954	3.002	4.042	4.108	4.405	4.413	6.000	8.000
4	DPM-DS40	G105	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
14.00	DPM-DS40	S135	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
	DPM-DS40	DPM 140	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
	DPM-DS40	DPM 150	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
4	DPM-DS40	G105	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
15.70	DPM-DS40	S135	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
	DPM-DS40	DPM 140	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
	DPM-DS40	DPM 150	5.031	2.703	0.250	5.000	5.157	4.910	4.918	3.145	3.193	4.304	4.370	4.916	4.924	6.000	8.000
4 1/2	DPM-DS46	G105	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
16.60	DPM-DS46	S135	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
	DPM-DS46	DPM 140	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
	DPM-DS46	DPM 150	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
4 1/2	DPM-DS46	G105	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
20.00	DPM-DS46	S135	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
	DPM-DS46	DPM 140	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000
	DPM-DS46	DPM 150	5.734	3.515	0.313	5.703	5.860	4.910	4.918	3.685	3.733	4.866	4.932	4.916	4.924	6.000	8.000

Table 3.7.21 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-DS

Nominal			Premium Class			Bevel Diameter		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length		Minimum Tong Space[3]	
Size/Wt	Conn	Grade	Min OD[2]	Max ID	Min Cbore	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Pin	Box
5	DPM-DS50	G105	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
19.50	DPM-DS50	S135	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
	DPM-DS50	DPM 140	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
	DPM-DS50	DPM 150	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
5	DPM-DS50	G105	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
25.60	DPM-DS50	S135	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
	DPM-DS50	DPM 140	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
	DPM-DS50	DPM 150	6.078	3.765	0.313	6.047	6.204	4.910	4.918	4.110	4.158	5.273	5.338	4.916	4.924	6.000	8.000
5 1/2	DPM-DS55	G105	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
21.90	DPM-DS55	S135	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
	DPM-DS55	DPM 140	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
	DPM-DS55	DPM 150	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
5 1/2	DPM-DS55	G105	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
24.70	DPM-DS55	S135	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
	DPM-DS55	DPM 140	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
	DPM-DS55	DPM 150	6.734	4.015	0.313	6.703	6.860	5.423	5.431	4.545	4.593	5.862	5.928	5.429	5.437	6.000	8.000
6 5/8	DPM-DS65	G105	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
25.20	DPM-DS65	S135	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
	DPM-DS65	DPM 140	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
	DPM-DS65	DPM 150	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
6 5/8	DPM-DS65	G105	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
27.70	DPM-DS65	S135	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
	DPM-DS65	DPM 140	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000
	DPM-DS65	DPM 150	7.718	5.015	0.313	7.687	7.844	5.423	5.431	5.466	5.514	6.800	6.866	5.429	5.437	6.000	8.000

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
2 Premium Class Min OD is the recommended minimum acceptable box OD for the connection.
3 Tong space excludes hardbanding.
4 Dimensions listed are recommended dimensions. Should End User require a more stringent dimensional inspection to be applied, then End User requirements shall apply.

Table 3.7.22 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-MT®

Nominal			Premium Class			Bevel Diameter		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length		Minimum Tong Space[3]	
Size/Wt	Conn	Grade	Min OD[2]	Max ID	Min Cbore	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Pin	Box
2 3/8	DPM-MT24	G105	2.847	1.516	0.188	2.816	2.973	2.797	2.805	1.789	1.803	2.511	2.563	2.801	2.806	6.000	8.000
6.65	DPM-MT24	S135	2.847	1.516	0.188	2.816	2.973	2.797	2.805	1.789	1.803	2.511	2.563	2.801	2.806	6.000	8.000
	DPM-MT24	DPM 140	2.847	1.516	0.188	2.816	2.973	2.797	2.805	1.789	1.803	2.511	2.563	2.801	2.806	6.000	8.000
	DPM-MT24	DPM 150	2.847	1.516	0.188	2.816	2.973	2.797	2.805	1.789	1.803	2.511	2.563	2.801	2.806	6.000	8.000
2 7/8	DPM-MT26	G105	3.315	1.766	0.188	3.284	3.541	3.377	3.385	1.977	2.053	2.918	2.970	3.381	3.386	6.000	8.000
10.40	DPM-MT26	S135	3.315	1.766	0.188	3.284	3.541	3.377	3.385	1.977	2.053	2.918	2.970	3.381	3.386	6.000	8.000
	DPM-MT26	DPM 140	3.315	1.766	0.188	3.284	3.541	3.377	3.385	1.977	2.053	2.918	2.970	3.381	3.386	6.000	8.000
	DPM-MT26	DPM 150	3.315	1.766	0.188	3.284	3.541	3.377	3.385	1.977	2.053	2.918	2.970	3.381	3.386	6.000	8.000
2 7/8	DPM-MT26SP	G105	3.315	1.831	0.188	3.284	3.541	3.177	3.185	2.095	2.109	2.918	2.970	3.181	3.186	6.000	8.000
10.40	DPM-MT26SP	S135	3.315	1.831	0.188	3.284	3.541	3.177	3.185	2.095	2.109	2.918	2.970	3.181	3.186	6.000	8.000
	DPM-MT26SP	DPM 140	3.315	1.831	0.188	3.284	3.541	3.177	3.185	2.095	2.109	2.918	2.970	3.181	3.186	6.000	8.000
	DPM-MT26SP	DPM 150	3.315	1.831	0.188	3.284	3.541	3.177	3.185	2.095	2.109	2.918	2.970	3.181	3.186	6.000	8.000
2 7/8	DPM-MT31	G105	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
10.40	DPM-MT31	S135	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
	DPM-MT31	DPM 140	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
	DPM-MT31	DPM 150	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
3 1/2	DPM-MT31	G105	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
13.30	DPM-MT31	S135	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
	DPM-MT31	DPM 140	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
	DPM-MT31	DPM 150	3.915	2.141	0.188	3.884	4.141	3.666	3.674	2.639	2.653	3.481	3.533	3.670	3.675	6.000	8.000
3 1/2	DPM-MT34	G105	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
13.30	DPM-MT34	S135	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
	DPM-MT34	DPM 140	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
	DPM-MT34	DPM 150	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
3 1/2	DPM-MT34	G105	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
15.50	DPM-MT34	S135	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
	DPM-MT34	DPM 140	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000
	DPM-MT34	DPM 150	4.505	2.516	0.250	4.474	4.631	3.666	3.674	2.895	2.978	3.934	3.986	3.670	3.675	6.000	8.000

Table 3.7.22 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-MT®

Nominal Size/Wt	Conn	Grade	Premium Class Min OD[2]	Premium Class Max ID	Premium Class Min Cbore	Bevel Diameter Min	Bevel Diameter Max	Pin Connection Length Min	Pin Connection Length Max	Pin Nose Diameter Min	Pin Nose Diameter Max	Box Cbore Diameter Min	Box Cbore Diameter Max	Box Connection Length Min	Box Connection Length Max	Minimum Tong Space[3] Pin	Minimum Tong Space[3] Box
3 1/2	DPM-MT38	G105	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
13.30	DPM-MT38	S135	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
	DPM-MT38	DPM 140	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
	DPM-MT38	DPM 150	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
3 1/2	DPM-MT38	G105	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
15.50	DPM-MT38	S135	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
	DPM-MT38	DPM 140	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
	DPM-MT38	DPM 150	4.635	2.454	0.250	4.604	4.761	3.666	3.674	3.029	3.043	3.998	4.050	3.670	3.675	6.000	8.000
4	DPM-MT39	G105	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
14.00	DPM-MT39	S135	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
	DPM-MT39	DPM 140	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
	DPM-MT39	DPM 150	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
4	DPM-MT39	G105	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
15.70	DPM-MT39	S135	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
	DPM-MT39	DPM 140	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
	DPM-MT39	DPM 150	4.765	2.704	0.250	4.734	5.016	3.991	3.999	3.152	3.247	4.201	4.253	3.995	4.000	6.000	8.000
4	DPM-MT40	G105	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
14.00	DPM-MT40	S135	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 140	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 150	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
4	DPM-MT40	G105	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
15.70	DPM-MT40	S135	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 140	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 150	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
4 1/2	DPM-MT40	G105	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
16.60	DPM-MT40	S135	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 140	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 150	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
4 1/2	DPM-MT40	G105	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
20.00	DPM-MT40	S135	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 140	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000
	DPM-MT40	DPM 150	5.105	2.616	0.250	5.074	5.231	3.991	3.999	3.370	3.384	4.394	4.446	3.995	4.000	6.000	8.000

Table 3.7.22 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-MT®

Nominal Size/Wt	Conn	Grade	Premium Class Min OD[2]	Premium Class Max ID	Premium Class Min Cbore	Bevel Diameter Min	Bevel Diameter Max	Pin Connection Length Min	Pin Connection Length Max	Pin Nose Diameter Min	Pin Nose Diameter Max	Box Cbore Diameter Min	Box Cbore Diameter Max	Box Connection Length Min	Box Connection Length Max	Minimum Tong Space[3] Pin	Minimum Tong Space[3] Box
4 1/2	DPM-MT50	G105	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
16.60	DPM-MT50	S135	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 140	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 150	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
4 1/2	DPM-MT50	G105	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
20.00	DPM-MT50	S135	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 140	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 150	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
5	DPM-MT50	G105	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
19.50	DPM-MT50	S135	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 140	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 150	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
5	DPM-MT50	G105	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
25.60	DPM-MT50	S135	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 140	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
	DPM-MT50	DPM 150	6.235	3.766	0.313	6.204	6.551	4.912	4.920	4.354	4.368	5.531	5.583	4.916	4.921	6.000	8.000
5	DPM-MT54	G105	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
19.50	DPM-MT54	S135	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 140	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 150	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
5	DPM-MT54	G105	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
25.60	DPM-MT54	S135	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 140	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 150	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
5 1/2	DPM-MT54	G105	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
21.90	DPM-MT54	S135	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 140	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 150	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
5 1/2	DPM-MT54	G105	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
24.70	DPM-MT54	S135	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 140	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000
	DPM-MT54	DPM 150	6.355	4.266	0.313	6.324	6.681	4.991	4.999	4.486	4.581	5.702	5.754	4.995	5.000	6.000	8.000

Table 3.7.22 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-MT®

Nominal			Premium Class			Bevel Diameter		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length		Minimum Tong Space[3]	
Size/Wt	Conn	Grade	Min OD[2]	Max ID	Min Cbore	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Pin	Box
5 1/2	DPM-MT57	G105	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
21.90	DPM-MT57	S135	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 140	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 150	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
5 1/2	DPM-MT57	G105	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
24.70	DPM-MT57	S135	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 140	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 150	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
5 7/8	DPM-MT57	G105	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
23.40	DPM-MT57	S135	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 140	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 150	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
5 7/8	DPM-MT57	G105	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
26.40	DPM-MT57	S135	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 140	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000
	DPM-MT57	DPM 150	6.805	4.266	0.313	6.774	7.041	4.991	4.999	4.786	4.881	6.002	6.054	4.995	5.000	6.000	8.000

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
2 Premium Class Min OD is the recommended minimum acceptable box OD for the connection.
3 Tong space excludes hardbanding.
4 Dimensions listed are recommended dimensions. Should End User require a more stringent dimensional inspection to be applied, then End User requirements shall apply.

Table 3.7.23 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-ST®

			Premium Class			Bevel Diameter		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length		Minimum Tong Space[3]	
Nominal Size/Wt	Conn	Grade	Min OD[2]	Max ID	Min Cbore	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Pin	Box
3 1/2	DPM-ST38	G105	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
13.30	DPM-ST38	S135	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
	DPM-ST38	DPM 140	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
	DPM-ST38	DPM 150	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
3 1/2	DPM-ST38	G105	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
15.50	DPM-ST38	S135	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
	DPM-ST38	DPM 140	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
	DPM-ST38	DPM 150	4.578	2.703	0.250	4.547	4.704	4.616	4.625	3.252	3.378	3.947	4.089	4.623	4.628	6.000	8.000
4	DPM-ST39	G105	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
14.00	DPM-ST39	S135	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
	DPM-ST39	DPM 140	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
	DPM-ST39	DPM 150	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
4	DPM-ST39	G105	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
15.70	DPM-ST39	S135	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
	DPM-ST39	DPM 140	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
	DPM-ST39	DPM 150	4.801	2.890	0.250	4.770	4.927	4.491	4.500	3.432	3.578	4.121	4.283	4.498	4.503	6.000	8.000
5	DPM-ST50	G105	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
19.50	DPM-ST50	S135	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
	DPM-ST50	DPM 140	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
	DPM-ST50	DPM 150	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
5	DPM-ST50	G105	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
25.60	DPM-ST50	S135	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
	DPM-ST50	DPM 140	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
	DPM-ST50	DPM 150	6.349	3.765	0.313	6.302	6.459	7.291	7.300	4.548	4.790	5.409	5.541	7.305	7.310	6.000	8.000
5 1/2	DPM-ST54	G105	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
21.90	DPM-ST54	S135	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
	DPM-ST54	DPM 140	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
	DPM-ST54	DPM 150	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
5 1/2	DPM-ST54	G105	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
24.70	DPM-ST54	S135	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
	DPM-ST54	DPM 140	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000
	DPM-ST54	DPM 150	6.500	4.015	0.313	6.453	6.610	6.991	7.000	4.901	5.067	5.667	5.849	7.005	7.010	6.000	8.000

Table 3.7.23 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-ST®

Nominal			Premium Class			Bevel Diameter		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length		Minimum Tong Space[3]	
Size/Wt	Conn	Grade	Min OD[2]	Max ID	Min Cbore	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Pin	Box
5 1/2	DPM-ST57	G105	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
21.90	DPM-ST57	S135	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 140	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 150	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
5 1/2	DPM-ST57	G105	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
24.70	DPM-ST57	S135	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 140	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 150	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
5 7/8	DPM-ST57	G105	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
23.40	DPM-ST57	S135	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 140	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 150	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
5 7/8	DPM-ST57	G105	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
26.40	DPM-ST57	S135	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 140	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000
	DPM-ST57	DPM 150	6.736	4.265	0.313	6.705	6.862	7.241	7.250	5.063	5.309	5.909	6.171	7.255	7.260	6.000	8.000

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
2 Premium Class Min OD is the recommended minimum acceptable box OD for the connection.
3 Tong space excludes hardbanding.
4 Dimensions listed are recommended dimensions. Should End User require a more stringent dimensional inspection to be applied, then End User requirements shall apply.

Table 3.7.24 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

DP-Master DPM-HighTorque

Nominal Size/Wt	Conn	Grade	Premium Class Min OD[2]	Premium Class Max ID	Premium Class Min Cbore	Bevel Diameter Min	Bevel Diameter Max	Pin Connection Length Min	Pin Connection Length Max	Pin Nose Diameter Min	Pin Nose Diameter Max	Box Cbore Diameter Min	Box Cbore Diameter Max	Box Connection Length Min	Box Connection Length Max	Minimum Tong Space[3] Pin	Minimum Tong Space[3] Box
2 3/8	DPM 2-3/8 HighTorque PAC	G105	2.716	1.265	0.188	2.685	2.844	4.622	4.631	1.813	1.860	2.375	2.437	4.636	4.641	6.000	8.000
6.65	DPM 2-3/8 High orque PAC	S135	2.716	1.265	0.188	2.685	2.844	4.622	4.631	1.813	1.860	2.375	2.437	4.636	4.641	6.000	8.000
	DPM 2-3/8 HighTorque PAC	DPM 140	2.716	1.265	0.188	2.685	2.844	4.622	4.631	1.813	1.860	2.375	2.437	4.636	4.641	6.000	8.000
	DPM 2-3/8 HighTorque PAC	DPM 150	2.716	1.265	0.188	2.685	2.844	4.622	4.631	1.813	1.860	2.375	2.437	4.636	4.641	6.000	8.000
2 7/8	DPM 2-7/8 HighTorque PAC	G105	3.015	1.625	0.188	2.984	3.204	4.821	4.830	1.967	2.014	2.539	2.601	4.835	4.840	6.000	8.000
10.40	DPM 2-7/8 HighTorque PAC	S135	3.015	1.625	0.188	2.984	3.204	4.821	4.830	1.967	2.014	2.539	2.601	4.835	4.840	6.000	8.000
	DPM 2-7/8 HighTorque PAC	DPM 140	3.015	1.625	0.188	2.984	3.204	4.821	4.830	1.967	2.014	2.539	2.601	4.835	4.840	6.000	8.000
	DPM 2-7/8 HighTorque PAC	DPM 150	3.015	1.625	0.188	2.984	3.204	4.821	4.830	1.967	2.014	2.539	2.601	4.835	4.840	6.000	8.000
3 1/2	DPM-HighTorque38	G105	4.684	2.578	0.250	4.637	4.794	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
13.3	DPM-HighTorque38	S135	4.684	2.578	0.250	4.859	5.016	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
	DPM-HighTorque38	DPM 140	4.684	2.578	0.250	4.859	5.016	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
	DPM-HighTorque38	DPM 150	4.684	2.578	0.250	4.859	5.016	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
3 1/2	DPM-HighTorque38	G105	4.684	2.578	0.250	4.637	4.794	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
15.5	DPM-HighTorque38	S135	4.684	2.578	0.250	4.859	5.016	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
	DPM-HighTorque38	DPM 140	4.684	2.578	0.250	4.859	5.016	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
	DPM-HighTorque38	DPM 150	4.684	2.578	0.250	4.859	5.016	5.497	5.507	3.172	3.219	4.047	4.109	5.507	5.517	6.000	8.000
4	DPM-HighTorque40	G105	4.906	2.703	0.250	4.859	5.016	6.268	6.278	3.306	3.353	4.313	4.375	6.278	6.288	6.000	8.000
14.0	DPM-HighTorque40	S135	4.906	2.703	0.250	4.859	5.016	6.268	6.278	3.306	3.353	4.313	4.375	6.278	6.288	6.000	8.000
	DPM-HighTorque40	DPM 140	4.906	2.703	0.250	4.859	5.016	6.268	6.278	3.306	3.353	4.313	4.375	6.278	6.288	6.000	8.000
	DPM-HighTorque40	DPM 150	4.906	2.703	0.250	4.859	5.016	6.268	6.278	3.306	3.353	4.313	4.375	6.278	6.288	6.000	8.000
5	DPM-HighTorque50	G105	6.171	3.515	0.313	6.124	6.281	6.151	6.161	4.297	4.344	5.282	5.344	6.161	6.171	6.000	8.000
19.50	DPM-HighTorque50	S135	6.171	3.515	0.313	6.124	6.281	6.151	6.161	4.297	4.344	5.282	5.344	6.161	6.171	6.000	8.000
	DPM-HighTorque50	DPM 140	6.171	3.515	0.313	6.124	6.281	6.151	6.161	4.297	4.344	5.282	5.344	6.161	6.171	6.000	8.000
	DPM-HighTorque50	DPM 150	6.171	3.515	0.313	6.124	6.281	6.151	6.161	4.297	4.344	5.282	5.344	6.161	6.171	6.000	8.000
5 1/2	DPM-HighTorque55	G105	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
21.90	DPM-HighTorque55	S135	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
	DPM-HighTorque55	DPM 140	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
	DPM-HighTorque55	DPM 150	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
5 1/2	DPM-HighTorque55	G105	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
24.70	DPM-HighTorque55	S135	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
	DPM-HighTorque55	DPM 140	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000
	DPM-HighTorque55	DPM 150	6.904	4.015	0.313	6.857	7.014	7.339	7.349	4.667	4.713	5.875	5.937	7.349	7.359	6.000	8.000

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
2 Premium Class Min OD is the minimum acceptable box OD for the connection.
3 Tong space excludes hardbanding.
4 Dimensions listed are recommended dimensions. Should End User require a more stringent dimensional inspection to be applied, then End User requirements shall apply.

Table 3.7.25 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Command Tubular Products CET™

Nominal Size	Nominal Weight	Conn	Grade	Premium Min OD[2]	Max ID[3]	Min Cbore Wall	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box
2.375	6.65	CET20	SS-105	2.855	1.863	0.144	2.991	2.834	3.018	3.005	2.106	2.071	2.617	2.560	3.022	3.008	4.000	6.000
		CET20	G-105	2.782	1.863	0.108	2.991	2.834	3.018	3.005	2.106	2.071	2.617	2.560	3.022	3.008	4.000	6.000
		CET20	S-135	2.761	1.863	0.097	2.991	2.834	3.018	3.005	2.106	2.071	2.617	2.560	3.022	3.008	4.000	6.000
	6.65	CET21	SS-105	2.681	1.563	0.125	2.966	2.809	3.318	3.305	1.976	1.941	2.482	2.425	3.322	3.308	4.000	6.000
		CET21	G-105	2.681	1.563	0.125	2.966	2.809	3.318	3.305	1.976	1.941	2.482	2.425	3.322	3.308	4.000	6.000
		CET21	S-135	2.703	1.563	0.136	2.966	2.809	3.318	3.305	1.976	1.941	2.482	2.425	3.322	3.308	4.000	6.000
2.875	6.85	CET22	SS-105	3.383	2.313	0.131	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
		CET22	G-105	3.309	2.313	0.094	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
		CET22	S-135	3.425	2.313	0.152	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
	6.85	CET23	SS-105	3.067	1.963	0.160	3.203	3.046	3.318	3.305	2.278	2.243	2.798	2.741	3.322	3.308	4.000	6.000
		CET23	G-105	2.984	1.963	0.118	3.203	3.046	3.318	3.305	2.278	2.243	2.798	2.741	3.322	3.308	4.000	6.000
		CET23	S-135	3.114	1.963	0.183	3.203	3.046	3.318	3.305	2.278	2.243	2.798	2.741	3.322	3.308	4.000	6.000
	6.85	CET24	SS-105	3.253	2.063	0.137	3.579	3.422	3.318	3.305	2.518	2.483	3.029	2.972	3.322	3.308	4.000	6.000
		CET24	G-105	3.253	2.063	0.137	3.579	3.422	3.318	3.305	2.518	2.483	3.029	2.972	3.322	3.308	4.000	6.000
		CET24	S-135	3.253	2.063	0.137	3.579	3.422	3.318	3.305	2.518	2.483	3.029	2.972	3.322	3.308	4.000	6.000
	6.85	CET31	SS-105	3.730	2.063	0.170	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
		CET31	G-105	3.730	2.063	0.170	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
		CET31	S-135	3.730	2.063	0.170	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
	8.85	CET22	SS-105	3.335	2.322	0.107	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
		CET22	G-105	3.425	2.322	0.152	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
		CET22	S-135	3.335	2.322	0.107	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
	10.40	CET22	SS-105	3.196	2.188	0.038	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
		CET22	G-105	3.403	2.188	0.141	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
		CET22	S-135	3.196	2.188	0.038	3.591	3.434	3.018	3.005	2.595	2.555	3.171	3.114	3.022	3.008	4.000	6.000
	10.40	CET23	SS-105	2.978	1.963	0.115	3.203	3.046	3.318	3.305	2.278	2.243	2.798	2.741	3.322	3.308	4.000	6.000
		CET23	G-105	2.978	1.963	0.115	3.203	3.046	3.318	3.305	2.278	2.243	2.798	2.741	3.322	3.308	4.000	6.000
		CET23	S-135	2.978	1.963	0.115	3.203	3.046	3.318	3.305	2.278	2.243	2.798	2.741	3.322	3.308	4.000	6.000
	10.40	CET24	SS-105	3.320	2.063	0.171	3.579	3.422	3.318	3.305	2.518	2.483	3.029	2.972	3.322	3.308	4.000	6.000
		CET24	G-105	3.253	2.063	0.137	3.579	3.422	3.318	3.305	2.518	2.483	3.029	2.972	3.322	3.308	4.000	6.000
		CET24	S-135	3.376	2.063	0.199	3.579	3.422	3.318	3.305	2.518	2.483	3.029	2.972	3.322	3.308	4.000	6.000
	10.40	CET31	SS-105	3.730	2.063	0.170	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
		CET31	G-105	3.730	2.063	0.170	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
		CET31	S-135	3.730	2.063	0.170	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
3.500	13.30	CET31	SS-105	3.941	2.063	0.275	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
		CET31	G-105	3.805	2.063	0.207	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000
		CET31	S-135	4.016	2.063	0.313	4.021	3.864	3.505	3.492	2.648	2.598	3.441	3.369	3.509	3.495	4.000	6.000

Table 3.7.25 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Command Tubular Products CET™

Nominal Size	Nominal Weight	Conn	Grade	Premium Min OD[2]	Max ID[3]	Min Cbore Wall	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box
3.500	13.30	CET38	SS-105	4.520	2.626	0.255	4.641	4.484	4.005	3.992	3.206	3.156	4.061	3.989	4.009	3.995	4.000	6.000
		CET38	G-105	4.520	2.626	0.255	4.641	4.484	4.005	3.992	3.206	3.156	4.061	3.989	4.009	3.995	4.000	6.000
		CET38	S-135	4.520	2.626	0.255	4.641	4.484	4.005	3.992	3.206	3.156	4.061	3.989	4.009	3.995	4.000	6.000
	15.50	CET38	SS-105	4.520	2.626	0.255	4.641	4.484	4.005	3.992	3.206	3.156	4.061	3.989	4.009	3.995	4.000	6.000
		CET38	G-105	4.520	2.626	0.255	4.641	4.484	4.005	3.992	3.206	3.156	4.061	3.989	4.009	3.995	4.000	6.000
		CET38	S-135	4.520	2.626	0.255	4.641	4.484	4.005	3.992	3.206	3.156	4.061	3.989	4.009	3.995	4.000	6.000
4.000	14.00	CET39	SS-105	4.650	2.751	0.255	4.766	4.609	4.005	3.992	3.348	3.298	4.191	4.119	4.009	3.995	6.000	6.000
		CET39	G-105	4.650	2.751	0.255	4.766	4.609	4.005	3.992	3.348	3.298	4.191	4.119	4.009	3.995	6.000	6.000
		CET39	S-135	4.650	2.751	0.255	4.766	4.609	4.005	3.992	3.348	3.298	4.191	4.119	4.009	3.995	6.000	6.000
	14.00	CET40	SS-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	G-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	S-135	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
	15.70	CET39	SS-105	4.650	2.751	0.255	4.766	4.609	4.005	3.992	3.348	3.298	4.191	4.119	4.009	3.995	6.000	6.000
		CET39	G-105	4.650	2.751	0.255	4.766	4.609	4.005	3.992	3.348	3.298	4.191	4.119	4.009	3.995	6.000	6.000
		CET39	S-135	4.713	2.751	0.286	4.766	4.609	4.005	3.992	3.348	3.298	4.191	4.119	4.009	3.995	6.000	6.000
	15.70	CET40	SS-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	G-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	S-135	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
4.500	16.60	CET40	SS-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	G-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	S-135	4.979	2.751	0.269	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
	16.60	CET43	SS-105	5.117	3.063	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	SS-105	5.117	3.313	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	G-105	5.117	3.063	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	G-105	5.117	3.313	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	S-135	5.117	3.063	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	S-135	5.138	3.313	0.265	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
	16.60	CET46	SS-150	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	G-105	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	S-135	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
	20.00	CET40	SS-150	5.066	2.751	0.313	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	G-105	4.950	2.751	0.255	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
		CET40	S-135	5.158	2.751	0.359	5.156	4.999	4.505	4.492	3.552	3.502	4.491	4.419	4.509	4.495	6.000	6.000
	20.00	CET43	SS-105	5.117	3.063	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	SS-105	5.222	3.313	0.307	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	G-105	5.117	3.063	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000

Table 3.7.25 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Command Tubular Products CET™

Nominal Size	Nominal Weight	Conn	Grade	Premium Min OD[2]	Max ID[3]	Min Cbore Wall	Bevel Diameter Max	Bevel Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box
4.500	20.00	CET43	G-105	5.117	3.313	0.255	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	S-135	5.184	3.063	0.288	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
		CET43	S-135	5.307	3.313	0.350	5.266	5.109	4.505	4.492	3.911	3.861	4.658	4.586	4.509	4.495	6.000	6.000
	20.00	CET46	SS-105	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	G-105	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	S-135	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
5.000	19.50	CET46	G-105	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	G-105	5.590	3.563	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	G-105	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	S-135	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	S-135	5.590	3.563	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
		CET46	S-135	5.590	3.313	0.255	5.842	5.685	4.505	4.492	4.177	4.127	5.131	5.059	4.509	4.495	6.000	6.000
	19.50	CET50	SS-150	5.950	3.813	0.255	6.156	5.999	4.505	4.492	4.552	4.502	5.491	5.419	4.509	4.495	6.000	6.000
		CET50	G-105	5.950	3.813	0.255	6.156	5.999	4.505	4.492	4.552	4.502	5.491	5.419	4.509	4.495	6.000	6.000
		CET50	S-135	5.950	3.813	0.255	6.156	5.999	4.505	4.492	4.552	4.502	5.491	5.419	4.509	4.495	6.000	6.000
	25.60	CET50	SS-105	6.003	3.813	0.281	6.156	5.999	4.505	4.492	4.552	4.502	5.491	5.419	4.509	4.495	6.000	6.000
		CET50	G-150	5.950	3.813	0.255	6.156	5.999	4.505	4.492	4.552	4.502	5.491	5.419	4.509	4.495	6.000	6.000
		CET50	S-135	6.094	3.813	0.327	6.156	5.999	4.505	4.492	4.552	4.502	5.491	5.419	4.509	4.495	6.000	6.000
5.500	21.90	CET54	SS-105	6.200	4.063	0.264	6.422	6.265	5.005	4.992	4.701	4.651	5.723	5.651	5.009	4.995	6.000	6.000
		CET54	G-105	6.200	4.063	0.264	6.422	6.265	5.005	4.992	4.701	4.651	5.723	5.651	5.009	4.995	6.000	6.000
		CET54	S-135	6.239	4.063	0.283	6.422	6.265	5.005	4.992	4.701	4.651	5.723	5.651	5.009	4.995	6.000	6.000
	24.70	CET54	SS-105	6.260	4.063	0.294	6.422	6.265	5.005	4.992	4.701	4.651	5.723	5.651	5.009	4.995	6.000	6.000
		CET54	G-105	6.200	4.063	0.264	6.422	6.265	5.005	4.992	4.701	4.651	5.723	5.651	5.009	4.995	6.000	6.000
		CET54	S-135	6.347	4.063	0.337	6.422	6.265	5.005	4.992	4.701	4.651	5.723	5.651	5.009	4.995	6.000	6.000
5.875	23.40	CET57	SS-105	6.500	4.063	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	SS-150	6.510	4.313	0.260	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	G-105	6.500	4.063	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	G-105	6.500	4.313	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	S-135	6.500	4.063	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	S-135	6.597	4.313	0.303	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
	26.30	CET57	SS-105	6.500	4.063	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	SS-105	6.623	4.313	0.316	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	G-150	6.500	4.063	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	G-105	6.500	4.313	0.255	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	S-135	6.591	4.063	0.300	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000
		CET57	S-135	6.719	4.313	0.364	6.860	6.703	5.005	4.992	5.019	4.969	6.041	5.969	5.009	4.995	6.000	6.000

Table 3.7.25 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Command Tubular Products CET™

Nominal Size	Nominal Weight	Conn	Grade	Premium Min OD[2]	Max ID[3]	Min Cbore Wall	Bevel Diameter		Pin Connection Length		Pin Nose Diameter		Box Cbore Diameter		Box Connection Length		Minimum Tong Space[4]	
							Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Pin	Box
6.625	25.20	CET65	SS-105	7.350	4.813	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	SS-150	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	G-105	7.350	4.813	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	G-150	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	S-135	7.350	4.813	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	S-135	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
	25.20	CET69	SS-105	7.730	5.063	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	SS-150	7.730	5.563	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	G-105	7.730	5.313	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	S-135	7.730	5.063	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	S-135	7.730	5.313	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
	27.70	CET65	SS-105	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	SS-105	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	G-150	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	G-105	7.350	5.063	0.255	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	S-135	7.375	4.813	0.267	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
		CET65	S-135	7.375	5.063	0.267	7.816	7.659	5.005	4.992	5.869	5.819	6.891	6.819	5.009	4.995	6.000	6.000
	27.70	CET69	SS-105	7.730	5.063	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	SS-105	7.730	5.313	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	G-105	7.730	5.313	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	S-135	7.730	5.063	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000
		CET69	S-135	7.730	5.313	0.255	8.316	8.159	5.005	4.992	6.249	6.199	7.271	7.199	5.009	4.995	6.000	6.000

1 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
2 Premium Min OD is the CET minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and premium class pipe, whichever is greater.
3 Premium Min OD and Max Pin ID of some connection might be different from this chart if manufactured to a non-standard OD/ID, check CTP drill pipe data sheet or consult CTP.
4 Tong space excludes hardbanding.

Table 3.7.26 Used Tool Joint Acceptance Criteria for Reduced Torsional Strength Ratio (Premium Class-Reduced TSR)

Note: The industry has for many years been using certain drill pipe and tool joint combinations that do not meet the torsional strength ratio (TSR)* of approximately 0.8 that is recommended for API RP7G-2 and DS-1® Premium Class condition. For low-torsion drilling, this practice offers the advantage being able to use pipe with adequate tensile capacity while maintaining good fishing clearances. Unless operating torsion exceeds make-up torque on these connections, there is no technical reason to prohibit the practice, although users should be aware that such pipe cannot properly be called API RP7G-2 or DS-1 "Premium Class."

To recognize this long-standing practice for certain drill pipe and tool joint combinations, the category "Premium Class-Reduced TSR" is designated by this supplement. If the buyer of inspection services specifies "Premium Class-Reduced TSR" as the acceptance criteria in effect, the inspection company shall apply all criteria for "Premium Class" found elsewhere in this standard, except for tool joint diameters. The tool joint diameters specified below shall replace those applicable to "Premium Class." *Users are cautioned that, while a "Premium Class-Reduced TSR" drill string may be adequate for low-torsion drilling, it is not as strong in torsion as a true "Premium Class" drill string as defined in API RP7G-2 and DS-1.*

Premium Class-Reduced TSR - E, X, G, and S Grade Drill Pipe Assemblies

Size (in)	Weight (lb/ft)	Conn	Grade	Max Pin ID (in)	Min Box OD (in)	Min Shoulder (in)	Min Bevel Diam (in)	Min Tong Space Pin (in)	Min Tong Space Box (in)	Max CBore Diam (in)	Max Bevel Diam (in)	Torsional Strength Prem Class Tube (ft-lb)	Torsional Strength Tool Joint (ft-lb)	TSR
2 7/8	10.40	PAC	E	1 9/16	3	11/64	2 57/64	4	4	2 41/64	2 61/64	8858	5259	0.59
		NC26	E	1 63/64	3 1/4	1/8	3 3/16	4	4 5/8	3	3 9/32	8858	5008	0.57
3 1/2	13.30	NC38	G	2 11/16	4 5/8	15/64	4 31/64	4	5 5/8	4 9/64	4 19/32	20106	15580	0.77
		NC38	S	2 11/16	4 5/8	15/64	4 31/64	4	5 5/8	4 9/64	4 19/32	25850	15580	0.60
	15.50	NC38	X	2 11/16	4 5/8	15/64	4 31/64	4	5 5/8	4 9/64	4 19/32	20452	15580	0.76
		NC38	G	2 11/16	4 5/8	15/64	4 31/64	4	5 5/8	4 9/64	4 19/32	22605	15580	0.69
		NC38	S	2 11/16	4 5/8	15/64	4 31/64	4	5 5/8	4 9/64	4 19/32	29063	15580	0.54
4	14.00	4SH	X	2 7/16	4 5/8	21/64	4 11/32	4	5 1/8	3 15/16	4 35/64	23048	16867	0.73
		4SH	G	2 7/16	4 5/8	21/64	4 11/32	4	5 1/8	3 15/16	4 35/64	25474	16867	0.66
		4SH	S	2 7/16	4 5/8	21/64	4 11/32	4	5 1/8	3 15/16	4 35/64	32753	16867	0.52
		NC40	S	2 59/64	5	19/64	4 27/32	4	6 1/8	4 13/32	5 1/32	32753	20948	0.64
5	25.60	NC50	S	3 1/4	6 3/8	31/64	6	4 25/32	6 1/8	5 3/8	6 5/64	72980	50484	0.69

Table 3.7.26 Used Tool Joint Acceptance Criteria for Reduced Torsional Strength Ratio (Premium Class-Reduced TSR)

continued

Premium Class-Reduced TSR - V Grade Drill Pipe Assemblies

Size (in)	Weight (lb/ft)	Conn	Grade	Max Pin ID (in)	Min Box OD (in)	Min Shoulder (in)	Min Bevel Diam (in)	Min Tong Space Pin (in)	Min Tong Space Box (in)	Max CBore Diam (in)	Max Bevel Diam (in)	Torsional Strength Prem Class Tube (ft-lb)	Torsional Strength Tool Joint (ft-lb)	TSR
2 7/8	10.40	NC31	V	2 1/32	4 1/16	17/64	3 55/64	4	5 1/8	3 33/64	3 31/32	17716	12823	0.72
3 1/2	13.30	NC38	V	2 17/32	4 13/16	21/64	4 9/16	4	5 5/8	4 9/64	4 19/32	28723	21023	0.73
		NC40	V	2 29/32	5	9/32	4 25/32	4	6 1/8	4 13/32	5 1/32	28723	20948	0.73
3 1/2	15.50	NC38	V	2 11/16	4 5/8	15/64	4 31/64	4	5 5/8	4 9/64	4 19/32	32292	15580	0.48
		NC40	V	2 13/16	5 3/32	21/64	4 53/64	4	6 1/8	4 13/32	5 1/32	32292	23280	0.72
4	14.00	NC40	V	2 39/64	5 11/64	3/8	4 57/64	4	6 1/8	4 13/32	5 1/32	36392	26666	0.73
		NC46	V	3 1/2	5 9/16	9/32	5 11/32	4 11/64	6 1/8	4 31/32	5 47/64	36392	26312	0.72
4 1/2	16.60	NC46	V	3 5/32	5 25/32	25/64	5 31/64	4 11/32	6 1/8	4 31/32	5 47/64	48278	35384	0.73
		NC50	V	3 13/16	6 1/16	21/64	5 13/16	4 35/64	6 1/8	5 3/8	6 5/64	48278	35029	0.73
4 1/2	20.00	NC46	V	2 7/8	5 59/64	15/32	5 37/64	4 7/16	6 1/8	4 31/32	5 27/32	57367	41487	0.72
		NC50	V	3 19/32	6 7/32	13/32	5 57/64	4 21/32	6 1/8	5 3/8	6 5/64	57367	41810	0.73
5	19.50	NC50	V	3 13/32	6 5/16	29/64	5 61/64	4 23/32	6 1/8	5 3/8	6 5/64	64571	47042	0.73
		5-1/2 FH	V	4 1/4	6 3/4	3/8	6 29/64	5 3/64	6 5/8	5 31/32	6 47/64	64571	46724	0.72
5	25.60	NC50	V	3 1/4	6 3/8	31/64	6	4 25/32	6 1/8	5 3/8	6 5/64	81088	50484	0.62
		5-1/2 FH	V	3 29/32	6 15/16	15/32	6 37/64	5 13/64	6 5/8	5 31/32	6 47/64	81088	58930	0.73
5 1/2	21.90	5-1/2 FH	V	3 15/16	6 15/16	15/32	6 9/16	5 3/16	6 5/8	5 31/32	7 7/64	79727	57856	0.73
5 1/2	24.70	5-1/2 FH	V	3 23/32	7 1/32	33/64	6 5/8	5 17/64	6 5/8	5 31/32	7 7/64	88641	64836	0.73
6 5/8	25.20	6-5/8 FH	V	4 11/16	7 29/32	31/64	7 17/32	5 15/16	6 5/8	6 29/32	7 23/32	111532	80341	0.72
6 5/8	27.70	6-5/8 FH	V	4 17/32	8	17/32	7 19/32	6	6 5/8	6 29/32	7 23/32	120383	87856	0.73

**TSR = (Tool Joint Torsional Strength)/(Tube Torsional Strength) = 0.8 for API "Standard" and "Premium Class" conditions.*

Table 3.8.1 Used Tool Joint Acceptance Criteria[8]

(All dimensions in inches)

Thick-Walled Drill Pipe

Nominal Size/ Wall	Conn.	Nominal Dimensions & MUT: Box OD (in)	Nominal Dimensions & MUT: Pin ID (in)	Nominal Dimensions & MUT: API MUT (ft-lb)	Min Box OD[1] (in)	Max Pin ID[2] for E, X, G, & S Grade Pipe: 95% Nom Wall (in)	Max Pin ID[2] for E, X, G, & S Grade Pipe: 90% Nom Wall (in)	Max Pin ID[2] for E, X, G, & S Grade Pipe: 80% Nom Wall (in)	Max Pin ID[2] for V Grade Pipe: 95% Nom Wall (in)	Max Pin ID[2] for V Grade Pipe: 90% Nom Wall (in)	Max Pin ID[2] for V Grade Pipe: 80% Nom Wall (in)	API MUT Min OD and Max ID (ft-lb)	Min Shoulder[3] (in)	Min Bevel Diam[4] (in)	Min Tong Space[5]: Pin (in)	Min Tong Space[5]: Box (in)	Max Cbore Diam[6] (in)	Max Bevel Diam[7] (in)
5 0.713	NC 50	6 7/8	2 3/4	38036	6 15/32	2 15/16	3 1/32	3 5/64	2 25/32	2 7/8	3 1/16	33205	33/64	6 1/4	4 55/64	6 1/8	5 3/8	6 27/64
5 0.750	NC 50	6 5/8	2 3/4	38036	6 15/32	2 57/64	2 31/32	3 5/64	**2 3/4**	2 13/16	3 1/64	33205	33/64	6 1/4	4 55/64	6 1/8	5 3/8	6 27/64
		6 5/8	3	34520	6 3/8	**3**	3 1/16	3 15/64	**3**	**3**	3 7/64	30290	15/32	6 11/64	4 25/32	6 1/8	5 3/8	6 21/64
		6 5/8	3 1/4	30730	6 9/32	**3 1/4**	**3 1/4**	3 21/64	**3 1/4**	**3 1/4**	**3 1/4**	27437	27/64	6 3/32	4 23/32	6 1/8	5 3/8	6 15/64
		6 5/8	3 1/2	26674	6 11/64	**3 1/2**	**3 1/2**	**3 1/2**	**3 1/2**	**3 1/2**	**3 1/2**	24186	3/8	6	4 5/8	6 1/8	5 3/8	6 1/8
5 1/2 0.500	5 1/2 FH	7 1/2	3	52059	7 3/16	3 13/32	3 13/32	3 13/32	3 13/32	3 13/32	3 13/32	44812	37/64	6 61/64	5 25/64	6 5/8	5 31/32	7 9/64
		7 1/2	3 1/16	51035	7 11/64	3 7/16	3 7/16	3 7/16	3 7/16	3 7/16	3 7/16	44212	37/64	6 15/16	5 3/8	6 5/8	5 31/32	7 1/8
		7 1/2	3 3/16	48928	7 1/8	3 35/64	3 35/64	3 35/64	3 35/64	3 35/64	3 35/64	42425	35/64	6 57/64	5 11/32	6 5/8	5 31/32	7 5/64
		7 1/2	3 7/8	35998	6 27/32	4 3/64	4 1/16	4 1/16	3 61/64	4	4 1/16	32058	13/32	6 21/32	5 9/64	6 5/8	5 31/32	6 51/64
		7 1/4	3 1/4	47230	7 3/32	3 39/64	3 39/64	3 39/64	3 39/64	3 39/64	3 39/64	41243	17/32	6 7/8	5 21/64	6 5/8	5 31/32	7 3/64
		7 1/4	3 1/2	43328	7	3 25/32	3 25/32	3 25/32	3 25/32	3 25/32	3 25/32	37742	31/64	6 51/64	5 1/4	6 5/8	5 31/32	6 61/64
		7 1/4	3 3/4	38513	6 29/32	3 61/64	3 61/64	3 61/64	3 57/64	3 61/64	3 61/64	34309	7/16	6 45/64	5 3/16	6 5/8	5 31/32	6 55/64
		7 1/8	3 1/8	42425	6 63/64	3 13/16	3 13/16	3 13/16	3 13/16	3 13/16	3 13/16	37165	31/64	6 25/32	5 15/64	6 5/8	5 31/32	6 15/16
		7	3 1/2	37742	6 57/64	3 31/32	3 31/32	3 31/32	3 29/32	3 31/32	3 31/32	33743	7/16	6 11/16	5 11/64	6 5/8	5 31/32	6 27/32
		7	3 3/4	37742	6 57/64	3 31/32	3 31/32	3 31/32	3 29/32	3 31/32	3 31/32	33743	7/16	6 11/16	5 11/64	6 5/8	5 31/32	6 27/32
		7	4	33412	6 25/32	4 3/32	4 9/64	4 5/32	**4**	4 3/64	4 5/32	29836	3/8	6 39/64	5 3/32	6 5/8	5 31/32	6 47/64
5 1/2 0.750	5 1/2 FH	7 1/2	3	52059	7 3/16	3 21/64	3 13/32	3 13/32	3 11/64	3 17/64	3 13/32	44812	37/64	6 61/64	5 25/64	6 5/8	5 31/32	7 9/64
		7 1/2	3 1/16	51035	7 11/64	3 11/32	3 7/16	3 7/16	3 3/16	3 9/32	3 7/16	44212	37/64	6 15/16	5 3/8	6 5/8	5 31/32	7 1/8
		7 1/2	3 3/16	48928	7 1/8	3 13/32	3 31/64	3 35/64	3 15/64	3 21/64	3 33/64	42425	35/64	6 57/64	5 11/32	6 5/8	5 31/32	7 5/64
		7 1/2	3 7/8	35998	6 27/32	**3 7/8**	**3 7/8**	3 57/64	**3 7/8**	**3 7/8**	**3 7/8**	32058	13/32	6 21/32	5 9/64	6 5/8	5 31/32	6 51/64
		7 1/4	3 1/4	47230	7 3/32	3 27/64	3 33/64	3 39/64	3 17/64	3 23/64	3 35/64	41243	17/32	6 7/8	5 21/64	6 5/8	5 31/32	7 3/64
		7 1/4	3 1/2	43328	7	3 33/64	3 39/64	3 49/64	**3 1/2**	**3 1/2**	3 41/64	37742	31/64	6 51/64	5 1/4	6 5/8	5 31/32	6 61/64
		7 1/4	3 3/4	38513	6 29/32	**3 3/4**	**3 3/4**	3 27/32	**3 3/4**	**3 3/4**	**3 3/4**	34309	7/16	6 45/64	5 3/16	6 5/8	5 31/32	6 55/64
		7 1/8	3 1/8	42425	6 63/64	3 17/32	3 5/8	3 25/32	3 23/64	3 15/32	3 21/32	37165	31/64	6 25/32	5 15/64	6 5/8	5 31/32	6 15/16
		7	3 1/2	37742	6 57/64	3 39/64	3 45/64	3 55/64	**3 1/2**	3 35/64	3 47/64	33743	7/16	6 11/16	5 11/64	6 5/8	5 31/32	6 27/32
		7	3 3/4	37742	6 57/64	**3 3/4**	**3 3/4**	3 55/64	**3 3/4**	**3 3/4**	**3 3/4**	33743	7/16	6 11/16	5 11/64	6 5/8	5 31/32	6 27/32
		7	4	33412	6 25/32	**4**	**4**	**4**	**4**	**4**	**4**	29836	3/8	6 39/64	5 3/32	6 5/8	5 31/32	6 47/64
6 5/8 0.500	6 5/8 FH	8 1/2	3 1/2	78092	8 9/32	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	66712	21/32	8 1/64	6 7/32	6 5/8	6 29/32	8 15/64
		8 1/2	4	71377	8 11/64	4 25/64	4 25/64	4 25/64	4 25/64	4 25/64	4 25/64	61184	39/64	7 15/16	6 1/8	6 5/8	6 29/32	8 1/8
		8 1/2	4 1/4	65012	8 5/64	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/2	4 1/2	58309	7 31/32	4 3/4	4 3/4	4 3/4	4 47/64	4 3/4	4 3/4	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4	65122	8 5/64	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/4	65012	8 5/64	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32

Table 3.8.1 Used Tool Joint Acceptance Criteria[8]

(All dimensions in inches)

Thick-Walled Drill Pipe

Nominal Size/ Wall	Conn.	Nominal Dimensions & MUT Box OD (in)	Pin ID (in)	API MUT (ft-lb)	Min Box OD[1] (in)	Max Pin ID[2] for E, X, G, & S Grade Pipe 95% Nom Wall (in)	90% Nom Wall (in)	80% Nom Wall (in)	Max Pin ID[2] for V Grade Pipe 95% Nom Wall (in)	90% Nom Wall (in)	80% Nom Wall (in)	API MUT Min OD and Max ID (ft-lb)	Min Shoulder[3] (in)	Min Bevel Diam[4] (in)	Min Tong Space[5] Pin (in)	Box (in)	Max Cbore Diam[6] (in)	Max Bevel Diam[7] (in)
6 5/8 0.500	6 5/8 FH	8 1/4	4 1/2	58309	7 31/32	4 3/4	4 3/4	4 3/4	4 47/64	4 3/4	4 3/4	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4 3/4	51280	7 27/32	4 15/16	4 61/64	4 61/64	4 27/32	4 57/64	4 61/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	4 3/4	51280	7 27/32	4 15/16	4 61/64	4 61/64	4 27/32	4 57/64	4 61/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	5	43934	7 23/32	5 1/32	5 5/64	5 9/64	**5**	**5**	5 3/32	39417	3/8	7 35/64	5 51/64	6 5/8	6 29/32	7 43/64
6 5/8 0.522	6 5/8 FH	8 1/2	3 1/2	78092	8 9/32	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	66712	21/32	8 1/64	6 7/32	6 5/8	6 29/32	8 15/64
		8 1/2	4	71377	8 11/64	4 25/64	4 25/64	4 25/64	4 25/64	4 25/64	4 25/64	61184	39/64	7 15/16	6 1/8	6 5/8	6 29/32	8 1/8
		8 1/2	4 1/4	65012	8 5/64	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/2	4 1/2	58309	7 31/32	4 3/4	4 3/4	4 3/4	4 45/64	4 3/4	4 3/4	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4	65122	8 5/64	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/4	65012	8 5/64	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/2	58309	7 31/32	4 3/4	4 3/4	4 3/4	4 45/64	4 3/4	4 3/4	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4 3/4	51280	7 27/32	4 57/64	4 61/64	4 61/64	4 51/64	4 55/64	4 61/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	4 3/4	51280	7 27/32	4 57/64	4 61/64	4 61/64	4 51/64	4 55/64	4 61/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	5	43934	7 23/32	**5**	5 3/64	5 9/64	**5**	**5**	5 1/16	39417	3/8	7 35/64	5 51/64	6 5/8	6 29/32	7 43/64
6 5/8 0.625	6 5/8 FH	8 1/2	3 1/2	78092	8 9/32	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	66712	21/32	8 1/64	6 7/32	6 5/8	6 29/32	8 15/64
		8 1/2	4	71377	8 11/64	4 25/64	4 25/64	4 25/64	4 21/64	4 25/64	4 25/64	61184	39/64	7 15/16	6 1/8	6 5/8	6 29/32	8 1/8
		8 1/2	4 1/4	65012	8 5/64	4 35/64	4 9/16	4 9/16	4 27/64	4 31/64	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/2	4 1/2	58309	7 31/32	4 41/64	4 45/64	4 3/4	**4 1/2**	4 37/64	4 23/32	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4	65122	8 5/64	4 35/64	4 9/16	4 9/16	4 27/64	4 31/64	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/4	65012	8 5/64	4 35/64	4 9/16	4 9/16	4 27/64	4 31/64	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/2	58309	7 31/32	4 41/64	4 45/64	4 3/4	**4 1/2**	4 37/64	4 23/32	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4 3/4	51280	7 27/32	**4 3/4**	4 51/64	4 59/64	**4 3/4**	**4 3/4**	4 53/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	4 3/4	51280	7 27/32	**4 3/4**	4 51/64	4 59/64	**4 3/4**	**4 3/4**	4 53/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	5	43934	7 23/32	**5**	**5**	5 1/64	**5**	**5**	**5**	39417	3/8	7 35/64	5 51/64	6 5/8	6 29/32	7 43/64
6 5/8 0.640	6 5/8 FH	8 1/2	3 1/2	78092	8 9/32	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	4 11/64	66712	21/32	8 1/64	6 7/32	6 5/8	6 29/32	8 15/64
		8 1/2	4	71377	8 11/64	4 25/64	4 25/64	4 25/64	4 19/64	4 3/8	4 25/64	61184	39/64	7 15/16	6 1/8	6 5/8	6 29/32	8 1/8
		8 1/2	4 1/4	65012	8 5/64	4 33/64	4 9/16	4 9/16	4 25/64	4 15/32	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/2	4 1/2	58309	7 31/32	4 39/64	4 43/64	4 3/4	**4 1/2**	4 9/16	4 45/64	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4	65122	8 5/64	4 33/64	4 9/16	4 9/16	4 25/64	4 15/32	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/4	65012	8 5/64	4 33/64	4 9/16	4 9/16	4 25/64	4 15/32	4 9/16	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/2	58309	7 31/32	4 39/64	4 43/64	4 3/4	**4 1/2**	4 9/16	4 45/64	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4 3/4	51280	7 27/32	**4 3/4**	4 25/32	4 29/32	**4 3/4**	**4 3/4**	4 51/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	4 3/4	51280	7 27/32	**4 3/4**	4 25/32	4 29/32	**4 3/4**	**4 3/4**	4 51/64	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	5	43934	7 23/32	**5**	**5**	**5**	**5**	**5**	**5**	39417	3/8	7 35/64	5 51/64	6 5/8	6 29/32	7 43/64

Table 3.8.1 Used Tool Joint Acceptance Criteria[8]

(All dimensions in inches)

Thick-Walled Drill Pipe

Nominal Size/ Wall	Conn.	Nominal Dimensions & MUT Box OD (in)	Pin ID (in)	API MUT (ft-lb)	Min Box OD[1] (in)	Max Pin ID[2] for E, X, G, & S Grade Pipe 95% Nom Wall (in)	90% Nom Wall (in)	80% Nom Wall (in)	Max Pin ID[2] for V Grade Pipe 95% Nom Wall (in)	90% Nom Wall (in)	80% Nom Wall (in)	API MUT Min OD and Max ID (ft-lb)	Min Shoulder[3] (in)	Min Bevel Diam[4] (in)	Min Tong Space[5] Pin (in)	Min Tong Space[5] Box (in)	Max Cbore Diam[6] (in)	Max Bevel Diam[7] (in)
6 5/8 0.688	6 5/8 FH	8 1/2	4 7/16	60016	8	4 33/64	4 37/64	4 11/16	**4 7/16**	4 29/64	4 39/64	52714	33/64	7 25/32	6	6 5/8	6 29/32	7 61/64
6 5/8	6 5/8 FH	8 1/2	3 1/2	78092	8 9/32	4 5/32	4 11/64	4 11/64	3 63/64	4 3/32	4 11/64	66712	21/32	8 1/64	6 7/32	6 5/8	6 29/32	8 15/64
0.750		8 1/2	4	71377	8 11/64	4 1/4	4 11/32	4 25/64	4 3/32	4 3/16	4 3/8	61184	39/64	7 15/16	6 1/8	6 5/8	6 29/32	8 1/8
		8 1/2	4 1/4	65012	8 5/64	4 11/32	4 27/64	4 9/16	**4 1/4**	4 9/32	4 29/64	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/2	4 1/2	58309	7 31/32	**4 1/2**	4 33/64	4 43/64	**4 1/2**	**4 1/2**	4 35/64	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4	65122	8 5/64	4 11/32	4 27/64	4 9/16	4 11/64	4 9/32	4 29/64	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/4	65012	8 5/64	4 11/32	4 27/64	4 9/16	**4 1/4**	4 9/32	4 29/64	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/2	58309	7 31/32	**4 1/2**	4 33/64	4 43/64	**4 1/2**	**4 1/2**	4 35/64	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4 3/4	51280	7 27/32	**4 3/4**	**4 3/4**	4 49/64	**4 3/4**	**4 3/4**	**4 3/4**	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	4 3/4	51280	7 27/32	**4 3/4**	**4 3/4**	4 49/64	**4 3/4**	**4 3/4**	**4 3/4**	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	5	43934	7 23/32	**5**	**5**	**5**	**5**	**5**	**5**	39417	3/8	7 35/64	5 51/64	6 5/8	6 29/32	7 43/64
6 5/8	6 5/8 FH	8 3/4	3 1/2	83062	8 23/64	3 31/32	4 1/64	4 1/64	3 25/32	3 57/64	4 1/64	70727	45/64	8 3/32	6 17/64	6 5/8	6 29/32	8 5/16
0.813		8 11/16	3 1/2	83062	8 23/64	3 31/32	4 1/64	4 1/64	3 25/32	3 57/64	4 1/64	70727	45/64	8 3/32	6 17/64	6 5/8	6 29/32	8 5/16
		8 1/2	3 1/2	78092	8 9/32	4 3/64	4 9/64	4 11/64	3 55/64	3 31/32	4 11/64	66712	21/32	8 1/64	6 7/32	6 5/8	6 29/32	8 15/64
		8 1/2	4	71377	8 11/64	4 5/32	4 1/4	4 25/64	**4**	4 5/64	4 9/32	61184	39/64	7 15/16	6 1/8	6 5/8	6 29/32	8 1/8
		8 1/2	4 1/4	65012	8 5/64	**4 1/4**	4 21/64	4 1/2	**4 1/4**	**4 1/4**	4 3/8	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/2	4 1/2	58309	7 31/32	**4 1/2**	**4 1/2**	4 19/32	**4 1/2**	**4 1/2**	**4 1/2**	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4	65122	8 5/64	4 15/64	4 21/64	4 1/2	4 3/64	4 5/32	4 3/8	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/4	65012	8 5/64	**4 1/4**	4 21/64	4 1/2	**4 1/4**	**4 1/4**	4 3/8	56531	9/16	7 27/32	6 1/16	6 5/8	6 29/32	8 1/32
		8 1/4	4 1/2	58309	7 31/32	**4 1/2**	**4 1/2**	4 19/32	**4 1/2**	**4 1/2**	**4 1/2**	51202	1/2	7 3/4	5 63/64	6 5/8	6 29/32	7 59/64
		8 1/4	4 3/4	51280	7 27/32	**4 3/4**	**4 3/4**	**4 3/4**	**4 3/4**	**4 3/4**	**4 3/4**	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	4 3/4	51280	7 27/32	**4 3/4**	**4 3/4**	**4 3/4**	**4 3/4**	**4 3/4**	**4 3/4**	45241	7/16	7 21/32	5 57/64	6 5/8	6 29/32	7 51/64
		8	5	43934	7 23/32	**5**	**5**	**5**	**5**	**5**	**5**	39417	3/8	7 35/64	5 51/64	6 5/8	6 29/32	7 43/64
6 5/8 0.9375	6 5/8 FH	8 3/4	3 1/2	83062	8 23/64	3 3/4	3 7/8	4 1/64	3 33/64	3 43/64	3 59/64	70727	45/64	8 3/32	6 17/64	6 5/8	6 29/32	8 5/16

Table 3.8.1 Used Tool Joint Acceptance Criteria[8]

(All dimensions in inches)

Thick-Walled Drill Pipe

NOTES:

1 Minimum box OD is determined by adding 3/64 inch to the maximum bevel diameter, which allows for the minimum 1/32-inch wide, 45 degree bevel.

2 Maximum pin ID is limited such that the connection is box weak in torsion and the thick-walled drill pipe assembly is tube weak in tension.*
*Maximum pin ID values in **bold text** (equal to the nominal pin ID) indicate that the nominal pin neck tensile capacities at the specified connection makeup torques (for minimum OD and maximum ID connections) are less than the tensile capacities of the drill pipe tubes with the specified grade and remaining wall thickness. In such case, the tensile capacity of the thick-walled drill pipe assembly must be based on the pin neck tensile capacity and not the tube tensile capacity.

3 Minimum shoulder width is determined by subtracting 1/32 inch from half of the difference between the minimum box OD and the maximum allowable counterbore diameter per API Specification 7-2, Latest Edition.

4 Minimum bevel diameter is determined from the seal area that gives a connection seal stress equal to 90% MYS (108 ksi) at nominal API MUT.

5 Minimum pin tong space is 4 inches or 75% of the minimum OD, whichever is larger. The minimum box tong space is determined by adding 1 inch to the length of the box.

6 Maximum counterbore diameter is determined by adding 1/32 inch to the nominal counterbore diameter (in addition to the machining tolerance).

7 Maximum bevel diameter is determined from the maximum seal area that gives a connection seal stress equal to 75% MYS (90 ksi) at nominal API MUT.

8 Existing bevel diameters on thick-walled drill pipe (TWDP) connections are known to be cut in accordance with API Specification 5DP requirements for the corresponding normal weight drill pipe (NWDP) connections. For a given connection type, a TWDP tool joint will often have a larger OD and/or smaller ID than the corresponding NWDP tool joint. Therefore, the API MUT is higher for most TWDP connections and the seal widths should be modified to prevent seal stresses in excess of the connection's yield strength, which could cause seal damage. The acceptance criteria in this table has been set to ensure that the seal stress will not exceed the connection yield strength at API MUT. Because TWDP connection bevel diameters are currently based on API requirements for NWDP connections, existing TWDP connections may not be in compliance with the dimensional criteria in this table.

Table 3.8.2 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco HI TORQUE™ - Thick-Walled Drill Pipe

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 0.750	HT 55	G	3.375	6.531	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
5 1/2 0.750	HT 55	G	3.250	6.601	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352
		S	3.250	6.985	0.313	6	8.357	7.014	6.857	7.347	7.338	4.713	4.667	5.937	5.875	7.357	7.352

Table 3.8.3 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco eXtreme™ Torque - Thick-Walled Drill Pipe

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2 0.750	XT 57	G	3.875	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	3.813	6.775	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 1/2 0.813	XT 57	G	3.750	6.563	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	3.688	6.783	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8 0.625	XT 57	G	4.250	6.707	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		S	4.000	6.961	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8 0.750	XT 57	G	4.125	6.794	0.313	6	8.260	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.8.4 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque™ - Thick-Walled Drill Pipe

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2	TurboTorque™ 550	G	3.875	6.315	0.313	6	8	6.510	6.353	4.750	4.745	5.046	4.999	5.720	5.658	4.753	4.748
0.750		S	3.625	6.459	0.313	6	8	6.510	6.353	4.750	4.745	5.046	4.999	5.720	5.658	4.753	4.748
5 1/2	TurboTorque™ 585	G	3.875	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
0.750		S	3.875	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
5 1/2	TurboTorque™ 585	G	3.750	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
0.813		S	3.750	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
5 7/8	TurboTorque™ 585	G	4.500	6.695	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
0.625		S	4.125	6.810	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
		V-150	3.875	6.842	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
5 7/8	TurboTorque™ 585	G	4.250	6.671	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
0.750		S	3.750	6.778	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
5 7/8	TurboTorque™ 585	G	4.125	6.665	0.313	6	8	6.923	6.766	5.063	5.058	5.370	5.323	6.070	6.008	5.066	5.061
0.813																	

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.8.5 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco TurboTorque-M™ - Thick-Walled Drill Pipe

Nominal Size/Wt	Connection	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Ref.	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2	TurboTorque-M™ 550	G	3.875	6.395	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
0.750		S	3.625	6.620	0.313	6	8	6.510	6.353	5.188	5.183	4.814	5.720	5.658	5.193	5.188
5 7/8	TurboTorque-M™ 585	G	4.500	6.862	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
0.625		S	4.125	6.973	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
		V-150	3.875	7.004	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
5 7/8	TurboTorque-M™ 585	G	4.250	6.839	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
0.750		S	3.625	6.942	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
5 7/8	TurboTorque-M™ 585	G	4.125	6.822	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500
0.813		S	3.500	7.015	0.313	6	8	6.923	6.766	5.500	5.495	5.138	6.070	6.008	5.505	5.500

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.

2 Tong space excludes hardbanding.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.8.6 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco uXT™ - Thick-Walled Drill Pipe

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5 1/2	uXT 57	G	3.875	6.563	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
0.750		S	3.875	6.676	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 1/2	uXT 57	G	3.750	6.563	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
0.813		S	3.750	6.677	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8	uXT 57	G	4.438	6.711	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
0.625		S	4.125	6.894	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
		V-150	3.875	6.944	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8	uXT 57	G	4.250	6.745	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
0.750		S	3.750	6.888	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
5 7/8	uXT 57	G	4.125	6.737	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255
0.813		S	3.500	6.854	0.313	6	8.26	6.862	6.705	7.250	7.241	5.309	5.262	5.971	5.909	7.260	7.255

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.

2 Tong space excludes hardbanding.

3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.8.7 Used Tool Joint Acceptance Criteria

(All dimensions in inches)

Grant Prideco Delta™ - Thick-Walled Drill Pipe

Nominal Size/Wt	Conn	Grade	Premium Class New ID[1]	Premium Class Min OD[1]	Min CBore Wall	Minimum Tong Space[2] Pin	Minimum Tong Space[2] Box	Bevel Diameter[4] Max	Bevel Diameter[4] Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Cbore Diameter Max	Box Cbore Diameter Min	Box Connection Length Max	Box Connection Length Min
5	Delta 527	G-105	3.125	6.065	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
0.750		S-135	3.125	6.092	0.250	6	6.5	6.468	6.248	5.250	5.241	4.713	4.666	5.486	5.423	5.255	5.248
	Delta 544	G-105	3.375	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
		S-135	3.375	6.232	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
5 1/2	Delta 544	G-105	3.875	6.330	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
0.750		S-135	3.563	6.538	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
	Delta 576	G-105	3.875	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S-135	3.875	6.684	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	3.625	6.726	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
5 1/2	Delta 544	G-105	3.750	6.311	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
0.813		S-135	3.438	6.542	0.313	6	6.5	6.601	6.381	5.125	5.116	4.893	4.846	5.653	5.590	5.130	5.123
	Delta 576	G-105	3.750	6.549	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		S-135	3.750	6.679	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
5 7/8	Delta 576	G-105	4.500	6.789	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
0.625		S-135	4.125	6.914	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
		V-150	3.875	6.952	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
5 7/8	Delta 576	G-105	4.250	6.772	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311
0.750		S-135	3.688	6.859	0.313	6	6.5	6.963	6.743	5.313	5.304	5.190	5.143	5.970	5.907	5.318	5.311

1 Premium Class Min OD is the Grant Prideco minimum acceptable box OD for the connection or the box OD which generates a 0.8 TSR between the connection and the Premium Class tube, whichever is greater. The values in the table are based on one tool joint reference ID. For other IDs, the value may vary. The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the Grant Prideco online performance calculator shall be used to determine premium OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
2 Tong space excludes hardbanding.
3 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.
4 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range [8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to [1]	Bevel Diameter Range [2] Min	Bevel Diameter Range [2] Max	Other Dimensions [6]	
NC23	1 1/8	2 58/64	3 9/64	--	--	--	--	3 1/8	2 61/64	3 4/64	Max Pin Length	3 1/16
	1 1/4	2 56/64	3 7/64	--	--	--	--				Min C'Bore Depth	9/16
	1 1/2	2 51/64	3	--	--	--	--				Max C'Bore Diameter	2 11/16
	1 3/4	2 42/64	2 53/64	--	--	--	--				Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
NC26	1 1/2	3 17/64	3 34/64	--	--	--	--	3 3/8	3 19/64	**3 22/64**[7]	Max Pin Length	3 1/16
	1 3/4	3 12/64	3 27/64	--	--	--	--	3 1/2	3 20/64	3 29/64	Min C'Bore Depth	9/16
	2	3 2/64	3 15/64	--	--	--	--	3 5/8	3 20/64	**3 30/64**[7]	Max C'Bore Diameter	3
								3 3/4	3 20/64	**3 30/64**[7]	Boreback Diameter	N/A
								3 7/8	3 20/64	**3 42/64**[7]	Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
NC31	1 1/2	3 63/64	4 20/64	--	--	--	--	4 1/8	3 63/64	4 5/64	Max Pin Length	3 9/16
	1 3/4	3 60/64	4 16/64	--	--	--	--	4 1/4	3 63/64	4 13/64	Min C'Bore Depth	9/16
	2	3 55/64	4 10/64	--	--	--	--	4 3/8	3 63/64	4 21/64	Max C'Bore Diameter	3 33/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
NC35	2	4 23/64	4 46/64	--	--	--	--	4 1/2	4 21/64	4 29/64	Max Pin Length	3 13/16
	2 1/4	4 18/64	4 39/64	--	--	--	--	4 5/8	4 21/64	4 37/64	Min C'Bore Depth	9/16
	2 1/2	4 10/64	4 30/64	--	--	--	--	4 3/4	4 21/64	4 43/64	Max C'Bore Diameter	3 7/8
											Boreback Diameter	3 15/64 - 3 16/64
											Pin Relief Diameter	3.200 - 3.231
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	6 3/4 - 7 13/16
NC38	2 1/4	4 44/64	5 4/64	--	--	--	--	4 3/4	4 39/64	4 45/64	Max Pin Length	4 1/16
	2 1/2	4 38/64	4 61/64	--	--	--	--	4 7/8	4 39/64	4 53/64	Min C'Bore Depth	9/16
								5	4 39/64	4 61/64	Max C'Bore Diameter	4 9/64
								5 1/8	4 39/64	5 5/64	Boreback Diameter	3 30/64 - 3 31/64
								5 1/4	4 39/64	5 5/64	Pin Relief Diameter	3.477 - 3.508
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 - 8 1/16

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range [8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to [1]	Bevel Diameter Range [2] Min	Bevel Diameter Range [2] Max	Other Dimensions [6]	
NC40	2	5 6/64	5 34/64	--	--	--	--	5 1/4	5 2/64	5 13/64	Max Pin Length	4 9/16
	2 1/4	5 3/64	5 29/64	--	--	--	--	5 3/8	5 2/64	5 21/64	Min C'Bore Depth	9/16
	2 1/2	4 62/64	5 24/64	--	--	--	--	5 1/2	5 2/64	5 27/64	Max C'Bore Diameter	4 13/32
	2 13/16	4 53/64	5 13/64	--	--	--	--	5 5/8	5 2/64	5 27/64	Boreback Diameter	3 42/64 - 3 43/64
								5 3/4	5 2/64	5 27/64	Pin Relief Diameter	3.741 - 3.772
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 1/2 - 8 9/16
NC44	2 1/4	5 35/64	5 63/64 [8]	6 [8]	6 10/64	--	--	5 1/2	5 27/64	5 29/64	Max Pin Length	4 9/16
	2 1/2	5 31/64	5 60/64	6 [8]	6 5/64	--	--	5 5/8	5 27/64	5 37/64	Min C'Bore Depth	9/16
	2 13/16	5 24/64	5 52/64	--	--	--	--	5 3/4	5 27/64	5 45/64	Max C'Bore Diameter	4 3/4
	3	5 19/64	5 45/64	--	--	--	--	5 7/8	5 27/64	5 53/64	Boreback Diameter	4 - 4 1/64
								6	5 27/64	5 56/64	Pin Relief Diameter	4.086 - 4.117
								6 1/8	5 27/64	5 56/64	Pin Relief Width	3/4 (+9/32, -1/32)
								6 1/4	5 27/64	**5 57/64** [7]	Boreback Cylinder Length	7 1/2 - 8 9/16
NC46	2 1/4	5 54/64	5 63/64 [8]	6 10/64	6 31/64	--	--	6	5 45/64	5 61/64	Max Pin Length	4 9/16
	2 1/2	5 51/64	5 63/64 [8]	6 7/64	6 27/64	--	--	6 1/8	5 45/64	6 5/64	Min C'Bore Depth	9/16
	2 13/16	5 45/64	5 63/64 [8]	6	6 20/64	--	--	6 1/4	5 45/64	6 13/64	Max C'Bore Diameter	4 31/32
	3	5 41/64	5 63/64 [8]	6 [8]	6 14/64	--	--	6 3/8	5 45/64	6 19/64	Boreback Diameter	4 13/64 - 4 7/32
								6 1/2	5 45/64	6 19/64	Pin Relief Diameter	4.295 - 4.326
								6 5/8	5 45/64	6 19/64	Pin Relief Width	3/4 (+9/32, -1/32)
								6 3/4	5 45/64	6 19/64	Boreback Cylinder Length	7 1/2 - 8 9/16
								6 7/8	5 45/64	6 19/64		
NC50	2 1/4	--	--	6 50/64	7 9/64	--	--	6 1/4	6 11/64	6 13/64	Max Pin Length	4 9/16
	2 1/2	--	--	6 47/64	7 6/64	--	--	6 3/8	6 19/64	**6 23/64** [7]	Min C'Bore Depth	9/16
	2 13/16	--	--	6 43/64	7 1/64	--	--	6 1/2	6 21/64	6 29/64	Max C'Bore Diameter	5 3/8
	3	--	--	6 39/64	6 60/64	--	--	6 5/8	6 21/64	6 37/64	Boreback Diameter	4 40/64 - 4 41/64
	3 1/4	--	--	6 32/64	6 53/64	--	--	6 3/4	6 21/64	6 45/64	Pin Relief Diameter	4.711 - 4.742
	3 1/2	--	--	6 24/64	6 44/64	--	--	6 7/8	6 21/64	6 51/64	Pin Relief Width	3/4 (+9/32, -1/32)
								7	6 21/64	6 51/64	Boreback Cylinder Length	7 1/2 - 8 9/16
								7 1/8	6 21/64	6 51/64		
								7 1/4	6 21/64	6 51/64		
NC56	2 1/2	--	--	7 28/64	7 55/64	8 [8]	8 13/64	7 1/4	7 4/64	7 13/64	Max Pin Length	5 1/16
	2 13/16	--	--	7 24/64	7 51/64	8 [8]	8 8/64	7 3/8	7 4/64	7 21/64	Min C'Bore Depth	9/16
	3	--	--	7 21/64	7 48/64	8 [8]	8 5/64	7 1/2	7 4/64	7 29/64	Max C'Bore Diameter	6
	3 1/4	--	--	7 17/64	7 42/64	--	--	7 5/8	7 4/64	7 37/64	Boreback Diameter	4 51/64 - 4 52/64
	3 1/2	--	--	7 10/64	7 35/64	--	--	7 3/4	7 4/64	7 45/64	Pin Relief Diameter	5.246 - 5.277
								7 7/8	7 4/64	7 53/64	Pin Relief Width	3/4 (+9/32, -1/32)
								8	7 4/64	7 58/64	Boreback Cylinder Length	8 - 9 1/16

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
NC61	2 13/16	--	--	7 10/64	7 35/64	--	--	8	7 47/64	7 61/64	Max Pin Length	5 9/16
	3	--	--	--	--	8 27/64	9 2/64	8 1/8	7 47/64	8 5/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	8 24/64	8 63/64	8 1/4	7 47/64	8 13/64	Max C'Bore Diameter	6 9/16
	3 1/2	--	--	--	--	8 21/64	8 59/64	8 3/8	7 47/64	8 21/64	Boreback Diameter	5 15/64 - 5 16/64
								8 1/2	7 47/64	8 29/64	Pin Relief Diameter	5.808 - 5.839
								8 5/8	7 47/64	8 37/64	Pin Relief Width	3/4 (+9/32, -1/32)
								8 3/4	7 47/64	8 45/64	Boreback Cylinder Length	8 1/2 - 9 9/16
								8 7/8	7 47/64	8 53/64		
								9	7 47/64	8 54/64		
NC70	2 13/16	--	--	--	--	9 45/64	10 26/64	9 1/4	8 57/64	9 13/64	Max Pin Length	6 1/16
	3	--	--	--	--	9 43/64	10 24/64	9 3/8	8 57/64	9 21/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	9 41/64	10 22/64	9 1/2	8 57/64	9 29/64	Max C'Bore Diameter	7 7/16
	3 1/2	--	--	--	--	9 38/64	10 18/64	9 5/8	8 57/64	9 37/64	Boreback Diameter	5 63/64 - 6
								9 3/4	8 57/64	9 45/64	Pin Relief Diameter	6.683 - 6.714
								9 7/8	8 57/64	9 53/64	Pin Relief Width	3/4 (+9/32, -1/32)
								10	8 57/64	9 61/64	Boreback Cylinder Length	9 - 10 1/16
2 3/8 REG	1 7/16	2 47/64	2 62/64	--	--	--	--	3 1/8	2 62/64	3 5/64	Max Pin Length	3 1/16
	1 1/2	2 45/64	2 60/64	--	--	--	--	3 1/4	2 62/64	3 13/64	Min C'Bore Depth	9/16
								3 3/8	2 62/64	3 19/64	Max C'Bore Diameter	2 3/4
								3 1/2	2 62/64	3 19/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2 7/8 REG	1 5/16	3 18/64	3 37/64	--	--	--	--	3 7/8	3 31/64	3 51/64	Max Pin Length	3 9/16
	1 1/2	3 15/64	3 34/64	--	--	--	--				Min C'Bore Depth	9/16
	1 3/4	3 9/64	3 27/64	--	--	--	--				Max C'Bore Diameter	3 1/8
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
3 1/2 REG	1 1/2	3 60/64	4 19/64	--	--	--	--	4 3/8	4 6/64	4 21/64	Max Pin Length	3 13/16
	1 3/4	3 56/64	4 15/64	--	--	--	--	4 1/2	4 6/64	4 29/64	Min C'Bore Depth	9/16
	2	3 51/64	4 9/64	--	--	--	--				Max C'Bore Diameter	3 5/8
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
4 1/2 REG	2 1/4	5 23/64	5 53/64	--	--	--	--	5 1/2	5 25/64	5 29/64	Max Pin Length	4 5/16
	2 1/2	5 19/64	5 49/64	--	--	--	--	5 5/8	5 25/64	5 37/64	Min C'Bore Depth	9/16
								5 3/4	5 25/64	5 45/64	Max C'Bore Diameter	4 3/4
								5 7/8	5 25/64	5 53/64	Boreback Diameter	3 46/64 - 3 47/64
								6	5 25/64	5 58/64	Pin Relief Diameter	3.982 - 4.013
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 3/8 - 8 5/16
5 1/2 REG	2 1/2	--	--	6 55/64	7 16/64	--	--	6 5/8	6 35/64	6 37/64	Max Pin Length	4 13/16
	2 13/16	--	--	6 51/64	7 11/64	--	--	6 3/4	6 36/64	6 45/64	Min C'Bore Depth	9/16
	3	--	--	6 47/64	7 7/64	--	--	6 7/8	6 36/64	6 53/64	Max C'Bore Diameter	5 41/64
	3 1/4	--	--	6 41/64	7	--	--	7	6 36/64	6 61/64	Boreback Diameter	4 32/64 - 4 33/64
	3 1/2	--	--	6 33/64	6 55/64	--	--	7 1/8	6 36/64	7 5/64	Pin Relief Diameter	4.838 - 4.869
								7 1/4	6 36/64	7 12/64	Pin Relief Width	3/4 (+9/32, -1/32)
								7 3/8	6 36/64	7 12/64	Boreback Cylinder Length	7 1/2 - 8 13/16
								7 1/2	6 36/64	7 12/64		
6 5/8 REG	2 13/16	--	--	7 45/64	7 56/64[8]	8[8]	8 29/64	7 1/2	7 10/64	7 29/64	Max Pin Length	5 1/16
	3	--	--	7 43/64	7 56/64[8]	8[8]	8 26/64	7 5/8	7 10/64	7 37/64	Min C'Bore Depth	9/16
	3 1/4	--	--	7 39/64	7 56/64[8]	8[8]	8 21/64	7 3/4	7 10/64	7 45/64	Max C'Bore Diameter	6 1/8
	3 1/2	--	--	7 33/64	7 56/64[8]	8[8]	8 14/64	7 7/8	7 10/64	7 53/64	Boreback Diameter	5 18/64 - 5 19/64
								8	7 10/64	7 61/64	Pin Relief Diameter	5.386 - 5.417
								8 1/8	7 10/64	8 5/64	Pin Relief Width	3/4 (+9/32, -1/32)
								8 1/4	7 10/64	8 8/64	Boreback Cylinder Length	8 - 9 1/16
7 5/8 REG FF[3]	2 13/16	--	--	--	--	9 14/64	9 32/64[3]	8 5/8	8 31/64	8 37/64	Max Pin Length	5 5/16
	3	--	--	--	--	9 13/64	9 32/64[3]	8 3/4	8 31/64	8 45/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	9 10/64	9 32/64[3]	8 7/8	8 31/64	8 53/64	Max C'Bore Diameter	7 5/32 (Full Fc)
	3 1/2	--	--	--	--	9 6/64	9 32/64[3]	9	8 31/64	8 61/64	Boreback Diameter	5 55/64 - 5 56/64
								9 1/8	8 31/64	9 5/64	Pin Relief Diameter	6.318 - 6.349
								9 1/4	8 31/64	9 13/64	Pin Relief Width	3/4 (+9/32, -1/32)
								9 3/8	8 31/64	9 21/64	Boreback Cylinder Length	8 3/8 - 9 5/16
								9 1/2	8 31/64	9 29/64		
7 5/8 REG LT[4]	2 1/2	--	--	--	--	9 32/64[4]	9 59/64	9 1/2	8 60/64	9 29/64	Max Pin Length	5 5/16
	2 13/16	--	--	--	--	9 32/64[4]	9 56/64				Min C'Bore Depth	1/4
	3	--	--	--	--	9 32/64[4]	9 54/64				Max C'Bore Diameter	7 13/16 (Low Tq.)
	3 1/4	--	--	--	--	9 32/64[4]	9 51/64				Boreback Diameter	5 55/64 - 5 56/64
	3 1/2	--	--	--	--	9 32/64[4]	9 47/64				Pin Relief Diameter	6.318 - 6.349
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	8 3/8 - 9 5/16

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
8 5/8 REG FF[3]	3	--	--	--	--	N/A[5]	N/A[5]	9 5/8	9 35/64	9 37/64	Max Pin Length	5 7/16
	3 1/4	--	--	--	--	N/A[5]	N/A[5]	9 3/4	9 43/64	9 45/64	Min C'Bore Depth	9/16
	3 1/2	--	--	--	--	N/A[5]	N/A[5]	9 7/8	9 45/64	9 53/64	Max C'Bore Diameter	8 7/64 (Full Fc)
								10	9 45/64	9 61/64	Boreback Diameter	6 50/64 - 6 51/64
								10 1/8	9 45/64	10 5/64	Pin Relief Diameter	7.270 - 7.301
								10 1/4	9 45/64	10 13/64	Pin Relief Width	3/4 (+9/32, -1/32)
								10 3/8	9 45/64	10 21/64	Boreback Cylinder Length	8 1/2 - 9 7/16
								10 1/2	9 45/64	10 29/64		
8 5/8 REG LT[4]	2	--	--	--	--	10 44/64	11 28/64	10 5/8	10 6/64	10 37/64	Max Pin Length	5 7/16
	2 1/4	--	--	--	--	10 43/64	11 28/64				Min C'Bore Depth	1/4
	2 1/2	--	--	--	--	10 42/64	11 27/64				Max C'Bore Diameter	9 1/16 (Low Tq.)
	2 13/16	--	--	--	--	10 41/64	11 25/64				Boreback Diameter	6 50/64 - 6 51/64
	3	--	--	--	--	10 40/64	11 24/64				Pin Relief Diameter	7.270 - 7.301
	3 1/4	--	--	--	--	10 38/64	11 22/64				Pin Relief Width	3/4 (+9/32, -1/32)
	3 1/2	--	--	--	--	10 36/64	11 19/64				Boreback Cylinder Length	8 1/2 - 9 7/16
5 1/2 FH	2 1/2	--	--	7 33/64	7 56/64[8]	--	8 15/64	6 7/8	6 51/64	6 53/64	Max Pin Length	5 1/16
	2 13/16	--	--	7 29/64	7 54/64	--	8 11/64	7	6 59/64	6 61/64	Min C'Bore Depth	9/16
	3	--	--	7 27/64	7 51/64	--	8 8/64	7 1/8	7 1/64	7 5/64	Max C'Bore Diameter	5 31/32
	3 1/4	--	--	7 22/64	7 46/64	--	8 2/64	7 1/4	7 1/64	7 13/64	Boreback Diameter	5 7/64 - 5 8/64
								7 3/8	7 1/64	7 21/64	Pin Relief Diameter	5 7/32 - 5 8/32
								7 1/2	7 1/64	7 28/64	Pin Relief Width	3/4 (+9/32, -1/32)
								7 5/8	7 1/64	7 28/64	Boreback Cylinder Length	8 - 9 1/16
								7 3/4	7 1/64	7 28/64		
								7 7/8	7 1/64	7 28/64		
								8	7 1/64	**7 31/64**[7]		
6 5/8 FH	2 13/16	--	--	--	--	9 5/64	9 44/64	8	7 59/64	7 61/64	Max Pin Length	5 1/16
	3	--	--	--	--	9 3/64	9 42/64	8 1/8	8 3/64	8 5/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	9	9 39/64	8 1/4	8 11/64	8 13/64	Max C'Bore Diameter	6 29/32
	3 1/2	--	--	--	--	8 61/64	9 35/64	8 3/8	8 12/64	8 21/64	Boreback Diameter	6 3/64 - 6 4/64
								8 1/2	8 12/64	8 29/64	Pin Relief Diameter	6.148 - 6.179
								8 5/8	8 12/64	8 37/64	Pin Relief Width	3/4 (+9/32, -1/32)
								8 3/4	8 12/64	8 42/64	Boreback Cylinder Length	8 - 9 1/16
								8 7/8	8 12/64	8 42/64		
								9	8 12/64	8 42/64		
								9 1/8	8 12/64	8 42/64		
								9 1/4	8 12/64	8 42/64		

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
NC77	2 13/16	--	--	--	--	10 44/64	11 30/64	10 1/2	9 51/64	10 29/64	Max Pin Length	6 9/16
	3	--	--	--	--	10 43/64	11 29/64	10 5/8	9 51/64	10 37/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	10 41/64	11 27/64	10 3/4	9 51/64	10 45/64	Max C'Bore Diameter	8 1/8
	3 1/2	--	--	--	--	10 39/64	11 24/64	10 7/8	9 51/64	10 53/64	Boreback Diameter	6 35/64 - 6 36/64
								11	9 51/64	10 61/64	Pin Relief Diameter	7.371 - 7.402
								11 1/8	9 51/64	11 5/64	Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	9 1/2 - 10 9/16
3-1/2 FH	2	4 35/64	4 60/64	--	--	--	--	4 7/8	4 40/64	4 53/64	Max Pin Length	3 13/16
	2 1/4	4 30/64	4 55/64	--	--	--	--	5	4 40/64	4 61/64	Min C'Bore Depth	9/16
	2 1/2	4 23/64	4 47/64	--	--	--	--	5 1/8	4 40/64	5 4/64	Max C'Bore Diameter	4 7/64
								5 1/4	4 40/64	5 4/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
4-1/2 FH	2 1/2	5 36/64	5 63/64[8]	6[8]	6 13/64	--	--	5 3/4	5 37/64	5 45/64	Max Pin Length	4 1/16
	2 13/16	5 30/64	5 60/64	6[8]	6 5/64	--	--	5 7/8	5 37/64	5 53/64	Min C'Bore Depth	9/16
	3	5 25/64	5 53/64	--	--	--	--	6	5 37/64	5 61/64	Max C'Bore Diameter	4 15/16
	3 1/4	5 16/64	5 43/64	--	--	--	--	6 1/8	5 37/64	5 63/64	Boreback Diameter	3 61/64 - 3 62/64
								6 1/4	5 37/64	5 63/64	Pin Relief Diameter	4.149 - 4.180
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 - 8 1/16
2-3/8 OH	1 15/16	3 5/64	3 17/64	--	--	--	--	3 1/8	3 2/64	3 5/64	Max Pin Length	2 9/16
	2	3 2/64	3 14/64	--	--	--	--	3 1/4	3 2/64	3 13/64	Min C'Bore Depth	9/16
								3 3/8	3 2/64	3 19/64	Max C'Bore Diameter	2 55/64
								3 1/2	3 2/64	3 19/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-7/8 OH	1 3/4	3 48/64	4 3/64	--	--	--	--	3 3/4	3 40/64	3 45/64	Max Pin Length	3 1/16
	2	3 43/64	3 60/64	--	--	--	--	3 7/8	3 40/64	3 53/64	Min C'Bore Depth	9/16
								4	3 40/64	3 61/64	Max C'Bore Diameter	3 17/64
								4 1/8	3 40/64	4 1/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
2-3/8 PAC	1 3/8	2 46/64	2 59/64	--	--	--	--	2 3/4	2 43/64	**2 46/64**[7]	Max Pin Length	2 7/16
	1 1/2	2 43/64	2 55/64	--	--	--	--	2 7/8	2 44/64	2 49/64	Min C'Bore Depth	5/16
	1 3/4	2 33/64	2 42/64	--	--	--	--	3	2 44/64	2 49/64	Max C'Bore Diameter	2 15/32
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-7/8 PAC	1 1/2	2 60/64	3 9/64	--	--	--	--	3 1/8	2 56/64	3 5/64	Max Pin Length	2 7/16
	1 3/4	2 52/64	2 63/64	--	--	--	--				Min C'Bore Depth	5/16
											Max C'Bore Diameter	2 41/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
3-1/2 PAC	1 1/2	3 41/64	3 60/64	--	--	--	--	3 3/4	3 36/64	3 45/64	Max Pin Length	3 5/16
	1 3/4	3 37/64	3 55/64	--	--	--	--	3 7/8	3 36/64	3 53/64	Min C'Bore Depth	9/16
	2	3 31/64	3 47/64	--	--	--	--				Max C'Bore Diameter	3 11/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-3/8 SH	1 7/16	2 40/64	2 53/64	--	--	--	--	3	2 47/64	2 61/64	Max Pin Length	3 1/16
	1 1/2	2 39/64	2 51/64	--	--	--	--	3 1/16	2 47/64	3 1/64	Min C'Bore Depth	9/16
								3 1/8	2 47/64	3 1/64	Max C'Bore Diameter	2 9/16
								3 3/16	2 47/64	3 1/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-7/8 XH	1 1/2	3 55/64	4 12/64	--	--	--	--	4 1/8	3 56/64	4 5/64	Max Pin Length	4 1/16
	1 3/4	3 51/64	4 7/64	--	--	--	--	4 1/4	3 56/64	4 13/64	Min C'Bore Depth	9/16
	2	3 46/64	4 1/64	--	--	--	--	4 3/8	3 56/64	4 16/64	Max C'Bore Diameter	3 27/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
3-1/2 XH	1 5/8	4 36/64	4 60/64	--	--	--	--	4 3/4	4 32/64	4 45/64	Max Pin Length	3 9/16
	1 3/4	4 35/64	4 58/64	--	--	--	--	4 7/8	4 32/64	4 53/64	Min C'Bore Depth	9/16
	2	4 31/64	4 54/64	--	--	--	--	5	4 32/64	4 61/64	Max C'Bore Diameter	3 15/16
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
3-1/2 H90	2	4 60/64	5 23/64	--	--	--	--	5	4 50/64	4 61/64	Max Pin Length	4 1/16
	2 1/4	4 57/64	5 18/64	--	--	--	--	5 1/8	4 50/64	5 5/64	Min C'Bore Depth	9/16
	2 1/2	4 51/64	5 12/64	--	--	--	--	5 1/4	4 50/64	5 13/64	Max C'Bore Diameter	4 1/4
								5 3/8	4 50/64	5 17/64	Boreback Diameter	3 36/64 - 3 37/64
								5 1/2	4 50/64	5 17/64	Pin Relief Diameter	3 39/64 - 3 41/64
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 - 8 1/16
4 H90	2	5 29/64	5 59/64	6[8]	6 5/64	--	--	5 1/2	5 17/64	5 29/64	Max Pin Length	4 5/16
	2 1/4	5 27/64	5 56/64	6[8]	6 1/64	--	--	5 5/8	5 17/64	5 37/64	Min C'Bore Depth	9/16
	2 1/2	5 23/64	5 51/64	--	--	--	--	5 3/4	5 17/64	5 45/64	Max C'Bore Diameter	4 5/8
	2 13/16	5 16/64	5 42/64	--	--	--	--	5 7/8	5 17/64	5 47/64	Boreback Diameter	3 56/64 - 3 57/64
								6	5 17/64	5 47/64	Pin Relief Diameter	3 61/64 - 4 1/64
								6 1/8	5 17/64	**5 49/64**[7]	Pin Relief Width	3/4 (+9/32, -1/32)
								6 1/4	5 17/64	**5 49/64**[7]	Boreback Cylinder Length	7 3/8 - 8 5/16
4-1/2 H90	2	5 58/64	5 63/64[8]	6 16/64	6 37/64	--	--	6	5 44/64	5 61/64	Max Pin Length	4 9/16
	2 1/4	5 56/64	5 63/64[8]	6 13/64	6 35/64	--	--	6 1/8	5 44/64	6 2/64	Min C'Bore Depth	9/16
	2 1/2	5 53/64	5 63/64[8]	6 10/64	6 31/64	--	--	6 1/4	5 44/64	6 2/64	Max C'Bore Diameter	4 61/64
	2 13/16	5 47/64	5 63/64[8]	6 3/64	6 24/64	--	--	6 3/8	5 44/64	6 2/64	Boreback Diameter	4 12/64 - 4 13/64
	3	5 43/64	5 63/64[8]	6[8]	6 18/64	--	--	6 1/2	5 44/64	6 2/64	Pin Relief Diameter	4.319 - 4.350
	3 1/4	5 35/64	5 63/64	6[8]	6 8/64	--	--	6 5/8	5 44/64	**6 17/64**[7]	Pin Relief Width	3/4 (+9/32, -1/32)
								6 3/4	5 44/64	**6 17/64**[7]	Boreback Cylinder Length	7 1/2 - 8 9/16
5 H90	2 1/4	--	--	6 38/64	6 61/64	--	--	6 1/2	6 4/64	6 29/64	Max Pin Length	4 13/16
	2 1/2	--	--	6 35/64	6 58/64	--	--	6 5/8	6 4/64	6 29/64	Min C'Bore Depth	9/16
	2 13/16	--	--	6 30/64	6 52/64	--	--	6 3/4	6 4/64	6 29/64	Max C'Bore Diameter	5 15/64
	3	--	--	6 26/64	6 47/64	--	--	6 7/8	6 4/64	6 29/64	Boreback Diameter	4 26/64 - 4 27/64
	3 1/4	5 62/64	5 63/64[8]	6 19/64	6 39/64	--	--	7	6 4/64	6 29/64	Pin Relief Diameter	4 19/32 - 4 5/8
	3 1/2	5 54/64	5 63/64[8]	6 9/64	6 29/64	--	--				Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 1/2 - 8 13/16

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
5-1/2 H90	2 1/4	--	--	7	7 24/64	--	--	6 3/4	6 15/64	6 45/64	Max Pin Length	4 13/16
	2 1/2	--	--	6 61/64	7 21/64	--	--	6 7/8	6 15/64	6 53/64	Min C'Bore Depth	9/16
	2 13/16	--	--	6 57/64	7 16/64	--	--				Max C'Bore Diameter	5 1/2
	3	--	--	6 53/64	7 12/64	--	--				Boreback Diameter	4 44/64 - 4 45/64
	3 1/4	--	--	6 47/64	7 6/64	--	--				Pin Relief Diameter	4 55/64 - 4 57/64
	3 1/2	--	--	6 40/64	6 61/64	--	--				Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 1/2 - 8 13/16
6-5/8 H90	2 13/16	--	--	7 53/64	7 56/64[8]	8 2/64	8 38/64	7 5/8	7 6/64	7 37/64	Max Pin Length	5 1/16
	3	--	--	7 50/64	7 56/64[8]	8	8 35/64	7 3/4	7 6/64	7 45/64	Min C'Bore Depth	9/16
	3 1/4	--	--	7 46/64	7 56/64[8]	8[8]	8 30/64	7 7/8	7 6/64	7 53/64	Max C'Bore Diameter	6 1/8
	3 1/2	--	--	7 41/64	7 56/64[8]	8[8]	8 24/64	8	7 6/64	7 61/64	Boreback Diameter	5 17/64 - 5 18/64
								8 1/8	7 6/64	8 3/64	Pin Relief Diameter	5 31/64 - 5 33/64
								8 1/4	7 6/64	8 3/64	Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	8 - 9 1/16
7 H90 FF[3]	2 1/2	--	--	--	--	N/A[5]	N/A[5]	8 1/4	7 48/64	8 13/64	Max Pin Length	5 9/16
	2 13/16	--	--	--	--	N/A[5]	N/A[5]	8 3/8	7 48/64	8 21/64	Min C'Bore Depth	9/16
	3	--	--	--	--	N/A[5]	N/A[5]	8 1/2	7 48/64	8 29/64	Max C'Bore Diameter	6 5/8 (Full Fc)
	3 1/4	--	--	--	--	8 30/64	8 32/64[3]				Boreback Diameter	5 17/64 - 5 18/64
	3 1/2	--	--	--	--	8 26/64	8 32/64[3]				Pin Relief Diameter	5.914 - 5.945
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	8 1/2 - 9 9/16
7 H90 LT[4]	2 1/2	--	--	--	--	8 38/64	9 15/64	8 5/8	8 17/64	8 37/64	Max Pin Length	5 9/16
	2 13/16	--	--	--	--	8 36/64	9 12/64	8 3/4	8 17/64	8 45/64	Min C'Bore Depth	9/32
	3	--	--	--	--	8 34/64	9 9/64	8 7/8	8 17/64	8 53/64	Max C'Bore Diameter	7 3/16 (Low Tq.)
	3 1/4	--	--	--	--	8 32/64[4]	9 5/64	9	8 17/64	8 61/64	Boreback Diameter	5 17/64 - 5 18/64
	3 1/2	--	--	--	--	8 32/64[4]	9				Pin Relief Diameter	5.914 - 5.945
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	8 1/2 - 9 9/16
7-5/8 H90 FF[3]	2 13/16	--	--	--	--	N/A[5]	N/A[5]	9 3/8	8 50/64	9 21/64	Max Pin Length	6 3/16
	3	--	--	--	--	N/A[5]	N/A[5]	9 1/2	8 50/64	9 29/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	N/A[5]	N/A[5]	9 5/8	8 50/64	9 37/64	Max C'Bore Diameter	7 33/64 (Full Fc)
	3 1/2	--	--	--	--	N/A[5]	N/A[5]				Boreback Diameter	6 - 6 1/64
											Pin Relief Diameter	6.803 - 6.834
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	9 - 10 3/16

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
7-5/8 H90 LT[4]	2 13/16	--	--	--	--	9 55/64	10 37/64	9 3/4	9 21/64	9 45/64	Max Pin Length	6 3/16
	3	--	--	--	--	9 53/64	10 35/64	9 7/8	9 21/64	9 53/64	Min C'Bore Depth	9/32
	3 1/4	--	--	--	--	9 51/64	10 33/64	10	9 21/64	9 61/64	Max C'Bore Diameter	8 1/16 (Low Tq.)
	3 1/2	--	--	--	--	9 48/64	10 29/64	10 1/8	9 21/64	10 5/64	Boreback Diameter	6 - 6 1/64
								10 1/4	9 21/64	10 13/64	Pin Relief Diameter	6.803 - 6.834
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	9 - 10 3/16
8-5/8 H90 FF[3]	2 13/16	--	--	--	--	N/A[5]	N/A[5]	10 1/2	9 47/64	10 29/64	Max Pin Length	6 11/16
	3	--	--	--	--	N/A[5]	N/A[5]	10 5/8	9 47/64	10 37/64	Min C'Bore Depth	9/16
	3 1/4	--	--	--	--	N/A[5]	N/A[5]				Max C'Bore Diameter	8 25/64 (Full Fc)
	3 1/2	--	--	--	--	N/A[5]	N/A[5]				Boreback Diameter	6 3/4 - 6 49/64
											Pin Relief Diameter	7.678 - 7.709
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	9 1/2 - 10 11/16
8-5/8 H90 LT[4]	2 13/16	--	--	--	--	11 8/64	11 60/64	10 3/4	10 43/64	10 45/64	Max Pin Length	6 11/16
	3	--	--	--	--	11 7/64	11 59/64	10 7/8	10 43/64	10 53/64	Min C'Bore Depth	9/32
	3 1/4	--	--	--	--	11 5/64	11 57/64	11	10 43/64	10 61/64	Max C'Bore Diameter	9 7/16 (Low Tq.)
	3 1/2	--	--	--	--	11 3/64	11 55/64	11 1/8	10 43/64	11 5/64	Boreback Diameter	6 3/4 - 6 49/64
								11 1/4	10 43/64	11 13/64	Pin Relief Diameter	7.678 - 7.709
								11 3/8	10 43/64	11 21/64	Pin Relief Width	3/4 (+9/32, -1/32)
								11 1/2	10 43/64	11 24/64	Boreback Cylinder Length	9 1/2 - 10 11/16
NC10	23/32	1 18/64	1 23/64	--	--	--	--	1 3/8	1 19/64	1 21/64	Max Pin Length	1 9/16
											Min C'Bore Depth	3/8
											Max C'Bore Diameter	1 17/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
NC12	29/32	1 31/64	1 38/64	--	--	--	--	1 5/8	1 33/64	**1 38/64**[7]	Max Pin Length	1 13/16
											Min C'Bore Depth	3/8
											Max C'Bore Diameter	1 15/32
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
NC13	15/16	1 44/64	1 51/64	--	--	--	--	1 13/16	1 44/64	**1 50/64**[7]	Max Pin Length	1 13/16
											Min C'Bore Depth	3/8
											Max C'Bore Diameter	1 19/32
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
NC16	1	2	2 9/64	--	--	--	--	2 1/8	1 61/64	**2 6/64**[7]	Max Pin Length	1 13/16
											Min C'Bore Depth	3/8
											Max C'Bore Diameter	1 13/16
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-7/8 FH	2 1/8	3 62/64	4 20/64	--	--	--	--	4 1/4	4 7/64	4 13/64	Max Pin Length	3 9/16
	2 1/4	3 58/64	4 15/64	--	--	--	--	4 3/8	4 7/64	4 21/64	Min C'Bore Depth	9/16
	2 1/2	3 48/64	4 3/64	--	--	--	--	4 1/2	4 7/64	4 25/64	Max C'Bore Diameter	3 3/4
								4 5/8	4 7/64	4 25/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
5-1/2 IF	2 1/8	--	--	--	--	8 43/64	9 17/64	7 7/8	7 51/64	7 53/64	Max Pin Length	5 1/16
	2 1/4	--	--	--	--	8 43/64	9 17/64	8	**7 53/64**[7]	7 61/64	Min C'Bore Depth	9/16
	2 1/2	--	--	--	--	8 41/64	9 15/64	8 1/8	**7 53/64**[7]	8 5/64	Max C'Bore Diameter	6 33/64
	2 3/4	--	--	--	--	8 39/64	9 13/64	8 1/4	**7 53/64**[7]	8 13/64	Boreback Diameter	5 44/64 - 5 45/64
	3	--	--	--	--	8 36/64	9 9/64	8 3/8	7 54/64	8 21/64	Pin Relief Diameter	5.858 - 5.889
	3 1/4	--	--	--	--	8 33/64	9 5/64	8 1/2	7 54/64	8 29/64	Pin Relief Width	3/4 (+9/32, -1/32)
	3 1/2	--	--	--	--	8 28/64	9	8 5/8	7 54/64	8 37/64	Boreback Cylinder Length	8 - 9 1/16
								8 3/4	7 54/64	8 41/64		
								8 7/8	7 54/64	8 41/64		
6-5/8 IF	2 1/4	--	--	--	--	10 15/64	10 60/64	9 3/4	9 13/64	9 45/64	Max Pin Length	5 1/16
	2 1/2	--	--	--	--	10 15/64	10 59/64	9 7/8	9 13/64	9 53/64	Min C'Bore Depth	9/16
	2 3/4	--	--	--	--	10 13/64	10 58/64	10	9 13/64	9 61/64	Max C'Bore Diameter	7 37/64
	3	--	--	--	--	10 12/64	10 56/64	10 1/8	9 13/64	10 5/64	Boreback Diameter	6 48/64 - 6 49/64
	3 1/4	--	--	--	--	10 10/64	10 53/64	10 1/4	9 13/64	10 13/64	Pin Relief Diameter	6.920 - 6.951
	3 1/2	--	--	--	--	10 7/64	10 50/64	10 3/8	9 13/64	10 21/64	Pin Relief Width	3/4 (+9/32, -1/32)
	3 3/4	--	--	--	--	10 4/64	10 47/64				Boreback Cylinder Length	8 - 9 1/16
	4	--	--	--	--	10	10 42/64					

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
3-1/2 OH	2 1/8	4 47/64	5 7/64	--	--	--	--	4 7/8	4 34/64	4 53/64	Max Pin Length	3 5/16
	2 1/4	4 45/64	5 4/64	--	--	--	--	5	4 34/64	4 61/64	Min C'Bore Depth	9/16
	2 1/2	4 39/64	4 61/64	--	--	--	--	5 1/8	4 34/64	5 2/64	Max C'Bore Diameter	4 1/64
								5 1/4	4 34/64	5 2/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
4 OH SW	2 1/2	5 39/64	--	--	6 13/64	--	--	5 5/8	5 22/64	5 37/64	Max Pin Length	4 1/16
	2 3/4	5 34/64	5 62/64	--	6 7/64	--	--	5 3/4	5 22/64	5 45/64	Min C'Bore Depth	9/16
								5 7/8	5 22/64	5 53/64	Max C'Bore Diameter	4 45/64
								6	5 22/64	5 61/64	Boreback Diameter	4 10/64 - 4 11/64
											Pin Relief Diameter	4.135 - 4.166
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	7 - 8 1/16
4 OH LW	2 1/2	5 41/64	--	--	6 15/64	--	--	5 5/8	5 22/64	5 37/64	Max Pin Length	3 9/16
	2 3/4	5 36/64	--	--	6 9/64	--	--	5 3/4	5 22/64	5 45/64	Min C'Bore Depth	9/16
								5 7/8	5 22/64	5 53/64	Max C'Bore Diameter	4 45/64
								6	5 22/64	5 61/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
4-1/2 OH	2 1/8	--	--	6 32/64	6 54/64	--	--	6 3/8	5 54/64	6 21/64	Max Pin Length	3 13/16
	2 1/4	--	--	6 31/64	6 52/64	--	--	6 1/2	5 54/64	6 29/64	Min C'Bore Depth	9/16
	2 1/2	--	--	6 28/64	6 49/64	--	--	6 5/8	5 54/64	6 32/64	Max C'Bore Diameter	5 1/64
	2 3/4	--	--	6 24/64	6 44/64	--	--	6 3/4	5 54/64	6 32/64	Boreback Diameter	4 34/64 - 4 35/64
											Pin Relief Diameter	4.471 - 4.502
											Pin Relief Width	3/4 (+9/32, -1/32)
											Boreback Cylinder Length	6 3/4 - 7 13/16
2-3/8 WO	1 13/16	3 7/64	3 20/64	--	--	--	--	3 1/4	3 7/64	3 13/64	Max Pin Length	2 7/16
								3 3/8	3 7/64	3 21/64	Min C'Bore Depth	9/16
								3 1/2	3 7/64	3 29/64	Max C'Bore Diameter	2 59/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

Connection	ID Nom	Acceptable Outside Diameter Range[8] BSR 1.8 - 2.5 OD Min	BSR 1.8 - 2.5 OD Max	BSR 2.25 - 2.75 OD Min	BSR 2.25 - 2.75 OD Max	BSR 2.5 - 3.2 OD Min	BSR 2.5 - 3.2 OD Max	OD Greater or = to[1]	Bevel Diameter Range[2] Min	Bevel Diameter Range[2] Max	Other Dimensions[6]	
2-7/8 WO	1 1/2	3 60/64	4 16/64	--	--	--	--	4	**3 55/64**[7]	3 61/64	Max Pin Length	3 1/16
								4 1/8	**3 55/64**[7]	4 5/64	Min C'Bore Depth	9/16
								4 1/4	3 57/64	4 13/64	Max C'Bore Diameter	3 7/16
								4 3/8	3 57/64	4 20/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
3-1/2 WO	1 13/16	4 53/64	5 14/64	--	--	--	--	5	4 46/64	4 61/64	Max Pin Length	3 9/16
								5 1/8	4 46/64	5 5/64	Min C'Bore Depth	9/16
											Max C'Bore Diameter	4 9/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-3/8 SL H90	1 1/4	3 20/64	3 36/64	--	--	--	--	3 1/4	3 7/64	3 13/64	Max Pin Length	2 7/8
								3 3/8	3 7/64	3 21/64	Min C'Bore Depth	9/16
											Max C'Bore Diameter	2 53/64
											Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
2-7/8 SL H90	1 1/2	3 60/64	4 15/64	--	--	--	--	4	3 45/64	3 61/64	Max Pin Length	3
								4 1/8	3 45/64	4 5/64	Min C'Bore Depth	9/16
								4 1/4	3 45/64	4 13/64	Max C'Bore Diameter	3 19/64
								4 3/8	3 45/64	4 14/64	Boreback Diameter	N/A
											Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A
3-1/2 SL H90	1 7/8	4 49/64	5 9/64	--	--	--	--	4 3/4	4 28/64	4 45/64	Max Pin Length	3 1/4
	2	4 48/64	5 7/64	--	--	--	--	4 7/8	4 28/64	4 53/64	Min C'Bore Depth	9/16
								5	4 28/64	4 61/64	Max C'Bore Diameter	3 15/16
								5 1/8	4 28/64	5	Boreback Diameter	N/A
								5 1/4	4 28/64	5	Pin Relief Diameter	N/A
											Pin Relief Width	N/A
											Boreback Cylinder Length	N/A

Table 3.9 Used BHA Connection Dimensional Acceptance Criteria

(All dimensions in inches)

NOTES:

1. On BHA components (other than bit boxes) with smaller ODs than listed, break corner 1/32" × 45° or use smallest bevel diameter shown, whichever is smaller. The largest bevel diameter shown for a connection is the largest bevel diameter recommended for that connection. Depending on the mating component's dimensions and the API recommended makeup torque, galling or finning of the seal may occur from makeup alone, which may require seal refacing.
2. It was found that connections employing bevel diameter ranges from DS-1 First and Second Editions may experience seal stresses exceeding yield. This can occur in certain cases when tools with small pin ODs and IDs are mated with tools having large box ODs and are tightened to API makeup torque. To remedy this problem, bevel diameter ranges were calculated to ensure that seal stress always falls between 40 and 100 percent of minimum yield stress at API makeup torque. The formulas and methodology for calculating these bevel diameters are given in the Appendix.
3. The acceptance criteria here are based on the need for a "low torque" face on connections with larger diameters than those shown. For BSRs, see Table 3.16 of this volume.
4. The acceptance criteria here are based on the need for a "full face" on connections with smaller diameters than those shown. For BSRs, see Table 3.16 of this volume.
5. This connection cannot meet the listed BSR with "full face" dimensions.
6. The pin stress relief groove width range in this table is based on the results of finite element analysis (FEA) and fatigue analysis performed by T H Hill Associates. See DS-1 Fifth Edition, Volume 2 for more information on this analysis. If boreback cylinder diameter is the same as the ID of the component, then maximum boreback cylinder length requirement does not apply.
7. Bevel diameter has been modified in order to avoid a conflict with the acceptance criteria in Clause 6.2, API Specification 7-2, First Edition, Addendum 1. Connections may experience a seal stress less than 40 percent of minimum yield stress when tools with large pin IDs are mated with tools having small box ODs and tightened to API makeup torque. Connection may also experience seal stresses exceeding yield in certain cases when tools with small pin ODs and IDs are mated with tools having large box ODs and are tightened to API makeup torque.
8. The specified BSR (Bending Strength Ratio) range determines the acceptable minimum and maximum outside diameters for BHA components. The three BSR ranges (and their corresponding diameters) are:

Drill Collar OD	Recommended BSR Range
< 6 inches	1.8 - 2.5
6 - < 8 inches	2.25 - 2.75
≥ 8 inches	2.5 - 3.2

These ranges are based on the Recommended BSR Ranges and design constraints that have been provided in DS-1 Fifth Edition, Volume 3. They are given here for the inspector's convenience in the event that they apply to the inspection being conducted. If a BSR range other than one of these is specified, the inspector must refer to Table 3.16 of this volume to determine minimum and maximum acceptable outside diameters. If no BSR range is specified, the inspector should check with the person ordering the inspection to determine the BSR range he or she desires. The compliance of acceptable Drill Collar OD ranges with the design constraints has been explained in the following example:

The Outside Diameter Range has been calculated for recommended BSR ranges based on the formulas and methodology provided in DS-1 Fifth Edition, Volume 3.

Connection	ID Nom.	Calculated Outside Diameter Range (Volume 3)					
		BSR 1.8 - 2.5		BSR 2.25 - 2.75		BSR 2.5 - 3.2	
		OD Min	OD Max	OD Min	OD Max	OD Min	OD Max
NC44	2 1/4	5 35/64	6	5 54/64	6 10/64	6	6 27/64

The recommended BSR range of 1.8 - 2.5 is based on Design Constraint that Drill Collar OD < 6". Therefore maximum acceptable OD is restricted to 5 63/64".

The recommended BSR range of 2.25 - 2.75 is based on Design Constraint that Drill Collar OD is between 6" and 7-7/8". Therefore minimum acceptable OD is restricted to 6".

The recommended BSR range of 2.5 - 3.2 is based on Design Constraint that Drill Collar OD ≥ 8". Therefore, there is no acceptable OD range.

Therefore, the Acceptable Outside Diameter Range is given below:

Connection	ID Nom.	Acceptable Outside Diameter Range (Volume 3)					
		BSR 1.8 - 2.5		BSR 2.25 - 2.75		BSR 2.5 - 3.2	
		OD Min	OD Max	OD Min	OD Max	OD Min	OD Max
NC44	2 1/4	5 35/64	5 63/64	6	6 10/64	--	--

Table 3.10.1 Used Heavy Weight Drill Pipe Dimensional Data

(All dimensions in inches)

Size	Conn Type	Nom Box OD	Nom Pin ID	Min Box OD	Max Pin ID[2]	Max Bevel Diameter[4]	Min Seal Width[1]	Max Cbore Diameter	Min Tong Space		Pin Stress Relief Groove		Max Pin Length	Boreback Stress Relief	
									Pin	Box	Diameter	Width[3] (+9/32, -1/32)		Diameter	Length
2 7/8	NC26	3 3/8	1 1/2	3 11/32	1 53/64	3 9/32	9/64	3	7	10	N/A	N/A	3 1/16	N/A	N/A
	NC31	4 1/8	1 3/4	4 1/32	2 5/64	3 31/32	7/32	3 33/64	7	10	N/A	N/A	3 9/16	N/A	N/A
3 1/2	NC38	4 3/4	2 1/16 - 2 1/4	4 21/32	2 25/32	4 19/32	7/32	4 9/64	7	10	3.477 - 3.508	3/4	4 1/16	3 15/32 - 3 31/64	7 - 7 3/4
		4 7/8	2 1/16 - 2 1/4	4 21/32	2 25/32	4 19/32	1/4 [Note 5]	4 9/64	7	10	3.477 - 3.508	3/4	4 1/16	3 15/32 - 3 31/64	7 - 7 3/4
		5	2 1/16 - 2 1/4	4 21/32	2 25/32	4 19/32	1/4 [Note 5]	4 9/64	7	10	3.477 - 3.508	3/4	4 1/16	3 15/32 - 3 31/64	7 - 7 3/4
4	NC40	5 1/4	2 1/2	5 3/32	2 49/64	5 1/32	9/32	4 13/32	7	10	3.741 - 3.772	3/4	4 9/16	3 21/32 - 3 43/64	7 1/2 - 8 1/4
		5 1/4	2 9/16	5 3/32	2 49/64	5 1/32	17/64	4 13/32	7	10	3.741 - 3.772	3/4	4 9/16	3 21/32 - 3 43/64	7 1/2 - 8 1/4
4 1/2	NC46	6 1/4	2 11/16	5 51/64	3 1/8	5 47/64	11/32	4 31/32	7	10	4.295 - 4.326	3/4	4 9/16	4 13/64 - 4 7/32	7 1/2 - 8 1/4
		6 1/4	2 3/4 - 2 13/16	5 51/64	3 1/8	5 47/64	21/64	4 31/32	7	10	4.295 - 4.326	3/4	4 9/16	4 13/64 - 4 7/32	7 1/2 - 8 1/4
5	NC50	6 5/8	3	6 9/64	3 11/16	6 5/64	3/8	5 3/8	7	10	4.711 - 4.742	3/4	4 9/16	4 5/8 - 4 41/64	7 1/2 - 8 1/4
5 1/2	5 1/2 FH	7	3 1/4 - 3 3/8	6 51/64	4 9/64	6 47/64	3/8	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7	3 7/8	6 51/64	4 9/64	6 47/64	23/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7	4	6 51/64	4 9/64	6 47/64	21/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/4	3 1/4 - 3 3/8	6 51/64	4 9/64	6 47/64	13/32 [Note 5]	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/4	3 7/8	6 51/64	4 9/64	6 47/64	23/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/4	4	6 51/64	4 9/64	6 47/64	21/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/2	3 1/4	7 11/64	3 7/16	7 7/64	29/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/2	3 3/8	7 11/64	3 1/2	7 7/64	7/16	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/2	3 7/8	7 11/64	4	7 7/64	23/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
		7 1/2	4	7 11/64	4 1/8	7 7/64	21/64	5 31/32	7	10	5.219 - 5.250	3/4	5 1/16	5 7/64 - 5 1/8	8 - 8 3/4
6 5/8	6 5/8 FH	8	4 - 4 1/2	7 25/32	5 3/64	7 23/32	25/64	6 29/32	7	10	6.148 - 6.179	3/4	5 1/16	6 3/64 - 6 1/16	8 - 8 3/4
		8	5	7 25/32	5 1/8	7 23/32	21/64	6 29/32	7	10	6.148 - 6.179	3/4	5 1/16	6 3/64 - 6 1/16	8 - 8 3/4
		8 1/4	4 - 4 1/2	7 25/32	5 3/64	7 23/32	27/64 [Note 5]	6 29/32	7	10	6.148 - 6.179	3/4	5 1/16	6 3/64 - 6 1/16	8 - 8 3/4
		8 1/4	5	7 25/32	5 1/8	7 23/32	27/64	6 29/32	7	10	6.148 - 6.179	3/4	5 1/16	6 3/64 - 6 1/16	8 - 8 3/4
		8 1/2	4 - 4 1/2	7 25/32	5 3/64	7 23/32	27/64 [Note 5]	6 29/32	7	10	6.148 - 6.179	3/4	5 1/16	6 3/64 - 6 1/16	8 - 8 3/4
		8 1/2	5	7 25/32	5 1/8	7 23/32	27/64	6 29/32	7	10	6.148 - 6.179	3/4	5 1/16	6 3/64 - 6 1/16	8 - 8 3/4

Notes:

1 Values shown are based on concentric wear. In case of eccentric wear, ensure the minimum bevel width is 1/32 inch.

2 Maximum pin ID is determined from the larger of 1) 1/8 inch increase over assumed new standard ID; or 2) the maximum diameter at which a connection with the indicated minimum box OD would be box weak.

3 The pin stress relief groove width range in this table is based on the results of finite element analysis (FEA) and fatigue analysis performed by T H Hill Associates. See DS-1 Fifth Edition, Volume 2 for more information on this analysis.

4 The maximum bevel diameter requirements are based on the bevel diameter of tool joint connections for normal weight drill pipe in API Specification 5DP (First Edition). The minimum seal widths are calculated to ensure the seal stress falls below 100 percent of minimum specified yield stress. The minimum box OD is determined by adding 1/16 inch to the maximum bevel diameter, which allows for the minimum 1/32-inch wide 45 degree bevel. The method for determining the maximum pin ID is given in Note 2.

5 Seal width has been modified in order to avoid a conflict with the bevel diameter acceptance criteria of tool joint connections for normal weight drill pipe in API Specification 5DP (First Edition). The connection when tightened to API recommended make-up torque, may experience seal stresses exceeding yield in certain cases.

Table 3.10.2 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco HI TORQUE™

Nominal		Min	Standard	Bevel Diameter[3]		Minimum Tong Space[4]		Min Cbore Wall	Box CBore Diameter		Pin Connection Length		Pin Nose Diameter		Box Connection Length	
Size	Connection	Box OD[1]	Pin ID[2]	Max	Min	Pin	Box		Max	Min	Max	Min	Max	Min	Max	Min
3 1/2	HT 38	4.704	2.250	4.794	4.637	6.000	8.000	0.313	4.109	4.047	5.505	5.496	3.219	3.172	5.515	5.510
4	HT 40	4.969	2.563	5.016	4.859	6.000	8.000	0.313	4.375	4.313	6.276	6.267	3.353	3.306	6.286	6.281
5	HT 50	5.938	3.000	6.281	6.124	6.000	8.000	0.313	5.344	5.282	6.159	6.150	4.344	4.298	6.169	6.164
5 1/2	HT 55	6.531	3.250	7.014	6.857	6.000	8.357	0.313	5.937	5.875	7.347	7.338	4.713	4.667	7.357	7.352
6 5/8	HT 65	7.469	4.500	7.704	7.547	6.000	8.509	0.313	6.875	6.813	7.500	7.491	5.613	5.566	7.509	7.504

Table 3.10.3 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco eXtreme™ Torque

Nominal		Min	Standard	Bevel Diameter[3]		Minimum Tong Space[4]		Min Cbore Wall	Box CBore Diameter		Pin Connection Length		Pin Nose Diameter		Box Connection Length	
Size	Connection	Box OD[1]	Pin ID[2]	Max	Min	Pin	Box		Max	Min	Max	Min	Max	Min	Max	Min
3 1/2	XT 38	4.478	2.250	4.704	4.547	6.000	8.000	0.250	4.009	3.947	4.625	4.616	3.378	3.332	4.628	4.623
4	XT 39	4.653	2.563	4.927	4.770	6.000	8.000	0.250	4.183	4.121	4.500	4.491	3.578	3.531	4.503	4.498
	XT 40	4.859	2.563	5.157	5.000	6.000	8.000	0.250	4.386	4.324	4.500	4.491	3.782	3.735	4.503	4.498
4 1/2	XT 43	5.156	2.750	5.204	5.047	6.000	8.000	0.313	4.550	4.488	3.656	3.647	3.974	3.927	3.659	3.654
	XT 46	5.734	2.750	6.075	5.918	6.000	8.510	0.313	5.133	5.071	7.500	7.491	4.368	4.321	7.510	7.505
5	XT 50	6.065	3.000	6.459	6.302	6.000	8.310	0.313	5.471	5.409	7.300	7.291	4.790	4.743	7.310	7.305
5 1/2	XT 54	6.313	3.250	6.610	6.453	6.000	8.010	0.313	5.729	5.667	7.000	6.991	5.067	5.020	7.010	7.005
	XT 57	6.563	3.250	6.862	6.705	6.000	8.260	0.313	5.971	5.909	7.250	7.241	5.309	5.262	7.260	7.255
5 7/8	XT 57	6.563	4.000	6.862	6.705	6.000	8.260	0.313	5.971	5.909	7.250	7.241	5.309	5.262	7.260	7.255
6 5/8	XT 65	7.441	4.500	7.860	7.703	6.000	9.260	0.313	6.846	6.784	8.250	8.241	6.121	6.074	8.260	8.255
	XT 69	7.816	4.500	7.954	7.797	6.000	8.823	0.313	7.221	7.159	7.813	7.804	6.523	6.476	7.823	7.823

1 Min Box OD is the NOV Grant Prideco minimum acceptable box OD for the connection.
2 The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the online performance calculator shall be used to determine min OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
3 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
4 Tong space excludes hardbanding.
5 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.10.4 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco eXtreme™ Torque-M

Nominal Size	Connection	Min Box OD[1]	Standard Pin ID[2]	Bevel Diameter[3] Max	Bevel Diameter[3] Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Min Cbore Wall	Box CBore Diameter Max	Box CBore Diameter Min	Pin Nose Diameter Ref.	Pin Connection Length Max	Pin Connection Length Min	Box Connection Length Max	Box Connection Length Min
3 1/2	XT-M38	4.478	2.250	4.704	4.547	6.000	8.000	0.250	4.009	3.947	3.146	6.500	6.491	6.510	6.505
4	XT-M39	4.660	2.563	4.927	4.770	6.000	8.000	0.250	4.191	4.129	3.360	6.250	6.241	6.260	6.255
	XT-M40	4.855	2.563	5.157	5.000	6.000	8.000	0.250	4.386	4.324	3.550	6.500	6.491	6.510	6.505
4 1/2	XT-M43	5.156	2.750	5.204	5.047	6.000	8.000	0.313	4.550	4.488	3.742	5.625	5.616	5.635	5.630
	XT-M46	5.719	2.750	6.075	5.918	6.000	8.510	0.313	5.133	5.071	4.136	7.500	7.491	7.510	7.505
5	XT-M50	6.065	3.000	6.459	6.302	6.000	8.310	0.313	5.471	5.409	4.558	7.300	7.291	7.310	7.305
5 1/2	XT-M57	6.563	3.250	6.862	6.705	6.000	8.260	0.313	5.971	5.909	5.076	7.250	7.241	7.260	7.255
5 7/8	XT-M57	6.563	4.000	6.862	6.705	6.000	8.260	0.313	5.971	5.909	5.076	7.250	7.241	7.260	7.255
6 5/8	XT-M65	7.441	4.500	7.860	7.703	6.000	9.260	0.313	6.846	6.784	5.889	8.250	8.241	8.260	8.255

Table 3.10.5 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco Double Shoulder™

Nominal Size	Conn	Min Box OD[1]	Standard Pin ID[2]	Bevel Diameter[3] Max	Bevel Diameter[3] Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Min Cbore Wall	Box CBore Diameter Max	Box CBore Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2	GPDS™ 38	4.570	2.250	4.719	4.562	6.000	6.500	0.250	4.141	4.039	4.407	4.396	3.037	2.928	4.413	4.402
4	GPDS™ 40	4.836	2.563	5.157	5.000	6.000	6.500	0.250	4.406	4.305	4.918	4.907	3.209	3.115	4.927	4.915
4 1/2	GPDS™ 42	4.893	2.750	5.266	5.109	6.000	6.500	0.250	4.424	4.362	4.755	4.744	3.472	3.425	4.760	4.749
	GPDS™ 46	5.523	2.750	5.860	5.703	6.000	6.500	0.313	4.969	4.859	4.918	4.907	3.772	3.662	4.927	4.915
5	GPDS™ 50	5.930	3.000	6.204	6.047	6.000	6.500	0.313	5.375	5.274	4.918	4.907	4.178	4.084	4.927	4.915
5 1/2	GPDS™ 55	6.523	3.250	[NOTE 5]	[NOTE 5]	6.000	6.500	0.313	5.969	5.850	5.431	5.420	4.616	4.522	5.437	5.426
5 7/8	GPDS™ 55	6.523	4.000	[NOTE 5]	[NOTE 5]	6.000	6.500	0.313	5.969	5.850	5.431	5.420	4.616	4.522	5.437	5.426
6 5/8	GPDS™ 65	7.461	4.500	7.844	7.687	6.000	6.500	0.313	6.906	6.778	5.431	5.420	5.553	5.443	5.437	5.426

1 Min Box OD is the NOV Grant Prideco minimum acceptable box OD for the connection.
2 The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the online performance calculator shall be used to determine min OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
3 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
4 Tong space excludes hardbanding.
5 For GPDS55/uGPDS55, bevel diameter varies with tool joint OD. For OD ≤ 7.375", bevel = 6.860" (max), 6.703" (min). For OD ≥ 7.5", bevel = 7.235" (max), 7.078" (min).
6 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.10.6 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco uXT™

Nominal		Min	Standard	Bevel Diameter [3]		Minimum Tong Space [4]		Min Cbore Wall	Box CBore Diameter		Pin Connection Length		Pin Nose Diameter		Box Connection Length	
Size	Conn	Box OD [1]	Pin ID [2]	Max	Min	Pin	Box		Max	Min	Max	Min	Max	Min	Max	Min
3 1/2	uXT 38	4.478	2.250	4.704	4.547	6.000	8.000	0.250	4.009	3.947	4.625	4.616	3.378	3.331	4.628	4.623
4	uXT 39	4.653	2.563	4.927	4.770	6.000	8.000	0.250	4.183	4.121	4.500	4.491	3.578	3.531	4.503	4.498
	uXT 40	4.859	2.563	5.157	5.000	6.000	8.000	0.250	4.386	4.324	4.500	4.491	3.782	3.735	4.503	4.498
4 1/2	uXT 43	5.156	2.750	5.204	5.047	6.000	8.000	0.313	4.55	4.488	3.656	3.647	3.974	3.927	3.659	3.654
	uXT 46	5.734	2.750	6.075	5.918	6.000	8.000	0.313	5.133	5.071	7.500	7.491	4.368	4.321	7.510	7.505
5	uXT 50	6.065	3.000	6.459	6.302	6.000	8.000	0.313	5.471	5.409	7.300	7.291	4.790	4.743	7.310	7.305
5 1/2	uXT 54	6.313	3.250	6.610	6.453	6.000	8.000	0.313	5.729	5.667	7.000	6.991	5.067	5.020	7.010	7.005
	uXT 57	6.563	3.250	6.862	6.705	6.000	8.260	0.313	5.971	5.909	7.250	7.241	5.309	5.262	7.260	7.255
5 7/8	uXT 57	6.563	4.000	6.862	6.705	6.000	8.260	0.313	5.971	5.909	7.250	7.241	5.309	5.262	7.260	7.255
6 5/8	uXT 65	7.441	4.500	7.860	7.703	6.000	9.260	0.313	6.846	6.784	8.250	8.241	6.121	6.074	8.260	8.255

Table 3.10.7 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco uGPDS™

Nominal		Min	Standard	Bevel Diameter [3]		Minimum Tong Space [4]		Min Cbore Wall	Box CBore Diameter		Pin Connection Length		Pin Nose Diameter		Box Connection Length	
Size	Conn	Box OD [1]	Pin ID [2]	Max	Min	Pin	Box		Max	Min	Max	Min	Max	Min	Max	Min
3 1/2	uGPDS™ 38	4.570	2.250	4.719	4.562	6.000	6.500	0.250	4.141	4.041	4.407	4.396	3.037	2.928	4.413	4.402
4	uGPDS™ 40	4.836	2.563	5.157	5.000	6.000	6.500	0.250	4.406	4.305	4.918	4.907	3.209	3.115	4.927	4.915
4 1/2	uGPDS™ 42	4.893	2.750	5.266	5.109	6.000	6.500	0.250	4.424	4.362	4.755	4.744	3.472	3.425	4.760	4.749
5	uGPDS™ 50	5.930	3.000	6.204	6.047	6.000	6.500	0.313	5.375	5.275	4.918	4.907	4.178	4.084	4.927	4.915
5 1/2	uGPDS™ 55	6.523	3.250	[NOTE 5]	[NOTE 5]	6.000	6.500	0.313	5.969	5.850	5.431	5.420	4.616	4.522	5.437	5.426
5 7/8	uGPDS™ 55	6.523	4.000	[NOTE 5]	[NOTE 5]	6.000	6.500	0.313	5.969	5.850	5.431	5.420	4.616	4.522	5.437	5.426
6 5/8	uGPDS™ 65	7.461	4.500	7.844	7.687	6.000	6.500	0.313	6.906	6.778	5.431	5.420	5.553	5.443	5.437	5.426

1 Min Box OD is the NOV Grant Prideco minimum acceptable box OD for the connection.
2 The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the online performance calculator shall be used to determine min OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
3 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
4 Tong space excludes hardbanding.
5 For GPDS55/uGPDS55, bevel diameter varies with tool joint OD. For OD ≤ 7.375", bevel = 6.860" (max), 6.703" (min). For OD ≥ 7.5", bevel = 7.235" (max), 7.078" (min).
6 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.10.8 Used Heavy Weight Drill Pipe Dimensional Data

Grant Prideco Delta™

Nominal Size	Conn	Min Box OD[1]	Standard Pin ID[2]	Bevel Diameter[3] Max	Bevel Diameter[3] Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Min Cbore Wall	Box CBore Diameter Max	Box CBore Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Pin Nose Diameter Min	Box Connection Length Max	Box Connection Length Min
3 1/2	Delta 377	4.433	2.250	4.746	4.526	6.000	6.500	0.250	3.981	3.918	4.375	4.366	3.299	3.252	4.380	4.373
4	Delta 391	4.575	2.563	4.901	4.681	6.000	6.500	0.250	4.122	4.059	4.438	4.429	3.433	3.386	4.443	4.436
4 1/2	Delta 425	4.914	2.750	5.268	5.048	6.000	6.500	0.250	4.461	4.398	4.563	4.554	3.759	3.712	4.568	4.561
	Delta 494	5.737	2.750	6.202	5.982	6.000	6.500	0.313	5.158	5.095	5.625	5.616	4.346	4.299	5.630	5.623
5	Delta 527	6.065	3.000	6.468	6.248	6.000	6.500	0.250	5.486	5.423	5.250	5.241	4.713	4.666	5.255	5.248
	Delta 544	6.232	3.000	6.601	6.381	6.000	6.500	0.313	5.653	5.590	5.125	5.116	4.893	4.846	5.130	5.123
5 1/2	Delta 544	6.232	3.250	6.601	6.381	6.000	6.500	0.313	5.653	5.590	5.125	5.116	4.893	4.846	5.130	5.123
	Delta 576	6.549	3.250	6.963	6.743	6.000	6.500	0.313	5.970	5.907	5.313	5.304	5.190	5.143	5.318	5.311
5 7/8	Delta 576	6.549	4.000	6.963	6.743	6.000	6.500	0.313	5.970	5.907	5.313	5.304	5.190	5.143	5.318	5.311
6 5/8	Delta 663	7.427	4.500	7.936	7.716	6.000	6.627	0.313	6.848	6.785	5.625	5.616	6.036	5.989	5.630	5.623

1 Min Box OD is the NOV Grant Prideco minimum acceptable box OD for the connection.
2 The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the online performance calculator shall be used to determine min OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch.
3 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
4 Tong space excludes hardbanding.
5 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.10.9 Used Heavy Weight Drill Pipe Dimensional Data

Grant Prideco EIS™

Nominal Size	Connection	Min Box OD[1]	Standard Pin ID[2]	Bevel Diameter[3] Max	Bevel Diameter[3] Min	Minimum Tong Space[4] Pin	Minimum Tong Space[4] Box	Min Cbore Wall	Box CBore Diameter Max	Box CBore Diameter Min	Pin Connection Length Max	Pin Connection Length Min	Pin Nose Diameter Max	Box Connection Length Max	Box Connection Length Min
5	NC50 EIS™	5.844	3.000	6.109	5.781	6.000	6.500	0.313	5.375	5.274	5.127	5.120	4.197	5.132	5.125
5 1/2	5 1/2 FH EIS™	6.438	3.250	6.766	6.375	6.000	6.626	0.313	5.969	5.850	5.627	5.620	4.637	5.632	5.625
5 7/8	5 1/2 FH EIS™	6.438	4.000	6.766	6.375	6.000	6.626	0.313	5.969	5.850	5.627	5.620	4.637	5.632	5.625
6 5/8	6 5/8 FH EIS™	7.375	4.500	7.750	7.313	6.000	6.626	0.313	6.906	6.778	5.627	5.620	5.566	5.632	5.625

1 Min Box OD is the NOV Grant Prideco minimum acceptable box OD for the connection.
2 The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the online performance calculator shall be used to determine min OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch
3 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32" x 45° break edge is required.
4 Tong space excludes hardbanding.
5 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.10.10 Used Heavy Weight Drill Pipe Dimensional Data
Grant Prideco Express™

Nominal		Min	Standard	Bevel Diameter [3]		Minimum Tong Space [4]		Min	Box CBore Diameter		Pin Connection Length		Pin Nose Diameter	Box Connection Length	
Size	Connection	Box OD [1]	Pin ID [2]	Max	Min	Pin	Box	Cbore Wall	Max	Min	Max	Min	Max	Max	Min
5	Express VX™ 50	6.031	3.000	6.516	5.953	6.000	8.000	0.203	5.555	5.488	7.005	6.996	4.742	7.005	6.996
5 1/2	Express VX™ 57	6.469	3.250	6.922	6.391	6.000	8.000	0.203	5.990	5.923	7.006	6.997	5.177	7.006	6.997
6 5/8	Express VX™ 57	6.469	4.500	6.922	6.391	6.000	8.000	0.203	5.990	5.923	7.006	6.997	5.177	7.006	6.997
	Express VX™ 65	7.500	4.500	7.922	7.422	6.000	8.375	0.219	7.016	6.949	7.379	7.371	6.166	7.379	7.371

1 Min Box OD is the NOV Grant Prideco minimum acceptable box OD for the connection.
2 The TJ ID is a reference as it impacts other criteria. IDs are produced in increments of 1/16 inch for this connection, and the online performance calculator shall be used to determine min OD and operational capacity of the connection should the actual ID differ from this one by more than 1/16 inch
3 If the actual box OD is less than or equal to the specified bevel diameter plus 3/64 inch, then the bevel diameter range is void and a 1/32” x 45° break edge is required.
4 Tong space excludes hardbanding.
5 When conflicts arise between this standard and manufacturer's requirements, the manufacturer's requirements shall apply.

Table 3.11.1 Classification of Used Workstring Tubing

Condition	Ultra Class	Premium Class	Class 2
Min Remaining Wall Thickness	≥ 90%	≥ 80%	≥ 70%[1]
Cut Depth (slip cuts, gouges, etc)[2]	≤ 5% of avg adjacent wall[3]	≤ 10% of avg adjacent wall[3]	≤ 20% of avg adjacent wall[3]
Round-Bottomed Imperfection Depth (pits, etc)	≤ 10% of avg adjacent wall[3]	Limited by wall thickness requirement	Limited by wall thickness requirement
Diameter Reduction	≤ 2% of specified OD	≤ 3% of specified OD	≤ 4% of specified OD
Diameter Increase	≤ 2% of specified OD	≤ 3% of specified OD	≤ 4% of specified OD
Cracks	None	None	None

1 Minimum remaining wall thickness must be ≥ 80% under transverse cuts and gouges.

2 Surface imperfections include slip cuts, gouges, and corrosion pits. Surface imperfections may be removed by grinding provided the remaining wall is not reduced below the minimum remaining wall shown in this table.

3 Average adjacent wall is determined by averaging the wall thickness on each side of the imperfection adjacent to the deepest penetration.

Table 3.11.2 Dimensional Acceptance Criteria for Used Workstring Tubing

Nominal OD (inches)	Weight (pounds per foot) Non-Upset	Weight (pounds per foot) External Upset	Nominal ID (inches)	Nominal Wall (inches)	Ultra Class Min Wall (90%)	Ultra Class Min OD	Ultra Class Max OD	Premium Class Min Wall (80%)	Premium Class Min OD	Premium Class Max OD	Class 2 Min Wall (70%)	Class 2 Min OD	Class 2 Max OD	UT Field Reference Standard Thick Section Min	UT Field Reference Standard Thick Section Max	UT Field Reference Standard Thin Section Min	UT Field Reference Standard Thin Section Max	Drift Diameter (inches) Min	Drift Diameter (inches) Max
1.050	1.14	1.20	0.824	0.113	0.102	1.029	1.071	0.090	1.019	1.082	0.079	1.008	1.092	0.113	0.213	0.100	0.100	0.730	0.735
1.050	1.48	1.54	0.742	0.154	0.139			0.123			0.108			0.154	0.254	0.100	0.108	0.648	0.653
1.315	1.70	1.80	1.049	0.133	0.120	1.289	1.341	0.106	1.276	1.354	0.093	1.262	1.368	0.133	0.233	0.100	0.100	0.955	0.960
1.315	2.19	2.24	0.957	0.179	0.161			0.143			0.125			0.179	0.279	0.100	0.125	0.863	0.868
1.660	--	--	1.410	0.125	0.113	1.627	1.693	0.100	1.610	1.710	0.088	1.594	1.726	0.125	0.225	0.100	0.100	1.316	1.321
1.660	2.30	2.40	1.380	0.140	0.126			0.112			0.098			0.140	0.240	0.100	0.100	1.286	1.291
1.660	3.03	3.07	1.278	0.191	0.172			0.153			0.134			0.191	0.291	0.100	0.134	1.184	1.189
1.900	--	--	1.650	0.125	0.113	1.862	1.938	0.100	1.843	1.957	0.088	1.824	1.976	0.125	0.225	0.100	0.100	1.556	1.561
1.900	2.75	2.90	1.610	0.145	0.131			0.116			0.102			0.145	0.245	0.100	0.102	1.516	1.521
1.900	3.65	3.79	1.500	0.200	0.180			0.160			0.140			0.200	0.300	0.100	0.140	1.406	1.411
1.900	4.42	--	1.400	0.250	0.225			0.200			0.175			0.250	0.350	0.100	0.175	1.306	1.311
1.900	5.15	--	1.300	0.300	0.270			0.240			0.210			0.300	0.400	0.110	0.210	1.206	1.211
2.063	--	--	1.751	0.156	0.140	2.022	2.104	0.125	2.001	2.125	0.109	1.980	2.146	0.156	0.256	0.100	0.109	1.657	1.662
2.063	4.50	--	1.613	0.225	0.203			0.180			0.158			0.225	0.325	0.100	0.158	1.519	1.524
2 3/8	4.00	--	2.041	0.167	0.150	2.328	2.423	0.134	2.304	2.446	0.117	2.280	2.470	0.167	0.267	0.100	0.117	1.947	1.952
2 3/8	4.60	4.70	1.995	0.190	0.171			0.152			0.133			0.190	0.290	0.100	0.133	1.901	1.906
2 3/8	5.80	5.95	1.867	0.254	0.229			0.203			0.178			0.254	0.354	0.100	0.178	1.773	1.778
2 3/8	6.60	--	1.785	0.295	0.266			0.236			0.207			0.295	0.395	0.107	0.207	1.691	1.696
2 3/8	7.35	7.45	1.703	0.336	0.302			0.269			0.235			0.336	0.436	0.135	0.235	1.609	1.614
2 7/8	6.40	6.50	2.441	0.217	0.195	2.818	2.933	0.174	2.789	2.961	0.152	2.760	2.990	0.217	0.317	0.100	0.152	2.347	2.352
2 7/8	7.80	7.90	2.323	0.276	0.248			0.221			0.193			0.276	0.376	0.100	0.193	2.229	2.234
2 7/8	8.60	8.70	2.259	0.308	0.277			0.246			0.216			0.308	0.408	0.116	0.216	2.165	2.170
2 7/8	9.35	9.45	2.195	0.340	0.306			0.272			0.238			0.340	0.440	0.138	0.238	2.101	2.106
2 7/8	10.50	--	2.091	0.392	0.353			0.314			0.274			0.392	0.492	0.174	0.274	1.997	2.002
2 7/8	11.50	--	1.995	0.440	0.396			0.352			0.308			0.440	0.540	0.208	0.308	1.901	1.906
3 1/2	7.70	--	3.068	0.216	0.194	3.430	3.570	0.173	3.395	3.605	0.151	3.360	3.640	0.216	0.316	0.100	0.151	2.943	2.948
3 1/2	9.20	9.30	2.992	0.254	0.229			0.203			0.178			0.254	0.354	0.100	0.178	2.867	2.872
3 1/2	10.20	--	2.922	0.289	0.260			0.231			0.202			0.289	0.389	0.102	0.202	2.797	2.802
3 1/2	12.70	12.95	2.750	0.375	0.338			0.300			0.263			0.375	0.475	0.163	0.263	2.625	2.630
3 1/2	14.30	--	2.640	0.430	0.387			0.344			0.301			0.430	0.530	0.201	0.301	2.515	2.520
3 1/2	15.50	--	2.548	0.476	0.428			0.381			0.333			0.476	0.576	0.233	0.333	2.423	2.428
3 1/2	17.00	--	2.440	0.530	0.477			0.424			0.371			0.530	0.630	0.271	0.371	2.315	2.320
4	9.50	--	3.548	0.226	0.203	3.920	4.080	0.181	3.880	4.120	0.158	3.840	4.160	0.226	0.326	0.100	0.158	3.423	3.428
4	--	11.00	3.476	0.262	0.236			0.210			0.183			0.262	0.362	0.100	0.183	3.351	3.356
4	13.20	--	3.340	0.330	0.297			0.264			0.231			0.330	0.430	0.131	0.231	3.215	3.220
4	16.10	--	3.170	0.415	0.374			0.332			0.291			0.415	0.515	0.191	0.291	3.045	3.050
4	18.90	--	3.000	0.500	0.450			0.400			0.350			0.500	0.600	0.250	0.350	2.875	2.880
4	22.20	--	2.780	0.610	0.549			0.488			0.427			0.610	0.710	0.327	0.427	2.655	2.660
4 1/2	12.60	12.75	3.958	0.271	0.244	4.410	4.590	0.217	4.365	4.635	0.190	4.320	4.680	0.271	0.371	0.100	0.190	3.833	3.838
4 1/2	15.20	--	3.826	0.337	0.303			0.270			0.236			0.337	0.437	0.136	0.236	3.701	3.706
4 1/2	17.00	--	3.740	0.380	0.342			0.304			0.266			0.380	0.480	0.166	0.266	3.615	3.620
4 1/2	18.90	--	3.640	0.430	0.387			0.344			0.301			0.430	0.530	0.201	0.301	3.515	3.520
4 1/2	21.50	--	3.500	0.500	0.450			0.400			0.350			0.500	0.600	0.250	0.350	3.375	3.380
4 1/2	23.70	--	3.380	0.560	0.504			0.448			0.392			0.560	0.660	0.292	0.392	3.255	3.260
4 1/2	26.10	--	3.240	0.630	0.567			0.504			0.441			0.630	0.730	0.341	0.441	3.115	3.120

Table 3.11.3 API Round Connection Dimensions for Non-Upset Tubing

Nominal OD (inches)	Threads per Inch	Total Length L_4 (inches)	Effective Thread Length L_2 (inches)	Min Full-Height Thread Length L_c (inches)	Perfect Thread Length PTL (inches)
1.050	10	1.094	0.925	0.300	0.994
1.315	10	1.125	0.956	0.300	1.025
1.660	10	1.250	1.081	0.350	1.150
1.900	10	1.375	1.206	0.475	1.275
2 3/8	10	1.625	1.456	0.725	1.525
2 7/8	10	2.063	1.894	1.163	1.963
3 1/2	10	2.313	2.144	1.413	2.213
4	8	2.375	2.140	1.375	2.250
4 1/2	8	2.563	2.328	1.563	2.438

Table 3.11.4 API Round Connection Dimensions for Externally-Upset Tubing

Nominal OD (inches)	Threads per Inch	Total Length L_4 (inches)	Effective Thread Length L_2 (inches)	Min Full-Height Thread Length L_c (inches)	Perfect Thread Length PTL (inches)
1.050	10	1.125	0.956	0.300	1.025
1.315	10	1.250	1.081	0.350	1.150
1.660	10	1.375	1.206	0.475	1.275
1.900	8	1.438	1.269	0.538	1.338
2 3/8	8	1.938	1.703	0.938	1.813
2 7/8	8	2.125	1.890	1.125	2.000
3 1/2	8	2.375	2.140	1.375	2.250
4	8	2.500	2.265	1.500	2.375
4 1/2	8	2.625	2.390	1.625	2.500

Table 3.11.5 Dimensional Acceptance Criteria for API Round Tubing Box Connections / Couplings

Nominal Tubing OD (inches)	Non-Upset Tubing					External Upset Tubing				
	Coupling OD			Minimum Coupling Length (inches)	Pin-Tip Standoff ±0.250 (inches)	Coupling OD			Minimum Coupling Length (inches)	Pin-Tip Standoff ±0.250 (inches)
	Nominal	Minimum (-1%)	Maximum (+1%)			Nominal	Minimum (-1%)	Maximum (+1%)		
1.050	1.313	1.300	1.326	3.188	2.094	1.660	1.643	1.677	3.250	2.125
1.315	1.660	1.643	1.677	3.250	2.125	1.900	1.881	1.919	3.500	2.250
1.660	2.054	2.033	2.075	3.500	2.250	2.200	2.178	2.222	3.750	2.375
1.900	2.200	2.178	2.222	3.750	2.375	2.500	2.475	2.525	3.875	2.438
2 3/8	2.875	2.846	2.904	4.250	2.625	3.063	3.032	3.094	4.875	2.938
2 7/8	3.500	3.465	3.535	5.125	3.063	3.668	3.631	3.705	5.250	3.125
3 1/2	4.250	4.207	4.293	5.625	3.313	4.500	4.455	4.545	5.750	3.375
4	4.750	4.702	4.798	5.750	3.375	5.000	4.950	5.050	6.000	3.500
4 1/2	5.200	5.148	5.252	6.125	3.563	5.563	5.507	5.619	6.250	3.625

Table 3.11.6 Dimensions for Shoulder-Sealing, Two-Step Connections

Nominal OD (inches)	Weight (pounds per foot)	Minimum Box OD (inches)	Maximum Pin ID (inches)	Minimum Pin Length (inches)
2 3/8	5.95	2.782	1.887	3.770
2 3/8	7.70	2.924	1.660	3.770
2 7/8	7.90	3.312	2.306	3.780
2 7/8	8.70	3.365	2.250	3.780
2 7/8	9.50	3.419	2.175	3.780
3 1/2	12.95	4.189	2.765	4.190
3 1/2	15.80	4.367	2.650	4.190
4 1/2	15.50	5.021	3.821	4.190

Table 3.12 Float Bore and Float Valve Data

Valve Assembly Size	Connection Size	Bore Data: Bore Diameter (R, +1/64, -0) (in)	Bore Data: Bore Depth (A, ±1/16) (in) Box Down Configuration	Bore Data: Bore Depth (A, ±1/16) (in) Box Up Configuration	Valve Data: Valve Diameter (D) (in)	Valve Data: Valve Length (L_V) (in)
1R	2-3/8 Reg	1-11/16	9-1/8	9-13/32	1-21/32	5-7/8
1F-2R	2-7/8 Reg	1-15/16	10	10-1/4	1-29/32	6-1/4
2F-3R	3-1/2 Reg	2-7/16	10-1/2	10-1/2	2-13/32	6-1/2
4R	4-1/2 Reg	3-1/2	12-13/16	12-13/16	3-15/32	8-5/16
5R	5-1/2 Reg	3-29/32	14-3/4	15-1/16	3-7/8	9-3/4
4R	6-5/8 Reg	3-1/2	13-9/16	15-13/32	3-15/32	8-5/16
5F-6R	6-5/8 Reg	4-13/16	17	17-13/32	4-25/32	11-3/4
5F-6R	7-5/8 Reg	4-13/16	17-1/4	18-1/8	4-25/32	11-3/4
5F-6R	8-5/8 Reg	4-13/16	17-3/8	19-1/4	4-25/32	11-3/4
6F	8-5/8 Reg	5-23/32	20-1/4	20-9/16	5-11/16	14-5/8
1R	NC 23	1-11/16	9-1/8	9-13/16	1-21/32	5-7/8
1F-2R	NC 26	1-15/16	9-1/2	10-7/32	1-29/32	6-1/4
2F-3R	NC 31	2-7/16	10-1/4	10-29/32	2-13/32	6-1/2
3 ½ IF	NC 38	3-5/32	14-1/4	14-1/4	3-1/8	10
4R	NC 44	3-1/2	13-1/16	13-17/32	3-15/32	8-5/16
4R	NC 46	3-1/2	13-1/16	13-3/4	3-15/32	8-5/16
4F	NC 46	3-11/16	16-3/4	16-3/4	3-21/32	12
4R	NC 50	3-1/2	13-1/16	14-3/16	3-15/32	8-5/16
5R	NC 50	3-29/32	14-1/2	15-3/32	3-7/8	9-3/4
5F-6R	NC61	4-13/16	17-1/2	17-23/32	4-25/32	11-3/4
3F	3-1/2 FH	2-27/32	14	14	2-13/16	10
5F-6R	5-1/2 FH	4-13/16	17	17-7/32	4-25/32	11-3/4
5F-6R	5-1/2 IF	4-13/16	17	17-5/8	4-25/32	11-3/4
6F	6-5/8 IF	5-23/32	19-7/8	20-1/16	5-11/16	14-5/8

Table 3.12.1 Float Bore Calculation

(for cases not covered in Table 3.12)

To determine Float Bore Depth (A):

1) Measure Float Bore Diameter (R)

2) Obtain Valve Size and Valve Length (L_V) corresponding to (R) from Table 3.12 and the Max Pin Length (L_P) for the Sub's connection from Table 3.9.

3) Float Bore Depth

Box Down: (A) ± 1/16" = L_V + L_P + 3/16"

Box Up: (A) ± 1/16" = L_V + L_P + 3/16" + minimum length needed to have all seals seated within the float bore[1]

Where:

R = Bore Diameter

L_V = Valve Length

L_P = Max Pin Length (Table 3.9)

3/16" = Margin for proper Pin and Valve separation

A = Bore Depth

1 See DS-1 Volume 3, Section A.6 in the Appendix for more information on calculating float bore depth for box up configurations.

Table 3.13.1 Pipe Classification and Condition Bands

	Class Note 1	Number	Color	A (± 1")	B (± 1/4")	C (± 1/4")	D (± 1/4")
NWDP & Workstrings	Ultra	1	Blue	18	2	-	-
	Premium	2	White	18	2	2	2
	Class 2	1	Yellow	18	2	-	-
	Premium Reduced TSR	1	Green	18	2	-	-
	TWDP and HWDP	1	White	18	2	-	-
	Rejected (NWDP, Workstrings, TWDP, HWDP)	1	Red	18	2	-	-

Note 1: If marking Scheme-B is used, the marking of rejected components shall be according to procedure described in 3.35.5.2.a.

Table 3.13.2 Tool Joint and BHA Connection Condition Bands

Condition Note 1	Number	Color
Scrapped	1	Red
Shop Repairable	1	Yellow
Field Repairable	1	Green

Note 1: If marking Scheme-B is used, the marking of rejected components shall be according to procedure described in 3.35.5.2.b or 3.35.6.2.b as applicable.

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

(API connections in bold type are box-weak)

Standard makeup torque for most drill pipe rotary shouldered connections is that torque which results in a stress level of 72,000 psi in the weaker of pin or box, as calculated by equation A.1 in DS-1 Fifth Edition, Volume 3, Appendix A. (This torque amounts to 60 percent of minimum yield strength for tool joint material conforming to API Specification 5DP.) Thus, makeup torque on a given rotary shouldered tool joint is independent of the grade of pipe to which the tool joint may be attached. Wedge Thread™ connections are not rotary shouldered, but employ a different principle for carrying torsion. Makeup torques for HI TORQUE™, eXtreme™ Torque, eXtreme™ Torque-M, GPDS™, TurboTorque™, TurboTorque-M™, uXT™, uGPDS™, Delta™, EIS™, Express™, Wedge Thread™, NK DSTJ™, HLIDS, HLMT, HLST, HLIST, DPM-DS, DPM-MT, DPM-ST, DPM-High Torque, and CET connections found in this section are provided by their manufacturers.

Heavy Weight Drill Pipe

For non-proprietary HWDP connections, multiply the MUT value from this table by the factors shown on the right. For proprietary connections, including those listed in this table, consult the manufacturer.

Connection MYS (psi)	Multiply by:
100,000	0.83
110,000	0.92
115,000	0.96
120,000	1.00

NC26

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	3-5/8	3-1/2	3-3/8	3-1/4	3-1/8	3	2-31/32	2-15/16
1 3/4	4260	4260	**4130**	**3000**	**1940**	**940**	**700**	**460**
1 7/8	3640	3640	3640	**3000**	**1940**	**940**	**700**	**460**
2	2990	2990	2990	2990	**1940**	**940**	**700**	**460**
2 1/8	2300	2300	2300	2300	**1940**	**940**	**700**	**460**
2 5/32	2130	2130	2130	2130	**1940**	**940**	**700**	**460**
2 1/4	1580	1580	1580	1580	1580	**940**	**700**	**460**

NC31

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	4-3/8	4-1/4	4-1/8	4	3-7/8	3-3/4	3-5/8	3-1/2
1 5/8	10090	10090	**8510**	**6890**	**5350**	**3870**	**2460**	**1120**
1 3/4	9400	9400	**8510**	**6890**	**5350**	**3870**	**2460**	**1120**
1 7/8	8670	8670	**8510**	**6890**	**5350**	**3870**	**2460**	**1120**
2	7890	7890	7890	**6890**	**5350**	**3870**	**2460**	**1120**
2 1/8	7070	7070	7070	**6890**	**5350**	**3870**	**2460**	**1120**

NC38

1	2	3	4	5	6	7	8	9	10	11	12
	OD (in)										
ID (in)	5	4-15/16	4-7/8	4-13/16	4-3/4	4-11/16	4-5/8	4-9/16	4-1/2	4-7/16	4-3/8
2 1/8	15900	**14900**	**13740**	**12610**	**11500**	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 1/4	14870	14870	**13740**	**12610**	**11500**	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 3/8	13780	13780	**13740**	**12610**	**11500**	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 7/16	13220	13220	13220	**12610**	**11500**	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 1/2	12650	12650	12650	**12610**	**11500**	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 9/16	12060	12060	12060	12060	**11500**	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 5/8	11460	11460	11460	11460	11460	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**
2 11/16	10840	10840	10840	10840	10840	**10420**	**9350**	**8300**	**7270**	**6270**	**5280**

NC38 *(continued)*

1	13	14	15	16
	OD (in)			
ID (in)	4-5/16	4-1/4	4-3/16	4-1/8
2 1/8	**4320**	**3370**	**2440**	**1540**
2 1/4	**4320**	**3370**	**2440**	**1540**
2 3/8	**4320**	**3370**	**2440**	**1540**
2 7/16	**4320**	**3370**	**2440**	**1540**
2 1/2	**4320**	**3370**	**2440**	**1540**
2 9/16	**4320**	**3370**	**2440**	**1540**
2 5/8	**4320**	**3370**	**2440**	**1540**
2 11/16	**4320**	**3370**	**2440**	**1540**

NC40

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	5-1/2	5-3/8	5-1/4	5-1/8	5	4-7/8	4-3/4	4-5/8
2 1/4	19620	19620	**17610**	**15050**	**12570**	**10180**	**7880**	**5660**
2 3/8	18460	18460	**17610**	**15050**	**12570**	**10180**	**7880**	**5660**
2 7/16	17860	17860	**17610**	**15050**	**12570**	**10180**	**7880**	**5660**
2 1/2	17240	17240	17240	**15050**	**12570**	**10180**	**7880**	**5660**
2 9/16	16620	16620	16620	**15050**	**12570**	**10180**	**7880**	**5660**
2 5/8	15970	15970	15970	**15050**	**12570**	**10180**	**7880**	**5660**
2 11/16	15320	15320	15320	**15050**	**12570**	**10180**	**7880**	**5660**
2 3/4	14650	14650	14650	14650	**12570**	**10180**	**7880**	**5660**
2 13/16	13970	13970	13970	13970	**12570**	**10180**	**7880**	**5660**

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

(API connections in bold type are box-weak)

NC46

1	2	3	4	5	6	7	8	9	10	11
	OD (in)									
ID (in)	6-1/2	6-7/16	6-3/8	6-5/16	6-1/4	6-3/16	6-1/8	6-1/16	6	5-15/16
2 1/2	29580	29580	29580	29580	29580	29580	29580	**28680**	**26980**	**25310**
2 5/8	28130	28130	28130	28130	28130	28130	28130	28130	**26980**	**25310**
2 3/4	26620	26620	26620	26620	26620	26620	26620	26620	26620	**25310**
2 7/8	25040	25040	25040	25040	25040	25040	25040	25040	25040	25040
3	23400	23400	23400	23400	23400	23400	23400	23400	23400	23400
3 1/8	21700	21700	21700	21700	21700	21700	21700	21700	21700	21700
3 1/4	19940	19940	19940	19940	19940	19940	19940	19940	19940	19940
3 3/8	18120	18120	18120	18120	18120	18120	18120	18120	18120	18120
3 1/2	16240	16240	16240	16240	16240	16240	16240	16240	16240	16240

NC46 *(continued)*

1	12	13	14	15	16	17	18	19	20	21
	OD (in)									
ID (in)	5-7/8	5-13/16	5-3/4	5-11/16	5-5/8	5-9/16	5-3/8	5-5/16	5-1/4	5-5/32
2 1/2	**23660**	**22030**	**20430**	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
2 5/8	**23660**	**22030**	**20430**	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
2 3/4	**23660**	**22030**	**20430**	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
2 7/8	**23660**	**22030**	**20430**	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
3	23400	**22030**	**20430**	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
3 1/8	21700	21700	**20430**	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
3 1/4	19940	19940	19940	**18860**	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
3 3/8	18120	18120	18120	18120	**17310**	**15790**	**11360**	**9940**	**8530**	**6480**
3 1/2	16240	16240	16240	16240	16240	**15790**	**11360**	**9940**	**8530**	**6480**

NC50

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	6-5/8	6-9/16	6-1/2	6-7/16	6-3/8	6-5/16	6-1/4	6-3/16
2 3/4	38040	**36180**	**34190**	**32230**	**30290**	**28380**	**26500**	**24650**
2 7/8	36310	**36180**	**34190**	**32230**	**30290**	**28380**	**26500**	**24650**
3	34520	34520	**34190**	**32230**	**30290**	**28380**	**26500**	**24650**
3 1/16	33600	33600	33600	**32230**	**30290**	**28380**	**26500**	**24650**
3 1/8	32660	32660	32660	**32230**	**30290**	**28380**	**26500**	**24650**
3 1/4	30730	30730	30730	30730	**30290**	**28380**	**26500**	**24650**
3 3/8	28730	28730	28730	28730	28730	**28380**	**26500**	**24650**
3 1/2	26670	26670	26670	26670	26670	26670	**26500**	**24650**
3 5/8	24550	24550	24550	24550	24550	24550	24550	24550
3 3/4	22360	22360	22360	22360	22360	22360	22360	22360

NC50 *(continued)*

1	10	11	12	13	14	15	16	17
	OD (in)							
ID (in)	6-1/8	6-1/16	6	5-15/16	5-7/8	5-13/16	5-3/4	5-11/16
2 3/4	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
2 7/8	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 1/16	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 1/8	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 1/4	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 3/8	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 1/2	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 5/8	**22820**	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**
3 3/4	22360	**21020**	**19240**	**17500**	**15780**	**14080**	**12410**	**10770**

NC56

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	8	7-7/8	7-3/4	7-5/8	7-1/2	7-3/8	7-1/4	7-1/8
3	52620	52620	52620	52620	52620	**51520**	**46650**	**41910**
3 1/8	50580	50580	50580	50580	50580	50580	**46650**	**41910**
3 1/4	48450	48450	48450	48450	48450	48450	**46650**	**41910**
3 3/8	46250	46250	46250	46250	46250	46250	46250	**41910**
3 1/2	43980	43980	43980	43980	43980	43980	43980	**41910**
3 5/8	41630	41630	41630	41630	41630	41630	41630	41630
3 3/4	39210	39210	39210	39210	39210	39210	39210	39210
3 7/8	36720	36720	36720	36720	36720	36720	36720	36720
4	34160	34160	34160	34160	34160	34160	34160	34160

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

(API connections in bold type are box-weak)

4-1/2 FH

1	2	3	4	5	6	7	8	9	10
	OD (in)								
ID (in)	6-1/4	6-1/8	6	5-7/8	5-3/4	5-5/8	5-1/2	5-3/8	5-9/32
2 1/2	26530	26530	26530	**23980**	**20870**	**17860**	**14940**	**12120**	**10070**
2 5/8	25140	25140	25140	**23980**	**20870**	**17860**	**14940**	**12120**	**10070**
2 3/4	23690	23690	23690	23690	**20870**	**17860**	**14940**	**12120**	**10070**
2 7/8	22190	22190	22190	22190	**20870**	**17860**	**14940**	**12120**	**10070**
3	20620	20620	20620	20620	20620	**17860**	**14940**	**12120**	**10070**

5-1/2 FH

1	2	3	4	5	6	7	8	9	10	11
	OD (in)									
ID (in)	7-1/2	7-3/8	7-1/4	7-1/8	7	6-7/8	6-3/4	6-5/8	6-17/32	6-11/32
3	52060	52060	**47230**	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 1/16	51030	51030	**47230**	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 1/8	49990	49990	**47230**	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 3/16	48930	48930	**47230**	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 1/4	47850	47850	**47230**	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 3/8	45620	45620	45620	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 1/2	43330	43330	43330	**42420**	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 5/8	40960	40960	40960	40960	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 3/4	38510	38510	38510	38510	**37740**	**33180**	**28740**	**24410**	**21250**	**17130**
3 7/8	36000	36000	36000	36000	36000	**33180**	**28740**	**24410**	**21250**	**17130**
4	33410	33410	33410	33410	33410	**33180**	**28740**	**24410**	**21250**	**17130**

6-5/8 FH

1	2	3	4	5	6	7	8	9	10	11
	OD (in)									
ID (in)	8-3/4	8-5/8	8-1/2	8-3/8	8-1/4	8-1/8	8	7-3/4	7-1/2	7-1/8
3 1/2	83060	83060	**78090**	**71540**	**65120**	**58850**	**52710**	**40860**	**29550**	**24100**
3 3/4	77400	77400	77400	**71540**	**65120**	**58850**	**52710**	**40860**	**29550**	**24100**
4	71380	71380	71380	71380	**65120**	**58850**	**52710**	**40860**	**29550**	**24100**
4 1/4	65010	65010	65010	65010	65010	**58850**	**52710**	**40860**	**29550**	**24100**
4 1/2	58310	58310	58310	58310	58310	58310	**52710**	**40860**	**29550**	**24100**
4 3/4	51280	51280	51280	51280	51280	51280	51280	**40860**	**29550**	**24100**
5	43930	43930	43930	43930	43930	43930	43930	**40860**	**29550**	**24100**
5 1/4	36280	36280	36280	36280	36280	36280	36280	36280	**29550**	**24100**

2-7/8 PAC

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	3-1/8	3-1/16	3	2-15/16	2-7/8	2-13/16	2-3/4	2-11/16
1 1/4	4090	**3600**	**3120**	**2660**	**2220**	**1780**	**1360**	**960**
1 3/8	3870	**3600**	**3120**	**2660**	**2220**	**1780**	**1360**	**960**
1 1/2	3420	3420	**3120**	**2660**	**2220**	**1780**	**1360**	**960**
1 5/8	2930	2930	2930	**2660**	**2220**	**1780**	**1360**	**960**
1 3/4	2410	2410	2410	2410	**2220**	**1780**	**1360**	**960**

2-7/8 SL-H90

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	4-1/4	4-1/8	4	3-7/8	3-3/4	3-5/8	3-1/2	3-7/16
2	7870	7870	7870	7870	**6510**	**4920**	**3400**	**2670**
2 1/8	6970	6970	6970	6970	**6510**	**4920**	**3400**	**2670**
2 5/32	6740	6740	6740	6740	**6510**	**4920**	**3400**	**2670**
2 1/4	6020	6020	6020	6020	6020	**4920**	**3400**	**2670**
2 3/8	5020	5020	5020	5020	5020	**4920**	**3400**	**2670**
2 7/16	4510	4510	4510	4510	4510	4510	**3400**	**2670**

3-1/2 SL-H90

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	5	4-7/8	4-3/4	4-5/8	4-1/2	4-3/8	4-1/4	4-1/8
2 1/2	13080	13080	13080	13080	**11000**	**8740**	**6570**	**4490**
2 5/8	11760	11760	11760	11760	**11000**	**8740**	**6570**	**4490**
2 11/16	11080	11080	11080	11080	**11000**	**8740**	**6570**	**4490**
2 3/4	10380	10380	10380	10380	10380	**8740**	**6570**	**4490**
2 7/8	8960	8960	8960	8960	8960	**8740**	**6570**	**4490**
3	7470	7470	7470	7470	7470	7470	**6570**	**4490**

4 H90

1	2	3	4	5	6	7	8	9	10	11	12
	OD (in)										
ID (in)	6-1/4	6-1/8	6	5-7/8	5-3/4	5-5/8	5-1/2	5-5/32	5-1/32	4-7/8	4-27/32
2 3/4	21990	21990	21990	21990	21990	21990	21990	**13920**	**11060**	**7630**	**6960**
2 13/16	21180	21180	21180	21180	21180	21180	21180	**13920**	**11060**	**7630**	**6960**
2 7/8	20370	20370	20370	20370	20370	20370	20370	**13920**	**11060**	**7630**	**6960**
3	18680	18680	18680	18680	18680	18680	18680	**13920**	**11060**	**7630**	**6960**
3 1/8	16930	16930	16930	16930	16930	16930	16930	**13920**	**11060**	**7630**	**6960**

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

(API connections in bold type are box-weak)

4-1/2 H90

1	2	3	4	5	6	7	8	9	10	11	12
	OD (in)										
ID (in)	6-3/4	6-5/8	6-1/2	6-3/8	6-1/4	6-1/8	6	5-7/8	5-3/4	5-1/2	5-3/8
2 3/4	30540	30540	30540	30540	30540	30540	**30340**	**26660**	**23090**	**16260**	**13010**
2 7/8	28790	28790	28790	28790	28790	28790	28790	**26660**	**23090**	**16260**	**13010**
3	26970	26970	26970	26970	26970	26970	26970	**26660**	**23090**	**16260**	**13010**
3 1/8	25080	25080	25080	25080	25080	25080	25080	25080	**23090**	**16260**	**13010**
3 1/4	23130	23130	23130	23130	23130	23130	23130	23130	**23090**	**16260**	**13010**
3 3/8	21100	21100	21100	21100	21100	21100	21100	21100	21100	**16260**	**13010**
3 1/2	19020	19020	19020	19020	19020	19020	19020	19020	19020	**16260**	**13010**

3-1/2 XH

1	2	3	4	5	6	7	8	9
	OD (in)							
ID (in)	5	4-7/8	4-3/4	4-5/8	4-1/2	4-3/8	4-1/4	4-1/8
2 1/4	11690	11690	11690	11690	**9770**	**7820**	**5950**	**4150**
2 3/8	10650	10650	10650	10650	**9770**	**7820**	**5950**	**4150**
2 7/16	10120	10120	10120	10120	**9770**	**7820**	**5950**	**4150**
2 1/2	9570	9570	9570	9570	9570	**7820**	**5950**	**4150**
2 9/16	9020	9020	9020	9020	9020	**7820**	**5950**	**4150**
2 5/8	8450	8450	8450	8450	8450	**7820**	**5950**	**4150**

Proprietary Connections

The need for tool joints with higher torsional capacity has caused several proprietary connections to be introduced. The data below was provided by the manufacturers of these connections, and is listed solely for the convenience of users who may be considering using these connections. The DS-1 Technical Committee has made no analysis of the data or the engineering rationale behind the data.

HI TORQUE™ (HT™)

HI TORQUE™ connections employ a pin tip shoulder to provide more torsional capacity. Otherwise, they are similar to other connections of similar number designations. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HT 2-3/8 PAC	2 7/8	1 3/8	4200
HT 26	3 1/2	1 1/2	7300
	3 3/8	1 3/4	5200
	3 5/8	1 1/2	7700
	3 5/8	1 3/8	7700
HT 2 3/8 SLH90	3 1/8	1.975	4600
HT 31	4 1/8	2 1/8	10000
	4 1/8	2	11300
	4 1/8	1 7/8	11600
	4 1/8	2 5/32	9600
	4	2 5/32	8900
HT 2-7/8 PAC	3 1/8	1 1/2	5100
HT 34	4 1/4	2 9/16	10900
HT 38	5	2 9/16	17600
	4 3/4	2 11/16	15200
	4 3/4	2 9/16	16100
	4 3/4	2 7/16	17000
	4 7/8	2 5/8	16600
	4 7/8	2 9/16	17600
	4 7/8	2 1/2	17700
HT 40	5 1/2	2 9/16	23800
	5 5/16	2 9/16	23800
	5 1/4	2 13/16	19100
	5 1/4	2 11/16	21500
	5 1/4	2 9/16	23700
	5 1/4	2 7/16	24600

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

HI TORQUE™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HT 50	6 5/8	3 1/2	38200
	6 1/2	3 1/2	38200
	6 3/8	3 1/2	38200
	6 1/4	3 3/4	31600
	6 1/4	3 5/8	35500
	6 1/4	3 1/2	37600
HT 55	7 3/8	3 3/8	59300
	7 1/4	3 3/4	55400
	7 1/4	3 1/2	59400
	7 1/8	4	46300
	7 1/8	3 3/4	55400
	7 1/8	3 1/2	59200
	7 1/8	3 1/4	58500
	7	4	46300
	7	3 3/4	52700
	7	3 1/2	56300
HT 65	8 1/2	4 1/4	83700
	8 1/4	4 13/16	69600
	8 1/8	4 7/8	66400
	8 1/8	4 3/4	72900
	8	5	59600

eXtreme™ Torque (XT™)

eXtreme™ Torque connections employ a pin tip shoulder as well as an extended pin base, pin nose, and box counterbore to provide more torsional capacity. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
XT 22	2 7/8	1 3/8	4300
XT 24	3 3/16	1 3/8	6500
	3 1/8	1 1/2	5700
	3 1/8	1 3/8	6200
XT 26	3 1/2	1 3/4	6900
	3 3/8	1 3/4	6900
XT 27	3 3/8	1 27/32	6600
XT 29	3 7/8	1 3/4	11500
	3 3/4	2	8900
	3 3/4	1 13/16	10400
XT 30	3 7/8	2	11100
XT 31	4 1/8	2	12600
	4 1/8	1 7/8	14000
	4 1/8	1 3/4	14800
	4	2 1/8	11100
	4	2	12200
XT 38	5	2 7/16	20900
	4 7/8	2 9/16	18800
	4 13/16	2 7/16	20900
	4 3/4	2 13/16	14200
	4 3/4	2 11/16	16600
	4 3/4	2 5/8	17700
	4 3/4	2 9/16	18800
	4 3/4	2 1/2	19800
	4 3/4	2 7/16	20500
	4 3/4	2 1/4	21800
	4 5/8	2 13/16	14200
	4 5/8	2 11/16	16400
XT 39	5	2 13/16	19700
	5	2 11/16	22200
	5	2 9/16	24500
	5	2 7/8	18500
	4 7/8	2 13/16	19700
	4 7/8	2 11/16	21200
	4 7/8	2 9/16	22200

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

eXtreme™ Torque *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
XT 40	5 5/16	2 11/16	28800
	5 1/4	3	22300
	5 1/4	2 13/16	26300
	5 1/4	2 11/16	28800
XT 43	5 1/4	3 1/4	22300
	5 1/4	3	26400
XT 46	6 1/4	3 1/4	42000
	6 1/4	3 1/8	45300
	6	3 5/8	31000
	6	3 1/2	34800
	6	3 1/4	38900
XT 50	6 5/8	3 3/4	46100
	6 5/8	3 1/2	54300
	6 5/8	3 3/8	57900
	6 5/8	3 1/4	57600
	6 1/2	4	37300
	6 1/2	3 3/4	46100
XT 54	6 5/8	4	49900
	6 5/8	3 7/8	52000
	6 3/4	4 1/4	42100
	6 3/4	4	51900
	6 3/4	3 7/8	56400
XT 55	7	4	58000
XT 57	7 1/4	4	64600
	7 1/8	4	64600
	7	4 3/8	51200
	7	4 1/4	56500
	7	4	63700
	7	3 3/4	63700
XT 65	8 1/4	5	81100
	8 1/8	4 7/8	88000
	8 1/8	4 3/4	94800
	8	5	81100
XT 69	8 1/2	5 1/4	100100

eXtreme™ Torque-M (XT-M™)

These connections have performance similar to XT but with a metal to metal seal at the nose which has a 10,000 psi external gas pressure rating and 15,000 psi internal gas pressure rating. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
XT-M 24	3 1/8	1 1/2	4800
XT-M 26	3 3/8	1 3/4	5800
XT-M 38	4 3/4	2 11/16	14400
	4 3/4	2 5/8	15600
	4 3/4	2 9/16	16700
	4 3/4	2 1/2	17700
	4 3/4	2 7/16	18400
XT-M 39	5	2 9/16	22300
	5	2 7/16	23300
	4 7/8	2 11/16	18900
XT-M 40	5 5/16	2 11/16	26200
	5 1/4	2 13/16	23700
XT-M43	5 1/4	3 1/4	19400
	5 1/4	3	23500
XT-M 46	6 1/4	3 1/4	38500
	6 1/4	3 1/8	41900
	6	3 5/8	27600
	6	3 1/2	31400
XT-M 50	6 5/8	3 3/4	42000
	6 5/8	3 1/2	50200
	6 5/8	3 1/4	56200
	6 1/2	3 3/4	42000
XT-M 57	7 1/4	4	61700
	7 1/8	4	61700
	7	4 1/4	51500
XT-M 65	8 1/8	4 7/8	81500
	8 1/8	4 3/4	88200
	8	5	74500
XT-M 69	8 1/2	5 1/4	92700

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Grant Prideco Double Shoulder (GPDS™)

GPDS™ connections employ a pin tip shoulder to provide more torsional capacity and are fully interchangeable with API NC or FH connections of the same number designation. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
GPDS 26	3 1/2	1 5/8	6300
	3 1/2	1 1/2	7200
GPDS 31	4 1/8	2	10300
	4 1/8	1 7/8	11600
GPDS 38	5	2 9/16	15400
	5	2 7/16	17400
	5	3 3/8	18400
	5	2 1/4	20300
	4 7/8	2 9/16	15400
	4 7/8	2 1/2	16400
	4 7/8	2 7/16	17400
	4 13/16	2 9/16	15400
GPDS 40	5 1/2	2 7/16	24000
	5 3/8	2 1/2	22900
	5 1/4	2 11/16	19600
	5 1/4	2 5/8	20700
	5 1/4	2 9/16	21800
	5 1/4	2 1/2	22900
	5 1/4	2 7/16	23900
GPDS 42	5 3/8	2 13/16	23000
	5 3/8	2 3/4	24300
	5 1/4	2 13/16	22500
GPDS 46	6	3 1/4	25500
	6	3 3/16	27100
	6	3 1/8	28700
	6	3	31700
	6	2 15/16	33100
	6	2 3/4	37200

Grant Prideco™ Double Shoulder *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
GPDS 50	6 5/8	3 1/2	35900
	6 5/8	3 1/4	43000
	6 5/8	3	45900
	6 1/2	3 1/2	35900
	6 1/2	3 3/8	39500
	6 1/2	3 1/4	43000
	6 1/2	3 3/16	44700
	6 1/2	3 1/8	46000
	6 1/2	3	45900
GPDS 55	7 3/8	3 1/4	63000
	7 1/4	3 1/2	61200
	7 1/8	4 1/8	38900
	7 1/8	3 7/8	48300
	7 1/8	3 3/4	52700
	7	4 1/8	38900
	7	4	43700
GPDS 65	8 1/4	4 7/8	63400
	8 1/4	4 3/4	70000
	8 1/4	4 1/2	82500
	8 1/8	4 3/4	70000
	8	5	56700
	8	4 15/16	60100
	8	4 7/8	63400

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

TurboTorque™ (TT™)

The industry first double start thread allows for faster make-up times. It has higher than standard tool joint material yield strength and a fatigue resistant thread from which allows for higher make-up torque. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
TurboTorque 380	4 13/16	2 1/2	30200
	3 3/4	2 11/16	25400
	4 3/4	2 5/8	27100
	4 5/8	2 13/16	22100
TurboTorque 390	5	2 9/16	32900
	4 15/16	2 9/16	32900
	4 7/8	2 11/16	29700
TurboTorque 435	5 3/8	3 1/8	37400
	5 3/8	3	41200
TurboTorque 485	6 1/8	3 1/4	60100
	6 1/8	3 1/8	64800
	6	3 9/16	47600
	6	3 1/2	50200
	5 7/8	3 11/16	42200
TurboTorque 500	6 3/8	3 1/4	69300
	6 1/4	6 1/2	58800
TurboTorque 525	6 5/8	3 9/16	72600
	6 5/8	3 1/2	75500
	6 5/8	3 3/8	80900
	6 1/2	3 7/8	57700
	6 1/2	3 3/4	63800
TurboTorque 550	6 5/8	4 1/4	59200
	6 5/8	4	70200
	6 3/4	4	73100
TurboTorque 575	7 1/8	4 1/8	85300
	7	4 1/4	78000
TurboTorque 585	7 3/8	4	90900
	7 1/4	4 1/4	87900
	7 1/4	4 1/8	91000

TurboTorque™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
TurboTorque 585	7 1/8	4 3/8	80300
	7 1/8	4 5/16	84100
	7	4 1/2	72400
TurboTorque 690	8 1/4	5 1/2	95600

TurboTorque-M™ (TT-M™)

The industry first double start thread allows for faster make-up times. It has higher than standard tool joint material yield strength and a fatigue resistant thread from which allows for higher make-up torque. These connections have performance similar to TT but with a metal to metal seal at the nose which has a 10,000 psi external gas pressure rating and 20,000 psi internal gas pressure rating. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
TurboTorque-M 380	4 13/16	3 1/2	23200
	4 3/4	2 11/16	19100
	4 3/4	2 5/8	20500
TurboTorque-M 390	4 7/8	2 11/16	22600
TurboTorque-M 435	5 3/8	3 1/8	28600
TurboTorque-M 485	6 1/8	3 1/4	47300
	6 1/8	3 1/8	51300
	6	3 9/16	36500
	6	3 1/2	38800
	5 7/8	3 11/16	32000
TurboTorque-M 500	6 3/8	3 1/4	54900
	6 1/4	3 1/2	45900
TurboTorque-M 525	6 5/8	3 9/16	57300
	6 5/8	3 1/2	59800
	6 5/8	3 3/8	64500
	6 1/2	3 7/8	44500
	6 1/2	3 3/4	49800
TurboTorque-M 550	6 5/8	4 1/4	45200
	6 5/8	4 1/8	51300
	6 5/8	4	54700
TurboTorque-M 585	7 3/8	4	78200
	7 1/4	4 1/4	69200
	7 1/4	4 1/8	75500
	7 1/8	4 3/8	62600
	7 1/8	4 5/16	65900
	7	4 1/2	55900
TurboTorque-M 710	8 1/2	5 5/8	82300

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

uXT™

uXT is interchangeable with standard XT connections. It has higher than standard tool joint material yield strength and a fatigue resistant thread from which allows for higher make-up torque. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
uXT 22	2 7/8	1 3/8	5400
uXT 24	3 3/16	1 3/8	8200
	3 1/8	1 1/2	7200
	3 1/8	1 3/8	7900
uXT 26	3 1/2	1 3/4	8700
	3 1/2	1 1/2	9500
	3 3/8	1 3/4	8700
	3 3/8	1 5/8	9500
uXT 31	4 1/8	2	16000
	4 1/8	1 7/8	17700
	4 1/8	1 3/4	18700
	4	2 1/8	14100
	4	2	15400
	3 7/8	2 1/8	12600
uXT 38	5	2 7/16	26400
	4 13/16	2 7/16	26400
	4 3/4	2 13/16	18000
	4 3/4	2 11/16	20900
	4 3/4	2 5/8	22400
	4 3/4	2 9/16	23700
	4 3/4	2 1/2	25100
	4 3/4	2 7/16	25900
	4 3/4	2 1/4	27500
	4 5/8	2 13/16	18000
	4 5/8	2 11/16	20700
uXT 39	5	2 13/16	24900
	5	2 11/16	28000
	5	2 9/16	30900
	5	2 7/8	23400
	4 7/8	2 13/16	24900
	4 7/8	2 11/16	26800
	4 7/8	2 9/16	28000

uXT™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
uXT 40	5 5/16	2 11/16	36500
	5 1/4	3	28200
	5 1/4	2 13/16	33300
	5 1/4	2 11/16	36400
uXT 43	5 3/8	3 1/8	29900
	5 3/8	3	29800
	5 1/4	3 1/4	28200
	5 1/4	3	29600
uXT 46	6 1/4	3 1/4	53000
	6 1/4	3 1/8	57300
	6	3 5/8	39200
	6	3 1/2	44000
	6	3 1/4	49100
uXT 50	6 5/8	3 3/4	58300
	6 5/8	3 1/2	68600
	6 5/8	3 3/8	73100
	6 5/8	3 1/4	72800
	6 1/2	4	47100
	6 1/2	3 3/4	58300
	6 3/8	3 3/4	57000
	6 3/8	3 1/2	61600
uXT 54	6 5/8	4	63100
	6 5/8	3 3/8	73000
	6 3/4	4 1/4	53200
	6 3/4	4	65600
	6 3/4	3 3/8	73600
uXT 55	7 3/8	3 5/8	78000
	7	4	73200
uXT 57	7 1/4	4	81600
	7 1/8	4	81600
	7	4 3/8	64700
	7	4 1/4	71400
	7	4	80500
uXT 65	8 1/4	5	102500
	8	5	102500
uXT 69	8 1/2	5 1/4	108500

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

uGPDS™

uGPDS is interchangeable with standard GPDS connections. It has higher than standard tool joint material yield strength and a fatigue resistant thread from which allows for higher make-up torque. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
uGPDS 26	3 1/2	1 5/8	7800
uGPDS 31	4 1/8	2	12800
	4 1/8	1 7/8	14500
uGPDS 38	5	2 9/16	19100
	5	2 7/16	21700
	5	2 3/8	22600
	5	2 1/4	23200
	4 7/8	2 9/16	19100
	4 7/8	2 1/2	20400
	4 7/8	2 7/16	21700
	4 13/16	2 9/16	19100
uGPDS 40	5 1/2	2 7/16	29900
	5 3/8	2 1/2	28600
	5 1/4	2 11/16	24300
	5 1/4	2 5/8	25800
	5 1/4	2 9/16	27200
	5 1/4	2 1/2	28600
	5 1/4	2 7/16	29900
uGPDS 42	5 3/8	2 13/16	28700
	5 3/8	2 3/4	30300
	5 1/4	2 13/16	28400
uGPDS 46	6 1/4	3	39600
	6	3 1/4	31900
	6	3 3/16	33800
	6	3 1/8	35800
	6	3	39600
	6	2 15/16	41400
	6	2 3/4	46100

Grant Prideco uGPDS™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
uGPDS 50	6 5/8	3 1/2	44800
	6 5/8	3 1/4	53900
	6 5/8	3	57900
	6 1/2	3 1/2	44800
	6 1/2	3 3/8	49400
	6 1/2	3 1/4	53900
	6 1/2	3 3/16	56000
	6 1/2	3 1/8	58100
	6 1/2	3	57900
uGPDS 55	7 3/8	3 1/4	79600
	7 1/4	3 1/2	76900
	7 1/8	3 7/8	60600
	7 1/8	3 3/4	66300
	7 1/8	4 1/8	48800
	7	4 1/8	48800
	7	4	54800
uGPDS 65	8 1/4	4 7/8	79600
	8 1/4	4 3/4	87900
	8 1/4	4 1/2	103800
	8 1/8	4 3/4	87900
	8	5	71100
	8	4 15/16	75400
	8	4 7/8	79600

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Delta™

Delta connections come with the most balance and provide high performances, speed of makeup, and are designed to bring a lower cost of ownership. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
Delta 243	3 1/8	1 1/2	5900
Delta 259	3 1/2	1 3/8	8800
	3 1/2	1 1/4	9700
	3 3/8	1 1/2	7900
Delta 321	4 1/8	2	14000
Delta 377	4 7/8	2 3/8	22900
	4 3/4	2 9/16	19500
	4 3/4	2 1/2	20700
Delta 391	5	2 9/16	23800
	4 7/8	2 11/16	21400
Delta 425	5 3/8	2 7/8	28900
	5 1/4	3	26000
Delta 494	6 5/16	3 1/8	51500
	6 1/4	3 1/4	47800
Delta 527	6 1/2	3 3/4	49800
Delta 544	6 5/8	4	50300
	6 5/8	3 7/8	54200
Delta 576	7 1/4	3 7/8	71300
	7 1/8	4	70200
	7	4 1/4	59200
Delta 663	8	5	86600

Grant Prideco EIS™

Grant Prideco EIS™ connections employ a pin tip shoulder and a box internal shoulder to provide more torsional capacity and are fully interchangeable with API NC and FH connections of the same size designation. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
NC26 EIS	3-5/8	1-1/2	8,500
NC31 EIS	4-1/8	2	12,300
NC38 EIS	4-3/4	2-7/16	18,600
	4-3/4	2-9/16	17,600
NC46 EIS	6	3	37,100
NC50 EIS	6-1/2	3-1/4	49,800
	6-3/8	3-1/2	42,000
5 1/2 FH EIS	7	3-3/4	59,700
	7	4	50,700
	7-1/8	4	50,700
6 5/8 FH EIS	8	4-3/4	80,100
	8	5	65,700

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Grant Prideco Express™

Grant Prideco Express™ connections employ a pin tip shoulder, a box internal shoulder and a patented thread design to provide more torsional capacity. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
Express VX24	3-1/8	1-1/2	6,100
Express VX26	3-1/2	1-1/2	9,500
Express VX38	4-5/8	2-3/4	16,600
	5	2-7/16	22,900
Express VX39	4-7/8	2-13/16	21,100
	5	2-13/16	22,300
	5	2-3/4	23,700
Express VX40	5-1/4	3	26,700
Express VX46	6	3-3/4	33,200
	6	3-1/2	39,400
	6	3	43,000
Express VX50	6-1/2	4	44,700
	6-1/2	3-3/4	51,200
Express VX54	6-3/4	4	57,500
Express VX57	7	4-1/2	49,200
	7	4-1/4	60,800
Express VX65	8	5-1/2	68,800
	8-1/4	5-1/4	85,600

Hydril Wedge Thread™

Wedge Thread™ (WT™) tool joints employ an entirely different principle for carrying torsion than other connections. Unlike other connections, makeup torques are listed as ranges for standard sizes of Wedge Thread™ connections. The torque ranges below were provided by the manufacturer. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb) Minimum	Makeup Torque (ft-lb) Maximum
WT 14S	3 9/16	1.975	2800	8900
	3 1/4 - 3 3/8	1.975	2800	8900
	3 1/4 - 3 3/8	1.945	2800	8900
	3 1/4 - 3 3/8	1 3/4	2800	8900
WT23	3 1/8	1 1/2	2200	8300
WT26	3 3/8	1 3/4	2800	9800
WT31	4 1/8	2	6200	22500
WT38	4 3/4 - 5	2 9/16	9000	31500
	4 3/4 - 5	2 1/2	9000	31500
WT39	5 - 5 1/8	2 13/16	10000	36000
WT40	5 1/2	3 1/8	12000	42000
	5 3/8	3 1/8	12000	42000
WT46	6 - 6 1/4	3 1/2	15000	56000
	5 7/8	3 1/2	15000	56000
WT50	6 3/4 - 7	4	23000	86000
	6 3/4 - 7	3 7/8	23000	86000
	6 5/8	3 7/8	23000	86000
	6 5/8	3 5/8	23000	86000
WT54	7	4 3/8	25000	90000
WT56	7 - 7 1/4	4 5/8	27000	99000
	7 - 7 1/4	4 3/8	27000	99000
WT66	8	5 3/8	35000	120000

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

NK DSTJ™

DSTJ™ connections are similar to NC connections of the same number designation except they have a pin tip shoulder for added torsional capacity. The torques below were provided by the manufacturer. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
NK DSTJ NC38	5	2 1/8	25200
	4 7/8	2 1/8	22200
	4 3/4	2 1/8	19100
	4 5/8	2 1/8	16100
	5	2 5/16	22700
	4 7/8	2 5/16	21800
	4 3/4	2 5/16	18700
	4 5/8	2 5/16	18700
	5	2 7/16	20800
	4 7/8	2 7/16	20700
	4 3/4	2 7/16	18300
	4 5/8	2 7/16	18300
	5	2 1/2	19900
	4 7/8	2 1/2	19700
	4 3/4	2 1/2	18100
	4 5/8	2 1/2	15100
	5	2 9/16	18900
	4 7/8	2 9/16	18700
	4 3/4	2 9/16	17900
	4 5/8	2 9/16	17900
NK DSTJ NC40	5 1/2	2 7/16	28400
	5 3/8	2 7/16	28200
	5 1/4	2 7/16	27700
	5 1/8	2 7/16	24200
	5 1/2	2 9/16	26300
	5 3/8	2 9/16	26100
	5 1/4	2 9/16	26000
	5 1/8	2 9/16	23800
	5 1/2	2 11/16	24100
	5 3/8	2 11/16	23900
	5 1/4	2 11/16	23800
	5 1/8	2 11/16	23300
	5 1/2	2 3/4	22900
	5 3/8	2 3/4	22800
	5 1/4	2 3/4	22700

NK DSTJ™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
	5 1/8	2 3/4	22500
	5 1/2	2 13/16	21700
	5 3/8	2 13/16	21600
	5 1/4	2 13/16	21500
	5 1/8	2 13/16	21400
NK DSTJ NC46	6 1/4	2 1/4	52100
	6 1/8	2 1/4	49400
	6	2 1/4	44600
	5 7/8	2 1/4	40000
	5 3/4	2 1/4	35500
	6 1/4	2 1/2	47800
	6 1/8	2 1/2	47600
	6	2 1/2	40000
	5 7/8	2 1/2	39300
	5 3/4	2 1/2	34800
	6 1/4	2 3/4	43000
	6 1/8	2 3/4	42800
	6	2 3/4	42600
	5 7/8	2 3/4	38500
	5 3/4	2 3/4	34000
	6 1/4	3	37600
	6 1/8	3	37400
	6	3	37200
	5 7/8	3	37100
	5 3/4	3	32900
	6 1/4	3 1/4	31600
	6 1/8	3 1/4	31400
	6	3 1/4	31300
	5 7/8	3 1/4	31200
	5 3/4	3 1/4	31000
NK DSTJ NC50	6 5/8	2 3/4	61900
	6 1/2	2 3/4	56500
	6 3/8	2 3/4	51100
	6 1/4	2 3/4	45800
	6 1/8	2 3/4	40700
	6 5/8	3	56200
	6 1/2	3	55500
	6 3/8	3	50100
	6 1/4	3	44800
	6 1/8	3	39700
	6 5/8	3 1/4	49800
	6 1/2	3 1/4	49600
	6 3/8	3 1/4	48800

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

NK DSTJ™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
NK DSTJ NC50	6 1/4	3 1/4	43600
	6 1/8	3 1/4	38500
	6 5/8	3 1/2	42900
	6 1/2	3 1/2	42700
	6 3/8	3 1/2	42500
	6 1/4	3 1/2	42100
	6 1/8	3 1/2	37000
	6 5/8	3 3/4	35300
	6 1/2	3 3/4	35100
	6 3/8	3 3/4	35000
	6 1/4	3 3/4	34800
	6 1/8	3 3/4	34700
NK DSTJ 5 1/2 FH	7 1/4	3	77800
	7 1/8	3	71100
	7	3	64600
	6 7/8	3	58300
	6 3/4	3	52100
	7 1/4	3 1/4	76400
	7 1/8	3 1/4	69900
	7	3 1/4	63400
	6 7/8	3 1/4	57100
	6 3/4	3 1/4	50900
	7 1/4	3 1/2	70000
	7 1/8	3 1/2	68500
	7	3 1/2	62000
	6 7/8	3 1/2	55600
	6 3/4	3 1/2	49500
	7 1/4	3 3/4	61800
	7 1/8	3 3/4	61600
	7	3 3/4	60300
	6 7/8	3 3/4	53900
	6 3/4	3 3/4	47800
	7 1/4	4	52900
	7 1/8	4	52700
	7	4	52500
	6 7/8	4	52000
	6 3/4	4	45800

NK DSTJ™ *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
NK DSTJ ST39	5	2 9/16	22100
	4 7/8	2 9/16	21800
	4 3/4	2 9/16	18700
	5	2 5/8	21100
	4 7/8	2 5/8	21000
	4 3/4	2 5/8	18500
NK DSTJ ST39	5	2 11/16	20000
	4 7/8	2 11/16	19900
	4 3/4	2 11/16	18200
	5	2 3/4	18900
	4 7/8	2 3/4	18800
	4 3/4	2 3/4	18000
	5	2 13/16	17800
	4 7/8	2 13/16	17700
	4 3/4	2 13/16	17600
NK DSTJ ST58	7 1/4	3 3/4	73000
	7 1/8	3 3/4	66200
	7	3 3/4	59500
	7 1/4	4	66900
	7 1/8	4	64200
	7	4	57600
	7 1/4	4 1/8	62100
	7 1/8	4 1/8	61800
	7	4 1/8	56500
	7 1/4	4 1/4	57100
	7 1/8	4 1/4	56900
	7	4 1/4	55400

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Hilong Interchangeable Double Shoulder (HLIDS)

HLIDS connection are similar to NC connection of the same number designation except they have a pin tip shoulder for added torsional capacity. The torques below were provided by the manufacturer. For sizes not listed below, check with the manufacturer to determine makeup torque. Connections in **bold type** are box-weak.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HLIDS23	3	1 3/8	**3300**
HLIDS26	3 5/8	1 5/8	6500
	3 3/8	1 3/4	**5300**
HLIDS31	4 3/8	1 5/8	14400
	4 1/8	2 1/8	9100
	4 1/8	2	10500
HLIDS38	5	2 9/16	15900
	5	2 7/16	17900
	5	2 1/8	22500
	4 7/8	2 11/16	13700
	4 7/8	2 9/16	15800
	4 7/8	2 7/16	17800
	4 3/4	2 11/16	13600
	4 3/4	2 9/16	15200
HLIDS40	5 1/2	2	31000
	5 3/8	2 1/2	23400
	5 1/4	2 11/16	20000
	5 1/4	2 9/16	22200
	5 1/4	2 7/16	**24100**
HLIDS46	6 1/4	3 1/4	26600
	6 1/4	3	32700
	6 1/4	2 3/4	38200
	6	3 1/4	26400
	6	3 1/8	29500
	6	3	32400

Hilong HLIDS *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HLIDS50	6 5/8	3 1/2	36900
	6 5/8	3 1/4	44000
	6 5/8	3	50400
	6 1/2	3 3/4	29100
	6 1/2	3 1/2	36800
	6 1/2	3 1/4	43800
	6 1/2	3	**49900**
HLIDS5-1/2FH	7 1/2	3	77200
	7 1/4	4	44900
	7 1/4	3 3/4	53900
	7 1/4	3 1/2	62100
	7 1/4	3 1/4	**69100**
	7	4 1/8	39900
	7	4	44600
HLIDS6-5/8FH	8 1/4	4 3/4	71800
	8 1/4	4 1/2	84100
	8	5	58300
	8	4 3/4	71400

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Hilong Modified High-Torque (HLMT)

HLMT connections are modified from HLIDS connections. HLMT connections are similar to HLIDS except distance between shoulders is changed to improve performance. The torques below were provided by the manufacturer. For sizes not listed below, check with the manufacturer to determine makeup torque. Connections in **bold type** are box-weak.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HLMT2-3/8PAC	3	1 3/8	4200
HLMT2-7/8PAC	3 1/8	1 1/2	5100
	3 1/8	1 3/8	5900
HLMT38	5	2 9/16	17700
	5	2 7/16	19700
	4 3/4	2 11/16	15400
	4 3/4	2 9/16	**17000**
HLMT40	5 1/2	2 9/16	24100
	5 1/2	2 7/16	26300
	5 1/4	2 11/16	21600
	5 1/4	2 9/16	23900
	5 1/4	2 1/2	25000
HLMT46	6 1/4	3	34600
	6	3 1/4	28300
HLMT50	6 5/8	3 1/2	39700
	6 5/8	3 1/4	46700
	6 5/8	3	53200
	6 1/2	3 3/4	31800
	6 1/2	3 1/2	39500
	6 1/2	3 1/4	46600
	6 3/8	3 3/4	31700
	6 3/8	3 1/2	39400
HLMT5-1/2FH	7 1/2	3 1/2	64200
	7 1/2	3 1/4	71900
	7 1/4	3 3/4	55600
	7 1/4	3 5/8	59800
	7 1/4	3 1/2	63800
	7 1/4	3 3/8	67700
	7	4	46300
	7	3 7/8	50800

Hilong Super High-Torque (HLST)

HLST connections are the second generation double-shouldered RSC developed by Hilong. HLST connection have a pin tip shoulder for higher torsional capacity and have a special thread form. The torques below were provided by the manufacturer. For sizes not listed below, check with the manufacturer to determine makeup torque. Connections in **bold type** are box-weak.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HLST26	3 5/8	1 1/2	8700
	3 5/8	1 3/8	9500
	3 1/2	1 3/4	6700
	3 1/2	1 5/8	7700
	3 1/2	1 1/2	8600
	3 3/8	1 3/4	6600
HLST31	4 1/8	2	12900
	4 1/8	1 7/8	14200
	4 1/8	1 3/4	**15000**
	4	2 1/8	11400
	4	2	**12100**
HLST36	4 3/4	2 9/16	14700
	4 3/4	2 7/16	16600
	4 1/2	2 9/16	14500
	4 1/2	2 7/16	**16200**
HLST39	5	2 9/16	23300
	5	2 7/16	**25100**
	4 7/8	2 11/16	**20700**
	4 7/8	2 9/16	**21700**
HLST40	5 3/8	2 9/16	29900
	5 1/4	2 11/16	27400
	5 1/4	2 9/16	**29300**
HLST46	6 1/4	3	42000
	6	3 1/4	35500
HLST52	6 5/8	3 1/2	54200
	6 5/8	3 1/4	**60000**
	6 1/2	3 3/4	45900
HLST54	7	3 3/4	59400
	7	3 1/2	67800
	6 7/8	4	50200
	6 7/8	3 3/4	59200
	6 3/4	4 1/8	45300
	6 3/4	4	50100
	6 3/4	3 7/8	**53800**

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Hilong HLST *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HLST57	7 1/4	4	66100
	7 1/4	3 7/8	70800
	7 1/4	3 3/4	75400
	7 1/8	4 1/8	60900
	7 1/8	4	65800
	7	4 1/4	55700
	7	4 1/8	**59600**

Hilong Improved Super High-Torque (HLIST)

HLIST products are improved HLST products, based on customer feedback. HLIST connections are similar to HLST except the taper of thread. The torques below were provided by the manufacturer. For sizes not listed below, check with the manufacturer to determine makeup torque. Connections in **bold type** are box-weak.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
HLIST38	4 7/8	2 7/16	20900
	4 7/8	2 5/16	22800
	4 7/8	2 3/16	24700
	4 3/4	2 9/16	18800
	4 3/4	2 7/16	**20800**
HLIST39	5	2 11/16	22200
	5	2 9/16	24500
	5	2 1/2	**25500**
	4 7/8	2 13/16	19800
	4 7/8	2 3/4	21000
	4 7/8	2 11/16	**21600**
HLIST46	6 1/4	3 1/4	42100
	6 1/4	3	48600
	6	3 1/2	34900
	6	3 3/8	**37900**
HLIST50	6 5/8	3 1/2	54600
	6 5/8	3 3/8	58300
	6 5/8	3 1/4	**61000**
	6 1/2	3 3/4	46400
	6 1/2	3 5/8	50500
	6 1/2	3 1/2	**53600**
HLIST54	6 3/4	4	**55700**
	6 3/4	3 7/8	**59400**
	6 5/8	4 1/8	50300
	6 5/8	4	54900
HLIST57	7 1/2	3 1/2	85500
	7 1/2	3 3/8	89600
	7 1/2	3 1/4	93500
	7 1/2	3 1/8	97200
	7 1/4	4	67100
	7 1/4	3 7/8	71900
	7 1/4	3 3/4	76500
	7	4 1/4	56800
	7	4 1/8	61900
	7	4	**64600**

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

DP-Master DPM-DS

The DPM-DS connection is a high-performance generic API double-shouldered connection which is well established and field proven around the world. This stronger connection is fully interchangeable with API and selected market available double-shouldered connections. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb) 130 KSI
DPM-DS31	4 1/8	1 7/8	12400
	4 1/8	2	11100
DPM-DS38	4 3/4	2 9/16	16100
	4 7/8	2 9/16	16700
	5	2 7/16	19000
	5	2 9/16	16800
DPM-DS40	5 1/4	2 9/16	23700
DPM-DS46	6	3	34400
	6	3 1/4	27900
	6 1/4	2 3/4	40700
	6 1/4	3	34700
	6 1/4	3 1/4	28100
DPM-DS50	6 5/8	3	54000
	6 5/8	3 1/4	47000
	6 5/8	3 1/2	39300
	6 5/8	3 5/8	35300
	6 5/8	3 3/4	31000
DPM-DS55	7	3 1/2	60500
	7	3 3/4	56600
	7	4	47400
DPM-DS65	8	4 7/8	68800
	8 1/4	4 7/8	69200

DP-Master DPM-MT®

The DPM-MT® connection was developed based on a Fit for Purpose principle to provide users with a connection that has a substantial increase in torsional strength compared to API or 1st Generation Double Shoulder connections with the ability to run quickly and efficiently in very severe drilling operations. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb) 130 KSI
DPM-MT24	2 7/8	1 1/2	3400
DPM-MT26	3 3/8	1 1/2	6700
	3 3/8	1 3/4	5800
	3 1/2	1 1/2	8000
	3 5/8	1 1/2	8100
DPM-MT26SP	3 3/8	1 22/27	5600
DPM-MT31	4	2	11300
	4	2 1/8	10600
	4 1/8	2	13000
DPM-MT34	4 36/59	2 1/2	15700
	4 7/10	2 1/2	15800
DPM-MT38	4 3/4	2 7/16	18600
DPM-MT39	4 7/8	2 9/16	19600
	4 7/8	2 7/16	20600
	4 7/8	2 3/8	21100
	5	2 9/16	22200
	5	2 11/16	20000
DPM-MT40	5 1/4	2 3/5	25300
	5 1/4	2 11/16	25500
DPM-MT50	6 3/8	3 1/2	42100
	6 3/8	3 3/4	38300
	6 1/2	3 1/2	46400
	6 1/2	3 3/4	42600
	6 5/8	3 1/4	54300
	6 5/8	3 1/2	50800
	6 5/8	3 5/8	47100
	6 5/8	3 3/4	42700
DPM-MT54	6 5/8	3 3/4	47300
	6 5/8	4	43100
	6 5/8	4 1/4	33200
	6 3/4	3 3/4	52000
	6 3/4	4	43500
DPM-MT57	7	4	56600
	7	4 1/4	50900
	7 1/4	4	61900
	7 1/4	4 1/4	51200

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

DP-Master DPM-ST®

With offshore drilling operations being executed in ever deeper water and more remote and hostile locations, the DPM-ST® connection was developed to deliver exceptional performance and to overcome the demands of the most challenging drilling environments. The DPM-ST® connection is designed specifically for deviated and horizontal wells in ultra deep-water, extended reach, highpressure high temperature, and sour service environments. For sizes not listed below, check with the manufacturer to determine makeup torque.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb) 130 KSI
DPM-ST38	4 3/4	2 7/16	21600
	4 3/4	2 9/16	19400
	4 3/4	2 11/16	17000
DPM-ST39	4 7/8	2 9/16	21500
	4 7/8	2 11/16	20400
	4 7/8	2 3/4	19800
	4 7/8	2 13/16	19200
DPM-ST40	5 1/4	2 11/16	27600
	5 1/4	2 13/16	26400
	5 1/4	3	22900
DPM-ST46	6	3 1/4	37600
	6	3 1/2	34300
	6 1/4	3 1/4	43400
	6 1/4	3 1/8	46900
DPM-ST50	6 3/8	3 1/2	48700
	6 3/8	3 3/4	44900
	6 1/2	2 3/4	62600
	6 1/2	3 1/2	53100
	6 1/2	3 3/4	48500
	6 5/8	3 1/4	61100
	6 5/8	3 1/2	57300
	6 5/8	3 3/4	48600
	6 3/4	3 1/2	57500
DPM-ST52ZAD	6 1/2	3 3/4	53500
DPM-ST54	6 3/4	4	52600
	6 5/8	4	47800

DP-Master DPM-ST® *(continued)*

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
DPM-ST57	7	3 1/2	65900
	7	3 3/4	61800
	7	4	57400
	7	4 1/4	52500
	7 1/8	3 1/4	74800
	7 1/8	4 1/4	56000
	7 1/4	3 1/4	80200
	7 1/4	3 1/2	76500
	7 1/4	3 3/4	72400
	7 1/4	4	67000
	7 1/4	4 1/4	56100

DP-Master DPM-HighTorque

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb) 130 KSI
DPM 2-3/8 HighTorquePAC	2 7/8	1 1/4	5000
DPM 2-7/8 HighTorquePAC	3 1/8	1 1/2	5600
DPM-HighTorque38	5	2 9/16	18700
DPM-HighTorque40	5	2 9/16	20800
	5 1/8	2 9/16	23400
	5 1/4	2 11/16	22800
DPM-HighTorque50	6 5/8	3 1/2	42500
DPM-HighTorque55	7	4	50400

Table 3.14 Tool Joint Makeup Torque (ft-lb)

MAKEUP TORQUES IN THIS TABLE DO NOT APPLY TO DRILL COLLAR OR HWDP CONNECTIONS

Proprietary Connections

Command Tubular CET™

The CET Connection provides the highest torque with the fastest turns to makeup of any high torque connection. The table below shows the most commonly used configurations. For sizes that are not listed or custom configurations, contact Command Tubular Products.

Connection	OD (in)	ID (in)	Makeup Torque (ft-lb)
CET20	2 7/8	1 8/10	4900
CET21	2 7/8	1 1/2	6400
CET22	3 1/2	2 3/10	6000
CET23	3 1/8	1 9/10	6800
CET24	3 1/2	2	10700
CET31	4 1/8	2	13900
CET38	4 3/4	2 9/16	20500
CET39	4 7/8	2 9/16	23300
	4 7/8	2 11/16	22200
CET40	5 1/4	2 11/16	29100
CET43	5 1/4	3 1/4	25300
	5 3/8	3	31700
CET46	6 1/4	3 1/4	46000
CET50	6 5/8	3 3/4	48400
CET54	6 5/8	4	52600
	6 3/4	4	53800
CET57	7	4	65100
	7	4 1/4	59900
CET65	8	5	86800
CET69	8 1/2	5 1/4	107300

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DPM-DS, DPM-MT®, DPM-ST®, and DPM-HighTorque Series Connections are trademarks of DP-Master.
CET™ is trademark of Command Tubular Products.

Table 3.15 Recommended Makeup Torque for Drill Collar Connections

(ft-lb – Box-weak connections shown in **bold type**)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Connection		Bore of Drill Collar (in)											
Type	OD(in)	1	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2	2-13/16	3	3-1/4	3-1/2	3-3/4
NC23	3	**2508**	**2508**	**2508**									
	3-1/8	**3330**	**3330**	2647									
	3-1/4	4000	3387	2647									
2-3/8 REG	3		**2241**	**2241**	1749								
	3-1/8		**3028**	2574	1749								
	3-1/4		3285	2574	1749								
2-7/8 PAC	3		**2712**	**2712**	2090								
	3-1/8		**3548**	2965	2090								
	3-1/4		3718	2695	2090								
NC26	3-1/2		**4606**	**4606**	3697								
	3-3/4		5501	4668	3697								
2-7/8 REG	3-1/2		**3838**	**3838**	**3838**								
	3-3/4		5766	4951	4002								
	3-7/8		5766	4951	4002								
2-7/8 XH	3-3/4		**4089**	**4089**	**4089**								
	3-7/8		**5352**	**5352**	**5352**								
	4-1/8		**8059**	**8059**	7433								
NC31	3-7/8		**4640**	**4640**	**4640**	**4640**							
	4-1/8		**7390**	**7390**	**7390**	6853							
3-1/2 REG	4-1/8		**6466**	**6466**	**6466**	**6466**	5685						
	4-1/4		**7886**	**7886**	**7886**	7115	5685						
	4-1/2		10471	9514	8394	7115	5685						
3-1/2 SH	4-1/4		**8858**	**8858**	8161	6853							
	4-1/2		10286	9307	8161	6853							
NC35	4-1/2				**9038**	**9038**	**9038**	7411					
	4-3/4				12273	10825	9202	7411					
	5				12273	10825	9202	7411					
3-1/2 XH	4-1/4				**5161**	**5161**	**5161**	**5161**					
	4-1/2				**8479**	**8479**	**8479**	8311					
	4-3/4				**12074**	11803	10144	8311					
	5				13282	11803	10144	8311					
	5-1/4				13282	11803	10144	8311					
NC38	4-3/4				**9986**	**9986**	**9986**	**9986**	8315				
	5				**13949**	**13949**	12907	10977	8315				
	5-1/4				16207	14653	12907	10977	8315				
	5-1/2				16207	14653	12907	10977	8315				
3-1/2 H90	4-3/4				**8786**	**8786**	**8786**	**8786**	**8786**				
	5				**12794**	**12794**	**12794**	**12794**	10408				
	5-1/4				**17094**	16929	15137	13151	10408				
	5-1/2				18522	16929	15137	13151	10408				
NC40	5				**10910**	**10910**	**10910**	**10910**	**10910**				
	5-1/4				**15290**	**15290**	**15290**	14969	12125				
	5-1/2				**19985**	18886	17028	14969	12125				
	5-3/4				20539	18886	17028	14969	12125				
	6				20539	18886	17028	14969	12125				
4 H90	5-1/4					**12590**	**12590**	**12590**	**12590**				
	5-1/2					**17401**	**17401**	**17401**	16536				
	5-3/4					**22531**	21714	19543	16536				
	6					23671	21714	19543	16536				
	6-1/4					23671	21714	19543	16536				

Table 3.15 Recommended Makeup Torque for Drill Collar Connections

(ft-lb – Box-weak connections shown in **bold type**)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Connection		Bore of Drill Collar (in)											
Type	OD(in)	1	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2	2-13/16	3	3-1/4	3-1/2	3-3/4
4-1/2 REG	5-1/2					**15576**	**15576**	**15576**	**15576**				
	5-3/4					**20609**	**20609**	19601	16629				
	6					23686	21749	19601	16629				
	6-1/4					23686	21749	19601	16629				
NC44	5-3/4					**20895**	**20895**	**20895**	18161				
	6					25509	23493	21257	18161				
	6-1/4					25509	23493	21257	18161				
	6-1/2					25509	23493	21257	18161				
4-1/2 FH	5-1/2					**12973**	**12973**	**12973**	**12973**	**12973**			
	5-3/4					**18119**	**18119**	**18119**	**18119**	17900			
	6					**23605**	**23605**	23028	19920	17900			
	6-1/4					27294	25272	23028	19920	17900			
	6-1/2					27294	25272	23028	19920	17900			
NC46	5-3/4						**17738**	**17738**	**17738**	**17738**			
	6						**23422**	**23422**	22426	20311			
	6-1/4						28021	25676	22426	20311			
	6-1/2						28021	25676	22426	20311			
	6-3/4						28021	25676	22426	20311			
4-1/2 H90	5-3/4						**18019**	**18019**	**18019**	**18019**			
	6						**23681**	**23681**	23164	21056			
	6-1/4						28736	26402	23164	21056			
	6-1/2						28736	26402	23164	21056			
	6-3/4						28736	26402	23164	21056			
5 H90	6-1/4						**25360**	**25360**	**25360**	**25360**			
	6-1/2						**31895**	**31895**	29400	27167			
	6-3/4						35292	32825	29400	27167			
	7						35292	32825	29400	27167			
NC50	6-1/4						**23003**	**23003**	**23003**	**23003**	**23003**		
	6-1/2						**29679**	**29679**	**29679**	**29679**	26675		
	6-3/4						**36741**	35824	32277	29965	26675		
	7						38379	35824	32277	29965	26675		
	7-1/4						38379	35824	32277	29965	26675		
5-1/2 H90	6-3/4						**34508**	**34508**	**34508**	34142			
	7						**41993**	40117	36501	34142			
	7-1/4						42719	40117	36501	34142			
	7-1/2						42719	40117	36501	34142			
5-1/2 REG	6-3/4						**31941**	**31941**	**31941**	**31941**			
	7						**39419**	**39419**	36235	33868			
	7-1/4						42481	39866	36235	33868			
	7-1/2						42481	39866	36235	33868			
5-1/2 FH	7							**32762**	**32762**	**32762**	**32762**		
	7-1/4							**40998**	**40998**	**40998**	**40998**		
	7-1/2							**49661**	47756	45190	41533		
	7-3/4							51687	47756	45190	41533		
NC56	7-1/4							**40498**	**40498**	**40498**	**40498**		
	7-1/2							**49060**	48221	45680	42058		
	7-3/4							52115	48221	45680	42058		
	8							52115	48221	45680	42058		
6-5/8 REG	7-1/2							**46399**	**46399**	**46399**	**46399**		
	7-3/4							**55627**	53346	50704	46935		
	8							57393	53346	50704	46935		
	8-1/4							57393	53346	50704	46935		

Table 3.15 Recommended Makeup Torque for Drill Collar Connections

(ft-lb – Box-weak connections shown in **bold type**)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Connection		Bore of Drill Collar (in)											
Type	OD(in)	1	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2	2-13/16	3	3-1/4	3-1/2	3-3/4
6-5/8 H90	7-1/2							**46509**	**46509**	**46509**	**46509**		
	7-3/4							**55707**	**55707**	53628	49855		
	8							60321	56273	53628	49855		
	8-1/4							60321	56273	53628	49855		
NC61	8							**55131**	**55131**	**55131**	**55131**		
	8-1/4							**65438**	**65438**	**65438**	61624		
	8-1/2							72670	68398	65607	61624		
	8-3/4							72670	68398	65607	61624		
	9							72670	68398	65607	61624		
5-1/2 IF	8							**56641**	**56641**	**56641**	**56641**	**56641**	
	8-1/4							**67133**	**67133**	**67133**	63381	59027	
	8-1/2							74625	70277	67436	63381	59027	
	8-3/4							74625	70277	67436	63381	59027	
	9							74625	70277	67436	63381	59027	
	9-1/4							74625	70277	67436	63381	59027	
6-5/8 FH	8-1/2								**67789**	**67789**	**67789**	**67789**	67184
	8-3/4								**79544**	**79544**	76707	72102	67184
	9								83992	80991	76707	72102	67184
	9-1/4								83992	80991	76707	72102	67184
	9-1/2								83992	80991	76707	72102	67184
NC70	9								**75781**	**75781**	**75781**	**75781**	**75781**
	9-1/4								**88802**	**88802**	**88802**	**88802**	**88802**
	9-1/2								**102354**	**102354**	101107	96214	90984
	9-3/4								108841	105657	101107	96214	90984
	10								108841	105657	101107	96214	90984
	10-1/4								108841	105657	101107	96214	90984
NC77	10									**108194**	**108194**	**108194**	**108194**
	10-1/4									**124051**	**124051**	**124051**	**124051**
	10-1/2									**140491**	140488	135119	129375
	10-3/4									145476	140488	135119	129375
	11									145476	140488	135119	129375
7 H90	8								**53454**	**53454**	**53454**	**53454**	
	8-1/4								**63738**	**63738**	**63738**	60970	
	8-1/2								72066	69265	65267	60970	
7-5/8 REG	8-1/2									**60402**	**60402**	**60402**	**60402**
	8-3/4									**72169**	**72169**	**72169**	**72169**
	9									**84442**	84221	79536	74529
	9-1/4									88581	84221	79536	74529
	9-1/2									88581	84221	79536	74529
7-5/8 H90	9									**73017**	**73017**	**73017**	**73017**
	9-1/4									**86006**	**86006**	**86006**	**86006**
	9-1/2									**99508**	**99508**	**99508**	96284
8-5/8 REG	10									**109345**	**109345**	**109345**	**109345**
	10-1/4									**125263**	**125263**	**125263**	125034
	10-1/2									141134	136146	130777	125034
8-5/8 H90	10-1/4									**113482**	**113482**	**113482**	**113482**
	10-1/2									**130063**	**130063**	**130063**	**130063**
7 H90 (low torque modif.)	8-3/4								**68061**	**68061**	67257	62845	
	9								74235	71361	67257	62845	

Table 3.15 Recommended Makeup Torque for Drill Collar Connections

(ft-lb – Box-weak connections shown in **bold type**)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Connection		Bore of Drill Collar (in)											
Type	OD(in)	1	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2	2-13/16	3	3-1/4	3-1/2	3-3/4
7-5/8 REG	9-1/4									**73099**	**73099**	**73099**	**73099**
(low torque	9-1/2									**86463**	**86463**	82457	77289
modif.)	9-3/4									91789	87292	82457	77289
	10									91789	87292	82457	77289
7-5/8 H90	9-3/4									**91667**	**91667**	**91667**	**91667**
(low torque	10									**106260**	**106260**	104171	98803
modif.)	10-1/4									113850	109188	104171	98803
	10-1/2									113850	109188	104171	98803
8-5/8 REG	10-3/4									**112887**	**112887**	**112887**	**112887**
(low torque	11									**130676**	**130676**	**130676**	**130676**
modif.)													
8-5/8 H90	10-3/4									**92960**	**92960**	**92960**	**92960**
(low torque	11									**110782**	**110782**	**110782**	**110782**
modif.)	11-1/4									**129203**	**129203**	**129203**	**129203**

Table 3.16 Bending Strength Ratio for Drill Collar Connections

NC23

ID (in)	OD (in) 2-3/4	2-7/8	3	3-1/8	3-1/4	3-3/8	3-1/2
1-1/4	1.45	1.80	2.17	2.57	3.00	3.46	3.95
1-1/2	1.66	2.06	2.49	2.94	3.43	3.96	4.52
1-3/4	2.18	2.70	3.26	3.86	4.51	5.20	

NC26

ID (in)	OD (in) 3-1/8	3-1/4	3-3/8	3-1/2	3-5/8	3-3/4	3-7/8	4
1-1/2	1.43	1.74	2.07	2.42	2.79	3.18	3.60	4.04
1-3/4	1.64	1.99	2.36	2.76	3.19	3.64	4.11	4.62
2	2.10	2.55	3.03	3.54	4.08	4.66	5.27	5.92

NC31

ID (in)	OD (in) 3-7/8	4	4-1/8	4-1/4	4-3/8	4-1/2	4-5/8	4-3/4
1-1/2	1.59	1.84	2.10	2.37	2.65	2.95	3.27	3.60
1-3/4	1.69	1.94	2.22	2.51	2.81	3.13	3.46	3.81
2	1.85	2.14	2.44	2.75	3.08	3.43	3.80	4.19

NC35

ID (in)	OD (in) 4-1/8	4-1/4	4-3/8	4-1/2	4-5/8	4-3/4	4-7/8	5	5-1/8	5-1/4
1-1/2	1.26	1.46	1.66	1.88	2.11	2.35	2.60	2.86	3.14	3.42
1-3/4	1.30	1.51	1.73	1.95	2.19	2.44	2.69	2.97	3.25	3.55
2	1.38	1.60	1.83	2.07	2.32	2.58	2.85	3.14	3.44	3.76
2-1/4	1.51	1.75	2.00	2.26	2.53	2.82	3.12	3.43	3.76	4.11
2-1/2	1.74	2.01	2.29	2.59	2.91	3.24	3.58	3.95	4.32	4.72

NC38

ID (in)	OD (in) 4-1/2	4-5/8	4-3/4	4-7/8	5	5-1/8	5-1/4	5-3/8	5-1/2	5-5/8
1-1/2	1.31	1.50	1.69	1.89	2.09	2.31	2.54	2.78	3.02	3.28
1-3/4	1.35	1.54	1.73	1.94	2.15	2.37	2.61	2.85	3.10	3.37
2	1.40	1.60	1.80	2.01	2.24	2.47	2.71	2.97	3.23	3.50
2-1/4	1.49	1.70	1.92	2.14	2.38	2.63	2.88	3.15	3.43	3.73
2-1/2	1.64	1.87	2.10	2.35	2.61	2.88	3.17	3.46	3.77	4.09

Table 3.16 Bending Strength Ratio for Drill Collar Connections

NC40

	OD (in)									
ID (in)	**5**	**5-1/8**	**5-1/4**	**5-3/8**	**5-1/2**	**5-5/8**	**5-3/4**	**5-7/8**	**6**	**6-1/8**
2	1.66	1.85	2.04	2.25	2.46	2.68	2.91	3.14	3.39	3.65
2-1/4	1.74	1.93	2.14	2.35	2.57	2.80	3.04	3.29	3.55	3.82
2-1/2	1.86	2.07	2.29	2.51	2.75	2.99	3.25	3.52	3.79	4.08
2-13/16	2.11	2.35	2.60	2.86	3.12	3.40	3.70	4.00	4.31	

NC44

	OD (in)							
ID (in)	**5-5/8**	**5-3/4**	**5-7/8**	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**
2	1.86	2.04	2.22	2.41	2.61	2.82	3.03	3.25
2-1/4	1.92	2.10	2.29	2.49	2.70	2.91	3.13	3.36
2-1/2	2.01	2.20	2.40	2.61	2.82	3.04	3.27	3.51
2-13/16	2.19	2.39	2.61	2.84	3.07	3.31	3.56	3.82

NC46

	OD (in)												
ID (in)	**5-1/2**	**5-5/8**	**5-3/4**	**5-7/8**	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**	**6-5/8**	**6-3/4**	**6-7/8**	**7**
2	1.33	1.48	1.64	1.80	1.97	2.14	2.32	2.50	2.70	2.89	3.10	3.31	3.53
2-1/4	1.37	1.52	1.68	1.85	2.02	2.19	2.38	2.57	2.77	2.97	3.18	3.40	3.62
2-1/2	1.42	1.58	1.74	1.91	2.09	2.28	2.47	2.66	2.87	3.08	3.30	3.53	3.76
2-13/16	1.52	1.69	1.87	2.05	2.24	2.44	2.64	2.85	3.07	3.30	3.53	3.77	4.02
3	1.61	1.79	1.97	2.17	2.37	2.58	2.79	3.02	3.25	3.49	3.74	3.99	
3-1/4	1.78	1.98	2.19	2.40	2.62	2.85	3.09	3.34	3.60	3.86	4.14	4.42	

NC50

	OD (in)												
ID (in)	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**	**6-5/8**	**6-3/4**	**6-7/8**	**7**	**7-1/8**	**7-1/4**	**7-3/8**	**7-1/2**
2-1/4	1.31	1.45	1.59	1.74	1.89	2.04	2.21	2.37	2.54	2.72	2.91	3.10	3.29
2-1/2	1.34	1.48	1.63	1.78	1.93	2.10	2.26	2.43	2.61	2.79	2.98	3.17	3.38
2-13/16	1.41	1.55	1.71	1.86	2.03	2.19	2.37	2.55	2.73	2.92	3.12	3.32	3.53
3	1.46	1.61	1.77	1.93	2.10	2.28	2.46	2.64	2.83	3.03	3.24	3.45	3.67
3-1/4	1.56	1.72	1.89	2.06	2.24	2.43	2.62	2.82	3.02	3.24	3.45	3.68	3.91
3-1/2	1.70	1.88	2.06	2.25	2.45	2.65	2.86	3.08	3.30	3.53	3.77	4.02	

Table 3.16 Bending Strength Ratio for Drill Collar Connections

NC56

	OD (in)													
ID (in)	6-5/8	6-3/4	6-7/8	7	7-1/8	7-1/4	7-3/8	7-1/2	7-5/8	7-3/4	7-7/8	8	8-1/8	8-1/4
2-1/4	1.40	1.52	1.63	1.76	1.88	2.02	2.15	2.29	2.43	2.58	2.73	2.89	3.05	3.22
2-13/16	1.46	1.58	1.71	1.84	1.97	2.11	2.25	2.39	2.54	2.70	2.86	3.02	3.19	3.36
3	1.50	1.62	1.75	1.88	2.02	2.16	2.30	2.45	2.60	2.76	2.92	3.09	3.26	3.44
3-1/4	1.56	1.69	1.82	1.95	2.10	2.24	2.39	2.55	2.71	2.87	3.04	3.21	3.39	3.58
3-1/2	1.64	1.77	1.91	2.06	2.21	2.36	2.52	2.68	2.85	3.02	3.20	3.38	3.57	3.77

NC61

	OD (in)													
ID (in)	7-1/2	7-5/8	7-3/4	7-7/8	8	8-1/8	8-1/4	8-3/8	8-1/2	8-5/8	8-3/4	8-7/8	9	9-1/8
2-1/2	1.58	1.69	1.80	1.91	2.03	2.16	2.28	2.41	2.54	2.68	2.82	2.96	3.11	3.26
2-13/16	1.61	1.72	1.83	1.95	2.07	2.20	2.32	2.46	2.59	2.73	2.87	3.02	3.17	3.32
3	1.63	1.74	1.86	1.98	2.10	2.23	2.36	2.49	2.63	2.77	2.92	3.06	3.22	3.37
3-1/4	1.67	1.79	1.91	2.03	2.16	2.29	2.42	2.56	2.70	2.84	2.99	3.14	3.30	3.46
3-1/2	1.73	1.85	1.97	2.10	2.23	2.36	2.50	2.64	2.79	2.94	3.09	3.25	3.41	3.57

NC70

	OD (in)													
ID (in)	8-7/8	9	9-1/8	9-1/4	9-3/8	9-1/2	9-5/8	9-3/4	9-7/8	10	10-1/8	10-1/4	10-3/8	10-1/2
2-1/2	1.77	1.87	1.97	2.08	2.18	2.29	2.40	2.52	2.64	2.76	2.88	3.01	3.13	3.27
2-13/16	1.79	1.89	1.99	2.10	2.21	2.32	2.43	2.55	2.66	2.79	2.91	3.04	3.17	3.30
3	1.81	1.91	2.01	2.12	2.23	2.34	2.45	2.57	2.69	2.81	2.94	3.06	3.20	3.33
3-1/4	1.83	1.93	2.04	2.15	2.26	2.37	2.49	2.60	2.73	2.85	2.98	3.11	3.24	3.38
3-1/2	1.86	1.97	2.08	2.19	2.30	2.41	2.53	2.65	2.78	2.90	3.03	3.16	3.30	3.44
3-3/4	1.91	2.02	2.12	2.24	2.35	2.47	2.59	2.71	2.84	2.97	3.10	3.24	3.38	3.52

NC77

	OD (in)																
ID (in)	9-5/8	9-3/4	9-7/8	10	10-1/8	10-1/4	10-3/8	10-1/2	10-5/8	10-3/4	10-7/8	11	11-1/8	11-1/4	11-3/8	11-1/2	11-5/8
2-13/16	1.68	1.77	1.86	1.95	2.05	2.14	2.24	2.34	2.44	2.55	2.66	2.77	2.88	2.99	3.11	3.23	3.35
3	1.69	1.78	1.87	1.96	2.06	2.16	2.25	2.36	2.46	2.56	2.67	2.78	2.89	3.01	3.13	3.25	3.37
3-1/4	1.71	1.80	1.89	1.98	2.08	2.18	2.28	2.38	2.48	2.59	2.70	2.81	2.92	3.04	3.16	3.28	3.40
3-1/2	1.73	1.82	1.91	2.01	2.10	2.20	2.30	2.41	2.51	2.62	2.73	2.84	2.96	3.08	3.20	3.32	3.44
3-3/4	1.76	1.85	1.94	2.04	2.14	2.24	2.34	2.44	2.55	2.66	2.77	2.89	3.00	3.12	3.25	3.37	3.50

Table 3.16 Bending Strength Ratio for Drill Collar Connections

5-1/2 IF

ID (in)	OD (in) 7-3/4	7-7/8	8	8-1/8	8-1/4	8-3/8	8-1/2	8-5/8	8-3/4	8-7/8	9	9-1/8	9-1/4	9-3/8
2-1/2	1.59	1.71	1.83	1.95	2.08	2.21	2.34	2.48	2.62	2.77	2.92	3.07	3.22	3.38
2-13/16	1.62	1.74	1.86	1.99	2.12	2.25	2.39	2.53	2.67	2.82	2.97	3.12	3.28	3.45
3	1.65	1.77	1.89	2.02	2.15	2.29	2.42	2.57	2.71	2.86	3.01	3.17	3.33	3.50
3-1/4	1.69	1.81	1.94	2.07	2.21	2.34	2.49	2.63	2.78	2.93	3.09	3.25	3.42	3.59
3-1/2	1.74	1.87	2.00	2.14	2.28	2.42	2.57	2.72	2.87	3.03	3.19	3.36	3.53	3.70

6-5/8 IF

ID (in)	OD (in) 9	9-1/8	9-1/4	9-3/8	9-1/2	9-5/8	9-3/4	9-7/8	10	10-1/8	10-1/4	10-3/8	10-1/2	10-5/8
3-1/4	1.50	1.60	1.70	1.80	1.91	2.02	2.13	2.24	2.36	2.48	2.60	2.72	2.85	2.98
3-1/2	1.52	1.62	1.73	1.83	1.94	2.05	2.16	2.28	2.40	2.52	2.64	2.76	2.89	3.02

2-3/8 REG

ID (in)	OD (in) 2-3/4	2-7/8	3	3-1/8	3-1/4	3-3/8
1-1/4	1.67	2.01	2.36	2.75	3.17	3.61
1-1/2	1.91	2.29	2.70	3.14	3.62	4.13

2-7/8 REG

ID (in)	OD (in) 3-1/8	3-1/4	3-3/8	3-1/2	3-5/8	3-3/4	3-7/8	4
1-1/4	1.46	1.71	1.98	2.27	2.58	2.91	3.26	3.63
1-1/2	1.56	1.83	2.12	2.42	2.75	3.10	3.48	3.87
1-3/4	1.75	2.06	2.38	2.73	3.10	3.49	3.91	4.35

3-1/2 REG

ID (in)	OD (in) 3-5/8	3-3/4	3-7/8	4	4-1/8	4-1/4	4-3/8	4-1/2	4-5/8	4-3/4
1-1/2	1.28	1.48	1.69	1.92	2.16	2.41	2.67	2.95	3.25	3.56
1-3/4	1.35	1.56	1.79	2.02	2.27	2.54	2.82	3.11	3.42	3.75
2	1.47	1.70	1.95	2.21	2.48	2.77	3.07	3.39	3.73	4.09

4-1/2 REG

ID (in)	OD (in) 5-1/4	5-3/8	5-1/2	5-5/8	5-3/4	5-7/8	6	6-1/8	6-1/4	6-3/8
2	1.61	1.77	1.94	2.11	2.29	2.48	2.68	2.88	3.09	3.31
2-1/4	1.66	1.83	2.00	2.18	2.37	2.56	2.77	2.98	3.20	3.42
2-1/2	1.74	1.92	2.10	2.29	2.49	2.69	2.90	3.12	3.35	3.59

Table 3.16 Bending Strength Ratio for Drill Collar Connections

5-1/2 REG

	OD (in)												
ID (in)	6-1/8	6-1/4	6-3/8	6-1/2	6-5/8	6-3/4	6-7/8	7	7-1/8	7-1/4	7-3/8	7-1/2	7-5/8
2-1/4	1.39	1.51	1.65	1.78	1.92	2.07	2.22	2.37	2.53	2.70	2.87	3.04	3.22
2-1/2	1.42	1.55	1.68	1.82	1.96	2.11	2.27	2.42	2.59	2.76	2.93	3.11	3.29
2-13/16	1.48	1.61	1.75	1.89	2.04	2.20	2.36	2.52	2.69	2.87	3.05	3.24	3.43
3	1.52	1.66	1.81	1.96	2.11	2.27	2.43	2.60	2.78	2.96	3.15	3.34	3.54
3-1/4	1.61	1.76	1.91	2.07	2.23	2.40	2.57	2.75	2.94	3.13	3.33	3.53	3.74
3-1/2	1.74	1.90	2.06	2.23	2.41	2.59	2.77	2.97	3.17	3.37	3.59	3.81	4.04

6-5/8 REG

	OD (in)												
ID (in)	7-1/8	7-1/4	7-3/8	7-1/2	7-5/8	7-3/4	7-7/8	8	8-1/8	8-1/4	8-3/8	8-1/2	8-5/8
2-1/2	1.56	1.69	1.82	1.96	2.10	2.24	2.39	2.54	2.69	2.85	3.02	3.19	3.36
2-13/16	1.61	1.74	1.87	2.01	2.15	2.30	2.45	2.60	2.76	2.93	3.10	3.27	3.45
3	1.64	1.77	1.91	2.05	2.20	2.35	2.50	2.66	2.82	2.99	3.16	3.34	3.52
3-1/4	1.70	1.84	1.98	2.12	2.28	2.43	2.59	2.75	2.92	3.10	3.27	3.46	3.64
3-1/2	1.78	1.92	2.07	2.23	2.38	2.55	2.71	2.88	3.06	3.24	3.43	3.62	3.82

7-5/8 REG

	OD (in)													
ID (in)	8-3/8	8-1/2	8-5/8	8-3/4	8-7/8	9	9-1/8	9-1/4	9-3/8	9-1/2	9-5/8	9-3/4	9-7/8	10
2-1/2	1.70	1.80	1.91	2.02	2.13	2.25	2.37	2.49	2.62	2.75	2.88	3.01	3.15	3.30
2.04	2.16	2.28	2.40	2.53	2.66	2.79	2.93	3.07	3.22	3.36	3.52	3-3/4	1.86	1.98

8-5/8 REG

	OD (in)												
ID (in)	9-5/8	9-3/4	9-7/8	10	10-1/8	10-1/4	10-3/8	10-1/2	10-5/8	10-3/4	10-7/8	11	11-1/8
2-13/16	1.69	1.78	1.87	1.97	2.07	2.17	2.27	2.38	2.49	2.60	2.71	2.82	2.94
3	1.70	1.79	1.89	1.98	2.08	2.18	2.29	2.39	2.50	2.61	2.73	2.84	2.96
3-1/4	1.71	1.81	1.90	2.00	2.10	2.21	2.31	2.42	2.53	2.64	2.75	2.87	2.99
3-1/2	1.74	1.83	1.93	2.03	2.13	2.24	2.34	2.45	2.56	2.67	2.79	2.91	3.03
3-3/4	1.77	1.86	1.96	2.06	2.17	2.27	2.38	2.49	2.60	2.72	2.84	2.96	3.08

2-3/8 SH

	OD (in)					
ID (in)	2-5/8	2-3/4	2-7/8	3	3-1/8	3-1/4
1-1/4	1.57	1.96	2.38	2.83	3.31	3.84
1-1/2	1.88	2.34	2.85	3.39	3.97	4.59

Table 3.16 Bending Strength Ratio for Drill Collar Connections

2-3/8 PAC

	OD (in)						
ID (in)	2-1/2	2-5/8	2-3/4	2-7/8	3	3-1/8	3-1/4
1-1/4	1.02	1.38	1.76	2.17	2.61	3.09	3.60
1-1/2	1.21	1.63	2.09	2.58	3.11	3.67	4.25
1-3/4	1.76	2.37	3.03	3.74	4.50		

2-7/8 PAC

	OD (in)						
ID (in)	2-3/4	2-7/8	3	3-1/8	3-1/4	3-3/8	3-1/2
1-1/4	1.11	1.43	1.78	2.15	2.55	2.98	3.43
1-1/2	1.25	1.61	2.01	2.43	2.88	3.36	3.87
1-3/4	1.58	2.04	2.54	3.07	3.63	4.24	4.89

3-1/2 PAC

	OD (in)							
ID (in)	3-1/2	3-5/8	3-3/4	3-7/8	4	4-1/8	4-1/4	4-3/8
1-1/2	1.48	1.75	2.04	2.34	2.66	3.00	3.36	3.73
1-3/4	1.61	1.90	2.21	2.54	2.89	3.26	3.65	4.06
2	1.86	2.20	2.56	2.94	3.34	3.77	4.22	4.69

2-3/8 OH

	OD (in)								
ID (in)	3	3-1/8	3-1/4	3-3/8	3-1/2	3-5/8	3-3/4	3-7/8	4
1-1/4	1.03	1.32	1.62	1.94	2.28	2.65	3.03	3.44	3.87
1-1/2	1.12	1.43	1.75	2.10	2.47	2.86	3.28	3.72	4.19
1-3/4	1.29	1.65	2.02	2.42	2.85	3.30	3.78	4.29	
2	1.69	2.16	2.65	3.18	3.73	4.33	4.96		

2-7/8 OH

	OD (in)							
ID (in)	3-5/8	3-3/4	3-7/8	4	4-1/8	4-1/4	4-3/8	4-1/2
1-1/2	1.40	1.66	1.94	2.23	2.53	2.85	3.19	3.55
1-3/4	1.51	1.78	2.08	2.39	2.72	3.06	3.43	3.81
2	1.70	1.98	2.28	2.58	2.90	3.24	3.57	4.40

3-1/2 OH

	OD (in)								
ID (in)	4-3/4	4-7/8	5	5-1/8	5-1/4	5-3/8	5-1/2	5-5/8	5-3/4
1-1/2	1.65	1.86	2.08	2.30	2.54	2.79	3.04	3.31	3.59
1-3/4	1.70	1.91	2.13	2.37	2.61	2.86	3.12	3.40	3.68
2	1.77	1.99	2.22	2.47	2.72	2.98	3.26	3.54	3.84

Table 3.16 Bending Strength Ratio for Drill Collar Connections

4 OH

	OD (in)							
ID (in)	**5-5/8**	**5-3/4**	**5-7/8**	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**
2	1.69	1.86	2.04	2.23	2.43	2.63	2.84	3.05
2-1/4	1.74	1.92	2.11	2.30	2.50	2.71	2.92	3.15
2-1/2	1.82	2.01	2.20	2.40	2.61	2.83	3.05	3.29

4-1/2 OH

	OD (in)							
ID (in)	**5-3/4**	**5-7/8**	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**	**6-5/8**
3-1/2	1.80	2.01	2.23	2.45	2.69	2.93	3.18	3.43
3-3/4	2.13	2.37	2.63	2.90	3.17	3.46	3.75	4.05

2-3/8 FH

	OD (in)						
ID (in)	**2-3/4**	**2-7/8**	**3**	**3-1/8**	**3-1/4**	**3-3/8**	**3-1/2**
1-1/2			1.94	2.30	2.65	3.04	3.45
1-3/4		1.90	2.30	2.72	3.17		

2-7/8 FH

	OD (in)								
ID (in)	**4**	**4-1/8**	**4-1/4**	**4-3/8**	**4-1/2**	**4-5/8**	**4-3/4**	**4-7/8**	**5**
1-1/2	1.57	1.79	2.01	2.25	2.50	2.76	3.03	3.32	3.62
1-3/4	1.65	1.87	2.10	2.35	2.61	2.88	3.17	3.47	3.79
2	1.77	2.01	2.26	2.52	2.80	3.10	3.41	3.73	4.07

3-1/2 FH

	OD (in)									
ID (in)	**4-3/8**	**4-1/2**	**4-5/8**	**4-3/4**	**4-7/8**	**5**	**5-1/8**	**5-1/4**	**5-3/8**	**5-1/2**
1-1/2	1.43	1.61	1.80	2.00	2.21	2.42	2.65	2.89	3.14	3.40
1-3/4	1.47	1.66	1.85	2.05	2.27	2.49	2.73	2.97	3.23	3.50
2	1.54	1.73	1.93	2.15	2.37	2.60	2.85	3.11	3.37	3.65
2-1/4	1.64	1.85	2.07	2.30	2.54	2.79	3.05	3.32	3.61	3.91
2-1/2	1.82	2.05	2.29	2.55	2.81	3.09	3.38	3.69	4.00	4.34

Table 3.16 Bending Strength Ratio for Drill Collar Connections

4-1/2 FH

	OD (in)										
ID (in)	**5-1/2**	**5-5/8**	**5-3/4**	**5-7/8**	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**	**6-5/8**	**6-3/4**
2	1.60	1.76	1.92	2.09	2.26	2.45	2.64	2.83	3.03	3.24	3.46
2-1/4	1.65	1.81	1.97	2.15	2.33	2.52	2.71	2.91	3.12	3.34	3.56
2-1/2	1.72	1.88	2.06	2.24	2.43	2.62	2.82	3.03	3.25	3.47	3.71
2-13/16	1.85	2.03	2.22	2.41	2.61	2.82	3.04	3.27	3.50	3.75	4.00
3	1.97	2.16	2.36	2.57	2.78	3.01	3.24	3.48	3.73	3.99	
3-1/4	2.21	2.42	2.65	2.88	3.12	3.37	3.63	3.90	4.18		

5-1/2 FH

	OD (in)													
ID (in)	**6-3/4**	**6-7/8**	**7**	**7-1/8**	**7-1/4**	**7-3/8**	**7-1/2**	**7-5/8**	**7-3/4**	**7-7/8**	**8**	**8-1/8**	**8-1/4**	**8-3/8**
2-1/4	1.39	1.52	1.64	1.78	1.91	2.05	2.20	2.35	2.50	2.66	2.82	2.99	3.16	3.34
2-1/2	1.41	1.54	1.67	1.81	1.95	2.09	2.24	2.39	2.54	2.70	2.87	3.04	3.21	3.39
2-13/16	1.46	1.59	1.72	1.86	2.00	2.15	2.30	2.46	2.62	2.78	2.95	3.13	3.31	3.50
3	1.49	1.62	1.76	1.90	2.05	2.20	2.36	2.52	2.68	2.85	3.03	3.20	3.39	3.58
3-1/4	1.55	1.69	1.83	1.98	2.14	2.29	2.45	2.62	2.79	2.97	3.15	3.34	3.53	3.73
3-1/2	1.64	1.78	1.94	2.09	2.25	2.42	2.59	2.76	2.95	3.13	3.32	3.52	3.72	3.93

6-5/8 FH

	OD (in)													
ID (in)	**8-1/4**	**8-3/8**	**8-1/2**	**8-5/8**	**8-3/4**	**8-7/8**	**9**	**9-1/8**	**9-1/4**	**9-3/8**	**9-1/2**	**9-5/8**	**9-3/4**	**9-7/8**
2-1/2	1.65	1.76	1.88	2.00	2.12	2.25	2.38	2.51	2.64	2.78	2.93	3.07	3.22	3.37
2-13/16	1.68	1.79	1.91	2.03	2.16	2.28	2.41	2.55	2.69	2.83	2.97	3.12	3.27	3.42
3	1.70	1.81	1.93	2.06	2.18	2.31	2.44	2.58	2.72	2.86	3.01	3.15	3.31	3.46
3-1/4	1.73	1.85	1.97	2.10	2.23	2.36	2.49	2.63	2.77	2.92	3.07	3.22	3.38	3.53
3-1/2	1.78	1.90	2.02	2.15	2.28	2.42	2.56	2.70	2.85	3.00	3.15	3.30	3.46	3.63
3-3/4	1.84	1.96	2.09	2.23	2.36	2.50	2.64	2.79	2.94	3.10	3.25	3.42	3.58	3.75

2-7/8 XH

	OD (in)						
ID (in)	**3-7/8**	**4**	**4-1/8**	**4-1/4**	**4-3/8**	**4-1/2**	**4-5/8**
1-1/2	1.84	2.10	2.37	2.66	2.96	3.28	3.62
1-3/4	1.96	2.24	2.53	2.83	3.15	3.49	3.85
2	2.18	2.48	2.80	3.14	3.50	3.88	4.27

Table 3.16 Bending Strength Ratio for Drill Collar Connections

3-1/2 XH

ID (in)	OD (in) 4-1/4	4-3/8	4-1/2	4-5/8	4-3/4	4-7/8	5	5-1/8	5-1/4	5-3/8
1-1/2	1.27	1.47	1.67	1.89	2.12	2.35	2.60	2.86	3.13	3.41
1-3/4	1.31	1.52	1.73	1.95	2.19	2.43	2.68	2.95	3.23	3.52
2	1.38	1.60	1.82	2.06	2.30	2.56	2.83	3.11	3.40	3.71
2-1/4	1.50	1.73	1.97	2.23	2.49	2.77	3.06	3.37	3.69	4.02
2-1/2	1.70	1.96	2.23	2.52	2.82	3.14	3.47	3.81	4.18	4.55

3-1/2 H90

ID (in)	OD (in) 4-3/4	4-7/8	5	5-1/8	5-1/4	5-3/8	5-1/2	5-5/8	5-3/4	5-7/8
2	1.51	1.69	1.89	2.09	2.31	2.53	2.76	3.00	3.25	3.51
2-1/4	1.59	1.78	1.99	2.20	2.43	2.66	2.90	3.16	3.42	3.69
2-1/2	1.71	1.92	2.15	2.38	2.62	2.87	3.13	3.41	3.69	3.99

4 H90

ID (in)	OD (in) 5-1/4	5-3/8	5-1/2	5-5/8	5-3/4	5-7/8	6	6-1/8	6-1/4	6-3/8	6-1/2
2	1.52	1.69	1.86	2.04	2.23	2.42	2.63	2.84	3.05	3.28	3.51
2-1/4	1.57	1.74	1.92	2.11	2.30	2.51	2.72	2.93	3.16	3.39	3.64
2-1/2	1.65	1.83	2.02	2.22	2.42	2.63	2.85	3.08	3.32	3.57	3.82
2-13/16	1.81	2.01	2.22	2.43	2.66	2.89	3.13	3.38	3.64	3.91	4.19

4-1/2 H90

ID (in)	OD (in) 5-1/2	5-5/8	5-3/4	5-7/8	6	6-1/8	6-1/4	6-3/8	6-1/2	6-5/8	6-3/4	6-7/8	7
2	1.31	1.45	1.60	1.76	1.92	2.08	2.26	2.44	2.62	2.82	3.02	3.22	3.43
2-1/4	1.34	1.49	1.64	1.80	1.96	2.14	2.31	2.50	2.69	2.89	3.09	3.30	3.52
2-1/2	1.39	1.54	1.70	1.86	2.04	2.21	2.40	2.59	2.78	2.99	3.20	3.42	3.65
2-13/16	1.48	1.64	1.81	1.99	2.17	2.36	2.56	2.76	2.97	3.19	3.42	3.65	3.89
3	1.56	1.73	1.91	2.10	2.29	2.49	2.70	2.91	3.14	3.37	3.60	3.85	4.11
3-1/4	1.72	1.91	2.11	2.31	2.52	2.74	2.97	3.21	3.45	3.71	3.97	4.24	

Table 3.16 Bending Strength Ratio for Drill Collar Connections

5 H90

	OD (in)												
ID (in)	**5-7/8**	**6**	**6-1/8**	**6-1/4**	**6-3/8**	**6-1/2**	**6-5/8**	**6-3/4**	**6-7/8**	**7**	**7-1/8**	**7-1/4**	**7-3/8**
2-1/4	1.38	1.52	1.66	1.81	1.97	2.13	2.29	2.46	2.64	2.82	3.01	3.20	3.41
2-1/2	1.42	1.56	1.71	1.86	2.53	2.18	2.35	2.53	2.71	2.90	3.09	3.29	3.50
2-13/16	1.49	1.64	1.80	1.96	2.12	2.30	2.47	2.66	2.85	3.05	3.25	3.46	3.68
3	1.55	1.71	1.87	2.04	2.21	2.39	2.58	2.77	2.97	3.18	3.39	3.61	3.83
3-1/4	1.67	1.83	2.01	2.19	2.38	2.57	2.77	2.98	3.19	3.41	3.64	3.88	4.12
3-1/2	1.84	2.02	2.22	2.42	2.62	2.84	3.06	3.29	3.52	3.77	4.02	4.28	

5-1/2 H90

	OD (in)												
ID (in)	**6-1/4**	**6-3/8**	**6-1/2**	**6-5/8**	**6-3/4**	**6-7/8**	**7**	**7-1/8**	**7-1/4**	**7-3/8**	**7-1/2**	**7-5/8**	**7-3/4**
2-1/4	1.39	1.53	1.66	1.80	1.95	2.10	2.26	2.42	2.58	2.75	2.93	3.11	3.30
2-1/2	1.43	1.56	1.70	1.84	1.99	2.15	2.31	2.47	2.64	2.81	2.99	3.18	3.37
2-13/16	1.48	1.62	1.77	1.92	2.07	2.23	2.40	2.57	2.74	2.93	3.11	3.30	3.50
3	1.53	1.68	1.83	1.98	2.14	2.31	2.48	2.65	2.83	3.02	3.21	3.41	3.62
3-1/4	1.62	1.77	1.93	2.09	2.26	2.44	2.62	2.80	2.99	3.19	3.40	3.61	3.82
3-1/2	1.74	1.91	2.08	2.25	2.44	2.62	2.82	3.02	3.22	3.44	3.66	3.88	4.12

6-5/8 H90

	OD (in)												
ID (in)	**7-1/4**	**7-3/8**	**7-1/2**	**7-5/8**	**7-3/4**	**7-7/8**	**8**	**8-1/8**	**8-1/4**	**8-3/8**	**8-1/2**	**8-5/8**	**8-3/4**
2-1/2	1.60	1.72	1.85	1.98	2.12	2.26	2.40	2.54	2.70	2.85	3.01	3.17	3.34
2-13/16	1.64	1.77	1.90	2.03	2.17	2.31	2.46	2.61	2.76	2.92	3.08	3.25	3.42
3	1.67	1.80	1.93	2.07	2.21	2.35	2.50	2.66	2.81	2.98	3.14	3.31	3.49
3-1/4	1.73	1.86	2.00	2.14	2.28	2.43	2.59	2.74	2.91	3.07	3.24	3.42	3.60
3-1/2	1.80	1.94	2.08	2.23	2.38	2.54	2.70	2.86	3.03	3.21	3.39	3.57	3.76

7 H90

	OD (in)													
ID (in)	**7-5/8**	**7-3/4**	**7-7/8**	**8**	**8-1/8**	**8-1/4**	**8-3/8**	**8-1/2**	**8-5/8**	**8-3/4**	**8-7/8**	**9**	**9-1/8**	**9-1/4**
2-1/2	1.58	1.69	1.80	1.91	2.03	2.15	2.27	2.40	2.52	2.66	2.79	2.93	3.08	3.22
2-13/16	1.61	1.72	1.83	1.95	2.06	2.19	2.31	2.44	2.57	2.70	2.84	2.98	3.13	3.28
3	1.63	1.74	1.86	1.97	2.09	2.22	2.34	2.47	2.60	2.74	2.88	3.03	3.17	3.33
3-1/4	1.67	1.79	1.90	2.02	2.14	2.27	2.40	2.53	2.67	2.81	2.95	3.10	3.25	3.41
3-1/2	1.72	1.84	1.96	2.08	2.21	2.34	2.47	2.61	2.75	2.89	3.04	3.19	3.35	3.51

Table 3.16 Bending Strength Ratio for Drill Collar Connections

7-5/8 H90

	OD (in)													
ID (in)	8-7/8	9	9-1/8	9-1/4	9-3/8	9-1/2	9-5/8	9-3/4	9-7/8	10	10-1/8	10-1/4	10-3/8	10-1/2
2-13/16	1.69	1.78	1.88	1.98	2.08	2.19	2.30	2.41	2.52	2.63	2.75	2.87	3.00	3.12
3	1.70	1.80	1.90	2.00	2.10	2.21	2.32	2.43	2.54	2.66	2.77	2.90	3.02	3.15
3-1/4	1.73	1.82	1.92	2.02	2.13	2.24	2.35	2.46	2.57	2.69	2.81	2.93	3.06	3.19
3-1/2	1.76	1.85	1.96	2.06	2.17	2.27	2.39	2.50	2.62	2.74	2.86	2.98	3.11	3.24
3-3/4	1.79	1.89	2.00	2.10	2.21	2.32	2.44	2.55	2.67	2.80	2.92	3.05	3.18	3.31

8-5/8 H90

	OD (in)																
ID (in)	10	10-1/8	10-1/4	10-3/8	10-1/2	10-5/8	10-3/4	10-7/8	11	11-1/8	11-1/4	11-3/8	11-1/2	11-5/8	11-3/4	11-7/8	12
3	1.69	1.77	1.86	1.95	2.04	2.13	2.22	2.32	2.42	2.52	2.62	2.72	2.83	2.94	3.05	3.16	3.28
3-1/4	1.70	1.79	1.87	1.96	2.05	2.15	2.24	2.34	2.44	2.54	2.64	2.74	2.85	2.96	3.07	3.19	3.30
3-1/2	1.72	1.81	1.89	1.98	2.07	2.17	2.26	2.36	2.46	2.56	2.67	2.77	2.88	2.99	3.10	3.22	3.34
3-3/4	1.74	1.83	1.92	2.01	2.10	2.20	2.29	2.39	2.49	2.60	2.70	2.81	2.92	3.03	3.15	3.26	3.38

Table 3.17 Rotary Shouldered Connection Interchange List

(Connections in the same column are interchangeable)

1	2	3	4	5	6	7	8	9
	Current API Name (Preferred)							
	NC26	**NC31**	**–**	**–**	**NC38**	**NC40**	**NC46**	**NC50**
Obsolete API Name								
Internal Flush (IF)	2-3/8	2-7/8	–	–	3-1/2	–	4	4-1/2
Full Hole (FH)[1]	–	–	–	–		4	–	–
Other Obsolete Name								
Extra Hole (XH)	–	–	2-7/8	3-1/2	–	–	4-1/2	5
Double Streamline (DSL)	–	–	3-1/2	–	–	4-1/2	–	5-1/2
Slim Hole (SH)	2-7/8	3-1/2	–	4	4-1/2	–	–	–
External Flush (EF)	–	–	–	4-1/2	–	–	–	–

Several Rotary Shouldered Connections are interchangeable with other connections having different names. "Interchangeable" means that the connections will mate together, make-up, and function, though function may not be as good as with the preferred connection. This situation has occurred because efforts were made to maintain interchangeability with existing products as improvements were made to connections over the years.

The current API Nomenclature was adopted in 1968. The difference between the current API connections and their obsolete counterparts is that the NC connections *require* the use of an improved thread form (V-038R) while this thread form is *optional* with the older counterparts. Even though almost all connections that now carry the old names are cut with the improved thread form *current API nomenclature (NC—) should be used, if possible, when specifying connections on this list.*

[1] All "Full Hole" Connections except the 5-1/2FH and 6-5/8FH are obsolete.

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Table 3.18.1 New Normal Weight Drill Pipe (NWDP) Tube Dimensions

1	2	3	4	5	6	7	8	9	10
Nom Size OD (in)	Nom Weight (lb/ft)	Nom ID (in)	Nom Wall (in)	OD Min (in)	OD Max (in)	(A_o) Section Area OD (in^2)	(A_i) Section Area ID (in^2)	Section Area Wall (in^2)	(Z)[1] Section Modulus (in^3)
DS-1® Standard NWDP Tube Dimensions									
2 3/8	6.65	1.815	0.280	2.344	2.406	4.430	2.587	1.843	0.867
2 7/8	10.40	2.151	0.362	2.844	2.906	6.492	3.634	2.858	1.602
3 1/2	9.50	2.992	0.254	3.469	3.531	9.621	7.031	2.590	1.961
	13.30	2.764	0.368				6.000	3.621	2.572
	15.50	2.602	0.449				5.317	4.304	2.923
4	11.85	3.476	0.262	3.969	4.031	12.566	9.490	3.077	2.700
	14.00	3.340	0.330				8.762	3.805	3.229
4 1/2	13.75	3.958	0.271	4.478	4.545	15.904	12.304	3.600	3.592
	16.60	3.826	0.337				11.497	4.407	4.271
	20.00	3.640	0.430				10.406	5.498	5.116
5	16.25	4.408	0.296	4.975	5.050	19.635	15.261	4.374	4.859
	19.50	4.276	0.362				14.360	5.275	5.708
	25.60	4.000	0.500				12.566	7.069	7.245
5 1/2	21.90	4.778	0.361	5.473	5.555	23.758	17.930	5.828	7.031
	24.70	4.670	0.415				17.129	6.630	7.844
5 7/8	23.40	5.153	0.361	5.846	5.934	27.109	20.855	6.254	8.125
	26.30	5.045	0.415				19.990	7.119	9.083
6 5/8	25.20	5.965	0.330	6.592	6.691	34.472	27.945	6.526	9.786
	27.70	5.901	0.362				27.349	7.123	10.578
Other (Non-Standard) NWDP Tube Dimensions									
2 3/8	4.85	1.995	0.190	2.344	2.406	4.430	3.126	1.304	0.660
2 7/8	6.85	2.441	0.217	2.844	2.906	6.492	4.680	1.812	1.121
4	15.70	3.240	0.380	3.969	4.031	12.566	8.245	4.322	3.578
4 1/2	22.82	3.500	0.500	4.478	4.545	15.904	9.621	6.283	5.672
5 1/2	19.20	4.892	0.304	5.473	6.680	23.758	18.796	4.962	6.111

$$z = \left(\frac{\pi}{32}\right)\left(\frac{OD^4 - ID^4}{OD}\right)$$

[1] Note: The preceding formula is one of two that are used in API RP7G for the term "Section Modulus." To avoid confusion, this formula is used consistently throughout this standard. The values of section modulus herein will be one-half of the "polar sectional modulus" given in API RP7G. However, this will not cause any calculation error as long as values from this standard are not mixed with those from the other.

Table 3.18.2 New Thick-Walled Drill Pipe (TWDP) Tube Dimensions

1	2	3	4	5	6	7	8	9
Nom. Size OD (in)	Nom. Wall (in)	Nom. ID (in)	OD Min (in)	OD Max (in)	(A_o) Section Area OD (in^2)	(A_i) Section Area ID (in^2)	Section Area Wall (in^2)	(Z)[1] Section Modulus (in^3)
DS-1® Standard TWDP Tube Dimensions								
5	0.750	3.500	4.975	5.050	19.635	9.621	10.014	9.325
5 1/2	0.500	4.500	5.473	5.555	23.758	15.904	7.854	9.014
	0.750	4.000				12.566	11.192	11.764
5 7/8	0.625	4.625	5.846	5.934	27.109	16.800	10.308	12.262
	0.750	4.375				15.033	12.076	13.786
	0.813	4.249				14.180	12.929	14.461
6 5/8	0.500	5.625	6.592	6.691	34.472	24.851	9.621	13.711
	0.522	5.581				24.463	10.008	14.170
	0.625	5.375				22.691	11.781	16.178
	0.640	5.345				22.438	12.034	16.452
	0.750	5.125				20.629	13.843	18.324
	0.813	4.999				19.627	14.845	19.292
Other (Non-Standard) TWDP Tube Dimensions								
5	0.575	3.850	4.975	5.050	19.635	11.642	7.993	7.958
	0.625	3.750				11.045	8.590	8.389
	0.713	3.574				10.032	9.603	9.068
5 1/2	0.522	4.456	5.473	5.555	23.758	15.595	8.163	9.2964
	0.790	3.920				12.069	11.690	12.119
	0.813	3.875				11.793	11.965	12.309
5 7/8	0.500	4.875	5.846	5.934	27.109	18.666	8.443	10.470
	0.675	4.525				16.082	11.027	12.902
6 5/8	0.415	5.795	6.592	6.691	34.472	26.375	8.096	11.835
	0.688	5.250				21.648	12.824	17.289

$$Z = \left(\frac{\pi}{32}\right)\left(\frac{OD^4 - ID^4}{OD}\right)$$

[1] Note: The preceding formula is one of two that are used in API RP7G for the term "Section Modulus." To avoid confusion, this formula is used consistently throughout this standard. The values of section modulus herein will be one-half of the "polar sectional modulus" given in API RP7G. However, this will not cause any calculation error as long as values from this standard are not mixed with those from the other.

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
2 3/8	4.85	EU-E	NC26	5.26	3 3/8	1 3/4	7	8	0.178	--	RP7G
		EU-E	OH	4.95	3 1/8	2	7	8	0.167	--	RP7G
		EU-E	SLH90	5.05	3 1/4	2	7	8	0.171	--	RP7G
		EU-E	WO	5.15	3 3/8	2	7	8	0.174	--	RP7G
		EU-V	XT24	5.67	3 1/8	1 1/2	10	15	0.192	0.347	GP
		EU-V	XT26	5.76	3 3/8	1 3/4	10	15	0.195	0.353	GP
		EU-V	HT26	5.59	3 3/8	1 3/4	9	12	0.189	0.354	GP
2 3/8	6.65	EU-E	NC26	7.02	3 3/8	1 3/4	7	8	0.237	0.297	DS-1
		EU-E	HT26	7.25	3 3/8	1 3/4	9	12	0.246	0.296	GP
		EU-E	HLIDS26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H
		EU-E	OH	6.89	3 1/4	1 3/4	7	8	0.233	--	RP7G
		EU-E	SLH90	6.78	3 1/4	1 13/16	7	8	0.229	--	RP7G
		IU-E	PAC	6.71	2 7/8	1 3/8	7	8	0.227	--	RP7G
		EU-X	NC26	7.11	3 3/8	1 3/4	7	8	0.240	0.296	DS-1
		EU-X	HT26	7.25	3 3/8	1 3/4	9	12	0.246	0.296	GP
		EU-X	HLIDS26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H
		EU-X	SLH90	6.99	3 1/4	1 13/16	7	8	0.236	--	RP7G
		EU-G	NC26	7.11	3 3/8	1 3/4	7	8	0.240	0.296	DS-1
		EU-G	HT26	7.25	3 3/8	1 3/4	9	12	0.246	0.296	GP
		EU-G	WT26	7.20	3 3/8	1 3/4	7	10	0.242	0.298	T
		EU-G	WT23	7.10	3 1/8	1 1/2	7	10	0.242	0.288	T
		EU-G	WT14S	7.20	3 3/8	1 3/4	7	10	0.243	--	T
		EU-G	HLIDS26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H
		EU-G	SLH90	6.99	3 1/4	1 13/16	7	8	0.236	--	RP7G
		EU-G	CET20	6.80	2 7/8	1 13/16	11	12	0.234	0.301	CTP
		EU-G	CET21	6.96	2 7/8	1 1/2	11	12	0.238	0.297	CTP
		IU-G	HLIDS23	7.07	3 1/8	1 3/8	8	9	0.239	0.291	H
		IU-G	HLMT 2-3/8 PAC	7.22	3	1 3/8	10	15	0.248	0.293	H
		EU-S	HT26	7.35	3 3/8	1 5/8	9	12	0.249	0.294	GP
		EU-S	GPDS26	7.35	3 1/2	1 11/16	9	10	0.249	0.295	GP
		EU-S	HLIDS26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H
		EU-S	HLST26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H
		EU-S	DPM-MT24	6.90	2 7/8	1 1/2	9	10	0.236	0.295	DPM
		EU-S	DPM 2-3/8 HighTorquePAC	7.04	2 7/8	1 1/4	9	10	0.243	0.290	DPM
		EU-S	CET20	6.80	2 7/8	1 13/16	11	12	0.234	0.301	CTP
		EU-S	CET21	6.96	2 7/8	1 1/2	11	12	0.238	0.297	CTP
		IU-S	HLIDS23	6.96	3 1/8	1 3/8	8	9	0.235	0.291	H
		IU-S	HLMT 2-3/8 PAC	7.22	3	1 3/8	10	15	0.248	0.293	H
		EU-V	XT24	7.41	3 1/8	1 3/8	10	15	0.251	0.288	GP
		EU-V	XT26	7.62	3 3/8	1 1/2	10	15	0.258	0.290	GP
		EU-V	HT26	7.45	3 3/8	1 1/2	9	12	0.252	0.291	GP
		EU-V	GPDS26	7.48	3 1/2	1 1/2	9	10	0.254	0.291	GP
		EU-V	HLIDS26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H
		EU-V	HLST26	7.13	3 3/8	1 3/4	8	9	0.242	0.297	H

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
2 7/8	6.85	EU-E	HT31	7.83	4	2 5/32	9	13	0.265	0.530	GP
		EU-E	XT31	7.75	4	2 3/8	10	15	0.262	0.536	GP
		EU-E	NC31	7.50	4 1/8	2 1/8	7	9	0.254	--	RP7G
		EU-E	OH	6.93	3 3/4	2 7/16	7	9	0.234	--	RP7G
		EU-E	SLH90	6.93	3 7/8	2 7/16	7	9	0.234	--	RP7G
		EU-E	WO	7.31	4 1/8	2 7/16	7	9	0.247	--	RP7G
		IU-E	HT26	7.27	3 3/8	1 3/4	9	12	0.246	0.521	GP
		IU-E	XT26	7.43	3 3/8	1 3/4	10	15	0.252	0.518	GP
		EU-X	HT31	7.83	4	2 5/32	9	13	0.265	0.530	GP
		EU-X	XT31	7.75	4	2 3/8	10	15	0.262	0.536	GP
		IU-X	HT26	7.27	3 3/8	1 3/4	9	12	0.246	0.521	GP
		IU-X	XT26	7.43	3 3/8	1 3/4	10	15	0.252	0.518	GP
		EU-G	HT31	7.83	4	2 5/32	9	13	0.265	0.530	GP
		EU-G	XT31	7.75	4	2 3/8	10	15	0.262	0.536	GP
		EU-G	CET22	7.07	3 1/2	2 5/16	11	12	0.243	0.542	CTP
		EU-G	CET23	6.84	3 1/8	1 7/8	11	12	0.236	0.533	CTP
		EU-G	CET24	7.28	3 1/2	2	11	12	0.250	0.535	CTP
		EU-G	CET31	8.25	4 1/8	2	11	12	0.283	0.535	CTP
		IU-G	HT26	7.27	3 3/8	1 3/4	9	12	0.246	0.521	GP
		IU-G	XT26	7.43	3 3/8	1 3/4	10	15	0.252	0.518	GP
		EU-S	HT31	7.83	4	2 5/32	9	13	0.265	0.530	GP
		EU-S	XT31	7.75	4	2 3/8	10	15	0.262	0.536	GP
		EU-S	CET22	7.07	3 1/2	2 5/16	11	12	0.243	0.542	CTP
		EU-S	CET23	6.84	3 1/8	1 7/8	11	12	0.236	0.533	CTP
		EU-S	CET24	7.28	3 1/2	2	11	12	0.250	0.535	CTP
		EU-S	CET31	8.25	4 1/8	2	11	12	0.283	0.535	CTP
		IU-S	HT26	7.60	3 1/2	1 1/2	9	12	0.257	0.516	GP
		IU-S	XT26	7.43	3 3/8	1 3/4	10	15	0.252	0.518	GP
		EU-V	HT31	7.83	4	2 5/32	9	13	0.265	0.530	GP
		EU-V	XT31	7.75	4	2 3/8	10	15	0.262	0.536	GP
		IU-V	HT26	7.60	3 1/2	1 1/2	9	12	0.257	0.516	GP
		IU-V	XT26	7.43	3 3/8	1 3/4	10	15	0.252	0.518	GP
2 7/8	8.85	EU-G	CET22	9.24	3 1/2	2 1/4	11	12	0.317	0.468	CTP
		EU-S	CET22	9.24	3 1/2	2 1/4	11	12	0.317	0.468	CTP
2 7/8	10.40	EU-E	NC31	10.89	4 1/8	2 1/8	7	9	0.368	0.418	DS-1
		EU-E	HT31	11.26	4 1/8	2 1/8	9	13	0.381	0.417	GP
		EU-E	XT31	11.06	3 7/8	2 1/8	10	15	0.374	0.417	GP
		EU-E	NC31 EIS	11.39	4 1/8	2	9	11	0.391	0.418	GP
		EU-E	HLIDS31	11.15	4 1/8	2 1/8	8	10	0.381	0.419	H
		EU-E	OH	10.59	3 7/8	2 5/32	7	9	0.358	--	RP7G
		EU-E	SLH90	10.59	3 7/8	2 5/32	7	9	0.358	--	RP7G
		IU-E	NC26	10.35	4 1/8	1 3/4	7	8	0.350	0.410	DS-1
		IU-E	HTPAC	10.47	3 1/8	1 1/2	9	13	0.355	0.404	GP
		IU-E	HT26	10.85	3 1/2	1 1/2	9	12	0.367	0.404	GP
		IU-E	XT26	11.02	3 1/2	1 1/2	10	15	0.373	0.401	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
2 7/8	10.40	IU-E	HLIDS26	10.52	3 3/8	1 3/4	8	9	0.357	0.410	H
		IU-E	HLST26	10.52	3 3/8	1 3/4	8	9	0.357	0.410	H
		IU-E	HLMT 2-7/8 PAC	10.62	3 1/8	1 1/2	10	15	0.365	0.410	H
		IU-E	PAC	10.27	3 1/8	1 1/2	7	9	0.347	--	RP7G
		IU-E	XH	11.19	4 1/4	1 7/8	7	9	0.378	--	RP7G
		EU-X	NC31	11.08	4 1/8	2	7	9	0.375	0.414	DS-1
		EU-X	HT31	11.26	4 1/8	2 1/8	9	13	0.381	0.417	GP
		EU-X	XT31	11.06	3 7/8	2 1/8	10	15	0.374	0.417	GP
		EU-X	NC31 EIS	11.39	4 1/8	2	9	11	0.391	0.418	GP
		EU-X	HLIDS31	11.15	4 1/8	2 1/8	8	10	0.381	0.419	H
		EU-X	SLH90	10.95	4	2	7	9	0.370	--	RP7G
		IU-X	HTPAC	10.47	3 1/8	1 1/2	9	13	0.355	0.404	GP
		IU-X	HT26	10.85	3 1/2	1 1/2	9	12	0.367	0.404	GP
		IU-X	XT26	11.02	3 1/2	1 1/2	10	15	0.373	0.401	GP
		IU-X	NC26 EIS	11.10	3 5/8	1 1/2	9	10	0.381	0.403	GP
		IU-X	HLIDS26	10.52	3 3/8	1 3/4	8	9	0.357	0.410	H
		IU-X	HLST26	10.52	3 3/8	1 3/4	8	9	0.357	0.410	H
		IU-X	HLMT 2-7/8 PAC	10.62	3 1/8	1 1/2	10	15	0.365	0.410	H
		EU-G	NC31	11.08	4 1/8	2	7	9	0.375	0.414	DS-1
		EU-G	HT31	11.26	4 1/8	2 1/8	9	13	0.381	0.417	GP
		EU-G	XT31	11.06	3 7/8	2 1/8	10	15	0.374	0.417	GP
		EU-G	NC31 EIS	11.39	4 1/8	2	9	11	0.391	0.418	GP
		EU-G	HLIDS31	11.22	4 1/8	2	8	10	0.383	0.417	H
		EU-G	HLST31	10.92	4	2 1/4	8	10	0.369	0.420	H
		EU-G	SLH90	10.95	4	2	7	9	0.370	--	RP7G
		EU-G	CET22	10.53	3 1/2	2 1/8	11	12	0.362	0.423	CTP
		EU-G	CET23	10.18	3 1/8	1 7/8	11	12	0.351	0.418	CTP
		EU-G	CET24	10.62	3 1/2	2	11	12	0.364	0.421	CTP
		EU-G	CET31	11.59	4 1/8	2	11	12	0.398	0.421	CTP
		IU-G	HTPAC	10.47	3 1/8	1 1/2	9	13	0.355	0.404	GP
		IU-G	HT26	10.99	3 5/8	1 1/2	9	12	0.372	0.403	GP
		IU-G	XT26	11.02	3 1/2	1 1/2	10	15	0.373	0.401	GP
		IU-G	NC26 EIS	11.10	3 5/8	1 1/2	9	10	0.381	0.403	GP
		IU-G	VX24	10.71	3 1/8	1 1/2	11	12	0.368	0.401	GP
		IU-G	VX26	11.15	3 1/2	1 1/2	11	12	0.383	0.400	GP
		IU-G	HLIDS26	10.52	3 3/8	1 3/4	8	9	0.357	0.410	H
		IU-G	HLST26	10.52	3 3/8	1 3/4	8	9	0.357	0.410	H
		IU-G	HLMT 2-7/8 PAC	10.62	3 1/8	1 1/2	10	15	0.365	0.410	H
		EU-S	NC31	11.55	4 3/8	1 5/8	7	9	0.390	0.408	DS-1
		EU-S	HT31	11.39	4 1/8	2	9	13	0.386	0.414	GP
		EU-S	XT31	11.06	3 7/8	2 1/8	10	15	0.374	0.417	GP
		EU-S	GPDS31	11.27	4 1/8	2	9	11	0.382	0.414	GP
		EU-S	WT31	11.30	4 1/8	2	7	12	0.381	0.419	T
		EU-S	WT14S	10.50	3 3/8	1 39/40	7	10	0.353	0.419	T
		EU-S	HLIDS31	11.22	4 1/8	2	8	10	0.383	0.417	H
		EU-S	HLST31	10.92	4	2 1/4	8	10	0.369	0.420	H
		EU-S	SLH90	11.26	4 1/8	1 5/8	7	9	0.381	--	RP7G
		EU-S	CET22	10.53	3 1/2	2 1/8	11	12	0.362	0.423	CTP
		EU-S	CET23	10.18	3 1/8	1 7/8	11	12	0.351	0.418	CTP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
2 7/8	10.40	EU-S	CET24	10.62	3 1/2	2	11	12	0.364	0.421	CTP
		EU-S	CET31	11.59	4 1/8	2	11	12	0.398	0.421	CTP
		IU-S	HT26	10.99	3 5/8	1 1/2	9	12	0.372	0.403	GP
		IU-S	XT26	11.11	3 1/2	1 3/8	10	15	0.376	0.399	GP
		IU-S	WT26	10.50	3 3/8	1 3/4	7	10	0.353	0.409	T
		IU-S	WT23	10.50	3 1/8	1 1/2	7	10	0.353	0.409	T
		IU-S	NC26 EIS	11.10	3 5/8	1 1/2	9	10	0.381	0.403	GP
		IU-S	VX24	10.71	3 1/8	1 1/2	11	12	0.368	0.401	GP
		IU-S	VX26	11.15	3 1/2	1 1/2	11	12	0.383	0.400	GP
		IU-S	DPM 2-7/8 HighTorquePAC	10.38	3 1/8	1 1/2	9	10	0.358	0.409	DPM
		IU-S	DPM-MT26	10.62	3 3/8	1 1/2	9	10	0.365	0.409	DPM
		EU-V	NC31	11.92	4 3/8	1 5/8	9	11	0.403	0.406	DS-1
		EU-V	HT31	11.39	4 1/8	2	9	13	0.386	0.414	GP
		EU-V	XT31	11.38	4	2	10	15	0.385	0.414	GP
		EU-V	GPDS31	11.27	4 1/8	2	9	11	0.382	0.414	GP
		EU-V	WT31	11.30	4 1/8	2	7	12	0.381	0.419	T
		EU-V	HLIDS31	11.22	4 1/8	2	8	10	0.383	0.417	H
		EU-V	HLST31	11.22	4 1/8	2	8	10	0.383	0.417	H
		IU-V	HT26	11.15	3 5/8	1 1/4	9	12	0.378	0.399	GP
		IU-V	XT26	11.19	3 1/2	1 1/4	10	15	0.379	0.397	GP
3 1/2	9.50	EU-E	NC38	10.60	4 3/4	2 11/16	8	10 1/2	0.358	0.800	DS-1
		EU-E	HT38	11.31	4 3/4	2 11/16	10	15 1/2	0.383	0.796	GP
		EU-E	XT38	11.08	4 3/4	2 13/16	10	15	0.375	0.801	GP
		EU-E	NK DSTJ NC38	10.60	4 3/4	2 11/16	8	10 1/2	0.358	0.800	T
		EU-E	OH	9.84	4 1/2	3	8	10 1/2	0.333	--	RP7G
		EU-E	SLH90	9.99	4 5/8	3	8	10 1/2	0.338	--	RP7G
		EU-E	WO	10.14	4 3/4	3	8	10 1/2	0.343	--	RP7G
		IU-E	HT31	10.62	4 1/8	2 1/8	9	13	0.360	0.781	GP
		IU-E	XT31	10.61	4	2 1/8	10	15	0.359	0.778	GP
		EU-X	HT38	11.31	4 3/4	2 11/16	10	15 1/2	0.383	0.796	GP
		EU-X	XT38	11.08	4 3/4	2 13/16	10	15	0.375	0.801	GP
		IU-X	HT31	10.62	4 1/8	2 1/8	9	13	0.360	0.781	GP
		IU-X	XT31	10.61	4	2 1/8	10	15	0.359	0.778	GP
		EU-G	HT38	11.31	4 3/4	2 11/16	10	15 1/2	0.383	0.796	GP
		EU-G	XT38	11.08	4 3/4	2 13/16	10	15	0.375	0.801	GP
		IU-G	HT31	10.74	4 1/8	2	9	13	0.364	0.778	GP
		IU-G	XT31	10.61	4	2 1/8	10	15	0.359	0.778	GP
		EU-S	HT38	11.31	4 3/4	2 11/16	10	15 1/2	0.383	0.796	GP
		EU-S	XT38	11.08	4 3/4	2 13/16	10	15	0.375	0.801	GP
		IU-S	HT31	10.74	4 1/8	2	9	13	0.364	0.778	GP
		IU-S	XT31	10.74	4	2	10	15	0.364	0.775	GP
		EU-V	HT38	11.31	4 3/4	2 11/16	10	15 1/2	0.383	0.796	GP
		EU-V	XT38	11.08	4 3/4	2 13/16	10	15	0.375	0.801	GP
		IU-V	HT31	11.14	4 1/4	1 3/4	9	13	0.377	0.772	GP
		IU-V	XT31	10.74	4	2	10	15	0.364	0.775	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
3 1/2	13.30	EU-E	NC38	13.96	4 3/4	2 11/16	8	10 1/2	0.472	0.687	DS-1
		EU-E	HT38	14.45	4 3/4	2 11/16	10	15 1/2	0.489	0.687	GP
		EU-E	XT38	14.42	4 3/4	2 11/16	10	15	0.488	0.687	GP
		EU-E	NK DSTJ NC38	13.96	4 3/4	2 11/16	8	10 1/2	0.472	0.687	T
		EU-E	NC38 EIS	14.63	4 3/4	2 9/16	10	12 1/2	0.503	0.690	GP
		EU-E	HLIDS38	14.31	4 3/4	2 11/16	9	11 1/2	0.492	0.695	H
		EU-E	HLST36	14.13	4 3/4	2 11/16	8	10	0.483	0.691	H
		EU-E	H90	14.37	5 1/4	2 3/4	8	10 1/2	0.486	--	RP7G
		EU-E	OH	13.75	4 3/4	2 11/16	8	10 1/2	0.465	--	RP7G
		EU-E	XH	13.91	4 3/4	2 7/16	8	10 1/2	0.470	--	RP7G
		IU-E	HT31	13.91	4 1/8	2 1/8	9	13	0.471	0.670	GP
		IU-E	XT31	13.87	4	2 1/8	10	15	0.470	0.668	GP
		IU-E	HLIDS31	13.79	4 1/8	2	8	10	0.469	0.673	H
		IU-E	HLST31	13.50	4	2 1/4	8	10	0.459	0.678	H
		IU-E	NC31	13.40	4 1/8	2 1/8	7	9	0.453	--	RP7G
		EU-X	NC38	14.63	5	2 9/16	8	10 1/2	0.495	0.683	DS-1
		EU-X	HT38	14.45	4 3/4	2 11/16	10	15 1/2	0.489	0.687	GP
		EU-X	XT38	14.42	4 3/4	2 11/16	10	15	0.488	0.687	GP
		EU-X	NK DSTJ NC38	14.63	5	2 9/16	8	10 1/2	0.495	0.683	T
		EU-X	NC38 EIS	14.63	4 3/4	2 9/16	10	12 1/2	0.503	0.690	GP
		EU-X	HLIDS38	14.82	5	2 9/16	9	11 1/2	0.510	0.693	H
		EU-X	HLST36	14.23	4 3/4	2 9/16	8	10	0.486	0.688	H
		EU-X	H90	14.60	5 1/4	2 3/4	8	10 1/2	0.494	--	RP7G
		EU-X	SLH90	14.06	4 3/4	2 9/16	8	10 1/2	0.475	--	RP7G
		IU-X	HT31	14.04	4 1/8	2	9	13	0.476	0.666	GP
		IU-X	XT31	13.87	4	2 1/8	10	15	0.470	0.668	GP
		IU-X	HLIDS31	13.79	4 1/8	2	8	10	0.469	0.673	H
		IU-X	HLST31	13.79	4 1/8	2	8	10	0.469	0.673	H
		EU-G	NC38	14.73	5	2 7/16	8	10 1/2	0.498	0.680	DS-1
		EU-G	HT38	14.45	4 3/4	2 11/16	10	15 1/2	0.489	0.687	GP
		EU-G	XT38	14.42	4 3/4	2 11/16	10	15	0.488	0.687	GP
		EU-G	NK DSTJ NC38	14.73	5	2 7/16	8	10 1/2	0.498	0.680	T
		EU-G	NC38 EIS	14.63	4 3/4	2 9/16	10	12 1/2	0.503	0.690	GP
		EU-G	VX38	14.40	4 5/8	2 3/4	12	15	0.503	0.709	GP
		EU-G	HLIDS38	14.92	5	2 7/16	9	11 1/2	0.514	0.689	H
		EU-G	HLMT38	14.62	4 3/4	2 11/16	10	15	0.502	0.699	H
		EU-G	HLST36	14.32	4 3/4	2 7/16	8	10	0.489	0.685	H
		EU-G	HLST39	14.58	5	2 11/16	8	11	0.500	0.694	H
		EU-G	HLIST38	14.32	4 3/4	2 11/16	9	10	0.492	0.699	H
		EU-G	HLIST39	14.52	4 7/8	2 11/16	9	12	0.499	0.699	H
		EU-G	SLH90	14.06	4 3/4	2 9/16	8	10 1/2	0.475	--	RP7G
		EU-G	CET31	14.06	4 1/8	2	12	14.5	0.484	0.677	CTP
		EU-G	CET38	14.85	4 3/4	2 9/16	12	14.5	0.511	0.695	CTP
		IU-G	HT31	14.04	4 1/8	2	9	13	0.476	0.666	GP
		IU-G	XT31	14.21	4 1/8	2	10	15	0.481	0.664	GP
		IU-G	HLIDS31	13.79	4 1/8	2	8	10	0.469	0.673	H
		IU-G	HLST31	13.79	4 1/8	2	8	10	0.469	0.673	H
		EU-S	NC38	14.94	5	2 1/8	8	10 1/2	0.505	0.673	DS-1
		EU-S	NC40	15.14	5 3/8	2 7/16	7	10	0.512	0.680	DS-1

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
				(W) Approx Assembly Adj. Wt.[2]	Tool Joint Dimensions[1]		Tong Space		Disp/ Triple Stand[2]	Capacity/ Triple Stand[2,3]	
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(lb/ft)	OD (in)	ID (in)	Pin (in)	Box (in)	(Bbl)	(Bbl)	Data Source[4]
3 1/2	13.30	EU-S	HT38	14.63	4 3/4	2 9/16	10	15 1/2	0.496	0.682	GP
		EU-S	XT38	14.42	4 3/4	2 11/16	10	15	0.488	0.687	GP
		EU-S	GPDS38	14.62	4 7/8	2 9/16	10	12 1/2	0.495	0.683	GP
		EU-S	TurboTorque 380	14.89	4 3/4	2 11/16	10	15	0.524	0.684	GP
		EU-S	TurboTorque-M 380	14.89	4 3/4	2 11/16	10	15	0.501	0.706	GP
		EU-S	WT38	14.50	4 3/4	2 9/16	8	14	0.493	0.679	T
		EU-S	WT38	14.90	5	2 9/16	8	14	0.502	0.679	T
		EU-S	NK DSTJ NC38	14.94	5	2 1/8	8	10 1/2	0.505	0.673	T
		EU-S	NK DSTJ NC40	15.14	5 3/8	2 7/16	7	10	0.512	0.680	T
		EU-S	NC38 EIS	14.63	4 3/4	2 9/16	10	12 1/2	0.503	0.690	GP
		EU-S	HLIDS38	15.17	5	2 1/8	9	11 1/2	0.522	0.681	H
		EU-S	HLMT38	14.75	4 3/4	2 9/16	10	15	0.507	0.694	H
		EU-S	HLST36	14.53	4 3/4	2 1/8	8	10	0.496	0.677	H
		EU-S	HLST39	14.58	5	2 11/16	8	11	0.500	0.694	H
		EU-S	HLIST38	14.43	4 3/4	2 9/16	9	12	0.496	0.695	H
		EU-S	HLIST39	14.52	4 7/8	2 11/16	9	12	0.499	0.699	H
		EU-S	SLH90	14.65	5	2 1/8	8	10 1/2	0.495	--	RP7G
		EU-S	DPM-MT34	14.48	4 7/10	2 1/2	10	12.5	0.498	0.690	DPM
		EU-S	DPM-MT38	14.64	4 3/4	2 7/16	10	12.5	0.503	0.688	DPM
		EU-S	DPM-ST38	14.81	4 3/4	2 7/16	10	15	0.509	0.687	DPM
		EU-S	DPM-DS38	15.08	5	2 7/16	10	12.5	0.519	0.687	DPM
		EU-S	CET31	14.06	4 1/8	2	12	14.5	0.484	0.677	CTP
		EU-S	CET38	14.85	4 3/4	2 9/16	12	14.5	0.511	0.695	CTP
		IU-S	HT31	14.04	4 1/8	2	9	13	0.476	0.666	GP
		IU-S	XT31	14.34	4 1/8	1 7/8	10	15	0.486	0.661	GP
		IU-S	WT31	13.90	4 1/8	2	7	12	0.474	0.670	T
		IU-S	WT26	13.40	3 9/16	1 3/4	7	10	0.453	--	T
		IU-S	HLST31	13.79	4 1/8	2	8	10	0.469	0.673	H
		EU-V	NC38	15.40	5	2 1/8	10	12 1/2	0.520	0.670	DS-1
		EU-V	NC40	15.67	5 3/8	2 7/16	9	12	0.530	0.679	DS-1
		EU-V	HT38	14.63	4 3/4	2 9/16	10	15 1/2	0.496	0.682	GP
		EU-V	XT38	14.59	4 3/4	2 9/16	10	15	0.494	0.682	GP
		EU-V	GPDS38	14.84	5	2 9/16	10	12 1/2	0.503	0.683	GP
		EU-V	WT38	14.50	4 3/4	2 9/16	8	14	0.493	0.679	T
		EU-V	WT38	14.90	5	2 9/16	8	14	0.502	0.679	T
		EU-V	NK DSTJ NC38	15.40	5	2 1/8	10	12 1/2	0.520	0.670	T
		EU-V	NK DSTJ NC40	15.67	5 3/8	2 7/16	9	12	0.530	0.679	T
		EU-V	HLIDS38	15.17	5	2 1/8	9	11 1/2	0.522	0.681	H
		EU-V	HLMT38	14.75	4 3/4	2 9/16	10	15	0.507	0.694	H
		EU-V	HLST36	14.53	4 3/4	2 1/8	8	10	0.496	0.677	H
		EU-V	HLST39	14.58	5	2 11/16	8	11	0.500	0.694	H
		EU-V	HLIST38	14.43	4 3/4	2 9/16	9	12	0.496	0.695	H
		EU-V	HLIST39	14.52	4 7/8	2 11/16	9	12	0.499	0.699	H
		IU-V	HT31	14.47	4 1/4	1 3/4	9	13	0.490	0.660	GP
		IU-V	XT31	14.47	4 1/8	1 3/4	10	15	0.490	0.657	GP
		IU-V	WT31	13.90	4 1/8	2	7	12	0.474	0.670	T
		IU-V	WT26	13.40	3 9/16	1 3/4	7	10	0.453	--	T

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
3 1/2	15.50	EU-E	NC38	16.59	5	2 9/16	8	10 1/2	0.561	0.611	DS-1
		EU-E	HT38	16.71	4 3/4	2 9/16	10	15 1/2	0.566	0.610	GP
		EU-E	XT38	16.68	4 3/4	2 9/16	10	15	0.565	0.610	GP
		EU-E	NK DSTJ NC38	16.59	5	2 9/16	8	10 1/2	0.561	0.611	T
		EU-E	NC38 EIS	16.70	4 3/4	2 9/16	10	12 1/2	0.574	0.619	GP
		EU-E	HLIDS38	16.53	4 3/4	2 9/16	9	11 1/2	0.568	0.617	H
		EU-E	HLST36	16.36	4 3/4	2 9/16	8	10	0.559	0.613	H
		IU-E	HLIDS31	15.93	4 1/8	2	8	10	0.542	0.599	H
		IU-E	HLST31	15.64	4	2 1/4	8	10	0.532	0.604	H
		EU-X	NC38	16.85	5	2 7/16	8	10 1/2	0.570	0.607	DS-1
		EU-X	HT38	16.71	4 3/4	2 9/16	10	15 1/2	0.566	0.610	GP
		EU-X	XT38	16.68	4 3/4	2 9/16	10	15	0.565	0.610	GP
		EU-X	NK DSTJ NC38	16.85	5	2 7/16	8	10 1/2	0.570	0.607	T
		EU-X	NC38 EIS	16.70	4 3/4	2 9/16	10	12 1/2	0.574	0.619	GP
		EU-X	HLIDS38	16.93	5	2 9/16	9	11 1/2	0.583	0.618	H
		EU-X	HLST36	16.36	4 3/4	2 9/16	8	10	0.559	0.613	H
		IU-X	HLIDS31	15.93	4 1/8	2	8	10	0.542	0.599	H
		IU-X	HLST31	15.93	4 1/8	2	8	10	0.542	0.599	H
		EU-G	NC38	17.07	5	2 1/8	8	10 1/2	0.577	0.600	DS-1
		EU-G	NC40	16.99	5 1/4	2 9/16	7	10	0.574	0.610	DS-1
		EU-G	HT38	16.71	4 3/4	2 9/16	10	15 1/2	0.566	0.610	GP
		EU-G	XT38	16.68	4 3/4	2 9/16	10	15	0.565	0.610	GP
		EU-G	NK DSTJ NC38	17.07	5	2 1/8	8	10 1/2	0.577	0.600	T
		EU-G	NK DSTJ NC40	16.99	5 1/4	2 9/16	7	10	0.574	0.610	T
		EU-G	NC38 EIS	16.70	4 3/4	2 9/16	10	12 1/2	0.574	0.619	GP
		EU-G	HLIDS38	17.04	5	2 7/16	9	11 1/2	0.587	0.615	H
		EU-G	HLMT38	16.84	4 3/4	2 9/16	10	15	0.579	0.620	H
		EU-G	HLST36	16.45	4 3/4	2 7/16	8	10	0.562	0.610	H
		EU-G	HLST39	16.80	5	2 9/16	8	11	0.576	0.616	H
		EU-G	HLIST38	16.55	4 3/4	2 9/16	9	12	0.568	0.620	H
		EU-G	HLIST39	16.74	4 7/8	2 9/16	9	12	0.575	0.620	H
		EU-G	CET38	17.00	4 3/4	2 9/16	12	14.5	0.585	0.621	CTP
		IU-G	HLIDS31	15.93	4 1/8	2	8	10	0.542	0.599	H
		IU-G	HLST31	15.93	4 1/8	2	8	10	0.542	0.599	H
		EU-S	NC38	17.07	5	2 1/8	8	10 1/2	0.577	0.600	DS-1
		EU-S	NC40	17.61	5 1/2	2 1/4	7	10	0.595	0.603	DS-1
		EU-S	HT38	16.90	4 3/4	2 7/16	10	15 1/2	0.572	0.605	GP
		EU-S	XT38	16.86	4 3/4	2 7/16	10	15	0.571	0.606	GP
		EU-S	XT39	17.09	4 7/8	2 7/16	10	15	0.579	0.605	GP
		EU-S	GPDS38	17.11	5	2 7/16	10	12 1/2	0.580	0.606	GP
		EU-S	TurboTorque 380	17.28	4 13/16	2 1/2	10	15	0.592	0.615	GP
		EU-S	TurboTorque-M 380	17.28	4 13/16	2 1/2	10	15	0.592	0.615	GP
		EU-S	WT38	16.70	4 3/4	2 1/2	8	14	0.567	0.605	T
		EU-S	WT38	17.10	5	2 1/2	8	14	0.577	0.605	T
		EU-S	NK DSTJ NC38	17.07	5	2 1/8	8	10 1/2	0.577	0.600	T
		EU-S	NK DSTJ NC40	17.61	5 1/2	2 1/4	7	10	0.595	0.603	T
		EU-S	NC38 EIS	16.88	4 3/4	2 7/16	10	12 1/2	0.580	0.613	GP
		EU-S	HLIDS38	17.28	5	2 1/8	9	11 1/2	0.595	0.606	H
		EU-S	HLMT38	17.19	4 7/8	2 7/16	10	15	0.591	0.616	H

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
3 1/2	15.50	EU-S	HLST36	16.66	4 3/4	2 1/8	8	10	0.569	0.603	H
		EU-S	HLST39	16.80	5	2 9/16	8	11	0.576	0.616	H
		EU-S	HLIST38	16.65	4 3/4	2 7/16	9	12	0.572	0.617	H
		EU-S	HLIST39	16.74	4 7/8	2 9/16	9	12	0.575	0.620	H
		EU-S	DPM-MT34	16.59	4 7/10	2 1/2	10	12.5	0.570	0.617	DPM
		EU-S	DPM-MT38	16.75	4 3/4	2 7/16	10	12.5	0.576	0.615	DPM
		EU-S	DPM-ST38	16.91	4 3/4	2 7/16	10	15	0.582	0.614	DPM
		EU-S	DPM-DS38	17.19	5	2 7/16	10	12.5	0.591	0.615	DPM
		EU-S	CET38	17.00	4 3/4	2 9/16	12	14.5	0.585	0.621	CTP
		IEU-S	WT31	16.20	4 1/8	2	7	12	0.549	0.595	T
		EU-V	NC38	17.50	5	2 1/8	10	12 1/2	0.591	0.597	DS-1
		EU-V	NC40	18.17	5 1/2	2 1/4	9	12	0.614	0.601	DS-1
		EU-V	HT38	17.63	5	2 1/4	10	15 1/2	0.597	0.599	GP
		EU-V	XT38	17.11	4 3/4	2 1/4	10	15	0.580	0.599	GP
		EU-V	XT39	17.35	4 7/8	2 1/4	10	15	0.588	0.599	GP
		EU-V	GPDS38	17.35	5	2 1/4	10	12 1/2	0.588	0.600	GP
		EU-V	WT38	16.70	4 3/4	2 1/2	8	14	0.567	0.605	T
		EU-V	WT38	17.10	5	2 1/2	8	14	0.577	0.605	T
		EU-V	NK DSTJ NC38	17.50	5	2 1/8	10	12 1/2	0.591	0.597	T
		EU-V	NK DSTJ NC40	18.17	5 1/2	2 1/4	9	12	0.614	0.601	T
		EU-V	HLIDS38	17.28	5	2 1/8	9	11 1/2	0.595	0.606	H
		EU-V	HLMT38	17.61	5	2 1/4	10	15	0.605	0.610	H
		EU-V	HLST36	16.66	4 3/4	2 1/8	8	10	0.569	0.603	H
		EU-V	HLST39	16.80	5	2 9/16	8	11	0.576	0.616	H
		EU-V	HLIST38	16.65	4 3/4	2 7/16	9	12	0.572	0.617	H
		EU-V	HLIST39	16.74	4 7/8	2 9/16	9	12	0.575	0.620	H
		IEU-V	WT31	16.20	4 1/8	2	7	12	0.549	0.595	T
4	11.85	EU-E	NC46	13.52	6	3 1/4	7	10	0.457	--	RP7G
		EU-E	OH	12.10	5 1/4	3 15/32	7	10	0.409	--	RP7G
		EU-E	WO	12.91	5 3/4	3 7/16	7	10	0.436	--	RP7G
		IU-E	HT38	13.08	4 3/4	2 11/16	10	15 1/2	0.443	1.056	GP
		IU-E	XT38	13.04	4 3/4	2 11/16	10	15	0.442	1.056	GP
		IU-E	XT39	13.08	4 7/8	2 13/16	10	15	0.443	1.061	GP
		IU-E	HLST31	11.89	4	2 1/4	8	10	0.402	1.061	H
		IU-E	H90	13.00	5 1/2	2 13/16	7	10	0.439	--	RP7G
		IU-X	HT38	13.08	4 3/4	2 11/16	10	15 1/2	0.443	1.056	GP
		IU-X	XT38	13.04	4 3/4	2 11/16	10	15	0.442	1.056	GP
		IU-X	XT39	13.08	4 7/8	2 13/16	10	15	0.443	1.061	GP
		IU-X	HLST31	11.96	4	2 1/8	8	10	0.404	1.059	H
		IU-G	HT38	13.27	4 3/4	2 9/16	10	15 1/2	0.449	1.051	GP
		IU-G	XT38	13.04	4 3/4	2 11/16	10	15	0.442	1.056	GP
		IU-G	XT39	13.08	4 7/8	2 13/16	10	15	0.443	1.061	GP
		IU-G	HLIDS31	11.96	4	2 1/8	8	10	0.405	1.055	H
		IU-G	HLST31	11.89	4	2 1/4	8	10	0.403	1.057	H
		IU-G	HLST36	12.64	4 3/4	2 9/16	8	10	0.430	1.067	H
		IU-S	HT38	13.45	4 3/4	2 7/16	10	15 1/2	0.455	1.046	GP
		IU-S	XT38	13.04	4 3/4	2 11/16	10	15	0.442	1.056	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4	11.85	IU-S	XT39	13.08	4 7/8	2 13/16	10	15	0.443	1.061	GP
		IU-S	HLST31	12.02	4	2	8	10	0.406	1.056	H
		IU-V	HT38	13.93	5	2 7/16	10	15 1/2	0.472	1.046	GP
		IU-V	XT38	13.23	4 3/4	2 9/16	10	15	0.448	1.052	GP
		IU-V	XT39	13.08	4 7/8	2 13/16	10	15	0.443	1.061	GP
4	14.00	EU-E	NC46	15.91	6	3 1/4	7	10	0.538	1.005	DS-1
		EU-E	NK DSTJ NC46	15.91	6	3 1/4	7	10	0.538	1.005	T
		EU-E	OH	15.02	5 1/2	3 1/4	7	10	0.508	--	RP7G
		IU-E	NC40	15.06	5 1/4	2 13/16	7	10	0.509	0.989	DS-1
		IU-E	HT38	15.28	4 3/4	2 11/16	10	15 1/2	0.518	0.979	GP
		IU-E	HT40	15.93	5 1/4	2 13/16	9	15	0.539	0.984	GP
		IU-E	XT38	15.25	4 3/4	2 11/16	10	15	0.517	0.979	GP
		IU-E	XT39	15.29	4 7/8	2 13/16	10	15	0.518	0.984	GP
		IU-E	NK DSTJ NC40	15.06	5 1/4	2 13/16	7	10	0.509	0.989	T
		IU-E	NC38 EIS	15.49	4 3/4	2 9/16	10	12 1/2	0.532	0.978	GP
		IU-E	HLIDS40	15.58	5 1/4	2 13/16	8	11	0.533	0.998	H
		IU-E	HLST31	14.19	4	2 1/4	8	10	0.481	0.978	H
		IU-E	HLST36	14.93	4 3/4	2 9/16	8	10	0.508	0.987	H
		IU-E	HLST39	15.18	5	2 13/16	8	11	0.519	0.997	H
		IU-E	H90	15.43	5 1/2	2 13/16	7	10	0.522	--	RP7G
		IU-E	SH	14.35	4 5/8	2 9/16	7	10	0.485	--	RP7G
		EU-X	NC46	16.22	6	3 1/4	7	10	0.548	1.003	DS-1
		EU-X	NK DSTJ NC46	16.22	6	3 1/4	7	10	0.548	1.003	T
		IU-X	NC40	15.29	5 1/4	2 11/16	7	10	0.517	0.986	DS-1
		IU-X	HT38	15.28	4 3/4	2 11/16	10	15 1/2	0.518	0.979	GP
		IU-X	HT40	15.93	5 1/4	2 13/16	9	15	0.539	0.984	GP
		IU-X	XT38	15.25	4 3/4	2 11/16	10	15	0.517	0.979	GP
		IU-X	XT39	15.29	4 7/8	2 13/16	10	15	0.518	0.984	GP
		IU-X	NK DSTJ NC40	15.29	5 1/4	2 11/16	7	10	0.517	0.986	T
		IU-X	NC38 EIS	15.49	4 3/4	2 9/16	10	12 1/2	0.532	0.978	GP
		IU-X	HLIDS40	15.58	5 1/4	2 13/16	8	11	0.533	0.998	H
		IU-X	HLST31	14.26	4	2 1/8	8	10	0.483	0.976	H
		IU-X	HLST36	14.93	4 3/4	2 9/16	8	10	0.508	0.987	H
		IU-X	HLST39	15.18	5	2 13/16	8	11	0.519	0.997	H
		IU-X	H90	15.63	5 1/2	2 13/16	7	10	0.528	--	RP7G
		EU-G	NC46	16.22	6	3 1/4	7	10	0.548	1.003	DS-1
		EU-G	NK DSTJ NC46	16.22	6	3 1/4	7	10	0.548	1.003	T
		IEU-G	CET39	15.30	4 7/8	2 11/16	11	14	0.526	1.001	CTP
		IEU-G	CET40	16.13	5 1/4	2 11/16	11	14	0.556	1.001	CTP
		IU-G	NC40	15.87	5 1/2	2 7/16	7	10	0.537	0.979	DS-1
		IU-G	HT38	15.95	5	2 9/16	10	15 1/2	0.540	0.974	GP
		IU-G	HT40	15.93	5 1/4	2 13/16	9	15	0.539	0.984	GP
		IU-G	XT38	15.25	4 3/4	2 11/16	10	15	0.517	0.979	GP
		IU-G	XT39	15.29	4 7/8	2 13/16	10	15	0.518	0.984	GP
		IU-G	NK DSTJ NC40	15.87	5 1/2	2 7/16	7	10	0.537	0.979	T
		IU-G	NC38 EIS	15.49	4 3/4	2 9/16	10	12 1/2	0.532	0.978	GP
		IU-G	VX39	15.66	4 7/8	2 13/16	12	15	0.538	0.988	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4	14.00	IU-G	HLIDS38	15.38	5	2 9/16	8	11	0.520	0.984	H
		IU-G	HLMT38	15.91	5	2 9/16	10	15	0.547	0.994	H
		IU-G	HLIDS40	16.11	5 1/2	2 11/16	8	11	0.552	0.995	H
		IU-G	HLMT40	16.29	5 1/4	2 11/16	10	15	0.560	0.998	H
		IU-G	HLST31	14.26	4	2 1/8	8	10	0.483	0.976	H
		IU-G	HLST36	15.02	4 3/4	2 7/16	8	10	0.511	0.984	H
		IU-G	HLST39	15.28	5	2 11/16	8	11	0.522	0.993	H
		IU-G	HLIST38	15.13	4 3/4	2 9/16	9	12	0.520	0.999	H
		IU-G	HLIST39	15.22	4 7/8	2 11/16	9	12	0.523	1.002	H
		IU-G	H90	15.63	5 1/2	2 13/16	7	10	0.528	--	RP7G
		EU-S	NC46	16.44	6	3	7	10	0.556	0.995	DS-1
		EU-S	WT40	15.80	5 3/8	3 1/8	8	14	0.534	--	T
		EU-S	WT40	16.00	5 1/2	3 1/8	8	14	0.541	0.995	T
		EU-S	NK DSTJ NC46	16.44	6	3	7	10	0.556	0.995	T
		IEU-S	CET39	15.30	4 7/8	2 11/16	11	14	0.526	1.001	CTP
		IEU-S	CET40	16.13	5 1/4	2 11/16	11	14	0.556	1.001	CTP
		IU-S	NC40	16.15	5 1/2	2	7	10	0.546	0.970	DS-1
		IU-S	HT38	16.13	5	2 7/16	10	15 1/2	0.547	0.969	GP
		IU-S	HT40	16.12	5 1/4	2 11/16	9	15	0.546	0.979	GP
		IU-S	XT38	15.44	4 3/4	2 9/16	10	15	0.523	0.975	GP
		IU-S	XT39	15.67	4 7/8	2 9/16	10	15	0.531	0.974	GP
		IU-S	GPDS40	15.82	5 1/4	2 11/16	9	12	0.536	0.982	GP
		IU-S	TurboTorque 390	16.00	4 7/8	2 11/16	10	15	0.545	0.999	GP
		IU-S	TurboTorque 420	16.25	5 1/4	2 15/16	10	15	0.547	1.003	GP
		IU-S	TurboTorque-M 390	16.00	4 7/8	2 11/16	10	15	0.545	0.999	GP
		IU-S	TurboTorque-M 420	16.25	5 1/4	2 15/16	10	15	0.547	1.003	GP
		IU-S	WT39	15.30	5	2 13/16	8	14	0.521	0.986	T
		IU-S	WT39	15.50	5 1/8	2 13/16	8	14	0.521	0.986	T
		IU-S	WT38	15.20	4 3/4	2 9/16	8	14	0.512	0.977	T
		IU-S	WT38	15.60	5	2 9/16	8	14	0.530	0.977	T
		IU-S	WT31	14.70	4 1/8	2	7	12	0.493	0.967	T
		IU-S	NK DSTJ NC40	16.15	5 1/2	2	7	10	0.546	0.970	T
		IU-S	NC38 EIS	15.67	4 3/4	2 7/16	10	12 1/2	0.538	0.972	GP
		IU-S	VX38	16.56	5	2 7/16	12	15	0.569	0.966	GP
		IU-S	VX39	15.92	5	2 13/16	12	15	0.547	0.988	GP
		IU-S	VX40	15.91	5 1/4	3	11	14	0.547	1.000	GP
		IU-S	HLIDS38	15.48	5	2 7/16	8	11	0.523	0.981	H
		IU-S	HLMT38	16.03	5	2 7/16	10	15	0.551	0.990	H
		IU-S	HLIDS40	16.21	5 1/2	2 9/16	8	11	0.556	0.992	H
		IU-S	HLMT40	16.29	5 1/4	2 11/16	10	15	0.560	0.998	H
		IU-S	HLST36	15.14	4 3/4	2 1/4	8	10	0.512	0.979	H
		IU-S	HLST39	15.38	5	2 9/16	8	11	0.526	0.990	H
		IU-S	HLIST38	15.23	4 3/4	2 7/16	9	12	0.523	0.996	H
		IU-S	HLIST39	15.33	4 7/8	2 9/16	9	12	0.527	0.999	H
		IU-S	H90	15.63	5 1/2	2 13/16	7	10	0.528	--	RP7G
		IU-S	DPM-MT39	15.36	5	2 9/16	9	12	0.528	0.990	DPM
		IU-S	DPM-ST39	15.46	4 7/8	2 9/16	10	15	0.532	0.986	DPM
		IU-S	DPM-MT40	15.76	5 1/4	2 3/5	9	12	0.542	0.990	DPM
		IU-S	DPM-DS40	15.80	5 1/4	2 9/16	9	12	0.543	0.989	DPM

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4	14.00	IU-S	DPM-ST40	16.05	5 1/4	2 11/16	10	15	0.552	0.991	DPM
		EU-V	NC46	17.08	6	3	9	12	0.577	0.993	DS-1
		EU-V	WT40	15.80	5 3/8	3 1/8	8	14	0.534	--	T
		EU-V	WT40	16.00	5 1/2	3 1/8	8	14	0.541	0.995	T
		EU-V	NK DSTJ NC46	17.08	6	3	9	12	0.577	0.993	T
		EU-V	HLIDS46	16.49	6	3 1/4	8	11	0.567	1.016	H
		IU-V	NC40	16.76	5 1/2	2	9	12	0.567	0.963	DS-1
		IU-V	HT38	16.13	5	2 7/16	10	15 1/2	0.547	0.969	GP
		IU-V	HT40	16.12	5 1/4	2 11/16	9	15	0.546	0.979	GP
		IU-V	XT38	15.61	4 3/4	2 7/16	10	15	0.529	0.970	GP
		IU-V	XT39	15.67	4 7/8	2 9/16	10	15	0.531	0.974	GP
		IU-V	GPDS40	15.99	5 1/4	2 9/16	9	12	0.542	0.977	GP
		IU-V	WT39	15.30	5	2 13/16	8	14	0.521	0.986	T
		IU-V	WT39	15.50	5 1/8	2 13/16	8	14	0.521	0.986	T
		IU-V	WT38	15.20	4 3/4	2 9/16	8	14	0.512	0.977	T
		IU-V	WT38	15.60	5	2 9/16	8	14	0.530	0.977	T
		IU-V	WT31	14.70	4 1/8	2	7	12	0.493	0.967	T
		IU-V	NK DSTJ NC40	16.76	5 1/2	2	9	12	0.567	0.963	T
		IU-V	HLIDS40	16.31	5 1/2	2 7/16	8	11	0.559	0.988	H
		IU-150	HLMT40	16.42	5 1/4	2 9/16	10	15	0.564	0.993	H
		IU-150	HLST39	15.38	5	2 9/16	8	11	0.520	0.984	H
		IU-150	HLIST39	15.37	4 7/8	2 9/16	9	12	0.519	0.983	H
4	15.70	EU-E	NC46	17.54	6	3 1/4	7	10	0.593	--	RP7G
		IU-E	HT40	17.49	5 1/4	2 13/16	9	15	0.593	0.930	GP
		IU-E	XT39	17.24	4 7/8	2 9/16	10	15	0.584	0.920	GP
		IU-E	XT40	17.59	5 1/4	2 13/16	10	15	0.596	0.929	GP
		IU-E	HLIDS40	17.23	5 1/4	2 13/16	8	11	0.590	0.941	H
		IU-E	HLST36	16.59	4 3/4	2 9/16	8	10	0.565	0.931	H
		IU-E	HLST39	16.83	5	2 13/16	8	11	0.575	0.940	H
		IU-E	NC40	16.80	5 1/4	2 11/16	7	10	0.568	--	RP7G
		IU-E	H90	17.09	5 1/2	2 13/16	7	10	0.578	--	RP7G
		EU-X	NC46	17.80	6	3 1/4	7	10	0.602	--	RP7G
		IU-X	HT40	17.49	5 1/4	2 13/16	9	15	0.593	0.930	GP
		IU-X	XT39	17.24	4 7/8	2 9/16	10	15	0.584	0.920	GP
		IU-X	XT40	17.59	5 1/4	2 13/16	10	15	0.596	0.929	GP
		IU-X	HLIDS40	17.33	5 1/4	2 11/16	8	11	0.593	0.938	H
		IU-X	HLST36	16.68	4 3/4	2 7/16	8	10	0.568	0.928	H
		IU-X	HLST39	16.94	5	2 11/16	8	11	0.579	0.937	H
		IU-X	NC40	17.52	5 1/2	2 7/16	7	10	0.592	--	RP7G
		IU-X	H90	17.23	5 1/2	2 13/16	7	10	0.582	--	RP7G
		EU-G	NC46	17.80	6	3 1/4	7	10	0.602	--	RP7G
		IEU-G	CET39	16.94	4 7/8	2 11/16	11	14	0.583	0.943	CTP
		IEU-G	CET40	17.77	5 1/4	2 11/16	11	14	0.612	0.943	CTP
		IU-G	HT40	17.49	5 1/4	2 13/16	9	15	0.593	0.930	GP
		IU-G	XT39	17.24	4 7/8	2 9/16	10	15	0.584	0.920	GP
		IU-G	XT40	17.59	5 1/4	2 13/16	10	15	0.596	0.929	GP
		IU-G	VX39	17.42	5	2 13/16	12	15	0.617	0.960	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
				(W) Approx Assembly	Tool Joint Dimensions[1]		Tong Space		Disp/ Triple	Capacity/ Triple	
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	Adj. Wt.[2] (lb/ft)	OD (in)	ID (in)	Pin (in)	Box (in)	Stand[2] (Bbl)	Stand[2,3] (Bbl)	Data Source[4]
4	15.70	IU-G	HLIDS40	17.44	5 1/4	2 9/16	8	11	0.597	0.934	H
		IU-G	HLST36	16.68	4 3/4	2 7/16	8	10	0.568	0.928	H
		IU-G	HLST39	17.04	5	2 9/16	8	11	0.583	0.933	H
		IU-G	HLIST39	16.76	4 7/8	2 13/16	9	12	0.576	0.949	H
		IU-G	NC40	17.52	5 1/2	2 7/16	7	10	0.592	--	RP7G
		IU-G	H90	17.23	5 1/2	2 13/16	7	10	0.582	--	RP7G
		EU-S	WT40	17.40	5 3/8	3 1/8	8	14	0.588	--	T
		EU-S	WT40	17.60	5 1/2	3 1/8	8	14	0.595	0.949	T
		EU-S	NC46	18.02	6	3	7	10	0.609	--	RP7G
		IEU-S	CET39	16.94	4 7/8	2 11/16	11	14	0.583	0.943	CTP
		IEU-S	CET40	17.77	5 1/4	2 11/16	11	14	0.612	0.943	CTP
		IU-S	HT40	17.88	5 1/4	2 9/16	9	15	0.605	0.920	GP
		IU-S	XT39	17.24	4 7/8	2 9/16	10	15	0.584	0.920	GP
		IU-S	XT40	17.59	5 1/4	2 13/16	10	15	0.596	0.929	GP
		IU-S	GPDS40	17.57	5 1/4	2 9/16	9	12	0.595	0.922	GP
		IU-S	TurboTorque 420	17.88	5 1/4	2 15/16	10	15	0.615	0.957	GP
		IU-S	TurboTorque-M 420	17.88	5 1/4	2 15/16	10	15	0.615	0.957	GP
		IU-S	WT39	16.90	5	2 13/16	8	14	0.571	0.930	T
		IU-S	WT39	17.10	5 1/8	2 13/16	8	14	0.578	0.930	T
		IU-S	WT38	16.80	4 3/4	2 9/16	8	14	0.568	--	T
		IU-S	WT38	17.10	5	2 9/16	8	14	0.578	0.921	T
		IU-S	WT31	16.20	4 1/8	2	7	12	0.548	0.911	T
		IU-S	VX39	17.54	5	2 3/4	12	15	0.617	0.937	GP
		IU-S	HLIDS40	17.96	5 1/2	2 7/16	8	11	0.616	0.932	H
		IU-S	HLMT40	18.04	5 1/4	2 9/16	10	15	0.620	0.927	H
		IU-S	HLST39	17.13	5	2 7/16	8	11	0.579	0.925	H
		IU-S	HLIST39	17.18	5	2 9/16	9	12	0.590	0.942	H
		IU-S	DPM-MT39	16.97	5	2 9/16	9	12	0.584	0.934	DPM
		IU-S	DPM-ST39	17.06	4 7/8	2 9/16	10	15	0.586	0.931	DPM
		IU-S	DPM-MT40	17.37	5 1/4	2 3/5	9	12	0.596	0.936	DPM
		IU-S	DPM-DS40	17.42	5 1/4	2 9/16	9	12	0.599	0.934	DPM
		IU-S	DPM-ST40	17.65	5 1/4	2 11/16	10	15	0.607	0.936	DPM
		IU-V	HT40	18.05	5 1/4	2 7/16	9	15	0.612	0.915	GP
		IU-V	XT39	17.24	4 7/8	2 9/16	10	15	0.584	0.920	GP
		IU-V	XT40	17.79	5 1/4	2 11/16	10	15	0.602	0.924	GP
		IU-V	GPDS40	17.74	5 1/4	2 7/16	9	12	0.601	0.918	GP
		IU-V	HLIDS40	17.96	5 1/2	2 7/16	8	11	0.616	0.932	H
		IU-V	HLMT40	18.16	5 1/4	2 7/16	10	15	0.624	0.922	H
		IU-V	HLST39	17.13	5	2 7/16	8	11	0.579	0.925	H
		IU-V	HLIST39	17.18	5	2 9/16	9	12	0.590	0.942	H
4 1/2	13.75	EU-E	NC50	15.90	6 5/8	3 3/4	7	10	0.538	1.407	DS-1
		EU-E	NK DSTJ NC50	15.90	6 5/8	3 3/4	7	10	0.538	1.407	T
		EU-E	OH	14.04	5 3/4	3 31/32	7	10	0.475	--	RP7G
		EU-E	WO	14.77	6 1/8	3 7/8	7	10	0.499	--	RP7G
		IU-E	NC46	15.12	6	3 3/8	7	10	0.511	1.393	DS-1
		IU-E	NK DSTJ NC46	15.12	6	3 3/8	7	10	0.511	1.393	T
		IU-E	H90	15.23	6	3 1/4	--	--	0.515	--	RP7G

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4 1/2	16.60	EU-E	NC50	18.50	6 5/8	3 3/4	7	10	0.625	1.320	DS-1
		EU-E	HT50	18.73	6 1/4	3 3/4	9	15	0.634	1.318	GP
		EU-E	XT50	19.17	6 3/8	3 3/4	10	15	0.649	1.318	GP
		EU-E	NK DSTJ NC50	18.50	6 5/8	3 3/4	7	10	0.625	1.320	T
		EU-E	NC50 EIS	19.45	6 3/8	3 1/2	9	12	0.668	1.320	GP
		EU-E	OH	17.07	5 7/8	3 3/4	7	10	0.577	--	RP7G
		IEU-E	NC46	18.40	6 1/4	3 1/4	7	10	0.622	1.296	DS-1
		IEU-E	XT40	17.92	5 1/4	3	10	15	0.607	1.282	GP
		IEU-E	HT46	19.59	6 1/4	3 1/4	9	15	0.663	1.292	GP
		IEU-E	XT46	18.63	6	3 1/2	10	15	0.631	1.304	GP
		IEU-E	NK DSTJ NC46	18.40	6 1/4	3 1/4	7	10	0.622	1.296	T
		IEU-E	NC46 EIS	19.30	6	3	9	12	0.663	1.287	GP
		IEU-E	HLIDS46	18.50	6	3 1/4	8	11	0.634	1.312	H
		IEU-E	HLST46	18.23	6	3 1/2	8	11	0.625	1.321	H
		IEU-E	FH	18.14	6	3	7	10	0.613	--	RP7G
		IEU-E	H90	17.92	6	3 1/4	7	10	0.606	--	RP7G
		IEU-E	NC38	16.79	5	2 11/16	8	10 1/2	0.568	--	RP7G
		EU-X	NC50	18.87	6 5/8	3 3/4	7	10	0.638	1.318	DS-1
		EU-X	HT50	18.73	6 1/4	3 3/4	9	15	0.634	1.318	GP
		EU-X	XT50	19.17	6 3/8	3 3/4	10	15	0.649	1.318	GP
		EU-X	NK DSTJ NC50	18.87	6 5/8	3 3/4	7	10	0.638	1.318	T
		EU-X	NC50 EIS	19.45	6 3/8	3 1/2	9	12	0.668	1.320	GP
		IEU-X	NC46	18.64	6 1/4	3	7	10	0.630	1.285	DS-1
		IEU-X	HT46	19.59	6 1/4	3 1/4	9	15	0.663	1.292	GP
		IEU-X	XT40	17.92	5 1/4	3	10	15	0.607	1.282	GP
		IEU-X	XT46	18.63	6	3 1/2	10	15	0.631	1.304	GP
		IEU-X	NK DSTJ NC46	18.64	6 1/4	3	7	10	0.630	1.285	T
		IEU-X	NC46 EIS	19.30	6	3	9	12	0.663	1.287	GP
		IEU-X	HLIDS46	18.50	6	3 1/4	8	11	0.634	1.312	H
		IEU-X	HLST46	18.23	6	3 1/2	8	11	0.625	1.321	H
		IEU-X	FH	18.33	6	3	7	10	0.620	--	RP7G
		IEU-X	H90	18.11	6	3 1/4	7	10	0.612	--	RP7G
		EU-G	NC50	18.87	6 5/8	3 3/4	7	10	0.638	1.318	DS-1
		EU-G	HT50	18.73	6 1/4	3 3/4	9	15	0.634	1.318	GP
		EU-G	XT50	19.17	6 3/8	3 3/4	10	15	0.649	1.318	GP
		EU-G	NK DSTJ NC50	18.87	6 5/8	3 3/4	7	10	0.638	1.318	T
		EU-G	NC50 EIS	19.45	6 3/8	3 1/2	9	12	0.668	1.320	GP
		IEU-G	NC46	18.64	6 1/4	3	7	10	0.630	1.285	DS-1
		IEU-G	HT46	19.59	6 1/4	3 1/4	9	15	0.663	1.292	GP
		IEU-G	XT40	17.92	5 1/4	3	10	15	0.607	1.282	GP
		IEU-G	XT46	18.63	6	3 1/2	10	15	0.631	1.304	GP
		IEU-G	NK DSTJ NC46	18.64	6 1/4	3	7	10	0.630	1.285	T
		IEU-G	NC46 EIS	19.30	6	3	9	12	0.663	1.287	GP
		IEU-G	VX46	18.30	6	3 3/4	11	14	0.629	1.337	GP
		IEU-G	HLIDS46	18.50	6	3 1/4	8	11	0.634	1.312	H
		IEU-G	HLMT46	19.27	6	3 1/4	10	15	0.662	1.316	H
		IEU-G	HLST46	18.23	6	3 1/2	8	11	0.625	1.321	H
		IEU-G	HLIST46	18.94	6	3 1/2	10	15	0.651	1.328	H
		IEU-G	FH	18.33	6	3	7	10	0.620	--	RP7G

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4 1/2	16.60	IEU-G	H90	18.33	6	3	7	10	0.620	--	RP7G
		IEU-G	CET40	17.87	5 1/4	2 11/16	11	14	0.614	1.298	CTP
		IEU-G	CET43	17.84	5 3/8	3	11	14	0.614	1.309	CTP
		IEU-G	CET43	17.56	5 3/8	3 1/4	11	14	0.605	1.318	CTP
		IEU-G	CET46	19.78	6 1/4	3 1/4	11	14	0.679	1.318	CTP
		EU-S	NC50	19.14	6 5/8	3 1/2	7	10	0.647	1.308	DS-1
		EU-S	HT50	19.52	6 3/8	3 1/2	9	15	0.661	1.305	GP
		EU-S	XT50	19.17	6 3/8	3 3/4	10	15	0.649	1.318	GP
		EU-S	WT46	18.60	6	3 1/2	8	14	0.629	--	T
		EU-S	WT46	19.10	6 1/4	3 1/2	8	14	0.646	1.311	T
		EU-S	NK DSTJ NC50	19.14	6 5/8	3 1/2	7	10	0.647	1.308	T
		EU-S	NC50 EIS	19.45	6 3/8	3 1/2	9	12	0.668	1.320	GP
		IEU-S	NC46	18.86	6 1/4	2 3/4	7	10	0.637	1.277	DS-1
		IEU-S	HT46	19.59	6 1/4	3 1/4	9	15	0.663	1.292	GP
		IEU-S	XT40	18.23	5 1/4	2 13/16	10	15	0.617	1.274	GP
		IEU-S	XT46	18.63	6	3 1/2	10	15	0.631	1.304	GP
		IEU-S	GPDS46	19.14	6 1/4	3 1/4	9	12	0.648	1.295	GP
		IEU-S	TurboTorque 435	18.61	5 3/8	3 1/8	10	15	0.636	1.340	GP
		IEU-S	TurboTorque 485	18.97	6	3 9/16	10	15	0.663	1.326	GP
		IEU-S	TurboTorque-M 435	18.61	5 3/8	3 1/8	10	15	0.636	1.317	GP
		IEU-S	TurboTorque-M 485	18.97	6	3 9/16	10	15	0.640	1.349	GP
		IEU-S	WT40	17.60	5 1/8	2 13/16	8	14	0.595	1.293	T
		IEU-S	WT39	17.10	4 5/8	2 9/16	8	14	0.578	1.274	T
		IEU-S	NK DSTJ NC46	18.86	6 1/4	2 3/4	7	10	0.637	1.277	T
		IEU-S	NC46 EIS	19.30	6	3	9	12	0.663	1.287	GP
		IEU-S	VX46	18.87	6	3 1/2	11	14	0.648	1.317	GP
		IEU-S	HLIDS46	18.75	6	3	8	11	0.643	1.303	H
		IEU-S	HLMT46	19.27	6	3 1/4	10	15	0.662	1.316	H
		IEU-S	HLST46	18.23	6	3 1/2	8	11	0.625	1.321	H
		IEU-S	HLIST46	18.94	6	3 1/2	10	15	0.651	1.328	H
		IEU-S	FH	19.19	6 1/4	2 1/2	7	10	0.649	--	RP7G
		IEU-S	H90	18.33	6	3	7	10	0.620	--	RP7G
		IEU-S	DPM-MT40	18.09	5 1/4	2 11/16	9	12	0.621	1.280	DPM
		IEU-S	DPM-ST40	18.46	5 1/4	2 11/16	10	15	0.635	1.274	DPM
		IEU-S	DPM-DS46	18.71	6	3 1/4	9	12	0.643	1.307	DPM
		IEU-S	DPM-ST46	19.84	6 1/4	3 1/4	10	15	0.682	1.303	DPM
		IEU-S	CET40	17.87	5 1/4	2 11/16	11	14	0.614	1.298	CTP
		IEU-S	CET43	17.84	5 3/8	3	11	14	0.614	1.309	CTP
		IEU-S	CET43	17.56	5 3/8	3 1/4	11	14	0.605	1.318	CTP
		IEU-S	CET46	19.78	6 1/4	3 1/4	11	14	0.679	1.318	CTP
		IU-S	WT38	17.80	5 1/2	3 1/8	8	14	0.602	--	T
		EU-V	NC50	19.89	6 5/8	3 1/2	9	12	0.672	1.306	DS-1
		EU-V	HT50	19.52	6 3/8	3 1/2	9	15	0.661	1.305	GP
		EU-V	XT50	19.67	6 3/8	3 1/2	10	15	0.666	1.305	GP
		EU-V	WT46	18.60	6	3 1/2	8	14	0.629	--	T
		EU-V	WT46	19.10	6 1/4	3 1/2	8	14	0.646	1.311	T
		EU-V	NK DSTJ NC50	19.89	6 5/8	3 1/2	9	12	0.672	1.306	T
		IEU-V	NC46	19.60	6 1/4	2 3/4	9	12	0.662	1.270	DS-1
		IEU-V	HT46	19.59	6 1/4	3 1/4	9	15	0.663	1.292	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4 1/2	16.60	IEU-V	XT40	18.23	5 1/4	2 13/16	10	15	0.617	1.274	GP
		IEU-V	XT46	19.74	6 1/4	3 1/4	10	15	0.668	1.291	GP
		IEU-V	GPDS46	19.14	6 1/4	3 1/4	9	12	0.648	1.295	GP
		IEU-V	WT40	17.60	5 1/8	2 13/16	8	14	0.595	1.293	T
		IEU-V	WT39	17.10	4 5/8	2 9/16	8	14	0.578	1.274	T
		IEU-V	NK DSTJ NC46	19.60	6 1/4	2 3/4	9	12	0.662	1.270	T
		IEU-V	HLIDS46	18.75	6	3	8	11	0.643	1.303	H
		IEU-V	HLMT46	19.27	6	3 1/4	10	15	0.662	1.316	H
		IEU-V	HLST46	18.50	6	3 1/4	8	11	0.634	1.312	H
		IEU-V	HLIST46	18.94	6	3 1/2	10	15	0.651	1.328	H
		IU-V	WT38	17.80	5 1/2	3 1/8	8	14	0.602	--	T
4 1/2	20.00	EU-E	NC50	22.14	6 5/8	3 5/8	7	10	0.749	1.196	DS-1
		EU-E	HT50	22.31	6 1/4	3 5/8	9	15	0.756	1.196	GP
		EU-E	XT50	22.99	6 3/8	3 1/2	10	15	0.779	1.190	GP
		EU-E	NK DSTJ NC50	22.14	6 5/8	3 5/8	7	10	0.749	1.196	T
		EU-E	NC50 EIS	22.76	6 3/8	3 1/2	9	12	0.782	1.206	GP
		IEU-E	NC46	22.15	6 1/4	3	7	10	0.749	1.170	DS-1
		IEU-E	HT46	22.89	6 1/4	3 1/4	9	15	0.775	1.177	GP
		IEU-E	XT46	21.93	6	3 1/2	10	15	0.743	1.189	GP
		IEU-E	NK DSTJ NC46	22.15	6 1/4	3	7	10	0.749	1.170	T
		IEU-E	NC46 EIS	22.61	6	3	9	12	0.777	1.174	GP
		IEU-E	HLIDS46	21.95	6	3 1/4	8	11	0.753	1.193	H
		IEU-E	HLST46	21.68	6	3 1/2	8	11	0.743	1.202	H
		IEU-E	FH	21.64	6	3	7	10	0.732	--	RP7G
		IEU-E	H90	21.64	6	3	7	10	0.732	--	RP7G
		EU-X	NC50	22.61	6 5/8	3 1/2	7	10	0.764	1.191	DS-1
		EU-X	HT50	22.55	6 1/4	3 1/2	9	15	0.764	1.190	GP
		EU-X	XT50	22.99	6 3/8	3 1/2	10	15	0.779	1.190	GP
		EU-X	NK DSTJ NC50	22.61	6 5/8	3 1/2	7	10	0.764	1.191	T
		EU-X	NC50 EIS	22.76	6 3/8	3 1/2	9	12	0.782	1.206	GP
		IEU-X	NC46	22.65	6 1/4	2 3/4	7	10	0.766	1.158	DS-1
		IEU-X	HT46	22.89	6 1/4	3 1/4	9	15	0.775	1.177	GP
		IEU-X	XT46	21.93	6	3 1/2	10	15	0.743	1.189	GP
		IEU-X	NK DSTJ NC46	22.65	6 1/4	2 3/4	7	10	0.766	1.158	T
		IEU-X	NC46 EIS	22.61	6	3	9	12	0.777	1.174	GP
		IEU-X	HLIDS46	21.95	6	3 1/4	8	11	0.753	1.193	H
		IEU-X	HLST46	21.68	6	3 1/2	8	11	0.743	1.202	H
		IEU-X	FH	22.39	6	2 1/2	7	10	0.757	--	RP7G
		IEU-X	H90	21.78	6	3 1/4	7	10	0.736	--	RP7G
		EU-G	NC50	22.61	6 5/8	3 1/2	7	10	0.764	1.191	DS-1
		EU-G	HT50	22.55	6 1/4	3 1/2	9	15	0.764	1.190	GP
		EU-G	XT50	22.99	6 3/8	3 1/2	10	15	0.779	1.190	GP
		EU-G	NK DSTJ NC50	22.61	6 5/8	3 1/2	7	10	0.764	1.191	T
		EU-G	NC50 EIS	22.76	6 3/8	3 1/2	9	12	0.782	1.206	GP
		IEU-G	NC46	22.84	6 1/4	2 1/2	7	10	0.772	1.151	DS-1
		IEU-G	HT46	22.89	6 1/4	3 1/4	9	15	0.775	1.177	GP
		IEU-G	XT46	21.93	6	3 1/2	10	15	0.743	1.189	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
4 1/2	20.00	IEU-G	NK DSTJ NC46	22.84	6 1/4	2 1/2	7	10	0.772	1.151	T
		IEU-G	NC46 EIS	22.61	6	3	9	12	0.777	1.174	GP
		IEU-G	VX46	22.14	6	3 1/2	11	14	0.761	1.205	GP
		IEU-G	HLIDS46	22.20	6	3	8	11	0.761	1.184	H
		IEU-G	HLMT46	22.67	6	3 1/4	10	15	0.779	1.198	H
		IEU-G	HLST46	21.68	6	3 1/2	8	11	0.743	1.202	H
		IEU-G	HLIST46	22.34	6	3 1/2	10	15	0.767	1.210	H
		IEU-G	FH	22.39	6	2 1/2	7	10	0.757	--	RP7G
		IEU-G	H90	22.00	6	3	7	10	0.744	--	RP7G
		IEU-G	CET40	21.32	5 1/4	2 11/16	11	14	0.733	1.179	CTP
		IEU-G	CET43	21.30	5 3/8	3	11	14	0.733	1.190	CTP
		IEU-G	CET43	21.02	5 3/8	3 1/4	11	14	0.724	1.199	CTP
		IEU-G	CET46	23.23	6 1/4	3 1/4	11	14	0.799	1.199	CTP
		EU-S	NC50	23.09	6 5/8	3	7	10	0.780	1.174	DS-1
		EU-S	HT50	22.85	6 3/8	3 1/2	9	15	0.774	1.190	GP
		EU-S	XT50	22.99	6 3/8	3 1/2	10	15	0.779	1.190	GP
		EU-S	WT46	22.00	6	3 1/2	8	14	0.744	--	T
		EU-S	WT46	22.50	6 1/4	3 1/2	8	14	0.761	1.190	T
		EU-S	NK DSTJ NC50	23.09	6 5/8	3	7	10	0.780	1.174	T
		EU-S	NC50 EIS	22.76	6 3/8	3 1/2	9	12	0.782	1.206	GP
		IEU-S	NC46	23.01	6 1/4	2 1/4	7	10	0.778	1.145	DS-1
		IEU-S	HT46	23.34	6 1/4	3	9	15	0.791	1.165	GP
		IEU-S	XT46	22.42	6	3 1/4	10	15	0.759	1.177	GP
		IEU-S	GPDS46	22.89	6 1/4	3	9	12	0.775	1.168	GP
		IEU-S	TurboTorque 485	23.25	6 1/8	3 1/4	10	15	0.800	1.211	GP
		IEU-S	TurboTorque-M 485	23.25	6 1/8	3 1/4	10	15	0.800	1.211	GP
		IEU-S	WT40	21.50	5 1/2	3 1/8	8	14	0.727	1.172	T
		IEU-S	WT39	21.30	5 1/8	2 13/16	8	14	0.720	1.163	T
		IEU-S	NK DSTJ NC46	23.01	6 1/4	2 1/4	7	10	0.778	1.145	T
		IEU-S	NC46 EIS	22.61	6	3	9	12	0.777	1.174	GP
		IEU-S	VX46	23.17	6	3	11	14	0.788	1.170	GP
		IEU-S	HLIDS46	22.43	6	2 3/4	8	11	0.769	1.176	H
		IEU-S	HLMT46	22.98	6	3	10	15	0.789	1.187	H
		IEU-S	HLST46	21.95	6	3 1/4	8	11	0.753	1.193	H
		IEU-S	HLIST46	22.67	6	3 1/4	10	15	0.779	1.198	H
		IEU-S	DPM-MT40	21.45	5 1/4	2 11/16	9	12	0.738	1.163	DPM
		IEU-S	DPM-ST40	21.79	5 1/4	2 11/16	10	15	0.749	1.159	DPM
		IEU-S	DPM-DS46	22.05	6	3 1/4	9	12	0.758	1.192	DPM
		IEU-S	DPM-ST46	23.14	6 1/4	3 1/4	10	15	0.796	1.189	DPM
		IEU-S	CET40	21.32	5 1/4	2 11/16	11	14	0.733	1.179	CTP
		IEU-S	CET43	21.30	5 3/8	3	11	14	0.733	1.190	CTP
		IEU-S	CET43	21.02	5 3/8	3 1/4	11	14	0.724	1.199	CTP
		IEU-S	CET46	23.23	6 1/4	3 1/4	11	14	0.799	1.199	CTP
		IU-S	WT38	20.80	4 5/8	2 9/16	8	14	0.703	--	T
		EU-V	NC50	23.89	6 5/8	3	9	12	0.807	1.170	DS-1
		EU-V	HT50	22.85	6 3/8	3 1/2	9	15	0.774	1.190	GP
		EU-V	XT50	22.99	6 3/8	3 1/2	10	15	0.779	1.190	GP
		EU-V	WT46	22.00	6	3 1/2	8	14	0.744	--	T
		EU-V	WT46	22.50	6 1/4	3 1/2	8	14	0.761	1.190	T

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
				(W) Approx Assembly	Tool Joint Dimensions[1]		Tong Space		Disp/ Triple	Capacity/ Triple	
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	Adj. Wt.[2] (lb/ft)	OD (in)	ID (in)	Pin (in)	Box (in)	Stand[2] (Bbl)	Stand[2,3] (Bbl)	Data Source[4]
4 1/2	20.00	EU-V	NK DSTJ NC50	23.89	6 5/8	3	9	12	0.807	1.170	T
		IEU-V	NC46	23.79	6 1/4	2 1/4	9	12	0.804	1.137	DS-1
		IEU-V	HT46	23.34	6 1/4	3	9	15	0.791	1.165	GP
		IEU-V	XT46	23.26	6 1/4	3 1/8	10	15	0.788	1.170	GP
		IEU-V	GPDS46	22.89	6 1/4	3	9	12	0.775	1.168	GP
		IEU-V	WT40	21.50	5 1/2	3 1/8	8	14	0.727	1.172	T
		IEU-V	WT39	21.30	5 1/8	2 13/16	8	14	0.720	1.163	T
		IEU-V	NK DSTJ NC46	23.79	6 1/4	2 1/4	9	12	0.804	1.137	T
		IEU-V	HLIDS46	22.43	6	2 3/4	8	11	0.769	1.176	H
		IEU-V	HLMT46	22.98	6	3	10	15	0.789	1.187	H
		IEU-V	HLST46	22.20	6	3	8	11	0.761	1.184	H
		IEU-V	HLST46	22.69	6 1/4	3	8	11	0.779	1.185	H
		IEU-V	HLIST46	22.67	6	3 1/4	10	15	0.779	1.198	H
		IU-V	WT38	20.80	4 5/8	2 9/16	8	14	0.703	--	T
4 1/2	22.82	EU-E	NC50	24.11	6 3/8	3 5/8	7	10	0.815	--	RP7G
		IEU-E	NC46	24.56	6 1/4	3	7	10	0.830	--	RP7G
		EU-X	NC50	24.24	6 3/8	3 1/2	7	10	0.819	--	RP7G
		IEU-X	FH	25.13	6 1/4	2 1/4	7	10	0.850	--	RP7G
		IEU-X	NC46	24.77	6 1/4	2 3/4	7	10	0.837	--	RP7G
		EU-G	NC50	24.72	6 1/2	3 1/4	7	10	0.836	--	RP7G
		IEU-G	NC46	24.96	6 1/4	2 1/2	7	10	0.844	--	RP7G
		EU-S	NC50	25.41	6 5/8	2 3/4	7	10	0.859	--	RP7G
5	19.50	EU-E	HLST52	21.21	6 1/2	4 1/8	8	11	0.717	1.645	H
		IEU-E	5-1/2 FH	22.35	7	3 3/4	8	10	0.756	1.623	DS-1
		IEU-E	NC50	21.37	6 5/8	3 3/4	7	10	0.723	1.625	DS-1
		IEU-E	HT50	22.57	6 5/8	3 3/4	9	15	0.765	1.620	GP
		IEU-E	XT46	21.69	6	3 1/2	10	15	0.735	1.607	GP
		IEU-E	XT50	21.83	6 1/2	4	10	15	0.739	1.634	GP
		IEU-E	NK DSTJ 5-1/2 FH	22.35	7	3 3/4	8	10	0.756	1.623	T
		IEU-E	NK DSTJ NC50	21.37	6 5/8	3 3/4	7	10	0.723	1.625	T
		IEU-E	NC50 EIS	22.28	6 3/8	3 1/2	9	12	0.765	1.618	GP
		IEU-E	HLIDS50	21.68	6 1/2	3 3/4	8	11	0.743	1.643	H
		IEU-E	HLST46	20.97	6	3 1/2	8	11	0.717	1.630	H
		EU-X	HLST52	21.21	6 1/2	4 1/8	8	11	0.717	1.645	H
		IEU-X	5-1/2 FH	22.61	7	3 3/4	8	10	0.764	1.617	DS-1
		IEU-X	NC50	21.90	6 5/8	3 1/2	7	10	0.740	1.610	DS-1
		IEU-X	HT50	22.57	6 5/8	3 3/4	9	15	0.765	1.620	GP
		IEU-X	XT46	21.69	6	3 1/2	10	15	0.735	1.607	GP
		IEU-X	XT50	21.83	6 1/2	4	10	15	0.739	1.634	GP
		IEU-X	NK DSTJ 5-1/2 FH	22.61	7	3 3/4	8	10	0.764	1.617	T
		IEU-X	NK DSTJ NC50	21.90	6 5/8	3 1/2	7	10	0.740	1.610	T
		IEU-X	NC50 EIS	22.28	6 3/8	3 1/2	9	12	0.765	1.618	GP
		IEU-X	HLIDS50	21.94	6 5/8	3 3/4	8	11	0.753	1.644	H
		IEU-X	HLST46	20.97	6	3 1/2	8	11	0.717	1.630	H
		IEU-X	H90	21.93	6 1/2	3 1/4	8	10	0.741	--	RP7G

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5	19.50	EU-G	HLST52	21.21	6 1/2	4 1/8	8	11	0.717	1.645	H
		IEU-G	5-1/2 FH	22.61	7	3 3/4	8	10	0.764	1.617	DS-1
		IEU-G	NC50	22.15	6 5/8	3 1/4	7	10	0.749	1.601	DS-1
		IEU-G	HT50	23.10	6 5/8	3 1/2	9	15	0.782	1.607	GP
		IEU-G	XT46	21.69	6	3 1/2	10	15	0.735	1.607	GP
		IEU-G	XT50	21.83	6 1/2	4	10	15	0.739	1.634	GP
		IEU-G	GPDS50	22.61	6 5/8	3 1/2	9	12	0.766	1.611	GP
		IEU-G	NK DSTJ 5-1/2 FH	22.61	7	3 3/4	8	10	0.764	1.617	T
		IEU-G	NK DSTJ NC50	22.15	6 5/8	3 1/4	7	10	0.749	1.601	T
		IEU-G	NC50 EIS	22.28	6 3/8	3 1/2	9	12	0.765	1.618	GP
		IEU-G	VX50	22.03	6 1/2	4	11	14	0.757	1.653	GP
		IEU-G	HLIDS50	22.24	6 5/8	3 1/2	8	11	0.763	1.634	H
		IEU-G	HLMT50	23.21	6 5/8	3 1/2	10	15	0.797	1.637	H
		IEU-G	HLIST46	21.64	6	3 1/2	10	15	0.743	1.639	H
		IEU-G	HLIST50	22.52	6 1/2	3 3/4	10	15	0.774	1.650	H
		IEU-G	HLST46	21.23	6	3 1/4	8	11	0.726	1.621	H
		IEU-G	H90	22.15	6 1/2	3	8	10	0.749	--	RP7G
		IEU-G	CET46	21.34	5 7/8	3 1/4	11	14	0.733	1.631	CTP
		IEU-G	CET46	22.33	6 1/4	3 1/4	11	14	0.769	1.631	CTP
		IEU-G	CET46	22.03	6 1/4	3 1/2	11	14	0.758	1.642	CTP
		IEU-G	CET50	22.76	6 5/8	3 3/4	11	14	0.783	1.654	CTP
		EU-S	WT50	22.70	6 3/4	4	8	15	0.767	--	T
		EU-S	WT50	23.30	7	4	8	15	0.788	1.637	T
		EU-S	HLST52	21.37	6 1/2	4	8	11	0.722	1.640	H
		IEU-S	5-1/2 FH	23.49	7 1/4	3 1/2	8	10	0.794	1.606	DS-1
		IEU-S	NC50	22.59	6 5/8	2 3/4	7	10	0.763	1.585	DS-1
		IEU-S	HT50	23.10	6 5/8	3 1/2	9	15	0.782	1.607	GP
		IEU-S	XT46	21.69	6	3 1/2	10	15	0.735	1.607	GP
		IEU-S	XT50	22.39	6 1/2	3 3/4	10	15	0.759	1.620	GP
		IEU-S	GPDS50	22.61	6 5/8	3 1/2	9	12	0.766	1.611	GP
		IEU-S	TurboTorque 500	22.91	6 1/4	3 1/2	10	15	0.775	1.641	GP
		IEU-S	TurboTorque 525	22.66	6 1/2	3 7/8	10	15	0.777	1.669	GP
		IEU-S	TurboTorque-M 500	22.91	6 1/4	3 1/2	10	15	0.775	1.641	GP
		IEU-S	TurboTorque-M 525	22.66	6 1/2	3 7/8	10	15	0.777	1.673	GP
		IEU-S	WT50	22.20	6 5/8	3 7/8	8	15	0.750	1.628	T
		IEU-S	WT46	21.40	6	3 1/2	8	14	0.723	1.609	T
		IEU-S	WT40	20.80	5 3/8	3 1/8	8	14	0.703	1.600	T
		IEU-S	WT39	20.80	5 1/8	2 13/16	8	14	0.703	--	T
		IEU-S	NK DSTJ 5-1/2 FH	23.49	7 1/4	3 1/2	8	10	0.794	1.606	T
		IEU-S	NK DSTJ NC50	22.59	6 5/8	2 3/4	7	10	0.763	1.585	T
		IEU-S	NC50 EIS	22.28	6 3/8	3 1/2	9	12	0.765	1.618	GP
		IEU-S	VX50	22.64	6 1/2	3 3/4	11	14	0.778	1.632	GP
		IEU-S	HLIDS50	22.51	6 5/8	3 1/4	8	11	0.773	1.625	H
		IEU-S	HLMT50	23.21	6 5/8	3 1/2	10	15	0.797	1.637	H
		IEU-S	HLIST46	21.64	6	3 1/2	10	15	0.743	1.639	H
		IEU-S	HLIST50	22.52	6 1/2	3 3/4	10	15	0.774	1.650	H
		IEU-S	HLST46	21.47	6	3	8	11	0.734	1.613	H
		IEU-S	DPM-DS50	23.15	6 5/8	3 1/4	9	12	0.796	1.608	DPM
		IEU-S	DPM-MT50	23.15	6 5/8	3 1/4	9	12	0.796	1.608	DPM

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	Tool Joint Dimensions[1] ID (in)	Tong Space Pin (in)	Tong Space Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5	19.50	IEU-S	DPM-ST50	23.81	6 5/8	3 1/4	10	15	0.819	1.601	DPM
		IEU-S	CET46	21.34	5 7/8	3 1/4	11	14	0.733	1.631	CTP
		IEU-S	CET46	22.33	6 1/4	3 1/4	11	14	0.769	1.631	CTP
		IEU-S	CET46	22.03	6 1/4	3 1/2	11	14	0.758	1.642	CTP
		IEU-S	CET50	22.76	6 5/8	3 3/4	11	14	0.783	1.654	CTP
		EU-V	WT50	22.70	6 3/4	4	8	15	0.767	--	T
		EU-V	WT50	23.30	7	4	8	15	0.788	1.637	T
		EU-V	HLST52	21.94	6 5/8	3 3/4	8	11	0.742	1.629	H
		IEU-V	5-1/2 FH	24.45	7 1/4	3 1/2	10	12	0.827	1.600	DS-1
		IEU-V	NC50	23.43	6 5/8	2 3/4	9	12	0.792	1.575	DS-1
		IEU-V	HT50	23.10	6 5/8	3 1/2	9	15	0.782	1.607	GP
		IEU-V	XT46	22.78	6 1/4	3 1/4	10	15	0.772	1.594	GP
		IEU-V	XT50	22.39	6 1/2	3 3/4	10	15	0.759	1.620	GP
		IEU-V	GPDS50	22.61	6 5/8	3 1/2	9	12	0.766	1.611	GP
		IEU-V	WT50	22.20	6 5/8	3 7/8	8	15	0.750	1.628	T
		IEU-V	WT46	21.40	6	3 1/2	8	14	0.723	1.609	T
		IEU-V	WT40	20.80	5 3/8	3 1/8	8	14	0.703	1.600	T
		IEU-V	WT39	20.80	5 1/8	2 13/16	8	14	0.703	--	T
		IEU-V	NK DSTJ 5-1/2 FH	24.45	7 1/4	3 1/2	10	12	0.827	1.600	T
		IEU-V	NK DSTJ NC50	23.43	6 5/8	2 3/4	9	12	0.792	1.575	T
		IEU-V	HLIDS50	22.51	6 5/8	3 1/4	8	11	0.773	1.625	H
		IEU-V	HLMT50	23.21	6 5/8	3 1/2	10	15	0.797	1.637	H
		IEU-V	HLIST46	22.57	6 1/4	3 1/4	10	15	0.775	1.627	H
		IEU-V	HLIST50	22.52	6 1/2	3 3/4	10	15	0.774	1.650	H
		IEU-V	HLST46	21.96	6 1/4	3	8	11	0.752	1.614	H
5	25.60	EU-E	HLST52	27.32	6 5/8	4	8	11	0.938	1.459	H
		IEU-E	5-1/2 FH	28.35	7	3 1/2	8	10	0.958	1.420	DS-1
		IEU-E	NC50	27.38	6 5/8	3 1/2	7	10	0.926	1.421	DS-1
		IEU-E	HT50	28.01	6 5/8	3 3/4	9	15	0.949	1.431	GP
		IEU-E	XT50	28.14	6 5/8	3 3/4	10	15	0.953	1.431	GP
		IEU-E	NK DSTJ 5-1/2 FH	28.35	7	3 1/2	8	10	0.958	1.420	T
		IEU-E	NK DSTJ NC50	27.38	6 5/8	3 1/2	7	10	0.926	1.421	T
		IEU-E	NC50 EIS	27.72	6 3/8	3 1/2	9	12	0.953	1.431	GP
		IEU-E	HLIDS50	27.38	6 1/2	3 3/4	8	11	0.939	1.447	H
		IEU-E	HLST46	26.69	6	3 1/2	8	11	0.913	1.434	H
		EU-X	HLST52	27.32	6 5/8	4	8	11	0.938	1.459	H
		IEU-X	5-1/2 FH	28.59	7	3 1/2	8	10	0.967	1.415	DS-1
		IEU-X	NC50	28.10	6 5/8	3	7	10	0.950	1.400	DS-1
		IEU-X	HT50	28.53	6 5/8	3 1/2	9	15	0.966	1.418	GP
		IEU-X	XT50	28.14	6 5/8	3 3/4	10	15	0.953	1.431	GP
		IEU-X	NK DSTJ 5-1/2 FH	28.59	7	3 1/2	8	10	0.967	1.415	T
		IEU-X	NK DSTJ NC50	28.10	6 5/8	3	7	10	0.950	1.400	T
		IEU-X	NC50 EIS	27.72	6 3/8	3 1/2	9	12	0.953	1.431	GP
		IEU-X	HLIDS50	27.93	6 5/8	3 1/2	8	11	0.959	1.438	H
		IEU-X	HLST46	26.94	6	3 1/4	8	11	0.921	1.425	H
		EU-G	HLST52	27.32	6 5/8	4	8	11	0.938	1.459	H
		IEU-G	5-1/2 FH	29.17	7 1/4	3 1/2	8	10	0.986	1.414	DS-1

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5	25.60	IEU-G	NC50	28.31	6 5/8	2 3/4	7	10	0.957	1.392	DS-1
		IEU-G	HT50	28.53	6 5/8	3 1/2	9	15	0.966	1.418	GP
		IEU-G	XT50	28.14	6 5/8	3 3/4	10	15	0.953	1.431	GP
		IEU-G	GPDS50	28.08	6 5/8	3 1/2	9	12	0.951	1.420	GP
		IEU-G	NK DSTJ 5-1/2 FH	29.17	7 1/4	3 1/2	8	10	0.986	1.414	T
		IEU-G	NK DSTJ NC50	28.31	6 5/8	2 3/4	7	10	0.957	1.392	T
		IEU-G	NC50 EIS	27.72	6 3/8	3 1/2	9	12	0.953	1.431	GP
		IEU-G	VX50	28.02	6 1/2	3 3/4	11	14	0.963	1.447	GP
		IEU-G	HLIDS50	27.93	6 5/8	3 1/2	8	11	0.959	1.438	H
		IEU-G	HLMT50	28.81	6 5/8	3 1/2	10	15	0.990	1.443	H
		IEU-G	HLIST50	28.81	6 5/8	3 1/2	10	15	0.990	1.443	H
		IEU-G	HLST46	27.67	6 1/4	3	8	11	0.947	1.419	H
		IEU-G	CET50	28.45	6 5/8	3 3/4	11	14	0.979	1.458	CTP
		EU-S	WT50	28.50	6 3/4	3 7/8	8	15	0.963	--	T
		EU-S	WT50	29.10	7	3 7/8	8	15	0.984	1.442	T
		EU-S	HLST52	27.64	6 5/8	3 3/4	8	11	0.949	1.448	H
		IEU-S	NC50	28.76	6 3/4	2 1/2	7	10	0.972	1.385	DS-1
		IEU-S	5-1/2 FH	29.45	7 1/4	3 1/4	8	10	0.995	1.405	DS-1
		IEU-S	HT50	28.53	6 5/8	3 1/2	9	15	0.966	1.418	GP
		IEU-S	XT50	28.67	6 5/8	3 1/2	10	15	0.971	1.417	GP
		IEU-S	GPDS50	28.08	6 5/8	3 1/2	9	12	0.951	1.420	GP
		IEU-S	TurboTorque 525	29.19	6 5/8	3 9/16	10	15	1.006	1.463	GP
		IEU-S	TurboTorque-M 525	29.19	6 5/8	3 9/16	10	15	1.006	1.463	GP
		IEU-S	WT50	28.20	6 5/8	3 5/8	8	15	0.953	1.423	T
		IEU-S	WT46	27.00	6	3 1/2	8	14	0.913	1.423	T
		IEU-S	WT40	26.40	5 3/8	3 1/8	8	14	0.892	1.404	T
		IEU-S	WT39	26.40	5 1/8	2 13/16	8	14	0.892	--	T
		IEU-S	NK DSTJ NC50	28.76	6 3/4	2 1/2	7	10	0.972	1.385	T
		IEU-S	NK DSTJ 5-1/2 FH	29.45	7 1/4	3 1/4	8	10	0.995	1.405	T
		IEU-S	NC50 EIS	28.49	6 1/2	3 1/4	9	12	0.979	1.414	GP
		IEU-S	HLIDS50	28.45	6 5/8	3	8	11	0.976	1.420	H
		IEU-S	HLMT50	29.15	6 5/8	3 1/4	10	15	1.001	1.431	H
		IEU-S	HLIST50	28.98	6 5/8	3 3/8	10	15	0.996	1.437	H
		IEU-S	HLST46	27.89	6 1/4	2 3/4	8	11	0.955	1.411	H
		IEU-S	DPM-DS50	28.63	6 5/8	3 1/4	9	12	0.985	1.419	DPM
		IEU-S	DPM-MT50	28.63	6 5/8	3 1/4	9	12	0.985	1.419	DPM
		IEU-S	DPM-ST50	29.25	6 5/8	3 1/4	10	15	1.006	1.415	DPM
		IEU-S	CET50	28.45	6 5/8	3 3/4	11	14	0.979	1.458	CTP
		EU-V	WT50	28.50	6 3/4	3 7/8	8	15	0.963	--	T
		EU-V	WT50	29.10	7	3 7/8	8	15	0.984	1.442	T
		EU-V	HLST52	27.93	6 5/8	3 1/2	8	11	0.959	1.438	H
		IEU-V	NC50	29.63	6 3/4	2 1/2	9	12	1.002	1.375	DS-1
		IEU-V	5-1/2 FH	30.39	7 1/4	3 1/4	10	12	1.027	1.399	DS-1
		IEU-V	HT50	29.02	6 5/8	3 1/4	9	15	0.983	1.405	GP
		IEU-V	XT50	28.93	6 5/8	3 3/8	10	15	0.980	1.410	GP
		IEU-V	GPDS50	28.54	6 5/8	3 1/4	9	12	0.967	1.409	GP
		IEU-V	WT50	28.20	6 5/8	3 5/8	8	15	0.953	1.423	T
		IEU-V	WT46	27.00	6	3 1/2	8	14	0.913	1.423	T

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5	25.60	IEU-V	NK DSTJ NC50	29.63	6 3/4	2 1/2	9	12	1.002	1.375	T
		IEU-V	NK DSTJ 5-1/2 FH	30.39	7 1/4	3 1/4	10	12	1.027	1.399	T
		IEU-V	HLIDS50	28.45	6 5/8	3	8	11	0.976	1.420	H
		IEU-V	HLMT50	29.15	6 5/8	3 1/4	10	15	1.001	1.431	H
		IEU-V	HLIST50	28.98	6 5/8	3 3/8	10	15	0.996	1.437	H
		IEU-V	HLST46	27.89	6 1/4	2 3/4	8	11	0.955	1.411	H
5 1/2	21.90	IEU-E	FH	23.82	7	4	8	10	0.805	2.019	DS-1
		IEU-E	HT55	25.32	7	4	10	15	0.858	2.010	GP
		IEU-E	XT54	24.04	6 3/4	4 1/4	10	15	0.814	2.027	GP
		IEU-E	XT57	24.72	7	4 1/4	10	15	0.837	2.026	GP
		IEU-E	NK DSTJ 5-1/2 FH	23.82	7	4	8	10	0.805	2.019	T
		IEU-E	5 1/2 FH EIS	25.17	7	4	10	12	0.865	2.026	GP
		IEU-E	HLIDS5-1/2FH	24.50	7	4	9	11	0.842	2.047	H
		IEU-E	HLST52	23.52	6 5/8	4	8	11	0.805	2.040	H
		IEU-E	HLST54	23.32	6 5/8	4 1/4	9	11	0.800	2.055	H
		IEU-E	HLST57	24.16	7	4 1/4	9	11	0.831	2.059	H
		IEU-X	FH	24.45	7	3 3/4	8	10	0.826	2.001	DS-1
		IEU-X	HT55	25.42	7	4	10	15	0.861	2.010	GP
		IEU-X	XT54	24.04	6 3/4	4 1/4	10	15	0.814	2.027	GP
		IEU-X	XT57	24.72	7	4 1/4	10	15	0.837	2.026	GP
		IEU-X	NK DSTJ 5-1/2 FH	24.45	7	3 3/4	8	10	0.826	2.001	T
		IEU-X	5 1/2 FH EIS	25.17	7	4	10	12	0.865	2.026	GP
		IEU-X	HLIDS5-1/2FH	24.50	7	4	9	11	0.842	2.047	H
		IEU-X	HLST52	23.52	6 5/8	4	8	11	0.805	2.040	H
		IEU-X	HLST54	23.32	6 5/8	4 1/4	9	11	0.800	2.055	H
		IEU-X	HLST57	24.16	7	4 1/4	9	11	0.831	2.059	H
		IEU-X	H90	24.80	7	3 1/2	8	10	0.838	--	RP7G
		IEU-G	FH	25.30	7 1/4	3 1/2	8	10	0.855	1.989	DS-1
		IEU-G	HT55	25.42	7	4	10	15	0.861	2.010	GP
		IEU-G	XT54	24.04	6 3/4	4 1/4	10	15	0.814	2.027	GP
		IEU-G	XT57	24.72	7	4 1/4	10	15	0.837	2.026	GP
		IEU-G	GPDS55	24.83	7	4	10	12	0.841	2.015	GP
		IEU-G	NK DSTJ 5-1/2 FH	25.30	7 1/4	3 1/2	8	10	0.855	1.989	T
		IEU-G	5 1/2 FH EIS	25.17	7	4	10	12	0.865	2.026	GP
		IEU-G	VX57	24.67	7	4 1/2	12	15	0.848	2.066	GP
		IEU-G	HLIDS5-1/2FH	24.50	7	4	9	11	0.842	2.047	H
		IEU-G	HLMT5-1/2FH	25.33	7	4	10	15	0.870	2.049	H
		IEU-G	HLIST54	23.92	6 5/8	4 1/4	10	15	0.822	2.064	H
		IEU-G	HLIST57	24.92	7	4 1/4	10	15	0.856	2.063	H
		IEU-G	HLST52	23.52	6 5/8	4	8	11	0.805	2.040	H
		IEU-G	HLST54	23.32	6 5/8	4 1/4	9	11	0.800	2.055	H
		IEU-G	HLST57	24.16	7	4 1/4	9	11	0.831	2.059	H
		IEU-G	CET54	24.25	6 5/8	4	12	15	0.835	2.052	CTP
		EU-S	WT56	24.20	7	4 5/8	8	15	0.818	2.055	T
		EU-S	WT56	24.70	7 1/4	4 5/8	8	15	0.835	--	T
		IEU-S	FH	26.43	7 1/2	3	8	10	0.894	1.970	DS-1

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5 1/2	21.90	IEU-S	HT55	25.42	7	4	10	15	0.861	2.010	GP
		IEU-S	XT54	24.04	6 3/4	4 1/4	10	15	0.814	2.027	GP
		IEU-S	XT57	24.72	7	4 1/4	10	15	0.837	2.026	GP
		IEU-S	GPDS55	24.83	7	4	10	12	0.841	2.015	GP
		IEU-S	TurboTorque 550	24.49	6 5/8	4 1/4	10	15	0.820	2.074	GP
		IEU-S	TurboTorque 585	24.72	7	4 1/2	10	15	0.846	2.103	GP
		IEU-S	TurboTorque-M 550	24.49	6 5/8	4 1/4	10	15	0.820	2.074	GP
		IEU-S	TurboTorque-M 585	24.72	7	4 1/2	10	15	0.846	2.103	GP
		IEU-S	WT56	24.30	7	4 3/8	8	15	0.821	2.037	T
		IEU-S	WT56	24.90	7 1/4	4 3/8	8	15	0.842	--	T
		IEU-S	WT54	24.30	7	4 3/8	8	15	0.821	2.037	T
		IEU-S	WT50	24.40	6 3/4	4	8	15	0.825	2.018	T
		IEU-S	WT50	25.00	7	4	8	15	0.845	--	T
		IEU-S	WT46	23.40	5 7/8	3 1/2	8	14	0.791	1.990	T
		IEU-S	NK DSTJ 5-1/2 FH	26.43	7 1/2	3	8	10	0.894	1.970	T
		IEU-S	5 1/2 FH EIS	25.17	7	4	10	12	0.865	2.026	GP
		IEU-S	VX54	25.32	6 3/4	4	12	15	0.870	2.019	GP
		IEU-S	HLIDS5-1/2FH	25.44	7 1/4	3 3/4	9	11	0.876	2.038	H
		IEU-S	HLMT5-1/2FH	25.33	7	4	10	15	0.870	2.049	H
		IEU-S	HLIST54	24.65	6 3/4	4	10	15	0.847	2.050	H
		IEU-S	HLIST57	24.92	7	4 1/4	10	15	0.856	2.063	H
		IEU-S	HLST52	24.09	6 5/8	3 1/2	8	11	0.824	2.020	H
		IEU-S	HLST54	23.76	6 3/4	4 1/8	9	11	0.816	2.050	H
		IEU-S	HLST57	24.16	7	4 1/4	9	11	0.831	2.059	H
		IEU-S	DPM-MT54	24.01	6 5/8	4	10	12	0.826	2.034	DPM
		IEU-S	DPM-ST54	24.38	6 5/8	4	10	15	0.838	2.030	DPM
		IEU-S	DPM-DS55	24.96	7	4	10	12	0.858	2.032	DPM
		IEU-S	CET54	24.25	6 5/8	4	12	15	0.835	2.052	CTP
		EU-V	WT56	24.20	7	4 5/8	8	15	0.818	2.055	T
		EU-V	WT56	24.70	7 1/4	4 5/8	8	15	0.835	--	T
		IEU-V	FH	27.57	7 1/2	3	10	12	0.932	1.956	DS-1
		IEU-V	HT55	25.42	7	4	10	15	0.861	2.010	GP
		IEU-V	XT54	24.63	6 3/4	4	10	15	0.834	2.011	GP
		IEU-V	XT57	24.72	7	4 1/4	10	15	0.837	2.026	GP
		IEU-V	GPDS55	24.83	7	4	10	12	0.841	2.015	GP
		IEU-V	WT56	24.30	7	4 3/8	8	15	0.821	2.037	T
		IEU-V	WT56	24.90	7 1/4	4 3/8	8	15	0.842	--	T
		IEU-V	WT54	24.30	7	4 3/8	8	15	0.821	2.037	T
		IEU-V	WT50	24.40	6 3/4	4	8	15	0.825	2.018	T
		IEU-V	WT50	25.00	7	4	8	15	0.845	--	T
		IEU-V	WT46	23.40	5 7/8	3 1/2	8	14	0.791	1.990	T
		IEU-V	NK DSTJ 5-1/2 FH	27.57	7 1/2	3	10	12	0.932	1.956	T
		IEU-V	HLIDS5-1/2FH	25.44	7 1/4	3 3/4	9	11	0.876	2.038	H
		IEU-V	HLMT5-1/2FH	25.33	7	4	10	15	0.870	2.049	H
		IEU-V	HLIST54	24.65	6 3/4	4	10	15	0.847	2.050	H
		IEU-V	HLIST57	24.92	7	4 1/4	10	15	0.856	2.063	H
		IEU-V	HLST52	24.09	6 5/8	3 1/2	8	11	0.824	2.020	H

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
				(W) Approx Assembly	Tool Joint Dimensions[1]		Tong Space		Disp/ Triple	Capacity/ Triple	
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	Adj. Wt.[2] (lb/ft)	OD (in)	ID (in)	Pin (in)	Box (in)	Stand[2] (Bbl)	Stand[2,3] (Bbl)	Data Source[4]
5 1/2	21.90	IEU-V	HLST54	24.82	7	3 3/4	9	11	0.853	2.036	H
		IEU-V	HLST57	24.16	7	4 1/4	9	11	0.831	2.059	H
5 1/2	24.70	IEU-E	FH	26.35	7	4	8	10	0.891	1.933	DS-1
		IEU-E	HT55	27.85	7	4	10	15	0.943	1.926	GP
		IEU-E	XT54	26.46	6 3/4	4 1/4	10	15	0.896	1.942	GP
		IEU-E	XT57	27.14	7	4 1/4	10	15	0.919	1.942	GP
		IEU-E	NK DSTJ 5-1/2 FH	26.35	7	4	8	10	0.891	1.933	T
		IEU-E	5 1/2 FH EIS	27.59	7	4	10	12	0.948	1.943	GP
		IEU-E	HLIDS5-1/2FH	26.98	7	4	9	11	0.928	1.960	H
		IEU-E	HLST52	26.00	6 5/8	4	8	11	0.890	1.952	H
		IEU-E	HLST54	25.80	6 5/8	4 1/4	9	11	0.885	1.968	H
		IEU-E	HLST57	26.64	7	4 1/4	9	11	0.916	1.971	H
		IEU-X	FH	27.79	7 1/4	3 1/2	8	10	0.940	1.904	DS-1
		IEU-X	HT55	27.85	7	4	10	15	0.943	1.926	GP
		IEU-X	XT54	26.57	6 3/4	4 1/4	10	15	0.900	1.942	GP
		IEU-X	XT57	27.25	7	4 1/4	10	15	0.923	1.942	GP
		IEU-X	NK DSTJ 5-1/2 FH	27.79	7 1/4	3 1/2	8	10	0.940	1.904	T
		IEU-X	5 1/2 FH EIS	27.59	7	4	10	12	0.948	1.943	GP
		IEU-X	HLIDS5-1/2FH	26.98	7	4	9	11	0.928	1.960	H
		IEU-X	HLST52	26.00	6 5/8	4	8	11	0.890	1.952	H
		IEU-X	HLST54	25.80	6 5/8	4 1/4	9	11	0.885	1.968	H
		IEU-X	HLST57	26.64	7	4 1/4	9	11	0.916	1.971	H
		IEU-G	FH	27.79	7 1/4	3 1/2	8	10	0.940	1.904	DS-1
		IEU-G	HT55	27.85	7	4	10	15	0.943	1.926	GP
		IEU-G	XT54	26.57	6 3/4	4 1/4	10	15	0.900	1.942	GP
		IEU-G	XT57	27.25	7	4 1/4	10	15	0.923	1.942	GP
		IEU-G	GPDS55	27.27	7	4	10	12	0.924	1.930	GP
		IEU-G	NK DSTJ 5-1/2 FH	27.79	7 1/4	3 1/2	8	10	0.940	1.904	T
		IEU-G	5 1/2 FH EIS	27.59	7	4	10	12	0.948	1.943	GP
		IEU-G	VX57	26.97	7	4 1/2	12	15	0.940	2.018	GP
		IEU-G	HLIDS5-1/2FH	26.98	7	4	9	11	0.928	1.960	H
		IEU-G	HLMT5-1/2FH	27.78	7	4	10	15	0.954	1.963	H
		IEU-G	HLIST54	26.36	6 5/8	4 1/4	10	15	0.906	1.977	H
		IEU-G	HLIST57	27.37	7	4 1/4	10	15	0.940	1.977	H
		IEU-G	HLST52	26.30	6 5/8	3 3/4	8	11	0.900	1.942	H
		IEU-G	HLST54	26.24	6 3/4	4 1/8	9	11	0.901	1.963	H
		IEU-G	HLST57	26.64	7	4 1/4	9	11	0.916	1.971	H
		IEU-G	CET54	26.78	6 5/8	4	12	15	0.922	1.964	CTP
		EU-S	WT56	26.60	7	4 5/8	8	15	0.899	1.972	T
		EU-S	WT56	27.20	7 1/4	4 5/8	8	15	0.920	--	T
		IEU-S	FH	28.92	7 1/2	3	8	10	0.978	1.885	DS-1
		IEU-S	HT55	27.85	7	4	10	15	0.943	1.926	GP
		IEU-S	XT54	27.17	6 3/4	4	10	15	0.920	1.927	GP
		IEU-S	XT57	27.25	7	4 1/4	10	15	0.923	1.942	GP
		IEU-S	GPDS55	27.27	7	4	10	12	0.924	1.930	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5 1/2	24.70	IEU-S	TurboTorque 585	28.01	7 1/8	4 5/16	10	15	0.960	1.989	GP
		IEU-S	TurboTorque-M 585	28.01	7 1/8	4 5/16	10	15	0.960	1.989	GP
		IEU-S	WT56	26.70	7	4 3/8	8	15	0.903	1.953	T
		IEU-S	WT56	27.30	7 1/4	4 3/8	8	15	0.923	--	T
		IEU-S	WT54	26.70	7	4 3/8	8	15	0.903	1.953	T
		IEU-S	WT50	26.90	6 3/4	4	8	15	0.909	1.934	T
		IEU-S	WT50	27.40	7	4	8	15	0.926	--	T
		IEU-S	WT46	25.80	5 7/8	3 1/2	8	14	0.872	--	T
		IEU-S	NK DSTJ 5-1/2 FH	28.92	7 1/2	3	8	10	0.978	1.885	T
		IEU-S	5 1/2 FH EIS	28.17	7	3 3/4	10	12	0.968	1.923	GP
		IEU-S	VX54	27.71	6 3/4	4	12	15	0.952	1.936	GP
		IEU-S	VX57	27.78	7	4 1/4	12	15	0.955	1.959	GP
		IEU-S	HLIDS5-1/2FH	28.22	7 1/4	3 1/2	9	11	0.972	1.940	H
		IEU-S	HLMT5-1/2FH	27.78	7	4	10	15	0.954	1.963	H
		IEU-S	HLIST54	27.09	6 3/4	4	10	15	0.931	1.963	H
		IEU-S	HLIST57	27.78	7	4	10	15	0.954	1.963	H
		IEU-S	HLST52	26.58	6 5/8	3 1/2	8	11	0.909	1.933	H
		IEU-S	HLST54	26.41	6 3/4	4	9	11	0.907	1.957	H
		IEU-S	HLST57	26.64	7	4 1/4	9	11	0.916	1.971	H
		IEU-S	DPM-MT54	26.47	6 5/8	4	10	12	0.910	1.949	DPM
		IEU-S	DPM-ST54	26.82	6 5/8	4	10	15	0.922	1.946	DPM
		IEU-S	DPM-DS55	27.41	7	4	10	12	0.942	1.948	DPM
		IEU-S	CET54	26.78	6 5/8	4	12	15	0.922	1.964	CTP
		EU-V	WT56	26.60	7	4 5/8	8	15	0.899	1.972	T
		EU-V	WT56	27.20	7 1/4	4 5/8	8	15	0.920	--	T
		IEU-V	FH	30.03	7 1/2	3	10	12	1.015	1.872	DS-1
		IEU-V	HT55	28.42	7	3 3/4	10	15	0.963	1.911	GP
		IEU-V	XT54	27.17	6 3/4	4	10	15	0.920	1.927	GP
		IEU-V	XT57	27.85	7	4	10	15	0.943	1.926	GP
		IEU-V	GPDS55	27.31	7 1/8	4 1/8	10	12	0.925	1.937	GP
		IEU-V	WT56	26.70	7	4 3/8	8	15	0.903	1.953	T
		IEU-V	WT56	27.30	7 1/4	4 3/8	8	15	0.923	--	T
		IEU-V	WT54	26.70	7	4 3/8	8	15	0.903	1.953	T
		IEU-V	WT50	26.90	6 3/4	4	8	15	0.909	1.934	T
		IEU-V	WT50	27.40	7	4	8	15	0.926	--	T
		IEU-V	WT46	25.80	5 7/8	3 1/2	8	14	0.872	--	T
		IEU-V	NK DSTJ 5-1/2 FH	30.03	7 1/2	3	10	12	1.015	1.872	T
		IEU-V	HLIDS5-1/2FH	28.22	7 1/4	3 1/2	9	11	0.972	1.940	H
		IEU-V	HLMT5-1/2FH	27.97	7	3 7/8	10	15	0.961	1.956	H
		IEU-V	HLIST54	27.28	6 3/4	3 7/8	10	15	0.937	1.957	H
		IEU-V	HLIST57	27.78	7	4	10	15	0.954	1.963	H
		IEU-V	HLST52	26.58	6 5/8	3 1/2	8	11	0.909	1.933	H
		IEU-V	HLST54	27.30	7	3 3/4	9	11	0.939	1.949	H
		IEU-V	HLST57	26.64	7	4 1/4	9	11	0.916	1.971	H
5 7/8	23.40	IEU-E	XT57	26.48	7	4 1/4	10	15	0.897	2.336	GP
		IEU-E	HLIDS5-1/2FH	26.11	7	4	10	12	0.897	2.375	H

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5 7/8	23.40	IEU-E	HLST57	25.49	7	4 1/4	9	11	0.875	2.374	H
		IEU-X	XT57	26.48	7	4 1/4	10	15	0.897	2.336	GP
		IEU-X	HLIDS5-1/2FH	26.11	7	4	10	12	0.897	2.375	H
		IEU-X	HLST57	25.49	7	4 1/4	9	11	0.875	2.374	H
		IEU-G	XT57	26.48	7	4 1/4	10	15	0.897	2.336	GP
		IEU-G	5 1/2 FH EIS	26.86	7	4	10	12	0.920	2.340	GP
		IEU-G	HLIDS5-1/2FH	26.11	7	4	10	12	0.897	2.375	H
		IEU-G	HLST57	25.49	7	4 1/4	9	11	0.875	2.374	H
		IEU-G	HLIST57	26.24	7	4 1/4	10	15	0.901	2.381	H
		IEU-G	CET57	26.60	7	4	12	15	0.916	2.369	CTP
		IEU-G	CET57	26.21	7	4 1/4	12	15	0.902	2.383	CTP
		IEU-S	XT57	26.48	7	4 1/4	10	15	0.897	2.336	GP
		IEU-S	TurboTorque 585	26.53	7	4 1/2	10	15	0.911	2.393	GP
		IEU-S	TurboTorque-M 585	26.53	7	4 1/2	10	15	0.911	2.393	GP
		IEU-S	5 1/2 FH EIS	27.42	7	3 3/4	10	12	0.950	2.320	GP
		IEU-S	HLIDS5-1/2FH	26.11	7	4	10	12	0.897	2.375	H
		IEU-S	HLST57	25.49	7	4 1/4	9	11	0.875	2.374	H
		IEU-S	HLIST57	26.24	7	4 1/4	10	15	0.901	2.381	H
		IEU-S	DPM-ST57	26.42	7	4 1/4	10	15	0.908	2.355	DPM
		IEU-S	DPM-MT57	26.56	7	4	10	12	0.913	2.341	DPM
		IEU-S	CET57	26.60	7	4	12	15	0.916	2.369	CTP
		IEU-S	CET57	26.21	7	4 1/4	12	15	0.902	2.383	CTP
		IU-S	WT54	25.90	7	4 3/8	8	15	0.876	2.353	T
		IU-S	WT56	25.50	7	4 5/8	8	15	0.862	2.362	T
		IEU-V	XT57	26.48	7	4 1/4	10	15	0.897	2.336	GP
		IEU-150	HLIDS5-1/2FH	27.10	7 1/4	3 3/4	10	12	0.931	2.362	H
		IEU-V	HLST57	25.82	7	4	9	11	0.886	2.363	H
		IEU-150	HLIST57	26.24	7	4 1/4	10	15	0.901	2.381	H
5 7/8	26.30	IEU-E	XT57	29.12	7	4 1/4	10	15	0.986	2.245	GP
		IEU-E	HLIDS5-1/2FH	28.78	7	4	10	12	0.989	2.281	H
		IEU-E	HLST57	28.17	7	4 1/4	9	11	0.966	2.280	H
		IEU-X	XT57	29.12	7	4 1/4	10	15	0.986	2.245	GP
		IEU-X	HLIDS5-1/2FH	28.78	7	4	10	12	0.989	2.281	H
		IEU-X	HLST57	28.17	7	4 1/4	9	11	0.966	2.280	H
		IEU-G	XT57	29.12	7	4 1/4	10	15	0.986	2.245	GP
		IEU-G	HLIDS5-1/2FH	28.78	7	4	10	12	0.989	2.281	H
		IEU-G	HLST57	28.17	7	4 1/4	9	11	0.966	2.280	H
		IEU-G	HLIST57	28.89	7	4 1/4	10	15	0.992	2.288	H
		IEU-G	CET57	29.33	7	4	12	15	1.010	2.275	CTP
		IEU-G	CET57	28.93	7	4 1/4	12	15	0.997	2.288	CTP
		IEU-S	XT57	29.12	7	4 1/4	10	15	0.986	2.245	GP
		IEU-S	TurboTorque 585	29.26	7	4 1/2	10	15	1.003	2.301	GP
		IEU-S	TurboTorque-M 585	29.26	7	4 1/2	10	15	1.003	2.301	GP
		IEU-S	HLIDS5-1/2FH	29.76	7 1/4	3 3/4	10	12	1.022	2.268	H
		IEU-S	HLST57	28.50	7	4	9	11	0.978	2.268	H
		IEU-S	HLIST57	29.28	7	4	10	15	1.006	2.274	H

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
5 7/8	26.30	IEU-S	DPM-ST57	29.05	7	4 1/4	10	15	0.999	2.265	DPM
		IEU-S	DPM-MT57	29.21	7	4	10	12	1.004	2.250	DPM
		IEU-S	CET57	29.33	7	4	12	15	1.010	2.275	CTP
		IEU-S	CET57	28.93	7	4 1/4	12	15	0.997	2.288	CTP
		IEU-V	XT57	29.12	7	4 1/4	10	15	0.986	2.245	GP
		IEU-V	HLIDS5-1/2FH	29.93	7 1/4	3 5/8	10	12	1.028	2.262	H
		IEU-V	HLST57	28.50	7	4	9	11	0.978	2.268	H
		IEU-V	HLIST57	29.28	7	4	10	15	1.006	2.274	H
5 7/8	26.70	IEU-G	5 1/2 FH EIS	29.47	7	4	10	12	1.010	2.250	GP
		IEU-S	5 1/2 FH EIS	29.80	7 1/8	3 3/4	10	12	1.040	2.250	GP
5 7/8	27.00	IU-S	WT54	28.60	7	4 3/8	8	15	0.967	2.260	T
		IU-S	WT56	28.10	7	4 5/8	8	15	0.950	2.269	T
6 5/8	25.20	IEU-E	FH	27.60	8	5	8	11	0.933	3.144	DS-1
		IEU-E	HT65	29.38	8	5	10	16	0.995	3.133	GP
		IEU-E	XT65	29.18	8	5	10	15	0.989	3.135	GP
		IEU-E	NK DSTJ 6-5/8 FH	27.60	8	5	8	11	0.933	3.144	T
		IEU-E	6 5/8 FH EIS	29.25	8	5	10	13	1.005	3.157	GP
		IEU-E	HLIDS6-5/8FH	28.06	8	5	9	12	0.949	3.153	H
		IEU-X	FH	27.60	8	5	8	11	0.933	3.140	DS-1
		IEU-X	HT65	29.38	8	5	10	16	0.995	3.133	GP
		IEU-X	XT65	29.18	8	5	10	15	0.989	3.135	GP
		IEU-X	NK DSTJ 6-5/8 FH	27.60	8	5	8	11	0.933	3.140	T
		IEU-X	6 5/8 FH EIS	29.25	8	5	10	13	1.005	3.157	GP
		IEU-X	HLIDS6-5/8FH	28.06	8	5	9	12	0.949	3.153	H
		IEU-G	FH	28.67	8 1/4	4 3/4	8	11	0.969	3.125	DS-1
		IEU-G	HT65	29.38	8	5	10	16	0.995	3.133	GP
		IEU-G	XT65	29.18	8	5	10	15	0.989	3.135	GP
		IEU-G	NK DSTJ 6-5/8 FH	28.67	8 1/4	4 3/4	8	11	0.969	3.125	T
		IEU-G	6 5/8 FH EIS	29.25	8	5	10	13	1.005	3.157	GP
		IEU-G	VX65	28.76	8	5 1/2	12	17	0.990	3.195	GP
		IEU-G	HLIDS6-5/8FH	28.06	8	5	9	12	0.949	3.153	H
		IEU-G	CET65	29.65	8	4 3/4	12	15	1.021	3.168	CTP
		IEU-G	CET65	29.19	8	5	12	15	1.003	3.184	CTP
		IEU-G	CET69	30.10	8 1/2	5 1/2	12	15	1.035	3.220	CTP
		IEU-S	FH	30.12	8 1/2	4 1/4	8	11	1.018	3.097	DS-1
		IEU-S	HT65	29.38	8	5	10	16	0.995	3.133	GP
		IEU-S	XT65	29.18	8	5	10	15	0.989	3.135	GP
		IEU-S	GPDS65	29.13	8	4 7/8	10	13	0.987	3.131	GP
		IEU-S	WT66	28.30	8	5 3/8	10	16	0.957	3.162	T
		IEU-S	WT56	27.00	7	4 5/8	8	15	0.913	3.116	T
		IEU-S	NK DSTJ 6-5/8 FH	30.12	8 1/2	4 1/4	8	11	1.018	3.097	T
		IEU-S	6 5/8 FH EIS	29.25	8	5	10	13	1.005	3.157	GP

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
6 5/8	25.20	IEU-S	VX65	28.76	8	5 1/2	12	17	0.990	3.195	GP
		IEU-S	HLIDS6-5/8FH	28.27	8	4 7/8	9	12	0.956	3.146	H
		IEU-S	DPM-DS65	30.00	8 1/4	4 7/8	10	13	1.032	3.154	DPM
		IEU-S	CET65	29.65	8	4 3/4	12	15	1.021	3.168	CTP
		IEU-S	CET65	29.19	8	5	12	15	1.003	3.184	CTP
		IEU-S	CET69	31.10	8 1/2	5	12	15	1.071	3.184	CTP
		IEU-S	CET69	30.10	8 1/2	5 1/2	12	15	1.035	3.220	CTP
		IEU-V	FH	31.43	8 1/2	4 1/4	10	13	1.063	3.080	DS-1
		IEU-V	HT65	29.38	8	5	10	16	0.995	3.133	GP
		IEU-V	XT65	29.18	8	5	10	15	0.989	3.135	GP
		IEU-V	GPDS65	29.91	8 1/4	4 7/8	10	13	1.013	3.130	GP
		IEU-V	WT66	28.30	8	5 3/8	10	16	0.957	3.162	T
		IEU-V	WT56	27.00	7	4 5/8	8	15	0.913	3.116	T
		IEU-V	NK DSTJ 6-5/8 FH	31.43	8 1/2	4 1/4	10	13	1.063	3.080	T
		IEU-V	HLIDS6-5/8FH	30.74	8 1/2	4 1/4	9	12	1.062	3.159	H
6 5/8	27.70	IEU-E	FH	29.45	8	5	8	11	0.996	3.080	DS-1
		IEU-E	HT65	31.19	8	5	10	16	1.056	3.070	GP
		IEU-E	XT65	31.00	8	5	10	15	1.050	3.072	GP
		IEU-E	NK DSTJ 6-5/8 FH	29.45	8	5	8	11	0.996	3.080	T
		IEU-E	6 5/8 FH EIS	31.05	8	5	10	13	1.067	3.095	GP
		IEU-E	HLIDS6-5/8FH	29.90	8	5	9	12	1.011	3.089	H
		IEU-X	FH	30.52	8 1/4	4 3/4	8	11	1.032	3.062	DS-1
		IEU-X	HT65	31.19	8	5	10	16	1.056	3.070	GP
		IEU-X	XT65	31.00	8	5	10	15	1.050	3.072	GP
		IEU-X	NK DSTJ 6-5/8 FH	30.52	8 1/4	4 3/4	8	11	1.032	3.062	T
		IEU-X	6 5/8 FH EIS	31.05	8	5	10	13	1.067	3.095	GP
		IEU-X	HLIDS6-5/8FH	29.90	8	5	9	12	1.011	3.089	H
		IEU-G	FH	30.52	8 1/4	4 3/4	8	11	1.032	3.062	DS-1
		IEU-G	HT65	31.19	8	5	10	16	1.056	3.070	GP
		IEU-G	XT65	31.00	8	5	10	15	1.050	3.072	GP
		IEU-G	NK DSTJ 6-5/8 FH	30.52	8 1/4	4 3/4	8	11	1.032	3.062	T
		IEU-G	6 5/8 FH EIS	31.05	8	5	10	13	1.067	3.095	GP
		IEU-G	VX65	34.12	8	5 1/2	12	17	0.990	3.195	GP
		IEU-G	HLIDS6-5/8FH	29.90	8	5	9	12	1.011	3.089	H
		IEU-G	CET65	31.18	8	4 3/4	12	15	1.073	3.116	CTP
		IEU-G	CET65	30.71	8	5	12	15	1.057	3.132	CTP
		IEU-G	CET69	31.62	8 1/2	5 1/2	12	15	1.089	3.166	CTP
		IEU-S	FH	31.97	8 1/2	4 1/4	8	11	1.081	3.034	DS-1
		IEU-S	HT65	31.19	8	5	10	16	1.056	3.070	GP
		IEU-S	XT65	31.00	8	5	10	15	1.050	3.072	GP
		IEU-S	GPDS65	30.96	8	4 7/8	10	13	1.049	3.068	GP
		IEU-S	TurboTorque 690	30.94	8 1/4	5 1/2	10	15	1.051	3.200	GP
		IEU-S	TurboTorque-M 690	30.94	8 1/4	5 1/2	10	15	1.074	3.177	GP
		IEU-S	TurboTorque-M 710	31.25	8 1/2	5 5/8	10	15	1.097	3.177	GP
		IEU-S	WT66	30.10	8	5 3/8	10	16	1.018	3.097	T
		IEU-S	WT56	28.80	7	4 5/8	8	15	0.974	3.050	T

Table 3.19.1 New Normal Weight Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Caution: See notes at the end of this table.)

1	2	3	4	5	6	7	8	9	10	11	12
Size (in)	Nominal Weight (lb/ft)	Upset/ Grade	Conn Type	(W) Approx Assembly Adj. Wt.[2] (lb/ft)	Tool Joint Dimensions[1] OD (in)	ID (in)	Tong Space Pin (in)	Box (in)	Disp/ Triple Stand[2] (Bbl)	Capacity/ Triple Stand[2,3] (Bbl)	Data Source[4]
6 5/8	27.70	IEU-S	NK DSTJ 6-5/8 FH	31.97	8 1/2	4 1/4	8	11	1.081	3.034	T
		IEU-S	6 5/8 FH EIS	31.78	8	4 3/4	10	13	1.092	3.070	GP
		IEU-S	VX65	32.12	8 1/4	5 1/4	12	17	1.127	3.174	GP
		IEU-S	HLIDS6-5/8FH	31.25	8 1/4	4 5/8	9	12	1.057	3.067	H
		IEU-S	DPM-DS65	31.82	8 1/4	4 7/8	10	13	1.094	3.091	DPM
		IEU-S	CET65	31.18	8	4 3/4	12	15	1.073	3.116	CTP
		IEU-S	CET65	30.71	8	5	12	15	1.057	3.132	CTP
		IEU-S	CET69	32.62	8 1/2	5	12	15	1.123	3.132	CTP
		IEU-S	CET69	31.62	8 1/2	5 1/2	12	15	1.089	3.166	CTP
		IEU-V	FH	33.26	8 1/2	4 1/4	10	13	1.124	3.018	DS-1
		IEU-V	HT65	31.19	8	5	10	16	1.056	3.070	GP
		IEU-V	XT65	31.00	8	5	10	15	1.050	3.072	GP
		IEU-V	GPDS65	31.74	8 1/4	4 7/8	10	13	1.075	3.066	GP
		IEU-V	WT66	30.10	8	5 3/8	10	16	1.018	3.097	T
		IEU-V	WT56	28.80	7	4 5/8	8	15	0.974	3.050	T
		IEU-V	NK DSTJ 6-5/8 FH	33.26	8 1/2	4 1/4	10	13	1.124	3.018	T
		IEU-V	HLIDS6-5/8FH	32.58	8 1/2	4 1/4	9	12	1.126	3.094	H

Note 1: Tool joint diameters in this table refer to those listed in API documents or manufacturer's literature, or those in common use. These dimensions should be used only to estimate actual weight per foot. Tool joints are often ordered in other dimensions, and wear changes tool joint OD. Therefore, tool joint torsional strength and makeup torque must be based on measured tool joint diameters.

Note 2: Adjusted weights, displacements, and capacities for the same components may differ due to differences in upset geometry dimensions.

Note 3: "--" Capacity data was not available. Please check with your pipe manufacturer for capacity information.

Note 4: Data source refers to how the adjusted weight, displacement, and capacity data was obtained.
Where:
"RP7G" signifies that the data was obtained from API RP7G.
"GP" signifies that the data was obtained from NOV Grant Prideco.
"T" signifies that the data was obtained from Tenaris.
"H" signifies that the data was obtained from Hilong.
"DPM" signifies that the data was obtained from DP-Master.
"CTP" signifies that the data was obtained from Command Tubular Products.
"DS-1" signifies that the data was calculated by T H Hill Associates based on the dimensions provided in API Spec 5DP. For V grade pipe (not originally covered by API) the same tool joint diameters and upset dimensions as S grade pipe were used.

Note 5: Please refer to XT and GPDS for uXT and uGPDS data.

Table 3.19.2 New Thick-Walled Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Note: The user should independently verify the numbers below before employing them in design calculations.)

A) Grant Prideco Thick-Walled Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12
						Tool Joint Dimensions		Tong Space			
Size (in)	Nominal Wall (in)	Upset	Grade	Conn. Type	(W) Approx. Assembly Adj. Wt. (lb/ft)	OD (in)	ID (in)	Pin (in)	Box (in)	Disp/ Triple Stand (Bbl)	Capacity/ Triple Stand (Bbl)
5	0.713	IEU	G, S, Z	NC50	37.67	6 7/8	2 3/4	9	12	1.28	1.12
	0.750	IEU	G	NC50	38.34	6 5/8	2 3/4	9	12	1.30	1.08
		IEU	G	NC50	38.04	6 5/8	3	9	12	1.29	1.09
		IEU	G, S	DS50	38.37	6 1/2	2 3/4	9	12	1.33	1.08
5 1/2	0.500	IEU	E, X, G, S, Z	5 1/2 FH	32.77	7 1/4	3 1/2	10	12	1.11	1.78
	0.750	IEU	E, X, G, S, Z	5 1/2 FH	44.22	7 1/2	3	10	12	1.50	1.40
		IEU	E, X, G, S, Z	5 1/2 FH	43.25	7 1/4	3 1/4	10	12	1.47	1.41
		IEU	G	HT 55	43.45	7 1/4	3 1/2	10	15	1.47	1.42
		IEU	G	HT 55	43.08	7 1/4	3 3/4	10	15	1.46	1.43
		IEU	E, X, G, S, Z	HT 55	43.43	7 1/8	3 1/4	10	15	1.47	1.41
		IEU	S, Z	HT 55	43.15	7	3 1/4	10	15	1.46	1.41
		IEU	S, Z	XT 57	44.16	7 3/8	3 1/4	10	15	1.50	1.41
		IEU	S, Z	XT 57	43.50	7 1/8	3 1/4	10	15	1.45	1.41
	0.813	IEU	S	XT 57	46.20	7 1/4	3 1/5	10	15	1.57	1.32
5 7/8	0.625	IEU	E, X, G, S	XT 57	39.26	7	4	10	15	1.33	1.90
		IEU	E, X, G, S, Z, V	XT 57	39.63	7	3 3/4	10	15	1.34	1.88
	0.750	IEU	E, X, G, S, Z	XT 57	46.05	7 1/4	3 1/2	10	15	1.56	1.68
		IEU	G	XT 57	45.34	7	3 1/2	10	15	1.54	1.69
		IEU	G	XT 57	45.66	7	3 1/4	10	15	1.55	1.67
	0.813	IEU	E, X, G, S	XT 57	48.61	7 1/4	3 1/2	10	15	1.65	1.59
		IEU	G, S, Z	XT 57	48.94	7 1/4	3 1/4	10	15	1.66	1.58
		IEU	G, S, Z, V	XT 57	50.00	7 1/2	3	10	15	1.69	1.57
6 5/8	0.500	IEU	S, Z	6 5/8 FH	40.29	8 1/4	4 3/4	10	13	1.36	2.80
		IEU	E, X, G, S, Z	6 5/8 FH	38.89	8	4 3/4	10	13	1.32	2.80
	0.522	IEU	E, X, G, S, Z	6 5/8 FH	42.49	8 1/2	4 1/4	10	13	1.44	2.73
		IEU	S, Z	6 5/8 FH	42.66	8 1/4	4	10	13	1.45	2.72
		IEU	E, X, G, S, Z	6 5/8 FH	40.84	8 1/4	4 3/4	10	13	1.38	2.76
	0.625	IEU	E, X, G, S, Z, V	6 5/8 FH	47.06	8 1/4	4 1/4	10	13	1.59	2.54
	0.688	IEU	S, Z	6 5/8 FH	51.15	8 1/2	4 7/16	10	13	1.73	2.44
	0.750	IEU	E, X, G, S, Z	6 5/8 FH	54.12	8 1/2	4 1/4	10	13	1.83	2.32
	0.813	IEU	E, X, G, S, Z, V	6 5/8 FH	58.23	8 1/2	3 1/2	10	13	1.97	2.18
		IEU	E, X, G, S, Z	6 5/8 FH	57.53	8 1/2	4	10	13	1.95	2.20
	0.938	IEU	E, X, G, S, Z, V	6 5/8 FH	66.00	8 3/4	3 1/2	10	13	2.30	1.98

Table 3.19.2 New Thick-Walled Drill Pipe Connections, Tool Joint Dimensions, Approximate Adjusted Weights, Displacements, and Capacities

(Note: The user should independently verify the numbers below before employing them in design calculations.)

B) DP-Master Thick-Walled Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12
						Tool Joint Dimensions		Tong Space			
Size (in)	Nominal Wall (in)	Upset	Grade	Conn. Type	(W) Approx. Assembly Adj. Wt. (lb/ft)	OD (in)	ID (in)	Pin (in)	Box (in)	Disp/ Triple Stand (Bbl)	Capacity/ Triple Stand (Bbl)
5	0.750	IEU	S,DPM-140,DPM-150	NC50	42.45	6 5/8	2 3/4	9	12	1.459	1.395
5 1/2	0.500	IEU	S,DPM-140,DPM-150	5 1/2 FH	34.34	7 1/2	3	10	12	1.181	1.753
	0.750	IEU	S,DPM-140,DPM-150	5 1/2 FH	44.52	7 1/2	3	10	12	1.531	1.403
	0.813	IEU	S,DPM-140,DPM-150	5 1/2 FH	46.90	7 1/2	3	10	12	1.612	1.321
5 7/8	0.500	IEU	S,DPM-140,DPM-150	ST57	34.39	7.25	4	10	15	1.182	2.105
	0.625	IEU	S,DPM-140,DPM-150	ST57	40.05	7.25	4	10	15	1.377	1.911
	0.750	IEU	S,DPM-140,DPM-150	ST57	45.41	7.25	4	10	15	1.561	1.726
	0.813	IEU	S,DPM-140,DPM-150	ST57	48.00	7.25	4	10	15	1.650	1.637
6 5/8	0.500	IEU	S,DPM-140,DPM-150	6 5/8 FH	41.72	8.5	4.25	10	13	1.435	2.775
	0.522	IEU	S,DPM-140,DPM-150	6 5/8 FH	42.90	8.5	4.25	10	13	1.475	2.735
	0.625	IEU	S,DPM-140,DPM-150	6 5/8 FH	48.30	8.5	4.25	10	13	1.661	2.549
	0.750	IEU	S,DPM-140,DPM-150	6 5/8 FH	54.58	8.5	4.25	10	13	1.877	2.333
	0.813	IEU	S,DPM-140,DPM-150	6 5/8 FH	57.64	8.5	4.25	10	13	1.982	2.228

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

A) DS-1® Standard Heavy Weight Drill Pipe [5]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight [4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	(Z)[2] Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
2 7/8	17.26	1 1/2	0.6875	1	3 5/16	24	NC26	1 1/2	3 3/8	21/21	4.725	2.160	110,000	110,000
2 7/8	17.40	1 3/4	0.563	1	3 1/4	24	NC31	1 3/4	4 1/8	21/21	4.087	2.013	55,000	110,000
3 1/2	23.70	2 1/4	0.625	1	4	24	NC38	2 1/4	4 3/4	21/21	5.645	3.490	55,000	110,000
3 1/2	23.90	2 1/16	0.719	1	4	24	NC38	2 1/16	4 3/4	21/21	6.280	3.702	55,000	110,000
4	36.00	2 1/2	0.750	1	4 1/2	24	NC40	2 1/2	5 1/4	21/21	7.658	5.324	55,000	110,000
4	29.90	2 9/16	0.719	1	4 1/2	24	NC40	2 9/16	5 1/4	21/21	7.409	5.225	55,000	110,000
4 1/2	42.20	2 11/16	0.906	1	5	24	NC46	2 11/16	6 1/4	21/21	10.232	7.808	55,000	110,000
4 1/2	41.45	2 3/4	0.875	1	5	24	NC46	2 3/4	6 1/4	21/21	9.965	7.698	55,000	110,000
4 1/2	40.80	2 13/16	0.844	1	5	24	NC46	2 13/16	6 1/4	21/21	9.692	7.581	55,000	110,000
5	50.38	3	1.000	1	5 1/2	24	NC50	3	6 5/8	21/21	12.566	10.681	55,000	110,000
5 1/2	60.13	3 1/4	1.125	1	6	24	5 1/2 FH	3 1/4	7	21/21	15.463	14.342	55,000	100,000
5 1/2	52.89	3 3/8	1.063	1	6	24	5 1/2 FH	3 3/8	7	21/21	14.812	14.018	55,000	100,000
5 1/2	48.89	3 7/8	0.813	1	6	24	5 1/2 FH	3 7/8	7	21/21	11.965	12.309	55,000	100,000
5 1/2	41.00	4	0.750	1	6	24	5 1/2 FH	4	7	21/21	11.192	11.764	55,000	100,000
5 1/2	--	3 1/4	1.125	1	6	24	5 1/2 FH	3 1/4	7 1/2	21/21	15.463	14.342	55,000	100,000
5 1/2	--	3 3/8	1.063	1	6	24	5 1/2 FH	3 3/8	7 1/2	21/21	14.812	14.018	55,000	100,000
5 1/2	--	3 7/8	0.813	1	6	24	5 1/2 FH	3 7/8	7 1/2	21/21	11.965	12.309	55,000	100,000
5 1/2	--	4	0.750	1	6	24	5 1/2 FH	4	7 1/2	21/21	11.192	11.764	55,000	100,000
5 7/8	57.42	4	0.938	1	6 3/8	24	---------------- Not specified ----------------				14.542	15.630	55,000	100,000
6 5/8	83.40	4	1.313	1	7 1/8	24	6 5/8 FH	4	8	21/21	21.905	24.753	55,000	100,000
6 5/8	71.43	4 1/2	1.063	1	7 1/8	24	6 5/8 FH	4 1/2	8	21	18.567	22.470	55,000	100,000
6 5/8	58.87	5	0.813	1	7 1/8	24	6 5/8 FH	5	8	21	14.837	19.285	55,000	100,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

B) Grant Prideco Standard Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	$(Z)^2$ Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
3 1/2	25.65	2 1/16	0.719	1	4	26	NC 38	2 1/16	4 3/4	24/24	6.280	3.702	55,000	120,000
3 1/2	23.48	2 1/4	0.625	1	4	26	NC 38	2 1/4	4 3/4	24/24	5.645	3.490	55,000	120,000
4	29.92	2 9/16	0.719	1	4 1/2	26	NC 40	2 9/16	5 1/4	24/24	7.409	5.225	55,000	120,000
4	28.40	2 9/16	0.719	1	4 1/2	26	XT 39	2 9/16	5	24/24	7.409	5.225	55,000	120,000
4	28.40	2 9/16	0.719	1	4 1/2	26	TT 390	2 9/16	4 7/8	24/24	7.409	5.225	55,000	130,000
4 1/2	41.45	2 3/4	0.875	1	5	26	NC 46	2 3/4	6 1/4	24/24	9.965	7.698	55,000	120,000
5	50.38	3	1.000	1	5 1/2	26	NC 50	3	6 5/8	24/24	12.566	10.681	55,000	120,000
5	50.38	3	1.000	1	5 1/2	26	HT 50	3	6 5/8	24/24	12.566	10.681	55,000	120,000
5 1/2	61.63	3 1/4	1.125	1	6	26	5 1/2 FH	3 1/4	7 1/4	24/24	15.463	14.342	55,000	120,000
5 1/2	61.63	3 1/4	1.125	1	6	26	HT 55	3 1/4	7 1/4	24/24	15.463	14.342	55,000	120,000
5 7/8	57.42	4	0.938	1	6 3/8	26	XT 57	4	7	24/24	14.542	15.630	55,000	120,000
5 7/8	57.42	4	0.938	1	6 3/8	26	TT 585	4	7 1/4	24/24	14.542	15.630	55,000	130,000
6 5/8	71.43	4 1/2	1.063	1	7 1/8	26	6 5/8 FH	4 1/2	8	24/24	18.567	22.470	55,000	120,000

C) Grant Prideco Spiral-Wate™ Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	$(Z)^2$ Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
3 3/16	19.48	2	0.594	1	3 5/16	261	2 7/8 SLH90	2	3 7/8	24/24	4.838	2.687	110,000	110,000
3 3/16	19.48	2	0.594	1	3 5/16	261	XT 31	2	4 1/8	24/24	4.838	2.687	110,000	110,000
3 1/2	30.39	2 1/4	0.625	1	4	261	NC 38	2 1/4	4 7/8	24/24	5.645	3.490	55,000	120,000
4	28.90	2 9/16	0.719	1	4 1/2	261	NC 40	2 9/16	5 1/4	24/24	7.409	5.225	55,000	120,000
4	28.90	2 9/16	0.719	1	4 1/2	261	XT 39	2 9/16	5	24/24	7.409	5.225	55,000	120,000
4	28.90	2 9/16	0.719	1	4 1/2	261	TT 390	2 9/16	4 7/8	24/24	7.409	5.225	55,000	130,000
4 1/2	49.53	2 3/4	0.875	1	5	261	NC 46	2 3/4	6 1/4	24/24	9.965	7.698	55,000	120,000
5	59.16	3	1.000	1	5 1/2	261	NC50	3	6 5/8	24/24	12.566	10.681	55,000	120,000
5	59.16	3	1.000	1	5 1/2	261	HT 50	3	6 5/8	24/24	12.566	10.681	55,000	120,000
5 1/2	70.45	3.25	1.125	1	6	261	5 1/2 FH	3 1/4	7 1/4	24/24	15.463	14.342	55,000	120,000
5 1/2	70.45	3.25	1.125	1	6	261	HT 55	3 1/4	7 1/4	24/24	15.463	14.342	55,000	120,000
5 7/8	65.38	4	0.938	1	6 3/8	261	XT 57	4	7	24/24	14.542	15.630	55,000	120,000
5 7/8	65.38	4	0.938	1	6 3/8	261	TT 585	4	7 1/4	24/24	14.542	15.630	55,000	130,000
6 5/8	82.12	4.5	1.063	1	7 1/8	261	6 5/8 FH	4 1/2	8	24/24	18.567	22.470	55,000	120,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

D) Grant Prideco Tri-Spiral™ Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	Number	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	(Z)[2] Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
3 1/2	27.05	2 1/16	0.719	3	4	26	NC 38	2 1/16	4 3/4	24/24	6.280	3.702	55,000	120,000
3 1/2	24.88	2 1/4	0.625	3	4	26	NC 38	2 1/4	4 3/4	24/24	5.645	3.490	55,000	120,000
4	31.51	2 9/16	0.719	3	4 1/2	26	NC 40	2 9/16	5 1/4	24/24	7.409	5.225	55,000	120,000
4	29.99	2 9/16	0.719	3	4 1/2	26	XT 39	2 9/16	5	24/24	7.409	5.225	55,000	120,000
4	29.99	2 9/16	0.719	3	4 1/2	26	TT 390	2 9/16	4 7/8	24/24	7.409	5.225	55,000	130,000
4 1/2	43.31	2 3/4	0.875	3	5	26	NC 46	2 3/4	6 1/4	24/24	9.965	7.698	55,000	120,000
5	52.34	3	1.000	3	5 1/2	26	NC 50	3	6 5/8	24/24	12.566	10.681	55,000	120,000
5	52.34	3	1.000	3	5 1/2	26	HT 50	3	6 5/8	24/24	12.566	10.681	55,000	120,000
5 1/2	63.78	3 1/4	1.125	3	6	26	5 1/2 FH	3 1/4	7 1/4	24/24	15.463	14.342	55,000	120,000
5 1/2	63.78	3 1/4	1.125	3	6	26	HT 55	3 1/4	7 1/4	24/24	15.463	14.342	55,000	120,000
5 7/8	57.42	4	0.938	3	6 3/8	26	XT 57	4	7	24/24	14.542	15.630	55,000	120,000
5 7/8	57.42	4	0.938	3	6 3/8	26	TT 585	4	7 1/4	24/24	14.542	15.630	55,000	130,000
6 5/8	74.67	4 1/2	1.063	3	7 1/8	26	6 5/8 FH	4 1/2	8	24/24	18.567	22.470	55,000	120,000

E) Smith Services Standard Hevi-Wate® Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	Number	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	(Z)[2] Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
3 1/2	23.40	2 1/4	0.625	1	4	24	NC38	2 3/8	4 3/4	30/27	5.645	3.490	55,000	110,000
4	29.90	2 9/16	0.719	1	4 1/2	24	NC40	2 11/16	5 1/4	30/27	7.409	5.225	55,000	110,000
4 1/2	41.10	2 3/4	0.875	1	5	24	NC46	2 7/8	6 1/4	30/27	9.965	7.698	55,000	110,000
5	50.10	3	1.000	1	5 1/2	24	NC50	3 1/16	6 5/8	30/27	12.566	10.681	55,000	110,000
5 1/2	57.60	3 3/8	1.063	1	6	24	5 1/2 FH	3 1/2	7	30/27	14.812	14.018	55,000	100,000
6 5/8	71.30	4 1/2	1.063	1	7 1/8	24	6 5/8 FH	4 5/8	8	30/27	18.567	22.470	55,000	100,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

F) Smith Services Spiraled Hevi-Wate® Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Number	OD	Length	Connection Type	ID	OD	Length (P/B)[1]	Section Area Pipe Body	$(Z)^2$ Section Modulus	Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
3 1/2	27.50	2 1/4	0.625	1	4	222	NC38	2 3/8	4 3/4	30/27	5.645	3.490	55,000	110,000
4	34.30	2 9/16	0.719	1	4 1/2	222	NC40	2 11/16	5 1/4	30/27	7.409	5.225	55,000	110,000
4 1/2	46.50	2 3/4	0.875	1	5	222	NC46	2 7/8	6 1/4	30/27	9.965	7.698	55,000	110,000
5	55.40	3	1.000	1	5 1/2	222	NC50	3 1/16	6 5/8	30/27	12.566	10.681	55,000	110,000
5 1/2	63.80	3 3/8	1.063	1	6	222	5 1/2 FH	3 1/2	7	30/27	14.812	14.018	55,000	100,000
6 5/8	77.70	4 1/2	1.063	1	7 1/8	222	6 5/8 FH	4 5/8	8	30/27	18.567	22.470	55,000	100,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

G) Weatherford (Pearland Manufacturing) Non-Spiraled Heavy Weight Drill Pipe[3]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	(Z)[2] Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
3 1/2	24.40	2 1/4	0.625	1	4	24	NC38	2 5/16	4 7/8	27/24	5.645	3.490	55,000	110,000
4	30.30	2 9/16	0.719	1	4 1/2	24	NC40	2 11/16	5 1/4	27/24	7.409	5.225	55,000	110,000
4 1/2	44.60	2 3/4	0.875	1	5	24	NC46	2 7/8	6 1/4	27/24	9.965	7.698	55,000	110,000
5	50.60	3	1.000	1	5 1/2	24	NC50	3 1/16	6 1/2	27/24	12.566	10.681	55,000	110,000
5 1/2	47.50	4	0.750	1	6	24	5 1/2 FH	4	7 1/4	27/24	11.192	11.764	100,000	100,000

H) Weatherford (Pearland Manufacturing) Spiraled Heavy Weight Drill Pipe[3]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	(Z)[2] Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
2 9/16	10.50	1.975	0.294	1	2 7/8	261	2 3/8 SLH90	1.975	3 1/8	28/25	2.094	1.069	110,000	120,000
3 3/16	15.10	2 1/8	0.531	1	3 5/16	261	2 7/8 SLH90	2 1/8	3 3/4	28/25	4.433	2.551	110,000	120,000
3 1/2	26.80	2 1/4	0.625	1	4	261	NC38	2 5/16	4 7/8	28/25	5.645	3.490	55,000	115,000
4	33.30	2 9/16	0.719	1	4 1/2	261	NC40	2 11/16	5 1/4	28/25	7.409	5.225	55,000	115,000
4 1/2	44.30	2 3/4	0.875	1	5	261	NC46	2 7/8	6 1/4	28/25	9.965	7.698	55,000	115,000
5	53.80	3	1.000	1	5 1/2	261	NC50	3 1/8	6 5/8	28/25	12.566	10.681	55,000	110,000
5 1/2	59.80	4	0.750	1	6	261	5 1/2 FH	4	7 1/4	28/25	11.192	11.764	100,000	110,000
5 1/2	58.40	3 1/2	1.000	1	6	261	5 1/2 FH	3 1/2	7	28/25	14.137	13.655	100,000	110,000
6 5/8	62.80	5	0.813	1	7 1/8	261	6 5/8 FH	5	8	28/25	14.837	19.285	100,000	110,000
6 5/8	75.50	4 1/2	1.063	1	7 1/8	261	6 5/8 FH	4 1/2	8	28/25	18.567	22.470	100,000	110,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

I) Grant Prideco Standard Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	Number	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	(Z)[2] Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
2 7/8	17.40	1 3/4	0.563	1	3 1/4	25	NC31	1 3/4	4 1/8	28/22	4.087	2.013	65,000	120,000
3 1/2	25.00	2 1/16	0.719	1	4	25	NC38	2 1/16	4 3/4	28/22	6.280	3.702	65,000	120,000
3 1/2	23.70	2 1/4	0.625	1	4	25	NC38	2 1/4	4 3/4	28/22	5.645	3.490	55,000	110,000
3 1/2	23.40	2 1/4	0.625	1	4	25	NC38	2 1/4	4 3/4	28/22	5.645	3.490	65,000	120,000
4	30.40	2 1/2	0.750	1	4 1/2	25	NC40	2 1/2	5 1/4	28/22	7.658	5.324	65,000	120,000
4	29.90	2 9/16	0.719	1	4 1/2	25	NC40	2 9/16	5 1/4	28/22	7.409	5.225	55,000	110,000
4 1/2	39.80	2 13/16	0.844	1	5	25	NC46	2 13/16	6 1/4	28/22	9.692	7.581	65,000	120,000
4 1/2	40.80	2 13/14	0.844	1	5	25	NC46	2 13/16	6 1/4	28/22	9.692	7.581	55,000	110,000
5	50.00	3	1.000	1	5 1/2	25	NC50	3	6 1/2	28/22	12.566	10.681	55,000	110,000
5	49.50	3	1.000	1	5 1/2	25	NC50	3	6 5/8	28/22	12.566	10.681	65,000	120,000
5	50.39	3	1.000	1	5 1/2	25	NC50 EIS	3	6 5/8	28/22	12.566	10.681	55,000	120,000
5	50.00	3	1.000	1	5 1/2	25	VX50	3	6 5/8	28/22	12.566	10.681	55,000	120,000
5 1/2	47.50	3 7/8	0.813	1	6	25	5 1/2 FH	3 7/8	7	28/22	11.965	12.309	65,000	120,000
5 1/2	46.70	4	0.750	1	6	25	5 1/2 FH	4	7 1/4	28/22	11.192	11.764	55,000	100,000
5 1/2	48.31	3 7/8	0.812	1	6	25	5 1/2 FH EIS	3 7/8	7	28/22	11.965	12.309	55,000	120,000
5 1/2	45.52	4	0.750	1	6	25	VX57	4	7	28/22	11.192	11.764	55,000	120,000
5 7/8	58.20	3 7/8	1.000	1	6 3/8	25	5 1/2 FH EIS	4	7	28/22	15.315	16.140	65,000	120,000
6 5/8	83.40	4	1.313	1	7 1/8	25	VX57	4	7 1/4	28/22	14.542	15.630	55,000	120,000
6 5/8	58.20	5	0.813	1	7 1/8	25	6 5/8 FH	5	8	28/22	14.837	19.285	65,000	120,000
6 5/8	66.70	4 3/4	0.940	1	7 1/8	25	6 5/8 FH EIS	4 3/4	8 1/4	28/22	16.751	21.003	55,000	120,000
6 5/8	58.25	5	0.813	1	7	25	VX65	5	8	28/22	14.837	19.285	55,000	120,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

J) Grant Prideco Spiralled Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	(Z)[2] Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
2 7/8	22.70	1 3/4	0.563	1	3 1/4	258	NC31	1 3/4	4 1/8	28/22	4.087	2.013	65,000	120,000
3 1/2	29.60	2 1/16	0.719	1	4	258	NC38	2 1/16	4 3/4	28/22	6.280	3.702	65,000	120,000
4	35.30	2 1/2	0.750	1	4 1/2	258	NC40	2 1/2	5 1/4	28/22	7.658	5.324	65,000	120,000
4 1/2	45.40	2 13/16	0.844	1	5	258	NC46	2 13/16	6 1/4	28/22	9.692	7.581	65,000	120,000
5	55.90	3	1.000	1	5 1/2	258	NC50	3	6 5/8	28/22	12.566	10.681	65,000	120,000
5 1/2	54.60	3 7/8	0.813	1	6	258	5 1/2 FH	3 7/8	7	28/22	11.965	12.309	65,000	120,000
5 1/2	52.77	4	0.750	1	6	258	5 1/2 FH EIS	4	7	28/22	11.192	11.764	65,000	120,000
5 1/2	52.64	4	0.750	1	6	258	VX57	4	7	28/22	11.192	11.764	65,000	120,000
5 7/8	64.10	3 7/8	1.000	1	6 3/8	258	5 1/2 FH EIS	4	7	28/22	15.315	16.140	65,000	120,000
6 5/8	62.00	5	0.813	1	7 1/8	258	6 5/8 FH	5	8	28/22	14.837	19.285	65,000	120,000

K) Grant Prideco Directional-Wate® Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nominal OD	Approx. Weight[4] (W)	ID	Wall Thickness	Center Upsets			Connection Type	Tool Joint / Connection			Section Area Pipe Body	(Z)[2] Section Modulus	Minimum Yield Strength	
				Number	OD	Length		ID	OD	Length (P/B)[1]			Tube	Tool Joint
(in)	(lb/ft)	(in)	(in)		(in)	(in)		(in)	(in)	(in)	(in^2)	(in^3)	(psi)	(psi)
3 1/2	32.30	2 1/4	0.625	1	4	270	NC38	2 1/4	4 3/4	28/22	5.645	3.490	55,000	110,000
4	37.50	2 9/16	0.719	1	4 1/2	270	NC40	2 9/16	5 1/4	28/22	7.409	5.225	55,000	110,000
4 1/2	50.00	2 13/16	0.844	1	5	270	NC46	2 13/16	6 1/4	28/22	9.692	7.581	55,000	110,000
5	59.10	3	1.000	1	5 1/2	270	NC50	3	6 1/2	28/22	12.566	10.681	55,000	110,000
5 1/2	56.20	4	0.750	1	6	270	5 1/2 FH	4	7 1/4	28/22	11.192	11.764	55,000	100,000
5 1/2	54.12	4	0.750	1	6	270	5 1/2 FH EIS	4	7	28/22	11.192	11.764	55,000	120,000
5 1/2	53.99	4	0.750	1	6	258	VX57	4	7	28/22	11.192	11.764	55,000	120,000
5 7/8	64.77	4	0.940	1	6 3/8	258	VX57	4	7	28/22	14.542	15.630	55,000	120,000
6 5/8	66.90	5	0.813	1	7 1/8	270	6 5/8 FH	5	8	28/22	14.837	19.285	55,000	100,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

L) Grant Prideco HYDROCLEAN™ Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	Number	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	$(Z)^2$ Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
2 7/8	25.26	1 1/2	0.688	2	4 3/4	48	NC31 EIS	2	4 3/4	30/26	--	--	110,000	110,000
3 1/2	32.19	2 1/16	0.719	2	5 3/8	48	NC38 EIS	2 9/16	5 3/8	30/26	--	--	110,000	110,000
4	39.06	2 1/2	0.750	2	5 7/8	48	NC40 EIS	2 9/16	5 7/8	30/26	--	--	110,000	110,000
4 1/2	51.17	2 3/4	0.875	2	6 5/8	48	NC46 EIS	3	6 5/8	30/26	--	--	110,000	110,000
5	60.38	3	1.000	2	7	48	NC50 EIS	3 1/4	7	30/26	--	--	110,000	110,000
5 1/2	62.27	3 3/4	0.875	2	7 5/8	48	5 1/2 FH EIS	3 3/4	7 5/8	30/26	--	--	110,000	110,000
5 7/8	66.38	4	0.938	2	8 1/8	48	VX57	4 1/4	8 1/8	30/26	--	--	110,000	110,000
6 5/8	82.95	4 1/2	1.063	2	8 5/8	48	6 5/8 FH EIS	5	8 5/8	30/26	--	--	110,000	110,000

M) Grant Prideco HYDROCLEAN™ Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	Number	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	$(Z)^2$ Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
2 7/8	18.84	2	0.438	3	4 3/4	24	NC31 EIS	2	4 3/4	29/23	--	--	120,000	120,000
3 1/2	23.05	2 5/8	0.438	3	5 3/8	24	NC38 EIS	2 9/16	5 3/8	29/23	--	--	120,000	120,000
4	29.42	3	0.500	3	5 7/8	24	NC40 EIS	2 9/16	5 7/8	29/23	--	--	120,000	120,000
4 1/2	35.45	3 1/2	0.500	3	6 5/8	24	NC46 EIS	3	6 5/8	29/23	--	--	120,000	120,000
5	38.56	4	0.500	3	7	24	NC50 EIS	3 1/4	7	29/23	--	--	120,000	120,000
5 1/2	42.22	4 1/2	0.500	3	7 5/8	24	5 1/2 FH EIS	3 3/4	7 5/8	29/23	--	--	120,000	120,000
5 7/8	43.41	4 7/8	0.500	3	8 1/8	24	VX57	4 1/4	8 1/8	29/23	--	--	120,000	120,000
6 5/8	52.61	5 1/2	0.516	3	8 5/8	24	6 5/8 FH EIS	5	8 5/8	29/23	--	--	120,000	120,000

Table 3.20 New Heavy Weight Drill Pipe Dimensions, Weights, and Yield Strengths

(Note: The user should independently verify the numbers below before employing them in design calculations.)

N) Grant Prideco Nonmagnetic Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
				Center Upsets				Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	Number	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	$(Z)^2$ Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
2 7/8	13.40	2	0.438	2	3 1/4	15	NC26	2	3 1/4	36/36	3.350	1.787	116,000	116,000
3 1/2	25.30	2 1/4	0.625	2	4 3/4	15	NC38	2 1/4	4 3/4	36/36	5.645	3.490	116,000	116,000
4	20.50	2 11/16	0.406	2	4 3/4	15	NC38	2 11/16	4 3/4	24/24	3.948	2.746	116,000	116,000
5	23.90	3	1.000	2	6 1/2	15	NC50	3	6 1/2	24/24	12.566	10.681	116,000	116,000

O) DP-Master Heavy Weight Drill Pipe

1	2	3	4	5	6	7	8	9	10	11	12	13	14
				Center Upsets			Tool Joint / Connection					Minimum Yield Strength	
Nominal OD (in)	Approx. Weight[4] (W) (lb/ft)	ID (in)	Wall Thickness (in)	OD (in)	Length (in)	Connection Type	ID (in)	OD (in)	Length (P/B)[1] (in)	Section Area Pipe Body (in^2)	$(Z)^2$ Section Modulus (in^3)	Tube (psi)	Tool Joint (psi)
3 1/2	24.06	2 1/4	0.625	4	25	DPM-DS38	5	2 1/4	24/24	5.645	3.490	55,000	120,000
4	29.22	2 9/16	0.719	4 1/2	25	DPM-MT39	4 7/8	2 9/16	24/24	7.409	5.225	55,000	120,000
4	27.99	2 11/16	0.656	4 1/2	25	DPM-MT39	5	2 11/16	24/24	6.894	5.003	55,000	120,000
4 1/2	38.70	2 11/16	0.906	5	25	DPM-DS40	5 1/4	2 11/16	24/24	10.232	7.808	55,000	120,000
4 1/2	42.89	2 13/16	0.844	5	25	DPM-ST46	6 1/4	2 13/16	24/24	9.692	7.581	55,000	120,000
5	51.91	3	1.000	5 1/2	25	DPM-DS50	6 5/8	3	24/24	12.566	10.681	55,000	120,000
5 1/2	63.49	3 1/4	1.125	6	25	DPM-DS55	7 1/4	3 1/4	24/24	15.463	14.342	55,000	120,000
5 1/2	47.32	4	0.750	6	25	DPM-MT57	7	4	24/24	11.192	11.764	55,000	120,000
5 7/8	56.88	4	0.938	6 3/8	25	DPM-MT57	7	4	24/24	14.542	15.630	55,000	120,000
6 5/8	69.05	4 3/4	0.938	7 1/8	25	DPM-DS65	8 1/4	4 3/4	24/24	16.751	21.003	55,000	120,000

1 Pin tool joint length includes the tong space length and pin length, except for DS-1® Standard HWDP and NOV Grant Prideco HWDP where the pin tool joint length refers to the tong space length excluding the pin length.

2 $$z = \left(\frac{\pi}{32}\right)\left(\frac{OD^4 - ID^4}{OD}\right)$$

The preceding formula is one of two that are used in API RP7G for the term "Section Modulus." To avoid confusion, this formula is used consistently throughout this standard.

3 Weatherford no longer manufactures heavy weight drill pipe. This data was only provided in case there is Weatherford heavy weight drill pipe remaining in some inventories.

4 Approximate Weight (W) is the assembly weight including tube and tool joints.

5 DS-1® Standard HWDP on this table are those sizes standardized by DS-1® Fifth Edition, Volume 1. Additional tool joint ODs may be acceptable upon agreement between purchaser and manufacturer.

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Table 3.21 Drill Collar Weight, Section Modulus, and Displacement

1	2	3	4	5	6
Dimensions (in)		(W_{DC}) Weight (lb/ft)	$(Z)^1$ Section Modulus (in^3)	Displacement/Stand (bbl) (open ended)	
OD	ID			Triple	Double
2-7/8	1	19	2.299	.635	.423
	1-1/4	18	2.250	.586	.391
	1-1/2	16	2.160	.526	.351
3	1	21	2.618	.699	.466
	1-1/4	20	2.571	.650	.433
	1-1/2	18	2.485	.590	.393
3-1/8	1	23	2.965	.766	.511
	1-1/4	22	2.919	.717	.478
	1-1/2	20	2.837	.657	.438
3-1/4	1	26	3.340	.836	.557
	1-1/4	24	3.296	.787	.525
	1-1/2	22	3.217	.723	.482
3-1/2	1	30	4.181	.984	.656
	1-1/4	29	4.141	.934	.623
	1-1/2	27	4.067	.874	.583
3-3/4	1	35	5.151	1.142	.761
	1-1/4	33	5.113	1.093	.729
	1-1/2	32	5.045	1.033	.689
4	1	40	6.259	1.311	.874
	1-1/4	39	6.223	1.262	.841
	1-1/2	37	6.159	1.202	.801
	1-3/4	35	6.053	1.131	.754
	2	32	5.890	1.049	.699
	2-1/4	29	5.654	.956	.637
4-1/8	1	43	6.867	1.400	.933
	1-1/4	41	6.833	1.351	.901
	1-1/2	39	6.770	1.291	.861
	1-3/4	37	6.668	1.220	.813
	2	35	6.510	1.138	.759
	2-1/4	32	6.281	1.045	.697
4-1/4	1	46	7.513	1.492	.995
	1-1/4	44	7.480	1.443	.962
	1-1/2	42	7.419	1.382	.921
	1-3/4	40	7.320	1.311	.874
	2	38	7.167	1.229	.819
	2-1/4	35	6.944	1.137	.758
4-1/2	1	51	8.924	1.682	1.121
	1-1/4	50	8.893	1.634	1.089
	1-1/2	48	8.836	1.574	1.049
	1-3/4	46	8.742	1.503	1.002
	2	43	8.597	1.421	.947
	2-1/4	41	8.387	1.328	.885
4-3/4	1-1/2	54	10.417	1.776	1.184
	1-3/4	52	10.328	1.705	1.137
	2	50	10.191	1.623	1.082
	2-1/4	47	9.992	1.530	1.020
	2-1/2	44	9.714	1.426	.951

1 See note, Table 3.18.1.

Table 3.21 Drill Collar Weight, Section Modulus, and Displacement *(continued)*

1	2	3	4	5	6
Dimensions (in)		(W_{DC}) Weight (lb/ft)	(Z)[1] Section Modulus (in³)	Displacement/Stand (bbl) (open ended)	
OD	ID			Triple	Double
5	1-1/2	61	12.172	1.989	1.326
	1-3/4	59	12.088	1.918	1.279
	2	56	11.958	1.836	1.224
	2-1/4	53	11.769	1.743	1.162
	2-1/2	50	11.505	1.639	1.093
5-1/4	1-1/2	68	14.112	2.213	1.475
	1-3/4	65	14.031	2.142	1.428
	2	63	13.907	2.060	1.373
	2-1/4	60	13.727	1.967	1.311
	2-1/2	57	13.476	1.863	1.242
5-1/2	1-1/2	75	16.243	2.448	1.632
	1-3/4	73	16.166	2.377	1.585
	2	70	16.048	2.295	1.530
	2-1/4	67	15.876	2.202	1.468
	2-1/2	64	15.636	2.098	1.399
	2-13/16	60	15.216	1.953	1.302
5-3/4	1-1/2	82	18.578	2.694	1.796
	1-3/4	80	18.504	2.623	1.749
	2	78	18.391	2.541	1.694
	2-1/4	75	18.226	2.448	1.632
	2-1/2	72	17.997	2.344	1.563
	2-13/16	67	17.595	2.199	1.466
	3	64	17.281	2.104	1.403
	3-1/4	60	16.759	1.967	1.311
6	1-1/2	90	21.123	2.951	1.967
	1-3/4	88	21.052	2.880	1.920
	2	85	20.944	2.798	1.865
	2-1/4	83	20.786	2.705	1.803
	2-1/2	79	20.567	2.601	1.734
	2-13/16	75	20.181	2.456	1.637
	3	72	19.880	2.361	1.574
	3-1/4	68	19.380	2.224	1.483
6-1/4	1-1/2	98	23.889	3.218	2.145
	1-3/4	96	23.821	3.147	2.098
	2	94	23.717	3.065	2.043
	2-1/4	91	23.566	2.972	1.981
	2-1/2	88	23.355	2.869	1.913
	2-13/16	83	22.985	2.723	1.815
	3	80	22.696	2.628	1.752
	3-1/4	76	22.216	2.492	1.661
	3-1/2	72	21.611	2.344	1.563
6-1/2	1-1/2	107	26.885	3.497	2.331
	1-3/4	105	26.819	3.426	2.284
	2	102	26.719	3.344	2.229
	2-1/4	99	26.574	3.251	2.167
	2-1/2	96	26.371	3.147	2.098
	2-13/16	91	26.016	3.002	2.001
	3	89	25.738	2.907	1.938
	3-1/4	85	25.276	2.770	1.847
	3-1/2	80	24.695	2.623	1.749

[1] *See note, Table 3.18.1.*

Table 3.21 Drill Collar Weight, Section Modulus, and Displacement *(continued)*

1	2	3	4	5	6
Dimensions (in)		(W_{DC}) Weight	(Z)[1] Section	Displacement/Stand (bbl) (open ended)	
OD	ID	(lb/ft)	Modulus (in^3)	Triple	Double
6-3/4	1-1/2	116	30.120	3.787	2.525
	1-3/4	114	30.057	3.716	2.477
	2	111	29.961	3.634	2.423
	2-1/4	108	29.821	3.541	2.361
	2-1/2	105	29.623	3.437	2.291
	2-13/16	100	29.283	3.292	2.195
	3	98	29.015	3.197	2.131
	3-1/4	93	28.571	3.060	2.040
	3-1/2	89	28.011	2.912	1.941
7	1-1/2	125	33.603	4.087	2.725
	1-3/4	123	33.542	4.016	2.677
	2	120	33.450	3.934	2.623
	2-1/4	117	33.315	3.841	2.561
	2-1/2	114	33.126	3.738	2.492
	2-13/16	110	32.796	3.592	2.395
	3	107	32.538	3.497	2.331
	3-1/4	103	32.109	3.361	2.241
	3-1/2	98	31.569	3.213	2.142
	3-3/4	93	30.900	3.055	2.037
	4	84	30.084	2.885	1.923
7-1/4	1-1/2	134	37.344	4.399	2.933
	1-3/4	132	37.285	4.328	2.885
	2	130	37.196	4.246	2.831
	2-1/4	127	37.065	4.153	2.769
	2-1/2	124	36.883	4.049	2.699
	2-13/16	119	36.564	3.904	2.603
	3	116	36.315	3.809	2.539
	3-1/4	112	35.901	3.672	2.448
	3-1/2	108	35.380	3.524	2.349
	3-3/4	103	34.734	3.366	2.244
	4	93	33.946	3.197	2.131
7-1/2	1-1/2	144	41.351	4.721	3.147
	1-3/4	142	41.295	4.650	3.100
	2	139	41.208	4.568	3.045
	2-1/4	137	41.082	4.475	2.983
	2-1/2	133	40.906	4.371	2.914
	2-13/16	129	40.598	4.226	2.817
	3	126	40.357	4.131	2.754
	3-1/4	122	39.957	3.994	2.663
	3-1/2	117	39.453	3.847	2.565
	3-3/4	113	38.829	3.688	2.459
	4	102	38.066	3.519	2.346
7-3/4	1-1/2	154	45.635	5.054	3.369
	1-3/4	152	45.580	4.983	3.322
	2	150	45.496	4.901	3.267
	2-1/4	147	45.374	4.809	3.206
	2-1/2	144	45.204	4.705	3.137
	2-13/16	139	44.906	4.559	3.039
	3	136	44.673	4.464	2.976
	3-1/4	132	44.286	4.328	2.885
	3-1/2	128	43.798	4.180	2.787
	3-3/4	123	43.194	4.022	2.681
	4	112	42.456	3.852	2.568

[1] *See note, Table 3.18.1.*

Table 3.21 Drill Collar Weight, Section Modulus, and Displacement *(continued)*

1	2	3	4	5	6
Dimensions (in)		(W_{DC}) Weight	(Z)[1] Section	Displacement/Stand (bbl) (open ended)	
OD	ID	(lb/ft)	Modulus (in³)	Triple	Double
8	1-1/2	165	50.203	5.399	3.599
	1-3/4	163	50.150	5.328	3.552
	2	160	50.069	5.246	3.497
	2-1/4	157	49.951	5.153	3.435
	2-1/2	154	49.786	5.049	3.366
	2-13/16	150	49.497	4.904	3.269
	3	147	49.271	4.809	3.206
	3-1/4	143	48.896	4.672	3.115
	3-1/2	138	48.424	4.524	3.016
	3-3/4	133	47.839	4.366	2.911
	4	122	47.124	4.196	2.797
8-1/4	1-1/2	176	55.066	5.724	3.836
	1-3/4	174	55.015	5.683	3.789
	2	171	54.936	5.601	3.734
	2-1/4	168	54.822	5.508	3.672
	2-1/2	165	54.662	5.404	3.603
	2-13/16	160	54.382	5.259	3.506
	3	158	54.163	5.164	3.443
	3-1/4	154	53.799	5.027	3.351
	3-1/2	149	53.341	4.880	3.253
	3-3/4	144	52.773	4.721	3.147
	4	133	52.080	4.552	3.035
8-1/2	1-1/2	187	60.233	6.120	4.080
	1-3/4	185	60.183	6.049	4.033
	2	182	60.107	5.967	3.978
	2-1/4	179	59.996	5.874	3.916
	2-1/2	176	59.840	5.770	3.847
	2-13/16	172	59.568	5.625	3.750
	3	169	59.356	5.530	3.687
	3-1/4	165	59.003	5.393	3.595
	3-1/2	160	58.558	5.246	3.497
	3-3/4	155	58.008	5.087	3.391
	4	150	57.335	4.918	3.279
9	1-1/2	210	71.514	6.885	4.590
	1-3/4	208	71.467	6.814	4.543
	2	206	71.395	6.732	4.488
	2-1/4	203	71.290	6.639	4.426
	2-1/2	200	71.143	6.535	4.357
	2-13/16	195	70.886	6.390	4.260
	3	192	70.686	6.295	4.197
	3-1/4	188	70.352	6.158	4.105
	3-1/2	184	69.932	6.011	4.007
	3-3/4	179	69.412	5.852	3.901
	4	174	68.777	5.683	3.789
9-1/2	1-1/2	234	84.120	7.694	5.129
	1-3/4	232	84.076	7.623	5.082
	2	230	84.007	7.541	5.027
	2-1/4	227	83.908	7.448	4.965
	2-1/2	224	83.769	7.344	4.896
	2-13/16	220	83.526	7.199	4.799
	3	216	83.336	7.104	4.736
	3-1/4	212	83.020	6.967	4.645

[1] *See note, Table 3.18.1.*

Table 3.21 Drill Collar Weight, Section Modulus, and Displacement *(continued)*

1	2	3	4	5	6
Dimensions (in)		(W_{DC}) Weight (lb/ft)	(Z)[1] Section Modulus (in^3)	Displacement/Stand (bbl) (open ended)	
OD	ID			Triple	Double
9-1/2	3-1/2	209	82.622	6.819	4.546
	3-3/4	206	82.129	6.661	4.441
	4	198	81.527	6.492	4.328
9-3/4	1-1/2	248	90.943	8.114	5.409
	1-3/4	245	90.900	8.043	5.362
	2	243	90.833	7.961	5.307
	2-1/4	240	90.736	7.869	5.246
	2-1/2	237	90.601	7.765	5.177
	2-13/16	232	90.364	7.619	5.079
	3	229	90.179	7.524	5.016
	3-1/4	225	89.871	7.388	4.925
	3-1/2	221	89.483	7.240	4.827
	3-3/4	216	89.003	7.082	4.721
	4	211	88.416	6.912	4.608
10	1-1/2	261	98.125	8.546	5.697
	1-3/4	259	98.083	8.475	5.650
	2	257	98.018	8.393	5.595
	2-1/4	254	97.923	8.300	5.533
	2-1/2	251	97.791	8.196	5.464
	2-13/16	246	97.560	8.051	5.367
	3	243	97.380	7.956	5.304
	3-1/4	239	97.079	7.819	5.213
	3-1/2	235	96.702	7.672	5.115
	3-3/4	230	96.233	7.513	5.009
	4	225	95.661	7.344	4.896
11	1-1/2	317	130.625	10.382	6.921
	1-3/4	315	130.587	10.311	6.874
	2	313	130.528	10.229	6.819
	2-1/4	310	130.442	10.136	6.757
	2-1/2	307	130.322	10.032	6.688
	2-13/16	302	130.112	9.887	6.591
	3	299	129.948	9.792	6.528
	3-1/4	295	129.675	9.655	6.437
	3-1/2	291	129.331	9.508	6.339
	3-3/4	286	128.906	9.349	6.233
	4	281	128.386	9.180	6.120
12	1-1/2	379	169.605	12.393	8.262
	1-3/4	377	169.569	12.322	8.215
	2	374	169.515	12.240	8.160
	2-1/4	371	169.436	12.147	8.098
	2-1/2	368	169.326	12.043	8.029
	2-13/16	364	169.134	11.898	7.932
	3	361	168.983	11.803	7.869
	3-1/4	357	168.733	11.666	7.777
	3-1/2	352	168.418	11.519	7.679
	3-3/4	347	168.028	11.360	7.573
	4	342	167.552	11.191	7.461

[1] *See note, Table 3.18.1.*

4. Failure Analysis

4.1 Scope and Definition

Failure mechanism is a shorthand name given to a chain of conditions and events which cause drill stem failure. This chapter describes how to recognize the major failure mechanisms that attack drill strings. The chapter is not an exhaustive treatment of general failure analysis procedures, nor should it in most cases substitute for analysis of drill string failures by qualified engineers or metallurgists. However, the ability to recognize common signs may enable the designer to take quick action to prevent a repeat failure, while awaiting a review of the first.

4.2 Preserve the Specimens

Even if there are no immediate plans to send the failed part to a laboratory for analysis, it's a good idea to preserve the failure specimens. (Plans often change as word of a problem works its way up through an organization.) Every effort must be made to safeguard failed parts, especially fracture surfaces and adjacent metal, from further damage. Post-failure damage to failure specimens occurs mainly due to mishandling and corrosion. The following steps will help minimize further damage while the next action is being decided.

4.2.1 Prevent Further Mechanical Damage

Do not:

a. Put fracture surfaces together.

b. Touch or rub the fracture surfaces.

c. Remove fragments from the fracture surfaces.

d. Clean the fracture surface with solvents, high pressure sprays, or wire brushes.

e. Paint the fracture surface or adjacent areas.

4.2.2 Prepare Specimens for Transportation

Unless the receiving party instructs otherwise, it's usually better to cut off the fracture from long tubes, as this makes handling and transportation easier and less likely to cause further damage. Using a cutting torch is acceptable, so long as at least 18 inches of metal are left on each side of the fracture so heat from the torch does not alter metallurgical properties near the fracture. If the fracture surfaces have been exposed to salt water or water-based mud, coat them with a water-soluble oil (such as WD-40) as soon as possible. If the surfaces are coated with oil-based mud, it is probably best to leave the coating undisturbed. Package the pieces to prevent further mechanical and corrosion damage to the fracture surfaces during shipment. Even a sturdy cardboard wrap around the fracture surfaces, held in place with duct tape, will be better than no protection, though contact between fracture surfaces and the protective wrap should be avoided. Ship the pieces as soon after the failure as practical. Do not ship them on the decks of vessels where they will be exposed to saltwater spray.

4.3 Analysis and Corrective Action

After preserving the failure specimens, the first step is to establish the probable failure mechanism. Until the failure mechanism is identified, it is difficult to focus on a corrective action. However, most failure mechanisms can be established with a reasonable degree of confidence on the rig, using the information in this section. Further investigation to confirm causes and establish metallurgical properties is usually a good idea, but the designer should not delay taking corrective action when the mechanism is reasonably clear.

4.4 Fatigue Failures

Fatigue is the most common cause of drill stem failure, and design steps for controlling fatigue are outlined in Chapter 4 of Volume 2. Recognizing the mechanism in drill string components is relatively easy most of the time. The reader should review the introductory paragraphs of Chapters 2 and 4 of Volume 2 for a description of how the mechanism works. Recognizing fatigue should focus on the location, appearance, and orientation of the fracture.

4.4.1 Failure Location

Fatigue failures occur regularly in both drill pipe tubes and BHA connections. However, they are relatively rare in drill pipe tool joints. Figure 4.1 shows a drill pipe tube fatigue crack under magnification. The usual locations for fatigue cracks are:

a. Drill Pipe Tubes: The most common locations for fatigue failure is the area near the internal upset, usually 16-24 inches from the pin or box end, and in the slip area. They are less common but may also occur in other locations between upsets.

b. BHA Connections: The last engaged pin or box threads are the usual starting points for connection fatigue (Figure 4.2). Connections most susceptible

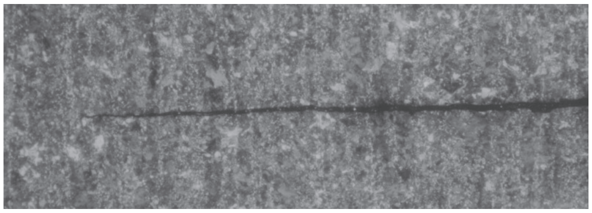


Figure 4.1 A drill pipe tube fatigue crack. (x100)

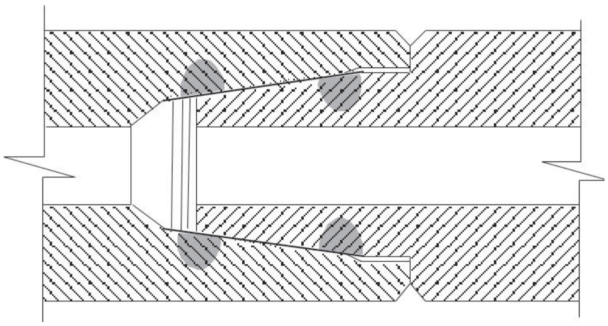


Figure 4.2 Fatigue cracks in BHA connections occur in the regions of highest tensile stress (shaded above). In drill pipe tubes, most fatigue cracks form in stress concentrations from slip cuts and from internal upsets.

to fatigue are the end connections on stiff BHA components and midbody connections on specialty tools like jars and motors. Fatigue is more likely on connections that join stiff components, and less likely on those joining limber components.

c. Other Locations: Fatigue cracks also occur in the slip grooves on drill collars, in stabilizer bodies (often near welds on welded blade stabilizers), and in other locations where the drill string undergoes a sharp section change.

4.4.2 Appearance of Fatigue Failures

Fatigue often has a characteristic appearance that differentiates it from overload failures.

a. Tubes: A fatigue crack will be planar and perpendicular to the pipe axis. If the crack has penetrated the tube wall, leaking drilling mud often erodes the crack into what is called a tube “washout” (Figure 4.3). Even when eroded by drilling mud, however, the fatigue crack usually retains its transverse orientation.

Figure 4.3 “Washouts” in drill pipe tubes are almost always caused by fatigue.

Figure 4.4 Brittle material may fail before the crack penetrates the pipe wall.

Figure 4.5.a Typical fatigue failure in a drill collar box.

Figure 4.5.b Typical fatigue failure in a pin connection.

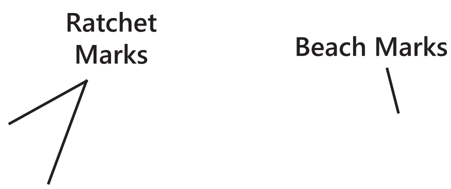


Figure 4.6 Ratchet marks on the fatigue crack surface of a drill collar box (left). Beach marks on a box fatigue crack (right).

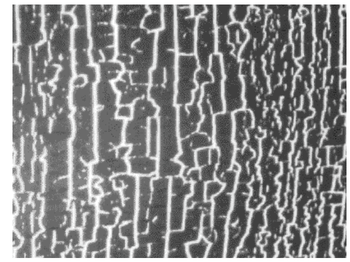


Figure 4.7 A split box failure (left) is often associated with superficial box cracks called "heat checks" (shown at the right under blacklight).

On very brittle drill pipe, sudden catastrophic fracture can occur before the crack is large enough to have penetrated the tube wall (Figure 4.4).

b. Connections: Fatigue cracks in connections will be flat, planar, and perpendicular to the pipe axis. The fatigue crack surface may be worn smooth. The crack surface may also be washed and eroded by leaking mud, and mechanical damage from fishing operations or from rotating parted surfaces on one another is often seen. If a string separation has occurred and the surfaces are relatively undamaged, the fatigue crack surface will occupy less than the entire fracture face. The remainder will have parted when the fatigue crack grew too large for the remaining sound metal to carry the applied load. This non-cracked portion of the fracture often has the 45 degree orientation typical of tensile overload (Figure 4.5). The non-cracked part may also show a fair amount of plastic deformation, but little plastic strain will be associated with the fatigue crack itself. The relative sizes of the cracked and non-cracked surfaces of a fracture will vary depending on material properties and loads, though tougher material will support larger cracks without parting, other things equal.

4.4.3 Other Indicators of Fatigue

If a fracture or washout exhibits the features above, it was almost certainly caused by fatigue. Occasionally, a connection fracture may be recovered that is neither mechanically damaged nor severely corroded. If so, other indicators may be present on the fracture surface that will further establish fatigue as the failure mechanism.

a. Ratchet Marks: Ratchet marks are small steps in a connection fatigue crack face near the thread root. Ratchet marks occur when many small cracks initiate and begin growing in the thread root from slightly different positions. As the small cracks grow, they join together to form one large crack, but leave small steps and depressions (ratchet marks) at the edge of the crack (Figure 4.6).

b. Beach Marks: Beach marks are impressions that may occur on a fatigue crack surface when the part undergoes a sudden change in crack growth rate, perhaps from going into and out of service. Examples are shown in Figure 4.6. Beach marks, though less common and more difficult to see than ratchet marks, are sometimes visible when the surface has not been corroded.

4.5 Split Box

This is a special type of fatigue that occurs when tool joint boxes are operated under high Curvature Index conditions. A split box failure is often accompanied by heat checking that results from the same high side loads. Heat checks (Figure 4.7) are superficial longitudinal cracks which, though not detrimental in themselves, cause stress concentrations that speed the formation of the longitudinal split box fatigue cracks. Unlike boxes that split from over-refacing and torsion overload, split box fatigue failures like the one in Figure 4.7 show little or no plastic deformation.

4.6 Corrective Actions

Fatigue is a complex mechanism, and efforts to prevent it should encompass a wide range of actions. Details are given in Chapter 4 of Volume 2. A summary flowchart is shown in Figure 4.8.

4.7 Torsion Failure

Torsion failure can occur in a tool joint or drill pipe tube, though the former is more common because API connections of standard dimensions are weaker in torsion than the tubes to which they're attached. The only time that externally applied torsion will affect a connection will be when the load is high enough to cause relative rotation between pin and box. If the applied torsion is not sufficient

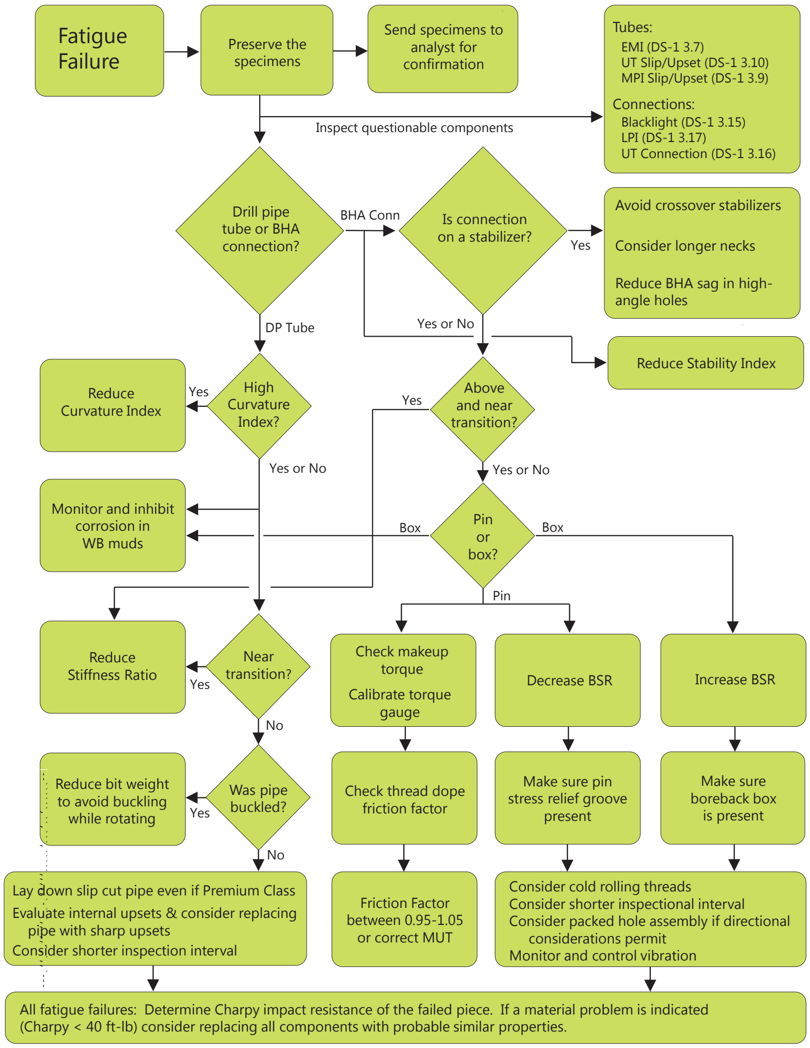


Figure 4.8 An overview of corrective actions to consider in case of fatigue failure. Detailed instructions are found in Volume 2, Chapter 4.

Figure 4.9 Box-weak torsion failure begins as box swell (top left) and may progress to the extreme stage at top right. Pin-weak torsion failure starts as pin stretch (bottom left) and may progress until final separation of the pin neck (bottom right).

to cause pin-box movement, it is transmitted through the connection with no significant effect on connection stress.

4.7.1 Failure Location

Because torsion is applied from the surface, connections higher in the hole are more likely to fail, although variations in strength or dimensions from one tool joint to the next may affect this. Also, BHA connections are typically stronger than the tool joints above, so torsional failures in BHA connections are rare except when "slim" components are used or when the BHA is under torsional vibration (stick-slip) conditions.

4.7.2 Appearance

A connection torsion failure will first show up as a stretched pin or belled box, depending on which is weaker. In extreme cases, the pin may be parted or the box split. A box that is split by torsion alone (not fatigue) will also exhibit heavy plastic deformation and belling (Figure 4.9).

4.8 Preventing Torsion Failure

Torsion failure is an overload mechanism that occurs when the stress in the weaker of connection pin or box exceeds yield stress. Torsion failure can be averted using the actions outlined in Chapter 3 of Volume 2.

4.8.1 Calibrate Torque Application Devices

If a torsional failure occurs, or if operating torques are expected to approach tool joint makeup torque, you should make sure the makeup torque application devices are calibrated.

4.8.2 Check Tool Joint Diameters

Tool joints purchased by contractors and rental companies often do not comply with "standard" dimensions found in API. This is particularly true with respect to the ID. There is no particular problem with nonstandard dimensions as long as you check the actual dimensions with which you're dealing and adjust load capacities accordingly.

4.8.3 Monitor Tool Joint Wear and Condition

If you anticipate drilling with high side loads or long reaches, you should establish a box wear tolerance. Set the minimum tool joint OD at the dimension required to maintain torque load factor below the maximum allowed. Pin wear is usually ignored. Dynamic torque indicators may not be very accurate, so if torque load factor is approaching the limit, you should monitor the condition of tool joints near the surface, at section tops and those that have recently been rotating at high side loads. This can be done on trips out of the hole, and will show whether the connections have been or are about to be overstressed. Use the Rig Floor Trip Inspection, procedure 3.33. Alternatively, you can use dividers or a gage similar to the one shown on the left in Figure 4.10. Set the dividers or gage at the wear limit and attempt to place it on tool joints as they pass through the rotary. A tool joint over which the gage will slide is worn past the limit. On pin-weak connections, check pin lead with a hardened and ground profile gage (Figure 4.10) to make sure they are not being overstressed. Thin, stamped "tool joint identifiers" are not recommended for checking pin lead.

4.8.4 Note Break Out Torque

Break out torque could normally be 10-15 percent higher than makeup torque because of the difference in static and dynamic friction coefficients. Break out torques significantly higher than this may indicate downhole makeup. This could warn of pending torsion overstress and failure as the hole gets deeper and operating torque continues to increase. Figure 4.11 gives a systematic approach for dealing with a torsional failure.

4.9 Tension Failure

In deep, vertical and near-vertical holes, tension is usually the load of primary concern. Tension failure is an overload mechanism whose identification and prevention is relatively straightforward.

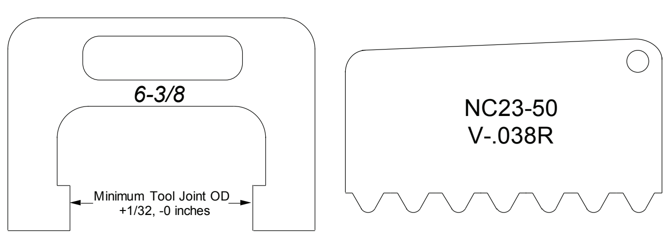


Figure 4.10 A gage for checking tool joint box wear (left). Hardened and ground profile gage for checking pin stretch (right).

4.9.1 Location

A tensile failure will probably occur in a drill pipe tube between upsets, near the surface or a section top. However, variations in wall thickness and tensile strength between tubes can place a tensile failure at other locations. Tensile failures in tool joint pins are rare because pin necks on most standard sized tool joints have cross sections capable of carrying both makeup-induced stress and external string tension. Exceptions to this can occur, and pin neck tensile capacity can be degraded by excess makeup torque, as described in Chapter 3 of Volume 2.

4.9.2 Appearance

Tension failures are often jagged in appearance, and the tube is usually necked down or "bottlenecked" near the fracture. Tension fracture surfaces often show extensive plastic deformation, though in brittle material this may not be the case. The fracture surfaces will be oriented 45 degrees

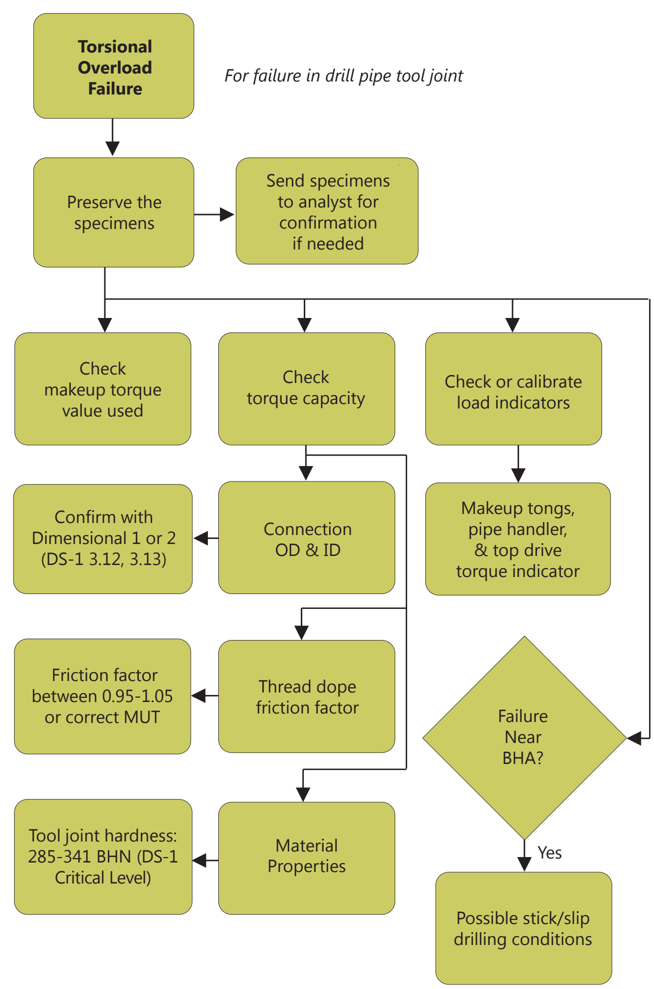


Figure 4.11 A systematic approach for responding to a torsional failure.

to the axis of the pipe (Figure 4.12) unless the material is very brittle. Figure 4.13 shows a systematic approach for correcting a tension failure.

4.10 Combined Loads

Tension and torque loads interact, and the capacity of a component to carry the loads simultaneously will usually be less than the capacity to carry either load individually. Combined load capacities are given in Volume 2, Chapter 3. Failure by combined tension and torsion may occur in tubes or tool joint pins. Tool joint boxes will not fail by this mechanism because pin failure will occur first. In drill pipe tubes, the failure will usually display the plastic deformation and necking down that characterize a tensile failure. A helical fracture surface like that shown in Figure 4.14 may also be present. In tool joints, the appearance of a combined load failure will be much like that of a pin torsional failure. In the early stages, a stretched pin, and in extreme cases, total pin separation, will be the indicators.

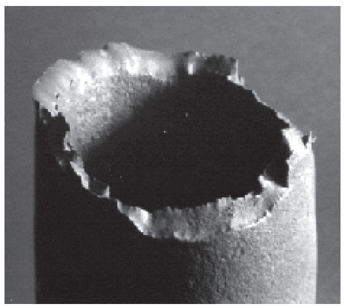


Figure 4.12 Tension failure appearance.

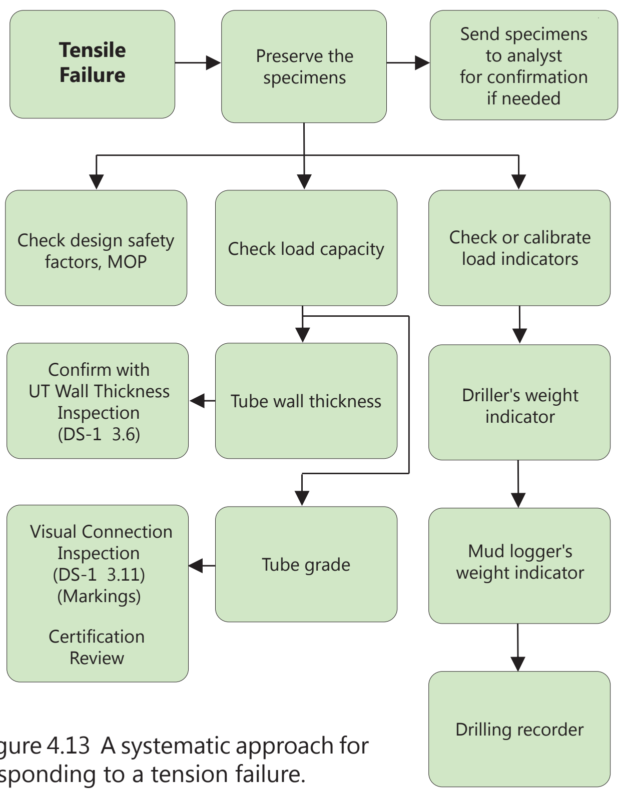


Figure 4.13 A systematic approach for responding to a tension failure.

4.11 Sulfide Stress Cracking

Sulfide stress cracking failures in drill strings are relatively rare. The mechanism is very complex, and identifying it is probably best left to professional failure analysts. A higher tensile stress state, higher H_2S concentrations, lower pH, higher pressure, higher chloride concentration, lower temperature, and harder material all promote SSC attack. Conversely, moving one or more of these factors in the opposite directions will retard attack, other things equal. Possible sources of hydrogen sulfide in drilling fluids may include formation fluid, bacterial activity, or breakdown of chemicals in the drilling fluid. Of these, formation fluid is obviously the most concern. Prevention of the SSC mechanism is outlined in Chapter 5 of Volume 2.

Figure 4.14 The fracture surface of combined load failure in a drill pipe tube may have a helical shape.

5. Fitness for Purpose

5.1 Scope

This section covers the engineering rationale behind the acceptance criteria in Section 3. It also gives guidelines for adjusting these acceptance criteria to achieve fitness for purpose. These guidelines are only intended for normal weight rotary drill strings and are not to be used for heavy duty landing strings.

5.2 Acceptance Criteria

5.2.1 Definition

Acceptance criteria are the dimensions, attributes, and properties that a used drill stem component must possess to pass inspection under this standard.

5.2.2 History and Evolution

The first industry-wide list of acceptance criteria for used drill pipe was written in API Recommended Practice 7G (RP7G). This standard was published to help the industry uniformly classify drill pipe according to its cumulative wear and tear. Originally, RP7G established five classes, numbered 1 (new pipe) through 5 (junk). Later, a class called "Premium" was inserted between Class 1 and Class 2. Premium Class and Classes 2, 3, and 4 represent advancing stages of deterioration. Under this system, a pipe's classification is based upon a number of attributes. During inspection, each attribute is examined, and the pipe is placed at the highest class at which all required attributes are met or exceeded. When RP7G was first published, Class 3 and Class 4 pipe were considered usable in many circles, but by now they are considered too worn for most needs. Today, even Class 2 drill pipe is rarely specified, and "Premium Class" has emerged as having the preferred minimum set of attributes for used drill pipe in most commercial transactions.

RP7G provided acceptance criteria, but did not cover the procedures by which the criteria were to be evaluated. To

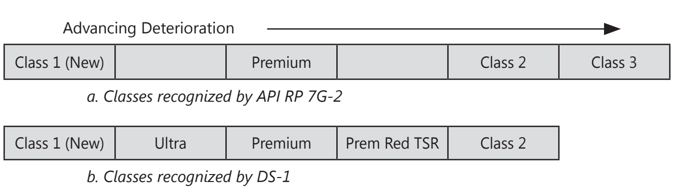


Figure 5.1 Classes of pipe recognized by API RP 7G-2 and DS-1. The gap between Premium and Class 2 in the upper figure represents a class of pipe that has been in common use for years and is recognized in DS-1.

supplement RP7G in this regard, DS-1® was published in 1992 under the sponsorship of the Drilling Engineers Association as DEA Project 74. Among other things, DS-1 gives a standard set of inspection *procedures* by which the desired attributes are to be evaluated. In virtually all cases, the acceptance criteria in RP7G were incorporated unchanged into DS-1. Thus, in Service Category 3 and below, "Premium Class" drill pipe is essentially identical under either standard. However, RP7G did not address every attribute DS-1 sponsors feel are important in more critical drilling applications. Therefore, in DS-1 Service Categories 4 and 5, a few attributes are measured (for example, tool joint pin ID) that were assumed or ignored under RP7G. This meant that at higher Service Categories, drill pipe may be rejected under DS-1 for conditions that would not even be examined if the pipe was inspected to RP7G requirements. Figure 5.1 shows the different classes covered in the two standards. Specific differences between acceptance criteria in the two standards are detailed later in this section.

API published RP7G-2 effective August 2009. This document provides recommended inspection levels, which are similar in concept to DS-1 inspection categories, and inspection procedures. While DS-1 Fifth Edition and API RP7G-2 have some similarities, the user should compare the method selection, acceptance criteria, and inspection frequency before selecting the inspection standard.

Table 5.1 lists some key attributes governed by API and DS-1 acceptance criteria. See Table 3.5.1 for a complete listing.

Table 5.1 Four Classes of Used Normal Weight Drill Pipe

Attribute	Ultra Class[1]	Premium Class	Premium Class Reduced TSR[1]	Class 2
Minimum remaining tube wall thickness	≥ 90%	≥ 80%	≥ 80%	≥ 70%
Maximum slip cut (depth)[2]	≤ 5%	≤ 10%	≤ 10%	≤ 20%
Tool Joint torsional strength[3]	≥ 80%	≥ 80%	50-80%	≥ 80%
Fatigue Cracks	None	None	None	None

[1] *Not an API class. Recognized in DS-1 only.*
[2] *Percent of adjacent wall thickness.*
[3] *Percent of torsional strength of the tube.*

5.2.3 Recognition of "Premium Class, Reduced TSR" (Torsional Strength Ratio)

A few drill pipe/tool joint combinations with undersized tool joint ODs (but Premium Class in every other respect) are still used widely. For these combinations, the industry seems to prefer a slimmer tool joint for fishing clearance, and is willing to accept a nominal reduction in torsional capacity to gain the increased clearance. An example is 3-1/2 inch, 13.30 ppf, Grade S pipe with NC38 tool joints. A new tool joint built to API standard dimensions has a 5-inch outside diameter. A tool joint worn to no less than 4-13/16 inches OD is Premium Class. Yet rental companies still purchase pipe with 4-3/4 inch tool joints to meet their customers' needs for more clearance. Thus, these tool joints are often *manufactured* with Class 2 dimensions, which wear will certainly reduce further. This is "fitness for purpose" in action. When the artificial standard (Premium Class) did not meet the required performance need (fishing clearance), the industry informally changed acceptance criteria to meet the need. For these particular items, the inspection community has for years applied an informal, unregulated set of tool joint diameter requirements, while more or less rigorously enforcing other requirements. To recognize and to establish some control over this practice, DS-1 sponsors have adopted a new class called "Premium Class, Reduced TSR."

5.2.4 Application of Grouped Attributes

"Ultra Class," "Premium Class," "Premium Class, Reduced TSR," and "Class 2" are labels that fix several attributes of normal weight drill pipe and the tool joints attached to normal weight drill pipe. These labels have no meaning in reference to any other drill string component. For all other components, attributes are specified singly.

5.3 Fitness for Purpose

5.3.1 Definition and Application

"Fitness for Purpose," in this standard, means adjusting the inspection acceptance criteria to fit an intended application. The occasional need to modify acceptance criteria arises from the fact that those criteria in use were not established to meet any specific sets of drilling conditions. Thus, a given set (for example: Premium Class) will not fit every drilling situation. If the criteria are too stringent, forcing drill stem components to comply with them needlessly drives up drilling cost. On the other hand, high drilling loads may demand more robust equipment. In these cases, acceptance standards need to be tighter.

5.3.2 How to Use This Section

Figure 5.2 outlines a general process which the user of this standard can apply to modify acceptance criteria and achieve fitness for purpose. It is envisioned that users will continue the practice of specifying "Premium Class" (or "Premium Class, Reduced TSR") unless drilling loads demand more stringent standards. This section may be used as a resource to handle one of two specific situations:

a. If Premium Class attributes are too loose for the well under consideration and the user needs guidance on how to tighten them selectively. The pipe will then be inspected to the tighter standard.

b. If Premium Class or Premium Class, Reduced TSR are adequate for the application and one of these is specified, however, the pipe fails to pass inspection. If this occurs and pipe replacement costs are very high, the user may be able to save money by selectively loosening criteria to make the pipe in hand acceptable. Of course, the lower limits must still provide adequate operating safety margins.

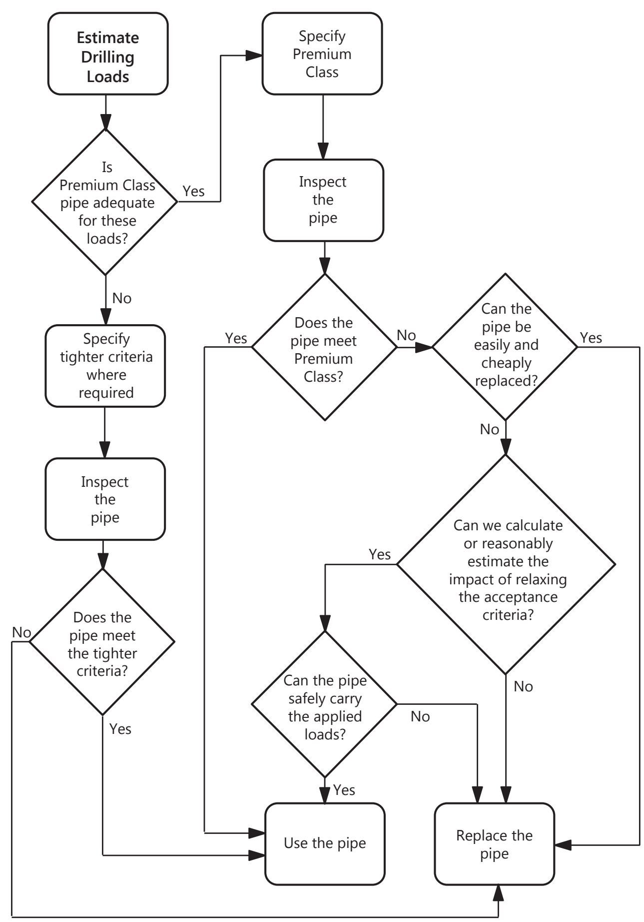


Figure 5.2 Typical process for using this approach.

5.3.3 Responsibilities

Under DS-1, the purchaser of inspection services will normally decide what acceptance criteria are in effect, and will notify the inspection company. The responsibility of the inspection company is to follow the procedures given in this standard and determine to the best of its ability whether or not the pipe meets the specified criteria. The inspection company shall not unilaterally decide the acceptance criteria unless it is specifically instructed to do so by the purchaser. This in no way precludes the inspection company from advising the purchaser, however.

5.4 Types of Acceptance Criteria

Acceptance criteria have evolved over many years, and are formed from many different perceptions of need. Some have a direct relationship to the drill string's ability to carry loads, some have an indirect relationship, and some have little or no relationship to load capacity. Before deciding whether to adjust them to achieve fitness for purpose, it is useful to classify them into groups. Whether or not to adjust them, and the confidence one may take in the adjustment, will depend upon which group the attribute in question falls into. This standard considers four types of acceptance criteria. Later in this section, each attribute is discussed individually and procedures are given that will aid the user in adjusting them.

5.4.1 Type A

A Type A condition is one in which flaw *severity* is irrelevant. If the flaw can be shown to exist at all, the part is rejected out of hand. The best example of a Type A condition is a fatigue crack. No adjustment should be made to Type A criteria.

5.4.2 Type B

Type B acceptance criteria relate some dimension to a load capacity by direct calculation. Type B criteria may be adjusted upward or downward to achieve fitness for purpose, while maintaining full confidence in the drill string. The adjustment is straightforward and based on sound engineering principles. Furthermore, with a Type B attribute, there will always be a known load limit below which failure will not occur. For example, suppose an NC38 tool joint OD was 4-5/8 inches instead of 4-13/16 inches as required for Premium Class. The tool joint can still be safely used as long as makeup torque and operating torque are determined for the actual diameter, and applied loads are kept below the new (lower) limits. All type B criteria are readily adjustable in this manner.

5.4.3 Type C

Type C criteria describe flaws whose severity will affect string performance, but unlike Type B criteria, their effects are never accurately known or determinable. Also, there will be no convenient, engineering-based level at which to fix Type C limits to guarantee against failure, nor indeed do the limits in present use meet this test. To illustrate, consider the maximum allowable slip cut (10 percent of adjacent wall for Premium Class in both RP7G-2 and DS-1). It is well documented that slip cuts are detrimental to drill pipe fatigue life, and other things equal, a deeper cut is worse than a shallower one. Obviously, some limit must be placed on slip cut severity, so fixing the maximum allowable depth at 10 percent (or somewhere else) is a necessary and convenient decision. But it cannot be tied to drill string performance in any quantitative or predictable manner. A smaller slip cut could lead to rapid fatigue failure under certain conditions, while a larger one might be harmless in other conditions. Like those of Type B, Type C criteria may be adjusted to improve fitness for purpose. Unlike Type B however, adjustment is based on subjective judgement and risk assessment rather than simple calculation. Therefore, Type C criteria cannot be adjusted with the same confidence in the result as Type B criteria.

5.4.4 Type D

A Type D criterion is something other than any of the above. Type D criteria may cause pipe that has been cold worked to be rejected, may cause rejection of pipe if inspection uncertainty is high, or may simply be some arbitrary damage limit or wear tolerance. Type D acceptance criteria may or may not affect drill string performance but are judged to be important in the decision on whether to inspect and use the pipe. Type D criteria are usually not adjusted.

5.4.5 Individual Attributes

When a drill stem component is inspected, the inspector evaluates many attributes. All of these must meet minimum levels or the component will be rejected. Table 5.2 lists the attributes that may be evaluated under this standard. In general, more attributes are evaluated at higher Service Categories, so not all items listed on Table 5.2 will be examined by the inspector except at Categories 4 and 5. If the attribute is not measured, it will not be cause for rejection.

5.5 Adjusting Acceptance Criteria

In the following pages, procedures and recommendations are given to aid the user in determining when and by how

Table 5.2 Acceptance Criteria Used in DS-1

Component	Attribute	Type
Drill Pipe Tubes	Cracks	A
	Tube wall thickness	B
	Slip area cuts, gouges	C
	Raised metal in slip area	C
	Unprovable repetitive non-destructive test indications	C
	Straightness	C,D
	OD variations	D
	Pitting	C,D
	Scale, coatings	D
Drill Pipe Tool Joints *(Visual Connection, Dimensional 1&2 Inspections)*	Weight/grade stencil	B
	Seal surface condition	C
	Refacing limits	C
	Bevel width	C
	Thread surface condition	C
	Thread profile/Pin lead	D
	Box swell	D
	Hardfacing	C
	Cracks	A
	Box OD, Pin ID	B
	Box shoulder width	C
	Tong space	B
	Box counterbore depth	B
	Box counterbore diameter	B
	Bevel diameter	C
	Box seal width	C
	Shoulder flatness	C
	Pin neck length	B
BHA Components *(Visual Connection & Dimensional 3 Inspections)*	Seal surface condition	C
	Refacing limits	C
	Bevel width	C
	Thread surface condition	C
	Thread profile/Pin lead	D
	Box swell	D
	Hardfacing	C
	Stress relief surface condition	C
	Box OD, Pin ID, BSR	B
	Box counterbore diameter	B
	Box counterbore depth	B
	Pin stress relief diameter and length	C
	Box boreback diameter and length	C
	Bevel diameter	C
	Pin length	B
	Pin neck length	B
	Center pad diameter (HWDP)	D
	Tong space (HWDP)	B
	Cracks	A
Slip Groove Drill Collars	Recess length	B
	Recess depth	B
	Drill collar OD	B
	Cracks	A

much each attribute may be adjusted to achieve fitness for purpose. A consistent format, described in Table 5.3, is used to discuss each attribute. The references to API RP7G-2 refer to the first edition, dated August 2009. Except as noted, all new and recut dimensions are based on standard API/industry values and machining tolerances.

Table 5.3 Format for Discussing Drill Stem Acceptance Criteria

Type:	The attribute type (A, B, C, or D).
Basis:	The probable reason the particular criterion is being evaluated during inspection.
Required:	The condition(s) which must be met for a component to be acceptable under DS-1. Conditions may vary depending on the drill pipe class specified. Also, this limit will not apply if the particular attribute is not to be measured (in lower Service Categories).
Reference:	The code reference and location where the particular attribute is specified. Differences in requirements between DS-1 and RP7G-2 (if any) are mentioned here.
Effects:	The probable effects that changes in the attribute will have on drill stem performance and failure probability.
Adjustment:	Discussion and formula references for adjusting the attribute.
Comments:	Additional information may be provided here.
Mechanism:	The drill string failure mechanisms that are likely to be affected if the attribute is modified.
Inspection:	The DS-1 inspection methods that are used to evaluate the attribute in question are listed here. Sometimes the attribute in question, apart from affecting drill string performance, may also affect the reliability of other inspection. The affected inspection methods, if any, are also listed.
Verify:	This paragraph lists operating equipment to check or calibrate when the attribute in question is pivotal to the string's structural integrity under the anticipated load conditions.

5.6 Acceptance Criteria on Drill Pipe Tubes

5.6.1 Fatigue Cracks

Type: A

Basis: The presence of a fatigue crack establishes that the component is damaged beyond repair. A crack is cause for rejection in all Service Categories. However, in Categories 1 and 2, fatigue cracks on tubes can only be located visually. In Category 3 and higher, various nondestructive tests are used to look for cracks. Thus, the reliability of fatigue crack detection will be higher at the higher Service Categories.

Required: None allowed for any class.

Reference: DS-1: Table 3.5.1.
RP7G-2: Table B.18.
(DS-1 and RP7G-2 are identical.)

Effects: The crack may continue to grow until failure occurs.

Adjustment: No adjustment is recommended.

Comments: Up to 90 percent or more of the component's fatigue life may be expended by the time a crack has formed and grown large enough to be detected by inspection. Given the normal cost of a drill string failure and the usual uncertainty about the magnitudes of downhole environment and cyclic loads, components with known fatigue cracks should not be run.

Mechanism: Fatigue

Inspection: Visual Tube, EMI, FLUT, MPI Slip/Upset, or UT Slip/Upset Inspection

5.6.2 Slip Area Cuts and Gouges

Type: C

Basis: Arbitrary damage tolerance

Required: Ultra Class: ≤ 5 % of adjacent wall
Premium Class & Premium Class Reduced TSR: ≤ 10 % of adjacent wall
Class 2: ≤ 20 % of adjacent wall

Reference: DS-1: Table 3.5.1.
RP7G-2: Table B-18.
(DS-1 and RP7G-2 are identical.)

Effects: Slip cuts and gouges concentrate stress and accelerate fatigue crack formation whenever the pipe is rotated, unless the pipe remains perfectly straight.

Adjustment: Allowing bigger cuts and gouges is not recommended. *The detrimental effect of a given notch increases exponentially with increasing stress. Notches that are acceptable to Premium Class requirements can still cause severe problems when the pipe is operating at high cyclic stresses. Therefore, if the drill pipe will be rotated in hole sections with high dogleg severity, particularly in water-based mud systems, the user should strongly consider a tighter tolerance such as that required by Ultra Class. Since no quantitative method exists for setting this tolerance, the user should simply make it as small as possible while still obtaining the necessary footage to drill the well. If it is necessary to use pipe with slip cuts approaching 10 percent of the adjacent wall, every effort should be made to run them in a hole section where they will not be under high cyclic load conditions.*

Comments: Mud corrosiveness, crack growth coefficients, actual stress levels and other important parameters that together determine fatigue life are rarely if ever known in any particular situation. Therefore, there is no practical way to predict how much a given slip cut or gouge on a drill pipe will reduce its fatigue life. Nevertheless, useful generalizations can still be made. Figure 5.3 illustrates the problem of slip cuts on drill pipe. The inset shows a finite element model of an (acceptable) 10 percent slip cut. This particular cut has a stress magnification effect of about 80 percent in the tension/bending conditions that were modeled. The curve shows that the effect on fatigue life of this cut could vary from no effect to as much as an 80-90 percent life reduction. The real effect will be unknown because the exact material properties, stress conditions, and environment are themselves often unknown. However, one thing we do know for certain is that any notch or cut can shorten the life under certain conditions. *In high-stress situations and corrosive muds, notches and cuts on drill pipe should be minimized or avoided altogether.*

Mechanism: Fatigue

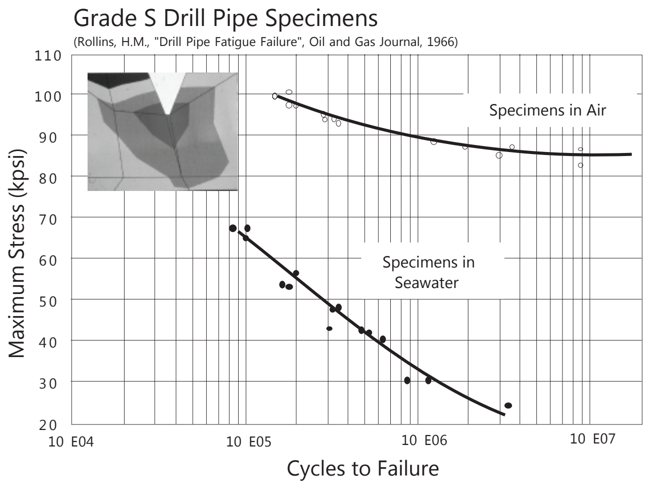


Figure 5.3 Slip cuts accelerate fatigue attack. The inset shows a FEA model of a 10 percent slip cut on 4-1/2 inch 16.60 ppf drill pipe subject to tension and bending. Stress at the bottom of the cut in this model is about 80 percent higher than bulk stress in the pipe. The actual effect of cuts will vary with the bulk stress and the environment, but will be more significant in more aggressive environments. (Curve: Reference 1, Inset: Reference 2)

Inspection: Visual Tube, EMI, FLUT, MPI Slip/Upset, UT Slip/Upset

5.6.3 Raised Metal in Slip Area

Type: C

Basis: Raised metal in the slip area increases the possibility of damaging blowout preventer elements when stripping or snubbing. Such damage could lead to premature failure of the elements and possible well control problems.

Required: Raised metal must be removed or the tube rejected.

Reference: DS-1: Visual Tube inspection procedure. (RP7G-2 does not address this attribute.)

Effects: Protrusions on the pipe surface will increase the possibility of damage to rubber elements in blowout preventers or stripper heads when the elements are energized and pipe is passing through them.

Adjustment: Adjustment is not recommended.

Inspection: Visual Tube

5.6.4 Unprovable Repetitive NDT Indications

Type: C

Basis: This requirement prevents accepting a joint of pipe containing a possibly injurious flaw that is not accessible for quantitative measurement.

Required: A repeatable flaw indication that exceeds the standardization reference level of the inspection method being used, and that is inaccessible for mechanical measurement, must result in rejection.

Reference: DS-1: EMI, FLUT, UT Slip/Upset inspection procedures.
(RP7G-2 does not address this point.)

Effects: --

Comments: The mere presence of a fatigue crack is cause for rejection, and other types of flaws cause rejection if they exceed certain sizes. Unfortunately, inspection devices that scan for flaws, such as EMI and ultrasonic units, cannot, because of their inherent technical limitations, give an accurate quantitative readout of either flaw type or size. Therefore, these units are useful only to indicate that a flaw may be present at some location on the pipe. Subsequent "prove-up" inspection is required to pinpoint the flaw and determine its type and severity. But unless these flaws are accessible to the inspector, they are impossible to prove up. Therefore, if a flaw is inaccessible, but consistently shows in repeated scans, the standard for rejection becomes the reference indication from the unit's reference standard.

Adjustment: Adjustment is not recommended.

Mechanism: All

Inspection: EMI, FLUT, MPI Slip/Upset, UT Slip/Upset

5.6.5 Tube Straightness

Type: C, D

Basis: Arbitrary damage tolerance

Required: All classes - tubes shall not be "visibly crooked."

Reference: DS-1: Visual Tube inspection procedure. RP7G-2: Pipe Body - Full-length visual inspection.

Effects: The fact that the tube is crooked establishes that its yield strength has been exceeded in past service. A crooked tube will be more prone to vibrate, with possible fatigue damage. It may result in additional side loads on casing with attendant casing wear.

Adjustment: Adjustment is not recommended.

Comments: Quantitative effects of running a bent tube are hard to determine, as strength and load capacity have probably not decreased. However, there seems little compelling reason to relax this requirement because of the possible problems related above.

Mechanism: Drill pipe tube fatigue

Inspection: Visual Tube

5.6.6 OD Variations

Type: D

Basis: Arbitrary damage tolerance

Required: Ultra Class: ±2% of specified OD

Premium Class & Premium Class Reduced TSR: ±3% of specified OD

Class 2: ±4% of specified OD

Reference: DS-1: Table 3.5.1.
RP7G-2: Table B-18.
(DS-1 and RP7G-2 are identical.)

Effects: There is little likelihood that diameter variations of this magnitude would substantially reduce the load capacity of the pipe. They may however, interfere with the proper operation of slips or result in nonuniform slip loading.

Comments: These conditions establish that the pipe yield strength has been exceeded. The causes might be slip crushing or expansion by string shot.

Adjustment: Adjustment is not recommended.

Inspection: OD Gage Tube

5.6.7 Pitting On the Pipe Surface

Type: C, D

Basis: Arbitrary damage tolerance

Required: DS-1: Corrosion pits on ID may not exceed 1/8 inch in depth for Ultra Class, Premium Class, and Premium Class, Reduced TSR. Corrosion pits may not exceed 3/16 inches in depth for Class 2. Corrosion pits on OD are addressed using surface imperfection depth criteria covered in section 5.6.2.

RP7G-2: A pit may not reduce remaining wall below 80% for Premium Class (70% for Class 2).

Reference: DS-1: Visual Tube Inspection procedure.
RP7G-2: Paragraph 10.13.8.6.2.

Effects: Pitting has two detrimental effects: First, it increases inspection uncertainty by creating background noise on inspection scan units and by creating systematic errors in wall thickness measurement units. Second, the pits act as stress concentrators to accelerate fatigue crack formation.

Adjustment: Adjustment is not recommended.

Comments: The effects of these pits are impossible to quantify. Because they usually don't significantly affect cross section, there is little likelihood that they reduce the strength or static load capacity of the drill pipe. However, their effects on fatigue life and inspection reliability are often significant.

Mechanism: Drill pipe tube fatigue

Inspection: Visual Tube, EMI, FLUT, UT Wall Thickness, UT Slip/Upset

5.6.8 Scale, Heavy Coatings, Plastic Coatings

Type: D

Basis: Arbitrary tolerance

Required: Pipe must be free from gummy protective coatings, loose scale, and flaking internal plastic coatings. Internal plastic coating in good condition is acceptable.

Reference: DS-1: Various procedures.
RP7G-2: Various procedures.

Effects: Heavy, gummy coatings are often applied to drill pipe to prevent corrosion during storage and transportation. These coatings can interfere with drill pipe inspection. Loose, flaking internal plastic coating, and flaking corrosion products not only interfere with drill pipe inspection but also can plug downhole and surface tools.

Adjustment: No Adjustment is recommended.

Comments: Pipe in this condition must be cleaned to achieve adequate inspection, or set aside as “un-inspectable.”

Mechanism: --

Inspection: Visual Tube Inspection

5.7 Acceptance Criteria for Tool Joints

5.7.1 Weight/Grade Stencil

Type: B

Basis: Weight/Grade stencils on the tool joint pin indicate the weight and grade of the drill pipe tube.

Required: At least one marking must be present. If more than one marking is present, all must agree.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.14.7. (DS-1 requires rejection of pipe with no markings or conflicting markings. RP7G-2 requires reporting lack of markings on the inspection report.)

Effects: Incorrect drill pipe weight or grade can cause failure by a number of mechanisms.

Adjustment: None recommended.

Mechanism: Tension, torsion, combined tension/torsion, burst pressure, and collapse pressure.

Inspection: Visual Connection inspection

5.7.2 Seal Surface Condition

Type: C

Basis: The only pressure seal in a rotary shouldered connection occurs at the seal face. If seal surfaces are significantly damaged, the connection will leak.

Required: DS-1: No protruding metal or corrosion deposits, no interruptions of the seal surface that exceed 1/32 inch in depth or 20% of the seal width.

RP7G-2: No protrusions are allowed. Depressions more than 1/16 inch from the OD bevel or counterbore, cover less than 50% of the seal area, and extend no more than 0.25 inch in the circumferential direction are acceptable.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.14.8.1.2 & 10.14.8.1.4.

Effects: See above.

Adjustment: None recommended.

Comments: This attribute is one of the most difficult to specify in any meaningful manner. Seal condition has a direct relationship to sealing capability. However, any damage tolerance must be arbitrary because the other factors that affect sealing are unknown at the time of inspection. The requirements in DS-1 are preferable to those in RP7G-2 because they will reduce the risk of leakage through the seal.

Mechanism: Connection leak

Inspection: Visual Connection Inspection

5.7.3 Refacing Limits

Type: C

Basis: Cumulative refacing can be determined on those connections equipped with a refacing benchmark. The limits below are arbitrary.

Required: Not more than 1/32 inch may be removed from a connection shoulder at a time, and cumulative refacing may not exceed 1/16 inch.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.14.8.1.5. (DS-1 and RP7G-2 are identical.)

Effects: Excessive refacing causes inadequate seal loading and possible downhole shoulder separation. It also creates tensile hoop stress in boxes, which can result in split box failures.

Adjustment: None recommended.

Comments: If no benchmark is present, it may be possible to determine whether or not too much refacing has occurred by examining other thread elements. This is done by comparing their measurements to presumed original dimensions. However, manufacturing tolerances on other dimensions will often cause these attempted comparisons to fail.

Mechanism: Connection Leak, Split Box

Inspection: Visual Connection inspection

5.7.4 Bevel Width

Type: C

Basis: A bevel is required on all rotary shouldered connections, primarily to help prevent seal and shoulder damage that could cause leaks.

Required: DS-1 requires that a bevel at least 1/32 inch wide and approximately 45 degrees must be present for the full circumference of the connection. RP7G-2 requires a 1/32 inch bevel for the full circumference but has no requirement regarding the angle of the bevel.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.14.7.

Effects: The absence of a bevel increases the probability that minor handling impacts will raise metal above the seal surface and cause a leak.

Adjustment: None recommended.

Comments: See above.

Mechanism: Connection Leak

Inspection: Visual Connection inspection

5.7.5 Thread Surface Condition

Type: C

Basis: Thread condition is examined primarily to ensure that the connection will makeup properly and will retain its structural strength.

Required: DS-1: No damage exceeding 1/16 inch in depth or 1/8 inch in diameter, or that extends more than 1-1/2 inches along the thread helix, or that penetrates below the thread root. RP7G-2: Threads are rejected for: protrusions (repairable by filing); galling; pits, cuts, and gouges that are located on the thread flanks and are deeper than 1/32 inch; pits, cuts, and gouges that are located in the thread root and are within two threads of the last engaged thread, and; pits, cuts, and gouges that are located outside of the last two threads of the last engaged thread and that are deeper than 1/32 inch.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.14.8.2.1, 10.14.8.2.2, and 10.14.8.2.3.

Effects: Thread condition plays a key role in the function and structural strength of the connection.

Adjustment: The thread condition limits above are arbitrary. Therefore, except for flaws that penetrate the thread roots, the user could probably loosen the requirements somewhat if doing so would allow accepting a large number of otherwise rejectable connections. Flaws in the thread roots should be avoided as they will increase the probability that fatigue cracks will form.

Comments: Like seal condition requirements, thread condition requirements in DS-1 have little quantitative engineering basis beyond general experience. Nevertheless, some values are required, so those listed above are used.

Mechanism: Connection Leak

Inspection: Visual Connection inspection

5.7.6 Thread Profile/Pin Lead

Type: D

Basis: Thread profile and lead are measured to determine if the pin has been cold worked (stretched) in past use, and to make sure thread flanks are not worn excessively.

Required: DS-1: No stretch exceeding 0.006 inches in 2 inches. Thread crest gap not to exceed 1/16 inch. Uniform flank wear not to exceed 0.010 inches.
RP7G-2: No gaps between the profile gauge and the thread crests exceeding 1/32 inch over four consecutive threads or 1/16 inch over two consecutive threads. No gaps between the profile gauge and the thread flanks exceeding 1/64 inch. No stretch exceeding 0.006 inches in 2 inches.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.14.8.2.4

Effects: Thread condition plays a key role in the function and structural strength of the connection.

Adjustment: None recommended.

Comments: The limit for pin stretch in DS-1 are consistent with RP7G-2. The other requirements in DS-1 are arbitrary wear tolerances. Lead measurement with a lead gage on all connections is required when visible gaps are present if a hardened and ground profile gage is applied to the threads.

Mechanism: Connection Leak

Inspection: Visual Connection inspection

5.7.7 Box Swell

Type: D

Basis: Box swell, like pin stretch, is an indication that a connection has been stressed past its yield point in the past.

Required: DS-1: No box swell exceeding 1/32 inch. RP7G-2: No box swell exceeding 1/32 inch.

Reference: DS-1: Visual Connection Procedure. RP7G-2: Paragraph 10.15.6.1. (DS-1 and RP7G-2 are identical.)

Effects: Box swell of this magnitude is evidence that the connection has been overtorqued. While this may have little or no effect on the box's ability to carry torsional loads and to seal pressure, the box's resistance to splitting under high side loads may be impaired.

Adjustment: None recommended.

Comments: Measuring box counterbore is another check on the same condition.

Mechanism: Split box

Inspection: Visual Connection, Dimensional 1, Dimensional 2, Dimensional 3 inspection

5.7.8 Hardfacing

Type: C

Basis: This requirement places arbitrary limits on the height and surface condition of tool joint hardfacing.

Required: DS-1: Hardfacing may not be higher than 3/16 inch above the surface nor contain broken or missing areas greater than 1/8 inch across. No protruding carbide chips are allowed. (This attribute is not covered in RP7G-2.)

Reference: DS-1: Visual Connection Procedure

Effects: Hardfacing that is too rough or raised too high above the tool joint surface can cause severe casing wear.

Adjustment: Loosening these requirements is not recommended if the drill pipe will be rotated inside casing. Furthermore, if the pipe will be rotated for long periods with high side loads inside casing, consider tightening the requirements. Even if drill pipe will be rotated only in open hole, limits on hardfacing condition may still need tightening if the well has sharp doglegs. Trip wear could still be a major problem as side loads are highest while tripping out.

Inspection: Visual Connection inspection

5.7.9 Cracks

Type: A

Basis: The presence of cracks in the tool joint body or threads (except for hairline cracks in hardbanding metal) is considered presumptive evidence that the component is damaged beyond repair. Note: Although a tool joint crack is cause for rejection if detected in any Service Category, in Categories 1 through 4, cracks must be located visually. In Category 5, Blacklight Connection inspection is used to detect cracks.

Required: None allowed for any class.

Reference: DS-1: Table 3.5.1 and various inspection procedures. RP7G-2: Paragraph 10.16.

Effects: The crack may continue to grow until failure occurs.

Adjustment: No adjustment is recommended.

Comments: Almost all cracks in tool joints will be either fatigue cracks or heat checks. If a crack is fatigue related, up to 90 percent or more of the component's life may be expended by the time a crack has formed and grown large enough to detect by inspection. Heat checks, because of their predominate longitudinal orientation, probably do not reduce string tensile or torsional capacity, but will aggravate failure by box splitting. Therefore, heat checks should cause somewhat less immediate structural concern than fatigue cracks, which are virtually always transverse in orientation and do reduce the string's capacity to bear tension and torsion. Given the usual cost of drill string failures, there is little justification to run components with any kind of cracks.

Mechanism: Fatigue, Split box

Inspection: Visual Connection, Blacklight Connection, UT Connection, Liquid Penetrant Connection Inspection

5.7.10 Outside Diameter, Inside Diameter

Type: B

Basis: Tool joint OD and ID are measured to ensure that they will provide adequate tool joint torsional strength for the size, weight, grade, and class of drill pipe to which the tool joint is attached.

Required: Ultra Class, Premium Class, & Class 2: Tool joint minimum OD and maximum ID are those which will result in a tool joint torsional capacity of approximately 80 percent of the torsional capacity of the tube.

Premium Class, Reduced TSR: Tool joint minimum OD and maximum ID may allow a tool joint torsional capacity down to about 60 percent of the premium class tube.

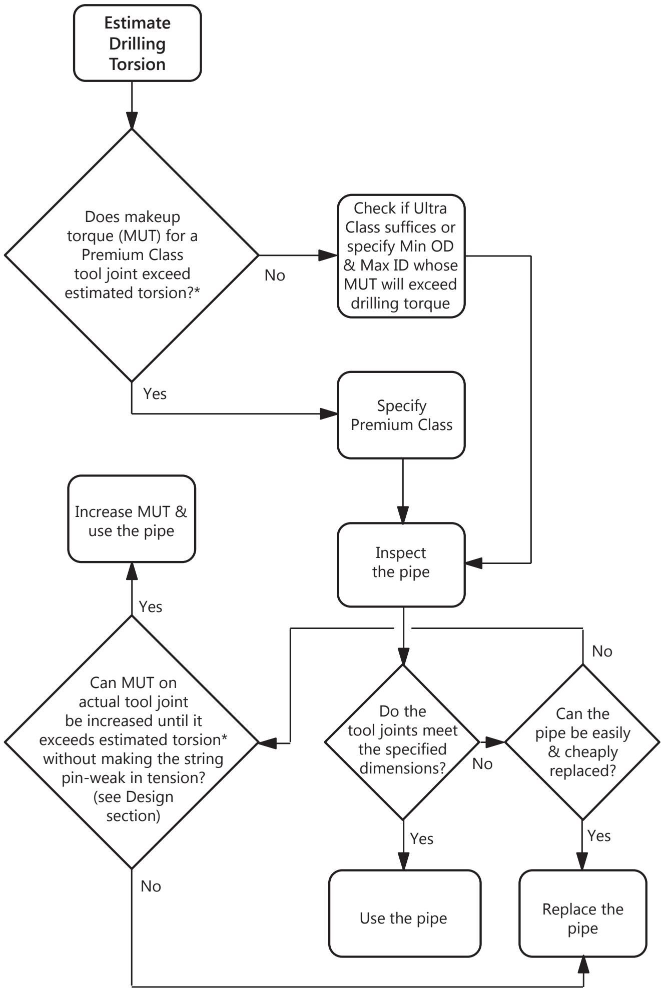
Reference: Ultra Class, Premium Class, & Class 2: DS-1 Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable.
RP7G-2: Table D.6. (DS-1 and RP7G-2 requirements are identical.)
Premium Class, Reduced TSR: Minimum tool joint OD is given in Table 3.7.26 of DS-1. RP7G-2 does not officially recognize this class of drill pipe, though it's commonly used for drilling.

Effects: For a given connection, tool joint torsional capacity and makeup torque are governed by tool joint OD and ID. The weaker of the two elements limits. Thus, variations in pin ID do not affect the makeup torque or torsional capacity of a box-weak connection, and vice-versa. However, variations in pin ID do affect a connection's ability to carry combined makeup torque and drill string tension, regardless of whether the connection is pin or box weak.

Adjustment: Tool joint box OD and pin ID may be adjusted to achieve fitness for purpose. In horizontal and extended reach drilling, torsional capacity of the tool joint is often the factor that limits further loading of the drill string. Therefore, tool joint diameters larger than Premium Class may be required for these type wells. In moderate angle wells, torsional capacity may not be a major concern, and tool joints having less than Premium Class dimensions are often strong enough.

Operating torsion should always be less than makeup torque, taking anticipated wear and safety factors into account. Therefore, adjustment is made after forecasting torsional loads in the drilling operation. If the anticipated drilling torque exceeds makeup torque, then only three choices are available: 1) Increase makeup torque, 2) Replace the pipe with stronger tool joints or 3) Change the frictional characteristics of the wellbore, pipe, and mud system. Option 1 is the cheapest, and as long the procedures in the design section are followed, should result in satisfactory performance of the string. Figure 5.4 illustrates the process. Makeup torques for various connection diameters are given in Table 3.14.

Comments: If possible, makeup torques should be maintained at least 10-15 percent above maximum operating torque and within the pin neck combined makeup torque and tension limits. Within these constraints, the acceptable tool joint dimensions may be adjusted as required by the loads to be applied. However, if the anticipated operating torque will be very close to the makeup torque, rig crews should be instructed and equipped to watch for signs of over-torque and downhole makeup. Specific signs of over-torque are given in section 4. Also, if the pin neck tensile capacity is made weaker than the tube tensile capacity by excessive makeup torque, the string tensile capacity should be derated accordingly.



** Taking probable wear and safety factors into account*

Figure 5.4 A process for setting and adjusting tool joint diameter requirements. References to Premium Class also apply to Premium Class, Reduced TSR.

Mechanism: Torsion, Combined Tension/Torsion

Inspection: Dimensional 1, Dimensional 2

Verify: Rig makeup torque indicator, rig operating torque indicator. While drilling, monitor tool joint wear and confirm the accuracy of the drilling torque prediction and assumptions.

5.7.11 Box Shoulder Width

Type: C

Basis: This dimension is established to force a minimum sized box shoulder (not seal) for rotary shouldered connections.

Required: Varies with size, weight, and grade.

Reference: DS-1: Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable.
RP7G-2: Table D.6.
(DS-1 and RP7G-2 are identical.)

Effects: Insufficient shoulder width could cause local yielding on the thin section of a box shoulder at makeup.

Adjustment: None recommended.

Comments: Under eccentric wear, it's possible for a tool joint box to meet the minimum OD requirements of this standard, yet have a very thin box shoulder that is incapable of carrying full makeup torque at the thin point. The minimum box shoulder width limit is intended to prevent this condition. Shoulder width is often confused with seal width on a rotary shouldered connection. Box shoulder width is the distance from the counterbore to the outside diameter of the box, neglecting bevel. Seal width (of the box) is the distance from the counterbore to the inside diameter of the bevel.

Mechanism: Torsion

Inspection: Dimensional 1, Dimensional 2 Inspection

5.7.12 Minimum Tong Space

Type: B

Basis: Tool joints must be long enough to be gripped by tongs.

Required: Pins: 75% of minimum tool joint OD with a minimum of 4 inches

Boxes: Box length (L_{BC}) plus 1 inch minimum.

Reference: DS-1: Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable.
RP7G-2: Paragraph 10.20.6. (DS-1 and RP7G-2 are identical except that DS-1 excludes the bevel from the tong space measurement whereas RP7G-2 includes the bevel in the measurement of tong space.)

Effects: Inadequate tong gripping space can result in damage to tool joint seal surfaces.

Adjustment: None recommended.

Mechanism: Connection leak

Inspection: Visual Connection

5.7.13 Counterbore Depth

Type: C

Basis: This measurement may identify over-refacing if no refacing benchmark is present or if a benchmark is in the wrong position.

Required: New nominal depth minus machining tolerance minus 1/16 inch.

Reference: DS-1: Dimensional 2 inspection procedures. RP7G-2: Paragraph 10.26.5.

Effects: Excessive refacing causes inadequate seal loading and possible downhole shoulder separation. It also creates tensile hoop stress in boxes, which can result in split box failures.

Adjustment: None recommended.

Comments: In the absence of a refacing benchmark, measuring counterbore depth is the best method of discovering an over-refaced box. The 1/16 inch reduction on minimum new counterbore depth accounts for the maximum refacing limit. Measuring counterbore depth is not a foolproof method for detecting over-refacing. If a counterbore was originally machined to the other end of its tolerance, an over-refaced condition would be less likely to be detected.

Mechanism: Connection leak, Split box

Inspection: Dimensional 2 (Counterbore depth is not measured in Dimensional 1 inspection.)

5.7.14 Maximum Counterbore Diameter

Type: B

Basis: This measurement may identify past torsional yield in connection boxes.

Required: New nominal diameter plus machining tolerance plus 1/32 inch.

Reference: DS-1: Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable.
RP7G-2: Paragraph 10.15.6.1.
(DS-1 and RP7G-2 are identical.)

Effects: Torsion beyond the torsional yield strength of a box-weak connection will cause belling in the seal area.

Adjustment: None recommended.

Comments: The presence of a belled box suggests that connection has been torqued past its yield point in the past. Because of OD wear on the tool joint, this condition may only show up as an enlarged counterbore. If this condition is present, it has been long standing practice to recut the tool joint, though in emergency situations with no other material available there is probably no technical reason why such a connection could not be used temporarily.

Mechanism: Torsion, Split box

Inspection: Dimensional 2, Dimensional 3 (Counterbore diameter is not measured in Dimensional 1 inspection.)

5.7.15 Maximum Bevel Diameter

Type: C

Basis: Excess bevel diameter could mean reduced connection sealing capacity.

Required: New nominal diameter plus 1/64 inch machining tolerance, rounded up to the nearest 1/32 inch

Reference: DS-1: Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable. (RP7G-2 does not address.)

Effects: A connection's sealing capacity may be reduced if the bevel diameter is too large. Also, bevel mismatch can result in finning or galling of the seal areas.

Adjustment: None recommended.

Comments: The restriction is placed on maximum bevel diameter. Refacing increases bevel diameter. Unless the connection is re-beveled after being refaced, its sealing capacity can be reduced because increased shoulder area will result in lowered bearing (sealing) stress between the pin and box seals. After refacing, connections are required to be re-beveled to achieve a bevel diameter no larger than that shown in Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable.

Mechanism: Connection leak, Split box

Inspection: Dimensional 2 (Bevel diameter is not measured in Dimensional 1 inspection.)

5.7.16 Seal Width

Type: B

Basis: Minimum seal width is established to reduce the probability of leaking and galling at the seal surfaces.

Required: Minimum seal width is that which would result in a seal bearing pressure (at nominal makeup torque) equal to the yield stress of the tool joint or component material.

Reference: DS-1: Table 3.7.1-3.7.25 and 3.8.1-3.8.7, as applicable.
RP7G-2: Paragraph 10.26.5.

Effects: A higher probability of connection leaks exists if seal width is not controlled.

Adjustment: None recommended.

Comments: Confusion often exists between shoulder width and seal width. Shoulder width (of the box) is the distance from the counterbore to the outside diameter of the box, neglecting bevel. Seal width (of the box) is the distance from the counterbore to the inside diameter of the bevel. Shoulder width is primarily a torsional strength issue, while seal width bears more on connection sealability.

The method by which the minimum seal width given in DS-1 Table 3.7.1 were calculated is as follows:

1. Seal radius:

$$R_S = \frac{W_S + Q_C}{2} \quad \text{(5.1)}$$

2. Seal area:

$$A_S = \pi\left[(W_S \bullet Q_C) + W_S^2\right] \quad \text{(5.2)}$$

Where:

Q_C = Box counterbore diameter (in)
R_S = Seal radius (in)
A_S = Seal area (in^2)
W_S = Minimum seal width (in)

Equations 5.1 and 5.2 are substituted into the torsional strength equation (equation A.14) and rearranged to produce a third-degree polynomial in terms of W_S. This equation is solved with an iterative technique to determine minimum seal width.

Seal width values in API RP7G-2 are arbitrarily set at the minimum box shoulder width less 3/64 inch.

Mechanism: Connection leak

Inspection: Dimensional 2 (Seal width is not measured in Dimensional 1 inspection.)

5.7.17 Shoulder Flatness

Type: C

Basis: Shoulders must be flat and perpendicular to the connection axis for uniform loading and adequate leak resistance.

Required: No visible gap is allowed when a straightedge and/or a flat plate is placed on the shoulder.

Reference: DS-1: Visual Connection Procedure.
RP7G-2: Paragraph 10.14.8.1.5.
(DS-1 and RP7G-2 are identical.)

Effects: A connection's capacity to makeup and seal properly requires that the shoulders be flat and perpendicular to the connection axis.

Adjustment: None recommended.

Mechanism: Connection leak

Inspection: Visual Connection (Shoulder flatness is not measured in Dimensional 1 inspection.)

5.7.18 Pin Neck Length

Type: B

Basis: Excessive pin neck length may result from improper machining or excessive field refacing.

Required: Pin neck length may not be more than the minimum counterbore depth on the mating box minus 1/16 inch. This ensures that box threads will always have full depth pin threads with which to mate.

Reference: DS-1: Dimensional 2 and Dimensional 3 inspection procedures.
RP7G-2: Paragraph 10.26.5.
(DS-1 and RP7G-2 are identical.)

Effects: If this dimension is too long, thread crests may not have mating pin thread roots. In that event, severe hoop stress would arise as box thread crests ride up onto the pin neck cylinder during makeup. Proper connection makeup would be impaired, and box failure by splitting would be much more likely.

Adjustment: None recommended.

Mechanism: Connection leak, Split box

Inspection: Dimensional 2, Dimensional 3

5.8 Acceptance Criteria for Rotary Shouldered Connections on BHA Components

(Note: The above comments applying to tool joint connection damage also apply to BHA connection damage for the following conditions: Seal surface condition, Refacing limits, Bevel width, Thread surface condition, Thread profile/pin lead, Box swell, Hardfacing, Counterbore depth , Counterbore diameter, Bevel diameter, Pin neck length, and Cracks. The rationale and comments below apply only to connections on BHA components).

5.8.1 Outside Diameter, Inside Diameter, BSR

Type: B, C

Basis: Connection OD and ID are measured on BHA components to determine connection Bending Strength Ratio (BSR).

Required: The allowed values are determined by the connection type and specified BSR ranges.

Reference: DS-1: Table 3.16.
RP7G-2: Paragraph 10.26.6.1.
RP7G-2 and DS-1 OD and ID requirements are identical for a given connection and BSR.

Effects: A high BSR increases the probability of pin fatigue failure, and vice versa for box failures. A balanced BSR optimizes connection fatigue life.

Adjustment: Bending Strength Ratio is a concept that applies only to the fatigue mechanism in BHA components. In theory, a "balanced" connection has the maximum fatigue life because it distributes fatigue damage equally between box and pin so that one component or the other doesn't fail prematurely (see Figure 5.5). BSR has no meaning when applied to tool joints on normal weight drill pipe, nor does it relate to other performance properties of BHA connections. The historical BSR target of 2.5 has led the industry to specify a "standard" range of around 2.25-2.75 as acceptable for BHA components. This range was adjusted into the current three size categories based on empirical trends. However, the target is experiential rather than based upon calculation or a large amount of empirical data. Therefore, it should not be considered inviolable. The availability of equipment, the need for clearance or failure history can help decide the target BSR. The best approach is probably to use the standard range unless experience suggests otherwise. Then, if problems occur, the BSR can be adjusted as shown in Figure 5.6.

Comments: If it becomes necessary to change BSR, this may be done in one of two ways: By adding material to the weaker member or taking material away from the stronger member. The first alternative is preferable from the failure prevention standpoint. It is not always economical however, as it requires a complete change out of equipment.

For most standard size BHA's, fatigue is the dominant concern, so torsional strength is rarely a factor in component inspection. For small BHA components where torsional strength is the dominant concern, OD and ID may need to be controlled to ensure torsional strength is above the minimum required.

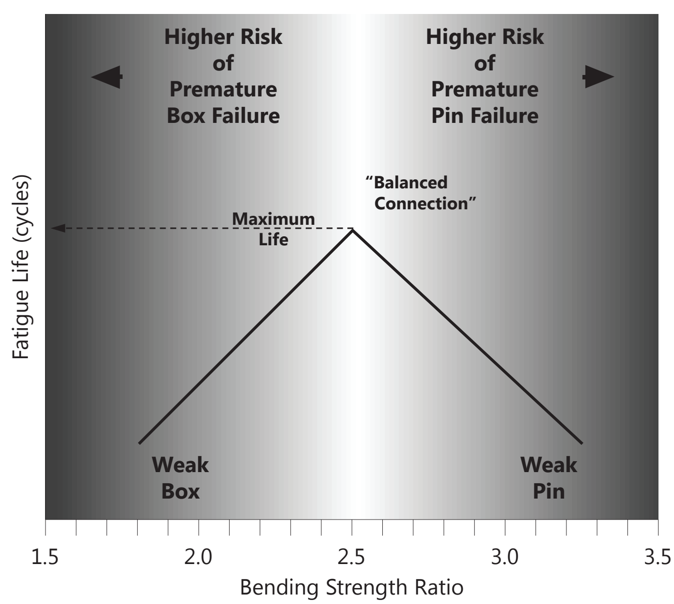


Figure 5.5 Controlling Bending Strength Ratio (BSR) by controlling drill collar connection OD and ID is an attempt to spread fatigue damage equally between box and pin. The historical target of 2.5 is only an approximation. Local experience and equipment availability also play large parts.

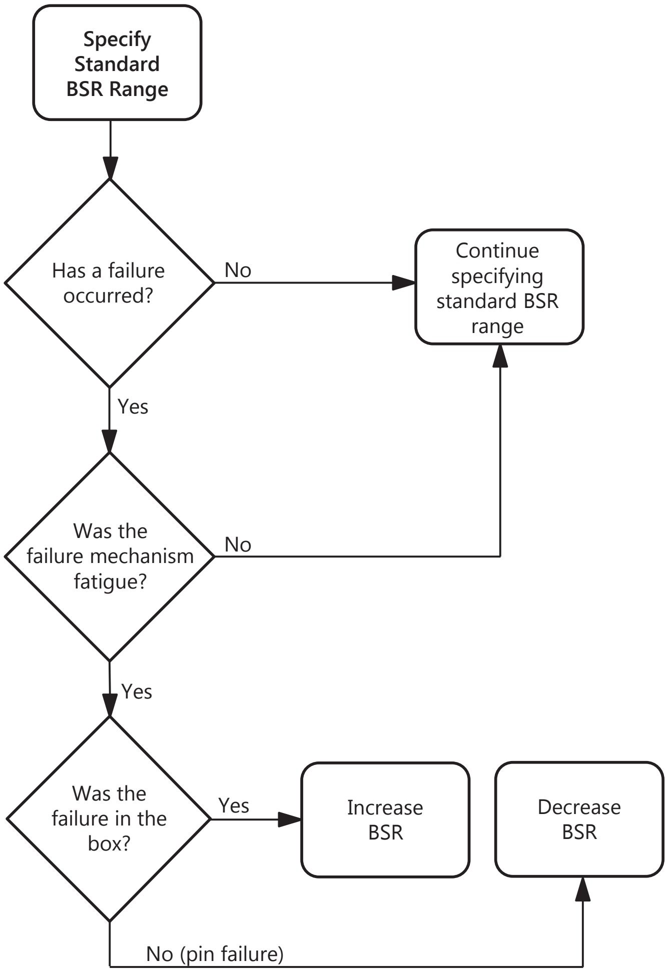


Figure 5.6 The general process for adjusting BSR.

Mechanism: Fatigue

Inspection: Dimensional 3

5.8.2 Cracks

Type: A

Basis: The presence of cracks in a BHA connection or slip groove is considered presumptive evidence that the component is damaged beyond repair. Note: A BHA connection crack is cause for rejection if detected in any Service Category. However, in Categories 1 and 2, cracks must be located visually. In Categories 3-5, Blacklight Connection inspection, Ultrasonic Connection Inspection, or Liquid Penetrant Connection inspection (whichever applies) are used to detect cracks.

Required: None allowed.

Reference: DS-1: Various inspection procedures.
RP7G-2: Various inspection procedures.

Effects: The crack may continue to grow until failure occurs.

Adjustment: None recommended.

Comments: Almost all cracks in BHA connections will be fatigue cracks. Up to 90 percent or more of the component's life may be expended by the time a crack has formed and grown large enough to detect by inspection. Given the usual cost of drill string failures, there is little justification to run components with any kind of cracks.

Mechanism: Fatigue

Inspection: Visual Connection, Blacklight Connection, UT Connection, Liquid Penetrant Connection Inspection

5.8.3 Dimensions of Stress Relief Features

Type: C

Basis: Stress relief features extend a connection's fatigue life by lowering stress at the critical sections of the connection.

Allowed: Dimensions vary with the connection.

Reference: DS-1: The allowed values are given in Table 3.9 for drill collars and Table 3.10.1 for HWDP. RP7G-2: Table D.10.

Effects: The absence of properly dimensioned stress relief features can shorten a connection's fatigue life.

Adjustment: Stress relief features reduce the effects of cyclic stresses, which in BHA's come primarily from rotating components while they're bent or buckled, and from vibration. Therefore, loosening this criterion is not recommended if the BHA component will be operated under any of these conditions. However, dimensional requirements for stress relief features could be relaxed without serious concern if the component were to be operated under conditions where all of the following are met: 1) The hole is straight, neither building or dropping angle or inclination, 2) Hole angle is higher than 15 degrees from vertical and 3) High vibration or stick-slip conditions are not present.

Comments: DS-1 Fifth Edition recommends a pin relief groove width of 3/4 inch (-1/32 inch, + 9/32 inch).

Mechanism: Fatigue

Inspection: Dimensional 3

5.8.4 HWDP Center Pad Diameter

Type: D

Basis: Arbitrary wear allowance on the center upset of heavy weight drill pipe.

Required: Varies for each size.

Reference: DS-1: Section 3.14.4.
RP7G-2: Paragraph 10.41.6.

Effects: Inadequate wear tolerance may result in the company that rents the HWDP being charged with replacement costs for which it may not be totally responsible.

Adjustment: This attribute has little effect on the performance of the string. If the commercial agreement between the owner and renter of HWDP satisfactorily addresses the issue of responsibility for wear, there is no need for this requirement.

Mechanism:

Inspection: Dimensional 3

5.8.5 Maximum Pin Length

Type: B

Basis: The threaded length of a pin must not be so long as to bottom out at the base of the box and prevent proper makeup and sealing.

Required: Maximum length is new nominal plus manufacturing tolerance plus 1/16 inch (for refacing tolerance).

Reference: DS-1: Table 3.9.
RP7G-2 does not address pin length.

Effects: If the pin tip bottoms out at the back of the box, proper connection makeup and sealing are impaired.

Adjustment: None recommended.

Comments: The requirement to measure pin length applies only to BHA components.

Mechanism: Connection leak

Inspection: Dimensional 3, Table 3.9

5.8.6 Stress Relief Feature Surface Condition

Type: C

Basis: Stress relief features should be relatively smooth, as rough, pitted surfaces create stress concentrations that can negate the benefit of the stress relief feature.

Required: Pits may not exceed 1/32 inch in depth.

Reference: DS-1: Visual Connection procedure.
RP7G-2: Paragraph 10.27.8.4.

Effects: See above.

Adjustment: This criterion is arbitrary. No quantitative assessment of pitting can be made unless the pitting geometry is already known, which of course cannot be the case. Therefore, the user may elect to relax this requirement somewhat if replacement is costly and drilling conditions will not be too severe. Unfortunately, no firm guidelines on how much relaxation is appropriate can be given here without knowing the conditions under which the components will be used. However, the following approximations may be useful:

- If the components will be drilling at angles less than 15 degrees or in curved hole sections, maintain the requirement.
- If the components will only be drilling oil-based mud, or in straight holes at angles greater than 15 degrees, the maximum allowable pit depth may be increased.

Comments: The reader is cautioned that no data or analysis is available to establish maximum pit depth.

Mechanism: Fatigue

Inspection: Visual Connection

5.9 Acceptance Criteria for Elevator Grooves on Drill Collars

The inspection of drill collar elevator grooves has been covered in past editions of DS-1 Volume 3, but in the Fifth Edition these inspections have been removed. Recent industry failures have highlighted to the API committees that there was a weakness in available drill collar elevator sizes and their ability to safely lift collars in many cases. The API committees have decided to no longer support square-shouldered drill collar elevators or traditional square-shouldered drill collar elevator grooves. The DS-1 sponsor group agrees and has followed this pattern.

References

1. Rollins, H.M.: "Drill Pipe Fatigue Failure," Oil and Gas Journal, April, 1966.
2. Hill, T.H., Seshadri, P.V., Durham. K.S., "A Unified Approach to Drill String Failure Prevention," SPE Drilling Engineering, December, 1992.

Glossary

A

Acceptable Component: A drill stem component that meets or exceeds the acceptance criteria of this standard after undergoing the specified inspection program.

Acceptance Criteria: The dimensions, conditions, and properties that a drill stem component must meet or exceed to be considered acceptable.

API: American Petroleum Institute.

Arbitrary Acceptance Criteria: A set of acceptance criteria that was not established to meet a specific set of drilling conditions. (Example: "Premium Class").

ASNT: American Society for Nondestructive Testing.

ASQC: American Society for Quality Control.

Auditable Statement: A statement that will result in the same action when performed independently by more than one individual. Examples (auditable statement): "The tube shall not be longer than 33.0 feet." (Non-auditable statement): "The tube length shall not be excessive."

Austenitizing: Heating steel to the austenitizing temperature (about 1670 degrees F) and allowing time for the steel microstructure to transform to Austenite. Normally the first step in heat treating a steel drill stem component.

B

Bevel Diameter: The outer diameter of the contact face (seal surface) of a rotary shouldered connection.

BHA (bottom hole assembly): An assembly of heavy drill stem components configured to accomplish certain tasks and placed at the bottom of the drill string. BHA components may concentrate weight on the bit, rotate the bit, measure drilling parameters and hole trajectory, steer the bit, or perform other functions.

Bit Sub: The component that connects the bit to the component immediately above. Bit subs usually have box connections on both ends.

Blacklight Connection Inspection: A DS-1 inspection method employing a wet-fluorescent magnetic particle process to look for fatigue cracks in connections.

Blacklight Inspection

Boreback Box: Machining in the box end of BHA connections to remove un-engaged threads and make the connection more limber. These steps increase the fatigue life of the box.

Box End: The half of a threaded connection having internal (female) threads.

BSR (Bending Strength Ratio): On bottomhole assembly connections, the ratio of the box section modulus to the pin section modulus. BSR applies only to connections on drill collars and other stiff-bodied components that are run in the BHA. It does not apply to HWDP connections, except the one immediately above the drill collars, or to the connections of any components that are not normally run in the BHA.

C

Calibration: Correcting a measuring device by comparing its output with a standard of known dimensions traceable to the NIST (National Institute of Standards and Technology) or an equivalent body.

Category: One of six different inspection levels which roughly parallel the severity of drilling service. The inspection category is set by the purchaser of inspection services and establishes the inspection program to be applied to the drill string.

Class: See Drill Pipe Class.

Class 2: A set of acceptance criteria for used drill pipe taken from API RP7G-2. Class 2 pipe may have more wear and damage than Premium Class pipe.

Cold-Rolling: Imparting residual compressive strain to a BHA connection to improve its fatigue resistance.

Cold Working: Imparting plastic strain to a component by stressing it beyond its elastic limit. Cold working hardens steel and may render it less resistant to certain failure mechanisms like sulfide stress cracking.

Crack: A line on the surface of the material along which it has partial separation, with or without a perceptible opening.

Crossover Sub: A short component with different threads on either end used to convert sections of the drill stem from one threaded connection to another.

Curvature Index (CI): A measure of the relative fatigue life of a drill pipe tube that is rotating in a curved hole section, taking into account hole curvature, pipe diameter, grade, class and weight, and axial tension in the pipe.

D

Dedendum: The distance between the pitch line and root of a thread.

Dimensional 1: A DS-1 inspection method applied to connections on normal weight drill pipe. Dimensional 1 consists of measurement or go-no-go gaging of box OD, pin ID, shoulder width, and tong space.

Dimensional 2: A DS-1 inspection method (more rigorous than Dimensional 1) applied to connections on normal weight drill pipe. In addition to the measurements made in Dimensional 1, measurement or go-no-go gaging of counterbore depth, box counterbore, pin flat length, and bevel diameter are measured in Dimensional 2.

Dimensional 3: A DS-1 inspection method applied to connections on heavy weight drill pipe and other BHA components. Dimensional 3 consists of measuring box OD, pin ID, pin lead, bevel diameter, pin stress relief diameter and width, box counterbore diameter, pin thread length, and HWDP center upset diameter.

Drill Collar: Thick-walled pipe used to provide stiffness and to concentrate weight at the bit.

Drill Pipe: A length of pipe, usually steel, to which threaded connections called tool joints are attached.

Drill Pipe Class: A system established by API for ranking the extent of wear and deterioration of drill pipe tubes and tool joints. The specified drill pipe class determines the acceptance criteria to be used by the inspector, and some of the loads that can be safely applied to the component. Drill pipe classes recognized in this standard are, in declining order of load capacity:

- Class 1 (New)
- Ultra Class (Not recognized by API)
- Premium Class
- Premium Class, Reduced TSR (Not recognized by API)
- Class 2

Drill Stem: All the components that are connected together and form the assembly used to drill the well, usually considered from the bottom of the top drive or swivel downward. Also called "Drill String," although the latter term is often used to refer to that part consisting only of normal weight drill pipe.

E

Electromagnetic Inspection: A DS-1 inspection method involving full-length scanning (between upsets) of normal weight drill pipe tubes using a longitudinal field buggy unit. Only transverse flaws are detected by EMI Inspection. Optional wall thickness monitoring can also be incorporated.

EMI buggy unit

Elevator Groove: A groove cut into drill collars in which elevators can be latched. In Fifth Edition, following the recommendations of the API committees of interest, lifting drill collars with elevator grooves is discouraged. As such, there is no longer a dimensional inspection associated with drill collar elevator grooves as there has been in previous editions.

Extended Reach (ER): A term applied to certain wells characterized by large horizontal displacement to TVD ratios. For design considerations in this standard, ER wells are those wells in which traditional BHAs are removed from the drill stem and bit weight is applied by operating normal weight drill pipe in compression.

F

Failure: Improper performance of a component that prevents completion of its intended function.

Failure Driver: A condition or situation which accelerates a failure mechanism and leads to more rapid failure. Example: Drilling mud corrosiveness is a failure driver for fatigue. More corrosive mud systems cause a drill string component to fail quicker by fatigue, other things equal.

Failure Mechanism: A name given to a chain of conditions and events by which failure can occur (example: Fatigue).

Fatigue: The progressive localized permanent structural damage that occurs when a material undergoes repeated, fluctuating stress cycles. As fatigue damage accumulates at a point, a fatigue crack or cracks can form. Under continued stress cycles, these cracks can grow until failure occurs. In drill stem components, stress cycles occur when the component is bent or buckled, then rotated. They also result from vibration.

Fatigue Crack: A crack resulting from fatigue.

Fitness for Purpose: The principle of tightening or loosening the arbitrary acceptance criteria in this standard when such action is appropriate for either reducing risk or safely reducing cost.

Forging: *(verb)* Plastically deforming metal into desired shapes with compressive force. *(noun)* A shaped metal part formed by the forging method.

Full Length Ultrasonic Inspection (WT/TL/Obl): A DS-1 inspection method involving full length inspection of drill pipe tube bodies using ultrasonic scans. The customer can choose which types of scans are used: Wall Thickness (WT) uses compressional wave scans for minimum wall thickness measurements; Transverse & Longitudinal (TL) uses transverse and longitudinal shear waves to detect flaws in those directions; and Oblique (Obl) uses oblique-angled shear waves to detect flaws in those directions.

G

Galling: The unplanned transfer of metal from one surface to another as the two surfaces slide over one another while being pressed together. Galling is sometimes a problem in rotary shouldered connections. An excellent anti-galling treatment is to apply a phosphate coating on one or both surfaces.

H

Heat Checks: Shallow cracks on the exterior of tool joints. The cracks are usually formed while the pipe is rotated with high side loads. Typically longitudinal and not detrimental in themselves, heat checks can lead to failures such as split box.

Heavy Duty Landing String (HDLS): See paragraph 2.5.6.

Heavy Weight Drill Pipe (HWDP): A group of pipes that are between normal drill pipe and drill collars in weight. They are characterized by the absence of an internal upset and the presence of an external upset about midway in the tube.

I

Information: Data supplied in this standard as a convenience to users. No requirement or recommendation is implied or intended.

Inspection: Under DS-1, examining a used drill stem component to make sure that it has not been worn or damaged beyond the limit allowed by the specified set of acceptance criteria.

Inspection Method: One of several inspection processes outlined in this standard. A single method usually serves to evaluate only one or, at most, a few conditions.

Inspection Procedure: Step-by-step requirements and process quality controls for the conduct of an inspection method.

Inspection Program: A group of one or more inspection methods that are applied to evaluate the acceptability of drill stem components, and the criteria against which the acceptability of the components will be judged.

Integral Pup Joint: A pup joint manufactured from a solid bar and typically heat treated to drill collar or tool joint specifications.

ISO: International Organization for Standardization.

J

Joint: 1) A length of pipe. 2) A connector.

K

Kelly: The square or hexagonal shaped steel pipe connecting the swivel to the drill pipe. The kelly is driven by the rotary table to transmit torque to the drill string.

L

Last Engaged Thread: The last thread on the pin engaged with the box or on the box engaged with the pin.

Liquid Penetrant Connection Inspection: A DS-1 inspection method employing liquid penetrant to look for fatigue cracks in connections of nonmagnetic components.

M

Makeup: To screw a connection together.

MPI Slip/Upset Inspection: A DS-1 inspection method employing Magnetic Particle Inspection (MPI) applied to slip and upset areas on normal weight drill pipe and HWDP.

N

NIST: National Institute of Standards and Technology.

Non-Auditable Statement: See "Auditable Statement."

Normal Weight Drill Pipe (NWDP): Any size or weight of drill pipe that is listed on Table 3.18.1 of this Standard.

Normalized and Tempered: A term to describe material that has been heat treated by first normalizing, then tempering.

Normalizing: Hardening a ferrous alloy by heating it to the austenitizing temperature then allowing it to cool slowly.

O

OD Gage Tube Inspection: A DS-1 inspection method for measuring the outside diameter of normal weight drill pipe to detect diameter variations that fall outside acceptable limits.

Tube OD gage

Oil Country Tubular Goods (OCTG): A term used to refer to the broad group of pipes that are run downhole. Used to differentiate casing and tubing from surface pipe like line pipe. However, the term is not used to refer to some downhole pipes, like heavy weight drill pipe and drill collars.

P

Pin End: The half of a threaded connection having external (male) threads.

Pony Collar: A short drill collar, often about 1/3 to 1/2 the length of a full drill collar.

Premium Class: A set of acceptance criteria for normal weight drill pipe taken from API RP7G-2, Recommended Practice for Inspection and Classification of Used Drill Stem Elements. DS-1 requires the same attributes for a "Premium Class" drill pipe tube as does API RP7G-2, but addresses more of the attributes of the rotary-shouldered connection on that tube than does API RP7G-2.

Premium Class, Reduced TSR: A class of used drill pipe that meets the requirements of premium class in every detail except tool joint diameters. Tool joint diameters are allowed to be smaller to recognize and control an industry-wide practice of using certain tube/tool joint combinations that give better fishing clearances than Premium Class. ***Premium Class, Reduced TSR*** is not recognized in API standards.

Pup Joint: A short joint of drill pipe typically used at the top of the string when spacing out or to facilitate handling of short tools.

Q

Quenched and Tempered (Q&T): A term to describe material that has been heat treated by first quenching, then tempering. The preferred method for heat treating most ferrous drill stem components.

Quenching: Hardening a ferrous alloy by heating it to the austenitizing temperature, then cooling it rapidly enough to transform all or much of the austenite to martensite.

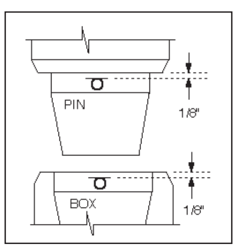
R

Range: A length classification for API Oil Country Tubular Goods.

Recommended Action: An action that is recommended by this standard based on assumed conditions which will not apply in every case. Recommended actions are offered solely as a convenience to users of this standard. Users must always consider local conditions before applying any recommendations of this standard, then modify the action if sound engineering judgement dictates.

Refacing: Field repair of seal damage on a rotary shouldered connection by grinding or cutting the seal face. Refacing changes pitch diameter of pin and box, and can lead to seal failure in extreme cases. As a general rule, refacing should be avoided if practical.

Refacing Benchmark: A mark made on the pin neck or box counterbore of a rotary shouldered to indicate the axial position of the original shoulder seal. The benchmark helps quantify the amount of refacing a connection has undergone.



API Refacing Benchmark

Reference Indication: The indication that a flaw detecting inspection device gives when it scans an artificial calibration reference standard with the calibration gain setting.

Rejectable Component: A drill stem component which fails to meet or exceed the acceptance criteria outlined in this standard after undergoing all or part of the specified inspection program.

Required Action: An action that must be accomplished in order to comply with this standard. Responsibility for compliance with any required action of this standard can only be established by one user of this standard upon another by agreement between the two parties.

Rotary Shouldered Connection: A threaded connection used on drill stem components characterized by coarse, tapered threads and makeup shoulders.

S

Saver Sub: A sub that screws onto a high-cost drill stem component. Repeated make-breaks are made on the saver sub, protecting the threads on the high-cost component from damage.

Service Category: See Category.

Shoulder: On a rotary shouldered connection, the parts of pin and box that abruptly stop further thread engagement when the connection is made up (screwed together). Also called makeup shoulder. However, for calculating makeup torque and torsional capacity, the shoulder is assumed to be 3/8 of an inch from this location. This removes the influence of the bevel when calculating these values.

Shoulder Width: The distance from the box counterbore or pin neck to the tool joint outside diameter, ignoring the tool joint bevel.

Slip Area: The area on drill pipe, usually near the box end, where slips are set when running the pipe into or out of the well.

Slip Groove: A groove cut into drill collars, in which slips can be set.

Slip Groove Inspection: A DS-1 inspection method used for measuring the dimensions of drill collar slip grooves and checking for flaws in the grooves.

Split Box Failure: A drill stem failure mode in which a connection box splits longitudinally.

Stabilizer: A BHA component having a body diameter about the same size as a drill collar, and having longitudinal or spiral blades that form a larger diameter, often at or near hole diameter.

Standard Rack Inspection: An obsolete term once used in the inspection industry to refer to a program for inspecting drill pipe. The actual meaning of the term was not defined on any industry-wide basis, and its meaning varied from company to company, and by geographical location. DS-1 Category 3 was the precisely defined inspection program which the sponsor committee used to replace what was once generally practiced as "Standard Rack Inspection."

Standardization: Adjusting the output of an instrument to some arbitrary reference value; a check to ensure that an instrument setting has remained constant.

Stiffness Ratio: The ratio of the section modulus (Z) of drill stem components immediately below a change in drill stem diameter, to the section modulus of those immediately above. Stiffness Ratio is calculated using tube diameters, not connection diameters.

Stress Corrosion Cracking (SCC): A failure mechanism that affects some nonmagnetic material. In SCC, rapid anodic corrosion attacks the material along its grain boundaries while the material is under tensile stress.

Stress Relief Groove: A groove machined on a BHA connection pin to reduce stress by removing unused threads that act as stress concentrators. Stress relief grooves may have a nominal effect on the torsional and tensile capacity of the pin neck, but are placed primarily to increase its fatigue life.

Sub: A short drill stem component.

Sulfide Stress Cracking (SSC): A drill stem failure mode in which cracks form in a drill stem component when hydrogen is liberated during a chemical reaction between steel and hydrogen sulfide.

T

TSR: Torsional Strength Ratio. The ratio of tool joint torsional strength divided by tube torsional strength.

Tempering: Reheating a quenched-hardened or normalized ferrous alloy to a temperature below the transformation range and then cooling.

Tensile Capacity: In this standard, the product of the cross-sectional area of a drill string component times the specified minimum yield strength of that component.

Tensile Failure: A failure mode in which the applied tension on a component exceeds the product of its cross-sectional area times the actual yield strength of that component.

Thick-Walled Drill Pipe (TWDP): A class of drill pipe having thicker wall than normal weight drill pipe. Often used for heavy duty landing strings.

Thread Root: In a connection, the area at the base of the thread form. If the threads are considered projections above a surface, the thread root would be the part of the surface between adjacent threads.

Tolerance: The amount of variation permitted from the nominal or stated value.

Tool Joint: A heavy bar with a rotary shouldered connection pin or box on one end. The other end is attached to a joint of drill pipe or heavy weight drill pipe. Tool joints provide a means for connecting drill pipe, and a robust place to attach makeup tongs.

Torsional Capacity: The calculated torsion required to yield a drill string component, assuming minimum specified yield strength and either actual or assumed minimum dimensions.

Torsional Failure: A failure mode in which a part of the drill stem is plastically deformed beyond specified acceptance limits due to the application of torsion loading.

Traceability: A DS-1 inspection method for critical service drilling and landing equipment to ensure that each tool is uniquely identified and manufactured from material that is in accordance with previously defined material specifications.

U

Ultra Class: An inspection acceptance criterion of used drill pipe that is more stringent than Premium Class. Ultra Class was mainly developed for deepwater applications.

Un-Inspectable Component: A drill stem component which can be determined to be neither acceptable nor rejectable due to some condition which renders the inspection process unreliable. Example: A drill pipe tube that is pitted to the extent that the EMI inspection log background noise exceeds the limits of this standard.

UT Connection Inspection: A DS-1 inspection method employing normal-beam ultrasonic testing to look for fatigue cracks in connections.

UT Slip/Upset Inspection: A DS-1 inspection method employing shear-wave ultrasonic testing to look for fatigue cracks in slip and upset areas of drill pipe.

UT Wall Thickness Inspection: A DS-1 inspection method employing normal-beam ultrasonic testing to measure the wall thickness of drill pipe tubes.

UT Thickness gage.

V

Visual Connection Inspection: A DS-1 inspection method for visually examining rotary shouldered connections.

Visual Tube Inspection: A DS-1 inspection method for visually examining the tubes of normal weight drill pipe.

W

Welded Pup Joint: A pup joint manufactured similar to normal weight drill pipe where tool joints are welded to an upset tube.

Y

Yield Strength: The stress level above which a material changes from predominately elastic to predominately plastic strain behavior.

Z

Z (Section Modulus):

$$Z = \frac{\pi}{32}\left[\frac{(D^4 - d^4)}{D}\right]$$

Where D and d are large and small diameters respectively.

Appendix

Strength and Design Formulas

Note: Equations A.1 through A.10 were adapted from Appendix A of API RP7G (reference 1).

A.1 Makeup Torque Calculations for Rotary Shouldered Connections

Recommended makeup torque for rotary shouldered connections is the amount of torque required to achieve a desired stress level in the weaker member, pin or box. Makeup torque is calculated using Equation A.1:

$$T = \frac{SA}{12}\left(\frac{P}{2\pi} + \frac{R_t f}{\cos\phi} + R_s f\right) \quad \text{(A.1)}$$

Where:

- A = Smaller of pin or box cross-sectional area (in^2)
- T = Makeup torque (ft-lb)
- S = Desired stress level from makeup (see below)

Connection	Desired Stress (psi)
Used tool joints	72,000
New tool joints (break-in)	72,000
PAC drill collars	62,500
H-90 drill collars	56,200
Other drill collars	62,500

$$A_b = 0.25\pi\left[OD^2 - (Q_c - E)^2\right] \quad \text{(A.2)}$$

$$A_p = 0.25\pi\left[(C - B)^2 - ID^2\right] \quad \text{(A.3)}$$

$$B = (H - 2S_{rs}) + \frac{tpr}{96} \quad \text{(A.4)}$$

$$E = \frac{3tpr}{96} \quad \text{(A.5)}$$

- H = Thread height (in) (API Spec. 7-2)
- S_{rs} = Root truncation (in) (API Spec. 7-2)
- P = Lead of threads (in)
- R_t = Average mean radius of thread (in)
- R_S = Mean shoulder radius (in)
- f = Coefficient of friction (assume 0.08)
- ø = 1/2 thread angle (API Spec. 7-2)
- tpr = Thread taper (in/ft)

The variables R_t and R_S are calculated using the following equations:

$$R_S = \frac{(Q_c + OD)}{4} \quad \text{(A.6)}$$

The maximum value of R_S is limited to the value obtained from the calculated OD where $A_p = A_b$.

$$R_t = 0.25\left\{C + \left[C - (L_{pc} - 0.625)\cdot\frac{tpr}{12}\right]\right\} \quad \text{(A.7)}$$

Where:

- Q_C = Box counterbore (in)
- L_{pc} = Length of pin (in)
- C = Gage point pitch diameter (in)
- OD = Outside diameter (in)
- ID = Inside diameter (in)

A.2 Drill Collar Bending Strength Ratio

The bending strength ratios in this standard were determined by application of the following equation:

$$BSR = \frac{Z_B}{Z_P} = \left(\frac{D^4 - b^4}{D}\right) \div \left(\frac{R^4 - d^4}{R}\right) \quad \text{(A.8)}$$

Where:

- BSR = Bending Strength Ratio
- Z_B = Box Section Modulus (in^3)
- Z_P = Pin Section Modulus (in^3)
- D = Outside Diameter of Box (in)
- d = Inside Diameter of pin (in)
- b = Thread root diameter of box threads at end of pin (in)
- R = Thread root diameter of pin threads (in)

To use Equation A.8, perform the following calculations:

$$\text{Dedendum} = (0.5H - f_{rn}) \quad \text{(A.9)}$$

Where:

- H = Thread height not truncated (in) (API Spec. 7-2)
- f_{rn} = Root truncation (in) (API Spec. 7-2)

$$b = C - \left[\frac{tpr(L_{pc} - 0.625)}{12}\right] + (2\cdot\text{dedendum}) \quad \text{(A.10)}$$

Where:

- C = Pitch diameter (in)
- tpr = Taper (inch per foot on diameter)
- L_{pc} = Length of pin (in)
- R = C-(2 × dedendum)-(tpr/96)

A.3 Bevel Diameter

The maximum and minimum bevel diameters in this standard were determined using the following equations:

$$BD = Q_C + 2W_S \quad \text{(A.11)}$$

$$W_S = \frac{Q_C}{2}\left[\sqrt{1 + \frac{4W_{S1}}{Q_C}} - 1\right] \quad \text{(A.12)}$$

$$W_{S1} = \frac{24T}{S_Y \pi Q_C \left[\frac{P}{\pi} + \frac{f}{\cos\phi} \left(C - \frac{(L_{PC} - 0.625)tpr}{24} \right) + f\left(\frac{OD + Q_C}{2} \right) \right]} \qquad (A.13)$$

$$T = \frac{SA}{12}\left(\frac{P}{2\pi} + \frac{R_t f}{\cos\phi} + R_S f \right) \qquad (A.14)$$

Connection	Desired Stress (psi)
Used tool joints	72,000
New tool joints (break-in)	60,000
PAC drill collars	62,500
H-90 drill collars	56,200
Other drill collars	62,500

Bevel Diameter Calculation	S_y (psi)
Min BHA bevel diameter	100% of MYS
Max BHA bevel diameter	40% of MYS
Min TWDP pipe bevel diameter	90% of MYS
Max TWDP drill pipe bevel diameter	75% of MYS

$$A_b = 0.25\pi\left[OD^2 - (Q_C - E)^2\right] \qquad (A.15)$$

$$A_p = 0.25\pi\left[(C - B)^2 - ID^2\right] \qquad (A.16)$$

$$B = (H - 2S_{rs}) + \frac{tpr}{96} \qquad (A.17)$$

$$E = \frac{3tpr}{96} \qquad (A.18)$$

$$R_t = \frac{C}{2} - \frac{(L_{PC} - 0.625)tpr}{48} \qquad (A.19)$$

$$R_S = \frac{(Q_C + OD)}{4} \qquad (A.20)$$

The maximum value of R_S is limited to the value obtained from the calculated OD where $A_p = A_b$.

Where:

Q_c = Box counterbore (in)
P = Lead of threads (in)
L_{PC} = Length of pin (in)
C = Gage point pitch diameter (in)
tpr = Thread taper (in/ft)
H = Thread height (in) (API Spec. 7-2)
S_{rs} = Root truncation (in) (API Spec. 7-2)
ø = Half thread angle (API Spec. 7-2)
BD = Bevel diameter (in)
W_s = Width of seal (in)
T = Makeup torque (ft-lb)
ID = Inside diameter (in)
OD = Outside diameter (in)
S = Makeup torque stress level (psi)
S_y = Desired seal stress (psi)
MYS = Material yield strength (psi)
A = Smaller of cross-sectional area 3/4 inch from the pin shoulder or 3/8 inch from the box shoulder (in^2)
A_p = Pin cross-sectional area 3/4 inch from the shoulder
A_b = Box cross-sectional area 3/8 inch from the shoulder
f = Coefficient of friction (assume 0.08)
R_t = Average mean radius of thread (in)
R_s = Mean shoulder radius (in)

Example - BHA Bevel Diameter Calculation Method

Connection	ID Nom.	OD Greater or = to	Bevel Diameter Range Min	Bevel Diameter Range Max
6 5/8 FH	2 13/16	8	7 59/64	7 61/64
	3	8 1/8	8 3/64	8 5/64
	3 1/4	8 1/4	8 11/64	8 13/64
	3 1/2	8 3/8	8 12/64	8 21/64
		8 1/2	8 12/64	8 29/64
		8 5/8	8 12/64	8 37/64
		8 3/4	8 12/64	8 42/64
		8 7/8	8 12/64	8 42/64
		9	8 12/64	8 42/64
		9 1/8	8 12/64	8 42/64
		9 1/4	8 12/64	8 42/64

The API MUT based on the minimum pin ID and maximum box OD is used to calculate the minimum bevel diameter to achieve a seal stress of 100% MYS.

The API MUT based on the maximum pin ID and minimum box OD is used to calculate the maximum bevel diameter to achieve a seal stress of 40% MYS.

The minimum bevel diameter calculated based on a seal stress of 100% MYS is not less than the maximum bevel diameter minus 1/32 inch. Therefore, the minimum bevel diameter is set to the maximum bevel diameter less 1/32 inch.

The maximum bevel diameter calculated based on a seal stress of 40% MYS is larger than the OD minus 3/64 inch. Therefore, the maximum bevel diameter is set to the OD minus 3/64 inch.

A.4 Inspection and Repair Guidelines for Pits in Boreback Cylinders

Surfaces to be cleaned and inspected include all areas of the boreback cylinder lengths within the required boreback cylinder lengths defined in Table 3.9 or 3.10.1, as applicable. All pits must be inspected with appropriate Liquid Penetrant method or Wet Magnetic Particle method. Any cracks or crack-like indications identified in the pits are cause for the tool to be rejected. No grinding or repair of cracks or crack-like indications is allowed.

A.4.1 Pits that meet the requirement in paragraph 3.11.5.11 for rejection and do not contain cracks or crack-like indications may be repaired in accordance with the following guidelines.

a. The maximum depth of the repaired surface must not exceed 3/32 inch relative to the box boreback surface (box boreback diameter must meet the requirements of Table 3.9 or 3.10.1, as applicable).

b. The repaired area (pit) must be blended into the surrounding boreback cylinder over a minimum surface area that spans twice the diameter of the original pit (at its maximum dimension), but not more than three times the diameter of the original pit.

c. The repaired surface must be smooth to the touch and not contain any notches or step changes.

A.4.2 The following restrictions apply to the repair of pits in boreback cylinders:

a. No more than one repair may occupy a 45 degree circumferential x 2-inch length of the boreback cylinder, when measured from the center of the repair.

b. Repair or blending that would alter full-crested or engaged threads is prohibited.

c. Repair or blending that would alter a seal surface or other tool geometry that affects tool function or performance is prohibited.

A.5 Inspection and Repair Guidelines for Pits in Pin IDs

Surfaces to be cleaned and inspected include the entire pin ID for a length exceeding the threaded length. Internal surfaces, on equipment with a pin ID 2 inches or smaller, are exempt from being inspected. All pits must be inspected with appropriate Liquid Penetrant method or Wet Magnetic Particle method. Any cracks or crack-like indications identified in the pits are cause for the tool to be rejected. No grinding or repair of cracks or crack-like indications is allowed.

A.5.1 Pits that meet the requirement in paragraph 3.11.5.14 for rejection and do not contain cracks or crack-like indications may be repaired in accordance with the following guidelines.

a. The maximum depth of the repaired surface must not exceed 3/32 inch relative to the pin ID surface (pin ID must meet the requirements for maximum pin ID, as applicable).

b. The repaired area (pit) must be blended into the surrounding pin ID over a minimum surface area that spans twice the diameter of the original pit (at its maximum dimension), but not more than three times the diameter of the original pit.

c. The repaired surface must be smooth to the touch and not contain any notches or step changes.

d. Repair or blending that affects tool function or performance is prohibited.

A.6 Float Bore Depth Calculations for Box Up Configurations

The float bore depth required to ensure all float valve seals are located within the float bore for box up configurations (A_{bu}) can be calculated using the following equations:

$$X = C + H - (2 \cdot S_{rs}) - \left[(L_{BC} - 0.625) \cdot \left(\frac{tpr}{12}\right)\right] \quad \text{(A.21)}$$

If $X < R$:

Length of Box =

$$\left(\frac{12}{tpr}\right) \cdot [C - (2 \cdot S_{rs}) - R + H] + 0.625 \quad \text{(A.22)}$$

If $X \geq R$:

$$L = \frac{(X - R)}{2 \tan 25^\circ} \quad \text{(A.23)}$$

$$\text{Length of Box} = L_{BC} + L \quad \text{(A.24)}$$

Take Length of Box dimension calculated from either Equation A.22 or A.24:

$$\text{Valve Stick Out} = L_V - (A_{bd} - 0.0625 - \text{Length of Box}) \quad \text{(A.25)}$$

Additional Length Required =

$$\text{Valve Stick Out} - \text{Top of Valve to 1st Seal} \quad \text{(A.26)}$$

$$A_{bu} = A_{bd} + \text{Additional Length Required} \quad \text{(A.27)}$$

Round A_{bu} up to the nearest 1/32 inch.

Where:

C = Gage point pitch diameter (in) (API Spec. 7-2)

tpr = Thread taper (in/ft) (API Spec. 7-2)

H = Non-truncated thread height (in) (API Spec. 7-2)
S_{rs} = Root truncation (in) (API Spec. 7-2)
L_{BC} = Depth of box (in) (API Spec. 7-2 evaluated at max tolerance)
R = Bore diameter (in) (DS-1 Table 3.12)
L_V = Valve length (in) (DS-1 Table 3.12)
A_{bd} = Box down configuration float bore depth (in) (DS-1 Table 3.12)
Top of Valve to 1st Seal = Distance measured from the top of the float valve to the top of the first seal (in)

References:

1. API RP 7G, "Recommended Practice for Drill Stem Design and Operating Limits," Fifteenth Edition, American Petroleum Institute, January 1, 1995.

Table A.1 Changes to DS-1 Volume 3 from Fourth Edition

Section	Method	Comments
2.20	Personnel Competency	In Fourth Edition (and earlier) there was a dedicated procedure for the qualification of inspectors (Procedure 3.28, Inspection Personnel Qualification). That procedure was intended to be in force for every DS-1 inspection performed, but its applicability was not clear to many. To highlight the overarching nature of those requirements, they were moved to chapter 2 at the beginning of the book (section 2.20). Additionally, the requirements were expanded somewhat using the competency language and patterns that are standard for our industry.
2.21	Calibration	The calibration requirements for inspection apparatus have in the past been listed in the specific sections where the tools would be used. In order to simplify the reading of the inspection program and help the inspection companies to have a unified list of requirements to refer to, the calibration requirements for inspection apparatus have been moved to section 2.21 at the beginning of the book. All relevant apparatus sections in chapter 3 then point back to that set of requirements.
Table 2.3		Category 1 & 2 inspections have historically used Class 2 acceptance criteria as the default. These inspections are perfectly suited for "maintenance" inspections in low-cost environments, but most contracts and expectations are written around the Premium Class criteria. The default acceptance criteria for Class 1 & 2 has been changed to Premium Class.
3.30	FLUT (WT/TL/Obl)	This is a combination of the FLUT 1 and 2 procedures from Fourth Edition (and earlier). The difference originally was that the FLUT 1 covered the full-length ultrasonic inspection of drill pipe tubes for wall-thickness reduction and longitudinal and transverse flaws. FLUT 2 added to that more transducers searching for oblique flaws as well. This method puts those procedures together to prevent duplication and adds the possibility of a full-length, wall-thickness-only inspection. The differences in options are given in the parenthetical label after the inspection name: "WT" is full-length wall thickness inspection, "TL" is transverse and longitudinal flaw detection, and "Obl" is oblique flaw detection. Thus, what was FLUT 1 in Fourth Edition is now FLUT (WT/TL) in Fifth Edition, and what was FLUT 2 in Fourth Edition is FLUT (WT/TL/Obl) in Fifth Edition.
3.34	Demagnetization	The previous method for demagnetization of components after inspection simply required the inspector to measure the magnetism in the component—no instructions about locations were given. That measurement method was added, which also allows users to specify simply the measurement method as a field check.
3.36–3.39	Workstring Tubing Inspections	Multiple methods have been added to aid users in inspecting workstring tubing under Standard DS-1. These methods are specific to workstring tubing, though other more generic methods (such as Blacklight Inspection) are also used in workstring inspections (see Table 2.3 for category definitions).

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