

Torque-Position Assembly Guidelines for API Casing and Tubing Connections

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Contents

	Page
1 Scope	1
2 Normative References	1
3 Terms and Definitions	1
4 Background	2
4.1 Torque-Position Application	2
4.2 API Connection Sealing Mechanism	2
4.3 Thread Compound	3
4.4 Coupling Coating or Plating	3
4.5 Thread Features, Measurements, and Inspection	4
4.6 Torque Control and Monitoring	5
5 Procedure	5
5.1 General	5
5.2 Torque-Position Tables	6
5.3 Position Control-Templates	6
5.4 Thread Compound Application	7
5.5 Make-up Speed	9
5.6 Mill-end Axial Position Stripe	9
Annex A (informative) Implementation Aids	11
Annex B (normative) Torque-Position Tables	16
Bibliography	30
Figures	
1 Torque-Position Assembly Schematic	3
2 Connection Assembly Acceptance Criteria for Torque-Position	6
3 Example Reference Sheet for Torque-Position	7
4 Dimensional Example for Torque-Position Template	8
5 An Example of Axial Position Stripe Applied Across Interface	10
Tables	
1 Converted 5B Tolerances for Average Crest Diameter	4
2 Suggested Target Range for Average Crest Diameter for Torque-Position	4
3 Tolerances on Thread Ovality for Torque-Position	5
4 Suggested Template Slot Width	9
B.1 Torque-Position Tubing	17
B.2 Torque-Position Casing	18
B.3 Torque-Position Buttress	23
B.4 Torque-Position Buttress 4T	26

Torque-Position Assembly Guidelines for API Casing and Tubing Connections

1 Scope

This document provides alternative connection assembly procedures to those found in API 5B (power turns) and those found in API 5C1 (optimum torque). The procedures set forth are referred to as “torque-position” because the make-up torque and final position are used as acceptance criteria for the assembly operation. The connections are threaded in accordance with API 5B. The torque-position assembly parameters have been developed for most SC (short round thread casing), LC (long round thread casing), BC (buttress thread casing), and EU (external upset tubing) connections.

Torque-position is a precision assembly method that relies on a controlled process for successful implementation. When defined threading and assembly procedures are followed, the performance of the resulting assembled connection is optimized.

2 Normative References

This document contains no normative references. For a list of documents and articles associated with API TR 5TP and torque-position assembly guidelines, please see the Bibliography.

3 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1

addendum

The distance from the crest cone to the pitch cone.

3.2

connection

A connection is defined as a single pin assembled into one side of a coupling.

3.3

crest diameter

A measurement of the diameter of the crests of the pin or coupling threads at a specified axial position measured from the pin nose or coupling face.

3.4

field-end make-up

The side or end of the coupling that is assembled at the rig floor as the pipe is being run into the well.

3.5

mill-end make-up

The side of the coupling that is assembled (bucked on) before the pipe is shipped to the field location. This connection assembly operation is typically performed at the facility where the pin end is threaded (mill or thread processor). See Figure 1.

3.6

position band

A stenciled color mark applied at a specific axial distance from the nose of the pin that serves as an external reference point for the position of the pin within the coupling during assembly (see Figure 3). In addition, the position of the coupling face can be compared visually to judge for acceptance or rejection of the final assembly (see Figure 2).

3.7

torque-position

An assembly technology for selected API connections that features criteria for acceptance of the assembly based on engagement of the pin within the coupling (position) and final torque.

3.8

4T

A variation of torque-position intended for BC connections on 8 ⁵/₈-in. through 20-in. OD casing that requires tin-plated couplings and a thread compound that has polytetrafluoroethylene (PTFE) particles. The term "4T" represents torque, triangle, tin, and PTFE.

4 Background

4.1 Torque-Position Application

Torque-position is a precision assembly method for assembling API connections. The connection is made up within a prescribed torque range using hydraulic power tongs, such that the face of the coupling progresses into a position band stenciled on the OD of the pipe. Connections that do not meet **both** the torque and position criteria are rejected.

The use of torque-position connection assembly procedures and the application of this document shall be by agreement between the user/purchaser and the manufacturer. These guidelines shall be used at the designated mill, processor's facility, and rig site in order to ensure appropriate assembly of the connections (see Figure 1 and Figure 2).

4.2 API Connection Sealing Mechanism

API connections rely on contact pressure on the thread flanks to form an effective seal and a particulate thread compound to plug the root-to-crest gap on 8-round connections (SC, LC, EU) and thread flank gaps on buttress connections.

In an interference connection, the threads on both the pin and coupling are cut at a matching angle or taper. As the connection is made up, the pin becomes wedged into the coupling creating contact pressure. This contact or bearing pressure is the sealing mechanism for this connection. To form a leak-resistant seal, the bearing pressures on the thread flanks must be greater than the internal pressure.

In addition to thread flank bearing pressures, it is also necessary to use a thread compound and a suitable coating or plating on the coupling threads to form a leak-resistant seal. This combination of thread compound and coating or plating prevents the migration of gas or fluid through the root-to-crest and thread flank clearances.

Sealing performance of some sizes and connections is enhanced by using modified seal-ring couplings conforming to API 5CT, SR13. Seal rings are recommended for these connections because of the high make-up torques that would be required without them. In a seal-ring coupling, a groove is cut in the coupling and a nonmetallic ring is installed in the groove prior to any thread compound application and connection assembly.

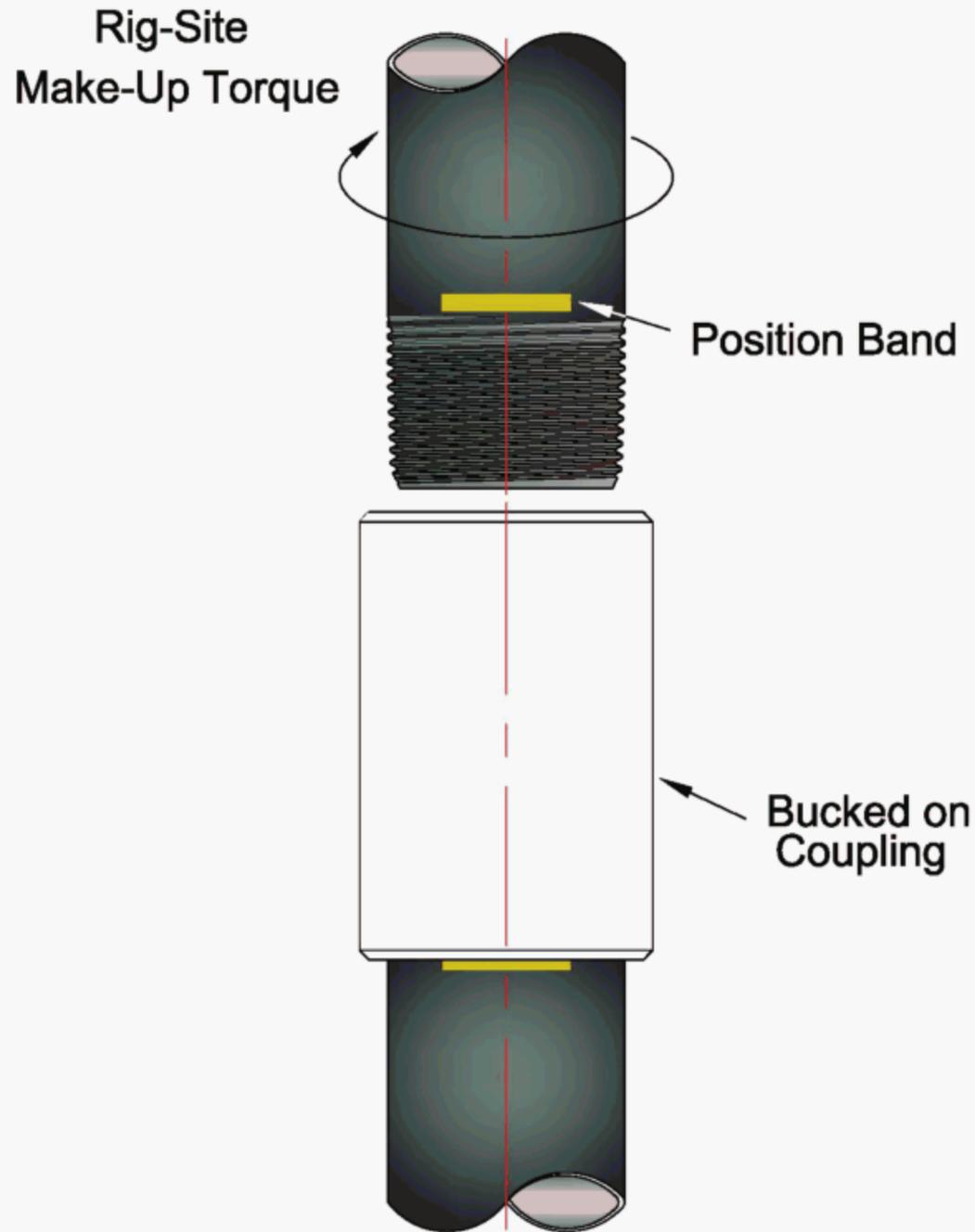


Figure 1—Torque-Position Assembly Schematic

4.3 Thread Compound

Thread compound serves three basic functions:

- 1) seals the thread clearances in the thread profile,
- 2) lubricates the threads during make-up, and
- 3) resists galling that results from metal-to-metal contact.

Most thread compounds consist of particles suspended in carrier grease. The types and ratios of the particles generally determine the performance of a thread compound.

Torque-position technology was developed using API 5A3 Reference compound (formerly called API Modified) for 8-round and non-4T buttress connections and a PTFE-based thread compound for BC 4T make-up.

4.4 Coupling Coating or Plating

API couplings intended for assembly with torque-position parameters should have a phosphate coating or tin plating on the threads to prevent galling during assembly and to assist in providing seal integrity. The type of coating or plating used will affect the assembly torque. Torque values for tin-plated couplings are much lower than for phosphate coated couplings; therefore, a separate torque range is given in the tables. The torques

tabulated for seal-ring couplings assume phosphate-coated threads and the BC 4T assembly requires tin-plated coupling threads.

Phosphate coatings are typically applied to a coupling to a thickness of less than 0.001 in. With tin-plated couplings, both the thickness and uniformity of the tin should be carefully checked. Lack of uniformity can cause erratic make-up, galling, and potential leak paths. Tin plating should be applied to a thickness between 0.0025 in. and 0.0045 in.

4.5 Thread Features, Measurements, and Inspection

Maintaining all thread parameters set forth by API 5B will ensure downhole performance and smooth assembly operations. Significant variations in thread height, lead, and taper can affect the assembly torque and subsequent performance.

Two additional measurements are critical but are not specified in the 15th Edition of API 5B: crest diameter and ovality. Specifying requirements for crest diameter and ovality measurements when ordering pipe is recommended in order to achieve more consistent assembly results, fewer rejected make-ups, and better field performance for the resulting connections. Note that satisfying the crest diameter tolerances may require tighter control of other API 5B thread element dimensions. Additionally, addendum measurements that relate the crest diameter to the pitch diameter may be necessary when setting up for threading.

Follow the crest diameter gauge manufacturer's measurement procedures to obtain a maximum and minimum reading of local crest diameter around the circumference of the thread (typically expressed as a variation from the nominal value). The average crest diameter referenced in Table 1 and Table 2 is defined as the average of the minimum and maximum readings. The ovality of the thread is defined as the algebraic difference between the minimum and maximum readings. Formulas for determining ovality limits are provided in Table 3.

Note that some pin and coupling combinations that have thread features that meet API 5B gauging specifications will not successfully meet the torque-position assembly parameters. However, pin and coupling threads that meet the suggested target crest diameter ranges shown in Table 2 provide a greater probability that the assembly will satisfy the torque and position requirements.

Table 1—Converted 5B Tolerances for Average Crest Diameter

Thread Type	Coupling	Pin
8-round	±0.008 in.	±0.008 in.
Buttress ≤ 13 ³ / ₈ in.	–0, +0.006 in.	–0, +0.006 in.
Buttress > 13 ³ / ₈ in.	–0, +0.008 in.	–0, +0.008 in.

Table 2—Suggested Target Range for Average Crest Diameter for Torque-Position

Thread Type	Coupling	Pin
8-round	±0.004 in.	–0, +0.006 in.
Buttress ≤ 13 ³ / ₈ in.	–0, +0.004 in.	–0, +0.006 in.
Buttress > 13 ³ / ₈ in.	–0, +0.004 in.	–0, +0.008 in.

Table 3—Tolerances on Thread Ovality for Torque-Position

Pipe OD/ <i>t</i> ratio	Formula for Max Ovality
<20	OD × 0.003 in.
≥20	OD × 0.004 in.

Any surface-breaking flaws in the threaded area could affect assembly and performance of the connection. Perform a magnetic particle inspection (MPI) of the pin end areas and coupling in accordance with API 5A5 and API 5CT. However, a wet MPI is recommended on the pin ends of all grades, unless access to the ID is restricted (e.g. tubing less than 4 1/2-in. diameter), then dry MPI may be substituted. If MPI is performed before threading the pin ends, then a visual inspection shall be performed after threading. If MPI is performed before threading the coupling, then a visual inspection shall be performed after threading and before coating or plating. The purchaser may designate when the pin end area inspection is performed by specifying this on the purchase order.

4.6 Torque Control and Monitoring

Accurate torque measurement enhances the torque-position connection assembly. The preferred method to monitor torque is to use a calibrated load cell in conjunction with a digital torque readout. Torque accuracy shall be demonstrated to be within 3 %. Torque measurement based solely on hydraulic pressure is not recommended.

5 Procedure

5.1 General

Assembly make-up procedure for torque-position is as follows.

- a) Determine the appropriate position and torque ranges for the connection from the torque-position tables (see 5.2).
- b) Stencil a yellow position band on the pipe at a specific distance from the end of the pin (see 5.3).
- c) Apply thread compound to the pin and coupling (see 5.4).
- d) Assemble the connection with a buck-on machine or a set of power tongs. The face of the coupling progresses into the position range (i.e. between D_1 and D_2) within the specified torque range (i.e. between T_{min} and T_{max}).
 - Reject the connection if the coupling face falls short of D_1 at maximum torque, T_{max} .
 - Reject the connection if the coupling face progresses through the position band before attaining the minimum torque T_{min} .

An acceptable made up connection is compared with rejected make-ups in Figure 2. The tabulated torque and position ranges also define the assembly acceptance and rejection criteria.

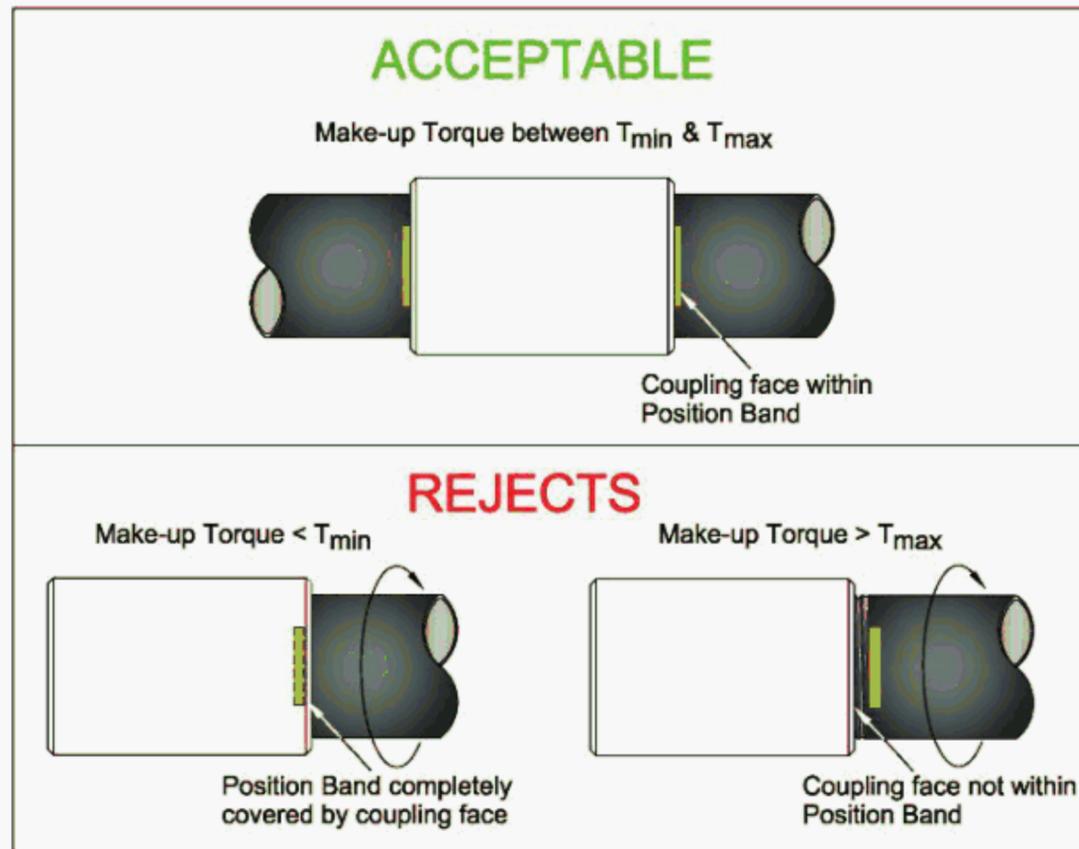


Figure 2—Connection Assembly Acceptance Criteria for Torque-Position

5.2 Torque-Position Tables

Torque-position assembly ranges for the most common SC, LC, BC, and EU connections are provided in tables contained in this document (see Annex B). The listings are organized by size, weight, thread type, grade, coupling OD, and coupling surface coating or plating. The following four values are specified for each connection:

- D_1 = minimum position (relative to the nose of the pin),
- D_2 = maximum position (relative to the nose of the pin),
- T_{min} = minimum torque,
- T_{max} = maximum torque.

5.3 Position Control—Templates

The technique used to apply the yellow position band(s) to the joint behind the pin threads must be capable of preserving the precision of the torque-position assembly method. Rather than trying to apply a tolerance to the position bands after they are applied on the tubular, a tolerance of ± 0.003 in. is applied to the D_1 and D_2 dimensions on the templates used to apply the position bands. Figure 4 is a drawing of a typical template that is durable and capable of applying position bands with accurate dimensions. The yellow position bands are applied at several locations around the pipe, ensuring band visibility as the pipe is being rotated. Note that other methods of controlling the position of the pin nose relative to the coupling face may be acceptable if it can be demonstrated that the precision of the assembly method is maintained.

The width of the template slot shown in Figure 4 will vary according to OD size. Some example template slot widths are suggested in Table 4 below. All dimensions below are in inches.

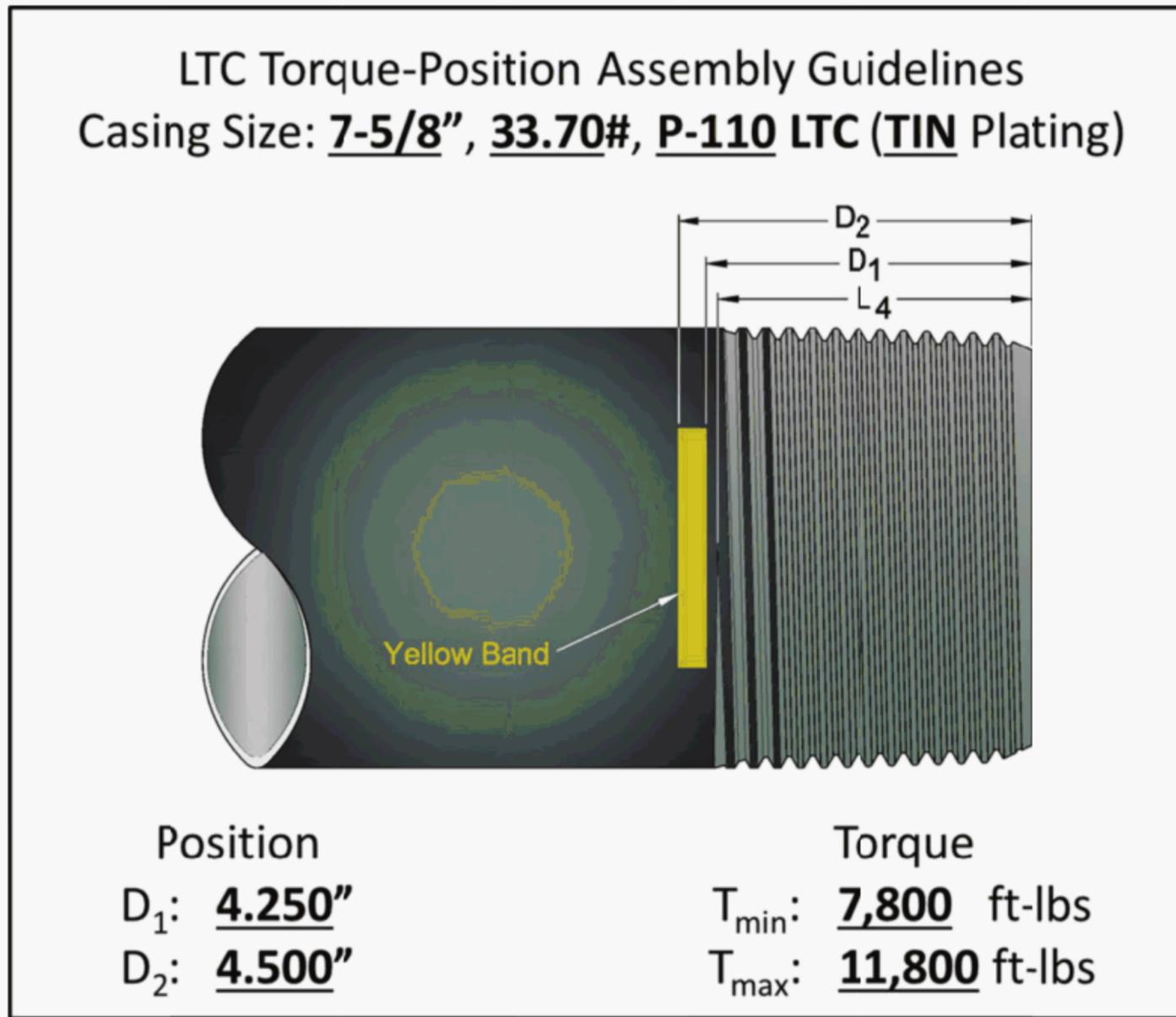


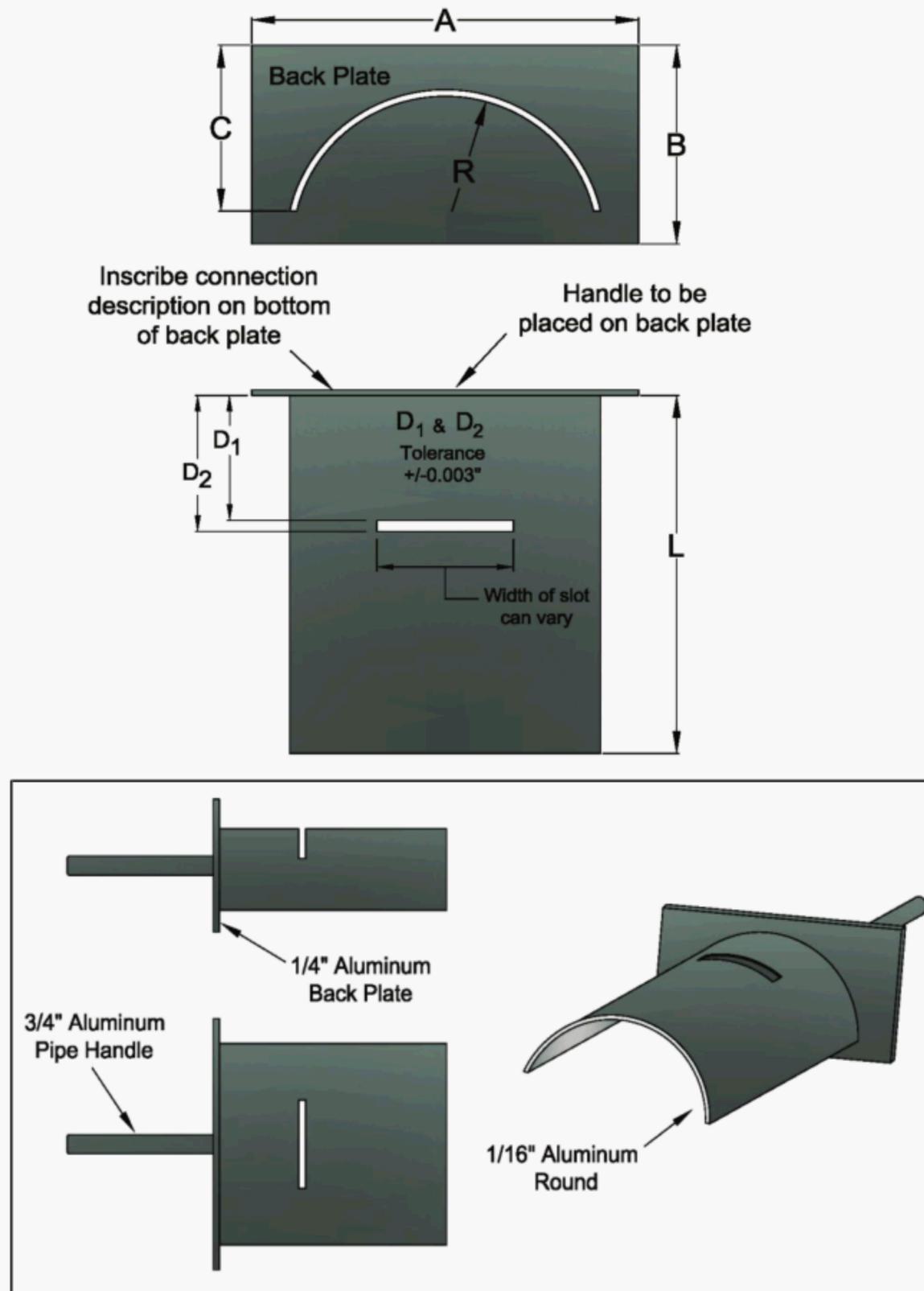
Figure 3—Example Reference Sheet for Torque-Position

5.4 Thread Compound Application

Torque-position technology was developed using API 5A3 Reference compound (formerly called API Modified thread compound) for round thread and for non-4T buttress connections and using a PTFE-based thread compound for BC 4T assembly. Refer to U.S. Patent 5,212,885 for specific test results with BC and various thread compounds.

When performing application of product, it is recommended to stir the compound in the bucket prior to and periodically during the thread compound application task, to maintain particle suspension. In addition, following manufacturer recommendations for appropriate temperature ranges of the compound application will optimize performance of the compound and connection. Do not add thinning agents to the compound.

Apply a thin uniform coat of thread compound to the entire length of coupling threads that will be engaged during make-up. Prior to pin engagement, it is recommended that a thin uniform coat of thread compound also be applied to the perfect thread length of the pin end threads. Note that when applying thread compound, the profile of the thread should still be visible after applying the compound. When applying compound by hand, it is recommended to use a “moustache” or paint brush that is free of foreign matter. A large tool joint or drill pipe brush is not recommended.



Key

D_1, D_2 are given in the torque-position tables

A, B, C, L are arbitrary dimensions that can be specified by the template user

$$R = \frac{OD + \text{Max API Tolerance}}{2} + 0.030 \text{ in.}$$

where

R is the radius of curved plate;

OD is the D_4 reference from API 5B (OD of non-upset tubing and casing or OD of upset for EUE tubing);

Max API Tolerance is found in API 5CT.

Figure 4—Dimensional Example for Torque-Position Template

Table 4—Suggested Template Slot Width

Size Designation	Slot Width in.
4 1/2	2 7/8
5	3
5 1/2	3 1/2
6 5/8	4
7	4 1/2
7 5/8	6
8 5/8	6 1/2
9 5/8	7
10 3/4	7
11 3/4	7 3/4
13 3/8	7 3/4
16	8
18 5/8	8
20	8 1/2

5.5 Make-up Speed

5.5.1 Mill-end Make-up

The coupling should first be installed to the hand-tight position using a strap wrench or an equivalent device. The buck-on operator may perform initial make-up at higher speed but should perform the final two-and-a-half turns in **low gear (<10 rpm)**. This reduces the chance of spikes in the torque that could be interpreted as either a measure of the actual applied torque or abnormal resistance. It is also recommended to achieve a make-up condition with the final torque in the upper half of the torque range and the final position in the back half of the position range. Achieving this condition increases the chance of success during field operations by lowering the chance that mill-end assemblies may rotate.

5.5.2 Field-end Make-up

The tong operator should stab the connection using **low gear (<10 rpm) until the threads are engaged**. Thereafter, the connection can be assembled at 10 rpm to 20 rpm max until the torque begins to rise (i.e. the reaction line gets taut). Then the tong should be **shifted back to low gear for the final assembly at <10 rpm**. The torque numbers recommended in this document are based on slow make-up speeds of <10 rpm.

5.5.3 All Make-ups

Stopping and starting near final position should be avoided. In order to accomplish torque-position assembly objectives, the torque reading must represent the contact stress in the connection rather than the torque needed to overcome static friction and initiate rotation.

5.6 Mill-end Axial Position Stripe

Once the mill-end make-up is complete, apply a 1-in. wide by 6-in. long orange stripe across the connection interface to indicate the final position of the coupling relative to the pin as indicated in Figure 5. This axial

stripe facilitates monitoring any mill-end rotation during field-end assembly. If rotational movement of the coupling is observed relative to the lower pipe, i.e. the two halves of the axial stripe become misaligned, then the thread compound in the thread helix is disturbed and the mill-end connection should be rejected.

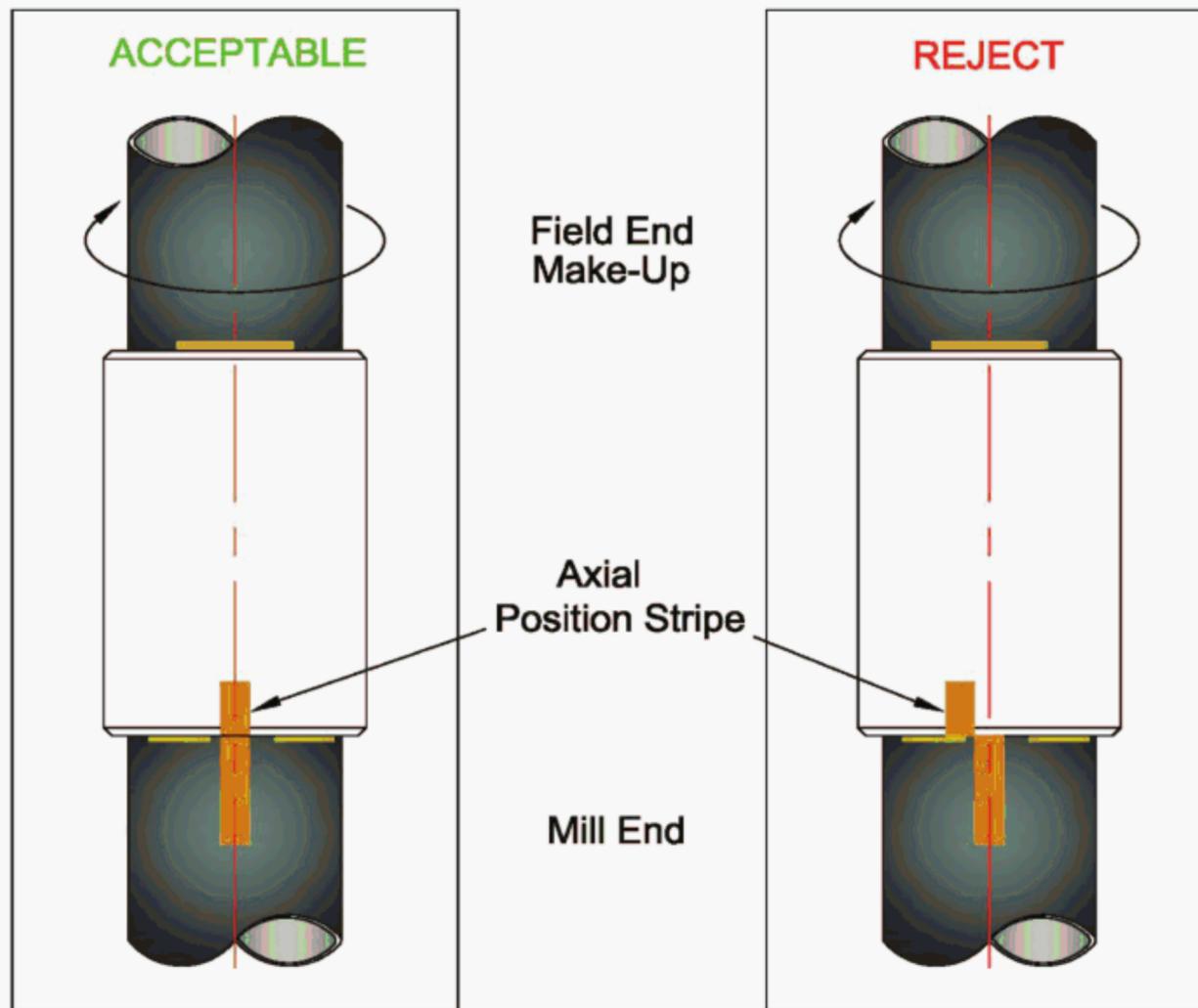


Figure 5—An Example of Axial Position Stripe Applied Across Interface

Annex A (informative)

Implementation Aids

A.1 Torque-Position Checklist

A.1.1 Select Appropriate Torque-Position Values from the Tables

Based on the specifications of the supplied connection (i.e. size, weight, thread type, grade, coupling OD, coupling plating, etc.), determine the corresponding position values (D_1 and D_2) and torque values (T_{min} and T_{max}) from the torque-position tables in Annex B. A specification sheet like that shown in Figure 3 can be used as a reference guide.

A.1.2 Verify the Size, Weight, and Grade of the Pipe and Coupling

Confirm that the pipe to be run corresponds to the torque-position guidelines being used. Generally, the pipe identification information is stenciled on each joint. In addition to the pipe information, verify that the coupling being used is the correct outside diameter and grade for the product being used and that a special-clearance or oversized coupling has not been substituted. For reference, color codes for all API material grades are provided in API 5CT.

A.1.3 Verification of Pipe Threads and Thread Gauge Data

Determine the type of threads on the pipe to be utilized by visual inspection. Eight-round threads, used on SC, LC, and EU, will have radiused (or rounded) crests and roots. Buttress threads will be rectangular in appearance.

A.1.4 Verify the Coupling Plating Material

Identify the coating or plating on the coupling and reference the torque range applicable to that coating or plating. Phosphate coating is dark gray or charcoal color in appearance and thin (typically no more than 0.001 in. thick); and tin plating is characterized by a dull silver or white appearance and thick (normally applied to a thickness between 0.0025 in. and 0.0045 in.).

A.1.5 Check the Torque-Position Template Dimensions

The templates used to apply the position bands to the pins should have very strict slot dimension tolerances (see 5.2 and 5.3). Slot dimensions (D_1 and D_2) shall have a tolerance of ± 0.003 in. Confirm these dimensions with a metal ruler or caliper to make certain that the correct template is being used. Note that different templates may be required for each size, weight, thread type, grade, and coating or plating.

A.1.6 Apply Position Bands on Both Ends of the Pipe (Buck-on Operations)

Prior to applying bands, consider buffing the area behind the pin threads to ensure it is clean and dry. Apply several bands on each end and equally spaced around the circumference. A bright yellow fast drying stencil ink is recommended as illustrated in Figure 3. Ensure that the position bands are not smeared or removed during handling and thread cleaning operations. In addition to the fast drying stencil ink, a thin coat of acrylic plastic spray can be applied to the band area to enhance durability. When applying the acrylic plastic spray, use caution to avoid contact with the threaded area and allot adequate drying time between steps. The general appearance of the color bands should have sharp edges with no runs. Occasionally, a pin protector will rub off the applied bands. If this occurs, a light dressing of the outer edge of the pin protector may be required.

A.1.7 Check Position Band Dimensions (Rig Site Operations)

If the field-end position bands were applied at the mill or a thread processor, randomly check the dimensions at the rig site using a ruler prior to running the tubulars in the well to ensure that the correct template was used. Prior to use, reapply any position bands that may have been rubbed off during handling (see 5.3).

A.1.8 Cleaning Pin and Coupling Threads (Rig Site Operations)

Prior to applying thread compound, all threads should be thoroughly cleaned, preferably using solvent and a stiff nylon brush. Wire brushes are not recommended. Compressed air is only recommended for drying. After cleaning, inspect the threads and remove any dirt or metal particles. For seal-ring couplings, visually check the installation of the seal rings to ensure they are securely installed. Then assemble the connection as soon as possible. If allowed to sit overnight, a layer of dirt or rust can form on the thread profile that will affect make-up torque.

A.1.9 Verifying Thread Compound

The torque-position specifications given in this document for SC, LC, EU, and non-4T buttress connections are based on API 5A3 Reference compound (formerly called API Modified). Torque-position specifications for 4T are based on a PTFE-based thread compound. See 4.3 and 5.4 for more information.

A.1.10 Applying Thread Compound

When performing application of product, stir the compound in the bucket prior to and periodically during the thread compound application task, to maintain particle suspension. In addition, following manufacturer recommendations for appropriate temperature ranges of the compound application will optimize performance of the compound and connection. Do not add thinning agents to the compound.

Apply a thin uniform coat of thread compound to the entire length of coupling threads that will be engaged during make-up. Prior to pin end engagement, it is recommended that a thin uniform coat of thread compound also be applied to the perfect thread length of the pin end threads. Note that when applying thread compound, the profile of the thread should still be visible after applying the compound. When applying compound by hand, it is recommended to use a "moustache" or paint brush that is free of foreign matter. A large tool joint or drill pipe brush is not recommended.

A.1.11 Check Torque Measurement Configuration

An accurate method of measuring torque shall be used in torque-position jobs (3 % accuracy). If a digital system is used, make certain that the load cell calibration certificates are up to date. In addition, make certain that proper setup parameters are being used, such as torque dumps, etc. On rig site tongs, verify the length of the moment arm and check to ensure that the moment arm is perpendicular to the reaction line and that the reaction line is parallel to the rig floor. After this verification, also make certain that the correct moment arm length has been entered into digital measurement devices.

A.1.12 Make Up the Connection Using the Torque-Position Method

The connection shall be made up such that the coupling face stops within the position band and within the prescribed torque range. A spotter may be used to watch the coupling face position and to notify the tong operator when the position range has been satisfied.

For buck-on at the mill, thread processor, or pipe yard, the connection should first be made up to the hand-tight position (using a strap wrench or an equivalent device) and then the final two-and-a-half turns should be completed in **low gear (<10 rpm)**.

For field-end make-up, the connection should be made up initially in low gear (<10 rpm) until the threads are fully engaged. Thereafter, the connection can be made up at 10 rpm to 20 rpm max until the torque level

begins to rise. Final assembly should be completed in **low gear (<10 rpm)**. Stopping and starting at high torque levels should be avoided.

For buck-on at the mill, thread processor, or pipe yard, it is recommended to achieve a make-up condition with the final torque in the upper half of the torque range and the final position in the back half of the position range. Achieving this condition increases the chance of success during field operations by lowering the chance that mill-end assemblies may rotate. Once the mill-end make-up is complete, apply a 1-in. wide by 6-in. long orange stripe across the connection interface as shown in Figure 5.

Reject connections that are short of the range (i.e. do not reach D_1) at maximum torque, T_{max} (see Figure 2). Reject connections that do not achieve minimum torque, T_{min} , at the D_2 position (see Figure 2). Reject mill-end connections that rotate relative to the lower pipe while the field-end connection is assembled (see Figure 5). Clearly mark any rejected connections and set joints aside.

A.1.13 Check ID Clearance Under the Coupling (Buck-on Operations)

Verify the pipe inside diameter by using the required drift of the pin ends under the coupling to check for pin nose neck-down. If the connection does not drift, flag the pin such that the coupling can be bucked off and the pin rethreaded using the torque-position requirements.

A.1.14 Apply Corrosion Inhibitor and Thread Protectors (Buck-on Operations)

If the bucked-on coupling will not be used immediately, apply a suitable corrosion inhibitor or storage compound to the non-made-up coupling and pin threads and apply a thread protector on both ends. Thread running compound may be preferred for the non-made-up threads if the pipe will be run within a 30-day period.

A.2 Running a Torque-Position Job at the Rig—Suggested Responsibilities

A.2.1 User/Purchaser

The user/purchaser should:

- confirm that the mill or thread processing facility followed the recommended torque-position procedures when they assembled the mill-end couplings;
- ensure that the rig supervisor and casing crew supervisor have the correct information about the coupling coatings or platings, thread compound, position range, and torque range.

A.2.2 Onsite User or Rig Supervisor

The onsite user or rig supervisor (alternate) should:

- confirm that the proper tubulars and connections were received at the rig;
- verify the condition of the threads, coupling coatings or platings, thread compound, and position bands (on the field end of the pipe);
- verify that the tongs, load cell, and reaction arm (if so equipped) are properly configured;
- confirm that the load cell is calibrated;
- verify that the tong's dump valve is set within the range of T_{min} and T_{max} and that the dump valve operates properly by testing the tongs on the pipe body;
- ensure that each connection receives the proper application of thread compound (see 5.4);

- confirm that the tong operator does not exceed recommended torque-position assembly speeds (see 5.5).

A.3 Troubleshooting

A.3.1 General

Problems can occur in the field that can hamper a successful connection assembly. Some of the more common problems are discussed in this section along with possible remedial actions excluding weather, alignment, and other operational factors.

A.3.2 Insufficient Torque

Insufficient torque occurs when the connection makes up to the far end of the position band, D_2 , without achieving minimum torque, T_{\min} . The consequence of exceeding the position range could be internal drift problems, mating of imperfect threads with fully formed threads, and thread galling if the connection is backed out. If insufficient torque occurs, reject the connection.

Several potential sources of the problem and possible remedial actions are offered as follows.

- The assembly may be proceeding too fast to develop the necessary torque.
 - Ensure the connection is made up slowly (<10 rpm) during the final stages of assembly.
- Moisture on the compound applied to the pin or box (as can occur when running in the rain) will reduce torque.
 - Leave protectors installed until the pipe is ready for assembly or clean the connection and apply fresh (i.e. uncontaminated) thread compound.
- The torque measurement system may be displaying an erroneous value.
 - Recheck the torque measurement configuration and verify load cell calibrations.
- The pins may be undersized (i.e. small crest diameter) and/or the couplings oversized (i.e. large crest diameter).
 - Review the thread gauge inspection report and perform additional gauging for verification.
- The thread compound in use may be slick compared to the API 5A3 Reference compound, or too much compound may have been applied to the connection.
 - Check both the thread compound and application procedure. Clean and properly redope several pins to confirm.
- The tin plating may be excessively thick.
 - If the plating is thicker than 0.0045 in., consider replacing the couplings.

A.3.3 Excessive Torque

Excessive torque occurs when the connection makes up short of the position band, D_1 , at maximum torque, T_{\max} . A short make-up can reduce tensile capacity of the connection. If this situation occurs, reject the connection.

When attempting to determine the cause of excessive torque, check for the following:

- galling or cross threading of the connection,
- misalignment of the tongs,
- improper load cell calibration,
- extremely thin plating on the coupling threads,
- inadequate or inferior thread compound,
- high make-up speed,
- misalignment of the pin and coupling,
- pitting in the threads during storage,
- inferior thread machining,
- pins and/or couplings exceeding the API 5B tolerances or other measurement tolerances that are specified on the purchase order.

A.3.4 Pin Drift Restrictions

Pin drift restrictions can occur if the pin is made up too far into the coupling or if the tubular wall eccentricity is severe. This problem may or may not be associated with high torque. A connection could achieve excessive engagement at moderate torque levels if the coupling has thick tin plating, or if the thread compound has a friction factor lower than that of the API Reference thread compound.

Suggested remedial action includes:

- reevaluating the connection assembly method,
- measure the actual body wall thickness,
- verify coupling OD by means of a caliper.

Annex B (normative)

Torque-Position Tables

B.1 Table Organization

Torque-position assembly values for the most common SC, LC, BC, and EU connections are provided in tables contained in this document. The listings are organized by size, weight, thread type, grade, coupling OD, coupling surface coating or plating, and any special modifications. The following four values are specified for each connection:

- D_1 = minimum position (relative to the nose of the pin),
- D_2 = maximum position (relative to the nose of the pin),
- T_{\min} = minimum torque,
- T_{\max} = maximum torque.

Numeric grade designations are listed in the torque-position tables.

The minimum and maximum torques found in API 5TP are independent of the optimum, minimum, and maximum torques found in API 5C1 for some API connections. The use of torque-position connection assembly procedures and the application of this document shall be by agreement between the user/purchaser and the manufacturer. These guidelines shall be used at the designated mill, processor's facility, and rig site in order to ensure appropriate assembly of the connections.

The position range (i.e. D_1 and D_2) will change for connections with different pipe OD, weight, thread type, and grade. Randomly check the dimensions of the yellow position bands when running a torque-position product.

A separate torque range is given in the tables for couplings with phosphate coating or with tin plating, and for phosphate-coated couplings with seal-rings for some heavy-wall EU tubing sizes and for BC on 4 1/2-in. through 7 5/8-in. OD casing. Seal-ring couplings shall conform to API 5CT, SR13.

Assembly torques for buttress 4T (for 8 5/8-in. through 20-in. OD casing) are based on tin-plated threads and a PTFE-based thread compound. Torques for all other torque-position assemblies are based on the use of the API 5A3 Reference Thread Compound (formerly known as API Modified). See 4.3 and 5.4 for more information.

NOTE Do not apply any safety factor to the recommended torque range. The optimum assembly condition is the minimum torque required to achieve the position range.

B.2 Torque-Position Tables

Table B.1—Torque-Position Tubing

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		Seal Ring Coupling (Phosphate Coated)	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
2-3/8	4.7	EUE	55	3.063	1.900	2.313	1,300	2,200	900	1,600		
			80		1.938	2.313	1,800	2,600	1,300	1,900		
			90		1.938	2.313	2,000	2,800	1,400	2,000		
			95		1.938	2.313	2,100	3,000	1,500	2,100		
2-3/8	5.95	EUE	80	3.063	1.938	2.313					1,400	2,200
			90		1.938	2.313					1,600	2,500
			95		1.938	2.313					1,700	2,600
2-7/8	6.5	EUE	55	3.668	2.125	2.500	1,700	2,400	1,200	1,700		
			80		2.188	2.500	2,500	3,500	1,800	2,500		
			90		2.188	2.500	2,700	3,900	1,900	2,700		
			95		2.188	2.500	2,900	4,200	2,000	3,000		
2-7/8	7.9	EUE	80	3.668	2.188	2.500	2,900	3,700	2,000	2,600		
			90		2.250	2.500	3,100	4,100	2,200	2,900		
			95		2.250	2.500	3,200	4,200	2,200	3,000		
2-7/8	8.7	EUE	80	3.668	2.188	2.500					2,000	2,800
			90		2.188	2.500					2,200	3,100
			95		2.188	2.500					2,300	3,200
3-1/2	9.3	EUE	55	4.500	2.438	2.750	2,400	3,400	1,700	2,400		
			80		2.438	2.750	3,000	4,000	2,100	2,800		
			90		2.438	2.750	3,400	4,500	2,400	3,200		
			95		2.438	2.750	3,600	4,800	2,500	3,400		
3-1/2	12.95	EUE	80	4.500	2.438	2.750					3,000	4,100
			90		2.438	2.750					3,400	4,600
			95		2.438	2.750					3,500	4,800
4-1/2	12.6	NUE	55	5.200	2.625	2.938	1,900	3,100	1,300	2,200		
4-1/2	12.75	EUE	55	5.563	2.625	3.000	3,000	4,500			2,100	3,200
			80		2.625	3.000	3,800	5,700			2,700	4,000

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Table B.2—Torque-Position Casing

Tubular Designation					Position		Torque Range			
							Phosphate		Tin	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
4-1/2	9.5	STC	40	5.000	2.000	2.419	800	1,600	600	1,100
			55		2.000	2.419	1,100	2,200	800	1,500
4-1/2	10.5	STC	55	5.000	2.625	3.000	1,400	2,800	1,000	2,000
4-1/2	11.6	STC	55	5.000	2.625	3.000	1,500	2,900	1,100	2,000
4-1/2	11.6	LTC	55	5.000	3.000	3.375	1,800	2,900	1,300	2,000
			80		3.063	3.375	2,000	3,000	1,400	2,100
			90		3.063	3.375	2,200	3,300	1,500	2,300
			95		3.063	3.375	2,400	3,600	1,700	2,500
			110		3.125	3.375	2,700	4,100	1,900	2,900
4-1/2	13.5	LTC	80	5.000	3.063	3.375	2,600	3,900	1,800	2,700
			90		3.063	3.375	2,900	4,400	2,000	3,100
			95		3.063	3.375	3,100	4,700	2,200	3,300
			110		3.125	3.375	3,500	5,300	2,500	3,700
4-1/2	15.1	LTC	110	5.000	3.125	3.375	4,500	6,800	3,200	4,800
5	11.5	STC	55	5.563	2.500	2.919	1,400	2,800	1,000	2,000
5	13	STC	55	5.563	2.750	3.125	1,900	3,800	1,300	2,700
5	13	LTC	55	5.563	3.375	3.750	2,400	4,000	1,700	2,800
5	15	STC	55	5.563	2.750	3.125	2,500	4,100	1,800	2,900
5	15	LTC	55	5.563	3.375	3.750	2,600	4,200	1,800	2,900
			80		3.438	3.750	3,000	4,500	2,100	3,200
			90		3.438	3.750	3,400	5,100	2,400	3,600
			95		3.438	3.750	3,600	5,400	2,500	3,800
			110		3.500	3.750	4,200	6,300	2,900	4,400
5	18	LTC	80	5.563	3.438	3.750	4,200	6,300	2,900	4,400
			90		3.438	3.750	4,700	7,100	3,300	5,000
			95		3.438	3.750	5,000	7,500	3,500	5,300
			110		3.500	3.750	5,800	8,700	4,100	6,100
5	21.4	LTC	80	5.563	3.438	3.750	5,000	7,500	3,500	5,300
			90		3.438	3.750	5,600	8,400	3,900	5,900
			95		3.438	3.750	5,900	8,900	4,100	6,200
			110		3.500	3.750	6,800	10,200	4,800	7,100

Table B.2—Torque-Position Casing (Continued)

Tubular Designation					Position		Torque Range			
							Phosphate		Tin	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D ₁ (in.)	D ₂ (in.)	T _{min} (ft-lb)	T _{max} (ft-lb)	T _{min} (ft-lb)	T _{max} (ft-lb)
5-1/2	14	STC	40	6.050	2.875	3.250	1,500	3,000	1,100	2,100
			50		2.875	3.250	2,100	4,000	1,500	2,800
5-1/2	15.5	STC	55	6.050	2.875	3.250	2,200	4,200	1,500	2,900
5-1/2	15.5	LTC	55	6.050	3.500	3.875	2,500	4,400	1,800	3,100
5-1/2	17	STC	55	6.050	2.875	3.250	2,500	4,400	1,800	3,100
5-1/2	17	LTC	55	6.050	3.500	3.875	2,600	4,600	1,800	3,200
			80		3.563	3.875	3,100	4,800	2,200	3,400
			90		3.563	3.875	3,500	5,300	2,500	3,700
			95		3.563	3.875	3,700	5,600	2,600	3,900
			110		3.625	3.875	4,300	6,500	3,000	4,600
5-1/2	20	LTC	80	6.050	3.563	3.875	4,100	6,200	2,900	4,300
			90		3.563	3.875	4,600	6,900	3,200	4,800
			95		3.563	3.875	4,900	7,400	3,400	5,200
			110		3.625	3.875	5,600	8,400	3,900	5,900
5-1/2	23	LTC	80	6.050	3.563	3.875	4,700	7,100	3,300	5,000
			90		3.563	3.875	5,700	8,600	4,000	6,000
			95		3.563	3.875	6,000	9,000	4,200	6,300
			110		3.625	3.875	7,100	10,700	4,700	7,100
6-5/8	20	STC	40	7.390	3.125	3.500	2,300	4,600	1,600	3,200
			55		3.125	3.500	2,600	5,200	1,800	3,600
6-5/8	20	LTC	55	7.390	3.875	4.250	3,300	5,600	2,300	3,900
6-5/8	24	STC	55	7.390	3.125	3.500	3,500	5,800	2,500	4,100
6-5/8	24	LTC	55	7.390	3.875	4.250	3,700	5,900	2,600	4,100
			80		3.938	4.250	4,600	6,900	3,200	4,800
			90		3.938	4.250	5,100	7,700	3,600	5,400
			95		3.938	4.250	5,400	8,100	3,800	5,700
			110		4.000	4.250	6,300	9,500	4,400	6,700
6-5/8	28	LTC	80	7.390	3.938	4.250	5,500	8,300	3,800	5,800
			90		3.938	4.250	6,200	9,300	4,300	6,500
			95		3.938	4.250	6,600	9,900	4,600	6,900
			110		4.000	4.250	7,600	11,400	5,300	8,000
6-5/8	32	LTC	80	7.390	3.938	4.250	6,800	10,200	4,800	7,100
			90		3.938	4.250	7,700	11,600	5,400	8,100
			95		3.938	4.250	8,100	12,200	5,700	8,500
			110		4.000	4.250	9,400	14,100	6,600	9,900

Table B.2—Torque-Position Casing (Continued)

Tubular Designation					Position		Torque Range			
							Phosphate		Tin	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
7	17	STC	40	7.875	2.375	2.794	1,300	2,600	900	1,800
7	20	STC	40	7.875	3.125	3.500	1,500	3,000	1,100	2,100
			55		3.125	3.500	2,100	4,200	1,500	2,900
7	23	STC	55	7.875	3.125	3.500	2,800	5,600	2,000	3,900
7	23	LTC	55	7.875	4.000	4.375	3,600	6,100	2,500	4,300
			80		4.063	4.375	4,400	6,600	3,100	4,600
			90		4.063	4.375	4,900	7,400	3,400	5,200
			95		4.063	4.375	5,000	7,500	3,500	5,300
7	26	STC	55	7.875	3.125	3.500	3,400	6,800	2,400	4,800
7	26	LTC	55	7.875	4.000	4.375	4,500	7,700	3,200	5,400
			80		4.063	4.375	5,500	8,300	3,800	5,800
			90		4.063	4.375	6,200	9,300	4,300	6,500
			95		4.063	4.375	6,300	9,500	4,400	6,700
			110		4.125	4.375	6,500	9,800	4,600	6,900
7	29	LTC	80	7.875	4.063	4.375	6,600	9,900	4,600	6,900
			90		4.063	4.375	7,500	11,300	5,300	7,900
			95		4.063	4.375	7,600	11,400	5,300	8,000
			110		4.125	4.375	7,800	11,700	5,500	8,200
7	32	LTC	80	7.875	4.063	4.375	7,100	10,700	5,000	7,500
			90		4.063	4.375	8,000	12,000	5,600	8,400
			95		4.063	4.375	8,400	12,600	5,900	8,800
7 ^{5/8}	24	STC	40	8.500	3.250	3.625	2,700	5,400	1,900	3,800
7 ^{5/8}	26.4	STC	55	8.500	3.250	3.625	3,300	6,600	2,300	4,600
7 ^{5/8}	26.4	LTC	55	8.500	4.125	4.500	4,300	7,800	3,000	5,500
			80		4.188	4.500	5,600	8,400	3,900	5,900
			90		4.188	4.500	6,300	9,500	4,400	6,700
			95		4.188	4.500	6,600	9,900	4,600	6,900
7 ^{5/8}	29.7	LTC	80	8.500	4.188	4.500	7,100	10,700	5,000	7,500
			90		4.188	4.500	7,900	11,900	5,500	8,300
			95		4.188	4.500	8,400	12,600	5,900	8,800
			110		4.250	4.500	9,700	14,600	6,800	10,200
7 ^{5/8}	33.7	LTC	80	8.500	4.188	4.500	8,100	12,200	5,700	8,500
			90		4.188	4.500	9,200	13,800	6,400	9,700
			95		4.188	4.500	9,700	14,600	6,800	10,200
			110		4.250	4.500	11,200	16,800	7,800	11,800
7 ^{5/8}	39	LTC	80	8.500	4.188	4.500	9,000	13,500	6,300	9,500
			90		4.188	4.500	10,100	15,200	7,100	10,600
			95		4.188	4.500	10,700	16,100	7,500	11,300
			110		4.250	4.500	12,300	18,500	8,300	12,500

Table B.2—Torque-Position Casing (Continued)

Tubular Designation					Position		Torque Range			
							Phosphate		Tin	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D ₁ (in.)	D ₂ (in.)	T _{min} (ft-lb)	T _{max} (ft-lb)	T _{min} (ft-lb)	T _{max} (ft-lb)
8-5/8	24	STC	55	9.625	3.000	3.424	3,700	7,400	2,600	5,200
8-5/8	28	STC	40	9.625	3.375	3.750	3,100	6,200	2,200	4,300
8-5/8	32	STC	40	9.625	3.375	3.750	4,100	8,200	2,900	5,700
			55		3.375	3.750	4,200	8,400	2,900	5,900
8-5/8	32	LTC	55	9.625	4.500	4.875	4,400	8,800	3,100	6,200
8-5/8	36	STC	55	9.625	3.375	3.750	5,200	10,400	3,600	7,300
8-5/8	36	LTC	55	9.625	4.500	4.875	5,500	11,000	3,800	7,700
			80		4.563	4.875	8,000	12,000	5,600	8,400
			90		4.563	4.875	9,000	13,500	6,300	9,500
			95		4.563	4.875	9,500	14,300	6,700	10,000
8-5/8	40	LTC	80	9.625	4.563	4.875	8,800	13,200	6,200	9,200
			90		4.563	4.875	9,900	14,900	6,900	10,400
			95		4.563	4.875	10,500	15,800	7,300	11,100
			110		4.625	4.875	12,100	18,200	8,500	12,700
8-5/8	44	LTC	80	9.625	4.563	4.875	10,100	15,200	7,100	10,600
			90		4.563	4.875	11,300	17,000	7,900	11,900
			95		4.563	4.875	11,900	17,900	8,300	12,500
			110		4.625	4.875	13,800	20,700	9,700	14,500
8-5/8	49	LTC	80	9.625	4.563	4.875	11,600	17,400	8,100	12,200
			90		4.563	4.875	13,100	19,700	9,200	13,800
			95		4.563	4.875	13,800	20,700	9,700	14,500
			110		4.625	4.875	16,000	24,000	11,200	16,800
9-5/8	32.3	STC	40	10.625	3.375	3.750	2,900	5,800	1,700	3,500
9-5/8	36	STC	40	10.625	3.375	3.750	3,600	7,200	2,200	4,300
			55		3.375	3.750	5,000	9,000	3,000	5,400
9-5/8	36	LTC	55	10.625	4.750	5.125	5,700	10,100	3,400	6,100
9-5/8	40	STC	55	10.625	3.375	3.750	5,200	9,400	3,100	5,600
9-5/8	40	LTC	55	10.625	4.750	5.125	6,800	10,900	4,100	6,500
			80		4.813	5.125	7,900	11,900	4,700	7,100
			90		4.813	5.125	8,900	13,400	5,300	8,000
			95		4.813	5.125	9,400	14,100	5,600	8,500
9-5/8	43.5	LTC	80	10.625	4.813	5.125	8,900	13,400	5,300	8,000
			90		4.813	5.125	10,100	15,200	6,100	9,100
			95		4.813	5.125	10,600	15,900	6,400	9,500
			110		4.875	5.125	12,200	18,300	7,300	11,000
9-5/8	47	LTC	80	10.625	4.813	5.125	9,600	14,400	5,800	8,600
			90		4.813	5.125	10,800	16,200	6,500	9,700
			95		4.813	5.125	11,400	17,100	6,800	10,300
			110		4.875	5.125	13,100	19,700	7,900	11,800
9-5/8	53.5	LTC	80	10.625	4.813	5.125	12,100	18,200	7,300	10,900
			90		4.813	5.125	13,600	20,400	8,200	12,200
			95		4.813	5.125	14,300	21,500	8,600	12,900
			110		4.875	5.125	16,500	24,800	9,900	14,900

Table B.2—Torque-Position Casing (Continued)

Tubular Designation					Position		Torque Range			
							Phosphate		Tin	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
10 ^{-3/4}	32.75	STC	40	11.750	2.750	3.174	3,300	6,600	2,000	4,000
10 ^{-3/4}	40.5	STC	40	11.750	3.500	3.875	4,100	8,200	2,500	4,900
			55		3.500	3.875	5,700	11,400	3,400	6,800
10 ^{-3/4}	45.5	STC	55	11.750	3.500	3.875	6,000	12,000	3,600	7,200
10 ^{-3/4}	51	STC	55	11.750	3.500	3.875	7,300	14,600	4,400	8,800
			80		3.563	3.875	10,700	16,100	6,400	9,700
			90		3.563	3.875	12,000	18,000	7,200	10,800
			95		3.563	3.875	12,700	19,100	7,600	11,500
			110		3.625	3.875	13,700	20,600	8,200	12,400
10 ^{-3/4}	55.5	STC	80	11.750	3.563	3.875	12,500	18,800	7,500	11,300
			90		3.563	3.875	14,000	21,000	8,400	12,600
			95		3.563	3.875	14,800	22,200	8,900	13,300
			110		3.625	3.875	16,000	24,000	9,600	14,400
10 ^{-3/4}	60.7	STC	110	11.750	3.625	3.875	18,600	27,900	11,200	16,700
10 ^{-3/4}	65.7	STC	110	11.750	3.625	3.875	21,400	32,100	12,800	19,300
11 ^{-3/4}	42	STC	40	12.750	3.500	3.875	6,400	10,900	3,800	6,500
11 ^{-3/4}	47	STC	55	12.750	3.500	3.875	6,900	11,100	4,100	6,700
11 ^{-3/4}	54	STC	55	12.750	3.500	3.875	7,000	11,300	4,200	6,800
11 ^{-3/4}	60	STC	55	12.750	3.500	3.875	7,100	11,400	4,300	6,800
			80		3.563	3.875	7,800	11,700	4,700	7,000
			90		3.563	3.875	8,800	13,200	5,300	7,900
			95		3.563	3.875	9,300	14,000	5,600	8,400
			110		3.625	3.875	9,600	14,400	5,800	8,600
13 ^{-3/8}	48	STC	40	14.375	3.500	3.875	4,500	9,000	2,700	5,400
13 ^{-3/8}	54.5	STC	55	14.375	3.500	3.875	4,800	9,300	2,900	5,600
13 ^{-3/8}	61	STC	55	14.375	3.500	3.875	5,900	9,400	3,500	5,600
13 ^{-3/8}	68	STC	55	14.375	3.500	3.875	6,100	9,800	3,700	5,900
			80		3.563	3.875	7,200	10,800	4,300	6,500
			90		3.563	3.875	8,100	12,200	4,900	7,300
			95		3.563	3.875	8,500	12,800	5,100	7,700
			110		3.625	3.875	9,000	13,500	5,400	8,100
13 ^{-3/8}	72	STC	80	14.375	3.563	3.875	8,000	12,000	4,800	7,200
			90		3.563	3.875	9,000	13,500	5,400	8,100
			95		3.563	3.875	9,500	14,300	5,700	8,600
			110		3.625	3.875	10,100	15,200	6,100	9,100

Table B.3—Torque-Position Buttress

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		Seal Ring Coupling (Phosphate Coated)	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
4-1/2	10.5	BTC	55	5.000	3.938	4.313	2,750	4,700	2,500	4,250	2,750	4,700
4-1/2	11.6	BTC	55	5.000	3.938	4.313	3,250	5,550	3,000	5,100	3,250	5,550
			80		3.938	4.313	3,550	6,050	3,300	5,600	3,550	6,050
			90		3.938	4.313	3,650	6,250	3,400	5,750	3,650	6,250
			95		3.938	4.313	3,700	6,350	3,450	5,850	3,700	6,350
			110		3.938	4.313	3,850	6,550	3,550	6,050	3,850	6,550
4-1/2	13.5	BTC	80	5.000	3.938	4.313	3,900	6,650	3,600	6,100	3,900	6,650
			90		3.938	4.313	4,050	6,850	3,700	6,300	4,050	6,850
			95		3.938	4.313	4,100	6,950	3,750	6,400	4,100	6,950
			110		3.938	4.313	4,250	7,200	3,900	6,600	4,250	7,200
4-1/2	15.1	BTC	110	5.000	3.938	4.313	4,850	8,250	4,450	7,600	4,850	8,250
5	13	BTC	55	5.563	4.063	4.438	3,500	5,950	3,150	5,350	3,500	5,950
5	15	BTC	55	5.563	4.063	4.438	4,100	6,950	3,550	6,000	4,100	6,950
			80		4.063	4.438	4,500	7,650	3,900	6,600	4,500	7,650
			90		4.063	4.438	4,650	7,850	4,000	6,800	4,650	7,850
			95		4.063	4.438	4,700	7,950	4,050	6,900	4,700	7,950
			110		4.063	4.438	4,850	8,250	4,200	7,150	4,850	8,250
5-1/2	15.5	BTC	55	6.050	4.125	4.500	3,950	6,750	3,550	6,000	3,950	6,750
5-1/2	17	BTC	55	6.050	4.125	4.500	4,300	7,350	3,850	6,550	4,300	7,350
			80		4.125	4.500	4,750	8,050	4,200	7,200	4,750	8,050
			90		4.125	4.500	4,850	8,300	4,350	7,400	4,850	8,300
			95		4.125	4.500	4,950	8,400	4,400	7,500	4,950	8,400
			110		4.125	4.500	5,100	8,700	4,600	7,800	5,100	8,700

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Table B.3—Torque-Position Buttress (Continued)

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		Seal Ring Coupling (Phosphate Coated)	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
6-5/8	20	BTC	55	7.390	4.313	4.688	4,800	8,200	4,350	7,400	4,800	8,200
6-5/8	24	BTC	55	7.390	4.313	4.688	5,700	9,700	5,100	8,650	5,700	9,700
			80		4.313	4.688	6,300	10,700	5,600	9,500	6,300	10,700
			90		4.313	4.688	6,450	11,000	5,750	9,800	6,450	11,000
			95		4.313	4.688	6,550	11,150	5,850	9,950	6,550	11,150
			110		4.313	4.688	6,800	11,550	6,050	10,300	6,800	11,550
6-5/8	28	BTC	80	7.390	4.313	4.688	7,250	12,300	6,600	11,200	7,250	12,300
			90		4.313	4.688	7,450	12,700	6,800	11,550	7,450	12,700
			95		4.313	4.688	7,550	12,850	6,900	11,700	7,550	12,850
			110		4.313	4.688	7,850	13,350	7,150	12,150	7,850	13,350
7	23	BTC	55	7.875	4.500	4.875	5,450	9,250	4,950	8,400	5,450	9,250
			80		4.500	4.875	6,000	10,200	5,450	9,250	6,000	10,200
			90		4.500	4.875	6,150	10,500	5,600	9,500	6,150	10,500
			95		4.500	4.875	6,250	10,650	5,700	9,650	6,250	10,650
7	26	BTC	55	7.875	4.500	4.875	6,100	10,350	5,550	9,450	6,100	10,350
			80		4.500	4.875	6,700	11,350	6,100	10,400	6,700	11,350
			90		4.500	4.875	6,900	11,700	6,300	10,700	6,900	11,700
			95		4.500	4.875	7,000	11,850	6,400	10,850	7,000	11,850
			110		4.500	4.875	7,250	12,300	6,600	11,250	7,250	12,300
7	29	BTC	80	7.875	4.500	4.875	7,400	12,600	7,150	12,200	7,400	12,600
			90		4.500	4.875	7,650	13,000	7,400	12,550	7,650	13,000
			95		4.500	4.875	7,750	13,150	7,500	12,700	7,750	13,150
			110		4.500	4.875	8,050	13,650	7,750	13,200	8,050	13,650

Table B.3—Torque-Position Buttress (Continued)

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		Seal Ring Coupling (Phosphate Coated)	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
7-5/8	26.4	BTC	55	8.500	4.688	5.063	6,450	11,050	5,750	9,800	6,450	11,050
			80		4.688	5.063	6,800	12,150	6,050	10,750	6,800	12,150
			90		4.688	5.063	6,950	12,450	6,200	11,100	6,950	12,450
			95		4.688	5.063	7,000	12,650	6,250	11,250	7,000	12,650
7-5/8	29.7	BTC	80	8.500	4.688	5.063	8,250	13,800	7,350	12,600	8,250	13,800
			90		4.688	5.063	8,400	14,200	7,500	12,950	8,400	14,200
			95		4.688	5.063	8,500	14,400	7,600	13,150	8,500	14,400
			110		4.688	5.063	8,750	15,950	7,850	13,650	8,750	15,950
7-5/8	33.7	BTC	80	8.500	4.688	5.063	9,150	15,500	8,200	14,000	9,150	15,500
			90		4.688	5.063	9,350	15,950	8,350	14,400	9,350	15,950
			95		4.688	5.063	9,450	16,200	8,450	14,600	9,450	16,200
			110		4.688	5.063	9,750	16,800	8,700	15,150	9,750	16,800
7-5/8	39	BTC	80	8.500	4.688	5.063	10,250	17,350	9,150	15,700	10,250	17,350
			90		4.688	5.063	10,500	17,850	9,400	16,150	10,500	17,850
			95		4.688	5.063	10,600	18,100	9,500	16,350	10,600	18,100
			110		4.688	5.063	10,900	18,800	9,750	17,000	10,900	18,800

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Table B.4—Torque-Position Buttress 4T

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		4T Method	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
8-5/8	32	BTC	55	9.625	4.813	5.188	7,500	12,750	6,750	11,500	5,550	8,350
8-5/8	36	BTC	55	9.625	4.813	5.188	8,050	13,700	7,200	12,250	5,750	8,650
			80		4.813	5.188	8,450	14,350	7,550	12,850	6,050	9,100
			90		4.813	5.188	8,650	14,700	7,700	13,100	6,200	9,300
			95		4.813	5.188	8,750	14,900	7,800	13,250	6,250	9,400
8-5/8	40	BTC	80	9.625	4.813	5.188	9,050	15,400	8,100	13,750	6,500	9,800
			90		4.813	5.188	9,250	15,700	8,250	14,050	6,600	9,900
			95		4.813	5.188	9,350	15,900	8,350	14,200	6,650	10,000
			110		4.813	5.188	9,650	16,400	8,600	14,600	6,850	10,300
8-5/8	44	BTC	80	9.625	4.813	5.188	9,300	15,800	8,300	14,100	6,650	10,000
			90		4.813	5.188	9,500	16,150	8,500	14,450	6,800	10,200
			95		4.813	5.188	9,600	16,300	8,550	14,550	6,850	10,300
			110		4.813	5.188	9,900	16,850	8,800	14,950	7,100	10,700
8-5/8	49	BTC	80	9.625	4.813	5.188	9,550	16,250	8,500	14,450	6,800	10,200
			90		4.813	5.188	9,750	16,600	8,700	14,800	6,950	10,400
			95		4.813	5.188	9,850	16,750	8,800	14,950	7,050	10,600
			110		4.813	5.188	10,100	17,150	9,050	15,400	7,250	10,900

Table B.4—Torque-Position Buttress 4T (Continued)

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		4T Method	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
9-5/8	36	BTC	55	10.625	4.813	5.188	7,500	12,750	6,900	11,750	5,800	8,700
9-5/8	40	BTC	55	10.625	4.813	5.188	8,350	14,200	7,450	12,650	5,950	8,900
			80		4.813	5.188	8,800	14,950	7,850	13,350	6,250	9,400
			90		4.813	5.188	9,000	15,300	8,000	13,600	6,400	9,600
			95		4.813	5.188	9,050	15,400	8,100	13,750	6,450	9,700
9-5/8	43.5	BTC	80	10.625	4.813	5.188	9,400	16,000	8,400	14,300	6,700	10,050
			90		4.813	5.188	9,600	16,300	8,550	14,550	6,850	10,300
			95		4.813	5.188	9,700	16,500	8,650	14,700	6,900	10,350
			110		4.813	5.188	9,950	16,900	8,900	15,150	7,150	10,700
9-5/8	47	BTC	80	10.625	4.813	5.188	9,500	16,150	8,500	14,450	6,800	10,200
			90		4.813	5.188	9,700	16,500	8,650	14,700	6,950	10,450
			95		4.813	5.188	9,800	16,650	8,750	14,900	7,050	10,600
			110		4.813	5.188	10,100	17,150	9,050	15,400	7,250	10,900
9-5/8	53.5	BTC	80	10.625	4.813	5.188	9,800	16,650	8,750	14,900	7,000	10,500
			90		4.813	5.188	10,000	17,000	8,900	15,150	7,100	10,650
			95		4.813	5.188	10,100	17,150	9,000	15,300	7,200	10,800
			110		4.813	5.188	10,400	17,700	9,300	15,800	7,400	11,100

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Table B.4—Torque-Position Buttress 4T (Continued)

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		4T Method	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
10 ³ / ₄	40.5	BTC	55	11.750	4.813	5.188	6,900	11,750	6,150	10,455	5,350	7,950
10 ³ / ₄	45.5	BTC	55	11.750	4.813	5.188	7,450	12,650	6,650	11,300	5,800	8,700
10 ³ / ₄	51	BTC	55	11.750	4.813	5.188	8,300	14,100	7,400	12,600	6,450	9,700
			80		4.813	5.188	8,750	14,900	7,800	13,250	6,800	10,200
			90		4.813	5.188	8,950	15,200	8,000	13,600	6,950	10,450
			95		4.813	5.188	9,000	15,300	8,050	13,700	7,000	10,500
			110		4.813	5.188	9,250	15,750	8,300	14,100	7,200	10,800
10 ³ / ₄	55.5	BTC	80	11.750	4.813	5.188	9,250	15,750	8,300	14,100	7,200	10,800
			90		4.813	5.188	9,450	16,050	8,450	14,350	7,350	11,050
			95		4.813	5.188	9,600	16,300	8,550	14,550	7,450	11,200
			110		4.813	5.188	9,850	16,750	8,800	14,950	7,650	11,500
10 ³ / ₄	60.7	BTC	90	11.750	4.813	5.188	9,700	16,500	8,700	14,800	7,550	11,350
			95		4.813	5.188	9,850	16,750	8,800	14,950	7,650	11,500
			110		4.813	5.188	10,100	17,150	9,050	15,400	7,850	11,800
10 ³ / ₄	65.7	BTC	90	11.750	4.813	5.188	10,350	17,600	9,250	15,750	8,050	12,100
			95		4.813	5.188	10,500	17,850	9,350	15,900	8,150	12,250
			110		4.813	5.188	10,800	18,350	9,650	16,400	8,400	12,600
11 ³ / ₄	47	BTC	55	12.750	4.813	5.188	7,900	13,450	7,050	12,000	6,150	9,250
11 ³ / ₄	54	BTC	55	12.750	4.813	5.188	8,350	14,200	7,500	12,750	6,500	9,750
11 ³ / ₄	60	BTC	55	12.750	4.813	5.188	8,550	14,550	7,650	13,000	6,650	10,000
			80		4.813	5.188	9,000	15,300	8,050	13,700	7,000	10,500
			90		4.813	5.188	9,200	15,650	8,200	13,950	7,150	10,750
			95		4.813	5.188	9,350	15,900	8,350	14,200	7,250	10,900
			110		4.813	5.188	9,600	16,300	8,550	14,550	7,450	11,200

Table B.4—Torque-Position Buttress 4T (Continued)

Tubular Designation					Position		Torque Range					
							Phosphate		Tin		4T Method	
Size (in.)	Wt. (lb/ft)	Thread	Grade	Coupling OD (in.)	D_1 (in.)	D_2 (in.)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)	T_{min} (ft-lb)	T_{max} (ft-lb)
13-3/8	54.5	BTC	55	14.375	4.813	5.188	8,000	13,600	7,150	12,150	6,200	9,300
13-3/8	61	BTC	55	14.375	4.813	5.188	8,300	14,100	7,400	12,600	6,450	9,700
13-3/8	68	BTC	55	14.375	4.813	5.188	8,500	14,450	7,600	12,900	6,600	9,900
			80		4.813	5.188	8,950	15,200	8,000	13,600	6,950	10,450
			90		4.813	5.188	9,150	15,550	8,150	13,850	7,100	10,650
			95		4.813	5.188	9,200	15,650	8,200	13,950	7,150	10,750
			110		4.813	5.188	9,550	16,250	8,500	14,450	7,400	11,100
13-3/8	72	BTC	80	14.375	4.813	5.188	9,450	16,050	8,450	14,350	7,350	11,050
			90		4.813	5.188	9,650	16,400	8,650	14,700	7,500	11,250
			95		4.813	5.188	9,800	16,650	8,750	14,900	7,600	11,400
			110		4.813	5.188	10,100	17,150	9,050	15,400	7,850	11,800
16	75	BTC	55	17.000	4.813	5.188	7,300	12,400	6,700	11,400	5,600	8,400
16	84	BTC	55	17.000	4.813	5.188	7,850	13,350	7,200	12,250	6,000	9,000
			80		4.813	5.188	8,600	14,600	7,900	13,450	6,300	9,450
16	109	BTC	55	17.000	4.813	5.188	9,100	15,450	8,350	14,200	6,950	10,450
			80		4.813	5.188	10,000	17,000	9,150	15,550	7,300	10,950
18-5/8	87.5	BTC	55	20.000	4.813	5.188	8,200	13,950	7,550	12,850	6,250	9,400
20	94	BTC	55	21.000	4.813	5.188	7,300	12,400	6,700	11,400	5,600	8,400
20	106.5	BTC	55	21.000	4.813	5.188	7,900	13,450	7,250	12,350	6,050	9,100
20	133	BTC	55	21.000	4.813	5.188	8,950	15,200	8,250	14,050	6,850	10,300

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