



U. S. STEEL TUBULAR PRODUCTS
PROPRIETARY THREAD CONNECTION MANUAL
(Printed Copies of this Document are *UNCONTROLLED*)

**RUNNING AND HANDLING PROCEDURE FOR U. S. STEEL
USS-EAGLE TC™ CONNECTIONS**

Procedure: ENG 21
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1.0 Applicable Connections

1.1 USS-EAGLE TC™

1.2 USS-EAGLE TC™ RD (Reduced Diameter)

2.0 Scope

- 2.1 This engineering procedure describes the requirements for running and pulling of U. S. Steel (USS) premium connections. No variations from these requirements shall be permitted without written approval from a U. S. Steel representative.

3.0 Definitions

- 3.1 Premium Connections – Proprietary connections that incorporate a metal-to-metal seal to create a gas tight connection.
- 3.2 Make-up Signature – A graph that is generated from the Torque vs. Turn monitoring system. This is also called a make-up graph. See Figures 4-9.
- 3.3 Early “Shoulder Engagement” is defined as a sudden spike or change in slope to the make-up graph prior to achieving the final torque value. See Figure 7.

4.0 Reference Documents

- 4.1 ENG 05 Approved Running and Storage Compounds and Thread Protectors.

5.0 Equipment Requirements

5.1 Accessory Equipment

- 5.1.1 Inspection of all accessory equipment and backup equipment, such as crossovers, safety subs, float equipment and packer assemblies, shall be conducted prior to any operation. Care shall be taken to ensure that the proper connection is threaded on all accessories.
- 5.1.2 Only accessories threaded by a USS facility, licensed manufacturer or repair shop shall be used. Unauthorized connections can jeopardize the entire string resulting in catastrophic consequences.

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5.1.3 Handling plugs provided by USS shall be used.

5.1.3.1 Handling plugs must be made up hand tight until the connection is snug. Extreme care shall be used to ensure the handling plug is not cross threaded in the box during make-up. Dial calipers, a go/no go gauge, or an equivalent measuring device shall be used to measure the distance between the coupling face and the external handling plug shoulder after make-up. The measured stand-off may not exceed the values listed in Table 1.

Table 1: USS-EAGLE TC™ Acceptable Handling Plug Stand-off

Product Line	Size Range		Max. Stand-off
USS-EAGLE TC™ USS-EAGLE TC™ RD	5.500	0.415	0.45
USS-EAGLE TC™ USS-EAGLE TC™ RD	6.000	0.436	0.45

5.2 Elevators

5.2.1 Slip type or spider type elevators are mandatory for all Eagle TC connections. The elevator shall have a minimum 1" thick striker plate that accommodates the OD of the casing being ran and shall not be larger in ID than the smallest RD coupling OD of that casing size. Slips shall not be set over the threaded area or any formed area of the connection.

5.3 Power Tongs, Gauges, and Torque Recorders

5.3.1 Tongs shall be in good condition with jaws that correctly fit the pipe.

5.3.1.1 Tong jaws that contact the maximum surface area of the pipe as possible are preferred. Greater contact area evenly distributes contact pressure during make-up and minimizes the risk of deforming or crushing the pipe body.

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5.3.2 Make-up torque should be accurately measured and controlled. Torque measuring equipment shall be in good working order and cover the appropriate range and be properly calibrated.

5.3.3 If a snub line is used, it shall be set at a 90-degree angle to the arm of the tong.

5.4 Thread Protectors

5.4.1 Properly fitting, clean thread protectors shall be installed on each connection when stored on pipe racks or when pipe is being moved.

5.4.2 It is recommended that thread protectors be removed as close as practical to the start of the casing running. If the casing run is delayed, thread protectors should be replaced on connections to avoid prolonged exposure to the environment and debris.

5.5 Thread Field Inspection and Repair

5.5.1 Threads shall be thoroughly cleaned and dried prior to inspection to remove all dirt, thread or storage compound, or other residue. Proper cleaning solution shall be used. Do not use metal brushes or other abrasive methods that will cause scratching of the threads and/or seals.

5.5.2 An authorized USS Representative shall perform a thread inspection to evaluate for damage and corrosion.

5.5.3 Minor anomalies on pin thread surfaces may be field repaired. Couplings are not repairable. Damage to seal surfaces, other than very minor oxidation, is cause for rejection. After repairs, threads and seal shall be cleaned and dried. Molybdenum Disulfide spray shall be applied to all repaired areas.

6.0 Thread Locking Procedure

6.1 Connections may be assembled with thread locking compound when required.

6.1.1 Pin application: Apply a thin uniform coating of thread locking compound on threads 5 through 10 – starting approximately 1.5" from the pin face covering the entire circumference for about a 2" span. The thread locking compound must be well worked into the thread form.

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- 6.1.2 Coupling application: Apply an extremely light, uniform coating of the thread running compound to the entire coupling as per section 6.3.2.
- 6.1.3 For best results, it is recommended to assemble the connection well within the short time frame specified per the thread locking compound manufacturers recommendation to guarantee material performance on the connections.
- 6.1.4 A torque that exceeds the connection maximum make-up torque may be required to make-up connections assembled with thread locking compound.
- 6.1.5 The use of excessive thread locking compound may result in an improper connection make-up.

7.0 Running Procedure

7.1 Pipe Handling

- 7.1.1 Extreme care shall be used when handling pipe. Pipe shall not be moved unless the threads, both pins and couplings, are protected with thread protectors. Pipe shall be lifted with straps, not hooks. If a soft line is used, it shall be double wrapped when picking up a joint of pipe.

7.2 Thread Running Compound

- 7.2.1 Thread compound shall be applied to clean, dry connections.
- 7.2.2 Thread running compound and applicator shall be free of foreign contaminants (sand, dirt, etc.). It is recommended that a new container of compound be used at the start of each job. Diesel or other thinning agents shall not be added to thread running compound for any reason.
- 7.2.3 Thread compound shall be specifically designed for use with premium connections. Reference ENG 05 latest revision for a list of approved thread compounds. All other premium connection compounds shall be reviewed and approved by USS Product Engineering prior to use.

7.3 Thread Running Compound Application

- 7.3.1 Thread compound shall be applied to the entire thread and seal surfaces of **the box connection only. The pin connection shall remain bare.**

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- 7.3.2 A very light, even, uniform coating of thread compound shall be applied to the thread and seal area. The compound shall be applied evenly so that the thread form is visible (paper thin amount in the threads is preferred). An example of proper thread compound distribution is shown in Figure 1. The use of a mustache brush is highly recommended for thread compound application. Extreme care should be taken to remove excess thread compound from inside thread roots close to the box seal.



Figure 1: Proper Thread Compound Application

7.4 Stabbing and Thread Engagement

- 7.4.1 A stabbing guide shall be used on the box end to prevent damage to thread and seal surfaces.
- 7.4.2 The pipe must be in vertical alignment over the box. Movement or sway of the pipe shall be held to a minimum. Only after the pipe is positioned properly, the pipe shall be slowly lowered into the box until the stab flanks of the pin are in contact with the stab flanks of the box.
- 7.4.3 A weight compensator is recommended, especially when running large diameters and doubles.

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- 7.4.4 Remove stabbing guide after stabbing. Rotate the pipe by hand to ensure proper thread engagement. Tongs can be used to slowly rotate the pipe for thread engagement verification if weight restricts doing this by hand.
NOTE: Slack shall remain in the snub line and no substantial torque buildup shall be seen during this process. If connection is not stabbed correctly, rotate the connection counterclockwise 1/4 to 1/2 turn to correct. Pipe shall not be rocked back and forth during thread engagement.

7.5 Power Make-up

- 7.5.1 Power tongs are required. Casing running tools (CRTs) may be used for rotating pipe only. Pipe wrenches, rig tongs or spinning chain shall not be used for connection make-up. Make-up at a steady and controlled speed, shifting from high gear to low gear when the torque exceeds 2000ft-lb. Table 2 lists high gear and low gear RPM. Backup tongs shall be located as close to the power tong as possible to prevent bending during make-up. Back up tongs shall not be set over the box end under any circumstances. The elevator should not be unlatched until the make-up process is complete.

Table 2: Power Make-up Speeds

Product Line	High Gear RPM	Low Gear RPM
USS-EAGLE TC™ USS-EAGLE TC™ RD	10 Maximum	5 Maximum

7.6 Final Make-up Position and Torque

- 7.6.1 Make-up acceptance is primarily based on final position, with final torque being a secondary means of verification. Final make-up position and torque shall be verified upon completion of connection make-ups by an authorized USS representative.

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7.6.2 USS Product Data Sheets provide torque values for USS proprietary connections.

7.6.2.1 A connection with an acceptable make-up signature that has a final torque reading within the minimum and maximum torque window range shall be considered acceptable, provided the make-up position requirements are also met. Torque values are recommended and can be affected by field conditions.

7.6.3 The authorized USS representative has the authority to accept connections that make-up outside the established minimum and maximum torque window requirements. When all other make-up requirements are met, the value shall not exceed 10% below or above the recommended torque value.

7.6.4 Verification of the make-up marker's final position shall be performed from a suitable location that is directly in the line of sight with the connection make-up marker intersection. This method is used to avoid any potential for error. See Figure 2.

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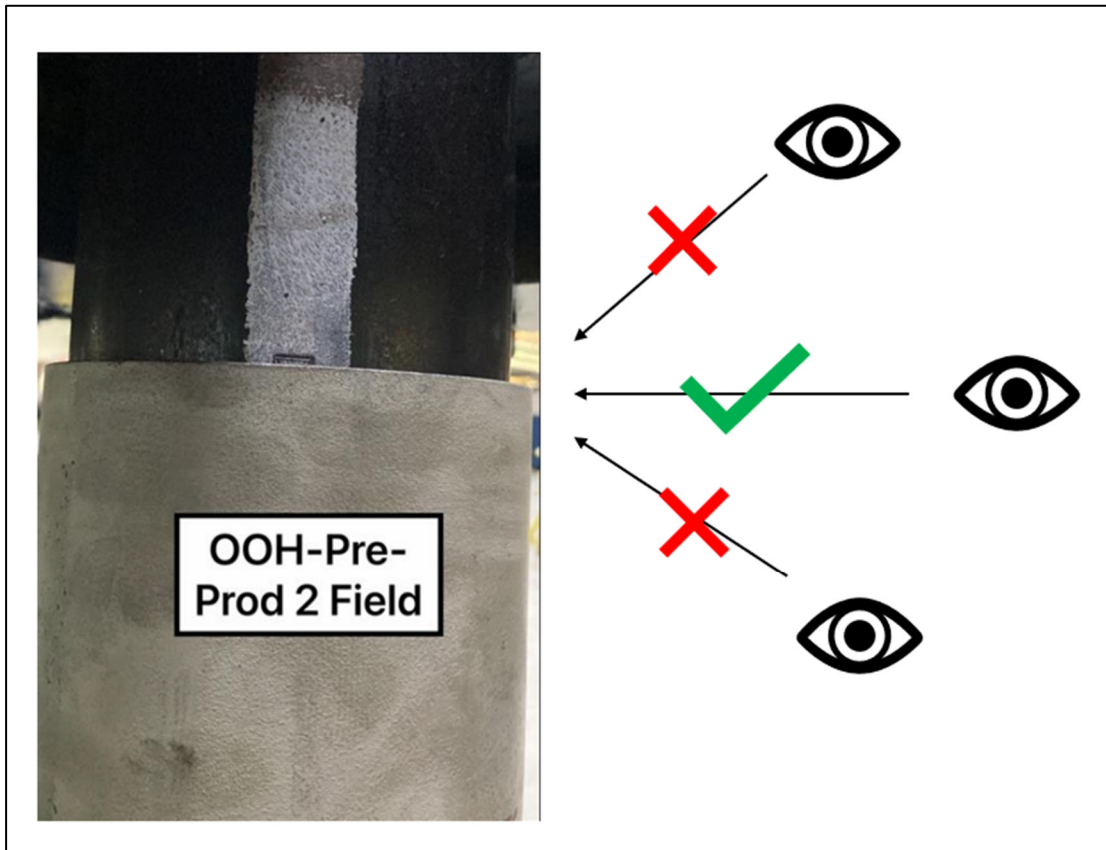


Figure 2: Acceptable Make-up Marker Viewing

7.7 Acceptable Make-up Requirements

7.7.1 The primary requirement for Make-up is position and is considered acceptable when:

7.7.1.1 The coupling face correctly intersects the make-up marker location as indicated in Figure 3.

7.7.1.2 The final torque value for the make-up lands between the minimum and maximum recommended Make-up torque window.

NOTE: The Make-up position is deemed unacceptable if the coupling face either falls short or extends beyond the make-up marker. See Figure 3 for examples of each scenario.

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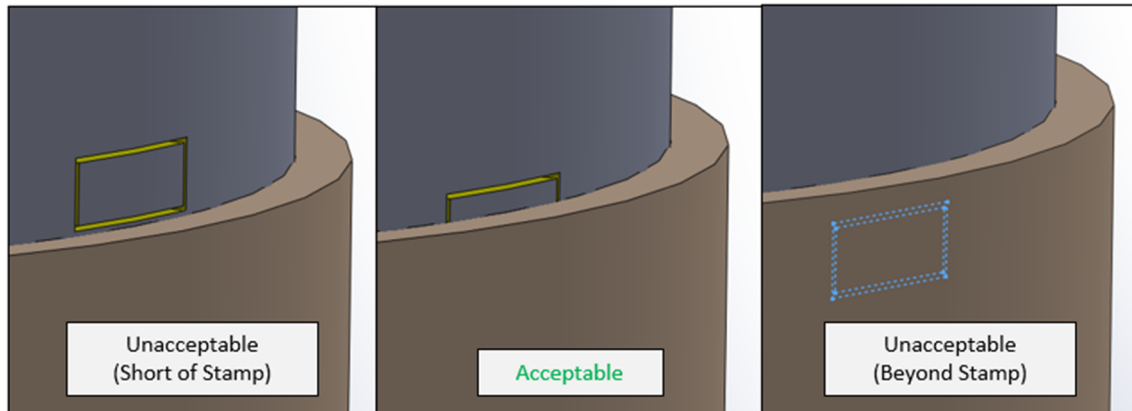


Figure 3: Acceptable / Unacceptable Make-up Positions

7.8 Unacceptable Make-up Conditions

7.8.1 The following make-up conditions are unacceptable even if the final make-up torque is within the minimum and maximum recommended values.

7.8.1.1 The make-up marker position requirement is not met (Figure 3). The torque-turn graph indicates an early shoulder engagement condition during make-up (Figure 7). Reference Section 9.1.2.3 for disposition.

7.9 Breakout

7.9.1 When break-out of a connection is necessary, backup tongs shall be applied to the pipe body below the coupling.

7.9.2 Elevators must be in the relaxed position and not engaged on the pipe body. Place power tongs and backup tongs as close to each other as possible. The tongs shall be equally spaced from the coupling. Slowly apply torque required to break-out connection. Never strike the connection to assist in break-out. Doing so will result in damage to the connection and will jeopardize its performance.

7.9.3 A weight compensator should be used during the break-out process whenever possible to prevent damage to the connection. A weight compensator is recommended for pipe larger than 8-5/8" OD or heavy wall pipe. Use power tongs to back out in low gear until the pipe can be rotated with a strap or chain wrench to complete the removal.

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- 7.9.4 Stop rotation immediately when the pin jumps inside the box. The use of a stabbing guide is required when lifting the pin out of the box. Lift the pin out slowly to avoid damage. Remove power tongs prior to separating the pin from the box connection.
- 7.9.5 Install clean, dry thread protectors prior to pipe movement.

8.0 Torque Monitoring Equipment

- 8.1 The use of a computerized torque monitoring system is highly recommended for make-up of USS proprietary connections. The use of such equipment permanently records the make-up signature and final torque of each connection. It also gives the opportunity to evaluate the connection make-up prior to running the connection in the hole.
- 8.1.1 Torque vs. Turn plots are required. These plots shall be evaluated for signature characteristics. Any major anomalies shall require break-out of the connection. Inspection and repair of the connection, if needed, shall be conducted prior to the connection being re-made.
- 8.2 Setup of torque monitoring equipment
- 8.2.1 Minimum and maximum recommended make-up torques are listed on the USS connection performance sheet.
- 8.2.2 Reference torque shall be set between 200 to 600 ft-lbs.
- 8.2.3 Graph size and scale shall be set to produce a clear signature curve of the make-up.
- 8.2.3.1 Recommended scale setting is 3 to 4 turns on the make-up graph.
- 8.2.3.2 A maximum of two curves per sheet of paper are permitted on printed output.

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9.0 Make-up Marker Position Disposition

8.1 If the proper make-up marker position is not achieved, then the connection shall be broken out, and inspected as outline in Section 6.9.

8.1.1 If Pin is rejected, lay down joint and use new Pin.

8.1.2 If Coupling is rejected, lay down joint and use new Coupling.

8.1.3 If Pin and Coupling are both acceptable, perform second make-up.

NOTE: Target the upper torque range for 2nd Make-up attempt.

8.1.4 If after second make-up the proper make-up location is achieved, the connection shall be accepted.

8.1.5 If the make-up location has not been achieved after the second make-up, **do not** break out.

8.1.5.1 “Bump” the connection using increased torque up to 85% of connection maximum operating torque, to achieve make-up location.

8.1.6 If proper location has been achieved after the “bump” torque has been applied, the connection shall be accepted.

8.1.7 If the make-up location has not been achieved, the connection shall be broken out and both Pin and Box joints are to be rejected.

Note: Coupling may need to be secured by tongs during break out to keep from rotating during the breakout process.

9.0 Disposition of Make-up Curves

9.1 Make-up curves or signatures display the relationship of torque vs turns. These curves demonstrate the make-up characteristics of each connection. The signatures should look similar to the other signatures of the entire string of pipe. Any major abnormalities shall result in break-out of the connection to examine for damage and to determine the cause of the unusual graphs. USS representatives are responsible for acceptance or rejection of the connection make-up curve.

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9.1.1 An acceptable make-up signature is shown in Figure 4. The make-up signature shall be defined by the following criteria:

- The final torque shall fall between the minimum and maximum recommended make-up torque values.
- The maximum non-linear shoulder torque target shall be equal to 83% of the minimum recommended make-up torque. The start of the linear portion of the make-up graph shall fall below the maximum non-linear shoulder torque target line and shall remain linear until final acceptable torque is achieved.

9.1.2 A questionable make-up signature is defined as an irregular appearing signature that is significantly different than the acceptable make-up signature (Figure 4) and the signatures from the rest of the order. Some examples of reject signatures are:

9.1.2.1 Final torque falling below the minimum torque value (Figure 5). The make-up position of a connection with this signature shall be verified.

9.1.2.1.1 If proper make-up location is achieved, the connection shall be accepted.

9.1.2.1.2 If the make-up location has not been achieved, additional torque (up to 90% of connection maximum operating torque) may be applied to the connection to achieve acceptable make-up location.

9.1.2.1.3 If the make-up location is beyond the acceptable limit, the connection shall be broken out, and inspected as outlined in Section 6.9. Connection is to be reassembled at 90% of minimum torque and make-up position shall be verified.

9.1.2.2 Final torque exceeds the maximum torque value (Figure 6). The make-up position of a connection with this signature shall be verified.

9.1.2.2.1 If proper make-up location is achieved, the connection shall be accepted.

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- 9.1.2.2.2 If the make-up location has not been achieved, additional torque (up to 90% of connection maximum operating torque) may be applied to the connection to achieve acceptable make-up location.
- 9.1.2.2.3 If the make-up location is beyond the acceptable limit, the connection shall be broken out, and inspected as outlined in Section 6.9. Connection is to be reassembled at 90% of minimum torque and make-up position shall be verified.
- 9.1.2.3 If Early Shoulder engagement occurs and is outside of the minimum and maximum recommended make-up torque values the connection shall be broken out as outlined in Section 6.9 and inspected. See Figure 7 as reference.
- 9.1.2.3.1 The pin shall be rejected, marked appropriately, and not reused.
- 9.1.2.3.2 The box will be inspected, and if acceptable, will be used in second make-up with new pin. Connection to be reassembled at 90% of the minimum torque value and make-up position shall be verified.
- 9.1.2.3.3 Any Early Shoulder Engagement must occur between the new 90% minimum and maximum recommended make-up torque limit for the connection to be accepted during second make-up.
- 9.1.2.3.4 If the Early Shoulder Engagement occurs below the new 90% minimum recommended make-up torque, breakout connection as outlined in Section 6.9, and reject both Pin and Box.
- 9.1.2.4 Yielding or deformation indications prior to final torque release (Figure 8). A connection with this signature shall be broken out and the pin and box connection shall be rejected.
- 9.1.2.5 Irregularities in the make-up chart (Figure 9). A connection with this signature shall be broken out and inspected as outlined in Section 6.9.

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- 9.1.3 In the case of a rejected signature curve, the connection in question shall be subjected to a breakout evaluation.
- 9.1.3.1 If the connection make-up signature is rejected, the pin shall be broken out completely to expose the entire pin and box connection.
- 9.1.3.2 The pin and box shall be thoroughly cleaned, and visually inspected for damage to the threads and seal area.
- 9.1.3.2.1.1 Connections found with detrimental damage in the thread area (galling) or any damage on the seal surface, the connection shall be rejected and marked appropriately. Minor thread damage can be field repaired.
- 9.1.3.3 Connections with no damage may be reassembled provided the maximum number of make-up attempts is not exceeded.
- 9.1.4 If the second make-up signature is acceptable or similar to the first make-up signature and final torque of the second make-up are within the acceptable limits, the connection shall be considered acceptable.
- 9.1.5 Connections shall not be made up more than two times. After the second attempt to get an acceptable make-up signature, the connection shall be rejected.

10.0 Common Causes of Connection Damage

- 10.1** When connections are experiencing galling or torn metal during break-out of signature rejects, there are some common causes that can be evaluated to correct this issue. Some of these causes are as follows:
- 10.1.1** Foreign materials (sand, dirt, diesel, or other) on threads and/or in thread compound. Reference Section 6.2.
- 10.1.2** Insufficient or improperly applied thread compound. Proper thread compound application is critical to connection make-up. Reference Section 6.3.
- 10.1.3** Misalignment from vertical during stabbing, make-up or break-out. Reference Section 6.4.

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- 10.1.4** Rocking of pipe to correct cross threading. Reference Section 6.4.
- 10.1.5** Setting backup tongs over box threads. Reference Section 6.5.
- 10.1.6** Continued rotation of pipe after threads have disengaged during pulling of pipe. Reference Section 6.9.
- 10.1.7** Improper handling of pipe during storage and movement of pipe. See Section 6.1.
- 10.1.8** Use of accessories with non-authorized USS connections. See Section 4.1.
- 10.1.9** Over-torque of the connection. See Section 6.6.

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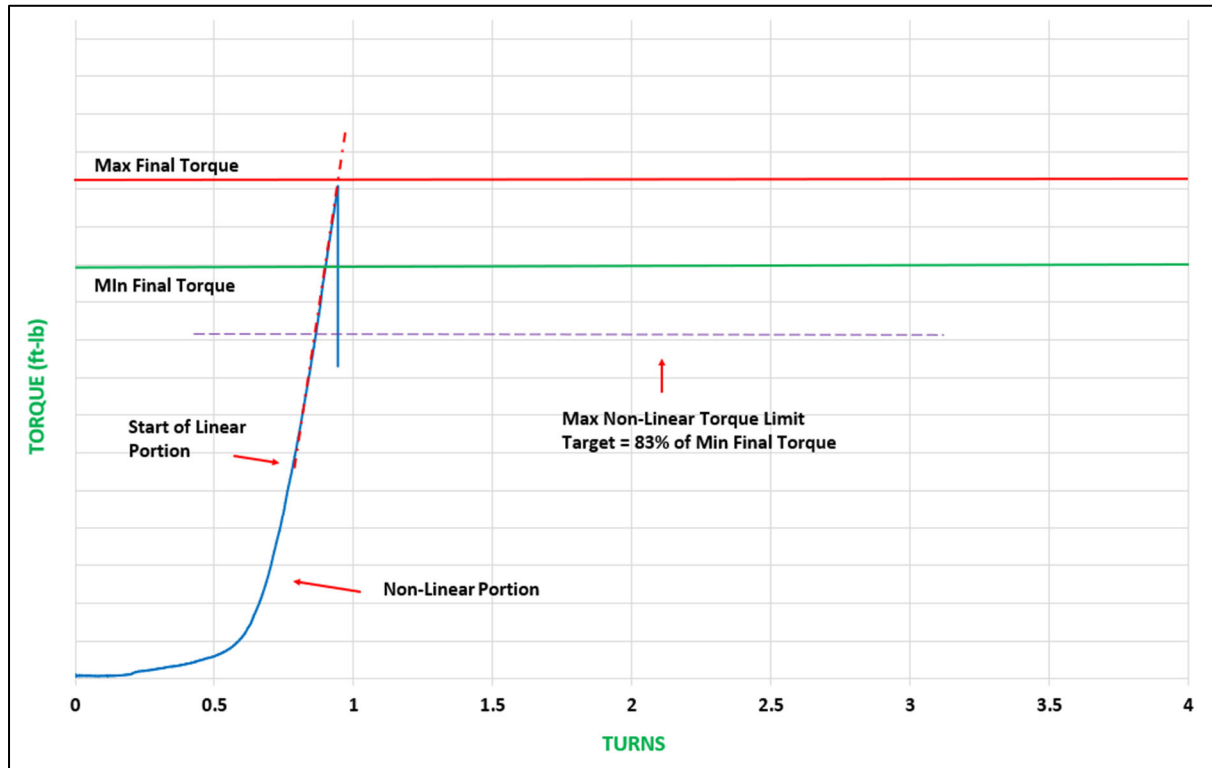


Figure 4: Typical Acceptable Make-up Signature

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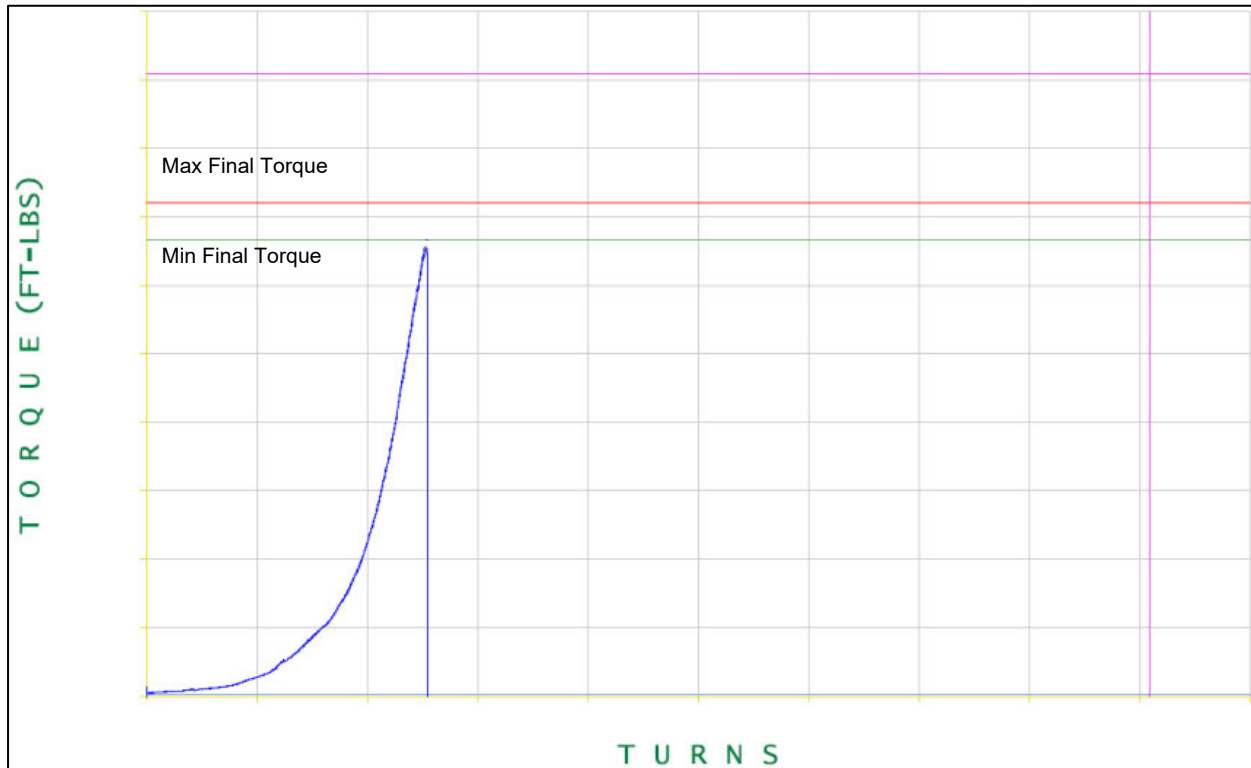


Figure 5: Below Min Final Torque

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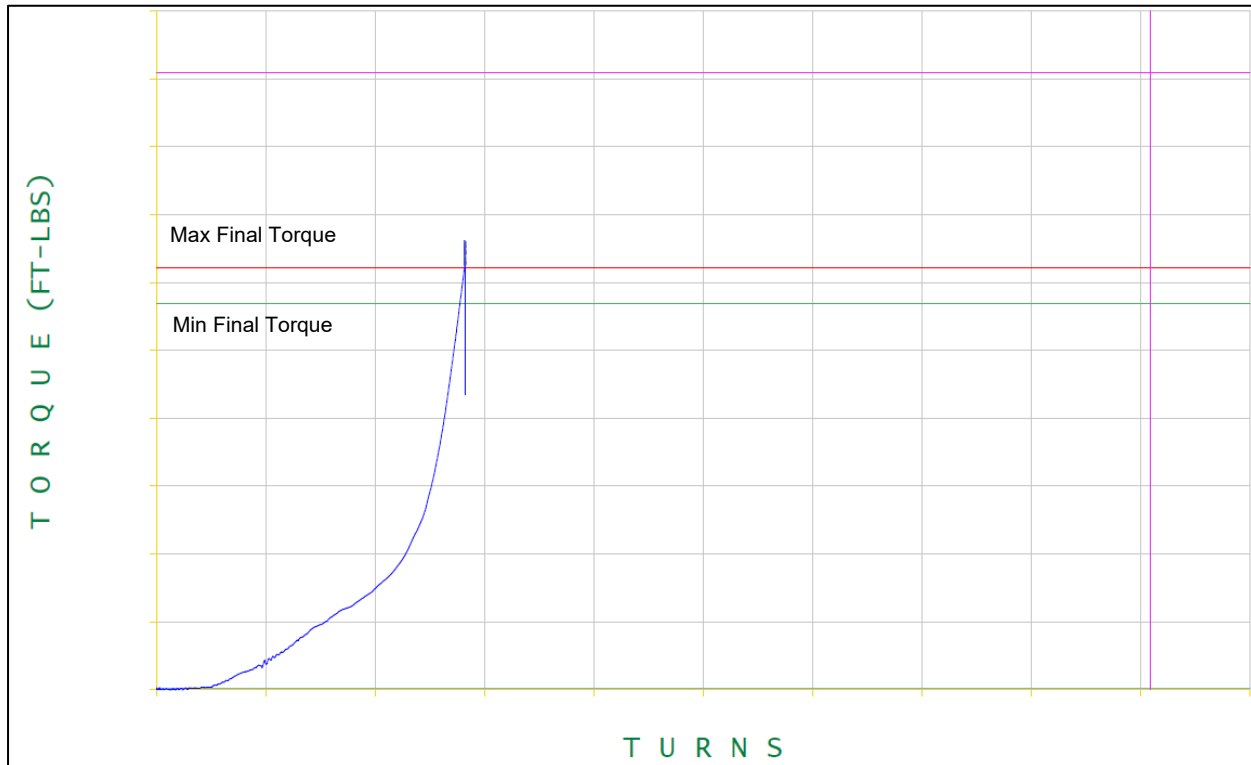


Figure 6: Exceeded Max Final Torque

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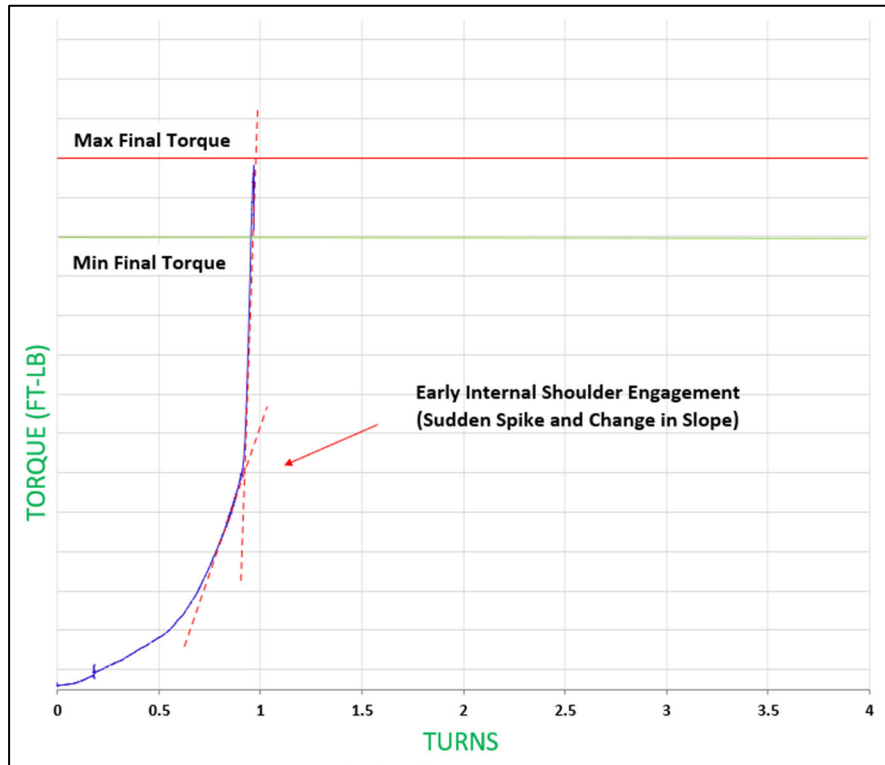


Figure 7: Early Internal Shoulder Engagement Prior to Final Torque

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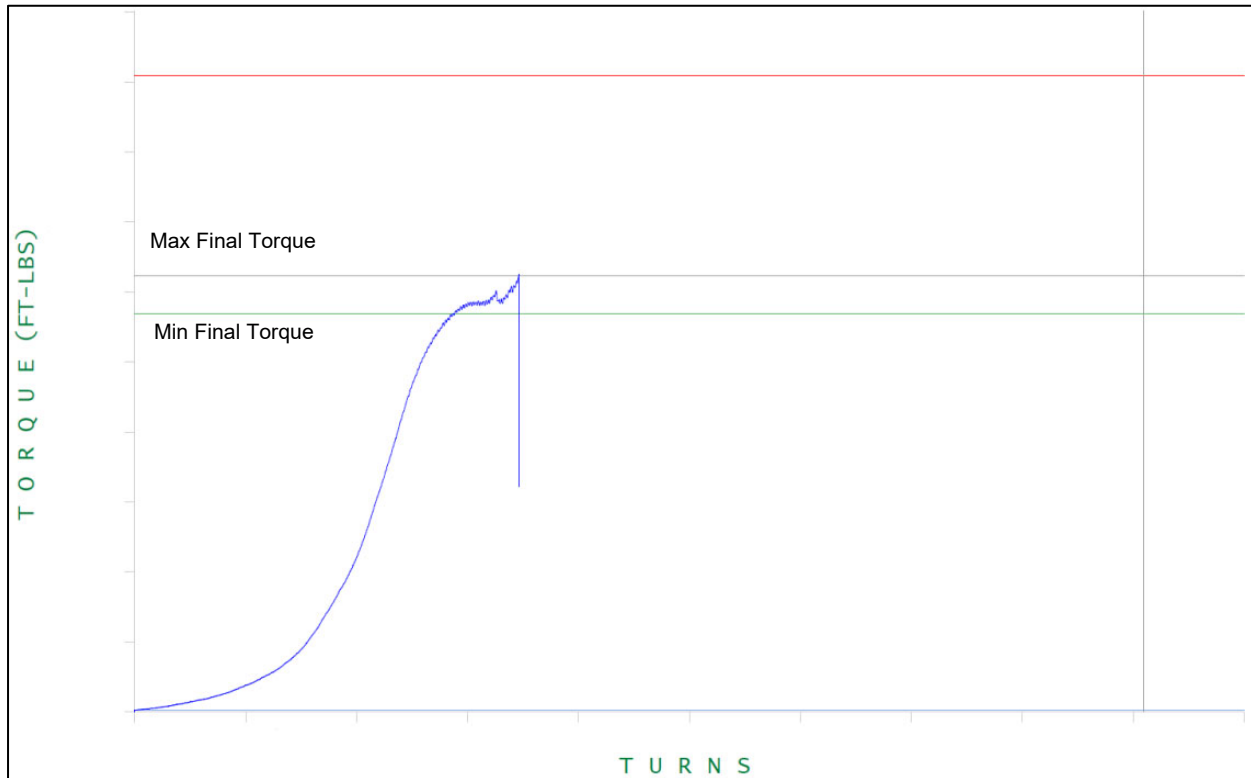


Figure 8: Yielding/deformation Prior to Final Torque (Connection Shall Be Rejected)

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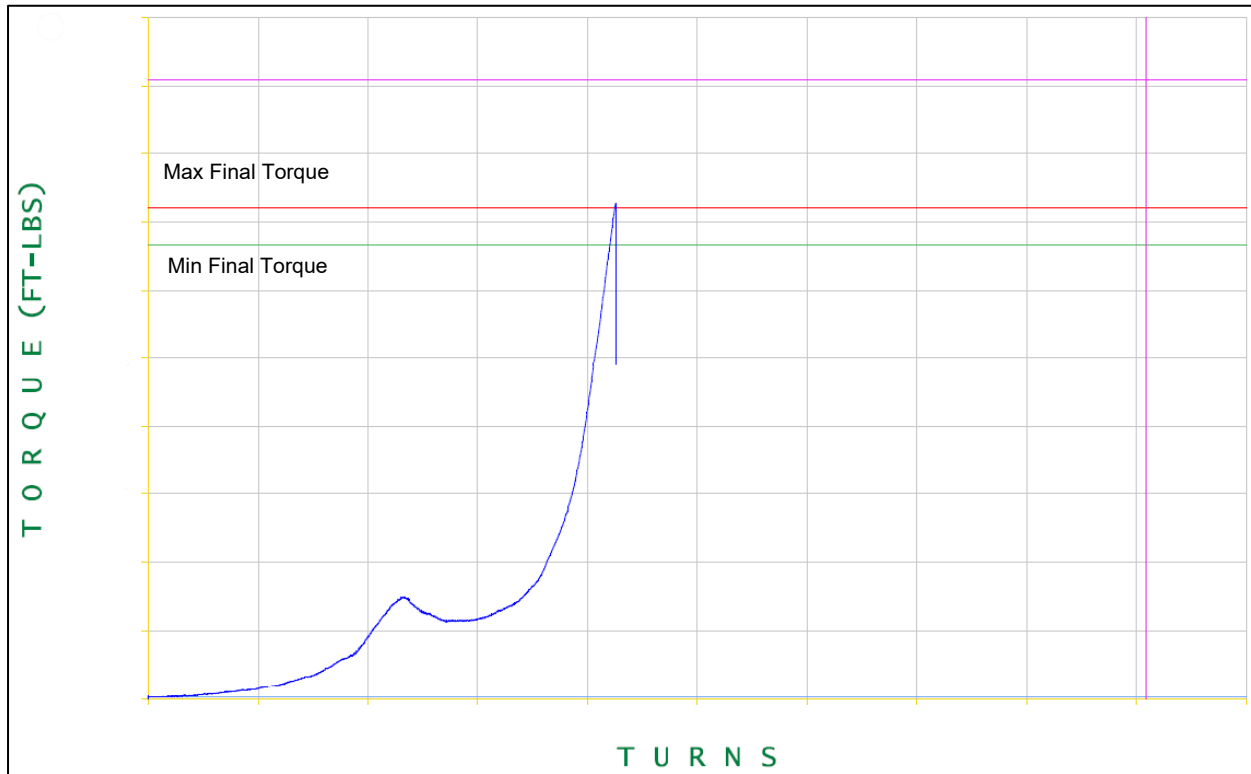


Figure 9: Irregularities in the Make-up Chart

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11.0 Revision Notes

11.1 Updated Document name.

11.2 Added Section 1.0.

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