RUNNING AND HANDLING SPECIFICATION FOR U. S. STEEL USS-FREEDOM HTS CONNECTIONS	**Procedure: ENG 23** **Revision: 3** **Effective Date: 05/01/2026** **Page: 1 of 21**

1.0 Applicable Connections

1.1 USS-FREEDOM HTS™
1.2 USS-FREEDOM HTS™ RD (Reduced Diameter)

2.0 Scope

2.1 This engineering specification describes the requirements for running and pulling of the U.S Steel (USS) USS-FREEDOM HTS™ connections. No variations from these requirements shall be permitted without written approval from a U.S Steel Representative.

3.0 Definitions

3.1 Internally Shouldered Threaded and Coupled Connections – Proprietary connections that incorporate an internal shoulder configuration.

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 4-10 for various examples.

3.3 Shoulder Torque – The mating of the two torque shoulders (Pin and Box) and evidenced by increasing torque with no additional turns on the Torque vs. Turn graph. See Figures 4, 5, and 7 for various examples.

3.4 Pin Nose Surface – The sloped area between the Pin Face and the first thread.

3.5 Shoulder Transition Surface – The contoured surface between the coupling/box shoulder and groove.

3.6 Coupling Internal Torque Shoulder – The area of the box that engages with the Pin Face at full make-up.

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 USS connections can jeopardize the entire string resulting in catastrophic consequences.

5.1.3 It is recommended to use handling plugs provided by USS. If Buttress-compatible handling plugs are selected, the stabbing depth (or make-up loss) shall be a minimum of 0.125" less than the specified make-up loss of the USS-FREEDOM HTS™ connection being run.

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-FREEDOM HTS™ Acceptable Handling Plug Stand-off

Size Range	Max. Stand-off
5.500” OD x 0.361” wall	0.95
6.000” OD x 0.400” wall	0.95

5.2 Elevators

5.2.1 Slip type or spider type elevators are recommended for all connection types, but mandatory for all USS-FREEDOM HTS™ reduced diameter (RD) couplings. 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.

5.3.2 Make-up torque shall 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 damage the pin nose surface, shoulder transition surface, or threads.

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

5.5.3 Minor anomalies on thread and torque shoulder surfaces may be field repaired. After repairs, the threads, along with the pin nose surface and shoulder transition surface, 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 **The shoulder transition surface and internal torque shoulder on the box shall both remain bare.**

6.1.2 Pin application: Apply a thin, uniform coat of thread running compound to first two threads on pin, covering the entire circumference. Apply a thin, uniform coat of thread locking compound on the remainder of the threads on the pin, including the imperfect thread area, covering the entire circumference. The thread locking compound must be well worked into the thread form.

6.1.3 Box application: Apply a thin, uniform coat of thread running compound to the first two threads adjacent to shoulder transition surface in box, covering the entire circumference. No thread locking compound shall be applied to the box.

6.1.4 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.

6.1.5 A torque that exceeds the connection maximum make-up torque may be required to shoulder the connection.

6.1.6 The use of excessive thread locking compound may result in an improper connection make-up.

6.1.7 Leaching of thread running compound and thread locking compound is acceptable at the mating areas.

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 boxes, 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. All of the storage compound shall be removed to avoid a mixture of storage and running compounds during make-up.

7.2.2 Thread running compound shall be free of foreign contaminates (sand, dirt, etc.). It is recommended that a new container of compound be used at the start of each job. Diesel or other foreign thinning agents shall not be added to thread running compound for any reason.

7.2.3 Approved thread compounds are listed in USSTP specification ENG 05. Other approved API modified thread compounds commonly used on API LTC and API BTC casing may also be used with USSTP permission.

7.3 Thread Running Compound Application

7.3.1 **Thread compound shall be applied to the entire thread surface of the box connection only. Do not apply dope to the shoulder transition surface or internal torque shoulder. The pin shall remain bare.**

7.3.2 An even, uniform coating of thread compound shall be applied such that the thread form is still visible. An example for proper thread compound distribution is shown (see Figure 1). The use of a mustache brush is highly recommended for thread compound application.

Figure 1: Thread Compound Application

7.4 Stabbing and thread engagement

7.4.1 A stabbing guide shall be used on the coupling thread to prevent damage to the pin nose surface, shoulder transition surface, and threads.

7.4.2 The pipe must be in vertical alignment over the box. It is important to have good alignment when stabbing the pin connection into the box to prevent any cross threading or improper make-up. 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 The use of a weight compensator is recommended, especially when running multiple joints.

7.4.4 Remove stabbing guide after stabbing. Rotate the pipe by hand to insure 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 appreciable torque buildup shall be seen during this process. The connection shall be free running without torque required. 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 from stab board during thread engagement.

7.5 Power Make-up

7.5.1 Power tongs are required. 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 prior to shoulder engagement. Make-up at a steady and controlled speed, usually between 5 and 35 RPMs. The power tongs shall be in low gear before shoulder contact. Make-up to within the recommended make-up torque range. 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 coupling. The elevator should be in a relaxed position during the make-up process.

7.6 Make-up Requirements (Coupling/Box with Shoulder)

7.6.1 The USS-FREEDOM HTS™ shall be made up to established torque requirements. First and foremost, the associated torque requirements shall be met, followed by verifying position of the coupling face to the triangle stamp make-up position indicator. An acceptable make-up is when both torque requirements and make-up position are met, and the make-up signature is not irregular.

7.6.2 USS Connection Performance Data sheets provide torque values for USS proprietary connections. The torque values listed are the

minimum and maximum recommended make-up torques, as well as the connection operating or yield torque. The minimum and maximum recommended make-up torques can be averaged to obtain an optimum torque however, a connection with an acceptable make-up signature that has a final torque reading within the minimum and maximum torque window shall be considered acceptable. Torque values are recommended and can be affected by field conditions.

7.6.3 The make-up triangle is a secondary visual verification of proper make-up of the connection. Refer to Section 7.7.2.1 and 7.7.2.2.

7.6.4 In isolated cases, the USS authorized rig site services representative has the authority to accept connections, which are outside the minimum and maximum torque window at their discretion. The value shall not exceed 10% below or above the recommended torque value.

7.7 Accessory Make-up Requirements (Non-Shouldered Box)

7.7.1 In the absence of an internal shoulder, the following position make-up procedure shall be used to establish accept/reject criteria conformance.

7.7.2 The primary requirement of position shall be met, with final torque being a secondary component. ***Note that even if the torque is within the minimum and maximum requirements, the make-up is unacceptable if the position requirement described below is not met.***

7.7.2.1 Connection make-up position is acceptable if the coupling/box face falls anywhere on or inside of the pin triangle stamp, and the make-up signature is not irregular. See Figure 2.

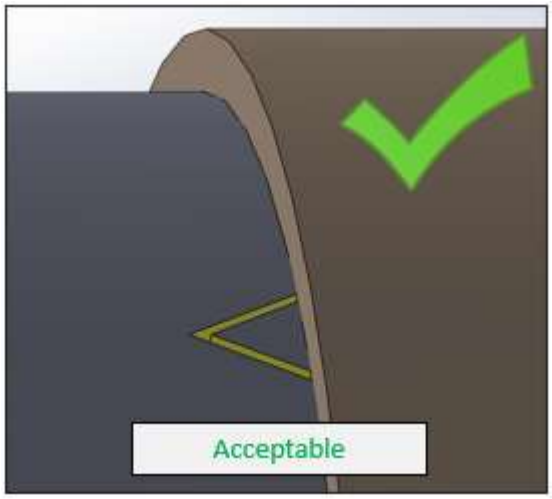

Figure 2: Acceptable Make-up Position

7.7.2.2 Two examples of unacceptable make-ups are shown in Figure 3 where the make-up is short of the triangle stamp (left), and the make-up is beyond the triangle stamp (right).

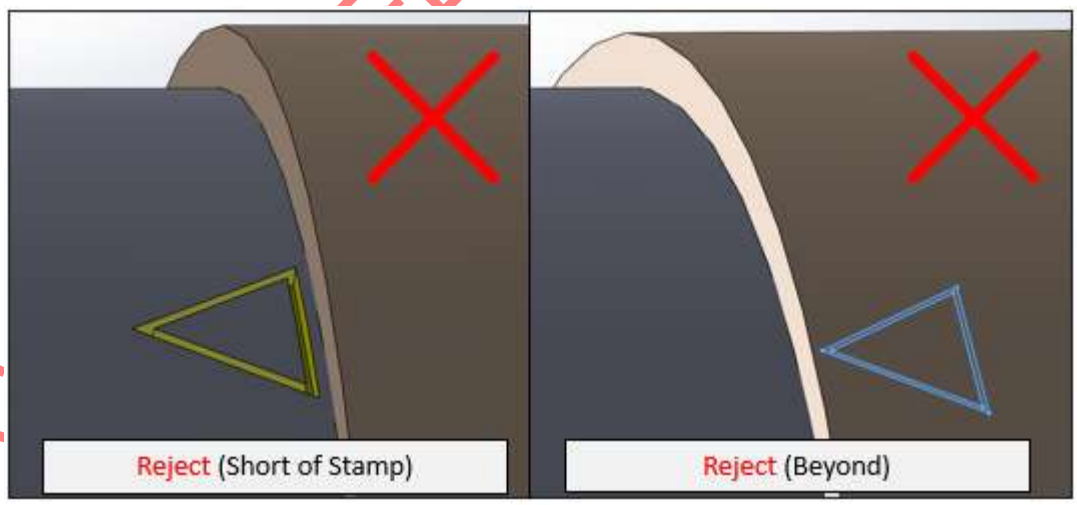

Figure 3: Reject Make-up Positions

7.7.2.3 MIN and MAX Accessory Final Torque Limit is shown in Table 2.

Table 2: Accessory Make-up Torque (Non-Shouldering Box)

Accessory Make-up Final Torque Requirements (Non-Shouldering Box)		
Connection	**Torque (ft-lb)**	
USS-FREEDOM HTS™ USS-FREEDOM HTS™ RD	Min Torque =	40% x Min Torque (Data Sheet)
	Max Torque =	95% x Min Torque (Data Sheet)

7.8 Breakout

7.8.1 When breakout of a connection is necessary, backup tongs shall be applied to the center of the coupling.

7.8.2 Elevators shall be in a relaxed position during the breakout process. Place power tongs and backup tongs as close to each other as possible to prevent bending during breakout. Slowly apply torque required to break out connection. Never strike the connection to assist in breakout. Doing so will result in damage to the connection and will jeopardize its performance.

7.8.3 A weight compensator should be used during the breakout process whenever possible to prevent damage to the connection.

7.8.4 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.

7.8.5 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 required for make-up of USS proprietary connections. The use of such equipment permanently records the make-up signature, shoulder torque, 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 at 5% of the minimum recommended torque.

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 5 turns on the make-up graph.

8.2.3.2 A maximum of two curves per sheet of paper are permitted on printed output.

8.2.4 Minimum Shoulder Torque is 40% of minimum make-up torque. Maximum Shoulder Torque is 95% of minimum make-up torque.

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 other signatures of the entire string of pipe. Any major abnormalities shall result in breakout of the connection to examine for damage and to determine the cause of the unusual graph. USS Rig Site Services representatives are responsible for acceptance or rejection of the connection make-up curve.

9.1.1 An acceptable make-up signature is shown in Figure 4. A distinct shoulder shall be present and shall fall in between the minimum and maximum required shoulder torque values. The final torque value shall fall between the minimum and maximum required make-up torque values as noted on the corresponding Product Data Sheet.

9.1.1.1 Figure 4 shows three distinct phases of the make-up curve, each represented by a linear best-fit line. The purple line corresponds to the initial torque buildup in the threads. This is followed by the yellow line, which marks the onset of shoulder engagement. The blue line shows a near-vertical slope, indicating full shoulder engagement.

9.1.1.2 The shoulder point shall be selected at the intersection of the yellow and blue lines, where the shoulder is fully engaged.

9.1.2 A rejected 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 casing job. Some examples of reject signatures are:

9.1.2.1 Final torque falling outside the final torque maximum and minimum values (Figure 5). A connection with this

signature shall be broken out and inspected as outlined in Section 7.8.

9.1.2.2 No distinct and visible shoulder (Figure 6). A connection with this signature shall be broken out and inspected as outlined in Section 7.8.

9.1.2.3 Shoulder torque value falling outside the shoulder torque maximum and minimum values (Figure 7). A connection with this signature shall be broken out and inspected as outlined in Section 7.8.

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 Interrupted rotation during make-up (Figure 9). A connection with this signature shall be broken out and inspected as outlined in Section 7.8.

9.1.2.6 Irregularities in the make-up chart prior to shouldering (Figure 10). A connection with this signature shall be broken out and inspected as outlined in Section 7.8.

9.1.3 In the case of a rejected signature curve, the connection in question shall be subjected to a back-out 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 pin nose surface, shoulder transition surface, and threads.

9.1.3.2.1 Connections found with detrimental damage on the pin nose surface, shoulder transition surface, or thread area (galling), shall be rejected and marked appropriately. Minor thread damage can be field repaired.

9.1.3.2.2 Connections with no damage may be reassembled provided the maximum number of make-up attempts is not exceeded.

9.1.3.2.3 If the second make-up signature is acceptable or similar to the first make-up signature and the shoulder torque and final torque of the second make-up are within the acceptable limits, the connection shall be considered acceptable.

9.1.3.2.4 Connections shall not be made up more than three times. After third attempt to get an acceptable make-up signature, the connection shall be rejected and shall not be used.

10.0 Common Causes of Connection Damage

10.1 When connections are experiencing galling or torn metal during breakout 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 7.2.

10.1.2 Insufficient or improperly applied thread compound. Proper thread compound application is critical to connection make-up. Reference Section 7.3.

10.1.3 Misalignment from vertical during stabbing, make-up, or breakout. Reference Section 7.4 and 7.5.

10.1.4 Rocking of pipe to correct cross threading. Reference Section 7.4.

10.1.5 Setting backup tongs over box threads. Reference Section 7.8.

10.1.6 Continued rotation of pipe after threads have disengaged during pulling of pipe. Reference Section 7.8.

10.1.7 Improper handling of pipe during storage and movement of pipe. See Section 7.1.

10.1.8 Use of accessories with non-authorized USS connections. See Section 5.1.

10.1.9 Over torque of the connection. See Section 7.6.

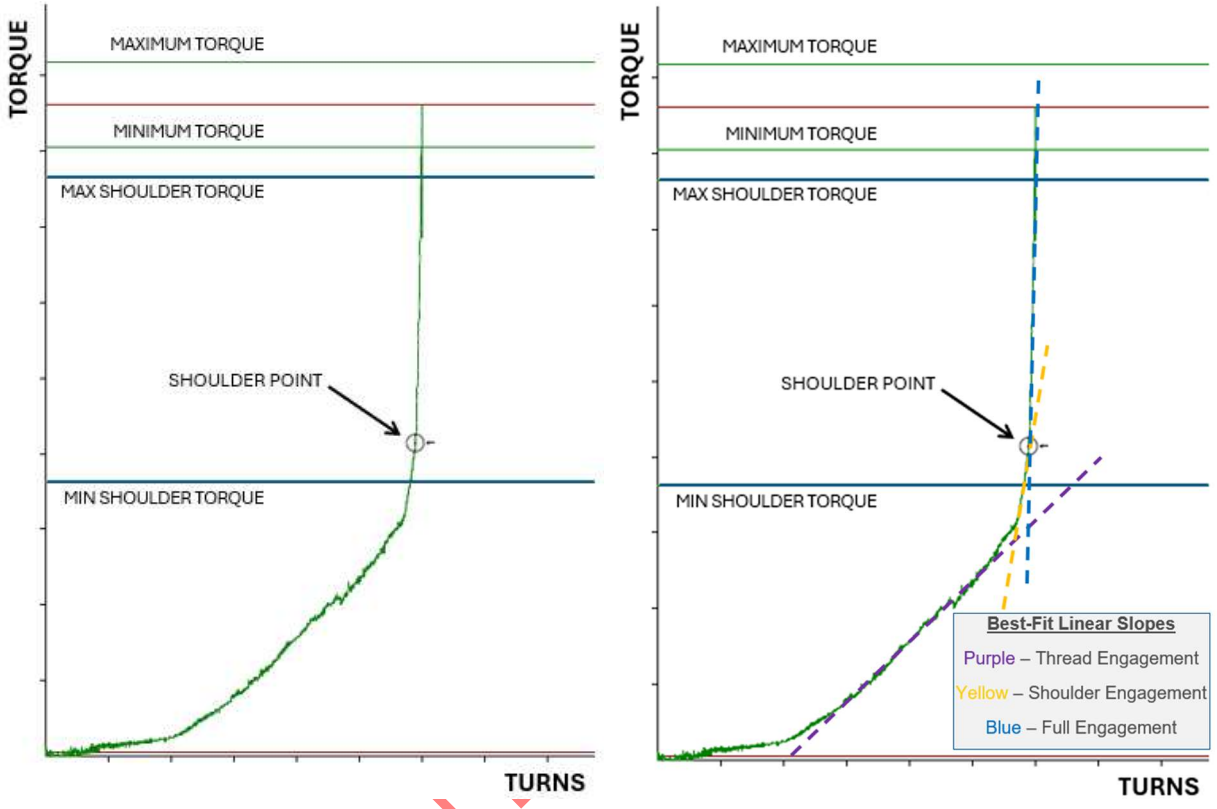

Figure 4 - Typical Acceptable Make-up Signature. The intersection between the yellow and blue lines of best-linear-fit indicates where the shoulder point should be selected.

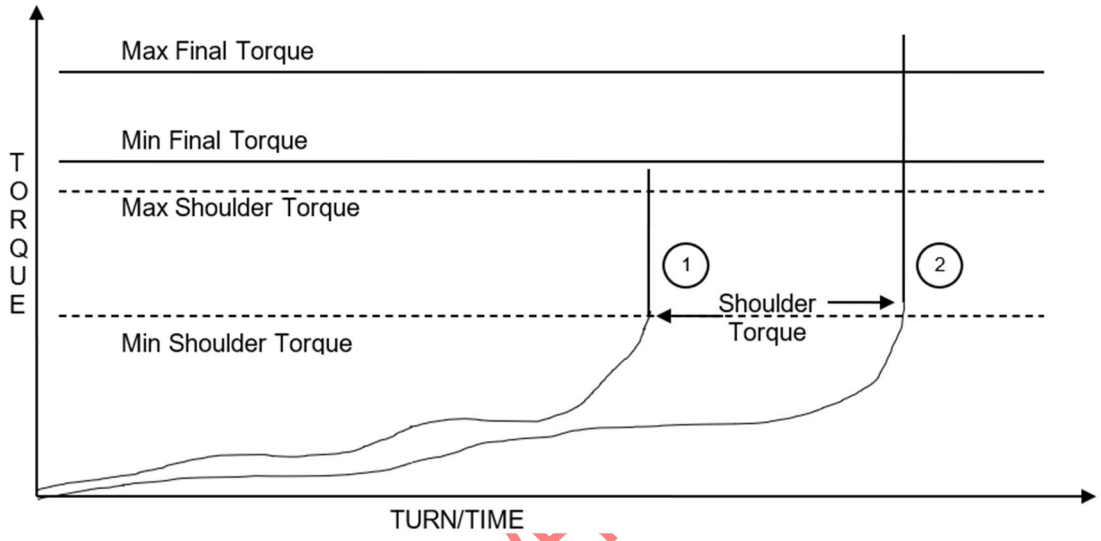

Figure 5 - 1. Below Min Final Torque (Breakout and evaluate).

2. Exceeded Max Final Torque (Breakout and evaluate).

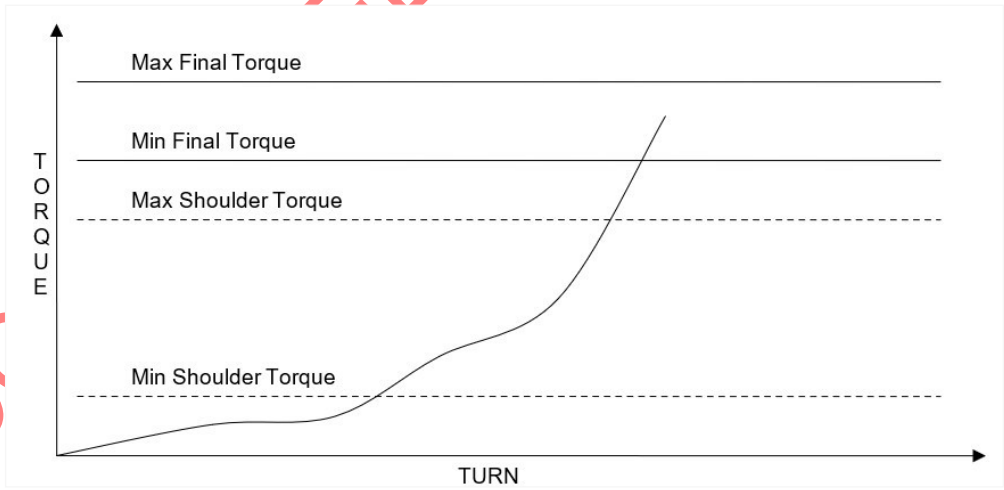

Figure 6 - No visible shoulder (Breakout and evaluate).

Prepared by: Burnap, Andrew C	Prepared date: 05/01/2026
Reviewed by: Becker, Shelby L	Reviewed date: 05/01/2026
Approved by: Tuma, Keith	Approved date: 05/01/2026

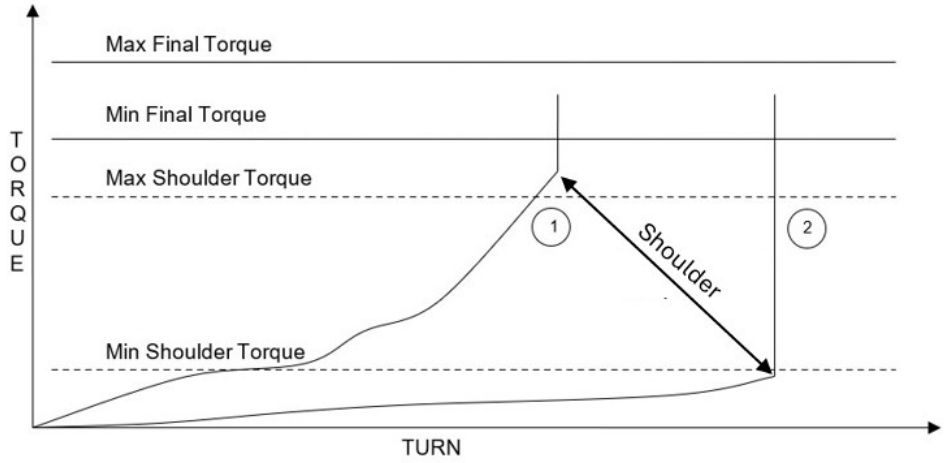

Figure 7 - 1. High shoulder (Breakout and evaluate). 2. Low shoulder (Breakout and evaluate).

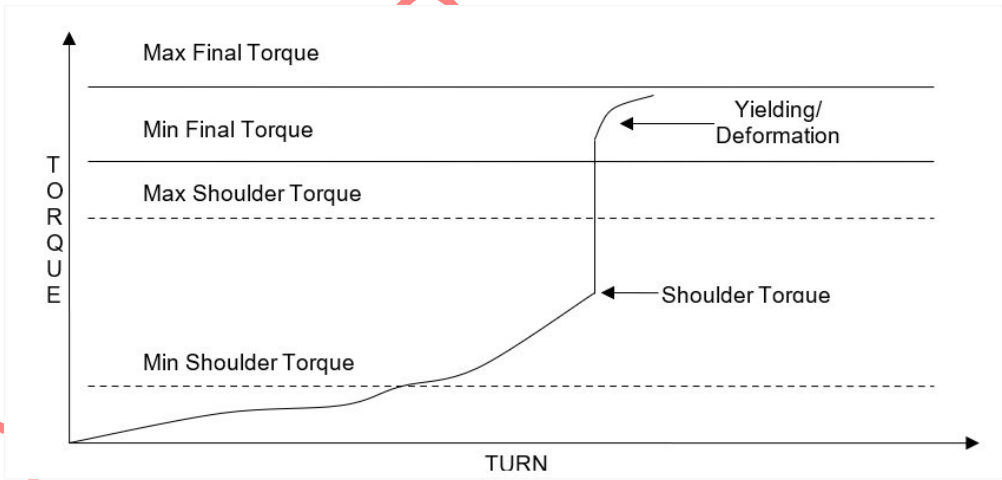

Figure 8 - Yielding/deformation prior to final torque **(Connection shall be rejected).**

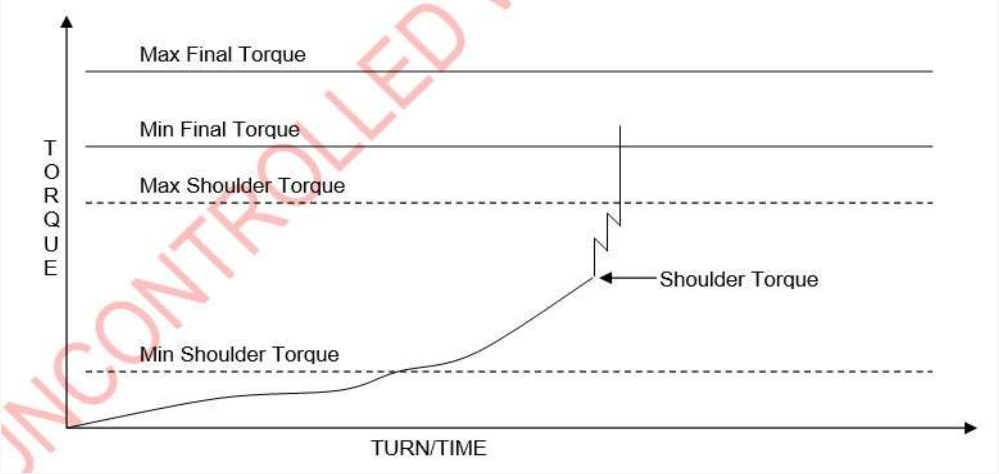

Figure 9 - Interrupted rotation during make-up (Breakout and evaluate).

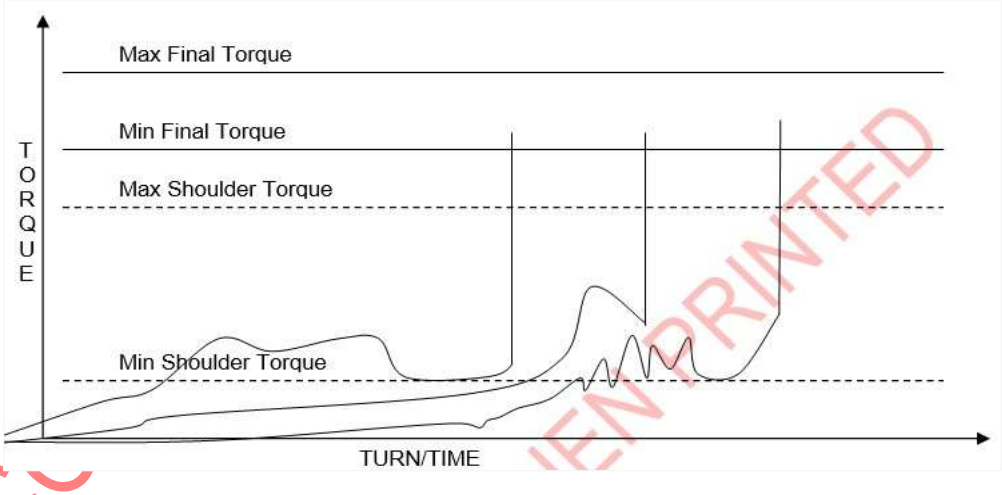

Figure 10 - Irregularities prior to shoulder (Breakout and evaluate).

11.0 Revision Notes:

11.1 Added 9.1.1.1 and 9.1.1.2 to serve as guidance towards appropriately selecting the shoulder point on the make-up chart.

11.2 Added additional chart to Figure 4 to illustrate the 3 phases of an acceptable make-up, including guidance on selecting the shoulder point.

Prepared by: Burnap, Andrew C	Prepared date: 05/01/2026
Reviewed by: Becker, Shelby L	Reviewed date: 05/01/2026
Approved by: Tuma, Keith	Approved date: 05/01/2026