Technical Bulletin		
No: TB096	**Rev: Draft 1**	**Date: May 21, 2013**
Torque Rating of 500/750TON ESI 1350HP T-Bar and Tubular Torque Track When Handling Drill Pipe		

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BACKGROUND INFORMATION:

During initial operations of the ESI Top Drive, TESCO observed higher than expected rates of wear on the ESI torque bushing liner material. Because the wear rate was beyond TESCO accepted reliability standards, the TESCO engineering team began a follow up design review of the entire top drive system as part of TESCO's continuous improvement process. Specifically, the design team wanted to ensure that the torque specifications of 72,000 ft-lbs continuous operations and 100,000 ft-lbs of grabber box operations were still valid. Therefore, TESCO conducted a destructive test of the ESI torque path components per API-8C section 5.5 (alternative rating method) to confirm the safe continuous torque rating that was originally determined from the Finite Element Analysis (FEA).

The ESI Top Drive is rated to 72,000 ft-lbs maximum continuous drilling torque and the destructive test confirmed that the maximum safe continuous torque rating of the ESI torque track and T-bar is 72,000 ft-lbs with a minimum safety factor of 1.77. API requires a safety factor of 1.5. Destructive test details and results are outlined in the Appendix at the end of this bulletin.

TESCO understands that operators may periodically use backup tongs instead of the grabber box to makeup or breakout drill pipe. It must be clarified that TESCO recommends the grabber box be utilized to break and make such connections. It is particularly important, however, to understand that if there is a need to exceed 72,000 ft-lbs while handling drill pipe, the operator must utilize the grabber box. Makeup torque of 72,000 ft-lbs up to 84,000 ft-lbs or breakout torque of 72,000 ft-lbs up to 100,000 ft-lbs must be reacted solely through the integrated grabber box.

Caution: If making up or breaking out drill pipe using backup tongs, the torque should be limited to a maximum of 72,000 ft-lbs.

Caution: In the avoidance of doubt, TESCO, as part of this analysis, is investigating whether certain stress risers on the T-bar and torque track can present a long-term stress cracking concern to customers. As such, if top drive operations will occur whereby the top drive is rotated for extended periods at or near the maximum allowable operation of 72,000 ft-lbs, it is recommended that the operator immediately notify TESCO. Note that this topic does not address the occasional maximum torque experienced associated with, for example, a stuck pipe scenario; only sustained cyclical loading. TESCO simply wishes to study what the effects are on TESCO torque tracks from features such as lifting holes drilled into the torque track. This information will help determine if any reliability concerns could exist in the torque track from high cyclical loading in the months and years ahead. TESCO is prepared to cover the costs of any non-destructive testing in the field associated with this analysis. Do not operate in this mode long-term without discussing this with TESCO.

Version	Date (D/M/Y)	ECN	Description of changes
Rev 0	21/May/2013	097-0256	Initial release of document

Figure 1: Torque arrest connection to the test frame

AFFECTED PRODUCTS:

The test results were used to define the safe continuous torque rating of standard rig-up 500/750-ESI-1350 Top Drives that are equipped with tubular torque tracks and sliding torque bushings as torque restraint systems. In particular, this test pertains to the 500/750-ESI torque track segment and T-Bar (TESCO part numbers 5007361 and 5007241-1, respectively). See Figure 2.

CONCLUSION:

As a result of the destructive test and in accordance with the alternative verification procedure described in API-8C section 5.5, the 500/750-ESI torque arrest system design has a minimum safety factor of 1.77 when operating at 72,000 ft-lbs.

ACTION REQUIRED:

Activity	Torque Range	Action Required
Drilling	0 to 72,000 ft-lbs	Drill as normally, visually inspect lower T-bar daily
	72,000 ft-lbs continuous for extended periods of time	Notify TESCO to inspect torque arrest system components
Tool joint makeup	0 to 72,000 ft-lbs	Use backup tong or grabber box
	72,000 to 84,000 ft-lbs	Use grabber box only
Tool joint breakout	0 to 72,000 ft-lbs	Use backup tong or grabber box
	72,000 to 100,000 ft-lbs	Use grabber box only

APPENDIX:

Destructive Test Details

According to API-8C section 5.5, the yield to tensile ratio T_R can be used as an alternative verification procedure to derive a safe load rating for a component from a destructive test.

To this end, a destructive test was performed according to this section to a 500/750-ESI torque track segment and T-Bar (TESCO part numbers 5007361 and 5007241-1, respectively). The torque path assembly was loaded in torsion using a coupled set of hydraulic cylinders (Figure 1) and the API procedure was followed to determine a safe continuous torque rating based on the test results.

Figure 2: Coupled torque application cylinders of test frame

Destructive Test Results

For deriving the safe torque rating of a torque restraint device, API-8C section 9.17 corresponding to Guide Dollies has been deemed applicable to the torque restraint system as a whole. Consequently, the minimum factor of safety prescribed by API-8C is SF_D = 1.5 for working equipment when neglecting environmental loads.

The test results (Figure 3) were recorded by means of a LabVIEW program acquiring the pressure at both ends of the hydraulic cylinders into a data acquisition system on a PXI instrumentation chassis. High speed data was acquired and a digital filter put in place in order to decrease the effect of electrical noise and to improve the accuracy of the recorded average values.

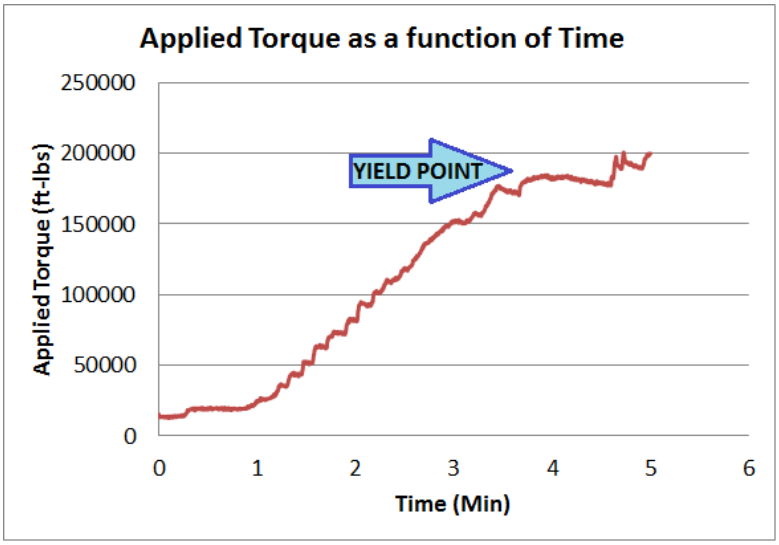

Figure 3: Maximum confirmed torque of 185,000 ft-lbs

Using the alternative verification procedure suggests a safe torque rating of 85,000 ft-lbs (with a 1.5 safety factor):

$$R = 185{,}000\ \frac{0.69}{1.5} = 85{,}000 ft.lbs.$$

With a maximum safe continuous torque of 72,000 ft-lbs the actual factor of safety against ultimate loading per this test would be 1.77, which exceeds the prerequisite design safety factors required by API-8C for hoisting components under this class.

Figure 4: 9.6° permanent deformation in the torque track

As shown in Figure 4, the maximum applied torque of 185,000 ft-lbs resulted in the permanent plastic deformation (failure) of the section of torque track involved after the yield point shown in Figure 3. This permanent twist was measured as 9.6° (this deflection was ultimately limited by the stroke of the test stand).