A Simple Alternative to Keyed Hubs -

No More Torches

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33rd Turbomachinery Symposium
September 20-23
George R Brown Convention Center
Background Information

• BP purchased five new screw compressors in 1990

• Each compressor was rated 6000 HP at 1800 rpm

• The nominal shaft diameter was 6 inches

• The motors and compressors were connected by diaphragm couplings

• The compressors required periodic seal replacement
Compressor
Problem Origination

• The compressor shaft was cylindrical with a single key
• The seal on the screw compressor needed periodic change out
• The heat-up and pulling process to remove the hub from a 6” shaft was a demanding task for the field
• These compressors are located in gas fields and required hot work permits for hub removal
• Safety systems had to be bypassed to use torches – other equipment left unprotected
• Periodic heating and cooling of the alloy steel hubs tends to deform the metal
Problem Specifics

• After several years and numerous seal change cycles, a simpler removal and installation method was sought

• The coupling vendor was asked to design a hub which could be installed and removed without heat

• The new hub needed to have the same weight and \( WR^2 \) as the original keyed hub

• The first approach by the user was to try a hydraulic hub, but the retrofit to the straight shaft was difficult
New Hub Concept

• The vendor designed a mechanical shrink-fit hub that would be actuated mechanically with simple hand tools.

• Instead of one continuous taper, it used many small tapered sections by putting an asymmetric buttress thread between the two pieces of the hub.
Design

• The shaft is driven purely by friction – no key required

• The hub can be positioned anywhere axially and angularly and then tightened

• The interference is achieved by mechanical means rather than heating and cooling the hub

• The hub consists of two main pieces – the flanged sleeve and the collar
• Load screws are threaded into the flange of the sleeve
• As the load screws are turned in, the collar moves along the tapered thread, and the split sleeve is forced inward
Hub Operation

• Once the hub is in the correct position the load screws are tightened with a hex wrench (or a socket wrench for bigger sizes).

• The gap between the flange of the sleeve and the collar is measured to know how much squeeze interference there is between the hub and shaft.

• Once the gap reaches the predetermined amount, the hub is ready to accept the torque.
Clamp Hub Picture
Testing

• BP Amoco wanted to be sure that the hub would handle the application torque loads
• The hub was installed on a test shaft on a static torque machine
• Torque was applied gradually
• The required torque was 231,000 in-lb
• At 1,290,000 in-lb the hub had not slipped, but the test was stopped for safety reasons
• BP Amoco personnel were present to watch the installation, testing, and removal
Torque Testing
Final Result

• BP Amoco installed the hub on to the compressor in 1997, and it handled the imposed torque

• At the next outage for seal change the hub was removed and reinstalled very easily with hand tools

• Downtime during maintenance was reduced by 8 hours – a 50% reduction in time

• No hot work permits were required for maintenance because no heat was needed – no bypass of safety system

• Additional benefits include less chance of galling, no heat soaking of the shaft and surroundings, and less people involved in the process
Future Implications

• BP Amoco proceeded to put the new hub design on the other five compressors

• Similar hubs and couplings have been supplied to BP Amoco for other applications

• The hub design can be applied to numerous coupling designs regardless of the original manufacturer

• Other present applications are high-speed centrifugals and lower-speed pumps

• Hubs could be made to accommodate shaft sizes up to 30” and can be retrofit to work on any shaft (tapered, hydraulic, keyed)