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› ROD STRING MAKE-UP

6/11/2020

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› OUTLINE

- Introduction
- Standards and Recommended Practices
- Some Rod and Connection Definitions
- Types of Rod String Failures
- Connection Make-Up

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› INTRODUCTION

- **Main lesson for today's presentation:** *If you are having rod string failures at the connections, this can be solved by changing how you make-up your rod string connections.*

- **Who am I, and what is my background?**

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› STANDARDS AND RECOMMENDED PRACTICES

- **API Specification 11B (2010)**

This is the default standard people refer to when talking about sucker rods

Most PCP rods either follow this standard or are strongly based on it. Variations are usually just:

 - Modified thread length
 - Higher strength material

- **API Recommended Practice 11BR (2008) "Care and Handling of Sucker Rods"**

Overall this recommended practice is very good—especially in relation to handling, storage, and transportation. However, it is intended for reciprocating applications. Some problems for PCPs include:

 - Make-up procedure is good, but the amount of make-up is not correct
 - Load calculations ("modified Goodman diagrams") are not for use in PCP rods

- **ISO 15136**
 - 1 (2009) is for pumps, but Annex J contains some good background information on rods
 - 2 (2006) is for driveheads but Annex H also has some background on rods
 - 3 is for drive strings (rods), but is only in draft, and the committee hasn't met since the 2014 downturn

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DEFINITIONS

- The picture below is from API 11B, and is a cross section of a standard sucker rod connection

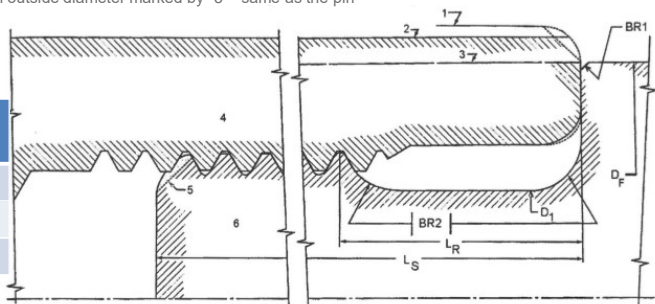
The section with length L_R and Diameter D_1 is called the "stress relief" in the standard, but is also known as the "undercut". This section is very important in reciprocating applications, but not in PCP applications

The "pin shoulder" is the part with diameter D_F

A "full size" coupling has an outside diameter marked by "1" or "2" – larger than the pin

A "slimhole" coupling has an outside diameter marked by "3" –same as the pin

Rod Size	Undercut Diameter
7/8" (0.875")	1.040"
1"	1.227"
1-1/8" (1.125")	1.414"



MODIFICATIONS

- How does a "modified" pin differ from an API pin?

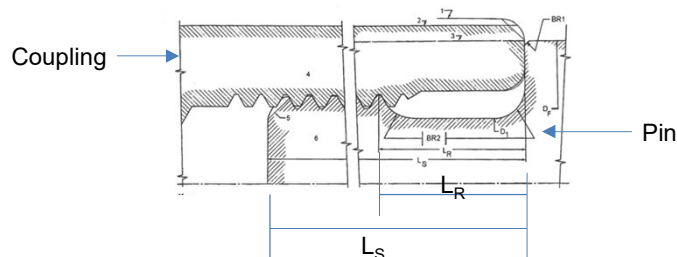
- There are three main differences:

The length of the undercut (L_R) is reduced (but L_S stays the same)

Pin size doesn't match rod size

The material strength can be higher.

- This does not include thread designs which are totally different and are not called modified API






› ROD STRING FAILURES

- **Rod Body**
 - Fatigue
 - Wear
 - Corrosion
 - Overtorque

- **Connection**
 - Backed-off
 - Belled or split coupling
 - Sheared threads
 - Broken pin



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› ROD STRING MAKE-UP

- **There are only three things to know to make up a rod connection properly:**
- **1. The connection must be properly cleaned prior to make-up**

The grease or oil applied to the couplings and pins at the manufacturer is intended to protect them from corrosion during shipment. It must be cleaned off prior to installation. Most importantly, there must be NO lubricant (grease or oil) on the pin shoulder or coupling face
- **2. The proper lubricant, and proper amount of lubricant must be used, applied following the manufacturer's instructions**

Some rod vendors suggest using NO lubrication at all with their rods
 Some suggest applying the lubricant to the coupling and not the pin threads
- **3. The proper torque must be applied to the connection before the rods are run in hole**

The most common way to do this is using "circumferential displacement". Torque-based make-up may be better, but most rod tongs can't measure torque accurately. Check calibration regularly!

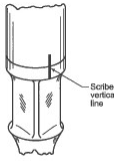


Figure 2—Hand-tight Joint

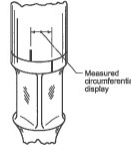
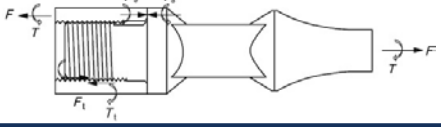



Figure 3—Made-up Joint



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› MAKE-UP

- **When these procedures are followed in lab testing, the rod body always fails first**
 - This is true even when a slimhole 7/8" coupling is tested on a 1" rod.
 - Also true even when the pins aren't modified with the shorter undercut and longer threads.
- **Presentation in 2006 (at SPE PCP ATW) showed:**
 - Rods made-up using lab procedures failed in the rod body at over 155% of the rated torque
 - Rods made-up with a careful wiping of the pin and shoulder (but no solvent) failed in the connection (at 128-146% of the torque rating)
 - Rods made-up with excess lubrication (or the anti-corrosion grease still in place) failed in the connection (at 78-83% of the torque rating)
- **Backspin**
 - Torque during backspin is less than operating torque
 - Couplings should not back-off during backspin if they were made up properly

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› CONCLUSION

- ***If you are having rod string failures at the connections, this can be solved by changing how you make-up your rod string connections.***
- **I hope that I have given enough information to justify this statement I made at the beginning**

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› THANK YOU!

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› SUPPORTING SLIDES

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› ADDITIONAL REFERENCE

- **For more information on PCP rod string fatigue, please see:**
SPE 171352; Skoczylas, 2014, "Drive String Fatigue in PCP Applications"

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› ROD FAILURE PICTURES - CORROSION



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› ROD FAILURE PICTURES - FATIGUE



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› ROD FAILURE PICTURES – BROKEN PIN



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› ROD FAILURE PICTURES – STRIPPED THREADS



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