Effects of Water Depth Workshop

BSEE
Bureau of Safety and Environmental Enforcement

Topic 3 – Well Drilling & Completion Design and Barriers

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Reliability of Connections

Bob Sivley

Connections are generally categorized within three broad groups.

Connections:

- Standardized Connections (API)
- Semi-Premium Connections (Proprietary)
- Premium Connections (Proprietary)

Connections are manufactured on a variety of materials:

Steels:

- 5CT (Seamless)
  - L80
  - P110
  - Q125 etc.
  - Proprietary OCTG Grades
- 5L (ERW)
  - X-Grades

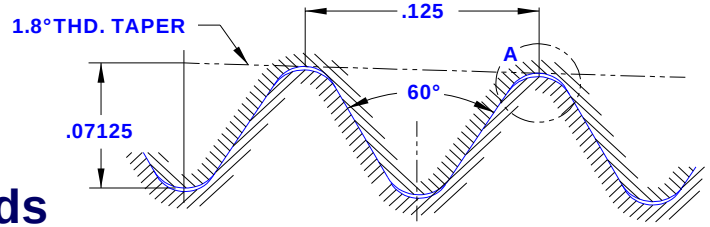
Specialty/Severe Service Metals:

- Cr
- Duplex
- Others

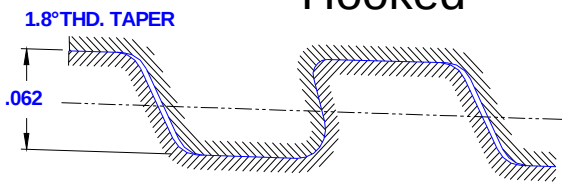
What are the features of the Connections that resist these loads

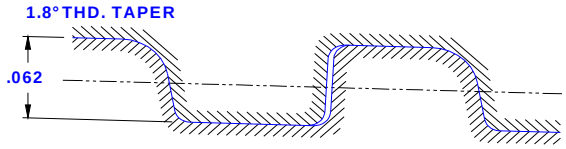
Threads

- Round Threads
- Buttress Threads
- Hooked Threads
- Wedge Threads

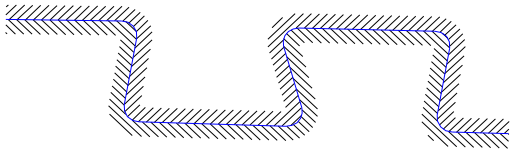


Round



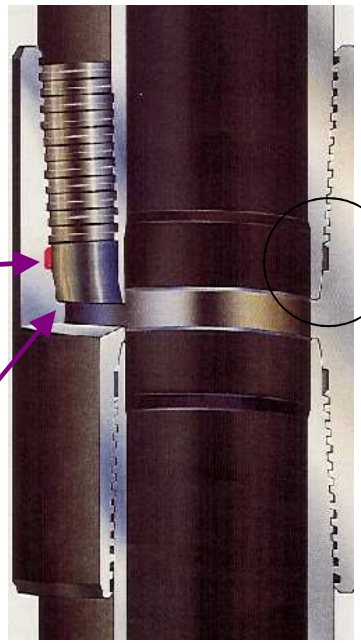


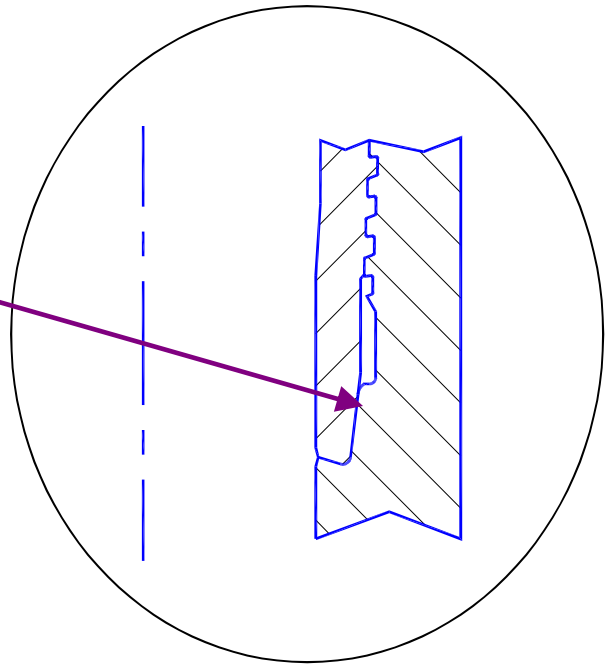
Buttress



Wedge

- Seals
  - Thread Seals
  - Metal to Metal Seals
  - Elastomeric
- Shoulders
  - External Shoulder
  - Internal Shoulder





Barriers

Axial Loads:

Tensile Areas

Compressive Areas

Internal Pressures

Metal to Metal

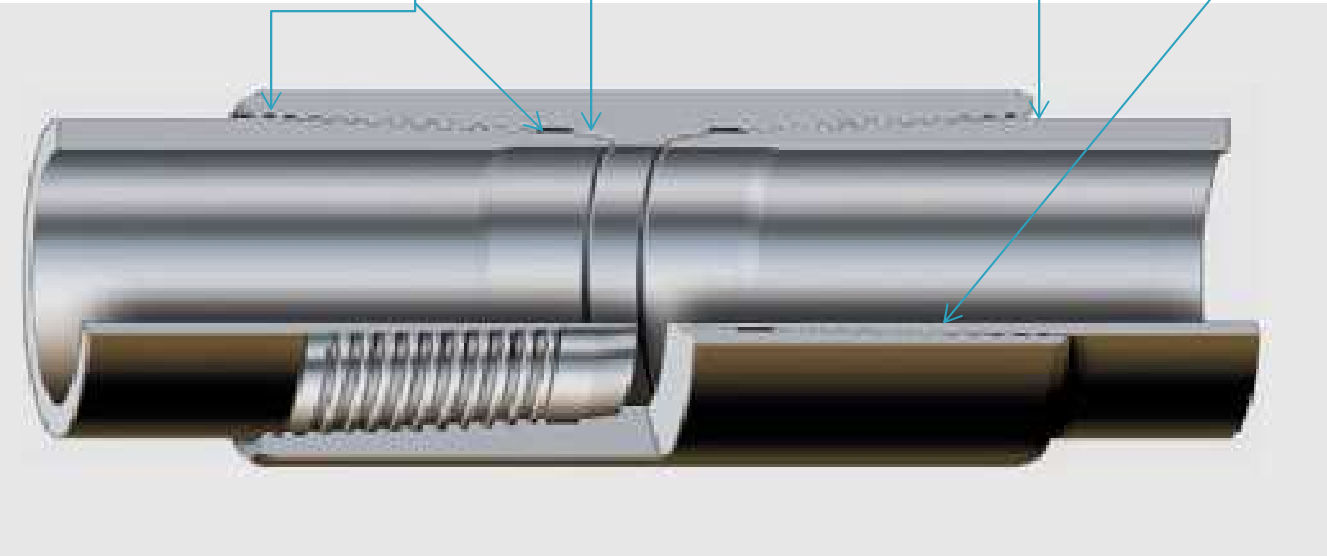
Elastomers

External Pressures

Metal to Metal

Threads

Threads



Reliability

Single Barriers

Redundant Barriers

Reliability of Manufacture

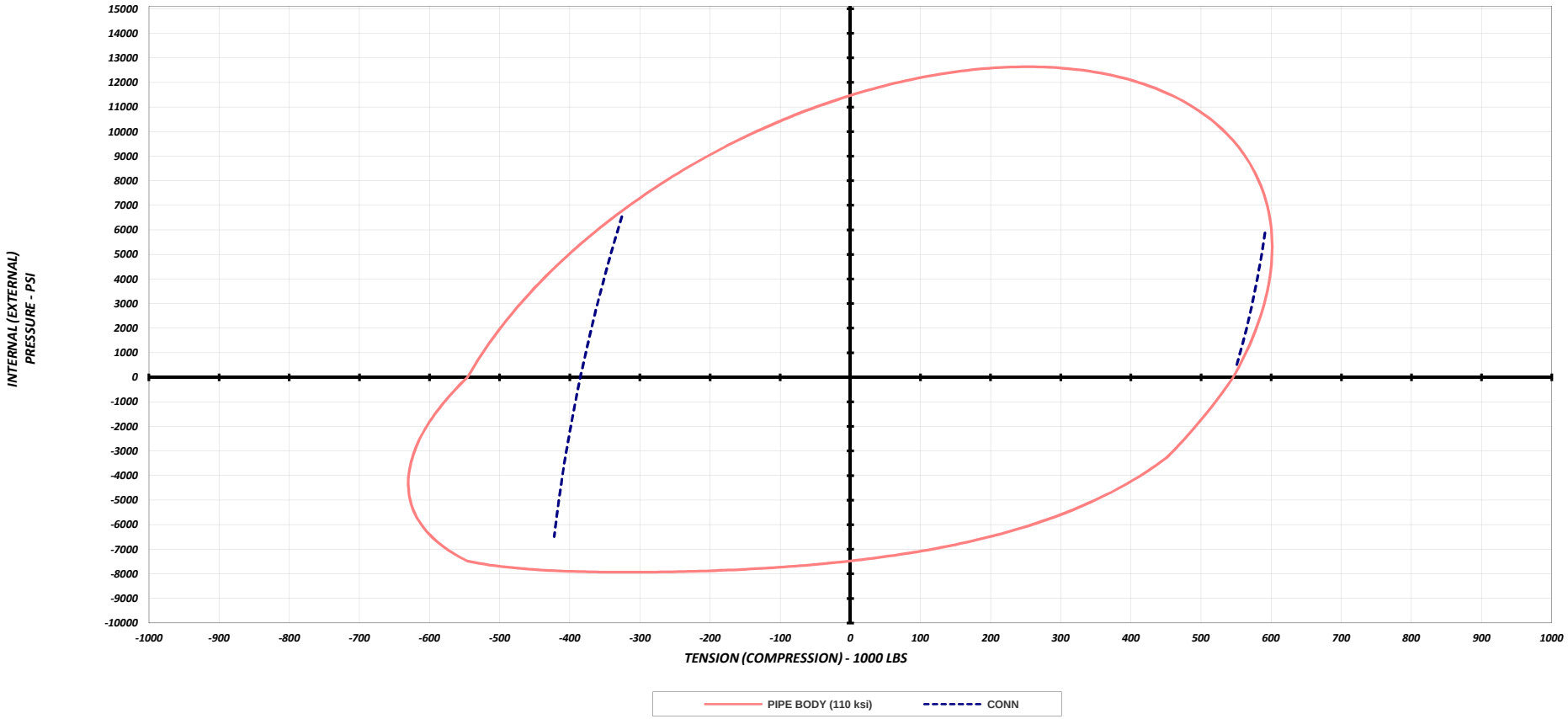
Reliability of Qualification

Reliability of Performance

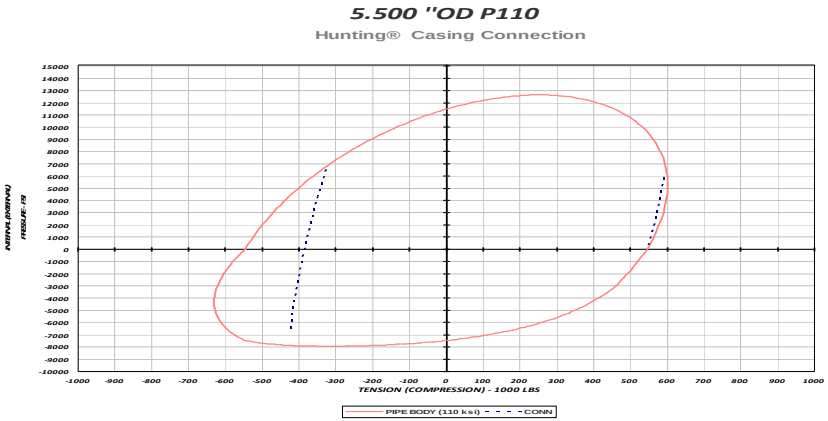
Rating System

5.500 "OD P110

Casing Connection



What are the styles of the Connections



➢Styles

Upset:

100% Tension

100% Comp

Threaded and Coupled

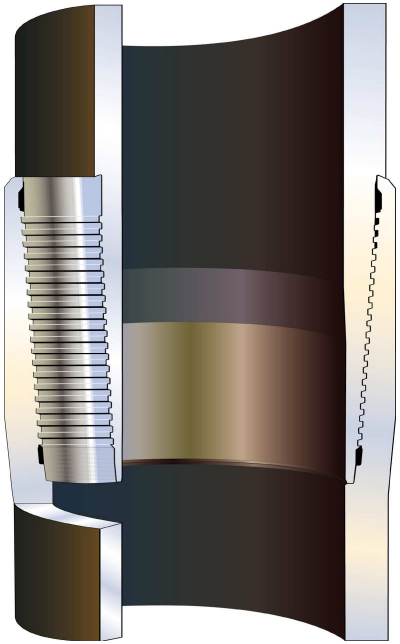
100% Tension

50% - 100% Comp

Semi-Flush

60% - 90% Tension

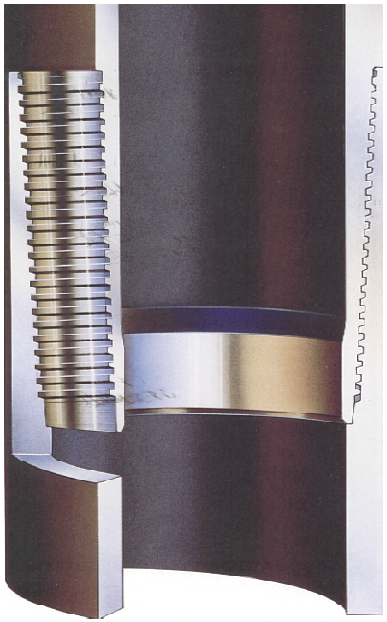
25% - 80% Comp



Flush

40% - 70% Tension

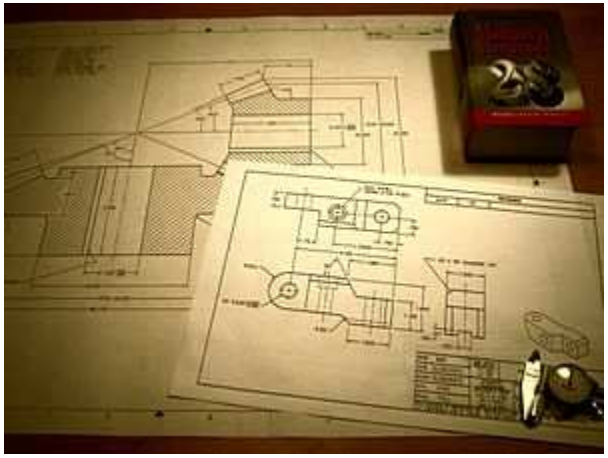
15% - 70% Comp

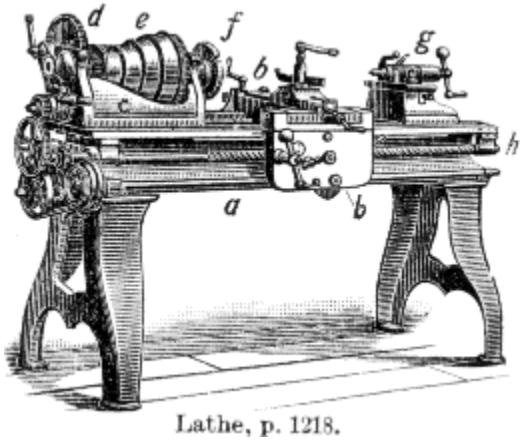


General Types of Connections

- Non Premium (A.P.I, Standardized Designs)
  - 8 & 10 Round (thread seal, no torque shoulder)
  - Buttress (thread seal, no torque shoulder)
  - Available in Upset & T&C
- Semi-Premium (Alternatives to A.P.I)
  - Semi-premium (thread seal w/ torque shoulder)
  - Non-API Thread Forms
  - Increased Pressure Performance.
  - Predominantly T&C Style
- Premium (Premium Thread Manufacturers)
  - Premium (m-t-m seal w/ torque shoulder feature)
  - Proprietary thread form
  - Highest Pressure performance (All ratings approaching 100%)
  - Available in Upset, T&C, Semi-Flush, and Flush

How do we make them?





Lathe, p. 1218.

Old

New

Accurate to 10^{-9}

How do we insure that they're correct.

Accurate to 10^{-6}

Accurate to 10^{-5}

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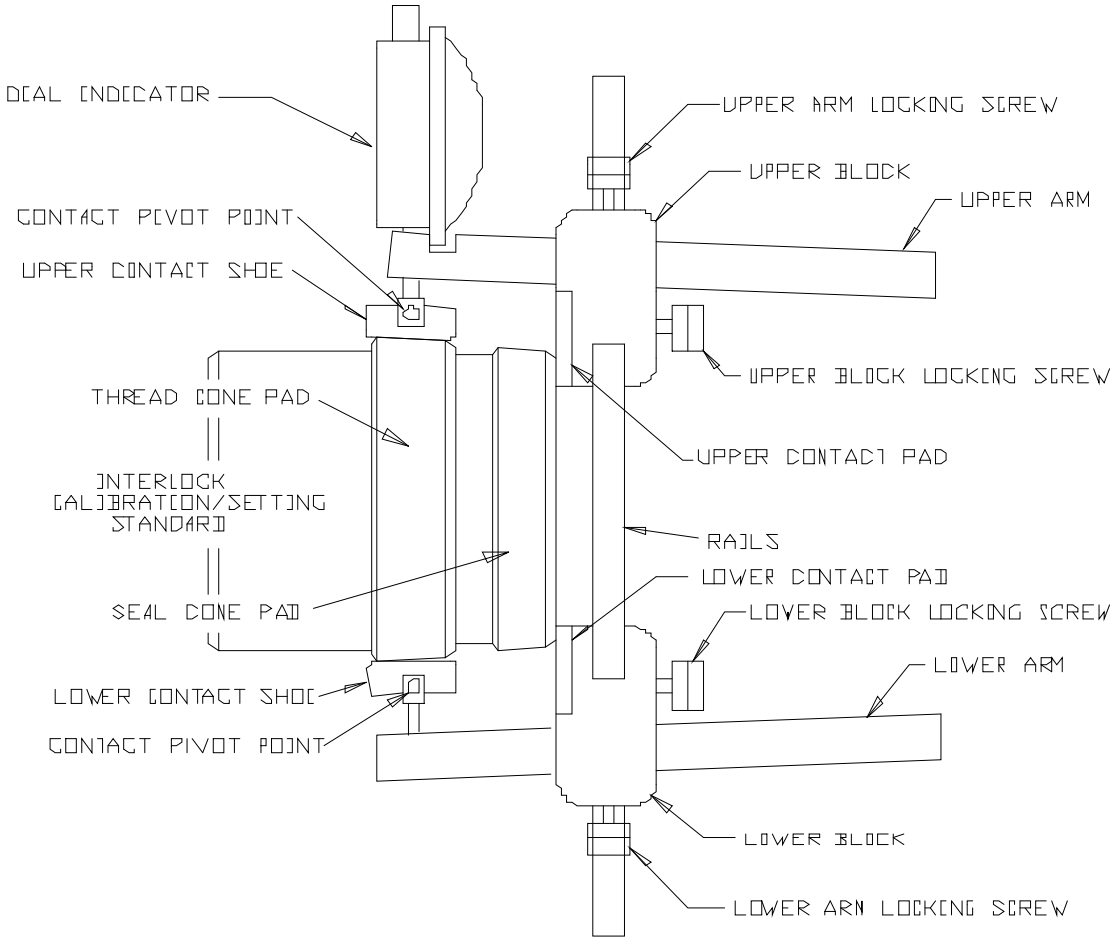
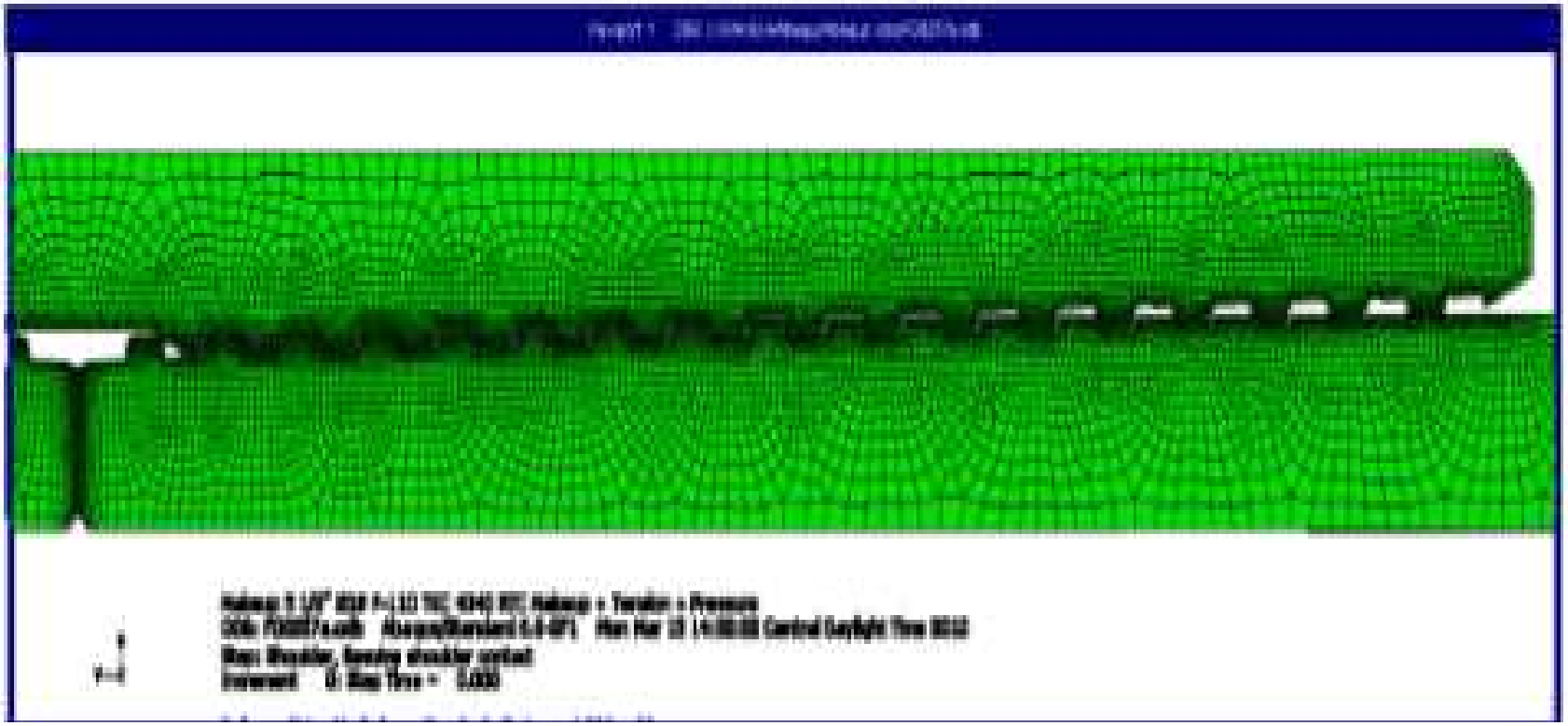
Quality Control Systems



We measure all features to insure they comply.

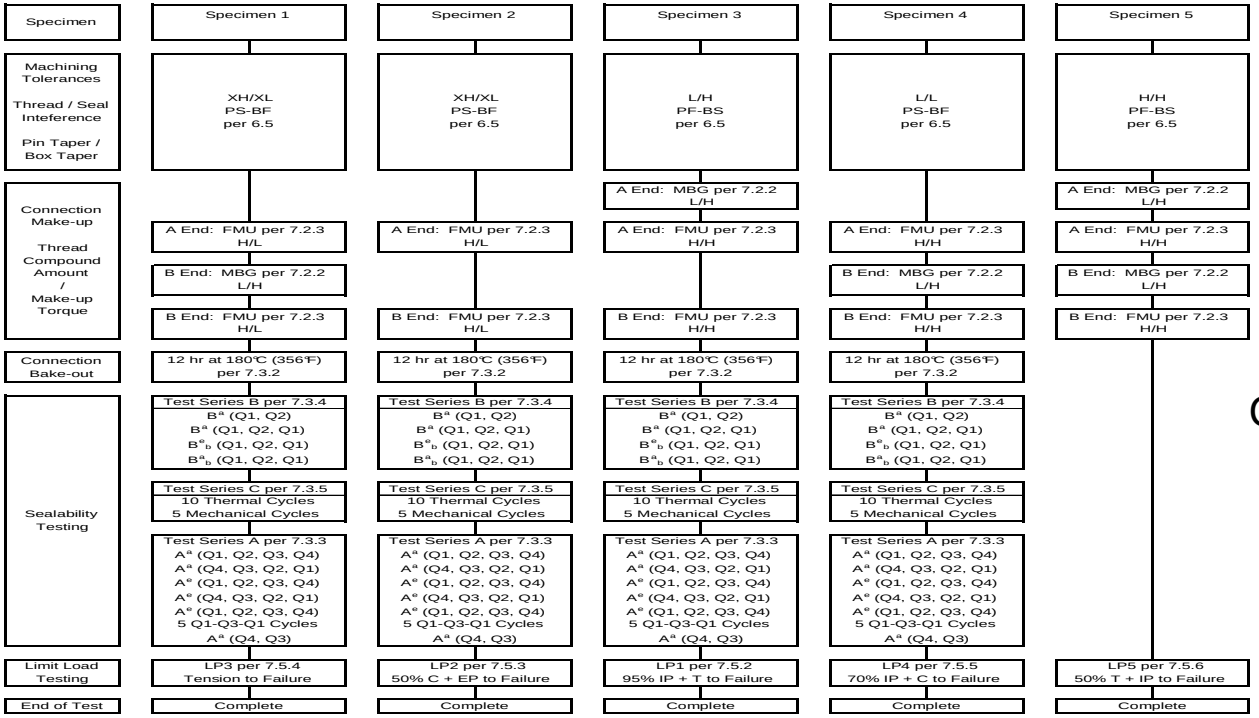
How do we know what the connection will do?



Finite Element Analysis

How do we know what the connection will do?

STANDARDIZED TESTING SUCH AS ISO 13679 CAL-IV



Sample Manufacture

Make and Break

Bake Out

Combined Load Testing

Limit Load Test

CUSTOMER QUALIFICATION TESTING

FIT FOR PURPOSE TESTING

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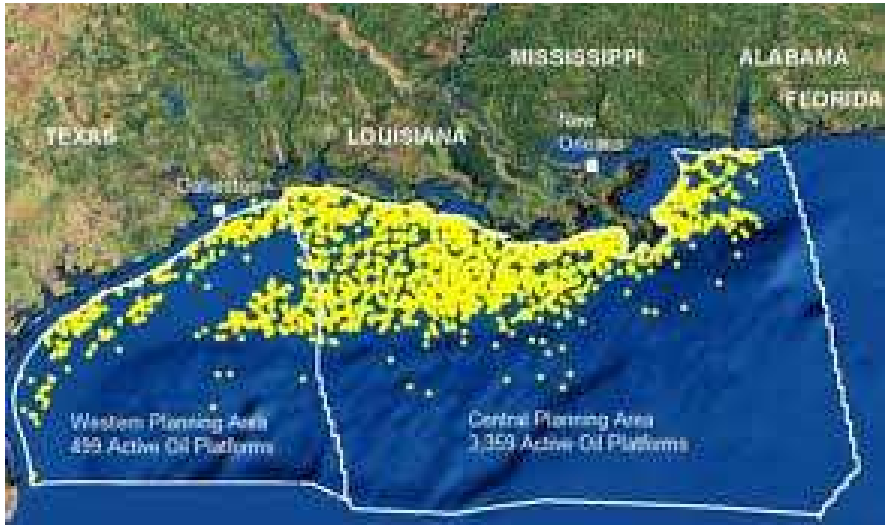
How do we know what the connection will do?

Develop Running Procedures

Dispatch Service Personnel

Run the connections



Field Usage

New Requirements and Drivers

RP-96

Consider the following for the selection of down hole threaded connections.

a) Use connections designed with a metal-to-metal seal feature to assemble casing joints that will be exposed when drilling hydrocarbon zones. Due to clearance considerations, most DW casing connections are flush or semi-flush.

b) Intermediate casing connection wear while drilling: Flush or semi-flush connections can have less wear tolerance than threaded and coupled connections. Consider additional wear mitigations when using these types of connections.

c) Consider API 5C5 testing of the intermediate connection for wells with casing connections potentially exposed to hydrocarbons (e.g., during a well control situation).

d) d) Production casing – consider a connection that was successfully evaluated to either of the two most stringent connection application levels of API 5C5. This is particularly important where pressure sealing from the back side is required. Alternatively, sufficient field experience with expected production casing loads and conditions can form a technical basis for determining that the connection is fit for use. Note: Consult local regulations for production casing pressure testing requirements.

e) e) API 5C5 testing to either of the two most stringent connection application levels is recommended for all production tubing connections. The combination of field experience and physical testing can be used to demonstrate that a connection design is suitable for specific applications.

f) The API 5C5 laboratory testing provides discriminating qualification of the connection design within its manufacturing and makeup tolerances. Equally important are manufacturing process control, quality assurance process, and a field deployment procedure consistent with the connection design that was qualified. These processes are essential in assuring that the connection that is manufactured and installed in the well is consistent with the product qualified in laboratory testing.

Other elements to consider include:
— quality system;
— quality control and inspection;
— consistency between first and last articles manufactured;
— thread compound (type and application);
— field deployment procedures (including monitoring shoulder torque and final make-up torque using torque turn, if applicable);
— history of successful deployment.

What do we do next?

1) Manufacturers are constantly seeking ways to improve the connections and the steel.

2) To do this, they need Data Data…

3) Better Connections
   Ongoing and constantly improving

4) Better Materials
   Ongoing and constantly improving

5) Thread Designers and Well designers collaboration
   Ongoing and constantly improving

6) Better Analysis / Better Tools
   Ongoing and constantly improving