

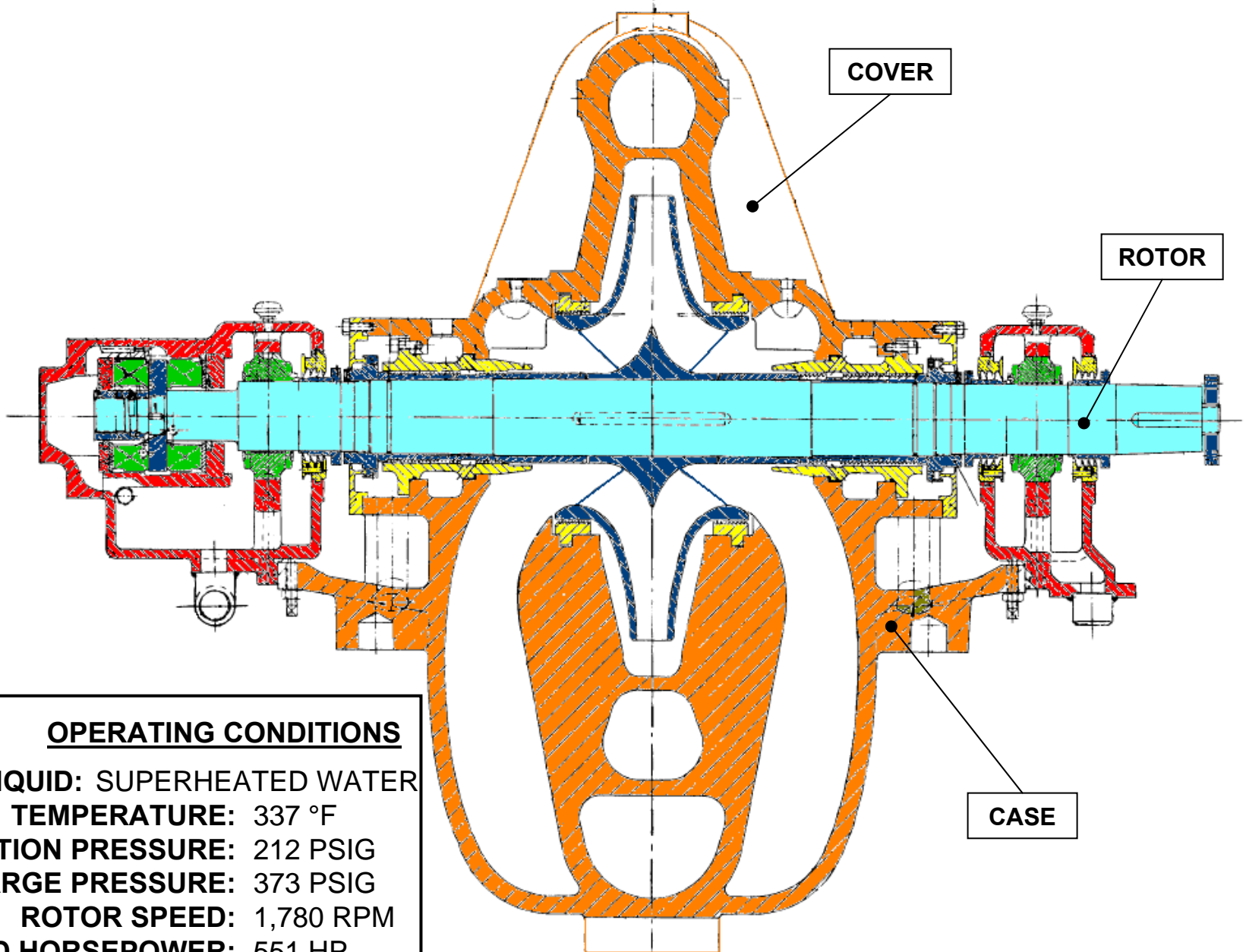
CASE STUDY

CURING A BOOSTER PUMP JOINT FACE LEAK

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SINGLE STAGE, DOUBLE SUCTION BOOSTER PUMP



OPERATING CONDITIONS

LIQUID: SUPERHEATED WATER

TEMPERATURE: 337 °F

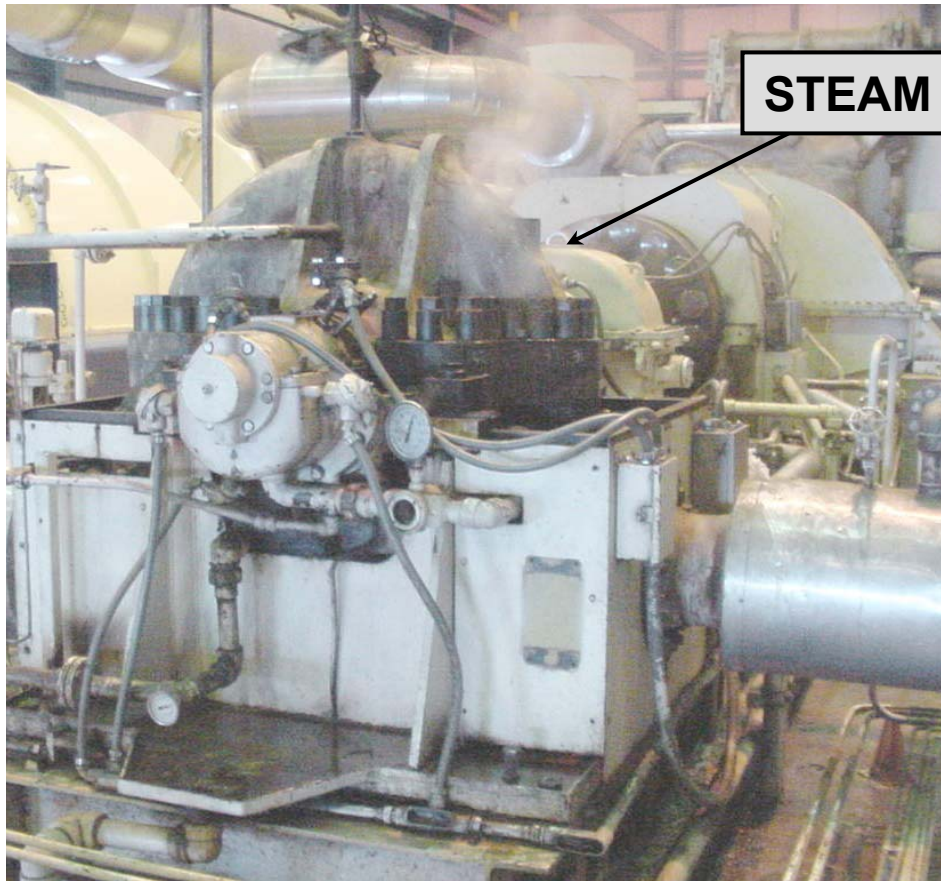
SUCTION PRESSURE: 212 PSIG

DISCHARGE PRESSURE: 373 PSIG

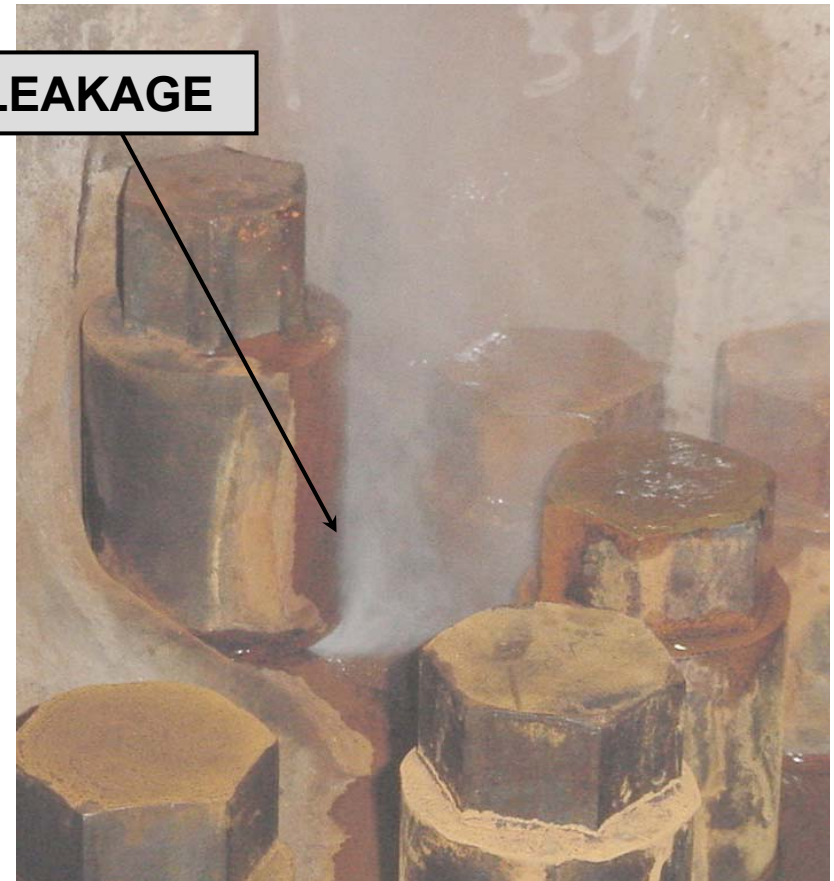
ROTOR SPEED: 1,780 RPM

REQUIRED HORSEPOWER: 551 HP

PUMP WITH ORIGINAL HORIZONTAL JOINT (STANDARD STUDS AND CAPNUTS)

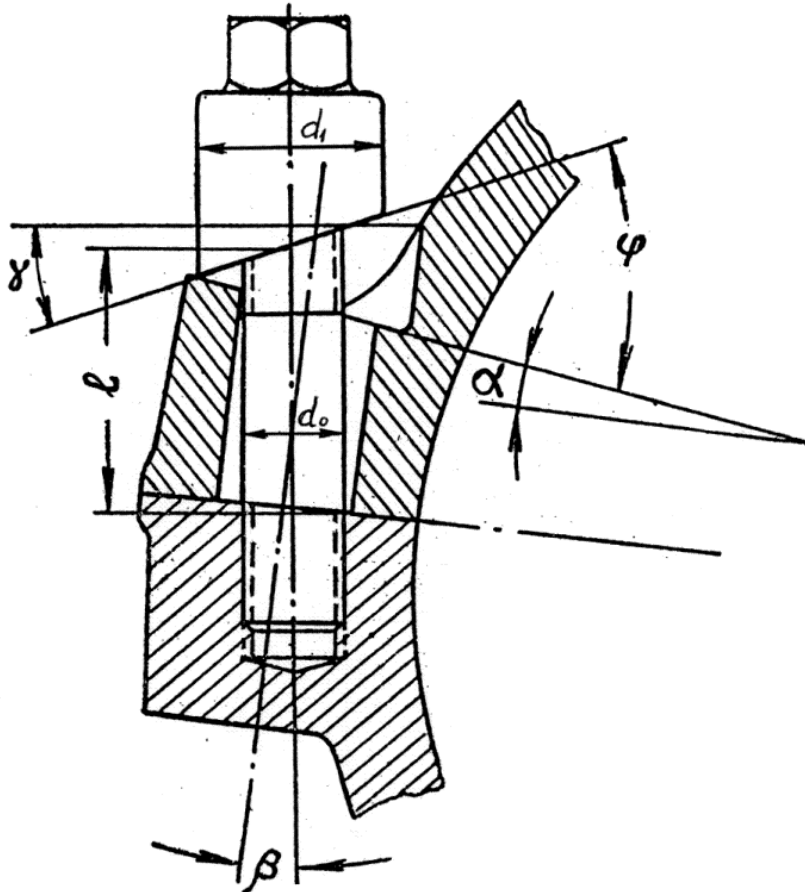


STEAM LEAKAGE



**LEAKAGE IS SHOWN IN THE FORM OF STEAM BECAUSE OF
SUPERHEATED WATER BEING PUMPED**

Major Items Considered for the Reliability of Bolted Joints

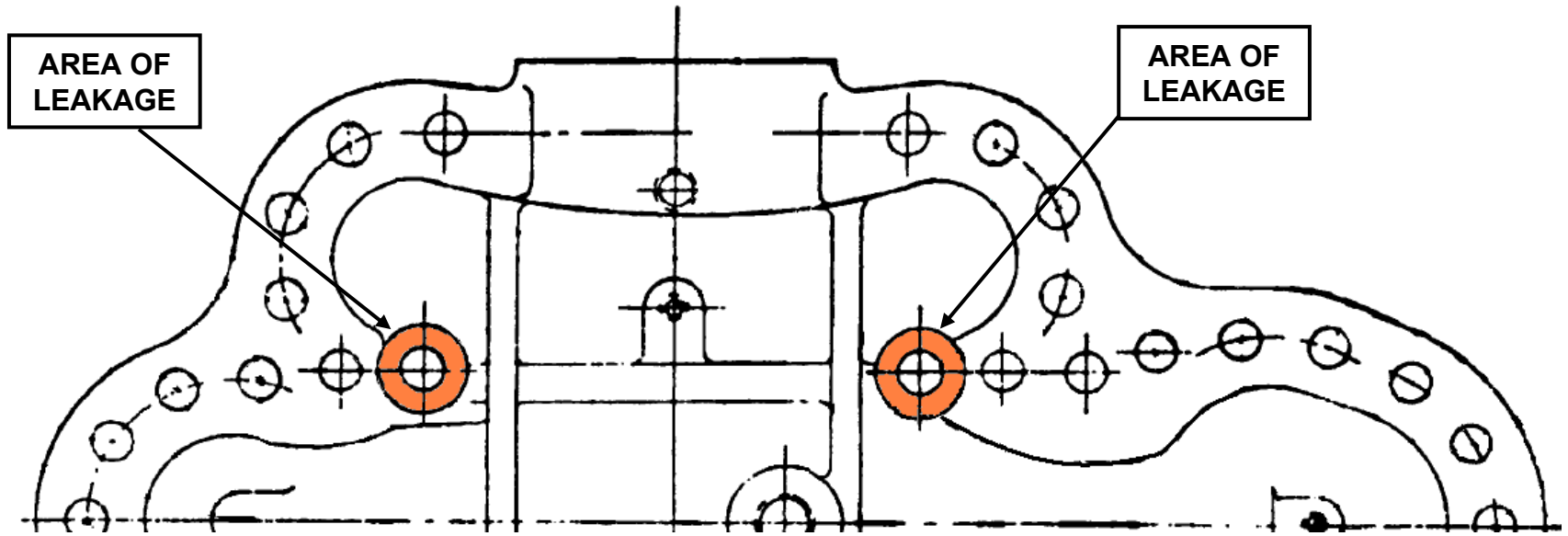


1. Quality of flange contact surfaces:
 - Surface finish
 - Flatness
 - Quality of the gasket (thickness & types)
2. Quality of thread engagement
 - Surface finish (galling)
 - Geometry
3. Non-parallelism of seating faces (flange, spot face, capnut) and perpendicularity of the bolted hole to seating faces

Potential Accumulative Angular Deviations
from Design in Bolted Horizontal Joint

$$(\varphi = \alpha + \beta + \gamma)$$

SUMMARY



ORIGINAL FEATURES

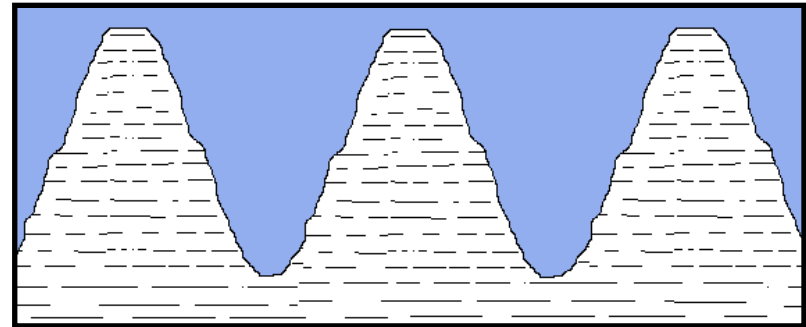
1. Existing Stud Design:
 - Non-optimized configuration.
 - Mechanical machined thread.
 - Insufficient length of stud-to-case thread engagement.
2. Stud jammed into threaded end of case hole.
3. Uncontrollable and inaccurate hand torqued capnut in restricted area.

PROPOSED BOLTING IMPROVEMENTS

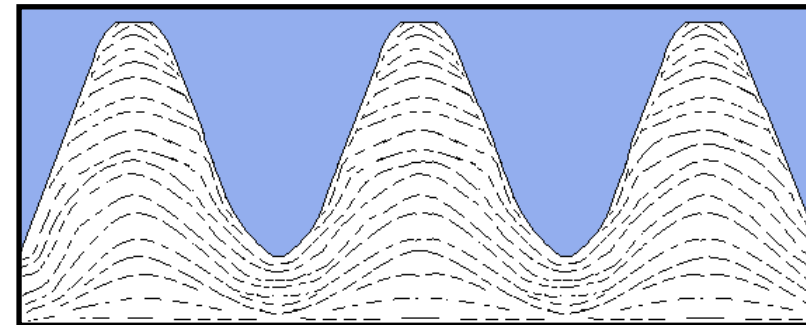
1. Advanced stud design:
 - Optimized configuration.
 - Cold rolled thread.
 - Increased length of stud-to-case thread engagement.
2. Bottom down stud support (better load distribution between threads).
3. Advanced thread tensioner: controlled and accurate preload in restricted area, stud is tightened in pure tension. Simple hand tools for installation.

ADVANTAGES OF ROLLED THREADS VERSUS MACHINED THREADS

1. **Increased tensile strength (by at least 10%):**
 - Resistance to cracks due to work-hardened surface of the thread.
 - Rolling does not cut through the material fibers.
2. **Increased shear strength because material fibers/grains are not damaged/destroyed by rolling.**
3. **Significantly Improved wear characteristics and antigalling properties:**
 - High hardness.
 - Excellent surface finish (32 finish or better).

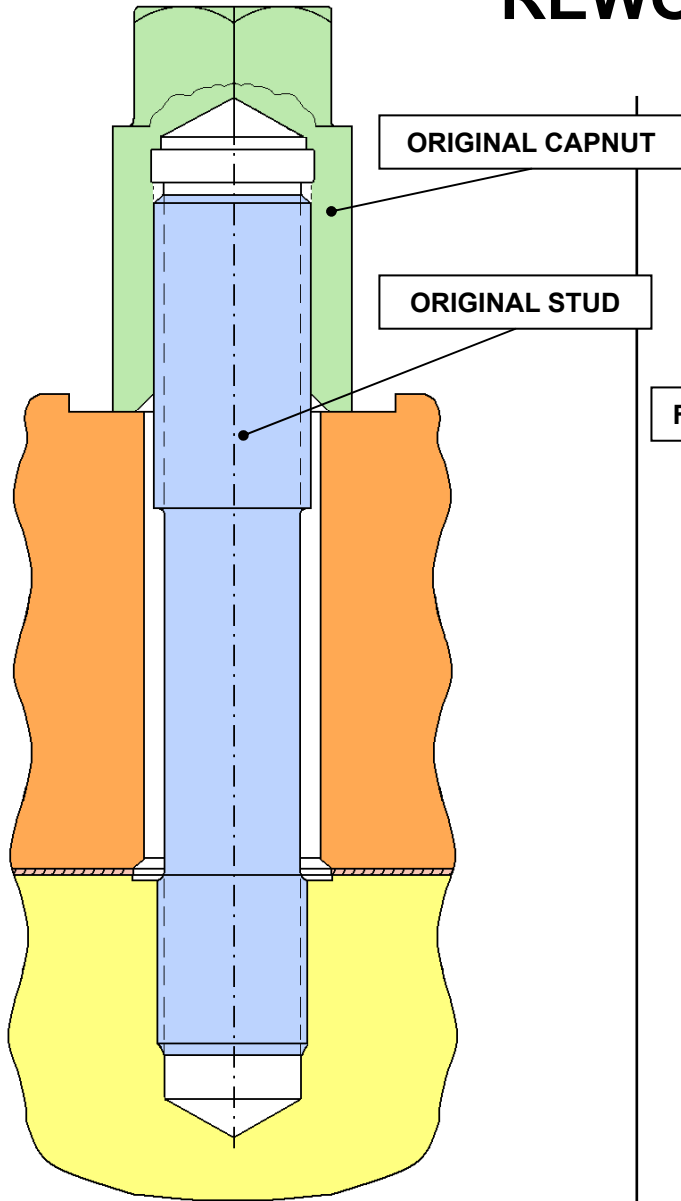


MACHINED THREADS

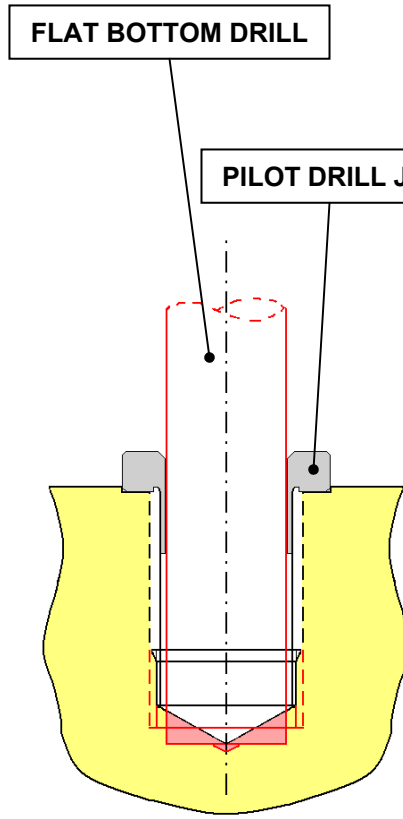


ROLLED THREADS

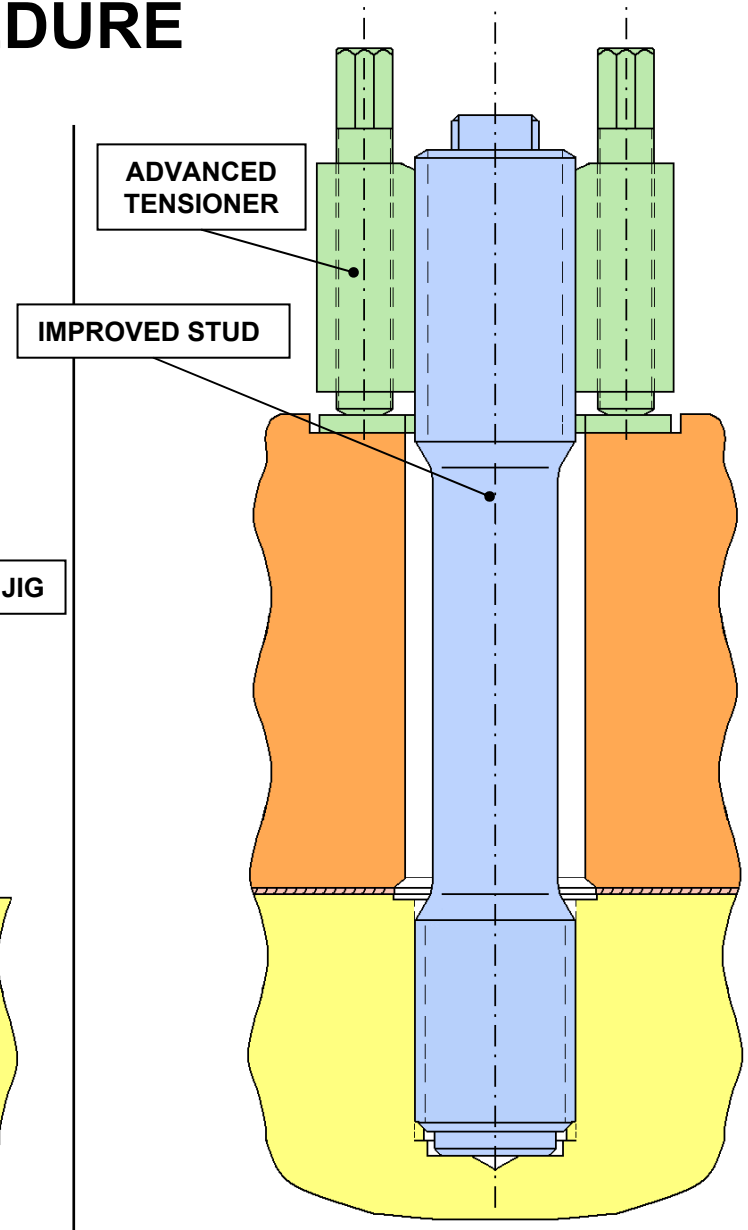
REWORK PROCEDURE



ORIGINAL HORIZONTAL JOINT WITH STANDARD STUD AND CAPNUT

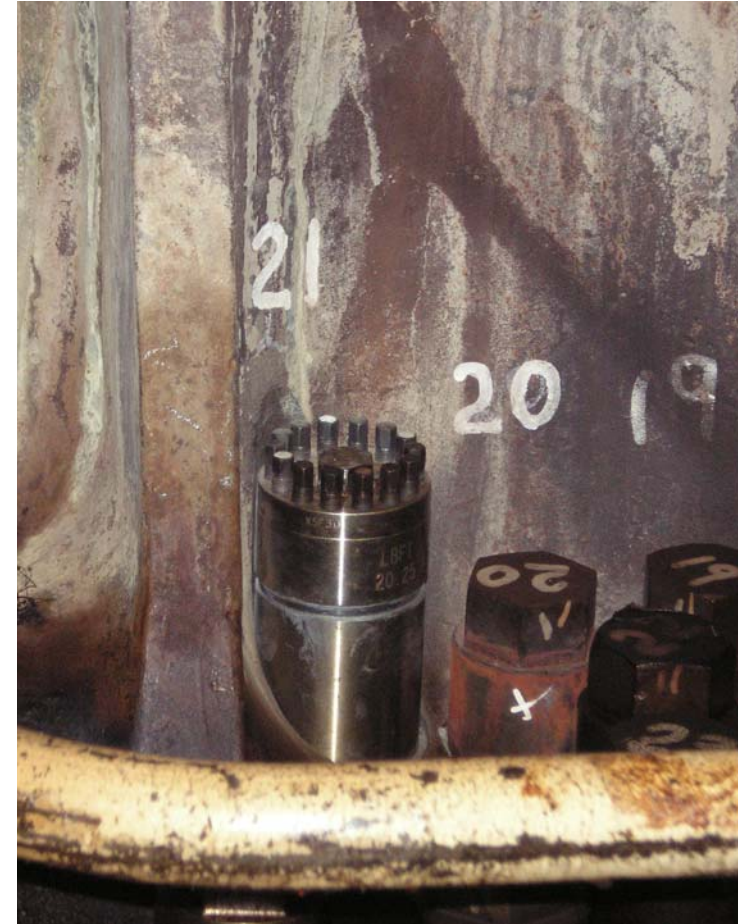
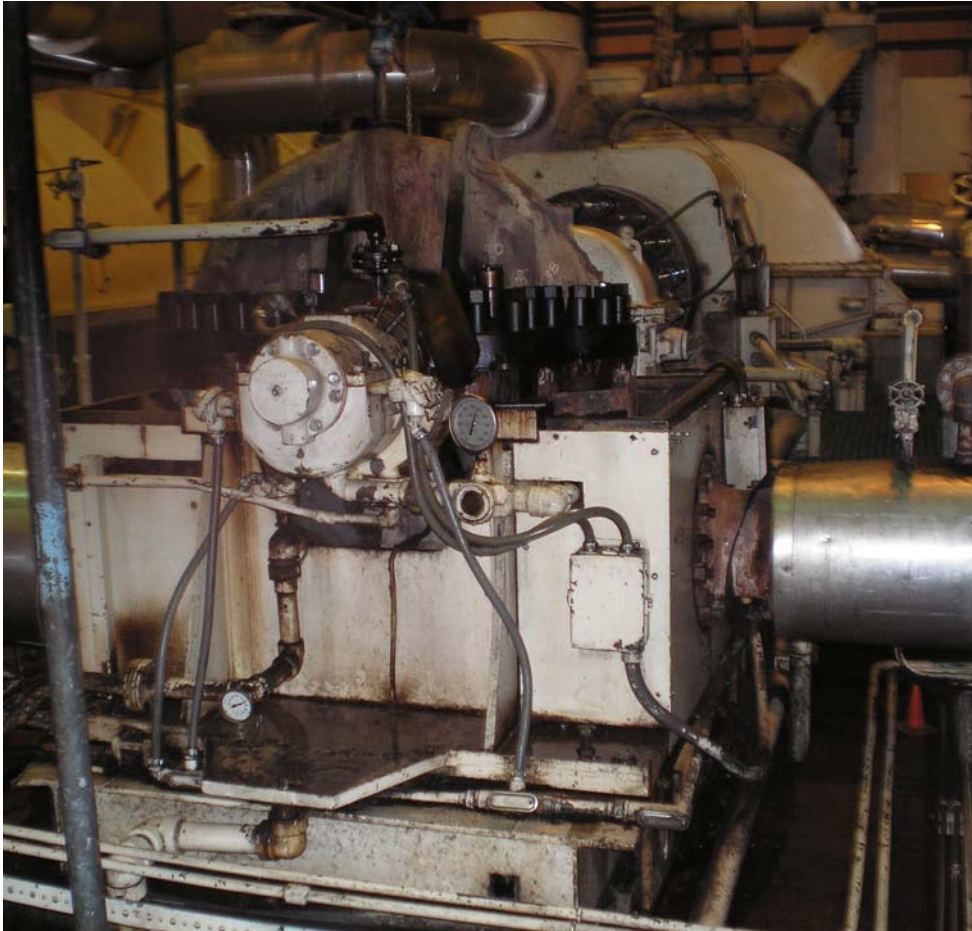


REMANCHING OF ORIGINAL HOLE



IMPROVED HORIZONTAL JOINT WITH ADVANCED STUD AND TENSIONER

IMPROVED HORIZONTAL JOINT WITH UPGRADED BOLTING (ADVANCED STUDS AND TENSIONERS)



NO LEAKAGE AFTER BOLTING UPGRADE!

PUMP OPERATION BEFORE AND AFTER UPGRADE



HORIZONTAL JOINT WITH ORIGINAL STUDS AND CAPNUTS

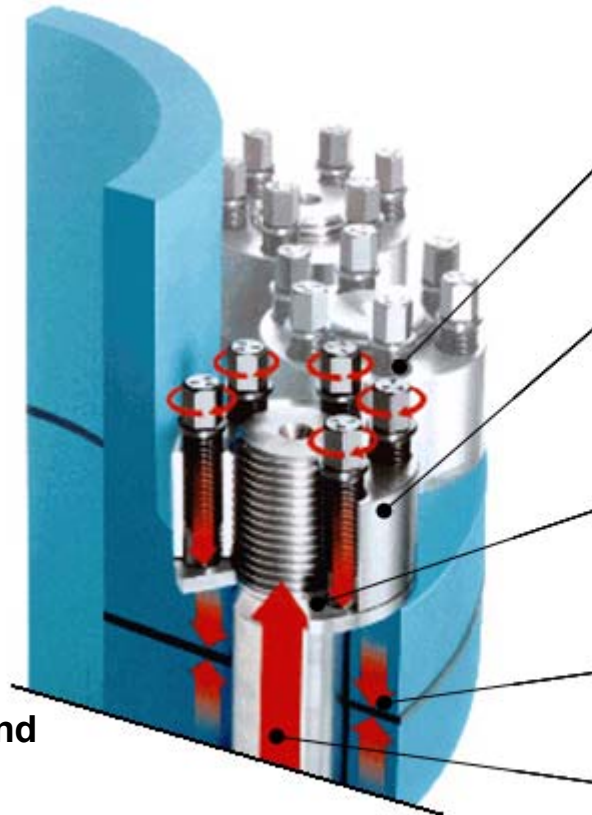


IMPROVED HORIZONTAL JOINT WITH ADVANCED STUDS AND ADVANCED TENSIONERS

CONCLUDING REMARKS ON ADVANCED TENSIONERS

ADVANTAGES

1. Tightens in pure tension (no thread galling).
2. Accurate preload ($\pm 5\%$).
3. Holding power: joint remains tight at vibration, thermal/dynamic cycles.
4. Fits in restricted areas
5. Very forgiving design.
6. Safe to use.
7. Hand tools (torque wrenches and air wrenches) required.
8. Time and labor savings.



Torque applied to jackbolts

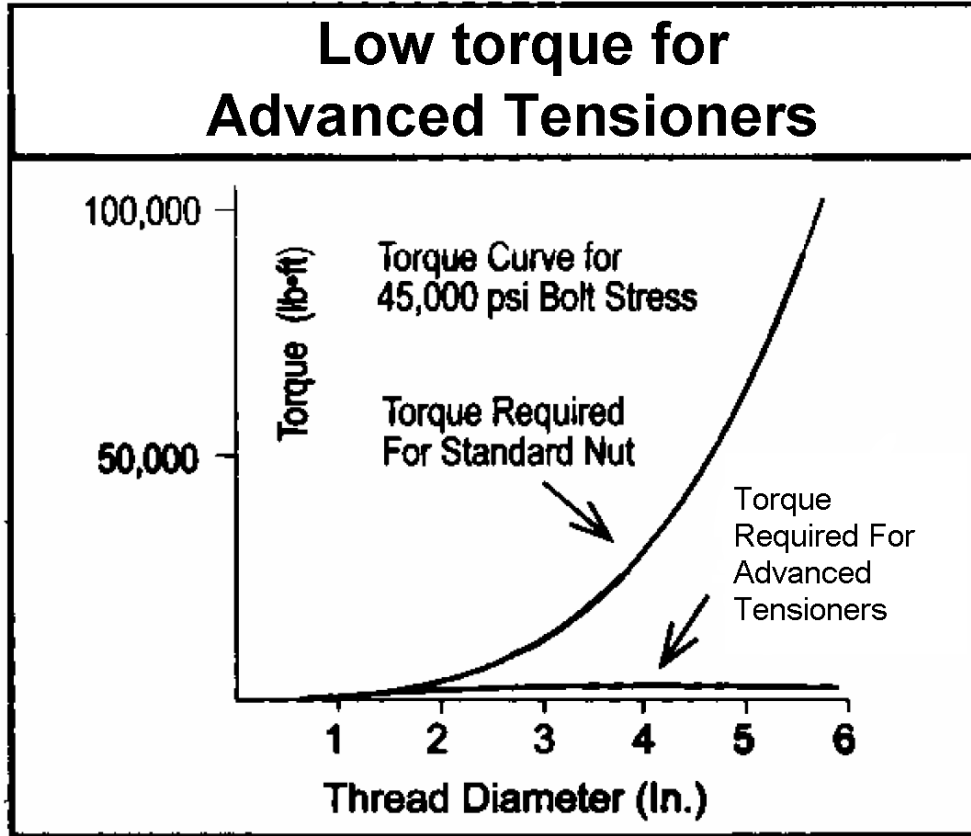
Tensioner assembly spun on hand tight

Hardened washer
Protects joint surface

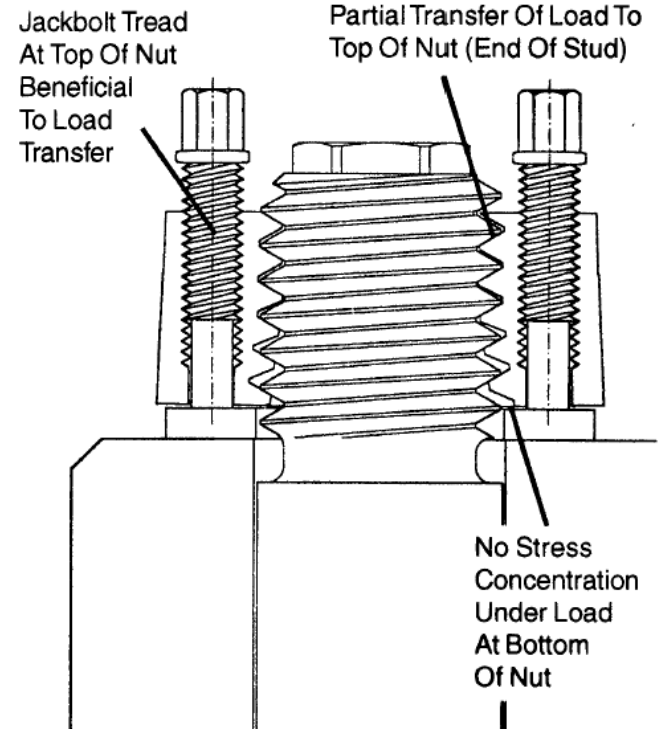
Joint is clamped tight

Existing bolt/stud is tightened in pure tension

ADVANCED TENSIONERS



ADVANCED TENSIONERS AFTER TIGHTENING



BETTER LOAD DISTRIBUTION BETWEEN THREADS