Design A Lead Screw For Lathe Machine

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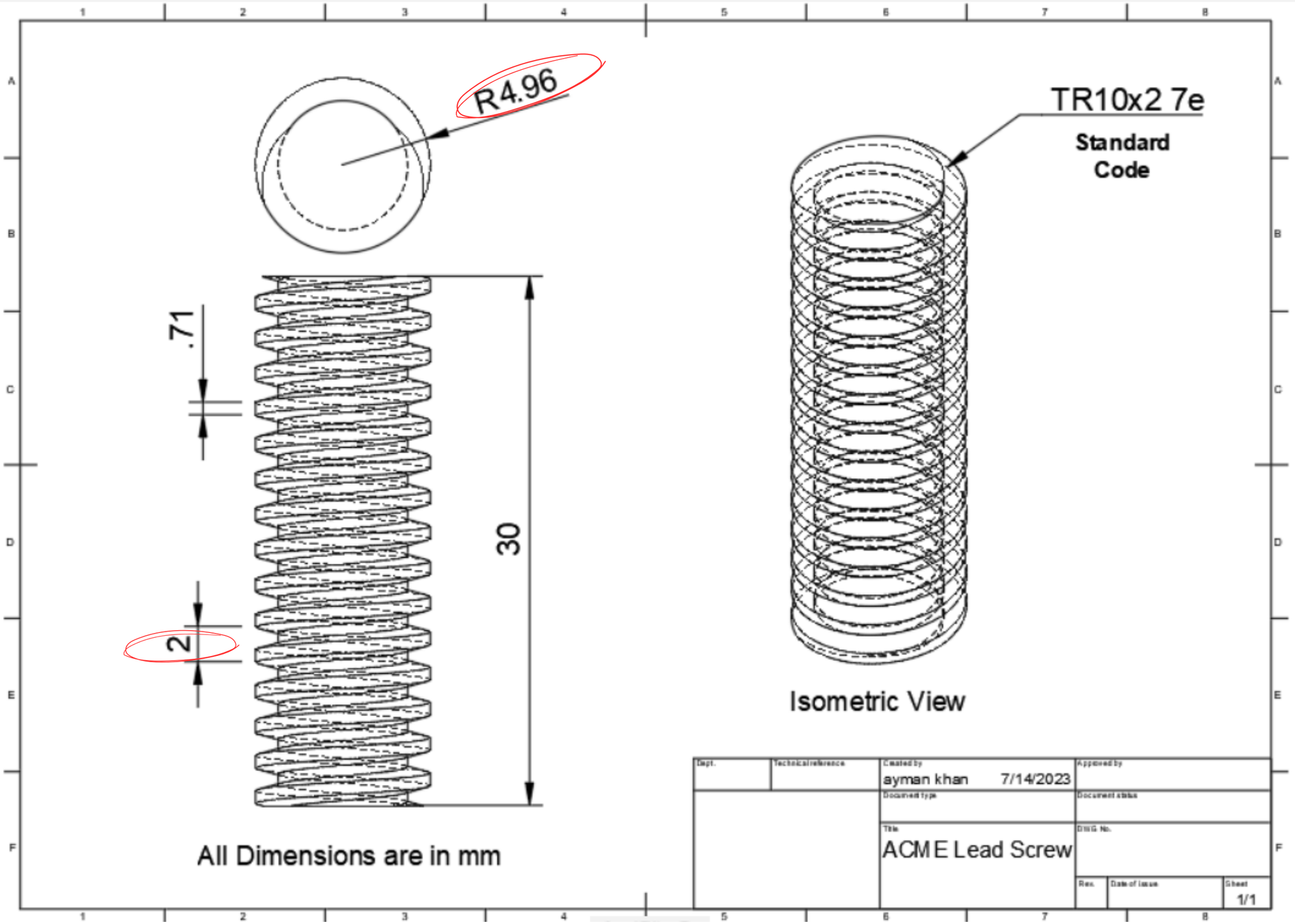
REDESIGN & SOLUTION



2D DRAWING

For better view,
L = 30 mm

Technical Specifications

Specifications	Value
Major Diameter, d	10 mm
Pitch, p	2 mm
Pitch Diameter, Dp	9 mm
Minor Diameter, Dm	8 mm
Force, F	6.0 kN (approx.)
Target Tolarence	1.00%
Actual	0.46%
Rasing Torque, Tr	4.44 Nm
Torsional Shear Stress (MPa)	44.19 MPa
Axial Stress (MPa)	123.27 MPa
Bending Stress (MPa)	224.07 MPa
Efficiency	44.39%

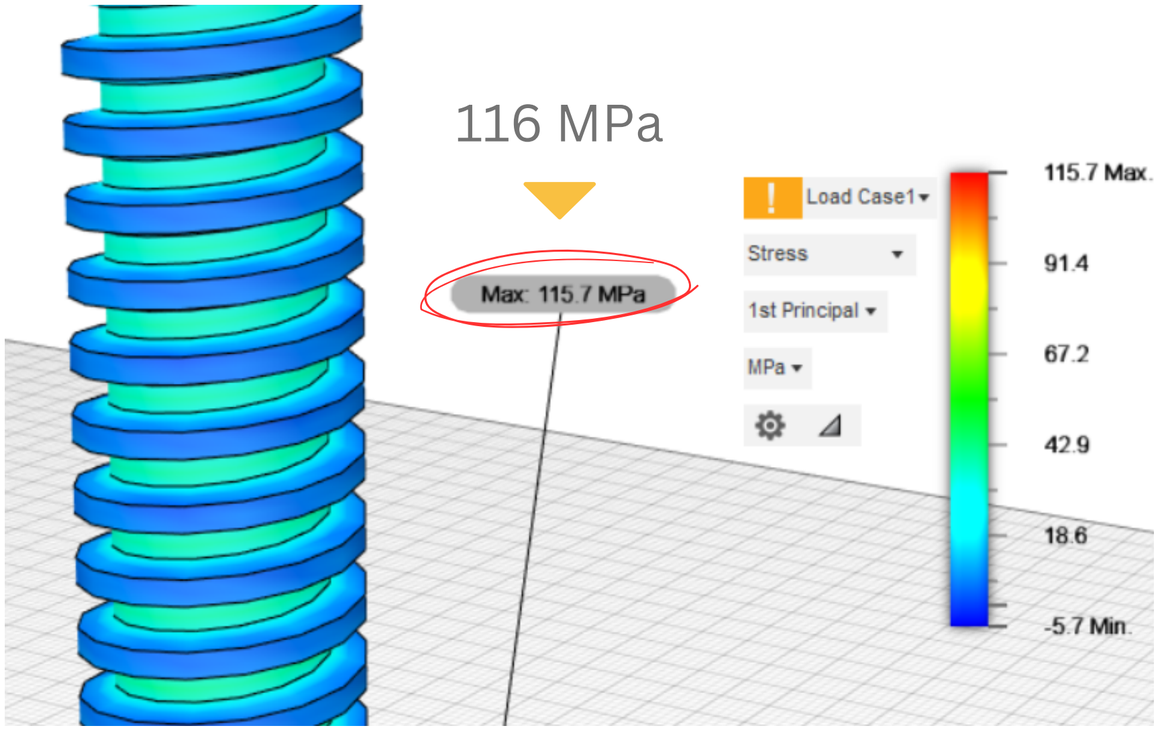
ACME Lead Screw (Optimized solution)

Material: SS Grade 316L

Efficient lead screws (>50%) can **back-drive**, requiring brakes for vertical loads.

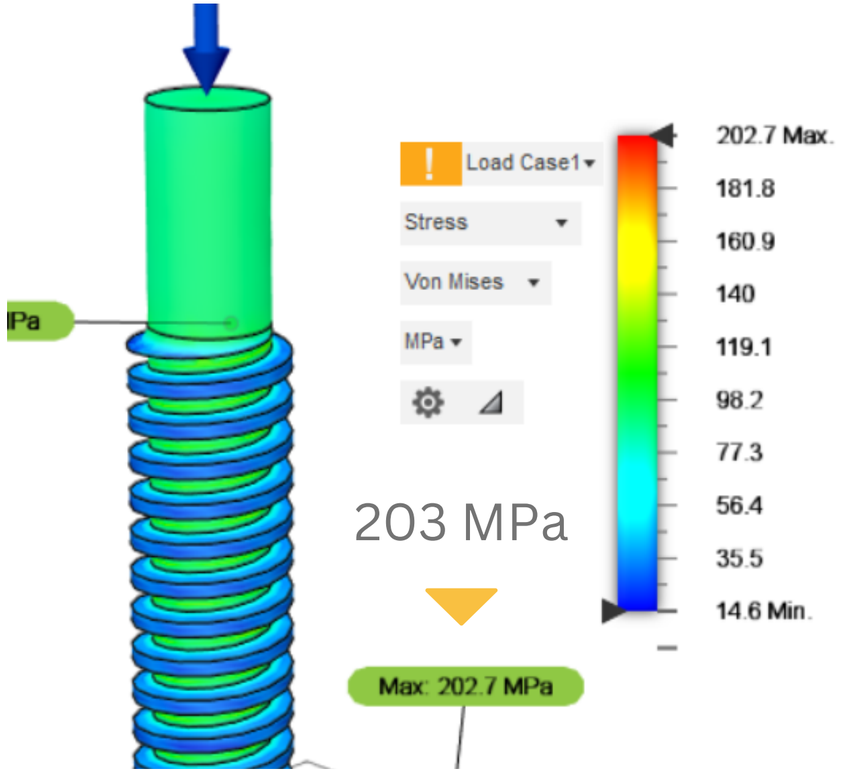
Verification

- Results consistent with the mathematical model? (YES, based on Stress Analysis sim and Mesh Refinement)
- Acceptable amount of Numerical error? (<10% acceptable)
- Acceptable variation in comparison with hand calculations? (Ans in Next slide)



Axial Stress

Theoretical value : 123 MPa
Experimental value : 116 MPa
Error % : ((123-116)/123) % = 5.7 %



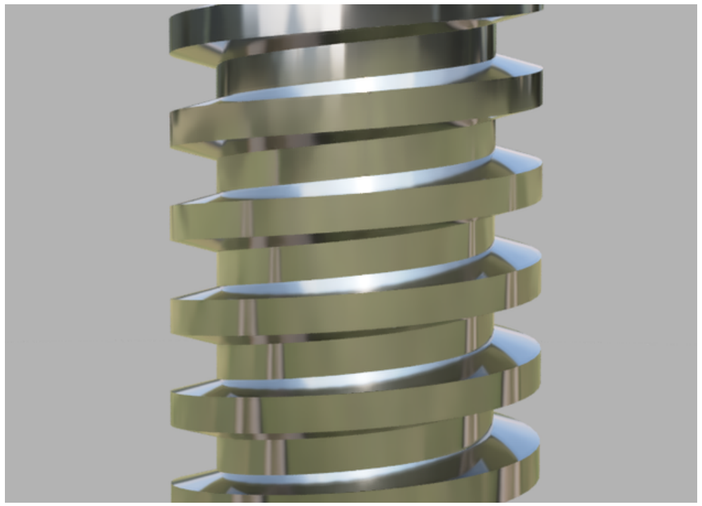
Bending Stress

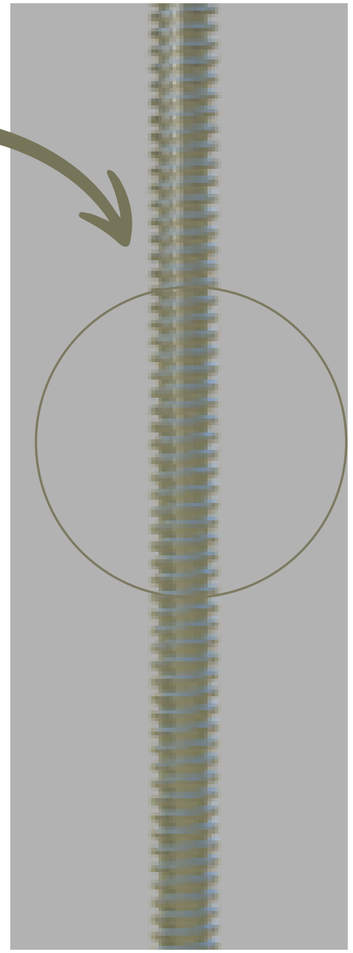
Theoretical value : 224 MPa
Experimental value : 203 MPa
Error % : ((224-203)/224) % = 9.37%

Validation

- Comparing the results with those of experimental results

- d = 10 mm
- p = 2 mm





ACME
Thread Rendered (NEW)
<u>OPTIMAL SOLUTION</u>

As the experimental machines were unavailable, we compared the theoretical calculation with simulated data

Parameters	Axial Stress	Bending Stress
Theoretical value	123	224
Experimental value	116	203

Fatigue Life (S-N Curve)

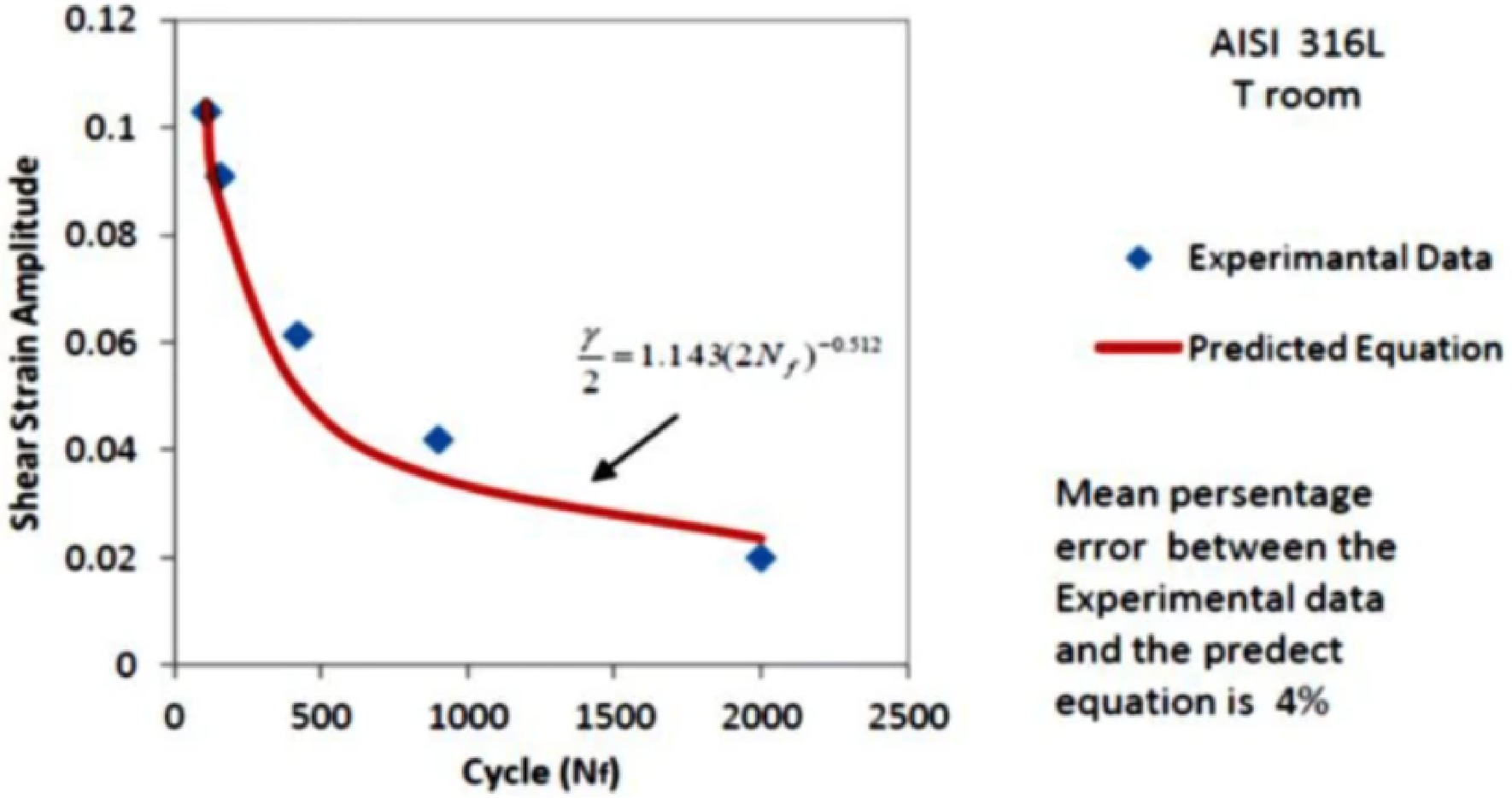


Fig 1, Courtesy: https://doi.org/10.1007/s42452-019-1390-7

Fatigue Life Comparison

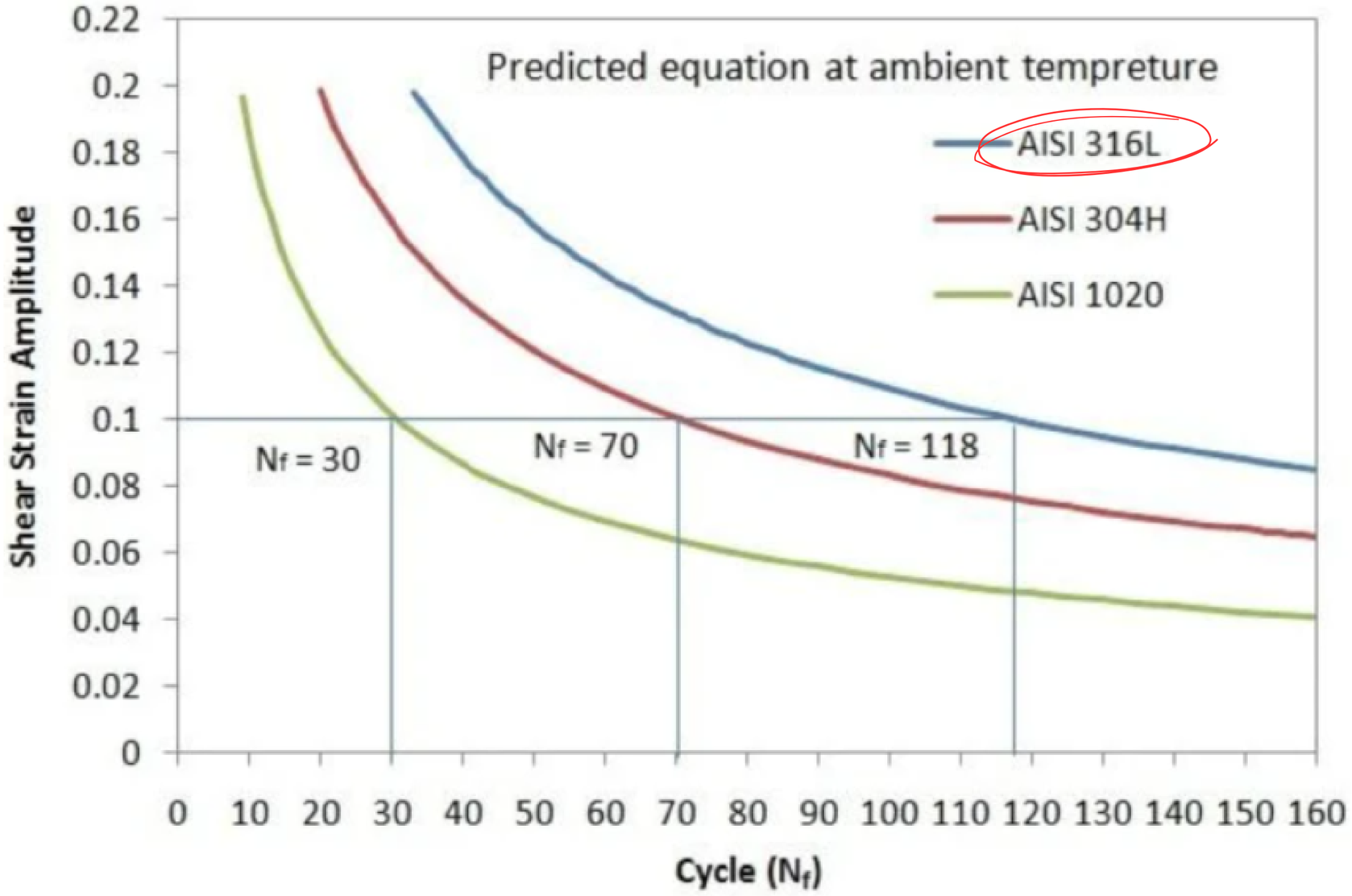
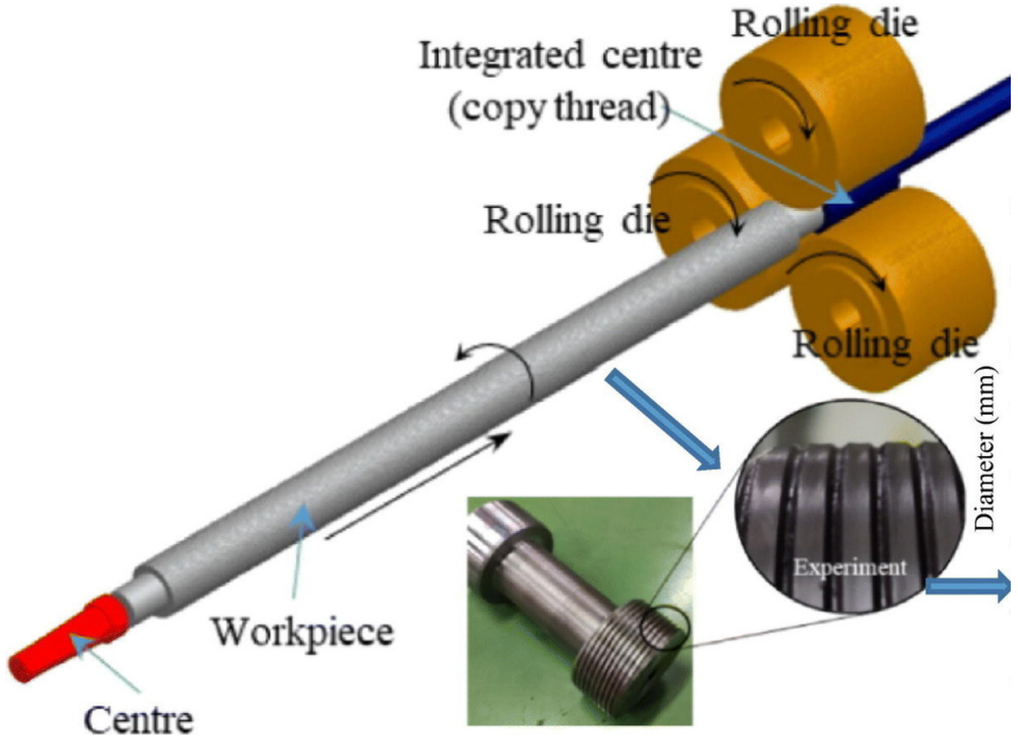


Fig 2, Courtesy: https://doi.org/10.1007/s42452-019-1390-7

Forming Lead Screw by Through-Feed Rolling Process with Active Rotation (paper 2022)

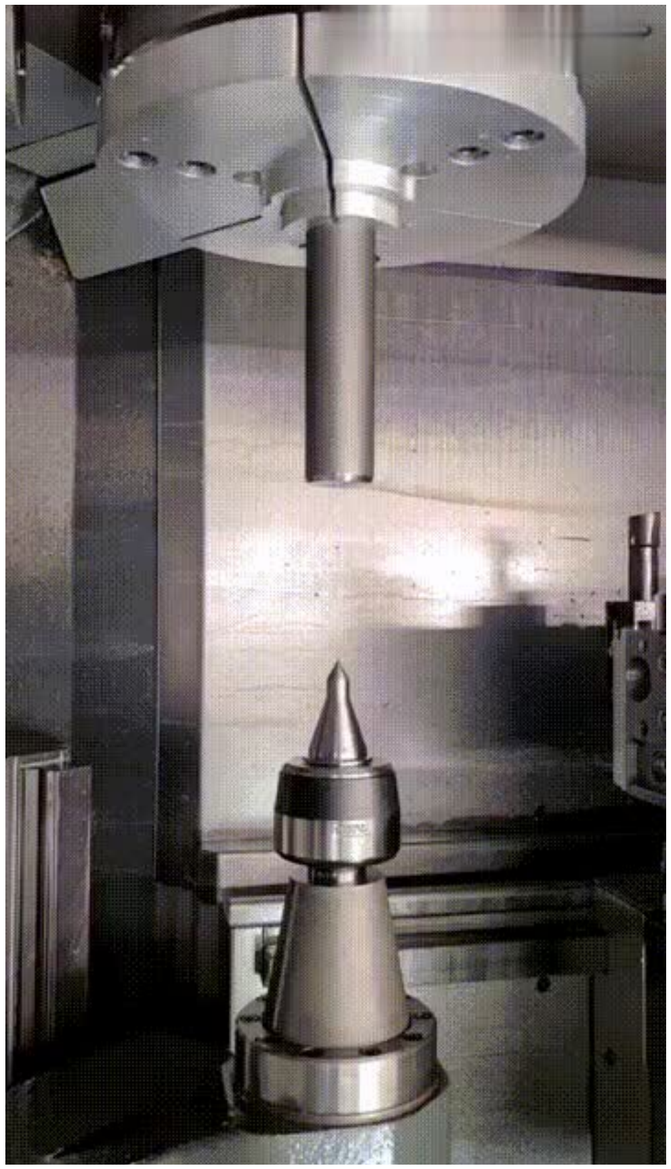
TFRPAR creates a lead screw by,

- utilizing parallel-axis rolling dies with a taper angle,
- active rotation of both the rolling die and workpiece



Courtesy: https://ars.els-cdn.com/content/image/1-s2.0-S1526612522005308-ga1.jpg

Efficient way of making in modern days!



Vertical Lathe Machine

(Source: @themachinistden470)

HOW IS IT MADE GENERALLY?

Take Cylindrical Bar

Plug into Chuck

Hold end with Tailstock

Use ACME Cutting tool

THANK YOU