



Bolted Connections

For In-pavement Airfield Lighting

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Airfield. Our Field.

Introduction



Introduction



Introduction



Bolted Connections Outline

- Engineering of a bolted connection
- Torque vs. Tension
- Tension Meter demonstration
- Conclusion/Questions

Engineering of a bolted connection

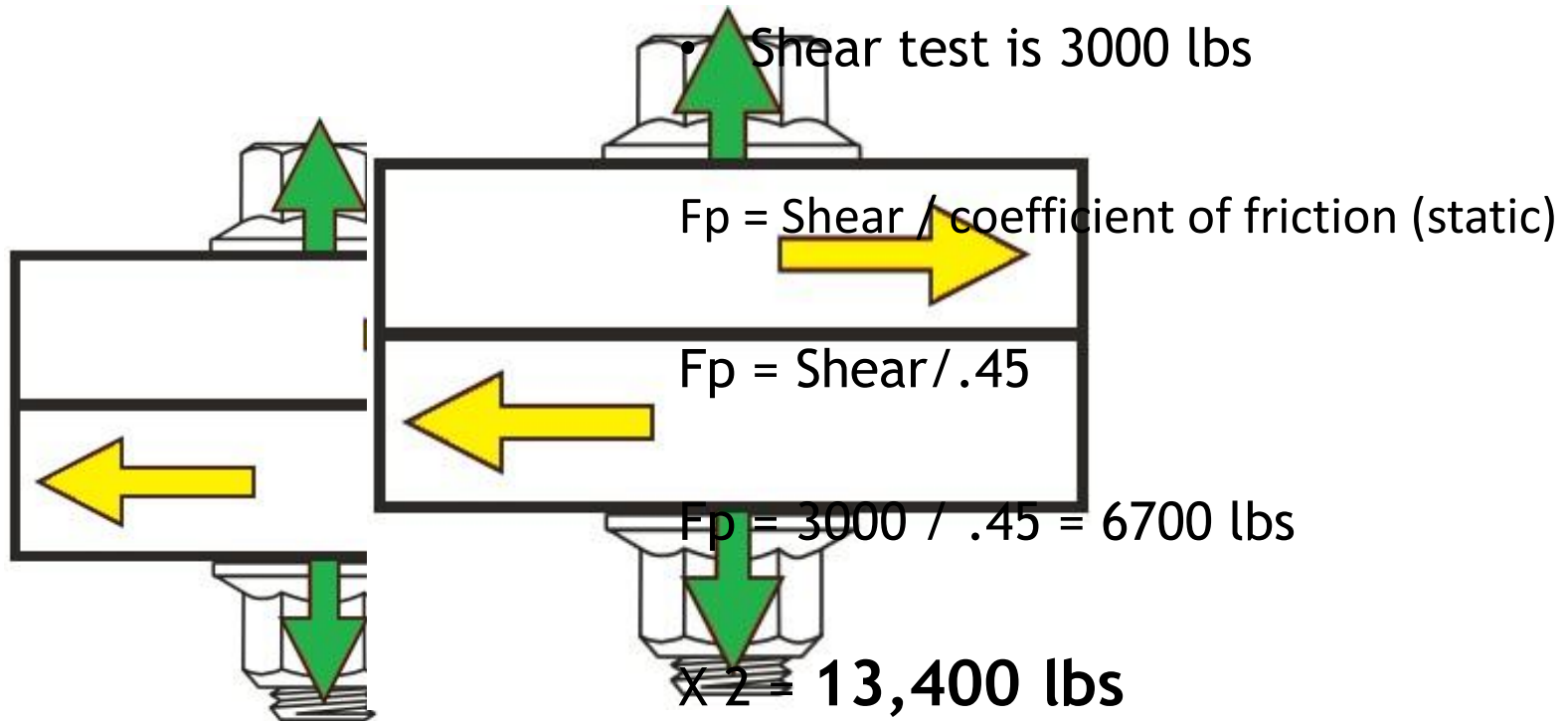


Engineering of a bolted connection



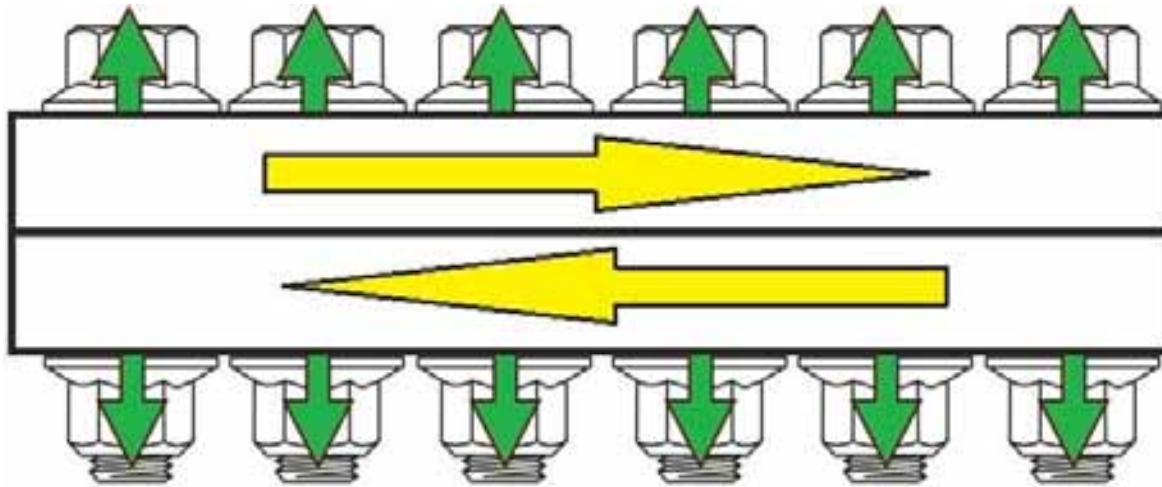
Engineering of a bolted connection

- Clamping force
 - Clamp force resists the shear load of the fixture



Engineering of a bolted connection

Clamping and shear force is spread over (6) bolts on an IPL



$$13,400 / 6 = \text{approx. } 2300 \text{ lbs. per bolt}$$

Engineering of a bolted connection



Engineering of a bolted connection

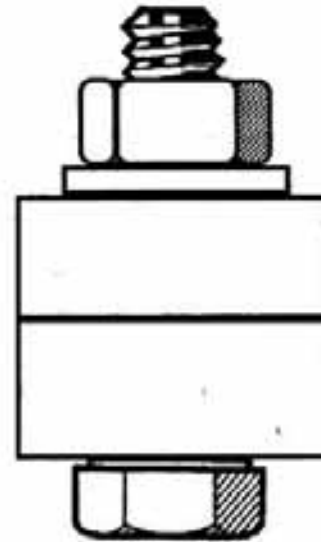
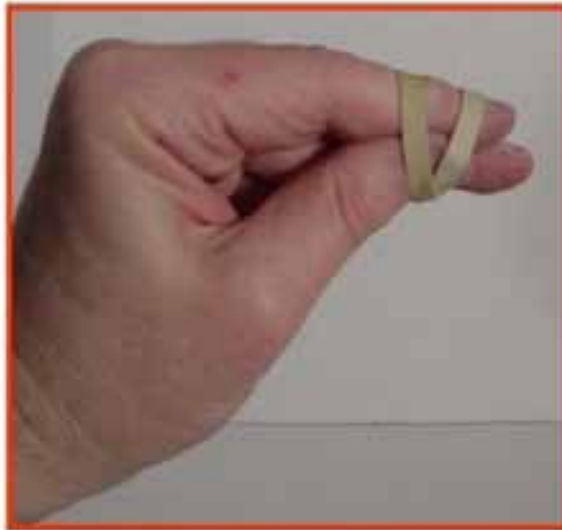


Engineering of a bolted connection



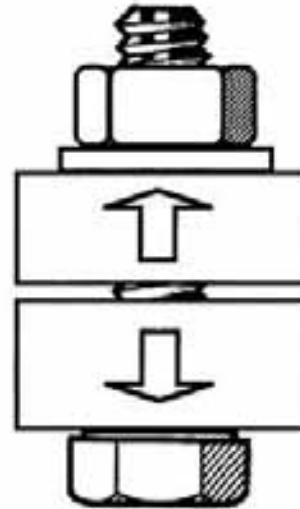
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Engineering of a bolted connection



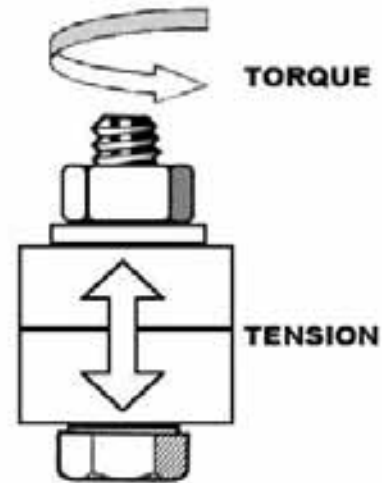
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Engineering of a bolted connection



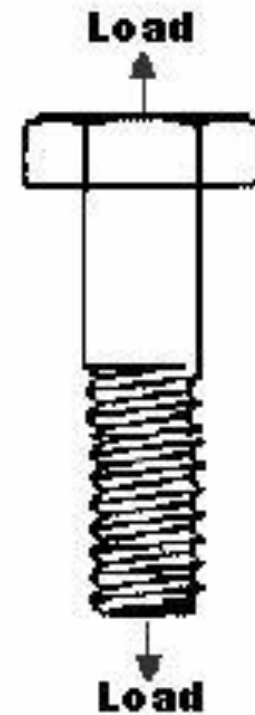
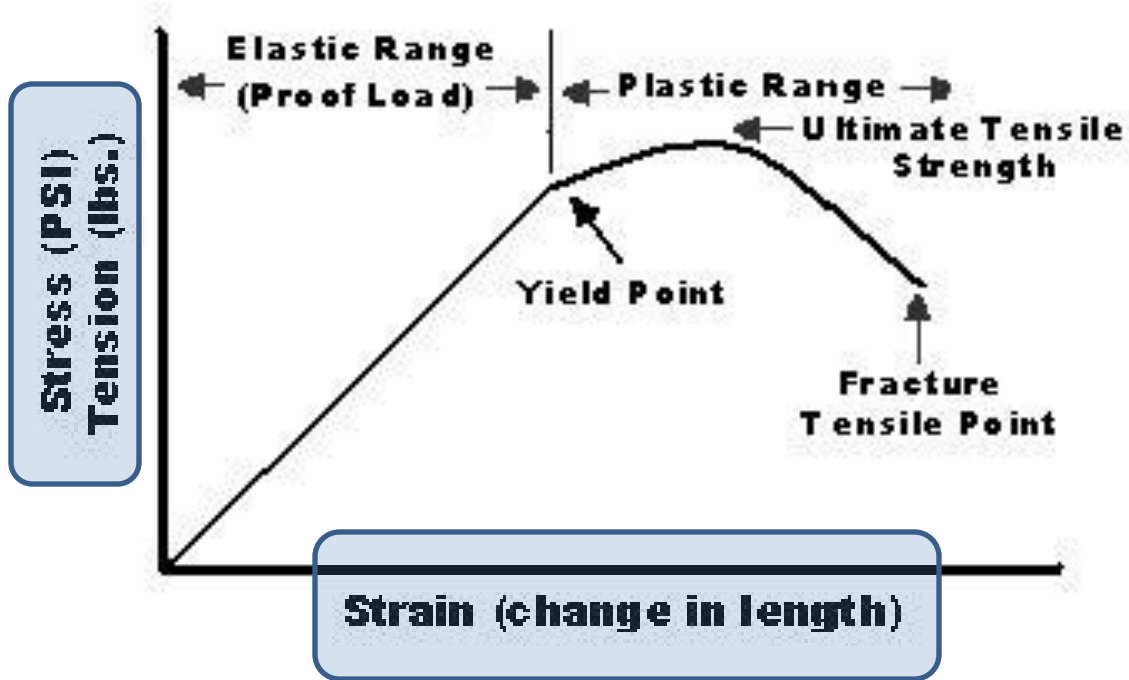
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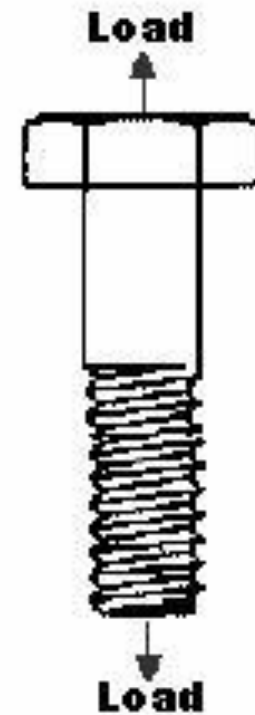
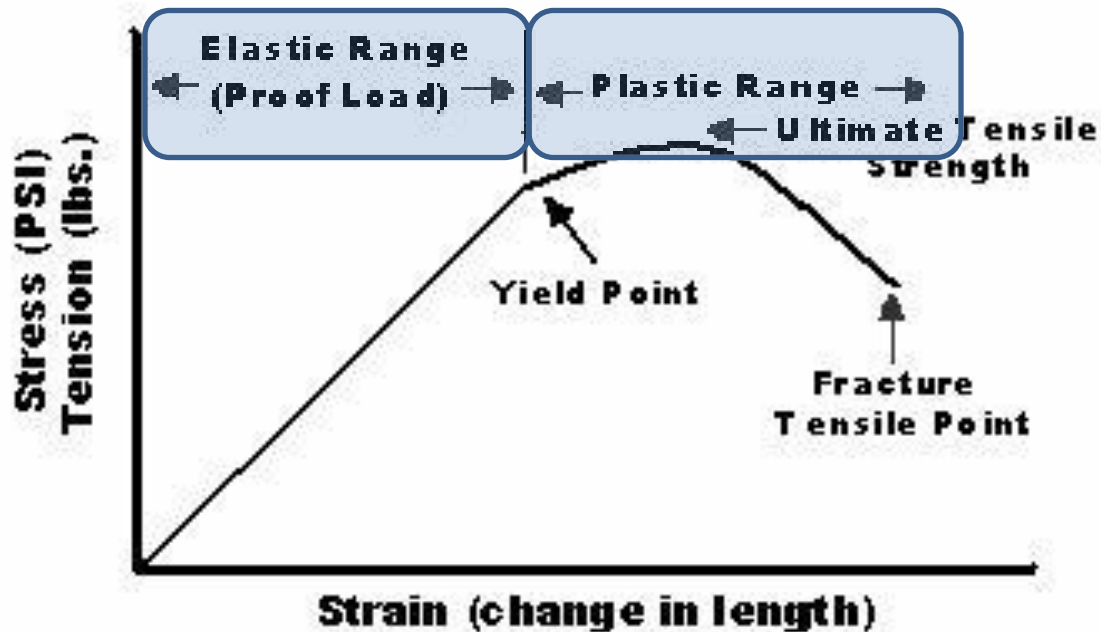
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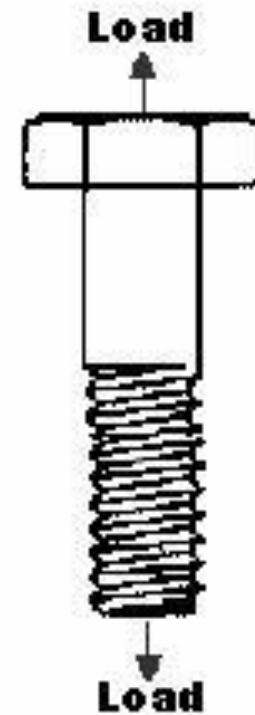
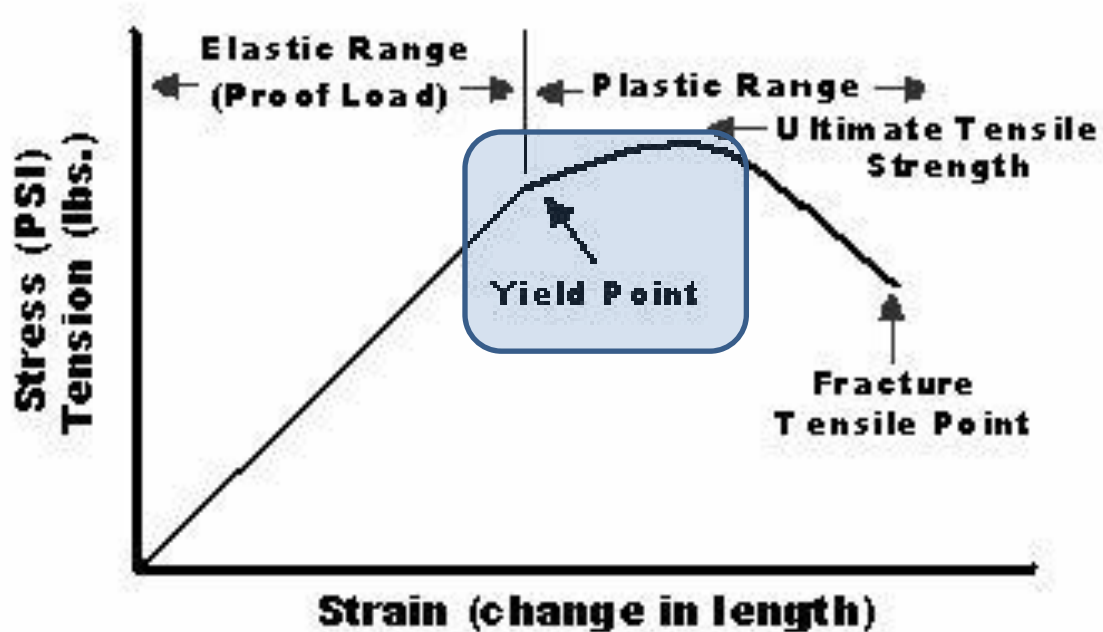
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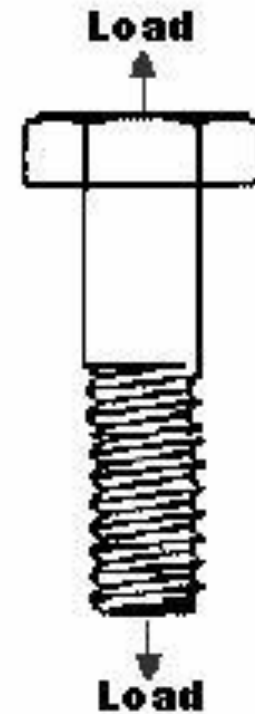
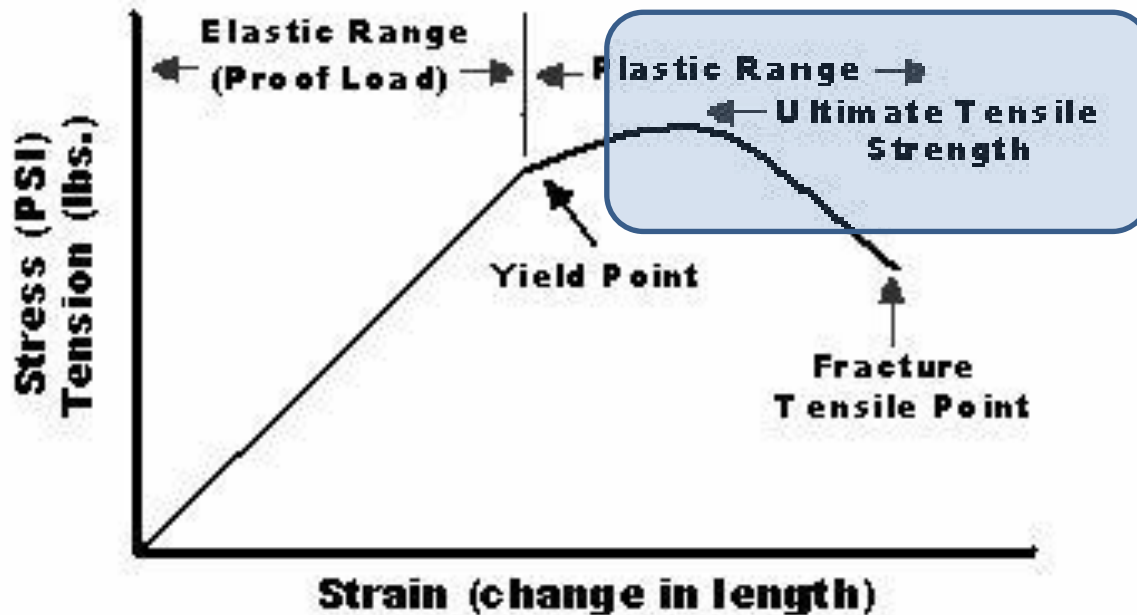
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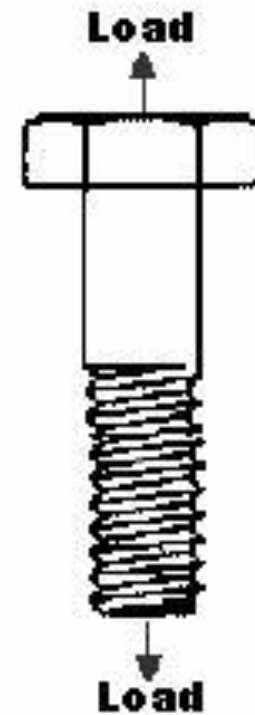
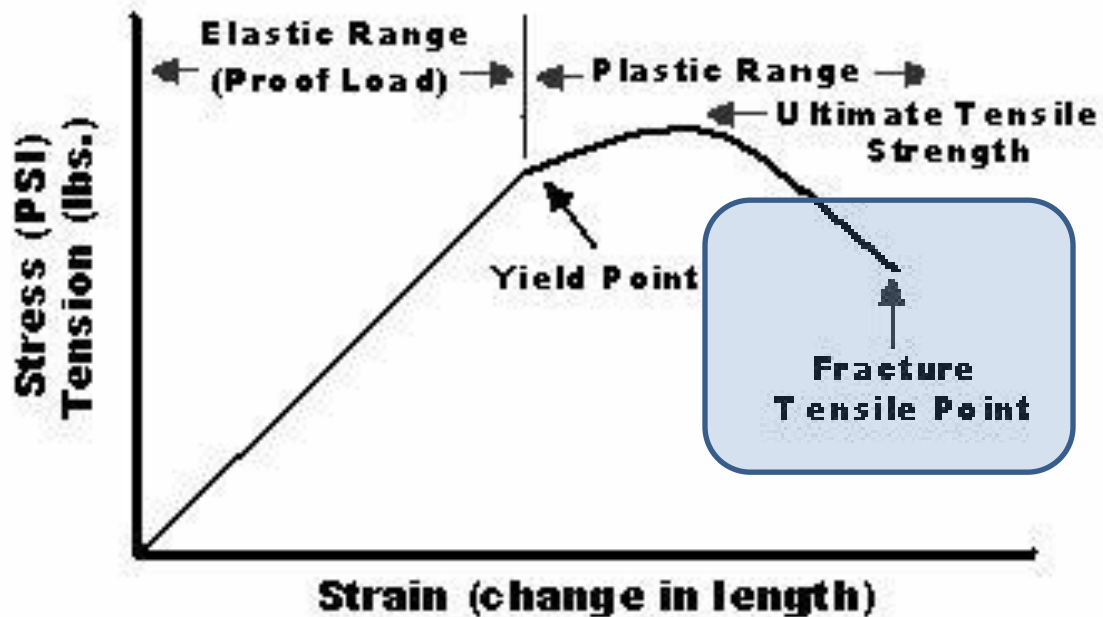
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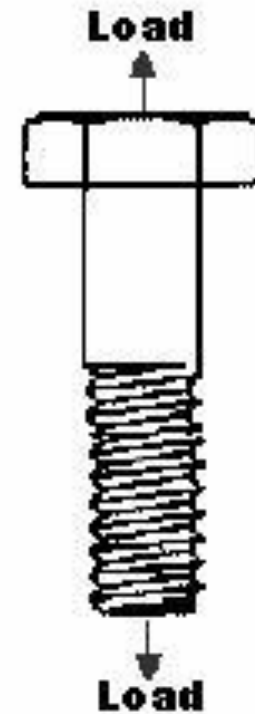
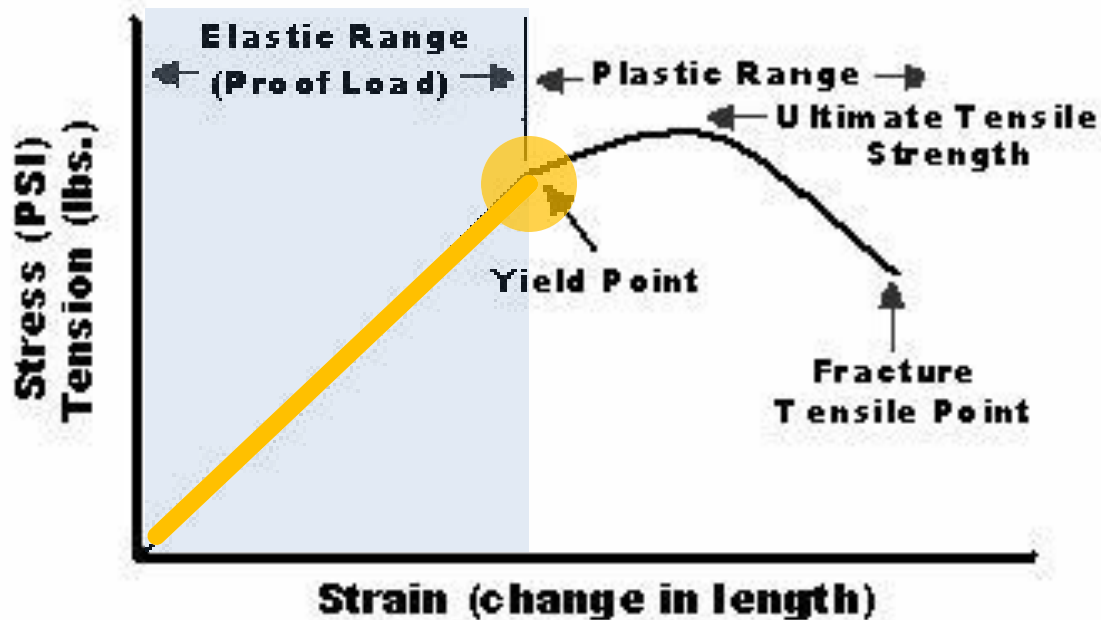
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Engineering of a bolted connection



Image: Courtesy of Jaquith Industries Inc.

Engineering of a bolted connection

Mechanical Properties of Common Stainless Steel Fasteners in Accordance with ASTM F593

Stainless Alloy Group	Condition	Nominal Dia. (in.)	Tensile Strength (psi)	Core Hardness Rockwell		Min. Yield Strength (psi)	Grade Identification Marking
				Min.	Max.		
1 (303, 304, 304L, 305, 384, XM1, 18-9LW, 302HQ, 303Se)	CW	1/4 - 5/8	100,000 - 150,000	B95	C32	65,000	F593C
	CW	3/4 - 1 1/2	85,000 - 140,000	B80	C32	45,000	F593D
2 (316, 316L)	CW	1/4 - 5/8	100,000 - 150,000	B95	C32	65,000	F593G
	CW	3/4 - 1 1/2	85,000 - 140,000	B80	C32	45,000	F593H

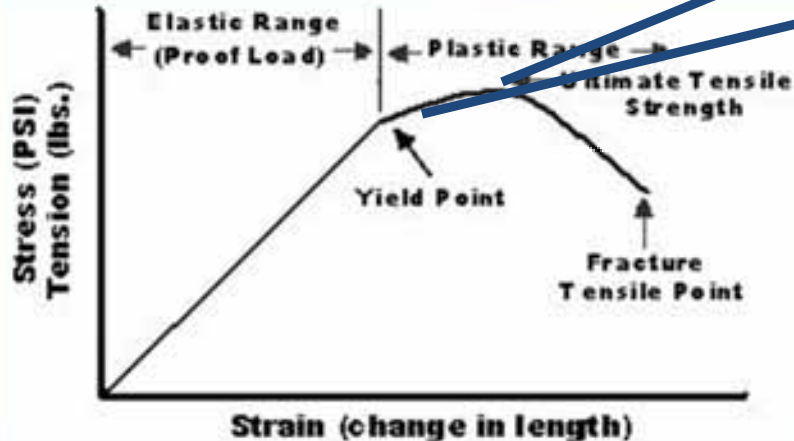
rolled from annealed or solution-annealed stock



Image: Courtesy of Jaquith Industries Inc.

Engineering of a bolted connection

Mechanical Properties of Common Stainless Steel Fasteners in Accordance with ASTM F593						
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		3/4 - 1 1/2	85,000 - 140,000	B80	C32	45,000



Engineering of a bolted connection

- $P = St \times As$

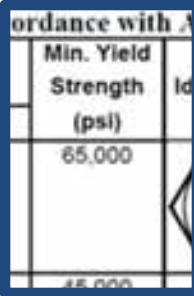
P = Tensile Load (lbs)

St = Yield Strength (psi)

As = Tensile stress area of the bolt (square inches)

St = 65,000 psi

For a 3/8-16 bolt ... As = .0775 sq inches



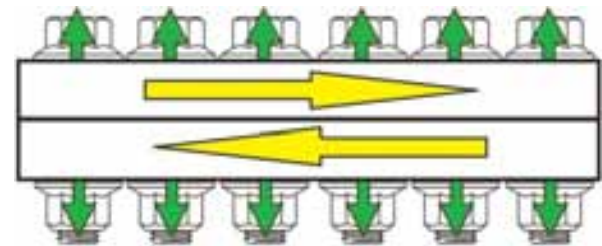
Core Hardness Rockwell		Min. Yield Strength (psi)	Grade Identification Marking
Min.	Max.		
B95	C32	65,000	F593C
B80	C32	45,000	F593D

$$\begin{aligned}\text{Max tensile load before yield} &= 65,000 \times .0775 \\ &= \underline{\underline{5037 \text{ lbs}}}\end{aligned}$$

Engineering of a bolted connection

Max Tensile load = 5037 lbs

Recall from before:



2300 lb requirement per bolt ... but it can withstand 5000 lbs without permanently deforming

Torque - Tension

Torque - Tension

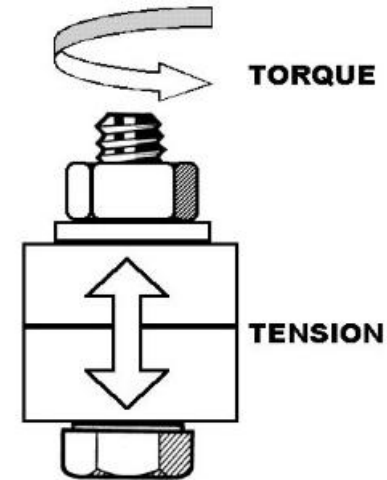
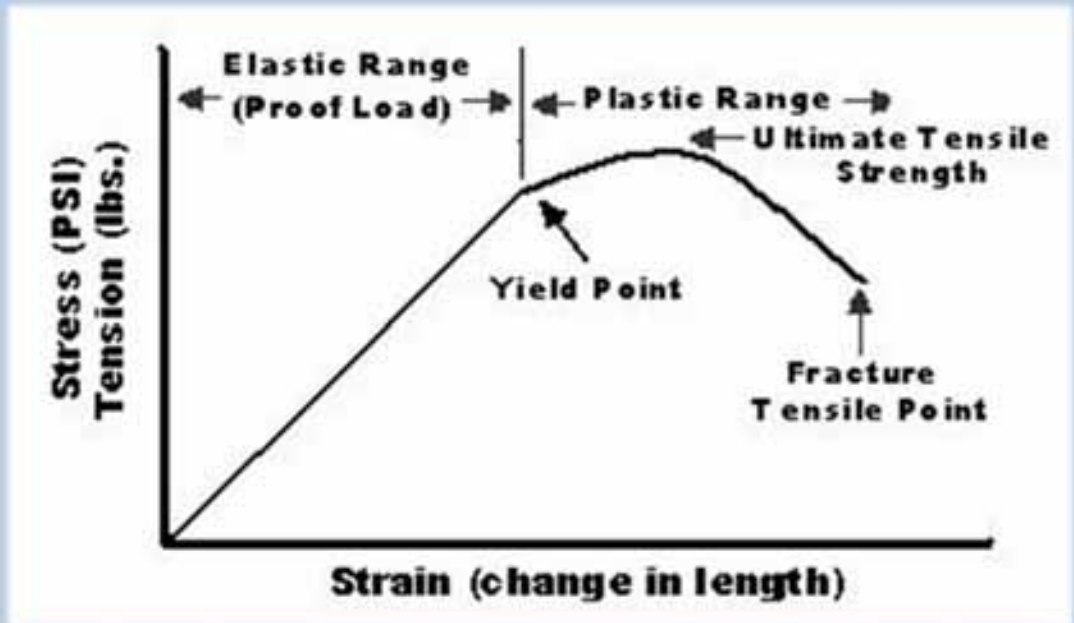
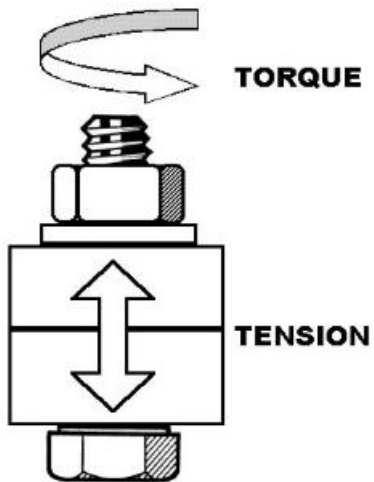


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Torque - Tension



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Torque - Tension



Skidmore-Wilhelm

Model P

For 3/8" diameter bolts

Image courtesy Skidmore-Wilhelm

Torque - Tension



Image: Copyright Fastener Training Institute

Torque - Tension



**100 ft-lbs
1200 in-lbs**

400 in-lbs / 35 ft-lbs

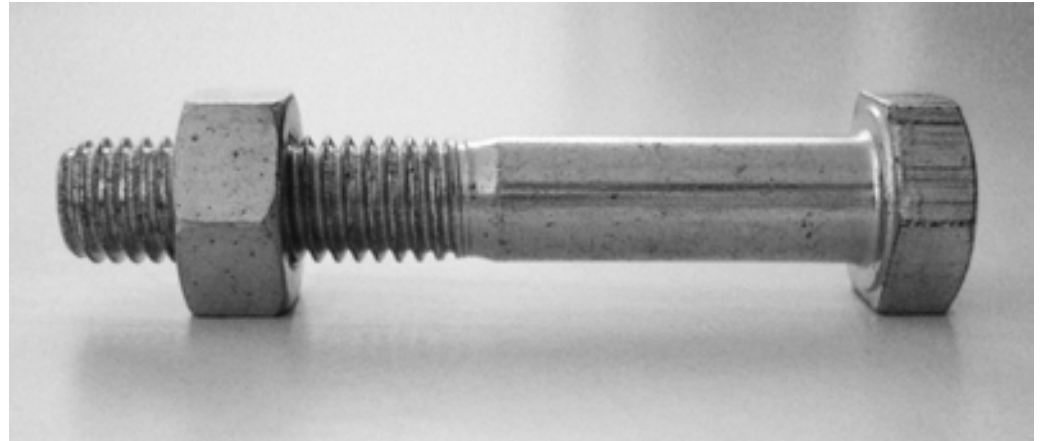
Torque - Tension



Torque - Tension

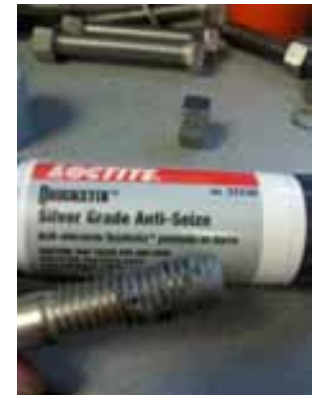


Torque - Tension



Torque - Tension

Bolt	Anti-Seize	Tension (lbs)	Torque (in-lbs)
S30400 (304 SS)	none (dry)	2450	178
S30400 (304 SS)	Loctite 51609	2450	139
S30400 (304 SS)	Loctite 37230	2450	126
LSO1-2416x1.75 "orange ceramic"	none	2450	119

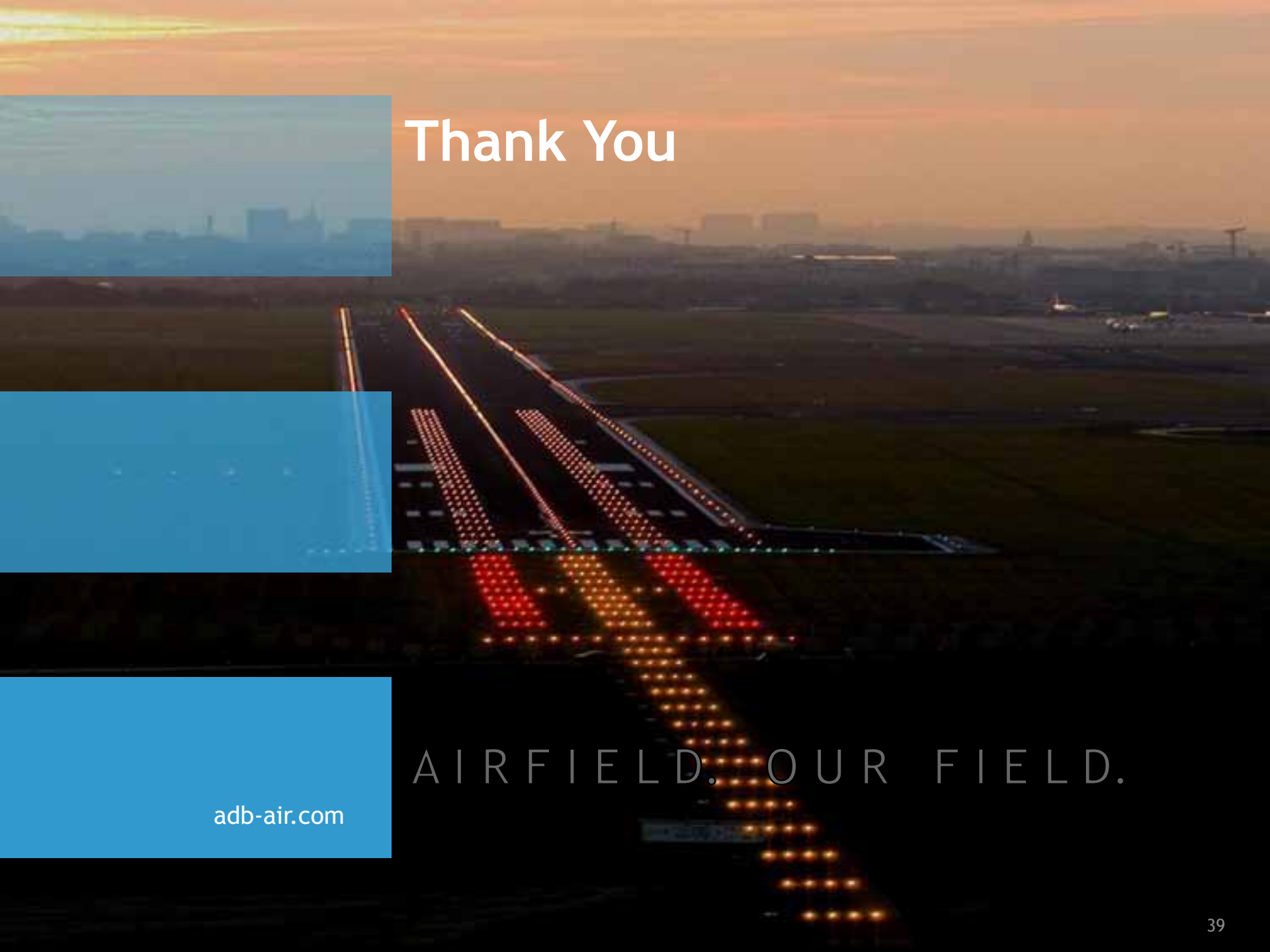


Procedure for use of torque-tension meter in airfield lighting

- Determine tension requirement (2300 lbs)
- Select anti-seize / lubricant (if required)
- Sample using calibrated torque-tension meter along with calibrated torque wrench
- With different bolt/lube/nut combination, re-check tension using selected torque value
- Install fixtures using calibrated torque wrench
- After install, re-verify torque-tension on another bolt/lube/nut (to insure torque wrench still operational)

Conclusion



An aerial photograph of an airport runway at night. The runway is illuminated with a series of red and white lights that recede into the distance. In the background, a city skyline is visible under a hazy, orange-tinted sky, suggesting a sunset or sunrise. The foreground shows the dark, flat landscape of the airfield.

Thank You

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