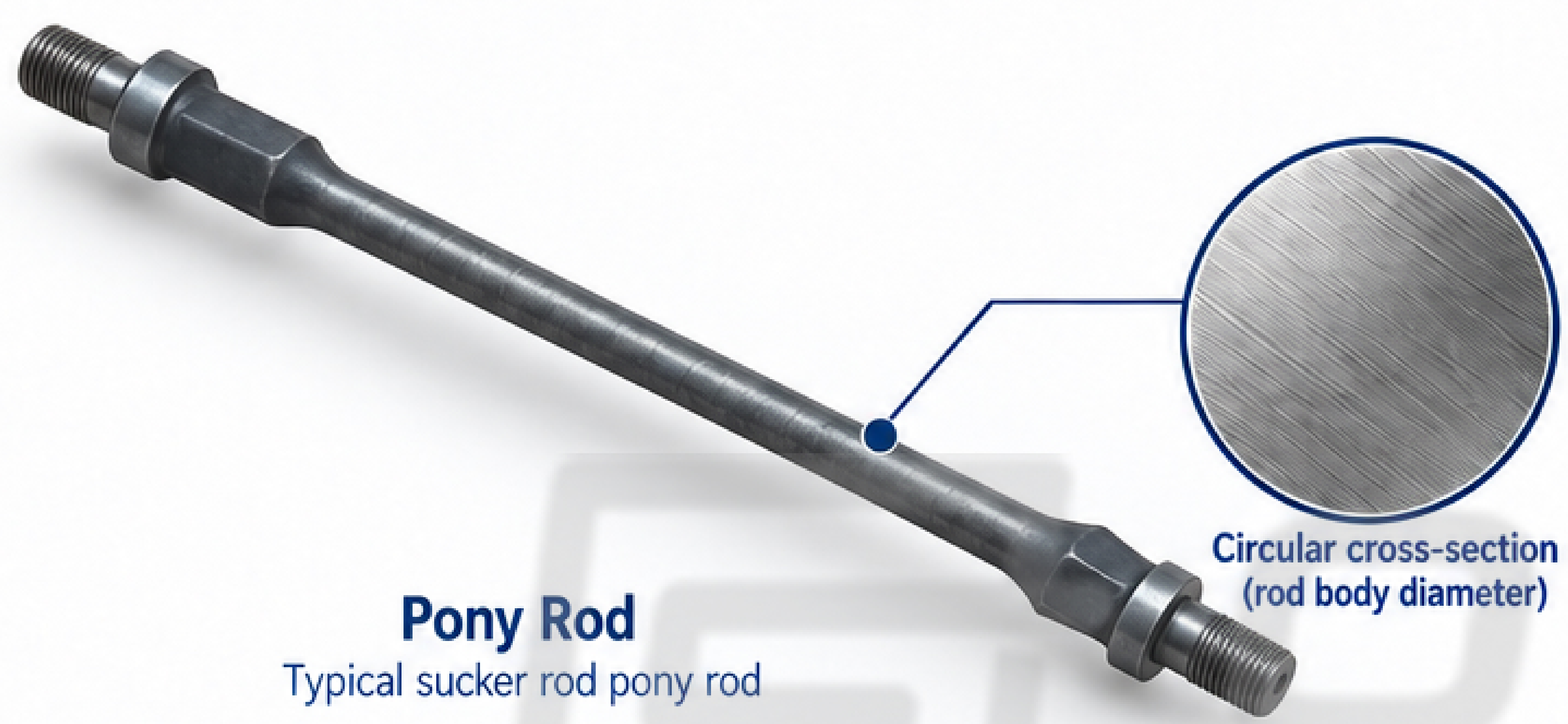
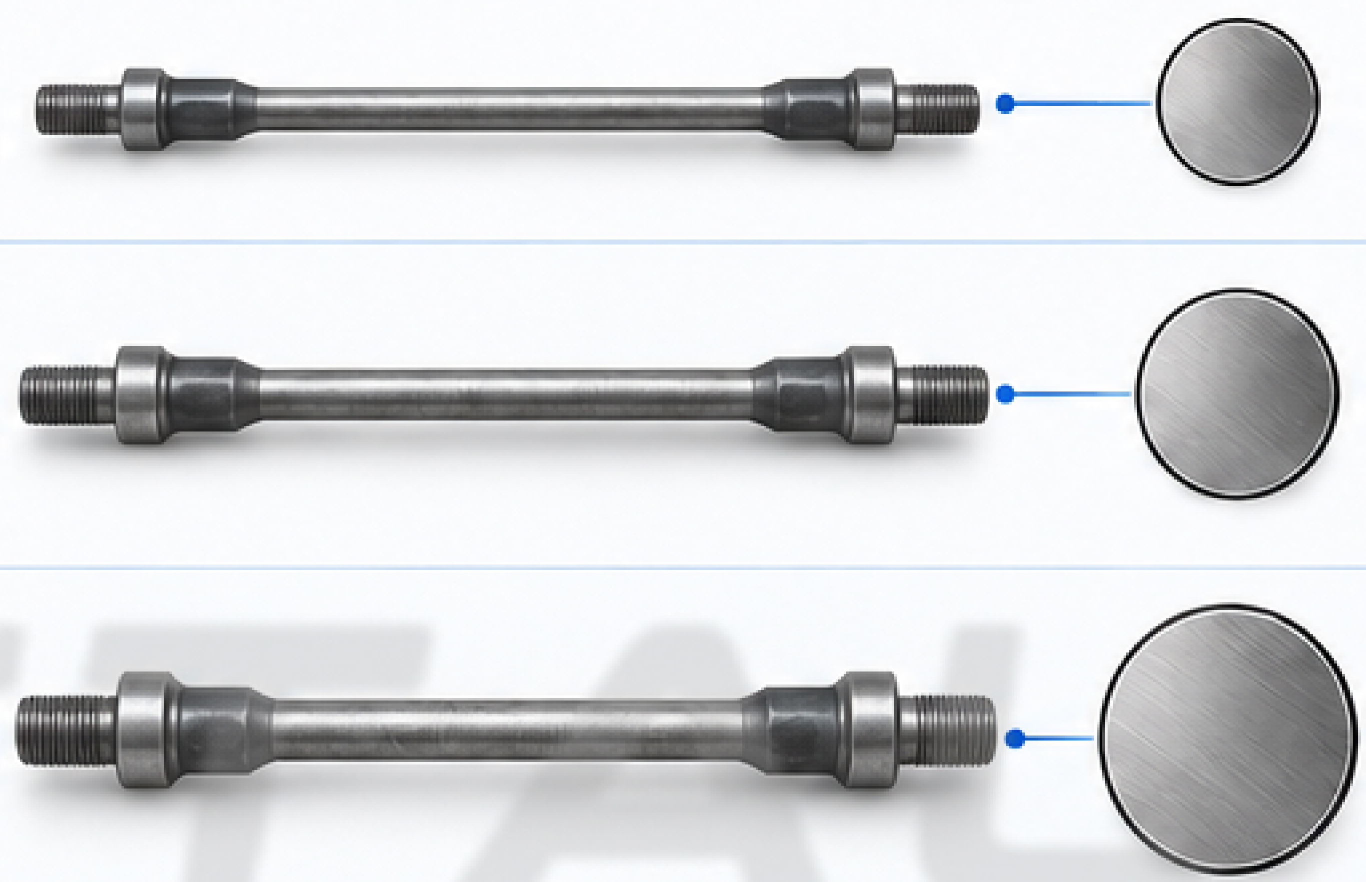
Pony Rod Load, Stress and Fatigue Evaluation Guide

Engineering reference for how rod diameter changes nominal load-bearing area in sucker rod systems.



PONY ROD SIZES AND CROSS-SECTIONS

LARGER DIAMETER → LARGER LOAD-BEARING AREA



CROSS-SECTIONAL AREA

$$A = \frac{\pi d^2}{4}$$

Nominal area based on circular rod-body diameter.

NOMINAL CROSS-SECTIONAL AREA DATA

Pony Rod Size	Body Diameter	Nominal Cross-Sectional Area
3/4 in.	19.05 mm	**285.0 mm²**
7/8 in.	22.23 mm	**388.1 mm²**
1 in.	25.40 mm	**506.7 mm²**

INCREASE IN LOAD-BEARING AREA

- 3/4 → 7/8 in. **Area +36%**
- 7/8 → 1 in. **Area +31%**
- 3/4 → 1 in. **Area +78%**

ENGINEERING LOGIC

Rod Diameter ↑ → Load-Bearing Area ↑ → Nominal Axial Stress ↓

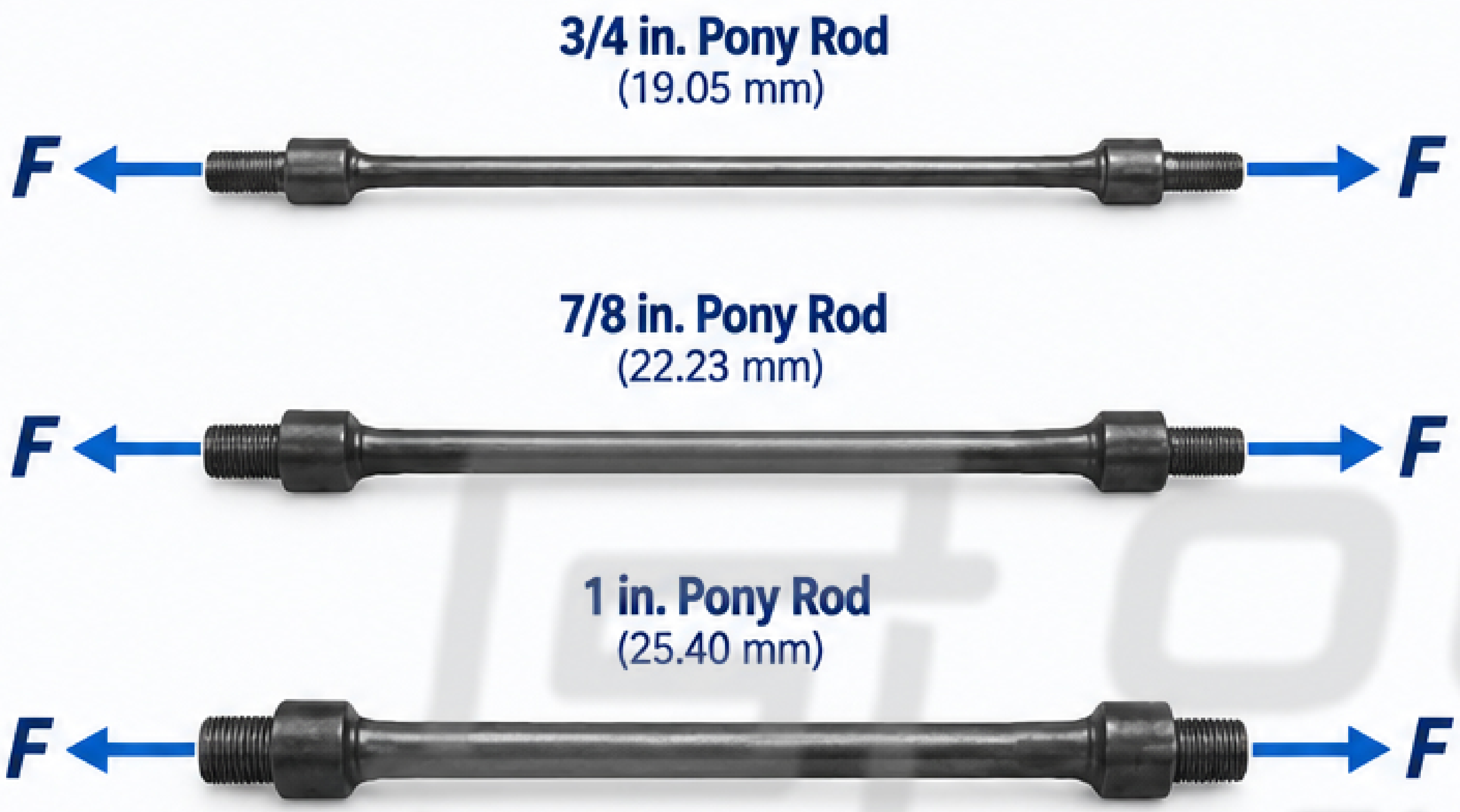
Under the same axial load, a larger rod body carries lower nominal stress.

NOTE Calculated areas are based on nominal circular rod-body diameter and do not include local geometric effects at the upset transition or threaded connection.

Pony Rod Load, Stress and Fatigue Evaluation Guide

Engineering Reference for Axial Load and Nominal Stress Comparison

SAME AXIAL LOAD — DIFFERENT ROD DIAMETER



$$\sigma = \frac{F}{A}$$

Where:

- σ = nominal axial stress
- F = axial tensile load
- A = nominal rod-body cross-sectional area

Same Load → Different Rod Diameter → Different Nominal Stress

Illustrative Engineering Calculation — Not a Design Load

Axial Load	3/4 in. Pony Rod	7/8 in. Pony Rod	1 in. Pony Rod
20 kN	70.2 MPa	51.5 MPa	39.5 MPa
40 kN	140.3 MPa	103.1 MPa	78.9 MPa
60 kN	210.5 MPa	154.6 MPa	118.4 MPa
80 kN	280.7 MPa	206.1 MPa	157.9 MPa

Stress Comparison at 60 kN

3/4 in.	7/8 in.	1 in.
210.5 MPa	**154.6 MPa**	**118.4 MPa**

Larger rod diameter reduces nominal body stress under the same axial load.

Grade Strength Reference

Grade C / K Minimum Yield: 414 MPa

D-Family Minimum Yield: 586 MPa

Nominal body stress is only one part of rod evaluation. Actual cyclic loading, stress concentration, corrosion and connection geometry must also be considered.

KEY TAKEAWAY | Nominal axial stress decreases as rod diameter increases under the same applied load.

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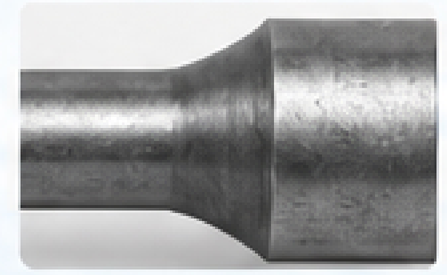
Engineering Reference for Fatigue-Sensitive Areas in a Pony Rod

FATIGUE-SENSITIVE AREAS IN A PONY ROD

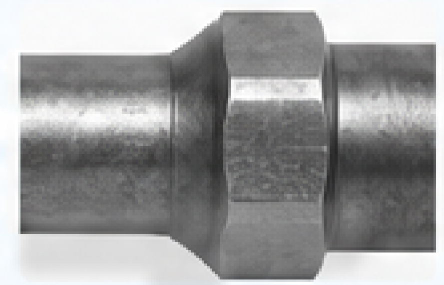
Rod Body → Upset Transition → Wrench Area → Pin Shoulder → Thread Root → Coupling

1. Upset Transition



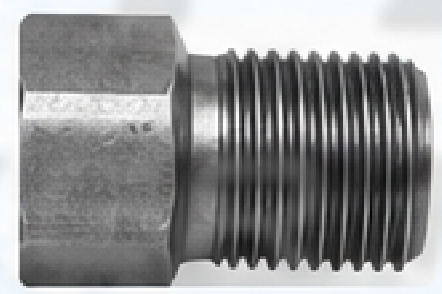
The transition from the rod body to the forged end creates a geometric change in the load path. Poor transition geometry or surface discontinuities can increase local stress concentration.

2. Pin Shoulder



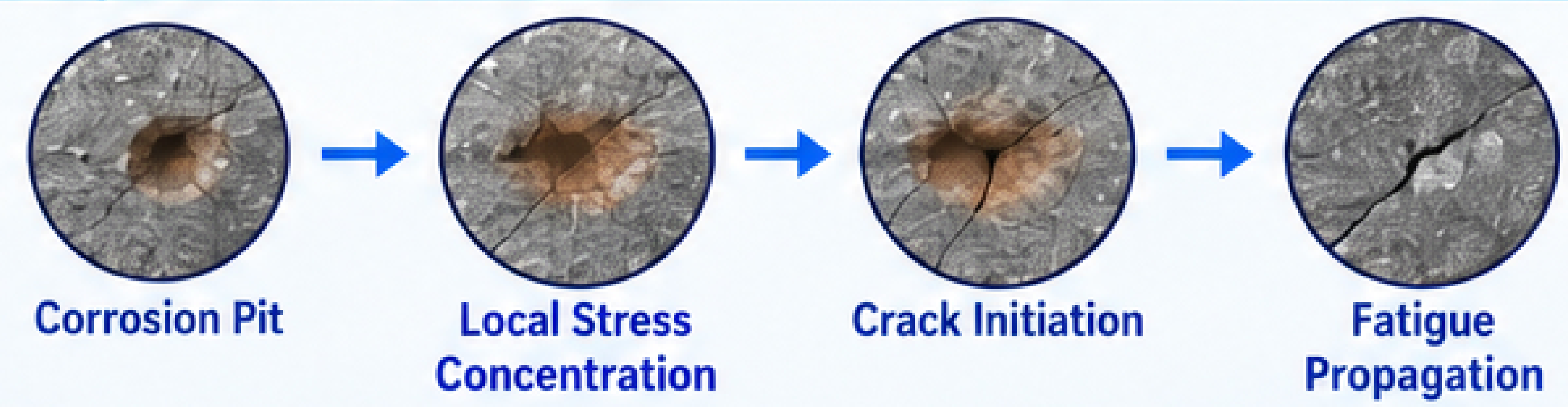
The shoulder forms part of the connection load path and is repeatedly loaded during each pumping cycle. Surface damage or poor geometry can increase local stress.

3. Thread Root



Thread roots naturally create localized stress concentration. Connection damage, corrosion or poor machining can further reduce fatigue resistance.

Corrosion-Fatigue Initiation



Corrosion pits can act as fatigue initiation sites under repeated tensile loading.

KEY TAKEAWAY | Fatigue risk is governed by local stress concentration and cyclic loading, not by nominal rod-body stress alone.

Pony Rod Load, Stress and Fatigue Evaluation Guide

Engineering Reference for Load and Fatigue Evaluation Logic

LOAD AND FATIGUE EVALUATION LOGIC

1. Rod String Position
Upper / intermediate / lower string position

2. Determine Load Sources
- Rod weight
- Fluid load
- Pump load
- Dynamic / acceleration load

3. Rod Diameter
3/4 / 7/8 / 1 in. or project-specific size

4. Calculate Nominal Axial Stress
$\sigma = F / A$

5. Compare with Material Strength Range
- Grade C / K
- D-family

6. Check Local Fatigue Factors
- Upset transition
- Pin shoulder
- Thread root
- Surface condition

7. Check Service Environment
- Produced water
- Chlorides
- CO_2
- H_2S
- Corrosion inhibitor condition

8. Final Engineering Review
Mechanical Load + Material Grade + Connection Geometry + Corrosion Condition

RISK MATRIX

Corrosion Severity \ Mechanical Load	Low	High
High	Strength margin generally less critical	Corrosion behavior becomes a major material-selection factor
Low	Strength and fatigue become dominant	Combined corrosion-fatigue condition requires the most attention

EVALUATION NOTE

Evaluation should integrate loading, material strength, fatigue-sensitive geometry and corrosion exposure rather than relying on grade designation alone.

KEY TAKEAWAY Final pony rod evaluation combines axial load, material strength range, local fatigue factors and service environment.