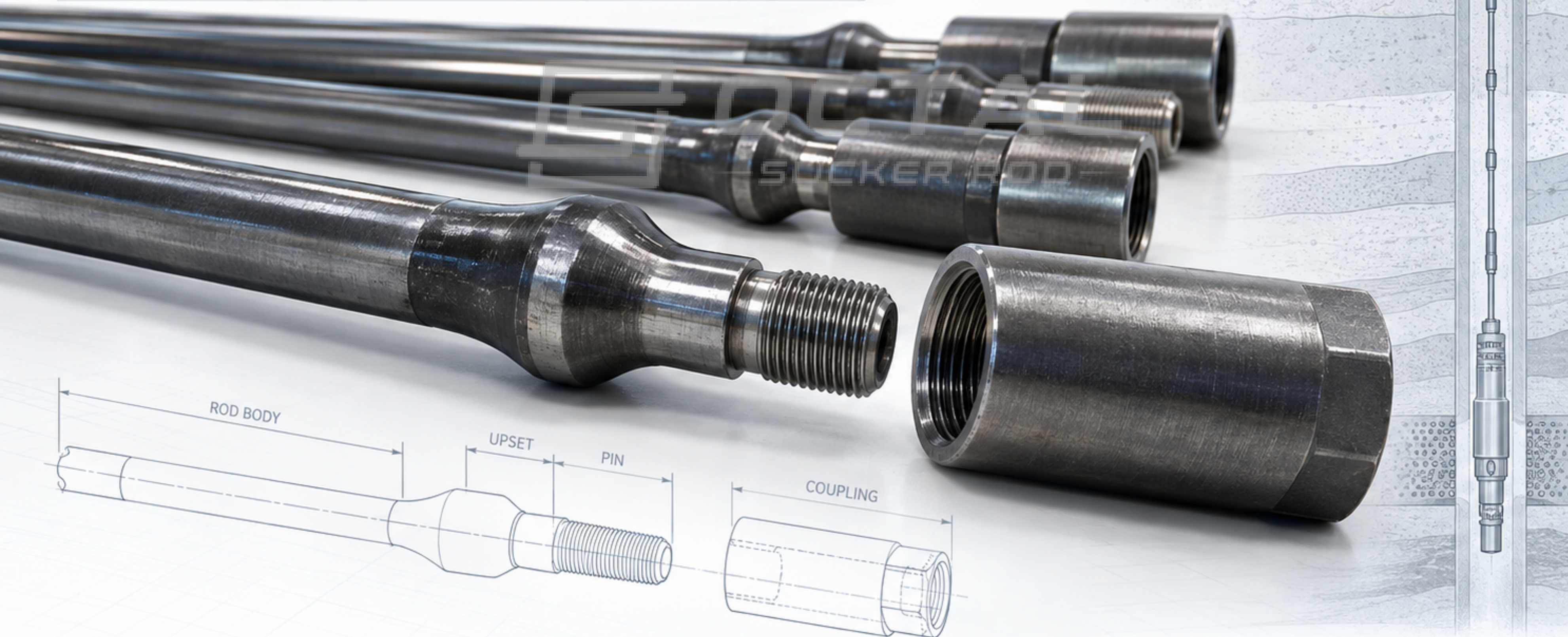


Sucker Rod Grade Selection and Fatigue Engineering Guide

Engineering Reference for Grade, Diameter, Cyclic Load, Corrosion and Connection Evaluation

Purpose

Preliminary engineering reference for comparing sucker rod grades, rod diameter, cyclic loading, corrosion exposure and connection requirements. Final rod-string design must follow the applicable project specification, API 11B edition and manufacturer-qualified product data.



Mechanical Strength Comparison of Conventional Sucker Rod Grades

Sucker Rod Grade	Minimum Yield Strength		Tensile Strength (Range)	
	ksi	MPa	ksi	MPa
Grade C	60	414	90 – 115	621 – 793
Grade K	60	414	90 – 115	621 – 793
D Carbon	85	586	115 – 140	793 – 965
D Alloy	85	586	115 – 140	793 – 965
D Special	85	586	115 – 140	793 – 965

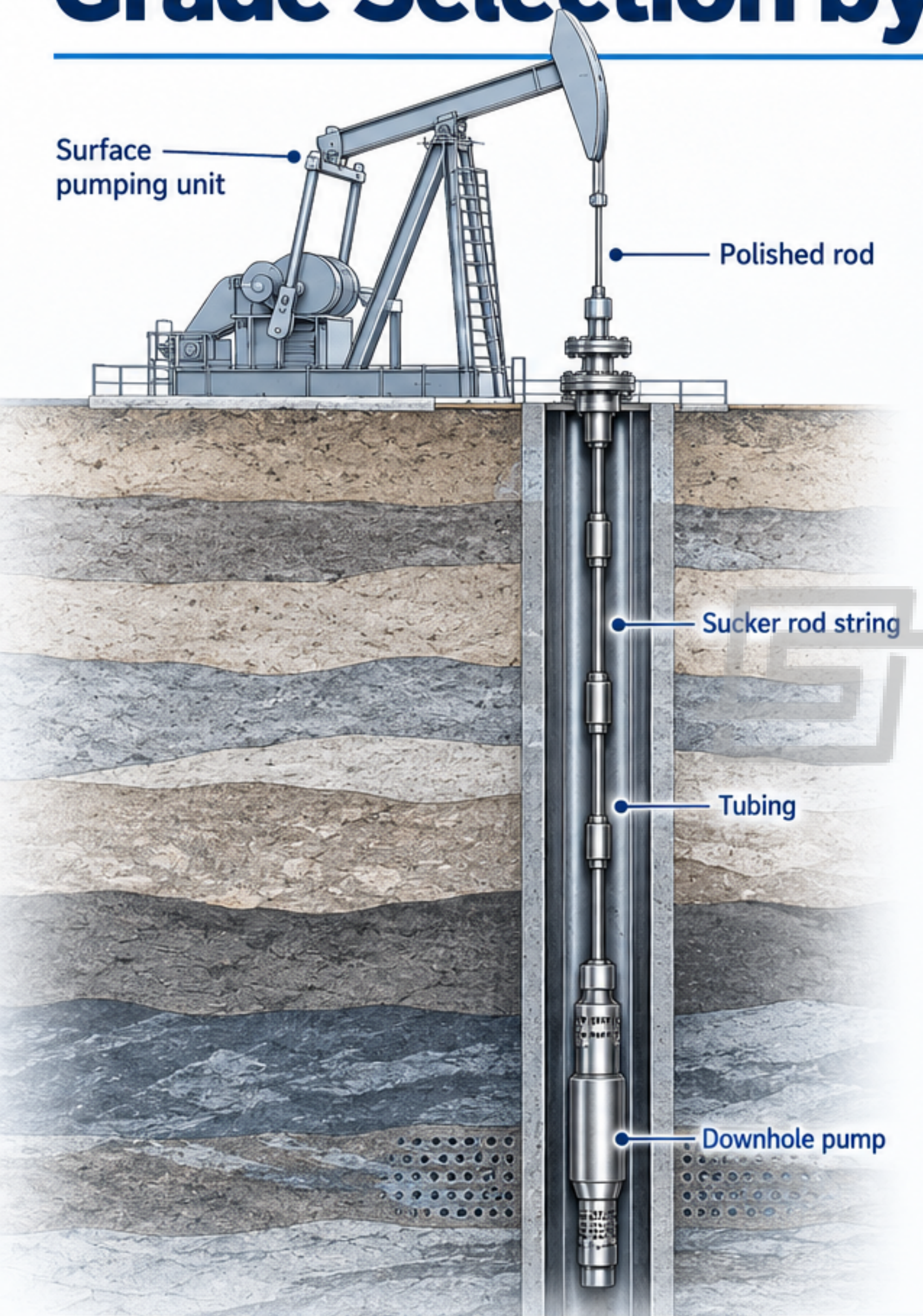
Technical Note

KD and proprietary high-strength grades require verification against the specified manufacturer., product specification and applicable standard edition.

Engineering Note Higher tensile strength does not by itself predict fatigue life. Surface condition, metallurgy, stress range, connection geometry and corrosive exposure must also be evaluated.



Grade Selection by Actual Well Conditions



Actual Well Conditions	Grade Selection for Engineering Evaluation
Light-to-moderate cyclic load	Grade C to evaluate
Moderate load + corrosion concern	Grade K to evaluate
Moderate-to-heavy axial load	D Carbon / D Alloy
Higher load + corrosive produced fluids	Qualified KD / D Special
High-load rod-string design	Qualified High Strength grade
Deviated well with rod/tubing contact	Evaluate combined load, wear, bending and corrosion

Engineering Note
This matrix identifies candidate grade families for engineering evaluation. It is not an unconditional grade recommendation.

Rod Diameter, Cross-Section and Load Distribution

5/8 in.
15.88 mm

3/4 in.
19.05 mm

7/8 in.
22.23 mm

1 in.
25.40 mm

1-1/8 in.
28.58 mm



5/8 in.
15.88 mm



3/4 in.
19.05 mm



7/8 in.
22.23 mm



1 in.
25.40 mm

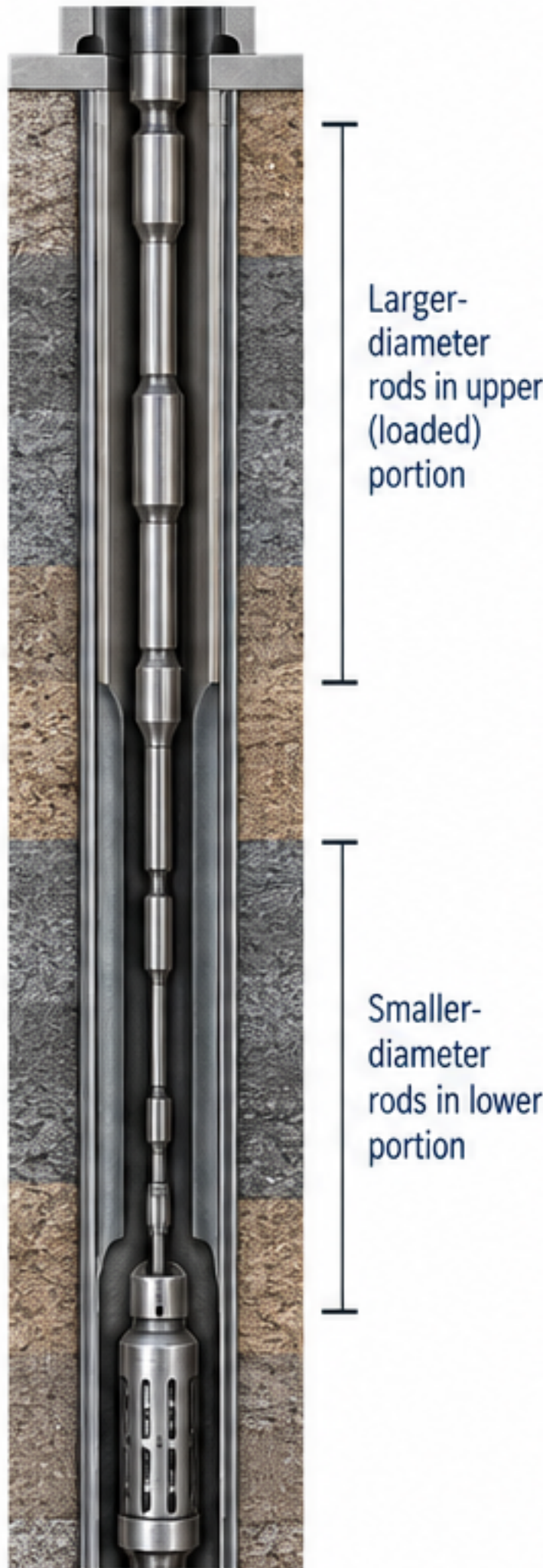


1-1/8 in.
28.58 mm

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

F = Axial Force
A = Rod-Body Cross-Sectional Area
 σ = Nominal Axial Stress

For the same axial force,
a smaller rod-body area
produces higher nominal
axial stress.



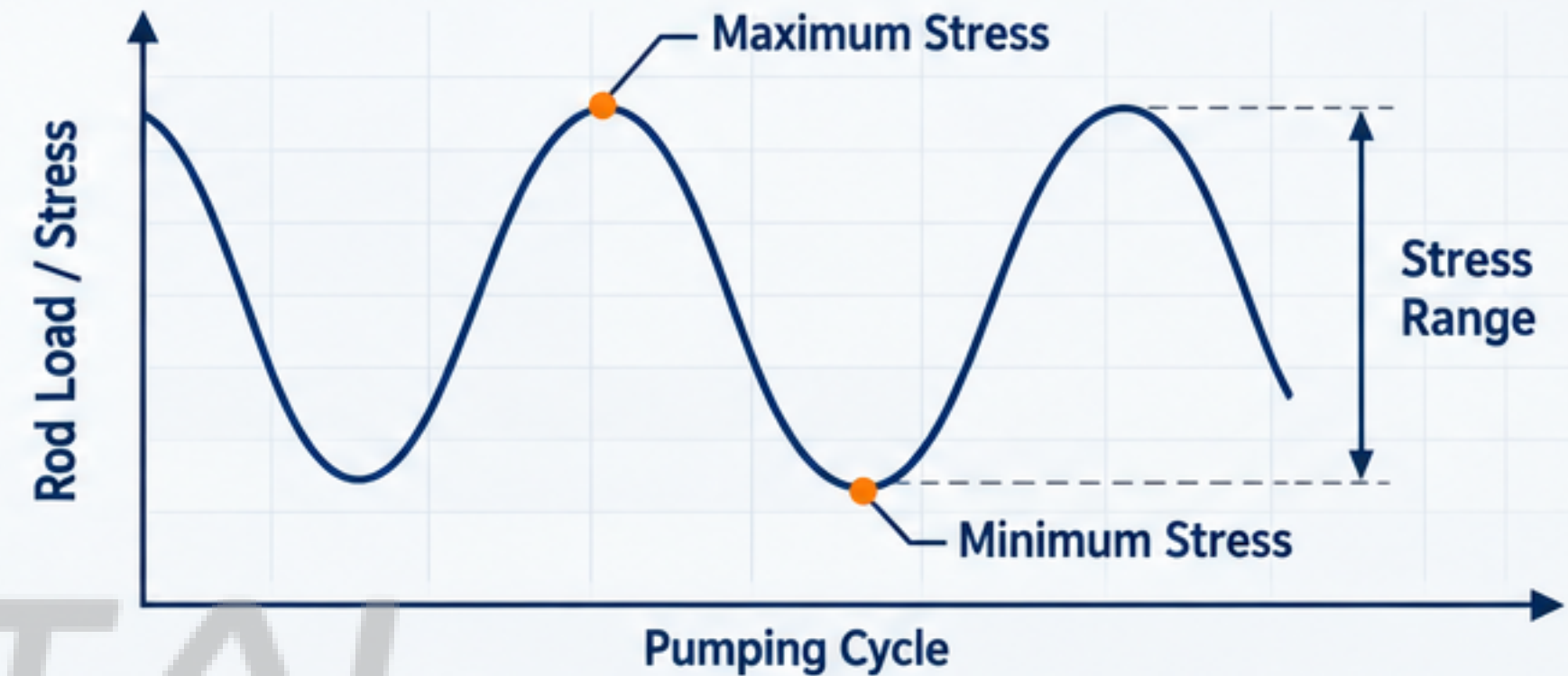
Rod diameter and grade may vary
by section according to calculated
rod-string loading.

Cyclic Load and Fatigue Assessment



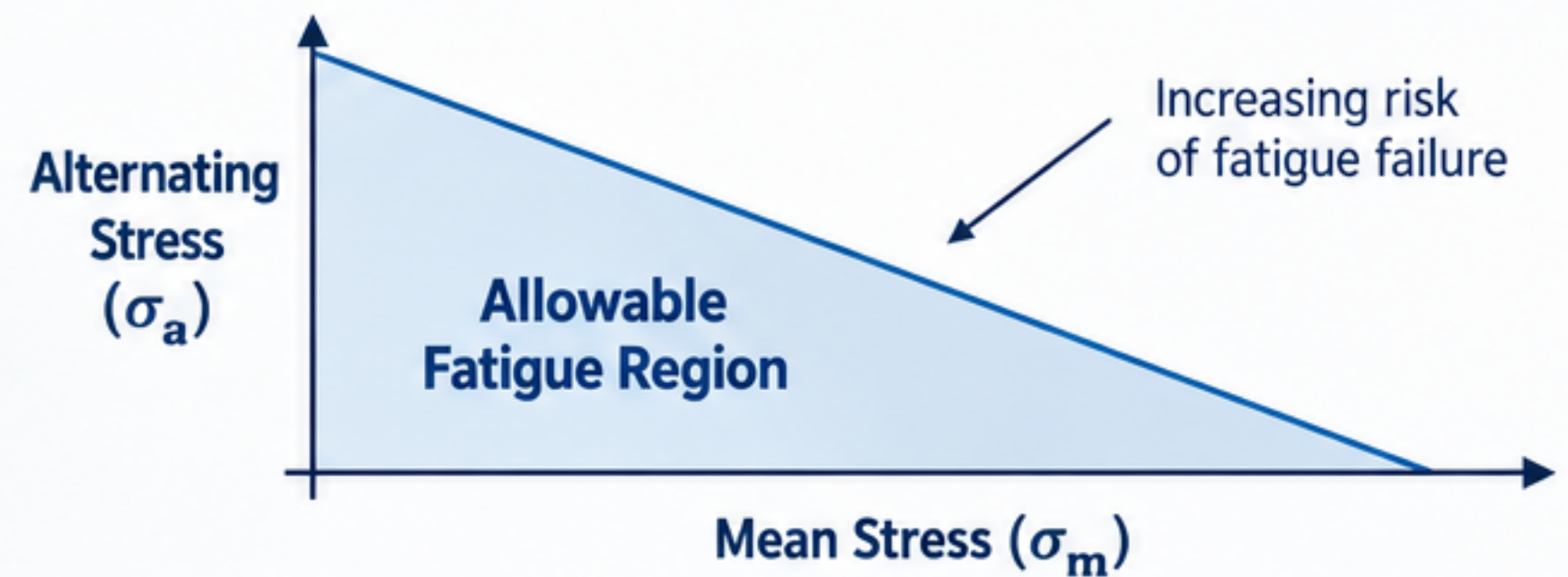
Nominal axial stress alone does not capture local rod-end stress concentration, bending effects, or corrosion-related damage.

Cyclic Load During Pumping Cycle



Maximum and minimum stresses during each pumping cycle must both be considered when evaluating fatigue.

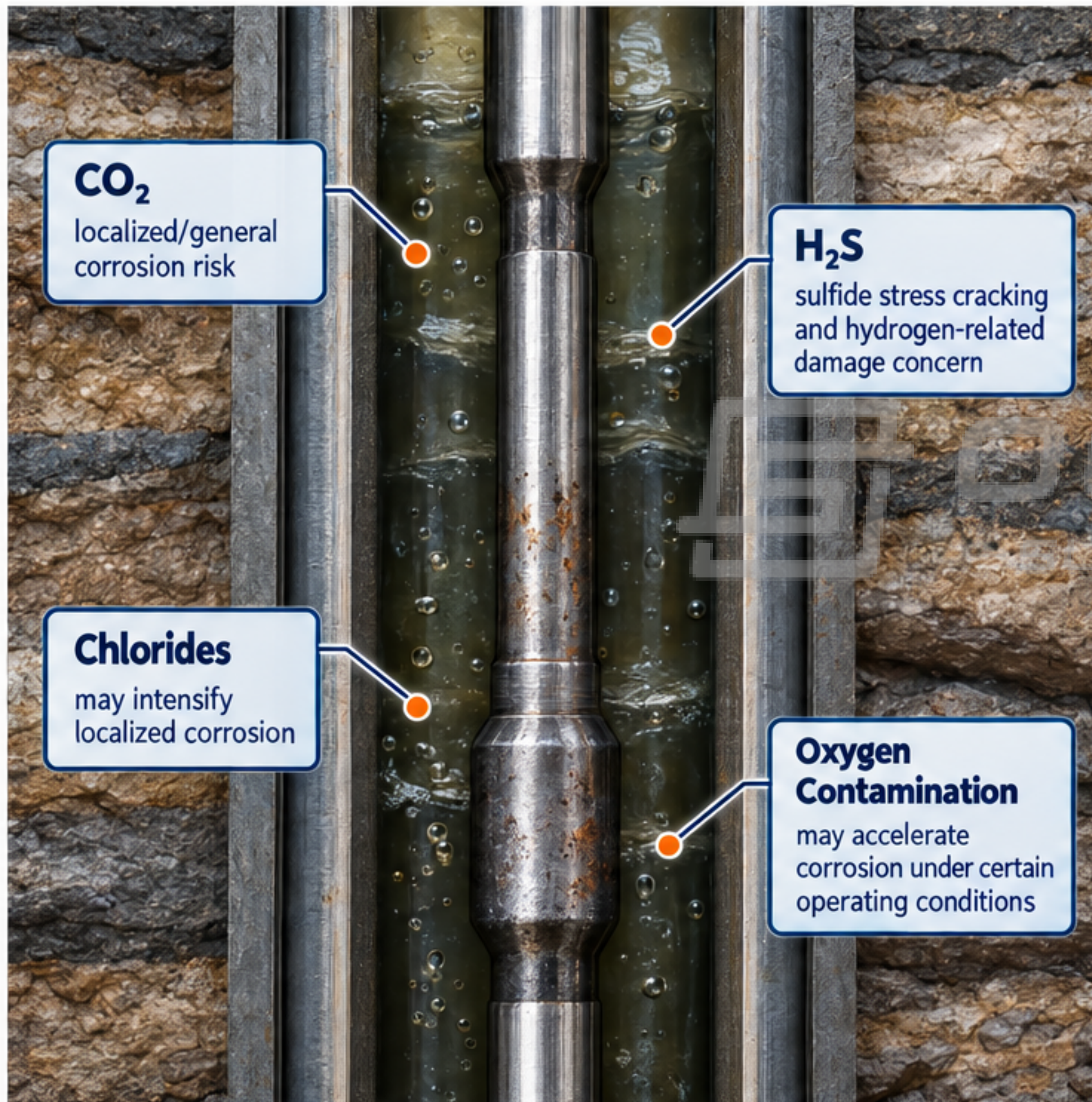
Modified Goodman Concept (Fatigue Assessment)



Engineering Note

Actual fatigue limits and service factors must follow the selected rod-string design method and qualified product data.

Corrosion and Final Grade Selection



Before Final Grade Selection

Review the following technical inputs before confirming rod grade selection.

1. Fluid Analysis

- CO₂, H₂S and total chlorides
- pH, salinity and other corrosive species
- Produced water and gas composition
- Variations over time (e.g., startup, breakthrough, water cut changes)

2. Operating Temperature

- Normal operating temperature
- Maximum expected temperature
- Temperature variations (startup/shutdown)
- Effect on corrosion rate and material properties

3. Maximum / Minimum Rod Load

- Peak tensile and compressive loads
- Load range during pumping cycle
- Transient loads (startup, shutdown, plunger hit, gas interference)
- Combined effects of load and corrosion

4. Well Deviation

- Measured depth and true vertical depth
- Deviation angle and dogleg severity
- Lateral loading and side forces on rods
- Effect on wear, fatigue and corrosion risk

5. Corrosion History

- Previous rod and connection performance
- Types of corrosion observed (general, localized, SSC indications)
- Service life and failure locations
- Changes in well conditions since previous service

6. Connection Requirements

- Preferred connection type and size
- Make-up practices and torque control
- Corrosion resistance of connections
- Compatibility with selected rod grade and operating environment



Grade K or KD should not be treated as automatically suitable for every corrosive or sour-service condition.