Sucker Rod Overview and Rod Pumping System

Sucker rods are API Spec 11B steel load-transfer components used in rod pumping systems, mainly manufactured from alloy steel, designed to transfer reciprocating forces from surface pumping units to downhole pumps, and intended for repeated tensile loading and fatigue conditions.



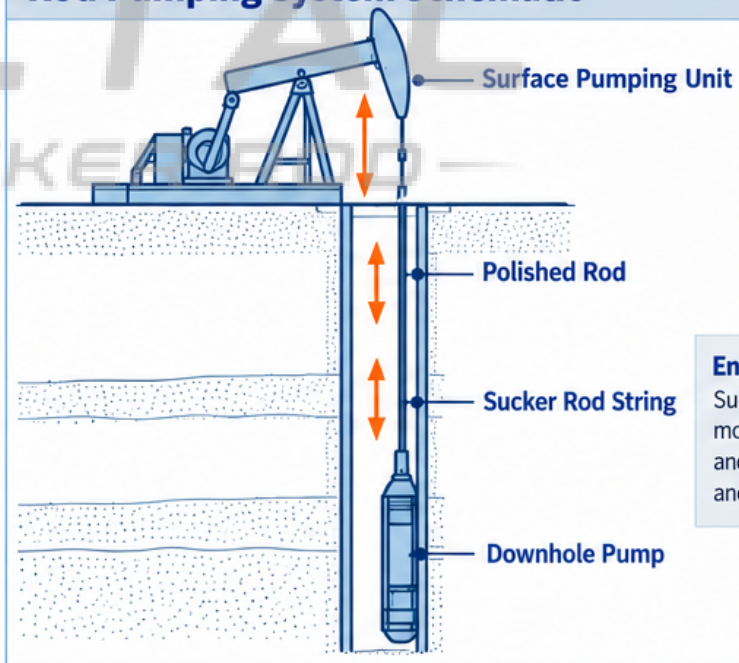
Steel sucker rods with threaded pin ends and coupling (API Spec 11B)

Sucker Rod Technical Data

Product Type	Steel Sucker Rod
Standard	API Spec 11B
Material	Alloy Steel
Common Sizes	5/8 in., 3/4 in., 7/8 in., 1 in., 1-1/8 in.
Standard Length	25 ft (7.62 m), 30 ft (9.14 m)

Designed for repeated tensile loading and fatigue conditions.

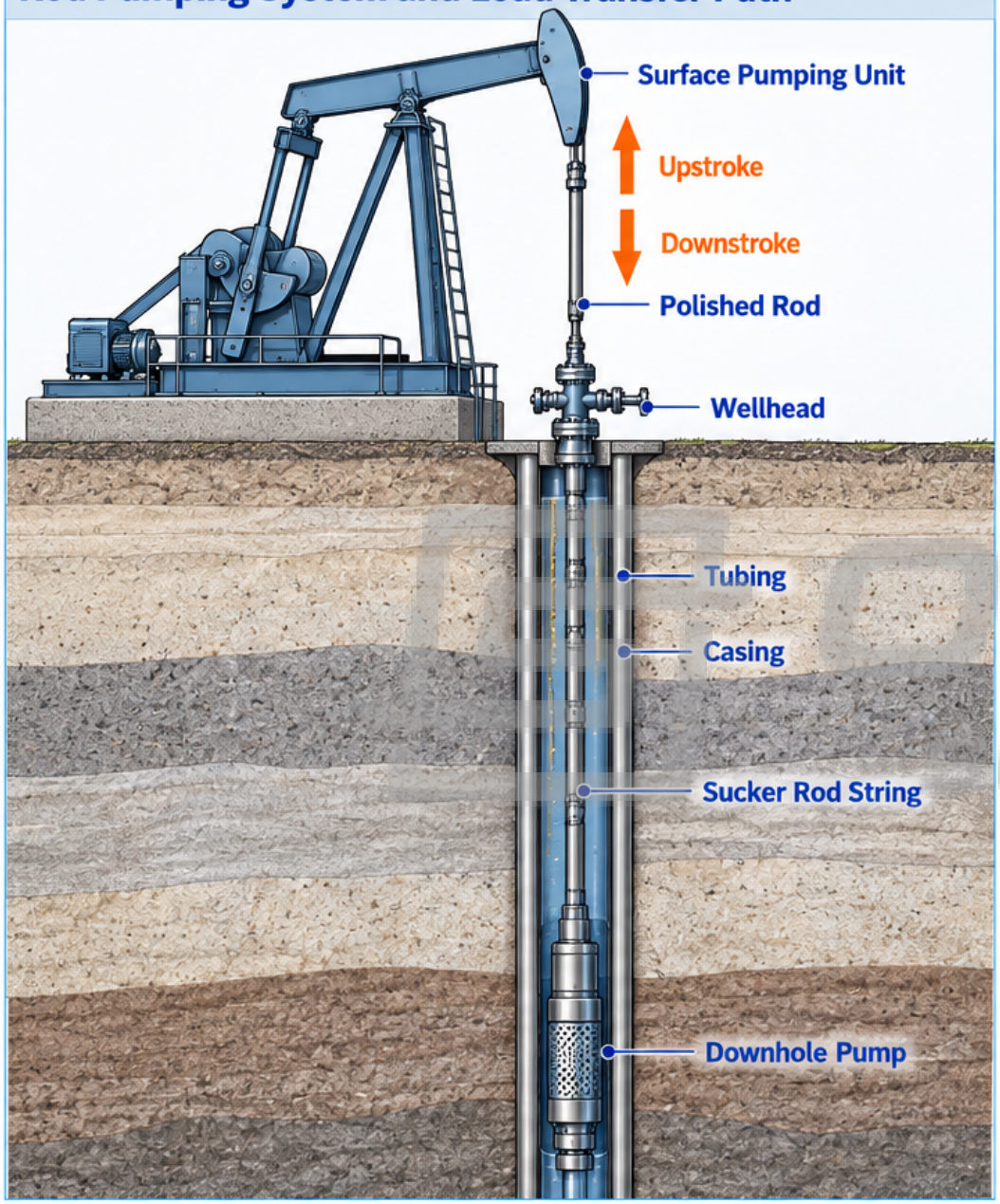
Rod Pumping System Schematic



Engineering Note:
Sucker rods connect surface motion to the downhole pump and are selected by size, length, and operating conditions.

Working Principle and Load Transfer Mechanism

Rod Pumping System and Load Transfer Path



Operating Cycle

Pumping Stage	Sucker Rod Function	Main Loading Condition
Upstroke	Pulls the pump plunger upward and lifts the fluid column	Tensile loading
Downstroke	Transfers downward movement and completes the pumping cycle	Compression and dynamic loading
Continuous Operation	Repeats the lifting cycle over a long service period	Fatigue loading

Load Factors Affecting Sucker Rod Performance

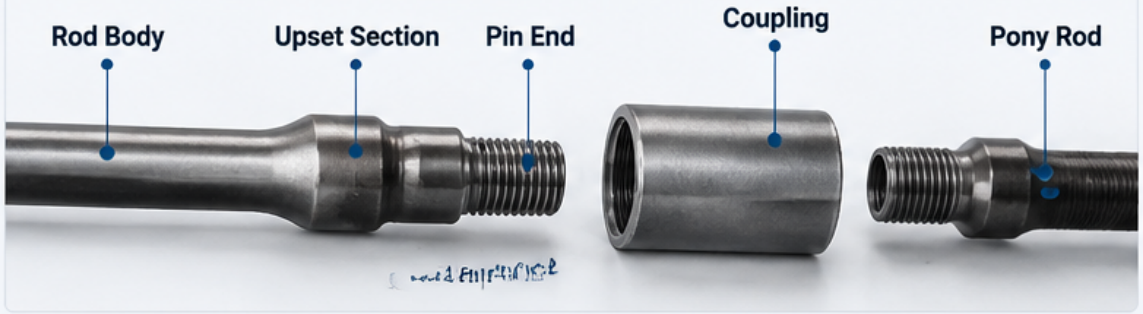
Load Factor	Effect on Rod String
Rod string weight	Creates basic tensile load and increases with pump setting depth
Fluid load	Adds lifting resistance and affects peak rod stress
Pumping speed and stroke length	Increase dynamic loading and fatigue frequency
Well depth	Raises total string load and influences rod selection
Well deviation and tubing contact	Causes side loading, wear, and local stress concentration
Corrosive produced fluid	Reduces fatigue life and may accelerate connection failure

Engineering Note

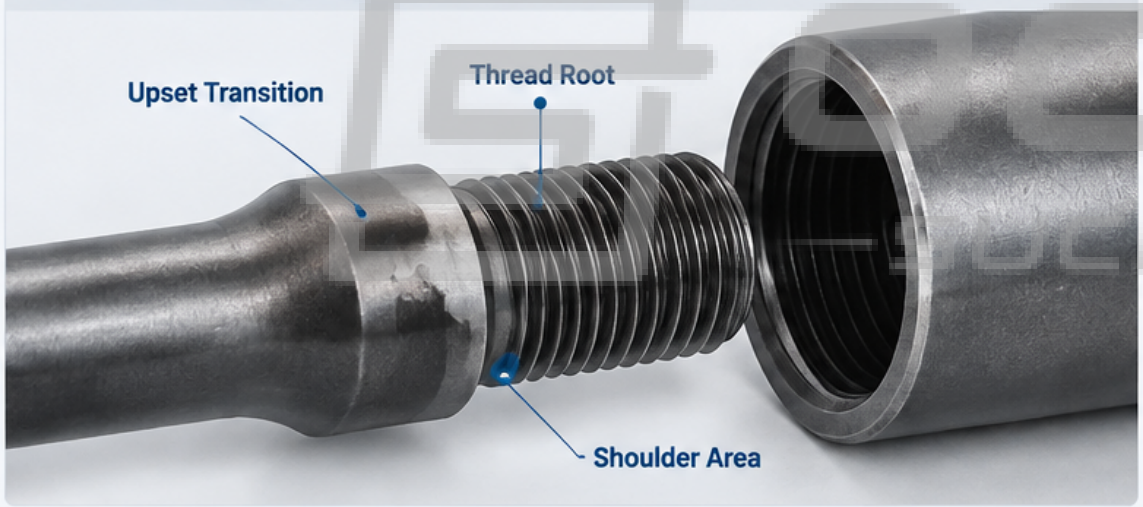
Sucker rods are evaluated based on fatigue resistance, connection integrity, and service conditions rather than tensile strength alone.

Sucker Rod Structure and Connection Design

Sucker Rod Assembly and Components



Connection Area (Enlarged View)



Pony Rod

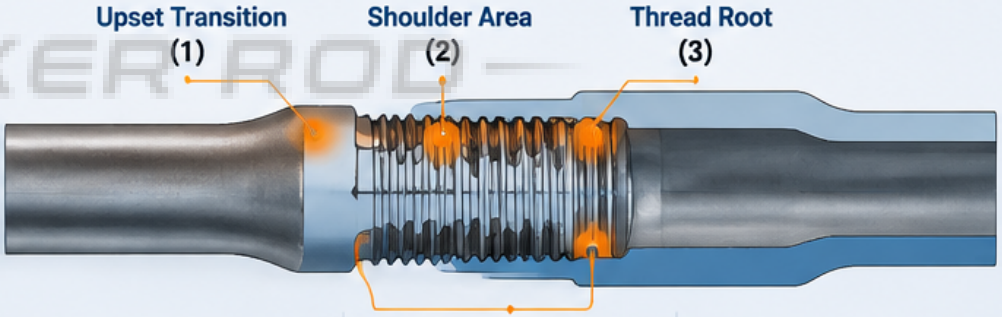


Pony rods are non-standard length rods used to adjust the overall rod-string length according to well design requirements.

Main Structural Components

Component	Function	Engineering Importance
Rod Body	Transfers axial loads through the well	Requires controlled strength and straightness
Pin End	Provides threaded connection	Thread accuracy affects load distribution
Coupling	Connects individual rods	Maintains connection strength
Upset Section	Provides additional material near connection area	Helps reduce stress concentration
Pony Rod	Adjusts rod-string length	Selected according to string design

Critical Connection Areas



1 **Upset Transition**
Geometry change affecting fatigue behavior.

2 **Shoulder Area**
Transfers connection force.

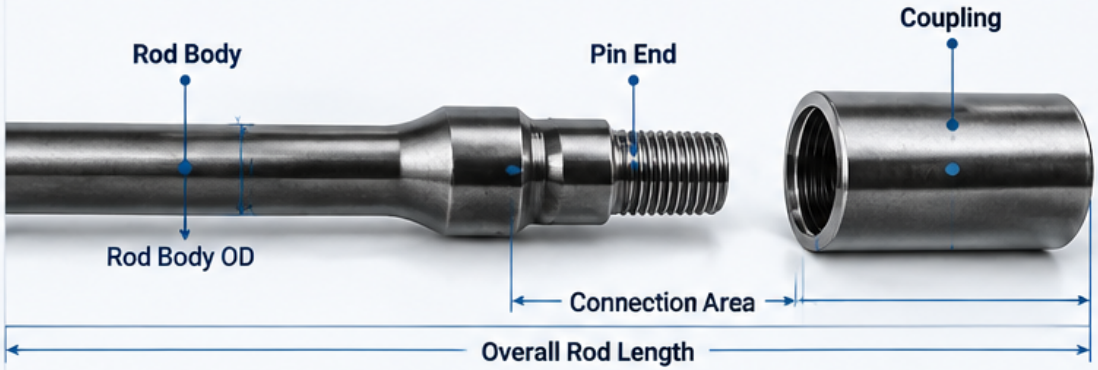
3 **Thread Root**
Stress concentration caused by thread geometry.

Engineering Note

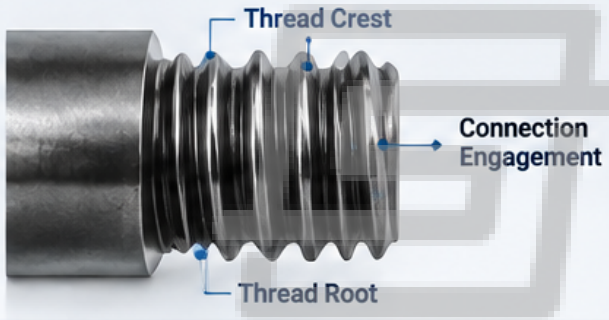
The connection area is often more critical than the rod body because repeated pumping cycles create localized stress concentration around threads and transitions.

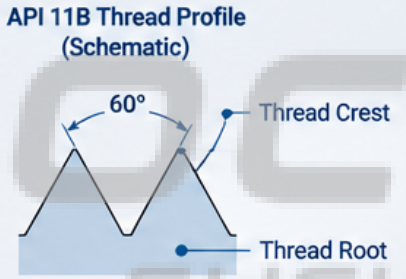
API 11B Dimensions and Sucker Rod Specifications

Sucker Rod Dimensional Identification

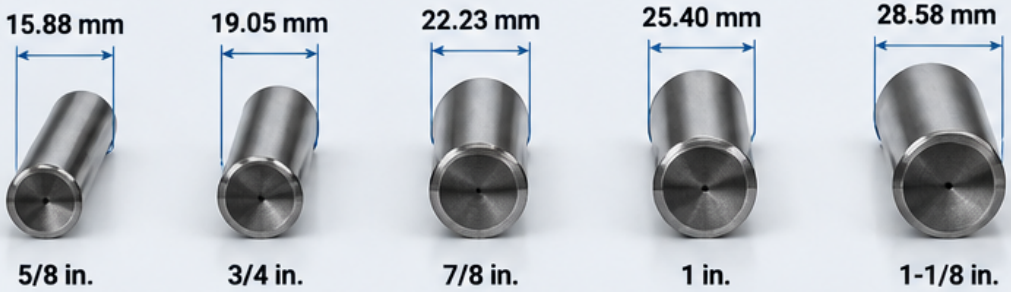


Thread Profile Detail





Sucker Rod Size Comparison (Rod Body OD)



Common Sucker Rod Sizes

Nominal Size	Rod Body OD	Typical Application
5/8 in.	15.88 mm	Standard rod string applications
3/4 in.	19.05 mm	General rod pumping systems
7/8 in.	22.23 mm	Common medium-load applications
1 in.	25.40 mm	Higher load requirements
1-1/8 in.	28.58 mm	Larger load capacity applications

Standard Supply Information

Parameter	Typical Specification
Manufacturing Standard	API Spec 11B
Standard Length	25 ft (7.62 m), 30 ft (9.14 m)
Material Type	Alloy Steel
Connection	Threaded Pin and Coupling
Main Control Items	Dimensions, Mechanical Properties, Thread Quality, Traceability

Engineering Note

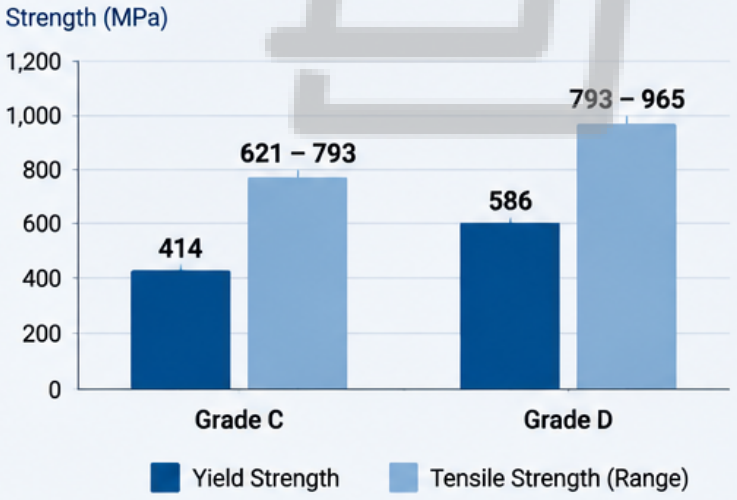
Sucker rod selection is not based on diameter alone. Rod grade, connection envelope, loading condition, and well environment must also be considered.

Sucker Rod Grades and Mechanical Properties

Sucker Rod Grade Comparison



Mechanical Property Comparison (Grade C vs Grade D)



Key Points

Grade D provides approximately 42% higher yield strength than Grade C (586 MPa vs 414 MPa), which increases the allowable operating load range under the same diameter.

API 11B Grade Comparison

Grade	Yield Strength	Tensile Strength	Selection Consideration
Grade C	414 MPa	621 – 793 MPa	Moderate mechanical loading
Grade D	586 MPa	793 – 965 MPa	Higher tensile loading requirements
Grade K	Material selection related to corrosion conditions	–	Corrosion-related service evaluation
Grade KD	Higher strength with corrosion-related considerations	–	Combined mechanical and environmental requirements

Grade Selection Based on Service Conditions

Operating Condition	Main Evaluation Factor
Deep well	Tensile load and rod string weight
Higher pumping load	Yield and tensile strength
Corrosive produced fluid	Material selection and corrosion evaluation
Deviated well	Wear, tubing contact, and side loading
Long-term cyclic operation	Fatigue resistance

Engineering Note

A higher sucker rod grade does not automatically provide better performance. Grade selection should follow calculated loading, corrosion conditions, and service requirements.

Materials, Manufacturing Process and Quality Control

Careful selection of alloy steel materials, controlled manufacturing processes, and stringent inspection ensure that sucker rods meet required mechanical properties and dimensional accuracy, resulting in reliable performance in the field.

Material Control → Manufacturing Accuracy → **Inspection** → **Field Reliability**

Manufacturing Process Flow

From raw material to finished sucker rod through controlled manufacturing and inspection.

1. Alloy Steel Preparation



- Alloy steel bars
- Controlled chemistry
- Material certification
- Traceable heat number

2. Upsetting / Forging



- Upset rod ends
- Hot forging process
- Refined grain flow
- Strengthened connection areas

3. Heat Treatment



- Quenching and tempering
- Controlled furnace cycle
- Achieve required mechanical properties
- Consistent hardness

4. Straightening



- Mechanical straightening
- Control alignment
- Meet straightness requirements

5. Thread Machining



- Precision thread machining
- API thread form
- Dimensional control
- Surface finish

6. Inspection



- Dimensional inspection
- Thread gauging
- Surface inspection
- Mechanical testing
- Final acceptance



Finished Sucker Rod

Production Traceability Chain

Complete documentation links each sucker rod to its raw material and inspection records.

Steel Heat Number
Material certificate and chemical composition

→

Manufacturing Record
Process parameters and production data

→

Inspection Report
Test results and acceptance records

→

Packing Documentation
Product identification and shipment records

Manufacturing Process Control

Manufacturing Stage	Engineering Purpose
Steel Preparation	Control chemical composition and material consistency
Upsetting / Forging	Form strengthened connection areas
Heat Treatment	Achieve required mechanical properties
Straightening	Control rod alignment and straightness
Thread Machining	Produce accurate threaded connections
Inspection	Verify product acceptance requirements

Inspection and Traceability Requirements

Inspection Item	Purpose
Chemical Composition Report	Verify material grade
Mechanical Testing	Confirm strength requirements
Dimensional Inspection	Check rod size and geometry
Thread Inspection	Verify connection accuracy
Surface Inspection	Identify defects affecting fatigue performance
Heat Number Traceability	Link product records to raw material batch

Engineering Note

Sucker rod reliability depends on the combined control of material properties, connection quality, manufacturing accuracy, and inspection records.

Types of Sucker Rods and Application Conditions

Different Design → Different Performance Characteristics → Different Application Conditions

Sucker Rod Designs

Conventional Steel Sucker Rod



- Alloy steel rod body
- Threaded connection

Hollow Sucker Rod



- Internal fluid passage

Fiberglass Sucker Rod



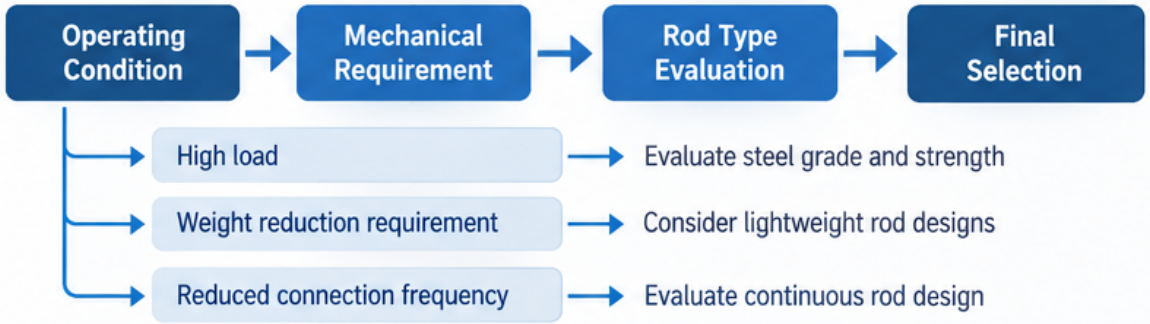
- Lightweight composite structure

Continuous Sucker Rod



- Reduced number of threaded connections

Selection Logic



Sucker Rod Type Comparison

Type	Main Characteristics	Engineering Consideration
Steel Sucker Rod	Conventional alloy steel design	Balanced strength and fatigue performance for standard rod pumping systems
Hollow Sucker Rod	Internal passage through rod body	Requires evaluation of mechanical capacity and pumping system compatibility
Fiberglass Sucker Rod	Lower density material design	Reduced rod-string weight but different mechanical behavior
Continuous Sucker Rod	Continuous rod structure with fewer connections	Changes connection-related maintenance requirements

Application Considerations

Operating Factor	Evaluation Requirement
Mechanical loading	Required load capacity and fatigue resistance
Well depth	Rod string weight and tensile loading
Well deviation	Wear and tubing contact conditions
Production environment	Corrosion evaluation
Installation method	Compatibility with pumping system

Engineering Note

Sucker rod selection depends on the complete operating environment. Different rod designs address different mechanical, installation, and service requirements.

Engineering Selection Guide and Procurement Checklist

Sucker Rod Selection Process

Step 1
Well Condition Assessment



Evaluate:
- Well depth
- Pump load
- Well deviation
- Corrosion environment

Step 2
Mechanical Requirement



Evaluate:
- Rod grade
- Tensile loading
- Fatigue resistance
- Connection design

Step 3
Product Specification



Confirm:
- Size
- Length
- Connection type
- Material

Step 4
Quality Verification



Confirm:
- Inspection records
- Traceability documents

Required Quality Documentation

Material Certificate → Mechanical Test Report → Dimensional Inspection Record → Thread Inspection Record → Final Packing Documentation

Procurement Specification Checklist

Item	Confirmation Requirement
Standard	API Spec 11B requirement
Grade	Confirm selected sucker rod grade
Nominal Size	Verify rod body diameter
Length	25 ft or 30 ft standard supply
Connection	Confirm pin and coupling compatibility
Material	Verify alloy steel specification
Inspection	Confirm required test records

Engineering Evaluation Factors

Factor	Why It Matters
Loading Condition	Determines required mechanical properties
Well Depth	Influences rod string weight and tensile load
Pumping Frequency	Affects fatigue cycles
Well Deviation	Influences wear and side loading
Corrosion Environment	Affects material selection



Engineering Note

Reliable sucker rod performance requires matching product specifications with actual well conditions, mechanical loading, connection requirements, and quality documentation.