

API Sucker Rod Grades

Mechanical Properties & Design Reference

Grade C, Grade K and Grade D strength envelopes, dimensional properties, axial-stress calculations, fatigue inputs and inspection release criteria.

GRADE POSITIONING



C / K

60 ksi

minimum yield baseline

C / K

90-115 ksi

tensile range

D

85 ksi

minimum yield baseline

D

115-140 ksi

tensile range

READ THE DATA IN THE CORRECT ORDER

1. Confirm grade strength limits. 2. Calculate stress in every taper. 3. Apply fatigue, corrosion, wear and deviation checks. 4. Release only against heat-specific MTR and inspection records.

Mechanical Properties: Grade C, K and D

Mechanical grade establishes a strength envelope; it does not by itself establish corrosion resistance, fatigue life or allowable operating load. Values below must be verified against the ordered edition and heat-specific test report.

Property	Grade C	Grade K	Grade D	Engineering interpretation
Minimum yield strength	414 MPa 60 ksi	414 MPa 60 ksi	586 MPa 85 ksi	Onset of permanent strain in a qualifying tensile specimen
Tensile strength range	621-793 MPa 90-115 ksi	621-793 MPa 90-115 ksi	793-965 MPa 115-140 ksi	Grade D provides the higher static tensile envelope
Elongation reference	13% minimum	13% minimum	Product route dependent; referenced products commonly state 10-13%	Confirm specimen basis and current product specification
Metallurgical position	Carbon/Mn route	Ni-Mo corrosion-oriented route	Higher-strength alloy route; chemistry varies	Grade designation must not be used as a universal chemistry table
Typical application logic	Moderate load with controlled corrosion	Moderate load where corrosion fatigue is important	Higher calculated load with a separate corrosion plan	Final choice requires load plus environment review

How tensile data should be qualified

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STANDARD / PRODUCT LIMIT
The acceptance range stated for the ordered grade and edition.

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HEAT-SPECIFIC RESULT
Actual yield, tensile and elongation values reported for the released heat or lot.

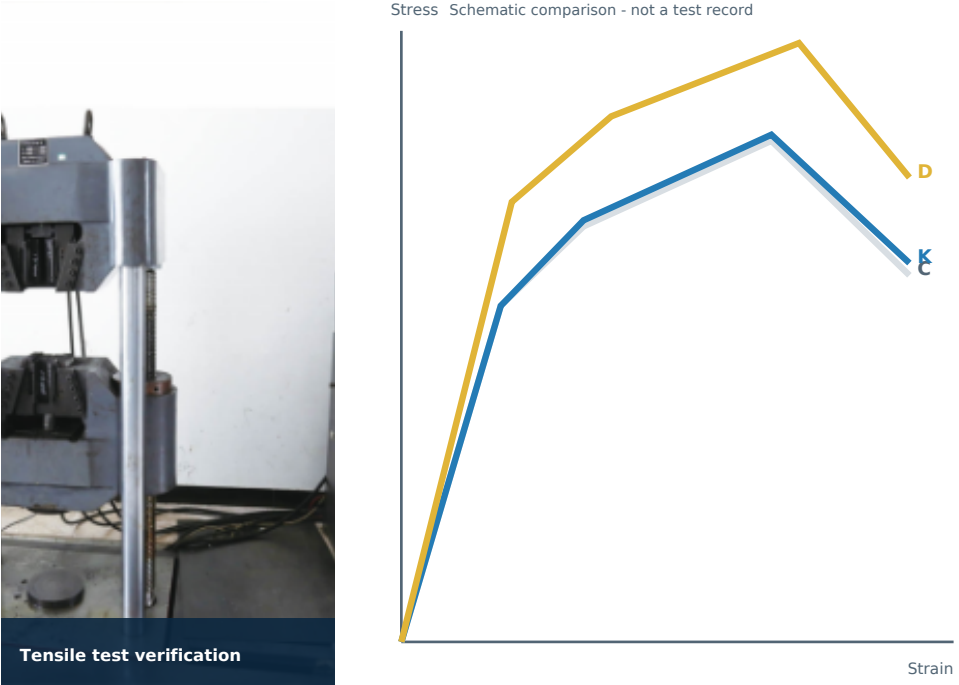
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FACTORY TARGET
A tighter internal target; not contractual unless written into the purchase order.

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DESIGN VALUE
The value selected by the engineer after fatigue, corrosion and uncertainty factors.



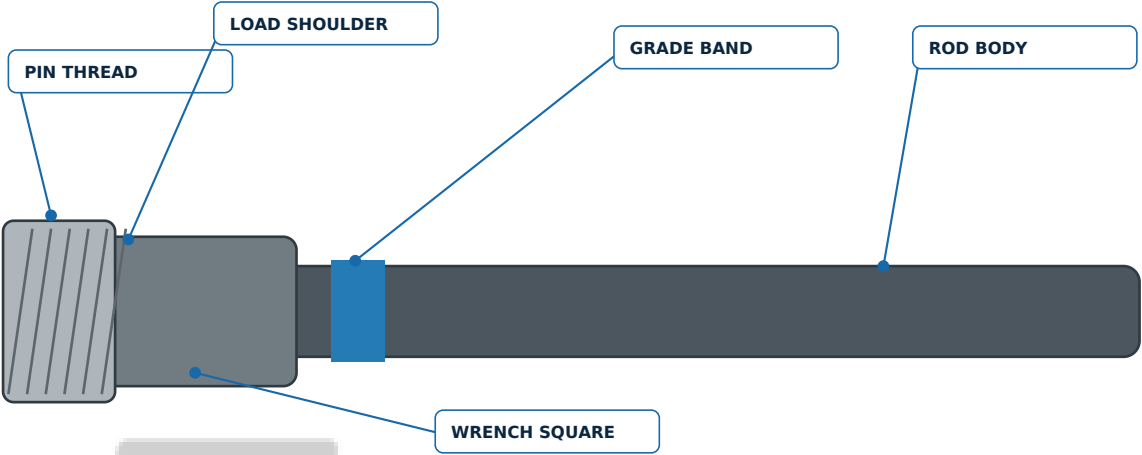


Nominal Dimensions and Section Properties

Rod diameter controls nominal tensile area, body mass and annular clearance. Calculated mass values use a steel density of 7,850 kg/m3 and exclude forged ends, couplings, coatings and packing.

Nominal size	Diameter	Body tolerance	Nominal area	Body mass	25 ft body mass	30 ft body mass
5/8 in	15.88 mm	+0.18 / -0.36 mm	0.3068 in2	1.044 lb/ft 1.55 kg/m	26.1 lb	31.3 lb
3/4 in	19.05 mm	+0.20 / -0.41 mm	0.4418 in2	1.503 lb/ft 2.24 kg/m	37.6 lb	45.1 lb
7/8 in	22.23 mm	+0.20 / -0.41 mm	0.6013 in2	2.046 lb/ft 3.05 kg/m	51.2 lb	61.4 lb
1 in	25.40 mm	+0.23 / -0.46 mm	0.7854 in2	2.673 lb/ft 3.98 kg/m	66.8 lb	80.2 lb
1-1/8 in	28.58 mm	+0.25 / -0.51 mm	0.9940 in2	3.383 lb/ft 5.03 kg/m	84.6 lb	101.5 lb

Where dimensions are controlled



Dimensional interpretation

- NOMINAL AREA** Calculated from the specified body diameter; local wear or pits reduce the remaining section.
- THEORETICAL MASS** Useful for preliminary rod-string weight calculations, but not a shipping-weight guarantee.
- TOLERANCE** Use measured minimum diameter when evaluating a worn or suspect rod.
- CONNECTION** Pin, shoulder and coupling capacity require the approved connection drawing and gauging records.

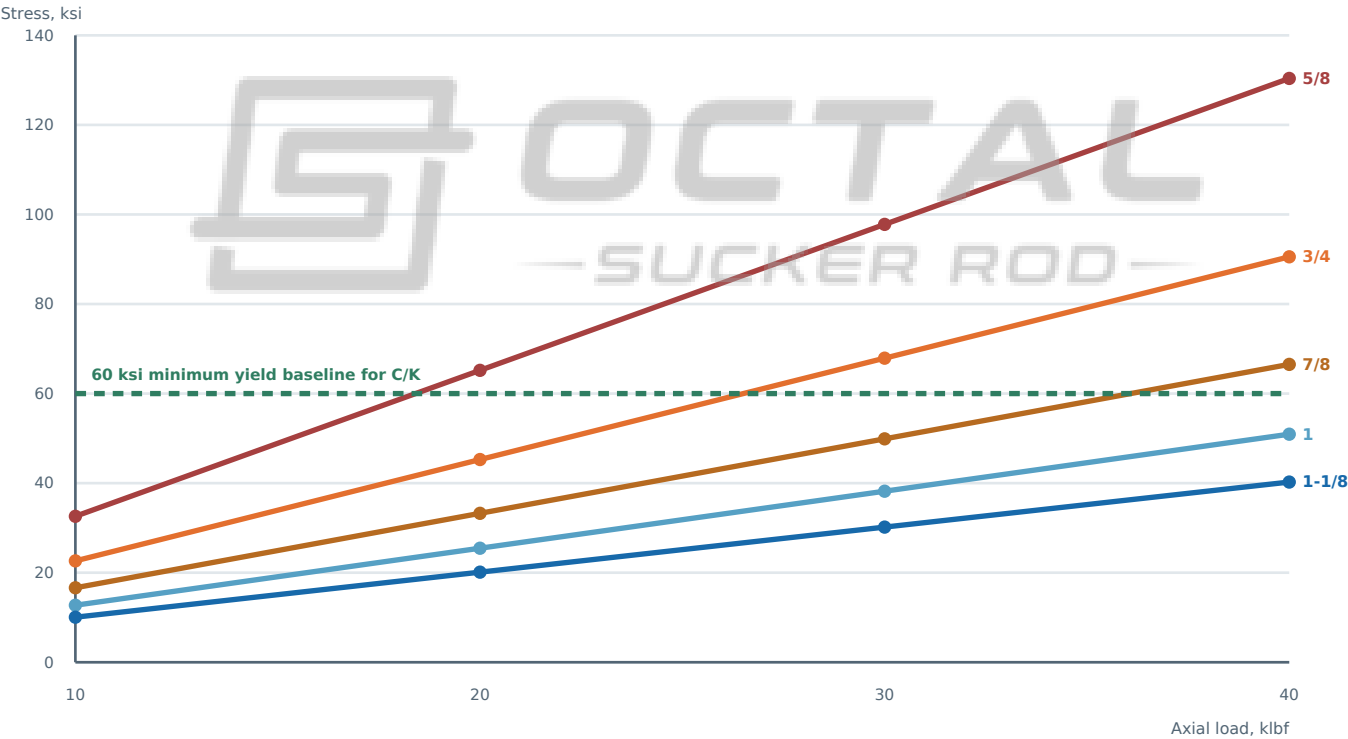
Length reference: 25 ft (7.62 m) and 30 ft (9.14 m) are common nominal rod lengths. Confirm measurement points, effective assembled length and tolerance from the approved product drawing.

Axial Load, Nominal Stress and Yield Utilization

The table isolates rod-body axial stress so diameter effects are visible. It is not an allowable operating-load table: cyclic loading, connections, corrosion, wear, bending and dynamic effects remain separate checks.

Rod size	Area	10,000 lbf	20,000 lbf	30,000 lbf	40,000 lbf	20 klbf / 60 ksi yield
5/8 in	0.3068 in2	32.6 ksi	65.2 ksi	97.8 ksi	130.4 ksi	109%
3/4 in	0.4418 in2	22.6 ksi	45.3 ksi	67.9 ksi	90.5 ksi	75%
7/8 in	0.6013 in2	16.6 ksi	33.3 ksi	49.9 ksi	66.5 ksi	55%
1 in	0.7854 in2	12.7 ksi	25.5 ksi	38.2 ksi	50.9 ksi	42%
1-1/8 in	0.9940 in2	10.1 ksi	20.1 ksi	30.2 ksi	40.2 ksi	34%

Calculated stress by applied axial load



Calculation and engineering boundary

Axial stress = Applied load / Rod area

Example: 20,000 lbf / 0.6013 in2 = 33.3 ksi for a nominal 7/8 in rod body.

- STATIC CHECK**

Compare calculated peak stress with the selected material design limit.
- FATIGUE CHECK**

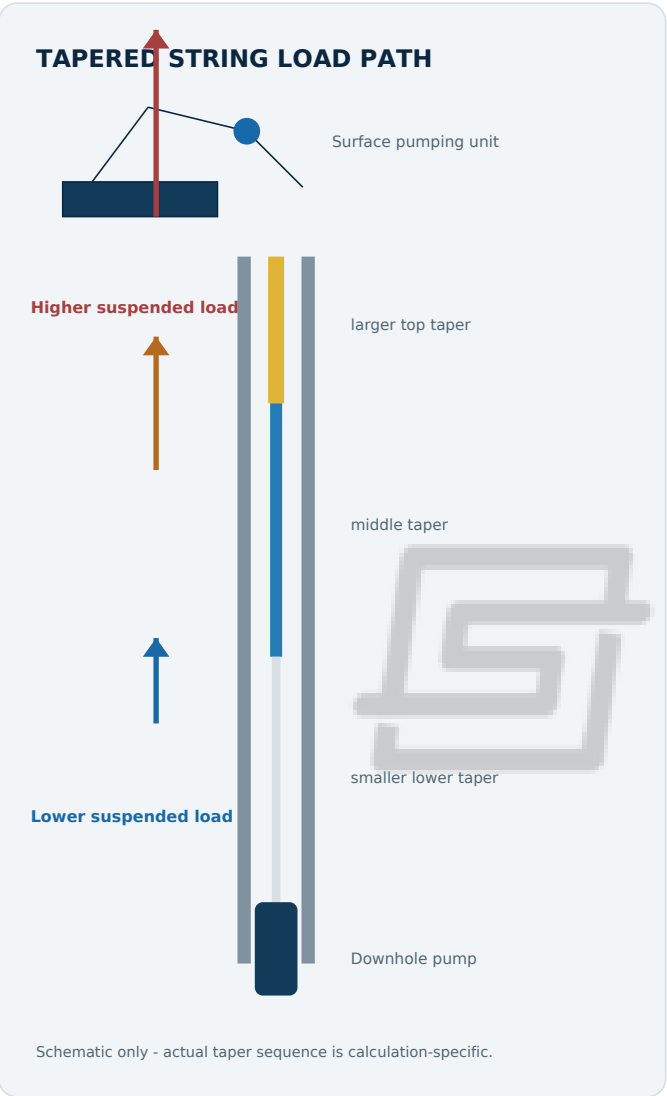
Use maximum and minimum cycle stress, not peak stress alone.
- SECTION CHECK**

Review body, worn section, upset transition, pin and coupling separately.
- SERVICE CHECK**

Apply the operator-approved corrosion and uncertainty treatment.

Fatigue Inputs and Tapered Rod-String Design

Sucker rod design combines cyclic axial stress with rod weight, fluid load, acceleration, well deviation, tubing contact and service environment. The smallest or most damaged effective section may control.



Cycle-stress quantities

Quantity	Calculation	Use
Stress range	$\Delta \sigma = \sigma_{\max} - \sigma_{\min}$	Measures cycle amplitude from peak to minimum
Mean stress	$\sigma_m = (\sigma_{\max} + \sigma_{\min}) / 2$	Positions the cycle on the tensile stress axis
Alternating stress	$\sigma_a = (\sigma_{\max} - \sigma_{\min}) / 2$	Primary fatigue-driving component
Stress ratio	$R = \sigma_{\min} / \sigma_{\max}$	Defines the loading cycle used for comparison or testing
Cycle count	$\text{strokes/min} \times 60 \times \text{operating hours}$	Converts pumping frequency into accumulated cycles

Minimum design input set

LOAD Rod mass by taper, buoyancy, fluid load, acceleration, pump load and polished-rod load.

GEOMETRY Measured depth, inclination, dogleg severity, tubing size, guide spacing and contact load.

CONDITION Minimum remaining diameter, pit depth, thread condition and prior service damage.

ENVIRONMENT H₂S/CO₂ partial pressure, chloride, pH, temperature, water cut and inhibitor performance.

Modified Goodman check: use only with operator-approved fatigue strength, stress concentration and service factors. A generic endurance limit is not an API grade guarantee.

Manufacturing Verification and Release Records

Mechanical grade is accepted through traceable test and inspection records, not paint color alone. The release package should connect finished rods to the heat, manufacturing lot and calibrated inspection results.



Acceptance matrix

Control point	Verification	Release evidence	Acceptance boundary
Raw material / heat	Grade route, chemistry and heat identification	Mill test certificate and heat/lot register	Matches ordered material route and PO limits
Heat treatment	Furnace recipe, time/temperature and quench/temper control	Batch chart and process record	Approved process window; affected lot remains traceable
Mechanical properties	Yield, tensile and elongation; supplemental tests if ordered	Signed mechanical test report	Every required result inside ordered grade limits
Body and forged end	Diameter, length, straightness, shoulder and wrench-square dimensions	Calibrated dimensional report	Current drawing and specified sampling plan
Threads / couplings	Profile, pitch diameter, lead, effective length and shoulder condition	Gauge calibration and thread inspection report	Approved working gauges and connection drawing
Surface / NDT	Visual condition plus specified electromagnetic, ultrasonic or MPI method	Lot inspection and reject-disposition record	No unaccepted indication under the agreed procedure
Marking / packing	Grade band, permanent marking, pin protectors and bundle ID	Final release checklist and packing record	Rod, bundle, MTR and inspection records remain linked

Release gates

01 GRADE

Heat and material route verified

02 PROPERTIES

Mechanical results accepted

03 ENDS

Dimensions and threads accepted

04 TRACEABILITY

Rod, bundle and records linked

RELEASE RULE

Align the purchased API edition, PO limits, heat-specific MTR, dimensional and NDT records, connection requirements and actual service envelope. No single table establishes field suitability.