

# Drill Pipe Selection Guide: API 5DP or Special Material Route

Data-first reference for comparing standard API drill pipe grades with controlled special material routes under severe drilling conditions.

Purpose. API 5DP grades provide the standard drill pipe strength ladder. A special material route is reviewed when the limiting factor moves from grade strength to toughness, hardness, fatigue behavior, sour-service control or tool-joint matching.

Selection question	API 5DP route is normally enough when...	Special material route should be reviewed when...
Strength boundary	E75 / X95 / G105 / S135 provide enough yield-strength margin for the well profile.	The load case approaches or exceeds the practical margin of standard API-grade review.
Environment	No severe sour service, low-temperature impact demand or high-fatigue interval controls the design.	H2S exposure, low temperature, long lateral rotation or severe dogleg makes cracking / fatigue control critical.
Connection / tool joint	Common API rotary shouldered connections and tool-joint inspection cover the operation.	High torque, repeated make-up, shoulder loading or connection-side fatigue may control the decision.
Verification level	Grade, dimensions, PSL, MTC and standard inspection records support release.	Toughness, hardness, heat treatment, fatigue-sensitive areas and tool-joint matching need stronger evidence.

Core rule. Select API 5DP when standard grade performance is enough. Review a special material route when strength, toughness, hardness, fatigue or tool-joint performance becomes the controlling factor.

# 1. API 5DP Grade Strength Baseline

The API 5DP grade number gives the minimum yield-strength level in ksi. This table is the first filter before any special material route is considered.

Grade	Min Yield Strength	Max Yield Strength	Min Tensile Strength	Selection Meaning
E75	75 ksi / 517 MPa	105 ksi / 724 MPa	100 ksi / 689 MPa	Baseline API grade for moderate drill-string tensile load.
X95	95 ksi / 655 MPa	125 ksi / 862 MPa	105 ksi / 724 MPa	Intermediate API grade; often reviewed when E75 margin is not enough.
G105	105 ksi / 724 MPa	135 ksi / 931 MPa	115 ksi / 793 MPa	Higher API grade for deeper or higher-load drilling.
S135	135 ksi / 931 MPa	165 ksi / 1138 MPa	145 ksi / 1000 MPa	Common high-strength API-grade baseline; still requires separate toughness and fatigue review.

Control point	Useful data / review threshold	Why it affects selection
Grade ladder	E75 -> X95 -> G105 -> S135	Defines the initial strength class before severe-condition review.
Yield window	Typical 30 ksi window for each common API grade above	Higher grade improves tensile-load margin but does not close fatigue or toughness review.
Length range	R1, R2, R3 should be checked against applicable standard / order item	Longer ranges affect handling, rig compatibility and logistics planning.
Pipe assembly	Pipe body + upset end + weld zone + tool joint + connection	Drill pipe should be reviewed as an assembly, not only as pipe body strength.

## 2. Drilling Condition Matrix

The correct route is driven by the operating condition. The table below separates normal grade review from situations where the material route needs a deeper performance check.

Drilling condition	API 5DP route	Special material route	Main control data
Conventional vertical well	E75 / X95 / G105 often covers tensile and torque demand.	Usually not required unless unusual environment or high fatigue risk exists.	Hook load, torque, OD / WT, connection, MTC.
Deep well with high load	S135 may be enough if calculated margin remains acceptable.	Review when S135 margin is low or strength-to-weight target changes.	Yield strength, tensile strength, OD / WT, tool joint.
Long horizontal / ERD	Use only if torque-drag and fatigue remain within grade / connection limit.	Review for weight, cyclic bending, fatigue and connection-side stress.	Torque, drag, dogleg severity, fatigue, connection.
Severe dogleg section	Standard grade route needs verified fatigue margin.	Review upset transition, bend fatigue and tool-joint matching.	Dogleg severity, bending cycle, transition geometry.
Low-temperature drilling	Acceptable only when required Charpy temperature / energy is met.	Review toughness + heat treatment + hardness stability together.	Charpy test temp, average/single absorbed energy.
Sour service / H2S	Use only with applicable sour-service qualification / controls.	Review hardness, microstructure, SSC / H2S resistance and record chain.	Hardness, H2S exposure, NACE / sour-service basis.
High-torque operation	Common connections may be enough if torque and shoulder condition are verified.	Review tool-joint strength, shoulder contact and thread fatigue.	Make-up torque, thread inspection, shoulder condition.

Reading note. The special material route is not a universal upgrade. It is technically justified only when a defined load, environment or fatigue condition needs review beyond the standard API grade framework.

### 3. Performance Review Areas

Many online references stop at grade strength. A complete route decision should also include toughness, hardness, fatigue and tool-joint performance.

Review area	API 5DP route data / baseline	Special material route data / focus	Selection effect
Strength	E75: 75 ksi; X95: 95 ksi; G105: 105 ksi; S135: 135 ksi minimum yield.	May require tighter strength window or route beyond common API grade margin.	Defines first load boundary, but not fatigue or cracking behavior.
Toughness	API addendum reference: X/G/S/V drill pipe body 10x10 mm CVN 54 J average / 47 J single at 21 C +/-3 C for PSL-1 where applicable.	Higher-strength or low-temperature use requires stricter Charpy review at specified test temperature.	Controls brittle-fracture resistance and crack-initiation behavior.
Hardness	API addendum: surface hardness <=37 HRC for E/X/G/S, <=40 HRC for V; SS surface hardness <=32 HRC.	Sour or high-strength route needs close hardness + microstructure review.	Excessive hardness can increase cracking sensitivity.
Fatigue	Standard grade review plus normal dimensional and connection checks.	Upset transition, cyclic bending, dogleg and long lateral rotation become major controls.	Fatigue often starts at stress-concentration zones, not from low yield strength alone.
Tool joint	Tool joint tensile requirement commonly reviewed with >=965 MPa / >=140 ksi tensile strength in API data references.	Tool joint strength, hardness, shoulder and thread condition must match pipe body demand.	Connection-side performance can limit the string before pipe body strength does.

## 4. Route Decision Guide

Use this page as a compact selection checklist. It is not a substitute for drill-string design, but it helps show where the review changes from standard API grade selection to a special material route.

Question to answer	API 5DP route is supported when...	Special material route is supported when...
Is grade strength enough?	Calculated load remains within E75 / X95 / G105 / S135 grade margin.	S135 or selected grade has low margin under the actual load case.
Is toughness enough?	Required impact values and test temperature are satisfied by grade / PSL / specification.	Low-temperature, high strength or impact-sensitive operation requires stronger toughness evidence.
Is hardness controlled?	Grade / service condition has acceptable hardness results and no sour-service concern.	H2S, sour service or high-strength route requires stricter hardness and cracking review.
Is fatigue controlled?	Dogleg, rotation and lateral length remain within verified standard margin.	Long horizontal rotation, severe dogleg or repeated bending makes fatigue a limiting factor.
Is the connection matched?	Tool joint, shoulder and thread inspection support the expected torque and load.	Tool joint matching, high torque or connection-side fatigue becomes critical.
Are records complete?	MTC, marking, dimensions and inspection records match the API grade item.	Datasheet, heat treatment, Charpy, hardness and traceability chain must support the route.

Route	Typical technical role	Avoid using when...
API 5DP route	Standard grade, size, connection, PSL and inspection basis.	Sour service, low temperature, high fatigue or high torque exceed grade / connection review.
Special material route	Controlled performance route for severe strength, toughness, hardness, fatigue or tool-joint demand.	No defined severe condition, no datasheet / test evidence, or API grade already provides enough margin.

## 5. Tests, Records and Release Evidence

The final route decision should be supported by records. A high-strength claim has limited value without test evidence tied to heat number and pipe marking.

Record / test item	API 5DP route	Special material route
Pipe marking	Confirms grade, OD, WT, connection and identity.	Must match special route, heat number and technical datasheet.
MTC + heat number	Links chemistry and mechanical tests to product identity.	Critical for chemistry, heat treatment and traceability review.
Tensile test	Checks yield strength, tensile strength and elongation.	Confirms strength window or route-specific mechanical target.
Charpy impact test	Reviewed by grade, PSL and project requirement.	Key evidence for toughness, low-temperature or high-strength service.
Hardness record	Used where required by grade / service condition.	Important for sour service, high-strength and cracking-risk control.
NDT / dimensional inspection	Supports pipe body, weld-zone and dimensional acceptance.	Supports higher-risk service release and transition-area review.
Tool-joint / thread inspection	Checks connection, shoulder, OD / ID and thread condition.	Must confirm matching with pipe body strength and torque demand.

Traceability chain: Pipe marking -> Heat number -> MTC -> Tensile test -> Charpy impact where required -> Hardness where required -> NDT -> Dimensional inspection -> Tool-joint / thread inspection -> Final release record.

Reference basis: public API 5DP / ISO 11961 technical text, API 5DP Addendum 1 (2025) publicly available text, and commonly referenced API 5DP drill pipe data tables. This PDF is an engineering reference only; final decisions should follow the applicable standard edition, project specification and certified MTC.