

Drill String Accessories Materials and Manufacturing Reference

Material and Construction Routes

Drill string accessories do not use one universal material or one manufacturing route. Solid rotary subs are commonly produced from heat-treated alloy-steel bar, while pup joints may use integral or welded construction and drill stem valves add pressure-containing parts and internal valve components. Material selection should therefore follow the **accessory function, construction route, connection design and service requirement**, not the product-family name alone. 4140, 4145-series and 4145H modified steels are common industry routes, but they are not universal requirements for every accessory.



Construction and material reference

Accessory group	Common construction route	Material / heat-treatment basis	Key manufacturing focus
Crossover / Saver / Bit Subs	Solid integral body machined from alloy-steel bar	Heat-treated modified alloy steel is common; supplier literature includes 4140/4145-series examples	Body integrity, shoulder geometry, connection machining, concentric bore
Integral Pup Joint	One-piece integral body with end connections machined into the same body	4145H modified Q&T; is one established supplier route; exact properties are product-specific	Length, drill-pipe-compatible connections, bore, full-section mechanical continuity
Welded Pup Joint	Pipe-body section combined with welded end/tool-joint components	Material route follows the approved welded pup-joint design rather than the solid-sub route	Welded assembly, alignment, connection geometry, final length and bore
Pump-In / Side Entry Sub	Machined body with main drill-string connections plus auxiliary fluid port	Heat-treated alloy steel is common for integral bodies; pressure requirement must be considered	Main connections, auxiliary outlet geometry, internal flow path, local section around port
Kelly Valve	Pressure-containing valve body with rotary connections and internal valve parts	Alloy-steel body is common, but valve material and heat treatment follow pressure/service requirements	Body pressure integrity, connection geometry, bore, valve internals and functional assembly

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Integral vs Welded Pup Joint Construction

Pup joints are short drill-string sections used when standard drill-pipe length does not provide the required spacing. The terms **integral** and **welded** describe different construction routes. Neither term should be treated as a universal indicator of quality; the correct design is the one specified for the required length, connection, bore and drill-string configuration.

INTEGRAL PUP JOINT	WELDED PUP JOINT
One-piece body Connections and body are produced from a continuous integral section. The bore and end connections are machined into the same component.	Assembled construction A pipe-body section is combined with welded end or tool-joint components according to the approved drill-pipe-type design.

Construction comparison

Control item	Integral pup joint	Welded pup joint
Body construction	Continuous integral body	Pipe-body section plus welded end / tool-joint components
Connection construction	Connections machined directly into the integral body	Connections are provided by the welded end/tool-joint components
Heat-treatment route	Heat treatment is controlled for the integral body to achieve the specified properties	Body and end components follow the approved welded assembly route; treatment cannot be assumed identical to an integral sub
Bore	Machined/trepanned through the integral body as required	Must remain aligned through the assembled body and welded ends
Manufacturing focus	Material condition, concentric bore, thread/shoulder machining, finished length	Body/end compatibility, weld assembly, alignment, finished length, connection geometry
Selection logic	Used when the approved design calls for an integral short section and matching drill-string connections	Used when the approved design uses drill-pipe-type welded construction for the required length/configuration

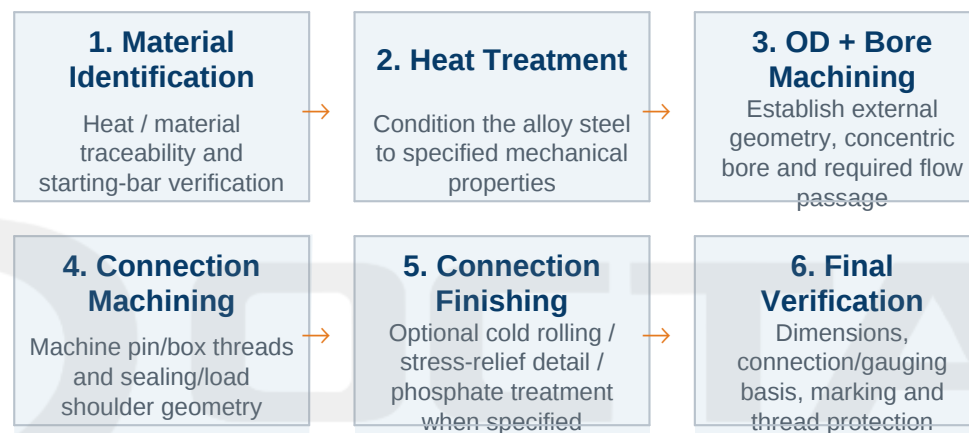
Manufacturer examples reviewed

Beckenford identifies integral pup joints machined from 4145H MOD Q&T; bar and also offers welded pup joints. DP-Master states that its 5 ft pup joints are integral, while longer lengths can be manufactured as welded assemblies. These are supplier-specific product routes and should not be treated as universal dimensional rules.

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Manufacturing Route for Integral Rotary Subs

Crossover, saver, bit, pump-in and side-entry subs are commonly produced as machined integral bodies. The exact sequence varies by manufacturer and product design, but the manufacturing logic must control **material condition, bore alignment, connection geometry and the local body sections that transmit drilling loads or contain pressure**. Optional connection treatments should be identified separately from mandatory operations.



What each manufacturing stage controls

Stage	Technical control	Important boundary
Material identification	Confirms the starting material and traceability basis before machining	Material name alone does not define the finished sub
Heat treatment	Establishes the specified strength/toughness condition for the selected alloy-steel route	Required condition and mechanical properties are product-specific
OD and bore machining	Controls outside profile, wall section, concentricity and internal flow passage	Bore size and local wall thickness must suit the approved design
Pin / box connection machining	Produces the rotary connection, shoulder and make-up geometry	Where API rotary shouldered connections are specified, threading/gauging is controlled by the applicable connection requirement
Optional connection finishing	Cold rolling, stress-relief features or phosphate may be applied when specified	These are options/processes used by some manufacturers; they are not universal requirements

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Manufacturing Route by Accessory Type

The same drill-string accessory family can contain solid rotary subs, welded assemblies and pressure-containing valve products. The manufacturing route should therefore be selected from the **actual construction** before material, machining or acceptance requirements are assigned. The matrix below summarizes the key differences.

Accessory / construction	Primary body route	Distinctive manufacturing feature	Main verification focus
Crossover / Saver / Bit Sub	Solid heat-treated alloy-steel body	Two end connections machined into one body; bore through the sub	Upper/lower connection identity, shoulder, OD, bore, length
Integral Pup Joint	One-piece heat-treated body	Longer integral section with drill-pipe-compatible connections	Overall length, connection compatibility, bore, body properties
Welded Pup Joint	Pipe-body-based welded assembly	Welded joining of body and end/tool-joint components	Assembly alignment, welded construction, connection geometry, final length
Pump-In / Side Entry Sub	Integral machined body with auxiliary port	Additional inlet/side outlet creates a local pressure/flow feature	Main connections, auxiliary port, bore, local body section, pressure requirement
Kelly Valve	Pressure-containing valve body + internal components	Valve bore, closure element, operating mechanism and drill-stem connections	Connection compatibility, pressure/function requirement, bore and valve operation

Manufacturing decision sequence

Step	Decision	What must be established
1	Define function	Connection adaptation, length adjustment, wear protection, fluid access or flow shutoff
2	Identify construction	Integral solid body, welded pup-joint assembly, or pressure-containing valve
3	Set material / heat treatment	Choose the material condition required by the approved design and service
4	Define interfaces	Upper/lower connections, pin/box orientation, shoulder, OD, bore, auxiliary port if present
5	Apply machining and finishing route	Bore and connection machining; optional cold rolling/phosphate only when specified