

Drill Pipe

Hydraulics

Calculation Reference

- Drill pipe ID and internal flow area
- Flow velocity at a fixed circulation rate
- Upset and tool-joint bore restrictions
- Pressure-loss review inputs and checklist

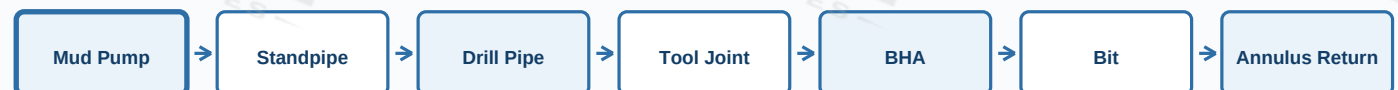
Engineering purpose

A data-led reference for checking the internal flow path through the pipe body, upset and tool joint before finalizing drill-string hydraulic assumptions.

PRELIMINARY ENGINEERING REFERENCE

Verify final values against approved product data and project calculations

Drill String Hydraulic Path



Drill Pipe ID, Flow Area and Velocity Reference

Illustrative geometry comparison at a fixed circulation rate of 500 gal/min

1 Basic Relationships

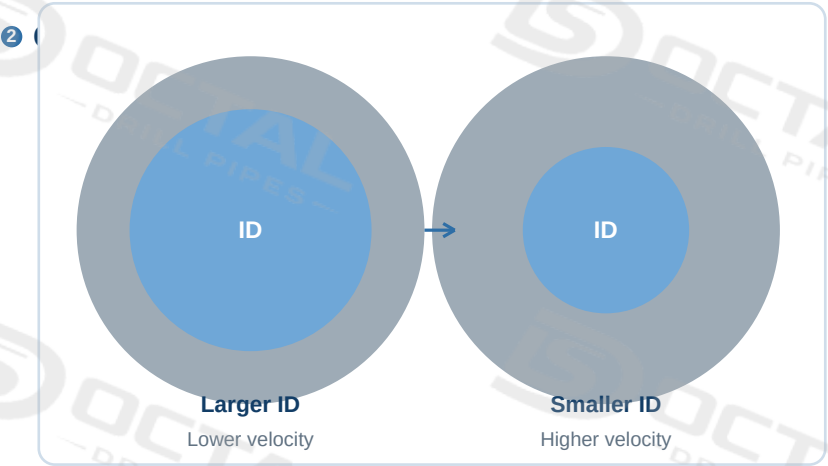
Flow Area = 3.1416 x D^2 / 4

Average Fluid Velocity = Flow Rate / Flow Area

- D = internal diameter
- Flow Area = cross-sectional area available to drilling fluid
- Flow Rate = circulation volume per unit time
- Average Fluid Velocity = mean velocity through the selected bore

Internal Diameter	Flow Area (sq in.)	Velocity at 500 gpm (ft/s)	Relative Velocity
2.75 in.	5.94	27.01	1.86x
3.00 in.	7.07	22.69	1.56x
3.25 in.	8.30	19.34	1.33x
3.50 in.	9.62	16.67	1.15x
3.75 in.	11.04	14.52	1.00x

Illustrative geometry only. The table isolates the effect of ID on flow area and average velocity; it is not a complete drill pipe pressure-loss calculation.



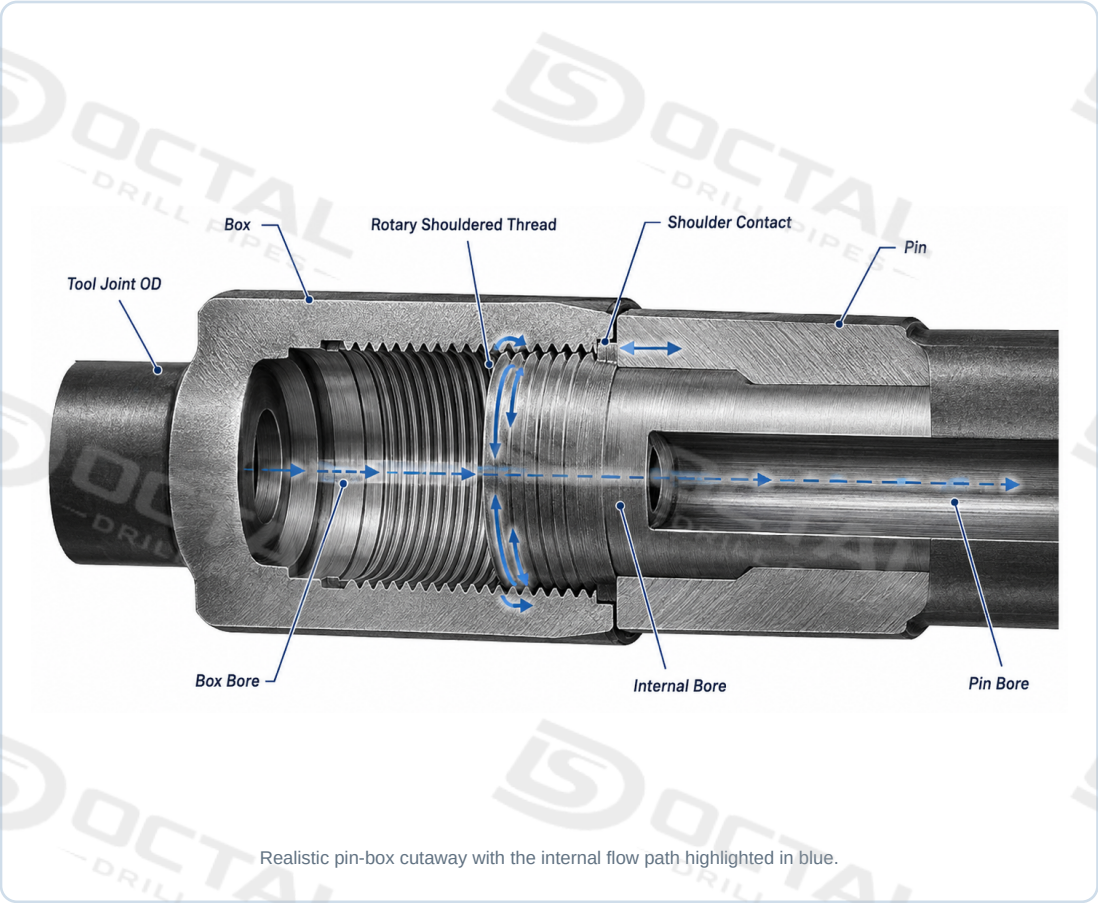
A smaller ID leaves less area for the same circulation rate, so average fluid velocity rises. Higher velocity generally increases internal friction, although final **drill pipe pressure loss** still depends on total length, drilling-fluid properties and local restrictions.

Design Check	Engineering Interpretation
Pipe OD	Outside diameter alone does not show the available internal flow area.
Wall thickness	Directly changes the calculated pipe-body ID.
Pipe-body ID	Controls the main long-section flow area.
Tool joint ID	Can become a repeated local restriction at every connection.

Pipe Body ID vs Upset Bore vs Tool Joint ID

Internal flow path through a complete drill pipe joint

1 Internal Flow Path Through a Drill Pipe Joint



Flow Section	Dimension	Hydraulic Importance
Pipe body	Pipe-body ID	Primary long-section flow area.
Upset transition	Minimum upset bore	Local reduction at the transition into the tool joint.
Tool joint	Tool joint ID	Repeated restriction at every drill pipe connection.
Connection area	Pin / box internal passage	Must remain compatible with the selected rotary shouldered connection.

2 Why All Three IDs Matter

The pipe body may provide a relatively open bore while the upset or tool-joint passage is smaller. Hydraulic review should follow the complete internal path rather than treating pipe-body ID as a constant dimension from end to end.

- Confirm the **minimum** internal passage, not only nominal pipe-body ID.
- Repeated restrictions matter more as the number of drill pipe joints increases.
- Use the approved product drawing and ordered connection data for final calculations.

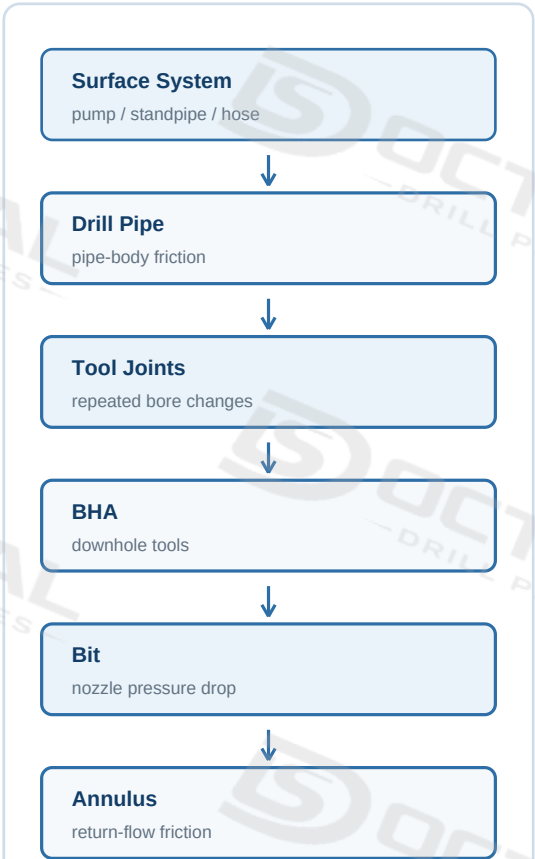
Pressure Loss Factors and Calculation Inputs

Use the complete circulation system and confirmed drill-string geometry

1 Drill Pipe Hydraulic Calculation Inputs

Input	Unit / Data Required	Why It Is Needed
Flow rate	gal/min or L/min	Sets the circulation volume and internal velocity.
Pipe-body ID	in. / mm	Defines the main internal flow area through the pipe body.
Upset bore	in. / mm	Identifies a local reduction between pipe body and tool joint.
Tool joint ID	in. / mm	Defines the repeated bore through each connection.
Drill pipe length	ft / m	Controls the length over which internal friction accumulates.
Number of joints	quantity	Indicates how many repeated tool-joint restrictions are present.
Drilling-fluid data	project data	Density and flow properties are required for the hydraulic model.
BHA / bit data	minimum ID / nozzle data	Needed to review total circulating pressure below the drill pipe.

2 System Pressure Allocation



Pressure is consumed across the full circulation path

High standpipe pressure should not automatically be attributed to drill pipe ID. Surface equipment, BHA restrictions, bit nozzles and annular conditions also contribute.

Calculation boundary: this PDF does not apply one universal pressure-loss equation. Final pressure loss depends on the selected hydraulic model, drilling-fluid properties, flow regime, internal geometry, total length and local restrictions.

5 in. Drill Pipe Hydraulic Comparison

Same OD can produce different internal flow area and velocity

2 Same OD, Different Internal Passage

1 Pipe-Body Geometry at the Same 5.000 in. OD

Parameter	Thinner-wall case	Thicker-wall case
Pipe OD	5.000 in.	5.000 in.
Wall thickness	0.362 in.	0.500 in.
Calculated pipe-body ID	4.276 in.	4.000 in.
Internal flow area	14.36 sq in.	12.57 sq in.
Velocity at 500 gpm	11.17 ft/s	12.77 ft/s

Illustrative geometry only. The wall-thickness values show how the same outside diameter can produce different pipe-body IDs. They are not presented as a universal product configuration.

Thinner-wall case

5.000 in. OD | wall 0.362 in. | body ID 4.276 in.



Flow area 14.36 sq in. | Velocity 11.17 ft/s at 500 gpm

Thicker-wall case

5.000 in. OD | wall 0.500 in. | body ID 4.000 in.



Flow area 12.57 sq in. | Velocity 12.77 ft/s at 500 gpm

3 Illustrative Tool Joint Bore Reference

Tool Joint ID	Flow Area (sq in.)	Velocity at 500 gpm (ft/s)	Relative Velocity
2.750 in.	5.94	27.01	1.74x
3.250 in.	8.30	19.34	1.24x
3.500 in.	9.62	16.67	1.07x
3.625 in.	10.32	15.54	1.00x

The tool-joint values above are a geometric reference only. Actual tool-joint ID must come from the selected connection and approved product drawing. A larger bore reduces velocity, but connection strength and wear allowance must still be checked.

Engineering takeaway: nominal drill pipe OD is only the starting point. Pipe-body wall thickness, upset bore and tool-joint ID can all change the internal hydraulic path.

Hydraulic Review Worksheet

Project checklist before finalizing drill pipe hydraulic assumptions

PAGE 06 | DRILL PIPE HYDRAULICS

① Drill Pipe Geometry

Item	Project Value
Drill pipe OD	
Nominal weight	
Grade	
Wall thickness	
Pipe-body ID	
Upset type	
Minimum upset bore	
Tool joint OD	
Tool joint ID	
Connection designation	

② Operating Conditions

Item	Project Value
Planned flow rate	
Total drill-pipe length	
Number of joints	
Mud density	
Fluid properties	
BHA minimum ID	
Bit / nozzle data	
Available standpipe pressure	

③ Review Checklist

Review Question	Status
Pipe-body ID confirmed from approved product data?	☐
Minimum upset bore confirmed?	☐
Tool joint ID confirmed for the selected connection?	☐
Complete internal flow path represented in the model?	☐
BHA and bit restrictions included?	☐
Mechanical connection requirements checked alongside hydraulics?	☐
Final values reviewed against the project hydraulic model?	☐

④ Reference Scope

API Specification 5DP

Use the applicable controlled edition for drill pipe product and dimensional requirements.

API Specification 7-2

Use the applicable controlled edition for rotary shouldered connection threading, dimensions and gauging. It is not a drilling-hydraulics calculation standard.

FINAL PROJECT VALUES REQUIRE APPROVED PRODUCT DATA