USER MANUAL

ESTINEER PIPE SPOOL FABRICATION

Shop-fabricated pipe spools, NPS ½ to 24: material take-off, cut lengths, welds, man-hours, price, drawings and reports



www.estineer.com / support@estineer.com
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Software output only: must be checked and approved by a qualified engineer. Not engineering advice and not an estimate or quotation.

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Pipeline Spool Fabrication. The companion tool that splits a whole line into shop spools uses the same engine, inputs and outputs. It has its own short manual covering only what it adds: break and valve cards, the line package and the line summary.

CHAPTER 1

INTRODUCTION

1.1 WHAT THE TOOL IS

The Estineer Pipe Spool Fabrication tool prices the shop fabrication of one pipe spool and produces its fabrication drawings. You copy the spool from the client's isometric: the material, size, schedule and flange class, then each component in fabrication order, from the start face to the finish face. The tool builds the spool in 3D, cuts the pipe into pieces, lists every weld, takes the weights and prices from its catalogue, builds the man-hours activity by activity and turns them into a cost, a price and a schedule.

The design is by others. The tool does not size the pipe or check it for pressure, stress or support: the line class and the isometric come from the client's piping design. It does check what matters to the workshop: pieces too short to weld, the transport envelope, the shop test pressure against the flange class, heat treatment and the NDT scope.

1.2 WHAT GOES IN AND WHAT COMES OUT

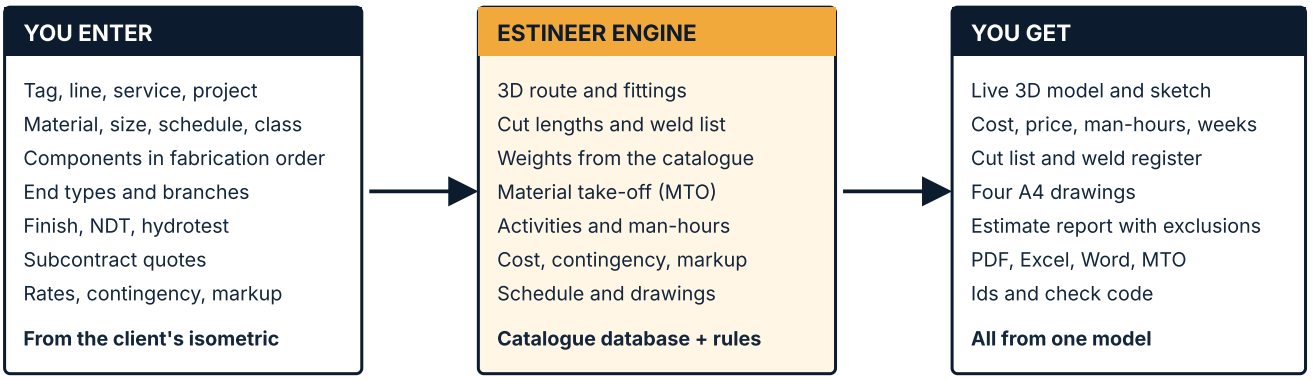


Figure 1.1 What goes in, what happens, what comes out. There is no AI in the number path: every figure comes from the engine and the catalogue database.

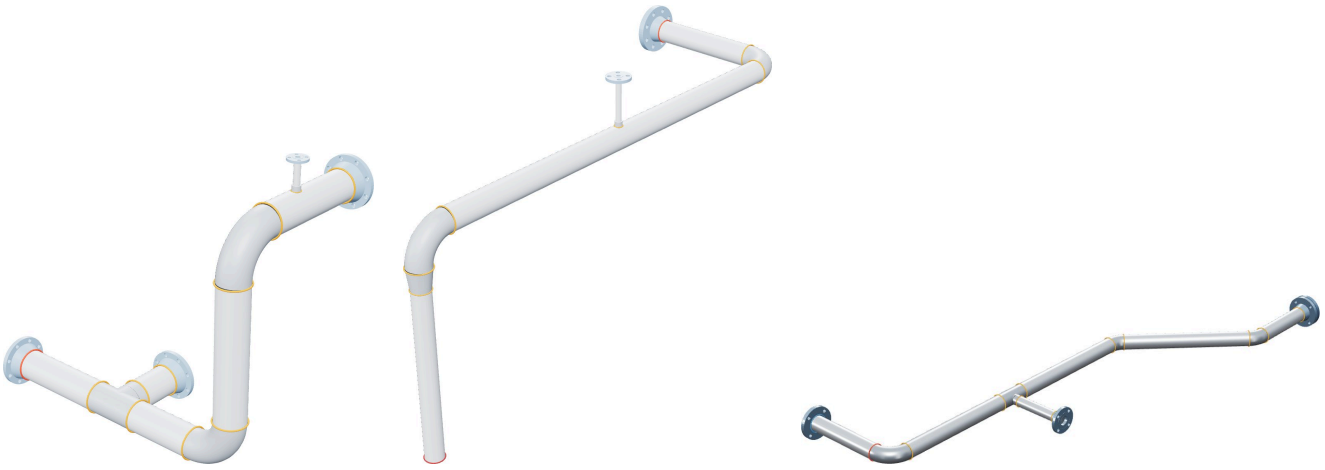
The same model drives the 3D view, the drawings, the report and the Excel and Word files. Change a field and all of them change together. Enter the same inputs twice and you get the same result; every purchased report carries a check code that proves which inputs, engine version and database produced it.

1.3 CONVENTIONS

- **Units.** Metric: mm for lengths, m for the spool envelope, kg, bar g, °C. Sizes are NPS (inch) as in the pipe class.
- **Money.** AUD excluding GST at the exchange rate in the form (default 1.4706 AUD per USD).
- **Alerts.** Yellow means confirm; red means the run is stopped or a check fails.
- **Figures.** Overview pictures are renders from the tool's 3D model; technical figures are black-and-white drawings.
- **Help.** Email support@estineer.com with your report id; the check code lets us reproduce your result.

1.4 WHAT THE TOOL COVERS

Item	Covered
Spool	One shop-fabricated spool: straight runs, elbows, reducers, tees, half couplings, olets, end flanges
Size	NPS ½ to 24 for the run; branches and olets down to NPS ½
Construction	Butt-welded ASME B16.9 fittings above NPS 1½; socket-weld ASME B16.11 Class 3000 at NPS 1½ and smaller
Materials	Carbon steel (A106 B seamless or A53 B ERW), low-temperature carbon steel (A333 Gr 6), stainless 304L and 316L
Flanges	ASME B16.5 weld neck, slip-on, socket weld and blind, Class 150 to 1500
Route	Up to 12 straight runs of 20 mm to 12 m each, and up to 6 branches
Finish and test	Blast and paint systems for carbon steel, pickling and passivation for stainless, NDT by method, shop hydrotest, preheat and PWHT
Subcontract	Painting, hydrotest and NDT can be priced from a subcontractor's quote instead of in-house work
Currency	AUD by default, any currency by exchange rate; prices exclude GST and tax



A SP-101, cooling water
6" carbon steel, tee and vent

B SP-201, steam
4" carbon steel, bevelled end

C SP-301, process water
3" stainless 316L, slip-on and blind

Figure 1.2 The three starting examples, rendered by the tool from its own 3D model. Every spool you enter is drawn the same way.

1.5 WHAT IT DOES NOT COVER

- Pipe design: wall thickness, flexibility, stress, supports and pipe class selection.
- Site work: field welds, erection, bolting at site, supports, insulation and site painting.
- Valves, instruments and other in-line items; free-issue material from the client.
- Transport, packing for export, escalation, overtime and design changes after approval.

1.6 THE SCREEN AT A GLANCE

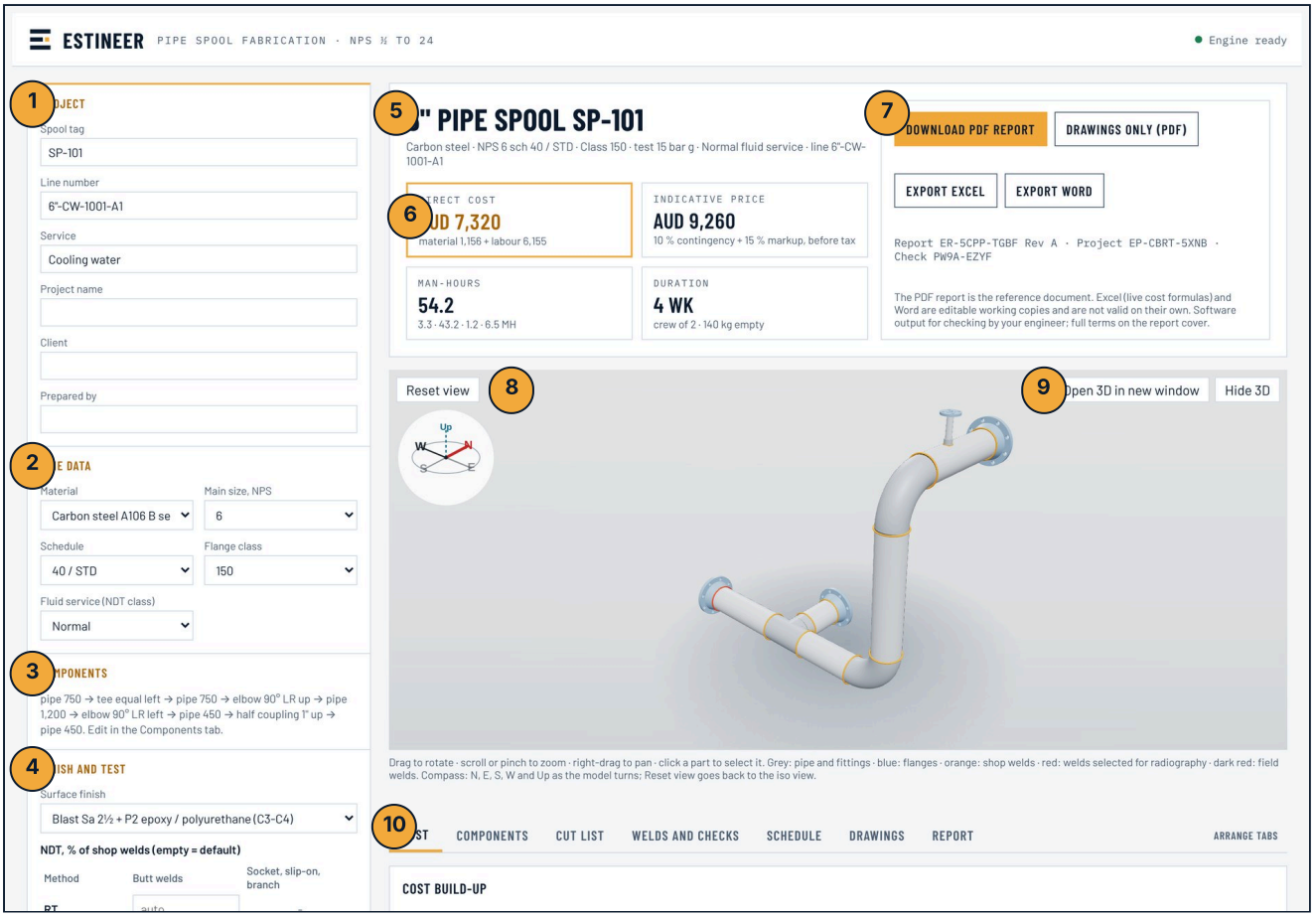


Figure 1.3 The tool page with the SP-101 example loaded. The numbers match the key below.

1. **Project:** spool tag, line number, service, project name, client, prepared by.
2. **Line data:** material, main size, schedule, flange class, fluid service.
3. **Components:** a one-line summary; the cards themselves are in the Components tab.
4. **Finish and test:** surface finish, NDT, hydrotest, PWHT, preheat; subcontract quotes and workshop rates follow below.
5. **Title:** size, tag and the main line data.
6. **Result cards:** direct cost, indicative price, man-hours, duration.
7. **Downloads:** PDF report, drawings, Excel and Word, with the report, project and check ids.
8. **3D model:** drag to rotate, scroll to zoom, right-drag to pan; click a part to select it; Reset view.
9. **Open 3D in new window:** a large view that follows every change; Hide 3D folds it away.
10. **Tabs:** Cost, Components, Cut list, Welds and checks, Schedule, Drawings, Report; drag them into your own order.

Colours in the 3D view. Grey: pipe and fittings. Blue: flanges. Orange: shop welds. Red: welds selected for radiography. Dark red: field welds. Amber: the part you selected.

1.7 QUICK START: ONE SPOOL IN FIVE STEPS

Step	What to do
1	**Project.** Enter the spool tag and the line number exactly as on the isometric. Project name, client and prepared by go on the report cover; leave them empty and the cover leaves them blank.
2	**Line data.** Choose the material, the main size (the size at the start face), the schedule and the flange class from the line class. Choose the fluid service: it sets the default radiography.
3	**Components.** Open the Components tab. Set the start end and what it connects to. Then add the cards in fabrication order with the buttons at the bottom: pipe, elbow, reducer, branch or olet. Pipe lengths are centre-line lengths from the isometric. Finish with the end type at the finish face. The sketch beside the cards updates as you type; click a part of the sketch to edit its card.
4	**Finish and test.** Choose the surface finish, the hydrotest pressure from the client's line list, and any NDT the client asks for. Leave NDT empty to use the default for the fluid service.
5	**Rates and price.** Check the workshop rates, contingency and markup. Read the result cards, the Cost tab and the alerts; then download the report and drawings.

> Start from an example and change it: the tool opens with SP-101. Changing the main size, material or schedule updates every card that follows the main size.

1.8 PREVIEW AND THE PURCHASED REPORT

On estineer.com the tool is free to use on screen. The cost, man-hours, weights, bill of materials, cut list and weld register are shown in full.

	Free preview on screen	Purchased report
Cost, price, man-hours, BOM, cut list, welds	Full	Full
Drawings	First sheet, low resolution, marked PREVIEW	Four clean A4 vector sheets
Report	Cover page only	Complete PDF
Excel, Word, MTO	Not available	Live-formula workbook, editable Word file, MTO in Excel and CSV
Ids and verification	None	Report id, project id and check code

To buy, press a download button, sign in with a code sent to your email and pay by card. Files are produced on the server after payment, you receive a tax invoice and you can download again for 12 months. Prices and offers are shown on the site at the time of purchase.

> The PDF report is the reference document. The Excel and Word files are editable working copies and have no standing on their own.

CHAPTER 2

INPUTS, FIELD BY FIELD

The form on the left holds the spool-wide data. The components themselves are cards in the Components tab. Every field is named here exactly as on screen. Where a field has a default, leaving it empty uses the default.

2.1 PROJECT

Field	Meaning	Default / limit
Spool tag	The spool number from the isometric. Printed on every drawing and file name.	Up to 24 characters
Line number	The line the spool belongs to, for example 6"-CW-1001-A1.	Free text
Service	What flows in the line. Shown in the title and on the report.	Free text
Project name, Client, Prepared by	Printed on the report cover table and the Word cover. Empty fields print blank.	Optional

2.2 LINE DATA

Field	Meaning	Options
Material	Sets the pipe, fitting and flange specifications, the filler metal, the material factor on welding hours and the finishes on offer.	Carbon steel A106 B seamless; carbon steel A53 B ERW; low-temperature CS A333 Gr 6; stainless 304L; stainless 316L
Main size, NPS	The pipe size at the start face. The size changes along the spool only at a reducer or swage nipple card.	NPS ½ to 24
Schedule	Wall schedule from the catalogue for the material and size. Fittings follow the pipe wall.	As listed for the size
Flange class	ASME B16.5 pressure class of every flange on the spool.	150, 300, 600, 900, 1500
Fluid service (NDT class)	Sets the default radiography of butt welds.	Normal 5 %; Category D 0 %; Category M 20 %; Severe cyclic 100 %

Material	Pipe	Fittings	Flanges	Filler
CS seamless	A106 Gr B	A234 WPB	A105	E7018 / ER70S-6
CS ERW	A53 Gr B ERW	A234 WPB	A105	E7018 / ER70S-6
LTCS	A333 Gr 6	A420 WPL6	A350 LF2 Cl 1	E7018-1 / ER70S-6
SS 304L	A312 TP304/304L	A403 WP304/304L	A182 F304/304L	ER308L
SS 316L	A312 TP316/316L	A403 WP316/316L	A182 F316/316L	ER316L

2.3 COMPONENTS

The Components tab lists the spool in fabrication order, from the start face to the finish face. Each card is one item. Use the arrows to move a card, the cross to delete it, and the buttons at the bottom to add a card at the end of the list. Click a card, or a part of the live sketch, to open it for editing.

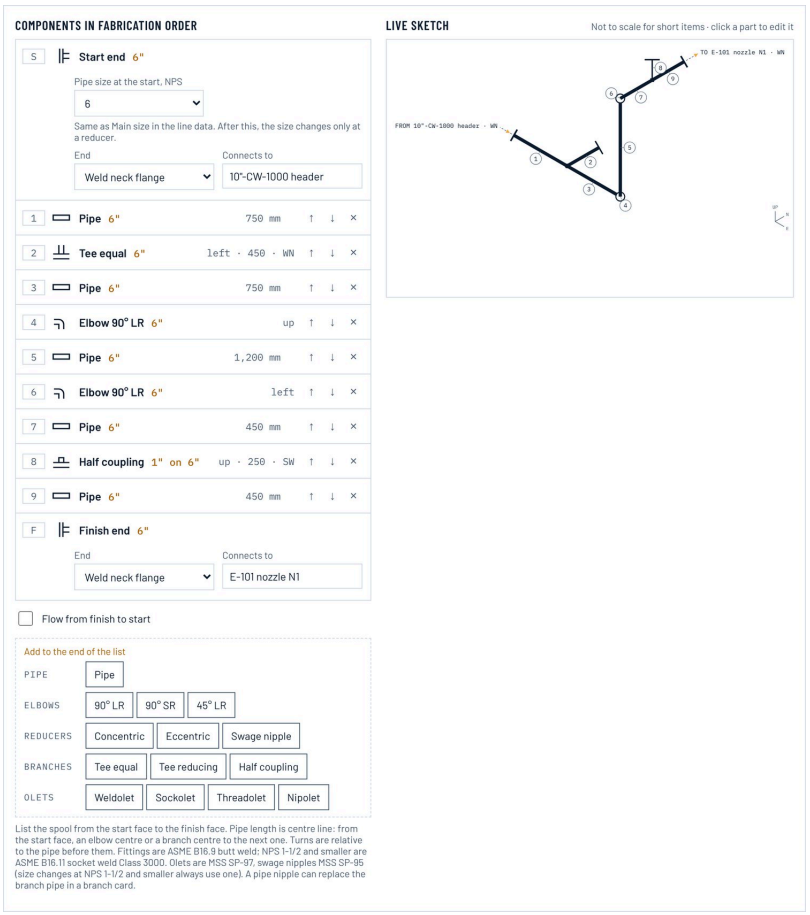


Figure 2.1 The Components tab for SP-101: start end, nine cards, finish end, the add buttons and the live sketch with item numbers.

Rules that apply to every card

- **Pipe length is centre line:** from the start face, an elbow centre or a branch centre to the next one, as dimensioned on the isometric. The tool deducts the fittings and the weld gaps to get the cut length (Chapter 3).
- **Turns are relative** to the pipe before the card: up, down, left or right on a horizontal pipe; left, right, forward or back on a vertical pipe.
- **Every straight run** needs a pipe card of at least 20 mm, and fittings cannot butt directly against each other.
- **Flow from finish to start** reverses the flow arrows on the drawings only; it does not change the price.

> Sizes NPS 1½ and smaller are built with socket-weld fittings (ASME B16.11 Class 3000); larger sizes with butt-weld fittings (ASME B16.9). The tool chooses this from the size; you do not set it.

Card	Fields	Notes
Start end / Finish end	Pipe size at the start; end type; Connects to (text on the drawings)	End types below
Pipe	Length, mm (centre line)	20 mm to 12,000 mm per straight run
Elbow	Type: 90° LR (1.5 D), 90° SR (1.0 D), 45° LR; Turn	ASME B16.9 / B16.11
Reducer	Type: concentric, eccentric (flat on top or bottom), swage nipple; Outlet size, NPS	Swage nipples are MSS SP-95; used automatically where the big end is NPS 1½ or smaller
Tee equal / Tee reducing	Branch size; Branch direction; Branch pipe (pipe or nipple 75, 100, 150 mm); Branch length, mm; Branch end; Connects to; Flows in or out	Branch length is from the run centre line to the branch end face
Half coupling	As a branch; branch end usually socket weld	Class 3000, welded to the run with a hole cut
Weldolet, Sockolet	As a branch	MSS SP-97; the olet sits on the run pipe
Threadolet, Nipolet	Branch size and direction	The NPT thread or the 89 mm plain end is the branch end; the connection is by others

End types

End	What the tool adds
Weld neck flange (WN)	B16.5 weld neck flange, one butt weld, hydrotest end with a test blind
Slip-on flange (SO)	B16.5 slip-on flange, two fillet welds; pipe set back by the wall thickness + 3 mm
Socket-weld flange (SW)	B16.5 socket-weld flange (NPS 3 and smaller), one socket weld with a 1.6 mm gap
Weld neck + blind (BL)	Weld neck flange plus a blind flange, gasket and bolts fitted in the shop
Bevelled end (BE)	No item; the end is bevelled for a field weld; hydrotest with a test plug
Plain end (PE)	No item; plain end for a field socket weld
Cap	B16.9 butt-weld cap (or B16.11 socket-weld cap at small sizes)

> Up to 12 straight runs and 6 branches per spool. A spool larger than that is usually two spools on the isometric: enter each as its own spool, or use the Pipeline Spool Fabrication tool, which splits a whole line.

2.4 FINISH AND TEST

Field	Meaning	Default / options
Surface finish	Carbon steel: abrasive blast to Sa 2½ plus a paint system. Stainless: pickling and passivation inside and outside.	CS: P1 alkyd, P2 epoxy/polyurethane, P3 zinc silicate/epoxy/polyurethane, P5 silicone aluminium, P6 phenolic epoxy (CUI), none. SS: pickle, none
NDT, % of shop welds	Six fields: RT and UT for butt welds; MT and PT for butt welds and for socket, slip-on and branch welds. Empty uses the default.	RT default by fluid service; MT on carbon steels only (MT on stainless is refused)
Per-weld NDT	In the Welds tab you can tick the methods weld by weld; those welds are marked as set by you.	Optional
Shop hydrotest	Includes the shop hydrotest with test blinds or plugs at every end.	On
Test pressure, bar g (client)	From the client's line list. Checked against 1.5 × the flange rating at 38 °C.	Above 0, at most 400; empty uses 15 bar g with an alert
PWHT	Post-weld heat treatment. Auto suggests it for carbon steel walls above 19 mm.	Auto, yes, no
Preheat, °C	Empty uses the suggested value (79 °C on carbon steel walls above 25 mm).	5 to 300 °C
Insulated in service	Information only (insulation is by others); suggests a coating for use under insulation.	Off

The tool chooses which welds get NDT: the largest and thickest first, until the percentage is reached. Radiography uses the butt welds of the run; MT and PT on “other” welds cover socket, slip-on and branch welds.

2.5 SUBCONTRACT QUOTES

Painting (or pickling), hydrotest and NDT can each be bought from a subcontractor. Tick the scope and enter the quote in the report currency. The tool then removes the in-house hours and materials of that scope and adds the quote as a cost line “(subcontract)”. Tick it with no amount and the scope is listed under “The price excludes”. Amounts must be zero or more.

2.6 WORKSHOP RATES

Field	Meaning	Default	Allowed
Currency, Rate per 1 USD	Report currency and its exchange rate. Catalogue prices are in USD.	AUD, 1.4706	Rate above 0
Shop labour, /h all-in	Fitters, welders, helpers, painters, test crew.	110	Above 0
Engineering, /h all-in	Spool drawing check, weld map, test pack, data book.	150	Above 0
NDT, /h all-in	In-house NDT technicians.	160	Above 0
Contingency, %	On the direct cost.	10	0 to 100
Markup on cost, %	On cost plus contingency.	15	0 to 100
Crew	People working on the spool at the same time; sets the duration only.	2	1 to 50
Hours / week	Working hours per week; sets the duration only.	38	1 to 84

A value outside the allowed range stops the run with a message, for example *Shop labour rate must be more than zero*. The last good result stays on screen, marked as not updated.



Figure 2.2 The Workshop rates section of the form.

CHAPTER 3

HOW THE ESTIMATE IS CALCULATED

This chapter explains each step from the cards to the price. The tool does not design the pipe: there are no wall-thickness or stress calculations. The calculations are those of a fabrication estimate, and every allowance the tool assumes is printed in the report under “Basis of estimate”.

3.1 ROUTE AND FITTINGS

The cards are walked from the start face. Each pipe card moves along the current direction by its centre-line length; each elbow turns the direction; each branch card places a branch at the current point. Fitting dimensions come from the catalogue tables: ASME B16.9 elbows, tees, reducers and caps; ASME B16.11 socket-weld fittings; ASME B16.5 flanges; MSS SP-97 olets and SP-95 swage nipples. The result is a 3D route with every item and every joint located.

3.2 CUT LENGTHS

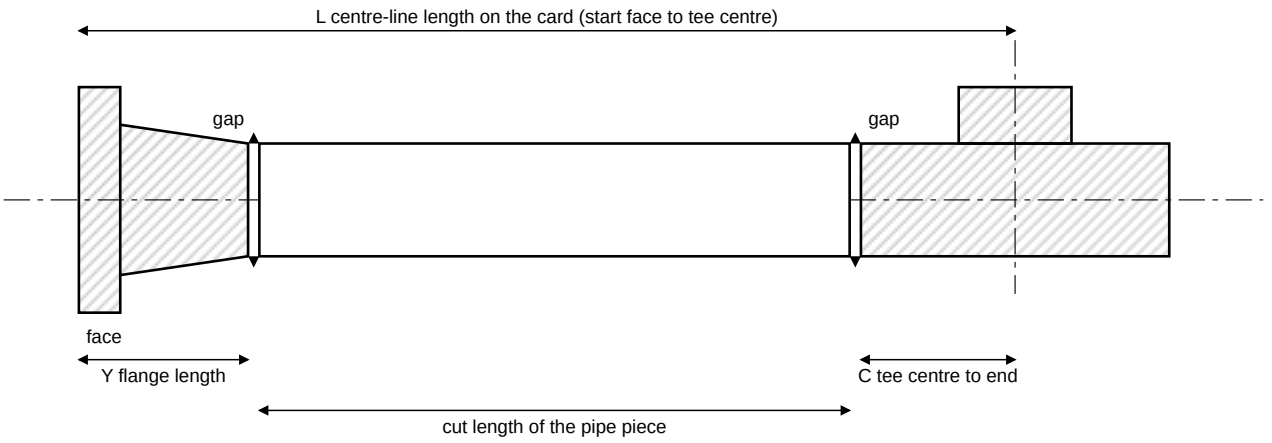


Figure 3.1 The cut length of a pipe piece is the centre-line length less the parts of the fittings that sit on that length and less the weld gaps.

```
cut length = L − (take-out of the fitting or flange at each end) − (half the root gap at
each bevelled end)
pipe to buy per size = sum of cut lengths × (1 + 5 % cutting loss)
```

Take-outs: elbow centre to end; tee centre to end (run) or centre to branch end; reducer length; flange length Y for weld neck; socket depth less a 1.6 mm gap for socket welds; for slip-on flanges the pipe stops short of the face by the wall thickness + 3 mm. The root gap is 2 mm, so each bevelled end loses 1 mm. A piece shorter than 50 mm gives a warning (hard to weld); a straight run that cannot hold its fittings stops the run.

Example (SP-101, first piece): L = 750 mm from the start face to the tee centre; weld-neck flange Y = 89 mm; 6" tee C = 143 mm; two bevelled ends 2 × 1 mm. Cut length = 750 − 89 − 143 − 2 = **516 mm**, as in the Cut list tab.

3.3 WELDS

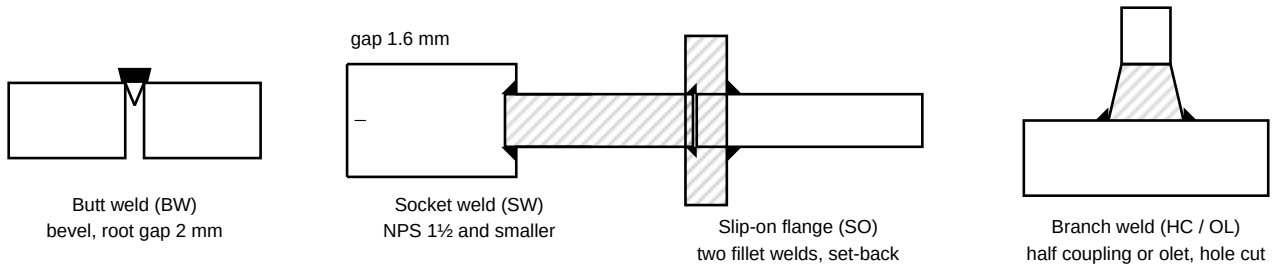


Figure 3.2 The four weld families the tool counts. Each joint is one line in the weld register with its number, type, size and wall.

Every joint between two items is a weld: pipe to fitting, fitting to fitting, flange to pipe. Branch welds join a half coupling or an olet to the run pipe, with the hole cut included. Field welds at bevelled ends are listed but not priced. The register numbers the shop welds W1, W2 … in fabrication order; the same numbers appear on the 3D view, the isometric and the weld and test record.

3.4 WEIGHTS AND CENTRE OF GRAVITY

- **Pipe:** cut length × catalogue kg/m for the size and schedule.
- **Fittings, flanges, olets, nipples:** catalogue weight per item. Weights are never computed from geometry.
- **Blind flanges:** catalogue weight plus the bolting of that joint, placed at that flange.
- **Water-filled and test weight:** empty weight plus the water in the bore of every piece.
- **Centre of gravity:** the weighted mean of every item at its own position; printed on the GA drawing with a lifting note.

3.5 MATERIALS AND PRICES

The material take-off groups the items by size and description: pipe in metres (with the cutting loss), fittings and flanges in each, welding consumables in kg (from the weld size and count), abrasive and paint by area. Prices are catalogue prices in USD multiplied by the exchange rate. A catalogue item with no price is listed under “The price excludes”, never silently priced at zero.

> Any material line or any activity can be overridden in the Cost tab: type your own price or hours. The original tool value is kept beside it and the report marks the line as set by you.

3.6 MAN-HOURS

The man-hours are built activity by activity. Each activity has a quantity, a unit rate from the Estineer man-hour tables and a material factor:

```
MH = quantity × MH per unit × material factor + extra hours
```

Activity	Quantity and unit	Stage
Handling	metres of pipe by size and schedule	Shop
Cutting, bevelling	one cut per piece; one bevel per butt-welded end	Shop
Butt welds	per joint, by size and wall	Shop
Flange attachment	weld neck (with its butt weld), slip-on (two fillets), socket weld	Shop
Branch welds	half coupling or olet, including the hole	Shop
Socket welds	per joint, Class 3000	Shop
Preheat, PWHT	per weld, when used	Shop
Blind bolting	0.1 MH per bolt	Shop
Blasting, painting	outside area; 0.08 MH per m^2 per coat	Shop
Pickling (stainless)	inside and outside area, 0.15 MH per m^2	Shop
QC	0.5 MH + 0.05 MH per joint: fit-up, marking, dimensional check	Test
Hydrotest	per end: flanged end or plugged end, by size	Test
NDT	per weld examined, by method and size	NDT
Engineering	2 MH + 0.1 MH per weld: drawing check, weld map, test pack, data book	Engineering

Material	Handling, cutting	Welding	Extra per joint
Carbon steels	1.00	1.00	0
Stainless 304L, 316L	1.20	1.46	0.6 h

3.7 NDT AND TESTING

The NDT percentages apply to the count of welds in each group. The tool picks the welds, largest and thickest first, and lists them in the weld register; welds you tick yourself are kept. The hydrotest is priced per end (flanged ends with a test blind, plain or bevelled ends with a test plug). Category M adds a sensitive leak test at half the hydrotest hours. A subcontracted scope replaces these hours by the quote.

3.8 COST AND PRICE

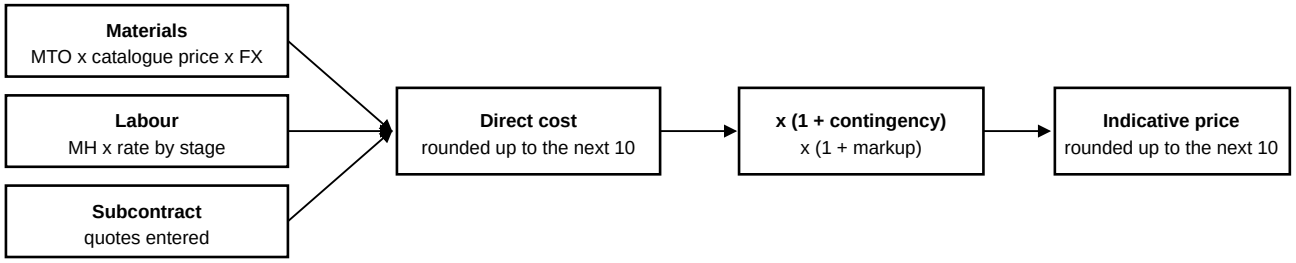


Figure 3.3 From quantities to the indicative price.

```
labour = engineering MH × engineering rate + (shop MH + test MH) × shop rate + NDT MH × NDT rate
direct cost = materials + labour + subcontract, rounded up to the next 10
price = direct cost × (1 + contingency) × (1 + markup), rounded up to the next 10
```

The price excludes GST and tax, transport, site work and anything listed in the red box “The price excludes”.

3.9 DURATION

```
fabrication weeks = (shop MH + test MH + NDT MH) / (crew × hours per week), at least 0.2
drawing approval 0.5 week; procurement 2 weeks (carbon steel) or 3 weeks (stainless);
fabrication, NDT and test = fabrication weeks + 0.3; finishing and dispatch 0.5 week
duration = total, rounded up to whole weeks
```

For SP-101: Drawing approval from week 0.0 for 0.5; Material procurement from week 0.5 for 2.0; Fabrication, NDT and test from week 2.5 for 1.0; Finishing and dispatch from week 3.5 for 0.5. Duration **4 weeks**. Crew and hours per week change only the duration, never the cost.

3.10 FABRICATION CHECKS

Check	Rule
Pieces between welds	Each straight run must hold its fittings; a piece under 50 mm gives a warning
Transport	The spool envelope against 12.0 × 2.4 × 2.6 m, a standard truck without a permit
Shop test pressure	At most 1.5 × the flange rating at 38 °C for the class
Heat treatment	PWHT suggested for carbon steel above 19 mm; preheat suggested above 25 mm; confirm with the WPS
Materials	MT is refused on stainless; LTCS needs impact-tested procedures (noted)

Points the client or the welding engineer must confirm are listed as open items, in amber; they do not stop the estimate.

CHAPTER 4

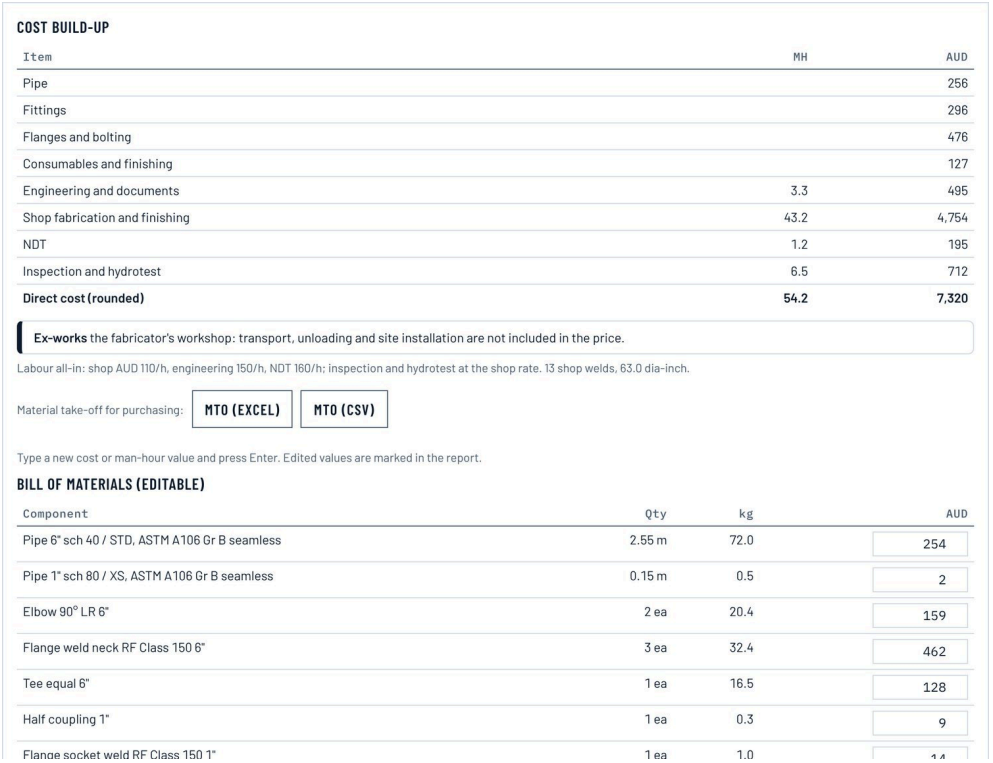
OUTPUTS

4.1 RESULT CARDS AND ALERTS

Four cards sit under the title: **Direct cost** (materials + labour), **Indicative price** (with the contingency and markup used), **Man-hours** (engineering, shop, NDT and test) and **Duration** (weeks, with the crew and the empty weight). Alerts appear above the 3D view: yellow points to confirm, red where a check fails or the input was refused.

4.2 THE TABS

Tab	What it shows
Cost	Cost build-up by group, the ex-works note, the editable bill of materials and the editable man-hours by activity
Components	The cards in fabrication order and the live sketch (Chapter 2)
Cut list	Every pipe piece: size, schedule, cut length, end preparation, piece mark
Welds and checks	The weld register with type, size, wall and NDT by weld (tick to choose), then the fabrication checks and open items
Schedule	Bar chart: drawing approval, procurement, fabrication with NDT and test, finishing and dispatch
Drawings	The four A4 sheets (section 4.3)
Report	The estimate report as it will print



COST BUILD-UP

Item	MH	AUD
Pipe		256
Fittings		296
Flanges and bolting		476
Consumables and finishing		127
Engineering and documents	3.3	495
Shop fabrication and finishing	43.2	4,754
NDT	1.2	195
Inspection and hydrotest	6.5	712
Direct cost (rounded)	**54.2**	**7,320**

Ex-works the fabricator's workshop: transport, unloading and site installation are not included in the price.

Labour all-in: shop AUD 110/h, engineering 150/h, NDT 160/h; inspection and hydrotest at the shop rate. 13 shop welds, 63.0 dia-inch.

Material take-off for purchasing: MTO (EXCEL) MTO (CSV)

Type a new cost or man-hour value and press Enter. Edited values are marked in the report.

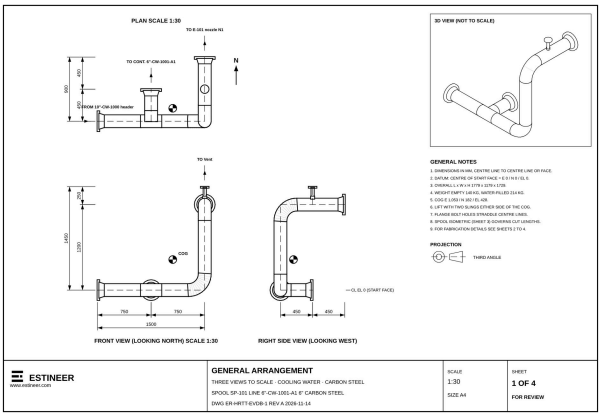
BILL OF MATERIALS (EDITABLE)

Component	Qty	kg	AUD
Pipe 6" sch 40 / STD, ASTM A106 Gr B seamless	2.55 m	72.0	254
Pipe 1" sch 80 / XS, ASTM A106 Gr B seamless	0.15 m	0.5	2
Elbow 90° LR 6"	2 ea	20.4	159
Flange weld neck RF Class 150 6"	3 ea	32.4	462
Tee equal 6"	1 ea	16.5	128
Half coupling 1"	1 ea	0.3	9
Flange socket weld RF Class 150 1"	1 ea	1.0	14

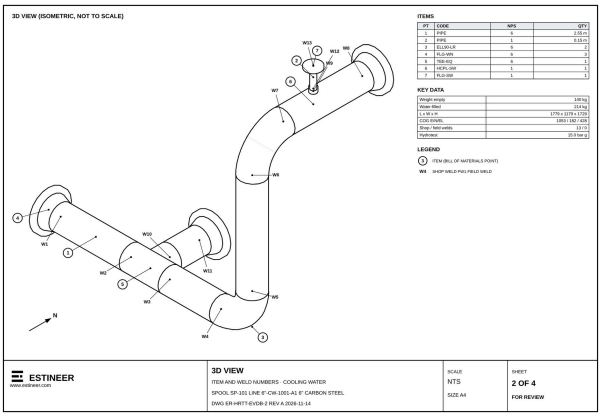
Figure 4.1 The Cost tab for SP-101: cost build-up, the ex-works note, the MTO downloads and the start of the editable bill of materials.

4.3 DRAWINGS

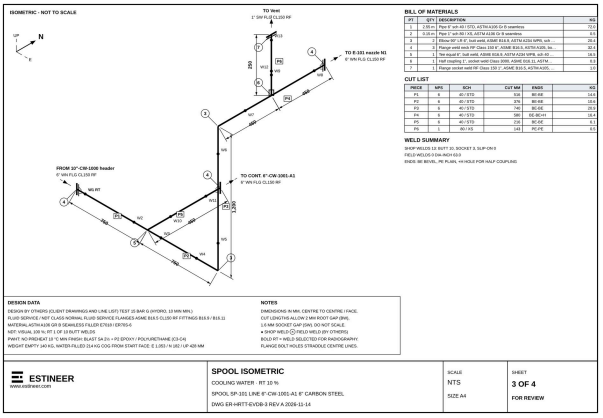
Four A4 landscape sheets, black on white, generated from the same model as the price. Each carries the Estineer title block, the spool tag and line, a drawing number, the revision and the words FOR REVIEW.



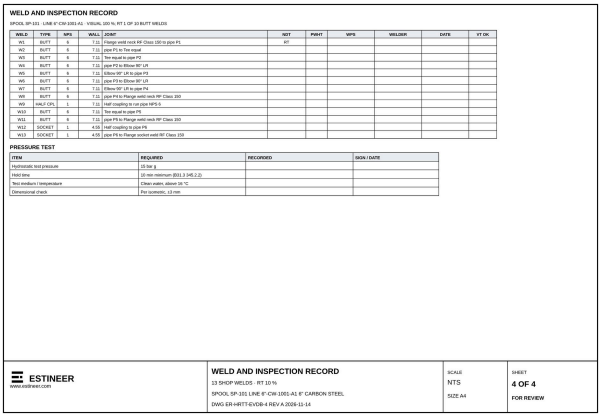
Sheet 1 General arrangement. Plan, front and side views to scale with overall dimensions, the centre of gravity, a 3D view and general notes.



Sheet 2 3D view. The spool in 3D with item numbers and weld numbers.



Sheet 3 Spool isometric. The fabrication isometric with dimensions, the bill of materials and the cut list. It governs the cut lengths.



Sheet 4 Weld and inspection record. Every weld with its joint, NDT, and columns for PWHT, WPS, welder, date and visual check; then the pressure test record.

4.4 THE PDF REPORT

The full report opens with a cover page: the 3D picture, the spool, size and class, and a table with project, client, equipment, prepared by, document number and date. The disclaimer is printed once, on the cover. The body follows, with bookmarks, a contents list that links to each section and searchable text:

No.	Section	Content
1	Estimate summary	Direct cost, price, man-hours, duration, weight; cost build-up
2	Spool data	Tag, line, service, material, specifications, ends, branches, envelope, weights, test, finish, NDT
3	Design basis and fabrication checks	Statement that the design is by others; checks and open items
4	Bill of materials and MTO	Items, quantities, weights, prices
5	Cut list	Pipe pieces and lengths
6	Weld register	Every weld and its inspection
7	Labour man-hours	Every activity with quantity, unit rate, factor and hours
8	Basis of estimate: assumptions	Every allowance the tool used
9	Exclusions	What the price does not include

The four drawing sheets follow the report in the same PDF. “Drawings only (PDF)” saves the four sheets alone.

4.5 EXCEL, WORD AND MTO

File	Content
Excel	Sheets Cover, Summary, Materials, Man-hours, Spool data, Cut list, Welds, Checks, Assumptions, Exclusions and MTO. Rates, contingency and markup are named input cells; the cost and price are live formulas, so you can change a rate and see the price move.
Word	The report as an editable document with the cover, the tables and the drawings as pictures.
MTO (Excel, CSV)	The material take-off for purchasing: one line per item with quantity, unit, weight and price.

4.6 IDS, CHECK CODE AND VERIFICATION

Each purchased report carries a **report id** (ER-XXXX-XXXX) with its revision, a **project id** (EP-XXXX-XXXX) and a **check code**. The check code is a fingerprint of the inputs, the engine version and the database. Anyone can confirm a report at **estineer.com/verify**: the page says whether the report is genuine and when it was issued, without showing the price or the buyer. The ids are printed on the cover, in every page footer, under every drawing frame and in the Excel and Word files.

CHAPTER 5

WORKED EXAMPLE: SP-101

SP-101 is the example the tool opens with: a 6" carbon steel cooling-water spool with a branch tee, two elbows and a 1" vent. Every number in this chapter is produced by the engine when the manual is built, so it matches the tool exactly.

5.1 INPUTS

Spool tag / line	SP-101 / 6"-CW-1001-A1
Service	Cooling water
Material	Carbon steel, ASTM A106 Gr B seamless
Main size, schedule, class	NPS 6, 40 / STD, Class 150
Fluid service	Normal fluid service
Start end	Weld neck flange, from 10"-CW-1000 header
Components	pipe 750 mm; tee equal NPS 6 left, branch 450 mm, WN; pipe 750 mm; elbow 90° LR up; pipe 1,200 mm; elbow 90° LR left; pipe 450 mm; half coupling NPS 1 up, branch 250 mm, SW; pipe 450 mm
Finish end	Weld neck flange, to E-101 nozzle N1
Finish and test	P2 Epoxy / polyurethane; hydrotest 15 bar g; NDT default
Rates	shop 110, engineering 150, NDT 160 AUD/h; contingency 10 %; markup 15 %; crew 2, 38 h/week



SP-101 in the tool's 3D view.

5.2 GEOMETRY, PIECES AND WELDS

The route gives an envelope of 1.78 × 1.73 × 1.18 m, inside the 12.0 x 2.4 × 2.6 m truck envelope. The pipe is cut into 6 pieces:

Piece	NPS	Schedule	Cut, mm	Ends
P1	6"	40 / STD	516	BE-BE
P2	6"	40 / STD	376	BE-BE
P3	6"	40 / STD	740	BE-BE
P4	6"	40 / STD	580	BE-BE
P5	6"	40 / STD	216	BE-BE
P6	1"	80 / XS	143	PE-PE

Piece P1 is worked in section 3.2: 750 − 89 − 143 − 2 = 516 mm. There are 13 shop welds: 10 butt, 1 half coupling, 2 socket. With normal fluid service, radiography is 5 % of the butt welds, which rounds up to 1 weld.

5.3 MATERIALS

Catalogue prices in USD × 1.4706 = AUD. Pipe includes the 5 % cutting loss.

Item	Quantity	kg	AUD
Pipe 6" sch 40 / STD, ASTM A106 Gr B seamless	2.55 m	72.0	254.27
Pipe 1" sch 80 / XS, ASTM A106 Gr B seamless	0.15 m	0.5	1.72
Elbow 90° LR 6"	2.00 ea	20.4	159.00
Flange weld neck RF Class 150 6"	3.00 ea	32.4	462.18
Tee equal 6"	1.00 ea	16.5	128.44
Half coupling 1"	1.00 ea	0.3	8.81
Flange socket weld RF Class 150 1"	1.00 ea	1.0	14.26
Welding consumables (E7018 / ER70S-6)	4.39 kg	4.4	58.13
Abrasive for blasting Sa 2½	48.70 kg	0.0	28.66
Paint system P2 Epoxy / polyurethane	2.21 m2	0.0	40.16
Materials total		**147.5**	**1,155.63**

5.4 WEIGHTS

Empty 139.6 kg; water 74.1 kg; full of water for the test 213.7 kg. Centre of gravity from the start face: E 1,053 / N 182 / Up 428 mm, shown on the GA drawing.

5.5 MAN-HOURS

ID	Activity	Quantity	MH/unit	Factor	MH
HAND-6	Pipe handling in shop NPS 6 sch 40 / STD	2.43 m	0.200	1	0.49
CUT-6	Pipe cutting, machine NPS 6 (one cut per piece)	5 ea	0.681	1	3.41
BEV-6	Pipe bevelling, machine NPS 6	10 ea	0.445	1	4.45
HAND-1	Pipe handling in shop NPS 1 sch 80 / XS	0.14 m	0.103	1	0.01
CUT-1	Pipe cutting, machine NPS 1 (one cut per piece)	1 ea	0.259	1	0.26
BW-6-7.11	Butt weld, manual NPS 6 wall 7.11 mm	7 joint	2.780	1	19.46
HC-1	Half coupling NPS 1 welded to run pipe (incl. hole)	1 ea	1.580	1	1.58
SW-1	Socket weld NPS 1 Class 3000	2 joint	0.614	1	1.23
WN-6	Weld neck flange attachment NPS 6 Class 150 (incl. butt weld,	3 ea	3.860	1	11.58
QC	Fit-up checks, marking and dimensional inspection	1 spool	1.150	1	1.15
BLAST	Abrasive blasting Sa 2½	2.21 m2	0.100	1	0.22
PAINT	Painting P2 Epoxy / polyurethane, 3 coats	2.21 m2	0.240	1	0.53
RT	Radiography (RT): 1 of 10 butt welds	1 ea	1.220	1	1.22
HT-start	Hydrotest, flanged end (start, NPS 6)	1 end	1.440	1	1.44
HT-end	Hydrotest, flanged end (end, NPS 6)	1 end	1.440	1	1.44
HT-branch 1	Hydrotest, flanged end (branch 1, NPS 6)	1 end	1.440	1	1.44
HT-branch 2	Hydrotest, flanged end (branch 2, NPS 1)	1 end	1.000	1	1.00
ENG	Spool drawing check, weld map, test pack and data book	1 spool	3.300	1	3.30
	Total				**54.2**

By stage: engineering 3.30, shop 43.21, NDT 1.22, test 6.47 MH. Engineering = 2 + 0.1 × 13 welds = 3.3 MH.

5.6 COST AND PRICE

```
labour      = 3.30 x 150 + (43.21 + 6.47) x 110 + 1.22 x 160 = AUD 6,155.42
materials   = AUD 1,155.63
direct cost = 1,155.63 + 6,155.42 = 7,311.05  -> rounded up to AUD 7,320
price       = 7,320 x 1.1 x 1.15 = 9,259.80  -> rounded up to AUD 9,260
```

The tool shows **direct cost AUD 7,320** and **indicative price AUD 9,260**, excluding GST, ex works.

5.7 SCHEDULE

Shop, test and NDT hours 50.9 MH / (crew 2 × 38 h) = 0.67 weeks of fabrication.

Stage	Starts, week	Lasts, weeks
Drawing approval	0.0	0.5
Material procurement	0.5	2.0
Fabrication, NDT and test	2.5	1.0
Finishing and dispatch	3.5	0.5

Duration: **4 weeks** from order to dispatch.

5.8 CHECKS AND OPEN ITEMS

- Shop test pressure within the flange shell test (1.5 x Class 150 rating at 38 °C): 15 bar g against 29.4 bar g, OK.
- Transport envelope (12.0 x 2.4 × 2.6 m): 1.78 × 1.73 × 1.18 m against no permit load, OK.

CHAPTER 6

LIMITS AND QUESTIONS

6.1 LIMITS

Item	Limit
Sizes	NPS ½ to 24; schedules as in the catalogue for each material and size
Route	1 to 12 straight runs, each 20 mm to 12,000 mm; up to 6 branches
Flanges	Class 150 to 1500; socket-weld flanges NPS 3 and smaller
Test pressure	Above 0 and at most 400 bar g; checked against the flange class
Preheat	5 to 300 °C
Commercial inputs	Rates and exchange rate above 0; contingency and markup 0 to 100 %; crew 1 to 50; 1 to 84 hours per week; edited costs and hours zero or more
Transport	Spools larger than 12.0 x 2.4 × 2.6 m are warned: split with a field weld or plan an oversize load

6.2 WHAT IS NOT INCLUDED

- Pipe design, stress analysis, supports and pipe class selection: by others.
- Site work: field welds, erection, site bolting, site painting, insulation.
- Valves, instruments and free-issue items; any catalogue item without a price (listed in red).
- Transport, export packing, escalation, overtime, design changes after approval.
- A subcontract scope that is ticked without an amount.

6.3 MESSAGES YOU MAY SEE

Message	What to do
Add a pipe before this item	Two fittings cannot touch: put a pipe card of at least 20 mm between them.
Straight run is too short for its fittings	The centre-line length is shorter than the fittings on it; check the isometric dimension.
The reducer outlet is the same as the pipe before it	Choose a smaller outlet size, or delete the reducer.
Forward / back are for a vertical pipe	On a horizontal pipe turn up, down, left or right.
MT does not work on stainless steel	Use PT for surface examination of stainless welds.
Hydrotest pressure not given	Enter the test pressure from the client's line list; 15 bar g is used meanwhile.
Larger than a standard truck load	Add a field weld (two spools) or allow for an oversize transport.
... must be more than zero / at most ...	A rate, percentage or crew value is outside the allowed range (Chapter 2).

6.4 FREQUENT QUESTIONS

Does the tool check the pipe for pressure?

No. The design is by others: the wall thickness and class come from the client's pipe class. The tool checks fabrication points only, and says so in the report.

Why is my cut length shorter than the dimension on the isometric?

Isometric dimensions are centre to centre or face to centre. The cut length deducts the fittings and the weld gaps (section 3.2).

Can I use my own prices or hours?

Yes. Type a new value in the bill of materials or the man-hours table in the Cost tab. The report marks the line as set by you and keeps the tool value for reference.

Why does stainless take longer?

Stainless handling and cutting carry a factor of 1.2, welding 1.46, plus 0.6 h per joint for purging and cleaning, and pickling replaces painting.

The price includes transport?

No. The price is ex works: the fabricator's workshop. Transport, unloading and site installation are excluded.

Can two people get the same report from the same inputs?

Yes: the same inputs, engine version and database always give the same numbers and the same check code.

My spool has more than 12 straight runs.

It is usually more than one spool on the isometric. Enter each spool separately, or use Pipeline Spool Fabrication, which splits a whole line into spools.

6.5 GLOSSARY

BE / PE	Bevelled end for a butt weld / plain end for a socket weld	**NDT: RT, UT, MT, PT**	Radiography, ultrasonic, magnetic particle, dye penetrant
BW / SW	Butt weld / socket weld	**NPS**	Nominal pipe size, inch
CoG	Centre of gravity	**PWHT**	Post-weld heat treatment
LR / SR	Long-radius (1.5 D) / short-radius (1.0 D) elbow	**Spool**	A shop-fabricated piece of piping between field joints
MH	Man-hour	**WN / SO / BL**	Weld neck / slip-on / blind flange
MTO	Material take-off	**WPS**	Welding procedure specification

Responsibility. Software output only: must be checked and approved by a qualified engineer. Not engineering advice and not an estimate or quotation.