CNC Step-Over and Passes

How-to guide: what the workbook does, how to use it and what every number means. mfgcalcs.com

CNC Step-Over and Passes

Plan the step-over, passes and cutting time of every milling operation on a part, and check ball-nose finishing passes against a scallop height limit.

For: CNC programmers, machinists, manufacturing engineers and estimators planning milling operations and cycle times.

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Quick start

1. On Setup, type the shop and part, and choose inch or mm for every dimension.
2. On Operations, give each milling operation a row: cutter type and diameter, radial engagement, radial stock, pass length and feed rate.
3. For ball-nose rows, type the scallop height limit the drawing or finish needs; fix anything the Check column names.
4. Open the Dashboard: cutting time and passes by operation, and any finishing pass whose scallop is above its limit.

What is in the workbook

Start Here	Read this first: what the workbook does and how to use it.
Setup	Shop and part, and the length unit every dimension on Operations is typed in.
Operations	One row per milling operation: cutter, engagement and stock in; step-over, passes, final pass, time and scallop out.
Dashboard	Cutting time and passes by operation, and the finishing passes whose scallop is above its limit.
Method	How every number is calculated, with assumptions, limits and sources.
Verify	Self-check: the workbook's formulas recomputed on fixed inputs against an independent reference.

What each number means

Quantity	How it is calculated	Units
Step-over	Cutter diameter x radial engagement.	length unit
Step-over (in), (mm)	In the other unit: mm = in x 25.4; in = mm / 25.4 (exact).	in, mm
Passes	Radial stock / step-over, rounded up. Excel: =ROUNDUP(ROUND(stock / step-over, 9), 0)	passes
Final pass	Radial stock - (passes - 1) x step-over.	length unit

Quantity	How it is calculated	Units
Cutting time	Passes x pass length / feed rate.	min
Scallop height	Ball cutters: R - sqrt(R^2 - (step-over / 2)^2), with R = diameter / 2 (flat surface), x 1,000 to show it in thou (0.001 in) or µm (0.001 mm).	thou, µm
Scallop status	On target at or below the limit; Near target up to 5% above; Above target beyond.	-
Dashboard tiles	Sum of cutting times and of passes; count of Above target; operation with the longest cutting time.	-

Assumptions, limitations, sources and the self-check (the Verify sheet, which recomputes the workbook's formulas on fixed test inputs) are in the workbook. The last page shows the Dashboard with the example data for Halden Precision, a fictional business.

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Engineering estimates for planning and improvement work. Verify the results against your own process, data and standards before you rely on them.

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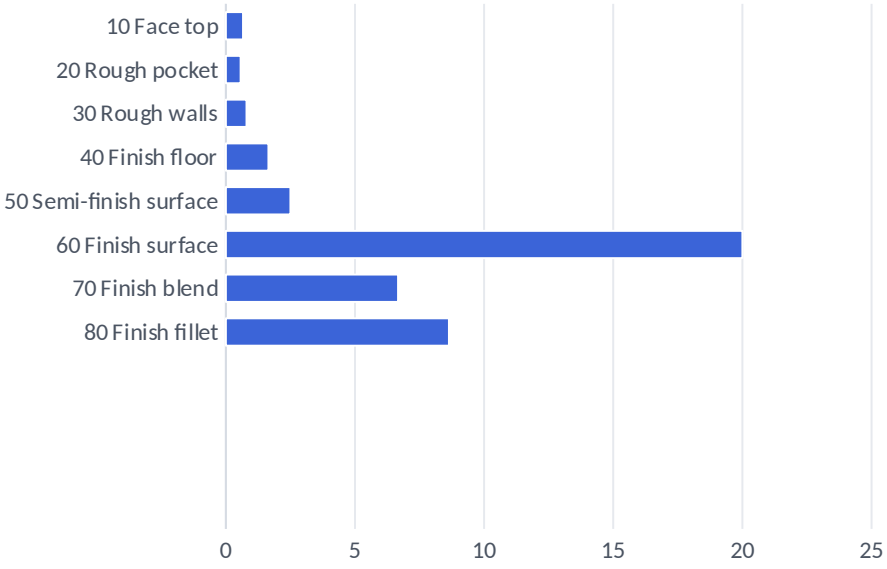
Cutting time and passes by operation, and the finishing passes whose scallop is above its limit.

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Halden Precision (example), Pump housing PH-220, op 1: 8 operations, dimensions in in, cutting time at programmed feed.

CUTTING TIME PER PART (MIN)	PASSES PER PART	OPERATIONS OVER SCALLOP LIMIT	LONGEST OPERATION
41.5	**577**	**1**	**60 Finish surface**
Feed moves of every operation	Every operation	Scallop status Above target	By cutting time

Cutting time by operation (min)



Passes by operation

