// COMPLETE COURSE • 5 MODULES • 32 LESSONS

# CLAUDE FOR MACHINISTS

**Setup sheets, scrap reports, print maths, tool requests and setup prep. Drafted with Claude. Checked by you.**




| 08 | 07 | 06 | 06 | 05 |
|---|---|---|---|---|
| SETUP SHEETS lessons | SCRAP REPORTS lessons | PRINT MATHS lessons | TOOL REQUESTS lessons | SETUP TECH PREP lessons |

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PRACTICAL MANUFACTURING AI

SELF-STUDY COURSE

EDITION 1 • NOVEMBER 2026

# HOW THIS COURSE WORKS

Each lesson takes about fifteen minutes and has the same four parts: the idea, the points that matter, a prompt you can copy into Claude, and a short exercise to do on a real job. Lessons with sums include a worked example you can check on a calculator.

Do the lessons on jobs you are running this week. Reading the course teaches you very little. Using each prompt once on real work teaches you most of it. One lesson a working day finishes the course in about six and a half weeks.

**01** **SETUP SHEETS** — Write a sheet that a setter who has never seen the job can run without phoning you. — 8 lessons

**02** **SCRAP REPORTS** — Report what happened so clearly that the cause can be found and the fix can be checked. — 7 lessons

**03** **PRINT MATHS** — Let Claude explain the method and lay out the working. You check the sums. — 6 lessons

**04** **TOOL REQUESTS** — Ask for tooling in a way that is quick to approve: exact, justified, honest about urgency. — 6 lessons

**05** **SETUP TECH PREP** — Do the thinking before the spindle stops, and leave the next shift a job they can pick up cold. — 5 lessons

**About certificates.** This is a self-study course. It does not come with a certificate, and no certificate would prove much. What you have at the end is a folder of working documents from your own machine: a setup-sheet template, a scrap report, a calculation sheet, a tool request and a handover note. Those are what you show a supervisor or an interviewer.

# FOUR RULES BEFORE YOU START

## 01

### THE DRAWING, THE PROGRAM AND THE MACHINE ARE THE TRUTH

Claude drafts and organises. It has never seen your part. When its text disagrees with the drawing or the machine, the text is wrong.

## 02

### CHECK EVERY NUMBER

Claude can slip on arithmetic, misread a digit in a photo, or state a wrong figure confidently. Ask for the working and redo it on a calculator.

## 03

### PROTECT CONFIDENTIAL INFORMATION

Customer drawings, part numbers and prices belong to someone else. Follow your company's policy on AI tools. If unsure, replace names and numbers with placeholders.

## 04

### NEVER RUN UNPROVEN CODE

Use Claude to explain programs. Anything it writes or changes goes through your shop's full prove-out before a tool gets near a part.

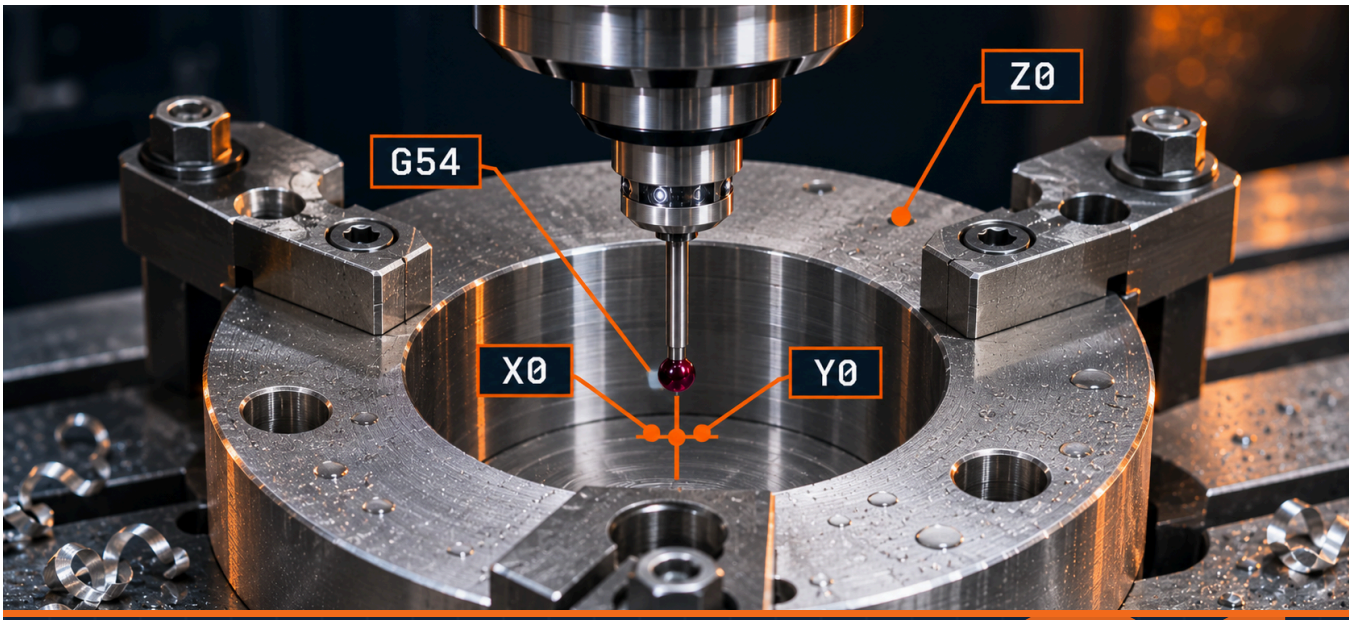
## THE SHAPE OF A GOOD PROMPT

Every prompt in this course is built from the same five parts. Once you see the pattern you can write your own. Anything shown like `[this]` is for you to replace with your own details.

| ROLE | CONTEXT | TASK | RULES | FORMAT |
|---|---|---|---|---|
| Who Claude should act as: a setter, a quality engineer. | The job: part, machine, material, operation. | One clear thing to produce. | What it must not do: guess, round, rewrite. | Table, numbered steps, word limit. |

## THREE PHRASES WORTH MEMORISING

| | |
|---|---|
| **“ASK ME QUESTIONS FIRST.”** | Stops Claude filling gaps with guesses. It interviews you until it has what it needs. |
| **“MARK ANYTHING MISSING AS TO CONFIRM.”** | Makes the gaps in your notes visible on the page instead of hidden behind invented detail. |
| **“SHOW THE WORKING.”** | Turns an answer you have to trust into a calculation you can check. |




// MODULE 01 · 8 LESSONS

# 01 SETUP SHEETS

Write a sheet that a setter who has never seen the job can run without phoning you.

1.1 WHAT A SETUP SHEET MUST ANSWER
1.2 FROM ROUGH NOTES TO A CLEAN SHEET
1.3 DESCRIBING WORKHOLDING AND DATUMS
1.4 THE TOOL LIST
1.5 OPERATION SEQUENCE AND IN-PROCESS CHECKS
1.6 PHOTOS, SKETCHES AND HANDWRITING
1.7 STRESS-TEST THE SHEET
1.8 MASTER TEMPLATE AND REVISIONS

**YOU FINISH WITH** A master setup-sheet template and one finished sheet for a real job.

## 1.1 WHAT A SETUP SHEET MUST ANSWER

A setup sheet is finished when a competent setter who has never run the job can set it without asking anyone. Everything else is decoration.

- **Header**: part number, drawing issue, operation, machine, program number and revision.
- **Workholding**: fixture or vice, jaw type, stops, clamping torque or pressure.
- **Datum**: where zero is, how it is picked up, which work offset.
- **Tools**: pocket number, description, stick-out, holder.
- **Checks**: critical dimensions, gauge, frequency.

- **Known problems**: what went wrong last time and how it was fixed.

PROMPT TO COPY

```
You are an experienced CNC setter writing documentation for a machine shop. I will describe a job. Before you write anything, list the questions a new setter would need answered to run this job without help. Group them under: Header, Workholding, Datum, Tools, Program, In-process checks, Known problems.

Job: [describe the part, machine and operation in two or three sentences]
```

AT THE MACHINE

Take a setup sheet you used this week. Mark each of the six sections as present, missing or unclear. That score is your starting point.

## 1.2 FROM ROUGH NOTES TO A CLEAN SHEET

You already know the job. The slow part is writing it down. Give Claude your notes the way you would say them to a colleague and let it do the structure.

- Type or dictate notes in any order, in your own words.
- Tell Claude not to invent. Missing information must be marked **TO CONFIRM**.
- Ask for one instruction per line, starting with a verb.
- Read every number back against the program and the machine.

PROMPT TO COPY

```
Turn my rough notes into a setup sheet with these sections: Header, Workholding, Datum, Tools, Program, In-process checks, Known problems.

Rules: use only the information in my notes. Where something is missing write TO CONFIRM. Do not guess. One instruction per line, starting with a verb. Metric units.

Notes: [paste your notes]
```

AT THE MACHINE

Count the TO CONFIRM lines. Each one is a question the next shift would have had to come and ask you.

## 1.3 DESCRIBING WORKHOLDING AND DATUMS

Most setup errors are datum errors. “Front left corner” means different things to different people standing at different sides of the machine.

- Write the datum as feature and face: **X0 = left end stop, Y0 = fixed jaw face, Z0 = top of finished part.**
- Say how it is picked up (probe, edge finder, touch-off on a gauge block) and which offset it goes in.
- Say what the part sits on and what locates it. Cast faces vary from part to part, machined faces do not.

- Give clamping order and torque where distortion matters.

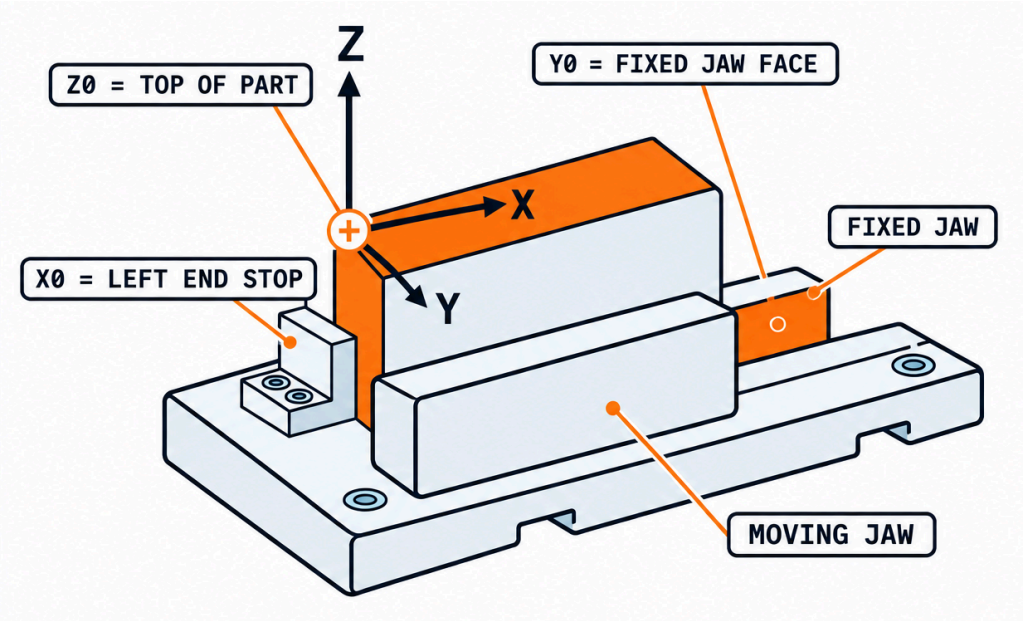



Fig. 1.3 Datum on a vice: each zero is a face, not a corner.

**PROMPT TO COPY**

```
Here is how the part is held and where the datum is: [your description]

Rewrite it so it cannot be misread. Use the pattern 'X0 = …, Y0 = …, Z0 = …'. Then list every
phrase in my original that a new setter could read in two ways, and ask me one question for
each.
```

**AT THE MACHINE**

Hand the rewritten text to a colleague and ask them to point at X0, Y0 and Z0 on the fixture. If they hesitate, the text is not finished.

## 1.4 THE TOOL LIST

A tool list in a table is faster to read at the machine than a paragraph, and it pastes straight into Word or Excel.

- Keep the same columns on every sheet so people know where to look.
- Record minimum stick-out wherever reach or clearance is tight.

- Note sister tools and tool-life counts.

**WORKED EXAMPLE**

| T | DESCRIPTION | Ø MM | MIN. STICK-OUT | HOLDER | NOTES |
|---|---|---|---|---|---|
| 1 | Face mill, 5 inserts | 50 | — | Shell mill arbor | Check all inserts seated |
| 2 | Carbide end mill, 3 flute | 10 | 32 | ER32 | Clears clamp by 4 mm |
| 3 | Carbide drill | 6.8 | 40 | ER32 | For M8 × 1.25 |
| 4 | Machine tap M8 × 1.25 | 8 | 35 | Tapping chuck | Life 400 holes |

**PROMPT TO COPY**

```
Make a tool list table from the information below. Columns: T no., Description, Diameter (mm), Minimum stick-out (mm), Holder, Offset no., Notes. Keep my values exactly as given. If a value is missing, write TO CONFIRM in the cell. After the table, list any tool whose stick-out is more than 4 × its diameter so I can check it for chatter.

Tools: [paste your list, or the tool calls from the program header]
```

**AT THE MACHINE**

Compare every row with the magazine. The machine is the truth, the table is a copy of it.

## 1.5 OPERATION SEQUENCE AND IN-PROCESS CHECKS

A check written at the bottom of the sheet gets done at the end of the batch. A check written directly after the cut gets done after the cut.

- Number the steps in the order you do them at the machine.
- Put each check straight after the step that makes the feature.
- For each check give feature, limits, gauge and frequency.

- Add the reaction: which offset to adjust and who to tell if it is out.

**PROMPT TO COPY**

```
Write the operation sequence for this job as numbered steps. After any step that creates a
critical dimension, add a line in this format:
CHECK – [feature] – [limits] – [gauge] – [frequency] – if out: [action]

Use only the dimensions I give you.
Job steps: [list]
Critical dimensions: [list with tolerances]
```

**AT THE MACHINE**

Every critical dimension on the drawing should appear exactly once as a CHECK line. Count them against the drawing.

## 1.6 PHOTOS, SKETCHES AND HANDWRITING

Claude can read images. A photo of a handwritten sheet or a whiteboard can become typed text in a minute, and a clear photo of the fixture replaces a paragraph.

- Upload a photo of handwritten notes and ask for an exact transcription.
- Ask for a shot list: which photos the sheet needs and what each must show.
- Caption every photo with what to look at.
- Follow company policy on photographing drawings, parts and the shop floor.

**PROMPT TO COPY**

```
I am attaching a photo of my handwritten setup notes. Transcribe them exactly. Mark any word or
number you are not sure about with [?]. Do not correct or complete anything.

Then list the photos this setup sheet needs. For each: what it shows, the angle to take it
from, and a one-line caption.
```

**AT THE MACHINE**

Check every digit against the original. Handwritten 1 and 7, 3 and 8, and decimal points are where transcription goes wrong.

## 1.7 STRESS-TEST THE SHEET

You cannot see the gaps in your own sheet because your memory fills them in. Claude has no memory of the job, which makes it a useful first reader.

- Ask for problems, not a rewrite. You fix the sheet yourself.
- Repeat until the list of questions is short.

- Then run the real test: a colleague sets the job from the sheet alone.

**PROMPT TO COPY**

```
Act as a competent setter who has never run this job and cannot ask anyone. Read the setup
sheet below and list:
1. every point where you would have to stop and ask,
2. anything that could be read two ways,
3. any step where a mistake could cause a crash or scrap and the sheet gives no warning.
Do not rewrite the sheet.

Sheet: [paste]
```

**AT THE MACHINE**

Run this on the sheet for a job that had a setup problem recently. See whether the review finds the gap that caused it.

## 1.8 MASTER TEMPLATE AND REVISIONS

The second sheet should take a quarter of the time of the first. That only happens if the first one becomes a template.

- One template for the shop, same headings every time.
- Revision, date and author in the header, with a one-line change log.
- Store it where the shop controls its documents. A sheet on your phone is not a controlled document.
- Paste the blank template at the start of a new chat so every sheet comes out in the same shape.

**PROMPT TO COPY**

```
Here is my finished setup sheet. Turn it into a blank reusable template. Keep the section
headings and table columns. Replace job-specific content with short placeholders in square
brackets. Add a revision table at the bottom with columns: Rev, Date, Changed by, What changed
and why.

Sheet: [paste]
```

**AT THE MACHINE**

Fill the template in for a second, different job. Anything that does not fit tells you what to fix in the template.

### MODULE 01 RECAP

1. The test of a sheet: a setter who has never run the job sets it without phoning you.
2. Every zero is a face, not a corner: X0 end stop, Y0 fixed jaw, Z0 top of part.
3. Write each check straight after the operation it protects, not at the bottom.
4. Claude fills nothing in: anything you did not give it is marked TO CONFIRM.

**DONE WHEN**

**Your master template is saved and one real sheet has passed a stress test.**




// MODULE 02 · 7 LESSONS

# 02 SCRAP REPORTS

Report what happened so clearly that the cause can be found and the fix can be checked.

2.1 FACTS BEFORE OPINIONS
2.2 DESCRIBE THE DEFECT SO IT CAN BE FOUND AGAIN
2.3 CONTAINMENT
2.4 5 WHYS: CLAUDE ASKS, YOU ANSWER
2.5 THE 6M CHECK
2.6 CORRECTIVE ACTION THAT CHANGES SOMETHING
2.7 RATE, COST AND TREND

**YOU FINISH WITH** A scrap-report template and one completed report with a 5 Whys chain.

## 2.1 FACTS BEFORE OPINIONS

A scrap report that opens with a theory gets argued with. One that opens with facts gets acted on.

- Part, operation, machine, program revision.
- Quantity scrapped out of quantity produced.
- When it was found, by whom, at which check.
- Feature affected, measured values, drawing limits.

- Causes and opinions go in a separate section, later.

**PROMPT TO COPY**

```
Help me write the facts section of a scrap report. Ask me one question at a time until you have: part number and operation, machine, quantity scrapped and quantity produced, when and how it was found, the feature affected, measured values and drawing limits. Then write the facts as short sentences. Do not include causes or opinions.
```

**AT THE MACHINE**

Read the result and delete any sentence containing "probably", "because" or a person's name used as a cause. What is left is your facts section.

## 2.2 DESCRIBE THE DEFECT SO IT CAN BE FOUND AGAIN

"Bore oversize" cannot be investigated. A description with numbers, method and pattern can.

- Give the measured **range**, not one value.
- Say what it was measured with.
- Say where on the part and whether there is a pattern: every part, after a tool change, one fixture station only.

**WORKED EXAMPLE**

| | |
|---|---|
| WEAK | Bore oversize on some parts. |
| STRONG | Ø25 H7 bore (limits 25.000–25.021) measured 25.034–25.041 on 6 consecutive parts with the air gauge. All from fixture station 2. Station 1 parts within limits. |

**PROMPT TO COPY**

```
Rewrite this defect description so an inspector who was not there could find and confirm the same defect: [your description]

Include: feature, drawing requirement, measured range, number of parts, measuring equipment, location on the part, pattern. Where I have not told you something, write NOT RECORDED.
```

**AT THE MACHINE**

Every NOT RECORDED is something to measure or write down next time before the parts leave the machine.

## 2.3 CONTAINMENT

The first question from quality is always the same: where are the suspect parts now? Answer it before they ask.

- Immediate action: machine stopped, parts tagged and separated.
- Suspect quantity: everything from the last good check to the point of detection.

- Location of suspect parts: at the machine, at the next operation, already shipped.
- Who was told, and at what time.

**WORKED EXAMPLE**

Last good check at part 40. Defect found at part 52. Suspect parts are 41 to 52, which is **12 parts**, not just the one you measured.

**PROMPT TO COPY**

```
Write the containment section of a scrap report from these notes: [notes]

Structure: Immediate action / Suspect quantity and how it was defined / Location of suspect parts / People informed, with times. Then tell me whether my notes leave any suspect parts unaccounted for.
```

**AT THE MACHINE**

Add up the located parts. The total must equal the suspect quantity. If it does not, some parts are still out there.

## 2.4 5 WHYS: CLAUDE ASKS, YOU ANSWER

Claude was not at the machine. Ask it for the root cause and you get a plausible guess. Make it the questioner and you get your own knowledge, organised.

- Answer each why with evidence, not a feeling.
- "Operator error" is never the last why. Ask why the error was possible.
- Stop at something a person can change: a method, a setting, a check, a document.
- If the chain splits in two, run it twice.

**PROMPT TO COPY**

```
Act as a quality engineer running a 5 Whys with me. Ask one 'why' at a time and wait for my answer. If my answer is a guess, an opinion, or blames a person, say so and ask what evidence I have. Stop when we reach a cause that someone can change (a method, a setting, a check, a document). Then summarise the chain in five lines.

Problem: [one-sentence defect statement from lesson 2.2]
```

**AT THE MACHINE**

Read the chain from the bottom up, joining the lines with "therefore". If it does not make sense in that direction, a link is missing.

## 2.5 THE 6M CHECK

5 Whys follows one line of thought. The 6M list makes sure you have looked in the other five directions

before you commit.

- **Machine**: warm-up, backlash, coolant concentration. **Method**: program revision, offsets, clamping order.
- **Material**: casting batch, hardness, stock allowance. **People**: training, handover.
- **Measurement**: calibration, technique, part temperature. **Environment**: shop temperature, swarf on locators.

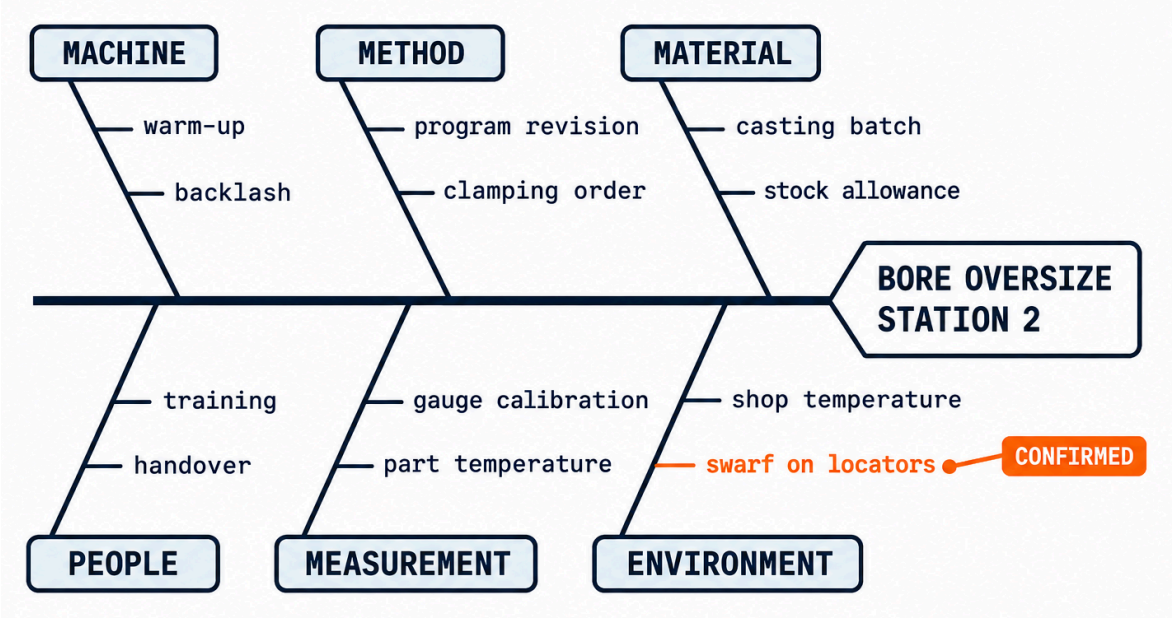



Fig. 2.5 6M check for the station 2 bore defect.

**PROMPT TO COPY**

```
For this machining defect, list possible causes under Machine, Method, Material, People,
Measurement, Environment. No more than four per heading, specific to this process. For each
one, give the quick check that would confirm it or rule it out.

Defect: [description]
Process: [machine, material, operation]
```

**AT THE MACHINE**

Tick only the causes you have checked. In the report, list them in three groups: confirmed, ruled out, not checked.

## 2.6 CORRECTIVE ACTION THAT CHANGES SOMETHING

"Operator reminded to take more care" changes nothing, and everyone reading the report knows it.

- **Correction**: what happens to these parts.
- **Corrective action**: what changes so it cannot happen the same way again.
- **Verification**: how and when you will know it worked.

- Every action has an owner and a date.

**PROMPT TO COPY**

```
Here are my proposed actions after a scrap event: [actions]

For each one, tell me whether it changes the process or only relies on people remembering. Then rewrite each as: Action – Owner – Due date – How we verify it worked. Use a placeholder where I have not given an owner or a date.
```

**AT THE MACHINE**

For each action ask: would this still work on a night shift with an agency setter? If not, it relies on memory.

## 2.7 RATE, COST AND TREND

One scrap report is a story. Ten of them in a table show where the money goes.

- Scrap rate = scrapped ÷ produced × 100.
- Cost = quantity × (material + machining time already spent).
- Sort defects largest first. Two or three types usually account for most of the loss.

**WORKED EXAMPLE**

12 scrapped of 480 produced: 12 ÷ 480 × 100 = **2.5%**.
Each part carries £6.40 material and 9 min at £45/h (£6.75) = £13.15.
12 × £13.15 = **£157.80**.

**PROMPT TO COPY**

```
Here is my scrap tally for [period]: [paste rows: date, part, defect, quantity]

Group by defect type, total each group, sort largest first, and show each group's share of the total and the running cumulative share. Show the arithmetic so I can check it. Then state which defect types account for most of the scrap.
```

**AT THE MACHINE**

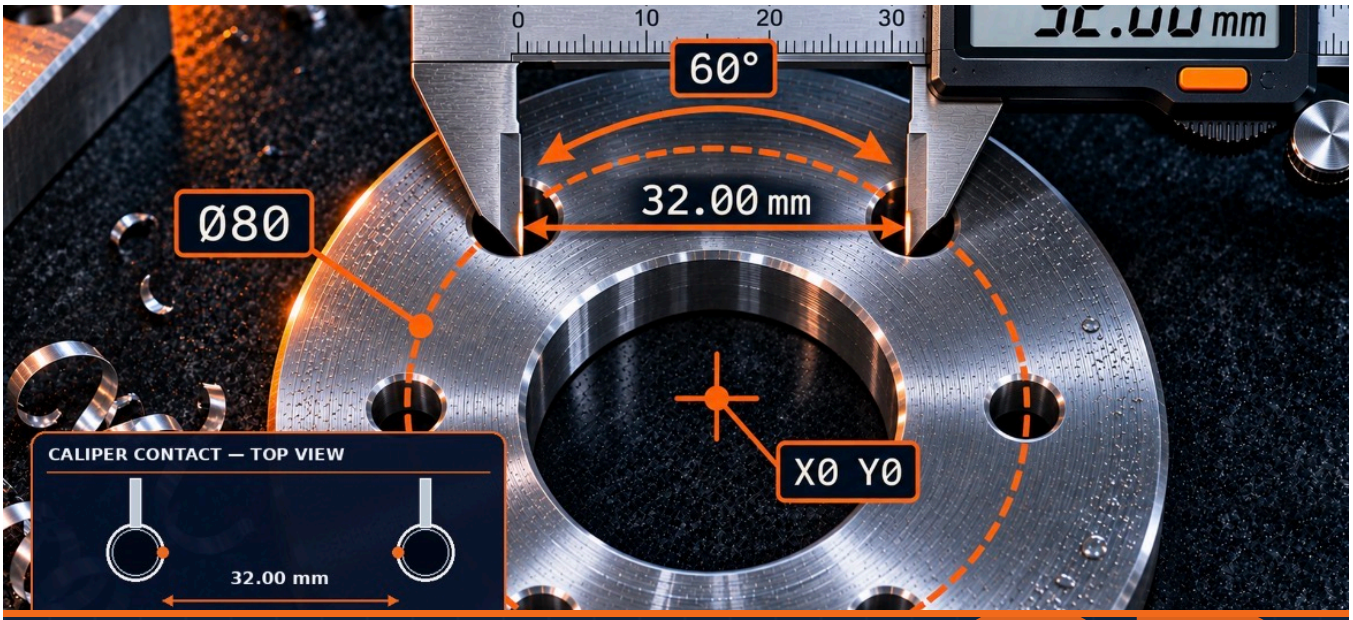
Add the group totals yourself. They must equal the grand total of your tally before you show the table to anyone.

### MODULE 02 RECAP

1. Facts first, theory last. Numbers, method and pattern for every defect.
2. Answer "where are the suspect parts now?" before quality asks.
3. Claude asks the 5 Whys, you answer from the machine. Then run the 6M check.
4. A corrective action changes a part, a program or a sheet, never "take more care".

**DONE WHEN**

**One real report with containment, a 5 Whys chain and an owner for every action.**




// MODULE 03 · 6 LESSONS

# PRINT MATHS

03

Let Claude explain the method and lay out the working. You check the sums.

3.1 LIMITS AND MID-LIMIT TARGETS
3.2 UNITS AND CONVERSIONS
3.3 TRIG ON THE DRAWING
3.4 BOLT CIRCLES AND HOLE PATTERNS
3.5 SPEEDS, FEEDS AND TAPPING
3.6 POSITION, TEMPERATURE AND CHECKING THE CHECKER

**YOU FINISH WITH** A one-page calculation sheet for a real drawing, every line verified with a calculator.

## 3.1 LIMITS AND MID-LIMIT TARGETS

You machine to a target, not to a tolerance. Working out the limits once, on paper, stops you doing it in your head forty times a shift.

- Aim for mid-limit unless wear pushes one way: bores get smaller and outside diameters get bigger as the tool wears.
- For fit codes such as H7 or g6, take the limits from an ISO 286 chart. Use Claude's figures only after checking them against the chart.

**WORKED EXAMPLE**

42.00 +0.05 / −0.02 gives lower **41.98**, upper **42.05**, mid-limit **42.015**, band 0.07.

**PROMPT TO COPY**

```
For each dimension below give: lower limit, upper limit, mid-limit and total tolerance band.
Show the working for each line. Present the result as a table.

Dimensions: [list them exactly as written on the drawing]
```

**AT THE MACHINE**

Check two rows by hand. If both are right the method is right, and you only need to scan the rest for typing errors.

## 3.2 UNITS AND CONVERSIONS

A conversion error is the cheapest mistake to make and one of the most expensive to find.

- 1 in = 25.4 mm exactly. 0.001 in = 0.0254 mm.
- Convert the nominal and the tolerance separately.
- Never round a tolerance to a looser value.
- Surface finish: 1 µm = 39.37 µin, so Ra 1.6 µm is about 63 µin.

**WORKED EXAMPLE**

2.375 in × 25.4 = **60.325 mm**. Tolerance ±0.0005 in × 25.4 = **±0.0127 mm**.

**PROMPT TO COPY**

```
Convert these drawing dimensions from inches to millimetres. Convert the nominal and the
tolerance separately, show the multiplication, and give results to 0.001 mm. Do not round a
tolerance to a looser value.

[list]
```

**AT THE MACHINE**

Sanity check every answer: millimetres should be about 25 times the inch figure. 2.375 in cannot be 6 mm or 600 mm.

## 3.3 TRIG ON THE DRAWING

Chamfers, tapers and drill points are all right-angled triangles. The skill is seeing which triangle; the calculator does the rest.

- Drill point length = (D ÷ 2) ÷ tan(half the point angle). For 118° that is close to 0.3 × D.
- Taper half-angle: tan = (D − d) ÷ (2 × L).

- Ask for the triangle to be described in words before any numbers.

**WORKED EXAMPLE**

Ø10 drill, 118° point: 5 ÷ tan 59° = **3.00 mm** point length.
Taper Ø30 to Ø20 over 40 mm: tan = 10 ÷ 80 = 0.125, half-angle **7.125°**, included angle 14.25°.

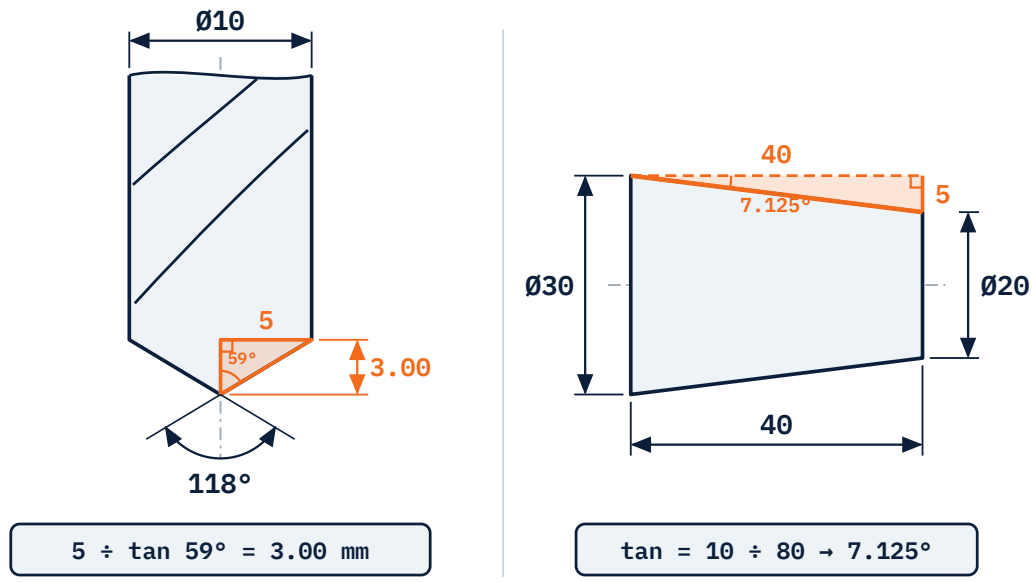



Fig. 3.3 Drill point and taper: the same right-angled triangle, drawn to scale.

**PROMPT TO COPY**

I need to work out **[what you need]** from a drawing. Known values: **[values]**

Explain which triangle to use and which sides I know. Write the formula. Then calculate step by step with units. Finish with a one-line sanity check: is the answer a sensible size?

**AT THE MACHINE**

Sketch the triangle on paper and label it from Claude's explanation. If you cannot draw it, do not use the number.

## 3.4 BOLT CIRCLES AND HOLE PATTERNS

Coordinates for a pitch circle are quick to calculate and quick to get wrong by one sign. Ask for a table and a cross-check dimension.

- X = centre X + R × cos(angle). Y = centre Y + R × sin(angle).
- Always state where the first hole is and which direction angles run.
- Distance between adjacent holes = 2 × R × sin(180° ÷ number of holes).

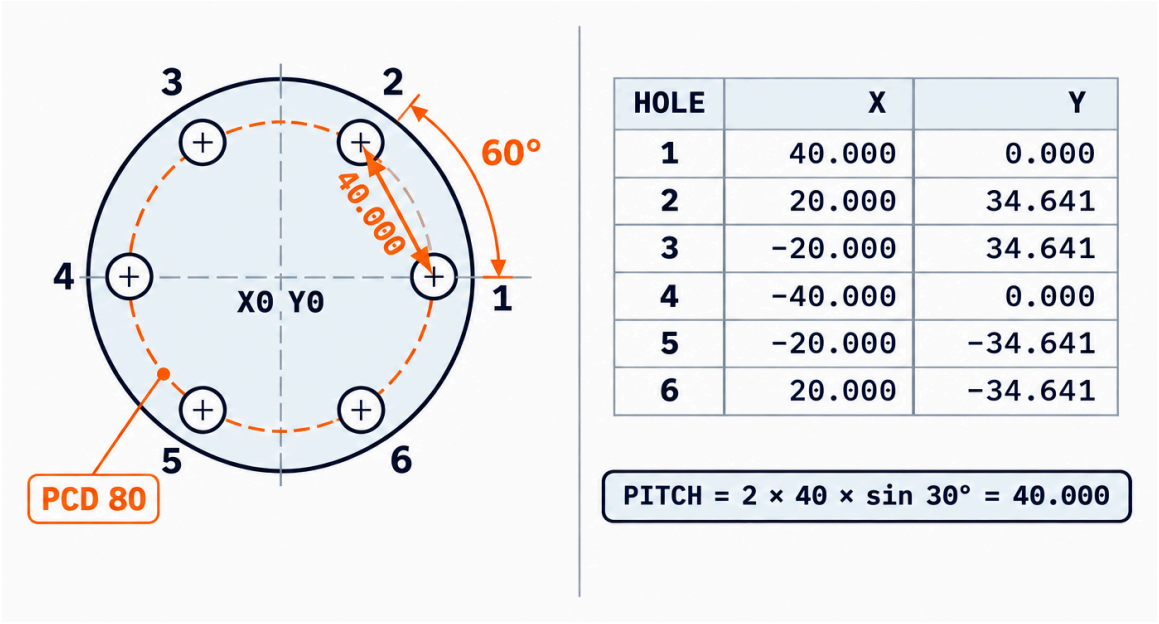
- Calipers measure wall to wall, not centre to centre: measure between the inner walls and add the hole diameter. Ø8 holes at 40.000 pitch read 32.00 on the caliper.

**WORKED EXAMPLE**

6 holes on an 80 mm PCD, centre X0 Y0, first hole at 0°:

| HOLE | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| X | 40.000 | 20.000 | -20.000 | -40.000 | -20.000 | 20.000 |
| Y | 0.000 | 34.641 | 34.641 | 0.000 | -34.641 | -34.641 |

Adjacent holes are 40.000 mm apart, centre to centre.




| HOLE | X | Y |
|---|---|---|
| 1 | 40.000 | 0.000 |
| 2 | 20.000 | 34.641 |
| 3 | -20.000 | 34.641 |
| 4 | -40.000 | 0.000 |
| 5 | -20.000 | -34.641 |
| 6 | 20.000 | -34.641 |

PITCH = 2 × 40 × sin 30° = 40.000

Fig. 3.4 Bolt circle: 6 holes on PCD 80, pitch measured centre to centre.

**PROMPT TO COPY**

```
Calculate X and Y coordinates for [n] holes equally spaced on a [PCD] mm pitch circle. Centre at X[..] Y[..]. First hole at [angle]°, measured anticlockwise from X+. Give a table with hole number, angle, X and Y to 0.001 mm. Then give the straight-line distance between adjacent holes so I can check the part with calipers.
```

**AT THE MACHINE**

Check the signs against a sketch: which holes are left of centre, which are below. Then prove the program in graphics before cutting.

## 3.5 SPEEDS, FEEDS AND TAPPING

The cutting data comes from the tool manufacturer for your material. Claude's job is the arithmetic, not the choice.

- Spindle speed n = Vc × 1000 ÷ (π × D).

- Feed rate = n × feed per tooth × number of teeth.
- Tapping feed = n × pitch. Tapping drill is roughly D − pitch.
- Cap the speed at the machine maximum and recalculate the feed.

**WORKED EXAMPLE**

Ø12 end mill, 3 flutes, Vc 300 m/min, fz 0.08 mm: n = 300 000 ÷ (π × 12) = **7958 rpm**. Feed = 7958 × 0.08 × 3 = **1910 mm/min**.

M8 × 1.25: drill Ø6.8. At 800 rpm the tapping feed is 800 × 1.25 = **1000 mm/min**.

**PROMPT TO COPY**

```
Using the cutting data I give you (do not suggest your own), calculate spindle speed and feed rate.
Tool: Ø[D] mm, [z] flutes.
Manufacturer's data: Vc = [..] m/min, fz = [..] mm per tooth.
Machine maximum: [..] rpm.
Show the formulas and the working. If the calculated speed is above the machine maximum, recalculate the feed at maximum rpm with the same feed per tooth.
```

**AT THE MACHINE**

Compare the result with what the job runs at today. A big difference means a wrong input or a good question for your supervisor.

## 3.6 POSITION, TEMPERATURE AND CHECKING THE CHECKER

Claude can make arithmetic slips and state them with complete confidence. These habits catch them.

- Position error = $2 \times \sqrt{(\Delta X^2 + \Delta Y^2)}$, compared with the diameter tolerance zone.
- Thermal growth = length × coefficient × temperature difference. Aluminium is about 23 µm per metre per °C, steel about half that.
- Always ask for the working, redo it on a calculator, and for anything critical ask again in a fresh chat and compare.

**WORKED EXAMPLE**

Hole measured 0.05 off in X and 0.06 off in Y: 2 × √(0.0025 + 0.0036) = **0.156**. Inside a Ø0.2 position tolerance.

200 mm aluminium part measured 5 °C warm: 200 × 0.000023 × 5 = **0.023 mm** larger than at 20 °C.

**PROMPT TO COPY**

```
Check my calculation. Here is the problem and my working: [paste]

Go through it line by line. Tell me the first line where you disagree and why. If you agree
with all of it, say so and give me one independent way to cross-check the answer.
```

**AT THE MACHINE**

Give Claude a calculation with a deliberate mistake in it. Seeing whether it catches the error teaches you how far to trust it.

## MODULE 03 RECAP

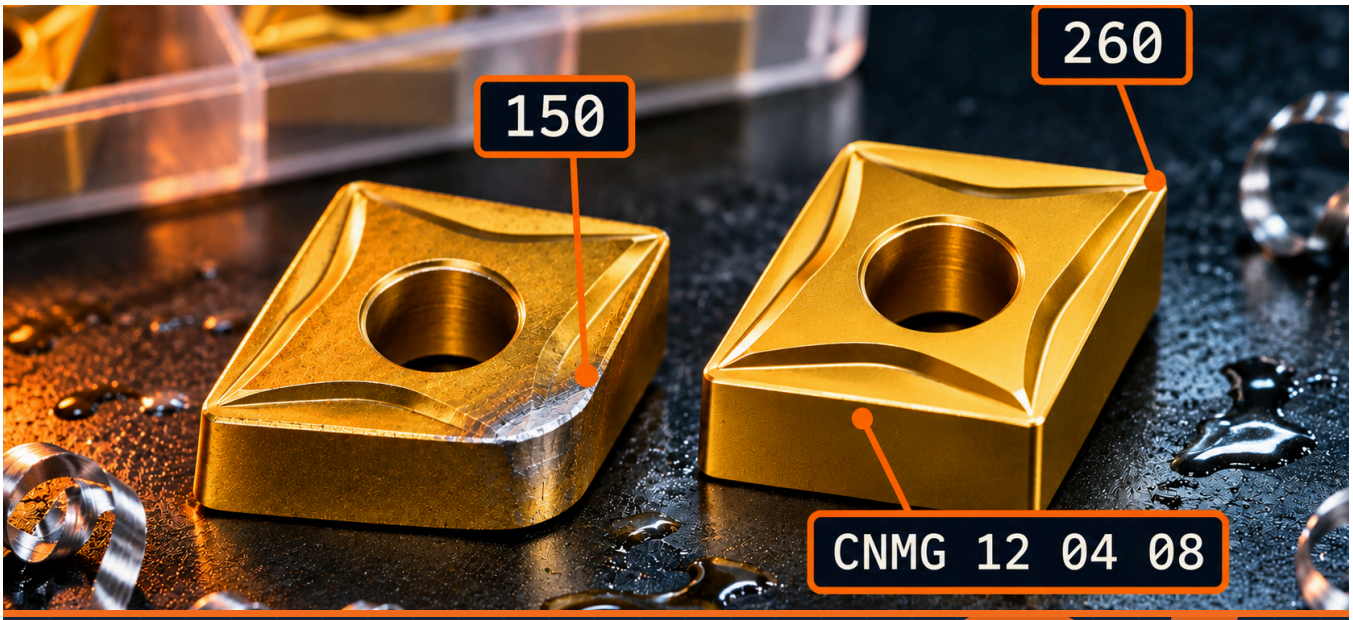
1. You machine to the mid-limit target, not to the tolerance.
2. Ask for the formula and the working, then redo every line on a calculator.
3. Cutting data comes from the tool manufacturer. Claude only does the arithmetic.
4. Calipers read wall to wall: add the hole diameter to get pitch.

**DONE WHEN**

**A one-page calculation sheet for a real drawing, every number checked by you.**

## NOTES

Your machine, your numbers, your questions.




// MODULE 04 · 6 LESSONS

# 04 TOOL REQUESTS

Ask for tooling in a way that is quick to approve: exact, justified, honest about urgency.

4.1 A REQUEST THAT GETS APPROVED
4.2 SPECIFY THE TOOL EXACTLY
4.3 JUSTIFY IT WITH COST PER PART
4.4 URGENCY WITHOUT DRAMA
4.5 TRIAL REQUESTS AND TRIAL REPORTS
4.6 MIN/MAX STOCK LIST

**YOU FINISH WITH** A request template, a cost-per-part comparison and a min/max stock table.

## 4.1 A REQUEST THAT GETS APPROVED

Your supervisor reads requests between other jobs. Put the ask in the first line and the reasons underneath.

- **What**: exact specification, order code, quantity.
- **Why**: the job it is for and the problem it solves.
- **Needed by**: the date, and what happens if it is late.

- **Cost**: price, and payback if you can show one.

**PROMPT TO COPY**

```
Write a tool request to my supervisor. Put the request in the first sentence. Then four short
labelled lines: What, Why, Needed by, Cost. Plain English, no sales language, under 120 words.

Details: [your notes]
```

**AT THE MACHINE**

Read only the first sentence. Could your supervisor say yes or no from that alone? If not, rewrite it.

## 4.2 SPECIFY THE TOOL EXACTLY

"Some more of the turning inserts" produces the wrong box. An order code produces the right one.

- Use the manufacturer's full order code, including grade and chipbreaker.
- Confirm it fits the holder you have.
- Claude can decode ISO designations as a learning aid. Grades and chipbreakers are specific to each manufacturer, so the catalogue decides.

**WORKED EXAMPLE**

**CNMG 12 04 08**: C = 80° rhombic shape, N = 0° clearance, M = tolerance class, G = hole with chipbreaker on both faces, 12 = cutting edge about 12.9 mm (inscribed circle 12.7 mm), 04 = 4.76 mm thick, 08 = 0.8 mm nose radius.

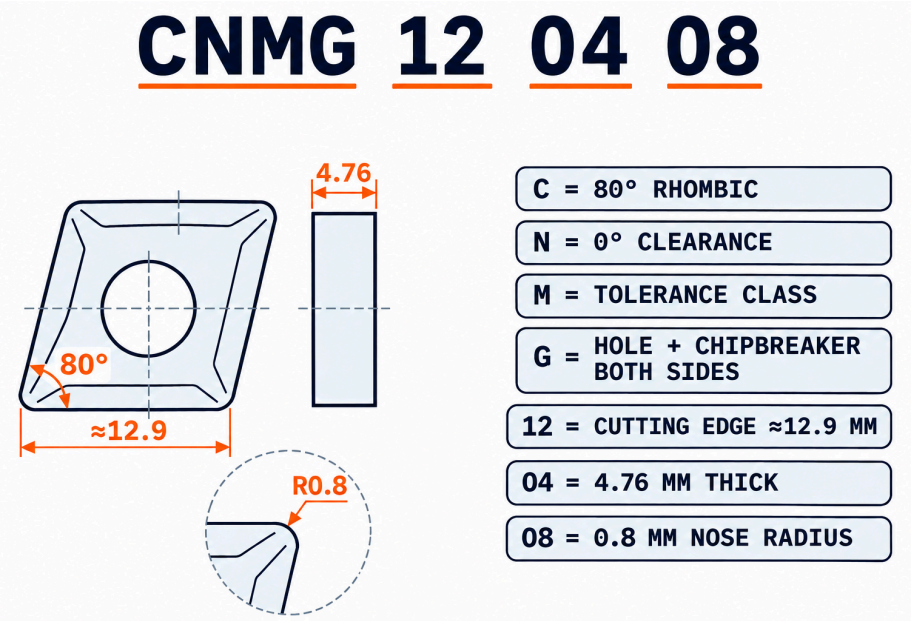



Fig. 4.2 CNMG 12 04 08 decoded. Grade and chipbreaker still come from the catalogue.

**PROMPT TO COPY**

```
Decode this ISO insert designation position by position and explain what each part means:
[code]

Then list what the code does NOT tell me (grade, chipbreaker, manufacturer) that I must add to
make a complete order.
```

**AT THE MACHINE**

Look the same insert up in the manufacturer's catalogue and compare. Any difference between Claude and the catalogue goes to the catalogue.

## 4.3 JUSTIFY IT WITH COST PER PART

A dearer tool that lasts longer is often the cheaper one. Cost per part proves it in one line.

- Cost per part = tool price ÷ (edges × parts per edge).
- Add the downtime from tool changes: it is usually worth more than the insert.
- Use your own measured tool life, not the brochure figure.

**WORKED EXAMPLE**

**Current**: £9.00, 4 edges, 150 parts per edge = 600 parts = **1.50p per part**.
**Proposed**: £12.00, 4 edges, 260 parts per edge = 1040 parts = **1.15p per part**.
At 40 000 parts a year: about £138 saved on inserts, and 113 fewer edge changes. At 3 min each and £45/h that is another £254 of machine time.

**PROMPT TO COPY**

```
Compare two tooling options. For each, calculate cost per part = tool price ÷ (edges × parts
per edge), tool changes per year, and downtime from those changes. Show the working.
Option A: [price, edges, parts per edge]
Option B: [price, edges, parts per edge]
Annual volume: [..]. Change time: [..] min. Machine rate: £[..] per hour.
Finish with a two-sentence summary I can put in a request.
```

**AT THE MACHINE**

Redo the two cost-per-part divisions on a calculator before the numbers go in front of anyone who controls a budget.

## 4.4 URGENCY WITHOUT DRAMA

State the stock, the usage and the lead time and the urgency explains itself. Exaggerate once and your next urgent request waits.

- Days of cover = stock ÷ daily usage.
- Gap = lead time − days of cover.

- Name the job that stops and when.
- Offer two options and say which one you recommend.

**WORKED EXAMPLE**

6 inserts in stock, using 2 a day: **3 days of cover**. Lead time 5 days. **Gap of 2 days** with no inserts unless something changes.

**PROMPT TO COPY**

```
Write a short urgent tooling request. Facts: stock [..], usage [..] per day, supplier lead time
[..] days, jobs affected [..]

Calculate days of cover and the gap. State the consequence factually. Give two options (for
example express delivery, or an alternative tool from stock) and say which I recommend. Under
100 words, no dramatic language.
```

**AT THE MACHINE**

Count the stock yourself before you send it. A request built on a wrong count costs you more credibility than the shortage would.

## 4.5 TRIAL REQUESTS AND TRIAL REPORTS

A tool trial with no plan produces an opinion. A trial with a plan produces a decision.

- Change one thing at a time.
- Agree the pass mark before the trial starts.
- Record every edge: parts made, wear type, finish, cycle time.
- Report in the same layout as the plan.

**PROMPT TO COPY**

```
Help me plan a tool trial.
Current tool: [..]
Trial tool: [..]
Job: [..]

Write: objective, what stays the same, what changes, what I record for each edge, pass/fail
criteria to agree before the trial, and a blank results table.
```

**AT THE MACHINE**

Show the plan to your supervisor before the first cut and get the pass mark agreed. Afterwards the result argues for itself.

# 4.6 MIN/MAX STOCK LIST

The best tool request is the one you never have to mark urgent.

- Minimum stock = daily usage × lead time + safety stock.
- Round reorder quantities up to the pack size.
- Review the figures when volumes or suppliers change.

**WORKED EXAMPLE**

Usage 2 a day, lead time 5 days, safety stock 2 days: 2 × 5 + 2 × 2 = **minimum 14**. Packs of 10, so reorder **20** when stock reaches 14.

**PROMPT TO COPY**

```
Build a tooling stock table from this list: [tool, daily usage, lead time in days, pack size]

Add columns: minimum stock = usage × lead time + safety stock of [..] days' usage; reorder
quantity rounded up to pack size. Show the calculation for the first row so I can check the
method.
```

**AT THE MACHINE**

Compare the calculated minimums with what is in the cabinet today. Anything already below minimum is your next request.

## MODULE 04 RECAP

1. Put the ask in the first line: tool, order code, quantity, date.
2. Cost per part beats unit price. One line of maths ends the argument.
3. Stock, usage and lead time explain urgency better than capital letters.
4. A trial needs a plan and a pass mark before the first part is cut.

**DONE WHEN**

**A request template, a cost-per-part comparison and a min/max stock table.**

## NOTES

Your machine, your numbers, your questions.




// MODULE 05 · 5 LESSONS

# 05 SETUP TECH PREP

Do the thinking before the spindle stops, and leave the next shift a job they can pick up cold.

5.1 PRE-SETUP CHECKLIST FROM THE JOB PACK
5.2 READ THE PROGRAM BEFORE YOU RUN IT
5.3 FIRST-OFF INSPECTION PLAN
5.4 THE PRE-MORTEM
5.5 HANDOVER NOTES

**YOU FINISH WITH** A pre-setup checklist, a first-off inspection sheet and a handover-note template.

## 5.1 PRE-SETUP CHECKLIST FROM THE JOB PACK

Finding out the plug gauge is in calibration after you have stripped the last job is expensive. Finding out an hour earlier is free.

- Paperwork: drawing issue, program revision and route card agree with each other.
- Material, workholding and tooling are at the machine.
- Gauges are available and in calibration date.

- Machine condition: coolant, warm-up, chip conveyor.

**PROMPT TO COPY**

```
From the job information below, build a pre-setup checklist I can tick off before I touch the
machine. Group it: Paperwork (drawing issue, program revision, route card), Material,
Workholding, Tooling, Gauges (calibration in date), Machine condition. Include only items
relevant to this job.

Job information: [paste]
```

**AT THE MACHINE**

Time your next changeover with the checklist done in advance. Compare it with your usual time for a similar job.

## 5.2 READ THE PROGRAM BEFORE YOU RUN IT

A program you understand is one you can prove out with confidence. Claude is a patient explainer of code you did not write.

- Always name the control: Fanuc, Heidenhain, Siemens and Mazak read the same letters differently.
- M-codes and macros are set by the machine builder. The machine manual wins every time.
- Never run code that Claude wrote or changed without your shop's full prove-out: graphics, single block, reduced rapid, hand on feed hold.

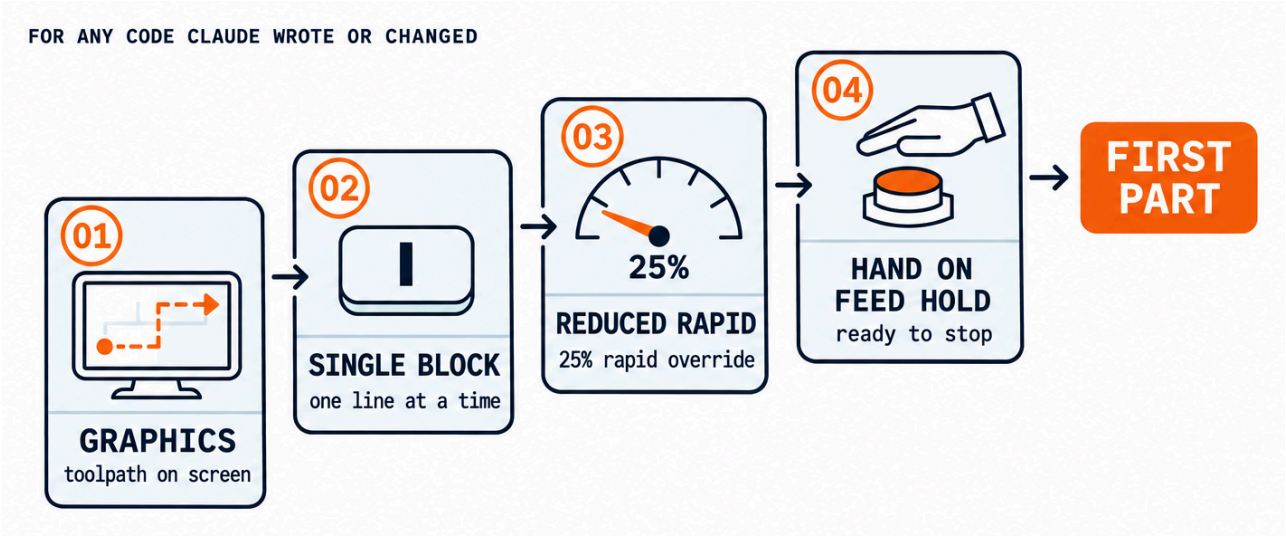



Fig. 5.2 Prove-out order for any program Claude wrote or changed.

**PROMPT TO COPY**

```
Explain this CNC program section line by line in plain English. Control: [make and model]

For each line: what the machine does and where the tool ends up. Flag any line whose meaning depends on the machine builder (M-codes, custom macros) as CHECK MANUAL. Do not modify the code.

[paste the section]
```

**AT THE MACHINE**

Follow the explanation with the program in graphics or single block. Where the machine and the explanation disagree, the machine is right.

## 5.3 FIRST-OFF INSPECTION PLAN

A first-off checked from memory misses the dimension nobody likes measuring. A sheet does not.

- Every drawing dimension with a tolerance gets a row.
- Limits are worked out on the sheet so nobody does sums at the bench.
- Rows are in measuring order, grouped by gauge.

**PROMPT TO COPY**

```
Create a first-off inspection sheet from these drawing dimensions: [feature, nominal, tolerance]

Columns: No., Feature, Nominal, Lower limit, Upper limit, Gauge, Measured, Pass/Fail. Calculate the limits and show them. Put the rows in the order I would naturally measure the part, grouped by gauge.
```

**AT THE MACHINE**

Count the rows against the toleranced dimensions on the drawing, then check three sets of limits by hand.

## 5.4 THE PRE-MORTEM

Before the first cut, assume it went wrong and ask why. Five minutes of pessimism is cheaper than a fixture repair.

- Claude's list is general experience. Add what you know about this machine and this fixture.
- Pick the top three risks and decide the check for each.

- Write them into “Known problems” on the setup sheet.

**PROMPT TO COPY**

```
This job is set up as follows: [part, material, workholding, tools, critical features]

Imagine the first-off was scrapped or the machine crashed. List the eight most likely reasons
for this specific setup, most likely first. For each: the early warning sign, and the check
that prevents it. Two lines each.
```

**AT THE MACHINE**

After the job has run, mark which risks were real. Over a few months this becomes your own list, better than any generated one.

## 5.5 HANDOVER NOTES

At the end of a long shift, writing is the last thing you want to do. Say it into your phone and let Claude lay it out.

- Job status: quantity done, quantity left.
- Last inspection result and the time it was taken.
- Offsets changed: which, how much, why.
- Problems, what was tried, and the first thing to do next shift.

**PROMPT TO COPY**

```
Turn these end-of-shift notes into a handover note. Headings: Job status / Last inspection
result and time / Offsets changed (which, how much, why) / Problems and what was tried / First
thing to do next shift. Keep my numbers exactly. Short lines. If I have not mentioned one of
the headings, write NOT STATED so I can add it.

Notes: [paste or dictate]
```

**AT THE MACHINE**

Ask the next shift one question tomorrow: was anything missing? Their answer improves the template faster than anything else.

### MODULE 05 RECAP

1. Check gauges, tools and material from the job pack before the spindle stops.
2. Read every program Claude wrote or changed before you prove it out.
3. First-off from a sheet, not from memory, grouped by gauge.
4. Five minutes of pre-mortem is cheaper than one scrapped fixture.

**DONE WHEN**

**A pre-setup checklist, a first-off inspection sheet and a handover template.**

# FINAL PROJECT: ONE JOB, START TO FINISH

Pick one real job that you set regularly. Build the full document pack for it using what you made in each module. This is the piece of work that shows you can do it.

**01** **PRE-SETUP CHECKLIST AND PRE-MORTEM** (lessons 5.1, 5.4). Top three risks written into the setup sheet.

**02** **SETUP SHEET** on your master template (module 1), stress-tested with lesson 1.7 and then set by a colleague from the sheet alone.

**03** **CALCULATION SHEET** (module 3): limits and mid-limits for every critical dimension, speeds and feeds from the manufacturer's data, every line checked by calculator.

**04** **FIRST-OFF INSPECTION SHEET** (lesson 5.3), filled in for a real first-off.

**05** **ONE TOOL REQUEST** for this job with a cost-per-part comparison (lessons 4.1, 4.3).

**06** **ONE SCRAP REPORT** for a past problem on this or a similar job, with containment, a 5 Whys chain and actions that have owners and dates (module 2).

**07** **A HANDOVER NOTE** written at the end of a real shift on this job (lesson 5.5).

KEEP IN TOUCH

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# FORMULA SHEET

| | |
|---|---|
| **LIMITS** | Lower = nominal + lower deviation. Upper = nominal + upper deviation. Mid-limit = (lower + upper) ÷ 2. |
| **INCH TO MM** | mm = in × 25.4. Convert nominal and tolerance separately. |
| **SURFACE FINISH** | µin = µm × 39.37. Ra 0.8 ≈ 32 µin, Ra 1.6 ≈ 63 µin, Ra 3.2 ≈ 125 µin. |
| **SPINDLE SPEED** | n (rpm) = Vc (m/min) × 1000 ÷ (π × D mm). |
| **FEED RATE, MILLING** | vf (mm/min) = n × feed per tooth × number of teeth. |
| **TAPPING** | Feed = n × pitch. Tapping drill ≈ nominal diameter − pitch. |
| **DRILL POINT LENGTH** | (D ÷ 2) ÷ tan(point angle ÷ 2). About 0.3 × D for a 118° point. |
| **TAPER HALF-ANGLE** | tan(half-angle) = (D − d) ÷ (2 × L). |
| **BOLT CIRCLE** | X = Xc + R × cos(angle). Y = Yc + R × sin(angle). Adjacent holes: 2 × R × sin(180° ÷ n). |
| **POSITION ERROR** | 2 × √(ΔX² + ΔY²), compared with the diameter of the tolerance zone. |
| **THERMAL GROWTH** | ΔL = L × α × ΔT. Aluminium ≈ 23 µm per m per °C. Steel ≈ 12 µm per m per °C. |
| **SCRAP RATE** | Scrapped ÷ produced × 100. |
| **COST PER PART** | Tool price ÷ (edges × parts per edge). |
| **DAYS OF COVER** | Stock ÷ daily usage. Gap = lead time − days of cover. |
| **MINIMUM STOCK** | Daily usage × lead time + safety stock. |

**Keep the limits in view.** Cutting data, fit tolerances and insert grades in this course are there to show the method. For real work, take the values from the tool manufacturer, the ISO chart and your own drawing.

# SELF-ASSESSMENT

Tick a box only when you have done it on real work, not when you have read about it.

- [ ] A colleague set a job from my sheet without asking me anything.
- [ ] My datum descriptions use the X0 / Y0 / Z0 pattern.
- [ ] I mark missing information TO CONFIRM instead of letting Claude guess.
- [ ] My scrap reports keep facts and causes in separate sections.
- [ ] I can state suspect quantity from last good check to detection.
- [ ] I have run a 5 Whys that ended on something changeable.
- [ ] Every corrective action I write has an owner, a date and a check.
- [ ] I calculate limits and mid-limits before the first cut.
- [ ] I have caught Claude in a calculation error at least once.
- [ ] I take cutting data from the manufacturer, not from Claude.
- [ ] My tool requests put the ask in the first sentence.
- [ ] I can show cost per part for two tooling options.
- [ ] I name the control when I ask about a program.
- [ ] I have never run generated code without a full prove-out.
- [ ] The next shift told me my handover note was enough.
- [ ] I have not pasted anything my company's policy forbids.

# PROMPT INDEX

| | |
|---|---|
| **NEED A DOCUMENT** | 1.2 notes to setup sheet · 1.4 tool table · 1.8 template · 5.1 checklist · 5.3 first-off sheet · 5.5 handover |
| **NEED A SECOND PAIR OF EYES** | 1.3 datum wording · 1.7 stress test · 3.6 check my calculation · 5.4 pre-mortem |
| **SOMETHING WENT WRONG** | 2.1 facts · 2.2 defect description · 2.3 containment · 2.4 5 Whys · 2.5 6M · 2.6 actions · 2.7 trend |
| **NEED A NUMBER** | 3.1 limits · 3.2 conversions · 3.3 trig · 3.4 bolt circle · 3.5 speeds and feeds · 4.3 cost per part |
| **NEED TOOLING** | 4.1 request · 4.2 specification · 4.4 urgent request · 4.5 trial plan · 4.6 stock list |
| **NEED TO UNDERSTAND CODE** | 5.2 line-by-line program explanation |

# AI SUGGESTS.
# YOU VERIFY.




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