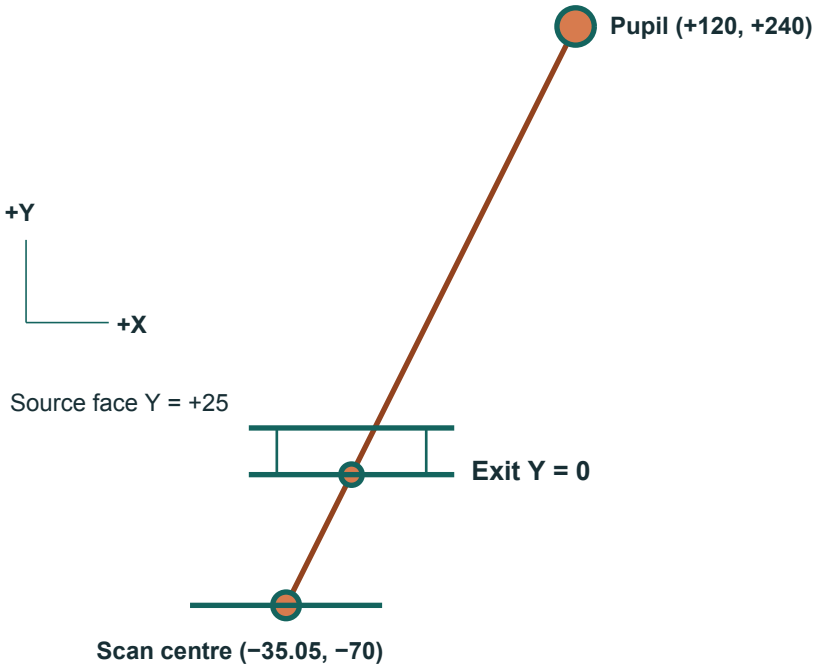
# One fixture, five interchangeable states

SQ and RECT are the two recesses. Each has its own matched thin reference. A solid shutter measures stray background.

## 01 / ON THE TABLE




PLAN / X and Y in mm. All three optical centres are at Z = 120. X is lateral and Z points up. A left-to-right mirror on a drawing changes the physical test.

### Preserve the datum

Every measurement uses the same seat. With the axis toward the source, the exit is at (0, 0, 120), the opposite face at Y = +25. Install the rectangle's 50 mm span along X.

### Make the trial before the matched pair

Use the four-piece wall construction on sheet 2. Assemble a trial square or corner coupon with the shop's actual finish and fastening process; measure it after disassembly and remount.

### Build the station and references

Make one uncommitted base footprint, one fixture, one reference frame and three interchangeable foils. The extra CAD copies of the frame illustrate alternate configurations.

### What the exchange set contains

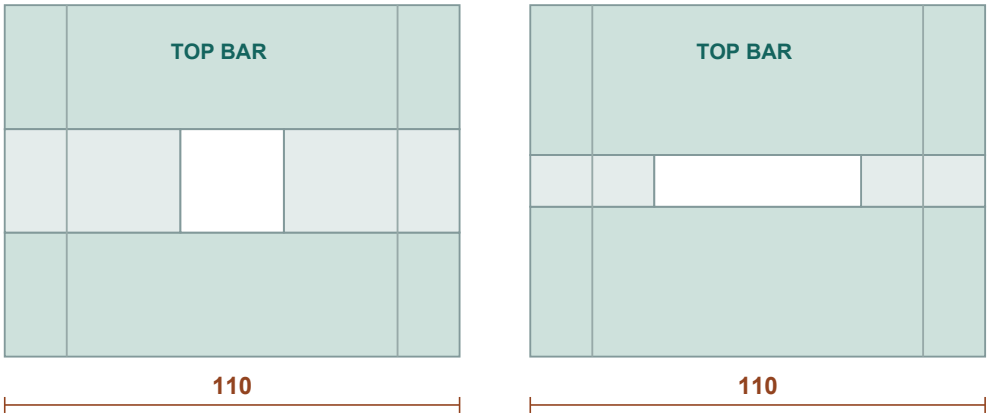
Six metric STEP assemblies. A1_SQ and A1_RECT each contain four wall bars. A2_SQ, A2_RECT and A2_DARK each show one reference state. A3 is the proposed fixture with three swing fingers. Inspect each mass and datum after import.

## Start with a dry fit and source-off station alignment.

The existing 560 × 500 × 10 base is the datum reference. Keep its lens, receiver and stage drilling open until the selected parts and the vertical-load envelope are checked.

# A1 / Two four-wall cassettes

View in X–Z, with +X toward the right and +Z up. Datum A is the detector-facing end of every bar at Y = 0.




**SQ 25.00 × 25.00** **RECT 50.00 × 12.50**

85.00 high × 25.00 deep for both. Two long caps span the whole 110 width. The two side blocks butt against the cap seats. Their inward faces create continuous walls for the full depth.

Material proposal: machinable aluminium plate. Dark, matte finish on four exposed inward wall faces. Mask the joint lands, external contact faces and threads. Prepare a witness coupon with the same coating. Measure coated openings.

## Four tie rods parallel to Z

Ø3.4 through at X = ±40.0, Y = 6.5 and 18.5. Drill or line-drill in a 110-wide jig. Counterbore Ø8.0 × 4.5 deep from top and bottom outside faces. Dry-assemble rods, nuts and washers below both roll faces.

## Size the finished opening first

Nominal stocks appear on sheet 5. Coat thickness c on each inward face reduces a bare span by 2c. Size or selectively fit the bars to gauge after finishing. Keep clamp lands bare. Keep all machining breaks off the optical edges and record residual radius.

## Candidate first-article limits

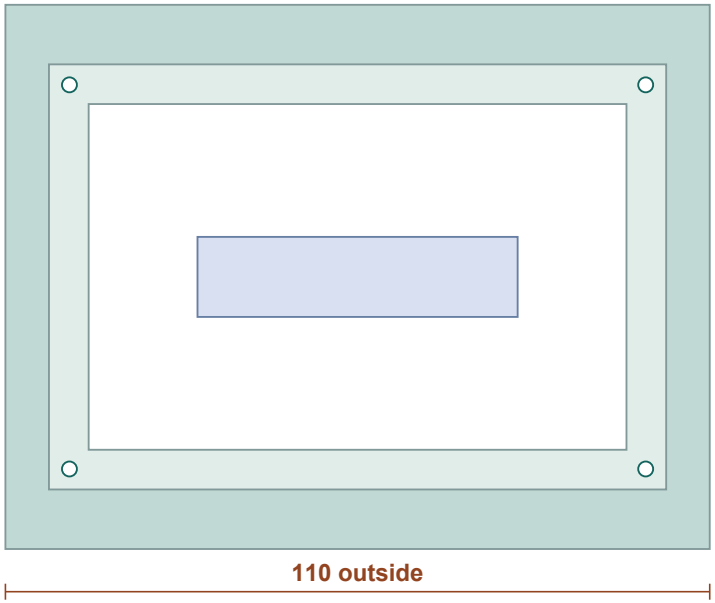
W, H and depth ±0.05 at each end. Face-to-face W/H change ≤0.05. Front and rear centres within 0.10 of each other. End-face step or upstream/downstream taper >0.05 requires a disposition. Inspect internal bow independently.

## Assembly and roll

Clamp bars against a flat datum while tightening rods in a cross pattern. Use a known spacing gauge. Record clamp setting and before/after clear dimensions. ID each finished component. Lift the rectangle clear, turn 180° about Y, reseat and remeasure.

# A2 / Matched reference and shutter

One common holder carries three foils. The downstream foil face reproduces the exit datum. Swap foils with the holder removed.




Sources behind the page, coordinates as sheet 2.

Blue area shows RECT foil opening. White shows the larger support window behind the foil. The foil covers the support window everywhere outside its own opening. Corners of foil blank clipped 2 × 45°.

## Holder, 1 required

Outside 110 × 85 × 25. Mill centred 84 × 54 through window (R ≤2.5 inside corners). Downstream pocket 96.4 × 66.4, R ≤1.5; depth to match measured foil thickness, nominal 0.10. Separate mounting lands from the opening.

## Foils, one of each

Start with 96 × 66 × 0.10 opaque sheet. Cut centred 25 × 25, 50 × 12.5 or no opening. Four Ø2.4 holes at (X,Z−120) = (±45, ±30). In the holder, M2 × 0.4 at these positions, ≥4 full threads. Deburr and inspect both foil edges. Keep faces flat when the four screws are tightened.

## Seating and illumination

Check installed foil exit plane at four rim points; candidate deviation ±0.05 from Y = 0. Measure foil thickness, edge radius and shape for attenuation correction. The 84-wide window at Y = +25 leaves 3.39 mm lateral margin for direct rays from the rectangular exit.

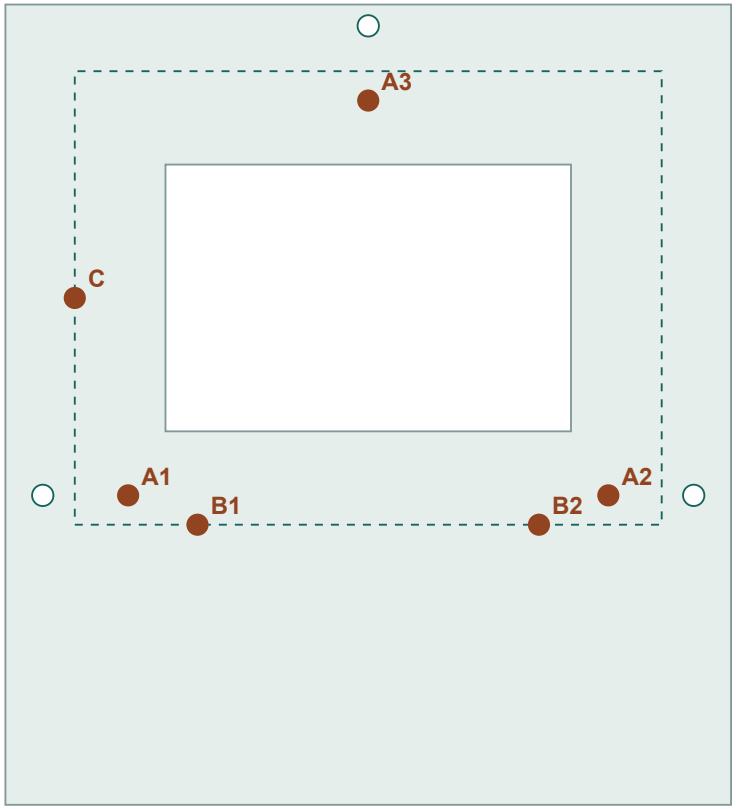
## Handling

Use low-profile washers, maximum outside Ø5, under the four M2 screws. Maximum total projection toward the detector 3.5. The fixture has four Ø8 × 3 counterbores opposite the fixings. Record serial, thickness, finish and orientation after each change. Sight through against a dark surrounding screen. Test shutter background with the source on.

# A3 / Common datum and retention

View in X–Z. Three end contacts, two bottom contacts and one side contact locate the carrier. The swing fingers apply seating force.

**Filled markers = contact tips. Open rings = finger pivots.**




**Dashed rectangle = 110 × 85 cassette perimeter.**

## Locate on six points

A tips at (X,Z−120) = (−45,−37), (+45,−37), (0,+37); set tips to Y = 0. B ledge top Z = 76.5, B tips at X = ±32, Y = 12.5, finish Z = 77.5. C tip touches X = −55 at Y = 12.5, Z = 120. Use flat-ended adjustment screws with locks.

## Apply controlled opposing forces

Gravity seats B. A soft-tipped adjuster on the opposite ledge seats C. Three swing fingers press toward −Y over A. Pivots (X,Z−120) = (±61,−37), (0,+51); use M4 posts with spacers and finger nuts. Set spacer below the 25 mm source face, then check the minimum holding load and release travel.

## Tie the fixture to the base

Solid plate spans X ±68, Y −9 to −1 and Z 25–175. At the foil fixings, counterbore Ø8 × 3 from Y = −1. Shelf and ledges butt to Y = −1. Foot is 155 × 75 × 15. Use two M4 screws from the underside, X ±54, Y = −5. Choose screw length and engagement before cutting. Inspect fixture stiffness under actual load.

## Check both directions of light

Rear plate through window 76 × 50 is centred on the exit. Conservative direct-ray lateral clearance is 8.10 mm at Y = −9. Left, right and bottom elements stop short of the optical envelope. Confirm the actual retaining hardware, coating and oblique light path on the assembled instrument.

# Cut list and joining details

Stock is finished nominal geometry. X = width, Y = depth, Z = height. Coating thickness and machining allowances are shop inputs.

| Item / quantity | Finished geometry (mm) | Operations / release note |
|---|---|---|
| SQ caps ×2; sides ×2 | Caps 110 × 25 × 30. Sides 42.5 × 25 × 25. | Four Ø3.4 tie passages per assembled cassette. Counterbores at both external ends. Blacken optical faces. |
| RECT caps ×2; sides ×2 | Caps 110 × 25 × 36.25. Sides 30 × 25 × 12.5. | Use the same 110-wide assembly jig. Final coated opening governs over individual stock sizes. |
| Reference body ×1; foils ×3 | Body 110 × 25 × 85. Foils 96 × 0.10 × 66. | One window, one rebate, four M2 taps. Foil apertures and edges per sheet 3. |
| Fixture plate ×1; foot ×1 | Plate 136 × 8 × 150. Foot 155 × 75 × 15. | Plate: M4 × 0.7 tips/pivots and two foot taps. Foot: two Ø4.5 through, bottom Ø8 × 5 deep. Four mounting Ø5.5 at X ±63 and Y −12, +45; base drilling held. |
| Bottom ledge ×1; side ledges ×2 | Bottom 124 × 27 × 6. Sides 6 × 27 × 40. | Six M3 fasteners total. Plate Ø3.4 through. Ledges M3 × 0.5, ≥6 full threads, pilot 9 deep. Axis +Y; (X,Z) = (±31,73.5), (±59,108), (±59,132). |
| Fingers ×3; posts and spacers ×3 | Side 22 × 3 × 8. Upper 8 × 3 × 20. | Ø4.5 pivot, M4 post and thumb nut. Smooth the pressure face. Trial spacer length ≈25.75 from plate; trim for gentle seating and service clearance. |
| Rods ×8; nuts + washers ×16 ea. | M3 threaded stock, cut 82; check before final cut. | Two ends per rod. Nominal 1.5 recession on each roll face. Match nut/washer stack to Ø8 × 4.5 recess. |
| Locator screws ×6; side pusher ×1 | Six M4 × 0.7 flat tips + locks. One compliant M4 pusher. | Adjust and lock contact heights. Confirm thread, tip diameter and travel on supplied hardware. Other hardware: six M3 ledge screws, two M4 foot screws, four M2 foil screws and four M5 foot fasteners. |

All tap-drill bores in STEP represent nominal minor-hole tooling and omit helical threads. Select fastening length so that tips do not bottom, interfere with light or project into other components. Inspect datum flatness before final finish.

# First-article inspection and release

Use one dated sheet per specimen or fixture. Record actual values, instrument ID, resolution and uncertainty with the measurements.

| Check and method | Candidate first-article decision | As-built reading / file ID |
|---|---|---|
| Cassette SQ / RECT and serial | Measure W and H at both faces at three locations. Check multiple intermediate wall positions with profile access or disassembled straightedge. Record seam/radius and coating. | ID _____ |
| Depth, taper and centre | Measure four corner depths, profile both face centres, photograph rims. Evaluate the sheet 2 limits. If exceeded, log the deviation or rework before treating this as a nominal part. | Depth _____ / _____ / _____ / _____ |
| Reference plane and aperture | Measure thickness and W/H for each foil. Inspect four rim positions after tightening, check curl and measured centre. Confirm holder aperture is unobstructed from both sides. | SQ _____ RECT _____ DARK _____ |
| Station repeatability | Seat, indicate, remove and reinstall ≥5 times; repeat with rectangle rolled 180°. Record centre X/Z, A plane at ≥3 points, clamp setting and instrument uncertainty. Trial criterion: total range ≤0.10 in each centre coordinate and ≤0.05 at each plane point. | Run file _____ |
| Source + detector clearance | Condenser outside Ø75, nominal clear Ø72; layout requires ≥65.96 clear for modeled direct rays. Test real retainer/baffles. Check Y = −70 receiver, useful X ≥100 / Z ≥75. With cable and actual payload run corners, endpoints and homing. | Fixture / head revision _____ |
| Base / physical build release | Fit real parts or certified outlines before base drilling. Check source alignment, all five states and aperture service access. Confirm no fastener proud at either end of roll, zero visible gaps and repeatable seat after tightening. | Shop _____ Owner _____ |

Engineering allowance: using the independent ±0.05 mm W/H/depth limits in the ideal straight-bore model, a worst-slope derivative estimate gives ≤0.00235 transmission units for SQ and ≤0.00130 for RECT. It excludes orientation, wall bow, scatter, coating, illumination, seating and metrology. Actual uncertainty needs the measured geometry and input covariances.

References: 27 Oct SolidWorks planning geometry and layout calculations; 28 Oct build guide; 31 Oct first-build traveler; the 27 Oct working revision 7 experiment card. The six proposed STEP files are separate from the earlier planning assembly.