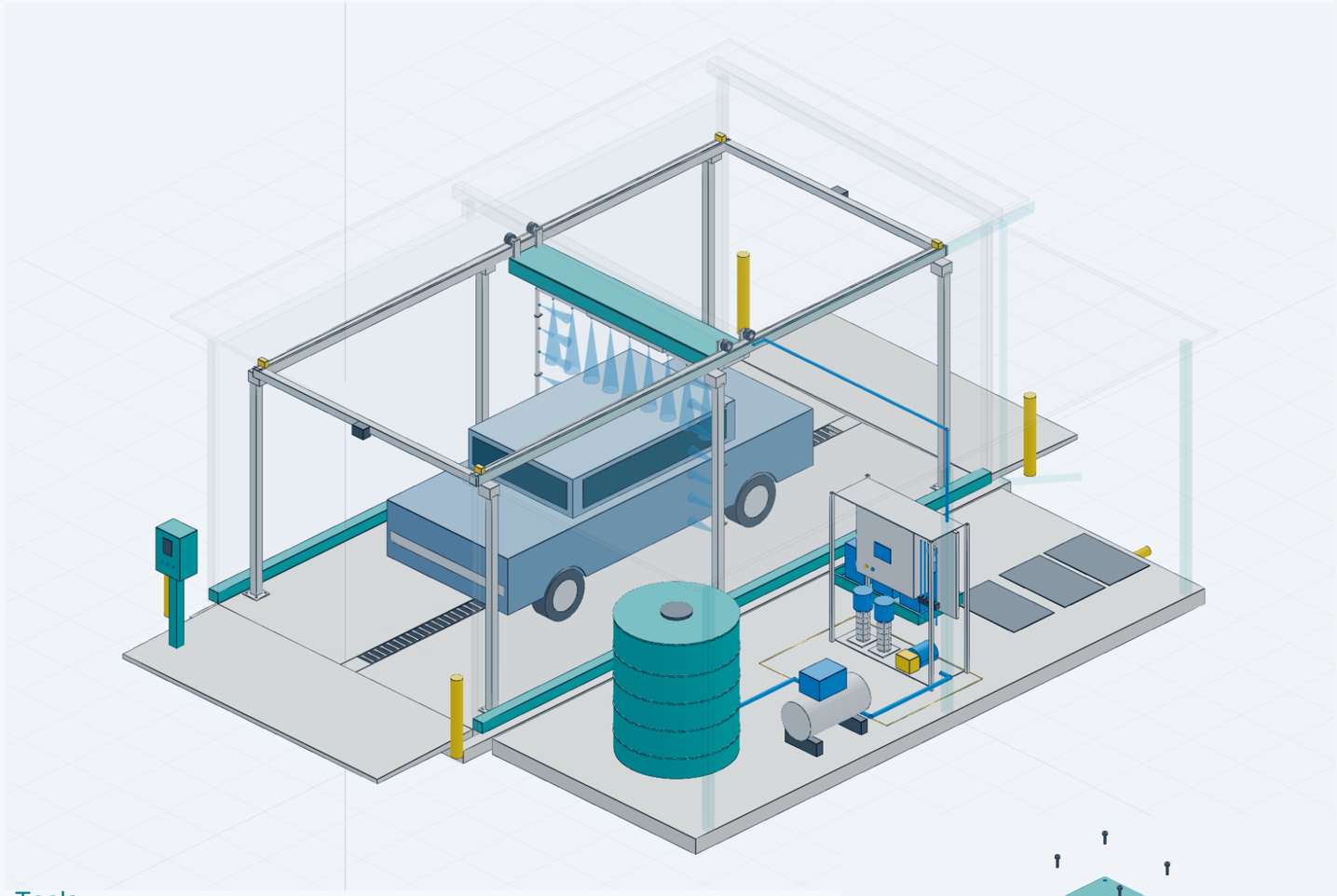
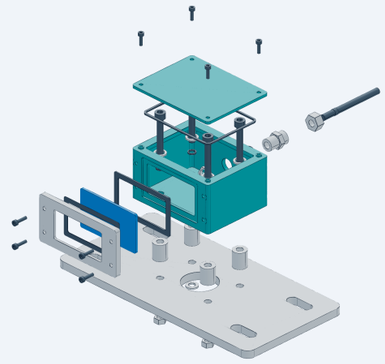
Carwash CAD study

Mechanical assembly, part design and installation planning.





Tools

Python / build123d / OpenCascade / cadgen
STEP / DXF / Three.js

Review the work

Project brief
Plan an automatic carwash bay around a parked vehicle, with a travelling spray carriage, service equipment and an adjustable sensor mount. Produce editable CAD assemblies, dimensioned drawings and an interactive presentation.

Role
Stefan McFeeters / Project direction and AI-assisted CAD development: reference research, parametric modelling, assembly detailing, drawing production, geometric verification and presentation.

CAD capabilities
Parameter-driven part design; multi-part assemblies; mounting and sealing interfaces; section views; equipment layouts; STEP and DXF exchange; and five illustrative motion sequences.

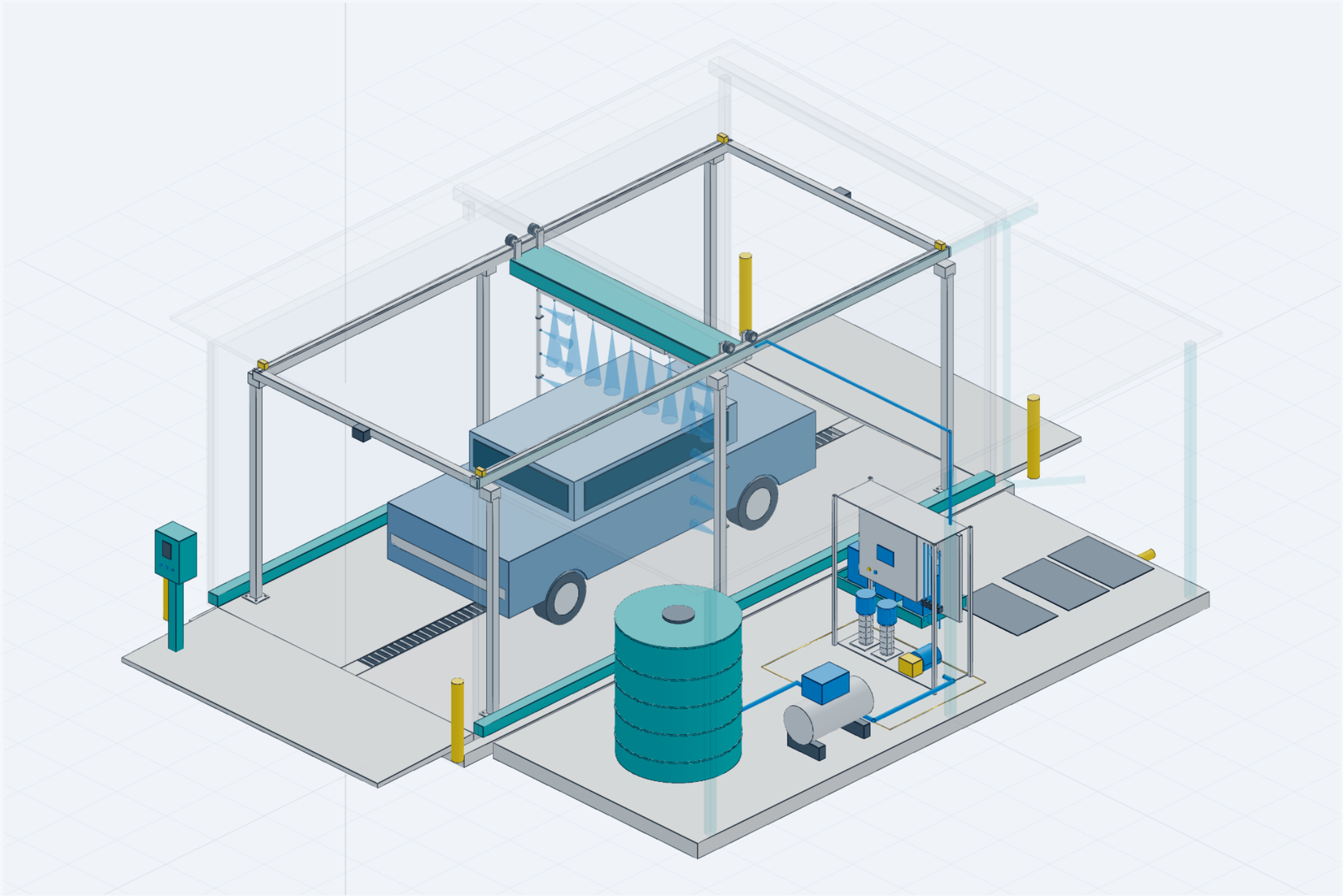
Deliverables
A public 3D viewer, editable CAD source, two mounting-plate variants, exchange files and this nine-page drawing and assembly record. 192 geometry and export checks support the documented model.

Project status
Independent concept study based on public manufacturer information. Not commissioned work for Modular, an OEM reproduction or a surveyed installation.

Open interactive models

Carwash bay

CAD model, moving assemblies and installation layout.



Wash cycle
Play the travelling spray carriage, rolling wheels, ghosted building and opening service cabinet.

Sensor assembly
Explode an original sensor-mount assembly. Review its slotted adapter plate, spacers, fasteners and enclosure.

Configurable mounting plate
Compare 240 mm and 260 mm plate widths, each with matching STEP and 1:1 DXF exports. Both variants retain the same sensor mounting interface.

CAD files
AI-assisted parametric modelling, assembly organisation, motion presentation, exchange files and measured drawing support.

Basis
Published Modular installation envelopes anchor the study. Detailed equipment, custom parts and motion are concept assumptions, not an OEM reproduction.

Open wash bay

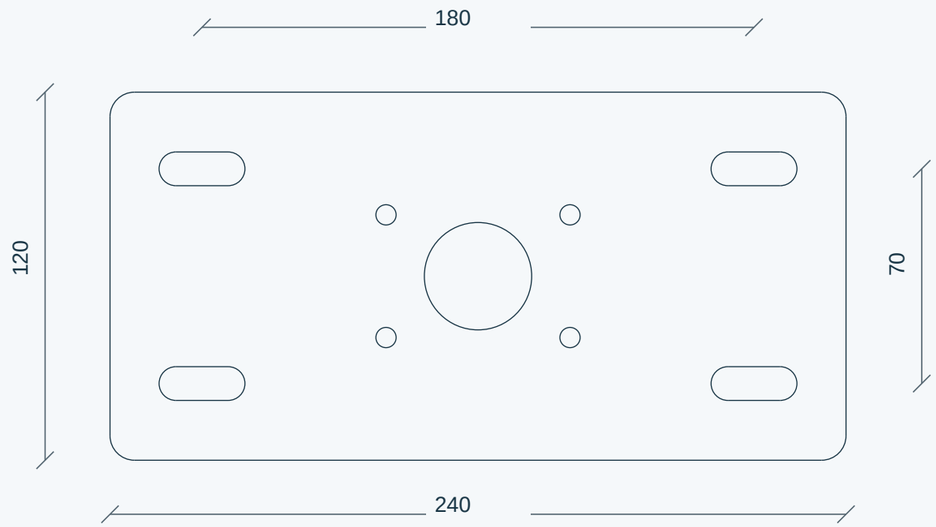
Open sensor assembly

Review focus: component placement, carriage movement, service access and communication of the assembly.

Sensor mounting plate

ADP-001 / Adjustable sensor adapter plate. Dimensions in mm; drawing views at 1:2 on A3.

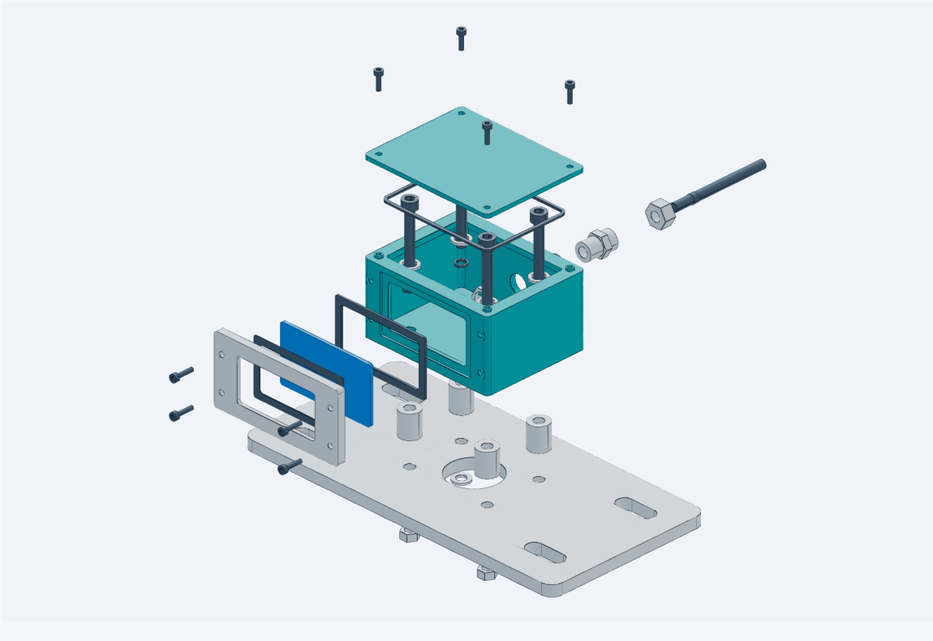
TOP VIEW / 240 mm VARIANT



EDGE VIEW

4 x slots 28 x 11 overall; centres at (+/-90, +/-35).
4 x dia 6.6 through holes; centres at (+/-30, +/-20).
Central dia 35 through hole. Four outside corners R8.
Origin at plate centre. Thickness 8. No kerf compensation.

Material, finish and tolerances require agreement before manufacture.



Assembly interfaces
A retaining frame supports the window between a rear seal and front cushion. The housing includes mounting-driver access, supported screw bores, lid and mounting seals, a gland locknut and cable components.

260 mm plate variant
The wider plate has a 200 mm horizontal slot pitch. Both variants share the 120 mm height, 8 mm thickness and 60 x 40 sensor-hole pattern. Minimum outer slot-to-edge ligament: 16 mm.

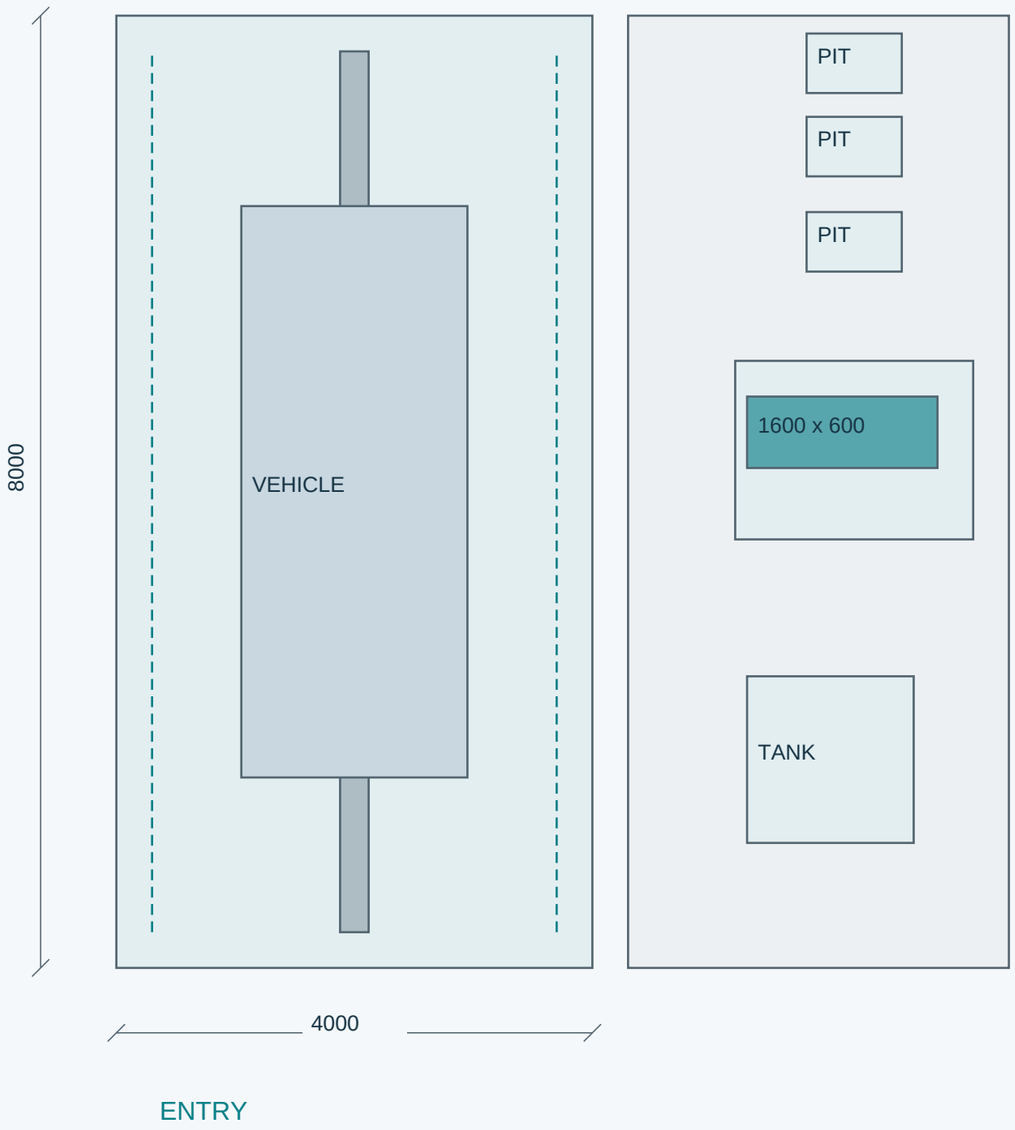
Assembly detail: sections, parts and design specification

Open sensor assembly

Bay layout

Installation dimensions, equipment positions and clearance checks.

PLAN / DIAGRAMMATIC; USE LABELLED DIMENSIONS



Published basis [1]
Minimum bay: 8000 long x 4000 wide x 3200 high. Bench: 1600 x 600 x 1900. Bench allocation: 2000 x 1500, including the bench.

Concept choices
Rail centres 3400; carriage centre moves Y=1200 to 6800. Vehicle envelope 1900 x 4800 x 1650. Drainage, tank positions, structure and component details need site/OEM input.

Carriage clearance
The track supports sit outside the carriage travel envelope. Exported geometry was checked against the frame and vehicle at five positions across the 5600 mm travel range; no intersection above 1 mm3 was detected at those positions.

Application to a real project
Start from a measured part or surveyed layout. Confirm mating geometry and equipment requirements, revise the model, review clearances and issue the drawing set for approval.

Checks and assumptions
508 positive-volume valid solids in the technical bay export; 46 in the adapter assembly. STEP sizes and DXF units checked. This is an illustrative CAD proof, not continuous collision certification, structural design, hydraulic design or validated machine control.

[1] Modular National Cleaning / System requirements

Supplier and sealing references: page 9.

CAD workflow and verification

Parametric design, coordinated exports and geometric checks.

Method

1. Establish the design basis
Use the manufacturer's published bay and pump-bench envelopes. Record unavailable dimensions as assumptions instead of treating reference images as measured drawings.

2. Build separate components
Organise civil work, frame, carriage, water visuals, plant, vehicle and enclosure separately. Keep the technical STEP export free of illustrative spray-cone solids.

3. Derive parts and drawings together
Use one parameterised profile for the 3D sensor plate and its 2D DXF. Preserve the sensor-hole pattern while changing plate width and mounting pitch.

4. Detail assembly interfaces
Define fastener stacks, mounting-driver paths, window retention and seal lands. Check nominal contacts and clearances against the exported assembly. Document the specifications needed for manufacture.

5. Prepare the review model
Export the existing CAD geometry into browser meshes grouped by moving component. Retain the same animation logic and verify its coordinate conversion and travel limits.

Parametric plate variants

Parameter	Variant A	Variant B
Plate width	240 mm	260 mm
Horizontal slot pitch	180 mm	200 mm
Sensor-hole pitch	60 x 40 mm	60 x 40 mm
Plate thickness	8 mm	8 mm
Outer slot-to-edge ligament	16 mm	16 mm

Verification record

CAD and drawing exports
192 checks passed: 26 bay and export checks plus 166 sensor checks. These cover solid validity, hole patterns, nominal stack contact, driver access, seal support and assembled interference.

Travel check
Five positions from Y=1200 to 6800 mm were tested against the vehicle and frame. No intersection above the 1 mm3 reporting threshold remained at those positions.

Public model
529 bay display occurrences and 46 adapter occurrences are retained in 34 motion groups. Five clips were sampled with finite transforms. Actual meshes passed separation, return-to-assembly and exploded framing checks at three viewport sizes.

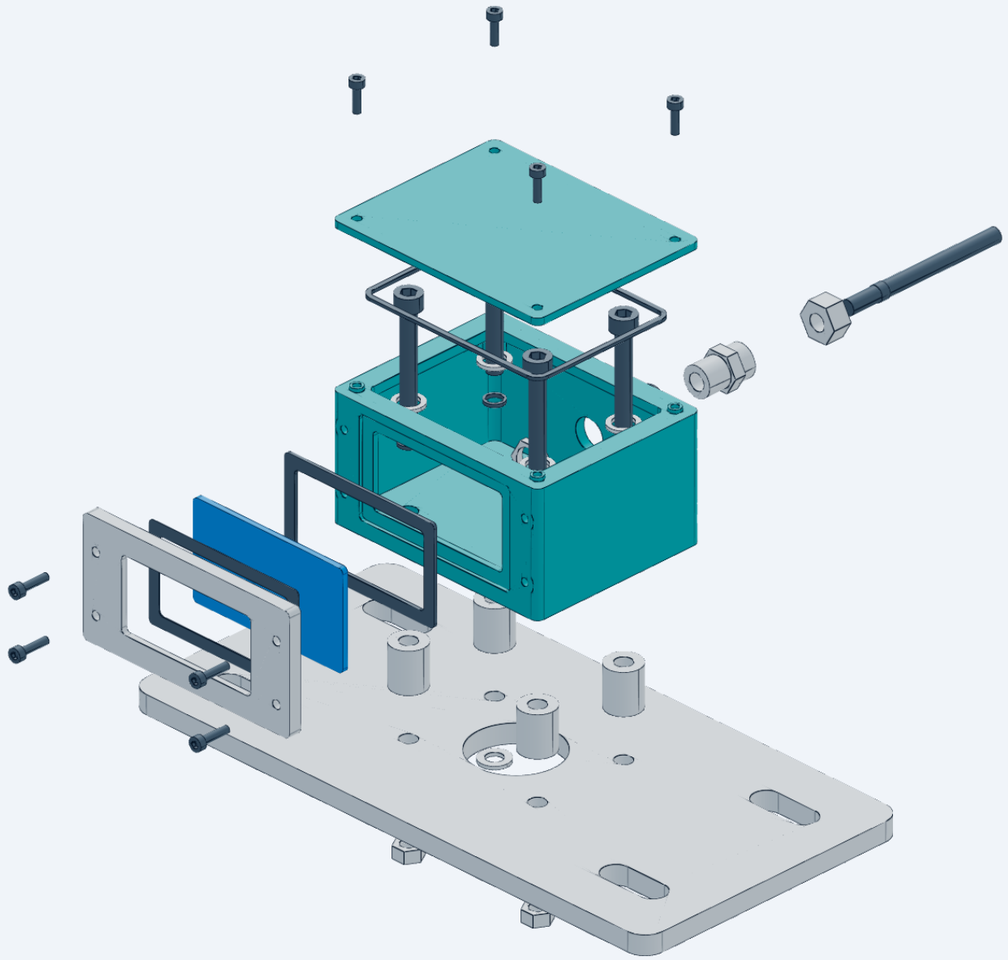
Further verification
Real application requires OEM dimensions, selected materials and hardware, tolerances, loads and site requirements. Motion is illustrative; checks do not establish continuous collision clearance, fluid performance or machine-control behaviour.

Evidence retained with the project

Parametric source, source ledger, STEP/DXF exports, geometry reports and CAD review images.

Sensor assembly

ADP-001 / Sensor enclosure, window retention and adjustable mounting adapter



Exploded presentation. Hardware and seal shapes include stated simplifications.

Open the moving assembly

Design purpose
An original enclosure and mounting assembly for a generic sensor envelope. The design combines adjustable installation slots, a removable lid, a retained window and a rear cable entry in one documented assembly.

Access and attachment
The 96 x 76 mm housing uses a 60 x 40 mm mounting pattern with spacers and M6 fasteners. Fastener heads, washer carriers and driver approaches are checked against the exported geometry.

Front window
Rear gasket, blue window, front cushion and screwed frame form a closed nominal stack. The cushion separates the window from the metal frame. Four supported M3 screw bosses locate the retaining frame.

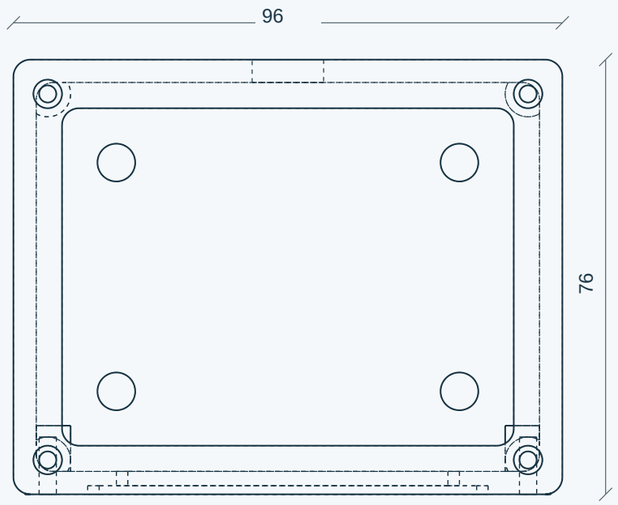
Lid and cable entry
A continuous lid seal sits between the housing land and lid; hard stops define its nominal gap. The rear gland shows body, wall seal, locknut, cap, cable seal and a cable example.

CAD documentation
The exported STEP contains 46 solids in 22 named component groups, supported by 166 geometric checks. Section views and the parts schedule describe the assembly. Project-specific requirements are listed on page 9.

Housing and assembly sections

Geometry derived from the delivered STEP. Reference dimensions only; views are not at a fixed print scale.

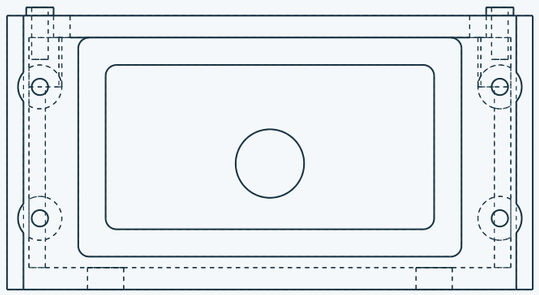
HOUSING / TOP



Cover pattern: X +/-42, Y +/-32. Floor pattern: X +/-30, Y +/-20.

Main pocket 88 x 68 R3; top opening 79 x 59 R3; floor thickness 4.

HOUSING / FRONT

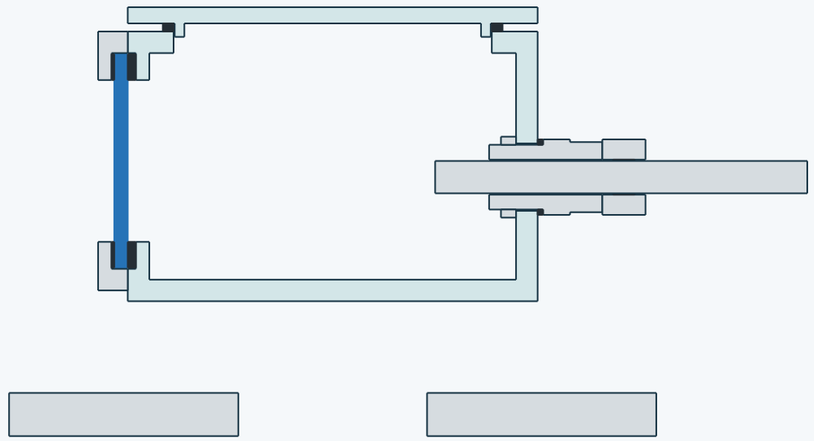


Front screws: X +/-42, Z38 and Z62; nominal M3 blind threads.

Window aperture 60 x 30 R2 at X0, Z51. Rebate 70 x 40 R2, depth 1.5.

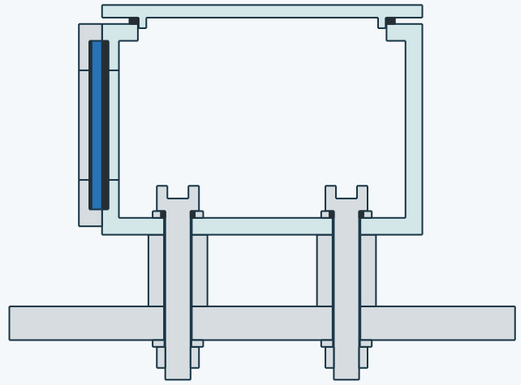
Housing base Z25; rim Z75; stop tops Z76.5. Cover top Z79.5.

CENTRE SECTION / X = 0



Shading shows cut material. Blue: window; dark: seals. Window -Y; cable +Y.

MOUNTING SECTION / X = 30



M6 stack: floor 4 + spacer 17 + plate 8 + seal carrier 1.6

+ underside washer 1.6 + nut 5 = 37.2. M6 x 40 leaves 2.8 projection.

Datum A: plate underside Z0. B/C: X0 and Y0 centre planes.

M3 / M6 / M12 threads are nominal cylinders. Drill points, tap runout, chamfers, finishes and production tolerances await specification.

Parts and assembly

Item numbers follow the 22 STEP groups. Quantities are checked against the re-imported 46-solid assembly.

No.	Part	Qty	Nominal definition / mm	Specification status
01	Mounting plate	1	240 x 120 x 8; R8 corners; 4 slots 28 x 11	Custom; material and tolerances open
02	Spacer	4	OD14 / ID6.6 / length 17	Custom; material and tolerances open
03	Mounting screw	4	M6 x 40; head dia10 x 6; 5 AF key	ISO 4762 envelope; grade/locking open
04	Housing	1	96 x 76; base Z25; rim Z75; stops Z76.5	Custom; process and material open
05	Window	1	69.6 x 39.6 x 2.5; outside R1.8	Optical material / sensor compatibility open
06	Cover	1	96 x 76 x 3; locating lip 2.5 deep	Custom; flatness and finish open
07	Gland body	1	M12 x 1.5; thread 10; total external H19	HUMMEL reference; internal split assumed
08	Mounting nut	4	M6 x 1; 10 AF; height 5	Plain nut envelope; locking method open
09	Cover screw	4	M3 x 10; head dia5.5 x 3; 2.5 AF key	ISO 4762 envelope; grade/torque open
10	Rear window seal	1	Assembled 1.5; outer 69.6 x 39.6	Seal grade / free thickness open
11	Window frame	1	96 x 48 x 5.5; rear pocket 3 deep	Custom; material and face flatness open
12	Frame screw	4	M3 x 12; head dia5.5 x 3; 2.5 AF key	ISO 4762 envelope; grade/torque open
13	Sealing washer carrier	4	OD12 / ID8 / height 1.6	CONCEPT profile; supplier part needed
14	Plain washer	4	OD12 / ID6.4 / height 1.6	ISO 7089 envelope; material open
15	Mounting-hole seal	4	OD8 / ID6 / assembled height 1.6	CONCEPT compressed envelope
16	Lid seal	1	Outer 83 x 63 R5; inner 79 x 59 R3; H1.5	Assembled envelope; compression open
17	Front window cushion	1	Assembled 0.5; outer 69.6 x 39.6	Seal grade / free thickness open
18	Gland locknut	1	M12 x 1.5; 15 AF; height 2.8	HUMMEL 1161120050 geometry reference
19	Gland wall seal	1	OD14 / ID12 / assembled height 1	CONCEPT envelope; actual O-ring needed
20	Gland cap	1	14 AF; external envelope split 8 long	Split and internal features assumed
21	Cable seal	1	OD6.5 / ID6 / assembled length 4	CONCEPT; actual insert assembly needed
22	Cable example	1	OD6; shown length 69; no connector	Cable/jacket/bend radius not selected

Assembly sequence to verify on a sample

Fit the gland wall seal and body, then the inside locknut. Feed and terminate the cable using the selected gland instructions. Seat the floor seals/carriers and mounting screws; install the spacers, plate, lower washers and nuts. Fit the rear window seal, window, front cushion and frame. Fit the lid seal and cover. Tighten to an agreed procedure after materials and hardware are selected.

Sealing washer note

Items 13 and 15 are a concept metal/rubber pair, not a standard plain washer or a selected bonded-seal product. Replace both with the approved supplier geometry.

Design specification

Project-specific inputs and verification required to develop this concept for manufacture.

R01 / Sensor and optics
Obtain sensor part number, envelope, fastener pattern, connector, sensing distance and field of view. No sensor or internal sensor bracket has been designed. Blue colour is illustrative; optical transmission is unspecified.

R02 / Material and environment
Agree wash chemicals, concentration, temperature, UV and pressure exposure. Select housing, frame, window, spacer, fastener and seal materials together; review galvanic corrosion, creep and detergent compatibility.

R03 / Manufacturing route
Agree process and stock. The top seal land overhangs the main pocket: this needs an undercut tool, a split construction or another process. Check tool reach, R3 pocket corners, workholding and access to the blind front bores.

R04 / Threads and retention
Choose tapped threads, inserts or other retention appropriate to the material. Nominal M3 cylinders show thread envelopes, not drilled holes. Define drill depth, drill point, tap runout, engagement, edge breaks and inspection gauges.

R05 / Fasteners and tightening
Select grade, corrosion protection, nut locking and lubrication. Establish torque/preload and window screw sequence using the actual materials. Verify thread stripping, cover/frame bending and access with real tools.

R06 / Tolerances and datums
Plate underside is datum A; X/Y centre planes are B/C. Agree hole positions, housing-floor flatness, gasket-land flatness, surface finish and fit tolerances. The 0.20 nominal location clearances are not tolerance allowances.

R07 / Seal selection and stack
Select continuous seal profiles, free thickness, hardness and compression-force data. The model shows assembled envelopes only. Floor seals and gland seal internals are concept geometry; replace them with supplier profiles.

R08 / Window retention
Verify window stress, bowing, thermal expansion, edge support and optical clearance. Confirm cushioning, gasket corner continuity and a compatible retention/adhesive method for handling during service.

R09 / Cable and gland
Verify actual cable OD/jacket, connector feed-through, strain relief, bend radius, drip routing and internal termination. Check the complete supplier gland assembly and its sealing faces against the 1 mm provisional wall-seal space.

R10 / Installation and loads
Confirm the mating structure and mounting fasteners for the four plate slots. Determine impact/vibration/cable loads, drainage orientation, external clearance and access below the plate. Anchors and host structure are outside this model.

R11 / Assembly and service
Build a sample; check installation/removal order, washer retention, tool reach, service cycles and replacement seals. Exploded motion communicates part relationships; it is not a collision-free assembly sequence.

R12 / Inspection and ingress
Agree dimensional inspection and leak/ingress acceptance criteria. Test the complete enclosure for the specified exposure. No IP rating, strength certification or fabrication release is established by these CAD checks.

Seal compression and tolerance stack

For each seal, obtain free thickness t and the full closed-gap range g, including surface, coating and part tolerances. Check compression (t - g) / t at both extremes against the selected supplier data. Nominal assembled thicknesses here do not establish preload or leakage performance.

Primary references: supplier dimensions and sealing design guidance

Bossard / ISO 4762 · HUMMEL M12 gland · Rogers / seal design · IEC 60529

Open the assembly

Full source notes and machine-readable review accompany the CAD.