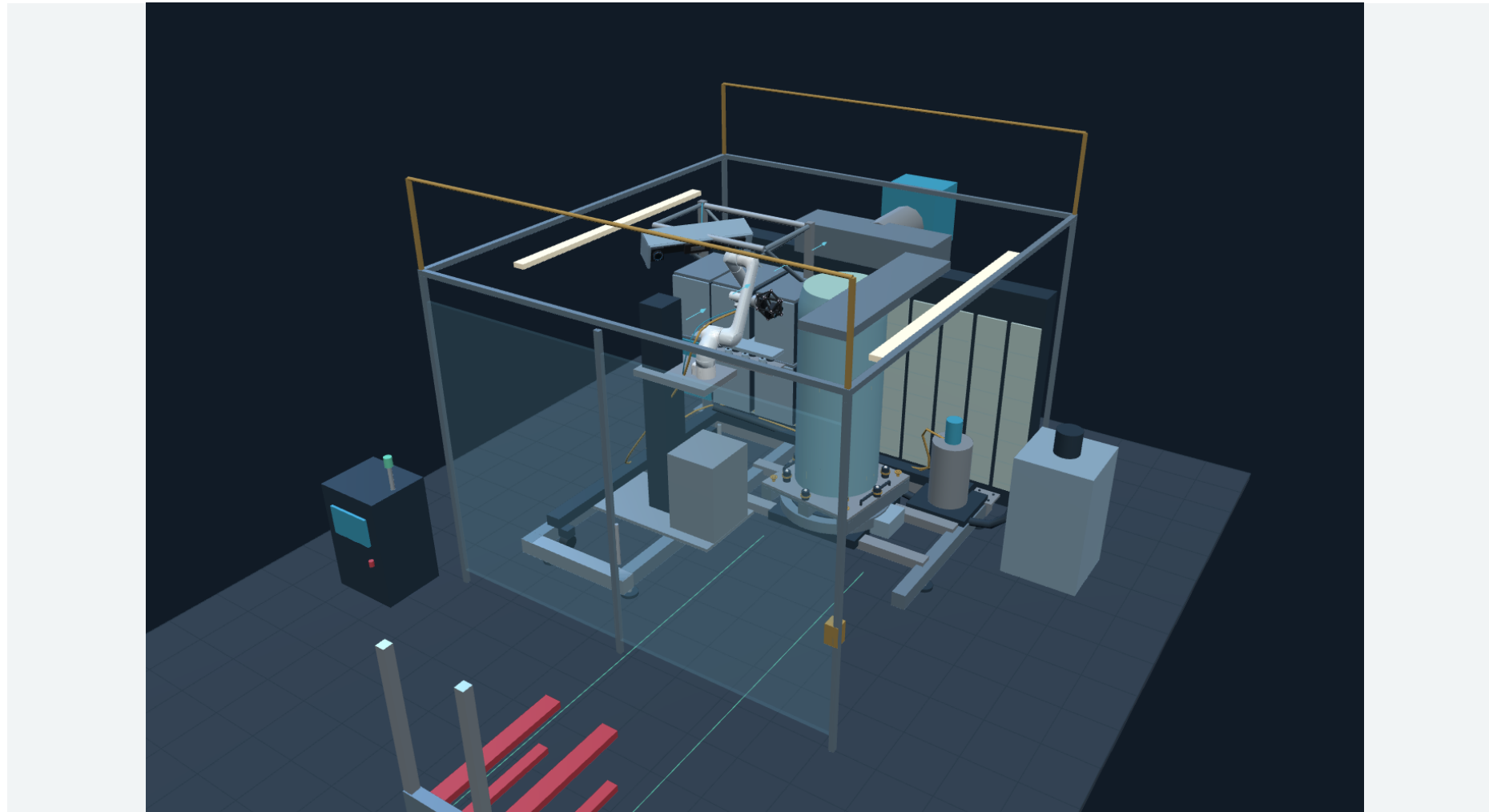


01 / Overall arrangement and two design stages

The part stays on the same removable aluminium fixture through scan, coat, measure, correct and verify. Latest R4 arrangement supersedes R3 permanent spray tooling.



Existing Booth A: 4,200 W x 4,600 D x 3,300 H mm. The external collector and controller require additional service space.

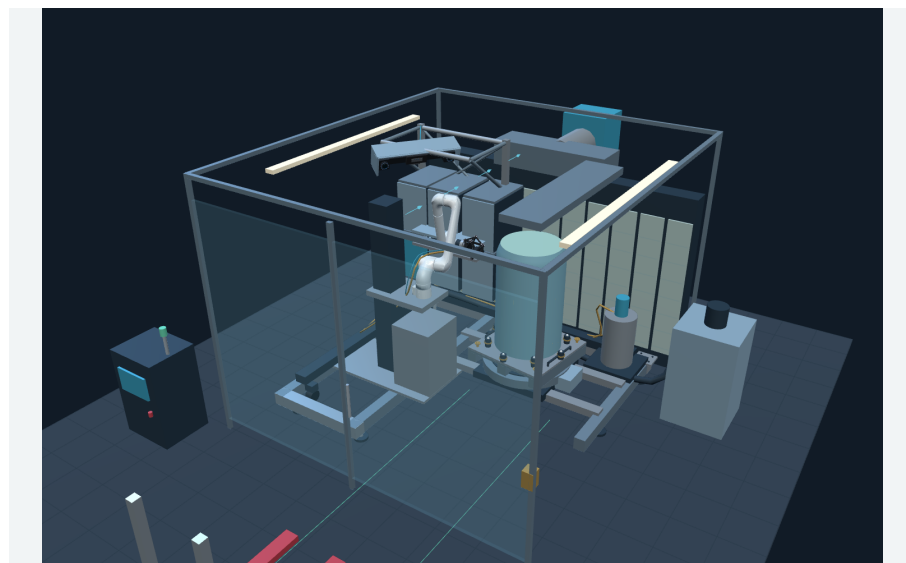
Robot: ABB PoWa 20 on a common-frame guided column. Base centre X -400 / Y -500 mm; starting mounting plane 1,200 mm above floor. Up to 1,400 mm concept travel.

Turntable: vertical C axis at X +550 / Y +450 mm. Concept table diameter 1,160 mm; part seat at 720 mm above floor. Dimensions use booth centre in plan as origin.

Load interface: 1,100 x 1,100 mm carrier; 1,200 mm clear stacker lane and 2,220 mm right door leaf. No low rail across the approach.

Height finding: final normal crown scan needs a flange at 3,481 mm before rear wrist clearance. Raising the robot cannot make it fit under a 3,300 mm ceiling.

Final 2.1 m part study - gold outline is an unapproved 4.1 m headroom option



AETEC in-house POC / 1.4 m samples
Establish fixture repeatability, spray and sanding parameters, clean release and thickness correlation. Exact in-house room dimensions remain a survey input. The sampled bare robot reaches about 3.28 m: reserve at least a 3.6 m clear-height study allowance for services and protection, rather than treating 3.3 m as released clearance.

Final / 2.1 m part study

The sampled bare robot reaches about 3.80 m. A 4.1 m top-access envelope is drawn as a planning option. Alternatives are a qualified inclined scanning arrangement or a lower fixture / positioner. The current 3.3 m booth is not yet a proven full-crown solution. The illustrated 860 mm part diameter is an assumption, not an extraction of the native part CAD.

02 / Tools and protected exchange

Six assigned positions: scanner, sander, spray, cap gripper, cleaning head and blast reserve. The spray head is fully interchangeable in this revision.



Creaform MetraSCAN BLACK+ Elite

289 x 235 x 296 mm nominal OEM envelope. Tracking cage and twin lenses use official imagery; mount and jacket are concept geometry.



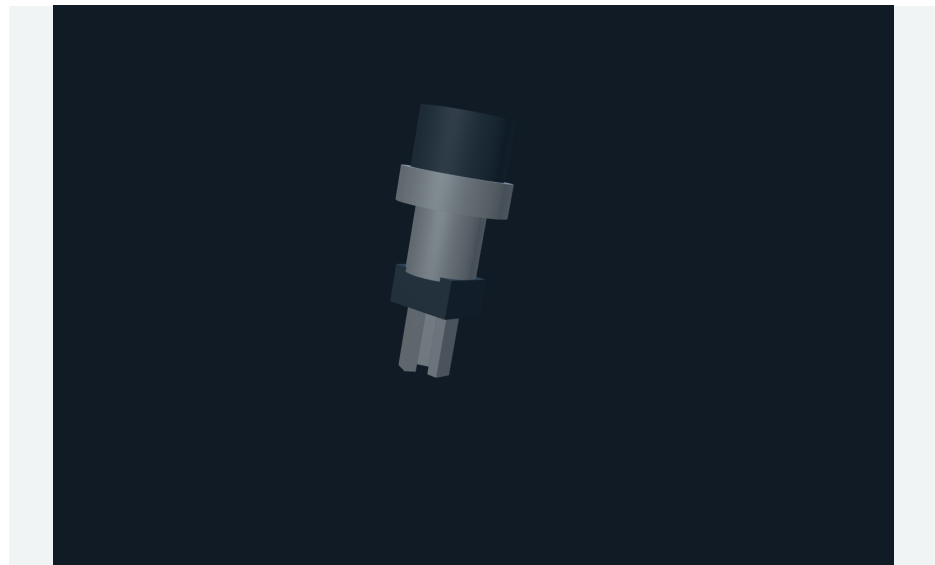
Compliant sanding head

Force compliance, abrasive pad and dedicated dust take-off. Establish tool mass, centre of gravity, hose force, grit and removal rate by trials.



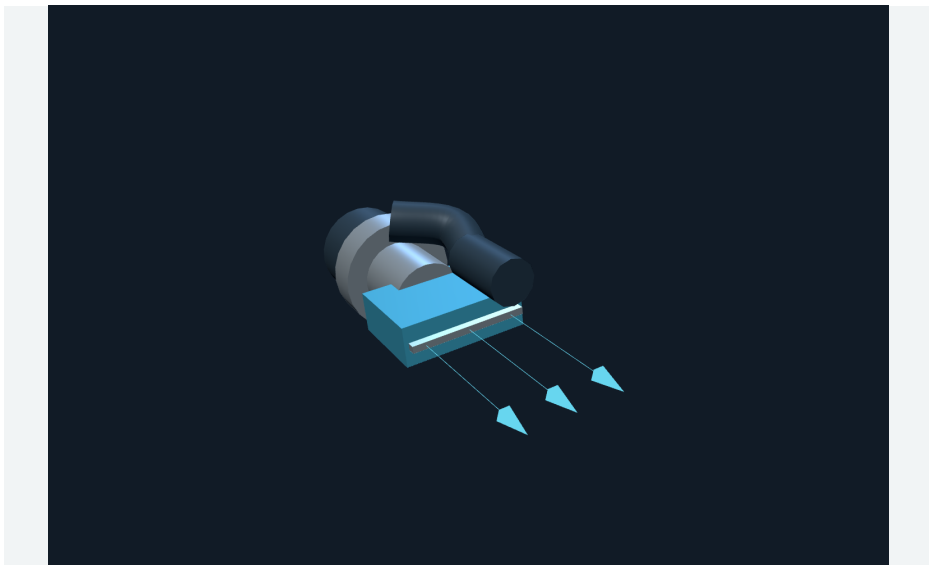
Interchangeable spray nozzle

Head shut-off, sealed automatic material / air couplings and contained wet receiver. Paint supply remains inside the booth.



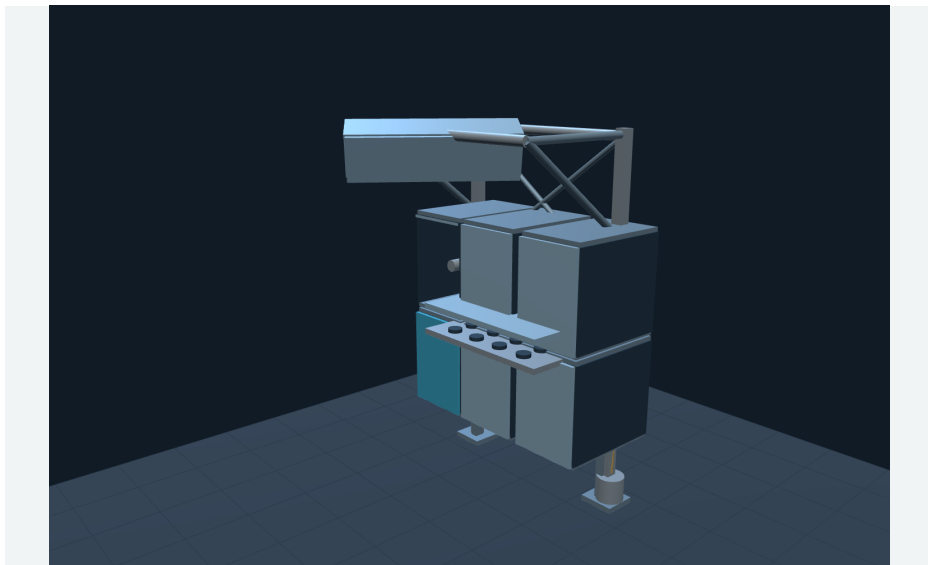
Target-cap gripper

Three-jaw grip on the cap knob with positive latch release / closure. The gripper never contacts the optical target or its datum seat.



Air knife + local vacuum

Filtered, dry, oil-free air dislodges qualified loose residue; near-source suction captures it. Cleaning conditions depend on the residue and coating state.

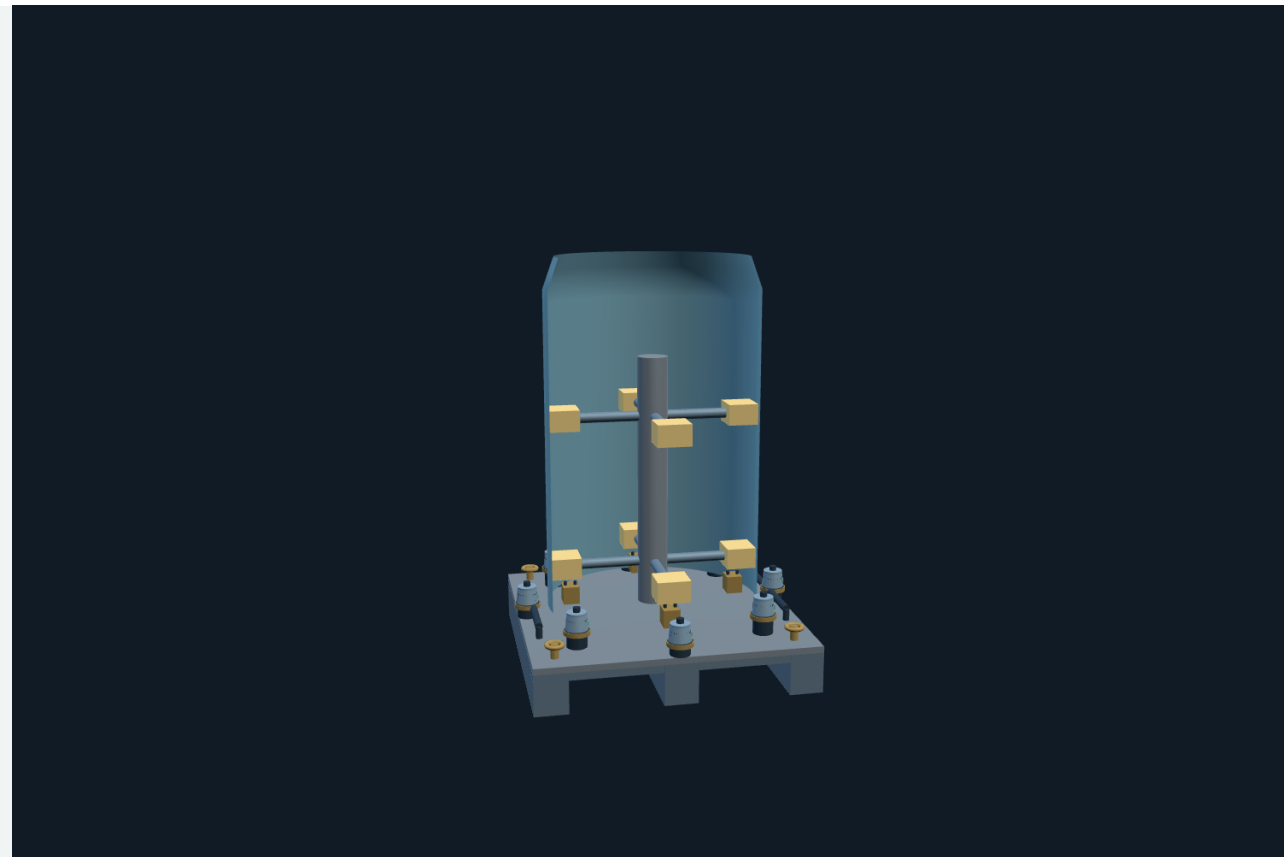


Sealed tool cabinet

Two tiers of three bays. Retracting front shutters, separated wet receiver and covered cap nests on the front shelf. Blast position is reserved scope.

03 / Fixture, permanent targets and sealing adapter

No optical targets on the workpiece. Part retention, target seats and the carrier datum remain unchanged during the entire process.

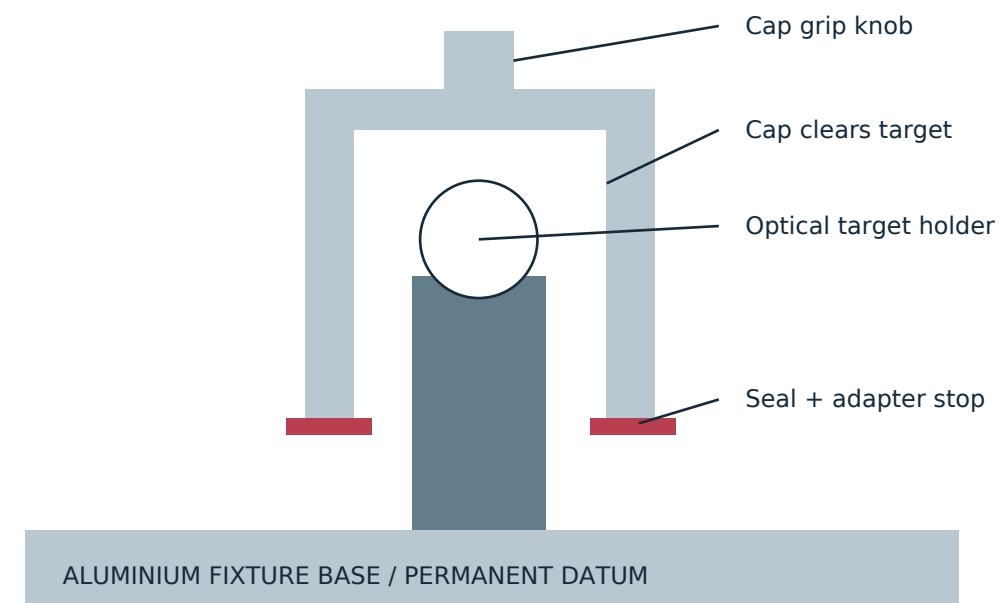


Fixture assembly: solid aluminium carrier and deep fork-pocket rails. Internal mast with broad pads supports the inverted cup. Multiple fasteners act through approved lower interfaces; no top clamp or contact on the closed crown. Final contact areas, clamp forces and allowable part interfaces require the part-CAD review.

Eight target stations: mechanically retained spherical / 360-degree holders on exposed base regions, nominal radius 515 mm around the C axis. Small height offsets avoid an entirely coplanar layout. Captive retention is required on aluminium; do not rely on a loose magnet alone.

Independent protection: each cap lands on a separate adapter shoulder with a replaceable seal and positive latches. A latch sensor proves closure. Cleaning acts on the still-closed cap rim before the robot removes the cap. The optical reference is never used as a cover stop.

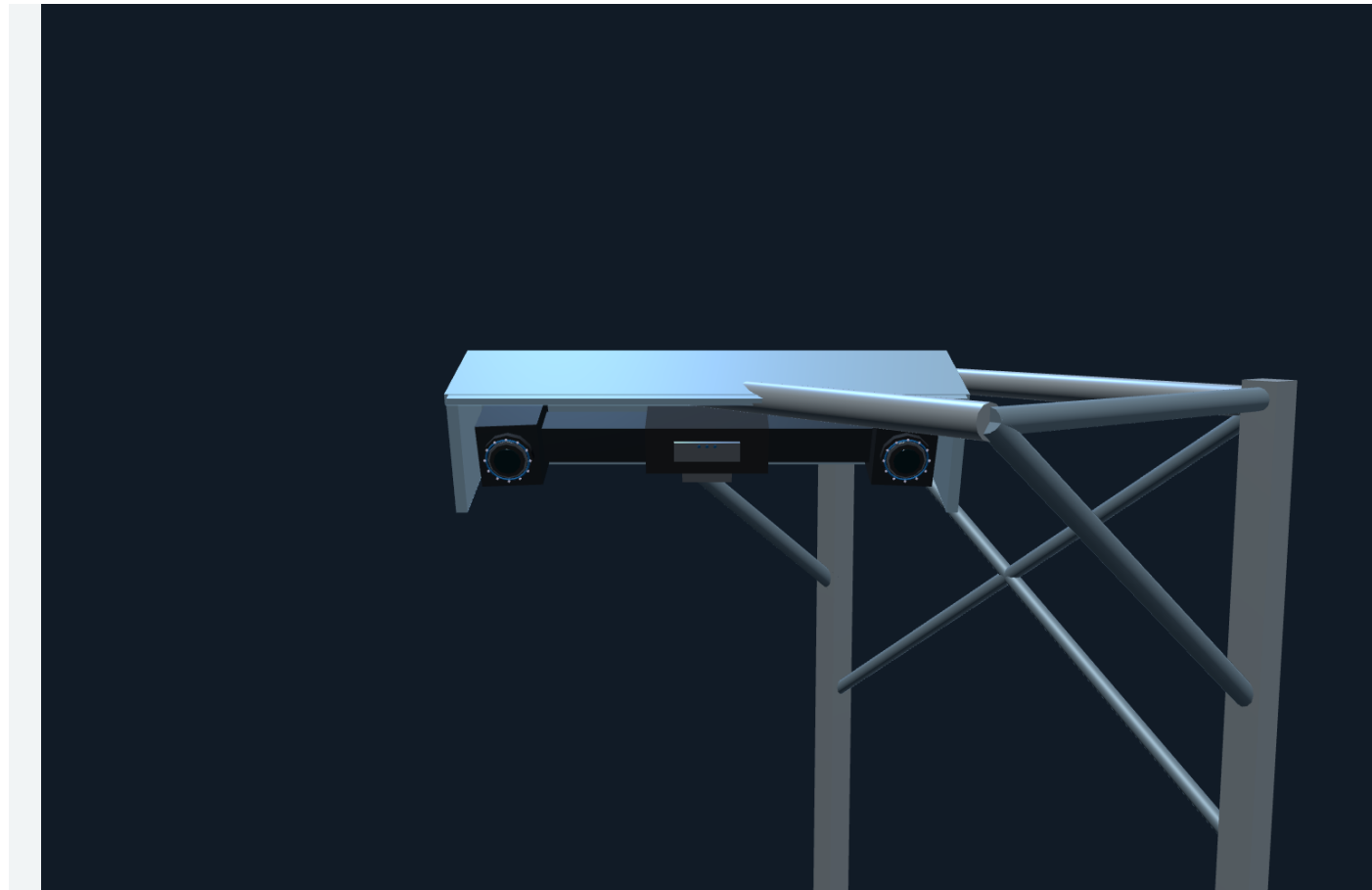
SECTION CONCEPT / TARGET COVER



Illustrated holder diameter 36 mm and cap outside diameter about 90 mm are study envelopes. Creaform confirms 360-degree magnetic targets for BLACK+; exact accessory number, holder geometry, adapter and optical acceptance are release items.

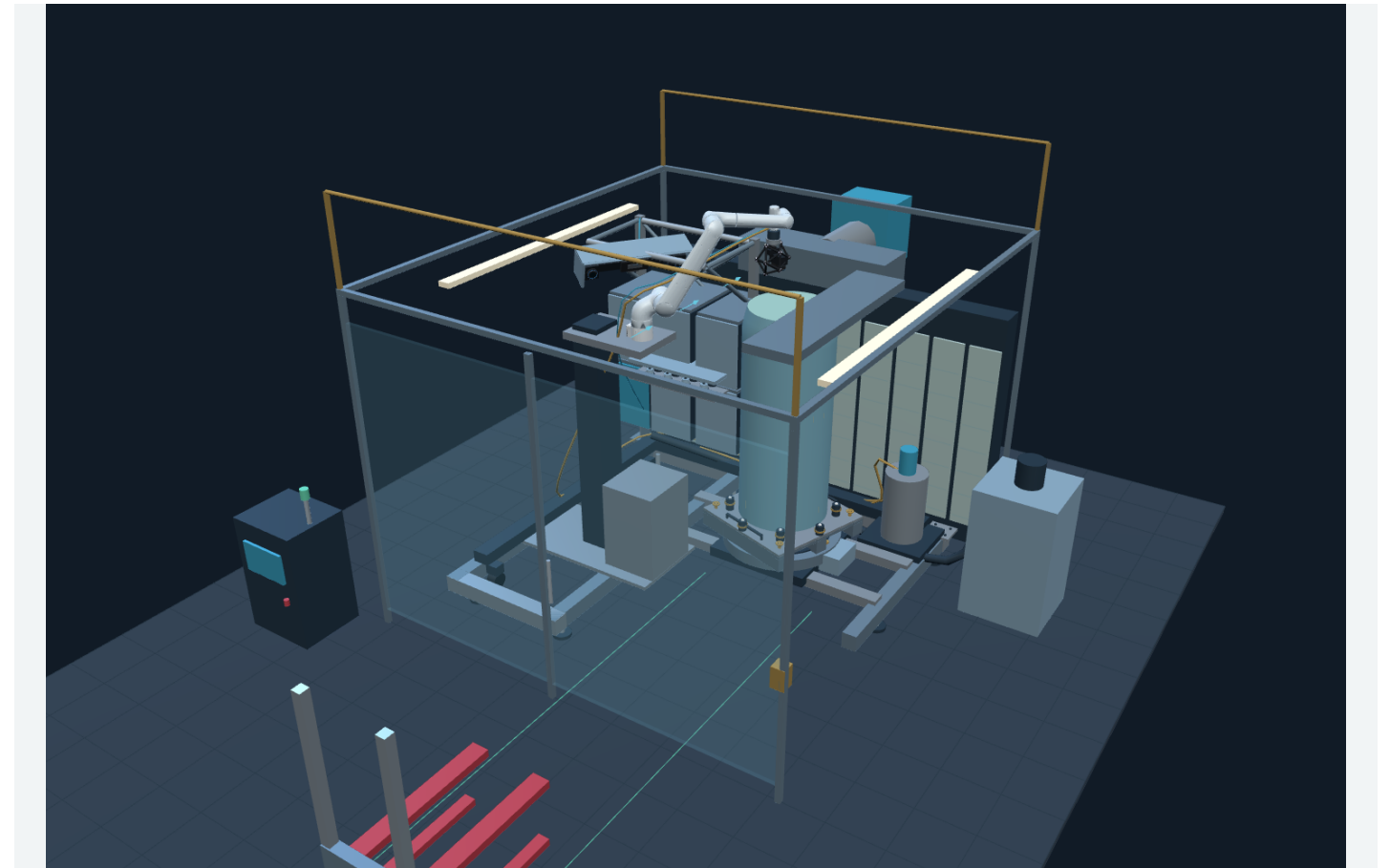
04 / C-Track support, reach and room-height decision

Wall mounting is permitted by ABB. It changes the workspace orientation; it does not add arm length or create ceiling clearance.



Braced C-Track portal: two uprights, rear and forward cross-beams, triangulated cantilevers and rear diagonals. The complete support bolts to the common rear / side frame. Head centre is about 2.82 m, looking down from above the cabinet under the lighting. Lighting and the head shroud need separate clearance checks.

Visibility study: 120 sampled scan poses per design. No camera-to-scanner ray was blocked by the simplified solid part; at least four fixture targets were visible to both cameras. Maximum sampled camera-to-scanner distance was about 2.34 m. This excludes cabinet, robot and fixture occlusions and does not validate the OEM optical field or measurement volume.



Mounting conclusion: the original X -950 / Y -450 mm base was studied at fixed mounting heights from 1.05 to 1.85 m, both floor and wall orientations. The numerical search did not find a complete lower-side / crown solution for every tool. R4 moves the base and retains vertical travel. This does not prove that every possible fixed wall design is impossible.

Use a guided vertical column: a telescopic riser is not inherently required. Specify linear guides, a brake / holding system, position feedback, protected service loops, bellows and duty-specific stiffness. POC sampled travel is about 0.851 m; final about 1.397 m. These are kinematic-study values, not an approved purchased-axis specification.

Required release: full part CAD; robot and tooling loads; actual scanner TCP / orientation; full swept-volume and joint-continuity checks; emergency-stop loads; frame stiffness / modal response; sliding and overturning; floor bearing; tracking quality through rotation; and booth / protection-package integration. The no-floor-anchor arrangement remains a design intent subject to those checks.

05 / Cleaning and metrology release

Purpose: remove loose residue, protect the optics and obtain a stable, repeatable surface for pre/post comparison. Cleaning is not curing or a thickness calibration.

Condition	Operation with all optics and target caps closed	Evidence before opening
After spraying	Maintain extraction through validated booth clearance AND the coating supplier flash / cure condition. Only then use qualified low-energy filtered air and local suction. Do not direct an air jet onto wet / soft coating.	Acceptable atmosphere; coating permits cleaning; no transferable overspray; clean cap rims; stable part / fixture temperature.
After sanding	Keep source vacuum capture active. Vacuum loose residue first. Then use a qualified air knife with close-coupled suction over the rotating component. Clean the sealed cap surrounds and cabinet exteriors.	Measured vacuum / extraction performance; acceptable airborne and settled residue; witness surfaces; no residue transfer onto exposed datum or optics.
Tool cabinet and cap nests	Each inactive bay stays closed. Clean exterior faces before opening. Keep the wet receiver segregated from dry scanner storage and the protected cap nests.	Closed / clean proof, verified tool ID and coupling lock, no fluid leak or residue carried into the dry compartment.
Clean release	Robot opens the target caps only after the clean-release condition. Targets remain fixed. Open the C-Track and scanner systems, verify the target pattern and tracking quality, then acquire data.	No timer-only release. Recheck datum geometry, valid tracked targets, temperature and the qualified scan setup.

Why rear suction is insufficient by itself: a high-energy air jet can create a fast, difficult-to-capture dust or mist cloud. Use source capture first and qualify any blow-off inside the extraction envelope. The dust collector, filters, waste route and bonded / conductive paths must suit the assessed coating residue. Paint extraction and sanding collection are separate duties.

Air-clearance calculator: the app uses an illustrative well-mixed dilution relationship, with $V = 63.756\text{ m}^3$ for the existing booth and a 1% residual example. Five minutes is only an example minimum. Measured airflow, mixing, residue, coating condition and temperature determine release. Air-clearance calculation does not establish cure, cleanliness or ignition safety.

Thickness study: correlate baseline and coated surfaces in the unchanged fixture reference frame, then qualify against direct thickness references. Composite warpage, temperature, invalid geometry and inaccessible regions can invalidate a simple surface difference. The displayed 1.0 / 1.5 mm map is synthetic and is not a measured POC result.

06 / Complete functional sequence

55 steps remain in one continuous simulation. Robot transport, tools, covers, cleaning and unloading are included. Demonstration waits are compressed.

- 01

Prepare the fixture
- 02

Open the right access door
- 03

Bring in the fixture pallet
- 04

Seat and lock the pallet
- 05

Withdraw the stacker
- 06

Close and lock the door
- 07

Pick the cover gripper
- 08

Remove and store all eight target covers
- 09

Return the cover gripper
- 10

Pick up the scanner
- 11

Scan the uncoated surface
- 12

Return and protect the scanner
- 13

Pick the cover gripper
- 14

Replace and lock all eight target covers
- 15

Return the cover gripper
- 16

Pick the interchangeable spray nozzle
- 17

Apply the coating
- 18

Flush, dock and enclose the nozzle
- 19

Extract and condition
- 20

Pick the air-knife / vacuum head
- 21

Conditioned-part air knife + local capture
- 22

Return the cleaning head
- 23

Confirm clean / stable release
- 24

Pick the cover gripper
- 25

Remove and store all eight target covers
- 26

Return the cover gripper
- 27

Pick up scanner for thickness
- 28

Measure coating build
- 29

Park optics before sanding
- 30

Pick the cover gripper
- 31

Replace and lock all eight target covers
- 32

Return the cover gripper
- 33

Pick up the compliant sander
- 34

Correct excess coating
- 35

Park the sanding tool
- 36

Clear the sanding residue
- 37

Pick the air-knife / vacuum head
- 38

Vacuum first, then captured air knife
- 39

Return the cleaning head
- 40

Confirm dust-free metrology release
- 41

Pick the cover gripper
- 42

Remove and store all eight target covers
- 43

Return the cover gripper
- 44

Pick up scanner for verification
- 45

Verify and record the result
- 46

Return scanner and park robot
- 47

Pick the cover gripper
- 48

Replace and lock all eight target covers
- 49

Return the cover gripper
- 50

Open for unloading
- 51

Insert the stacker forks
- 52

Release the pallet clamps
- 53

Lift clear of the datums
- 54

Withdraw the loaded fixture
- 55

Cycle complete

Each of the six cover operations indexes all eight cap stations. The complete part remains clamped to its fixture. After final scanning, all caps are locked again before the fixture leaves the cell. The two complete part families share the handling and protection sequence; exact open-cover paths depend on the supplied CAD.

07 / Scope, evidence and commercial reconciliation

R2 proposal and detailed quotation are retained as the budgetary baseline. R4 is a design addendum, not a new firm quotation.

R4 assembly / task	Concept quantity or deliverable	Commercial treatment
Interchangeable wet tooling	1 spray head / bay with sealed couplings, contained flush receiver and head shut-off	Reconcile tool changer, services and wet receiver with supplier scope.
Datum protection kit	8 retained target holders, 8 adapters / caps / lock proofs, 8 clean nests and 1 gripper	New detailed tooling scope; obtain firm accessory / machining costs.
Cleaning tooling	1 air-knife / suction tool and assigned bay; captured cabinet cleaning	Qualify cleaning recipe, air quality, capture and residue compatibility.
Tracking support	1 rigid braced portal and C-Track protective shutter	Include structural / vibration and visibility validation.
Robot axis and headroom	Guided vertical axis; 4.1 m final headroom option; POC clear-height survey	Axis and booth work require supplier / site reconciliation before commitment.
POC evidence	Fixtures, repeatability, parameter trials, direct-reference thickness correlation, timing and video records	Keep the defined POC objectives; confirm changed hardware and provisional sums.

Existing planning envelope: S\$441,000 excluding GST (S\$386,000 defined POC scope plus S\$55,000 controlled provisional sums). R4 added hardware and any booth modification are not automatically included in that figure. Final permanent equipment is separately priced after POC and design freeze.

Verification: 13,956 software-state samples and 1,748 rendered checks across POC / final and cylinder / cover. Stacker-to-base checks and required protection / capture fault holds passed. 1,745 IK samples per size met the position check after numerical repair. Transit continuity, dynamics, exact-CAD collisions, optics field of view and production control remain unreleased.

Sources / design basis

ABB PoWa CRB 1920 datasheet (27 May 2026): mounting, reach and load basis

Creaform MetraSCAN technical specifications: nominal dimensions and stand-off

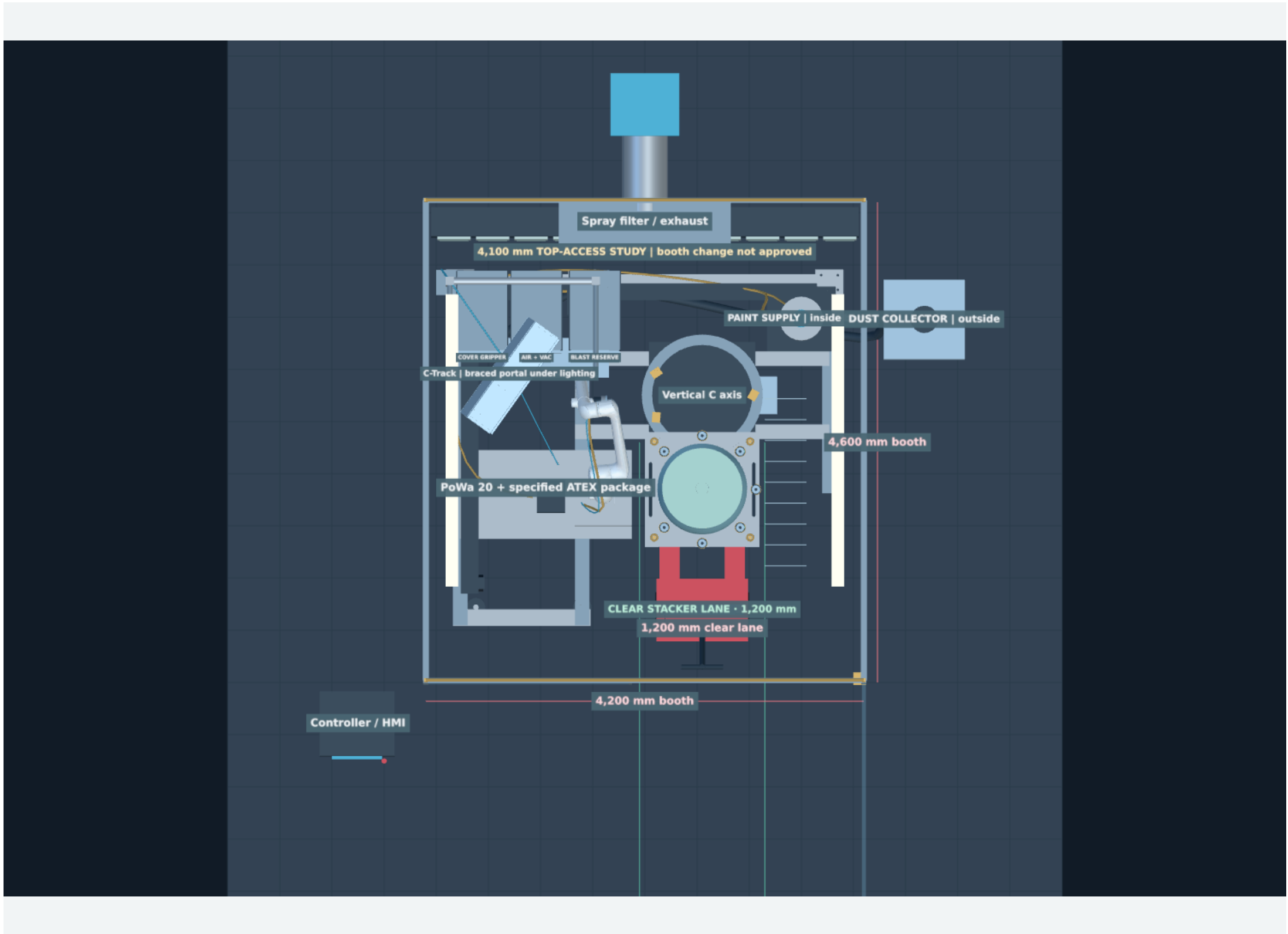
Creaform: BLACK+ setup assistance and 360 magnetic targets

HSE: local exhaust ventilation and compressed-air surface cleaning

Project basis: supplied DSO SOW v2 and associated 1.4 m / 2.1 m part descriptions; user-specified ATEX-certified PoWa protective configuration. Native part CAD was not converted into this concept mesh. Exact protective-package configuration and installation conditions belong in the supplier dossier. ABB IRB 5500 remains a separately engineered spray alternative.

08 / Plan view and handling interfaces

Dimensioned concept layout. Overall booth dimensions are existing-site inputs; carrier, clearances and peripheral positions remain engineering assumptions.



Loading lane
1,200 mm nominal clear width. A 1,100 mm carrier leaves 50 mm per side before positioning tolerances.

Fork interface
Two nominal 190 x 105 mm pockets at 580 mm pitch. Illustrated forks are 150 x 65 mm. Actual stacker dimensions and safe working load must be checked.

Under-table gap
Elevated bridge lower face at 240 mm; illustrated stacker legs reach 130 mm. Nominal 110 mm gap. Withdrawn fork bottom is 525 mm; table top is 514 mm.

Vertical positioner
Carrier seats at Z 500 mm; part seat at Z 720 mm. Positive location, clamps, drive engagement, identity and bonding are separate verified interfaces.

Modular base
About 3,700 x 3,350 mm. Bolted rear / side spines connect robot, table, tools and tracking support. Feet and wheels stay outside the loading lane.

Site reservation
Allow additional external area for the dust collector, controller, maintenance and the loaded stacker. These are not included in the 4,200 x 4,600 mm booth plan.