Composite Process POC and Final Cell Proposal

Automated spraying and sanding with integrated coating thickness measurement

Prepared by	Prepared for
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Reference: AETEC-DSO-POC-20260920-R2 | 20 September 2026 | Revision 2

Vertical turntable. Bottom-supported parts. Protected metrology. Connected modular construction.

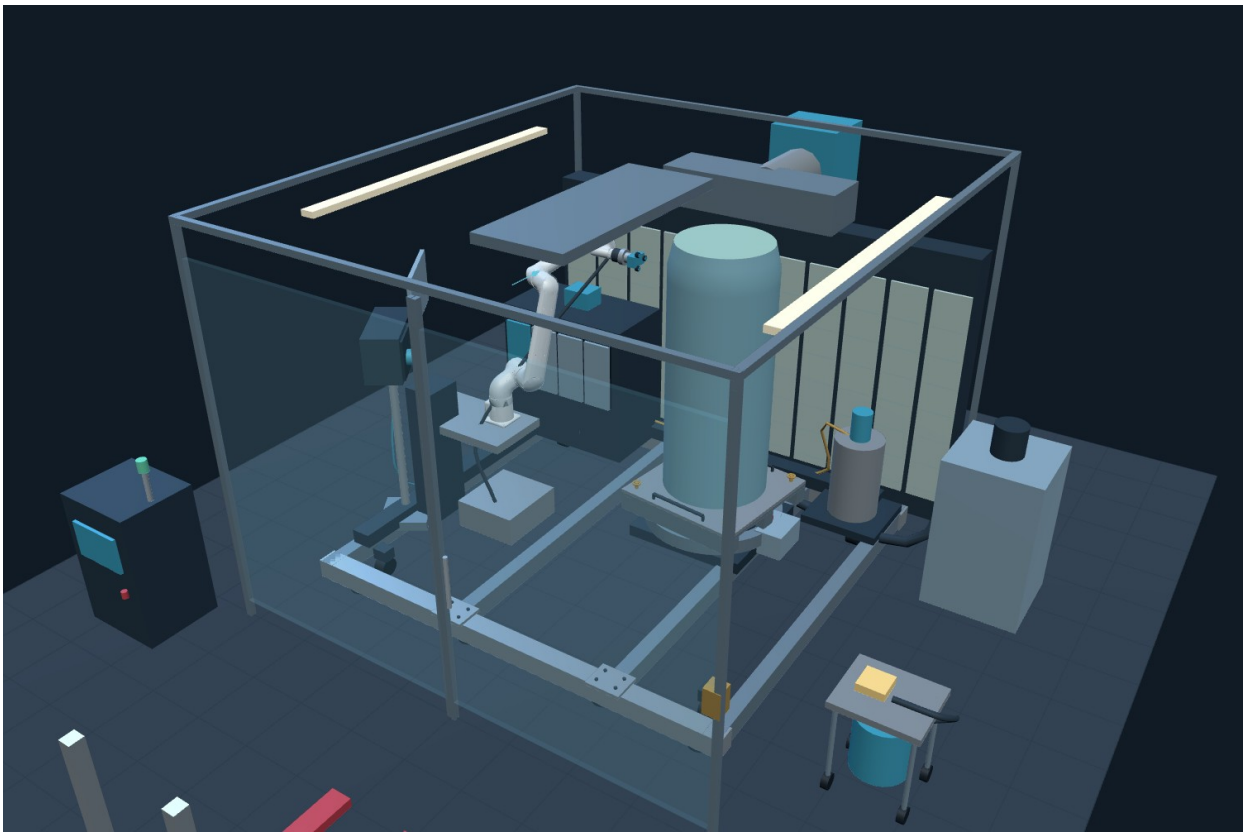


Figure 1. Final-cell design intent for the 2.1 m study, with the actual ABB PoWa 20 manufacturer model. Booth walls are cut away. The part, fixture and peripheral equipment are concept geometry; native part CAD is not yet verified.

Design element	Proposed basis / verification
POC	AETEC in-house; 1.4 m physical cylinder and open-cover trials.
Final cell	DSO Booth A; 2.1 m design study, modular machine and vertical C axis.
Technical outcome	Measured feasibility, verified process windows, maps / reference correlation, fixture records and production design recommendation.

1. Requirements and revision basis

The latest September SOW and 18 September customer email govern the coating/sanding/thickness study. The 20 September direction replaces the horizontal headstock/tailstock concept with a vertical axis and an inverted-cup fixture; the top remains unobstructed. POC execution moves to AETEC in-house.

SOW	R2 response / evidence
3.1 Setup	Vertical table, transportable pallet, internal support / retention, contact-area and deflection checks, measured setup time.
3.2 Geometry scan	Creaform scan / C-Track datum chain, actual geometry, missing-data masks, scan-to-path and 2.1 m scaling.
3.3 Spray	Batch delivery/agitation, deposition trials, protected tool change, extraction proof and measured build per pass.
3.4 Sand	Compliant force control, tool load/torque budget, local extraction, removal-per-pass and surface-finish study.
3.5 Thickness	Pre/post scan correlation plus qualified direct reference; bias, repeatability and coverage in 1.0 / 1.5 mm zones.
3.6 Closed loop	Mask invalid / edge / occluded areas, add only to deficient zones, remove only excess, clean and remeasure.
3.7 Booth	Two design layouts; connected demountable structure; separate spray / dust extraction branches; final-cell option study.
Deliverables	Reports, parameters, maps, cycle breakdown, fixture/docking/protection design sheets, images/video and processed parts.

The gentle chamfer is customer-supplied geometry. It requires edge-aware scanning and controlled spray/sanding transitions; machining or cutting the chamfer is outside this POC. Abrasive blasting is a future interchangeable tool interface, not a synonym for the included sanding trials.

2. Robot options and selection gate

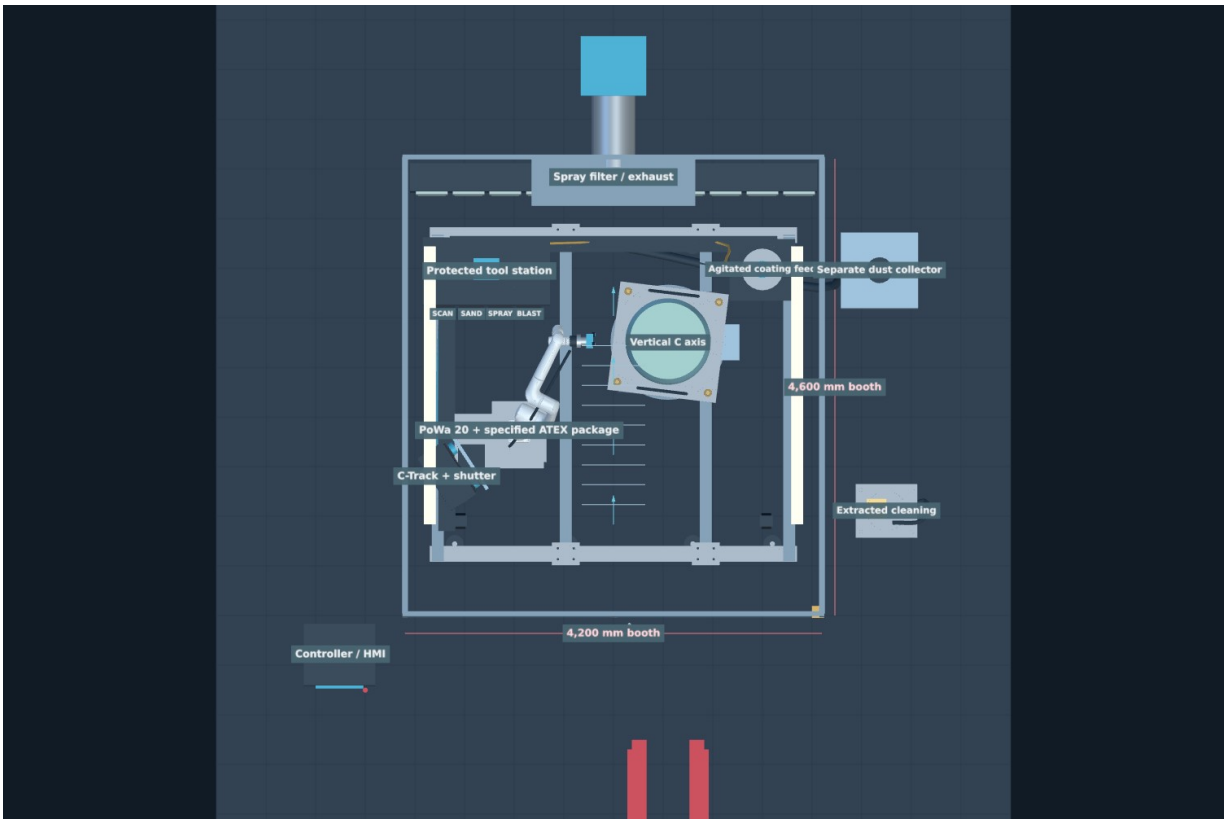
Criterion	Option 1 - ABB PoWa 20	Option 2 - ABB IRB 5500-22
Identity	CRB 1920-20/1.67; actual ABB GLB used.	IRB 5500-22 FlexPainter; exact mounting variant to freeze.
Published load	20 kg rated payload; 1.67 m wrist / 1.82 m flange reach.	13 kg payload at wrist.
Proposed duty	Primary scan, protected-spray and controlled-sanding POC platform with the specified ATEX protection package.	Purpose-built spray alternative; retain a separate qualified sanding platform.
Spray environment	User specifies an ATEX-certified PoWa 20 protective package. Freeze exact robot/cover combination, certificate scope and installation conditions in the supplier dossier.	Published configurations have Ex protection. Confirm exact current certificate and installation conditions for ordered unit.
Sanding judgement	Higher payload offers room for changer, sensor, compliant tool and dress pack; force/stiffness still need trials.	Lower payload alone does not prove inability. Sanding, contact loads and abrasives are not qualified here; manufacturer review required.
Final structure	Common frame with candidate vertical lift for upper regions of 2.1 m part.	Different base loads, envelope, controller and services. Re-engineer frame; no drop-in substitution.

Provisional sanding wrist budget: changer/master 1.5 kg + F/T sensor/adaptor 1.5 kg + compliance/spindle 6 kg + abrasive/guard 1 kg + effective hose/cable load 2 kg = 12 kg. This is an allocation, not a weighed BOM. Check centre of gravity, all-axis inertia, supplier load curves and process reaction forces in addition to payload.

At an illustrative 0.25 m lever arm, a 40 N tangential reaction contributes 10 N m, before gravity, acceleration and hose forces. Neither this estimate nor the animation is a robot load approval. Use the OEM limits for the exact tool and motion.

R2 follows Dr Lim’s confirmation that the selected protection package is ATEX certified. The design basis is the complete protected configuration, including supply/purge monitoring and a package-ready inhibit. The certificate itself was not supplied for this document; the supplier must identify the exact covered assembly and installation conditions. The standard robot manual remains a reference for the underlying unit, not the sole basis for the protected assembly. [1-4]

3. Final cell layout and modular structure



Design element	Proposed basis / verification
Envelope	DSO Booth A: 4,200 W x 4,600 D x 3,300 H mm. Main machine rails: 3,700 x 3,350 mm concept. External controller, fan/duct, dust collector and loading/service aisle are additional.
Machine modules	Robot/lift module, table/fixture module, tool/metrology module. Bolted machined splice plates, dowel references, crossbracing and bonded joints connect the assembly.
No floor anchors	Working feet support the machine; wheels retract/unload for operation. Verify emergency-stop foundation loads, sliding, overturning, floor pressure and worst-case tool force with each pallet present or absent. Ballast may be needed.
Height / access	Table + pallet nominal part seat 720 mm. A 2.1 m part reaches about 2,820 mm. Proposed robot lift stroke up to 900 mm; exact reach, overhead lights, dress pack and service clearances remain to verify.

4. In-house POC configuration

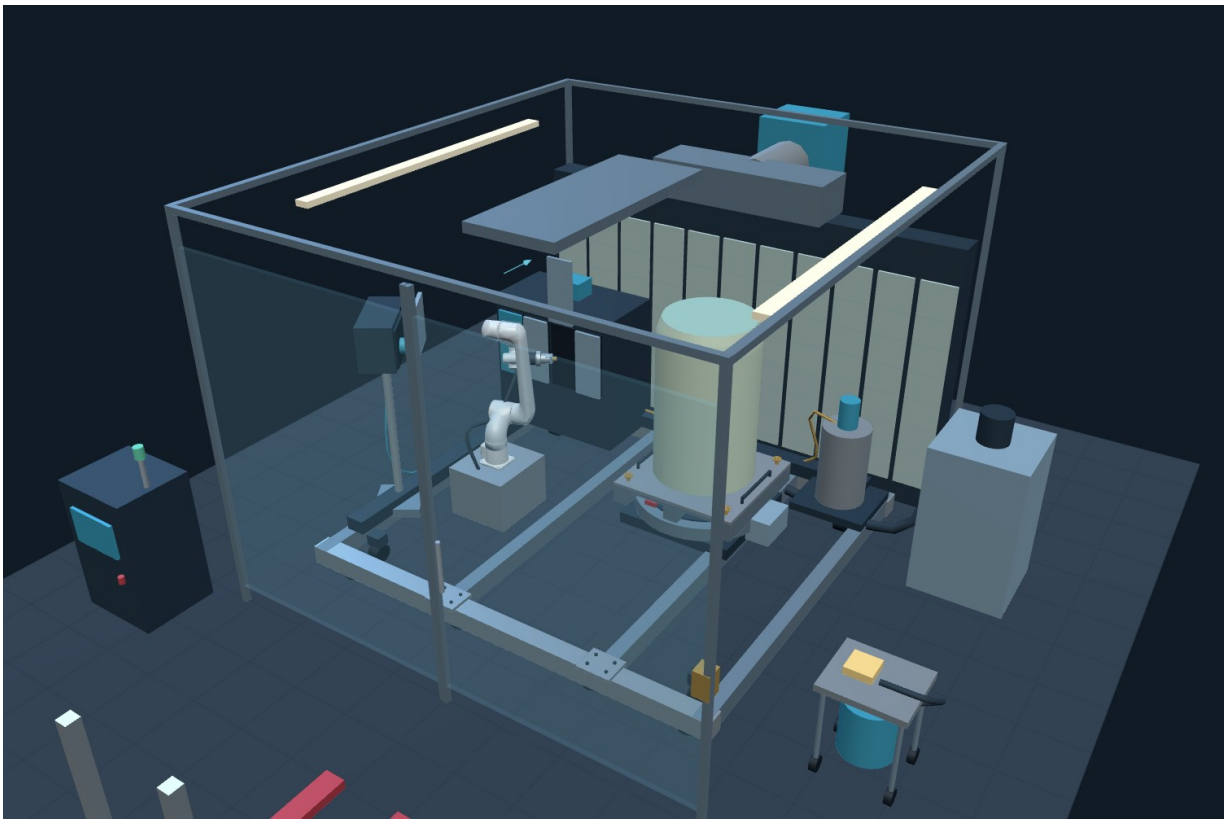


Figure 3. AETEC trial arrangement with 1.4 m part, fixed raised PoWa pedestal, adapted vertical table and prototype protection stations. The drawn booth envelope is a planning reservation; the actual AETEC facility dimensions, equipment and process suitability must be surveyed.

Design element	Proposed basis / verification
Retained for POC	Vertical rotation; fixture pallet / datums / positive clamps; distributed internal support; separate cover cassette; scanner and C-Track covers; covered tool docks; process / cleaning interlocks; local dust capture.
Simplified for POC	Temporary equipment, manually supervised setup, fixed pedestal, adapted rotary drive, prototype covers, existing approved material / extraction interfaces and staged coupon tests.
Final-cell study only	Production robot lift, final enclosure and service panels, production utilities/plant, endurance/SAT and permanent robot/metrology purchases.
Readiness	Validate facility and equipment before material trials. Start with dry motion and safe surrogate checks. Actual coating/sanding proceeds only after applicable process and installation release.

5. Inverted-cup fixture and handling

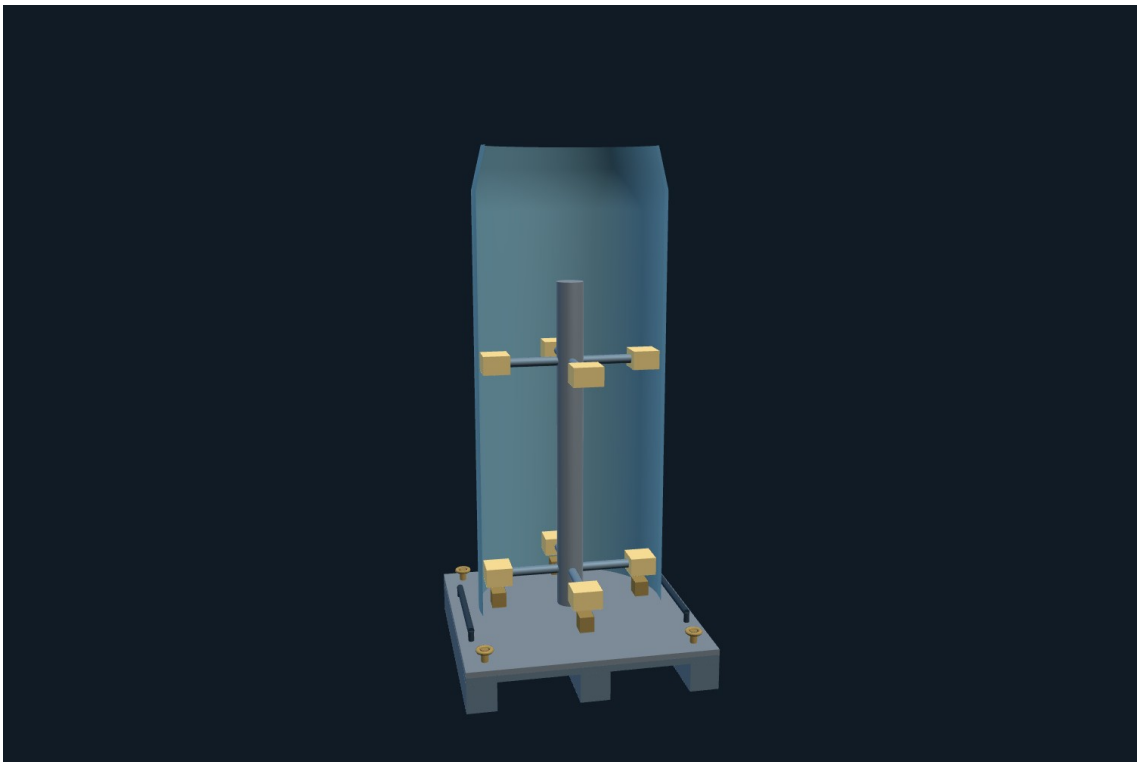
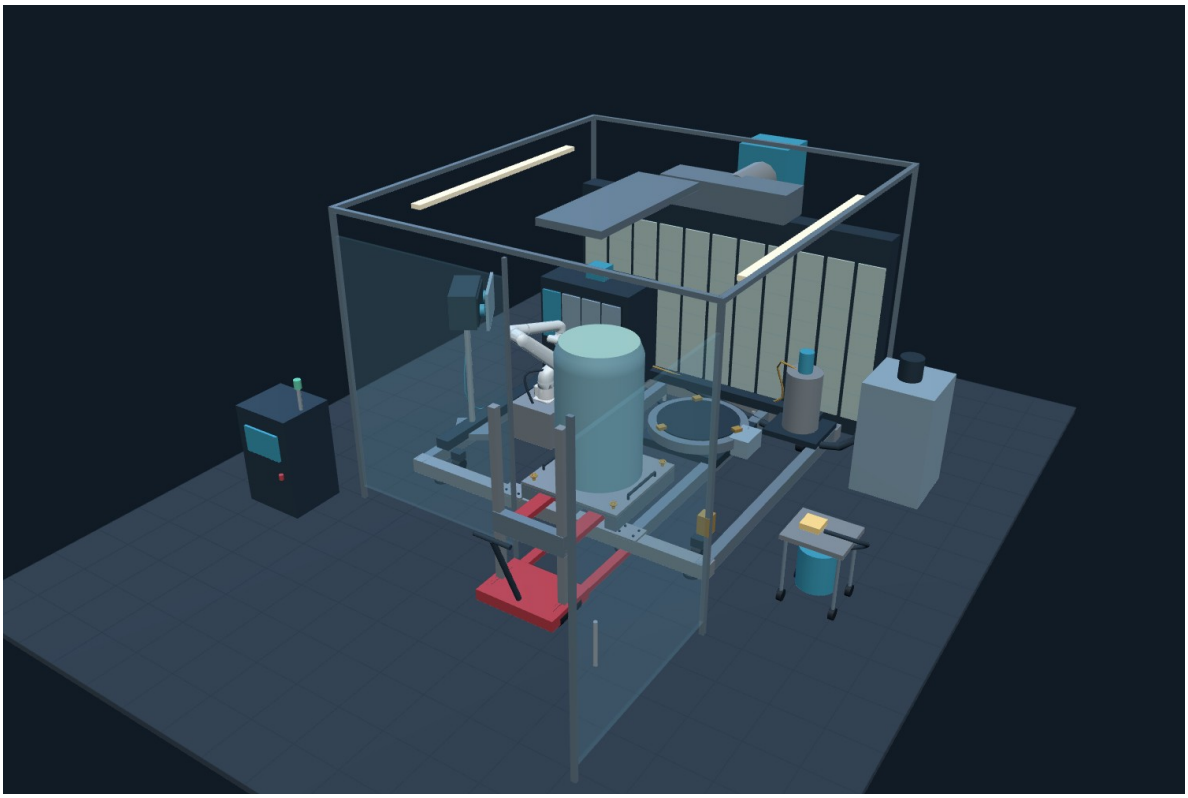


Figure 4. Cutaway: internal mast and pads stop below the closed crown. No external top support is used. Final mast, pads and lower retention must follow approved internal geometry.

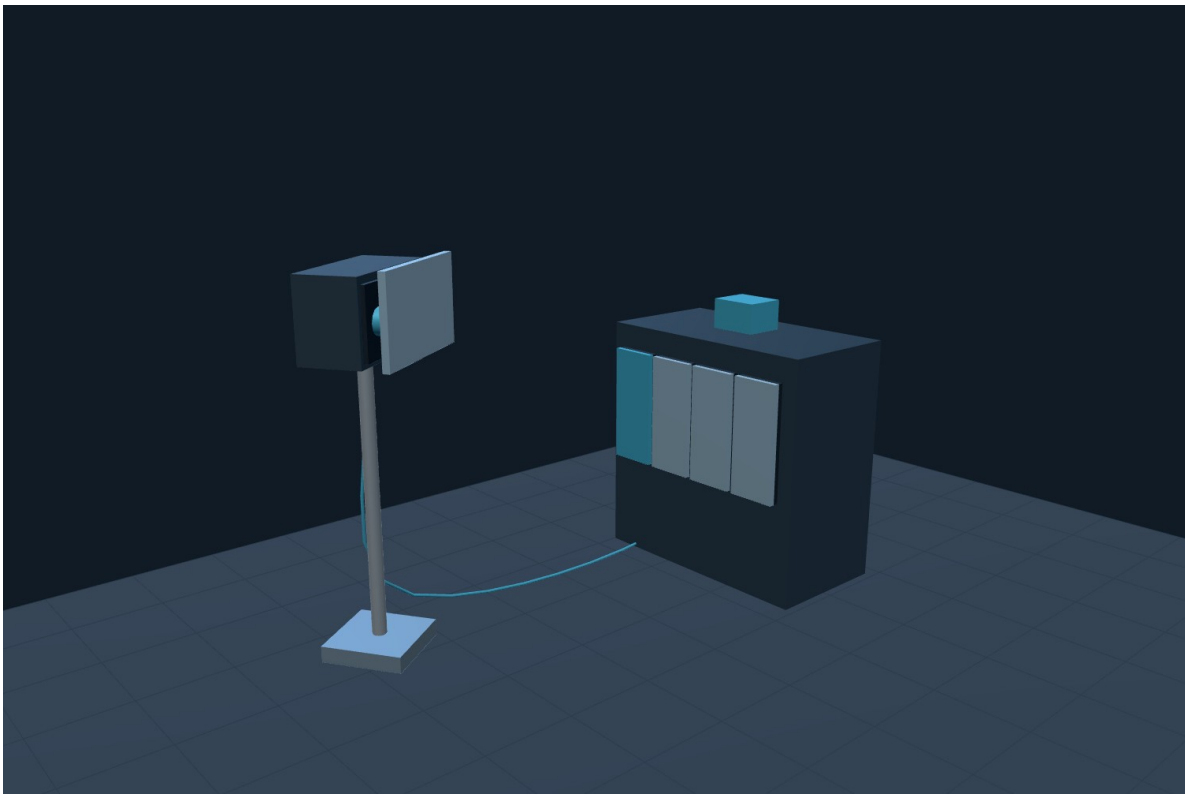
Design element	Proposed basis / verification
Carrier	Nominal 1,100 x 1,100 mm stiff aluminium pallet; candidate 25 mm top plate over deep bolted rails with machined steel locating inserts. Handles and eyes attach to the carrier, never the composite skin.
Support / retention	Broad contoured pads on sound laminate at lower and intermediate stations. A central drawbar/cam may actuate pads with limited, measured preload. A positive axial stop/retainer engages an approved lower internal feature; do not rely on friction only.
Unknown lower feature	If no suitable internal ledge/retaining feature exists, a separately qualified temporary internal adapter or revised lower restraint is required. Do not assume an attachment feature on the customer part.
Access	Keep the closed crown, external coating surface and chamfer clear. Cover parts use their own supported cassette; they are not clamped like a closed cylinder.

6. Pallet docking and ergonomic interfaces



Design element	Proposed basis / verification
Handling sequence	Prepare and clamp part off-cell; verify load and ID; lift carrier through fork pockets; enter at table home; lower onto datums; clamp and bond; withdraw forks; close access and prove status. Reverse only at safe stop.
Fork and lift basis	Two through-pockets shown as 190 W x 105 H mm concept, with 580 mm pitch. Freeze stacker fork width, spread, thickness, reach and lift capacity before manufacture. Ordinary pallet jack is for ground transport, not the elevated table transfer.
Location / locking	Three plane supports, round/diamond location and positive clamps. Drive torque is carried by a mechanical key/interface, not locating-pin friction. Detect seated, clamped, carrier ID and bonding status.
Handles / lifting	Fold-flat long grips and removable T-handle provision; retained hardware / pinch clearance. Four lifting-eye interfaces on the stiff frame, with rated sling geometry only after SWL calculation and proof. No lifting by scanner mast or part crown.
Qualification	Check combined mass/CG, tipping through transport, fork bending, frame deflection, clamp failure, table overturning moment and stop/brake torque. The carrier requires a load plaque after engineering release.

7. Tool change and optical protection



Design element	Proposed basis / verification
Scanner	Creaform MetraSCAN BLACK+ Elite project basis. Park inside its dry cabinet before dirty operations; no camera/laser window faces open process air. Verify supported mounting and software/SDK with supplier.
C-Track	C-Track+ Elite remains on a stiff datum mast; a retracting shutter covers its optical face. Do not move the tracker to close its cover. Preserve line of sight to scanner targets across each indexed view.
Dock cabinet	Four independent bays: scan, sand, spray and future blast. Cover all unused bays and mating interfaces. Separate wet/flush containment from dry sensor compartment; protect the robot-side master with a shroud and capped connectors.
Interfaces	Tool ID, mechanical lock / unlock feedback, safe depressurisation, keyed media connectors, capped clean ports and TCP verification. No pressurised fluid coupling/uncoupling.
Purge	Filtered, dry, compatible low-pressure air with flow/pressure feedback can reduce contamination ingress. Check OEM temperature/cleanliness requirements. Optical purge protects cleanliness; ATEX suitability follows the separately specified certified robot protection package.

8. Ventilation, cleaning and release sequence

State	Optics / tool bays	Process / release logic
Load / baseline	Clean and exposed only for scan	Safe access / clamp / datum checks; clean baseline acquired.
Prepare spray	Scanner parked; all inactive bays and tracker closed	Verify cover closed, tool locked, bonding, guards, material delivery and proven extraction.
Spray	All metrology covered	Qualified spray installation only. Loss of extraction or cover proof inhibits process.
Ventilate / condition	Remain closed	Spray off, shut valves; continue exhaust; material flash/cure requirements remain separate.
Extracted clean	Remain closed	Capture settled residues with approved vacuum / wipe method. Avoid blowing dust back into optical bays.
Clean release	Open only after permissives	Measured ventilation, clean witness / optics surroundings, stable temperature, acceptable atmosphere and required material condition.
Scan / thickness	Optical apertures open	Check targets/visibility and reference datum, then acquire map.
Sand / dust clear	Optics closed again	Prove local vacuum, sand bounded excess regions, stop tool, continue capture/cleaning and release before rescanning.

Illustrative air-clearance calculation

Booth A volume V = 4.2 x 4.6 x 3.3 = 63.756 m3. For idealised dilution, t = 60 V/(eta Q) ln(C0/C), with Q in m3/h. Using eta = 0.7 and C/C0 = 1%: Q = 3,000 gives 8.4 minutes; Q = 5,000 gives 5.0 minutes. These are model examples, not measured facility results or clearance authorisation.

The web app uses a five-minute minimum only as a demonstration setting. Actual release must account for dead zones, continuing solvent emission, dust settling/re-entrainment and surface contamination. Measure flow and verify an agreed end condition; do not open simply when a timer expires. Air clearance does not equal coating cure.

Spray mist / solvent exhaust and sanding dust capture use separate assessed branches. Do not combine combustible dust and solvent residues in an ordinary shared collector. Final fan, filters, duct, discharge, make-up air and fire interfaces require specialist selection for the actual materials.

9. Services, controls and modular interfaces

Subsystem	Design content and release requirement
Spray material	Agitated batch vessel, regulated feed, shutoff, pressure proof, suitable wetted materials, bund and flush catchpot. Existing SOW guns/nozzles are process references, not frozen robot-tool choices.
Air / extraction	Fan/duct/filter shown; pressure/flow proof and filter differential pressure. Separate sanding vacuum; extraction maintained during clearance. No recirculation assumption.
Electrical / safety	Robot controller, PLC/HMI and ordinary panels outside process zone. Monitored access, E-stops, drive/process isolation, status lights and validated restart/reset. Field equipment follows accepted environment.
Lighting	Perimeter lighting at booth frame; maintained access and robot/part clearance. Select appropriate luminaires and protected cables; do not mount a top brace on the part.
Routing	All floor cables and hoses in covered, segregated trunking fixed to the machine frame. Provide removable lids, protected risers, strain relief, bend radii and service loops at moving joints.
Modular disconnect	Labelled / keyed connectors, isolated and depressurised before separation; bonding jumpers and datum witness marks. Reconnect by checklist and recalibrate/check references.
Maintenance	External service aisle, removable panels, filter/collector access, spill/waste access, tool service and isolated recovery. Do not assume all these spaces fit inside the booth envelope.
Blast-ready provision	Reserved bay and modular interface only. Media supply/recovery, nozzle reaction, cabinet wear, optical protection and process/ventilation qualification require a separate scope.

Minimum permissive / fault logic

Enable process only with correct tool ID, lock feedback, part seated/clamped, access secured, required extraction and covers proven, ATEX protection-package ready/pressure feedback, and the accepted robot/process basis. Faults stop material flow/tool energy and controlled motion as designed while maintaining extraction where safe. No automatic restart after fault/access; deliberate authorised reset and safe recovery are required.

10. Thickness and adaptive process method

Design element	Proposed basis / verification
Reference chain	Keep fixture/pallet references stable across before/after scans. Record table index, clamping setting, temperature and load state. Recheck after each cover cycle and relocation.
Scanner basis	Supplied Creaform brochure lists BLACK+ Elite accuracy 0.025 mm and volume accuracy 0.064 mm at 9.1 m3 / 0.078 mm at 16.6 m3. These are catalogue conditions, not achieved coating-thickness uncertainty. Scanner 1.49 kg; C-Track 5.7 kg. [5]
Thickness interpretation	Registered surface change is affected by part deformation, alignment, temperature and support. It is not automatically coating thickness. Correlate with a qualified direct reference on approved sample locations.
Direct reference	Earlier indicator/probe work remains a candidate controlled comparison; penetrating the coating is local and destructive and requires approved locations. Confirm exact gauge / interface and reference validity; do not assume it solves all geometry/materials.
Mapping	Study 1.0 and 1.5 mm zones on the same part. Apply visibility, edge and confidence masks. Invalid regions are excluded from automatic correction and reported explicitly.
Correction	Spray only where below the agreed target rule. Sand only where measured excess exceeds the agreed guard band. Use bounded removal, compliant force control and local extraction; remeasure after cleaning / conditioning.
Edges / chamfer	Segment transition zones separately, reduce contact force as required, use a suitable small tool and ramp entry/exit. Verify scan access and avoid coating breakthrough or unsupported edge loading.

No thickness tolerance or surface-finish acceptance is claimed as frozen. The prior nominal +100/-0 micrometre discussion remains a study reference only until DSO signs the criteria. The app maps are explicitly synthetic and cannot be used as measured evidence.

11. Verification, programme and acceptance

Gate	Evidence / decision
G0 - basis	Native neutral CAD, part mass/CG, laminate/contact/retention, robot model/environment, scanner availability/SDK, facility and material data.
G1 - design	Fixture/handling load study; datum scheme; tool load budget; robot/lift reach; cover and extraction sequence; signed verification matrix.
G2 - dry readiness	Pallet docking/retention, three refixtures, tool lock/ID, cover proof, extraction-loss and power-loss recovery, visibility and interference checks.
G3 - coupons	15 metrology and 12 process coupons. Build/removal/finish study, low/mid/high ten-repeat readings; direct-reference correlation.
G4 - representative parts	Three full-part executions across two families; at least 60 reference locations; up to three correction iterations per family. Record uncertainty, coverage and actual cycle.
G5 - handover	Reports, parts, fixtures, recipes, maps, limitations, Go/Conditional-Go/No-Go, final-cell recommendation and training.

Indicative weeks: 1-2 basis and design; 3-4 prototype / equipment readiness; 5-6 calibration and coupons; 7-9 part/process trials; 10 correction / repeatability; 11 evidence and design recommendation; 12 witness/handover. Target starts after PO/payment/readiness and changes if mandatory inputs or suitable equipment are delayed.

Record fixture setup, scan, spraying, conditioning, cover/tool changes, sanding, extracted cleaning and handover separately. Three executions do not establish production reliability. Extra blind holdout parts are needed for independent validation of both families.

Technical success must be supported by agreed uncertainty/guard bands, coverage, surface finish and damage checks. Commercial completion requires the agreed tests/data/report even when the technical conclusion is limited; AETEC implementation deficiencies receive the defined correction/retest.

12. Design release register and references

Open release item	Required evidence
Customer part	Neutral STEP/IGES, units and exact skin/core / section / holes / chamfer. Current illustrations assume 860 mm diameter and a closed crown for fixture discussion only.
Fixture / structure	FEA or defensible calculations for frame, mast, spindle/pallet, clamps, lifting/fork interfaces; positive lower retention; supplier foundation loads and loaded/unloaded stability.
Robot motion	Exact robot/lift/controller configuration, load curves, full swept-volume collision with actual part, fixture, tooling and hoses; reach and recovery paths.
Optics	Confirmed scanner/tracker configuration, mounting permission, visibility through all indexes, shutter geometry, contamination tests and stable datums.
Facility / process	AETEC bay survey; DSO access/service survey; SDS/TDS and current hazard/ventilation assessment; certified equipment scope and verified clean-release conditions.
Commercial freeze	Equipment loan/hire dates, final procurement choices, approved allowances, no duplicate prior scope, registered quotation and agreed test matrix.

The enclosed design sheets are dimensional design intent, not fabrication-release drawings. The application checks the illustrated state logic and manufacturer-DH pose solutions; neither verifies exact customer CAD collision, machine safety performance nor actual process capability.

Source register

[1] ABB PoWa product page: www.abb.com/global/en/areas/robotics/products/robots/collaborative-robots/powa (checked 20 September 2026).

[2] ABB Product specification CRB 1920, 3HAC097952-001 Rev A; payload, dimensions/load limits and prohibition on explosive environments. search.abb.com/library/Download.aspx?DocumentID=3HAC097952-001&LanguageCode=en&Action=Launch

[3] Official ABB GLB CRB 1920-20/1.67, 9AKK108473A0633 Rev A. ABB RobotStudio generator. Display mesh simplified; original file retained. Robot geometry copyright ABB.

[4] ABB IRB 5500-22 product page and IRB 5500 FlexPainter RP50010EN Rev G; wrist payload / paint duty / published Ex configurations. Current exact ordered configuration takes precedence.

[5] Supplied Creaform MetraSCAN 3D brochure, BLACK+ / BLACK+ Elite, copyright 2025 V2; project communications identify C-Track+ Elite.

[6] DSO September SOW (spraying/sanding/thickness v2), 18 September 2026 email/CAD package, and 20 September user design direction. Junxiang Q912226008A and common-frame Rev F used for design conventions only.

13. Complete simulation - handling and coating

Step	Operation	Purpose / demonstrated action
01	Prepare the fixture	Seat the inverted-cup part on approved internal pads. Check lower retention, carrier ID and lifting interfaces.
02	Open the right access door	Robot parked; process energy isolated. The right door opens onto the straight loading lane.
03	Bring in the fixture pallet	A stacker carries the aluminium fixture through the fork pockets. Align with the vertical turntable.
04	Seat and lock the pallet	Lower onto three datums. Prove positive clamps, seating, carrier ID and bonding.
05	Withdraw the stacker	Lower forks clear of the carrier, then reverse along the loading lane. The fixture stays on the table.
06	Close and lock the door	Close the right door; prove guarding and ATEX protection-package pressure / purge readiness.
07	Pick up the scanner	Open only the scanner bay. Couple the MetraSCAN head, verify lock / ID and move to the part.
08	Scan the uncoated surface	C-Track shutter open. Rotate the vertical C axis and scan the complete study surface before coating.
09	Return and protect the scanner	Retract, park the scanner in its dry bay, uncouple and close both optical covers.
10	Pick up the spray head	Open the spray bay, lock the selected head, check services, then close unused bays.
11	Apply the coating	Protected PoWa configuration, extraction and tool lock proven. Rotate and traverse for controlled coverage.
12	Park and flush the spray head	Stop material flow, retract and park. Contain the flush in the wet catchpot and cap unused couplings.
13	Extract and condition	After the spray head is parked, extraction continues and the optics stay covered. This waiting period is compressed in the animation. At the example airflow, the simple dilution model gives about eight point four minutes, followed by the actual cleanliness and material release checks.
14	Clean and release for metrology	Use the extracted cleaning station. Verify residues, clean targets and temperature before opening optics.
15	Pick up scanner for thickness	Open clean optical systems after release. Verify scanner lock and tracking before measuring.
16	Measure coating build	We compare the pre and post surfaces, supported by a qualified direct reference. The map separates thin, excess and invalid regions. These displayed values are illustrative; real POC measurements will establish uncertainty and correction limits.

One uninterrupted state timeline drives the web app and video. Handling, tool docking, cover movement, process waits and unloading remain in the same scene. Demonstration times are compressed; material/extraction release is condition-based.

14. Complete simulation - correction and unloading

Step	Operation	Purpose / demonstrated action
17	Park optics before sanding	Return scanner to dry bay. Close scanner and C-Track covers; protect every unused interface.
18	Pick up the compliant sander	Verify force-tool ID, lock, compliant travel and dedicated vacuum connection.
19	Correct excess coating	The compliant sander works only on approved excess coating. Local vacuum captures the residue at the tool. Thin, invalid and unsupported regions are protected, and coating removal is bounded by the recipe.
20	Park the sanding tool	Retract, stop the spindle and return the head to its protected bay. Keep capture active.
21	Clear the sanding residue	Continue dedicated dust capture and extracted cleaning. Optics stay shut through the dirty interval.
22	Release the clean cell	Check witness surfaces, target cleanliness and stable temperature; then permit metrology.
23	Pick up scanner for verification	Reopen optical systems under clean release and confirm tracking / tool identity.
24	Verify and record the result	After cleaning, the system remeasures the part and records the result. This demonstration shows an improved synthetic map. The real trial determines whether another bounded correction is needed and whether the agreed acceptance criteria are met.
25	Return scanner and park robot	Store the scanner, close its bay and park the robot clear of the loading lane.
26	Open for unloading	Process stopped, table at home and robot parked. Unlock and open the right access door.
27	Insert the stacker forks	Enter straight and align the forks with the two carrier pockets; support the pallet before release.
28	Release the pallet clamps	Confirm the load is supported. Release the positive table clamps and the bonding interface.
29	Lift clear of the datums	Raise the complete carrier clear of the locating features. The part stays clamped to its fixture.
30	Withdraw the loaded fixture	Reverse straight out. Move the fixture to the off-cell review / handling area.
31	Cycle complete	The complete cycle is finished, with the fixture removed and the robot parked. The same sequence is available in the final-cell simulation, including the larger workpiece and vertical robot lift. POC evidence will guide the final equipment, process settings and detailed engineering release.

One uninterrupted state timeline drives the web app and video. Handling, tool docking, cover movement, process waits and unloading remain in the same scene. Demonstration times are compressed; material/extraction release is condition-based.