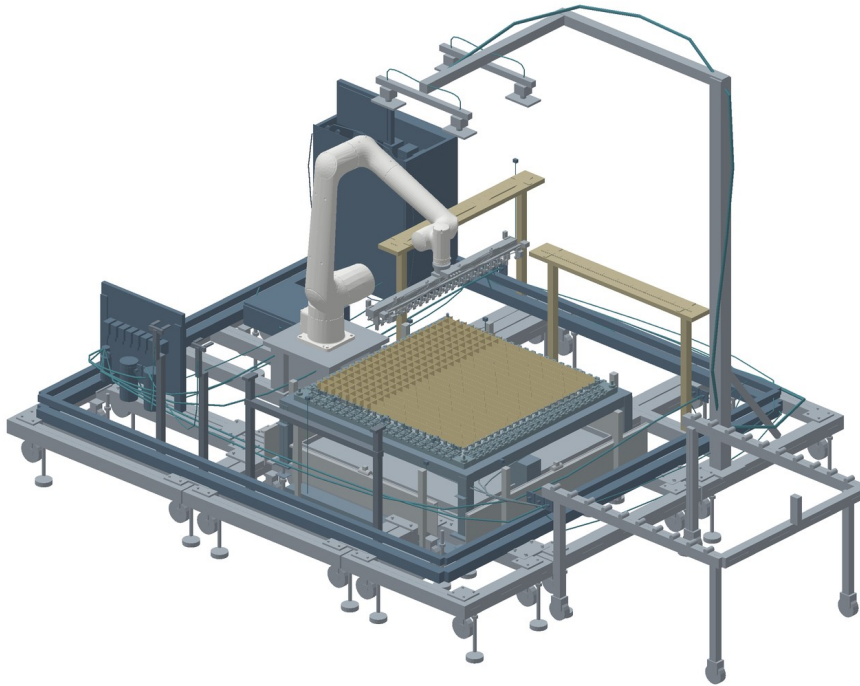




# Nomex Robotic Assembly

Technical proposal | AETEC-DSO-NOMEX-TP-20260913-RevG

One ABB PoWa 20 machine for supported assembly, inspection and adhesive application to flexible, pre-cut Nomex strips. Nominal grid: 1000 x 1000 mm centreline span at 50 mm pitch.



Design status: coordinated design and budget release. Manufacturing and energisation release remain subject to the defined POC, supplier details, site access survey, structural and machine safety validation. Native STEP geometry does not by itself establish production readiness.

| System   | Defined basis                                                                  |
|----------|--------------------------------------------------------------------------------|
| Robot    | ABB PoWa 20 / CRB 1920-20/1.67; official ABB external geometry                 |
| Core     | 21 A strips + 21 B strips; 400 nominal square cells; 441 intersections         |
| Assembly | Supported planar pickup, controlled tension, slot alignment and slow insertion |
| Adhesive | Drip only, spray with automatic fixture protection, or dual mode               |

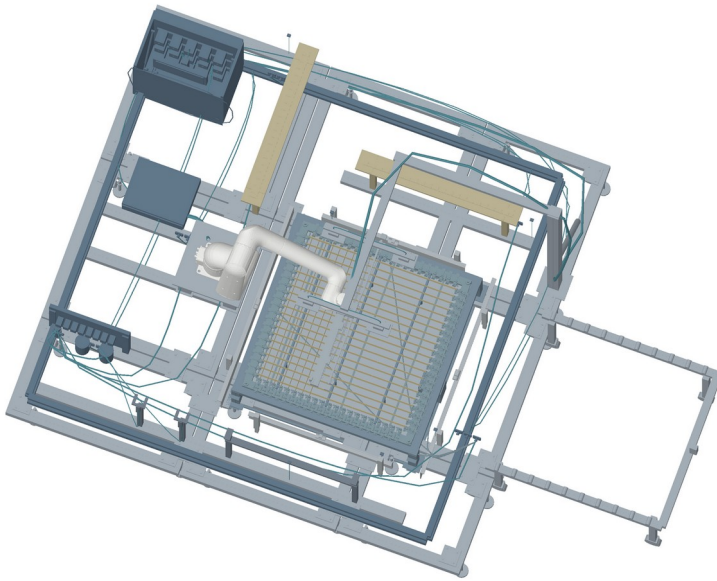


## 1 Complete material and machine sequence

| Step        | Motion and retention                                                                                 | Required confirmation                                              |
|-------------|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| 01 Feed     | Operator loads keyed A/B magazines with pre-cut blanks.                                              | Recipe, orientation, material batch and stack present.             |
| 02 Pick     | Approach parallel to the flat sheet; establish all four vacuum zones.                                | Single sheet and every vacuum zone; no tool tilt during pickup.    |
| 03 Support  | Lift clear; close segmented soft jaws and end grips; take up slack.                                  | Two end grips and limited tension.                                 |
| 04 Transfer | Orient above the stack; follow the fixed high-clearance corridor.                                    | Grip remains proved; abort on vacuum loss.                         |
| 05 Align    | At the approach gap, scan all 21 slot locations with two cameras.                                    | Correct global XY/yaw; local residual or hidden edge gives HOLD.   |
| 06 Insert   | Controlled vertical engagement, with abnormal-force retract.                                         | Position, force envelope and seating evidence.                     |
| 07 Handover | Close paired datum and floating jaws; prove both, then unload EOAT tension.                          | Fixture retention before opening the tool.                         |
| 08 Inspect  | Re-image visible cut edges and joint lips after every placement.                                     | Record 42 pre-placement and 42 post-placement inspection sets.     |
| 09 Qualify  | Withdraw combs; park long tool; acquire selected adhesive tool; inspect full grid and height.        | Tool identity, lock, count, geometry and height.                   |
| 10 Glue     | Drip: 441 metered deposits. Spray: deploy four covers then raster.                                   | Inspection accepted; shutoff and relevant cover/extraction proofs. |
| 11 Finish   | Inspect deposits, park tool and retain the core during qualified cure.                               | Cure release is material-specific.                                 |
| 12 Output   | Safe stop; operator transfers supported cassette to the trolley, removes panel and returns cassette. | Coded reconnection, location and inspection checks before restart. |



## 2 Robot layout and collision review



The current rigid geometry was screened at 34,480 distinct sampled states across the two recipes. The latest report records 0 non-exempt contact classes and zero joint-limit violations. The report includes its input hashes and contact exemptions.

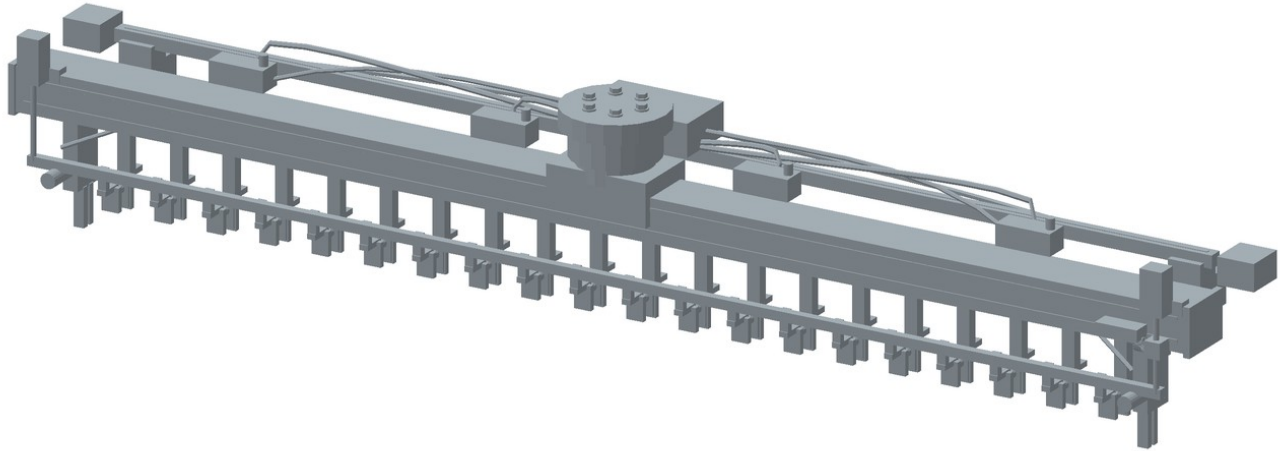
This is offline triangle-mesh screening using the supplied joint coordinates. It is not a RobotStudio/controller virtual commissioning certificate, continuous swept-volume proof or a flexible-body simulation. Camera slide sweep, dress-pack torsion, stopping envelopes and the operator-assisted carrier transfer require separate physical/engineering checks.

The cover stow level was lowered from 710 to 550 mm, with 450 mm lift before folding. Sensor brackets are placed outside the nominal pickup beam envelope. Tool rack contacts are exempt only during defined docking events; moving robot links receive no rack exemption.

| Route | Displayed duration | Scope                                                                  |
|-------|--------------------|------------------------------------------------------------------------|
| Drip  | 25.4 min           | Includes illustrative output/reset motion; excludes actual cure dwell. |
| Spray | 18.2 min           | Includes cover sequencing; excludes actual cure dwell.                 |



### 3 Flexible-paper end effector

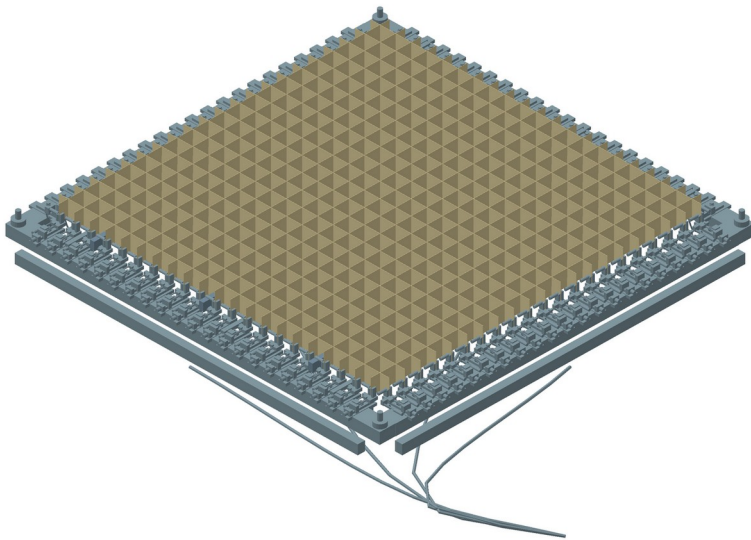


| Component | Design and manufacturing basis                                                                                                                                                       |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Load path | 1120 mm stiff support beam, machined flange adapter, F/T interface and automatic coupler. Check assembled mass, centre of gravity and inertia against the ordered PoWa load diagram. |
| Support   | 20 pads at 50 mm pitch, four independently sensed vacuum zones. Restrict each pad branch so a local leak does not collapse all retention.                                            |
| Pickup    | Full planar support is established first. A 75 mm retraction of the guided jaw bridge provides stack clearance before jaws close.                                                    |
| End grips | Separate fixed and floating end grips use intact handling lands. Tool and fixture grips occupy different lands to allow controlled handover.                                         |
| Vision    | Two half-span camera slides scan 10 + 11 stations. Camera carriage end stops, cable management, lens focus and calibrated working distance require selection trials.                 |
| Utilities | Tool-side keyed DC, independent camera data, compressed air and lock-proof circuits. Ejector exhaust is silenced away from the paper.                                                |
| Pads      | Trial silicone-free, non-marking polyurethane, nominal 40 Shore A, 2 mm thick, mechanically retained. Pad hardness and contamination must pass the paper and adhesive tests.         |

The ABB data sheet specifies an ISO 9409-1-50-6-M6 flange and C2 Ethernet at 100 Mbit/s. Two high-bandwidth cameras therefore use dedicated robot-rated camera cables; no Gigabit performance is assumed through C2. The integrated 24 V current limit must be checked against the ordered controller; external fused tool supply is included in the interface design.



## 4 Fixture, slot geometry and tension



| Feature             | Design basis                                                                                                                                                              |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Perimeter retention | 42 fixed datum jaws and 42 independent spring carriages. Pneumatic opening with spring retention prevents uncontrolled paper release on loss of air.                      |
| Tension             | Illustrative preload 0.30 N, spring rate 0.15 N/mm, 2 mm take-up gives 0.60 N. Set from notched-strip tests; do not treat slide travel as paper strain.                   |
| Support             | Three retractable comb rails between incoming B planes; fixed lower rails support the grid after comb withdrawal.                                                         |
| Blank allowance     | 1060 mm blank with 30 mm provisional handling land beyond each outer crossing. Finished edge and trimming method must be agreed.                                          |
| Geometry hold       | 50 mm pitch is the requested basis. Core height 50 mm, thickness 0.13 mm, 0.8 mm slot and 25 + 25 mm depth are unqualified placeholders, not derived production drawings. |

At a 1 m span, 0.01 degree yaw represents about 0.175 mm lateral displacement. Global alignment, accumulated slot pitch error, local bow and burr/fibre condition must all fit the available slot clearance. Increasing spring tension cannot correct an incorrect slot pattern.



## 5 Modular structure and access

The operating base uses nine bolted aluminium-profile subframes with accessible splice plates. Robot, feeder and tool-rack feet have dedicated support rails. The precision carrier remains one located assembly and travels empty on a restrained vertical transport trolley.

| Subframe row | Widths, mm        | Depth, mm |
|--------------|-------------------|-----------|
| B1 / B2 / B3 | 1230 / 1110 / 870 | 1110      |
| B4 / B5 / B6 | 1230 / 1110 / 870 | 1150      |
| B7 / B8 / B9 | 1230 / 1110 / 870 | 690       |

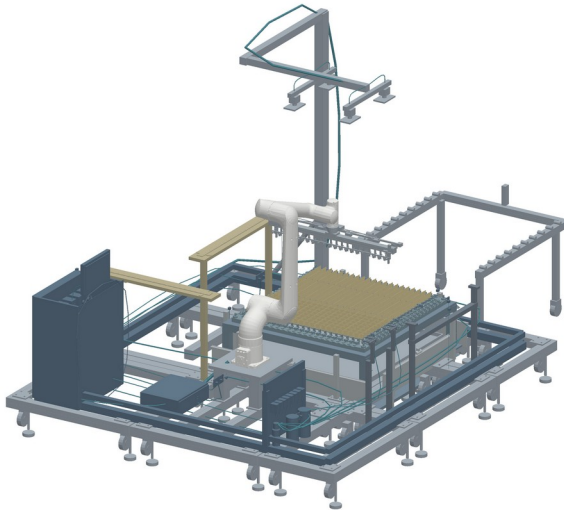
These are bare base-frame envelopes, not complete packed module sizes. Tall masts, magazines, electrical cabinet, robot tool and guard panels detach at bolted interfaces. The robot transport posture and packed mass require ABB and access review. No complete-module lift-fit approval is claimed.

The earlier 1800 x 1500 x 2000 mm lift cabin is retained only as a provisional planning reference. Door clear opening, lift load, threshold, landing turn and packing protection remain unconfirmed. Use measured access dimensions to release the packing plan.

| Joint / interface | Implementation                                                                                                                                                                          |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Structural        | Round/diamond locating strategy plus bolted splice plates; locators establish position and bolts carry defined loads. Robot stop loads and profile joint stiffness require calculation. |
| Operating support | Lockable feet support operation; casters are transport devices. Re-level and recheck datum after every reassembly.                                                                      |
| Electrical/data   | Coded interface bays on accessible dry faces, protected DC branches, labelled networks and separate safety connectors.                                                                  |
| Air/fluid         | Vented pneumatic coupling per module, local valves and pre-piped actuators. Separate keyed/capped adhesive lines.                                                                       |
| Reconnect         | PE first, mechanical ties and level, air/DC/data/safety, module identity, I/O check, calibration check and dry cycle.                                                                   |



## 6 Electrical, computer and cable architecture



The local computer handles recipes, inspection images, diagnostics and authorised requests. The PLC owns the deterministic sequence and machine interlocks; the ABB controller owns robot motion. A dedicated safety control system owns protective functions independently of the application and standard Ethernet.

| Path            | Physical route and interface                                                                                                                                                             |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Incoming AC     | Isolator, protective distribution, protective-earth bar and selected controller feed. Site voltage, prospective fault current and ABB order-specific protection remain release inputs.   |
| 24 V DC         | Separate system and actuator branches. Preliminary M12 L allocation: 1 +24S; 2 0S; 3 0L; 4 +24L; FE functional earth. Verify vendor mating-face diagrams.                                |
| Machine network | Industrial switch to PLC, ABB controller and remote I/O. GigE cameras connect to vision NICs or a qualified dedicated switch.                                                            |
| Trunking        | 60 x 60 mm covered power duct at lower profile rail; separate 40 x 40 mm signal duct above it. Clamp and label at module exits.                                                          |
| Robot wiring    | Original ABB arm cable remains intact. Dynamic utility bundle has defined clips and strain relief; final bend radius, twist and cycle life depend on selected cable products.            |
| Cabinet         | Protected supplies, disconnect, safety controller, PLC/I/O, switch, IPC interface, terminals and PE bonding. Ventilation and enclosure rating follow heat and spray exposure assessment. |



## 7 Pneumatics and connection definition

One incoming isolation and regulated-air station feeds module-local valve islands. Local cylinders remain piped on their modules; relocation disconnects the coded trunk interfaces. Air is vented and zero pressure confirmed before coupling separation.

| Circuit        | Preliminary design definition                                                                                                                                                          |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fixture clamps | 42 independently addressed air-open channels, each feeding one fixed and one floating jaw. 4 mm OD / 2.5 mm ID PU actuator tube; individual soft-close qualification.                  |
| Vacuum         | 4 generators, 4 vacuum pressure switches, 20 restricted pad branches. Preliminary 8 mm trunk, 6 mm zone line and 4 mm pad branches.                                                    |
| Comb support   | 3 guided retracting support rails, each with end position feedback. Flow controls fitted at actuators; stroke and load released after geometry trials.                                 |
| Covers         | 4 lift and 4 fold axes, individual end feedback and sequenced deployment. The 450 mm lift requires a qualified guided unit.                                                            |
| Adhesive       | Separate fluid supply, shutoff and purge per head; controlled atomising air for spray. Wetted hose bore, liner and seals require adhesive TDS/SDS compatibility.                       |
| Fittings       | 4 mm branches: M5 swivel elbows; 6 mm pilots: G1/8; 8 mm tool supply: G1/4; module trunk: G3/8 bulkhead and keyed venting coupling. Final cylinder port threads follow selected parts. |

The route register reports model centreline lengths and a 0.20 m service allowance rounded upward to 0.05 m. It is a cutting estimate, not a measured harness. Ejector pad tails, camera slide loops and OEM arm cable lengths are listed separately in the engineering basis and are not silently included in those centreline totals.



## 8 Inspection and control acceptance

| Gate               | Failure response                                                                                                                                                   |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Before pickup      | Stack absent, double sheet or any vacuum zone not proved: stop before transfer and reacquire within an agreed retry count.                                         |
| Before insertion   | Global slot pose correction only; local residual, obstructed edge or missing feature: HOLD and supported rework.                                                   |
| Insertion          | Excess force, abnormal displacement or incomplete seat: controlled retract while keeping the strip retained.                                                       |
| Handover           | Fixture grip and tension must both be confirmed before tool release. An air or power fault must not create an uncontrolled release.                                |
| After placement    | Check visible cut edges on both accessible sides and joint lift. Unknown views require another qualified view or supported rework.                                 |
| Before adhesive    | 42-strip count, grid geometry and height accepted; correct tool and fluid recipe verified. Spray additionally needs four covers and extraction proof.              |
| After adhesive     | Visible presence/coverage and distortion check; cure and bond performance remain a separate qualified process.                                                     |
| Communication loss | Application disconnect cannot command motion; standard PLC/robot communication timeout inhibits automatic continuation. Safety reactions are separately validated. |

PLC ladder sheets show functional sequencing and signal ownership. They are not a compiled brand-specific safety program. ABB safety terminal numbers, protective-function settings, fieldbus addresses and camera driver interfaces must match the selected devices before energisation.



## 9 Adhesive, optional settling and proof of concept

| Route           | Equipment and development criteria                                                                                                                                                                           |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drip            | 21 x 21 addressed crossings. Meter, shut off and retract at every point. Trial shot 6 microlitres gives 2.646 mL over 441 points; this is a trial quantity, not an approved dose. No cover deployment.       |
| Spray           | Four leaves lift 450 mm, fold inward then lower 120 mm to the 880 mm shield level. Final aperture 1020 x 1020 mm. Extraction, overspray collection and cleanable liners are included in the spray allowance. |
| Optional platen | Guided flat plate with hard stops, parallel guides and load measurement. Begin with static limited force before trying low-amplitude excitation. Park fully clear before any robot motion.                   |
| Vibration risk  | May help frictional seating but may also buckle paper, propagate slot tears, distort pitch or smear wet glue. Evaluate on dry coupons first; do not use as an assumed correction method.                     |

### POC sequence and measurable outcomes

P1: one strip with six crossing slots; printed guide bodies and replaceable jaw pads on a 4040 profile frame. Measure pickup reliability, vacuum leakage, clamp slip and insertion force. P2: 5 x 5-cell fixture with a manually driven, force-instrumented Z slide and dual-edge imaging. P3: full 1 m handling beam and at least one full 21-slot insertion before production frame release.

The included allowance covers a small prototype fixture and two tooling iterations within the specified trial hours. Test normal, bowed, pitch-error and edge-damaged blanks. Log force/displacement, image residuals, vacuum level, humidity and tear/slip observations. Agree thresholds from samples before FAT requirements are frozen.



## 10 Manufacturing and deliverable basis

| Part family         | Proposed process / material                                                             | Release dependency                                                              |
|---------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Main structure      | Supplier aluminium profile, bolted brackets and splice plates.                          | Section, joint loads, caster/foot ratings and stop-load analysis.               |
| Adapter / tool beam | Machined aluminium 6061; machined adapter and vendor coupler.                           | ABB flange and coupler drawings; inertia and balance.                           |
| Fixture datum parts | Machined tooling plate and replaceable POM guides.                                      | Flatness, datum tolerances, finished blank pattern.                             |
| Spring carriages    | Machined aluminium/POM slide with selected guides and tested spring.                    | Preload, travel and notched-strip allowable tension.                            |
| Printed POC parts   | PA12 or PETG for guides, sensor nests and prototype covers; inserts at repeated joints. | Not a substitute for the robot structural adapter or load-bearing safety parts. |
| Contact pads        | Die-cut mechanically retained non-marking PU trial pads.                                | Grip, compression set, contamination and adhesive compatibility.                |
| Covers              | Folded sheet metal with replaceable qualified liner.                                    | Stow/lift envelope, cleanability and actuator selection.                        |
| Fasteners / tubes   | External fasteners and pipe routes represented in the assembly.                         | Torque, locking method, thread engagement, bend radius and final cut check.     |

Handover comprises the coordinated web simulation, native STEP assembly and detail subsets, engineering drawings, route register, editable budget workbook and the technical/commercial documents. OEM internal fasteners and proprietary circuit internals remain part of the supplied vendor units.



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## 11 Included scope and exclusions

### EX01 Material envelope

One agreed Nomex grade, thickness range and A/B blank drawing. Customer supplies representative blanks and adhesive. Different grades, coatings, slot geometry, moisture limits, sizes or batch variability outside the agreed envelope require a scope review.

### EX02 Flexible insertion

Initial supported vacuum handling, guided insertion and two POC tooling iterations are included. Additional handling methods, new fixtures, segmented insertion devices or trials beyond the agreed POC allowance are separately quoted.

### EX03 Optional settling

The layout retains a provision for a guided alignment platen and trial excitation. The platen, vibration hardware and vibration qualification are optional. No vibration-assisted insertion benefit is guaranteed.

### EX04 Adhesive

One qualified formulation per installed head. Drip and spray options have separate wetted circuits. Two-component mixing, solvent/explosive atmosphere equipment, new seal materials or alternative curing equipment are excluded unless selected.

### EX05 Inspection

Two EOAT cameras, four overhead cameras and the selected profiler head; visible edges, height and deposit presence. Hidden bond coverage, internal wetting, peel strength, resin chemistry or destructive strength certification are outside optical inspection scope.

### EX06 Throughput and yield

Robot process sequence and trial timing are included. Acceptance metrics will be agreed from POC evidence. Animation duration is not a production takt, availability or yield guarantee. Guaranteed targets require an agreed trial and capacity study.



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## 11 Scope boundaries continued

### EX07 Output and replenishment

Manual magazine replenishment and operator-assisted supported carrier unloading are included. Upstream cutting, automatic bulk feeding, robotic finished-panel handling and automatic margin trimming are excluded.

### EX08 Site and relocation

One local installation/SAT allowance. Coded module interfaces and reassembly procedure are included. Lift alterations, cranes, building works, long external ducts, repeated relocation/SAT or out-of-hours work are separately quoted.

### EX09 Cure and finishing

Supported cure parking for the selected qualified ambient process. Oven, vacuum impregnation, face-sheet bonding press, humidity chamber and downstream finishing are excluded.

### EX10 Safety and approval

Safeguarding and validation necessary for the agreed cell are included in the engineering scope. Special third-party certification is excluded. Required safe design and correction of defects against the agreed specification are not optional extras.

### EX11 Vendor interfaces

Original ABB arm cable remains unmodified; ordered OEM options determine terminals, load limits and mounting details. Proprietary OEM internals are not reproduced. Supplier changes after agreed order codes may require a variation.

### EX12 Change control

Changes are assessed with the technical effect, deliverables, cost and schedule recorded before work proceeds. R&D uncertainty does not authorise unlimited extra charges. Optional work requires a written agreed variation.



## 12 Design release and source references

| Release gate         | Required evidence                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| G1 Inputs            | Approved A/B drawings, grade/thickness/flatness envelope, adhesive TDS/SDS, panel edge definition and access survey.                   |
| G2 Feasibility       | POC results for flexible handling, full-width slot engagement, visible-edge inspection and cured joint performance.                    |
| G3 Detail            | Supplier models, final electrical terminals and protection, pneumatic ports, tolerances, fastener schedule and structural load report. |
| G4 Motion and safety | Controller simulation, all tool loads, camera-slide and dress-pack sweeps, stop/restart behaviour and validated protective functions.  |
| G5 FAT/SAT           | Agreed count and quality metrics, repeatability, recovery cases, commissioning records and operator training.                          |

The rigid simulation and STEP are design evidence for these gates. Physical manufacturing release requires the gates relevant to machining or procurement to be completed; commissioning closes the remaining machine acceptance gates.

ABB PoWa product family

<https://www.abb.com/global/en/areas/robotics/products/robots/collaborative-robots/powa>

ABB original articulated GLB, 9AKK108473A0633

[https://search.abb.com/library/Download.aspx?](https://search.abb.com/library/Download.aspx?DocumentID=9AKK108473A0633&LanguageCode=en&DocumentPartId=&Action=Launch)

[DocumentID=9AKK108473A0633&LanguageCode=en&DocumentPartId=&Action=Launch](https://search.abb.com/library/Download.aspx?DocumentID=9AKK108473A0633&LanguageCode=en&DocumentPartId=&Action=Launch)

ABB PoWa 1920 datasheet, 27 May 2026

<https://a.storyblok.com/f/298593/x/811e622955/powa-1920-datasheet-27-05-2026.pdf>

ABB native STEP, CRB1920 20kg-1670 Rev00

[https://a.storyblok.com/f/298593/x/2e45ea2810/crb1920\\_20kg-1670\\_omnicore\\_rev00\\_step.zip](https://a.storyblok.com/f/298593/x/2e45ea2810/crb1920_20kg-1670_omnicore_rev00_step.zip)

DuPont Nomex characteristics

<https://www.dupont.com/news/characteristics-of-nomex-for-insulation.html>

Nordson EFD 741V needle valve class

<https://www.nordson.com/en/products/efd-products/741v-needle-valves>

Nordson EFD 781S spray valve class

<https://www.nordson.com/en/products/efd-products/781s-general-purpose-spray-valves>

Sources reviewed September 2026. ABB geometry and trademarks remain ABB property; the fixture and process are the proposed AETEC integration. Product-class references are not supplier quotations or endorsements.