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IAF PROTOTYPE AND NEW MODEL INTRODUCTION MANUAL

Controlled prototype builds
and evidence for production launch

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Industrial additive manufacturing controls
Pilot runs and serial production readiness

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Publication identity and use

IAF Prototype Production and New Model Introduction Manual

This manual defines controlled prototype production and the transition of a new automotive model into serial manufacture. It covers confidential development workshops, mule and clay builds, additive manufacturing, pilot production and evidence based launch decisions.

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Reading and applying requirements

“Shall” identifies a requirement when adopted by a site, programme or agreement. “Should” identifies a recommendation. An example is illustrative; it is not a machine setting, test acceptance limit or completed operating record. Annex worksheets may be reproduced for controlled internal use.

Controlled implementation

Stable Release identifies the completed publication text. Site approval, process validation, competence authorization and equipment release are recorded when performed. A missing safety limit, test criterion or release authority prevents activation of the affected operation. Mandatory law, product requirements and validated equipment instructions remain applicable.

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Using the annexes

Enter actual values, evidence references, names and dates in the worksheets. A blank, unsigned or illustrative record is not proof of completion. Retain the record with its governing instruction and revision.

1 Purpose scope and required outcomes

1.1 This manual defines controlled prototype production and the introduction of a new automotive model into serial manufacture. It covers confidential research workshops, mule vehicles, clay models, fabricated and additively manufactured parts, engineering builds, pilot runs and production readiness. The required outcome is a traceable progression from development intent to an accepted production configuration.

1.2 Apply the requirements to vehicle manufacturers, engineering centres, prototype suppliers, tooling teams and production sites within the adopted programme. Include outsourced work, temporary workshops and material returned from testing. A development label does not remove obligations for safe equipment, competent personnel or accurate records.

1.3 The programme shall define the intended use and limitations of every prototype and build stage. Appearance evaluation, packaging checks, functional testing and durability testing need different levels of material and process evidence. A part suitable for a styling review shall not be assumed suitable for a road vehicle or a safety critical test.

1.4 New product introduction is abbreviated NPI in this manual. It includes the technical and operational decisions needed to introduce a new model, derivative or significant product change. The programme shall identify which requirements apply to the actual scope rather than using an identical gate checklist for every change.

1.5 Prototype learning shall remain visible through issues, design changes, test results and launch decisions. A successful demonstration or small batch of acceptable parts is evidence for its stated conditions only. Serial production release requires the additional process, supply, quality and operating evidence defined by the programme.

2 Build categories and readiness definitions

2.1 A mule is a development vehicle that combines selected systems, often using a modified existing body or platform, to investigate defined functions. Its mixed configuration shall be documented. A clay model primarily supports form, surface, packaging or presentation evaluation and shall not be represented as a structurally validated vehicle.

2.2 An engineering prototype tests design assumptions using a declared level of production representativeness. A pilot build exercises the intended manufacturing process and supply arrangements under controlled conditions. A serial production build uses the released product, process and quality configuration within its approved operating scope.

2.3 Distinguish design verification from process validation. Design verification demonstrates that the design meets its requirements through suitable evidence. Process validation demonstrates that the intended manufacturing process can consistently produce conforming output under the defined conditions. One does not automatically establish the other.

2.4 Assign a readiness status to the product, tooling, process, software, suppliers and workforce separately. A vehicle can have mature body geometry while its software or battery assembly remains experimental. A single overall colour or percentage shall not hide a consequential immature subsystem.

2.5 The programme shall define stage entry and exit criteria, permitted uses and required evidence in its own plan. Use consistent terms across suppliers and sites. Record actual readiness and unresolved limitations; do not relabel an engineering build as a production pilot to imply evidence that was not generated.

3 Programme governance and release authority

3.1 The programme director shall appoint accountable owners for design, prototype operations, manufacturing, quality, supply, software and safety. Each owner shall define deliverables and acceptance criteria for the relevant stage. The director coordinates decisions but shall not replace specialist technical acceptance with schedule approval.

3.2 Design engineering owns product requirements and authorized design changes. Prototype operations owns build execution and configuration records. Manufacturing engineering owns tooling, work methods and industrialization. Quality owns inspection planning, evidence review and nonconforming product control, with appropriate independent review of consequential decisions.

3.3 The test owner shall approve test purpose, configuration, instrumentation and safe operating conditions. High voltage, pressure, lifting, hazardous materials and vehicle motion require the relevant competent specialists. A general prototype supervisor shall not be presumed authorized for every hazardous test or repair.

3.4 Suppliers shall have clear responsibilities for material identity, process records, confidentiality and change notification. Agree how deviations and late design changes will be approved. A supplier shall not substitute material or process without authorization merely to meet a prototype delivery date.

3.5 Adopt this manual through the programme plan in Annex A. Record actual release authorities and deputies, escalation routes and operating scope. IAF membership or Corporate Recognised status does not replace the programme's responsibility to verify a particular prototype, supplier delivery or production launch.

4 Programme stages and evidence planning

4.1 Plan the sequence of concept evaluation, engineering prototypes, design confirmation, manufacturing trials, pilot production and serial release. For each stage, define the questions to be answered, required configuration, representative conditions and evidence. Avoid building prototypes without a clear learning or validation objective.

4.2 Create a requirements and evidence matrix covering product functions, safety, quality, manufacturability, serviceability and applicable obligations. Link each requirement to its verification method and build stage. Identify evidence that depends on production tooling or materials so it is not incorrectly closed by an earlier substitute.

4.3 Define entry conditions such as released drawings, available material, safe workshop, trained team and approved test plan. Define exit conditions including accepted results, issue disposition and configuration reconciliation. A stage shall remain incomplete where a required test failed or the tested configuration is uncertain.

4.4 Use risk to determine the depth of review and the consequences of a deferred item. Safety, legal and critical product requirements shall not be waived through an ordinary programme concession. Any allowable noncritical deferral shall have a defined scope, owner, expiry and effect on the next stage.

4.5 Annex A records milestone decisions with evidence references. Preserve the reason for a conditional decision and the restriction communicated to downstream teams. Meeting a planned date is not, by itself, evidence that a product or process is ready for its next use.

5 Confidential workshop access and physical security

5.1 Classify prototype areas, vehicles, parts and information according to programme sensitivity. Establish controlled access with named authorization, visitor arrangements and a practical escort policy. Limit access to the work needed while ensuring that emergency responders can obtain necessary hazard information.

5.2 Control photography, filming, display screens and visible material near windows or shared routes. Use approved devices and storage for authorized images. Confidentiality rules shall be clear to employees, contractors and visitors and shall not obstruct reporting of safety concerns through the protected channels.

5.3 Move confidential prototypes through planned routes with suitable covers, packaging and custody records. A cover shall not obstruct ventilation, sensors, lifting points or safe vehicle operation. Test camouflage shall be assessed for its effect on cooling, visibility, aerodynamics and measurement where those factors matter.

5.4 Store keys, badges, parts and sensitive assemblies under controlled issue and return. Record losses or unexplained access promptly and assess their effect on programme confidentiality and safety. Avoid collecting unnecessary personal data when managing access and retain records under the appropriate privacy controls.

5.5 At programme completion or transfer, reconcile physical assets, drawings, models, scrap and media. Dispose of or retain confidential material through the authorized route. A rejected prototype part shall not enter public resale or ordinary scrap circulation with sensitive features or unsafe reuse potential unassessed.

6 Digital data and supplier collaboration

6.1 Control computer aided design files, bill of materials, software, test data and manufacturing instructions through a managed repository. Identify owner, revision, access and permitted use. A local working copy shall show its status so an unfinished design is not mistaken for a released build instruction.

6.2 Share information with suppliers through approved channels and a defined scope. Verify recipient authorization and contractual confidentiality before transfer. Do not place confidential vehicle geometry or software into an unapproved public service for convenience or automated processing.

6.3 Record the exact data package sent for a build or quotation and acknowledge receipt where traceability requires it. Changes shall identify affected parts and superseded files. A supplier shall not be expected to discover a critical revision by comparing informal messages or unlabelled attachments.

6.4 Protect credentials, signing material and vehicle identities outside ordinary design folders. Test datasets containing people, location or customer information shall use appropriate minimization and access controls. Retain a record of approved anonymization or synthetic substitution where it affects interpretation.

6.5 Define backup, restoration and access revocation arrangements for development information. Verify that a historical build can be reconstructed from retained data. Apply the IAF Data Protection and Privacy Policy and the relevant connected systems controls without allowing confidentiality to conceal a material product or safety issue.

7 Prototype identity and build configuration

7.1 Give every prototype vehicle, major assembly and controlled test article a unique identifier. Link it to the build order, design baseline, material lots, software and intended use. Annex B provides a prototype passport that follows the item through build, test, modification and disposition.

7.2 Maintain the actual as-built bill of materials, including substitute parts, temporary fixtures, hand modifications and mixed revision assemblies. Record serial numbers where relevant. The released design bill of materials alone does not describe a prototype that was built with authorized deviations.

7.3 Identify software, calibration and parameter versions in the same configuration record as hardware. A changed controller or calibration can invalidate a test conclusion even where the physical vehicle appears unchanged. Record the configuration before each consequential test and after each modification.

7.4 Mark prototypes and parts with their status and use restrictions through durable, appropriate identification. Avoid labels that interfere with function, surface evaluation or safety. If the physical marking must be removed for testing, preserve identity through an approved alternative and restore it afterward.

7.5 Before transferring an item, reconcile its passport and physical condition and communicate remaining hazards and restrictions. Unknown configuration or missing provenance shall trigger a hold on the affected test or use. An experienced engineer's recollection is not an adequate substitute for a controlled build record.

8 Mule vehicle construction and use limits

8.1 Define the mule's purpose and the systems it represents. Record donor vehicle configuration, modifications, added mass, mounting, wiring, cooling and control changes. Identify systems that remain original and those that are experimental so test results can be interpreted within the actual configuration.

8.2 Engineering shall assess the effect of modifications on structure, braking, steering, restraint systems, electrical protection, thermal management and vehicle stability. Temporary mounts, exposed wiring and development instrumentation shall be secured and protected for the intended operating environment.

8.3 Before movement, verify the required mechanical and electrical checks, software baseline and emergency stop or shutdown arrangements appropriate to the test. High voltage work requires authorized personnel and the applicable isolation procedure. A donor vehicle's original approval does not establish the safety of its modified configuration.

8.4 Define permitted operating locations, speed or load envelope, driver competence, supervision and test restrictions through the approved plan. Use controlled test facilities where required. Public road operation needs the applicable authorization and conditions; this manual does not grant permission to operate an experimental vehicle in public traffic.

8.5 Record test damage, anomalies and modifications before further use. A mule shall not be transferred, sold or released as a normal customer vehicle without the separate technical and legal decisions required for its actual condition. End of programme disposition shall prevent uncontrolled reuse of unsafe development assemblies.

9 Clay models surface masters and appearance builds

9.1 Define the scale, purpose and datum system of each clay model or surface master. Record the approved design dataset and intended evaluation, such as exterior form, occupant packaging or surface transition. The model shall carry a clear status that distinguishes appearance evidence from functional or structural validation.

9.2 Control armatures, support structures, model mass and movement equipment for safe stability and handling. Heating, cutting, milling and finishing shall follow assessed workshop methods with suitable extraction and guarding. Do not use improvised lifting points or rely on a fragile surface as a structural support.

9.3 Maintain the geometry baseline through measured datums, scan records and controlled surface changes. Record which areas were hand modified and reconcile them with the digital design. A visually accepted clay surface shall not silently become a production geometry release without engineering review.

9.4 Control lighting, viewing conditions, colour and finish where they influence appearance decisions. Document the evaluation conditions and decision makers. Photographs can support the record but may not preserve shape, gloss or colour accurately enough to replace the required physical or measured assessment.

9.5 Protect models from damage, contamination and uncontrolled access during storage and transport. Record repair or resurfacing that can affect later comparison. At disposal, control confidentiality and material handling and retain the design evidence needed to explain the accepted surface decision.

10 Workshop readiness and safe operating controls

10.1 The prototype workshop shall have a defined equipment inventory, competent supervision, suitable utilities, safe routes and emergency arrangements. Include machining, welding, bonding, painting, battery work and additive manufacturing hazards as applicable. A temporary development location requires the same risk based control as a permanent workshop.

10.2 Assess nonroutine tasks before execution, especially mixed systems, improvised fixtures and repeated design changes. Use approved lifting, energy isolation, guarding and hazardous material procedures. Development urgency shall not justify unsupported loads, exposed live conductors or bypassed protective devices.

10.3 Separate incompatible activities such as solvent work, hot work, powder handling and battery charging. Provide appropriate extraction, containment and housekeeping. Define access and competence restrictions for high voltage areas and prevent unqualified personnel from opening or working on battery assemblies.

10.4 Control temporary tools, cables, instrumentation and test rigs so they do not create trip, fire, electrical or unintended actuation hazards. Verify ratings and condition before use. Temporary equipment shall have an owner and an inspection and removal plan rather than remaining indefinitely without records.

10.5 Use IAF-MAN-IHE-001 for industrial safety and IAF-MAN-IRB-001 for emergencies and battery quarantine. The workshop lead shall verify readiness before a new build and after material layout or process changes. A missing critical protection requires a hold on the affected activity.

11 Prototype build authorization and execution

Authorize each build against a controlled order and a defined learning or test objective. The build leader shall coordinate design, material, process and safety readiness before work begins.

Step / owner	Required action and evidence
1 Define build	Identify prototype category, quantity, purpose, intended use and required configuration. Link requirements and the planned tests to the build order.
2 Verify inputs	Confirm drawings, bill of materials, software, material lots and approved deviations. Hold unidentified parts and resolve conflicting revisions before assembly.
3 Check readiness	Verify workshop, tools, fixtures, measurement, personnel and hazardous task controls. Confirm that the team understands the build restrictions and stop conditions.
4 Build and record	Execute the released instructions and record actual parts, process results and interventions. Obtain authorization before substituting material or changing a consequential method.
5 Inspect and resolve	Perform the specified checks, identify nonconforming items and record rework or repair. Preserve the actual as-built configuration and evidence of accepted corrections.
6 Release to use	The appropriate technical and quality authorities approve only the stated test or next stage. Complete the prototype passport and communicate residual restrictions to the receiver.

Do not release an item solely because it is complete or needed for a demonstration. Missing identity, unresolved safety concerns or an unverified critical characteristic blocks the affected use.

12 Material sourcing receiving and traceability

- 12.1** Specify material and component requirements for the intended prototype purpose. Identify where production equivalent material is essential and where a controlled substitute is acceptable. A substitute used for fit checking shall not later be treated as evidence for durability or safety without additional validation.
- 12.2** Receiving controls shall verify identity, revision, quantity, condition and required evidence. Record source, lot and relevant storage or shelf life information. Quarantine suspect, damaged or undocumented material and obtain a technical disposition before use.
- 12.3** Prototype purchases from rapid suppliers still require assessment of capability and provenance appropriate to risk. Confirm critical dimensions, material properties and process conditions where they affect the test. A supplier statement of compliance shall not replace required verification for a consequential unknown.
- 12.4** Preserve traceability through cutting, machining, printing, assembly and test. When one source lot is divided into several parts, maintain the relationship in the build record. Label leftover stock and prevent unidentified remnants from being used in another programme.
- 12.5** Record material consumed, scrapped, retained or transferred at build closeout. Apply the IAF Supplier Quality Assurance and Auditor Manual for supplier development and approval interfaces. Changes to source, grade or manufacturing route shall be reviewed for their effect on prototype evidence and later production readiness.

13 Temporary tooling fixtures and joining processes

13.1 Tooling shall be designed and released for its intended loads, accuracy, durability and use duration. Identify prototype, pilot and production tools distinctly. A temporary fixture that holds a part once may not provide the repeatability or endurance needed for a pilot run.

13.2 Verify locating datums, clamping, access and error prevention before use. Assess the effect of fixture distortion, wear and operator adjustment on the part. Provide safe handling and maintenance instructions and do not assume that a printed fixture has adequate strength because it matches the required shape.

13.3 Control welding, bonding, fastening and other joining through defined parameters, material preparation and inspection. Record process evidence where it supports the test purpose. A hand finished prototype joint shall not be used to claim capability of an automated production joining process that has not been evaluated.

13.4 Changes to tooling or joining methods shall identify affected parts and tests. Rework that alters geometry, heat history or surface condition requires technical assessment. Cosmetic improvement shall not conceal a crack, incomplete joint or other functional defect.

13.5 Before pilot use, confirm tooling condition, measurement suitability, process instructions and maintenance needs under representative cycles. Record which prototype operations still rely on skilled adjustment and resolve how those operations will be controlled in serial production.

14 Measurement inspection and validation planning

14.1 The inspection plan shall connect product characteristics to measurement methods, acceptance limits and responsible personnel. Identify critical features and the uncertainty required for a meaningful decision. A measuring device with insufficient capability shall not be used to declare a close tolerance feature acceptable.

14.2 Use controlled datums, fixtures, environmental conditions and instrument status for dimensional evaluation. Record the actual method and results rather than only a pass mark. Scans and comparison colour maps require a defined alignment and tolerance basis; an attractive visual overlay does not establish dimensional conformity.

14.3 Plan functional, material and durability tests around the intended use and configuration. Identify destructive tests, retained samples, instrumentation and failure criteria. Annex D records the validation plan and results, including limitations caused by nonproduction material or process.

14.4 Distinguish a measurement system problem from product variation. Repeated adjustment of the measurement method to obtain a pass requires investigation. Where results conflict, hold the affected decision and resolve method, calibration, sampling and configuration differences.

14.5 Keep test evidence linked to the exact article and its modification history. A passed test before a significant design or process change may no longer support the revised item. The technical owner shall determine which evidence remains valid and which tests must be repeated.

15 Additive manufacturing process selection

15.1 Select additive manufacturing from the part's purpose, material properties, dimensions, surface requirements and loading. Distinguish visual models, fit checks, tooling and functional components. The manufacturing method shall be suitable for the required evidence; shape similarity alone does not establish material equivalence.

15.2 Define the process family, machine, material, build orientation, supports, layer strategy, parameter set and post-processing route. Record the approved digital input and preparation software version. The build file is a controlled manufacturing instruction, not an informal derivative of the design model.

15.3 Assess anisotropy, porosity, thermal history, residual stress and surface effects relevant to the process. Determine which characteristics need testing on the part, representative coupons or both. A coupon is useful only where its relationship to the actual part and build conditions is justified.

15.4 Evaluate the machine and process capability for the required use. Establish a validated operating window and identify changes that require requalification. A parameter set supplied with a printer shall not automatically be accepted for every geometry, material lot or safety critical application.

15.5 Annex C provides an additive manufacturing traveller covering preparation, build, post-processing and release. No universal layer height, energy setting, cure time or powder reuse percentage is prescribed here. Those values shall be defined through the actual material, equipment and product validation.

16 Polymer printing and resin process controls

16.1 Control polymer filament, powder or resin identity, batch, storage, age and condition according to the approved process. Moisture, contamination and thermal exposure can affect printing and final properties. Record drying or conditioning where required and prevent material mixing or unlabelled returns.

16.2 Verify build orientation, support placement, wall and feature limitations and the effect of layer direction on loading. Test the relevant properties in the intended orientation and condition. A material data sheet measured under different preparation conditions is not proof of the finished part's performance.

16.3 For resin processes, control handling, washing, support removal and post-curing as an integrated route. Define compatible chemicals, ventilation and protective measures from the actual materials. Incomplete processing can affect dimensions, surface condition and mechanical properties even where the part looks finished.

16.4 For extrusion or powder polymer processes, control machine condition, thermal settings, feed consistency and post-build cooling where relevant. Record interruptions and environmental deviations. Do not restart a failed build or reuse powder through an undocumented method and assume unchanged part quality.

16.5 Release parts only for the validated intended use after the required inspection and tests. Printed polymer fixtures or functional parts used near heat, chemicals, electrical systems or significant loads need specific compatibility evidence. A prototype label does not justify using an unverified part as a safety device.

17 Metal printing and powder handling controls

17.1 Metal additive manufacturing shall use a controlled machine, material and parameter combination appropriate to the intended part. Record powder or wire identity, composition, storage, handling and reuse history where relevant. Different lots or recovered fractions shall not be mixed outside the approved material specification.

17.2 Powder operations require an assessed approach to inhalation, skin contact, combustible dust, static, ignition and housekeeping. Inert gas systems can create an oxygen deficiency hazard. Only trained personnel shall perform the approved handling, cleaning and maintenance methods with suitable equipment and monitoring.

17.3 Do not use ordinary vacuum cleaners, uncontrolled compressed air or improvised cleanup methods for reactive or combustible powder. Segregate incompatible materials and manage spills through the specific response plan. Fire response shall match the actual material and equipment; a generic battery or solvent instruction is not suitable for every metal powder event.

17.4 Control build atmosphere, machine condition, parameter identity and monitoring records. Assess interruptions, recoater events, unstable process indications and other anomalies before accepting the build. A visually complete part shall not be released when the process record shows an unresolved consequential deviation.

17.5 Plan safe depowdering, support removal, heat treatment and machining before printing. Trapped powder, residual stress and hidden defects can remain after the build finishes. Technical release requires the specified material, dimensional and internal integrity evidence for the actual application.

18 Post processing inspection and part condition

18.1 Define the complete post-processing route in the traveller, including cleaning, depowdering, support removal, curing, heat treatment, machining, surface finishing and inspection as applicable. Sequence matters because one operation can change dimensions, stress or surface condition relevant to the next.

18.2 Identify outsourced post-processing with the same traceability and change controls as internal work. Record equipment, programme, batch and required process evidence. A supplier's generic certificate shall not conceal a missing link between the delivered part and its actual treatment batch.

18.3 Evaluate defects appropriate to the process and intended use, including incomplete fusion, porosity, cracks, distortion, delamination and residual contamination. Select inspection methods with demonstrated suitability for the material and geometry. A surface scan cannot establish internal integrity by itself.

18.4 Record actual dimensional and property results after the final relevant processing stage. If a test sample is representative rather than the part itself, document the basis and limitations. Rework or repair requires a defined method and reassessment of affected properties.

18.5 Protect accepted parts during storage and transport and identify any expiry or condition restrictions. Parts that fail required criteria shall remain segregated until a competent disposition is recorded. Do not improve appearance and then relabel a failed functional part as conforming without technical evidence.

19 Additive build execution and release

Use this procedure for a controlled printed batch. The machine specific instruction governs actual operation, while the traveller preserves evidence from input data to final disposition.

Step / owner	Required action and evidence
1 Authorize input	Confirm part revision, intended use, material, machine and validated parameter route. Verify build orientation, supports, batch identity and the released digital file.
2 Verify readiness	Check material condition, equipment status, environment, operator competence and process safety. Resolve missing acceptance criteria before starting the build.
3 Execute and record	Run the approved build and retain machine logs, parameter identity and anomalies. Do not make undocumented changes to compensate for a fault or interrupted process.
4 Post-process	Perform the released cleaning, curing, heat treatment, machining and other steps. Preserve part identity and record actual process evidence and subcontractor operations.
5 Inspect and evaluate	Complete dimensional, material and integrity checks appropriate to the use. Assess coupons and process anomalies together; a coupon pass does not automatically clear every part.
6 Release or hold	Quality and engineering authorize the stated use, restrictions and traceability. Segregate failures and retain the traveller, test results and any accepted deviation.

A part shall not enter a vehicle, load bearing fixture or safety relevant application beyond its approved scope. Changes in material, machine, orientation or post-processing require an impact review before earlier validation is reused.

20 Prototype testing and evidence interpretation

20.1 Test plans shall state the requirement, article configuration, operating conditions, instrumentation, acceptance criteria and stop conditions. Identify whether the test explores behaviour or verifies a defined requirement. An exploratory result may guide development without constituting formal acceptance.

20.2 Use appropriate facilities and competent personnel for vehicle motion, high voltage, thermal, pressure, structural and other hazardous tests. Define exclusion, emergency response and recovery. Do not improvise a destructive or failure provoking test in an ordinary occupied workshop.

20.3 Record the exact hardware, software, material and process condition before the test. Document deviations from the intended production design and assess their effect on the conclusion. A mule result shall not be extrapolated to a substantially different production vehicle without a justified technical basis.

20.4 Preserve raw data, processing methods and failed results. Test interruptions, sensor faults and manual interventions shall be visible in the record. Repeat testing shall have a stated reason, and a later pass shall not erase an unexplained earlier failure.

20.5 The technical reviewer shall determine what the evidence demonstrates and its limits. Link open issues to design or process actions and required retesting. Annex D supports the decision, while the IAF Software Defined Vehicle and Software Quality Manual governs software specific verification and release evidence.

21 Design changes deviations and nonconforming items

21.1 Control every consequential design or process change through an identified request with reason, affected items, technical review and implementation point. Assess its effect on existing prototypes, tooling, tests, suppliers and planned pilot builds. A small drawing change can require substantial revalidation where it affects a critical interface.

21.2 A deviation permits a defined departure for a stated scope and duration where technically allowable. It shall identify the actual condition, intended use, risk, authority and expiry. A deviation does not rewrite the nominal design or automatically establish acceptability for serial production.

21.3 Nonconforming items shall be identified and segregated from released material. Decide rework, repair, restricted use, further evaluation or disposal through the appropriate authority. Rework to the original requirement and repair under an alternative accepted condition shall be recorded distinctly.

21.4 Annex G records concessions and change impact. Safety, mandatory obligations and critical requirements shall not be bypassed through an ordinary concession. Where a restricted development use is technically justified, the restriction shall follow the item and prevent unintended production or customer use.

21.5 Before the next build or test, reconcile implemented changes with the actual configuration and required evidence. Close a change only after instructions, data, physical items and downstream recipients are updated. An approved drawing revision that has not reached the workshop is not an implemented correction.

22 Industrialization and production representative builds

22.1 Translate prototype learning into a production process with defined material flow, tooling, work instructions, controls and acceptance criteria. Identify operations that relied on expert hand fitting, selective assembly or laboratory equipment and establish how they will be controlled at production volume.

22.2 Review design for manufacture, assembly, inspection, service and repair using evidence from development builds. Record difficult access, variable fits, excessive force and repeated rework. A prototype that can be assembled by a specialist may still be unsuitable for consistent assembly by the intended production workforce.

22.3 Introduce production tooling, materials, software and suppliers in a planned sequence. Record the representativeness of each build and the remaining substitutions. Tests intended to demonstrate production capability shall use the relevant production configuration or clearly state their limitations.

22.4 Use the digital twin and virtual commissioning process in IAF-MAN-DTV-001 to evaluate layout, controls and capacity where appropriate. Virtual results shall feed the physical commissioning plan and pilot acceptance; they shall not replace actual process and product verification.

22.5 Coordinate supplier approval, part submission and advanced quality planning through the IAF Supplier Quality Assurance and Auditor Manual. Ensure that approved product and process information reaches receiving, line operations, quality and service before the pilot or serial launch depends on it.

23 Pilot run planning and readiness

23.1 The pilot plan shall define the learning and acceptance objectives, quantity, duration, product mix, shifts and intended production rate. Select conditions that exercise relevant tooling, operators, suppliers and process variation. A short demonstration using selected parts and expert staff shall not be presented as proof of sustained production capability.

23.2 Confirm product, process, software, tooling, measurement and supplier readiness before scheduling the run. Review open issues and define which prevent entry. Annex E records readiness and restrictions. A pilot may intentionally investigate a noncritical open question only where its boundary and product disposition are controlled.

23.3 Define control plans, inspection frequency, traceability, defect recording and stop criteria. Include abnormal conditions, rework flow, replenishment and equipment recovery where relevant. Plan how all pilot output will be identified and prevented from unintended shipment.

23.4 Specify resources, maintenance support, spare parts, training and emergency arrangements. Confirm that the actual team can execute the released work method without undocumented coaching or adjustment. If extra development support is used, record it so the result is interpreted accurately.

23.5 Establish the statistical and engineering basis for sample size and duration before the run. Risk, expected variation, process maturity and the decision influence the evidence needed. This manual supplies no universal pilot quantity that proves readiness for every automotive product or process.

24 Pilot production execution and closeout

Run the pilot as a controlled production experiment with complete product and process traceability. The pilot leader shall have authority to stop the run when an entry condition or critical control fails.

Step / owner	Required action and evidence
1 Confirm entry	Review Annex E, actual line configuration, material lots, software and personnel. Resolve critical gaps and brief objectives, restrictions and stop criteria.
2 Start controlled run	Use the approved work instructions and planned mix. Identify every pilot unit and record start conditions, timestamps and actual process settings.
3 Observe and measure	Capture accepted output, defects, rework, downtime, cycle variation and interventions. Record staffing and support conditions as they actually occur.
4 Contain deviations	Stop or hold affected production according to the plan. Identify the last known acceptable state, segregate suspect units and obtain technical disposition before continuing.
5 Reconcile results	Account for all inputs and output, including scrap, held units and reworked parts. Compare actual evidence with acceptance criteria and identify limitations.
6 Decide next stage	Record pass, further controlled trial or hold with actions and owners. Release pilot output only through its explicit disposition and retain the complete run record in Annex F.

Do not hide manual adjustments, selected material or repeated restarts from the pilot report. A later successful interval does not erase earlier defects; the closeout shall explain the full run and the evidence supporting the next decision.

25 Pilot metrics capability and sampling limits

25.1 Define each metric before data collection, including numerator, denominator, time basis and treatment of rework or planned stops. Report first pass yield separately from final yield after correction. A unit repaired into conformity shall not be counted as first pass accepted.

25.2 Illustrative pilot: 200 units enter the run, 180 pass without rework, 15 pass after rework and 5 are scrapped. First pass yield is 180 divided by 200, or 90 percent. Final accepted yield is 195 divided by 200, or 97.5 percent. Both results and the rework burden belong in the launch review.

25.3 Assess process stability and measurement suitability before using capability indices. A short, selected or unstable pilot sample may not support a reliable capability claim. Distinguish observed trial performance from a statistically justified estimate of sustained production behaviour.

25.4 Zero observed defects does not prove zero defect risk. Consider sample size, independence, representativeness and the consequence of a missed failure. Engineering evidence, targeted testing and process controls may be necessary even where a pilot's observed defect count is zero.

25.5 Review variation by product variant, shift, operator, cavity, tool and material lot where these factors matter. Aggregated results can conceal a weak subgroup. Define further trials or controls where evidence is insufficient instead of declaring readiness from a favourable average.

26 Serial production readiness and launch decision

The programme acceptance authority shall review the complete product and process evidence before serial release. The decision applies to a defined model, site, configuration and operating scope.

Step / owner	Required action and evidence
1 Product evidence	Confirm requirements, design verification, validation results and disposition of consequential issues. Identify any evidence invalidated by later changes.
2 Process evidence	Confirm production tooling, controls, work methods, measurement, capability basis and pilot results. Verify the actual operating configuration and critical protections.
3 Supply and workforce	Confirm approved material and suppliers, logistics, trained personnel, maintenance support and contingency arrangements for the intended launch volume.
4 Software and service	Confirm released software and calibration, factory loading, diagnostics, repair information and service readiness. Reconcile vehicle and component configuration records.
5 Risk and restrictions	Review open actions, allowed noncritical deferrals, customer conditions and containment. Unresolved safety or mandatory requirements prevent the affected release.
6 Authorize launch	Record the decision, scope, actual effective date, responsible signatures and ramp monitoring plan in Annex H. Communicate restrictions and shipment controls to all affected functions.

A launch meeting or management signature alone does not replace missing technical evidence. Conditional release shall be specific and enforceable, with an expiry and verification plan; it shall not become an indefinite substitute for production readiness.

27 Ramp monitoring and transfer to normal operations

27.1 Define a controlled ramp period with enhanced monitoring appropriate to the product and process risk. Track quality, rework, equipment reliability, supplier performance, software loading and customer feedback. Establish triggers for containment, rate restriction or suspension before launch begins.

27.2 Maintain traceability from early production units to material, process and software baselines. Investigate recurring defects and compare them with prototype and pilot findings. A known development issue that reappears in production requires review of the earlier closure evidence.

27.3 Control changes during ramp through the same impact and release process as prelaunch changes. Avoid undocumented adjustments made only to sustain output. Where containment or additional inspection is used, verify its effectiveness and define the evidence needed to remove it.

27.4 Transfer ownership to normal operations only after the agreed stability, capability, training and support conditions are met. Confirm maintenance plans, spare parts, repair methods, documentation and unresolved action ownership. A calendar date alone shall not determine the end of launch controls.

27.5 Record lessons and update programme planning, supplier requirements and design practices. Preserve the prototype and pilot evidence needed for future changes, field investigations and service. Close or dispose of development assets through controlled confidentiality and safety arrangements.

28 Document control and IAF interfaces

28.1 Control programme plans, prototype passports, build travellers, test records and launch decisions under the IAF Documents and Records Guide. Assign owner, revision, access, retention and disposal. Preserve records required to reconstruct a build or investigate a later product concern.

28.2 This manual interfaces with IAF-QM-001, IAF-MAN-LMS-001 for production methods, IAF-MAN-GAA-001 for advanced assembly, IAF-MAN-DTV-001 for virtual commissioning and IAF-MAN-SDV-001 for vehicle software. Apply IAF-MAN-IHE-001 and IAF-MAN-IRB-001 to workshop safety and emergency arrangements.

28.3 Use the IAF Supplier Quality Assurance and Auditor Manual for supplier and part approval interfaces and the IAF Authorized Service and Maintenance Standards Manual for service preparation. The programme shall reconcile shared responsibilities and avoid treating one discipline's approval as acceptance of another discipline's unresolved requirement.

28.4 Revision proposals shall identify the affected requirement, technical reason, evidence and transition needs. The competent IAF authority controls publication under the Constitution and document management arrangements. Programme owners shall assess changes and update active instructions and training before applying revised practice.

28.5 Annexes A to H are controlled working templates for actual evidence. Complete them with real identities, results and signatures. Stable Release identifies the completed publication text; it does not claim that an individual prototype, printed part or new vehicle model has already been validated or approved for production.

Annex A Programme stages and decision record

Define the actual programme scope and stage criteria before building. Use a controlled continuation sheet for detailed requirements and evidence links.

Programme field	Entry to complete
Identity	Programme / model or derivative / site / director: _____
Scope	Product, process and supplier changes / intended volume: _____
Stages	Concept / engineering / confirmation / pilot / serial milestones: _____
Entry criteria	Required configuration / material / people / safety / instructions: _____
Exit evidence	Requirements / tests / process evidence / acceptance limits: _____
Readiness owners	Design / manufacturing / quality / supply / software / service: _____
Open items	Risk / restriction / owner / due date / next stage impact: _____
Decision	Proceed for stated scope / further trial / hold / justification: _____
Authority	Actual reviewers / signatures / date / next review: _____

Keep product, process, software and supplier readiness visible separately. A high overall completion percentage shall not conceal an unresolved critical subsystem. Record the evidence supporting each decision and communicate restrictions to the next build or test owner.

Annex B Prototype passport and use restrictions

The passport follows the physical article through build, testing, modification and disposition. Keep detailed medical or personal information outside this technical record.

Passport field	Entry to complete
Identity	Prototype ID / category / programme / custodian: _____
Purpose	Appearance / fit / function / durability / pilot / other use: _____
Configuration	As-built parts / material lots / software / calibration: _____
Differences	Donor systems / substitutes / hand modifications / deviations: _____
Build evidence	Order / traveller / inspection / joining and process records: _____
Permitted use	Location / test envelope / operator competence / restrictions: _____
Hazards	High voltage / stored energy / motion / thermal and other risks: _____
History	Test IDs / damage / repairs / configuration changes: _____
Disposition	Released to stated use / held / transferred / destroyed: _____

Before each consequential test, confirm that the actual article matches the recorded configuration. The releasing authority and receiver shall acknowledge residual restrictions. A mule or appearance model shall not be represented as an approved production vehicle.

Annex C Additive manufacturing traveller

Use one traveller per controlled build and maintain part identities through every post-processing operation. Attach detailed machine logs and test results.

Traveller field	Entry to complete
Input	Part and revision / intended use / approved design file: _____
Build preparation	Machine / software / orientation / supports / parameter set: _____
Material	Type / grade / lot / storage / conditioning / reuse history: _____
Readiness	Equipment status / environment / safety / authorized operator: _____
Execution	Build ID / start and finish / logs / interruptions / anomalies: _____
Post-processing	Cleaning / curing / heat treatment / machining / supplier batch: _____
Verification	Dimensions / material properties / integrity / coupon basis: _____
Disposition	Pass / hold / rework / restricted use / rejected items: _____
Release	Engineering and quality authority / scope / date / traceability: _____

A change in material, machine, orientation, parameter route or post-processing requires impact assessment. Do not use a visually acceptable print or a passing unrelated coupon as the sole basis for release of a functional or safety relevant part.

Annex D Prototype validation plan and result

Separate exploratory testing from verification against a defined requirement. Record the article configuration and test conditions before execution.

Test field	Entry to complete
Identity	Test ID / requirement / article ID / owner: _____
Configuration	Hardware / material / process / software / deviations: _____
Method	Facility / equipment / instrumentation / measurement uncertainty: _____
Conditions	Loads / environment / duration / representative variants: _____
Safety	Competence / exclusion / emergency plan / stop conditions: _____
Acceptance	Predeclared limits / expected behaviour / decision method: _____
Results	Raw data / processing / failures / interruptions / actual result: _____
Interpretation	What is demonstrated / limitations / invalidated prior evidence: _____
Disposition	Accepted scope / issue IDs / design actions / retest / reviewer: _____

Do not transfer a conclusion to a materially different configuration without a technical basis. Preserve failed runs and record the reason for repetition. A successful later test shall close the earlier failure only when its cause and correction are understood.

Annex E Pilot readiness checklist

Complete before the pilot begins. Status choices are Ready, Hold or Not applicable with a reason. Critical gaps prevent entry; noncritical experimental conditions require explicit scope and disposition controls.

Readiness area	Evidence and status
Product baseline	Drawings / bill of materials / software / changes reconciled: _____
Tooling and line	Production representativeness / commissioning / maintenance: _____
Material and supply	Approved sources / lots / receiving / replenishment: _____
Workforce	Actual shifts / training / standard work / support roles: _____
Quality controls	Measurement / inspection / traceability / defect containment: _____
Run design	Quantity / duration / mix / rate / sampling basis / objectives: _____
Safety and response	Hazard controls / emergency capability / stop authority: _____
Output disposition	Pilot identification / hold area / shipment prevention: _____
Authorization	Open restrictions / owners / leader and reviewers / date: _____

Record any expert assistance, selected material or temporary tooling expected during the run. Those conditions affect what the pilot can demonstrate. A readiness checklist shall point to actual evidence rather than contain unsupported general assurances.

Annex F Pilot run and output reconciliation

Capture the complete run, including failed intervals, manual interventions and rework. Use continuation records for time series and individual unit traceability.

Run field	Entry to complete
Identity	Pilot ID / line / date / shift / leader / baseline: _____
Conditions	Mix / actual rate / staffing / material lots / tooling: _____
Production	Units entered / first pass accepted / reworked / held / scrapped: _____
Performance	Cycle variation / downtime / causes / support interventions: _____
Quality	Defects by type and subgroup / inspection results / containment: _____
Changes	Adjustment / authority / implementation time / affected units: _____
Reconciliation	All input and output accounted for / remaining work in process: _____
Decision	Criteria met / limitations / further trial / hold / release scope: _____

Illustrative yield calculation

For 200 units, 180 pass without rework, 15 pass after rework and 5 are scrapped. First pass yield = $180 \div 200 \times 100 = 90$ percent. Final accepted yield = $195 \div 200 \times 100 = 97.5$ percent. These are example results, not target values or evidence of production capability.

Record the disposition of every pilot unit. Customer shipment requires its own explicit authorization and shall not occur merely because a unit passed a development inspection.

Annex G Deviation and change impact record

Use a defined scope and expiry for any technically allowable deviation. A concession shall not bypass a safety or mandatory requirement.

Control field	Entry to complete
Identity	Change or deviation ID / programme / requestor / date: _____
Condition	Nominal requirement / proposed or actual difference / reason: _____
Affected scope	Parts / prototypes / tests / tools / suppliers / quantities: _____
Technical impact	Safety / function / durability / manufacturing / service: _____
Evidence impact	Prior tests affected / additional verification / limitations: _____
Disposition	Rework / repair / restricted use / further evaluation / reject: _____
Restrictions	Allowed use / expiry / marking / shipment or test hold: _____
Authority	Design / quality / safety and other required approval: _____
Implementation	Actual configuration / instructions / recipients / closure evidence: _____

Preserve the original condition and the accepted correction. A drawing approval is not proof that every physical article was changed. Reconcile implementation and communicate restrictions to all downstream users before closing the record.

Annex H Launch release and ramp review

The launch decision applies to the stated model, site and configuration. Attach the product and process evidence and retain the actual approval record.

Release area	Evidence and decision
Product	Requirements / verification / validation / issue disposition: _____
Process	Tooling / controls / measurement / pilot / capability basis: _____
Supply	Approved parts / capacity / logistics / contingency: _____
People and support	Training / maintenance / spares / service information: _____
Software	Released package / factory loading / diagnostics / traceability: _____
Open actions	Allowed deferrals / restrictions / owner / expiry / containment: _____
Launch authority	Decision / scope / signatures / actual effective time: _____
Ramp plan	Monitoring / triggers / rate limits / exit criteria / owner: _____

Ramp review date: _____ Actual quality and reliability: _____ Corrective actions: _____ Transfer to normal operations: _____. End enhanced controls only when the agreed evidence supports the decision. A planned calendar date alone does not demonstrate stable production.