

Guide for Composites Conformity Inspections

January 28, 2003 rev C

This guide has been developed for inspections and conformities during the manufacturing of composite parts and assemblies. These questions/statements are memory joggers that can impact the entire composite manufacturing process. This checklist may also be helpful to engineers reviewing process specifications. Should the answer be negative it may be necessary to note that on the conformity report, if that subject is applicable to the part in question.

Receiving Inspection of Materials (note that additional visual inspections for defects in a roll of material should be continuously performed during fabrication steps, e.g., ply lay-up)

- Have all receiving inspection tests been done for each batch used, and are the results in compliance with the specification acceptance limits?
- Are there “TBDs” in the specification? (If TBDs are present, an unsat should be written, and cleared when the values are available and have been compared with the receiving inspection limits)
- Were test panels prepared and inspected in accordance with specification limits?
- Do test panels represent production parts?
- Are test specimens taken from various locations within the material?
- Are traveler panels used, and if so, were they prepared in accordance with specification limits? (Leave an open unsat if testing is pending)
- Does the fabric weave style meet the specifications?
- Does the specification call out number of yarns per inch and can it be inspected?
- Does the bi-directional fabric have tracers which identify warp and fill yarn direction and warp and fill faces per the specification?
- Does the certificate of conformance from the vendor show the manufacturing date?
- Are warp tracers spaced across the width of the fabric per the specification?
- Does the honeycomb core configuration and density meet the specification?
- Does the specification require inspecting the honeycomb cells for signs of separation?
- Do procedures assure shelf life of material include transportation time?
- Are freezer strip charts used during transportation?
- Are strip chart durations adequate to record transportation periods?

Molds/Tools

- Is the mold/tool contour in conformance with the engineering drawing limits?
- Are mold release compounds applied in an area separate, or outside of the lay-up areas?
- Is traceability provided from the mold/tool back to type design?
- Is there a written process for periodic calibrating of molds/tools, and is it followed?
- Does the mold/tool show when the last, and next, calibration was, or is to be, performed?
- Is there a record of any repairs/rework performed on the mold/tools?
- What is the mold/tools surface quality (nicks, scratches, handling damage)?

Material Handling and Storage

- Are shelf life and temperature limitations established for all sensitive materials?
- Are all materials used in the part within their storage limitations?
- Are frozen materials protected in sealed bags, and are the bags resealed and water tight, before re-freezing?
- Are temperatures recorded, and are the recorders maintained per the specifications?
- Are frozen materials allowed to thaw prior to opening bags?

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- Is the thawing area humidity controlled?
- Is the lay-up room temperature and humidity controlled?
- Are air tools used in the lay-up room and, if so, are appropriate precautions taken to eliminate oil contamination?
- Are mold release compounds allowed in the lay-up room?
- Are lay-up technicians using gloves, and are the gloves clean and talc free?
- Are food and beverages allowed in the lay-up room?
- Is positive pressure and air filtration required in the lay-up room?
- Are their provisions so technicians don't have to walk directly on uncured surfaces on large parts?
- Are parts in process covered when not in work?
- Are all materials that come in contact with the finished part controlled by specifications?
- Does the refrigerated material possess sufficient room temperature working life?
- Is there a process for documenting the material in-time and out-time from the freezer?
- Upon the expiration date of the material does the specification allow for extension periods after the material was inspected and/ or tested?

Ply lay-up

- Is the shape of each ply controlled in the type design?
- Are templates used to control ply shape per drawing?
- Are templates inspected/calibrated and the information recorded for them?
- If automated ply cutters are used, are the data files traceable to the type design?
- Is the location of each ply controlled in the type design?
- Is the orientation of each ply controlled in the type design?
- Are the plies placed in the mold in accordance with the orientation and locations specified?
- Is the ribbon direction on honeycomb core controlled in the type design?
- Are the core chamfers per drawing?
- Is the core dry before lay-up?
- Are core splices done in accordance with spec requirements?
- Is there dust from core machining left on the part?
- Do the drawings specify areas where core splices are not allowed?
- Are ply splices done in accordance with specification requirements?
- Do the drawings specify areas where ply splices are not allowed?
- Are corner details, like pleats, addressed on the drawings?
- Are pleats/corner details done according to drawing requirements?
- Are plies trimmed when they are added to the mold, and is the trim per drawing?
- Has a coupon been constructed for the parts? (This can be a tab on the part that can be removed from the part after cure for testing.)
- Has lay-up taken place at a temperature and humidity within spec requirements?
- Are all fibers of the prepreg completely wetted by the resin?
- Is there sufficient tackiness in the prepreg to lay a complete contoured part?
- Are prepreg defects discovered during lay-up within specification allowances?
- How are lay-up technicians trained to respond to any evidence of ply surface moisture?
- What is done to ensure prepreg backing paper does not end up in the lay-up?
- How is ply trim and waste (e.g., layers with defects beyond allowances) controlled?
- How is the time from start of lay-up until part cure tracked?

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- Does the specification require a positive pressure to be maintained in the lay-up room to prevent contamination from the outside?

Cure Process Control

- Are their appropriate controls over laminating resin mix ratios using calibrated scales?
- Are fillers and additives, if used, in controlled quantities per specifications?
- Do thermocouples have a correction factor recorded on them, and is it included in readings?
- Are thermocouple locations specified in the manufacturing planning and specifications?
(This can be done in many ways, but often a temperature survey of the mold is conducted and the thermocouple locations are determined from that. Particular attention should be paid to thick and thin areas of the part due to exotherm issues. Epoxy resins release heat during cure. If not controlled, this can be a problem)
- Are both the part and oven thermocouple readings in compliance with the specification cure cycle?
- Are the temperatures and vacuum/pressures in compliance with the process specifications?
- Have oven/autoclave uniformity surveys been conducted within the proscribed intervals?
- Did the cure begin before shelf life limited materials expire?
- Are the oven controllers, recorders and thermocouple outputs calibrated?
- Are vacuum bag leak checks done?
- Does the specification identify debulking and pre-bleeding methods?
- Are release-film, separators, bleeders, and breathers required and are they being used?
- Do all components entering a particular autoclave or oven run follow the same cure cycle
- What provisions exist to control and track the number of autoclave or oven cycles experienced by a given part, which undergoes repair and rework?

Bonding Surface Preparation

- Has the peel ply been removed from the joint?
- Is there any evidence of contamination under the peel ply surfaces?
- Are peel plies kept in place until bonding?
- If sanding is used, is the whole bonding surface abraded, with no damage to fibers?
- If grit blasting is used, is the grit kept clean and free of contamination?
- How often is the grit media replaced?
- Are the type of grit and the pressure settings per specification?
- Is loose grit kept out of bonding surfaces?
- Is water used in water break free testing in accordance with applicable specifications?
(should be deionized water with specific cleanliness standards)
- Are parts dried properly after water break free tests?
- Are solvents used to clean bonding surfaces of the appropriate grades per specifications?
- Is the bonding done within the time limits after the surface is prepared?
- Are bond line thickness measurements conducted per applicable specifications and are the results acceptable?
- Have any required test panels been prepared in accordance with applicable specifications? (If testing is pending, leave open unsat)
- Do the test panels represent the actual bonding surface prep? (If the part has peel ply, do the panels, is the grit blasting the same, solvent wipe, water break free test etc.)
- If composite to metal bonding is used, are approved surface preparation methods used for the metal surface (phosphoric acid anodizing, grit-blast/silene, etc)?

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Secondary Bonding and Co-curing

- Is the correct type of adhesive (foam or film) per specification used in the assembly?
- Is the amount of adhesive, as called out in the specification, being applied to the bonding surfaces?
- Does the specification require application of a primer for bonding composites to metal surfaces?
- Are technicians wearing clean gloves?
- Does the specification take into consideration of filling gaps with adhesive?
- Are part tolerance measurements within drawing requirements before proceeding with bonding?
- What is done to ensure any release agent or other contamination from bond tooling aids don't come in contact with bond surfaces?
- Are bonding fixtures used to ensure geometric accuracy in holding the two bonding surfaces in place during adhesive cure?

Mixing Adhesive and Bonding

- Is there some verification that the proper mix ratio for part A & B are used per the specification? (different colors for part A and B are a good aid here)
- Are process verification tests accomplished to verify adequate cure, hardness, etc?
- If fillers are required, are they added per specification and recorded?
- If beads are added for minimum bondline control, has the ratio been specified and recorded?
- Are adhesive application requirements per the specification?
- Is the spew (excess glue squeezed out) smoothed out before the adhesive cures? (This is often a finger fillet, and can have a significant effect on the strength of the joint)
- Are post bond operations per specifications, i. e.: excess adhesive removal by grinding or sanding, etc to provide a flush surface?
- Are there special conditions in the specification that address continued operation when the temperature, humidity, pressure, vacuum, etc exceed the specification requirements?
- Are closed areas, like inside fuel tanks, checked for debris like excess glue, sanding dust, old gloves, bag film etc. before access is restricted? (this is one of the leading causes of fuel starvation on takeoff for amateur built aircraft)

Drilling & Cutting Composites

- Are the saws and drill bit types (high speed steel, diamond, tungsten carbide, etc.) being used to cut or drill the panels identified by the specification?
- Does the specification identify the minimum tooth design for saw blades?
- Does the specification require two step drilling of hybrid structure?
- Does the specification require a drill block on the backside of the panel to prevent broken and separated fibers at the drill exit side of the hole?
- Are there delaminations inside the hole?
- Are the machining speeds and feed rates within specified requirements?
- Is there any evidence of heat damage in the machined composite?
- Are the methods used to cool tools and the work piece properly maintained and operating?
- What criteria is provided in the specification to remove saw blades and drill bits from the factory line when they reach wear limits?

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- Are edge distances per drawing? (The metal standard of 2D +.03 doesn't apply in most cases in composites)
- For bolted joints, is the fit up/shimming per specification? (excessive clamp up can damage the parts)

Non Destructive Inspection: (Refer to NDI checklist as well, the part is not complete until the NDI is done when required)

- Is the type of NDI called out on the drawing?
- Are surfactants added to water used as a UT couplant? If so, is contamination addressed (e.g., pre-cured parts that get NDI before bonding)?
- During UT inspection, is water able to penetrate into core materials? If so, is it dried after inspection?
- Are allowable defects clearly identified in the specification?
- Are required NDI inspections performed in accordance with Tech cards and process specification requirements?
- Are Tech Cards Level Three approved.
- Are the appropriate NDI standards available and in use?
- Is there accept/reject criteria in the NDI (e.g., tap test) specification for porosity, voids, or disbonds?
- Does the tap test specification identify the tool used to perform the test?
- Does the tap test specification identify the acceptable or unacceptable acoustic response that can detect the flaws or defects in the part?
- Does the tap test specification require periodic hearing tests?
- Are limits established for visual defects like nicks, scratches, impact damage, porosity, delams, wrinkling etc, and are the limits complied with?
- Are completed parts checked for warpage and thickness variation, which are controlled within drawing and/or manufacturing spec requirements?
- How often is NDI equipment calibrated?
- How often is NDI equipment subjected to maintenance?

Workforce Training

- Are technicians trained for all process steps in which they are involved?
- Is there a mentoring program for new technicians involved in the more critical process steps (e.g., bond surface preparation) before they are allowed to work on their own?
- Is the workforce educated on approved changes in materials and processes?
- Is the workforce evaluated for continuous competency?