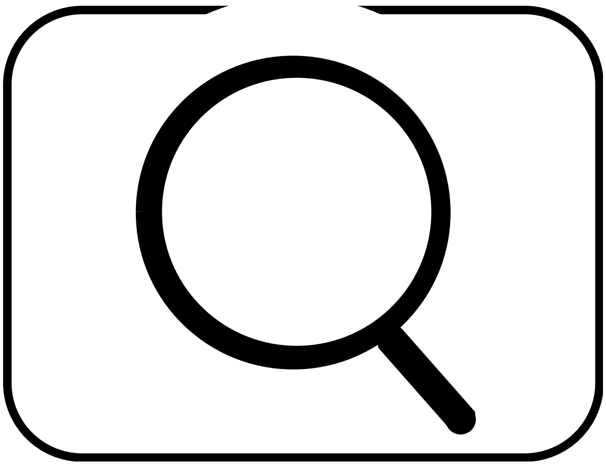
A251

Production Troubleshooting
Practice article



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MSTE workflow	Troubleshooting
Prerequisites	• Practice

Overview[edit | edit source]

Is your manufacturing process failing to meet requirements? This section of the KPC will help you troubleshoot your process and factory. It contains common troubleshooting questions which link out to pages explaining how to conduct typical troubleshooting activities such as troubleshooting the quality of a part with variable thicknesses or the rate of a thermal transformation equipment. The troubleshooting questions are grouped according to the manufacturing outcomes to be improved: cost, rate, and quality. A more structured approach to the troubleshooting process is also introduced below and illustrated in a flowchart. This structured approach will guide you methodically through three fundamental troubleshooting steps: diagnosis, remediation and validation. The diagnosis step consists of systematically identifying the root cause(s) of the problem, and more specifically the malfunctioning process step(s) and manufacturing object(s) or physical asset(s): material, part shape, tooling & consumables, and equipment. When part quality is the issue, the diagnosis step is based on a taxonomic approach which classifies the large number of sources of variability and defect types in composites manufacturing. In the following remediation step, the deficient step(s) and manufacturing objects are optimized to meet specifications or to increase their robustness by addressing any source of variability.

Troubleshooting Activities[edit | edit source]

Thermal Management Outcomes[edit | edit source]

- I am trying to transition basic tooling styles, such as from composite to steel tooling, or vice versa, with everything else the same, to lower cost but am experiencing new cure quality issues. Visit troubleshooting when changing production tooling material.

- I am finally making good quality parts but am not meeting my production rate and would like to cure them faster to make better use of my capital equipment. Visit troubleshooting throughput during thermal transformation.
- I am making good quality parts in one cure vessel and am considering moving to another, seemingly similar, vessel where I will use the same cure program. How do I ensure that my part quality does not drop? Visit maintaining part quality when changing curing equipment.
- I am having difficulty establishing cure families for a given cure vessel where all the parts in the family can be cured in a reasonable amount of time. Visit troubleshooting cure families for batch loads during thermal transformation to meet rate or quality requirements.
- I am attempting to transition tooling styles, from autoclave to press cure, to increase production rate and am experiencing new quality problems. Visit transitioning tooling styles between different thermal transformation equipment.
- I am making good quality parts in one cure vessel but in another, seemingly similar, vessel part quality has dropped or become inconsistent, despite using the same cure program. Visit troubleshooting quality issues during cure for different equipment types.
- I am trying to make thicker parts than I have before with a given resin system and am experiencing large exotherms and associated part quality issues. Visit troubleshooting scale-up issues from thin to thick parts.

Material Deposition Outcomes[edit | edit source]

- I have used a given resin system to cure a wide variety of good quality parts but am looking at switching reinforcement styles (such as to a tightly woven reinforcement). How do I ensure that I can continue to make good quality parts with the same cure cycle? Visit maintaining equivalency during cure for different fibre architectures.
- I have used a given prepreg resin system to cure a wide variety of good quality parts, but having switched reinforcement types to lower cost, I can no longer make good quality parts with the same cure cycle. Visit troubleshooting part quality during cure when changing the reinforcement.
- I am making a part containing regions with a wide range of thicknesses and am having issues getting good part quality in all part regions at the same time. Visit troubleshooting part quality for variable thickness parts.
- I have been successful in making smaller parts but in trying to cure larger ones I am experiencing new quality issues. Visit troubleshooting scaling issues from small to large parts.
- I have made lots of good quality flat panels during qualification but my parts, cured in the same way (and perhaps using the same cure program), are of poor quality. Visit troubleshooting scaling-up issues from coupons to parts.

Flow and Consolidation Outcomes[edit | edit source]

- I have defined a baseline cure cycle leading to a satisfactory level of consolidation but am looking at moving to a different one. How do I ensure that the amount of resin flow of my new cure cycle is neither too little nor too much when compared to the baseline cure cycle? Visit ensuring appropriate resin flow and part consolidation for a new cure cycle.

- I am experienced in making relatively complex parts with standard tooling strategies but am looking at using a new resin chemistry. How do I ensure that that I get adequate flow and consolidation, neither excessive nor insufficient, with a new resin system? Visit ensuring appropriate resin flow and part consolidation for a new material.
- I am experiencing too much resin flow during my cure cycle and would like less. Visit troubleshooting resin flow and part consolidation for a cure cycle.
- My tooling for a given type of part is the same style as used for similar parts around the world but the prepreg system chosen has a different resin chemistry compared to that used for every other part like this. The tools do not function in the same way (excessive flow) and do not provide good quality parts. Visit troubleshooting tooling to achieve part quality.

Assembly Outcomes[edit | edit source]

Troubleshooting Process[edit | edit source]

Diagnose[edit | edit source]

Coming soon.

Remediate[edit | edit source]

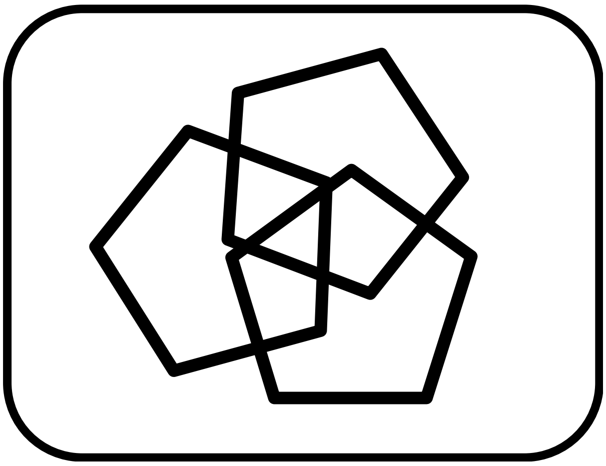
Coming soon.

Validate[edit | edit source]

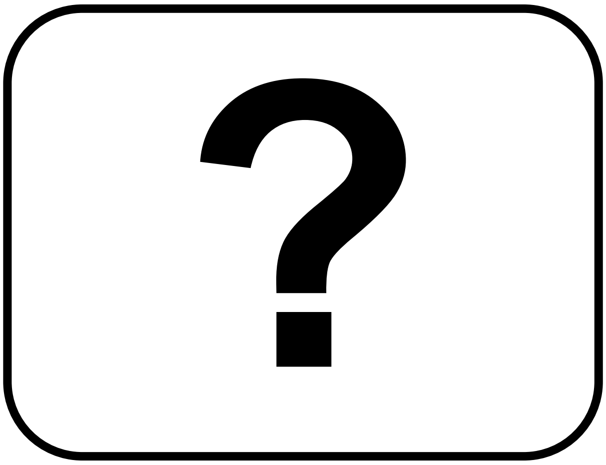
Coming soon.

Explore this area further

- Production Troubleshooting - A251
    - Practice for troubleshooting a Light RTM step - P107
    - Maintaining part quality when changing curing equipment - P122
    - Troubleshooting part quality during cure when changing the reinforcement - P131
    - Troubleshooting scale-up issues from thin to thick parts - P140
    - Troubleshooting quality issues during cure for different equipment types - P141
    - Ensuring appropriate resin flow and part consolidation for a new cure cycle - P119
    - Troubleshooting scaling-up issues from coupons to parts - P134
    - Troubleshooting scaling issues from small to large parts - P136
    - Troubleshooting tooling to achieve part quality - P142
    - Ensuring appropriate resin flow and part consolidation for a new material - P120
    - Transitioning tooling styles between different thermal transformation equipment - P139
    - Troubleshooting when changing production tooling material - P130
    - Troubleshooting a cure cycle for improved production rates - P132



About



Help

Outcomes represent the range of response/sensitivity to factory system attributes. Those that fail to satisfy manufacturing requirements are known as defects. Examples of manufacturing outcomes include process parameter outcomes, material structure outcomes, and material performance outcomes.

With regards to modelling & simulation, validation demonstrates the accuracy of a computational model — in the context of its intended use — to check that it represents the physics of the problem and the ‘reality of interest’ (needs are satisfied).

Engineered materials (designed to have specific properties) made from two or more constituent materials with different physical or chemical properties. The constituents remain separate and distinct on a macroscopic level within the finished structure.

For polymer matrix composites (PMCs), resin refers to the matrix; the continuous material phase that binds the reinforcement together, maintains shape, and transfers load. Resins are divided into two main groups: thermosets and thermoplastics.

Pre-impregnated (prepreg) material refers to fibre that is already combined with resin. It is the most common material form used in aerospace.

During prepreg production, (e.g. fibres are run through a resin bath), prepreg is heated and partially cured to B Stage (< 5 % degree of cure). Thermoset prepregs (e.g. epoxy prepreg) have to be kept in a freezer at around -20 °C. At room temperature, the epoxy starts to cure.