Common MRB for Composite Parts

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Introduction

- An issue that frequently occur with composite parts is manufacturing defects
- After the design is FAA approved and fabrication starts, defects occur
- Therefore, the part is subject to the material review board (MRB) process (or similar process, if there is no MRB approval)

Introduction

- Manufacturing defects have a significant impact upon the economic viability of the project
- There are many reasons for these defects, but the transition of prototype tools and staff to production is a big contributor
- The MRB process requires data to justify using or repairing defects.

Introduction

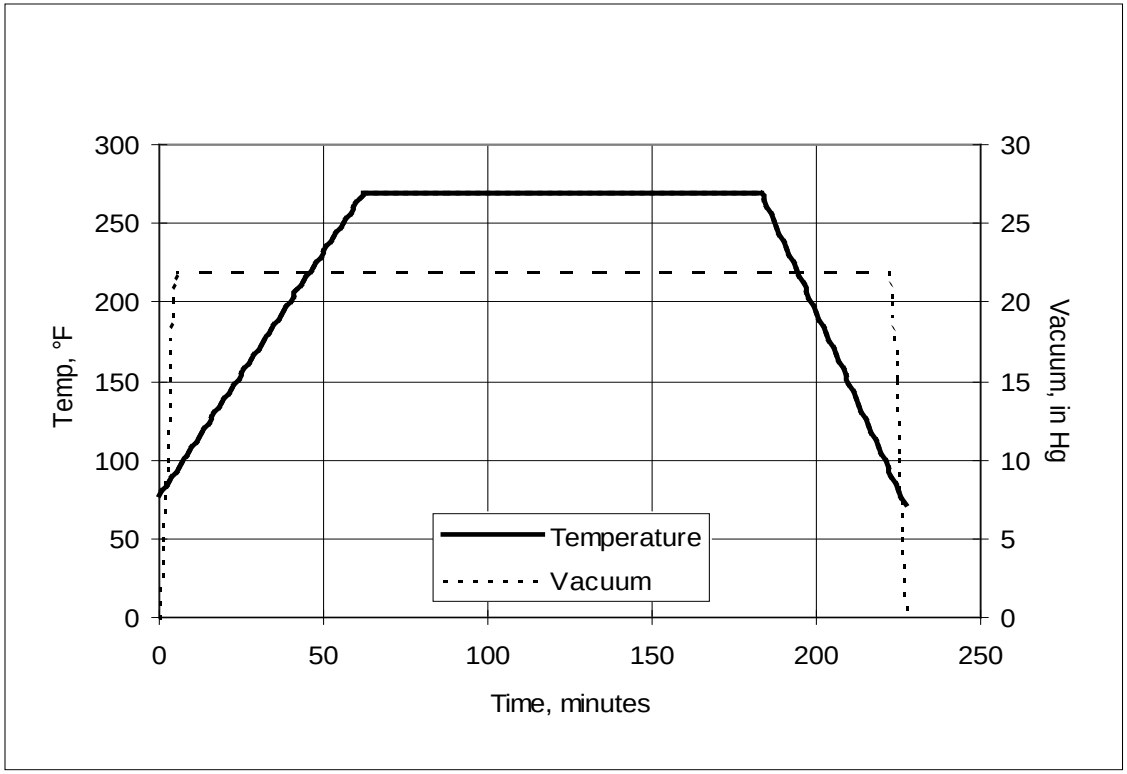
- If a robust building block approach is used for certification, it will include sensitivity studies of process variations and defects. But often the building block is abbreviated (or not done at all) and this data does not exist.
- Even robust programs do not always consider the common defects that occur in manufacturing.

Introduction

- There are too many variations of manufacturing defects to easily list, but two of the most common defect categories are cure cycle deviations and porosity/voids.
- Cure cycle deviations are usually temperature variations (thermocouple spread, failed thermocouple, or time at temperature).

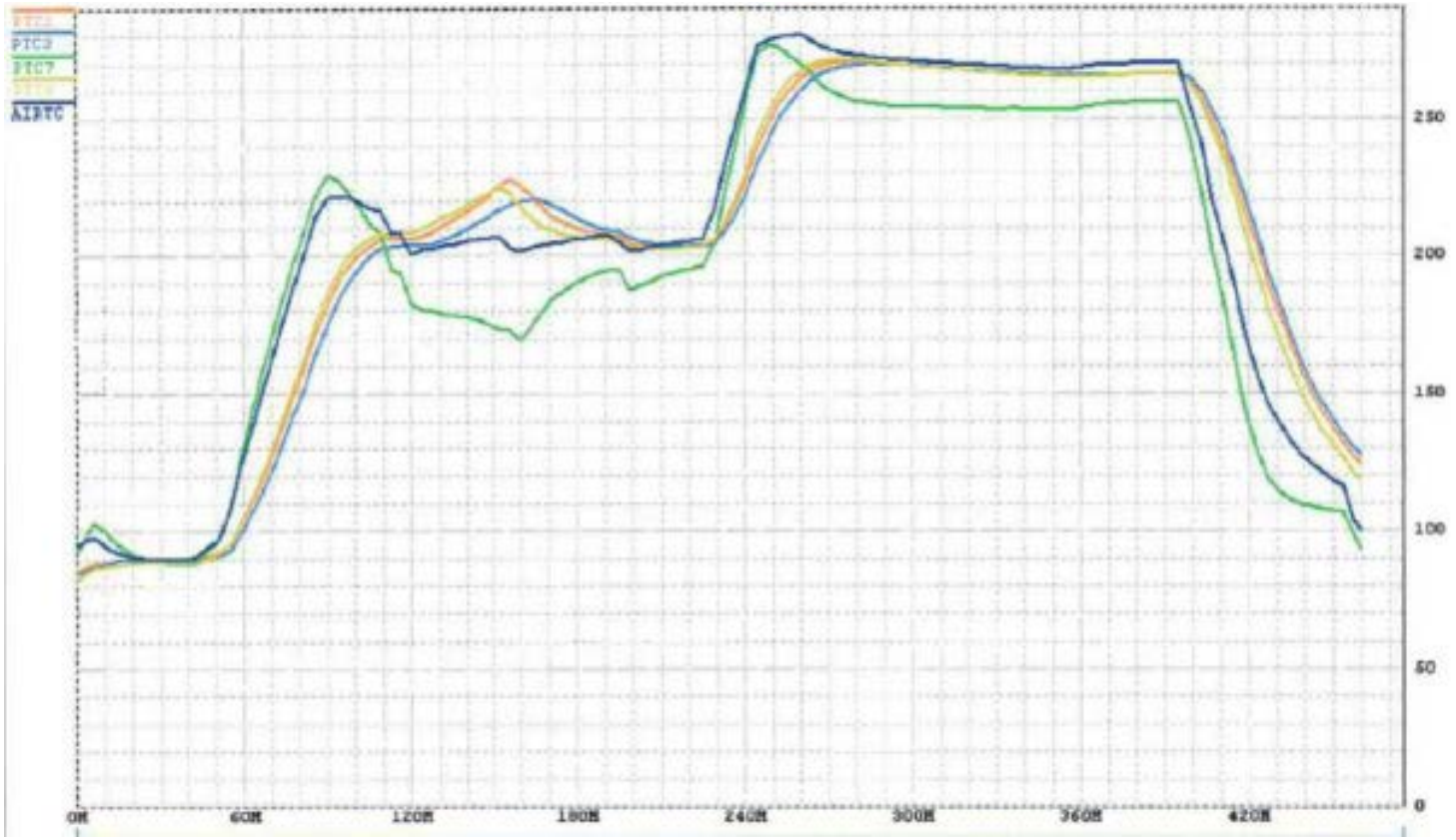
Cure Cycle

- Typical Spec Cure Cycle



Cure Cycle

- Example of measured temperatures during cure cycle



Cure Cycle

- This cure cycle has three deviations, max temperature spread, low temperature on one thermocouple, and slow cool down.
- All of these deviations may be "acceptable as is", but it requires data to justify the decision.
- Many projects do not acquire this data prior to the production phase and then must generate the data during production, which causes production delays.

Cure Cycle

- Most process specs require thermocouple placement in terms of minimum number per square foot.
- It is assumed that someone will do a thermo survey to determine the hot/cold spots of the part and place the thermocouples at these locations, but this may not be done.

Cure Cycle

- The thermo survey should be documented and can be used for dispositions. For example the thermo survey may indicate that the low/high thermocouple is malfunctioning.
- Other helpful data is doing cures that deviate from the max/min for a short time and evaluating the effect upon properties.

Porosity

- Another common cause for part rejection is porosity
- There can be varying levels of porosity.
- Surface porosity is the most common type of porosity but porosity can be through the laminate thickness.

Porosity

- Inspection methods must be developed to determine the extent of porosity.
- If inspection methods do not exist, then the worst case must be assumed and the part must be repaired or scrapped.

Defects

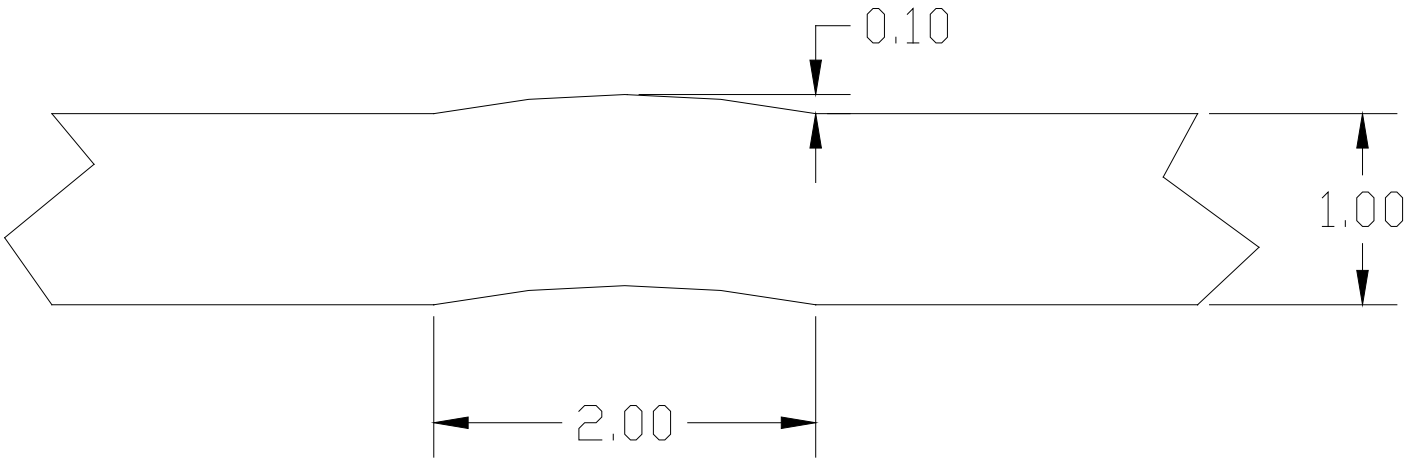
- There is a large variety of manufacturing defects. Voids and fiber distortion are the most common.
- The regulations and policy require manufacturing defects to be installed in the test articles.
- The intent is to insure the structure is capable of ultimate load with the minimum detectable defects.

Defects

- But some companies will install defects that may occur but have minor impact upon strength, and may not be detectable.
- The regulations require the defects are placed in the most critical structural area.
- There are not many of these and therefore the number and type of defects are limited and must have careful consideration.

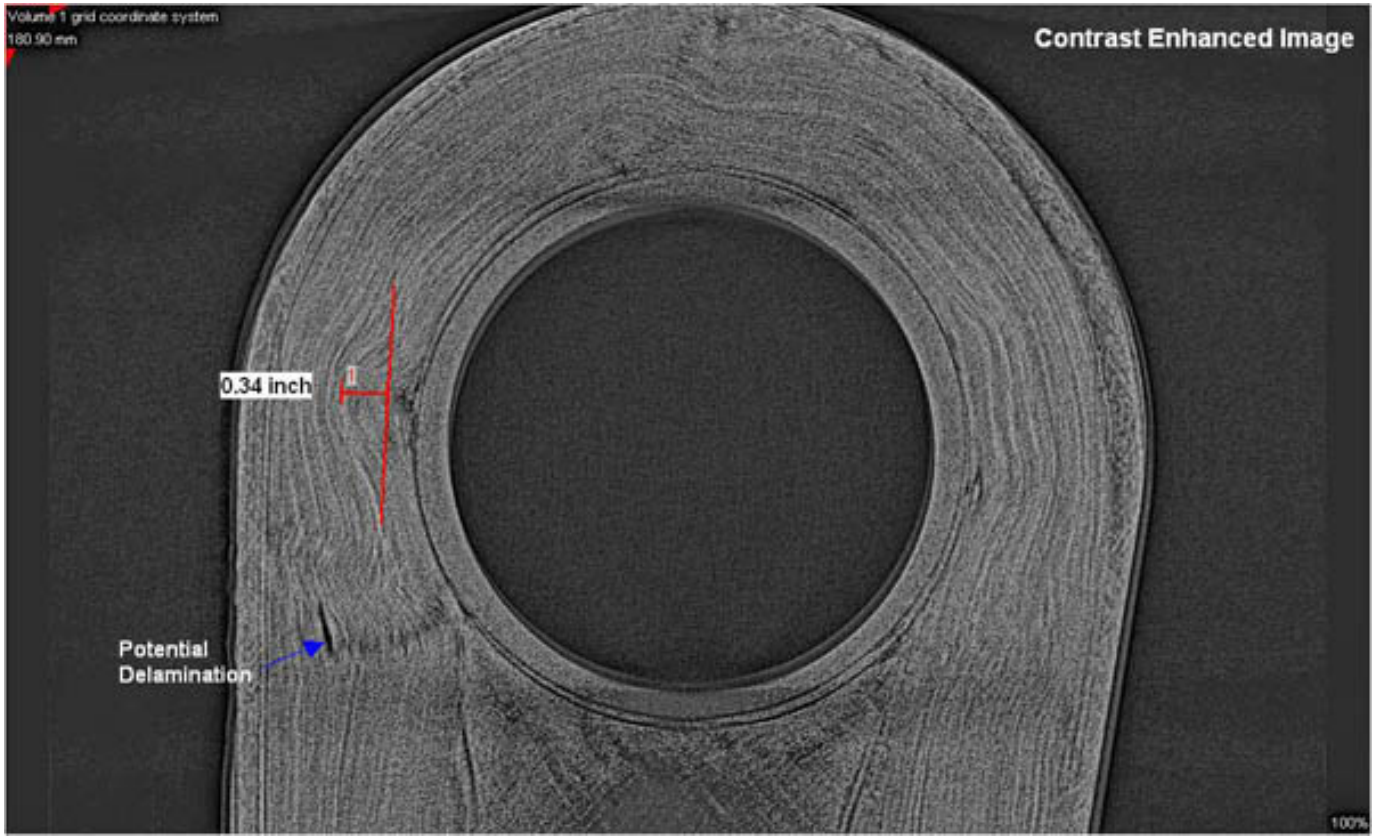
Defects

- Example of a non-significant defect (uni-tape)



Defects

- Example of a significant defect



Defects

- In most cases, BVID causes the largest strength reductions in composite structure and this should be placed in the most critical areas of the structure.
- A typical winglet structure normally has two spars and these are the most critical structure.
- Failure of either spar will generally cause complete wing failure.

Defects

- In theory, a spar can be designed to have the same margin of safety throughout its complete length, but this generally does not happen and the critical areas tend to be at the root end.
- When choosing locations and defect type for the structural test articles, likely manufacturing defects should be considered.

Defects

- It is common to insert Teflon discs into the layup to simulate disbonds/voids and while this is a good defect to have in the structure, disbonds/voids do not frequently occur in laminate structures.
- Porosity is much more common than voids but porosity is rarely simulated in the structural test articles.

Summary

- Common manufacturing MRB issues are cure cycle and porosity
- Other defects, such as voids, occur but not as often
- The program plan should include substantiation methods for common MRB issues, even if the plan is to scrap the part for certain type of MRB issues.
- The program plan should consider MRB issues when selecting the defects installed in the test articles