CCT Open Molding Content Review
Andrew Pokelwaldt
Director, Certifications
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ACMA Certified Composites Technician Exams

Exam Administration
All CCT exams consist of 100 multiple choice questions and are “closed-book.” Two (2) hours are allocated for the exam. The passing standard of the CCT examination is a minimum score of 80 questions answered correctly, or 80%. Online testing is most convenient and preferred.

CCT written material is to be complemented with hands on training or manufacturing experience with composites processes.

Candidates must provide the name and contact information of their proctor when requesting an exam code from ACMA. Exam codes should be requested at least two (2) weeks before the candidates desired exam date. Request an exam code by emailing cct@acmanet.org.
Webinar Review

• This review is designed to assist with CCT material that is part of the CCT Open Molding exam.

• This is not a substitute but complements experience, hands on training and CCT manual reading/questions/review.

• It covers important CCT Open Molding material but does not include the complete ACMA CCT-OM Study Guide material.
Open Molding Review

• Gel Coat Application
Critical Elements of Gel Coat Application

• the Gel Coat

• the Application Equipment

• the Application Method
Gel Coating Hazards

Toxic

Spill

Spray Equipment

Fire
Safety Requirements

• Gel coat MSDS or SDS data sheets provide information on personal protective equipment (PPE) required and safe handling procedures for Gelcoat.

• Individual manufacturer safety standards should also be followed.
Safety Procedures

• Follow shop safety requirements.

• Spray in ventilated gelcoat spray booth.

• Always wear proper PPE and respirator when spraying gelcoat. The standard for styrene exposure is 50 ppm without a respirator. Recommended that Gelcoat spray work has employees wearing respirators.
Gelcoat Spraying Safety

• Whenever spraying gelcoat it is strongly recommended that a well maintained respirator is worn.

• Eye protection is required.

• The industry standard maximum exposure for spray styrene is 50 ppm (parts per million). This should not be exceeded without proper Personal Protective Equipment (PPE).
Gel Coat

- Sometimes referred to as in mold coating.
- Usually sprayed for best results.
- Measured with Mil Gauge
Gel Coat

- In Mold Coating designed to cure in a thin film.

A “mil” is one thousandth (0.001) of an inch
Mil Gauge

- Sometimes called wet film gauge. Used to measure thickness of gelcoat while still wet.
Influences on Gelcoat

- Initiator ratio (Catalyst)(MEKP)
- Temperature - ambient air and mold temperature
- Application Method and Thickness
Percentage of Gelcoat Initiator (Catalyst)

• Usually mixed at 1 ½% to 3% depending on temperature, humidity, gelcoat type and application.
Gelcoat Temperature

- Does influence spray application and it is critical that it be controlled for quality results.
- Temperature equals higher viscosity which makes gelcoat harder to spray.
Spray Gun setting influences emissions and quality

- Set fluid pressure properly.
- Be sure air pressure is as low as possible to produce fan pattern.
- Select proper spray gun tip size and maintain/clean gun and tip for correct application results.
Spray gun- fluid handling equipment

• If plural mixing equipment is used, be sure that equipment is properly grounded.

• This prevents static discharge and fire hazard and lowers quality problems.
Spraying Guidelines

- Gelcoat should always be sprayed at the lowest possible pressure that allows a consistent fan spray pattern. This allows proper gelcoat cure. It prevents excess emissions and product waste from overspray that is not kept in the mold surface.
Styrene

• A component of polyester resins that provides crosslinking sites and reduces polyester to a workable viscosity. Sometimes called a reactive diluent.
• Excess styrene in the air or off gassing from gelcoat or laminate is the smell in an open molding shop.
• Excess styrene at high levels is an indication of improper equipment settings and gelcoat or resin waste.
Gelcoat Print Out

Even when gelcoat is sprayed correctly print out, print thru can be caused by heat in the lamination process. This is often due to:

- Resin rich laminate
- Initiator % above recommended amount for shop temperature.
- Thick laminate stacks with excessive exotherm.
- Mold temperature not consistent with gelcoat and shop temperature.
Spraying gelcoat in corners

Often spraying Gelcoat in mold corners and tight areas can cause gelcoat to be sprayed on to thick.

For best results gelcoat should be 18-24 Mils thick and Applied in 3 passes.
External Mix Spray gun

• Use minimum pressure to form a spray pattern and have a tip that gives correct spray width for the job.

• Be sure the initiator is dispensing evenly across the spray pattern.
Viscosity measurement

• Unit of Measurement – POISES

• Viscosity – CENTIPOISES
  (1 poise equals 100 centipoise)
Gelcoat Viscosity

- As the temperature of gel coat decreases, viscosity increases.
  - Gel coat should be stored at shop temperature.
  - If stored at low temperature, it should be let warm for 2 to 3 days before use.
  - High viscosity does not allow gelcoat to spray in proper fan pattern.

Low Viscosity = High flow
Thin gelcoat in Warmer temperatures

High Viscosity = low flow
Thick gelcoat in colder Temperatures.
Gelcoat Quality

Gel coats are manufactured with a shelf life and do not perform as specified past expiration. Page 14 of the Open Molding CCT has a QA checklist. Manufacturers have recommendations for specific product best quality results.

Gel coat should be mixed each 24 hour period for at least 10 minutes.

The Pre Gel Coat Checklist on page 17-18 of the CCT Open Molding study guide should be used prior to production.

Gelcoat and manufacturing facilities may have additional standards and procedures to assure gelcoat quality and proper use.
Common Gelcoat (in mold coating) quality issue causes

• Mold temperature different than gelcoat at spraying.
• Mold condition or chemical treatment residue that is not compatible with the gelcoat.
• Gelcoat is out of date, not properly stored or mixed.
• Initiator ratio is incorrect.
• Gel coat is applied to thin or to thick.
• Spraying is done at excess pressure and spray pattern is poor.
Open Molding Review

- Spray up
Open Molding Resin Application

- Resin is applied in various different ways in open molding.

These Application Methods can include:

**Controlled Spraying** – spray up, chopper gun, chop
**Uncontrolled Spraying** – usually chopper set incorrectly, no spray control
**Brush application** – hand applied with bucket, brush, squeegee
**Pressure fed Roller application**
**Flow coater application**
Spray up

- Chopper application which cuts continuous strand roving into short lengths and deposits a mixture of resin and fibers commonly known as “Chop.”
Spray Gun Setup for best performance

• Glass distribution in fan pattern.
• Proper resin to glass ratio. (not to wet or to dry). In open molding having 25 to 30% of the part weight in glass is desired.
• To much resin – resin rich part. To little – resin starved (dry)
• Correct spray gun pressure should be set (low as possible while still creating fan pattern).
Chopper Gun Operation

• If chop gun is applying fiberglass that is to wet or to dry adjust by:
  – Changing resin pressure on plural mixing equipment
  – Increase or decrease speed of chopper gun movement
  – Spray patterns should be applied in two directions
Resin System Measurement

• Determined at a standard temperature 77 degrees F or 25 degrees C.

• Initiator (catalyst, kick, juice, MEKP, activator) is adjusted for shop conditions (temp).

• Not all initiators are the same, use the specified chemical initiators.

• Can be set by plural mixing machine or mixed manually using measuring cups, scale and measured initiator to put in proper %.

• Resins may be pre promoted or promoted as specified by manufacturers to meet product needs.

• Many modern initiators are pre mixed for use various applications to maintain even and full cure (cross linking).
Open Molding Review

- Hand tools and hand lay up
Resin and Material Distribution on Part

• With spray up or hand layup of composite parts, proper wet out and material distribution requires manual processes.

• Laminate consolidation or compacting is done with hand tools. Commonly called- rolling glass, rolling out air, manual consolidation, wet out, wetting.
Resin System Measurement

- Thixotropic index (Thix) – measures how resin resists flow or drainage during application on vertical surface.
- Determined at a standard temperature 77 degrees F or 25 degrees C.
Measure Chopped Laminate Thickness

- Use a mil gauge (wet film thickness gauge). Larger scale mil gauge than one used in gelcoat.

- Do not guess or go by feel only – most chopped parts have excess fiberglass and resin adding weight and cost.
Reinforcements

• Be sure lamination schedule is followed. Laminates create heat during cure and often cannot be applied all at one time.

• The more complex the reinforcements being applied, the more important it is to use in process quality control to check resin content, check for air voids in laminate and ensure correct material placement.
Gel Time influences

• **Gel time**- sometimes called cure, gel, set up, kick off times.

  – Influenced by initiator level, temperature, laminate thickness.

  – Variations by resin system, type, brand, additives, promotors and initiators occur.

  – Thicker laminates create more heat which can cause curing problems, distortion in laminate surfaces or even chemical fires.
Open Molding Lamination Tools

- **Compaction tools:** hand rollers, cull plates, paint roller.

- **Resin Content Modification tools:** squeegee, paint brush, paint roller, flow coater.
Tool selection in Open molding

• Select tools that fit the job. If the roller is too large it will leave resin rich corners and not properly compact material leaving air voids.

• Keep tools clean and in good condition. Be sure they are free of cleaning solvent that can contaminate laminate.
Filament Wound Parts

- Larger Open Molded cylindrical parts frequently require use of a squeegee or roller to control resin content.
- These parts should also be checked with a mil gauge to meet specifications.
Open Molding Wet Out tools

• For parts that require large amounts of resin saturation and spreading, a squeegee or roller can be used.
  – These include heavy weight textile reinforcement fabrics, core fabrics and materials.
Excess Resin or Resin Rich Parts

- Resin rich parts have many negative attributes.
- These are cases where the % of resin compared to the % of fiberglass is high. More resin than glass.
  - Extra weight.
  - Resin shrinkage at cure.
  - Weaker parts.
  - Added cost.
  - Cosmetic surface blemishes
  - Excessive cure temperature (heat) in areas with puddled resin
Questions ??

• Presenter Contact Information:

Andrew Pokelwaldt  MS, SPHR, CCT-VIP
Director, Certifications
American Composites Manufacturers Association
2000 N. 15th Street, Ste. 250
Arlington, VA 22201
Main:  703-525-0511
Direct:  571-645-5267
Mobile:  865-684-8949
apokelwaldt@acmanet.org