3-Day Introduction to Composites Manufacturing Bootcamp

The Introduction to Composites Manufacturing Bootcamp is an immersive three-day training program designed to introduce participants to one of the fastest-growing advanced manufacturing sectors. Through a blend of industry-recognized Tooling U learning modules and hands-on instruction, participants gain foundational knowledge in composite materials, reinforcement fibers, resin systems, and modern manufacturing techniques. Students will learn core industry concepts while working directly with materials such as fiberglass and carbon fiber.

Participants will then apply their knowledge through guided fabrication labs where they complete the full composite manufacturing workflow: plug preparation, mold creation, composite layup, and vacuum bagging using professional materials and equipment. By the end of the program, each participant will have manufactured their own composite mold and finished composite part while gaining experience in inspection, finishing, and defect identification—providing practical exposure to processes used across aerospace, automotive, robotics, marine, and advanced product manufacturing industries.

While designed as an introductory training experience, the bootcamp serves as an important workforce development pathway by connecting participants to continued education opportunities through Westmoreland County Community College's new Advanced Composites in Manufacturing Center. Students interested in pursuing careers in advanced manufacturing will be encouraged to continue their training through WCCC's specialized programs, creating a clear pipeline from introductory exposure to industry-ready technical skills.

Duration: 3 Days
Daily Time: ~6–7 hours
Equipment:

- Vacuum pump
- Vacuum bagging materials
- Epoxy resin
- Fiberglass / carbon fiber cloth
- Mold release wax or PVA
- Gelcoat or surface coat epoxy
- Foam or 3D printed plug shapes
- Sandpaper, brushes, rollers
- Digital scales

Participants will now complete the **full composite workflow**: **Plug → Mold → Composite Part**

DAY 1 — Composite Fundamentals + Mold Making

Learning Objective: Understand composite materials and create a **basic composite mold**.

Morning (9:00–12:00)

Tooling U Modules

1. **Introduction to Composite Materials**
2. **Composite Reinforcements**
3. **Composite Matrix Systems**

Instructor Topics

- What makes a composite
- Fiber vs matrix roles
- Fiber orientations
- Composite part structure
- Introduction to **molds vs plugs**

Key concept:

Plug = the original shape
Mold = the negative tool used to make parts

Afternoon (1:00–4:30)

Hands-On Lab: Plug Preparation & Mold Creation

Students use a **simple plug shape** such as:

- 3D printed coaster form, Foam block shape, Small tray mold or a Phone stand plug.

Step 1 — Plug Prep

Students learn:

- Surface preparation
- Mold release wax
- PVA application

Step 2 — Mold Layup

Students create a **fiberglass mold** over the plug.

Process:

1. Apply release agent
2. Apply gelcoat or surface epoxy
3. Lay fiberglass layers
4. Wet layup
5. Consolidation

Molds cure overnight.

DAY 2 — Manufacturing Processes + Vacuum Bagging

Learning Objective: Learn manufacturing techniques and produce parts using the mold created on Day 1.

Morning (9:00–12:00)

Tooling U Modules

1. **Composite Manufacturing Methods**
2. **Vacuum Bagging for Composites**
3. **Composite Safety**

Topics covered:

- Hand layup
- Vacuum bagging
- Resin infusion
- Filament winding
- Pultrusion

Deep focus on **vacuum bagging stack structure**

Layer stack: Part → Peel ply → Perforated film → Breather → Vacuum bag

---

Afternoon (1:00–4:30)

Hands-On Lab: Mold Demold + Part Fabrication: Students remove the **plug from the fiberglass mold** they made.

Instructor demonstrates:

- Mold trimming
- Surface prep
- Release agent

Students then **produce a composite part in their mold**.

Material options:

- Fiberglass part
- Carbon fiber part

Steps:

1. Mold release
2. Fabric cutting
3. Resin mixing
4. Layup in mold
5. Vacuum bagging setup
6. Leak test
7. Cure under vacuum

Parts cure overnight.

DAY 3 — Inspection, Finishing & Testing

Learning Objective: Understand composite defects and finishing techniques

---

Morning (9:00–12:00)

Tooling U Modules

1. **Composite Inspection and Defects**
2. **Composite Repair and Finishing**

Topics covered:

Common defects:

- Voids
- Delamination
- Dry fiber
- Resin-rich zones
- Wrinkles

Quality techniques:

- Visual inspection
- Tap testing
- Thickness inspection

Afternoon (1:00–4:30)

Hands-On Lab: Demolding & Finishing Students remove their parts from molds.

Activities:

- Vacuum bag removal
- Part demolding
- Edge trimming
- Sanding
- Surface finishing

Strength Demonstration

Students test:

- Fiber orientation strength
- Carbon vs fiberglass stiffness
- Resin ratio differences

Final Student Outcome

Each participant produces:

1. A **fiberglass mold**
2. A **vacuum bagged composite part**
3. Knowledge of **full composite workflow**