



# NON-STRUCTURAL DUCT BUSINESS CASE

Find out how switching from autoclave cured washout mandrel tooling to oven cured Smart Tooling can provide a payback in 7.3 months

## PROBLEM

Fabricate a non-structural duct in a quick, clean, and efficient process without an autoclave.

## OPPORTUNITY

Create an oven cure solution that will produce a high-quality composite duct with a reusable Smart Tool.

## SOLUTION

A Smart Tool that acts as a bladder during cure was combined with a OML cure mold to create an oven cure process that consolidates the composite laminate during cure and creates a high-quality duct with cost savings of 19% and an 81% reduction in cycle time.

## WASHOUT PROCESS

The previous process of using washout tooling to create a mandrel to layup on was dirty and laborious. From beginning to end, it took 60 hours to fabricate a duct, with nearly 6 hours of touch time.

Technicians would start by cleaning up the casting tool, removing excess plaster and debris from the previous cycle. Next, they mix the plaster and pour it into the mold, waiting 24 hours for it to cure. After cure, technicians disassemble the casting mold and rework any damage, voids, or blemishes.

After repair, the plaster mold is sanded to create a smooth surface. Next, release

tape is applied to the surface, followed by the prepreg, then breather.

The laid up mandrel is then vacuum bagged and placed in an autoclave for a 6 hour cure. After debagging, the mandrel is soaked in water for 24 hours to soften the washout material. Next, the washout material is manually removed from the duct, and then the composite duct is washed, trimmed, and finished.

## SMART TOOLING PROCESS

The Smart Tooling process is fast, clean, and efficient. The Smart Tool that acts as a bladder has its release film pre-applied, allowing the layup process to begin right away. Because the Smart Tool is rigid at layup, you can apply prepreg directly to the released Smart Tool.

Once finished, the laid up Smart Tool is placed into the cure mold, sealed with a pressurized bag placed through the inside of the Smart Tool, then placed in an oven for a 6 hour cure cycle. As the cure temperature ramps up, the Smart Tool becomes elastic and the inner bag is pressurized to apply force on the laminate to drive out air and excess resin. Because it was desired by the customer to eliminate an autoclave for cure, the duct will have both a smooth outside mold line (OML) and a smooth inside mold line (IML) after it is cured.

Once the cure is complete and the temperature is ramping down, but is still

above the transition temperature of the Smart Tool, the mold is opened and the Smart Tool is extracted from the trapped geometry composite part. Elastic Smart Tools can be extracted with low-force from the cured composite duct.

After extraction, the still elastic Smart Tool is placed into a pre-heated form mold, a vacuum bag is pulled through the Smart Tool and sealed to the ends of the mold, vacuum is pulled to reset geometry, and it is left to cool so it can begin the next cycle.

## RESULTS

**Smart Tools reduce cycle time by 81%, labor cost by 14%, and material cost by 33%, netting a payback of only 7.3 months. If the customer had requested we use a Smart Tool mandrel solution and stayed in the autoclave, the payback would be only 1.7 months.**

The dirty, time consuming, and tedious process of washout is eliminated and replaced by the simple and elegant Smart Tooling process.



Preparing plaster mold



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## SMART TOOLING PROCESS

| Step                                     | Touch Time (min) | Cycle Time (min) | Labor Cost       |
|--|------------------|------------------|------------------|
| Prep Smart Tool                          | 2.5              | 2.5              | \$ 3.67          |
| Layup                                    | 180              | 180              | \$ 264.00        |
| Cure Tool Closure with Internal Tube Bag | 30               | 30               | \$ 44.00         |
| Cure                                     | 360              | 360              | \$ 528.00        |
| Demold Smart Bladder from Composite      | 20               | 20               | \$ 29.33         |
| Form Tool Loading                        | 10               | 10               | \$ 14.67         |
| Form Tool Cooling                        | 0                | 60               | \$ 0.00          |
| Remove Smart Tool from Form Tool         | 10               | 10               | \$ 14.67         |
|  |                  |                  |                  |
|  |                  |                  |                  |
|  |                  |                  |                  |
|  |                  |                  |                  |
| <b>TOTAL:</b>                            | <b>613</b>       | <b>673</b>       | <b>\$ 898.33</b> |

## WASHOUT PROCESS

| Step                        | Touch Time (min) | Cycle Time (min) | Labor Cost         |
|-----------------------------|------------------|------------------|--------------------|
| Prep the Casting Tool       | 4.5              | 4.5              | \$ 6.60            |
| Mix & Pour Plaster          | 5.5              | 5.5              | \$ 8.07            |
| Allow Plaster to Cure       | 0                | 1440             | \$ 0.00            |
| Disassemble Casting Tool    | 3                | 3                | \$ 4.40            |
| Rework Blemishes in Plaster | 3.75             | 3.75             | \$ 5.50            |
| Prep Plaster                | 29               | 29               | \$ 42.53           |
| Layup                       | 180              | 180              | \$ 264.00          |
| Bag                         | 90               | 90               | \$ 132.00          |
| Autoclave Setup             | 15               | 15               | \$ 22.00           |
| Cure                        | 360              | 360              | \$ 528.00          |
| Debag                       | 6                | 6                | \$ 8.80            |
| Soak                        | 0                | 1440             | \$ 0.00            |
| Washout EZ Out              | 12               | 18               | \$ 17.60           |
| Wash With Clean Water       | 2                | 2                | \$ 2.93            |
| <b>TOTAL:</b>               | <b>711</b>       | <b>3597</b>      | <b>\$ 1,042.43</b> |

## BILL OF MATERIALS

|   |                  |
|---|------------------|
| Prepreg   | \$188.60         |
| Smart Bladder with a Life Cycle of 60             | \$66.42          |
| Consumables (vacuum bag, mold release, tape, etc) | \$5.50           |
| <b>Complete Bill of Materials</b>                 | <b>\$ 260.51</b> |

## BILL OF MATERIALS

|  |                 |
|--|-----------------|
| Prepreg                                      | \$188.60        |
| Consumables (plaster, vacuum bag, tape, etc) | \$101.24        |
| Autoclave Cure                               | \$ 100.00       |
| <b>Complete Bill of Materials</b>            | <b>\$389.84</b> |

|                            |                    |
|----------------------------|--------------------|
| <b>Total Cost Per Part</b> | <b>\$ 1,159.00</b> |
|----------------------------|--------------------|

|                            |                    |
|----------------------------|--------------------|
| <b>Total Cost Per Part</b> | <b>\$ 1,432.00</b> |
|----------------------------|--------------------|

## SUMMARY OF SAVINGS

|                           |                  |
|---------------------------|------------------|
| <b>Labor Savings</b>      | <b>1.64 HRS</b>  |
| <b>Cycle Time Savings</b> | <b>48.74 HRS</b> |
| <b>Unit Price Savings</b> | <b>\$ 273.00</b> |

## RETURN ON INVESTMENT SUMMARY

|  |             |
|--|-------------|
| Difference In NRE                                | \$ 61,831   |
| Parts to Build to Recover additional NRE/Tooling | 226.14      |
| <b>Number of Months ROI</b>                      | <b>7.29</b> |