Fixture for Blasting Turbine Compressor Blades

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Introduction

StandardAero is an international company that repairs, rebuilds, and overhauls jet engines, with a facility in Summerside, PEI. Part of this process involves the cleaning of each turbine compressor blade with 240 Grit Aluminum oxide. This is done in an enclosed sandblasting cabinet (Figure 1), with the operator holding the individual blades by the fir tree (Figure 2), which cannot be touched by the 240 Grit abrasive. A fixture for holding the turbine blades was sought to reduce worker fatigue, improve time efficiency, and reduce the chance of damage.

Figure 1 : Interior of Blast Cabinet

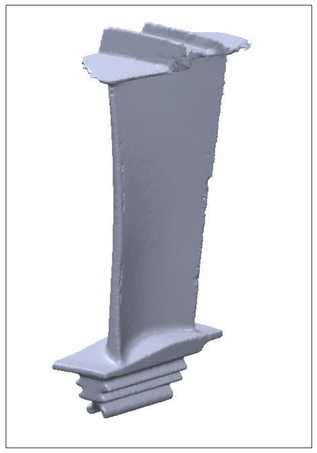

Figure 2 :3D scan of a turbine compressor blade

Project Background

When tasked with the design project the team had to consider all things at hand for the technicians and the turbine compressor blades. The design team had to consider the following

- Safety of the worker
- Safety of turbine compressor blades (Figure 2)
- Weight of design
- Simplicity of the design to be manufactured
- Hold a full set of blades
- Fit within the cabinet (Figure 1)
- Durability of the design

Prototype

After considering all these factors the team designed several designs but only moved forward with the modular tray design (Figure 3). The Modular Tray design was based on a similar design created by StandardAero for a different process (Figure 4).We then looked at the plastic housing designs. Each team member designed a plastic housing (Figure 5). These were then printed and tested to see which fit the fir tree the best. The next steps included building a small-scale prototype and testing. After testing, the team chose one of the four sample housings to be a template for a universal housing (Figure 8).

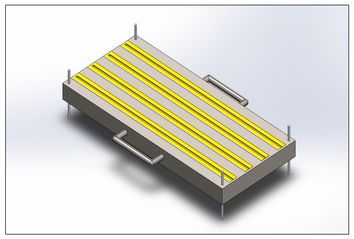

Figure 3: Modular Tray

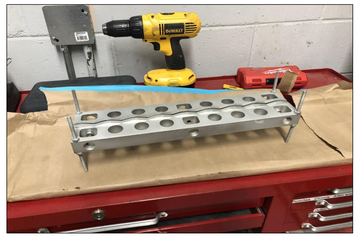

Figure 4: StandardAero's Tray

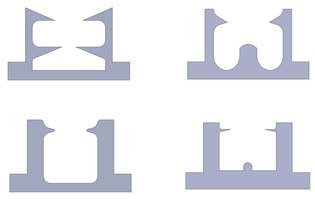

Figure 5: The four variations of housings tested

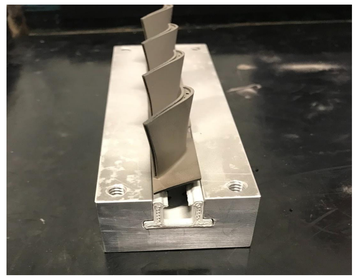

Figure 6: Prototype

Results

Prototype testing found that the prototype resulted in a time saving of 75% while blasting. The true amount of time savings will be lower due to the loading and unloading of the tray, but it is estimated that the time savings will be approximately 50%. These results use data of a small sample size yielding unreliable data (Figure 6). Further testing was planned but due to unforeseen circumstances it was not completed. Testing determined that the cover would not be necessary. A final prototype was created, shown in Figure 9. It included holes cut for weight savings, as well as 24 sections of the universal housing. The total weight (unloaded) was estimated to be 9 lbs.

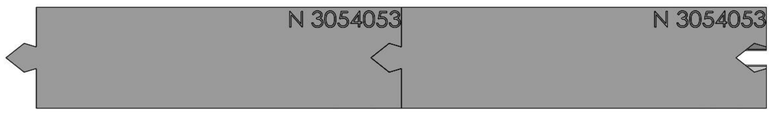

Figure 7: The underside of two linked plastic housings

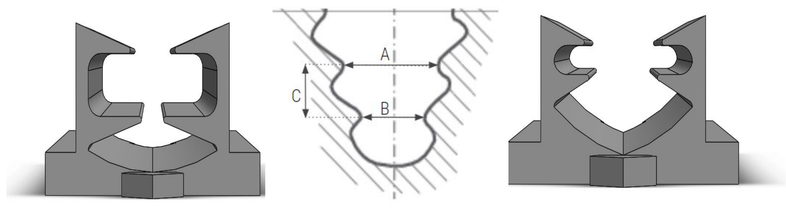

Figure 8: Front view of two configurations of the universal housing

Implementation

StandardAero works with over 15 different blade types and the team did not have an opportunity to measure all of the blades, so it was important to create a system to allow the client to easily add new blades into the system. This was done by linking an excel sheet to the part file (Table 1), new configurations could be created automatically by inputting 3 dimensions (A, B, and C (Figure 6)). The table will automatically add the part number to the part (Figure 7). This excel file allows the client to easily update and keep track of the catalogue of plastic housings.
A standard linking mechanism was created for all the housings, as most 3D printers are incapable of longer lengths than 3".

Table 1: Excel file that can be modified to create new housings

Design Table for: Universal Housing				
		Top Width (in)	Bottom Width (in)	Distance From Top to Bottom (in)
Type/Model	Part Number	D17@Sketch2	D20@Sketch2	D11@Sketch2
PW123E	N 3122702-01	0.1822	0.08976	0.1825
JT15D4	N 3022202	0.29488189	0.25984252	0.086614173
PT6S1	N 3054053	0.215	0.125	0.1625

The full-scale design was created and sent to StandardAero for manufacturing. The full-scale prototype was manufactured by the client (Figure 9). StandardAero will use this prototype to perform testing. Once the testing is completed, the client will make any changes needed to improve the functionality of the fixture. They will then choose a material best suited for the product and manufacture a full-scale model which will be implemented into their cleaning and repair process.

Figure 9: Full-scale Prototype

Acknowledgements
This design was possible due to the help of the team at StandardAero, including Scott Smallwood, Chris Johnson & Jon Jessome. The Faculty of Sustainable Design Engineering at UPEI, Including Jeff Bowser & Sandy Doucette and our professors Wayne Simmons and Dr. Aitazaz Farooque