Trent XWB 84K Enhanced Performance Fan Disc

NPI / Almen Redesign / Program Transfer

s9394

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23 Years Old

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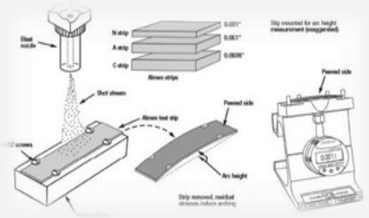
My Project Selection

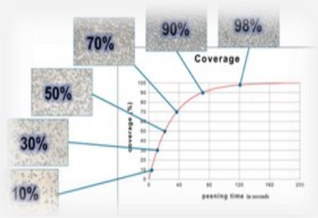
The project has been put in place to create a new process for the Trent XWB 84K EP Fan Disc. The project will look at: Designing an almen carrier (creating models and drawings), creating intensity curves, developing a coverage map / peening parameters, creating a new shotpeen program on machine 4 then producing a final report with the findings to engineering in Derby. Once the process has been signed off. it will be transferred on the other 3 shotpeen machines.

What is Shotpeen /an Almen Test

Shot peening is a cold working process, which is used in industry to improve the fatigue life of metallic components by firing spherical particles at a surface create plastic deformation in the surface layer generally using cast steel shot. The impact of media causes plastic deformation on the components surface, when the components surface has been peened a compressive residual stress layer is generated. This layer increases the life of the component in service significantly. The peening application has two measureable outputs that are coverage and intensity.

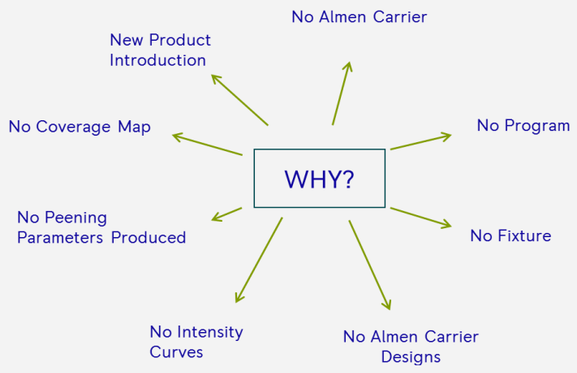
The Almen Test tests the intensity of the shotpeen on certain areas before sending the part in for operation. They do this on almen strips and measure the arc created on the strips from the shot peen intensity. This arc height is measured using an Almen gauge. This gauge is made to industry standards .





Problem

The old XWB 84K has some issues with the fan system and the fuel combustion within the engine performance. As part of the Trent XWB-84EP programme there are various modifications on the existing Trent XWB engine to achieve a 1.3% improvement in operational cruise performance. As a part of the EP programme modification on the fan system, the rotating rear seal is replaced with a new rotating windage shield, this modification aids SAS in flow reduction. Additionally, a new Mk3 fan blade is being introduced which has been optimised to true 39000 feet thrust condition. These changes have been incorporated on the production standard fan disc. The problem with the change in engine is there is no process created or in operation for the XWB 84K EP fan disc.



Why

The Trent XWB 84K EP fan disc is a new introduction part. It has a lot of similarities to the XWB 84K. With it being a new part there is no Almen carrier, Disc fixture, shotpeen program, intensity curves or coverage map . Because of that the disc cant not be shotpeen. There is a lot of time needed on the machine to produce the program including (intensity curves, peening parameters and coverage map) but the time slots are very limited with the production work still being carried out during the week. There is also other parts needing to be programed by other ME operators.

How

1) Redesigning the old XWB 84K Almen carrier to meet new specifications.

2) Creating Almen intensity curves from the Almen carrier . Changing the air, flow and angle of the tool to get the intensity into specification.

3) Creating peening parameters which include—Shut down limits, air pressure, media flow, tool angles, tools being used, paths being create with what tool and 25 off runs for stability .

4) Creating a fixture for the disc to sit on.

5) Creating a program on the machine with both robots for the disc. including the peening parameters created and doing a coverage map to make the part 125% covered.

6) Creating a report to discuss the findings and if there was any issues. For engineering in derby to sign off for production.

Almen Intensity Graph

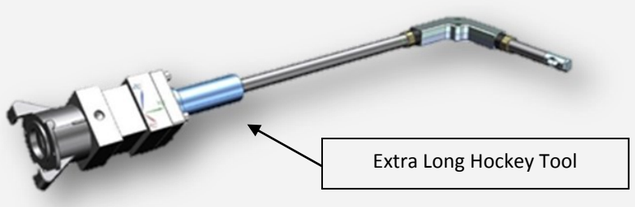
Almen strips tested at different times : 160,80,40,20 seconds. To develop the curve. Identifying the T1 time. Also allowing to process centre to get in the middle of the tolerance band.

Capability Six Pack Charts

Congregation of Almen intensity runs, to develop different capability charts. To identify a stable shotpeen process. as a whole and in different areas, on the disc. Making sure it has good stability and capability.

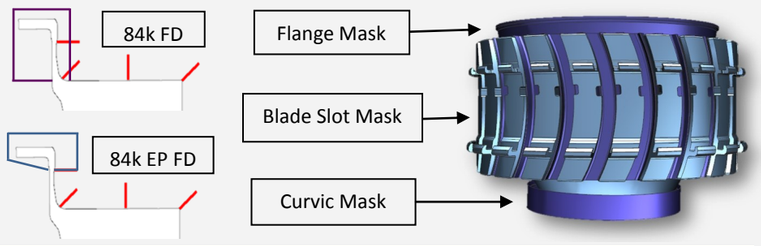
Issues

Position X on the almen carrier wasn't getting the correct hit angle causing the position to be out of tolerance. A new tool was needed to be developed to reach the lower bore at the correct angles.



Masking Re-design

There are a lot of similarities within the 84k FD and the 84k EP FD. The masking on the 84k EP FD blade slots are longer. Also the top flange masking is shorter on the flange to get more shot peen coverage.



Project Time

The project lead time was 12 weeks.

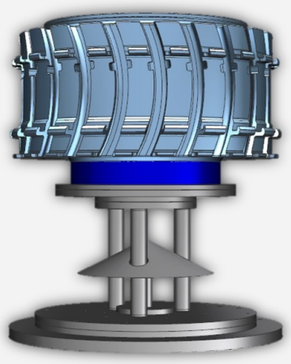
An extra 4 weeks was needed for changes which was rejected by engineering.

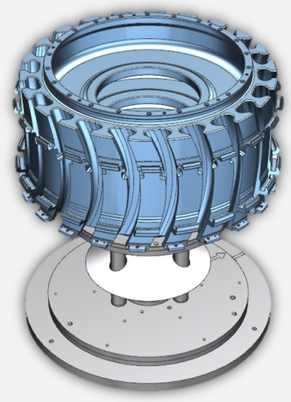
Cost Savings

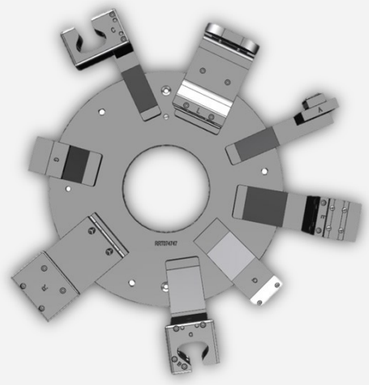
Trent XWB 84K £58,235.94 compared to the Trent XWB 84K EP £58,257.25. There is a forging change saving £250 per forging.

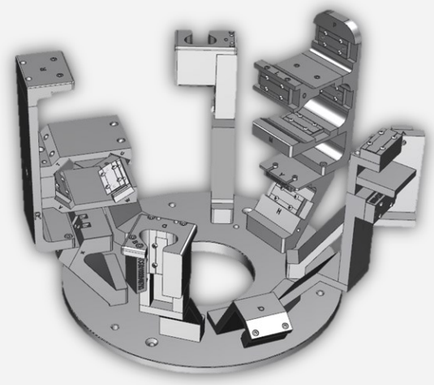
Shotpeen process saving £1500 per concession and production permit submitted. As the part is meeting drawing requirements.

Shotpeen process hours for the 84k was 8.5 hours compared to the 84k EP at 6.5 hours saving £262.5 per disc calculating up to £1,312.5 per week and £68,250 a year.





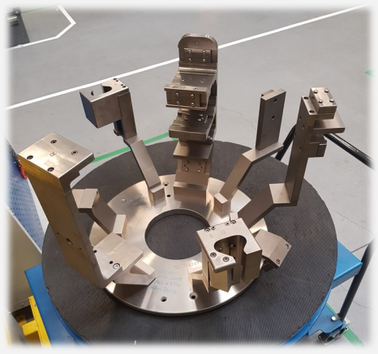


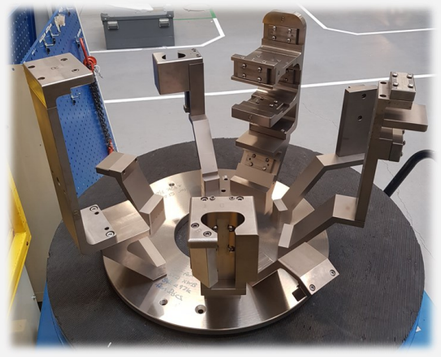


Comparison from XWB 84K to XWB 84K EP

The Trent XWB 84K Almen carrier is being modified to be able to meet the 84K EP drawing requirements. There were also new sections being added due to them parts not being measured on the XWB 84K. These new sections include the full lower bore and the corners within the middle bore section. These areas are shown below in the comparison photos.

Trent XWB 84K Almen Carrier

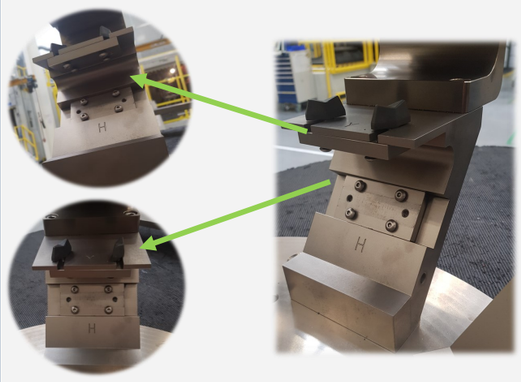


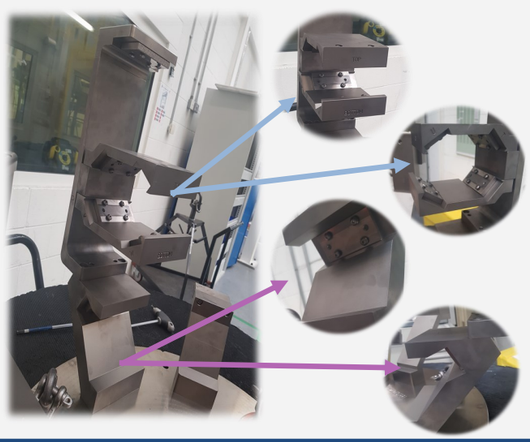


Trent XWB 84K EP Almen Carrier

Position H & Y

These are positions within the bore which wasn't getting measured on the old Trent XWB 84K. The bottom of the bore was not getting any intensity measured. These positions measure the flat faces on the bottom of the bore. This has now been implemented and measuring to M0.15 – 0.25 mmA.





Position T, U, V, W & X

These are positions within the bore which was not getting measured on the old Trent XWB 84K. On the old part it was only measuring the flat faces and not the corners within the part.

The tolerance band specified for the new positions on the bore section is M0.15 – 0.25 mmA.

Future Work

Going forward there will be some process centring required as each machine is different. When transferring the program on other machines the program is working up to standard. The only issue is, it's measuring the shotpeen intensity on the lower side of the specification. This might causes an issue in the future. Process centring on each machines might be required. There was also a tool which was made in house because it wasn't long enough for the bottom bore. This tool has been manufactured correctly with models and drawings on NX and sent away to Brown and Holmes for manufacture. The tool will need to tested for performance before used in production.

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