Operating Efficiency Savings through Specialist Blast Cleaning

ABC Blast Cleaning Ltd

- Best Practices – Safety
  - Equipment
  - Personal Protection
  - Blast Facilities
- Best Practices – Standard blast for NDT
  - Medium
  - Blast Nozzles
  - Post Blast – Good / Bad
- Operating Efficiency Savings - Specialist Blast Cleaning
  - Why
  - Trials
  - 3 Stage process
  - Outcome

Best Practices – Safety

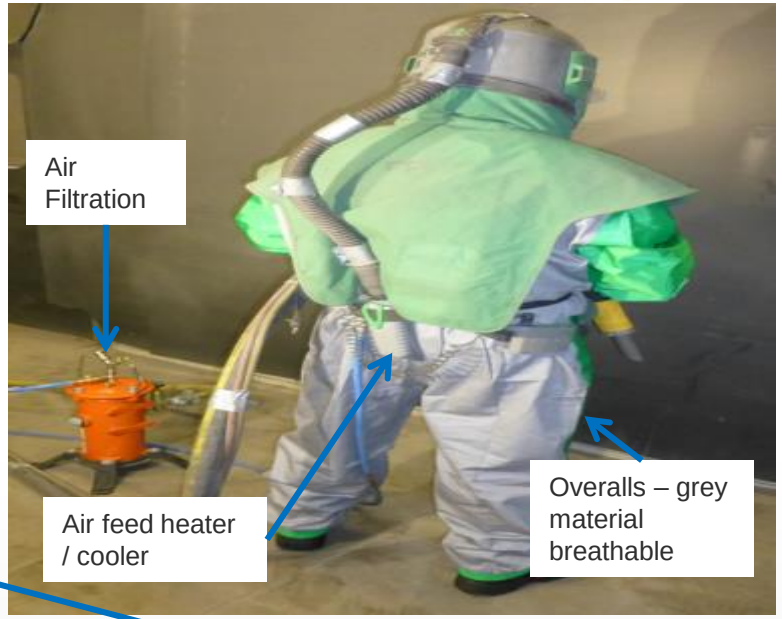
Blasting Equipment

- Semi-elliptical head for larger storage
- Pop-up valve seal
- Inspection door
- Heavy-gauge Steel pot construction
- Conical base for medium flow
- Metering valve for abrasive flow control
- Remote control noise reducing exhaust valve
- Pop up valve to relieve load pressure when hopper is top mounted
- Remote control valve – links to dead mans handle
- Choke Valve
- Pusher-line hose

A blast pot is considered a pressure assembly and falls under the legislation of the European Pressure Equipment Directive 2014/68/EU (PED)

Best Practices – Safety

Blasting Personal Protection equipment



Best Practices – safety

Blast room and set up

Key Features

- Shut off door safety sensor
- Lighting
- Weld solid steel panel floor
- Screw conveyors or recycling medium pit
- Extraction system (LEV)
- Earth straps (static electricity discharge)
- Rubber curtain walls (for steel shot)
- Vision windows
- External safety shut down buttons

Equipment setup (example Rotor)

- Roller stand with journal protection or Knife stands
- Coupling protection
- Gland protection
- Task light
- Access equipment / scaffolding
- trailers

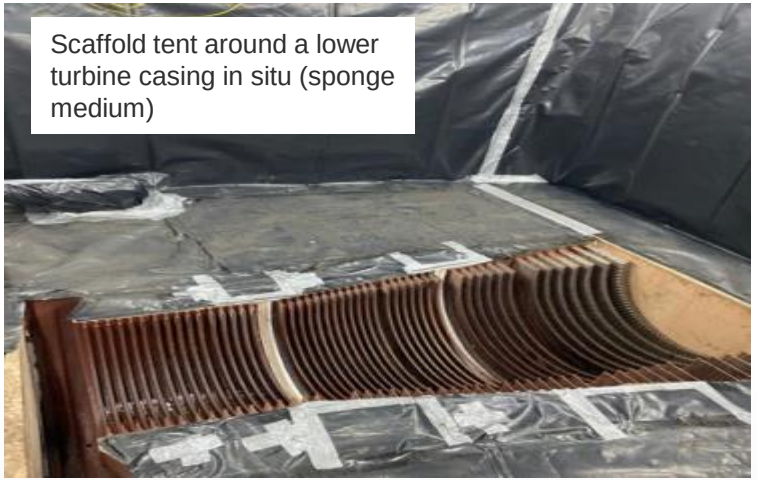
Best Practices – safety

On site

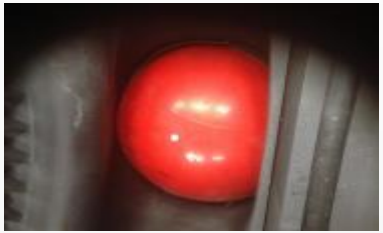
COST VS TIME & SPACE

Internally or externally erectable tents

IMPROVED QUALITY VS HAND PREPARATION



Scaffold tent around a lower turbine casing in situ (sponge medium)



Bungs in casing to stop ingress

Best Practices – Standard blast for NDT

Blast Medium

Medium	Usage / typical application	Grain size / hardness / Specific Gravity	Cost comparison
Garnet 80 (US mesh size)	Single use Profiling steel for coatings / removing coatings	177 microns 8.0 mohs 4.0kg/dm3	60 bags (datum) 
Garnet 180-220 (US mesh size)	Single use – removal of scale from non critical parts	63-88 microns 8.0 mohs 4.0kg/dm3	45 bags
FEPA 80 – 100 Ali oxide	Recyclable – removal of scale on balance of plant / coatings	125-180 microns 9.0-9.2 mohs 4.0kg/dm3	29bags
FEPA180-220 Ali oxide	Recyclable – removal of scale for NDT turbine equipment	53-90 microns 9.0-9.2 mohs 4.0kg/dm3	25 bags
FEPA220 - 240 Ali oxide (micro-grit)	Recyclable – Blade path on steam turbine equipment	45-75 microns 9.0-9.2 mohs 4.0kg/dm3	17 bags
FEPA320 – 360 Ali oxide (micro-grit)	Recyclable – stage 2 surface improvement	22.8 microns 9.0-9.2 mohs 4.0kg/dm3	14 bags
Glass bead 75-150 (spherical)	Recyclable – stage 3 surface improvement / disc head work	75-150 microns 5.0 - 6.0 mohs 2.5kg/dm3	38 bags
Sponge A30	Recyclable & dust free* – HP steam chest in situ	Sponge containing 30 US Mesh aluminium	9 bags
Dry Ice	Specialist cleaning applications	N/A used to freeze/impact to remove surface impurities	Equivalent to 20 bags

Best Practices – Standard blast for NDT

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Standard Nozzles

Specialist Nozzles

Best Practices – Standard blast for NDT

Blasting Outcome - Good

- Scale removed from all areas of the aero foil, root, shroud, back of shroud and surfaces/locations, to the clients specification
- Minimal parent material removed and no deformation of surface or geometry due to blasting e.g. trailing edges e

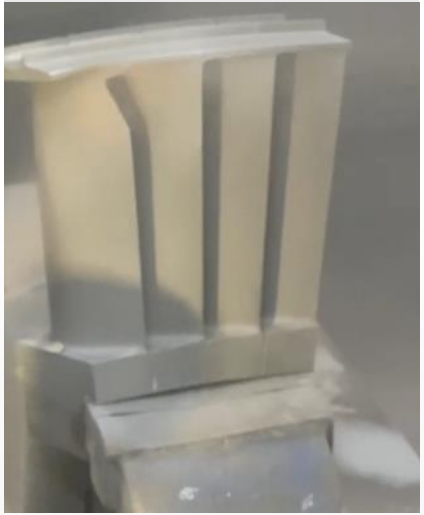
- Knowing when to stop, reporting concerns and finding solutions
- Self and Peer inspection through out the blast process and completion
- At this stage of blasting we would expect a surface reading of approx. 1.2 Ra or better, dependent upon parent surface condition

Best Practices – Standard blast for NDT

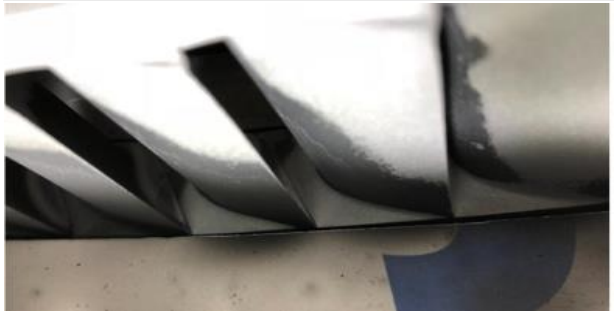
Blasting Outcome – Bad

Poor surface condition

Removed material from trailing edge

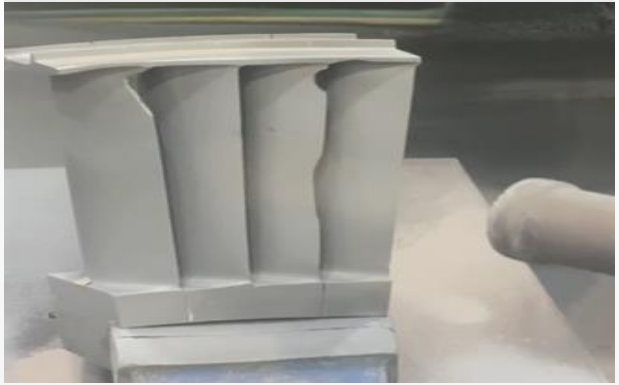


Remaining Scale



Damage when cleaning back of shroud

Damage to neighbouring blade



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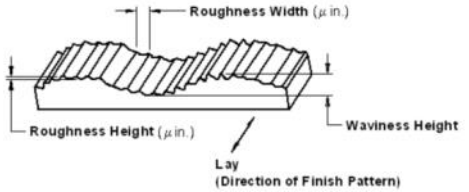
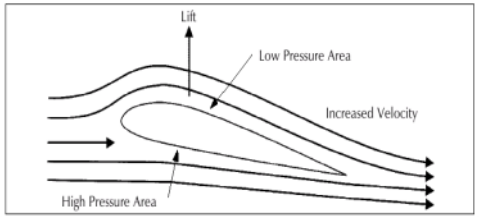
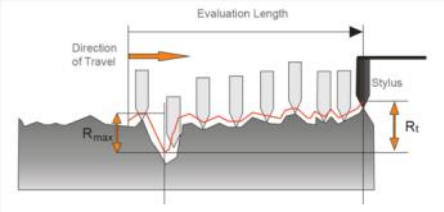
Surface finish - A process of altering a metal's surface through removing, adding, or reshaping and measuring it's 3 characteristics of surface roughness, waviness, and lay.



Why – To enable the flow of steam over the aero foil, creating minimum drag or turbulence across the surface. A number of studies demonstrate positive effect between the relationship of the fluid flow past an object (Reynold number) and surface roughness, on efficiency.



Measurements - Direct measurement method, showing arithmetic average of surface heights that have been measured across a surface. Ra = Roughness average in micrometer



Typical surface finish of a new blade 0.4um to 0.5um

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Parties involved -
Roger Pillar (Drax), Frank Andrusyk (ABC), Steve Haupt

Target –
Recover or improve original surface finish (approx. 0.4 – 0.5 Ra)
Improve turbine efficiency – 0.25%
Reduction in fuel due to increased efficiency

Trials –
Performed on spare Drax turbine blades

Blast for NDT had to be fully achieved first – Surface finish approx. 1.1 – 1.2Ra

Surface improvement stage(s), Numerous mediums from natural products (walnut shells), soda blasting, silicates, ali-silicate, aluminum oxides, glass bead.

Polished datum blade 0.28 Ra

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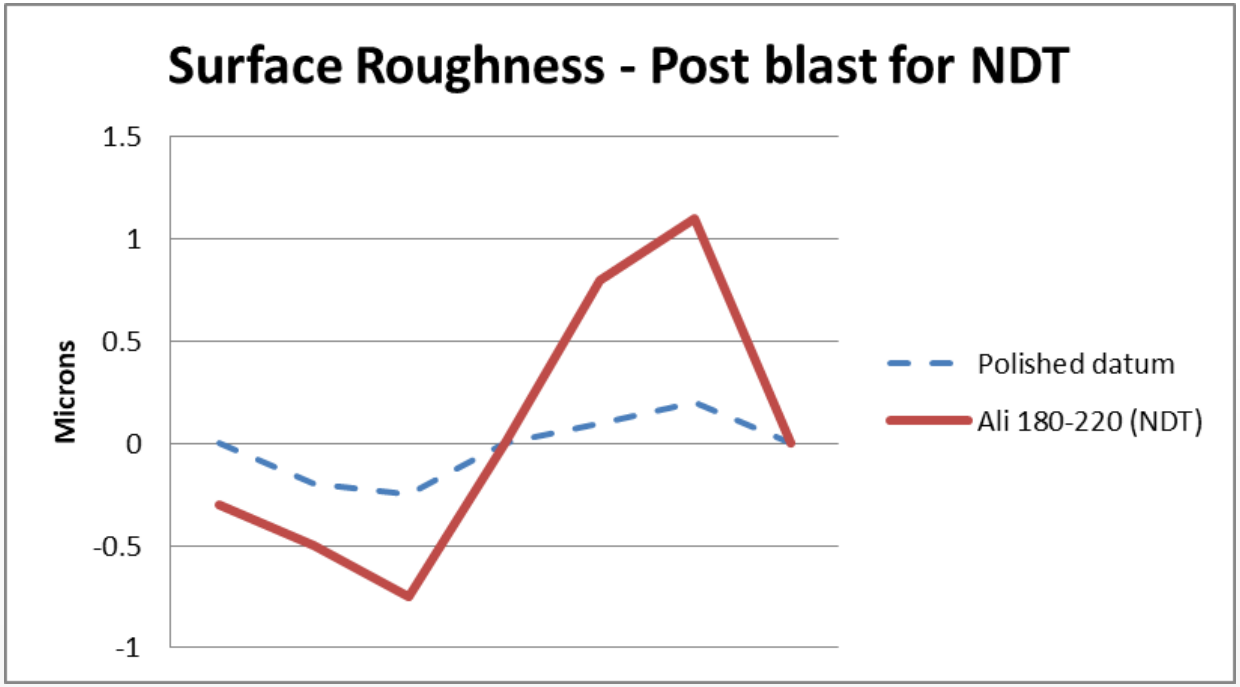
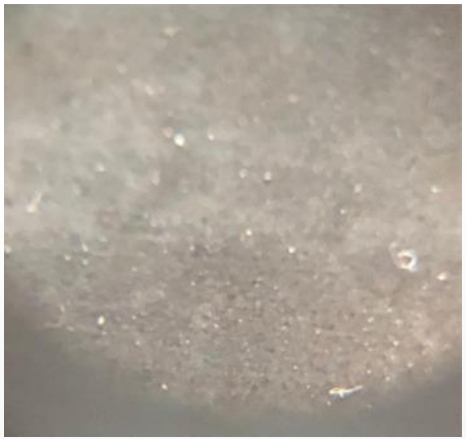
Surface Improvement Stage 1 – Blast Clean for NDT

- Medium - 180 – 220 Aluminium oxide
- Grain Size 53-90 microns
- Pressure – 20 to 60 psi
- Ra surface reading 1.163





*Graphical representation of a single peak/trough only

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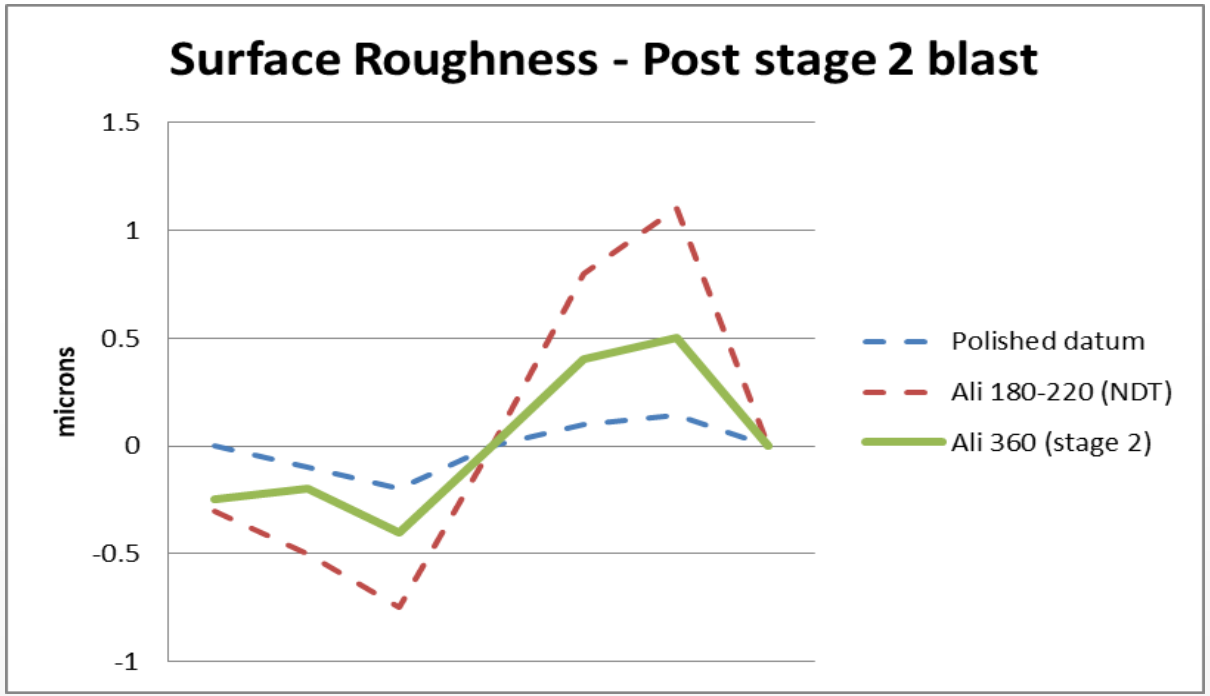
Surface Improvement Stage 2 – Surface improvement

- Medium - 320 - 360 Aluminium oxide
- Grain Size 22.8 microns
- Pressure – 20 to 60 psi
- Ra surface reading 0.463



*Graphical representation of a single peak/trough only

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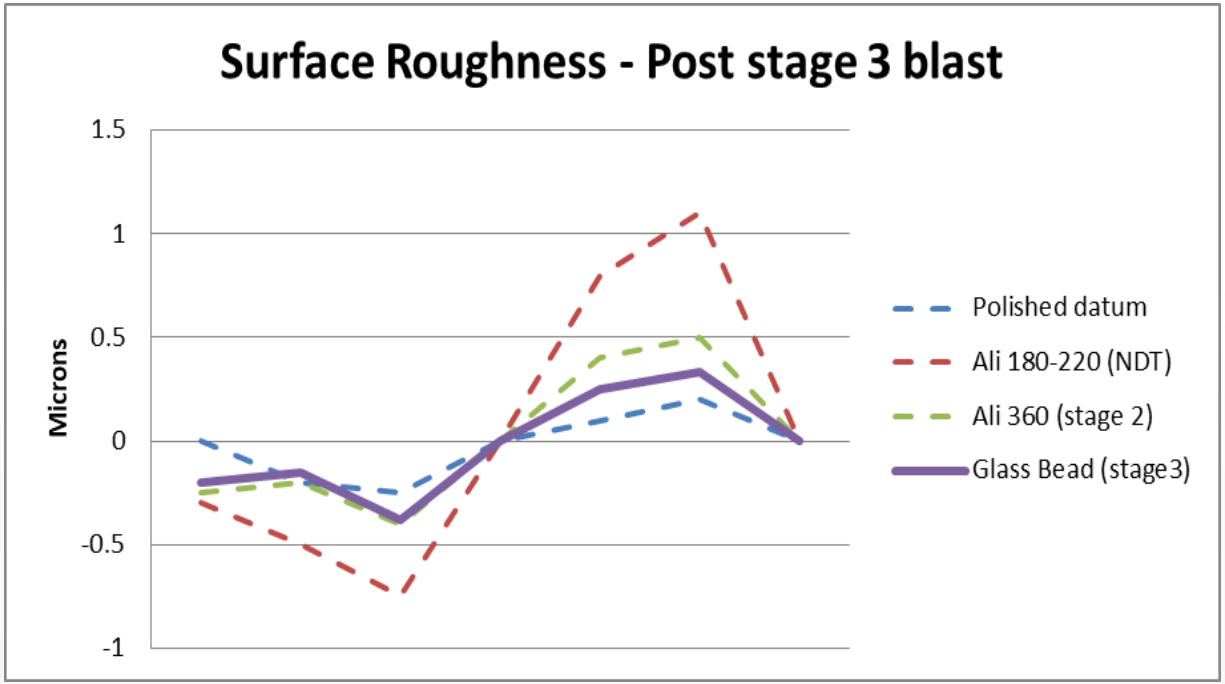
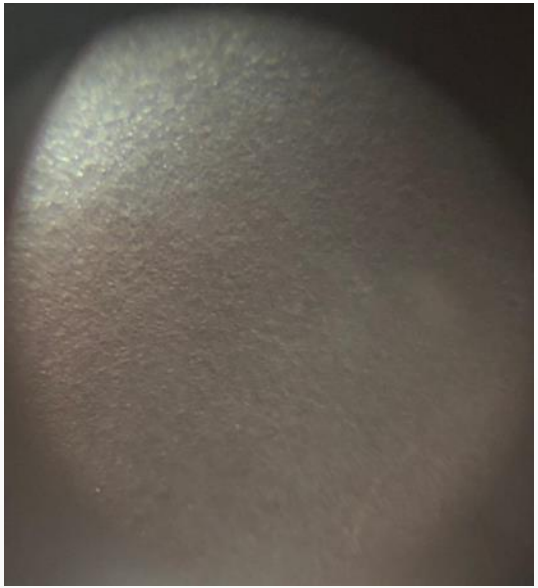
Surface Improvement Stage 3 – Surface improvement

- Medium - Glass Bead
- Grain Size 75-150 microns
- Pressure – 20 to 60 psi
- Ra surface reading 0.330





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Outcome

Drax

- Surface finished achieved – 0.350 to 0.550Ra across the HP module
- Improved efficiency 0.25% to 0.5% (overall 2% efficiency seen on module reseal)
- Reduction in efficiency derogation and drop off over the running campaign
- Reduced operating costs
- Improved surface condition and reduction of scale build-up on next outage

Drax Power Station – 9off HP modules completed to date

Other Operators Worldwide – 7off HP-IP & LP modules completed to date, with 2 more contracted for 2022/3