

# Automatic and Gentle Surface Finishing of Large Work Pieces

With an internal diameter of 1650 mm the new vibratory finishing system is one of the largest of this machine type. It fully automatically finishes the surface of components with a diameter of up to 1300 mm in one single operation, be it aircraft engine components, such as turbine disks, or forging dies.

Christoph Cruse

A major benefit of mass finishing is that it produces an all-around perfect finish for external as well as internal surface areas. However, until recently no mass finishing machines were available that allow the mechanical finishing of somewhat larger work pieces. With its new multivibrator, model MV 50, was able to close this gap.

## More gentle and precise finishing of jet engine components

Walther Trowal serves customers in a wide range of different industries all

over the world, for example, automotive, aerospace, medical engineering and wind power. One reason for Walther Trowal undertaking the development of the new MV 50 vibratory finishing system was the request of a customer to finish the surface of blisks ("blade integrated disks") for aircraft engines faster, more gently and with a higher precision. These components must have an excellent surface finish essential for optimal air flow conditions that determine the overall operational efficiency, fuel consumption and noise emission.

Because it creates extremely smooth surface finishes without rounding the edges of the blades, a customer who will receive the first MV 50 system, has been using mass finishing methods for treating blisks for some time. However, so far he had to use costly, partially manual finishing process with extremely long cycle times.

To achieve greater flexibility in the processing of components with different dimensions, the customer decided to process his range of blisks individually in a new vibratory system. He requested a fully automated and gentle solution that guarantees consistent, high-quality results.

For this reason Walther Trowal proposed the use of a MV multivibrator. For example, compared to tub vibrators MV machines generate a considerably higher pressure by the processing media on the work pieces without an unwanted excessive radiusing effect on the work piece edges. Tests have shown that the processing times for typical work pieces could be reduced from several hours to 90 minutes. The new finishing system is designed for fully automatic operation. The integrated loading crane and the magnetic clamping of the work pieces minimize the setup times. After a work piece has been mounted to the bottom of the processing bowl, no additional manual operations are necessary. This also ensures high consistency and stability of the finishing results.

Especially in the production of components for jet engines manual operations should be prevented at all costs because they are frequently the reason for poor and inconsistent finishing results. There-



The work piece is firmly attached to the bottom of the processing bowl. The media is automatically transferred from the lower storage hopper to the upper loading hopper.



Plastic grinding media produce low surface roughness readings on the special shapes of blisks and the materials they are made of.

fore, when developing the new vibratory finishing machine, Walther Trowal considered the entire process – even the automatic replenishment of the processing media into the processing bowl and the cleaning of the process water.

For finishing the surface of blisks Walther Trowal utilizes plastic processing media, type AF. On the typical materials used for making blisks this media type creates smooth surface finishes with very low surface roughness readings. Walther Trowal has now delivered the first MV 50 system to a customer in the aerospace industry.

### The finishing process

A work piece is externally mounted to a special fixture, then placed into the bottom of the processing bowl, where it is magnetically clamped. The bowl is then automatically filled with media and vibration is induced into the machine by vibratory motors mounted on the outer wall of the processing bowl. Since the work piece is firmly attached to the processing bowl, the motion of the media against the work piece is very intensive. But at the same time the overall process is rather gentle. This applies equally to

all external as well as internal surface areas, thus resulting in a homogeneous, all-around surface finish. After completion of the process the surface roughness readings amount to about 0.2 to 0.4  $\mu\text{m}$ . Since the overall vibratory amplitude is rather low, very little material is removed at the functional edges.

Upon completion of the finishing process the pneumatically activated unload plug in the process bowl is opened. This causes the media to be discharged from the processing bowl into a storage hopper. From there the media is passing over a bar screen for removing undersized media pieces and is then transferred to the conveyor belt.

Any residual media sticking to the finished work piece is rinsed off with process water by a pneumatic rinse nozzle that moves – guided by laser sensors – over the entire work piece. A camera system allows the operator to check that all residual media has been removed from the work piece.

As soon as the fixture holding the next work piece has been attached to the bottom of the processing bowl, the media from the loading hopper is returned to the machine. Since especially components for the aerospace industry must have absolutely stable, consistent surface finishes, the media batch in the hopper is automatically weighed, and if needed, additional media is automatically added. This is very important, because during the finishing process the media wears and becomes smaller. Over time this would result in a lower media level in the processing bowl causing the finishing qualities to deteriorate. The automatic media replenishment ensures that the process remains stable and consistent. Manual process adjustments are not necessary.

The process water is cleaned in a centrifuge and returned to the finishing machine in a closed loop system. //



The system works fully automatically. The operator must merely monitor the process.

### Author

**Christoph Cruse**, Sales Director  
Walther Trowal GmbH & Co. KG  
Haan (Germany)  
c.cruse@walther-trowal.de  
www.walther-trowal.de