

MASS FINISHING

How it works!

A guide to selecting the right processing machine

The mass finishing technology – also called “trowalizing” – is basically a copy of a natural phenomenon found in rivers. The moving water mixed with sand is grinding down ragged rocks, until they are smooth, perfectly rounded pebbles.

Today’s modern mass finishing systems are doing exactly the same thing: The right combination of processing machine, grinding and/or polishing media, water and compound allows creating perfect surface finishes and defined edge radiusing on practically any type of work piece.

Compared to manual finishing operations mechanical mass finishing methods produce not only absolutely consistent, repeatable finishing results but also help reduce the overall manufacturing costs for work pieces requiring special surface finishes. It is not surprising that mass finishing has established itself in many industries as a universally used mechanical-chemical technology for

- Deburring and edge radiusing,
- Surface smoothing and polishing,
- Cleaning, including degreasing and de-oiling
- Removal of mill scale and rust.

Mass finishing can be used for work pieces made from all kinds of metals and metal alloys, but also components made from rubber, plastic, wood and, even, ceramic.



Functional principle

In mass finishing systems a mix of untreated work pieces and grinding/polishing media placed into a processing bowl is put into motion causing the work pieces and media to constantly rub against each other. The media acts like thousands of little wire brushes on the work piece surface creating the desired finishing effect. The process is supported by the continuous addition of water and compound.

The motion in the processing bowl is generated in different ways:

- **Rotation:**
The entire processing bowl is rotating causing the mix of work pieces and media to gently slide over each other.
- **Vibration:**
Vibratory motors or special imbalance units generate a defined vibration in the processing bowl.
- **Drag finishing:**
The work pieces, mounted to a carousel, are “dragged” through a processing bowl filled with media. The media remains stationary.



Processing of spacer disks
in a tub vibrator

High value added – at low costs

In contrast to the manual finishing of single work pieces the mechanical “Trowalizing” technology generates highly homogeneous and absolutely repeatable, high-quality finishing results.

Since the work pieces are completely immersed in the media, all surface areas – even difficult-to-reach cavities like undercuts and drilled holes can be finished.

Moreover, the mechanical processing also ensures that absolutely all work pieces are treated....Not a single one is forgotten!

Compared to manual treatment methods mass finishing significantly reduces the time required to achieve the required surface finishes. For some applications like, for example, the deburring and surface smoothing of blisks for jet engines, the finishing times could be reduced from literally days to a few hours.

Once the work pieces have been placed into the processing bowl, the finishing process runs fully automatically – no operator intervention or process supervision is required.

Small to midsize components are mostly processed in bulk: Work pieces are loaded into the processing bowl as one complete batch or they are automatically transferred from a prior manufacturing stage – not a single part must be touched by hand.

In certain finishing systems somewhat larger and delicate high value components may have to be mounted to special fixtures in the processing bowl. But even in these cases the manual handling is limited to loading and unloading of the work pieces.

Initial overview

The “trowalizing” process offers numerous treatment options for a wide variety of different work pieces. Optimum, cost-effective surface finishes are achieved whenever the right combination of finishing machine, media and compound are perfectly adapted to the finishing task at hand.

Many selection criteria must be considered in the determination of the most suitable machine. The following parameters will provide a general guideline:



Racecar engine pistons before and after polishing



Processing aim

Mass finishing can create a wide range of different surface finishes ranging from intensive deburring all the way to high gloss polishing. The process results depend to a large extent on the machine intensity, the duration of the process and, above all, the type of grinding or polishing media.

While standard vibrators offer an average grinding performance, so-called “multi-vib” vibrators, centrifugal disk finishing machines and drag finishers generate a considerably higher metal removal rate.



Work piece size

Rotary and tub vibrators with their different work bowl dimensions are suitable for a wide spectrum of different sized work pieces – from dental drills up to large structural aircraft components.



Integration into the manufacturing process

In many mass finishing applications the work pieces are processed in batch mode, i.e. one complete batch of work pieces is loaded into the finishing machine. The loading can take place manually or fully automatic.

Whenever a mass finishing process must be integrated into a linked manufacturing system, continuous feed operation with single piece work flow is the preferred processing mode. It allows the continuous processing of large work piece volumes. Of course, sizing of the mass finishing machines must be such that they can cope with the production volume of the overall manufacturing system.

Other important aspects to be considered are, for example, shape and type of the processing media and the technical characteristics of the compounds.

For this reason Walther Trowal maintains a technical lab that allows running processing trials with the work pieces of potential and actual customers under actual manufacturing conditions. The lab is staffed with experienced process engineers who develop tailor-made finishing solutions for the customers.

Which machine type for which work pieces?

To cope with the numerous customer requirements Walther Trowal offers a comprehensive portfolio of different finishing machines. The distinguishing characteristic of the different machine types is the way the work piece/ media mass is put into motion ranging from simple rotation, vibration, centrifugal force up to drag finishing.

Machines with rotary work piece movement

Rotary barrels are used for the gentle finishing of very small parts like coin blanks, jewelry, small bearing components, etc. They are ideal for fine grinding, surface smoothing and polishing and can frequently be found in such diverse industries as optical and precision engineering.

Vibrators

Among the different machine types vibratory systems are the most common mass finishing machines. Especially rotary vibrators have been and still are the most popular machine type.

Rotary vibrators

Rotary vibrators are truly universal finishing machines. They are equally suitable for deburring, edge radiusing and high gloss polishing of small to midsize work pieces made from all kinds of materials. Their applications range from simple pre-grinding to generating pre-plate finishes. Rotary vibrators can be used as simple stand-alone units. But they can also be easily integrated into fully automatic manufacturing processes.

How they work:

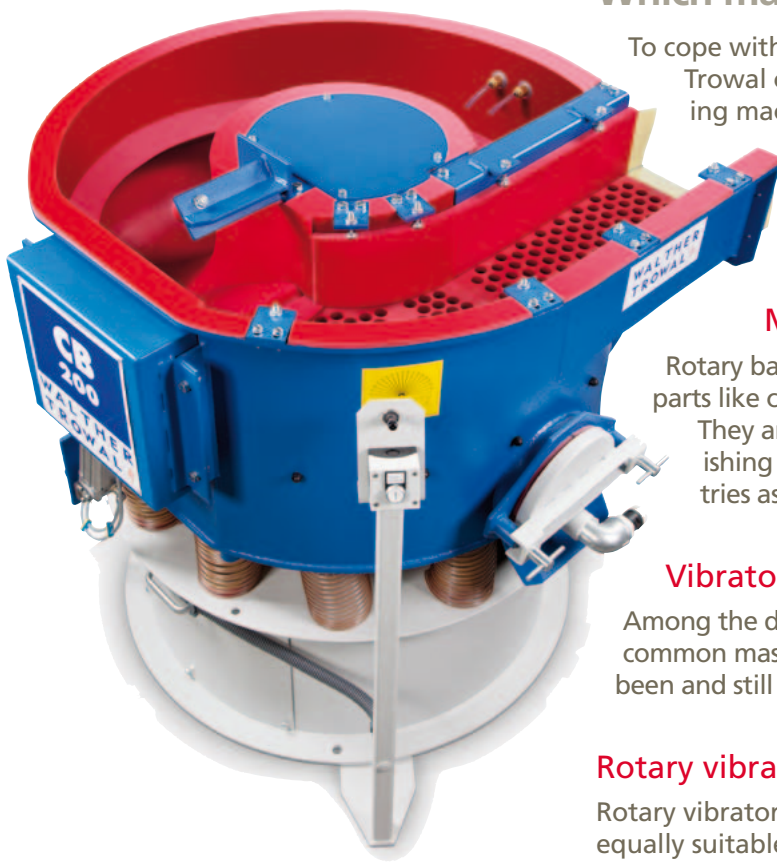
A vibratory motor mounted at the center of the processing bowl causes the latter to vibrate. The vibratory energy is transferred to the mix of work pieces and media causing it to move in a distinct manner through the processing bowl.

“Multivib” vibrators

How they work:

While in standard rotary vibrators the work pieces are freely floating within the processing media, in MV multivib vibrators the work pieces are electro-magnetically or mechanically attached to the bottom of the processing bowl. This transfers the vibratory energy – frequency and amplitude – of the processing bowl directly to the work pieces creating a significantly more intensive contact between the processing media and the work piece surface.

Multivib vibrators are equipped with several high-speed vibratory motors mounted to the outside wall of the processing bowl. The orientation and rotary direction of these motors is adjustable allowing extremely low amplitudes. This generates highly homogeneous surface finishes – be it smoothing or polishing – even on



Rotary vibrator, model range CB



Multivibrator, model range MV

difficult to reach surface areas. And it also ensures that the inner and outer contours on complex work pieces are maintained and delicate cross members on the parts are not broken.

Multivib vibrators are ideal for finishing internal work piece passages, for example, drilled holes, even holes crossing each other, with diameters as small as 4 mm, can be deburred.

Tub vibrators

The rectangular tub vibrators are mostly used for processing of single work pieces, which are too big for rotary vibrators.

They are also suitable for pressure deburring and ball burnishing with steel media.

How they work:

Depending on the machine size a single vibratory motor or multiple imbalance units driven by an electric motor are inducing vibration into the processing bowl. The work pieces are usually free-floating in the media. Delicate work pieces, which must not touch each other during the finishing process, can be processed in separate chambers created by divider plates in the processing bowl, or they are mounted to special work piece fixtures.

The finished work pieces are removed individually from the processing bowl, or the complete work piece/media mix is discharged to an external vibratory screening machine.

Linear continuous flow vibrators

Continuous flow vibrators, so-called AV machines, are usually utilized in fully linked, integrated manufacturing systems. The work pieces are individually passing through the machine at the frequency dictated by the preceding manufacturing stage, for example, one or multiple die-casting cells.

Due to the relatively large rectangular processing bowl these machines can handle large volumes of small to midsize work pieces like stampings and die-castings. But they are equally suitable for larger components like oil pans and cylinder head covers.

How they work:

The work pieces fed into the processing bowl at the narrow end of the rectangular tub are passing through the machine embedded into the media mass. At the tub exit they are passing through a vibratory screening station, where the media is separated and returned to the processing bowl with a special conveyor belt.

Centrifugal disk finishing machines

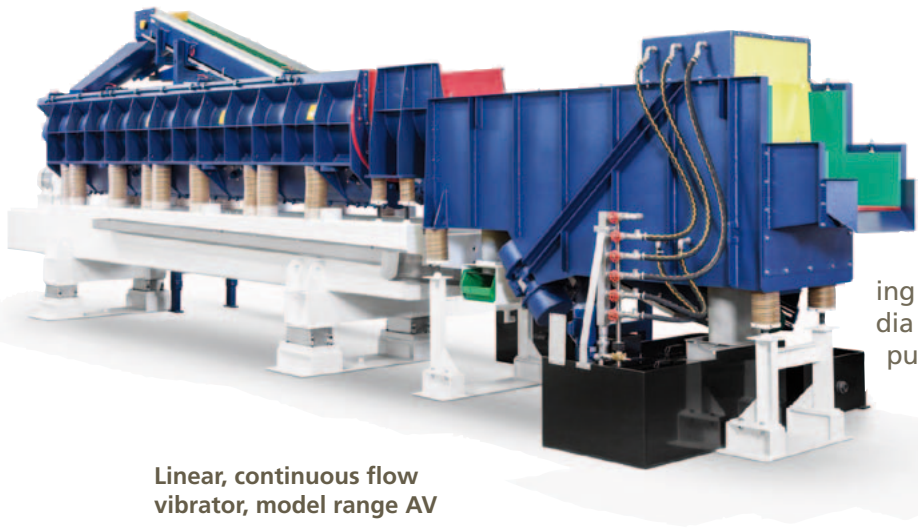
The high-performance Turbotron centrifugal disk finishing machines are utilized for work pieces not bigger than a human fist, which require a particularly high grinding performance. Typical applications are the deburring, edge radiusing and surface smoothing of small to midsize mass-produced parts. But with certain technical modifications these high-energy machines can also be used for polishing.



Work piece before and after deburring



Tub vibrator, model range TMV, for up to 5,000 mm long work pieces

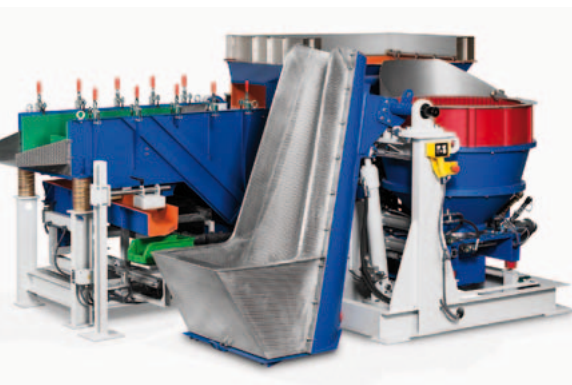


Linear, continuous flow vibrator, model range AV

How they work:

The bottom section of the cylindrical work bowl is equipped with a rotating spinner that accelerates the mix of media and work pieces. The centrifugal force pushes the media and work pieces up the wall of the stationary work bowl. Once the kinetic energy is exhausted the mix is sliding back to the spinner, where it is accelerated again. This process takes place with processing water and compound being constantly injected into the work bowl.

The motion created by the centrifugal force and the subsequent high pressure between media and work pieces produces a process intensity and grinding performance that, compared to rotary vibrators, is more than 10 times higher.



Centrifugal disk finishing machine, model range TT/A 2-C

Drag finishers

The drag finishing technology, developed and further refined by Walther Trowal, is the most intensive mass finishing method with a 4 to 40 times higher grinding performance compared to centrifugal disk, respectively, vibratory finishing.

Specifically developed for finishing of expensive components requiring a first-class surface finish, drag finishing is ideal for treating

- Delicate, high-value work pieces,
- Work pieces with complex shapes,
- Work pieces made from difficult-to-machine materials.

Typical examples are hip and knee implants requiring a high-gloss polish, turbine blades for jet engines, precision components for pumps and compressors or parts made from hard metals.

How they work:

At the heart of the M-TMD drag finishers is a carousel, which is equipped with rotating workstations. The work pieces are mounted individually to these workstations. Occasionally, the workstations may be equipped with multi spindle heads allowing the clamping of multiple work pieces to one single station.



Work piece before and after de-oiling/degreasing

For the actual finishing process the carousel is lowered into a circular work bowl filled with grinding or polishing media. Through the carousel rotation the work pieces attached to the workstations are "dragged" through the media bed. The simultaneous rotation of carousel and workstations creates an epicyclical movement – a small circular motion within a larger circle.

The high speed of up to 1.7 m/second, at which the work pieces are "dragged" through the stationary media bed creates a high pressure between media and work pieces resulting in particularly high metal removal rates.

Consumables (media and compounds)

Besides the finishing equipment Walther Trowal also produces the processing media and compounds at its plants in Haan and Stoke-on-Trent.

Grinding and polishing media

Next to the machine selection choosing the right processing media is key to the success of any mass finishing process.

Depending on the application the users can choose between plastic or ceramic media with different abrasive characteristics. High-density plastic media are closing the gap between the lighter weight plastic and heavier ceramic.

The processing media are available in different shapes and sizes to account for the practically infinite different work piece geometries. Small media are especially useful to treat tight internal work piece cavities.

The broad media range produced by Walther Trowal is ideally suited for practically any finishing application irrespective of the work piece size, shape and material. The program also includes steel media for pressure deburring and ball burnishing and glass beads for fine deburring.

Compounds

The compounds support the actual grinding and polishing process. At the same time they are used for cleaning and degreasing/ de-oiling of the work pieces and even provide a temporary corrosion protection for the finished parts.

The Walther Trowal product range consists of liquid compounds as well as grinding and polishing pastes.



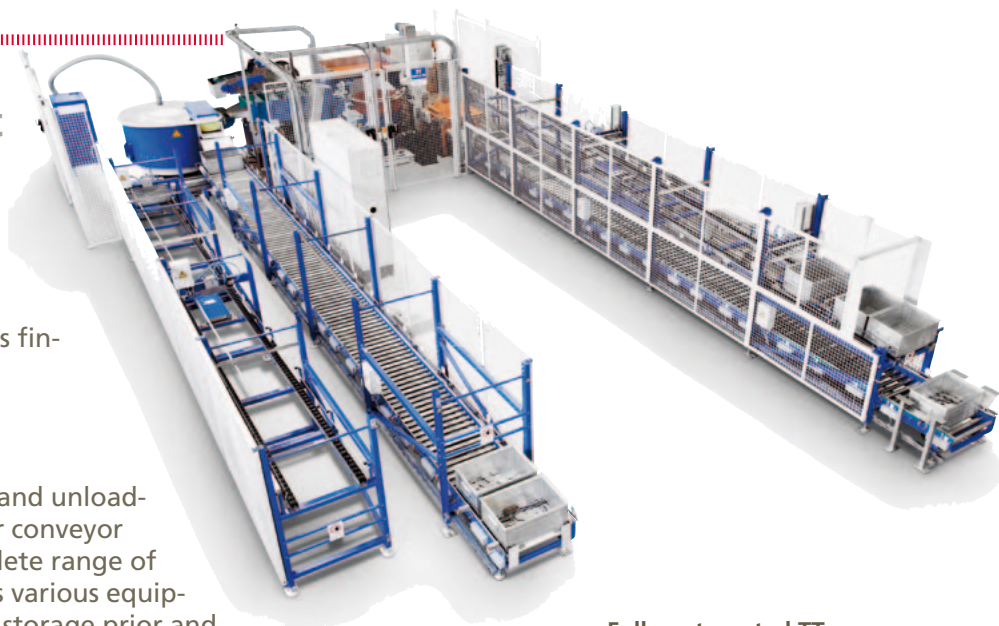
Drag finisher, model range M-TMD

Peripheral equipment

“Trowalizing” is never an isolated process but is always part of the overall manufacturing operation. That is why Walther Trowal offers a complete program of peripheral equipment around the actual mass finishing machinery.

Work piece handling

For work piece loading, transport and unloading Walther Trowal offers modular conveyor belts and roller conveyors, a complete range of lift & tip loading systems as well as various equipment for intermediate work piece storage prior and after the mass finishing operation.



Fully automated TT centrifugal disk finishing machine

Drying of the finished work pieces

Walther Trowal offers different systems for drying of the finished, still wet work pieces.

In vibratory driers (type G) a heated drying medium, usually consisting of ground corn cob, crushed walnut shells or small wooden cubes, absorbs the moisture from the wet work pieces. The medium has also a cleaning and light polishing effect and ensures that the work pieces are leaving the drier not only dry but also with a perfectly cleaned surface.

In the continuous hot air belt driers the wet work pieces are placed on a wire mesh belt before passing through a drying tunnel. During the drying process the work pieces never touch each other. Since the hot air is streaming through all work piece openings hot air belt driers are especially suitable for work pieces with complex internal passages.



Rotary vibratory work piece drier, model range G

Process water cleaning and recycling

The process water coming from a mass finishing machine is contaminated with fine metal particles from the work pieces and media fines, frequently also with oil and grease carried into the machine with the work pieces. For this reason, the process water must be cleaned, before it can be re-used in the mass finishing process or discharged to drain.

The cleaning centrifuges ZM and ZA remove practically all solid particles from the process water. Cleaning and recycling of the process water with centrifuges can reduce the water consumption by up to 98% and compound usage by up to 90%!

When the process water contains oil and grease, it must be cleaned in so-called flocculation systems. The result:

Clear water, free of contaminants and in compliance with legal requirements for going to drain.



Work piece before and after descaling



Centrifuge ZM for cleaning and recycling of the process water

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