FOCUS: Mass-Finishing Media and Compounds

Fundamentals of Mass Finishing

There are many facets to mass finishing one must consider: part size and shape, media type and equipment . . .

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A typical mass-finishing operation has many elements. And each one must be evaluated to determine what is best for your application as well as your wallet. Mass finishing can be used to clean, burnish or color parts. Each application requires different media and compounds. Also, part shape, size and fragility must be considered.

Cleaning. Oil and grease are removed from a part using a saponifying compound in combination with a non-abrasive media. Fast-cutting media and a detergent compound will cut through a layer of paint. A cutting or non-abrasive media in a chemically active compound removes heat treat, scale and rust from steel or oxides from copper and brass.

Cutting is best performed using a fast-cutting media to remove coated abrasive belting lines, mold irregularities, machining marks or discoloration from heat treating. Cutting produces a smooth matte finish that is free of surface abnormalities. The surface also displays low reflectivity.

Mass finishing regulates the degree of surface profile on a part. It is measured in terms of the average micro-inch distance from the surface's peaks to its valleys. The degree of surface texture is expressed as the root mean square (RMS) of these surface variations. A higher micro-finish translates into a rougher surface and, conversely, a lower number equates to a smoother surface.

Burnishing a part's surface involves smoothing the surface peaks into the valleys, producing a highly reflective finish. The operation uses non-abrasive sintered bauxite or metal media and a viscous lubricating compound. Media with abrasive content can be used if the compound is especially viscous.

Certain general concepts about burnishing include: 1) Dense media is preferred; 2) Smaller size media burnishes more effectively. 3) Media previously broken in and free of sharp edges or corners are required; 4) Burnishing cannot be achieved if a part's surface is ultra-smooth and devoid of surface peaks and valleys.

Coloring is another phase of finishing that shows the degree of light reflectivity or light distortion of a part's surface. The operation exposes the ultimate color potential, polish or brightness of a part's surface.

Deburring removes undesirable protrusions and sharp edges generated from previous manufacturing operations. There are three types of deburring operations.

1. Light deburring removes small brittle burrs produced by preliminary grinding operations or flash resulting from powdered metal moldings. Using a long-wearing media, these appendages are broken free from the part and the exposed edges are smoothed.

2. Heavy burr removal uses a fast-cutting media to remove large, thick burrs caused by sawing, milling, drilling or turning operations.

3. Radiusing rounds sharp edges or corners using cutting media ranging in composition from average to high.

Part analysis. In addition to addressing the work objective, proper media selection requires analysis of a part's hardness, ductility and configuration.

Hardness impacts heavily on the type of abrasive used. Aluminum oxide abrasive has sufficient hardness to cut metals, alloy metals and plastics. Silicon carbide is the choice for processing carbides and ceramics. Hard materials are more brittle, so long-wearing, light abrasive media is best for removing heavy burrs.

In radiusing hard materials, a small radius is produced quickly. Heavy radiuses are harder to generate. When ultra-smooth surface finishes are required on hard material, roughing must be performed initially in the soft state to ensure a minimum of cutting in the hardened state.

Hardened work pieces are much less likely to be damaged by impingement or contact with other parts or media, therefore, larger media is used.

Ductility. Ductile parts are more prone to burring during preliminary machining operations. Such burrs are difficult to remove and fast cutting media is needed to remove them. Also, such parts are subject to more damage during the mass finishing process from part-on-part impingement.

Part configuration. A part's shape can impede or restrict normal media contact during a mass finishing operation. One must consider recessed areas and odd-shaped parts when selecting media.

Major media selection considerations. Media needs to be shaped so that there is as much surface contact as possible between media and parts. This is critical where parts have hard-to-reach areas.

For a square part, the most productive media shape is a flat configuration. Cone-shaped, cylindrical or triangular media penetrates recesses in parts and does not lodge in them.

Cone-shaped media is the most versatile for work applications because it features a flat base, flaring body and narrow or pointed nose. Most media manufacturers provide this shape in four basic sizes: $^3/_8$ by $^1/_2$ inch; $^1/_2$ by $^5/_8$ inch; $^3/_4$ by $^7/_8$ inch; and 1-$^1/_8$ by $^1/_4$ inch.

Size selection. Media size impacts the degree of cut or finish. Large media removes more metal because of the increased force it imposes. However, damage may result from impingement and denting. Careful control helps avoid this.

Conversely, smaller media produces smoother finishes, resulting from the reduced cutting action.

Media composition is the most difficult finishing decision because of the variables involved. The choice of abrasive type and grade is based on the work objectives, such as burnishing, light deburring, general purpose, fast cutting. Popular media selections are as follows:

1. Aluminum oxide abrasive media. The ideal aluminum oxide mass finishing abrasive is dense and tough. Sintered bauxite has these attributes. Harder than steel, this ceramic media is used to color hardened steel, other ferrous metals, exotic metals, brass and aluminum. A pre-formed version enhances luster on stainless steel surfaces and exotic non-ferrous materials. The shape and closely controlled sizing also eliminate lodging in recessed areas.

Fused aluminum oxide abrasive is a dense, solid structure with fine crystal size and carefully controlled chemistry.

Pre-formed aluminum oxide media is a random-shaped, free and fast-cutting media provided in graded sizes for applications from burr removal to final surface finishing.

2. Silicone carbide. Unlike aluminum oxide, silicon carbide does not impregnate soft ductile metals. Therefore, this media is best for parts that will be welded or braised, for bearing surfaces and parts that will be machined after deburring. It is more friable than aluminum oxide and fractures more readily in contact with work pieces under heavy loads. Diamond, cubic boron nitride and boron carbide are the only media abrasives harder and sharper than silicon carbide.

Silicone carbide is especially effective with non-ferrous metals such as brass, copper and aluminum. It is preferred for finishing hard, brittle parts like cemented carbides, ceramics, granite, marble, glass, cast iron and low-tensile-strength, ductile nonferrous materials.

3. Ceramic media. Ceramic compositions are virtually all abrasive, hard and produce higher abrasive results than equivalent resin-bonded media. The combination of an ultra-tough surface area and rigidity exposes a constant abrading surface and an aggressive cutting action.

Available in a number of compositions, ceramic media can be used in a variety of delicate or aggressive applications, including burnishing, radiusing, polishing, rapid cut down, deflashing and deburring.

4. Resin-bonded media produces softer surface finishing action and provides a uniform finish. The media is best for parts requiring more restricted edge and corner radiusing. Resin-bonded media is manufactured in lower densities than ceramic media. The media smooths parts but does not impart a high luster.

Post-finishing operations. Post-finishing processes often determine the type of media used. If the part will be plated, a smooth surface is mandatory. If aluminum oxide abrasive is used, a fine grit is needed to avoid subsequent dull plating.

For parts destined for welding, brazing or soldering, silicon carbide is required. Parts undergoing painting are processed with fast-cutting media to develop the rough, matte finish required for adhesion.

The role of compounds in mass finishing is to keep parts and media clean. The chemical compounds remove solids and grease and lubricate the media. They also reduce loading and glazing and contribute to uniform finishing.

Some compounds are used in two-stage processes. Stage one fosters the rate of cut initially and the second stage enhances luster. An abrasive compound is applied in the first operation for maximum metal or burr removal. Following a careful cleaning operation, a burnishing compound is used that lubricates the media and parts and promotes coloring.

Compounds also reduce corrosion, effectively protecting parts during the entire manufacturing operation. Chemically active compounds remove rust and scale from parts.

In burnishing operations, non-abrasive media immersed in a viscous compound works well. Abrasive media is acceptable in company with more viscous compounds. Water is used less with metal parts because of rusting. Caustic compounds are used with steel parts without concern for rust. Caustics, however, will attack aluminum.

Steel and iron can be run with compounds above pH 7. Brass copper and stainless clean well in slightly acidic compounds. Since aluminum parts require a neutral compound, detergents are used because they do not attack metal.

With the availability of many machine designs, along with improved media, descaling can be accomplished by mechanical action alone, free from compounds.

Parts processing equipment. The extensive availability of mass-finishing equipment provides for a broad selection of machine types, sizes, production capacities and processing techniques. Choices of mass-finishing equipment run the gamut from basic rotating and vibratory units to automated designs producing high-energy output.

Machines can be divided into five major categories: 1) Barrel tumblers; 2) Vibratory finishers; 3) Centrifugal finishers; 4) Centrifugal disc finishers; and 5) Spindle machines. The size and operating intensity are major considerations when selecting media.

Tumbling barrels use media with more abrasive content and less strength. High-intensity machines, such as centrifugal types use media with less abrasive but require material with high-impact strength. Vibratory finishers range in the center in intensity between tumbling and centrifugal. Radial bowls are regarded as the most gentle vibratory type. Circular vibratory bowls are popular where frequent media changes are not required. **PF**

Captions:

1.

PRECISION PARTS mass finished to achieve a specific surface integrity.

2.

LIGHTWEIGHT ceramic media remove oxidation and discoloration from heat-treated titanium jet engine blades.

3.

MACHINE LINES are removed form one-inch-round threaded brass rings

4.

THIN, LIGHTWEIGHT die-cast eye glass frames are deburred in a combination of triangular- and cylindrical-shaped ceramic media.

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