Classification System for Deburring Systems

Introduction

Although surface finishing is in the title of this organization's name, rarely is any time or space devoted to mechanical abrasive processes. For that matter, no other organization devotes much time or effort to discuss this topic either. Unfortunately, there is no good central organization or discussion group with which to create uniform standards or practices. Mechanical finishing technology is somewhat of a small niche or orphan industry and relies almost solely on the practices of each company in that related abrasives industry. Some common practices or standard guidelines are self explanatory and don't need a lot of clarification; however, there are enough discrepancies or problems to warrant some form of common standard practices. In short, considering the wording of surface finishing in your organizations title, I've elected you as the best source for discussing these problems. So here it goes.

Your organization deals with protective coatings or surface modifications. In order for you to achieve good results you have established some common practices which have resulted in proven processes that hold up to certain environmental conditions. For you to achieve good results, you need to start out with good acceptable materials. That's where mechanical processes come in. Even though both technologies deal with surface finishing, they do so differently. Why? Because the medium and energy forces that are used are different.

Most technologies use energy and molecules of different density, characteristics, and behavior to effect the surface of yet another density of material. One relates to the other and both effect the over all surface finish of the part(s). In mechanic finishing, surface modifications have a greater effect on a part than liquid chemical processes. That is, mechanical processes remove more material in a shorter period of time and actually modify the surface features of the part. Most plating systems clean and protect a part by applying some kind of coating. It does not normally remove material. With those basics down, we can pursue the fundamentals of mechanical finishing.

So, where do we go from here? There are 3 main options for parts finishing. The finish depends mostly upon how the part is to be used, or in what environment it will be working in. These options are as follows: 1. Surface preparation for a heavy or thick coating, such as paint or a plastic based film product. 2. Surface preparation for a thin film chemical coating or treatment. 3.Aestethic appearances or a polished finish. I most case design engineers will specify surface finishing requirements based upon this criteria.

Once the surface finish requirement is determined, the method to achieve that surface preparation needs to be selected. In mechanical finishing, there are 3 main options for surface finishing. These options are primarily determined by how the part is to be used and relates to the surface finish desired. Most engineers will usually specify what surface requirements are needed based upon the environment the part will be used in. What determines what equipment to use is largely determined by what equipment already exists in house. However, just as there are surface finishing options, so too are there equipment or processing options. If we include a manual hand operation to the equipment or processing options I have come up with 6 classifications of equipment or methods for surface finishing.

Surface Finishing Options

Type 1 **Surface preparation for heavy thickness coatings.**

A. Surface finish will be the roughest of all the options and the finished part will exceed the parts final dimensions because of the coating.

B. Surface finish should be as rough as possible to increase the surface area for good adhesion properties and/or wear characteristics or longevity of the coating. RMS 35 or higher.

C. Roughness of surface should not exceed in height the profile of the thickness of the film or coating to be placed on part.

D. Surface should be as clean as possible from debris, oils, and oxidation. Therefore, cleaning should be done immediately before coating, but part(s) should be dry.

Type 2 **Surface preparation for thin film coatings.**

A. Surface finish normally requires a secondary modification and that will be the final dimensions of part, but it can be on the plus side depending on the film or coating.

B. Surface finish requires a smoothing or modification of the part to improve uniformity of the surface profile of the finalized processed part. Normal RMS range is 12 to 20.

C. Roughness profile is not as critical for most chemical treatments; however, the smoother the surface, the more uniform the treatment. See Type 1, C & D above for non-chemical coatings.

Type 3 **Polished finishes.**

A. Surface finish will be the smoothest of all the options and close to the final dimension of the part, but on the minus side. If a thin film coating is still required, dimensions may exceed final part size.

B. This process is not considered surface preparation, but a modification procedure or material removal process. The finalized part will either have a textured pattern or mirror finish in the RMS range of 2 to 18.

C. Surface finish is mostly for appearance sake or a question of porosity; however, coatings can still be applied for protective reasons.

Equipment Classification

Type 0 This system is for manual hand working of parts only. Energy is directed downward in a back and forward or circular pattern with an abrasive medium. The greater the force downward, the greater the abrasion.

Type 1 This system is used on relatively flat materials where the energy forces are directed down and parallel to the material being worked, via a wheel, disc, or belt. The results of action create a horizontal wiping action and the smoothing of surface features.

Type 2 This system is used primarily for surface preparation for heavy thickness coatings. This uses the abrasive blast method where the energy force is transmitted to a solid particle which is directed perpendicular or downward at a slight angle to the work piece. The results of the action are a rough textured surface finish.

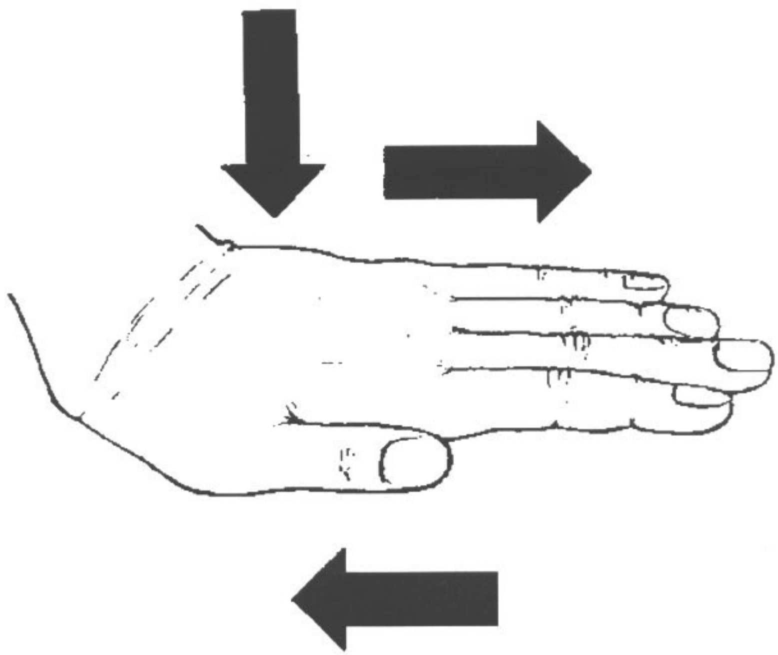
Type 3 This system is used in mass finishing type equipment. This uses abrasive particles or preform shapes in a random combination or mixed energy forces or patterns that occur in all directions relative to the part. The results produced are modified blended surfaces and uniformly worked parts.

Type 4 This system is used in the plating industry. This is primarily an electrical current directed through a liquid medium type energy force system. The results produced are both surface and sub surface molecular changes to parts.

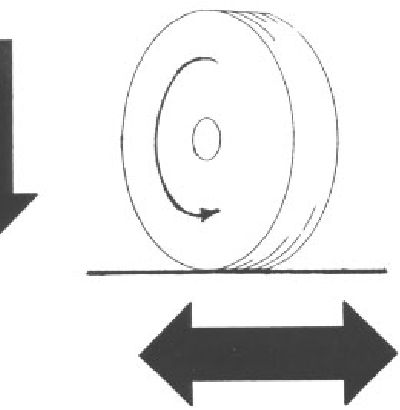
Type 5 This system is an air based, high temperature heat method. This is a very selective material removal system that works primarily on surface irregularities or burrs. The results of this process vaporize and melt thin surface protrusions.

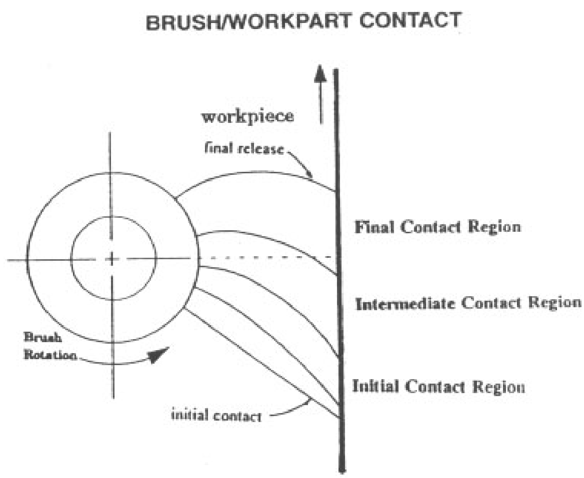
TYPE 0 System

This system is self explanatory. In the hand working of parts, energy is transferred from the hand onto a tool or medium and force or pressure is directed at the object that requires material removal or modification. In some cases, the object can be applied to the tool in a reverse mode of operation. The greater the force downward, or pressure, the greater the abrasion or material removal.



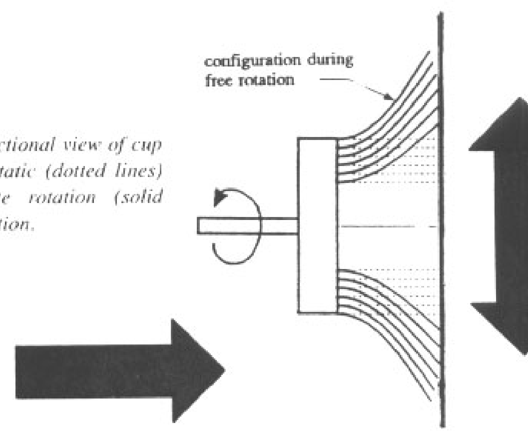
This system is used on relatively flat or simple uniform part configurations. Like Type 0 systems, energy is transferred from the hand, in most cases, through the tool to turn a wheel device, disc, or belt. The turning of the wheel, disc, or belt creates multiple over lapping patterns of abrasion or polishing. The speed of material removal is accomplished or largely due to the amount of pressure exerted downward on the tool or part. However, the amount of resistance encounter between tool and part, is also influenced by the rigidity of the abrasive and transfer medium device.





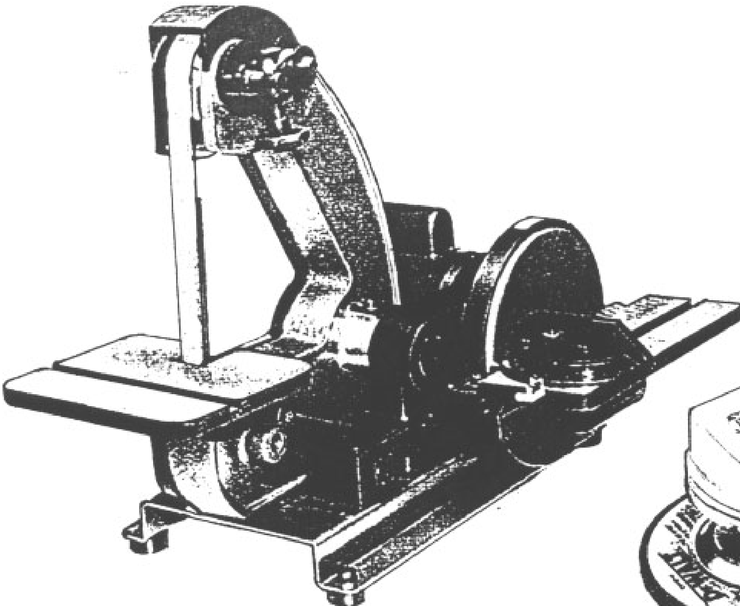
Geometry and force system of circular brush in contact with flat workpart surface.

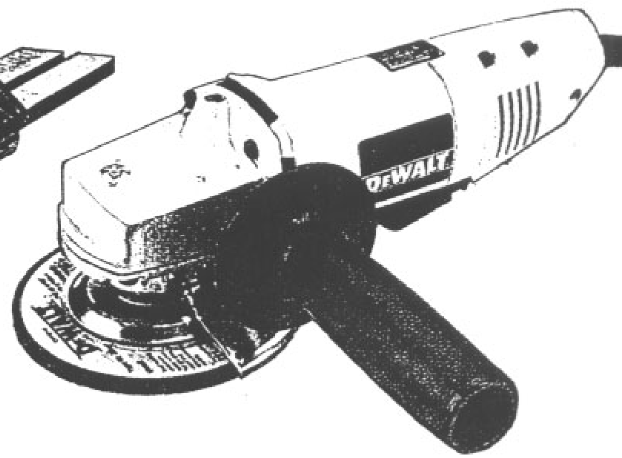
Cross-sectional view of cup brush in both static (dotted lines) and steady-state rotation (solid lines) configuration.

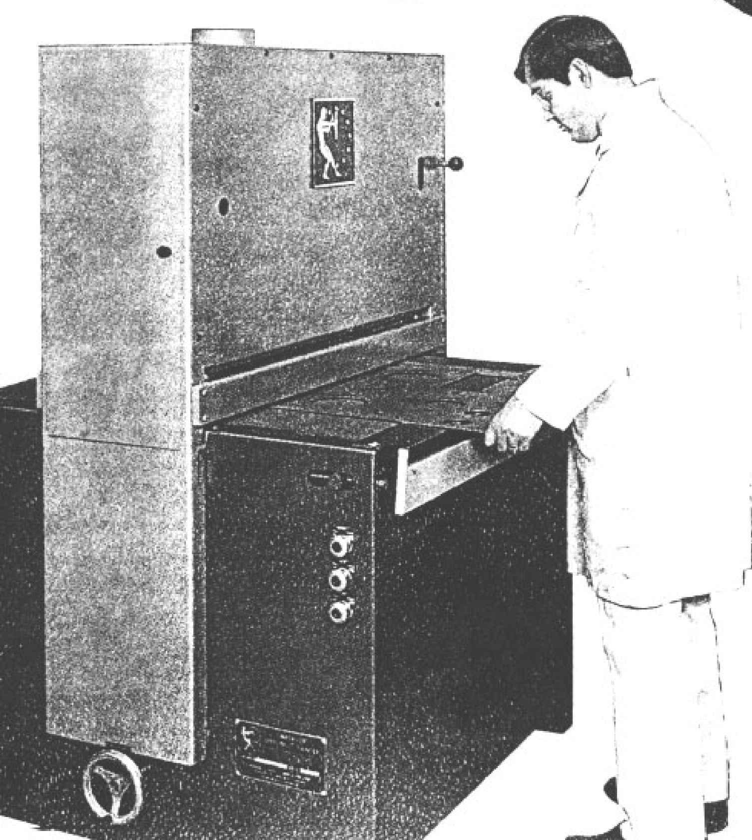


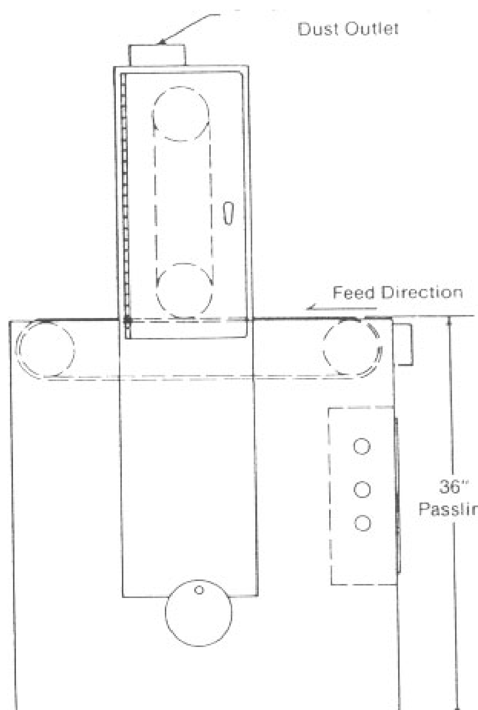
Wheel or brush systems under pressure and on contact with parts deform slightly. However, these flexible systems are better for more contour or detail type parts.

remove more material in a **shorter period of time. Rigid systems are normally better for flat part configurations.**





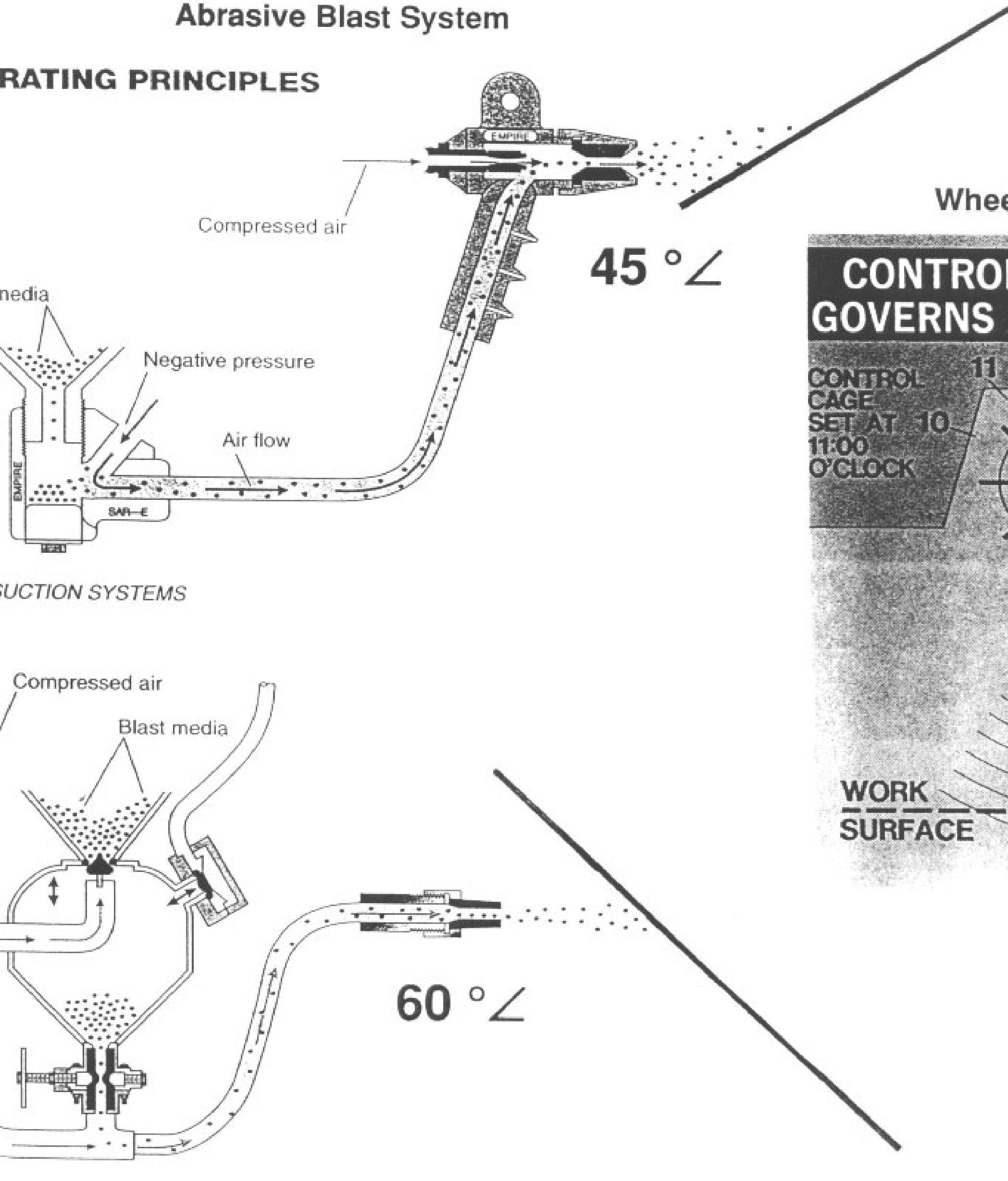




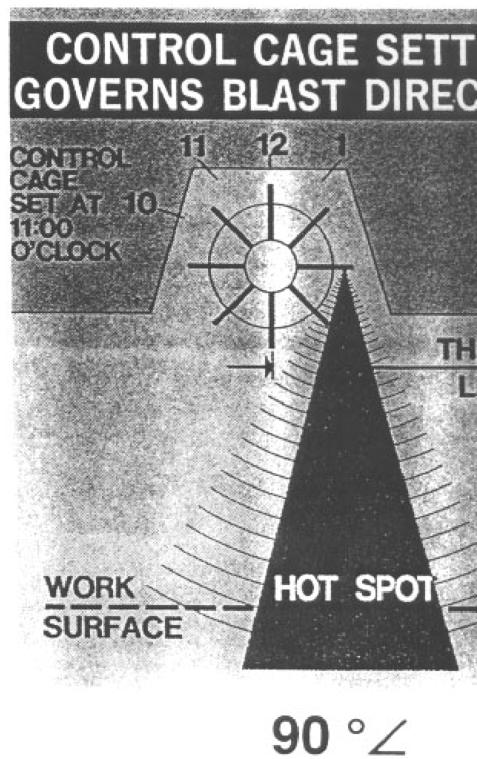
TYPE 2 Systems

This system is used for surface preparation or cleaning. That is, material removal is accomplished by a linear material flow over the part to be worked. This is primarily a mechanical abrasive process that uses relatively uniform particles of matter which are energized via a pressure source which is then transmitted to the part in a blast type operation. Smooth uniform surfaces are best accomplished at an angle of 45 to 60 degrees to the part's surface; whereas, the greatest amount of force or material removal is at 90 degrees. Abrasion is a factor of energy and resistance of the particle in relationship to the part.

Abrasive Blast System



Wheel Blast System



This system is used for deburring and surface modification on most machined or high volume parts; therefore, it is often referred to as mass finishing systems. Unlike previous methods where parts or the tool is fixed, this system uses mostly preform uniform abrasive shapes and parts in a free floating mix within a work chamber container. This equipment system energizes or transmit energy to the mix to create a continuous X, Y, and Z axis motion. The speed and finish of material removal depends on the size, shape, and composition of the abrasive preform as well as the method of energy transfer .

Barrel System
Approx. RPM 27±
Produces 1 G's
Average time 2-4 hours

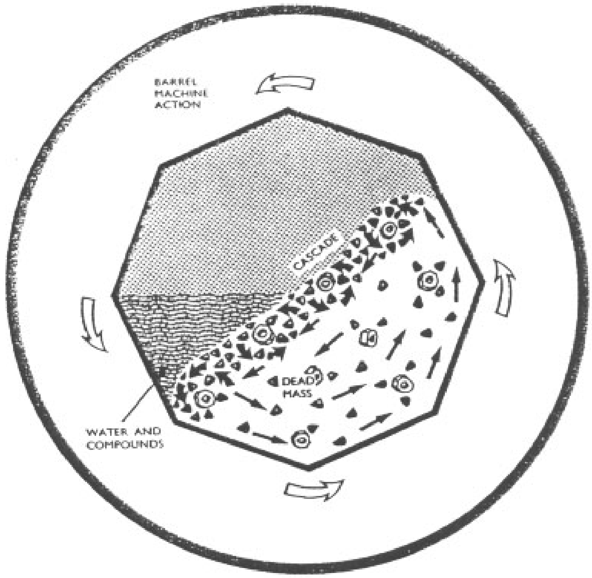
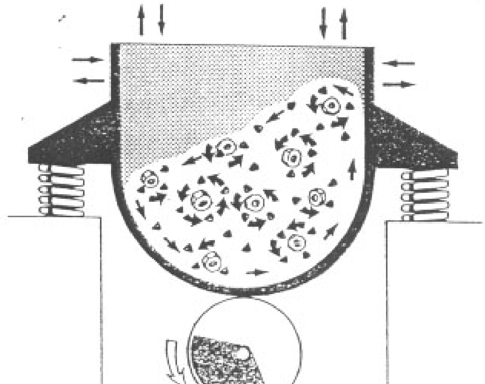
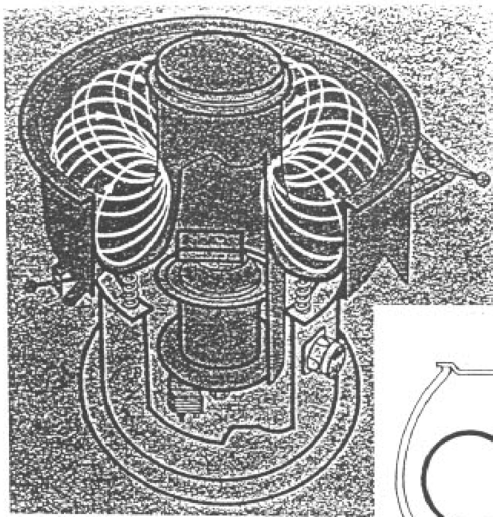


Diagram of barrelling action

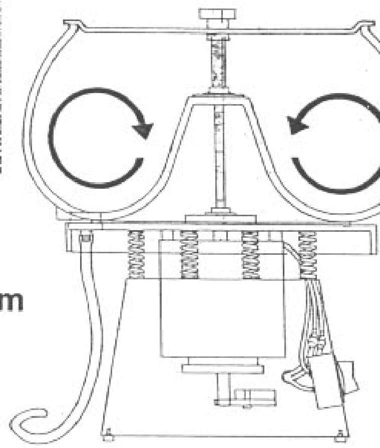
Vibratory System
RPM 1400-1800
Produces 8 G's
Average time 10-60 minutes



Vibratory Tub System

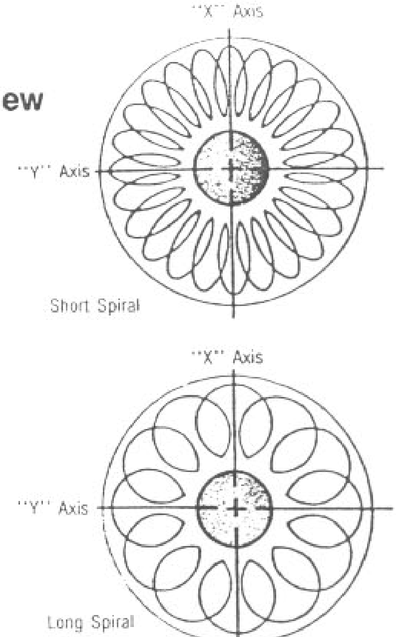


Vibratory Bowl System



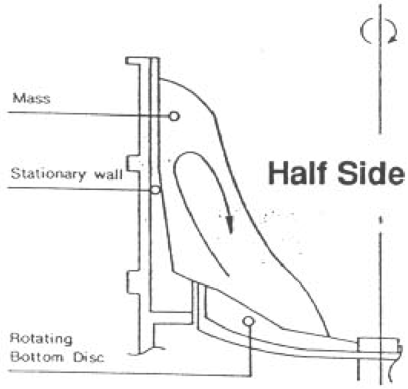
Side View

Top View

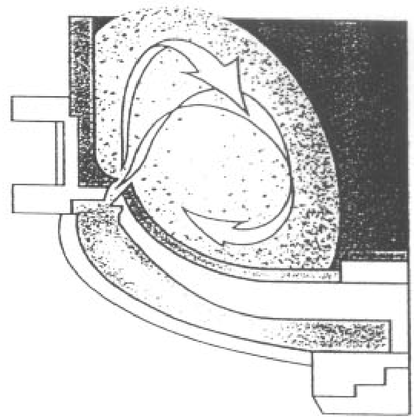


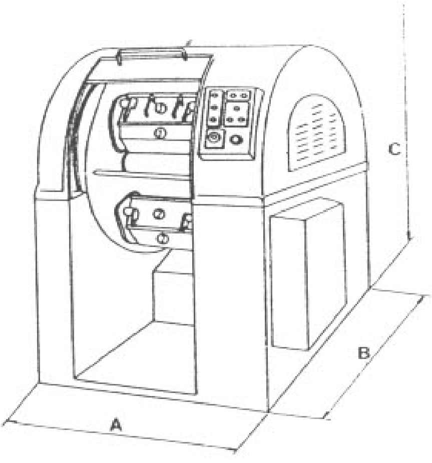
2-A. CHANGING the relationship of one flywheel to another extends or closes the spiral.

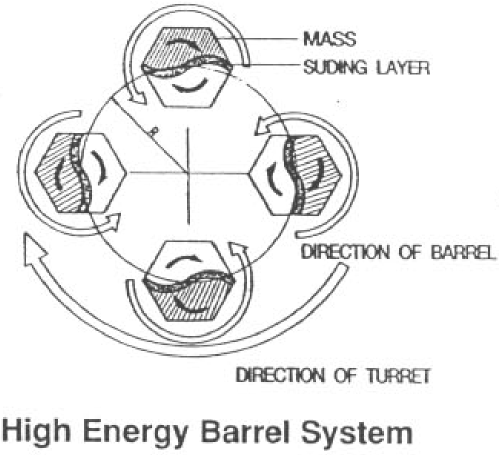
High Energy Disc Systems
RPM 80-250 @ 800-1200feet/min.
Produces 12-15 G's
Average time 10-20 min.



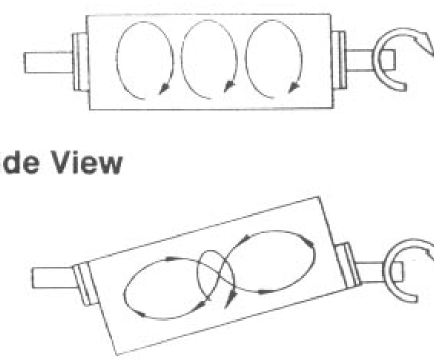
Half Side View







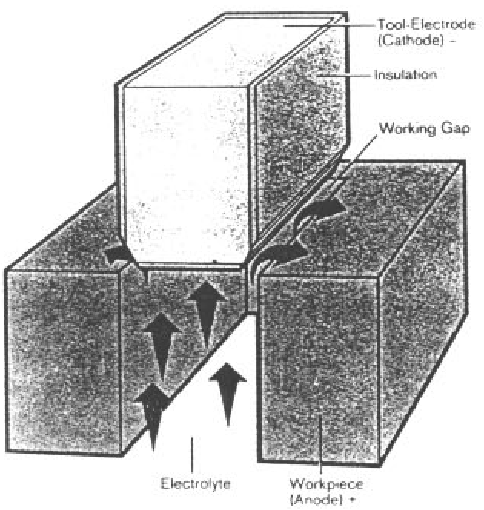
Side View

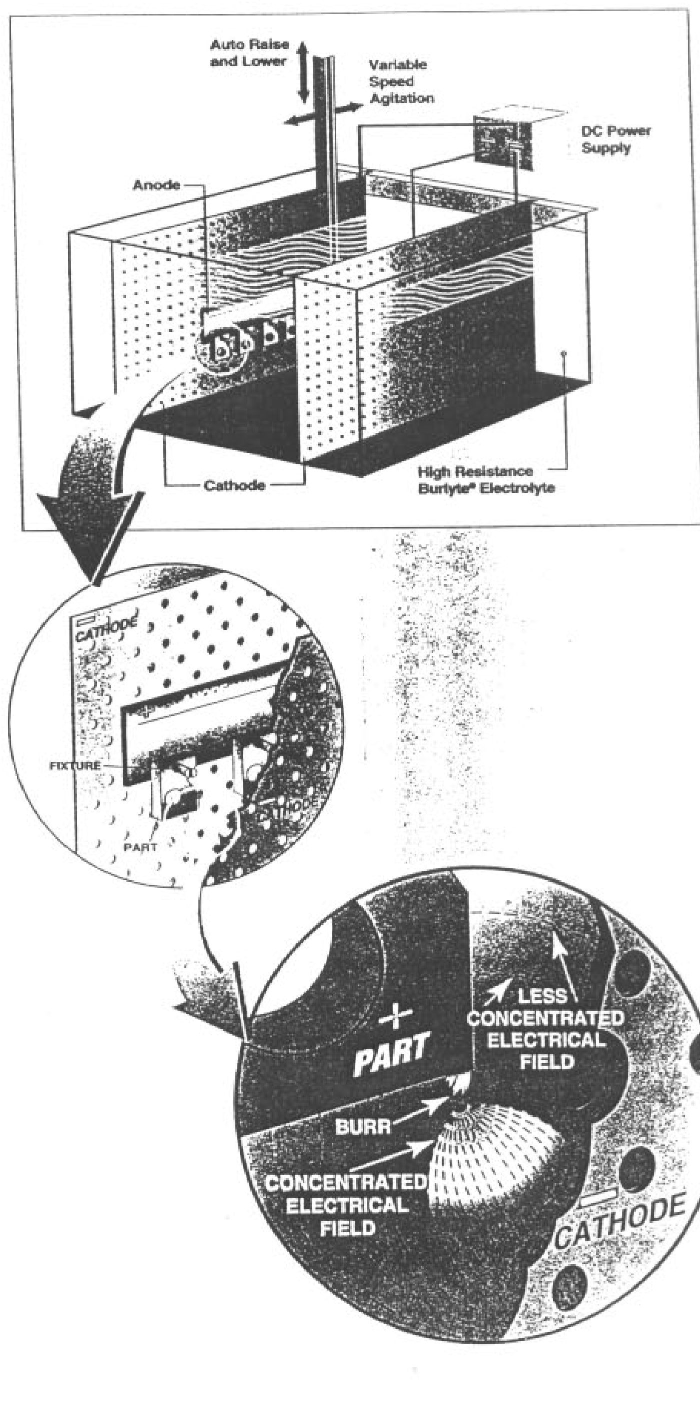


High Energy Barrel System
RPM 250 & 60
Produces 20- 30 G's
Average time 10-15 min.

TYPE 4 Sytems

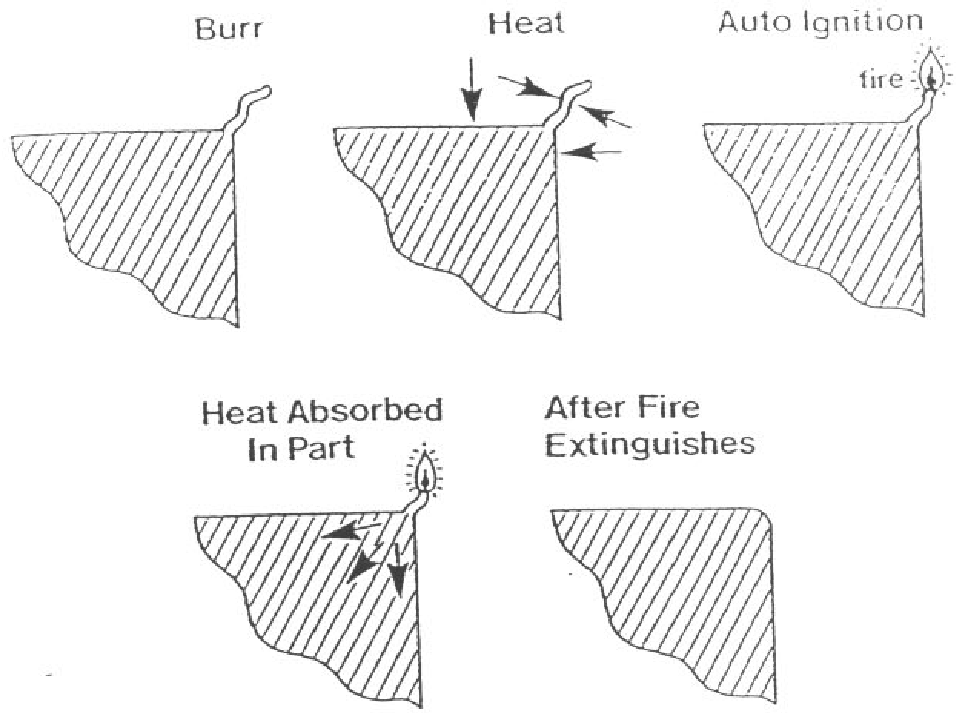
This system is used to do minor amounts of material removal as well as surface modification. This is not a true mechanical method like Type 0, 1, 2, and 3 systems. Rather, this process uses a chemically enhanced liquid in an electrically charged tank. Parts are immersed into a bath and electrical energy or a charge acts as a catalyst to precipitate or alter the atomic molecular structure of the material being processed. The speed of removal is regulated primarily by the amount of electrical current.





TYPE 5 Systems

This system is an very fast effective method of selective material removal on relatively thin uniform burrs. It will not do surface modification finishing work. This equipment system is designed to produce an extremely high temperature or millisecond controlled explosion which vaporizes thin material burrs.



Burr on workpiece before, during ignition, and after oxidizing

As stated, the classification system is based upon how the energy forces are applied to the media processing the part. Even though we are showing a single digit number or type of equipment based upon a single digit, there are other considerations to our classification system. Therefore the single digit will represent the number 100, or a type 1 system now becomes 100. Besides the classification of equipment by energy forces used, it is also necessary to classify the aggressiveness of the material removal methods used by this equipment; therefore, it is also necessary to classify the burr or the amount of material removal and where that burr is located. That means that the 00 or 2nd and 3rd digits will represent these parameters respectively. They are as follows:

Burr Classification

Class 0	Burrs or material irregularities do not exist, but surface modification is required.
Class 1	Burrs are sharp edges which can cut one's finger or cut wire or tubing over a period of time and/or vibration.
Class 2	Burrs are thin irregularities which can be removed from part with one's fingernail. Material thickness approx. 0 to .010.

DEBURRING EQUIPMENT CLASSIFICATION CHART

System	Range	Option
Wheel and Belt Systems	100 - 141	3 - 2 - 1
Abrasive Blasting	200 - 213	1 – 2
Cryogenic Blasting	5200 - 5213	2
Wheel Blasting	200 - 241	1
Wet Blasting	4200 - 4213	2
Water Jet	4200 - 4231	2
Ultrasonic	4200 - 4211	2 – 3
Abrasive Extrusion	4200 – 4213	2 – 3
Thermal	500 - 533	2
Chemical	400 - 433	2 – 3 – 1
Mass Finishing Systems	300 – 341	2 – 3 – 1
Spindle/Drag Finishing	300 – 341	3 – 2 – 1
Turbo-Abrasive	300 – 341	2 – 3 – 1
Orbital/Sonic Beam	300 - 323	2
Orbital	300 – 331	3 – 2
Magnetic	300 – 321	3

Part size is a very important factor for also determining equipment and processes, not only for determining production rates, but also for controlling accountability of parts. Why I mention this factor is because almost every material removal system classified so far has an alternative smaller system. One size does not fit all. Finishing equipment is built to reflect different size parts and volume; therefore, machine selection is normally determined by a range or mix of part sizes. Generally speaking, there are 4 sizes or ranges of parts in most processing systems that we can classify and relate to our equipment classification system..

Classification of Part Size

Letter	Measurement	Description
A	1/2" or smaller parts	Can't be seen in closed hand
B	1/2" up to 12" lgth.	Can be held in one hand
C	weight	Need 2 hands and under 2 lbs.
D	weight	Need material handling assistance

EQUIPMENT CLASSIFICATION BY PART SIZE

System	A	B	C	D
Wheel & Belt	S	VG	G	
Abrasive Blasting	S	VG	G	G
Cryogenic Blasting	G	G	P	
Wheel Blasting		S	VG	VG
Wet Blasting	S	VG	S	
Water Jet	S	G	G	
Ultrasonic	S	G		
Abrasive Extrusion	S	G	G	S
Thermal	G	G	S	
Chemical	G	G	S	
Mass Finishing	VG	VG	G	G
Spindle		G	G	
Turbo-Abrasive		G	S	
Orbital Beam		G	VG	S
Orbital	VG	G	S	
Magnetic	VG	S		

Explanation of letter symbols in graph

VG Very Good
G Good
S Some
P Poor

Left Blank not recommended for application