ABRASIVE TECHNICAL INFORMATION

ABRASIVE FINISHING

Abrasive finishing combines a harder than workpiece abrasive mineral combined with a bonded or coated product that is rubbed or moved with pressure across the workpiece surface. Abrasive finishing can produce a visual or mechanical finish on metals, composites, stone, glass or wood products.

The abrasive finishing processes can be achieved by hand, portable equipment, manual or automated machinery. Processes include grinding, polishing, buffing, lapping and honing.

Surface affects from the abrasive finishing process

VISUAL	MECHANICAL
Soft brushed	Deburring
Grained	Surface refinement
Swirled lines	Surface preparation
Non directional random scratch	Radiusing
Statin	Peening
Bright reflective(buffed)	

Factors that affect Abrasive finishing

1. Abrasive minerals type, size, shape ad hardness
2. Bonding types
3. Cutting speed
4. Machinery

ABRASIVE TECHNICAL INFORMATION

1. Mineral Type (most commonly used)

ALUMINUM OXIDE (AL_2O_3) is a man made heat treated fused alumina bauxite produced in electric-arc furnaces at temperatures exceeding 4,000 degrees Fahrenheit. After heating and then cooling, the mineral is crushed and sized and is available in grit sizes from 6 to 1200 and finer. Aluminum oxide (A/O) has a blocky structure that when fractured maintains a sharp edged blocky shape. A/O's hardness is 9 on the Mohs scale. A/O is one of the widest used abrasive mineral because of its toughness and durability. It's used to finish metals, composites, and wood.

SILICON CARBIDE (SIC) or carborundom is a naturally occurring but mainly man made abrasive produced by heating or fusing silicon and carbon in vast outdoor facilities. Silicon carbide (S/C) has a sharp slivery shape and is more friable than aluminum oxide. S/C hardness is 9.5 on the Mohs scale. S/C is widely used for finishing hard metal, glass and ceramic surfaces.

CERAMIC ABRASIVES is a man made non metallic crystalline structure produced by heating and cooling ceramic matrixes. Ceramic abrasives are very tough, hard and long lasting with a life of 2-3 times that of aluminum oxide. Ceramic abrasives are used on hard metals and long abrasive life requirements. Higher pressures are required to fracture the ceramic abrasives.

ZIRCONIA ALUMINA is a man made aluminum oxide enhanced with approximate 20% zirconium oxide. The zirconia increases the strength of the aluminum oxide by stress induced transformation toughening. Zirconia is stronger, tougher with life up of 1-1/2 to 2 times that of aluminum oxide. Zirconia is blocky or cubic in structure and is a good choice when longer life or tougher abrasives are required. Most applications are in the coarser grits between 24 and 120 grits. The finish is coarser than that of the same grit size of aluminum oxide.

DIAMOND And CBN ABRASIVES are naturally occurring and can be produced synthetically in a high pressure and high temperature process. Most diamonds that are mined are used industrially and most diamonds used in industry are synthetic. Diamond abrasives are used because of their hardness which is a 10 on the Mohs scale and because of their thermal conductivity. Diamonds have a face cubic structure. The diamond abrasives are used in hard grinding wheels, powders and coated abrasives and are used on hard steels, ceramics and interrupted cutting of composites.

ABRASIVE TECHNICAL INFORMATION

EMERY ABRASIVE is a naturally occurring aluminum oxide mixed with other minerals such as silica. The black color material is mined. The hardness ranges between 6-8 on the Mohs scale. The softer abrasive is used in emery boards, emery cloth, and polishing abrasives reducing polishing line depth.

BUFFING ABRASIVES utilize the fine grades of aluminum oxide and silicon carbide abrasives. Buffing also uses fine graded calcined alumina, Tripoli, iron oxide and chrome oxides abrasives that are carried by greaseless or tallow based materials forced into the buffing wheels(which acts as the abrasive carrier) or sprayed onto the buffs of automated systems.

ABRASIVE SIZE

Abrasive size, referred to as grits, affects the amount of work achieved as well as the finish produced.Coarse abrasive sizes range between 8-60 grit. Coarser grits remove significant material and leave coarser finishes. The coarser grit sizes are a good choice for large weld removal, de-flashing, and de-gating castings, and removal of large amounts of stock.

Medium abrasive sizes range between 80-150 grits. Medium grits will also remove a fare amount of material and leave finer and paintable surfaces. They are also good for spot weld removal, radiusing, deburring and finer weld removal.

Finer abrasive sizes range between 180-400 and super fine up to1200 grits, The material removal is less but are capable of maintaining good rms finishes. The finer abrasives remove
scratches in paint and are used in lapping, polishing prior to buffing, and fine radiusing with very pleasant appearances

GRIT SIZES FOR COATED ABRASIVES AND RELATED RMS FINISH CAPABILITIES

When producing coated abrasives products (belts, discs, paper) the abrasive manufacturers of American, Europe, and Asia have slightly different abrasive grain size standards. The ISO standard FEPA designated with a P is the European designation and the CAMI is the American. Below is the size range variances and approximate finish capabilities. The RMS (root means squared surface measurement) average range is calculated at 1/2 life abrasive on coated products. Belt grease and lubricants will reduce RMS readings

ABRASIVE TECHNICAL INFORMATION

	ISO/FEPA Grit Standard designation	CAMI Grit Standard designation	Mircon size average	RMS Finish Aluminum oxide 1/2
Course Grits	P12		1815	
	P16		1324	
	P20		1000	
	P24		764	
		24	708	
	P30		642	
		30	632	
	P36		538	
		36	530	
	P40	40	425	
		50	348	100 RMS
	P50		336	
		60	265	95 RMS
	P60		269	
Medium Grits	P80		201	
		80	190	70 RMS
	P100		162	
		100	140	60 RMS
	P120		125	
		120	115	45 RMS
	P150		100	
		150	92	35 RMS
Fine grits	P180	180	82	20 RMS
	P220	220	68	15 RMS
	P240		59	
		240	53	
	P280		52	
	P320		46	
	P360		41	
		320	36	8 RMS
	P400		35	
	P500		30	
		360	41	
	P600		36	
		400	23	
SuperFine Grits	P800		22	
		500	20	
	P1000		18	
		600	16	
	P1200		15.3	
	P1500	800	12.6	
	P2000	1000	10.3	
	P2500		8.4	

ABRASIVE TECHNICAL INFORMATION

GRIT SIZE FOR BONDED ABRASIVES

ANSI table1-(8-240 grit) are sized to ANSI B74.12 1976 (R1982) and ANSI table 2 (240-1200 grits) to ANSI B74 . 10-1976 are utilized for sizing for abrasive grains in grinding wheels.

This chart is designed to compare millimeters, microns and inches to match them to corresponding ANSI grit sizes. Subject to normal variations. A grit size is defined by the distribution of grits retained on sieves set up to meet the requirements of ANSI table 2 or 3.

Mill	Micron	Inches	ASTM Sieve	Tyler Sieve	ANSI Table 2	ANSI Table 3
5.60	5600	0.220	3 1/2	3 1/2	S-S	-
4.75	4750	0.187	4	4	4	-
4.00	4000	0.157	5	5	5	-
3.35	3350	0.132	6	6	6	-
2.80	2800	0.110	7	7	7	-
2.36	2360	0.093	8	8	8	-
2.00	2000	0.079	10	9	10	-
1.70	1700	0.067	12	10	12	-
1.40	1400	0.055	14	12	14	-
1.18	1180	0.046	16	14	16	16
1.00	1000	0.039	18	16	20	20
0.850	850	0.033	20	20	22	24
0.710	710	0.028	25	24	24	-
0.600	600	0.024	30	28	30	30
0.500	500	0.02	35	32	36	36
0.425	425	0.018	40	35	40	-
0.355	355	0.014	45	42	46	46
0.300	300	0.012	50	48	54	54
0.250	250	0.010	60	60	60	60
0.212	212	0.008	70	65	70	70
0.180	180	0.007	80	80	80	80
0.150	150	0.006	100	100	90	90
0.125	125	0.005	120	115	100	100
0.106	106	0.004	140	150	120	120
0.075	75	0.003	200	200	150	150
0.063	63	0.0025	230	250	180	180
0.053	53	0.0021	270	270	220	220
0.045	45	0.0018	325	325	240	240

ABRASIVE TECHNICAL INFORMATION

Micro Grits

Millimeters	Microns	Inches size)	ANSI Grit Size
0.0500	50.0	0.00200	240
0.0395	39.5	0.00156	280
0.0295	29.5	0.00116	320
0.0230	23.0	0.00091	360
0.0183	18.3	0.00072	400
0.0139	13.9	0.00055	500
0.0106	10.6	0.00042	600
0.0077	7.8	0.0003	800
0.0058	5.8	0.00023	1000
0.0038	3.8	0.00015	1200
0.0450	45	0.0018	F
0.0275	27.5	0.0011	FF
0.0160	16	0.0006	FFF
0.011011	11	0.00043	FFFF

ABRASIVE TECHNICAL INFORMATION

ABRASIVE HARDNESS

Abrasive minerals are chosen by their hardness. The basic abrading principle is a harder material chipping, abrading, or wearing away a softer workpiece material. The abrasive minerals generally run between 7 and 10 on the Mohs scale.

Below is a chart on abrasive mineral hardness

Hardness Comparison

Abrasive	Mohs Value	Knoop Value
Diamond	10.0	7000
Silicon Carbide	9.5	2480
Ceramic abrasive	9+	
Zirconia	9.0	
Aluminum oxide	9.0	2100
Emery	7-8	
Garnet	7.0	1360
Quartz	7.0	820
Sand	6.0	560

ABRASIVE TECHNICAL INFORMATION

2. **BONDING TYPES**

BONDED ABRASIVES (Grinding Wheels) is an abrasive mineral contained and mixed within a matrix of metal, clay, resin, or rubber. The matrix is molded into wheels, discs, and sticks. These bonded processes are referred to as grinding.

The most common bonds are resin and vitrified. Resin wheels are plastic that are cured most often used in cut off wheels and diamond wheels. The vitrified is a ceramic glass like material fired or cured at higher temperatures and are used more commonly than resin. Vitrified wheels are used for bench wheels and surface grinding.

Hardness of the bond are rated from A-Z, A being weaker and Z the strongest. Weaker bonds ratings range between F-H, Medium bonds between I - K. and Stronger rated between L - P.

Structure or amount of openness between the grits is the grinding wheels basic structure.The ratings for structure is the higher the number the more open. The rating 12 is open in structure while 5 is a much closer structure.

The common grits used in grinding wheels are Aluminum oxide A/O (white, pink, ruby red, brown and grey) - Silicon carbide (black or green) - Ceramics (blue or pink) - Cubic boron nitrate (CBN) - and Diamonds.

General grinding practices utilize white and pink A/O which are more friable and run cooler for carbon steels. Ruby Red A/O is a tougher semi friable grit used to grind tool steel. The Brown and Grey A/O is also semi friable and is the most common grit used in production grinding and bench wheels. The Silicon Carbide black mineral is very sharp and used to grind softer metals such as Aluminum, brass, and composites. The green Silicon Carbide is even sharper than the black and is used to grind carbides and Titanium. The Ceramic grits are very tough, it fractures but keeps a sharp blocky edge. Ceramics last longer, can be used with higher pressures removing more materials while running cooler. Ceramics are used in grinding tool steels. Diamonds and CBN are the hardest of abrasives used in grinding, they are used on grinding carbides and uninterrupted cuts on composites.

A typical grinding wheel call out or wheel identification may differ from manufactures but commonly a typical call out is as follows.

A80 - J10 - VS

A = grit type (Aluminum oxide
80 = grit size
J = relative hardness
10 = structure or density
vs = the bond (vitrified)

ABRASIVE TECHNICAL INFORMATION

COATED ABRASIVES is an abrasive mineral fixed to a flexible paper, cloth, or film backed material. The abrasives are electrostatically applied with various glues or resins. The jumbo rolls are cut and converted into 9x11 paper,bench rolls, discs and various sizes of abrasive belts. The abrasive finishing processes with coated abrasives is considered polishing.

The most common backing holding the abrasives, in the metal and composite industry, is cloth and film. The Cloth varies in weight and flexibility with X and J classifications.The X is heaver and less flexible than the J. Generally The coarser grinding applications utilize X weight for their durability. The Finer finishing often times uses the J weight cloth. Both X and J have a flexible version(X-flex and J-flex) that has additional flexibility.
The film backing is stronger than cloth. It also has the property of being flatter than cloth (because of less porosity) allowing the more even and accurate coating of abrasives resulting in finer lower RMS finishing.
The most common abrasive used in the metal and composite industry is Aluminum oxide, used to finish steel and aluminum.
Ceramic abrasives are also very popular because they are tough, last longer, can be used with higher pressures for automation, and less time is wasted on changing abrasive belts. The finish range is more constant on long run of parts with longer lasting ceramic abrasives. The ceramics are used on harder metals and composites.
Other popular abrasives used is Silicon Carbide often used when a better finish is required and Zirconium Aluminum abrasives which outlast Regular Aluminum oxide by approx. 30%.

BUFFING is an ultra fine abrasive mineral that is impregnated onto and into a Round cloth buffing wheel. Buffing is the process used for a high luster shine on various materials. The terminology of cloth impregnated wheels processes for shine is buffing. There is a complete section (section 4, chapter 10) That explains buffing processes, materials,etc.

ABRASIVE TECHNICAL INFORMATION

3. CUTTING SPEED

Cutting speed is affected by:

Grit size (larger grit sizes generally increase cutting speed))

Abrasive material (Hardness and shape affect cutting speed)

Bonding of abrasive

Pressure applied to the workpiece (more pressure increases cutting speed)

Use of lubricants (reduce heat and produce finer finishes)

Surface feet speed (Faster surface speed = faster finishing times)

Surface Feet Speed is the speed at which the abrasive passes by the workpiece being finished. Abrasive finishing of various workpiece materials require specific ranges of surface feet speed to be finished properly.

The right surface feet speed for a given workpiece material will reduce heat, surface gauling and loading. The right surface feet speed will also increase abrasive life and effectiveness.

Below is a chart on effective surface feet speed for various materials

Approximate Surface Feet Speed Recommendations

Material	Surface Speed (SFPM)
Steel	6500
Stainless Steel	6500 - 6900
Aluminum	6500 - 8000
Brass	7200 - 7900
Titanium	2400 - 3100
Glass	5000 (faster with diamond 7500)
Composite	6000 - 7000

Surface feet speed is measured in SFPM surface feet per minute. Below is a chart that gives the surface speed per minute with different motor rpm's and wheel diameters. SFM = Wheel Dia (inches) X RPM X .2618

ABRASIVE TECHNICAL INFORMATION

Surface Feet Speed Chart / Feet per minute

RPM **Wheel Diameter (inches)**

	4	6	8	10	12	14	16	18	20	22	24
800	838	1257	1676	2094	2513	2932	3351	3770	4189	4608	5037
900	942	1414	1885	2356	2827	3299	3770	4241	4712	5184	5655
1000	1047	1571	2094	2618	3142	3665	4189	4712	5236	5760	6283
1100	1152	1728	2304	2880	3456	4032	4608	5184	5760	6336	6911
1200	1257	1885	2513	3142	3770	4398	5027	5655	6283	6911	7540
1300	1361	2042	2723	3403	4084	4765	5445	6126	6807	7487	8168
1400	1466	2199	2932	3665	4398	5131	5864	6597	7330	8063	8796
1600	1676	2513	3351	4189	5027	5864	6702	7540	8378	9215	10053
1700	1780	2670	3560	4451	5341	6231	7121	8011	8901	9791	10681
1800	1885	2827	3770	4712	5655	6597	7540	8482	9425	10367	11310
1900	1990	2985	3979	4974	5969	6964	7959	8954	9948	10943	11938
2000	2094	3142	4189	5236	6283	7330	8378	9425	10472	11519	12566
2100	2199	3299	4398	5498	6597	7697	8796	9896	10996	12095	13195
2300	2409	3613	4817	6021	7226	8430	9634	10838	12043	13247	14451
2400	2513	3770	5027	6283	7540	8796	10053	11310	12566	13823	15060
2500	2618	3927	5236	6545	7854	9163	10472	11781	13090	14399	15708
2600	2723	4084	5445	6807	8168	9529	10891	12252	13614	14975	16336
2700	2827	4241	5655	7069	8482	9896	11310	12723	14137	15561	16965
2800	2932	4396	5864	7330	8796	10263	11729	13195	14661	16127	17593
3000	3142	4712	6283	7854	9425	10996	12566	14137	15708	17279	18850
3600	3770	5655	7540	9425	11310	13195	15080	16965	18850	20734	22619

ABRASIVE TECHNICAL INFORMATION

4. ABRASIVE MACHINERY

Abrasive machinery are built to rotate or move an abrasive by the workpiece while pressure is applied from the machine or workpiece to the abrasive of the machine. The pressure is applied by hand on manual machines or by the machine on semi-automated and automated systems.

Abrasive belt machinery utilize a contact wheel behind the abrasive for higher pressures because of single point part contact or a backup plate called a platten for wide area contact.

Automated abrasive wheel machines utilize pressure compensation devices to keep the pressures consistent as the wheel wears smaller.

Abrasive finishing machinery are classified by the following:

1. Portable
2. Manual
3. Semi and automated

1. The portable abrasive machinery is defined by tools that are brought to the workpiece. Efficiency drops when the tools are brought to the workpiece. The portable tools size, weight and horsepower are reduced so they can be held by hand. Portable tools are the only way to abrasive finish large complex workpieces.

Portable Equipment includes:

Equipment	Abrasive Used	Applications
Die Grinders	coated & bonded discs, buffs, cutters, stones, cut off wheels	small areas to be reached swirled surface lines
Rt Angle Grinders	same as die grinders	helps work the surface at a different angle
Disc Sanders	2” thru 8” coated, non woven resin fibre discs and bonded discs	higher metal removal on welds, swirled line finish
Orbital Sander	coated psa and velcro paper, cloth and non woven discs	surface prep, spot welds random surface scratch
In line Sanders	coated paper, cloth, non-woven strips	straight line scratch
Hand Sanders	coated abrasives and non-woven belts	rotating belts straight scratch

ABRASIVE TECHNICAL INFORMATION

2. Manual abrasive machinery are much more productive than portable equipment because they are built with larger horsepower and rigidity. The operators bring the workpiece to the machine and apply the pressure manually.

Manual machinery includes:

Equipment	Abrasive used	Applications
Pedestal sanders	coated and non woven belts	straight line finishes on hand held parts. stock removal, and deburr
Pedestal Disc sanders	coated and non woven disc	facing and deburring swirled line finishes
Pedestal Buffers	buffs, polishing wheels non woven	high polish finishes deburring sheet metal edges
Bench grinding	bonded grinding wheels	tool sharpening, deburr high metal removal
Stroke sander	coated and non woven belts	straight line finishes and weld removal on formed sheet metal parts

3. Semi automated and automated machinery are very efficient because of their increased horsepower and rigidity over manual machines. This equipment is built to apply higher pressures to the workpiece increasing productivity by reducing finishing times. The automated machines produce better finishes with higher repeatability than manual machines.

Semi and Automated machinery include:

Machinery	Abrasive	Applications
O.D. Grinders	Bonded wheels and coated belts	Shaft grinding and deburring
I.D. Grinders	Bonded wheels	Precision id shaft work
Surface Grinding	Bonded wheels	Flat surface precision work
Blanchard Grinding	Bonded wheels	Flat surfaces
Wide Belt Sanders	Coated and non woven belts and non woven wheels	Flat sheet graining, deburr surface prep and pre paint

ABRASIVE TECHNICAL INFORMATION

Machinery	Abrasive	Applications
Shaft polishers	coated and non woven belts, wheels, buffs	shaft polish and buffed finishes
Lapping machines	loose abrasives, alum.oxide sil.carbide, diamonds,compounds	super finishing of flat parts
Honing machines	Bonded stone abrasives	ID and inside cylinder work polishing
Specialized systems	all types	built for specific and high production applications
Robotic finishing	all types	Robot holds workpiece or tool and controls multitude steps with the same part.

ABRASIVE TECHNICAL INFORMATION

OVERVIEW: OF ABRASIVE FINISHING MACHINERY AND ABRASIVES

MACHINERY	ABRASIVES
Grinders	Coated and Bonded abrasives
ID Grinders	Aluminum oxide
Surface grinders	Silicon carbide
Blanchard grin	Zirconium oxide
Bench grinders	Ceramic grits
Hand held grinders	Diamond abrasives
Belt Sanders	Scotch-Brite (woven abrasives)
Pedestal mounted sander	Rubberized bonded
Flat sheet sander	Cloth woven abrasives
Stroke sanders	
Disc sanders	
Shaft polisher	
Rt angle grinder	
Die grinders	
Hand held belt sanders	
Orbital sanders	
In line jitterbugs	
Lapping machines	
Robotic sanders	
Buffers	
Pedestal and hand held buffers. Automated and Robotic Buffing equipment.	

ABRASIVE TECHNICAL INFORMATION

PART IV INDUSTRIAL SPECIALIZED FINISHES AND INDUSTRY SPECIFICATIONS

SPECIALIZED FINISHES

Abrasive finishes
- Buffing/Polishing
- Stainless sheet polishing

Blast Finishing
- Shot Peening
- Surface Prep prior to Coatings

Mass Finishing
- Chemical accelerator surface refinement

INDUSTRY SPECIFICATIONS

Surface finish measurements
ANSI Particle Size Conversion
CAMI / FEPA Grit Size Comparison
Surface feet speed chart
Blasting Air consumption chart
SSPC Blast specifications

ABRASIVE TECHNICAL INFORMATION

There are quite a number of abrasive specialized finishes. We will cover two basic specialized industrial finishes that are commonly used in general manufacturing.

BUFFING/POLISHING
STAINLESS STEEL SHEET POLISHING

BUFFING/POLISHING

Finishing processes that utilizes abrasive belts are referred to as polishing and processes that use cloth wheels with compound applied is buffing. Polishing generates a brushed or lined finish where buffing removes the lines and creates a bright luster finish. When a finish requires buffing, polishing is in most cases the first refinement processes to level surfaces, remove welds or surface imperfections(pits,scale and scratches). The process of buffing will most always include polishing prior to buffing. **Buffing** is a rotating cloth wheel that is impregnated with fine abrasive compounds that produces a bright-luster finish on metal and composites.

Buffing wheels are constructed of various types and sizes of cloth, sisal or synthetic materials that hold a tallowed rouge or greaseless based matrix of specialized fine abrasive referred to as compound. The compound is sprayed or pressured into the rotating buffing wheel. The buff acts as the carrier of the compound which ultimately does the surface finishing

The two basic buffing processes in manufacturing are

Tangential buffing is the traditional hand buffing process which also can be automated. The part surface is positioned 90 degrees to the buff. The buff width is generally designed to be sized to the part. Tangential buffing creates high heat because of the higher required buff pressure applied to the workpiece. The tangential buffing process works well with parts that can be easily repositioned and uses buffs that range from 12” to 18” diameter running at 1700 rpm’s. The process is just ok for contouring, it works well for harder metals(steel and stainless) and harder ceramic composites. The process is a good choice for robotic automated processes.

Mush buffing is done with parts that are not easily repositioned. The process uses large diameter buffs up to 24” and run at approximately 800 rpm’s. The slow speed allows the buff to conform or mush around the part, running cooler resulting in less damage of the part or buff. The automated buff lengths are up to 16 to 18 feet. Compound penetration down into the buffs are important. Mush buffing is a good cost effective process for softer metals (Aluminum,Brass,Copper,Zinc) and softer composites.

Buffing is generally a multiple step process including surface **polishing**, the **cut** buff process and the **finish/color** buff process.

ABRASIVE TECHNICAL INFORMATION

Surface polishing by abrasive belts or discs are required to level surfaces, remove scratches, pits, scale and polish the surface smooth enough so the cut buff can remove the polishing lines. The first polishing step should be done with the finest abrasive possible that efficiently removes the weld,levels, or refines the surface imperfections. From that point on, the subsequent process, are working to remove the first polishing scratch lines. Each finer polishing step should be crossed polished 90 degrees from the previous polishing process. A 320 grit to a 400 grit polishing line is generally the courses surface prep that a cut buff process can efficiently remove.

There can be up to 3 polishing steps to prepare a surface for a cut buff. Soft metals and composites take less steps, Castings take more steps than forgings, hot rolled materials take more steps than cold rolled, stampings and machined parts take less steps than raw materials, welds need to be removed with finer abrasives instead of coarser grinding so not to create excessive additional polishing steps
Mass finishing is used extensively to remove the first polish line and reducing cost and processes of future polishing steps. Mass Finishing is a good process on certain smaller size and complex shaped parts setting up a fine finish prior to cut buffing as well as possible eliminating the cut buff process.

The **Cut** buff is the coarse buff process. The cut buff removes the fine polishing lines, producing a smoother line finish that the finish/color buff can remove. The cut buff is the more difficult buff process requiring more time and effort to accomplish and causing higher operator fatigue.

The **Finish/Color** buff is the finest buff process for surface finishing. The finish buff will remove the fine lines created by the cut buff process while creating a bright luster finish. The finish buff is an easier, quicker process then the cut buff

Buffing processes have three components to achieve their objectives.

1. Buffs (type and size)
2. Buffing Compounds
3. Buffing Equipment

1. BUFFS

Buffs wheels are constructed of cloth, treated cloth, sisal, and synthetic materials. The buff is sewn and constructed in many different ways. Stiffer buffs are better for cutting and finishing flat surfaces. Softer buffs with flexibility will conform around complex surfaces and are used primarily for the finish buff applications.
The buff carries the compound which ultimately accomplishes the work, but the buff construction can assist in the cut, finish, and ability of holding the compound.
The buff wheel will not perform well if it is ; the wrong buff , is worn or raged, over or under pressured, run the wrong direction, using the wrong diameter, or out of balance.'

ABRASIVE TECHNICAL INFORMATION

Loose wheel threads mainly in the finishing process will drag across the parts surface creating a drag scratch on the surface. Dressing the wheel with abrasive belts will remove the loose threads.

BUFF TYPES

Some buffs can be used for both cut and finishing but Most common buff type and construction fall into the cut or finish categories listed below:

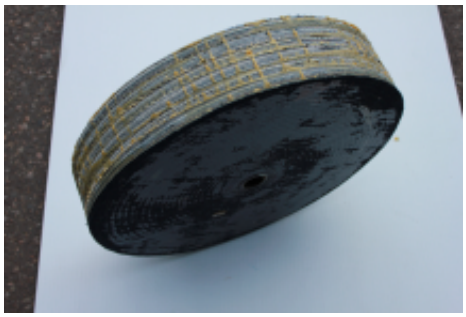
Cut Buffs:

The cut buffs can be made from cloth, denim or sisal . Sisal is the fastest cutting material with denim being the next stiffer material followed by treated cloth and then cloth itself. Synthetic materials are new and used is specialty applications of automated buffing. The part is dragged with pressure thru the cut buff requiring 2-3 passes. More compound is left on the part after the cut buff. Cleaning the part before finishing (color buffing) keeps the courser compound of the cut process contaminating the finer abrasives of the finish buff process.

The construction of buffs very important to their performance and are how they pick up there names.

Spiral Sewn constructed of cloth sheets and sewn in different spacings of 1/8" 1/4" and 3/8" being the most common. The tighter the sewing the stiffer the buff. These buffs are 1/4 to 3/8" thick and can be stacked to create a wider buff surface. This is a buff that is produced in cloth, denim or sisal material. The spiral sewn buff is used primarily for manual cut buffing for general cutting ability.

Set up wheels are made of spiral sewn wheels that are glued together and balanced to obtain a thicker (commonly up to 4") and stiffer cut buff. These buffs are used for set up wheels using Aluminum oxide for fast and efficient cutting or turkish emery combined with grease to create a finer polished surface prior to chrome plating on steel bumpers. These wheels will be set up with 2-3 layers of glued abrasives and can be run for 2-6 hrs of production. These wheels are available in cloth or denim with spirals sewn from 1/8" to 3/8". These wheels are very stiff and are the fastest cutting buff available.



ABRASIVE TECHNICAL INFORMATION

Airway Ventilated buffs are constructed to decrease the heat created by the buff process away from the workpiece. The air flows thru the buff as it is rotated. This buff is made of various materials (cloth,treated cloth,sisal) and densities(2,4,6 and 8 with the buff being firmer as number increases). The airway is produced in plys (12,14,16,18.20) the increased ply increases the material used and affects also the buffs thickness.There are three different mill treatments of cloth, white,white firm, and yellow maze. Each buff manufacturer will have 3-4 standard to specialized colored dip treatments that will also vary in hardness. The Airway buff is the standard buff for production buffing whether it be a manual or automated process. The buff can cut or finish all metals and composites.

Finger buffs are a very aggressive cutting buff. The finger buff is stacked together and can conform well to curved surfaces. these buffs are made in cloth, sisal, and a combination of cloth and sisal. The finger buff is used for fast cutting of stainless metals.

Finish Buffs:
The finish buffs are generally made of softer cloth materials so they will not scratch the surface of the work piece. They are also constructed in various ways and are identified by their construction.The finish buff requires less pressure than the cut buff process. Two passes thru the buff is normal and less compound is left on the part after the finish buff.

Loose buffs are a very popular manual and automated finish buff. They are sewn once around the arbor hole creating a loose floppy disc of cloth. The loose buff can be made in various thickness and is referred as number of plies. The more plies the thicker the buff. The thread count is also important on the finish loose buff, the higher the thread count the finer the material creating a finer finish. The loose buff is a good choice for all metals and composite finishing.

ABRASIVE TECHNICAL INFORMATION

Concentric Sewn buffs also referred to as a Jewelers buffs are a buff that are sewn in round 1/2" to 1" increments. These buffs are firmer than a loose finishing buff, and sometimes are used as a minor cut buff. The buff sewn seems are commonly cut when reached to expose the next softer amount of material. The concentric sewn buff is produced in 1/2" to 1" widths which is also determined by the number of plies. This buff is popular because of its width and extra firmness. It can be used on all metals and composites.

Airway buff is widely used as mentioned earlier for finishing. The best finishing airway is a standard mill cloth low 2 density material. If the metal is harder the stiff firm treatment can also finish well. The Airway is also produced in a flannel material for excellent softness. The flannel is the softest cloth material and is used for very soft metals and composites, The cotton is (picked) an operation the mill uses to pull the nap. The Domet flannel is picked or soft on one side and the Canton flannel is picked or soft on both sides.

BUFF SIZE

The buff diameter is determined by the type of buffing methods, surface feet speed recommendations (generally in the 6-9000 SFPM range and horse power of the buffing equipment.

If too large of a diameter or width of wheels are run for the available horse power the buff will be stalled easily with normal pressure applied. The larger the diameter and width of buff the more horsepower is required.

Surface feet speed (how fast the buff rotates across the workpiece) is very important in buffing. The right recommended surface feet speed will maximize production as well as create the maximum luster required.
Below is the surface feet speed achieved by different buff diameters and motor rpm's. The horse power recommendations are approximate and will need to be increased as the buff width increases beyond 2" wide

ABRASIVE TECHNICAL INFORMATION

SURFACE FEET SPEED PER MINUTE (SFPM)

Spindle rpms	Buff Diameters 4”	6”	8”	10”	12”	14”	16”	18”
800	838 sfsm	1257	1676	2094	2513	2932	3351	4189
1700	1780	2670	3560	4451	5341	6231	7121	8011
3000	3142	4712	6283	7854	9425	10,995	12,556	14,137
Horse Power required	3/4 hp	3/4hp	1hp	1 hp	11/2hp	2-3 hp	3-5hp	5 hp 7

SURFACE FEET SPEED RECOMMENDATIONS (SFPM)
Tangential buffing and polishing

Material	**Steel**	**Stainless**	**Brass**	**Aluminum/Zinc**	**Nickel**
Cut buff	8-9000	9-10,000	7-9000	6-9000	7-9000
Finish/color buff	7-9000	8-9000	6-8000	6-7000	6-8000
Polishing	6-7000	6500-6900	9200-7900	6500-8000	6500-6900
Satin finishing	5-6000	5-6000	3-5000	3-5000	3-5000

2.BUFFING COMPOUND

Compounds are produced in liquid or solid soft bar construction. The liquid are sprayed on to the rotating buff and are generally used in automated tangential or mush buffing processes. The abrasives are mixed with binders and are carried by a water or petroleum based liquids.
The bar compounds are a soft but solid tallow rouge or greaseless tube matrix of abrasives made in various sizes. The bar compounds are generally used in manual buffing processes but also can be automated. The bar is pressured and loaded onto the rotating buff. Compounds should be dedicated to a buff wheel so as not to mix various abrasives grit sizes. Too little compound on the buff wheel will create excessive heat

reducing buff life and increasing finishing time. Manual buffing requires approximately 20% of the operators time for applying compound to the wheel. To remove the compound and light haze off the workpiece a clean buff can be used or a hand wipe with a soft rage or gloves covered with a whiting compound. To reduce compound residue on the part light pressure on the final pass will help.

Compounds are generally in two basic groups.

Cutting compounds	**Finishing/Color Compound**
Type/ abrasive	**Type/ abrasive**
Greaseless - 80-400 grit alum oxide	Green rouge- chrome oxide
Stainless(grey) -150-400 “ “	White rouge- calcined Alumina
Tripoli - Tripoli	Red rouge- Iron oxide
	Calcined unfused Alumina- liquid

Cutting compounds

Greaseless compound are used in cut buffing and satin finishing. It has a binder of water and glue and is mixed with aluminum oxide (blocky structure) or silicon carbide(slivery in structure) with grit sizes form 80 thru 400 grit. The greaseless compound is loaded onto a decelerating wheel to keep it from flinging off. the grit will dry hard but still be flexible on the wheel. The compound can be used in the moist or dry state. Greaseless compound is good for complex shapes, deburing, and satin finishing on all metals

Stainless compound are a cut compound used for harder metals.It has a tallow(animal fat) binder with 150 to 400 grit aluminum oxide abrasive (blocky structure). The binder can be produced to be dry or greasy. The greaser the compound the faster the cut. There is a light grey(Dryer) version and a darker grey(greaser) version. Stainless compound is an excellent choice for steel and stainless steel cut buff applications.

ABRASIVE TECHNICAL INFORMATION

Tripoli is a cut compound used in softer metals, plastics and composites. The abrasive is a tripoli (micro crystaline structure) classified as a silica from a mine that is crushed and finely graded. Tripoli is a good cutting compound for aluminum, brass, copper, zinc,plastics and soft composites.

Finishing/Coloring compounds

Green rouge is a finishing compound widely used for all metals. The abrasive is a chrome oxide(blocky structure) that does minor cutting while giving an excellent bright finish.The green rouge is an excellent choice for all metals and hard composites.

White rouge is a finishing compound used for a finer coloring of aluminum, plastics and soft composites.White rouge however is used on many other metals including brass, stainless and steel. The abrasive is a calcined alumina (flat platelet)

Red rouge is the finest finishing rouge produced. It is used on gold, silver and super high luster brass coloring applications.The abrasive is an iron(ferric) oxide and is round in structure. The Red rouge is very messy and harder to clean off the workpiece.

Calcined unfused Alumina is utilized in liquid compound as well as the bars of white rouge. This abrasive can have different properties because of different firing temperatures and can be used for cutting or finishing. The abrasive structure is a flat platelet used in eye glass polishing. It is one of the most versatile abrasives for liquid compound systems.

ABRASIVE TECHNICAL INFORMATION

OVERVIEW BUFFING RECOMMENDATIONS

Materials

Processes	Aluminum/zinc	Brass	Steel	Stainless	Composites
Cut Buffing					
SFPM (surface feet per minute)	6-9000	7-9000	8-9000	9-10,000	6-9000
Buffs	cloth or sisal spiral sewn, treated airway	cloth spiral sewn treated airway	cloth/sisal spiral sewn treated airway	cloth/sisal spiral sewn treated airway	cloth spiral sewn treated airway
Compounds	Tripoli Greaseless	Tripoli Greaseless	Stainless(grey) Greaseless	Stainless Greaseless	Tripoli Greaseless
Finish/Color Buff					
SFPM	6-7000	6-9000	7-9000	7-9000	5-7000
Buffs	Loose, Concentric(Conc.) Mill soft airway(Air.)	Loose, Conc. Mill soft Air.	Loose,Conc. Mill Firm Air.	Loose,Conc. Mill Firm Air.	Loose,Conc. Mill Soft Air
Compounds	Green/White Rouge	Green/Red Rouge	Green	Green	White
Satin Finishing					
SFPM	3-5000	4-6000	4-6000	4-6000	3-5000
Buffs	Sisal/Cloth Spiral Sewn(SS),Conc. Treated Airway	Cloth/Sisal SS,Conc. Treated Airway	Cloth/Sisal SS,Conc. Treated Airway	Cloth/Sisal SS, Conc. String Wheel,Air.	Cloth/Sisal SS,Conc. Airway
Compounds	Greaseless 120-320 grit	Greaseless 180-400 grit	Greaseless 120-180 grit	Greaseless 120 to 150 grit	Greaseless 220-400x
Polishing					
SFPM	6500-8000	7200-7900	6-7000	6500-6900	6-7000
Abrasives	Coated Belts,Discs	Coated Belts,discs	Coated Belts,discs	Coated Belts	Coated Belts,discs
	80-320 grit	80-400 grit	60-400 grit	60-400 grit	120-320 grit

ABRASIVE TECHNICAL INFORMATION

3. Buffing Equipment

The **Manual** buffing lathe is a machine that has a rotating shaft on one side or generally both sides of the machine that extends beyond the machine and holds the Buffing wheels or polishing belts. The extension of the shaft allows the operator to have clearance so the part can be manipulated without interfering with the equipment. The machine heights are built for operator height convenient working positions.

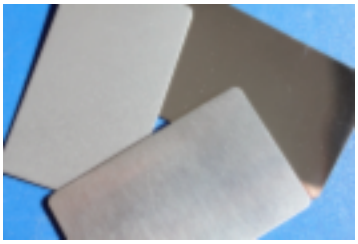
Manual lathe machines have two motor/shaft designs. The least expensive smaller machines(1/2 to to 5 hp) have the shafts built thru the motor, The higher priced heavy duty industrial applications have the motor mounted within the base of the machine with a v-belt drive system from the motor to the shaft mounted on bearing housings. The manual lathe v-belt machines are built from generally(2-10 hp) and up to 20 hp for automated Robotic applications.
The RPM choices are usually fixed 1750 to 3600 with a variable speed options. Buffing RPM recommendations for manual tangential processes are 1750. Small polishing lathe recommendations can include the 3600 rpm range.
When choosing a buffing machine look at the workpiece size. The size of the workpiece has a big influence on the machine size recommendation. The larger the workpiece the higher the horse power required. The buffing machines horse power running at the required surface feet speed for the material type,size and process is important, anything less is less productive.

Safety
The manual buffing lathe shafts, wheels, and ends must be guarded,and the wheel hoods connected to a dust collector.The operator must not be wearing loose clothing and wear well guarded eye and face and hand protection.The free wheeling silent nature of the buffing lathe can be very dangerous. HorsePower can also be dangerous, We do advise the beginning buffing operators to operate more that 1 1/2 hp motor with a 12” wheel for parts 12” x 12” and smaller, which is still dangerous but at least can be usually stalled if the operator gets tangled with the machine. Flying parts and getting caught into a rotating shaft are two of the many dangers.

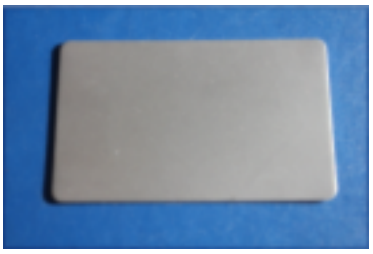
The **Automated** equipment is produced in all sizes. There are systems built for sheet up to 60” wide. Most commonly machines are built that automate and rotate smaller parts going by large lengths up to 16’ of cut and color buffs with automated spray compound systems. These machines are built for both tangential and mush buffing.
The Robotic automation has become very popular for cellular finishing. The Robot can not only be manipulated to run all three processes of polish,cut, and finish buff but can also itagrate other operations such as blasting and part stacking.
Most all automated buffing and polishing systems are designed for the production rates and process required of an individual manufacturing applications.

ABRASIVE TECHNICAL INFORMATION

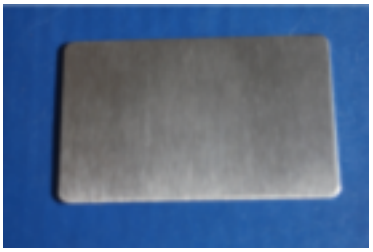
STAINLESS STEEL SHEET POLISHING



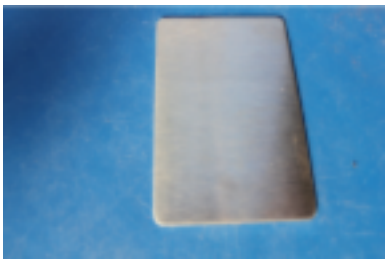
Many of the standard sheet polishing requirements are satisfied by the mills(original manufactures), or secondary sheet finishing companies. These finishes have been standardized by the stainless sheet manufactures. Common standard stainless finishes and how the mill arrives at these are as follows:



2B - finish is cold rolled finish with a finish polished roll pass that produces a matte finish with a minor sheen. This is the standard and most common of stainless sheet finishes. Standard mill finish is on booth sides of the sheet.



#3 - finish is a grained finish produced with multiple passes of coated abrasive belts with a final finish of 120 grit. The finish processes are run (wet or dry) with a heavy duty multiple head wide belt abrasive machine. The finish is a stop/ start grain pattern that is accomplished by a hard rubber contact roll with single point contact that pressures the abrasive belt against the sheet. This finish is a standard food grade non pit finish required in the food industry. Standard mill finish is on booth sides of the sheet.



#4 - finish is a grained finish produced with multiple passes of coated abrasives belts with a final finish of 150 grit. The finish processes are run (wet or dry) with a heavy duty multiple head wide belt abrasive machine. The finish is a stop/start grain pattern that is accomplished by a hard rubber contact roll with single point contact that pressures the abrasive belt against the sheet. This finish is also specified by the food grade industry requiring a non pit finish, as well as architectural applications. Standard mill finish is on one side of the sheet but it can be ordered on 2 sides.

ABRASIVE TECHNICAL INFORMATION

#7 - finish is bright finish with visible fine lines that is produced by a multiple passes of coated abrasive belts(wet or dry) wide belt machine process with a final finish of 320 grit. This finish is then sisal cut buff process that produces the fine lined bright finish. This finish is used in architectural and food industries.
Standard mill finish is on one side of the sheet.

#8 - finish is a bright buffed finish with no lines that is produced by a multiple pass of coated abrasive belts(wet of dry) wide belt machine process with a final finish of 320 grit. This finish is then sisal cut and then final color buffed to produce the no lined br buffed finish. This finish is expensive but popular in the architectural and food grade industries. Standard mill finish is on one side of the sheet.

The finishing process from the mill give good guidance on how to refinishing sheet after welding or fabricating.

It is difficult to exactly visually duplicate the mill finish after welding or fabricating because various wear stages of abrasives produce different finish depth lines reflecting light differently. The different abrasive or buffing manufactures products will also vary the scratch or luster of the original mill finished material.

Reworking the processed area and blending into the original finish works well when a close match is generally sufficient, When an exact match is required, the entire area of the sheet has to be refinished.

The stainless steel kitchen cabinetry manufacturers, for example, fabricate and weld the #3 material, polish the faded area, and then run a final mop buff coated with a 80 grit greaseless compound over the entire finish to blend everything to a uniform finish.

The 2B and the no 3,4,7 and 8 finishes are always common refinish applications. The 2B finish is generally a finish manufactures do not have to refinish much because finish is not usually important when a 2B is called for. The 2B finish can be bead blasted to refinish and blend to the original finish.