Buffalo Abrasives, Inc.

Roll Grinding Manual

Revised May 11th, 2012

Roll Grinding

- **Rolls are used in the production of a large variety of materials including steel, aluminum, brass, copper, textile and paper. During use, these rolls are subject to wear. Grinding is necessary to bring rolls back to their proper geometry and finish.**

- **Roll grinding uses many of the same techniques as any other cylindrical grinding operation. However, the large size and hardness of the rolls being ground requires a higher degree of operator technique and skill to impart the desired shape and finish.**

Roll Grinding Wheel

- **Most important aspect is cutting action of the wheel**

•Stock must be removed and a required finish generated in a minimum amount of time

Roll Grinding Wheel

- **Wheels Types:**
  - **1 (straight)**
  - **5 (recessed one side)**
  - **7 (recessed two sides)**
- **Diameters: 12” to 36″**
- **Thicknesses: 1″ to 6″**

Roll Grinding Wheel Bonds

- **Organic bonded (resin and shellac) wheels are preferred for roll grinding because of their "forgiving" nature and good polishing characteristics.**

- **Shellac bonded wheels stay particularly sharp and free cutting. They produce a desired finish in less time. They also do not produce as much chatter as other bonds under the same operating conditions.**

Operator Technique

- **A skilled operator by manipulation of controllable factors can compensate for deficiencies in wheel size and grade**

Cutting Action of the Wheel Depends On:

- **Abrasive Type**
- **Grit Size**
- **Spacing of the Abrasive Grain**
- **Bond Hardness**
- **Structure (porosity)**
- **Bond Type**

Abrasive Types

- **Aluminum Oxide, AL_2O_3**
- **Silicon Carbide, SiC**
- **AL2O3 / SiC Combination**
- **Ceramic – High Performance**

Aluminum Oxide Types

- **A Regular Aluminum Oxide**
- **MA Mixture of "A" & "SA"**
- **AB Friable White "Bubble" Aluminum Oxide**
- **JA Friable Lavender Aluminum Oxide**
- **SA Friable White Aluminum Oxide**
- **WA Friable Pink Aluminum Oxide**

Aluminum Oxide Types *(cont.)*

- **KA Silane Coated "A"**
- **KSA Silane Coated "SA"**
- **KJA Silane Coated "JA"**
- **KMA Silane Coated "MA"**

Silicon Carbide Types

- **C Black Silicon Carbide**
- **GC Green Silicon Carbide**
- **RC Mixture of "C“ & GC**

- **KC Silane Coated “C”**
- **KGC Silane Coated "GC“**
- **KRC SilaneCoated "RC"**

Al_2O_3 & SiC Combinations

- **CA** — **Mixture of "C" & "A"**
- **CJA** — **Mixture of "C" & "JA"**
- **GCSA** — **Mixture of "GC" & "SA"**

- **KCA** — **Silane Coated "CA"**
- **KCJA** — **Silane Coated "C" & "JA"**
- **KGCJA** — **Silane Coated "GC" & "JA"**

Ceramic/High Performance

- **SPECIAL Ceramic Blends**

- **Proprietary formulations engineered for specific applications to optimize wheel cut rate and wheel life**

Size of the Abrasive

- **Buffalo Abrasives has available a full range of grain sizes to suit your application and finish requirements. The following grain sizes are available in our roll grinding wheels:**

Extra Coarse	*Coarse*	*Medium*	*Fine*	*Extra Fine*
12	*30*	*70*	*150*	*320*
14	*36*	*80*	*180*	*400*
16	*46*	*90*	*220*	*500*
20	*54*	*100*	*240*	*600*
24	*60*	*120*	*280*	

Grinding Wheel Hardness

- **Wheel hardness ranges from A to Z**
  - ***A is very soft and Z very hard***
- **Most roll grinding wheels range from F through Q**

Soft	Medium
F	*L*
G	*M*
H	*N*
I	*O*
J	*P*
K	*Q*

Grinding Wheel Structure

- **The structure of a wheel is the relation of the grain, bond and the open space between the two. This relationship is built into the wheel from dense (1) to open (16) Roll grinding wheels typically run in the 10 to 14 range.**

Dense	*Medium*	*Open*
6	*9*	*13*
7	*10*	*14*
8	*11*	*16*
	12	

The purpose of wheel structure is to provide clearance for the metal being removed from the roll, which prevents loading up of the face. An open wheel will resist loading and the inherent chatter caused by loading. An open wheel will more easily self dress which speeds up production, but at the expense of wheel life.

Bond Type

- **Buffalo Abrasives' manufactures organic bonded grinding wheels, including resin and shellac bonded roll grinding wheels. Our roll grinding wheels will in most cases be designated either:**
  - ***"B" for resin***
  - ***"E" for shellac or***
  - ***"EB" for resin/shellac combination***
- **The choice of the wheel bond gives you different degrees of finish capabilities, can be used to change the surface appearance of your roll, and can be selected to help mask minor machine faults.**
- **For example, wheels with a shellac bond are often used to achieve higher degrees of finish and because of the bonds' "forgiving" nature can be used on a broader range of applications.**

Wheel Dimensions

- **Wheel Diameter**

Every 4” reduction in wheel diameter makes the wheel act about one grade softer in performance

- **Wheel Thickness**

Every additional inch in wheel thickness makes the wheel act about one grade harder due to an increased arc of contact.

Arc of Contact

- **The arc of contact of a wheel is the portion of the circumference of the roll grinding wheel in contact with the work**
- **As wheels decrease in diameter they act "softer" (even if you compensate by increasing wheel speed). This is because of the higher unit pressures between the roll and wheel interface and the smaller wheel periphery contains fewer abrasive grains to do the work**
- **There is a relationship between the wheel diameter and roll diameter, particularly with Sendzimir mill work rolls. Most machines use a 14″ or 18″ wheel for small work rolls and a 20″ to 42″ wheels for larger intermediate or work rolls**

General Recommendations

- **1″ or less work roll = 14″ diameter wheel**
- **1″ to 2.5″ work roll = 18″ diameter wheel**
- **2.5″ and larger roll = 20″ or greater diameter wheel**

General Recommendations

- **Actual operating conditions, specific job requirements and grinding techniques of the operator will determine which wheel is best suited for your application. The following general recommendations are useful as a starting point to obtain a "best" wheel specification for:**

  - **Hot Mill**
  - **Cold Mill**
  - **Tandem Mill**
  - **Temper Mill**
  - **Sendzimir Mill**
  - **Specialty Mill**
  - **Paper Mill**

Hot Mill Recommendations

Roll	Finish (Ra)	Wheel Rx
Backup	**30-100**	**Aluminum Oxide, Resin, 24-46 grit**
Work	**Varies**	**SiC, Ceramic, Al_2O_3 Resin, 36 grit**

Note: "Ra", is the absolute distance from the mean line of the roughness profile within the evaluation length. There are many other surface texture measurement terms

Cold Mill Recommendations

Roll	Finish (RA)	Wheel Rx
Backup	**30-100**	**Aluminum Oxide, Resin, 24-46 grit**
Work	**10-15**	**Ceramic / Al_2O_3 Shellac/ Resin, 60-100 grit**

Note: "Ra", is the absolute distance from the mean line of the roughness profile within the evaluation length. There are many other surface texture measurement terms.

Tandem Mill Recommendations

Roll	*Finish (RA)*	*Wheel Rx*
Backup	*30-100*	*Aluminum Oxide, Resin, 24-46 grit*
Work	*15-18*	*SiC / Al_2O_3 Shellac, 80-150 grit*

Note: "Ra", is the absolute distance from the mean line of the roughness profile within the evaluation length. There are many other surface texture measurement terms

Temper Mill Recommendations

Roll	Finish (RA)	Wheel Rx
Backup	**30-100**	**Aluminum Oxide, Resin, 24-46 grit**
Front Stand Work	**6-12**	**Silicon Carbide Shellac, 80-150 grit**
Back Stand Work	**10-15**	**Aluminum Oxide, Resin/Shellac, 80-150 grit**

Note: "Ra", is the absolute distance from the mean line of the roughness profile within the evaluation length. There are many other surface texture measurement terms

Sendzimer Mill Recommendations

Roll	*Finish (RA)*	*Wheel Rx*
Chrome	*4-6*	*White Aluminum Oxide, Shellac, 220 grit*
D2, M-series, 52100	*2-10*	*Silicon Carbide Shellac, 80-320 grit*

Note: "Ra", is the absolute distance from the mean line of the roughness profile within the evaluation length. There are many other surface texture measurement terms

Specialty / Paper Recommendations

Roll	Finish (RA)	Wheel Rx
Mirror Finish	1-2	Silicon Carbide, Shellac, 500 grit
Iron, Rubber, Granite	Varies	Silicon Carbide Shellac, 36-60 grit

Note: "Ra", is the absolute distance from the mean line of the roughness profile within the evaluation length. There are many other surface texture measurement terms

Grinding Tips

- **Wheel speed is commonly held at 6500 SFPM but it is common to reduce wheel speed toward 3000 SFPM as the work progresses from roughing to semi-finishing and then to finishing.**
- **The roll speed should be held as high as possible without causing vibration and/or heating of the centers or neck journals.**
- **For fast stock removal traverse the wheel just fast enough to barely lap.**
- **On a new wheel, chamfer the wheel corners with a diamond dresser to avoid feed lines.**

Grinding Tips

- **The coolant should be free flowing and the carriage traversing before any contact between the wheel and roll is established.**
- **The wheel should not be allowed to travel off the roll more than a third of its width before reversing, and on the last pass the wheel should not travel off the end of the roll at all. This action will prevent a dressing action on the wheel by the roll edge and avoid damaging the roll.**
- **As a general rule, a bright finish is generated using aluminum oxide grain and a satin (black) finish is generated using silicon carbide.**

How to Make a Roll Grinding Wheel Act Harder

- **Decrease the roll speed**
- **Decrease the traverse speed**
- **Decrease infeed rate**
- **Increase wheel speed while observing proper safety procedures, never exceeding maximum operating speed marked on the wheel**
- **Dress at a slower traverse rate**
- **Use a lighter dressing feed**
- **Use a thicker wheel**

How to Make a Roll Grinding Wheel Act Softer

- **Increase the work speed**
- **Increase the traverse speed**
- **Increase infeed rate**
- **Decrease the wheel speed**
- **Dress at a faster traverse rate**
- **Use a thinner wheel**
- **Dress more often**

Do's and Don'ts for Diamond Dressers

Do's	*Don'ts*
Before inserting a new dresser, back off the previous feed. Many diamonds are damaged when first put into the holder	**Don't hit wheel with diamond point when inserting in holder**
Set the diamond point at a 5° to 15° angle, pointing in the direction of wheel rotation	**Don't set point on center - always set at 5° to 15° below**
Tighten tool firmly in holder	**Don't quench a hot dresser - you'll fracture the diamond**
Flood diamond with coolant	**Don't assume the wheel is flat - look for highest point**
Start to dress at the highest point on the wheel	**Don't take more than .001-.002" depth of cut-the heat and pressure will fracture the diamond**

Do's and Don'ts for Diamond Dressers

Do's	*Don'ts*
Take light cuts. Max depth roughing .001-.002", finishing .0005-.001"	**Don't overfeed or underfeed**
Use proper traverse feed. Rough at 18-30 ipm. finish at 6-15 ipm. The slower the traverse feed the finer the finish. Caution: Too slow a feed will tend to glaze the wheel	**Don't leave dresser in one position too long you'll generate a flat so big it will glaze the wheel, overheat and damage the diamond**
Dress the wheel at regular intervals to prevent loading	**Don't continue to use a dresser which has worn excessively flat. Have it reset**
Rotate the dresser in its holder 20° to 40° at regular intervals to maintain a sharp point	**Don't gouge the wheel with the dresser, you might grind away the supporting matrix and lose the diamond**
When the point becomes dull and flattened excessively, have the tool reset	

Roll Grinding Machine Variables

- **Wheel Speed**
- **Roll Speed**
- **Traverse Rate**
- **Amount of Infeed**

Wheel Speed

- **As wheel speed is increased relative to roll speed the stresses between the roll and the wheel face are reduced and the wheel does not break down as rapidly as at lower wheel speeds.**

Slow (4,000-7,000 SFPM)	Fast (7,000-9,500 SFPM)
Decreased Metal Removal Rate Increased Wheel Wear Lower Wheel Amperage Less Wheel Chatter Wheel Acts Softer	Increased Metal Removal Rate Decreased Wheel Wear Higher Wheel Amperage More Wheel Chatter Wheel Acts Harder

Roll Speed

As roll speed is increased relative to wheel speed, the stresses set up between the roll and the wheel face are increased and the wheel breaks down more rapidly.

There are no hard and fast rules for roll speed. As a general guideline 60 SFPM is usually considered a roughing speed and 100 SFPM is considered a finishing speed. However, in Sendzimir mill roll grinding for example, due to the better (low Ra) finish requirements, 150 SFPM is more common for finishing.

Low Roll Speed	Higher Roll Speed
Worse (high Ra) finish	Better (low Ra) Finish
Increased Metal Removal	Decreased Metal Removal
Decreased Wheel Wear	Increased Wheel Wear
Higher Wheel Amps	Lower Wheel Amps
Wheel Acts Harder	Wheel Acts Softer

Traverse Speed

- **The traverse speed of the carriage depends on the type of roll being ground. Typically, for rough grinding you should travel about 3/4″ of the width of the wheel for every revolution of the roll. For finishing this should be reduced to about 1/2″ per revolution of the roll and for very fine (low Ra) finishes this may be 1/8″ per revolution of the roll.**

Minimum Traverse	Maximum Traverse
Improved Surface Finish	Rougher (high Ra) finish
Decreased Metal Removal	Increased Metal Removal
Lower Wheel Amperage	Higher Wheel Amperage
Wheel Acts Harder	Wheel Acts Softer
Wheel Acts “Closed”	Wheel Acts “Open”

Wheel Infeed Rate

- **The roll grinding wheel infeed rate influences every aspect of the grind. Hardened rolls such as Sendzimir mill rolls do not tolerate great amounts of infeed without causing chatter or burning of the roll face.**

- **When using the automatic infeed function on your grinder it is vital that the machine infeed the same amount at each table reversal. Many older machines are not consistent in this regards. This can cause shape problems which will require additional sparking out (polishing) to correct. This will in turn lower roll production.**

Low Infeed Rate	High Infeed Rate
Improved Surface Finish (low Ra)	Poor Surface Finish (High Ra)
Decreased Metal Removal	Increased Metal Removal
Less Wheel Wear	Increased Wheel Wear
Lower Wheel Amperage	Higher Wheel Amperage
Wheel Acts Harder	Wheel Acts Softer
Less Chance of Chatter	More Chatter

Coolant Function

- **Cool the Roll and Wheel**
- **Provide Lubrication to Reduce Friction Between Surfaces**
- **Rust Inhibitor**
- **Clean the Wheel of Metallic Particles**

Clean coolant is very important in roll grinding.
Filtering is advised to avoid fishtails and scratches.

Warning!!

The integrity of shellac bonded wheels can be effected by oil based coolants. Use only non-oil based synthetic coolants or plain water with a rust inhibitor with shellac wheels

CAUSES AND CORRECTIONS OF COMMON ROLL GRINDING ERRORS *

- ***The elements in a grinding problem are the machine, the work and the wheel. Given the data on the machine and the work, a wheel manufacturer has close enough control over the grit, grade and structure to supply a grinding wheel accurately fitted to the job.***
- ***Work, machine and wheel thus become the known quantities in the equation. There are unknown and variable factors such as mounting and dressing of the wheel, condition of the machine and skill of the operator, and it is to them that we must look for the solution of grinding troubles, like accidents, do not simply happen, they have causes.***
- ***The causes of grinding troubles ought to be and frequently are visible to the experienced eye but all too often the remedy is sought in a wheel of special character made up expressly for the job at hand. Such a wheel may perform satisfactorily but it will seldom do the job as efficiently as would a standard wheel operating under proper and usually easily attainable conditions.***
- ***The following listing of grinding faults is designed to show how many a grinding problem may be solved without recourse to specially made wheels.***

CYLINDRICAL (ROLL) GRINDING

CHATTER MARKS Indication	Cause	Correction
Short, close evenly spaced marks	Loose wheel spindle bearings	Reduce speed, tighten or readjust bearings, lap bearings to spindle, allow sufficient preliminary heating, take up thrust bearings
Slightly longer and more widely spaced marks	Wheel spindle sprung or out of round	If warped replace, if out of round regrind and lap to new bearing
Regularly spaced marks	General vibration Idlers loose or out of balance	Check alignment and couplings, be sure motor and spindle are in balance Re-bush and lap to shaft; balance carefully
Long, regularly spaced chatter marks forming checkerboard pattern	Wheel out of balance Wheel out of round	Rebalance carefully on own sleeve, repeat after truing. If trouble persists run wheel without coolant to throw off excess water, store on side to prevent water from settling at lower edge of wheel True before and after balancing; true sides to face

CYLINDRICAL (ROLL) GRINDING

CHATTER MARKS Indication	Cause	Correction
Chatter marks long and widely spaced, regular in pattern but may vary around body of work	Back-lash in drive gears	Replace old gears or use V-belt drive; check lubricant
Regular or irregular marks	Faulty thrust bearings	Replace thrust bearings
Regular or irregularly spaced marks of any width but following one pattern	Metal belt lacing on spindle drive	Use endless belt
Chatter marks synchronous with building vibration	Building vibration	If a heavy grinder, provide a separate foundation independent of floor. If a light grinder, tighten or loosen anchor bolts. Vibration dampers will often help. Moving the machine to a better location is sometimes the right solution. Overhead crane should ride on welded rails to minimize bumps. Crane wheels should have rubber cores for the same reason. If vibration continues a more expensive "spring mounting" may be necessary for the grinder

CYLINDRICAL (ROLL) GRINDING

CHATTER MARKS Indication	Cause	Correction
Chatter marks fairly long, wide and evenly spaced at wide intervals and generally discolored; wheel glazed or loaded	Wheel too hard	Select softer grade or coarser grit. See "Wheel Glazing." Use a narrower wheel to increase unit pressure on the abrasive
Irregular chatter marks	Work centers or work rests not true or improperly lubricated	Check fit of centers and rests; provide constant and even lubrication. On large jobs such as in roll grinding, provide hold-down clamps on necks and arrange for adequate lubrication.
General	Dressing	Use sharp diamond rigidly held close to wheel

CYLINDRICAL (ROLL) GRINDING

SCRATCHING OF WORK Indication	Cause	Correction
Narrow and deep regular marks	Wheel too coarse	Use finer grit
Wide irregular marks of varying depth	Wheel too soft	Use harder grade (See Grinding Grade of Wheel)
Widely spaced spots on work	Oil spots or glazed areas on wheel face	Balance and true wheel. Avoid getting oil on wheel face
Uneven marks on work	Whipping belt	Take up belt
Fine spiral or thread on work	Faulty wheel dresser	Replace cracked or broken diamonds; use slower dressing traverse; set tools at angles of 5 degrees down and 30 degrees side; turn diamond every third dressing; tighten holder of diamond. Dress with less penetration; do not allow tool to dwell in contact with wheel; do not start dressing cuts on face - locate diamond on face but start cuts from edge. Make final pass in dressing in direction opposite to grinding traverse; traverse diamond evenly across face of wheel; round off wheel edges

CYLINDRICAL (ROLL) GRINDING

SCRATCHING OF WORK Indication	Cause	Correction
	Faulty operation	Prevent penetration of advancing or following edge of wheel by being careful to dress wheel face parallel to work; reduce wheel pressure; replace worn parts which permit swiveling of wheel head. Provide additional steadyrests; reduce traverse in relation to work rotation; when making numerous passes make slight change in traverse rate at each pass to break up pattern
Wavy traverse lines	Ragged wheel edges	Round off wheel edges
Uneven traverse lines	Worn traverse drive parts	Eliminate play; replace worn parts
Isolated deep marks	Improper wheel dressing Chatter or hammering Coarse grits or foreign matter in wheel face Grit pulls out of bond	Use sharper dressing tools; flush wheel with coolant after dressing Remove cause (See Chatter Marks) Remove by dressing Coolant too alkaline for some organic bonds; decrease soda or change coolant

CYLINDRICAL (ROLL) GRINDING

SCRATCHING OF WORK Indication	Cause	Correction
Irregular marks	Loose dirt settling on machine	Keep air and shop clean; install dust collectors
Irregular marks of various lengths and widths; scratches usually fishtail	Dirty coolant	Provide efficient filter; clean tank often, flush guards, etc., after dressing and when changing to finer wheels
Deep irregular marks	Loose wheel flanges	Tighten flanges using blotters or lead washers
Grit marks	Wheel too coarse or too soft Too much difference in grit size between roughing and finishing wheels Dressing too coarse Improper cut from finishing wheel	Select correct wheel Use finer roughing wheel or finish out better with roughing wheel Less dresser penetration and slower dresser traverse Start with fairly high work and traverse speeds to remove previous wheel marks; finish out with high work and slow traverse speeds, allowing wheel to spark out

CYLINDRICAL (ROLL) GRINDING

SPIRALS ON WORK *Indication*	*Cause*	*Correction*
Spirals (traverse lines) same lead on work as rate of traverse	*Misalignment*	*Check alignment of head and tail stocks; also wheel head to work*
	Truing	*Have truing tool set exactly on work-wheel contact line but pointed down 3 degrees. Round off edges of wheel face*
GRINDING WHEEL GRADE *Indication*	*Cause*	*Correction*
Lack of cut; glazing; some loading; burning of work; chatter	*Wheel acts too hard*	*Increase work and traverse speeds; decrease spindle speed, wheel diameter and width of face; open up wheel by sharper dressing; increase wheel pressure (infeed); avoid dwell at end of traverse; avoid gummy coolants; use coarser grit or softer grade wheel.*
Wheel marks on work; short wheel life; not holding cut; tapered work	*Wheel acts too soft*	*Decrease work and traverse speeds and wheel pressure (infeed); increase spindle speed, wheel diameter and width of face; dress with slow traverse and slight penetration; filter coolant; do not pass off work at end of traverse*

CYLINDRICAL (ROLL) GRINDING

WHEEL LOADING Indication	Cause	Correction
Metal lodged on abrasive grains or in wheel pores	Incorrect wheel	Use coarser grit or more open structure to provide chip clearance; use type of abrasive that fractures more easily; use more coolant
	Faulty dressing	Use sharper dresser; dress faster; clean wheel after dressing
	Faulty coolant	Use more, cleaner or thinner coolant
	Faulty operation	Manipulate to soften grinding grade of wheel (See Grinding Grade of Wheel); Use less infeed
WHEEL GLAZING Indication	**Cause**	**Correction**
Shiny appearance; slick feel	Improper wheel	Use coarser grit, softer grade; manipulate wheel to get softer grinding effect (see Grinding Grade of Wheel)
	Improper dressing	Keep wheel sharp with sharp dresser, faster traverse, deeper penetration
	Faulty coolant	Use less oily coolant; use more coolant
	Faulty operation	Use greater infeed (see Grinding Grade of Wheel)
	Gummy coolant	Increase soda content if water is hard; do not use soluble oils in hard water

CYLINDRICAL (ROLL) GRINDING

INACCURACIES IN WORK *Indication*	*Cause*	*Correction*
Work out of round	*Uneven pressure of driving dog*	*Provide cushion between dog and work.*
Work out of parallel or tapered	*Faulty grinding machine* *Improper dressing* *Improper operation* *Expansion of work*	*Correct worn ways and setting of tail or headstock; tighten spindle bearings* *Make sure machine conditions are same at point of dressing as at point of grinding* *Do not permit wheel to pass off work at end of traverse, which causes taper at work ends; reduce wheel feed; use harder wheel* *Reduce temperature of work by using more coolants and lighter cuts*
CHECKING OF WORK *Indication*	*Cause*	*Correction*
Work shows check marks	*Improper wheel manipulation*	*Prevent wheel from acting too hard (see Grinding Grade of Wheel); Do not force wheel into work; use larger and more even flow of coolant; prevent belt slippage*

CYLINDRICAL (ROLL) GRINDING

BURNING OF WORK Indication	*Cause*	*Correction*
Work shows discoloration	*Improper wheel*	*Use softer wheel or manipulate to get softer effect (see Grinding Grade of Wheel); Prevent glazing and loading; use more coolant; prevent chatter*
	Faulty operation	*Bring wheel to work more gradually, use less infeed; elimination belt or wheel slippage; prevent possible stoppage of work*

Glossary of Grinding Terms

- ***AA (arithmetical average) - The preferred mathematical measure of surface finish.***
- ***ABRASIVE - The material from which the grains in the wheel are made--usually crystalline aluminum oxide, silicon carbide, or diamond.***
- ***ALUMINA - Aluminum oxide, A1203.***
- ***ALUMINUM OXIDE - The chemical name for the hard abrasive substance found in natural emery and corundum, and for ALUNDUM made by fusing natural bauxite in an electric furnace.***
- ***ARBOR - The spindle of a grinding machine on which the wheel is mounted.***
- ***ARBOR HOLE - The hole in a grinding wheel sized to fit the machine arbor or spindle.***
- ***ARC OF CONTACT - The portion of the circumference of a grinding wheel in contact with the work.***
- ***BALANCE (dynamic) - A wheel in static balance is also in dynamic balance if, upon rotating, there is no vibration or whip due to unequal distribution of weight throughout its mass.***
- ***BALANCE (static) - A grinding wheel is in static balance when, centered on a frictionless horizontal arbor, it remains at rest in any position.***
- ***BALANCING - Testing for balance; adding or subtracting weight to put a grinding wheel into either static or dynamic balance.***
- ***BLOTTER - A paper disc used between a grinding wheel and its mounting flanges.***
- ***BOND - The material which cements the grains together making up the wheel. Bond may be rubber, shellac, resin, silicate, vitreous material, or metal depending upon the abrasive material.***
- ***BURN - Visible discoloration, or sub-surface damage, from excessively high temperature produced by grinding.***

Glossary of Grinding Terms

- ***CHATTER - A surface finish pattern caused by vibration of the wheel and/or work.***
- ***CHECKS -Very small, often microscopic, cracks.***
- ***COOLANT - The fluid used to cool the work being ground. It may be either plain water, straight oil, or water-soluble oil or compound.***
- ***CRACKS - Fissures in the work occurring or exposed during grinding.***
- ***CUTTING SURFACE - The surface or face of the wheel against which the material is ground.***
- ***DRESSERS - Tools used for dressing a grinding wheel.***
- ***DRESSING - A grinding wheel is dressed to improve or alter its cutting action. The dressing action removes the outside layer of dulled abrasive grains and any loading of metal or foreign material that the wheel may have picked up so that new and sharp grains are presented to the work. FEED LINES - An objectionable spiral pattern produced on the work in grinding.***
- ***FEED LINES – An objectionable spiral pattern produced on the work in grinding.***
- ***FINISH - The surface quality or appearance, such as that produced by grinding or other machining operation.***
- ***FINISH SIZE - The required part diameter.***
- ***FINISHING - The final cuts taken with a grinding wheel to obtain the dimensional accuracy and surface finish desired.***
- ***FISHTAILS - Short, comet-like scratches caused by loose grains, or grains in the coolant, which are carried around by the wheel for only part of a revolution.***

Glossary of Grinding Terms

- ***FLANGES - The circular metal plates on a grinding machine used to support and drive the grinding wheel. (See wheel sleeves).***
- ***FRIABILITY - The ability of abrasive grains to fracture under pressure.***
- ***GLAZED WHEEL - A wheel with a cutting surface too smooth to grind efficiently. Glazing is caused by worn or improperly dressed grains.***
- ***GLAZING - The dulling of the cutting particles of a grinding wheel as when a wheel is too hard for the job, resulting in a decreased rate of cut.***
- ***GRADE - The strength of bonding of a grinding wheel, frequently referred to as its hardness.***
- ***GRAIN - The tiny particles of abrasive which, with the bond, make up the wheel. It is the grains which do the actual cutting.***
- ***GRAIN SIZE - The size of the abrasive particles of a grinding wheel or polishing abrasive.***
- ***GRINDING - Removing material with a rotating grinding wheel.***
- ***GRINDING ACTION - Refers to the cutting ability of, and the finish produced by, a grinding wheel.***
- ***GRINDING WHEEL - A cutting tool of circular shape made of abrasive grains bonded together. Its cutting action is derived from its peri-pheral speed.***
- ***GUARDS - Metal hoods used to protect personnel and equipment in case of accidental grinding wheel breakage.***

Glossary of Grinding Terms

- ***HARD ACTING WHEEL - Grinding wheel that retains its dull abrasive grains.***
- ***ID (inside diameter): Refers to the arbor hole of the grinding wheel.***
- ***IN-FEED - The advance of the wheel toward and into the material (stock) to be ground away.***
- ***LOADED WHEEL - A wheel with the voids between the grains filled with metal particles or grinding debris.***
- ***LOADING - Filling of the pores of the wheel face with the material being ground, usually resulting in a decrease in rate of cut and poor finish.***
- ***OPERATING SPEED - The speed of revolution of a grinding wheel expressed in either revolutions per minute (r.p.m.) or surface feet per minute (s.f.p.m.).***
- ***ORGANIC BOND - A bond consisting of an organic material such as rubber, synthetic resin, or shellac.***
- ***PERIPHERAL SPEED - The speed at which a point on the face of a wheel is traveling when the wheel is revolving, expressed in surface feet per minute (sfpm), or meters per second (m/s).***
- ***PERIPHERY - The line bounding a rounded surface - the circumference of a wheel.***
- ***PROFILOMETER - An instrument for measuring the degree of surface roughness in micro-inches, rms (root mean square).***
- ***Ra (Roughness Average) – A mathematical measure of surface finish.***

Glossary of Grinding Terms

- ***RECESSED WHEELS - Grinding wheels made with a depression in one side or both sides to fit special types of flanges or sleeves provided with certain grinding machines.***
- ***RESINOID BOND - A bonding material described commercially as synthetic resin.***
- ***RMS (root mean square, Rq) - A mathematical measure of surface finish.***
- ***ROCKWELL HARDNESS TESTER - A machine for testing the indentation hardness of all metals.***
- ***ROLL GRINDING MACHINE - A special type of cylindrical grinding machine for grinding cylindrical rolls to be used for rolling metals, paper, or rubber.***
- ***ROUGH FEED - Feeding with a relatively large increment. Usually done early in the cycle for fast stock removal.***
- ***ROUGH GRINDING - The first grinding operation for removing stack rapidly without regard to the finish produced by the wheel.***
- ***R.P.M.(revolutions per minute) - The number of rotations of the wheel or the workpiece per minute.***
- ***SCLEROSCOPE - An instrument for determining the relative hardness of materials by a drop and rebound method.***
- ***SCRATCHES - Mark. left on a ground surface usually caused by dirty coolant or a grinding wheel unsuited for the operation.***
- ***S.F.P.M. - Surface feet per minute. See "Peripheral Speed. " To get surface speed in feet per minute, the circumference in feet is multiplied by the wheel revolutions per minute.***

Glossary of Grinding Terms

- ***SHELLAC BOND - A bonding material for grinding wheels, the principal constituent of which is flake shellac.***
- ***SILICON CARBIDE - An abrasive (SiC) produced by the reaction of coke and silica sand in a resistance type electric furnace.***
- ***SOFT ACTING WHEEL - Grinding wheel that loses its abrasive grains before they are dull.***
- ***STOCK - Material to be ground from the workpiece to produce the required diameter.***
- ***STRAIGHT WHEEL - A grinding wheel of any dimension which has straight sides, a straight face, and a straight or tapered arbor hole, and is not recessed, grooved, dovetailed, or beveled.***
- ***STRUCTURE - A general term referring to the proportion and arrangement of abrasive and bond in an abrasive product.***
- ***STUB - That portion of a grinding wheel left after having been worn down to the discarding diameter.***
- ***TENSILE STRENGTH - The strength of a material when tested in tension; usually expressed in pounds per square inch.***
- ***WHEEL SLEEVES - A form of flange used on precision grinding machine's where the wheel hole is larger than the machine spindle. Usually, the sleeve is so designed that the wheel and sleeve are assembled as a single unit for mounting on the spindle.***
- ***WHEEL SPEED - The speed at which a grinding wheel is revolving, measured either in revolutions per minute or in surface feet per minute.***

Glossary of Grinding Terms

- ***WHEEL STRUCTURE - The character of the wheel as determined by the proportion and the arrangement of the grains and bond.***
- ***WHEEL TRAVERSE - Rate of movement of wheel across the work.***
- ***WORK - Designation for the piece being ground or polished.***
- ***WORK SPEED - In cylindrical, centerless and internal grinding, the rate at which the work revolves, measured in either r. p. m. or s. f. p. m.; in surface grinding, the rate of table traverse measured in feet per minute.***
- ***WORK SURFACE - That part of the work being ground.***

GLOSSARY OF STEEL MAKING TERMS

- ***ALLOY STEEL - A type of steel which contains other metals in addition to iron. Alloys enhance the metallurgical properties of the steel for specific applications.***
- ***ANNEALING - A heat treating process which relieves uneven stresses in steel and yields uniform structure. Annealing will soften steel which has become work hardened.***
- ***BACK UP ROLL - A large cast steel roll on a cast iron body. Back up rolls are used to support the work rolls in a 4 high mill stand.***
- ***BASIC OXYGEN PROCESS (BOP) - A process for converting pig iron into steel by blowing high purity oxygen into a molten bath of iron.***
- ***BESSEMER CONVERTER - A type of furnace which converts pig iron to steel by introducing a blast of air at the bottom of a bath of molten iron.***
- ***BILLET - A square bar of steel smaller than a bloom ranging in size from 2 inches to 5 inches on each side, Billets are usually finished into bars, seamless tubing, or wire products.***
- ***BLACK PLATE - Cold rolled sheet or strip that has not been coated. Black plate, a product of the tin mill is usually 29 gage (.0138") or thinner.***
- ***BLAST FURNACE - A furnace used to convert iron ore into metallic pig iron. Coke, limestone and iron ore are fed into the furnace and subjected to a blast of preheated air which ignites the coke and burns out impurities which are removed in the form of slag.***

GLOSSARY OF STEEL MAKING TERMS

- ***BLOOM - A square bar of steel larger than a billet. Blooms usually range in size from 6 inches to 12 inches on a side. Structural steel and railroad are hot rolled from blooms.***
- ***CARBON STEEL - A pure steel containing primarily iron with less than 1% carbon. No other metals are alloyed with this steel.***
- ***CHILL ROLLS - Work rolls for a hot mill made of chilled white iron. The necks of the roll are cast in a sand mold and the body is cast in an iron mold. The iron cools the roll body quickly forming a very hard fine grained surface. The necks cool more slowly and are softer and less brittle than the body. These rolls have a tendency to crack and spall in heavy use.***
- ***COILER - A device placed at the end of a continuous hot strip mill to receive the strip as it comes out of the mill and roll it into a coil.***
- ***COKE - A fuel and source of carbon used in blast furnaces. Coke is made from coal by destructive distillation which removes impurities and yields a relatively pure form of carbon.***
- ***COLD REDUCTION - The portion of the cold rolling process in which the thickness of a sheet or strip of steel is reduced. This is usually accomplished in a tandem mill.***
- ***COLD ROLLING - A generic term applied to the process of passing unheated metal through rolls for the purpose of reducing its thickness; producing a smooth dense surface and developing controlled mechanical properties.***
- ***CONTINUOUS STRIP MILL - A hot strip mill with many stands of rolls, each one reducing the thickness of the slab being rolled and increasing its length until it ends up as a coil. The slab moves through the mill in only one direction from start to finish.***

GLOSSARY OF STEEL MAKING TERMS

- ***CROWN - The shape ground onto the body of a work roll. The diameter at the center of the face is larger than at the ends. This compensates for roll deflection during the rolling process and improves the flatness of the finished product.***
- ***DOUBLE POURED ROLL - An iron work roll cast in two operations. The body of the roll is made of extremely hard chrome nickel iron for a depth of 3 or 4 inches, The core and necks are made of a different type of iron which is softer and tougher.***
- ***FIRE CRACKS - Deep cracks which sometimes appear on the face of a work roll after it has been used in a hot mill. Fire cracks are caused by the differential expansion of the roll surface resulting from the heat of the slab being rolled.***
- ***FORGED STEEL ROLL - An extremely hard, fine grain roll made of heat treated forged tool steel. These are usually used as work rolls in a cold mill.***
- ***HOT ROLLING - The process in which heated steel is formed or reduced in thickness by passing it between a pair of rolls. Steel is usually hot rolled at temperatures between 2000º and 2400º F.***
- ***INGOT - A large block of steel cast in an iron mold at the steel making furnace. Ingots which weigh from 10 to 40 tons are reduced in size during primary rolling operation,***
- ***INTERMEDIATE ROLL - A roll which goes between work rolls and back up rolls in a cluster mill such as a sendzimir.***
- ***IRON ALLOY ROLL - Also called grain iron rolls, are chilled cast iron which contains alloys such as chromium and nickel to increase hardness and strength. This type of roll gets softer as it is reduced in diameter.***

GLOSSARY OF STEEL MAKING TERMS

- ***MILL - Generic term applied to a roll stand or group of roll stands. It may be for hot or cold rolling,***
- ***OPEN HEARTH FURNACE - A large capacity steel making furnace which is charged with molten pig iron from the blast furnace and cold ferrous scrap. Flames from burning oil or gas mixed with pre-heated air sweep down across the shallow hearth to melt the charge and to provide necessary heat to refine the iron into steel.***
- ***PICKLING - Uniform removal of all scale and oxide from hot rolled steel using hydrochloric or sulfuric acid. After pickling, most steel is then oil coated preparatory to cold rolling.***
- ***PIG IRON - Metallic iron refined from iron ore in a blast furnace. Pig iron is refined into steel by reducing the carbon content and removing other impurities.***
- ***PINCH ROLL - Rolls used in a cold mill to grip the steel strip and feed it between the work rolls.***
- ***PRIMARY MILL - Usually a large reversing type hot mill which reduces ingots into slabs, blooms or billets.***
- ***REVERSING MILL - Either a 2 high or a 4 high roll stand which can be driven in both directions. The thickness of a hot ingot or slab is reduced by passing it back and forth between the same pair or rolls.***
- ***ROLL BODY - The large diameter portion of the roll which comes into contact with the material being rolled or the body of another roll.***
- ***ROLL NECK - The small diameter portions of the roll which extend from either side of the body. The necks support the roll during use and during grinding.***

GLOSSARY OF STEEL MAKING TERMS

- ***ROLL WOBBLER - The shaped portion at the end of one roll neck. Driving force is applied to the roll wobbler through a drive line of loose fitting spindles and boxes.***
- ***SEMI-CONTINUOUS MILL - A hot mill with a reversing stand at the end and a continuous mill for finishing.***
- ***SHORE SCLEROSCOPE - A non-destructive hardness tester widely used in roll shops because of its portability.***
- ***SKIN MILL - A cold rolling mill which imparts a final finish to the steel rather than reducing its thickness. It also hardens the surface of the steel strip or sheet.***
- ***SLAB - A large piece of steel which always has a rectangular cross section. Slab sizes vary from 2 to 12 inches thick and 20 to 80 inches wide. Length may be from 60 to 280 inches. Slabs are converted to plates, sheets or strip.***
- ***SLAG - Material formed in a blast furnace from impurities in the iron ore combining with lime from the limestone.***
- ***SOAKING PIT - A special type of furnace used to bring up the temperature of a cold ingot, slab, bloom, or billet to a point where it can be hot rolled.***
- ***SPALL - A defect on the surface of a roll. A small patch of iron or steel becomes detached from the face of the roll body.***
- ***STECKEL MILL - A four high reversing hot rolling mill.***

GLOSSARY OF STEEL MAKING TERMS

- ***TANDEM MILL - A cold reduction mill consisting of two or more stands of rolls. Each stand reduces the thickness of the strip slightly more than the previous stand. The tandem mill is usually considered the roughing stage of the cold rolling process.***
- ***TIN MILL - A cold mill which rolls steel to very thin gages and tight tolerances. Finish requirements are also very severe. Much of the tin mill product is given a protective coating of some type.***
- ***TIN FREE STEEL - Thin gage uncoated steel which is given an electrolytic chrome plate.***
- ***TIN PLATE - Steel rolled in the tin mill and then coated on both sides with a thin layer of tin. The tin may be applied by the electrolytic method or the hot dip method.***
- ***WORK ROLL - A hot or cold mill roll which actually comes into contact with the steel being worked. Hot mill work rolls are usually made of iron and cold mill work rolls are usually made of forged steel.***

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