World Wide Sales Network

STERLING ABRASIVES LIMITED
GRINDING WHEELS

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STERLING ABRASIVES LIMITED
GRINDING WHEELS

TÜV NORD CERT ISO 9001 : 2015

GRINDING GUIDE

selection, storage, safety

50 YEARS ANNIVERSARY

www.sterlingabrasives.com

Unit for vitrified bonded grinding wheels

Unit for resin bonded grinding wheels


TÜV NORD

CERTIFICATE

Management system as per
ISO 9001 : 2015

STERLING ABRASIVES LIMITED
REGISTERED OFFICE & WORKS:
45/46, GIDC Estate, Odhav - Kathwada Road,
Odhav, Ahmedabad - 382 415, Gujarat,
India
and other location as per Annexure

Design, Manufacture and Supply of Standard & Special Purpose Bonded Abrasives Products

IAF

Quality Certificate

STERLING ABRASIVES LIMITED
GRINDING WHEELS

COMPANY PROFILE

Sterling Abrasives Limited (SAL) is an ISO 9001 : 2015 certified enterprise manufacturing a wide range of grinding wheels for the past five decades.
We are one of the leading manufacturers of Grinding wheels, making full range of Vitrified and Resin Bonded grinding wheels upto Diameter 1220mm.
Our quality is comparable with the best in the industry. We pride ourselves for our ability to provide :

- Consistent high quality products
- On time, error-free shipments
- Prompt, accurate information and answers

Sterling Abrasives Limited today caters to the need of major industries like Auto, Auto components, Bearing, Steel, Spring, Surgical blades, General engineering, Foundry, Glass, Agri sector etc. With the in house development, Sterling Abrasives Limited has mastered the manufacturing of Rice Whitening stones and is the largest supplier of Rice Whitening Stones in India.

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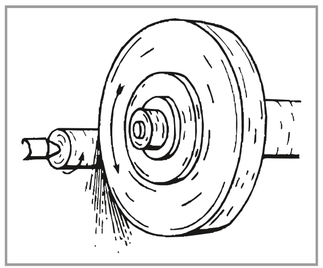
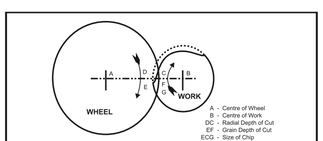
STERLING ABRASIVES LIMITED
GRINDING WHEELS

GRINDING PROCESS



A Grinding wheel actually cuts away chips from the piece being ground



The abrasive grain cuts into the work until it becomes dull.
Then it breaks down (fractures) and exposes new cutting crystals with sharp edges to the work.

What is grinding ?

"Grinding" in simple terms can be defined as a process of abrasion. The material is removed by using sharp abrasive grains on the face or on the sides of bonded grinding wheels. The grains actually cut chips out of the work. The two major types of grinding are Off-hand grinding and Precision grinding.

Off–hand grinding or Non-Precision Grinding is where the grinding wheel is applied manually to the work or where the work is applied off-hand to the grinding wheel. Off-hand grinding includes Snagging of castings/forging, Tool sharpening, Weld grinding, Cutting Off, Bench grinding or Pedestal grinding applications.

Precision Grinding is machine grinding where the traverse and feed rates can be set and process parameters are measured and controlled. As the name indicates, here the need is more on surface finish, geometry, size control etc. Precision grinding operations include Cylindrical grinding, Centreless grinding, Internal grinding, Surface grinding , Tool and Cutter grinding, Thread grinding, Crankshaft, Camshaft grinding etc.

A Grinding Wheel is basically a precision tool composed of abrasive grains held together by a bonding material or 'bond'. The abrasive grains provide the wheel with its cutting points , which in turn help in cutting the material to the required dimensional accuracy or help impart a fine surface finish.

The arrangement of the abrasive grain and the bond in the grinding wheel gives a definite characteristic known as **'structure'** or **'pores'**. These pores are designed based on application needs and provide for chip clearance.

ELEMENTS OF ABRASIVES

Grain or Grit Size

The size of the abrasive grain is expressed by the size of the screen opening through which the grains are sifted or sorted. For instance, a grain or grit which goes through a screen 8 mesh or openings per linear inch is called 8 grain or grit size, while a 24 grit size is roughly twenty fourth of an inch across. The higher the grit size, the finer its type.

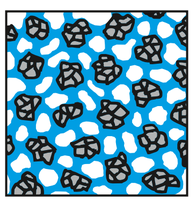
Structure

This is basically the spacing of the abrasive grains in a wheel or the volume content of the abrasive in the wheel. This is defined by the 'voids' or spaces between the abrasive grain and the bonding material and is called wheel 'porosity'. A 'close' structure wheel is one where the volume of closely packed grains are more. Conversely, 'open' structure wheels are those with wider grain spacing. Wheel structure is specified in numbers like 1,2,3,4 and so on. Wheel structure range for '3' for more closed structure to '24' for more open structure.

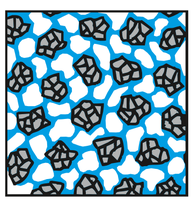
Wheel Grade

This is generally a measure of 'hardness' or bonding strength of the wheel. For a wheel, of a particular bond type, the amount of bond used in the wheel mainly determines its hardness. When the amount of bond is increased, the size of the bond posts connecting each abrasive grain to its neighbours is also increased. The larger bond post is naturally stronger, thereby increasing the wheel's hardness.

Strong "Posts"



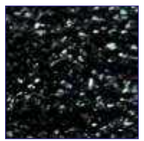
Medium Strength "Posts"



Weak "Posts"

Grade is therefore not a measure of the hardness of the abrasive material but of the durability of the wheel. A hard abrasive can be bonded into a 'soft', free cutting wheel by using less bond, while an increase in the amount of bond can make the wheel act harder. Wheel gradings range from 'D' for the softest, to 'Z' for the hardest.

TYPES OF ABRASIVES



Aluminium oxide and Silicon carbide are the two major abrasives used in the manufacture of grinding wheels. These synthetic or manufactured abrasives allow accurate control over the form and physical characteristics of the abrasive grain. It is therefore used in the manufacture of grinding wheels with very specific requirements of performance allied to application needs.

Aluminium Oxide

This grain is derived by refining bauxite ores in an electric furnace. The bauxite is first heated to drive off moisture and then mixed with coke and iron borings to form the furnace charge. After the mixture has been fused and cooled, the resulting rock-like mass is crushed and screened into various sizes.

The colour and the toughness of the abrasive is determined by the amount of impurities (iron oxide, titanium oxide and silica).Toughness is also strongly affected by additives.

White Aluminium Oxide is a highly refined form of aluminium oxide containing over 99 % pure alumina. The high purity of this abrasive not only bestows its characteristic white colour, but also lends it with its unique property of high friability. The hardness of this abrasive is however similar to that of Brown Aloxide (1700 – 2000 kg/mm^2 knoop).

Zirconia

Specialized alumina or Zirconia Aluminium Oxide is a fused mixture of zirconium oxide and aluminium oxide which is used for high production snagging.

Pink Aluminium Oxide

Aluminium oxide and chromium oxide alloy is used to combine the cool, low stress grinding action of high purity aluminium with low abrasive wear. The result is a pink grinding abrasive which is slightly tougher and less friable than white abrasive, while still retaining its free cutting properties.

Ceramic Aluminium Oxide

Ceramic aluminium oxide abrasive is an extremely tough and durable abrasive produced in an unique sol or seeded gel process. The resulting grain is chemically quite pure and of uniform quality and is comprised of a complex polycrystalline micro structure. This is blended in varied percentages, with more friable conventional aluminium oxide, to make sol – gel wheels. The wheel made out of this abrasive stays sharper because the grains actually discard microscopic crystals during use, which creates new, vital grinding surfaces.

Silicon Carbide

Silicon Carbide (SiC) is produced by fusing a mixture of pure white quartz (sand) and fine petroleum coke in an electric furnace. This process is one of synthesising or combining the sand and coke, in contrast to refining bauxite into aluminium oxide. Again the resulting crystalline mass is crushed and graded by particle size.

Silicon carbide abrasives are not only harder than aluminium oxide abrasives but also more brittle. These characteristics make silicon carbide abrasives ideal for grinding low tensile materials like Grey iron and unannealed malleable iron, non- metallic materials such as glass, gem stones, plastic and rubber.

There are two types of Silicon carbide, Black Silicon carbide "C" & Green Silicon carbide "GC".

Black Silicon carbide is very hard and friable than Aluminium Oxide. It has silicon content about 98% minimum.

Green Silicon carbide is also hard and friable. It has silicon content about 99% minimum.

Diamond

Diamond is the hardest known substance. Until recently, use of diamond abrasive was generally limited to hard and dense materials like cemented carbides, marble, granite ,glass and ceramics. However, recent developments in manufactured diamonds leading to controlled crystal configurations and surface coatings have expanded its use in some specialized cases, for grinding of other metals also.

Cubic Boron Nitride

This newest manufactured abrasive has a hardness second only to diamond and is 2.5 times as hard as aluminium oxide. It can withstand a temperature of 2500° F, unlike diamond which begins to burn around 1300° F. In its metal-coated form, cubic boron nitride has proven generally superior to both manufactured diamond and aluminum oxide in grinding super hard, high speed steel, tool steel and die steel.

STERLING ABRASIVES LIMITED
GRINDING WHEELS

SAL-ABRASIVE TYPES, PROPERTIES & USAGE

Abrasive	SAL Abrasive Denotion	Properties	Major Applications
Brown Aluminium Oxide	"A"	Very tough abrasive	The most widely used SAL abrasive. Used for heavy duty work such as snagging steel casting and for stock removal in cylindrical grinding, on all but the hardest and most heat-sensitive steels like low alloy steel, cast steel and rough grinding applications.
White Aluminium Oxide	"AA"	More friable than Brown Aluminium Oxide. This is also a cool cutting grain.	AA is used for light grinding of all kinds of hard, heat-sensitive steels. It is excellent for tool room grinding, sharpening of high speed steel, cast alloy tools like hardend steel, H.S.S., Tool steels, S.S (400 series) and chrome plated material. It is recommended for cylindrical, surface and internal grinding applications of tools, dies and gauges.
Mixture of brown and white aluminium oxide	"DA"	DA is a blend of brown regular A and white AA and therefore, has intermediate grinding actions.	Used in applications where high stock removal rate with less thermal damage and better form holding is required. Eg : Cylindrical plain and angular head grinding, camlobe grinding, Inner ring track grinding, bore grinding etc.
Pink Aluminium Oxide	"PA"	PA (Pink)-Chromic oxide alloyed with Brown Regular alumina give a pink abrasive, which is very sharp and less friable than white aluminium oxide.	Very cool cutting, retains better form and sharp cutting edge for a long time. Used for bore grinding, cylindrical and some specialised precision applications. It works well on tool steel, H.S.S. applications.
Pink aluminium oxide	"PAA"	PAA (Pink)-Chromic oxide alloyed with white aluminium gives a lovely pink abrasive. Free cutting properties, slightly tougher and less friable than white aluminium oxide.	Excellent for dry grinding in tool sharpening and tool room grinding applications. Very cool cutting and sharp on 5% to 10% cobalt steels, Alloyed HSS and on difficult-to-grind materials. A popular abrasive and cost effective for tool room applications.
Black silicon carbide	"C"	Very hard and friable than Aluminium oxide	It is used for general grinding, heavy duty snagging, cylindrical, centreless and internal grinding. With special bonding process, it is also used for grinding cemented carbide, for bench grinding and centreless grinding application. Also used for non-ferrous materials, cast iron, stainless steel and rough grinding applications.

Abrasive	SAL Abrasive Denotion	Properties	Major Applications
Green silicon carbide	"GC"	Hard and friable	Used for grinding cemented carbide tools, hard chilled cast iron rolls etc. Extensively used in food applications like rice whitening.
Combination of black and green SiC	"CGC"	Combined properties of C ang GC	Used mainly in the mining field and also in double disc grinding application for grinding piston rings. Also used in food applications like rice and pulse milling.
Blend of Aluminium oxide & Silicon carbide	"AC"	Combined properties of A and C.	Used mainly in specialized precision and non precision applications.
Zirconia with Brown Aluminium Oxide	"ZA"	Free cutting, very tough and long life abrasive	Ideal for heavy stock removal operation. Used for de-scaling in stainless steel applications.
Mono Crystalline	"MCA"	High hardness and micro fracturing	It is suited for wide variety of application from general grinding to precision grinding of high hardness tools and steels. Eg: Internal Grinding wheels, gear grinding wheels, Tool Industry (flute grinding wheels).
Ruby Grains	"RB"	The presence of chromium oxide in the lattice of the fused aluminium oxide alters the friability of the material	Used mainly in vitrified bonds for precision grinding of hardened steel, high speed steel and tool steel.
Semi friable Aluminium Oxide	"FS"	Its friability and chemical composition is in between that of brown and white aluminium oxide.	Good form holding and high degree of versatility makes suitable for precision grinding operations Eg: Suitable for crankshaft, surface and cylindrical grinding of sensitive steels, metal and alloys because of its particularly cool and fast cutting quality.
Sol Gel	"CG"	Multi fracturing property due to micro crystalline structure.	Very cool cutting with self sharpening cutting edges. This abrasive is ideal for very high material removal. Eg: Used in centerless, surface, internal, cylindrical, tool & cutter, roll grinding, gear grinding etc. Preferred for higher durability and longer life.
Norzon	"NZ"	Very tough abrasives	Recommended for very heavy stock removal operation on heat sensitive material.
Mono crystalline blue	"MCZ"	High Hardness and micro fracturing.	Surface and cylindrical grinding of high speed steel, stainless steel generally high alloyed, hardened steels above 62 HRC. Further used for tool room grinding, roll grinding and gear grinding.
Polycrystalline	"ZPMX"	Polycrystalline and high-porous chromium-titanium oxide	Profile grinding, roll grinding, disc grinding, creep feed grinding and gear grinding. Main advantages are - improved bonding of the abrasive grain inside the grinding wheel and a controlled fracturing in between and inside the small crystals, resulting in high cut rates, a cool cut with less burning sensitivity, lower grinding forces.

TYPES OF BONDS

Types of Bond used in grinding wheels

The various bonds used in grinding wheels or bonded abrasives are Vitrified, Resinoid, Rubber, Silicate, Shellac, Magnesite and Metal bonds. Besides holding the grains together, these bonds also help in defining the type and character of the grinding wheel.

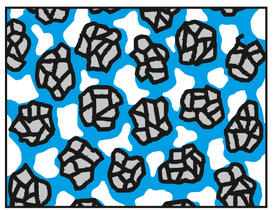


Illustration showing bond "Post" holding abrasives grain particles (Cyan portion represents bond "Post")

Vitrified (V) or Ceramic bonds

These are made from clays, feldspar and other fusible materials in a carefully monitored process. Wheels which use this bond have a porous structure and are fired in kilns with temperature exceeding 1000° C. Vitrified wheels are unaffected by water, acids, oils or normal temperature variation. The porosity and strength of these wheels make them ideal for high stock removal operations. Added to this, Vitrified bonded wheels have a high modulus of elasticity and this rigidity makes them suitable for precision grinding applications.

Resinoid or Organic (B) bonds

Resinoid or Organic Bonds are made from phenolic type plastics or resins and cured in ovens under carefully controlled conditions of temperature ranging between 150° C to 200° C. Resinoid wheels are tougher and less rigid than vitrified wheels and are ideally suited for high operating speeds and also for heavy duty of operations, often with the aid of fabric or steel ring reinforcement. Their lower modulus of elasticity helps in achieving finer finishes. Unlike vitrified wheels, resinoid bonded wheels are affected by alkalies, humidity or extremes of climatic conditions and tend to deteriorate over a period of time.

Rubber (R) bonds

These are made of both natural and synthetic rubber in a varied range of formulations. Used mainly in centreless and control wheels, these are ideally suited for grinding operations that require a high degree of precision and fine surface finish. In wet grinding operations, thin cut-off wheels used to produce burr and burn free cuts are also made of rubber.

Shellac (E) Bonds

Denoted by the letter "E" these are made of both natural and synthetic shellac. Wheels made from these bonds have exceptionally cool cutting properties and are particularly suited for grinding very soft materials such as copper. Shellac bonded wheels are highly recommended for very special grinding applications that require high surface finish such as razor blade and roll grinding.

Plastic (PD) / Epoxy (ED) bond

They are made by polymerizing a mixture of two starting compounds, the resin and the hardener. When resin is mixed with a specified catalyst, curing is initiated. Plastic/Epoxy bonded wheel is not affected by water, acid and is more elastic than resinoid wheel. It is widely used for grinding applications that require high stock removal, cool cutting, excellent finish, superior wheel life etc.

VARIOUS BONDS USED BY STERLING

Vitrified Bonds

SR No.	Name of the Bond	Characteristic	Application
1)	V4 & V4-M	Suitable for Black & Green Silicon Carbide. Speed 35 MPS Max.	• S.S. Bright Bar Grinding • Cylinder Liner Grinding • S.G. Cast Iron Grinding • Carbide Tips Sharpening • Saw Gumming Wheels
2)	V23	Suitable for Black & Green Silicon Carbide Speed 50 MPS Max.	• S.S. Bright bar Grinding • Cylinder Liner Grinding • S.G. Cast Iron Grinding • Carbide Tips Sharpening
3)	V5	Suitable for Alu.Oxide Grain i.e. White, Pink, Brown, Ceramic, Ruby ,semi friable, etc.	• Bore grinding for Bearing Industries • Internal Grinding for Automobile Parts
4)	VC8	Suitable for Alu.Oxide grain like White, Pink, Ruby, MCA & Ceramic grains. Speed 45 MPS Max.	• Surface grinding and Tool Room Application • Bearing Industries for Centreless wheel • Hard grade Wheel for Thread Grinding / Precision Grinding • Non porous segment for surface grinding application • Cylindrical Grinding Operation for general purpose

STERLING ABRASIVES LIMITED
GRINDING WHEELS

VARIOUS BONDS USED BY STERLING

SR No.	Name of the Bond	Characteristic	Application
5)	V15 & V15M	Suitable for all type of Alu.Oxide Grain Speed 45 MPS Max.	• Centreless Wheel for Bright bar grinding application • Surface Grinding Application • Cylindrical and Roll grinding Application
6)	VC10	Suitable for all type of Alu.Oxide Grain Speed 45 MPS Max.	• Surface grinding and Tool Room Application • Centreless wheel in Bearing Industry • Hard grade Wheel for Thread Grinding / Precision Grinding • Non porous segment for surface grinding application • Cylindrical Grinding Operation for general purpose
7)	VC11 & VCE	Suitable for Alu.Oxide grain like White,Pink, Ruby, MCA Ceramic, MCZ etc. Speed 50 MPS Max.	• Surface grinding and Tool Room Application • Centreless wheel in Bearing Industry • Precision Grinding Wheel • Non porous segment for surface grinding application • Cylindrical Grinding Operation for general purpose • Crank Shaft Grinding
8)	VSC	Suitable for Brown, White, Ceramic, Pink, MCA , Ruby, MCZ etc. Speed 60 MPS Max. Good form retention ability	• Crank Shaft Grinding • High Porous Segment for surface grinding • Creep-feed grinding • Gear grinding for open structure soft grade Reishauer Wheel.

VARIOUS BONDS USED BY STERLING

SR No.	Name of the Bond	Characteristic	Application
9)	VP7	Suitable for Brown, White, Ceramic, Pink, MCA grain Speed 60 MPS Max. & Good form retention	• Inner Track, Outer Track in Bearing Industry • Gear Grinding Application
10)	V9	Suitable for Brown, White, Pink, Semi friable etc. Speed 35 MPS Max.	• Fettling and Snagging Industry • Spring Industry • Offhand Tool Grinding
11)	V6	Suitable for Brown, White, Pink & Semi friable. Speed 35 MPS max.	• Fettling and Snagging Industry • Spring Industry • Offhand Tool Grinding
12)	V13	Suitable for Black & Green Silicon Carbide Grain Speed 35 MPS max.	• Extensively used in food applications like rice whitening, pulse hulling, wheat milling etc. • Fettling Operation in SG Cast Iron Industry.
13)	VB19	Suitable for Black & Green silicon carbide grain. Also we can use this bond for aluminum oxide grain or combination with sic Black / Green + Aluminum oxide.	• Extensively used in food applications like rice whitening, pulse hulling, wheat milling etc. • Longer stone life / Less rice brokens / Excellent whiteness and shining.
14)	V17	Suitable for Brown, White, Ceramic, Pink, MCA grain Speed 60 MPS Max. Excellent form retention ability	• Inner Track, Outer Track in Bearing Industries • Gear Grinding Application

STERLING ABRASIVES LIMITED
GRINDING WHEELS

VARIOUS BONDS USED BY STERLING

SR No.	Name of the Bond	Characteristic	Application
15)	V18N	Suitable with White Alu Oxide Grain Speed 35 MPS Max.	• Surface grinding application for segment & ring wheel • Used in bearing, connecting rod and auto-parts grinding
16)	V84 & VCEF	Suitable with White Alu. Oxide Grain Speed 45 MPS Max.	• Used in tool room industries. • Rubber roll grinding.
17)	VKM	Suitable with Brown, White, Ceramic, Pink, MCA grain Speed 80 MPS Max and hardness 'J+' & above Can use this bond for aluminum oxide grain or combination with sic Black / Green + Aluminum oxide Good stock removal, Better Productivity	• Surface grinding and tool room application • Precision grinding wheel • Cylindrical grinding operation for general purpose

ADVANCED BOND SYSTEMS

Cool grind bonds for vitrified aluminium oxide grinding wheels

SR No.	Name of the Bond	Characteristic	Application
1)	VTR	High fusibility Bond suitable for Brown, White, Pink, MCA, Ruby, MCZ, SF, etc. It is highly suitable For Ceramic grain having cool grinding properties. Speed 45 MPS Max.	Surface grinding with segment / Large contact area / Rotary & Reciprocating type surface grinding / High hardness job grinding.
2)	V31	Semi fusibility bond suitable for Brown , White, Pink, MCA, Ruby, Ceramic, MCZ etc. Speed 45 MPS Max.	Tool room industries / C'less grinding wheel for surface operation / Non Ferrous grinding with segment & Ring wheel for surface grinding / Cylindrical grinding operation for general purpose.
3)	VLT	Highly fusible bond for Brown, White , Pink , MCA , Ruby , Ceramic , MCZ etc. Speed 45 MPS Max.	High porous segment for surface grinding / Internal wheel for high hardness job grinding.
4)	V75	Semi glassy fusion bond suitable for Brown, White, Pink, MCA, Ruby, MCZ, SF, etc. Speed 50 MPS Max.	Highly suitable for porous and open structure wheel / Creep feed wheel.
5)	V34	Suitable for 80 MPS wheel having hardness of 'J+" & above. It is suitable for Brown, White, Pink, MCA & Ceramic Grains.	IR Track & Outer track in bearing industries / Precision grinding in automobile industries / Tool room / Highly suitable for ceramic grain grinding wheel Benefits; Good form retention / Less dressing frequency / Easy fracturing / Better productivity & Longer life.
6)	V32	Semi glassy fusion bond suitable for Brown, White, Pink, MCA,Ruby, MCZ, SF, etc. Speed 60 MPS Max.	Highly suitable for 20 MnCr5 & 16 MnCr5 Job material / IR Track / Precision grinding in automobile industries / Highly suitable for ceramic grain segment wheel / Highly suitable for valve sheet grinding.
7)	V615	Suitable for Brown, White, Pink, Ruby, Ceramic, MCA etc. Speed 45 MPS Max.	Highly suitable for Internal grinding application.

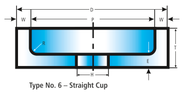
RESIN BOND APPLICATION

SR No.	Name of the Bond	Characteristic	Application
1)	BS	Resinoid grinding wheel. Speed 50 MPS Max.	Snagging operation in foundry & casting industries / Face grinding operation in bearing / Spring & con rod grinding / Automobiles industries / Surface grinding / Centreless / Cylinder & liner OD grinding.
2)	EFP & EF	Shellac bonded wheel for cool cutting. Speed 45 MPS Max.	Surgical blade grinding / Hypodermic needle grinding / Razor blade and roll grinding.
3)	BS86 & BS60	Special resin formulation for 60 MPS Max.	Disc brake grinding (Two wheeler) / Roll grinding (hot & cold roll grinding) / Valve plate grinding. Benefit: High stroke removal / Better Productivity / Less dressing frequency.
4)	BS75 & BS33	Special resin formulation for high stock removal and longer life. Speed 60 MPS Max.	Shock absorber rod (Two wheeler & Four wheeler) / Lapping & Compressor valve plate / Bearing face grinding / Brake disc grinding (for two wheeler). Benefit: More depth of cut / No scratch mark / Higher productivity & longer life / Dressing frequency low.
5)	BS19	Special resin formulation for foundry & snagging application for higher grinding ratio. Speed 50 MPS Max.	Foundry & Snagging application / Suitable for Dry grinding / Manganese & High chrome job grinding. Benefit: High stock removal / Better output / No Burning (low heat generation during grinding) / High grinding ratio.
6)	BS23	Special resin formulation for high stock removal. Speed 50 MPS Max.	Foundry & Snagging application Benefit: Fast stock removal / high grinding ratio

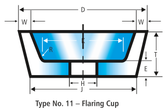
STANDARD GRINDING WHEEL SHAPES

Straight Wheels Types

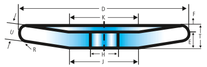
Type No. 1 – Straight



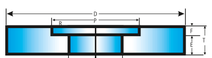
Type No. 6 – Straight Cup



Type No. 11 – Flaring Cup



Type No. 13 – Saucer



Type No. 5 – Recessed One Side

Straight Cup Wheels

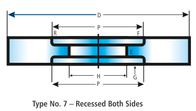
Wheel Type No.6 is a straight cup wheel and is used primarily surface grinding on horizontal or vertical spindle machines. It is also useful for off hand grinding when a flat surface on the work being ground is desired. Available in either plain or bevel face.

Flaring Cup Wheels

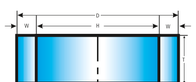
Wheel Type No. 11 is a flaring cup wheel used for grinding in the tool room and in resinoid bonds for snagging. It is supplied with either a plain or bevelled face.

Saucer Wheels

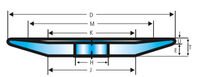
Wheel Type No. 13 is a saucer wheel or saw gummer. Its name is derived from its use for re-sharpening saws. (saw gumming).



Type No. 7 – Recessed Both Sides



Type No. 2 – Cylinder



Type No. 12 – Dish

D	Diameter (overall)
E	Thickness at hole or back thickness
F	Depth of recess (see type 5 & 7)
G	Depth or recess (see type 7)
H	Hole
J	Diameter of outside flat
K	Diameter of inside flat
M	Large Diameter of bevel
P	Diameter of recess
R	Radius of corner
T	Thickness (Overall)
U	Width of edge
W	Wall thickness of grinding face

Straight Wheels

Wheel Type No.1, 5 & 7 are standard for internal grinding, cylindrical grinding, tool grinding, offhand grinding and snagging. The recesses in Type No. 5 and 7 give clearance for the mounting flanges.

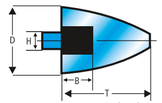
Cylinder Wheels

Wheel Type No.2 is used for surface grinding on both horizontal and vertical spindle machines with the grinding performed on the face of the wheel.

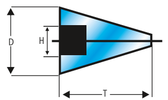
Dish Wheels

Wheel Type No. 12 is a dish wheel for grinding in the tool room. Its thinness permits the insertion of the grinding edge of the wheel into narrow places.

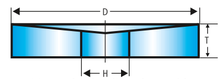
STANDARD GRINDING WHEEL SHAPES



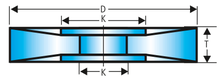
Type 16. - Cone. curved side



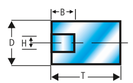
Type 17. - Cone.
straight side square tip.



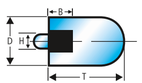
Type 20R - Wheel, relieved one side.



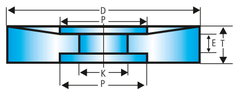
Type 21 - Wheel, relieved two sides.



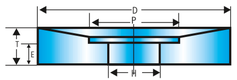
Type 18 - Plug.
Square end



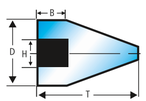
Type 18R - Plug.
Round end



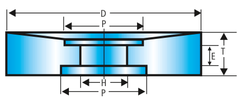
Type 22 - Wheel, relieved one side.
recessed other side.



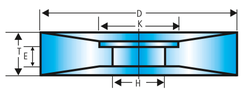
Type 23 - Wheel, relieved and recessed
same side.



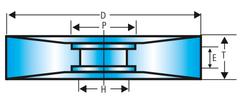
Type 19 - Plug.
Conical end, square tip



Type 24 - Wheel relieved and
recessed side, recessed other side.

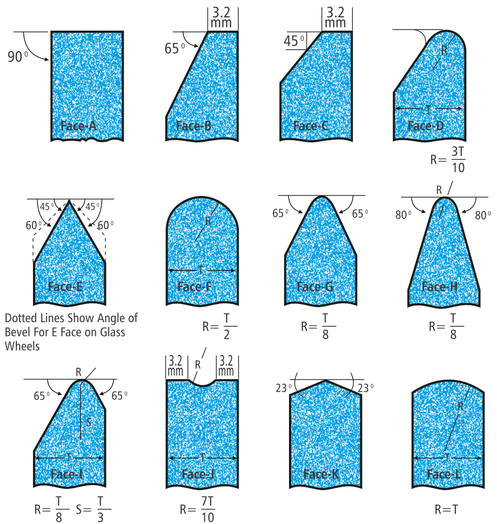


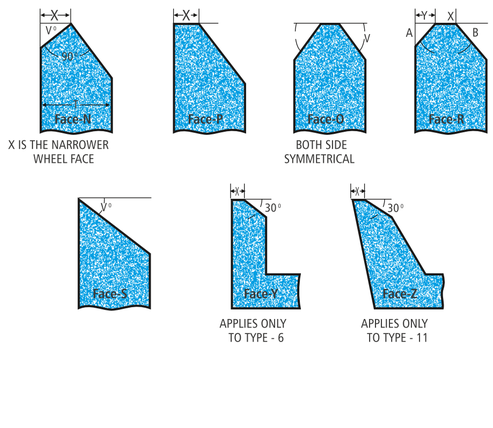
Type 25 - Wheel, relieved and
recessed one side, relieved other side.



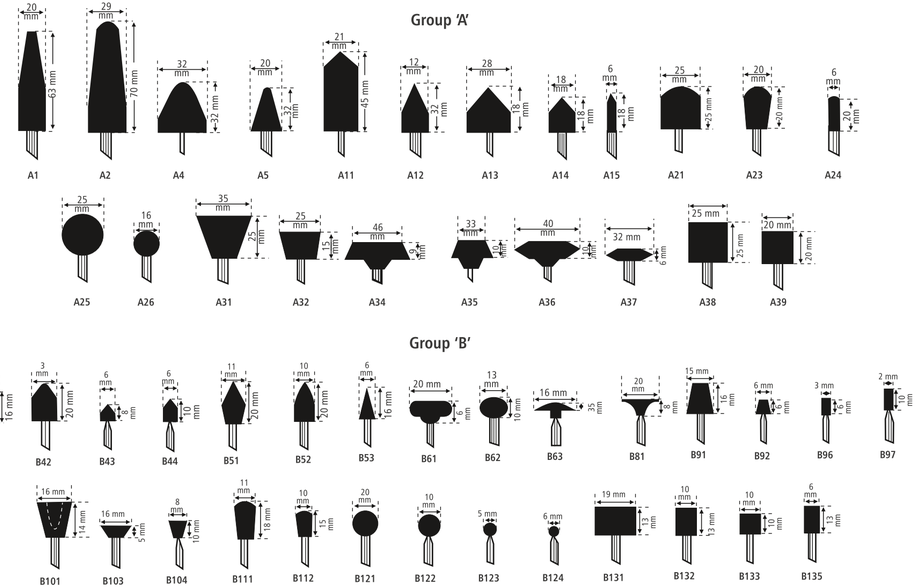
Type 26 - Wheel, relieved and
recessed both sides.

STANDARD SHAPES OF GRINDING WHEEL FACES





STANDARD SHAPES OF MOUNTED POINTS



HOW TO SPECIFY A WHEEL ?

To specify a grinding wheel requirement, it is important to follow the following steps:

Standard Wheels :

1. Specify the wheel size by quoting in mm the overall dimension

   Diameter x Thickness x Bore

   The diameter and thickness can be specified in nominal dimension whereas the bore diameter should be indicated to the closest two decimal places.

   E.g. 500 x 200 x 304.8 mm
2. Indicate the type and shape of the wheel face.
3. Specify wheel grading / speed

Customised Wheels:

1. Specify the dimensions in the order of

   Diameter x Thickness x Bore
2. Mention the type of wheel required.
3. Indicate the recess size and depth for type 5 & 7 wheels (ROS & RBS)
4. Indicate the shape of the wheel face, if it is applicable
5. If the dimension has special tolerance of diameter, thickness or bore, this needs to be indicated.
6. Specify wheel grading / speed
7. A detailed drawing of the wheel to be provided.

   Grinding wheels can be manufactured in a wide range of standard shapes or customized to different application requirements. For easy selection, refer list of Standard Grinding Wheel Shapes as well as **SAL Wheel Marking System.**

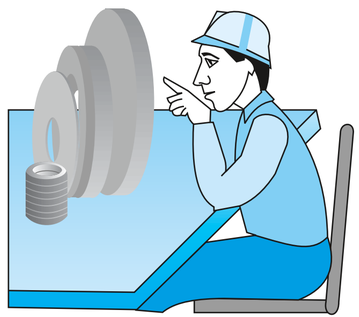
SAL Wheel Marking System

NOMENCLATURE OF STERLING GRINDING WHEELS

A	46	L	5	VSC	
TYPE OF ABRASIVES	**GRAIN SIZE**	**HARDNESS**	**STRUCTURE**	**BOND TYPE**	**WHEEL SPPED MPS**
A REGULAR BROWN ALUMINIUM OXIDE	8	D EXTREMELY SOFT	3 CLOSE	V – VITRIFIED	33
AA WHITE ALUMINIUM OXIDE	10 VERY COARSE	E	4	BS – RESINOID	45
DA REGULAR + WHITE ALUMINIUM OXIDE	12	F VERY SOFT	5	EF/ EFP – SHELLAC	60
PA PINK ALUMINIUM OXIDE	14	G	6 MEDIUM	ED – EPOXY	80
PAA PINK + WHITE ALUMINIUM OXIDE	16	H SOFT	7	PD – PLASTIC	
FS SEMI FRIABLE ALUMINIUM OXIDE	20	I	8		
RB RUBY GRAINS	24 COARSE	J	9		
ZR ZIRCONIA GRAINS	30	K MEDIUM	10 OPEN		
NZ SPECIAL NORZON GRAINS	36	L	11		
CG CERAMIC GRAIN (BLUE)	46	M	12		
SK CERAMIC GRAIN (WHITE)	54 MEDIUM	N HARD	13		
MCA MONOCRYSTALINE ABRASIVES - GREY	60	O	14 POROUS		
MCZ MONOCRYSTALINE ABRASIVES - BLUE	70	P	16		
C BLACK SILICON CARBIDE	80	Q	18		
GC GREEN SILICON CARBIDE	90	R VERY HARD	19		
CGC BLACK + GREEN SILICON CARBIDE	100	S	20		
	120 FINE	T EXTREMELY HARD	21 VERY POROUS		
	150	U	22		
	180		23		
	220		24		
	320				
	400 VERY FINE				
	500				
	600				
	800				

WHEEL SELECTION

SAL has one of the widest range of grinding wheels. Available in standard sizes or customized to specific grinding applications, these premium quality wheels are manufactured to suit the diverse grinding needs of all user industries. Since there are as many types of wheels as there are grinding applications, correct wheel selection assumes very critical importance.



Factors affecting the Selection of a Grinding Wheel

Wheel selection is dependant on the kind of material to be ground and the type of grinding operation. The eight important factors that need to be considered in the selection of a grinding wheel are:

1. Material to be ground and its hardness
2. Stock removal and surface finish
3. The grinding process - whether wet or dry
4. Peripheral speed of the wheel
5. The area of grinding contact - large or small
6. The severity of grinding operation
7. Condition of grinding machine
8. Type of grinding machine

1. Material to be ground and its hardness

The type of material to be ground determines the selection of abrasives, its grit size and grade. Aluminium oxide abrasives are ideal for grinding hard or high tensile materials such as alloy steel, high speed steel, annealed malleable iron and other ferrous metals.

Silicon Carbide abrasives are excellent for grinding or cutting low tensile strength materials such as cast iron, bronze, aluminium, copper and other non metallic materials.

While choosing the grit size, the hardness of the material is a major determining factor. While

finer grit size wheels are required for hard and brittle materials, coarser grit wheels are ideal for soft and ductile materials.

Material hardness also dictates the choice of wheel grades. For optimum performance, harder grade wheels are recommended for soft and easily penetrated materials while softer grades are ideal for hard materials.

2. Stock removal and surface finish

The amount of stock removal and the degree of surface finish required also depends on the abrasive size and the type of bond. When an operation demands high stock removal rates, as in fettling, coarse grit wheels are used. Whereas, fine grit wheels are ideally suited to achieve extremely close surface tolerances and fine geometrical finish.

Resinoid, rubber or shellac bonded wheels are usually recommended for operations that require fine finishes. The following table illustrates the grit size vs form radius for grinding wheels that are commonly in use

Grit Size vs Form Radius

Work Radius (mm)	Girt Size	Abrasive Particle Dia. (microns)
1	36	500
0.75	46	350
0.50	60	250
0.40	80	177
0.20	120	100
0.13	180	70
0.10	220	60

3. Grinding Process - Wet or Dry

The grade of the wheel depends on whether the operation is wet or dry. During dry grinding with vitrified wheels, in order to minimize the heat generated, soft grade wheels should be used. These should be at least one or two grades softer than the ones chosen for wet grinding operations.

In wet grinding applications, where coolants reduce the heat, harder grade wheels should be used.

4. Peripheral Speed of the Wheel

The speed at which the grinding edge of the wheel passes the work surface is called the 'Peripheral Speed' of the wheel. This is a very important factor in grinding wheel selection.

Standard vitrified wheels are usually for speeds of not more than 33 MPS. However, on the other hand, special bonded vitrified wheels can take speeds up to 60 MPS. This is usually indicated on the blotter or on the face of the wheel. Organically bonded wheels (resinoid, rubber or shellac) are used for most applications where the required speed rate is above 33 MPS to 48 MPS. Higher speeds for reinforced products can go up to 100 MPS. Reducing the wheel speed reduces the wheel hardness.

The following table illustrates the effect of speed on grinding action:

Speed	Effect on Grinding Action when Speed is	
	Increased	Decreased
Wheel Speed	Harder	Softer
Work Speed	Softer	Harder
Traverse Speed	Softer	Harder
Infeed rate	Softer	Harder

5. Area of Grinding Contact - Large or Small

The area of grinding contact influences the selection of wheel grade and grit size. As far as wheel grade is concerned, it is normal practice to use soft grade wheels where the area of grinding contact is large and harder grade wheels where the area of grinding contact is small.

In surface grinding, for instance, where the area of grinding is large, coarser grit, open structure wheels are recommended. Conversely, fine grit, closer structure wheels are ideal for use in narrower and close precision areas of contact, as in cylindrical grinding operations.

6. Severity of Grinding Operation

Severity of a grinding operation can be due to various factors such as, the pressure of shock loads, heavy infeeds, high work speeds, high traverse rates and intermittent grinding contact. Hence, for wheel selection, the severity of a grinding operation dictates the choice of abrasive type, grade and even type of bond.

The greater the severity of the grinding operation, the harder the grade of wheel required and tougher the abrasive that should be used. For example, for severe grinding operations, like snagging, a tough abrasive like A or ZA is required. Medium and soft grade wheels are ideally suited for precision grinding jobs.

7. Condition of Grinding Machine

Many grinding faults can be traced to bad machine conditions. These can vary from loose bearings, uneven or improperly spliced belts, belt slippage, worn gears, wrong alignment of machine, inadequate foundation or general machine vibration. In fact, it is very important that all grinding machines must be installed or fixed on flat and strong foundations.

8. The Type of Grinding Machine

A very important factor in a grinding wheel selection, is the type of the grinding machine. The type of wheel and grinding operation defines the type of machine to be used. Only wheels, for which the machine is intended should be used. For instance, a non-reinforced cutting off wheel should never be mounted on a portable grinding machine or on any machine where the work is fed into the wheel.

8. a. The Power of the Machine (Kw)

The power of the machine is of paramount importance. This greatly influences the stock removal rate. If the motor power is insufficient, then the speed of the grinding wheel will be correspondingly reduced, as also the cutting power. This can result in increased temperatures and excessive pressure between the wheel and the work piece. If the power of the machine is high then a wheel of a harder grade should be used for efficient operations.

8. b. Machine Speed

The user should take care to check that the maximum rpm stated on the wheel is compatible with that stated on the machine. Under no circumstances should the user exceed the permissible speed limits. Machines with adjustable rotational speeds must be fitted with a locking system to prevent wheels from exceeding the maximum permissible speed.

STERLING ABRASIVES LIMITED
GRINDING WHEELS

TECHNICAL GRINDING INFORMATION

Wheel Spindle

The design of the wheel spindle should suit the requirements of the grinding wheel with which it is to be used (dimensions, weight, speed etc.) and the loads to which it will be subjected.

To ensure ideal wheel and spindle fit, grinding wheel bores should have positive tolerances on them and grinding wheel spindles negative tolerances.

The spindle should be of sufficient length and threaded sufficiently to ensure that when the wheel and flanges are mounted there will be a bearing for atleast a full nut on the spindle. The spindle thread should extend inside the flange, but not into the hole in the wheel.

Spindles should be properly lubricated to prevent them from becoming overheated during grinding.

Mounting Flanges

The mounting flange is used to clamp the wheel to the machine and to transfer the driving forces from the machine spindle to the grinding wheel.

The design and type of the wheel flange varies according to the machine and type of grinding wheel. The flange should not be less than one-third of the diameter of the wheel used. The grinding machine manufacturer should clearly state the type of material to be used and the thickness of the flange.

The various types of flanges are

1. Straight recessed flange

2. Straight adaptor flange

3. Hubbed flange

4. Tapered flange

5. Straight flange

Flanges should be of a matched pair and of equal diameter. They should have equal bearing surfaces and be properly recessed or undercut.

The area between the grinding wheel and the clamping flanges should be flat and free from all foreign matter. The flange should be fixed to the machine spindle by keying, bolting or by any other similar method.

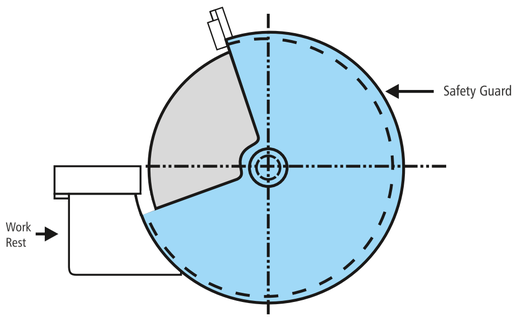
The screws or nuts used for clamping the flanges should be tightened uniformly in diametrical sequence and just sufficiently to hold the wheel firmly.

Safety Guards

All grinding machines should be fitted with safety guards and guard bands, designed specifically for the type of wheel and grinding application. These safety guards should conform to standard specifications and cover the entire wheel, except the area of grinding. Certain operations however, require even the working area to be guarded. Mainly, safety guards should be able to effectively contain wheel fragments and protect the operator, in the event of a wheel breakage. These guards should also be adjustable to allow for wheel wear.

Work Rests

Work rests should be fitted with fixed grinding heads to help in the easy guidance of hand held work pieces. They should be strong and rigid and be adjustable to allow for wheel wear. Work rests should be placed on the horizontal centreline of the wheel at a distance of not more than 3 mm from the wheel.



Wheel Balancing System

All **SAL** wheels are balanced within normal limits. However, for certain precision grinding operations where closer limits of wheel balance are required, the machines should be equipped with wheel balancing systems. In such cases the machine manufacturer's instructions should be followed.

Similarly, when a wheel has been worn down or used for a long time without being trued, re-balancing it becomes necessary. Generally, the larger the wheel and higher its speed, greater is the need for balancing it. Using an out-of-balance wheel can result in damage both to the wheel and the spindle.

Blotters

Blotters are very important in the operation of a grinding wheel. These are made of a flexible and compressible material, like cardboard or plastic of around 0.2 to 1.0 mm thickness and are placed between the flange and the grinding wheel.

Blotters of identical sizes are usually pasted on both sides of the wheel face or supplied loose with the wheel. In the case of loose blotters, the user should take care to see that there is no mix-up and that same size blotters are fixed on either side of the wheel.

The size of the blotters should always be larger than that of the mounting flange. Blotters must also be placed without any wrinkling on them.

The purpose of using blotters are

- To act as a cushion between the metal mounting plates and the granular surface of the grinding wheel
- To eliminate any distortion, between the wheel and the flange within the locating area.
- To minimise the risk of slippage between the wheel and the flanges.
- To distribute equally, the axial clamping force, when the nuts are tightened, over the entire flange locating area.
- To prevent any uneven wear of the mounting flanges.

Wheel types for which blotters are not required

- Small wheels up to 20mm diameter.
- Type 27 depressed centre wheels
- Type 29, semi-flexible wheels
- Type 41 and 42, reinforced cutting off wheels, up to 230mm diameter
- Type 43 steel centred saws
- Type 4 taper sided wheels
- Type 6 and 11 straight and flared cup wheels, with centre nuts
- Type 35 and 36 cemented or nut inserted disc wheels
- Type 2 and 37 cemented cylinder and nut inserted cylinder wheels
- Type 31 segments
- Type 52 mounted wheels and points
- Type 16 to 19 plugs and cones with central thread insets
- Type 54 honing stones
- Type 90 hand stones
- Thin cutting and slitting wheels, up to 0.5mm thickness.
- Dove-tailed recessed wheels

Dressers

Dressers are used for Truing and Dressing a grinding wheel. Truing a wheel is done to obtain the required geometry or form on the grinding face of the wheel.

Dressing a wheel changes the shape and cutting action of the grinding face. It restores the form and surface of a grinding wheel and also increases grinding efficiencies.

Guidelines for dressing

- The dresser should be held as rigidly and as close as possible to the point of dressing. For machines equipped with work piece supports, the dresser should be made to rest against the support. This is to ensure vibration free operation.
- The diamond point of the dresser should be presented at an angle between 3° to 10° relative to the centre line of the wheel.
- To maintain the sharpness of the diamond point, the dresser should be rotated in the machine tool holder at an angle of 15° to 45°. Rotating the dresser before starting the machine for the day enhances the life of the tool as well provides consistent performance.
- Dressing should be carried out at normal speeds with copious amount of Metal working fluids.
- The dresser should not be quenched, if by accident it becomes overheated. It should be allowed to cool naturally.
- Never use a worn out diamond tool as it may jam into the grinding wheel and fracture or disintegrate.
- For best results, each machine should have its own dresser.

Grinding or Metal Working Fluids

One of the most critical factors in achieving a good finish and excellent finished product is the Metal Working Fluid (MWF) or the Grinding Fluid or the Coolant. Grinding fluids are used to reduce and dissipate the heat generated during a grinding operation.

Functions of a coolant

The main functions of the coolant are cooling and lubrication. Other functions of the coolant are as follows:

1. Dissipate the heat generated during grinding thus keeping the work and wheel cool.
2. Aids the grinding wheel to reproduce size more accurately through elimination of work distortion due to heat.
3. As a lubricant, it reduces the amount of friction between the cutting tool and the chip.
4. Decreases the effect of ductility of metal being ground and thus influences the form of chip.
5. Protects the diamond dressing tool while dressing.
5. Reduces loading to improve finish.
7. Good coolant has anti-rust characteristics to prevent rusting of machine or work being ground.
8. Aids in chip transportation and dust elimination.

Types of Coolants

Coolants can be classified as follows:

1. Neat Cutting Oils
2. Water based Cutting Fluids

Water based fluids can be further classified as Synthetic, Emulsion and Semi - Synthetic.

Synthetic

Synthetic metal working fluids are fluids which are free from mineral oil. The constituents are finely distributed in water and form a transparent solution. The mineral oil free chemical solutions contain corrosion inhibitors and wetting agents. They have exceptional cooling and lubricating properties especially in very high speed cutting applications and hence are ideally suited for high speed CNC machines.

Emulsion

The most common form of water miscible metal working fluid is the emulsion. An emulsion is a dispense system which arises through mixing together of two liquids which are not soluble in each other. Emulsions basically contains higher proportion of mineral oil viz., 30 to 70% along with corrosion inhibitors and wetting agents. Product concentrates are diluted with water to form milky, opaque emulsions.

Some fluids in the above category contain synthetic lubricants and/or EP additives to extend their application range and enable the fluid to perform more difficult operations.

Semi Synthetic

Semi Synthetic are so called because they form in the main, clear emulsion combined with synthetic or natural emulsifiers. They contain 10 to 30% mineral oil, corrosion inhibitors and wetting agents. Product concentrates are dissolved in water to form stable, translucent mixes.

Selection of Coolants

Coolant type selection is based on the following factors:

- Application type & Severity of operation viz., stock removal
- Nature of machine operation (cutting method)

- Water quality (Soft, Hard, Chloride, Sulphate, Bi-carbonate %)
- Material to be machined
- Surface finish
- Filtering system in the machine tool
- High performance to cost ratio.

Coolant Usage

Metal working fluids should be used in the right proportion, since the strength of resin, shellac and rubber bonded grinding wheels can be reduced by Metal working fluids.

The concentration and alkalinity of Metal working fluids used should be regularly checked and the pH value should be maintained between 8.9 to 9.3.

Never immerse a stationary wheel in Metal working fluids for a long time. This will produce an out-of-balance condition in the wheel.

Always shut off the supply of Metal working fluids before the end of any wet grinding operation and allow the wheel to rotate until the Metal working fluids is completely drained.

For a detailed list of troubleshooting tips on coolant usage check section on Problem Solving.

TORQUE FOR TIGHTENING THE FLANGES

Grinding wheel must be clamped with adequate torque so that it is neither loose, which will result in wheel slippage, nor excessively tight to cause wheel cracking.

The torque required for tightening of flanges depends on the flange design, bearing area, diameter of the wheel and pitch of the bolt.

Machine manufacturers have their own flange design and they differ from each other. It is recommended to use torque specified by the machine manufacturers in their manual. The following table gives the torque to be used for standard flanges.

This is taken from French Safety Code INRS-12 -F- 1996. This can be referred only if machine manufactures recommendation is not available.

Flange Tightening Torque		
Dia	Up to 45 MPS	60 MPS
Up to 500 mm	30 Nm	40 Nm
Above 500 & up to 750 mm	40Nm	50 Nm
800 mm and above	50 Nm	60 Nm
Please Note : For thickness upto 25 mm, use as per 60 MPS values		

Thread Pitch				
Wheel	2 mm	3 mm	4 mm	5 mm
Diameter	M – kg	M – kg	M – kg	M- kg
100 mm	0.4	0.4	0.6	0.8
200 mm	1.2	1.6	2	2.8
300 mm		3.6	4.8	6
400 mm		6.4	8	10
500 mm		10	14.8	16
600 mm		14.4	19.2	24
800 mm		25.5	34	44

Note :- For Resinoid wheels multiply the toque by a factor of 2 / Torque in M-kg

Torque For Vitrified wheels with Adaptor Type Flanges			
Wheel	No.of Bolts	Types of	Torque
Diameter		Bolts	M- kg
250 mm	6	M8	0.3
300 mm	6	M8	0.42
350 mm	6	M10	0.6
400 mm	6	M10	0.72
500 mm	8	M10	0.96
600 mm	8	M12	1.5
750 mm	8	M16	3
900 mm	8	M16	4.2
1060 mm	8	M16	6
1250 mm	8	M16	7.8

STORAGE

Storage of Grinding Wheels

Grinding wheels must be handled with extreme care and great importance should also be given to the method of storing them. A grinding wheel, if handled or stored badly, can cause serious problems when in operation.

Given below are a few basic guidelines in handling and storing of grinding wheels

On receipt of a wheel

When you receive a grinding wheel, first check to see if the wheel shows any sign of damage, such as chipping, cracking or discolouration. If the wheel has any one of these problems, then it is definitely damaged. Just reject the wheel.

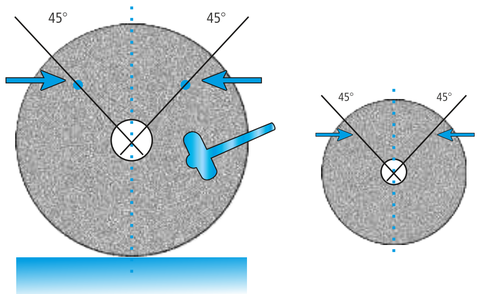
Ring Test

A ring test should always be conducted on receipt of a grinding wheel as well as before mounting it. This is mainly done to detect if there is any damage to the wheel. While conducting the ring test, small wheels should be held with the fore finger inside the bore while large wheels should be placed on a stand or support as shown in the figure.

The wheel should be tapped lightly with a non metallic implement like a screw driver handle in case of small wheels or a wooden mallet in the case of heavier wheels.

Ring Test

While conducting the ring test, tap the wheel on either side at 45° of its vertical axis and at 1" or 2" from its periphery. Rotate the wheel again to 45° and repeat the test till the entire circumference of the wheel is covered. A good wheel will give a clear ring while a cracked or damaged wheel will produce a dull sound. The wheel giving a dull sound should not be used.



A ring test should be held in a place where the 'ring' can easily be heard. It should be conducted only by a person qualified or skilled enough to interpret the result.

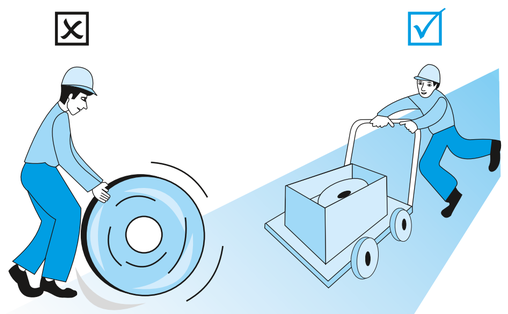
Wheel handling

Grinding wheels can also be damaged by mis-handling. This can be during transportation or when they are moved from one place to another within the workplace.

Never drop a grinding wheel. This is a major cause for most wheel damages. In case, you do drop a wheel by mistake, check immediately to see if it is damaged or not. A cracked grinding wheel should be discarded since it can seriously injure the operator while in use.

Wheel handling

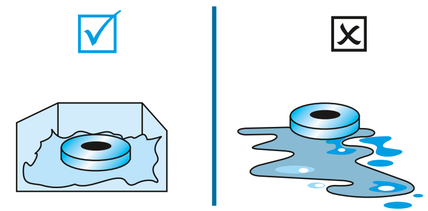
- Never pile other objects on top of stacked grinding wheels.
- Never roll a grinding wheel on the floor.
- Use trucks or suitable conveyors to move a grinding wheel from one place to another.



- Never bang a grinding wheel against any other object. This may chip or break the wheel. Also, any shock applied to a grinding wheel can cause a crack in the wheel which may not be visible to the naked eye. These kind of invisible cracks can result in a wheel breakage, due to centrifugal forces applied when the wheel is in motion.

Rules for Grinding Wheel Storage

- Grinding wheels should be stored in a dry place and not exposed to humidity, water or other liquids.

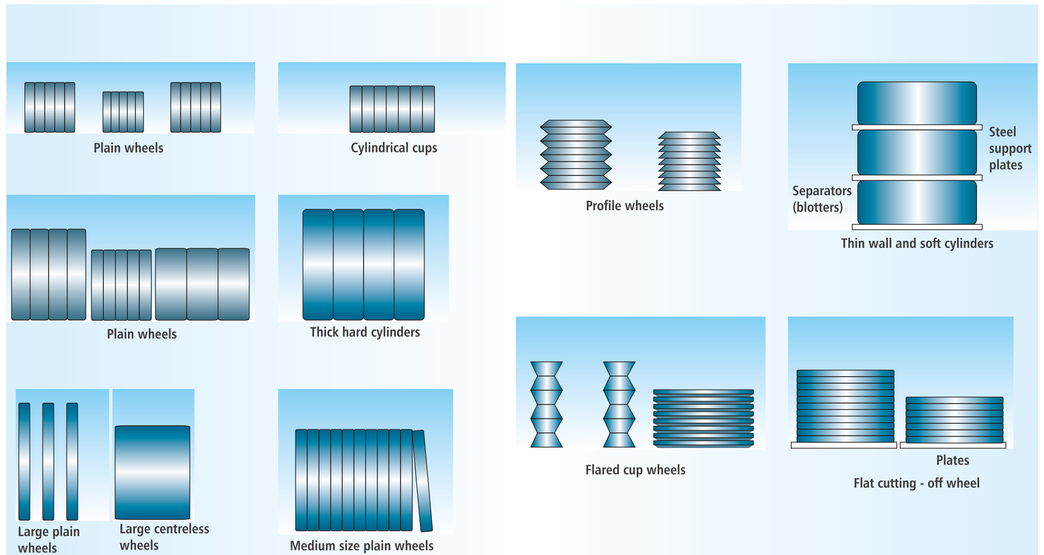


- Wheels should not be exposed to freezing temperature conditions.
- Subjecting wheels to any extreme fluctuations in temperature should also be avoided. For instance, avoid any sudden variance in temperature that can cause condensation on the wheels when moving them from storage to an area of high temperature conditions.
- The outer surface of certain rubber, resinoid, shellac and magnesite wheels may be affected by oxidation if the wheels are stored for a long period. These wheels should not be stored beyond two years. Careful monitoring of stock is also required to ensure that earlier stocked wheels are used first. However, vitrified grinding wheels can be stored for any period of time.
- Grinding wheels should be stored in racks or bins in such a way so as to prevent any damage to them. While removing a wheel, the adjacent wheels should not be disturbed.

The method for storing a grinding wheel varies according to the wheel type :

- Flat cutting-off wheels should be placed without anything between them, on a flat surface of steel or a similar rigid material to prevent warpage.
- Thin wall, soft grade cylinder wheels (Type 2), cup wheels (Type 6), dish wheels (Type 12) and saucer wheels (Type 13) should be stored on flat sides with blotters or cushioning material between them.
- Thick rim, hard grade cylinder wheels, straight cup wheels and also medium sized plain wheels may be stored on their periphery.
- Soft grade straight cup wheels and taper cup wheels (Type 11) are best stored base to base, on the opposite way to the other, to prevent chipping of the edges and cracking of the walls.
- Large, plain and centreless wheels (Types 1,3, 5, 7, 9, 20 to 26, 35 & 37) of considerable thickness have to be made to stand on their sides in the racks and so positioned that they do not move or roll.
- Small wheels, upto 80 mm, mounted wheels and points, inserted nut cones (Type 16 to19) may be stored in appropriate sized boxes, bins or drawers.

Rack design suitable for storing a wide variety of grinding wheels



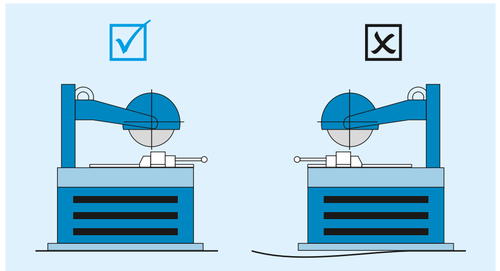
SAFETY

Safety measures in the usage of Grinding Wheels

SAL grinding wheels are manufactured to very high standard specifications and are subjected to stringent quality tests before they are sold to the customer. However, much depends on their correct and safe usage. A badly handled or misused wheel can not only be under productive, but could also, in extreme cases, prove dangerous to the user. It is therefore the user's responsibility to strictly observe the safety requirements in the handling, mounting and operating of the grinding wheel.

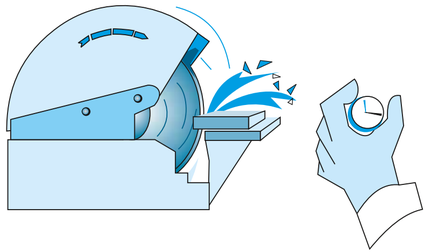
Wheel Mounting Procedures

- The wheel must be mounted only by a trained and certified person, competent to carry out the job.
- Before mounting, a grinding wheel must first be checked for damage and a 'ring test' should be conducted to ensure that the wheel is in good condition.
- The wheel should be mounted only on the machine for which it is intended.
- The area surrounding a grinding machine should be free from obstruction. For wet grinding operations splash guards should be provided to prevent the floors surrounding the machine from becoming slippery.

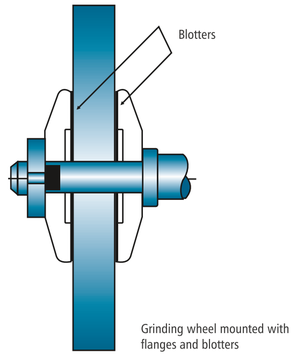


- Wheel guards should be securely fitted before a wheel is run. This will protect the operator by containing or diverting the fragments of an accidentally broken wheel.
- Work rests should be adjusted as close as possible to the grinding wheel.

- The speed marked on the machine should not, under any circumstances, exceed the speed marked on the wheel blotter or any other document. Operating wheels beyond the maximum permissible speeds or 'MOS' indicated, may cause them to break and lead to fatal accidents.



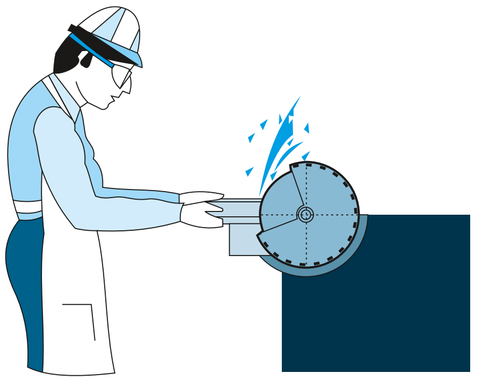
- The wheel should fit freely, but not loosely, on the spindle. The grinding wheel should be fixed to the spindle without applying force and then securely clamped to it.
- Flanges should be clamped firmly and run true to the spindle. Their bearing surfaces should be flat and free from burrs. Any foreign matter between the wheel and the flange can trigger local pressure or stress and cause the wheel to break.



Grinding wheel mounted with flanges and blotters

Blotters which are slightly larger than the flanges, should be fixed without wrinkling, on all bonded abrasive wheels, except for exceptions.

- The bush, if used, should not project beyond the wheel and the blotters.
- After mounting, a wheel must be allowed to run freely, at its full operating speed, for atleast 1 minute. This test run is applicable both for new wheels as well as old wheels re-mounted for grinding.



- Never grind material for which the wheel is not designed.
- Do not grind on the side of the wheel unless the wheel is specifically designed for that purpose.
- Since a grinding operation generates sparks and swarf, the operator should compulsorily wear safety goggles and face shields. Protective clothing like aprons, gloves and safety shoes should also be used to enable the operator to work safely and efficiently.
- In certain types of grinding where the swarf or dust generation is very high, operators should be provided with dust masks.
- Wheels should never be stopped by applying pressure or force to the periphery or face. Instead the wheel should be allowed to stop by itself.

RIGHT MOUNTING FOR SAFE GRINDING

Though all grinding wheels are relatively fragile, they are safe operating tools if handled and used properly. However, if abused they can pose serious safety hazards.

Most common type of abuse is in the form of wrong mounting and studies have established that 3/4th of the total number of accidents on the shop floor are the result of incorrect mounting. In many countries abroad regulations have been brought out to make training in the correct mounting of abrasive wheels mandatory.

Grinding wheels will withstand substantial compressive stresses but under tensile or bending stresses they give away easily. Besides, all major stresses that develop in a grinding wheel under operating conditions are maximum near the bore. Keeping the above two factors in view, mounting flanges are designed in such a way that wheels are subjected only to compressive stresses and such stresses act on the wheel away from the bore. Most of the wheels are held between symmetrical flanges. These flanges are relieved near the bore and the bearing area is sufficiently away from the hole. The bearing area depends upon the size of the wheel and forces acting on the wheel. The flanges should be made from good quality mild steel or similar material and possess sufficient rigidity and resist deflection when they are tightened on to the wheel.

Refer Flange Selection table Nos. 1, 2, 3 & 4 which show the important dimensions of the various types of flanges commonly used for mounting grinding wheels.

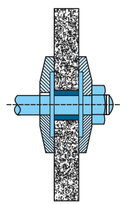
(For additional information please refer to Indian Safety Code No. IS : 1991-1993).

Types of mounting

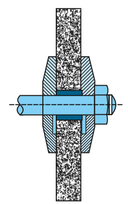
The manner of mounting wheels depends upon the size and shape of the wheel and the grinding operation.

1. Straight Wheels with small holes

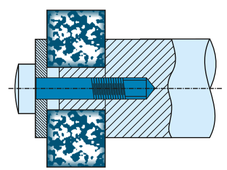
These wheels are generally used on Bench and Pedestal grinders (fig. 1)



A straight-sided wheel with a small hole, correctly mounted.
Fig. 1



An incorrectly mounted wheel. Flanges not recessed and washers not fitted.
Fig. 2



Method of mounting a small wheel used for internal grinding.
Fig. 3

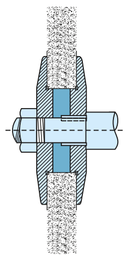
The wheel is held between two flanges having equal diameter. The driving flange is key to avoid slippage between the flange and the spindle. Both flanges are symmetrical in all other respects. The recesses shift the mounting stresses away from the hole. Fig. 2 shows a wheel which is incorrectly mounted. The flanges are not recessed and there is no blotter between the wheel face and flanges to provide a cushioning effect when the nut is tightened, with the result that the stresses concentrate at the bore region. This type of mounting can easily cause wheel breakage.

However when the wheel diameter is very small as in the case of the internal grinding wheel such relieving is not necessary (Fig. 3).

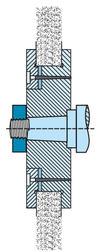
2. Straight wheels with large holes

Straight wheel with large holes are commonly used for high speed snagging. Instead of mounting the wheel directly on the spindle, adaptor flanges are used (Fig. 4). These flanges are similar to the ones shown in fig. 1 in all other respects. The undercut at the corner facilitates proper sitting.

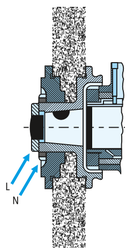
Large precision grinding wheels are mounted by means of sleeve flanges (Fig. 5 & 6). The wheel holder or collet is machined to form one of the flanges for gripping the wheel. The collet fits the tapered end of the spindle and is held in place by means of a lock knot. It is usual to keep wheels of different specifications mounted on the sleeve and kept ready so that the complete mounting can be replaced to save time.



A flange assembly for a wheel with a large hole. The corners of the wheel seatings must be undercut as shown.
Fig. 4



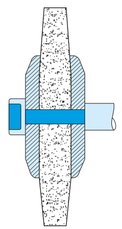
A sleeve flange used with a wheel of large bore.
Fig. 5



A method of mounting a precision wheel for external cylindrical grinding.
Fig. 6

3. Taper Wheels

Whenever it is impractical to fit the guards on the machine the breakage risk can be reduced by using a taper wheel and protection flanges as shown in (Fig.7). The taper on the wheel prevents it from flying apart and causing injury to the operator in case of wheel breakage. However, this will not eliminate such risks.



Protection flanges used with a tapered wheel. To be effective the degree of taper of the flanges must correspond with that of the wheel
Fig.7

CAUTION

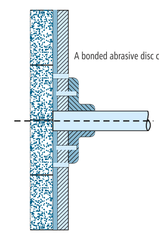
It has been proved that protection flanges can cause wheel breakage if the wheel face and bearing surface are not absolutely parallel. Such flanges will cause stress concentration, which may develop cracks in the wheel. Therefore, protection flanges should be used only if the guard cannot be used.

Protection flanges provide no protection if a portion of the wheel breaks up outside the flanges. For this reason minimum exposure of the wheel is important.

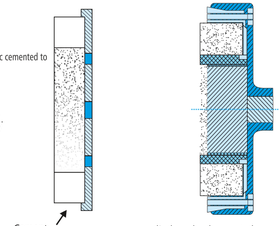
Table 4 specifies the minimum diameters of protection flanges for various diameters of taper wheels used on portable machines. Here also it can be seen that no blotters are used between the wheel face and protection flanges.

4. Cylinder Wheels and nut inserted discs

(a) Cylinder Wheels are mounted to a back plate or wheel head by means of mechanical clamps or by using cements. When mechanical clamps are used they should conform to the OD of the wheel and provided good gripping (Fig. 8, 9, 10).



(a) a plain backplate and
Fig. 8



b) a lipped backplate
Fig. 9

A cylinder wheel mounted In a protection chuck. The chuck should be kept adjusted for minimum exposure of the wheel.
Fig. 10

(b) Nut inserted discs These wheels are commonly used for disc grinding operations and are mounted by means of steel nuts embedded on the side. The hole on the face plate and nuts on the wheels should be accurately matched. The penetration of the screw should be less than the depth of the nut otherwise the screw will pull the nut off the wheel. The face plate should be of adequate thickness and flat and provide even support over a large area of contact. Before mounting, the face plate should be thoroughly cleaned. The screws should be tightened uniformly in a diametrical sequence (Fig. 11).

Incorrect nut mounting for a cylinder wheel. The screws must, not come into contact with the abrasive material.

Fig.11

A typical mounting for abrasive segments

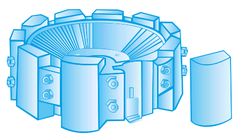


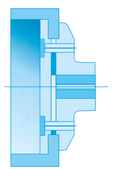
Fig.12

5. Grinding Segments

Fig. 12 shows typical arrangements for mounting segments. The segments are held in position by dovetailed wedges fitted on the periphery of the chuck. It is advisable to use blotters between the segments and the wedges. These wedges should be regularly checked to see that worn out wedges are not used for clamping. Such wedges will develop uneven mounting stresses and cause breakage. The overhang of the segment should not exceed its thickness.

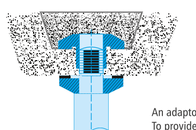
6. Cup Wheels

(a) On fixed machine situations, cup wheels are commonly used on tool and cutter grinding machines, for sharpening cutting tools (Fig. 13). Flanges used for mounting cup wheels are similar to the sleeve type flanges described earlier.



A cup wheel mounting for a fixed machine.

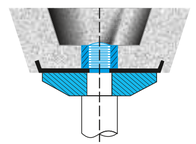
Fig.13



An adaptor flange for an unthreaded-hole cup wheel. To provide proper support, the adaptor flange and back flange should be equal in outside diameter and diameter of recess.

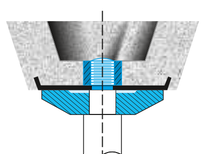
Fig.14

(b) On portable machine situations, cup wheels with plain or threaded holes are used. Plain wheels are mounted by means of adaptor flanges as shown in Fig. 14. Wheels with threaded holes are screwed on to the end of the machine spindle against the flange. The flange should be flat and not recessed (Fig. 15). Recessed flanges (Fig. 16) would tend to strain the threaded bushings. Blotters are not necessary.



A correctly mounted threaded-hole wheel.

Fig. 15

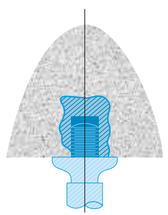


An incorrectly mounted threaded-hole wheel.
The recessed flange does not provide proper support.

Fig. 16

7. Nut inserted cones

These are used on portable grinders in place of mounted points. Before mounting, the hole should be checked to see that it is free from foreign matter. Threaded spindles should be shorter than the depth of the nut but long enough for sufficient threaded engagement. Flanges should be flat and not recessed, otherwise the nut will be pulled out while tightening (Fig. 17 & 18).



A correctly mounted cone wheel

Fig. 17

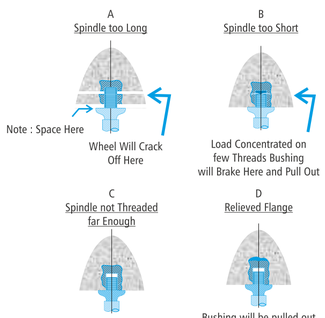


Fig. 18

FLANGES SELECTION I TABLE - 1

Important Dimensions of Flanges For Straight Wheels With Small Holes

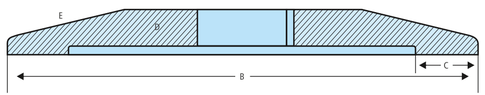


Table-1

Diameter of Wheel	B Minimum Outside Dia. of Flanges	C Radial Width of Bearing Surface		D Minimum Thickness of Flanges at Bore	E Minimum Thickness of Flanges at edge of Recess
		Minimum	Maximum		
25	10	2	3	2	2
50	20	3	5	3	2
75	25	3	6	5	2
100	32	5	10	5	3
125	38	5	10	6	3
150	50	6	13	10	5
175	63	6	13	10	5
200	75	6	13	10	5
250	88	8	16	10	6
300	100	8	16	13	8

(Continued on page no.43)

Diameter of Wheel	B Minimum Outside Dia. of Flanges	C Radial Width of Bearing Surface		D Minimum Thickness of Flanges at Bore	E Minimum Thickness of Flanges at edge of Recess
		Minimum	Maximum		
350	114	10	20	13	8
375	125	13	25	13	8
400	140	13	25	13	8
450	150	13	25	16	10
500	175	16	32	16	10
550	190	16	32	16	11
600	200	20	32	16	11
650	215	20	32	16	13
700	225	20	32	16	10
750	250	22	38	20	13
825	275	25	50	22	20
900	300	25	50	22	20
1050	350	25	50	22	20
1125	375	32	50	29	25
1200	400	32	50	29	25
1350	450	32	50	32	29
1500	500	32	50	32	29
1575	525	32	50	32	29
1800	600	32	50	38	21

(Dimensions in mm)

TABLE - 2

Important Dimensions Of Flanges For Straight Wheels With Large Holes

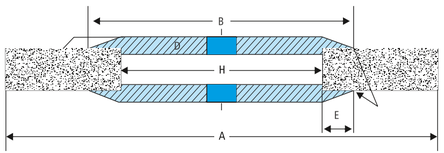


Table-2

A Wheel Diameter	H Hole Diameter	B Minimum Flanges Diameter	D Minimum Thickness of Flanges at Bore	E Minimum Thickness of Flanges at edge of Recess
300 to 350	100	150	16	10
	125	175	16	10
	150	200	16	10
Larger than 350 upto 450	100	150	16	10
	125	175	16	10
	150	200	16	10
	175	225	16	10
	200	250	16	10

(Continued on page no.45)

A Wheel Diameter	H Hole Diameter	B Minimum Flanges Diameter	D Minimum Thickness of Flanges at Bore	E Minimum Thickness of Flanges at edge of Recess
Larger than 450 upto 600	150	200	20	13
	175	225	20	13
	200	250	20	13
	250	300	20	13
	300	350	20	13
Larger than 600 upto 900	300	375	20	13
	400	500	29	22
	500	600	32	25
Larger than 900 upto 1200	300	400	25	20
	400	500	29	22
	500	600	32	25
Larger than 1200 upto 1500	400	500	29	22
	500	600	32	25
	600	725	32	25

(Dimensions in mm)

TABLE - 3

Minimum Dimensions Of Straight Collet Flanges Used As Wheels Sleeves For Precision Grinding Only

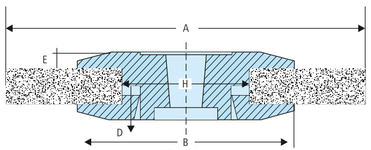


Table-3

A Wheel Diameter	H Wheel Hole Diameter of Flanges	B Minimum Outside of Flanges at Bore	D Minimum Thickness of Flanges at edge of Recess	E Minimum Thickness
300 to 350	125	175	13	11
	125	175	13	11
	150	200	16	11
Larger than 350 upto 500	200	250	16	11
	250	290	16	11
	300	340	16	11

(Continued on page no.47)

A Wheel Diameter	H Wheel Hole Diameter of flanges	B Minimum Outside Diameter of Flanges	D Minimum Thickness of Flanges at Bore	E Minimum Thickness of Flanges at edge of Recess
Larger than 500 upto 750	250	290	20	13
	300	340	20	13
	400	440	20	13
Larger than 750 upto 1250	300	340	20	13
	400	440	20	13
	450	490	20	13
	500	540	20	13
Larger than 1250 upto 1700	400	500	25	20
	500	600	25	20
	600	725	29	22

(Dimensions in mm)

TABLE - 4

Minimum Dimensions For Tapered Protection Flanges For Speed Upto 33 Peripheral Meters Per Second

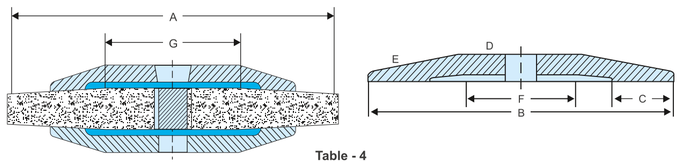


Table - 4

A Wheel Diameter	B Minimum Outside Diameter of Flanges	C Radial Width of Bearing Surface		D Minimum Thickness of Flange at Bore	E Minimum Thickness of Flange at edge of Recess	F Maximum Flat spot at centre of flange Inside	G Maximum Dia. of Flat spot or hub of wheel
		Minimum	Maximum				
150	75	6	13	10	5	100	25
200	100	8	16	10	6	100	25
250	125	13	25	13	6	100	50
300	150	13	25	16	8	100	114
350	200	16	32	16	10	100	114
400	250	20	38	16	10	10	150
450	300	25	50	20	13	100	150

(Continued on page no.49)

A Wheel Diameter	B Minimum Outside Diameter of Flanges	C Radial Width of Bearing Surface		D Minimum Thickness of Flange at Bore	E Minimum Thickness of Flange at edge of Recess	F Maximum Flat spot at centre of flange Inside	G Maximum Dia. of Flat spot or hub of wheel
		Minimum	Maximum				
500	350	32	63	20	13	100	150
550	400	35	75	20	14	100	150
600	450	20	75	14	14	100	150
650	500	38	83	20	16	100	150
700	550	45	95	22	16	100	150
750	600	50	100	22	20	100	150
900	700	50	100	25	22	100	150

(Dimensions in mm)

PROBLEM SOLVING

Chatter

Indication	Cause	Methods of Correction
Chatter	Wheel out of balance	• Re-balance wheel on own mounting. Re-balance wheel after truing. Run wheel without coolant to remove excess water. • After removing wheel from machine, store on side to prevent water from settling at lower edge of wheel.
	Wheel out of round	• True before and after balancing. True sides to face.
	Wheel grading too hard	• Select softer grade, more open bond or coarser grit. See "Wheel Grading".
	Work centres or work rests not true or improperly lubricated	• Check fit of centres and rests. • Provide constant and even lubrication.
	Dressing	• Use sharp diamond dresser rigidly held close to wheel.

Spirals On Work

Indication	Cause	Methods of Correction
Spirals(traverse lines) same lead on work as rate of traverse	Mis-alignment	• Check alignment of head and tail stocks, also wheel head to work.
	Truing	• Have truing tool set on work wheel contact line, but pointed down 3^{0}. Round off edges of wheel face.

Wheel Grading Effect

Indication	Cause	Methods of Correction
Lack of cut, glazing, some loading, burning of work, chatter.	Wheel too hard in effect	• Increase work and traverse speeds and wheel pressure (in feed). • Decrease spindle speed, wheel diameter and width of wheel face. • Open up wheel by sharper dressing. • Use thinner coolant. • Avoid dwelling at end of traverse. • Avoid gummy coolant. • Use coarser grain size and softer grade.
Wheel marks, short wheel life, not holding cut, Tapered work	Wheel too soft in effect	• Decrease work and traverse speeds and wheel pressure(in feed). • Increase spindle speed, wheel diameter and width of wheel face. • Dress with slow traverse and slight penetration. • Use heavier coolants. • Do not pass off work at end of traverse.

Wheel Loading

Indication	Cause	Methods of Correction
Metal lodged on grains or in wheel pores	Incorrect wheel	• Use coarser grain size or more open bond to provide chip clearance. • Use more coolant.
	Faulty dressing	• Use sharper dresser. Dress faster. Clean wheel after dressing.
	Faulty coolant	• Use more, cleaner and thinner coolant.
	Faulty operation	• Manipulate operation to soften. See" Wheel Grading Effect". • Use more in-feed.

Wheel Glazing

Indication	Cause	Methods of Correction
Shiny appearance, smooth feel	Improper wheel	• Use coarser grain size, softer grade. • Manipulate operation to soften effect. • See"Wheel Grading Effect".
	Improper dressing	• Keep wheel sharp by using sharp dresser. Use faster dressing tool traverse. Allow more dressing tool penetration.
	Faulty coolant	• Use less oily coolant. Use more coolant.
	Gummy coolant	• Increase soda content if water is hard. Do not use soluble oils in hard water.
	Faulty operations	• Use greater in-feed. See "Wheel Grading Effect"

Inaccuracies In Work

Indication	Cause	Methods of Correction
Work out-of-round, out-of-parallel or tapered	Work centres or work rests not true or improperly lubricated.	• Check fit of centres and rests. Provide constant and even lubrication. Provide adequate steady rests.
	Improper dressing	• Make sure machine condition are the same at dressing point as at point of grinding position.
	Improper operation	• Do not permit wheel to pass off work at end of traverse, which causes taper at work ends. Decrease pressure, which springs work. Use harder wheel.
	Expansion of work	• Reduce temperature of work by using more coolant & lighter cuts.

'Checking' of Work

Indication	Cause	Methods of Correction
Work Shows check marks	Improper wheel manipulation	• Prevent wheel from acting too hard. • Do not force wheel into work. • See"wheel Grading Effect". • Use greater and even flow of coolant.

'Burning' of Work

Indication	Cause	Methods of Correction
Work shows discoloration	Improper wheel	• Use softer wheel or manipulate to get softer effect. • See "Wheel Grading Effect". • Prevent glazing & loading. Use more coolant.
	Faulty operation	• Bring wheel to work more gradually. • Use less in-feed. • Prevent stoppage of work while in contact with wheel.

Scratching of Work

Indication	Cause	Methods of Correction
Narrow and deep regular marks	Wheel too coarse	• Use finer grain size.
Wide irregular marks of varying depth.	Wheel too soft	• Use harder grading. • See "Wheel Grading Effect".
Widely spaced spots on works.	Oil spots or glazed areas on wheel face.	• Balance and true wheel. • Avoid getting oil on wheel face.
Fine spiral or thread on work	Faulty wheel dresser	• Replace cracked or broken diamonds. Use slower dressing traverse. Set dressing tool at angle of 5° down and 3° side. Turn diamond every third dressing.
		• Tighten holder or diamond. Dress with less penetration. Do not allow tool to dwell in contact with wheel. Do not start dressing cuts on face, locate tool on face but start cuts from edge. • Make final pass in dressing in opposite direction to grinding traverse. Traverse diamond evenly across wheel face. Round off wheel edges, just chamfering or dressing back is not enough.
	Faulty operation	• Prevent penetration of advancing or following edge of wheel by being careful to dress wheel face parallel to work. Reduce wheel pressure. Provide additional steady rests. Reduce traverse in relation to work rotation. When making numerous passes, make slight change in traverse rate at each pass to break up pattern.

Scratching of Work

Indication	Causes	Methods of Correction
Wavy traverse lines	Ragged wheel edges	• Round off wheel edges.
Isolated deep marks	Improper wheel dressing	• Use sharper dressing tools. Brush wheel after dressing using a stiff bristle brush.
	Coarse grains or foreign matter on wheel face	• Dress out.
	Bond disintegrates, grain pull out	• Coolant too strong for some organic bonds, decrease soda content.
Irregular marks	Loose dirt	• Keep machine clean.
Irregular marks of varying length and width, scratches usually 'fishtail'	Dirty coolant	• Clean tank frequently. Flush guards, etc. after dressing and when changing to finer wheels.
Deep Irregular marks	Loose wheel flanges	• Tighten flanges, using blotters.
Grain marks	Wheel too coarse or too soft	• Select finer grain size or harder grade wheel.
	Too much difference in grain size between roughing and finishing wheels	• Use finer roughing wheel or finish out better with roughing wheel.
	Dressing too coarse	• Less dresser penetration and slower dresser traverse.
with	Improper cut from finishing wheel	• Start with high work and traverse speeds, to cut away previous wheel marks, finish out high work and slow traverse speeds, allowing wheel to spark out entirely.

Wheel Breakage

Indication	Cause	Methods of Correction
Radial break, three or more pieces	Excess wheel speed	• Reduce wheel speed to rated speed.
	Improper mounting of wheel	• Correct improper mounting such as lack of blotters, tight arbors, uneven flange pressure, dirt between flanges and wheel etc.
	Over heating	• Prevent overheating by using sufficient amount of coolant.
	Excessive wheel pressure	• Prevent excessive wheel pressure on work.
	Jamming of wheel	• Do not allow wheel to become jammed on work.
Radial break, two pieces	Excessive side strain	• Prevent excessive strain on the side of the wheel.
Irregular break	Wheel jamming	• Do not allow wheel to become jammed on work.
	Wheel damage	• Prevent blows on wheel. Do not use wheels that have been damaged in handling. • Examine wheel before using. Check wheels for damage by 'ring test' or tapping.
General	Wheel arbor too tight	• Do not use a wheel that is too tight on the arbor as wheel will break when started.
	Excessive wheel hammering	• Prevent excessive hammering action on the wheel.

Coolants – Trouble Shooting Tips

Indication	Reason	Remedy
Excessive foam	High Concentration	• Check concentration and adjust to the recommended concentration.
	Soft Water	• Use foam depressant.
	Contamination	• Drain thoroughly and clean the reservoir. Then charge with a fresh coolant.
	Turbulance due to wrong machine design	• Modify machine design to avoid sharp corners for coolant passage. • Check to see if coolant drain line is free of all obstruction.
Corrosion of the work piece or machine	Low concentration	• Check concentration and adjust to the recommended concentration.
	Hard Water	• Check concentration of rust inhibitor.
	High Chloride or sulphate content in the water	• Analyse the water and change to another product that is more compatible with these conditions.
	High Bacteria Content	• Improve hygienic conditions, make a bacteria count and add biocide to bring the coolant to normal condition.
	Hot, Humid conditions may accelerate corrosion problems	• Increase the concentration of mix. • Improve plant ventilation. • Apply suitable rust preventive.
Rancidity or foul smell	Lack of ventilation	• Ensure coolant tank is kept open to air circulation atleast once in 2 to 3 days during long lay off or on holidays.

Coolants – Trouble Shooting Tips

Indication	Reason	Remedy
Rancidity or Foul smell	Low Concentration	• Check concentration and adjust to the recommended concentration. Supplement it with additives.(Biocide)
	Contamination	• Drain thoroughly and clean the Reservoir. Then charge with a fresh coolant. • Ensure metal swarf and tramp oil is removed periodically from the coolant.
	High sulphate content	• Analyse the water and change to another product that is more compatible with these conditions.
	High tramp oil content	• Ensure tramp oil is removed regularly and add biocides.
Unsatisfactory surface finish or Burn marks on the work piece	Wrong Concentration	• Check concentration and adjust to the recommended concentration.
	Insufficient flow of coolant	• Increase the volume and readjust the of coolant nozzle so that a maximum amount of fluid reaches the metal removal area.
	Wrong direction of coolant noozle	• Adjust the noozle so that coolant is directed to the right spot.
	Cutting fluid is full of chips or grinding swarf	• Check the dirt content (should not exceed 75 mg/litre) • Check if filtration system is working properly. • Drain thoroughly and clean the reservoir. Then charge with a fresh coolant.

Coolants – Trouble Shooting Tips

Indication	Reason	Remedy
Unsatisfactory surface finish or Burn marks on the work piece	Water may be too hard	• Analyse the water and change to another product that is more compatible with hard water. • Use treated water.
Skin Irritation	High concentration	• Make a concentration analysis and adjust to the recommended concentration. • Most frequently this is a human error or mechanical problem with the mixing devices.
	High PH (>9.5)	• Could be due to alkaline cleaners or contamination. Only remedy is to flush out the contaminated coolant and use fresh coolant.
	Metal chips and grinding grit may cut the skin	• Repair defective filter media. • Encourage use of water proof barrier creams or protective gloves.
	Operator's hand may be immersed continually in the cutting fluid	• Use material handling devices wherever feasible. • Relocate workers who are allergic to some chemicals.
Eye, Nose or Throat Irritation	High concentration	• Make a concentration analysis and adjust to the recommended concentration.
		• Provide good ventilation/exhaust system in the shop floor.
		• Most frequently this is a human error or mechanical problem with the mixing devices.
	Excessive splashing or misting of the cutting fluid	• Reposition the guards on the machine to contain the splash or mist. • Encourage use of safety glasses.

INTERNAL GRINDING

Source of Fault		Methods of Correction
Spindles	:	High speed internal grinder spindles of the ball bearing type are very sensitive to slight irregularities. Because of their special construction and special races and balls it is best that repairs be made only by the spindle manufacturer.
Machine Play	:	Since both wheel and workheads may be of the swiveling type they must be checked for play and anchorage.
Belts	:	Internal grinder belts with their high speed, short centres and small diameter pulleys must be checked frequently for oiliness, wear and tightness, slippage is an especially serious fault.
Dressing	:	Faulty dressing is one of the most frequent causes of faulty grinding, short wheel life and poor finish. Keep careful watch to prevent wear in the diamond holder bearings. Because of the small size of the wheels used in internal grinding it is essential that the diamond be of proper size and maintained with a sharp point.
Wheel Characteristics	:	Most internal wheels are less efficient than other wheels because of the extreme change in wheel diameters with no corresponding change in spindle speed. It is often possible to increase wheel life by using a wheel of greater width. Due to the limitations of chip clearance in internal grinding it is necessary to use coarse, open wheels.
Tapper in straight hole	:	Be sure wheel head is parallel with table travel. Use softer wheel or increase work speed for softer effect. Correct work or wheel head angling. Prevent gumminess of coolant. Use lighter infeed. Be sure wheel is dressed parallel to table travel. Use harder wheel.

REFERENCE TABLES

Approximate Diameter of Abrasive Grains

FEPA grain size (mesh) in mm and inches Average Grain Diameter 1/1000inch=25 microns 1 micron = 0.001 mm		
FEPA Designation	**Average Dia. In mm**	**Average Dia. In inch**
8	2.40	0.096
10	2.00	0.080
12	1.70	0.068
14	1.40	0.056
16	1.20	0.048
20	1.00	0.040
24	0.71	0.028
30	0.59	0.024
36	0.50	0.020
40	0.42	0.017
46	0.35	0.014
54	0.30	0.012
60	0.25	0.010
70	0.21	0.008
80	0.18	0.007

FEPA grain size (mesh) in mm and inches Average Grain Diameter 1/1000inch=25 microns 1 micron = 0.001 mm		
FEPA Designation	**Average Dia. In mm**	**Average Dia. In inch**
90	0.15	0.006
100	0.13	0.005
120	0.10	0.004
150	0.08	0.003
180	0.07	0.0028
220	0.06	0.0024
240	0.05	0.0021
280	0.04	0.0017
320	0.03	0.0012
400	0.02	0.0008
500	0.014	0.0006
600	0.010	0.0004
850	0.007	0.0003
1200	0.004	0.0002

GRIT SIZE vs RA VALUE

Roughness			Grit size								
R=R_t (μm)	R_a (μm)	Surface Finish Grade	36	46	60	80	120	180	320	500	Surface
5,0	1,6	N7									Coarse grinding
4,5	1,5										
3,5	1,1										
2,5	0,80	N6									Medium fine grinding
2,1	0,67										
1,7	0,54										
1,3	0,40	N5									
1,1	0,34										
0,88	0,27										
0,65	0,20	N4									Fine grinding
0,55	0,17										
0,45	0,14										
0,35	0,10	N3									
0,29	0,08										
0,24	0,07										
0,175	0,05	N2									Polishing
0,14	0,04										
0,11	0,03										
0,08	0,025	N1									
0,068	0,017										
0,053	0,014										
0,04	0,010										

CONVERSION CHART

Hardness Conversion Chart

Rockwell C-Scale Hardness No.†'	Diamond Pyramid Hardness No., Vickers	Brinell Hardness No. 10-mm Ball, 3000-kg Load	Rockwell Hardness No.†'			Shore Scleroscope Hardness No.
		Standard Ball	A-Scale 60-kg Load, Brale Penetrator	B-Scale 100-kg Load, 1/16 in. Dia. Ball	C-Scale 100-kg Load, Brale Penetrator	
68	940	—	85.0	—	76.9	97
67	900	—	85.0	—	76.1	95
66	865	—	84.5	—	75.4	92
65	832	—	83.9	—	74.5	91
64	800	—	83.4	—	73.8	88
63	772	—	82.8	—	73.0	87
62	746	—	82.3	—	72.2	85
61	720	—	81.8	—	71.5	83
60	697	—	81.2	—	70.7	81
59	674	—	80.7	—	69.9	80
58	653	—	80.1	—	69.2	78
57	633	—	79.6	—	68.5	76
56	613	—	79.0	—	67.7	75
55	595	—	78.5	—	66.9	74
54	577	—	78.0	—	66.1	72
53	560	—	77.4	—	65.4	71
52	544	500	76.8	—	64.6	69
51	528	487	76.3	—	63.8	68
50	513	475	75.9	—	63.1	67
49	498	464	75.2	—	62.1	66
48	484	451	74.7	—	61.4	64
47	471	442	74.1	—	60.8	36
46	458	432	73.6	—	60.0	62
45	446	421	73.1	—	59.2	60

(Continued on page no. 64)

Hardness Conversion Chart

Rockwell C-Scale Hardness No.†'	Diamond Pyramid Hardness No., Vickers	Brinell Hardness No. 10-mm Ball, 3000-kg Load	Rockwell Hardness No.†'			Shore Scleroscope Hardness No.
		Standard Ball	A-Scale 60-kg Load, Brale Penetrator	B-Scale 100-kg Load, 1/16 in. Dia. Ball	C-Scale 100-kg Load, Brale Penetrator	
44	434	409	72.5	—	58.5	58
43	423	400	72.0	—	57.7	57
42	412	390	71.5	—	56.9	56
41	402	381	70.9	—	56.2	55
40	392	371	70.4	—	55.4	54
39	382	362	69.9	—	54.6	52
38	372	353	69.4	—	53.8	51
37	363	344	68.9	—	53.1	50
36	354	336	68.4	(109.0)	52.3	49
35	345	327	67.9	(106.5)	51.5	48
34	336	319	67.4	(108.0)	50.8	47
33	327	311	66.8	(107.5)	50.0	46
32	318	301	66.3	(107.0)	48.2	44
31	310	294	65.8	(106.0)	48.4	43
30	302	286	65.3	(105.5)	47.7	42
29	294	279	64.7	(104.5)	47.0	41
28	286	271	64.3	(104.0)	46.1	41
27	279	264	63.8	(103.0)	45.2	40
26	272	258	63.3	(102.5)	44.6	38
25	266	253	62.8	(101.5)	43.8	38
24	260	274	62.4	(101.0)	43.1	37
23	254	243	62.0	100.0	42.1	36
22	248	237	61.5	99.0	41.6	35
21	243	231	61.0	98.5	40.9	35

(Continued on page no. 65)

Hardness Conversion Chart

Rockwell C-Scale Hardness No.†'	Diamond Pyramid Hardness No., Vickers	Brinell Hardness No. 10-mm Ball, 3000-kg Load	Rockwell Hardness No.†'			Shore Scleroscope Hardness No.
		Standard Ball	A-Scale 60-kg Load, Brale Penetrator	B-Scale 100-kg Load, 1/16 in. Dia. Ball	C-Scale 100-kg Load, Brale Penetrator	
20	238	226	60.5	97.8	40.1	34
(18)	230	219	—	96.7	—	33
(16)	222	212	—	95.5	—	32
(14)	213	203	—	93.5	—	31
(12)	204	194	—	92.3	—	29
(10)	196	187	—	90.7	—	28
(8)	188	179	—	89.5	—	27
(6)	180	171	—	87.1	—	26
(4)	173	165	—	85.5	—	25
(2)	166	158	—	83.5	—	24
(0)	160	152	—	81.7	—	24

Bore (H11) Tolerance Chart

Bore Diameter Above (mm)	Up to and Including (mm)	H11 Tolerance Maximum (mm)	Maximum (inches)	Minimum
3	6	+0.075	+0.0030	0
6	10	+0.090	+0.0035	0
10	18	+0.110	+0.0042	0
18	30	+0.130	+0.0050	0
30	50	+0.160	+0.0060	0
50	80	+0.190	+0.0075	0
80	120	+0.220	+0.0085	0
120	180	+0.250	+0.0100	0
180	250	+0.290	+0.0115	0
250	315	+0320	+0.0125	0
315	400	+0.360	+0.0145	0
400	500	+0.400	+0.0160	0

Surface Finish Comparison Table

R_a µ m	R_t µ m	R_z µ m	RMS µ inch	CLA µ inch	PVA µ inch
0.025	0.2	0.16	1.12	1	6
0.05	0.4	0.32	2.2	2	12
0.06	0.5	0.38	2.7	2.4	16
0.08	0.6	0.5	3.6	3.2	20
0.1	0.8	0.6	4.5	4	25
0.12	1	0.75	5.3	5	32
0.16	1.25	1	7.1	6.3	40
0.2	1.5	1.25	9	8	50
0.25	2	1.6	11.2	7.1	63
0.31	2.5	2	14	12.5	80
0.4	3.2	2.5	18	16	100
0.5	4	3.2	22.4	20	125
0.6	5	4	28	25	160
0.8	6.3	5	35.5	31.5	200
1.0	8	6.3	45	40	250
1.25	10	8	56	50	320
1.6	12.5	10	71	63	400

R_a = DIN Centre line Average
R_t = Maximum Peak to Trough Height over the surface
RMS = Root Mean Square Avg. Height
CLA = Centre Line Average
PVA = Peak to Valley Avg. Height
R_z = Average of fine absolute maximum peaks and troughs within the length of 1m.

CONVERSION TABLE-WHEEL SPEEDS

Revolutions Per Minute For Various Diameters Of Grinding Wheels To Give Peripheral Speed In Meters/sec

DIAMETER IN MM	PERIPHERAL SPEED IN METERS/SEC.														
	22 m/s	23 m/s	25 m/s	28 m/s	30 m/s	33 m/s	35 m/s	40 m/s	42 m/s	45 m/s	48 m/s	50 m/s	55 m/s	60 m/s	70 m/s	80 m/s
	REVOLUTIONS PER MINUTE (APPROX)															
25	16800	17600	19100	21500	22900	25000	26500	30500	32000	34500	36500	38000	42000	46000	-	-
50	8400	8800	9500	10800	11500	12600	13400	15300	16100	17200	18300	19100	21100	23000	-	-
80	5200	5500	6000	6800	7100	7900	8400	9500	10100	10700	11400	12000	13200	14300	-	-
100	4200	4400	4750	5400	5700	6300	6700	7600	8000	8600	9200	9600	10600	11500	-	-
125	3350	3500	3800	4300	4600	5050	5600	6100	6500	6900	7300	7600	8400	9200	-	-
150	2800	2950	3200	3600	3800	4200	4450	5100	5400	5700	6100	6400	7000	7600	-	-
180	2330	2430	2650	3000	3200	3500	3800	4250	4450	4750	5100	5300	5900	6400	7400	8500
200	2070	2160	2350	2620	2820	3100	3300	3750	3950	4250	4500	4700	5200	5600	6600	7500
230	1820	1910	2070	2320	2490	2740	2900	3320	3490	3730	4000	4150	4670	4980	5820	6600
250	1650	1720	1880	2100	2230	2500	2650	3000	3150	3400	3600	3750	4150	4500	5300	6000
300	1370	1440	1570	1750	1880	2070	2190	2500	2600	2800	3000	3150	3450	3750	4400	5000
350	1180	1240	1350	1500	1610	1780	1890	2160	2250	2400	2600	2700	2950	3250	3750	4300

(Continued on page no.68)

DIAMETER IN MM	PERIPHERAL SPEED IN METERS/SEC.															
	22 m/s	23 m/s	25 m/s	28 m/s	30 m/s	33 m/s	35 m/s	40 m/s	42 m/s	45 m/s	48 m/s	50 m/s	55 m/s	60 m/s	70 m/s	80 m/s
	REVOLUTIONS PER MINUTE (APPROX)															
400	1030	1080	1180	1320	1410	1550	1650	1880	1970	2120	2260	2350	2600	2850	3300	3750
450	900	960	1050	1170	1250	1380	1470	1680	1760	1880	2010	2090	2300	2500	2950	3350
500	830	870	940	1050	1130	1240	1320	1500	1580	1700	1810	1880	2060	2260	2650	3000
550	750	790	860	960	1030	1130	1200	1370	1440	1550	1650	1710	1910	2085	-	-
600	690	720	780	880	940	1030	1090	1250	1320	1410	1500	1570	1750	1910	-	-
650	640	670	720	810	870	960	1020	1160	1210	1310	1390	1450	1615	1765	-	-
700	590	620	670	750	810	890	940	1080	1130	1210	1290	1350	1500	1640	-	-
750	550	580	630	700	750	830	880	1000	1050	1130	1210	1260	1400	1530	-	-
800	520	550	580	660	700	770	820	940	980	1060	1130	1170	1315	1435	-	-
900	460	480	520	580	630	690	730	840	880	940	1000	1050	1170	1275	-	-
1000	415	430	460	530	560	620	660	750	790	850	910	940	1050	1145	-	-
1060	395	415	450	505	540	595	630	720	760	810	865	900	990	1080		
1100	380	400	430	490	520	570	610	690	730	780	830	870	-	-	-	-
1200	345	360	400	440	470	520	550	630	660	710	750	780	-	-	-	-

MINIMUM DIAMETER OF GRINDING MACHINE SPINDLES

Minimum Diameters of Machine Spindles for Overhung wheels of various Diameters and thicknesses operating at Speeds up to 33 Peripheral meters per second

THICKNESS OF WHEEL	DIAMETER OF WHEEL															
	150	180	200 to 203	230	250 to 254	300 to 305	350 to 355	400 to 406	450 to 457	500 to 508	600 to 610	650 to 660	750 to 760	900 to 915	1200 to 1220	1500 to 1520
6	13	13	16	16	19	19	22	-	-	-	-	-	-	-	-	-
10	13	13	16	16	19	19	22	-	-	-	-	-	-	-	-	-
13	13	13	16	16	19	19	22	-	-	-	-	-	-	-	-	-
16	13	13	16	16	19	19	22	-	-	-	-	-	-	-	-	-
20	13	16	16	19	19	19	25	32	32	-	-	-	-	-	-	-
25	13	16	16	19	19	25	25	32	32	38	-	-	-	-	-	-
30 to 32	16	16	16	19	19	25	32	32	32	38	38	38	-	-	-	-
40	16	16	16	19	19	25	32	32	38	38	38	38	45	-	-	-
45	19	19	19	25	25	25	32	32	38	38	45	45	45	50	-	-
50	19	19	25	25	25	25	32	32	38	38	45	45	50	57	64	-
57 to 60	19	19	25	25	25	32	32	38	38	38	45	45	50	57	64	-
65	19	19	25	25	32	32	32	38	38	38	45	45	50	57	64	-
70	19	19	25	25	32	32	32	38	38	45	45	50	50	64	70	-
75	19	25	25	32	32	32	38	38	38	45	45	50	50	64	70	75
80 to 83	19	25	25	32	32	32	38	38	45	45	50	50	57	64	70	75
90	19	25	25	32	32	32	38	45	45	50	50	50	57	70	75	80
100 to 102	25	25	32	32	32	38	38	45	45	50	50	57	64	70	75	80
115	25	25	32	32	38	38	38	45	50	50	50	57	64	75	80	90
127	25	25	32	32	38	38	38	45	50	50	50	57	64	75	80	90
150 to 152	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	90

For intermediate sizes, the recommendations of the manufacturer should be obtained.
Above dimensions are in mm

GLOSSARY

Abrasives : A substance used in the processes of grinding, polishing and lapping of materials, which actually does the abrading or wearing away. Natural abrasives include corundum, emery, garnet and diamond. Man-made abrasives include aluminium oxide, silicon carbide, boron carbide , cubic boron nitride and synthetic diamond.

Abrasive file : A special-shaped sharpening stone, used to reach into corners or rounded surfaces for special sharpening jobs.

Arbor : The spindle of the grinding machine on which the wheel is mounted.

Arbor hole : The hole in a grinding wheel sized to fit the machine arbor.

Arc of contact : That portion of the circumference of a grinding wheel touching the work being ground.

Balance (dynamic) : A piece in static balance is in dynamic balance if, upon rotating, there is no vibration or "whip" action due to unequal distribution of its weight throughout its length.

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 a wheel for balance, adding or subtracting weight to put a piece into either static or dynamic balance.

Bearing : The part of a machine in which the spindle revolves.

Bench stand : An offhand grinding machine with either one or two wheels mounted on a horizontal spindle, attached to a bench.

Blotter : A disc of compressible material usually of blotting paper stock, used between a wheel and flanges when mounting.

Bond : The material in a grinding wheel which holds the abrasive grains together.

Bonded abrasives : Grinding wheels, sharpening stones and other abrasive products in which the abrasive is held together with bonding material.

Brinnell Hardness Tester : A machine used for testing the indentation hardness of metals except very hard ones like tool.

Burr : A turned over edge of metal resulting from punching a sheet or form grinding or cutting-off applications.

Bushing : A material, usually lead, sulfur or plastic which sometimes serves as a lining for the hole in a grinding wheel.

CBN : Cubic boron nitride abrasive, a man-made abrasive used for precision grinding of steel.

Centrehole : Tapered precision holes in the ends of work pieces to be ground between centres on a cylindrical grinder.

Centrehole lapping : The cleaning or lapping of centreholes with a bonded abrasive wheel cemented onto a steel mandrel.

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Centreless grinding : Grinding the outside diameter of a round piece not mounted on centres not chucked.

Ceramics : Science and art of clay working and various related industries. The use of vitrified bonds brings abrasive wheel manufacturing under this classification.

Chatter marks : Surface imperfections on the work being ground, usually caused by vibrations between the wheel and the work.

Chuck : A device for holding grinding wheels of special shape or for holding the workpiece being ground.

Coated abrasives : Abrasive products in which the abrasive is coated on a relatively thin layer on a backing of cloth, fibre or paper. Coated abrasive products include sheets, rolls, belts, discs and speciality shapes.

Crank Wheel : An expression used to designate wheels for grinding crankshafts.

Crush truing (or forming) : The process of using steel or tungsten carbide rolls to true or form grinding wheels to special face shapes.

Cutters : The part of a mechanical dresser for grinding wheels which comes in contact with the wheel and actually does the dressing.

Cylindrical grinding : Grinding the outside surface of a cylindrical part mounted on centres.

Deburring : The process of removing burrs from metal.

Diamond dressing tool : A tool for dressing or truing a wheel, made with a single diamond point or with multiple points.

Diamond wheel : A grinding wheel in which the abrasive is mined or manufactured diamond.

Disc wheel : A grinding wheel used in a disc grinder, with a shape similar to a Type 1 straight wheel. Usually mounted on a plate for reinforcement, using the side of the wheel for grinding.

Dressers : Tools used for Dressing a grinding wheel.

Dressing : The process of restoring, improving or altering the cutting action of the face of a grinding wheel.

Dressing Stick : An abrasive stick used to dress the face of the grinding wheel.

Dry grinding : Performing a grinding operation without the use of grinding fluids.

Ductility : A characteristic of a material, usually metal, which indicates its capability of being readily pressed, drawn or formed into various shapes.

Emery : A natural abrasive of the aluminium oxide type.

External grinding : Grinding on the outside surface of an object as distinguished from internal grinding or cutting-off.

Face : The periphery of a grinding wheel also, the part of a grinding wheel that is brought into contact with the workpiece.

Face shape : The physical shape of the periphery or face of a grinding wheel, designated by a letter in wheel description.

Feed, cross : In surface grinding, the distance of horizontal feed of the wheel across the table.

Feed, index : In cylindrical grinding, a measurement indicated by the index of the machine. On most machines this measurement refers to the diameter of the work; on a few to the radius.

Feed lines : A pattern on the work produced by grinding. The finer the finish, the finer and more evident are these lines.Some types of feed lines indicate incorrect grinding condition.

Finish : The surface quality or appearance, such as that produced by grinding or other machining operation.

Finishing : The final cuts taken with a grinding wheel to obtain accuracy and the surface.

Flanges : The circular metal plates on a grinding machine used to drive the grinding wheel.

Flaring cup : A Type 11 cup wheel with file rim extending from the back at an angle so that the diameter at the outer edge is greater than at the back.

Glazing : An extreme condition of loading on a grinding wheel face caused by dulled abrasive and a buildup of swarf, resulting in sharply decreased cutting rates.

G-Ratio : A measurement for grinding efficiency made by dividing cubic inches of metal removed from a workplaces by cubic inches of wheel wear.

Grinding action : The cutting ability of, and the finish produced by, a grinding wheel.

Grinding Fluid : A liquid or solution used in wet grinding to cool the workpiece, lubricate the grinding wheel, clean away swarf and prevent rust.

Guard : A cover surrounding a grinding wheel, grinding machine table, or any moving part of the grinding machine, used to protect the operator in case of wheel breakage, to direct sparks, swarf and carry fluid away from the operator, and provide machine safety in operation.

Honing : An abrasive operation typically performed on internal cylindrical surfaces and employing bonded abrasive sticks in a special holder to remove stock and obtain surface accuracy.

Internal grinding : Grinding the inside surface of the hole in a piece of work.

Lapping : A finishing process typically employing loose abrasive grain, but now often including similar types of operation with bonded abrasive wheel.

Lubricant : The liquid or solution used to lubricate the wheel and promote a more efficient cutting action.

Magnetic chuck : A workpiece-holding device used in surface grinding, which holds the workpiece by means of magnetic force.

Mandrel : A solid, cylindrical piece of metal on one end of which a grinding wheel or abrasive is mounted. The other end is fixed in the machine chuck. May be made of steel or a heavier metal to provide greater stability and resistance to whipping.

Maximum safe speed : The fastest speed at which a grinding wheel or mounted wheel can be operated safely. May be expressed as RPM or SFPM.

Peripheral speed : The speed at which given point or particle on the face of the wheel is travelling when the wheel is revolved, expressed in surface feet per minute (SFPM). Multiply the circumference in feet by the wheel revolutions per minute.

Periphery : The Line bounding a surface – the circumference of a wheel.

Polishing : An operation to smooth off roughness from a workpiece, or put a high finish on metal by using a polishing wheel.

Polishing wheel : A wheel made of one of several kinds of materials and coated with abrasive grain and glue.

Portable grinder : A hand-held grinding machine which uses portable wheels, depressed centre discs, plugs or cones.

Portable wheel : A grinding wheel used for portable grinding and stock removal. These wheels usually have hard, durable abrasives, coarse grit sizes, organic bonds, and may have molded-in bushings.

Precision grinding : Those types of grinding which result in the workpiece being ground to exact measurements, finish, etc.

Reinforcing : One or more layers of fibre glass material molded into the grinding wheel to add strength and stability in operations. Cut-off wheels, depressed centre discs, floor stand snagging wheels and portable wheels use reinforcing. Cylinder wheels often have several bands of wire wound reinforcing on their periphery to add stability and protection.

Resinoid bond : An organic bonding material made up of synthetic resin.

Rockwell Hardness : A measurement of hardness of all metals. The indentation hardness of a metal is measured against a standard numbered scale. The higher the number, the harder the metal.

Roll grinding : A specialized type of cylindrical grinding used to finish or refinish the long, large-diameter rolls used in metal rolling mills, paper mills, rubber and plastic processing plants.

Rough grinding : A type of grinding used for stock removal, or where a precision dimension or finish is not the primary requirement.

RPM : The revolutions per minute, or speed of a revolving object such as a grinding wheel.

Scratches : Marks left on a ground surface caused by a dirty coolant or a grinding wheel unsuited for the operation.

Segments : Bonded abrasive sections of various shapes to be assembled to form a continuous or intermittent grinding wheel.

Shellac bond : An organic bonding material composed of shellac.

Snagging : A type of stock removal grinding, used in Foundries to remove gates, fins from castings.

Stock Removal : The grinding or the abrading away of material from a workpiece. Also a general type of grinding in which stock removal is the primary requirement.

Straight Wheel : A type 1 grinding wheel made with straight parallel sides, a straight face, and a straight or a tapered arbor. Straight wheels contain no recesses, grooves, bevels or dovetails.

Structure : A term designating the relative grain spacing in a grinding wheel, and expressed as a number in the wheel marking. Dense structures have low numbers, while open structures have higher numbers.

Surface Grinding : A type of precision grinding used to produce flat plane surfaces.

Tensile strength : The strength of a material when tested in tension usually given in pounds per square inch.

Thread grinding : A type of precision grinding used to generate screw-type threads.

Truing : The process of shaping a grinding wheel to an accurate form. This is done to make the wheel face run absolutely true and grind without making chatter marks. A diamond tool is usually used for truing,

Wet grinding : A kind of grinding where a flow of grinding fluid is directed over the wheel and workpiece.

Wheel Sleeve : A form of flange used on Precision Grinding machines where the wheel hole is larger than the machine Arbor. Usually, the sleeve is so designed that the wheel and sleeve are assembled as one unit.

Wheel traverse : The rate of movement of the wheel across the work during grinding.

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TECHNICAL TIPS.

1. Vitrified bonded wheels are not recommanded on portable machines.
2. It is not recommanded to use 200mm dia and above wheel on portable machine.
3. Always use Guard while working on the heavy duty snagging machines like swing frame grinder.
4. For crank shaft mounting flanges should be at least 1/3 of diameter of the wheel and relieved around the Hole.
5. Ensure to use wheels as per mount up marking.
6. Off Hand wheels - Always ensure that the machine bearing are in good condition and check for excessive run out due to worn out bearing before use.
7. Don't hit the job on wheel face to open the Grinding face.
8. C'less wheel Dressing - Dressing of the wheel is to be done only when strictly required and dressing depth should be just adequate to clean the wheel face and maintain it's sharpness.
9. Work rest blade in c'less wheel Grinding - Wheel performance and Job quality is largely influenced by correct work rest blade setting, it's angle and hardness. Ensure no slippage takes place while driving regulating wheel to avoid Flat spot.
10. Cylindrical wheels - A fast traverse of the diamond dresser along the wheel face results in an open wheel aiding higher material removal rate. Use abundant supply of coolant during grinding operation i.e. one litre per mm of the wheel thickness per minute.
11. Regulating wheels - The tilt given to the Regulating wheel directly effect the feed rate of the work piece and hence it is important with respect to the finish obtained and the productivity of the process.
12. Please set proper off set of dressing tool to ensure line contact between regulating wheel and job in through feed grinding.
13. Segment - The current drawn as shown in a meter on the machine gives a very good estimate of the load on the segment and hence the efficiency of the process.
14. Lowering of the segment should not be more than it's thickness.
15. F type - Always ensure alignment of both wheels to achieve optimum geometrical tolerances .
16. Ensure coolent PH does not exceed 9.0 when using resin bonded wheels.
17. Maintain coolent bulk temperature between 20° - 25° C to achieve best result.

18. Sintered and powder metal component - use combination abrasives of Al-oxide and silicon carbide .

19. Ensure thread engagement does not exceed 10 mm to avoid Nut pull out in case of nut inserted wheels.

20. Ensure the straightness of the wheel Mounting plate.

21. Ensure the Filter coolent circulate while grinding.

22. Thread Grinding - Dress the form from point of wheel towards edges of wheel for better maintenance of root width and edge form. Form Dressing using Diamond Roll,always gives best result on thread grinding.

23. How to choose diamond carat : The selection of the diamond carat depends mainly on the dimension of the wheel to be dressed. Multiply the diameter of the wheel by it's thickness. Refer the below value chart that follows and select the carat size of the diamond.

0.35 carat	0.50 carat	0.75 carat	1 carat
up to 6000 mm	6000 to 12000 mm	12000 to 25000 mm	25000 and above mm

When using a single point diamond tools approach the wheel at 10 to 15 degree angle.
When using Multi-point diamond tool approach the wheel at 0 degree angle.

Dressing Method.

Semi Roughing: Traverse tool at 40" per minute (16.93mm per second) at tool feed 0.002" to 0.003" per pass.

Commercial surface: Dress the wheel as above with few pass at feed 0.002" to 0.005" than reduce traverse to 20"/minute and feed to 0.001" for several pass.

Medium Fine Surface: After the above procedure ,further reduce traverse to 10" per minute.

24. Selection of grit size as per needle gauge (G)

	JIS	ANSI	FEPA
22G (0.8 mm)	GC800	GC500	GC400
23 to 25G (0.6 mm)	GC1000	GC600	GC500
25 to 26G (0.4 mm)	GC1200	GC800	GC600

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