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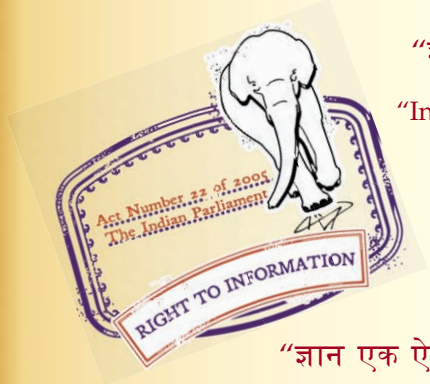
IS 1249 (1997): Recommendations for selection of grinding wheels [PGD 9: Abrasives]



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पषेण पहियों के चयन की सिफारिशें

(दूसरा पुनरीक्षण)

Indian Standard

RECOMMENDATIONS FOR SELECTION OF GRINDING WHEELS

(Second Revision)

ICS 25.100.70

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 1997

Price Group 3

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by Abrasive Sectional Committee had been approved by Production Engineering Division Council.

This Indian Standard was first published in 1959 and revised in 1972, the Sectional Committee dealing with the subject had decided to revise this standard again and bring it in line with the present practices prevailing in the industrry. In the revised standard, speed of abrasive wheels have been changed.

It is customary for grinding wheel manufacturers to provide through their published literature, information on the selection and use of grinding wheels, but it may not always be possible or convenient for users to take advantage of such consultative service. Furthermore, as industry develops in the country, more and more precision grinding will be carried out and the necessity for wider dissemination of information on grinding wheels will become imperative. The need for a ready-to-use general guide on grinding wheels has been keenly felt and this standard is an attempt in that direction.

It is well known that it is extremely difficult to make definite recommendations for the selection of grinding wheels for different applications in view of the number of considerations that are involved, such as grit, the bond, method of operation, finish, hardness of material to be ground, etc. This standard attempts to provide information, in very general terms, on the major considerations that should influence the selection, of a wheel for a given class of work and it is at least only one in a series of approaches to the choice of the ideal wheel. It is not possible for any standard to be so comprehensive as to eliminate the need for the consultative service usually provided by the manufacturers. The recommendation in respect of a particular job generally varies from manufacturer to manufacturer and the identity of markings between two makes of a wheel does not guarantee identical performance. There are modifications of both abrasive and bond which are peculiar to individual companies. The task of the manufacturer would be considerably facilitated if the user conveys to him his duty conditions in as detailed a manner as possible, and to assist the user in giving such information, a standard proforma is given in Annex A.

Indian Standard
RECOMMENDATIONS FOR SELECTION OF GRINDING WHEELS
(Second Revision)

1 SCOPE

This standard gives recommendations on the general considerations which should guide the selection of grinding wheels for different applications.

2 REFERENCES

2.1 The following Standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
551 : 1989	Bonded abrasive products (other than diamond/cubic boron nitride) — Marking system (*second revision*)
2324	Bonded abrasive grinding wheels:
(Part 1) : 1985	Profiles and types (*second revision*)
(Part 2) : 1985	Dimensions (*second revision*)
13596 : 1992	Dimensional tolerances on grinding wheels

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Abrasive

Substances used for abrading, grinding, polishing and lapping, such as the natural materials like corundum, emery, diamond, garnet, etc, and the manufactured or artificial materials like aluminium oxide, silicon carbide, born carbide, etc.

3.2 Bond

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

3.3 Centreless Grinding

Grinding the diameter of a piece not mounted on centres or otherwise held.

3.4 Cone Wheel

A wheel shaped like a bullet nose used more frequently for portable grinding.

3.5 Crank-Shaft Wheel

An expression used to designate wheels for grinding crank-shafts.

3.6 Cup Wheel

A grinding wheel shaped like a cup.

3.7 Cutting-off Wheel

A thin, high-speed wheel, usually made with organic bond, used for cutting-off.

3.8 Cutting Rate

The amount of material removed by a grinding wheel per unit of time.

3.9 Cylinder Wheel

A grinding wheel of characteristics similar to a straight wheel but with a bore more than three-fourths of its diameter and usually of large thickness.

3.10 Cylindrical Grinding

Grinding the outside diameter of a piece.

3.11 Disc Wheel

A grinding wheel similar to a straight wheel but usually mounted on a plate and using the side of the wheel for grinding.

3.12 Dish Wheel

A wheel shaped like a dish.

3.13 External Grinding

Grinding on the outside surface of an object as distinguished from internal grinding. This applies to

an object of any shape and is not necessarily precision grinding.

3.14 Face

That surface of a wheel which grinds the work-piece.

3.15 Feed Lines

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

3.16 Fin

A thin projection on a casting.

3.17 Floor-Stand Grinder

An off-hand grinder, mounting either one or two wheels running on a horizontal spindle fixed to a metal base attached to the floor.

3.18 Fluting

Grinding the flutes of twist drills, taps, etc.

3.19 Form Retention

The ability of the wheel to retain the form or contour during grinding operation.

3.20 Gate

The part of a casting formed by the opening in the mould through which the metal is poured.

3.21 Glazing

The dulling of the cutting particles of a grinding wheel resulting in a decreased rate of cutting.

3.22 Grit of Grain Size

The size of the cutting particles of a grinding wheel or polishing abrasive (*see also* IS 551).

3.23 Grain Spacing

The relative position of the cutting particles in a grinding wheel.

3.24 Grade or Hardness

The strength with which the bond holds the grain is considered as the grade or hardness of the wheel and it varies between limits arbitrarily designed as 'A' to 'Z'. 'A' being the softest and 'Z' the hardest (*see also* IS 551).

3.25 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.

3.26 Internal Grinding

Grinding the inside surface of the hole in a work-piece.

3.27 Lapping

A finishing process typically employing loose abrasive grains, but now often including, similar types of operation with bonded abrasive wheels or coated abrasives.

3.28 Loading

Filling of the pores of the grinding wheel surface with the material being ground usually resulting in a decrease in production and poor finish.

3.29 Off–Hand Grinding

Grinding by holding the work against the wheel or wheel against work by hand. This includes snagging, tool grinding speed in metres per second.

3.30 Operating Speed

The speed of revolution of a grinding wheel expressed either as number of revolutions per minute or as surface speed in metres per second.

3.31 Organic Bond

A bond made of organic materials, such as synthetic resins, rubber or shellac.

3.32 Peripheral Speed

The speed at which any point or particle on the face of the wheel is travailing when the wheel is revolved. It is expressed as surface metres per second and is obtained by multiplying the circumference of the wheel by the number of revolutions per second.

3.33 Planer Type Grinder

A type of surface grinding machine built similar to an open side planer.

3.34 Precision Grinding

A machine grinding where the work limits are exceedingly fine. This includes cylindrical grinding, centreless grinding, internal grinding, surface grinding, tool and cutter grinding, etc.

3.35 Recessed Wheel

Grinding wheels made with a depression in one side or both sides to fit special types of flanges or sleeves

provided with certain grinding machines.

3.36 Resinoid Bond

A bonding material described commercially as synthetic resin.

3.37 Roll Grinding Machine

A machine for grinding cylindrical rolls used for rolling metal, paper or rubber.

3.38 Rough Grinding

The first grinding operation for reducing stock rapidly without regard to the finish the wheel leaves.

3.39 Rubber Bond

A bonding material, the principal constituent of which is natural or synthetic rubber.

3.40 Saw Gumming

Saw sharpening with a grinding wheel.

3.41 Scale

A brittle oxide skin on the surface of heated steel and upon other metals, as in forging and rolling.

3.42 Segments

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

3.43 Shellac Bond

A bonding material, the principal constituent of which is shellac.

3.44 Silicate Bond

Type of bond matured by baking, in which sodium silicate is the bonding material.

3.45 Snagging or Fettling

Grinding the gates, fins and sprues from castings.

3.46 Straight Wheel

A grinding of any dimension which has straight sides, a straight face, and a straight or tapered arbor hole, and is not recessed, grooved, dovetailed, bevelled or otherwise changed from a plain straight wheel.

3.47 Structure

A general term denoting the spacing of abrasive grains (*see also* **3.24**).

3.48 Surface Grinding

Grinding a plane surface.

3.49 Swing Frame Grinder

A grinding machine suspended by a chain at the centre point so that it may be turned and swung in any direction for the grinding of billets, large castings and other heavy work.

3.50 Taper Cup Wheel

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

3.51 Tapered Wheel

A grinding wheel shaped similar to a straight wheel but having a taper from the hub of the wheel to the face and thus being thicker at the hub than at the grinding face.

3.52 Universal Grinding Machine

A machine on which cylindrical internal, surface, tool and cutter grinding can be done, usually used for tool room work.

3.53 Vitrified Bond

A bonding material made of ceramic material.

3.54 Work Speed

In cylindrical, centreless and internal grinding, the rate at which the work revolves, measured in either revolutions per minute or surface speed per minute; in surface grinding, the rate of table traverse.

4 SELECTION OF GRINDING WHEELS

4.1 The main elements in grinding wheel specification are:

a) abrasive,

b) grit or grain size,

c) grade or hardness,

d) structure number, and

e) bond.

4.2 The following factors should be considered when making selection of grinding wheels:

a) Material to be ground and its hardness,

b) Stock removal,

c) Severity of operation,

d) Surface finish,

e) Area of grinding contact,

f) Wheel speed,

g) Wet or dry grinding,

h) Machine condition, and

j) Work speed.

4.3 Abrasive

The selection of abrasive depends upon the material to be ground and the severity of operation.

4.3.1 *Material to be Ground*

In cases of high tensile metals, aluminium oxide is the abrasive generally used. Silicon carbide is used for grinding low tensile metals and non-metallics. Different types of aluminium oxide and silicon carbide are available and the choice of type is dependent upon the sensitivity of the material to be ground and the severity of the operation.

4.4 Grit Size

The selection of grit size depends upon the material to be ground, stock removal, finish and area of contact.

4.4.1 *Material to be Ground*

As a rule, finer grit sizes are used for grinding harder metals and coarser grit sizes for softer materials.

4.4.2 *Stock Removal*

If a job calls for heavy and rapid stock removal, a coarser grit will be needed and grit sizes 12 to 36 would be considered adequate, where precision grinding is involved the stock removal is not so high and for such applications, grit size 40 to 80 would be considered suitable. When an extremely small amount of stock has to be removed, particularly on very small work-pieces, it may be necessary to use even finer grit sizes, but such applications are not common. Fine grits may also be required if form grinding has to be attempted on intricate work-pieces.

4.4.3 *Finish*

Normally, when the stock removal is high, a good finish is not expected. When the stock removal is low, good finishes are usually required. In general, finer grit sizes are used for better finish and coarser grit sizes for faster stock removal.

4.4.4 *Area of Contact*

Finer grit size are used where the area of contact is small and coarser grit sizes when the area of contact involved is large.

4.5 Grade

4.5.1 *Selection of Grade*

The grade of a grinding wheel is ultimately a measure of the resistance offered by the bond to the grinding stresses. These stresses tend to tear the grain particles out of the wheel face and wear away the wheel. A self-sharpening action characterizes a wheel which is suitably graded for the job for which it is being used. The self-sharpening action is more to be expected from wheels used for rough work; the same degree of self-sharpening cannot be expected from finer wheels used for precision work. The object should always be to select a wheel which will grind the maximum number of pieces before wheel dressing is restored to. It is false economy to use a hard wheel, which constantly glazes, in the hope that thereby longer wheel life will result. On the other hand, too soft a wheel will not hold form and will wear out too fast to be considered economical. Experiment and experience will soon enable balance to be struck between these factors.

4.5.2 *Material to be Ground*

An important principle to remember when selecting wheel grade is that on softer metals a hard grade can be used, whereas on hard metals, a soft grade shall be used. This distinction is more applicable in cases of precision grinding than in the case of rough grinding.

4.5.3 *Severity of Operation*

Hard grades are normally recommended for severe grinding operations, whereas medium and soft grade are recommended for precision operations.

4.5.4 *Area of Contact*

The grade is sometimes varied depending upon the area of contact and as a rule, the smaller the area of contact, the harder should be the wheel.

4.5.5 *Wet or Dry Operation*

As a rule, wet grinding allows the use of wheels one grade harder, as compared to the case of dry grinding.

4.5.6 *Condition of Machine*

The condition of the grinding machine has a bearing on the grade of the wheel to be selected. Heavy and rigidly constructed machines take softer wheels than the lighter and less rigid machines. If due to poor maintenance the spindles are loose in their bearings and vibrations are present, a harder grade may be found necessary.

4.5.7 *Work Speed*

The work speed with relation to the wheel speed determines the hardness of the wheel. The higher the work speed with relation to the wheel speed, the harder the wheel should be.

4.6 Structure

Generally, wide grain spacing is used for rapid removal of stock and close grain spacing for fine finish, in other words close grain spacing with a small structure number is preferable in cases where the area of contact is small. Wide grain spacing with higher structure numbers is preferred for large areas of contact.

4.7 Bond

In grinding wheel manufacture, various bonds are used as binders according to the type of wheel being made, which in turn depends on the operation for which the wheel is intended. Rubber bonds are used for control wheels on centreless grinders or for extremely thin slitting wheels; resin bonds are used for high speed snagging or cutting-off wheels as well as for control wheels on centreless grinders; shellac bonds are used for roll grinding operation and sodium silicate bonds are useful for knife for grinding and similar work. However, the majority of wheels used on precision grinding operations and many wheels used for rough grinding are manufactured with vitrified bonds. The class of work usually dictates the bond to be used. Bond selection can, of course, be safely left to the manufacturers, if the class of work for which the wheel is required is clearly stated.

Vitrified bond is usually specified for speeds up to 35 m/s and organic (rubber, shellac and resinoid) bonds for speeds above 45 m/s. However, the vitrified bond grinding wheels are available up to 125 m/s and resinoid up to 100 m/s.

4.8 The commonly used grit sizes, grades and bonds for various operations are shown below:

Type of Grinding Operation	*Grit*	*Grade*	*Bond*
Surface (segments and cups)	24-46	F-I	Resinoid
Surface (straight wheels)	46-60	H-K	Vitrified
Tool and cutter	46-80	J-L	Vitrified
Thread	120-320	J-N	Vitrified/ Resinoid/ Rubber
Internal	46-120	K-N	Vitrified
Centreless	46-80	K-N	Resinoid/ Vitrified
Cylindrical	46-80	K-N	Vitrified
Crankshaft	46-70	N-P	Vitrified
Tool (off-hand)	36-80	N-Q	Vitrified
Saw gumming	80-100	N-P	Vitrified
Low speed snagging	16-36	Q-R	Vitrified
High speed snagging	16-24	Q-T	Resinoid
Swing frame and billet	12-16	R-T	Resinoid
Cutting-off	36-60	P-T	Resinoid

4.9 The number of factors which influence the selection of grinding wheel characteristics may appear to be somewhat confusing but when properly considered in the general order in which they are mentioned in this standard, the practical application will be found to be simple and effective. The first consideration in selection is either from the wheel formerly used or from the recommendations given in this standard. If the grinding wheel user is not geting satisfactory results with a wheel, consideration of the influential factors will usually reveal the cause of the trouble and will enable him to change the wheel characteristics, or to remedy the condition as the case may be. It is desirable to consider each of the influential factors separately. changing but one wheel characteristics at a time until a solution is reached.

4.10 The standard system by which abrasives, grits, grades and bonds of grinding wheels are indicated is contained in IS 551.

ANNEX A

(Foreword)

INFORMATION TO BE SUPPLIED BY THE USER WHILE ORDERING

A-1 OPERATION (OR GRINDING)

a) Automatic-half—automatic-off-hand with/ without tool rest;

b) Contact between work-piece and wheels; Narrow, below 15 mm—Medium, 15-30 mm—Broad, above 30 mm;

c) Cylindrical—Surface—Internal—Cutting—off; and

d) Precision tool grinding—Snagging—Knife Grinding–Centreless.

A-2 MACHINE (ON WHICH TO BE USED)

a) Make,

b) Description,

c) Wheels speed,

d) Work speed,

e) Traverse speed,

f) Infeed (depth of cut),

g) Wet or dry grinding, and

h) Coolant specification/Description.

A-3 WORK

a) Description of work;

b) Overall size or weight;

c) Material;

d) Condition—Soft, annealed, hardened or chilled, hardness value may also be given;

e) Amount of material to be removed; and

f) Degree of finish required—Very rough, rough, medium, fine, polished, highly polished, rasp file, bastard file, second cut or smooth; surface hardness value may be given.

A-4 SIZE AND SHAPE OF GRINDING WHEEL

Size and shape of grinding wheel shall be as per IS 2324 (Parts 1 and 2):

a) Diameter,

b) Thickness (straight or taper),

c) Size of hole (plain or recessed),

d) Recesses (given diameter and depth, if taper, give amount of taper), and

e) Shape of face.

For Repeat Orders

1) Reference number of wheel previously used, if available;

2) Was it too fine—coarse—hard—soft; and

3) Was it entirely satisfactory—did its glaze—wear out quickly.

A-5 DIMENSIONAL TOLERANCES

May be given as per IS 13596.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act,* 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

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