TITLE:- GRINDING DRILLS, PUNCHES & LATHE TOOLS

LECTURER:-

DATE:-

EQUIPMENT:- Twist drill, Centre punch, Lathe tool

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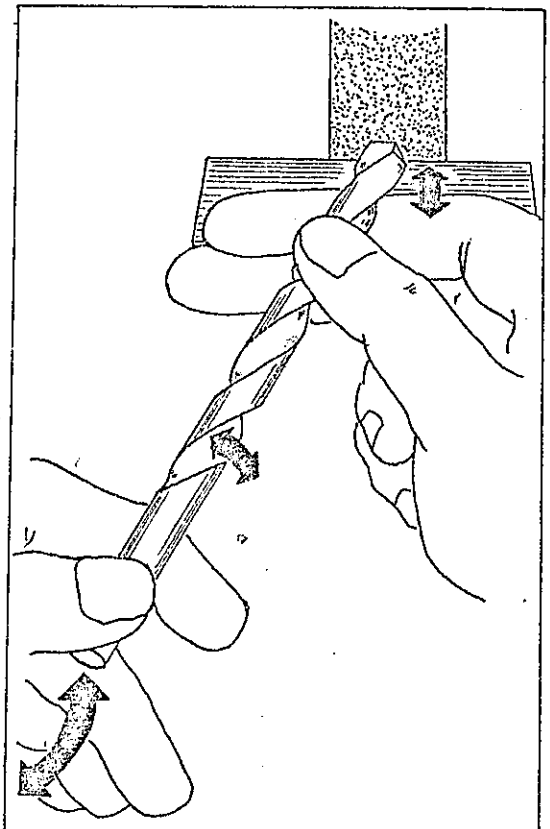
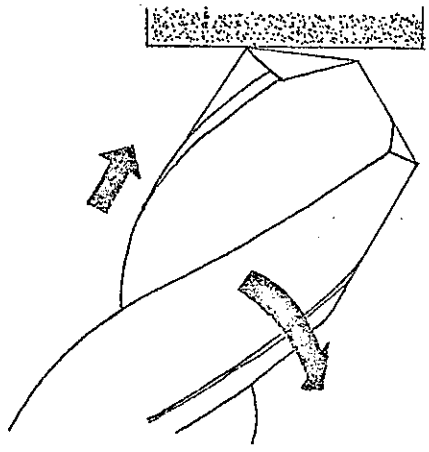
Sharpening a Twist Drill -

A bench type grinding machine, with an abrasive wheel 32A.46.K.VBE, is suitable for the purpose of sharpening a twist drill.

Firstly, ensure that the machine is in good working order with regard to guards, work rest and wheel condition. Stand comfortably in front of the machine and slightly to the left of the wheel. Hold the drill at about $\frac{1}{4}$ of its length from the point, between the thumb and first finger of the right hand , and support the hand on the work rest with the other fingers. Hold the shank of the drill between the thumb and fingers of the left hand, and keep both elbows tucked into the side. Hold the drill level and present the drill at an angle of $59^{\circ}$ -$60^{\circ}$ to the wheel face. Grind the cutting edge of the drill horizontal and parallel to the wheel face. Follow the same procedure to grind the other cutting edge of the drill, making sure that both cutting edges have the same angle and length.



SHARPENING A TWIST DRILL

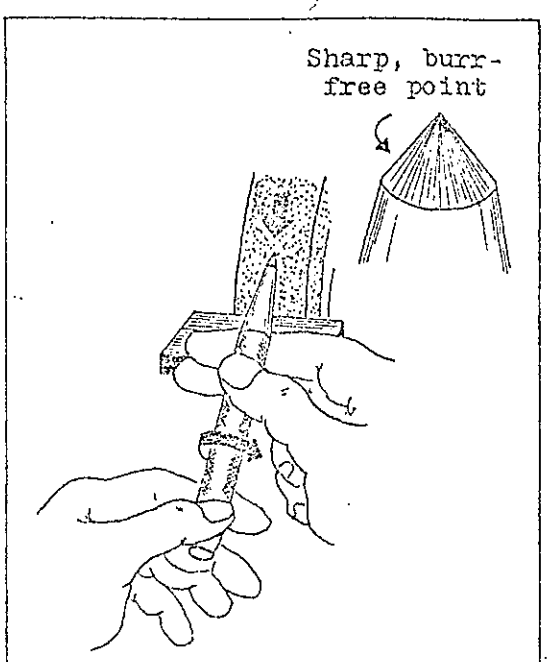


Lip Clearance Swing the shank of the drill slightly downwards and to the left with the left hand - the right hand is supported on the tool rest. Roll the drill to the right by turning it between the thumb and finger as the left hand swings down. Note that the cutting edge moves slightly upwards and away from the wheel face. Apply a slight forward motion to your hands - this will bring the heel of the point against the wheel to produce lip clearance. These above 3 movements must be co-ordinated to produce a correctly sharpened drill - very little movement is required and remove as little metal as possible.

When the drill is sharpened, check the cutting angle and lengths of the cutting edges with a drill gauge, then test the drill by drilling a hole in a piece of scrap material.

Sharpening a Centre Punch

Hold the punch to the wheel face at the required angle (60° for centre punch) on the vertical plane. Support the punch with fingers on the work rest and rotate the punch with the fingers of the other hand. Very little pressure is required on the wheel - excessive pressure will cause the punch point to overheat and lose some of its hardness qualities. This method will produce a strong, sharp, burr-free point.



SHARPENING A CENTRE PUNCH

Sharpening Lathe Tools - Select a suitable wheel (similar to one used for sharpening twist drills) and place the tool steel firmly on the work rest to grind the front clearance angle. Hold the tool at the angle required to the wheel face, and, by moving the tool across the wheel face, grind until the front clearance angle is parallel to the wheel face. Carry out the same procedure to grind the side and top clearance angles on the tool - avoid grinding on the edges and sides of the wheel. A light rub on an oilstone may be necessary to remove burrs from the cutting edge of the tool.

TITLE:- GRINDING WHEELS
LECTURER:- PERRY HENNIS
DATE:- 25-5-81
EQUIPMENT:-

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Introduction

Satisfactory grinding results can only be obtained by having the right type of abrasive wheel rotating at the correct speed for the kind of work being performed. The speed of the machine is fixed, but the type of abrasive wheel can be varied to suit the work. Abrasive or grinding wheels are made from manufactured abrasive grains held together by suitable material, called a bond.

Abrasive - two abrasives are used in the manufacture of abrasive wheels. They are - (1) Aluminium oxide
(2) Silicon carbide

Aluminium oxide is formed from an aluminium ore called bauxite. Heat is used to fuse the bauxite to form a mass of aluminium oxide called "alundum" is a hard, tough abrasive suitable for grinding high tensile tough materials and all types of steels.

Silicon carbide is made from silica sand and carbon. The silica and carbon are fused together by heat to form large crystals of silicon carbide, which is crushed and graded to size. Silicon carbide called "Crystolon" is a harder abrasive than "Alundum", and is used to grind hard materials such as stone or ceramics. Non-ferrous materials are also ground with silicon carbide.

Bonds - The bond, which is the material which holds the grains or abrasive particles together, may be one of several types -

(1) Vitrified - clays are mixed with the grains and fused, by heat, into a glass-like substance. On cooling, a bond forms between the grains. Vitrified bonds produce a strong rigid wheel, which is not affected by water, acid or temperature change.

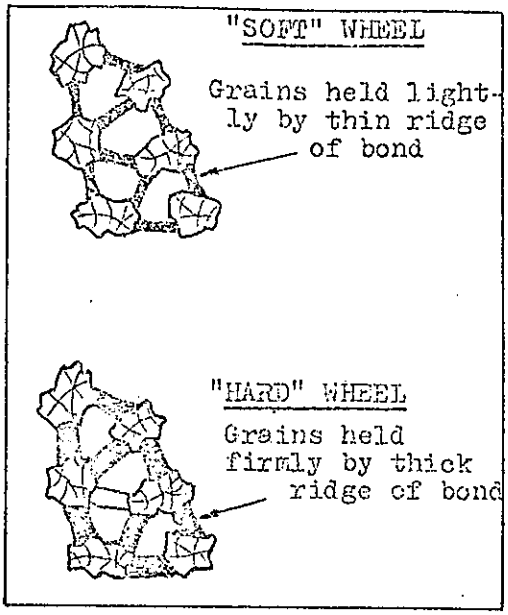
(2) Silicate - Silicate of soda is used in this bond, which produces a wheel that has a milder cutting action than the vitrified bonded wheel. Large diameter wheels usually have a silicate bond.

(3) Organic - Bonds such as resinoid, bakelite, rubber and shellac are used in organic bonded wheels, which have a higher safe operating speed than other types.
Because they can withstand rough usage, they are used on portable grinders and for rough foundry work. The low temperatures used in the manufacturing process, make it possible to mould reinforced pieces into the wheel.

Amount of Bond

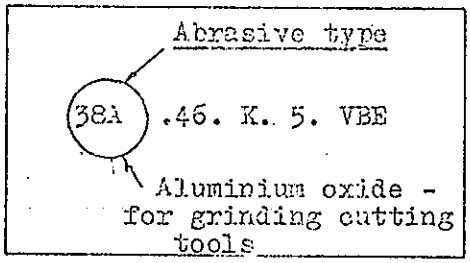
The amount or grade of bond determines whether an abrasive wheel is "hard" or "soft". The abrasive grains are extremely hard and do not vary in degree of hardness. The grains can break away easily when a

thin ridge of bond holds them together - these wheels are termed "soft". A thick ridge of bond holds the grains firmly - they are called "hard" wheels.
As a general rule, use "soft" light bond wheels for hard materials because, as the grains become blunted, they break away easily from the bond, and in doing so, present new sharp grains to the material.
Use "hard" firm bond wheels for soft materials, because the grains do not blunt as quickly and are maintained for a longer period by the firm bond.




## Abrasive Wheel Identification

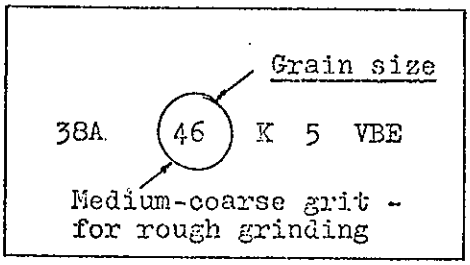
There is a standard marking system used to identify abrasive wheels, and it is arranged in the following sequence -



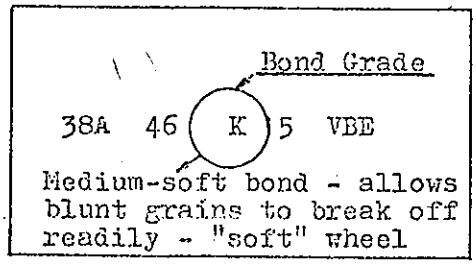

(1) Abrasive type - letters are used to identify types i.e.

A - aluminium oxide
C - silicon carbide.

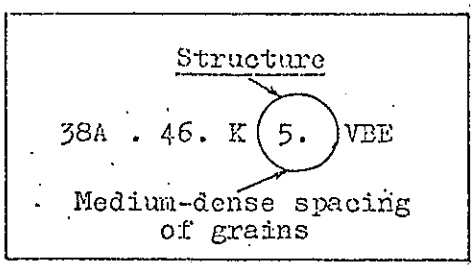
The manufacturer may use a number in front of this letter to indicate a particular variation of each type. e.g. 38A is an aluminium oxide abrasive designed for grinding high speed steel cutting tools.



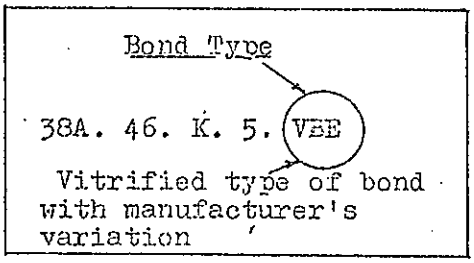

(2) Grain size - grain size or grit is obtained by passing the abrasive particles through a series of sieves of various sizes. It is indicated on the wheel by a number ranging from 10 (coarse) up to 600 (very fine). Generally, a fine grit wheel gives a smooth surface and is used for finishing work. Coarse grit removes large amounts of material and leaves a rough finish - hence it is used for roughing-down work.




(3) Amount or Grade of Bond - Indicated by a letter. The grades range from A, indicating a light or "soft" bond, through to Z which indicates a firm or "hard" bond.




(4) Structure - the spacing of the abrasive grains is called the "structure". It is represented by a number e.g. 1 indicates the grains are packed tightly together and 12 indicates the grains are spaced more openly.




(5) Bond type - a letter indicates the type of material or the process used for the bond of the wheel.
V - Vitrified
S - Silicate
B - Resinoid
R - Rubber
E - Shellac.

There may be a manufacturers particular bond characteristic, which is indicated by further letters after the basic bond type.

Wheel selection - factors which affect the selection of an abrasive wheel are -

(1) Type of material
(2) Amount of material
(3) Surface finish required
(4) Type and condition of grinding machine
(5) Wheel speed
(6) Arc of contact between the wheel and the work.

Testing a wheel for cracks

(a) Support the wheel with one finger through the bore or suspended on a piece of string and allow the wheel to hang free.

(b) Tap the side of the wheel (approx. $45^{\circ}$ to centre) with a non-metallic object such as wooden mallet.
- a clear "ringing" sound, indicates no cracks.
- a dull sound means a cracked wheel.

TITLE:- HAND FINISHED SURFACES

LECTURER:- CERYL HENNIS

DATE:- 25-5-81

EQUIPMENT:- Old second cut file, oil can, file card, sticks of chalk, brass scriber.

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To put a good finished surface on a filed or machined face, is not easily achieved. To use a buffing machine or similar, merely polishes up the scratches. The scratches must be removed or at least reduced to a minimum in a regular pattern.

Method

Take an old second cut file. Clean it thoroughly with a file card on both sides. Using the side of a stick of chalk, rub chalk onto the faces of the file. Inspect the file carefully. The chalk will show up any pins remaining on the file. Remove these with the brass scriber. Tighten the piece in the vice so that it can be filed along its longest side. Apply a thin smear of oil and spread it out with the finger. Allow the oil to soak in. Lightly run the chalk along this surface, as with the file. Place the file flat onto the surface to be filed, along its length. Press the file onto the surface using the heel of the left hand. The pressure of filing is only applied in this way. Hold the handle of the file in the right hand and use this hand to drive the file back and forward along the surface. Light pressure and steady action is all that is required, as the object is to smooth an already finisned surface, not remove metal. Keep the file clean and continually oil and chalk the filing surface and chalk the file.

Lapping:- To obtain a better surface, a process called lapping is employed. This entails rubbing a surface by hand with a lapping tool. A lapping tool consists of a former or arbor of soft metal such as brass or cast iron. Set onto the face are fine abrasives, such as flour of Emery or even Diamond dust.
Two mating surfaces can be lapped together, by spreading a thin coating of special grinding paste between the two surfaces, then rubbing the surfaces against each other. This method is the one used to lap the valves on cars and motorbikes etc.

TITLE:- ABRASIVE PAPER AND POLISHING

LECTURER:-

DATE:-

EQUIPMENT:- Emery paper, glass paper, metal polish, steel wool, carborundum paper

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This lecture deals with the type of abrasives or polish which are used to remove oxides or put a protective surface onto metals, or both.

Emery cloth:- is a cloth sheet or backing to which an abrasive, "Emery", or Aluminium oxide is glued or bonded on one side. Used mainly to remove oxides, tends to scratch a surface badly. Available as a long tape which is extremely useful for round objects such as shafts, the idea being the tape is wrapped round the surface and by pulling on the ends, will follow the surface of the shaft, giving a very even effect.
Conductive material not to be used on commutators or carbon brushes. Used mainly on metals.

Glass paper:- a paper backing to which silicone abrasives are glued; obtainable in a large range of grades. The different grades are given a number and a letter. The number refers to the grain size; the higher the number, the smaller the grains, and the smoother the glass paper. The letter refers to the glue or bond; a soft glue would be "A", an extremely hard glue "Z". The main grades in common use are 150-C, a fine glasspaper; 80-D, a medium rough glasspaper; or 50-D, a very rough glasspaper.
Glasspaper can be used on most materials, again tends to scratch. Non-conductive. Glasspaper is used to bed in Carbon Brushes and on Commutators. Also used mainly to remove oxides.

Carborundum Paper or wet and dry, as it is known. Paper backing, carborundum the abrasive. Much finer than either glasspaper or emery cloth. As the given name implies, can be used wet or dry, but if used dry soon wears out. Often used to remove the scratches left by Emery cloth or glasspaper. Will give a smooth finish to most metals. Non-conductive.
When using the abrasive papers and cloths, if they are wrapped around a file or pinned to a flat board, it is much easier to obtain a flat surface.

Metal polish:- Removes oxides by the combined process of abrasives and chemicals, mainly white spirit. Also imparts a protective coating to the surface.

Steel wool:- Removes oxides from metal surfaces. Used mainly prior to machine buffing or polishing by hand. A conductive material, not to be used on electrical gear at all, due to the danger of loose strands being left behind and shorting out conductors.

Aluminium Foil:- Small electrical contact faces are usually made of expensive metals like platinum and silver alloys. These should never be cleaned with abrasives. A piece of aluminium foil, such as the inside wrapping of a cigarett packet, drawn between the contact faces will give just enough abrasion to polish the faces. If there are any arcing spots, too small to be seen, they will tear or indent the foil giving an indication of their presence.

TITLE:- PROTECTIVE COATINGS

LECTURER:-

DATE:-

EQUIPMENT:- Shellac flakes, Insulating enamel, Rustoleum, Hymeg, Resin, Methylated spirits.

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VARNISHES:- Numerous liquid materials, which form solid films are used extensively in the manufacture of insulating materials and for protecting windings etc.

Air-drying Varnishes, Paints etc:- One class of air-drying varnishes and lacquers consist of plain solutions of shellac, gums, cellulose derivatives or resins, which dry (fairly quickly, e.g. in 5 to 30 minutes), and deposit films simply by evaporation of the solvent. Other air-drying varnishes and paints form films, which harden by evaporation of solvent accompanied by oxidation, or other chemical changes, which harden and toughen the film, these processes often taking several hours.

Baking varnishes & Enamels:- Where the toughest and most resistant coatings are required, baking varnishes and enamels are used. Typical varnishes of this class require baking at approximately $90^{o}$-$110^{o}$C in a ventilated oven, for from 1 to 8 hours, or more in many cases.

Resin:- A resin is a solid, semi-solid, or liquid organic compound which is soluble in Meths, ether, alcohol etc., but insoluble in water. Resins may be divided into 4 groups - Animal, Vegetable, Mineral and Synthetic.

Animal Resins:- Shellac is the most important animal resin. It is a purified resin made from "Lac", which consists of excretions from certain insects, found in trees in India and the Far East. It has a resistivity of the order of $10^{15}$ to $10^{16}\Omega$.cm.

Vegetable Resins:- These are obtained from various trees, and are called "copals". One group which is found in fossilized deposits ("hard Copal") has a melting point of approx. $350^{o}$C.

Mineral Resins:- Asphalts are sometimes called mineral resins. They are soluble in carbon disulfide and benzine, are soft at $70^{o}$C and melt at approx. $100^{o}$C. Natural tars and pitches are in this group.

Synthetic Resins:- These are formed directly from organic compounds, and are largely replacing the natural resins, because of their uniformity of composition, and, in comparison with older varnishes, their superior performance in imparting chemical resistance, thermal stability and mechanical durability. Examples of these are:- Bakelite, P.V.C., Polythene, Nylon.

Protective Paints:- These are extensively employed to protect exposed metal from dampness, rust, oxidizing gases, tracking, etc. No one paint is suitable for all purposes.

Aluminium Paint:- Is conductive, but it reflects both infra-red and ultra-violet rays from the sun.

Anti-rust Paint:- Trade name "Rustoleum" and is used on bare metal as an undercoat to help prevent rust.

Insulating Enamel:- (Air drying) Commonly called Red insulating enamel, widely used in the electrical trade, as a protective electrical coating on motor and generator end windings, stator coils, commutator ends. Because of good dielectric properties, and excellent arc resistance and non-tracking properties, it is a very

good coating for bus-bars etc.
It also offers good resistance to oil, water, acid, alkali, salt water.

Insulating Varnishes:- (Baking)

Trade name "HYMEG"

Hymeg 1 - Rapid baking produces a clear hard leathery film, with good mechanical strength and electrical properties. Resistant to acids, alkilis, oils and moisture, it has good binding properties and good resistance to high temperatures.

Hymeg 2 - Clear varnish with similar "through drying" characteristics and the same general properties as Hymeg 1.
Although extremely elastic, it is used on high speed armatures as it does not soften appreciably under heat, and does not "throw". Its uses include small high speed motors, generators, 400-500 H.P. motors and radio and telephone equipment.

Petroleum Jelly:- The grease-like substance left, after the distillation of paraffin-base petroleum, is termed "Petrolatum".
The best grades are distinctly greenish in colour.
The best field of usefulness is in the wrapping process in making cable joints. Petrolatum is also known as Vaseline, Petroleum jelly and liquid parafin.