Trade of Metal Fabrication	
Module 1:	Basic Fabrication
Unit 12:	Abrasive Grinding and Cutting
	Phase 2

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Document Release History

Date	Version	Comments
24/08/06	First draft	
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Module 1 – Basic Fabrication

Unit 12 – Abrasive Grinding and Cutting

Duration – 2 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Identify various grades of grinding disc by specification
- State the types of portable grinding machines
- Describe an abrasive wheel cutting machine
- Identify types of cutting and grinding discs used with angle grinder
- Identify safety procedures

Key Learning Points:

Rk	Types and grades of grinding discs.
Rk	Specifications.
Rk Sk	Changing discs.
Rk H	Ratio of speeds between machine and discs.
Rk H	Portable grinders. *(See "Portable Grinding Machines" section in Module 1 Unit 10).*
Rk H	Cutting and grinding discs.
Rk H	Abrasive wheel cutting machines. *(See "Abrasive Wheel Cutting-Off Machines" section in Module 1 Unit 10).*
Rk H	Safety procedures - safety awareness. *(See "Basic Safety Rules" section in Module 1 Unit 10).*
P	Communication, safe work practice and attitude.

Training Resources:

Workshop – portable grinders. Hand tools, drills. Types of specifications. Sample wheel. Instructor lecture and demonstrations. Texts, notes and handouts.

Key Learning Points Code:

M = Maths D= Drawing RK = Related Knowledge Sc = Science

P = Personal Skills Sk = Skill H = Hazards

Angle Grinder

Uses:

- Grinding and cutting steel and metal

Power Input	1020 V
Power output	600 W
No-load speed	11.000 r.p.m.
Cutting disc diameter	Max. 125 mm
Drive spindle thread	M14
Cutting depth	Max. 35 mm
Weight	Approx. 1.8 kg

Table 1 - Technical Data Ag 125-S Abrasive Grinder

Features:

- Dust protection for longer carbon brushes life
- A slimmer design that lies well in the hand
- Permanent on/off switch
- Low vibration side handle (optional)
- Side handle can be mounted on the left or right
- Additional cooling slots for perfect cooling

Figure 1 - Angle Grinder 1

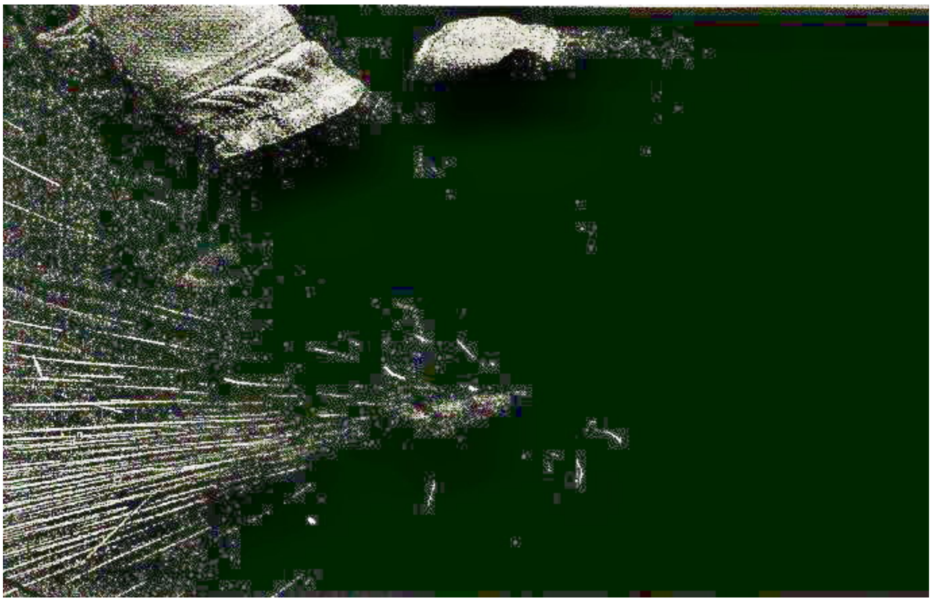


Figure 2 - Angle Grinder 2

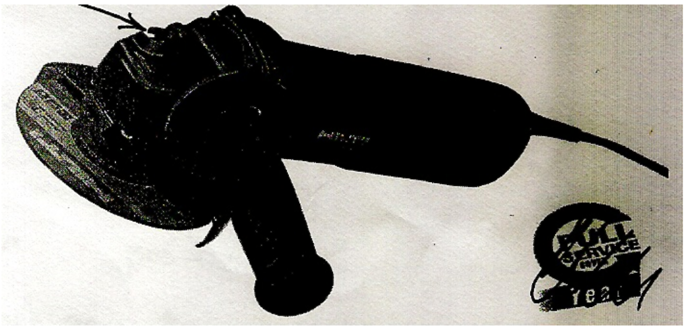


Figure 3 - Angle Grinder 3

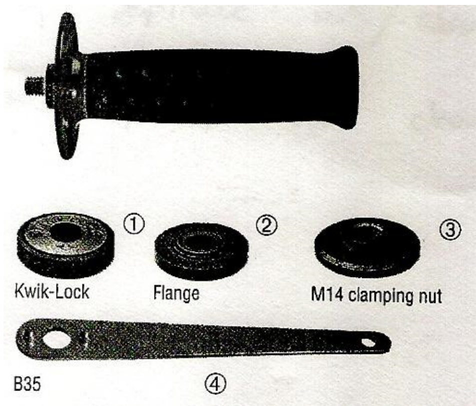


Figure 4 – Angle Grinder Accessories

1. Kwik-lock nut
2. Flange
3. M14 clamping nut

4. B35 pin wrench
   Tool for changing discs.

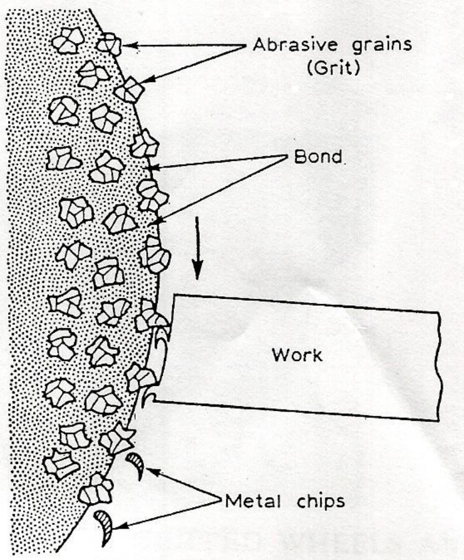
Changing Discs

To mount a grinding/cutting disc on an angle–grinder:

1. Select a disc – cutting, grinding, size etc.
2. Make sure that they are no defects in the disc (visually examine for cracks).
3. All mating parts should be clean and free from grease
   - Disc/flange faces
   - Spindle threads/flange threads (if threaded type)
4. Assembly
   (a) Flanges located in correct position
   (b) Spindle nut/clamping nut seated properly over disc securing it in position
   (c) Pressing in bottom to hold/lock disc whilst tightening spindle nut/clamping nut
   (d) Use pin wrench/tool for changing discs

Grinding

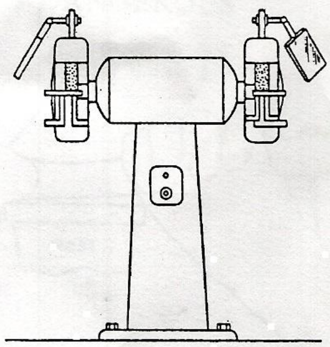
Cutting Action



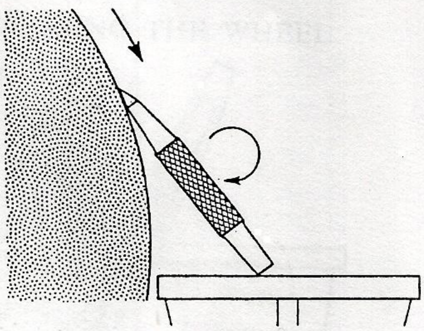
The grinding wheel is made up of small grains of abrasive material called grit. The grit is embedded in a softer substance called the bond. The grit size and the bond material will vary according to the type of work on which the wheel is to be used.

If we examine an abrasive wheel closely the grit can be seen held together by the bond.

As the work is applied to the wheel the grit cuts the metal in a manner similar to a cutting tool. As the grit becomes blunt, voids which are present in the bond release the grit, which exposes new grit to continue the cutting action.

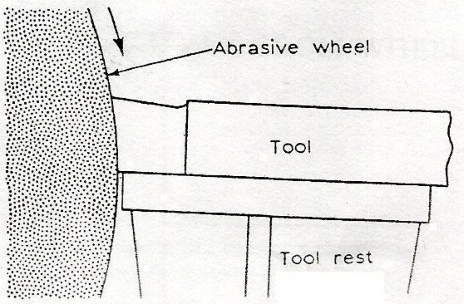


Sharpening Cutting and Small Tools



Hand tools such as cold chisels, centre punches and scribers are easily and quickly sharpened on the off hand grinding machine (shown opposite). Drills can, and are, frequently sharpened on the off hand grinder.

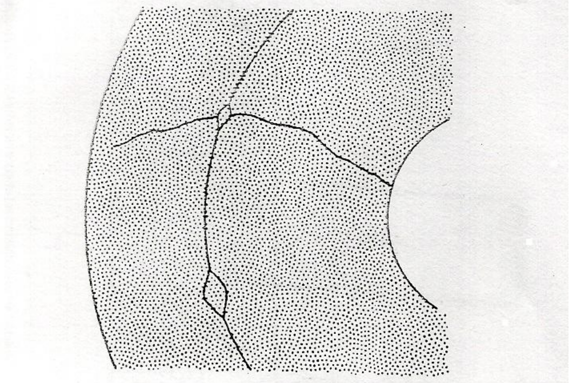
Large drills, however, cannot be sharpened accurately and must be ground on a special machine or by using a fixture attached to the off hand grinder.



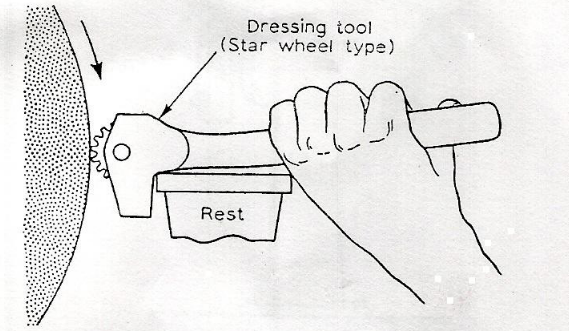
Single point tools as used on the lathe or sharper will frequently require sharpening. This can be achieved by setting the tool rest to the required angle and applying the tool to the wheel of the off hand grinder as shown here.

Precautions when Grinding

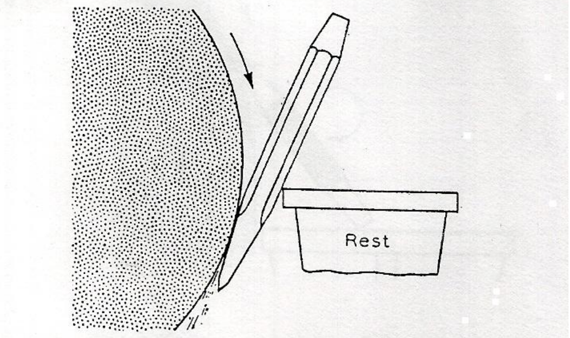
The Wheel



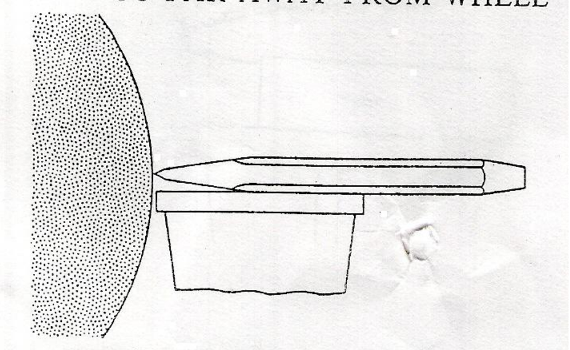
CRACKED OR CHIPPED WHEELS ARE DANGEROUS



DRESSING THE WHEEL



REST TOO FAR AWAY FROM WHEEL



REST CORRECTLY ADJUSTED

Due to the nature of its construction the wheel can, if not carefully treated, crack or even shatter during use. To reduce the danger of flying particles causing injury, the wheel must be guarded with only the working area exposed. Examine the wheel frequently for cracks or other defects.

When grinding move the work from side to side to avoid cutting grooves in the wheel. Use the front of the wheel as much as possible. If the side of the wheel is used avoid using too much force.

Wheel Balance

During use it is quite common for the wheel to wear unevenly so that it runs out of true. Excessive vibration when running usually indicates that the wheel is out of balance.

The wheel can be trued up by using an abrasive stick or a star wheel dresser as shown.

Dressing the wheel also opens up the grit if the wheel has become loaded (blocked with dirt, grease or other matter).

The Work Rest

When using the off hand grinder the work rest must be as close to the wheel as possible. Failure to observe this rule may result in the work becoming jammed between the wheel and rest.

Wheel Speed

Never exceed the manufacturer's recommended wheel speed. This speed is clearly indicated on the label on the side of the wheel. Always mount the wheel correctly.

British Standard Marking System for Abrasive Wheels

The British Standard Marking System denotes the composition an9 qualities of abrasive wheels.

All wheels are marked to show 5 qualities:

ABRASIVE

GRAIN

GRADE

STRUCTURE

BOND

A thorough understanding of this marking system will help one to always select the correct abrasive wheel for the particular job in hand.

Abrasive

The symbols ‘A’ or ‘C’ denote the abrasive used;

‘A’ - Aluminium Oxide - is ideal for grinding high-tensile material like steel.

‘C’ - Silicon Carbide - is used to grind materials of low-tensile strength like masonry or cast iron.

Grain

Aluminium Oxide and Silicon Carbide abrasive grains are screened into various sizes.

The larger grains are contained in wheels used for maximum stock removal, the smaller ones in wheels used for minimum stock removal and fine finishing.

Grain size is indicated by various numbers between 8 (coarse) and 600 (very fine).

Grade

This indicates the strength of the wheel, or, more precisely, the strength with which the bonding materials hold the abrasive grains in the wheel.

Abrasive grains act like thousands of cutters removing stock by tearing into the workpiece.

After some time they become blunt and must fall away if the wheel is to function correctly.

As they fall away new sharp abrasive grains are exposed for use.

Generally speaking, the harder the material being ground the quicker the grains lose their edge.

So, for grinding hard materials a soft grade wheel is used and for grinding soft materials a hard grade wheel is used.

Using too hard a wheel on a hard workpiece generates too much heat. This glazes the wheel and ruins the workpiece.

Using too soft a wheel on a soft workpiece results in excessive wheel wear and wastage.

Grade selection is made from an alphabetical list from A to Z.

‘E’ e.g. denotes a soft grade wheel suitable for grinding very hard materials like tungsten carbide and stainless steel.

‘U’ e.g. denotes a hard grade wheel suitable for grinding soft materials like aluminium.

ABRASIVE

A	C
For High-Tensile Materials e.g. Steel	For Low-Tensile Materials e.g. Cast Iron

GRAIN

Large Grain	Small Grain
For Maximum Stock Removal & Coarse Finish	For Minimum Stock Removal & Fine Finish

GRADE

Soft Grade	Hard Grade
For Hard Materials e.g. Stainless Steel	For Soft Materials e.g. Aluminium

STRUCTURE

Dense	Open
For Hard & Brittle Materials e.g. Hardened Steel	For Soft Materials e.g. Soft Steel

BOND

Vitrified	Resinoid
Used only on Fixed Machines	Used only on Portable Machines

Conversion Tables

Sometimes instead of in r.p.m., wheel speeds are shown in surface feet per minute (S.F.P.M.) – that is, the number of feet the circumference of the wheel would travel in one minute.

Surface Feet per Minute to Revolutions per Minute

For surface speeds greater than 10,000 S.F.P.M. take half the diameter and double the r.p.m. from the chart below.

Note: Vitrified bond must never exceed 6,500 S.F.P.M. Organic bond (resinoid, rubber or shellac) may exceed 6,500 S.F.P.M.

Grinding Wheel Speeds High Speed Table					
Diameter of Wheels		7,000 S.F.P.M.	8,000 S.F.P.M.	9,000 S.F.P.M.	10,000 S.F.P.M.
Ins.	m/m	r.p.m.	r.p.m.	r.p.m.	r.p.m.
1	25.4	20,738	30,558	34,377	38,197
2	50.8	13,369	13,279	17,159	19,098
3	70.2	8,913	10,188	11,459	12,732
4	101.6	6,684	7,639	8,304	9,549
5	127	5,347	6,111	6,573	7,639
6	152	4,466	5,093	5,729	6,366
7	178	3,820	4,363	4,911	5,457
8	203	3,342	3,820	4,297	4,775
10	254	2,674	3,056	3,439	3,820
12	305	2,223	2,546	2,563	3,183
14	356	1,910	2,183	2,455	2,728
16	406	1,671	1,910	2,148	2,357
18	457	1,485	1,698	1,910	2,122
20	503	1,337	1,528	1,719	1,810
22	559	1,215	1,359	1,563	1,756
24	609	1,114	1,273	1,432	1,591
26	660	1,028	1,175	1,322	1,469
28	711	966	1,091	1,226	1,364
30	762	891	1,018	1,140	1,273
32	813	835	955	1,074	1,194
34	863	786	899	1,101	1,123
36	914	743	840	833	1,061

Grinding Wheel Speeds Low Speed Table					
Diameter of Wheels		4,000 S.F.P.M.	5,000 S.F.P.M.	6,000 S.F.P.M.	6,500 S.F.P.M.
Ins.	m/m	r.p.m.	r.p.m.	r.p.m.	r.p.m.
1	25.4	15,279	10,098	22,918	24,828
2	50.8	7,639	9,549	11,459	12,414
3	70.2	5,093	6,368	7,639	8,276
4	101.6	3,820	4,775	5,729	6,207
5	127	3,066	3,820	4,584	4,906
6	152	2,548	3,183	3,820	4,138
7	178	2,183	2,723	3,274	3,547
8	203	1,910	2,387	2,805	3,103
10	254	1,528	1,910	2,292	2,483
12	305	1,273	1,591	1,910	2,069
14	356	1,091	1,304	1,637	1,773
16	406	956	1,194	1,432	1,532
18	457	849	1,001	1,273	1,379
20	503	764	955	1,146	1,241
22	559	694	868	1,042	1,128
24	609	637	796	955	1,034
26	660	588	734	881	953
28	711	540	682	818	887
30	762	500	637	764	828
32	813	477	597	716	776
34	863	449	562	674	730
36	914	424	530	637	690

Self Assessment

Questions on Background Notes – Module 1.Unit 12

No Suggested Questions and Answers.

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