MACHINIST GRINDER

NSQF LEVEL - 4

1st YEAR

TRADE PRACTICAL

SECTOR: CAPITAL GOODS & MANUFACTURING

(As per revised syllabus July 2022 - 1200 Hrs)

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
GOVERNMENT OF INDIA

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

Post Box No. 3142, CTI Campus, Guindy, Chennai - 600 032

Sector : **Capital Goods & Manufacturing**

Duration : **2 - Years**

Trade : **Machinist Grinder - Trade Practical - 1st Year - NSQF Level - 4 (Revised 2022)**

Developed & Published by

National Instructional Media Institute
Post Box No.3142
Guindy, Chennai - 600032
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in

First Edition : February 2023 Copies: 500

Rs.280/-

FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Media Development Committee members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Machinist Grinder - Trade Practical - 1st Year - NSQF Level - 4 (Revised 2022)** in **Capital Goods & Manufacturing Sector** under **Yearly Pattern.** The NSQF Level - 4 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

The Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

Director General of Training
Ministry of Skill Development & Entrepreneurship
Government of India.

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of Federal Republic of Germany. The prime objective of this Institute is to develop and provide instructional materials for various trades as per the prescribed syllabus under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVT/NAC in India, which is to help an individual to master skills to do a job. The instructional materials are generated in the form of Instructional Media Packages (IMPs). An IMP consists of Theory book, Practical book, Test and Assignment book, Instructor Guide, Audio Visual Aid (Wall charts and Transparencies) and other support materials.

The trade practical book consists of series of exercises to be completed by the trainees in the workshop. These exercises are designed to ensure that all the skills in the prescribed syllabus are covered. The trade theory book provides related theoretical knowledge required to enable the trainee to do a job. The test and assignments will enable the instructor to give assignments for the evaluation of the performance of a trainee. The wall charts and transparencies are unique, as they not only help the instructor to effectively present a topic but also help him to assess the trainee's understanding. The instructor guide enables the instructor to plan his schedule of instruction, plan the raw material requirements, day to day lessons and demonstrations.

IMPs also deals with the complex skills required to be developed for effective team work. Necessary care has also been taken to include important skill areas of allied trades as prescribed in the syllabus.

The availability of a complete Instructional Media Package in an institute helps both the trainer and management to impart effective training.

The IMPs are the outcome of collective efforts of the staff members of NIMI and the members of the Media Development Committees specially drawn from Public and Private sector industries, various training institutes under the Directorate General of Training (DGT), Government and Private ITIs.

NIMI would like to take this opportunity to convey sincere thanks to the Directors of Employment & Training of various State Governments, Training Departments of Industries both in the Public and Private sectors, Officers of DGT and DGT field institutes, proof readers, individual media developers and coordinators, but for whose active support NIMI would not have been able to bring out this materials.

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP **(Trade Practical)** for the trade of **Machinist Grinder - 1st Year - NSQF Level - 4 (Revised 2022)** under the **Capital Goods & Manufacturing** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. P.D. Manjula	-	Junior Training officer Govt. I.T.I. Arakonam, Tamilnadu.
Shri. T.J. Gopinath	-	Junior Training officer Govt. I.T.I. Trichy, Tamilnadu.
A. Vijayaraghavan	-	Asst. Director of Training (Retd) ATI, Chennai - 32.
M. Sampath	-	Training officer (Retd) CTI, Chennai - 32.

NIMI - CO-ORDINATORS

Shri. Nirmalya Nath	-	Deputy Director NIMI - Chennai - 32
Shri. V. Gopalakrishnan	-	Manager NIMI, Chennai - 32.

NIMI records its appreciation of the Data Entry, CAD, DTP Operators for their excellent and devoted services in the process of development of this Instructional Material.

NIMI also acknowledges with thanks, the invaluable efforts rendered by all other staff who have contributed for the development of this Instructional Material.

NIMI is grateful to all others who have directly or indirectly helped in developing this IMP.

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intented to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the course of the **Machinist Grinder** trade supplemented and supported by instructions/ informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF Level - 4 (Revised 2022) syllabus are covered.

This manual is divided into Nine modules. The Nine modules are given below.

Module 1	-	**Basic Fitting**
Module 2	-	**Turning**
Module 3	-	**Basic Grinding**
Module 4	-	**Surface Grinding**
Module 5	-	**Grinding Operation**
Module 6	-	**Dry & Wet Grinding**
Module 7	-	**Bore Grinding**
Module 8	-	**Gauges**
Module 9	-	**Preventive Maintenance**

The skill training in the shop floor is planned through a series of practical exercises centered around some practical project. However, there are few instances where the individual exercise does not form a part of project.

While developing the practical manual a sincere effort was made to prepare each exercise which will be easy to understand and carry out even by below average trainee. However the development team accept that there is a scope for further improvement. NIMI looks forward to the suggestions from the experienced training faculty for improving the manual.

TRADE THEORY

The manual of trade theory consists of theoretical information for the Course of the **Machinist Grinder** Trade Theory NSQF Level - 4 (Revised 2022) in Plumbing. The contents are sequenced according to the practical exercise contained in NSQF Level - 4 (Revised 2022) syllabus on Trade Theory attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indications about the corresponding practical exercises are given in every sheet of this manual.

It will be preferable to teach/learn the trade theory connected to each exercise at least one class before performing the related skills in the shop floor. The trade theory is to be treated as an integrated part of each exercise.

The material is not for the purpose of self learning and should be considered as supplementary to class room instruction.

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref.Ex.No
1	Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy by using steel rule, caliper etc. [Basic Fitting operation- marking, hack sawing, chiseling, filing, drilling, reaming,taping, off-hand grinding etc. accuracy±0.25mm] following safety precautions. **(Mapped NOS: CSC/N0304)**	**1.1.01 to 1.1.29**
2	Produce simple components by setting different machine parameters and performing different lathe operation [Different machine parameters: - Cutting, speed, feed, depth of cut; Different lathe operation – Facing, plain turning, taper turning, boring and simple thread cutting.] **(Mapped NOS: CSC/N0110)**	**1.2.30 to 1.2.38**
3	Perform grinding wheel mounting, balancing, dressing, truing and set surface grinder to make job by rough & finish grinding and check accuracy with precision measuring instrument [Accuracy limit:- ±0.25mm.] **(Mapped NOS: CSC/N0109)**	**1.3.39 to 1.3.46**
4	Set cylindrical grinder to produce job/ components by performing external and internal cylindrical operation and check accuracy [Accuracy limit: - ±0.25mm.] **(Mapped NOS: CSC/N0109)**	**1.4.47 to 1.4.62**
5	Set up cylindrical grinder for automatic movement to perform different cylindrical grinding operation using different machine accessories and check accuracy [Different cylindrical grinding:- straight parallel, taper, bush eccentric; Different machine accessories: - steady rest, chuck face plate,angle plate and check accuracy limit ±0.02 mm] **(Mapped NOS: CSC/N0109)**	**1.5.63 to 1.5.76**
6	Perform dry & wet grinding to make different shaped job of various metals and check accuracy. [Different shaped job: - square block angle plate, angular block; various metal: - cast iron, steel & accuracy limit ±0.02 mm.] **(Mapped NOS: CSC/N0109)**	**1.6.77 to 1.6.80**
7	Make a component by performing bore grinding and check accuracy by telescopic gauge. [Accuracy limit ±0.02 mm.] **(Mapped NOS: CSC/N0109)**	**1.7.81 to 1.7.82**
8	Perform operations on tools & cutter grinder and resharpening different tools on pedestal grinder. [Different tools: - lathe tools, drill, tool bit] **(Mapped NOS: CSC/N0109)**	**1.7.83 to 1.7.88**
9	Make components having angular and straight surface and check accuracy with different gauges and instruments. Different gauges: - sine bar, slip gauge & DTI (dial test indicator) and accuracy limit ±0.02mm.] **(Mapped NOS: CSC/N0109)**	**1.8.89 to 1.8.93**
10	Perform preventive maintenance of grinding machines. [Grinding machines: - surface and cylindrical] **(Mapped NOS: CSC/N0109)**	**1.9.94 to 1.9.95**
11	Make job of different material by cylindrical parallel grinding with appropriate accuracy. [Different material: - soft & hard metals; Accuracy limit±0.01mm] **(Mapped NOS: CSC/N0109)**	**1.9.96**

SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 100 Hrs; Professional Knowledge 20 Hrs	Plan and organize the work to make job as per specification applying different types o f basic fitting operation and check for dimensional accuracy by using steel rule, caliper etc. [Basic Fitting operation- marking, hack sawing, chiseling, filing, drilling, reaming, taping, off-hand grinding etc. accuracy±0.25mm] following safety precautions. **(Mapped NOS: CSC/N0304)**	1. Importance of trade training. (02 hrs) 2. List of tools & Machinery used in the trade. (02 hrs) 3. Health & Safety: Introduction to safety equipments and their uses. (02 hrs) 4. Introduction of First-aid. (01 hr) 5. Operation of Electrical mains (02 hrs) 6. Occupational Safety. (02 hrs) 7. Health Importance of housekeeping & good shop floor practices. (02 hrs) 8. Safety and Environment guidelines. Legislations & regulations as applicable. (02 hrs) 9. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. (03 hrs) 10. Personal protective Equipment's (PPE):- Basic injury prevention. (03 hrs) 11. Hazard identification and avoidance. (03 hrs) 12. Safety signs for Danger, Warning, caution & personal safety message. (02 hrs) 13. Preventive measures for electrical accidents & steps to be taken in such accidents. Use of Fire extinguishers. (02hrs)	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills: its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies e.g.; power failure, fire, and system failure. Introduction to Grinding trade and machine safety precautions according to IS: 1991-1962.(06 hrs.)
		14. Identify of tools & equipment's as per desired specifications for marking & sawing (Hand tools, Fitting tools & Measuring tools) (05 hrs) 15. Select material as per application, Inspect visually of raw material for rusting, scaling, corrosion etc. (05 hrs) 16. Mark out lines on job, (04 hrs) 17. Grip suitably in vice, cut different types of metals of different sections to given dimensions by a Hacksaw. (6 hrs) 18. Mark, punch and grind on pedestal grinder. (03 hrs)	Description of hand tools, Safety precautions, care and maintenance and material from which they are made. Ferrous and nonferrous metal and their identification by different methods. Heat treatment of metals, its importance, various methods of heat treatment such as hardening, tempering, normalizing, annealing etc. (05 hrs.)

		19. Measure different types of jobs by steel rule, caliper etc. and put dimension on freehand drawing (05 hrs) 20. Taper by angular protractor. (03 hrs)	Theory of Semi precision measuring instruments. General measuring tools (used in grinding shop) their description, use care and maintenance. (02 hrs.)
		21 Drill different sizes of holes by hand, Ream the holes, (05 hrs) 22. Make thread in drilled holes by tap. (02 hrs) 23. Prepare thread on a round bar (02 hrs) 24. Match an internal and external thread cutting with taps and dies using coolants. (03 hrs)	Relation between drill & tap sizes, care of taps and dies and their correct use. Types, properties and selection of coolants and lubricants. (03 hrs)
		25. Drill different sizes of holes by machine. (04 hrs) 26. Use of screw drivers, spanners, pliers etc. (03 hrs) 27. Make simple fitting job within accuracy ±0.4. (5 Hrs)	Brief description of drilling machine use and care Knowledge of tool fixing and job holding device on drilling machine. (02 hrs.).
		28. File a MS flat as given dimension. (12 hrs) 29. Make simple fitting job within accuracy ±0.2. (5 Hrs)	Knowledge of different types of files according to cut and shape. Methods of filing operation. Knowledge of surface finish accuracy by filing. (02 hrs.)
Professional Skill 80 Hrs; Professional Knowledge 22 Hrs	Produce simple components by setting different machine parameters and performing different lathe operation [Different machine parameters: - Cutting, speed, feed, depth of cut; Different lathe operation – Facing, plain turning, taper turning, boring and simple thread cutting.] **(Mapped NOS: CSC/N0110)**	30. Identify Centre lathe and its parts, (04 hrs) 31. Set lathe machine and perform on lathe operation with idle or dry run. (10 hrs) 32. Grind Lathe Tools on Pedestal Grinder. (10 hrs)	Brief description of a Centre lathe, its use. Knowledge of transmission of speed from motor to spindle of a lathe. Knowledge of aligning a job on lathe. Lathe tools nomenclature. (07 hrs.)
		33. Perform facing and turning on lathe. (05 hrs) 34. Perform drilling operation on lathe. (05 hrs) 35. Perform taper turning using compound rest and taper turning attachment. (05 hrs) 36. Perform boring operation on lathe. (11 hrs)	Knowledge of controlling cutting speed, feed and depth of cut. Lathe tools and their uses. Selection of tools for different operation in lathe. Taper and its types and problems. Taper turning methods and calculations. i.e. Form tool, TT attachment, Compound rest etc. (08 hrs.)

		37. Perform simple external screw cutting. (15 hrs) 38. Perform simple internal screw cutting. (15 hrs)	Method of screw cutting and simple calculation. Knowledge of spindle speed mechanism related to lead screw of lathe. (07 hrs.)
Professional Skill 100 Hrs; Professional Knowledge 20 Hrs	Perform grinding wheel mounting, balancing, dressing, truing and set surface grinder to make job by rough & finish grinding and check accuracy with precision measuring instrument [Accuracy limit:- ±0.25mm.] **(Mapped NOS: CSC/N0109)**	39. Set grinding wheel on wheel flange, truing and balancing of wheels. (20 hrs) 40. Dress grinding wheel. (05 hrs)	Application and use of pedestal grinder. General dressing tools used in grinding section such as wheel, diamond dresser, steel type dresser, abrasive dresser and nonferrous dresser. (05 hrs.)
		41. Check and measure various types of jobs using micrometers, Vernier caliper, Height gauge etc. (10 hrs) 42. Identify different parts of surface grinding machine. (10 hrs) 43. Set surface grinding machine and perform operating with dry / idle run. (12 hrs)	Precision measuring instruments English and metric micrometer, vernier caliper, dial test indicator etc. their description and uses. Knowledge of digital measuring instruments and its uses. Pneumatic gauges – its accessories and control device and use for checking dimensions. (06 hrs.)
		44. Perform rough and finish grinding on surface work. (15 hrs) 45. Perform rough and finish grinding on cylindrical job. (20 hrs) 46. Include diamond and CBN grinding wheel. (08 hrs)	Different types of abrasive, manufacture of grinding wheels, their grades. (09 hrs.)
Professional Skill 90 Hrs; Professional Knowledge 20 Hrs	Set cylindrical grinder to produce job/ components by performing external and internal cylindrical operation and check accuracy [Accuracy limit: - ±0.25mm.] **(Mapped NOS: CSC/N0109)**	47. Perform grinding on surface grinding machine. (07 hrs) 48. Identify different parts of cylindrical grinding machine. (02 hrs) 49. Set cylindrical grinding machine and perform operation with dry / idle run. (07 hrs) 50. Perform grinding on Cylindrical grinding machine (Grinding should be performed both on soft and hardened materials). (07 hrs)	Principle and value of grinding in finishing process, various types of grinding wheels their construction and characteristic glazed and loaded wheels. (03 hrs.)
		51. Grind parallel block within accuracy ±0.2mm. (06 hrs) 52. Perform Plain-mandrel grinding to size within accuracy ± 0.2. (06 hrs)	Knowledge how to square up a workpiece using an angle plate. Checking of squareness. Multiple clamping of parts to achieve concentricity & uniformity in size. (04 hrs.)
		53. Demonstrate selection of grinding wheels for grinding different metals. (03 hrs) 54. Select of suitable wheel to obtain rough and IS: 1249-1958. (03 hrs)	Factors effecting selection of wheels, identification of wheel, marking system of grinding wheels IS: 551- 1966. (03 hrs.)
		55. Grind different metals with suitable grinding wheels. (24 hrs)	Grit and different types of bonds, such as vitrified, resinoid, rubber etc. Different types of metals and electroplated bond. (05 hrs.)

		56. Perform externals cylindrical grinding operation within accuracy ± 0.1mm. (03 hrs) 57. Perform internal cylindrical grinding operation within accuracy ± 0.1mm. (03 hrs) 58. Change the recommended wheel speed and control depth of cut. (02 hrs) 59. Perform grinding of sockets both internal and external and check. (05 hrs) 60. Perform Morse taper grinding both internal and external and check. (05 hrs) 61. Perform grinding External sleeve and check. (05 hrs) 62. Perform depth checking by depth gaugemicrometer. (02 hrs)	Grinding wheel speed, surface speed per minute conversion of peripheral speed to r.p.m. Depth of cut and range at usefulness. Depth micrometer and vernier caliper. Common types of surface grinding machine, plain surface, rotary surface, horizontal and vertical surface grinder etc. Method of grinding tapers. (05 hrs.)
Professional Skill 200 Hrs; Professional Knowledge 30 Hrs	Set up cylindrical grinder for automatic movement to perform different cylindrical grinding operation using different machine accessories and check accuracy [Different cylindrical grinding:- straight parallel, taper, bush eccentric; Different machine accessories: - steady rest, chuck face plate,angle plate and check accuracy limit ±0.02 mm] **(Mapped NOS: CSC/N0109)**	63. Revise previous works. (05 hrs) 64. Perform machine setting for automatic movements. (10 hrs) 65. Perform parallel grinding on cylindrical grinder. (15 hrs)	Introduction TrainingRevision of previous works. Common types of grinding machines. Plain cylindrical external and internal cylindrical grinder and universal grinder. (04 hrs.)
		66. Test and mount wheels, sleeves, check truing and rebalancing. (15 hrs) 67. Perform grinding parallel mandrel within ± 0.03mm. (10 hrs)	Test for alignment and checking, balancing at wheel, dressing different types of wheel, dressers, their description and uses. (04 hrs.)
		68. Perform wheel balance and dressing grinding long bar using steady rest. (25 hrs)	Test for alignment and checking, balancing of wheel, dressing different types of wheel, dressers their description and uses. (03 hrs.)
		69. Perform grinding different types of jobs using machine chuck, face angle plate collets. (25 hrs)	Holding devices such as Magnetic chuck, chucks and face plates collets their description and uses. Method of holding jobs on magnetic chuck, face plate and chucks. (03 hrs.)
		70. Align table with the help of test bar and dial test indicator. (05 hrs) 71. Perform parallel grinding within accuracy ±0.02mm. (05 hrs) 72. Perform cylindrical Taper grinding (by swiveling machine table) (10 hrs) 73. Grind an eccentric job. (10 hrs) 74. Finish different types of jobs using jigs and fixtures, angle plates by grinding. (15 hrs)	External grinding operational steps in external grinding of a job and precautions to be taken. (04 hrs.) Holding devices such as jig and fixture angle plates 'V' blocks etc. their description and uses. (04 hrs.)

		75. Perform grinding of job by using face plate angle plate etc. (25 hrs,)	Internal grinding operational steps in internal grinding of a job precautions to be taken. (03 hrs.)
		76. Finish surfaces of bushes on mandrel within ±0.02 mm by grinding. (25 hrs)	Rough and finish grinding limit fit and tolerances as per ISI: 919-1963. Basic size and its deviation, position of tolerances as per ISI: 919-1963. Basic size and its deviation, position of tolerance zones with respect of zero line. Fits different types clearance, interference and transition. Interchangeable system. Letter symbols for holes and shaft and fundamental deviation hole basis and shaft basis system. (05 hrs.)
Professional Skill 40 Hrs; Professional Knowledge 10 Hrs	Perform dry & wet grinding to make different shaped job of various metals and check accuracy. [Different shaped job: - square block angle plate, angular block; various metal: - cast iron, steel & accuracy limit ±0.02 mm.] **(Mapped NOS: CSC/N0109)**	77. Perform dry and wet grinding of different classes of metals such as cast iron, brazed carbide tip and different classes of steel. (22 hrs)	Heat generated in grinding dry and wet grinding use of coolant, their composition and selection. Characteristic of coolant. (05 hrs.)
		78. Grind square block within accuracy ±0.02mm. (06 hrs) 79. Grind angle plate within accuracy ±0.02mm (06 hrs) 80. Grind angular block within accuracy ±0.02mm. (06 hrs)	Grinding a square job grinding angular surface taker grinding by stane land taper and angle protractor. (05hrs.)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Make a component by performing bore grinding and check accuracy by telescopic gauge. [Accuracy limit ±0.02 mm.] **Mapped NOS: CSC/N0109)**	81. Perform bore grinding withinaccuracy ±0.02mm. (13 hrs) 82. Use of Telescopic gauge for checking of bore. (12 hrs)	Grinding defects vibration, chattering, glazing and loading their causes and remedies. (05 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Perform operations on tools & cutter grinder and resharpening different tools on pedestal grinder. [Different tools: - lathe tools, drill, tool bit] (Mapped NOS: CSC/N0109)	83. Perform operation on tools and cutter grinding machine. (09 hrs) 84. Manipulate and control tools and cutter grinding machine (05 hrs) 85. Mount jobs on mandrel in tools and cutter grinding machine. (02 hrs) 86. Mount wheel and guards on pedestal grinder. (02 hrs) 87. Sharpen lathe tools on pedestal grinder. (02 hrs) 88. Sharpen drill, tool-bit on pedestal grinder. (05 hrs)	Tool and cutter grinding machine-parts and accessories, description use, care and maintenance, pedestal grinder and bench grinder-their description and uses. (05 hrs.)
Professional Skill 100 Hrs; Professional Knowledge 16 Hrs	Make components having angular and straight surface and check accuracy with different gauges and instruments.	89. Check tapered or angular jobs with help of sine bar, slip gauges and dial gauge. (23 hrs)	Use of snap gauges, sine bar and slip gauges their description and uses. Polishing, lapping powder and emery clothes lapping flat surface. (04 hrs.)

	[Different components: - V' block, parallel bar, drill point angle; Different gauges: - sine bar, slip gauge & DTI (dial test indicator) and accuracy limit ±0.02 mm.] (Mapped NOS: CSC/N0109)	90. Perform cylindrical and surfaces grinding operation (25 hrs)	Tools and cutter grinder their description, workin principles, operations care and maintenance. (04 hrs.)
		91. Perform step grinding on cylindrical grinding machine. (25 hrs)	Special types of grinding machines and centreless grinders. Their description, working principles, operations, care and maintenance. (04 hrs.)
		92. Grind Parallel block on surface grinding machine (12 hrs) 93. Grind gauges within finish accuracy ±0.02mm. (Rough and finish grinding using disc and diamond wheels). (15 hrs)	Diamond Wheel and Applications of diamond wheel in grinding. (04hrs.)
Professional Skill 30 Hrs; Professional Knowledge 06 Hrs	Perform preventive maintenance of grinding machines. [Grinding machines: - surface and cylindrical] (Mapped NOS: CSC/N0109)	94. Make simple utility jobs suchas V' block, Parallel bar, Drill point angle checking gauge with surface and cylindrical grinders. (12 hrs) 95. Perform preventive maintenance of grinding machines. (18 hrs)	Preventive maintenance and its necessity. Mode of frequency of lubrication. Preparation of Maintenance schedule, simple estimation, use of hand book and reference table. Total preventive Maintenance. (06hrs.)
Professional Skill 50 Hrs; Professional Knowledge 12 Hrs	Make job of different material by cylindrical parallel grinding with appropriate accuracy. [Different material: - soft & hard metals; Accuracy limit±0.01mm] (Mapped NOS: CSC/N0109)	96. Finish cylindrical surfaces by grinding within accuracy ±0.01mm (Maintaining parallelism) on both soft and hard metals. (50 hrs)	Cylindrical grinding machine, its parts, use care and maintenance surface grinding machine-its parts use care and maintenance Universal cylindrical grinding machines parts description use, care and maintenance. Internal grinding machine and its parts their description, use care and maintenance. (12 hrs.)

Importance of trade training

Objectives: At the end of this exercise you shall be able to
- **identify the staff structure of the institute**
- **identify the general discipline, laid down by the institute.**
- **record the general discipline, laid down by the institute.**

PROCEDURE

Familiarisation with the Institute

TASK 1 : **Visit to various sections in your ITI**

The Instructor will lead the new students to various sections in the ITI

1 During the visit note down and collect all information of staff, designation, their name.

2 Identify and note down the various sections (trades) in which training is given.

3 Locate your ITI, showing nearest land marks like post office, Railway stations, Bus stop, and their approximate distance from the ITI.

4 Collect the telephone numbers of the ITI office, nearest Hospital, Police station, nearest fire station and display it.

— — — — — — — —

TASK 2 : **Familiarisation**

1 Identify the head of the institution and his deputy.

2 Classify the major divisions of the Institute such as group Instructor, office Hostel, Stores, Medical.

3 list out the trades and the trade Instructor for each trade

4 list out the staff working under office Administration

5 list out the staff under hostel division

6 Medical division with a M.O. compounder and dresser

7 List out the general discipline to be followed with in the Institute

8 Learn and follow the rules and regulation of the Institute.

Based on the organisation structure, identify the major function of the staff listed in Table

Designation	Functions	Name
Principal		
Vice- Principal		
Medical Officer		
Accountant		
Trg & Placement officer		
Group Instructor		
Voc Instructor		
Office Supdt		
Hostel Warden		
Stores Officer		
Phy. Training Instructor		

— — — — — — — —

Importance of trade training

Skills thought in ITI

- Operation, control & monitoring of MC & equipment
- Operate & make component on CNC turning centre & CNC vertical machining centre.
- Select & use proper work holding tool holding equipments.

Skills headed by industry

- Operate conventional & CNC machines.
- In depth knowledge on geometrical tolerances.
- Troubleshooting causes of operating errors -------

Job opportunities of the ITI

- State & control gov. organisation
- Cutting tool manufacturing industry like addison to SRP tools ltd.
- Automobile sector related jobs in Renault Nissan, TVS, Ford, Hyundai

Up Skilling

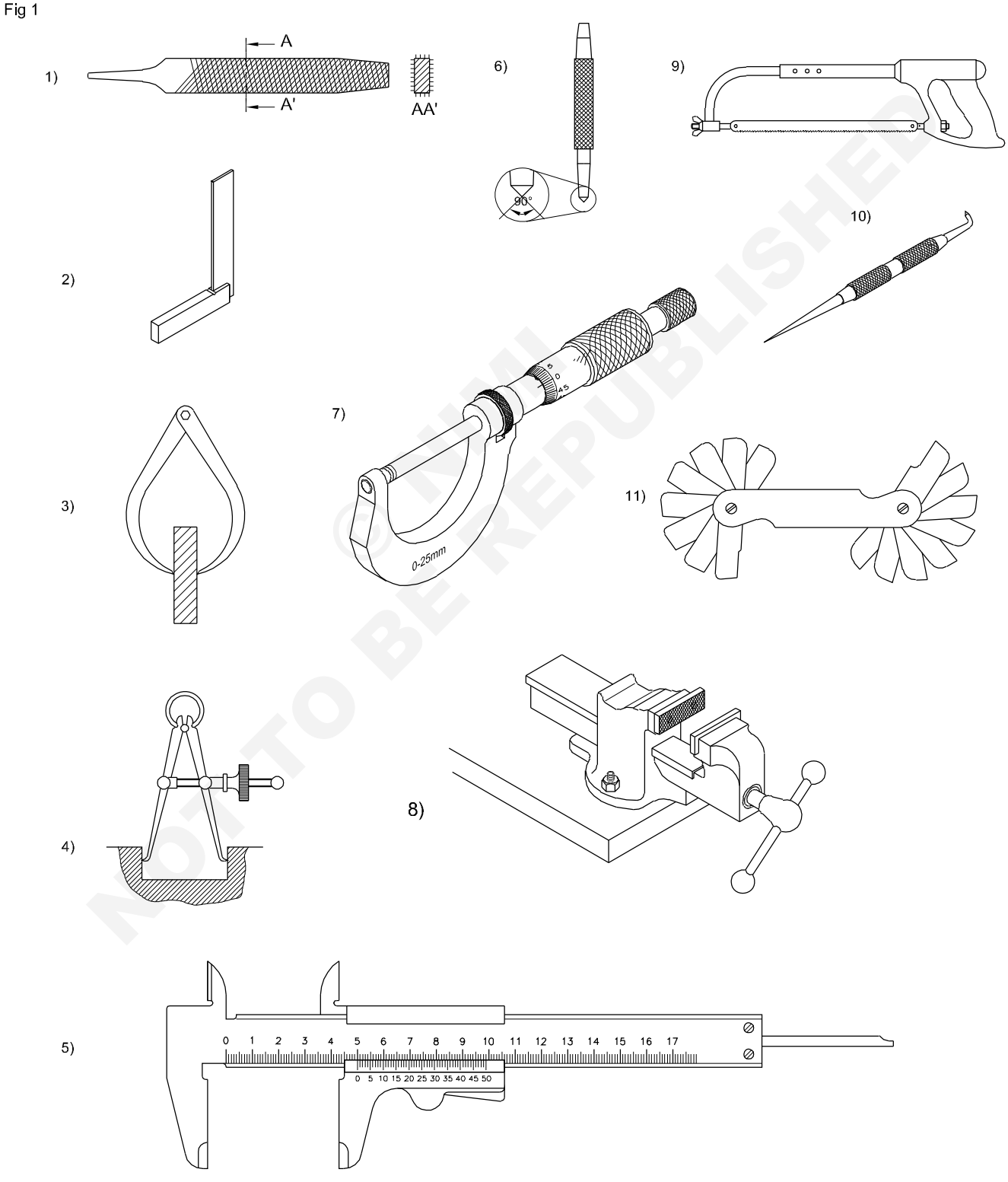
- Apprenticeship (NAC Certificate)
- Craft instructor training scheme (CITS) to become an instructor in ITI.
- Diploma course through (Full time/Part time). Advanced diploma (Vocational) course under DGT as applicable.
- Special short-term courses like computer - aided design (CAD) or computer - aided manufacturing (CAM) conducted by NSTI.

List of tools & machinery used in the trade

Objectives: At the end of this exercise you shall be able to

- **identify the tools and equipment used in machinist grinder section**
- **record the names of tools, do's and don't of each tool**
- **record the names of the industries where the machinist grinder are employed.**

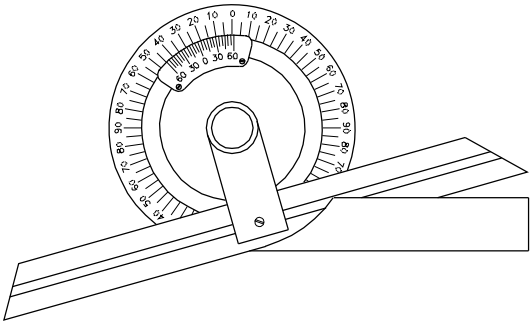
Fig 1



MG20N1102H1

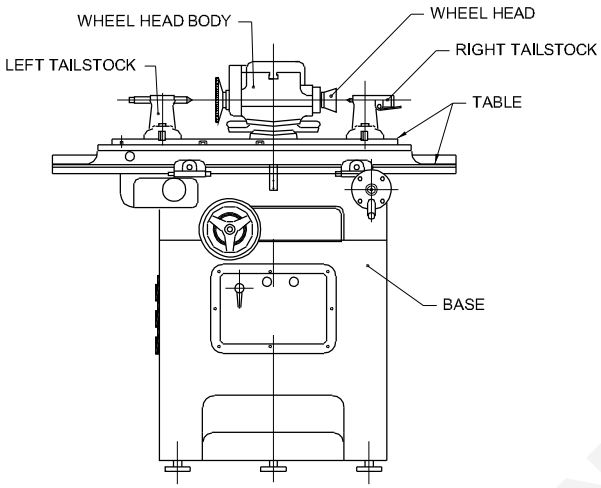
Fig 2

12)

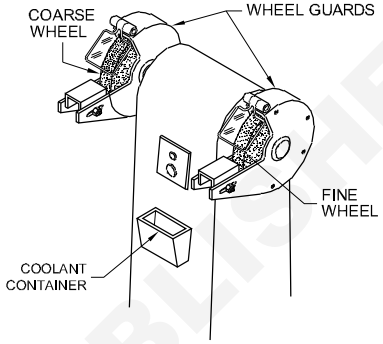


16)

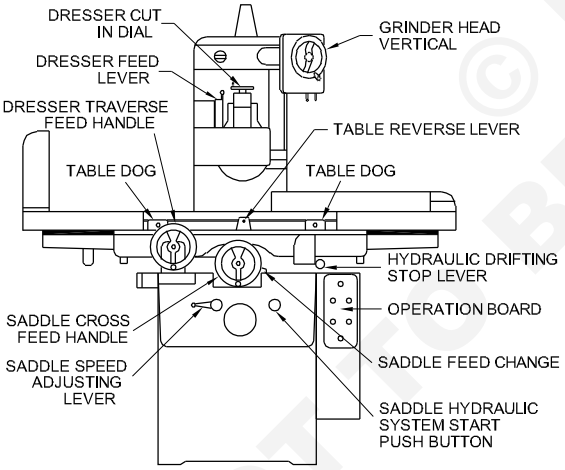
13)



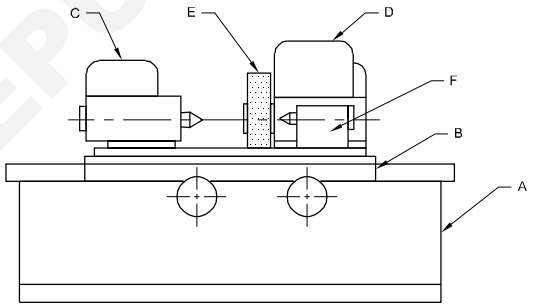
17



14)

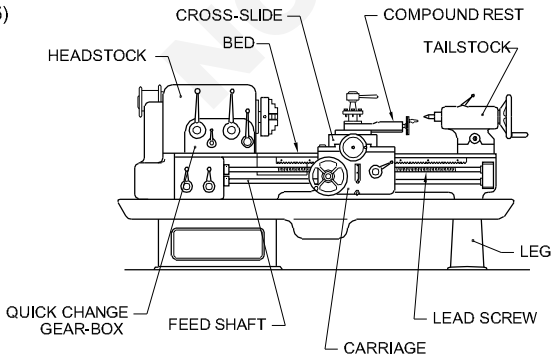


18)



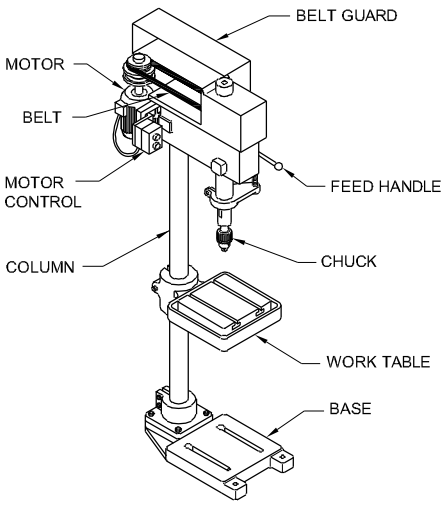
A. BASE
B. TABLE
C. HEADSTOCK
D. WHEEL HEAD
E. GRINDING WHEEL
F. TAILSTOCK

15)



CENTRE LATHE - MAJOR PARTS

19)



MG20N1102H2

Job Sequence

Instructor shall display all the tools and equipment in the section and brief their names, uses and the safety point to be observed for each tool and equipment.

- Trainees will note down all the displayed tools names, uses and the precaution to be observed while working with each tool.
- Record it in Table 1.
- Get it checked by the instructor.

Table 1

Sl.No	Name of tool/equipment	Uses	Precaution to be observed (Do's and Don't)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			

Instructor shall brief the role of a machinist grinder in industries. Emphasis more on the assembly shop by providing the names of the private and public sector industries, where the machinist grinder are largely employed. Ask the trainees to note down the names of the industries.

Exercise 1.1.03

Introduction to safety equipments and their uses

Objectives: At the end of this exercise you shall be able to
- **identify personal protective equipments**
- **write the names and uses in table - 1.**

Fig 1

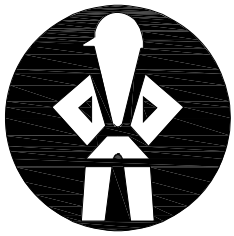


Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

Fig 6

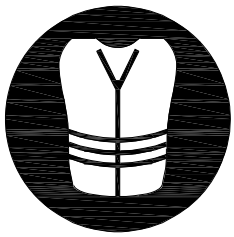


Fig 7

Fig 8

Fig 9

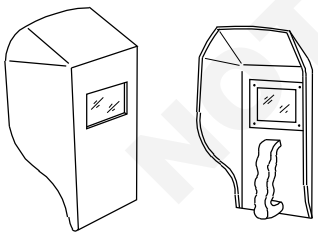


Fig 10

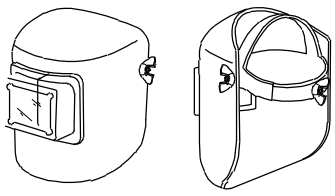


Fig 11

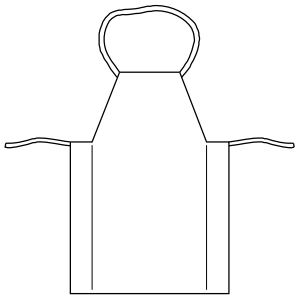


Fig 12

MG20N1103H1

Job Sequence

- Read and interpret the visuals of personal protective equipment on real devices or from the charts.
- Identify and select personal protective equipment used for different types of protection.
- Write the name of the PPE and the use in table 1.

The instructor shall display the different types of personal protective equipment or charts and explain how to identify and select the PPE devices suitable for the work and ask the trainees to note down the name and use Table1.

The instructor shall demonstrate how to wear and remove the all the PPE's.

Ask the trainees to practice it.

Table 1

S.No.	Name of the PPE	Uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Get it checked by your instructor.

Introduction of First aid

Objectives: At the end of this exercise, you shall be able to
- **provide first aid for chocking, wound, burn, bites and sting on human.**
- **take care a person with, eye injury, nose bleeding, diabetes, heat exhaustion by first aid treatment**
- **give first aid treatment to person with heat stroke.**

PROCEDURE

TASK 1: **Chocking**

1 Severe choking: back blows and abdominal thrusts as shown in Fig 1.

Fig 1

CHOCKING

MG20N1104-H1

2 Stand behind them and slightly to one side. Support their chest with 1 hand. ...

3 Give up to 5 sharp blows between their shoulder blades with the heel of your hand. ...

4 Check if the blockage has cleared.

5 If not, give up to 5 abdominal thrusts.

TASK 2: **Wound (Fig 2 to 3)**

The first step in care of a wound is to stop the bleeding.

1 Locate the source of the bleeding.

2 Wash your hands and, when possible, wear gloves or use a barrier between you and the wound.

3 Remove any loose debris.

4 Apply direct pressure on wound (FIg 1)

Fig 1

5 Dress the wound with cotton bandage (Fig 2)

Fig 2

TASK 3: **Burns (Fig 1, 2, 3)**

Fig 1

Fig 2

Fig 3

Treating minor burns

1 Cool the burn.

2 Remove rings or other tight items from the burned area.

3 Don't break blisters.

4 Apply lotion.

5 Bandage the burn.

6 If needed, take a nonprescription pain reliever, such as ibuprofen (Advil, Motrin IB, others), naproxen sodium (Aleve) or acetaminophen (Tylenol, others).

— — — — — — — — —

TASK 4: **Bites and Stings (Fig 1,2,3)**

Fig 1

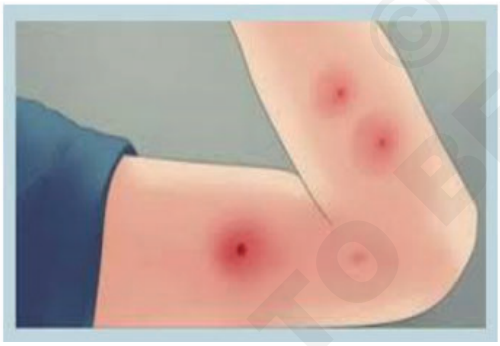


Fig 2

Fig 3

1 Stop the wound from bleeding by applying direct pressure with a clean, dry cloth.

2 Wash the wound. ...

3 Apply an antibacterial ointment to the wound. ...

4 Put on a dry, sterile bandage.

5 If the bite is on the neck, head, face, hand, fingers, or feet, call Doctor right away

— — — — — — — — —

TASK 5: **Eye Injury (Fig 1 & 2)**

Fig 1

Fig 2

1 Ask patient to look up.

2 Draw lower eyelid down. If object visible, remove with corner of moist cloth.

3 If not visible, pull upper lid down.

4 If unsuccessful, wash eye with sterile saline or clean water.

5 If still unsuccessful, cover injured eye only and seek medical aid.

TASK 6: **Nose Bleedings (Fig 1 & 2)**

Fig 1

NOSE BLEED

MG20N1104O1

Fig 2

MG20N1104O2

1 Make a patient to sit straight and bend forward the head portion only(This will reduce blood pressure in the Veins of your nose)

2 Ask the patient to breathe out from the nose.

3 Pinch the nose to take out the blood in the nose.

4 To prevent re-bleeding, don't pick or blow your nose and don't bend down for several hours.

5 If re-bleeding occurs, go through these steps again.

TASK 7: **Diabetes (Low blood Sugar)(Fig 1 & 2)**

Fig 1

Fig 2

1 Follow the Basic First Aid Plan to assess the casualty.

2 Give high-energy foods or sugar.

3 Only give food if the casualty is conscious.

4 If medical aid is delayed give sugar every 15 minutes.

5 The casualty will recover quickly if low blood sugar level is the cause.

TASK 8: **Heat Exhaustion (Fig 1 to 2)**

Fig 1

Fig 2

Heat Exhaustion

1 Rest in a cool place. Getting into an air-conditioned building is best, but at the very least, find a shady spot or sit in front of a fan.

2 Drink cool fluids. Stick to water or sports drinks.

3 Try cooling measures.

4 Loosen clothing.

— — — — — — — — —

TASK 9: **Heat Stroke**

1 Put the person in a cool tub of water or a cool shower.

2 Spray the person with a garden hose.

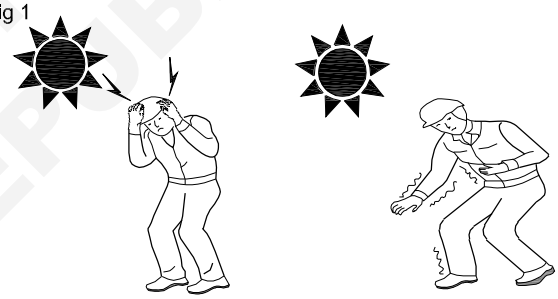
3 Sponge the person with cool water.

4 Fan the person while misting with cool water.

5 Place ice packs or cool wet towels on the neck and armpits.

6 Cover the person with cool damp sheets.

Fig 1



— — — — — — — — —

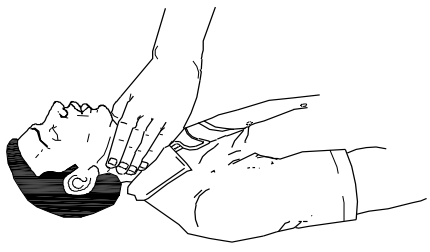
TASK 10: **Resuscitate a victim who is under cardiac arrest by (CPR) cardio pulmonary resuscitation**

In cases where the heart has stopped beating, you must act immediately.

1 Check quickly whether the victim is under cardiac arrest.

Cardiac arrest could be ascertained by the absence of the cardiac pulse in the neck (Fig 1), blue colour around lips and widely dilated pupil of the eyes.

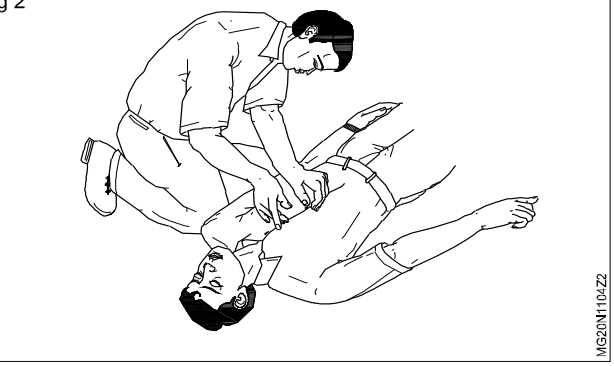
Fig 1



2 Lay the victim on his back on a firm surface.

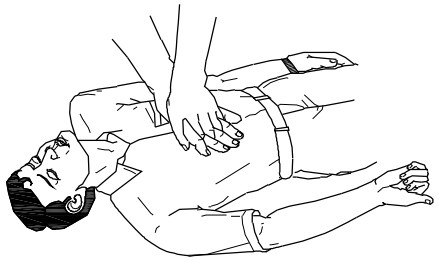
3 Kneel alongside facing the chest and locate the lower part of the breastbone. (Fig 2)

Fig 2



4 Place the palm of one hand on the centre of the lower part of the breastbone, keeping your fingers off the ribs. Cover the palm with your other hand and lock your fingers together as shown in Fig 3.

Fig 3



MG20N1104Z3

5 Keeping your arms straight, press sharply down on the lower part of the breastbone; then release the pressure. (Fig 4)

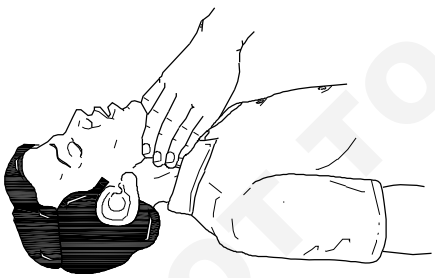
Fig 4

MG20N1104Z4

6 Repeat step above, fifteen times at the rate of atleast once per second.

7 Check the cardiac pulse. (Fig 5)

Fig 5



MG20N1104Z5

8 Move back to the victim's mouth to give two breaths (mouth-to-mouth resuscitation). (Fig 6)

Fig 6

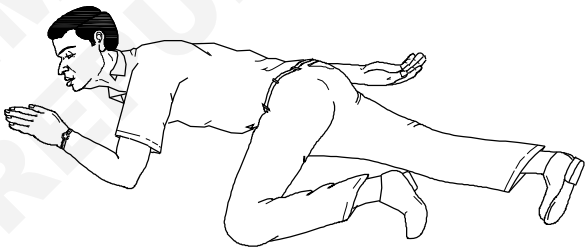
MG20N1104Z6

9 Continue with another 15 compressions of the heart followed by a further two breaths of mouth-to-mouth resuscitation, and so on, check the pulse at frequent intervals.

10 As soon as the heartbeat returns, stop the compressions immediately but continue with mouth-to-mouth resuscitation until natural breathing is fully restored.

11 Place the victim in the recovery position as shown in Fig 7. Keep him warm and get medical help quickly.

Fig 7



MG20N1104Z7

Other steps

12 Send word for a doctor immediately.

13 Keep the victim warm with a blanket, wrapped up with hot water bottles or warm bricks; stimulate circulation by stroking the insides of the arms and legs towards the heart.

Operation of electrical mains

Objectives : At the end of this exercise you shall be able to
- **operate different types of mains**
- **follow safety while operating.**

Fig 1

(a)

(b)

(c)

Job Sequence

- Before operate the lever type main
- Clean you hand and dry
- Wear shoes
- Before operate the main touch with tester whether power leaking.
- For operate the main shift lever upward.
- For operate the MCB switch on upper side.
- For operating the rotary main rotate the switch clock wise direction.
- Operate all three types of mains and practice.
- Follow safety while operating.

Occupational safety

Objectives: At the end of this exercise you shall be able to
- **able suggest safety measure for the accidents.**

Instructor shall explain the accidents to the trainees. Ask the trainees to write the remedy in table -1

Job Sequence

- Suggest the remedy for each accidents
- Record the remedies on each column in table 1

Table 1

Sl.No.	Accidents	Remedy
1		
2		
3		
4		
5		
6		

Get it checked by instructor

House keeping and good shop floor maintenance

Objectives: At the end of this exercise you shall be able to
- **clean the machine and the surrounding neatly**
- **lubricate the moving parts of machine/equipment by oil can**
- **arrange the tools/equipments in order.**

Job Sequence

- Clean machine with dust free cotton waste.

Take care do not get injury while cleaning

- Clean the sliding parts and guide ways.

Do not handle the chip by bear hand

Instructor should guide the trainees in cleaning the machine and its parts.

- Lubricate the mahcine with oil can (Fig 1) as per instructor guidance.
- Identify and segregate the cutting tools, measuring tools, hand tools and arrange them in proper place.
- Keep all the attachment and accessories in proper place as guided by the instructor.
- Reduce flow of materials
- Clean and maintenance
- Improve the prevention maintenance.

Good housekeeping reduces illnesses and injuries and promotes position behaviors, habits and attitudes. An effective house keeping program is an important element in workplace safety and health management system.

Fig 1

OIL CAN

FI1105E1

Safety and environment guidelines

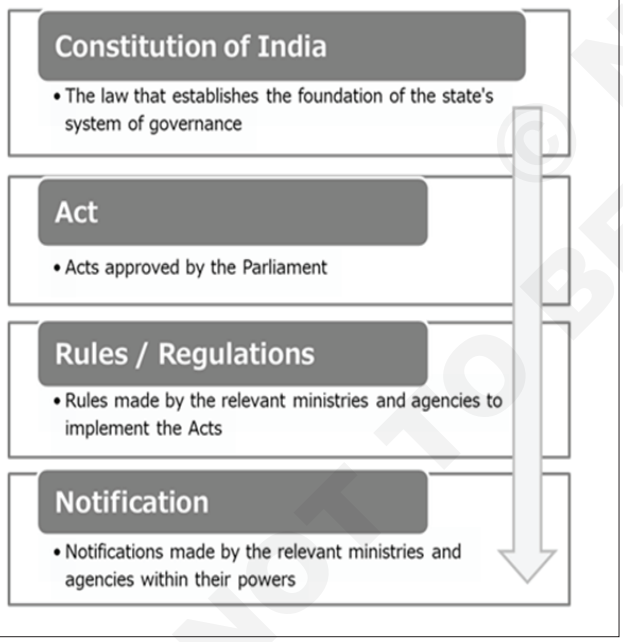
Objectives: At the end of this exercise you shall be able to
- **answer the questionaries' on legal frame work in India**
- **answer the questionaries' on health and safety in India**
- **answer the questionaries' on environment policy.**

The National Policy on Safety, Health and Environment at workplace to eliminate the incidence of work related injuries, diseases, fatalities, disaster and loss of national assets. It aims to not only ensure achievement of a high level of occupational safety, health and environment performance through proactive approaches but also to enhance the well-being of the employee and society at large.

Legal Framework

The main legal regime in India is shown in the following chart. The Indian legal system consists of Acts approved by the Parliament, Rules made by the relevant ministries and agencies to implement the laws, and Notifications made by the relevant ministries and agencies within their powers.

Fig 1



The main laws and regulations relating to occupational health and safety in India are as follows.

" Factories Act, 1948

The Factories Act, 1948 was enacted for the purpose of controlling occupational safety and health in factories and regulates the safety, health and welfare of the workers. The Act empowers the states to prescribe their implementing rules and regulations and many states have prescribed them.

e.g.

- Tamil Nadu Factories Rules, 1950
- Maharashtra Factories Rules, 1963
- Karnataka Factories Rules, 1969
- Explosive Act, 1884

The Explosives Act, 1884 was enacted to regulate the manufacture, possession, use, sale, transportation and import and export of explosives. Under this Act, the Central Government may prohibit the manufacture, possession and importation of explosives which may be deemed dangerous.

- Explosive Rules, 2008

The Explosives Rules, 2008 were enacted to regulate the manufacture, import, export, transport and possession for sale, sale or use of explosives. Other subordinate regulations of the Explosives Act 1884 include the following.

- Calcium Carbide Rules, 1987
- Ammonium Nitrate Rules, 2012
- Gas Cylinders Rules, 2016
- Static and Mobile Pressure Vessels (Unfired) Rules, 2016
- Petroleum Act, 1934

The Petroleum Act, 1934 regulates the importation, transportation, storage, production, refining and blending of petroleum. Under this Act and its subordinate legislation, the Petroleum Rules, 2002, any person importing or storing petroleum must obtain a license.

- Petroleum Rules, 2002

The Petroleum Rules, 2002 sets provisions for the approval of refineries and processing plants, authorization for the transportation of petroleum by water, land and pipelines, and for the containers in which petroleum is stored. These Rules have also been partially amended by the Petroleum (Amendment) Rules, 2011.

Fire Prevention

In India, laws and regulations related to firefighting equipment are not set at the national level, but each state government has its own fire prevention act and its implementing regulations. For example, Delhi has formulated the Delhi Fire Service Act, 2007 and the Delhi Fire Service Rules 2010.

Boilers

In India, Regulations for boiler equipment are also set out as follows.

- Boilers Act, 1923
- Boiler Regulations, 1950
- Boiler Operation Engineers Rules, 2011
- Boilers Attendants Rule, 2011
- Boiler Appeal Rules, 2013

Effective housekeeping results in

- reduced handling to ease the flow of materials.
- fewer tripping and slipping incidents in clutter free and split-free work areas.
- decreased fire hazards.
- lower worker exposures to hazardous (e.g. dusts, vapours)
- better control of tools and materials, including inventory and supplies.
- more efficient equipment clean up and maintenance.
- better hygienic conditions leading to improving preventive maintenance.
- more effective use of space
- reduced property damage by improving preventive maintenance
- less janitorial work.
- improved morale.
- improved productivity (tools and materials will be easy to find).

Good housekeeping reduces illnesses and injuries and promotes positive behaviors, habits, and attitudes. An effective housekeeping program is an important element in workplace safety and health management systems, according to the occupational safety and health administration (OSHA)

Fewer tripping and slipping incidents in clutter-free and spill-free work areas

Reduced fire hazards. Decreased worker exposures to hazardous products (e.g. dusts, vapours). Greater control of tools and materials, including inventory and supplies.

It reduces slip and trip hazards:

Experience has shown me that slip and trip incidents in the workplace account for a large percentage of injuries. Clean up now and get the immediate benefits.

Environmental Policy

In addition to the Constitution, which provides for environmental protection, India developed the following environmental policies.

- National Forest Policy, 1988
- Policy Statement on Abatement of Pollution,1992
- National Conservation Strategy and Policy Statement on Environment and Development, 1992
- National Water Policy, 1987, 2002, 2012

The National Environment Policy, 2006 was formulated based on these policies. The objectives of the policy are as follows.

1 Conservation of endangered environmental resources
2 Guaranteeing the livelihoods of the poor (ensuring access to resources)
3 Sustainable use of resources
4 Integration of environmental issues with economic and social development
5 Efficient use of resources
6 Improvement of environmental governance
7 Improvement of resources for environmental conservation

Ministry of Environment, Forest and Climate Change is as the implementing agency for the policy.

These policies are not legally binding, but serve as guidelines for the central and state governments.

Note

The trainees shall read the contents and answer the following questions

Legal frame work

1 What is act?

---

2 What is rules / regulation?

---

3 What is notification?

Occupational health and safety

1 List the other occupational health and safety act ?

---

2 State the purpose of Factories Act, 1948?

Environment policy

1 List the objectives of the environment policy

Disposal procedure of waste materials like waste, metal chips / burrs etc.

Objectives: At the end of this exercise you shall be able to
- **identify and segregate the waste material in workshop**
- **arrange the waste material in different bins.**

Fig 1

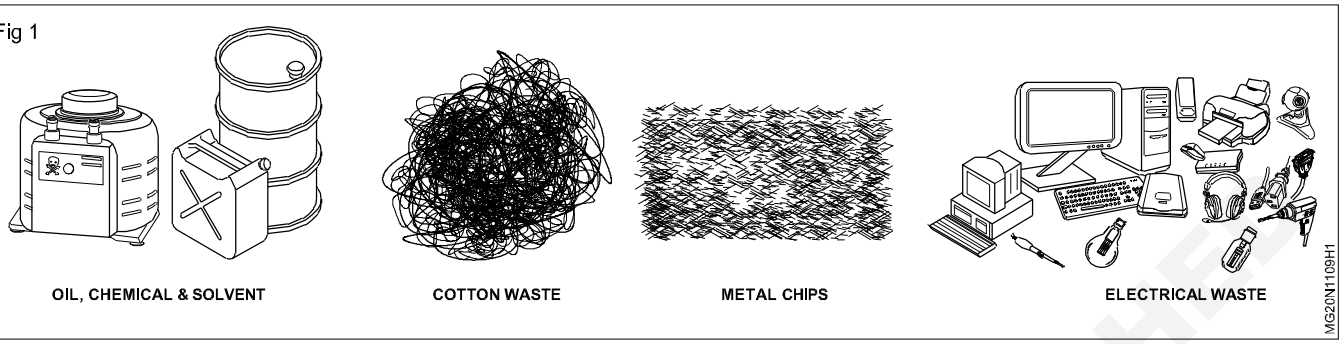
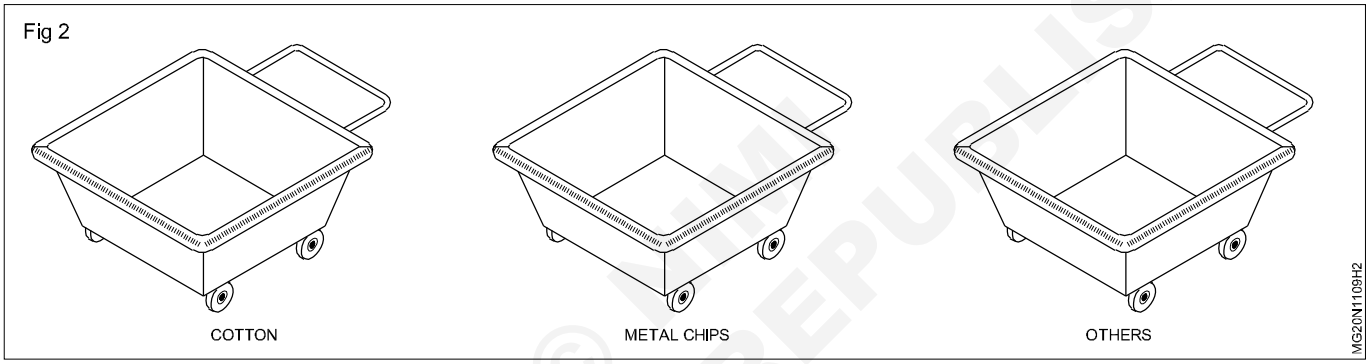


Fig 2



Job Sequence

- Separate the cotton waste.
- Collect the chips by hand shovel with the help of brush. (Fig 2).
- Clean the floor, if oil is spilled.

Do not handle the chip by bare hand

There may be different metal chips. So separate the chip according to metal.

- Separate the cotton waste material and store it in the bin provided to store the waste cotton material. (Fig 2)
- Similarly store the each category of metal chip in separate bins.

Each bin should have name of the material.

Identify the material given in Fig 1 and fill in table 1

Table1

S. No.	Name of the material
1	
2	
3	
4	
5	

Personal protective equipment (PPE): Basic injury prevention

Objectives: At the end of this exercise, yos shall be able to
- **identify personal protective devices**
- **interpret the different types of personal protective devices.**

Fig 1

Job Sequence

- Read and interpret the visuals of personal protective equipment on real devices or from the charts.
- Identify and select personal protective equipment used for different types of protection.
- Write the name of the PPE and the corresponding type of protection and the hazards in table 1.

The instructor shall display the different types of personal protective equipment or charts and explain how to identify and select the PPE devices suitable for the work and ask the trainees to note down the hazards and type of protection in the Table 1.

The instructor shall demonstrate how to wear and remove the all the PPE's.

Ask the trainees to practice it.

Table 1

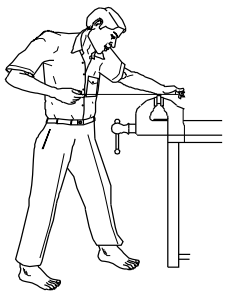
S.No.	Name of the PPE	Hazards	Type of protection
1			
2			
3			
4			
5			
6			
7			
8			
9			

Get it checked by your instructor.

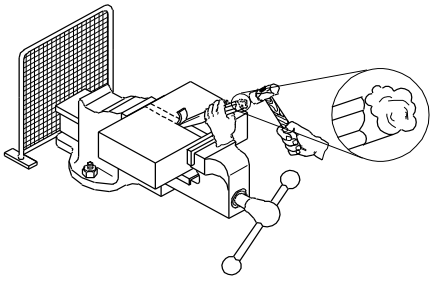
Hazard identification and avoidance

Objectives: At the end of this exercise you shall be able to
- **identify the occupational hazards**
- **suggest suitable methods to avoid occupational hazards.**

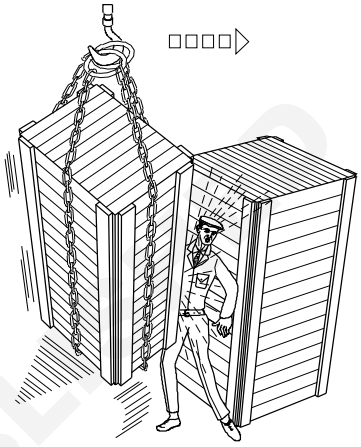
Fig 1



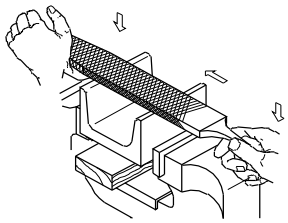
1 WORKING BARE FOOT IN SHOP FLOOR



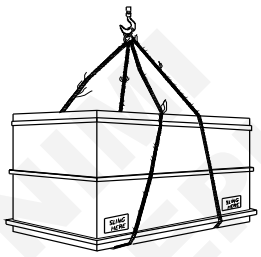
5 CHIPPING METAL SURFACE WITH MUSHROOM HEAD CHISEL



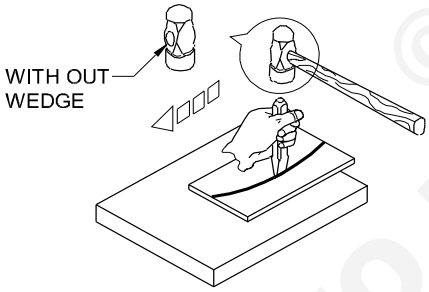
8 LIFTING A LOAD WHILE PEOPLE WORKING NEARBY



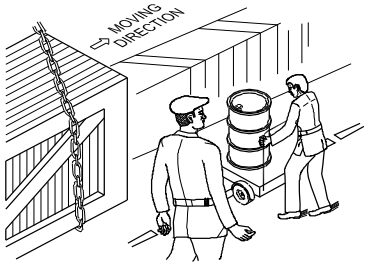
2 USING FILE WITHOUT HANDLE



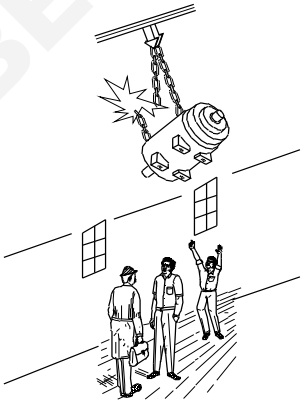
6 LIFTING LOAD WITH DAMAGED SLINGS



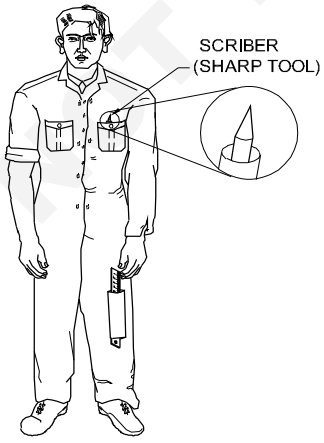
3 STRIKING ON CHISEL HEAD WITH BALL PEIN HAMMER WITHOUT WEDGE



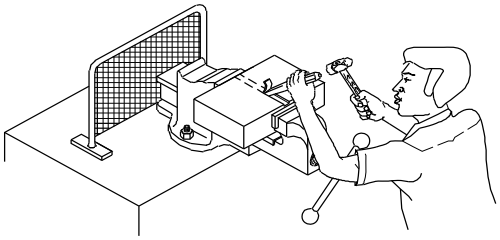
9 NO OBSTACLE WHILE MOVING THE LOAD



7 STANDING BELOW A SUSPENDED LOAD



4 KEEPING SCRIBER SHARP EDGE OPEN IN POCKET



10 CHIPPING ON METAL SURFACE WITHOUT SAFETY GOGGLES

MG20N1111H1

Job Sequence

The instructor shall emphasise the importance of hazard and avoidance to the students and insist them to follow properly.

- Study the drawing of industrial hazards.
- Identify the type of hazards.
- Name the hazards against their names.
- Record the hazards and avoidance in Table 1.
- Get it checked by your instructor

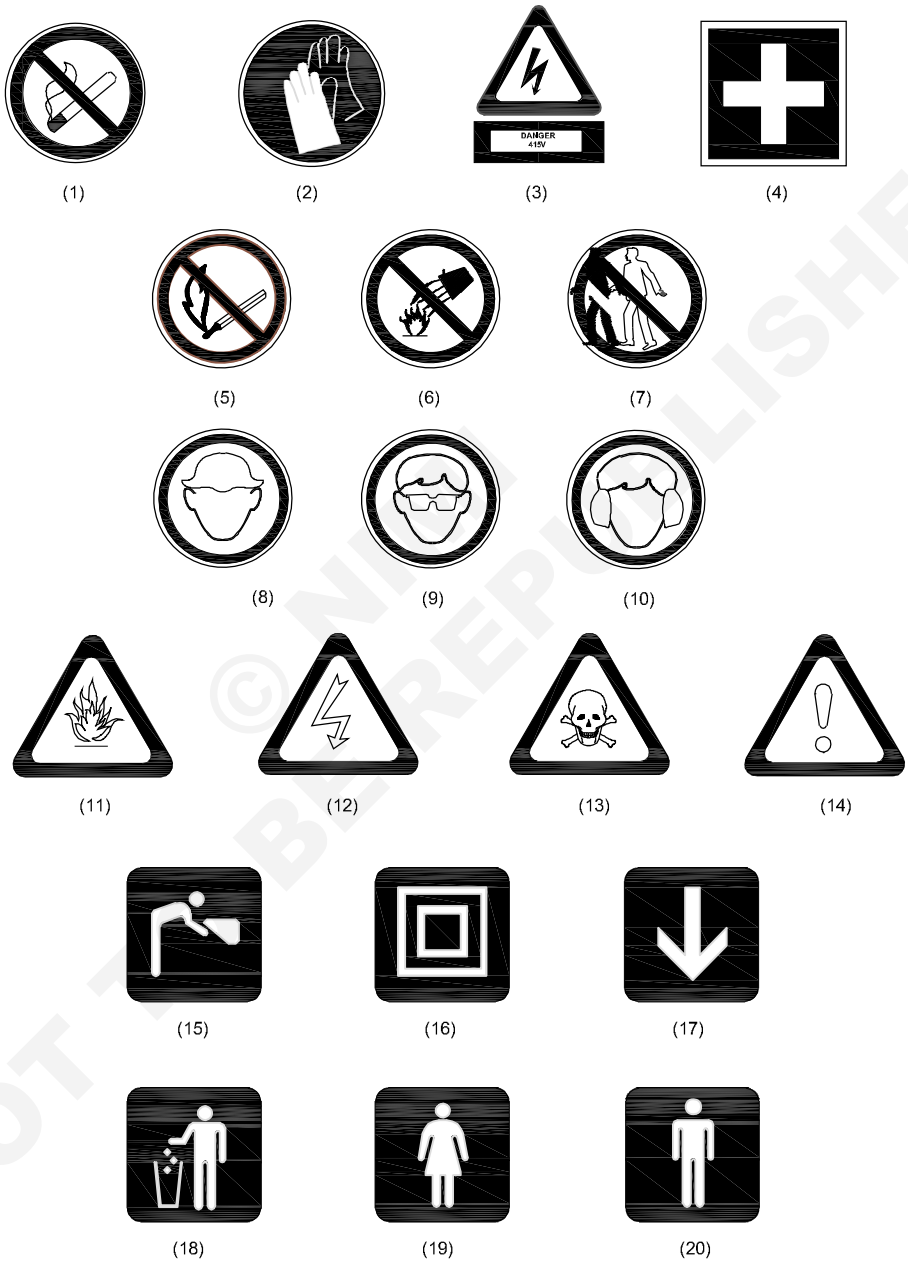
Table 1

S. No.	Identification of hazards	Avoidance
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Safety sign for danger, warning, caution and personal safety message

Objectives: At the end of this exercise you shall be able to
- **identify the basic categories of safety sign**
- **record the meaning of safety sign in the table given.**

Fig 1



FI20N1106H1

Job Sequence

Instructor shall provide various safety signs, chart categories and explain their meaning, description. Ask the trainee to identify the sign and record in Table 1.

- Identify the safety sign from the chart.
- Record the name of the category in Table 1.
- Mention the meaning description of the safety sign in Table 1.

Table 1

Fig. No.	Basic Categories/Safety sign	Meaning - description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

- Get it checked by your instructor.

Preventive measures for electrical accidents and step to be taken in such accidents, use of fire extinguishers

Objective: At the end of this exercise you shall be able to
- **adopt preventive measures to avoid electrical accidents**
- **take care of a person with electrical accident.**

Note: The instructor shall arrange suitable electrical Safety poster/chart/slogan appropriate to this exercise

PROCEDURE

TASK 1: **Preventive measures for electrical accidents**

1 Never touch any electrical apparatus /machinery with wet hands or while standing in water.

2 If you get a tingle or shock when touching any electrical item, a sink, tub, or other wet area, turn off the power at the main panel and immediately call an electrician.

3 Don't use damaged or broken cords/ wires or plug in anything with a missing prong.

4 When unplugging, don't pull the cord; pull it by the plug.

5 Don't overload sockets; use a power extension board with a safety switch.

6 Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.

7 Avoid for water or chemical spills on or near electrical equipment. Wear rubber shoes in wet areas.

8 Cover unused outlets and keep metal objects away from outlets. you should always take extra care to ensure that you do not come into contact with the exposed live wires as this runs the risk of shock and burns.

9 Put a notice nearby to the appliance to inform others of the danger and to ensure that it is protected until you are able to schedule repairs.

10 Use safe work practices every time electrical equipment is used.

11 All electrical installations regardless of whether at home or in the workplace, must be grounded, which is otherwise known as earthing to track down any excess electricity, the most effective route to return to the ground without posing any safety risks.

12 It is safe to work on the electrical equipment that is plugged in with only dry hand and wear non-conductive gloves and insulated-soles shoes.

13 Disconnect the device from the source in the period of service or maintenance of the device.

14 Disconnect the power source before servicing or repairing electrical equipment.

15 All electrical cords should have sufficient insulation to prevent direct contact with wires.

16 In a laboratory/workshop it is particularly important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.

17 Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.

18 Keep away from the energized or loaded circuits Arcing, sparking, or smoking from the equipment

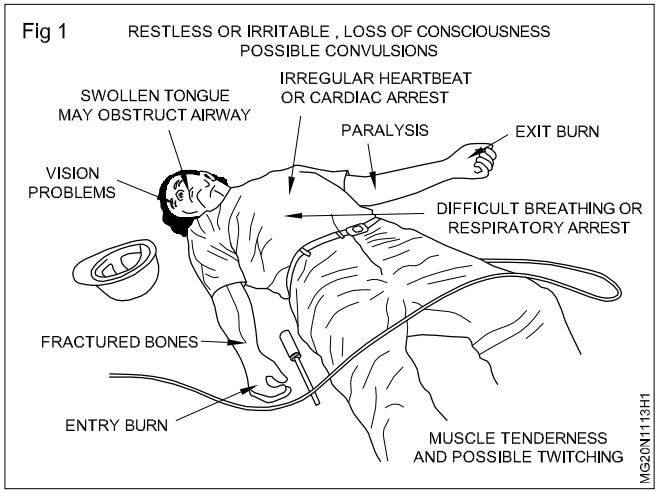
19 If the device interacts with water or other liquid chemicals, equipment must be shut off power at the main switch or circuit breaker and unplugged.

20 If any individual comes in contact with a live electric line, do not touch the individual or equipment / source/ cord; disconnect the power source from the circuit breaker or pull out the plug using a leather belt.

21 always stay at least ten feet away from the overhead power lines, carry highest voltage, which means that should anyone come into contact with them, there is a significant risk of not only electrocution but also severe burns.

First Aid for Accidental Electric Shock Victims (Fig 1)

Fig 1



1 Ensure that you are taking sufficient safety precaution to protect yourself before going to help the other person met with accidental electric shock.

2 Talk to the person and ask loudly, "Are you OK?"; make him feel comfortable.

3 Check for ventilation and airways; clear obstruction and provide fresh air flow.

4 Check for signs of normal breathing; observe breathing.

5 If not breathing normally, begin CPR

6 Unplug the appliance or turn off the power at the control panel.

7 If you can't turn off the power, use a dry wooden piece, like a broom handle, dry rope or dry clothing, to separate the victim from the electrical contact / power source.

8 Do not try to move the victim touching a high voltage wire; Call for emergency help/immediate superior for assistance.

9 Unconscious victims should be placed on their side to allow drainage of fluids; Keep the victim lying and observe for the symptoms shown in Fig.1

10 Do not move the victim if there is a suspicion of neck or spine injuries call for the ambulance service.

11 If the victim is not breathing, apply mouth-to-mouth resuscitation. If the victim has no pulse, begin cardiopulmonary resuscitation (CPR). Then cover the victim with a blanket to maintain body heat, keep the victim's head low and get medical attention.

First Aid for Accidental Electrical Burn Victims

Electrical burns vary in severity depending upon the following conditions

1 how long the victim is in contact with the electric current;

2 the strength of the current flow;

3 the type of current AC or DC; and

4 the direction of the current takes through the body.

5 Observe the person, if the person is conscious and there are no signs of shock (such as being cold, clammy, pale and having a rapid pulse)

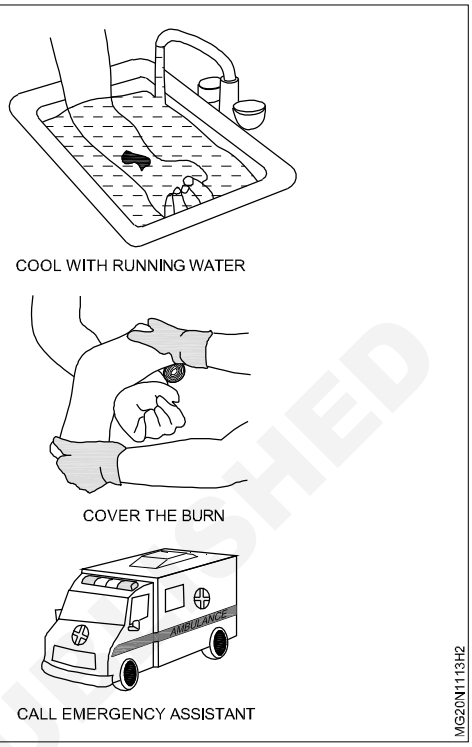
6 Do not apply grease or oil to the burn.

7 Cover the burn with a dry, sterile dressing.

8 There may be more than one area burned.

9 If the person has electrical burn, check for shock and follow the outlined points shown in Fig.2

Fig 2



10 Keep the victim from getting chilled; Seek medical attention as soon as possible.

Accidental Electrical Fire

1 Keep flammable materials away: Electrical appliances or outlets that come into contact with flammable materials that may trigger a fire.

2 Inspect electrical wiring: Have your electric wiring checked to prevent electrical fires. Wiring does not last forever, so it is a good idea to have your wiring checked

3 Be wary of certain appliances: If an appliance blows a fuse, trips a circuit, or sparks while being used, unplug the appliance immediately, and check to see if it needs to behave it repaired or replaced.

4 Check Switches or outlets that are hot to touch and/or emit an acid odour; Inspect and repair outlets and switches.

5 In case of electrical fire, use only CO_2 type of Fire extinguisher.

— — — — — — — —

TASK 2: **Uses of fire extinguishers**

Extinguishing fire

1 Alert people surrounding by shouting fire, fire, fire.

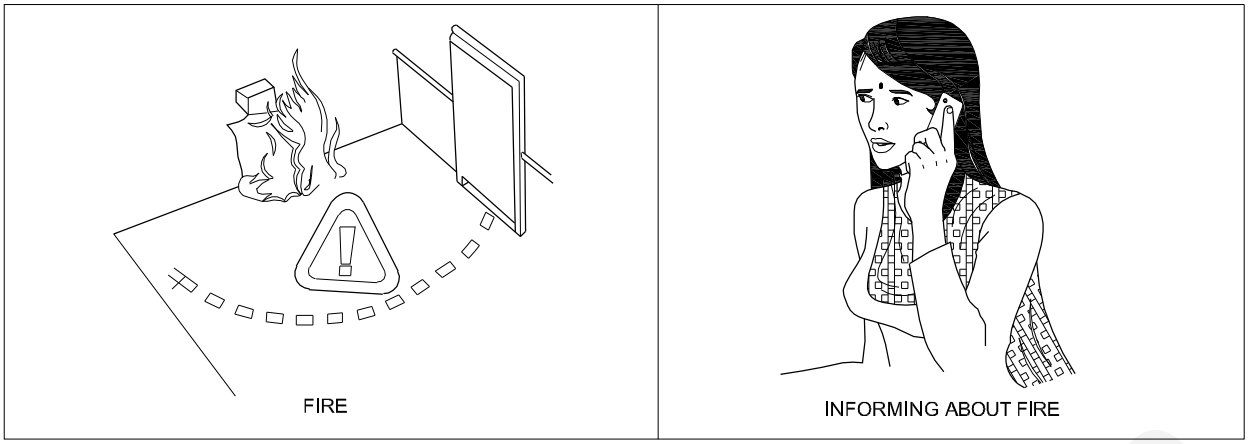
2 Inform fire service or arrange to inform immediately.

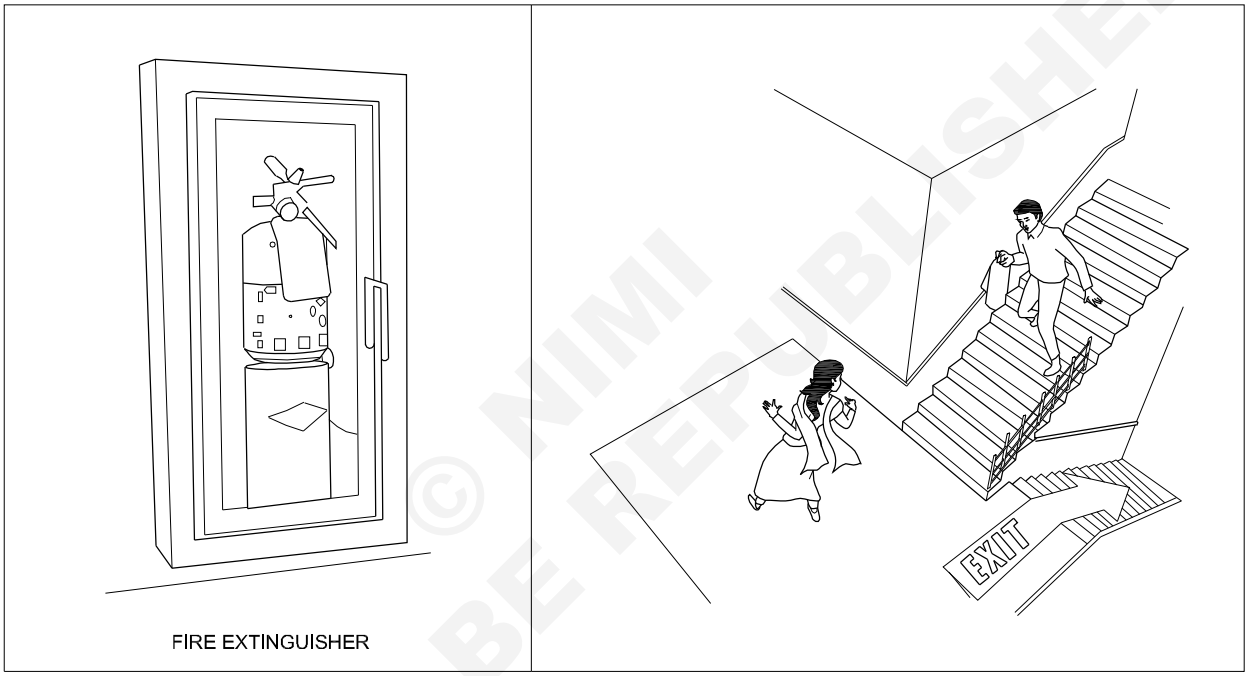
3 Open emergency exist and ask them to go away.

4 Analyze and identify the type of fire. Refer Table1.

All fire extinguisher are labelled to indicate which class of fire they are designed to combat.

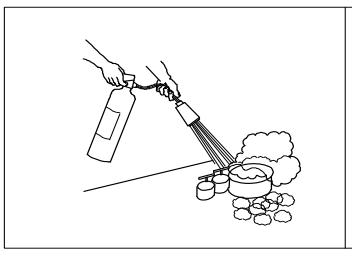
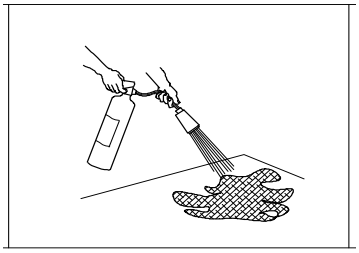
Fig 1

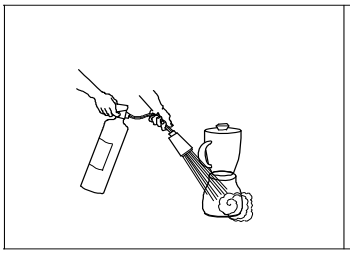
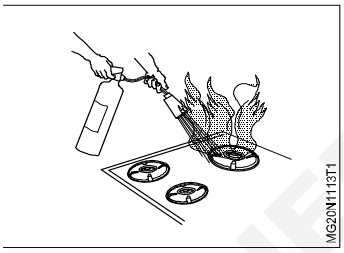




MG20N1113J1

Table1

Class 'A'	Wood, paper, cloth, solid material	
Class 'B'	Oil based fire (grease, gasoline, oil) & liquefiable solids	

Class 'C'	Gas and liquefied gases	
Class 'D'	Metals and electrical equipment	

Assume the fire is 'B' type (flammable liquefiable solids)

5 Select CO_2 (carbon dioxide) fire extinguisher

6 Locate and pick up CO_2 fire extinguisher. Check for its expiry date.

7 Break the seal.

Stand back: Face the fire and keep your back to the exit stay between six and eight feet away from flame.

Operator: Operate the fire extinguisher

Most of the fire extinguisher operator the same basic way stand six to eight feet away from the fire and remember to PASS - PULL - AIM - SQUEEZE - SWEEP.

PULL the pin: This will allow you to discharge the extinguisher. (Fig 1)

AIM at the base of fire: If you aim at the flames (Which is frequently the temptation). The extinguishing agent will fly right through and do no good. (Fig 2)

Squeeze the top handle or lever: This depress a button that releases the pressurised extinguishing agent in the extinguisher. (Fig 3)

Sweep from side to side until the fire is completely put off. Start using the extinguisher from distance away. Then move forward. Once the fire is put off keep on eye on the area incase re-ignite. (Fig 4)

Fig 2

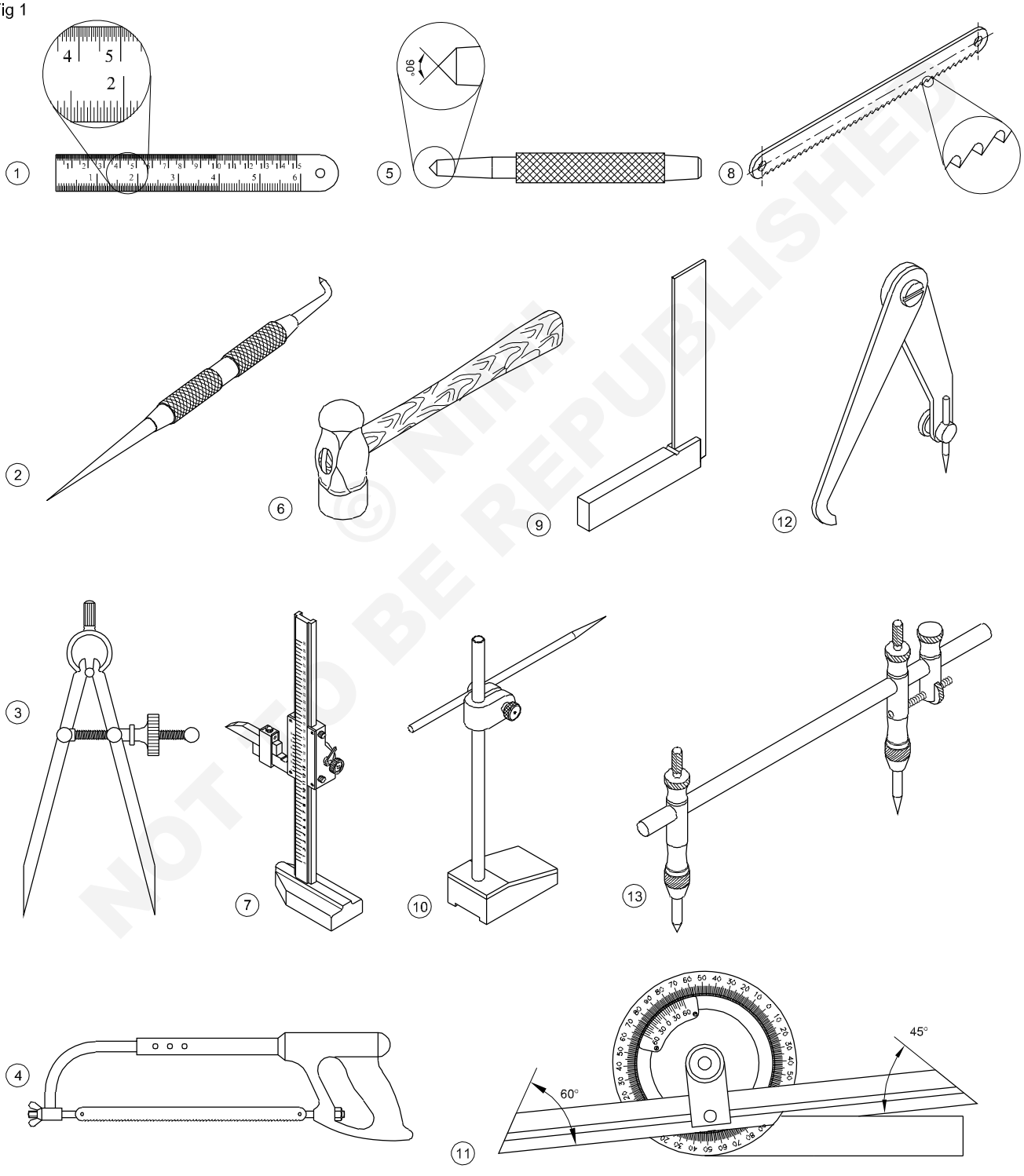
Exercise 1.1.14

Identification of tools and equipments as per desired specifications for marking & sawing (hand tools, fitting tools & measuring tools)

Objectives : At the end of this exercise you shall be able to

- **identify the marking tools used in fitting shop**
- **identify the sawing tools used in fitting shop**
- **record the names of tools in table.**

Fig 1



MG20N1114H1

Job Sequence

Instructor shall display all the tools and equipments in the section and brief their names, uses and the working condition of each tool and equipment

- Trainees will note down all the displayed tools names.
- Record it in table 1.
- Get it checked by the instructor.

Table 1

Fig. No.	Name of the tool	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Select material as per application, inspect visually of raw material for rusting, scaling, corrosion etc.

Objectives : At the end of this exercise you shall be able to
- **select the material for engineering application**
- **record it in the table.**

PROCEDURE

TASK 1: **Selection of material**

- Trainees will determine the type of material used for the purpose mentioned in the table.
- Record it in table 1.
- Get it checked by the instructor.

Table 1

S.No.	Part Name	Material used for manufacturing
1	Vernier Caliper	
2	Scriber	
3	Hacksaw blade	
4	Protective coating on Iron and steel	
5	Worm wheels, Gears	
6	Casting of guns	
7	Bell	
8	Machine Bed casting	
9	Die block, hand tools	
10	High speed steel	
11	Bolts and nuts	
12	Surface plate	

TASK 2: **Inspection of raw material**

Fig.1 Rusted components

Fig.2 Corroded gears

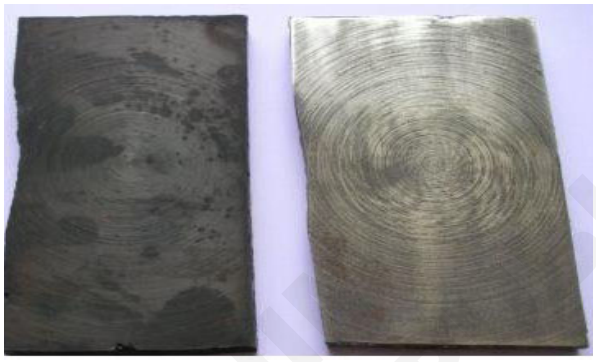


Fig.3 Scaled part

Job Sequence

Instructor shall arrange to display various section of raw metals with rusting, scaling corroded conditions and without any defects.

Differentiate with one another

Ask the trainees to record it in the table

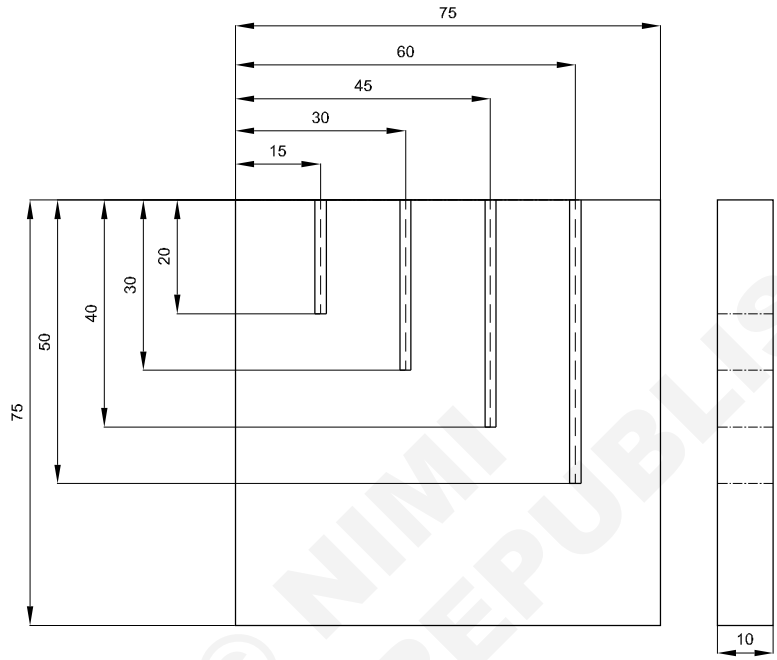
- Observe the given raw material
- Identify the formation of materials for rusting, corrosion and scaling
- Record the appearance of the defects in Table1. Get it checked by the instructor

Table 1

S.No.	Defects on raw material	Brief the Appearance
1	Scaling	
2	Corrosion	
3	Rusted	

Mark out lines on job

Objectives : At the end of this exercise you shall be able to
- **apply marking media**
- **markout lines using jenny caliper and steel rule.**



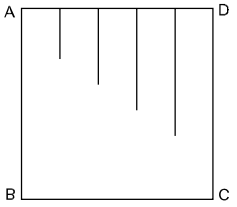
1	75 ISF10 - 75	-	Fe310 PRE - MACHINED	-		
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.1.1.16
SCALE 1:1	**MARK OUT LINES ON JOB**				TOLERANCE : ±0.5mm	TIME : 8Hrs
					CODE NO.MG20N1116E1	

Job Sequence

Marking lines

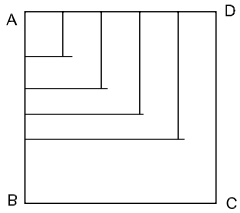
- Check the pre - machined size of 75x75x10 mm using steel rule.
- Apply marking media cellulose lacquer evenly on the surface of the Job.
- Place the job in levelling plate.
- Set the measurement 15 mm in Jenny caliper using steel rule.
- Draw parallel line of 15 mm to the side "AB" with the help of Jenny caliper as shown in Fig 1.
- Similarly, Set 30 mm, 45 mm and 60 mm and draw Parallel lines to "AB". (Fig 1).

Fig 1



- Set the measurement 20 mm in jenny caliper using steel rule.
- Draw parallel line to side "AD" using Jenny caliper.
- Similarly, set 30 mm, 40 mm and 50 mm and draw parallel lines to side "AD" as shown in Fig 2.

Fig 2



Skill Sequence

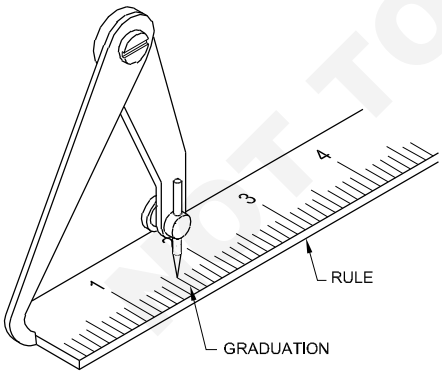
Marking lines parallel to the edge of the job

Objective: This shall help you to
- **mark parallel lines using a jenny caliper.**

Apply marking medium on the surface to be marked.

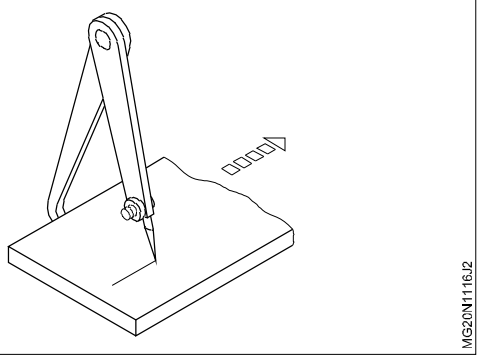
Set the jenny caliper to the size to be marked (i.e. dimension) with the help of a steel rule. (Fig.1)

Fig 1



Transfer the set dimension to the job. (Fig.2)

Fig 2

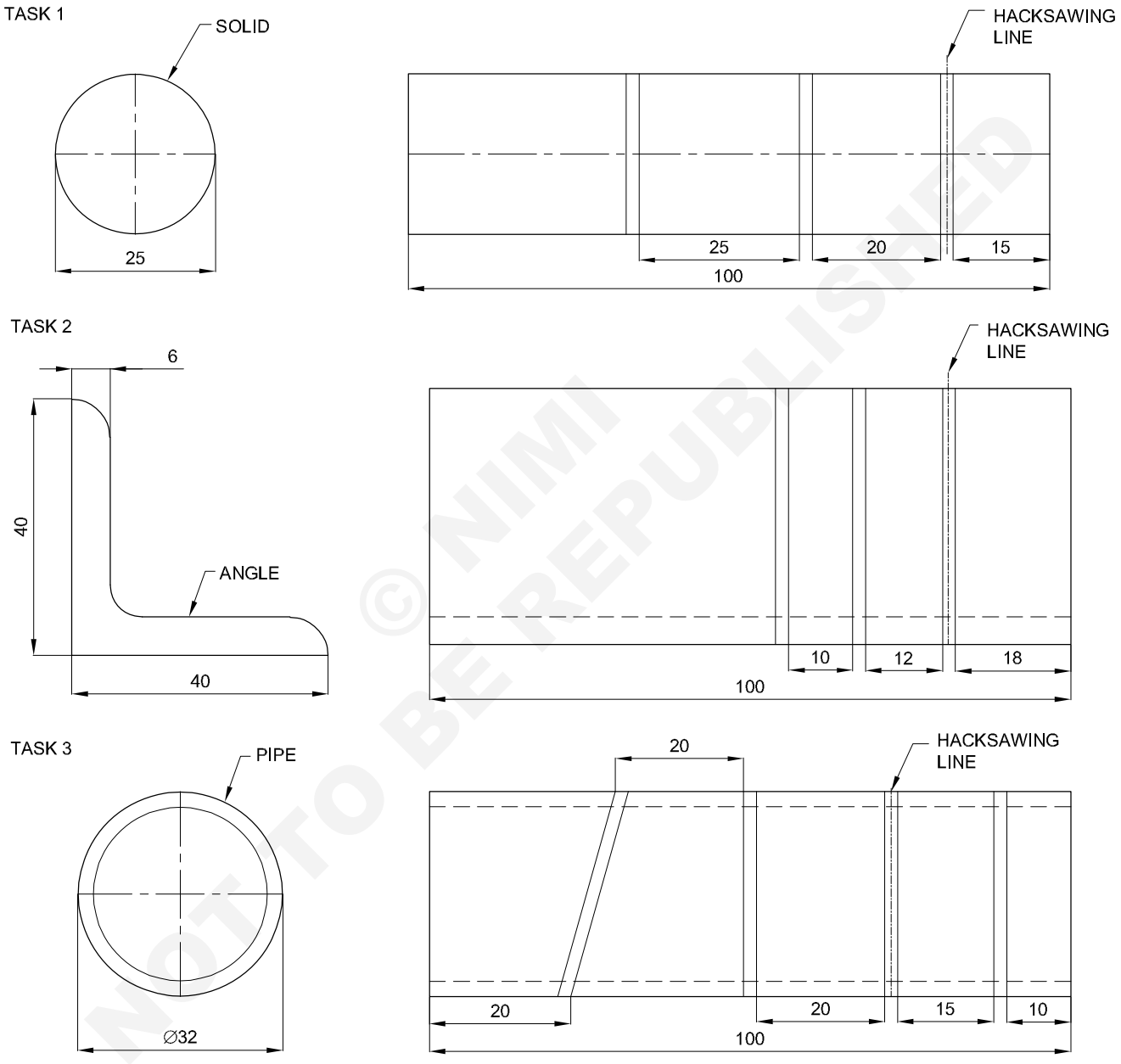


Incline slightly and move the jenny caliper with uniform speed and mark lines.

Make witness marks on the lines marked using a 60° prick punch. The witness marks should not be too close to one another.

Sawing different types of metals of different sections

Objectives: At the end of this exercise you shall be able to
- **cut different thickness of metals**
- **cut different sections of metals.**



1	Ø32 x 3.2 - 100 IS:1161	-	Fe310	05	TASK - 3	1.1.17
1	ISA 40x40x6 - 100	-	Al310	05	TASK - 2	1.1.17
1	Ø25 - 100	-	Co310	05	TASK - 1	1.1.17
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SAWING DIFFERENT TYPES OF METAL OF DIFFERENT SECTION**	TOLERANCE : ±0.5mm	TIME : 6 hrs
		CODE NO. MG20N1117E1	

Job Sequence

TASK 1: **Sawing on round rod**

- Check the raw material using steel rule.
- File the both ends of round rod to 100mm length.
- Remove the burrs from the edges.
- Apply marking media only where marking is required.
- Place the round rod vertically on marking table.
- Support the round rod using V block and mark the hack sawing lines by marking block.
- Punch witness mark on the sawing line with dot punch.
- Hold the Job in bench vice.
- Fix 1.8 mm pitch hacksaw blade in hacksaw frame.
- File a notch at the point of cutting to avoid slippage of the blade.
- Start cutting with a slight downward pressure on round rod using hacksaw.
- Cut on the hacksawing line giving proper pressure on forward and return stroke using full length of the blade.
- Cutting movement should be steady while sawing on round rod.
- While finishing the cut, slow down the pressure to avoid breakage of the blade and injury to yourself and others.
- Check the size of the round rod with steel rule.

Selection of hacksaw blade

- **For soft materials use 1.8 mm pitch blade while sawing.**
- **For hard materials use 1.4 mm pitch blade while sawing.**

TASK 2: **Sawing on steel angle**

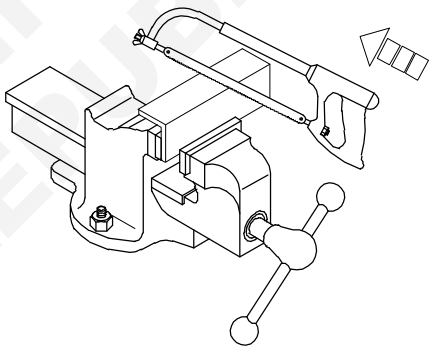
- Mark and punch the sawing lines.
- Hold the job in bench vice as shown in Figure.1
- Fix 1.8 mm coarse pitch blade in hacksaw frame.
- Cut along the sawing lines with hacksaw.
- Check the size of the angles with steel rule

Caution

Select correct pitch blade according to the shape and materials to be cut.

While sawing, two or more teeth of blade should be in contact on metal section.

Fig 1



MG20N1117H1

TASK 3: **Sawing on pipe**

- Mark and punch the sawing lines.
- Hold the job in bench vice as shown in Fig 1
- Fix 1.0 mm pitch blade in hacksaw frame
- Cut along the sawing lines with hacksaw.
- Turn and change the position of the pipe while hack sawing

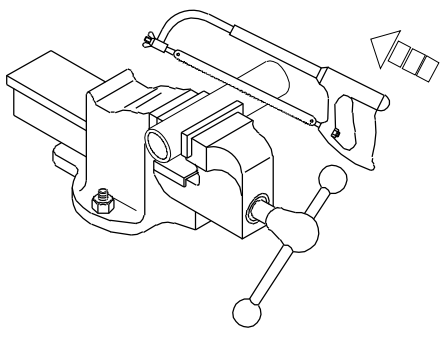
Caution

Avoid over tightening the pipe in the vice which causes deformation.

Do not cut too fast.

Cut very slow and reduce pressure while cutting through

Fig 1



MG20N1117J1

Skill Sequence

Hacksawing (holding-pitch selection)

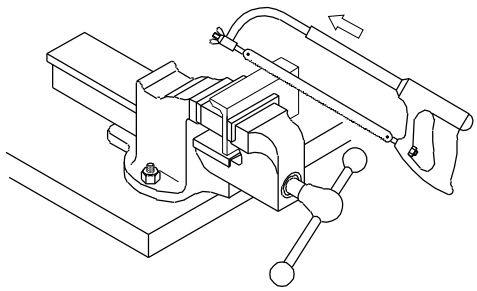
Objectives: This shall help you to
- **select blades for different metal sections**
- **hold different sections of workpieces for hacksawing.**

Holding the workpiece

Position the metal to be cut according to the cross-section for hacksawing.

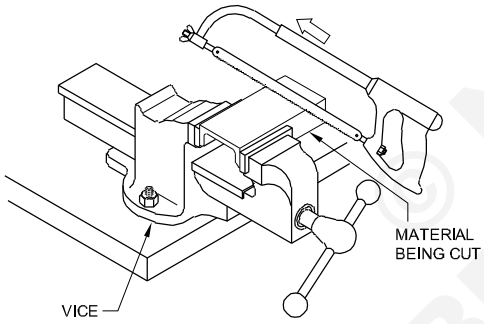
As far as possible the job is held so as to be cut on the flat side rather that the edge or the corner. This reduces the blade breakages. (Figs 1,2 and 3)

Fig 1



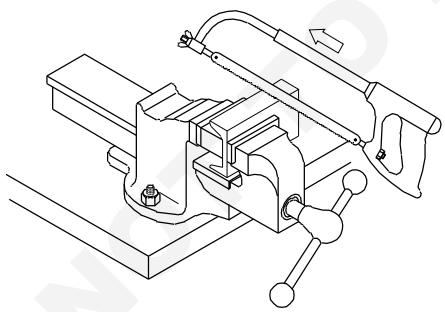
MG20N1117X1

Fig 2



MG20N1117X2

Fig 3



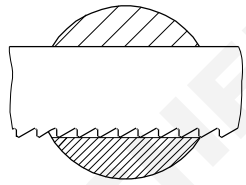
MG20N1117X3

The selection of the blade depends on the shape and hardness of the material to be cut.

Pitch selection

For soft materials such as bronze, brass, soft steel, cast iron, heavy angles etc. use a 1.8mm pitch blade. (Fig.4)

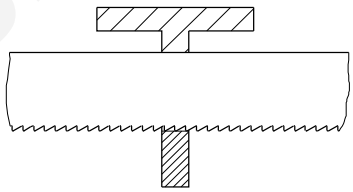
Fig 4



MG20N1117X4

For tool steel, high carbon, high speed steel etc. use a 1.4mm pitch. For angle iron, brass tubing, copper, iron pipe etc. use a 1mm pitch blade. (Fig.5)

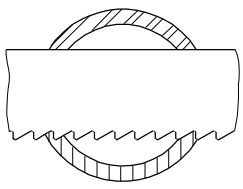
Fig 5



MG20N1117X5

For conduit and other thin tubing, sheet metal work etc. use a 0.8mm pitch. (Fig.6)

Fig 6



MG20N1117X6

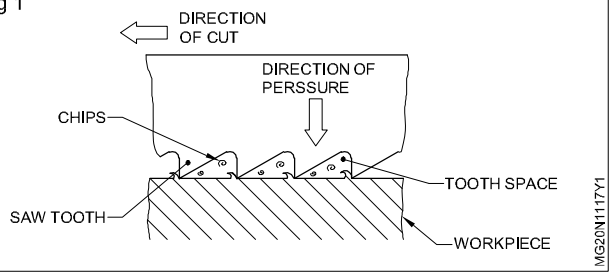
Hacksawing

Objectives: This shall help you to
- **fix hacksaw blades by maintaining correct tension and direction**
- **cut metal pieces with a hacksaw.**

Fixing of hacksaw blades

The teeth of the hacksaw blade should point in the direction of the cut and away from the handle. (Fig.1)

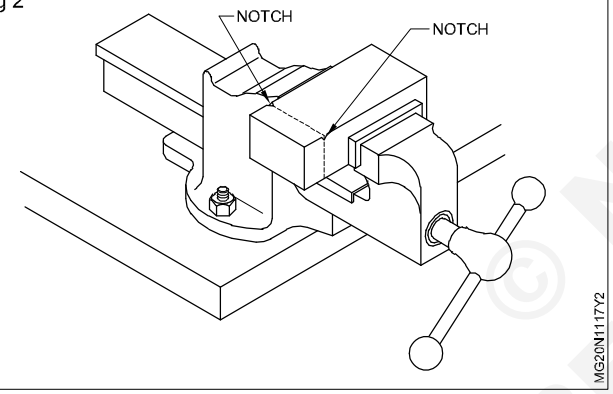
Fig 1



The blade should be held straight, and correctly tensioned before starting.

While starting the cut make a small notch. (Fig.2)

Fig 2

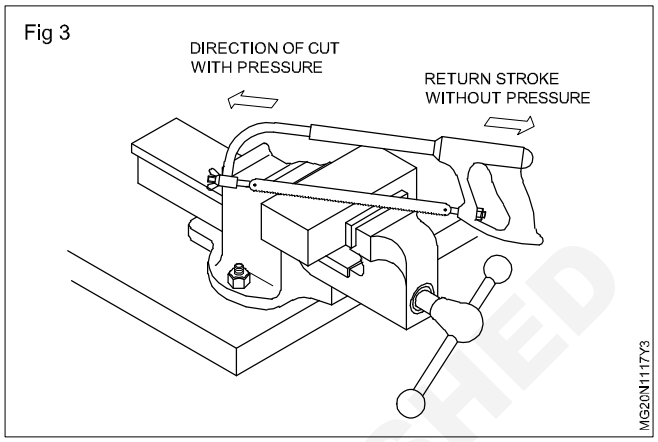


File 'V' notch using a triangular file.

The cutting movement should be steady and the full length of the blade should be used.

Apply pressure only during the forward stroke. (Fig.3)

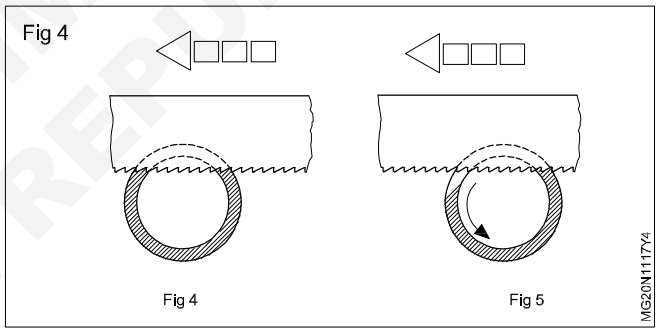
Fig 3



Atleast two to three teeth should be in contact with the work while cutting. Select a fine pitch blade for thin work. (Fig.4 & 5)

Turn and change the position of the pipe while hacksawing. (Fig.4 & 5)

Fig 4

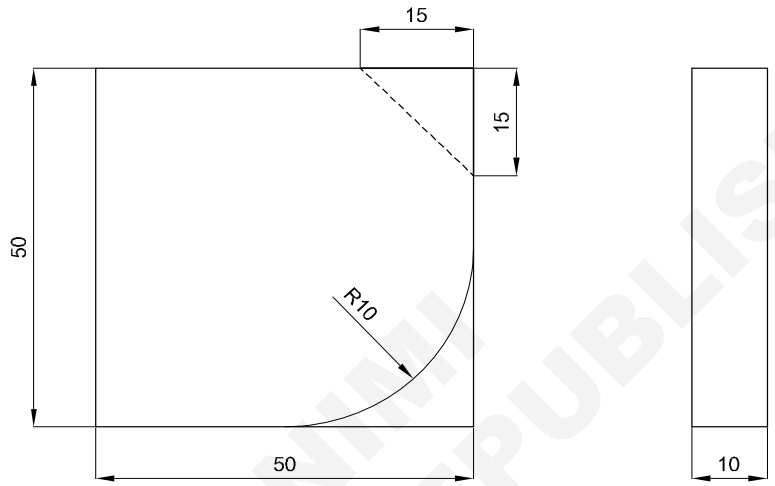


Normally, a coolant is not necessary while hacksawing by hand. However, to saw in heavy stock, intermittent coolant to be applied.

Do not move the blade too fast. While finishing a cut, slow down to avoid breakage of the blade and injury to yourself and others.

Mark punch and grind on pedestal grinder

Objectives : At the end of this exercise you shall be able to
- **apply marking media**
- **mark line using jenny caliper and divider**
- **punch the lines using dot punch**
- **grinding the job in pedestal grinding.**



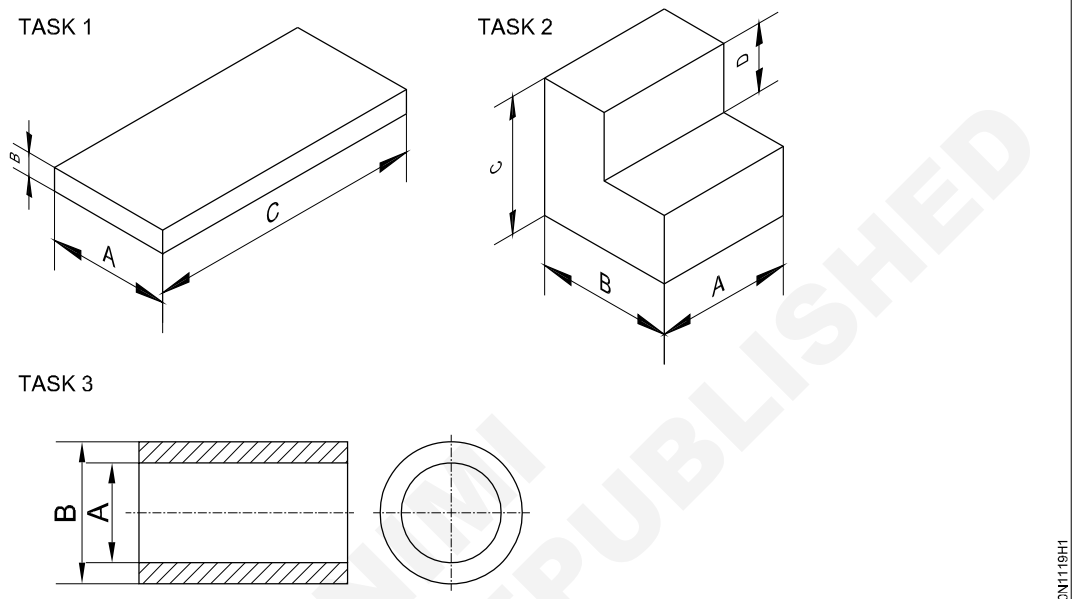
- Apply marking media
- Mark the line and radius using jenny caliper and divider.
- Punch line using prick punch 60°
- Prepare the pedestal grinding machine
- Grind the job upto the punch line

1	50 ISF 10 - 50	-	Fe310	-	-	1.1.18
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**MARK, PUNCH AND GRIND ON PEDESTAL GRINDER**				TOLERANCE : ±0.5mm	TIME : 3 hrs
					CODE NO. MG20N1118E1	

Measuring different types of jobs by steel rule and caliper

Objectives: At the end of this exercise you shall be able to
- **measure dimensions of finished square or rectangular jobs using steel rule**
- **measure outside and bore diameters of cylindrical components using caliper**
- **calculate average value of measurement.**

Fig 1

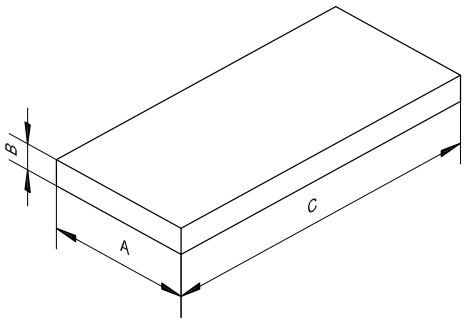


PROCEDURE

TASK 1**: Measuring the finished components with steel rule**

- Measure the dimensions A,B & C of parallel blocks (Fig. 1) available in section with steel rule.
- Take three measurements of each dimension at various places and enter in the given table
- Calculate the average value.
- Enter the average of measured value in the table.

Fig 1

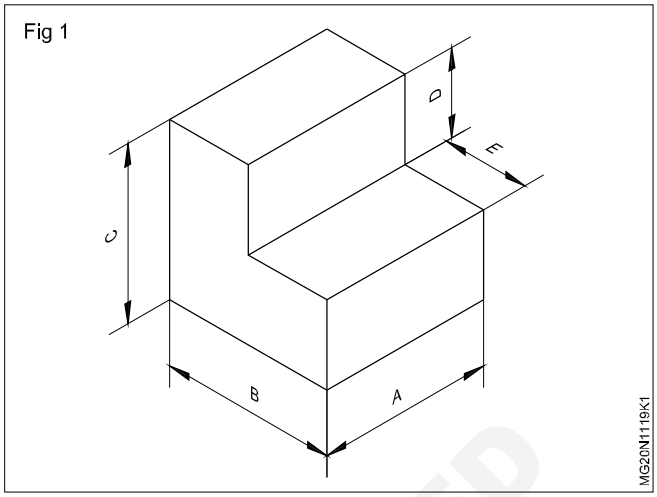


Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						Steel rule		
B						Steel rule		
C						Steel rule		

TASK 2 **: Measuring the finished components with firm joint outside caliper**

- Measure the finished components of dimensions A,B,C & D with firm joint outside caliper (Fig. 2)
- Measure the dimensions D & E with jenny caliper.
- Take three measurements of each dimension at various places and enter in the given table
- Calculate the average value.
- Enter the average of measured value in the table.

Fig 1



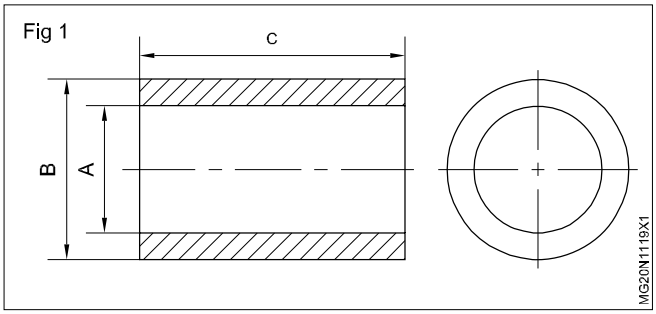
Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						O.S. caliper		
B						O.S. caliper		
D						Jenny caliper		
E						Jenny caliper		

— — — — — — — —

TASK 3 **: Measuring the finished cylindrical component with outside caliper and inside calliper**

- Measure the dimensions A,B & C of cylindrical component (Fig. 4) with outside and inside caliper.
- Take three measurements of each dimension and calculate the average value.
- Enter the average of measured value in the table.

Fig 1



Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						I.S Caliper		
B						O.S Caliper		
C						O.S. Caliper		

— — — — — — — —

Skill sequence

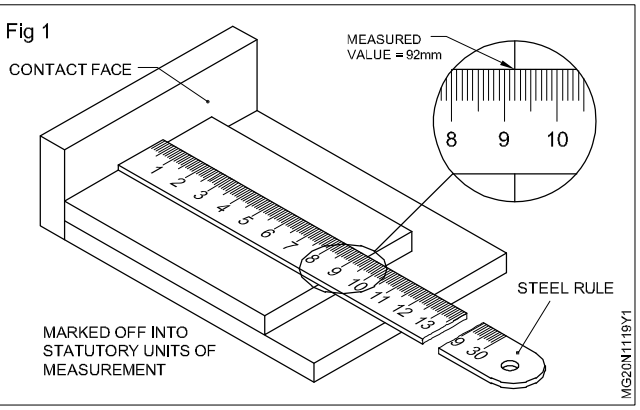
Measuring with a steel rule

Objective: This shall help you to
- **measure the length or a part of a length of object.**

Place the rule either directly on to the length to be measured or at right angle to the reference place.

Use a contact face, if possible and read off measurements by looking at the steel rule directly (Fig 1).

Fig 1



Measure with a rule starting off from the 1cm line if the edge of the rule is worm out or damaged (Fig 2).

The rule must be held parallel to the edge of the works otherwise the measurement will not be correct (Fig 3).

Fig 2

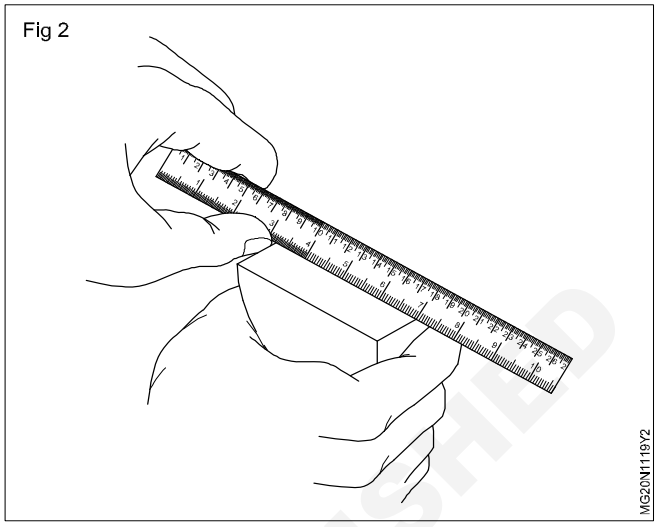
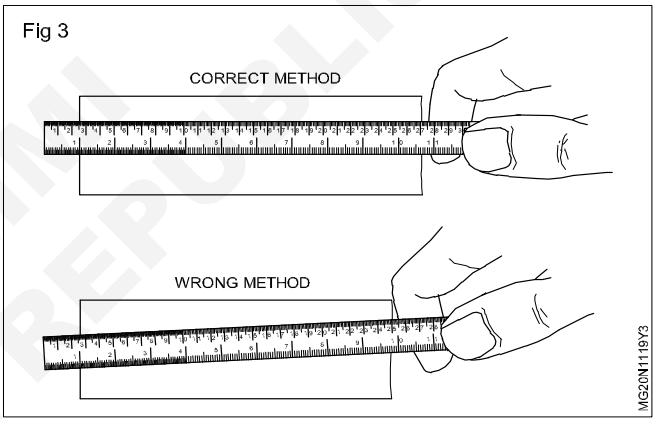


Fig 3



Setting outside and inside caliper to size of the work and measuring with steel rule

Objective: This shall help you to
- **measure the outside and inside dimensions of the work with steel rule and caliper.**

Adjusting outside caliper is held to size and measuring with steel rule

The caliper is held at right angles to the centre line of the work as in Fig. 1 and moved back and forth across the center side while they are being adjusted until the points bear lightly on the work.

The diameter may be read from a steel rule as shown in Fig. 2

Adjusting inside caliper to size and measuring with steel rule

To measure the dimension of a hole open the caliper to the approximate size then hold one leg of the caliper against the wall of the hole and turn the adjusting screw until the other leg just touches the opposite side. The caliper should be moved back and forth and the size is read from steel rule as shown in Figs 3 & 4.

Fig 1

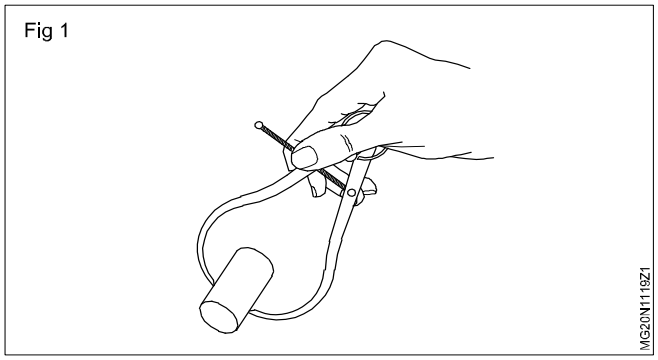
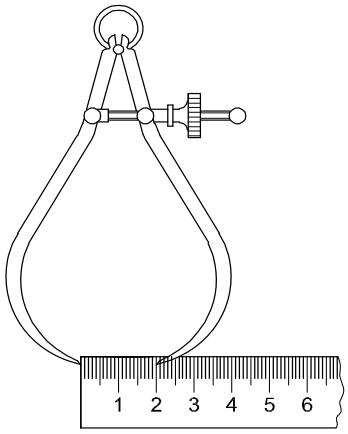
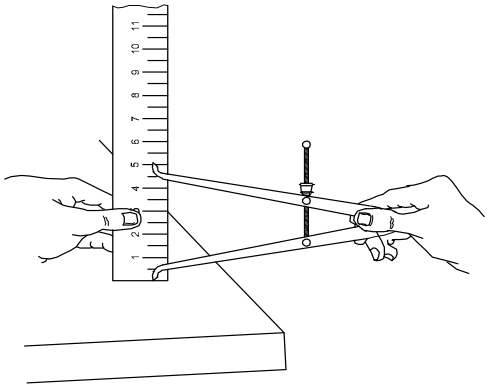


Fig 2



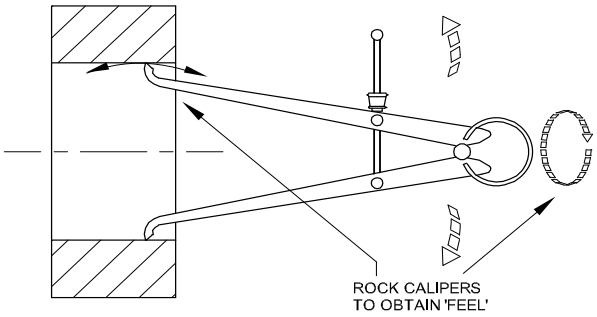
MG20N1119Z2

Fig 4



MG20N1119Z4

Fig 3

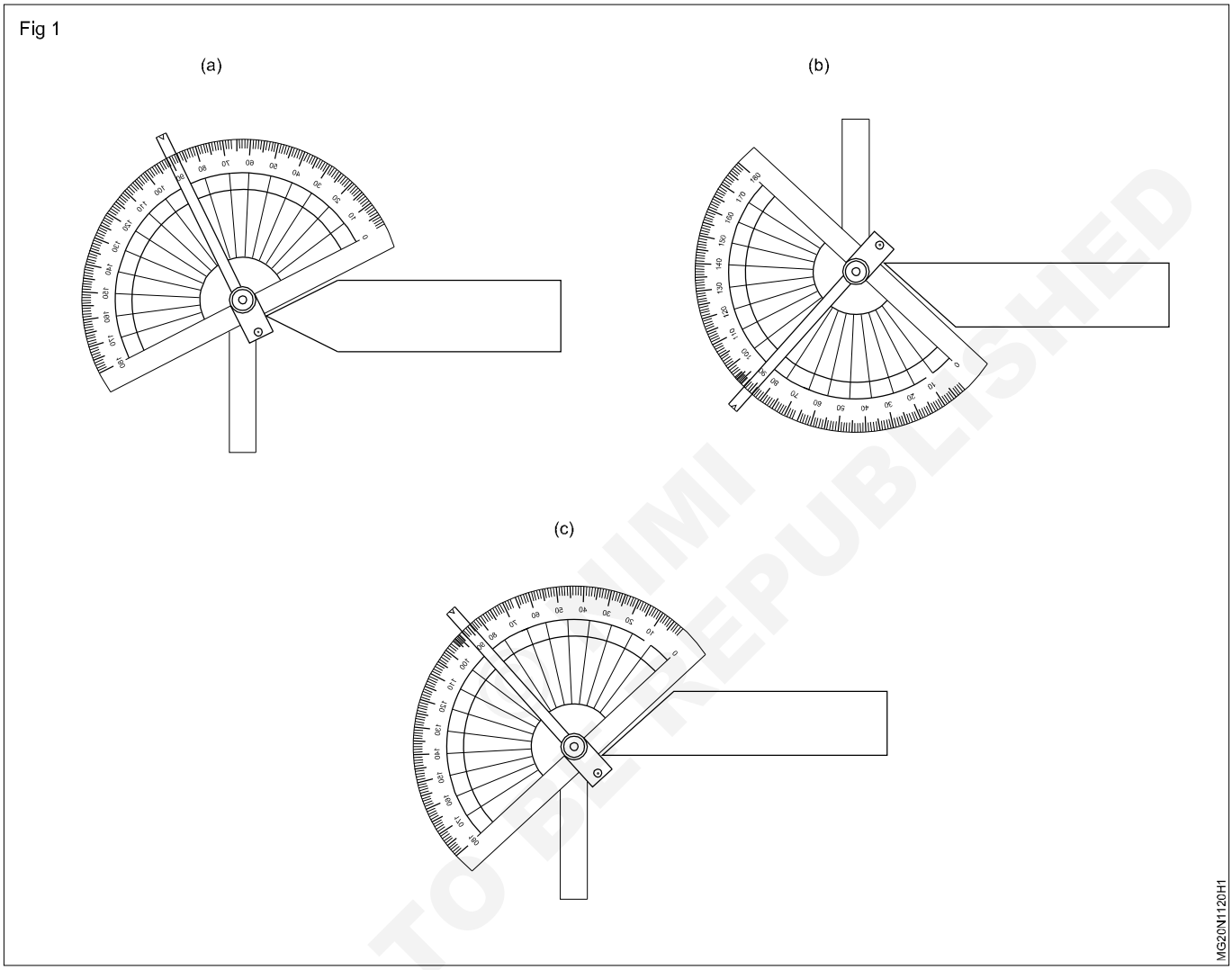


MG20N1119Z3

Measure taper by using angular protractor

Objectives: At the end of this exercise you shall be able to
- **setting the angle on bevel protractor**
- **measuring angle by bevel protractor.**

Fig 1



Job Sequence

- Select the finished components of taper jobs
- Measure different angles using bevel protractor
- Enter angles in Table 1.

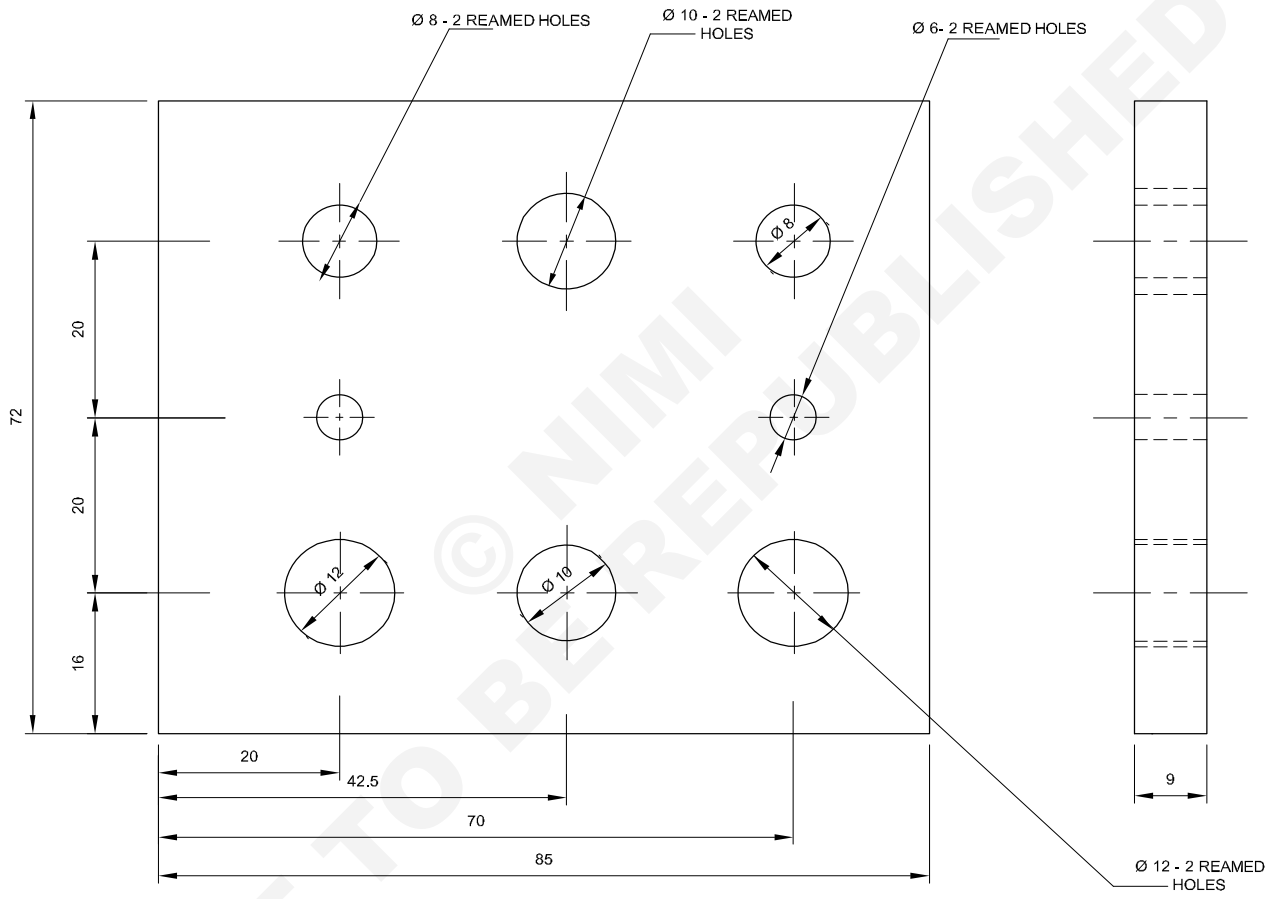
Note: Instructor shall arrange the different angular components for practicing with bevel protractor.

Sl.No.	Angle
Fig 1a	
Fig 1b	
Fig 1c	

Get it checked by your instructor

Drilling and reaming

Objectives: At the end of this exercise you shall be able to
- **mark drill holes as per drawing**
- **drill through holes using pedestal drilling machine**
- **mark the holes using hand reamer.**



Job sequence

- Check the raw material for its size.
- File and finish to size 85 x 72 x 9mm maintaining parallelism and perpendicularity.
- Mark drill holes as per drawing
- Punch on drill hole centres using centre punch 90°
- Make centre drill in all drill hole centres.
- Fix ϕ 5mm drill and drill pilot holes in all centre drilled holes.

1	75 ISF 10-90	-	Fe310	-	-	1.1.21
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE NTS	**DRILLING & REAMING**				TOLERANCE : ± 0.04	TIME : 5 Hrs
					CODE NO : MG20N1121E1	

- Similarly fix ϕ 8mm, ϕ 10 mm, ϕ 12mm, drill in drilling machine and drill holes as per drawing.
- Make reaming by hand reamer a size ϕ 6 mm ϕ 8 mm ϕ 10 mm and ϕ 12 mm.
- Finish file and de- burr in all the surfaces of the job.
- Check the size with vernier caliper.
- Apply a thin coat of oil and preserve it for evaluation.

Skill sequence

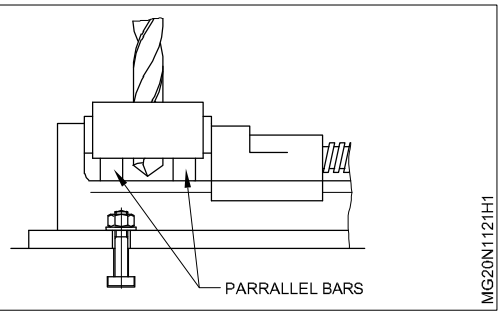
Drilling through holes

Objective: This shall help you to
- **fix the job in vice**
- **make the drilling**

Punch the centre of the holes to be drilled by a centre punch.

Set the job in the machine vice securely by using two parallel bars to clear the drill (Fig1)

Fig 1



Fix the drill chuck into the spindle of the drilling machine.

Fix centre drill and drill in all hole centre

Fix ϕ 6mm dia drill in the drill chuck for pilot hole.

Select the spindle speed by shifting the belt in the appropriate cone pulleys.

Drill all the holes first by ϕ 6mm drill. This will serve as a pilot hole for ϕ 8mm 10mm 12mm and 16mm dia drills.

Similarly, drill ϕ 8mm 10mm,12mm holes.

Remove the drill and drill chuck.

Fix ϕ16mm taper shank drill in the drilling machine spindle.

Change the spindle speed to suit ϕ 16mm drill and drill the hole.

Caution : Do not remove chips with your bare hand-use brush.

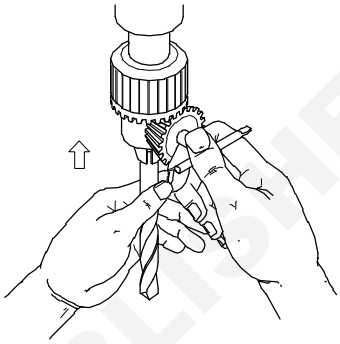
Do not try to change the belt while the machine is running.

Ensure that the drill do not penetrate into the vice.

Fix securely the drill deep into the drill chuck.(Fig 2).

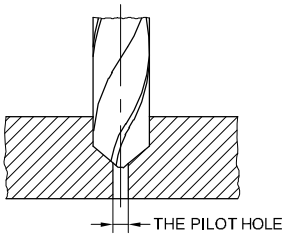
Since the web of large diameter drills are thicker, the dead centres of those drills do not sit in the centre punch marks. This can result in the shifting of the hole location. Thick dead centre can not penetrate into the material easily and will impose severe strain on the drill.

Fig 2



These problems can be overcome by drilling pilot holes initialy. (Fig 3)

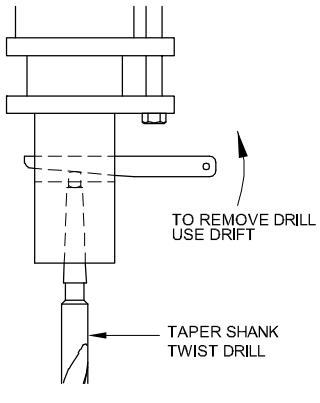
Fig 3



Use drift to remove the drill chuck and taper shank drill from drilling machine spindle. (Fig 4)

Set the spindle speed according to the diameter of drills. For smaller diameter drill keep the spindle speed in higher R.P.M and for larger diameter of drill keep the spindle speed in lower R.P.M.

Fig 4



Reaming drilled holes using hand reamers

Objective: This shall help you to
- **ream through holes within a limits and check reamed holes with cylindrical pins.**

Determining the drill size for reaming

Use the formula,

Drill diameter=reamed hole size. (undersize +oversize)

Refer to the table for the recommended undersizes in related theory on drill sizes for reaming.

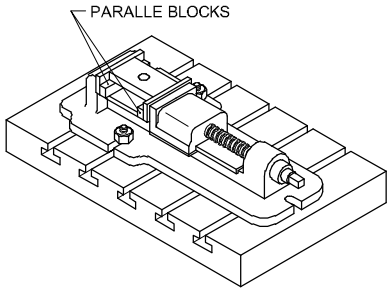
Drill holes for reaming as per the sizes determined.

Hand reaming

Drill holes for reaning as per the sizes determined.

Place the work on parallels while setting on the machine vice. (Fig 1)

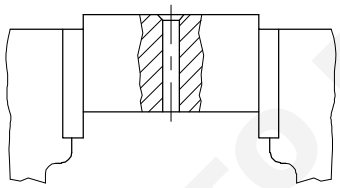
Fig 1



MG20N1121J1

Chamfer the hole ends slightly. This removes burrs and will also help to align the reamer vertically. (Fig 2) Fix the work in the bench vice. Use vice clamps to protect the finished surfaces. Ensure that the job is horizontal.

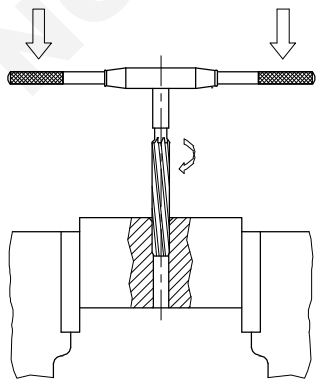
Fig 2



MG20N1121J2

Fix the tap wrench on the square end and place the reamer vertically in the hole. Check the alignment with a try square. Make corrections, if necessary. (Fig.3) Turn the tap wrench in a clockwise direction applying a slight downward pressure at the same time. (Fig 3) apply pressure evenly at both ends of the tap wrench.

Fig 3



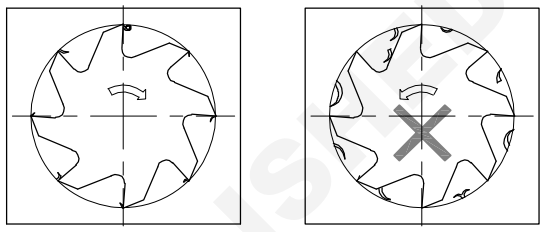
MG20N1121J3

Apply cutting fluid.

Turn the tap wrench steadily and slowly, maintaining the downward pressure.

Do not turn in the reverse direction for it will scratch the reamed hole. (Fig 4)

Fig 4

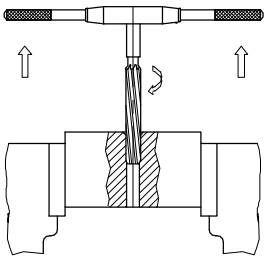


MG20N1121J4

Ream the hole through. Ensure that the taper lead length of the reamer comes out well and clear from the bottom of the work. Do not allow the end of the reamer to strike on the vice.

Remove the reamer with an upward pull until the reamer is clear of the hole. (Fig 5)

Fig 5



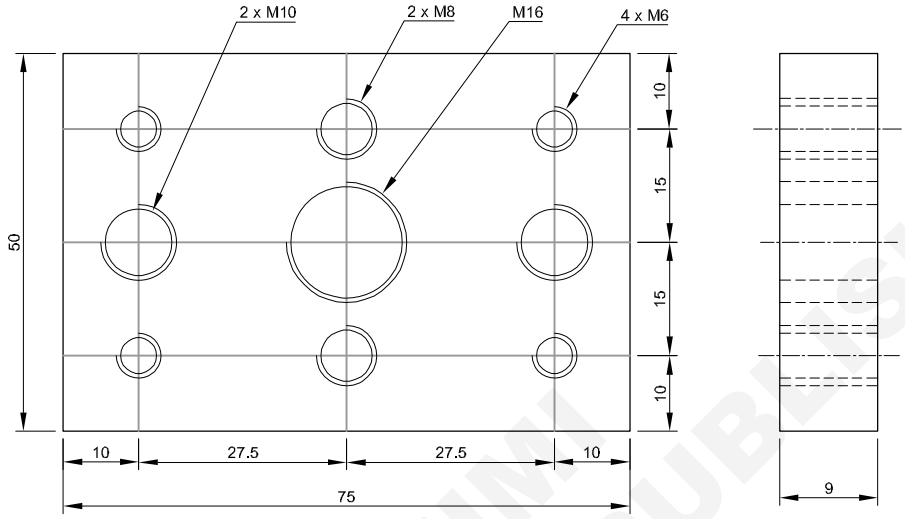
MG20N1121J5

Remove the burrs from the bottom of the reamed hole.

Clean the hole. Check the accuracy with the cylindrical pins supplied.

Make thread in drilled holes by tap

Objectives: At the end of this exercise you shall be able to
- **threading by tap using hand tap**
- **set job on vice**
- **check the squareness using Try square.**



Job Sequence

- Fix the Job in bench vice.
- Cut M6 internal thread using M6 hand tap and tap wrench.
- Similarly, cut internal threads using M8, M10 and M16 hand tap and tap wrench
- Finish and De - burr all the surfaces of the Job.
- Clean all the threads without burrs.
- Apply a little oil and preserve the job for evaluation

1	60 ISF 10 x 78 mm	PRE - DRILLED	Fe310	-	-	1.1.22
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	MAKE THREAD IN DRILLED HOLES BY TAP	TOLERANCE : ±0. 1mm	TIME : 2 Hrs
		CODE NO.MG20N1122E1	

Skill Sequence

Tapping through holes

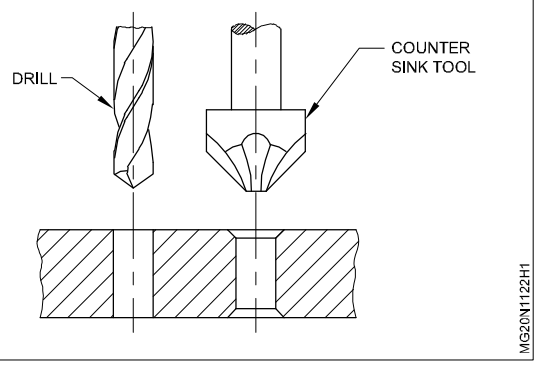
Objective: This shall help you to
- **cut internal threads using hand taps.**

Determine the tap drill size either using the formula or the table.

Drill the hole to the required tap drill size. [An undersized hole will lead to breakage of the tap].

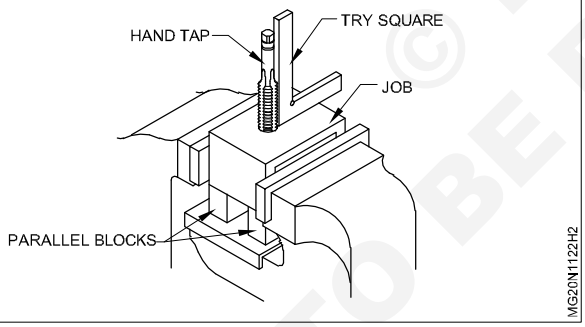
Chamfer the end of the drilled hole for easy aligning and starting of the tap. (Fig 1)

Fig 1



Hold the work firmly and horizontally in the vice. The top surface of the job should be slightly above the level of the vice jaws. This will help in using a try square without any obstruction while aligning the tap. (Fig 2)

Fig 2



Fix the first tap (taper tap) in the correct size tap wrench. Too small a wrench will need a greater force to turn the tap. Very large and heavy wrenches will not give the 'feel' required to turn the tap as it cuts and may lead to breakage of the tap.

Position the tap in the chamfered hole vertically by ensuring the wrench is in a horizontal plane.

Exert steady downward pressure and turn the tap wrench slowly in the clockwise direction to start the thread. Hold the tap wrench close to the centre. (Fig 3)

Remove the wrench from the tap when you are sure of starting the thread without disturbing the setting.

Check and make sure that the tap is vertical by using a try square in two positions at 90° to each other. (Figs 4 & 5)

Make correction if necessary by exerting slightly more pressure on the opposite side of the tap inclination.

Fig 3

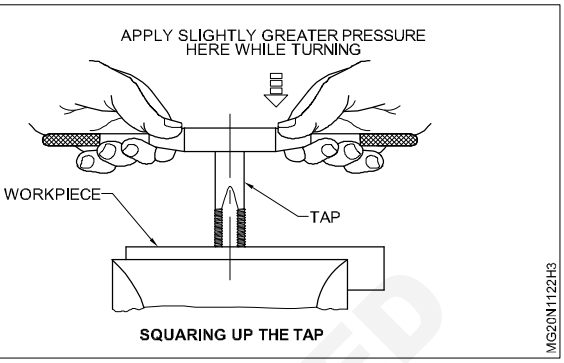


Fig 4

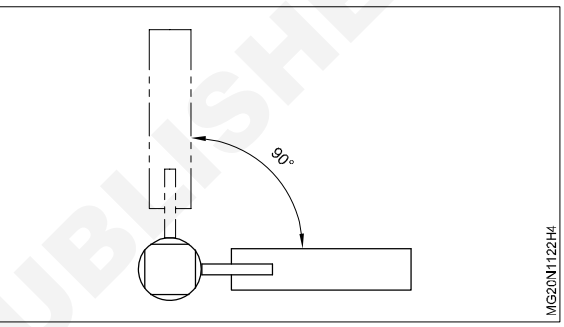
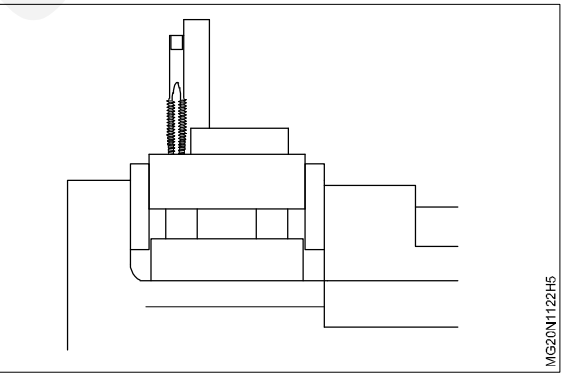


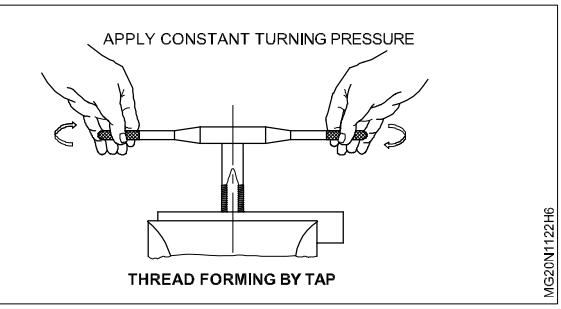
Fig 5



Check the tap alignment again. The tap alignment should be corrected within the first few turns. If it is tried afterwards there is a chance of breaking of the tap.

Turn the wrench lightly by holding at the ends without exerting any downward pressure after the tap is positioned vertically. The wrench pressure exerted by the hands should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap. (Fig 6).

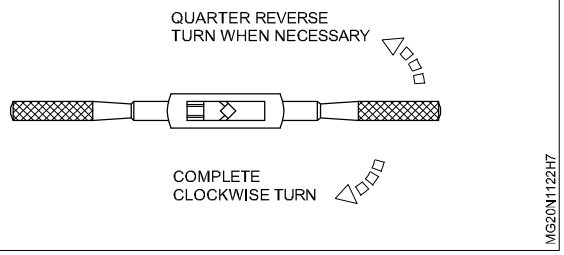
Fig 6



Continue cutting the thread. Turn backwards frequently about quarter turn, to break the chips. (Fig 7)

Stop and turn backwards when any obstruction to the movements is felt.

Fig 7



Use a cutting fluid while cutting the thread to minimise friction and heat.

Cut the thread until the hole is totally threaded.

Finish and clean up using the intermediate and plug tap. The intermediate and plug tap will not cut any thread if the first tap has entered the hole fully.

Remove the chips from the work and clean the tap with a brush.

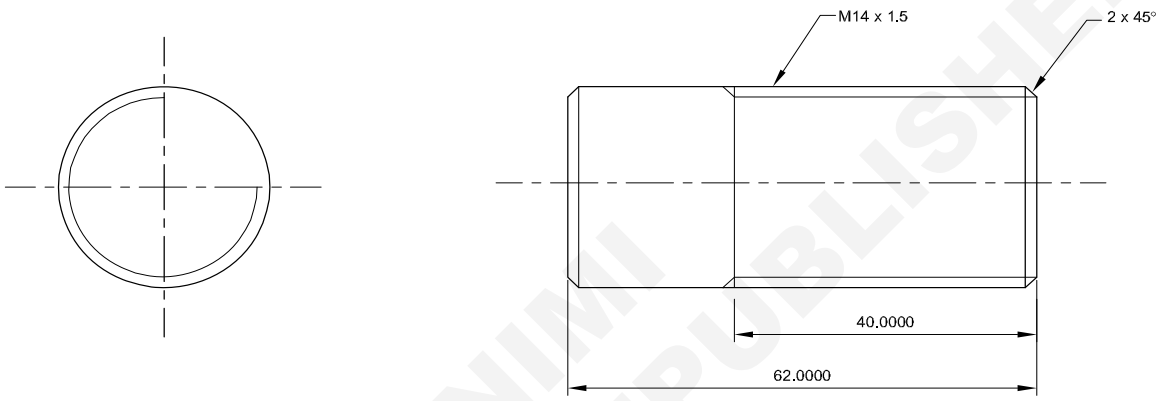
Make sure that the dia of the hole to be tapped is correct for the given size of the tap.

Turn backwards frequently about quarter turn to break the chips.

Select the length of wrench suitable to the size of the tap. Over length of wrench may cause the breakage of tap.

Prepare thread on round bar

Objectives: At the end of this exercise you shall be able to
- **file blank size in round rod to cut external thread**
- **cut M14 external thread using split die and die stock to the required length**
- **check the thread with screw pitch gauge and matching nut.**



Job Sequence

- Check the raw material for its size.
- File blank size to Ø 13.9 mm x 40 mm length as per drawing.
- File chamfer in both ends to 2 mm x 45°
- Hold the job at 90° in bench vice.
- Set M14 split die in die stock.
- Set the die on the blank end and press down evenly and turn in clockwise direction slowly to cut thread.
- Check the die 90° to the cylindrical rod.
- Apply pressure evenly on the die stock and turn in a clock wise direction to advance the die in cylindrical blank.
- Cut external thread slowly and reverse the die for short distance in order to break the chips.
- Increase depth of cut gradually by adjusting the screws and cut the thread to correct pitch of the thread.
- Check the thread with screw pitch gauge.
- Repeat the thread cutting process until the nut matches.
- Apply a little oil and preserve it for evaluation.

Use cutting lubricant while cutting thread

1	ISR ∅14 –65	-	Fe310	-	-	1.1.23
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE NTS					TOLERANCE : ± 0.04	TIME : 2 Hrs
			PREPARE THREAD ON A ROUND BAR			
					CODE NO : MG20N1123E1	

Skill Sequence

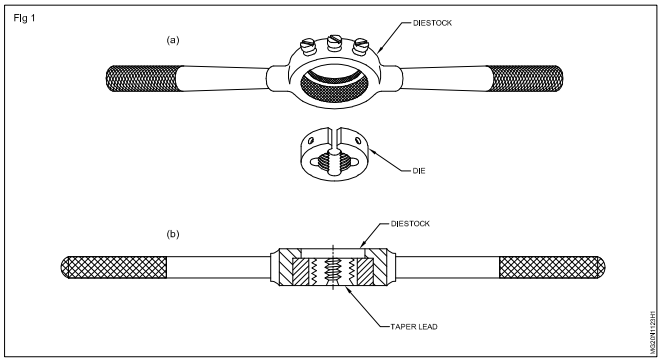
External threading using dies

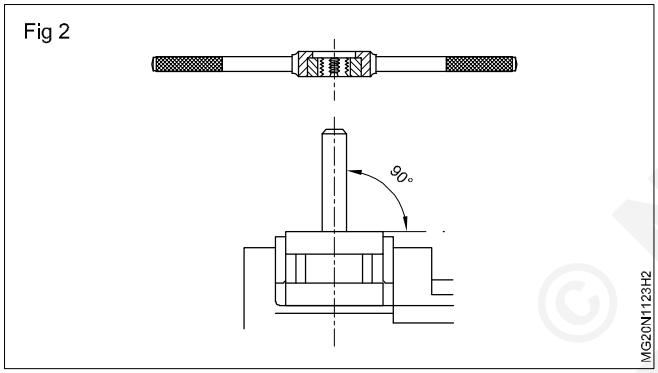
Objective: This shall help you to
- **Cut external threads using dies.**

Check blank size.

Blank size = Thread size - 0.1 x pitch of thread

Fix the die in the diestock and place the leading side of the die opposite to the step of the diestock. (Fig 1 & 2)

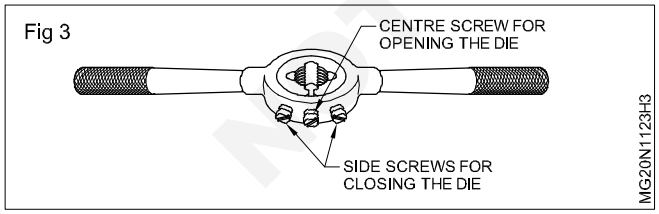




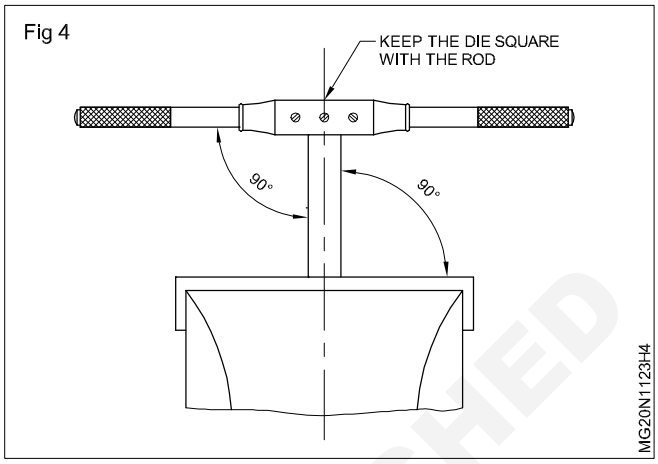
Use vice clamp for ensuring a good grip in the vice.

Project the blank above the vice - just the required thread length only.

Place the leading side of the die on the chamfer of the work. (Fig 3)

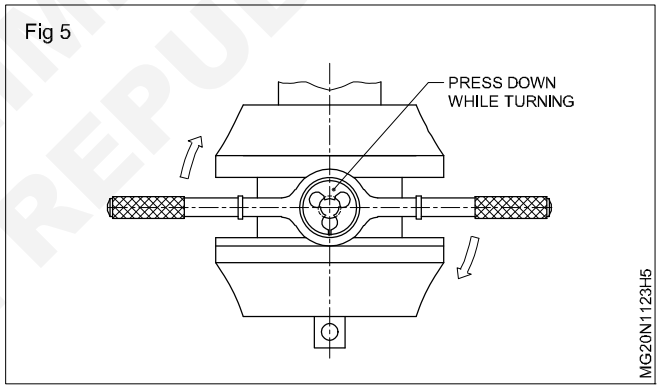


Make sure that the die is fully open by tightening the centre screw of the diestock. (Fig 4)



Start the die, square to the bolt centre line. (Fig 5)

Apply pressure on the diestock evenly and turn in a clockwise direction to advance the die on the bolt blank. (Fig 5)



Cut slowly and reverse the die for a short distance in order to break the chips.

Use a cutting lubricant

Increase the depth of the cut gradually by adjusting the outer screws.

Check the thread with a matching nut.

Repeat the cutting until the nut matches.

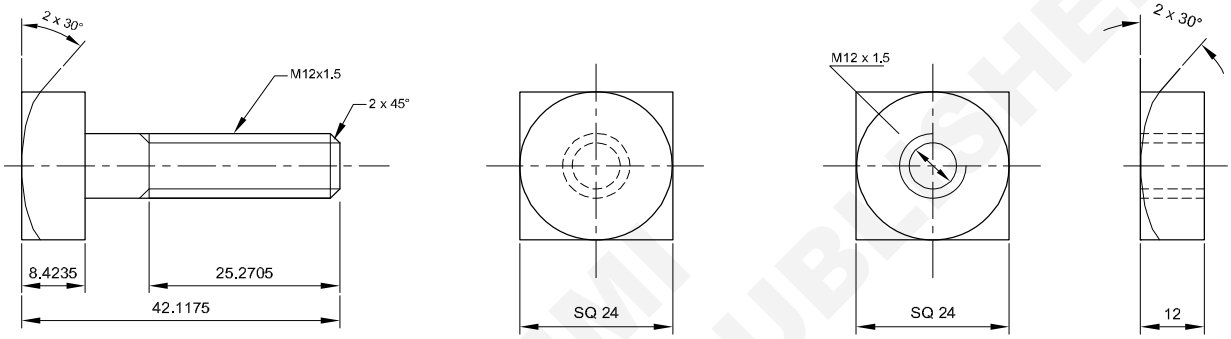
Too much depth of cut at one time will spoil the threads. It can also spoil the die.

Clean the die frequently to prevent the chips from clogging and spoiling the thread.

Make internal & external thread using tap & die match bolt & nut

Objectives: At the end of this exercise you shall be able to

- **cut and turn square rod to blank size to cut external threads**
- **file square bolt and nut to correct size and shape as per drawing**
- **determine tap drill sizes for square nut**
- **drill holes for tapping holes, to cut internal threads in square nut**
- **cut external threads on square head bolt using die and die stock**
- **cut internal threads on square nuts using tap and tap wrench**
- **match nuts with bolts.**



Job Sequence

Square head bolt

- Cut the square rod to size 53mm.
- File square rod side 25 mm to side 24 mm and length 50 mm.
- Turn to size Ø 11.8 mm x 40 mm length as shown in Fig 2.
- File chamfer in blank end to 2 mm x 45° and head side 2 x 30°
- Hold the square head bolt blank in bench vice to 90°
- Fix M 12 split die in die stock.
- Set M 12 split die on square head bolt blank end and cut external thread.
- Repeat the thread cutting process untill the nut matches.
- Check the external thread using screw pitch gauge and matching nut.

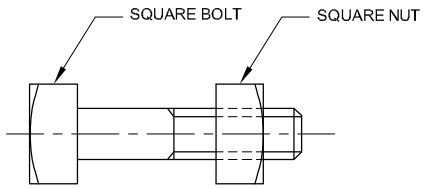
Square Nut

- Check the raw material size 15mm.
- File nut to size 12 mm thickness in 25 mm side square rod.
- File chamfer in one end to 2 mm x 30°.
- Determine tap drill size for M 12 tap.
- Mark centre of hole for tapping hole.
- Punch on the tap drill hole centre with centre punch 90°

1	SQUARE 25 - 68 (BOLT & NUT)	-	Fe310	-	-	1.1.24
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**MATCH INTERNAL AND EXTERNAL THREAD USING TAPS AND DIES MATCH BOLT & NUT**				TOLERANCE : ±0. 1mm	TIME : 3 Hrs
					CODE NO.MG20N1124E1	

- Make centre drill to locate hole centre.
- Drill Ø 6 mm pilot hole in square nut
- Drill Ø 10.8 mm for tapping hole.
- Chamfer both ends of drilled hole to 2 mm x 45°
- Hold the nut in bench vice parallel to vice jaws.
- Fix M 12 first tap in tap wrench and cut internal thread as per drawing.
- Similarly, fix M 12 second tap, third tap and cut and form full internal thread.
- Check the threaded hole with screw pitch gauge and matching bolt.
- Clean the thread in bolt and nut.
- Match the nut with bolt as shown in Fig 2.
- Apply a little oil and preserve it for evaluation.

Fig 1

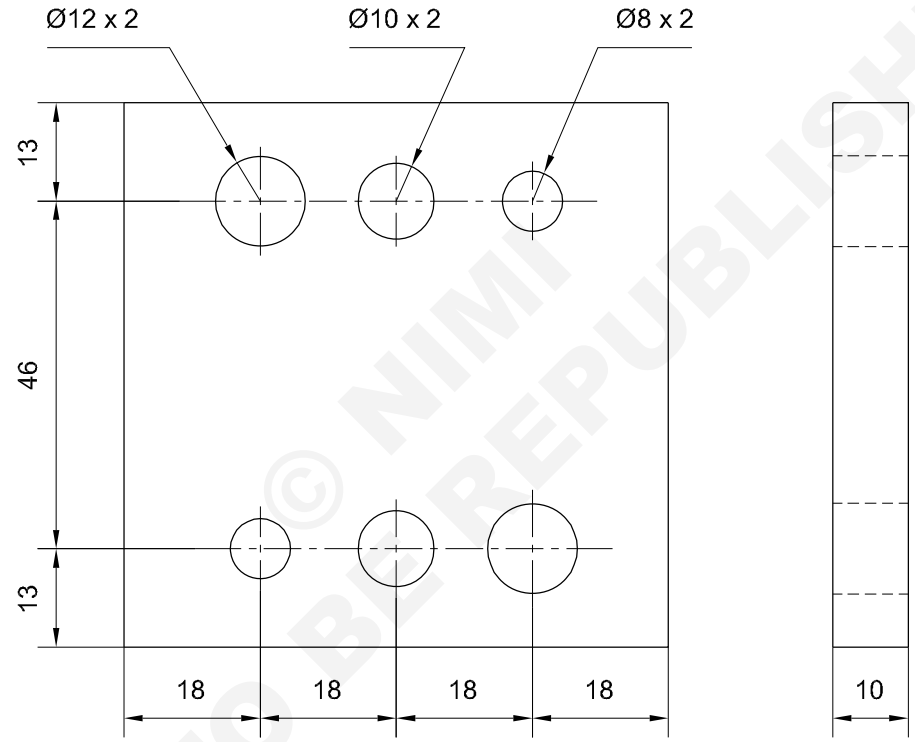


MG20N1124H1

Drilling different size of holes by machine

Objectives: At the end of this exercise you shall be able to

- **mark the job as per drawing using surface gauge**
- **punch the hole centre using centre punch**
- **drill the hole at the centre punch mark using bench drilling machine**
- **check the centre distance.**



1	75 ISF 10 - 75	-	Fe310	1	-	1.1.25
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	DRILLING DIFFERENT SIZES OF HOLES	DEVIATIONS ±0.5	TIME : 4 Hrs
		CODE NO. MG20N1125E1	

Job sequence

- Check the raw material size.
- File the job.
- Apply the chalk powder and allow it to dry.
- Mark and punch the holes centres with a centre punch and draw circles as per drawing.
- Fix the vice on the drilling machine table.
- Fix the job in the vice for drilling.
- Fix the drill chuck into the machine spindle.
- Fix Ø8mm drill in the chuck rigidly.
- Set the spindle speed.
- Use a coolant and drill Ø8mm holes.
- In the same way continue drilling for the remaining holes.

  Pilot hole drilling should be done for holes of Ø12mm.
- Deburr the edges of the holes with drills 3 to 5mm bigger in size than the hole sizes.

Skill sequence

Set vice on the table in position

Objective: This shall help you to
- **align a machine vice on the table in position.**

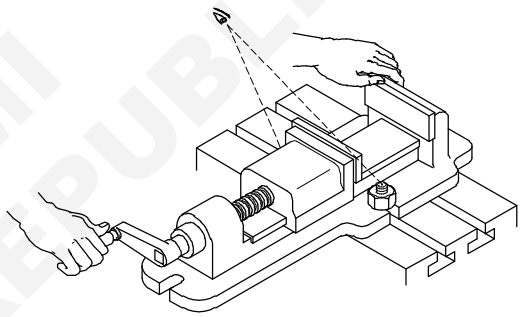
Clean the vice base and the machine table top, free from dust for seating.

Place the vice at the middle of the table with maximum support to avoid falling off of the vice. (Fig.1)

Position the 'T' bolts into the 'T' slot. (Fig.1) while shifting the vice towards the slots ensure that there is 1mm to 2mm clearance between the 'T' bolt and the vice slot to allow for adjustment.

Tighten all the bolts by hand.

Fig 1



Locating hole accurately by drilling centre hole

Objective: This shall help you to
- **drill centre holes with a drilling machine.**

Drilling centre holes by combination drills is an accurate method of locating the position of the holes (i.e within ±0.25mm). In drilling operations, this method will be specially helpful while drilling deeper holes and holes of fairly accurate locations. For doing centre drilling, proceed as follows.

Hold the combination centre drill in the drill chuck and check whether it 'runs true'. Adjust the spindle speed to suit the combination drill.

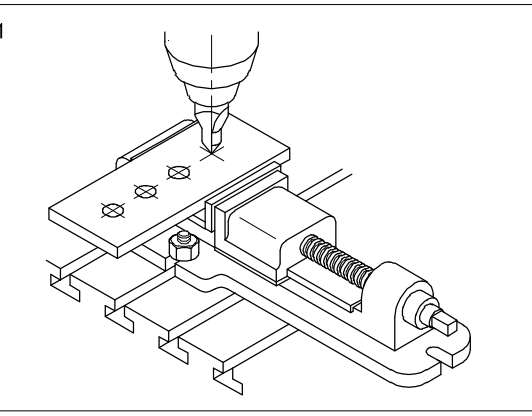
Adjust the job together with the vice and align with the centre punch mark.(Fig.1)

Drill a centre hole up to the depth of 3/4th of the counter sink. Do not apply undue pressure on the centre drill.

Apply sufficient quantity of cutting fluid.

Remove the centre drill, hold the twist drill of the required dia. check if it 'runs true'. start drilling the through hole.

Fig 1

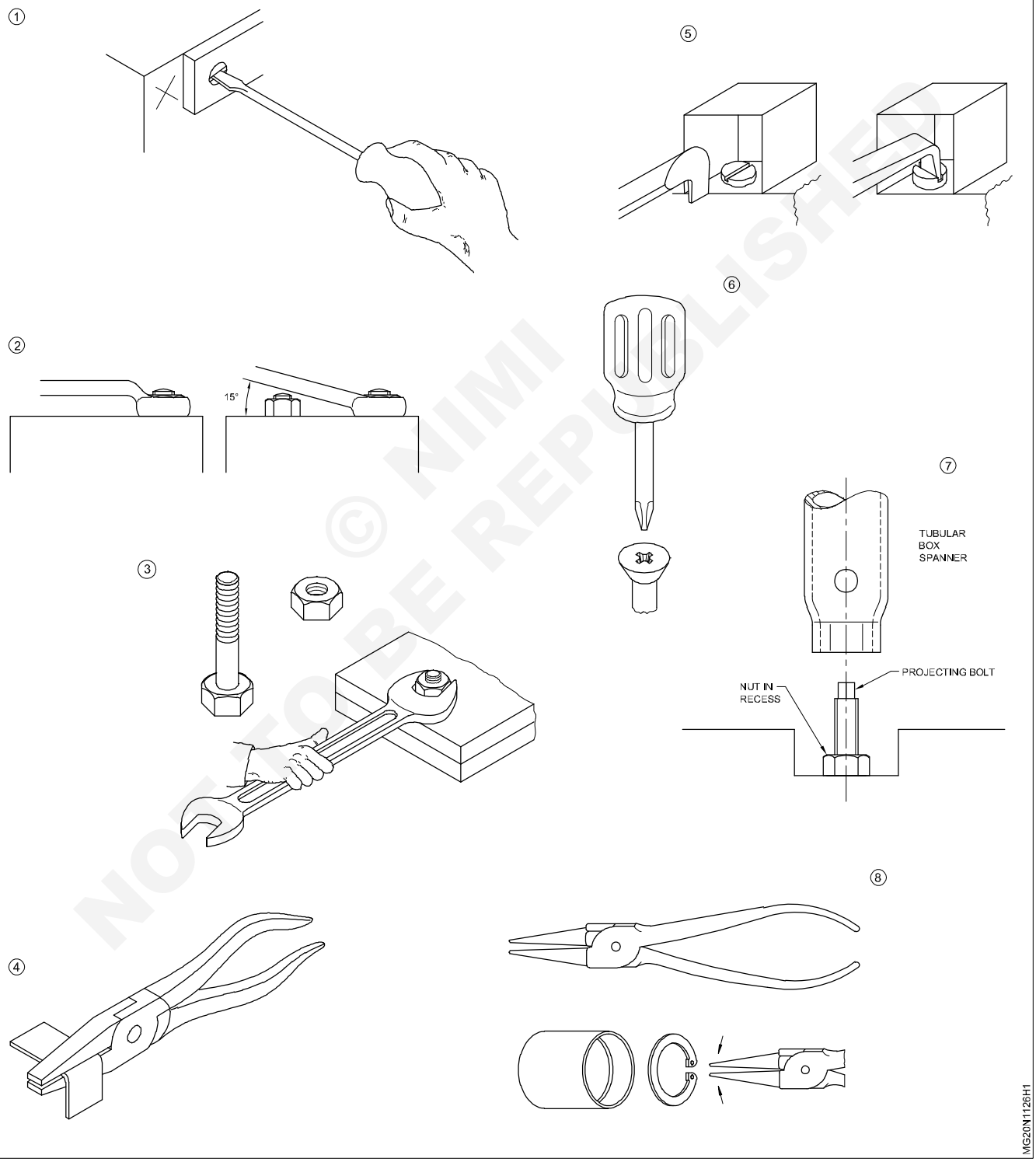


Use of screw drivers, spanners, pliers etc

Objectives: At the end of this exercise you shall be able to

- **loosening and tightening of different types of fasteners**
- **using screw driver, spanners and pliers.**

Fig 1



Job Sequence

Instructor shall guide and demonstrate to use the tool. The trainees should practice loosening and tightening the screws and bolts using the tools

- Record and the name of the tool in Table - 1
- Fill up and get it checked by instructor.

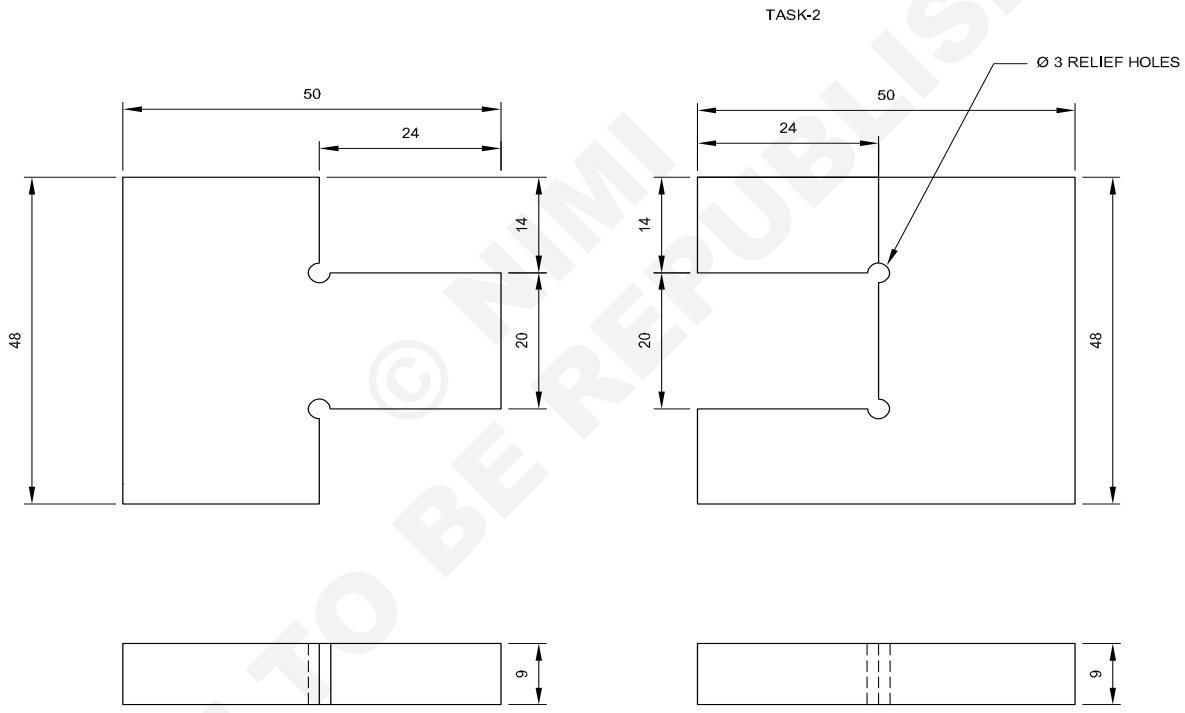
Table 1

Sl.No	Name of the tool
1	
2	
3	
4	
5	
6	
7	
8	

Make simple fitting job within accuracy ± 0.4mm

Objectives: At the end of this exercise you shall be able to

- **hold the job in a bench vice horizontally for filling**
- **file a flat surface**
- **check the flatness of filed job using straight edge/try square blade**
- **check the squareness of the job with try square**
- **file flat surface to flat and parallel within an accuracy of 0.4mm**
- **file and assemble the T fitting and obtain the required class of fit.**



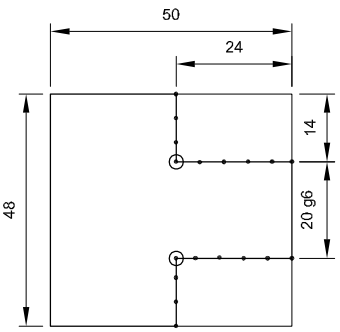
2	50 ISF 10 - 55	-	Fe310	-	A&B	1.1.27
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	**MAKE SIMPLE FITTING JOB WITH IN ACCURACY ±0.4 mm**				TOLERANCE : ± 0.04	TIME : 5 Hrs
					CODE NO : MG20N1127E1	

PROCEDURE

TASK 1: **Male part.**

- Check the raw material for its size.
- File and finish to size 50 x 48 x 9 mm maintaining parallelism and perpendicularity.
- Apply marking media ,mark as per job drawing and punch witness marks in part A as shown in Fig 1.

Fig 1

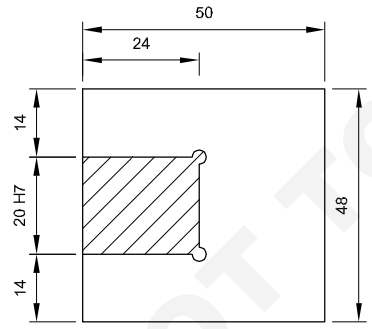


- Drill relief hole ϕ 3mm as per job drawing in part A.
- Mark lines as shown in Fig 2 leaving the metal 1mm away from the object line and cut and remove the excess metal by hack sawing.
- File part A as per drawing to size 14mm x 24mm with safe edge file and check the size with vernier caliper.

TASK 2: **Female part.**

- File and finish to size 50 x 48 x 9mm maintaining parallelism and perpendicularity.
- Apply marking media, mark and punch as shown in Fig 4.

Fig 4



- Drill relief hole φ 3mm on part B
- Chain drill holes, chips hacksaw and remove the excess metal as shown in Fig 5.

Fig 5

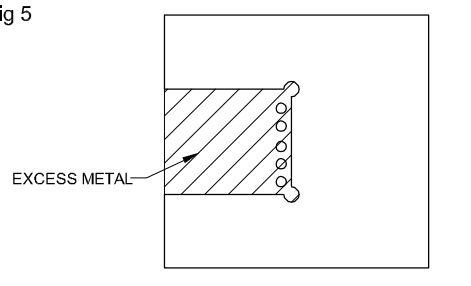
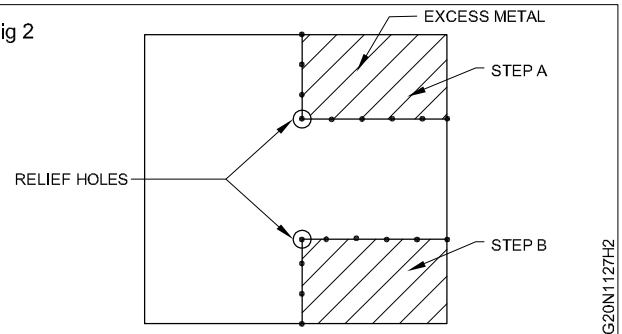
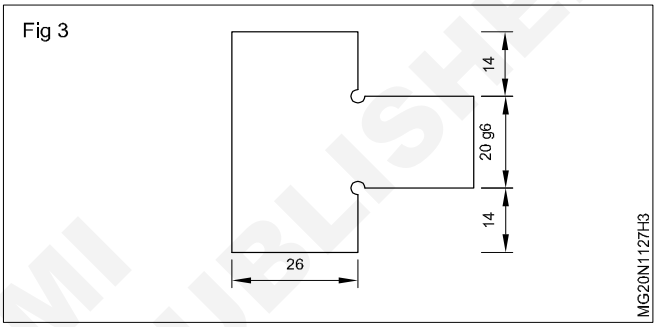


Fig 2



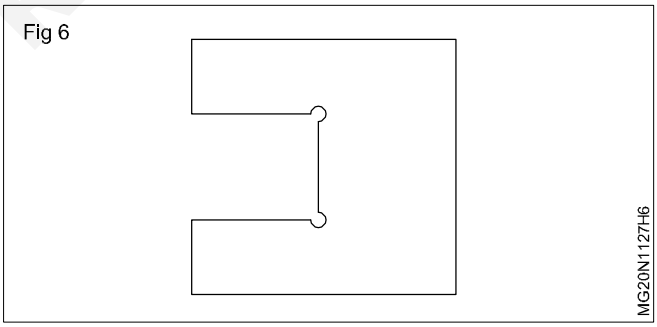
- Similarly cut and remove the excess metal and file step B to size and shape and check the size with veriner caliper as shown in Fig 3.

Fig 3



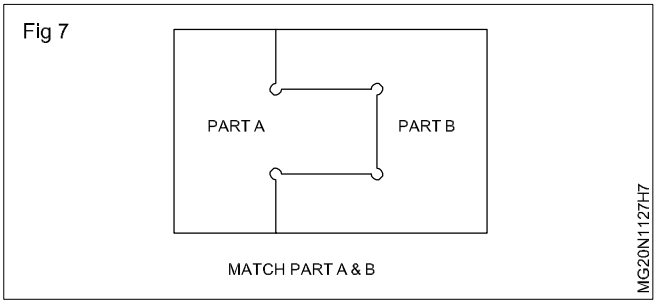
- File to size and shape maintaining the flatness and squareness as shown in Fig 6.

Fig 6



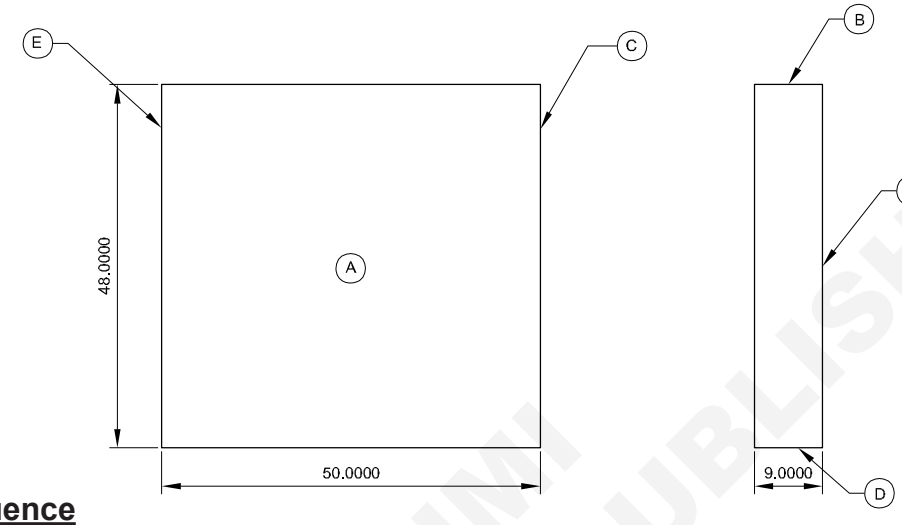
- Check the size with vernier caliper.
- Match part 'A' and 'B' as shown in Fig 7.
- Finish the filing and de- burr in all the surface of the job.
- Apply a thin coat of oil and preserve it for evaluation

Fig 7



File a M.S flat as given dimension

Objectives: At the end of this exercise you shall be able to
- **filing adjacent sides**
- **marking with jenny caliper**
- **punching with prick punch 60°**
- **finishing the size according to the dimensions .**



Job sequence

Filing M.S flat as required dimension

- Check the raw material size using steel rule.
- Remove the scaling by flat rough file.
- File side (A) with flat bastard file.
- Check the flatness by blade of a try square
- File side (B) and maintain the squareness with respect to side (A).
- Check the squareness with a try square.

The side A,B and C are mutually perpendicular to each other

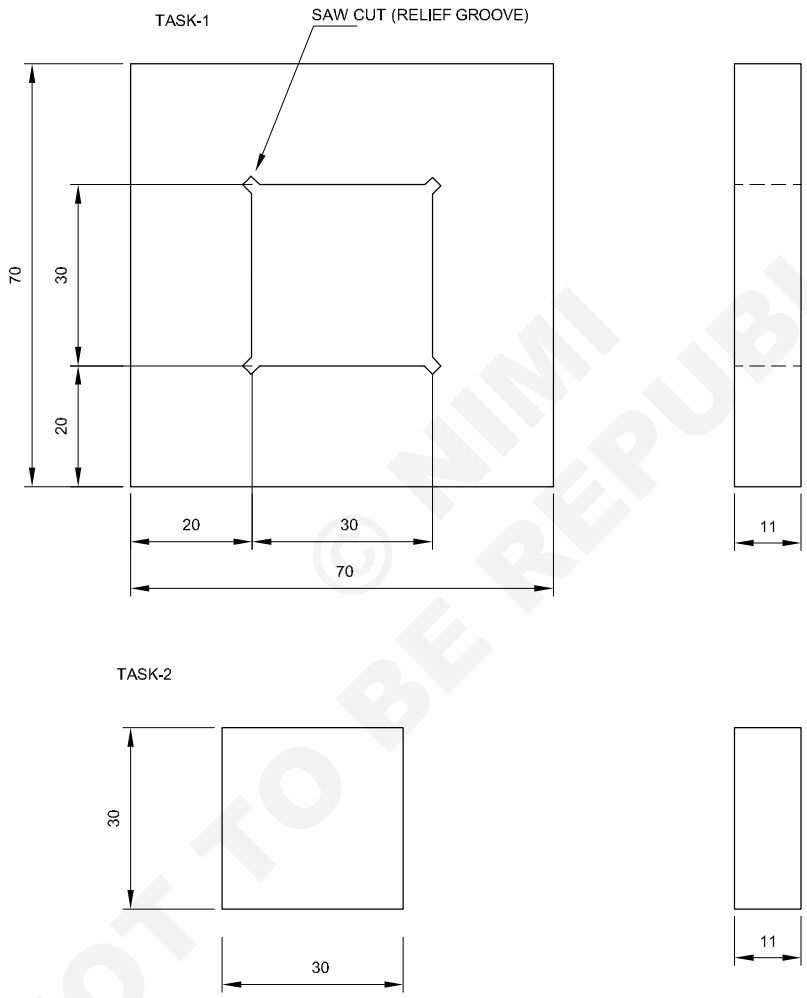
- Set Jenny caliper to 50mm using steel rule
- Draw parallel lines of 50mm to side (B) and (C)
- Punch the marked line using dot punch and ball pein hammer
- Set and file sides (D) and (E) to 48mm and maintain squareness to all other sides.
- Maintain (D) and (E) parallel to side (B) and (C) (Fig.2)
- Check the dimensions with a steel rule and squareness with a try square
- File surface (F) and maintain the thickness of 9mm parallelism to side A.
- Remove sharp edges. Apply little amount of oil and preserve it for evaluation.

1	50 ISF 10 - 55	-	Fe310	-	-	1.1.28
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	FILE A MS FLAT AS GIVEN DIMENSION				TOLERANCE : ± 0.04	TIME : 12 Hrs
					CODE NO : MG20N1128E1	

Make simple fitting job with an accuracy ± 0.2mm

Objectives: At the end of this exercise you shall be able to

- **mark the dimension lines as per drawing**
- **chain drill, cut and remove excess metal by chipping**
- **file square slot maintaining ± 0.2 mm**
- **match square in square slot.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	35 ISF 12- 35	–	Fe310	–	-	1.1.29
1	75 ISF 12 - 75	–	Fe310	–	-	1.1.29

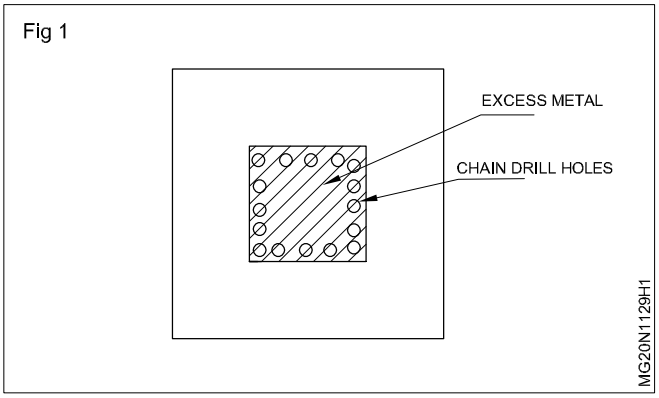
SCALE NTS	MAKE SIMPLE FITTING JOB WITH IN ACCURACY ±0.2 mm	TOLERANCE : ±0.01	TIME : 5 Hrs
		CODE NO : MG20N1129E1	

PROCEDURE

TASK 1: **Marking and chain drilling.**

- Check the given raw material for its size.
- Rough and finish file on surface flat and square to overall size 70 x70 x11 mm maintaining accuracy ± 0.2mm.
- Mark off sizes in part 1 as per job drawing and punch witness marks.
- Hold part 1 in drilling machine table and drill chain drill holes to remove excess metal as shown in Fig1 .

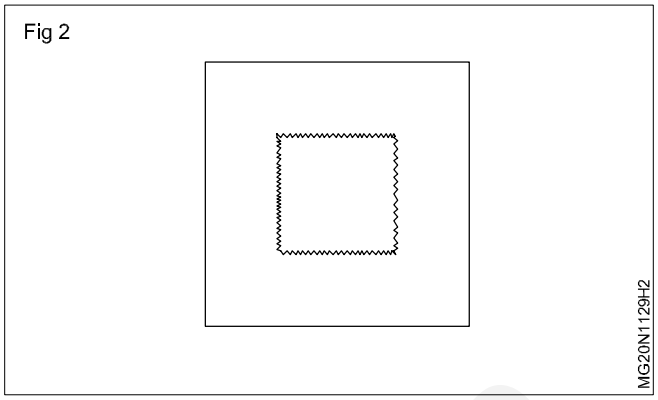
Fig 1



Periphery of the drill should not touch the witness marks

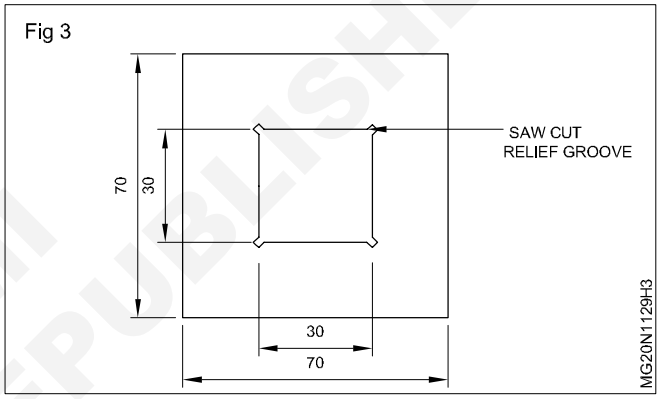
- Cut and remove the chain drilled hatched part using web chisel and ball pein hammer as shown in Fig 2.
- File the chipped portion to size and shape using safe edge file of different grades maintaining accuracy of ± 0.2mm and check the size with vernier caliper.

Fig 2



- Cut relief grooves using hacksaw at four inside corners as shown in Fig 3.

Fig 3

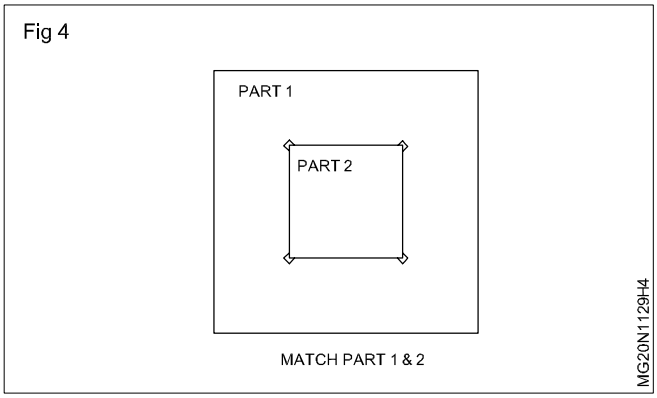


— — — — — — — —

TASK 2: **Filling the square and fitting.**

- File to size 30 x 30 x 11mm maintaining accuracy **±** 0.2mm.
- Check the flatness and squareness with try square.
- Check the size with vernier caliper.
- Match part - 2 into part 1 as shown in Fig 4.
- Finish file in part 1 and 2 with flat smooth file and de burr in all the surface and corners of the job.
- Apply a little oil and preserve it for evaluation.

Fig 4

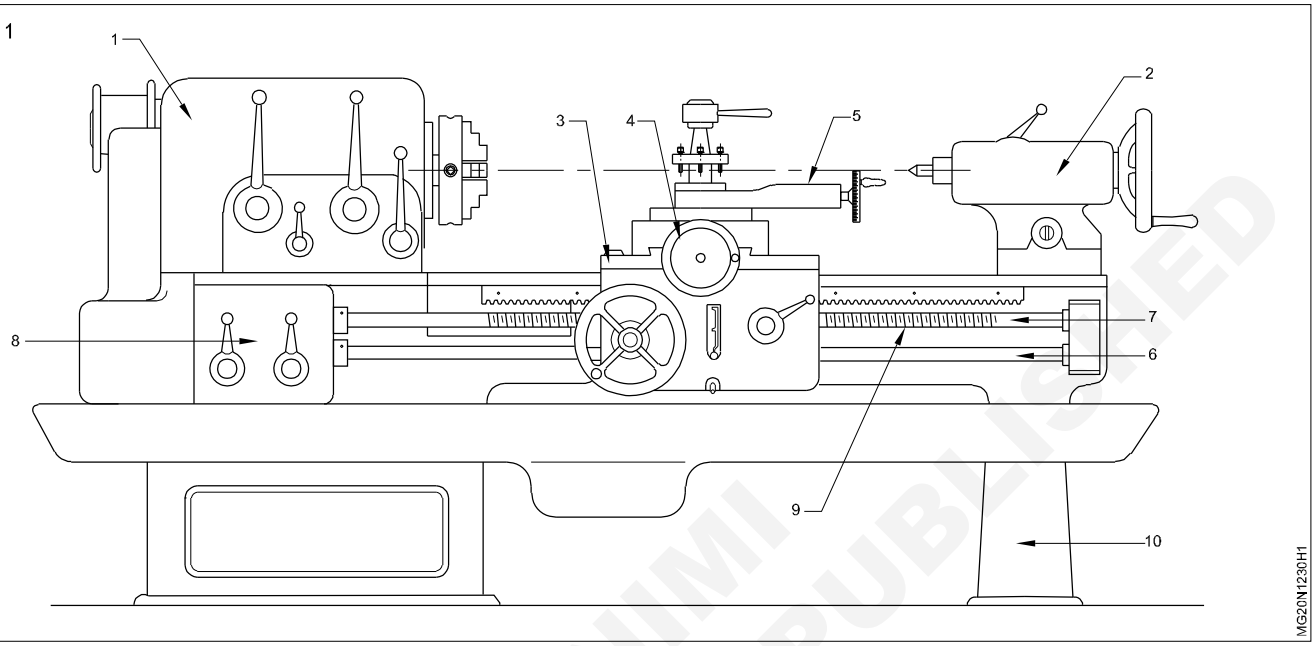


— — — — — — — —

Identify centre lathe and its parts

Objectives : At the end of this exercise you shall be able to
- **identifying the parts of lathe**
- **record the name parts in Table 1.**

Fig 1



- Instructor may brief the parts name to the trainees and ask them to record it on Table 1.
- Trainees will note down the each parts name
- Record it in Table 1
- Get it the checked by the instructor.

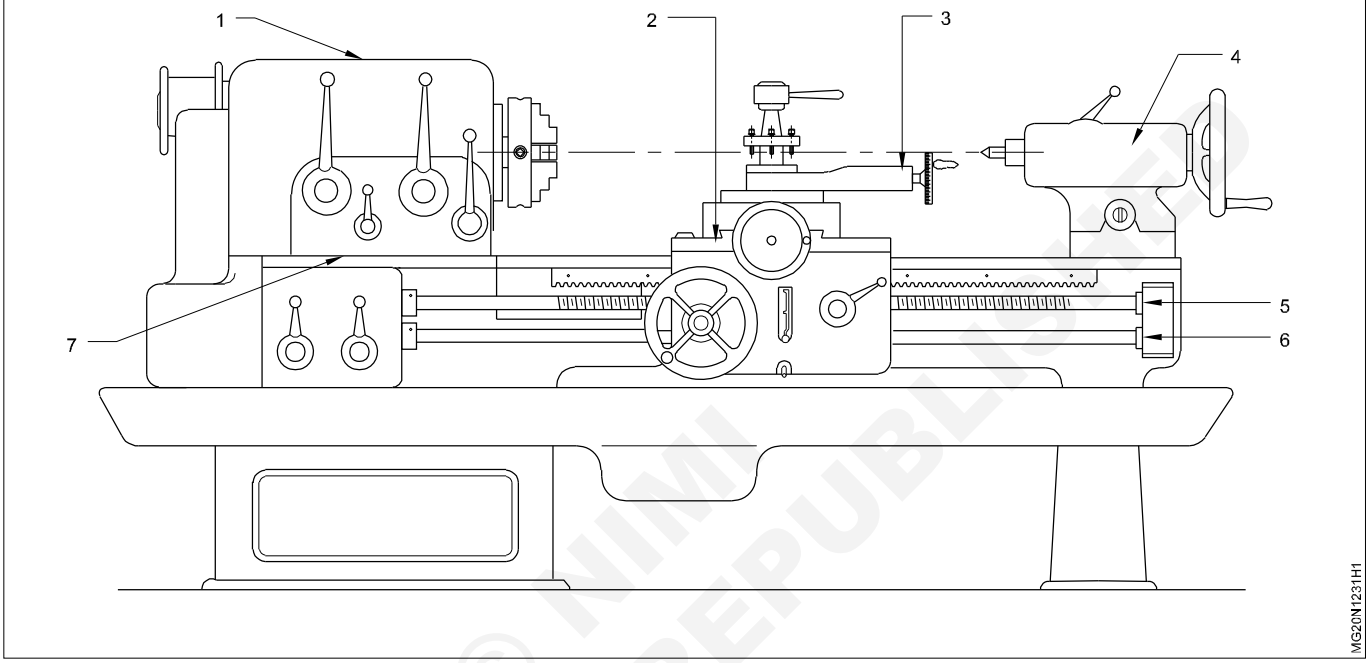
Table 1

Sl.No	Name of the part
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Set lathe machine and perform lathe operation with idle/dry run

Objectives : At the end of this exercise you shall be able to
- **identifying the parts and functions of lathe**
- **operate the lathe idle run.**

Fig 1



Job Sequence

Instructor shall identify the parts and function of the lathe. Ask trainees to record in Table 1. And instructor may train the trainees to operate the lathe on idle

- Identify the main parts and function of lathe.
- Run the lathe in idle and practice.

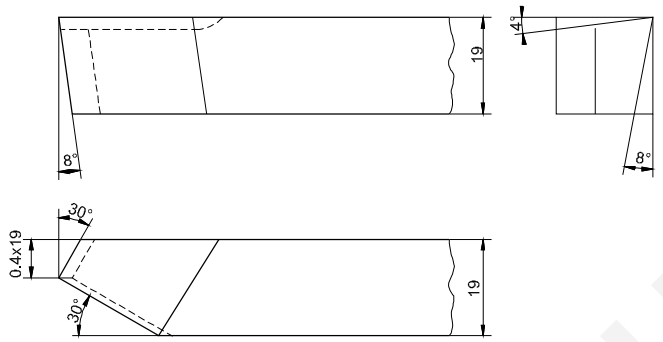
Table 1

Sl.No	Parts	Functions
1		
2		
3		
4		
5		
6		
7		

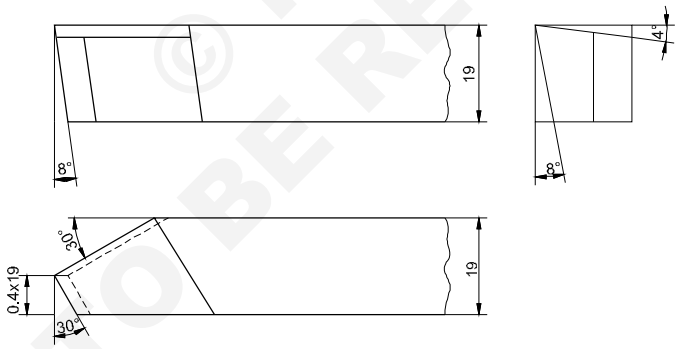
Grind lathe tools on pedestal grinder

Objectives : At the end of this exercise you shall be able to
- **grind lathe tool on pedestal grinder**
- **check the angles with a protractor.**

TASK-1

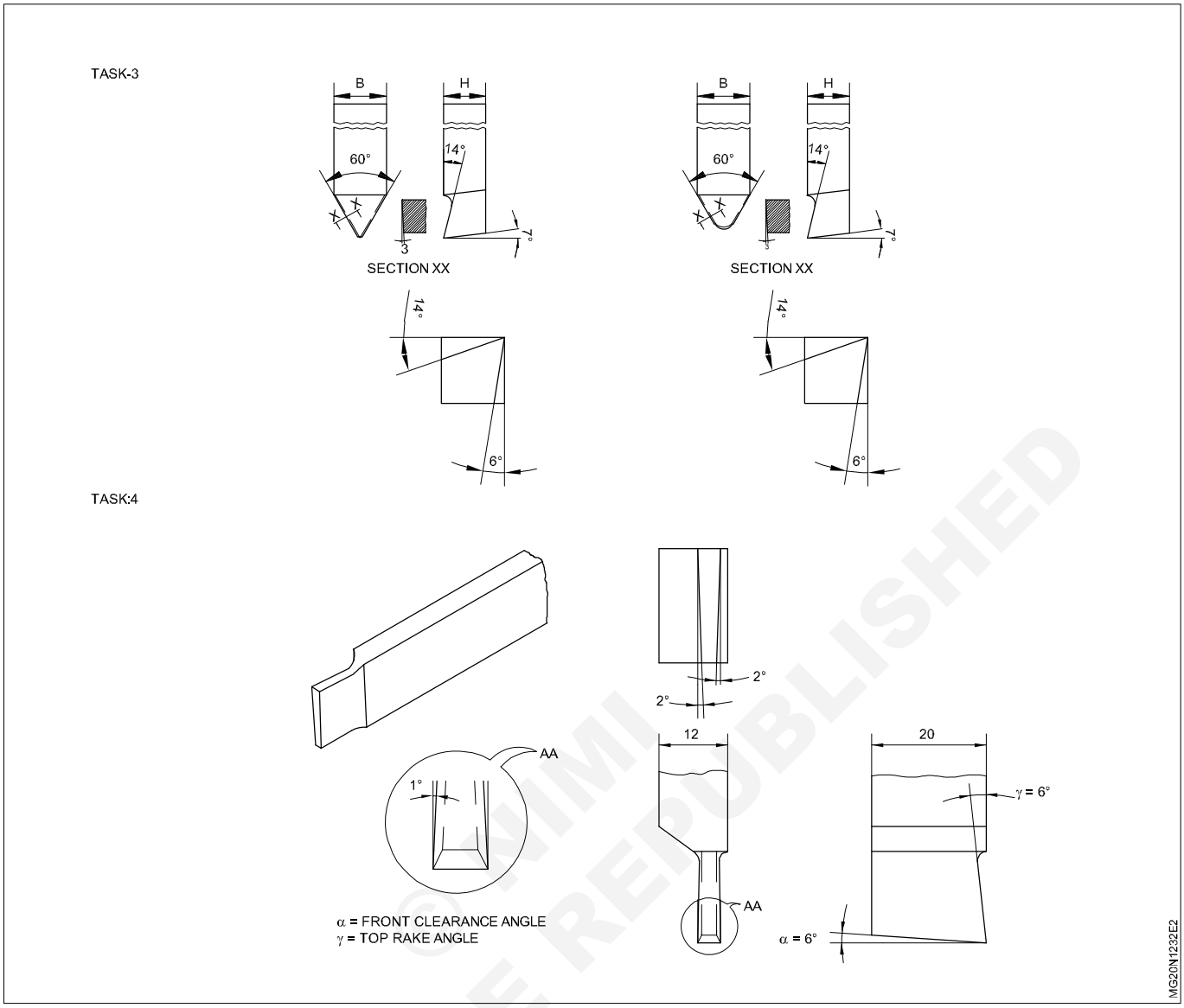


TASK-2



1	20ISF-12-150	–	1	Fe 310	-	1.2.32
3	SQ 19-150	–	1	Fe 310	-	1.2.32
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE NTS	**LATHE TOOLS ON PEDESTAL GRINDER**	DEVIATIONS ± 1°	TIME 10 Hrs
		CODE NO. MG20N1232E1	



Job sequence

TASK 1: **Grinding R.H and L.H tools.**

- Rotate the wheel by hand and observe for free rotation.
- Check the grinding wheels for true running.
- Wear goggles.
- Dress the wheels by a wheel dresser.
- Adjust the tool-rest to maintain a minimum gap from the wheel face to a minimum of 2 to 3 mm.
- Hold and apply the side flank of the tool to the front face of the grinding wheel at 30° to horizontal.
- Move the tool left to right and vice versa to grind the side cutting edge angle to cover 2/3rd width of the tool.
- Grind a side clearance angle of 8°, the bottom of the edge touching the wheel first.
- Rough grind the end cutting edge angle of 30° and the front clearance angle of 4° simultaneously.
- Hold the top flank of the tool against the wheel face inclined at 14°, the rear side contacting the wheel first, and grind the side rake angle of 14°.
- Ensure that the ground portion is parallel to the side cutting edge.
- Finish grind all the faces on the finishing wheel.
- Grind a nose radius of approximately R. 0.4 mm.
- Check the angles with a tool angle gauge and template.
- Lap the cutting edge with an oilstone.
- The top rake (back rake) angle should be kept at 4°.
- To prepare L.H tool follow the same procedure.

TASK 2 : **Grinding 'V' tools.**

- Set the pedestal grinder for tool grinding and make sure it is safe to start.
- Remove excess material on right hand side of the tool to length equal to the thickness of tool and width.
- Adjust the tool test to maintain a minimum gap from the wheel face of 2 to 3 mm.
- Wear the goggles, start the wheel, hold the tool firm at an angle of approximately 60° to the face of the wheel, grind the left hand side of tool.
- Repeat the above procedure for right hand side to get the included angle of 60° .
- Grind the top rake angle, back rake angle of 14°
- Grind the front clearance angle of 7°, the bottom of the edge touching the wheel first.
- Lap the cutting edge with an oilstone.

Precautions:

- Wear goggle
- Avoid burning of tool by using suitable coolant.

— — — — — —

TASK 3: **Grinding side cutting tool.**

- Check the gap between the wheel and the tool rest, and maintain the gap 2 to 3 mm.

Damages or any corrections needed should be brought to the notice of instructor.

- Hold the blank against the wheel to grind the end cutting edge angle 20° to 25° and the front clearance angle between 6° to 8° - simultaneously.
- Grind the side of the tool - for giving 6° to 8° side clearance. The side length should be equal to the width of the tool blank.
- Grind the top of the tool for a side rake angle of 12° to 15°.
- Finish grind all angles and clearances - on a smooth wheel.
- Grind a nose radius of approximately R 0.5 mm.

The ground surfaces should be without steps and should have a uniform smooth finish.

— — — — — —

TASK 4: **Grinding parting tool.**

- Set the pedestal grinder for tool grinding.
- Remove excess of material on right hand side of the tool to length equal to the thickness of tool and width.
- Grind Half of the thickness of tool on rough grinding wheel.
- Grind 6° to 8° front clearance angle.
- Hold the tool at an angle of 55° to the face of the wheel.
- Grind 27 $^{1}/_{2}$° on left hand side of the tool.
- Repeat the above procedure on the right side of the tool to get an included angle of 55° on the tool.
- Grind 2° to 4° side clearance angle on each side of the tool.
- Finish all sides by using smooth grinding wheel. Check the tool by centre gauge; there should not be any light passing through gauge and cutting edges of the tool.
- Cutting point is carefully ground in a smooth wheel.
- Finally lap the tool by applying oil stone on cutting edges.

Remember

- Avoid burning of the tool.
- The cutting edge should be visible during grinding.

— — — — — —

Skill sequence

Grinding a side cutting tool for machining steel

Objective : This shall help you to

- **grind a right hand side cutting tool to machine steel.**

The side cutting tool to be used on steel is illustrated in Fig 1. The right hand portion illustrates the tool blank in dotted lines before grinding, and the ground tool by thick lines. (Fig 1)

The side cutting edge is in line with the blank edge and the end cutting edge is inclined at an angle of 25°. The side rake angle is 14°. The front and side clearances are ground 6°. The length of the side cutting edge is maintained

equal to the size of the square cross-section of the tool blank, i.e. 12 mm. Fig 2 shows the shaded portion to be removed by grinding the tool blank to get the ground tool. The procedure in sequence is as follows.

Fig 1

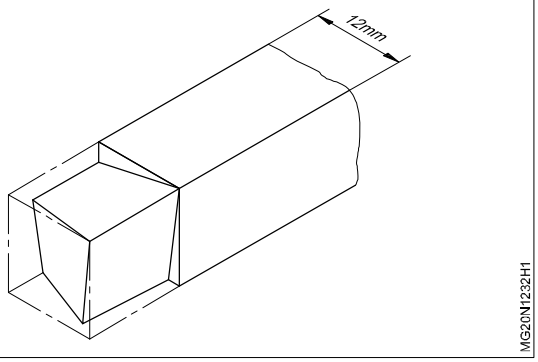
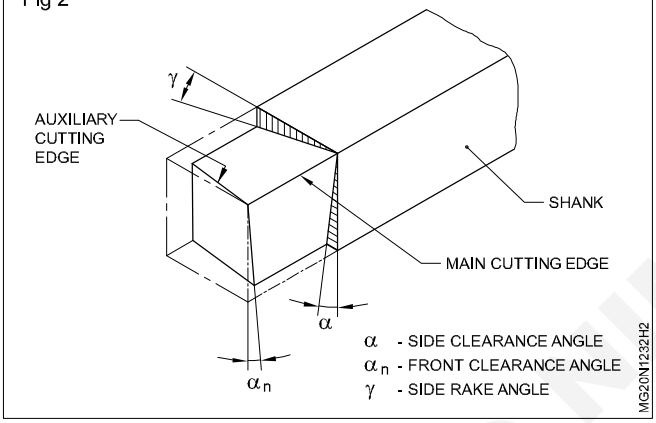
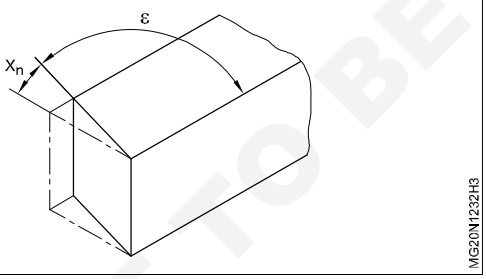


Fig 2



Grind the end cutting edge angle 25°. Angle 'x_n' (Fig 3)

Fig 3



Grind the side rake angle of 14°. Angle. (Fig 4)

Grind the side clearance angle of 6°. Angle α (Fig 5)

Grind the front clearance angle of 6°. Angle α_n (Fig 6)

Grind and provide a nose radius of R 0.4 to R 0.6 mm at the point of tool. Grind a flat for a short length of 0.2 to 0.3 mm as shown in Fig 7. For the sake of clarity the figure is magnified.

Fig 4

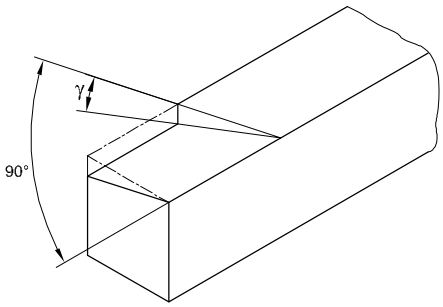


Fig 5

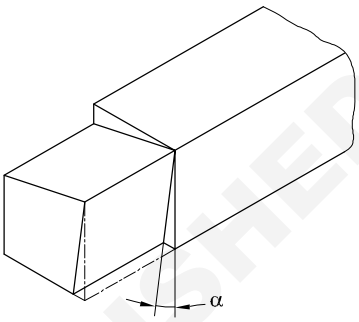


Fig 6

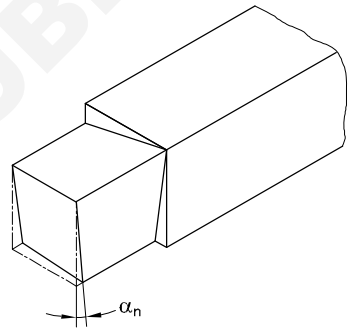
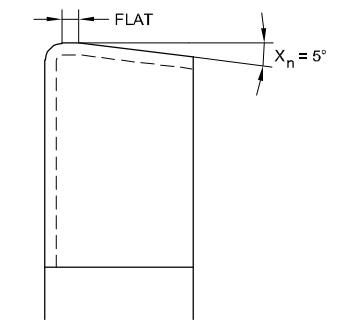


Fig 7

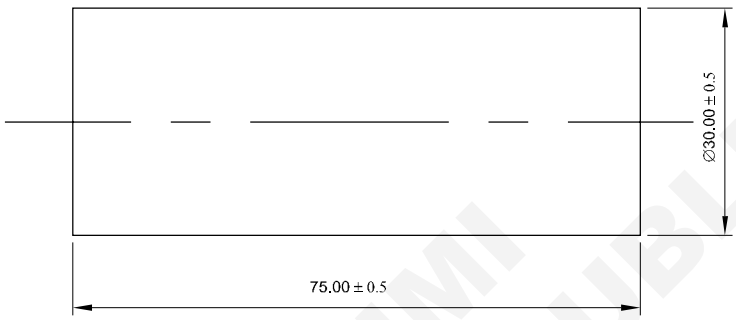


Exercise 1.2.33

Facing and turning on lathe

Objectives : At the end of this exercise you shall be able to

- **true the work piece on four jaw chuck**
- **set the tool to the centre height**
- **face the workpiece to the required length**
- **plain turn the work piece to the required diameter**
- **measure with outside caliper and steel rule.**



Job Sequence

- Check the raw material
- Hold the job in a 4 jaw chuck about 50mm outside and true it.
- Face one end
- Turn ϕ 30 to about 40mm length
- Reverse the job and reset it, holding on ϕ 30mm
- Face the other and to a total length of 75mm ±0.5 and turn the outer diameter ϕ30mm
- Check the dimension with a steel rule and calipers
- Deburr the workpiece.

1	ISRO Ø35 - 80	-	Fe 310	-	-	1.2.33
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	FACING AND TURNING ON LATHE				TOLERANCE : ± 0.04	TIME : 5 Hrs
					CODE NO : MG20N1233E1	

Skill sequence

Setting the job in a 4-jaw independent chuck

Objective: This shall help you to
- **true a round rod in a four-jaw independent chuck with the help of a surface gauge.**

If truing not done before turning, the following will be the results.

- Uneven load on the cutting tool.
- For the same depth, more metal will be removed from the out of centre potion. The surface turned may not be cylindrical.

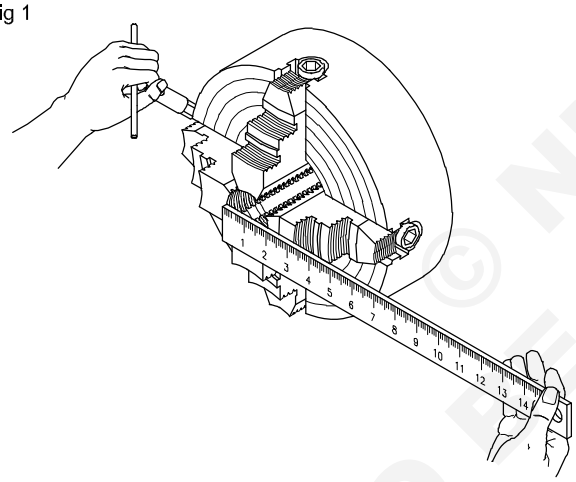
Sequence for truing

Keep the main spindle in a neutral position.

Measure the job diameter with an outside calliper or with a steel rule.

Position all the four jaws of the chuck equally spaced from the centre. The distance between the inner face of the opposite jaws is equal to the diameter of the work. (Fig 1)

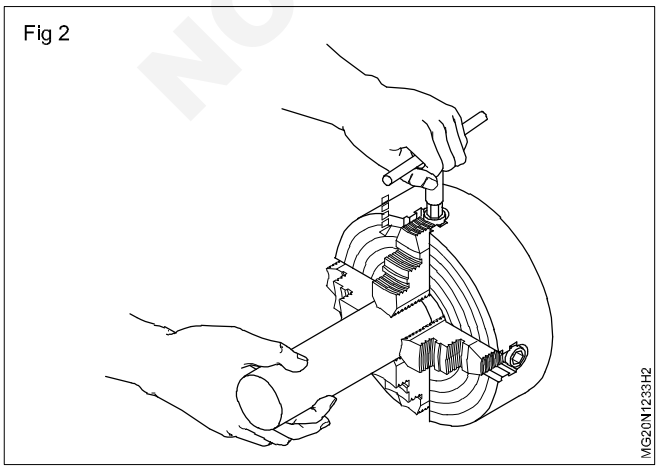
Fig 1



Open the adjacent jaws sufficiently enough to insert the work.

Open the work inside the chuck, keeping 20mm outside for facing, and tighten the two jaws enough to grip the work. (Fig 2)

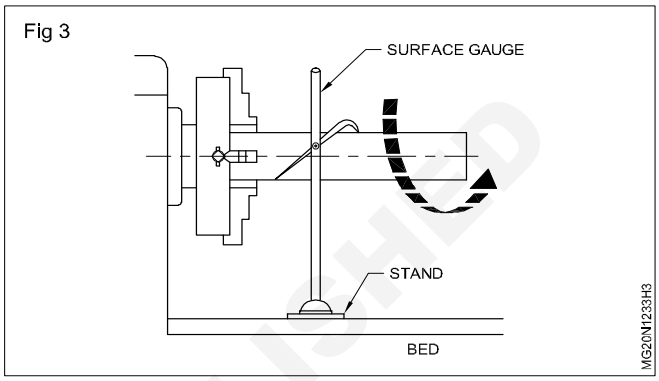
Fig 2



Place the surface gauge on the bed- ways close to chuck.

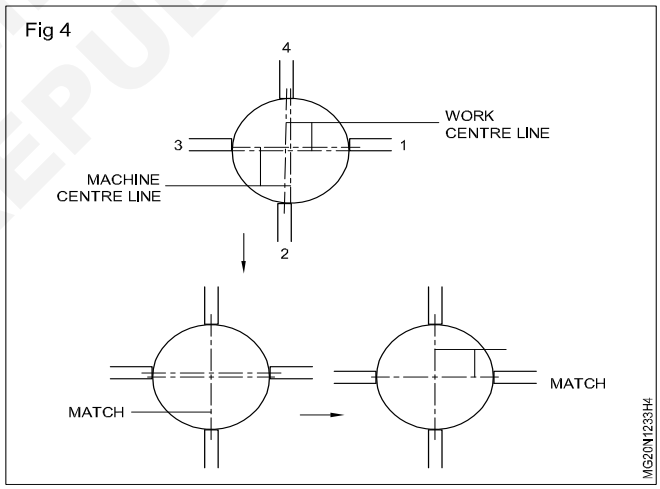
Adjust the pointer to Make its tip move close to the top or side portion of the work with a minimum gap of 2mm. (Fig 3)

Fig 3



Open the jaw slightly where the gap is more and tighten the opposite jaws. (Fig 4)

Fig 4



Repeat until the gap between the pointer and the surface of the job becomes equal.

Repeat the above sequence for the other set of jaws.

Bring the pointer tip closer to the workpiece.

Rotate the chuck by hand and observe the gap.

Engage the spindle levers at about 250 r.p.m and run the machine.

Give slight pressure on the top of the pointer to make the tip touch the work and feel.

If the feel of the contacting pointer tip is uniform, it indicates that the work is turned.

Repeat till a uniform feel is felt.

Finally, tighten the opposite jaws with equal amount of pressure.

Check once again for the trueness by running the work.

Setting of lathe tool in a tool post

Objective: This shall help you to
- **set the tool in the tool post for performing required operation.**

Clean the tool post seating face and place the shims on the seating face.

Use a minimum number of shims for height adjustment

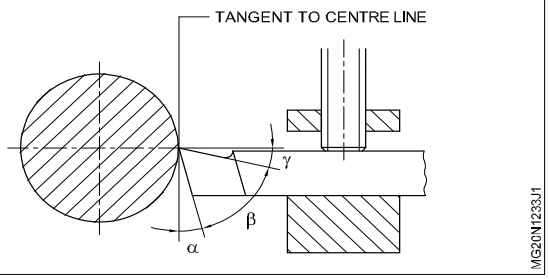
set the tool in the tool post for performing required operation.

Shims must be flushed with the edge of the seating face.

Place the tool in the tool post on the shims.

For optimum cutting, the effective rake angle and clearance angle of the clamped tool must be equal to the ground angles of the tool. This requires clamping of the tool to have its axis perpendicular to the lathe axis with the tool tip at the workpiece centre. (Fig 1)

Fig 1



The overhanging of the turning tool should be minimum. As a rule the over-hanging length of the tool can be 1.5 times of the width of the tool shank. (Fig 2)

Tighten the tool with the centre screw of the tool post.

Check the centre height with a height setting gauge or with the tailstock dead centre. (Fig 3)

The nose of the tool must coincide with the dead centre.

Remove or add shims and check the height when the tool is tightened by the centre screw.

Tighten the other two tool - holding screws alternatively applying the same amount of pressure.

When both the screws have a full gripping pressure, tighten the centre screw fully.

Check once again with a tool height setting gauge.

Fig 2

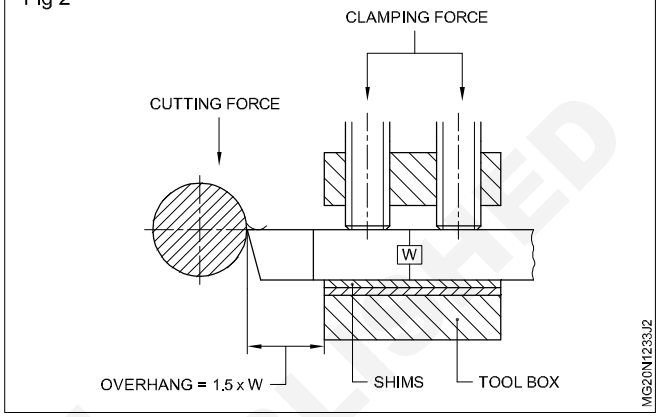
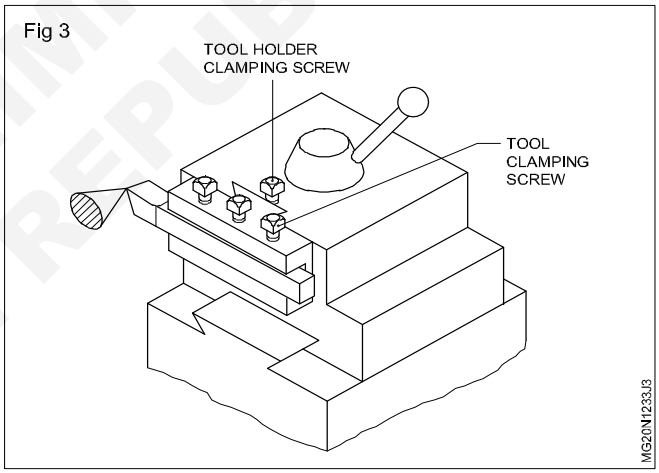


Fig 3

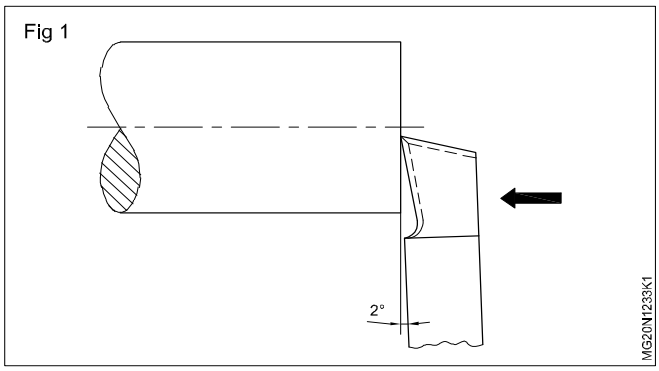


Facing work by hand feed method

Objective: This shall help you to
- **face the work on a lathe**.

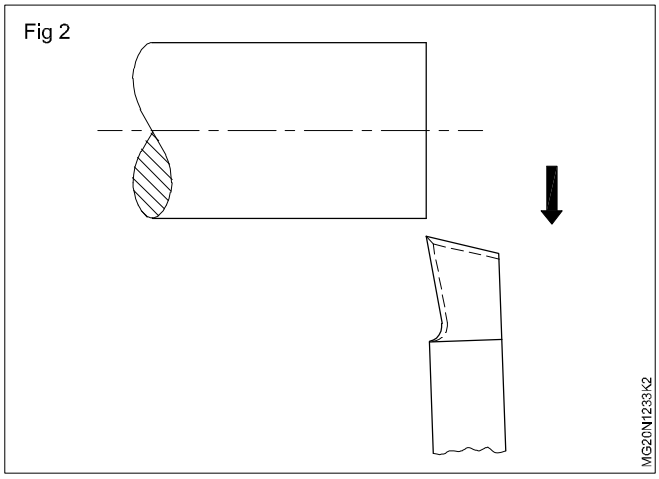
- Facing is the operation of removing excess material at the end or to make the face of the work perpendicular to the lathe axis.
- Hold the tool in the tool post to the correct centre height with a minimum overhang.
- Start the machine spindle.
- Touch the tool point with the work face at about 4 to 8mm from the centre. (Fig. 1)
- Set the top slide graduated collar to zero mark.
- Lock the Carriage.

Fig 1



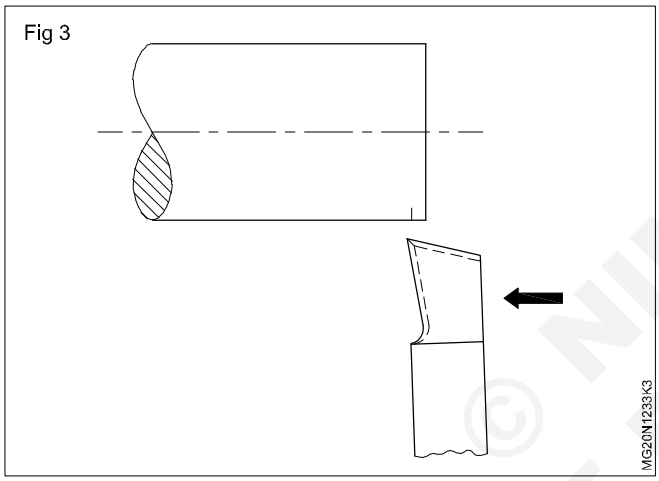
- Gradually move the tool away from the centre by cross feed handle. (Fig 2).

Fig 2



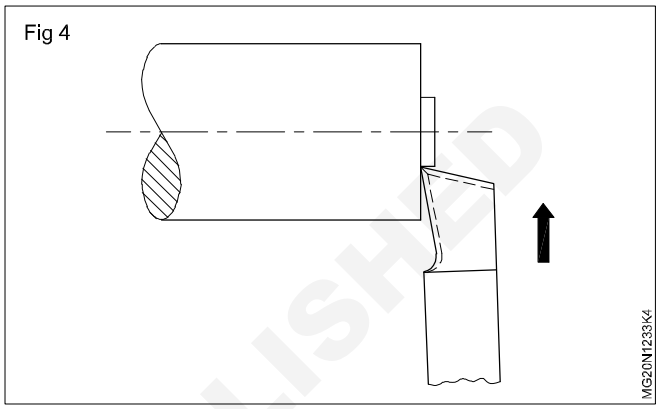
- Give the depth of cut 1.00mm by compound slide. (Fig.3)

Fig 3



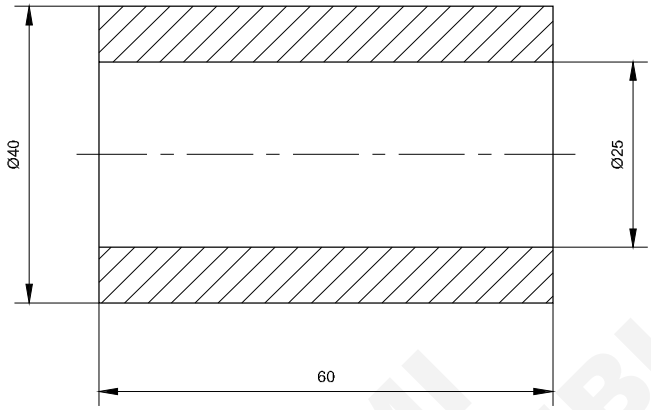
- Feed the tool towards the centre of the work by the cross slide till the tool tip crosses the centre. (Fig. 4)
- With draw the tool and give depth of cut and feed the tool until the entire surface in finished.
- Measure the length of the job
- Refix the job to face the other end to size.
- Repeat the sequence till the required amount of material is removed.
- Check the length of the job using vernier calliper.

Fig 4



Drilling operation on lathe

Objectives : At the end of this exercise you shall be able to
- **set the job on a four jaw chuck**
- **set the tool to the correct centre height**
- **centre drill on a job**
- **drill through hole.**



Job sequence

- Check the raw material size.
- Hold the job in a four jaw independent chuck with 40mm overhang and true it.
- Set the right hand facing tool in the tool post.
- Face one end of the work.
- Fix the drill chuck in the tailstock spindle and fix the centre drill of size A2x6.3 IS : 2473.
- Centre drill the work.
- Turn the outer diameter 40 mm to the length 35mm.
- Drill through hole in the job with ø 10mm drill bit after centre drilling.
- Drill through hole in the job with ø 25 mm drill bit after drilling 10mm.
- Chamfer the drilled hole 1x45° .
- Reverse the job and reset it.
- Face the other end maintain to 60mm length.
- Turn the outer dia 40mm to length 25mm.
- Chamfer the hole 1x45° .

1	ISRO Ø45 - 65	-	Fe 310	-	-	1.2.34
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	DRILLING OPERATION ON LATHE	DEVIATIONS	TIME : 5hrs
		CODE NO. MG20N1234E1	

Skill Sequence

Centre drilling on lathe

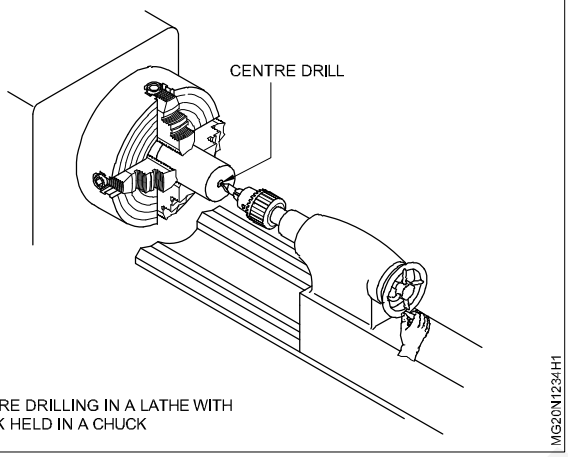
Objective: This shall help you to

- **centre drill the work held in a chuck.**

Round workpieces can be quickly and accurately centre drilled without the necessity of centre punch marks

The procedure to centre drill a work held in a chuck is given below in sequence (Fig).

Fig 1



CENTRE DRILLING IN A LATHE WITH WORK HELD IN A CHUCK

Hold the work in a four-jaw chuck about 50mm outside and true.

Finish face the work with a facing tool.

Ensure no pip is left out in the centre and the face is at right angles to the axis.

Mount the drill chuck in the tail stock spindle.

Remove dirt on the taper shank of the chuck and the tallstock spindle taper bore.

Mount a suitable centre drill securely in the drill chuck.

Set the lathe to about 1000 r.p.m.

Slide the tail stock over the bed untill the centre drill is close to the work face.

Lock the tallstock in the position.

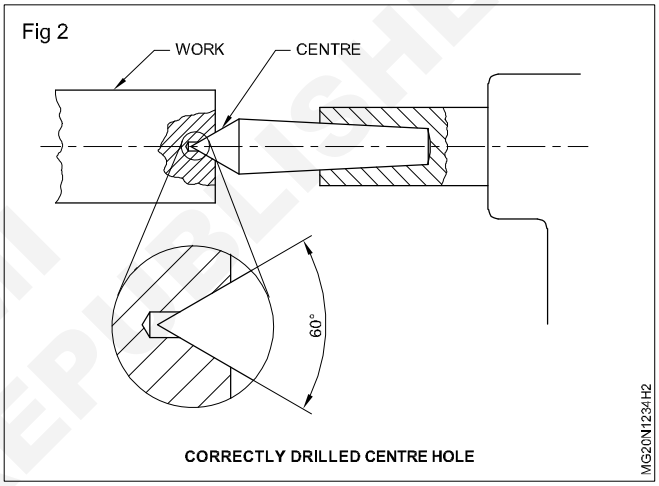
Start the machine and slowly feed the centre drill into work by rotating the tall stock hand wheel.

Withdraw the drill frequently from the workpiece to clean the chips and to apply the cutting fluid.

Continue drilling until about three fourths of the tapered portion of the centre drill has entered the work. (Fig 2).

Ensure that uniform continuous pressure is applied during feeding and no extra force given.

Fig 2

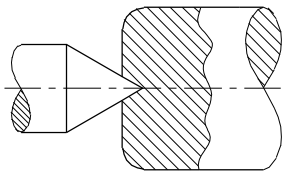
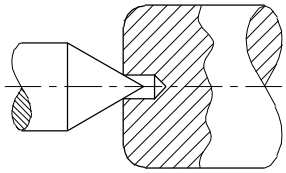
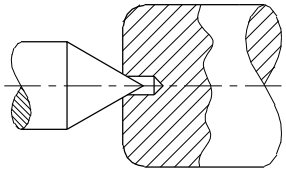
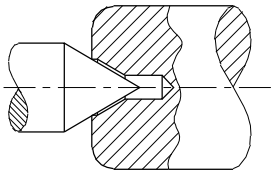
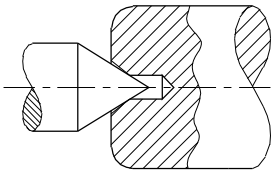
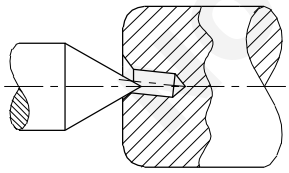


CORRECTLY DRILLED CENTRE HOLE

After drilling to the correct depth, withdraw the tailstock spindle.

When the diameter of the work is more than 150mm with the same amount outside the chuck, and when irregular work is held in the chuck, running the machine at 1000 r.p.m for centre drilling will centre undue load to the spindle. Avoid this method of centre drilling.

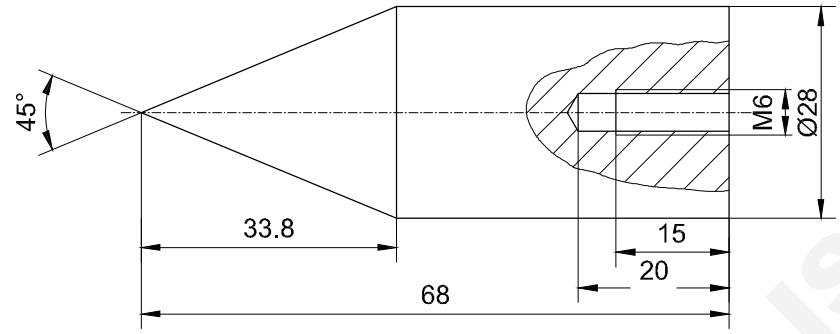
Common errors in centre drilling

Condition of centre hole	Errors	How to avoid and correct the errors
	No clearance for point of centre. Centre hole incomplete. Insufficient bearing surface for lathe centre.	Drill pilot hole. Countersink pilot hole at 60°. Drill centre hole with a centre drill.
	No bearing surface for. lathe centre	Countersink mouth of hole at 60°
	Insufficient bearing surface for lathe centres.	Countersink deeper
	Hole drilled too deep with centre drill. Poor bearing surface.	Face end if the job will allow it. Ream the mouth with a centre reamer.
	Poor bearing surface. Wrong angle.	Countersink hole with a 60° centre drill.
	Centre hole drilled at angle to the axis of work.	Align work squarely when drilling the centre hole. Face end and re-centre.

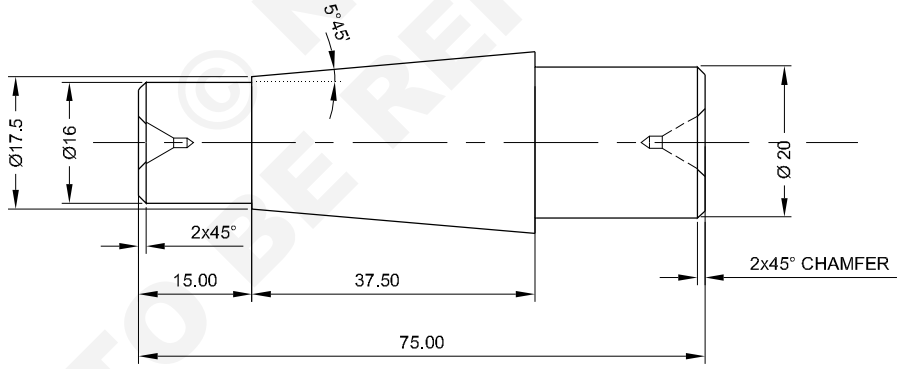
Taper turning using compound rest and taper turning attachment

Objectives : At the end of this exercise you shall be able to
- **turn taper by compound slide swivelling method**
- **turn taper by taper turning attachment.**

TASK-1



TASK-2



1	ISRO Ø30 - 87	–	Fe 310	–	–	1.2.35
1	ISRO Ø32 - 75	–	Fe 310	–	–	1.2.35
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1 : 1	**TAPER TURNING USING COMPOUND REST AND TAPER TURING ATTACHMENT**	Deviation ±0.02	TIME : 5 Hrs
		CODE NO. MG20N1235E1	

Job Sequence

TASK 1**: Taper turning by compound slide swivelling**

- Check the raw material size of the job
- Hold the job in the chuck, projection more than 35mm and true it.
- Hold the job and face at one end
- Make centre drill.
- Make 6mm tap drill to the depth of 20mm.
- Using M6 tap set and wrench, tap the job for 15mm depth.
- Remove the burrs on the tapped portion.
- Reverse and hold the job in the chuck by using soft packing pieces (Aluminium) under the jaws.
- Face the job and maintain the total length 68mm.
- Set the angle in the compound rest for 45°
- Turn the taper by feeding the tool with the help of the top slide.
- Deburr the job and do final checking.
- Use the tap in an orderly manner.
- Use cutting oil while tapping.
- Clear the chip by reversing tap frequently.

— — — — — — —

TASK 2: **External taper by using taper turning attachment**

- Check the raw material size
- Hold the material in 4 jaw chuck and true it.
- Face one end and make centre drill.
- Turn Ø 20 to a length of 22.5mm.
- Chamfer the end to 1 x 45°
- Reverse the work & clamp in the jaw.
- Ensure that the total length remains 75mm.
- Makee a centre drill to hold the job between centres.
- Turn a step 16mm to a length of 15mm.
- Set the angle to turn external taper by taper turning attachment method.
- Use the formula to findout the angle tan $\frac{\varnothing}{2} = \frac{D - d}{2\,l}$

  where l = 37.5mm

Turn the taper as per drawing

Safety

- Remove the sharp corners
- Use coolant while centre drilling and taper turning

— — — — — —

Skill sequence

Turning taper by compound slide swivelling

Objectives: This shall help you to
• turn the taper using a compound slide
• check the taper with a vernier bevel protractor.

One of the methods of turning taper is by swivelling the compound slide and feeding the tool at an angle to the axis of the work by hand feed. (Fig 1)

The procedure in sequence is as follows

Set and true the job turned to the bigger diameter of taper.

Set the machine to the required rpm.

Loosen the top slide clamping nuts.

Swivel the top slide to half the included angle of the taper as shown in Fig.2.

> **Ensure that equal pressure is exerted by the spanner for both the nuts.**
>
> **Fix the turning tool in the tool post to the correct centre height.**
>
> **Keep a minimum overhang of the tool.**
>
> **Position the top slide to cover the length of the taper turning**

As far as possible ensure that the top slide do not go beyond the edge of the base

Lock the carriage in position.

Touch the tool to the work - surface during running and set

the cross-slide graduated collar to zero.

Bring the tool to clear off the work by the top slide hand

wheel movement.

Give a depth of cut by the cross-slide and feed the tool by

the top slide hand wheel till the tool clears from the work.

> **Feeding by the top slide must be uniform and continuous.**

Give successive cuts by the cross-slide and feed the top slide each time.

Check the angle of the turned job with a verner bevel protractor.

Adjust the swivel if there is any difference.

Continue the taper turning and finish the taper.

Fig 1

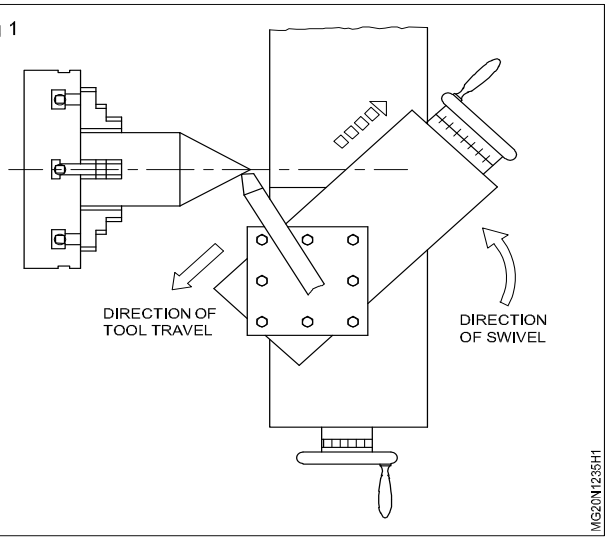
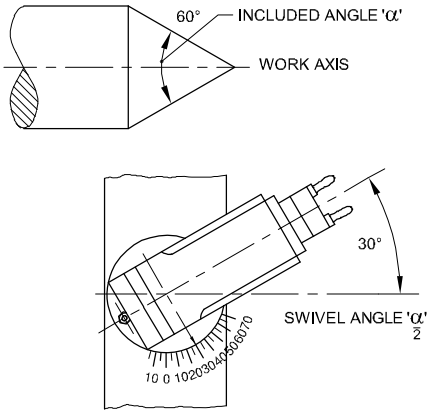
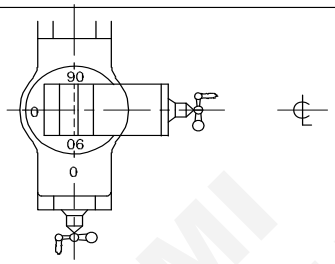
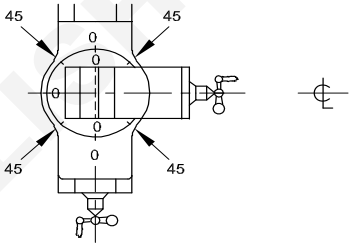
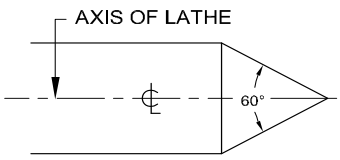
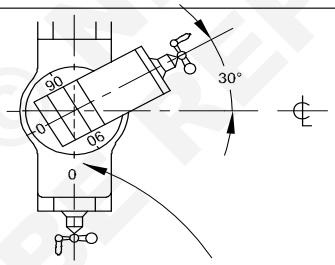
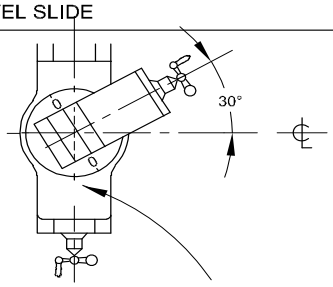
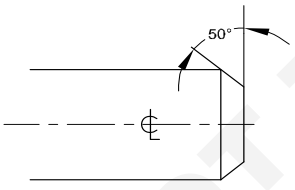
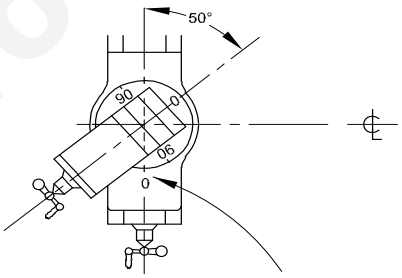
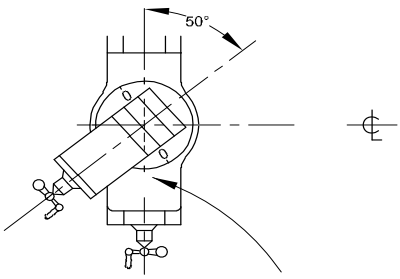
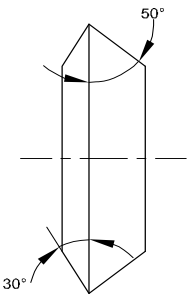
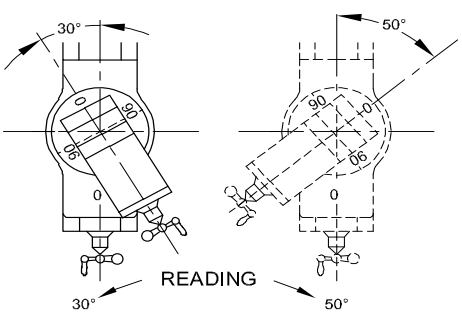
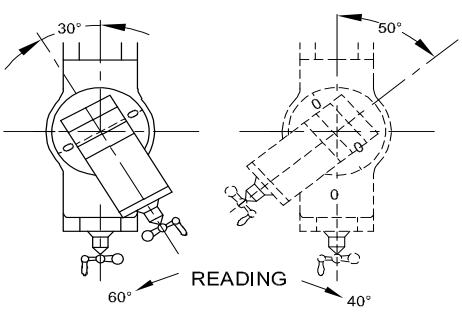


Fig 2

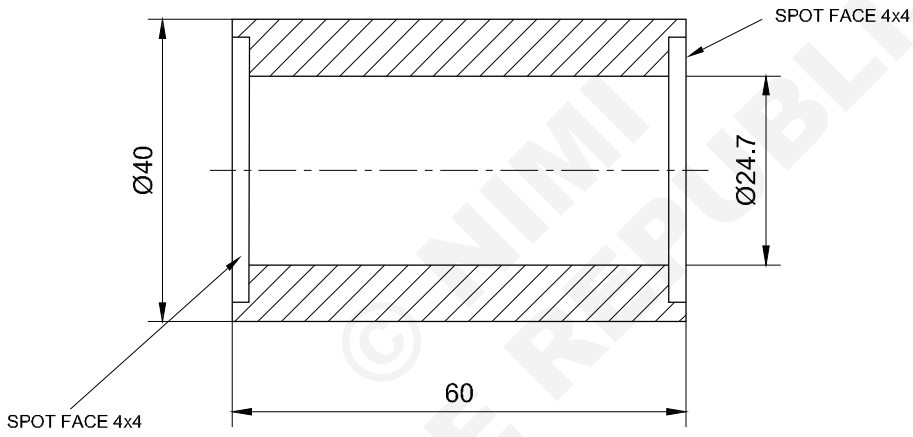


	ARRANGEMENT OF GRADUATIONS ON SWIVEL SLIDE	
SPECIAL ANGULAR SETTING ON COMPOUND REST	 GRADUATED FROM 90-0-90	 GRADUATED FROM 0-45-0
EXAMPLES	READINGS ON GRADUATED SWIVEL SLIDE	
 INCLUDED ANGLE MEASURED IN HORIZONTAL PLANE	 READING ON SCALE 60°	 READING ON SCALE 30°
 ANGLE GIVEN FROM A LINE AT 90° TO AXIS OF LATHE	 READING ON SCALE 50°	
	 READING	 READING

Boring operation on lathe

Objectives : At the end of this exercise you shall be able to

- **drill through hole**
- **bore a hole to an accuracy of ± 0.04 mm with boring tool**
- **measure the bore by using a vernier caliper**
- **spot face the end of bored hole.**



1	ISRO Ø45 - 65	–	Fe 310	–	–	1.2.36
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	BORING OPERATION BY LATHE	TOLERANCE : ± 0.04mm	TIME : 11Hrs
		CODE NO. MG20N1236E1	

Job Sequence

- Check the raw material for its size.
- Hold the job in a 4 jaw chuck and true it, keeping about 45mm outside the chuck.
- Set the facing tool to the correct centre height.
- Select and set the correct spindle speed, for facing.
- Face one side first, and turn the outer diameter to ∅40 mm for the maximum possible length.
- Centre drill.
- Select the required size of drills including the pilot drill.
- Hold the drill in the tailstock spindle with the help of suitable sleeves after cleaning.
- Select the spindle speed for drilling the pilot hole of 12mm dia.
- Bring the tailstock to a convenient position for drilling, and lock the tailstock on the bed.
- Run the lathe and advance the drill, so that it does the drilling operation on the job held in the chuck.
- Use coolant while drilling and advance the drill slowly.
- Enlarge ∅12 mm hole to ∅20 mm hole by drilling at a reduced spindle speed.
- Set the boring tool in the tool post to the centre height and bore the drilled hole to ∅24.7 mm through.
- Check the bore with vernier caliper.
- Make spot face 4x4 mm by boring tool
- After completion of drilling throughout the job reverse and true the job; face to the required length as per drawing, and turn outer dia ∅40mm.
- Make spot face by boring tool 4x4 mm

Safety precautions

- Select proper spindle speeds as per size and operation.
- Use pilot drill while drilling more than 20mm drill size.
- Feed the drill slowly while drilling.
- Use coolant while drilling.

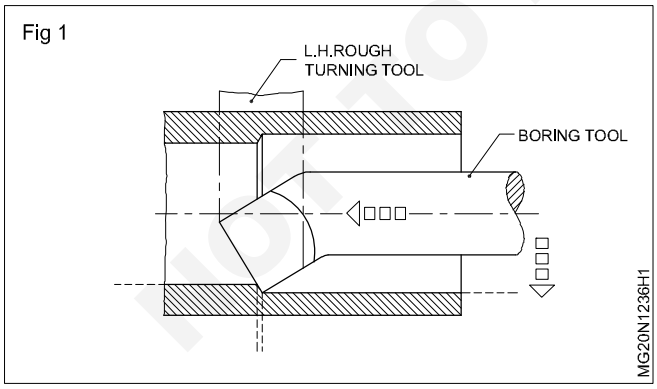
Skill Sequence

Boring a drilled hole

Objectives: This shall help you to
- **set the boring tool in the tool post**
- **bore the drilled hole to the required size**
- **check the hole with the help of a vernier caliper.**

Boring is an internal operation of enlarging a hole with the help of a single point cutting tool. (Fig 1)

Fig 1



To bore the hole the following procedure is to be followed.

Mount the workpiece in a four jaw chuck. True the face of the work and the outer diameter.

Set the lathe to the proper spindle speed for boring.

Mount the boring tool on the tool post of the compound rest.

Fix the boring tool, level and parallel to the centre line of the lathe.

Grip the boring tool as short as possible to reduce chatter.

Use the largest diameter boring tool which can be accommodated in the drilled hole. (Approximately 2/3rd size of the bore)

Set the cutting edge of the cutting tool just slightly above the centre line, since there is tendency for the tool to spring downwards when cutting.

Choose a proper feed for rough boring.

The speed for boring is the same as that for turning and is calculated for the diameter of the bore.

Start the machine and turn the cross-slide handle anticlockwise until the cutting tool touches the inside surface of the hole. (Fig 2)

Take a light trail cut about 0.2 mm deep and about 8 mm long at the right hand end of the work. (Fig 3)

Stop the machine and measure the diameter using a telescopic gauge or inside caliper. (Fig.4)

Fig 2

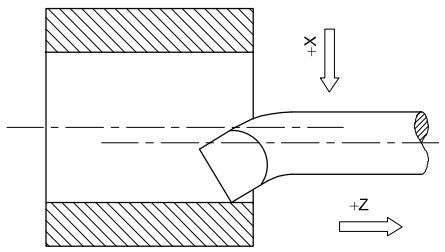


Fig 3

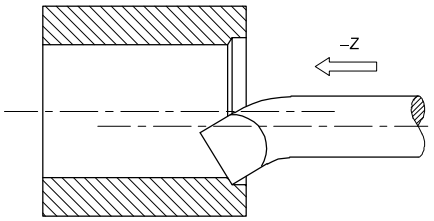
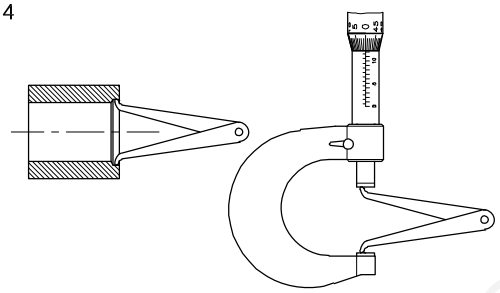


Fig 4

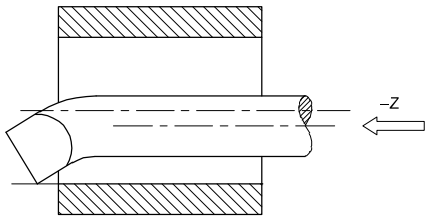


Calculate the amount of material to be removed from the hole for the roughing cut.

Leave about 0.5 mm undersize for a finish cut.

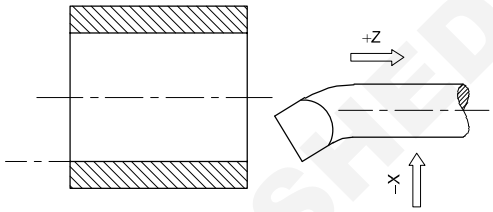
Take a roughing cut for the required length. (Fig 5)

Fig 5



Keep the machine and move the carriage to the right until the boring tool clears the hole. (Fig 6)

Fig 6



Set a fine feed of about 0.1 mm for the finish cut.

Set the cutting tool for the required depth to get the finished bore size.

Use the cross-slide graduated collar.

Finish the boring operation and measure with a vernier caliper.

To avoid bell mouth, repeat the same cut.

Several cuts taken without adjusting the depth of cut would correct bell mounting.

Remove the sharp corners.

Inside caliper & outside micrometer used for bore measurement

Objective: This shall help you to

- **take the measurement of a bored hole with an inside caliper, transfer it to an outside micrometer and read the measurement.**

Bores are checked for their dimensional accuracy by using:

- Inside micrometers.
- Universal vernier calipers.
- Inside calipers and outside micrometers (transfer measurement).
- Telescopic gauges and outside micrometers (transfer measurement).

The first two methods give direct reading whereas the 3rd and 4th are by transfer measurement.

For checking the bore diameters using inside calipers and outside micrometers the following sequence is to be followed.

Select the inside caliper according to the size of the bore to be measured.

Select an outside micrometer of suitable range for the size of the hole.

Open the legs of the inside caliper approximately permitting its entrance into the hole.

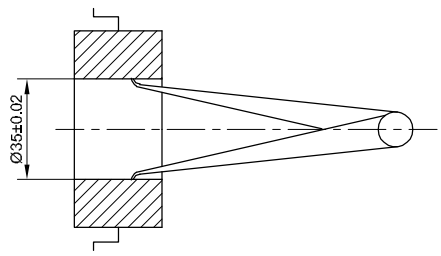
Position one leg in contact with the bottom of the bore.

Keeping this as the fulcrum, oscillate the other leg in the bore.

Adjust the distance between the legs by gentle tapping to increase or to decrease so as to enable the leg to enter.

Rock the inside caliper with respect to the axis of the work so as to make the leg of the inside caliper contact the bore top surface. (Fig 1)

Fig 1



MG20N1236J1

If the 'feel' is hard, reduce the distance between the leg tips and if the feel is less or if there is no feel, increase the distance between the leg tips slightly.

Check once again and repeat till you get the correct feel.

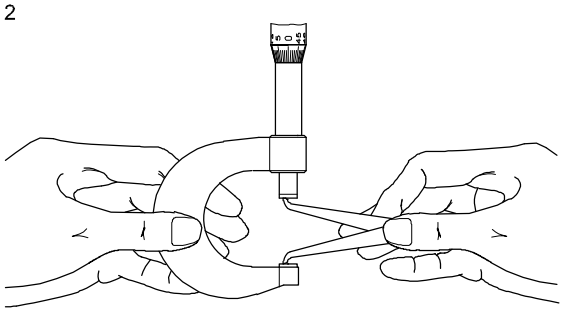
Ensure that the position of the legs is not disturbed, once the correct feel is obtained.

Hold the outside micrometer in one hand, and the spindle away from the anvil face, a little more than the distance between the two legs of the inside caliper.

Hold the inside caliper with the other hand, contacting the tip of one leg with the anvil face of the micrometer.

Oscillate the other leg and rotate the thimble of the outside micrometer to contact the tip of the oscillating leg of the inside caliper. (Fig 2)

Fig 2



MG20N1236J2

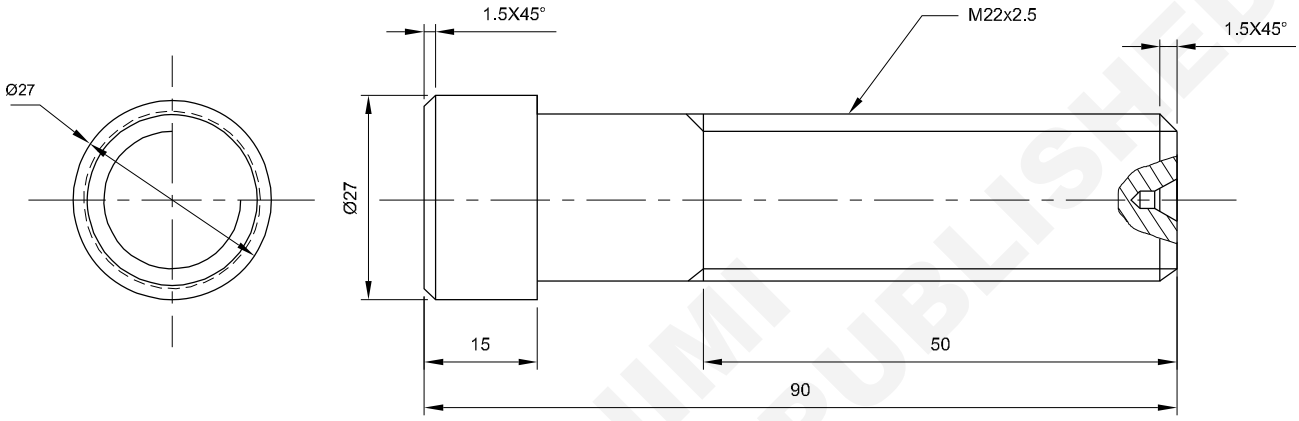
Ensure you get the same 'feel' as before.

Note the readings on the barrel and thimble of the outside micrometer, and determine the size of the measurement.

The accuracy depends on the skill. Practice to get the correct feel for the measurement.

Simple external screw cutting

Objectives: At the end of this exercise you shall be able to
- **hold the job in lathe machine**
- **turn and chamfer as per drawing**
- **grind threading tool to cut metric thread on lathe**
- **cut metric thread on lathe by single point tool**
- **check the metric thread using thread ring gauge.**



Job Sequence

- Check the raw material size.
- Hold the job in the chuck with 40 mm overhang and true it.
- Face end and turn to ∅ 27 mm to maximum length possible.
- Chamfer 1.5×45° at the end.
- Reverse and hold the job in the chuck with 75 mm overhang, face and centre drill.
- Chamfer 1.5×45° at the end.
- Turn the job to ∅ 22 mm to length of 75 mm.
- Chamfer 1 x 45° at the end.
- Set the metric 'V' threading tool in the tool post and with the help of centre gauge, set threading tool perpendicular to the axis.
- Set the machine for 2.5 mm pitch to cut right hand thread.
- Set across slide graduation collar to size.
- Move the tail stock with revolving centre close to the job and support the job in centre drilled portion
- Cut right hand metric 'V' thread, giving depth of cut by the cross slide for successive cuts.
- Withdraw the tool at the end of each cut by the cross slide. Again advance to zero before giving depth of cut by the cross slide.
- Rough and finish the thread and check with a thread by ring gauge.

1	Ø30 - 100	–	Fe 310	–	–	1.2.37
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SIMPLE EXTERNAL SCREW CUTTING				TOLERANCE : ± 0.04mm	TIME :15Hrs
					CODE NO. MG20N1237E1	

Skill Sequence

Chamfering on lathe

Objective: This shall help you to
- **chamfer the end to required size.**

Grind the tool to the given angle usually 45°.

Mount the tool and set centre height properly.

Set the speed, lock the carriage.

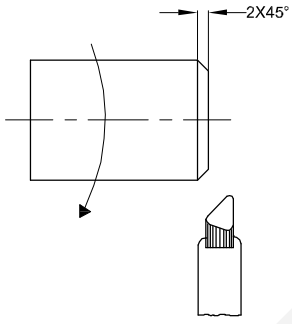
Move cross slide and plunge the tool to the required size.

Check the length of chamfer by vernier caliper.

If the protruding length is greater, support with centre.

Make sure the tool is perpendicular to the lathe axis.

Fig 1



MG20N1237H1

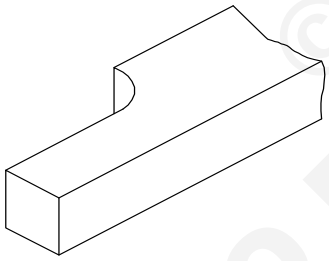
Grinding 60° threading tool

Objective: This shall help you to
- **grind 60° threading tool.**

Set the pedestal grinder for tool grinding.

Remove excess material on right hand side of the tool to length equal to thickness of tool and width being half of the thickness of tool on rough grinding wheel. (Fig 1)

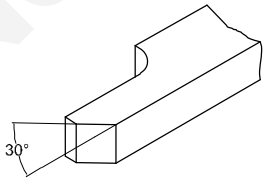
Fig 1



MG20N1237J1

Hold the tool at an angle of 60° to the face of the wheel, grind 30° on left hand side of the tool. (Fig.2)

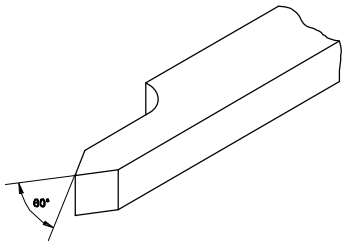
Fig 2



MG20N1237J2

Repeat the above procedure on the right side of the tool to get an included angle of 60° on the tool. (Fig.3)

Fig 3



MG20N1237J3

Grind 6° to 8° side clearance angle on each side of the tool.

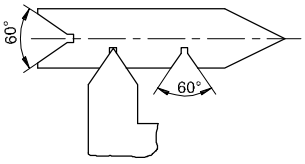
Grind 4° to 6° front clearance angle.

Finish all slides by using smooth grinding wheel.

Do not Grind Rake Angle

Check the tool by centre gauge, there light should not pass through gauge and cutting edge of the tool. (Fig.4)

Fig 4



MG20N1237J4

Cutting point is curved to 0.14 × pitch by carefully grinding in smooth wheel.

Finally Lap the tool by applying oil stone on cutting edges.

Safety precautions

Ensure grinding wheels are properly guarded.

Keep 2 mm gap between tool rest and grinding wheel face.

Ensure cutting edge is visible to the operator while grinding.

Do not give too much pressure on the wheel face.

Frequently cool the tool in coolant.

Cutting 'V' thread by plunge cut method

Objective: This shall help you to
- **cut 'V' thread using a single point tool on a lathe by the plunge cut method.**

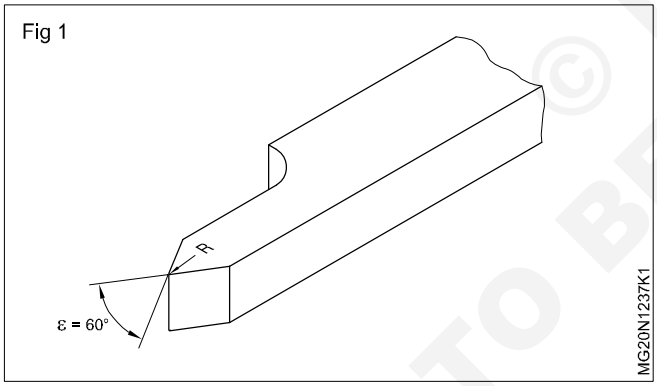
Thread has coarse and fine pitches according to their usage. Standard fine pitch threads, both external and internal, are generally cut by using taps and dies. When they are produced in large quantities, different methods are adopted on different machine tools. However, at times, it may be necessary to cut threads by a single point tool on a centre lathe.

The plunge cut method of threading by a single point tool is done by plunging the tool into the work to produce the thread form. The tip of the tool, as well as, the two flanks of the tool will remove metal during thread cutting and hence the load on the tool will be more. As the possibility of obtaining a good finish on the thread is limited, this method is applicable to fine pitch thread cutting.

The following is the procedural sequence in cutting the 'V' thread by the plunge cut.

Grind a 'V' thread tool for the required thread angle. (Fig 1)

Fig 1



Ensure that the thread angle ground is symmetrical with respect to the axis of the tool.

Arrange the change gear train and set the quick change gearbox levers for the required pitch and hand of thread.

Clamp the tool in the tool-post and set the tool to centre height.

Set the tool perpendicular to the lathe axis by using centre gauge. (Fig 2)

Ensure that the top slide is set at 0°, and slackness is removed by gib adjustment.

Set the machine to about 1/3rd of the rough turning r.p.m.

Start the machine and touch the tip to work. (Fig 3) set the cross-slide and the compound slide graduated collars to zero, eliminating backlash.

Fig 2

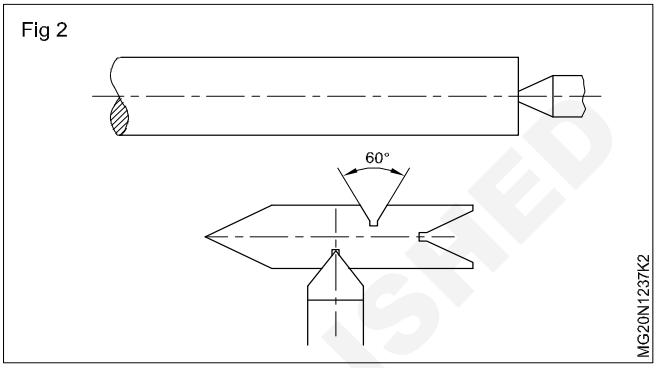
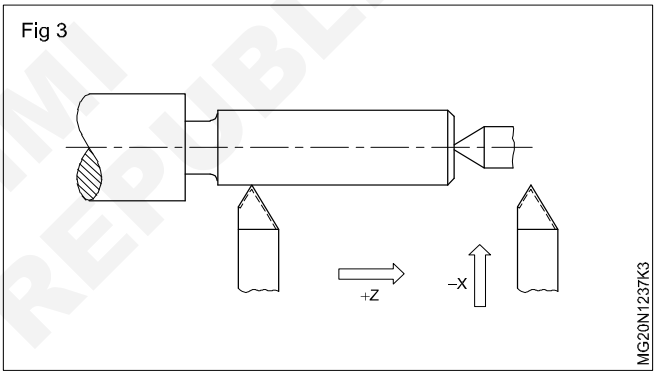


Fig 3



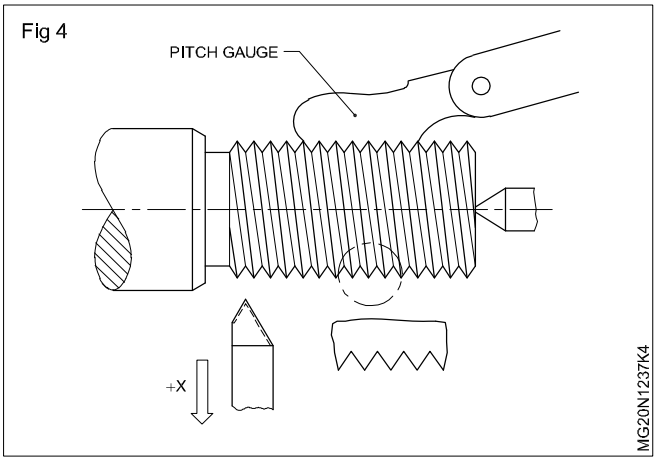
Bring the tool to the starting point and engage the half nut.

Allow the tool to take the trial cut, the depth being given 0.05 mm divisions of the cross-slide graduated collar.

Withdraw the tool at the end of the cut and stop the machine. (Fig 4)

Check with the screw pitch gauge to confirm the gear box setting. (Fig 4)

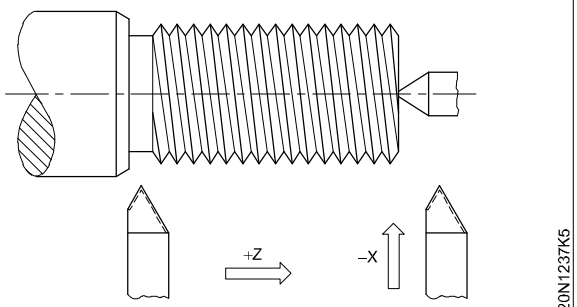
Fig 4



Reverse the machine to bring the carriage to the starting point. (Fig 5)

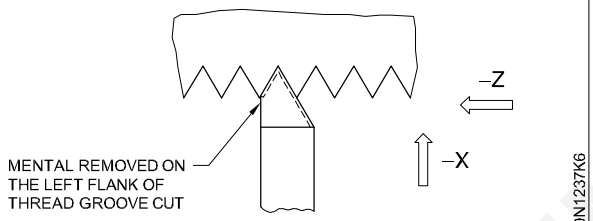
Give successive cuts.

Fig 5



For every 3 depths of cuts by the cross-slide, give one axial cut by feeding the tool axially by half division of the compound slide. This relieves the load on the tool. (Fig 6)

Fig 6

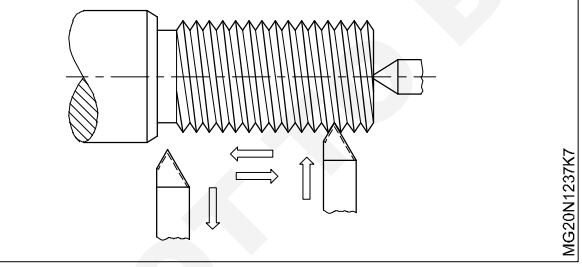


Continue the sequence till the thread profile is formed. (Fig 7)

Check with the screw pitch gauge for the thread form.

Match the mating component to ensure the class of fit.

Fig 7



If the tool is not set square to the axis of the work, the gauge will not match with the thread. (Fig 8)

In the plunge cut method of thread cutting with a single point tool on a lathe, the accuracy of the thread is greatly influenced by:

- The correctness of the tool profile.
- The accuracy with which the tool is set square to the axis of the work.
- The number of plunge cuts (depth of cut) given
- The relative number of side cuts (preferably on both flanks) given.

Effect of grinding positive back rake angle of 'V' thread tool and threads cut. (Figs 9 & 10)

Fig 8

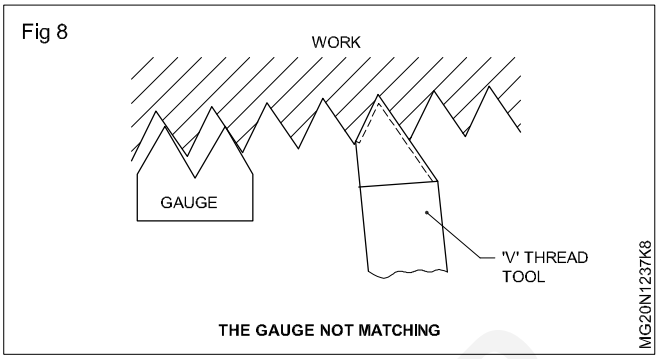


Fig 9

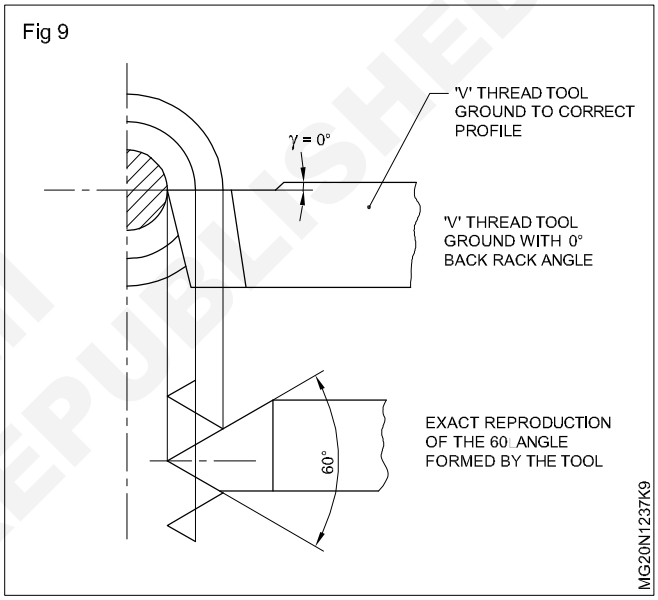
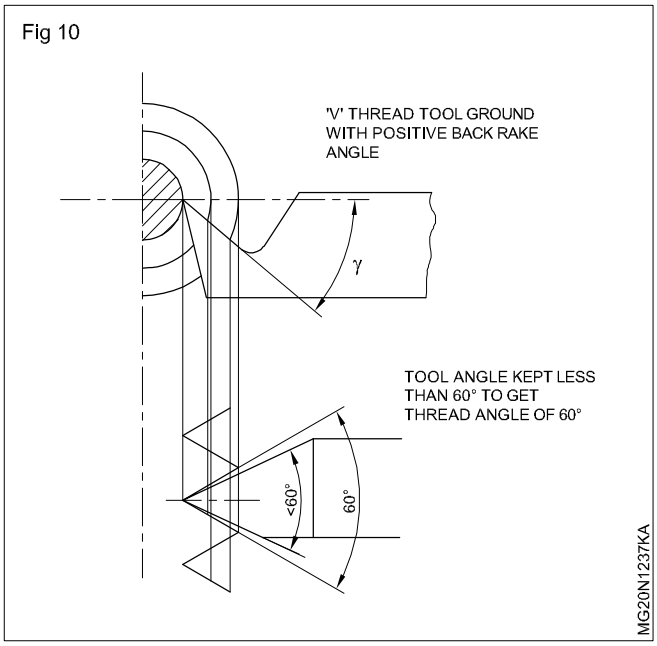
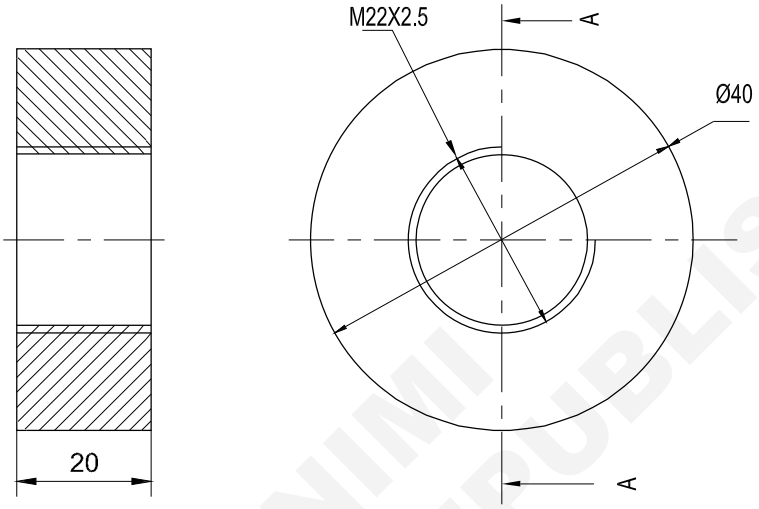


Fig 10



Simple internal screw cutting

Objectives: At the end of this exercise you shall be able to
- **cut internal 'V' thread by single point threading tool**
- **check the metric thread using thread plug gauge**
- **match the nut and bolt.**



SECTION - AA

Job Sequence

- Check the given material for its size by steel rule.
- Hold the work in a three jaw chuck about 10 mm inside the chuck.
- Turn the outer dia to 40 mm to possible length.
- Chamfer the edge 1x45° by chamfering tool.
- Centre drill, and drill a pilot of ∅ 10 mm through hole.
- Enlarge the drilled hole dia 10 mm ∅ 18 mm by drilling.
- Bore the drilled hole to the core (root) diameter of the thread i.e.19.5 mm.
- Set the machine to cut 2.5 mm pitch internal thread.
- Cut the internal thread.
- Check the thread with screw pitch gauge.
- Check the thread with external thread mating parts Ex.37
- Reverse and hold the work on ∅ 40 mm and true it.
- Face the end of the work, and maintain a total length of 20 mm.
- Chamfer 1x45° on the outer edge.
- Remove the sharp edges and have a final check.

1	ISRO Ø45 - 25	–	Fe310	–	–	1.2.38
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SIMPLE INTERNAL SCREW CUTTING				ACCURACY ±0.04mm	TIME :15Hrs
					CODE NO. MG20N1238E1	

Skill Sequence

Cutting an internal thread

Objective: This shall help you to
- **cut an internal thread on a centre lathe.**

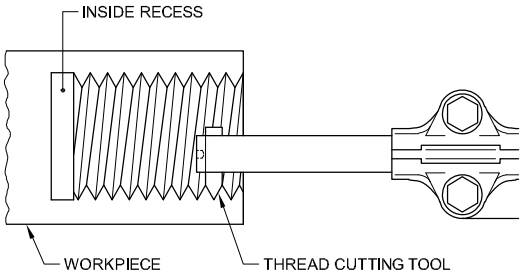
Mount the job on four jaw chuck / three jaw chuck/ collet.

Drill and bore the job to the core diameter of the thread to required length/ through hole.

For a blind hole, cut a recess at the end of the bore enough to permit the cutting tool to clear thread.

The recess must be larger than the major diameter of the thread. (Fig 1)

Fig 1

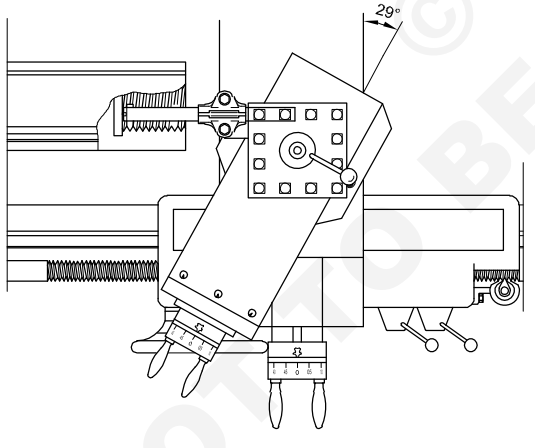


CUTTING AN INTERNAL THREAD

Chamfer the front end to 2×45°.

Set the compound rest at 29° to cut 60° included angle as shown in Fig 2.

Fig 2



COMPOUND REST SET AT 29° TO THE LEFT TO CUT A 60° INCLUDED ANGLE INTERNAL THREAD

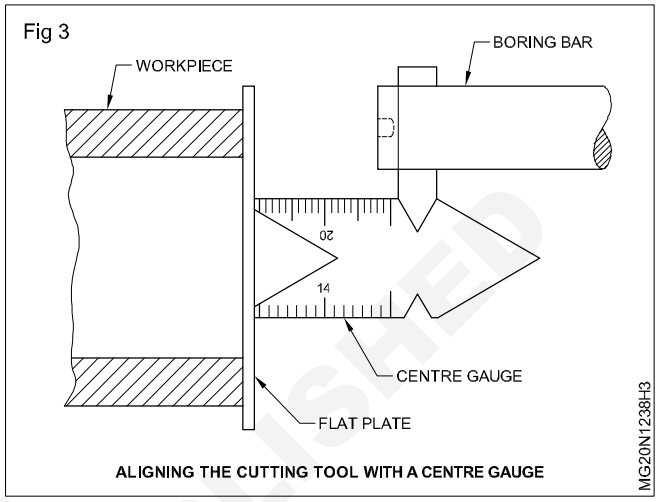
Set the gear box levers to the required pitch.

Fix the correctly ground threading tool in a boring bar.

Fix the boring bar parallel to the lathe centre line and set the point of the cutting tool to lie on the centre.

Align the cutting tool with a help of centre gauge as shown in Fig 3.

Fig 3



ALIGNING THE CUTTING TOOL WITH A CENTRE GAUGE

Mark the boring bar to indicate the required depth of entry into the bore.

Ensure that the boring bar does not foul anywhere on the job.

Reverse the cross slide until the tool point just touches the bore.

Set the cross-slide and compound slide graduated collars to zero.

Withdraw the cutting tool from the bore.

Set the spindle speed to 1/3 of the calculated r.p.m.

Start the machine.

Adjust the depth of cut to 0.1 mm.

Engage the half nut.

At the end of the cut, simultaneously reverse the chuck and clear the tool just away from the thread.

Ensure that the tool should not touch the thread in both side of the bore.

When cutting tool comes out of the bore stop the machine.

Give the depth of cut and run the machine in forward direction. Similarly finish the thread until final depth is achieved.

Check the finished thread with a thread plug gauge or a threaded bolt.

Set grinding wheel on wheel flange, truing and balancing of wheel

Objectives : At the end of this exercise you shall be able to
- **mount the flange in grinding wheel**
- **truing the grinding wheel**
- **balancing the grinding wheel.**

PROCEDURE

TASK 1: **Mounting the flange in grinding wheel**

Cleaning and inspection of the flange

1 Make sure that every part, e.g., balancing pieces has been already prepared.

2 Clean all the parts of the flange assembly.

3 If a flange surface is rusted, the rusted part should be removed away by an oil stone.

4 If there is a bruise on the surface of the flange or the inside of the taper, it should be amended by an oil stone or a scraper.

Insert the grinding wheel into the flange (Fig 1)

1 Make sure that labels are stuck on both sides of the grinding wheel.

2 Do not insert the grinding wheel into the flange with excessive force.

3 If abrasive grains comes out in the hole of the grinding wheel, they should be removed with a grinding stick, in order to have smooth fitting.

4 In between the flange and grinding wheel washers are placed. Washers are made up of card board, leather, rubber etc. thickness about 1.5mm.

Insert the outer flange

1 Insert the outer flange without touching the inner flange.

2 Make sure that the holes are rightly placed.

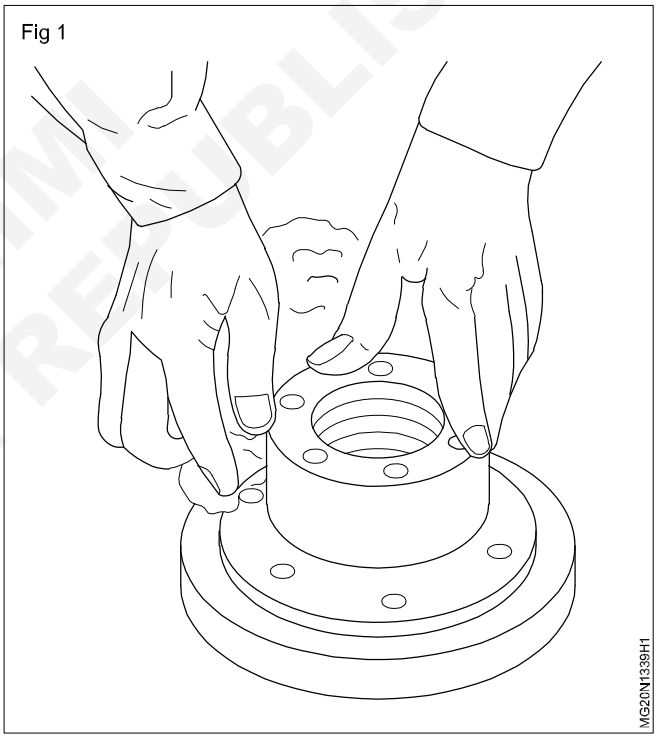
Turning of the outer flange

1 Make sure that the other flange can be smoothly rotated.

2 Fix all the screws / bolts and tighten properly.

After mounting flange in the grinding wheel place the grinding wheel in balancing stand and balance it.

Fig 1



— — — — — —

TASK 2: **True the grinding wheel**

Clean the grinding machine table

Select and hold the dresser in proper holder.

Mount the holder with dresser in finding machine table (Fig 1).

Start the wheel head and allow it to run, for the machine to attain normal working temperature.

Dress the wheel on the periphery. (Fig 2)

Dress the sides if the wheel diameter exceeds 250mm. Apply a small in-feed of the diamond until eccentricity of the wheel is removed. (Fig 3)

Stop the machine.

Fig 1

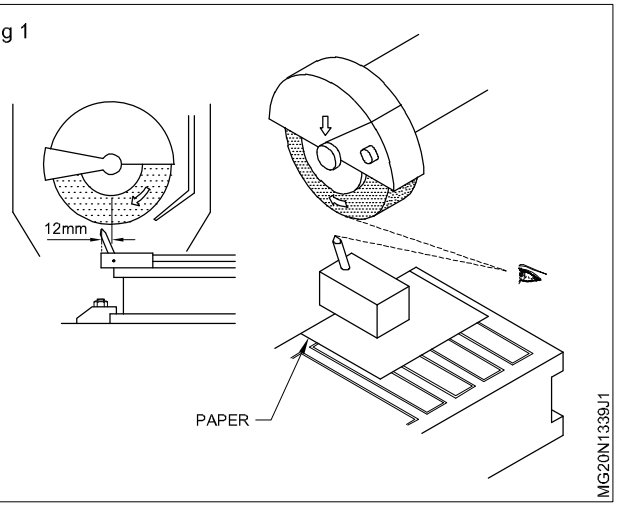
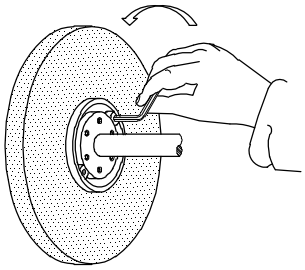


Fig 2

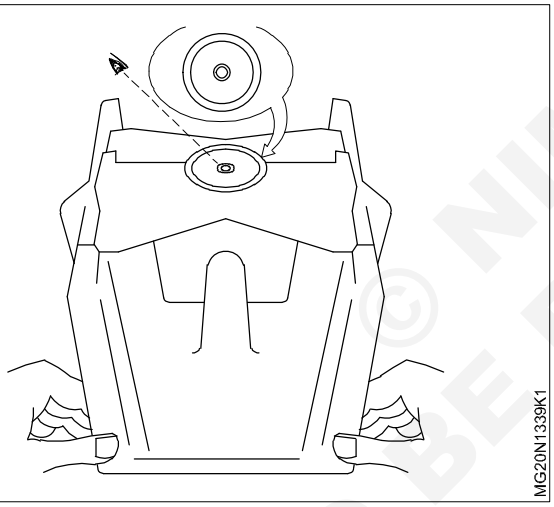


TASK 3: **Balancing a grinding wheel**

1 Mount the wheel on the machine.

2 Remove the balance weight. (Fig.1)

Fig 1



3 Clean the internal and external cones.

4 Place the wheel unit on the spindle nose and tighten the lock-nut.

5 Replace the wheel guard.

6 Remove the wheel guard and lock - nut.

7 Screw on the collet extractor and remove the wheel assembly.

Use both hands when removing the wheel assembly. Take care not to knock on any machine part to prevent damage to the wheel.

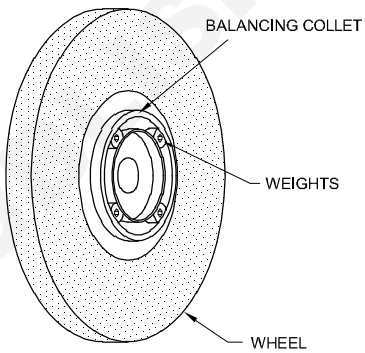
Preparing the balancing unit

Lower the protection guards.

Place the levelling plate on the balancing stand. (Fig. 2)

Adjust the unit, using two knurled screws on the base until the bubble in the levelling plate is concentric with the circle engraved on the glass.

Fig 2

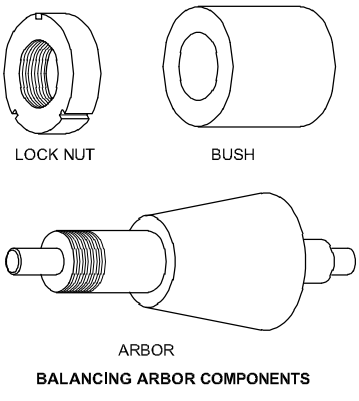


GRINDING WHEEL MOUNTED ON A BALANCING COLLET

Positioning wheel on unit

Clean the bore of the unit (Fig.5) and the balancing mandrel, then mount the wheel assembly on the mandrel. (Fig.3)

Fig 3



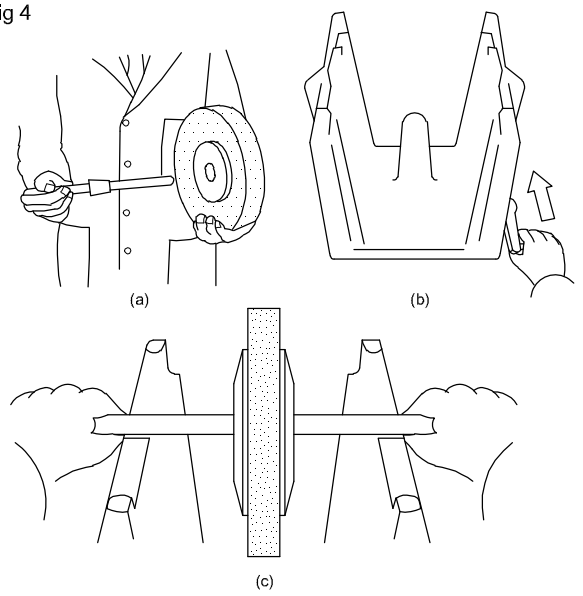
BALANCING ARBOR COMPONENTS

Tighten the nut on the mandrel. (Fig. 4a)

Raise the protection guards. (Fig. 4b)

Place the wheel to be balanced on the top of the protection slides and lower gently on to the balancing stand. (Fig. 4c)

Fig 4



Balancing the wheel

Visually ensure that the balancing mandrel is at right angles to the balancing ways. (Fig. 5a)

Allow the wheel to revolve slowly by its own momentum until stationary.

Place a chalk mark at the bottom to indicate a heavy point. (Fig. 5b)

Turn the wheel 90° to the heavy point and diametrically opposite. (Fig. 5C & D)

If the wheel finds the heavy points quickly, the balancing weights could be moved approximately 180°. (This indicates that the wheel is considerably out of balance) Move the weights equally towards the lighter side, approximately 3mm at a time. (Fig. 9)

Repeat until the assembly remains static in any position. (Fig.6)

Remount the assembly on to the wheel head, replace the guard and re-dress the wheel before putting it into further operation.

Fig 5

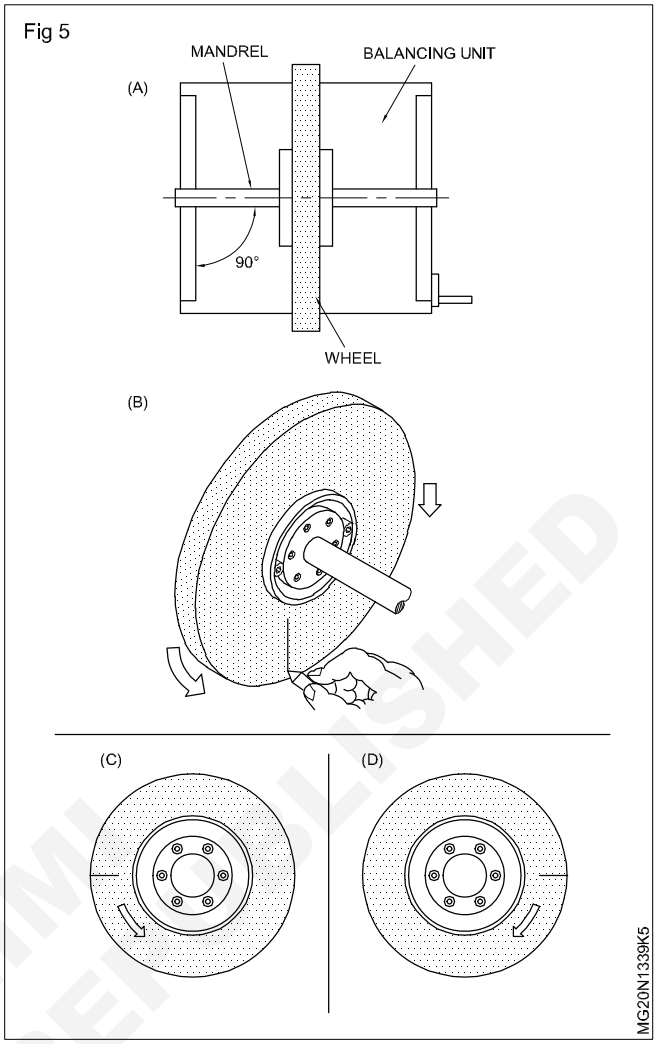
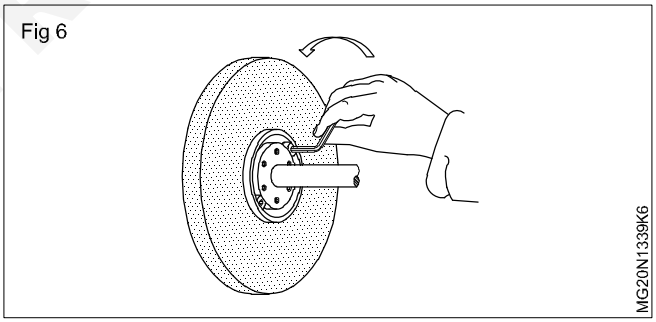


Fig 6

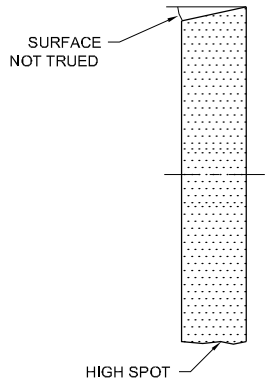


Dressing of grinding wheel

Objectives: At the end of this exercise you shall be able to
- **set the grinding wheel**
- **mount the holder with dresser.**

This operation is done after mounting the grinding wheel for removing any high spots on the face of the wheel with a diamond dresser. (Fig 1).

Fig 1



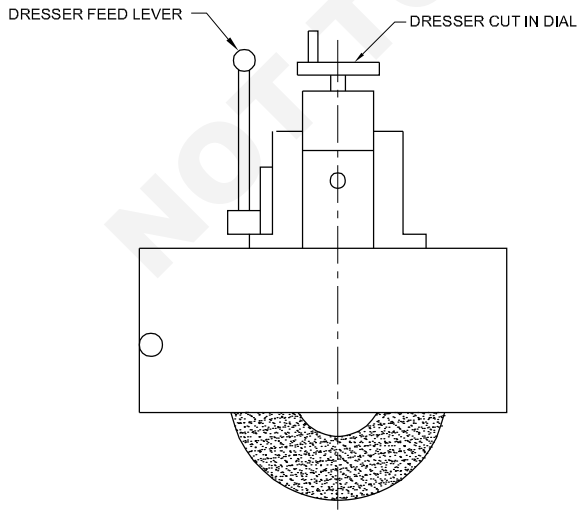
The high spots are removed for uniform contact of the wheel over the job. Otherwise only the high spots on the wheel will contact the surface resulting in poor surface finish.

Dressing is the operation of removing dull grains and metal particles from the cutting surface of a grinding wheel. This operation exposes sharp cutting edges of the abrasive grains to make the wheel cut better.

They are two method of dressing a grinding wheel for the surface grinder.

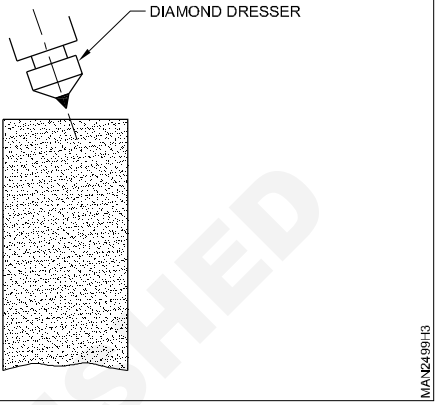
- Dressing of grinding wheel by grinding head dresser. (Fig.2)

Fig 2



- Dressing of grinding wheel by attached to holder. (Fig.3)

Fig 3



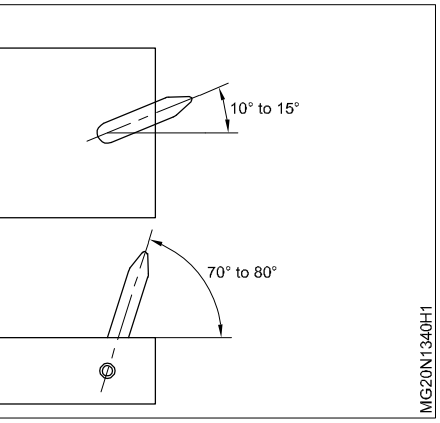
Dressing grinding wheel by grinding head dresser

- Start the motors for the grinding spindle and coolant.
- Open the cover of the grinding wheel, and shift the dresser to the centre of the grinding wheel as shown in Fig 2 by pulling the dresser feed lever to the front side.
- Turn the dresser cut in dial gently to let the dresser tip touch the perimeter of the grinding wheel.
- Restore the dresser feed lever to the original position and shut the cover of the grinding wheel.
- Set the depth of cut in the dresser by means of the dresser dial and carry out the dressing by operating the dresser feed lever. (The depth of cut for dressing is 0.015-0.025mm at a time, and the dresser feed speed is 250-500mm/min in case of the finish).

Dressing of grinding wheel by dresser attached to holder

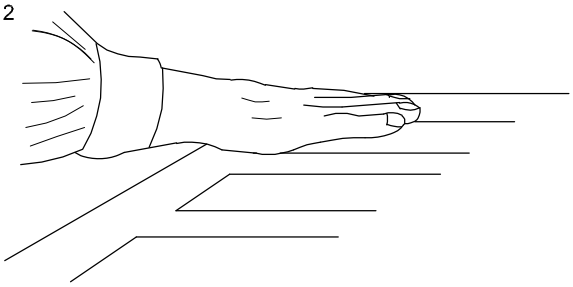
Keep the dresser on the base as shown in Fig.4. This position helps to prevent chattering and the tendency to drag in during the dressing operation.

Fig 1



Clean the magnetic chuck thoroughly with a cloth and then (Fig 5) feel for any dirt with your palm. Remove it if any.

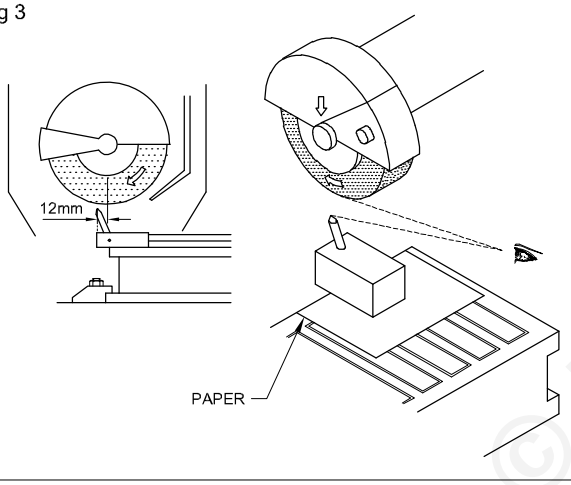
Fig 2



MG20N1340H2

Place the diamond on the last two magnetic poles on the left hand end of the magnetic chuck Paper should be placed between the diamond holder and the chuck is prevent scratching the chuck surface when removing the diamond holder. (Fig.6)

Fig 3



MG20N1340H3

The point of the diamond should be offset about 12mm from the grinding wheel centre line with reference to the direction of rotation of grinding wheel (Fig.6)

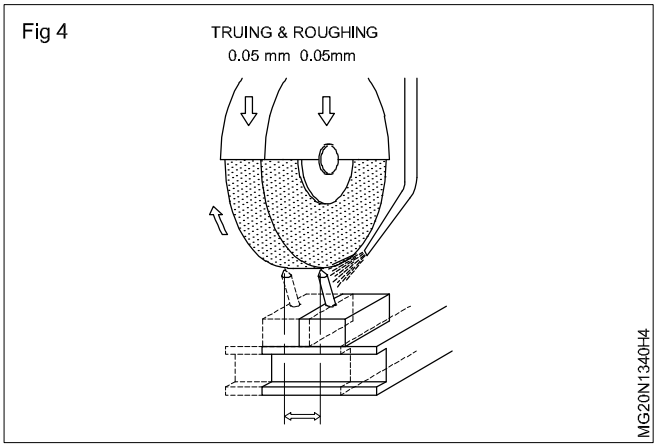
Make sure that the diamond clears the wheel, then start the grinder.

Lower the wheel until it touches the diamond.

Move the diamond slowly across the face of the wheel (Fig.7)

Take light cuts (0.02mm) until the wheel is clean, sharp and is running true.

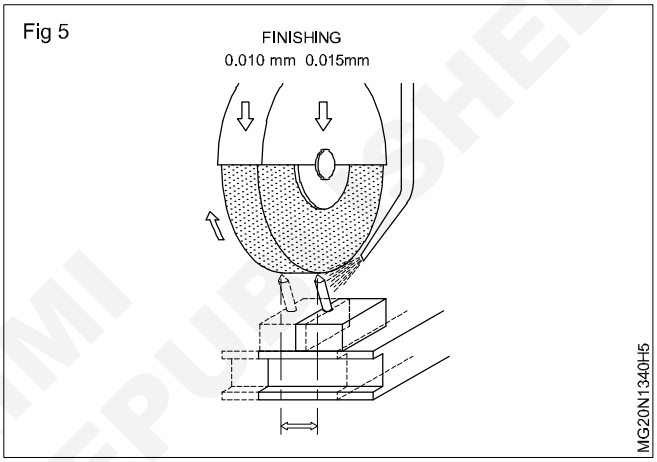
Fig 4



MG20N1340H4

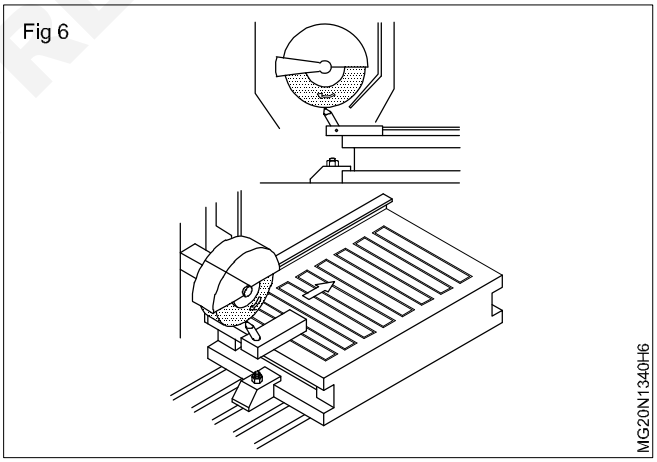
Take a finish pass with 0.01mm across the face of the grinding wheel. (Fig 8&9)

Fig 5



MG20N1340H5

Fig 6



MG20N1340H6

Check and measure various type of job using micrometers, vernier caliper, height gauge etc.

Objectives : At the end of this exercise you shall be able to
- **ensuring the dimension of finish component using vernier caliper**
- **measuring the dimension of finish components using micrometer**
- **measuring the dimension of finish components using vernier height gauge.**

Fig 1

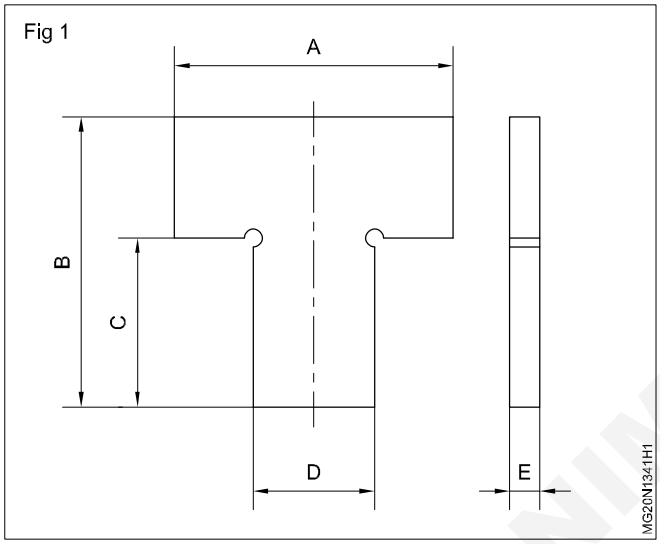


Fig 2

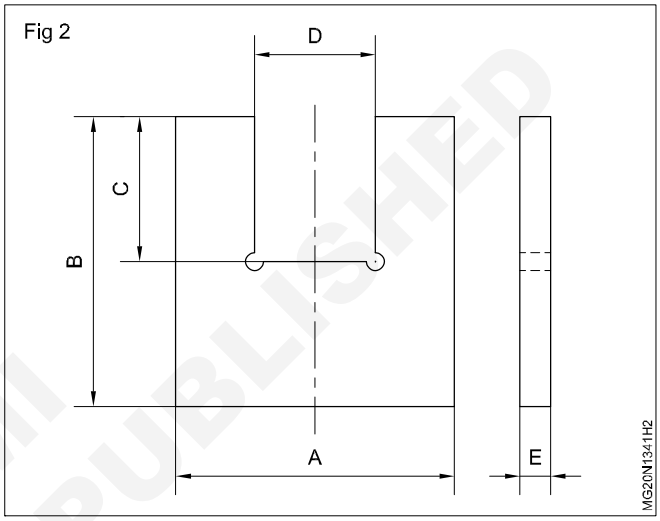


Fig 3

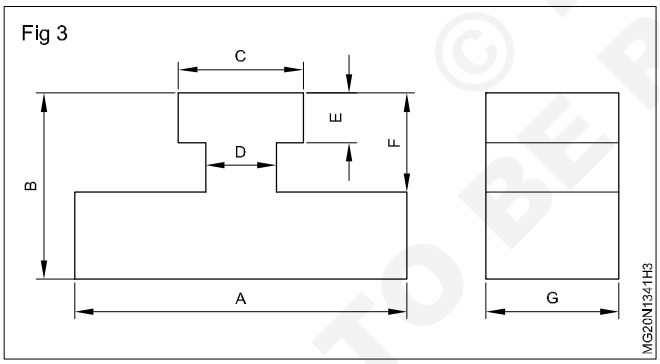


Fig 1

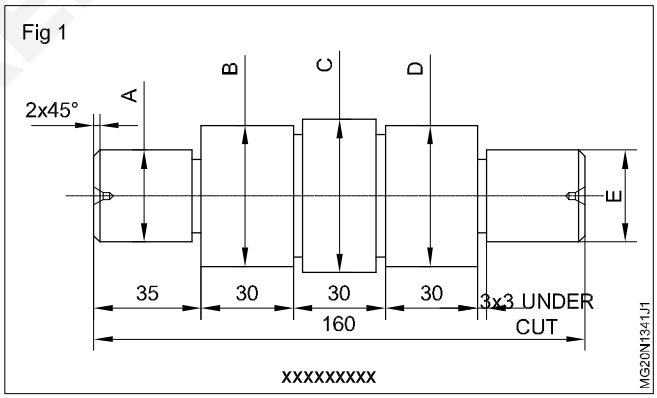
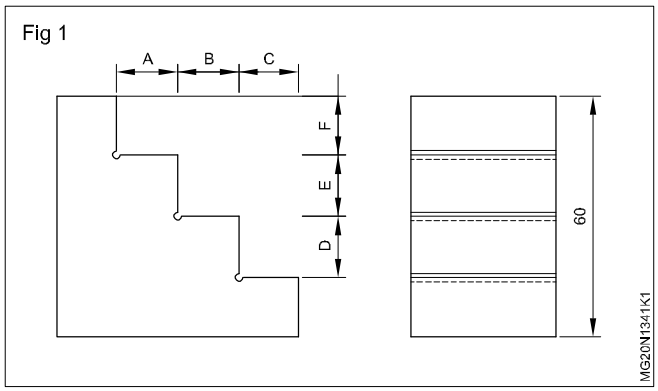


Fig 1



Job sequence

TASK 1: **Measuring the finished components with vernier caliper (Fig. 1)**

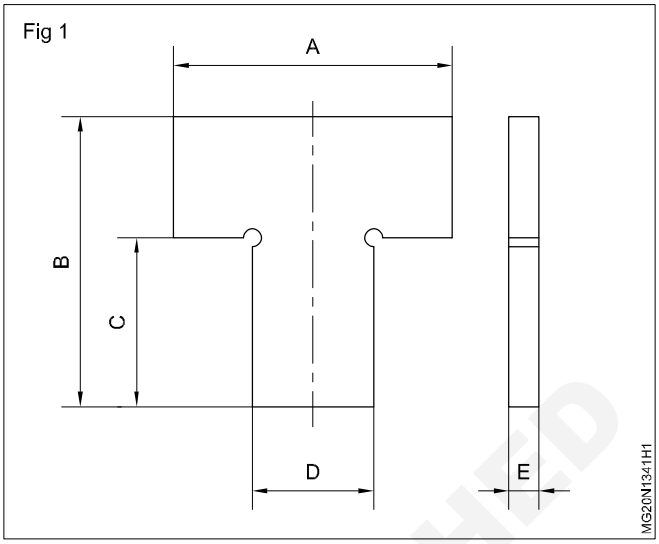
1 Measure the dimensions A, B, C, D & E of finished components available in section with vernier caliper and micrometer(outside)

2 Take three measurements of each dimension at various places and enter in the table.

3 Calculate the average value.

4 Enter the average of measured value in the table.

Fig 1



Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						Vernier Caliper		
B						Vernier Caliper		
C						Vernier Caliper		
D						Vernier Caliper		
E						Vernier Caliper		

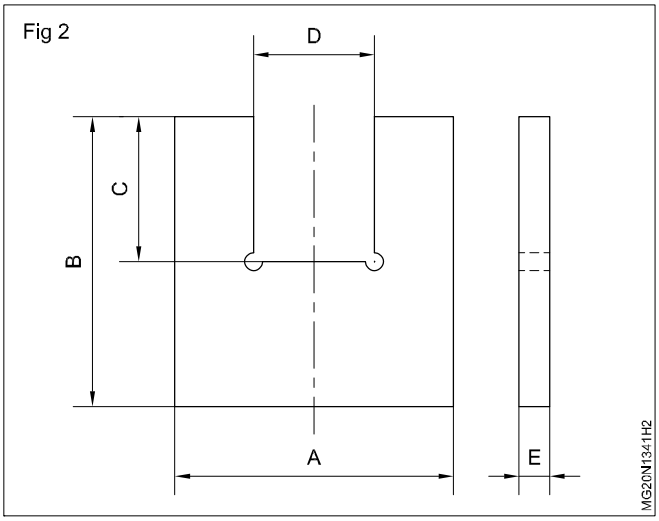
1 Measure the finished components of dimensions A, B, C, D & E with vernier caliper.

2 Take three measurements of each dimentions at various places and enter in the table.

3 Calculate the average of measured value.

4 Enter the average of measured value in the table.

Fig 2



Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						Vernier Caliper		
B						Vernier Caliper		
C						Vernier Caliper-		
D E						Vernier Caliper Vernier Caliper		

— — — — — — — —

TASK 2: **Measuring the finished components with outside micrometer (Fig 3)**

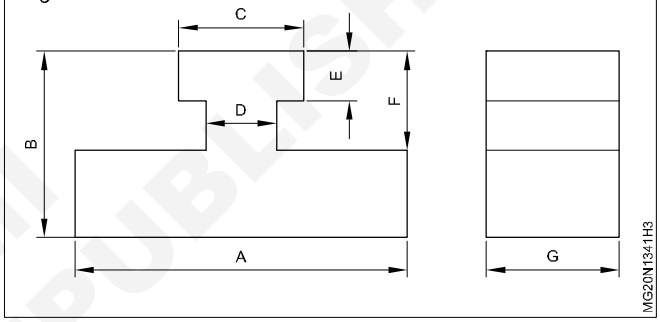
1 Measure the finished components of dimensions A, B, C, D & E with vernier caliper, outside micrometer and inside micrometer.

2 Take three measurements of each dimensions at various places and enter in the table.

3 Calculate the average of measured value.

4 Enter the average of measured value in the table.

Fig 3



Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						O.S Micrometer		
B						O.S. Micrometer		
C						O.S. Micrometer		

— — — — — — — —

TASK 3: **Measuring the finished recessed job with outside micrometer (Fig 4)**

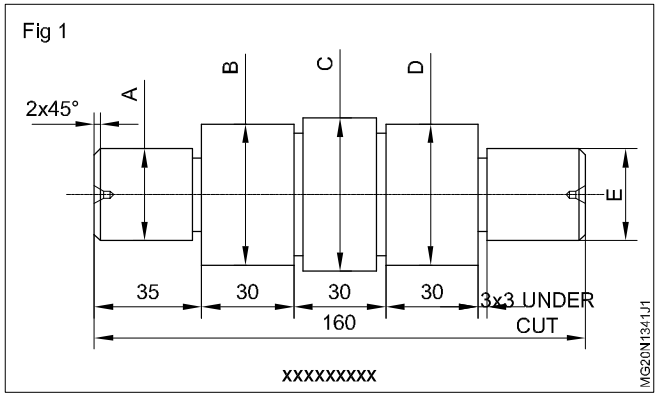
1 Measure the finished components of dimensions A, B, C, D & E with vernier caliper, outside micrometer and inside micrometer.

2 Take three measurements of each dimensions at various places and enter in the table.

3 Calculate the average of measured value.

4 Enter the average of measured value in the table.

Fig 1

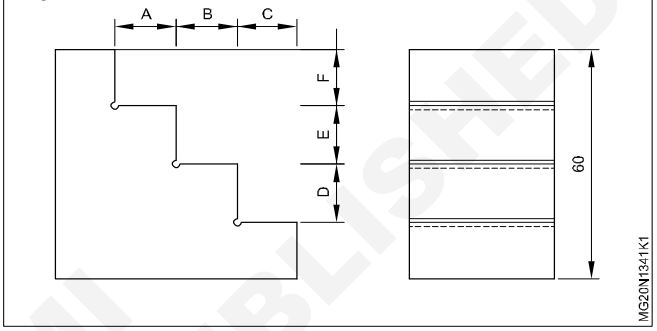


Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						Outside Micrometer		
B						Outside Micrometer		
C						Outside Micrometer		
D						Outside Micrometer		
E						Outside Micrometer		

TASK 5: **Measuring the finished components with vernier height gauge.** (Fig. 5)

- Measure the dimensions A, B, C,D,E & F of a stepped steel component with vernier height gauge.
- Enter the measured values in the table
- Calculate the average of measured value.
- Enter the average of measured value in the table.

Fig 1



Dimension in mm		Values of measurements obtained				Measuring Instrument	Range	Least Count
		1st	2nd	3rd	Average of 3 values			
A						Vernier height gauge		
B						Vernier height gauge		
C						Vernier height gauge		
D						Vernier height gauge		
E						Vernier height gauge		
F						Vernier height gauge		

Skill sequence

Measuring the sizes with a vernier caliper

Objectives: This may help you to
- **check the condition of the vernier caliper**
- **measure the outside diameter**
- **measure the inside diameter of a bore**
- **measure the width of a tongue**
- **measure the length of a step**
- **measure the depth of a stepped bore.**

The sense of feeling is very important to judge the accuracy of the reading.

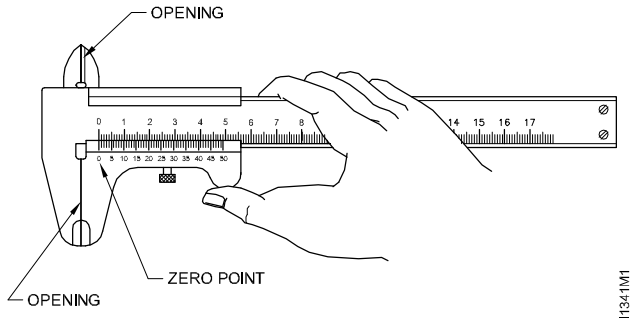
Checking the condition of the vernier caliper

Figs 1 to 5 indicate the general instructions for different applications of the universal vernier caliper.

- Check the vernier caliper.
- Confirm looseness of the locking screw.
- Clean every part of the caliper with rags.
- Close the jaw and examine the opening through light.

- Check whether the zero points coincide. (Fig.1)

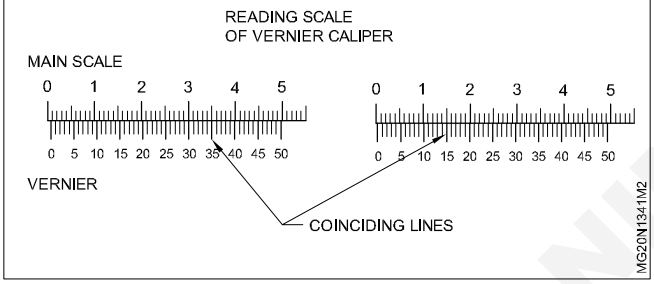
Fig 1



Reading scale of a vernier caliper

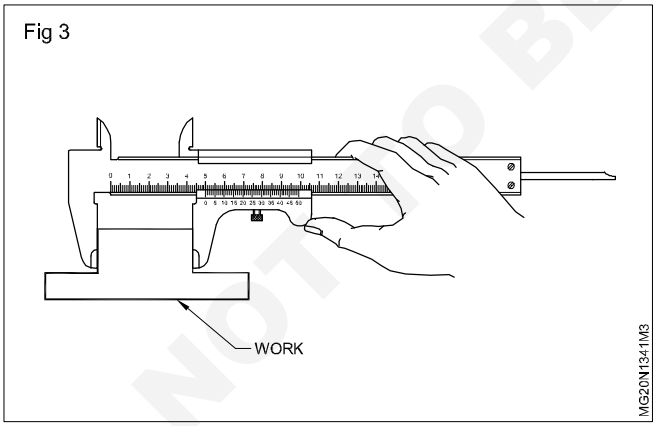
As for decimals, read the scale mark of the slide scale just where it lines up with the scale mark of the main scale.(Fig.2)

Fig 2



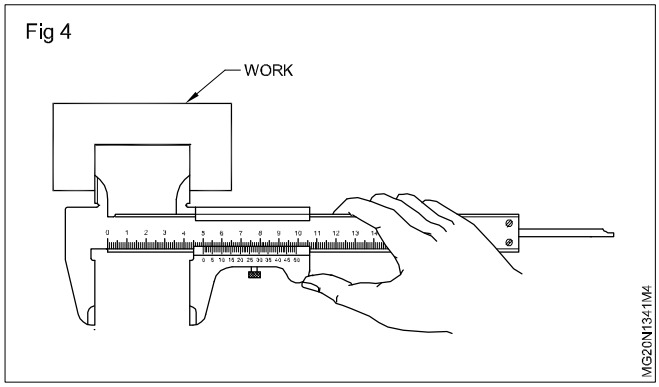
To measure the length of an object ,read the scale mark, keeping the work piece firmly held between the jaws so that the workpiece and the jaw faces establish a statisfactory contact. (Fig.3)

Fig 3



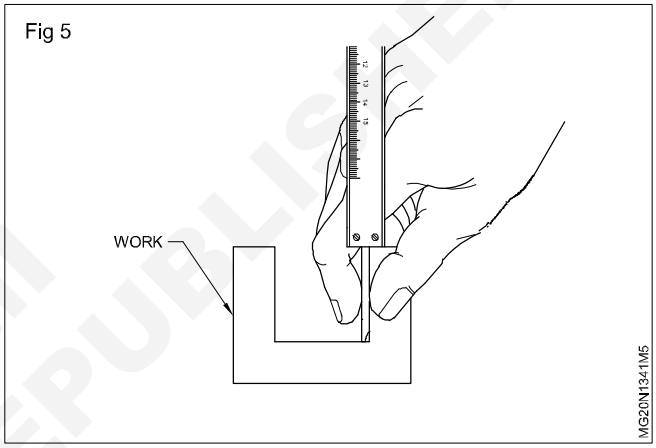
To measure the notch width of an object, fit the main scale nib correctly to the face of the object to be measured,hold it lightly with the fingers of the left hand and read the scale mark (minimum value) after moving the sliding unit so that it is contact with the other face of the notch. (Fig.4)

Fig 4



To measure the depth of a notch,fit the depth bar to the notch, hold it lightly with the fingers of the left hand, keep it upright and read the scale mark, while keeping the depth bar flush with the bottom of the notch and the depth reference surface in contact with the top of the notch.(Fig.5)

Fig 5



Measuring the outside diameter

Open out the movable jaw slightly more than the measurable size.

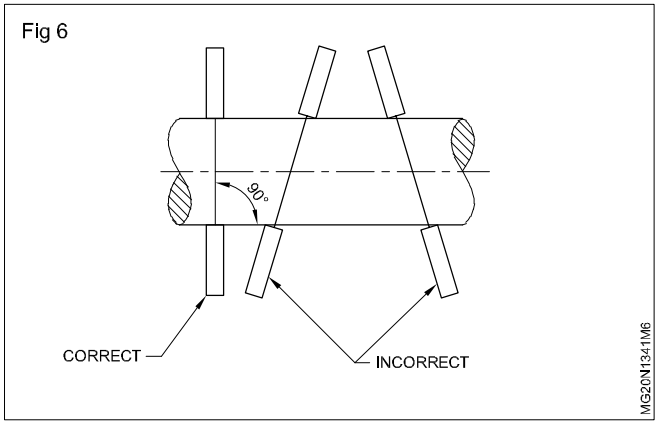
Place the jaws at right angle to the axis of the workpiece.

Close the jaw over the workpiece such that the nib of the jaws just slip from the point of contact.

Lock the nib and record the reading.

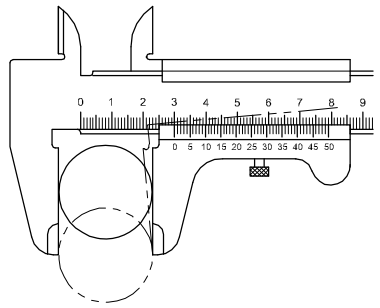
Measure the object with the vernier calliper, touching at right angles. (Fig.6)

Fig 6



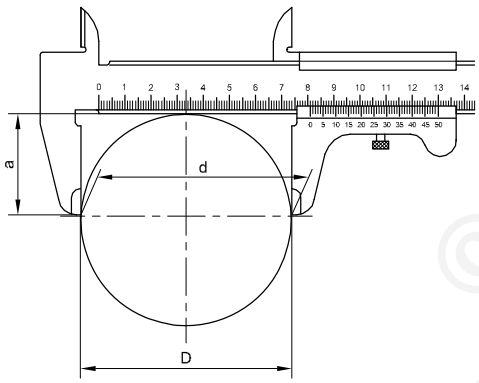
Measure by using the base of the jaws. If a measurement is performed by using the tip of the jaws, a bend occurs in the jaws and the value read on the vernier calipers become smaller than the actual dimentions. (Fig.7)

Fig 7



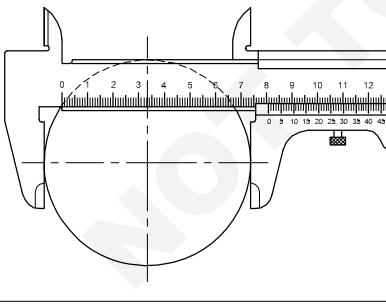
Measuring large diameters (Relationship between diameter D of the object to be measured and length 'a' of the jaws).In the case of 'a' <1/2 D the relationship of read value 'd' and diameter 'D' of the object being measured becomes as shown below. 'd'<'D' and the measurement of diameter D is no longer possible.(Fig.8)

Fig 8



In the above case, measure by letting the beam contact the ends of the object being measured.(Fig.9)

Fig 9



The maximum measuring length of a caliper and dimention 'a' is given below for reference.

Maximum measuring length	a
150mm	38mm
200 mm	50 mm
300 mnm	60 mm

Measuring the inside diameter

Open out the nibs of the vernier caliper slightly less than the measurable size.

Place the nibs inside the bore surface such that the nibs are parallel to the axis of the workpiece and centre of the bore.

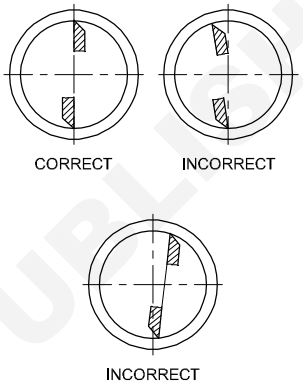
Open out the nibs so as to make contact on the bore surface and swing the nibs to measure the maximum value of the bore size.

Lock the nib and record the reading.

It is not advisable to have the measurement at right angle to the axis of the work because it reduces the actual size of the bore.

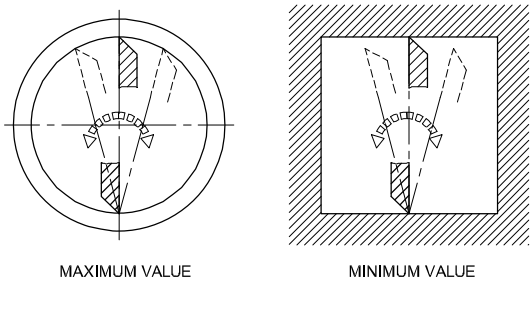
Measure by matching the nibs of the vernier caliper to the axial centre.(Fig.10)

Fig 10



Measurement of inside diameters and sequare holes: In the case of an inside diameter, the maximum measured value is the actual dimention. In the case of a square hole the minimum measured value is the actual dimension.(Fig.11)

Fig 11



To have correct content of nibs, insert nibs in the object as deeply as possible and let them be in contact.(Fig.12)

When the insertion is not sufficiently deep, the measuring surface tilts off the vernier caliper and a correct measurement is not possible.(Fig13 and 14).

Fig 11

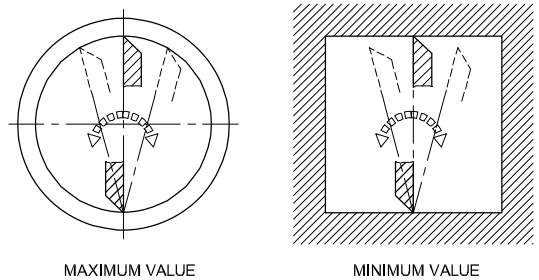


Fig 12

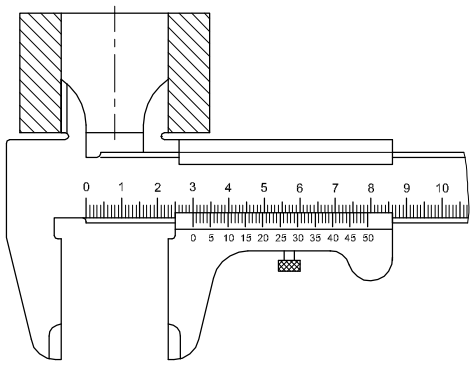
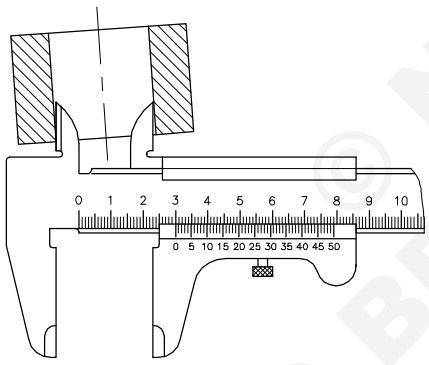
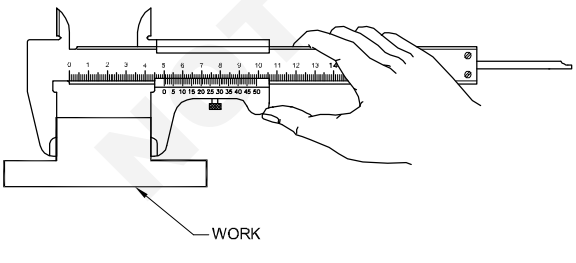


Fig 13



Measuring the width of a tongue. (Fig.15)

Fig 15



Open out the nibs of the vernier caliper slightly less than the measurable size.

Hold the fixed nib slightly with the left hand fingers and adjust the other nib so that it has a contact with the other face of the tongue.

Lock the nibs and record the reading.

Measuring the step length

Place the jaws parallal to the axis of the workpiece.

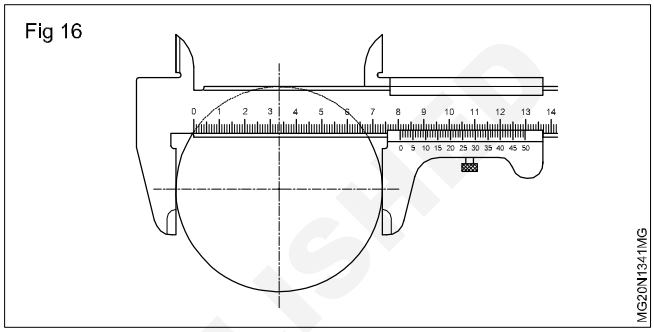
Keep one jaw firmly against one face of the step and adjust the other jaw that it just makes the contact with the other surface.

Lock the jaws and record the reading.

Measuring the depth of a hole

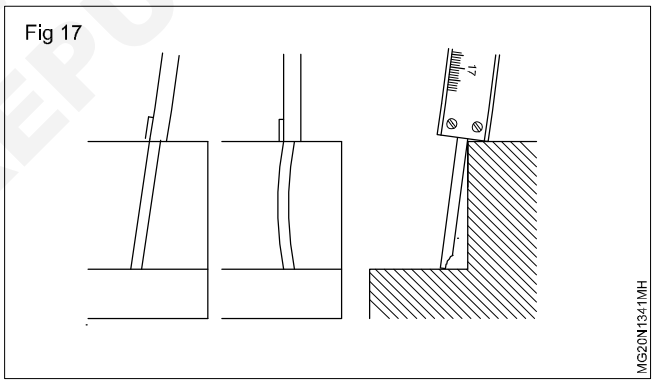
To measure depth put the depth reference surface of the vernier calipers in contact with the object to be measured. (Fig.16)

Fig 16



Be sure that the depth bar does not tilt with respect to the object being measured and that no measuring presure higher than what is specified is applied. (Fig.17)

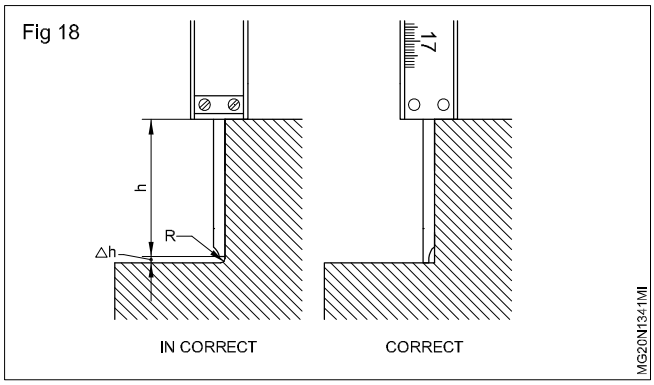
Fig 17



Connect the depth bar tip as shown in the drawing and make sure that it does not touch the corner R.

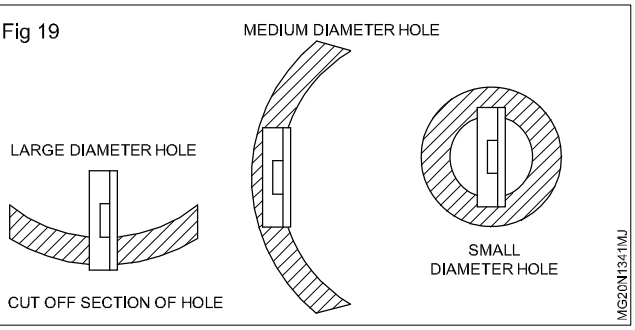
Take the measurement without contacting corner R or error Δ h will occur. (Fig.18)

Fig 18



When measuring the depths of holes, make the area where the depth level can touch the object that is being measured as large as possible. (Fig.19)

Fig 19

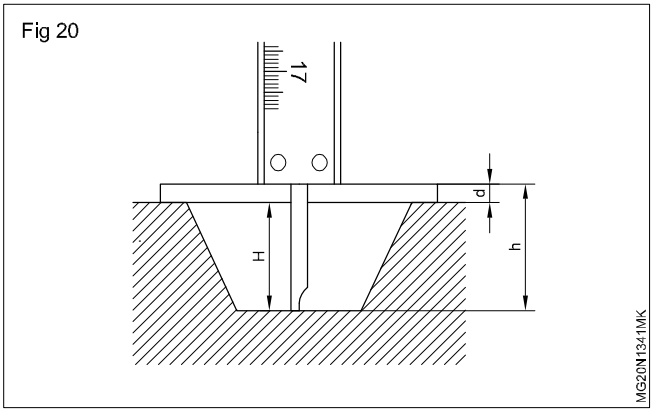


When no direct measurement is possible, bridge with an object which can be used as a reference for measurement.

H = h = d (Fig.20)

Place the base line of the main scale at right angles with the axis of the workpiece and move the depth bar so that it just makes contact over the other surface.

Fig 20



Lock the jaws record the reading.

When it is not possible to measure the depth with the instrument bridge the clearance with a flat object and take the reading.

While taking the measurement of a blind hole, hold the depth bar with the fingers lightly so that it is flush with the bottom surface.

Measuring with micrometers

Objective: This shall help you to

- **measure with an outside micrometer.**

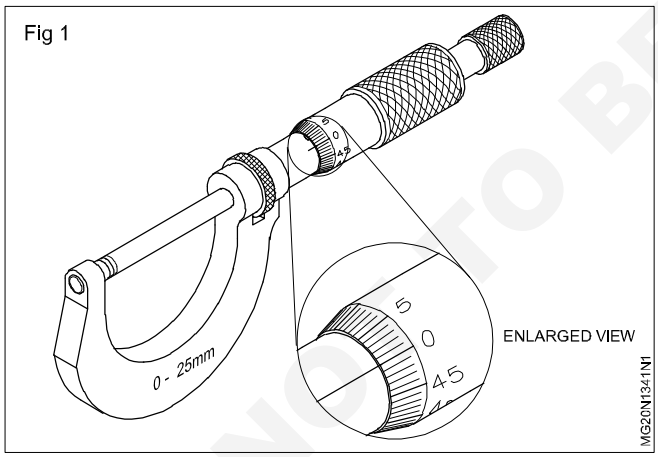
Observe the following aspects before takintg the measurements.

Clean the measuring faces of the micrometer and the surfaces of the work to be measured.

Check for the zero error.

In the case of a 0-25 mm outside micrometer, the zero of the thimble should coincide with the datum line. (Fig.1)

Fig 1



If they do not conincide, the instrument has an error.

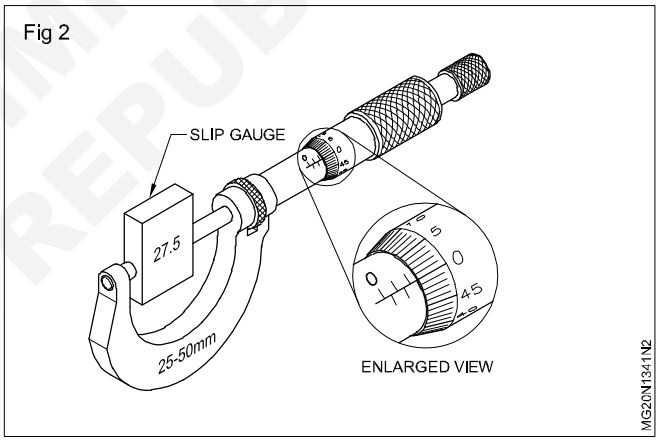
The other sizes of the outside micrometer should be checked for errors with the help of standard gauges provided for this purpose.

If standard gauges are not available, slip gauges can be used. (Fig.2)

The slip gauge may be of any size above the minimum range of the micrometer.

The trainees are not expected to handle slip gauges now.

Fig 2



Use the instrument only after making the necessary correction.

Do not attempt to correct the errors, If any. The instructor will do it for you.

Steps required while taking measurements.

Holding of the micrometer for measuring depends on the workpiece.

Use both hands for taking the measurement, it the workpeice is held on the machine, workbench, surface plate, etc (Fig.3)

Hold the workpeice in one hand and the micrometer in the other hand, if the workpeice is small. (Fig.4)

Use the ratchet stop when the measuring faces touch the workpiece. This will ensure uniform pressure that is needed for consistency while measuring accurately.

Make sure the measuring faces of the micrometer are squar with the surface begin measured.

Fig 3

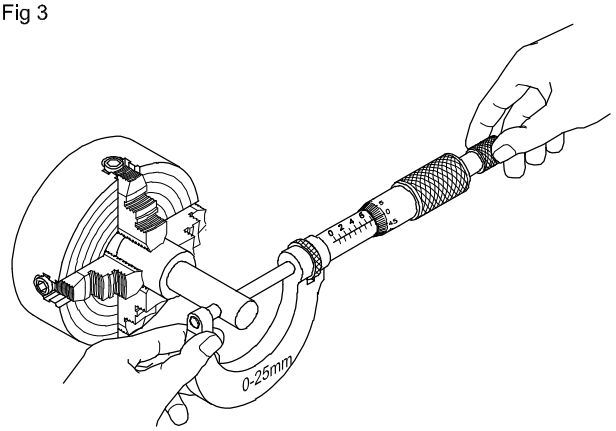
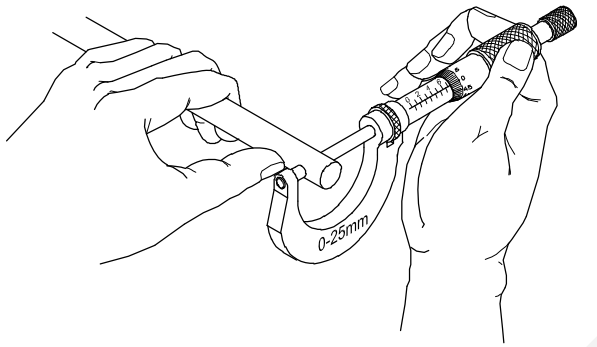


Fig 4



Do not force a micrometer on the job.

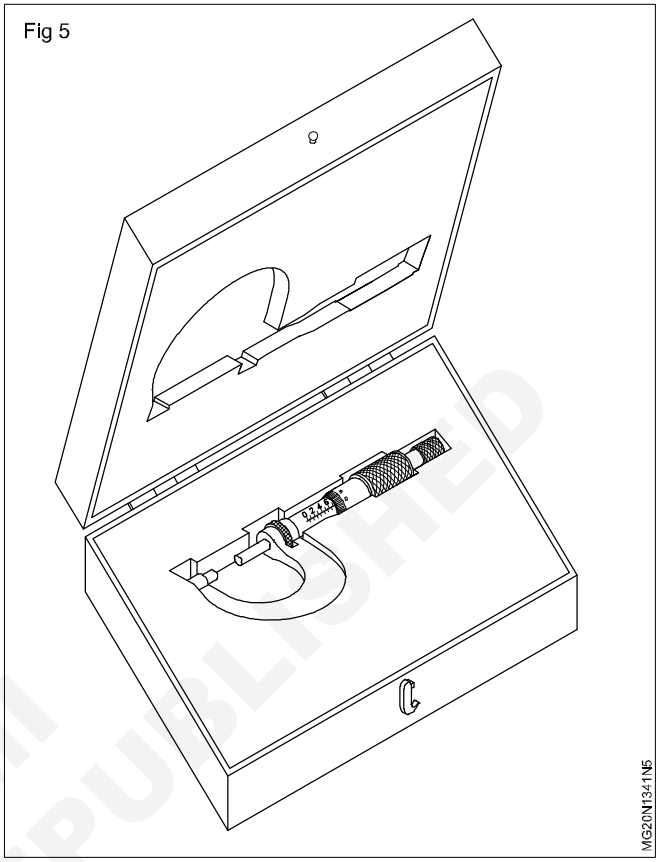
Steps required after taking measurements.

After use, clean the micrometer with a cloth and apply a thin film of oil.

Store the micrometer always in its box. (Fig.5)

Make sure the measuring faces are not in contact while keeping the micrometer away. (Fig.5)

Fig 5



Inside caliper & outside micrometer used for bore measurement

Objective: This shall help you to

- **take the measurement of a bored hole with an inside caliper, transfer it to an outside micrometer and read the measurement.**

Bores are checked for their dimensional accuracy by using:

Inside micrometers

Universal vernier calipers

Inside calipers and outside micrometers (transfer measurement)

Telescopic gauges and outside micrometers (transfer measurement).

The first two methods give direct reading whereas the 3rd and 4th are by transfer measurement.

For checking the bore diametes using inside calipers and out-side micrometers the following sequence is to be followed.

Select the inside caliper according to the size of the bore to be measured.

Select an outside micrometer of suitable range for the size of the hole.

Open the legs of the inside caliper approximately permitting its entracne into the hole.

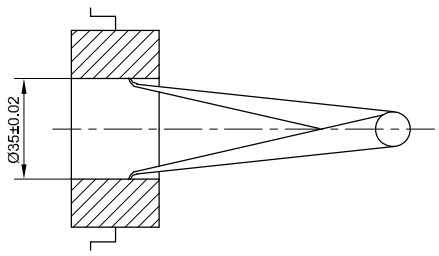
Position one leg in contact with the bottom off the bore.

Keeping this as the fulcrum, oscillate the other leg in the bore.

Adjust the distance between the legs by gently tapping to increase or to decrease so as to enable the leg to enter.

Rock the inside caliper with respect to the axis of the work so as to make the leg of the inside caliper contact the bore top surface. (Fig.1)

Fig 1



If the 'feel' is hard, reduce the distance between the leg tips and if the feel is less or if there is no feel, increase the distance between the leg tips slightly.

Check once again and repeat till you get the correct feel.

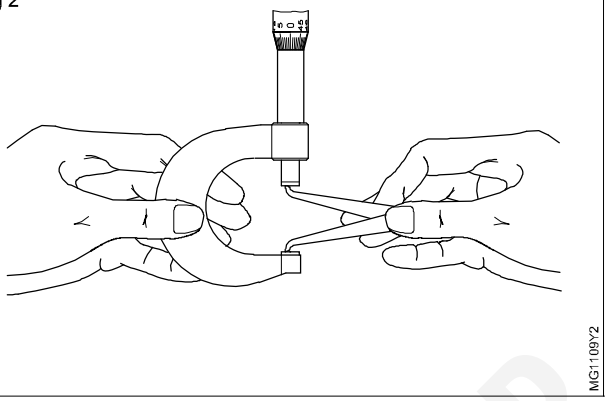
Ensure that the position of the legs is not disturbed, once the correct feel is obtained.

Hold the outside micrometer in one hand and the spindle away from the anvil face, a little more than the distance between the two legs of the inside caliper.

Hold the inside caliper with the other hand, contacting the tip of one leg with anvil face of the micrometer.

Oscillate the other leg and rotate the thimble of the outside micrometer to contact the tip of the oscillating leg of the inside caliper. (Fig.2)

Fig 2



Ensure you get the same 'feel' as before.

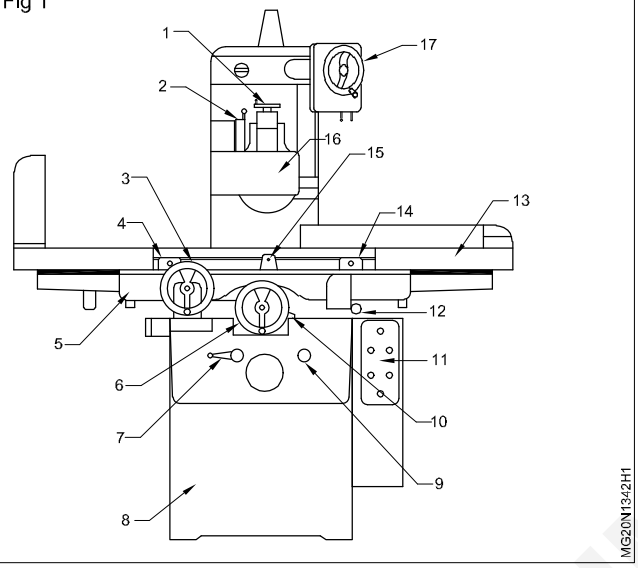
Note the reading on the barrel and thimble of the outside micrometer and determine the size of the measurement.

The accuracy depnds on the skill. Practice to get the correct feel for the measurement.

Identify different parts of surface grinding machine.

Objectives : At the end of this exercise you shall be able to
- **identify the different parts of surface grinding machine**
- **record the part name in table 1.**

Fig 1



Job Sequence

Instructor shall identify of the surface grinder. Ask trainees to record in Table 1

Trainees should with the name of each parts in Table 1

Get it checkes by the instructor.

Table 1

Sl.No	Part Name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	

Set surface grinding machine and uniform operation with dry/idle run

Objectives : At the end of this exercise you shall be able to
- **preparing the surface grinding machine**
- **setting the speed and feed**
- **operating the surface grinding dry/idle run.**

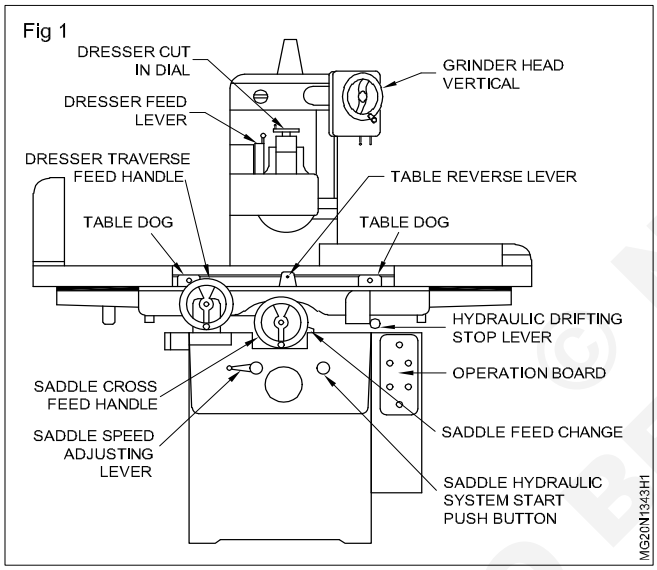
Preparing wheel spindle: It is very essential to check the different controls of the machine before actually starting the grinding operation. This will help the preparation of the machine for work. Check the following before the grinding operation.

Checking and oiling before start

Supply oil to all the lubricating points.(Consult your instructor)

Check that the button on the operation board is at the stop position. (Fig 1)

Fig 1



Check that the clutch of the table traverse feed handle is cut.

Check that the table dog is fixed.

Manual feed of table: Set the table reverse lever at the neutral position (Fig.1) Engage the clutch of the table traverse feed handle.

Move the table to the right and left by turning the handle clockwise and anticlockwise respectively.

Manual and automatic feed of saddle: Move the saddle forward by turning the saddle cross-feed handle clockwise. (Fig 1)

Move the saddle backward by turning the saddle cross-feed handle anticlockwise.

Set in the automatic feed by turning the saddle feed change lever upward and downward. (Fig 2) (when the lever is pushed up or down, the saddle moves forward or backward respectively)

Raise and lower the grinding wheel.

Disengage the fine feed knob. (Fig 3)

Fig 2

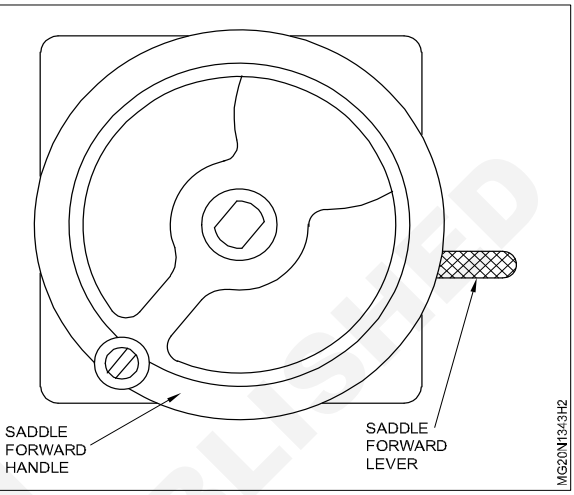
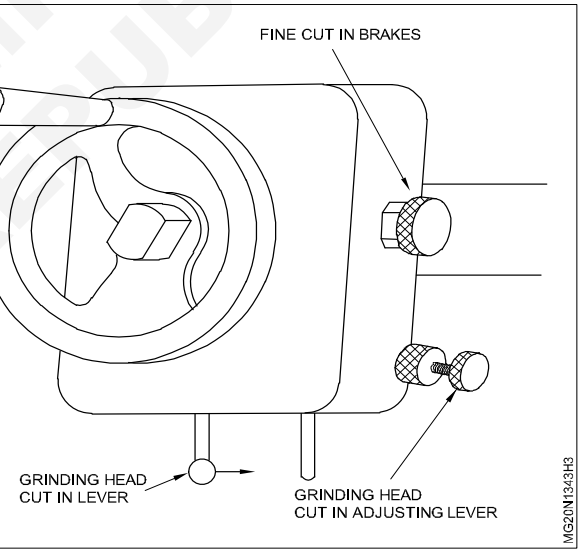


Fig 3



Turn the grinding wheel elevation handle anticlockwise to lower the grinding wheel. (Fig 1)

Turn the grinding wheel elevation handle clockwise to raise the grinding wheel.

Hydraulic operation of table

Pull the table traverse feed handle to the front side to disengage the clutch.

Push the hydraulic driving push-button to drive the table hydraulically. (Fig 1)

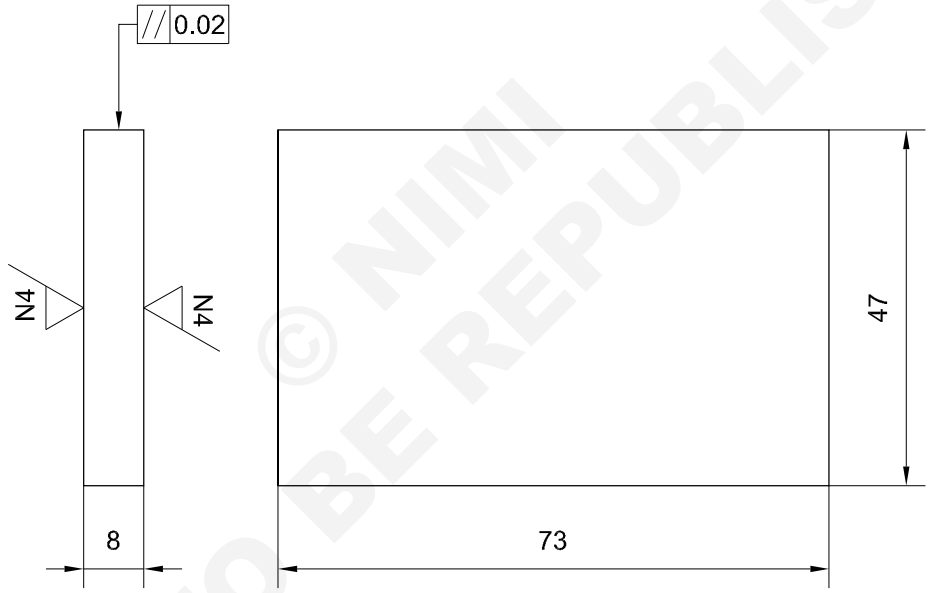
Adjust the table speed by the use of the table speed adjusting lever. (When the lever is pushed up, the table speed is increased. The speed is decreased by lowering the lever and the hydraulic drive is stopped at the lowest position of the lever)

Stop the hydraulic drive by pushing or pulling the hydraulic drive stop lever. (The table is stopped at the right end position)

Perform rough and finish grinding on surface work

Objectives: At the end of this exercise you shall be able to

- **prepare the surface grinding machine for grinding**
- **mount the grinding wheel**
- **dress the grinding wheel by using diamond point dresser**
- **balance the grinding wheel**
- **set the magnetic chuck and align with dial test indicator**
- **mount the job on magnetic chuck**
- **grind the flat surface with an accuracy of ± 0.05**
- **check the flat surface and parallelism with an outside micrometer.**



1	73 ISF 47 - 85	-	Fe310	-	-	1.3.44
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	ROUGH AND FINISH GRINDING ON SURFACE WORK	DEVIATIONS ±0.05	TIME :15 Hrs
		CODE NO.MG20N1344E1	

Job sequence

- Prepare the grinding machine for grinding.
- Mount the grinding wheel in the machine spindle.
- Dress the grinding wheel and switch on the coolant motor.
- Study the drawing and measure the grinding allowance for given job.
- Balancing the grinding wheel.
- Set the job on the magnetic chuck with supporting the stopper plate.
- Set the length of stroke by adjusting the reversing dogs.
- Start the machine and run the grinding wheel rotating idly.

Before starting first check the grinding wheel physically by rotating wheel with hand.

- Put on the table movement.
- Slowly move the grinding wheel downwards and try to touch the high spot on the job.
- Put on the coolant
- Grind rough and finish the surface removing only half of the grinding allowance.
- Remove the job from the magnetic chuck and deburr by using fine abrasive stone.
- Dress the grinding wheel and reset the job for finishing.
- Finish grind the surface.
- Reverse and reset the job on the magnetic chuck.
- Grind rough and finish the flat surface with dimension of 8mm to an accuracy of ± 0.05mm.

Protect your eyes always using goggles while grinding.

- Remove the job from magnetic chuck and remove the burrs.
- Check the dimensions and parallelism with 0-25 outside micrometer.

Skill sequence

Setting on magnetic chuck

Objectives: This shall help you to

- **set and align the magnetic chuck on the work table**
- **set and align the workpiece on the magnetic chuck with respect to the table traverse movement.**

Mount the magnetic chuck

Clean the table, check for burrs and remove with an abrasive stone.

Clean the bottom of the magnetic chuck, check for burrs and remove with an abrasive stone.

Place the chuck centrally on the machine table with a side stopper plate at the rear, remove the side stopper plate and clean the rear face of the chuck.

Align the back edge of the chuck with the rear of the machine table. (Fig. 1) Feel with your finger (x) at both ends of the magnetic chuck.

Position the bolts, clamps and tighten the nuts slightly.

Aligning the chuck parallel to table traverse

Fix the dial indicator over the wheel head and position the stylus upon the back face of the chuck. (Fig. 2)

Traverse the work table left and right with the hand wheel allowing the stylus to cover the full length of the chuck.

Note down the error registered on the dial and tap the chuck away from the dial indicator at high reading. (Fig.2)

Continue traversing and adjusting the chuck until the dial reads '0' error.

Ensure that the stylus is in touch with the surface, when the dial reads '0' error.

Tighten the nuts finally and check the reading once again. Reposition the side stopper plate.

Mounting the workpiece on the magnetic chuck

Clean the top surface of the chuck and check for burrs. Remove the burrs with a fine abrasive stone using a rubber felt pad for cleaning. (Fig. 3)

Check the workpiece and remove burrs and loose scales from the surface to be located on the magnetic chuck.

Place the workpiece centrally over the steel section of the magnetic chuck and engage the magnet. (Fig. 4)

Ensure that the workpiece is gripped well by attempting to move it.

If any movement is felt, remove the workpiece and check the mating surface for any burrs and relocate.

Small works that occupy one or two steel sections should be supported by parallel as shown in Fig. 4. Otherwise the workpiece will slip away while grinding.

Set the workpiece on the magnetic chuck with the use of the side stopper plate.

Fig 1

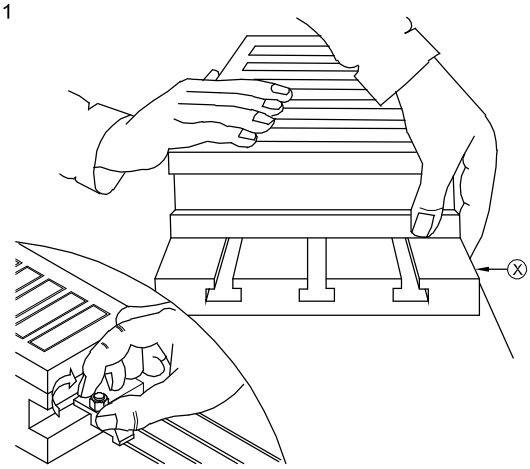


Fig 2

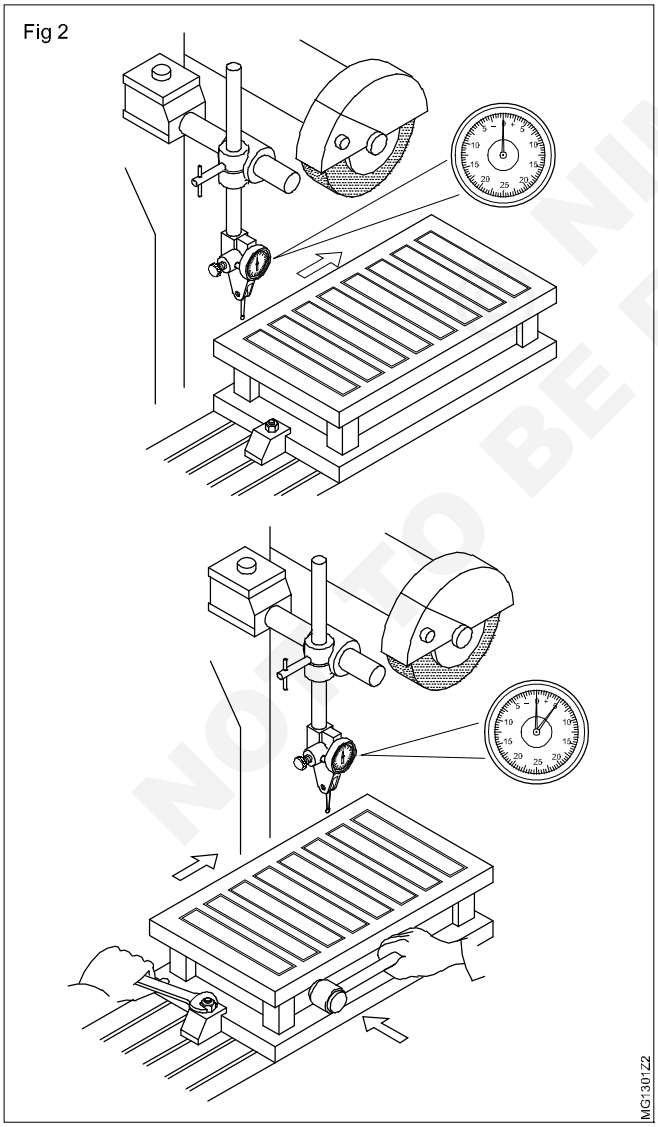


Fig 3

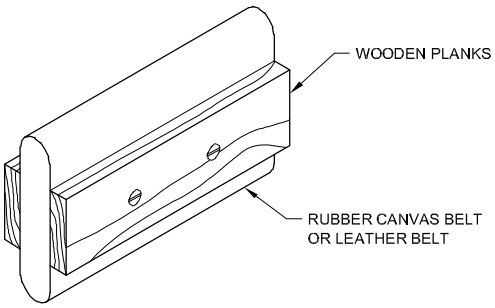
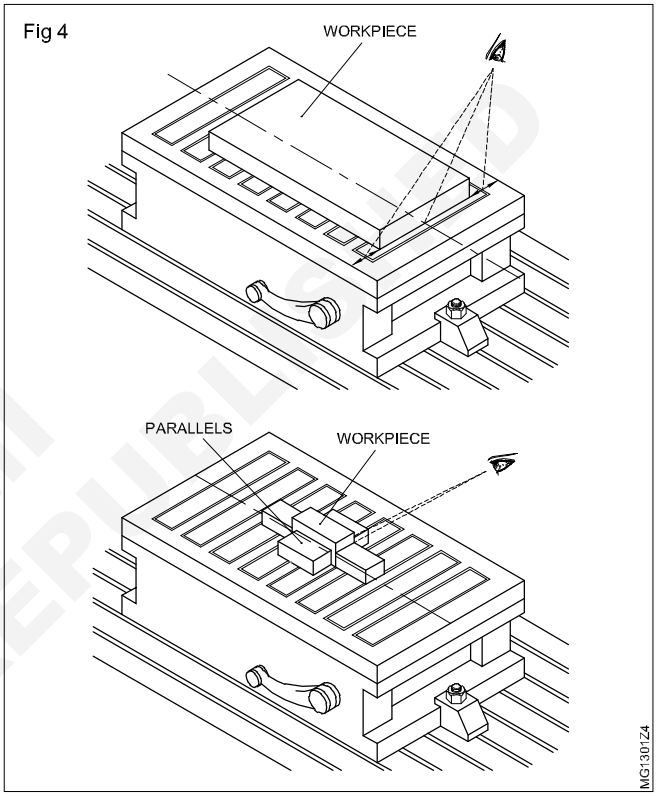


Fig 4



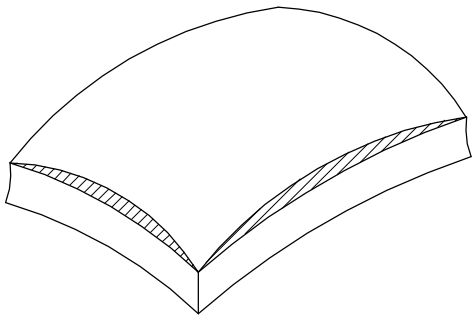
Grinding parallel surfaces

Objective: This shall help you to

- **grind parallel surfaces to an accuracy of ± 0.05.**

Always assume that the workpiece is distorted in one or more planes. (Fig. 1) For this reason a true reference face must first be produced.

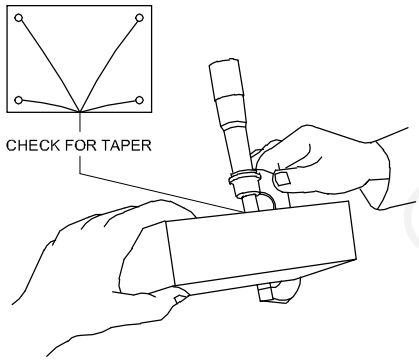
Fig 1



Check the flatness with a straight edge and locate the lowest spot by visual examination.

Check the parallelism using an outside micrometer and mark the high spot. (Fig. 2)

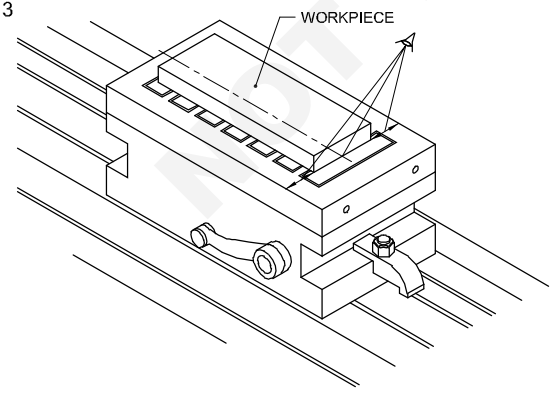
Fig 2



Clean the work surface and the magnetic chuck. (Fig. 3)

Place align and clamp securely the magnetic chuck over the work table. (Fig. 3)

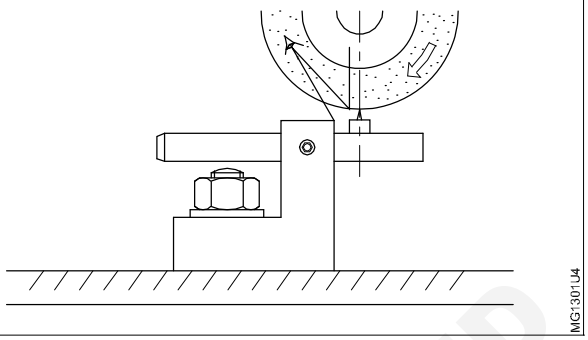
Fig 3



Dress the grinding wheel for rough grinding. (Fig. 4) (Seek the help of your instructor)

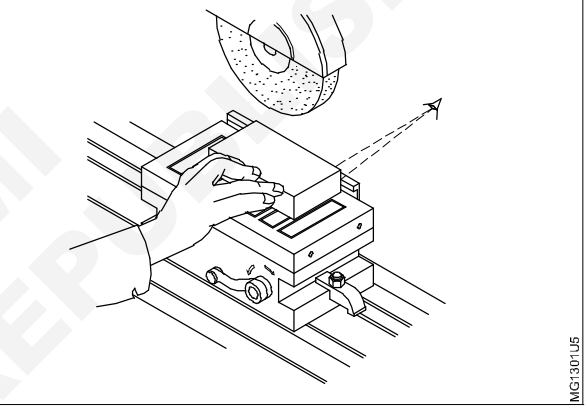
Clean the abrasive particles spread over the magnetic chuck and table.

Fig 4



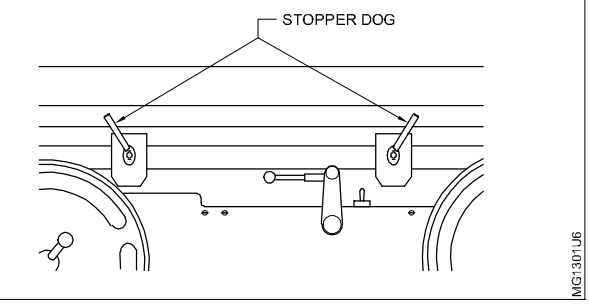
Mount the workpiece on the magnetic chuck, (Fig. 5) resting the lengthier surface with the side stopper plate of the magnetic chuck.

Fig 5



Set the table traverse-stopper dog considering the (Fig.6) approach length and over travel. Also set for the clearance of the job width.

Fig 6



Set the feed rate of the table to 10 to 15m/mm.

Hand - feed the wheel head down and watch the narrowing of the gap. Stop at 0.25mm gap approximately.

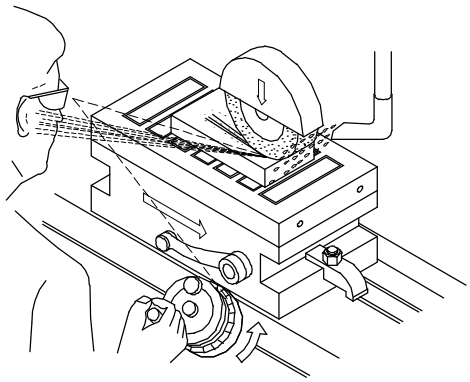
Clear the job from the grinding wheel.

Switch on the longitudinal power traverse using the fine feed mechanism and 'pick up spark' at the high spot.

Cross- traverse the workpiece to clear the wheel.

Start the coolant pump and direct the stream of the coolant between the wheel and the workpiece. (Fig. 7)

Fig 7

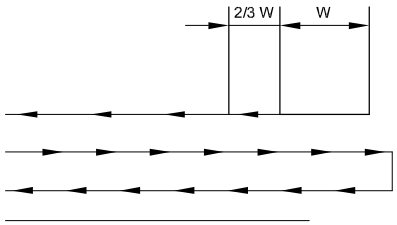


MG1301U7

This will reduce the heat of the job and the ground particles will be washed away.

Apply a 0.03mm depth of cut by the fine feed mechanism when the workpiece clears the grinding wheel after each cut. (Fig. 8)

Fig 8



MG1301U8

Keep your hands away from the revolving wheel at all times to avoid injuries to yourself.

Repeat rough grinding till the grinding allowance for that side is ground away.

Cross-traverse the workpiece to clear the wheel.

Re-dress the grinding wheel for finish grinding. Seek the help of your instructor). Clean the table and workpiece thoroughly.

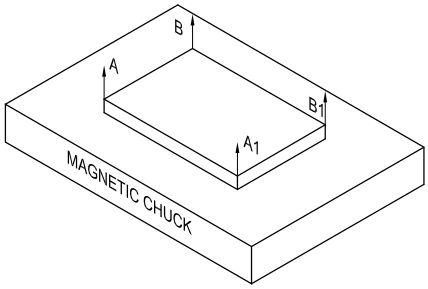
Engage the longitudinal travel feed.

Apply a 0.012mm cut and finish grind the workpiece allowing the wheel to 'spark out'.

Always apply the depth of cut at the end of the stroke.

Stop all traverses and turn off the coolant. Position the workpiece away from the wheel.

Fig 9



MG1301U9

Remove the job from the magnetic chuck. Switch of the magnetic force and lift a job from A and A1 side at the same time B and B1 side is placed on it and don't shake.

So doing this process see that no scratches are formed on the magnetic chuck.

Removal of the job from magnetic chuck while shaking of job side by side scratches are formed on the magnetic chuck.

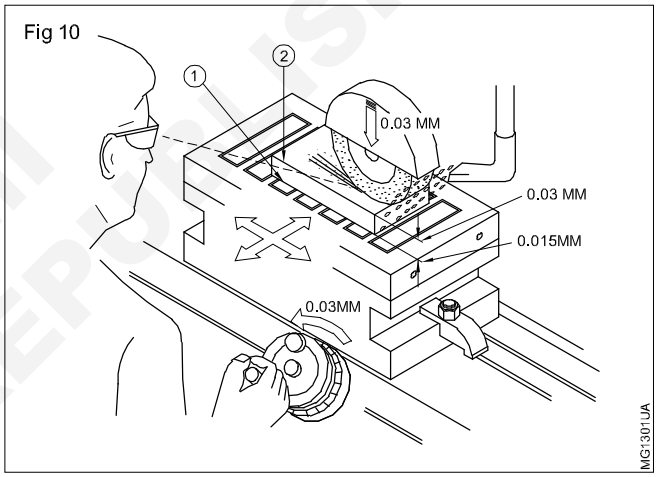
Remove the sharp edges of the workpiece by using a fine abrasive stick or stone.

Check the ground face with a straight edge and the thickness with an outside micrometer. This will be the reference surface for grinding the other surfaces.

Dress the grinding wheel for rough grinding.

Clean the magnetic chuck face and mount the ground surface of the workpiece over the face of the magnetic chuck. (Fig. 10)

Fig 10



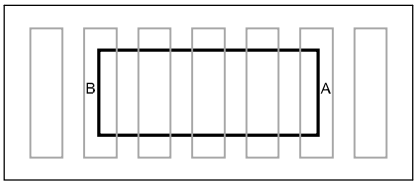
MG1301UA

Set table traverse stops.

Clean up the face by removing minimum material.

Arrange the job next side grinding (Fig. 11)

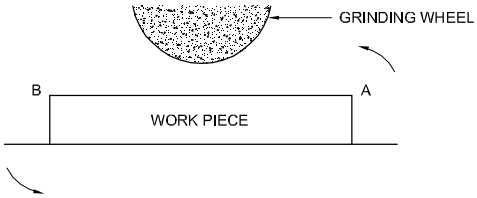
Fig 11



MG1301UB

Step - 1 (Fig. 12)

Fig. 12



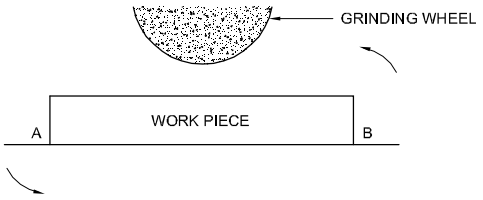
MG1301UB

Work piece mount and grind the surface shown step - 1.

After grinding the surface turn the job in length wise and placed on the left side (B) of the job is right side top of the magnetic chuck and A is placed on the left side of the magnetic chuck shown step 2 and step 2 a, b, c and d.

Step 2 (Fig. 13)

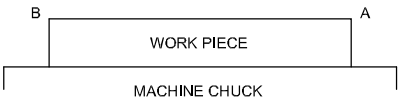
Fig 13



By this method we can eliminate the error in parallelism of the grounded surface.

Step 2a (Fig. 14)

Fig 14

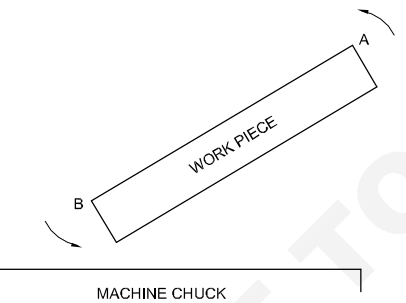


Following steps are involved for rest the job on magnetic chuck (Step 2a, 2b, 2c and 2d)

Grind surface of A and B

Step 2b (Fig. 15)

Fig 15



Lift the job and turn length wise

Step 2c (Fig. 16)

B is the right side of the magnetic chuck and A is placed on left side of the job.

Step 2d (Fig. 17)

Fig 16

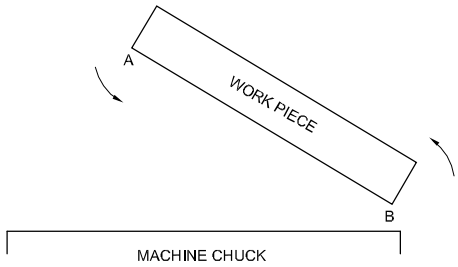


Fig 17

After completion of the turn the job A is left side and B is right side of the magnetic chuck.

Remove the workpiece deburr and clean it.

Determine the stock of material to be removed with an outside micrometer.

Check parallelism with an outside micrometer and determine the amount of taper if any. (To correct taper ask your instructor for advice)

Remount the workpiece in the same position and continue rough grinding, leaving an allowance of 0.012mm for finish grinding.

Remove the workpiece and dress the wheel for finish grinding.

Remount the workpiece and give a depth of cut of 0.05mm and grind the surface.

Remove the workpiece from the magnetic chuck.

Thoroughly clean the workpiece and the surface of the chuck.

Measure the thickness and parallelism and decide the remaining allowance.

Remount the workpiece and apply another 0.005mm depth of cut and finish grind.

Using the graduated dial of the wheel head, down feed for grinding the remaining allowance.

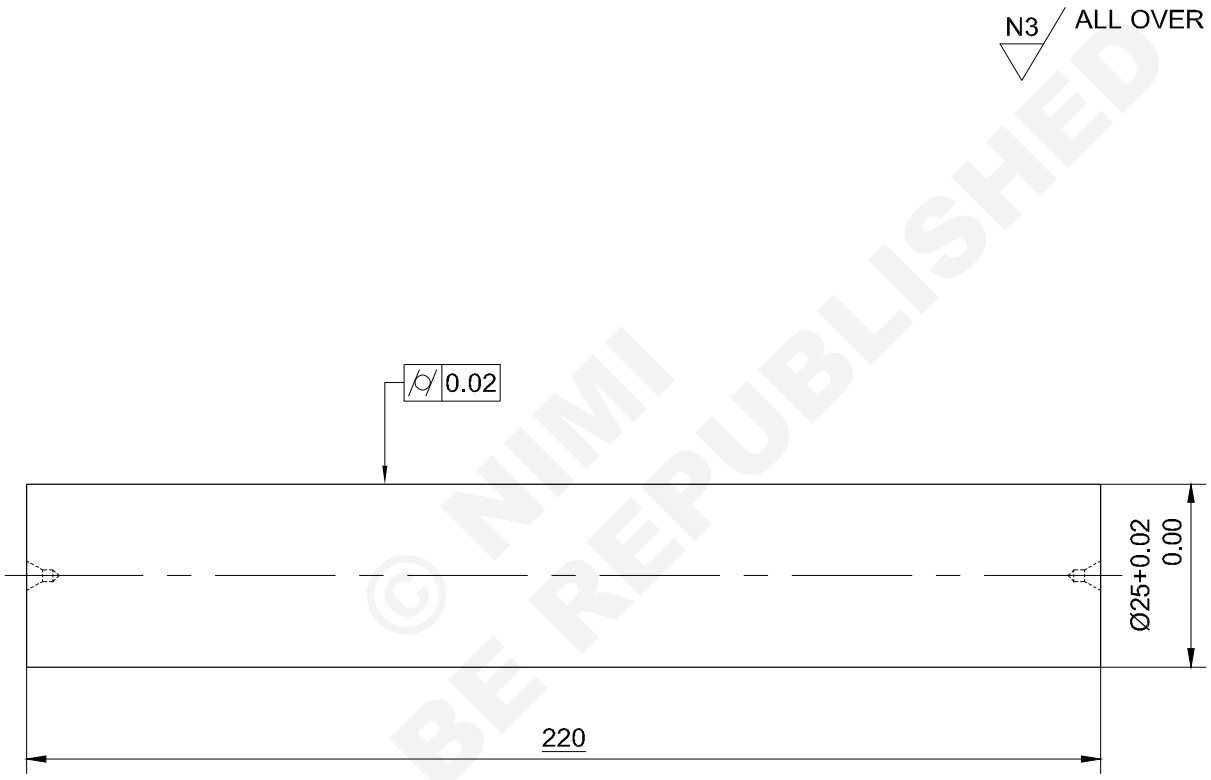
Allow the wheel to spark out.

Remove the workpiece and clean thoroughly. Check the thickness, parallelism and flatness of the surface texture.

Perform rough and finish grinding on cylindrical job

Objectives: At the end of this exercise you shall be able to

- **prepare the cylindrical grinding machine for grinding**
- **dress the grinding wheel for parallel grinding using single print diamond dresser**
- **grind a parallel cylindrical surface with an accuracy of ± 0.05mm**
- **check the dimension with an outside micrometer**
- **check the parallism with dial test indicator.**



1	ISRO ∅25 - 220	–	Fe310	–	–	1.3.45
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PERFORM ROUGH AND FINISH GRINDING ON CYLINDRICAL JOB.**				DEVIATIONS ±0.04	TIME : 20 Hrs
					CODE NO.MG20N1345E1	

Job sequence

- Prepare the cylindrical grinding machine
- Study the drawing and measure the grinding allowance for given job.
- Dress the grinding wheel make sure that the abrasive particles are removed uniformly.
- Mount the job in between centres.
- Set the length of stroke using reversing dogs.

Safety guards fix it in the proper place.

- Start the machine for grinding wheel rotating idly.
- Start the work table traverse
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.

Wear goggles at all time when using a grinding machine.

- Take a moderate cut (0.04mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse give depth of cut at the end of each traverse until the job is within 0.05 - 0.10mm of the required final size.
- Reserve the position of the job in the centres.

Use a soft metal spacer to protect the job.

- Grind the end of the job previously covered by the carrier to the same size as the other end of the job.
- Dress the grinding wheel.
- Grind the work piece to the finished size Ø25mm
- Remove the job from centres.
- Remove burrs of the job using fine abrasive stone.
- Measure the diameter of the job used by 0-25mm outside micrometer
- Check the cylindricity of the job.

Skill sequence

Grinding parallel cylindrical surfaces

Objectives: This shall help you to
- **prepare the cylindrical grinding machine for grinding**
- **align the work table perpendicular to the wheel head**
- **set tail stock for in between grinding operation**
- **set the job in between centres**
- **grind a parallel cylindrical surface**
- **check the parallelism checking.**

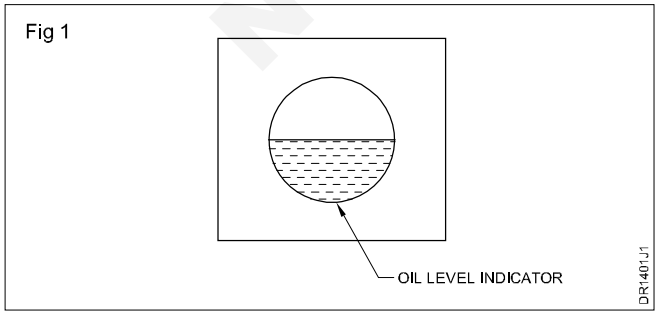
Prepare the cylindrical grinding machine for grinding

- Thoroughly clean the machine with banian cloth.

Don't use cotton waste for clean the grinding machine

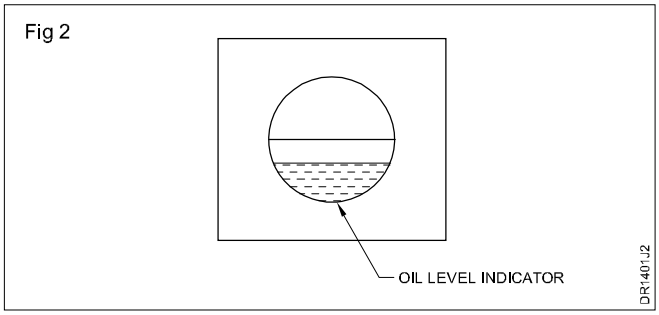
- Check the oil level in the workhead and wheel head (Fig 1)

Fig 1



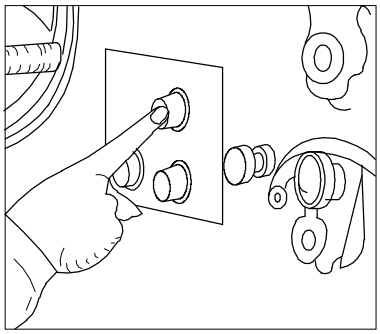
- If it is below the recommended oil level inform to the instructor. (Fig 2)
- Apply oil in all oil points use oil gun (IOC SAE 30/40)
- Apply grease in all grease points with grease gun (Servo gem No. 2)
- Ensure that the work head and wheel head are set to zero position.

Fig 2



- Check the wheel guards are in proper position.
- Start the hydraulic motor by pressing the hydraulic motor switch (Fig 3)

Fig 3



TURN ON THE START SWITCH WITH SWITCH ON-OFF.

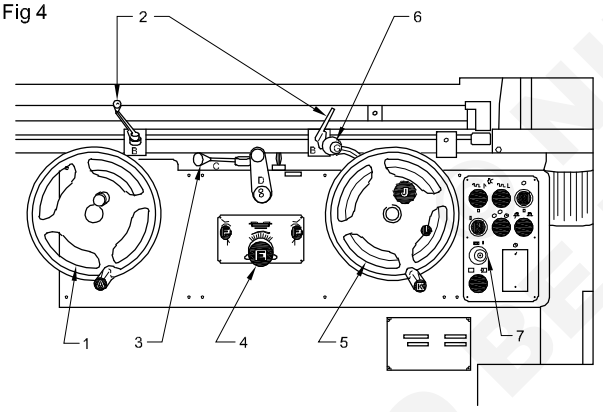
MG1401J3

- Check the oil pressure gauge.

Allow it to run for 3 minutes without any load

- Move the table hand feed handle part - 1.
- Set the length of stroke by adjusting the reversing dog part - 2.
- Release the airlock lever.
- Engage the longitudinal table traverse lever part 3 Fig 4.

Fig 4



MG1401J4

- Observe the movement of the table increase the speed and decrease the speed and decrease the speed are observe the movement. (by automatic lever) part - 4, Fig 4)

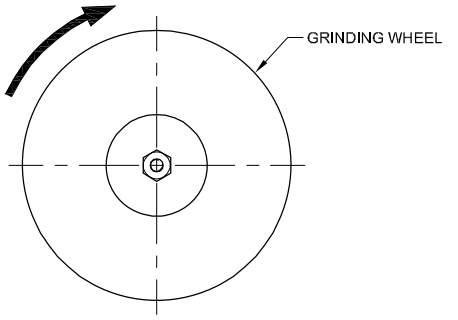
The table movement should be smooth without any jerk.

- Similarly check the wheel head movement towards the table as away from the table by operating the wheel head to rapid feed lever, part -6 Fig 4
- Start the grinding wheel and check the direction of rotation, Fig 5 by viewing the direction of arrow provided on the wheel guard.

Work sheet

- Start the work head spindle by pressing the workhead motor switch.

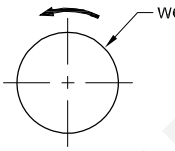
Fig 5



MG1401J5

- Check for the job rotation. (Fig 6)

Fig 6



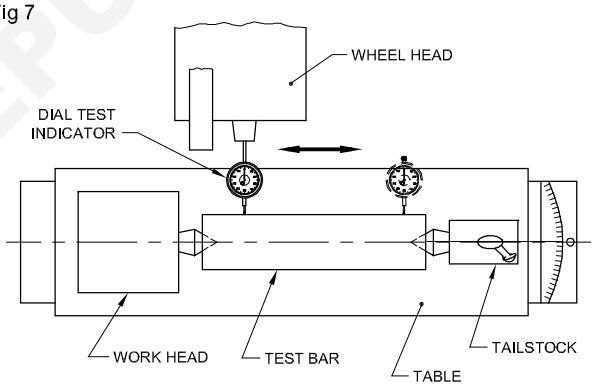
VIEWING FROM WORK HEADCENTRE SIDE

MG1401J6

Align the work table perpendicular to the wheel head

- Clean the wheel head of front side.
- Hold the dial test indicator with magnetic base on wheel head slide Fig 7.

Fig 7

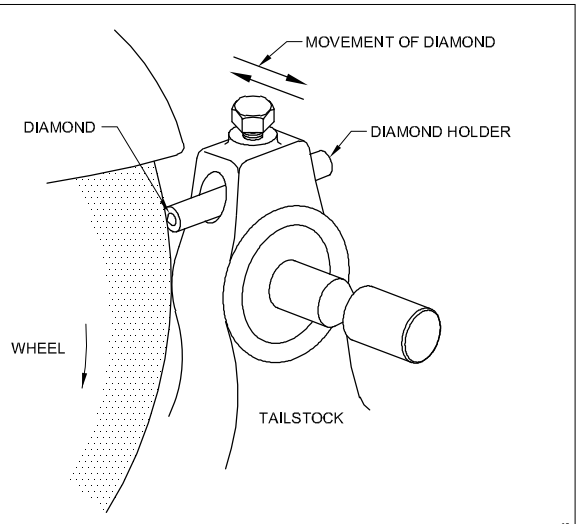


MG1401J7

- Fix the test bar in between centres.
- See the work head wheel head and table at zero degree.
- Touch the dial on the test bar and giving light pressure show the figures.
- Move the table from workhead to tailstock.
- Check the dial reading zero.
- Incase variation of reading +10 divisions.
- Loose the table top Allen screws and adjust slightly side screw
- Check the dial reading at zero so the work head centre tail stock centre same line.
- The table at zero degree aligning is correct position.

Tail stock holding method refer Fig 8

Fig 8



DRESSING WHEEL OF CYLINDRICAL GRINDING MACHINE WITH DIAMOND CLAMPED TO TAILSTOCK

- Hold the single point diamond dresser in dressing holder
- Fix the dressing holder on tailstock 'T' slot and tightening the dressing holder.
- Set the length of stroke for table traverse movement.
- Position of the wheel head
- Touch the dresser on grinding wheel.
- Give the cut for rough dressing 0.02 to 0.5m/min
- Put on the coolant.
- Start and move the table traverse automatic feed lever.
- Give the cut for finish dressing 0.01mm x 0.05mm and table feed move for 0.1 to 0.2 m/min.
- Do dressing by automatic feed on the whole face of the grinding wheel.
- Check the entire face of the grinding wheel proper dressing

Position of grinding wheel and diamond dresser at the approximately at the centre of the wheel and keep 3mm gap (Fig 9)

Fig. 9

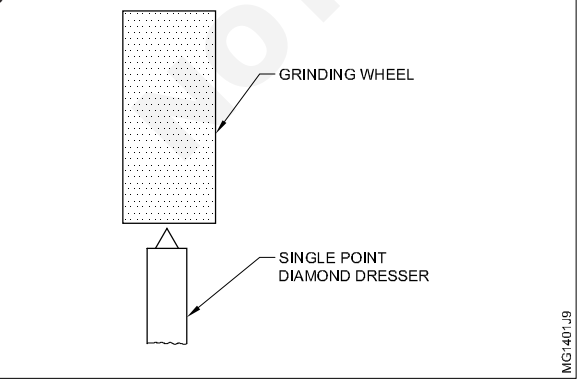
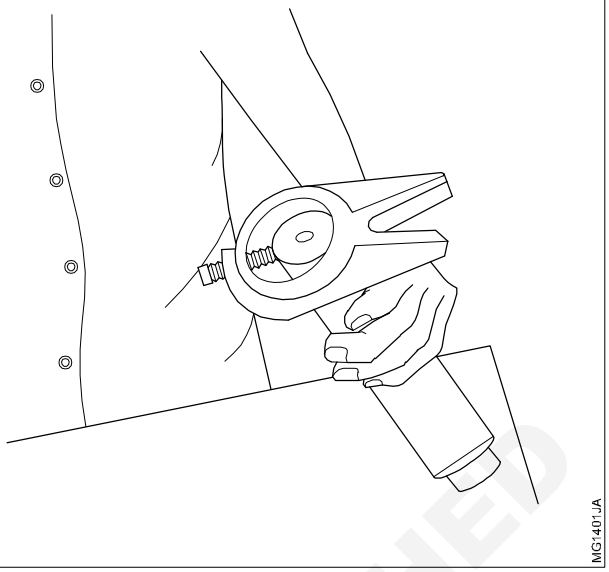
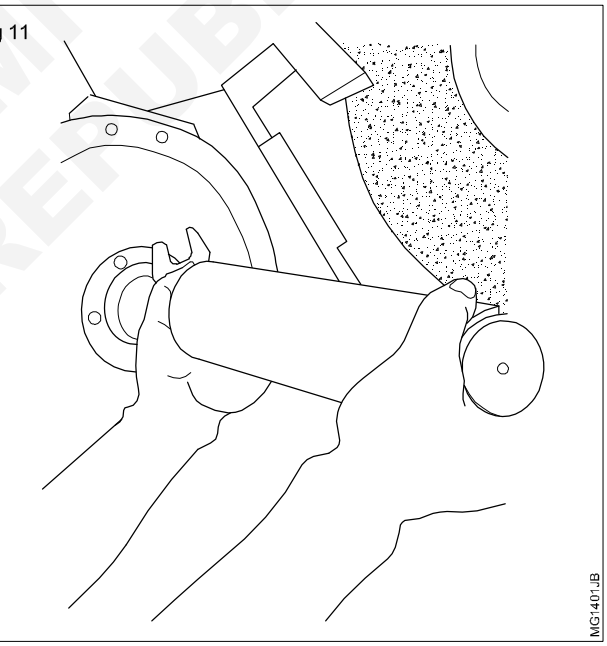


Fig 10



- Too long a bolt on a dog may become loose in the course of grinding. (Fig 10)
- Hold the work securely in both hands and fit the centre hole carefully to the centre on the work head side. Fig11

Fig 11



- Hold the work with the left hand as illustrated while holding the work to prevent the centre hole coming out.
- As illustrated support the work shall with the left hand and fit the centre to the centre hole by operating the lever of the tailstock with the right hand. (Fig. 12)

Before supporting the job in between tailstock centre gap is 5mm should be maintained. (Fig.12)

- Where the tailstock centre has a nut for a adjusting nut so as to allow the work to be turned tightly by the fingers.

Fig 12

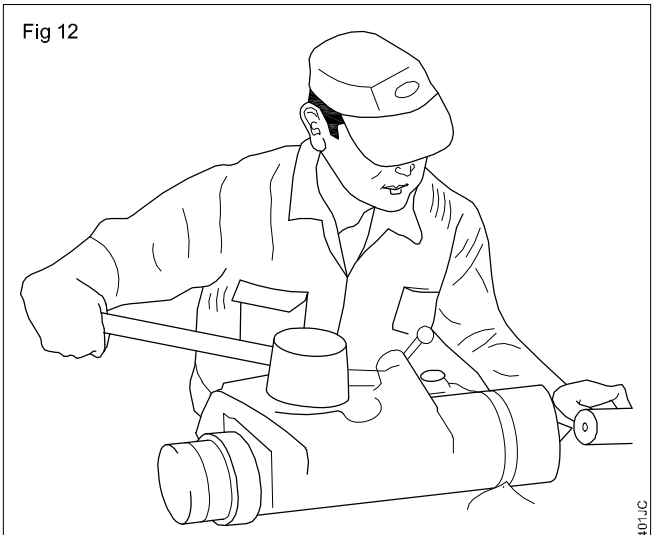
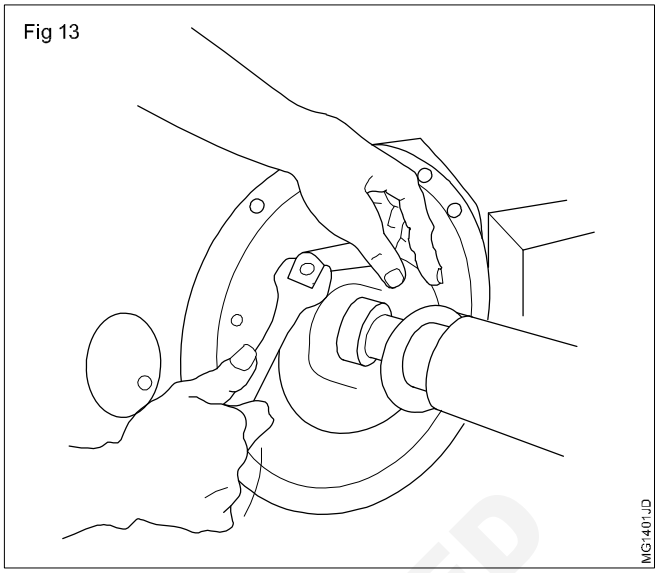
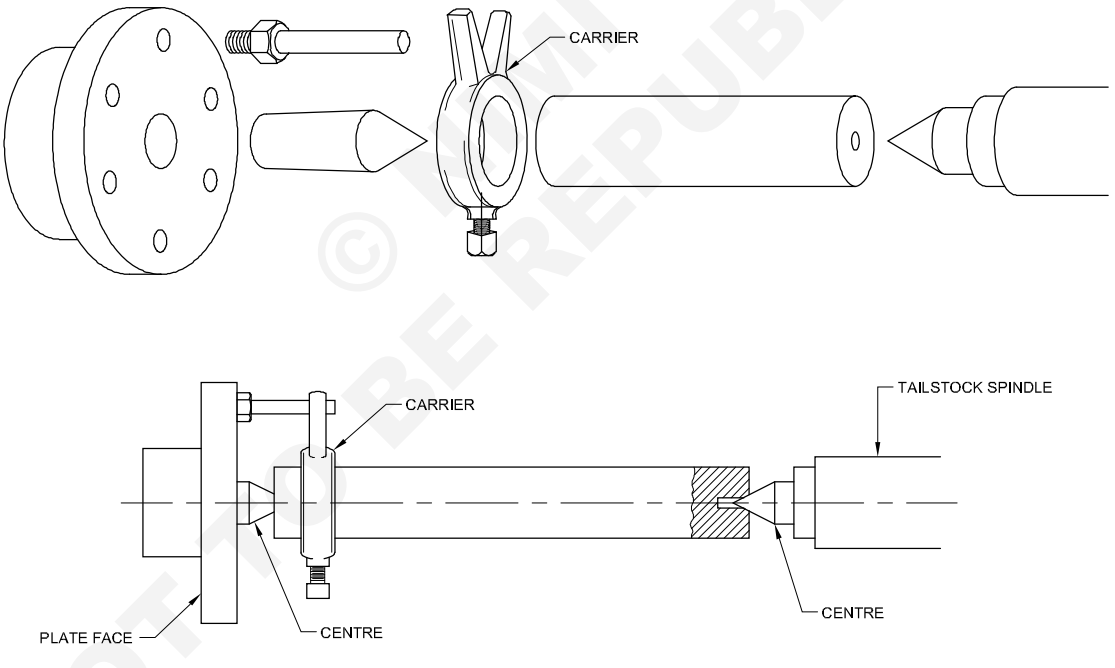


Fig 13



- Where the tailstock centre has a nut for adjusting so as to allow the work to be turned tightly in accordance with the dog leg length. (Fig. 13)
- So the workpiece mounted in between centres.

Fig 14

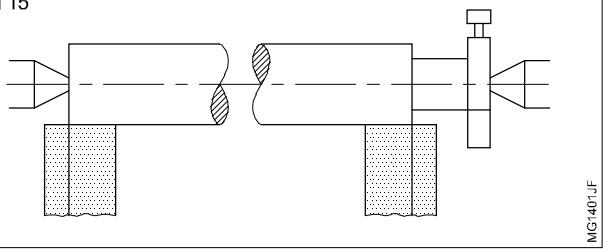


WORKPIECE MOUNTED BETWEEN CENTRES

Grind a parallel cylindrical surface refer Fig. 15

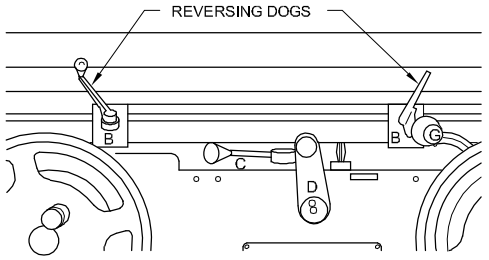
- Start the machine and warm up for about 5 minutes.
- Adjust the table stroke so as to make the grinding wheels over - run beyond both ends of the work by about 1/3 the length of the wheel thickness as illustrated. (Fig. 16)
- Set the workspeed and start the workhead motor spindle switch. (Fig. 17 & Fig.18)
- Adjust the feeding speed so as to feed the table by about 2/3 - ¾ of the wheel thickness per work revolution.
- Adjust the tally times of the table at both ends of the work so as to stop for a time during which the work would rotate 1-2 turns as illustrated Fig.19.

Fig 15



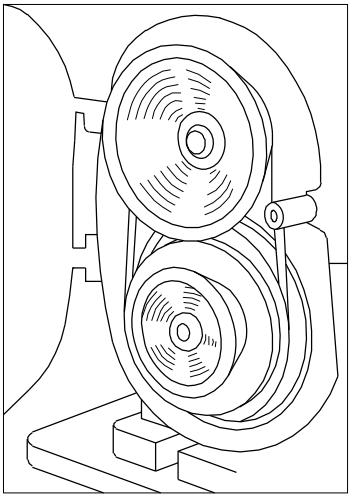
MG1401JF

Fig 16



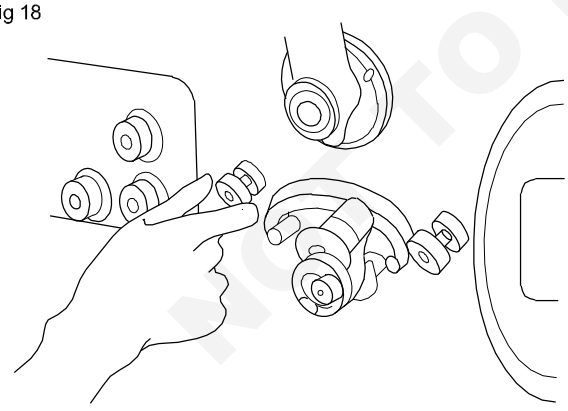
MG1401JG

Fig 17



MG1401JI

Fig 18

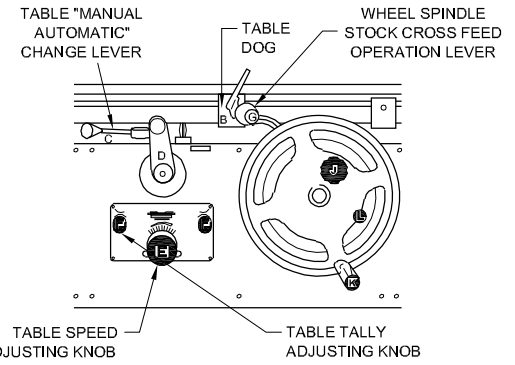


MG1401JJ

To rough - grind

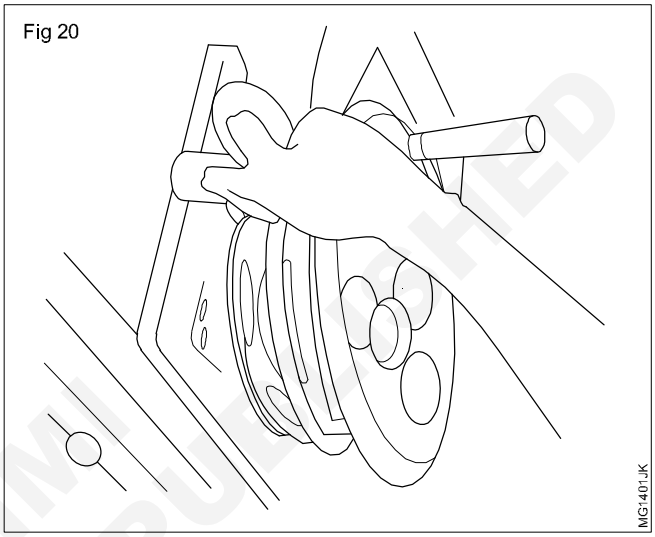
- After confirming that the distance between the wheel and the work is 25mm or more, move the wheel spindle slowly promptly forward and manually feed until the wheel lightly touches the work, set the zero division on the graduation collar (Fig. 20).

Fig 19



MG1401JH

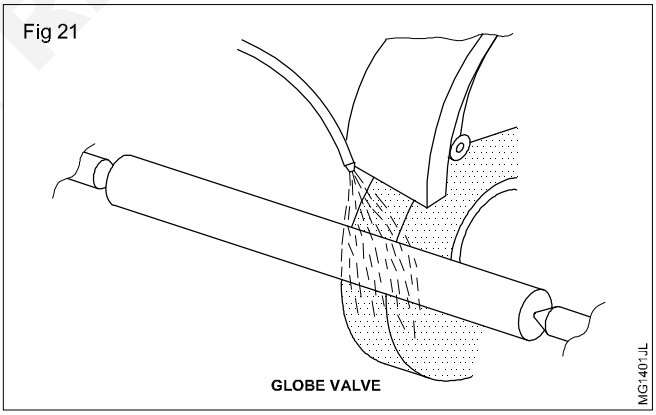
Fig 20



MG1401JK

- After applying grinding fluid feed the table automatically Fig. 21

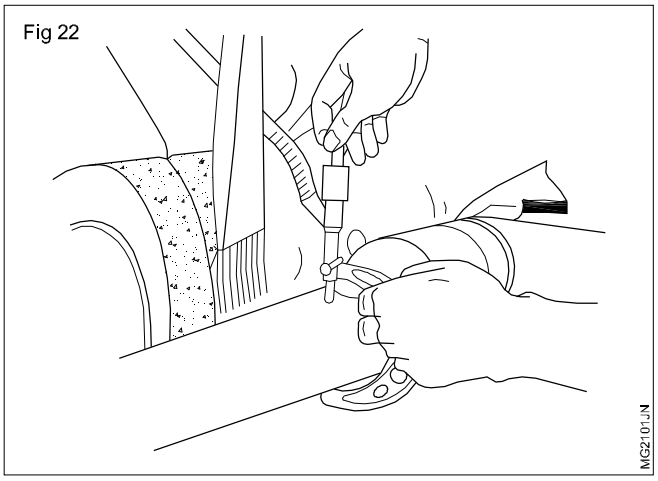
Fig 21



MG1401JL

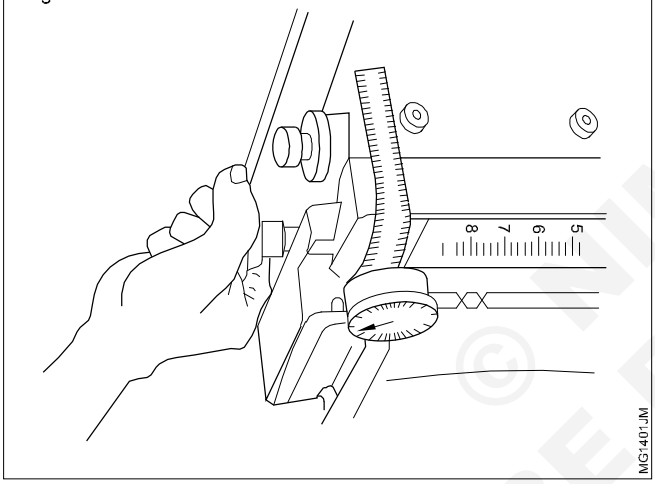
- Give the depth of cut from 0.02mm to 0.04mm at one end or both ends of the work and do rough grinding until its whole surface is ground evenly.
- Stop the automatic feed of the table at the right end of the table at the right end of the work back the wheel spindle stock promptly and measure the diameters at both ends of the work with an outside micrometer. (Fig.22)

Fig 22



- When the work has been tapered beyond expectation loosen the four fastening. Allen screw of the upper table, set the dial gauge at zero and then a move the swivelling of the table with the adjusting screw as illustrated. (Fig. 23)

Fig 23



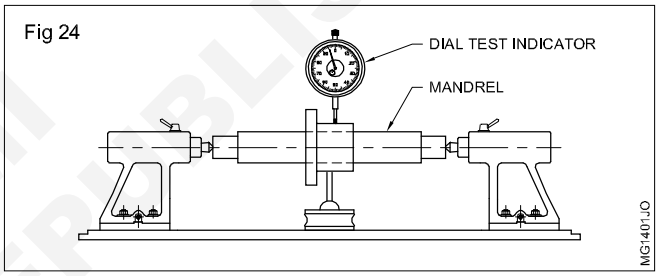
- When the diameter at the side of the work head is larger than the other turn the table clock wise and when the diameter at the tailstock side is too large turn in counter clockwise.
- As for table tilting give the specified conversion value to the dial gauge according to the length and the difference in size of the work.
- Tighten the upper table do trial grinding to repeat amendments for obtaining the given taper.
- When the given taper has been obtained, do rough grinding leaving a finish margin of 0.02 - 0.05mm in the outer diameter.

To finish - grind

- Determine the numbers of work revolution so as to make the peripheral speed of the work 12 - 15m/min.
- Adjust the table speed so as to fed at about 1/8 of the wheel thickness per work revolution.
- If necessary do finish dressing.
- Make the depth of cut from 0.0025mm to 0.01mm per stroke, while measuring from time to time as grinding by making the depth of cut by graduations.
- In the final stages the depth of cut shall not be made, but reciprocate the table 2-3 times to do spark - out.
- Back the wheel spindle stock and do fine chamfering with an oil - stone.
- Measure the size of the work in the state that the work stops fully after promptly retreating the wheel spindle stock.

Parallelism checking ref. Fig. 24

Fig 24



- Clean the surface plate without any dust and oil.
- Fix the tailstock centres on surface plate.
- Hold the dial in magnetic base.
- Keep it on the surface plate.
- Hold the job in between centres.
- Touch and pressure give on the job.
- Move the dial traversely.
- Check the reading at zero.
- Incase variation in job regrind it.
- Recheck the job for parallelism and correct to zero position.
- Rotate by hand and check cylindricity of job.
- Check the reading is zero position for correct accuracy.

Include diamond and CBN grinding wheel

Objectives: At the end of this exercise you shall be able to
- **resharpen the H.S.S blend right hand turning tool using CBN grinding wheel on bench grinder**
- **resharpen the right hand brazed carbide tipped tool on bench grinder using diamond wheel.**

PROCEDURE

TASK 1:

1 Mount the CBN wheel on the bench grinder (Fig 1)

2 Select H.S.S blend R.H tool for resharpening

3 Where good be put on the machine

4 Resharpen the tool by following the previously ground angle

5 Check the blend position is grounded off.

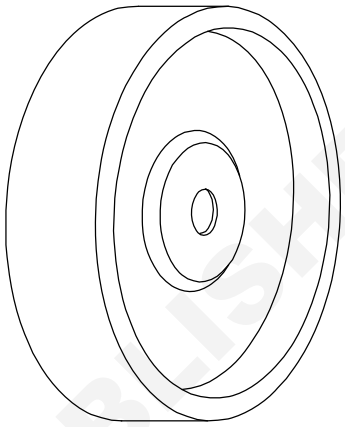
6 Check for the tool sharp edges.

7 Use CBN wheel of following specification.

8 B 100 P 75 B 1/16

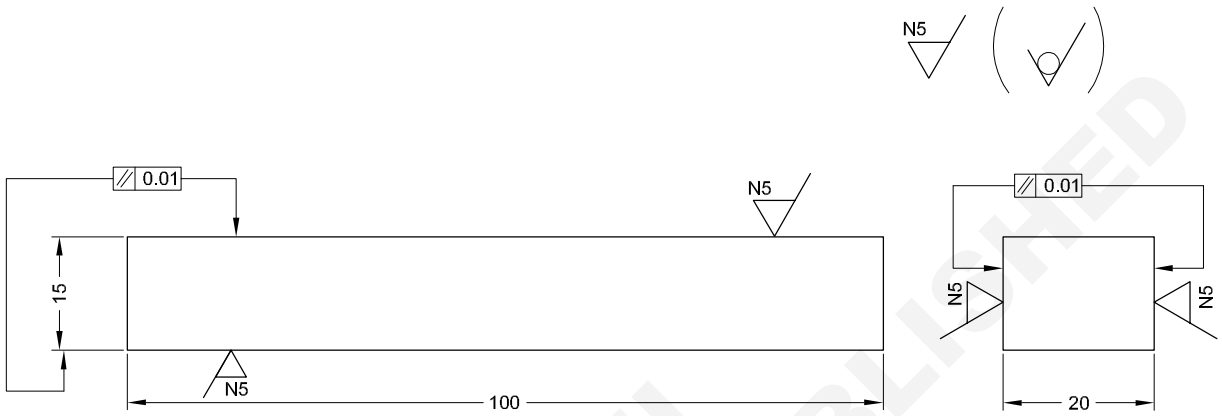
9 Diameter and thickness of wheel as per the machine specification.

Fig 1



Perform grinding on surface grinding machine

Objectives: At the end of this exercise you shall be able to
- **grind parallel surface**
- **prepare the surface grinding machine for grinding operation.**



Job Sequence

- Machine the jobs and determine the grinding allowance for each surface to be ground.
- Prepare the surface grinding machine for grinding.
- Rough grind both the opposite sides of the pieces and maintain to 15.04mm thick.
- Dress the wheel for finish grinding.
- Finish grind the pieces 15.00 thick to an accuracy of ±0.01mm. Measure the size with a 0-25 outside micrometer.
- Set the job with the angle plate (150x150) by 2 'C' clamps of 100mm size for grinding adjacent surfaces at 90°.
- Rough grind the adjacent sides individually leaving half of the grinding allowance for the opposite surfaces to 20.03mm thick.
- Mount the job on the magnetic chuck keeping down the surfaces already ground and rough grind the opposite surfaces of 20.03mm thick.
- Finish grind and bring the thickness to 20.00
- Remove the parallels from the magnetic chuck.
- Clean thoroughly and deburr with a fine abrasive stone.
- Measure the width and thickness for dimensional accuracy with an outside micrometer.
- Also check for parallelism with an outside micrometer on the four corners on each piece.
- Demagnetize the block.

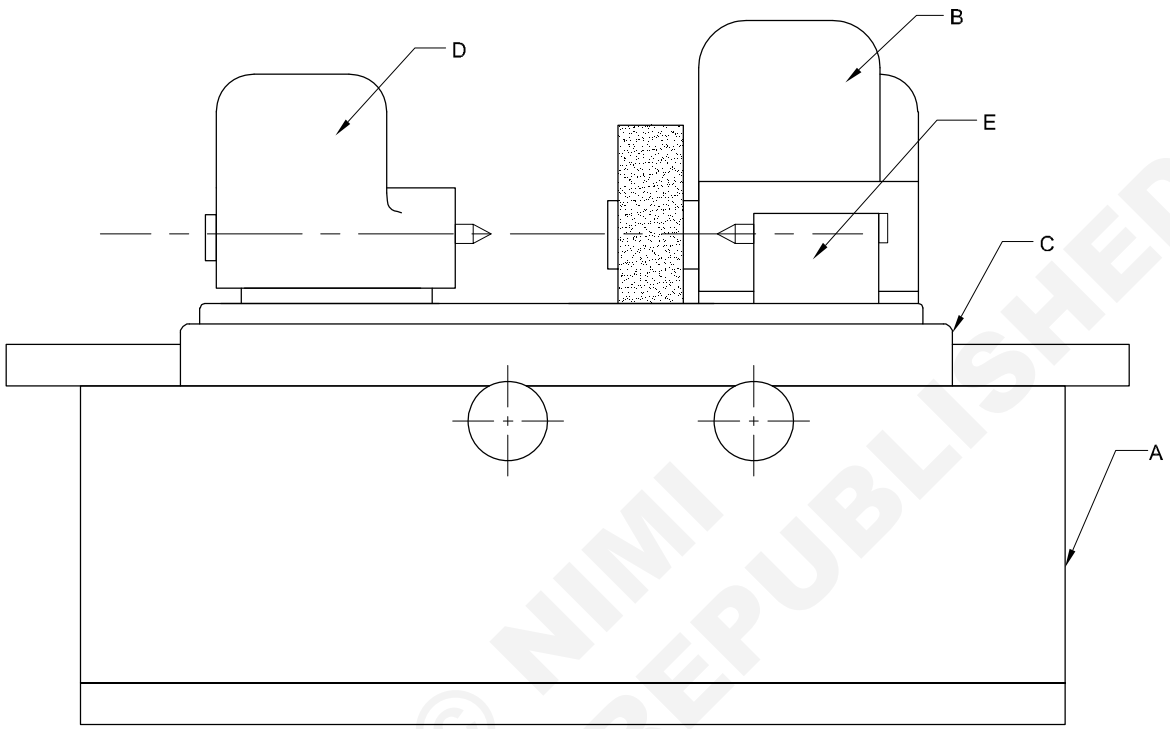
-	20x105x25	-	CI	-	-	1.4.47
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PERFORM GRINDING ON SURFACE GRINDING MACHINE	TOLERANCE = ±0.01mm	TIME 07 Hrs
		CODE NO. MG20N1447E1	

Identify different parts of cylindrical grinding machine

Objectives: At the end of this exercise you shall be able to
- **identify different parts of cylindrical grinding machine**
- **fill the name of parts in Table-1.**

Fig 1



Job Sequence

Instructor shall explain the each part of the cylindrical grinding machine and ask trainees to fill the name in Table-1.

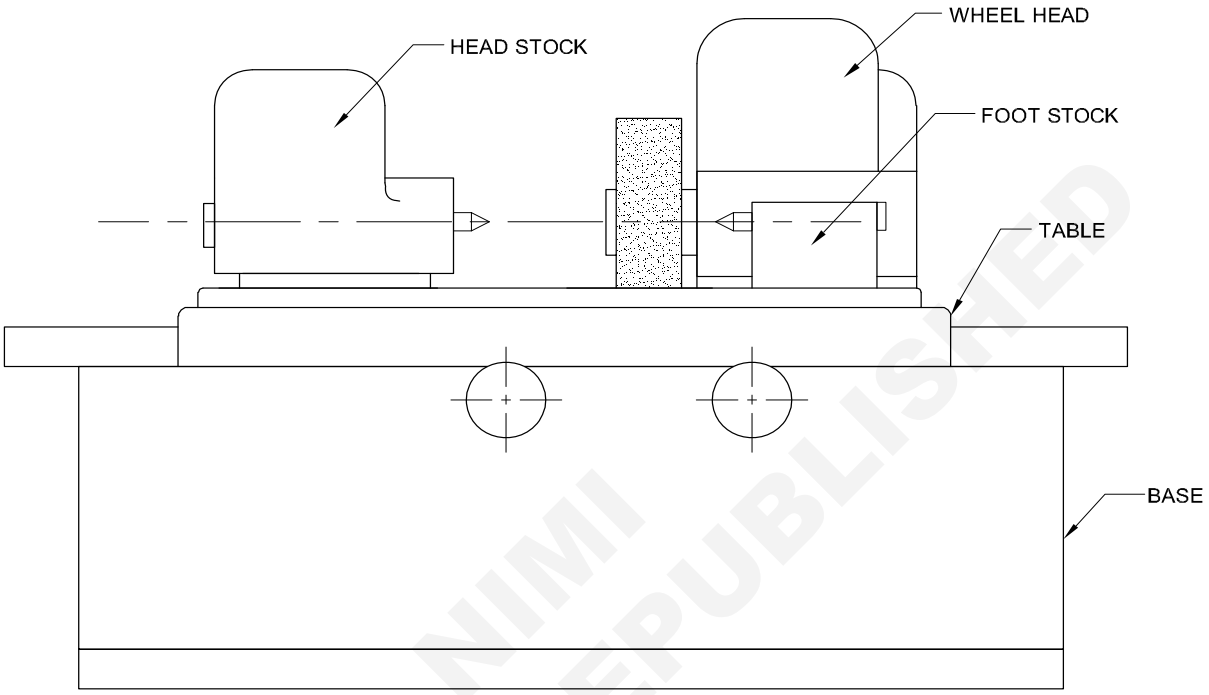
- Trainees will note down all the parts names
- Record in table-1
- Get it checked by instructor.

No	Name of the part
A	
B	
C	
D	
E	

Set cylindrical grinding machine and perform operation with dry/idle run

Objectives: At the end of this exercise you shall be able to
- **preparing cylindrical grinding machine**
- **operate with dry/idle run.**

Fig 1

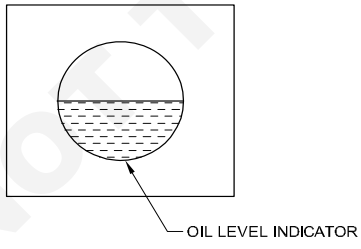


Prepare the cylindrical grinding machine for grinding

Thoroughly clean the machine with banian cloth.

Don't use cotton waste for clean the grinding machine.

Fig 1



Check the oil level in the workhead and wheel head (Fig. 1)

If it is below the recommended oil level inform to the instructor. (Fig. 2)

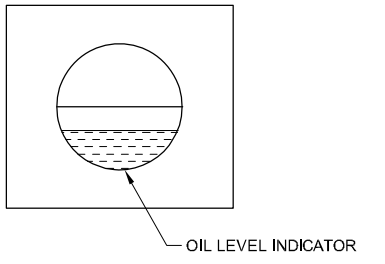
Apply oil in all oil points use oil gun (IOC SAE 30/40)

Apply grease in all grease points will grease gun.

(Servo gem No. 2)

Ensure that the work head and wheel head are set to zero position.

Fig 2



Check the wheel guards are in proper position.

Start the hydraulic motor by pressing the hydraulic motor switch

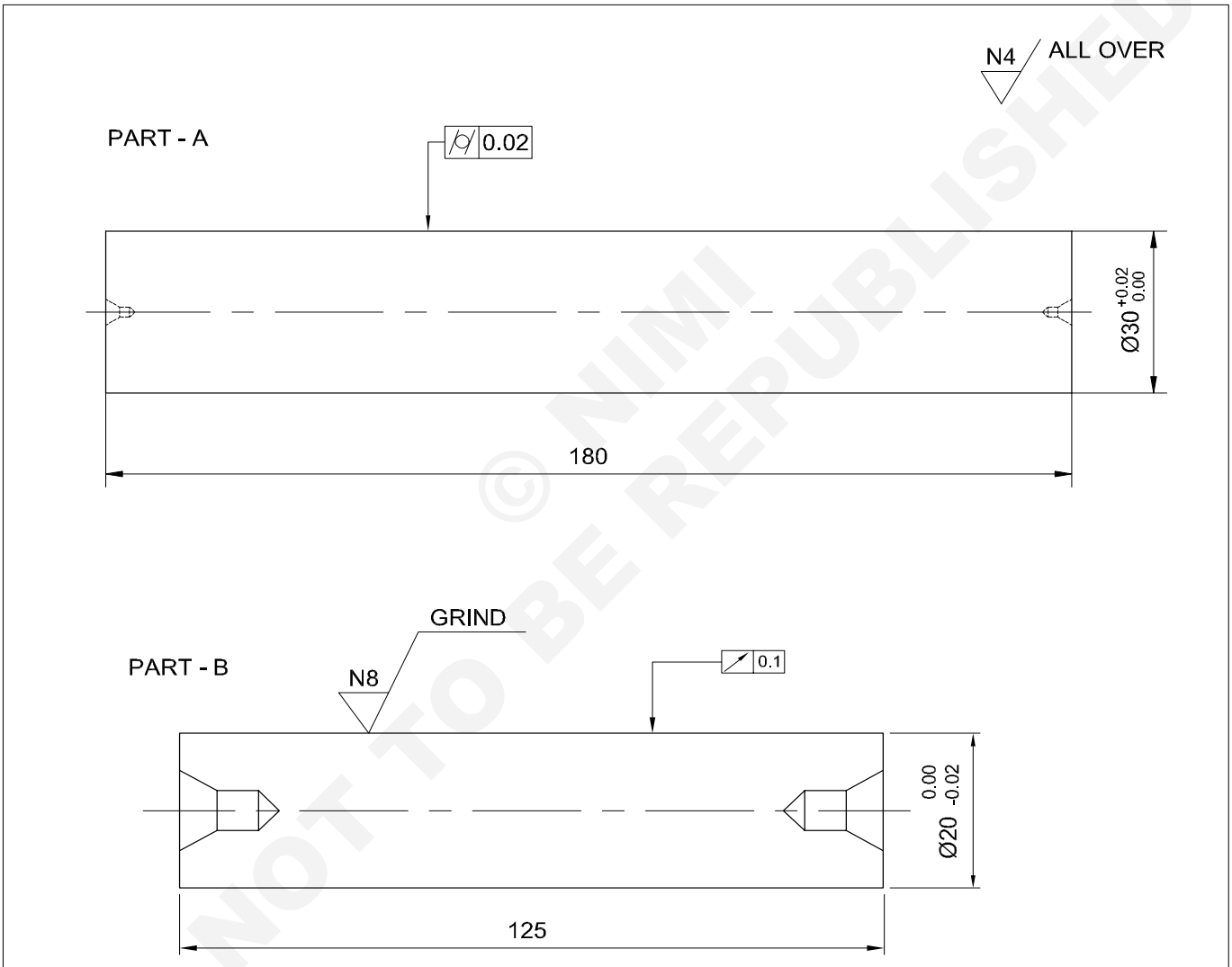
- Prepare the cylindrical grinding machine for part A operation.
- Study the drawing and measure the grinding allowance for given job.
- Dress the grinding wheel make sure that the abrasive particles are removed uniformly.
- Mount the job in between centres.
- Set the length of stroke using reversing dogs.

Safety guards fix it in the proper piece

Perform grinding on cylindrical grinding machine (hard and soft metal)

Objectives: At the end of this exercise you shall be able to

- **prepare the cylindrical grinding machine for grinding**
- **select the suitable grinding wheel for hard and soft metal grinding**
- **dress the grinding wheel for parallel grinding using single point diamond dresser**
- **grind a parallel cylindrical surface with an accuracy of ±0.02 mm**
- **check the dimension with an outside micrometer**
- **check the parallelism with dial test indicator**
- **select the grinding wheel for soft materials**
- **hold the soft work piece**
- **grind the soft work piece..**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	Ø 20 - 130	–	BRASS	–	B	
1	Ø 30 - 185	–	Fe310	–	A	1.4.50

SCALE NTS	PERFORM GRINDING CYLINDRICAL GRINDING MACHINE (HARD AND SOFT METAL)	DEVIATIONS ±0.02	TIME : 07 Hrs
		CODE NO. MG20N1450E1	

Job Sequence

- Prepare the cylindrical grinding machine for part A operation.
- Study the drawing and measure the grinding allowance for given job.
- Dress the grinding wheel make sure that the abrasive particles are removed uniformly.
- Mount the job in between centres.
- Set the length of stroke using reversing dogs.

Fix the safety guard in proper place.

- Put on the grinding wheel.
- Start the work table traverse.
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.

Wear goggles at all time when using a grinding machine.

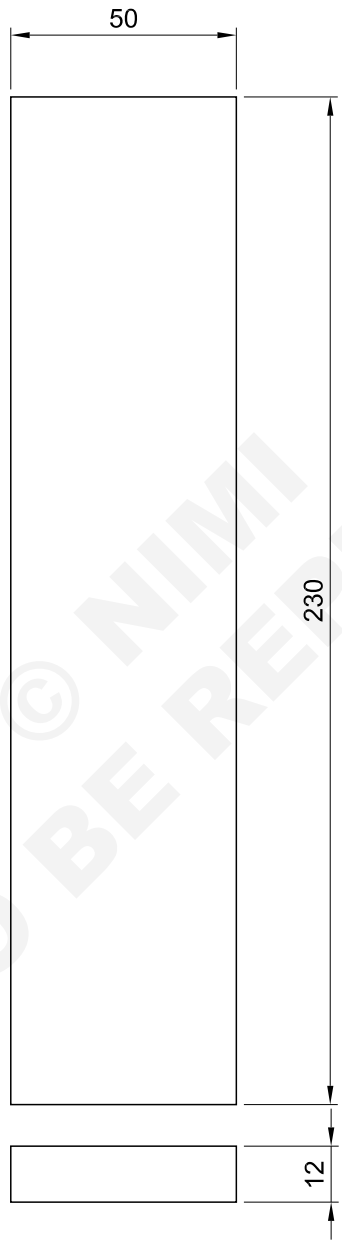
- Take a moderate cut (0.04mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse give depth of cut at the end of each traverse until the job is within 0.05 - 0.10mm of the required final size.
- Reserve the position of the job in the centres.

Use a soft metal spacer to protect the job.

- Grind the end of the job previously covered by the carrier to the same size as the other end of the job.
- Dress the grinding wheel.
- Grind the work piece to the finished size Ø25mm like roughing cycle.
- Remove the job from centres.
- Remove burrs of the job using fine abrasive stone.
- Measure the diameter of the job used by 0-25mm outside micrometer.
- Check the cylindricity of the job.
- Repeat the job sequence for part B operation after changing the grinding wheel according to the material to be grind.

Parallel block grinding with in accuracy ± 0.2mm

Objectives: At the end of this exercise you shall be able to
- **hold the workpiece on magnetic chuck**
- **make parallel surface within limit**
- **check the parallelism by dial test indicator.**



1	55 x 15 x 235		MILD STEEL			3.1.03
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PARALLEL BLOCK GRINDING**				DEVIATIONS ±0.001	TIME 25hrs
					CODE NO. MG3103E1	

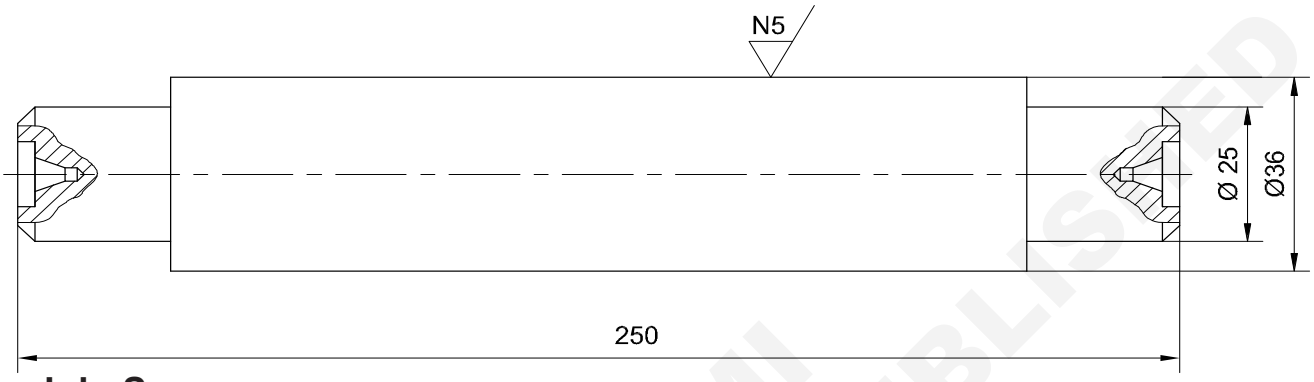
Job sequence

- Determine the grinding allowance for each surface to be ground.
- Prepare the surface grinding machine for grinding.
- Mount both pieces on a magnetic chuck.
- Rough grind both opposite sides and maintain 13 mm thickness.
- Dress the wheel for finish grinding.
- Finish grind both pieces to 12.0 mm to an accuracy of ± 0.2 mm.
- Measure the size with a 0-25 mm outside micrometer.
- Set both pieces together with the angle plate using parallel block to support and 'c' clamps.
- Rough and finish grind by leaving half of the grinding allowance for the opposite edge.
- Mount the pieces on a magnetic chuck keeping down the surface already ground and rough and finish grind to a width of 50.0 mm to an accuracy of ± 0.001 mm.
- Measure dimensions with a 50 to 75 mm outside micrometer.
- Dress the grinding wheel on the sides for relief and true the face to the required angle.
- Deburr the sharp edges.

Grinding of plain mandrel within accuracy ± 0.2mm

Objectives: At the end of this exercise you shall be able to

- **set the job between centres**
- **adjust the length and position of table traverse**
- **grind parallel cylindrical surface to an accuracy of ±0.2mm**
- **check the size and parallelism with the help of an outside micrometer**
- **dress the grinding wheel of cylindrical grinder**
- **follow the safety precautions to be followed while working on a cylindrical grinding machine.**



Job Sequence

- Lubricate all moving parts.
- Run the machine idle for few minutes keeping longer length of stroke to warm up the machine system.
- Ensure that the work head and tail stock is properly positioned with respect to the wheel head and the workpiece.
- Make sure that the workpiece is provided with proper centres of the desired shape and depth.
- Check the grinding allowance in the workpiece
- Wear goggles start the coolant and dress the wheel.
- Apply grease to the tip of the centres and mount the job between centres.
- Set proper tension at the tail stock centre and lock.
- Select and fix suitable driving dog/carrier on one end of the job.
- Set stroke length by adjusting table trip dogs, such that 1/3 rd of wheel clears the tail stock end of workpiece, and about 30.0mm from the workhead end of workpiece to allow the grinding wheel to clear the carrier.
- Make sure the running wheel or carrier do not hit any other part of the machine.
- Set job speed, and table speed as per diameter and type of workpiece.
- Run the machine, bring wheel head forward slowly by rotating cross feed hand wheel till you see sparks.
- Give a light 0.01mm at a time till it touches both ends.
- Measure at both ends of the workpiece by using outside micrometer.
- If there is any taper, adjust by table adjusting screw by unlocking the binding screws.
- While measuring taper, ensure the wheel is taken back.
- Repeat this till you get zero on both both ends.
- Start giving depth of cut, and finish to the required size.
- Take care to give depth of cut, when the job clears from the wheel at R.H. side.
- Reverse the job, take care to give soft packing under the carrier screw to avoid damage of the ground surface.
- Set the stroke length, grind the end of the job previously covered by the carrier, to the required size.
- Check the size.
- Remove burrs by smooth oil stone at the edges.
- Remove workpiece from the centres and detach carrier.

1	ISRO 40 - 260	PRE TURNER	–	-	8	1.4.52
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GRINDING OF PLAIN MANDREL WITH IN ACCURACY ± 0.2 mm	DEVIATIONS ±0.02	TIME : 06 Hrs
		CODE NO. MG20N1452E1	

Selection of grinding wheel for grinding different metals

Objectives: At the end of this exercise you shall be able to
- **select suitable abrasive/grinding wheel to grind different**
- **metals listed in table.**

Job Sequence

- Determine different abrasive grinding wheels to grind different metal listed in table 1 and record it

Table 1

S.No	Material to be ground	Kind of abrasive/wheel to be uses
1	Steel	
2	Malleable cast iron	
3	Gray cast iron	
4	Brass	
5	Bronze	
6	Copper	
7	Aluminium	
8	Plastic	

Get it verified by the trainer

Note
- **Hand material above 35 kg l/mm2 - Aluminium oxide**
- **Soft material up to 35 kg l/mm2 - Silicon carbide**
- **Soft material - hard wheel is used**
- **Hard material - soft wheel is used.**

Selection of suitable grinding wheel to obtain rough and fine finish as per IS 1249-1958

Objectives: At the end of this exercise you shall be able to
- **select suitable grain, grade, structure and bond to grins rough fine and super finish.**

Job Sequence

- Determine the suitable grinding wheel to grind rough, fine and super finish listed in table 1 and record it.

Kind of surface finish	Grain	Grade	Structure	Bond
Rough				
Finish				
Super finish				

Information

Grain size grit							
Coarse	10	12	14	16	20	24	
Medium	30	36	46	54	60		
Fine	80	100	120	150	180		
Very fine	220	240	280	320	400	500	600

Grade										
Soft	A	B	C	D	E	F	G	H		
Medium	I	J	K	L	M	N	O	P		
Hard	Q	R	S	T	U	V	W	X	Y	Z

Structure							
Dense	1	2	3	4	5	6	7 8
Open	9	10	11	12	13	14	15 or higher

Rough grinding select coarse structure

Finish grinding select dense structure

Polishing select dense structure

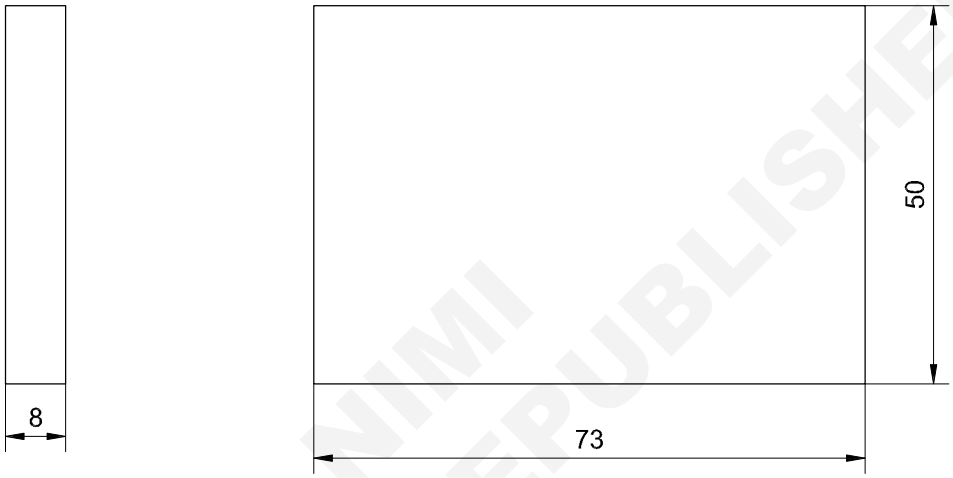
General purpose grinding of various material	-	**Vitrified bond**
Grinding cutter and precision tool	-	**Silicate bond**
Super finish grinding	-	**Rubber bond**

Get it verified by the trainer

Grind different metals with suitable grinding wheels

Objectives: At the end of this exercise you shall be able to
- **prepare the grinding machine**
- **dress the grinding wheel**
- **select the wheel according to the material to be grind**
- **grind as per dimension rough and finish grinding.**

TASK-1



TASK-2 HCS (SAME FIGURE)

TASK-3 CAST IRON (SAME FIGURE)

TASK-4 BRASS (SAME FIGURE)

1	50 BR 9 -75	-	BRASS	-	-	
1	50 CI 9 -75	-	CAST IRON	-	-	
1	50 HCS 9 -75	-	HCS	-	-	
1	50 ISF 9 -75	-	Fe 310	-	-	1.4.55
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**GRIND DIFFERENT METALS WITH SUITABLE GRINDING WHEELS**	DEVIATIONS ±0.02	TIME : 24 Hrs
		CODE NO. MG20N1452E1	

PROCEDURE

TASK 1: **Grinding Fe 310 (mild steel)**

- Hold the job in magnetic table.
- Select the wheel for mild steel an aluminiam oxide wheel may be selected.
- Select the coarse grained wheel for soft material.
- Grind the job as per drawing first rough grinding and then finish grinding.
- Use coolant while grinding.

— — — — — —

TASK 2: **Grinding high carbon steel**

- Hold job on magnetic table.
- Select the wheel of carbide and soft wheel.
- Select fine grain wheel for hard material.
- Grind the job as per drawing.
- First rough grinding and finish grinding.
- Use coolant while grinding.

— — — — — —

TASK 3: **Grinding cast iron**

- Select the coarse grain wheel of carbide.
- Hold the job on machine table.
- Grind the job and first rough grinding and finish grinding.
- Do not use coolant if necessary use air to remove burr.

— — — — — —

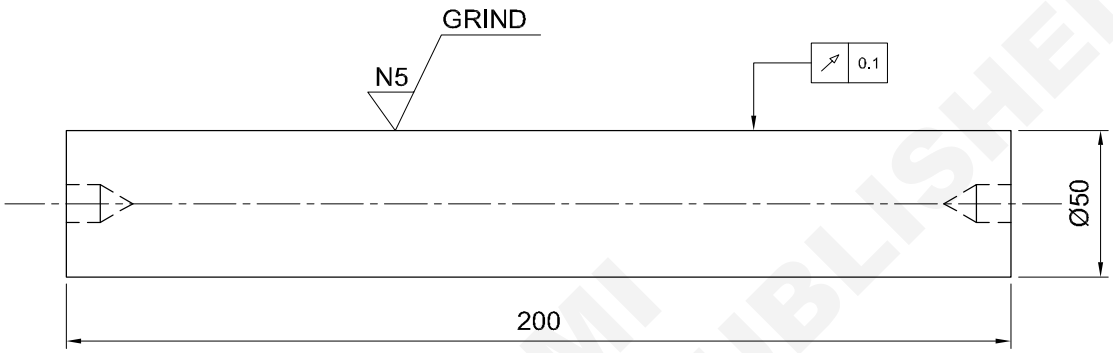
TASK 4: **Grinding brass**

- Follow the above procedure.
- Hole the job on machine vice.
- Use coolant.

— — — — — —

External cylindrical grinding operation within accuracy ± 0.1

Objectives: At the end of this exercise you shall be able to
- **hold the workpiece in between centres correctly**
- **select the grinding wheel speed, feed, depth of cut**
- **rough grind the job within limit**
- **finish grind the job within limit**
- **maintain cylindricity and straightness within limit**
- **check the diameter by vernier micrometer**
- **check parallelism & roundness.**



Job sequence

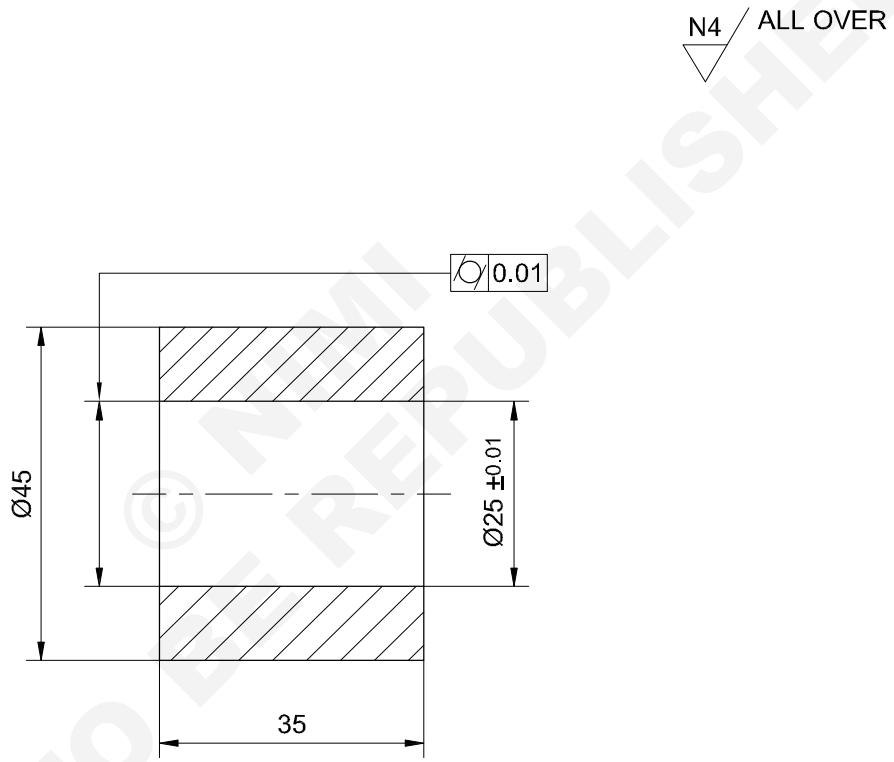
- Determine the grinding allowance.
- Balancing the grinding wheel.
- Mount the wheel on the cylindrical grinding machine.
- Dress the grinding wheel.
- Hold the job in between centres.
- Set the table traverse dog to grind 200 mm length(including over run).
- Start the grinding wheel and then the job for rotation.
- Bring the wheel to the job and allow it to touch.
- Grind the job (giving required feed) to an accuracy of ±0.1 mm to a length of 200 mm and the diameter of 50.05 mm.
- Move the wheel and job away.
- Stop the wheel and job rotation.
- Check the dimension with a 25 to 50 mm outside micrometer along with parallelism and roundness.
- If required dimension is not achieved, repeat the cycle till get the correct size.

1	Ø 50.5 - 200		Fe 310	-	-	1.4.56
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**EXTERNALS CYLINDRICAL GRINDING OPERATION WITHIN ACCURACY ± 0.1MM**				DEVIATIONS ± 0.01	TIME : 3 Hrs
					CODE NO. MG20N1456E1	

Internal grinding operation within accuracy ± 0.1mm

Objectives: At the end of this exercise you shall be able to

- **mount the internal grinding attachment on universal grinding machine**
- **mount the grinding wheel and dress the wheel by diamond dresser**
- **set the job in four jaw chuck by using D.T.I**
- **grind the plain bore with an accuracy of ± 0.1mm**
- **measure the bore diameter by using telescopic gauge.**



1	Ø 45 - 35	–	Fe310	–	–	1.4.57
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	INTERNAL CYLINDRICAL GRINDING OPERATION WITHIN ACCURACY ± 0.1MM.	DEVIATIONS as per IS : 2102(F)	TIME : 3 Hrs
		CODE NO. MG20N1457E1	

Job sequence

- Prepare the machine for internal grinding.
- Fit the internal grinding attachment and mount the grinding wheel with suitable spindle.
- Dress the wheel with a diamond tipped dressing tool.
- Measure the existing bore diameter of the workpiece to check the grinding allowance.
- Determine the work and wheel surface speeds and set the machine accordingly.
- Mount the workpiece in a chuck.
- True the workpiece using the dial test indicator.
- Set the length of stroke using reversing dogs.

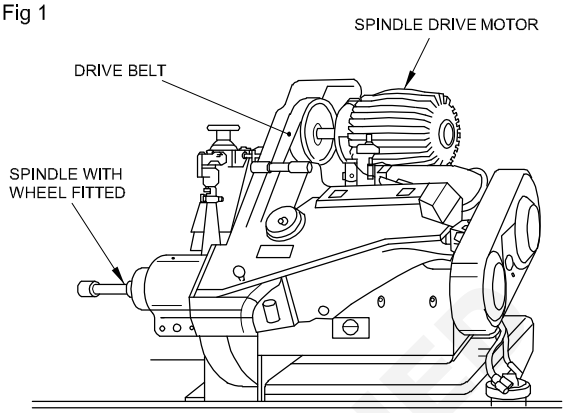
Make sure that the traverse setting do not cause the wheel to contact any internal shoulder in the workpiece and that the wheel does not leave the workpiece surface completely at the end of the traverse strokes.

- Put on your goggles.
- Start the grinding wheel.
- Start the head stock spindle drive.
- Check that the directions of rotation of the wheel and workpiece in opposite direction.
- Start coolant supply and table traverse if necessary.
- Move the grinding wheel to the workpiece by hand and advance the wheel against the bore taking a light cut.
- Grind the Ø 25 x 35mm bore.
- When cut is complete measure the bore and reset the feed.
- Make repeated cuts until desired size is ground.
- Dress the wheel again for finish grinding.
- Check the bore size, parallelism and make the final cuts.
- Remove burred edges.
- Measure the bore using telescopic gauge and compare with outside micrometer (0-25mm).
- **Mounting the spindle** (Fig. 1)

For setting up the internal grinding spindle of a universal grinding machine, the general procedure is as follows:

- Position the internal grinding attachment, including the spindle on the wheel head and fix securely. Refer to the operators handbook for the particular machine.
- Mount the flat drive belt between the internal grinding drive motor and the pulley on the internal grinding attachment and adjust to proper tension.

Fig 1

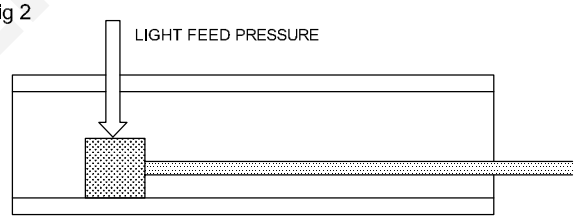


INTERNAL GRINDING SPINDLE MOUNTED ON WHEELHEAD OF UNIVERSAL GRINDING MACHINE

- If a machine motor selector control is provided turn it to the 'internal' position.
- Disengage the power operated cross - feed.
- Replace any guards removed to set the attachment in place.

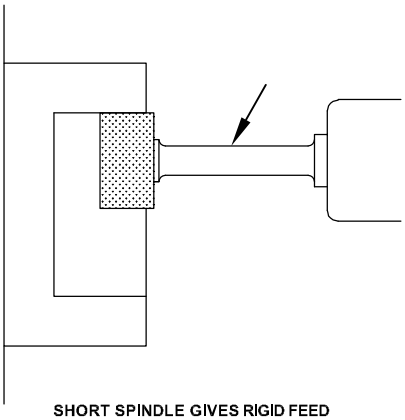
The dimensions of the workpiece (Fig 2 & 3)

Fig 2



LONG SPINDLE REQUIRES LIGHT FEED PRESSURE TO AVOID FLEXING

Fig 3



SHORT SPINDLE GIVES RIGID FEED

The spindle chosen should be as rigid as possible. Where a long workpiece is to be ground the spindle will be correspondingly long and thus subject to flexing under load. If care is not taken this flexing will cause chatter of

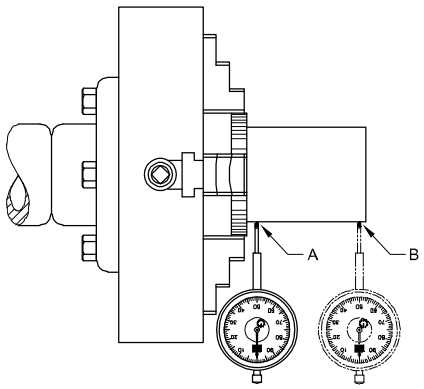
the wheel with resultant marking of the bore surface. It will also produce a bore of uneven diameter.

Due to the nature of the operation a wheel guard is not used during internal grinding operations. The workpiece serves as a guard during actual grinding, but remember that the unguarded wheel is a definite safety hazard when not within a workpiece.

Keep your hands away from the moving wheel and wear close fitting clothing. If a guard is available on the machine to shroud the wheel when not actually grinding make sure this set is in place after the wheel is retracted from the workpiece.

- Set the job in four jaw chuck using dial test indicator. (Fig. 4)

Fig 4



WORK MUST BE TRUED IN THE FOUR-JAW CHUCK SO THAT THE INDICATOR READINGS AT A & B ARE THE SAME.

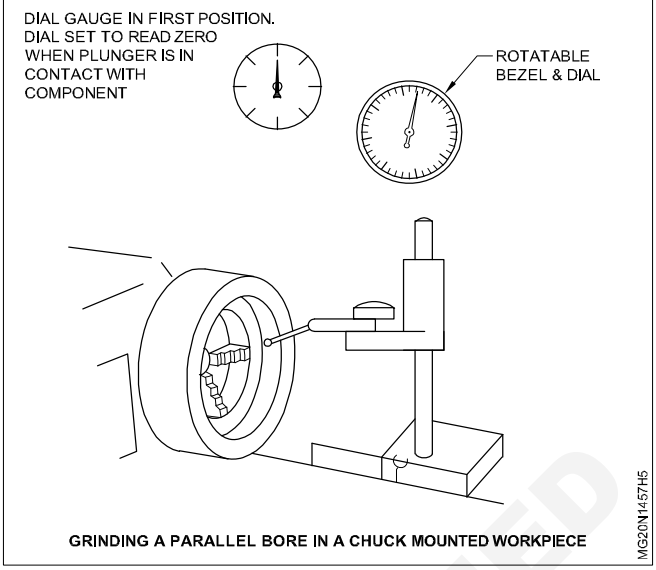
- Hold the job in a four jaw chuck.
- Mount the dial stand on machine table.
- Fix the dial and touch on the job.
- Move the dial and rotate the job.
- Check the trueness of the job with the indicator at zero position. (Fig 5)
- Incase difference reading the jaws adjust and rotate the chuck.
- The dial moving at A and B are the same reading at zero.

• **Grinding a parallel bore** (Fig. 6)

Procedure

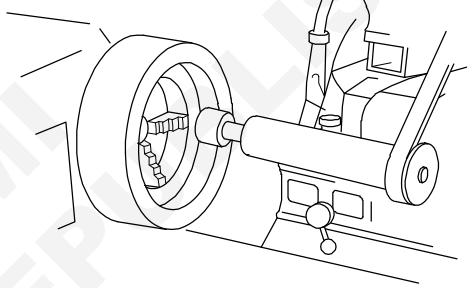
- Set up the machine for internal grinding.
- Fit the spindle and mount the wheel.
- Dress the wheel with a diamond tipped dressing tool.
- Measure the existing diameter of the workpiece to check the grinding allowance.
- Determine the work and wheel surface speeds and set the machine accordingly.

Fig 5



GRINDING A PARALLEL BORE IN A CHUCK MOUNTED WORKPIECE

Fig 6



GRINDING A PARALLEL BORE IN A CHUCK MOUNTED WORKPIECE

- Mount the workpiece in a chuck or other suitable support on the machine headstock.
- True the workpiece in the head stock and align the headstock to the wortable.
- If table traverse is necessary, adjust the machine by setting the table reversing dogs.

Caution

Make sure that the traverse settings do not cause the wheel to contact any internal shoulder in the workpiece and that the wheel does not leave the workpiee surface completely at the end of the traverse strokes.

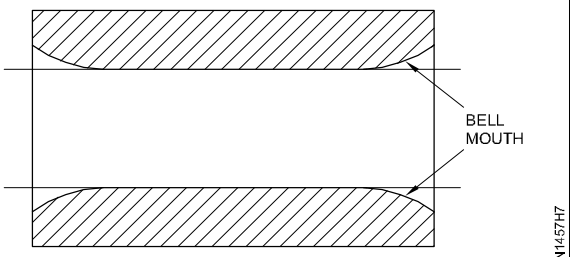
- Put on your goggles.
- Start the grinding wheel
- Start the headstock spindle drive
- Check that the directions of rotation of the wheel and workpiece are opposed.
- Start coolant supply and table traverse if necessary.
- Run the grinding wheel to the workpiece by hand and advance the wheel against the bore, taking a light cut.

- **During all internal grinding operations it is essential to:**

- Mount the workpiece firmly.
- Use a light feed.
- Prevent over traversing the work surface.

Failure to observe these precautions will cause distortions or "bell-mounting" of the bore. (Fig 7)

Fig 7

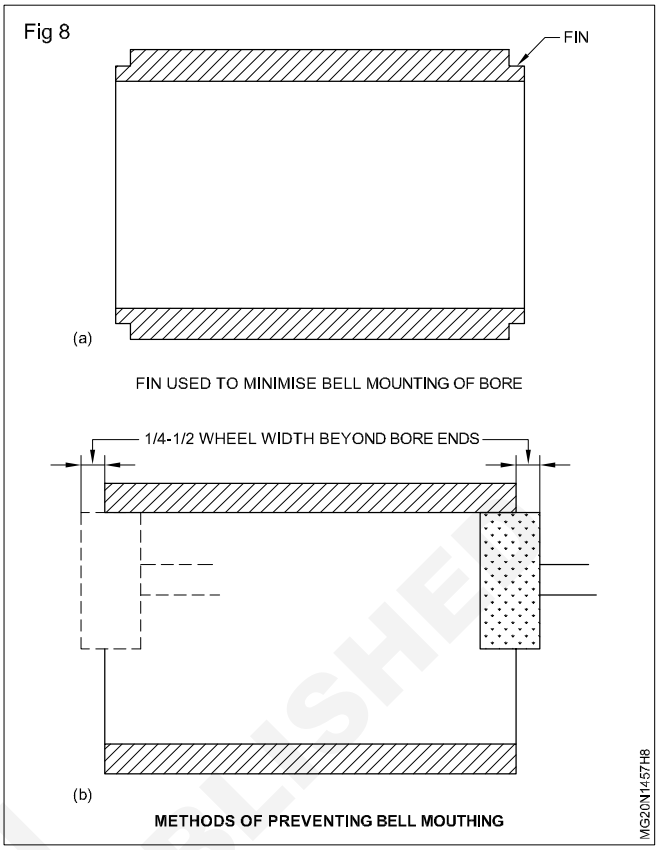


BORE DISTORTION DUE TO OVER TRAVERSE OR TOO FLEXIBLE SPINDLE

Where the best obtainable accuracy is required, a fin may be provided on each end of the bore. After grinding, the fin is removed leaving an accurate bore. (Fig 8a & b)

- Machine the bore diameter using telescopic gauge.

Fig 8



Change the recommended wheel speed and control depth

Objectives: At the end of this exercise you shall be able to
- **calculate the wheel speed and work speed**
- **determine the depth of cut.**

Note: Wheel speed is too fast the effect will be clogging of wheel, smoothing of wheel, over heating of work piece, in accuracy of surface and danger of accidents.
Wheel speed is low, the abrasive is wasted without much work being done.
Hence its best to run the wheel at the speed recommended by the manufacture.

Recommend circumferential speed (cutting speed) of grinding wheel (meters/second) is given in the table 1

Calculate the rpm of external cylindrical grinding for steel, cast iron and cemented carbide material. The diameter of grinding wheel is 200mm select the cutting speed from table 1.

Formula for rpm $n = \frac{V \times 1000 \times 60}{\pi D}$

Grinding Method	Material			
	Steel	Cast iron	Cemented carbide	Zinc alloys light metals
Internal grinding	25 m/s	20 m/s	8 m/s	25 m/s
External grinding	30 m/s	25 m/s	8 m/s	35 m/s
Surface grinding	25 m/s	25 m/s	8 m/s	20 m/s

Enter in the table

Material	RPM
Steel	
Cast iron	
Connected carbide	

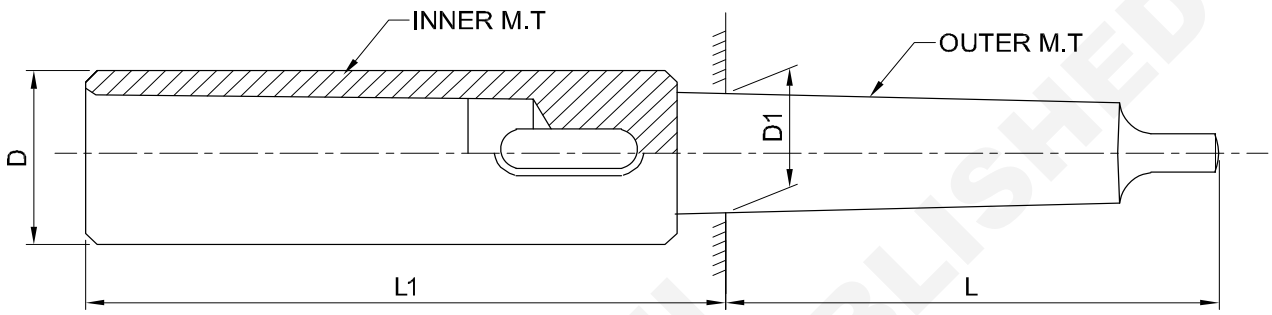
Get it checked by instructor

Depth of cut

Depends upon the following factors. Amount of metal to be removed. Type of finish required power and inside of the machine coolant used. Provision of work support. Gauge the depth of cut is 0.02 to 0.03mm for rough cut and 0.005 to 0.01mm for finish cut.

Grinding of sockets both internal and external

Objectives: At the end of this exercise you shall be able to
- **grind external taper of mT-3**
- **grind internal taper of mT4**
- **fit the socket in machine spindle check the external taper**
- **set the mT4 taper drill to check the internal taper.**



ITEM NAME	MODEL No. MT	OUTER M.T.	INNER M.T.	Ø D mm	Ø D1 mm	L mm	L1 mm
MT 3 to MT 4 MORSE TAPER EXTENSION SOCKET	3-4	3	4	48	23.825	94.0	146.0

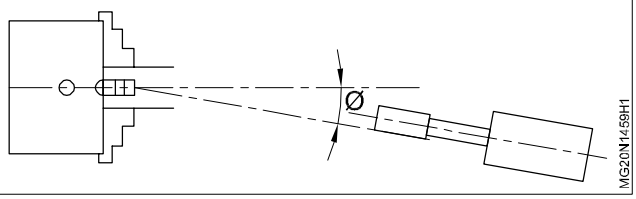
Job Sequence

- Grinding external MT3 taper
- Hold the pre machined job on cylindrical grinding machine
- Study the drawing turn the job as per drawing and maintain the size with grinding allowance
- Ascertain the grinding allowance
- Dress the wheel.
- Set the workpiece in 3 jaw chuck
- Swivel the table to the required angle i.e MT3
- Rough and finish grind the job to MT3 taper
- Swivel the table to zero position.
- Grinding inner MT4
- Study the drawing turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance
- Clamp the job in 3 jaw chuck.

-	PRE MACHINED WITH GRINDING ALLOWANCE	-	-	-	-	1.4.59
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	GRINDING OF SOCKETS BOTH INTERNAL AND EXTERNAL				DEVIATIONS ± 0.04	TIME : 05 Hrs.
					CODE NO. MG20N1459E1	

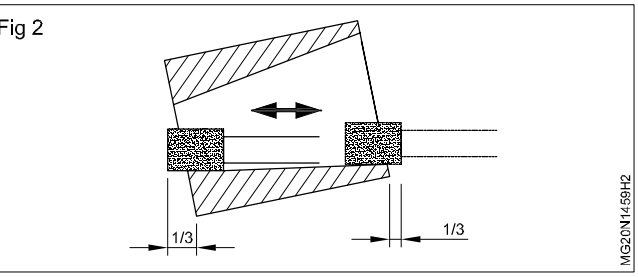
- Mount the internal grinding wheel in spindle.
- Dress the wheel.
- Swivel the work head to the MT4 taper angle (∅) as shown in Fig 1.

Fig 1



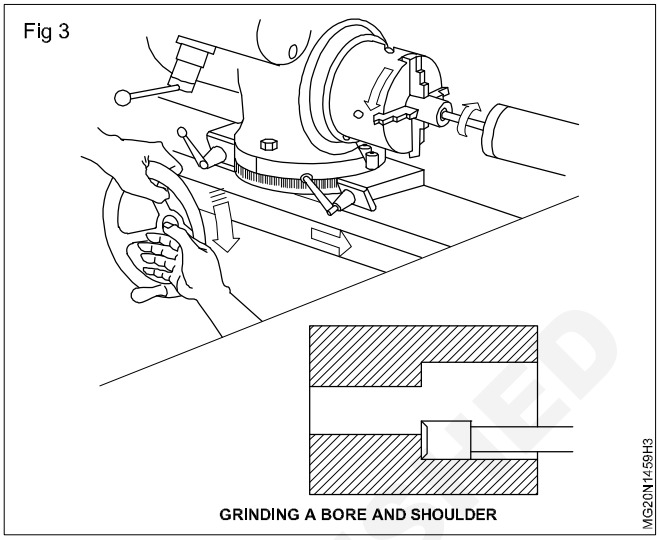
- Set the stopper for required stroke length.
- Rough and finish grind ID taper as shown in FIg 2.

Fig 2



- Check the taper using the taper plug gauge.
- The work to be taper ground is mounted in work head. The bolts in work head are loosened. The work head is fitted to required angle for internal taper grinding and the all bolts are tightened. (Fig 1)

Fig 3



Skill sequence

Grinding of a taper cylindrical surface

Objective: This shall help you to

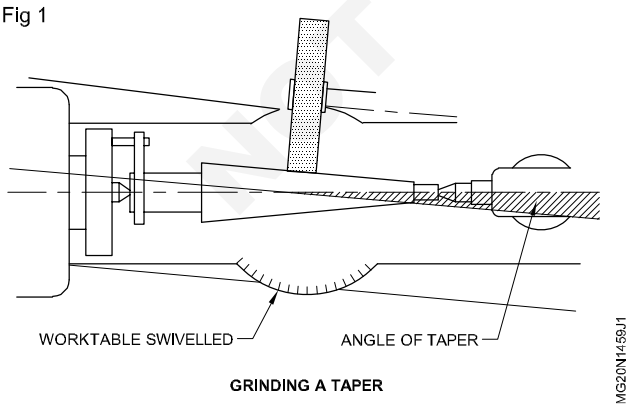
- **grinding of a taper cylindrical surface of ± 0.04mm.**

Tapers (Fig 1)

Tapers are usually produced by mounting the workpiece between centres.

The procedure is the same as for plain cylindrical grinding. The machine work table is swivelled to give the desired angle between the centres and the wheel spindle.

Fig 1



GRINDING A TAPER

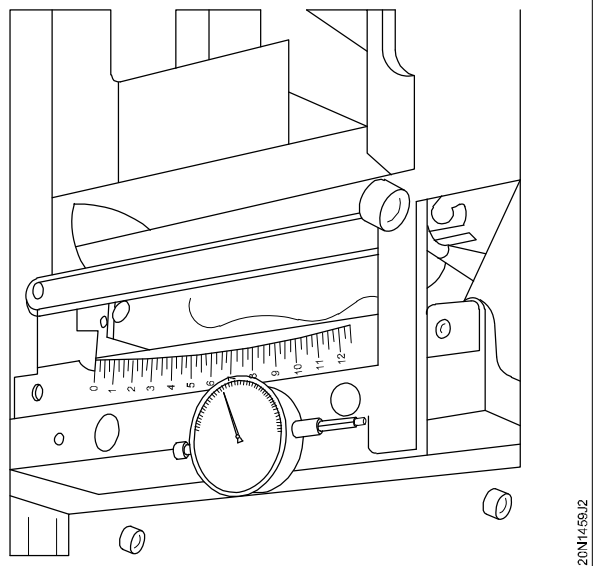
Mount the work for taper grinding

- Set a dog at right angles to one end of the work (Ø26mm)
- Wipe off chips sticking to the table thoroughly, pour on lubricating oil and slide the tailstock on the table surface while being lightly pushed onto the side face. Do positioning and fix the work.
- Clean the center holes and the centers thoroughly, apply oil or red lead to the center holes and set the work between both centers.
- Adjust the position of the driving pin so as to drive the dog securely.

To swivel the table (Fig 2)

- Loosen the nuts on the swivel - table pushing - plates at both ends of the traverse table.
- As illustrated, tilt the swivel table to the required angle, by turning the adjusting knob and watching the graduation on the pushing plate.
- Fix the swivel table to the traverse table by fastening the nuts.

Fig 2



To rough - grind

- After confirming that the distance between the wheel and the work is 25mm or more, move the wheel spindle stock promptly forward and manually feed until the wheel lightly touches the work to zero-set of the division of the micrometer collar for the depth of cut.
- Confirm the zero-setting of the depth of cut at both ends of the tapered portion, and start the grinding from the point of first touch.
- After applying the grinding fluid, feed the table automatically.
- Make the depth of cut from 0.02mm 0.04mm at the both ends of the work, and rough -grind the work until its whole surface is ground evenly.
- Suspend the automatic feed at the right end of the work back the wheel spindle stock promptly and remove the work.

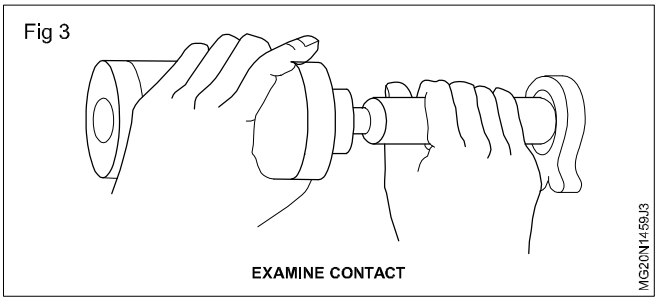
Contact test of taper

- Wipe off the taper face of the work and the inner face of the taper - gauge thoroughly with a cloth.
- Apply blue paste or red lead on the taper face in 2-3 stripes at equal intervals on the axial direction and thinly spread them out in a band shape.
- Set the work carefully set into the taper ring, push on lightly and then turn by about 1/8 turn and return the original position. (Fig 3)
- In this case it is recommended that the taper ring be left upright, turned by about 1/8 turn while lightly pressing down the work and returning it to the original position.
- Take out the work carefully from the taper ring and read the length of the contacting portion from the state of the blue paste.

Adjustment of swivel angle to the table

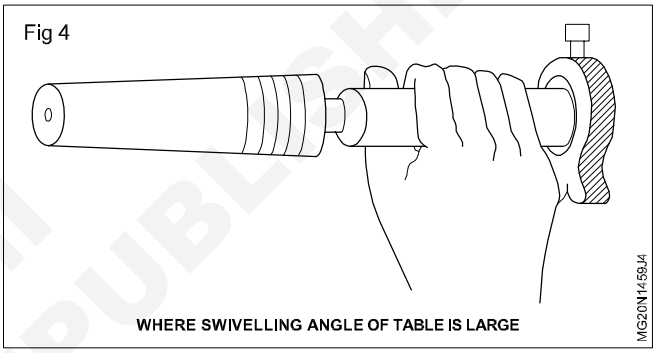
- When the larger diameter portion of the taper is in contact as illustrated, adjust the table angle in a clock wise direction, because it is too big. (Fig 4)

Fig 3



- When the smaller diameter portion is in contact, adjust the table angle counter clockwise because it is too small. (Fig 5)

Fig 4

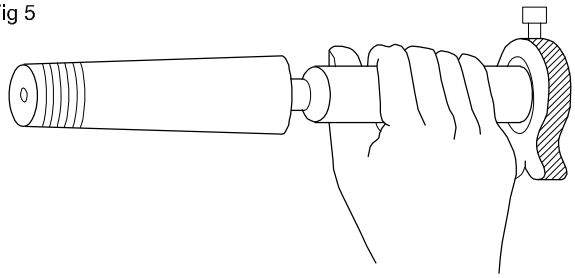


- After the adjustment of the table angle is over apply blue paste on the processing face back the wheel spindle stock slightly by manual turning and then promptly advance to zero-set the depth of cut at the contacting portion.
- Do re-grinding to the extent of evenly removing blue paste and again adjust the swivel angle of the table until the whole face of the taper is in contact through checking how the taper is in contact.

To finish - grind (Fig 6)

- Determine the numbers of work revolution so as to have the peripheral speed of the work at 12-15m/min.
- Adjust the table speed adjusted so as to feed by about 1/8 - 1/4 of the wheel thickness per work revolution.
- Keeping the depth of cut at 0.0025 - 0.01mm, while measuring at times the projecting length beyond the ring gauge, continue the grinding until it reaches the specified value.
- Do spark - out.

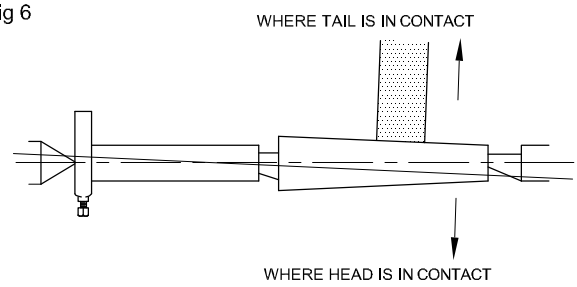
Fig 5



WHERE SWIVELLING ANGLE OF TABLE IS SMALL

MG20N1459J5

Fig 6



ADJUSTMENT OF TABLE ANGLE

MG20N1459J6

Check the taper using by sine bar method (Fig 7)

- Calculate the step gauge height.
- Taper angle = 7°.
- Length of sine bar=250mm
- Checking the correctness of a known angle Fig 8.
- Choose the correct slip gauge.
- The job to be checked should be mounted on the sine bar.
- After placing the selected slip gauges under the roller.

$$\text{Sine } \theta = \frac{a}{c}$$

$\theta = 7^{o}$

$a = C \sin \theta$

$= 250 \times 0.1219$

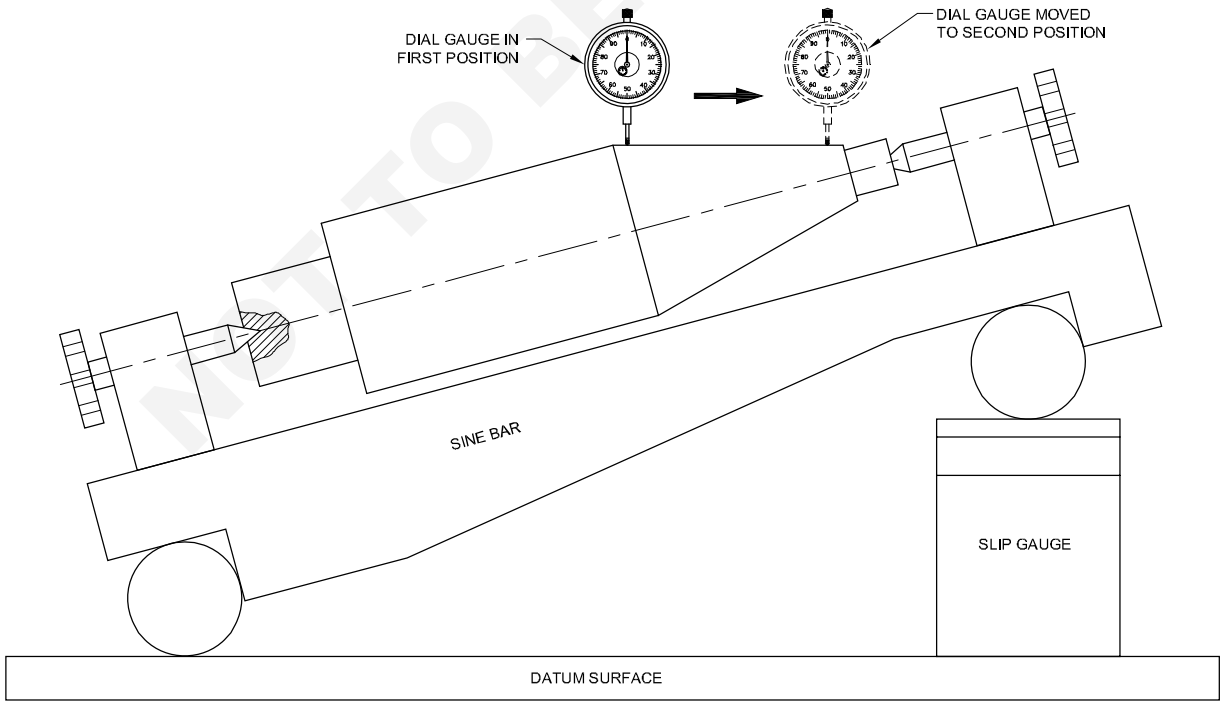
$a = 30.48mm$

The height of the slip gauge required is 30.48mm

- The dial test indicator is mounted on a suitable dial stand.
- The dial test indicator then set in first position as in the figure.
- The dial is set move the dial to the other end of the job (second position).
- If there is any difference then the angle is incorrect.
- The height of the slip gauge pack can be adjusted until the dial test indicator reads zero on both ends.
- The actual angle can then be calculated and the deviation if any will be the error.

While holding the slip gauges do not touch the lapped surfaces.

Fig 7



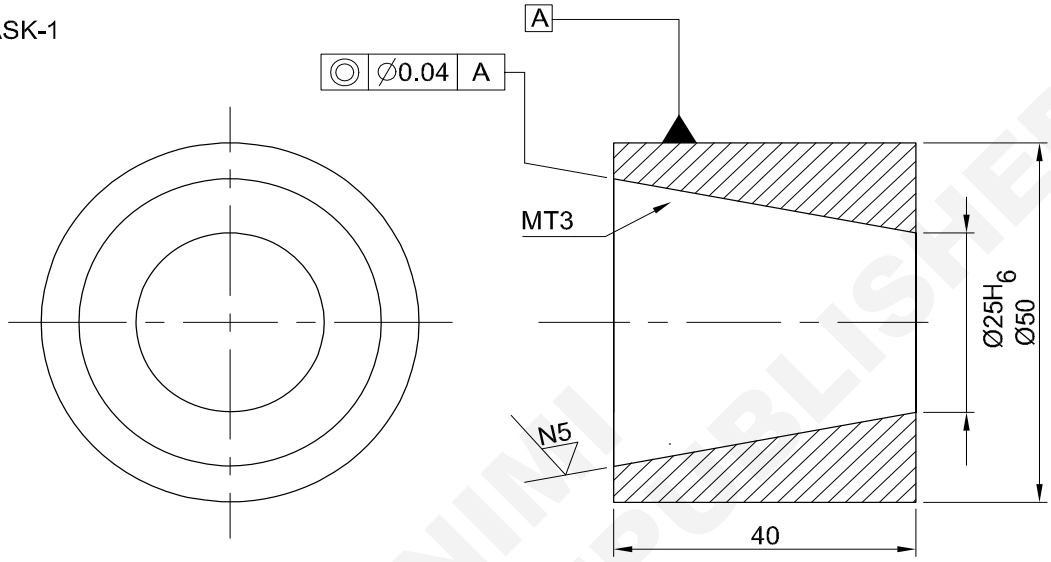
MG1417J8

Morse taper grinding both internal and external and check

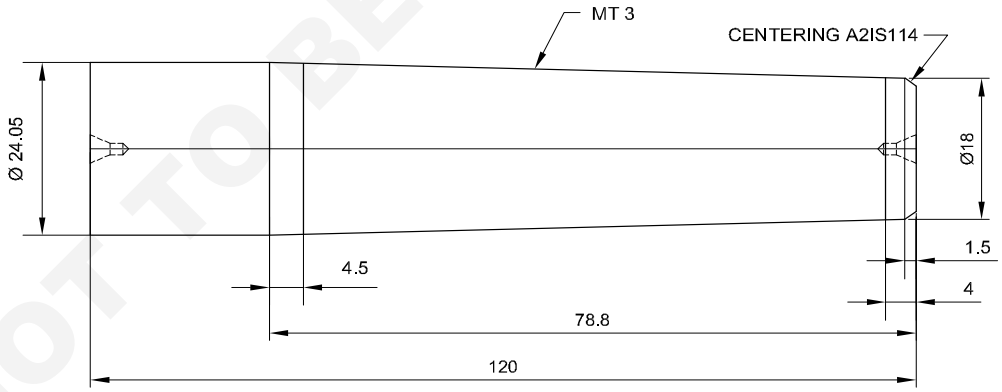
Objectives: At the end of this exercise you shall be able to

- **grind external taper of mT3**
- **grind internal taper of mT3**
- **set the wheel head to step taper angle**
- **set the taper angle by swivelling the upper table.**

TASK-1



TASK-2



-	-	-	-	-	-	1.4.60
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	MORSE TAPER GRINDING BOTH INTERNAL AND EXTERNAL AND CHECK	DEVIATIONS ± 0.04	TIME : 05 Hrs.
		CODE NO. MG20N1460E1	

Job Sequence

TASK 1: **Grinding internal morse taper**

1 Study the drawing turn the job as per drawing and maintain the size with grinding allowance.

2 Ascertain the grinding allowance.

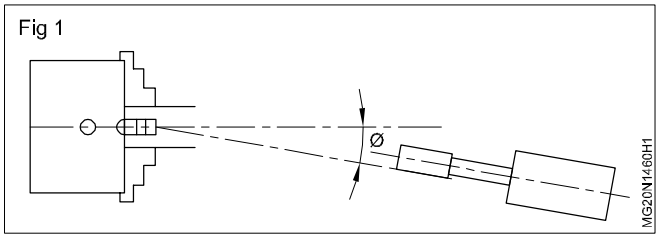
3 Clamp the job in 3 jaw chuck.

4 Mount the internal grinding wheel in spindle.

5 Dress the wheel.

6 Swivel the work head to the MT3 taper angle (∅) as shown in Fig 1.

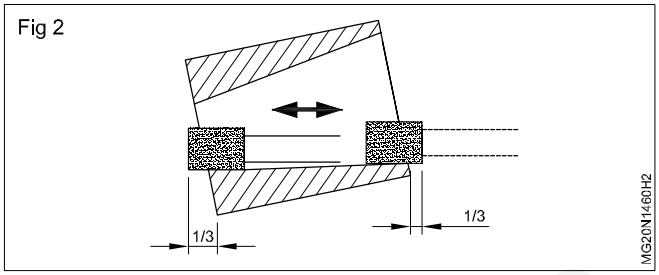
Fig 1



7 Set the stopper for required stroke length.

8 Rough and finish grind ID taper as shown in Fig 2.

Fig 2



- Check the taper using the taper plug gauge.

— — — — — —

TASK 2: **Grinding external morse taper**

1 Study the drawing turn the job as per drawing and maintain the size with grinding allowance.

2 Ascertain the grinding allowance.

3 Dress the wheel.

4 Set the workpiece in between center with carrier.

5 Swivel the table to the required angle i.e. MT3.

6 Rough and finish grind the job to MT3 taper.

7 Swivel the table to zero position.

— — — — — —

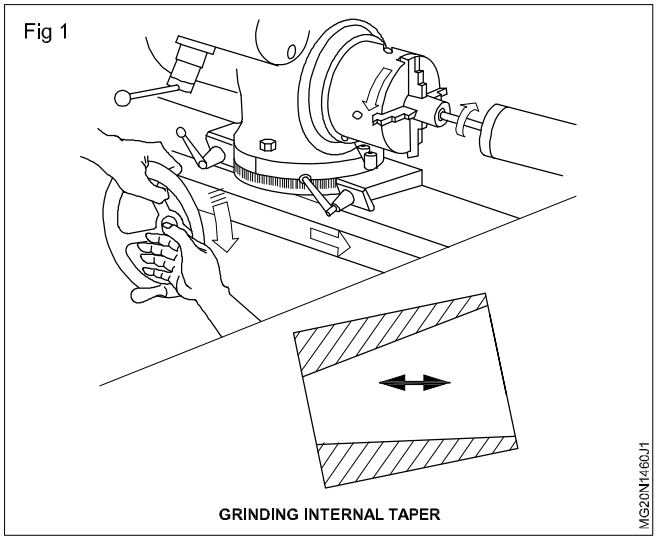
Skill Sequence

Swivelling the work head for internal taper grinding

Objectives: This shall help you to
- **swivel the work head.**

The work to be taper grounds is mounted in work head. The bolts in work head are loosened. The work head is fitted to required angle for internal taper grinding and then all bolts are tightened (Fig 1)

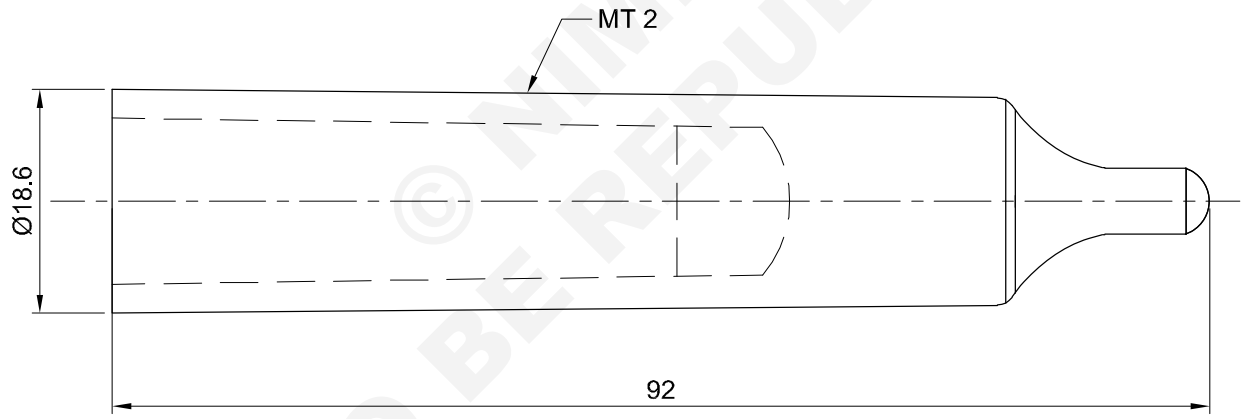
Fig 1



GRINDING INTERNAL TAPER

Perform grinding external sleeve and check

Objectives: At the end of this exercise you shall be able to
- **set the job on cylindrical grinder**
- **swivel the table for required angle for MT4 taper**
- **grind the external taper of MT4.**



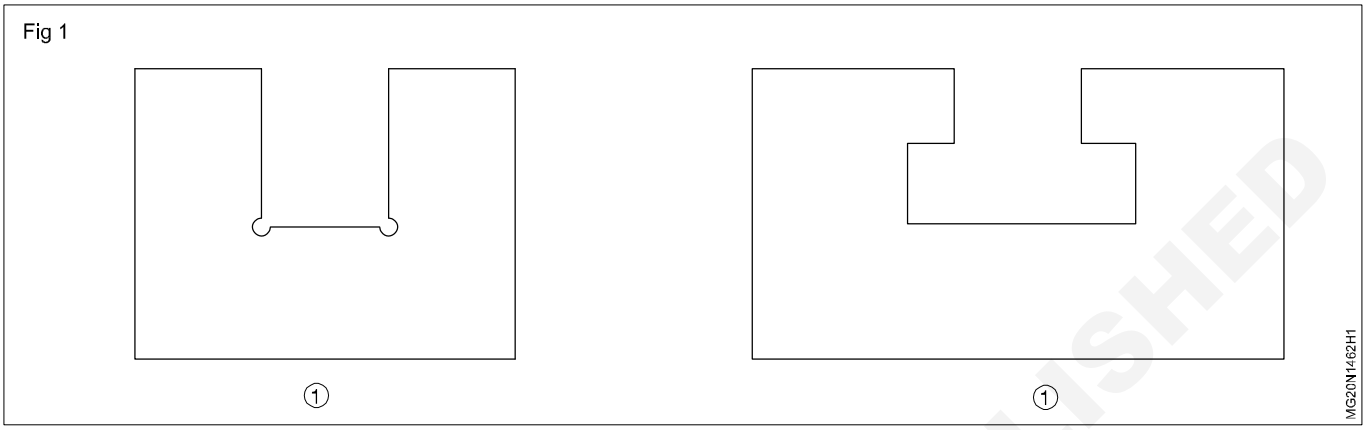
Trainees may asked to write the job sequence

-	PRE MACHINED	-	-	-	-	1.4.61
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PERFORM GRINDING EXTERNAL SLEEVE AND CHECK**				DEVIATIONS ± 0.04	TIME : 05 Hrs.
					CODE NO. MG20N1460E1	

Perform depth checking by depth micrometer

Objectives: At the end of this exercise you shall be able to
- **check the zero error of depth micrometer**
- **change the required extension rod**
- **measure the depth using depth micrometer.**

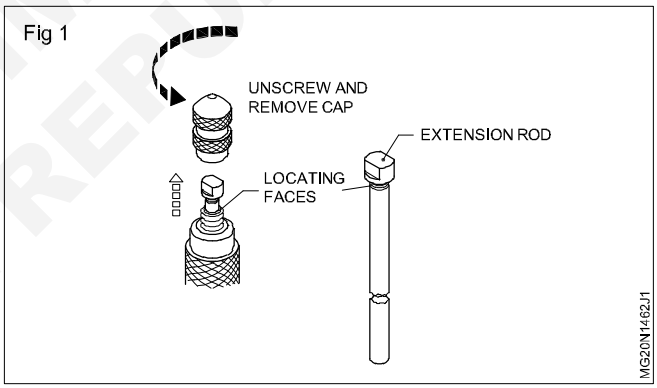
Fig 1



Job Sequence

- Observe the work piece and determine the size of the extension rod to be used in depth micrometer.
- Insert the extension rod in depth micrometer as shown in Fig 1.
- Check the dimension of component 1 and 2.

Fig 1



Skill Sequence

Using depth micrometer for measurement

This shall help you to
measure the depth of a recess
measure the depth of a keyway
measure the depth of a stepped hole or blind hole
measure the depth of a groove.

The procedure when using a depth micrometer

Check the zero setting of the depth micrometer. The method of checking this aspect is shown in Fig 1.

If an extension rod is used, this aspect has to be checked with the slip gauges.

Check that the extension rod fitted is suitable for the depth to be measured.

Clean the faces of the micrometer base and the area to be measured with a soft, clean.

Support the base across the edges of the recess.(Fig 2)

Hold down the base firmly on the top surface with the first and second fingers of one hand. (Fig 2)

Use the finger and thumb of the other hand to adjust the thimble until the end of the extension rod or spindle touches

the bottom of the recess. (Fig 2)

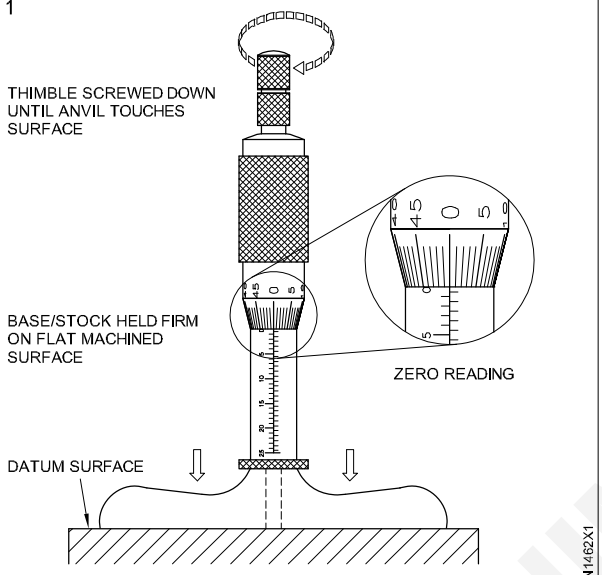
NOTE

A sense of feeling is very important to judge the accuracy of the measurement.

Allow your finger and thumb to slip on the knurled part of thimble to obtain the correct 'feel'.

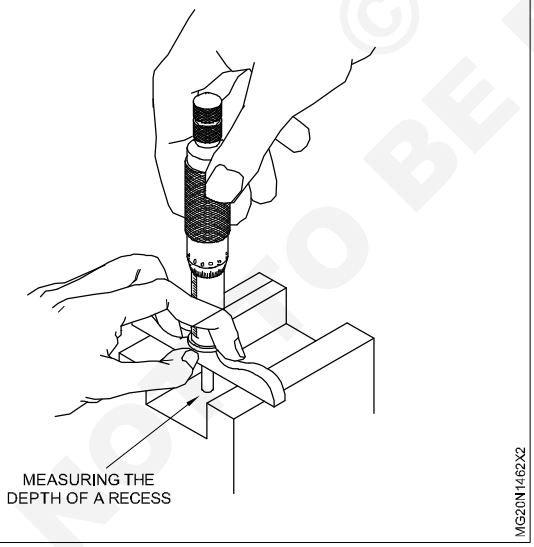
Press down firmly on the base with your hand. As the rod is screwed down, it tends to lift the base and gives an inaccurate reading. (Fig 2)

Fig 1



CHECKING THE ZERO SETTING

Fig 2



Remove your finger from the thimble carefully, lock the spindle and read the setting on the micrometer scale.

Method of reading (Figs 3a & 3b)

Fig 3

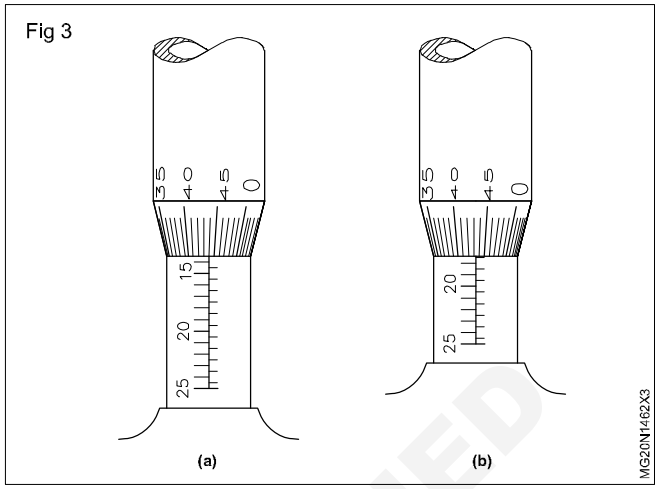


Figure '3a' reading **Figure '3b' reading**

13.00 mm	Hidden reading full mm	17.00mm
00.00 mm	Hidden reading 1/2 mm	00.00mm
00.44 mm	Thimble reading	00.03mm
Total reading 13.44mm		Total 17.03mm

By following the above procedure, it is possible measure the depth of the keyway, blind hole, step and groove.

Revise previous works

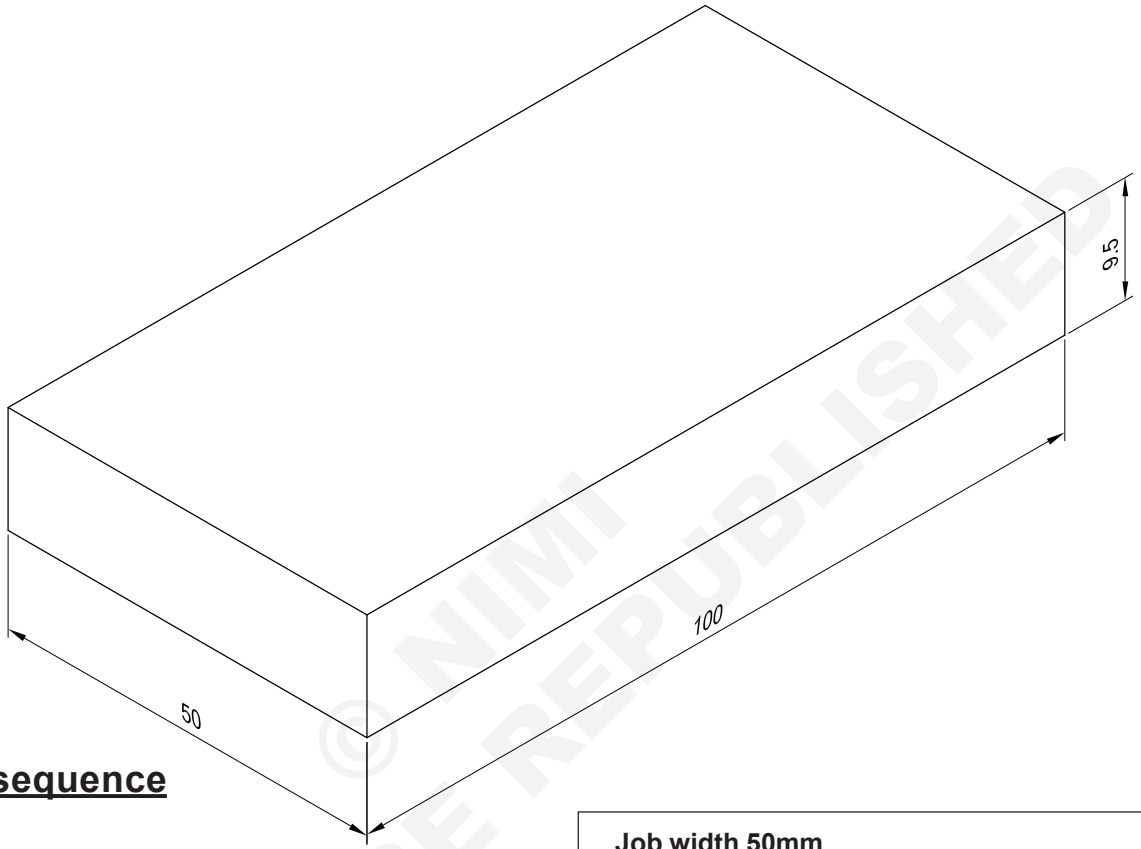
Objectives: At the end of this exercise you shall be able to
- **to explanation of previous works.**

PROCEDURE

1 Safety precaution,
   i Fitting tools.
   ii Measuring tools.
   iii Cutting tools.
2 Explain about take tools and operations (PLAIN TURNING, FACING, TAPER TURNING).
3 Discuss about surface grinding machine (FACE GRINDING, SIDE GRINDING, STEP GRINDING).
4 Describe about cylindrical external and internal grinding. Machine (PLAIN TURNING, TAPER TURNING).
5 Cylindrical universal grinding machine (SHOULDER GRINDING, TAPER GRINDING).

Perform machine setting for automatic movements

Objectives: At the end of this exercise you shall be able to
- **practice on automatic machine setting.**



Job sequence

- To set the job on the machine table
- To check the zero level to using by sprit level.
- To ensure breakage & crack of grinding wheel
- Start machine & stay 2 minutes form worm up.
- Set the lead time setting & automobile table movement arrangement.

Job width 50mm

Job length 100mm

Grinding wheel thickness 20mm

One time table travel in the surface - 15mm (Width) So mix time table 50mm full surface (Width) (Stroke distance front 20mm & job 50mm + Back 20mm)

15 x 6 = 90 (20+ 50 + 20)

- To slowly operated automatic control system.
- To start the automatic movement.

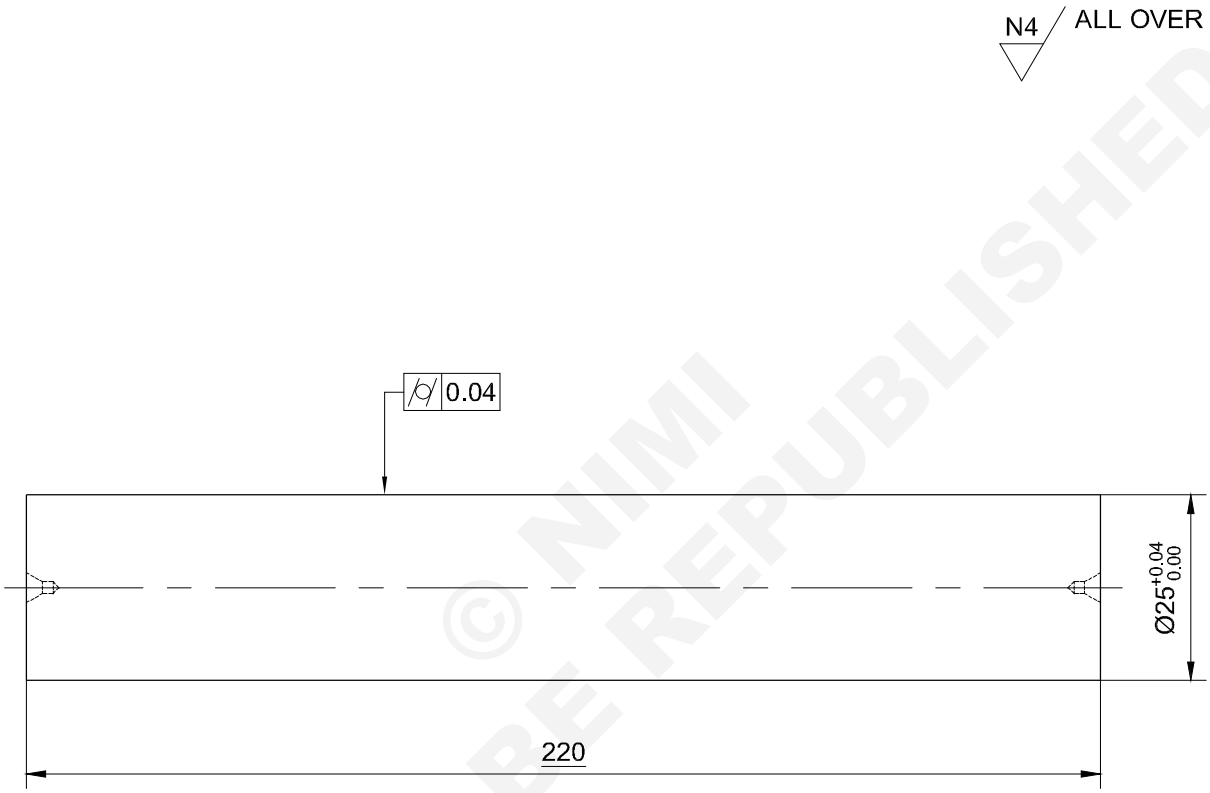
1	ISF 100X50X10	-	FE 310	-	-	1.5.64
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE: NTS	PERFORM MACHINE SETTING FOR AUTOMATIC MOVEMENT	DEVIATIONS ±0.08	TIME 10 Hrs
		CODE NO. MG20N1564E1	

Parallel cylindrical grinding on cylindrical grinder

Objectives: At the end of this exercise you shall be able to

- **prepare the cylindrical grinding machine for grinding**
- **dress the grinding wheel for parallel grinding using single point diamond dresser**
- **grind a parallel cylindrical surface with an accuracy of ± 0.05mm**
- **check the dimension with an outside micrometer**
- **check the parallism with dial test indicator.**



1	–	-	Fe310	–	–	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	-

SCALE NTS	PARALLEL CYLINDRICAL GRINDING	DEVIATIONS ±0.04	-
		CODE NO. MG1401E1	

Job sequence

- Prepare the cylindrical grinding machine
- Study the drawing and measure the grinding allowance for given job.
- Dress the grinding wheel make sure that the abrasive particles are removed uniformly.
- Mount the job in between centres.
- Set the length of stroke using reversing dogs.

Safety guards fix it in the proper place.

- Start the machine for grinding wheel rotating idly.
- Start the work table traverse
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.

Wear goggles at all time when using a grinding machine.

- Take a moderate cut (0.04mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse give depth of cut at the end of each traverse until the job is within 0.05 - 0.10mm of the required final size.
- Reserve the position of the job in the centres.

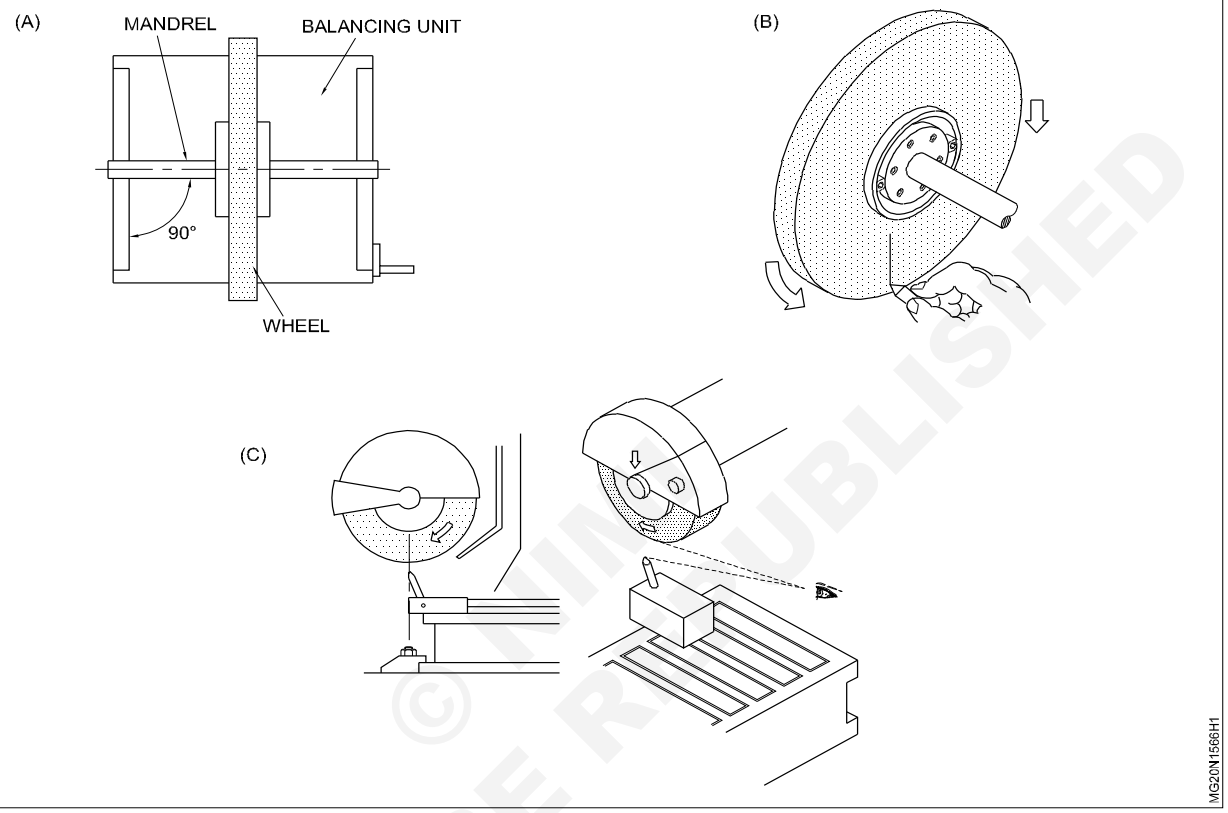
Use a soft metal spacer to protect the job.

- Grind the end of the job previously covered by the carrier to the same size as the other end of the job.
- Dress the grinding wheel.
- Grind the work piece to the finished size Ø25mm
- Remove the job from centres.
- Remove burrs of the job using fine abrasive stone.
- Measure the diameter of the job used by 0-25mm outside micrometer
- Check the cylindricity of the job.

Test and mount wheels, sleeves check truing and rebalancing

Objectives: At the end of this exercise you shall be able to
- **mounting new grinding wheel**
- **check trueness and rebalancing.**

Fig 1



PROCEDURE

TASK 1: **Assemble grinding wheel**

- Clean the machine and remove any loose metal or abrasive particles.
- Loosen the work rest clamp and remove the rest.
- Remove the outer plate of the wheel guard.
- Check the nut direction before loosening.
- Remove the nut and outer flange.
- Remove any paper, washer that has adhered to the flange.
- Clean the flange, spindle, thread and inside the guard.
- Push the wheel carefully against the driving flange and place the outer flange in position.
- Screw up the clamping nut by hand, firmly enough to hold the wheel in position.
- Turn the spindle and wheel a complete revolution.
- Ensure that the wheel is running true and it is clear of the inner part of the guard.
- Tighten the nut sufficiently enough so that the flanges will drive the wheel without slipping, & held securely.
- Refit the outer plate of the wheel guard.
- Reset the work rest as close to the wheel face as possible.
- Tighten the work reset clamp firmly.
- Rotate the wheel by hand to ensure that the wheel runs freely.

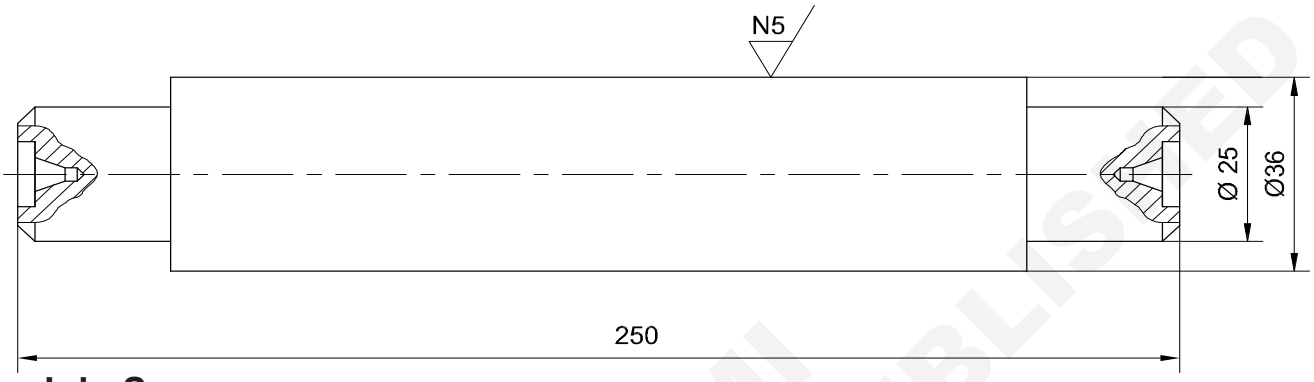
TASK 2: **Balancing grinding wheel**

- Check grinding wheel for cracks by light tapping
- Unclamp balance weight of grinding wheel .
- Prepare the balancing unit.
- Clean the bore of the unit and the balancing material.
- Mount the wheel assembly on the material.
- Fix the protection guard.
- Place the wheel to be balanced on the top of the protection guard and lower gently on to the balancing stand.
- Rotate the grinding wheel so that it can rotate by itself due to its mounted & resets at a heavy point.
- Mark the lowest point on the wheel.
- Turn diametrically opposite point, add balancing weight, moving to lighter side.
- Repeat the above until the assembly remains static in any position.

Grinding of plain mandrel within accuracy ± 0.03mm

Objectives: At the end of this exercise you shall be able to

- **set the job between centres**
- **adjust the length and position of table traverse**
- **grind parallel cylindrical surface to an accuracy of ±0.03mm**
- **check the size and parallelism with the help of an outside micrometer**
- **dress the grinding wheel of cylindrical grinder**
- **follow the safety precautions to be followed while working on a cylindrical grinding machine.**



Job Sequence

- Lubricate all moving parts.
- Run the machine idle for few minutes keeping longer length of stroke to warm up the machine system.
- Ensure that the work head and foot stock is property positioned with respect to the wheel head and the workpiece.
- Make sure that the workpiece is provided with proper centres of the desired shape and depth.
- Check the grinding allowance in the workpiece
- Wear goggles start the coolant and dress the wheel.
- Apply grease to the tip of the centres and mount the job between centres.
- Set proper tension at the foodstock centre and lock.
- Select and fix suitable driving dog/carrier on one end of the job.
- Set stroke length by adjusting table trip dogs, such that 1/3 rd of wheel clears the foot stock end of workpiece, and about 30.0mm from the workhead end of workpiece to allow the grinding wheel to clear the carrier.
- Make sure the running wheel or carrier do not hit any other part of the machine.
- Set job speed, and table speed as per diameter and type workpiece.
- Run the machine, bring wheel head forward slowly by rotating cross feed hand wheel till you see sparks.
- Give a light 0.01mm at a time till it touches both ends.
- Measure at both ends of the workpiece by using outside micrometer.
- If there is any taper, adjust by table adjusting screw by unlocking the binding screws.
- While measuring taper, ensure the wheel is taken back.
- Repeat this till you get zero, zero on both both ends.
- Start giving depth of cut, end finish to the required size.
- Take care to give depth of cut, when the job clears from the wheel at R.H. side.
- Reverse the job, take care to give soft packing under the carrier screw to avoid damage of the ground surface.
- Set the stroke length, grind the end of the job previously covered by the carrier, to the required size.
- Check the size.
- Remove burrs by smooth oil stone at the edges.
- Remove workpiece from the centres and detach carrier.

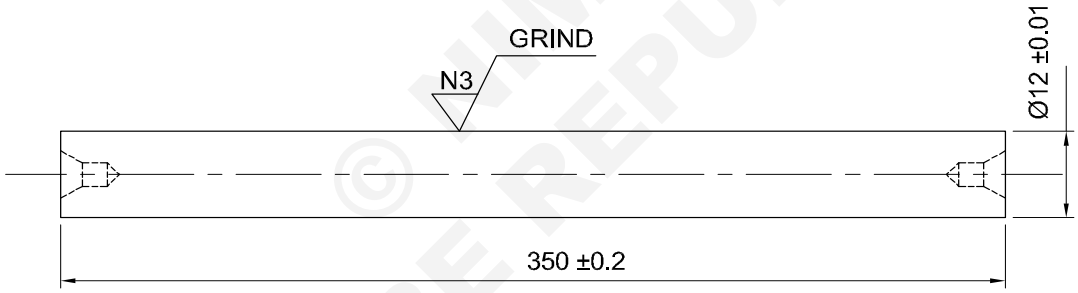
1	ISRO 40 - 260	PRE TURNER	–	-	8	1.4.52
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GRINDING OF PLAIN MANDREL WITH IN ACCURACY ± 0.2 mm	DEVIATIONS ±0.02	TIME : 06 Hrs
		CODE NO. MG20N1452E1	

Wheel balance and dressing, grinding long bar using steady rest

Objectives: At the end of this exercise you shall be able to

- **balancing the grinding wheel**
- **dressing the grinding wheel**
- **set the steady rest on the machine table**
- **set the workpiece**
- **grind the workpiece with in an accuracy of ± 0.01 mm**
- **measure the job with an o/s micrometer**
- **check the parallelism by D.T.I.**

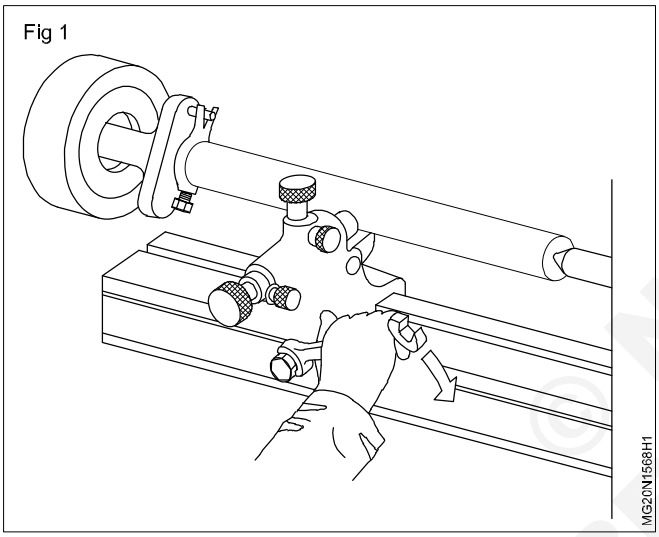


1	Ø16 - 350		MILD STEEL			1.5.68
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	LONG CYLINDRICAL BAR GRINDING				DEVIATIONS ± 0.01	TIME 30hrs
					CODE NO. MG20N1568E1	

Job sequence

- Study the drawing and measure the grinding allowance for given job.
- Prepare the machine for long test bar grinding.
- Get the workhead, wheel head and table at 0°.
- Dress the grinding wheel make sure that the abrasives particles are removed uniformly.
- Mount and align headstock and tailstock centres accurately.
- Hold the job with suitable dog carrier.
- Mount the job in between centres.
- Mount the back study on machine table.
- Set the study on work piece (Fig. 1)

Fig 1



- Set the length of stroke using reversing dogs.
- Start the machine for idle rotation of grinding wheel and work table operation.

Long workpiece grinding require the use of a supporting steady.

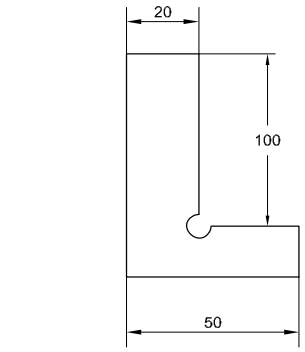
- Put on your goggles.
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.
- Start coolant supply.
- Take a moderate cut (0.03mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse adjusting the feed at the end of each traverse until the job is within 0.03m - 0.10mm of the required final size.
- Grind the Ø12.1 x 300 mm long.
- Grind to finish size Ø12 mm x 300 long.

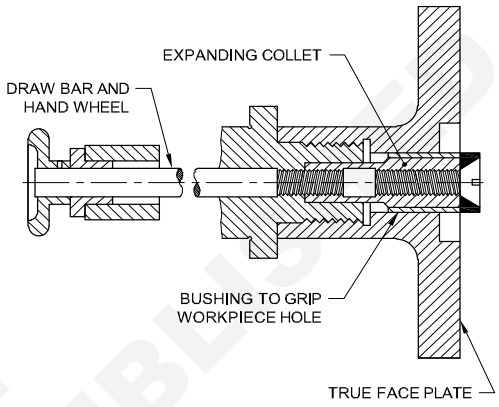
Back rests being used to support long a cylinder shaft while traverse grinding. **(Fig. 1)**

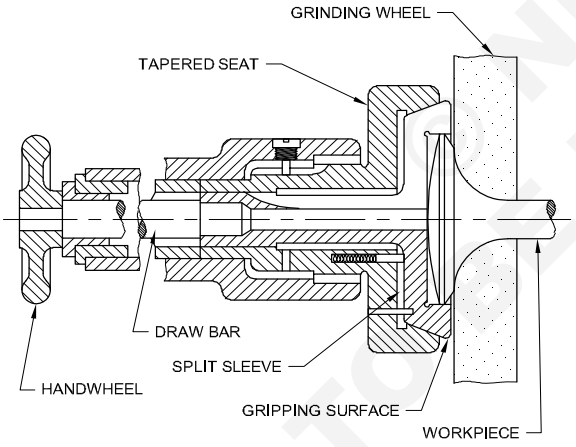
- Reverse the job and hold between centre. Do the rough grinding upto Ø12.1 x 50 long.
- Grind to finish size Ø12 mm x 50 long.
- Measure with o/s micrometer.

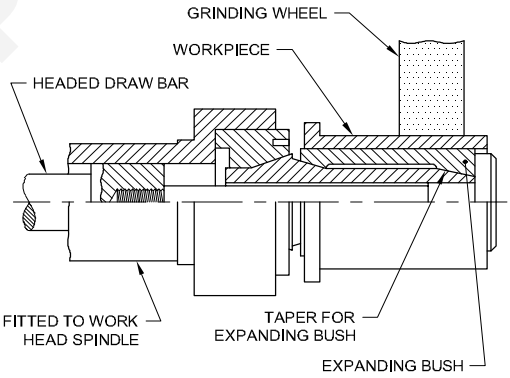
Perform grinding different types of jobs using machine chuck, face angle plate collets

Objectives: At the end of this exercise you shall be able to
- **set to the angle plate**
- **grind the job using angle plate**
- **Set the job using collet**
- **grind the job using collet.**









1	L ANGLE 125 X 125 X 60		FE 310	-	-	1.6.69
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: NTS	**PERFORM GRINDING DIFFERENT TYPES OF JOBS USING MACHINE CHUCK,FACE ANGLE PLATE AND COLLETS**				DEVIATIONS ±0.04	TIME 25 Hrs
					CODE NO. MG20N1669E1	

Job sequence

TASK 1:

- Prepare the machine and set the magnetic check and grinding wheel for the surface grinding operation.
- Set the job for level setting.
- Rough & finish grind surface and parallel.
- Measure the size using by outside micrometer.

TASK 2:

- Prepare the machine and set the collects for the cylindrical grinding operation.
- Set the job for level setting.
- Rough & finish grind face.
- Measure the size using by outside micrometer.

Skill sequence

Grinding stepped faces to an accuracy of ± 0.04mm

Objective: This shall help you to
- **grind stepped faces to an accuracy of ± 0.04mm.**

For grinding a stepped face, select a grinding wheel relieved on both sides. If such a wheel is not available dress and relieve both sides of a plain wheel with a diamond dressing stick. (Figs 1 & 2)

Fig 1

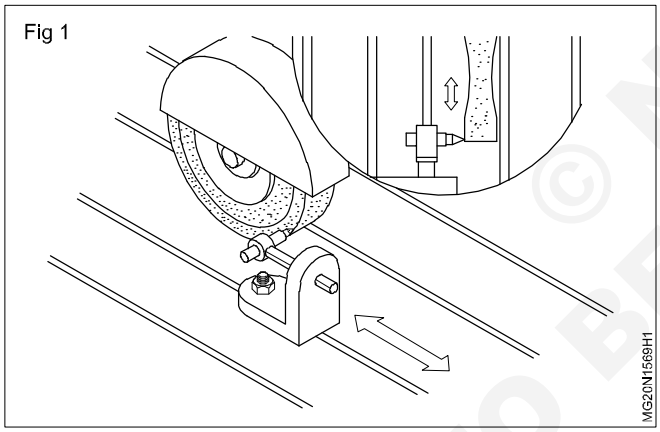
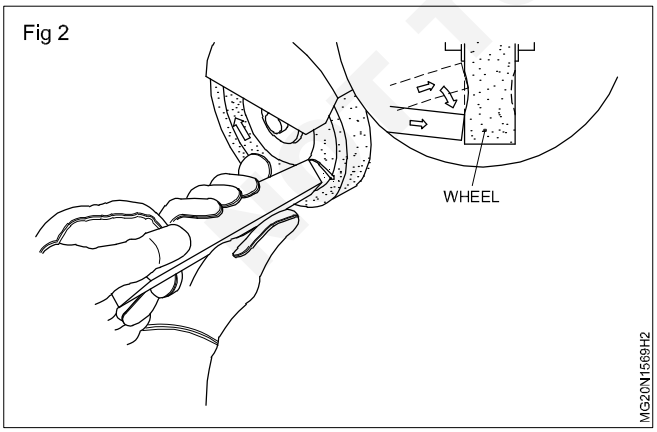


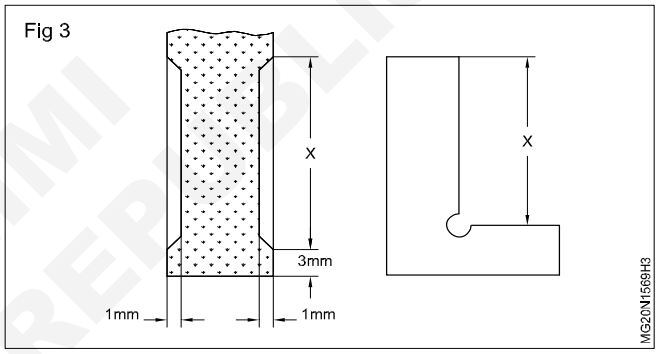
Fig 2



Relieve the sides of the wheel according to the depth of the step to be ground. (Fig 3)

Mount the workpiece on a magnetic chuck/an angle plate/ a plain vice in a position suitable for grinding the vertical and horizontal surfaces.

Fig 3



If the workpiece is small, secure the job on to an angle plate and mount the angle plate on a magnetic chuck or mount the plain vice on the magnetic chuck, align its fixed jaw parallel to the wheel axis using a dial test indicator.

If the workpiece is convenient enough to grip on the magnetic chuck straight away, align and grip using the dial test indicator. (Fig 4)

Set the table reverse dog, so that the centre of the grinding wheel clears each end of the work by approximately 25mm.

Start the machine and touch the top of the vertical side of the workpiece with the wheel side face and clear off.

Set the depth of cut.

Bring the job in contact with the running wheel and feed from the top edge vertically down. (Fig 5a)

Grind the vertical face until the wheel face touches the horizontal surface of the job.

Clear off the job for the wheel and set the depth of cut.

Grind the horizontal surface of the job feeding from the edge up to corner. (Fig 5b)

Deburr and clean the job.

Check the step with a depth micrometer.

Fig 4

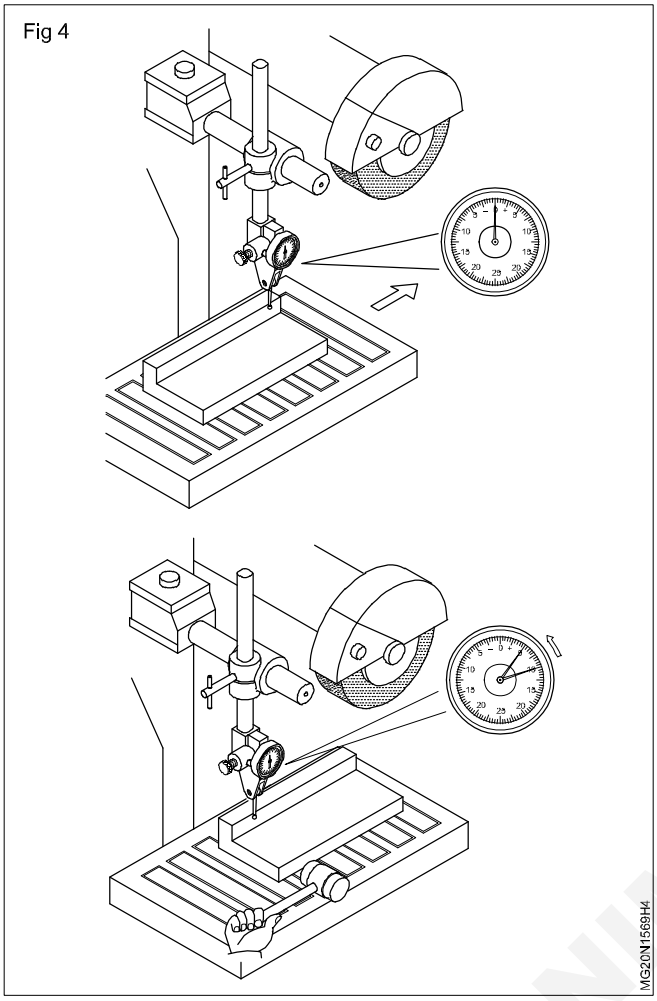
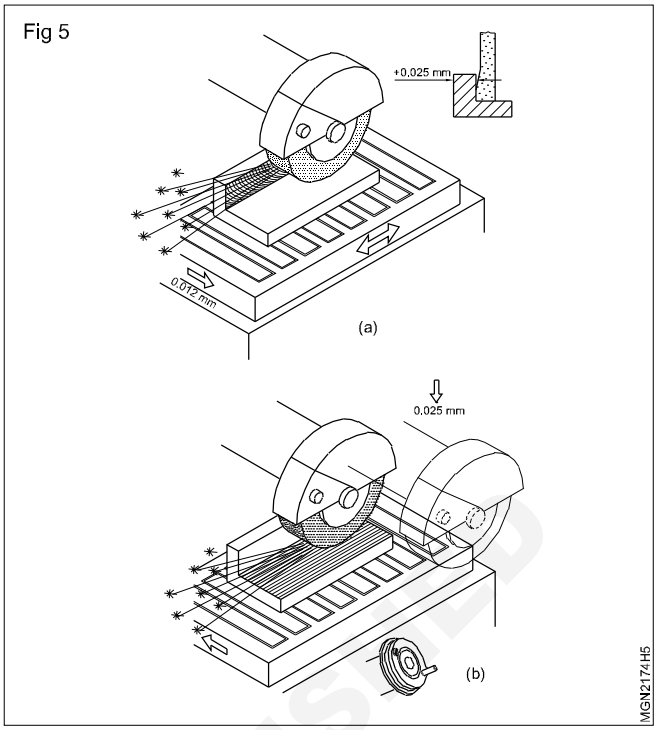


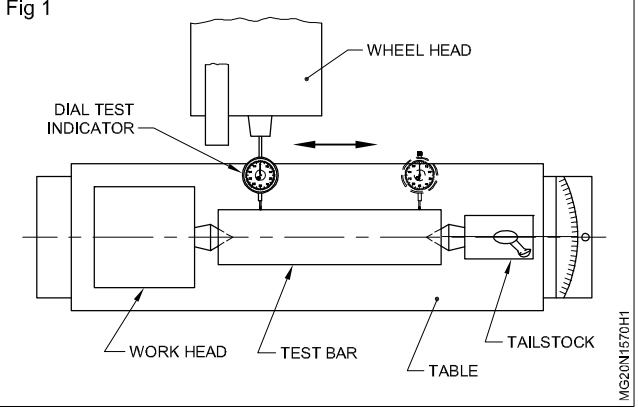
Fig 5



Align table with the help of test bar and dial test indicator

Objectives: At the end of this exercise you shall be able to
- **set the test bar between centre**
- **check the paralelism using dial test indicator.**

Fig 1



Job sequence

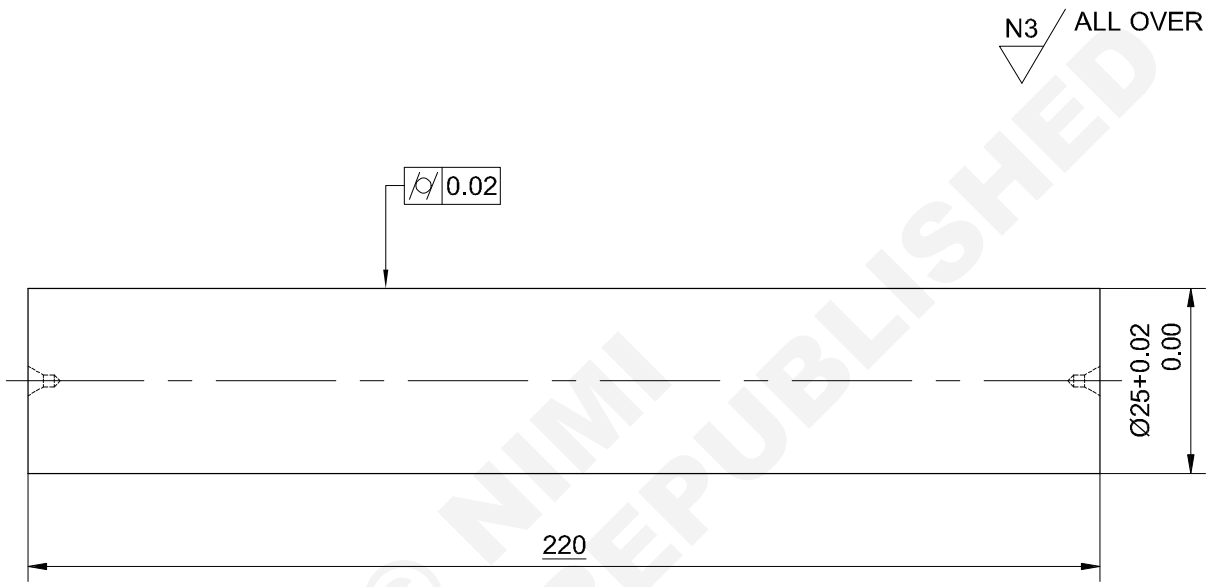
- Clean the wheel head of front side.
- Hold the dial test indicator with magnetic base on wheel head slide. (Fig 1)
- Fix the test bar in between centres.
- Set the work head, wheel head and table at zero degree.
- Touch the dial on job and giving light pressure show the figures.
- Move the table from workhead to tailstock.
- Check the dial reading zero
- Incase variation of reading ±10 divisions.
- Loose the table top allen screws and adjust slightly side screw
- Check the dial reading at zero so the work head center tail stock center same line
- The table at 0° aligning is correct position.

Exercise 1.5.71

Parallel cylindrical grinding within accuracy ± 0.02mm

Objectives: At the end of this exercise you shall be able to

- **prepare the cylindrical grinding machine for grinding**
- **dress the grinding wheel for parallel grinding using single point diamond dresser**
- **grind a parallel cylindrical surface with an accuracy of ± 0.02mm**
- **check the dimension with outside micrometer**
- **check the parallism with dial test indicator.**



1	ISR 30 x 225	–	Fe310	–	–	1.5.71
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PARALLEL CYLINDRICAL GRINDING	DEVIATIONS ±0.04	TIME 05 Hrs
		CODE NO. MG20N1571E1	

Job sequence

- Turn the part as per dimension by keeping grinding allowance.
- Prepare the cylindrical grinding machine
- Study the drawing and measure the grinding allowance for given job.
- Dress the grinding wheel make sure that the abrasive particles are removed uniformly.
- Mount the job in between centres.
- Set the length of stroke using reversing dogs.

Fix the safety guard in the proper place

- Start the machine for grinding wheel rotating idly.
- Start the work table traverse
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.

Wear goggles when using a grinding machine.

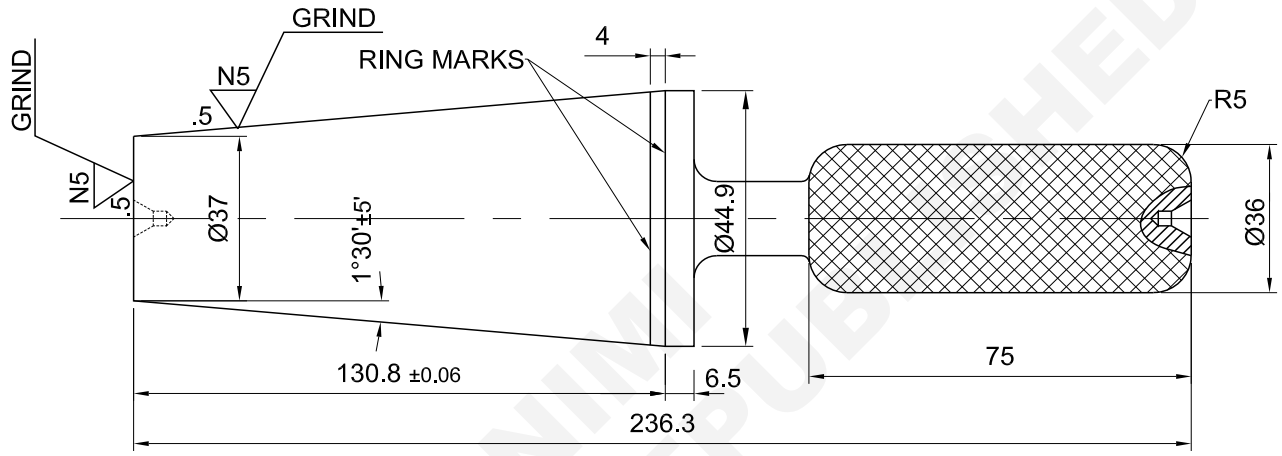
- Take a moderate cut (0.04mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse give depth of cut at the end of each traverse until the job is within 0.05 - 0.10mm of the required final size.
- Reserve the position of the job in the centres.

Use a soft metal spacer to protect the job.

- Grind the end of the job previously covered by the carrier to the same size as the other end of the job.
- Dress the grinding wheel.
- Grind the work piece to the finished size Ø25mm
- Remove the job from centres.
- Remove burrs of the job using fine abrasive stone.
- Measure the diameter of the job used by 0-25mm out-side micrometer
- Check the cylindricity of the job.

Cylindrical taper grinding (by swivelling machine table)

Objectives: At the end of this exercise you shall be able to
- **hold the job in chuck**
- **set the table according to taper angle**
- **set cutting speed, feed and depth of cut**
- **rough grind & finish grind the workpiece within accuracy**
- **check the taper by using standard gauge.**



Job sequence

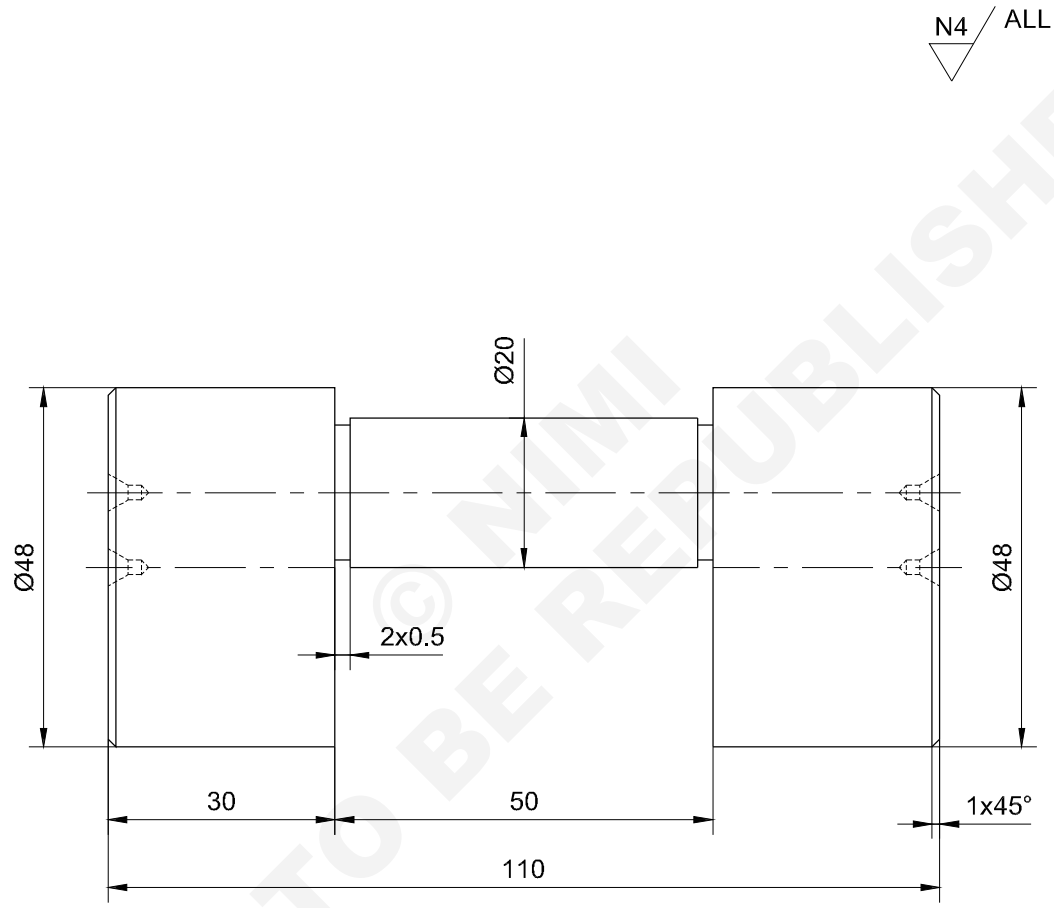
- Determine the grinding allowance.
- Balance the grinding wheel.
- Mount the wheel on the cylindrical grinding machine.
- Dress the grinding wheel.
- Hold the job in between centres.
- Tilt the table of 1°30' to grind.
- Set the table traverse dog to grind 130.8 mm length on the taper end.
- Start the grinding wheel and the job for rotation.
- Bring the wheel of the job and allow it to touch.
- Grind the job (giving required feed) to an accuracy of ±5 minutes.
- Move the wheel away from the job and stop the movement of the wheel and job.
- Check the taper angle with a vernier bevel protractor.

1						3.2.05
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	CYLINDRICAL TAPER GRINDING				DEVIATIONS ±1	TIME 20hrs
					CODE NO. MG3205E1	

Eccentric cylindrical grinding

Objectives: At the end of this exercise you shall be able to

- **mark the eccentric cylindrical using vernier height gauge**
- **truing a job for eccentric turning**
- **turn a eccentric job**
- **grind eccentric with an accuracy of ± 0.02mm**
- **check the dimension with an outside micrometer.**



1	ISRO 50 x 115	–	Fe310	–	–	2.2.03
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	ECCENTRIC CYLINDRICAL GRINDING	DEVIATIONS ±0.02	TIME 50h
		CODE NO. MG2204E1	

Job sequence

- Turn an eccentric job with required grinding allowance.
- Prepare the machine for eccentric cylindrical grinding.
- Set the work head wheel head and table at 0°.
- Dress the grinding wheel for rough grinding.
- Hold the job with suitable dog carrier.
- Mount the job in between centres.
- Start the machine and move the grinding on job.
- Touch the trail cut on job.
- Grind the larger diameter of 48 x 30mm long.
- Dress the grinding wheel.
- Remove the job from centres.
- Reset and hold the job in between centres.
- Grind the eccentric diameter of 20mm in 50mm long.
- Measure the dimension and parallism used by outside micrometer (0-25 and 25-50mm)
- Remove the job from the centres and carrier.
- Reverse and reset the job in between centres.
- Dress the grinding wheel.
- Grind the larger dia meter of 48 x 30mm long.
- Remove the job from the centres.
- Deburr the job by abrasive stick.
- Measure the dimension by outside micrometer (25-50mm)

Do not use fast work speed and table automatic feed.

Skill Sequence

Marking eccentricity centre lines of a job by using a vernier height gauge

Objective: This shall help you to

- **mark concentric and eccentric centre lines of a job by using a vernier height gauge.**

The height gauge marking is more accurate than the scribing block marking.

The marking surface must be free from sharp edges and unevenness.

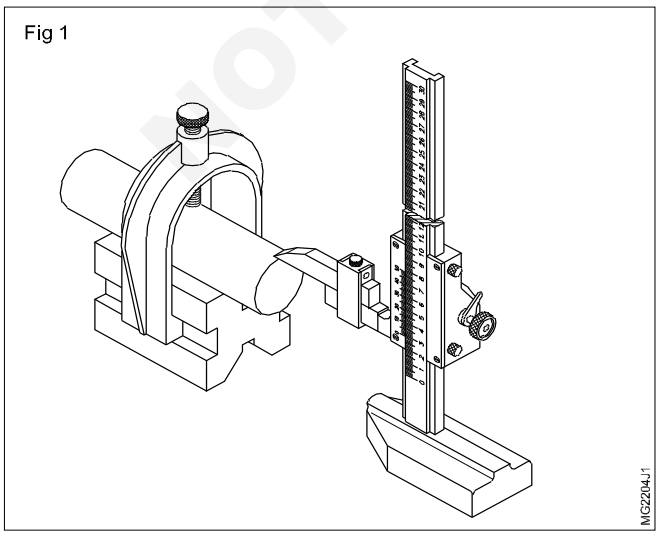
Clamp the finish turned rod in the 'V' block with the help of the clamps.

Apply marking media on both faces of the job.

Set the scriber point on the top edge of the job. (Fig.1)

Move the height gauge scriber over the round surface to get a feel that the scriber bottom face is contacting the work periphery. (Fig. 1)

Fig 1

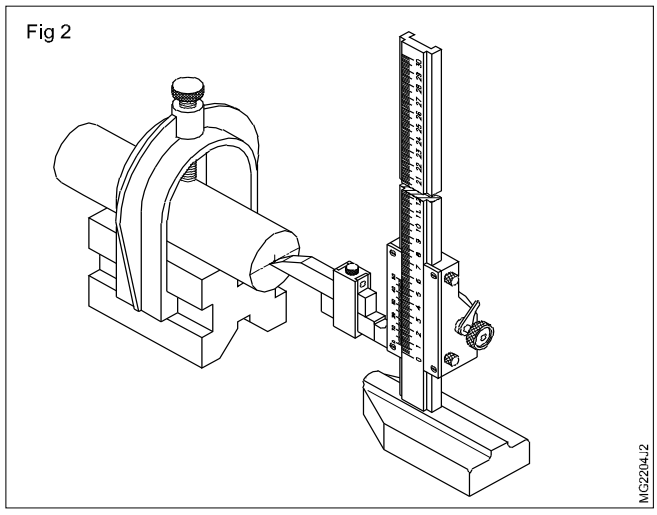


Lock the slides and note down the readings of the scales.

Subtract half the diameter from the reading and set the height gauge for that readings. (Fig. 2)

Scribe a horizontal line on both faces. (Fig. 2)

Fig 2

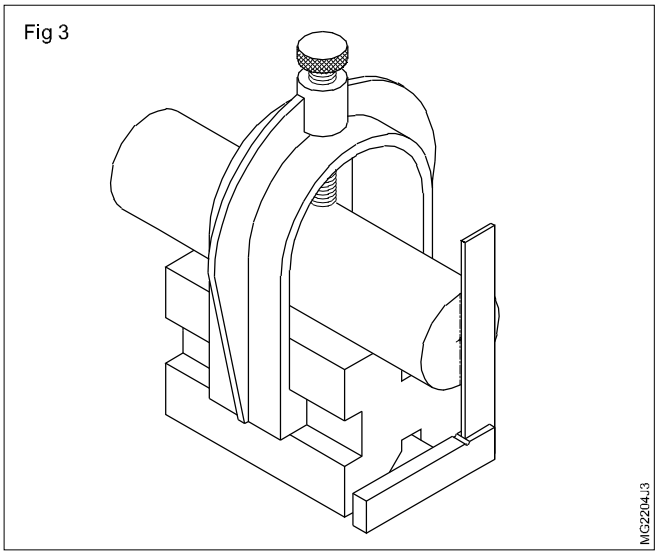


Release the workpiece from the clamp and rotate the workpiece through 90°, set the line at 90° with the help of a try square. (Fig. 3)

Clamp the workpiece to the 'V' block.

Scribe horizontal lines on both faces with the same reading which is set for centre position. (Fig. 4)

Fig 3



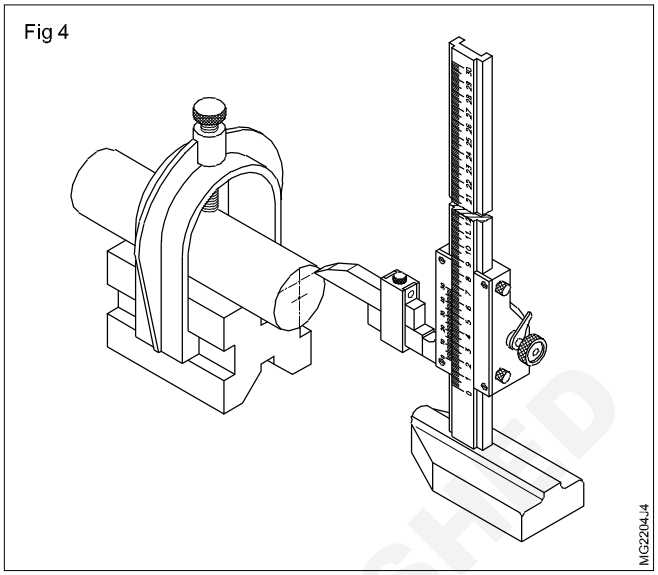
Add eccentricity amount to the above reading and reset the height gauge for the new reading. (Fig. 4)

Scribe horizontal lines on both faces. (Fig. 4)

Release the workpiee from the 'V' Block.

Punch mark on both sides concentric and eccentric centre points.

Fig 4



Truing a job for eccentric grinding

Objective: This shall help you to
- **true the job for external eccentric grinding.**

Truing the eccentric job in a four jaw chuck

Open all the four jaws to give clearance to the workpiece.

Hold the workpiece up to the chuck face with the scribed lines towards the tailstock.

Inset the tailstock centre and slide the tailstock over the bed towards the headstock.

Position the workpiece until the tailstock centre locates in the eccentric centre dot on the workpiece. (Fig. 5)

Move the tailstock centre until the pressure applied holds the workpiece against the chuck face.

Move the chuck jaws, tighten each jaw lightly in turn, taking care not to shift the workpiece.

Check and adjust the position of the workpiece so that it will protrude enough from the jaws to allow the total length of the eccentric portion to be machined.

Tighten the jaws.

Remove the tailstock.

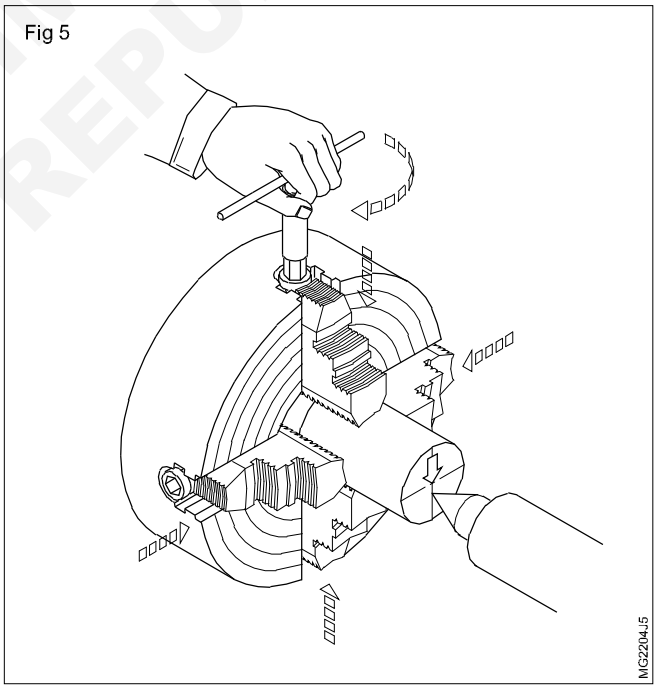
Truing of eccentric job held in a four jaw chuck by using a surface gauge. (Fig.5)

Most of the eccentric truing is done with the help of guide circles scribed on the face of the chuck and the surface gauge. Since the guide circle has been scribed in concentric with the eccentric marking, truing the work to the guide circle gives the exact centre point of the eccentric turning.

Open all the four jaws to give clearance to the workpiece.

Hold the workpiece up to the chuck face.

Fig 5



Set the scriber of the surface gauge over the lathe bed.

Rotate the chuck by hand and check the running of the centre dot or guide circle with the surface gauge pointer.

Tighten each jaw slightly in turn after necessary adjustments of the two sets of opposite jaws are made.

Recheck the centre dot or guide circle with the surface gauge.

Realign the jaws, if required.

Tighten the jaws fully.

Eccentric grinding

Objective: This shall help you to
- **turn external eccentric diameter.**

Turning external eccentric diameter, work held in a 4 jaw chuck.

The procedure of setting the work to turn the eccentric shaft has already been dealt with.

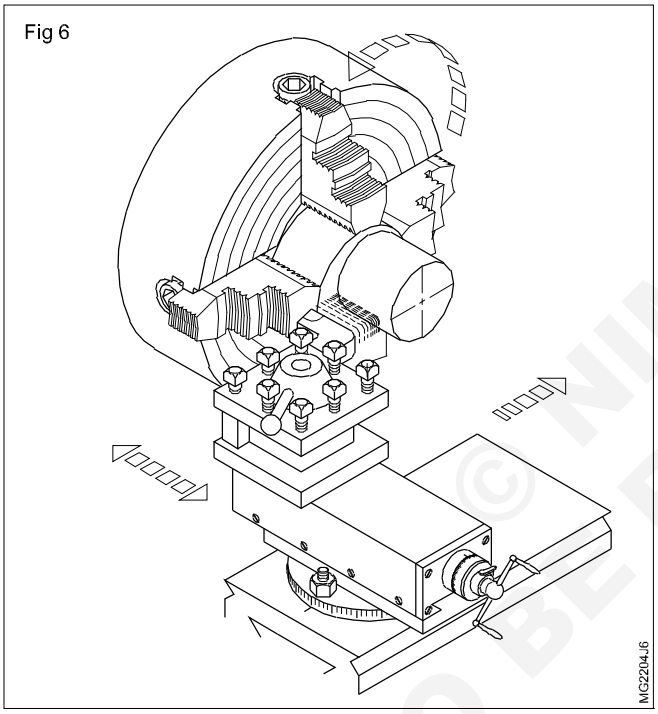
Further steps for turning are given below.

Set the tool to centre height with a minimum overhang.

Ensure that the tool tip is clear off the eccentric throw at the commencement of the operation as shown in Fig. 1.

Rough turn by successive cuts the eccentric diameter leaving approximately 0.8mm in the diameter for finish turning. (Fig. 6)

Fig 6



Set the finishing tool and finish turn to the diameter.

Face the length.

Remove the workpiece from the chuck.

Reverse and reset the job for turning concentric diameter. Use packing strips to protect the turned diameter held in chuck. (Fig. 7).

Release the chuck jaws, rotate the workpiece until the centre dot of the concentric centre is in line with the tailstock centre. (Fig. 7).

Check that all packing strips are in position.

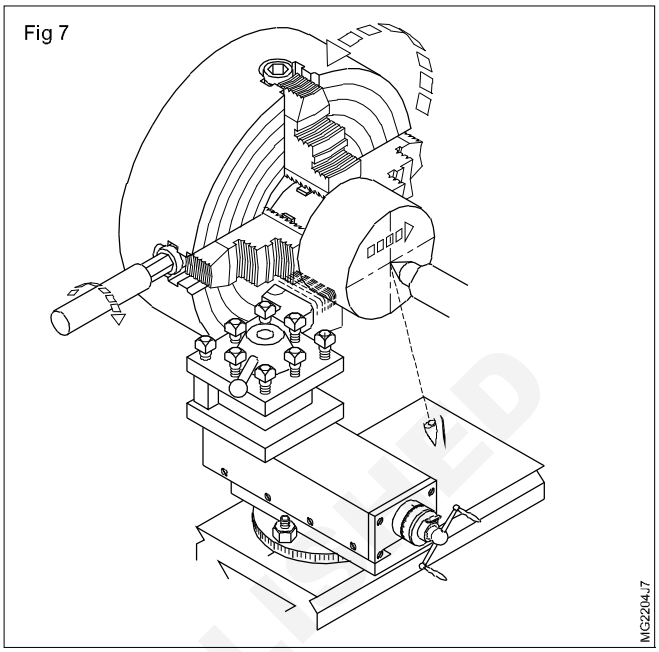
Tighten the jaws.

Remove the tailstock.

Check the running of the concentric centre dot with the help of the surface gauge.

Realign the jaws, if required.

Fig 7



Give each jaw a final tightening.

Make sure that the running of the concentric centre dot is in line with the lathe axis.

Set the tool for rough turn.

Rough turn the concentric diameter.

Set the tool for finish turn, and finish turn the concentric diameter.

Face to length.

Remove the eccentric turned job from the chuck.

Eccentric turning on work held between centres (Fig.8)

Centre drill the marked dots at both ends. (Concentric and eccentric centres)

Mount the catch place to the lathe spindle.

Clamp the carrier to the workpiece.

Grease the dead centre.

Support the workpiece between the eccentric centres for eccentric turning.

Ensure a positive drive from the catch plate to the carrier, and a minimum overhang of the tailstock barrel. Rotate the catch plate by hand to check that the workpiece is in the correct plane. (Fig. 8)

Clamp the tool in the tool post to correct centre height with a minimum over hang.

Rough turn eccentric diameter.

Take successive cuts until over hold the diameter leaving 0.8mm for finish turning. (Fig. 9)

Fig 8

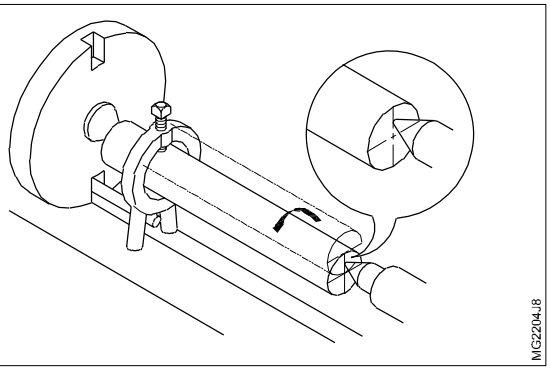
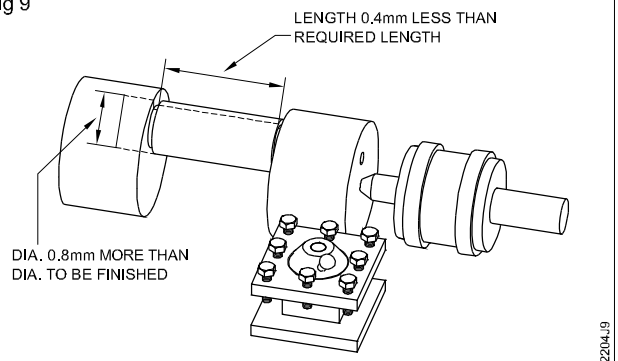


Fig 9



Turn length, leaving 0.4mm for finish turning.

Remove the workpiece and reset the job for concentric turning.

Clamp a suitable carrier to the eccentric diameter. Use soft packing strips between the finished diameter and the carrier.

Hold the workpiece between the concentric centres.

Check that the workpiece is located in the correct plane.

Rough turn the diameter.

Finish turn the diameter to size.

Remove the workpiece and reset the job for finish turning the eccentric diameter.

Clamp the carrier to the finished concentric diameter. Use soft packings to protect the finished diameter.

Finish turn the eccentric diameter to size.

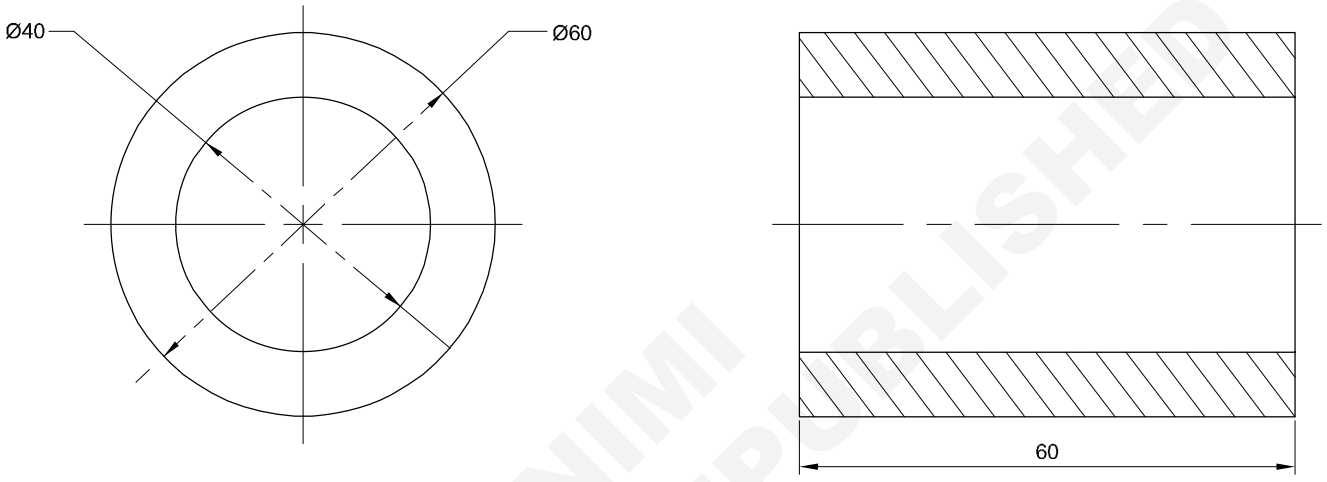
Finish turn the length to size.

This procedure applies only to jobs which will have both the centre holes available for roughing and finishing operations.

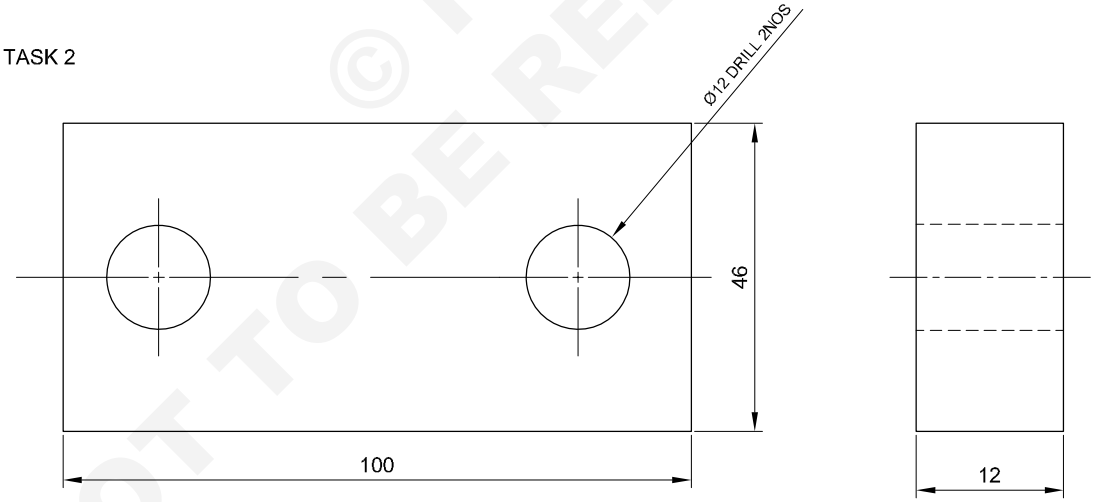
Finish different types of jobs using jigs and fixtures, angle plates by grinding

Objectives: At the end of this exercise you shall be able to
- **internal grinding hold the job using by fixture**
- **surface grinding hold the job using by angle plate.**

TASK 1



TASK 2



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	IS FLAT 50 X 12 X 104		Fe310			
1	ISO Ø63 X 65		Fe310	–	–	1.5.74

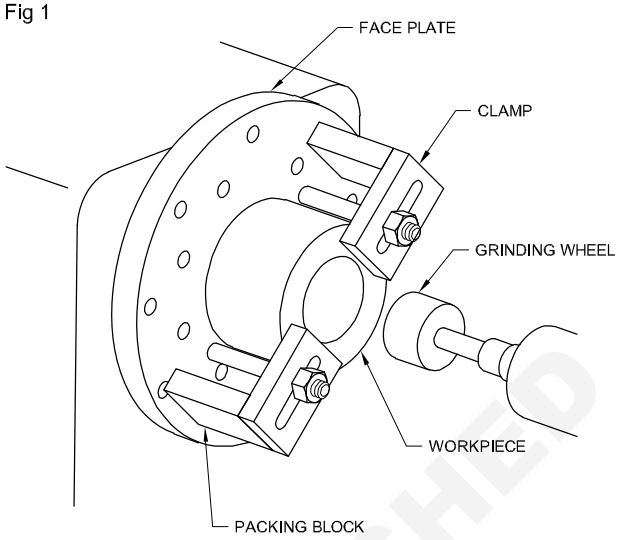
SCALE NTS	GRINDING DIFFERENT TYPES JOB USING FIXTURE AND ANGLE PLATE	DEVIATIONS ±0.04	TIME 15 Hrs
		CODE NO. MG20N1574E1	

PROCEDURE

TASK 1: **Internal grinding hold the job using by fixture**

1 Prepare the material on head stack for universal grinder.
2 Take the job face plate clamps bolt and nut etc.
3 Arrange the setting on head stock. (Fig 1)
4 Check the parallelism by using D.T.I.
5 Grind the job step by step gradually.
6 Finish the grinding.

Fig 1



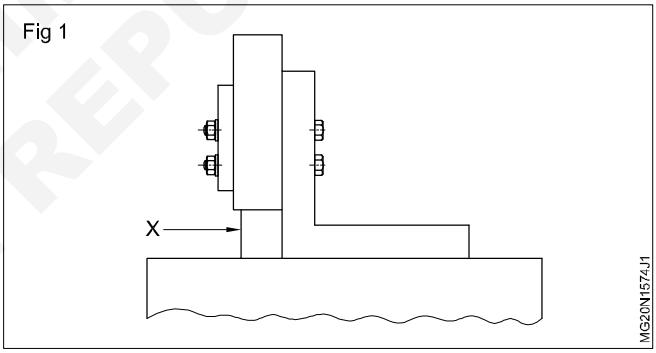
USE OF A FIXTURE FOR AN INTERNAL GRINDING OPERATION

— — — — — — — —

TASK 2: **Surface grinding hold the job using by angle plate.**

1 Prepare the surface plate.
1 Take the angle plate, strap plate and bolt & nut etc.
3 Arrange the setting on surface plate. (Fig 2)
4 Check the zero level by using D.T.I.
5 Grind the job step by step gradually.
6 Finish the grinding.

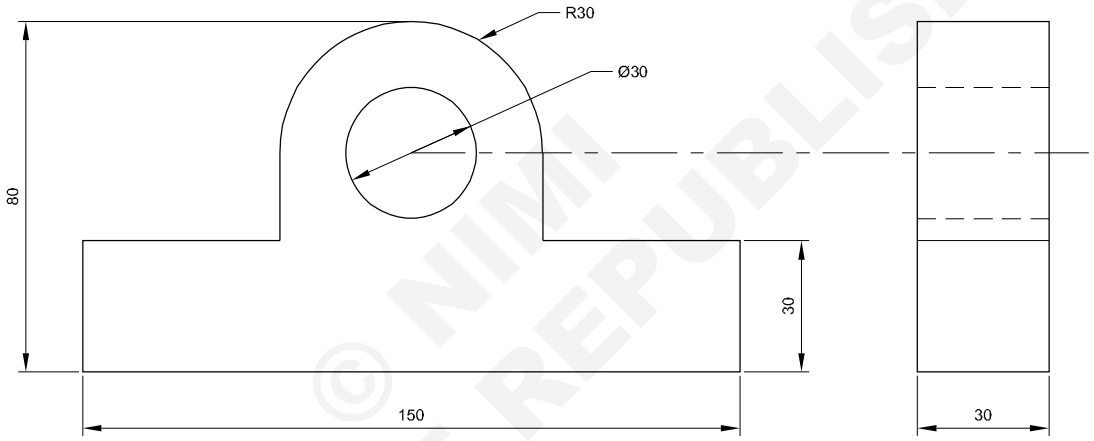
Fig 1



— — — — — — — —

Grinding of job by using face plate angle plate etc.

Objectives: At the end of this exercise you shall be able to
- **prepare job size by milling**
- **bore the hole by lathe using face plate & angle plate with grinding allowance**
- **set job an cylindrical grinding**
- **bore the job by internal grinding.**

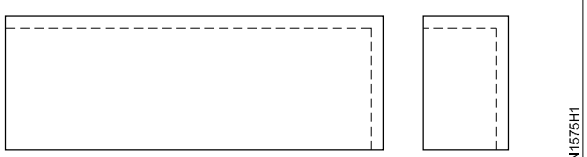


--	35 x 85 x 155	CI CASTING	--	--	--	1.5.75
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	**PERFORM GRINDING OF JOB BY USING FACE PLATE ANGLE PLATE ETC.**				DEVIATIONS	TIME: 12 Hrs
					CODE NO. MG20N1575E1	

Job Sequence

- Check the raw material for size 35x85x155mm
- Remove the burrs it any
- Machine squareness and flatness
- Mark the job for 30x80x150 (Fig 1)

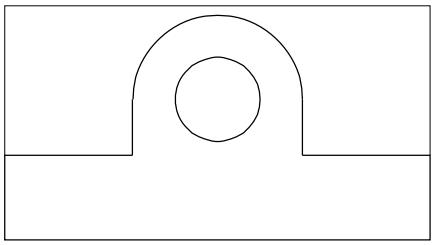
Fig 1



MG20N1575H1

- Remove the excess material.
- Mark the job as per drawing (Fig 2)

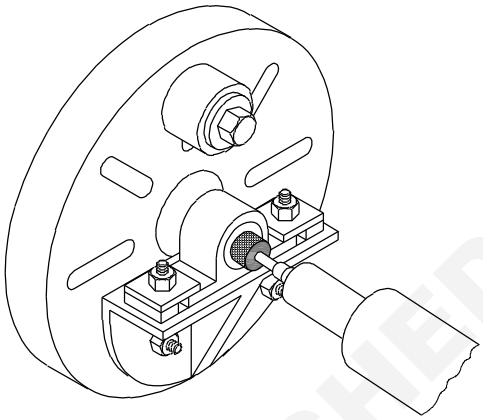
Fig 2



MG20N1575H2

- Drill the hole for 29.5mm
- Set the job on milling machine remove excess material.
- Set the job on fixture in cylindrical grinding (Fig 3).

Fig 3



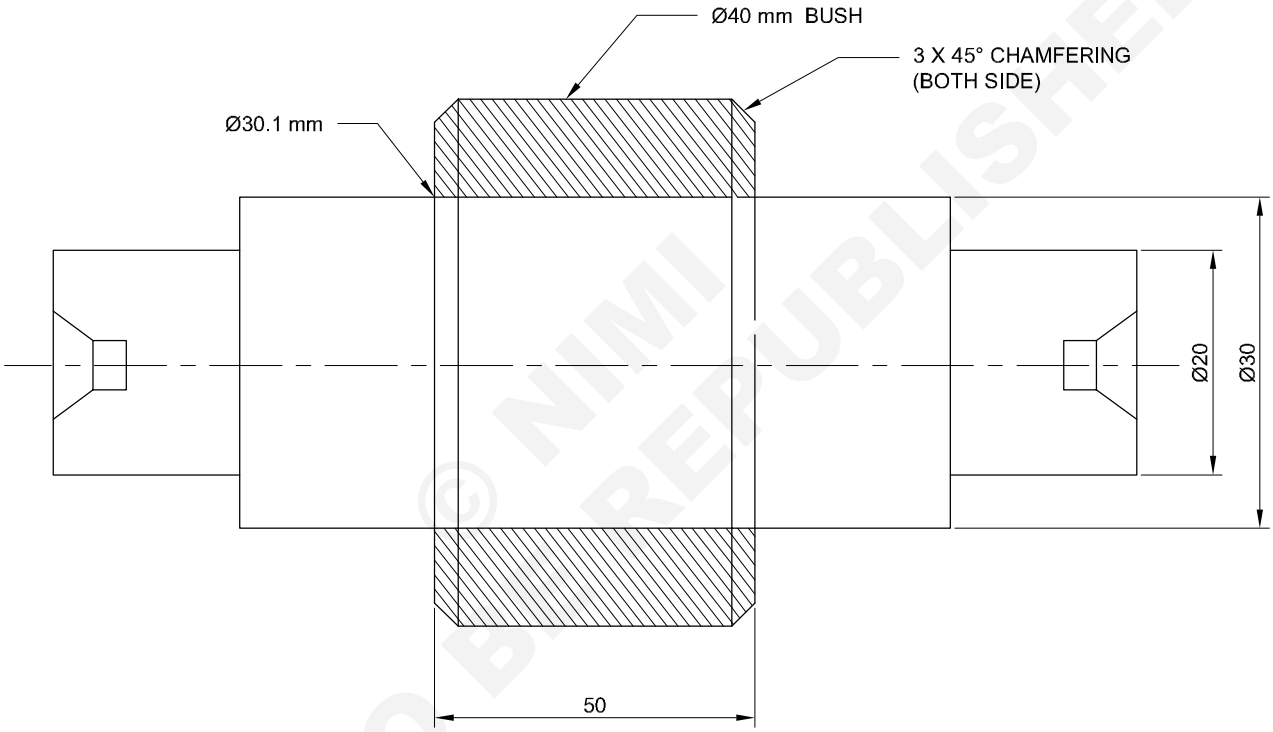
MG20N1575H3

- The fixture is fixed on face plate.
- The job seat on angle plate.
- True the job and tight with clamps.
- For even distribute of weight a balance weight is fixed in the other end of face plate.
- Set the internal grinding attachment.
- Grind the bore to required size.
- Check the size using inside micrometer or telescopic gauge.
- Remove job and deburr.

Finish surfaces of bushes on mandrel within ±0.02 mm by grinding

Objectives: At the end of this exercise you shall be able to

- **set the bushes on the mandrel**
- **set the mandrel in between centres**
- **grind the outside diameter with accuracy ± 0.02mm**
- **measure the dimension of job by using outside micrometer.**

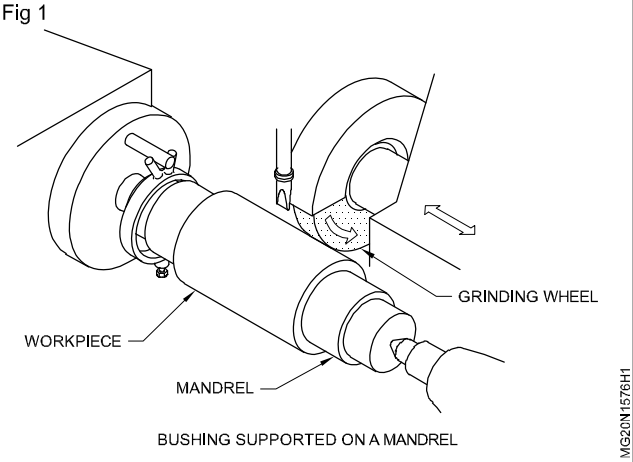


1	ISRO Ø42 X 55		FE 310	-	-	1.5.76
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: 1:1	**GRINDING OF BUSHES ON MANDREL**				DEVIATIONS ±0.02	TIME 25 Hrs
					CODE NO. MG20N1576H	

Job sequence

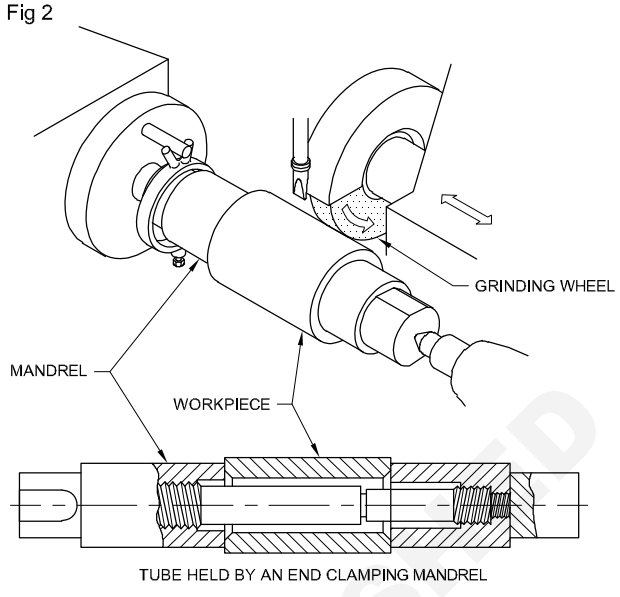
- Study the drawing , turn as per drawing and maintain the size with grinding allowance.
- Set the mandrel in between centres.
- Set stoppers to adjust the table traverse length.
- Rough and finish of grind Ø 40 × 50mm.
- Measure the dimension of job using outside micrometer.
- Finish the job.

Fig 1



BUSHING SUPPORTED ON A MANDREL

Fig 2

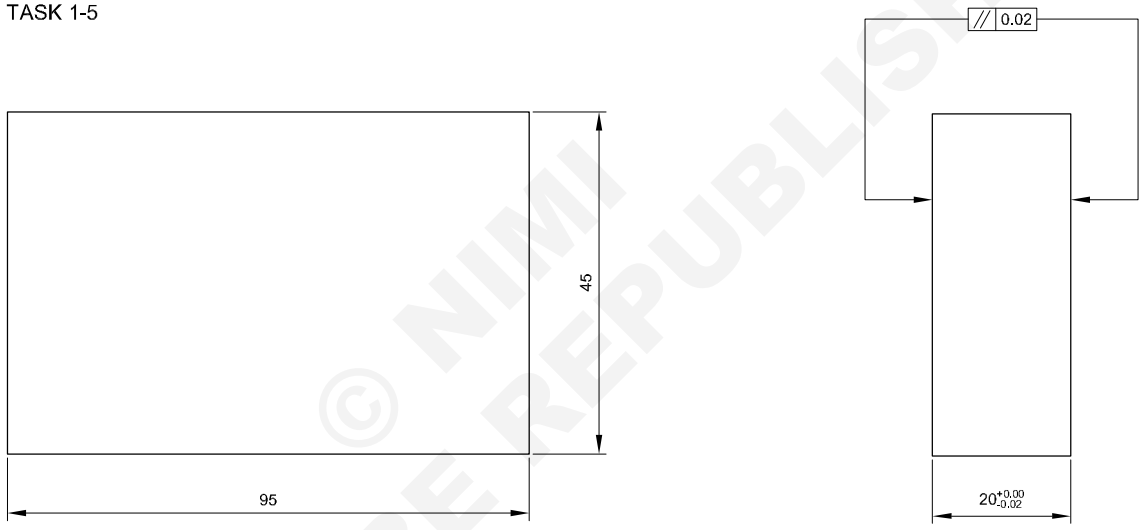


TUBE HELD BY AN END CLAMPING MANDREL

Perform dry and wet grinding of different classes of metals such as cast iron, brazed carbide tip and different classes of steel

Objectives: At the end of this exercise you shall be able to
- **grind parallel surface on soft materials**
- **grind parallel surface on hard materials**
- **maintain parallelism and dimension as per drawing.**

TASK 1-5



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	ISO 100X45X25		STEEL		TASK 5	
1	ISO 100X45X25		CAST IRON		TASK 4	
1	ISO 100X45X25		COPPER		TASK 3	
1	ISO 100X45X25		BRASS		TASK 2	
1	ISO 100X45X25		ALUMINIUM	–	TASK 1	1.6.77

SCALE 1:1	DRY AND WET GRINDING	DEVIATIONS ±0.02	TIME 22 Hrs
		CODE NO. MG20N1677E1	

Job sequence

- Check the size of the premachined workpieces horizontal.
- Set the workpiece on the table of the horizontal surface grinding machine.
- Set the workpiece on the precision vice, projecting 5mm from the jaw surface using suitable parallel blocks.
- Mount the grind wheel for grinding as per (Table).
- Dress the grinding wheel using diamond point dresser.
- Grind plain surface.
- Remove the workpiece and reverse it and set for grinding the other surface
- Grind and check the thickness and parallelism using micrometer and dial test indicator.
- Clean the machine.

Note:

- **Premachined block to size 95 × 45 × 22 mm.**
- **Grind only the thickness.**

Table - 1

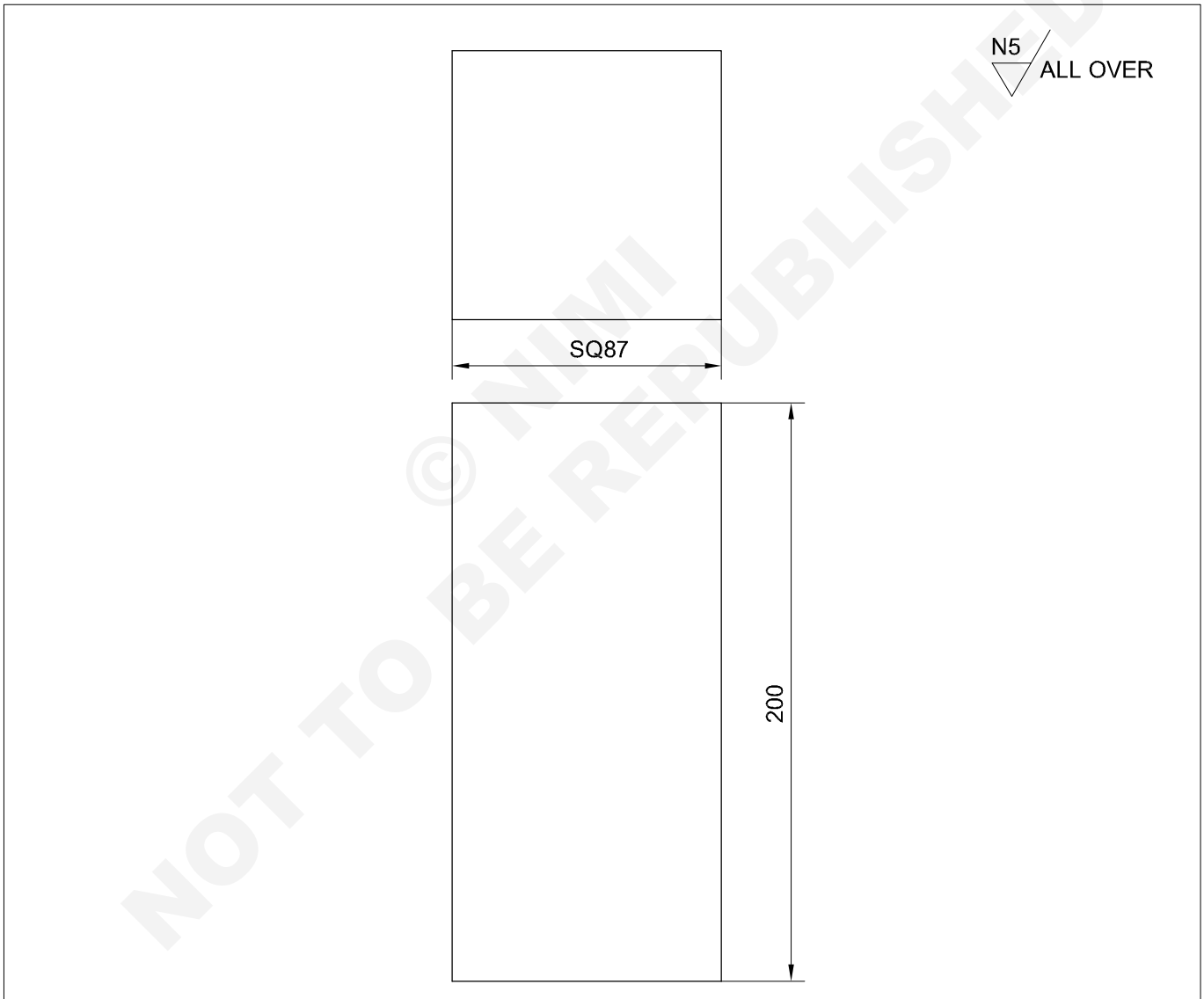
Recommended grinding wheels for Task 1 to Task 5

S.No	Table	Specification of Grinding wheel	Name of Grinding wheel	Coolant	Feed rate mm/min
1	1	51 - S 46 Q 10 S 3	Silicon carbide	-	50 - 65
2	2	51 - S 46 Q 10 S 6	Silicon carbide	-	50 - 65
3	3	51 - S 46 Q 10 S 10	Silicon carbide	-	50 - 65
4	4	51 A - 36 H 5 V 8	Aluminium oxide	Soluble Oil	45 - 65
5	5	51A - 36H 5V15	Aluminium oxide	Soluble Oil	30 - 40

Block grinding within accuracy ± 0.02mm.

Objectives: At the end of this exercise you shall be able to

- **set the job on the magnetic chuck**
- **set the table traverse using a stopper dog**
- **grind a flat surface to an accuracy ± 0.02 mm**
- **grind a surface flat and parallel**
- **set the job on an angle plate**
- **align the job on an angle plate**
- **grind two surfaces flat and square**
- **check the parallelism with an outside micrometer**
- **check the squareness by a try square.**



1	IS SQ 90 x 210	-	Fe310	-	-	2.1.03
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**PART : BLOCK GRINDING**				DEVIATION ± 0.2	TIME 25h
					CODE NO. MG2103E1	

Job sequence

- Prepare the part as per drawing with grinding allowance.
- Measure and determine the grinding allowance.
- Prepare the machine the magnetic chuck and the grinding wheel for grinding.
- Keep one of the parallel surface on the magnetic chuck, resting the length of 200mm against the side stopper plate through parallel.
- Adjust the stroke length by means of adjusting the trip dogs.
- Rough and finish grind the surface removing only half of the grinding allowance and supply of coolant deburr all edges.
- Keep the other surface of the job on the magnetic chuck resting against the stopper plate.
- Rough and finish grind the surface to 200mm to an accuracy of ± 0.01mm.
- Keep the adjacent side of the job on the angle plate and 'C' clamp/Strap clamp.
- Rough and finish grind the surface removing only half of the grinding allowance.
- Deburr all edges.
- Keep the other surface of the job on the magnetic chuck and rough and finish grind the adjacent side surface to 46mm to an accuracy of ± 0.01.
- Keep the job on angle plate parallel surface of 87mm against the side stopper plate through parallel
- Adjust the stroke length.
- Rough and finish grind the surface removing only half of the grinding allowance.
- Deburr all edges.
- Keep the other surface of the job on the angle plate.
- Rough and finish grind the surface to 87mm to an accuracy of ± 0.05mm.
- Remove the job from magnetic chuck clean thoroughly.
- Measure the width and accuracy with an outside micrometer.
- Also chuck right angles on four corner with dial test indicator.

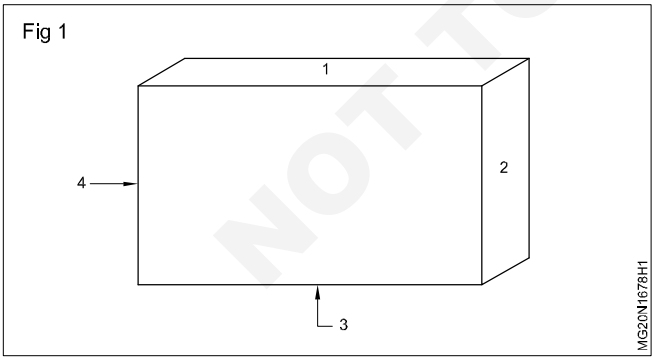
Skill sequence

Grind a surface at right angle

Objectives: This shall help you to
- **set the workpiece for grinding a surface at right angle.**
- **grind surface at right angle.**

Clean and remove all burrs from the workpiece, the angle plate and the magnetic chuck. All the four sides are to be ground parallel and perpendicular to each other. (Fig 1)

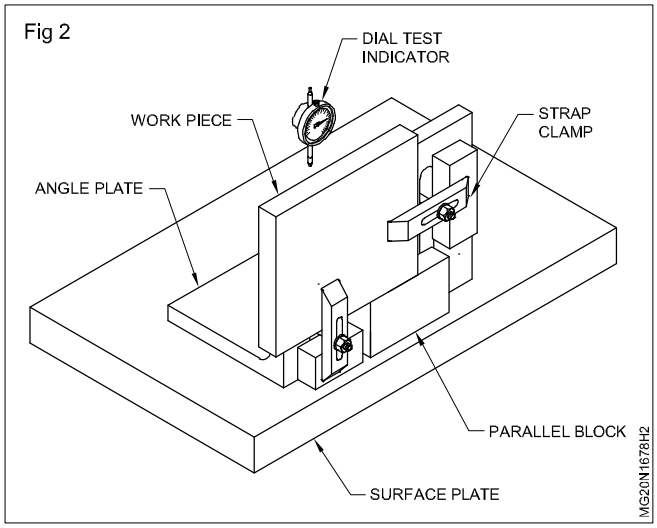
Fig 1



Place the angle plate on the surface plate and set the workpiece using strap clamp. Top and edge of the workpiece project 3mm or 4mm about edge of the angle plate. (Fig 2)

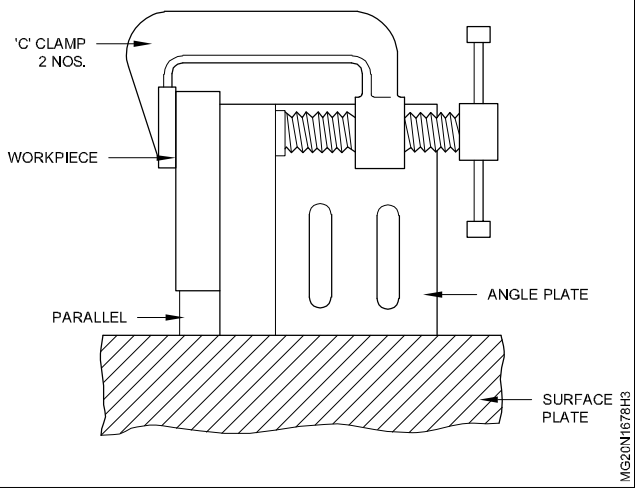
Be sure that the edge of the work does not project beyond the base of the angle plate.

Fig 2



3 If the work piece is smaller than the angle plate length, a suitable parallel must be used to being the top surfaces beyond the end of the angle plate. (Fig 3)

Fig 3



If the workpiee is continent enough height and clearance from the angle plate edge and align with dial test indicator reference to the surface plate.

Clamp the work securely to the angle plate and set the clamps so that they will not interface with the grinding operation.

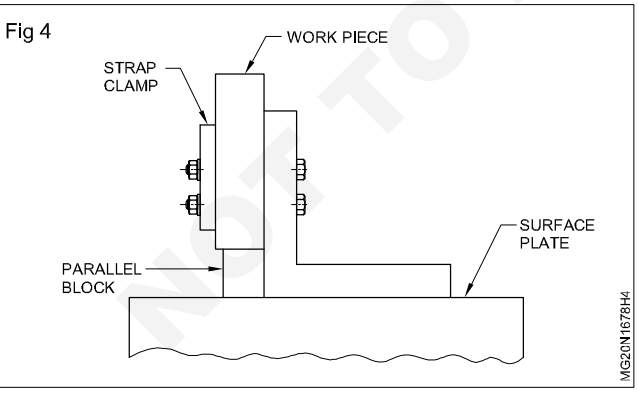
Carefully place the base of the angle plate on the magnetic chuck and switch 'ON'. Magnetic chuck of the grinding machine.

After the work has been properly set up on the magnetic chuck the following steps are to be followed for grinding the edges of work piece.

Raise the wheel head so that it is about 12mm above the surface of the job.

Adjust the table reverse dogs so that each end of the work clears the grinding wheel by about 25mm with the work under the centre of the wheel turn the cross feed handle until about 3mm of the wheel overlaps the edge of the work. (Fig 4)

Fig 4



Start the machine and lower the wheel head until the wheel just sparks the work (It makes depth of cut)

Don't touch the wheel on the job when the wheel is stationary

Move the work clear of the wheel with the cross feed handle.

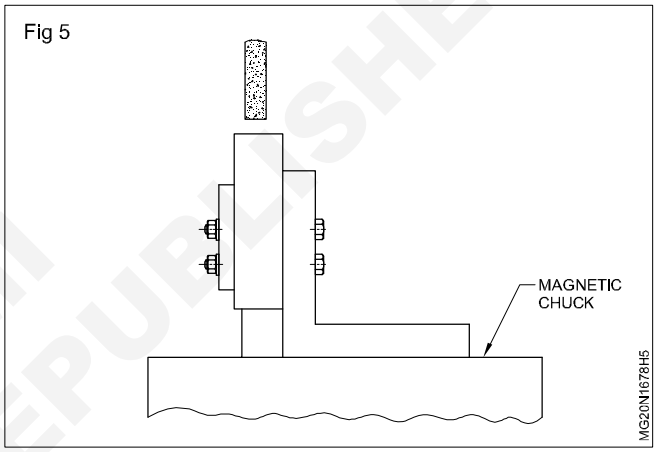
Check for further high spots by feeding the table by hand so that the entire length of the workpiece under the wheel.

The depth of cut should be 0.03 to 0.15mm for the roughing cuts and 0.01 to 0.02mm for the finishing cuts.

Turn off the magnetic and remove the angle plate. Keep vertical position of angle plate for grinding surface (46mm) (2) (Fig 5) repeat the above steps.

Be careful not to be disturb the work set up for above process.

Fig 5



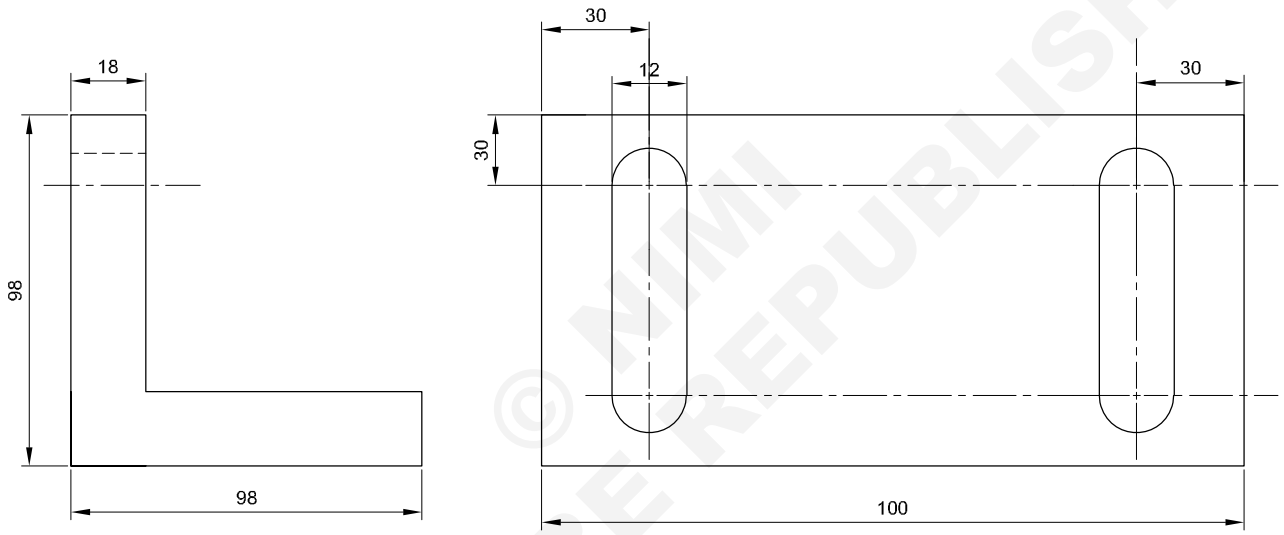
Turn off the magnetic chuck and remove the angle plate and workpiece clean the chuck and angle plate.

Rearrange the job with angle plate and repeat the above steps. When two adjacent sides have been ground they are then used as reference surface to grind the sides (3) and (4) right angle and parallel.

If the workpiece is atleast 25mm thick and long enough to span three magnetic poles on the chuck no angle plate is required.

Grind angle plate within accuracy ± 0.02mm

Objectives: At the end of this exercise you shall be able to
- **set the angle plate for grinding a surface at right angle**
- **grind angle plate**
- **check the dimension by an outside micrometer**
- **check the depth with a depth micrometer.**



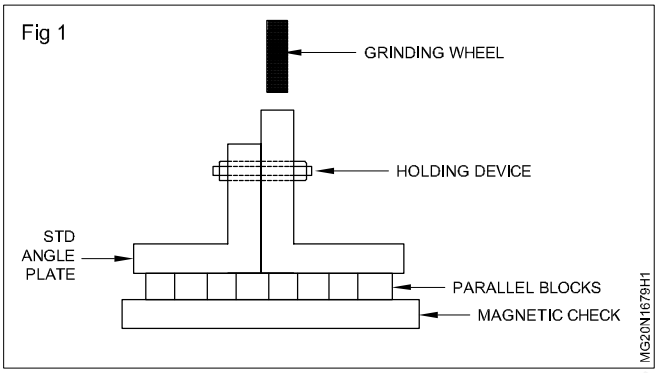
–	L ANGLE	–	–	–	–	
1	100X100X20-105	–	FE 310	–	–	1.6.79
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GRINDING ANGLE PLATE	DEVIATIONS ±0.02	TIME 06Hrs
		CODE NO. MG20N1679E1	

Job Sequence

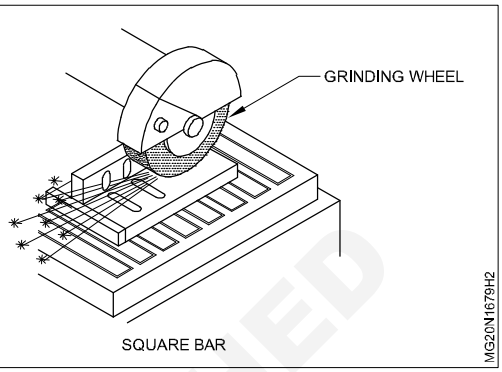
- Study the drawing measure of the job and determine the drawing allowance on surface and step to be ground.
- Prepare the machine the magnetic check and grinding wheel for the surface grinding operation.
- Set the magnetic check and square bar signing with reference the grinding wheel.
- Rough & finish grind the surface to parallel and maintain the size to removing a both side.
- Check the dimension by using outside micrometer.
- Set the another side (Fig 1).

Fig 1



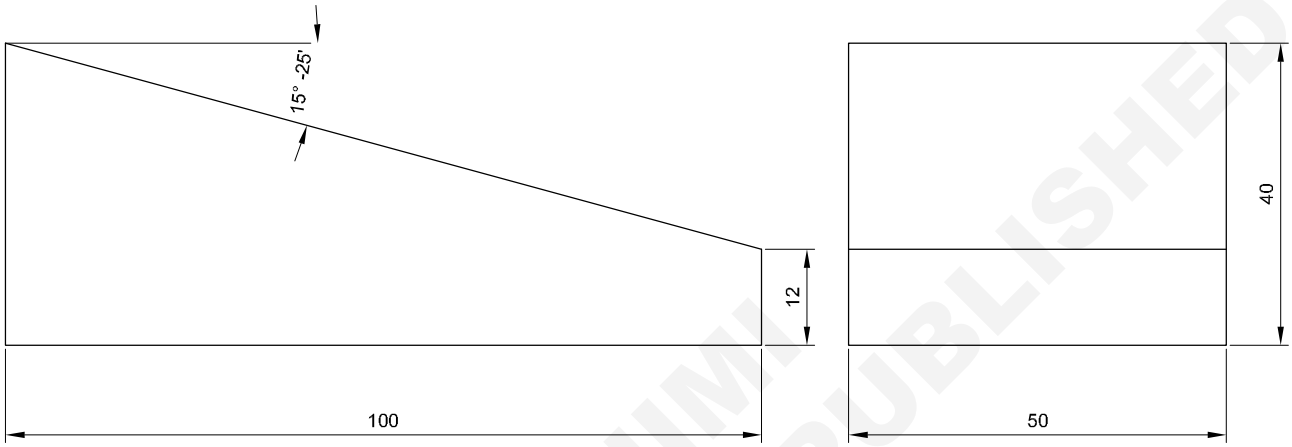
- Set the another angle plate connected to the job with using bolt and nut (Fig 2).
- Grind the both side.
- Check the depth with a depth micrometer.

Fig 2



Grind angular block within accuracy ± 0.02mm

Objectives: At the end of this exercise you shall be able to
- **set the angular by using sine bar and slip gauge**
- **clamp the job with angle plate**
- **grind required angle.**



Job Sequence

- Set the job using sine bar, slip gauge and DTI
- Clamp job with sine bar and slip gauge with angle plate
- Place job with angle plate on surface grinding table
- Grind the angle of 15’ 25’ by rough cut and finish cut.
- Before grinding dress the grinding wheel.

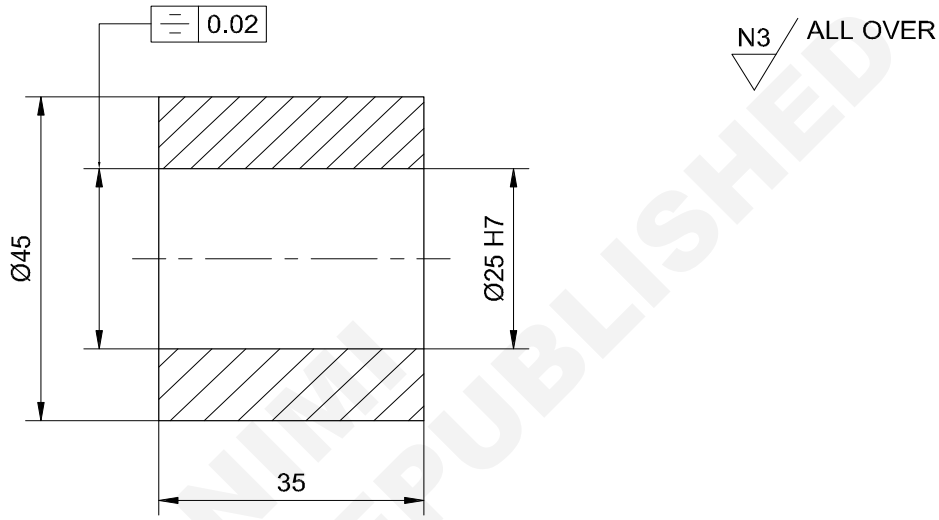
1	40 X 50 X 100	–	FE 310	–	–	1.6.80
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GRIND ANGULAR BLOCK WITHIN ACCURACY ±0.02MM	DEVIATIONS ±0.02	TIME 06 Hrs
		CODE NO. MG20N1680E1	

Perform bore grinding within accuracy ± 0.02mm

Objectives: At the end of this exercise you shall be able to

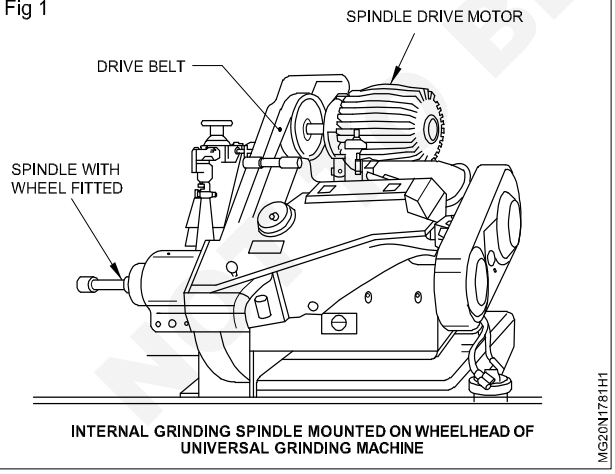
- **mount the internal grinding attachment**
- **mount the grinding wheel and dress the wheel by diamond dresser**
- **set the job in four jaw chuck by using D.T.I**
- **grind the plain bore with an accuracy of ± 0.02**
- **measure the bore diameter by using telescopic gauge.**



Job Sequence

- Turn the part as per drawing with required grinding allowance.
- Prepare the machine for internal grinding. (Fig 1)

Fig 1



INTERNAL GRINDING SPINDLE MOUNTED ON WHEELHEAD OF UNIVERSAL GRINDING MACHINE

- Fit the spindle and mount spindle.
- Dress the wheel with a diamond tipped dressing tool.
- Measure the bore diameter of the workpiece to check the grinding allowance.
- Determine the work and wheel surface speeds and set the machine accordingly.
- Mount the workpiece in a chuck.
- True the workpiece used by dial test indicator.
- Set the length of stroke using reversing dogs.

Make sure that the traverse setting do not cause the wheel to contact any internal shoulder in the workpiece and that the wheel does not leave the workpiece surface completely at the end of the traverse strokes.

- Put on your goggles.
- Start the grinding wheel.

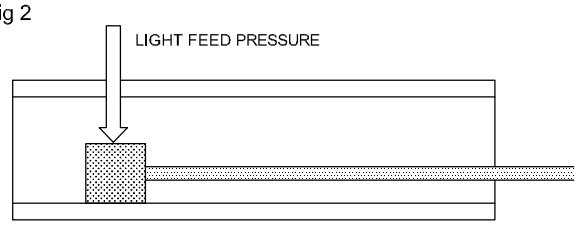
1	Ø 50 x 40 mm	–	Fe310	–	–	1.7.81
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PERFORM BORE GRINDING WITH IN ACCURACY ± 0.02 mm	DEVIATIONS as per IS : 2102(F)	TIME 5hrs
		CODE NO. MG20N1781E1	

- Start the head stock spindle drive.
- Check that the directions of rotation of the wheel and workpiece are opposed.
- Grind the Ø 25 x 35mm bore.
- Start coolant supply and table traverse if necessary.
- Run the grinding wheel to the workpiece by hand and advance the wheel against the bore taking a light cut.
- When cut is complete measure the bore and reset the feed.
- Make repeated cuts until close to the desired size.
- Dress the wheel again for finish grinding.
- Check the bore size, parallism and make the final cuts.
- Remove burred edges.
- Measure the base by using telescopic gauge bore.

Mounting the spindle (Fig 2)

Fig 2



LONG SPINDLE REQUIRES LIGHT FEED PRESSURE TO AVOID FLEXING

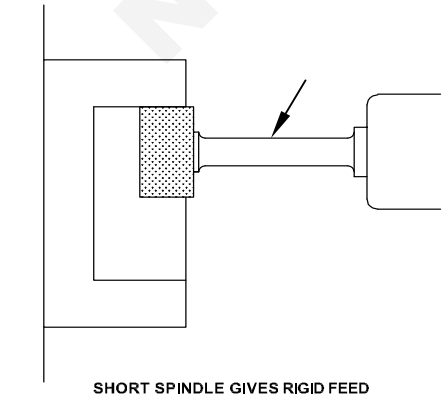
MG20N1781H2

For setting up the internal grinding spindle of a universal grinding machine, the general procedure is as follows:

- Position the internal grinding attachment, including the spindle on the wheel head and fix securely. Refer to the operators handbook for the particular machine.
- Mount the drive belt between the internal grinding drive motor and the pulley on the internal grinding attachment and adjust to proper tension.
- If a machine motor selector control is provided turn it to the 'internal' position.
- Disengage the power operated cross - feed.
- Replace any guards removed to set the attachment in place.

The dimensions of the workpiece (Fig 3)

Fig 3



SHORT SPINDLE GIVES RIGID FEED

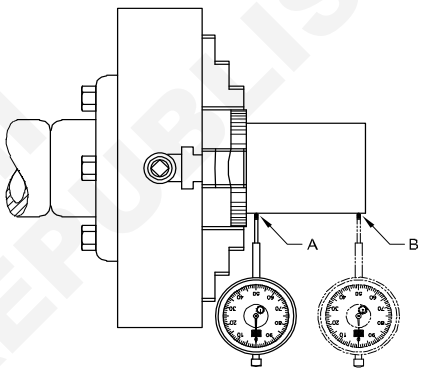
MAN24109H3

The spindle chosen should be as rigid as possible. Where a long workpiece is to be ground the spindle will be correspondingly long and thus subject to flexing under load. If care is not taken this flexing will cause chatter of the wheel with resultant marking of the bore surface. It will also produce a bore of uneven diameter.

Warning
Due to the nature of the operation a wheel guard is not used during internal grinding operations. The workpiece serves as a guard during actual grinding, but remember that the unguarded wheel is a definite safety hazard when not within a workpiece. Keep your hands away from the moving wheel and wear close fitting clothing. If a guard is available on the machine to the wheel when not actually grinding, make sure this set in place after the wheel is retracted from the workpiece.

Set the job in four jaw chuck using dial test indicator. (Fig. 4)

Fig 4



WORK MUST BE TRUED IN THE FOUR-JAW CHUCK
SO THAT THE INDICATOR READINGS AT A & B ARE THE SAME.

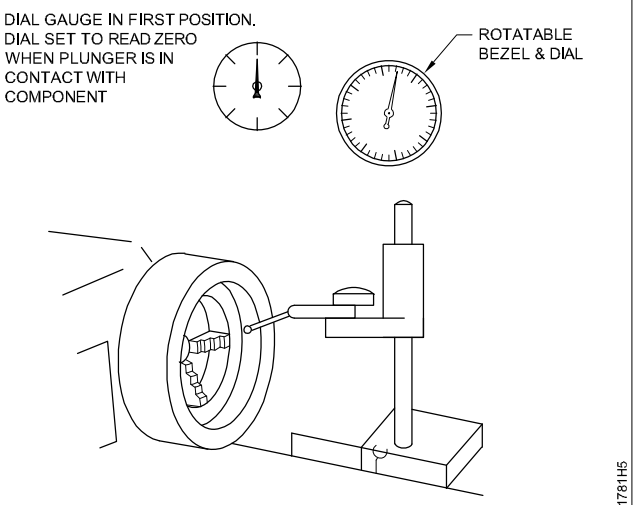
MG20N1781H4

- Hold the job in a four jaw chuck.
- Mount the dial stand on machine table.
- Fix the dial and touch on the job.
- Move the dial and rotate the job.
- Check the trueness of the job with the indicator at zero position.
- Incase of difference in reading adjust the jaw and rotate the chuck.
- The dial moving at A and B are the same reading at zero.

Grinding a parallel bore (Figs 5&6)

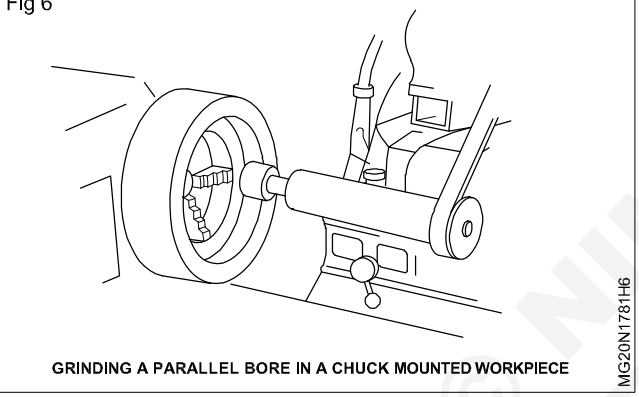
- Set up the machine for internal grinding
- Fit the spindle and mount the wheel.
- Dress the wheel with a diamond tipped dressing tool.
- Measure the diameter of the workpiece to check the grinding allowance.

Fig 5



GRINDING A PARALLEL BORE IN A CHUCK MOUNTED WORKPIECE

Fig 6



GRINDING A PARALLEL BORE IN A CHUCK MOUNTED WORKPIECE

- Determine the work and wheel surface speeds and set the machine accordingly.
- Mount the workpiece in a chuck or other suitable support on the machine headstock.
- True the workpiece in the head stock and align the headstock to the work table.
- If table traverse is necessary, adjust the machine by setting the table reversing dogs.

Caution

Make sure that the traverse settings do not cause the wheel to contact any internal shoulder in the workpiece and that the wheel does not leave the workpiece surface completely at the end of the traverse strokes.

- Put on your goggles.
- Start the grinding wheel
- Start the headstock spindle drive
- Check that the directions of rotation of the wheel and workpiece are opposite.
- Start coolant supply and table traverse if necessary.
- Run the grinding wheel to the workpiece by hand and advance the wheel against the bore, taking a light cut.

Use of telescopic gauge for checking of bore

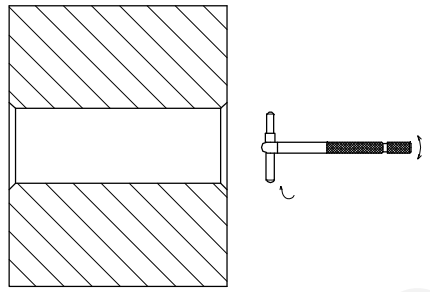
Objectives: At the end of this exercise you shall be able to

- **select the telescopic gauge**
- **measure the dimension of bore**
- **check the dimension using micrometer.**

PROCEDURE

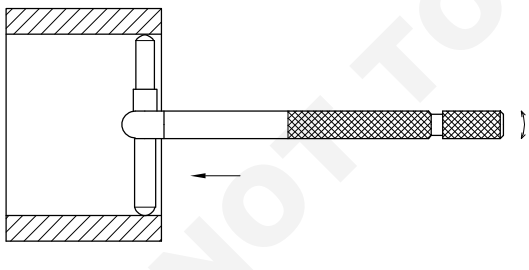
- Measure the approximate size of the hole or slot with a steel rule
- Select a suitable range of a telescopic gauge. Press the moving leg gently and place it inside the hole (Fig 1).
- Release the pressure and allow both the legs to touch on the wall of the hole.

Fig 1



- Keep the telescopic gauge perpendicular to the diameter of the hole.
- Move the gauge slightly inside the hole and get the correct feel. (Fig 2).

Fig 2

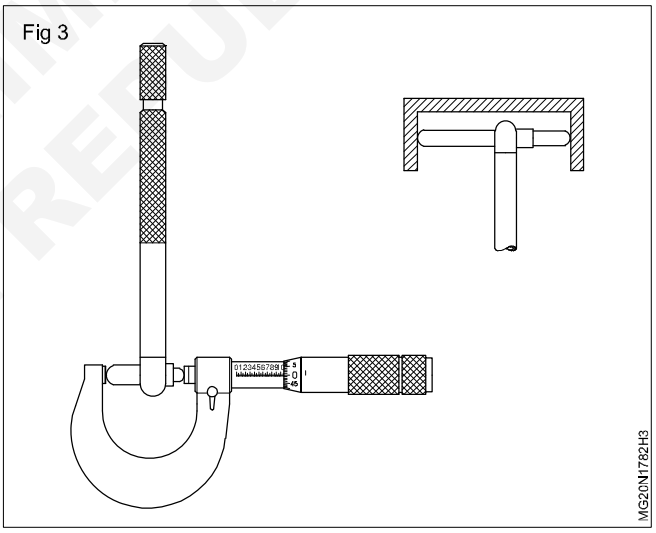


- Lock the telescopic gauge.
- Remove it gently from the hole.
- Transfer the measurement to an outside micrometer (Fig 3) and read.
- Check the diameter again and confirm the reading.

Note: Instructor shall provide some other and component having bore and slot.

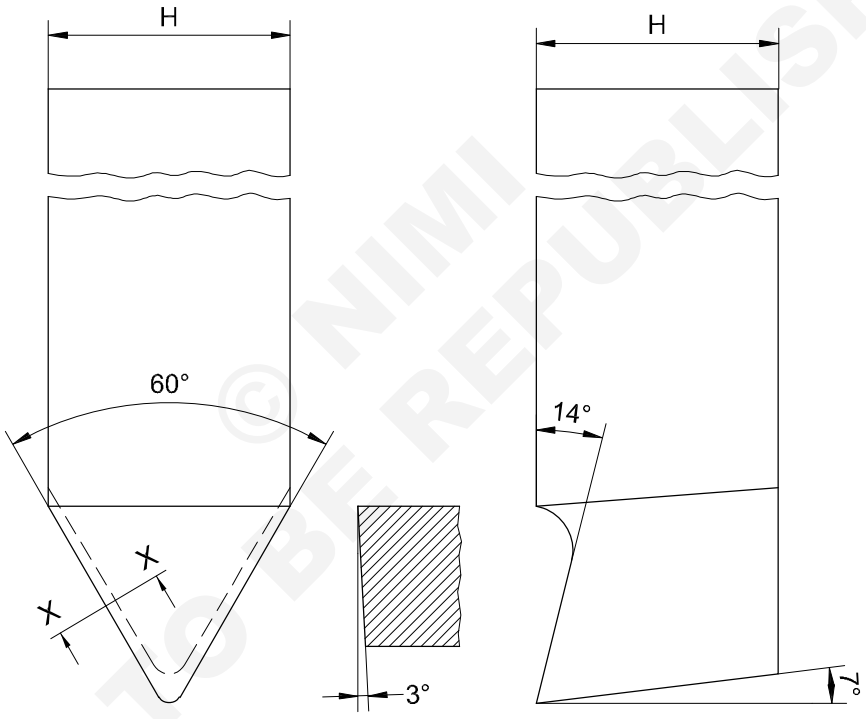
The trainees measure the bore and slots using telescopic gauge.

Fig 3



Perform operation on tools and cutter grinding machine

Objectives: At the end of this exercise you shall be able to
- **prepare the tool and cutter grinder for tool grinding**
- **mount the grinding wheel**
- **set the universal vice on the tool and cutter grinding machine table**
- **set the job on the universal vice**
- **grind the 'V' tool as per drawing with an accuracy of ±1°**
- **check the angles using bevel protractor.**



SECTION XX

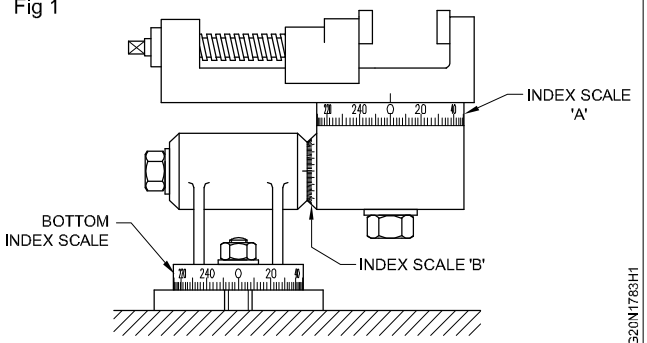
1	ISSQ 20 x 100	–	Fe310	–	–	1.7.83
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**PERFORM OPERATION ON TOOLS AND CUTTER GRINDING MACHINE**	DEVIATIONS ± 1°	TIME 09 Hrs
		CODE NO. MG20N1783E1	

Job sequence

- Sharpen a V-Tool (Shaper) on tool and cutter grinder.
- Rough grinding by hack sawing or off hand grinding before finish grinding on tool and cutter grinder.
- Inspect and mount the flaring cup wheel on the machine spindle.
- Dress the grinding wheel on the machine.
- Mount the universal vice on the table make sure that all the scales are set to zero degrees. (Fig. 1)

Fig 1



- Swivel the scale ‘A’ to 30 degree in anticlockwise direction. (Fig. 2)
- Swivel the scale ‘B’ to 3 degree in anticlockwise direction. (Fig. 2)
- Fix the tool on the vice such that the face of the tool is on top side and set the stop dogs.
- Start the machine rough and finish grind the side a (Fig. 3).
- Remove the tool and refix the tool keeping top side butting on the vice base (upside down).
- Swivel the scale ‘B’ to 3 degree in clockwise direction from zero degree.

Fig 2

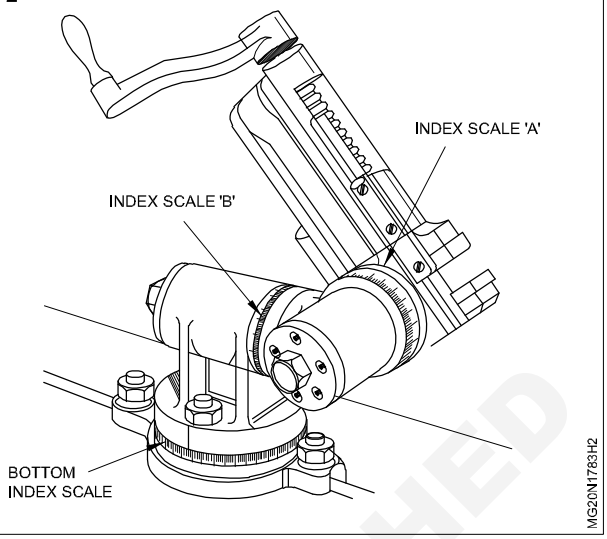
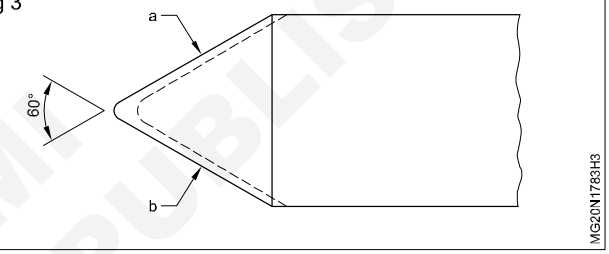


Fig 3



- Do not change the angle on scale ‘A’ .
- Rough and finish grind side ‘b’.
- Check the angles with protractor.
- Remove the tool from the vice set all scales to zero degree.
- Fix the tool in vertical position keeping the face of the tool towards the wheel.
- Swivel the scale ‘B’ to 14 degree in clockwise direction to grind top rake.

Skill sequence

Preparing tool and cutter grinder for re-sharpening of single point cutting tool

Objectives: This shall help you to

- **keep the tool and cutter grinder ready for re-sharpening work**
- **mount and dress the grinding wheel**
- **study your machine and understand the purpose and effect of every handle and hand wheel.**

Study your machine and understand the purpose every handle and hand wheel.

Refer to the Instructional manual supplied by the machine manufactures for function and identification of each operating control.

Clean thoroughly the working surface of the work table and other working area with a clean banian clean cutting waste.

A certain the position of every lubricating point and see that all get the required quantity of correct grade of oil regularly.

Make sure that the oil in the wheel head, the work head and the traverse gearbox is maintained at the correct level with the oil recommended by the machine manufacturers.

Check the lubrication of the table ways each morning as they wear rapidly if allowed to run dry.

Avoid spots of oil on the grinding wheel while refilling.

Always warm up the machine before commencing to grind or to dress the wheel.

Be familiar with the following electrical controls.

- Wheel spindle - 'ON-OFF' switch for changing the direction of rotation.
- Switch for power elevating 'UP' and 'DOWN'.
- Dust extractor - 'ON-OFF' switch.

Be familiar with the following mechanical arrangements

- Swivel the wheel head to the required angle and locking it firmly.
- Adjust the height of the wheel head and direction of rotation of the hand wheel manually for 'UP' & 'DOWN' movement and the method of locking it.
- Swivel the work table to the required angle and lock it.

Remove 'Taper dowels' if provided for '0' setting before swivelling the table.

Cross-traverse movement of the work table and remember the value of the graduations on the graduated dial.

Lock the work table in position.

Mount a grinding wheel on tool and cutter grinder

Objective : This shall help you to
• mount a grinding wheel on the tool and cutter grinder.

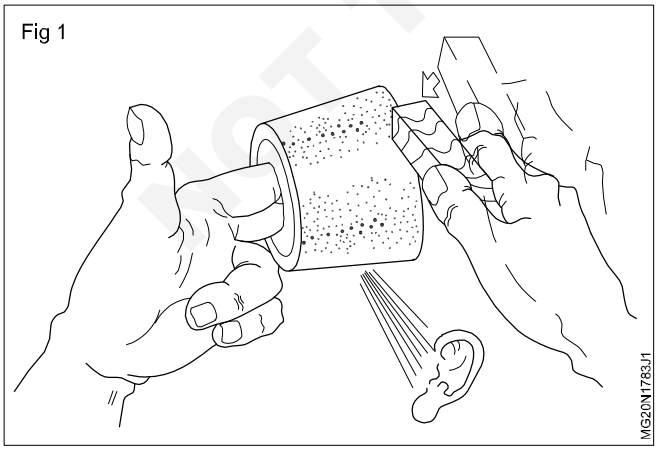
Select and inspect grinding wheel: Select the wheel to be mounted and visually check for cracks.

Check the bore of wheel is the same size as the spigot diameter of the adopter.

"Ring test" wheel by holding loosely with fingers in the bore and tap lightly with a piece of wood and listen for a distinct ringing sound to denote wheel is free from cracks. (Fig. 1)

If the sound is a dull, the wheel is cracked and should not be used.

Fig 1



Mount grinding wheel

Clean the wheel adopter.

Clean the side of the wheel.

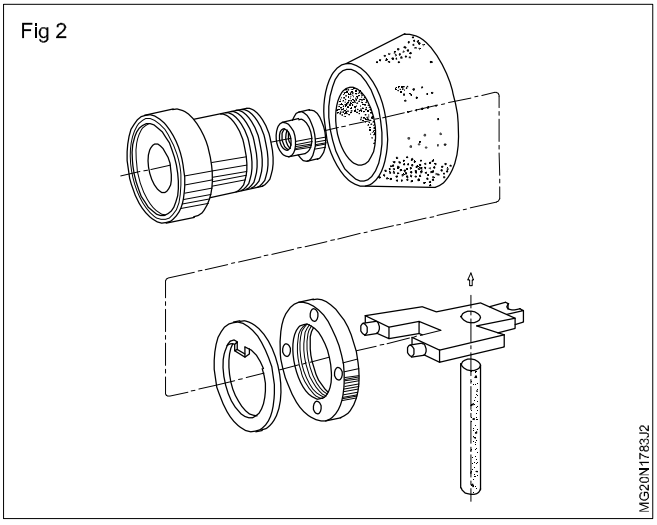
Ensure that paper washer is on each side of the wheel before mounting.

Fit wheel to spigot.

Place locking washer over spigot and up to the front face of the wheel.

Screw on locknut by hand and tighten with wheel key. (Fig. 2)

Fig 2



Dressing a cup grinding wheel

Switch on wheel head spindle.

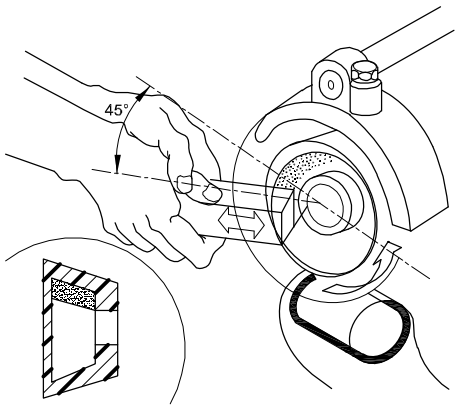
Hold dressing stick firmly with both hands at one end, at a suitable angle.

Move stick forward until gently touches front inside face of the wheel (Fig. 3)

Slowly move dressing stick backward and forward until wheel space to a thin pointed edge.

When wheel looks black and shining, it needs dressing.

Fig 3



Manipulate and control tools and cutter grinding machine

Objectives: At the end of this exercise you shall be able to

- **keep the tool and cutter grinder ready for re-sharpening**
- **measure the dimension of bore**
- **check the dimension using micrometer.**

Study your machine and understand the purpose every handle and hand wheel.

Refer to the instructional manual supplied by the machine manufactures for function and identification of each operating control.

Clean thoroughly the working surface of the work table and other working area with a clean banian clean cutting waste.

A certain the position of every lubricating point and see that all get the required quantity of correct grade of oil regularly.

Make sure that the oil in the wheel head, the work head and the traverse gearbox is maintained at the correct level with the oil recommended by the machine manufacturers.

Check the lubrication of the table ways each morning as they wear rapidly if allowed to run dry.

Avoid spots of oil on the grinding wheel while refilling.

Always warm up the machine before commencing to grind or to dress the wheel.

Be familiar with the following electrical controls.

- Wheel spindle - 'ON-OFF' switch for changing the direction of rotation.
- Switch for power elevating 'UP' and 'DOWN'.
- Dust extractor - 'ON-OFF' switch

Be familiar with the following mechanical arrangements

- Swivel the wheel head to the required angle and locking it firmly.
- Adjust the height of the wheel head and direction of rotation of the hand wheel manually for 'UP' & 'DOWN' movement and the method of locking it.
- Swivel the work table to the required angle and lock it.

Remove 'Taper dowels' if provided for '0' setting before swiveling the table.

Cross - traverse movement of the work table and remember the value of the graduations on the graduated dial.

Lock the work table in position.

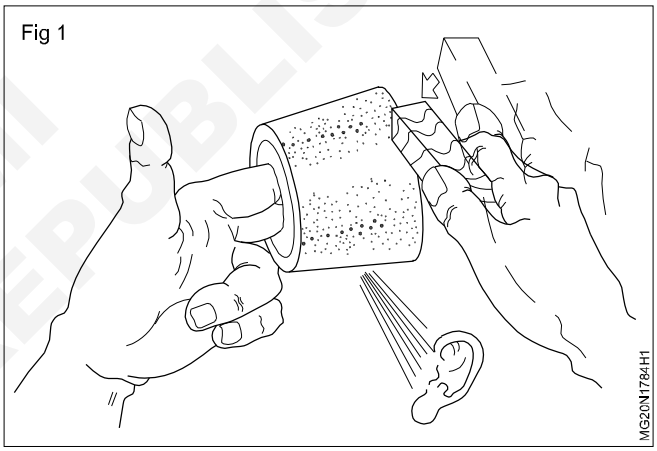
Mounting grinding wheel on tool & cutter grinder.

Select and inspect grinding wheel: Select the wheel to be mounted and visually check for cracks.

Check the bore of wheel is the same size as the spigot diameter of the adopter.

"Ring test" wheel by holding loosely with fingers in the bore and tap lightly with a piece of wood and listen for a distinct ringing sound to denote wheel is free from cracks.(Fig 1)

Fig 1



If the sound is a dull, the wheel is cracked and should not be used.

Mount grinding wheel

Clean the wheel adopter

Clean the side of the wheel.

Ensure the paper washer is on each side of the wheel before mounting.

Fit wheel to spigot.

Place locking washer over spigot and up to the front face of the wheel.

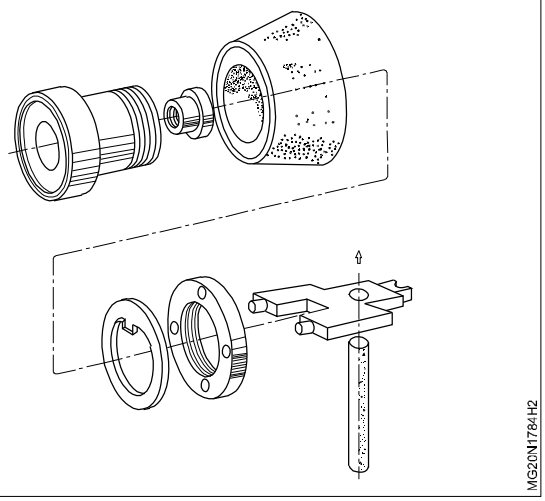
Screw on locknut by hand and tighten with wheel key. (Fig 2)

Dressing a cup grinding wheel

Switch on wheel head spindle.

Hold dressing stick firmly with both hands at one end, at a suitable angle.

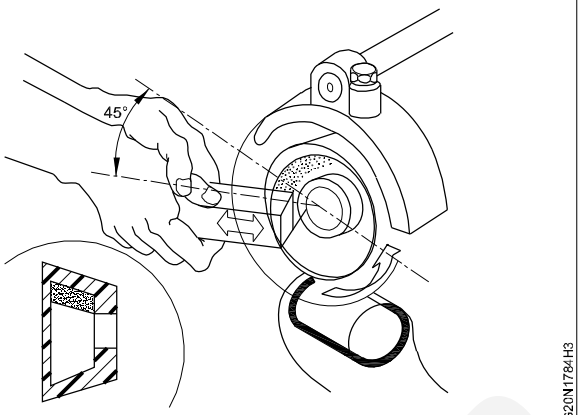
Fig 2



Instructor shall demonstrate to the trainees how to manipulate and control tools & cutter grinder ask them to do

Move stick forward until gently touches front inside face of the wheel (Fig 3)

Fig 3



Slowly move dressing stick backward and forward until wheel space to a thin pointed edge.

When wheel looks black and shining, it needs dressing.

Mount jobs on mandrel in tools and cutter grinding machine

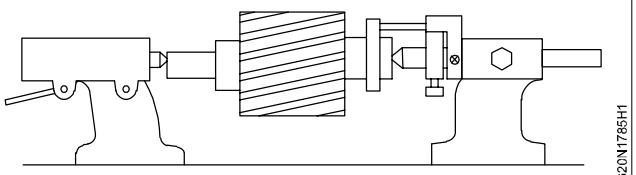
Objectives: At the end of this exercise you shall be able to

- **select the telescopic gauge**
- **measure the dimension of bore**
- **check the dimension using micrometer.**

Job Sequence

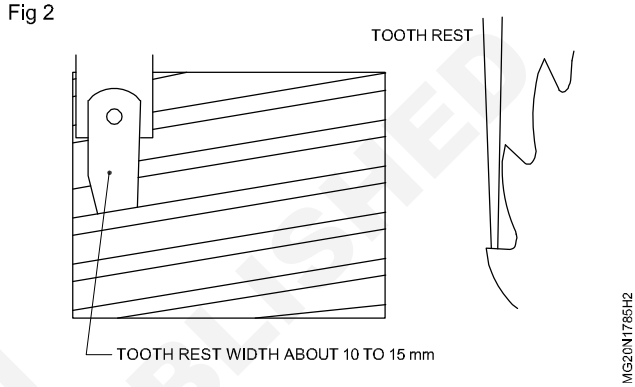
- Fix the tooth rest to the head. (Static type)
- Fasten it after moving it to the specified relief angle using the graduation of the relief angle indicator (Fig 1)

Fig 1



- Adjust the tooth rest and fasten it after setting it to the rake face of the cutter (Fig 2).
- Then remove the dog.
- Grip the mandrel with the right hand so as to press it lightly onto the tooth rest.
- Feed the table with the left hand.
- Grind two opposite teeth only and check their paralleism.

Fig 2



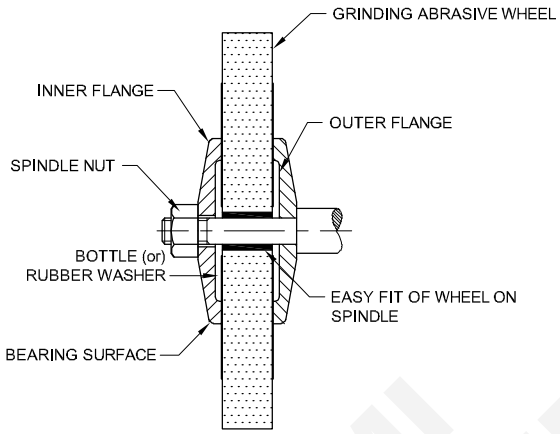
- For adjustment use the taper adjusting screw on the table.
- After parallelness has been obtained grind all peripheral teeth.
- See the “Side Cutter” chapter for the cut-in margin land width and other grinding points

Mount wheel and gaurds on pedestal grinder

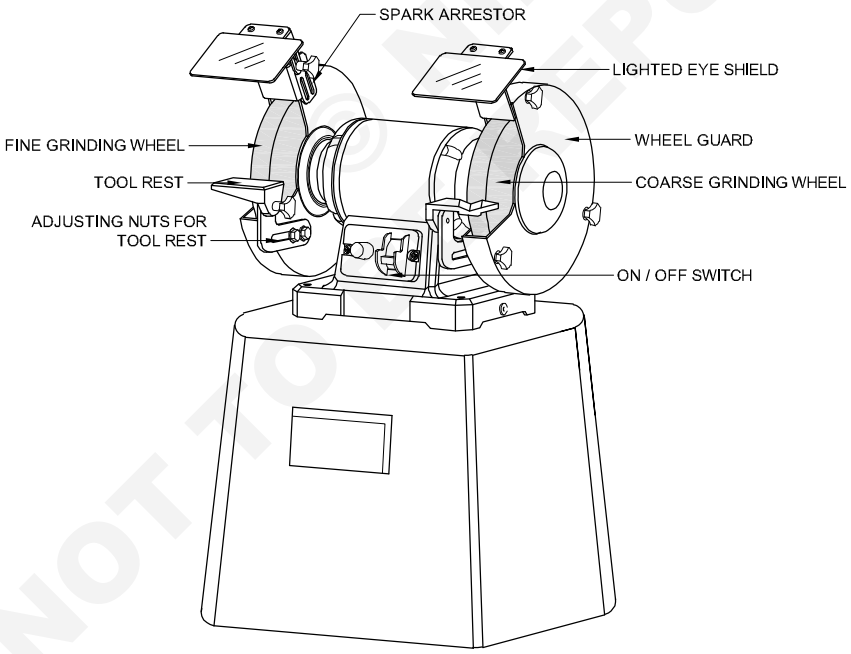
Objectives: At the end of this exercise you shall be able to

- **mounting wheels an pedestal grinder**
- **fixing gaurds an pedestal grinder.**

TASK-1



TASK-2



MG20N1786H1

PROCEDURE

TASK 1: **Mounting wheel or pedestal grinder**

- Disconnect machine from their power source before changing to abrasive wheel.
- Ensure the correct type and size wheel for the machine by checking the marking system.
- Select the proper abrasive wheels and machine both jobfinish quality, and the contact area of the wheel.
- Examine the wheel for cracks or chip (visual inspection) to ensure the wheel is in safe condition and perform 'ring test' replace the wheel if any fault.
- Maintain even pressure from both flanges against the sides of the wheel; check the flange with straight edge.
- Use proper mounting blotters between wheel and flanges. Do not reuse the blotters and only use on boltter for each side of the wheel.
- Tighten the grinding wheel just enough to prevent them from slipping.
- Place the threads of the central spindle with direction that allows the nut to tighten because of the force of the work being done.
- Before turning on the power, the operator should turn the wheel by hand to check for appropriate wheel clearance.
- Stand to one side and test the wheel, start and run the wheel for at least 1 minute. If any under vibration occurs, switch off immediately and make adjustments. Never adjust moving machinery.

— — — — — — —

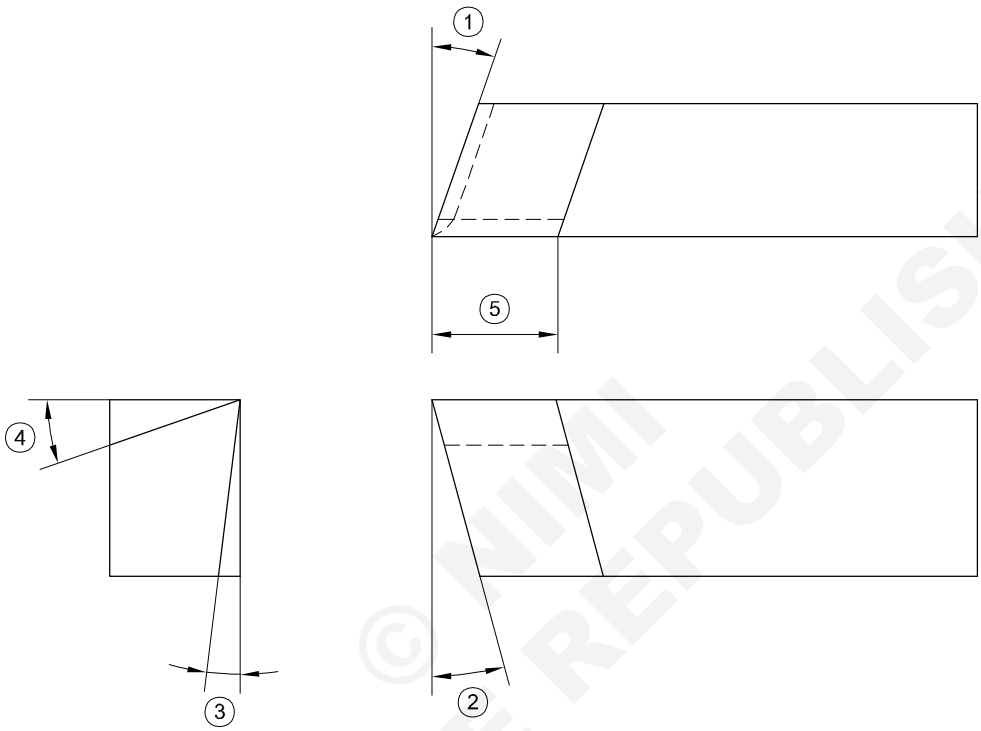
TASK 2: **Fixing wheel gaurds**

- After mounting the wheel fix the wheel gaurds both sides.
- Firmly tight the screws otherwise it will makes noise while grinding.

— — — — — — —

Sharpen lathe tools on pedestal grinder

Objectives: At the end of this exercise you shall be able to
- **prepare pedestal grinder**
- **grind the angles and clearances of side cutting tool**
- **check the angles and clearances with a tool angle gauge.**



1. END CUTTING EDGE ANGLE - 25°
2. FRONT CLEARANCE ANGLE - 6°
3. SIDE CLEARANCE ANGLE - 6°
4. SIDE RAKE ANGLE - 14°
5. CUTTING EDGE LENGTH - EQUAL TO TOOL THICKNESS

1	iS SQ 12 - 150		Fe 310-O			1.7.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE N.T.S	GRINDING A SIDE CUTTING TOOL	DEVIATIONS	TIME : 2 Hrs
		CODE NO. MG20N1787E1	

Job Sequence

- Check the gap between the wheel and the tool rest and maintain the gap 2 to 3mm.
- Before starting wear safety goggles.

Damages or any corrections needed should be brought to the notice of the instructor

- Hold the blank against the wheel to grind the end cutting edge 20° to 25°and the front clearance angle between 6° to 8°.

Dont allow the tool to be overheated dip the tool frequently in the coolant.

- Grind the side of the tool for giving 6° to 8° side clearance. The side length should be equal to the width of the tool blank.
- Grind the top of the tool for a side rake angle of 12° to 15°.
- Finish grind all angles and clearances on a smooth wheel.
- Check the angle to an accuracy of 1°
- Grind a nose radius of approximately 0.5mm R.

The ground surface should be without steps and should have a uniform smooth finish.

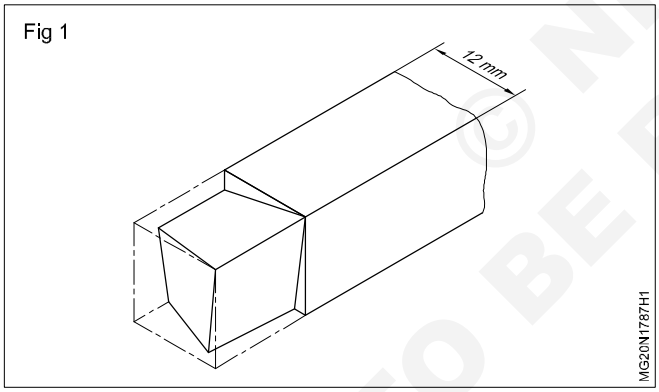
Skill sequence

Grinding a side cutting tool for machine steel

Objective: This shall help you to
• grind a right hand side cutting tool to machine steel.

The side cutting tool to be used on steel is illustrated in Fig 1. The left hand portion illustrates the tool blank in dotted lines before grinding, and the ground tool by thick lines. (Fig 1)

Fig 1



The side cutting edge is in line with the blank edge and the end cutting edge is inclined at an angle of 25°. The side rake angle is 14°. The front and side clearances are ground 6°. The length of the side cutting edge is maintained equal to the size of the square cross-section of the tool blank ie. 12 mm. Fig 2 shows the shaded portion to be removed by grinding the tool blank to get the ground tool. The procedure in sequence is as follows.

Grind the end cutting edge angle 25°. (Fig 3)

Grind the side rake angle of 14°. (Fig 4)

Grind the side clearance angle of 6°. (Fig 5)

Grind the front clearance angle of 6°. (Fig 6)

Grind and provide a nose radius of R 0.4 to R 0.6 mm at the point of the tool. Grind a flat for a short length of 0.2 to 0.3 mm as shown in Fig 7. For the sake of clarity the figure is magnified.

Fig 2

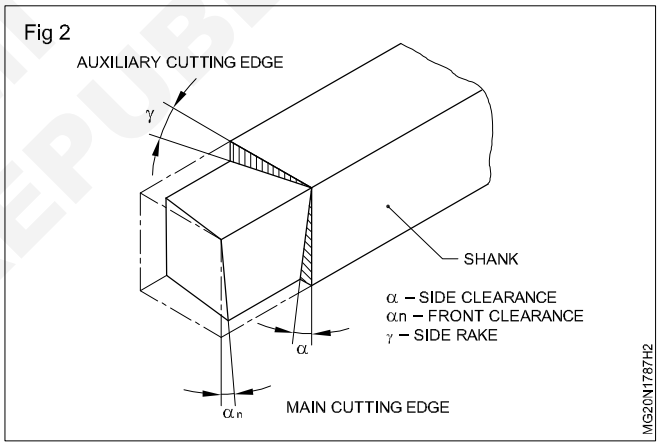


Fig 3

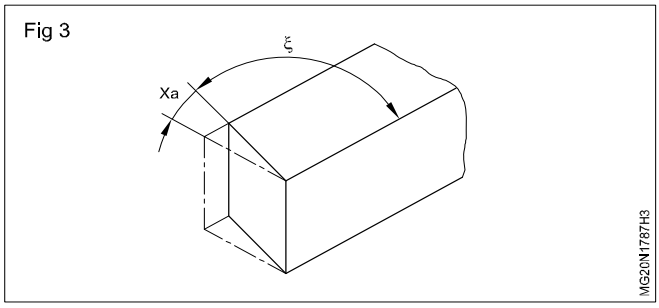


Fig 4

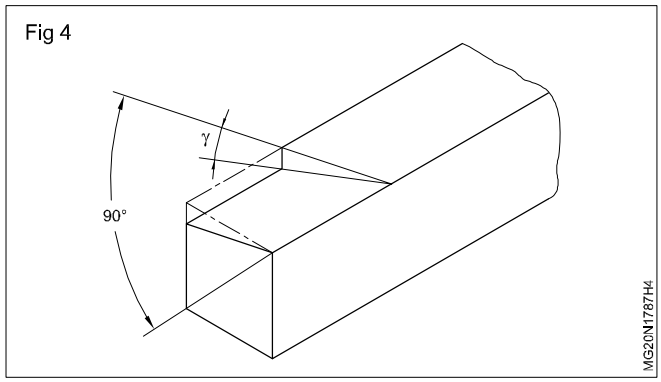
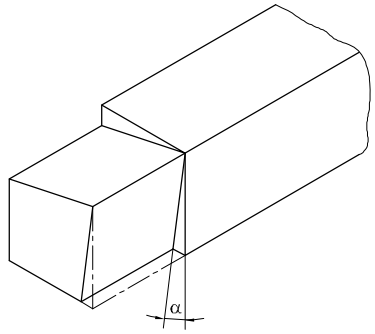
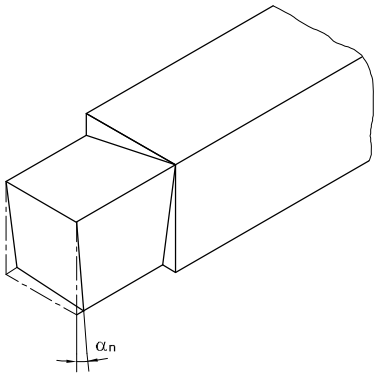


Fig 5



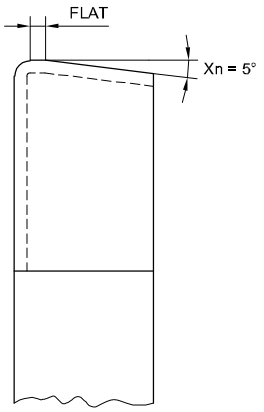
MG20N1787H5

Fig 6



MG20N1787H6

Fig 7

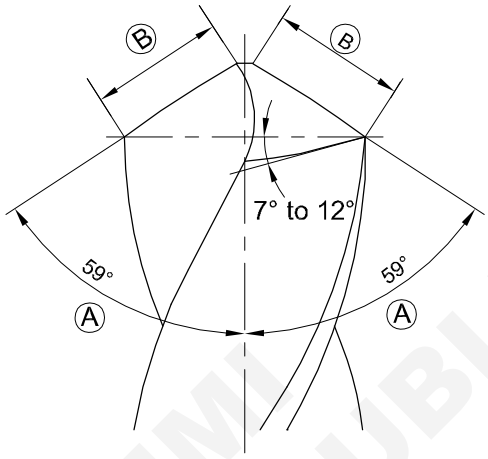


MG20N1787H7

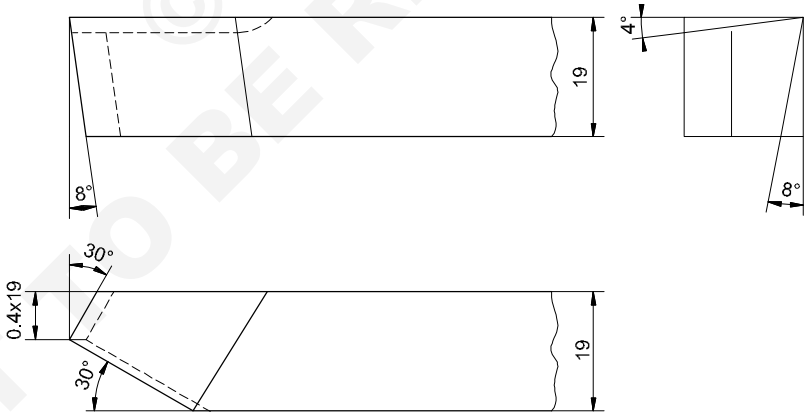
Sharpen drill, tool bit on pedestal grinder

Objectives: At the end of this exercise you shall be able to
- **resharpen, the twist drill point to 118°, when it becomes blunt**
- **check the drill grinding gauge**
- **check the angle with tool angle gauge or template.**

TASK-1



TASK-2



1	20 sq -150	-	-	-	-	
1	WORNOUT DRILL	-	H.S.S	-	-	1.7.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX.NO.

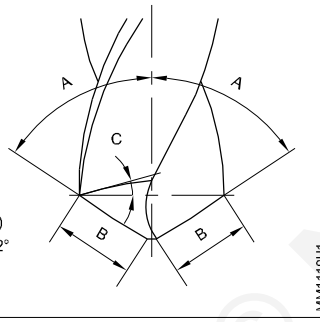
SCALE 1:1	**SHARPEN DRILL, TOOL-BIT ON PEDESTAL GRINDER**	DEVIATION ± 0.02	TIME : 5 Hrs
		CODE NO. MG20N1788E1	

Job sequence

TASK 1: **Re-sharpening of drill**

- For general purpose drilling of steel the point of the twist drill is ground with and angle of 118°.
- Select a bench grinder fixed with a dressed silicon carbide grinding wheel.
- Use the face of the wheel for grinding the drill.
- Follow the safety procedures of working in a bench grinder.
- Wear safety goggles.
- Grind both lips with equal length and equal lip clearance of approximately 12°.
- Maintain the lip angle 59° either side from the axis of the drill.
- Check the angle with a drill grinding gauge and ensure the angle. (Fig 1)

Fig 1



A = LIP ANGLES = 59°
B = CUTTING EDGES (LIP LENGTH)
C = LIP CLEARANCE = 8° to 12°

- Caution: Don't cool HSS drill in water allow to cool in air only.

— — — — — —

TASK 2: **Grind turning tool**

- Rough grind the end cutting edge angle of 30° and the front clearance angle of 4° simultaneously.
- Hold the top flank of the tool against the wheel face inclined at 14°, the rear side contacting the wheel first, and grind the side rake angle of 14°.
- Ensure that the ground portion is parallel to the side cutting edge.
- Rotate the wheel by hand and observe for free rotation.
- Check the grinding wheels for true running.
- Wear goggles.
- Dress the wheels by a wheel dresser.
- Adjust the tool-rest to maintain a minimum gap from the wheel face to a minimum of 2 to 3mm.
- Hold and apply the side flank of the tool to the front face of the grinding wheel at 30° to horizontal.
- Move the tool left to right and vice versa to grind the side cutting edge angle to cover 2/3" width of the tool.
- Grind a side clearance angle of 8°, the bottom of the edge touching the wheel first.
- Finish grind all the faces on the finishing wheel.
- Grind a nose radius of approximately R. 0.4mm.
- Check the angles with a tool angle gauge and template.
- Lap the cutting edge with an oilstone.
- The top rake (back rake) angle should be kept at 4°.
- To prepare L.H tool follow the same procedure.

— — — — — — —

Skill sequence

Sharpening of drills

Objective: This shall help you to
sharpen drills on an off hand grinder.

A drill will loose the sharpness of its cutting edges due to continuous use, and improper use of drills will also spoil the cutting edges.

Spoiled or blunt cutting edges of the drills must be sharpened on a grinder.

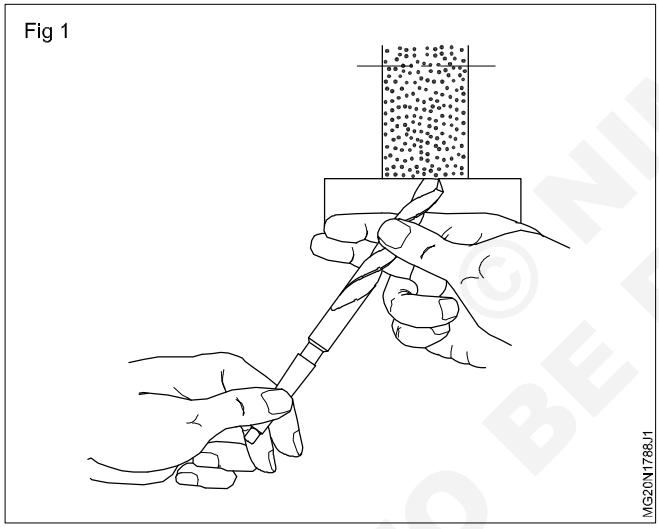
Check the grinding wheel for loading, glazing, trueness and cracks. Call your instructor for advice. Dress and true the wheel if necessary.

Protect your eyes either with goggles or by lowering the eye protecting shield near the tool rest and adjust the tool rest 2 mm closer to the wheel, if necessary.

Switch on the grinder.

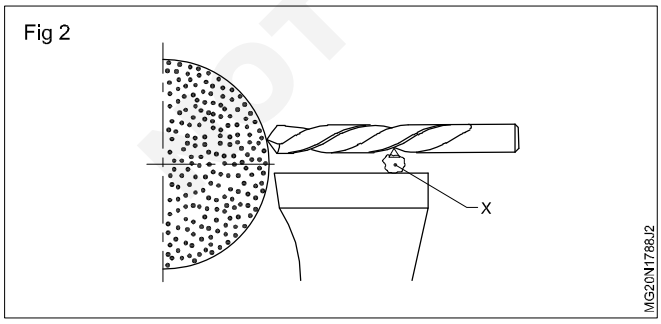
Hold the shank of the drill lightly between the thumb and the forefinger, and with the other hand hole the portion near the point. (Fig 1)

Fig 1



The hand near the point of the drill should be pivoted lightly on the tool rest at “X’ for easy manipulation (Fig 2)

Fig 2



Hold the drill level (Fig 1) and turn it to 59° to the face of the wheel and swing the drill slightly downward and towards left. (Figs 3 & 4)

Rotate the drill to the right by turning it between the thumb and the forefinger (Fig 4)

Fig 3

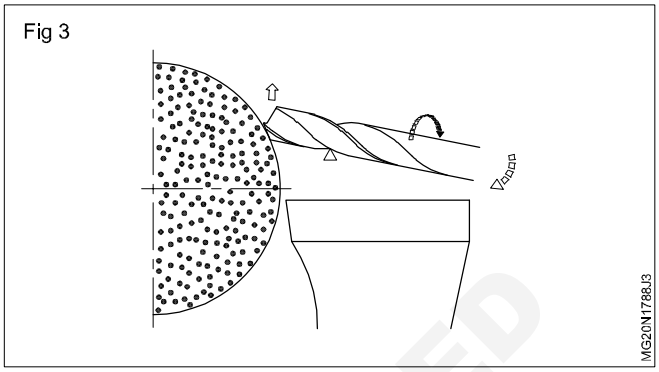
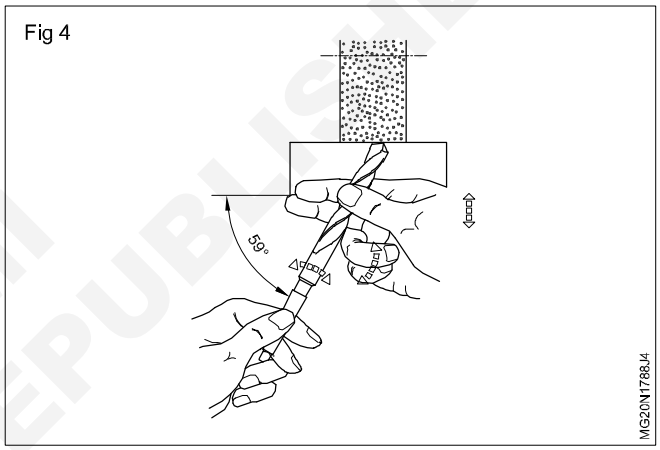


Fig 4



This turning movement is not necessary for smaller dia. drills

While swinging down, apply a slight forward motion. This will help to form the clearance angle

While swinging and turning the drill make sure you do not grind the other cutting edge.

All movements of the drill in angular turning, swinging and forward movements, should be well coordinated. They should result in one smooth movement to produce a uniformly finished surface.

Repeat the process to resharpen the other cutting edge.

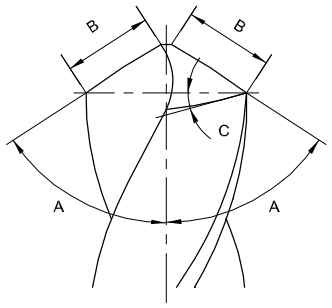
Check both the cutting edges with a drill angle gauge, for correctness of the lip angle and equality of the lip lengths. (Figs 5 and 6)

Check the lip clearance angle in Fig visually. The angle should be between 8° to 12°.

When you are satisfied correct equal angle and equal tip length. Drill a hole in a scrap metal. Before drilling confirm correct drill speed (r.p.m) use cutting fluid

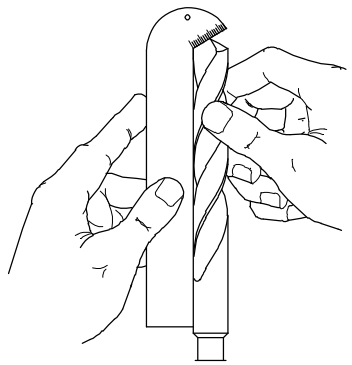
Verify the condition of the hole while drilling. Did the drill chatter? If chattering happened, this could cause by to much lip clearance. If the hole is over size by more than 0.12 to 0.25 mm then check lips lengths for uneven or the lip angle for uneven.

Fig 5



MG20N1788J5

Fig 6



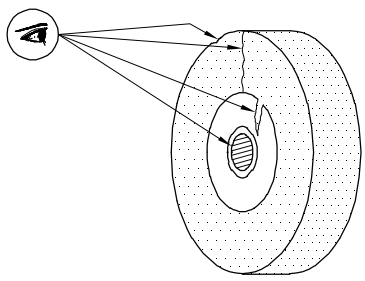
MG20N1788J6

Grinding right hand roughing tool

Objective: This shall help you to
- **grind a right hand roughing tool.**

Before grinding: Check the grinding wheel to detect glazing. In case of glazing, dress the wheel. Check visually for cracks. (Fig 1).

Fig 1

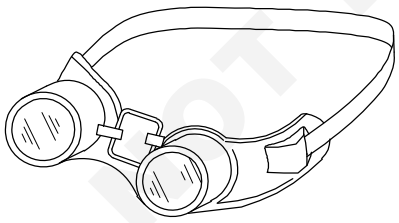


MG20N1788X1

Switch on the grinder but stand by the side of the wheel for safety and see whether runs true without any excessive vibration. In case of excessive vibration truing is necessary. Call the instructor for advice. Switch off the ensure enough coolant is in the container.

Protect your eyes with goggles or lower the protective shield near the tool rest. (Fig 2)

Fig 2



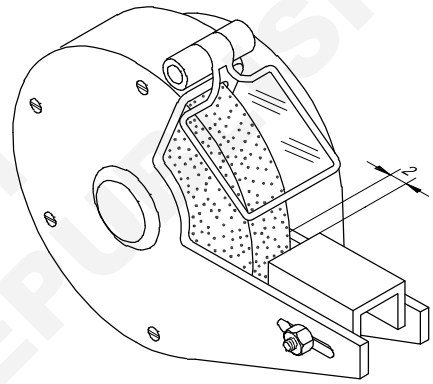
MG20N1788J2

Adjust the tool rest gap 2mm closer to the wheel if it is not set. (Fig 3)

Take a tool blank. The dotted line of the blank (Fig 4). Shows the boundary of the blank and the thick line shows the finished tool.

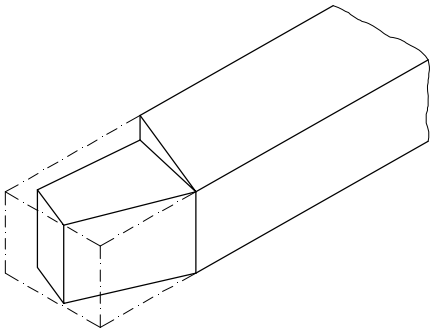
One of the factors for an efficient machining action of a cutting tool is the angles ground as per the recommended values.

Fig 3



MG20N1788J3

Fig 4

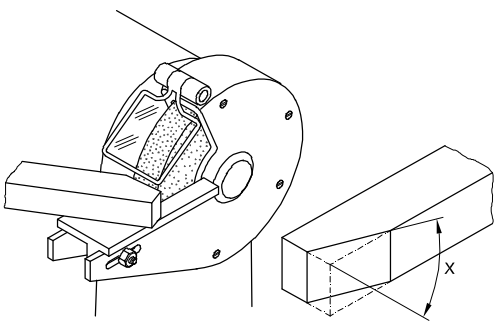


MG20N1788J4

Switch on the grinder.

Grind the approach angle by holding the tool against the wheel at the angle recommended. (Fig 5)

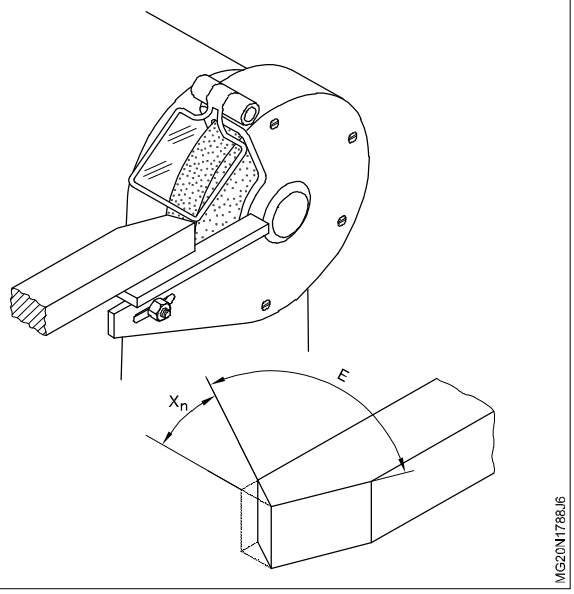
Fig 5



MG20N1788J5

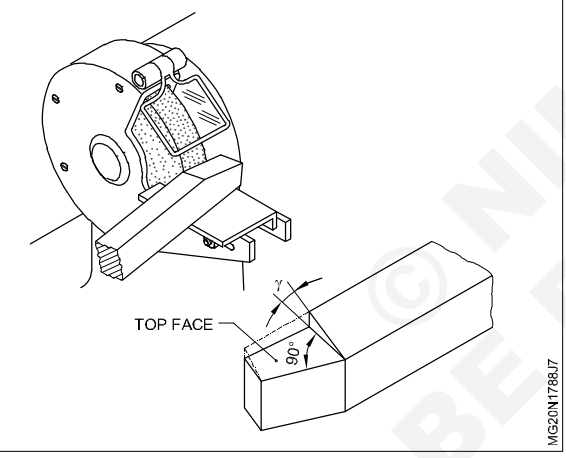
Grind the end cutting angle (Fig 6).

Fig 6



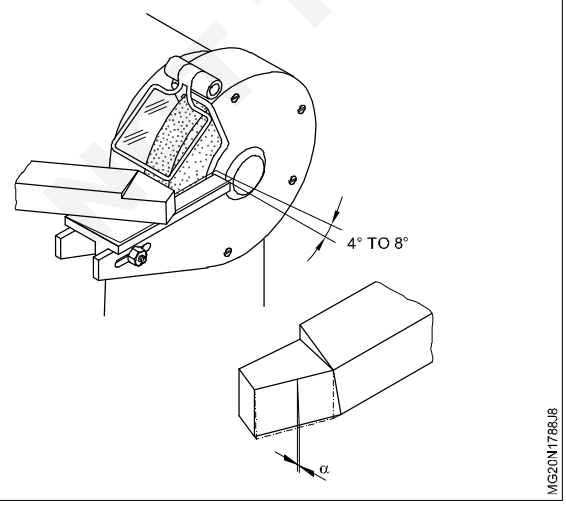
Grind the rake angel (top and side) by holding the top of the tool against the wheel (Fig 7)

Fig 7



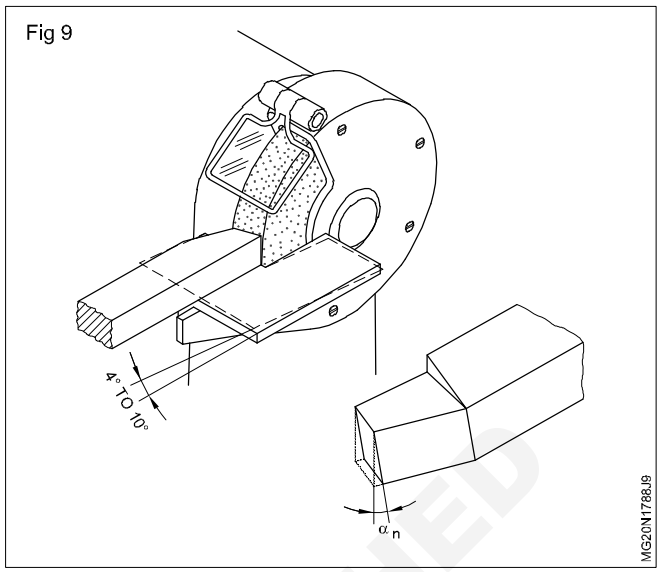
Till the tool rest downward (4° to 8° according to the requirement) and grind the side clearance. (Fig 8).

Fig 8



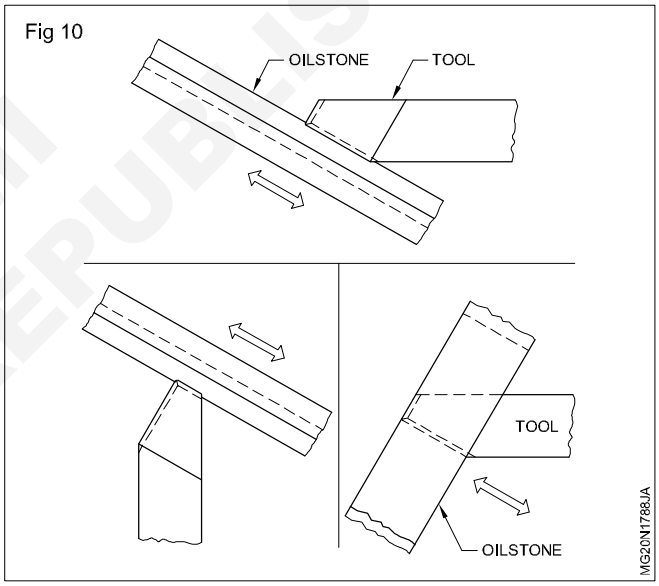
Grind the front clearance angle (4° to 10° according to the requirement). (Fig 9)

Fig 9



Lap all the ground surface using an oilstone (Fig 10)

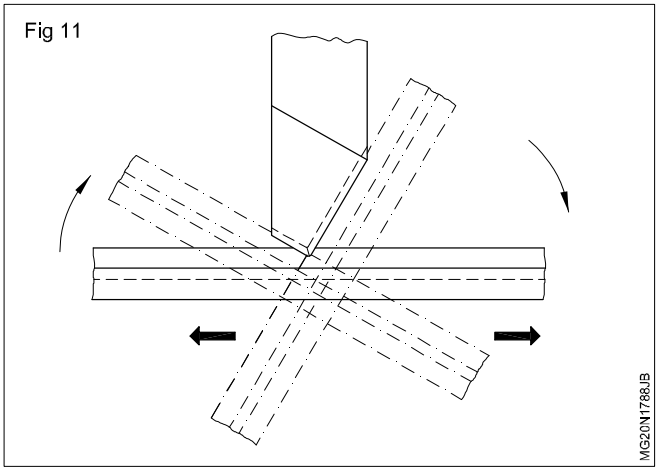
Fig 10



From a small nose radius using an oilstone. (Fig 11)

A similar procedure can be followed for grinding the left hand roughing tool.

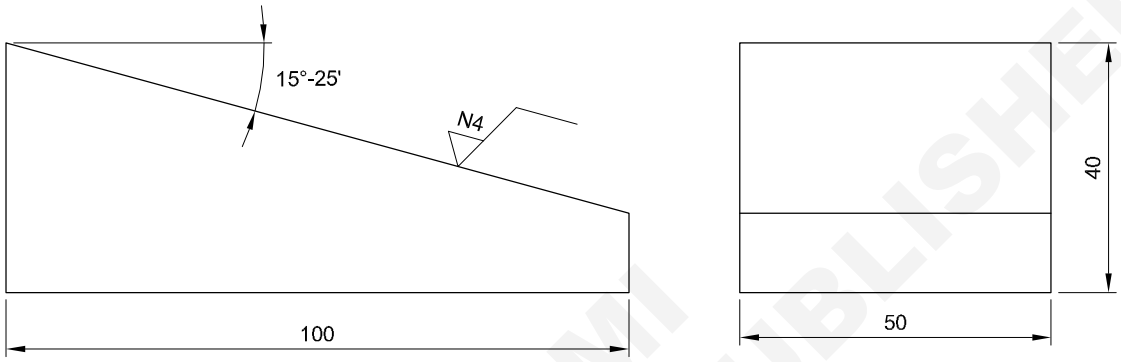
Fig 11



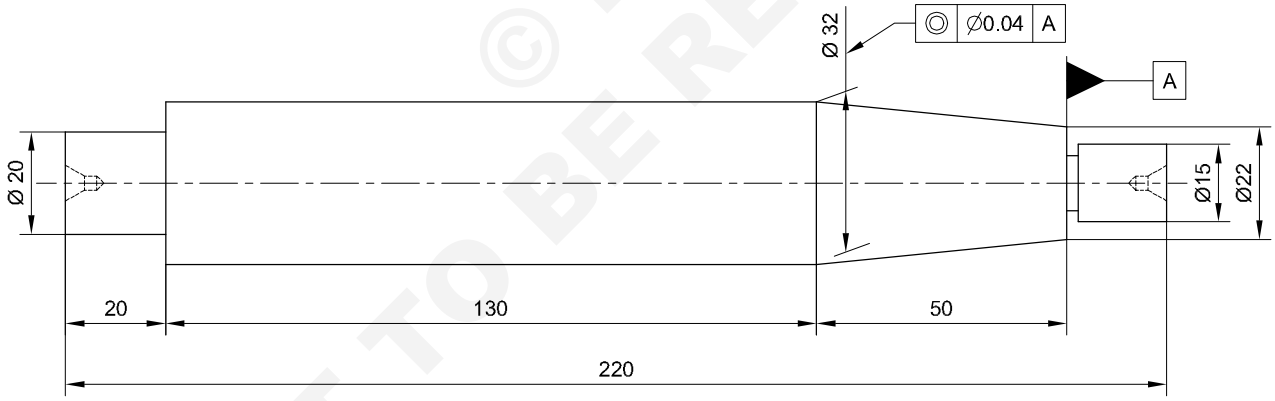
Check tapered or angular jobs with help of sine bar, slip gauges and dial gauge

Objectives: At the end of this exercise you shall be able to
- **check the angle of angular job by sine bar, slip gauge DTI**
- **check the tapered of cylindrical job by sine bar, slip gauge and DTI.**

TASK-1



TASK-2



1	-	-	-	-	-	1.8.89
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	CHECK TAPERED OR ANGULAR JOBS WITH HELP OF SINE BAR, SLIP GAUGES AND DIAL GAUGE				DEVIATIONS ± 0.02	TIME : 23 Hrs.
					CODE NO. MG20N1889E1	

PROCEDURE

TASK 1: **Checking angles**

Set up sine bar

- Select and clean appropriate size sine bar.
- Select slip gauges to build up sine bar to required angle.
- Clean slip gauges on chamois or soft cloth.
- Wringing slip gauges together.
- Place sine bar on surface and position slip gauges.

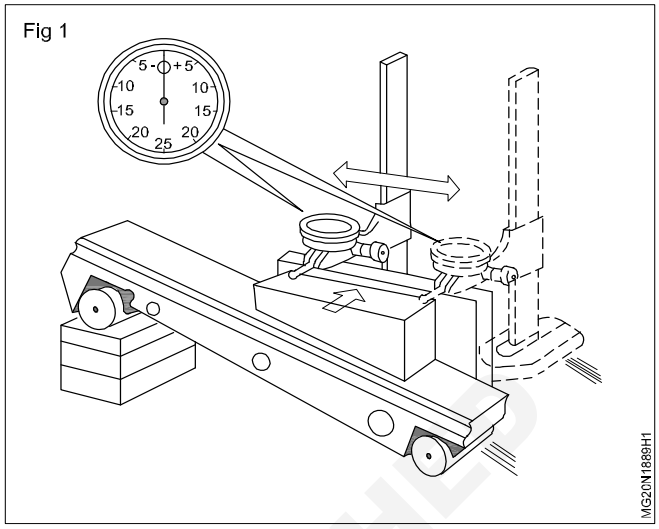
Position workpiece

- De-burr and clean workpiece.
- Position workpiece angle face resting on sine bar.
- Hold parallel strip against the side of the sine bar. Slide workpiece against strip, ensuring that workpiece is push to sine bar edge.

Check angular face

- Position dial indicator on surface plate with dial stylus engaged on one end of workpiece face. (Fig 1)

Fig 1



- Set dial face at zero
- Slide dial indicator to bring stylus to other end of workpiece face.

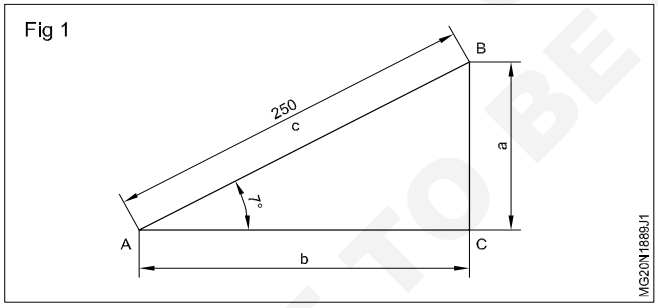
Note any error, from zero.

If angle is correct, dial stylus will be zero for full length of angle face.

TASK 2: **Checking taper on cylindrical job**

Check the taper using by sine bar method (Fig 1)

Fig 1



- Calculate the slip gauge height.
- Taper angle = 7°.
- Length of sine bar=250mm

$$\text{Sin}, = \frac{a}{c}$$

$, = 7°$

$a = C \sin,$

$= 250 \times 0.1219$

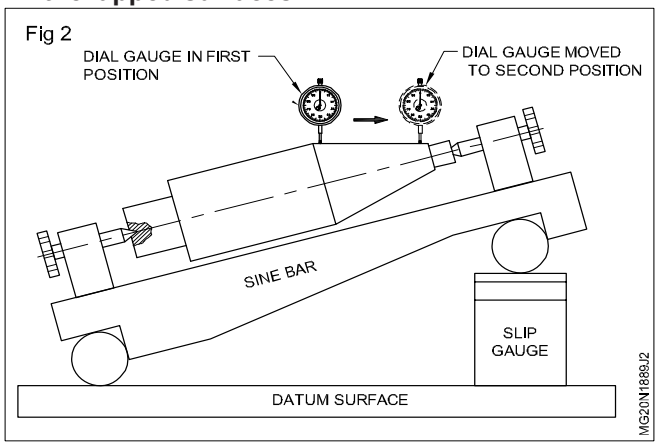
$a = 30.48mm$

The height of the slip gauge required is 30.48mm

- Checking the correctness of a known angle Fig 2.
- Choose the correct slip gauge.
- The job to be checked should be mounted on the sine bar.
- After placing the selected slip gauges under the roller.
- The dial test indicator is mounted on a suitable dial stand.
- The dial test indicator then set in first position as in the figure.
- The dial is set move the dial to the other end of the job (second position).
- If there is any difference then the angle is incorrect.
- The height of the slip gauge pack can be adjusted until the dial test indicator reads zero on both ends.
- The actual angle can then be calculated and the deviation if any will be the error.

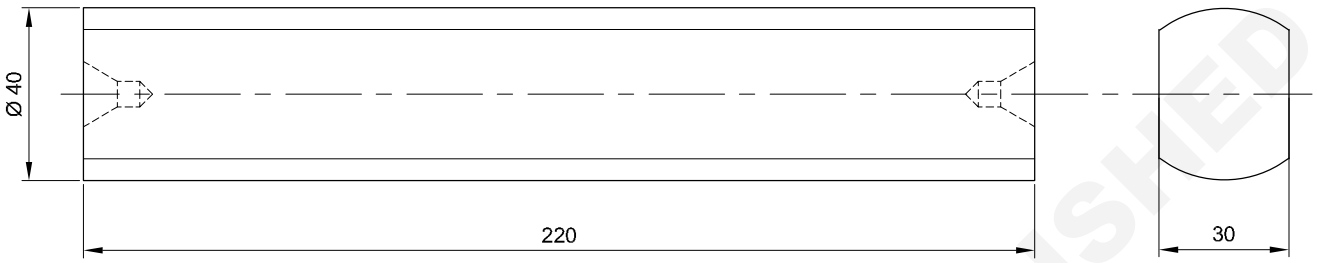
While holding the slip gauges do not touch the lapped surfaces.

Fig 2



Perform cylindrical and surface grinding

Objectives: At the end of this exercise you shall be able to
- **grind a parallel, cylindrical grinding**
- **check the dimension with an outside diameter**
- **set the machine vice on surface grinding table grind the flat.**



Job sequence

- Trainees may asked to write the job sequence for cylindrical grinding
- Surface grinding
- Set the vice on magnetic table perpendicular to the axis of the spindle (Fig 1)
- Hold the cylindrical job on vice (Fig 2)
- Set the wheel and make dressing and truing
- Grind top surface to required size.
- Reverse the job and grind to the required size.

Fig 1

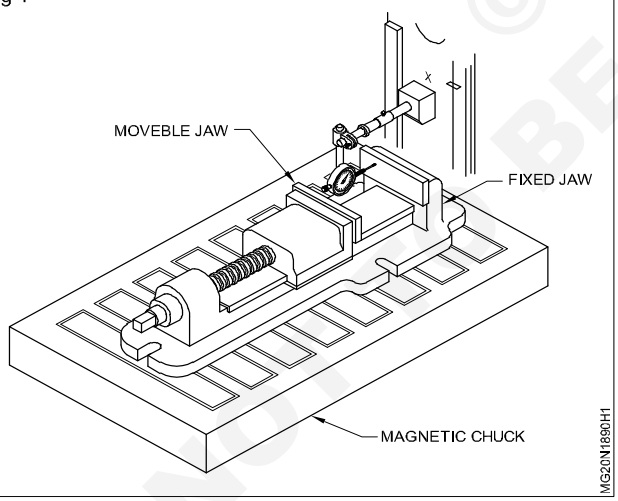
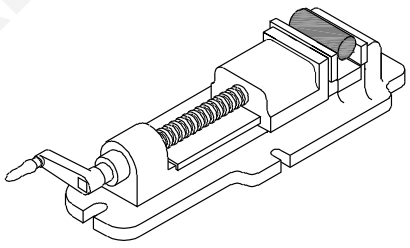


Fig 2



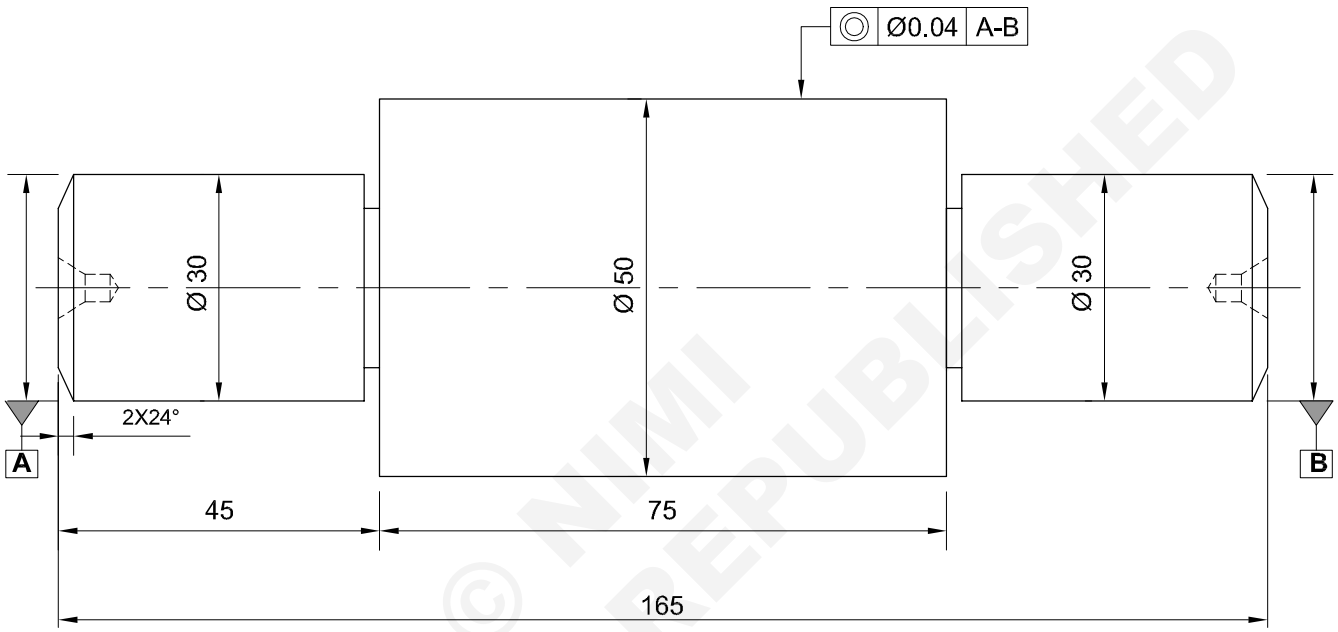
1	ISRO 40.5-220	-	PRE MACHINE	-	-	1.8.90
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**PERFORM STEP GRINDING ON CYLINDRICAL GRINDING MACHINE**	DEVIATIONS ± 0.02	TIME : 25 Hrs.
		CODE NO. MG20N1889E1	

Perform step grinding on cylindrical grinding machine

Objectives: At the end of this exercise you shall be able to

- **grind by the traverse feed method**
- **dress the grinding wheel**
- **grind steps with shoulder and chamfer**
- **check and measure the dimension with an outside vernier micrometer**
- **check the concentricity of the job.**



1	Ø55x170mm	-	Fe310	-	-	1.8.91
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PERFORM STEP GRINDING ON CYLINDRICAL GRINDING MACHINE	DEVIATIONS ±0.04	TIME : 25 Hrs
		CODE NO. MG20N1891E1	

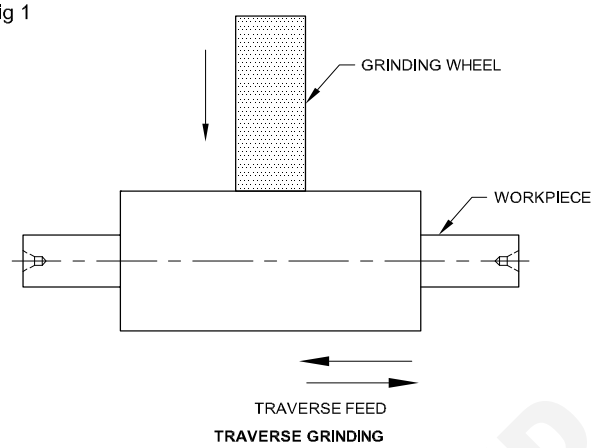
Job Sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Check the grinding wheel is rotating in correct direction.
- Set the work head, wheel head and table at 0º.
- Dress the wheel.
- Mount the workpiece in between centres with carrier.
- Start the machine for grinding wheel rotating.
- Move the grinding wheel back about 50 mm from the workpiece to allow the wheel to clear the carrier.

This will prevent accidental contact between the wheel and the carrier.

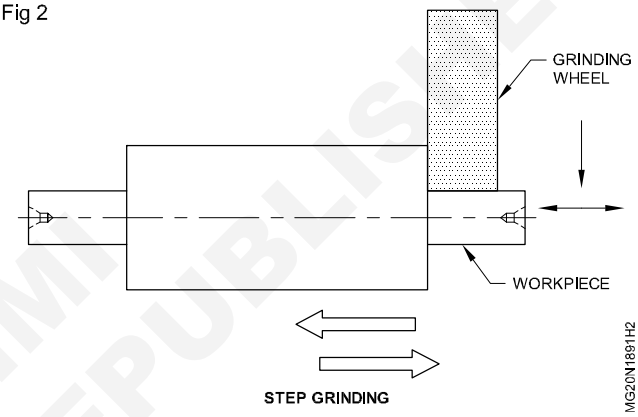
- Set the length of stroke.
- Move the table automatically in traverse feed. (Fig 1)
- Rough finish to grind the step ∅50 x 75 mm long.
- Feed the work traversal.
- Grind the step ∅30 x 45 mm long rough and finish grinding at both ends one after other. (Fig 2)
- Remove the job from the centres and dog carrier.
- Measure and check the job using by outside vernier-micrometer (25-50 mm).
- Check the concentricity of job using Dial Test Indicator.

Fig 1



TRAVERSE GRINDING

Fig 2



STEP GRINDING

Keep your hands away from the revolving wheel at all times to avoid injuries to yourself.

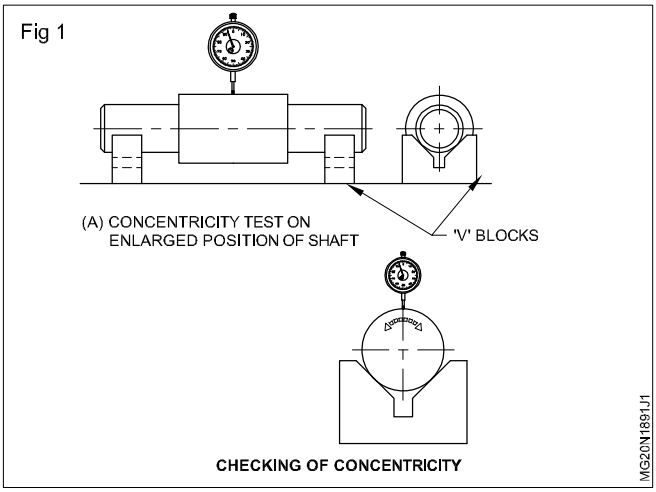
Skill Sequence

Checking the concentricity of job (Fig 1)

Objective: This shall help you to
- **check the concentricity of the cylindrical job using 'V' block and DTI.**

- Mount the job in 'V' blocks.
- Touch the dial plunger on job.
- Rotate the job for concentricity test.
- See the reading of dial.
- Measure the reading position of Dial Test Indicator for concentricity.

Fig 1

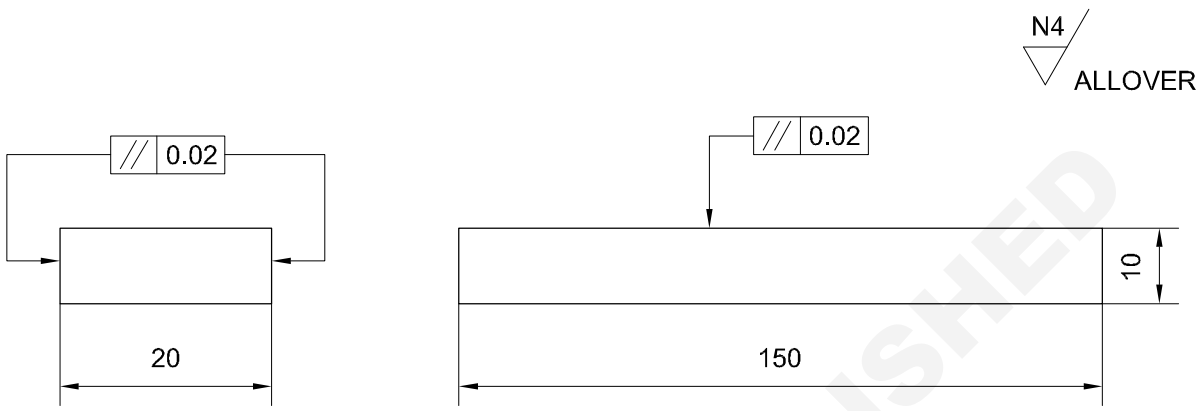


CHECKING OF CONCENTRICITY

Grinding parallel block on surface grinding machine

Objectives: At the end of this exercise you shall be able to

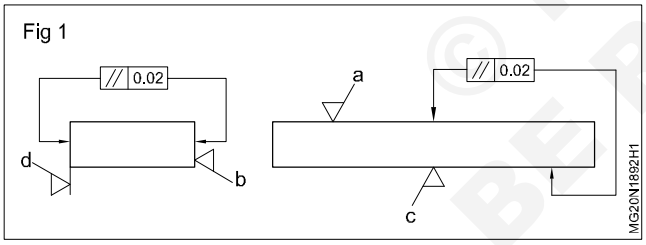
- **grind the parallel blocks as per the drawing to an accuracy of ± 0.02mm**
- **check the parallelism of both parallel blocks with dial test indicator.**



Job sequence

- Parallel blocks are always used in pairs and hence they should be ground in pairs.
- Machine the jobs (2 Nos) and determine the grinding allowance for each surface to be ground.

Fig 1



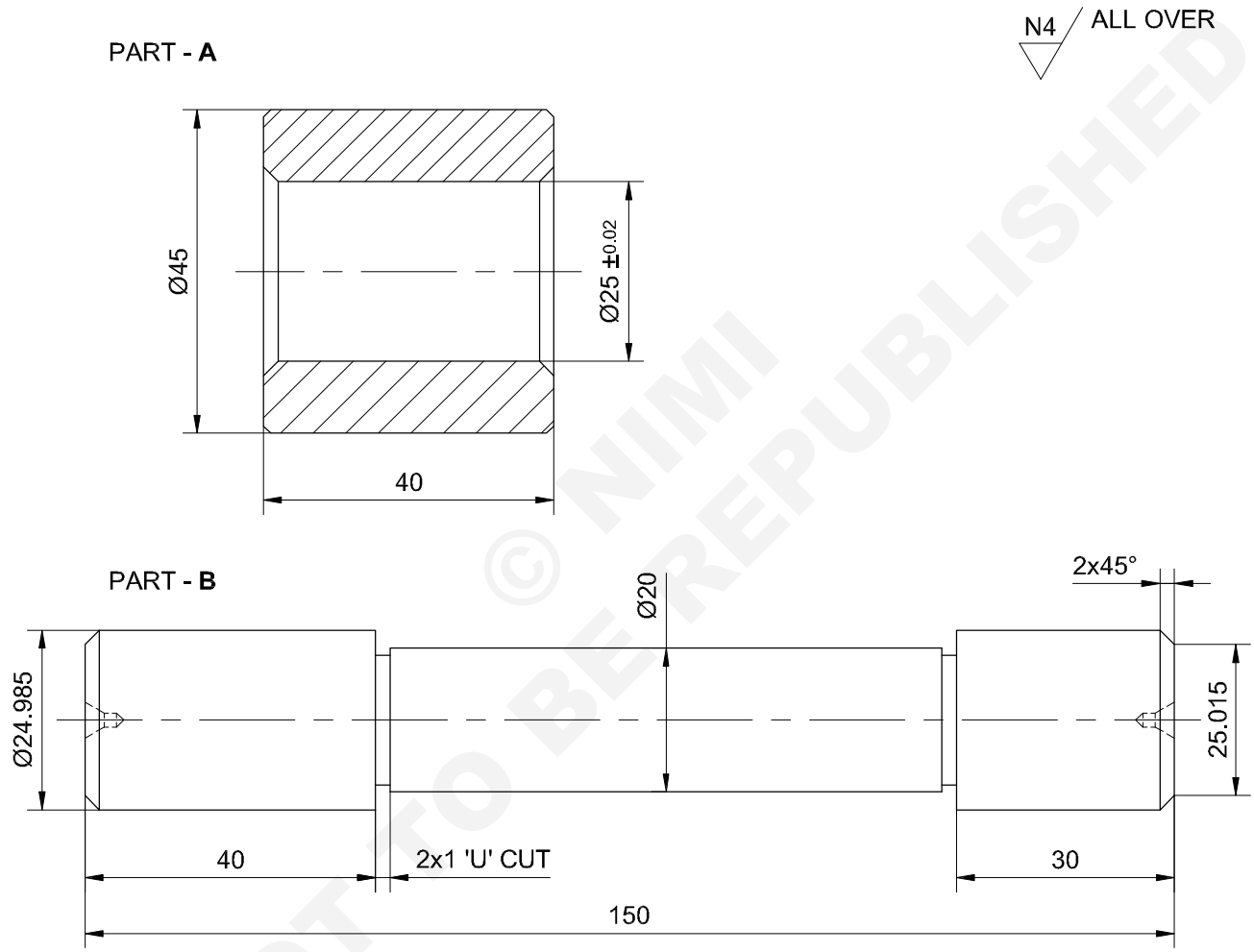
- Set the job lengthwise on the magnetic chuck and align the wheel edges parallel to job edge.
- Rough and finish grind the (a,b) surface with half of the grinding allowance.
- Reset the job (c,d) rough and finish grind the flat and parallel surface 10mm ± 0.02mm.
- Set the job individually rough and finish grind the adjacent side with half of the grinding allowance for each job. (e, f)
- Mount the both jobs on the magnetic chuck keeping down the surfaces already ground rough and finish grind the flat and parallel surface of 20 ± 0.02mm.
- Deburr the all edges with abrasive sticks.
- Mount the angle plate on the magnetic chuck.
- Clamp the jobs in vertical position by using 'C' clamps rough and finish grind the half of the grinding allowance.
- Reset the job on the angle plate rough and finish grinding the surface 150 ± 0.02mm.
- Deburr and clean thoroughly.
- Check the dimensions with an outside micrometer.
- Check the parallelism by using dial test indicator.

2	1 ISF 20-150	1.17 ←	Fe310	-	-	1.8.92
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	GRIND PARALLEL BLOCK ON SURFACE GRINDING MACHINE	DEVIATIONS ±0.03	TIME : 12 Hrs
		CODE NO. MG20N1892E1	

Grind gauge within finish accuracy ± 0.02mm

Objectives: At the end of this exercise you shall be able to
- **grind the plain bore of ring rouge**
- **check the bore size**
- **grind the go end plug gauge**
- **grind the no go end of plug gauge**
- **measure the dimension of plug gauge.**



GO END = 24.985
NO GO = 25.015

2	–	–	Fe310	–	–	1.8.93
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GRIND GAUGES WITHIN FINISH ACCURACY ±0.02MM	DEVIATIONS As per IS : 2102 (F)	TIME 15 Hrs
		CODE NO. MG20N1893E1	

Job Sequence

Ring gauge

- Prepare the machine for internal grinding and measure the grinding allowance.
- Fit the internal grinding spindle and mount on wheel head.
- Dress the wheel with a diamond dresser.
- Measure the existing bore diameter of the job to know the grinding allowance.
- Mount the job in a chuck.
- True the workpiece.
- Set the length of stroke.
- Put on your goggles.
- Start the grinding wheel for rotation.
- Engage the work head spindle drive.
- Take the grinding wheel inside the bore with rotation of job and wheel manually till grinding wheel touches the job make few setting.
- Start the coolant supply.
- Make repeated cuts until close to the desired size.
- Dress the wheel for finish grinding.
- Grind the bore diameter to 25.I0.02mm.
- Check the bore size using by telescopic gauge.
- Remove the job from the chuck.

Reset and hold the job on taper mandrel for external grinding

- Remove burred edges.
- Check the diameter of the job using outside micrometer to ascertain the grinding allowance.

Plug gauge

- Prepare the machine for external cylindrical grinding.
- Study the drawing and measure the grinding allowance.
- Set the workhead, wheel head and table at 0°.
- Dress the grinding wheel for rough grinding.
- Hold the job with suitable dog carrier.
- Mount the job in between centres.
- Rough and finish grind the go end surface removing half of the grinding allowance.
- Finish the surface and maintain the diameter to Ø30g6 on 40 mm long side.
- Fit the female part.

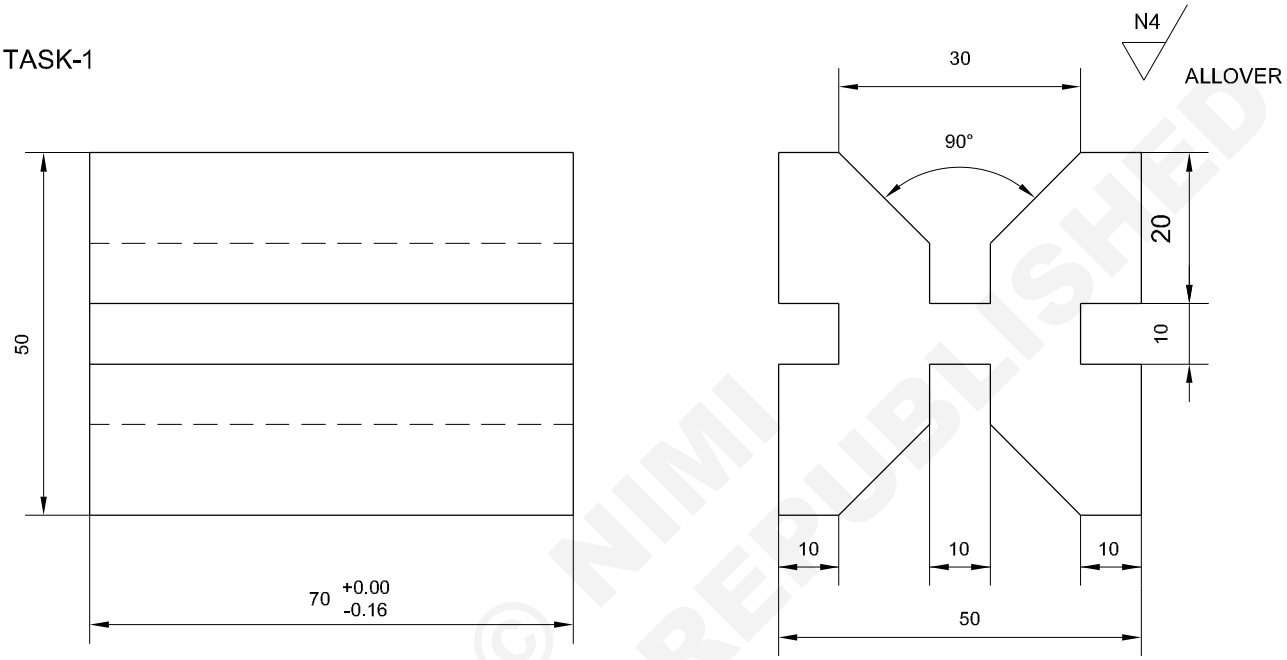
Use a soft metal spacer if necessary to protect the job.

- Check the diameter of the workpiece.
- Remove burred edges.
- Remove the workpiece from the centres.

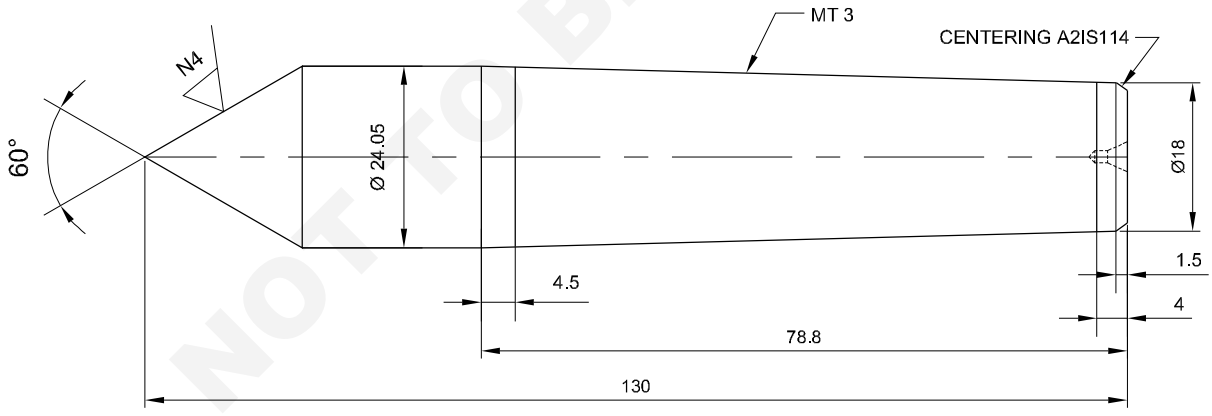
Make simple utility jobs

Objectives: At the end of this exercise you shall be able to
- **grind 'V' block**
- **check the dimensions with outside micrometer and depth micrometer**
- **check squareness and angle with vernier bevel protractor**
- **regrinding the conical point of lathe centre with accuracy of 5**
- **check the taper with an vernier bevel protractor.**

TASK-1



TASK-2



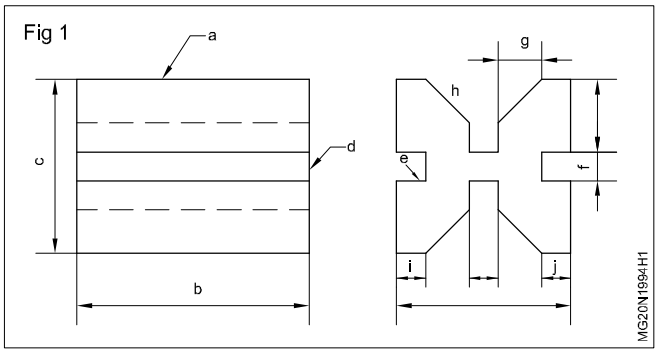
-	-	-	-	-	-	
-	-	-	CI	-	-	1.9.94
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**MAKE SIMPLE UTILITY JOBS**	DEVIATIONS ±0.02	TIME 12 Hrs
		CODE NO. MG20N1994E1	

Job sequence

- Study the drawing and determine the grinding allowance for each dimensions. (Fig 1)

Fig 1



- Prepare the machine and the grinding wheel for grinding.
- Mount the job length wise on the magnetic chuck rough and finish grind the surface (a) removing half of the grinding allowance.
- Grind the surface (b) and maintain the dimension to ± 0.02mm accuracy.
- Check the parallelism with a outside micrometer.
- Set the job on universal vice and ensure the all the swivel base graduations coincide with '0' degree and align the vice.
- Rough and finish grind the surface (c) removing half of the grinding allowance.
- Finish the surface (d) and maintain the dimension to ± 0.02mm check parallelism.
- Dress the wheel for slot grinding.
- Set the job on vice and align the surface (a) rough and finish grind the slot (e) with ± 0.02mm.
- Remove the job and reverse it align the surface (b) rough and finish grind the slot (f) with ± 0.02mm.
- Swiveling the universal vice 45° at vertical plane the jaws are perpendicular the grinding wheel axis.
- Rough and finish grind the angular surface (g) and (h).
- Set the job opposite side rough and finish the angular surface (i) and (j).
- Deburr the all edges thoroughly and clean.
- Measure the dimensions with an outside micrometer.
- Check the angular surface with vernier bevel protractor.

Regrinding of lathe centre

- Determine the grinding allowance.
- Balancing the grinding wheel.
- Mount the wheel on the cylindrical grinding machine.
- Dress the grinding wheel
- Hold the job in between male and female centres
- Tilt the table to 2 1/2° to grind
- Set the table traverse dog to grind 74.3mm length on the taper end.
- Start the grinding wheel and the job.
- Bring the wheel to the job and allow it to touch.
- Grind the job to an accuracy of ± 5 minutes.
- Move the wheel away from the job and stop the wheel and job.
- Check the taper portion with a vernier bevel protractor.

Skill sequence

Grinding V- Block using universal vice

Objective: This shall help you to

- **grind angular surfaces using a universal vice.**

1 Dress the grinding wheel on the sides for relief and on the face for trueness. (Fig 1)

2 Clean the machine table and mount the universal vice.

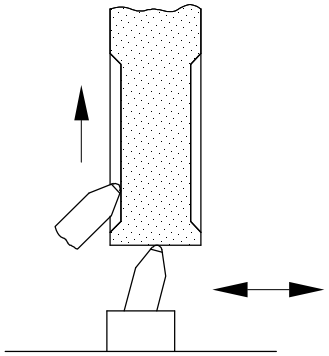
3 Align the fixed jaws of the vice perpendicular to the axis of the spindle. (Fig 2)

4 Ensure that all the swivel base graduation coincide with '0' degree dead mark before aligning.

5 Tilt the vice to 45° with reference to the graduated plate at the bottom of the vice. (Fig 3)

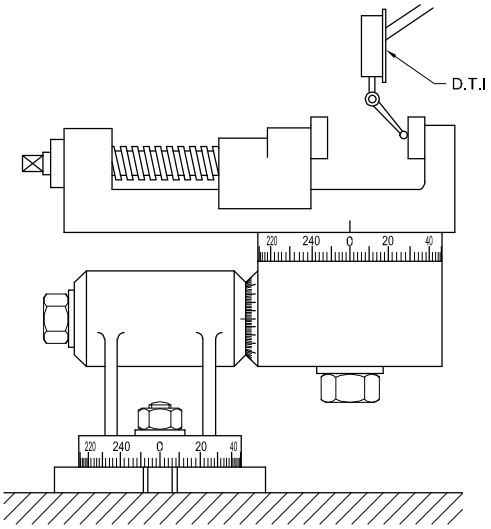
6 Clean the job and measure it to determine the grinding allowance. (Ask your instructor for help in determining the allowance).

Fig 1



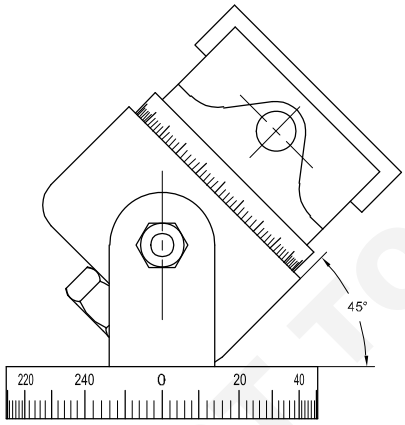
MG20N1994-J1

Fig 2



MG20N1994-J2

Fig 3



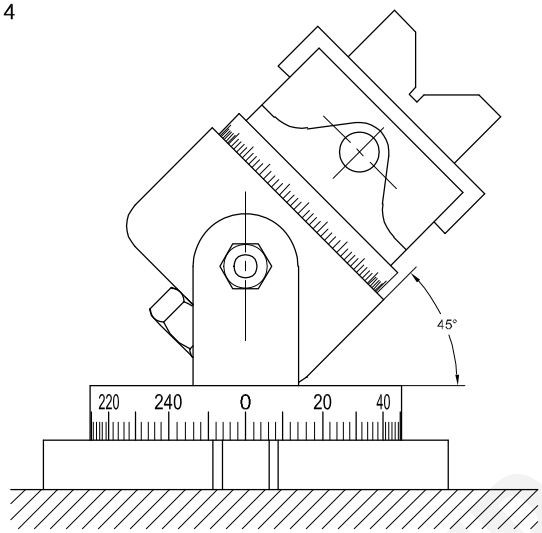
MG20N1994-J3

7 Hold the job in the vice such that the horizontal surface to be ground is aligned parallel to the surface of the table using a dial test indicator. (Fig 4)

8 Position the stop dogs for longitudinal traverse.

9 Start the wheel and lower the wheel head until the wheel just sparks the highest spot of the job.

Fig 4



MG20N1994-J4

10 Start the table travelling automatically and feed the entire length of the job and clear off the job from the wheel.

11 Engage the vertical depth for rough and finish cut as predetermined and feed from the cross-feed manually. (Fig 5a)

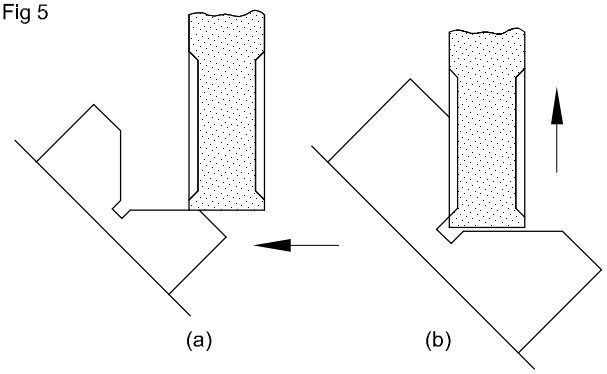
12 Grind the longitudinal surface up to the corner relief.

13 Remove only that much of material pre-determined as grinding allowance, and record the amount of material removed.

14 Raise the wheel head to 0.20mm and without releasing the wheel, plunge the wheel little by little against the vertical surface of the job to be ground to the depth equal to the horizontal surface.

15 Raise the wheel gradually to finish grind the vertical surface. (Fig 5b).

Fig 5



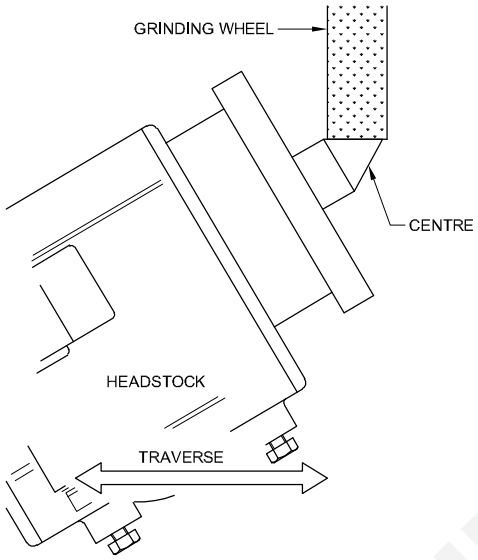
MG20N1994-J5

Regrinding of lathe centre

Objective: This shall help you to
- **regrinding of lathe centre.**

The workhead (Fig 1) may also be used to hold small workpieces for angle grinding. The workhead is swiveled to the desired angle and the wheel traversed. If required by longitudinal movement of the worktable. This method is used to grind the centres of the universal grinding machine when this becomes necessary.

Fig 1

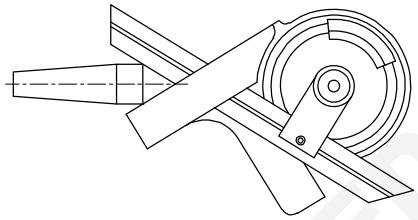


WORK HEAD SWIVELLED FOR GRINDING ANGLES

Measuring and checking of lathe centre (Fig 2)

Diameter and length is measured with the micrometer or vernier caliper respectively. The tapered point can be measured with the bevel protractor.

Fig 2

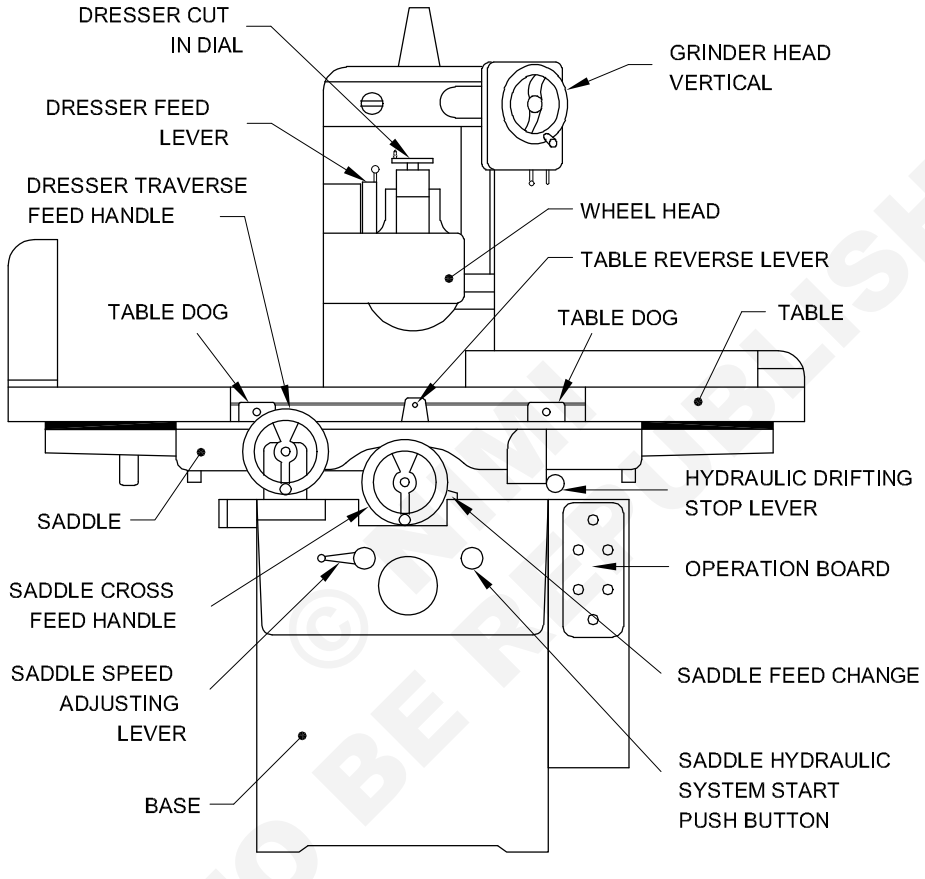


MEASURING WITH THE UNIVERSAL BEVEL PROTRACTOR

Perform preventive maintenance of grinding machines

Objectives: At the end of this exercise you shall be able to
- **lubricate the surface grinding machine**
- **adjust the belt tension in 'V' belt drive**
- **check the coolant level in the tank**
- **adjust the gib in the slides of a grinding machine**
- **adjust play in taper roller bearing.**

Fig 1



LUBRICATE MACHINE

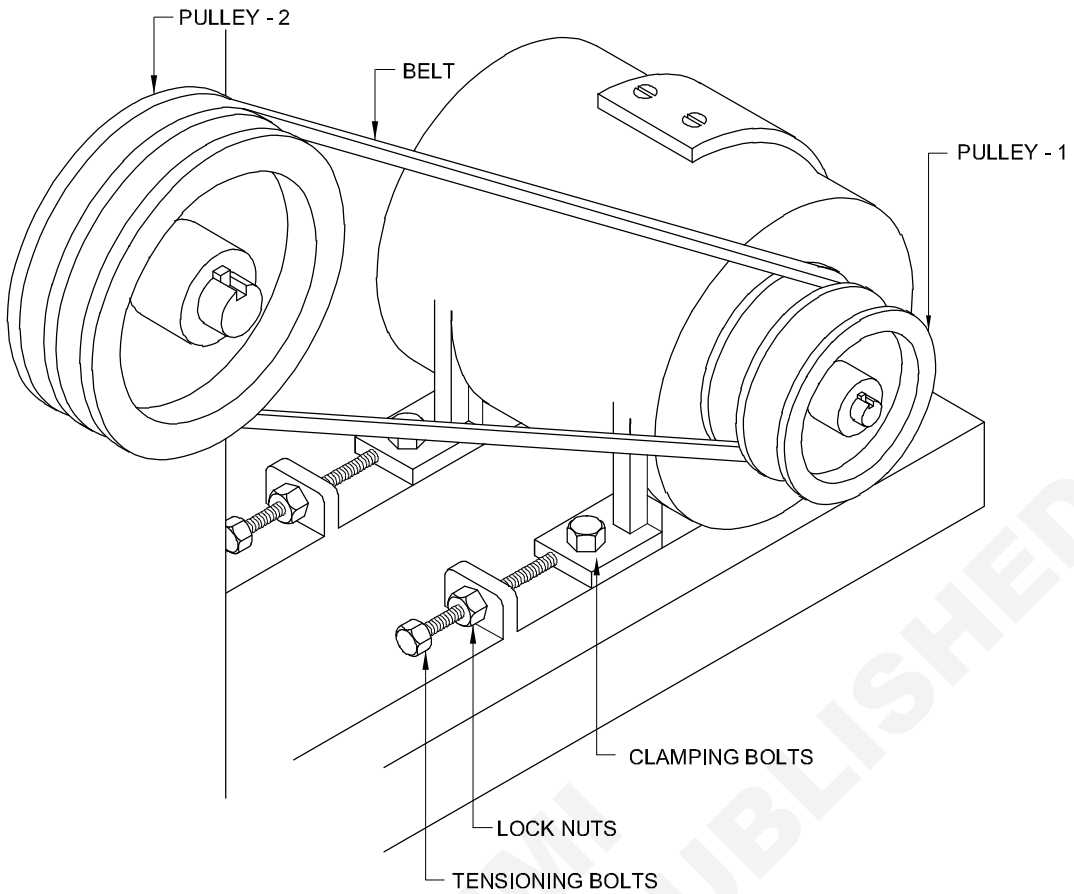
Job sequence

- Identify the oil and grease points.
- Identify the oil, and outlets and oil sight glass.
- Select the appropriate grade of lubricant (oil & grease as per manufacture's specification).
- Select the appropriate lubricating devices.
- Lubricate the machine as per the manufacture's maintenance manual.
- Make entry in the maintenance chart.

Adjust belt tension between pulleys

- Measure the span length of a belt drive using a steel tape.
- Note the recommended deflection from the table.
- Find the middle of the longest span of the belt between the pulleys.
- Put twine thread around the belt drive and tie it.
- Put the spring balance hook at the middle of the longest span of the belt.
- Pull the spring balance inwards to the required force and note the total deflection, using a steel rule.
- Adjust the tension as necessary, using tensioning bolts.

Fig 2



Skill sequence

Adjust belt tension in 'V' belt drive

Objectives: This shall help you to
- **check belt tension using a spring balance**
- **adjust belt tension by tensioning bolts.**

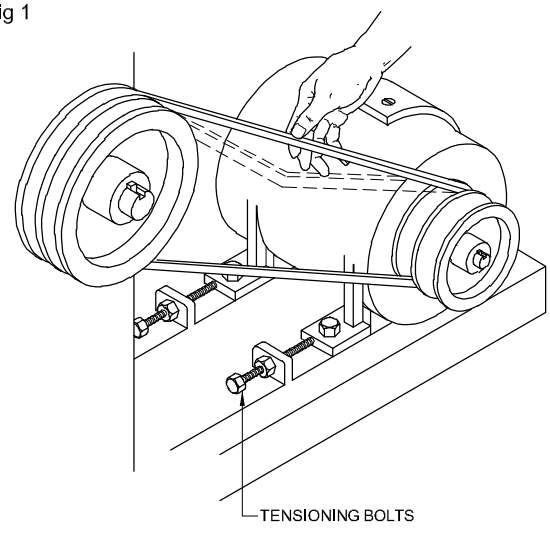
Measure the longest span length of the belt between the pulleys, using a steel tape.

Find the middle of the longest span of the belt between the pulleys.

Push this mid-point inwards, then pull it out and note the total deflection. (Fig 1)

This indicates the existing tension of the belt.

Fig 1



Loosen the lock-nuts. (Fig 2)

Slacken the clamping bolts. (Fig 2)

Move the pulley with the adjusting screws to alter the tension. (Fig 2)

The adjusting screws must be turned equally to keep the pulleys correctly aligned.

Attach a spring balance and check the tension of the belt. (Fig 3)

Readjust the adjusting screws until the tension is correct.

Tighten the clamping bolt

Fig 2

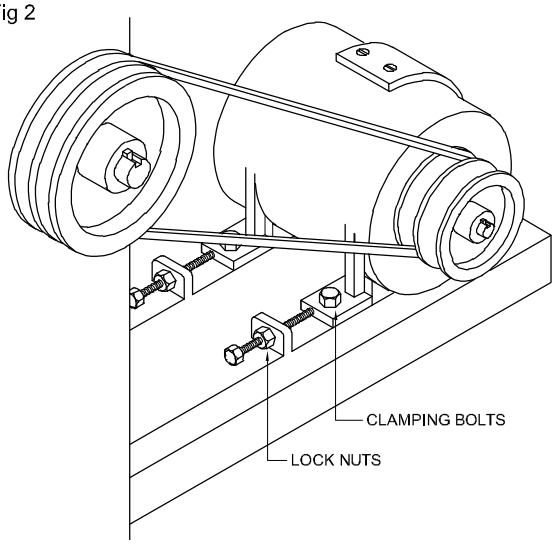
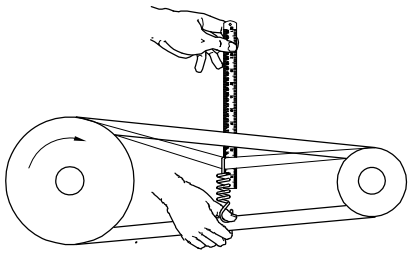


Fig 3



Tighten the lock-nuts.

Checking of coolant level

Check the coolant level and the functioning of the coolant pump. (Fig 4)

Check the safety guards. (Fig 5) and ensure they are in position.

Fig 4

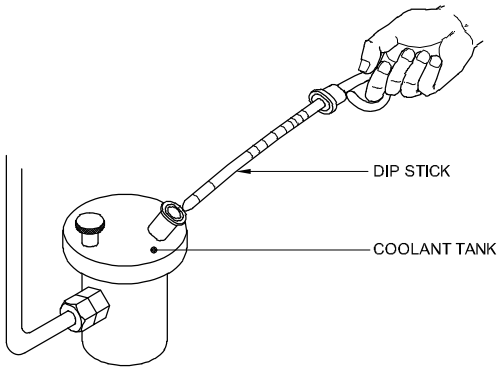
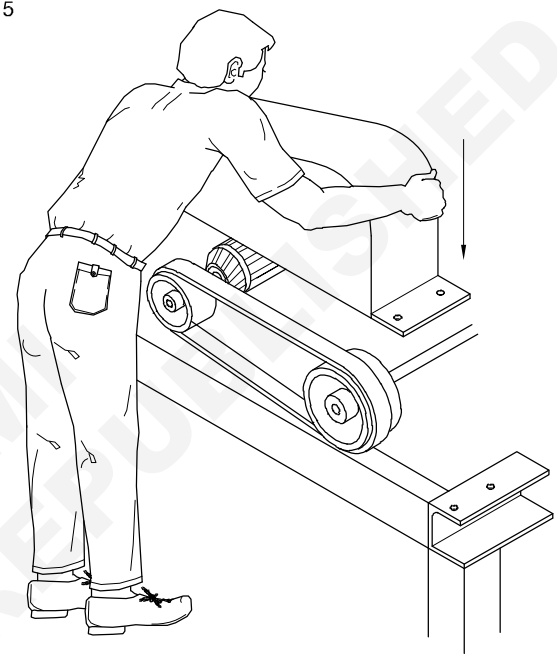


Fig 5

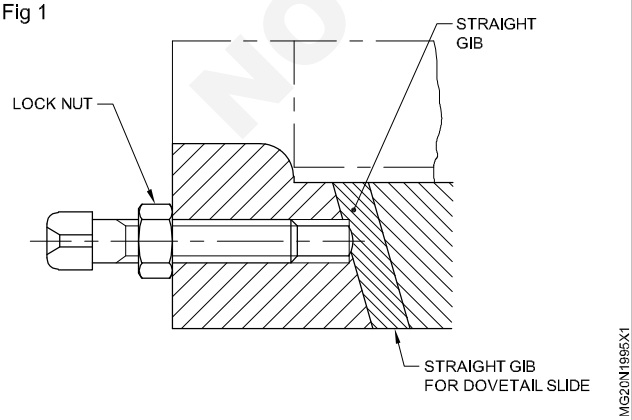


Adjust the gib strip

Objective: This shall help you to
- **adjust play in taper roller bearing.**

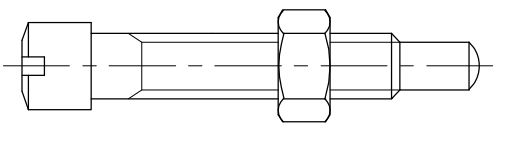
Loosen the lock-nuts. (Fig 1)

Fig 1



Remove the set screws. (Fig 2)

Fig 2



Pull the gib out. (Fig 3)

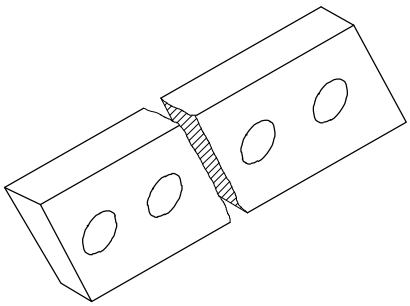
Clean all the parts.

Check the straightness of the gib using Prussian blue.

Scrape the gib to get even surface to prevent stick-slip motion of the cross-slide.

Lubricate all the parts.

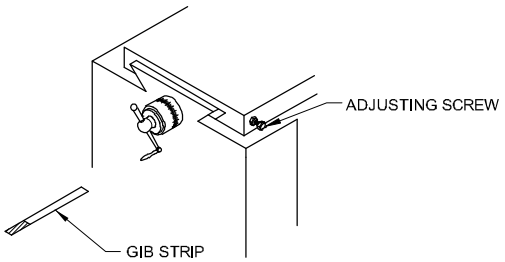
Fig 3



MG20N1995X3

Assemble the gib into the dovetail slide and position it. (Fig 4)

Fig 4



MG20N1995X4

Adjust the screws and eliminate the clearance between the slides for getting the correct freedom required in the assembly.

Lock the movement of the adjusting screws by the check-nut.

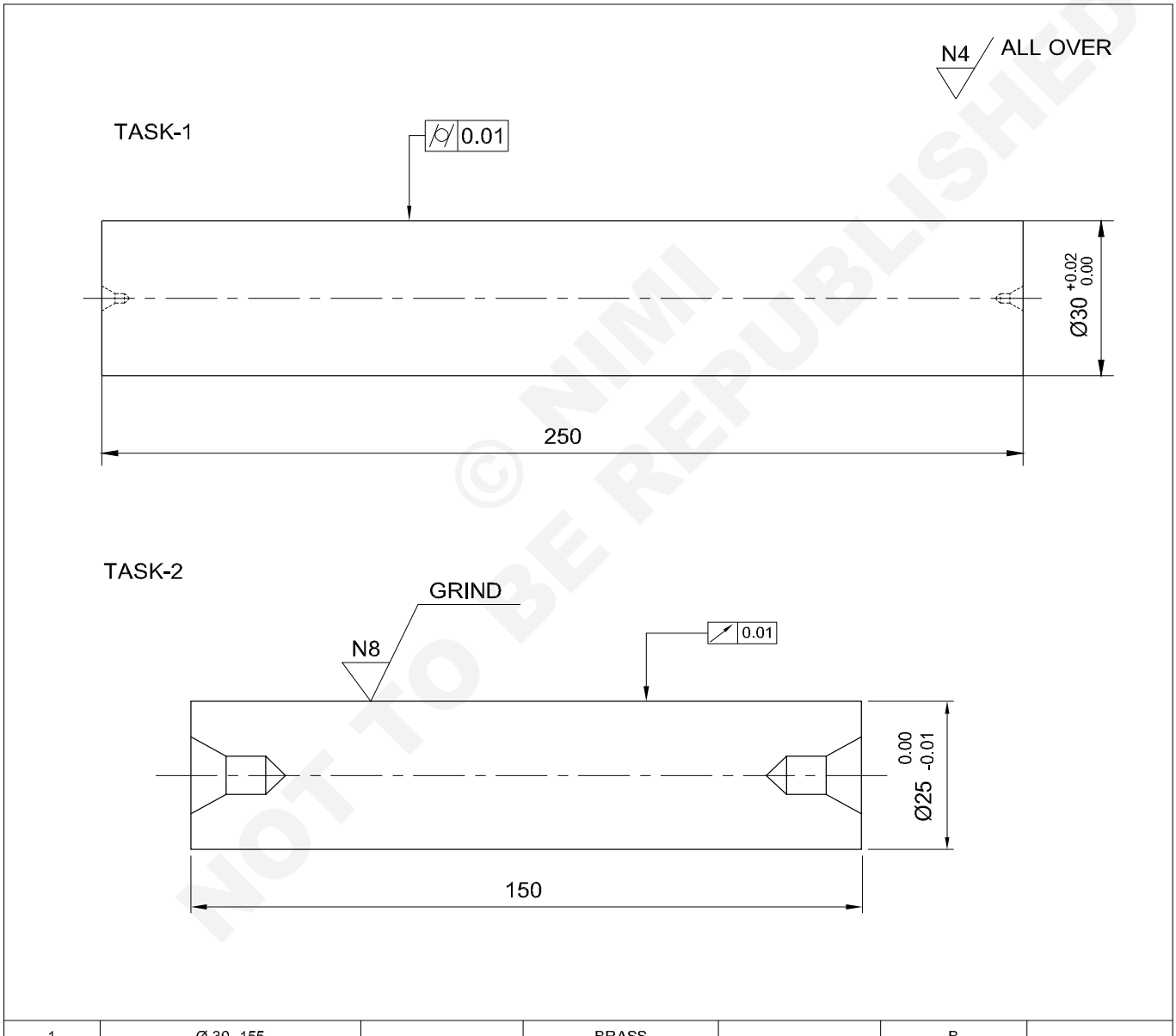
Hold the gib in correct position firmly while locking with check-nuts.

Check the function of the cross-slide.

Parallel cylindrical grinding (hard and soft metal) with in accuracy ±0.01mm

Objectives: At the end of this exercise you shall be able to

- **prepare the cylindrical grinding machine for grinding**
- **select the suitable grinding wheel for hard and soft metal grinding**
- **dress the grinding wheel for parallel grinding using single point diamond dresser**
- **grind a parallel cylindrical surface with an accuracy of 0.01mm**
- **check the dimension with an outside micrometer**
- **check the parallelism with dial test indicator**
- **select the grinding wheel for soft materials**
- **hold the soft work piece.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	Ø 30 -155	–	BRASS	–	B	
1	Ø 30 -255	–	HCS	–	A	1.9.96

SCALE NTS	PARALLEL CYLINDRICAL GRINDING (HARD AND SOFT METAL) WITHIN ACCURACY ± 0.01 mm	DEVIATIONS ±0.02	TIME 50 Hrs
		CODE NO. MG20N1996E1	

Job sequence

TASK 1: **Grinding HCS round rod (Hardened)**

- Check the raw material for its size.
- Hold the job between centre on lathe.
- Turn dia 30.5mm to maximum length of job
- Check the dia using vernier caliber
- Chamfer the one end 3x45° and deburr.
- Reverse the job clamping by shifting the lathe dog to turned side and clamp the job in between centres.
- Reduce the remaining length dia 30.5m by turning.
- Chamfer the other end 3x45° and deburr.
- Hardened the job in furnace to required hardness.
- Prepare the cylindrical grinding machine for HCS rod operation.
- Study the drawing and measure the grinding allowance for given job.
- Dress the grinding wheel make sure that the abrasive particles are remove uniformly.
- Mount the job in between centres.
- Set the length of stroke using reversing dogs.

Fix the safety guard in proper place.

- Put on the grinding wheel.
- Start the work table traverse.
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.

Wear goggles at all time using a grinding machine.

- Take a moderate cut (0.04mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse give depth of cut at the end of each traverse untill the job is within 0.02 0.01mm of the required final size.
- Reserve the position of the job in the centres.

Use a soft metal spacer to protect the job.

- Grind the end of the job previously covered by the carrier to the same size as the other end of the job.
- Dress the grinding wheel.
- Geind the work piece to the finished size 30mm like roughing cycle.
- Remove burrs of the job using fine abrasive stone.
- Measure the diameter of the job used by 25-50mm outside micrometer.
- Check the cylindrical of the job.
- Repeat the job sequence for TASK 2 operation after changing the grinding wheel according to the material being ground.