MACHINIST GRINDER

NSQF LEVEL - 4

2nd 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 - 2nd Year - NSQF Level - 4 (Revised 2022)**

Developed & Published by

National Instructional Media Institute
Post Box No.3142
Guindy, Chennai - 600 032
INDIA
Email: chennai-nimi@nic.in
Website: www.nimi.gov.in

First Edition : December 2023 Copies: 1000

Rs. 180/-

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 2nd Year Trade Practical** in **CG & M 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 Director General, Executive Director & Staff of NIMI and members of Media Development Committee deserve appreciation for their contribution in bringing out this publication.

Jai Hind

ATUL KUMAR TIWARI, *I.A.S*
Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

December 2023
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.

In order to perform the skills in a productive manner instructional videos are embedded in QR code of the exercise in this instructional material so as to integrate the skill learning with the procedural practical steps given in the exercise. The instructional videos will improve the quality of standard on practical training and will motivate the trainees to focus and perform the skill seamlessly.

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 2nd Year - NSQF Level - 4 (Revised 2022)** under the **CG & M** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. R. Kumar	-	Assistant Training Officer Govt ITI, Coimbatore, Tamilnadu.
Shri. P. Deiventhiran	-	Assistant Training officer Govt ITI, Coimbatore, Tamilnadu.
Shri. K. Maruthai Raj	-	Assistant Training officer Govt ITI, Trichy, Tamilnadu.
Shri. V. Muthu Raj	-	Junior Training Officer Govt ITI, Theni, Tamilnadu.

NIMI COORDINATORS

Shri. Nirmalya Nath	-	Deputy Director, NIMI, Chennai - 32.
Shri. V. Gopala Krishnan	-	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 workshop . It consists of a series of practical exercises to be completed by the trainees during the two years course of the **Machinist Grinder 2nd year** in **Capital Goods & Manufacturing** 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)

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

Module 1	Tool & Cutter Grinding
Module 2	Surface Grinding
Module 3	Gauges
Module 4	Surface and Cylindrical Grinding - I
Module 5	Cylindrical Grinding - I
Module 6	Honing
Module 7	Cylindrical Grinding - II
Module 8	Internal Grinding
Module 9	Lapping
Module 10	Surface and Cylindrical Grinder - II
Module 11	CNC Machine

The skill training in the shop floor is planned through a series of practical exercises centred 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 two years course of the **Machinist Grinder 2nd year** in **Capital Goods & Manufacturing** Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade Theory. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This co-relation 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

Sl.No.	Learning Outcome	Exercise No.
1	Perform re-sharpening of different milling cutters [Different milling cutters: -plain, slitting saw] **(Mapped NOS: CSC/N0109)**	2.1.97 & 98
2	Make different components having straight & angular surface with close tolerance limit and check different fault. [Different components: - V' block, plain cylindrical bar, cube; tolerance limit - ±0.01mm; different faults - cracks, blow-holes, chatters] **(Mapped NOS: CSC/N0109)**	2.2.99 - 112
3	Make different gauges with close tolerance limit and check accuracy with different gauges. [Different gauges: - snap gauge, ring gauge; tolerance limit- (H7/h7); Checking gauges- ring, plug] **(Mapped NOS: CSC/N0109)**	2.3.113 - 116
4	Produce different components of non-ferrous metal within appropriate accuracy. [Different components - taper pin, rectangular bar; accuracy limit- ±0.01mm.] **(Mapped NOS: CSC/N0109)**	2.4.117 - 119
5	Produce different components involving cylindrical angular grinding operation to close limit accuracy. [Different components- lathe centre, milling machine arbor; accuracy:- h6 or H6] **(Mapped NOS: CSC/N0109)**	2.5.120 - 123
6	Prepare surface of a component by honing operation & Check accuracy. [Accuracy limit: ±0.001mm] **(NOS: CSC/N9409)**	2.6.124
7	Produce components by different taper grinding operation and check accuracy. [Different taper grinding: - compound or double taper, steep taper, morse taper; accuracy limit - ±0.008mm.] **(Mapped NOS: CSC/N0109)**	2.7.125 - 133
8	Produce male and female components by different grinding to close tolerance limit. [Different grinding: - step and slot grinding; tolerance limit- H6/h5] **(NOS: CSC/N0109)**	2.8.134 - 139
9	Prepare surface of a job by performing lapping & buffing to close limit h5. **(NOS: CSC/N9409)**	2.9.140 - 142
10	Make components by different grinding to close tolerance limit and check accuracy. [Different grinding: - cylindrical taper, surface grinding & shoulder grinding; tolerance limit- h6] **(Mapped NOS: CSC/N0109)**	2.10.143 - 146
11	Identify different components of CNC lathe to understand working and prepare part programme by using simulation software. **(NOS: CSC/NO115)**	2.11.147 - 155

SYLLABUS FOR MACHINIST GRINDER

2ND YEAR **DURATION : TWO YEARS**

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 45 Hrs; Professional Knowledge 10 Hrs	Perform re-sharpening of different milling cutters [Different milling cutters: - plain, slitting saw] **(Mapped NOS: CSC/N0109)**	97. Perform grinding of plain milling cutter. (20 hrs) 98. Perform grinding of slitting saw milling cutter. (25 hrs)	Milling cutters and its nomenclature. Grinding of bushes and cylinders steps and precautions to be taken. (10 hrs.)
Professional Skill 160 Hrs; Professional Knowledge 45 Hrs	Make different components having straight & angular surface with close tolerance limit and check different fault. [Different components: - V' block, plain cylindrical bar, cube; tolerance limit - ±0.01mm; different faults - cracks, blow-holes, chatters] **(Mapped NOS: CSC/N0109)**	99. Perform grinding on plain flat surface in surface grinding machine with close tolerances (±0.01mm.) (21 hrs)	Dial test indicators marking block, height gauge and surface plate their description. (06 hrs.)
		100. Perform grinding on angular surface like 'V' block. (21 hrs)	Principle of vernier caliper, protractors, micrometers (O/S, I/S and depth) and other instruments having vernier graduations. Combination sets-their use care and maintenance. (06 hrs.)
		101. Grind parallel block on surface grinding machine within close limits (±0.01mm.) (08 hrs) 102. Perform plain cylindrical grinding to close limit with accuracy of h7. (12 hrs).	Bonding materials their kinds description and uses. Grade and structure at grinding wheels. Brief about ISO- 9000. Importance of Quality. (07 hrs.)
		103. Perform cylindrical bore grinding within accuracy ±0.01mm. (15 hrs) 104. Set and grind jobs on chucks and face plates. (08 hrs)	Wheel marking system selection of wheels. Specification and types (shapes & size) of grinding wheels, diamond wheels and their uses. (07 hrs.)
		105. Balance grinding wheel (06 hrs) 106. Mount grinding wheel. (03 hrs) 107. Perform right angle grinding on surface grinding machine within accuracy ± 0.01mm. (16 hrs)148. Identify different ferrous metals by spark test (2 hrs.)	Mounting of grinding wheels, grinding wheels, collets and mandrels, balancing of grinding wheels by different methods. (06 hrs.)
		108. Perform wheel dressing for rough and finishing grinding. (01 hrs) 109. Grind a cube to close limit. (Tolerance within ±0.01mm.) (24 hrs)	Types of dresses-steel type, abrasive Diamond tool and rotary dresses abrasive bricks and sticks their description, use, care and maintenance. (07 hrs.)
		110. Perform shoulder grinding on cylinder-grinding machine to close limit h7. (08 hrs) 111. Perform slot grinding on surface grinding machines to close limits H7. (09 hrs)	Dressing and truing of grinding wheels advantage of balancing, inspections and care of grinding wheels. Wheel storage.

		112. Find different faults while grinding. viz., Cracks, blow holes, chatters. (08 hrs)	Heat generated in grinding dry and wet grinding, use of coolants their composition and selection, limit, fit and tolerances as per ISI: 919-1963. Basic size and its deviation position of tolerance zone with respect to zero lines. Fits different types clearance, interference and transition Interchangeable system Letter symbols for holes and shafts and fundamental deviation hole basis and shaft 9basis systems. (06 hrs.)
Professional Skill 86 Hrs; Professional Knowledge 25 Hrs	Make different gauges with close tolerance limit and check accuracy with different gauges. [Different gauges: - snap gauge, ring gauge; tolerance limit- (H7/h7); Checking gauges- ring, plug] **(Mapped NOS: CSC/ N0109)**	113. Grind Snap gauge in close limit to H6. (25 hrs)	Gauges-feeler, taper gauge radius, plug, ring snap (fixed and adjustable) and slip their description use care and maintenance. (06 hrs.)
		114. Perform grinding on cylindrical taper using standards ring gauges. (19 hrs)	Inside micrometer depth gauge, special types of micrometers, universal dial test indicator their construction and function. (06 hrs.)
		115. Perform grinding of ring gauge using plug gauge. (20 hrs)	Special type of grinding machine centreless, thread crankshaft etc. their description, use care and maintenance. (06 hrs.)
		116. Grinding long cylindrical using steady rest to close limit of h6. (22 hrs)	Essential mechanism of grinding machines, wheel is guards to IS: 1991-1962 machine guards etc. Process of cleaning and oiling at grinding machines (care and Maintenance) types of steady rests their description and use (07 hrs.)
Professional Skill 65 Hrs; Professional Knowledge 17 Hrs	Produce different components of non-ferrous metal within appropriate accuracy. [Different components - taper pin, rectangular bar; accuracy limit- ±0.01mm.] **(Mapped NOS: CSC/N0109)**	117. Grind thin plates to close limits of h6 using coolants. (25hrs)	Principle types of grinding fluids importance of uniform temperature, selection and use at grinding fluids, method of supplying grinding fluids. (06 hrs.)
		118. Perform grinding on parallel and taper pins using chuck and collets-h6. (20hrs)	Types of holding devices methods of holding work, type of centres - holding work between centres types of chucks and holding process in chucks. (05 hrs.)
		119. Select grinding wheel and perform grinding on rectangular bar of non-ferrous metals within accuracy ±0.01mm. (20hrs)	Holding work on face plate, pneumatic chuck and magnetic chuck. Precautions to taken before grinding, peripheral of surface speed of grinding wheels, importance of constant wheel speeds, calculations at S.F.P.M. (06 hrs.)
Professional Skill 85 Hrs;	Produce different components involving cylindrical	120. Perform grinding on machine centre to close limit h6 or H6. (20hrs)	Calculation at R.P.M. and S.F.P.M. of grinding wheels calculation of work speed for cylindrical grinding speed

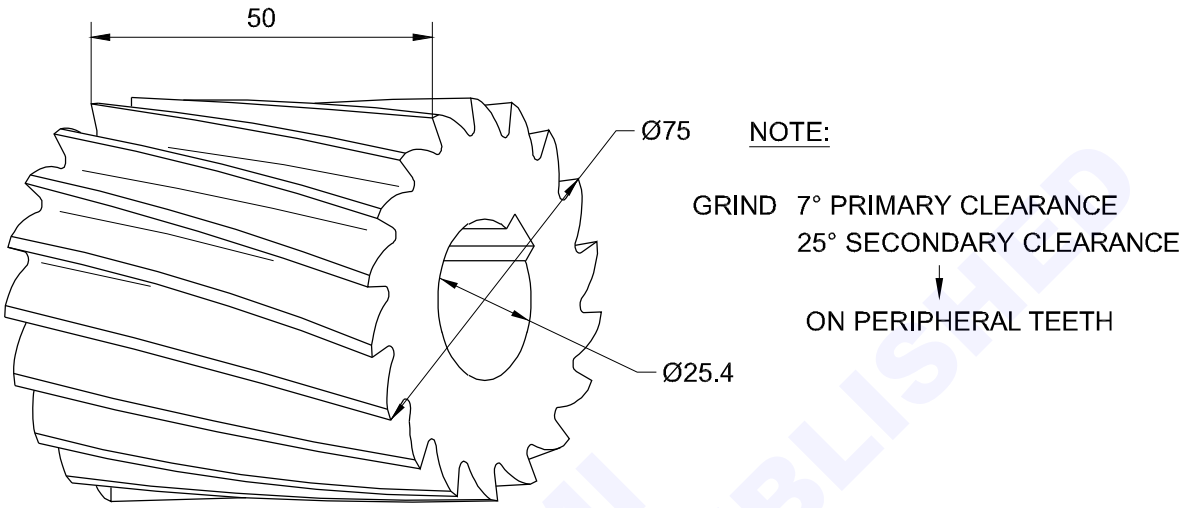
Professional Knowledge 20 Hrs	angular grinding operation to close limit accuracy. [Different components- lathe centre, milling machine arbor; accuracy:- h6 or H6] **(Mapped NOS: CSC/N0109)**		and feeds for cylindrical grinding speed and feeds for internal grinding. (05hrs.)
		121. Perform Facing and Chamfering within accuracy ±0.01mm or ± 5 minutes. (20hrs)	Traverse and over run of traverse, width of wheel and depth of cut in different types of grinding achiness. Grinding allowance and time estimation. Rough and finish grinding process. (05 hrs.)
		122. Perform step grinding on surface grinding machine to close limit h6 or H6. (22hrs)	Surface grinding methods of surface grinding by using periphery of grinding wheel and ring edge of grinding wheel. Types of surface grinding machines. Work finish, wheel selection holding of work. (05 hrs.)
		123. Perform V-block grinding within accuracy ±0.01 mm, ± 5 minutes, surface finish N5. (23hrs)	Process of grinding angular surfaces. Grinding slots and grooves. Grinding "V" blocks. Recommended wheel speeds for surface grinding machines. (05 hrs.)
Professional Skill 18 Hrs; Professional Knowledge 06 Hrs	Prepare surface of a component by honing operation & Check accuracy. [Accuracy limit: ±0.001mm] **(NOS: CSC/N9409)**	124. Grind cylindrical steps and perform honing (18hrs)	Hones and Honing, types of honing stones there description and use. Amount and rate of stock removal. Adjustment for elementary honing conditions, honing tolerances. (06 hrs.)
Professional Skill 135 Hrs; Professional Knowledge 30 Hrs	Produce components by different taper grinding operation and check accuracy. [Different taper grinding: - compound or double taper, steep taper, morse taper; accuracy limit - ±0.008mm.] **(Mapped NOS: CSC/N0109)**	125. Finish surface of Angular form grinding within accuracy of ±0.01mm. (20hrs)	Cylindrical-types of cylindrical grinding operation traverse method, plunge cut method and form grinding method. Alignment of head stock and tail stock. (05 hrs.)
		126. Grind cylindrical steps with shoulder and chamfer within accuracy ±0.008mm. (20hrs)	Method of plain cylindrical surface grinding step-grinding and shoulder and face grinding. (05 hrs.)
		127. Perform compound or double taper grinding accuracy of ±0.008mm. and surface finish of N5 (22hrs)	Method of grinding external and angle (simple) taper and steep. Taper double compound taper. (05 hrs.)
		128. Perform steep taper grinding with in accuracy ±0.008mm. (12 hrs) 129. Grind lathe centre within accuracy ±0.008 mm. surface finish N4. (13 hrs)	Use of universal head for angular grinding. Measuring and checking of taper and angles. Use of taper plug and ring gauges. (05 hrs.)
		130. Make Morse taper within accuracy ±0.008 mm. surface finish N4. (08 hrs) 131. Perform Plug grinding within accuracy ±0.008 mm. surface finish N4. (08 hrs)	Taper and angle checking by using protractors, micrometer and rollers. (05 hrs.)

		132. Finish Metric tapers by grinding within accuracy ±0.008 mm. surface finish N4. (09 hrs)	
		133. Perform Taper grinding using sine bar, D.T.I. and gauge blocks to close limit h6. (23hrs)	Use of sine bar and gauge block-taper checking by sine bar gauge block D.T.I. micrometer and rollers. Other out of round surfaces. Holding work with fixed steady rest, in process gauges and pneumatic gauges. (05 hrs.)
Professional Skill 67 Hrs; Professional Knowledge 20 Hrs	Produce male and female components by different grinding to close tolerance limit. [Different grinding: - step and slot grinding; tolerance limit- H6/ h5] **(NOS: CSC/ N0109)**	134. Grind taper up to close limit H6. (6hrs) 135. Grind lathe centre within h7. (8hrs)	Centreless grinding process of holding job, and types of operations. Effect of setting work above and below wheel centre. Jig and fixture holding work by fixture and vice non-electric and magnetic chuck. Use of three jaw and two jaw steady rest (05 hrs.)
		136. Perform internal step grinding to close limit H6, (13 hrs) 137. Grind ring gauge to close limit-H7. (8hrs)	Internal centreless grinding methods of holding jobs and processes of grinding. Selection of wheels. Internal grinding work movement and wheel movement. Rotation and reciprocation of job and wheel spindle, Internal grinding allowance, selection of wheels for internal grinding allowance, selection of wheels for internal grinding. Thread grinding method of holding jobs methods of grinding threads and thread calculation. (095hrs.)
		138. Perform slot grinding to close limit h5. (16hrs)	Thread grinding method of holding jobs method of grinding threads and thread calculation. (05 hrs.)
		139. Perform cylindrical step grinding (16hrs)	Various types of thread grinding wheels and their selection. Types of dressers and process of process of dressing selection of coolants and their use. (05 hrs.)
Professional Skill 19 Hrs; Professional Knowledge 06 Hrs	Prepare surface of a job by performing lapping & buffing to close limit h5. **(NOS: CSC/N9409)**	140. Perform Lapping on flat surface. (05hrs) 141. Perform Lapping on cylindrical surface (06hrs) 142. Perform Buffing to close limits . (8hrs)	Laps and lapping material, types of laps lapping abrasives rotary diamond lap lapping lubricants lapping pressures wet and dry lapping. Hand lapping and machine lapping. Lapping flat surface lapping cylindrical surface polishing wheels polishing operations abrasive buffing wheels (06 hrs.)
Professional Skill 70 Hrs; Professional Knowledge 20 Hrs	Make components by different grinding to close tolerance limit and check	143. Perform cylindrical Taper grinding. (10hrs)	-Do- (05 hrs.)

	accuracy. [Different grinding: - cylindrical taper, surface grinding & shoulder grinding; tolerance limit-h6] **(Mapped NOS: CSC/ N0109)**	144. Perform surface grinding within accuracy ±0.01mm. (20hrs)	Grinding defects and their corrections, inaccurate work out of round, out of parallel taper on and irregular marks spiral scratches, discoloured burnt surface etc. (05 hrs.)
		145. Perform Multi-step cylindrical grinding. (20hrs)	Grinding defects and their correction. Waviness marks of surface, chatters-short close evenly spaced long and regularly spaced, marks in phase with vibration of floor, random marks, random waves etc. Glazing of wheel and loading of wheel. (05 hrs.)
		146. Perform shoulder grinding on cylinder-grinding machine to close limit h7. (20hrs)	Dressing and truing of grinding wheels advantage of balancing, inspections and care of grinding wheels. Wheel storage. (05 hrs.)
Professional Skill 90 Hrs; Professional Knowledge 23 Hrs	Identify different components of CNC lathe to understand working and prepare part programme by using simulation software. **(NOS: CSC/NO115)**	147. Prepare different types of documentation as per industrial need by different methods of recording information. (12 hrs)	Importance of Technical English terms used in industry -(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards. (05 hrs.)
		148. Identify CNC machine (04 hrs) 149. CNC machine operation like Jog, Reference Edit, MDI, Auto Mode Program. Call & Entry, Simulation, Tool off-set Tool changing /Orientation. (12 hrs)	Introduction to CNC Technology CNC M/c. principle advantages classification, drives, controls. Basic information on CNC machine & maintenance of CNC M/c. computer aided CNC Language. Introduction to CNC grinding. (05 hrs.)
		150. Know rules of personal and CNC machine safety, safe handling of tools, safety switches and material handling equipment using CNC didactic/ simulation software and equipment. (10 hrs) 151. Identify CNC lathe machine elements and their functions, on the machine. (10 hrs) 152. Understand the working of parts of CNC lathe, explained using CNC didactic/ simulation software. (15 hrs) 153. Identify machine over travel limits and emergency stop, on the machine. (05 hrs) 154. Decide tool path for turning, facing, grooving, threading, drilling. (15 hrs) 155. Identify safety switches and interlocking of DIH modes. (05 hrs)	Personal safety, safe material handling, and safe machine operation on CNC turning centers. CNC technology basics, Comparison between CNC and conventional lathes. Concepts of positioning accuracy, repeatability. (06 hrs.) CNC lathe machine elements and their functions - bed, chuck, tailstock, turret, ball screws, guide ways, LM guides, coolant system, hydraulic system, chip conveyor, steady rest, console, spindle motor and drive, axes motors, tail stock, encoders, control switches. Feedback, CNC interpolation, open and close loop control systems. Machining operations and the tool paths in them – stock removal in turning and facing, grooving, face grooving, threading, drilling. (07 hrs.)

Perform grinding of plain milling cutter

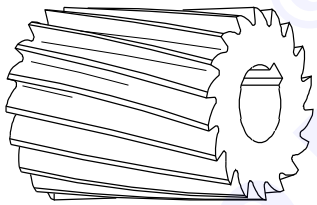
Objective: At the end of this exercise you shall be able to
- **resharpen the plain milling cutter primary clearance and secondary clearance angle.**



Job sequence

- Mount the plain milling cutter (Fig1) on the mandrel and in between centres.

Fig 1



- Mount the wheel on spindle.
- Turn the wheel head to 1° to the table and lock in position.
- Set the table graduations at 0°.
- Adjust the grinding wheel centre height with a centre gauge.
- Tooth rest is mounted on the table or work head and adjusted to the tooth to be sharpened first.
- Set the tooth rest to the plain angle of the cutter.
- Set the tooth rest side of the cutter and at the same centre height of the table centres.
- Lower the wheel head (for offset) amount calculating to the required clearance angle formula.

Offset = cutter dia x clearance angle x 0.0087

- The cutter wheel and tooth rest are contact at a common point.
- The cutter is rotated forward to the rotating wheel.
- Grind the cutter of peripheral primary clearance angle 7° the table is moved back and forth for all teeth finished by the wheel.
- The cutter is revolved backward 180° against the tooth rest.
- The tooth rest and a trail cut is taken on this opposite tooth without changing the depth of cut.
- This is done for checking the taper.

1	USED MILLING CUTTER	–	H.S.S	–	–	2.1.97
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	RESHARPENING OF PLAIN MILLING CUTTER				DEVIATIONS ±	TIME
					CODE NO. MG20N2197E1	

- If there is no taper the cutter again revolved backward and the next tooth is sharpened.
- The process is continued till the sharpening and concentric grinding of all the teeth has been completed.

Grinding secondary clearance

- Rotate the cutter to 25° for secondary clearance.
- Position the wheel such that the next teeth will not be ground by the grinding wheel.
- Start grinding the secondary clearance on the first tooth.
- Check the land width.
- It should be 2mm. approximately.
- Repeat and complete all the other teeth leaving uniform width of land on all peripheral teeth.
- Cutting edge formed on plain milling cutter

Skill sequence

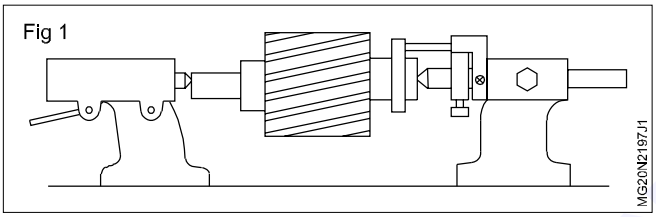
Grinding of peripheral clearance angle

Objective: This shall help you to

- **grind the clearance angle on the peripheral of helical milling cutter.**

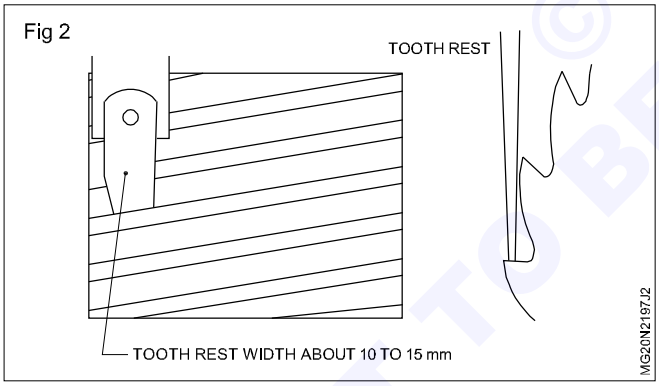
- Fix the tooth rest to the wheel head. (Static type)
- Fasten it after moving it to the specified relief angle using the graduation of the relief angle indicator. (Fig 1)

Fig 1



- Adjust the tooth rest and fasten it after setting it to the rake face of the cutter. (Fig 2)

Fig 2

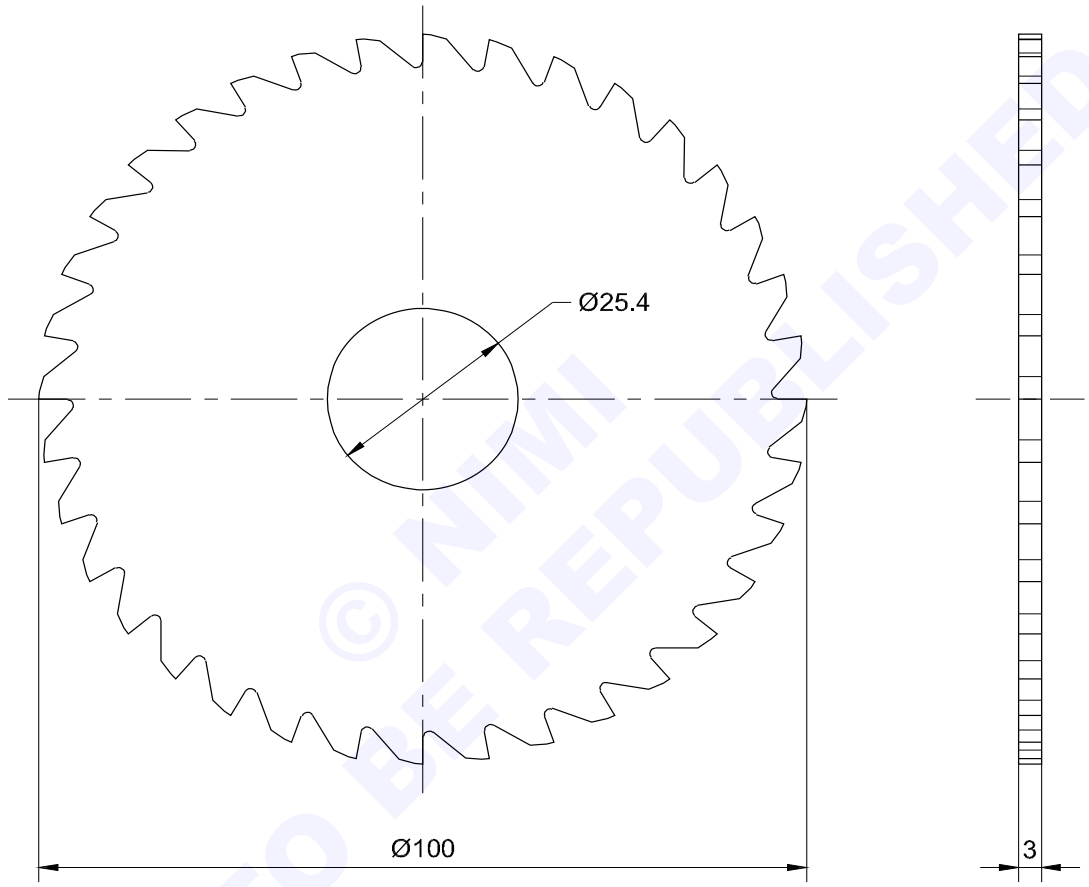


- Then remove the dog.
- Grip the mandrel with the right hand so as to press it lightly onto the tooth rest.
- Feed the table with the left hand.
- Grind two opposite teeth only and check their parallelness.
- For adjustment use the taper adjusting screw on the table.
- After parallelness has been obtained grind all peripheral teeth.
- See the "Side Cutter" chapter for the cut-in margin, land width and other grinding points.

Perform grinding of slitting saw milling cutter

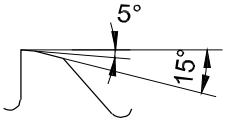
Objectives: At the end of this exercise you shall be able to

- **set the job on work head**
- **grind the of peripheral clearance angle.**



Note:

Grind - 5° PRIMARY CLEARANCE
15° SECONDARY CLEARANCE
ON PERIPHERAL TEETH ONLY



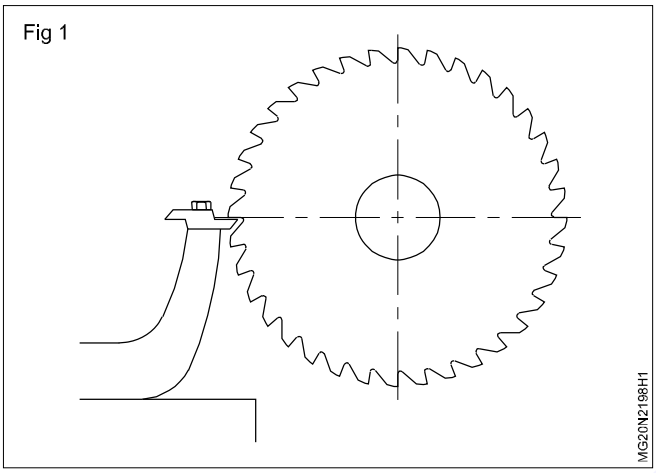
1	USED MILLING CUTTER	–	H.S.S	–	–	2.1.98
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**RESHARPENING OF SLITTING SAW CUTTER**				DEVIATIONS ±	TIME
					CODE NO. MG20N2198E1	

Job sequence

Grinding primary clearance angle

- Mount taper cup wheel and true it
- Adjust the grinding wheel centre height with a centre gauge.
- Set the table graduations at 0°.
- Dress the grinding wheel.
- Mount the cutter on the workhead or cutter head.
- Align the rake face of the cutter with centre gauge. (Fig 1)

Fig 1



- Set the cutter to primary clearance angle 5°.
- Set the tooth rest under the first tooth to be ground.
- Start the wheel head motor and start grinding the 1st tooth.
- Sharpen the opposite tooth and check for dimension and taper.
- Correct if necessary.
- Complete the grinding of all the teeth.

Grinding secondary clearance

- Rotate the cutter to 15° for secondary clearance.
- Position the wheel such that the next teeth will not be ground by the grinding wheel.
- Start grinding the secondary clearance on the first tooth.
- Check the land width. It should be 1mm approximately.
- Repeat and complete all the other teeth leaving uniform width of land on all peripheral teeth.

If the land width is more than 1.5mm, then grind the secondary clearance angle.

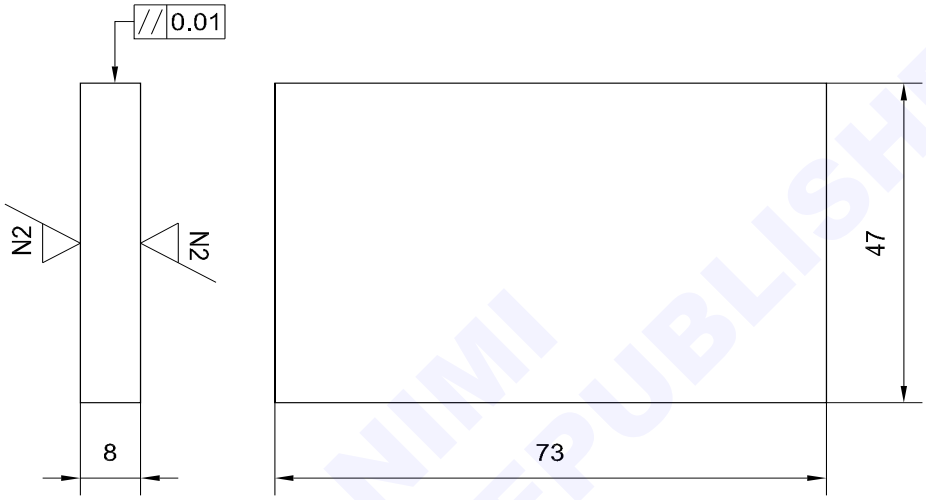
Table 1

Recommended primary clearance angles

Type of cutter	Primary clearance angle								
	Periphery			Corner			Face		
	Steel	C.I	Al.	Steel	C.I	Al.	Steel	C.I	Al.
Face or side	4-5°	7°	10°	4-5°	7°	10°	3-4°	5°	10°
Slotting	5-6°	7°	10°	5-6°	7°	10°	3°	5°	10°
Saw	5-6°	7°	10°	5-6°	7°	10°	3°	5°	10°

Perform grinding on plain flat in surface grinding machine with close tolerances (±0.01mm)

Objectives: At the end of this exercise you shall be able to
- **prepare the surface grinding machine for grinding**
- **dress the grinding wheel by using diamond point dresser**
- **balance the grinding wheel**
- **set the magnetic chuck and align with dial test indicator**
- **grind the flat surface with an accuracy of ±0.04.**



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.
- Balancing the grinding wheel.
- Set the magnetic chuck with supporting the stopper plate.
- Set the length of stroke by adjusting the reversing dogs.
- Start the machine and grinding wheel rotating idle.

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

- Study the drawing and measure the grinding allowance for given job.
- Take the reference cut on the job by the rotating wheel. Initial spark will appear when it touches the height point on the job surface and the switch on the coolant and it allow to flow sufficiently.
- Grind the rough and finish the surface removing only half of the grinding allowance.

1	ISF 75X50X10		Fe310	-	-	2.2.99
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	GRINDING FLAT AND PARALLEL SURFACE				DEVIATIONS ± 0.01 mm	TIME 25hrs
					CODE NO. MG20N2299E1	

- Remove the job from the magnetic chuck and deburr by using fine abrasive stone.
- Dress the grinding wheel and reset the job for finishing and deburring.
- Reverse and reset the job on the magnetic chuck.
- Grind rough and finish the flat surface with dimension of 8mm to an accuracy of ± 0.04mm.

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

Preparing surface grinding machine for grinding

Objective: This shall help you to

- **prepare the surface grinding machine for grinding operations.**

Preparing wheel spindle

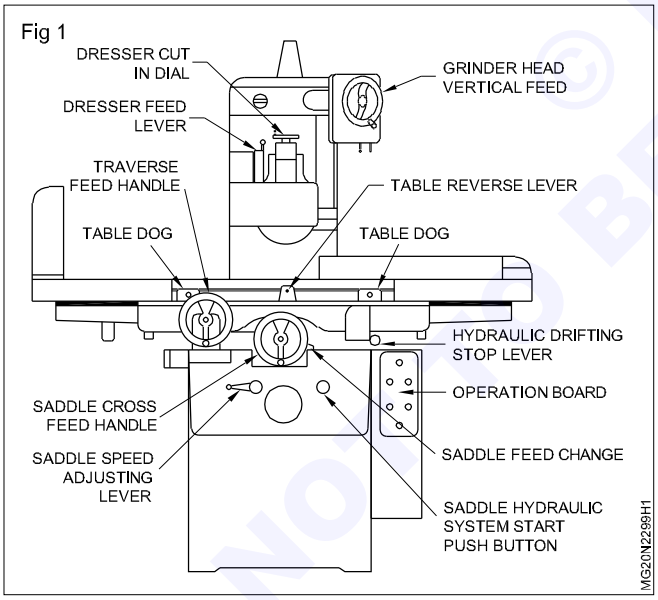
It's very essential to check the different controls of the machine before actually starting the grinding operation. This will help the preparation of the machine for work. Check the following before the grinding operation.

Checking and oiling before start

1 Apply oil to all the lubricating points. (consult your instructor).

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

Fig 1



3 Check that the clutch of the table traverse feed handle is idle / neutral.

4 Check that the table dog is fixed.

Start and stop the grinding machine

Switch on the power source, push the switch button of the operation board shown Fig 1 to start the grinding wheel, hydraulic motor and coolant motor individually push the all stop button to stop the machine totally.

Manual feed of table

Longitudinal feed

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

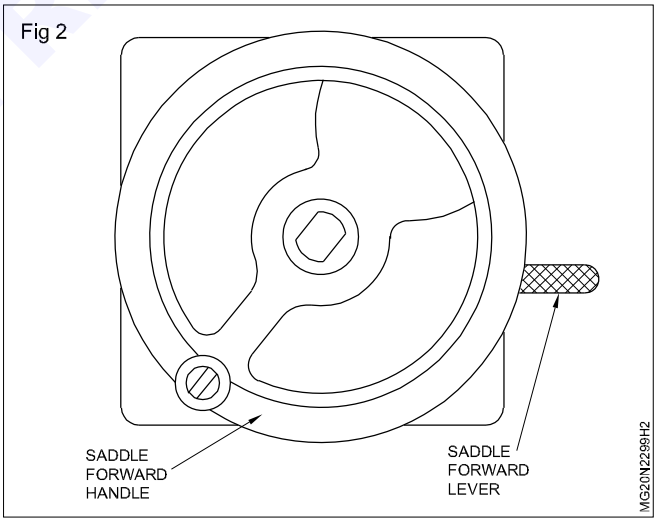
2 Move the table to the right and left by turning the saddle cross-feed handle clockwise respectively.

Cross feed

Manual and automatic feed of saddle

1 Move the saddle forward by turning the saddle cross-feed handle clockwise. (Fig 2)

Fig 2



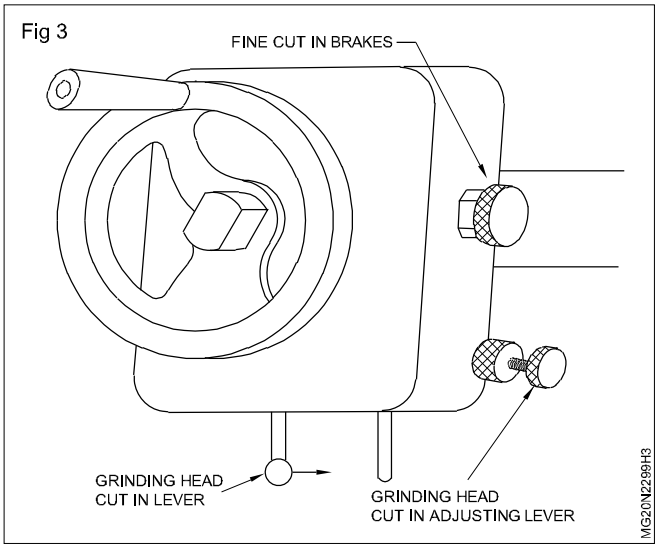
2 Move the saddle backward by turning the saddle cross feed handle anticlockwise.

3 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).

4 Raise and lower the grinding wheel.

5 Disengage the fine feed knob. (Fig 3)

Fig 3



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

7 Turn the grinding wheel elevation handle clockwise to raise the grinding wheel. The above provision is provided for giving depth of cut.

Hydraulic operation of table

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

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

3 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)

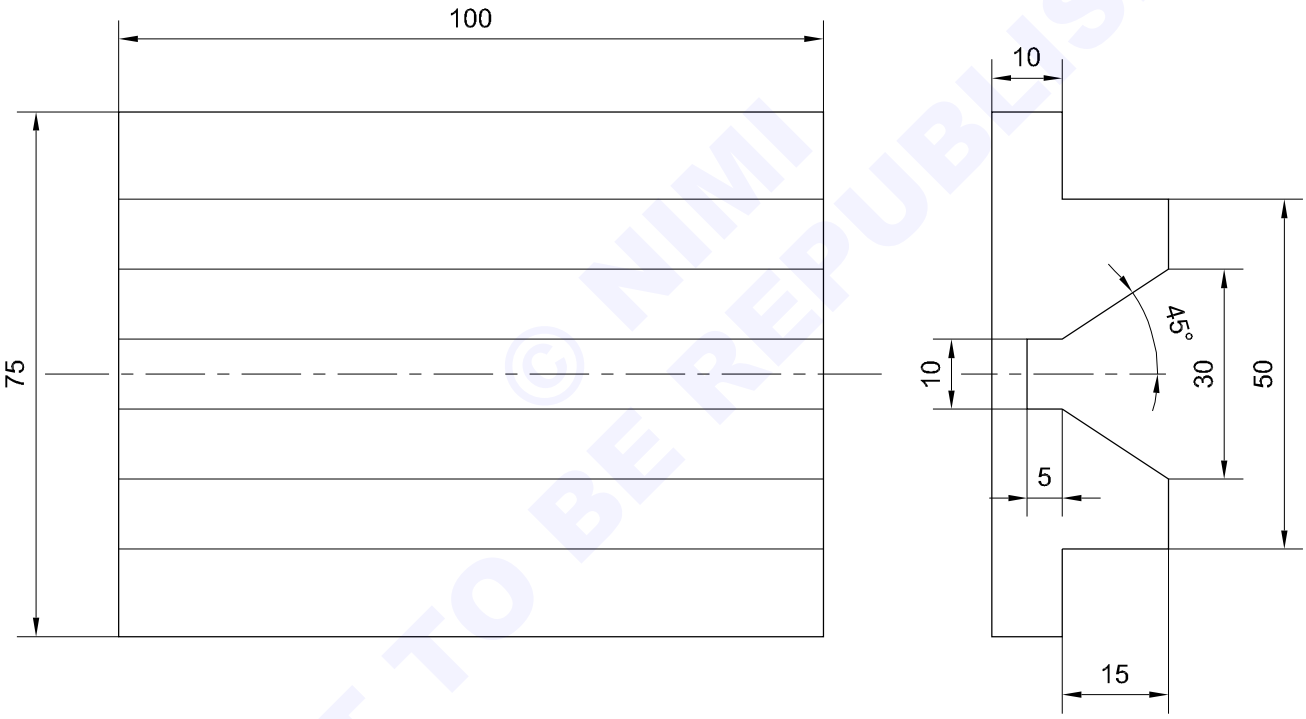
4 Stop the hydraulic drive by pushing or pulling the hydraulic drive stop lever. (The table is stopped at the right end position)

The hydraulic drive of the table must be started only after sufficient idle operation. As the oil is hardened in winter. It is necessary to carry out long idling in the season.

Grinding on angular surface like 'V' block

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

- **milling the job as per drawing**
- **setting job on tilting table**
- **grinding 'V' groove to required size**
- **measuring using micrometer and vernier bevel protractor.**



NOTE:

N4 ALLOVER SURFACE FINISHING (GRINDING)

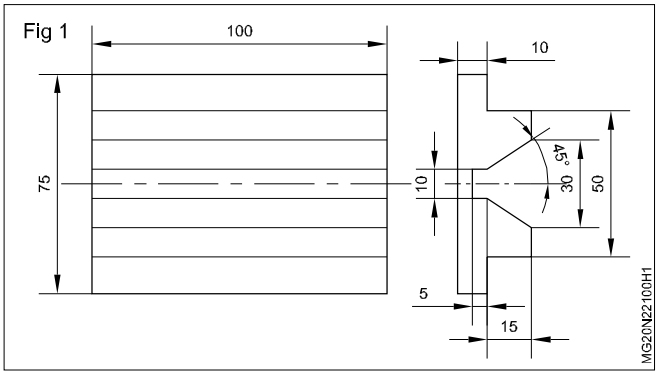
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	80 X 105 X 30	-	Fe310	-	-	2.2.100

SCALE NTS	ANGULAR SURFACE GRINDING	DEVIATIONS ±0.02 mm	TIME:
		CODE NO. MG20N22100E1	

Job sequence

- Check the raw material for its size.
- Machine job as drawing using milling machine leaving grinding allowance.
- 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.
- Check the parallelism with a outside micrometer.
- Set the job on tilting table and vice 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 rough and finish grind the slot with ± 0.02mm.
- Remove the job and reverse it align the surface rough and finish.
- Swivelling the tilting table 45° at vertical plane the jaws are perpendicular the grinding wheel axis.
- Rough and finish grind the angular surface.
- Deburr the all edges throughly and clean.
- Measure the dimensions with an outside micrometer.
- Check the angular surface with vernier bevel protractor.

Skill sequence

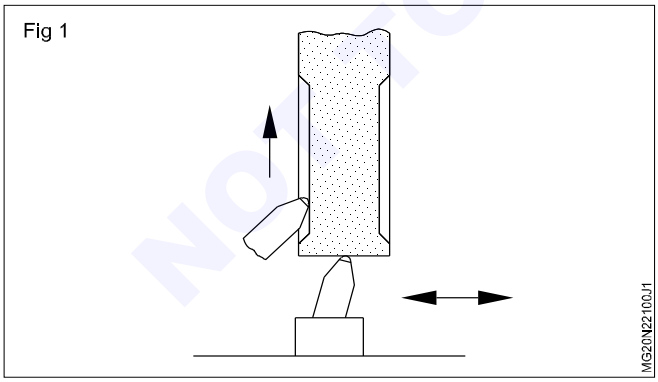
Grinding V- Block using universal vice

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)

Fig 1



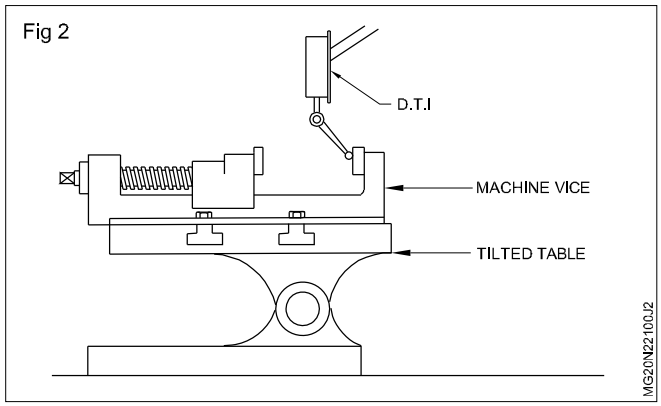
2 Clean the machine table and mount the tilting table.

3 Align the fixed jaws of the vice perpendicular to the axis of the spindle. (Fig 2)

4 Tilt the table to 45° using vernier bevel protractor.

5 Clean the job and measure it to determine the grinding allowance. (Ask your instructor for help in determining the allowance).

Fig 2



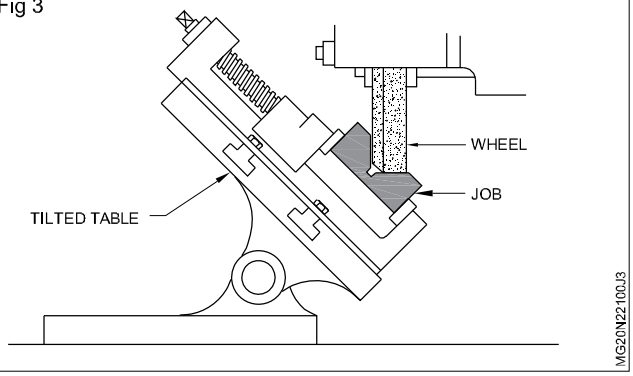
6 Hold the job in the vice such that the horizontal surface to be ground is aligned parallel to the surface of the table using a dial test indicator. (Fig 3)

7 Position the stop dogs for longitudinal traverse.

8 Start the wheel and lower the wheel head until the wheel just sparks the highest spot of the job.

9 Start the table travelling automatically and feed the entire length of the job and clear off the job from the wheel.

Fig 3



10 Engage the vertical depth for rough and finish cut as predetermined and feed from the cross-feed manually. (Fig 4a)

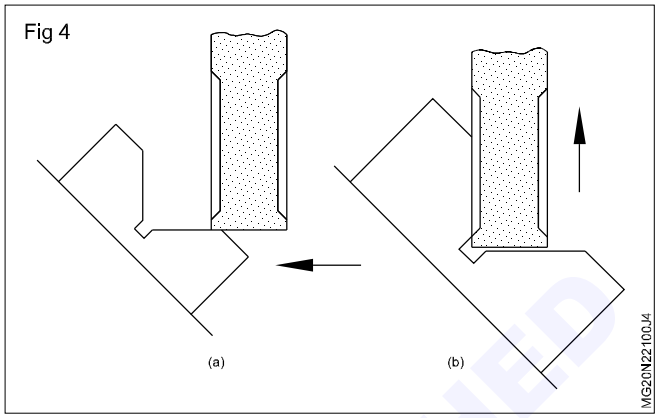
11 Grind the longitudinal surface up to the corner relief.

12 Remove only that much of material pre-determined as grinding allowance, and record the amount of material removed.

13 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.

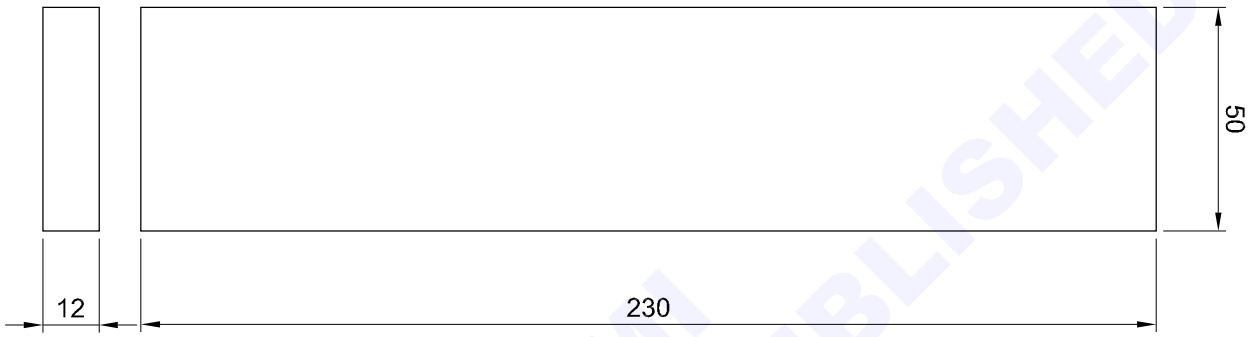
14 Raise the wheel gradually to finish grind the vertical surface. (Fig 4b)

Fig 4



Grind parallel block on surface grinding machine within close limits (±0.01mm.)

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.**



Job sequence

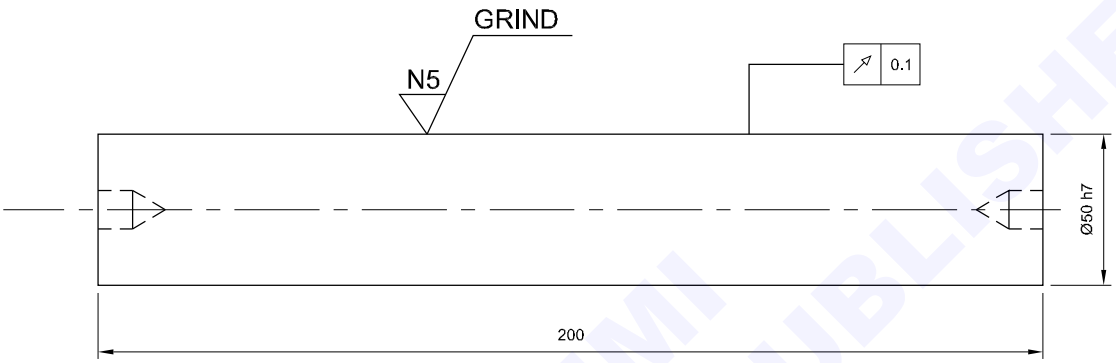
Premachined block

- 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 ± 0.02 mm.
- Measure the size with a 25 to 50 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 ± 0.01 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.

1	235 x 15 x 15		Fe 310			2.2.101
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	PARALLEL BLOCK GRINDING				DEVIATIONS ±0.01 mm	TIME
					CODE NO. MG20N22101E1	

Perform plain cylindrical grinding to close limit with accuracy of h7

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

- Check the raw material size.
- Turn the job as per drawing leaving grinding allowance.
- 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 ±0.03 mm to a length of 200 mm and the diameter of 49.97 mm.
- Move the wheel and job away.
- Stop the wheel and job rotation.
- Check the dimension with a 25 to 50 mm vernier micrometer along with parallelism and roundness.
- If required dimension is not achieved, repeat the cycle till get the correct size.

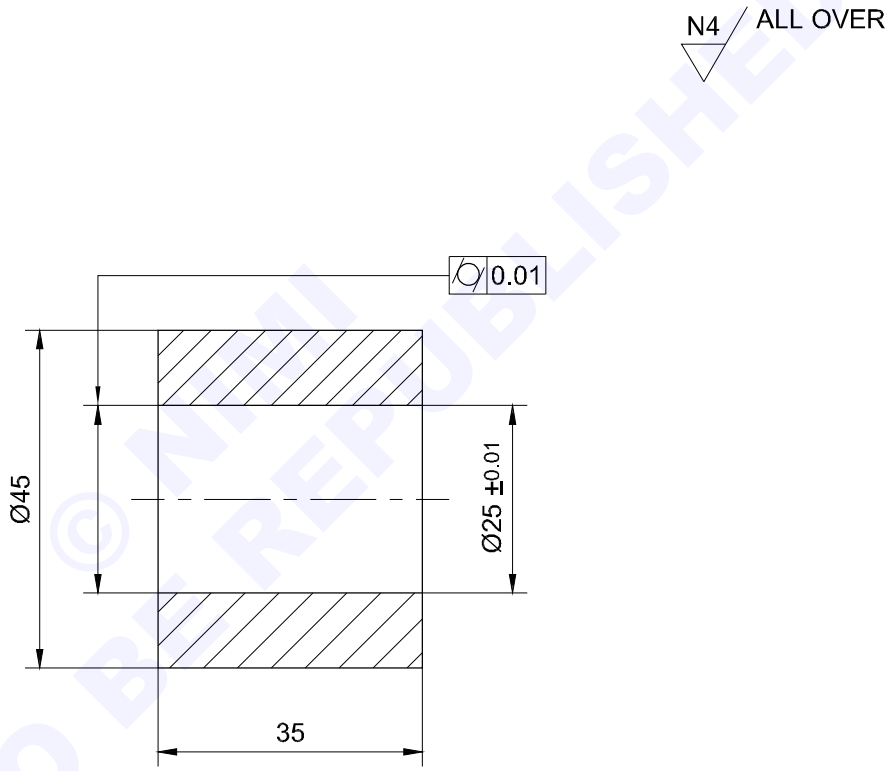
1	ISR Ø55 X 205		Fe 310	-	-	2.2.102
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PLAIN CYLINDRICAL GRINDING TO CLOSE LIMIT	DEVIATIONS ± 0.01 mm	TIME
		CODE NO. MG20N22102E1	

Cylindrical bore grinding within accuracy ±0.01mm.

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 Ø 25±0.01mm**
- **measure the bore diameter by using telescopic gauge.**



1	ISR Ø50 X 40		Fe310	–	–	2.2.103
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	CYLINDRICAL BORE GRINDING	DEVIATIONS as per IS :±0.01mm	TIME
		CODE NO. MG20N22103E1	

Job sequence

- Check the raw material size.
- Turn and bore the job in lathe leaving grinding allowance as required.
- 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.

- Wear safety 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).

Skill sequence

Preparing Internal Cylindrical Grinding

Objectives: This shall help you to

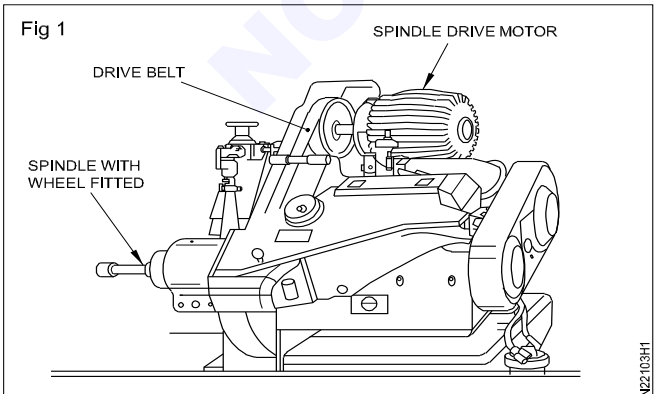
- **preparing the internal cylindrical grinding.**

- **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

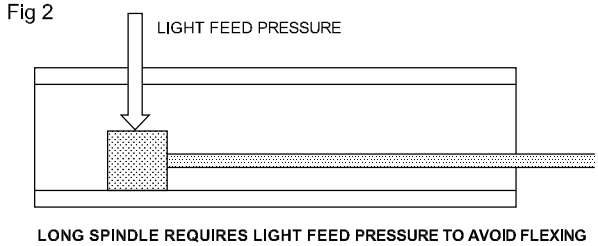


INTERNAL GRINDING SPINDLE MOUNTED ON WHEELHEAD OF UNIVERSAL GRINDING MACHINE

- 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)

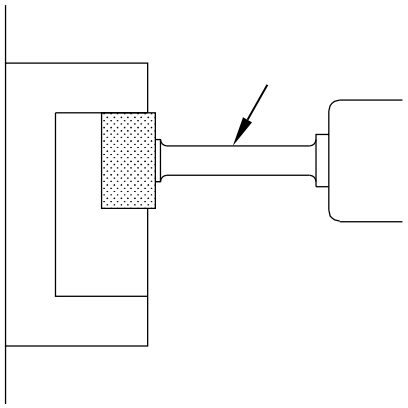
Fig 2



LONG SPINDLE REQUIRES LIGHT FEED PRESSURE TO AVOID FLEXING

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.

Fig 3



SHORT SPINDLE GIVES RIGID FEED

MG20N22103H3

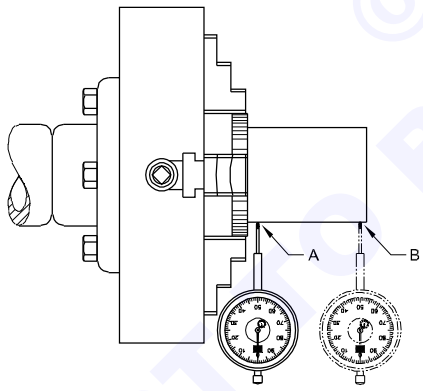
Warning

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 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

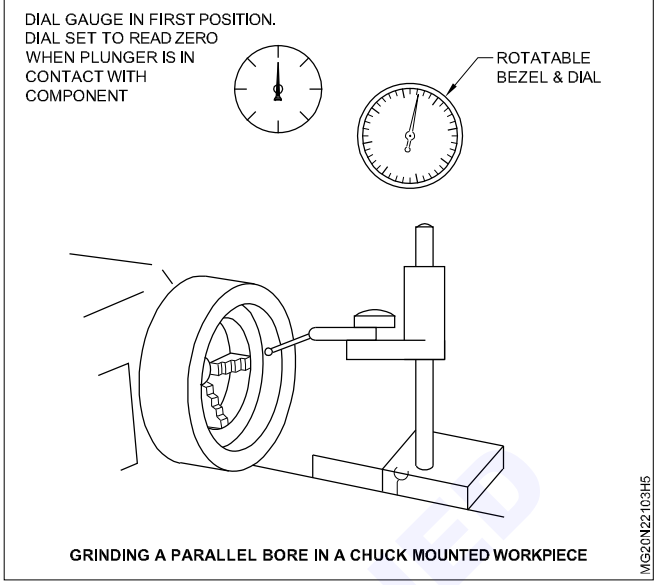


WORK MUST BE TRUED IN THE FOUR-JAW CHUCK
SO THAT THE INDICATOR READINGS AT A & B ARE THE SAME.

MG20N22103H4

- 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.

Fig 5

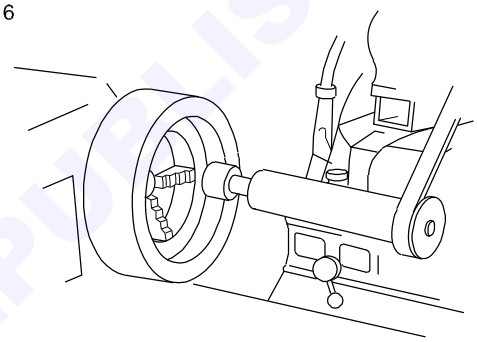


GRINDING A PARALLEL BORE IN A CHUCK MOUNTED WORKPIECE

MG20N22103H5

- **Grinding a parallel bore** (Fig 6)

Fig 6



GRINDING A PARALLEL BORE IN A CHUCK MOUNTED WORKPIECE

MG20N22103H6

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.
- 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 workpiece surface completely at the end of the traverse strokes.

- Wear safety goggles.

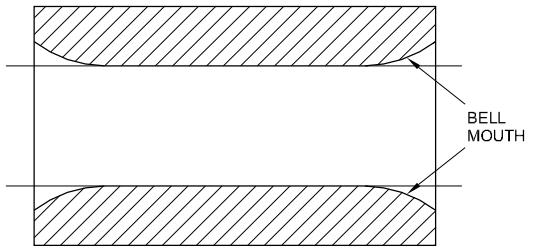
- Start the grinding wheel
- Start the headstock spindle drive
- Check that the directions of rotation of the wheel and workpiece are opposed.
- Start coolant supply and table traverse if necessary.
- Run the grinding wheel to the workpiece by hand and advance the wheel against the bore, taking a light 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



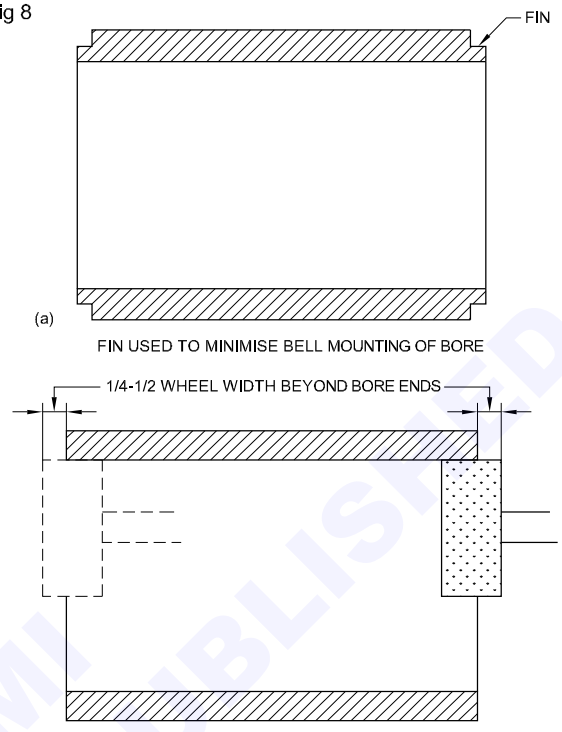
BORE DISTORTION DUE TO OVER TRAVERSE OR TOO FLEXIBLE SPINDLE

MG20N22103H7

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

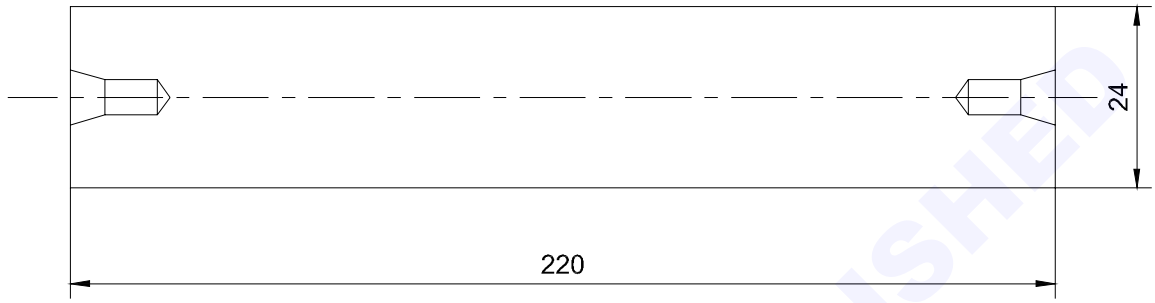


METHODS OF PREVENTING BELL MOUTHING

MG20N22103H8

Set and grind jobs on chuck and face plate

Objectives: At the end of this exercise you shall be able to
- **set and grind on chuck**
- **set and grind jobs on face plate.**

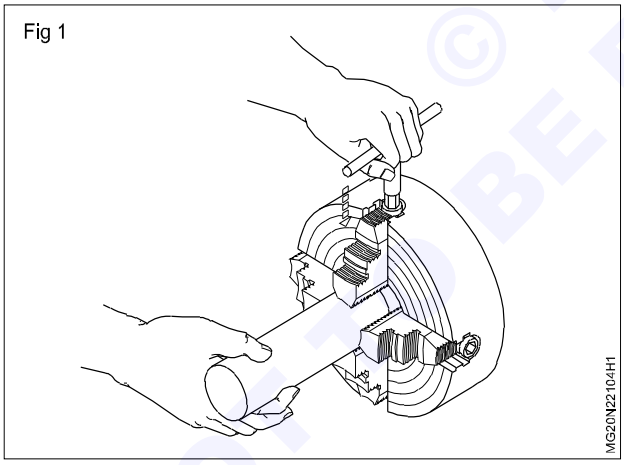


PROCEDURE

TASK 1 : **Set and grind on chuck**

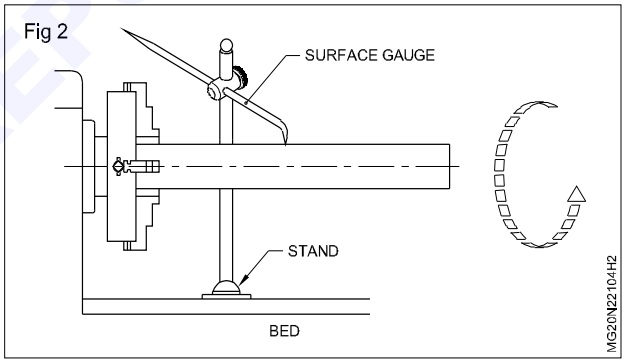
- Prepare the machine for cylindrical grinding.
- Dress the grinding wheel with help by diamond point dresser. (Fig 1)

Fig 1



- Set the job on the 4 jaw chuck.
- Check the job with the help of surface gauge.
- Grind and finish the job. (Fig 2)

Fig 2



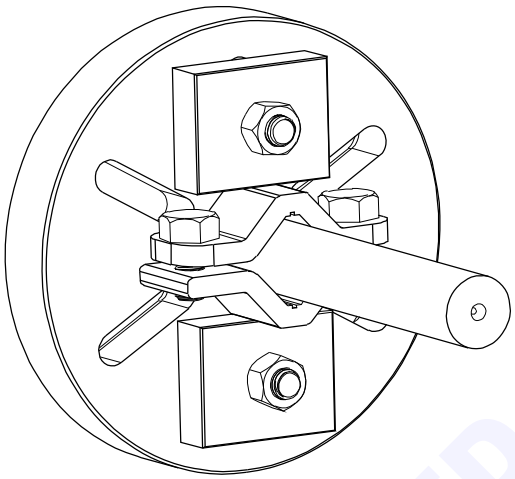
- Reverse the job and set using dial test indicator.
- Grind and finish the job.
- Measure with micrometer.

1	ISR Ø30 X 225	–	-	–	–	2.2.104
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**SET AND GRIND JOBS ON CHUCK AND FACE PLATE**				DEVIETION:±0.02	TIME
					CODE NO. MG20N22102E1	

TASK 2 : **Set job on face plate and grind**

- Remove the 4 jaw chuck in cylindrical grinding machine.
- Set the face plate on cylindrical grinding machine.
- Set the job using grinding fixture.
- Grind job as per size possible length.
- Reverse the job and set using dial test indicator.
- Grind and finish the job.
- Remove the job and measure with micrometer. (Fig 1)

Fig 1



Balance the grinding wheel

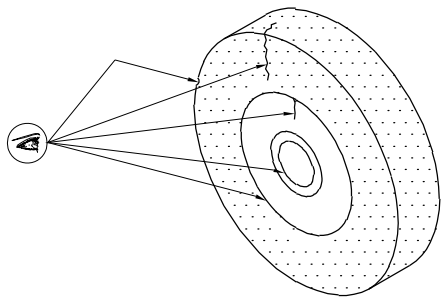
Objective: At the end of this exercise you shall be able to
- **balance a grinding wheel.**

PROCEDURE

Inspection of grinding wheel

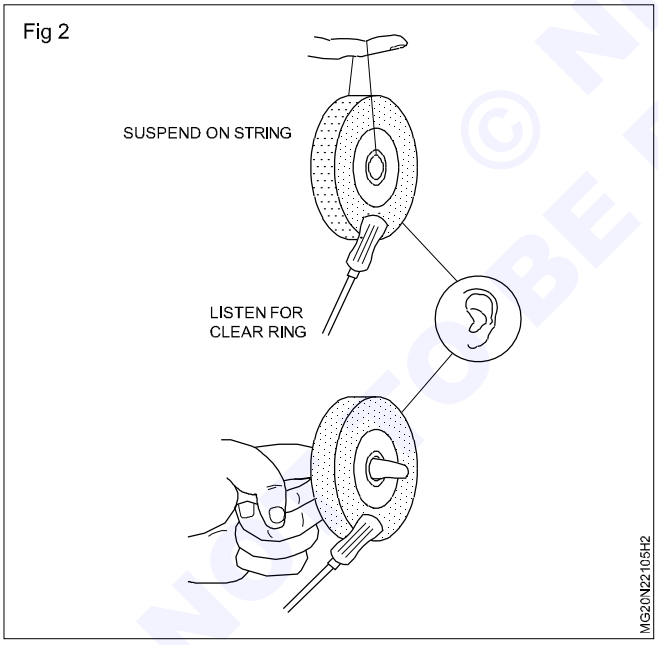
1 Check the wheel visually for any crack or damage on the surface. (Fig 1)

Fig 1



2 Check that the wheel is not cracked, by tapping at four points about 90° apart with the plastic handle of a screw driver. (Fig 2)

Fig 2



A good wheel will give a sharp clear ringing sound. Dull sound means a cracked wheel.

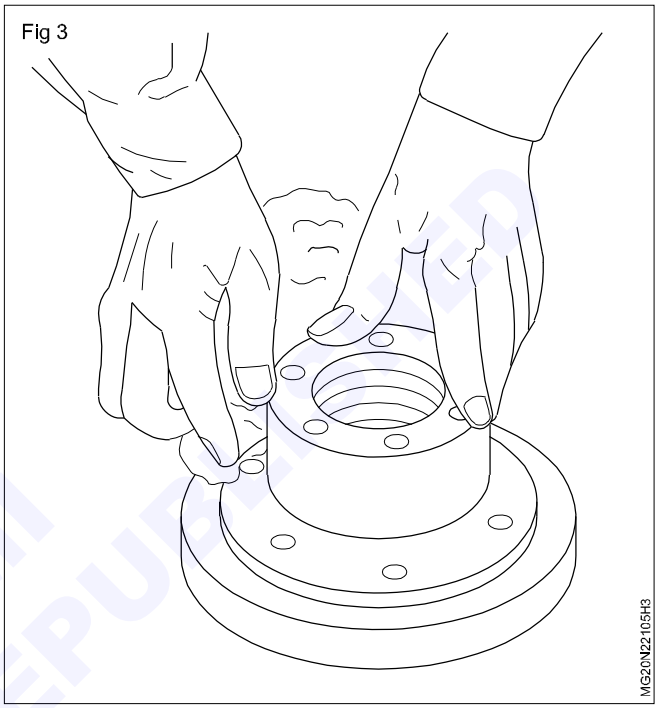
Mounting the flange in grinding wheel (Fig 3)

Cleaning and inspection of the flange

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

2 Make sure that the pitch of installing bolt, hole of bolt, contact surface of the flange, pitch of the balancing pieces and taper of hole are in good order.

Fig 3



3 If a flange surface is rusted, the rusted part should be taken 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.

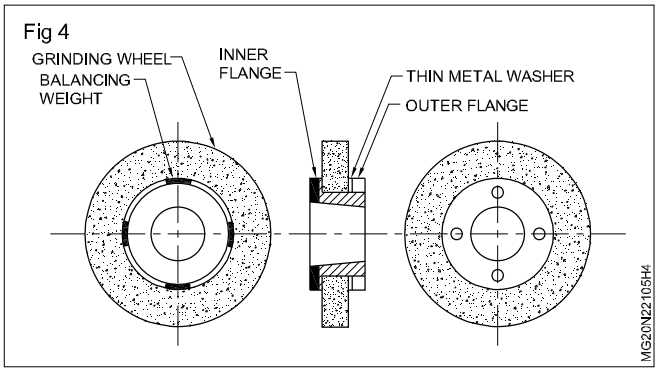
Insert the grinding wheel into the flange

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 taken off with a grinding stick, in order to smoothly inserted. (Fig 4)

Fig 4



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 damaging the inner flange.

2 Make sure that the installing holes of bolts are rightly placed.

Turning of the outer flange

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

2 Check that there is no deformation on the outer flange is proper for the inner flange.

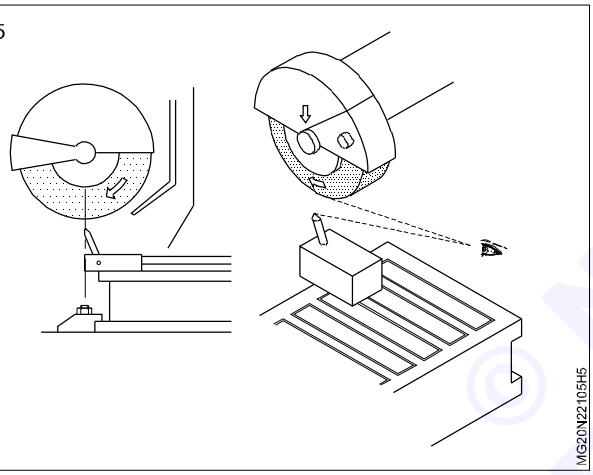
Wheel truing

1 Mount the wheel in grinding machine spindle.

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

3 Dress the wheel on the periphery. (Fig 5)

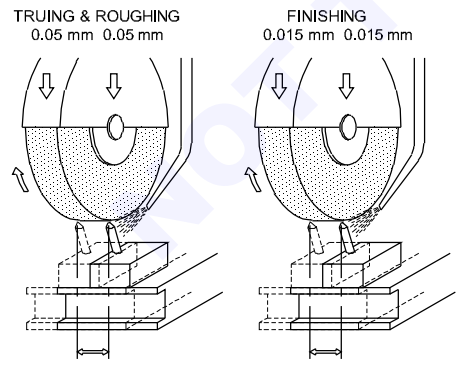
Fig 5



MG20N22105H5

Dress the sides if the wheel diameter exceeds 250 mm. Apply a small in-feed of the diamond until eccentricity of the wheel is removed. (Fig 6)

Fig 6



MG20N22105H6

4 Stop the machine.

5 Remove the wheel guard and lock - nut.

6 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 any damage to the wheel.

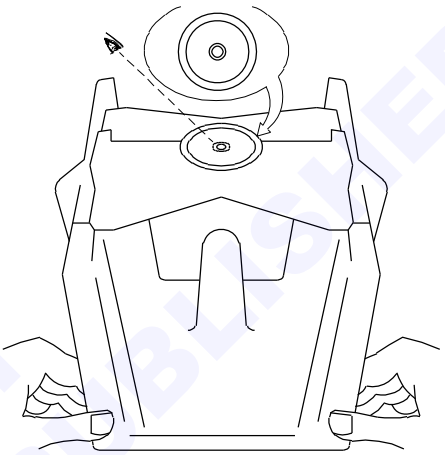
Preparing the balancing unit

1 Lower the protection guards.

2 Place the levelling plate on the balancing stand. (Fig 7)

3 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 7)

Fig 7

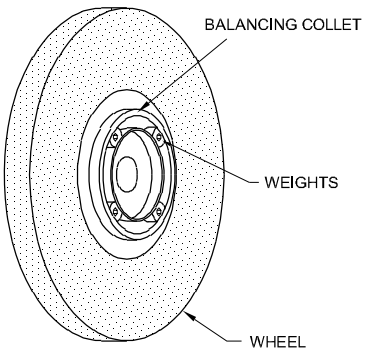


MG20N22105H7

Positioning wheel on unit

1 Clean the bore of the unit (Fig 8) and the balancing mandrel, then mount the wheel assembly on the mandrel. (Fig 9)

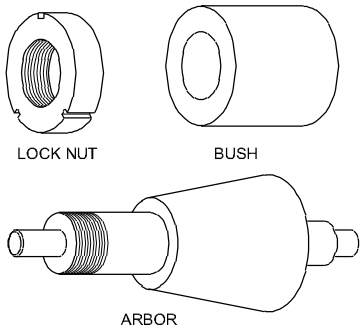
Fig 8



GRINDING WHEEL MOUNTED ON A BALANCING COLLET

MG20N22105H8

Fig 9



BALANCING ARBOR COMPONENTS

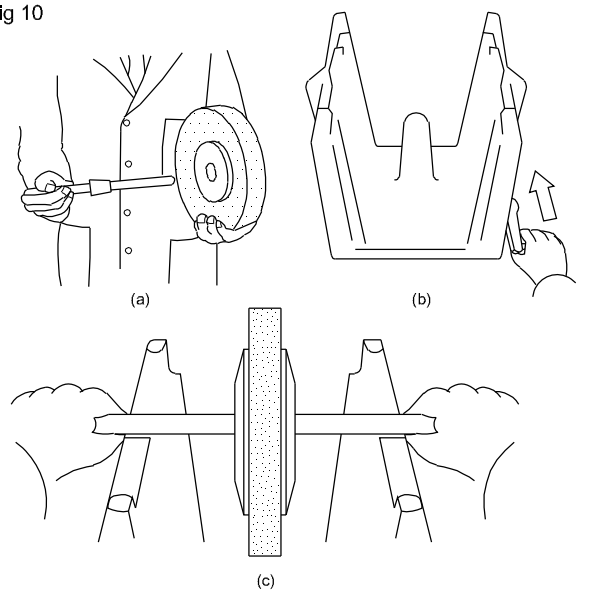
MG20N22105H9

2 Tighten the nut on the mandrel. (Fig 10a)

3 Raise the protection guards. (Fig 10b)

4 Place the wheel to be balanced on the top of the protection slides and lower gently on to the balancing stand. (Fig 10c)

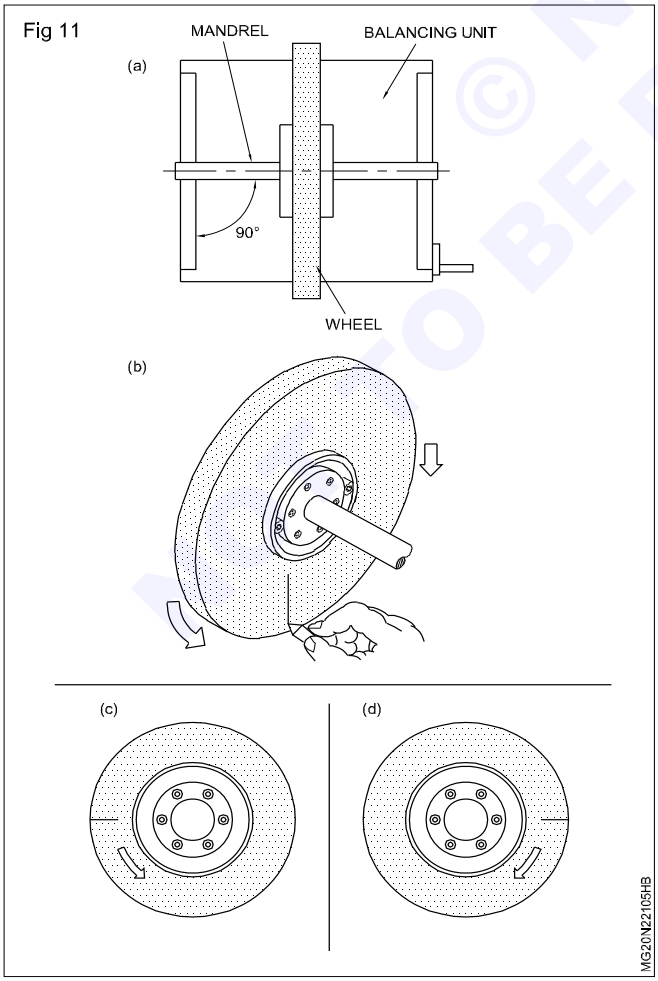
Fig 10



Balancing the wheel

1 Visually ensure that the balancing mandrel is at right angles to the balancing ways. (Fig 11a)

Fig 11



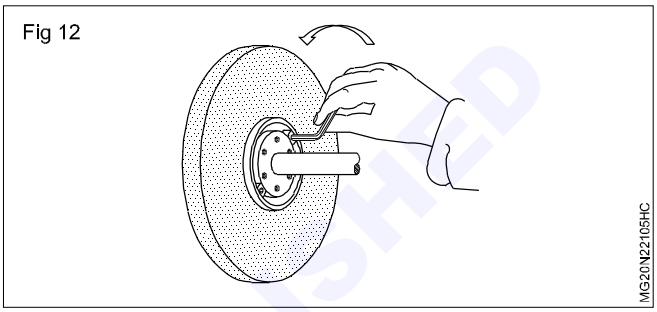
2 Allow the wheel to revolve slowly by its own momentum until stationary.

3 Place a chalk mark at the bottom to indicate a heavy point. (Fig 11b)

4 Turn the wheel 90° to the heavy point and diametrically opposite. (Fig 11c & 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 12)

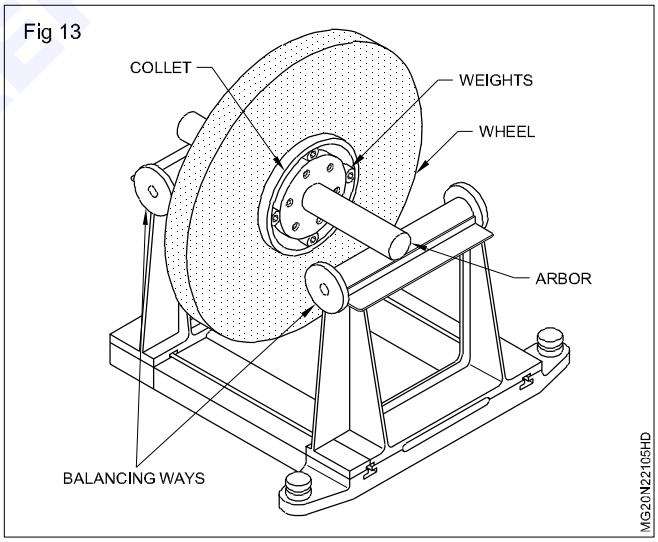
Fig 12



5 Repeat until the assembly remains static in any position. (Fig 13)

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

Fig 13



Mount grinding wheel

Objective: At the end of this exercise you shall be able to
- **mount the grinding wheel on spindle**
- **mount a grinding wheel on the surface grinder.**

PROCEDURE

Mounting a grinding wheel on the machine spindle

Cleaning of the spindle and the grinding flange

1 Remove the safety cover of the grinder and carefully clean the spindle.

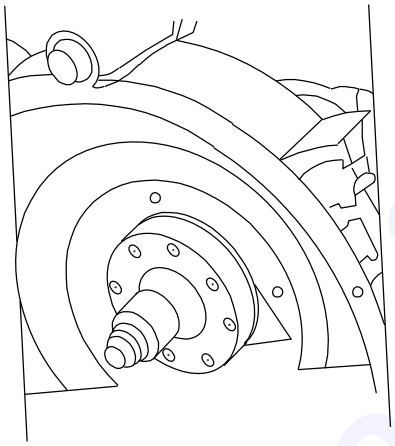
2 Clean the flange of the grinding wheel.

3 Confirm that there is no brush or rust on the spindle and the installing hole of the flange.

Inserting of the grinding wheel into the spindle

1 Holding the grinding wheel firmly with both hands, insert it into the spindle without bumping. (Fig 1)

Fig 1



2 If there is a key groove, insert the grinding wheel according to that groove.

3 If abrasive grains or chips go into the spindle, they damage the spindle or the hole and cause unbalance. So insert the wheel so as not to let chips in.

Fix the grinding wheel with a nut

1 Put the nut into the screw part at the toe of the spindle, and fix the grinding wheel to the spindle.

2 Fasten the nut by turning it counter clockwise because the screw goes to the left.

3 Do final fastening by a spanner or an exclusive tool.

Installation of a safety cover

1 Make sure that there is a proper opening between the grinding wheel and the safety cover.

2 Install the safety cover and fix it with a bolt.

3 Return the supply nozzle of the grinding fluid to the original position.

4 Start the grinding wheel and observe for vibration and spindle heat.

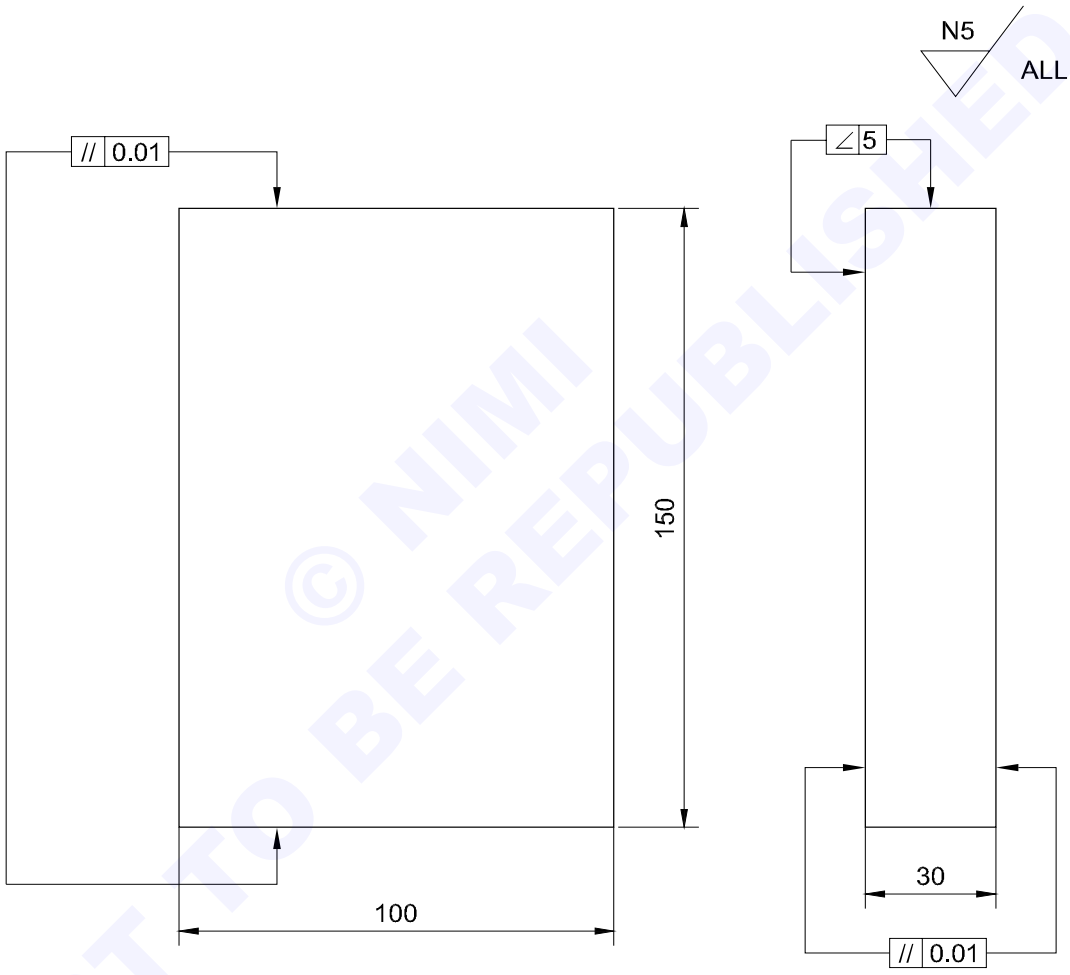
It more vibration observed, rebalance the grinding wheel.

Spindle having left hand thread to avoid running tight of the flange and nut.

Perform right angle grinding on surface grinding machine within accuracy ± 0.01mm

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

- **grind the flat surface**
- **grind all the surfaces right angle to each other**
- **check the parallelism with an outside micrometer**
- **check the squareness using trysquare.**



Job sequence

1 The trainees may be asked to write the job sequence.

1	IC BLOCK 155x105x35	–	CAST IRON	–	–	2.2.107
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	RIGHT ANGLE GRINDING				DEVIETION:±0.02	TIME
					CODE NO. MG20N22107E1	

Wheel dressing for rough and finishing grinding

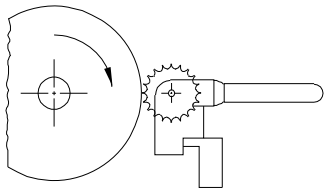
Objective: At the end of this exercise you shall be able to

- **dressing the grinding wheel for rough grinding**
- **dressing the grinding wheel for finish grinding.**

PROCEDURE

TASK 1: **Dressing for rough grinding**

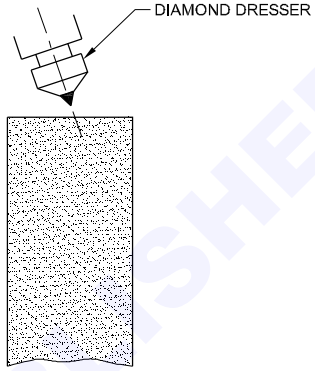
Fig 1



MG20N22108H1

TASK 2: **Dressing for finish grinding**

Fig 1



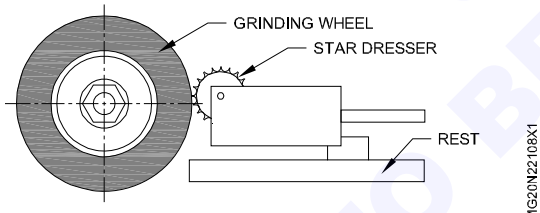
MG20N22108J1

Job sequence

TASK 1: **Dressing for rough grinding**

- Open the cover of grinding wheel.
- Set the star dresser to the centre of the grinding wheel (Fig 1).

Fig 1



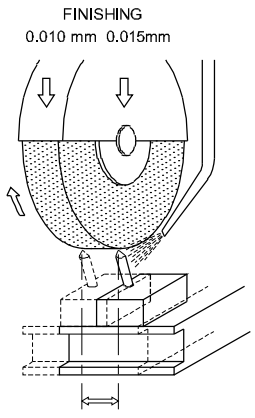
MG20N22108X1

- Let the dresser tip touch the perimeter of the grinding wheel.
- Start the motor of grinding wheel.
- The dresser is held against the face of revolving wheel and moves across the face.
- The depth of cut for rough grinding is 0.025mm.
- Feed rate 0.02mm.
- Take finish pass with 0.02mm across the face of the grinding wheel.
- Remove the dresser close the cover of wheel.
- Clean the machine.

TASK 2: **Dressing for finish grinding**

- Set the dresser to holder.
- Keep the dressed attached by holder on magnetic table.
- The point of the diamond should be offset about 12mm the grinding wheel centre line with reference to the direction of rotation of grinding wheel.
- Make sure 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.
- Take light cuts (0.02mm) until the wheel is clean, sharp and is running true.
- Take finish pass with 0.01mm across the face of the grinding wheel. (Fig 1)

Fig 1

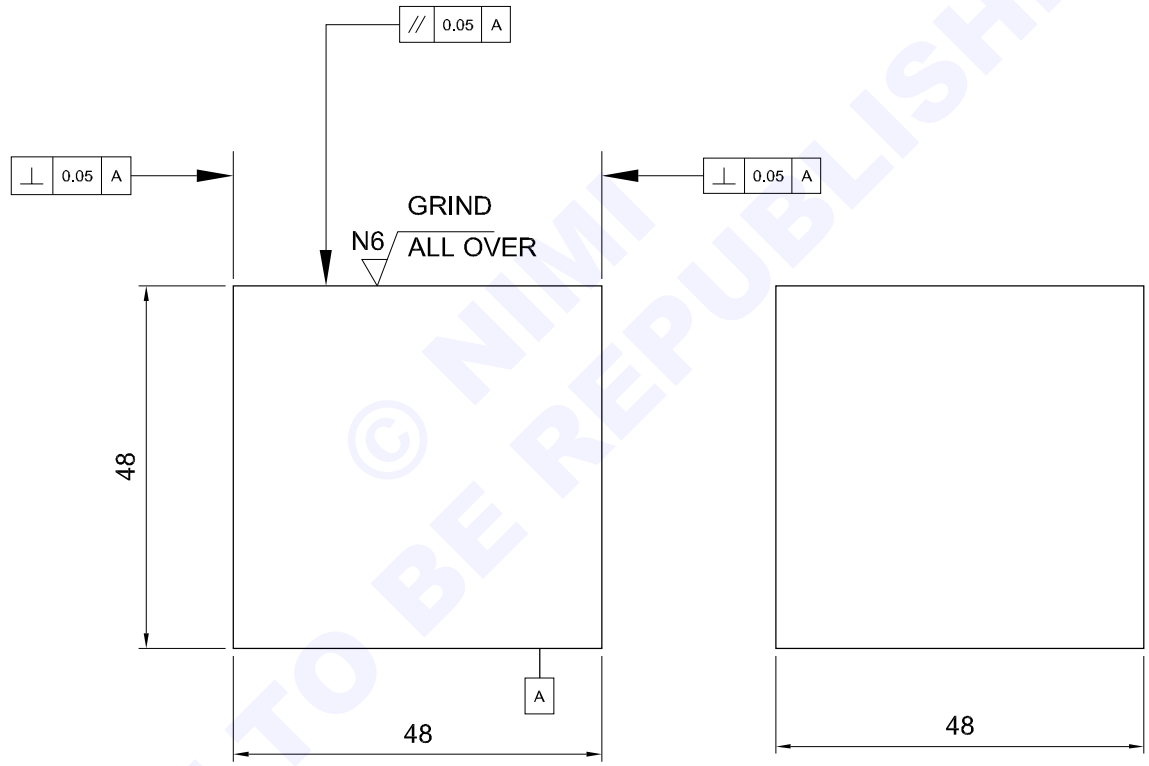


MG20N22108Y1

Grind a cube to close limit (Tolerance within ±0.01mm)

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

- **mount and dress the side of the wheel**
- **hold the job**
- **grind right angle of all adjacent surfaces**
- **check the dimensions by micrometer.**



1	IS SQ 50 X 52		Fe 310			2.2.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	CUBE GRINDING PRACTICE				DEVIATIONS ±0.01 mm	TIME
					CODE NO. MG20N22109E1	

Job sequence

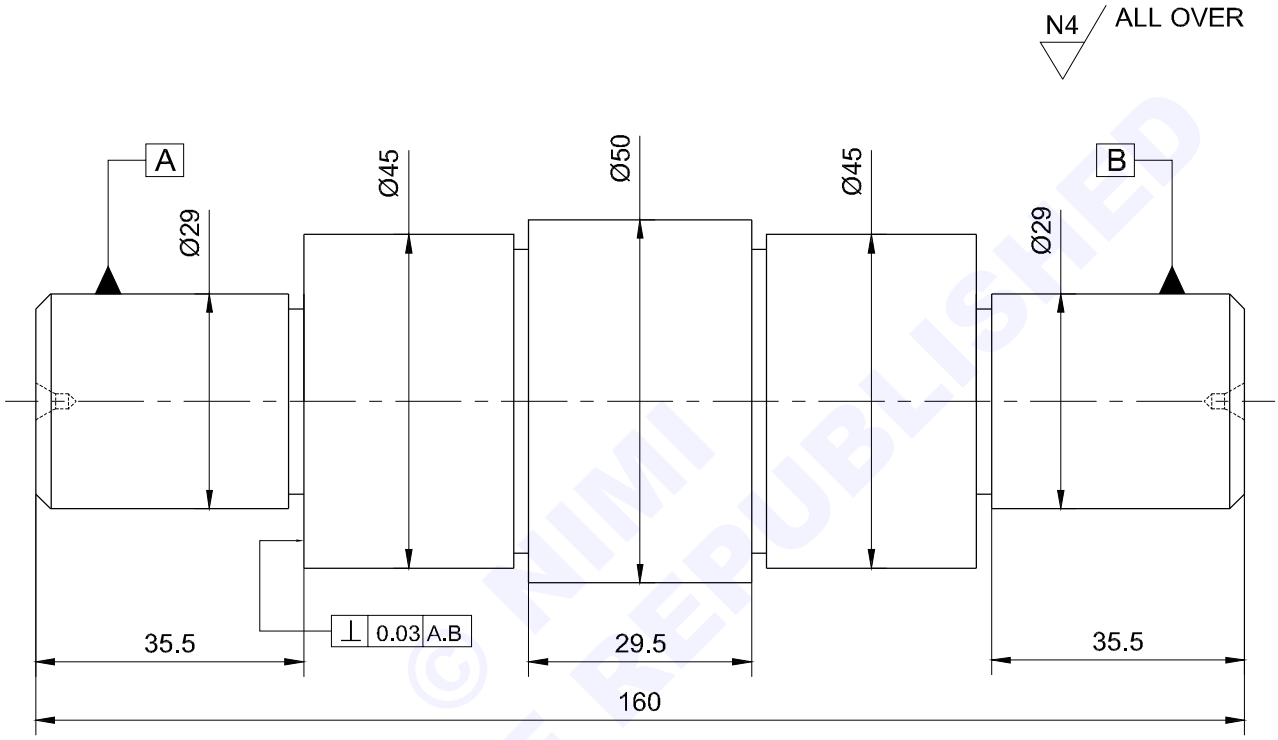
- Machine the cube as per drawing leaving grinding allowance as required.
- Determine the grinding allowance for each surface to be ground.
- Prepare the surface grinding machine for grinding.
- Rough grind both opposite sides and maintain 50.04 mm thickness.
- Dress the wheel for finish grinding.
- Finish grind the piece to 50 mm thick to an accuracy of ± 0.01 mm.
- Measure the size with a 25 to 50 mm outside micrometer.
- Set the workpiece with the angle plate by parallel clamp or 'C' clamp for grinding adjacent sides at 90°.
- Rough grind the adjacent side leaving half of the grinding allowance for the opposite surface.
- Mount the job on a magnetic chuck keeping down the surface already ground.
- Rough grind the opposite surface and maintain the width of job 50 mm to an accuracy of ± 0.01 mm.
- Similarly grind the other edges also to 50 mm to an accuracy of ± 0.01 mm.
- Check the dimensions with outside micrometer.
- Check the angles with a vernier bevel protractor.

— — — — — — — —

Perform Shoulder grinding on cylinder-grinding machine to close limit h7

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

- **dress the side of grinding wheel by using diamond dresser for shoulder grinding**
- **grind the different shoulder with an accuracy of ±0.03 mm**
- **measure the dimension with an outside micrometer**
- **check the squareness of job using by bevel edge square.**



Job Sequence

- Prepare the blank by turning according the job drawing leaving grinding allowance as required.
- Study the drawing and measure the grinding allowance for given job.
- Prepare the machine and dress the grinding wheel for grinding shoulder surfaces.
- Mount the job in between centres.
- Rough and finish grind the shoulder to maintain the 35.5mm length of job.
- Dress the side of the wheel.
- In the same setting rough and finish grind the 29.5mm length of shoulder surface at 90°.
- Dress the grinding wheel for the grinding of other end.
- Remove the job from the centres.
- Reverse the position of the job in the centres.
- Grind the end of the 35.5mm shoulder.
- Measure the dimension using by outside micrometer.
- Check the shoulder squareness with bevel edge square.
- Remove burrs of the job using fine abrasive stone.
- Remove the job from the centres and dog carrier.
- Check the all dimension of job.

1	ISR Ø55 X 170		Fe310	–	–	2.2.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SHOULDER CYLINDRICAL GRINDING				DEVIATIONS ±0.03 mm	TIME
					CODE NO. MG20N22110E1	

Skill sequence

Dressing of the grinding wheel for shoulder grinding

Objective : This shall help you to

- **dress the grinding wheel for shoulder cylindrical grinding.**

Installation of dresser

1 Fix the diamond dresser is shown in Fig 2 firmly to the diamond holder shown in Fig 1.

Fig 1

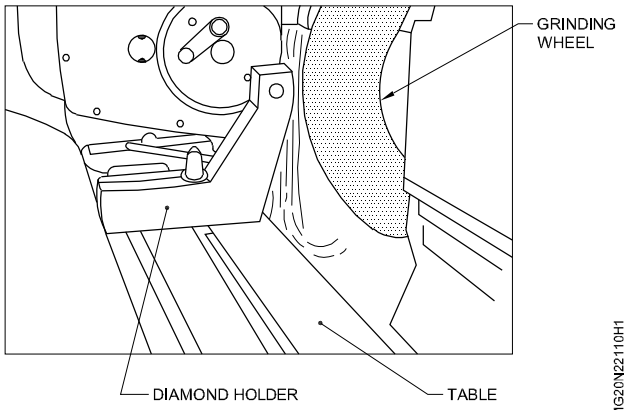
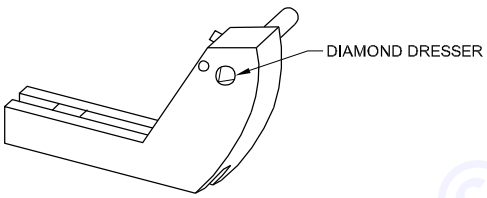


Fig 2



2 In the above case, if the projection of the dresser is too great it cause vibration so make the dresser as short as possible.

3 The diamond dresser should be fixed to the holder by turning the shank in such a way that the toe edge of the diamond dresser is always keep.

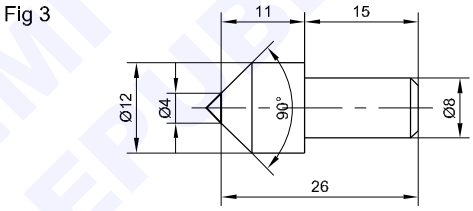
4 If the toe edge of the diamond dresser becomes very worn out and flat, such a dresser should not be used and must be adjusted.

Installation of the holder

1 Clean the table with waste cloth.

2 As shown in Fig 3 fix the holder firmly on the table in such a way that the dresser inclines 5 to 10 degrees up and down and 20 to 30 degrees from the direction of moving.

Fig 3



Dressing the side of a grinding wheel

Objective: This shall help you to

- **dress the side of a grinding wheel.**

1 Dress the side of a grinding wheel with a single point diamond dresser.

2 Mount the dressing attachment on work table.

3 Hold the dresser in attachment of side position.

4 The wheel head slide is moving a back and forth.

5 Move the table to side of the grinding wheel nearest.

6 Switch on the grinding wheel little touch the dressing on side of the wheel.

7 Rough dressing 0.02mm cut to giving a feed of 0.01mm

8 Make an adequate feed at the required side of the grinding wheel.

9 Finish dressing cut 0.01mm to giving a feed of 0.0025mm into little side of the wheel.

10 In the case of precision grinding two idle cutting at the end of dressing.

11 Avoid the overhanging of the dresser from the dressing holder.

Grinding shoulders

Objective : This shall help you to

- **grind the shoulder of cylindrical jobs.**

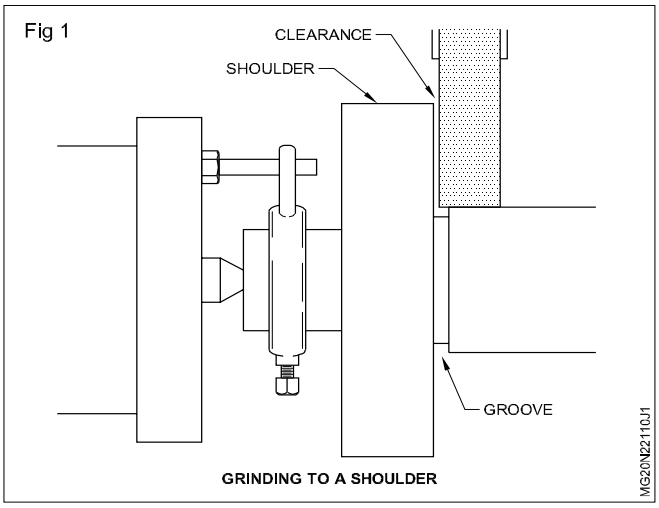
1 To produce a cylindrical component with two different diameters, a wheel dressed to the desired profile may be used.

2 The grinding operation is performed without traverse and the width of the wheel must be sufficient to extend beyond each end of the workpiece.

3 Where the grinding operation is respective, stops may be fitted to the worktable to make it easier to set up the wheel truing device between each grinding operation. (Follow the general grinding rules given previously in this book.)

4 Care must be taken in positioning the work piece beneath the wheel to ensure that the required dimensions of the shoulder are obtained.

Grinding a surface to a shoulder (Fig 1)



GRINDING TO A SHOULDER

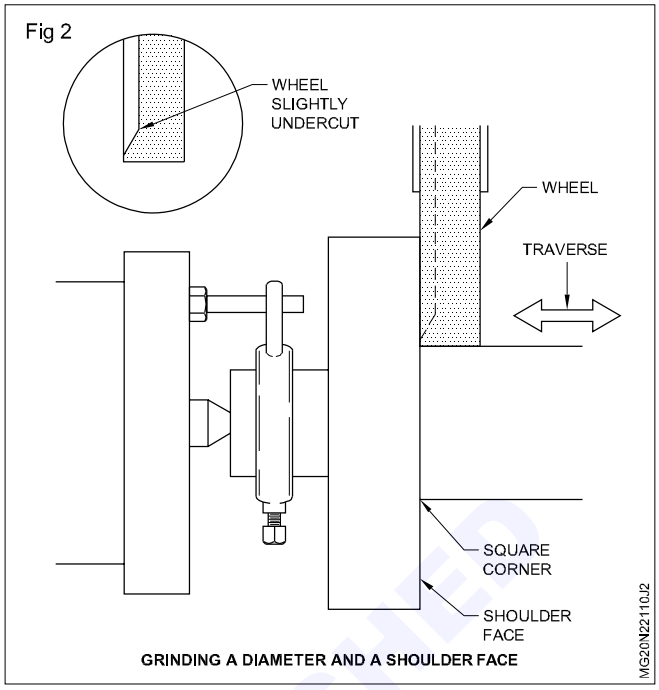
1 For grinding a surface adjacent to a shoulder on a workpiece a groove is provided in the workpiece near the shoulder.

2 This permits the grinding wheel to traverse the surface completely without coming into contact with the face of the shoulder. The groove may be turned on a lathe or ground with a narrow cutting -off wheel.

3 A square corner is produced by this method. (Follow the general grinding rules.

Grinding parallel diameters and shoulders (Fig 2)

1 In this case a dished wheel with a slightly undercut face is used to traverse the parallel diameter and lightly contact the face of the shoulder at the end of the traverse.



GRINDING A DIAMETER AND A SHOULDER FACE

2 The wheel is undercut to ensure a square corner where the face of the shoulder and the parallel diameter meet.

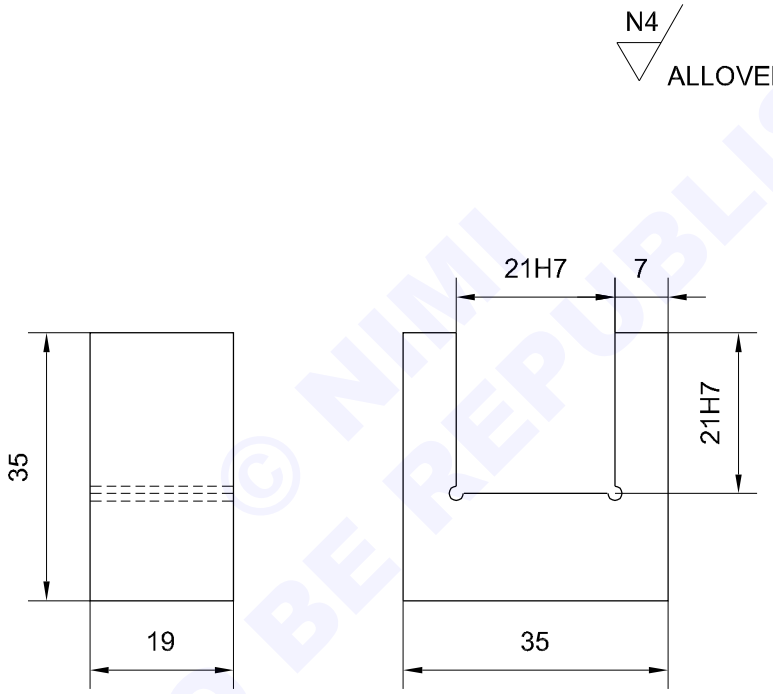
3 In the absence of the undercut, the edge of the wheel will wear rapidly and produce a radius instead of a square corner.

4 The wheel is undercut by a diamond tool dressing. Where the shoulder is relatively small the wheel may be fed into the work at the position of the shoulder until the desired sizes are obtained.

5 The rest of the parallel surface is then traversed to size. In this case, undercutting of the wheel is not necessary as the slight radius produced at the shoulder is usually of no consequence. Follow the general grinding rule.

Perform Slot grinding on surface grinding machines to close limits H7

Objectives: At the end of this exercise you shall be able to
- **dress the grinding wheel for slot grinding**
- **set the plain vice on magnetic chuck for grinding slot**
- **grind slot to tolerance of 21H7**
- **check the slot with slip gauge.**



1	IS SQ 40 X 20		Fe310	-	-	2.2.111
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		SLOT GRINDING			DEVIATIONS ±0.03 mm	TIME
					CODE NO. MG20N22111E1	

Job sequence

- Prepare the job as per drawing using vertical milling machine leaving grinding allowance.
- Prepare the machine and dress the grinding wheel for grinding parallel surfaces.
- Mount the job on the magnetic chuck. Rough and finish grind the surfaces parallel, to maintain the thickness to 19mm.
- Deburr the edges.
- Rough and finish grind the width to 35mm using an angle plate and 'C' clamps with suitable parallels.
- In the same setting, rough and finish grind the 35 x 19mm surface at 90° and remove half of the grinding allowance on the length of 35mm.
- Dress the grinding wheel for the grinding slot.
- Mount the plain vice on the magnetic chuck and align its fixed jaw parallel to the grinding wheel axis.
- Hold the job in the vice such that the bottom of the slot is 2mm above the top surface of the vice jaws.
- Rough and finish grind the top surfaces of the slot to maintain the length of 35mm.
- Measure the bottom of the slot with a depth micrometer and decide the grinding allowance.
- Rough and finish grind the bottom of the slot to maintain the depth of 21mm using the face of the grinding wheel. Check the depth with a depth micrometer.
- Rough and finish grind the shoulder to 7mm using the rear side of the grinding wheel.
- Grind only half of the grinding allowance.
- Check the size 7mm with an outside micrometer.
- Rough and finish grind the other shoulder until the width of the slot becomes 21.00 mm.
- Remove the job, deburr the edges and demagnetize.
- Check the slot for its centricity with an outside micrometer and the width by a snap gauge. (Consult your instructor)

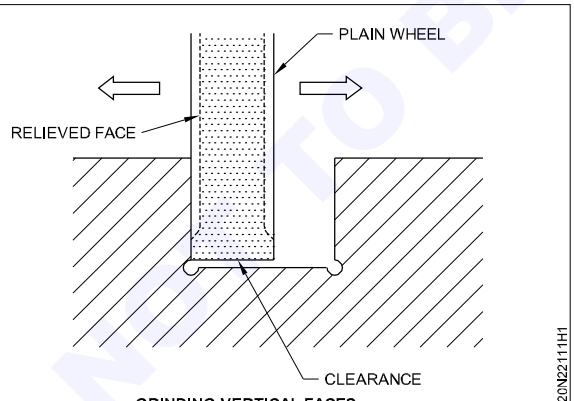
Skill sequence

Grinding a slot to an accuracy of 0.02mm

Objective: This shall help you to
- **grind a slot to an accuracy of ± 0.02 mm.**

1 Select and mount the grinding wheel such that the face width of the wheel is less than the width of the slot to be ground (Fig 1)

Fig 1



GRINDING VERTICAL FACES

2 Dress the wheel on the faces, clean up and relieve both sides of the wheel if a straight wheel is used.

3 Mount the workpiece on to the magnetic chuck directly if it is of a sufficiently large size.

4 If the job is small in nature, take the support of an angle plate.

5 Align the workpiece accurately in the correct plane and secure. (Fig 2) (Consult your instructor)

6 Set the table traverse stops in position.

7 Position the wheel approximately 0.4mm above the horizontal face of the slot and switch on the wheel.

8 Engage the table traverse and feed wheel in until it just touches the horizontal surface.

9 Keep the wheel clear of the vertical faces.

10 Clean up the whole horizontal surface by the table traverse and careful cross-feed operation. (consult your instructor)

11 Stop the wheel and clear it from the work and determine the amount of material to be removed.

12 Reposition the wheel into the slot, start up the wheel and engage the traverse.

13 Feed in the wheel and grind the whole surface with 0.02mm accuracy.

14 Keep the wheel clear of the horizontal face.

Determine the material to be removed on the vertical faces.

15 Position the wheel and touch the vertical face of the job with the wheel. (Fig 3)

16 Keep the wheel away from the job.

17 Set the depth of cut.

Fig 2

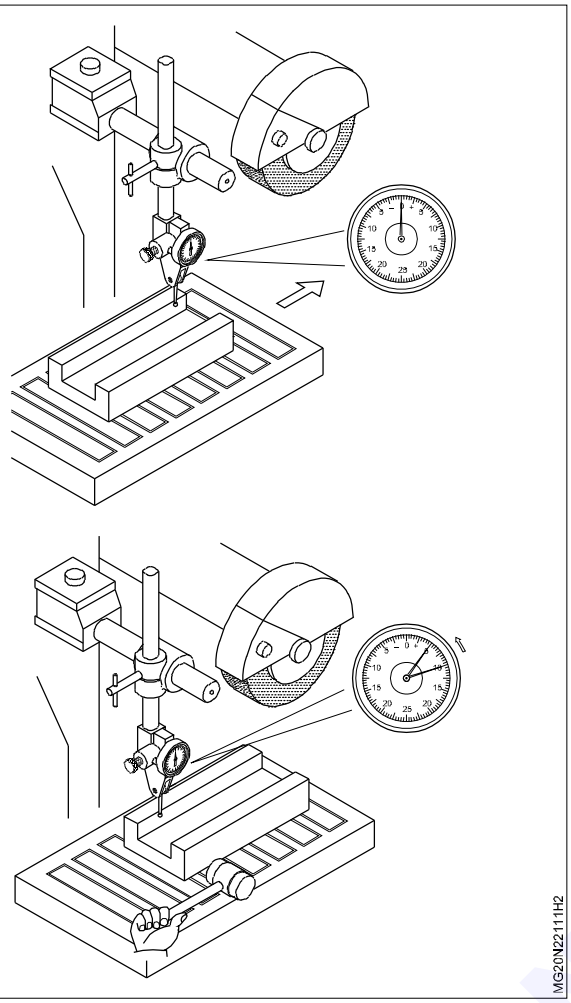
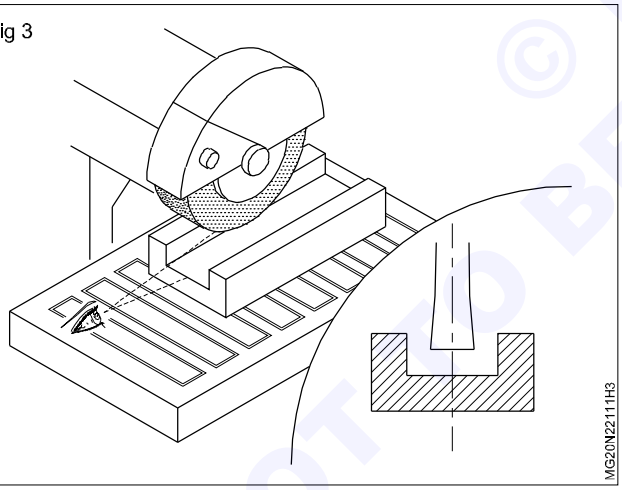


Fig 3



18 Feed the wheel down and grind the vertical face down up to the corner (recessed). (Fig 4)

19 Keep the wheel away from the slot.

20 Position the wheel and touch the other vertical face of the job with the wheel. (Fig 5)

21 Keep the wheel away from the job and set the depth of cut.

Fig 4

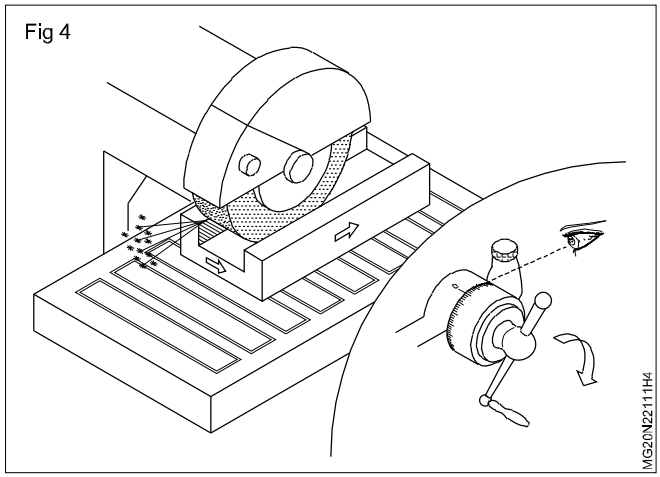
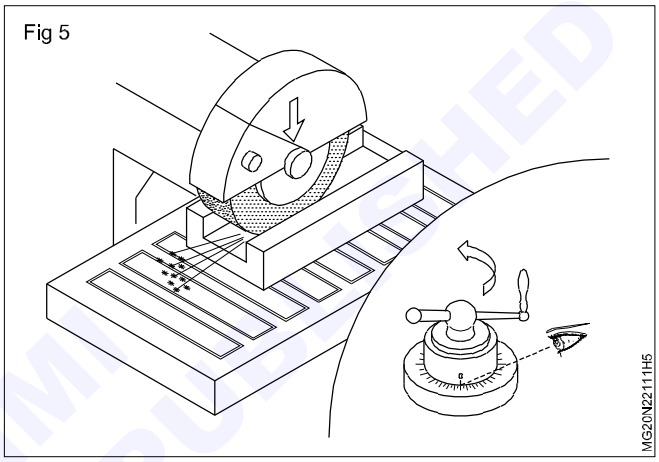
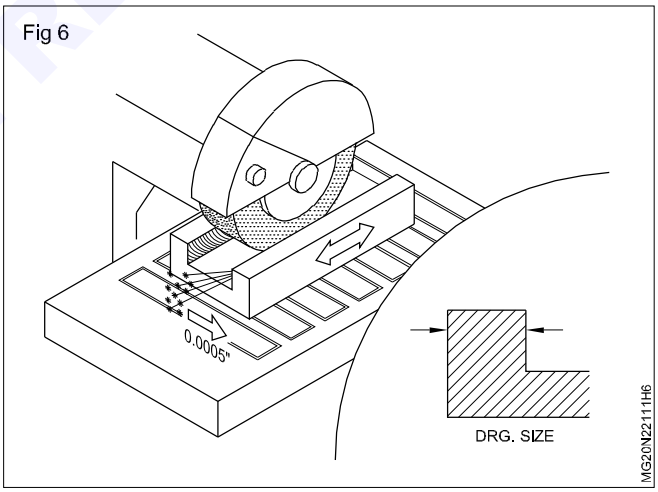


Fig 5



22 Down-feed the wheel and grind the vertical face down to the corner. (Fig 6)

Fig 6



23 Stop the job away from the grinding wheel.

24 Deburr and clear the ground surfaces.

25 Check the slot for its dimension with a vernier caliper and depth micrometer.

Aligning a plain vice on the table for slot grinding

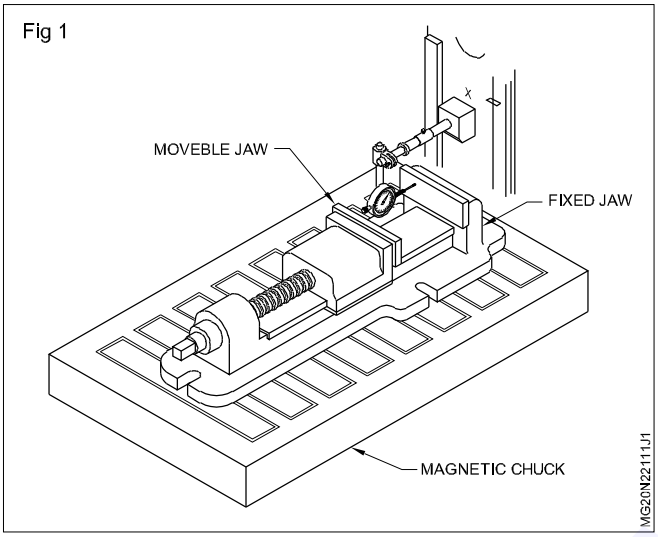
Objective: This shall help you to

- **align the plain vice fixed jaw parallel to the grinding wheel.**

1 Clean the magnetic chuck top surface and plain vice base free from dust and place the plain vice on the magnetic chuck.

2 Set the plain vice fixed jaw parallel to the wheel rotation or perpendicular to the axis of the spindle. (Fig 1)

Fig 1



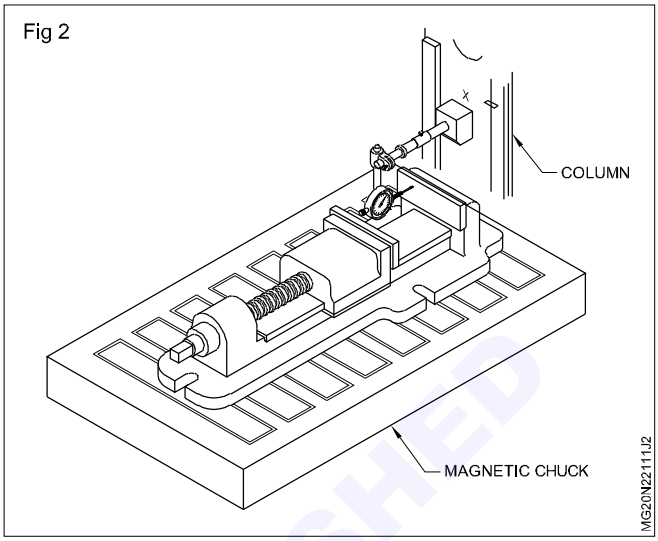
3 Position the dial test indicator with magnetic base firmly on the reference surface of the column of the machine (x) (Fig 2)

4 Engage the dial test indicator styles on one end of the parallel. (Fig 3) Ensure that the dial test indicator and stand do not foul anywhere.

5 Adjust the position of the dial pressure and set the reading to zero on one end of the parallel. (Fig 3)

6 Move the table so that the dial test indicator is at the other end of the parallel (Fig 3) observe the pointer movement.

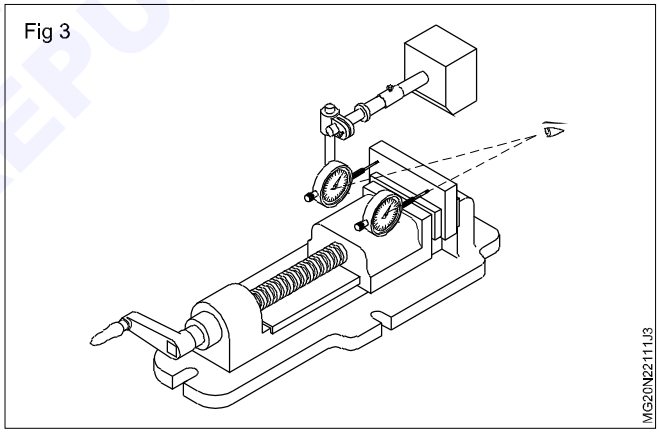
Fig 2



7 If the pointer deviates from zero adjust the vice by gentle tapping in the direction as needed.

8 Engage the styles again on one end of the parallel and move the table to check its position. If the dial test indicator reads zero the vice is correctly positioned.

Fig 3



Find different faults while grinding, viz., cracks, blow holes chatters

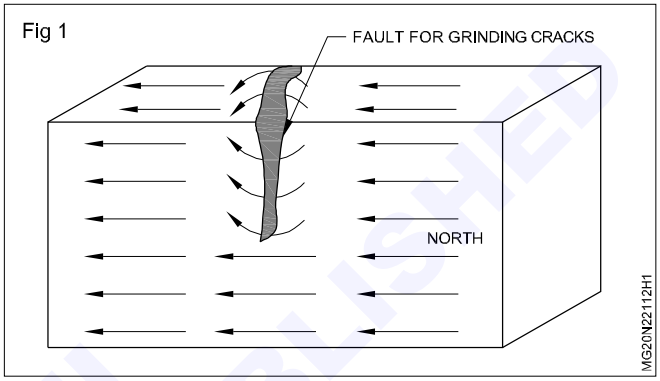
Objectives: At the end of this exercise you shall be able to
- **find the faults grinding of cracks while grinding**
- **find the fault of blowholes while grinding**
- **find the fault grinding chatter marks while grinding.**

PROCEDURE

TASK 1: **Fault of cracks (Fig 1)**

- Generally cracks of developed while grinding forged components.
- Set the forged components on grinding.
- Grind the job.
- Check for cracks.

Fig 1



TASK 2: **Fault of blow holes (Fig 1)**

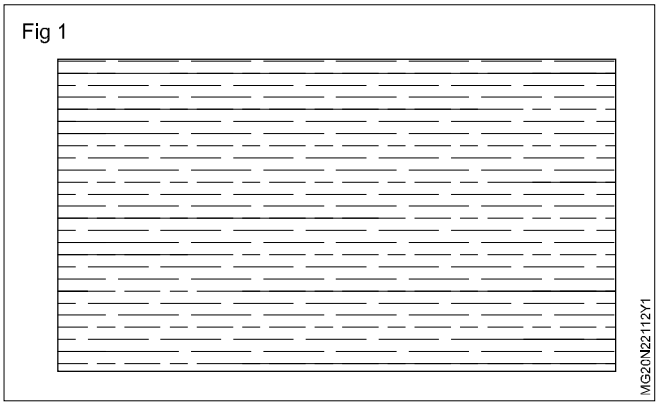
- Blow can develop in cast iron metal.
- Set the cast iron job on grinding machine.
- Grind the job.
- Check it for blow holes.

Fig 2

TASK **3: Fault of chatters (Fig 1)**

- Reason for chattering marks are cut too heavy, wheel too hard, adjusting dress feed, grinding fluid, slender work unsupported and machine vibration.
- Grinding the metal there will be chatter marks if any one it the above cause.

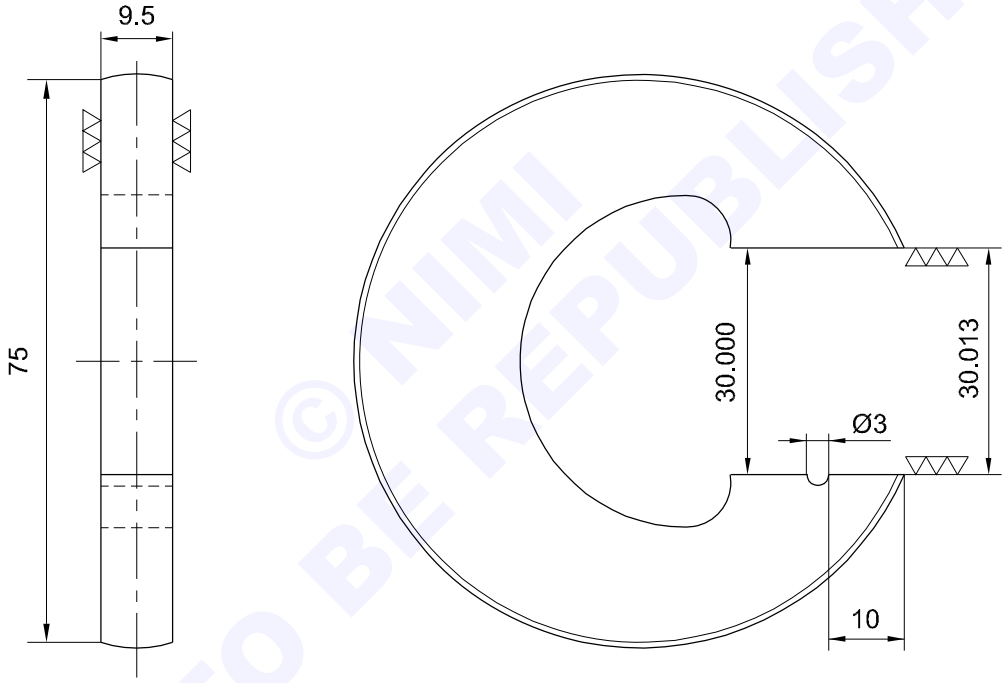
Fig 1



Grinding snap gauge in close limit to H6

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

- **dress the disc wheel for grinding the measuring faces of the snap gauge**
- **grind the measuring faces for a snap gauge**
- **check the width of the gauge with a slip gauge.**



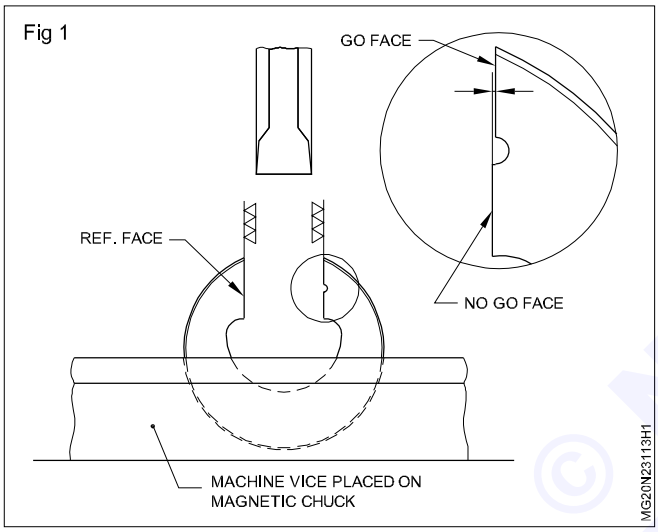
1	ISR Ø80 X 12		Fe310	-	-	2.3.113
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		GRINDING SNAP GAUGE			DEVIATIONS ±0.01 mm	TIME
					CODE NO. MG20N23113E1	

Job sequence

- Check the raw material for its size.
- Machining job as per drawing leaving the grinding allowance.

Grind measuring faces of snap gauge

- Prepare the surface grinder. Mount 60 grit, white aluminium oxide grinding wheel and true it.
- Grind the job thickness side to 9.5mm on a magnetic chuck.
- Remove the job from the magnetic chuck. Dress the grinding wheel sides to form relief for face grinding.
- Mount the snap gauge in the machine vice and place the vice on the magnetic chuck. (Fig 1)



- Align the measuring faces parallel to the vertical movement of wheel head.
- Grind the reference face taking very light cuts with the rear side of the grinding wheel.
- Adjust the position of the wheel head to cover the 'NO-GO' face and grind it to 30.000 mm with the front side of wheel.
- Check the gap with a slip gauge. If should match with a close snug fit.

Deburr before gauging

Apply only light cuts do dry grinding only. Heavier cuts will result in burn marks and loading of grinding wheel sides.

Adjust the position of the wheel head to cover the 'GO' face.

Grind the 'GO' face with the front side of the wheel 30.013mm

Check the size with slip gauge or inside vernier micrometer.

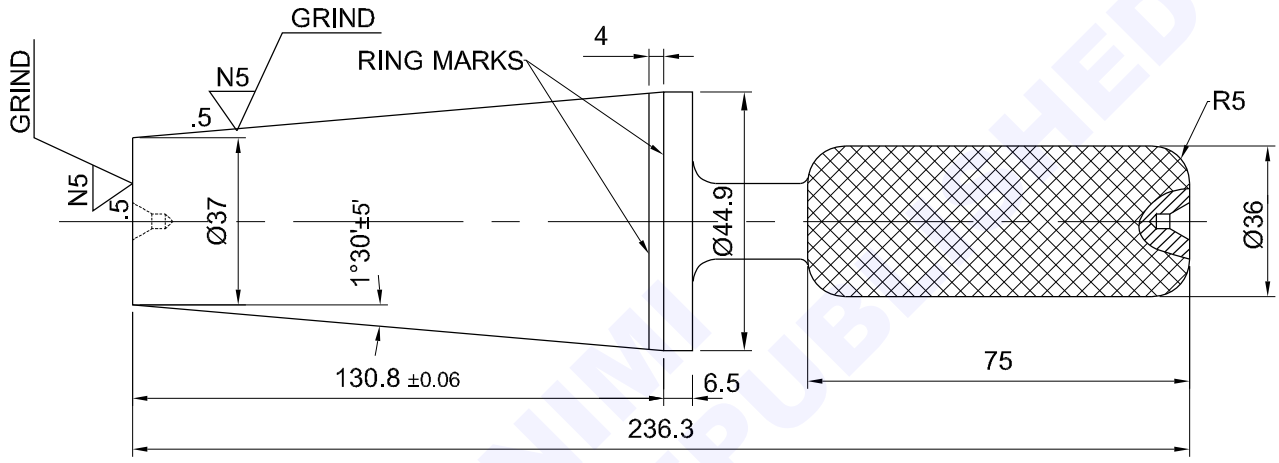
Deburr the measuring 'GO' face thoroughly and clean it with banian cloth, before using slip gauges for checking purposes.

Deburr all the sharp edges by a honing (fine abrasive grit) stick.

Perform Grinding on cylindrical taper using standards ring gauges

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 speed, feed and depth of cut**
- **rough grind & finish grind the workpiece within accuracy**
- **check the taper by using standard taper ring gauge.**



Job Sequence

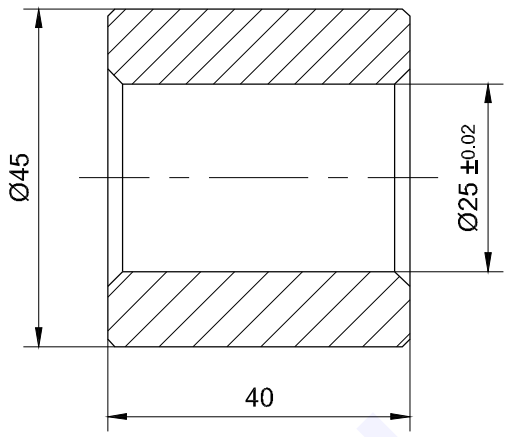
- Check the raw material for its size.
- Set the job on lathe.
- Finish job as per drawing in lathe leaving the grinding allowance.
- Determine the grinding allowance.
- Balance the grinding wheel.
- Mount the wheel on the cylindrical grinding machine.
- Dress the grinding wheel.
- Hold the job in between 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	ISR Ø50 X 240					2.3.114
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	CYLINDRICAL TAPER GRINDING				DEVIATIONS ± 0.02 mm	TIME
					CODE NO. MG20N23114E1	

Perform Grinding of ring gauge using plug gauge

Objectives: At the end of this exercise you shall be able to
- **grind the plain bore of ring gauge**
- **check the bore size using standard plug gauge.**

PART - **A**



N4 ALL OVER

Job sequence

Ring gauge

- Check the raw material for its size.
- Turn the job as per drawing leaving the grinding allowance.
- 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 bolt 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 25mm.
- Check the bore size using by standard plug gauge.
- Remove the job from the chuck.
- Remove burrs edges.
- Reset and hold the job on taper mandrel for external grinding.
- Hold the job between centre.
- Complete the external grinding.
- Check the diameter of the job using o/s micrometer to ascertain the grinding allowance.

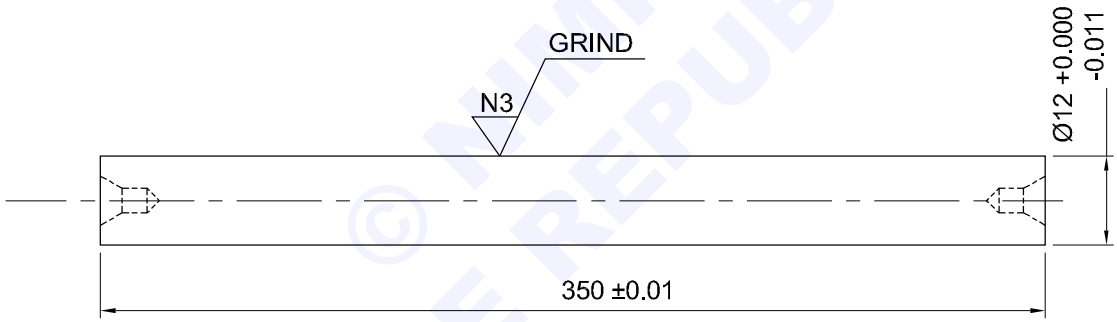
GO END = 24.985
NO GO = 25.015

1	ISR Ø50 X 50	2.14 ←	Fe310	–	–	2.3.115
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	RING GAUGE GRINDING				DEVIATIONS ±0.02 mm	TIME
					CODE NO. MG20N23115E1	

Grinding long cylindrical using steady rest to close limit of h6

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

- **set the steady rest on the machine table**
- **set the workpiece**
- **grind the workpiece with in an accuracy of** $\pm^{0.000}_{0.011}$
- **measure the job with an outside micrometer**
- **check the parallelism with the help of DTI**

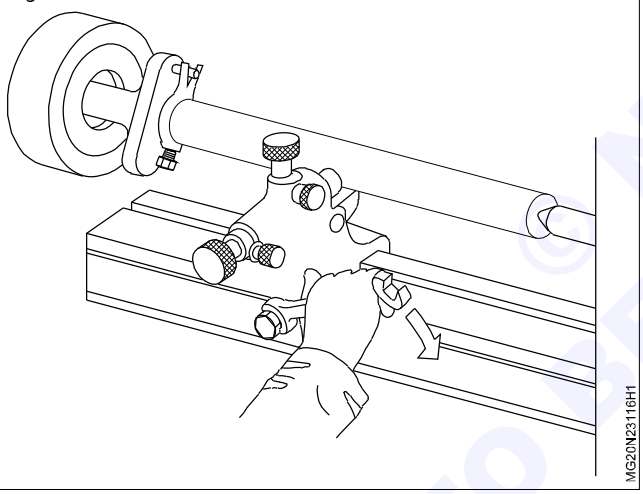


1	ISR Ø16 X 355		Fe 310			2.3.116
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**LONG CYLINDRICAL BAR GRINDING**				DEVIATIONS ± 0.01 mm	TIME
					CODE NO. MG20N23116E1	

Job sequence

- Check the raw material for its size.
- Turn the job on lathe as per drawing leaving the grinding allowance.
- 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 steady on machine table.
- Set the steady 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.

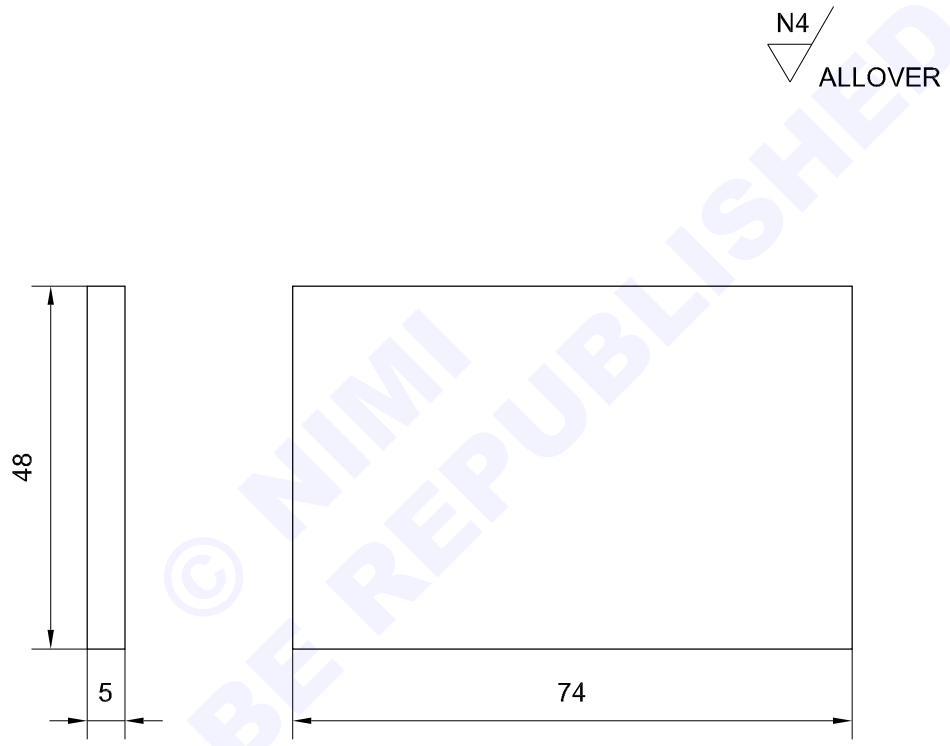
- Put on your goggles.
- Bring the grinding wheel forward to engage the workpiece by operating the cross feed hand wheel on the machine.
- Start coolant supply.
- Take a moderate cut (0.03mm) measure the workpiece diameter and the work is parallel after the first traverse.
- Continue traverse adjusting 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.
- Dress the wheel for Ø12 mm.
- 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.

Grind thin plates to close limits of h6 using coolants

Objectives: At the end of this exercise you shall be able to
- **grind a non-ferrous metal**
- **check the dimension with an vernier micrometer.**



1	ISF 75 X 50 X 6	-	-	-	-	2.4.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GRINDING THIN PLATE	DEVIATIONS ±0.03 mm	TIME
		CODE NO. MG20N24117E1	

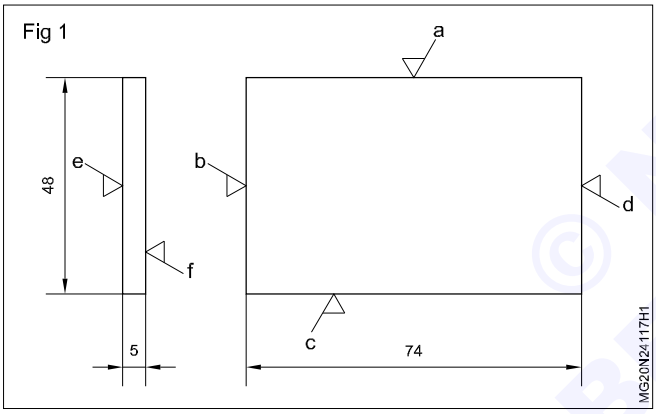
Job sequence

- Prepare the machine and select the grinding wheel for non ferrous metal.
- Dress the wheel for parallel grinding.
- Set the magnetic chuck and align the parallel for grinding wheel edge.
- Place the angle plate on the surface plate and set the work piece using flat clamp and align with dial test indicator.
- The workpiece project 1 or 2mm about top and side edge of the angle plate.

Do not use serration faced clamp. If the clamp pressed the work piece while clamping the impression made of the work piece and spoiled the surface always use plain faced clamp while the clamping of non ferrous metal.

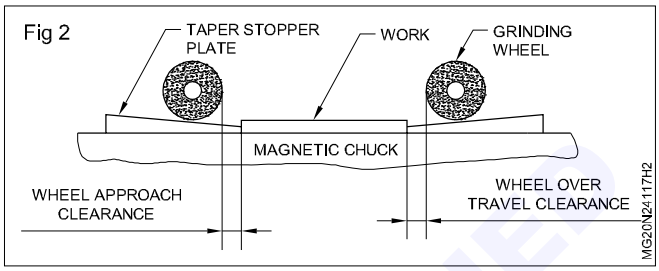
- Mount the angle plate on the magnetic chuck rough and finish the flat surface to half of the grinding allowance Fig 1(a).

Fig 1



- Keep the vertical position of the angle plate on the magnetic chuck rough and finish the flat surface to half of the grinding allowance. Fig 1(b)
- Remove the job and deburr with fine abrasive stick.
- Reset the job for same manner and keep the magnetic chuck in correct position for grinding.
- Rough and finish grind the flat and parallel surface Fig 1(c) to maintain 48 $\pm^{0.000}_{0.013}$ with an accuracy.
- Keep the vertical position of the angle plate on the magnetic chuck.
- Rough and finish grind the flat and parallel surface Fig 1(d) to maintain 74 $\pm^{0.000}_{0.013}$ with an accuracy.
- Remove the job and deburr the all edges.
- Set the job on magnetic chuck with longer wider and taper stopper plate at the four sides below the 0.4mm from the top of the job surface. (Fig 2)

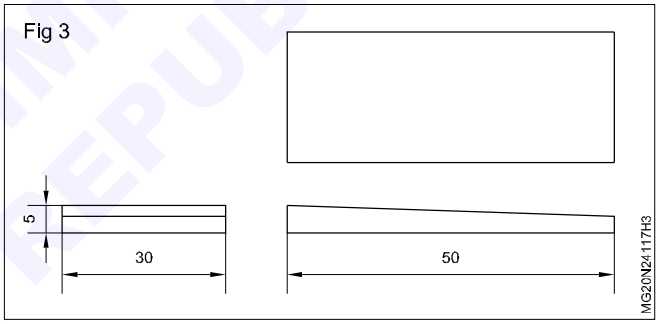
Fig 2



Ensure the grinding wheel does not touch the taper stopper plate for approach and over travel clearance.

- Prepare the taper stopper one pair as per given drawing and set in the magnetic chuck. (Fig 3)

Fig 3

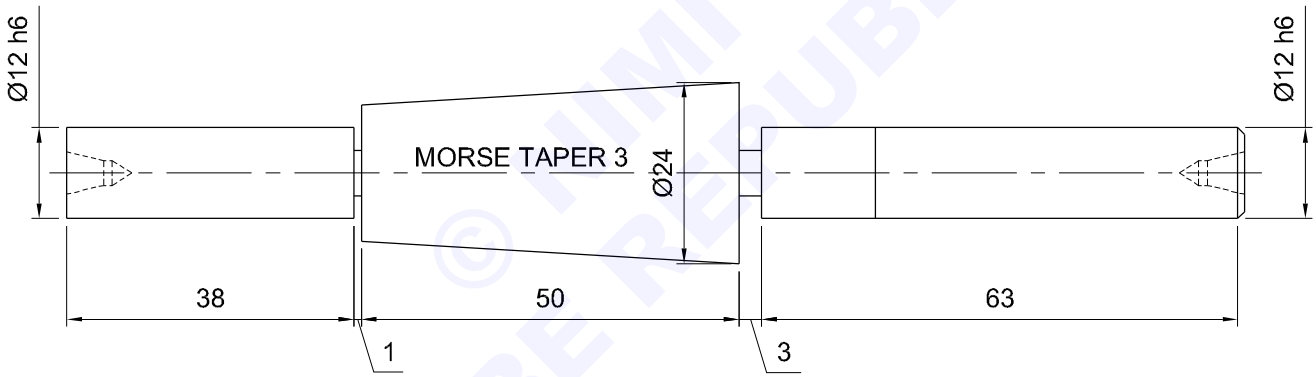


Thickness of the taper end must be less than the thickness of the plate to be ground.

- Rough and finish grind the flat surface with half of the grinding allowance with an accuracy of $\pm^{0.000}_{0.013}$
- Deburr the edges.
- Reset the job rough and finish grind the flat and parallel surface to maintain 5mm with an accuracy of $\pm^{0.000}_{0.013}$
- Clean and deburr the job.
- Check the dimensions with vernier micrometer check the parallelism by using dial test indicator.

Perform grinding on parallel and taper pins using chuck and collets-h6

Objectives: At the end of this exercise you shall be able to
- **hold the workpiece by collet chuck**
- **grind the workpiece with in an accuracy of h6**
- **check the taper.**



1	ISR Ø26 X 155		Fe 310			2.4.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**GRINDING PRACTICE ON PARALLEL AND TAPER PIN USING CHUCK OR COLLET**				DEVIATIONS ± 0.03 mm	TIME
					CODE NO. MG20N24118E1	

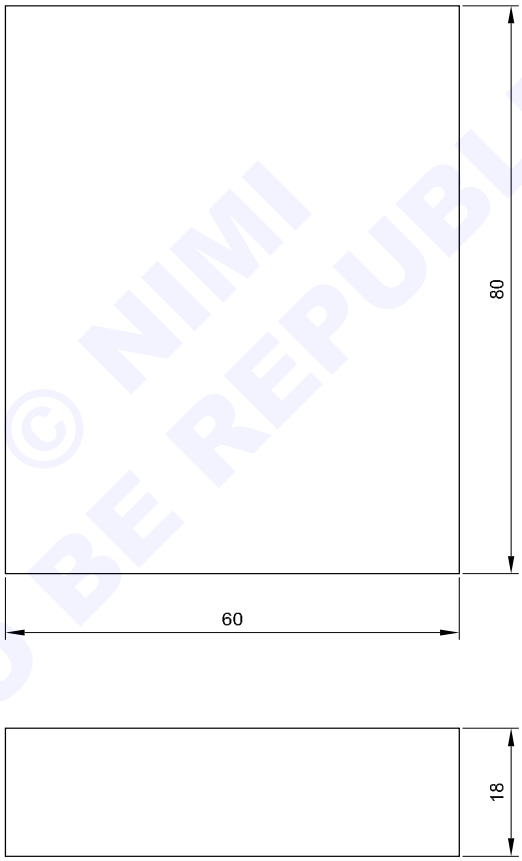
Job sequence

- Check the raw material for its size.
- Hold the job on lathe.
- Turn the job on lathe as per drawing leaving the grinding allowance.
- Determine the grinding allowance.
- Balancing the grinding wheel.
- Mount the wheel on the cylindrical grinding machine.
- Dress the grinding wheel.
- Hold the job in 3 jaw chuck.
- Set the table traverse dog to grind 63mm length cylindrical portion.
- State the grinding wheel first and start the job.
- Bring the wheel to the job and allow it to touch.
- Grind the job (giving required feed) to an accuracy of ±0.01 mm to a length of 63 mm.
- Move the wheel away from the job.
- Stop the wheel and job movements.
- Check the dimension with a micrometer.
- Reverse and reset the job in collet chuck using 12mm collet..
- Set the table traverse dog to grind 38 mm length cylindrical portion.
- Bring the wheel to the job and allow it to touch.
- Grind the job to an accuracy of $\pm^{0.000}_{0.013}$ mm to a length of 38 mm.
- Move the wheel away from the job.
- Stop the wheel and job movements.
- Check the dimensions with a micrometer.
- Tilt the table to 1.30° to grind the MT3 taper.
- Set the table traverse dog to grind 50 mm length on the taper end.
- Start the grinding wheel and the job rotation.
- 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 rotation of the wheel and job.
- Check the taper angle, inserting in a MT3 sleeve.

Select grinding wheel and perform grinding on rectangular bar of non-ferrous metals within accuracy ±0.01mm.

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

- **turn the rectangular block in lathe**
- **select the correct grinding wheel for non ferrous metal**
- **set & check the grinding wheel**
- **set the rectangular bar on the machine table using by parallel bar**
- **grind the rectangular bar within accuracy ±0.01mm.**



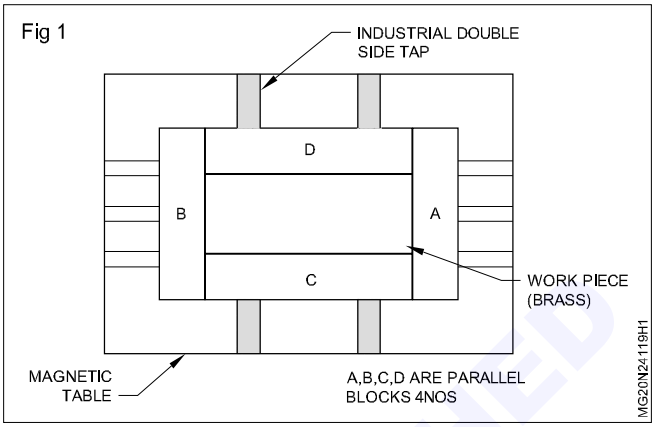
TOLERANCE ± 0.01mm
ALL DIMENSIONS ARE IN mm

1	ISF 63 X 80 X 20		BRASS			2.4.119
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**GRINDING ON RECTANGULAR BAR NON-FERROUS METAL**				DEVIATIONS ± 0.01 mm	TIME
					CODE NO. MG20N24119E1	

Job sequence

- Select the grinding machine.
- Insert the selection of grinding wheel attached.
- Check the grinding wheel like balancing and cracking.
- Set the grinding wheel & check the truing.
- Dress the grinding wheel.
- prepare the machine and non ferrous metal (brass)
- set the magnetic chuck and align the parallel for grinding wheel edge.
- Arranged the parallel black and paste the Industrial double side tap and set the work piece. (Fig 1)
- Grind the work piece on the surface slowly.
- Finish the workplace
- Check the dimension using byout side micrometer and vernier caliper.

Fig 1



TASK 1 : **Grinding wheel selection factor**

	Common Factors		Variable factors
1	Material to be ground	1	Wheel speed
2	Amount of stock to removed.	2	Work speed
3	Area of contact.	3	Condition of the machine.
4	Type of grinding machine.	4	Personal Factor.

- For brass plate aluminium oxide abrasive is to be selected.
- Coarse grain is selected for soft ductile material.
- Being brass is soft material hard wheel is used.
- Brass is soft and ductile material wide spacing wheel is selected.
- Fine grain is selected for this finish.
- Coarse grain and spacing is selected because of more area of contact.
- Grit size 40 - 60 and grade H - K is selected for surface grinding.
- According the wheel size the bond is selected.
- Select the wheel as per marking system.

Fig 1

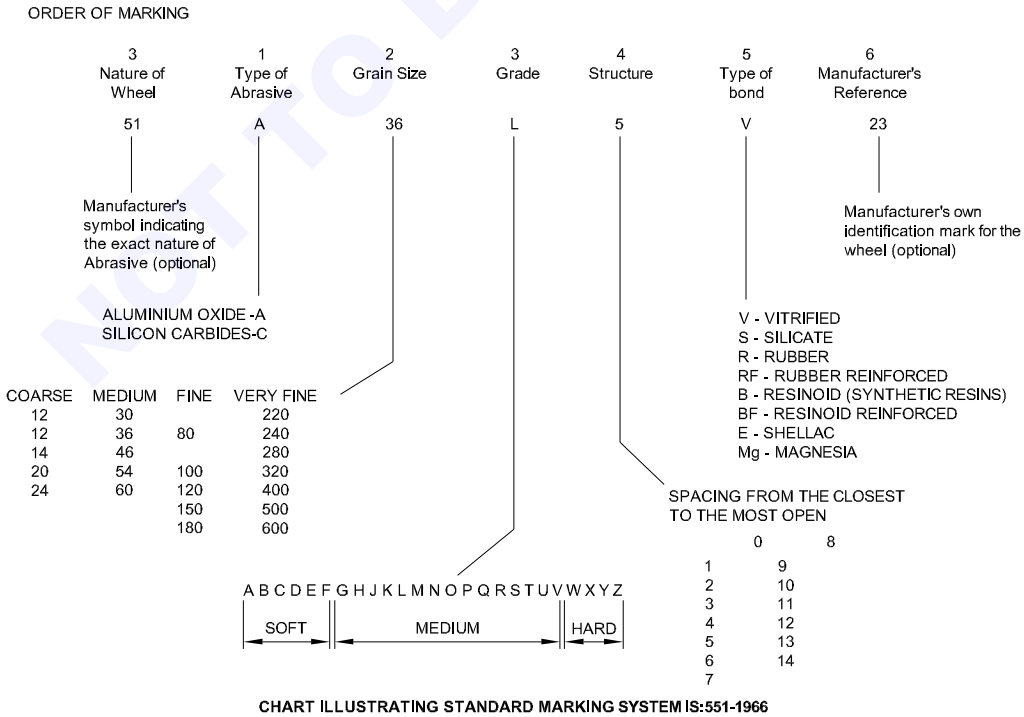


CHART ILLUSTRATING STANDARD MARKING SYSTEM IS:551-1966

TASK 2 : **Grinding wheel specification**

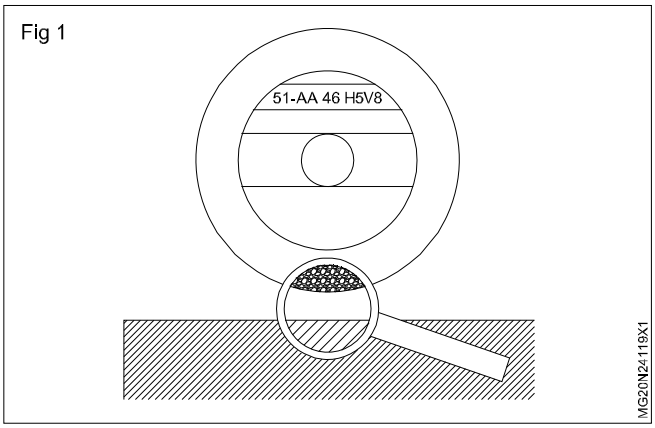
Grinding wheel marking system

- Standard wheel - markings specify all the important wheel characteristics. The marking system comprises of seven symbols which are arranged in the following order. (Fig 1)

Specification of grinding wheel

- A grinding wheel is specified by the standard wheel markings like diameter of the wheel, bore diameter of the wheel, thickness of the wheel type (shape) of the wheel.
- Example 32 A 46H8V, 250 X 20 X 32, Straight wheel.

Fig 1



Standard grinding wheel marking system

Example 1

Marking System - 51 - A 46H5V8

Table 1

Position 0	Position 1	Position 2	Position 3	Position 4	Position 5	Position 6
Manufacturers symbol for abrasive (optional)	Type of abrasive grit	Grain size	Grade	Structure (optional)	Type of bond (optional)	Manufacturers own mark
51	A Aluminium oxide	46 Medium	H Soft	5 dense	V Vitrified	8

Skill sequence

Construction of the grinding wheel

Objective: This shall help you to
- **construction of the grinding wheel.**

In order to suit the grinding wheel for different work situations, the features such as abrasive, grain size, grade, structure and bonding materials can be varied. A grinding wheel consists of the abrasive that does the cutting, and the bond that holds the abrasive particles together.

Different Types of Abrasives used in Grinding Wheels

1 Natural Abrasive

2 Artificial Abrasive

The natural abrasives are emery and corundum, These are impure forms of aluminium oxide. Artificial abrasives are silicon carbide and aluminium oxide. The abrasives are selected depending upon the material being ground.

'Brown' aluminium oxide is used for general purpose grinding of tough materials. 'White aluminium oxide is used for grinding ferrous and ferrous alloys. 'Green' silicon carbide is used for very hard materials with low tensile strength such as cemented carbides.

Grain Size or Grit Size of Grinding Wheel

The number indicating the size of the grit represents the number of openings in the sieve used to size the grain. The larger the grit size number, the finer the grit.

Grade of Grinding Wheel

Grade indicates the strength of the bond and, therefore, the 'hardness' of the wheel. In a hard wheel the bond is strong, and securely anchors the grit in place and, therefore, reduces the rate of wear. In a soft wheel, the bond is weak and the grit is easily detached resulting in a high rate of wear.

Structure of Grinding Wheel

This indicates the amount of bond present between the individual abrasive grains and the closeness of the individual grains to each other. An open structure wheel will cut more freely. That is, it will remove more metal in a given time and produce less heat. It will not produce such a good finish as a closely structured wheel.

Bond of Grinding Wheel

The bond is the substance which, when mixed with abrasive grains, hold them together, enabling the mixture to be shaped to the form of the wheel, and after suitable treatment to take on the necessary mechanical strength for its work. The degree of hardness possessed by the bond is called the 'grade' of the wheel, and indicates the ability of the bond to hold the abrasive grains in the wheel. There are several types of bonding materials used for making wheels.

Types of Bonds in Grinding Wheel

- Vitrified bond
- Silicate bond
- Shellac bond
- Rubber bond
- Resinoid bond

1 Vitrified bond

This is the most widely used bond. It has high porosity and strength which makes this type of wheel suitable for high rate of stock removal. It is not adversely affected by water, acid, oils or ordinary temperature conditions.

2 Silicate bond

Silicate wheels have a milder action and cut with less harshness than vitrified wheels. For this reason they are suitable for grinding fine edge tools, cutters etc.

3 Shellac bond

This is used for heavy duty, large diameter wheels where a fine finish is required. For example, the grinding of mill rolls.

4 Rubber bond

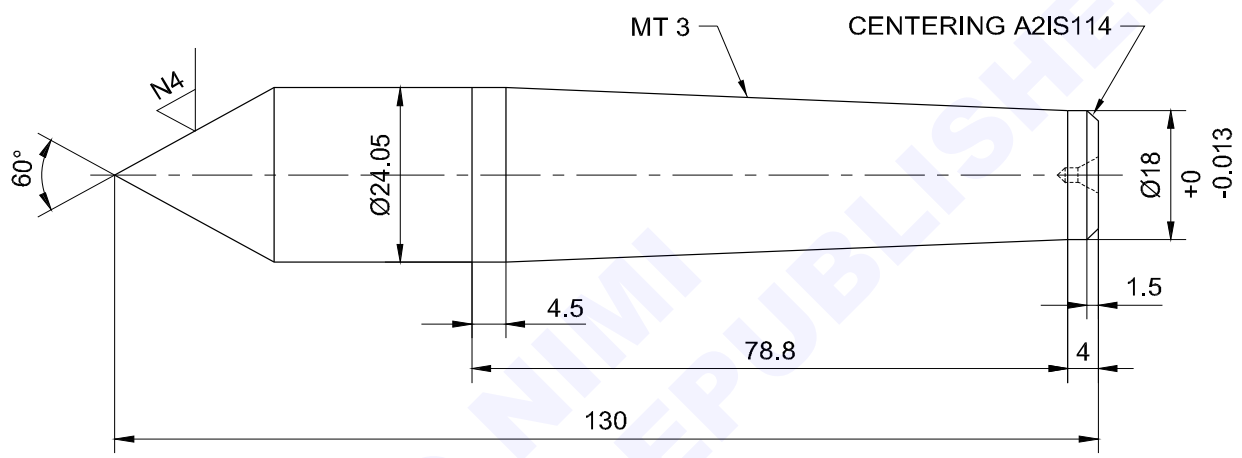
This is used where a small degree of flexibility is required on the wheel as in the cutting off wheels.

5 Resinoid bond

This is used for speed wheels. Such wheels are used in foundries for dressing castings. Resinoid bond wheels are also used for cutting off. They are strong enough to withstand considerable abuse.

Perform Grinding on machine centre to close limit h6 or H6.

Objectives: At the end of this exercise you shall be able to
- **turn the job to with taper size**
- **hold to job in work head spindle nose**
- **swivel the work head for grind conical surface**
- **grinding the conical point of centre with an accuracy of 5 minutes**
- **check the taper with an vernier bevel protractor.**



Job Sequence

1 Study the drawing and turn the job as per drawing and maintain the size with grinding allowance.

2 Ascertain the grinding allowance.

3 Dress the grinding wheel.

4 Hold the work piece in chuck (ϕ24.35mm) and grind the taper portion by tilt the table 1°29' 24" to grind the taper MT3.

5 Set the table traverse dog to grind 74.3mm length on the taper end.

6 Start the grinding wheel and the job.

7 Bring the wheel to the job allow it to touch.

8 Grind the job to an accuracy of ±5 minutes.

9 Move the wheel away from the job and stop the machine.

10 Remove the job and hold the job in spindle using MT -3 adopter.

11 Grind the diameter 24.35 to 24.05mm finish.

12 Grind the conical point by tilting the table at 30°and grind the surface finish N4.

13 Check the finish part.

1	ISR Ø25 X 135	–	Fe310	–	–	2.5.120
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	GRINDING ON MACHINE CENTRE				DEVIATIONS ±5'	TIME
					CODE NO. MG20N25120E1	

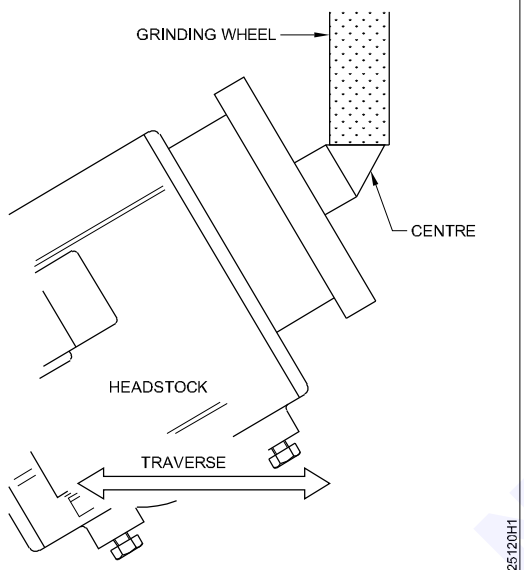
Skill sequence

Grinding 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 swivelled 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

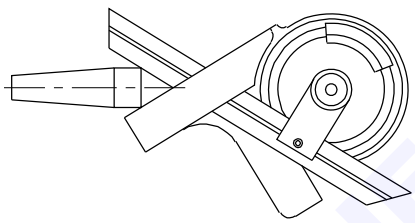


WORK HEAD SWIVELLED FOR GRINDING ANGLES

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

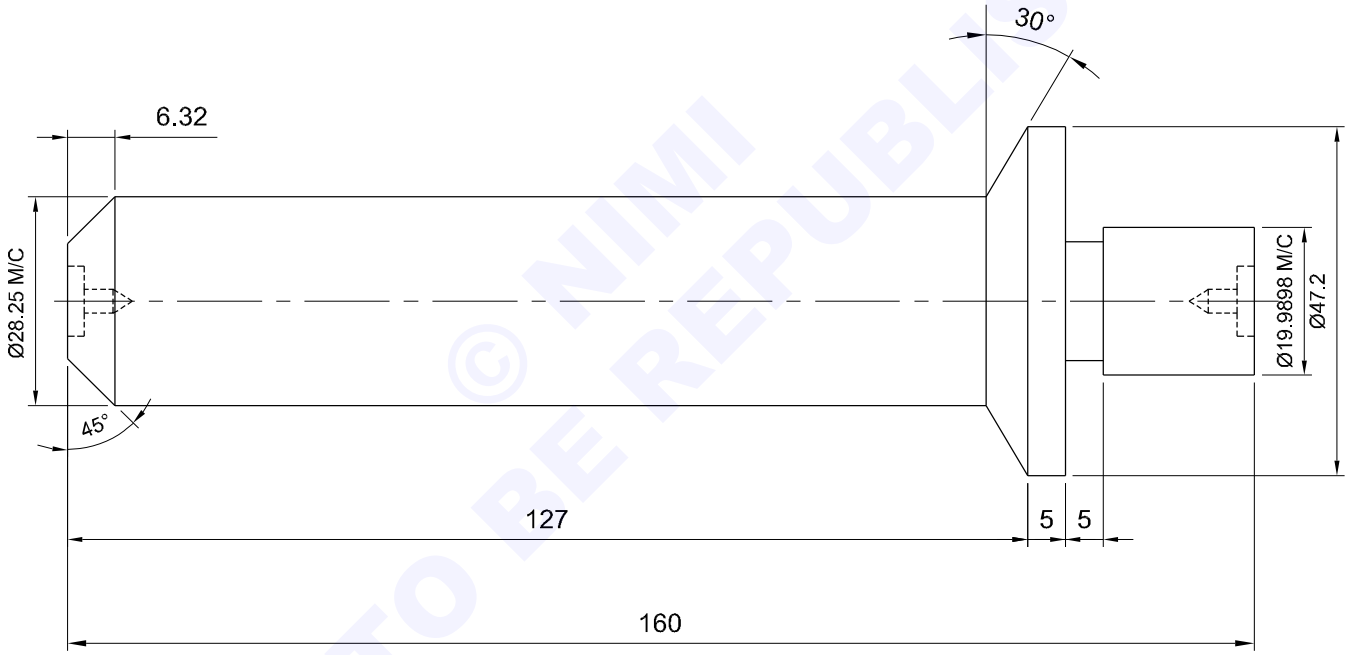


MEASURING WITH THE UNIVERSAL BEVEL PROTRACTOR

Perform facing and chamfering within accuracy ±0.01mm or ±5 minutes

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

- **mount the grinding wheel**
- **dress the grinding wheel**
- **set the workpiece**
- **grind the face of workpiece with the help of side surface of grinding wheel**
- **grind the chamfer angle.**



1	ISR Ø50 X 165		Fe 310			2.5.121
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	FACE & CHAMFER GRINDING	DEVIATIONS ±0.01 mm (or) 5 Minutes	TIME
		CODE NO. MG20N25121E1	

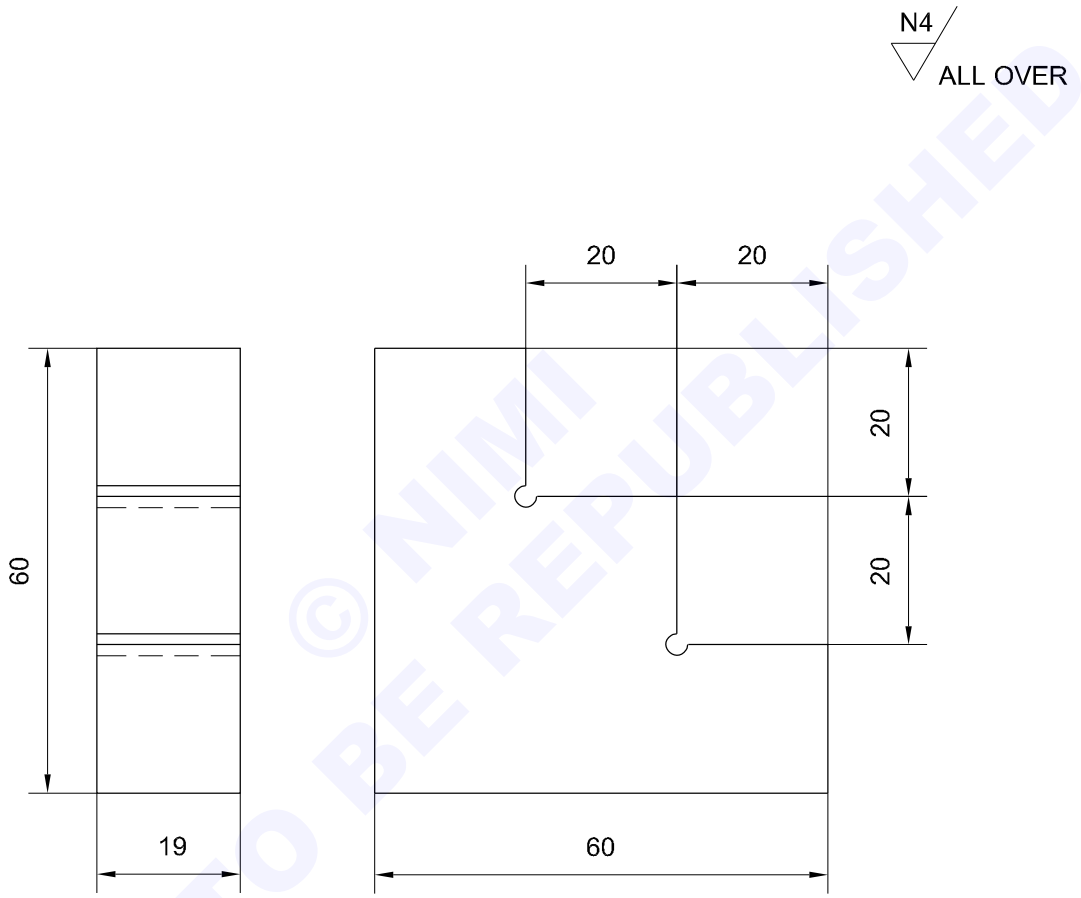
Job sequence

- Prepare the blank by turning according to the job drawing leaving grinding allowance.
- 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 120 mm long cylindrical portion.
- Start the grinding wheel first and then start the job.
- Bring the wheel nearer to the job and allow it to touch.
- Grind the job to an accuracy of ± 0.01 mm to a length of 120 mm.
- Move the wheel away from the job beyond the job shoulder ∅ 47.2.mm
- Stop the wheel and job movements.
- Check the dimensions with a micrometer.
- Tilt the table to 30° towards operator and lock the table movement.
- Start rotation of grinding wheel and job.
- Plunge left hand corner of the wheel face on to job till wheel edge touches the ∅ 28.25 mm at 120 mm long.
- Move the wheel away from the job and stop the movement of the wheel and job.
- Check the taper portion with a vernier bevel protractor.
- Release the table lock and move the table to other end of the job where 45° chamfer has to be formed by grinding. Set the table angle to 45° towards operator and lock the table.
- Switch on both grinding wheel and the job for rotation.
- Plunge the grinding wheel on the job till the 6.32 mm long achieved.
- Move the wheel head away from the job and stop the rotation of both wheel and job.
- Unlock the table and bring back to '0' position of the table.

Perform step grinding on surface grinding machine to close limit h6 or H6

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

- **grind the surface flat and parallel with an accuracy of 0.02mm**
- **grind stepped surfaces**
- **check the dimensions by an outside micrometer**
- **check the depth with a depth micrometer.**

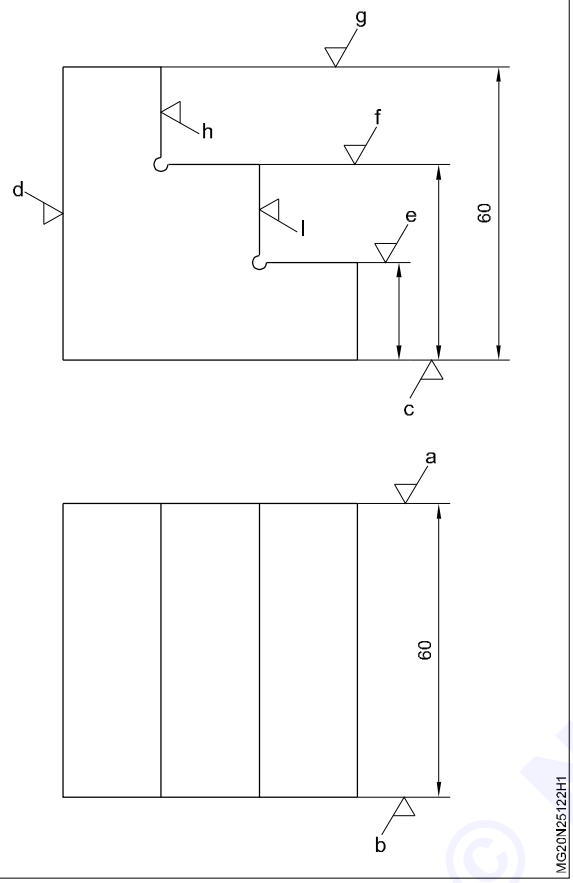


1	ISF 63 X 63 X 20		Fe310	-	1	2.5.122
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**STEP GRINDING**				DEVIATIONS ±0.02 mm	TIME
					CODE NO. MG20N25122E1	

Job sequence

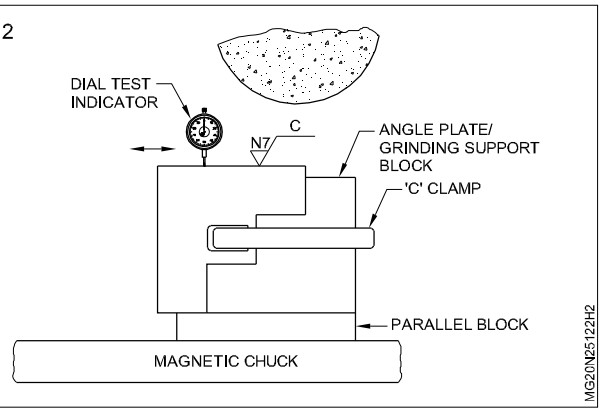
- Study the job drawing measure the job and determine the grinding allowance on each surface and step to be ground. (Fig 1)

Fig 1



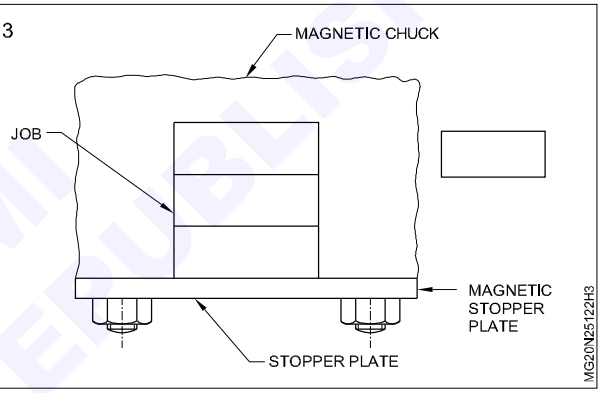
- Prepare the machine, the magnetic chuck and grinding wheel for the surface grinding operation.
- Set the magnetic chuck aligning with reference to the grinding wheel.
- Rough and finish grind the surfaces (a) and (b) to parallel and maintain the size to (60.5mm) removing half of the grinding allowance.
- Set the job on the angle plate (150 x 100mm) with a 10mm 'C' as shown in Fig. 2.
- Ensure that the surface (c) is 1 to 2mm above the top surface of the angle plate.
- Do not seat the job tight on the parallel, after aligning with the dial test indicator.
- Rough and finish grind the surface 'C' removing half of the grinding allowance.
- Repeat the above steps for grinding the surface (d) 60mm.

Fig 2



- Rough and finish grind the surface (d) removing half of the grinding allowance.
- Mount the surface (c) on a magnetic chuck and align the surface (d) against the stopper plate (Fig 3)

Fig 3

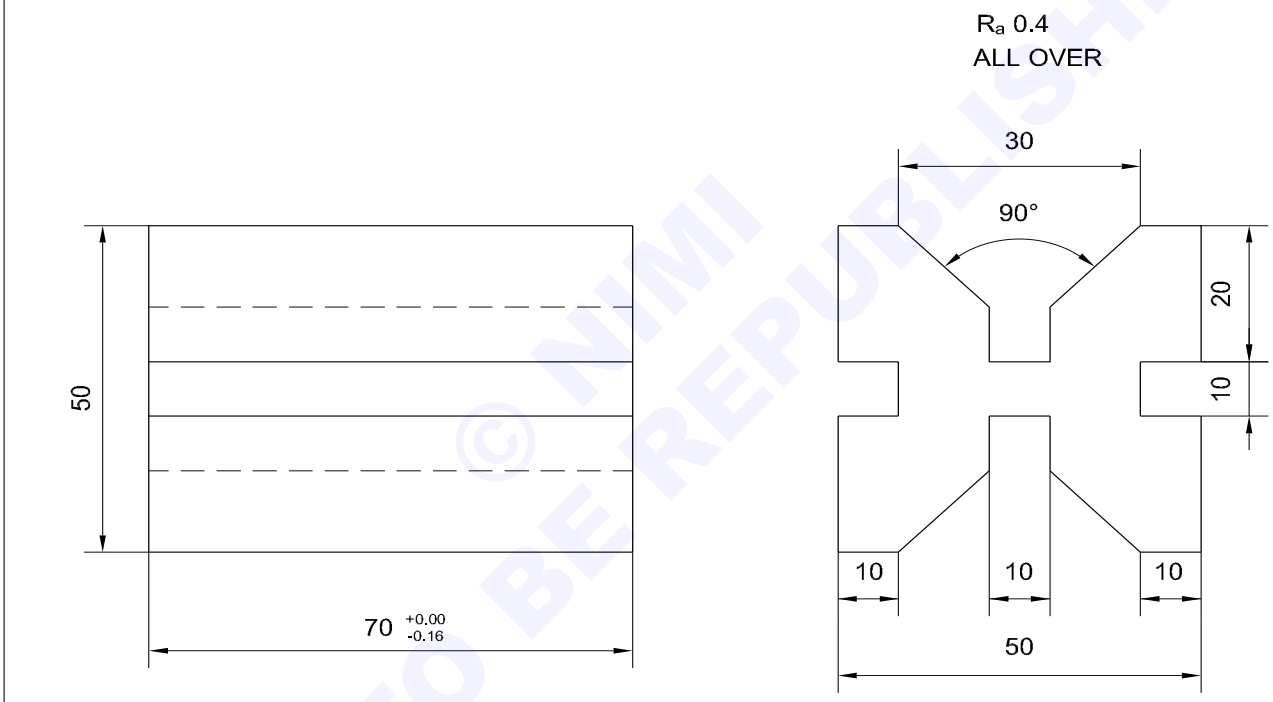


- Rough and finish grind the step (e) to 20mm. Check with a depth micrometer.
- Rough and finish grind the step ((f) to 20 (f)-(e) 40-20). Check with a depth micrometer.
- Rough and finish grind the step ((g) 20 (g)-(f) 60-40) check with a depth micrometer.
- Mount the surface (d) on the magnetic chuck and align the surface (f) against the stopper plate (Fig 2)
- Rough and finish grind steps (h) and (i) to the dimensions as per the dimensions given in the drawing.
- Check the steps with a depth micrometer at every stages.
- Deburr all the edges.
- Check the dimensions with an outside micrometer.

Perform 'V' block grinding within accuracy ±0.01mm, ±5 minutes, surface finish N5

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

- **grind surface flat and parallel with an accuracy of ±0.01 mm**
- **grind slot**
- **grind V groove**
- **check the dimensions with an outside micrometer**
- **check the slot with depth micrometer**
- **check the squareness and angle with a vernier bevel protractor.**



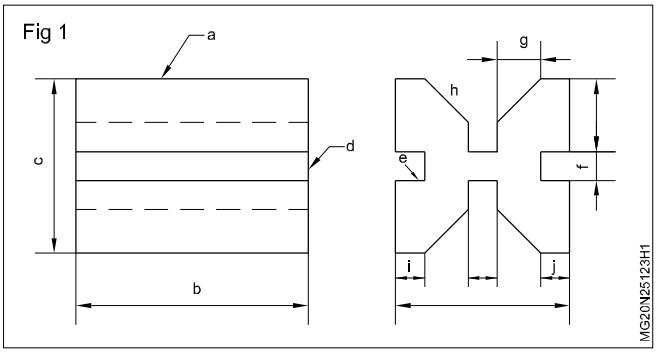
1	55x75x55	-	CAST IRON	-	-	2.5.123
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	V- BLOCK GRINDING	DEVIATIONS ±0.01 mm	TIME
		CODE NO. MG20N25123E1	

Job sequence

- Face the six sides of the job maintain the grinding allowance.
- 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 ± 0.01mm.
- 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 ± 0.01mm 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 ± 0.01mm.
- Remove the job and reverse it align the surface (b) rough and finish grind the slot (f) with ± 0.01mm.
- Swivelling 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 throughly and clean.
- Measure the dimensions with an outside micrometer.
- Check the angular surface with vernier bevel protractor.

Skill sequence

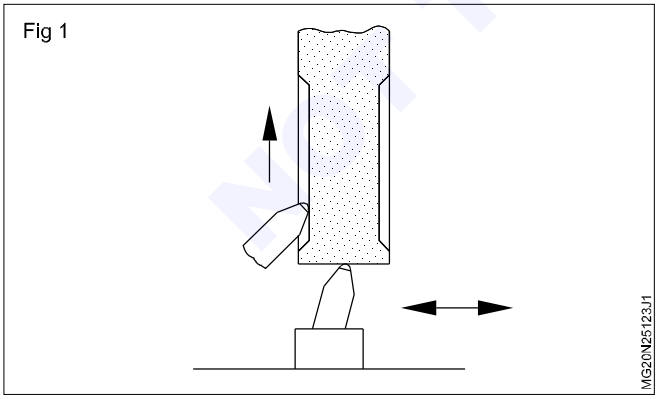
Grinding V- Block using universal vice

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)

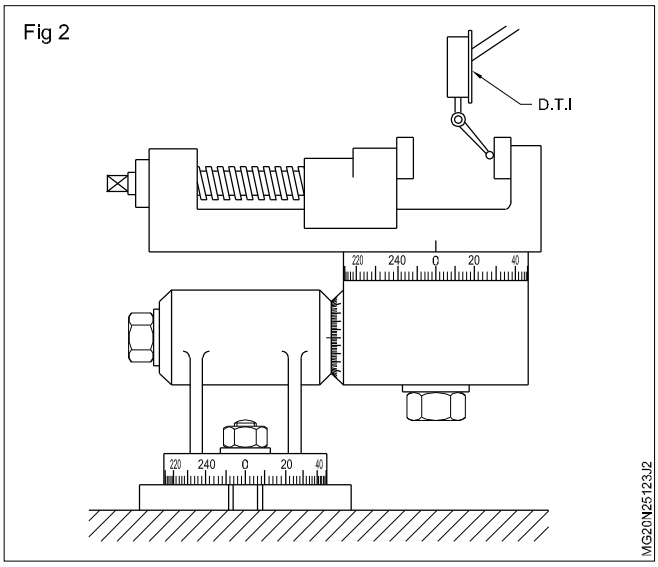
Fig 1



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)

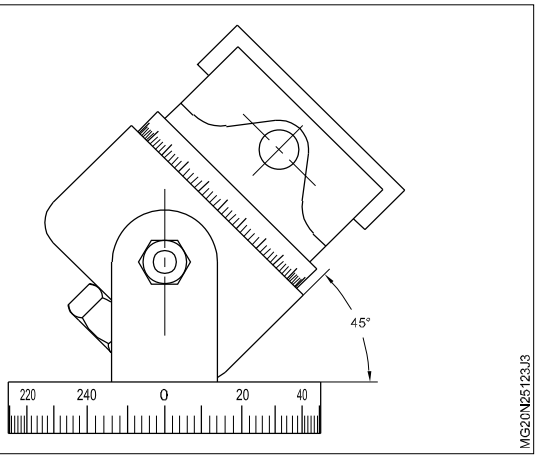
Fig 2



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)

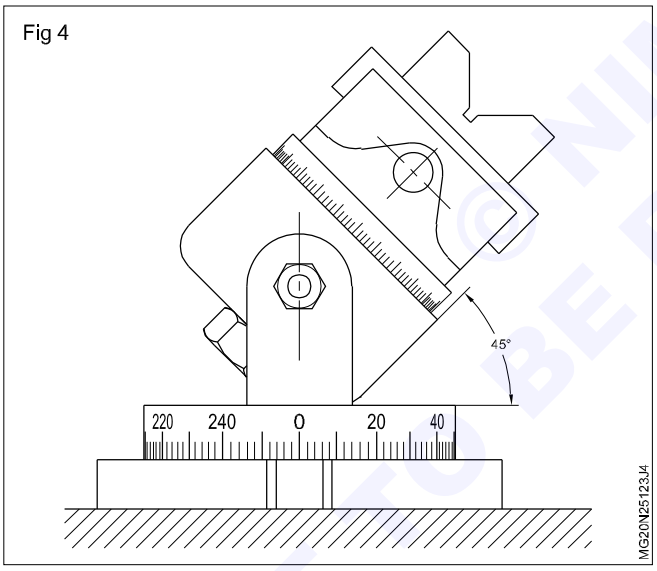
Fig 3



6 Clean the job and measure it to determine the grinding allowance. (Ask your instructor for help in determining the allowance).

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)

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.

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)

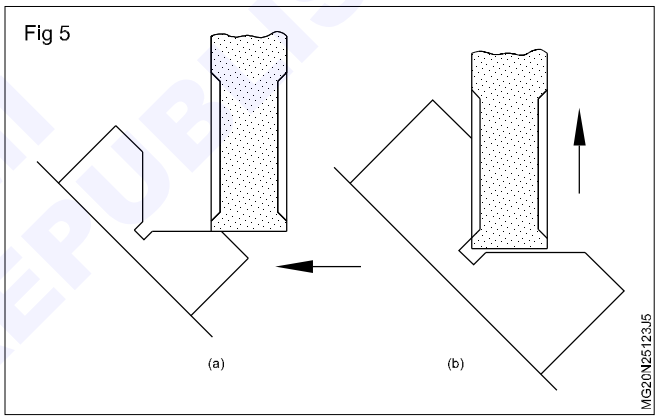
12 Grind the longitudinal surface up to the corner relief.

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.

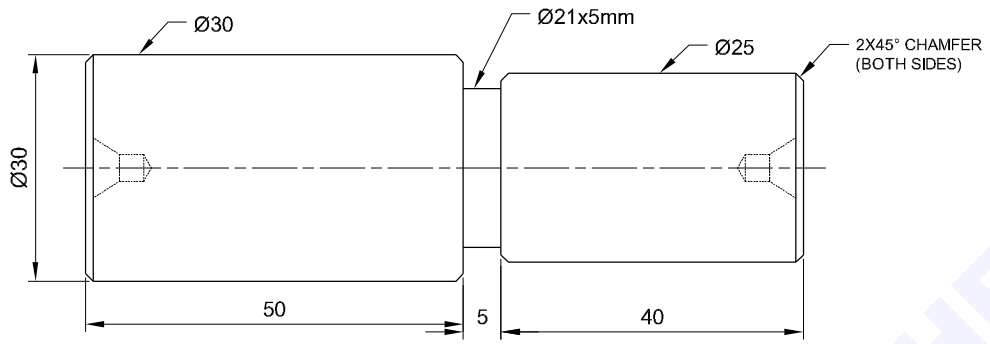
15 Raise the wheel gradually to finish grind the vertical surface. (Fig 5b).

Fig 5



Grind cylindrical steps and perform honing (External)

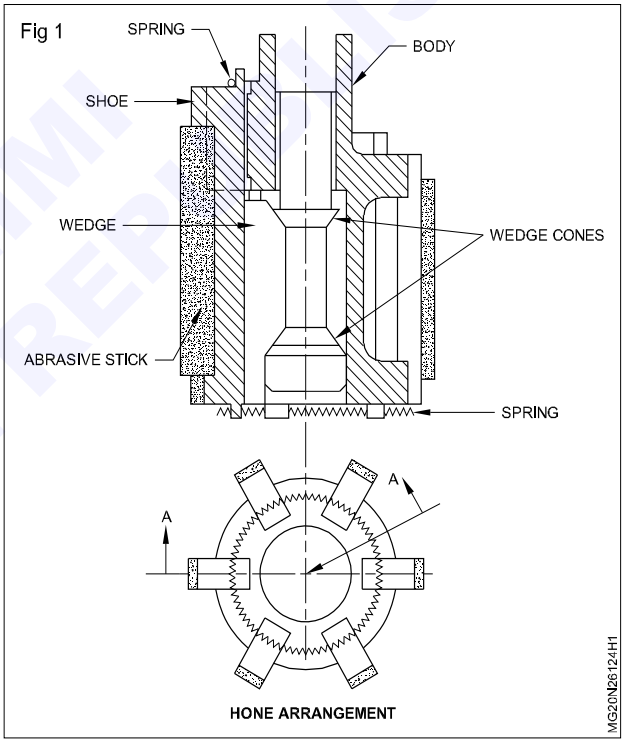
Objective: At the end of this lesson you shall be able to
- **select abrasive stick and hone for machine honing.**



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 0°
- Dress the wheel/
- Mount the workpiece in between centres with carrier.
- Start the machine for grinding wheel rotating.
- Grind the ∅ 30x50 and ∅ 25x40
- Select the abrasive stick and set the external honing machine
- Prepare the honing machine and set the abrasive stick. (Fig 1)
- Set the work piece using by Dial test indicator.
- Honing the work piece
- Measure of the work piece using by vernier micro meter.

Fig 1



HONE ARRANGEMENT

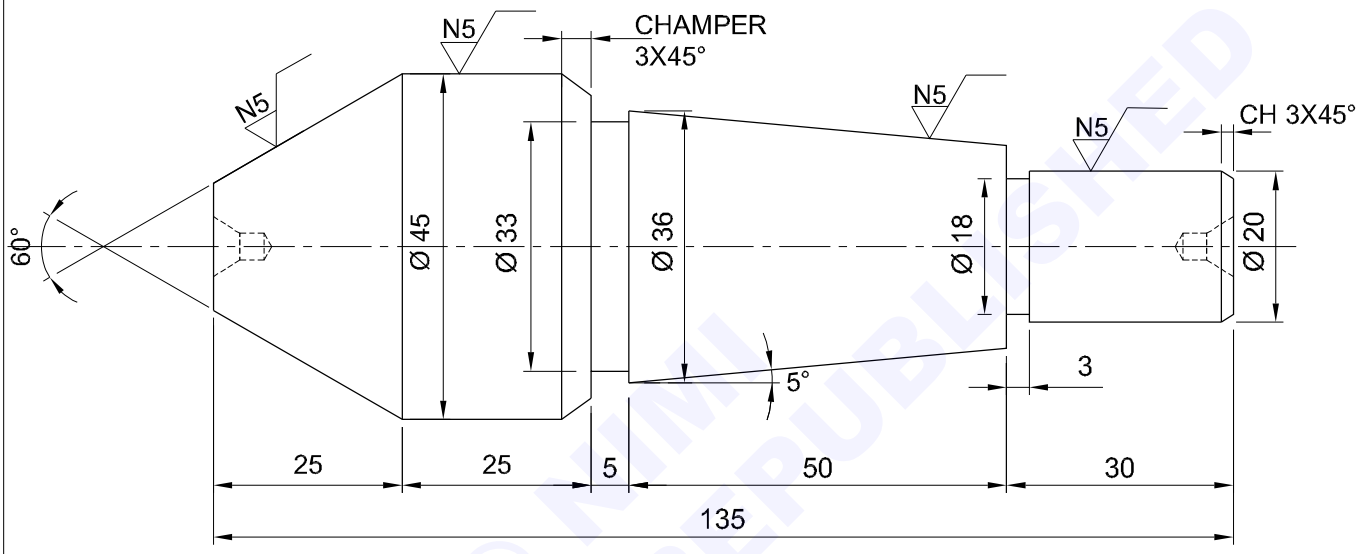
TOLERANCE ±0.01 mm
ALL DIMENSIONS ARE IN mm

1	ISR Ø32x100	-	FE310	-	-	2.6.124
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	GRIND CYLINDRICAL STEPS AND PERFORM HONING	DEVIATIONS ±0.01 mm	TIME
		CODE NO. MG20N26124E1	

Finish surface of angular form grinding within accuracy of ± 0.01mm

Objectives: At the end of this exercise you shall be able to
- **form the wheel by dressing to required angle**
- **grind taper to size**
- **check the taper using vernier bevel protractor.**



GEN.TOLERANCE ± 0.015 mm.
ALL DIMENSION ARE IN mm.

Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Dress the grinding wheel.
- Hold the workpiece in between centre with carrier and check for concentric alignment.
- Set stoppers to adjust the table traverse length.
- Start machine and stay two minutes for warm up.
- Rough and finish grind ∅20 x 30 mm.
- Set the table to 5° for taper grinding and finish.
- Reverse the job and hold it in ∅ 20 x 30mm using caliper.
- Grind step of ∅ 45 x 25 and finish.
- Dress the wheel to 30° angle.
- Grind the job to 60° of 25 mm length.
- Check the angles by vernier bevel protractor.

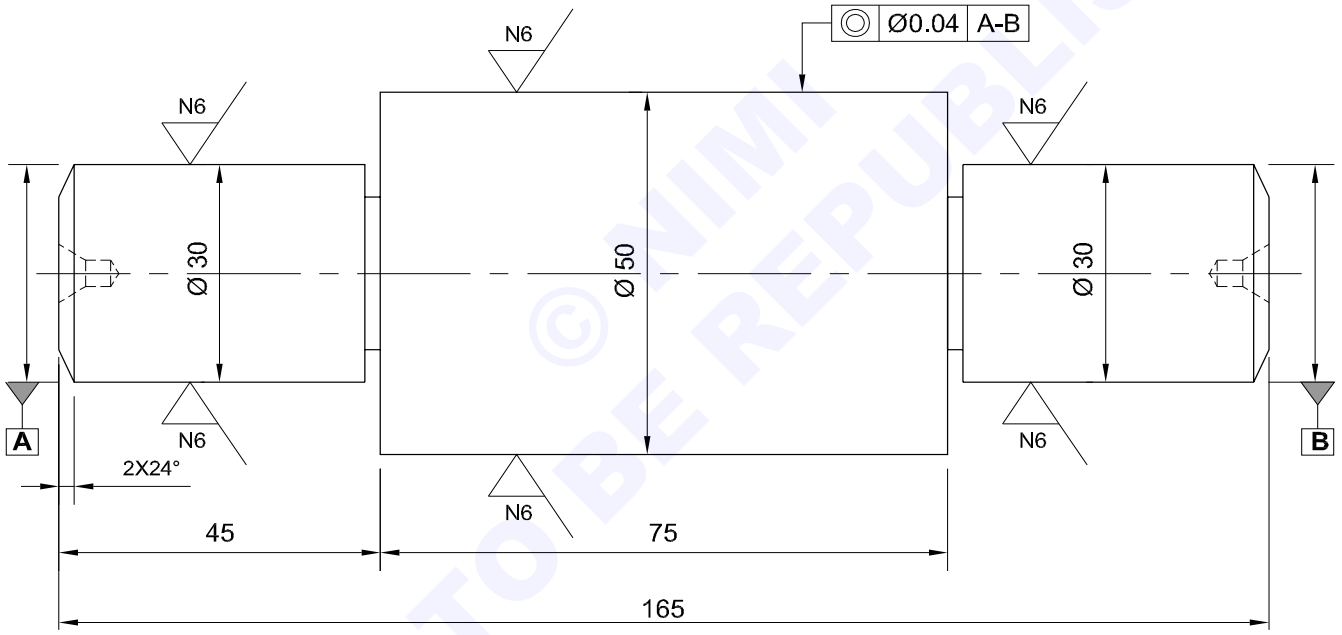
1	ISR Ø50x140	-	Fe 310	-	-	2.7.125
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	ANGULAR FORM GRINDING	DEVIATIONS ±0.01 mm	TIME
		CODE NO. MG20N27125E1	

Grinding cylindrical steps with shoulder and chamfer within accuracy ±0.008mm

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

- **grind by the traverse feed method with an accuracy ±0.008**
- **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 by using DTI.**



1	ISR Ø55x170	-	Fe310	-	-	2.7.126
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

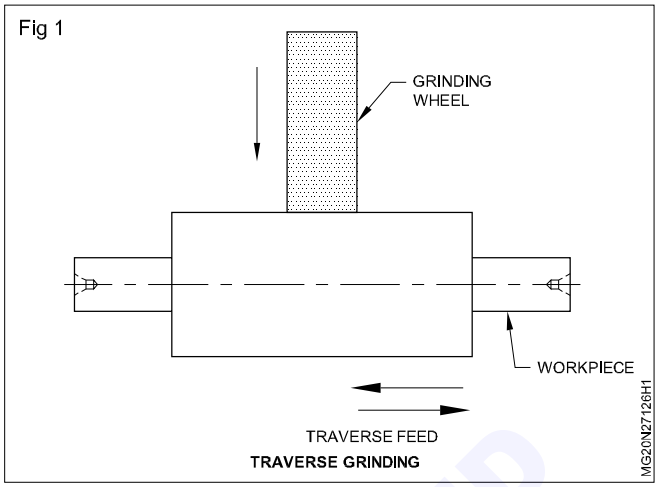
SCALE NTS	GRINDING CYLINDRICAL STEPS WITH SHOULDER AND CHAMFER	DEVIATIONS ±0.008 mm	TIME
		CODE NO. MG20N27126E1	

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.
- Start the machine for grinding wheel rotating.
- Move the grinding wheel back about 50 mm from the workpiece to allow the wheel.
- 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 traversely.
- Grind the step ∅30 x 45 mm long rough and finish grinding at both ends one after other. (Fig 2)
- Tilt the wheel head 24° and grind the taper two sides.
- 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 D.T.I.

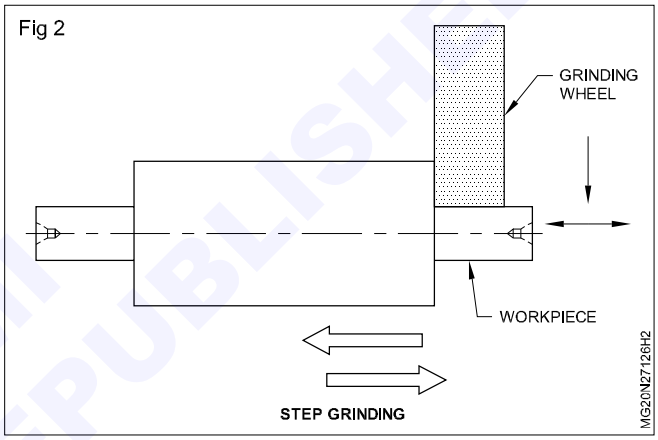
Keep your hands away from the revolving wheel at all times to avoid injuries to yourself.

Fig 1



TRAVERSE GRINDING

Fig 2

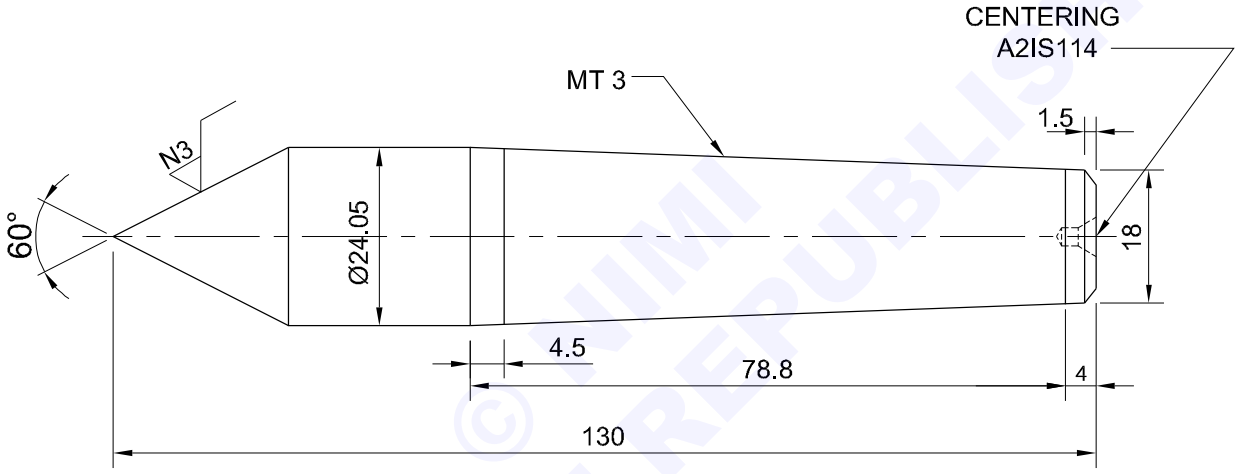


STEP GRINDING

Perform compound or double taper grinding accuracy of ±0.008mm. and surface finish of N5

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

- **set double taper angle by swivelling any combination of atleast two among work head, wheel head, upper table**
- **grind the job by compound or double taper method**
- **check concentricity and roundness**
- **check the accuracy within ±5 minutes.**



Job sequence

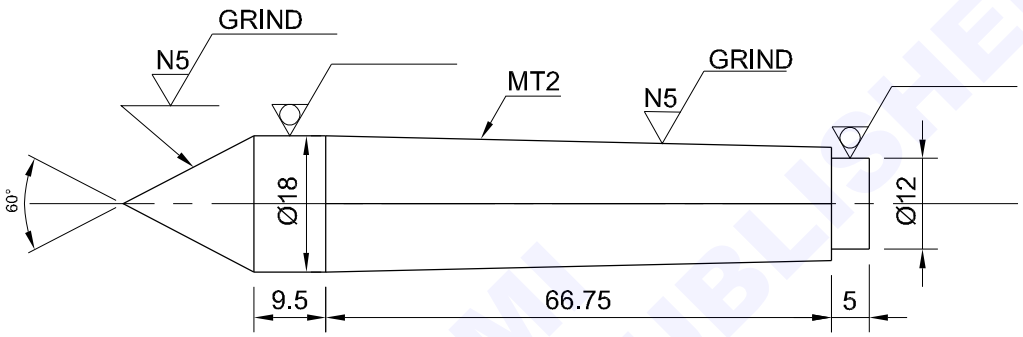
Compound angle method

- 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 between center with carrier.
- 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.
- Rough and finish grind the job to ∅24.05 mm.
- Set the job in towards head spindle bore with sleeve if required.
- Swivel the work head into 15° towards operator and wheel head into 15° away from operator clockwise.
- Rough and finish grind the job compound or double taper to size.
- Check the compound or double taper using vernier bevel protractor.
- Check the dimensions.

1	ISR Ø28x135	-	Fe 310	-	-	2.7.127
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	COMPOUND OR DOUBLE TAPER GRINDING				DEVIATIONS ±0.008 mm	TIME
					CODE NO. MG20N27127E1	

Perform steep taper grinding within accuracy ±0.008mm

Objectives: At the end of this exercise you shall be able to
- **grind lathe centre by swivelling wheel head or work head**
- **check taper angle 60° with the flat centre gauge and cone centre gauge for final accurate result.**



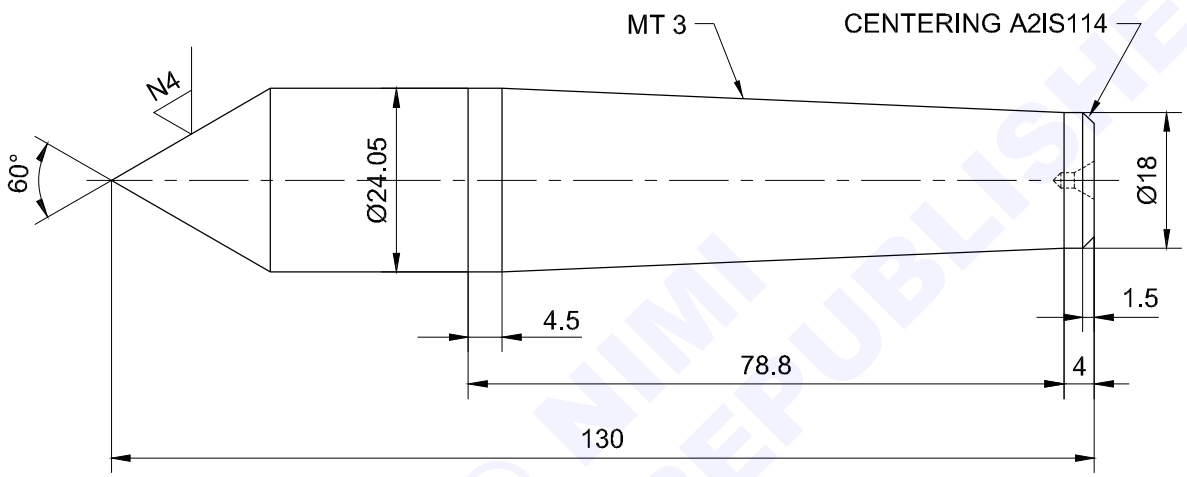
Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Hold the job in between center.
- Set the table to MT2 taper.
- Rough and finish grind the job to MT2 taper.
- Set the table to zero position.
- Set the job into work head spindle bore into directly or with suitable sleeves.
- Grind the dia 18 X 9.5mm.
- Swivel the wheel head to steep taper to 30° angle.
- Rough and finish grind the job to the required steep taper.
- Check the taper with flat center gauge and cone center gauge.

1	ISR Ø20x94	-	Fe 310	-	-	2.7.126
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	STEEP TAPER GRINDING				DEVIATIONS ±0.008 mm	TIME
					CODE NO. MG20N27128E1	

Grind lathe centre within accuracy ±0.008mm surface finish N4

Objectives: At the end of this exercise you shall be able to
- **hold the job in work head spindle nose**
- **swivel the work head for grind conical surface**
- **regrinding the conical point of centre with an accuracy of 5 minutes**
- **check the taper with a vernier bevel protractor.**



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 male and female centres.
- Tilt the table to 21/2° to grind.
- Set the table traverse dog to grind 74.3 mm 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.

1	ISR Ø25x135	–	Fe310	–	–	2.7.129
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	GRINDING OF LATHE CENTRE				DEVIATIONS 5 Min.	TIME
					CODE NO. MG20N27129E1	

Skill sequence

Setting the wheel head

Objective: This shall help you to
- **set the wheel head to steep taper angle.**

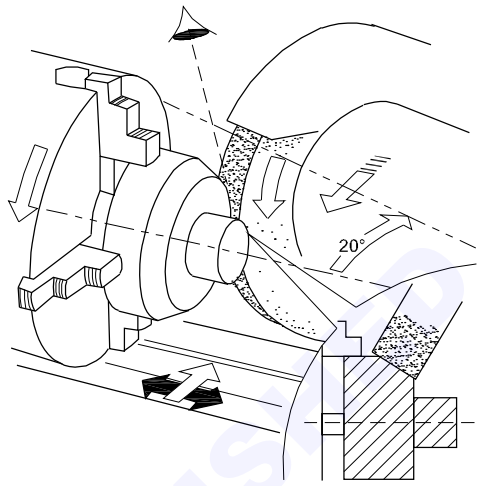
Set the wheel head to steep taper angle. (Fig 1)

Loosen the nuts on base of wheel head.

Turn wheel head required number of degrees as shown in Fig 1.

Tighten all nuts on wheel head base.

Fig 1



SETTING THE WHEEL HEAD

Checking the steep taper using flat center gauge and cone center gauge

Objective: This shall help you to
- **check the 60º angle using flat center gauge and cone center gauge.**

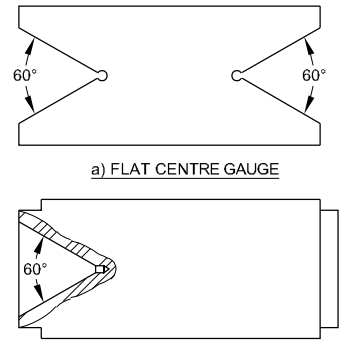
Check the 60º angle using flat center gauge and cone center gauge.

Check the 60° angle using flat center gauge (or) cone center gauge as shown in Fig 1.

Flat center gauge is shown in (Fig a) used to check the 60° angle.

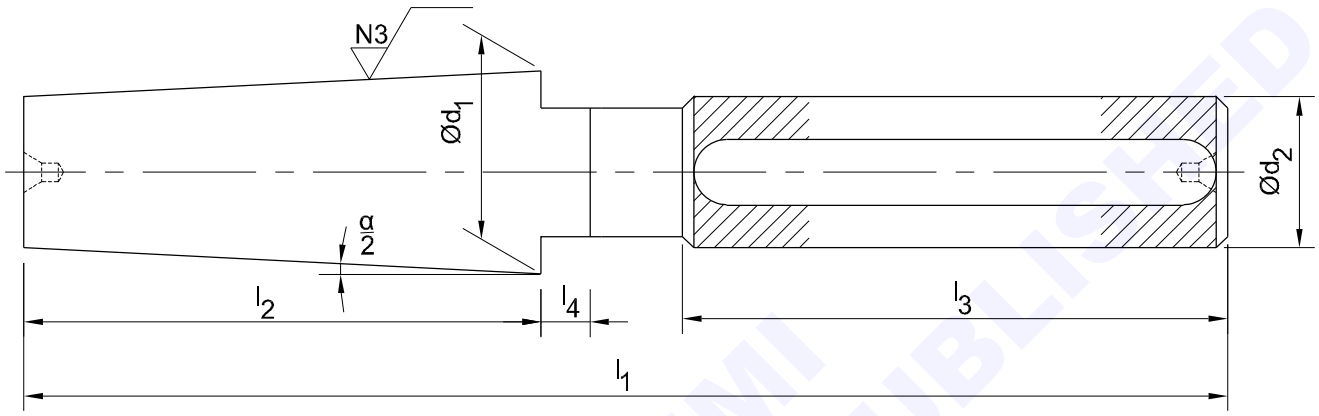
Cone center gauge is shown in (Fig b) used to check the taper angle with conical surface by blue bearing.

Fig 1



Make morse taper within accuracy ±0.008mm surface finish N4

Objectives: At the end of this exercise you shall be able to
- **set the workpiece**
- **set the table at an angle for MT3**
- **grind the MT3 plug - gauge**
- **check by slip gauges, micrometer and roller.**



DESIGNATION OF TAPER	d_1 js5	d_2	1	l_2 js8	l_3	l_4	$\frac{\alpha}{2}$	*AT_D µm
MT 3	23.825	17.5	176	81	80	5	1°26'16"	+5.1

*CONE ANGLE TOLERENCE(AT_D) IS AT_4 GRADE OVER LENGTH 'l_2' AS PER IS 7615-1975 SYSTEM OF CONE TOLERENCE

REFER - IS : 2251 - 1965
DIMENSIONS OF TAPER PLUG GAUGE

ALL DIMENSIONS IN MILLIMETERS

Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Hold the workpiece in chucks with soft jaws, and check for run out.
- Set the stopper to adjust the table traverse length.
- Swivel the table to MT3 taper angle.
- Rough and finish grind the job to MT3 taper angle.
- Check the workpiece by slip gauge, micrometer and roller.

1	ISR Ø25x180	→ EX 4.1.137	-	-	-	2.7.130
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	MORSE TAPER - PLUG GRINDING METRIC TAPER	DEVIATIONS ± 0.008 mm	TIME
		CODE NO. MG20N27129J1	

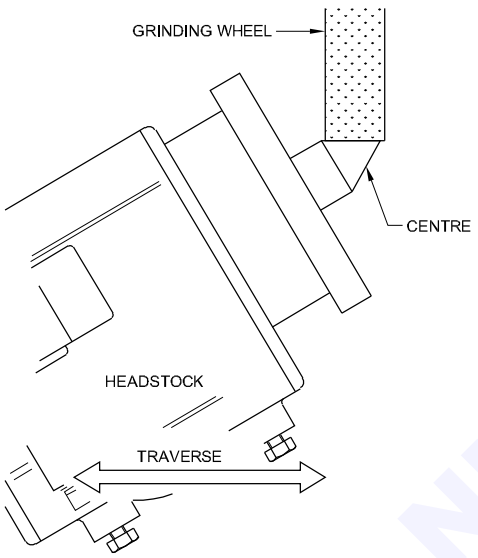
Skill sequence

Grinding 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 swivelled 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

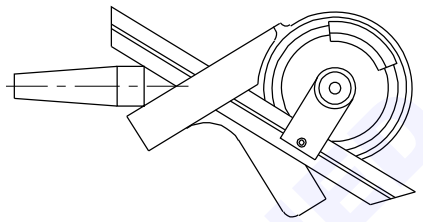


WORK HEAD SWIVELLED FOR GRINDING ANGLES

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.

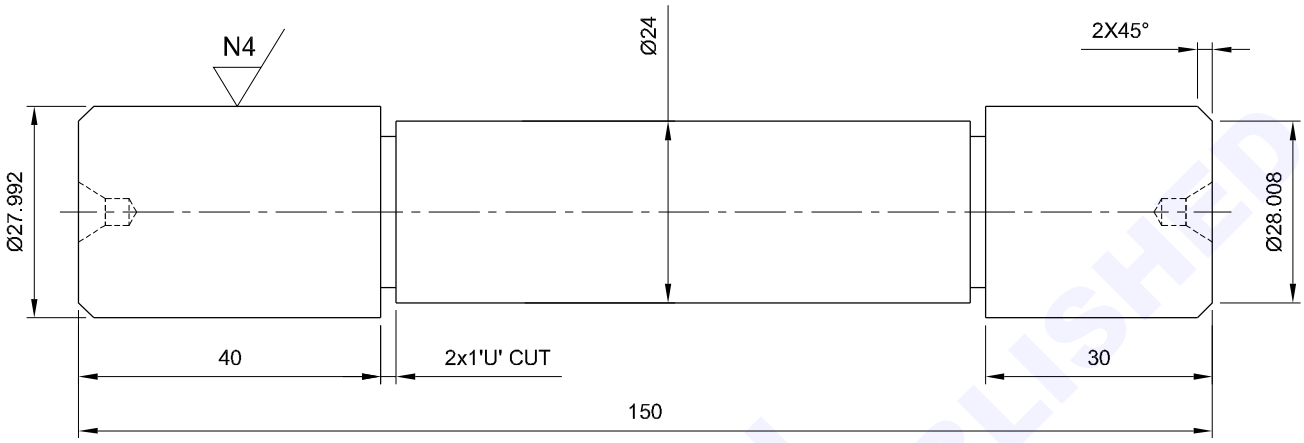
Fig 2



MEASURING WITH THE UNIVERSAL BEVEL PROTRACTOR

Plug grinding with accuracy ± 0.008mm (Surface finish N4)

Objectives: At the end of this lesson you shall be able to
- **grind the plug gauge with ±0.008mm accuracy**
- **measure the dimension using by ring gauge.**



Job sequence

Plug gauge

- Turn the job as per drawing leaving the grinding allowance.
- 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 and surface removing half of the grinding allowance.
- Finish the surface and maintain the diameter to ϕ 27.992mm on 40mm long side.
- Fit the ring gauge size.
- Reverse the position of the job in the centres.

Use a soft metal spacer if necessary to protect the job.

- Grind the No go end of the workpiece previously covered to ϕ 28.008mm on 30mm long side.
- Dress the wheel.
- Grind the workpiece to the finished size using light cuts.
  - Grind the ϕ 24mm rough and finish.
- Check the diameter of the workpiece.
- Remove burred edges
- Remove the workpiece from the centres.
- Check the gauge by plug gauge.

GEN.TOLERANCE ± 0.008 mm.
ALL DIMENSION ARE IN mm.

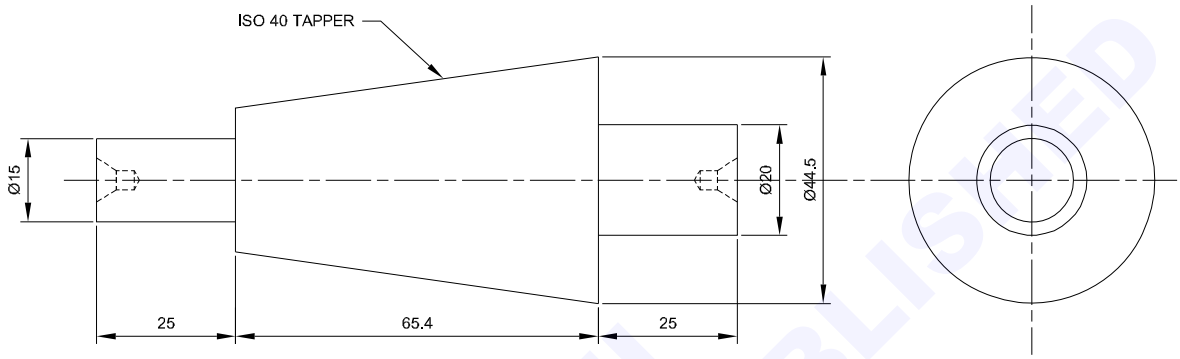
GO END : 27.992mm
NO GO END : 28.008mm

1	ISR Ø32x155	-	FE310	-	-	2.7.131
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PLUG GRINDING	DEVIATIONS ±0.008 mm	TIME
		CODE NO. MG20N27131E1	

Finish metric taper by grinding within accuracy ± 0.08mm surface finish N4

Objectives: At the end of this lesson you shall be able to
- **set the work piece**
- **set the table at an angle for IS040**
- **grind IS040 taper**
- **check the taper angle using vernier bevel protractor or sinebar.**



Job sequence

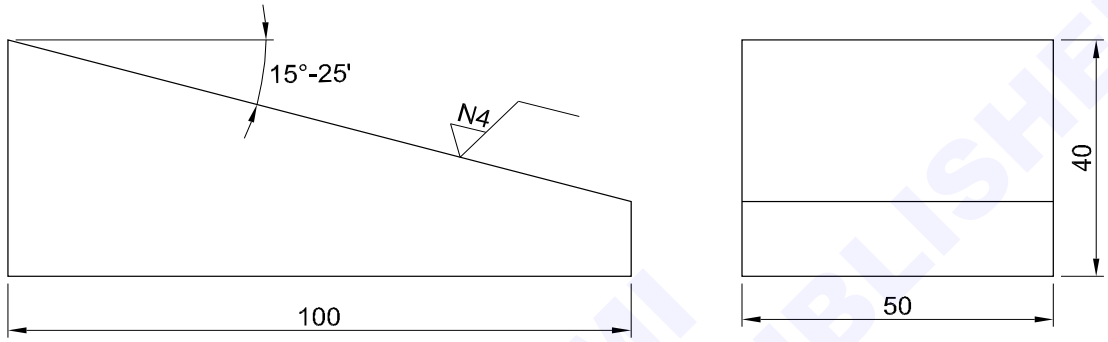
- Turn the job as per drawing leaving the grinding allowance.
- Set job on cylindrical grinding machine in between centres.
- Turn the table for IS040 taper (16° 26').
- Grind the angle and finish the dimensions within 0.08mm.
- Check the dimensions with micrometer and angle using vernier bevel protractor or sine bar.

1	ISR Ø45x125	-	-	-	-	2.7.132
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	TAPER GRINDING	DEVIATIONS ±0.01 mm	TIME
		CODE NO. MG20N27132E1	

Perform taper grinding using sine bar, D.T.I and gauge blocks to close limit h6

Objectives: At the end of this exercise you shall be able to
- **set the work using sine bar, DTI and slip gauge**
- **grind taper within close limit h6**
- **check the taper by sine bar, slip gauge, DTI (dial test indicator)**



Job sequence

- Check the block of premachined job with grinding allowance 0.5mm.
- Measure the workpiece to determine the grinding allowance.
- Dress the wheel.
- Select set of slip gauges to the required angle and build up the height of slip gauges.
- Set the magnetic chuck on the table and align with dial test indicator.
- Set the workpiece on sine bar.
- Rough and finish grind the workpiece.
- Stop the machine completely.
- Check the angle with vernier bevel protractor and with sine bar, slip gauge blocks, DTI accurately.

1	101x51x41mm	-	CAST IRON	-	-	2.7.133
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	TAPER GRINDING USING SINE BAR	DEVIATIONS ± 0.008	TIME
		CODE NO. MG20N27133E1	

Skill sequence

Checking angles

Objectives: This shall help you to
- **check the angle using vernier bevel protractor**
- **check the angle using sine bar, slip gauge and DTI.**

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.
- Wring 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 flush to sine bar edge.

Check angular face

- Position dial indicator on surface plate with dial stylus engaged on one end of workpiece face. (Fig 2)
- 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.

Fig 1

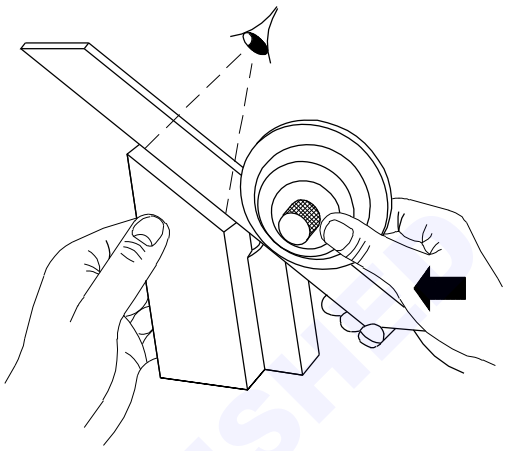
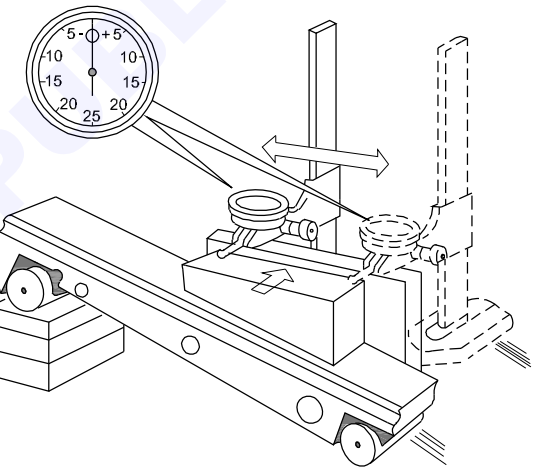
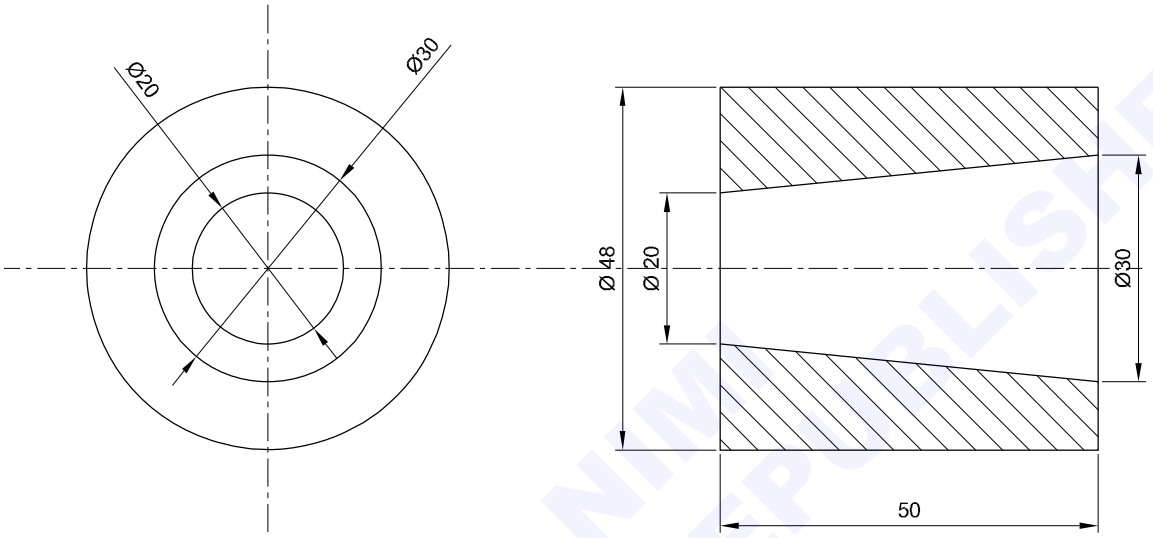


Fig 2



Grind taper up to close limit H6

Objectives: At the end of this exercise you shall be able to
- **mount the work for taper grinding**
- **set the table for taper grinding**
- **rough grind taper**
- **finish grind the taper**
- **check the taper using sine bar with an accuracy of ± 1 minute.**



Job sequence

- Turn the part as per drawing with required grinding allowance
- Measure the taper bore diameter
- Dress the wheel for roughing cut (by using carborundum dressing stick)
- Hold the job in four jaw chuck.
- Select suitable internal grinding wheel spindle and fix it to internal attachment.
- Connect the belt between motor and internal grinding spindle and fix the guard
- Set the stroke length and set spindle speed
- Grind minimum material and check the taper
- Rough grind and check with taper plug gauge
- Dress the wheel for finishing cut
- Remove sharp corners and remove work piece from chuck.

$$\tan\theta = \frac{D - d}{2\ell}$$

$$\tan\theta = \frac{30 - 20}{2 \times 50}$$

$$\tan\theta = \frac{10}{100} = \frac{1}{10} = 0.1$$

$$= 5^\circ\ 42'$$

1	ISR Ø50x55	–	Fe310	–	–	2.8.134
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	TAPER CYLINDRICAL GRINDING				DEVIATIONS ±0.03 mm	TIME :6hrs
					CODE NO. MG20N28134E1	

Skill sequence

Sine bar

Objective : This shall help you to
- **construct the sine bar.**

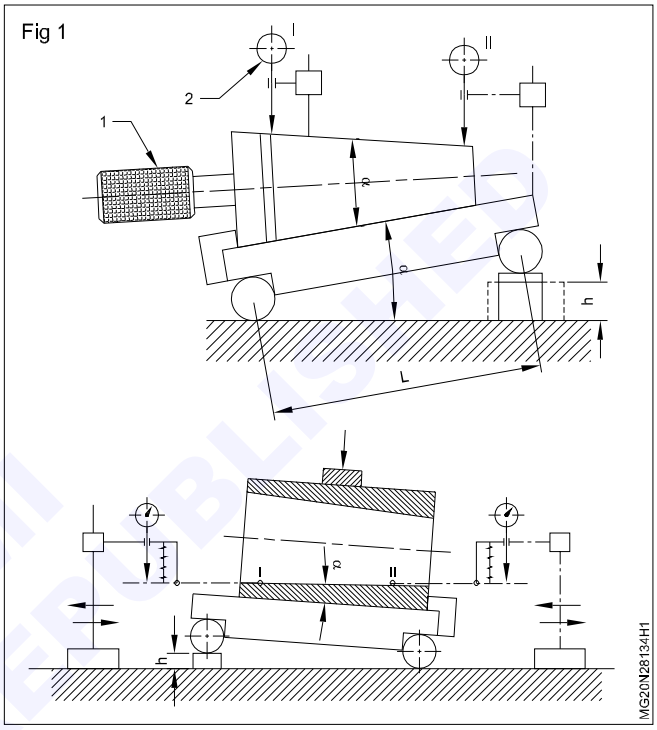
A special ruler in the form of a right parallel piped with a cylindrical roller or sphere at each of the two ends. Sine bars are used to compute angles in the manufacture or measurement of parts, for example, cones and wedges.

In operation, a gauge block is placed under one roller of the base of the sine bar. The height of the gage block h is calculated according to the formula h = sin, where is the angle at which the plane of the sine bar must lie and L is the distance between the axes of the rollers. The distance between the rollers usually 100 to 500 mm, and the angle is set in one direction or in two mutually perpendicular directions. The part being measured or worked is placed on the flat surface of the sine bar or in centers. Sine bars are most often used together with a dial guage for determining the angle error of taper gauges. The sine bar is adjusted to the nominal angle of the taper, the deviation from the horizontal formed by the taper relative to the base of the sine bar is read from the dial gauge.

Angle measurement using a sine bar (Fig 1): (a) external tape, (b) internal taper, (1) taper gauge, (2) dial gauge; (i) and (ii) positions of the dial gauge.

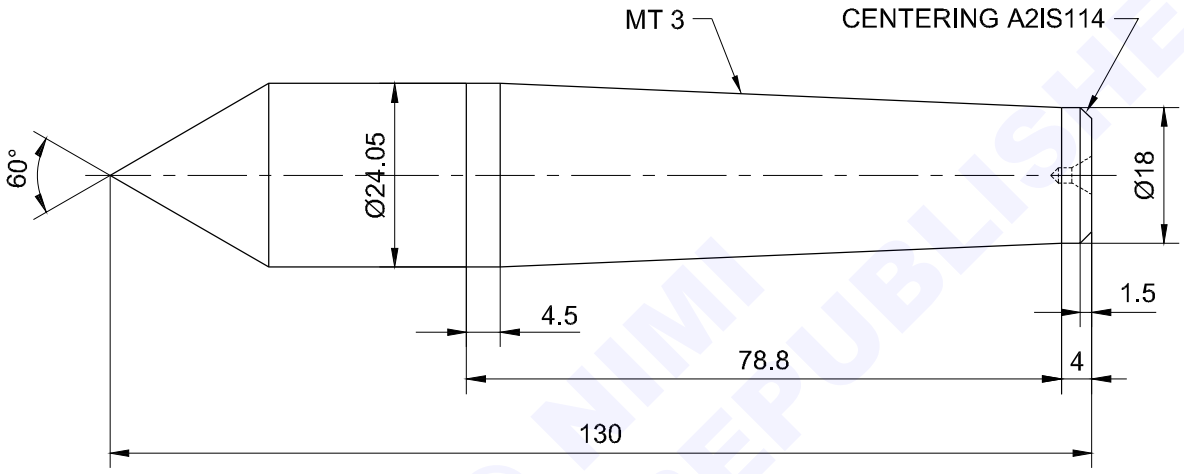
Sine bars are usually used to set angles from 0' to 45' with an error from 4" to 15" depending on the nominal distance between the rollers, the magnitude of the angle at which the sine bar is used, for example, in the design of various instruments for the transmission of motion at an angle to the primary motion and in attachments for metal-cutting machines used to work parts with inclined surfaces.

Fig 1



Grind lathe centre within h7

Objectives: At the end of this exercise you shall be able to
- **hold the job in work head spindle nose**
- **swivel the work head for grind conical surface**
- **regrinding the conical point of centre with an accuracy of 5'**
- **check the taper with a vernier bevel protractor.**



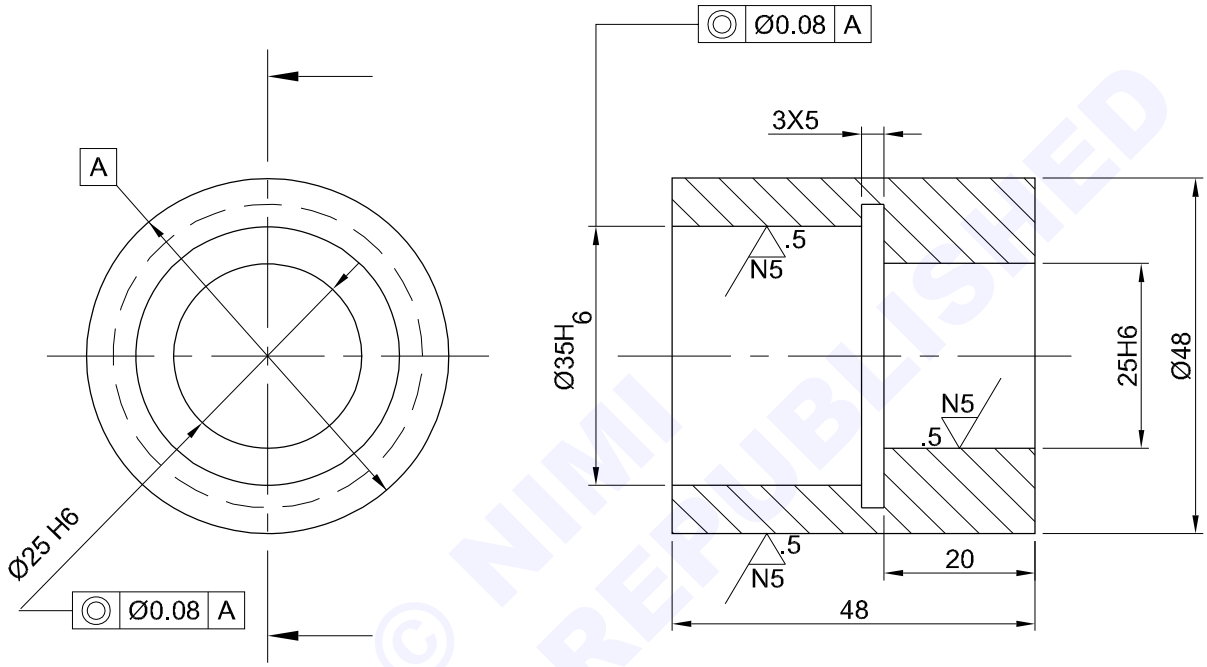
Job sequence

- 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 male and female centres.
- Tilt the table to 1°20: 4" to grind MT 3 taper.
- Set the table traverse dog to grind 74.3 mm 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.

1	PREMACHINE JOB EX 2.5.120	–	Fe310	–	–	2.8.135
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	GRINDING OF LATHE CENTRE				DEVIATIONS 5 Min.	TIME
					CODE NO. MG20N28135E1	

Perform internal step grinding to close limit H6

Objectives: At the end of this exercise you shall be able to
- **set the machine for grinding internal surfaces**
- **set workpiece and adjustment of table traverse length**
- **grind the internal bore maintaining concentricity within close limit.**



Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Mount the quill head and fix the appropriate grinding wheel.
- Mount the workpiece in the 3 jaws chuck.
- Check the concentricity by Dial test indicator.
- Adjust the coolant.
- Set stoppers to adjust the table traverse length accurately.
- Rough and finish grind the bore ∅35 H6.
- Check the finish part by inside micrometer.
- Rough and finish grind the bore ∅25 H6.
- Check the finish part by inside micrometer.
- Check the concentricity using Dial test indicator.

1	ISR Ø50x52	-	Fe 310	-	-	2.8.136
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**INTERNAL STEP GRINDING TO CLOSE LIMIT (RING GAUGE GRINDING)**				DEVIATIONS ± 0.03 mm	TIME
					CODE NO. MG20N28136E1	

Skill sequence

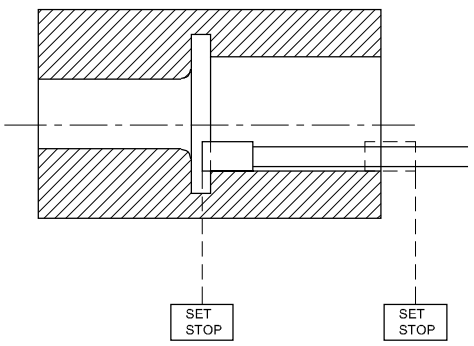
Grinding a bore and shoulder

Objective : This shall help you to
- **grind the bore and shoulder.**

General information

For this particular requirement two procedures are adopted. Firstly the bore is ground to size as covered in previous chapter, and secondly, a procedure is used to grind the face of the shoulder. In work of this nature an undercut may not be required in the finished workpiece and the undercut shown in the following illustrations is used purely as an aid to the grinding process. (Fig 1)

Fig 1



GRINDING A BORE AND SHOULDER

1 Measure workpiece

Check diameter and depth of bore.

2 Mount workpiece

3 Mount spindle and wheel

Select a recessed type wheel, ensuring that the head at the securing screw will seat below the face of the grinding wheel.

4 Dress wheel for roughing out

Apply slight angular relief to the front face of wheel.

5 Set table traverse stops

6 Clean up the bore

7 Measure bore size and parallelism

8 Rough grind bore to within 0.25mm of finished size.

9 Dress wheel for finish grinding

10 Finish grind bore

Final index reading

11 Measure bore

Safety

Before attempting to measure the bore. Switch OFF the job rotation and grinding wheel rotation completely.

12 **Check wheel diameter**

The wheel diameter must be of a size that will grind the face flat. In the example shown, the wheel diameter must not be greater than bore radius plus the central hole radius, or less than bore radius minus the central hole radius.

13 **Dress the front face of wheel**

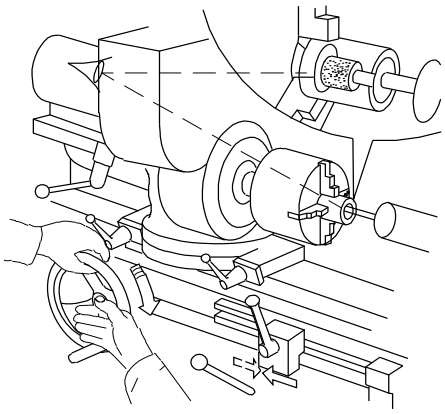
- Apply slight angular relief.
- Slightly relieve wheel diameter, leaving approximately 3.2 mm and at front.

14 **Grind shoulder face**

- Start workhead
- Working to the infeed index, position the wheel to clear the finished bore diameter by approximately 0.02 mm.
- Hand traverse table, to position the wheel inside the bore and just clear of shoulder face.

  The line previously marked upon the spindle will give indication of distance between wheel and face.
- Traverse table very slowly until sparks or sound indicate the wheel is grinding the face.
- With the left hand holding the traverse wheel to act as a brake, gently tap the handle with the right hand to advance the workpiece on to the wheel. (Fig 2)

Fig 2



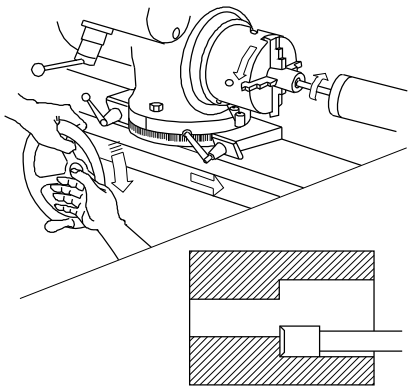
GRINDING A BORE AND SHOULDER

Very small movement is necessary. Take extreme care in applying feed, as too heavy a cut will tend to make the spindle whip, causing the wheel to bite into the finished bore.

- Clear workpiece from wheel and visually check face has fully cleaned up. Take further cuts until a satisfactory condition is achieved. Allow wheel to “spark out”.

- Re-dress the front face of wheel.
- Position wheel in bore.
- Adjust infeed index to bring the wheel within 0.002mm of the bore diameter.
- Traverse table until contact is made and apply feed as in Fig 3.

Fig 3



MG20N28136H3

GRINDING A BORE AND SHOULDER

If a reasonably square corner is required, it will be necessary to re-dress the wheel face frequently as the corner of the wheel tends to break down.

- Clear workpiece from wheel, stop workhead.

15 Remove sharp corners

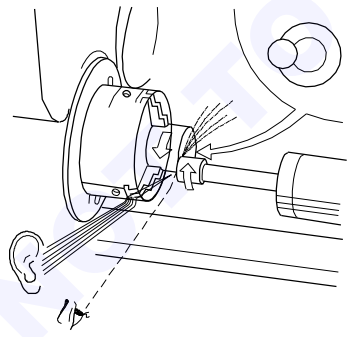
16 Check depth

17 Remove workpiece from machine

Grinding a face(Fig 4)

This type of operation is generally carried out to ensure that the face of the workpiece is square to the axis of the bore.

Fig 4



MG20N28136H4

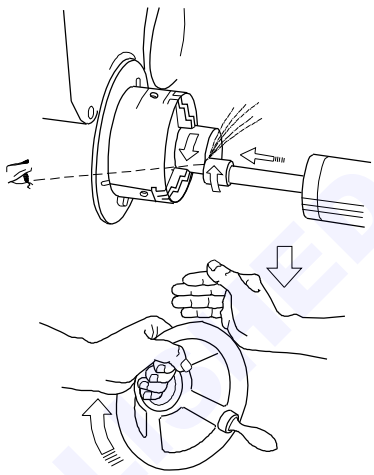
GRINDING A FACE

Basically the procedure is similar to that for grinding a shoulder, and is a secondary operation following the grinding of the bore.

- Finish grind bore
- Mount spindle and grinding wheel
  - Select and mount short robust spindle.
  - Select and mount a recessed wheel of diameter larger than the width of face to be ground. Ensure the head of the securing screw is below the wheel face.
- Dress the wheel

  Apply slight angular relief to the front face.
- Grind the face (Fig 5)

Fig 5



MG20N28136H5

GRINDING A FACE

  - Start workhead.
  - Use hand traverse, to position the wheel square to and just clear of the face to be ground.
  - Traverse table slowly, until the wheel lightly contacts the face.

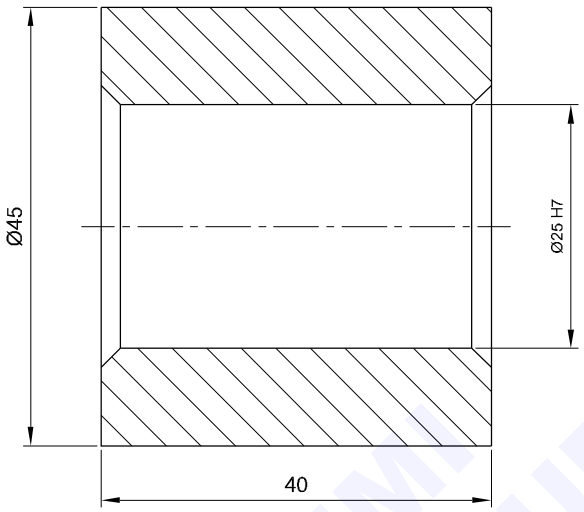
Safety

Safety glasses must be wear.

- With the left hand holding the traverse wheel to act as a brake, gently tap the handle with the right hand to advance the workpiece on to the wheel. (Fig 5)
- Very small movement is required. Extreme care should be taken in applying cuts, as too heavy a cut will tend to make the spindle whip. Allow wheel to spark out.
- Clear workpiece from wheel and visually check face has fully cleaned up.
- Re-dress face of wheel as necessary.
- Take further cuts as necessary, until a satisfactory condition is achieved.
- Clear workpiece from wheel, stop work head.
- Check surface texture and flatness of face.
- Remove sharp corners.
- Remove workpiece from machine.

Grind ring gauge to close limit-H7

Objectives: At the end of this lesson you shall be able to
- **mount the internal grinding attachment**
- **measure the bore diameter by using telescopic gauge**
- **grind the plain hole of ring gauge**
- **set the job in four jaw chuck by using dial test indicator.**



Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- 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.
- Hold the job between centre.
- Complete the external grinding.
- Take the grinding wheel inside the bore with rotation of bolt job and wheel manually till grinding wheel touches the job make few setting.
- Start the coolant supply.
- Make repeated cuts until close to the desire size.
- Dress the wheel for finish grinding.
- Grind the bore diameter to 25mm.
- Check the bore size using by telescopic gauge.
- Remove the job from the chuck.
- Remove burrs edges.
- Reset and hold the job on taper mandrel for external grinding.
- Check and diameter of the job Go and NOGO gauge and outside micrometer.

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.

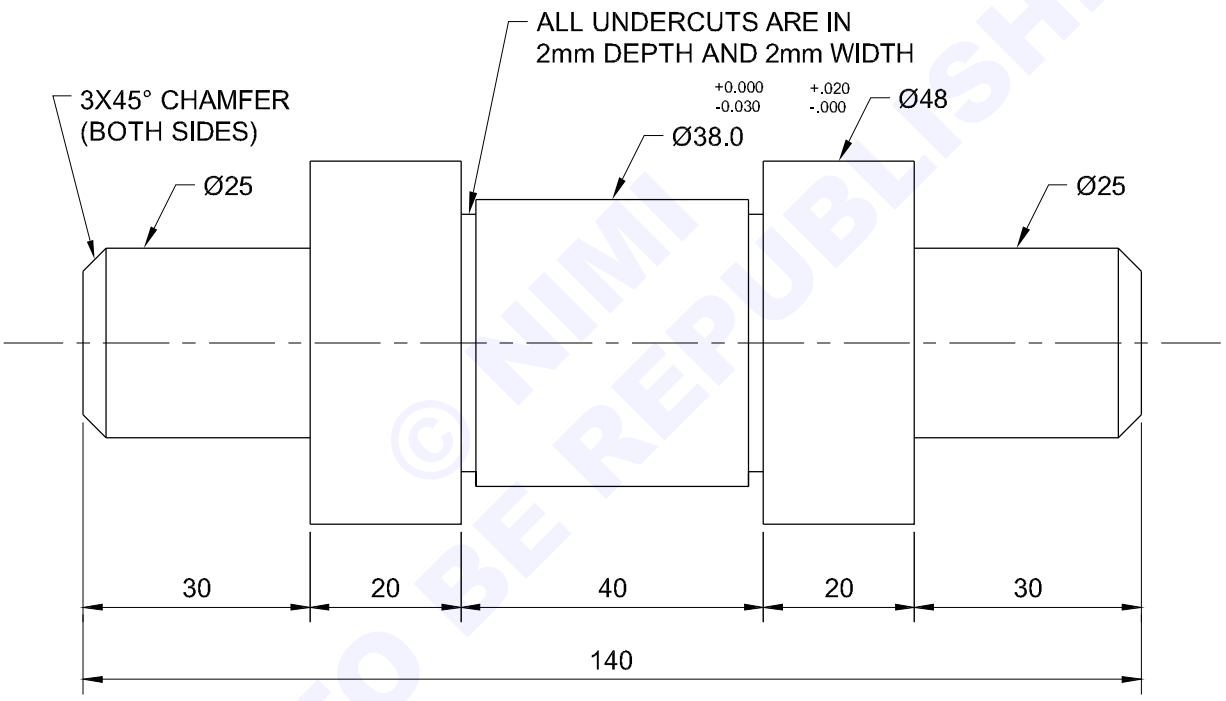
ALL DIMENSION ARE IN mm

1	ISR Ø50X45	-	FE310	-	-	2.8.137
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	GRIND RING GAUGE				DEVIATIONS ±0.03 mm	TIME
					CODE NO. MG20N28137E1	

Perform slot grinding to close limit h5

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

- **dress the side of grinding wheel by using diamond dresser**
- **grind the different slot with an accuracy of ±0.01mm**
- **measure the dimension with an outside vernier micrometer.**



1	ISR Ø50x145	–	Fe310	–	–	2.8.138
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	SLOT GRINDING	DEVIATIONS ±0.01 mm	TIME
		CODE NO. MG20N28138E1	

Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Prepare the machine and dress the grinding wheel for grinding shoulder surfaces.
- Mount the job in between centres.
- Rough and finish grind the slot 25mm to maintain the 30mm length of job.
- Dress the side of the wheel.
- In the same setting rough and finish grind the length of shoulder surface at 90°.
- Dress the grinding wheel for the grinding of other end.
- Remove the job from the centres.
- Reverse the position of the job in the centres.
- Grind the other end of the shoulder.
- Measure the dimension using by outside vernier micrometer.
- Check the all dimension of job.

— — — — — — —

Skill sequence

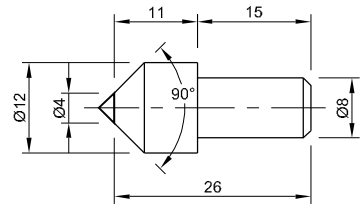
Dressing of the grinding wheel for slot cylindrical grinding

Objective : This shall help you to
- **dress the grinding wheel for shoulder cylindrical grinding.**

Installation of dresser

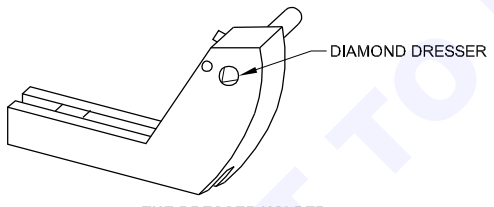
Fix the diamond dresser is shown in (Fig 1) firmly to the diamond holder shown in (Fig 2).

Fig 1



EXAMPLE OF DIAMOND DRESSER

Fig 2



THE DRESSER HOLDER

In the above case, if the projection of the dresser is too great it cause vibration so make the dresser as short as possible.

The diamond dresser should be fixed to the holder by turning the shank in such a way that the toe edge of the diamond dresser is always seen.

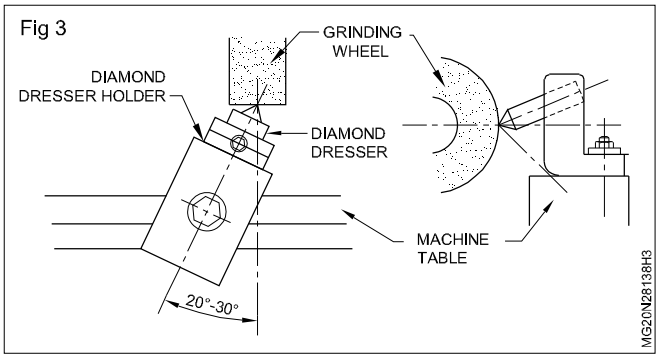
If the toe edge of the diamond dresser becomes very worn out and flat, such a dresser should not be used and must be adjusted.

Installation of the holder

Clean the table with waste cloth.

Fix the holder firmly on the table in such a way that the dresser inclines 5 to 10 degrees up and down and 20 and 30 degrees from the direction of moving. (Fig 3)

Fig 3



Dressing the side of a grinding wheel

Objective: This shall help you to
- **dress the side of a grinding wheel.**

- Dressing the side of a grinding wheel with a single point diamond dresser.
- Mount the dressing attachment on work table.
- Hold the dresser in attachment of side position.

- The wheel head slide is moving a back and forth.
- Move the table to side of the grinding wheel nearest.
- Switch on the grinding wheel and slightly touch the dressing on side of the wheel.
- Rough dressing 0.02 mm cut to giving a feed of 0.01mm.
- Make an adequate feed at the required side of the grinding wheel.

For finish dressing the depth of cut is 0.01 mm.

- In the case of precision grinding repeat the same depth of cut two times.
- Avoid the overhanging of the dresser from the dressing holder.

Grinding shoulders

Objective: This shall help you to
- **grind the shoulder of cylindrical jobs.**

To produce a cylindrical component with two different diameters, a wheel dressed to the desired profile may be used. The grinding operation is performed without traverse and the width of the wheel must be sufficient to extend beyond each end of the workpiece.

Where the grinding operation is restricted, stops may be fitted to the worktable to make it easier to set up the wheel truing device between each grinding operation. Follow the general grinding rules given previously in this book.

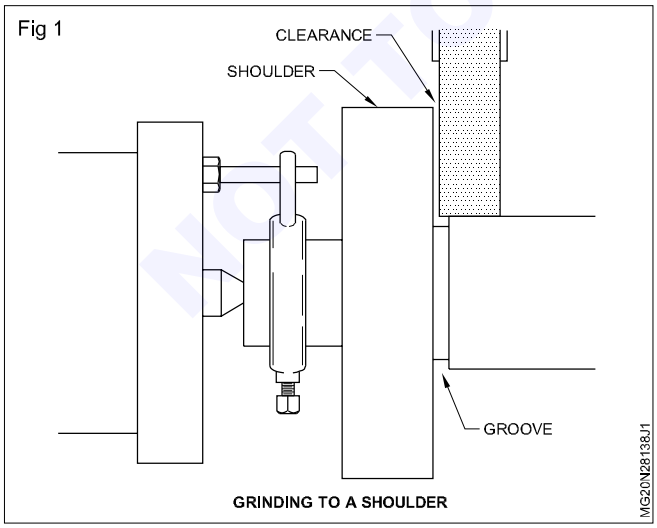
Care must be taken in positioning the work piece beneath the wheel to ensure that the required dimensions of the shoulder are obtained.

Grinding a surface to a shoulder (Fig 1)

For grinding a surface adjacent to a shoulder on a workpiece a groove is provided in the workpiece near the shoulder. This permits the grinding wheel to traverse the surface completely without coming into contact with the face of the shoulder. The groove may be turned on a lathe or ground with a narrow cutting -off wheel. A square corner is produced by this method.

– Follow the general grinding rules.

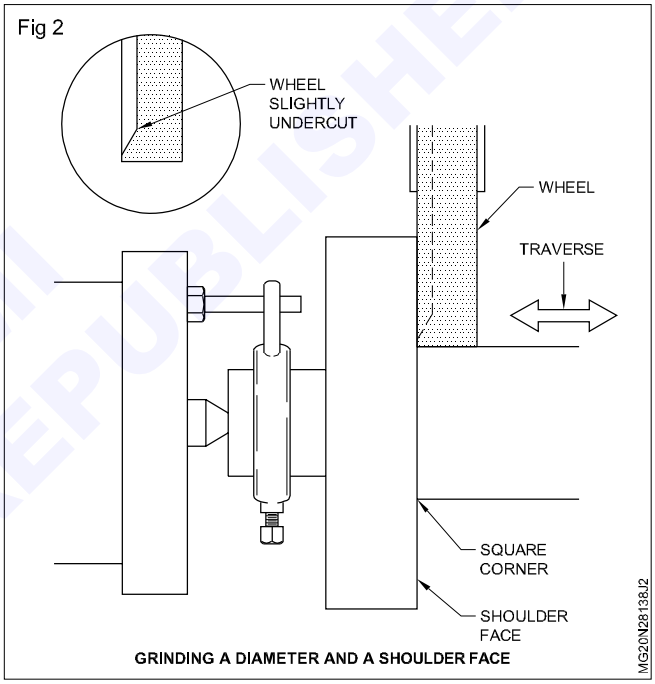
Fig 1



GRINDING TO A SHOULDER

Grinding parallel diameters and shoulders (Fig 2)

Fig 2



GRINDING A DIAMETER AND A SHOULDER FACE

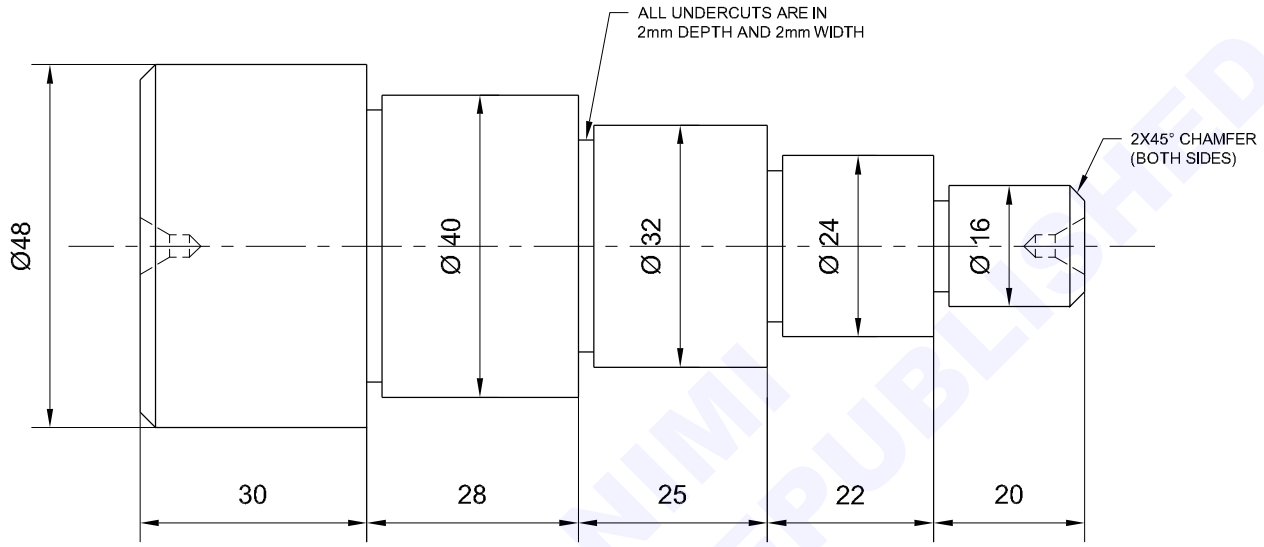
In this case a dished wheel with a slightly undercut face is used to traverse the parallel diameter and lightly contact the face of the shoulder at the end of the traverse. The wheel is undercut to ensure a square corner where the face of the shoulder and the parallel diameter meet. In the absence of the undercut, the edge of the wheel will wear rapidly and produce a radius instead of a square corner. The wheel is dressed with undercut by a diamond tool dressing.

Where the shoulder is relatively small the wheel may be fed into the work at the position of the shoulder until the desired sizes are obtained. The rest of the parallel surface is then traversed to size. In this case, undercutting of the wheel is not necessary as the slight radius produced at the shoulder is usually of no consequence.

Follow the general grinding rule.

Perform cylindrical step grinding

Objectives: At the end of this exercise you shall be able to
- **dress the grinding wheel**
- **grind the different steps with an accuracy of ± 0.01mm**
- **measure the dimension with an outside micrometer.**



Job sequence

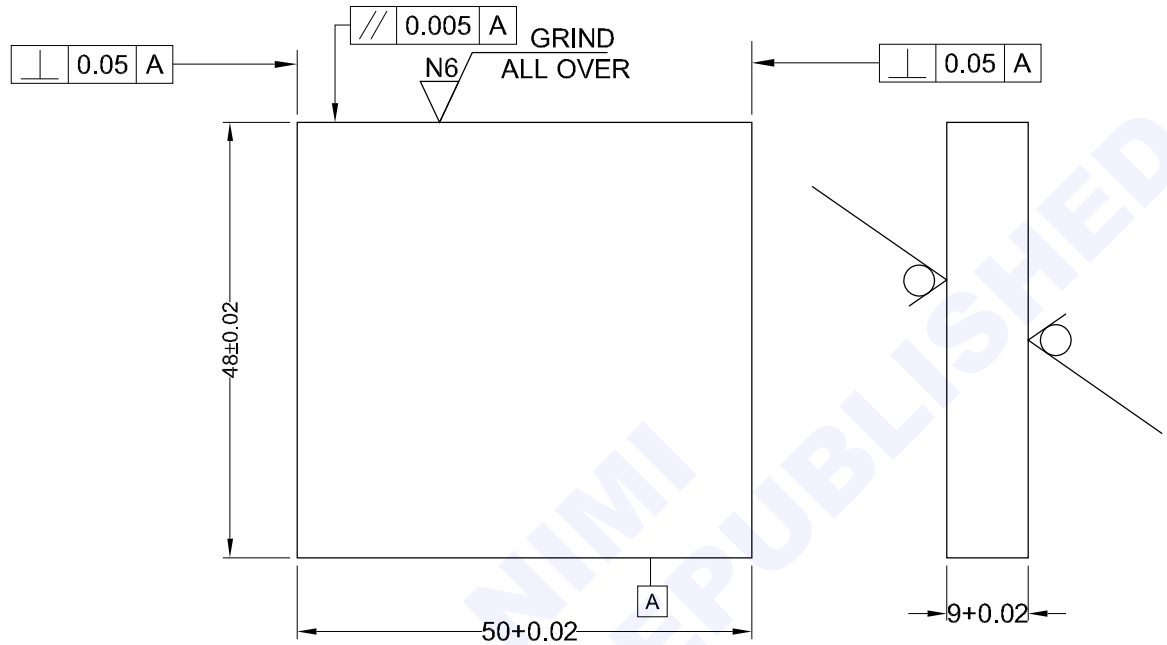
- Study the job drawing
- Turn the job as per drawing in the lathe
- Maintain the size with in grinding allowance
- Prepare the machine, chuck and grinding wheel for the cylindrical grinding operation
- Dress the grinding wheel with help of diamond dresser
- Mount the job in between centres.
- To maintain the accuracy of ± 0.01mm for all grinding sizes.
- Grind the step ϕ 40 X 28mm rough and finish grinding.
- Grind the step ϕ 32 X 25mm rough and finish grinding.
- Grind the step ϕ 24 X 22mm rough and finish grinding.
- Grind the step ϕ 16 X 20 mm rough and finish grinding.
- Remove and revers the job and grind the step ϕ 48 X 30 mm.
- Measure the dimensions using outside micrometer.

1	ISR Ø50x130		Fe310	-	1	2.8.139
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		**STEP GRINDING**			DEVIATIONS ±0.01	TIME
					CODE NO. MG20N28139E1	

Exercise 2.9.140

Perform lapping practice on flat surface

Objectives: At the end of this exercise you shall be able to
- **select abrasive powder and laps for hand lapping**
- **practice hand lapping**
- **check the lapping surface.**



Job sequence

- Study the drawing and grind the job as per drawing and maintain the size with lapping allowance.

Lapping Practice on flat surface

- Clean and check the workpiece to determined lapping allowance.
- Selection of lapping compound i.e abrasive dust of proper grain size for roughing and finishing lap.
- Place roughing abrasive dust on roughing lap plate and cutting oil is mixed with abrasive dust.
- The surface of workpiece is touched with abrasive and cutting oil mixture.
- The work piece is moved in such a way that the path of movement is followed looks like english letter eight i.e. '8' to avoid surface scratch by cross cutting surface texture i.e. surface roughness mark.
- Then clean the roughing lap plate and work piece.
- Again for finishing lapping, select the finishing lapping plate.
- Take abrasive dust and entering oil in finishing lapping plate and move the work piece similarly.
- Finish lapping the workpiece.
- Check surface finish.

ALL DIMENSION ARE IN MM

1	ISR 55x50x10	-	Fe 310	-	-	2.9.140
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	LAPPING PRACTICE ON FLAT SURFACE				DEVIATIONS ± 0.02mm	TIME
					MG20N29140E1	

Precautions:

- Always keep the lap moist.
- While lapping use the entire surface of the lapping plate.
- Do not give any excessive pressure.
- Check the surface roughness with standard set of roughness sample.

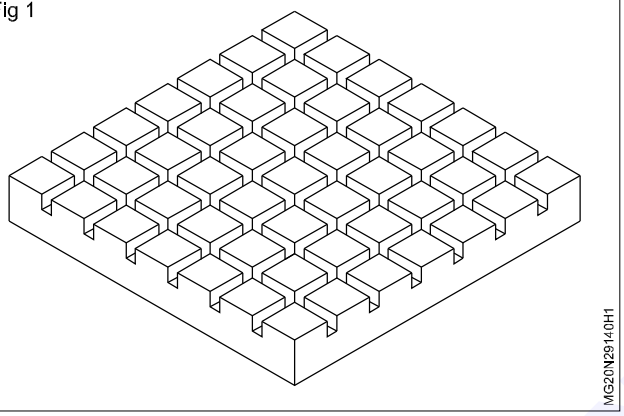
Skill Sequence

Lapping flat surfaces

Objective: This shall help you to
- **lap flat surfaces using a lapping plate.**

For lapping flat surfaces, a rigid cast iron plate - machined perfectly flat with grooves cut on it (Fig 1) can be used as a lapping plate.

Fig 1



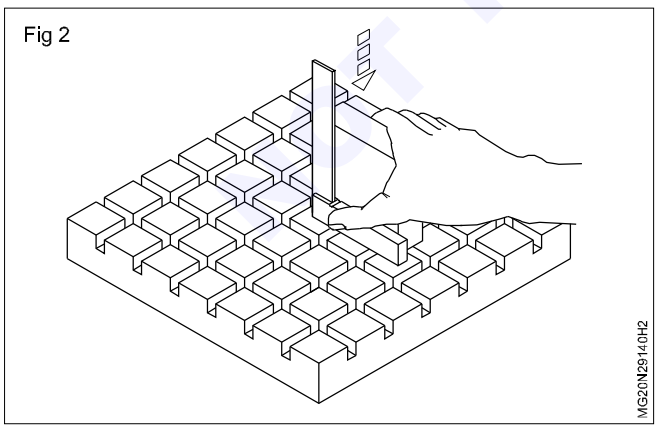
This lapping plate should be kept flat without any rocking on the workbench.

Aluminium oxide may be used as a lapping medium as the workpiece is unhardened steel.

Smear the lapping medium on the plate and charge that surface.

The section of the workpiece being very thin, use a machined and ground cast iron block to put against the workpiece while lapping. This will assist to keep the workpiece perpendicular while lapping. (Fig 2)

Fig 2

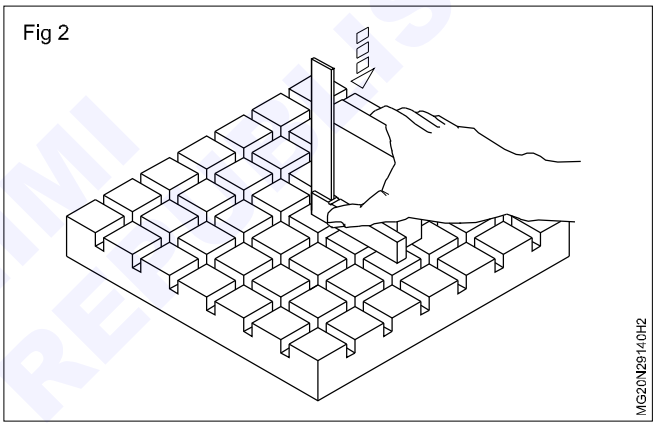


The method of holding the workpiece should be such that it moves along the lapping plate without any tilting or rocking.

Apply downward pressure with finger tips while moving the work.

Use the entire surface of the lapping plate while lapping (Fig 3) to avoid wear on the plate in different small areas.

Fig 2



Do not dwell in one place while lapping.

The lapped surface can be identified by the dull surface. Lapping should be continued until the entire surface being lapped has a dull appearance.

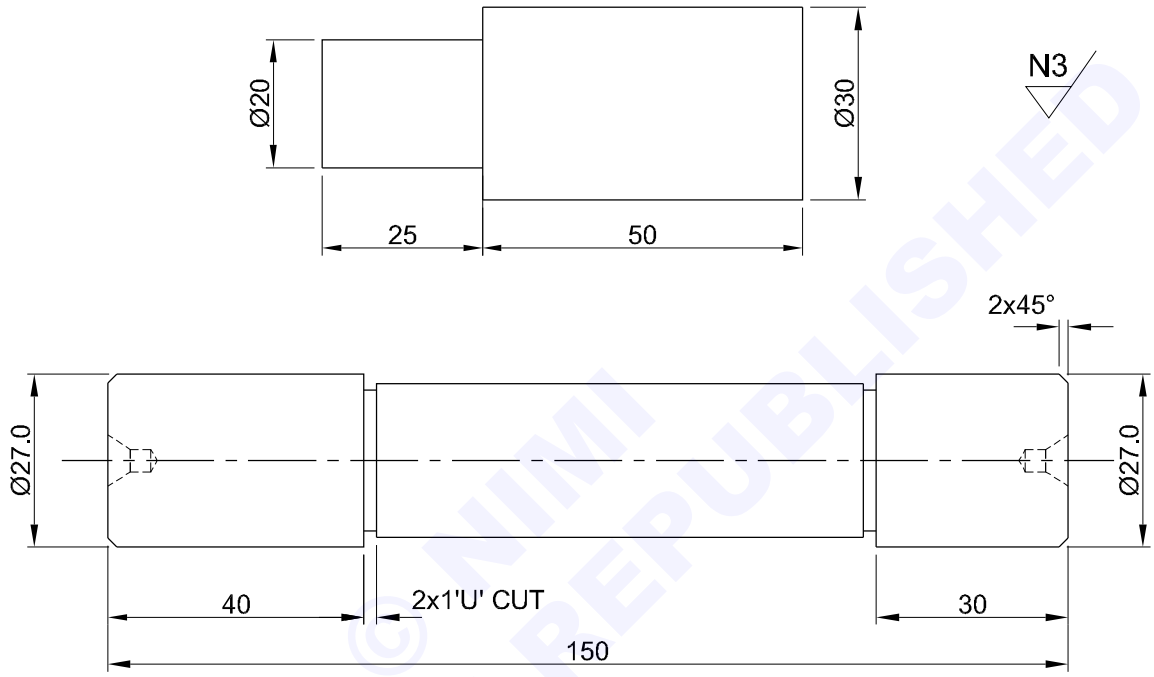
When the entire surface is lapped, clean the surface with kerosene and inspect the workpiece.

The surface texture of the surface being lapped should show a dull appearance.

Exercise 2.9.141

Perform lapping practice on cylindrical surface

Objectives: At the end of this exercise you shall be able to
- **practice on cylindrical surface lapping**
- **grind the job close limit**
- **select the suitable abrasive compound.**



Job sequence

- Grind the job as per drawing dimension (∅ 27 0 X 30.0 length and ∅ 27 0 X 40.mm) and maintain the size with lapping allowance for ∅ 27 0 X 30 mm surface
- Lapping external cylindrical surface (shaft) manual process.
- Prepare the shaft as per drawing.
- Hold the job in bench vice/lathe.
- Select a adjustable ring lap.
- Charge the abrasive compound in adjustable ring lap.
- Insert the abrasive ring lap on cylindrical surface.
- Rotate and slide the ring lap forward and backward along the cylindrical surface.
- Apply light pressure while lapping.
- Clean the lapped cylindrical surface with kerosene and wipe with soft cloth.
- Check the shaft size using vernier micrometer.
- Match shaft with hole.
- Apply thin coat of oil and preserve it for evaluation.

ALL DIMENSION ARE IN MM

1	ISR Ø35x80	-	Fe 310	-	-	2.9.141
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	LAPPING PRACTICE ON CYLINDRICAL SURFACE				DEVIATIONS ± 0.02mm	TIME
					CODE NO. MG20N29141E1	

Skill Sequence

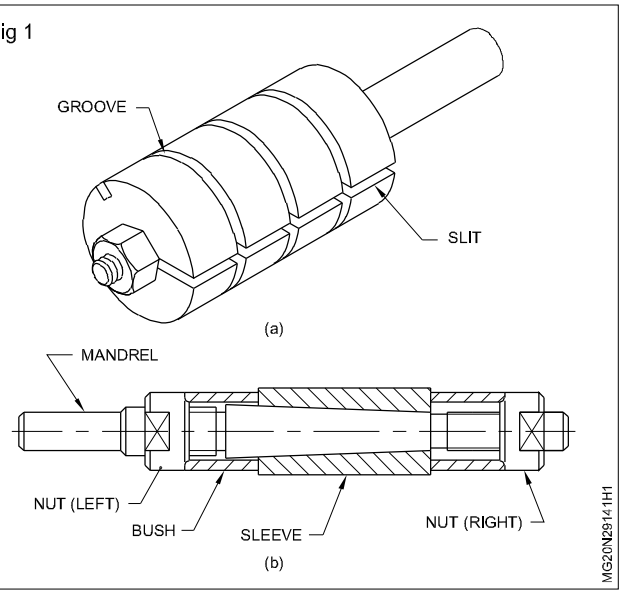
Lapping holes and cylindrical surfaces

Objective: This shall help you to

- **lap on internal and external cylindrical surfaces.**

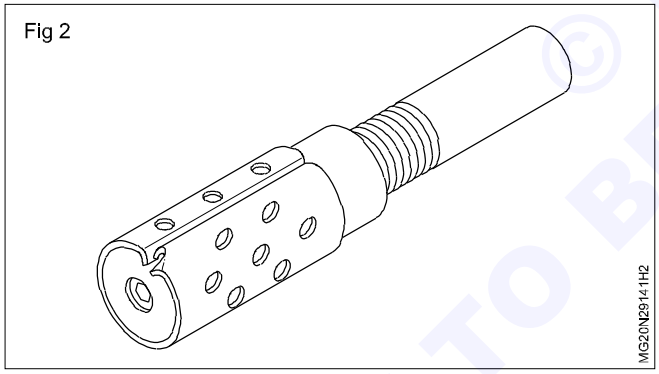
Solid or adjustable types of laps are used for lapping internal cylindrical surfaces/holes (Fig1). Adjustable lap have interchangeable sleeves made of copper.

Fig 1



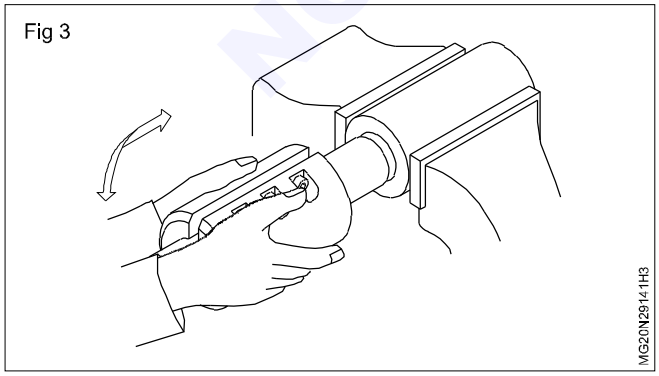
Laps are sometimes provided with holes which can hold the lapping compound. (Fig 2)

Fig 2



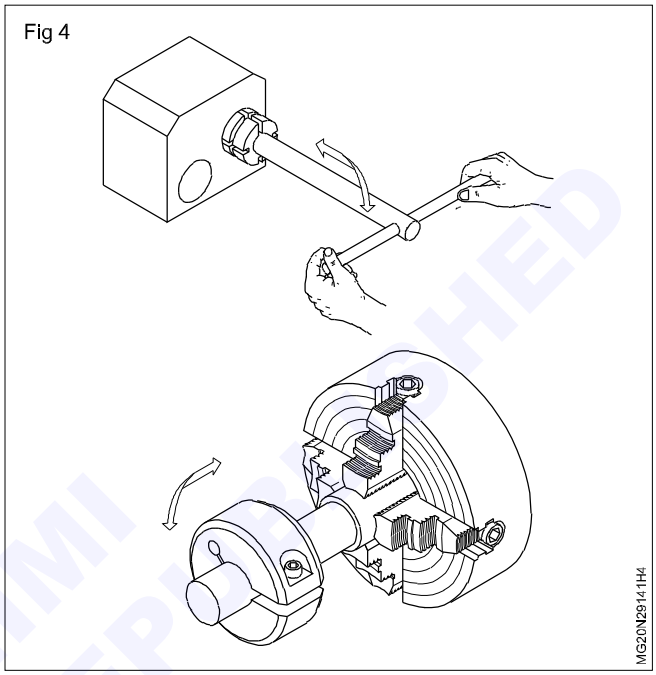
Ring lapping can be done manually Fig 3 or by holding the work on the lathe while the split ring is moved over the cylindrical surface.

Fig 3



The lap should not be removed from the hole while lapping, and should travel the full length of the bore Fig 4.

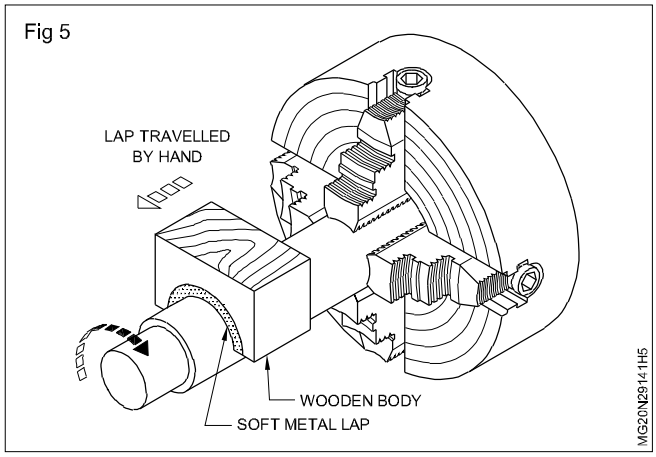
Fig 4



While lapping, the ring lap should slide forward and backward along the workpiece - rotating the lap at the same time in alternate directions.

For lapping large diameters, special laps can be prepared and used Fig 5.

Fig 5

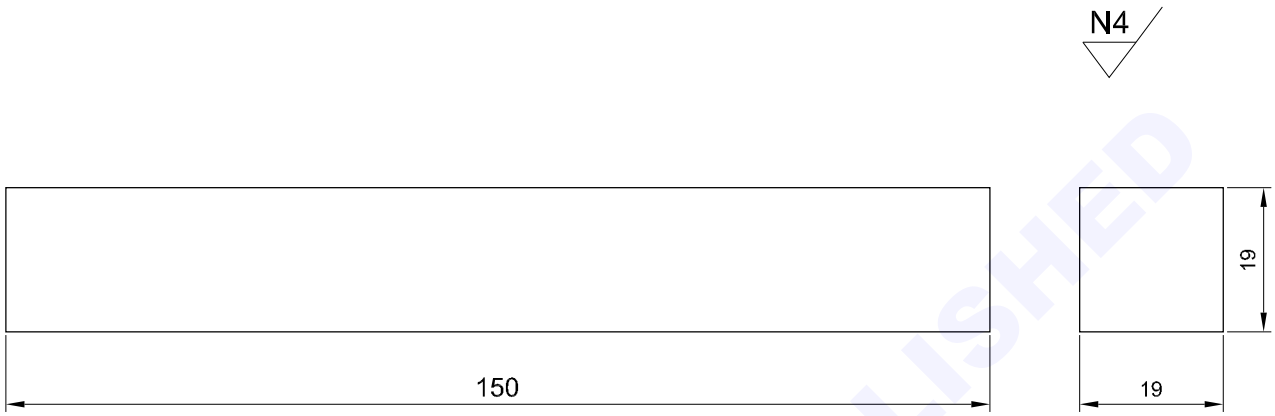


Precautions to observed while lapping:

- Do not dwell in the same place while lapping.
- Keep the lap moist always.
- Do not add fresh abrasive during lapping; recharge if necessary.
- Do not apply excessive pressure while lapping.

Perform buffing to close limit h5

Objectives: At the end of this lesson you shall be able to
- **select the buffing machine**
- **buffing the job to close limit h5**
- **grind the surface.**



Job sequence

- Study the drawing, cut the job as per drawing.
- prepare the surface grinder.
- Set the job on machine table.
- Grind the Job all surface.
- Set the Buffing wheel in The Buffing machine.
- Buffing the job to given size 150 X 19 mm
- Measure the dimension using by vernier micrometer.
- Check the surface after Buffing.

1	ISSQ □20X154	-	FE310	-	-	2.9.142
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	PERFORM BUFFING TO CLOSE LIMIT h5				DEVIATIONS ±0.02 mm	TIME
					CODE NO. MG20N29142E1	

Skill Sequence

Buffing process

Objective: This shall help you to
- **define buffing process**
- **state application of buffing process**
- **state advantage and disadvantage of buffing process.**

Buffing

The term buffing is a super finishing process in which there is a buffing wheel (attached with abrasive disc) that is used to remove the bus or unwanted material from the work piece for smoothing the surface of the work piece.

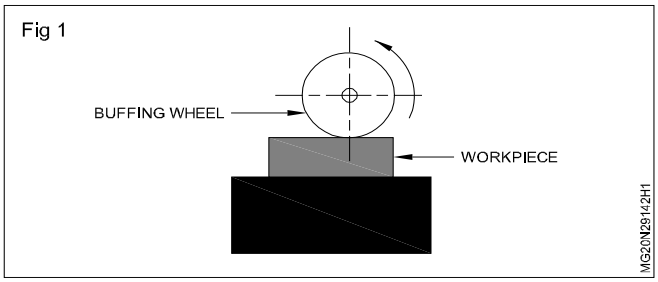
The other definition you can write is,

The buffing process is used to shine wood, metal, composites using a cloth wheel impregnated with cutting components or rough. In the cloth, there is an abrasive disc that works is to remove or cut and get a better surface finish.

This process is perform after polishing process. for providing a high luster to be polished surface. Here is buffing process diagram: The amount of material removal is very less because it is a superfinishing operating this operation helps for providing good surface finishing.

Buffing process line diagram

Fig 1



Buffing wheel construction:

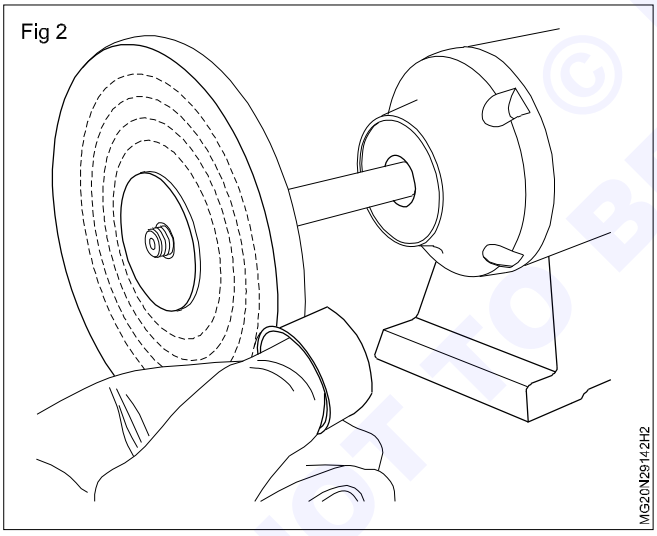
The buffing wheel used in this process is made up of cloth (like, wool, flannel, cotton, muslin, or fiber which is charged with loose abrasive grains.

Buffing process:

The buffing wheel is made linen, cotton, broad cloth and canvass and it is made by multiple layers of these cloths overlapped on each other.

When we perform an operation the wheel is attached with the tool holder and when operation starts it rotates during at a speed of 32. 5 -40 m/s and a small pressure applied on the wheel which promotes abrasive actin and removes metal in form of microchips.

Fig 2



It is used to remove find scratches or to remove oxide similar coatings which may be on the work surface.

The almost buffing process is done manually but automatic or semi-automatic buffing processes are also available which are used for mass production in various industries. And for complex work piece, manual buffing is suitable.

Application of buffing process:

- The following application of buffing process is:
- The buffing process is used tom remove scratches, oxides, coatings from the work piece surfaces.
- Used in the automobiles sector, motorcycles, boats, bicycles, commercial and residential hardware, and much more.
- Also used in the automotive sector (components is roller bearing, connecting rod, piston, and many more).
- The process used to shine the work piece. It may be tools, fixtures, or sports items.
- The buffing process also used in household utensils and appliances.

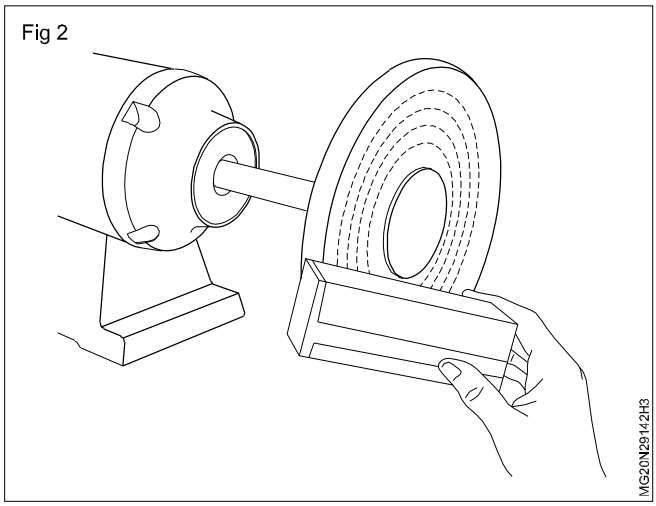
Advantage of buffing process:

- The following advantages of buffing process is:
- It does not require stripping
- Operations are done periodically not on daily basis.
- The aluminum oxide compound will not each the floor.
- The buffing process does not take much time as other operation takes.
- Better surface finishing and also materials shine when the buffing process is done.

Disadvantage of buffing process:

- The main disadvantages of buffing process is:
- A skill operator is required for the operation.
- Have to keep eye on operation when it is done manually. Otherwise, we can lose maximum material.
- The operation cost is a little costly.
- The buffing process directly cannot do on any work piece because it is the last operation to bring shine to the workspace.
- After the operation ends it needs to be clean.

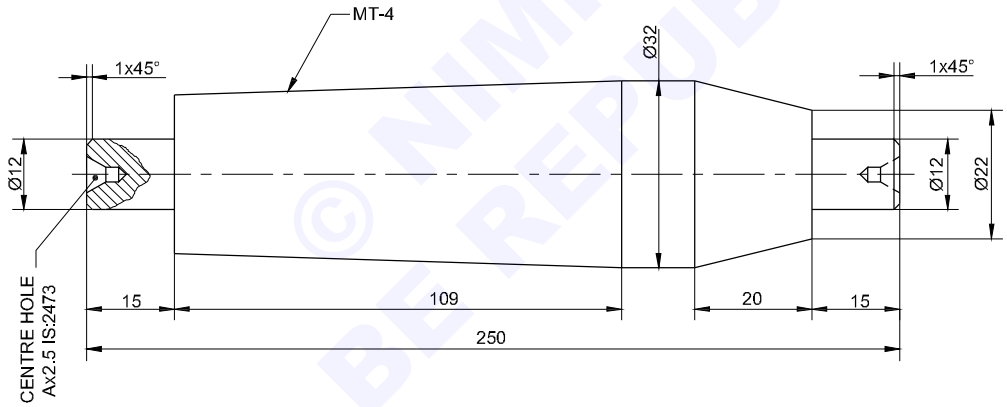
Fig 2



Perform cylindrical taper grinding

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

- **mount the work for taper grinding**
- **set the table for taper grinding**
- **rough grind taper**
- **finish grind the taper**
- **check the taper using by sine bar with the an accuracy of ≠ minute.**



1	ISR Ø35x255	–	Fe 310	–		2.9.143
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1 : 1	CYLINDRICAL TAPER GRINDING				DEVIATIONS ±0.1	TIME
					CODE NO. MG20N29143E1	

Job sequence

- balance the grinding wheel
- mount the wheel on the cylindrical grinder role.
- Dress the grinding wheels.
- Hold the job in between centres.
- Tilt the table "14° 210" to grind
- Set the table traverse dog to grind 20 mm length on the taper end.
- Start the grinder wheel to the job for rotation.
- Bring the wheel to the job and also it to touch.
- Grind the job (giving required feed) to an accurate of ≠ 5 minutes.
- Move the wheel away from the job and step the movement of the wheel and job.
- Check the taper angle with a vernier level protractor.
- Swivel the table 1°49".
- Grind the taper surface to maintenance the major dia 32° mm length 109 mm.
- Dress the grinding wheel.
- Grind ϕ 32 X 109 mm long.
- Remove the job from centres.
- Remove burrs of the job.
- Measure the job by using outside micrometer.
- Check the taper angle using by sinebar.

Skill sequence

Grinding of a taper cylindrical surface

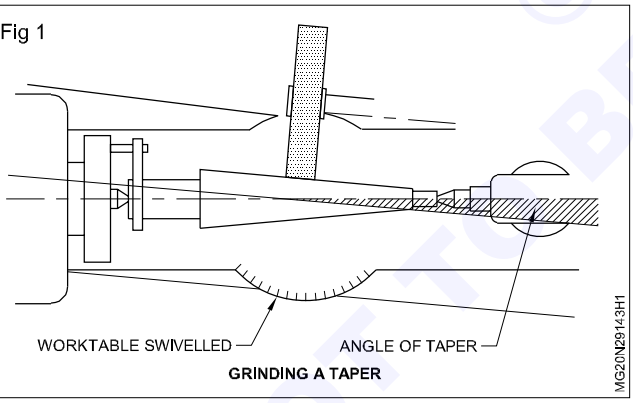
Objective: This shall help you to
- **grinding of a taper cylindrical surface of ±0.04mm**

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 centres and the wheel spindle.

Fig 1



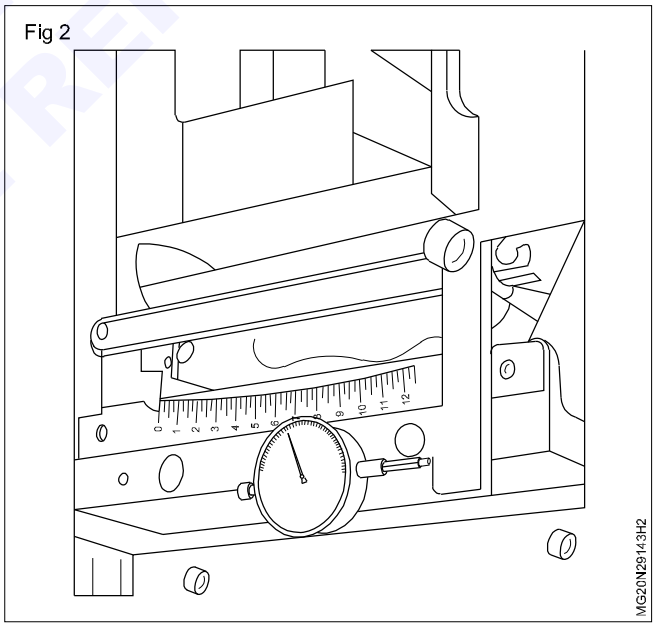
GRINDING A TAPER

Mount the work for taper grinding

- Set a dog at right angle to one end of the work (Ø26mm)
- Wipe off chips sticking to the table throughly, 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 throughly, 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)

Fig 2



- Loosen the nuts on the swivel - table pushing - plates at both ends of the traverse table.
- As illustrated, tilting the swivel table by 1 degree half while turning the adjusting knob and watching the graduation on the pushing plate.
- Fix the swivel table to the traverse table by fastening the nuts.

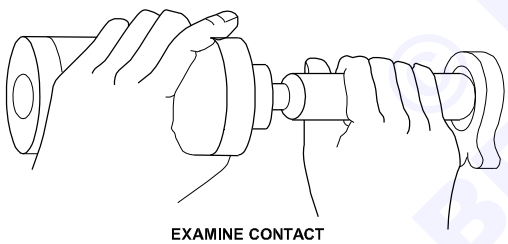
To rough - grind

- 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 to 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 throughly with a waster 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)

Fig 3

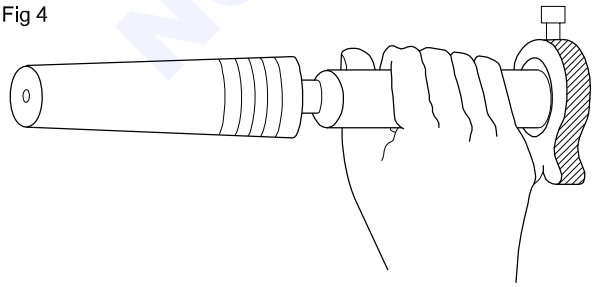


EXAMINE CONTACT

MG20N29143H3

- 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. (Fig 4)

Fig 4



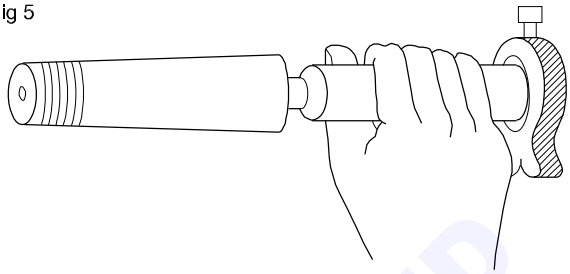
WHERE SWIVELLING ANGLE OF TABLE IS LARGE

MG20N29143H4

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.
- When the smaller diameter portion is in contact, adjust the table angle counter clockwise because it is too small. (Fig 5)

Fig 5

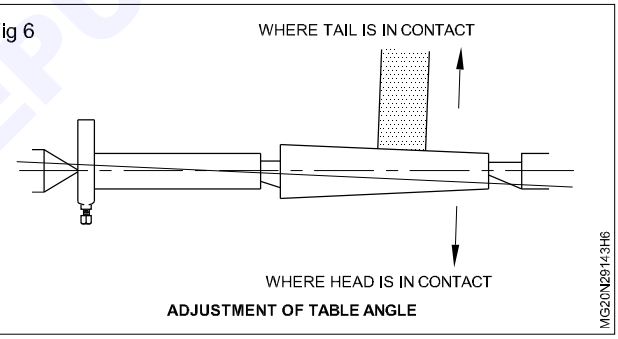


WHERE SWIVELLING ANGLE OF TABLE IS SMALL

MG20N29143H5

- 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. (Fig 6)

Fig 6



ADJUSTMENT OF TABLE ANGLE

MG20N29143H6

To finish - grind

- 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 per one time 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.

Check the taper using by sine bar method (Figs 7 & 8)

- Calculate the step gauge height.
- Taper angle = 7^{o}.
- Length of sine bar=250mm

Fig 7

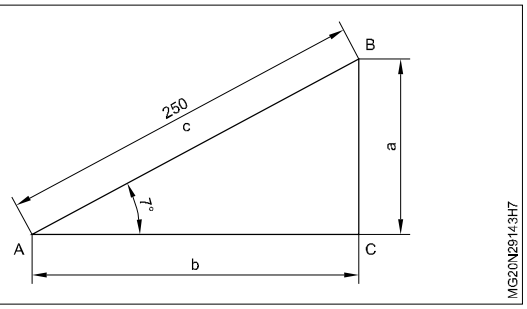
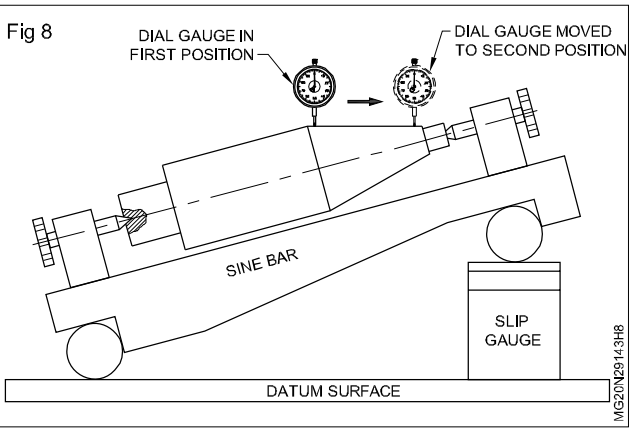


Fig 8



$$\text{Sin}, = \frac{a}{c}$$

= 7°

a = C sin,

= 250 x 0.1219

a = 30.48mm

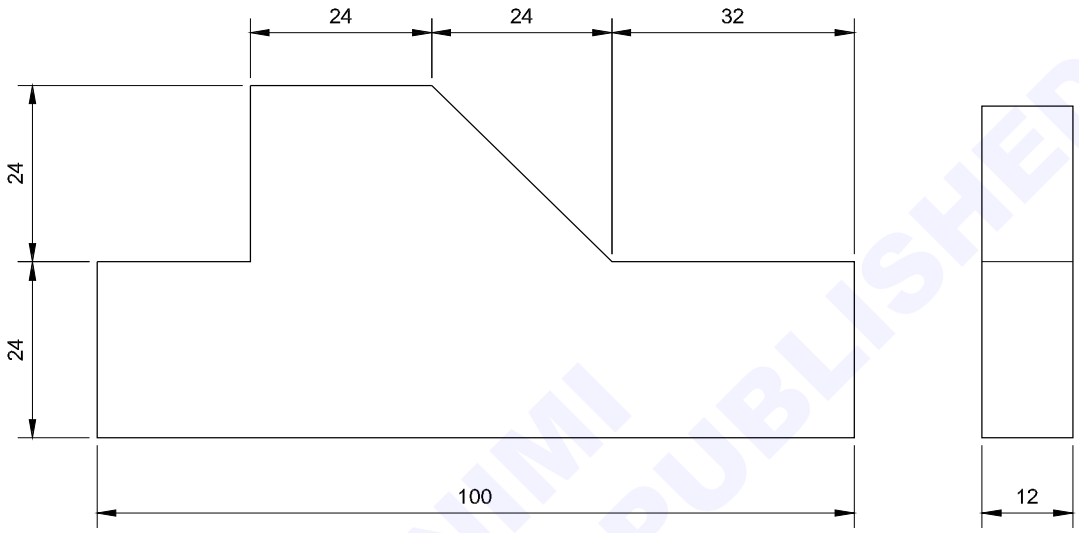
The height of the slip gauge required is 30.48mm

- 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.
- The dial test indicator is mounted on a suit 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.

Perform surface grinding within accuracy ±0.01mm

Objectives: At the end of this lesson you shall be able to
- **hold the workpiece on magnetic chuck**
- **make parallel surface within limit ±0.01mm**
- **check the parallelism by dial test indicator.**



Job sequence

- Check the raw materials size
- Determine the grinding allowance for each surface to be ground.
- Prepare the surface grinding machine chuck.
- Grind the workpiece 32 X 24 mm two sides & 24 X 12 mm.
- Mount the workpiece on universal vice
- Grind the workpiece side in 45°
- Measure the dimensions using by outside micrometer
- Check the angle using the vernier bevel protractor

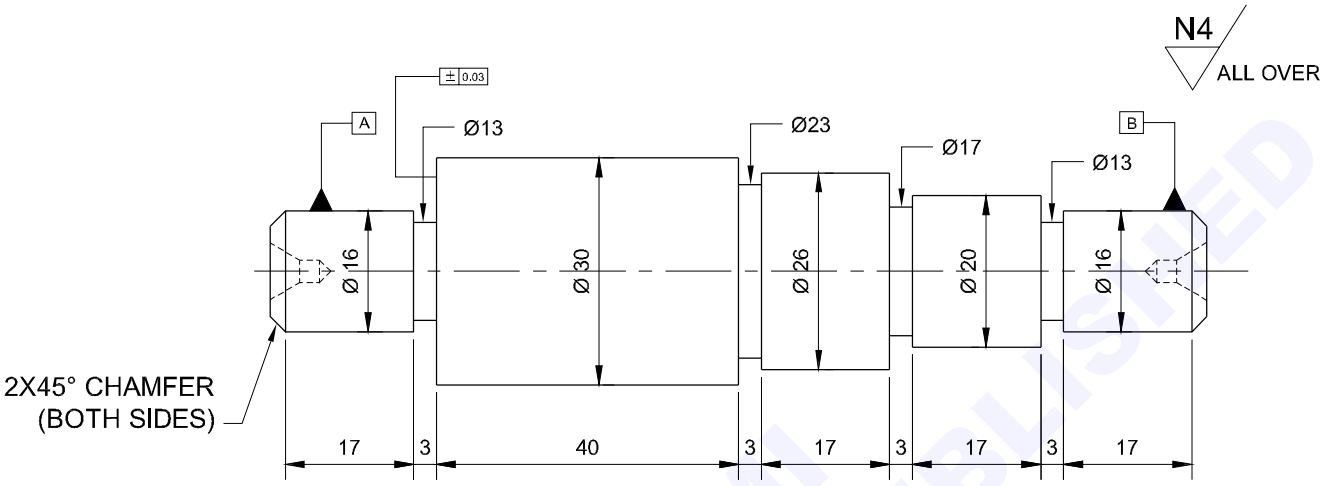
TOLERANCE ±0.01 mm
ALL DIMENSIONS ARE IN mm

1	100x50x13	–	Fe310	–	–	2.10.144
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	TAPER SURFACE GRINDING	DEVIATIONS ±0.02 mm	TIME: 20hrs
		CODE NO. MG20N210144E1	

Perform multi-step cylindrical grinding

Objectives: At the end of this lesson you shall be able to
- **prepare the cylindrical grinding machine for grinding**
- **dress the grinding wheel**
- **set the work piece between centre and set the carrier to measure the job with outside micrometer.**



Job sequence

- Study the drawing, turn the job as per drawing and maintain the size with grinding allowance.
- Ascertain the grinding allowance.
- Prepare the machine and dress the grinding wheel for grinding
- Mount the job in between centres with carrier
- Start the machine for grinding

This will prevent accidental contact between the wheel and the carrier

- Rough finish to grind the step ∅30x40mm long
- Feed the work traversely
- Grind the step ∅26x17mm long rough and finish grinding
- Grind the step ∅20x17mm long rough and finish grinding
- Grind the step ∅16x17mm long rough and finish grinding
- Remove the job and grind the stop ∅16x17mm on the other side
- Remove the job from the centres and carrier
- Measure and check the job using by out side micrometer
- Check the concentricity of Job using DTI dial test indicator

TOLERANCE ±0.01 mm
ALL DIMENSIONS ARE IN mm

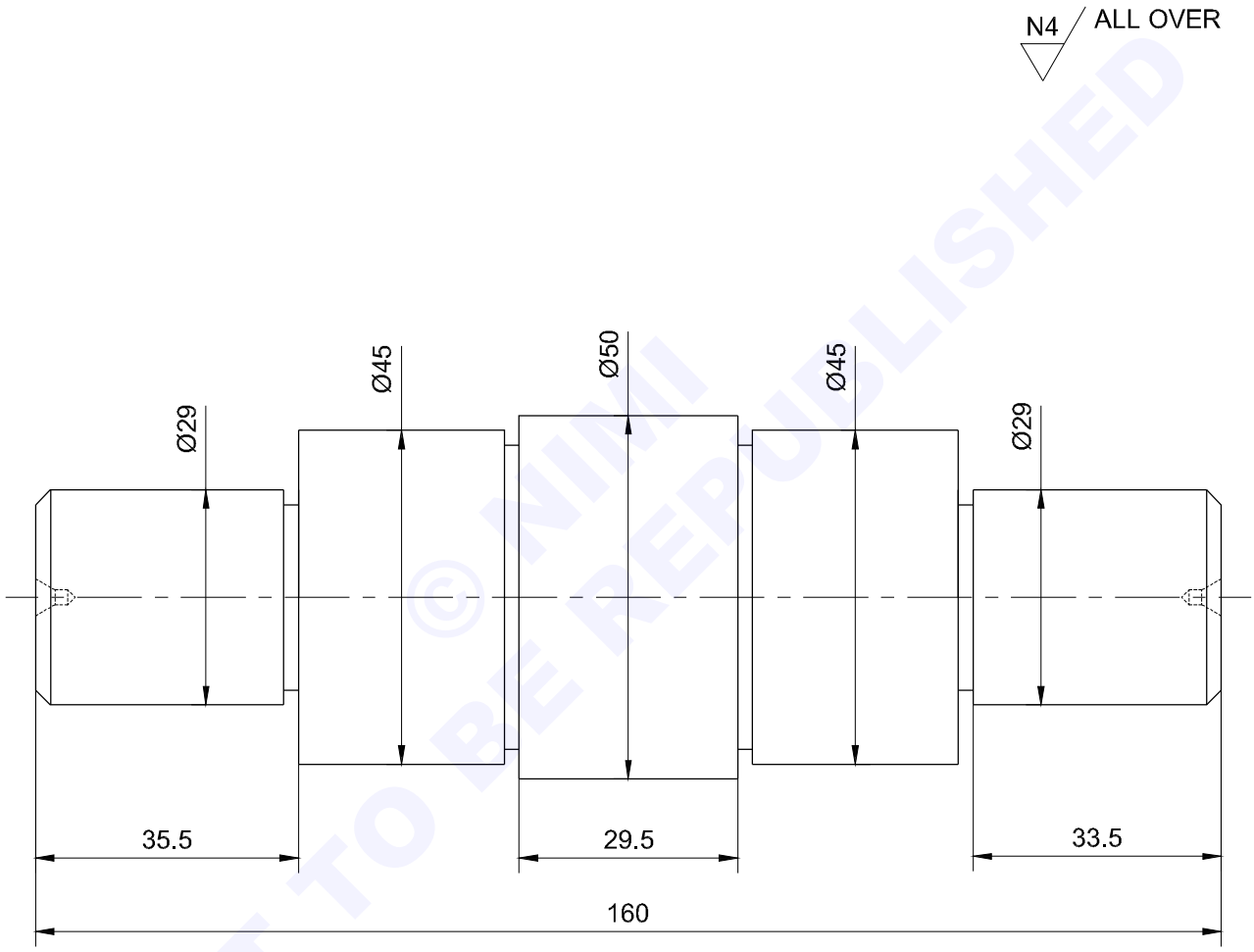
1	ISR Ø32x130	–	Fe310	–	–	2.10.145
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	MULTI - STEP CYLINDRICAL GRINDING	DEVIATIONS ±0.01 mm	TIME: 20hrs
		CODE NO. MG20N210145E1	

Perform shoulder grinding on cylinder - grinding machine to close limit h7

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

- **dress the side of grinding wheel by using diamond dresser for shoulder grinding**
- **grind the different shoulder with an accuracy of ±0.04 mm**
- **measure the dimension with an outside micrometer**
- **check the squareness of job using by bevel edge square.**



1	ISR Ø55x165		Fe310	–	–	2.10.146
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	SHOULDER CYLINDRICAL GRINDING	DEVIATIONS ±0.03	TIME
		CODE NO. MG20N210146E1	

Job sequence

- Study the drawing and measure the grinding allowance for given job.
- Prepare the machine and dress the grinding wheel for grinding shoulder surfaces.
- Mount the job in between centres.
- Rough and finish grind the shoulder to maintain the 35.5mm length of job.
- Dress the side of the wheel.
- In the same setting rough and finish grind the 29.5mm length of shoulder surface at 90°.
- Dress the grinding wheel for the grinding of other end.
- Remove the job from the centres.
- Reverse the position of the job in the centres.
- Grind the end of the 35.5mm shoulder.
- Measure the dimension using by outside micrometer.
- Check the shoulder squareness with bevel edge square.
- Remove burrs of the job using dine abrasive stone.
- Remove the job from the centres and dog carrier.
- Check the all dimension of job.

— — — — — — — —

Exercise 2.11.147

Prepare different type of Documentations and methods of recording information

Objectives : At the end of this exercise you shall be able to
- **prepare and fill up batch processing record format**
- **prepare and fill up bill of materials (BOM)**
- **prepare and fill up production cycle time format**
- **prepare and fill up daily production report format**
- **prepare and fill up manufacturing stage inspection report format.**

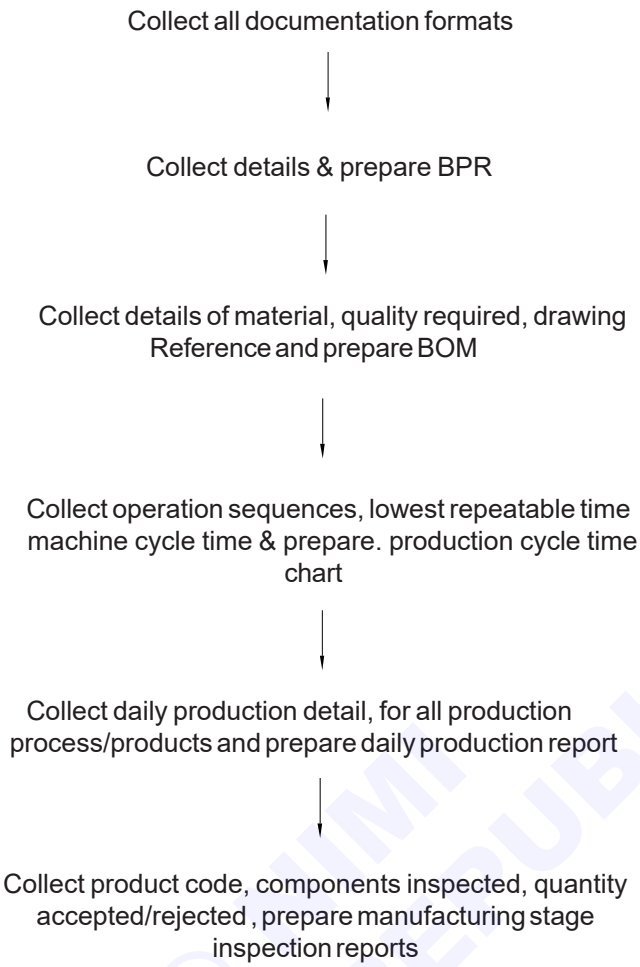
Job sequence

- Study the different types of documentation provided (format).
- Visit to industry and collect the input/ information from industry and fill it up of all the format.
- Prepare the required format with the knowledge gained during the industrial visit.
- Record relevant information in the format.
- Get it checked by your instructor/ Training Officer.

Note:
- **Instructor / Training Officer should arrange for a industrial visit near by your institute, collect inputs and fill up format as required.**
- **Trainees will be guided by the concerned instructor/ TO.**
- **Collect necessary information forms and instruct the trainees to reproduce the forms and guide them in Documentation**

-	-	-	-	-	-	2.11.147
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	PREPARE DIFFERENT TYPE OF DOCUMENTATIONS AND METHODS OF RECORDING INFORMATION				DEVIATIONS ± 0.1	TIME : 12hrs
					CODE NO. MG20N211147E1	

Flow chart



BATCH PROCESSING RECORD - FORMAT - 1

Batch Processing Record	
Description of job	Batch no. :
Part no. : Name of part :	Batch quantity : Batch record no. : Purchase order no. :
Description of process :	
Manufacturing Organisation :	
Period of manufacture (Year - Qtr): Start date of manufacture: End date of manufacture:	
Number of pages according to batch: Inserted pages: Manufacturing facilities:	
Total number of pages	
1. Operator / Technician Date Name and signature	
2. Production in-charge: Date Name and signature	
3. Section manager Date Name and signature	
4. Plant in-charge: Date Name and signature	
5. Production manager Date Name and signature	
Remarks (if any)	

BILL OF MATERIAL (BOM) - FORMAT-2

(as per IS: 11666 - 1985)

S. No.	Item No.	Description	Quantity	Reference dwg no.	Material as per standard	Remarks

Date:

Place: Incharge

PRODUCTION CYCLE TIME - FORMAT-3

Organisation Name: Department / Section:	Process:	Line Incharge:	Date/Time:

Operator:											
Operations Sequence	Observed Time								Lowest Repeatable	Machining Cycle Time	Notes

DAILY PRODUCTION REPORT - FORMAT-4

	Daily Production Report	
Date:	**Department:** **Section:**	**Organisation Name:**

	Process - I		Process-II		Process-III		Process-IV		Quality Control		Packing	
	Planned	Completed	Planned	Completed	Planned	Completed	Planned	Completed	Planned	Completed	Planned	Completed
Job Order No. Quantity Material & Size												
Job Order No. Quantity Material & Size												
Job Order No. Quantity Material & Size												
Job Order No. Quantity Material & Size												
Job Order No. Quantity Material & Size												

Signature of section Incharge

MANUFACTURING STAGE INSPECTION REPORT - FORMAT-5

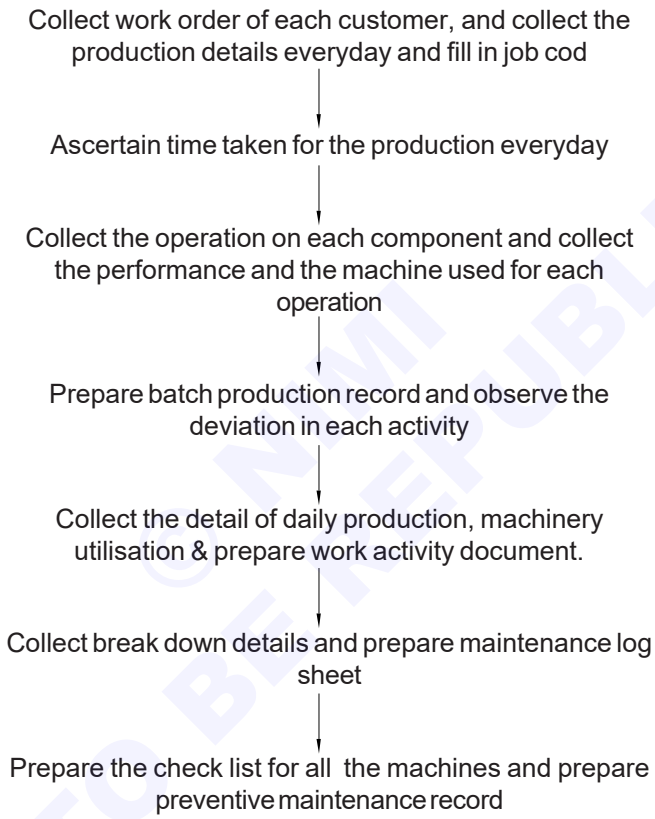
Organisation Name: **Department / Section:**										**Status: From Date ..../...../..... To Date ..../...../.....**	
Date	Product ID/ Code	Customer	P.O. No. & Date	Job Order No.	J.O. Date	Process	Qty	Accepted	Rejected	Inspection Record No. & Date	Inspection/ Test conducted by

Documentations - 2

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

- **prepare and fill job card format**
- **prepare and fill activity log format**
- **prepare and fill batch production record**
- **prepare and fill estimation sheet**
- **prepare and fill maintenance log format**
- **prepare and fill the history sheet of machinery and equipment format**
- **prepare and fill maintenance record.**

Flow diagram



-	-	-	-	-	-	4.6.151
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DOCUMENTATION-2**				DEVIATIONS ± 0.1	TIME : 4hrs
					CODE NO. TUN46151E2	

Job sequence

- Study the different types of documentation provided (format).
- Visit industry and collect the input / information from industry and fill it up in all the format.
- Prepare the required in format with the knowledge gained during the industrial visit.
- Record relevant information in the format.
- Get it checked by your instructor/ Training Officer.

Note:

- **Instructor / Training Officer should arrange for a industrial visit near by your institute, collect inputs and fill up format as required.**
- **Trainees will be guided by the concerned instructor/ TO.**
- **Collect necessary information forms and instruct the trainees to reproduce the forms and guide them to fill it up.**

JOB CARD - FORMAT-1

Job Card	Doc No.	
	Rev No.	
	Date	

Order Starting Date	
Customer	
Work Order No.	

Details

S.No.	Date	Production Line Description	Time (Minutes)			Location Time	Remarks
			Start Time	End Time	Total Time		

WORK ACTIVITY LOG - FORMAT-2

Organisation Name:

Department:

Section:

Employee Name:

Supervisor Name:

Date:

Start / Stop	Operations performed	Equipment / Machinery/ Instruments used	Remarks
8.00 to 9.00 a.m.			
9.00 to 10.00 a.m.			
10.00 to 11.00 a.m.			
11.00 to 12.00 noon			
12.00 to 1.00 p.m.			
1.00 to 2.00 p.m.			
2.00 to 3.00 p.m.			
3.00 to 4.00 p.m.			
4.00 to 5.00 p.m.			
5.00 to 6.00 p.m.			

BATCH PRODUCTION RECORD - FORMAT-3

Batch Production Record in accordance with batch processing record

Manufacturing Organisation Name: _____

Description of job: _____

Name of part: _____

Batch No.: _____

The following deviations have appeared (continued)

No. process step	Name of processing step	Document page no.	Short description of deviation
1	Raw material preparation: Operation 1: _____ Operation 2: _____ Operation 3: _____		1. _____ 2. _____ 3. _____ 4. _____
2	Sizing of material: Operation 1: _____ Operation 2: _____		1. _____ 2. _____ 3. _____

ESTIMATION SHEET - FORMAT-4

Part Name: _____ Assembly: _____ Assembly No.: _____	Part No.: _____ Material: _____ Stock size: _____	Part Drawing

Operation No.	Operation description	Machine	Estimated time	Rate / piece per hr.	Tools

Prepared by: _____ Date: _____

Approved by: _____

MAINTENANCE LOG - FORMAT-5

Organisation Name :

Department :

Section :

Name of the machine :

S. No.	Date	Nature of fault	Details of rectification done	Signature of in-charge

MACHINERY AND EQUIPMENT RECORD - FORMAT-6

Organisation Name :	
Department :	
Section :	
History sheet of machinery & Equipment	
Description of equipment	
Manufacturer's address	
Supplier's address	
Order No. and date	
Date on which received	
Date on which installed and placed	
Date of commissioning	
Size: Length x Width x Height	
Weight	
Cost	
Motor particulars	Watts/H.P./ r.p.m: Phase: Volts:
Bearings/ spares/ record	
Belt specification	
Lubrication details	
Major repairs and overhauls carried out with dates	

PREVENTIVE MAINTENANCE RECORD - FORMAT-7

Organisation Name	:		
Department	:		
Section	:		
Name of the Machine	:	Location of the machine :	
Machine Number	:		
Model No. & Make	:		

Check list for machine inspection

Inspect the following items and tick in the appropriate column and list the remedial measures for the defective items.

Items to be checked	Good working/ satisfactory	Defective	Remedial measures
Level of the machine			
Belt/chain and its tension			
Bearing condition (Look, feel, listen noise)			
Driving clutch and brake			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication and its system			
Coolant and its system			
Carriage & its travel			
Cross-slide & its movement			
Compound slide & its travel			
Tailstock's parallel movement			
Electrical controls			
Safety guards			

Inspected by

Signature

Name:

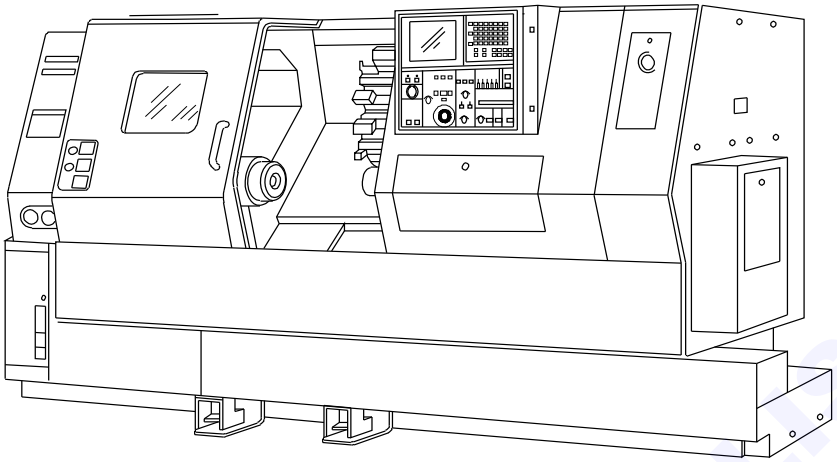
Date: Signature of in-charge

— — — — — — — —

Identify the CNC machine and CNC console

Objectives: At the end of this exercise you shall be able to
- **identify the CNC machine**
- **identify the controllers of CNC machine axis.**

Fig 1

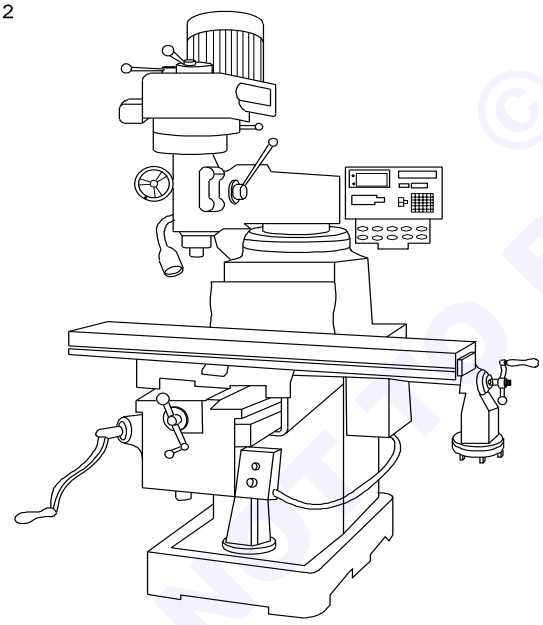


MG20N211148H1

Instructor to guide the trainees in major identification of CNC machine and in axis control

Job Sequence

Fig 2



MG20N211148H2

- Identify your CNC Machine and its console of axis
- List the name of CNC M/C in table - 1

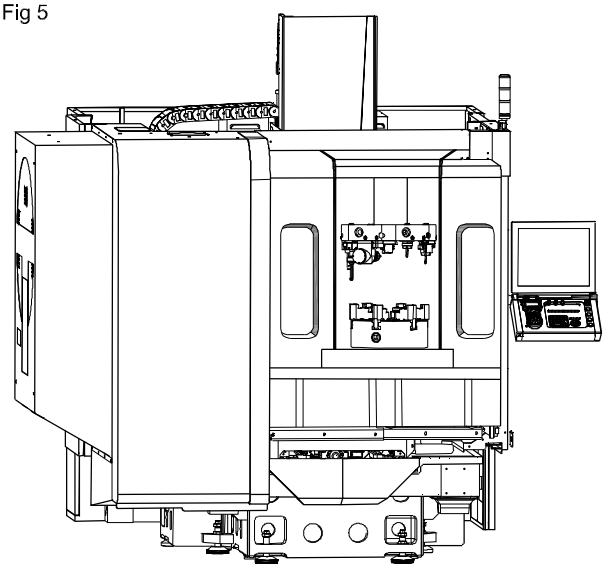
TABLE: 1

Sl. No M/C No	Name of the M/C Machine with major identification (Type & axis)
1	
2	
3	
4	

Note: Arrange industrial visit to trainees instruments/training officer your institute

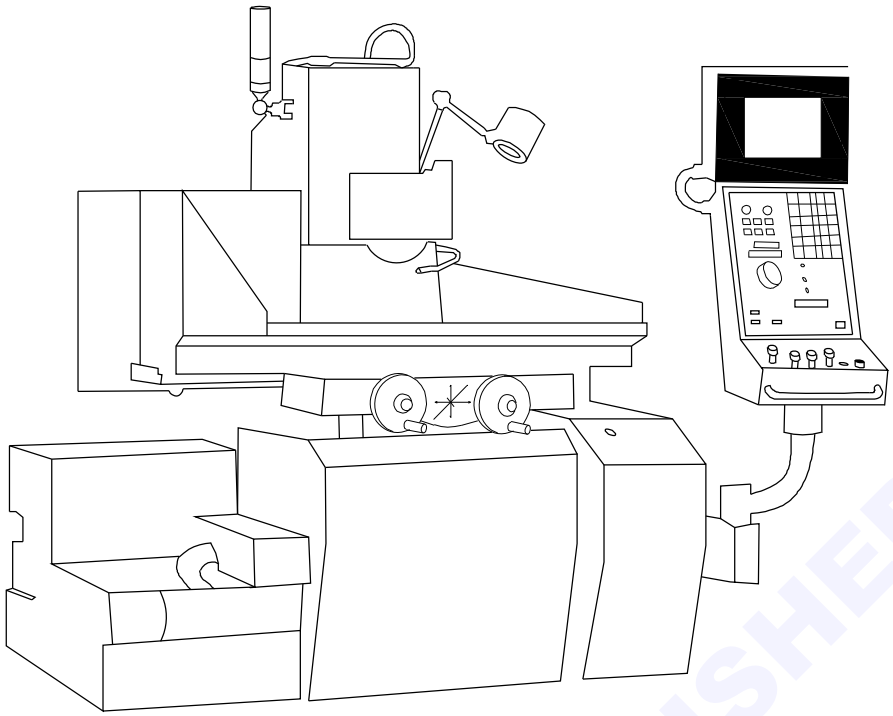
Trainees will be guided by the concerned on instructor / To.

Fig 5



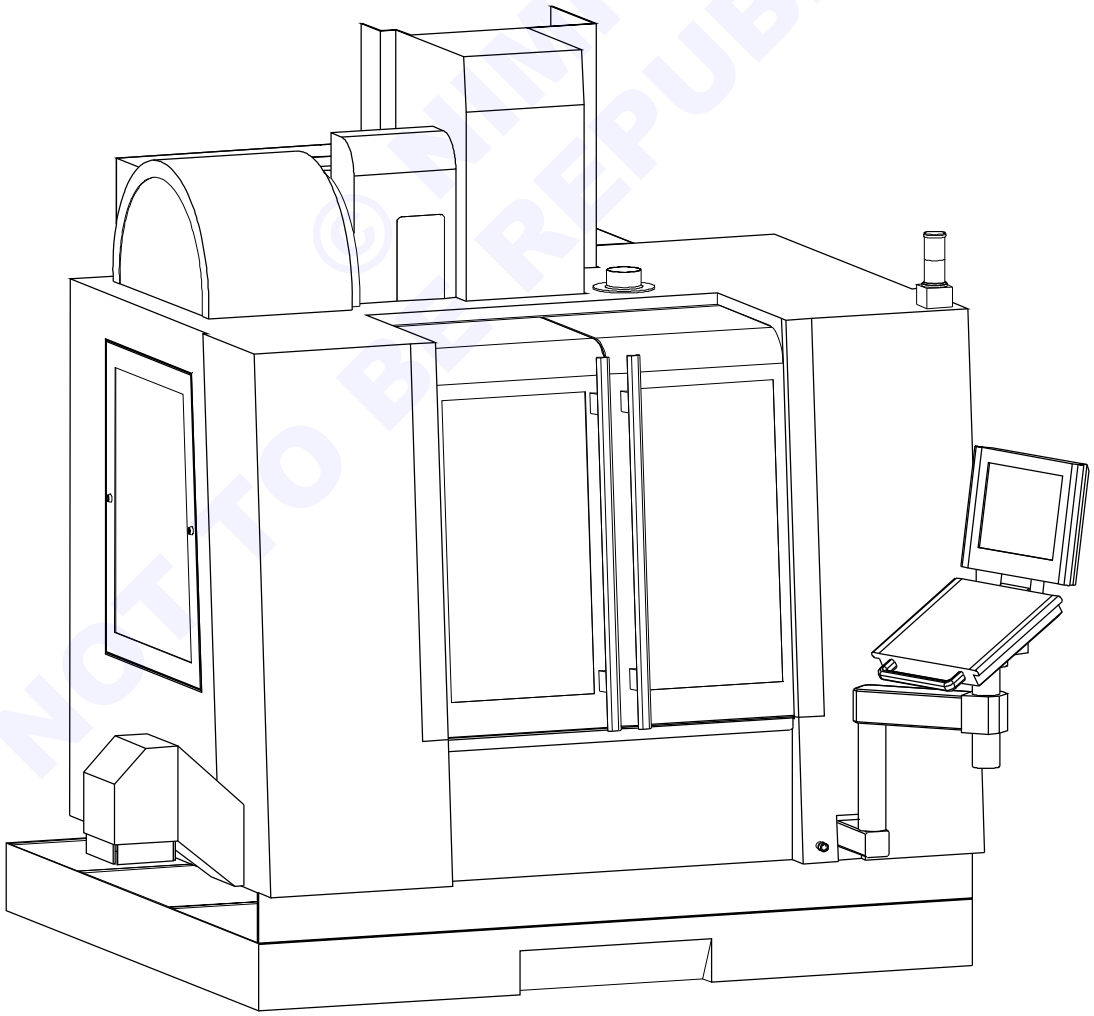
MG20N211148H5

Fig 3



MG20N211148H3

Fig 4



MG20N211148H4

CNC machine operations and like jog, reference edit MDI mode program call & entry simulation tool offset tool changing orientation

Objectives : At the end of this exercise you shall be able to
- **utilise effectively the JOG and edit mode function**
- **utilise effectively the MDI SBL & Auto mode functions.**

Fig 1

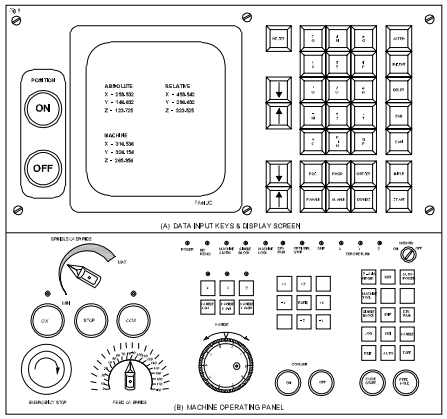
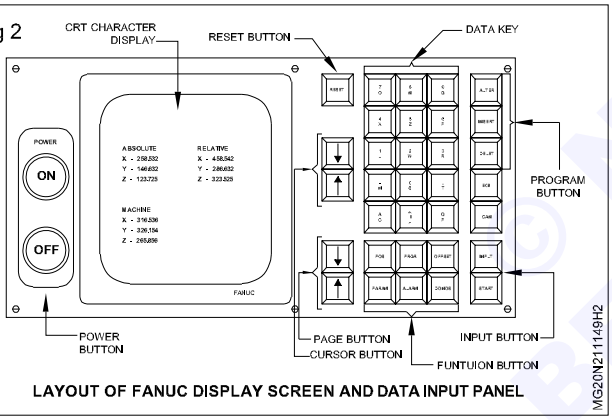
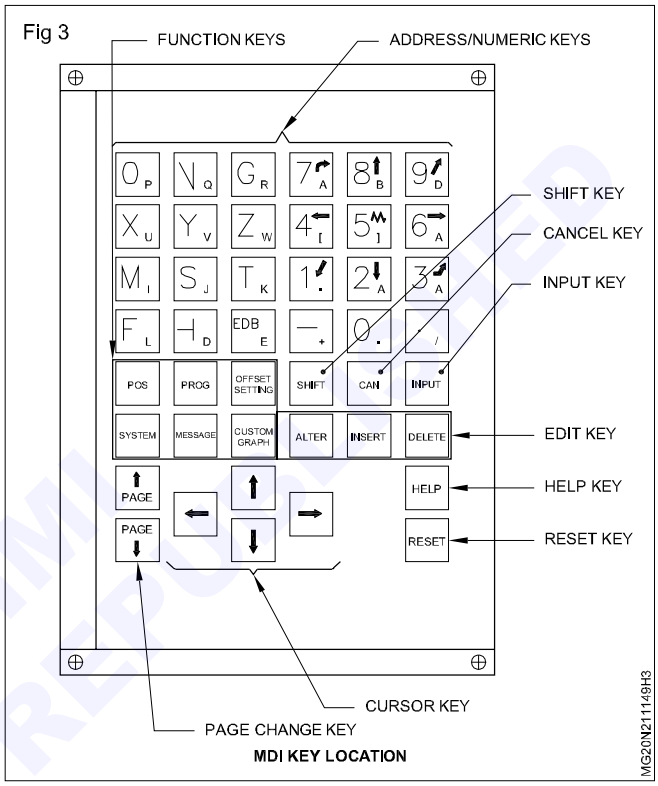


Fig 2



LAYOUT OF FANUC DISPLAY SCREEN AND DATA INPUT PANEL

Fig 3



MDI KEY LOCATION

TASK 1 : **JOG Mode**

- Set in Jog mode, use mode selector switch
- Press X- (or) X+ axis button
- To move in X - (or) X + as per required direction
- In the same manner we can move in Z direction also.
- Keep pressing the direction switch till the tool reaches the desired position.

— — — — — — — —

TASK 2 : **Edit Mode**

- Set edit mode using mode selector switch
- Enter the New programme in block by block
- To use input /alter/delete/ EOB keys.
- To alter the program, if any correction of the programme is needed, go to edit mode.

— — — — — — — —

TASK 3 : **MDI mode**

Manual data input key and functions.

- When the machine is not running a part program the operator may use this mode.
- Only one block is executed at a time.
- Once it is executed, it is gone from the computer in memory.

- An operator can use MDI mode to change cutting tool, spindle ON /OFF, Coolant ON/OFF, etc.,

Single block mode

Single block mode allows an operator to check the program by executing only one program block at a time.

Example

```
N1   G01   X50   Z5    F0.1 ;
N2   S1200 M03 ;
N4   M08 ;
N5   G01   X48   F0.1 ;
N6   G01   Z-25  F0.1 ;
N7   G00   X60   Z10 ;
N8   M09 ;
N9   M05 ;
N10  M30 ;
```

— — — — — — — —

TASK 4 : **Auto Mode**

- To select the programme numbers before selecting the Auto mode.
- To set Auto mode using mode selector switch.
- Press the cycle start button.
- With this mode, programme will be executed continuously in block- by - block.
- While machine is running in this mode do not change to any other mode or function.

Note: before machine running continuously in Auto mode, first job will be executed in single block.

Note : The instructor will demo the various modes.

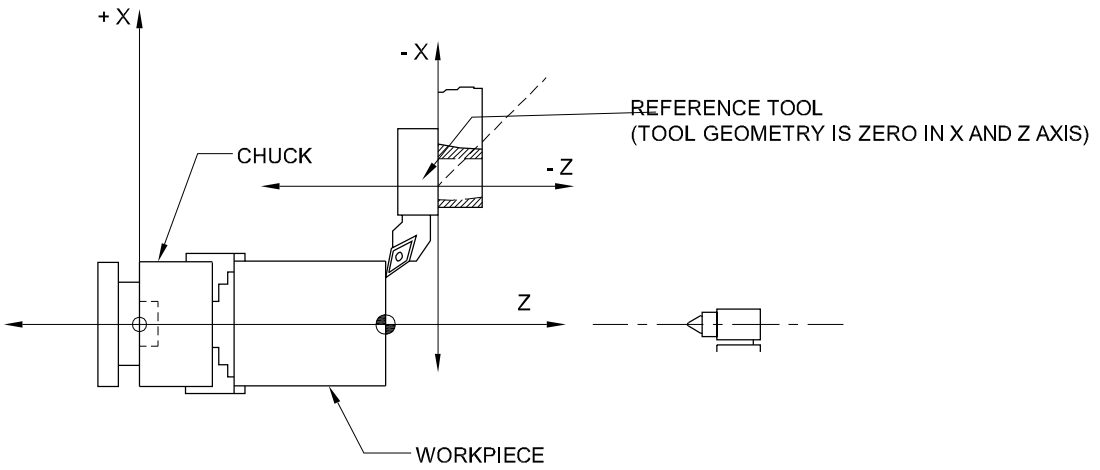
— — — — — — —

TASK 5 : **Simulation**

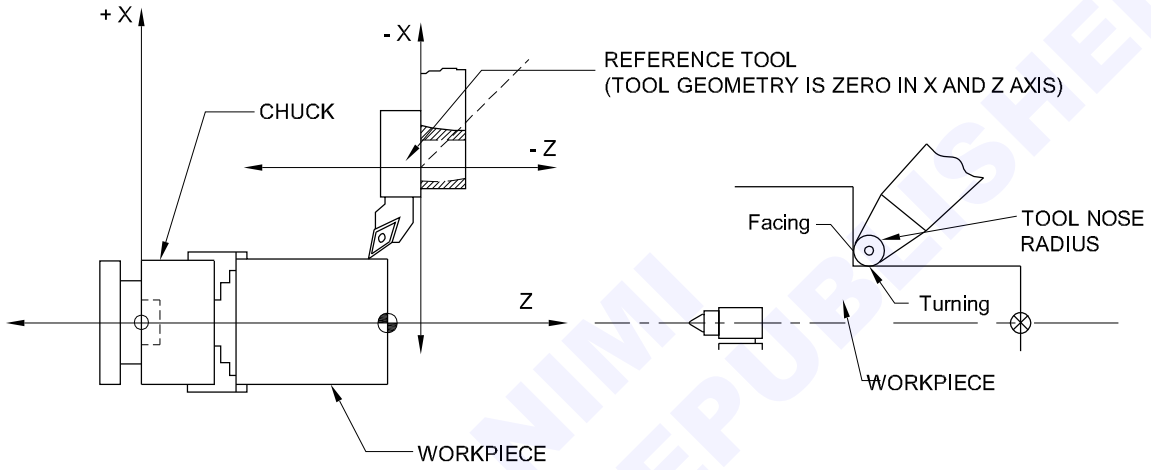
- Switch on the CPU and monitor
- Select the software
- Study the drawing
- Enter the programming in edit mode/ key board
- Select required and clamping device.
- Run the simulation in auto mode.
- Transfer the programme to the machine.
- Take the offset.
- Run the machine in automatic mode.
- Check the dimension and remove the job.
- Switch of the machine.
- Instructor to guide the trainee to write various programme and see the simulation on the machine (or) in the software control system

— — — — — — — —

Fig 4



TOOL OFFSET MEASUREMENT IN Z AXIS



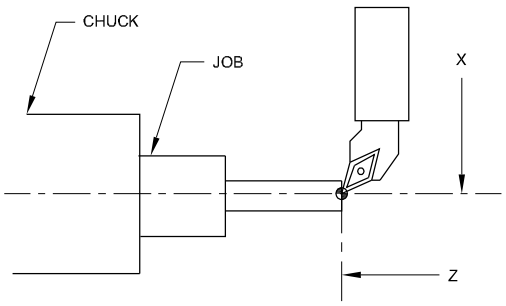
TOOL OFFSET MEASUREMENT IN X AXIS

MG20N211149H4

Z axis offset method

- Spindle ON rotate the job.
- Select jog mode or MPG mode to move axis. Manually turning job facing position no disturbance Z axis. (Fig 5)
- Select offset button press in geomentry mode.
- To use cursor select tool no 1 and z axis.
- Enter Z0.
- Measure
- Press in soft key
- Now Z axis tool offset OK.
- Tool offset is Z axis is saved

Fig 5



Z AXIS OFFSET METHOD

MG20N211149H5

Setting of tool offsets, entry of tool nose radius and orientation (FANUC Control)

Objectives : At the end of this exercise you shall be able to
- **measure the tool offset in x direction and enter in the tool offset**
- **measure the tool offset in z direction and enter in the tool offset page.**

FANUC control

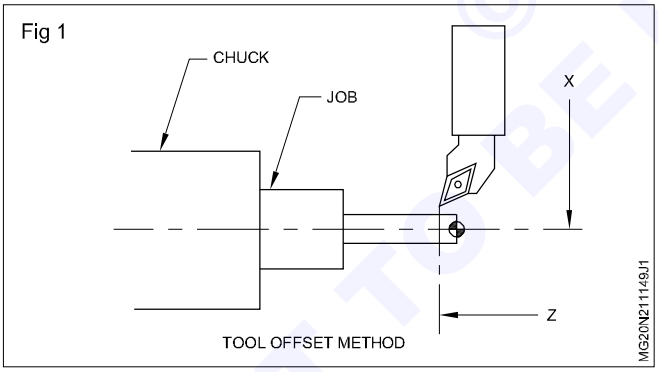
Tool offset method

X axis tool offset method

Reference tool is T01 and offset is zero in X and Z axis

- Clamping job in chuck.
- Select MDI mode. Press in MDI prog-screen.
- Enter tool number : T0202(Turning tool).
- Insert button Press
- Cycle start button Press
- Tool cutting edge position with spindle ON CW or CCW in MDI mode.
- Enter MO3 SI500
- Reset button press
- Cycle start button.
- To select jog mode or MPG mode

  To move x and z axis.
- Touch the job in x axis just clean OD turning to ensure no disturbance in x axis. (Fig 1)

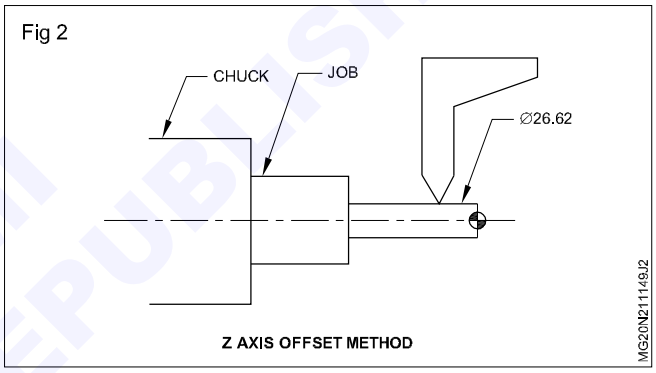


- Then stop spindle button.
- To measure job OD diameter, use vernier (or) micrometer for sample ∅ 28.62 mm.
- Select Offset button Press
- Displayed in geometry mode.
- Using cursor in geomentry screen select Tool no : 1 x axis select.
- Enter job diameter

  Ex: X28.62
- Measure button Press in soft key
- Now tool cutting edge in job centre is OK.
- Tool offset in X axis is saved

Second tool offset

- Select MDI mode Press
- MDI Prog Screen.
- Enter tool no (Threading tool) T0303
- Reset button Press
- Cycle start.
- Select jog mode or MPG mode then move axis.
- Same procedure MPG mode incremental touch job X axis with piece of paper whether contact of tool in job constant dia proper. No disturbance axis. (Fig 2)



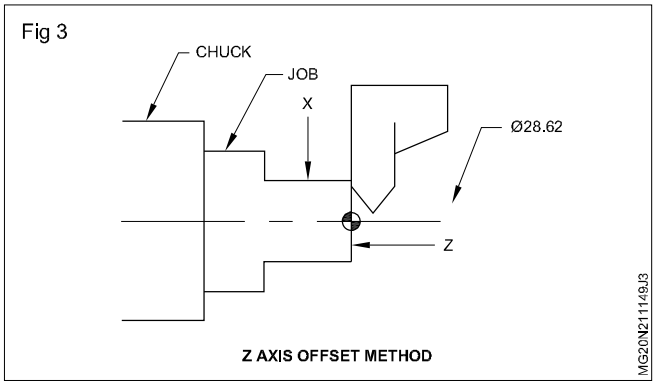
- Select offset button press in geomentry mode.
- Use cursor select tool no 3 and x axis.
- Enter constant same dia.

  Ex: X28.62
- Measure button Press in soft key

Threading tool offset measurement

Z axis offset

- Select MPG mode in incremental variation. To move axis z position.
- To check by inserting a piece of paper between tool and the job ensuring that there is no disturbance in Z axis (Fig 3).



- Select offset button Press in geomentry mode.
- To use cursor select tool no 3 and z axis.
- Enter Z0.

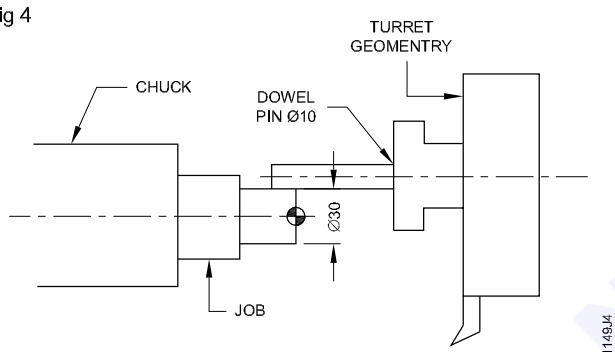
  Ex : Z0
- Measure Press in soft key
- Now second tool z axis offset saved.

Internal drilling tool x axis offset method

- Exact dia job fixing in chuck.
- Select MDI mode press
- Enter tool no T0101
- Cycle start.
- Select jog or MPG mode

  To move axis on the job of top side.
- Check with piece of paper whether contact of dowel pin with the job is proper. (Fig 4)

Fig 4



DIAMETER OF JOB + DIAMETER OF DOWEL PIN = TOTAL DIA
INTERNAL DRILLING TOOL X AXIS OFFSET METHOD

- Select offset screen in geomentry mode.
- To use cursor select X mode and tool number.
- Enter dia.

  Ex : Job dia + Dowel pin dia = Total dia

  30 + 10 = 40
- Enter dia X40 Measure button Press in soft key
- Drill cutting point in job centre point.
- Then drill fixing.
- Touch the job face a piece of paper whether contact of drill with the job in proper.
- Enter Z0 Measure Press in soft key
- Drilling tool off set is saved

Tools nose radius shall get automatically added in the tool offset. But in programming, TNC is considered through G codes.

CNC machine safety system

The built-in safety system on a CNC machine includes guards and protective devices which should be securely fitted and always kept in position while the machine is being used. It may include.

Emergency Stop Button

Used to shut down the machine immediately. It is located on the control panel and at other points on the machine, for example the hand held unit.

Soundproof Casing

Reduces noise emission generated by the operating section and protects the operator from the risk of flying objects or tool fragments.

Curtain Guards

Made of PVC and designed to protect the operator from the risk of airborne chips or tool fragments.

Guard Fence

The fence marks the working area in which the machine moves. It protects the operator from the risk of interference with moving parts. The guard may be of an open type or made of mesh.

Contact Mats

When the operator stands on the mat, the machine stops immediately, protecting the operator from moving parts of the machine.

Below are some general personal safety rules that you can use as a guide only. You might like to add any other rules that apply to you.

Tool Safety

Below are some general tooling safety rules that you can use as a starting guide. You might like to add any other rules that apply to you.

Do

- Always check that the machine is not operating when loading a tool magazine.
- Always check that tools are in good condition, for example, sharp and free of cracks.
- Always check that tools are set correctly.
- Always check that the correct tool data is entered into the CNC program.
- Always test tools before use.
- Always check that the seating surfaces are clean before installing tools.
- Always check that spindle direction is correct for right-hand or left-hand operation.
- Only use tools within the limits specified by the manufacturer.
- Only tighten tools to recommended torque values.

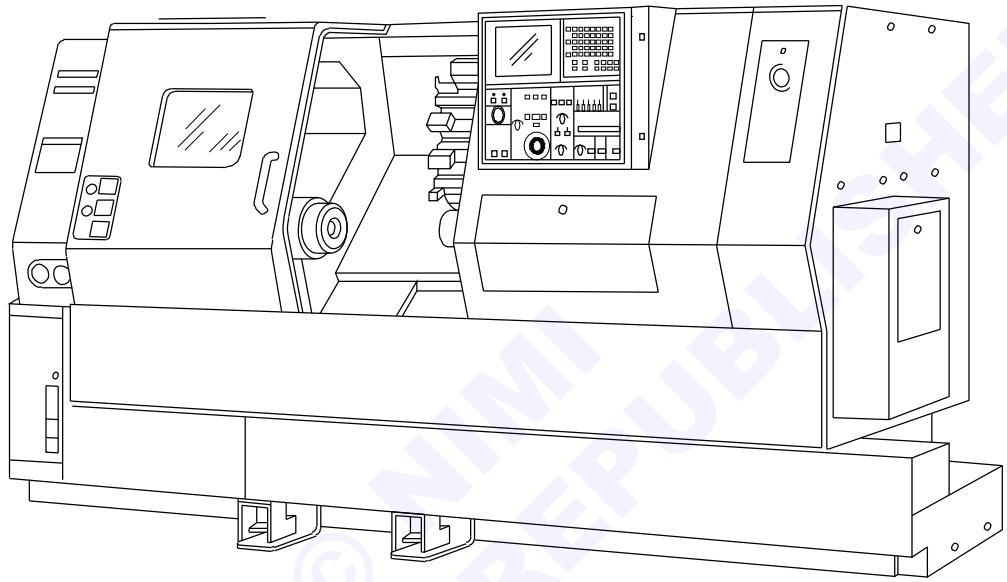
Material handling

Material handling now features technology that matches the sophistication of the machines that prepare the pieces. Swing arm panel feeders ensure continuous operation; panel stackers provide many options for storage and retrieval; robotics transfer pieces from machine to machine; conveyors and lift systems speed the transfer of materials with a minimum of human involvement; fully automated stacking/destacking machines easily handle input from multiple conveyors and trolleys.

Know rules of personal and CNC machine safety, safe handling of tools, safety switches and material handling equipment using CNC didactic/ simulation software and equipment

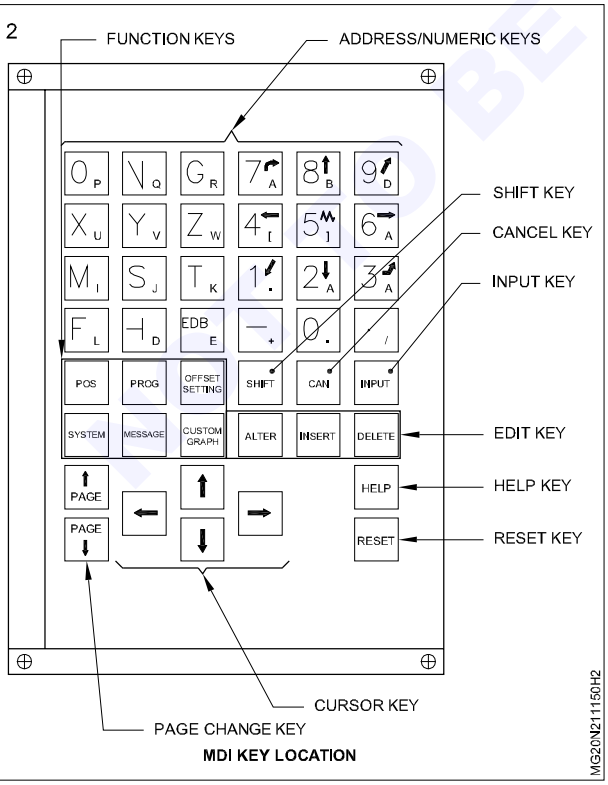
Objectives : At the end of this exercise you shall be able to
- **utilise effectively the JOG and edit mode function**
- **utilise effectively the MDI SBL & Auto mode functions.**
- **operate the multimedia based simulator**
- **identify the CNC machine simulator parts.**

Fig 1



MG20N211150H1

Fig 2



MDI KEY LOCATION

MG20N211150H2

Do's

- A well trained operator should operate the CNC Machine.
- Only one operator should operate the machine at a time.
- Check the lubrication oil and Hydraulic oil level before starting the machine.
- Ensure doors are closed before switching ON the machine.
- Keep less speed while operating in JOG mode, especially when the tool is near the chuck/Job.
- Operator should ensure the machine zero point while starting the machine.
- Operator should check the work offset for every required set tool and the same to be entered in the program.
- Special care should be taken while changing the tool.
- Check the part program for correction before operating.
- Learn all G codes, and M codes, of the control installed in your machine .

- Learn all offset, Reference points pertaining to your machine.
- Learn the basic maintenance schedule for your machine as per Autonomous maintenance.
- Ensure that the stabilizer is ON before starting.

Don'ts

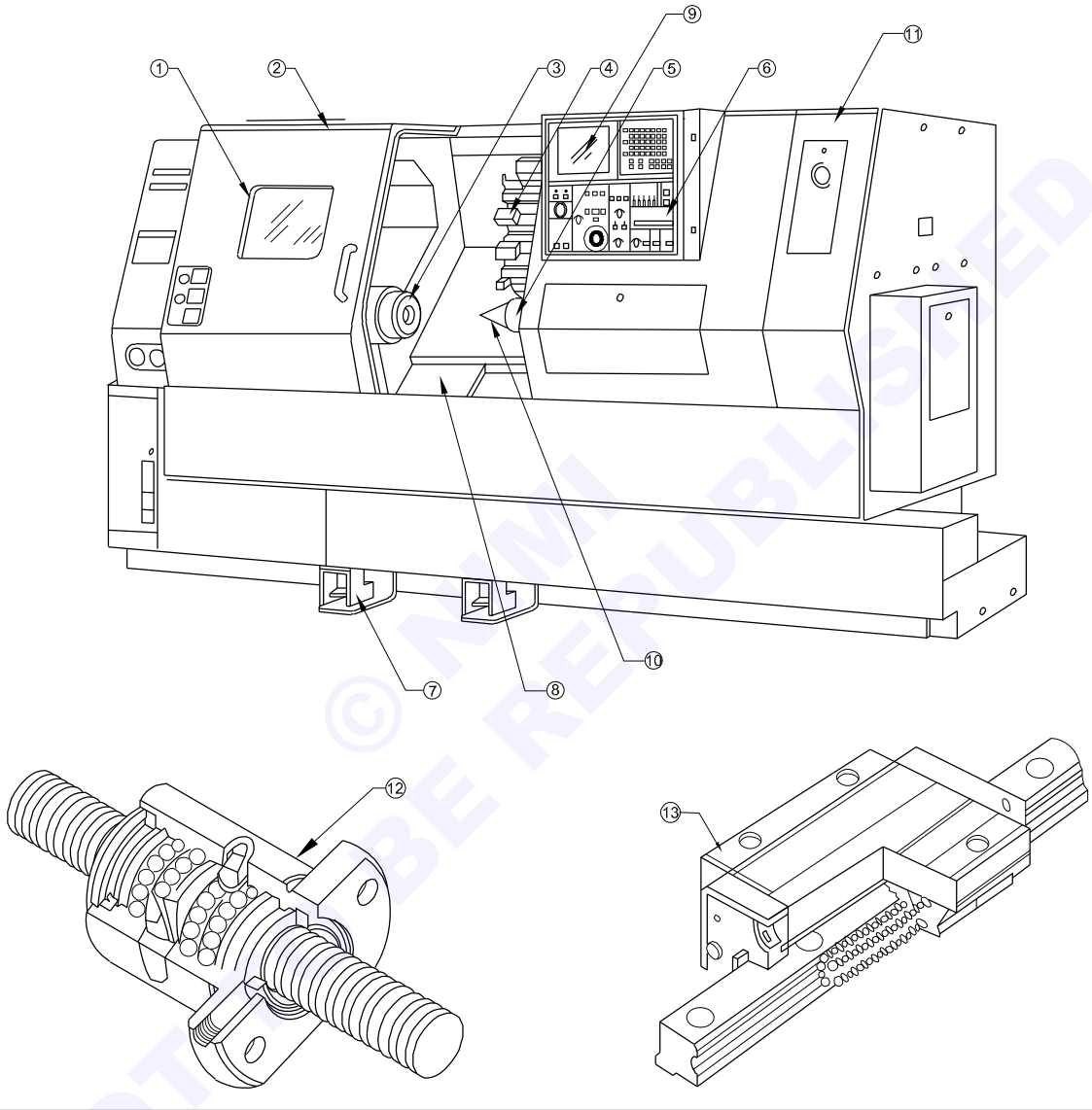
- Do not operate machine without the working knowledge of the machine.
- Do not operate the machine when covers are removed.
- Do not insert any bar or tool holder in the spindle while rotation.
- Do not open the control panel, without switching OFF power.
- Do not operate the machine without trying in simulation.
- Do not attend electrical fault, without removing the main fuse carriers.

— — — — — — — —

Identify CNC lathe machine elements and their functions, on the machine

Objectives : At the end of this exercise you shall be able to
- **identify the parts of CNC lathe machine**
- **list out the functions of each part of the CNC lathe machine.**

Fig 1



Job sequence

- Identify the parts of CNC lathe machine.
- List out the name of the parts shown in figure, in the given table 1
- List out the function of each part in the given table 2.
- Instructor will demonstrate the parts.

Instructor to guide to identify CNC machine parts and axis control.

Table 1

Part No.	Name of the parts
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

Table 2

Part No.	Name of the parts	Function of the part
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Get it checked by the instructor

Understand the working of parts of CNC lathe explained using CNC didactic/ simulation software

Objectives: At the end of this exercise you shall be able to
- **operate the multimedia based simulator**
- **identify the CNC machine simulator parts.**

- **Instructor will show the C.N.C Machine parts by using multimedia based simulator Trainees should identify parts and write in the parts given below table - 1**
- **Instructor to refer the previous exercise.**

Table 1

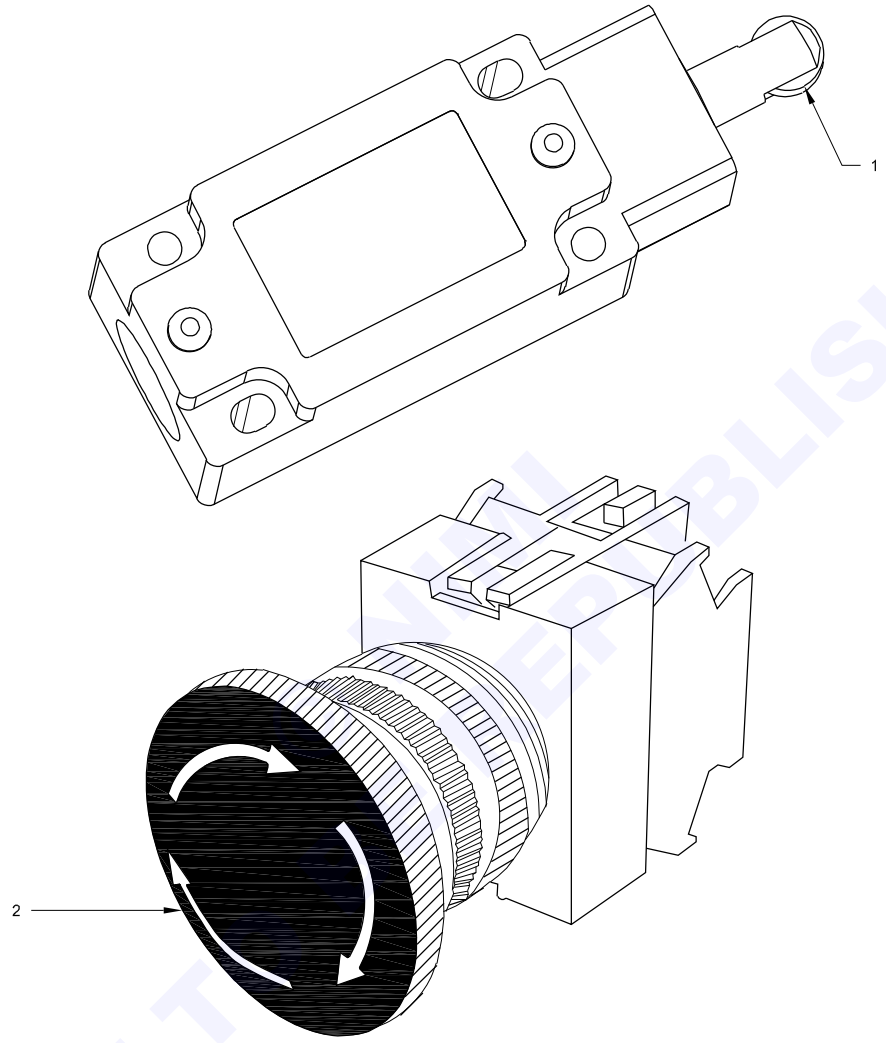
Sl No.	CNC parts Identified by trainee
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

— — — — — — — —

Identify machine over travel limits and emergency stop on the machine

Objectives: At the end of this exercise you shall be able to
- **identify limit switches**
- **identify emergency stop and release emergency stop.**

Fig 1



Instructor give about demo the function of the switches

Job sequence

- List the name and purpose of the switches in table 1.

Table 1

Sl. No	Name of the switch	Purpose of the switch
1		
2		

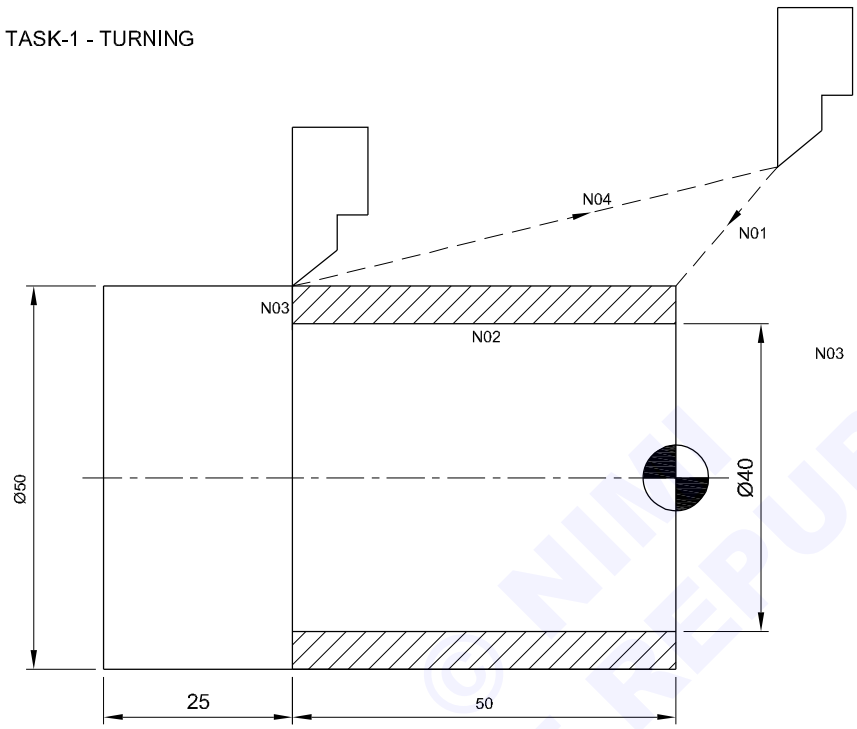
Exercise 2.11.154

Decide tool path for turning, facing, grooving, threading, drilling

Objective: At the end of this exercise you shall be able to
- **practice on various CNC turning operations - tool path.**

CNC turning operations

Fig 1



TASK 1: **Turning**

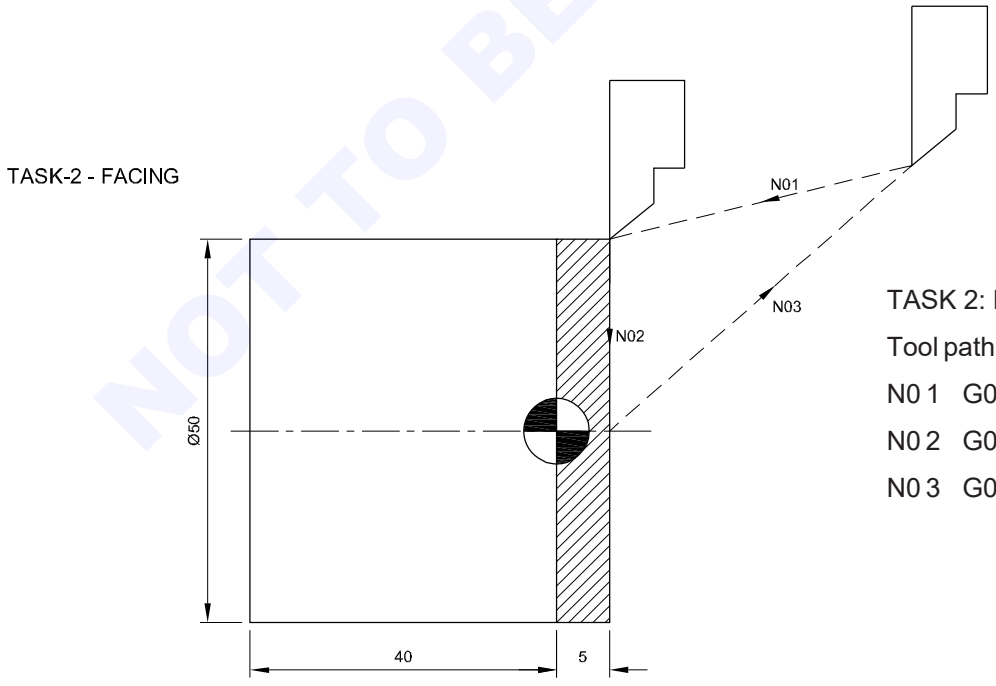
Tool path for turning

N0 1 G0 X 40.0 Z 0.0 Fo.1

N0 2 G01 X 40.0 Z-50.0 F0.1

N0 3 G01 X 50.0 Z-50.0 F0.1

N0 4 Goo X 50.0 Z 100



TASK 2: **Facing**

Tool path For Facing

N0 1 G00 X 50.0 Z 0.0 Fo.1

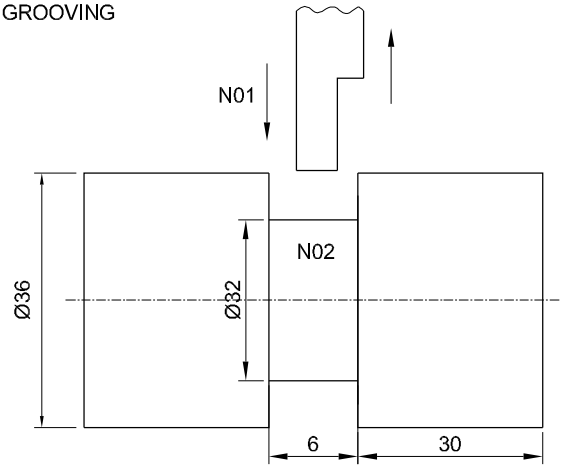
N0 2 G01 X 75.0 Z-50.0 Fo.1

N0 3 G00 X 0 Z25

MG20N211154H1

Fig 2

TASK-3 GROOVING



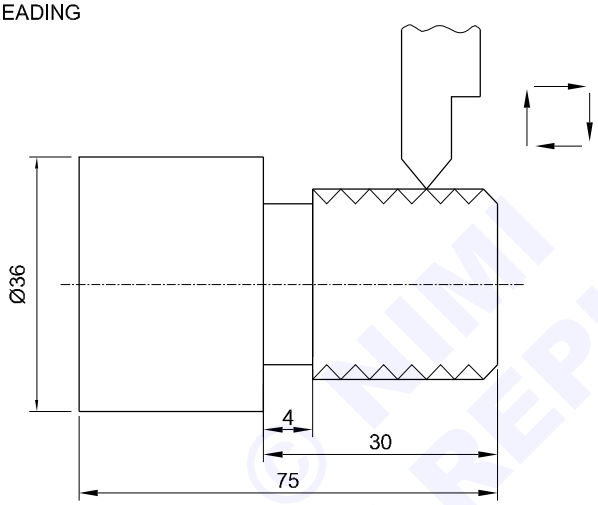
TASK 3: **Tool path for grooving**

N01 G00 X 37 Z-36 F0.1

N0 2 G01 X 32 Z-30 F01

N03 G00 X 25 Z-50 F01

TASK-4 THREADING



TASK 4: **Threading**

Tool path for threading

N01 G00 X 25.0 Z2.0:

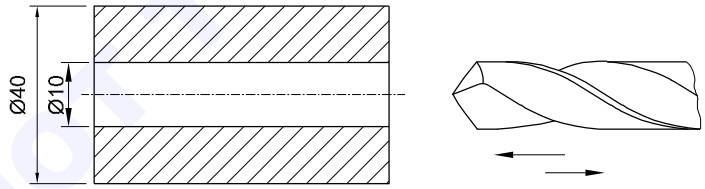
N02 G92 X 23.8 Z-27.0 F1.5:

X25.0:

X2.0:

X23.6:

TASK-5 DRILLING



TASK 5: **Drilling**

Tool path for drilling

N01 G00 X0.0 Z5.0

N02 G01 Z-10.0 F0.08

N03 G00 Z-2.0

N04 G01 Z-20.0 F0.08

N05 G00 22.0

(or)

N01 G76 P030060 Q150 R20;

N02 G76 X22.065 Z-27.0 P9675

Q200 F1.5:

MG20N211154H2

Identify safety switches and interlocking of DIH modes

Objectives: At the end of this exercise you shall be able to
- **identify safety switches in CNC lathe**
- **identify inter locks used in CNC lathe.**

Job sequence

1. **Trainer shall demonstrate the safety switches are provided in CNC lathe.**
2. **Identify and demonstrate the various interlocking system provided in CNC lathe.**
3. **Ask the trainees to identify, observe and record in the table 1.**

Table 1

Sl No	Condition	Operation	Observation
1	Edit key is OFF position	Enter the part program	.....
2	Keep door in open position	Press cycle start	
3	Chuck, open position	Start spindle rotation in MDI mode	.....
4	Emergency stop switch in	Homing the axis pressed condition	.....
5	Close the feed rate over ride	Move the axes switch to 'Zero' position	.....
6	"Machine lock" switch in 'ON' position	Start the auto cycle to machine the job	.....
7	Optional stop switch in 'OFF' position	Start the Auto cycle to machine job with various operation	.....
8	Block skip switch in OFF position (part program with/	Start the auto cycle to machine job blocks)	.....

Get it verify with trainer