MECHANIC MACHINE TOOL MAINTENANCE

NSQF LEVEL - 4

1st Year

TRADE PRACTICAL

SECTOR: CAPITAL GOODS & MANUFACTURING

(As per revised syllabus July 2022 - 1200 Hrs)

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 : MMTM - 1st Year - Trade Practical - 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 : January 2024 Copies: 1000

Rs.345/-

FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2022 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 comprising 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 **MMTM - 1st Year - Trade Practical NSQF Level - 4 (Revised 2022) in CG & M Sector under Annual pattern.** The NSQF Level - 4 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

Atul Kumar Tiwari, ***I.A.S***
Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

January 2024
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 syllabi 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** NSQF - 4 (Revised 2022) for the trade of **MMTM** under the **CG & M** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

A. Vijayaraghavan	-	Asst. Director of Training (Retd) ATI, Chennai - 32.
M. Sampath	-	Training officer (Retd) CTI, Chennai - 32.
Shri. V. Alagaiah	-	Assistant Training officer Govt ITI, Ambattur, Chennai

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

This manual is divided into nine modules. The eight modules are given below

Module 1	**Basic Fitting - I**
Module 2	**Basic Fitting - II**
Module 3	**Machining (Shaping & Milling)**
Module 4	**Heat Treatment**
Module 5	**Advance Fitting**
Module 6	**Mechanical Power Transmission**
Module 7	**Lubrication and Coolants**
Module 8	**Installation and Maintenance**
Module 9	**Turning**

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

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

TRADE THEORY

The manual of trade theory consists of theoretical information for the Course of the **MMTM - 1st** Trade Theory NSQF Level - 4 (Revised 2022) in CG & M. The contents are sequenced according to the practical exercise contained in NSQF Level - 4 (Revised 2022) syllabus on Trade Theory attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

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

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

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

CONTENTS

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
	Module 1 : Basic Fitting - I		
1.1.01	Importance of trade training, list of tools & machinery used in the trade		1
1.1.02	Safety attitude development of the trainee by educating them to use personal protective equipment (PPE)		5
1.1.03	First aid method and basic training		7
1.1.04	Safe disposal of waste materials like cotton waste, metal chips / burrs etc.		12
1.1.05	Hazard identification and avoidance		13
1.1.06	Safety signs for danger, warning, caution and personal safety message		15
1.1.07	Preventive measures for electrical accidents and steps to be taken in such accidents		17
1.1.08	Use of fire extinguishers		19
1.1.09	Study the drawing to plan the job/work and identification of tools and equipments as per desired specifications for marking & sawing		21
1.1.10	Visual inspection of raw material for rusting, scaling, corrosion etc.		24
1.1.11	Familiarisation of bench vice		25
1.1.12	Filing flat and square (rough finish)		26
1.1.13	Marking with scriber and steel rule		28
1.1.14	Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule	1 & 2	29
1.1.15	Filing channel, parallel		31
1.1.16	Filing flat and square (rough finish)		35
1.1.17	Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule		37
1.1.18	Marking practice with dividers, odd leg calipers and steel rule (circles, arcs, parallel lines)		39
1.1.19	Marking off straight lines and arcs using scribing block and dividers		41
1.1.20	Chipping flat surfaces along a marked line		44
1.1.21	Marking, filing, filing square and check using Try - square		46
1.1.22	Marking according to drawing for locating position of holes, scribing lines on chalked surfaces with marking tools		47
1.1.23	Finding center of round bar with the help of ‘V’ block and marking block		50
1.1.24	Prepare mushroom head and round bar and bending metal plate by hammering		52
1.1.25	Chipping flat surfaces along a marked line		54
1.1.26	Make a square from a round job by chipping upto 20mm length		55
1.1.27	Slot, straight and angular chipping		56
1.1.28	Mark off and drill through holes		58
1.1.29	Drill and tap on M.S.flat		60

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
1.1.30	Cutting external thread on M.S rod using die	1 & 2	63
1.1.31	Punch letter and number (letter punch and number punch)		65
	Module 2 : Basic Fitting - II		
1.2.32	File steps and finish with smooth file to accuracy of ±0.25mm		67
1.2.33	File and saw on M.S. square and pipe		69
1.2.34	File radius along a marked line (convex and concave) and match		71
1.2.35	Chip sheet metal (shearing)		73
1.2.36	Chip step and file		75
1.2.37	Truing of pedestal grinding wheel		76
1.2.38	Grinding and resharpening of hand tools		77
1.2.39	Repair and maintenance of hand tools	1 & 2	81
1.2.40	Dressing of grinding wheel by diamond dresser tool		84
1.2.41	Counter sinking, counter boring and reaming with accuracy ± 0.04 mm		86
1.2.42	Drill blind holes with an accuracy 0.04mm		90
1.2.43	Form internal threads with taps to standard size (blind holes)		92
1.2.44	Prepare studs and bolt to standard size and watch with nut		94
1.2.45	File and make step fit, angular fit, with surface accuracy of ± 0.20 mm (bevel gauge accuracy 1 degree)	3	96
1.2.46	Make simple open and sliding fits		98
	Module 3 : Machining (Shaping and Milling)		
1.3.47	Perform the holding job on sharper machine vice, setting length of stroke, setting of feed in a shaper machine		100
1.3.48	Make a square block in shaper machine		102
1.3.49	Perform preventive maintenance of shaping machine		104
1.3.50	Grinding of R.H. and L.H tools, V-tool, parting tool and round nose tool		106
1.3.51	Perform facing operation to correct length		110
1.3.52	Centre drilling and drilling operation to a required size	3	111
1.3.53	Perform parallel turning and step turning		115
1.3.54	Perform drilling, boring undercut, parting, grooving, chamfering operation		116
1.3.55	Demonstrate working principle of milling machine		121
1.3.56	Set arbor and cutter on arbor of milling machine		122
1.3.57	Sequence of milling six faces of a solid block		125
1.3.58	Perform step milling and slot milling with side & face cutter		128
1.3.59	Make 'V' Block using horizontal milling machine with accuracy ±0.02mm		133
	Module 4 : Heat Treatment		
1.4.60	Hardening and Tempering & Normalising		139
1.4.61	Case hardening		141

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
1.4.62	Hardness testing	4	143
1.4.63	Scraping practice on flat and curved surface		146
1.4.64	Make a plain flat surface of by scraping the high spots using prussian blue		151
1.4.65	Laping the surface with lapping stone		152
1.4.66	Fixing hammer handle		154
	Module 5 : Advance Fitting		
1.5.67	Make male & female 'T' fitting with an accuracy ± 0.15mm and 30 minutes	5	155
1.5.68	Make male and female square fit with accuracy ± 0.1mm		157
1.5.69	Make male and female Hexagon fitting with accuracy ± 0.1mm and 30 mins		159
1.5.70	Make male and female dovetail fitting scraping the surface with in an accuracy ± 0.1mm & 30min		160
	Module 6 : Mechanical Power Transmission		
1.6.71	Identify different components of power transmission	6	162
1.6.72	Dismantle and assemble different component of power transmission		163
1.6.73	Safety precautions related to power transmission		168
1.6.74	Identify different types of clutches in machine tools and their maintenance		170
1.6.75	Making key and mounting of coupling on the shaft with key		172
1.6.76	Identification and inspection of components of different types of brakes in machine tools		174
1.6.77	Fitting of hub and shaft with key		178
1.6.78	Installation of belt for transmission with adjusting the tension		180
1.6.79	Identification of various types of bearing in machine tools		183
1.6.80	Impression testing of split bush bearing for proper contact on journal & housing		185
1.6.81	Preloading of precision angular constact bearing		188
1.6.82	Dismantling inspection and mounting of ball bearing on shaft with press and pullers		190
1.6.83	Dismantling and assembly of tail stock of a lathe		194
1.6.84	Demonstrate of different types of knots and hitches used in material handling		196
1.6.85	Splicing of manila rope		199
1.6.86	Inspection of wire rope / steel rope / belts		202
1.6.87	Lift an object by using slings		205
1.6.88	Identification different types of gears and gear bones used in machine tools		208
1.6.89	Checking of Gear elements as PCD gear tooth thickness clearance concentricity		210
1.6.90	Checking of backlash and root clearance by feeler gauge, DTI & lead wire in gear meshing		211

Exercise No.	Title of the Exercise	Learning Outcome	Page No.
1.6.91	Inspection and replacing the lubricating oil of a given gear box		212
1.6.92	Overhauling of gear box of lathe & milling machine		213
1.6.93	Write a inspection report for maintenance job		217
1.6.94	Prepare action plan for maintenance work		218
	Module 7 : Lubrication and Coolants		
1.7.95	Identification of various types of lubrication system and their components		219
1.7.96	Cleaning of lubrication lines and oil filters		220
1.7.97	Fittings of different types of seals and oil rings		222
1.7.98	Preparing and fitting of gasket for different joint surface		224
1.7.99	Preventive maintenance of lubrication system of lathe, drilling and grinding machine	7	226
1.7.100	Lubrication schedule-Daily, weekly, monthly concept		228
1.7.101	Identification of components of coolant system		229
1.7.102	Preventive maintenance of coolant system		230
1.7.103	Breakdown maintenance of coolant system		231
	Module 8 : Installation and Maintenance		
1.8.104	Marking, locate on grouting and installation of foundation bolts		232
1.8.105	Erection and installation of a small machine like shaper/pedestal grinder machine		235
1.8.106	Levelling of small machine like shaper		237
1.8.107	Levelling of lathe & milling machine		238
1.8.108	Alignment of shaft with help of feeler gauge, dial test indicator & taper gauge		240
1.8.109	Alignment of pulley & sprocket with straight edge & thread	8	241
1.8.110	Geometrical alignment test of machine as per test chart		243
1.8.111	Dismantling, checking and assembly of various part of drilling machine such as motor, spindle head, gear box & arm		251
1.8.112	Measure current, voltage and resistance using simple ohm's Law circuit and familiarizing multimeter		254
1.8.113	Soldering Techniques		257
1.8.114	Step up and step down transformers		259
1.8.115	Working with solenoids and relays		261
1.8.116	Working of motor and generators		263
	Module 9 : Turning		
1.9.117	Perform taper turning in the lathe by different methods		265
1.9.118	Perform external thread cutting operation on the lathe machine		268
1.9.119	Dismantling and assembly of head stock, apron, saddle, tool post, tailstock removing broken studs/bolts of lathe machine		272
1.9.120	Accuracy checking of lathe machine after assembly	9	280
1.9.121	Perform preventive maintenance of lathe machine		283

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

Sl.No.	Learning Outcome	Exercise No.
1	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. [Basic fitting operation – marking, Hack-sawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] **NOS:CSC/N0304**	1.1.01-1.2.44
2	Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit – Sliding, Angular, Step fit, Required tolerance: ±0.20 mm, angular tolerance: 1 degree] **NOS:CSC/N0304**	1.2.45-1.2.46
3	Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper, Lathe & Milling, Different machining parameters – feed, speed & depth of cut.] **NOS:CSC/N0304**	1.3.47-1.3.59
4	Prepare components for assembly by carrying out different Heat Treatment and surface finishing operations. [Different Heat Treatment: - Hardening, Tempering case hardening, different surface finish- scrapping, lapping] **NOS:CSC/N0304**	1.4.60-1.4.66
5	Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit – square fits, T-fits, hexagonal fit, dovetail fit; surface accuracy: ±0.1 mm, angular tolerance:30 min.] **NOS:CSC/N0304**	1.5.67-1.5.70
6	Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. **NOS: CSC/N0901**	1.6.71-1.6.94
7	Carryout preventive maintenance of lubrication & cooling system of different machines as per manufactures guidelines. [Different machines- lathe, drilling, grinding] **NOS:CSC/N0901**	1.7.95-1.7.103
8	Prepare machine foundation for erection, install different machines and carry out geometrical tests. [Different machines – shaper, pedestal grinding] **NOS:CSC/N0304**	1.8.104-1.8.116
9	Conduct preventive maintenance, perform dismantling & assembly of different components and test for accuracy to carryout advance lathe operation. [Different components- head stock apron, saddle, tool post tail stock; Different advance lathe operation – taper turning, thread cutting] **NOS:CSC/N0901**	1.9.117-1.9.121

SYLLABUS FOR MECHANIC MACHINE TOOL MAINTENANCE

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 260Hrs; Professional Knowledge	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy following safety precautions. [Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] (Mapped NOS: NOS:CSC/ N0304)	1. Importance of trade training, List of tools & Machinery used in the trade. (1 hr) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (3 hrs) 3. First Aid Method and basic training.(2 hrs) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (1 hrs) 5. Hazard identification and avoidance. (2 hrs) 6. Safety signs for Danger, Warning, caution & personal safety message.(1 hr) 7. Preventive measures for electrical accidents & steps to be taken in such accidents.(2 hrs) 8. Use of Fire extinguishers.(2 hrs)	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills, its importance and Job area after completion of training. Importance of safety and general precautions observed in the in the industry/shop floor. Introduction of First aid. Operation of electrical mains and electrical safety. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure. **Importance of housekeeping & good shop floor practices.** Introduction to 5S concept & its application. **Occupational Safety & Health:** Health, Safety and Environment guidelines, legislations & regulations as applicable. Basic understanding on Hot work, confined space work and material handling equipment. (04 hrs)
		9. Study the drawing to plan the job/ work. Identification of tools &equipments as per desired specifications for marking, filling & sawing. (3 hrs) 10. Visual inspection of raw material for rusting, scaling, corrosion etc.(1 hr) 11. Familiarisation of bench vice. (1 hr) 12. Filing- Flat and square (Rough finish). (8 hrs) 13. Marking with scriber and steel rule (2hrs) 14. Filing practice, surface filing, marking of straight and parallel lines with odd leg callipers and steel rule. (08 hrs)	Linear measurements- its units, steel rule dividers, callipers – types and uses, Punch – types and uses. Uses of different types of hammers. Description, use and care of marking off table. (04 hrs)

		15. Filing Channel, Parallel. (4 hrs) 16. Filing- Flat and square (Rough finish), (08 hrs) 17. Filing practice, surface filing, marking of straight and parallel lines with odd leg callipers and steel rule. (5 hrs) 18. Marking practice with dividers, odd leg callipers and steel rule (circles, ARCs, parallel lines). (5 hrs)	Bench vice construction, types, uses, care & maintenance, vice clamps,hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws.Files- specifications, description, materials, grades, cuts, file elements, uses. Types of files, care and maintenance of files. Measuring standards (English, Metric Units), angular measurements. (04 hrs)
		19. Marking off straight lines and ARCs using scribing block and dividers. (5 hrs) 20. Chipping flat surfaces along a marked line. (05 hrs) 21. Marking, filing, filing square and check using tri-square.(05 hrs)	Marking off and layout tools, dividers, scribing block, odd leg callipers, punchesdescription, classification, material, care & maintenance. Try square, ordinary depth gauge, protractor- description, uses and cares. Callipers- types, material, constructional details, uses, care & maintenance of cold chisels- materials, types, cutting angles. (04hrs)
		22. Marking according to drawing for locating, position of holes, scribing lines on chalked surfaces with marking tools. (5 hrs) 23. Finding centre of round bar with the help of 'V' block and marking block. (5 hrs) 24. Prepare mushroom head and round bar and bending metal plate by hammering. (10hrs)	Marking media, Prussian blue, red lead, chalk and their special application, description. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. (04 hrs)
		25. Chipping flat surfaces along a marked line. (10 hrs) 26. Make a square from a round job by chipping upto 20mm length. (8hrs) 27. Slot, straight and angular chipping (5hrs) 28. Mark off and drill through holes. (5 hrs) 29. Drill and tap on M.S. flat. (8 hrs) 30. Cutting external thread on M.S. rod using Die.(5hrs) 31. Punch letter and number (letter punch and number punch) (5 hrs)	Drill, Tap, Die-types & application. Determination of tap drill size. Reamer- material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure. (7 hrs)

		32. File steps and finish with smooth file to accuracy of ± 0.25 mm. (10 hrs) 33. File and saw on M.S. Square and pipe. (15 hrs)	Micrometer- outside and inside – principle, constructional features, parts graduation, leading, use and care. Micrometer depth gauge, parts, graduation, leading, use and care. Digital micrometer. (04 hrs)
		34. File radius along a marked line (Convex & concave) & match. (15 hrs) 35. Chip sheet metal (shearing). (5 hrs) 36. Chip step and file. (5 hrs)	Vernier calipers, principle, construction, graduations, reading, use and care. Vernier bevel protractor, construction, graduations, reading, use and care, dial Vernier Calliper, Digital verniercalliper. (04 hrs)
		37. Truing of pedestal grinding wheel. (10 hrs) 38. Grinding and resharpening of hand tools. (10 hrs) 39. Repair and maintenance of hand tools. (10 hrs) 40. Dressing of grinding wheel by diamond dresser tool. (15hrs)	Pedestal grinder – Introduction, care & use. Procedure of wheel mounting & wheel dressing. Related hazards, risk and precautions. (10 hrs)
		41. Counter sinking, counter boring and reaming with an accuracy ± 0.04 mm.(5 hrs) 42. Drill blind holes with an accuracy 0.04 mm.(2 hrs) 43. Form internal threads with taps to standard size (blind holes).(3 hrs) 44. Prepare studs and bolt to standard size and watch with nut. (15 hrs)	Drilling machines-types &their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facingtools and nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations. (05hrs)
Professional Skill 40Hrs; Professional Knowledge 08hrs	Make different fit of components for assembling as per required tolerance observing principle of inter change ability and check for functionality. [Different Fit – Sliding, Angular, Step fit, Required tolerance: ±0.20 mm, angular tolerance: 1 degree] (Mapped NOS: **NOS:CSC/N0304)**	45. File and make Step fit, angular fit, with surface accuracy of ±0.20 mm (Bevel gauge accuracy 1 degree). (20hrs) 46. Make simple open and sliding fits. (20hrs)	Interchangeability: Necessity in Engg, field, Limit- Definition, types, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone, allowances. Different standard systems of fits and limits. (British standard system & BIS system (08 hrs)

Professional Skill 90Hrs; Professional Knowledge 20Hrs	Set the different parameters to produce components involving basic operations on different machine observing standard procedure and check for accuracy. [Different machines – Shaper, Lathe & Milling, Different machiningparameters – feed, speed & depth of cut.] (Mapped NOS: **NOS:CSC/N0304)**	47. Perform the holding job on shaper machine vice, setting length of stroke, setting of feed in a shaper machine. (5 hrs) 48. Make a square block in shaper machine. (10 hrs) 49. Perform preventive maintenance of shaping machine. (5hrs)	Shaper:Introduction to Shaper machine parts & constructional details, its function and operations. Quick return mechanism of shaper. Calculation of cutting Speed, feed & depth of cut. (04 hrs)
		50. Grinding of R.H & L.H tools, V tool, parting tool, round nose tool & 'V' tools. (10 hrs) 51. Perform facing operation to correct length. (5hrs) 52. Centre drilling & drilling operations to required size. (5hrs) 53. Perform parallel turning & step turning. (05hrs) 54. Perform drilling, boring, undercut, parting, grooving, chamfering operation. (10hrs)	Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing. Selection of grinding wheels. Bench grinder parts and use.Radius/fillet gauge, feeler gauge, hole gauge, and their uses, care and maintenance. (08 hrs)
		55. Demonstrate working principle of milling machine. (3hrs) 56. Set arbor and cutter on arbor of milling machine. (4hrs) 57. Sequence of milling six faces of a solid block. (08hrs) 58. Perform step milling and slot milling with side & face cutter. (10hrs) 59. Make 'V' block using horizontal milling machine (accuracy ±0.02mm) (10hrs)	**Milling:** Introduction to milling machine, parts & constructional details, types. Safety precaution followed during milling operation. Milling machine attachments. Different types of milling cutters and its materials. Nomenclature of milling cutters. Milling cutter holding devices, work holding devices, Milling machine operations, Up milling and Down milling. Calculation of cutting speed, feed, machining time for milling machine. Indexing methods and its calculations. (08 hrs)
Professional Skill 65 Hrs; Professional Knowledge 15Hrs	Prepare components for assembly by carrying out different Heat Treatment and surface finishing operations. [Different Heat Treatment: - Hardening, Tempering casehardening, different surface finishscrapping, lapping] (Mapped NOS: **NOS:CSC/ N0304)**	60.Hardening and tempering &Normalising. (10 hrs) 61. Case Hardening. (5 hrs) 62. Hardness Testing. (5 Hrs)	Heat Treatment: Iron Carbon Equilibrium Diagram, Time-TemperatureTransformation Curve. Annealing, Case Hardening, Tempering, Normalizing and Quenching (07 hrs)

		63. Scraping practice on flat & curved surface. (15hrs) 64. Make a plain flat surface of by scraping the high spots using Prussian blue. (20 hrs) 65. Lapping the surface with lapping stone. (5 hrs) 66. Fixing hammer handle. (5 hrs)	Classification, construction, materials and functional detail of Chisels & Hammers. Chipping technique. Related hazards, risk and precautions while working. Scrapers: Introduction, Its types, material and use. Types of nuts, bolts, studs, locking devices for nut, wrench and spanner, pliers, screw drivers, Circlip, split pin, washers, spring washer. Concept of torque & torque wrench. Different types of rivets and their applications. Identification of different fasteners & operating them by using proper hand tool (08 hrs)
Professional Skill 85Hrs; Professional Knowledge 15Hrs	Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit – square fits, T fits, hexagonal fit, dovetail fit; surface accuracy: ±0.1 mm, angular tolerance: 30 min.] (Mapped **NOS: CSC/N0304)**	67. Make Male & Female 'T' fitting with an accuracy ±0.15 mm and 30 minutes. (25hrs) 68. Make male female square fit with accuracy ±0.1 mm. (20hrs)	Surface finish - importance, symbol, measuring techniques. Lapping & honing process. Gauges: Classification and uses of Sine bar, Slip gauge, Limit gauge, Feeler gauge, thread gauge, screw pitch gauge, taper gauge. (6 hrs)
		69. Make Male & Female Hexagon fitting with accuracy ±0.1 mm and 30 min. (20 hrs)	Tolerances & interchangeability - Definition and its necessity, basic size, actual size, limits, deviation, Tolerance, allowance, clearance, interference, Fitsdefinition, types, description with sketches. Method of expressing Tolerance as per BIS, Hole and Shaft basis (BIS standard). Related calculation on Limit, Fit and Tolerance. (03 hrs)
		70. Make male & female dovetail fitting scraping the surface within an accuracy ±0.1 & 30 min	**Fasteners:** Introduction to fasteners, screw threads, related terminology and specification.Keys- types & use, (parallel, sunk, tangential, gib head, woodruff, key ways.) Related hazards, risk and precautions, while working. (06 hrs)
Professional Skill 130Hrs; Professional Knowledge 20 Hrs	Dismantle, Repair and Assemble of mechanical power transmission elements in machine tools and check for functionality. (Mapped NOS: **NOS:CSC/N0901)**	71. Identify different components of power transmission. (5 hrs) 72. Dismantle and assemble different components of power transmission. (10 hrs) 73. Safety precautions related to power transmission. (5 hrs)	**Maintenance Practice and Mechanical Assembly** Introduction to various maintenance practices such as preventive maintenance, predictive maintenance, breakdown maintenance & reconditioning. Organization Structure for maintenance, Roles and responsibility, advantage and disadvantage of TPM. Transmission of Power Elements of mechanical power transmission, type of

			spindles and shafts (Universal spindle, Plain shaft, Hollow shaft, crank shaft, cam shaft). Positive and Non-positive drive, Friction drive, Gear drive, Belt drive, Chain drive and Rope drive. (04 hrs)
		74. Identify different types clutches in machine tools and their maintenance. (05 hrs) 75. Making key and mounting of coupling on the shaft with key. (05 hrs) 76. Identification and inspection of components of different types of brakes in machine tools (04hrs) 77. Fitting of hub and shaft with key. (05 hrs) 78. Installation of belt in transmission with adjusting the tension. (05 hrs)	Clutches Function of Clutches, its types and use in power transmission system. Function of mechanical & electromagnetic system in clutch mechanism. Couplings: Concept of coupling and its type viz. Rigid coupling- Muff coupling, Flange coupling, Flexible coupling, Pin-bush coupling, Chain coupling, Gear coupling, Spider coupling, Tyre coupling, Grid coupling, Oldham-coupling, Fluid coupling, Universal coupling and their specific applications. **Brakes& Braking** Mechanism: Types & Functions. Inspection of brakes for safe & effective working. **Belts** Belt types (Flat and V) and specifications. Pulleys used for belt drive. Installation, Alignment of belts. Problems related to belts(Creep and slip) Belt maintenance. Sheave alignment, Chain drive- Roller chain, Silent chain, alignment of sprockets, and maintenance of chain drive. (04 hrs)
		79. Identification of various types of bearings in machine tools. (4 hrs) 80. Impression testing of split bush bearing for proper contact on journal & housing. (4 hrs) 81. Preloading of Precision angular contact bearing (4 hrs) 82. Dismantling, inspection and mounting of ball bearing on shaft with press & pullers. (10hrs) 83. Dismantling & assembly of tail stock of a lathe. (10hrs) 84. Demonstrate of different types of knots and hitches used in material handling. (5 hrs) 85. Splicing of manila rope. (2 hrs) 86. Inspection of wire rope/ steel rope/ belts. (2 hrs) 87. Lift an object by using slings. (2 hrs)	**Bearing:** Description and function of bearing, its types - Solid Bush, Split Bush, Collar, Pivot and Plummer Block Bearing. Mounting of bearings, measurement and adjustment of clearances in bearings. Types of bearing fitting on shaft and hubs. Type of Roller contact bearings- Ball bearings- single row & double row, Deep groove ball bearing, Angular contact, Self aligning and Thrust bearing. Roller bearing- Cylindrical, Needle roller, Taper roller, Spherical roller, self aligning and Spherical roller thrust bearing. Use of ISO bearing designation code to generate market survey and purchase. Checking and adjustment of bearing clearance. Methods of Mounting and dismounting of roller contact bearing, taper roller bearing

			and angular contact ball bearing. (Back-to-back, Faceto-face, tandem) Mounting-dismounting and adjustment of Taper bore bearings with adopter and withdrawal sleeve. Handling and storage of bearings. Related hazards, risk and precautions. Rigging Knowledge of different tools & tackles used in rigging. Construction and capacity of wire rope/steel rope/belts. Application of knots and hitches. Care and maintenance of all types of ropes. (6 hrs)
		88. Identification different types of gears and gear bones used in machine tools. (5 hrs) 89. Checking of gear elements as PCD, gear tooth thickness, clearance concentricity. (08 hrs) 90. Checking of backlash and root clearance by feeler gauge, DTI & lead wire in gear meshing. (07 hrs)	**Gear:** Type, description and function of gearsSpur, Helical, Spiral, Bevel, Straight and Spiral bevel, Worm gears, Rack and pinion. Gear Terminology. Gear train- simple, compound, reverted and epicyclic. (03 hrs)
		91. Inspection & replacing the lubricating oil of a givengearbox.(5hrs) 92. Overhauling of gear box of lathe & milling machine. (08hrs) 93. Write a inspection report for maintenance job. (5hrs) 94. Prepare a action plan for maintenance work. (5 hrs)	Types of Gear box Gear meshing: Checking of backlash and root clearances with Feeler Gauge, Dial Test Indicator and lead wire. Impression testing of gear mesh with Prussian blue. Running maintenance Related hazards, risk and precautions. (03 hrs)
Professional Skill 65 Hrs; Professional Knowledge 15Hrs	Carryout preventive maintenance of lubrication &cooling system of different machines as per manu factures guidelines. [Different machineslathe, drilling, grinding] (Mapped **NOS: CSC/N0901)**	95. Identification of various types of lubrication system and their components. (5hrs) 96. Cleaning of lubrication lines and oil filters. (07 hrs) 97. Fittings of different types of seals and oil rings. (07rs) 98. Preparing and fitting of gasket for different joint surface. (08hrs) 99. Preventive maintenance of lubrication system of lathe, drilling and grinding machines. (08hrs)	Lubrication and its importance, lubricating systems Concept of lubrication Types and properties of Oil and Grease. Methods of oil lubricationOnce through and centralized lubrication system. (05 hrs) Methods of grease lubrication system- grease guns, centralized lubrication system. Warning & protective devices used in centralized lubrication system (Pressure switch, temperature gauge, level indicator and relief valve.)

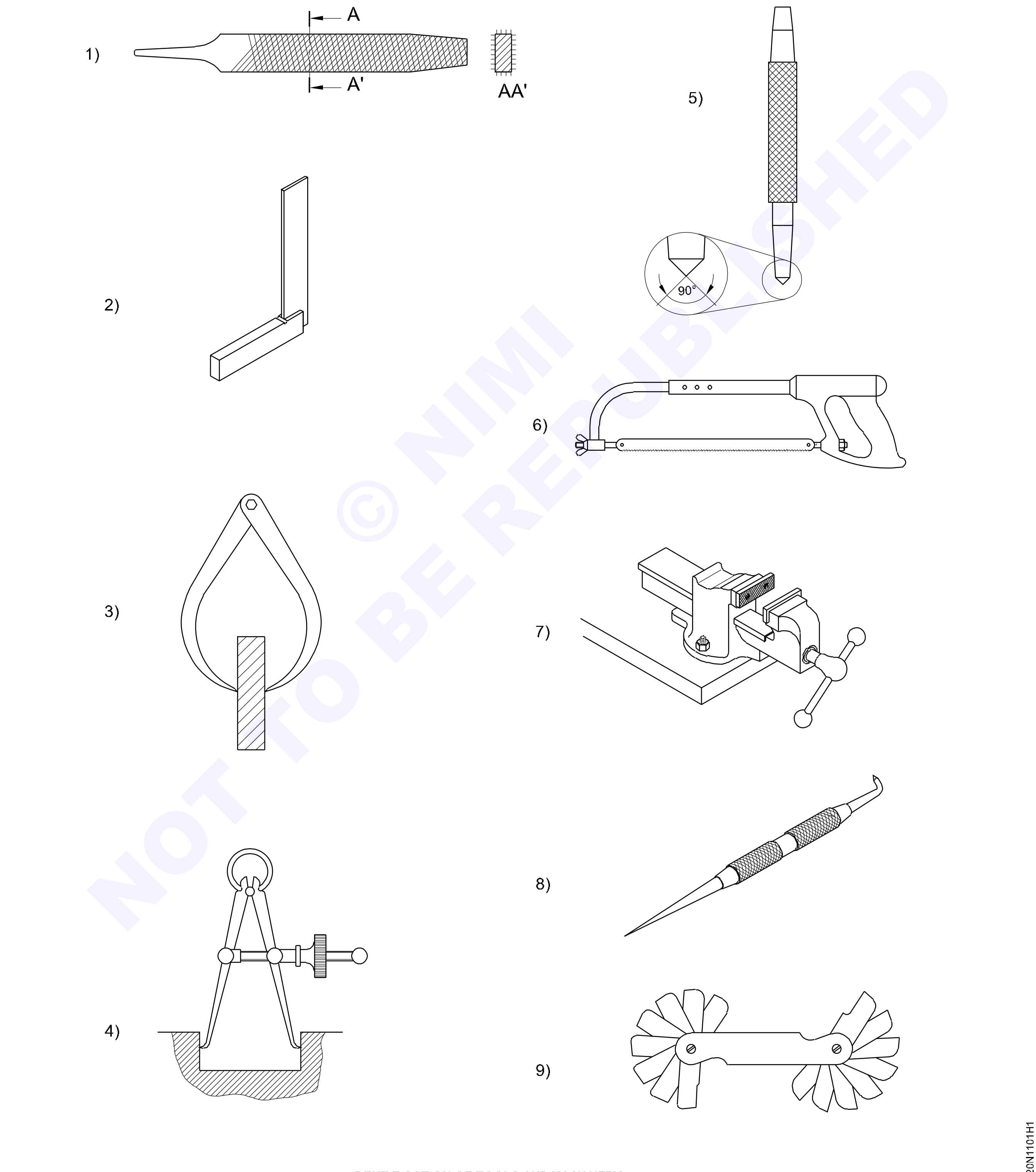
			Lubrication fittings. Storage and handling, Contamination control, Leakage prevention- Shaft seals, sealing devices and “O” rings. (05 hrs)
		101Identification of components of coolant system. (5hrs) 102 Preventive maintenance of coolanT system. (10hrs) 103.Breakdown maintenance of coolan Tsystem. (10hrs)	Cutting Fluids and Coolants. Essential parts of a basic coolant system used in the cutting of metals. Various types of coolants, its properties and uses ,coolantsystem type-soluble oils-soaps, sudsparaffin,soda water etc.Cutting Fluids and Coolants. Essential parts of a basic coolant system used in the cutting of metals. Various types of coolants, its properties and uses ,coolantsystem type-soluble oils-soaps, sudsparaffin,soda water etc. Effect of cutting fluids in metal cutting. Difference between coolant and lubricants. (05 hrs) Effect of cutting fluids in metal cutting. Difference between coolant and lubricants. (05 hrs)
Professional Skill 85Hrs; Professional Knowledge 16Hrs	Prepare machine foundation for erection, install different machines and carry out geometrical tests. [Different machines – shaper, pedestal grinding] (Mapped **NOS: CSC/N0304)**	104.Marking location, grouting and installation of foundation bolts. (10hrs) 105. Erection and installation of a small machine like shaper/ pedestal grinder machine. (10hrs)	MACHINE FOUNDATION Purpose & methods employed for installation & erection of precision &heavy duty machines. Location & excavation for foundation. Different types of foundations – structural, reinforced, wooden, isolated foundations. (04 hrs)
		106. Levelling of small machine like shaper. (10hrs) 107.Levelling of a lathe & milling machines. (10hrs) 108.Alignment of shaft with the help of feeler gauge & dial test indicator & taper gauges. (5hrs) 109.Alignment of pulley & sprocket with straight edge & thread. (5hrs) 110.Geometrical alignment test of machine as per test chart. (10hrs)	Foundation bolt: types (rag, Lewis cotter bolt) description of each erection tools, pulley block, crow bar, spirit level, Plumb bob, wire rope, manila rope, wooden block. The use of lifting appliances, extractor presses and their use. Practical method of obtaining mechanical advantage. The slings and handling of heavy machinery, special precautions in the removal and replacement of heavy parts. Energy usage in relevance for Mechanical assembly. (04 hrs)

		111.Dismantling, checking and assembly of various parts of drilling machine such as Motor, spindle head, gear box & arm. (10hrs) 112.Measure Current, Voltage and Resistance using Simple Ohm`s Law Circui And Familiarizing Multimeter. (3hrs) 113. Soldering Techniques. (3hrs) 114. Step up and step down transformers. (3hrs) 115.Working with Solenoids and Relays. (3hrs) 116.Working of Motor& Generators. (3hrs)	Maintenance - Total productive maintenance - Autonomous maintenance - Routine maintenance - Maintenance schedule - Retrieval of data from machine manuals Geometrical tests and inspection method with instruments. Preventive maintenanceobjective and function of Preventive maintenance, section inspection. Visual and detailed, lubrication survey, system of symbol and colour coding. Revision, simple estimation of materials, use of handbooks and reference table. Possible causes for assembly failures and remedies. Hazardous waste management. **Basic Electrical:** Study of basic ElectricalsVoltage – Current etc. Working Of Solenoids, Inductors, Motors, Generator Based On Electromagnetic Induction Principle. (08hrs)
Professional Skill 20Hrs; Professional Knowledge 05Hrs	Conduct preventive maintenance, perform dismantling & assembly of different components and test for accuracy to carryout advance lathe operation. [Different components- head stock apron, saddle, tool post tail stock; Different dvance lathe operation – taper turning, thread cutting] (Mapped NOS: NOS:CSC/N0901)	117.Perform taper turning in the lathe by different methods. (04hrs) 118.Perform external thread cutting operation on the lathe machine. (04hrs) 119.Dismantling and assembly of head stock apron, saddle, tool post tail stock, Removing Broken Studs / Bolts of lathe machine. (08hrs) 120.Accuracy checking of lathe machine after assembly. (2hrs) 121.Perform preventiv maintenance of lathe machine. (2hrs)	Safely precautions to be observed while working on a lathe, Lathe specifications, and constructional features. Lathe main parts descriptions- bed, head stock, carriage, tail stock, feeding and thread cutting mechanisms. Holding of job between centers, works with catch plate, dog, simple description of a facing and roughing tool and their applications. (05 hrs)

Importance of trade training, list of tools & machinery used in the trade

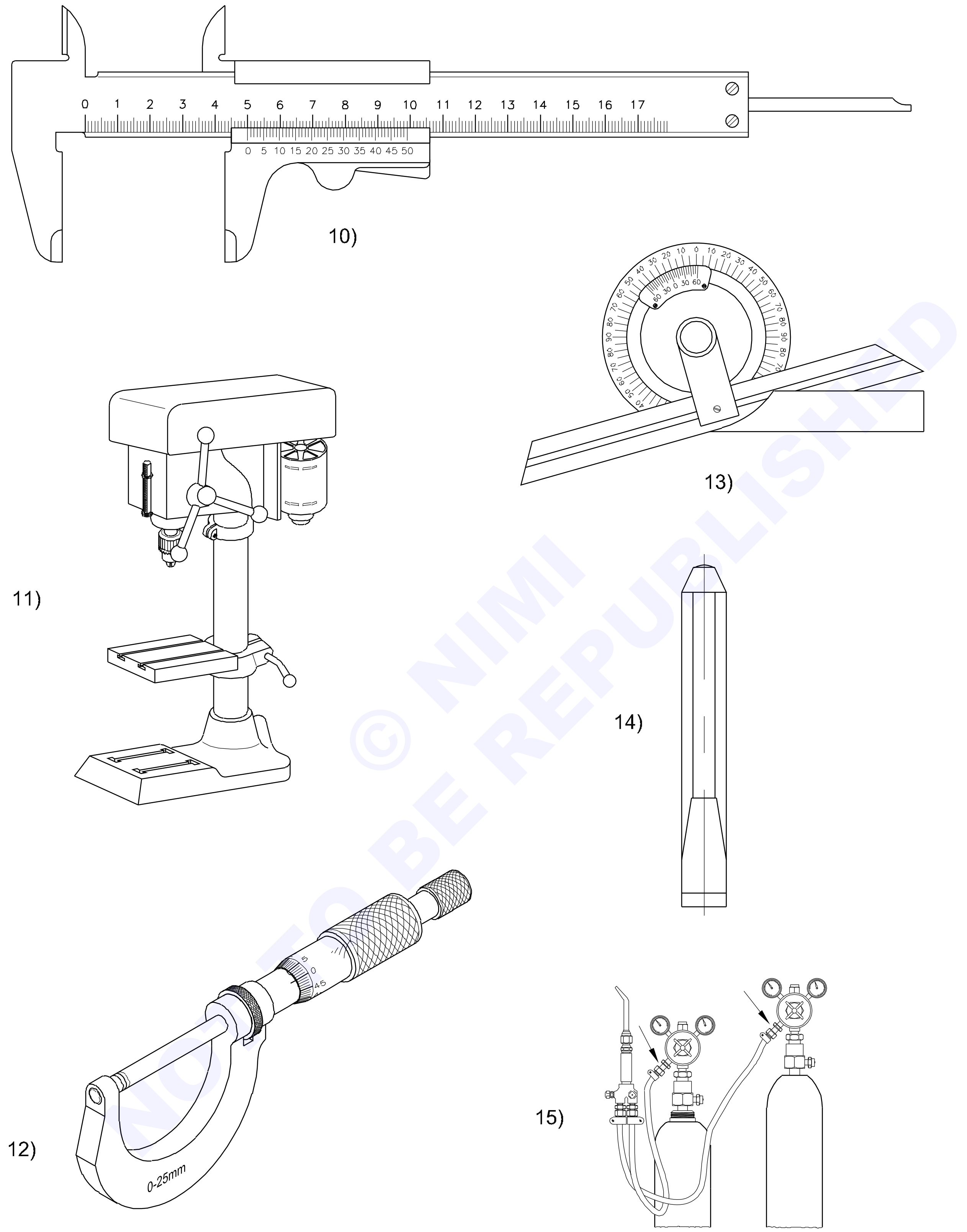
Objectives: At the end of this exercise you shall be able to
- **identify the tools and equipments used in MMTM section**
- **record the names of tools, do and don't of each tool and machinery.**

Fig 1



IDENTIFICATION OF TOOLS AND MACHINERY

Fig 2

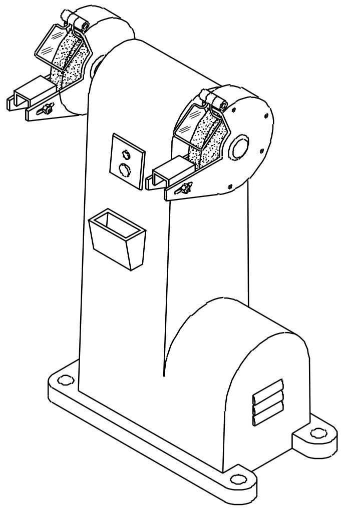


IDENTIFICATION OF TOOLS AND MACHINERY

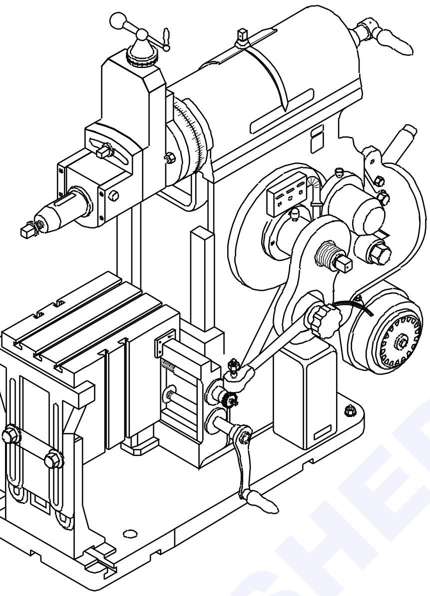
MM20N1101H2

Fig 3

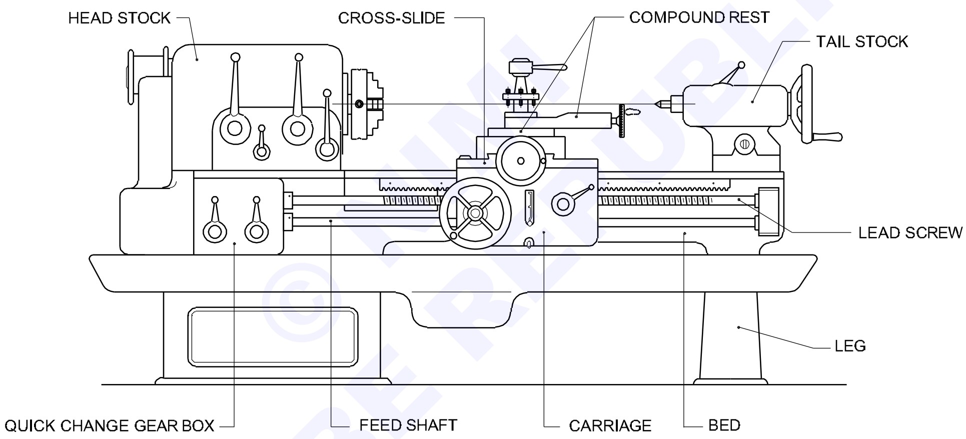
16)



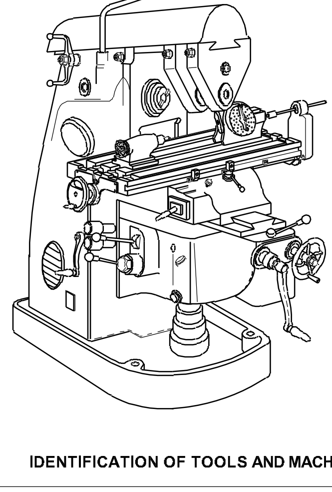
17)



18)



19)



IDENTIFICATION OF TOOLS AND MACHINERY

MM20N1101H3

Job Sequence

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

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

Table 1

Sl.No	Name of tool/machinery	Uses	Precaution to be observed (Do's and Don't)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			

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

Safety attitude development of the trainee by educating them to use personal protective equipment (PPE)

Objectives: At the end of this exercise, you shall be able to
- **identify personal protective devices**
- **interpret the different types of personal protective devices**
- **identify occupational hazards and the corresponding potential hazards.**

Fig 1

IDENTIFY THE CATEGORIES OF PERSONAL PROTECTIVE DEVICE

MM20N1102H1

Job Sequence

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

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

TASK 1

Table 1

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

Get it checked by your instructor.

— — — — — — — — —

TASK 2

Instructor may brief the various types of occupational hazards and their causes.

- Identify the occupational hazard and the corresponding situation with the potential harm and record it in Table 2.

Table 2

SI.No.	Source or potential harm	Type of occupational hazards
1	Noise	
2	Explosive	
3	Virus	
4	Sickness	
5	Smoking	
6	Non control device	
7	No earthing	
8	Poor house keeping	

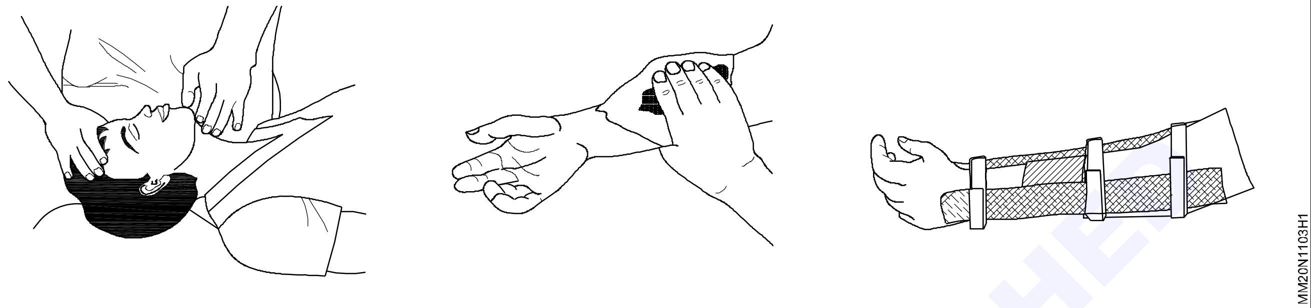
Fill up and get it checked by your instructor.

— — — — — — — — —

First aid method and basic training

Objectives: At the end of this exercise, you shall be able to
- **rescue breathing for an unconscious victim of different condition**
- **perform treatment for stopping of bleeding.**

Fig 1



Job Sequence

> **Assumption - For easy manageability, Instructor may arrange the trainees in group and ask each group to perform one method of resuscitation.**

TASK1: **Prepare the victim to receive artificial respiration**

1 Loosen the tight clothing which may interfere with the victim's breathing.

2 Remove any foreign materials or false teeth from his mouth and keep the victim's mouth open.

3 Bring the victim safely to the level ground, taking necessary safety measures.

4 Start artificial respiration immediately without delay. Do not waste too much time in loosening the clothes or trying to open the tightly closed mouth.

5 Avoid violent operations to prevent injury to the internal parts of the victim.

6 Send word for a doctor immediately.

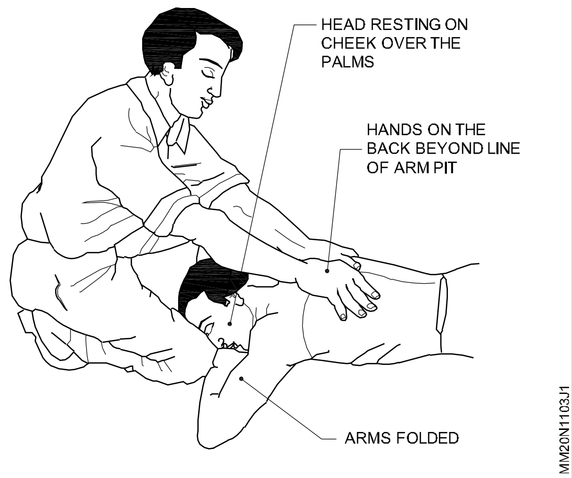
— — — — — — — — — —

TASK 2: **Resuscitate the victim by Nelson's arm - Lift back pressure method**

> **Nelson's arm-lift back pressure method must not be used in case there are injuries to the chest and belly.**

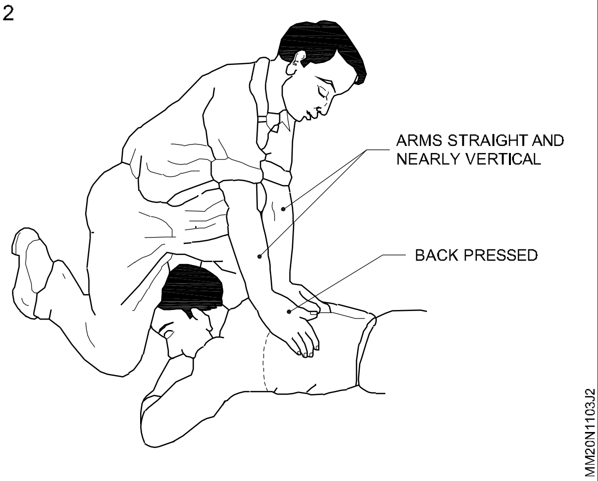
1 Place the victim prone (that is face down) with his arms folded with the palms one over the other and the head resting on his cheek over the palms. Kneel on one or both knees near the victim's hand. Place your hands on the victim's back beyond the line of the armpits, with your fingers spread outwards and downwards, thumbs just touching each other as in Fig 1.

Fig 1



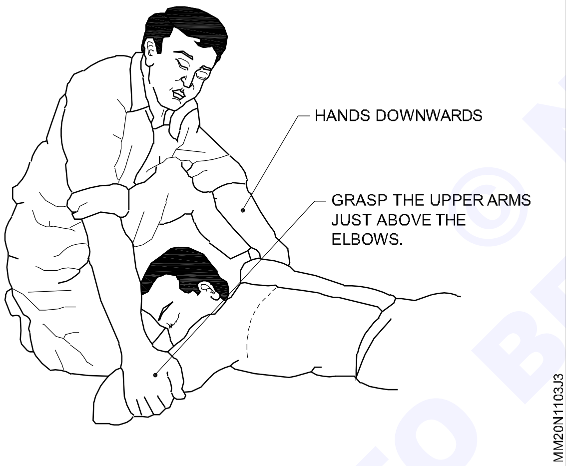
2 Gently rock forward keeping your arms straight until they are nearly vertical, and steadily pressing the victim's back as shown in Fig 2 to force the air out of the victim's lungs.

Fig 2



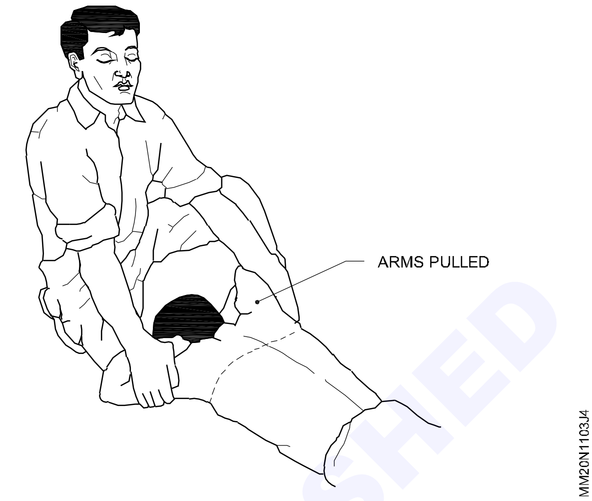
3 Synchronise the above movement of rocking backwards with your hands sliding downwards along the victim's arms, and grasp his upper arm just above the elbows as shown in Fig 3. Continue to rock backwards.

Fig 3



4 As you rock back, gently raise and pull the victim's arms towards you as shown in Fig 4 until you feel tension in his shoulders. To complete the cycle, lower the victim's arms and move your hands up to the initial position.

Fig 4



5 Continue artificial respiration till the victim begins to breathe naturally. Please note, in some cases, it may take hours.

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

7 Keep him in the lying down position and do not let him exert himself.

Do not give him any stimulant until he is fully conscious.

— — — — — —

TASK 3: **Resuscitate the victim by Schafer's method**

Do not use this method in case of injuries to victim on the chest and belly.

1 Lay the victim on his belly, one arm extended direct forward, the other arm bent at the elbow and with the face turned sideward and resting on the hand or forearm as shown in Fig 1.

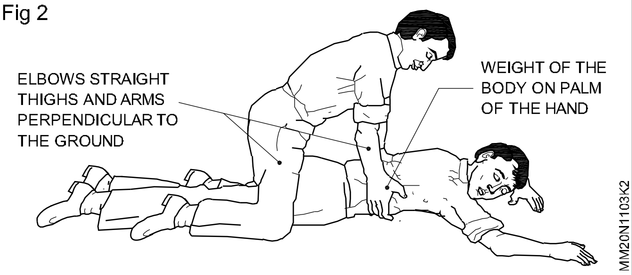
2 Kneel astride the victim, so that his thighs are between your knees and with your fingers and thumbs positioned as in Fig 1.

3 With the arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the lower ribs of the victim to force the air out of the victim's lungs as shown in Fig 2.

Fig 1

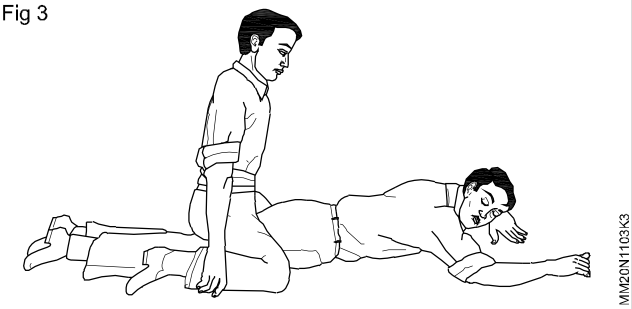
4 Now swing backward immediately removing all the pressure from the victim's body as shown in Fig 3, thereby, allowing the lungs to fill with air.

Fig 2



5 After two seconds, swing forward again and repeat the cycle twelve to fifteen times a minute.

Fig 3



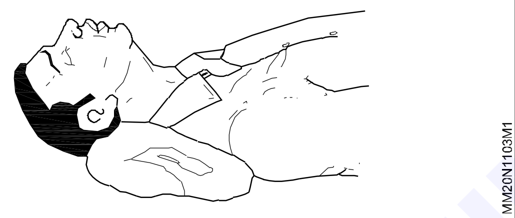
6 Continue artificial respiration till the victim begins to breathe naturally.

— — — — — —

TASK 4: **Resuscitate the victim by mouth-to-mouth method**

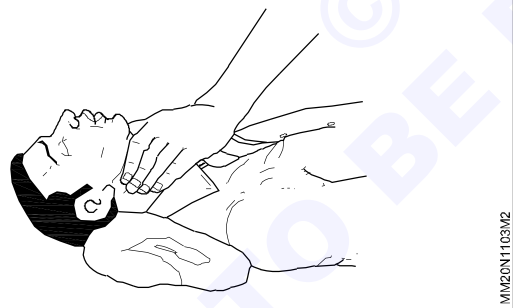
1 Lay the victim flat on his back and place a roll of clothing under his shoulders to ensure that his head is thrown well back. (Fig 1)

Fig 1



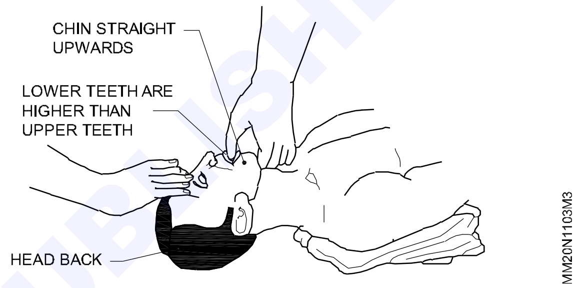
2 Tilt the victim's head back so that the chin points straight upward. (Fig 2)

Fig 2



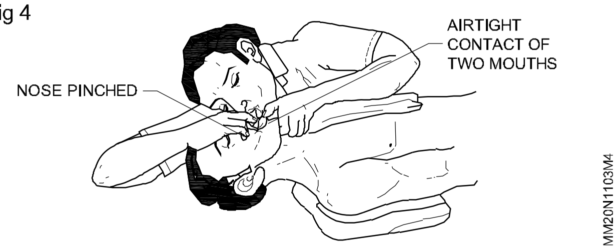
3 Grasp the victim's jaw as shown in Fig 3, and raise it upward until the lower teeth are higher than the upper teeth; or place fingers on both sides of the jaw near the ear lobes and pull upward. Maintain the jaw position throughout the artificial respiration to prevent the tongue from blocking the air passage.

Fig 3



4 Take a deep breath and place your mouth over the victim's mouth as shown in Fig 4 making airtight contact. Pinch the victim's nose shut with the thumb and forefinger. If you dislike direct contact, place a porous cloth between your mouth and the victim's. For an infant, place your mouth over his mouth and nose.

Fig 4



— — — — — —

5 Blow into the victim's mouth (gently in the case of an infant) until his chest rises. Remove your mouth and release the hold on the nose, to let him exhale, turning your head to hear the rushing out of air. The first 8 to 10 breathings should be as rapid as the victim responds, thereafter the rate should be slowed to about 12 times a minute (20 times for an infant).

If air cannot be blown in, check the position of the victim's head and jaw and recheck the mouth for obstructions, then try again more forcefully. If the chest still does not rise, turn the victim's face down and strike his back sharply to dislodge obstructions.

Sometimes air enters the victim's stomach as evidenced by a swelling stomach. Expel the air by gently pressing the stomach during the exhalation period.

— — — — — —

TASK 5: **Resuscitate the victim by Mouth-to-Nose method**

Use this method when the victim's mouth will not open, or has a blockage you cannot clear.

1 Use the fingers of one hand to keep the victim's lips firmly shut, seal your lips around the victim's nostrils and breathe into him. Check to see if the victim's chest is rising and falling. (Fig 1)

2 Repeat this exercise at the rate of 10 - 15 times per minute till the victim responds.

3 Continue this exercise till the arrival of the doctor.

Fig 1

— — — — — —

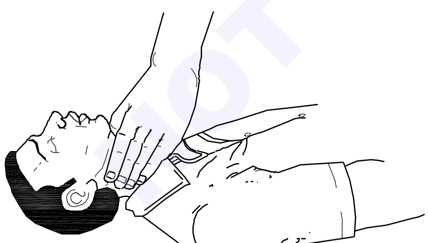
TASK 6: **Resuscitate a victim who is under cardiac arrest by (CPR) cardio pulmonary resuscitation**

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

1 Check quickly whether the victim is under cardiac arrest.

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

Fig 1



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

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

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

Fig 2

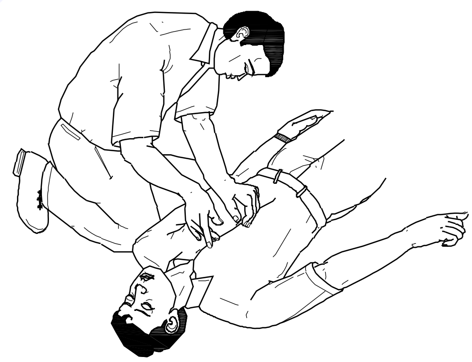
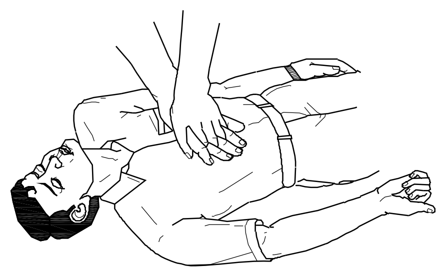


Fig 3



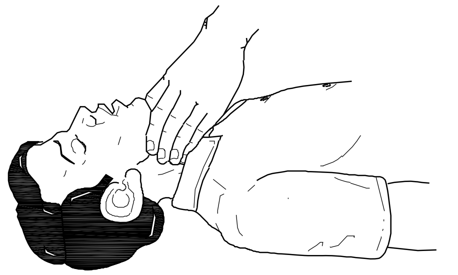
5 Keeping your arms straight, press sharply down on the lower part of the breastbone; then release the pressure. (Fig 4)

6 Repeat step 5, fifteen times at the rate of atleast once per second.

Fig 4

7 Check the cardiac pulse. (Fig 5)

Fig 5



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

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

Fig 6

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

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

Fig 7

Other steps

1 Send word for a doctor immediately.

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

— — — — — — —

TASK 7: **Treatment for bleeding victim**

1 Determine the location of the bleeding.

2 Elevate the injured area above the heart if possible.

3 Apply direct pressure to the bleeding area with sterile cloth.

4 Keep the pressure on for 5 seconds.

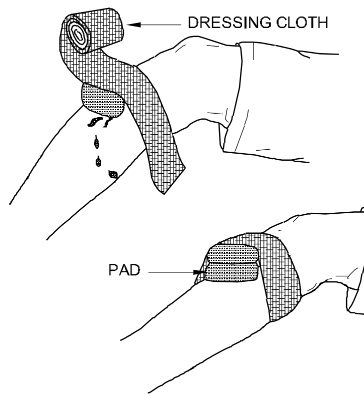
5 Check to see if the bleeding has stopped if not apply further pressure for 15 minutes.

6 Clean the wound.

7 Bandage the wound with pad of soft material. (Fig 1)

8 Advice victim to take treatment from doctor.

Fig 1



— — — — — — —

Safe disposal of waste materials like cotton waste, metal chips / burrs etc.

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

Fig 1

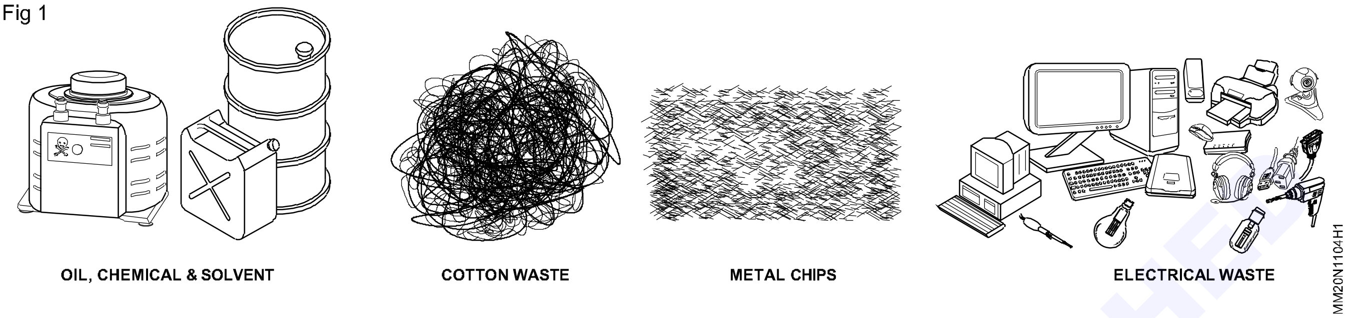
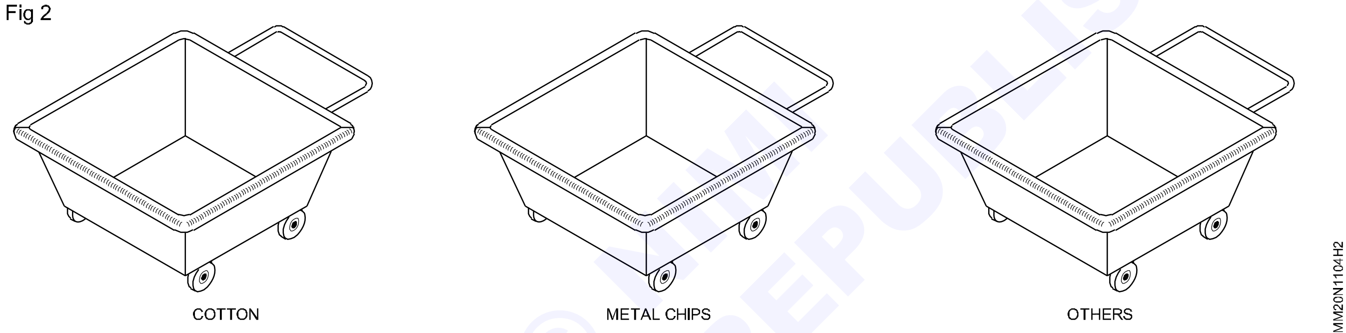


Fig 2



Job Sequence

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

Do not handle the chip by bare hand

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

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

Each bin should have name of the material.

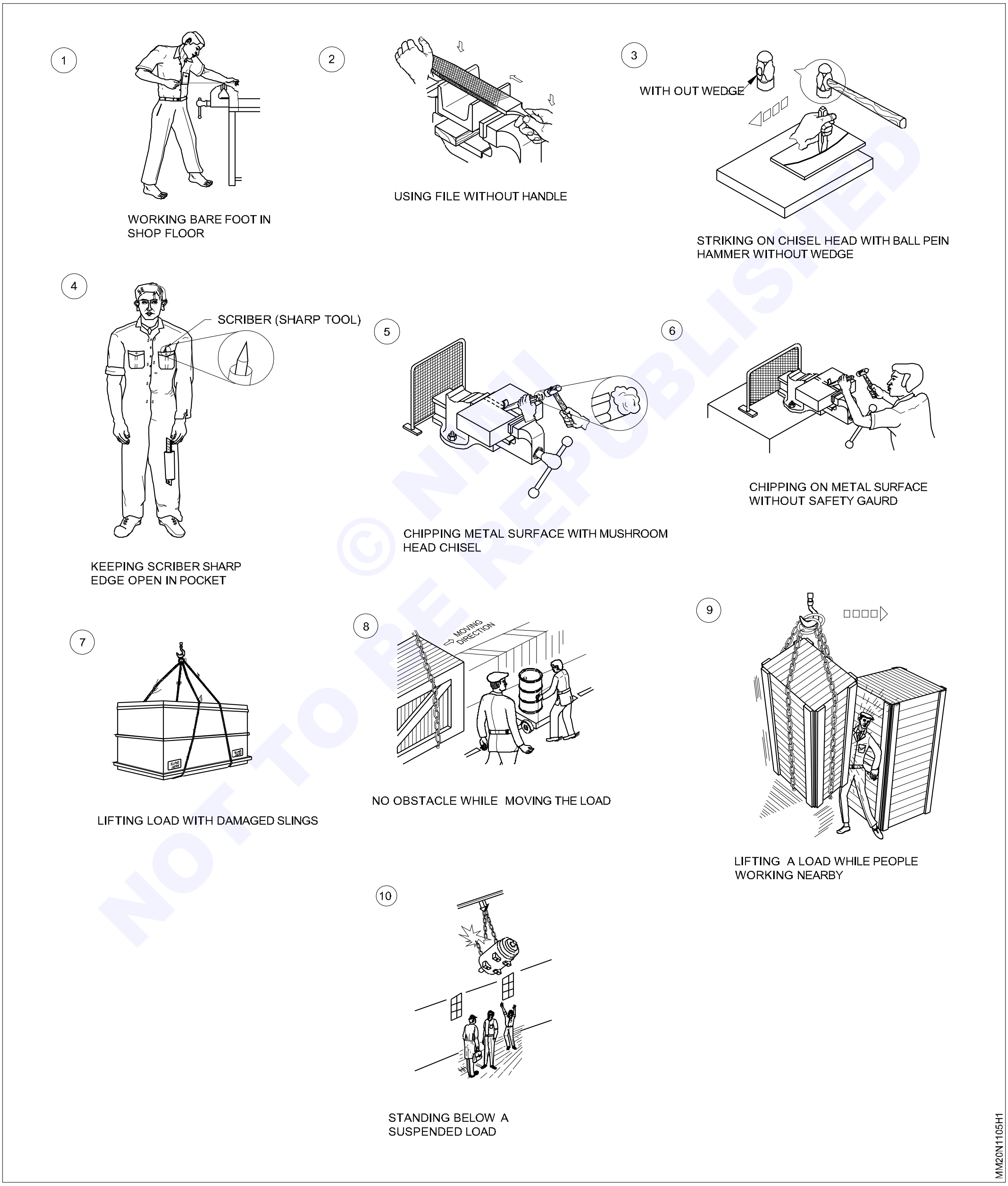
Identify the material given in fig 1 and fill in table 1

Table1

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

Hazard identification and avoidance

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



Job Sequence

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

- Study the drawing of industrial hazards.
- Identify the type of hazards.
- Name the hazards against their names.
- Record the hazards and avoidance in Table 1.

Table 1

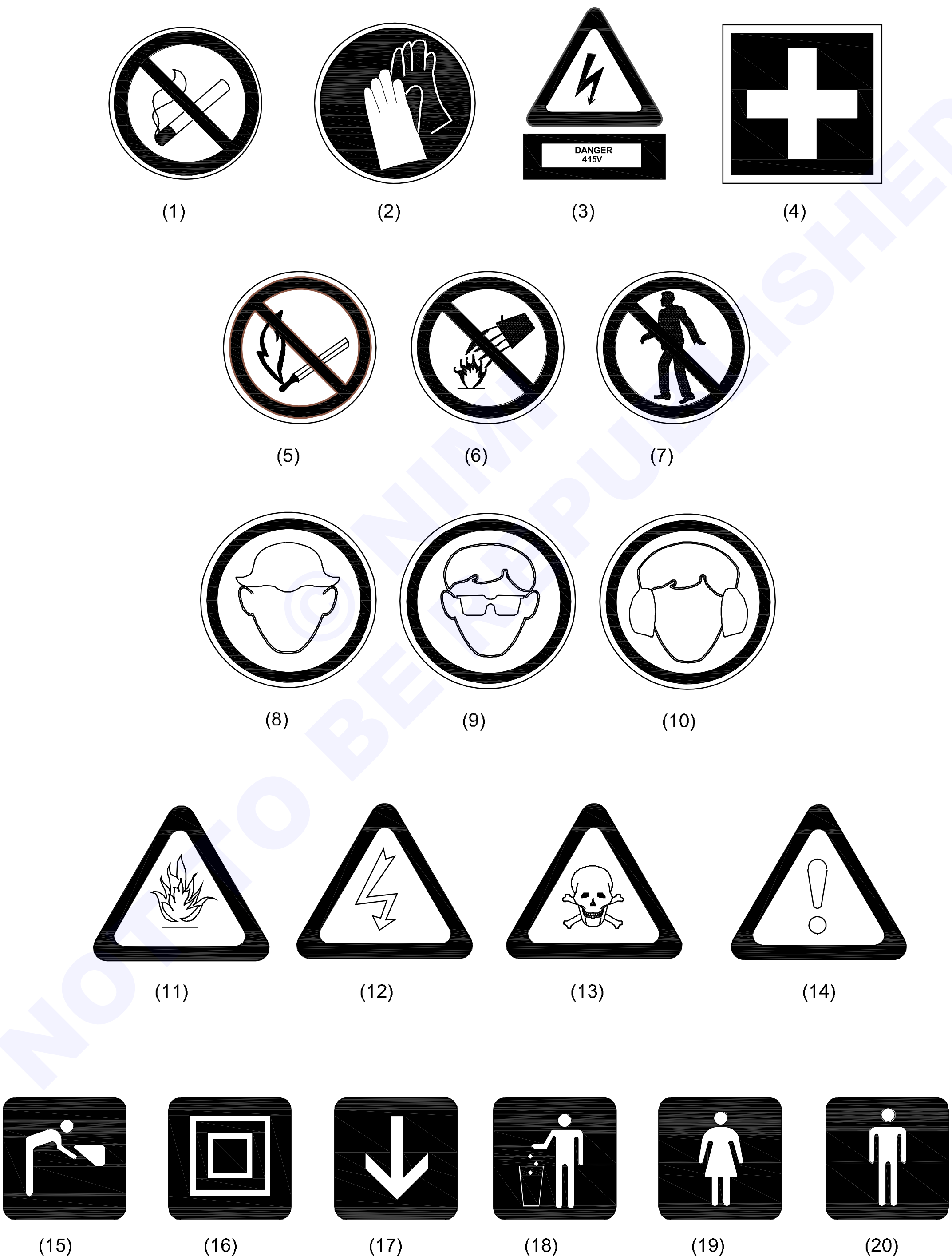
S. No.	Identification of hazards	Avoidance
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

- Get it checked by your instructor

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

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

Fig 1



IDENTIFY THE CATEGORIES OF THE SAFETY SIGN

MM20N1106H1

Job Sequence

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

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

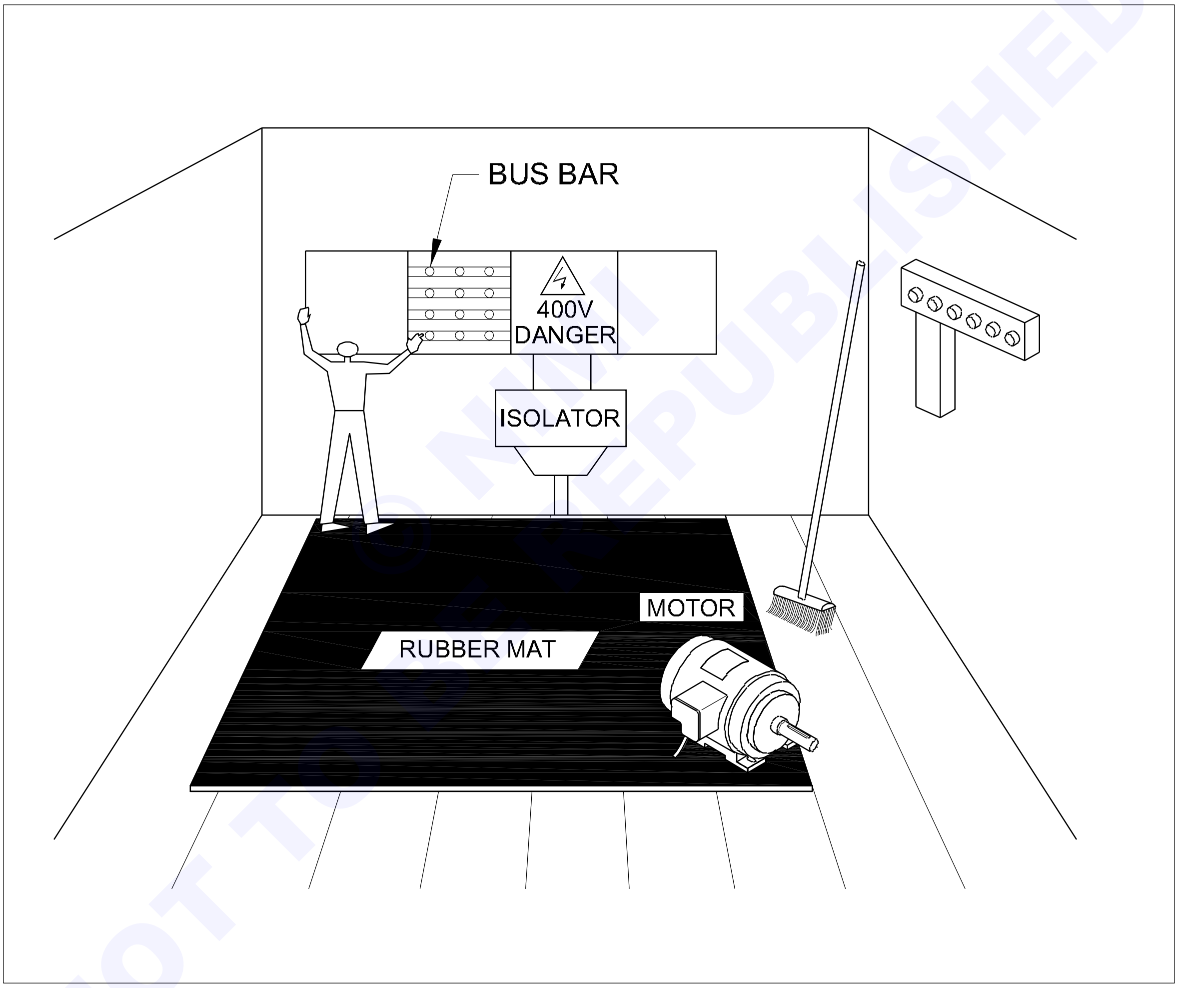
Table 1

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

- Get it checked by your instructor.

Preventive measures for electrical accidents and steps to be taken in such accidents

Objective: At the end of this exercise you shall be able to
- **rescue a person from live wire.**



--	--	--	--	--	--	1.1.07
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	PREVENTIVE MEASURES FOR ELECTRICAL ACCIDENTS				DEVIATIONS	TIME : 2 HOURS
					CODE NO. MM20N1107E1	

Job Sequence

Disconnecting a person (mock victim) from a live supply (simulated)

1 Observe the person (mock victim) receiving an electric shock. Interpret the situation quickly.

2 Remove the victim safely from the 'live' equipment by disconnecting the supply or using one of the items of insulating material.

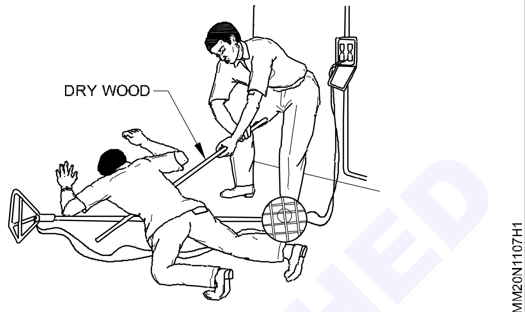
> **Do not run to switch off the supply that is far away.**
>
> **Do not touch the victim with bare hands until the circuit is made dead or the victim is moved away from the equipment.**
>
> **Push or pull the victim from the point of contact of the live equipment, without causing serious injury to the victim. (Fig.1)**

3 Move the victim physically to a nearby place.

4 Check for the victim's natural breathing and consciousness.

5 Take steps to apply respiratory resuscitation if the victim is unconscious and not breathing.

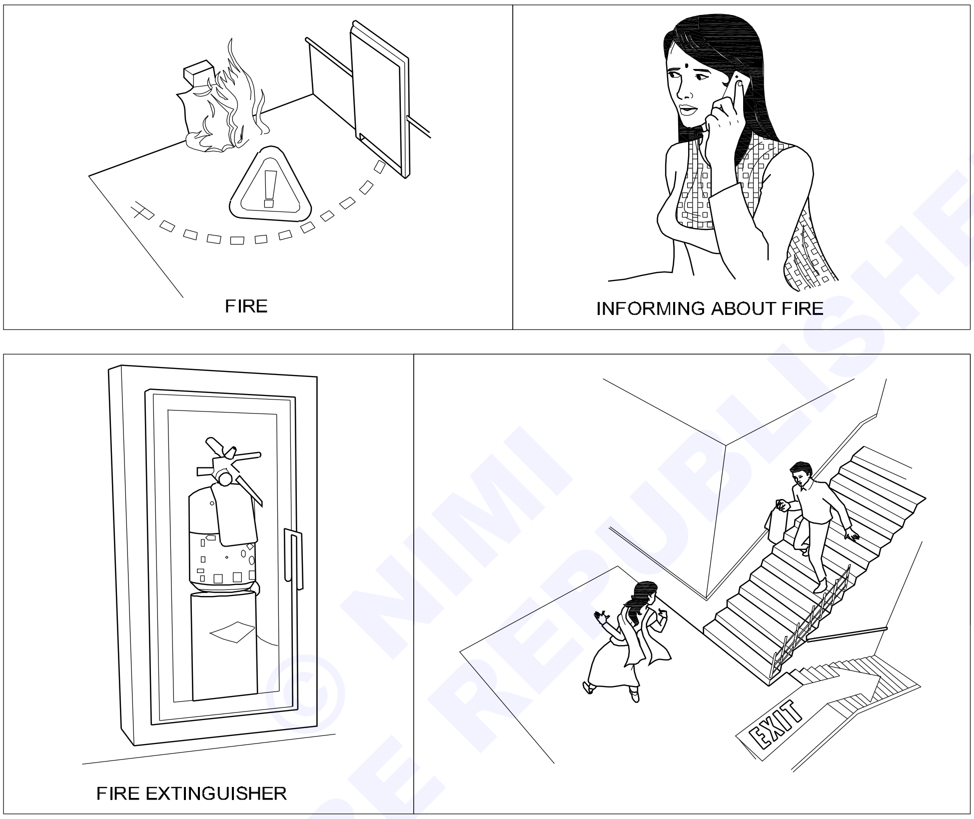
Fig 1



Use of fire extinguishers

Objectives: At the end of this exercise you shall be able to
- **select the fire extinguisher according to the type of fire**
- **operate the fire extinguisher**
- **extinguish the fire.**

Fig 1



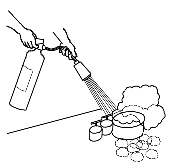
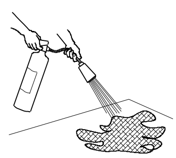
Job Sequence

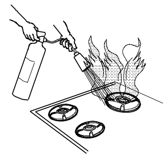
- Alert people surrounding by shouting fire, fire, fire when observe fire.
- Inform fire service or arrange to inform immediately.
- Open emergency exist and ask them to go away.
- Put "Off" electrical power supply.

Do not allow people to go nearer to the fire

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

Table1

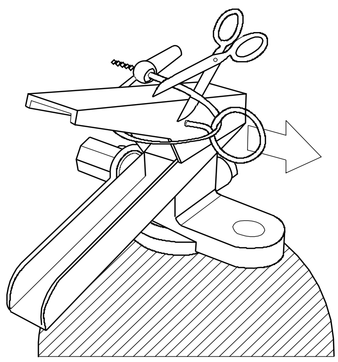
Class 'A'	Wood, paper, cloth, solid material	
Class 'B'	Oil based fire (grease, gasoline, oil) & liquefiable solids	

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

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

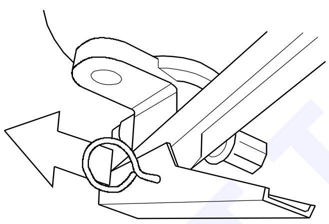
- Select CO_2 (carbon dioxide) fire extinguisher
- Locate and pick up CO_2 fire extinguisher. Check for its expiry date.
- Break the seal. Fig1

Fig 1



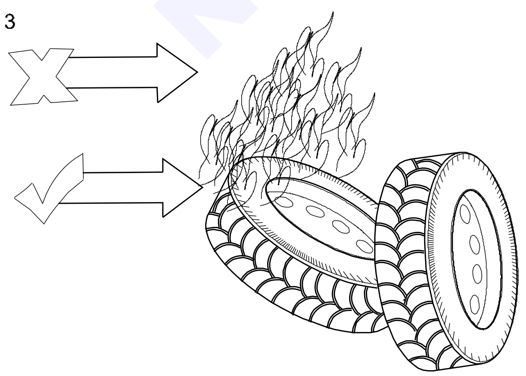
- Pull the safety pin from the handle (Fig 2) (Pin located at the top of the fire extinguisher) (Fig 2)

Fig 2



- Aim the extinguisher nozzle or hose at the base of the fire (this will remove the source of fuel fire) (Fig 3)

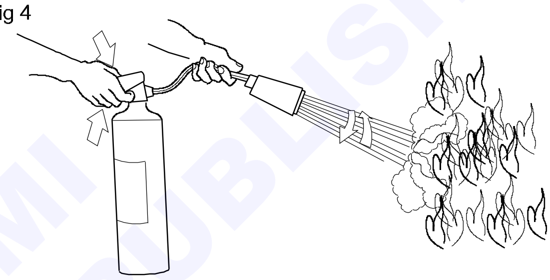
Fig 3



Keep your self low

- Squeeze the handle lever slowly to discharge the agent (Fig 4)
- Sweep side to side approximately 15 cm over the fuel fire until the fire is put off. (Fig 4)

Fig 4



Fire extinguishers are manufactured for use from the distance.

Caution

- While putting off fire, the fire may flare up.
- Do not be panic so long as it is put off promptly
- If the fire doesn't respond well after you have used up the fire extinguisher move your self away from the fire point.
- Do not attempt to put out a fire where it is emitting toxic smoke, leave it to the professionals.
- Remember that your life is more important than property. So don't place yourself or others at risk.

In order to remember the simple operation of fire extinguisher

Remember

P.A.S.S. This will help to use fire extinguisher

P for pull

A for aim

S for squeeze

S for sweep

Study the drawing to plan the job/work and identification of tools and equipments as per desired specifications for marking & sawing

Objectives: At the end of this exercise, you shall be able to
- **study the job drawing**
- **fill the given in table 1**
- **identify the marking tools used in fitting shop**
- **identify the sawing tools used in fitting shop**
- **record the names of tools in table.**

Job Sequence

TASK 1: **Studying drawing**

> **Note: Record the requirements in table 1.**

Fig 1

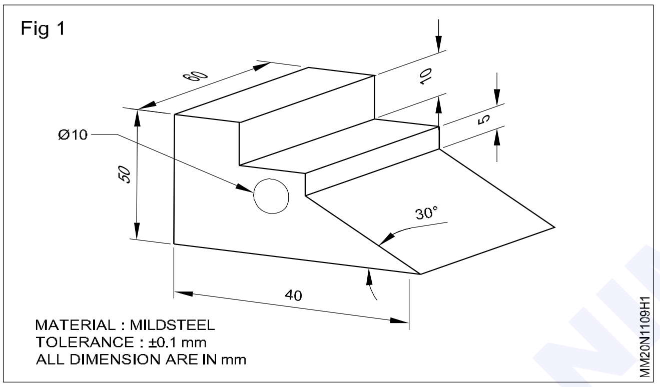


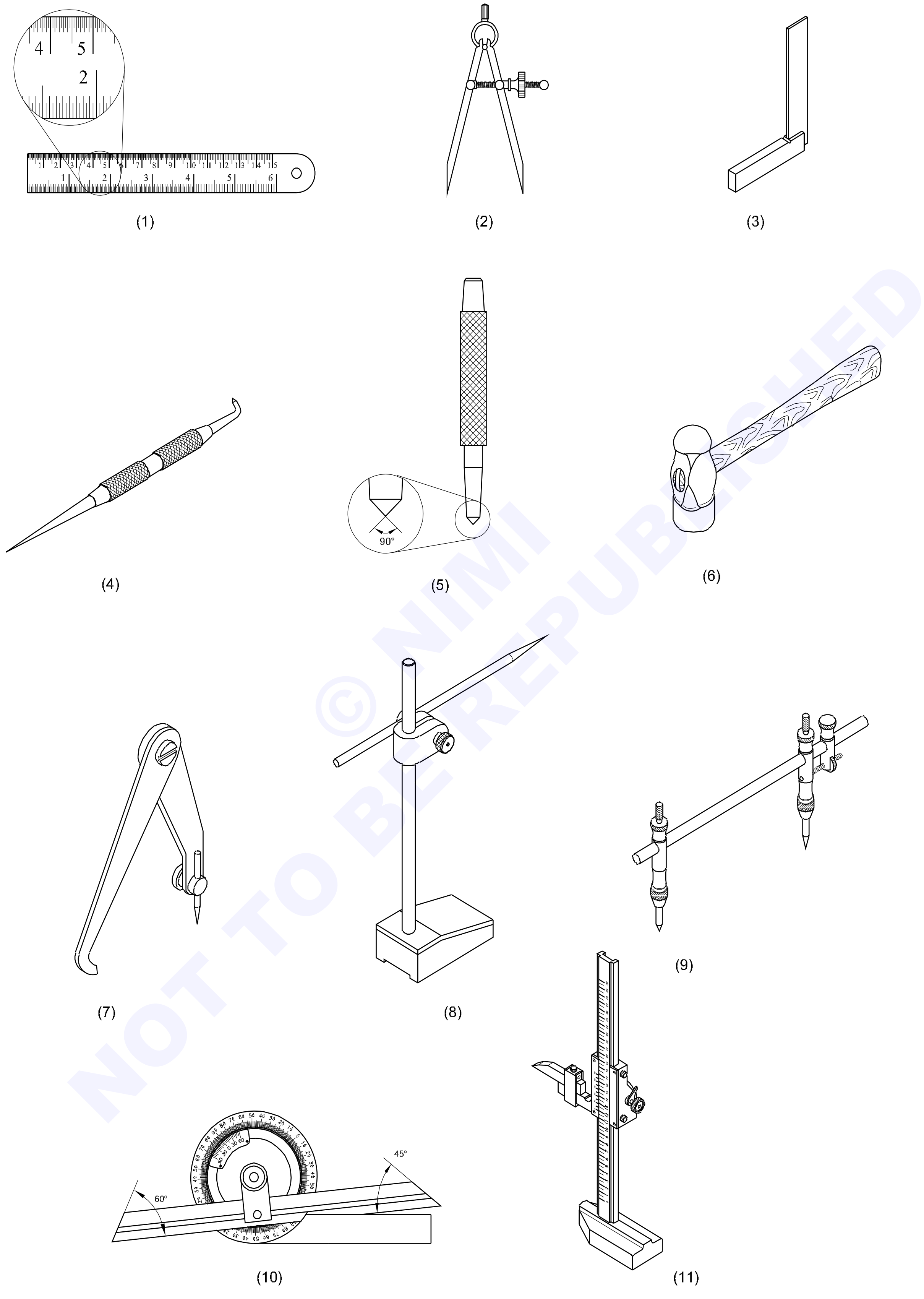
Table 1

Fig. No.	Elements	Mentioned in drawing
1	Length	
2	Width	
3	Height	
4	Top step height	
5	Middle step height	
6	Hole diameter	
7	Angle of taper	
8	Material	
9	Tolerance	

- Get it checked by the trainer

TASK 2: **Identification of tools (Figs 2&3)**

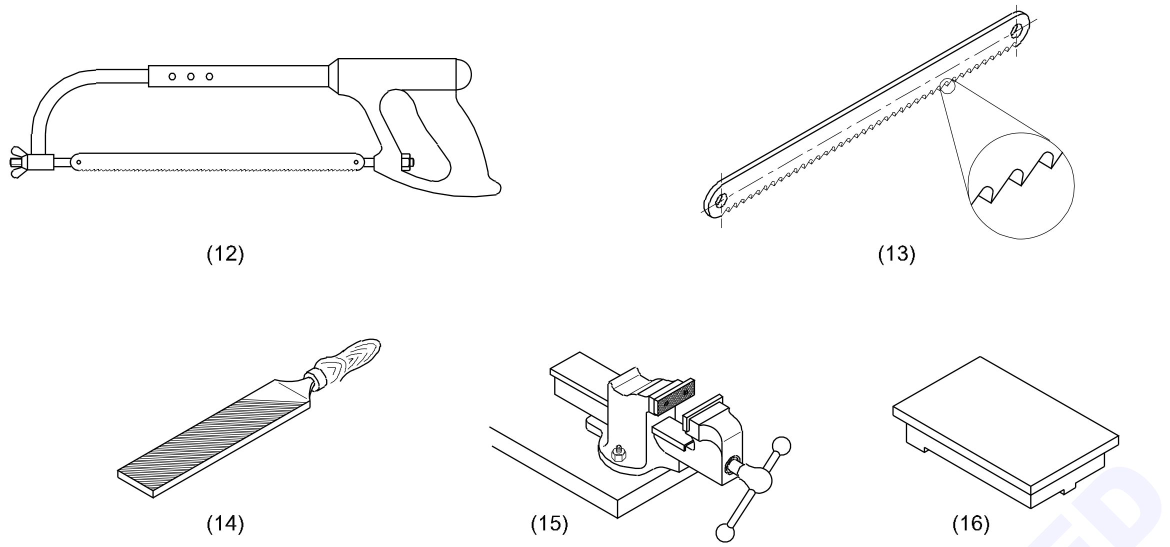
Fig 2



IDENTIFICATION OF MARKING AND SAWING TOOLS

MM20N1109H2

Fig 3



IDENTIFICATION OF MARKING AND SAWING TOOLS

Job Sequence

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

- Trainees will note down all the displayed tools names.
- Record it in table 2.
- Get it checked by the instructor.

Table 2

Fig. No.	Name of the tool	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Visual inspection of raw material for rusting, scaling, corrosion etc.

Objectives: At the end of this exercise you shall be able to
- **visual inspection of raw material for rusting**
- **scaling and corrosion.**

Fig.1 Rusted components

Fig.2 Corroded gears

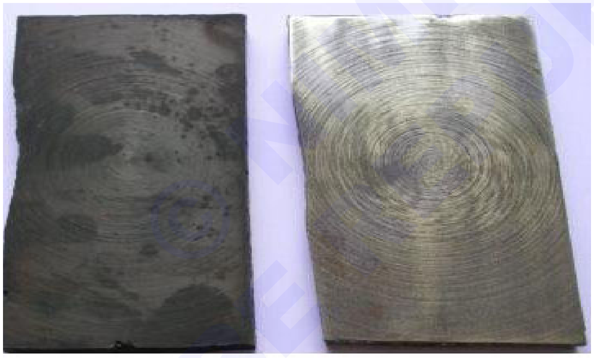


Fig.3 Scalled part

Job Sequence

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

Differentiate with one another

Ask the trainees to record it in the table

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

Table 1

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

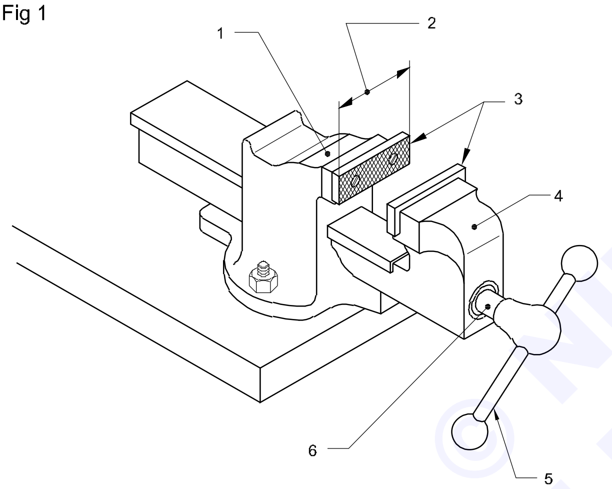
Familiarisation of bench vice

Objectives : At the end of this exercise you shall be able to
- **name the parts of bench vice**
- **name the operations using bench vice.**

Job Sequence

The instructor may give demo to the trainees. Explain the parts of bench vice and how to hold the job and ask the trainees to write each parts name in the table - 1 and table - 2 name of operations.

Fig 1



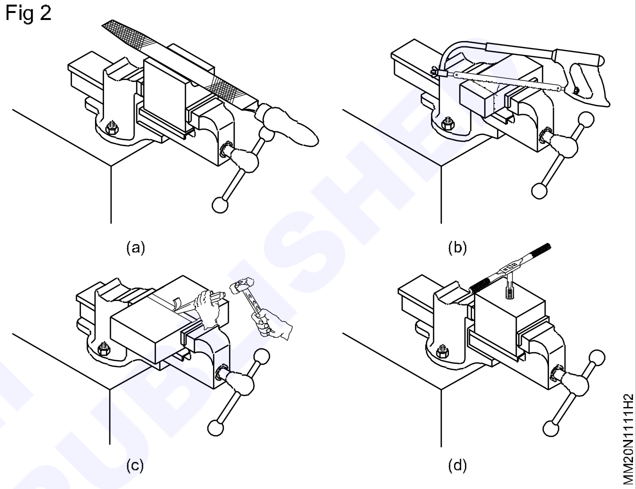
- Observe the each part in Fig 1.
- Record the bench vice part name in the Table -1

Table - 1

Part.No	Name of the part
1	
2	
3	
4	
5	
6	

- Observe the each operation in Fig 2.

Fig 2



- Record the name of operation in Table -2

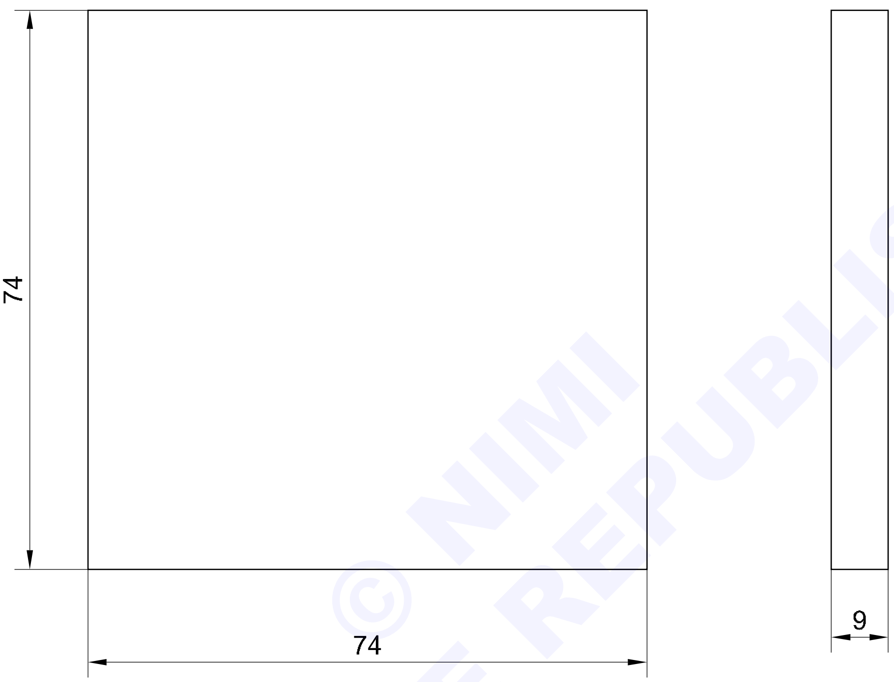
Table - 2

Part. No	Name of operation
a	
b	
c	
d	

Get it checked by instructor

Filing flat and square (rough finish)

Objectives: At the end of this exercise you shall be able to
- **hold the job in a bench vice horizontally for filing**
- **file a flat surface**
- **check the flatness of filed job using straight edge/try square blade**
- **check the squarness of the job with trysquare.**



Job Sequence

- Check the raw material size using steel rule.
- Remove the scaling by flat rough file.
- File side (A) with flat bastard file (fig 1)
- Check the flatness by blade of a try square
- File side (B) and maintain the squareness with respect to side (A).
- Check the squareness with a try square.

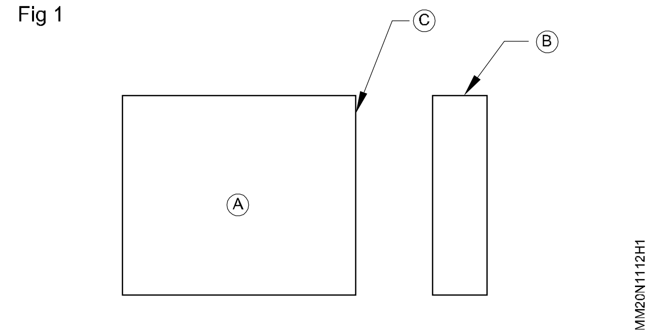
> **The side A,B and C are mutually perpendicular to each other (Fig 1)**

- Set Jenny caliper to 74 mm using steel rule
- Draw parallel lines of 74 mm to side (B) and (C)
- Punch the marked line using dot punch and ball pein hammer

1	75 ISF10 - 75	-	Fe310	-	-	1.1.12
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

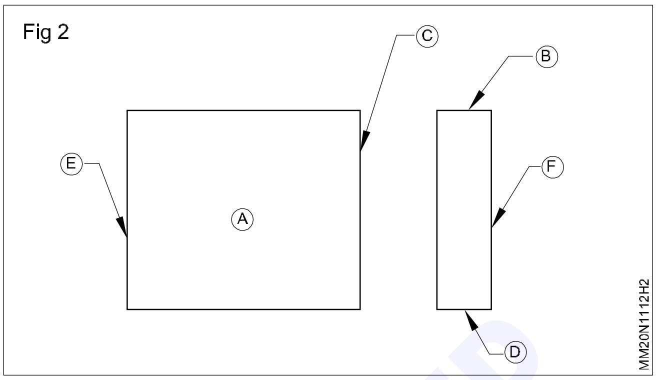
SCALE 1:1	FILING FLAT AND SQUARE (ROUGH FINISH)	TOLERANCE : ±0.5mm	TIME : 08Hrs
		CODE NO. MM20N1112E1	

Fig 1



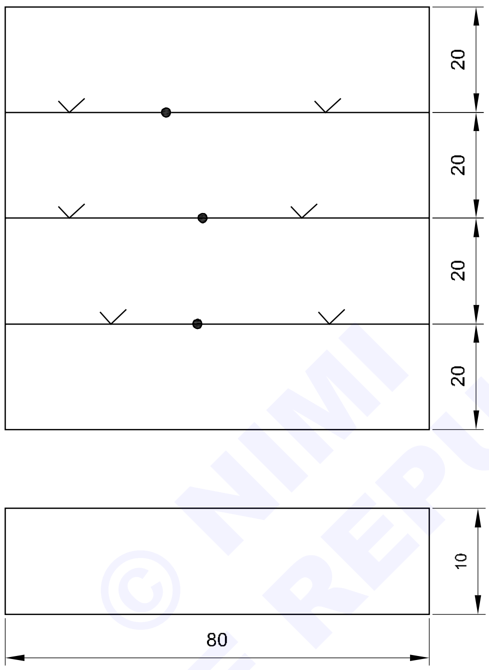
- Set and file sides (D) and (E) to 74mm and maintain squareness to all other sides.
- Maintain (D) and (E) parallel to side (B) and (C) (Fig.2)
- Check the dimensions with a steel rule and squareness with a try square
- File surface (F) and maintain the thickness of 9mm parallelism to side A.
- Remove sharp edges. Apply little amount of oil and preserve it for evaluation.

Fig 2



Marking with scriber and steel rule

Objectives: At the end of this exercise you shall be able to
- **filing squareness and flatness**
- **marking with scriber and steel rule.**



Job Sequence

- Check the raw material size
- File to flatness and squareness for size of 80x80x10mm
- Apply marking media
- Keep the job on the marking table
- Mark 20mm, 40mm and 60mm from one edge using steel rule and scriber.
- Mark two arrow on the above dimensions
- Join the two arrows for full length of job by using steel rule and scriber
- After scribing four lines handover the job for evaluation.

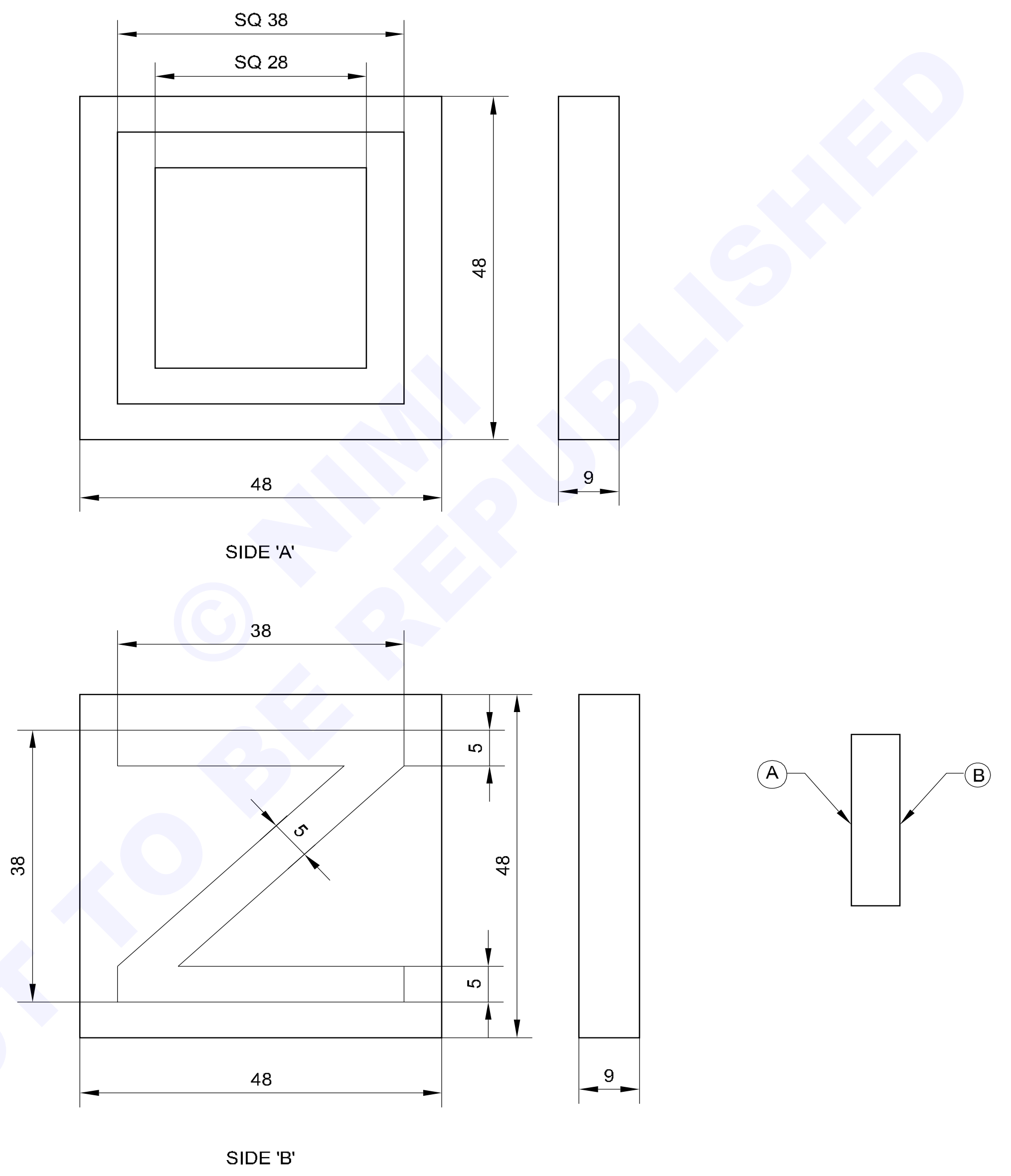
1	85 ISF 11 - 85	-	Fe310	-	-	1.1.13
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	MARKING WITH SCRIBER AND STEEL RULE	TOLERANCE :±0.5mm	TIME : 2Hrs
		CODE NO.MM20N1113E1	

 Exercise 1.1.14

Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule

Objectives: At the end of this exercise you shall be able to
- file and finish the flat to the required size
- **mark lines using odd leg caliper**
- **punch the marked lines.**



1	50 ISF 10-50	-	Fe310	-	-	1.1.14
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

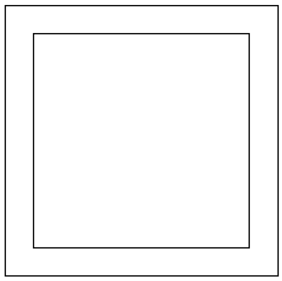
SCALE 1:1	**MARKING WITH ODD LEG CALIPER AND STEEL RULE**	TOLERANCE : ±0.5mm	TIME : 8 Hrs
		CODE NO. MM20N1114E1	

Job Sequence

Mark on side A

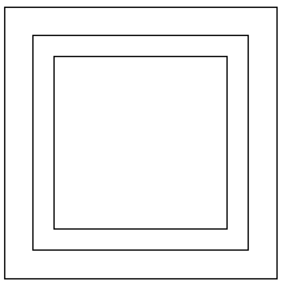
- Check the raw material size using steel rule
- File 3 sides mutually perpendicular to each other.
- Mark and file to size 48x48x9 mm.
- Set 5 mm in odd leg caliper and draw parallel lines to all sides (Fig 1)

Fig 1



- Similarly, set 10mm in odd leg caliper and draw parallel lines to all sides. (Fig 2) Punch on the marked line.

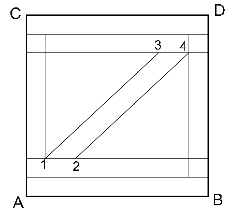
Fig 2



Mark on side B

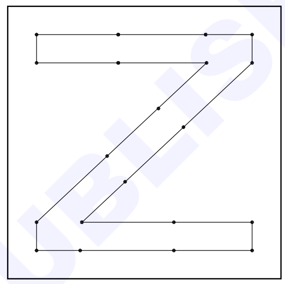
- Set 5 mm in odd leg caliper and draw parallel lines to side AB, CD, CA and DB Fig 3.

Fig 3



- Set 10 mm and draw parallel lines to side AB and CD.
- Mark 5 mm on line 1 and 2, 3 and 4 as shown in Fig.4.

Fig 4

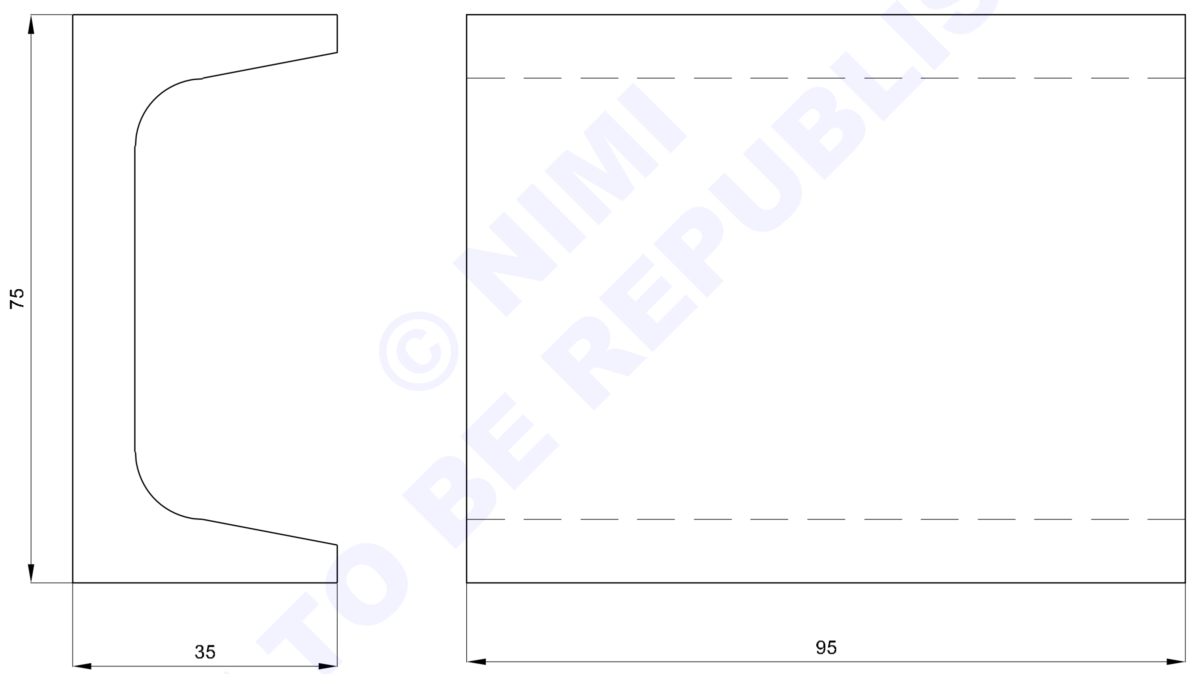


- Join point 1 and 3, 2 and.4, and punch witness marks
- Apply little oil and preserve it for validating the marking.

Filing channel, parallel

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

- **hold the job in a bench vice horizontally for filing**
- **file a flat surface with a flat bastard file**
- **check the flatness of the filed surface with a straight edge/blade of a try square**
- **check the parallelism with an outside caliper & steel rule.**



1	MC 75 - 95	-	Fe310	-	-	1.1.15
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

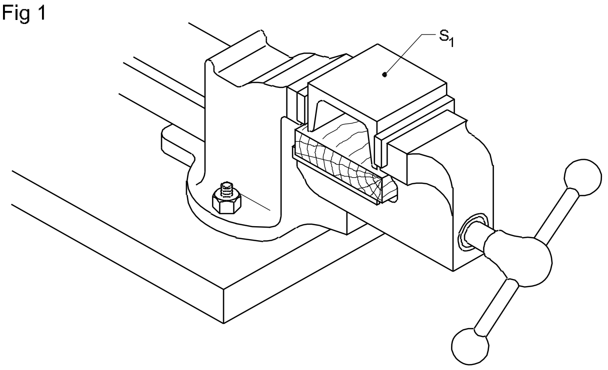
SCALE 1:1	**FILING CHANNEL PARALLEL**	TOLERANCE : ±0.5mm	TIME : 5Hrs
		CODE NO. MM20N1115E1	

Job Sequence

- Check the stock size with a steel rule.
- Hold the job in bench vice, so that surface S1 comes on top.(Fig 1)

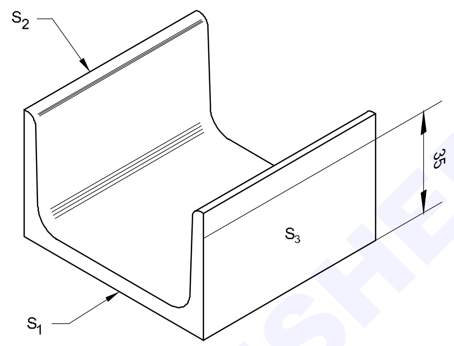
> **Apply only limited clamping force so that the ribs do not bend**

Fig 1



- File the surface S_1 with a flat bastard file.
- Check the surface level with straight edge/blade of a try square.
- Mark 35 mm line on surface S_2 and S_3 parallel to S_1 with a jenny caliper.
- File the rib up to the marked line (Fig 2) and check the size with steel rule.
- Check the surface level with the straight edge.
- Check the parallelism with an outside caliper and steel rule.

Fig 2



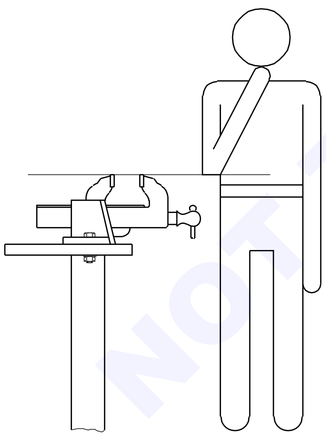
Skill Sequence

Filing flat surface

Objective: This shall be help you to
- **file flat.**

Check the height of the bench vice. (Fig 1) If the height is more, use a platform and if it is less, select and use another workbench.

Fig 1

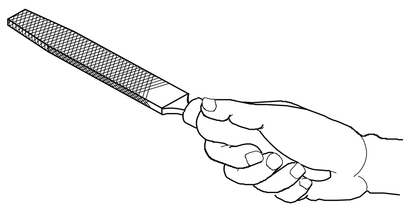


Hold the job in the bench vice with a projection of 5 to 10mm from the top of the vice jaw.

Select flat files of various grades and length according to the

– size of the job
– quantity of metal to be removed
– material of the job.

Fig 2

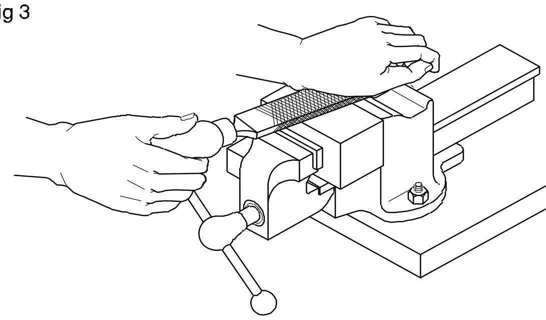


Check whether the handle of the file fits tightly.Hold the handle of the file (Fig 2) and push the file forward using your right hand palm or left hand palm.

Hold the tip of the file according to the quantity of the metal to be removed.

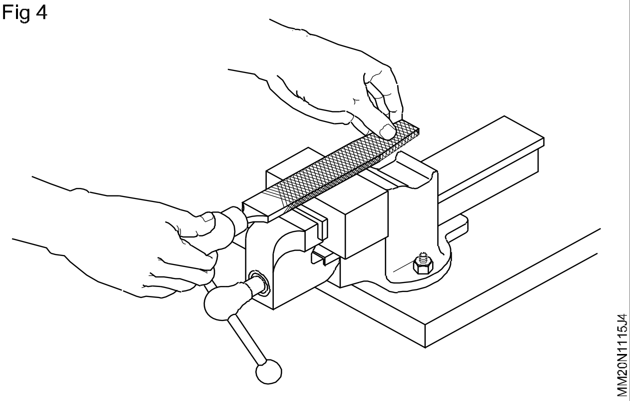
For heavy filing (Fig 3)

Fig 3



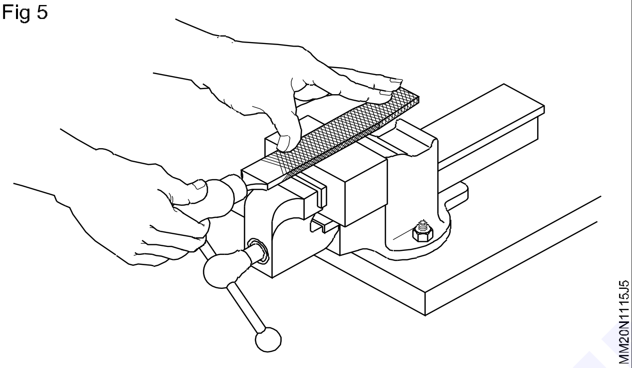
For light filing (Fig 4)

Fig 4



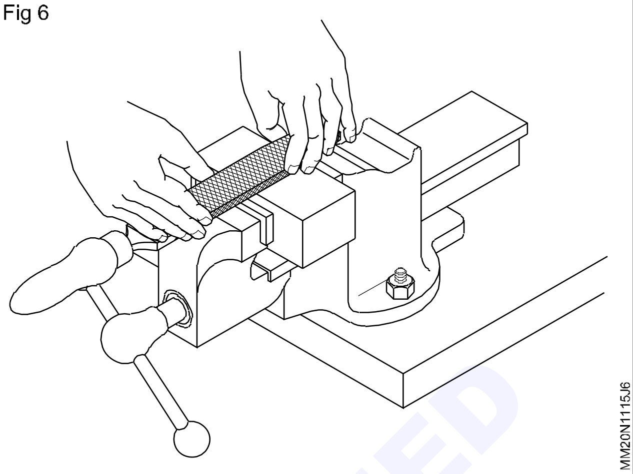
For removing local uneveness (Fig 5)

Fig 5



For removing the local unevenness draw filing can also be done. (Fig 6) The same filing can also be done for fine finishing.

Fig 6



Start filing by pushing the file uniformly during the forward stroke and release the pressure during the return stroke.

Continue giving strokes. Balance the pressure of the file in such a way that the file always remains flat and straight over the surface to be filed.

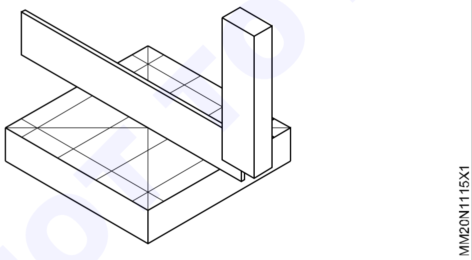
Checking flatness and squareness

Objectives: This shall help you to

- **check flatness**
- **check squareness.**

Checking flatness (Fig 1)

Fig 1



Use the blade of the try square as a straight edge for checking flatness.

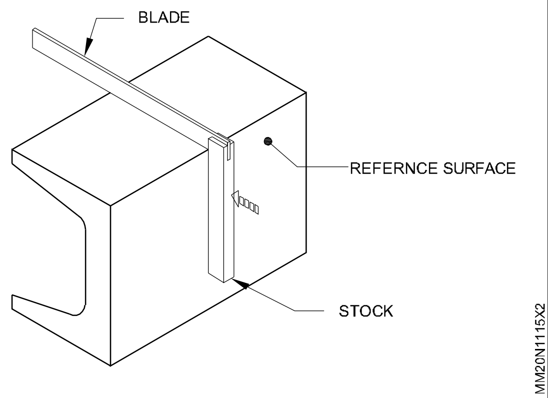
Place the blade of the try square on the surface to be checked in all directions so as to cover the entire surface.

Do the checking facing the light. Light gap will indicate high and low spots.

Checking squareness: Consider the large finished surface as the reference surface. Ensure that the reference surface is filed perfectly and is free from burrs.

Butt and press the stock against the reference surface. (Fig 2)

Fig 2



Bring down slowly (Fig 3) and make the blade touch the second surface with which the squareness is to be checked.

Light gap will indicate the high and low spots.

Checking parallelism with outside caliper. (Fig 4)

Fig 3

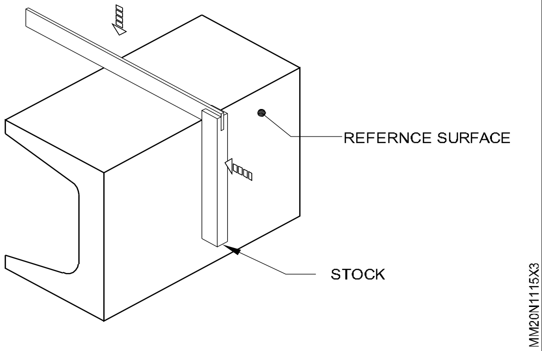
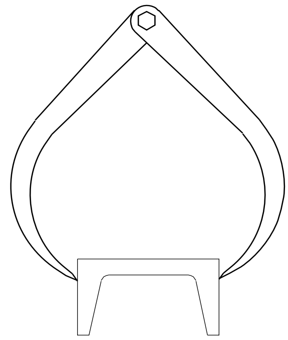


Fig 4



Measuring with outside calipers

Objective: This shall be help you to

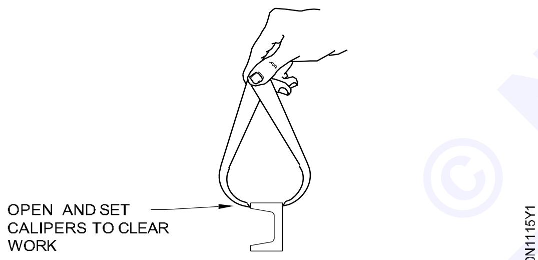
- **select the right capacity caliper for measurement**
- **set the sizes both in firm joint and spring calipers**
- **read the sizes by transferring them to a steel rule or other precision measuring devices as the case may be.**

Outside calipers: Select a caliper based on the dimension to be measured.

A 150mm capacity outside caliper is able to measure sizes from 0-150mm.

Open out the jaws of the calipers until they pass clearly over the dimension to be measured. The work must be stationary when measuring the sizes. (Fig.1)

Fig 1

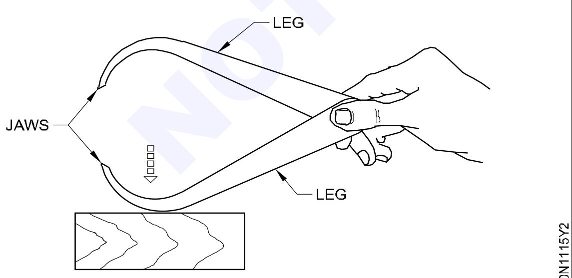


WORK MUST BE STATIONARY

Place one point of the leg over the workpiece and get the sense of feel of the other point of the leg.

If there is clearance on the other point of the leg, gently tap the back of one leg of the firm joint calipers on a wooden piece until it just slips from the external diameter of the workpiece to give the right sense of 'feel'. (Fig. 2)

Fig 2

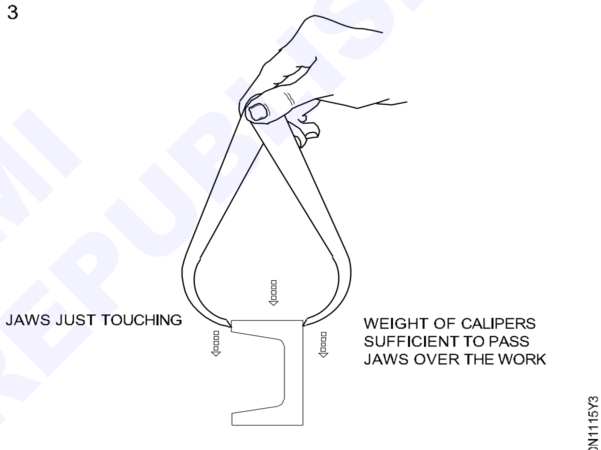


TAP GENTLY TO CLOSE CALIPERS

Because the accuracy of reading the sizes depends mainly upon the sense of feel of the user, high care should be exercised to get the correct 'feel'.

In the case of spring outside calipers, adjust the screw nut so that the adjustment of the jaws just slips from the external diameter of the workpiece to give the right sense of feel. (Fig.3)

Fig 3



OBTAINING THE 'FEEL'

When you have adjusted the outside caliper for the correct 'feel' transfer the measurement to a steel rule or any other precision measuring instrument as the case may be.

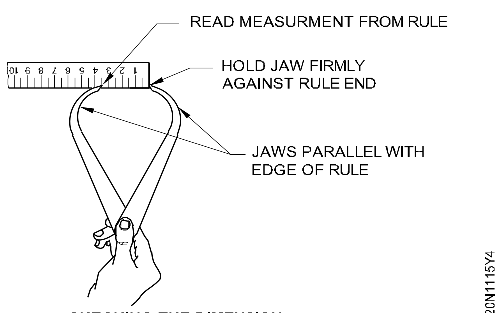
Keep the graduated steel rule on a flat surface and hold the point of one jaw firmly against the rule end. (Fig.4)

The point of one jaw must be placed over the graduation so that the point of the other jaw is parallel with the edge of the steel rule.

Record the reading to an accuracy of ±0.5mm.

Similarly take measurement at middle and at the end. If all the dimensions are equal then it is parallel.

Fig 4



CHECKING THE DIMENSION

Filing flat and square (rough finish)

Objectives: At the end of this exercise you shall be able to
- **hold the job in a bench vice horizontally for filing**
- **file a flat surface**
- **check the flatness of filed job using straight edge/try square blade**
- **check the squarness of the job with trysquare.**

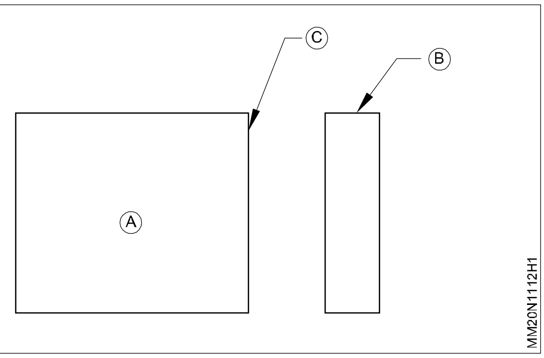
1	100ISF16-100	-	Fe310	-	-	1.1.16
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	FILING FLAT AND SQUARE (ROUGH FINISH)				TOLERANCE : ±0.5mm	TIME : 10Hrs
					CODE NO. MM20N1116E1	

Job Sequence

- Check the raw material size using steel rule.
- Remove the scaling by flat rough file.
- File side (A) with flat bastard file (fig 1)
- Check the flatness by blade of a try square
- File side (B) and maintain the squareness with respect to side (A).
- Check the squareness with a try square.

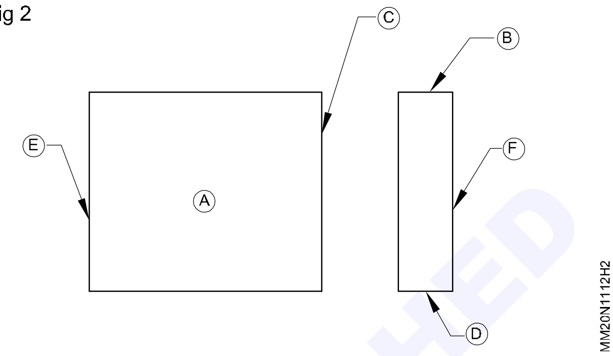
The side A,B and C are mutually perpendicular to each other (Fig 1)

Fig 1



- Set Jenny caliper to 95 mm using steel rule
- Draw parallel lines of 95 mm to side (B) and (C)
- Punch the marked line using dot punch and ball pein hammer
- Set and file sides (D) and (E) to 95mm and maintain squareness to all other sides.
- Maintain (D) and (E) parallel to side (B) and (C) (Fig.2)

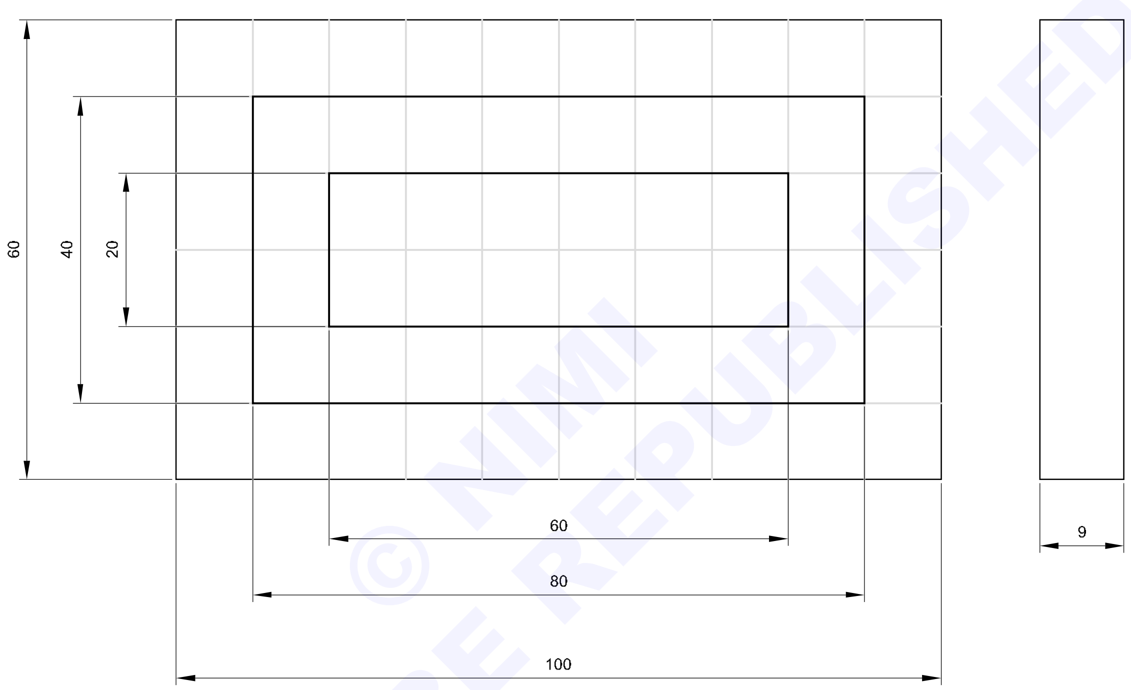
Fig 2



- Check the dimensions with a steel rule and squareness with a try square
- File surface (F) and maintain the thickness of 15mm parallelism to side A.
- Remove sharp edges. Apply little amount of oil and preserve it for evaluation.

Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule

Objectives: At the end of this exercise you shall be able to
- **file and finish the flat to the required size**
- **mark lines using odd leg caliper**
- **punch the marked lines.**



Job Sequence

Mark on side A

- Check the raw material size using steel rule
- File 3 sides mutually perpendicular to each other.
- Mark and file to size 100 x 60 x 9 mm.
- Set 10 mm in odd leg caliper and draw parallel lines to all sides (Fig 1)
- Similarly, set 20mm in odd leg caliper and draw parallel lines to all sides. (Fig 2) Punch on the marked line.

1	65ISF10-105	-	Fe310	-	-	1.1.17
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	FILLING PRACTICE, SURFACE FILING, MARKING OF STRAIGHT AND PARALLEL LINES WITH ODD LEG CALIPER AND STEEL RULE				TOLERANCE : ±0.5mm	TIME : 5 Hrs
					CODE NO. MM20N1117E1	

Fig 1

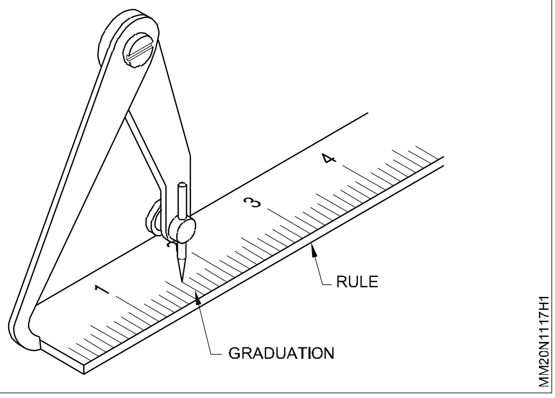
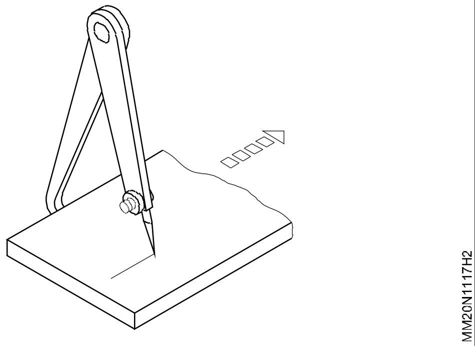


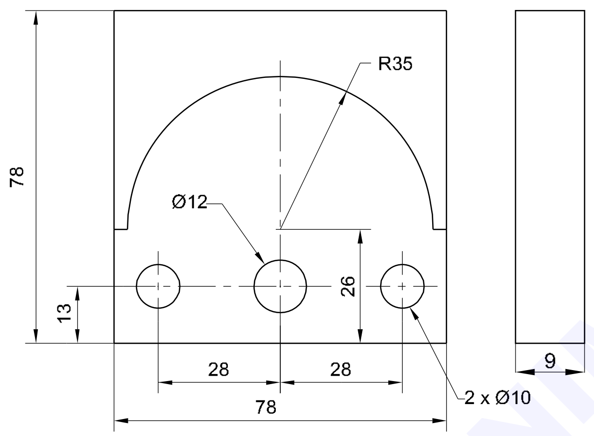
Fig 2



Marking practice with dividers, odd leg calipers and steel rule (circles, arcs, parallel lines)

Objectives: At the end of this exercise you shall be able to
- **mark parallel lines with jenny caliper**
- **mark angular lines with a protractor and scriber**
- **mark arcs, circles and tangents with divider and scriber.**

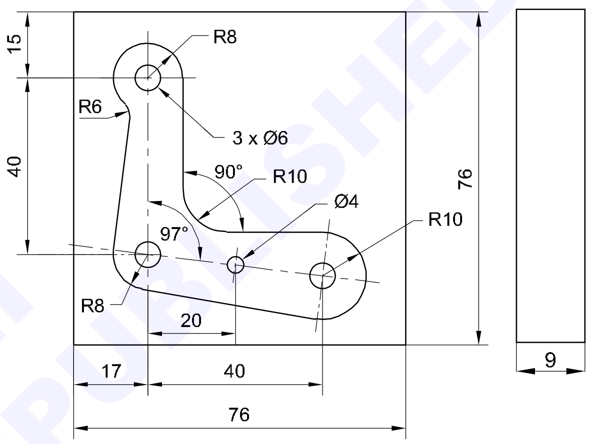
TASK 1



MARKING CURVES & CIRCLES
(BY JENNY CALIPER AND DIVIDER)

SIDE-A

TASK 2



MARKING TANGENTS & ARCS

SIDE-B

NOTE : USE SAME MATERIAL FOR BOTH THE TASKS (SIDE A & B)

Job Sequence

TASK1: **Marking curves & circles (Side A)**

- Check the raw material size using steel rule
- File the raw material to size 78x78x9 mm
- Apply marking media cellulose lacquer on the surface of the Job.
- Set the dimension 13 mm in Jenny caliper and draw parallel line as per drawing with reference to 'xy'. Fig 1
- Similarly, set the dimensions 26mm and draw parallel line Fig 1
- Set the dimension 11 mm in Jenny caliper and draw parallel line as per drawing with reference to 'xz'. Fig 2
- Similarly, set the dimensions 39 mm, 67 mm and draw parallel lines. Fig 2
- Punch on the intersecting point of centre lines to draw circle and radius using prick punch 30°
- Set the radius 5mm, 6mm in divider and draw circles, as per drawing.
- Set the radius 35 mm and draw arc as per drawing.

1	80 ISF 10-80	-	FE 310	-	-	1.1.18
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**MARKING PRACTICE**				TOLERANCE : ±0.5mm	TIME : 5Hrs
					CODE NO. MM20N1118E1	

Fig 1

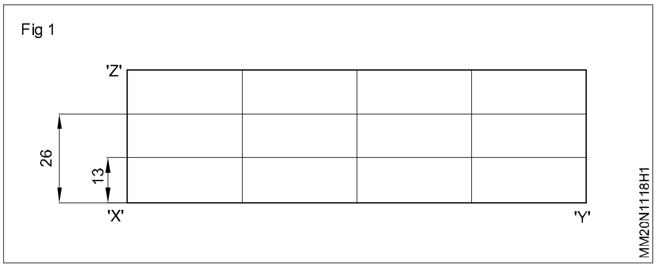
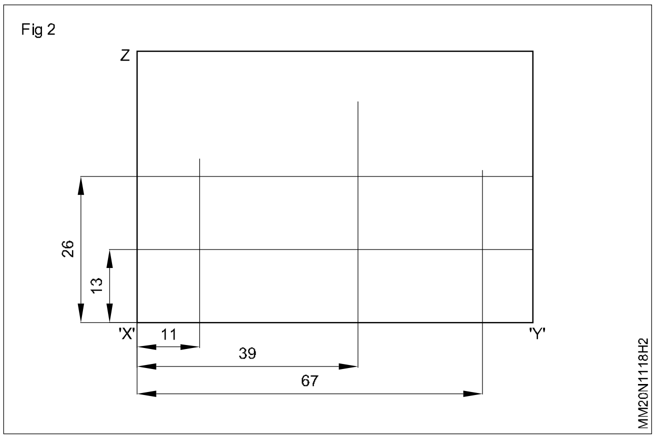


Fig 2



- Punch witness marks on the circles and radius.
- Preserve it for evaluation.

TASK 2: **Marking tangents & arcs (Side B)**

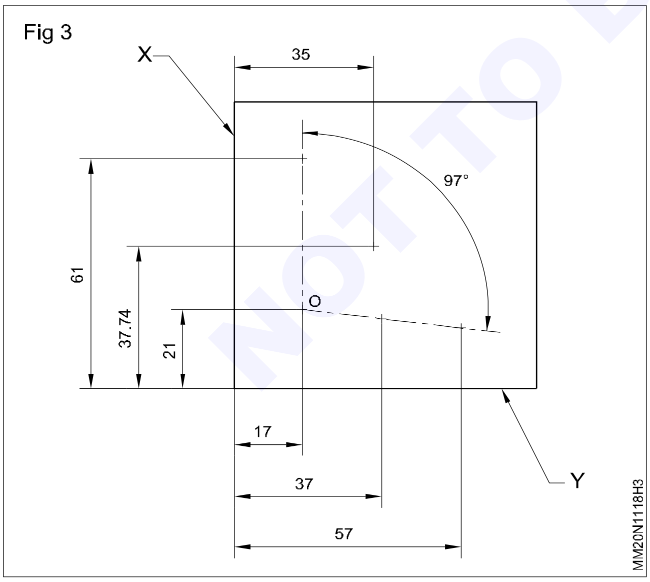
Step 1

- Check the material for its size and its squareness
- Apply marking media on one face of the job.

Step 2

- Draw parallel line of 17mm from side x (Fig 3).
- Mark 21mm and 61mm from side y on the marked parallel line (Fig 3).

Fig 3



- Set 97° on the bevel protractor
- Mark 97° line through point 'O' and set the centres of other two circle
- Punch centre marks on all four circles

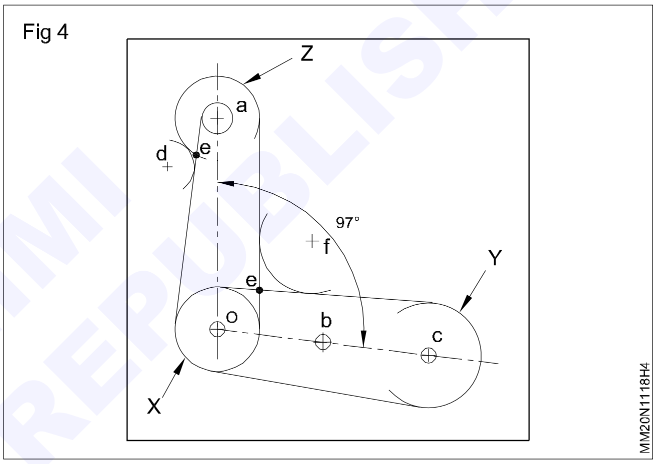
Step 3

- Draw Ø6 mm circle at 'a','o','c' and Ø4 mm circle at 'b'.
- Draw tangent lines to join x,y and z as shown in fig.4

Step 4

- Draw an arc, R8 mm from the centre ‘a’ and ‘o’
- Draw an arc, R10 mm from the centre ‘c’.
- Draw the tangent lines from the arc drawn, the inter section of the tangent (e) is the centre for joining the tangent with arc.
- Draw R10 mm arc from the centre at point ‘f’ as shown in fig.4

Fig 4

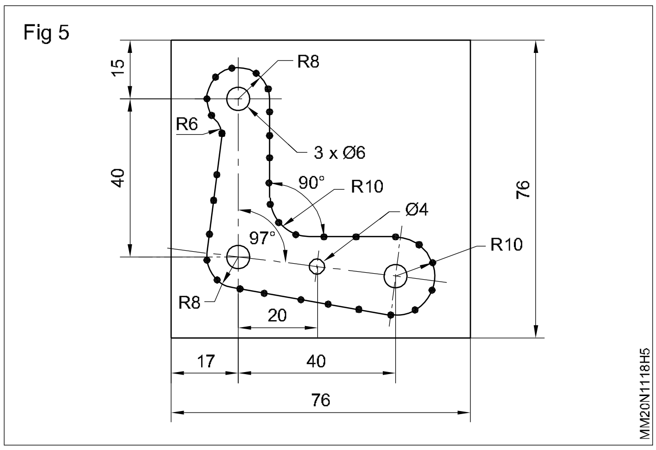


- Similarly, draw R6 mm arc at point ‘d’

Step 5

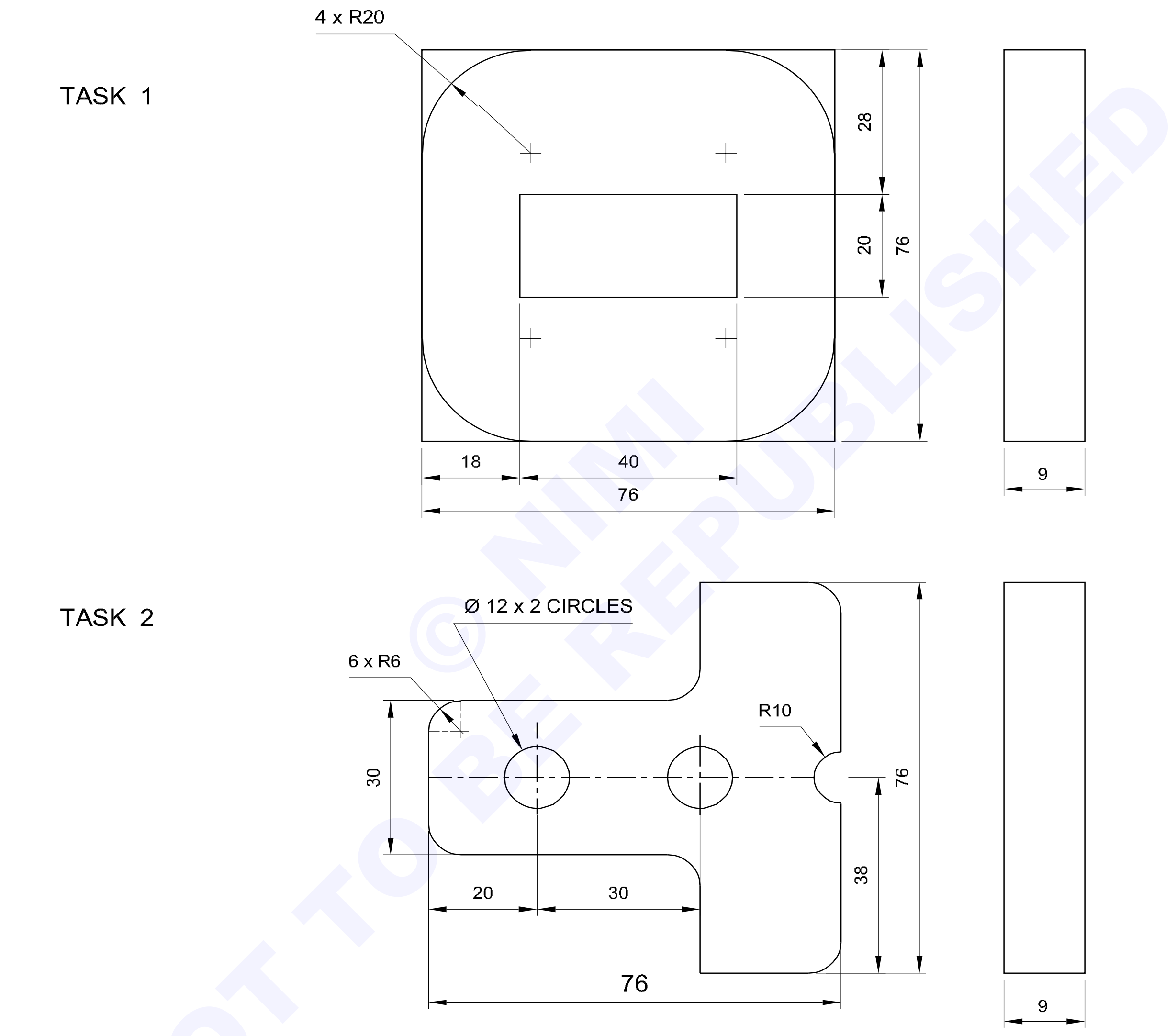
- Punch on the marked lines with equal intervals Fig 5.
- Preserve the job for evaluation.

Fig 5



Marking off straight lines and arcs using scribing block and dividers

Objectives: At the end of this exercise you shall be able to
- **mark parallel lines using scribing block**
- **mark arcs using dividers.**



NOTE : USE SAME MATERIAL FOR MARKING TASK 1&2

1	80 ISF 10 - 80	-	Fe310	-	-	1.1.19
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

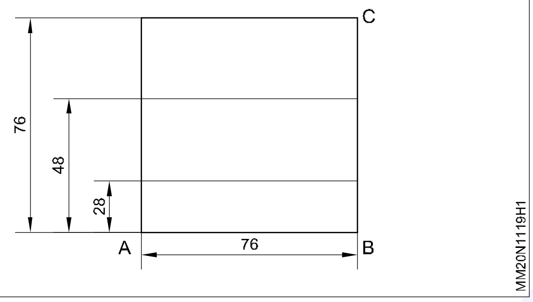
SCALE 1:1	**MARKING STRAIGHT LINES & ARCS USING SCRIBING BLOCK & DIVIDERS**	TOLERANCE : ±0. 5mm	TIME : 5Hrs
		CODE NO. MM20N1119E1	

Job Sequence

TASK 1: **Marking straight lines & arcs**

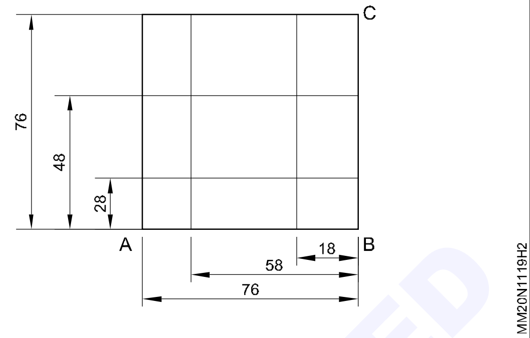
- Check the raw material size using steel rule.
- File three sides mutually perpendicular to each other.
- Mark and file to size of 76 x 76 x 9 mm
- Clean Marking Table, Angle plate, Scribing block and Steel rule with soft cloth.
- Place Scribing block, Angle plate and Steel rule on marking table.
- Support the Steel rule along with Angle plate.
- Set the dimension 28 mm in scribing block using Steel rule.
- Support the Job along with angle plate and scribe dimension line 28 mm in scribing block with reference to side 'AB' Fig 1

Fig 1



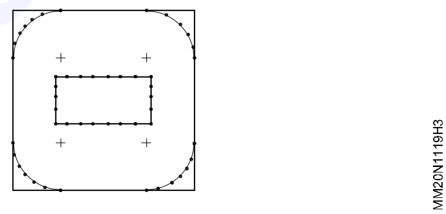
- Similarly, set 48 mm and scribe line with reference to side 'AB.
- Turn and place the Job with reference to side 'BC'.
- Set the size 18 mm and scribe line with reference to side 'BC' Fig 2.
- Similarly, set the size 58 mm and scribe line with reference to side 'BC'

Fig 2



- Set the size 20 mm and scribe line with reference to all over the four sides to draw radius.
- Punch on the four radius point with a 30° prick punch.
- Draw 20 mm radius using divider in four corners.
- Punch on the marked lines with equal intervals. (Fig 3)
- Preserve it for evaluation.

Fig 3



— — — — — — — —

TASK 2: **Marking straight lines, arcs & edges**

On other side of job, mark and punch TASK 2 as per drawing.

- Mark the centre line 38mm from reference surface AB.
- Mark 15mm above the centre line and 15mm below the centre line as per drawing.
- Mark 20mm and 30mm on the centre line draw reference surface AD.
- Mark radius R6 on the 6 place.
- Join radius lines as per drawing.
- Draw ∅ 12mm circle on the marked reference of 20mm and 30mm.
- Mark corner of the centre R10mm.
- Punch on the mark line by 60° dot punch.

Skill Sequence

Marking parallel lines using surface gauge

Objective: This shall help you to
- **mark parallel lines using a surface gauge**

Check the free movement of the scriber and other sliding units.

Clean the base of the surface gauge.

Keep the base firmly on the surface plate.

Rest the steel rule against the angle plate and set the scriber to the size to be marked. (Fig 1)

Make sure that the job has no burrs and has been properly cleaned.

Apply a thin and even coating of the marking media.

Butt the job against the angle plate.

Hold the job in one hand and move the scriber point touching the surface across the work and mark.(Fig 2)

Fig 1

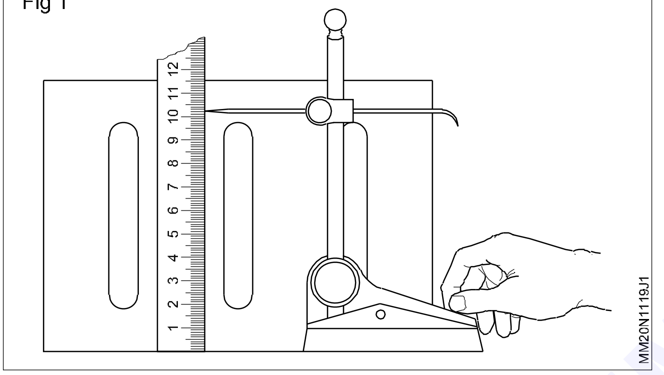
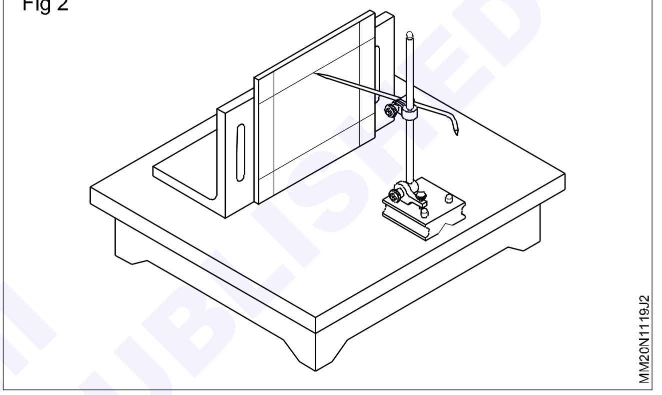


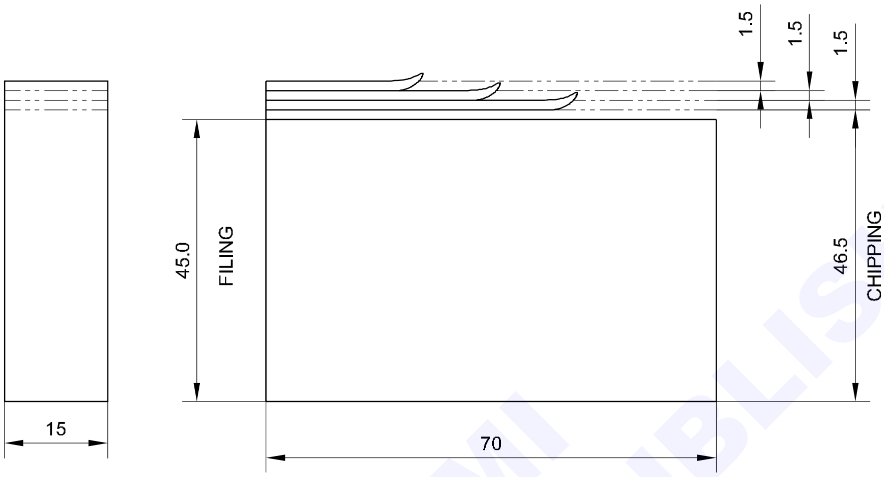
Fig 2



Chipping flat surfaces along a marked line

Objective: At the end of this exercise you shall be able to
- **chip surfaces evenly using a flat chisel.**

Note: Each trainee should practice chipping of 3 layers of 1.5 mm deep.



Job Sequence

- Apply marking media and mark the depth of metal to be removed by chipping.
- Punch the marked line with a dot punch.
- Hold the job firmly in the vice.
- Support the job with wooden block while chipping

If necessary give a wooden support below the work piece so that the marked line should be above the vice jaw face.

- Select a flat chisel 20 mm width with a proper cutting edge.
- Select a ball pein hammer of 1 kg.
- Hold the chisel at approximately 35° angle of inclination in chipping position.
- Hold the hammer at the end of the handle to get more leverage.

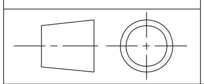
Caution: Chisel should be free from mushroom head.

Hammer handle should be securely fixed with eye hole with a wedge.

Use goggles while chipping.

Use a chipping guard behind the vice to arrest the flying chips.

1	50 ISF 15 - 70	-	Fe310	-	-	1.1.20
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	CHIPPING FLAT SURFACE				TOLERANCE : ±0.5mm	TIME : 5 Hrs
					CODE NO. MM20N1120E1	



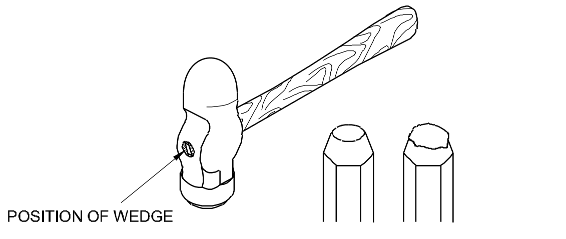
Skill Sequence

Chipping using flat chisel

Objective: This shall help you to
- **chip metal pieces.**

Before commencing chipping: Select a mushroom-free chisel and choose a hammer with a well secured handle. (Fig 1)

Fig 1

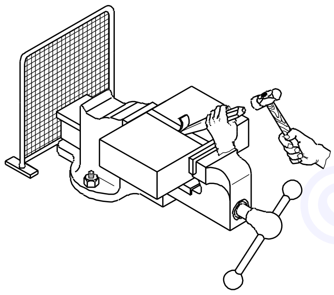


Wipe off oily substances, if any, from the face of the hammer.

Wear safety goggles.

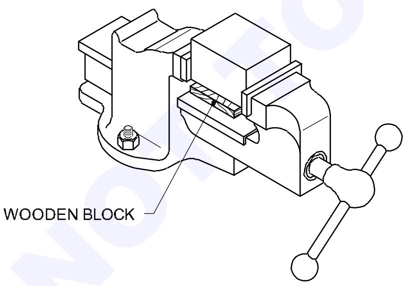
Install the chipping screen. (Fig 2)

Fig 2



Chipping process: Hold the work in a vice. If necessary, support the work on a wooden block. (Fig 3)

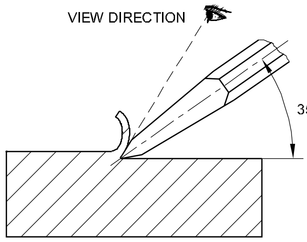
Fig 3



Position the chisel at an angle 35° (approximately) to cut the metal in uniform thickness. (Fig 4)

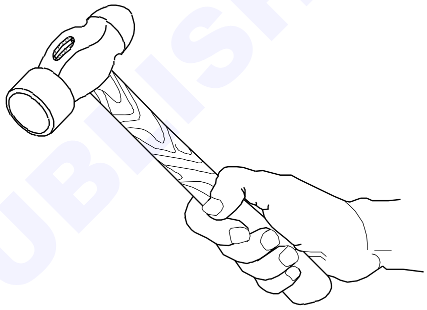
Hammer the head of the chisel by looking at the point of the chisel. (Fig 4)

Fig 4



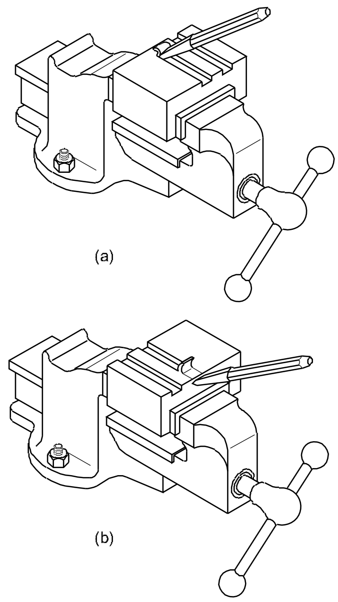
Hold the hammer at the end of the handle for maximum leverage. (Fig 5)

Fig 5



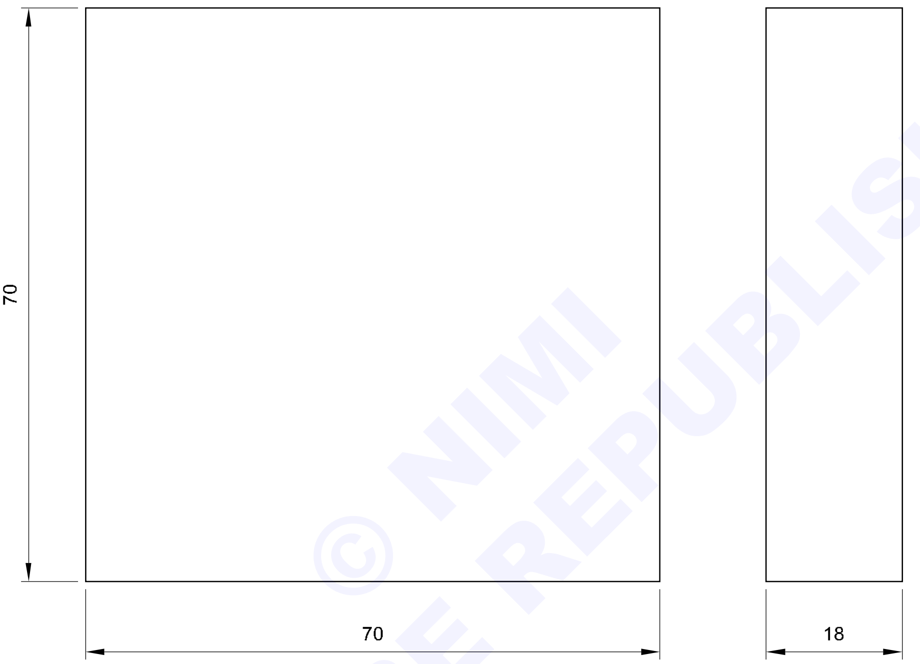
Stop chipping before the end of the surface; otherwise the edge of the job will break off. To prevent this, chip the end of the job from the opposite direction. (Figs 6A & B)

Fig 6



Marking, filing, filing square and check using Try - square

Objectives: At the end of this exercise you shall be able to
- **hold the job in a bench vice horizontally for filing**
- **file flat and square and maintain the sizes within ±0.5mm**
- **check the flatness of filed job using straight edge try square blade**
- **check the squareness of the job with try square.**



Job Sequence

- Check the raw material size using steel rule.
- File 3 sides mutually perpendicular to each other.
- Mark and file to size 70x70x18mm by maintaining the size ±0.5mm.
- Check the size with steel rule
- Check the squareness with try square and flat surface with straight edge/blade of try square.
- Clean and apply oil and preserve it for evaluation.

1	75 ISF 20-75	-	Fe310	-	-	1.1.21
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	FILING FLAT AND SQUARE	TOLERANCE :- ±0.5mm	TIME : 5 Hrs
		CODE NO. MM20N1121E1	

Marking according to drawing for locating position of holes, scribing lines on chalked surfaces with marking tools

Objectives: At the end of this exercise you shall be able to
- **mark drill holes and radius using divider**
- **mark angular lines using bevel protractor**
- **mark straight lines using marking block**
- **mark pitch circle diameter using divider.**

Fig 1

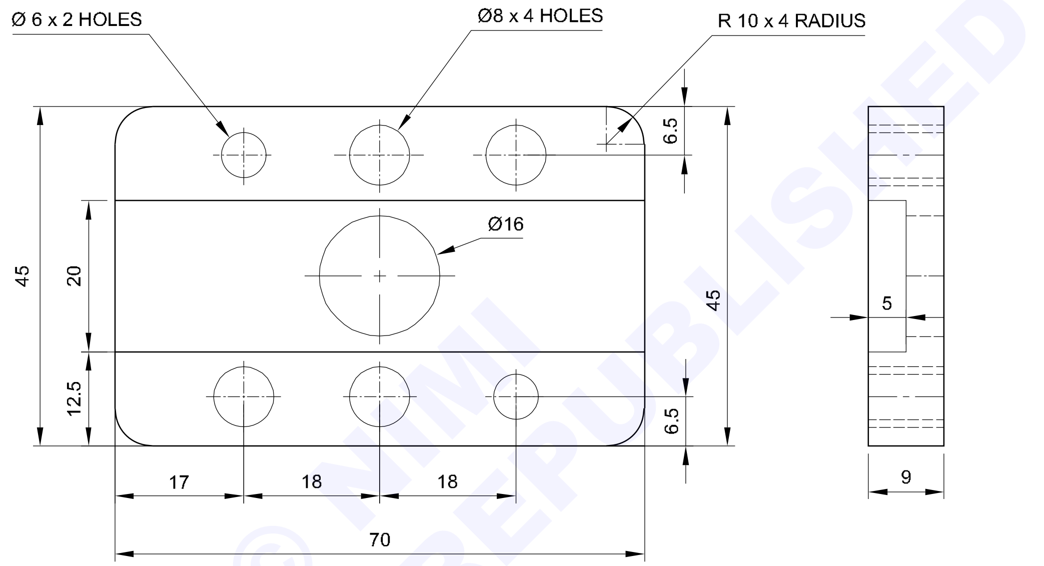
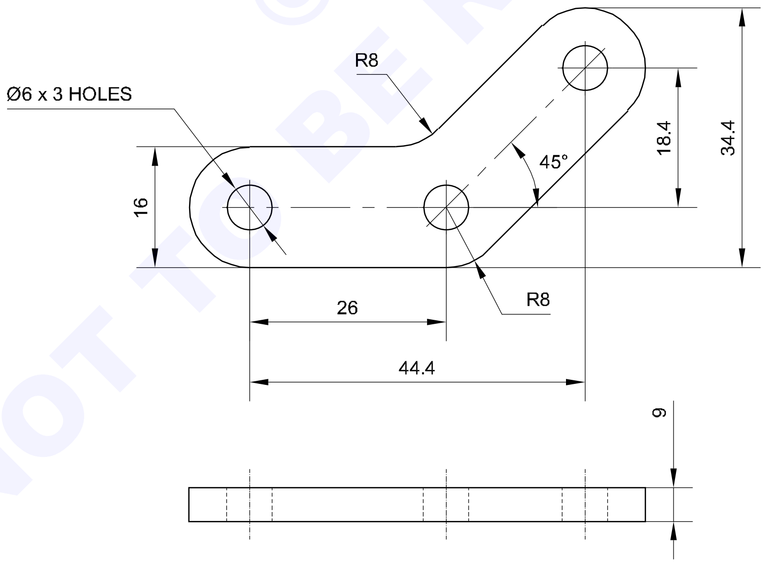


Fig 2



1	50 ISF 10-50	-	Fe 310	-	Fig 3	
2	50 ISF 10-75	-	Fe 310	-	Fig 1,2,4,5	1.1.22
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**MARKING PRACTICE**	TOLERANCE : - ±0.5mm	TIME : 5 Hrs
		CODE NO. MM20N1122E1	

Fig 3

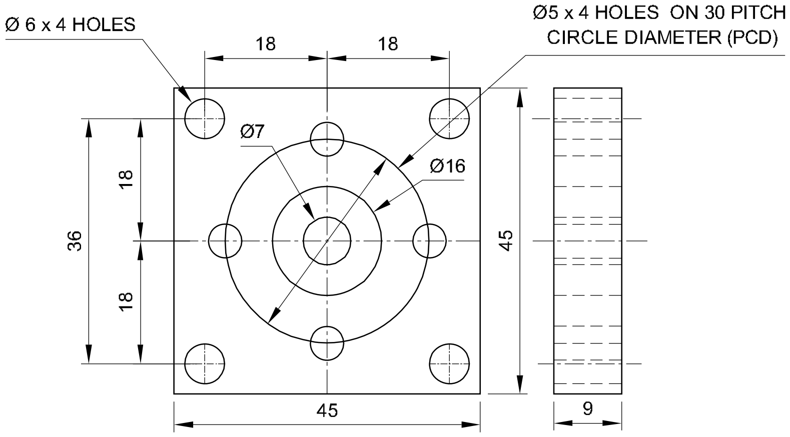


Fig 4

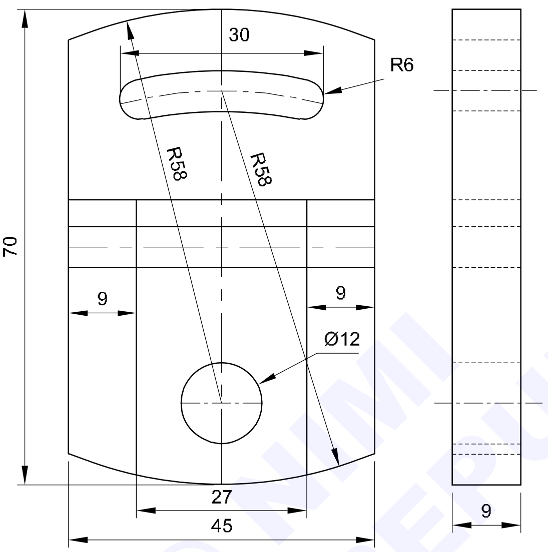
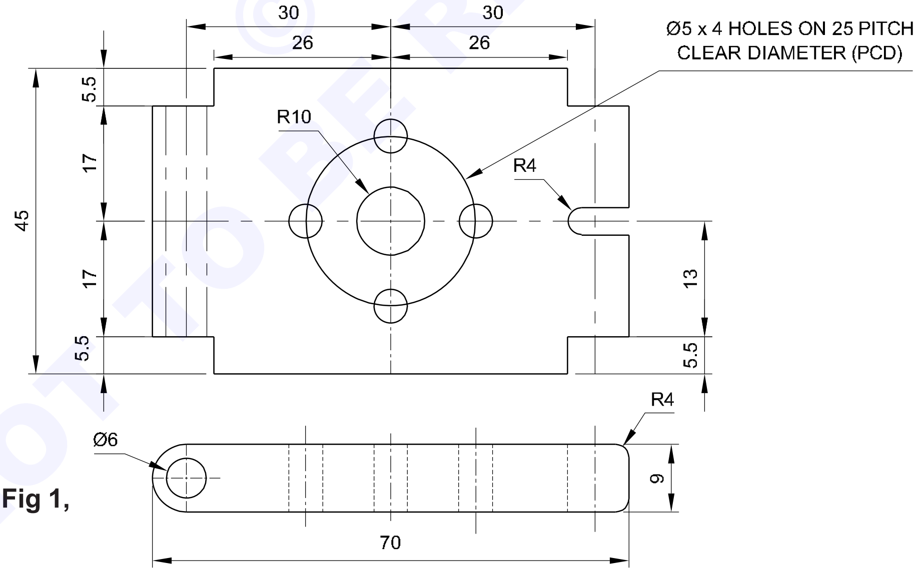


Fig 5



NOTE: Use both the surfaces of metal for Fig 1, 2, 4 and 5

-	-	-	-	-	-	1.1.22
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**MARKING PRACTICE**	TOLERANCE :	TIME :
		CODE NO. MM20N1122E2	

Job Sequence

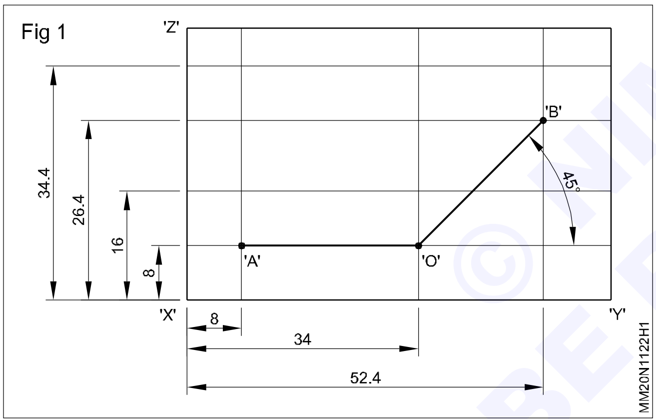
Figure 1

- Check the raw material size using steel rule
- File raw metal to size 70 x 45 x 9mm and check with steel rule.
- Apply marking media on the surface of the job.
- Mark circular holes centre, radius and groove as per drawing using a Jenny caliper.
- Set the radius of 5 mm in divider and draw circles ∅ 6 mm, ∅ 8 mm, and ∅ 16 mm as per drawing.
- Punch witness marks on marked line using a dot punch.
- Check the marking with steel rule.

Figure 2

- Apply marking media on the another surface of the job.
- Mark 8mm, 16mm, 26.4 mm and 34.4 mm lines using Jenny caliper with reference to 'xy'.
- Mark 8mm, 34 mm and 52.4 mm lines using Jenny caliper with reference to 'xz'. (Fig 1).

Fig 1



- Mark 45° angular line at point 'o' using Bevel Protector as per drawing.
- Locate the intersecting point 'A',' O' and 'B' using prick punch 30°.(Fig 2)
- Set the radius 3 mm in divider and draw circles Ø 6mm 3 holes at point 'A','O' and 'B'.
- Similarly, set the radius 8 mm and draw half round as shown in (Fig 2)
- Draw tangent line as shown in (Fig 2).
- Draw external radius 8mm, from point 'C' with references to tangent lines.
- Draw radius 8 mm at point 'o' to join tangent lines.
- Punch the witness marks on profile of the drawing.
- Check the marking with steel rule.

Fig 2

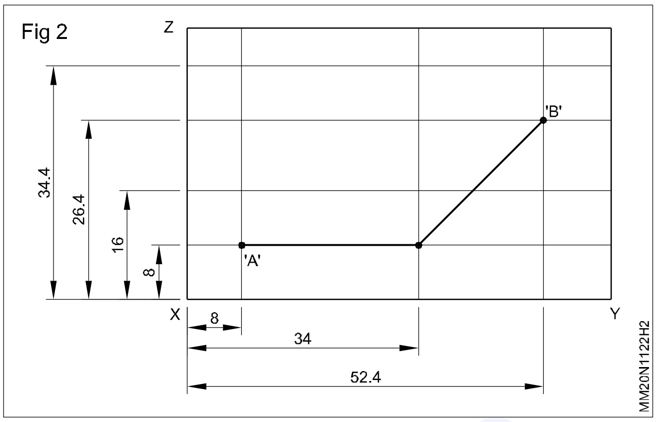


Figure 3

- Apply marking media.
- Mark holes centre line using a Jenny caliper as per drawing.
- Set the radius 3 mm, 3.5mm, 2.5 mm, 8 mm and 15 mm and draw holes and circle as per drawing.
- Punch to locate the centre of hole using prick punch 30°.
- Check the location of hole centres using steel rule.

Figure 4

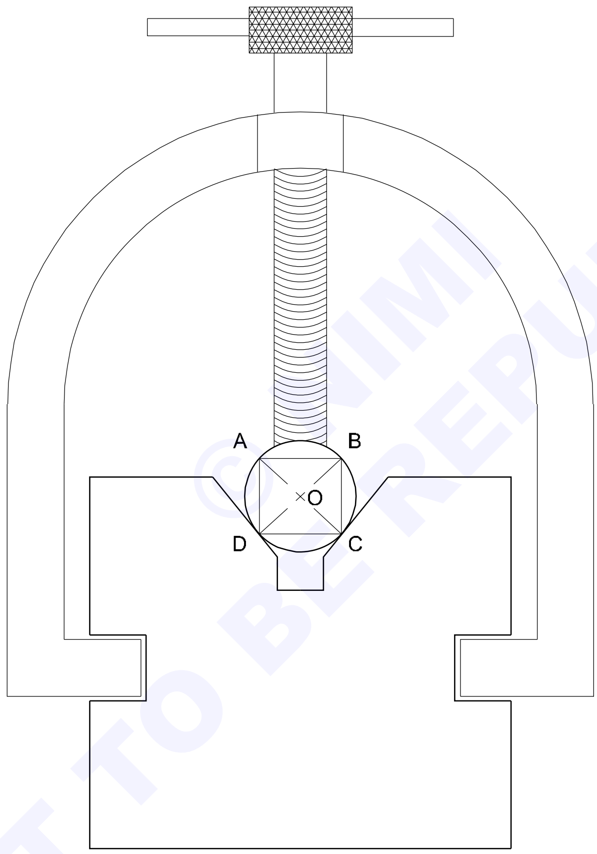
- Apply marking media.
- Mark lines as per drawing
- Set radius 58 mm in divider and draw radius as per drawing.
- Set radius 6 mm and 3 mm draw circle and curve.
- Punch on the peripheral of circle for prominent mark.
- Punch witness marks on the marked lines using dot punch 60°.
- Check the marking using steel rule.

Figure 5

- Apply marking media
- Mark lines as per drawing
- Draw holes, radius using divider.
- Punch on the peripheral of circle for prominent mark
- Punch witness marks on the marked lines using dot punch 60°
- Check the marking with steel rule.

Finding center of round bar with the help of 'V' block and marking block

Objectives: At the end of this exercise you shall be able to
- **select appropriate sizes of 'V' block to hold round bar**
- **find the centre of round bar using 'V' block and marking block.**



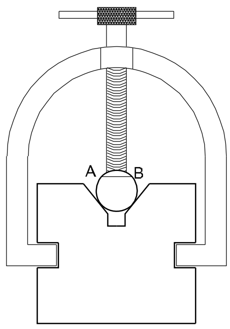
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	Ø50-50	-	Fe310	-	-	1.1.23

SCALE 1:1	FINDING CENTER OF A ROUND BAR	TOLERANCE : - ±0.5mm	TIME : 5Hrs
		CODE NO. MM20N1123E1	

Job Sequence

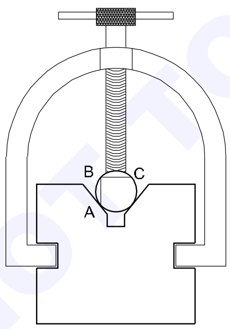
- File the faces of round bar
- Apply marking media on a face of round bar
- Clean marking table, 'V' block, marking block and steel rule
- Place 'V' block, marking block and steel rule on marking table.
- Set the round bar on 'V' block and clamp it with 'U' clamp.
- Place the marking block scriber on top of the round bar and read measurement in steel rule.
- Measure the height of round bar using steel rule
- Set the measurement in marking block using steel rule lesser than 10mm from the top of the round bar reading.
- Scribe line 'AB' on face of round bar using marking block as shown in Fig 1.

Fig 1



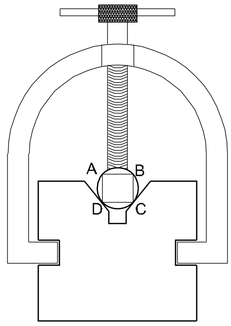
- Loosen the 'U' clamp
- Rotate and set the job to 90° using try square and Tighten the 'U' clamp and scribe line BC (Fig 2).

Fig 2



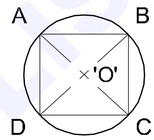
- Repeat the same procedure to scribe lines CD and AD Fig 3.

Fig 3



- Loosen the 'U' clamp and take out the round bar outside and keep it on marking table.
- Join the coordinate points 'AC' and 'BD' using steel rule and scriber Fig 4.

Fig 4

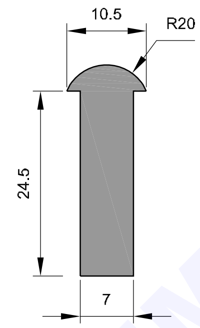


- Punch on the intersecting point 'O' using centre punch 90°.
- Point 'O' is the centre of round bar.
- Preserve it for evaluation.

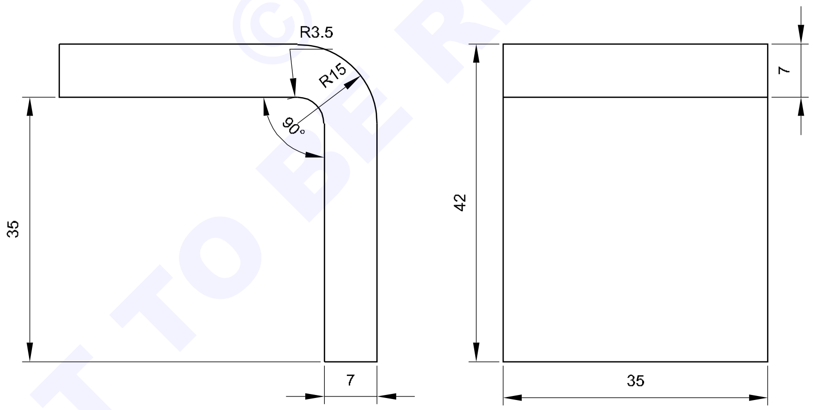
Prepare mushroom head and round bar and bending metal plate by hammering

Objectives: At the end of this exercise you shall be able to
- **to form mushroom head on a round bar by hammering**
- **to bend the M.S plate to an angle of 90° by using bench vice and ball pein hammer.**

TASK-1 MAKING OF MUSHROOM HEAD



TASK-2 BENDING OF METAL PLATE



ALL DIMENSIONS ARE IN MM

1	ISR Ø7x60	-	Fe310	-	-	
1	100ISF 7 -140	-	Fe310	-	-	1.1.24
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

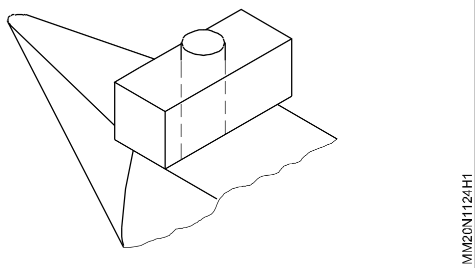
SCALE 1:1	**PREPARE MUSHROOM HEAD ON ROUND BAR AND BENDING OF METAL PLATE BY HAMMERING**	TOLERANCE : - ±0.5mm	TIME : 10 Hrs
		CODE NO. MM20N1124E1	

Job Sequence

TASK 1: **Making of mushroom head on round bar by hammering.**

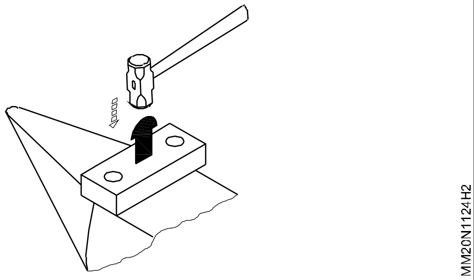
- Check the raw material for the correct size.
- Insert the round rod into the M.S Block as show in the (Fig1) and place it on the anvil, such that the rod is projecting 7mm above

Fig 1



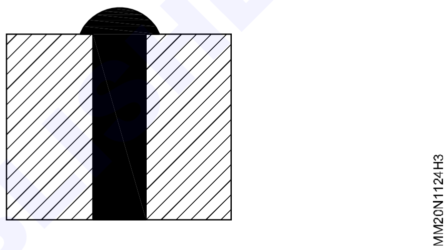
- Hammer it on the projection of the round rod above the M.S block so as to form mushroom head. (Fig 2). Use the ball been hammer
- Continue the hammering till we get the required shape of mushroom head
- (Note : Instructor shall provide a suitable template)

Fig 2



- Fill the burrs (if any) to have even shape and correct dimension (Fig 3).
- Check the mushroom head with a template

Fig 3

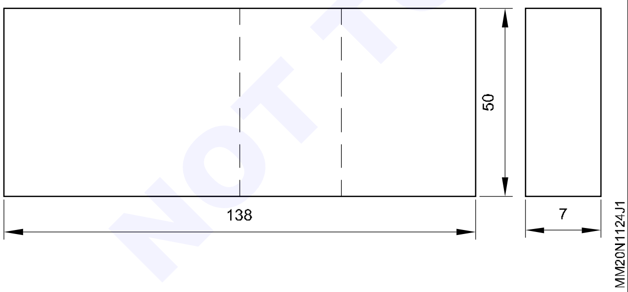


— — — — — — — —

TASK 2: **Bending of metal plate.**

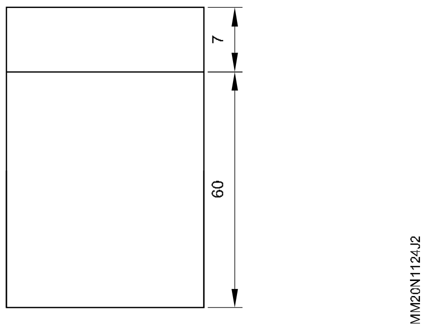
- Calculate the bending allowance for 90° (1/4 of the circumference)
- Determine the overall size of the job required.
- File the given raw material stock to overall size. (Fig 1).

Fig 1



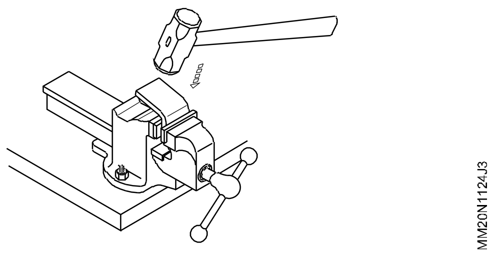
- Mark and punch the centre line of the job (Fig 2).
- Hold the job in a bench vice such that marking line is 2.5 mm above the vice jaw

Fig 2



- Strike at the edges of the plate as shown in Fig 3 by using as sledge hammer.
- Check the angle of bend and the radius.

Fig 3

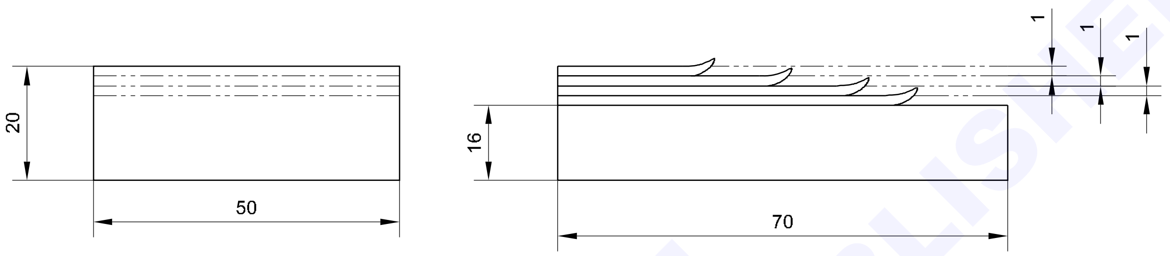


— — — — — — — —

Chipping flat surfaces along a marked line

Objectives: At the end of this exercise you shall be able to
- **chip surface evenly using flat chisel**
- **follow safety while chipping.**

Note: Each trainees should practice chipping of 3 layers of deep



Job Sequence

- Apply marking media and mark the depth of metal to be removed by chipping.
- Punch the marked line with a dot punch.
- Hold the job firmly in the vice.
- Support the job with wooden block while chipping

If necessary give a wooden support below the work piece so that the marked line should be above the vice jaw face.

- Select a flat chisel 20 mm width with a proper cutting edge.
- Select a ball pein hammer of 1 kg.
- Hold the chisel at approximately 35° angle of inclination in chipping position.
- Hold the hammer at the end of the handle to get more leverage.

Caution: Chisel should be free from mushroom head.

Hammer handle should be securely fixed with eye hole with a wedge.

Use goggles while chipping.

Use a chipping guard behind the vice to arrest the flying chips.

NOTE : EACH TRAINEE SHOULD PTACTICE CHIPPING OF 4mm DEEP

1	50 ISF 20 - 70	-	Fe310	-	-	1.1.25
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	CHIPPING FLAT SURFACE ALONG A MARKED LINE	TOLERANCE : ±0.5mm	TIME : 10 Hrs
		CODE NO. MM20N1125E1	

Make a square from a round job by chipping upto 20mm length

Objective: At the end of this exercise you shall be able to
- **to make a square job from a round rod.**

Job Sequence

- Check the size of metal
- Remove the burrs if any in the stock
- Apply marking media on both the faces
- Set the job in V-block and U clamp.
- Find the centre using the jenny caliper and punch the centre.
- Keep the job on the surface plate
- Use the scribing block and steel rule and mark the lines as per the drawing size .
- Turn the job 90° using try square.
- Mark the lines as per the drawing
- Punch the square shape using prick punch and hammer both the faces
- Remove the job from the 'V' block and hold it in the bench vice.
- Select the chisel for chipping
- Hold the chisel in left hand and hammer it with right hand
- Remove excess metal from the job by chipping upto the punched marks.
- Remove all the burrs.

Safety

- Do not use mushroom head chisel.
- Place /use the chip guard while chipping.

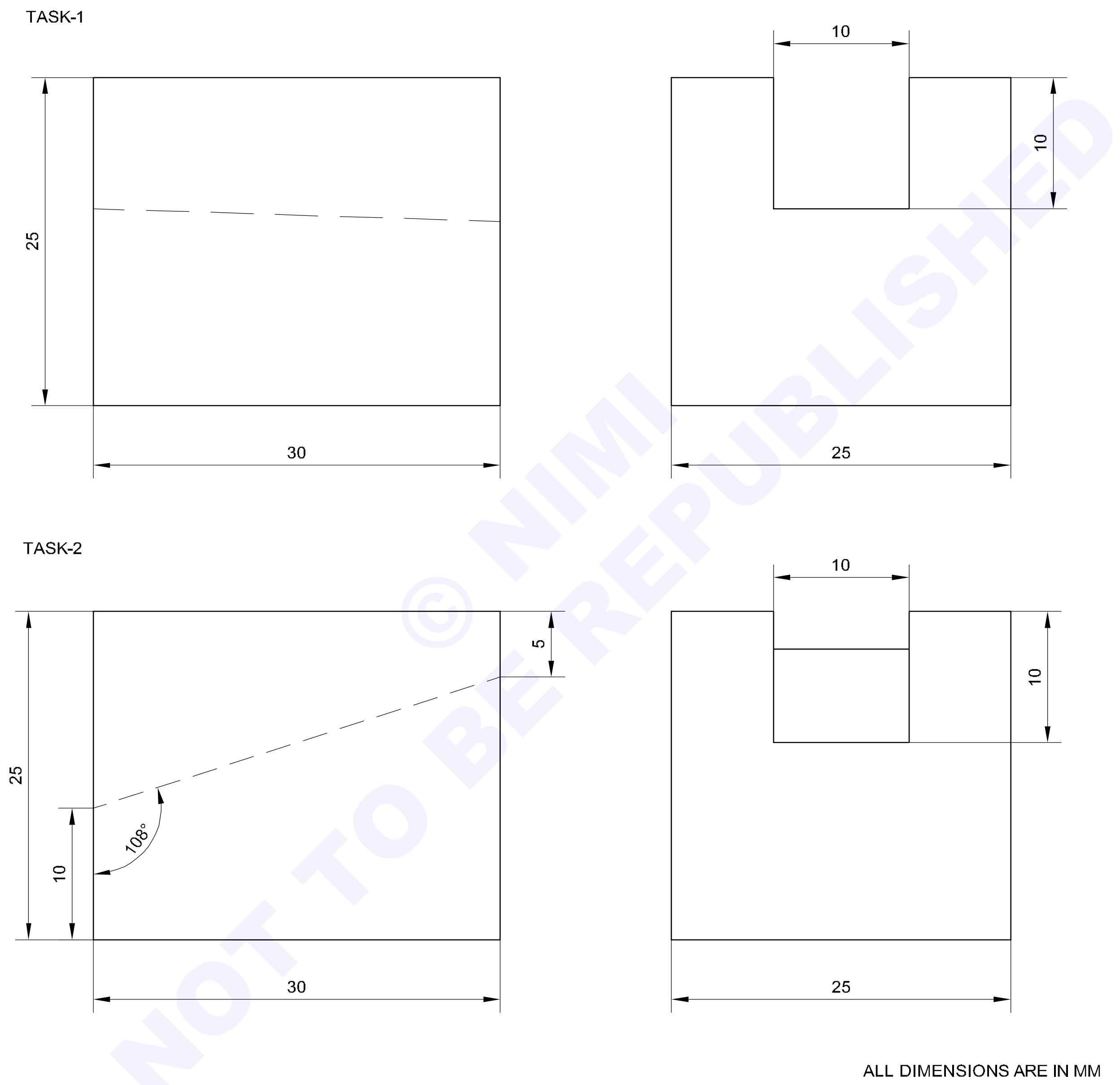
ALL DIMENSIONS ARE IN MM

1	ISR 25x20	-	Fe 310	--	--	1.1.26
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 4:1	**MAKE A SQUARE FROM A ROUND JOB BY CHIPPING UPTO 20 mm LENGTH**	DEVIATIONS ±0.25mm	TIME 8Hrs
		CODE NO. MM20N1126E1	

Slot, straight and angular chipping

Objectives: At the end of this exercise you shall be able to
- **select the chisel suitable for straight slot chipping**
- **select the chisel suitable for angular slot chipping.**



2	25 ISF - 30	-	Fe 310	--	--	1.1.27
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 2:1	SLOT,STRAIGHT AND ANGULAR CHIPPING	DEVIATIONS ±0.25mm	TIME 5 Hrs
		CODE NO. MM20N1127E1	

Job Sequence

TASK 1 : **Chipping straight slot**

- Check material for its size
- Remove the burrs if any
- Apply marking media
- Mark the slot using scribing block and steel rule.
- Punch the slot in both the sides by using prick punch and hammer.
- Hold the job firmly on the vice
- Support the job with wooden block while chipping
- Select the cross cut chisel for chipping slots
- Chip the slot upto required depth as per the drawing.
- Remove the burrs and finish the job
- Check the width and depth using steel rule

— — — — — — — —

TASK 2 : **Chipping angular slot**

- Check the raw material for its size.
- Remove the burrs if any
- Apply marking media
- Mark the angular slot for 108°
- Punch on both faces and side
- Hold the job angularly
- Select the cross cut chisel for chipping angular slot
- Chip the angular slot as per marking
- Check the angle using bevel protractor.
- Remove the burrs and finish the job.

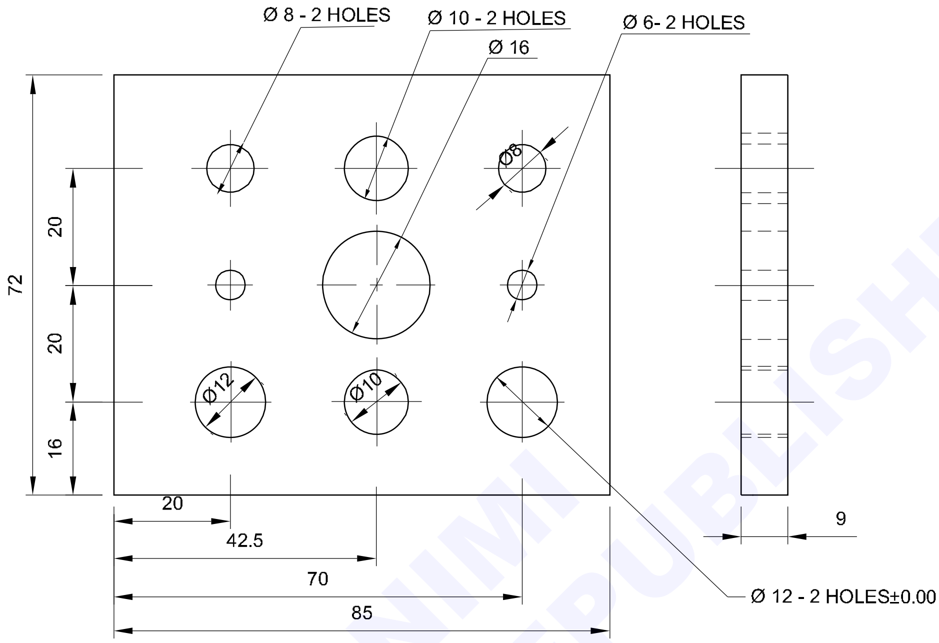
Safety

- Chisel should be free from mushroom head
- Hammer handle should be securely fixed with eyehole with a wedge
- Wear goggles while chipping
- Use chipping guard behind the vice to arrest the flying chips.

— — — — — — — —

Mark off and drill through holes

Objectives: At the end of this exercise you shall be able to
- **mark off using scribing block**
- **drill through holes using pillar/bench drilling machine.**



Job Sequence

- Check the raw material for its size.
- File and finish to size 85 x 72 x 9mm maintaning parallelism and perpendicularly.
- Make drill holes as per drawing.
- Punch on drill hole contres using centre punch 90°.
- Make centre drill in all drill hole centres.
- Fix Ø 6mm drill to drill pilot holes in all centre drilled holes.
- Similarly fit Ø 8mm Ø 10mm Ø 12mm and 16mm drill in drilling machine and drill holes as per drawing.
- Finish file and de burr in all the surfaces of the job.

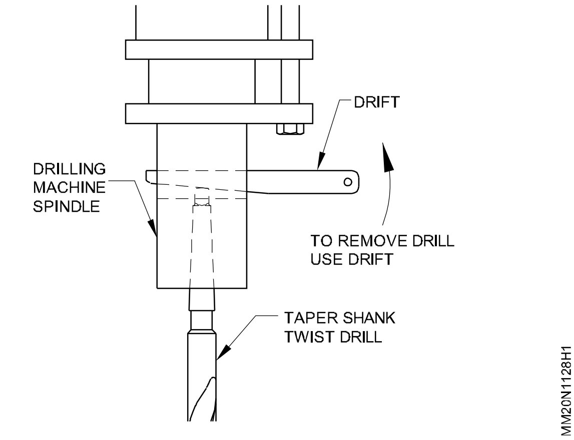
Caution: Use chuck key for tightening the drill in the drill chuck.

1	75 ISF 10-90	-	Fe310-O	-	-	1.1.28
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE 1:1	DRILLING THROUGH HOLES	TOLERANCE : ±0.1mm	TIME : 5 Hrs
		CODE NO. MM20N1128E1	

- Use drift to remove the taper shank drill from drilling machine spindle. (Fig 1)
- Do not hammer on drift to remove it out.
- Adjust the rpm of the spindle to suit the diameter of the drill. Ask your instructor.
- Finish the job and de-burr all corners.
- Apply thin coat of oil and preserve it for evaluation.

Fig 1



Skill Sequence

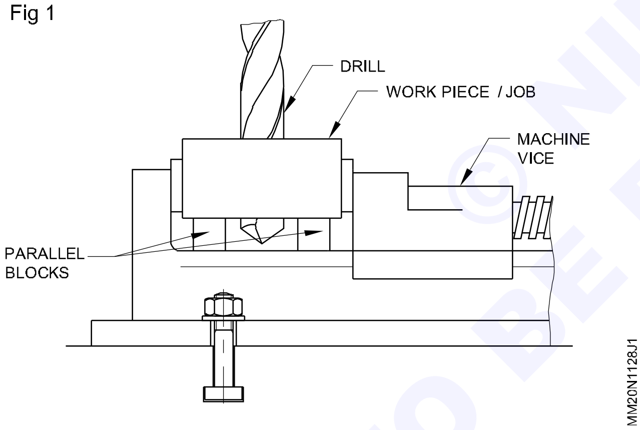
Drilling through holes

Objective: This shall help you to
- **drill holes of different diameter in a drilling machine.**

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

Set the job in the machine vice securely by using two parallel bars to clear the drill (Fig 1)

Fig 1



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

Fix the 4 mm dia drill in the drill chuck for pilot hole.

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

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

Drill Ø 8 mm.

Drill Ø 10 mm hole.

Remove the drill and drill chuck.

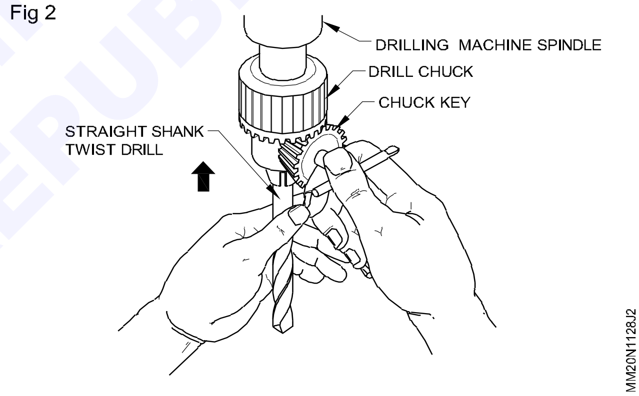
Caution: Do not remove chips with your bare hands- use brush.

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

Ensure that the drill do not penetrate into the vice.

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

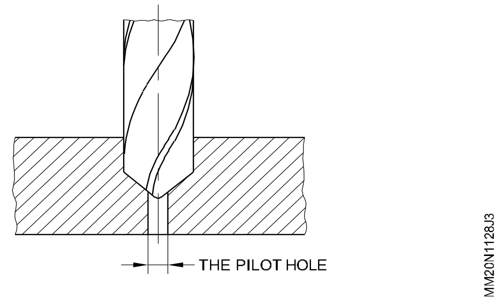
Fig 2



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

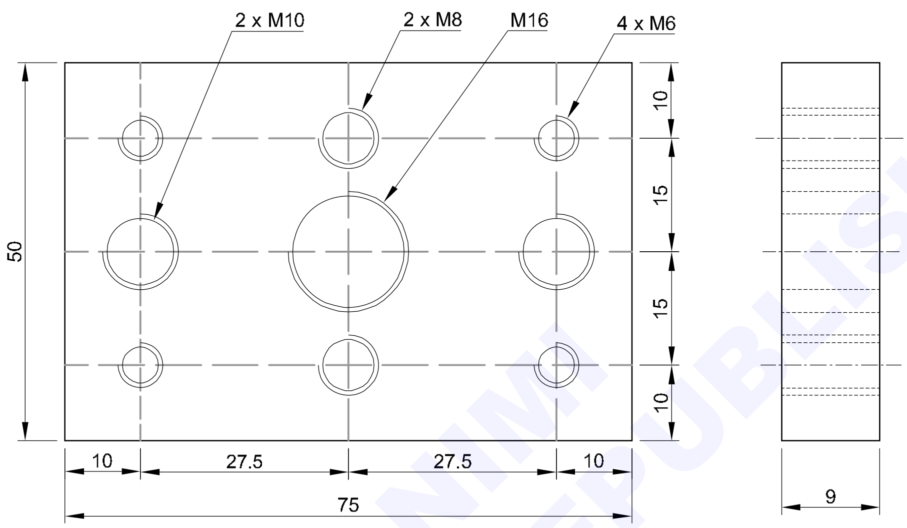
These problems can be overcome by drilling pilot holes initially. (Fig 3)

Fig 3



Drill and tap on M.S.flat

Objectives: At the end of this exercise you shall be able to
- **mark the tap holes with vernier height gauge**
- **determine the tap drill size**
- **drill tap drill hole on the job and chamfer it**
- **cut internal thread by hand tapping.**



Job Sequence

- Check the raw metal and file to size 75x50x9 mm.
- Mark the hole centres for the tap drill holes with vernier height gauge.

Drilling

- Set the pillar drilling machine for drilling operation
- Set the job on the machine vice.
- Fix the centre drill in a drill chuck.
- Align centre drill in drawing machine and drill in all hole location.
- Fix Ø 5 mm drill in a drill chuck and drill all the centre drilled holes. (this serve as pilot hole for larger diameter drills).
- Drill two holes Ø 6.8 mm for M 8 tap.
- Drill two holes Ø 8.5 mm for M 10 tap.
- Drill Ø 14 mm at the centre of the work for M16 tap.
- Fix the counter sink tool in a drilling machine and chamfer all the tap drill holes both sides to 1.0 mm depth.

Tapping

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

1	60 ISF 10 x 78 mm	-	Fe310	-	-	1.1.29
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	DRILLING AND TAPPING	TOLERANCE : ±0. 1mm	TIME : 8 Hrs
		CODE NO. MM20N1129E1	

Locating hole accurately by drilling centre drill

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

Drilling centre holes by combination or center drill is an accurate method of locating the position of the holes (i.e. within ± 0.025mm). In drilling operations, this method will be specially helpful while drilling deeper holes, and holes of fairly accurate locations. For doing centre drilling, proceed as follows.

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

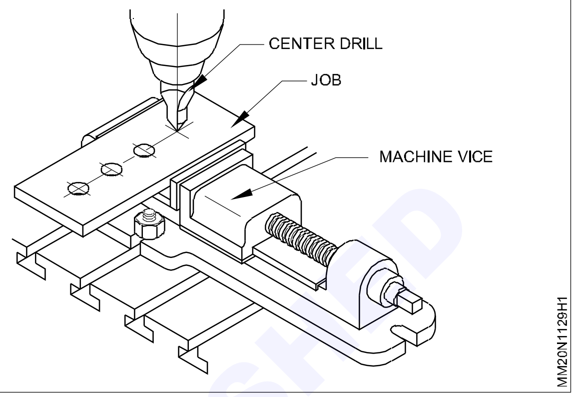
Adjust the job together with the vice and align with the centre punch mark. (Fig.1)

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

Apply sufficient quantity of cutting fluid.

Remove the centre drill. Drill hole with the required diameter twist drill. Check if it 'runs true'. Start drilling the through hole.

Fig 1



Tapping through holes

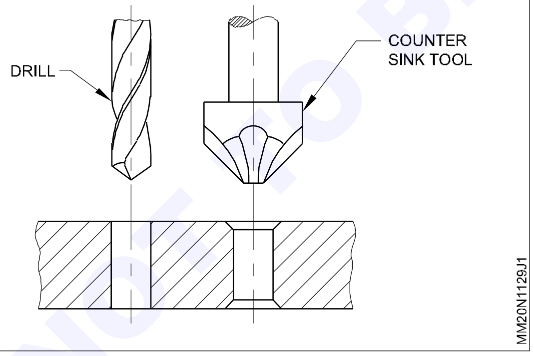
Objective: This shall help you to
• **cut internal threads using hand taps.**

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

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

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

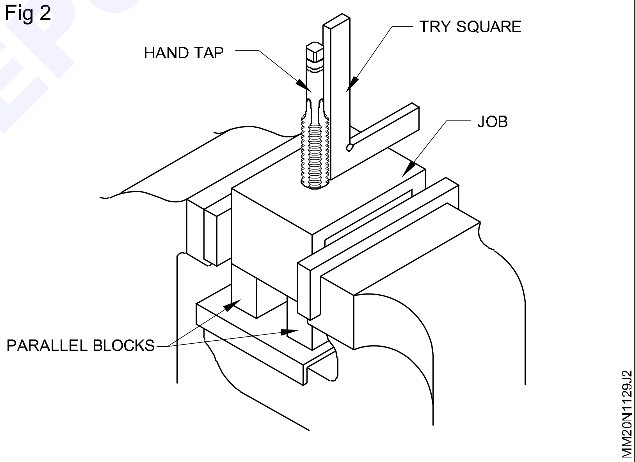
Fig 1



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

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

Fig 2



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

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

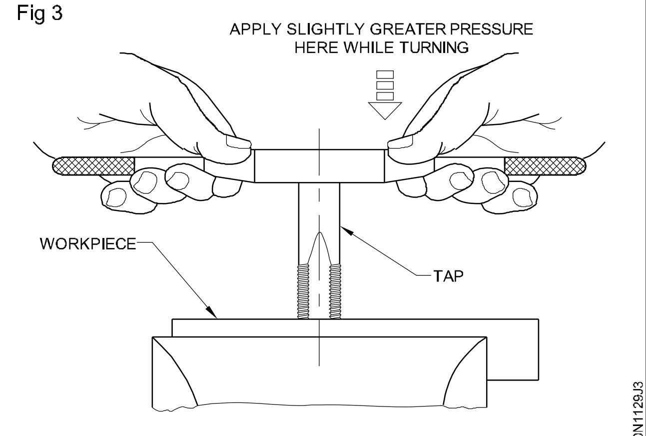
Remove the wrench from the tap when you are sure of starting the thread without disturbing the setting.

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

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

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

Fig 3



SQUARING UP THE TAP

Fig 4

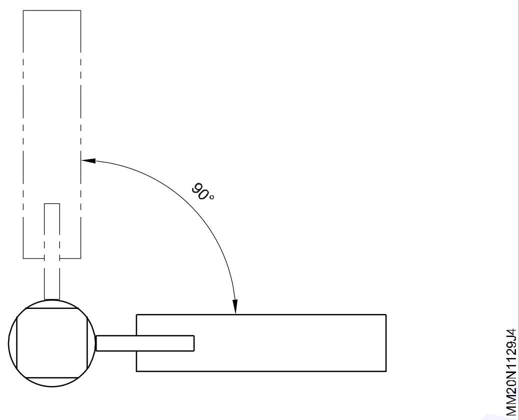
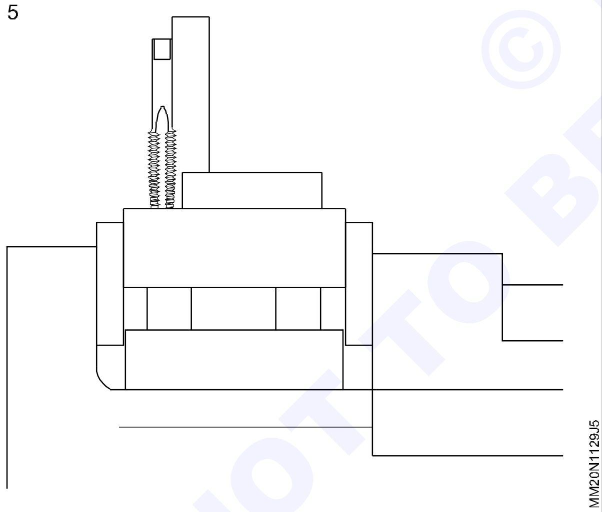
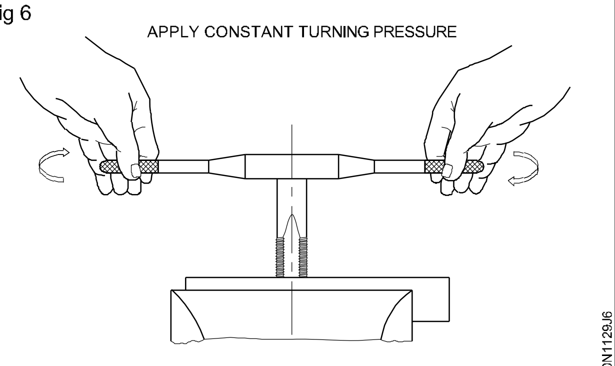


Fig 5



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

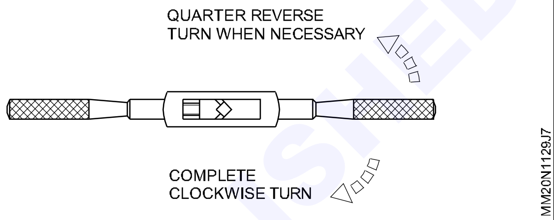
Fig 6



THREAD FORMING BY TAP

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

Fig 7



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

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

Cut the thread until the hole is totally threaded.

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

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

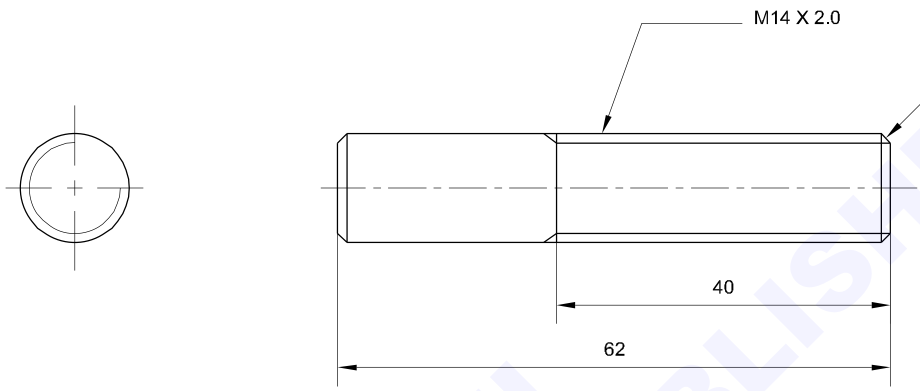
Make sure that the dia of the hole to be tapped is correct for the given size of the tap.

Turn backwards to break the chip after every quarter turn.

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

Cutting external thread on M.S. rod using die

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



Job Sequence

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

Use cutting lubricant while cutting thread

NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	ISR Ø 14 - 65		Fe310			1.1.30

SCALE 1:1	**FORM EXTRNAL THREADS WITH DIES TO STANDARD SIZE**	DEVIATIONS ±0.5	TIME 5Hrs
		CODE NO. MM20N1130E1	

Skill Sequence

External threading using dies

Objective : This shall help you to

• cut external threads using dies.

Select a correct size and circular rod as blank and chamfer the ends.

Blank size= Thread size 10% pitch of the thread

Grip the blank in the vice using a false jaw, projecting the blank above the vice jaws 5mm more than the required length of thread.

Fix the die in the diestock. The leading side of the die must be opposite to the step of the die stock. (Figs 1& 2)

Fig 1

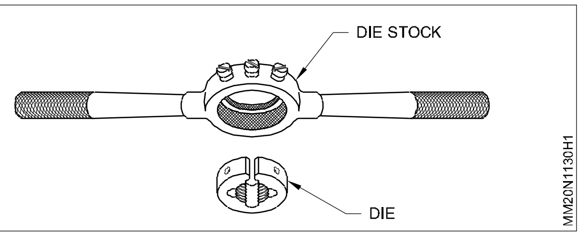
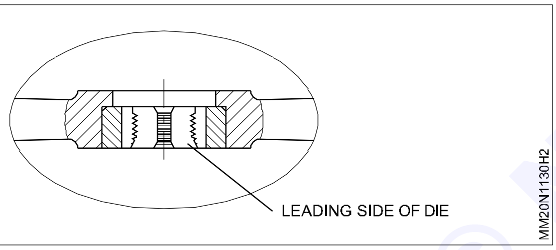


Fig 2



Open the die fully by tightening the centre screw of the die stock.(Fig 3)

Fig 3

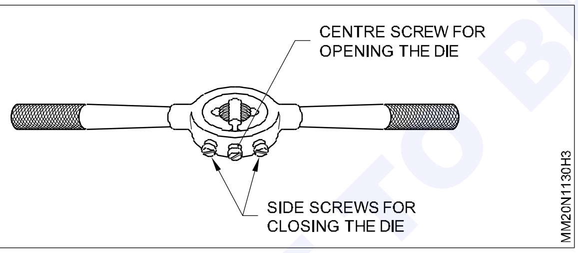
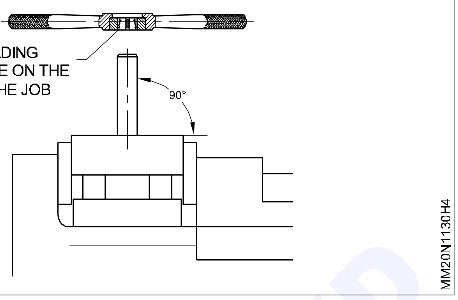
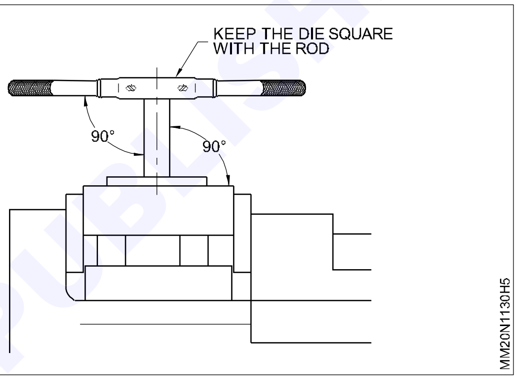


Fig 4



Cut thread slowly and reverse the die for a short distance in order to break the chips (Fig 5).

Fig 5



Use a cutting lubricant.

Clean the die frequently with a brush to prevent the chips from clogging and also from spoiling the thread.

Reverse and remove the die after the full height reached.

Increase the depth of cut gradually by loosening the centre screw and tightening the side screws.

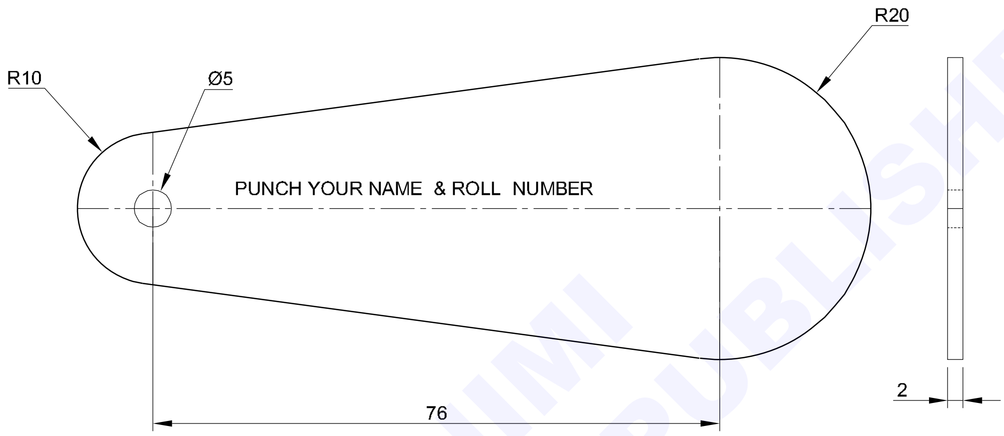
Too much depth of cut at one time will spoil the threads it can also spoils the die.

Check the fit of threads with a matching nut.

Tighten the side screw by hand and repeat the cutting until the standard nut matches with the external and without undue 'play' between the threads.

Punch letter and number (letter punch and number punch)

Objective: At the end of this exercise you shall be able to
- **punch the letters and numbers.**



Job Sequence

- Check the raw material size.
- Mark the line to punch the letters.
- Measure the length.
- Select the size of the letters according to space
- Count the letters on each line.
- Position the letter punch and hold vertical position hammer vertically above the punch.
- Practice letter and number punching.

1	SS 110 x45 x 2mm	-	STAINLESS STEEL	-	-	1.1.31
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	LETTER AND NUMBER PUNCHING PRACTICE ON KEY CHAIN TALLY	TOLERANCE : NIL	TIME : 5Hrs
		CODE NO. MM20N1131E1	

Skill Sequence

Objective: This shall help you to
• **punch letters and numbers.**

Letter and number punches

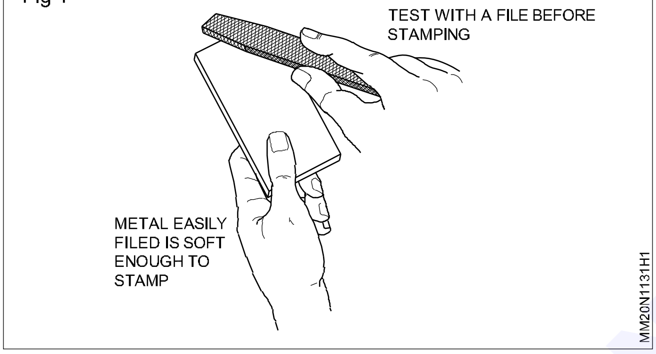
These hardened and tempered steel punches are used to stamp identifying symbols, letters or numbers as required on the work.

They are obtainable with symbols ranging in size from 0.8 mm to 13 mm.

They are kept in boxed sets.

Use a file on the work to be stamped to check the work is softer than the punch. Any attempt to stamp hard material would damage the punch. Use an electric pencil or acid etching to mark hard materials. (Fig 1)

Fig 1



Each symbol must be made with a single blow. A second blow gives a distorted second impression.

Letters such as **M** and **W** may require firmer blows to produce the same depth of impression such as letters **I** and **T** can make.

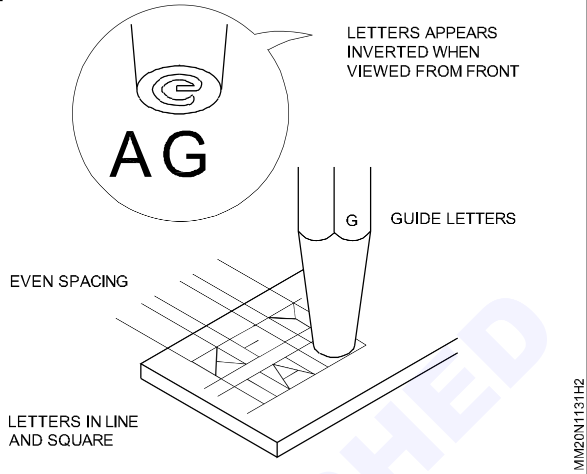
The depth of impression for a given blow varies with the softness of the material.

Practice on different metals.

Use the punches in the following manner :

- Mark out the guidelines for the symbols.
- Check that you have the correct symbol.
- Position the punch so that the symbol will be in line, square, correctly spaced and the correct way up. (Fig 2)

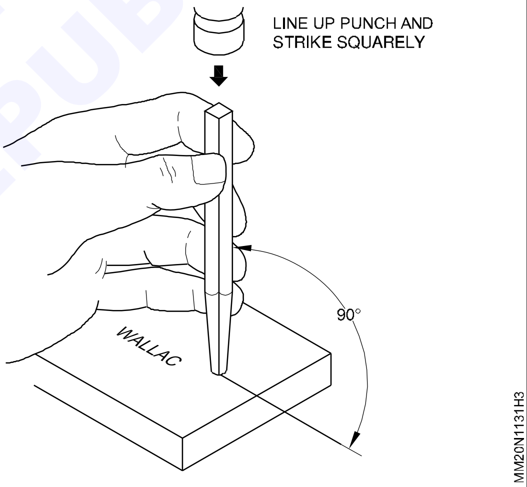
Fig 2



Hold the punch in a vertical position. (Fig 3)

Hold the hammer vertically above the punch. (Fig 3)

Fig 3

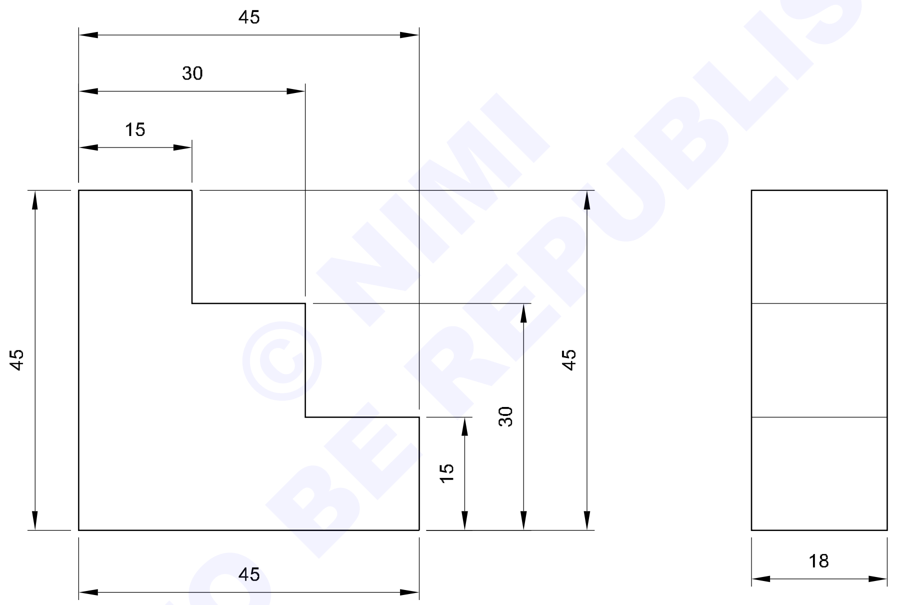


Watch the point of the punch.

Strike the punch squarely with one firm blow.

File steps and finish with smooth file to accuracy of ±0.25mm

Objectives: At the end of this exercise you shall be able to
- **mark steps with vernier height gauge**
- **cut metal by hacksawing**
- **file and finish steps to an accuracy of ± 0.25mm.**



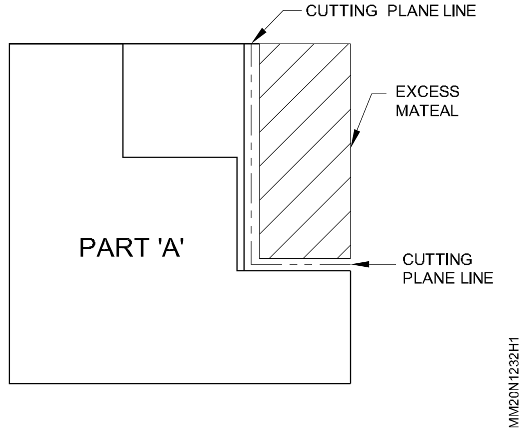
2	50 ISF 20 x 50	-	Fe310	-	1	1.2.32
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	STEP FILING AND MATCHING	TOLERANCE : ±0.25mm	TIME : 10 Hrs
		CODE NO. MM20N1232E1	

Job Sequence

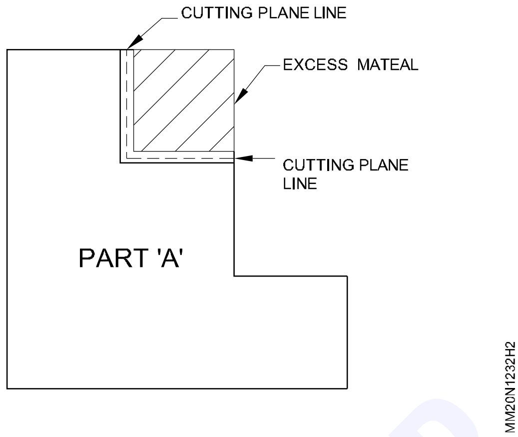
- Check the raw metal with steel rule.
- File and finish the raw metal to size 45x45x18 mm.
- Mark the steps with vernier height gauge as per drawing and punch witness marks.
- Cut and separate the excess material by sawing (Fig 1).

Fig 1



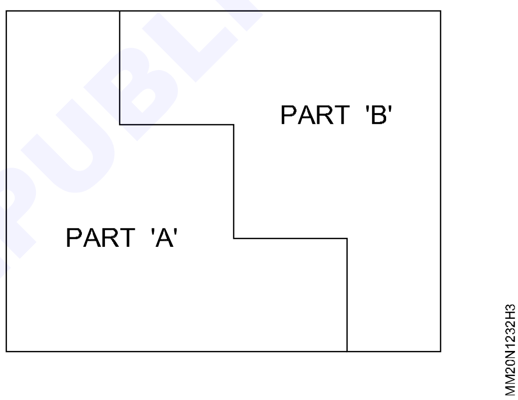
- File step with safe edge file using bastard, second cut and smooth grades.
- Measure the job sizes with outside micrometer maintaining the accuracy of ± 0.25 mm.
- Check the squareness with try square
- Similarly, cut and separate the excess material by sawing (Fig 2).
- File step with safe edge file using different grades
- Measure the job size with vernier caliper
- Check the squareness with try square
- Finish and de-burr the job

Fig 2



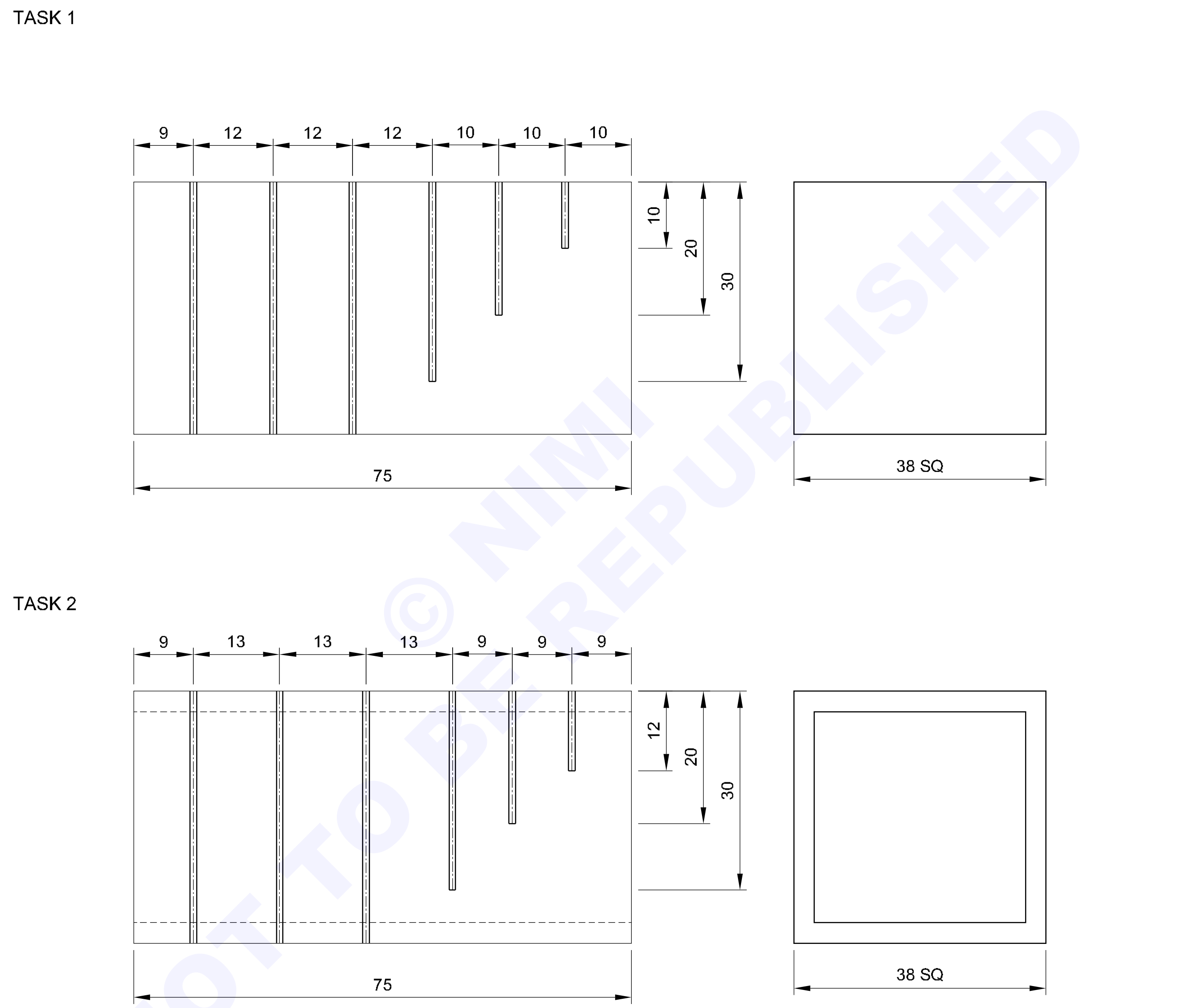
- Similarly, file and finish the another part 'B' and match with one another. (Fig 3)
- Apply thin coat of oil and preserve it for evaluation.

Fig 3



File and saw on M.S. square and pipe

Objectives: At the end of this exercise you shall be able to
- **file, mark and saw in M.S.square as per drawing**
- **file, mark and saw in M.S.square hollow pipe as per dimensions.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	◻ 40-78 HOLLOW PIPE	-	Fe310	-	TASK 2	1.2.33
1	■ 40-78	-	Fe310	-	TASK 1	1.2.33

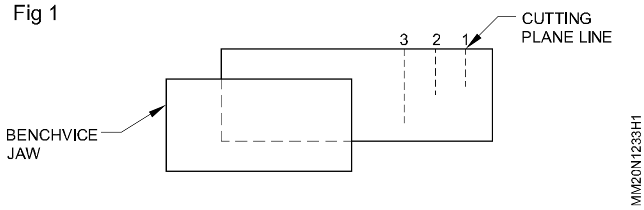
SCALE 1:1	**FILE AND SAW ON M.S SQUARE ROD AND PIPE**	TOLERANCE : ±0.5mm	TIME : 15Hrs
		CODE NO. MM20N1233E1	

Job Sequence

TASK 1: **Hacksawing on square section.**

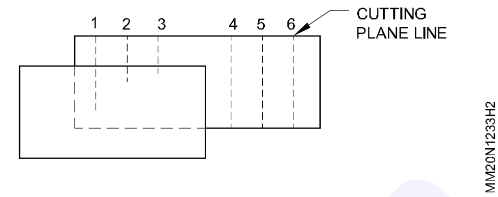
- Check the raw material size using steel rule.
- File and finish all sides of M.S. Square to 75x38x38mm and maintain parallelism and perpendicularity to each other.
- Mark and punch as per the drawing.
- Hold the job in bench vice, such that 35mm projecting outside jaw of bench vice.
- Cut along the marked line1,2 and 3 to the required depth (Fig 1).

Fig 1



- Hold the job as shown in Fig.2 to saw the other 3 cuttings
- Saw along the marked line and maintain perpendicularity and parallelism of the Job.

Fig 2



The cut piece should be parallel and should have uniform sawing mark

Frequently wet the blade in soluble oil

- Deburr the job and preserve it for evaluation.

Use coarse pitch blade for solid material and fine pitch blade for Hollow section.

— — — — — — —

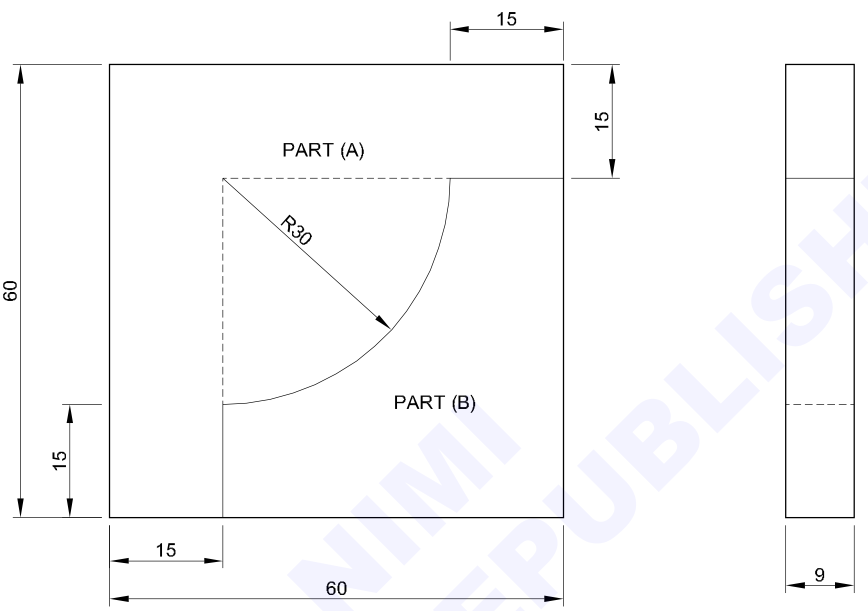
TASK 2: **Hacksawing on square pipe.**

- Check the raw metal size using steel rule.
- File and finish of M.S square pipe to ϕ 75 x 38 x 38 mm and maintain parallelism and perpendicularity to each other.
- Mark and punch as per drawing.
- Hold the job in bench vice and cut along the marked lines to the required depths as shown in job drawing.
- Check saw metal with steel rule.
- De-burr the job and preserve it for evaluation.

— — — — — — —

File radius along a marked line (convex and concave) and match

Objectives : At the end of this exercise you shall be able to
- **mark convex and concave radius**
- **file, convex and concave radius as per dimension**
- **match convex and concave radius as per drawing.**



Job Sequence

Part 'A'

- Check the raw metal size using steel rule.
- File and finish to size 60x60x9 mm maintaining parallelism and perpendicularity.
- Mark and punch in part 'A' as shown in Fig 1.
- Mark line as shown in fig 2 leaving the metal 1 mm away from the object line.
- Cut and remove, excess metal by sawing.
- Mark lines as shown in fig 3 and cut along the marked lines and remove excess metal.
- File radious as per drawing using half round file of different grades and check the size with vernier caliper Fig 4, and radious with template.
- File convex radius 'C 'to 30 mm with half round file using different grades and check the radius profile with template.

1	50 ISF 10-50	-	Fe310	-	PART 'B'	1.2.34
1	65 ISF 10-65	-	Fe310	-	PART 'A'	1.2.34
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	FILE CONVEX & CONCAVE RADIUS AND MATCH				TOLERANCE : ±0.1 mm	TIME : 15Hrs
					CODE NO. MM20N1234E1	

Fig 1

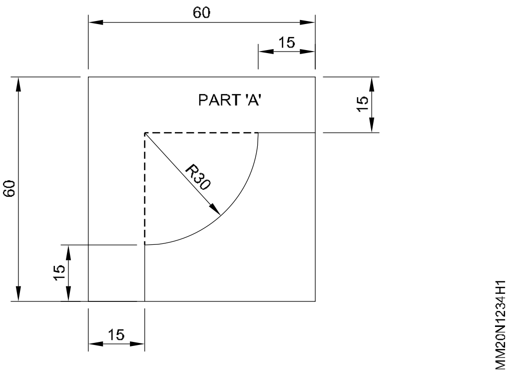


Fig 2

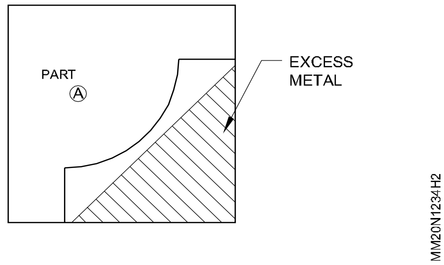


Fig 3

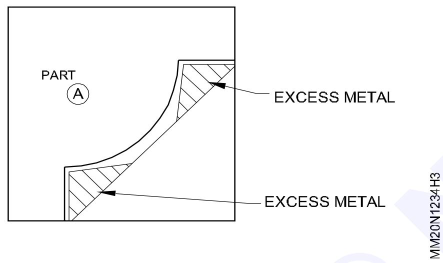
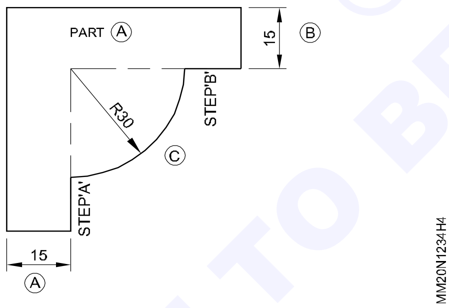


Fig 4



Instructor may arrange a template to check the radius.

Caution:

The flat surfaces are rounded and brought near about to finishing size, using a half round second cut file. In this, the file is moved across the curve with a rotary motion.

Check the radius frequently with a template.

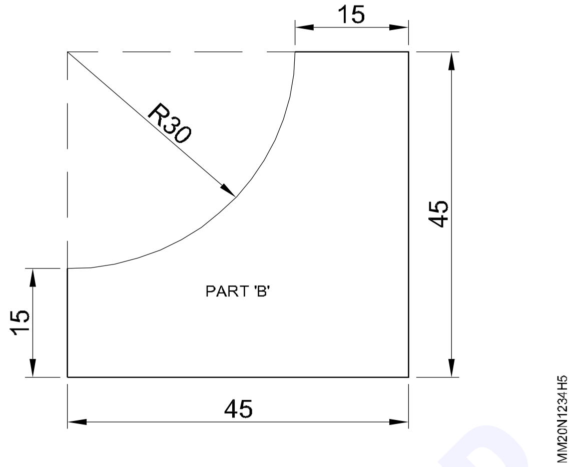
Do not give excessive pressure while filing radius, as the file may likely to slip.

Part 'B'

- File and finish to size 45x45x9 mm maintaining parallelism and perpendicularity.

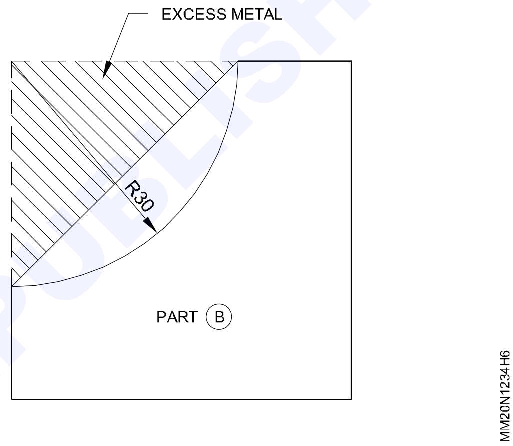
- Mark and punch the part 'B' as shown in fig 5.

Fig 5



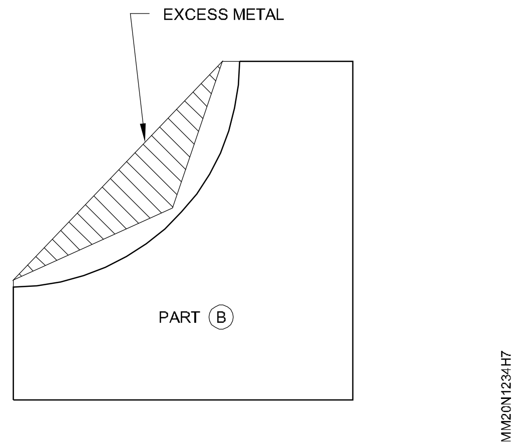
- Mark line as shown in fig 6 and cut along the marked line and remove excess metal

Fig 6



- Mark line as shown in fig 7 and cut along the marked lines and remove exess metal.

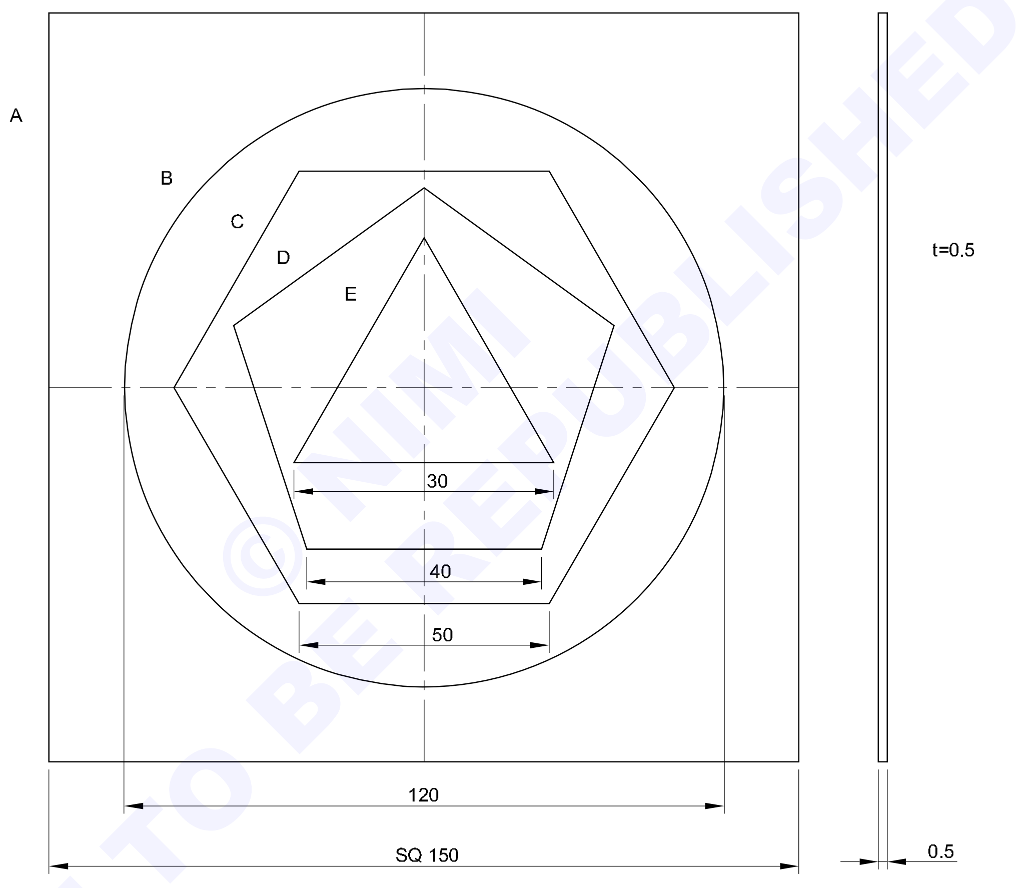
Fig7



- File concave radius with half round file using different grades and check the size with vernier caliper.
- Check the concave radius with template.
- Finish file and De - burr in part 'A' and 'B'
- Match part 'A' and 'B' as shown in Job drawing.
- Apply a little oil and preserve it for evaluation.

Chip sheet metal (shearing)

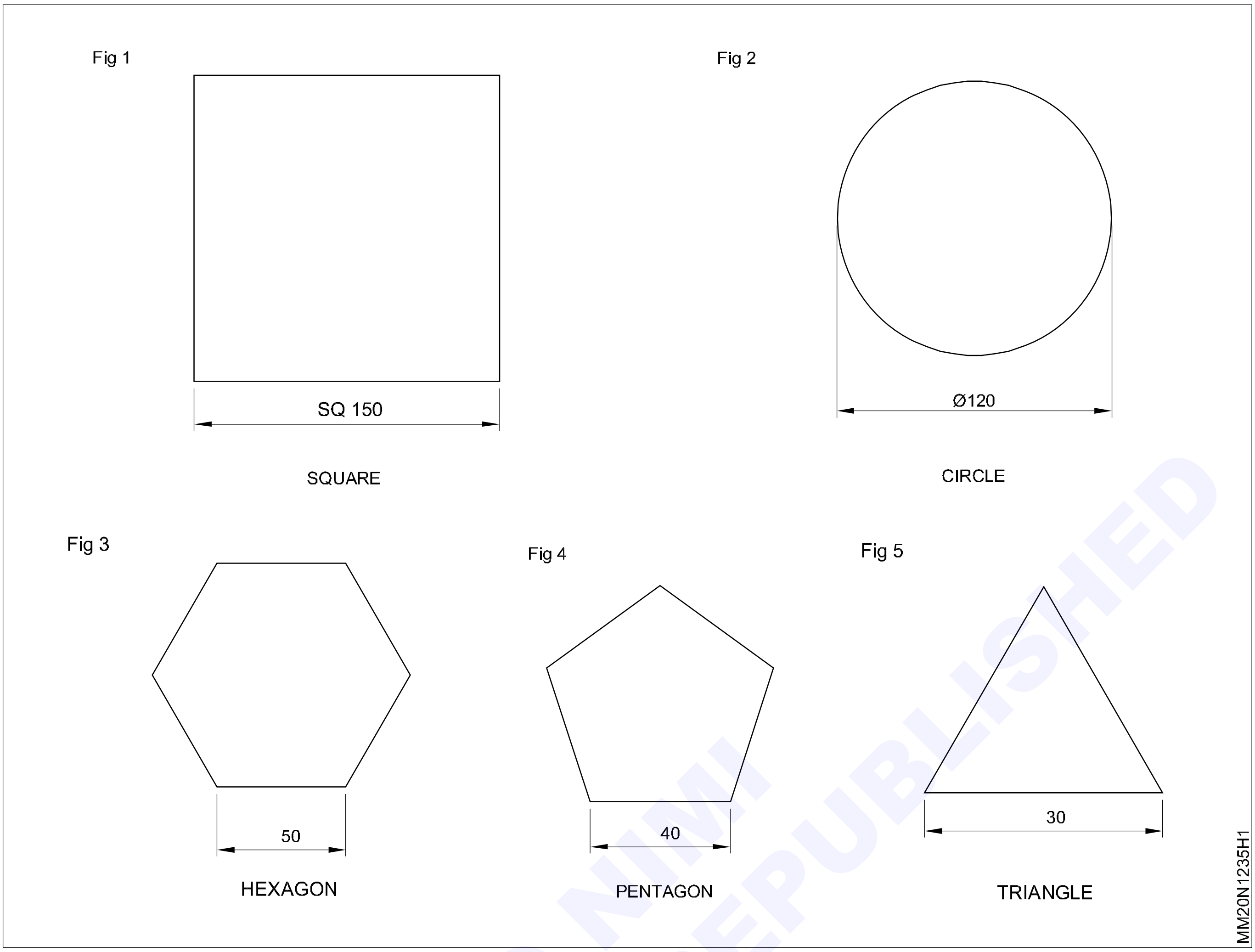
Objectives: At the end of this exercise you shall be able to
- **draw different types of geometrical shapes**
- **chip the different geometrical shapes by flat chisel.**



A . SQUARE
B . CIRCLE
C . HEXAGON
D . PENTAGON
E . TRIANGLE

1	ISSH 160 x 160 x 0.5	-	G.I STEEL	-	-	1.2.35
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**CHIPPING DIFFERENT GEOMETRICAL SHAPES**	TOLERANCE : ± 1mm	TIME : 5 Hrs
		CODE NO. MM20N1235E1	

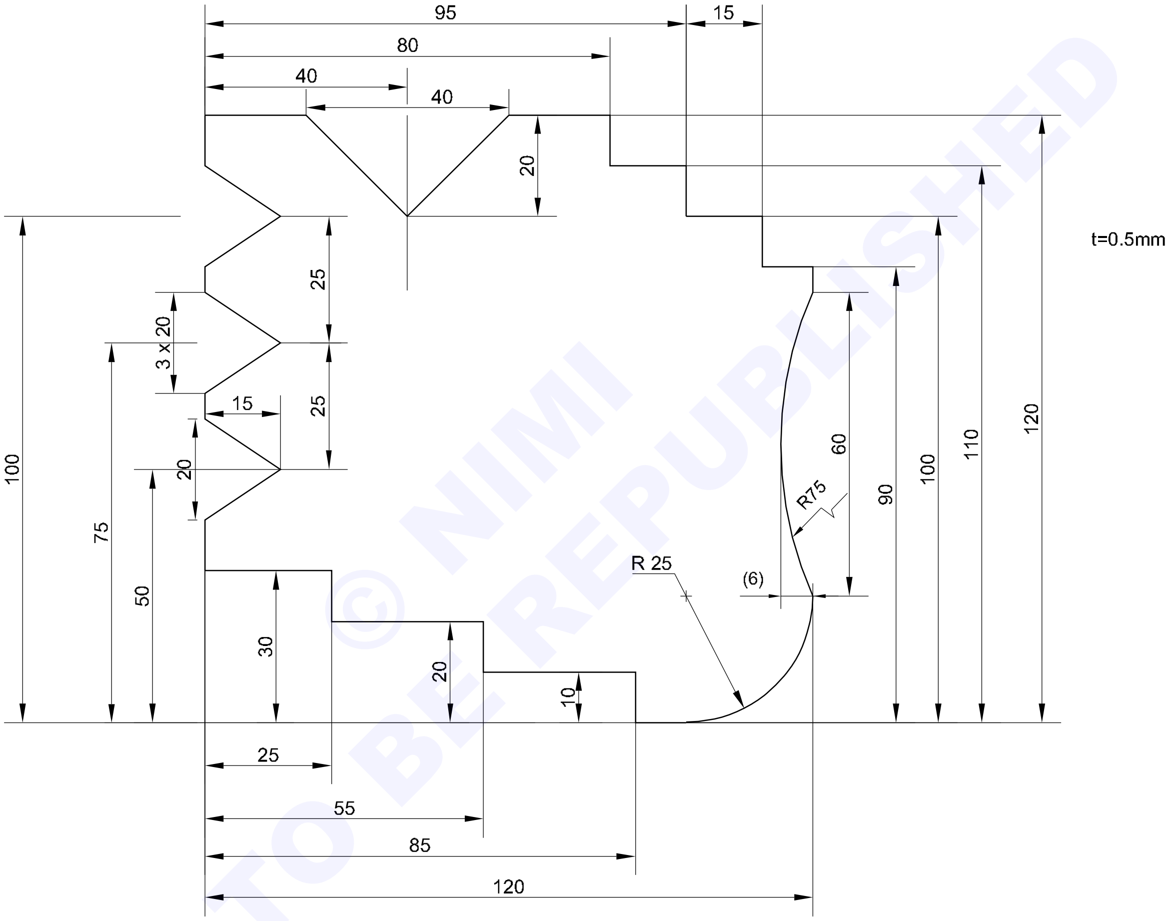


Job Sequence

- Planish the sheet metal on a tinman's Anvil using mallet.
- Check the sizes of the sheet 150x150x0.5 mm using a steel rule.
- Mark the centre line as shown in job drawing.
- Punch the centre point using a prick punch 30° and a ball pein hammer.
- Mark a square of 150mm side using a steel rule, straight edge, 'L' square and scriber.
- Draw a circle of ϕ120mm from the same centre point using steel rule and divider.
- Mark a hexagon of 50 mm side in the circle as shown in job drawing
- Mark a pentagon of 40 mm side within the hexagon as shown in job drawing.
- Mark an equilateral triangle of 30 mm side within pentagon as shown in job drawing.
- Place the sheet on Anvil.
- Cut the square 150 mm side using flat chisel and ball pein hammer fig 1.
- Similarly, cut the other geometrical profiles. Circle (Fig 2) hexagon (Fig 3) pentagon (Fig 4) and triangle (Fig.5) using flat chisel and ball pein hammer
- Check the different geometrical profiles with steel rule.

Chip step and file

Objectives: At the end of this exercise you shall be able to
- **mark and chip as per drawing**
- **file step to the given dimension.**



Instructor should assign the work to trainees.

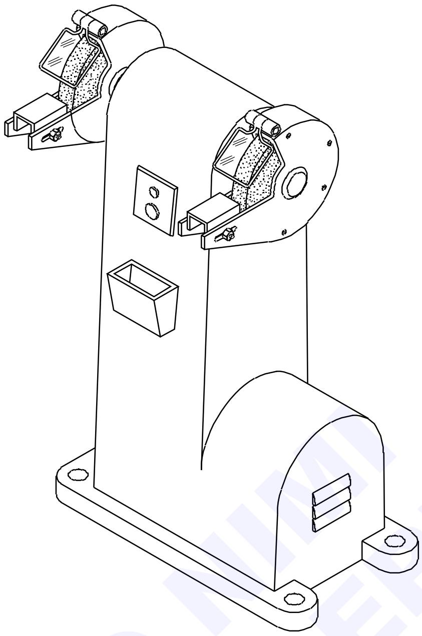
- Write the job sequence to do the work
- List out the tools and equipments required
- Mark and cut the profile using chisel and file the profile to an accuracy of ± 0.5 mm

1	ISSH 125 x 125 x 0.5	-	STEEL SHEET	-	-	1.2.36
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE 1:1	PROFILE MARKING AND CUTTING	TOLERANCE ±0.5mm	TIME: 5 Hrs
		CODE NO. MM20N1236E1	

Truing of pedestal grinding wheel

Objectives: At the end of this exercise you shall be able to
- **select the dresser**
- **truing the grinding wheel of pedestal grinder.**



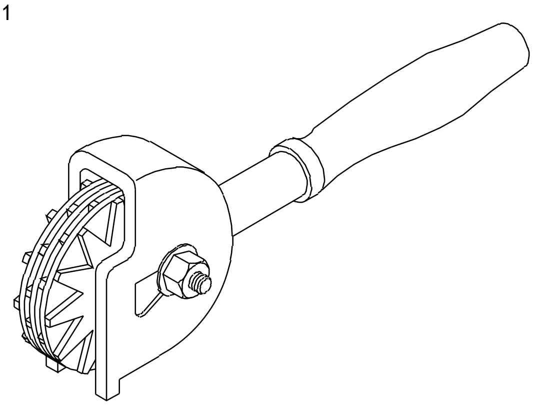
PEDESTAL GRINDER

Job Sequence

- Mount the new wheels on both sides of pedestal grinding machine.
- Clean the machine free from dust and burrs.
- Select the star wheel dresser for pedestal grinder (Fig 1)
- For truing the dresser is slowly brought into contact with the wheel and move across.
- For roughing, the dresser is moved faster.
- For fine finish, the dresser is move slowly.
- Dressing and truing are done at the same time

Star wheel dresser should be used only on wheels which are large enough to take the load.

Fig 1

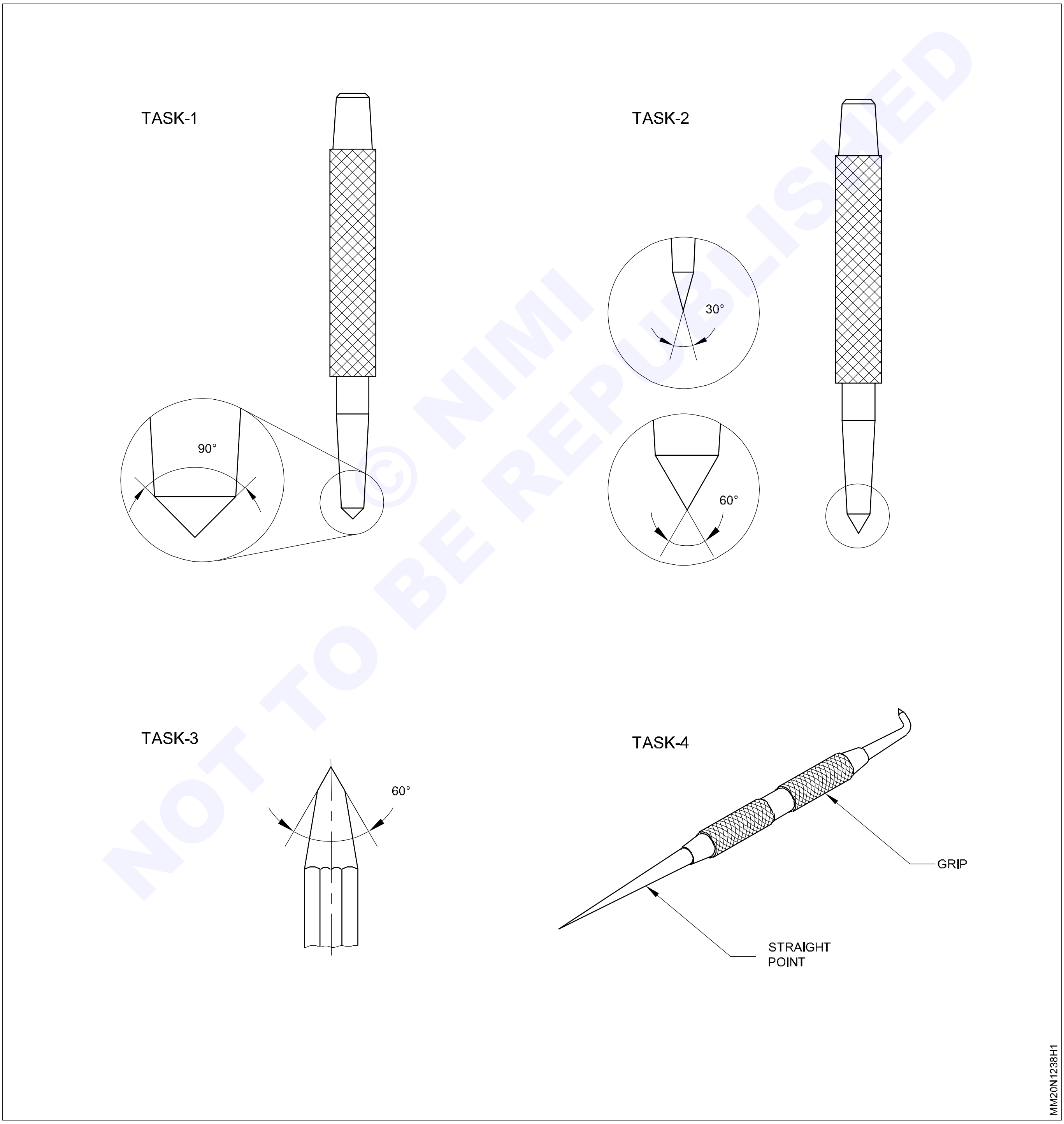


--	--	--	--	--	--	1.2.37
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO
SCALE	TRUING OF PEDESTAL GRINDING WHEEL				DEVIATIONS	TIME 5 Hr
					CODE NO. MM20N1237E1	

Grinding and resharpening of hand tools

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

- **re-sharpen the flat chisel using pedestal/bench grinder**
- **re-sharpen the centre punch**
- **re-sharpen the dot punch/prick punch**
- **re-sharpen scriber**
- **operate safely the pedestal or bench grinding machine.**



Job sequence

TASK 1 & 2 : **Grinding centre punch and dot punch**

- Check the grinding wheel usually for any cracks.
- Adjust the tool rest so that there is a gap of 2 to 3mm between the grinding wheel and the tool rest
- Hold the punch in a manner that the fingers of the left hand rest on the tool rest.
- The head of the punch should be held by right hand finger tips
- Position the punch at an angle to obtain the required included angle
- 90° for the centre punch and 60° for the dot punch.
- Check for the angle by using bevel protractor

TASK 3 : **Grinding chisel**

- Check the grinding wheel visually for any cracks
- Adjust the tool rest so that there is a gap of 2 to 3mm between the grinding wheel and the tool rest
- Hold the chisel parallel to the wheel surface
- Turn the chisel for 30° one side and 30° other side
- Rest the body of the chisel on the tool rest
- Allow the point to touch the wheel
- Keep minimum pressure on the chisel body while grinding
- Grind for slight convexity (Crown) on the face of the chisel
- Check the point angle with a bevel protector

TASK 4 : **Grinding Scriber**

- Hold the scriber vertical on the grinding wheel face and rotate it with the finger
- Quench the point frequently in the coolant
- Sharp the scriber to an angle of 15°
- Finish the scriber to the required sharp point.

Skill sequence

Grinding of flat chisel

Objective : This shall be help you to

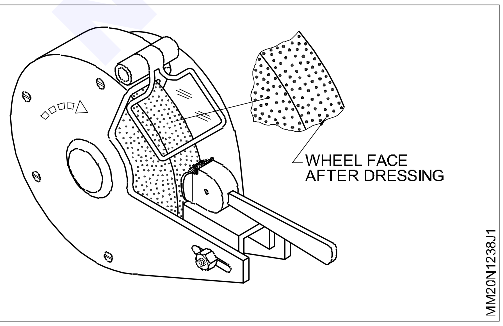
- **grind a flat chisel centre punch and dot punches when they become dull.**

Before grinding : check the grinding wheel by,

- Sliding the finger tip across the grinding wheel to detect glazing

  (In case the of glazing dress the wheel.) seek the help of the instructor. (Fig 1)
- Visually check for cracks.

Fig 1



Switch on the grinder but stand by the side of the wheel for safety, and see whether the wheel runs 'true' and has no excessive vibration. In case of excessive vibration truing is necessary. Ask the instructor for advice.

Ensure that there is enough coolant in the container.

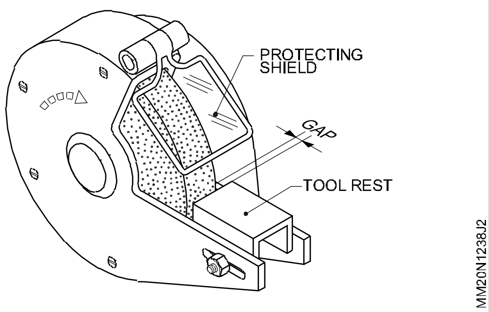
Protect your eyes with goggles or lower the protecting shield near the tool rest.(Fig 2)

Adjust the tool rest 2mm closer to the wheel, if necessary. (Fig 2)

During grinding : Take a blunt chisel for re-grinding. Chisel will become blunt due to use. For efficient chipping, chisel are to be re-sharpened regularly.

Do not use cotton waste or other material for holding the chisel while grinding

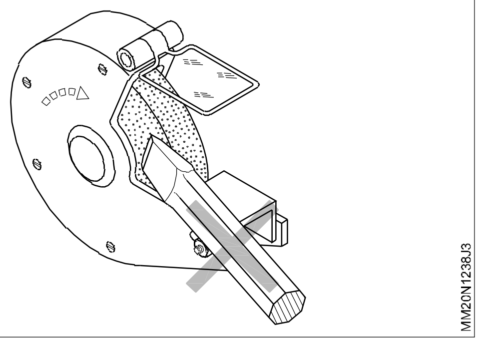
Fig 2



Use only the face of the wheel and not the sides (Fig 3)

Switch on the grinder.

Fig 3



Hold the chisel edge parallel to the wheel surface the body of the chisel must be at an angle of 30°in such a way as to get 60° wedge angle (Fig 5)

Rest the body of the chisel on the tool rest (A) and allow the point to touch the wheel. (Fig 4 &5).

Keep the pressure as minimum as possible to prevent excessive heating of the cutting edges, (avoid blue colour

Fig 4

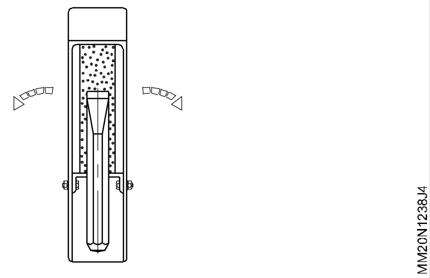
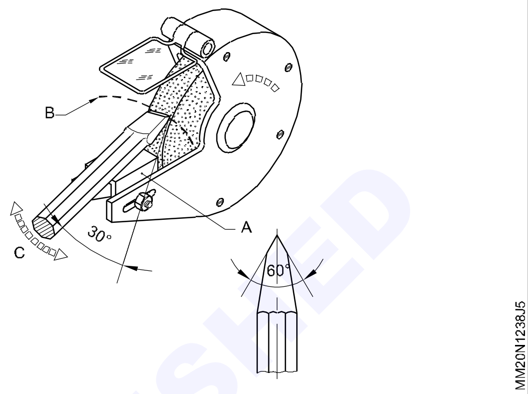


Fig 5



i.e annealing effect) Rock the point on both sides in an arc to provide convexity at the cutting edge. (Fig 5) See the arrows ’C’ separate pare

Dip the chisel in the coolant as and when it is required so as to avoid overheating.

Repeat the grinding on the opposite side of the cutting edge.

Check the wedge angle with a bevel protractor.

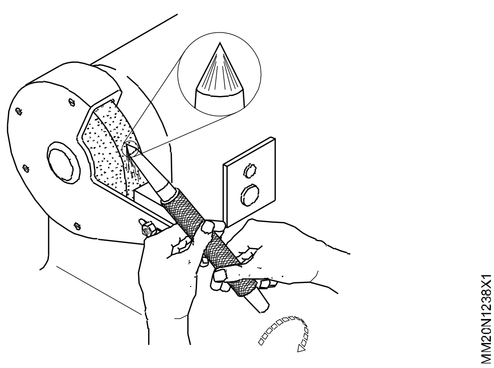
Sharpening a centre punch

Objective : This shall help you to

• sharpen worn out centre punch.

- For accurate layout work and hole locations it is important that the centre and prick punches are sharpened correctly.
- For grinding, hold the punch in a manner that the fingers of the left hand rest on the tool rest.(Fig.1)
- The head of the punch should be held by the right hand fingers tips.
- Position the punch at an angle - to obtain the required included angle.(90°for centre punch and 60° for prick punch)
- Grinding is always on the front of the wheel. Rotate the punch and exert even and continuous pressure while grinding.
- Do not overheat the point while grinding.
- Dip the point in the coolant frequently.

Fig 1



- Make sure that the tip of the centre punch point is in the centre.

Use goggles to protect your eyes while grinding.

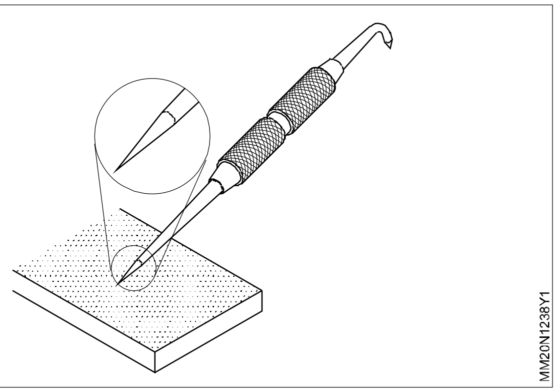
Sharpening a scriber

Objective: This shall help you to
- **sharpen a worn out scriber point.**

For drawing fine and accurate lines in layout work it is important to ensure that the scriber points are always maintained sharp.

If the scriber point is slightly blunt. It can be re-sharpened using an oilstone. (Fig 1)

Fig 1

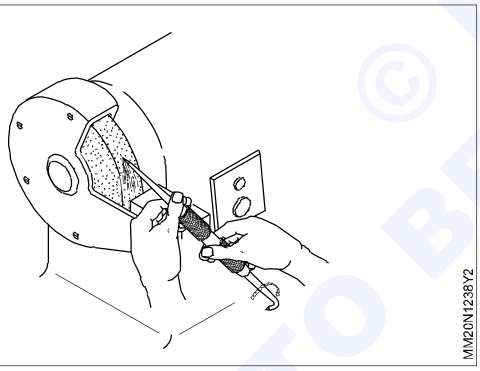


When the point cannot be re-sharpened with an oilstone, it should be re-sharpened on a grinder.

Do not sharpen the scriber by grinding unless it is absolutely necessary.

Re-sharpening of the point should be done on the face of the grinding wheel.(Fig 2)

Fig 2



For grinding the point hold the scriber vertically on the grinding wheel face and rotate it with the fingers.

The point being small can get heated up very quickly quench the point often in the coolant.

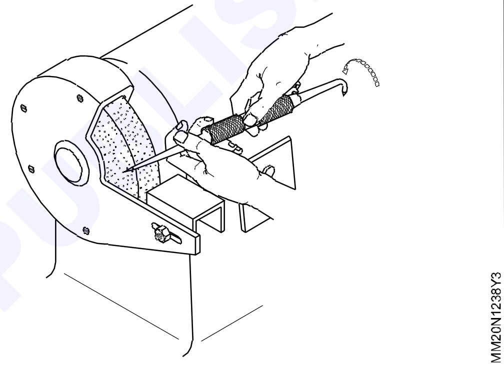
After a few sharpening the diameter of the point will become larger and would need re-sharpening of the tapered portion.

The long tapered portion also can be reground and brought to the required shape and size.

For this the scriber is placed horizontal on the face of the wheel and rotated by fingers. (Fig 3)

Be sure that the gap between the tool-rest and the wheel is correctly set before grinding.

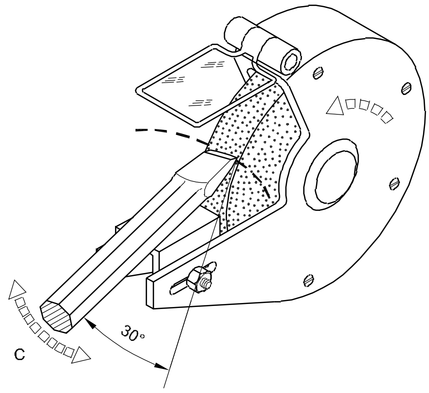
Fig 3



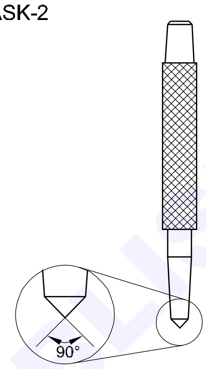
Repair and maintenance of hand tools

Objectives: At the end of this exercise you shall be able to
- **sharpen the blunt chisel**
- **sharpen the punch with centre and prick punches**
- **removing pinning of file**
- **sharpening of scraper**
- **fixing wedge in hammer.**

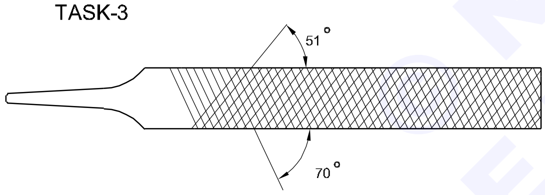
TASK-1



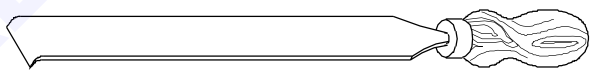
TASK-2



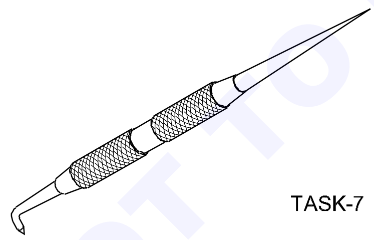
TASK-3



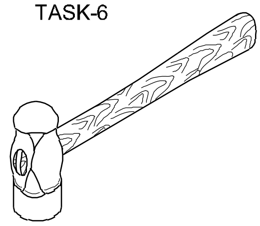
TASK-4



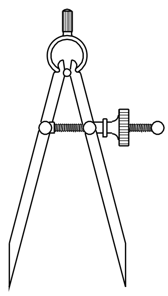
TASK-5



TASK-6



TASK-7



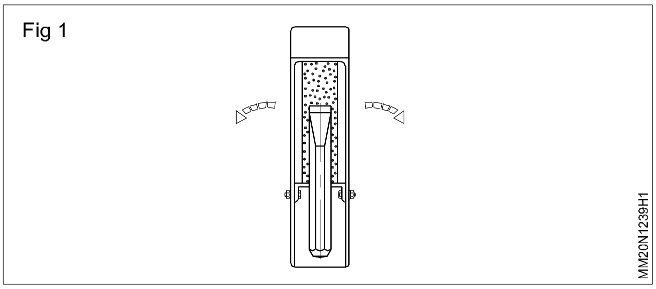
	-	-	-	-	-	1.2.39
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE NTS	REPAIR AND MAINTENANCE OF HAND TOOLS				TOLERANCE : ± 0.04	TIME : 10 Hrs
					CODE NO : MM20N1239E1	

Job Sequence

TASK 1: **Grinding blunt chisel**

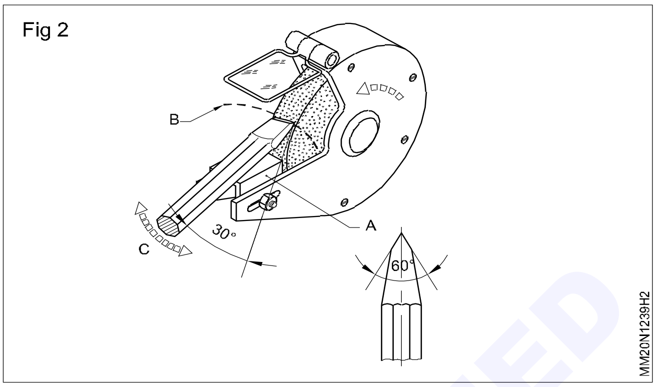
- Take a blunt chisel for regrinding
- Switch on the grinder
- Hold the chisel edge parallel to the wheel surface.
- The body of the chisel must be at an angle in such a way as to get 60° point angle.
- Rest the body of the chisel on the tool rest and allow the point to touch the wheel (Fig 1)

Fig 1



- Keep the pressure as minimum as possible to prevent excessive heating at the cutting edge.
- Rock the point an both sides in an arc to provide convexity at the cutting edge (Fig 2) see the arrows. (Fig 2)

Fig 2



- Dip the chisel in the coolant as and when it is required so as to avoid over heating.
- Repeat the grinding on the opposite side of the cutting edge.
- Check the point angle with a bevel protractor.

— — — — — — — —

TASK 2: **Resharpening centre punch**

- Take the blunt centre punch for resharpening.
- Switch on the grinder
- Hold the punch the body of the punch must be at angle in such way as to get 90° point angle.
- Rest the body of the punch on the tools, rest and allow point touch the wheel.
- Keeping the minimum pressure rotate the punch since is the point is sharpe and the cutting edge is 90°.
- Check the point angle using bevel protractor.

— — — — — — — —

TASK 3: **Cleaning the pinning of file**

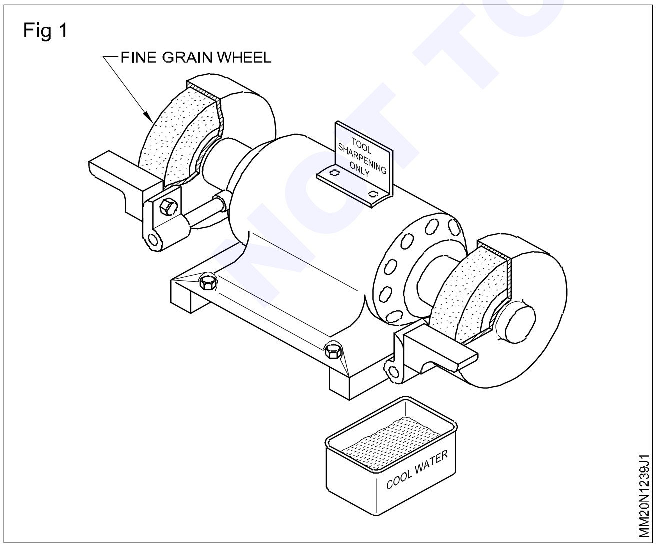
- Hold the pinned file on left hand and rest on work table.
- Clean the filecard and hold the file card on right hand.
- Move the file card toward or back ward stoke.
- Remove all the filling using this method.

— — — — — — — —

TASK 4: **Sharpening flat scraper**

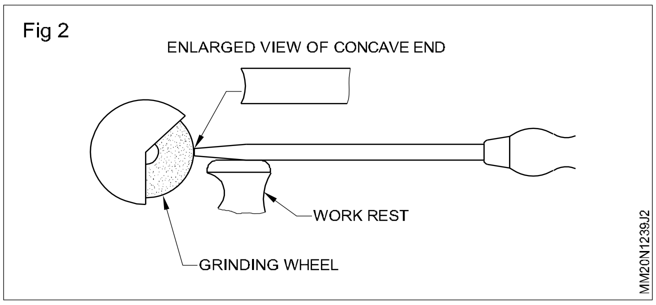
- Select a grinding wheel with fine grain (Fig 1)

Fig 1



- Soft grade aluminium oxide grinding wheel with large diameter gives best results.
- Check for gap between the work rest and the grinding wheel, and adjust if necessary.
- For grinding the cutting edges, hold the scraper horizontal and flat on the tool rest. (Fig 2)

Fig 2



- Move the scraper in an arc to provide a slightly concave surface on the cutting edge. (Fig3)
- If the scraper is carbide-tipped use silicon carbide or diamond wheels. (Fig 4)
- The cutting edges sharpened by grinding should be honed. Honing removes grinding marks and provides keen cutting edges.

Fig 3

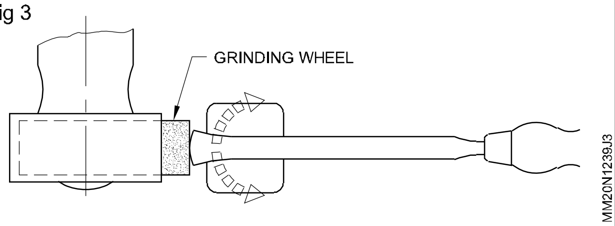
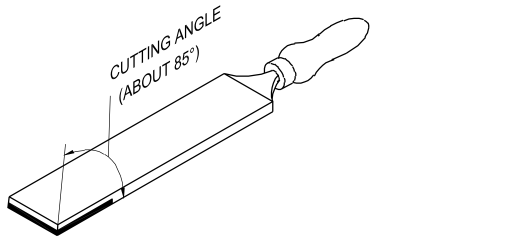


Fig 4



CEMENTED CARBIDE TIP SCRAPER

Fig 5

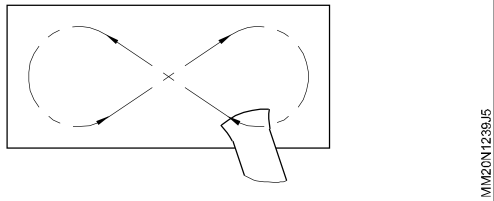


Fig 6

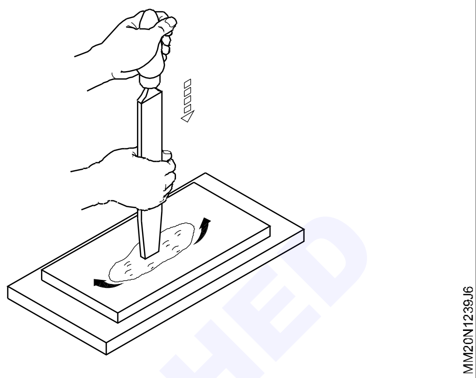
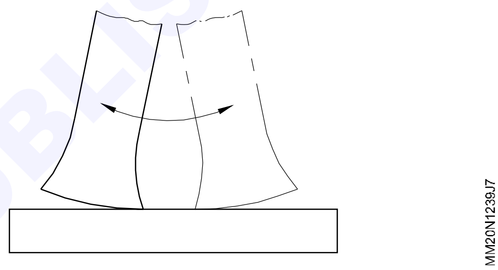


Fig 7



- Use a fine grade aluminium oxide oilstone for honing.
- While honing use a lubricant.
- Mix light mineral oil with kerosene for preparing the lubricant.
- Hone the faces first with a movement as shown in Fig 5.
- Then hone the cutting and by placing the scraper in an upright position on the oilstone with a rocking movement.. (Figs 6 and 7)
- What should be the cutting angle? It should be
  - for rough scraping - 60°
  - for final scraping - 90°

— — — — — — — —

TASK 5: **Reshapening scriber**

- Resharpen the scriber following step of grinding punch the angle is 15° on both end.

— — — — — — — —

TASK 6: **Fixing the wedge of loose handle hammer**

- Remove handle from hammer and worn out wedge of loose handle hammer.
- Prepare the new wedge according to size of handle.
- Fix the handle in eyehole. (Fig 1 and 2)

Fig 1

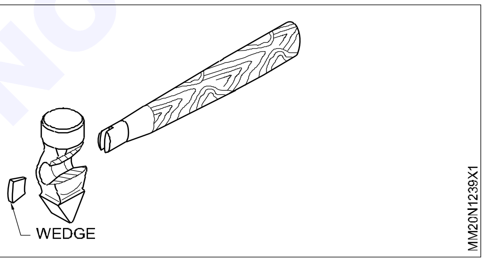
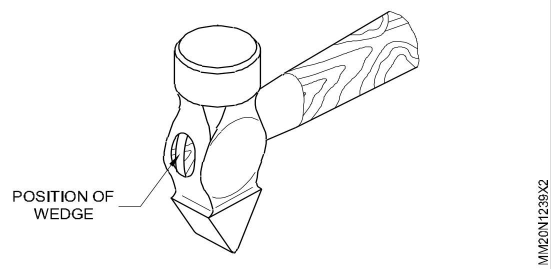


Fig 2



- Now the hammers is ready.

— — — — — — — —

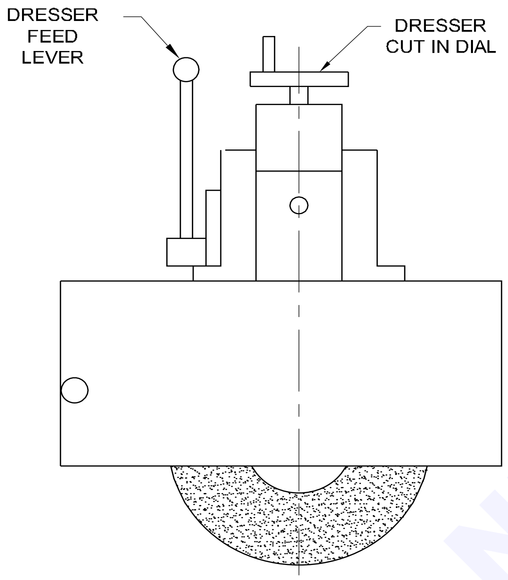
TASK 7: **Grinding of uneven length of divider leg**

- Grind the back side of the leg radially. Both the legs will same length.
- Sharpen the points using an oilstone.

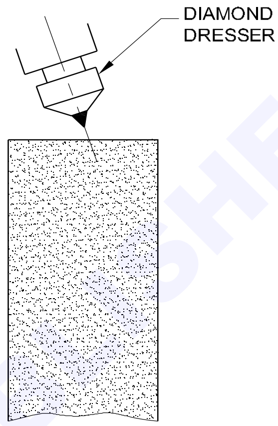
Dressing of grinding wheel by diamond dresser tool

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

TASK-1



TASK-2



PROCEDURE

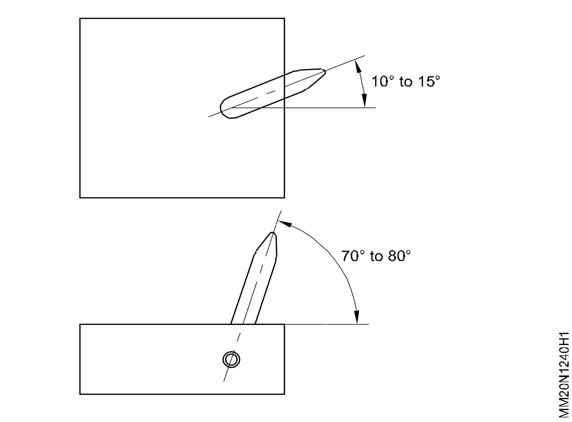
TASK 1: **Dressing of grinding wheel by grinding head dresser**

- Start the motors for the grinding spindle and coolant
- Open the cover of the grinding wheel, and shift the dresser to the centre of the grinding wheel as shown in Fig 1 by pulling the dresser feed lever to the front side
- Turn the dresser cut in dial gently to let the dresser tip touch the perimeter of the grinding wheel
- Restore the dresser feed lever to the original position and shut the cover of the grinding wheel
- Set the depth of cut in the dresser by means of the dresser dial and carry out the dressing by operating the dresser feed lever.(The depth of cut for dressing is 0.015-0.25mm at a time, and the dresser feed speed is 250 – 500 mm/min in case of the finish).

		-		-	-	1.2.40
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.

SCALE NTS	DRESSING OF GRINDING WHEEL BY DIMOND DRESSER TOOL	TOLERANCE : ± 0.04	TIME : 15 Hrs
		CODE NO : MM20N1240E1	

Fig 1

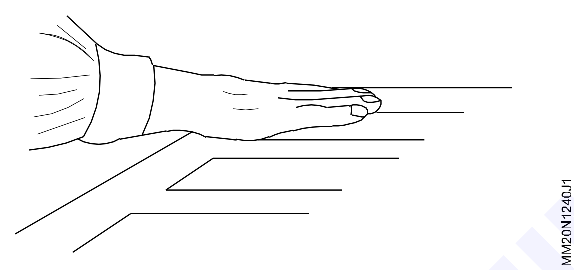


— — — — — — — —

TASK 2 : **Dressing of grinding wheel by attached to holder**

Clean the magnetic chuck thoroughly with a cloth and then (Fig 1) feel for any dirt with your palm remove it if any.

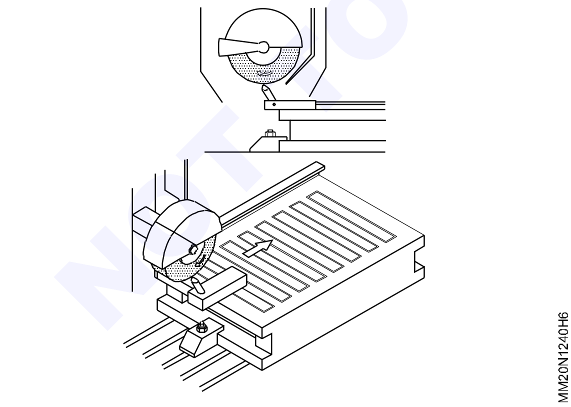
Fig 1



Keep the dresser on the base as shown in Fig 2 .This position helps to prevent chattering and the tendency to drag in during the dressing operation.

Place the diamond on the last two magnetic poles on the left hand end of the magnetic chuck paper should be placed between the diamond holder and the chuck is prevent scratching the chuck surface when removing the diamond holder.(Fig 2)

Fig 2

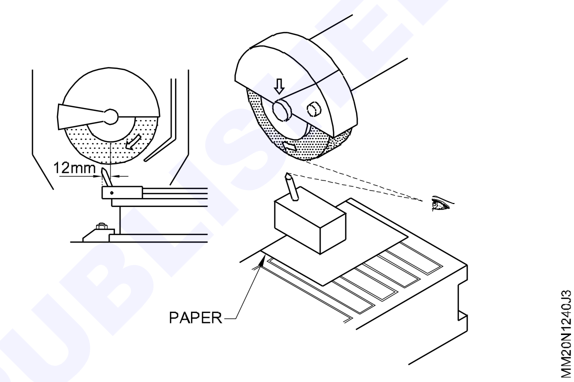


The point of the diamond should be offset about 12mm from the grinding wheel centre line with reference to the direction of rotation of grinding wheel (Fig 3)

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

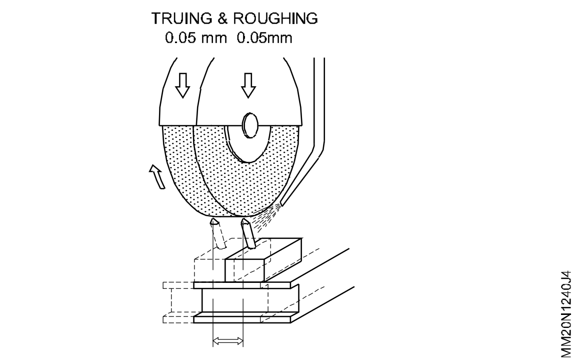
Lower the wheel until it touches the diamond

Fig 3



Move the diamond slowly across the face of the wheel (Fig 4)

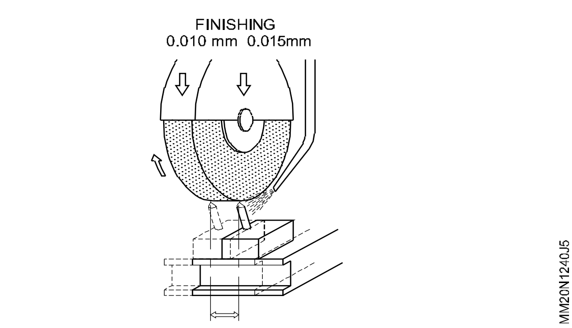
Fig 4



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

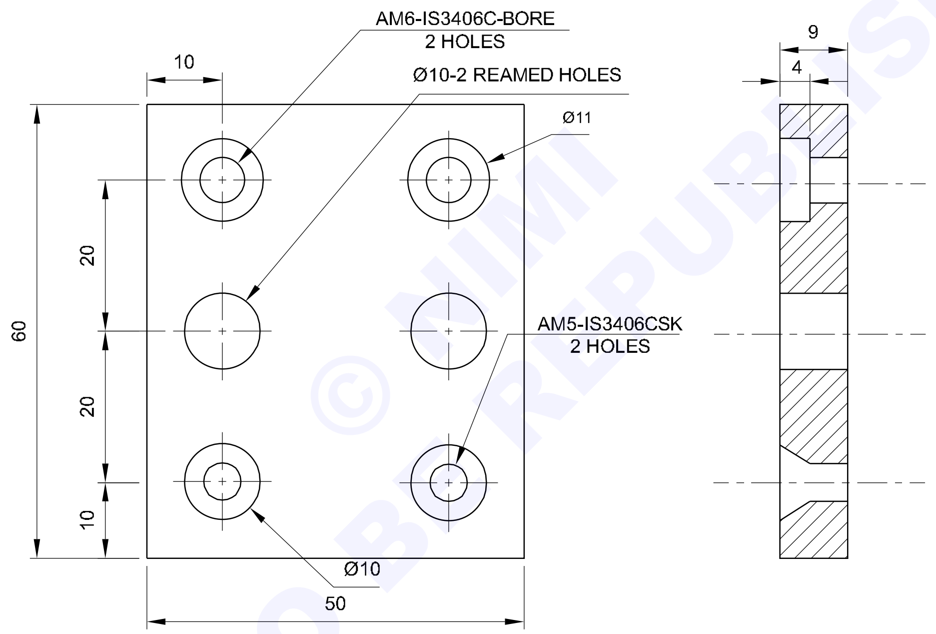
Take a finish pass with 0.01mm across the face of the grinding wheel (Fig 5)

Fig 5



Counter sinking, counter boring and reaming with accuracy ± 0.04 mm

Objectives: At the end of this exercise you shall be able to
- **file and finish to size and shape as per drawing**
- **mark the lines as per job drawing**
- **drill counter sink, counter bore and ream the holes as per drawing.**



1	55 ISF 10 - 65	-	Fe310	-	-	1.2.41
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**COUNTER SINKING,COUNTER BORING AND REAMING WITH ACCURACY ±0.04 mm**	TOLERANCE ±0.04	TIME 5Hrs
		CODE NO. MM20N1241E1	

Job Sequence

- Check the raw material for its size.
- File and finish to over all size of 60 x 50 x 9 mm, maintaining parallelism and perpendicularity.
- Mark the hole centres and punch as per job drawing.
- Fix the job in drilling machine table with suitable clamps.
- Fix centre drill in drilling machine spindle through drill chuck and drill centre drilling in all drill holes centres.
- Fix Ø 5 mm drill in drill chuck and drill through holes as per drawing in all centre drilled holes.
- Similarly, fix Ø 5.5, Ø 6.5 and Ø 9. 8 mm drill in drill chuck and drill through holes CSK, Counter bore and ream hole respectively.
- Fix counter sink tool in drilling machine and counter sink two holes to the required depth.
- Similarly, fix counter bore tool in drilling machine and counter bore two holes to the required depth.
- Ream in Ø 9.8 mm two drilled holes using Ø 10mm hand reamer with wrench.
- De - burr in all the surfaces and corners of the jobs.
- Apply oil and preserve it for evaluation.

Skill Sequence

Counter sink

Objective: This shall help you to
- **countersink holes of different sizes.**

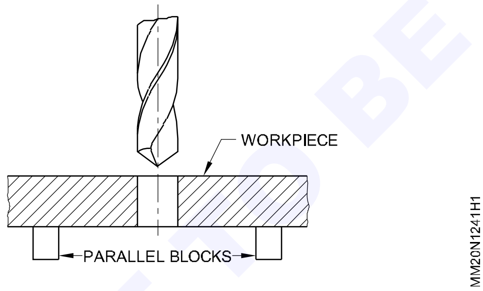
Selection of countersink tool

Select the countersink tool according to the angle of the taper head of the screw. Use the table for countersink holes.

Fix the job in the machine vice (if necessary, use parallel blocks) and set it square.

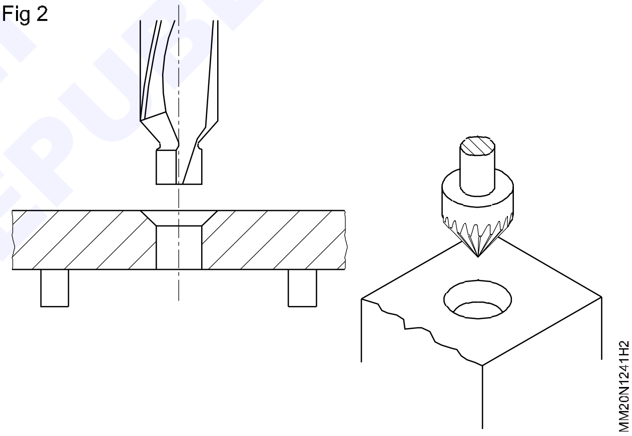
Align the machine spindle with the drilled hole to be countersunk. (Fig 1)

Fig 1



Remove the drill and fix the countersink tool on the machine without disturbing the alignment. (Fig 2)

Fig 2



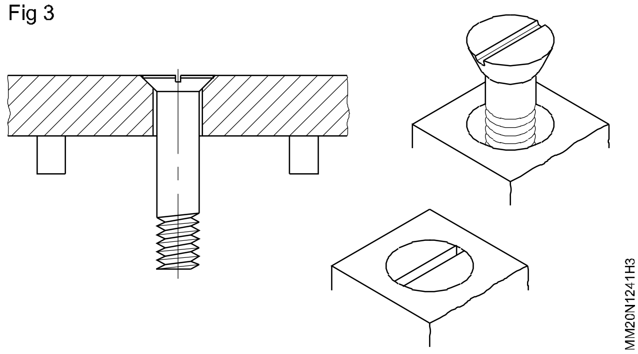
Set the spindle speed of the drilling machine RPM. Use the formula

Substitute the recommended speed of the countersink.

(V = 1/3rd of the cutting speed for drilling)

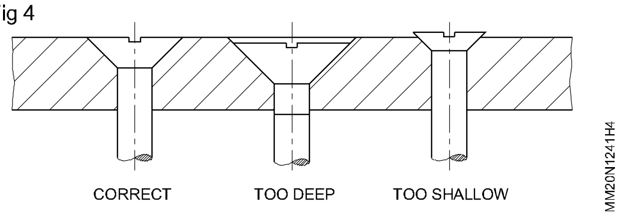
Countersink hole to a depth equal to the head length of the screw head. (Fig 3)

Fig 3



Check the countersink hole with a suitable countersink head screw for proper seating. (Fig 4)

Fig 4



Counterboring

Objective : This shall help you to
- **counterbore holes of different sizes concentric to the drilled holes.**

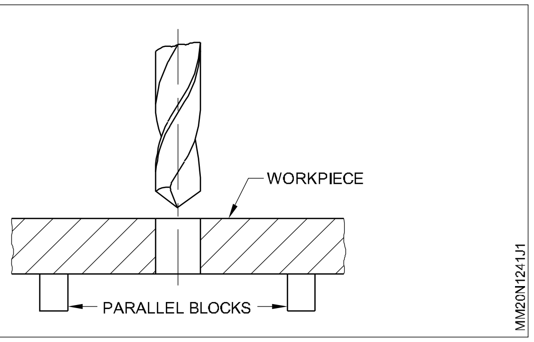
Selection of counterbore sizes

B.I.S. recommends different sizes of counterbores based on the sizes of the clearance holes.

Select the counterbore according to the screw size.

Fix the job in the machine vice, square to the axis of the machine spindle. Use parallel blocks. (Fig 1)

Fig 1

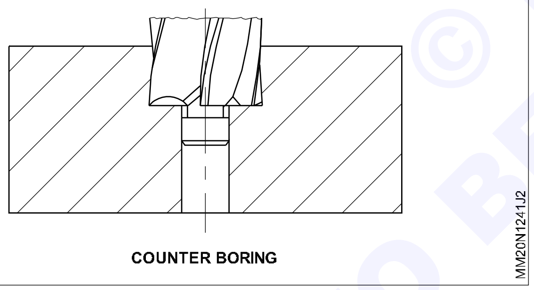


Set the location of the drilled hole position using the correct diameter drills.

Align the spindle axis with the drilled hole. For accurate work, drill and counterbore in one setting.

Mount and fix the counterbore tool on the drilling machine spindle. (Fig 2)

Fig 2



COUNTER BORING

Set the spindle speed of the driling machine to the nearest calculated RPM. Use the formula

$$V = \frac{\pi \text{ x d x n}}{1000}$$

(Consider the value of `V` as 1/3rd of the cuting speed for drilling)

Counterbore the hole to a depth slightly more than the thickness of the screwhead (Figs 3 & 4)

Fig 3

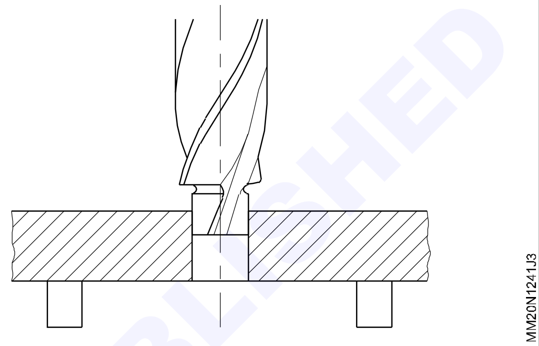
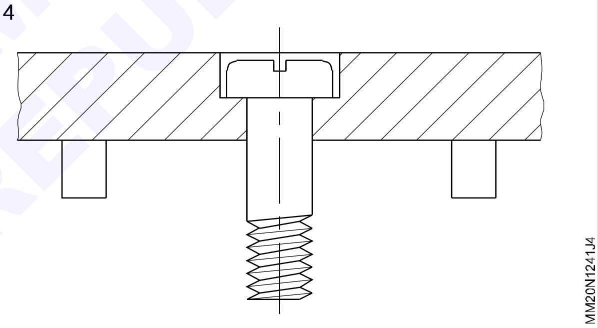


Fig 4



Use the depth stop arrangement for controlling the depth of the counterbore hole.

Check the depth of the counterbored hole. (Use the correct screw for checking the depth and seating).

Reaming drilled holes using hand reamers

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

Determining the drill size for reaming

Use the formula,

drill diameter = Reamed size - (under size + oversize)

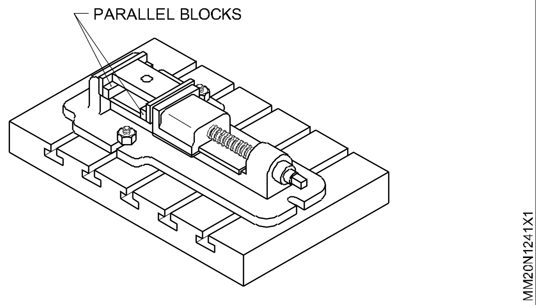
Refer to the table for the recommended under sizes in Related Theory on DRILL SIZES FOR REAMING.

Hand reaming

Drill holes for reaming as per the sizes determined.

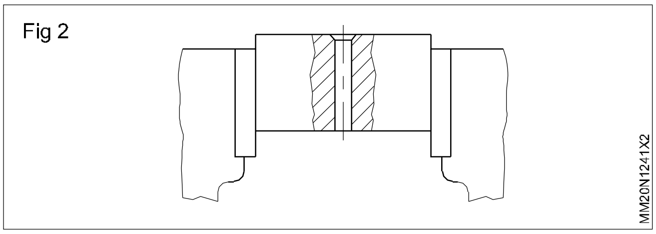
Place the work on parallels while setting on the machine vice. (Fig 1)

Fig 1



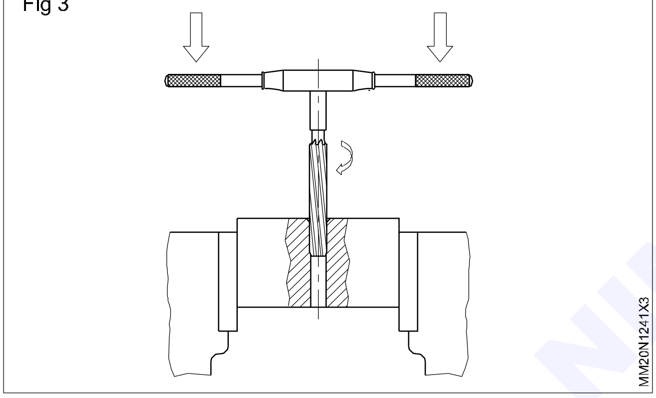
Chamfer the hole ends slightly. This removes burrs, and will also help to align the reamer vertically (Fig 2). Fix the work in the bench vice. Use vice clamps to protect the finished surfaces. Ensure that the job is horizontal.

Fig 2



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

Fig 3

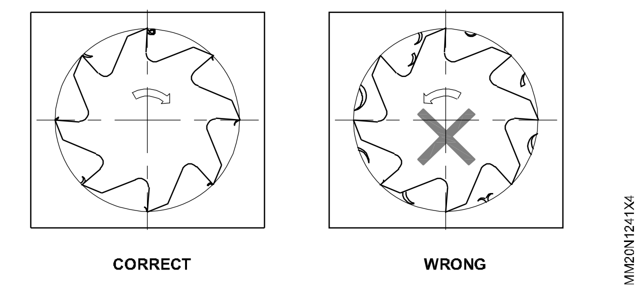


Apply cutting fluid.

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

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

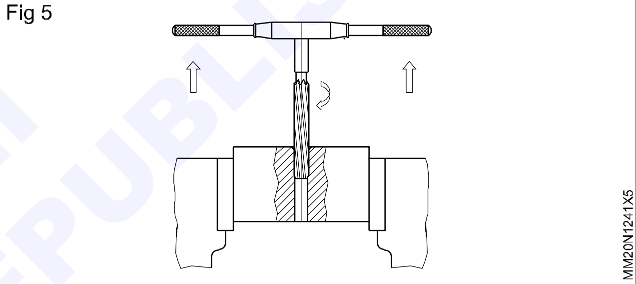
Fig 4



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

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

Fig 5

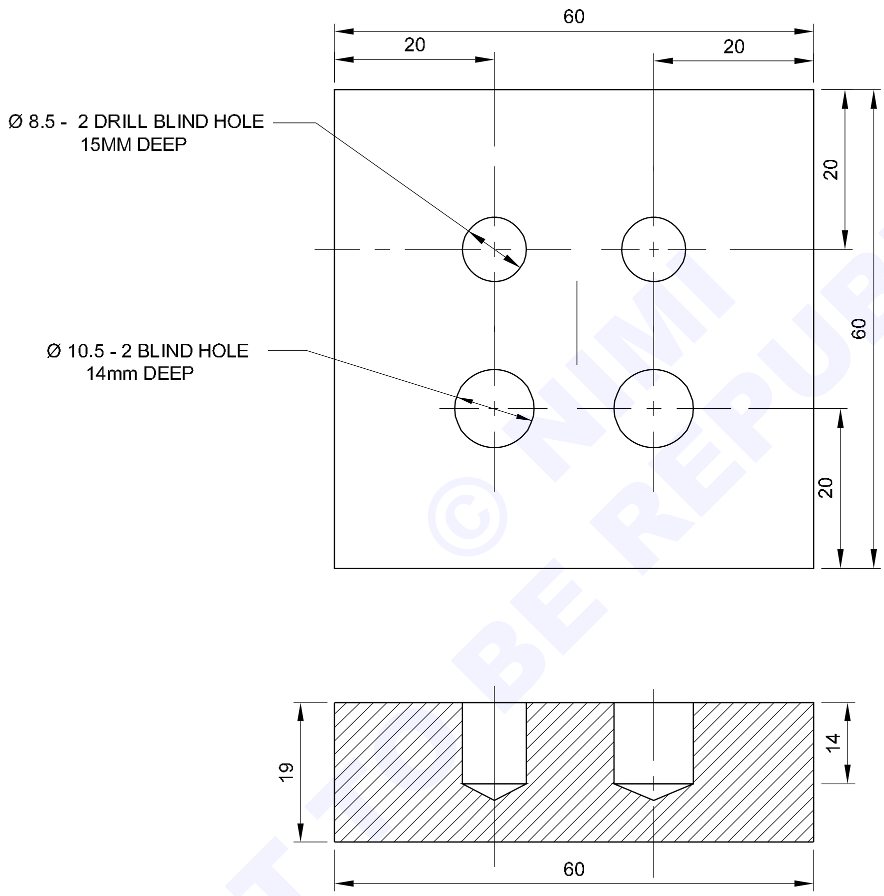


Remove the burrs from the bottom of the reamed hole.

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

Drill blind holes with an accuracy 0.04mm

Objectives: At the end of this exercise you shall be able to
- **mark drill hole centres using veriner height gauge**
- **set the correct spindle speed in drilling machine**
- **set the depth bar to drill blind hole**
- **drill blind hole to the required depth size.**



–	65 ISF 20 - 65	EX.NO.1.2.39 ←	Fe310	–	–	1.2.42
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	DRILL BLIND HOLES WITH AN ACCURACY 0.04mm	TOLERANCE : ± 0.04	TIME : 2 Hrs
		CODE NO : MM20N1242E1	

Job sequence

- Check the raw material size
- File and finish the metal size 60 x 60 x 19mm maintaining parallelism and perpendicularity
- Check the flatness and squareness with try square and size with vernier calliper.
- Apply marking media and mark drill hole, centres using veriner height gauge as per drawing.
- Punch on drill hole centres using centre punch 90°
- Hold the job in drilling machine table.
- Make centre drill in dirll hole centres.
- Fix φ 6mm drill in drilling machine spindle through drill chuck and drill pilot holes for blind holes.
- Fix ø 8.5mm drill and drill blind hole as per drawing to required depth of 15mm
- Fix ø 10.5mm drill and drill blind hole to the required depth of 14mm.
- File and de- burr in all the surfaces of the job
- Apply a thin coat of oil and preserve it for evaluation.

Skill sequence

Drilling blind holes

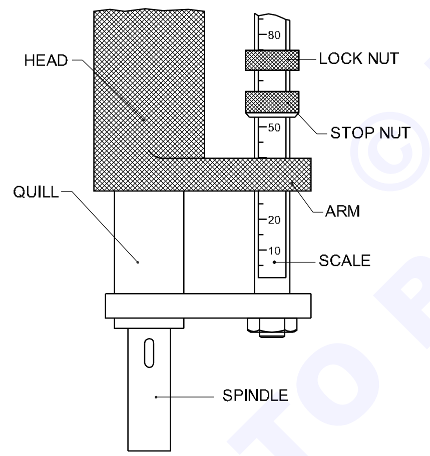
Objective : This shall be help you to

- **drill blind holes to the required depth using the depth stops.**

Method of controlling depth of blind holes

While drilling blind holes it is necessary to control the feed of the drill. Most machines are provided with a depth stop arrangement by which the downward movement of the spindle can be controlled. (Fig 1)

Fig 1



Most depth stop arrangements will have grauduation by which the advancement of the spindle can be observed.

Generally the blind hole depth tolerances depth are given up to 0.5mm accuracy.

Setting for drilling blind holes

For blind hole- depth setting , first the work is held on the machine and the hole is located correctly.

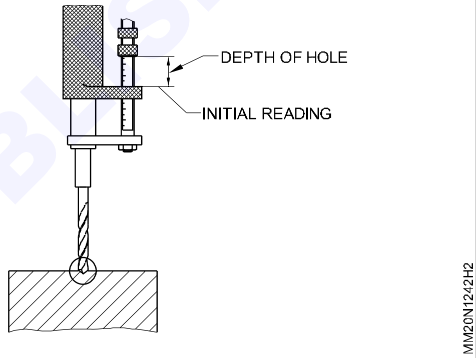
The drill is started, and the holeis located correctly.

The drill is started and it drills until the full diameter is formed. Note down the initial reading at this point.(Fig 2)

Add the initial reading to the depth of the blind hole to be drilled.

Initial reading + Depth of hole = Setting.

Fig 2



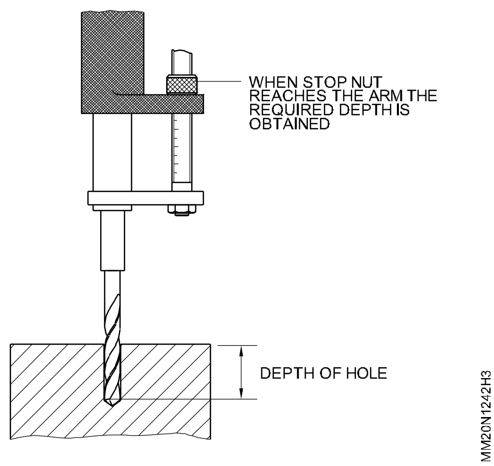
Adjust the stop next to the required setting, using the scale.

Tighten the lock nut to prevent the setting from being disturbed.

Start the machine and feed the drill. When the stop nut reaches the arm, the blind hole is drilled to the required depth. (Fig 3)

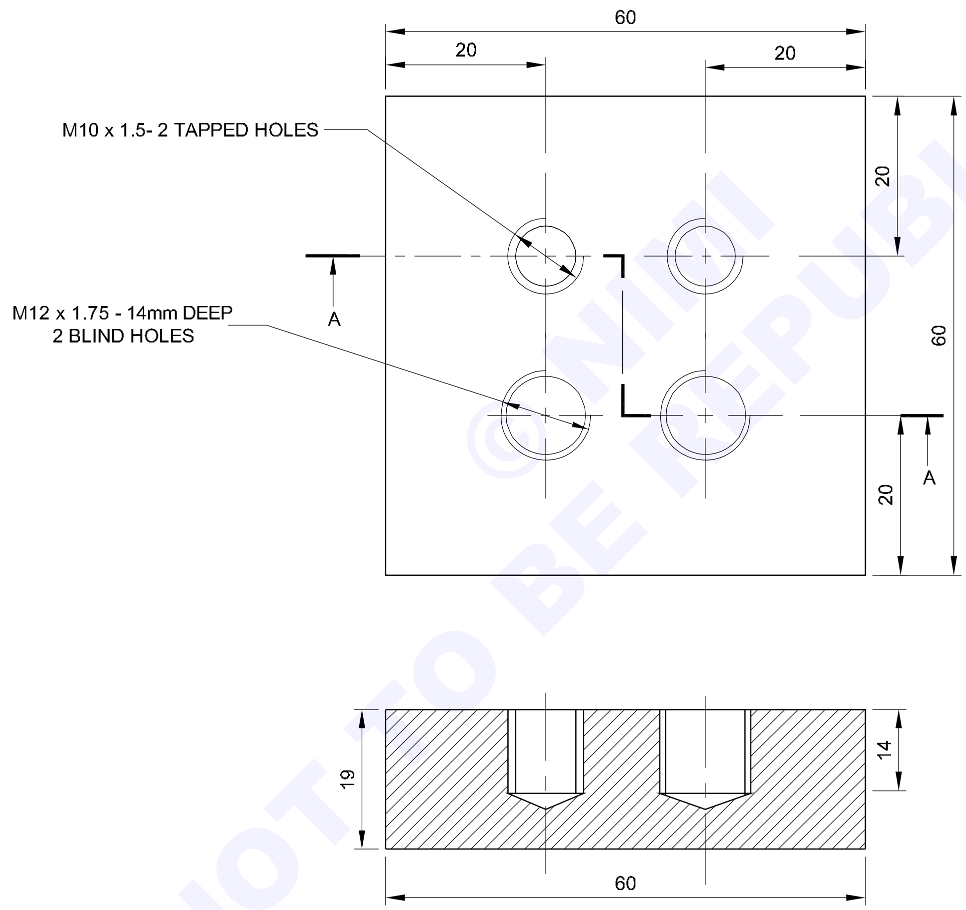
While drilling, release the drill frequently from the hole for the chips to be flushed out by the cutting fluid.

Fig 3



Form internal threads with taps to standard size (blind holes)

Objectives: At the end of this exercise you shall be able to
- **chamfer the holes for tapping**
- **fix the job in bench vice**
- **select the tap set**
- **cut internal threads in blind holes using hand tap and tap wrench.**



1	-	→ EX.NO:1.2.42	Fe310	–	–	1.2.43
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FORM INTERNAL THREADS WITH TAPS TO STANDARD SIZE (BLIND HOLE)**	TOLERANCE : ±0.04	TIME : 3 Hrs
		CODE NO : MM20N1243E1	

Job sequence

Cut internal thread in blind hole M10

- Use finished job Ex.No.1.2.42 for this exercise.
- Fix the job in bench vice.
- Fix M 10 first tap in tap wrench and cut internal thread to required depth of 15mm
- Similarly, fix M10 second tap and third tap in tap wrench one by one and cut the internal thread to form full thread.
- Repeat the above process to cut internal thread in other drilled blind hole

Cut internal thread M12 in blind hole

- Remove metal chips if any from the blind hole by turning it upside down and slightly tapping it on a wooden surface.
- Fix the M12 first tap in tap wrench.
- Screw a matching nut on the first tap to the required distance for 14 mm to act a depth stop.
- Cut internal thread in blind hole to the required depth 14mm.
- Remove the metal chips, if any from the threaded blind hole.
- Similarly ,fix M12 second tap and third tap in tap wrench one by one and cut the thread to form full thread.
- Clean the threaded hole without burrs.
- Repeat the above process to cut internal thread in other drilled blind hole.
- Check the threaded hole using the M10, and M12 matching bolts by screwing.
- Apply thin coat of oil and preserve it for evaluation.

Use cutting fluid while cutting the thread

Skill Sequence

Internal threading of blind holes using hand taps

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

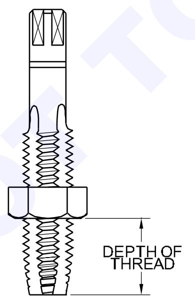
Procedure for threading

Remove metal chips, if any from the blind hole by drilling it upside down and slightly tapping it on a wooden surface.

Do not clear the chips by blowing as it can cause injury to your eyes

Screw a matching nut on the first tap to act as a depth stop. (Fig 1)

Fig 1



Thread the blind hole until the nut touches the plate surface.

Remove the chips from the hole frequently, using a flattened and bend wire. (Fig 2)

Finish tapping the hole with immediate and bottoming tap. Set the nut to control the depth of the thread.(Fig 3)

Fig 2

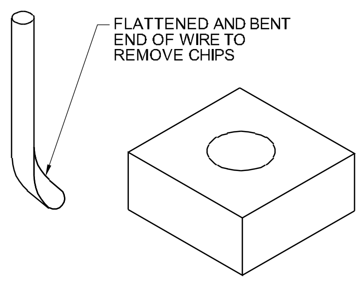
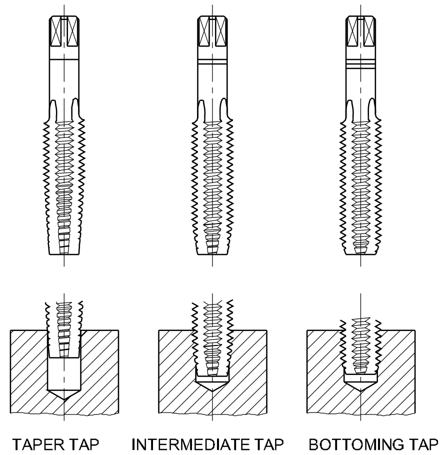
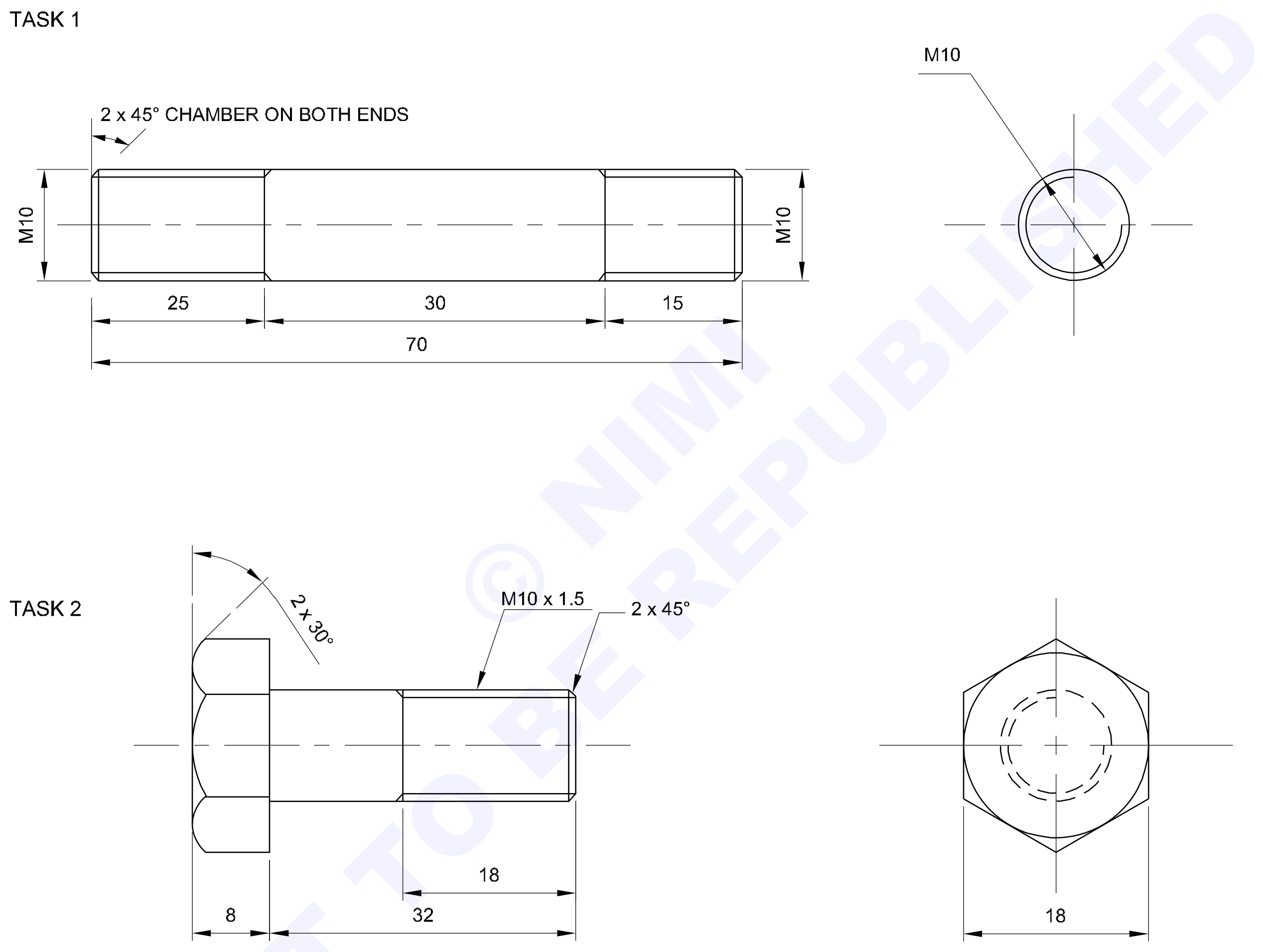


Fig 3



Prepare studs and bolt to standard size and watch with nut

Objectives: At the end of this exercise you shall be able to
- **file blank size to cut external thread for studs and bolts**
- **chamfer in both ends of studs and bolts**
- **mark the length required to cut external thread in studs and bolts**
- **cut external threads using die and die stock in studs and bolts**
- **check the external thread using screw pitch gauge and matching nuts.**



1	HEX A/F 18 - 45	–	Fe310	–	-	1.2.44
1	Ø10 - 75	–	Fe310	–	-	1.2.44
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PREPARE STUDS AND BOLT	TOLERANCE : ±0.04	TIME : 15 Hrs
		CODE NO : MM20N1244E1	

Job sequence

TASK 1 : **Prepare stud.**

- Check the raw material size.
- File the round rod ends to flatness and squareness maintaining size ø 10mm x 70mm length.
- File round rod cylindrical profile to ø 9.9mm blank size to cut external thread as per drawing.
- File chamfer in both ends of the round rod to 2mm x 45°.
- Apply marking media on cylindrical surface of the job and mark the required length and punch witness marks to cut external thread as per drawing
- Hold the cylindrical rod in bench vice to 90° with aluminium vice clamps and check the 90° with try square.
- Set M10 circular split die in die stock.
- Place the split die on the cylindrical round rod one end and cut external thread by rotating in clock wise and anti-clockwise direction to cut external thread.
- Apply pressure on the die stock evenly and turn in a clock wise direction to advance the die in stud blank and reverse the die for a short distance to break the chips.
- Following the above processes, cut the external thread upto the required length as per drawing.
- Clean the thread and check with suitable screw pitch gauge and matching nut.
- If the nut is not fitted with the external thread, increase the depth of cut gradually by adjusting the split die stock outer screw and deepen the cut of thread to correct pitch of thread and check with matching nut and screw pitch gauge.
- Similarly, repeat the thread cutting process in other end of cylindrical round rod to the required length and check with suitable screw pitch gauge and match with suitable nut.
- Clean the thread without burrs and apply little oil and preserve it for evaluation.

— — — — — — — — —

TASK 2: **Prepare bolt**

Pre machine as per drawing

- Hold hexagonal head bolt in bench vice to 90° along with aluminium vice clamps (Fig 1 & 2).

Fig 1

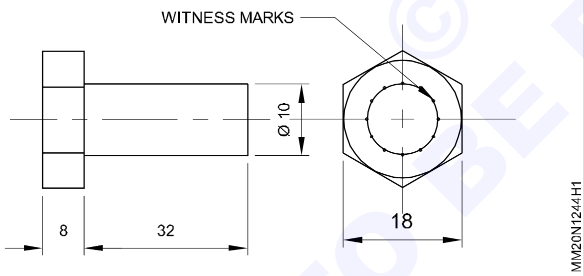
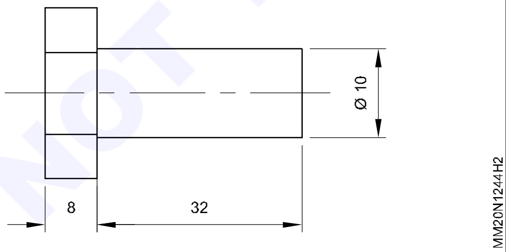
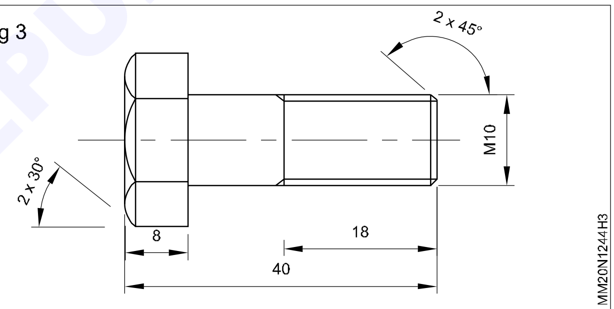


Fig 2



- Set M10 split die in the die stock.
- Place the split die on the hexagonal head bolt round blank end with die stock and turn in clock wise direction and anti- clockwise direction to cut external thread. (Fig 3)

Fig 3

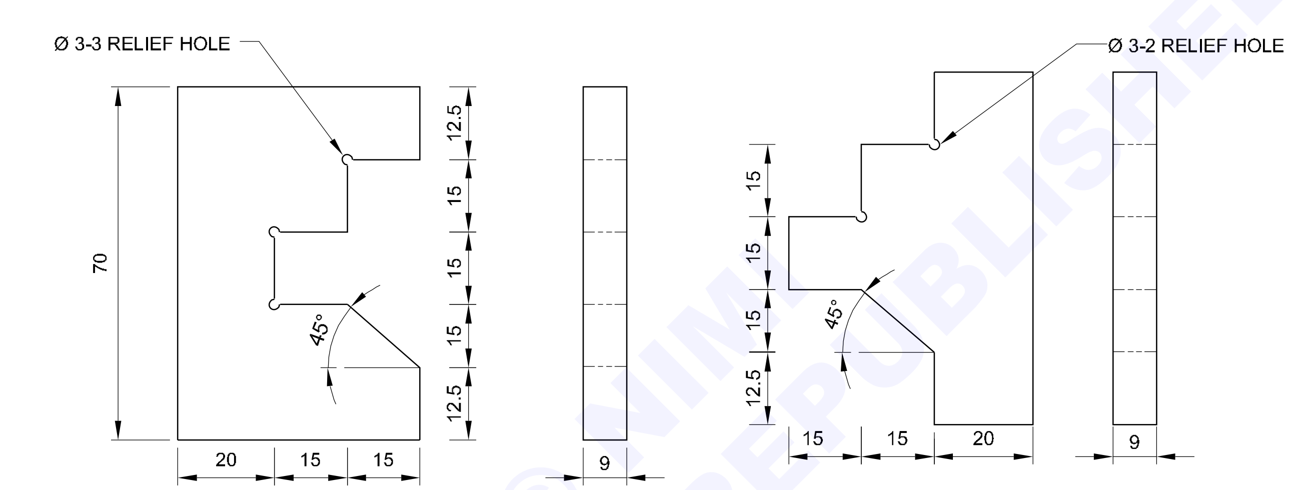


- Check the die to 90°, to the hexagonal head bolt blank while cutting external thread.
- Apply pressure on the die stock evenly and cut external thread as shown in job drawing
- Check the thread with screw pitch gauge and matching nut.
- Clean the thread and apply oil and preserve it for evaluation.

Use a cutting lubricant while cutting thread

File and make step fit, angular fit, with surface accuracy of ± 0.20 mm (bevel gauge accuracy 1 degree)

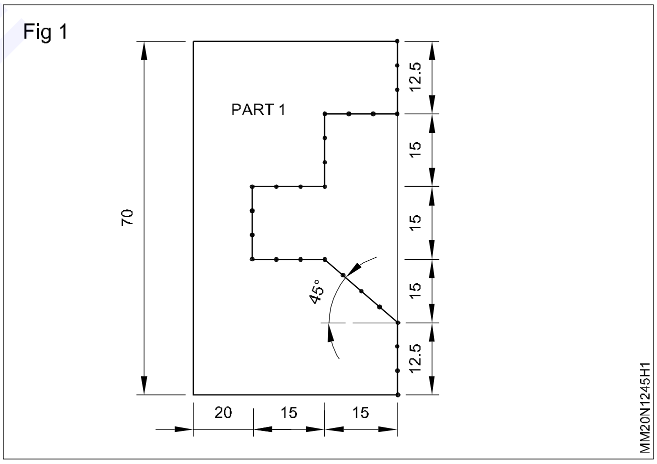
Objectives: At the end of this exercise you shall be able to
- **mark off lines using vernier height gauge**
- **file steps maintaining accuracy ± 0.2 mm**
- **mark 45° angle using bevel protractor**
- **file angle maintaining 1°accuracy**
- **make step and angular fit, finish and de - burr.**



Job Sequence

PART - 1

- Check the raw material for its size.
- File and finish to size 70 x 50 x 9 mm maintaining parallelism and perpendicularity.
- Mark and punch in part '1' as shown in Fig 1.
- Drill Ø 3 relief holes as shown job drawing.

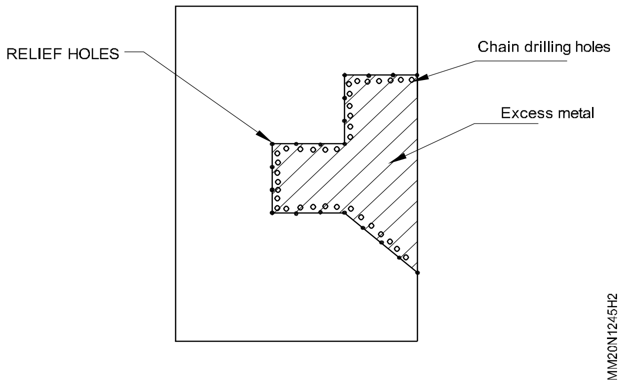


2	75 ISF 10 - 55	–	Fe310	–	1 & 2	1.2.45
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**FILE AND MAKE STEP FIT, ANGULAR FIT, WITH SURFACE ACCURACY OF ±0.20 mm (BEVEL GAUGE ACCURACY 1 DEGREE)**	TOLERANCE : ±0.04	TIME : 20 Hrs
		CODE NO : MM20N1245E1	

- Chain drill holes for parting off excess material from part ‘1’ as shown in Fig 2.

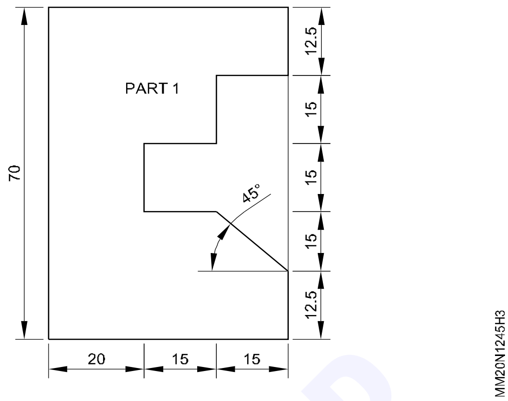
Fig 2



- Cut and remove excess material using web chisel and ball pein hammer.

- File steps to size maintaining accuracy ± 0.20 mm and angle to 45° maintaining 1° accuracy using safe edge different grades of files as shown in Fig 3.

Fig 3



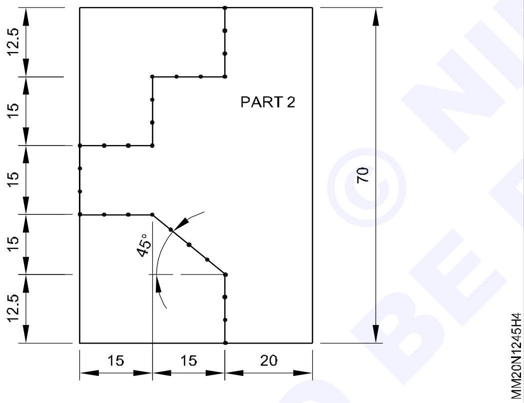
- Check the size with vernier caliper and angle with bevel gauge.

— — — — —

PART- 2

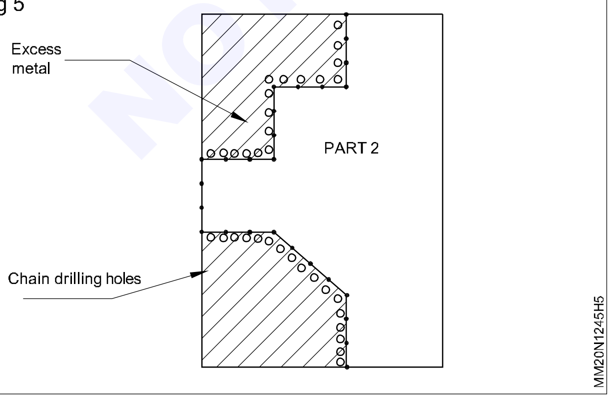
- File and finish to size 70 x 50 x 9 mm maintaining parallelism and perpendicularity.
- Mark and punch in part -2 as shown in Fig 4.

Fig 4



- Drill Ø 3 relief holes as shown in drawing.
- Chain drill holes for parting off excess material from part - 2 as shown in Fig 5.

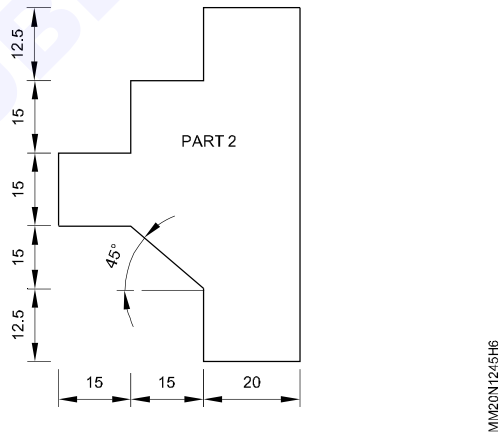
Fig 5



- Cut and remove excess material using web chisel and ball pein hammer.

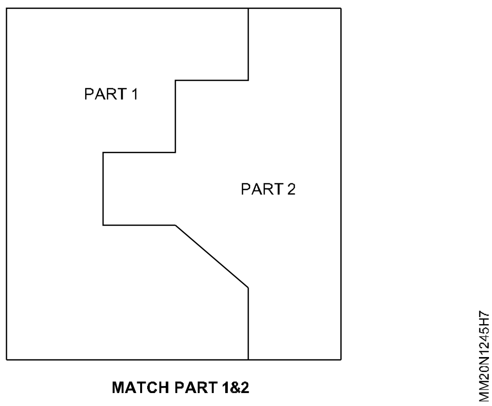
- File steps to size and angle to 45° using safe edge file different grades as shown Fig 6.

Fig 6



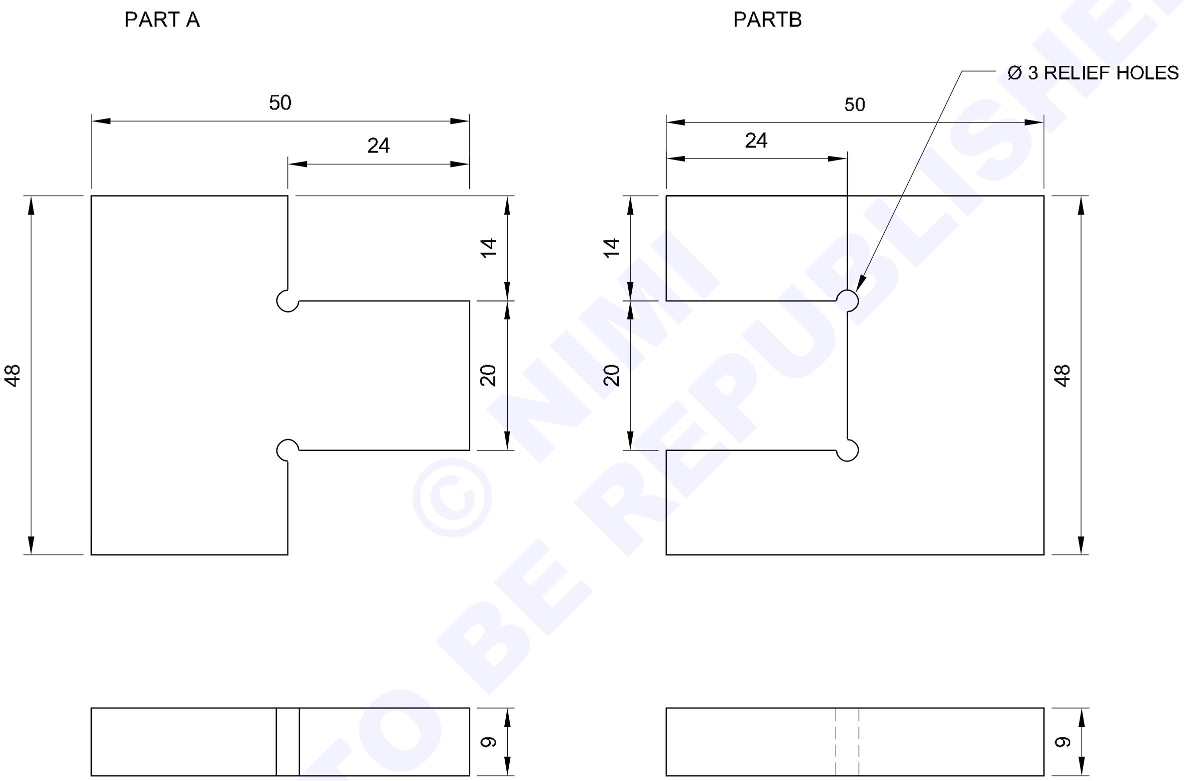
- Check the size with vernier caliper and angle with bevel gauge.
- Match part 1 and 2 as shown in Fig 7.
- Finish file on part 1 and 2 de - burr in all the surfaces.
- Apply a little oil and preserve it for evaluation.

Fig 7



Make simple open and sliding fits

Objectives: At the end of this exercise you shall be able to
- **file flat surfaces to flat and parallel**
- **file and assemble the tongue and groove, and obtain the required class of fit.**



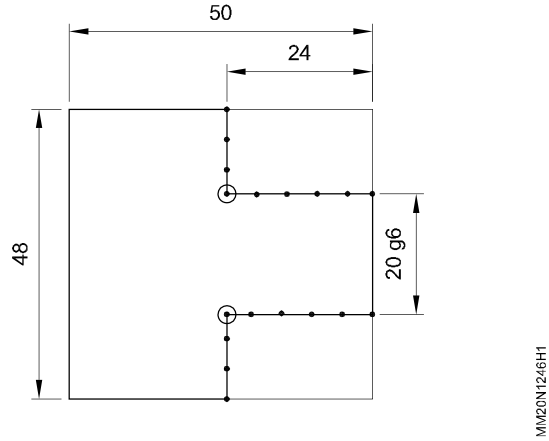
2	50 ISF 10 - 55	-	Fe310	-	-	1.2.46
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	MAKE SIMPLE OPEN AND SLIDING FITS				TOLERANCE : ± 0.04	TIME : 20 Hrs
					CODE NO : MM20N1246E1	

Job Sequence

Part - A

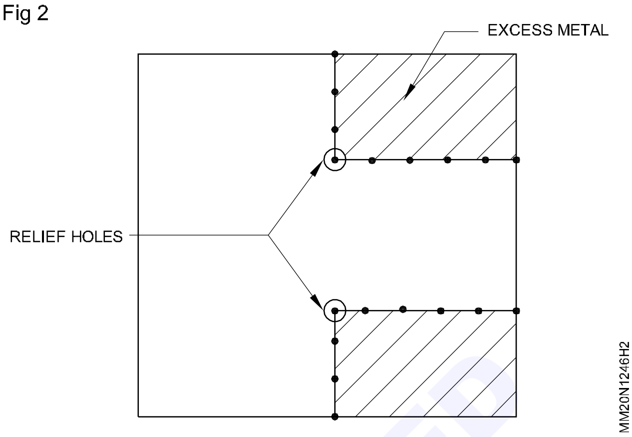
- Check the raw material for its size.
- File and finish to size 50 x 48 x 9 mm maintaining parallelism and perpendicularity.
- Apply marking media, mark as per job drawing and punch witness marks in part A as shown in Fig 1.

Fig 1



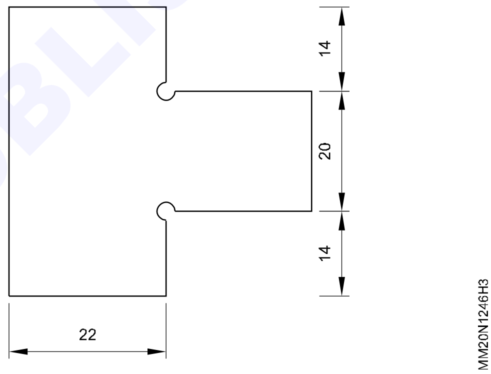
- Drill relief hole Ø 3 mm as per job drawing in part A.
- Mark lines as shown in Fig 2 leaving the metal 1 mm away from the object line and cut and remove the excess metal by hacksawing.
- File part A as per drawing to size 14 mm x 24 mm with safe edge file and check the size with vernier caliper.

Fig 2



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

Fig 3

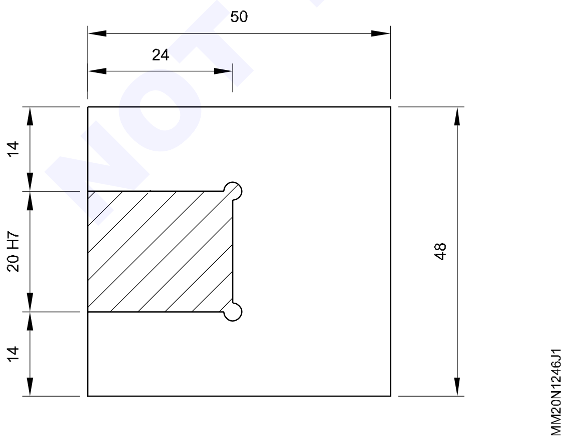


— — — — —

Part B

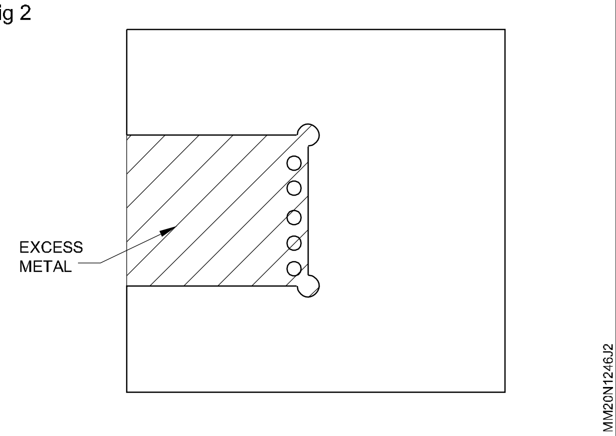
- File and finish to size 50 x 48 x 9 mm maintaining parallelism and perpendicularity.
- Apply marking media, mark and punch as shown in Fig 1.

Fig 1



- Drill relief hole Ø 3 mm on part B
- Chain drill holes, chip, hacksaw and remove the excess metal as shown in Fig 2.
- File to size and shape maintaining the flatness and squareness as shown in Fig 3.
- Check the size with vernier caliper.
- Match part 'A' and 'B'.
- Finish file and de - burr in all the surfaces of the job.
- Apply a thin coat of oil and preserve it for evaluation.

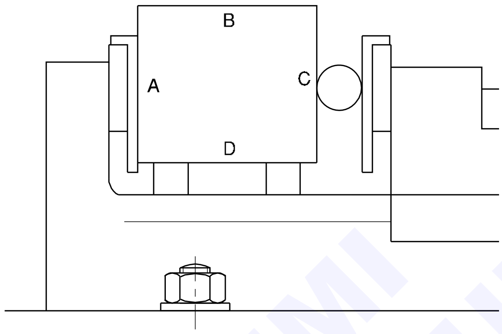
Fig 2



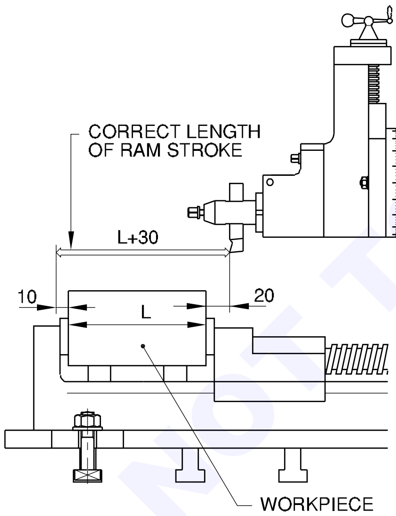
Perform the holding job on shaper machine vice, setting length of stroke, setting of feed in a shaper machine

Objectives : At the end of this exercise you shall be able to
- **holding the job in shaper machine vice**
- **setting of stroke length.**

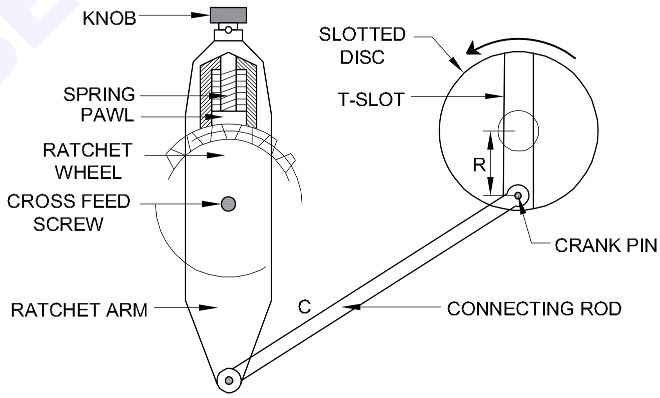
TASK-1 **HOLDING JOB**



TASK-2 **SETTING STROKE LENGTH**



TASK-3 **SETTING OF FEED**



1	-	-	-	-	-	1.3.47
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**PERFORM THE HOLDING JOB ON SHAPER VICE SETTING LENGTH OF STROKE**	TOLERANCE ±0.04	TIME 5Hrs
		CODE NO. MM20N1347E1	

Job Sequence

TASK 1: **Holding job**

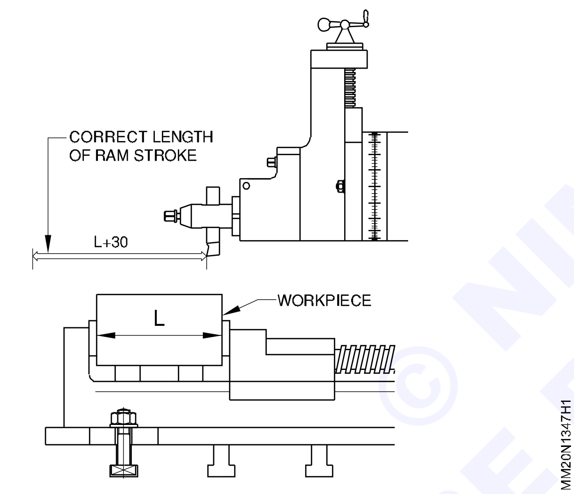
- Set the machine vice on the machine table
- Place one if the larger surface of the workpiece on the parallel to prevent its down movement while machining.
- Ensure that the workpiece is projecting the vice jaws by about 3 to 5 mm more than the total depth of cut.
- It prevents the vice jaws, tools and workpiece from damage
- Place a rod of diameter 6 to 15 mm between the middle of the unfinished side and movable jaw.
- This gives line contact between the job and prevents lifting of the workpiece.
- Tighten the workpiece.
- Tap the workpiece gently with a soft hammer for seating on the parallel. Ensure that the parallel block does not shake.

— — — — — —

TASK 2: **Setting stroke length**

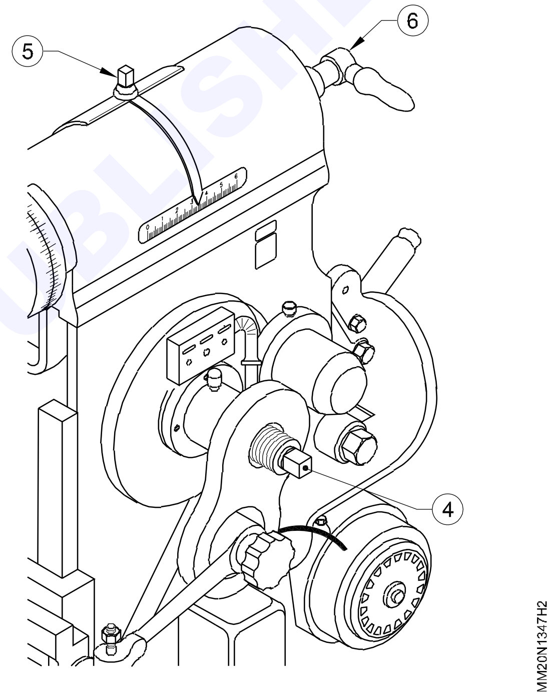
- Adjust and bring the stroke length 30mm more than the length of the workpiece (Fig 1).

Fig 1



- To increase the stroke length rotate the adjustment screw (4) in Fig 2 in clockwise.
- To decrease the stroke length rotate the adjustment screw in anticlockwise direction.
- Adjust the ram stroke position by loosening the adjustment nut (5).
- Adjust the position of the ram by rotating the positioning screw (6).
- Provide 5 to 20mm gap at the end of the cutting stroke for tool to clear the workpiece.

Fig 2



- Provide 15 to 20mm gap at the starting side of the cut to give time for the clapper box to fall and settle itself.
- Set the number of strokes per minute according to the material to be machined and the tool material.

While adjusting the stroke length/position keep the tool away from the workpiece to avoid damaging the tool and the workpiece.

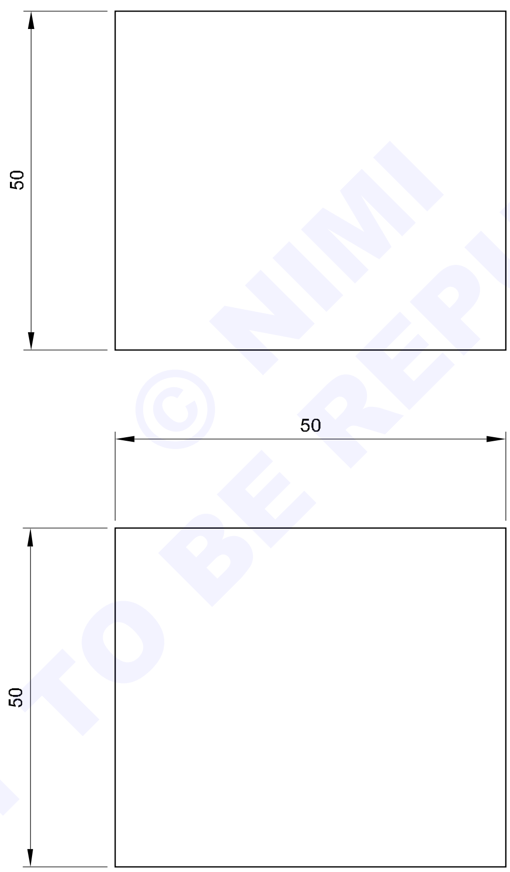
— — — — — —

TASK 3: **Setting of feed**

- To set the feed pull the knob out side
- The feed rate is depending upon, job material, type of cut, surface finish required tool material
- Desired amount of feed is set on the crank wheel adjusting crank pin.
- For increased feed the crank pin away from the centre of crank wheel.
- To decreased feed the crank pin is moved near to the centre of crank wheel.
- For indexing the opposite side the direction of the pawl is turned by 180° and engaged.
- During manual feed, pawl, is pulled up and the pin is placed in the disengaged position.

Make a square block in shaper machine

Objectives : At the end of this exercise you shall be able to
- **align machine vice on the shaper table in position**
- **fix workpiece in machine vice**
- **select and fix the tool on the tool head**
- **shape six sides as per drawing maintaining squareness**
- **check the dimension using vernier caliper.**



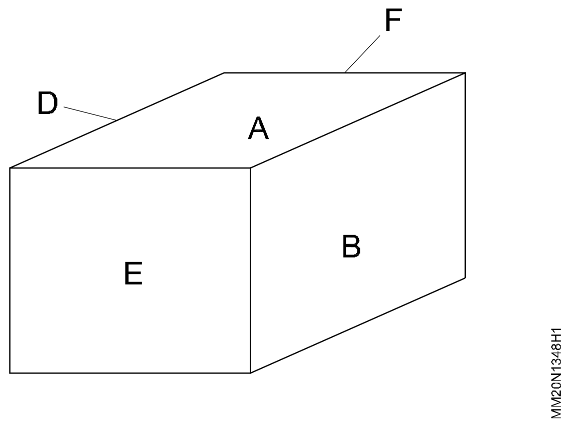
1	60Sq - 60	-	Fe310	-	-	1.3.48
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	MAKE A SQUARE BLOCK USING SHAPER MACHINE	TOLERANCE ±0.04	TIME 10Hrs
		CODE NO. MM20N1348E1	

Job Sequence

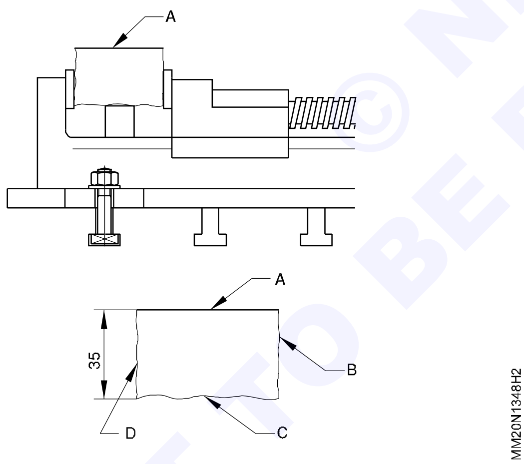
- Clamp the machine vice securely in the machine table.
- Shape surface 'A' flat (Fig 1).

Fig 1



- Keep surface 'A' against the fixed jaw and surface D on the parallel block.
- In the middle of the surface C, a round rod is kept between the job and the movable jaw for line contact to avoid lifting of job. This roller enables for maintain squareness of surface A & B (Fig 2).
- Shape surface 'B' right angle to surface 'A' (Fig 2)

Fig 2



- Keep surface 'A' on the parallel blocks and butt surface 'B' to the fixed jaw.
- Place a round rod in between movable jaw and surface D.
- Shape the surface C maintaing the size of 50mm (Fig 3).
- Keep the surface B on the parallel block.
- Shape surface 'D' maintains a size of 50mm (Fig 4).

Fig 3

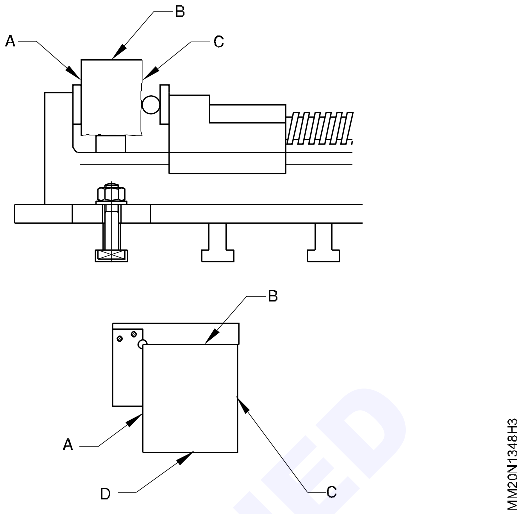
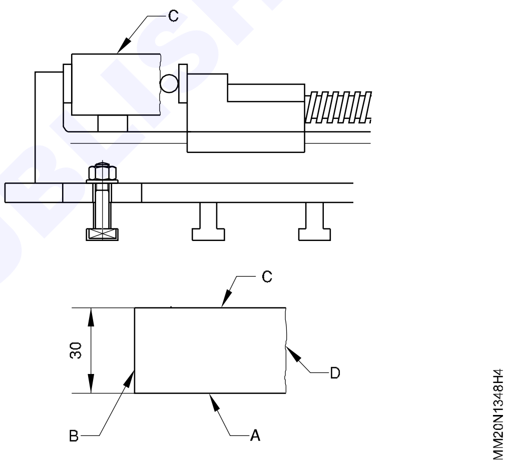
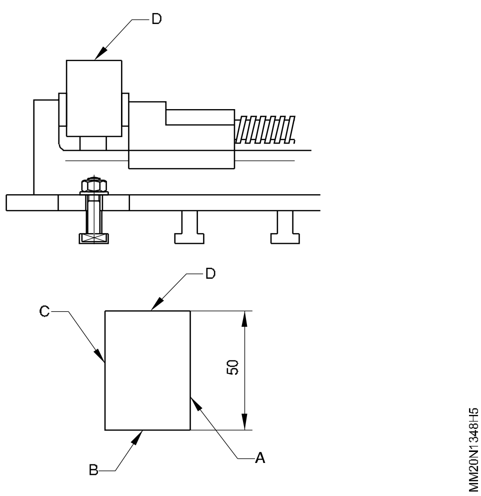


Fig 4



- Keep unfinished surface 'E' on parallel block.
- Set perpendicular its by using try square referencing side A & C or B & D.
- Shape the surface 'F'.
- Reverse and keep the surface 'F' inparallel block.
- Shape the surface 'E' maintaining 50mm (Fig 5).

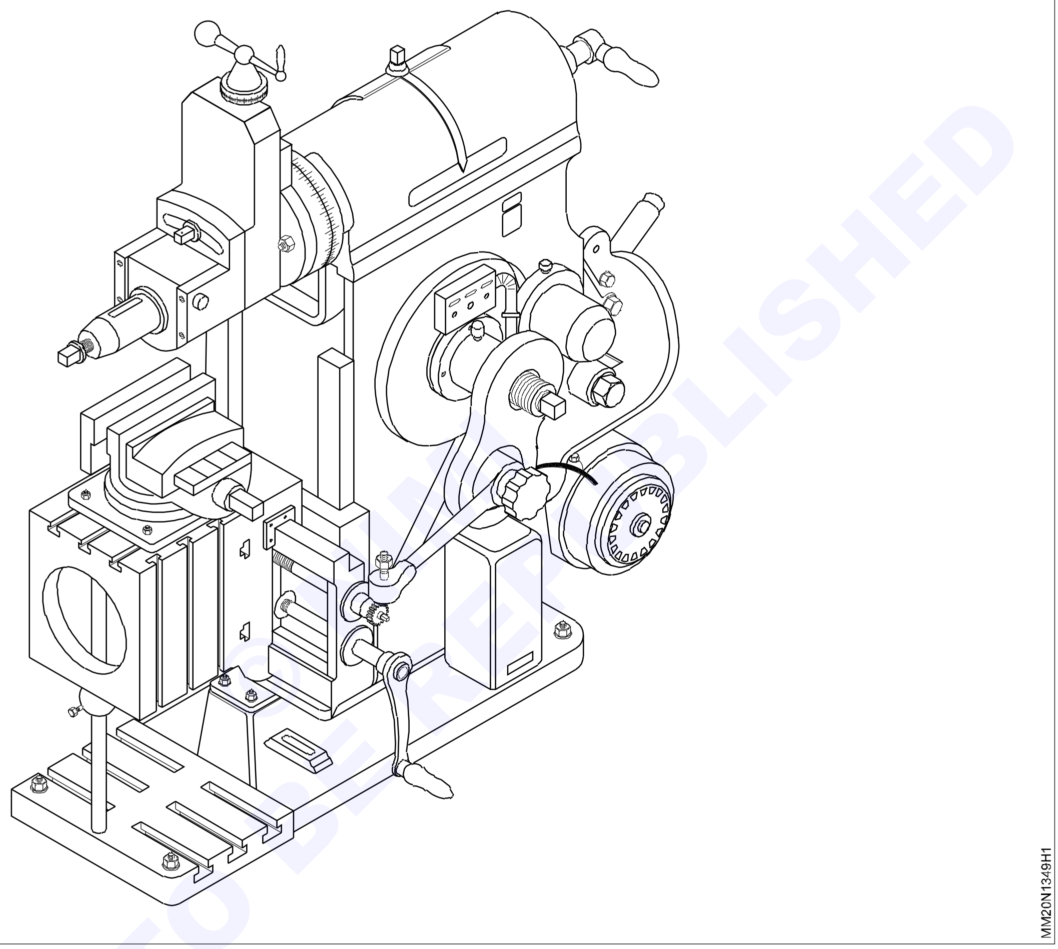
Fig 5



Perform preventive maintenance of shaping machine

Objectives : At the end of this exercise you shall be able to
- **Inspect the shaper as per check list and carry out preventive maintenance**
- **check the belt tension**
- **lubricate all the necessary parts.**

Fig 1



Job sequence

- Check the machine level by using a spirit level
- Check the tension of the belt and adjust it if necessary
- Check the alignment of vice using dial test indicator (Fig 1).
- Check the tool head movement by rotating the down feed handle (Fig 2).
- Check the table movement by rotating the cross feed screw. (Fig 3).
- Check the ram movement by switch on the machine (Fig 4).
- Check the ram driving mechanism and feed mechanism
- Check and maintain lubrication and oil pump.
- Clean the machine thoroughly.

Fig 1

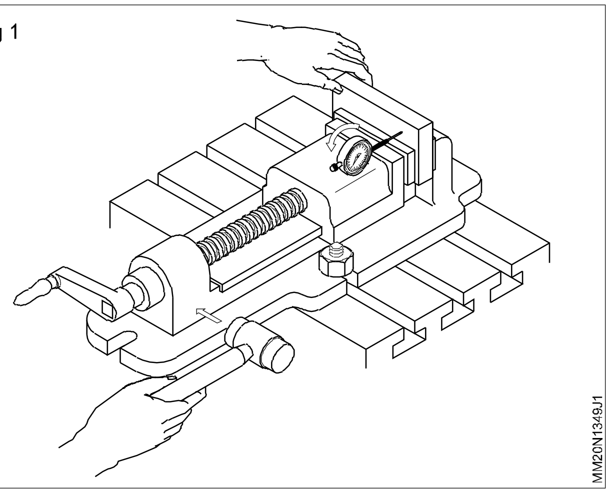
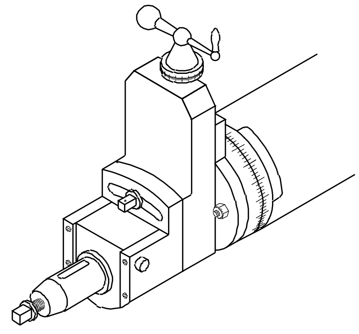


Fig 2



SWIVEL TOOL HEAD AND ADAPTOR PLATE

Fig 3

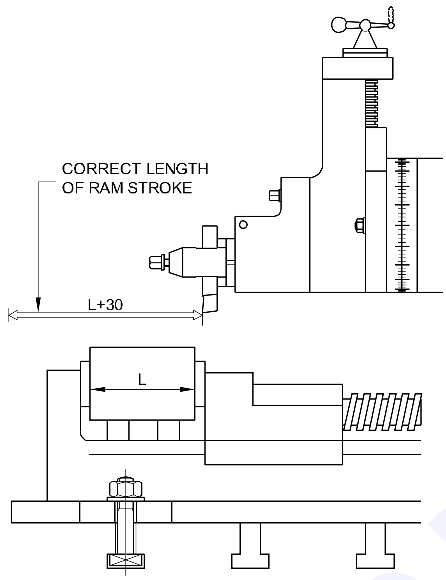
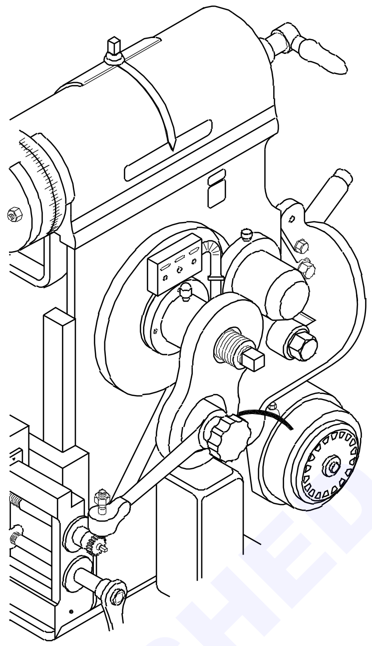


Fig 4

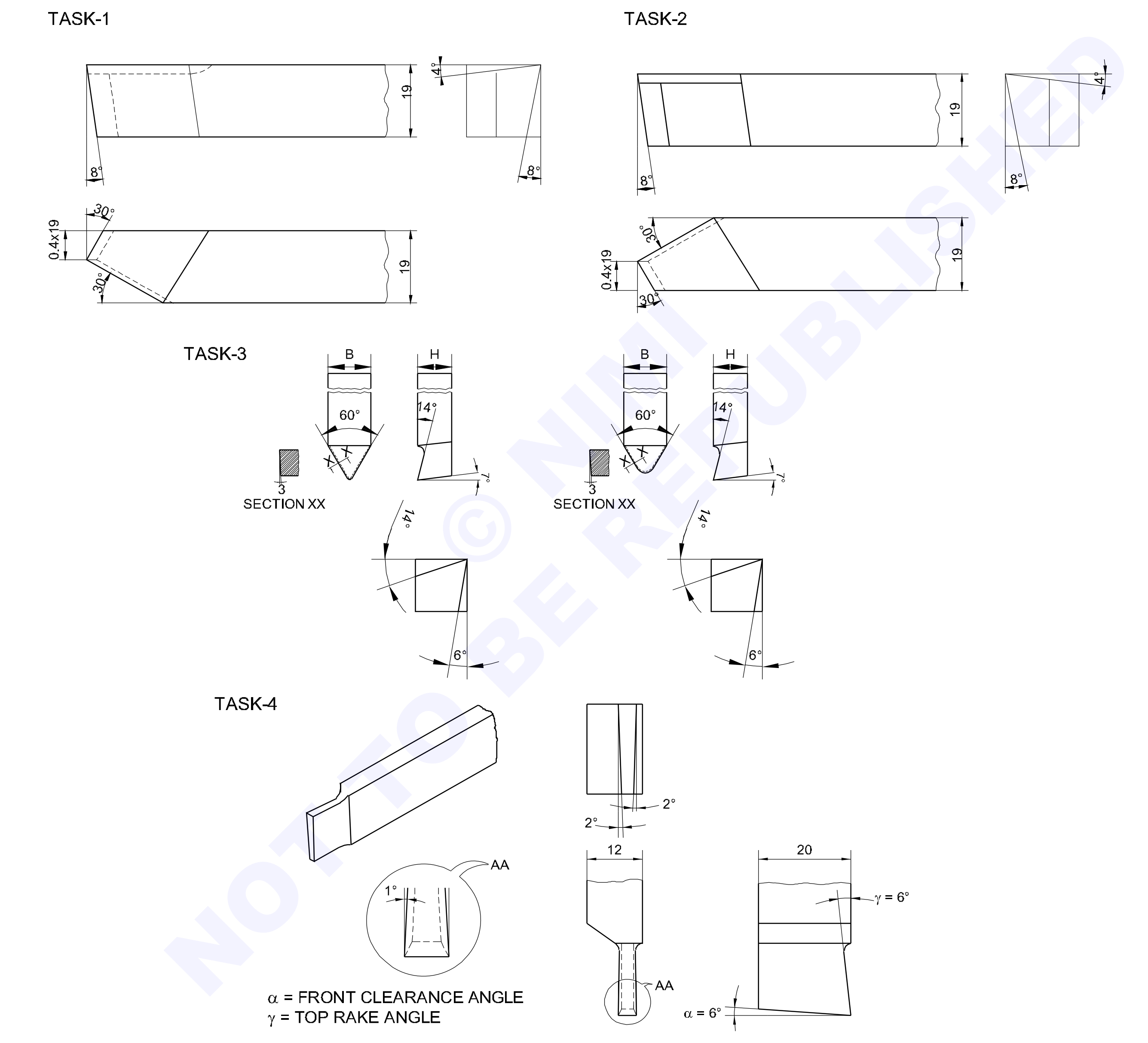


Inspect the following items and tick in the appropriate column and list the remedial measures for the defective items

Items to be checked	Good working/Satisfactory	Defective	Remedial measures carried out
Level of the machine			
Belt and its tension			
Bearing sound			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Ram & its movement			
Table & cross movement			
Electrical controls			
Safety guards			
Tool head movement			

Grinding of R.H. and L.H tools, V-tool, parting tool and round nose tool

Objectives : At the end of this exercise you shall be able to
- **grind R.H. and L.H. tool**
- **grind 'V' tool**
- **grind round nose tool**
- **grind parting tool**
- **check the angles with a protractor.**



1	20ISF-12-150	–	1	Fe 310	-	
1	SQ 12-110	–	1	Fe 310	-	1.3.50
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE NTS	**GRINDING OF R.H. AND L.H.TOOLS,V.TOOL, PARTING TOOL AND ROUND NOSE TOOL**	DEVIATIONS ± 1°	TIME 10 hrs
		CODE NO. MA20N1350E1	

Job sequence

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

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

— — — — — — — — —

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

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

Precautions:

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

— — — — — — — — —

TASK 3: **Grinding side cutting tool**

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

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

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

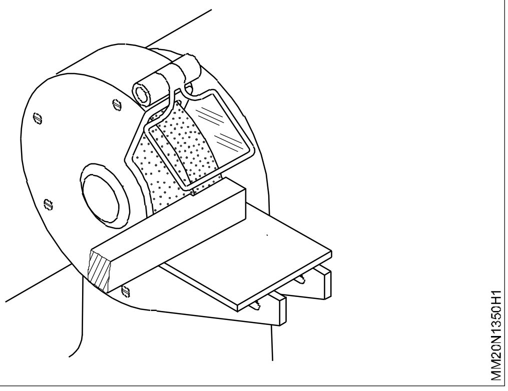
The ground surfaces should be without steps and should have a uniform smooth finish.

— — — — — — — —

TASK 4: **Grinding parting tool**

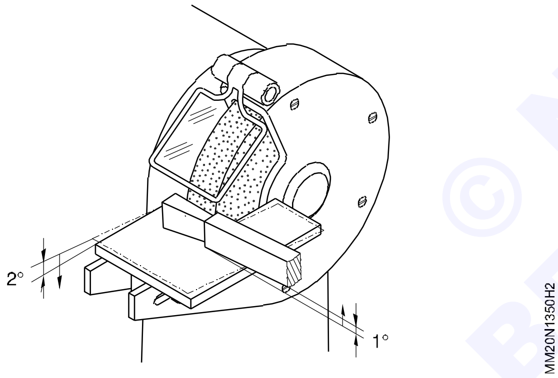
- Prepare the pedestal grinder
- Dress the grinding wheel.
- Adjust the tool rest and the safety sight glass
- Grind the sides of the tool blank on both sides and maintain the width of 4mm cutting edge to 20mm length (Fig 1).

Fig 1



- Grind the side relief angle of 1° and side clearance angle of 2° by holding the rear side of the stepped portion against the wheel (Fig 2).

Fig 2



- Similarly the other side relief angle and clearance angle (Fig 3).
- To grind the front clearance angle place the front cutting edge parallel to the wheel face tilt the tool 6°, so the bottom cutting edge should touch first (Fig 4).

Fig 3

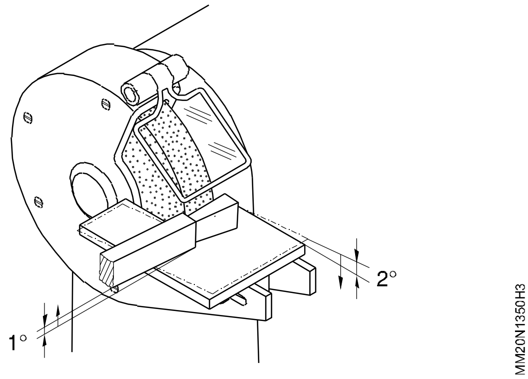
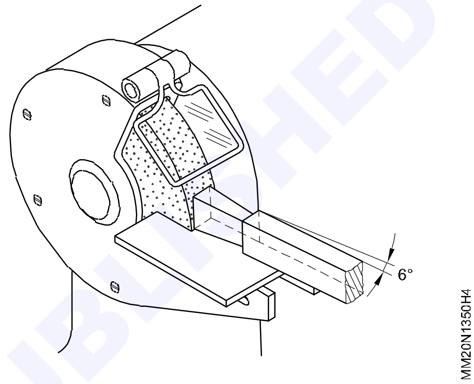
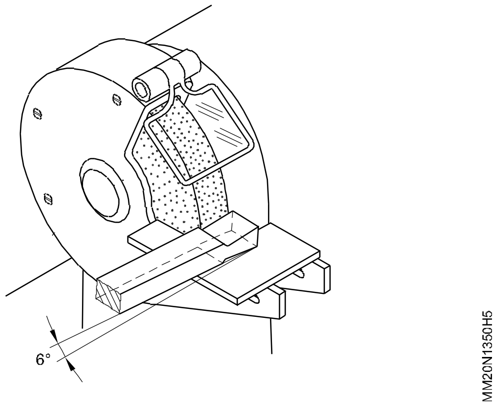


Fig 4



- Position the tool face parallel to the grinding wheel and swivel 6° so that back portion of the rake angle touched first grind until the front cutting edge touches (Fig 5).

Fig 5



Skill sequence

Grinding a side cutting tool for machining steel

Objective: This shall help you to

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

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

The side cutting edge is in line with the blank edge and the end cutting edge is inclined at an angle of 25°. The side rake angle is 14°. The front and side clearances are ground 6°. The length of the side cutting edge is maintained equal to the size of the square cross-section of the tool blank, i.e. 12 mm. Fig 2 shows the shaded portion to be removed by grinding the tool blank to get the ground tool. The procedure in sequence is as follows.

Fig 1

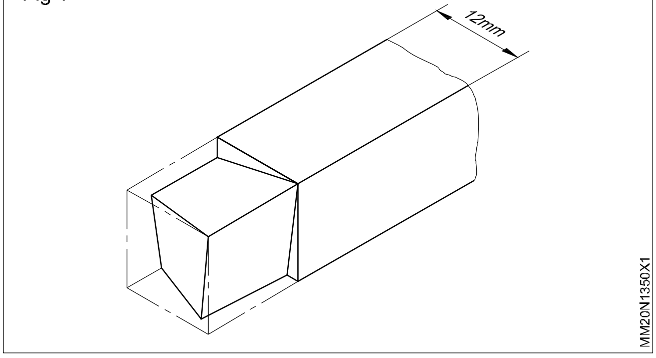
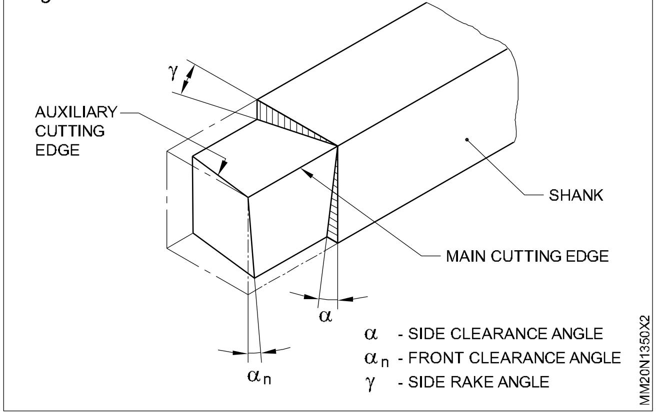
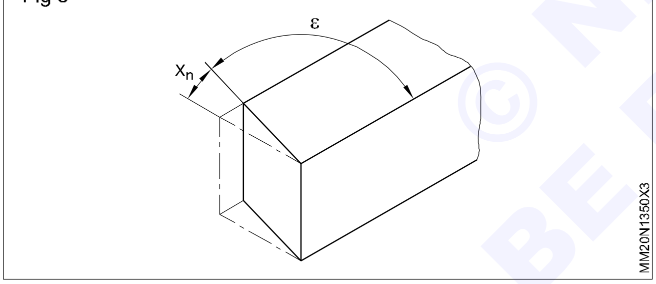


Fig 2



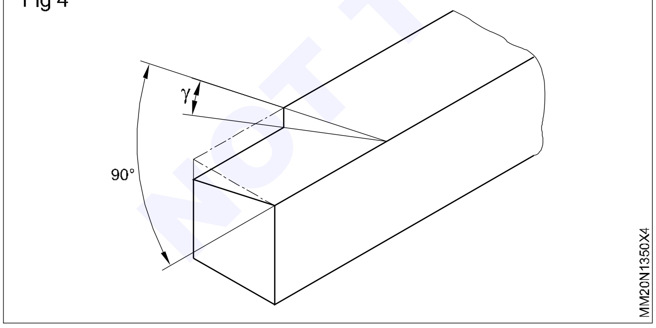
Grind the end cutting edge angle 25°. Angle 'x_n' (Fig 3)

Fig 3



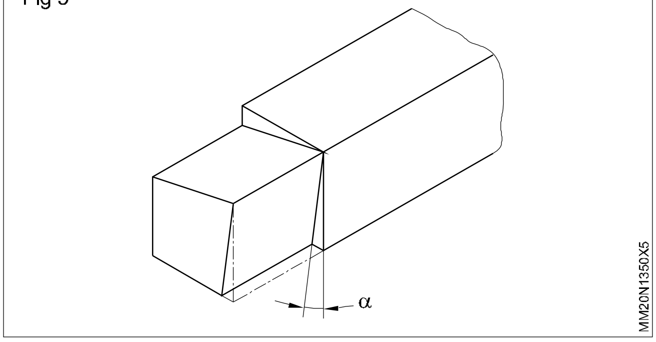
Grind the side rake angle of 14°. Angle. (Fig 4)

Fig 4



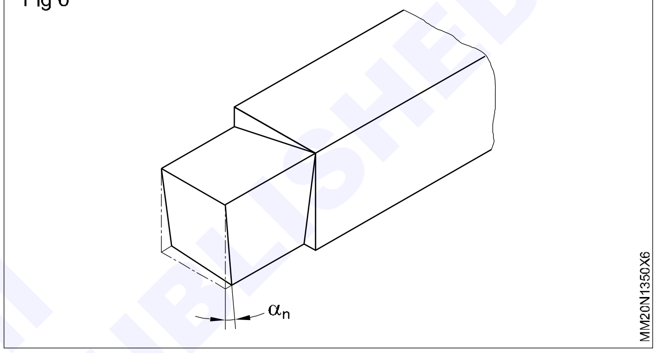
Grind the side clearance angle of 6°. Angle α (Fig 5)

Fig 5



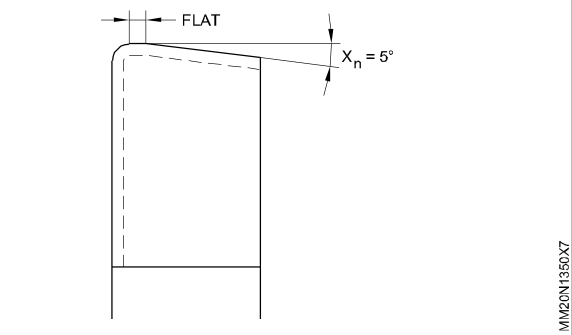
Grind the front clearance angle of 6°. Angle α_n (Fig 6)

Fig 6



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

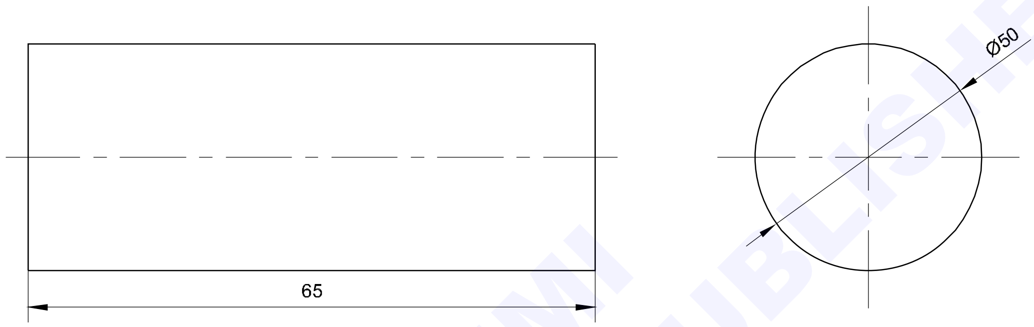
Fig 7



— — — — — — — — —

Perform facing operation to correct length

Objectives : At the end of this exercise you shall be able to
- **grind the facing tool**
- **true the work piece on a 4 jaw chuck**
- **set the tool to the correct centre height**
- **face the work piece with an accuracy of ±0.1mm.**



Job sequence

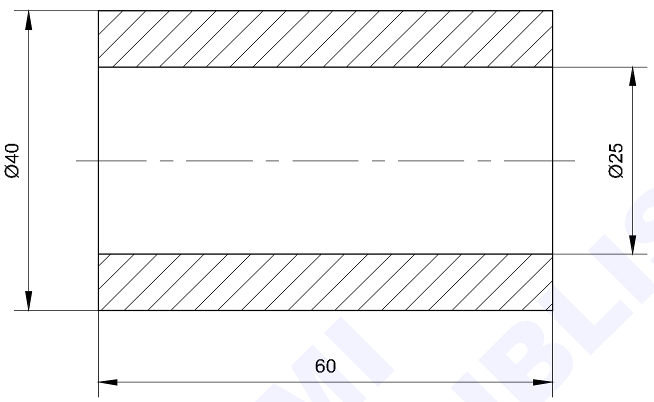
- Check the raw material for size.
- Hold the job in a four jaw chuck about 60mm out side and true it.
- Face one end.
- Turn ø 50mm to about 50mm length.
- Reverse the job and reset it, holding on ø 50mm.
- Face the other end to a total length of 65mm and turn the outer diameter to ø 50mm.
- Check the dimension with a steel rule and out side caliper.
- Deburr the workpiece.

NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	ISR Ø60x70	-	Fe 310	-	-	1.3.51

SCALE 1:1	**PERFORM FACING OPERATION TO CORRECT LENGTH**	DEVIATIONS ±0.1	TIME 5hrs
		CODE NO. MM20N1351E1	

Centre drilling and drilling operation to a required size

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



Job sequence

- Check the raw material size.
- Hold the job in a four jaw independent chuck with 40mm overhang and true it.
- Set the right hand facing tool in the tool post.
- Face one end of the work.
- Fix the drill chuck in the tailstock spindle and fix the centre drill of size A2x6.3 IS : 2473.
- Centre drill the work.
- Turn the outside diameter ø40 mm to the length 35mm.
- Drill through hole in the job with ø 10mm drill bit after centre drilling.
- Drill through hole in the job with ø 25 mm drill bit after drilling 10mm.
- Chamfer the drilled hole 1x45^{o} .
- Reverse the job and reset it.
- Face the other end maintain to 60mm length.
- Turn the outer dia 40mm to length 25mm.
- Chamfer the hole 1x45^{o}

1	Ø45 - 65	-	Fe 310	-	-	1.3.52
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**CENTRE DRILLING AND DRILLING OPERATION TO REQUIRED SIZE**	DEVIATIONS	TIME 5hrs
		CODE NO. MM20N1352E1	

Skill sequence

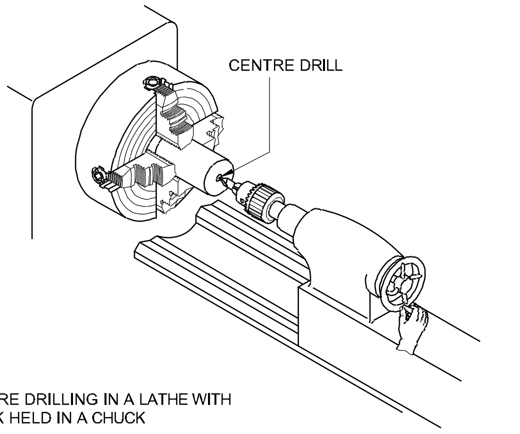
Centre drilling on lathe

Objective : This shall help you to
- **centre drill a work held in a chuck.**

Round work pieces can be quickly and accurately centre-drilled without the necessity of centre punch marks.

The procedure to centre drill a work held in a chuck is given below in sequence. (Fig 1)

Fig 1



CENTRE DRILLING IN A LATHE WITH WORK HELD IN A CHUCK

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

Finish face the work with a facing tool.

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

Mount the drill chuck in the tailstock spindle.

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

Mount a suitable centre drill securely in the drill chuck.

Set the spindle speed about 1000 r.p.m.

Slide the tailstock over the bed until the centre drill is close to the work face.

Lock the tailstock in this position.

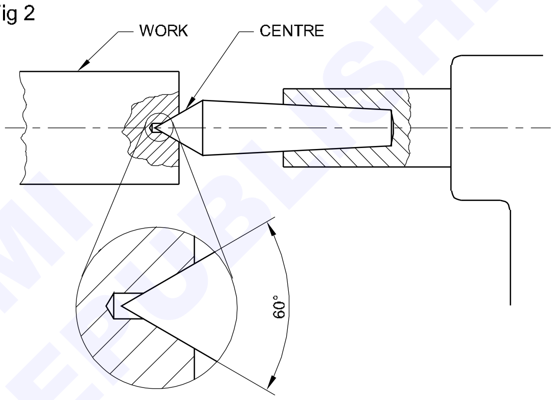
Start the machine and slowly feed the centre drill into the work by rotating the tailstock hand wheel.

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

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

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

Fig 2

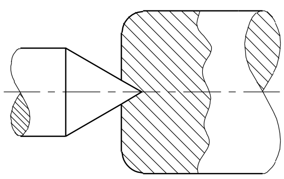


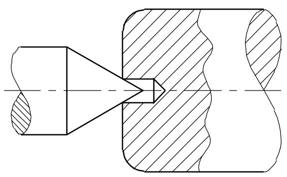
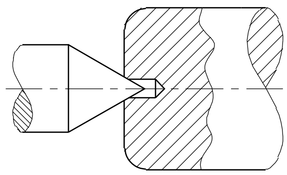
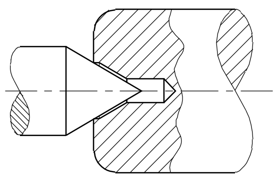
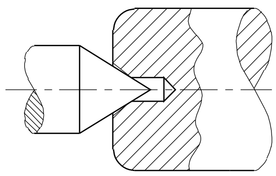
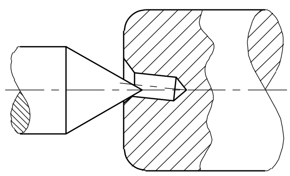
CORRECTLY DRILLED CENTRE HOLE

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

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

Common errors in centre drilling

Condition of centre hole	**Errors**	**How to avoid and correct the errors**
	No clearance for point of centre. Centre hole incomplete. Insufficient bearing surface for lathe centre.	Drill pilot hole. Countersink pilot hole at 60°. Drill centre hole with a centre drill.

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

Rectifying a damaged centre-drilled hole

Objective : This shall help you to

- **correct a damaged centre hole previously centre- drilled.**

When components are disassembled for repairs, the centre-drilled holes in the shafts often get damaged due to many reasons. Unless the damaged centre holes are rectified, the shaft will not run true when held between centres or between chuck and centre.

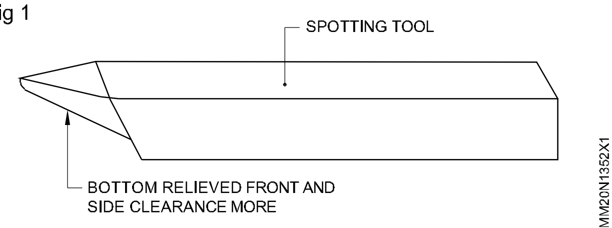
Centre holes may be rectified by any of the following methods.

1. With a spotting tool.
2. With a boring tool held in top slide and swivelled at 30°.
3. With a special countersink.

With a spotting tool

Hold the shaft in a four jaw chuck and true by using a dial test indicator.

Fig 1



Grind a 60° spotting tool with sufficient side and front clearance to prevent it from rubbing in the centre hole.(Fig.1)

Fix and clamp the tool straight in the tool post or fix it in a tool-holder and clamp the tool -holder in the tool post.

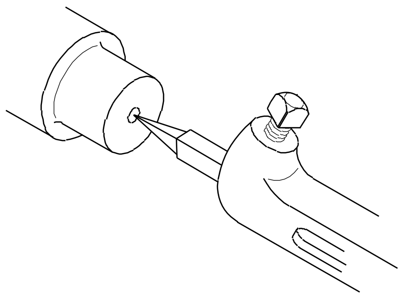
The tool tip must be on the centre line with the axis of the work.

Set the machine to the required r.p.m. depending upon the material and the diameter of the work.

Start the machine and slowly feed the tool bit into the centre hole with the carriage hand wheel.

With the cross-slide hand wheel, gradually feed the tool outwards to make contact with the damaged centre hole countersink portion. (Fig 2)

Fig 2



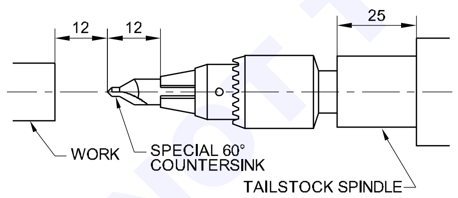
Continue feeding till the damaged centre hole runs true for its full length.

Finally finish the countersink portion of the centre hole using the 60° countersink drill held in the drill chuck mounted in tailstock.

With a special countersink

Better and quick results can be achieved by using a special countersink. This special countersink is nothing but a centre drill with a broken point but whose 60° angular portion is undamaged. A flat parallel with one cutting face is ground across the end of the centre drill so that only one lip or cutting edge remains. (Fig 3)

Fig 3



The sequence is as follows.

Mount the workpiece in a four jaw chuck and true it with the dial indicator.

Mount the drill chuck in the tailstock spindle.

Ensure that the tailstock spindle is aligned with the headstock spindle.

Insert the centering tool in the drill chuck with not more than 12 mm protruding.

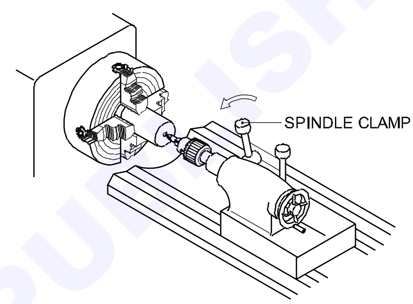
Set and position the tailstock spindle with a minimum overhang.

Slide the tailstock towards the workpiece and lock the tailstock in position.

Start the lathe and allow the work to rotate.

Tighten the tailstock spindle clamp until a slight drag is felt when turning the tailstock hand wheel. (Fig 4)

Fig 4

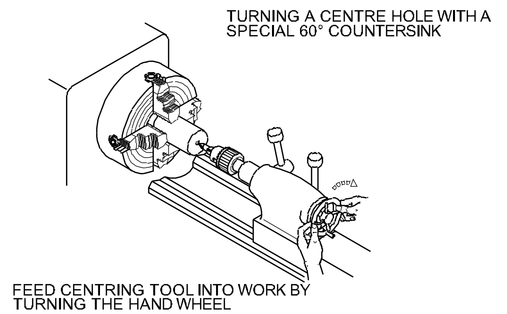


This prevents the tailstock spindle from deflecting.

Apply the cutting fluid, and slowly bring the centering tool into the damaged centre.

Continue feeding the centering tool until the centre hole runs true. (Fig 5)

Fig 5

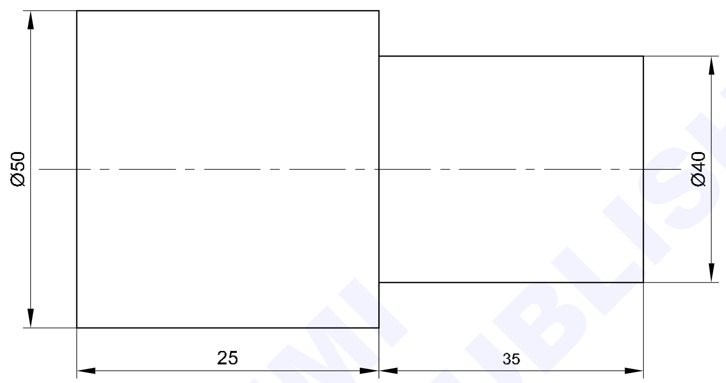


— — — — — — — — —

Exercise 1.3.53

Perform parallel turning and step turning

Objectives: At the end of this exercise you shall be able to
- **parallel turn the work by hand feed method with various depth of cuts**
- **turn step to the required diameter and length.**



Job sequence

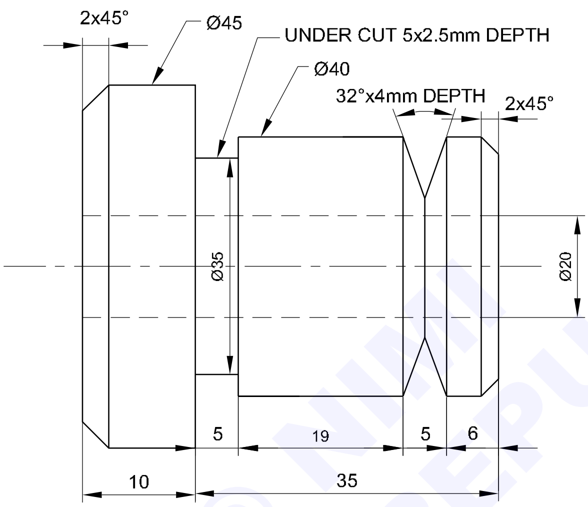
- Check the raw material size.
- Hold the job in a 4-jaw chuck and true it by keeping about 50mm over hanging outside the chuck.
- Set the tool to the correct centre height
- Select and set the spindle RPM
- Face one side and turn parallel the outer diameter to 60mm for the maximum possible length.
- Reverse the job and hold it
- Face the other end to total length of 60mm
- Turn step for size of ø 40 x 35mm length
- Remove the sharp corners
- Check the dimensions by using veriner caliper
- Apply thin film of oil and pressure it for evaluation.

-	-	-	-	-	-	-
1	ISR Ø52 X 65	-	Fe310	-	-	1.3.53
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**PERFORM PARALLEL TURNING AND STEP TURNING**	DEVIATIONS ± 0.1	TIME : 5hrs
		CODE NO. MM20N1353E1	

Perform drilling, boring undercut, parting, grooving, chamfering operation

Objectives: At the end of this exercise you shall be able to
- **drilling and boring**
- **undercut on shoulder**
- **chamfer the edge at an angle of 45°**
- **form 'V' groove**
- **setting parting tool and parting operation.**



Job sequence

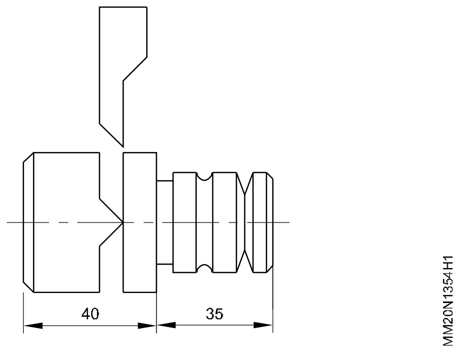
- Hold the pre machine job in 3 -jaw chuck by keeping about 55mm to overhang
- Set the centre drill,on the tailstock using drill chuck
- Make the center drill to required depth.
- Remove the centre drill insert the ø 8mm drill for pilot hole.
- Drill ø 15mm through hole.
- Set the boring tool to correct centre height
- Bore ø 20mm giving different cuts.
- Prepare the grooving tool for 32°.
- Hold the grooving tool at the correct centre height and rigidly
- Form the 'V' groove to a width of 5mm and the depth of 4mm
- Set the chamfering tool at correct centre height.
- Chamfer the end to 2x45°

1	ISR Ø50x55		Fe310	-	-	1.3.54
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**PERFORM DRILLING,BORING,UNDERCUT, PARTING,GROOVING, CHAMFERING OPERATION**	DEVIATIONS ± 0.06mm	TIME : 10 hrs
		CODE NO. MM20N1354E1	

- Set the 3mm width parting tool at correct centre height (Fig-1).
- Select and set correct spindle speed for parting operation
- Part the job using plunger cut method at 47mm from the end.
- Reverse the job and hold to face the other end to the length of 45mm
- Chamfer the end to 2x45°
- Deburr the job and apply oil for preserving.

Fig 1



— — — — — — — — —

Skill sequence

Step turning by using R.H Knife tool

Objective: This shall help you to

- **turn steps of different diameters for definite lengths on a shaft.**

When the width of the step turned does not permit plunge cuts to form the steps, they are turned by using a R.H knife tool, feeding the tool axially for the length of the step. By using a knife tool a square shoulder is also formed at each junction of the steps.

Hold the previously turned shaft in a four jaw chuck and true it at both ends (near the chuck and at the overhanging end.)

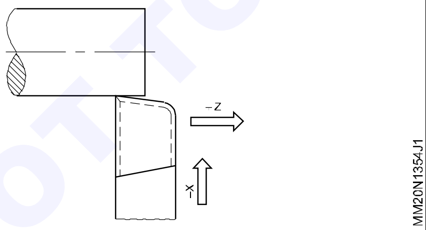
Ensure that the face is running true since the length measurement are taken from it as a reference.

Hold the right hand knife tool in the tool post to the centre height with a minimum overhang and the axis of the tool at right angles to the axis of the work.

Set the machine spindle speed to 300 RPM.

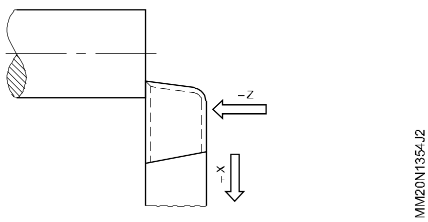
Start the machine and touch the tool tip to the work to set the cross-slide graduated collar to zero, with the backlash eliminated.(Fig 1)

Fig 1



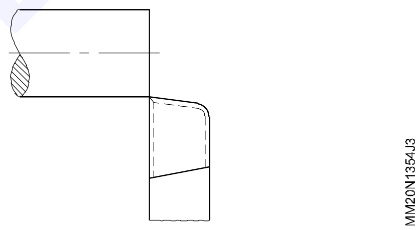
Withdraw the tool from the work and make the cutting edge contact the work face to set the top slide graduated collar to zero with the backlash eliminated.(Fig 2)

Fig 2



Position the tool to have the tip at the edge of the work (Fig 3)

Fig 3



Give the depth of cut by the cross-slide for the next smaller step to the shaft diameter.(Fig 4)

Advance the tool axially by rotating the top slide hand wheel to the required length, read by the graduated divisions of the graduated collar of the tool slide.

Ensure that the top slide is at zero setting with the base.

The rotation of the top slide hand wheel should be continuous and uniform till the required movement for the length of the step is attained.

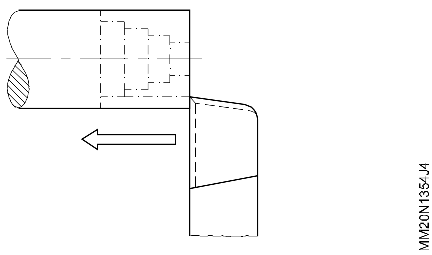
Restrict the depth of cut to a maximum of 3mm for each cut as only hand feed is given.

Repeat by further depth od cut, if needed to finish the first step.

Keep the carriage in a locked position.

Measure the diameter and length of each step to confirm the dimensional accuracy.

Fig 4



Form an undercut shoulder at the junction of two diameters

Objectives: This shall help you to
- **set the undercutting tool in the tool post**
- **set the tool at the required position**
- **perform undercut operations**
- **check the undercut width and depth with a vernier caliper.**

The end of a section to be threaded is mostly undercut to provide a channel into which the threading tool may run. It allows the mating part to sit squarely against it. When the diameter is to be finished to size by grinding. A channel is generally cut against the shoulder to provide a clearance for the grinding wheel. Thus ensuring a square corner.

To form an undercut shoulder at the junction, the following procedure is to be followed.

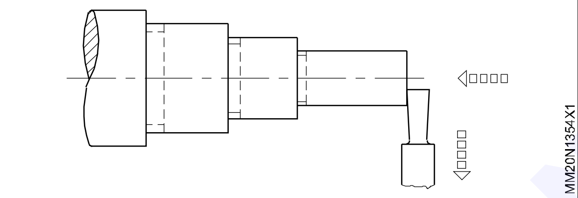
Select a suitable tool bit or grind one to the shape and size required.

Mount the tool bit in the tool - holder.

Set the correct spindle speed, and start the machine.

Rotate the carriage handle until the tool almost touches the face of the work.(Fig 1)

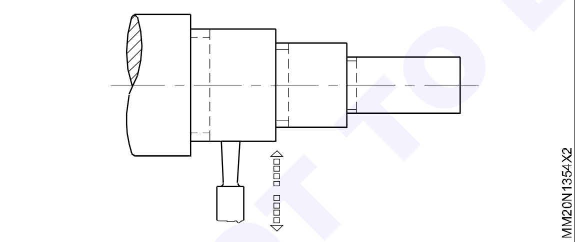
Fig 1



Lock the saddle in this position.

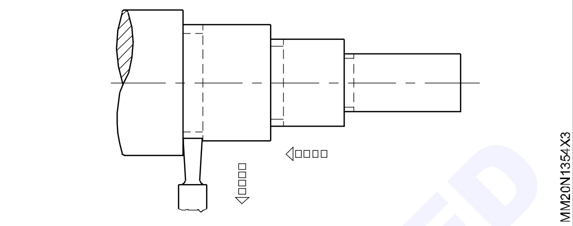
Rotate the cross slide handle and touch the work surface lightly with the front cutting edge of the tool. Set the cross slide graduated collar to zero. (Fig.2)

Fig 2



Rotate the cross-slide handle until the tool marks the shoulder lightly.(Fig.3)

Fig 3

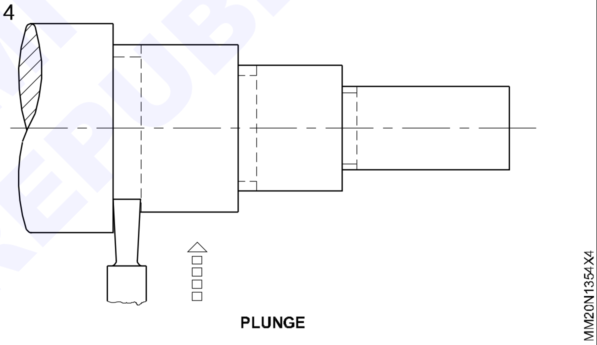


Note the reading on the graduated collar of the top slide feed screw and set the reading to zero.

Apply cutting fluid.

Feed the tool slowly and evenly into the work to the required depth using the cross-slide handle.(Fig 4)

Fig 4



Widthdraw the tool from the undercut when the required depth is reached.

Stop the lathe and check the undercut for its dimensions.

Remove sharp corners if any.

Chamfering on a lathe

Objective: This shall help you to
- **chamfer the end 45°**

- Chamfering is an operation of beveling the edge of a work piece
- Set the tool in any one of the ways shown in Fig.1,2 & 3 in the tool post to correct centre height.
- Plunge the tool and form the chamfer to the size specified.

Fig 1

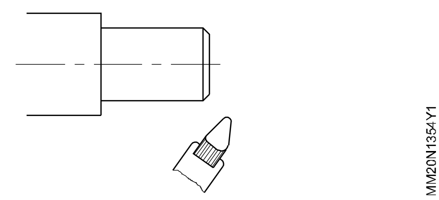


Fig 2

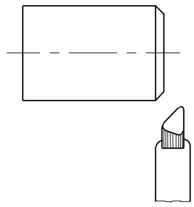
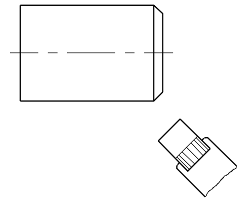


Fig 3



— — — — — — — — — —

Skill sequence

Parting off operation

Objectives: This shall help you to
- **set the parting off tool in the machine to the correct centre height**
- **follow the correct procedure while parting off**
- **observe certain precautions while parting off.**

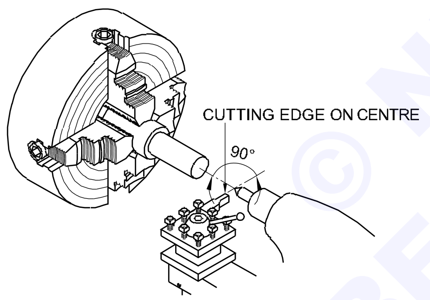
Parting off operation

Parting off or cutting off is the operation of severing a finished part from the rough or finished stock.

Setting of parting tool

Set the parting tool exactly on the centre with as little back-rake as possible. (Fig 1)

Fig 1

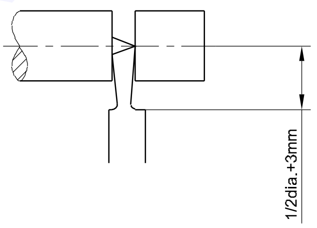


CORRECT CUTTING EDGE POSITION

Adjust the parting off tool so that it extends one half the diameter of the work plus about 3mm for clearance from the tool-holder (Fig 2)

> **If the cutting tool is too high, it will not cut through the workpiece. If it is too low, the work may be bent and the cutting tool may be damaged.**

Fig 2



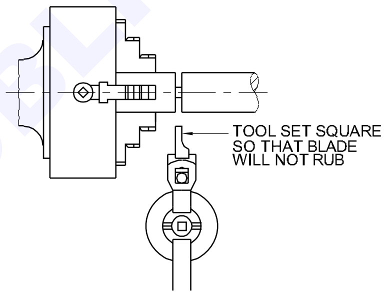
Procedure

Select the correct type of tool for a specified job.

Hold the work with the minimum overhang in a chuck.

Set the tool square with the work so that it does not rub against the sides of the groove, as it is fed into the work. (Fig 3)

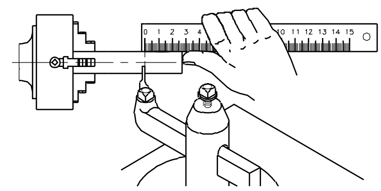
Fig 3



Set the spindle speed to half the speed for turning.

Move the carriage so that the right hand side of the blade is at the point where the work is to be cut off. (Fig 4)

Fig 4



PARTING TOOL POSITIONED TO CUT OFF
A DEFINITE LENGTH OF WORKPIECE

Start the lathe and feed the tool steadily into the work using the cross-slide handle.

Continue to feed the tool into the work until the part is severed.

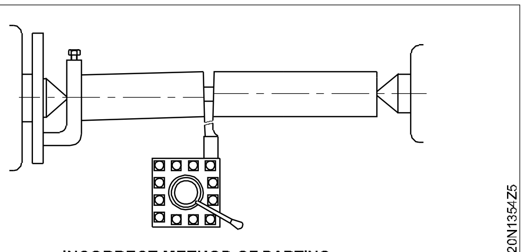
Precautions

The work should protrude from the chuck jaws, sufficiently enough to permit the cut to be made as close as possible to the chuck jaws.

The work must always be held securely in a chuck or a collet.

If the workpiece is held between centres, it may bend or break and fly out of the lathe during parting off. (Fig 5)

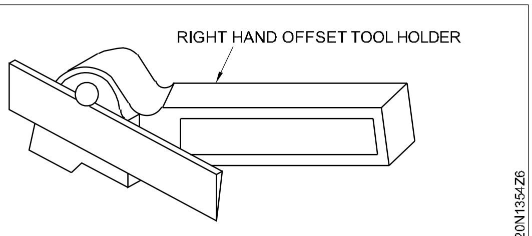
Fig 5



INCORRECT METHOD OF PARTING

Use a right hand offset tool-holder. (Fig 6)

Fig 6



INSERTED-BLADE TYPE PARTING TOOL

A work having more than one diameter should be gripped on the larger diameter while parting.

Intermittent feed tends to dull the tool's cutting edge.

Heavy feed causes jamming and tool breakage.

A work having more than one diameter should be gripped on the larger diameter while parting.

Intermittent feed tends to dull the tool's cutting edge .

Use sufficient coolant on steel. Brass and cast iron should be cut off dry.

Make sure the saddle is locked during the entire operation.

Reduce the rate of feed, when the work is almost cut off.

While parting off long work, it should be supported with the tailstock centre.

If the machine is in good condition, the automatic cross feed may be used.

When the tool has penetrated to about the depth of its width, withdraw it and move it sideways with the compound slide and feed again.

The above operation should be repeated frequently to minimise the tendency of the tool to dig in and cause trouble.

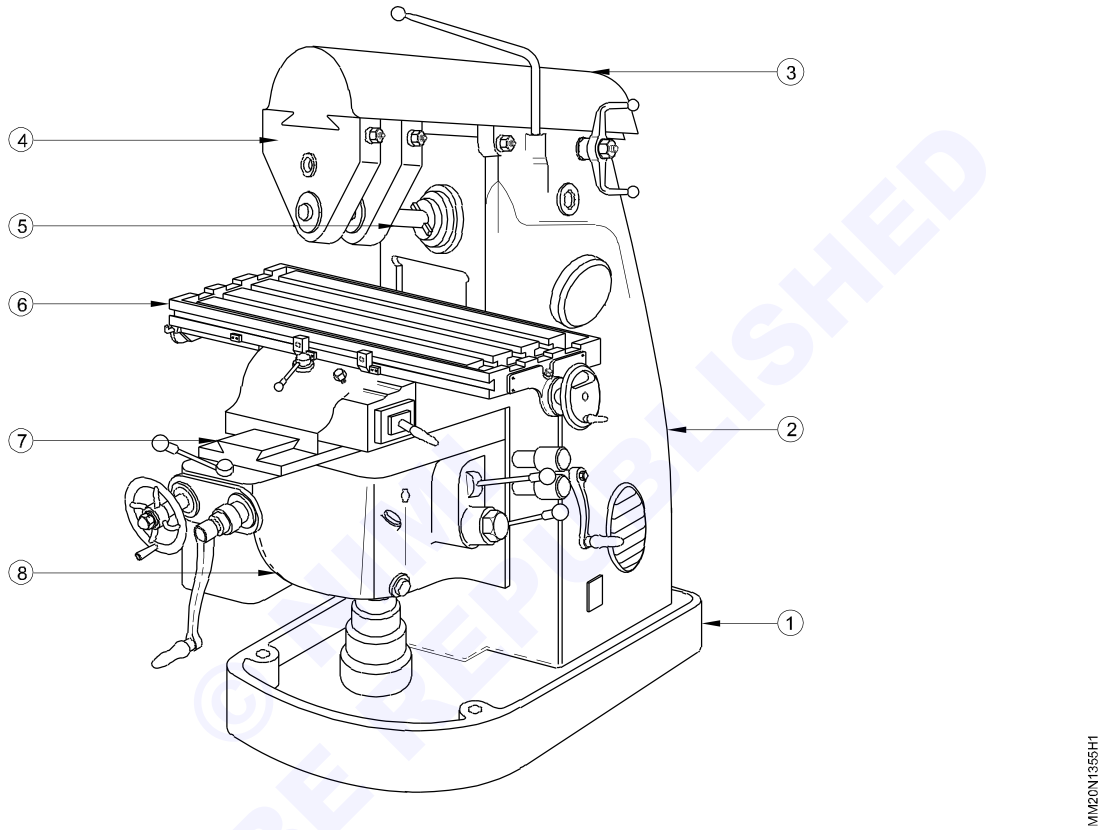
When the parting off operation is almost completed, hold the workpiece by hand to prevent it from falling, so that damage can be avoided.

— — — — — — — — — —

Demonstrate working principle of milling machine

Objectives: At the end of this exercise you shall be able to
- **movement of the slides manual and automatic**
- **run the machine in different spindle speed**
- **put ON and OFF the machine.**

Fig 1



Job Sequence

- Identify the machine parts.
- Move the slides manually
- Set the different spindle speed.
- Practice on mounting of different arbor.
- Practice on automatic feed and rapid movement

Table 1

Sl.No	Name of the parts	Type of movement
1		
2		
3		
4		
5		
6		
7		
8		

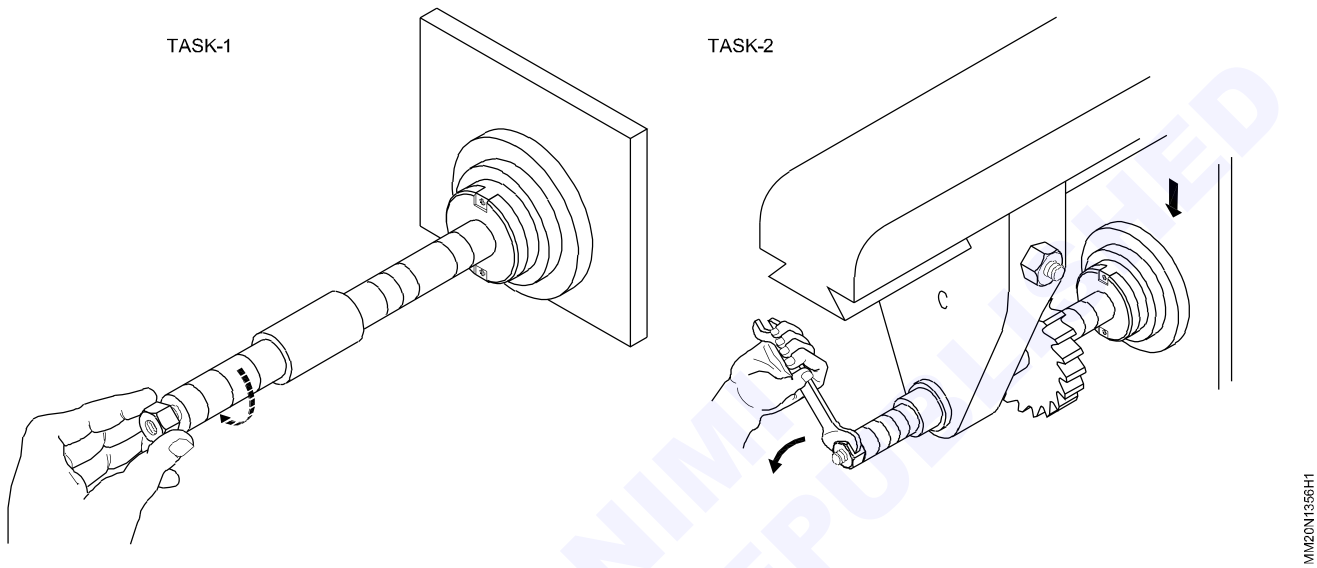
Set arbor and cutter on arbor of milling machine

Objectives: At the end of this exercise you shall be able to
- **mount arbor on the machine spindle of milling machine**
- **mount and position the cutter on milling machine arbor.**

PROCEDURE

TASK 1

Fig 1



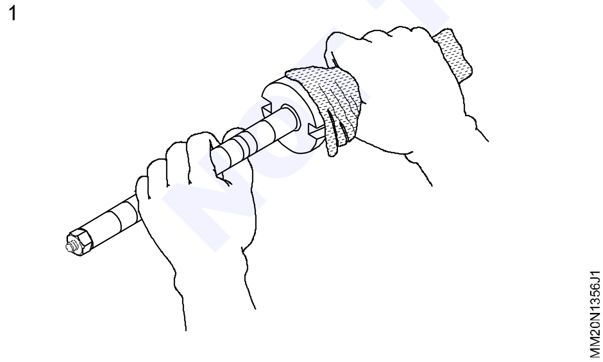
Set the lowest available spindle speed to avoid free rotation of the spindle nose.

Ensure that the machine is switched off. Consult your instructor.

Select the arbor with correct diameter and taper to suit the machine spindle nose.

Clean the internal thread and taper portion of the arbor. (Fig 1)

Fig 1



Clean the spindle nose of the machine. (Fig 2)

For cleaning, use soft cloth free from dust, chips etc. to avoid scratches on the surface.

Hold the arbor and ensure that the arbor notches fit on to the nose of the tenon to get the drive. (Fig 3)

Fig 2

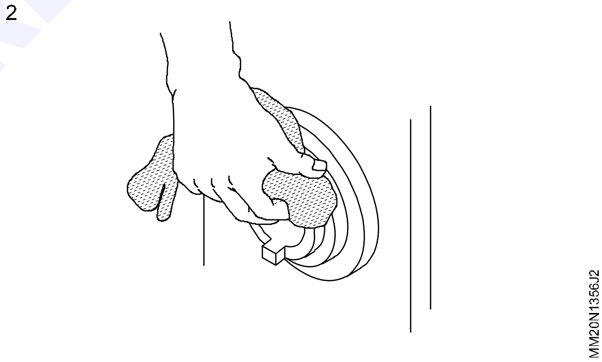
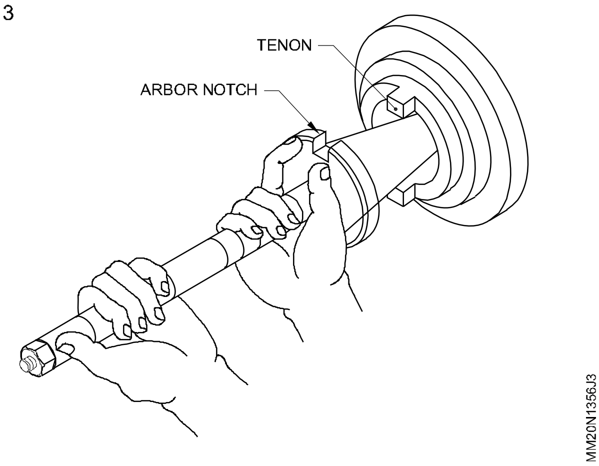
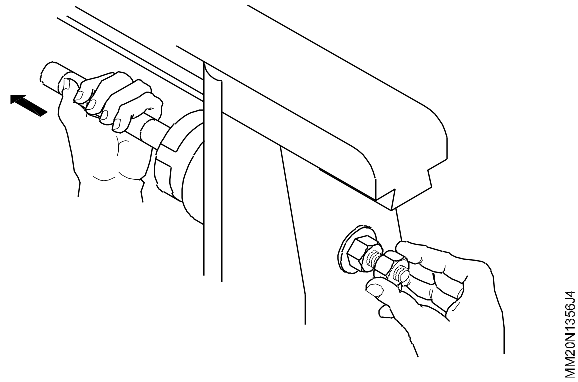


Fig 3



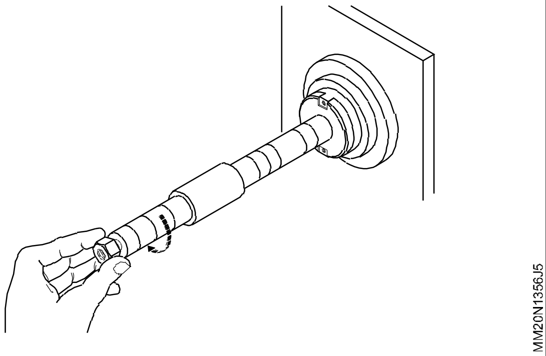
Tighten the draw - bar from the rear side of the spindle and secure the arbor into machine by tightening the lock - nut. (Fig 4)

Fig 4



Unscrew and remove the nut from the arbor end by rotating it in the clockwise direction. (Fig 5)

Fig 5

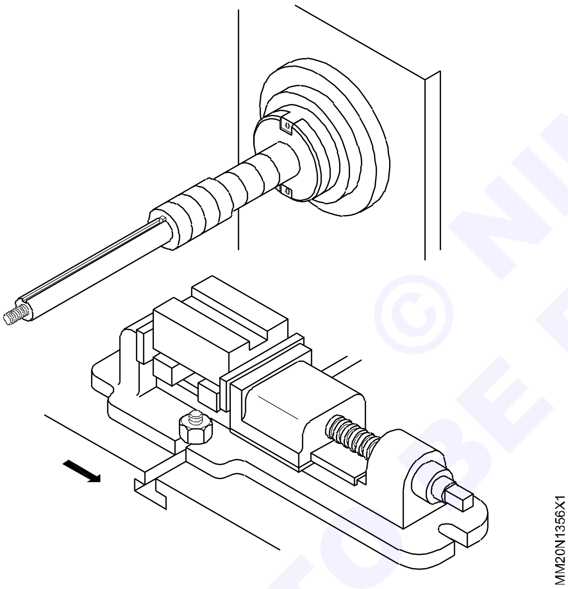


— — — — — — — —

TASK 2:

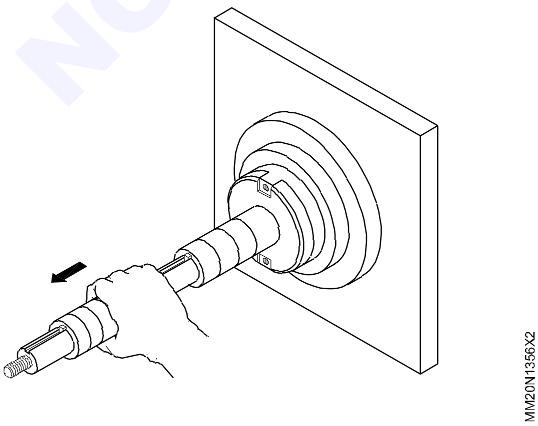
Remove the spacers and bearing bushes and clean them. (Fig 1)

Fig 1



Insert enough spacers on to the arbor so that the last spacer extends over the rear edge of the workpiece. This will enable you to fix the cutter in the middle of the workpiece for milling. (Fig 2)

Fig 2

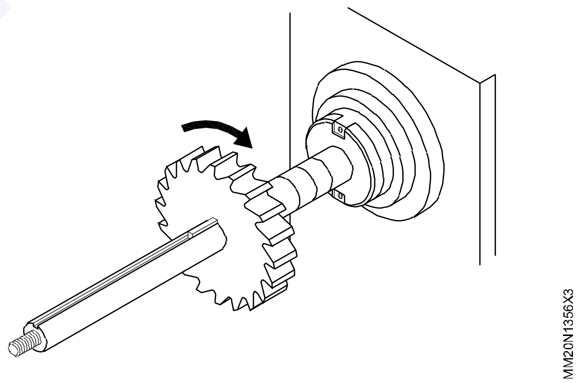


Clean the side and face the cutter and the bore of the - cutter.

Select the key to suit the cutter keyway.

Place the cutter on the arbor such that the direction of rotation of the cutter is in the opposite direction of the job feed for up-milling at the initial stage. Depending upon the condition of the machine, down-milling may be performed at a later stage of practice. (Fig 3)

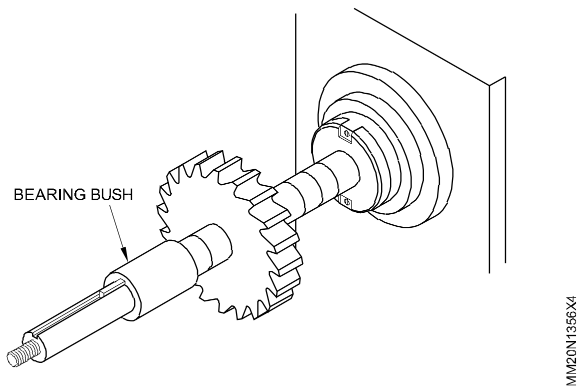
Fig 3



Ensure that the key is placed into the keyway, and milling cutter.

Slide the bearing bush on to the arbor. (Fig 4)

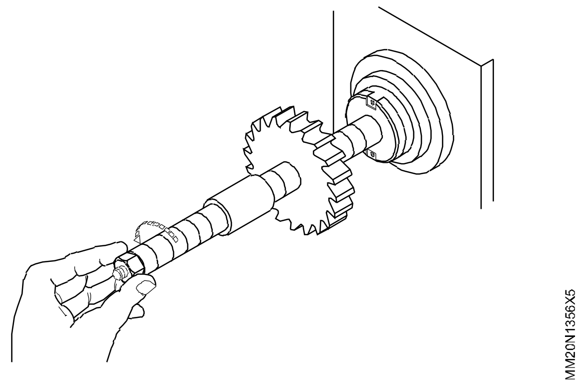
Fig 4



Slide on more spacers until one or two threads on the arbor screw are covered so that the spacers are pressed while tightening. If not, the cutter may not be tightened sufficiently.

Tighten the arbor nut by hand. (Fig 5)

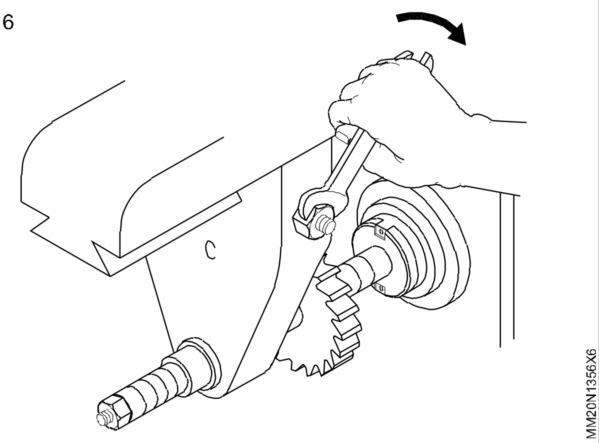
Fig 5



Carefully slide the arbor support. (Fig 6)

Ensure that the bearing bush extends equally on both sides of the arbor for uniform support.

Fig 6

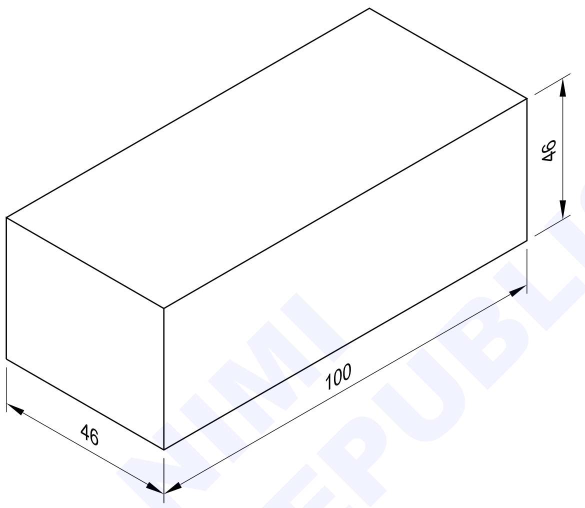


Tighten the arbor nut and switch on the machine and check visually that the cutter runs true.

The milling machine, like all machine tools, should be cleaned after each work period. A medium width paint brush may be used to remove the accumulated chips

Sequence of milling six faces of a solid block

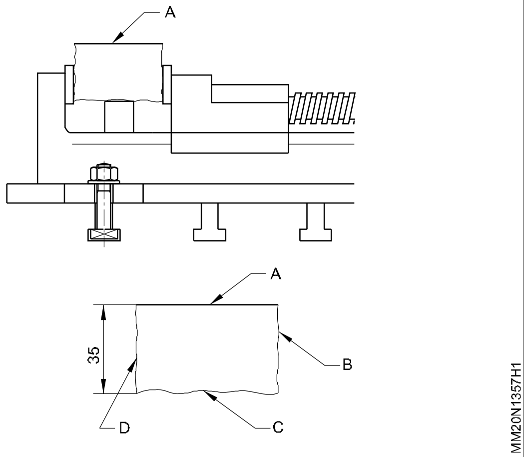
Objectives: At the end of this exercise you shall be able to
- **set the workpiece on a horizontal milling machine**
- **mill six faces perpendicular to each other**
- **maintain the size of the workpiece.**



Job Sequence

- Clamp the machine vice securely on the machine table and align jaw parallel to the column.
- Fasten the cutter in the machine.
- Set the required RPM
- Place surface ‘C’ on the parallel block, clamp the job. Ensure that the parallel block dose not move.
- Mill surface ‘A’ flat. (Fig 1).
- Keep surface ‘A’ against the fixed jaw and surface D on the parallel block.
- In the middle of the surface C, a round rod is kept between the job and the movable jaw for line contact to avoid lifting of the job. This roller enables for maintaining squareness of the surfaces A&B. (Fig 2)
- Mill surface ‘B’ at right angle to surface ‘A’. (Fig 2)

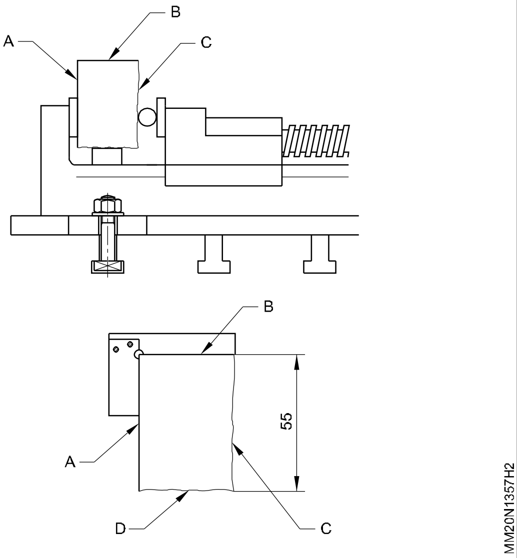
Fig 1



1	ISSQ50X105	-	Fe310	-	-	1.3.57
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

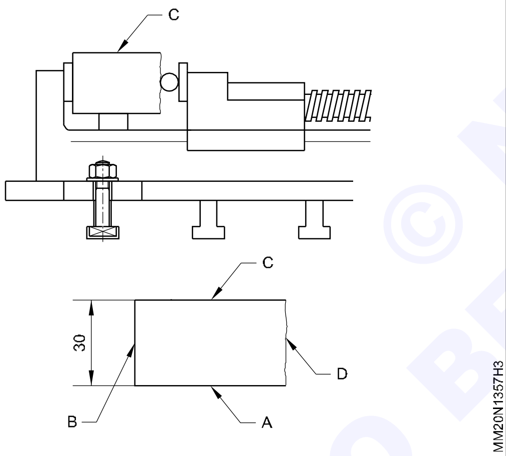
SCALE 1:1	SEQUENCE OF MILLING SIX FACES OF A SOLID BLOCK	DEVIATIONS ± 0.1	TIME : 8hrs
		CODE NO. MM20N1357E1	

Fig 2



- Keep the surface 'A' on the parallel blocks and butt the surface B to the fixed jaw.
- Place a round rod in between movable jaw and surface D.
- Mill surface C maintaining the size of 46mm (Fig 3).

Fig 3



- Keep surface C on the parallel blocks.
- Set the work, projecting it atleast 10mm from the sides of the vice.
- Mill surface 'D' maintaining a size of 46 mm (Fig 4)
- Keep surface 'C' on the parallel blocks (Fig 5)
- Set side and face milling cutter and mill the surface 'E' (Fig 6)
- Set the RPM for side and face cutter.
- Mill the 'F' side by the side and face cutter and maintain the size (Fig 7)
- Deburr the job and check all the dimensions.

Fig 4

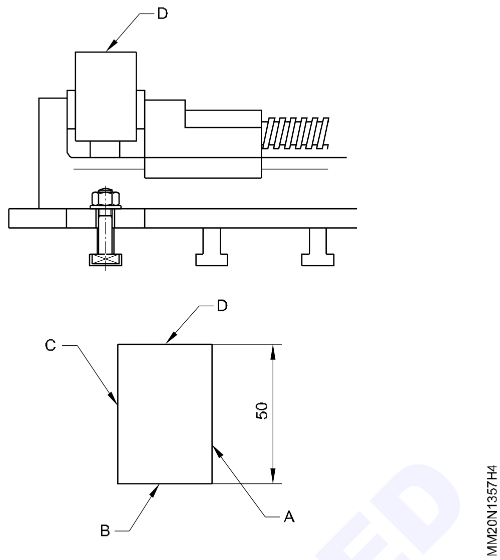


Fig 5

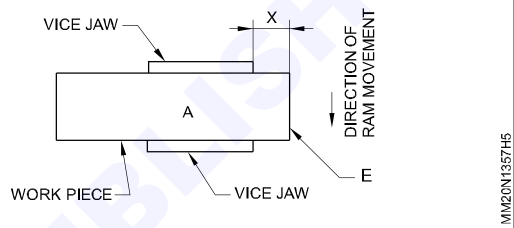


Fig 6

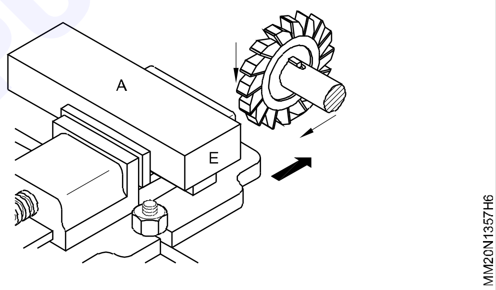
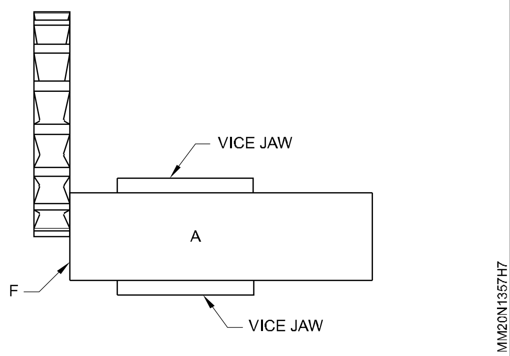


Fig 7



Skill Sequence

Objectives: This shall help you to
- **check the flatness with try square blade**
- **check the squareness with try square**
- **check the height with the vernier height gauge.**

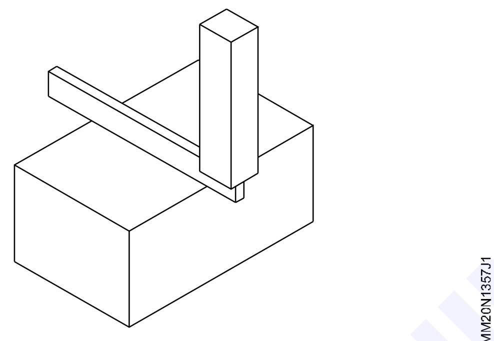
Checking flatness with try square blade

During the initial stages of filing the evenness of the surface can be visually observed to a reasonable degree of perfection from the surface texture of diagonal filing.

To ensure perfection, the surface should be checked with a straight edge. To do this, the blade of a try square can serve as a straight edge.

Flatness should be checked in all directions so as to cover the entire surface. Light gap will indicate high and low spots. (Fig 1)

Fig 1



Checking squareness

While checking for squareness, the large finished surface is taken as a reference surface. (Fig 2)

Ensure that the reference surface is finished perfectly before filing other surfaces.

Burrs, if any, should removed before checking with a try square.

Check the accuracy with the help of vernier height gauge (Fig 3)

- Keep the job on the surface table
- Set the vernier height gauge on the surface table
- Zero set the instrument using the offset scriber
- Zero setting of the instrument is at a level above the datum surface for using the straight scriber.
- Check the height of the job to a accuracy of ± 0.02mm.

Fig 2

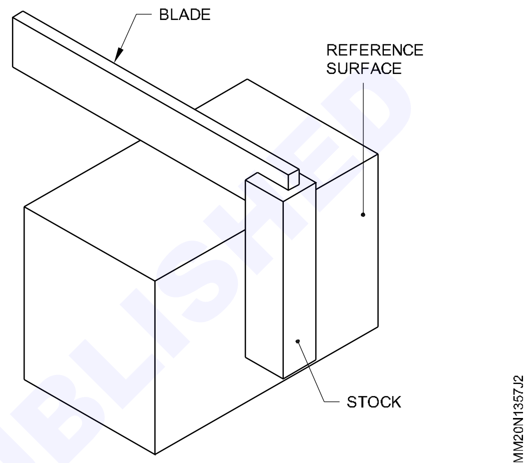
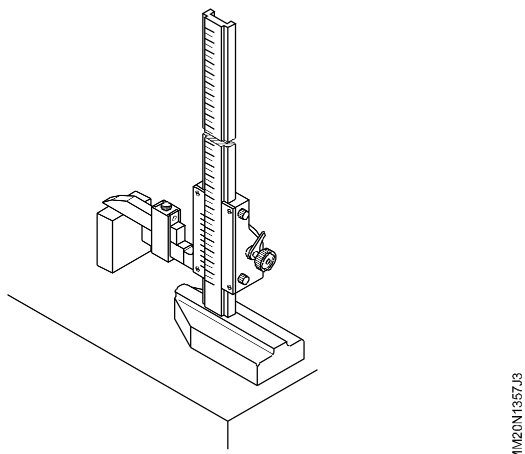


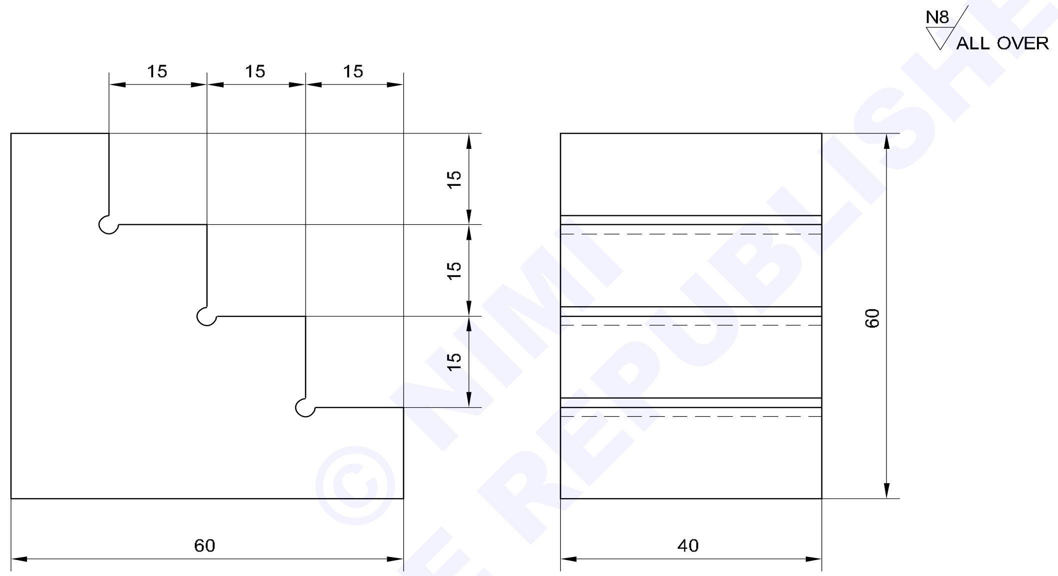
Fig 3



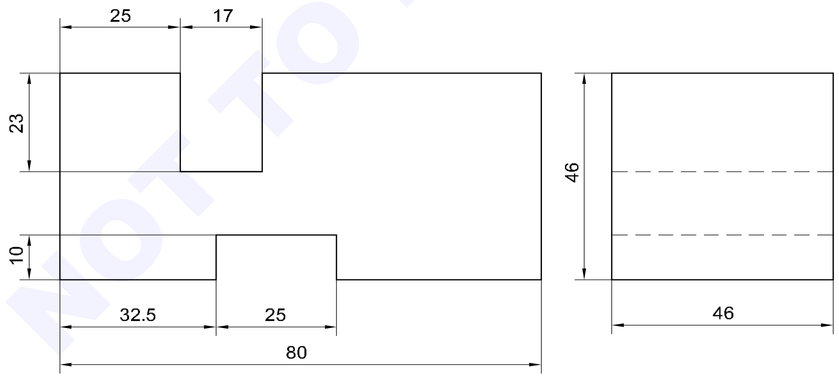
Perform step milling and slot milling with side & face cutter

Objectives: At the end of this exercise you shall be able to
- **lay out the job as per drawing with a vernier height gauge**
- **set the job in the machine vice for machining**
- **mount a side and face cutter on the arbor**
- **mill steps on the job**
- **check the dimensions of the steps using a depth micrometer.**
- **align the job with respect to the cutter**
- **mill the slot**
- **check the width of the slot using a vernier caliper**
- **check the depth of the slot using a vernier depth gauge.**

TASK:1



TASK:2



1	-	1.3.57 ←	CI BLOCK	-	-	1.3.58
1	60X60X40	-	CI BLOCK	-	-	1.3.58
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**PERFORM STEP MILLING AND SLOT MILLING WITH SIDE AND FACE CUTTER**	DEVIATIONS ± 0.1	TIME : 10 hrs
		CODE NO. MM20N1358E1	

TASK 1

Job Sequence

- Check the dimensions of the block. (Deburr, if necessary)
- Mark the steps on the block (steps) as per the dimensions and punch witness marks.
- Align the machine vice with reference to the column using dial indicator.
- Mount a Ø32 mm long arbor and a side and face milling cutter of Ø125x16x32mm bore for the horizontal milling machine
- Set the r.p.m. of the cutter near to 50.
- Clamp the job in the machine vice to mill all the steps in one setting.
- Align the cutter and the job for milling the step.
- Mill the steps in sequence and check with a depth micro meter. Mill the relief groove before grinding for grinding purpose.
- Drill relief hole Ø3 mm at the junction of steps.

Skill Sequence

Mill steps on plain milling machine

Objective: This shall help you to
• mill steps on plain milling machine.

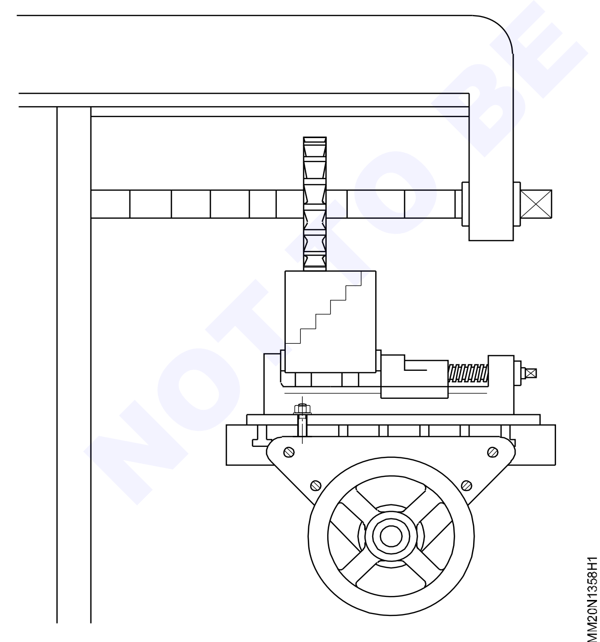
Align and mount the plain machine vice on the machine such that the vice jaws are parallel to the column.

Mark the job as per drawing and punch witness marks.

Hold the job in the machine vice.

> **Clamp the job in the machine vice such that all the steps can be machined in one setting. (Fig 1) If the job cannot be accommodated on the plain milling machine, step mill on the vertical milling machine.**

Fig 1



Mount the long arbor and the side and face milling cutter.

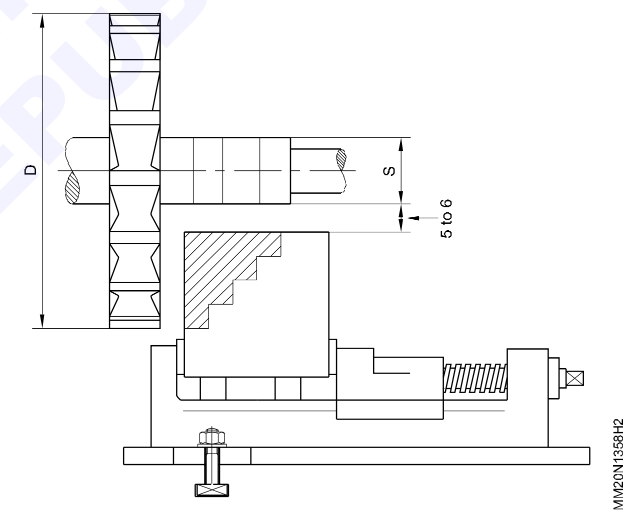
Ensure that (D - S)/2 is 5 to 6 mm more than the maximum depth to be machined.

D = diameter of the cutter

S = outside diameter of the spacers

The gap of 5 to 6 mm is provided to avoid fouling of the spacers with the job while machining. (Fig 2)

Fig 2

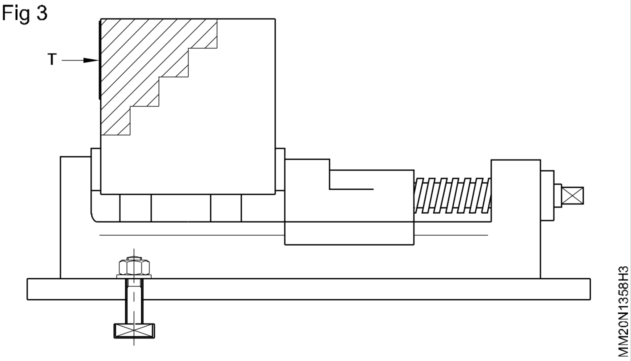


Set the machine for up-milling.

Calculate and select suitable r.p.m. for the cutter.

Stick tissue paper (T) on the side face of the job. (Fig 3)

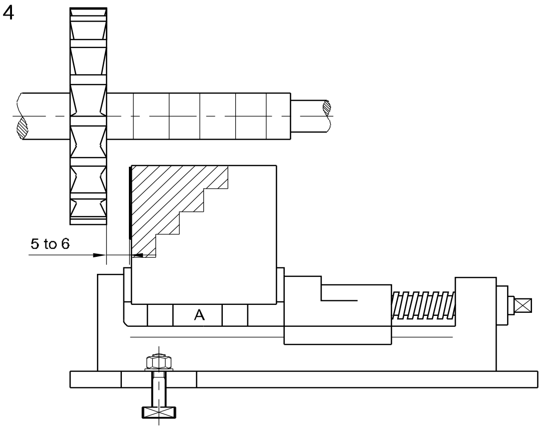
Fig 3



Raise the vertical slide such that the upper surface of the job is 10 to 15 mm above the cutter.

Move the table and bring the tissue paper side of the job parallel to the side of the cutter with a gap of 5 to 6 mm. (Fig 4).

Fig 4



Start the spindle.

Move the cross-slide slowly till the tissue paper is just displaced from its position.

Stop the machine as soon as the tissue paper slips.

Lock the cross-slide.

Adjust the graduated scale to zero of the cross-slide.

> **This is the datum in one axis for milling the steps horizontally.**

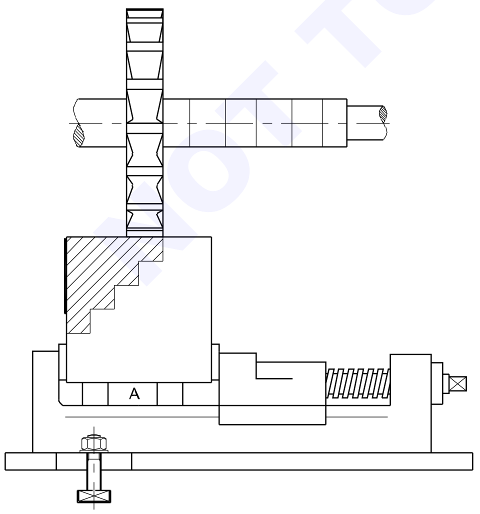
Stick the tissue paper on the top surface of the job.

Clear the workpiece from the cutter and set the cutter 10-15 mm above the top surface of the job.

Start the machine.

Raise the workpiece slowly and manually till the job just touches the cutting edges and the tissue paper slips away by the rotation of the cutter. (Fig 5)

Fig 5



Stop the machine as soon as the tissue paper slips.

Adjust the graduated scale to zero of the vertical slide.

> **This is the datum in another axis for milling the steps vertically.**

Unlock the vertical slide.

Clear the job from the cutter.

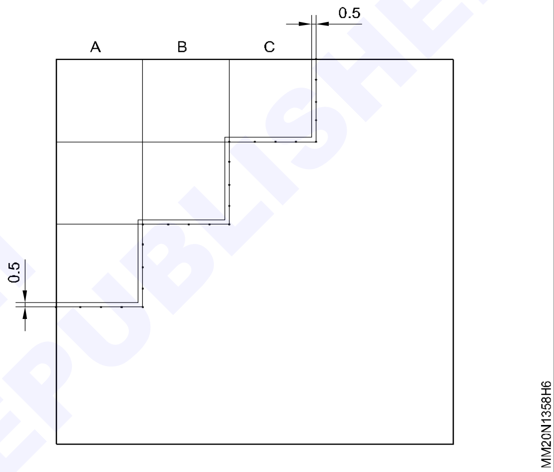
> **Take care that the datum, set for both the axes, is not disturbed.**

Set the coolant nozzle towards the cutter.

> **Depending upon the condition of the machine, rough milling is possible by using a heavy feed, with a depth of cut from 5 to 10 mm and a low cutting speed. Rough milling is done to remove surplus material in the shortest time. Consult the instructor when and if necessary.**

Rough mill the steps a,b,c in that order. (Fig 6)

Fig 6



Leave 0.5 mm allowance of material on both the axes for the final finish.

While machining observe for abnormal noise, vibration of job or cutter and bad surface finish. If you are in doubt stop the machine and check that the

- job is tightened firmly, without any shake
- cutter is tightened securely without play
- cutter teeth are not blunt.

Ensure defect-free machining condition, restart the machine and complete the rough milling operation.

Clear the job from the cutter and deburr the job.

Measure the job and confirm that 0.5 material is left for final finishing.

Set the machine and complete the steps to the final dimension and finish to a smooth surface by automatic feed.

> **A fine finish is achieved by relatively high cutting speed and fine feed - check the dimension after completion of each step - consult the instructor.**

Stop the machine and deburr the job.

Remove the job and measure for its size.

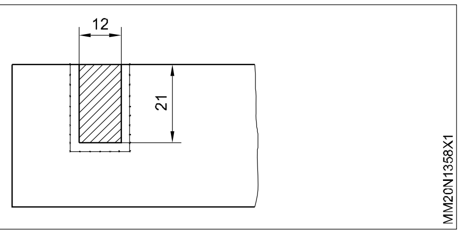
> **Stop the machine before attempting to make adjustments or measurements.**

TASK 2

Job Sequence

- Check the dimensions of the block, 100 x 46 x 46mm.
- Machine the block to the dimension of 96 x 46 x 46mm.
- Mark the groove as per drawing and punch witness marks.
- Hold the job on the machine vice using parallel blocks.
- Mount the side face milling cutter 100 x 12 x 27 mm bore at the centre of the arbor and set the spindle speed to 100 r.p.m.
- Align the workpiece with reference to the cutter.
- Mill the slot in the middle of the job giving a depth of cut of 4 mm up to a depth of 21 mm. (Fig 1)

Fig 1



- Offset the job towards the column by 2.0 mm (Fig 2) and mill the width to 14.0 mm (Fig 2). Offset the job away from the column by 5 mm and mill the slot to 17 mm. (Fig 3)
- Check the size of the slot.

Fig 2

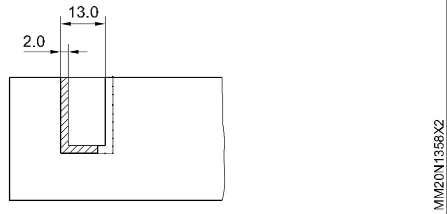
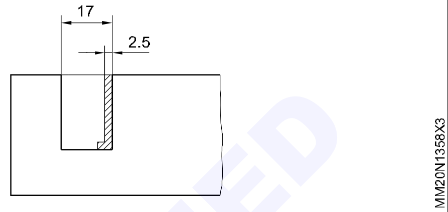


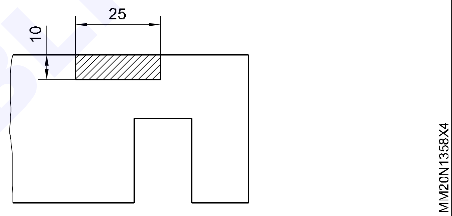
Fig 3



Reset the job and mill a slot of 25 x 10 on the opposite side. (Fig 4)

- Deburr and measure.

Fig 4



Skill Sequence

Mill a slot by side and face milling cutter

Objective: This shall help you to
- **mill a slot by a side and face milling cutter.**

Deburr and clean the workpiece.

Mark the job as per drawing and punch witness marks on the lines.

Mount the plain machine vice on the plain milling machine such that the vice jaws are parallel to the column.

Select the cutter size.

The width of the cutter should be less than the width of the slot required.

Calculate the diameter of the cutter approximately, using the following thumb rule.

Select the nearest higher diameter available.

Dia. of cutter/2 = (depth of slot + bore dia./2 + 20) x 2.

Mount the long arbor and the side and face milling cutter on the machine.

Ensure that the cutter is mounted at the middle of the arbor to facilitate the free traverse of the cross-slide.

Clamp the job with its marked surface on the top, between the vice jaws firmly.

Keep the job on the pair of parallels in such a way that the top surface of the job is above the top surface of the jaws by 4 to 5 mm. (Fig 1)

Calculate the r.p.m. for the selected dia. of the side and face cutter.

Calculate the feed per minute of the longitudinal traverse.

Set the r.p.m. and feed.

Stick tissue paper to the reference sides of the workpiece and set the datum for the cross and vertical slides.

Set the cutter at the middle of the slot to (X+W/2) mm

taking reference from the side datum (cross-slide).

(Fig 2) W is width of the slot.

Fig 1

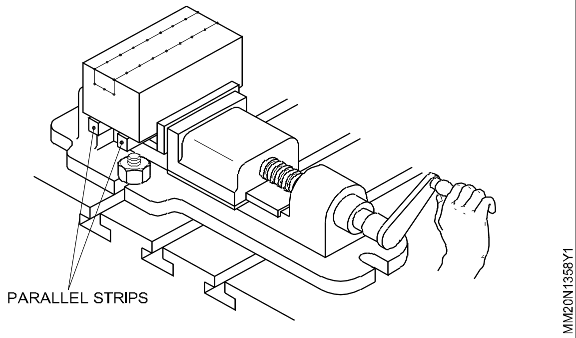
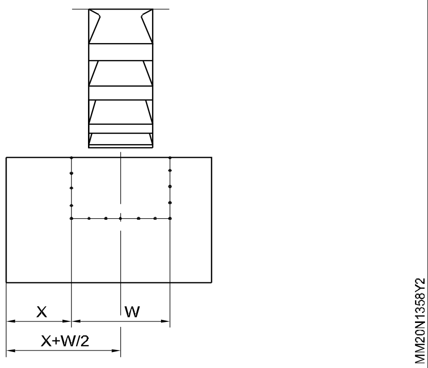


Fig 2



Set the depth of cut taking reference from the top surface of the job.

Be sure that whenever the depth of cut is taken, the cutter is away from the job.

Keep 0.4 to 0.5 mm on both the sides and depth of the slot for final finish.

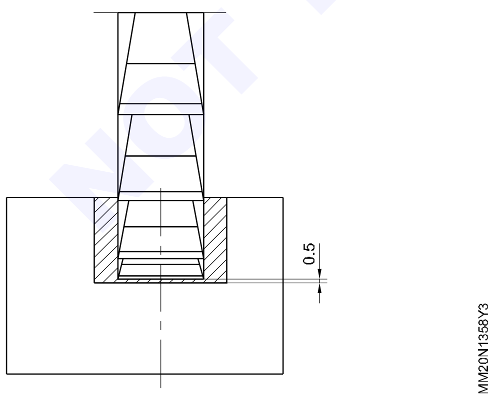
Lock the vertical and cross-slides. Adjust the coolant nozzle point on the cutter.

Start the machine and the coolant pump.

Move the longitudinal slide manually towards the cutter such that the workpiece comes in contact with the cutter gently. Sudden contact may damage the workpiece and the cutter may break.

Mill the depth at the middle of the slot leaving 0.4 to 0.5mm for final finish. (Fig 3)

Fig 3

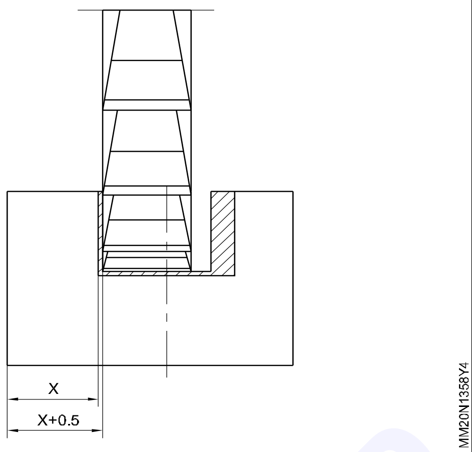


Move the cutter to the left to a distance of X + 0.5 mm and mill the side of slot. (Fig 4)

Ensure that the datum is again set whenever the cutter is changed or the job disturbed.

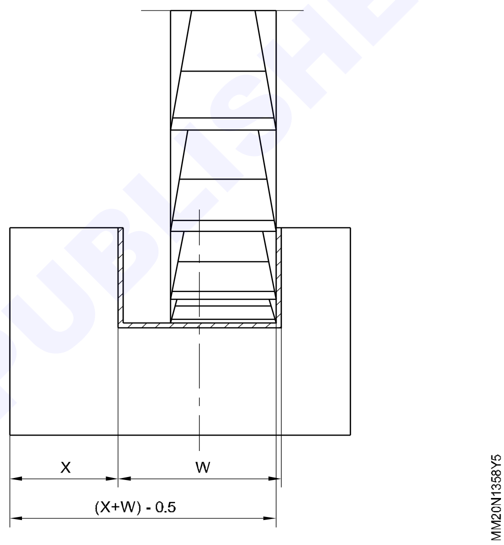
Move the cutter to the right to a distance of (X+W) =

Fig 4



0.5mm and mill the right side of the slot. (Fig 5)

Fig 5



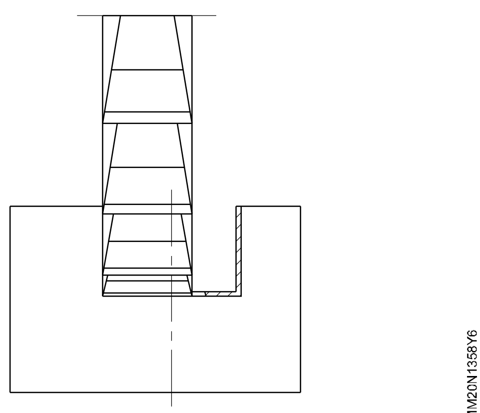
Follow the above procedure and mill the slot to size. (Fig 6)

Deburr the job.

Check the slot for dimension.

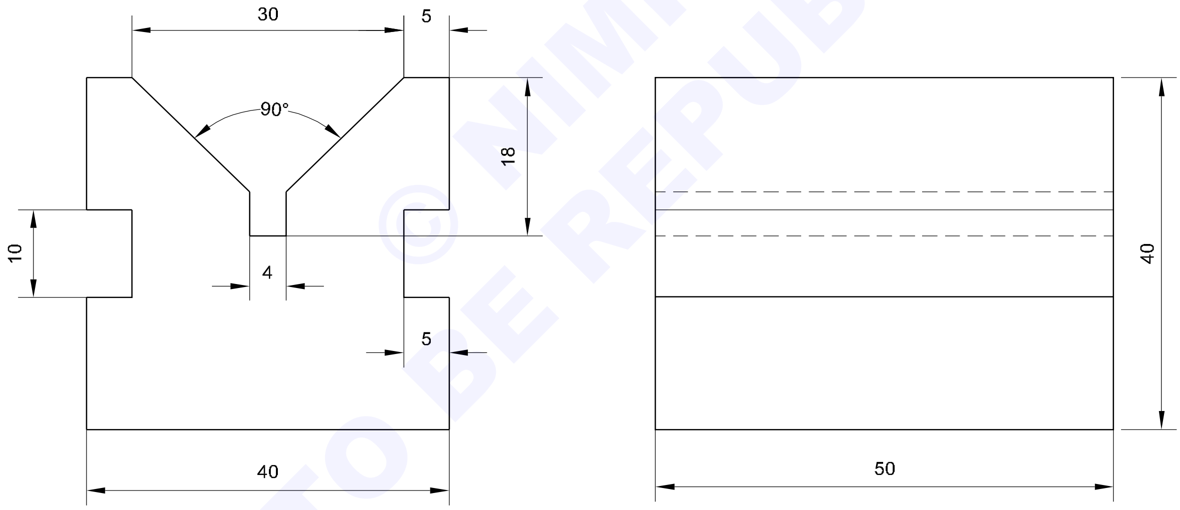
Be sure the holding device is mounted solidly to the table and the work is held firmly. Spring or vibration can cause thin cutters, like the slitting saw, to jam and chatter.

Fig 6



Make 'V' Block using horizontal milling machine with accuracy ±0.02mm

Objectives: At the end of this exercise you shall be able to
- **mark and punch as per drawing**
- **set slitting saw cutter**
- **set 90° equal angle milling cutter on arbor**
- **cut angular surface to an accuracy of ± 10 minutes**
- **check angle using vernier bevel protractor**
- **check dimensions using vernier caliper**
- **cut slots with an accuracy of ± 0.02mm.**



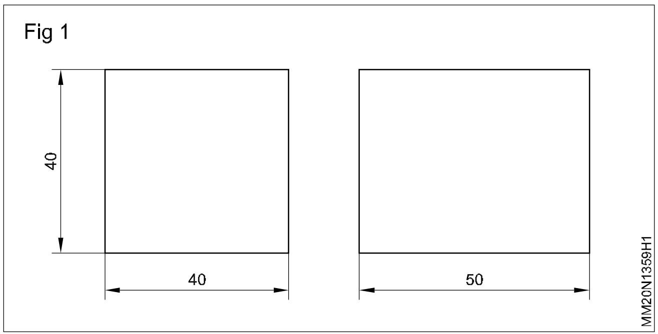
1	ISSQ 50-60	-	Fe310	-	-	1.3.59
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**MAKE 'V' USING HORIZONTAL MILLING MACHINE WITH ACCURACY ±0.02MM**	DEVIATIONS ± 0.02MM	TIME : 10 hrs
		CODE NO. MM20N1359E1	

Job Sequence

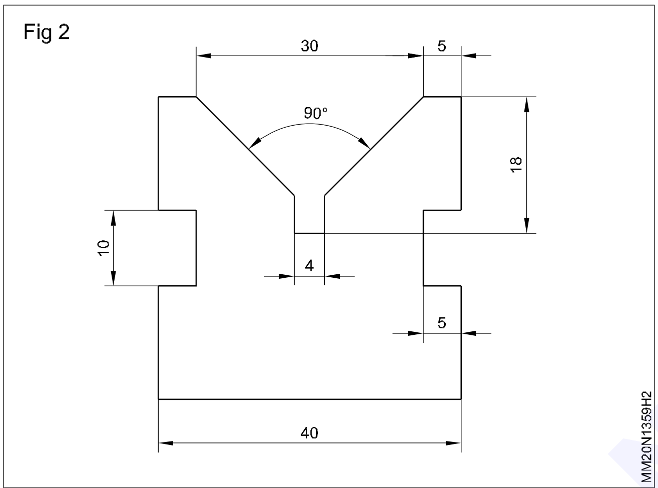
- Machine the block flat and square, to size 50x40x40mm (Fig 1)

Fig 1



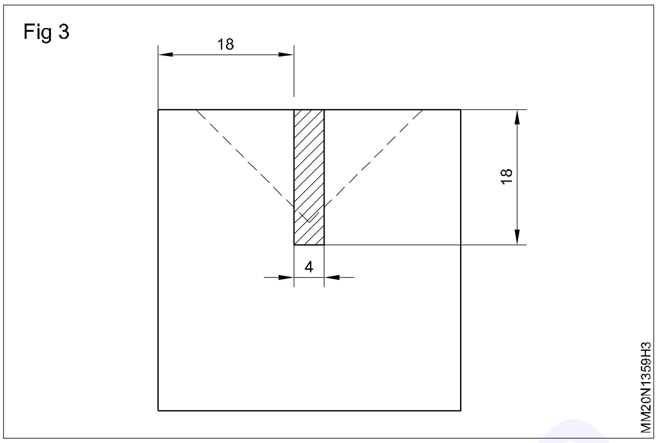
- Mark and punch the job as per drawing (Fig 2)

Fig 2



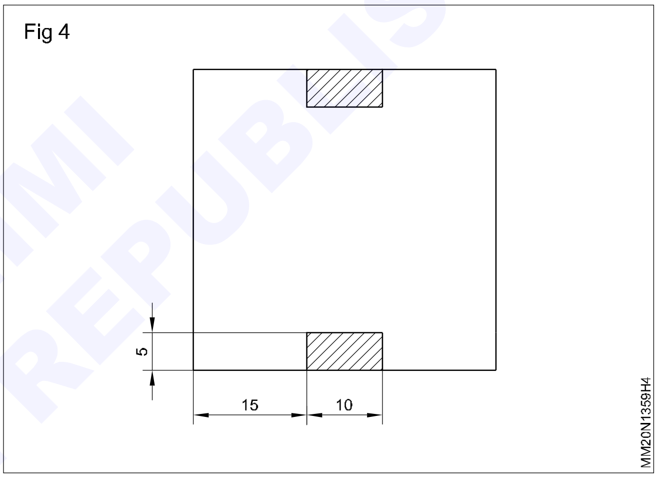
- Set the slitting saw 4mm width
- Hold the job on machine vice
- Mill the slot maintaining dimensions 18,18 and 4mm. (Fig 3)
- Machine angular surface using 45° double angle cutter both the sides.

Fig 3



- Cut slot (shaded portion) maintaining dimensions 15,10 and 5 mm on both sides (Fig 4) using 10mm width side face cutter.
- Check the angular dimensions using vernier bevel protractor.

Fig 4



- Check the dimensions with vernier caliper
- Remove the burrs

Skill Sequence

Mill narrow groove by using slitting saw

Objective: This shall help you to
• **mill a narrow groove by using a slitting saw.**

Mark the job as per drawing to mill a narrow groove.

Mount a plain machine vice on a plain milling machine such that the jaws are parallel to the column.

Set a pair of parallel blocks in such a way that the top surface of the job is 5 to 6 mm above the top surface of the jaws. This will help to measure the dimensions of the slot from the sides using a vernier caliper.

Clamp the workpiece in the machine vice.

Select the slitting saw.

The thickness of the slitting saw sholud be equal to the width of the groove.

The diameter must be sufficiently large so that the desired depth can be achieved.

Check that the slitting saw is sharp and undamaged.

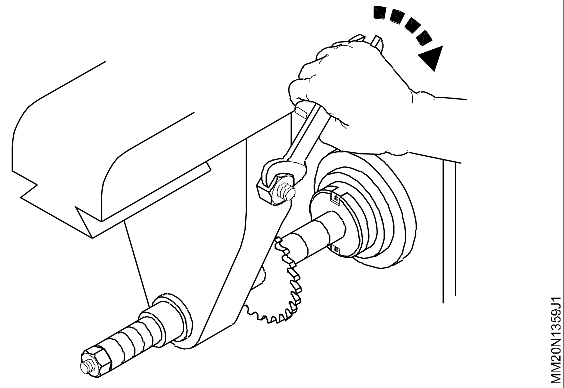
A blunt or damages slitting saw may create excessive vibration and may result in the breakage of the slitting saw.

Select the arbor having the same diameter as the bore of the slitting saw.

Mount the long arbor on the plain milling machine.

Mount the slitting saw on the centre of the arbor.(Fig 1)

Fig 1



Do not insert the key between the arbor and slitting saw, if the slitting saw is less than 4mm thick.

The use of a key may result in the breakage of the slitting saw if it gets jammed into the cut during cutting.

Select the cutting speed, the feed for the slitting saw considering the material the saw is made of .

Calculate the r.p.m., and the feed/min.

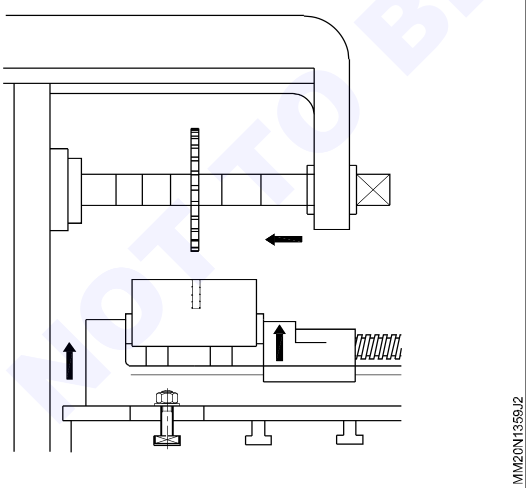
Set the r.p.m. cutter rotation and table feed.

If a higher r.p.m. is set the cutting edges may get blunt, and if a lower r.p.m. is set the cutting time will be more.

Set the nearest lower speed and feed available if the machine does not have the exact values.

By using a hand traverse of the vertical, cross and longitudinal, position the work such that the slitting saw is close to the top of the work. (Fig 2)

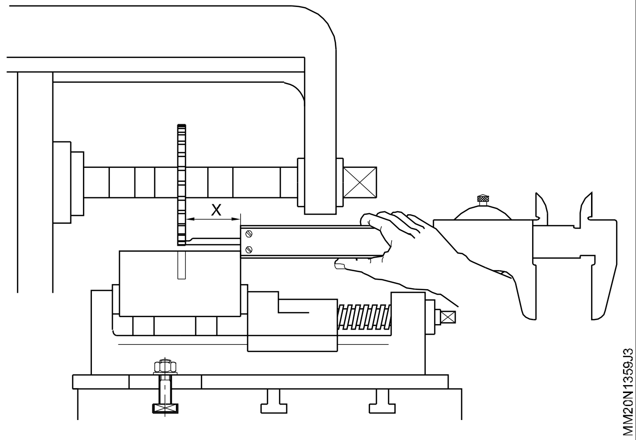
Fig 2



Set the workpiece under the slitting saw such that the distance (x) is as indicated in the drawing.(Fig 3)

For this, move the cross-slide manually. Check 'x' distance with a vernier depth gauge

Fig 3



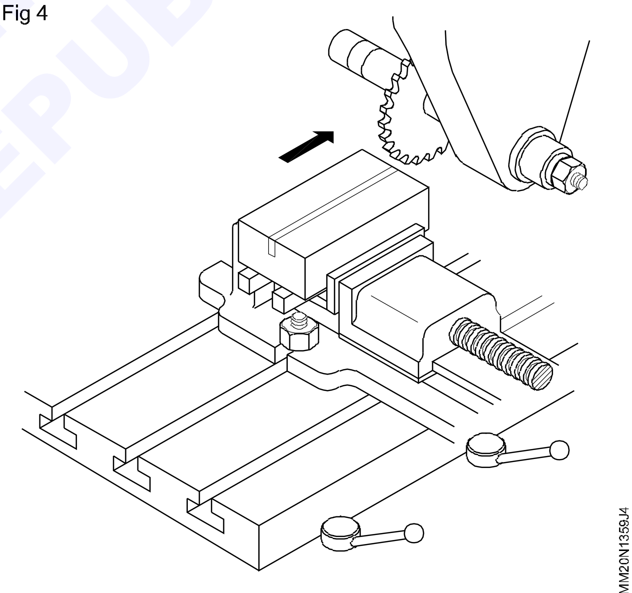
Ensure that the spindle is disengaged. This will ensure that the spindle will not rotate accidentally.

Lock the cross - slide.

Stick tissue paper on the top surface of the workpiece and set the datum for the vertical slide.

Move the longitudinal slide so as to clear the cutter from the workpiece. (Fig 4)

Fig 4



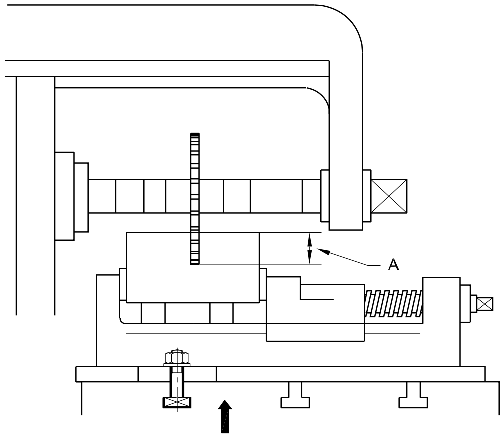
By moving the vertical slide upward, apply a depth of cut. (Fig 5)

Lock the vertical slide.

If the depth of the groove is more by 3 to 4 times than that of the thickness of the cutter (width of the groove), then the total depth of the groove should not be achieved in the first attempt. It should be completed with 2 to 3 passes.

Set the nozzle of the coolant pipe and start the coolant pump.

Fig 5



Start the spindle.

Mill the groove.

Observe the following points during grooving.

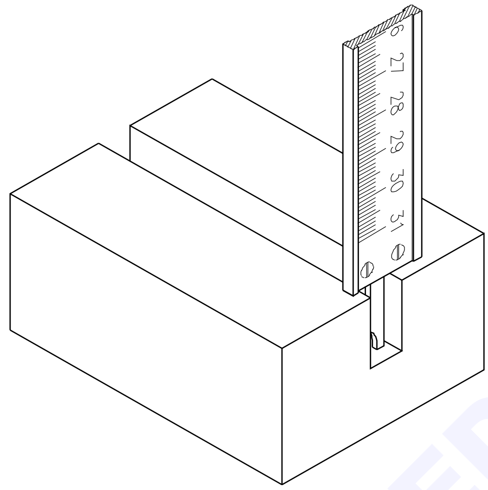
Apply only manual longitudinal feed. This facilitates withdrawing the workpiece from the cutter if it jams into the cut during cutting.

Ensure that there is no abnormal noise in the machine during cutting.

If abnormal noise is generated:

- Reduce the r.p.m and feed
- Check the sharpness of the cutter.
- Check the build up edge is generated in the teeth of the slitting saw.

Fig 6



Move the table to its initial position. Check the dimension (depth) by a vernier caliper. (Fig 6)

If required, take further cuts till the required depth is achieved.

Deburr and remove the workpiece.

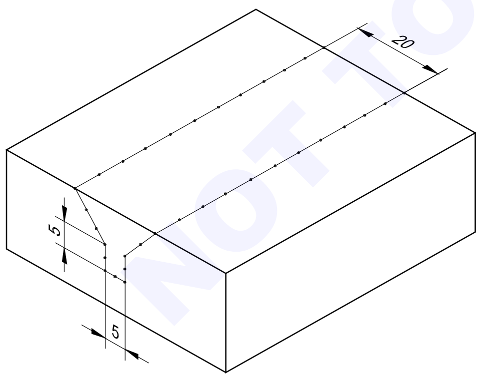
Keep the floor around the machine clear of chips and wipe off spilled cutting fluid immediately. Use sawdust, sweeping or special oil absorbing compound on slippery floors

Mill angular surface on horizontal milling machine

Objective: This shall help you to
- **mill an angular surface on a horizontal milling machine.**

Mark the workpiece as per drawing. Punch witness marks on the lines. (Fig 1)

Fig 1



Mount a plain machine vice on a horizontal milling machine such that the vice jaws remain parallel to the column.

Select pair of parallel blocks which will lift the workpiece, bringing the top surface of the workpiece above the vice jaws.

Clamp the workpiece in the machine vice.

Select an angular milling cutter.

Selection of the angular milling cutter depends upon the angle to be milled.

There are 90°, 60° equal angle cutters. And 45°,30° single side angle cutters.

Here select 90°equal angle cutters. (Fig 2) The cutter thickness should be more than the width of the 'V' groove.

Ensure that the cutter is sharp and undamaged

Select and mount the long arbor on the horizontal milling machine spindle.

Mount an equal angle cutter of 90° on the long arbor. (Fig 3)

Calculate the r.p.m for the given material and cutter. Set the nearest lower speed and feed available on the machine.

Use hand feed in vertical, longitudinal and cross directions to position the workpiece such that the cutter is close to the top surface of workpiece. (Fig 4)

Fig 2

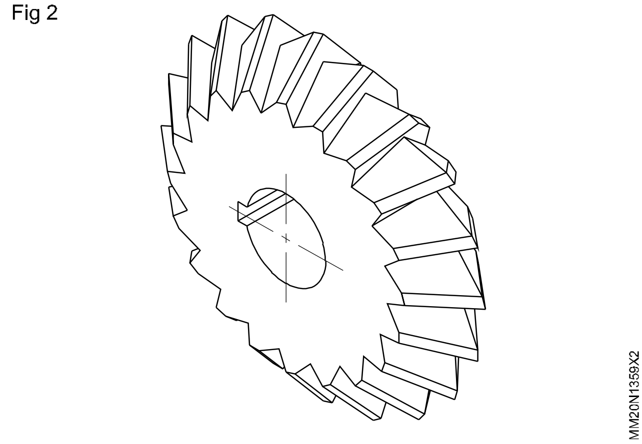
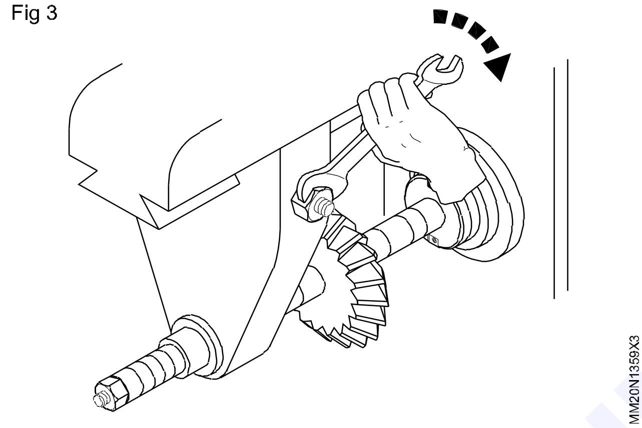


Fig 3

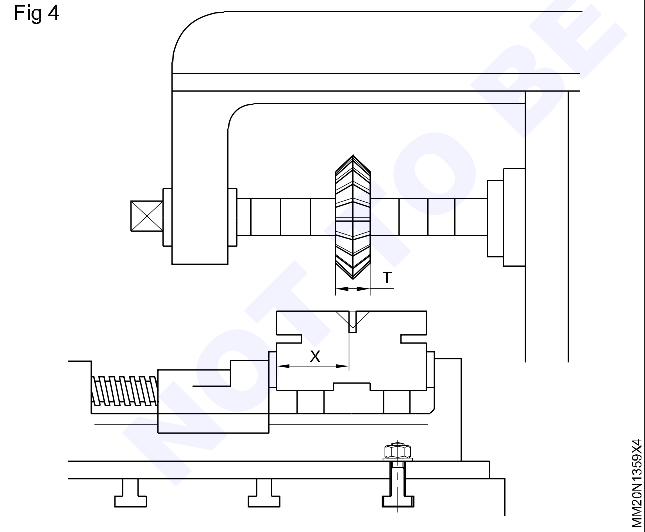


Measure the thickness of the cutter (T).

Find out the centre distance of the ‘V’ groove from the edge[X].

Now Y = X - T/2.

Fig 4



Set the Y distance on the depth gauge or vernier caliper. (Fig 5)

Use the cross - hand feed and adjust the workpiece such that the cutter surface and the workpiece edge are at [Y] distance.

Ensure the dimension with a vernier caliper or depth gauge.

Set the spindle to clockwise direction. (Fig 6)

Fig 5

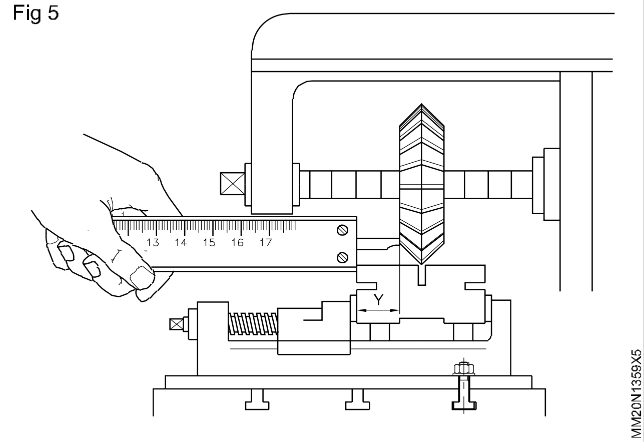
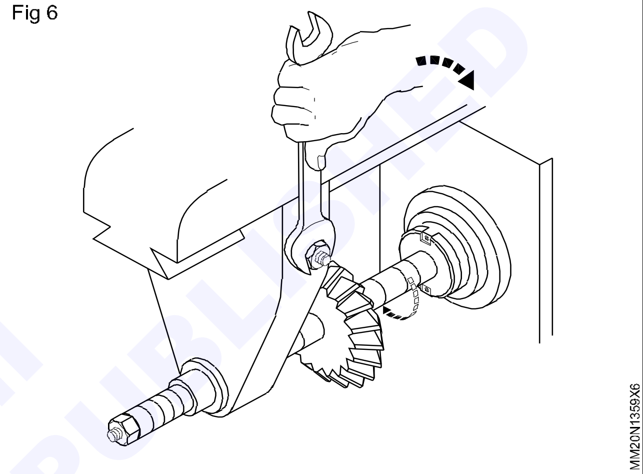
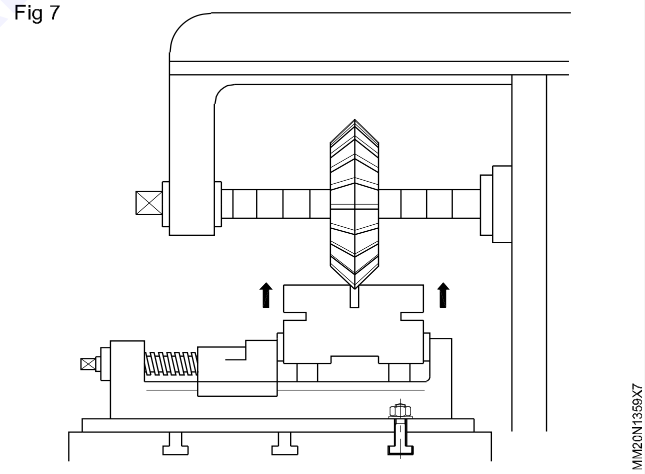


Fig 6



Set the datum at the top surface using tissue paper. (Fig 7)

Fig 7



Move the table to the left hand side to clear the cutter and workpiece. (Fig 8)

Unlock the vertical slide.

Set the depth of cut of 2 mm by vertical hand feed.

Lock the vertical slide.

Adjust the coolant nozzle and start the coolant pump.

Start the machine spindle.

Move the table to the right hand side slowly and mill the groove by rotating the longitudinal hand wheel manually. (Fig 9)

Fig 8

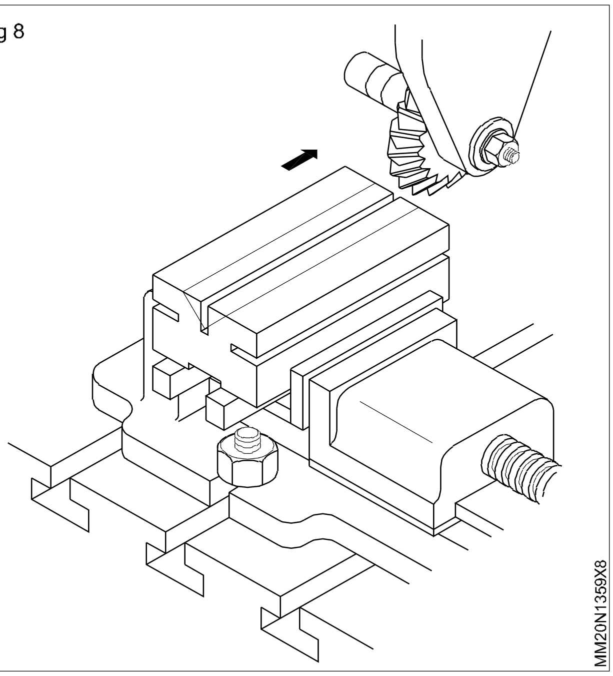
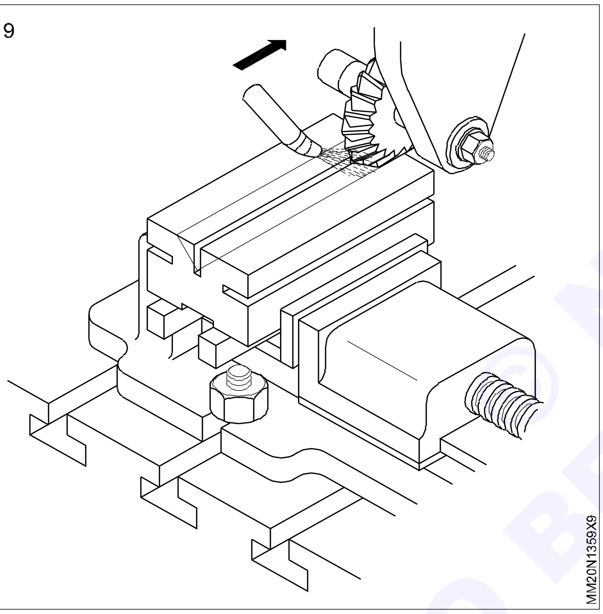


Fig 9

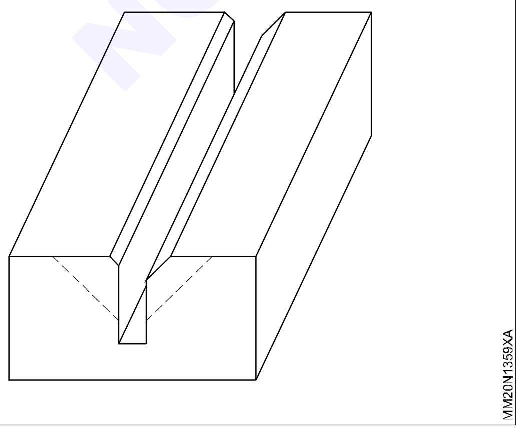


Stop the spindle.

Move the table to the left hand side to clear the cutter from the workpiece.

Check the position of the 'V' groove layout for any error. (Fig 10)

Fig 10

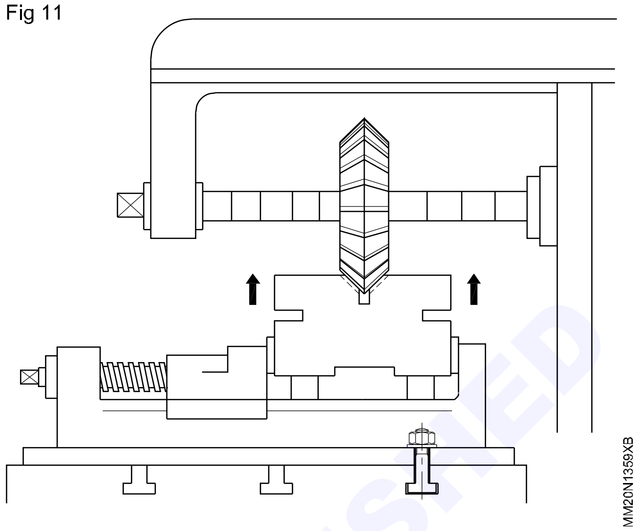


Adjust the cross -side to correct the error.

Lock the cross - slide.

Unlock the vertical slide and set final depth by rotating the vertical slide manually. (Fig 11)

Fig 11



Lock the vertical slide.

Start the machine spindle and mill the 'V' groove. (Fig 12)

> **Apply automatic feed if your machine permits. If not, apply manual feed.**

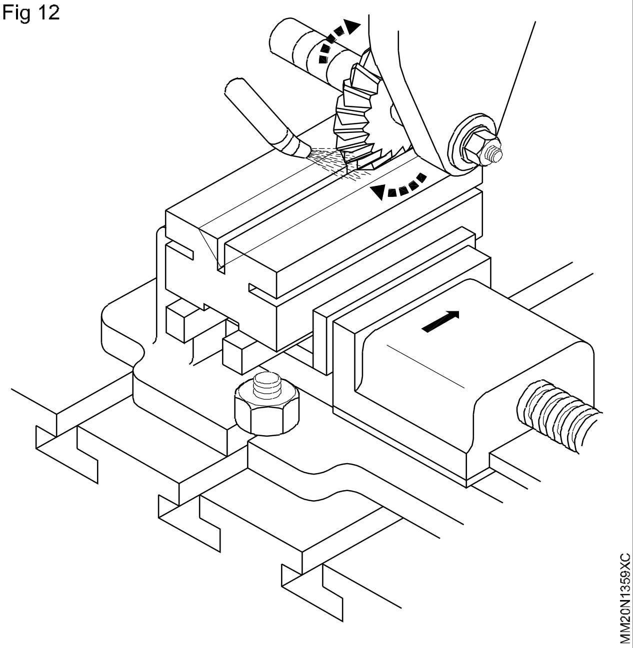
Stop the machine spindle.

De - clamp and deburr the sharp edges at the milled surface.

Check the groove for the following parameters.

- Central position
- Depth of groove

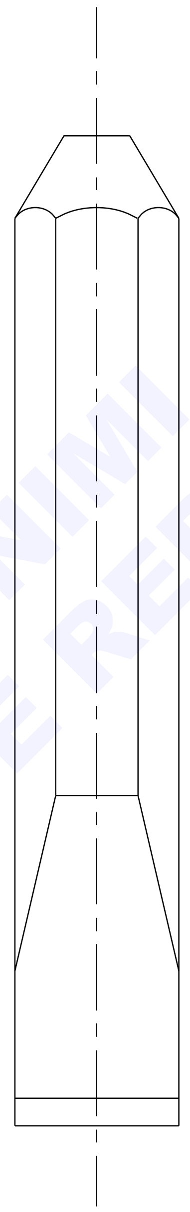
Fig 12



> **Be thoroughly familiar with the placement of the stop lever.**

Hardening, Tempering & Normalising

Objectives: At the end of this exercise you shall be able to
- **hardening the cutting edge of chisel**
- **tempering the cutting edge of chisel**
- **normalising the forged chisel for hardening and tempering.**



1	180 mm FORGED CHISEL		STEEL	-		1.4.60
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : 1:1	**HARDENING,TEMPERING & NORMALIZING**	DEVIATIONS ±0.1	TIME 10 Hrs
		CODE NO. MM20N1460E1	

PROCEDURE

TASK 1: **Normalising**

> **After forging normalising is done to produce fine grain for uniformity of structure and for improved mechanical properties.**

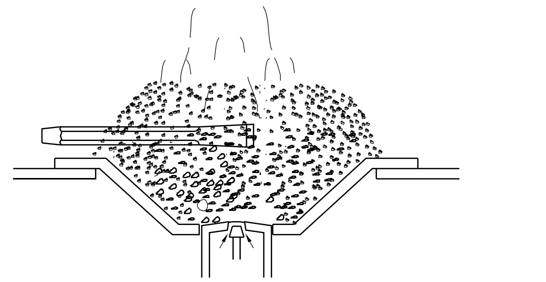
- Clean and remove scales from the chisel after forging.
- Prepare the hearth.
- Light the fire and maintain a good fire in the forge.
- Heat the chisel fully to a cherry red colour.
- Soak at this colour for about 8 minutes at this temperature.
- Remove the chisel from the fire.
- Cool it in chill air to room temperature.
- Clean the chisel after cooling with a wire brush.

— — — — — —

TASK 2: **Hardening**

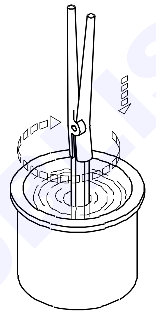
- Clean the cutting edge of chisel
- Heat half of the forging angle of chisel to a cherry red colour uniformely (Fig 1)

Fig 1



- Allow 5 minutes soaking time at the cherry red colour.
- Cool the chisel rapidly in a suitable medium (water, oil, brine water or air) (Fig 2)

Fig 2



— — — — — —

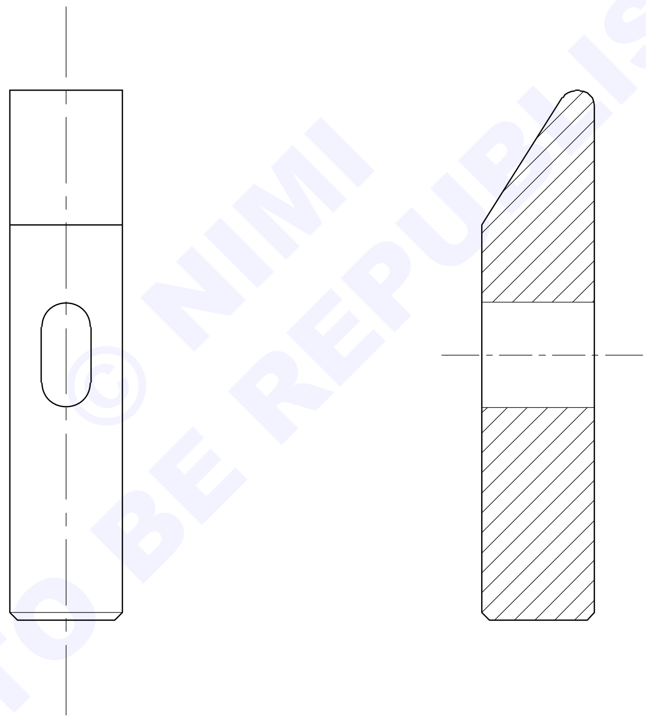
TASK 3: **Tempering**

- Clean the hardened chisel.
- Re-heat the cutting edge to a dark purple colour (280°C).
- Allow a soaking time of 10 minutes at this dark purple colour (280°C)
- Then, allow to cool in water.
- Tempering is completed.

— — — — — —

Case hardening

Objectives: At the end of this exercise you shall be able to
- **case hardening the tack hammer**
- **pack the steel components with carbonaceous material**
- **carburise the tack hammer.**



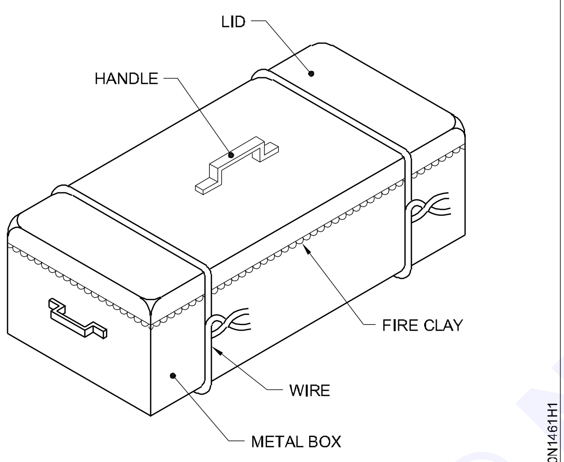
1	-	-	-	-	-	1.4.61
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: NTS	CASE HARDENING				TOLERANCE: ±0.02	TIME: 5Hrs
					CODE NO. MM20N1461E1	

Job Sequence

Pack carburising (Fig 1)

- Clean the parts to be case hardened free from dust, scale oil etc.
- Clean the box and keep the carbonaceous material and the box dry.
- Place a layer of the compound to a height of 30mm at the bottom of the box and then a layer of the work, spaced about 30mm apart and 30mm from the walls.
- Cover the work about 15mm to 25mm of the compound and repeat this until the box is full.
- Shake the box, and also the compound, well before fitting the lid finally.

Fig 1



PACK CARBURISING

- Seal the lid with fine clay mortar.
- Load the box in the hearth. Heat the box to 900° to 950°C.
- Allow a soaking time of 9 hours.
- Remove the box from the forge. Allow to cool of to room temperature.
- Remove the articles from the box. Re-heat the carburise parts to a hardening temperature and allow the require soaking time.
- Cool the articles rapidly in water.

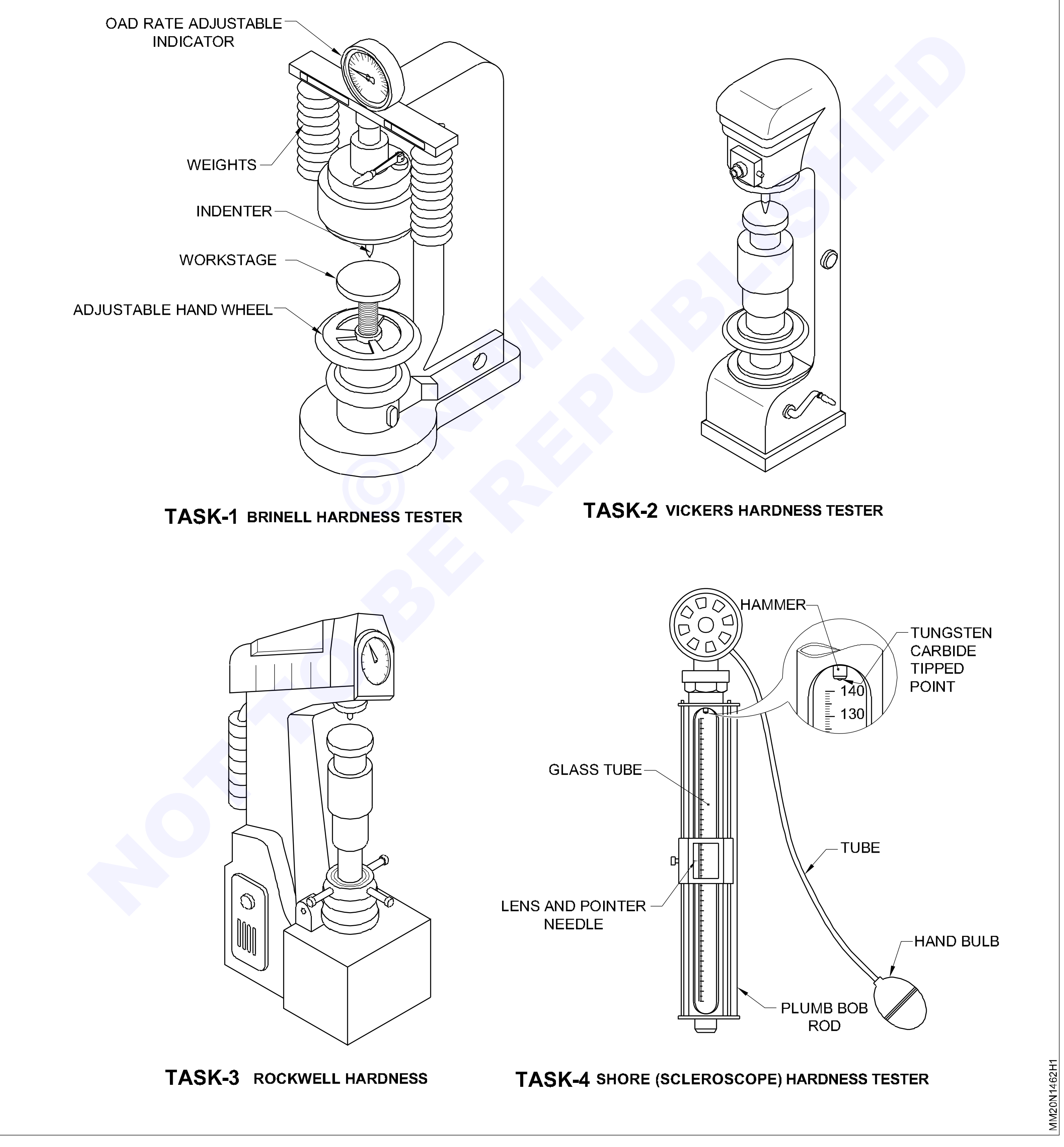
While packing the work.It is necessary to have each piece closely surrounded by the compound.

At the top of the box, there should be a deeper layer to avoid possible expossure of work, and shrinkage of the compound.

Hardness testing

Objectives: At the end of this exercise you shall be able to
- **test brinell hardness**
- **test vicker hardness**
- **test rockwell hardness**
- **test shore hardness.**

Fig 1



TASK-1 BRINELL HARDNESS TESTER

TASK-2 VICKERS HARDNESS TESTER

TASK-3 ROCKWELL HARDNESS

TASK-4 SHORE (SCLEROSCOPE) HARDNESS TESTER

PROCEDURE

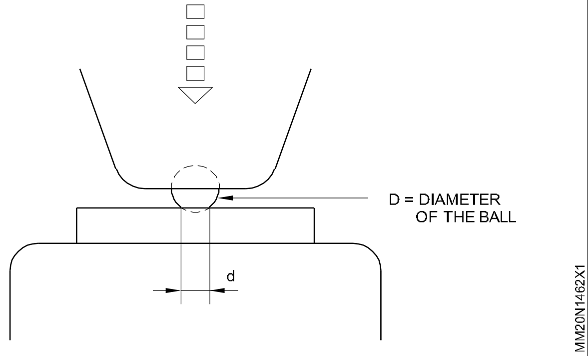
TASK 1: **Brinell hardness testing**

1 Place the workpiece to be tested on work stage.

2 Select the indentor tool, the indentor tool for brinell hardness tester is hardened steel ball or tungsten carbide.

3 Apply load of 100,250,500,1000, 2000 or 3000 Kg f for a specified period of time on an indentor tool (Fig 1)

Fig 1



4 After the removal of the tool, the circular impression made by the tool is measured in mm using a microscope and a scale (Fig 2 & 3).

5 Calculate brinell hardness using the formula

$$HPO = \frac{2P}{\pi o\,(D - \sqrt{D^2 - O}}$$

Where 'P' is the load in Kg f

'D' is the diameter of ball indentor.

'O' is the mean diameter of impression.

Fig 2

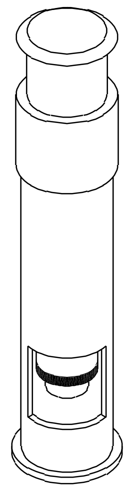
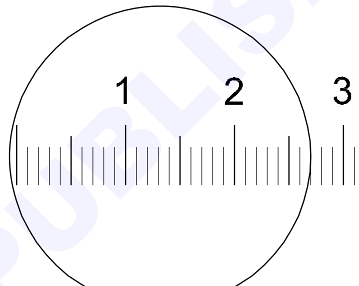


Fig 3



6 Take the mean diameter as the average of two readings at right angles to each other.

7 Standard HB table are readily. available forming various combination of load, diameter of ball and impression diameter.

— — — — — — —

TASK 2: **Vicker hardness testing**

1 Clean the vicker hardness tester.

2 Use the single size indentor tool for all test.

3 Test only hard speceimens like cutting tools and heat treated components.

4 Use highly polished diamond pyramid indentor (Fig 1) having a point angle of 136° (Fig 2).

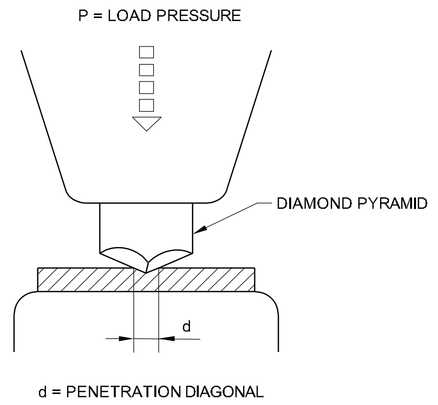
5 This method is similar to brinell, but a single indentor tool is used.

6 Vicker hardness value is calculated using the formula

$$HV = \frac{1.8544xP}{d^2}$$

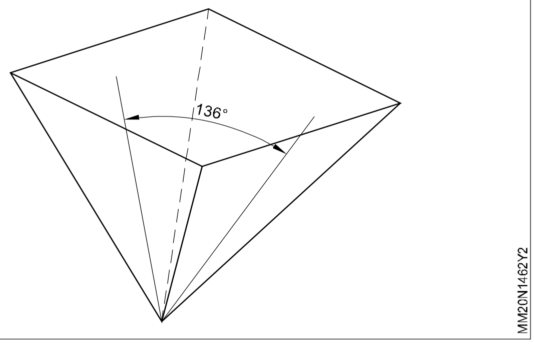
7 Where 'P' is the load in kgf and d is the mean diagonal impression in mm.

Fig 1



— — — — — — —

Fig 2



TASK 3: **Rockwell hardness testing (Fig 1)**

1 Select rockwell hardness tester.

2 Keep the workpiece on table.

3 Select using load, indentor tool, material, scale and major load as per the table shown.

4 Initially minor load 10 Kg is applied on the workpiece the small impression created as datum.

5 Major load is applied for a specified period (Fig 2)

6 Note the difference in the depth of penetration straight away by means of dial provided. (Fig 3)

Fig 1

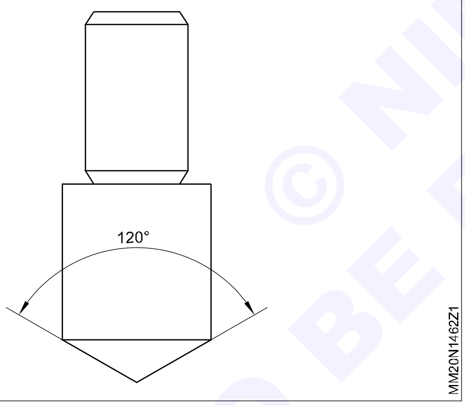


Fig 2

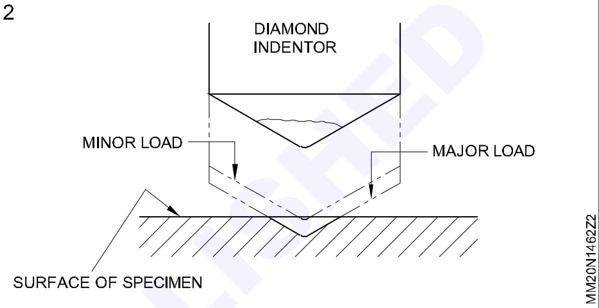
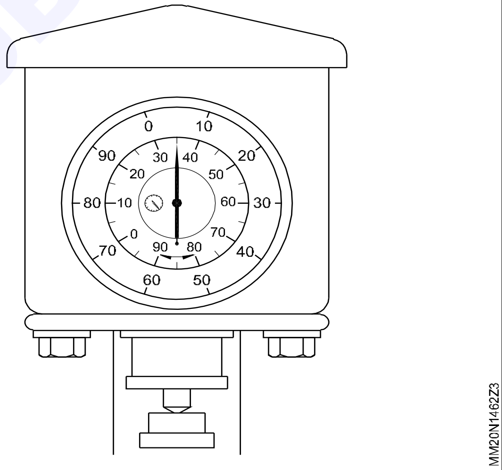


Fig 3



Scale	Materials	Indentation tool	Minor load	Major load	Hardness range
Hardness Rockwell B-scale (HRB)	for copper aluminium alloy mild steel	1.588mm (1/6') diameter steel ball	10 kgf (98.1 N)	100 kgf (981 N)	HRB 0 to 130
Hardness Rockwell C-scale (HRC)	Hardness Steel Steel	Diamond Cone face angle - 120° (Fig 1)	10 kgf (98.1 N)	150 kgf (1471 N)	HRC 0 to 100

TASK 4: **Shore hardness testing**

1 Test using shore scleroscope for finding hardness of big parts like machine bed etc.

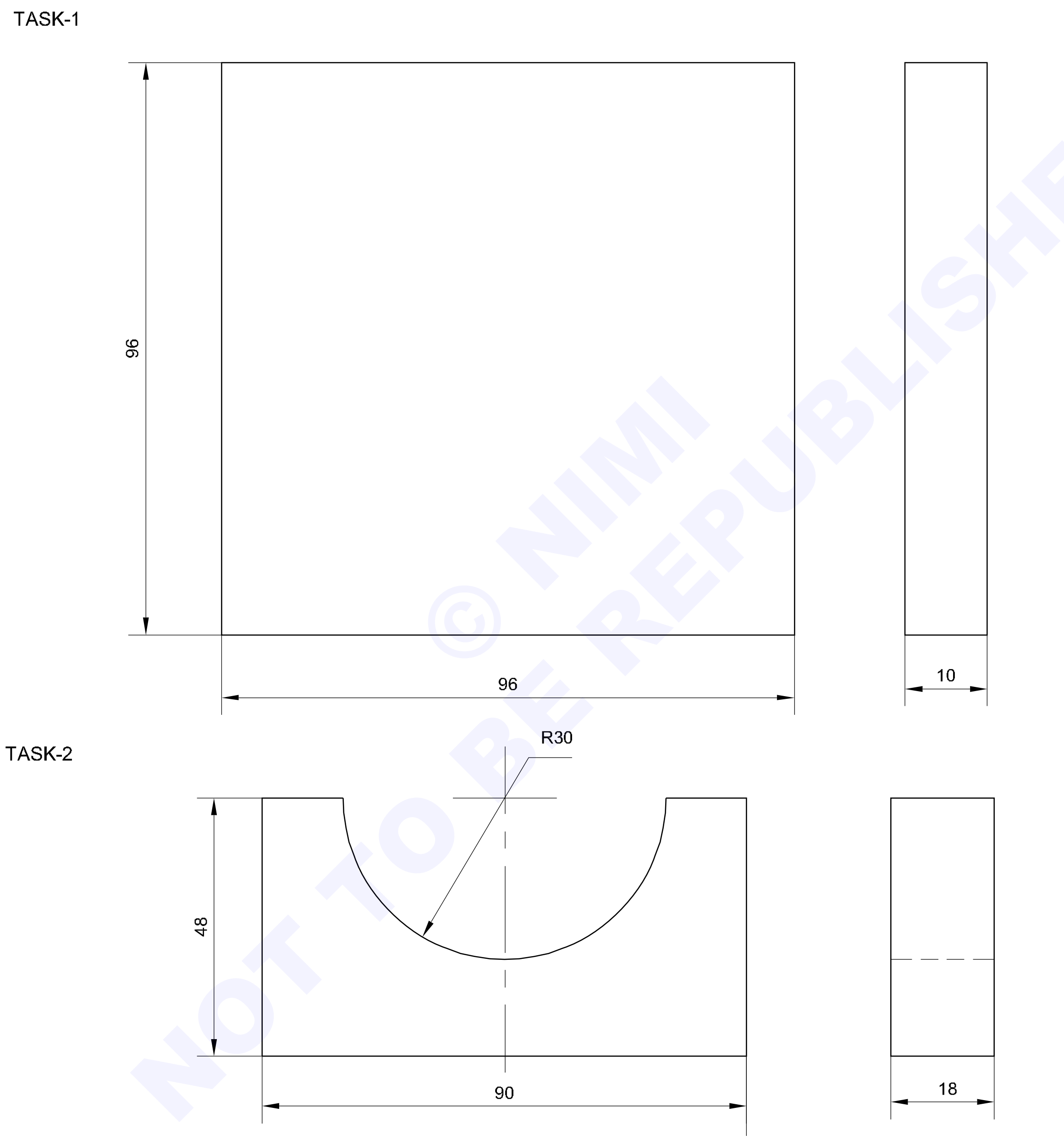
2 Keep the scleroscope on machine bed.

3 Drop the diamond hammer from a certain height on workpiece.

4 The height of the 1st repound indicats the hardness of the workpiece on the graduated tab.

Scraping practice on flat and curved surface

Objectives: At the end of this exercise you shall be able to
- **file surfaces flat and square to the accuracy of ± 0.04 mm**
- **find high spots on flat and curved surfaces using prussian blue**
- **scrap on flat, curved surfaces and test.**



1	100ISF12-100		Fe310	-	TASK-1	1.4.63
1	100ISF20-50	-	Fe310	-	TASK-2	1.4.63
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

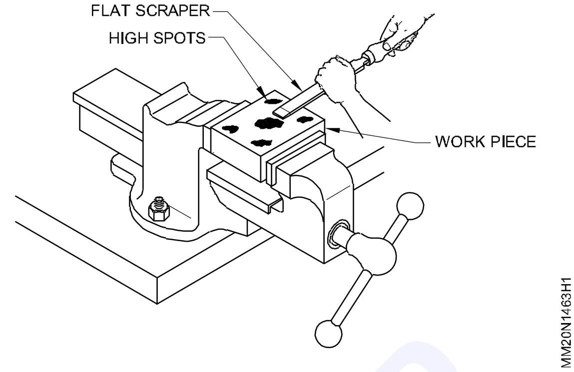
SCALE NTS	**SCRAPING PRACTICE ON FLAT AND CURVED SURFACES**	TOLERANCE ±0.04 mm	TIME 15Hrs
		CODE NO. MM20N1463E1	

Job Sequence

TASK 1: **Scraping on flat surface**

- Check the raw material for its size.
- File metal to size 96x96x10 mm maintaining flatness and squareness.
- Check the size with vernier caliper.
- Clean the surface plate with soft cloth.
- Apply prussion blue evenly on the surface plate.
- Place the job on surface plate and move slightly forward and backward
- Take the job from surface plate and notice the blue spotted marks on the flat surface.
- Hold the job in bench vice
- Scrap and remove the high spots on the flat surface of the job using flat scraper Fig1.
- Wipe off the scraped surface with soft cloth to remove burrs.
- Again, place the scraped surface on prussion blue applied surface and move forward and backward and notice the high spot marks.

Fig 1



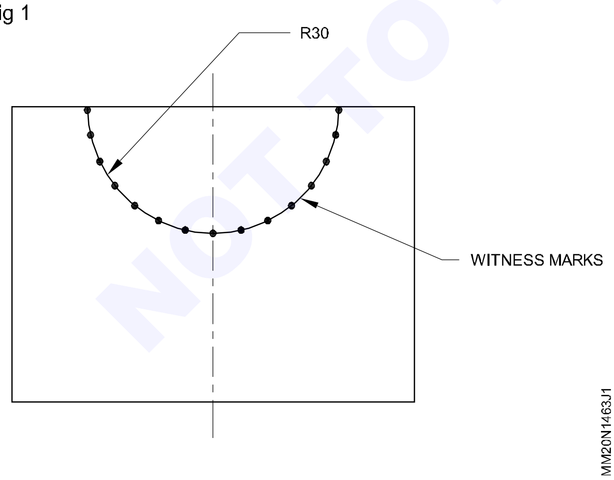
- Repeat the scraping process untill the prussian blue spotted marks spread over the entire surface of the job.
- Wipe off the scraped surface with soft cloth.
- Apply thin coat of oil and preserve it for evaluation.

— — — — — — — —

TASK 2: **Scraping on curved surface**

- Check the raw material for its size.
- File metal to size 90x48x18 mm maintaining flatness and squareness.
- Check the size with vernier caliper.
- Apply marking media, mark and punch as shown in Fig 1.

Fig 1



- Chain drill holes remove excess material as shown in Fig 2.
- Cut and remove the hatched portion of chain drilled holes excess metal using web chisel and ball pein hammer as shown in Fig 3.

Fig 2

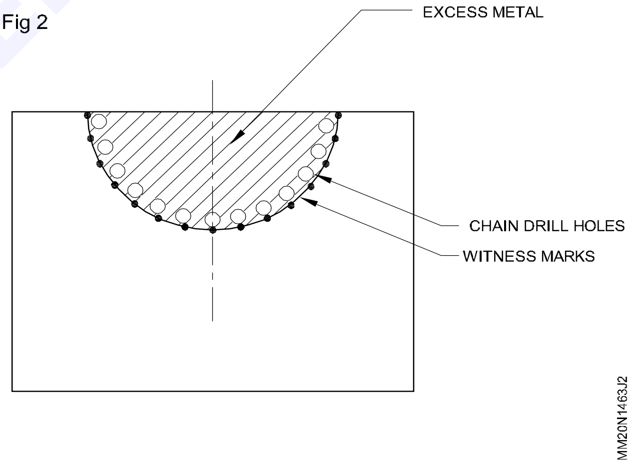
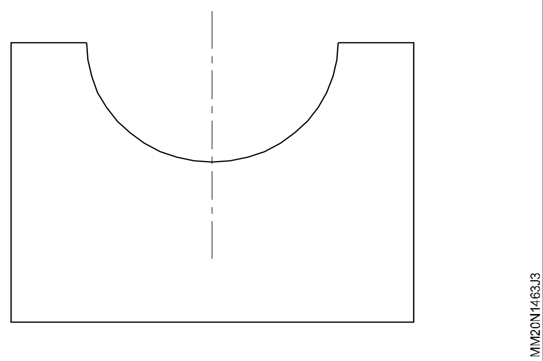


Fig 3



- File curved surface with half round file and check the curved profile with template.
- Hold the round test bar in bench vice along with aluminium vice clamps.
- Apply thin coat of prussian blue on the one end of cylindrical surface of test bar.
- Place the curved surface of the job on prussian blue applied test bar and rotate back and forth.
- Notice the blue spotted marks on curved surface.
- Hold the job in bench vice.
- Scrap and remove the high spots on the curved profile surface using half round scraper.
- Wipe off the scraped surface with soft cloth to remove burrs.
- Again, apply prussian blue on the test bar and place the curved scrapped surface on test bar and rotate back and forth.
- Repeat the scrapping process until the prussian blue spotted marks spread over the entire curved surface of the job.
- Wipe off the scraped surface with soft cloth.
- Apply thin coat of oil and preserve it for evaluation.

Skill sequence

Scraping curved surfaces

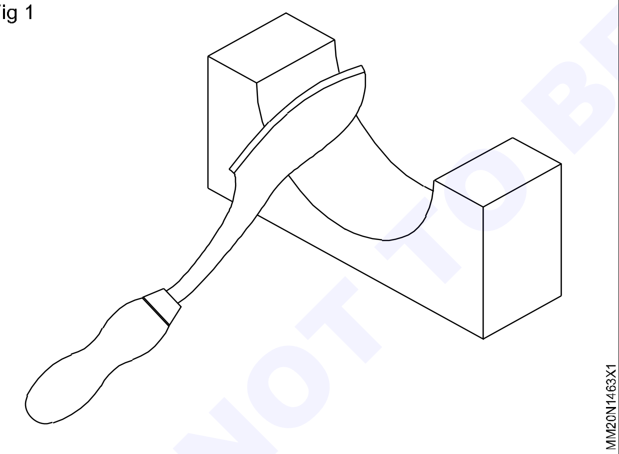
Objective: This shall help you to
- **scrap and test curved surfaces.**

A half round scraper is the most suitable scraper for scraping curved surfaces. This method of scraping differs from that of flat scraping.

Method

For scraping curved surfaces the handle is held by hand in such a way as to facilitate the movement of the scraper in the required direction. (Fig 1)

Fig 1



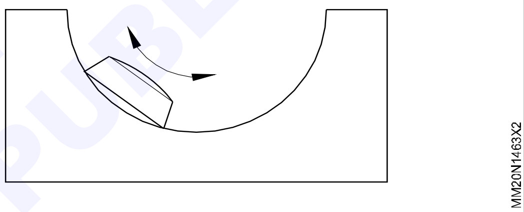
Pressure is exerted with the other hand on the shank for cutting.

Rough scraping will need excessive pressure with longer strokes.

For fine scraping, pressure is reduced and the stroke length also becomes shorter.

Cutting action takes place both on forward and return strokes. (Fig 2)

Fig 2



During the forward movement one cutting edge acts, and on the return stroke, the other cutting edge acts.

After each pass, change the direction of cutting. This ensures a uniform surface. (Figs 3 & 4)

Fig 3

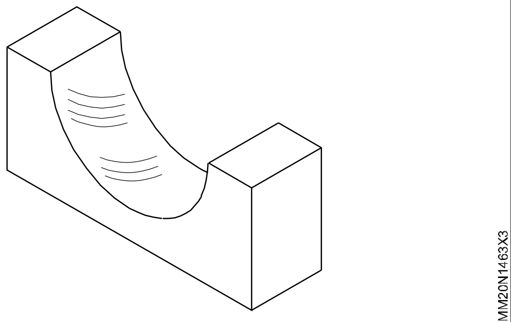
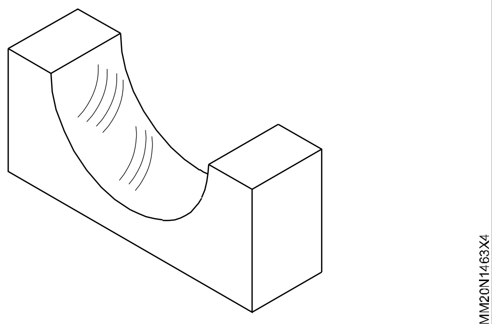


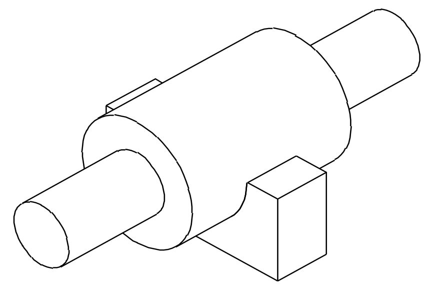
Fig 4



Use a master bar to check the correctness of the surface being scraped. (Fig 5)

Apply a thin coating of Prussion blue on the master bar to locate the high spots.

Fig 5



Sharpening a flat scraper

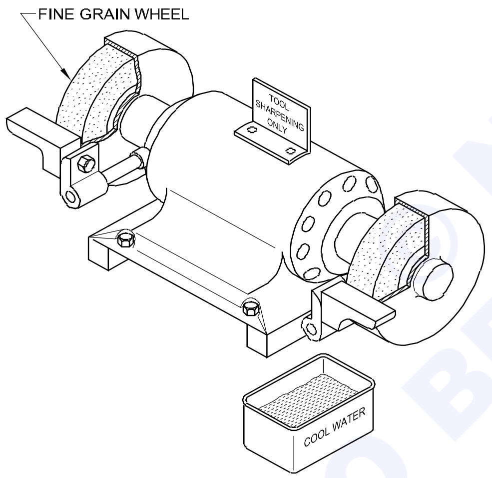
Objective: This shall help you to
• **sharpen a flat scraper by grinding and honing.**

Flat scrapers are sharpened by grinding the cutting edge and honing both faces.

To avoid overheating while grinding, use wet wheel grinding or ensure that there is a cooling arrangement for the pedestal/bench grinder.

Select a grinding wheel with fine grain. (Fig 1)

Fig 1

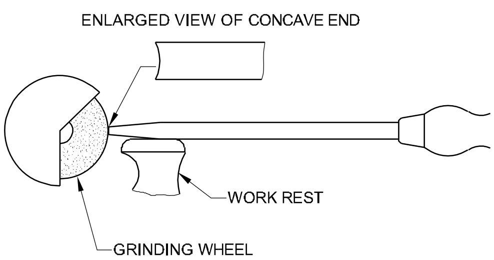


Soft grade aluminium oxide grinding wheel with large diameter gives best results.

Check for gap between the work-rest and the grinding wheel, and adjust, if neessary.

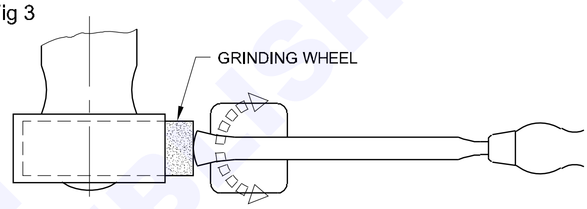
For grinding the cutting edges, hold the scraper horizontal and flat on the tool rest. (Fig 2)

Fig 2



Move the scraper in an arc to provide a slightly convex surface on the cutting edge. (Fig 3)

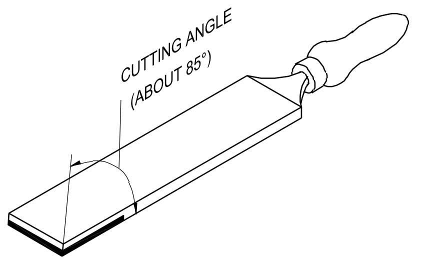
Fig 3



If the scraper is carbide-tipped use silicon carbide or diamond wheels. (Fig 4)

The cutting edges sharpened by grinding should be honed. Honing removes grinding marks and provides keen cutting edges.

Fig 4



CEMENTED CARBIDE TIP SCRAPER

Use a fine grade aluminium oxide oilstone for honing.

While honing use a lubricant.

Mix light mineral oil with kerosene for preparing the lubricant.

Hone the faces first with a movement as shown in Fig 5.

Then hone the cutting end by placing the scraper in an upright position on the oilstone with a rocking movement. (Figs 6 and 7)

What should be the cutting angle? It should be

- for rough scraping - 60°
- for final scraping - 90°.

Fig 5

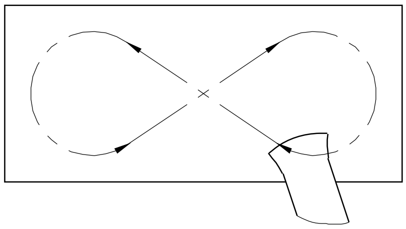


Fig 7

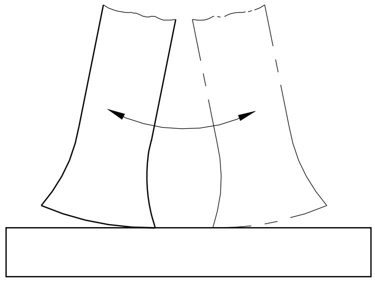
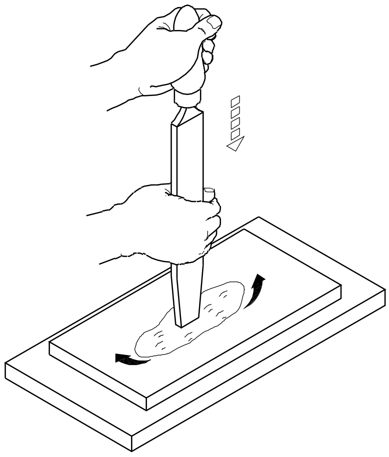


Fig 6



Sharpening half round scrapers

Objective: This shall help you to

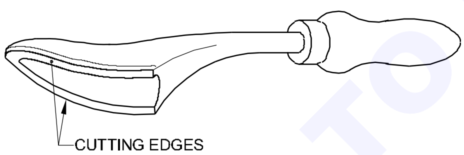
- **sharpen a half round scraper.**

Scrapers are usually re-sharpened on oilstones. When cutting edges are badly damaged, they are ground on pedestal grinders.

Sharpening half round scrapers

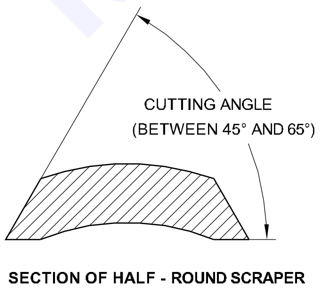
Half round scrapers have two cutting edges on the rounded back. (Fig 1)

Fig 1



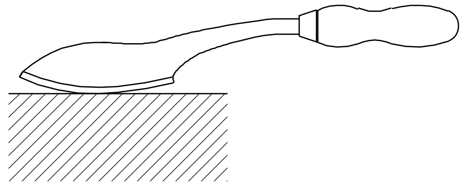
The cutting edges are formed by the bottom surface, and the flat surfaces are ground on the rounded back of the scraper. (Fig 2)

Fig 2



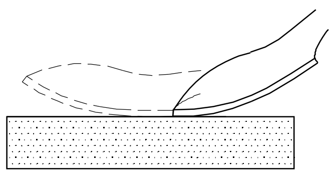
Grind the bottom surfaces with a slight curve. This helps the cutting edges to make point contact on the surfaces being scraped. (Fig 3)

Fig 3



Rub the bottom surface with a rocking motion on the oilstone for re-sharpening. (Fig 4)

Fig 4

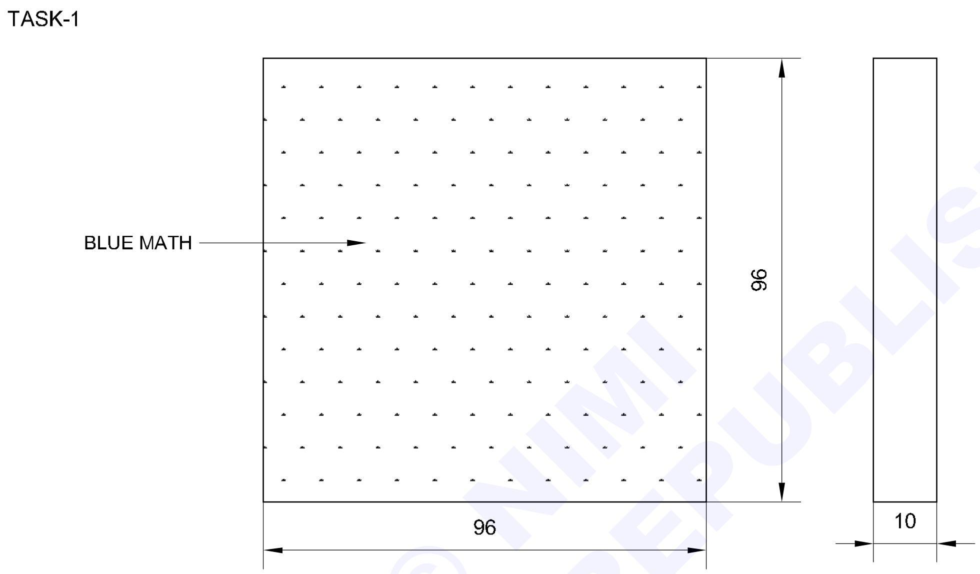


When the cutting edge is blunt it can be re-sharpened by grinding the bottom surface.

As far as possible avoid grinding of the edges. (Flat surface ground on the rounded back.)

Make a plain flat surface of by scraping the high spots using prussian blue

Objectives: At the end of this exercise you shall be able to
- **apply prussian blue on surface plate**
- **check the blue math of high spots on flat surface using surface plate**
- **scrap using flat scriber on high spots.**



Job Sequence

TASK 1: **Checking blue math on flat surface**

- Use exercise no:1-4-63 Task 1 job for this exercise.
- Clean the surface plate with soft cloth.
- Apply prussion blue evenly on the surface plate.
- Place the job on the surface plate
- Move slightly forward and backward and notice the blue math spreaded over entire the flat surface.
- Using flat scraper remove the high spot.
- Repeat the scraping process untill the prussion blue spotted marks. Spread over the entire surface of the job.

1	-	1.4.63	Fe310	-	TASK-1	1.4.64
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	MAKE A PLAIN FLAT SURFACE BY SCRAPING THE HIGH SPOTS USING PRUSSIAN BLUE	TOLERANCE ±0.04 mm	TIME 20Hrs
		CODE NO. MM20N1464E1	

Lapping the surface with lapping stone

Objectives: At the end of this exercise you shall be able to
- **lap the surface using lapping plate**
- **smear the lapping medium**
- **check the surface quality with surface roughness standard set.**

1	75 ISF 12 x 75	-	Fe310	-	-	1.4.65
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE: NTS	LAP FLAT SURFACES WITH LAPPING STONE	TOLERANCE: ±0.02	TIME: 5Hrs
		CODE NO. MM20N1465E1	

Job Sequence

- Check the raw material size.
- Cut the material as per size given in the drawing.
- Mark the job as per dimension given in the drawing.
- Punch on the marked line and cut the unwanted materials.
- File and finish to the size.
- Place the lapping plate on the bench vice.

Make sure the lapping plate not shacking.

- Position the job on the lapping plate.
- Apply lapping medium.
- Hold the job tightly and lap the surface.
- Checking the flatness by using try square.
- Finish the job accurately.

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.

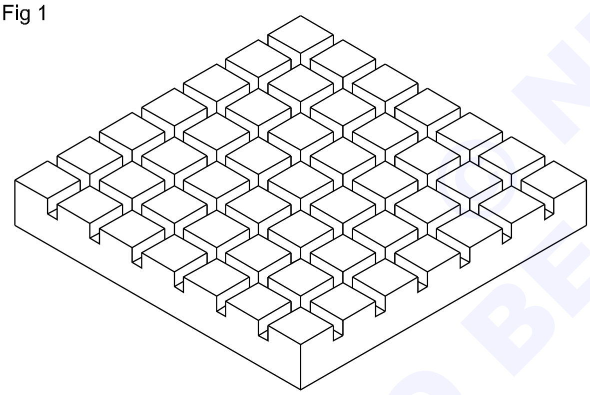
Skill Sequence

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 butt against the workpiece while lapping. This will assist to keep the workpiece perpendicular while lapping. (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

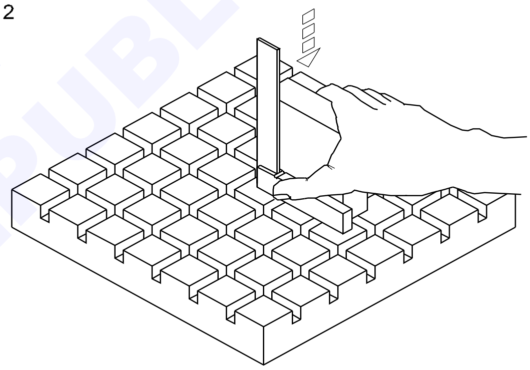
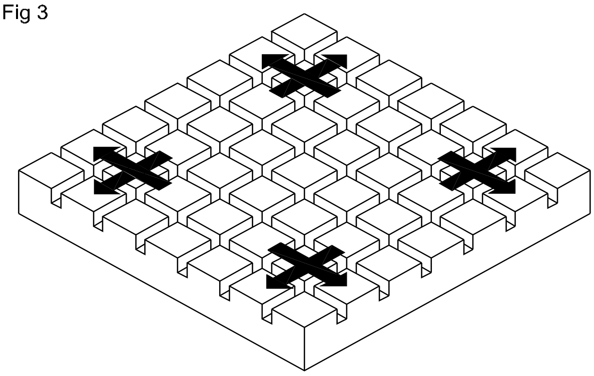


Fig 3



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.

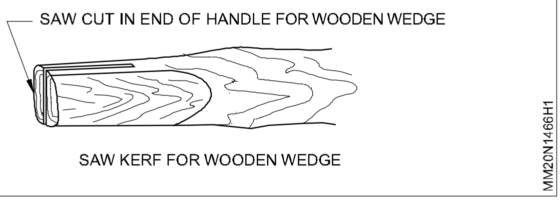
Fixing hammer handle

Objectives: At the end of this exercise you shall be able to
- **fix the hammer handle.**

Job Sequence

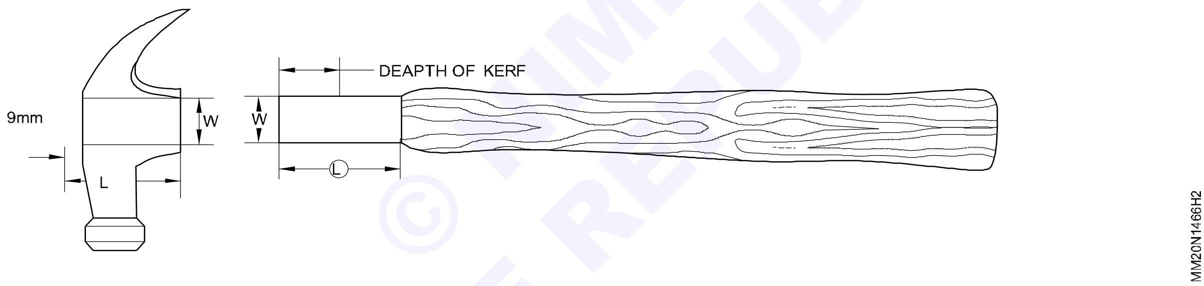
- Shape the handle and slightly taper to fix in the head about 9mm beyond the width of the head.
- Make the saw cut (kerf) at the end face of the handle to the depth of about 3/4 distance of the eye hole. (Fig 1)

Fig 1



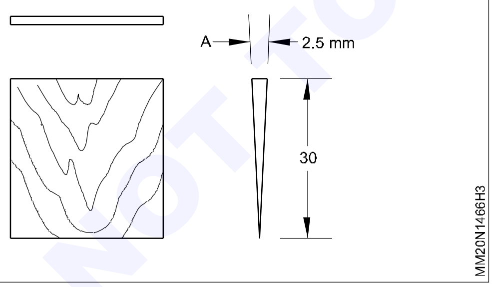
- Hold the hammer in work bench vice.
- Insert the handle in the eye hole and drive it so that it projects about 9mm through the eye hole. (Fig 2)
- Hold the handle in upward position with the head at the top.
- Hit the back end of th handle sown on a solid wooden surface.
- Make a series of firm on the solid wooden surface to seat the handle firmly in the eye hole of hammer.

Fig 2



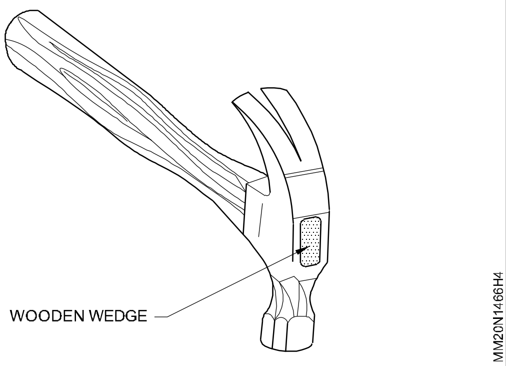
- Prepare a thin wedge equal in width of the eye hole and about 30mm long, drive it into the saw cut (kert) till it becomes maximum tight (Fig 3).

Fig 3



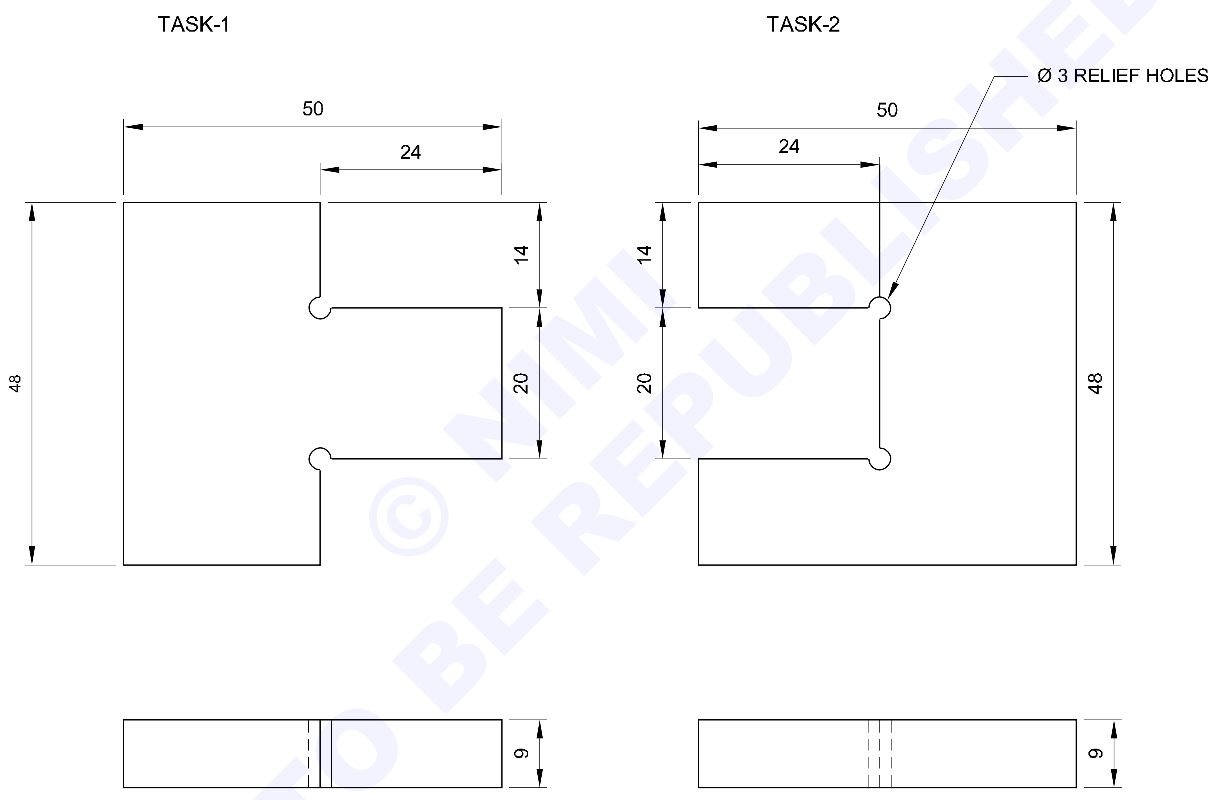
- Saw off the excess projecting portion of the handle to about 3mm outside of the hammer head (Fig 4).

Fig 4



Make male & female 'T' fitting with an accuracy ± 0.15mm and 30 minutes

Objectives: At the end of this exercise you shall be able to
- **file flat surface to flat and parallel within an accuracy of ± 0.15 mm**
- **file and assemble the T fitting and obtain the required class of fit.**



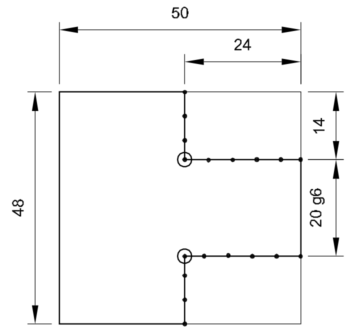
2	50 ISF 10 - 55	-	Fe310	-	A&B	1.5.67
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	MAKE MALE & FEMALE 'T' FITTING WITH AN ACCURACY ±0.15 mm AND 30' MINUTES				TOLERANCE : ± 0.04	TIME : 25 Hrs
					CODE NO : MM20N1567E1	

Job sequence

TASK 1: **Male part**

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

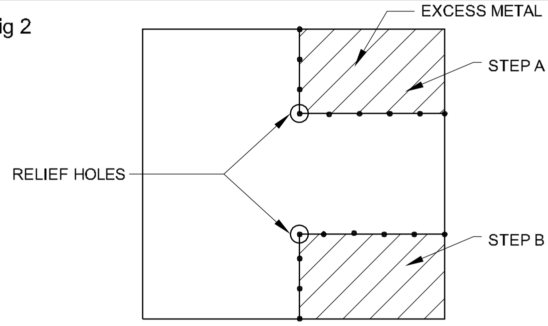
Fig 1



MM20N1567H1

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

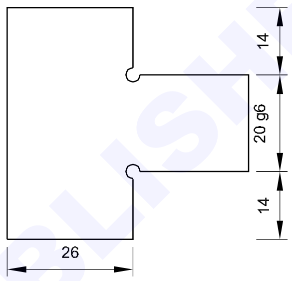
Fig 2



MM20N1567H2

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

Fig 3

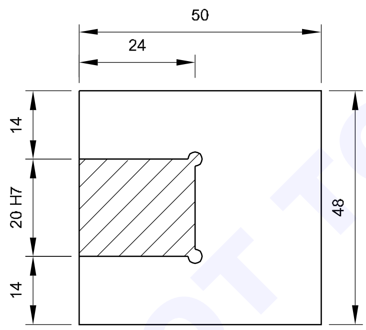


MM20N1567H3

TASK 2: **Female part.**

- File and finish to size 50 x 48 x 9mm maintaining parallelism and perpendicularity.
- Apply marking media, mark and punch as shown in Fig 1.

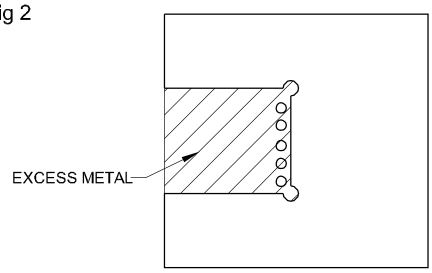
Fig 1



MM20N1567J1

- Drill relief hole φ 3mm on part B
- Chain drill holes, by chiping and hacksawing remove the excess metal as shown in Fig 2.

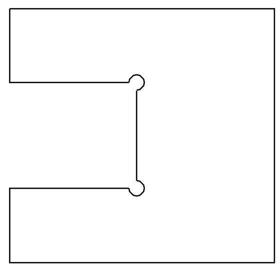
Fig 2



MM20N1567J2

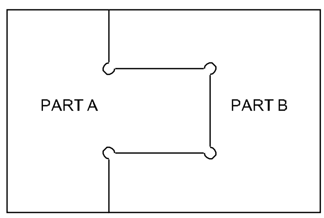
- File to size and shape maintaining the flatness and squareness as shown in Fig 3.

Fig 3


MM20N1567J3

- Check the size with vernier caliper.
- Match part ‘A’ and ‘B’ as shown in Fig 4.

Fig 4



MATCH PART A & B

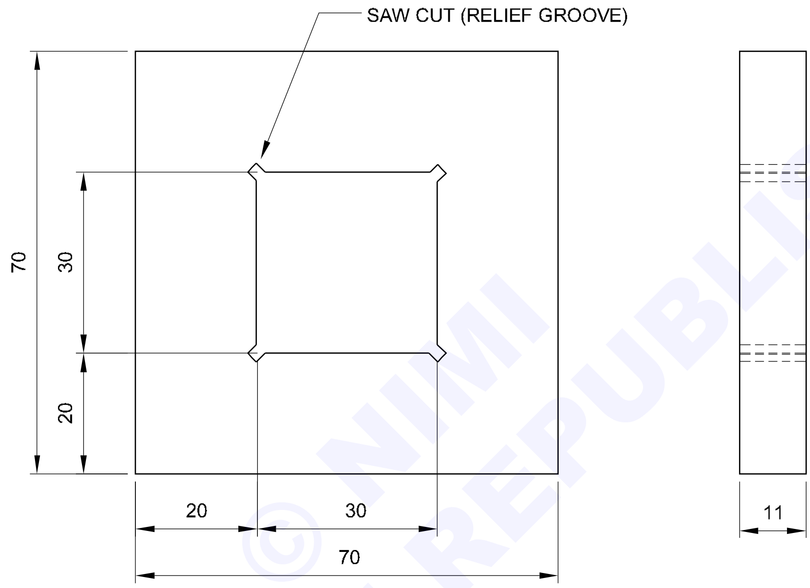
MM20N1567J4

- Finish the filing and de- burr in all the surface of the job.
- Apply a thin coat of oil and preserve it for evaluation

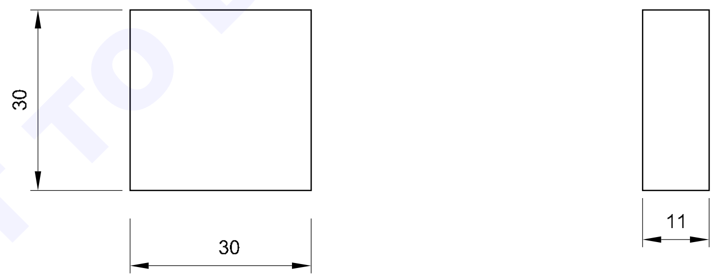
Make male and female square fit with accuracy ± 0.1mm

Objectives: At the end of this exercise you shall be able to
- **mark the dimension lines as per drawing**
- **chain drill, cut and remove excess metal by chipping**
- **file square slot maintaining ± 0.1 mm and 30 minutes**
- **match square in square slot.**

TASK-1



TASK-2



1	35 ISF 12- 35	–	Fe310	–	-	1.5.68
1	75 ISF 12 - 75	–	Fe310	–	-	1.5.68
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

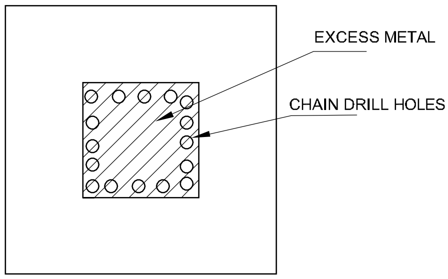
SCALE NTS	**MAKE MALE FEMALE SQUARE FIT WITH ACCURACY ±0.1 mm**	TOLERANCE : ±0.01	TIME : 20 Hrs
		CODE NO : MM20N1568E1	

Job sequence

TASK 1: **Marking and chain drilling**

- Check the given raw material for its size.
- Rough and finish file on surface flat and square to overall size 70 x70 x11 mm maintaining accuracy ± 0.1mm.
- Mark off sizes in part 1 as per job drawing and punch witness marks.
- Hold part 1 in drilling machine table and drill chain drill holes to remove excess metal as shown in Fig1 .

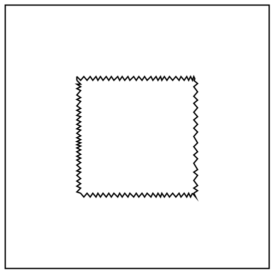
Fig 1



Periphery of the drill should not touch the witness marks

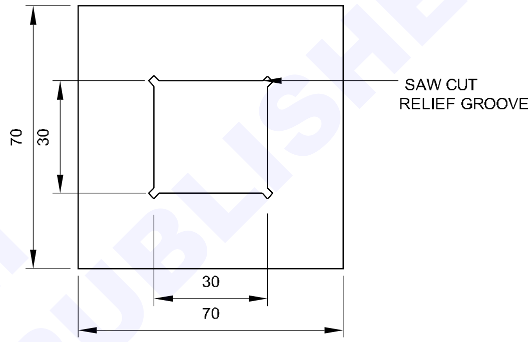
- Cut and remove the chain drilled hatched part using web chisel and ball pein hammer as shown in Fig 2.
- File the chipped portion to size and shape using safe edge file of different grades maintaining accuracy of ± 0.1mm and check the size with veriner caliper.

Fig 2



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

Fig 3

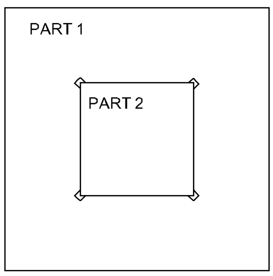


— — — — — — — —

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

- File to size 30 x 30 x 11mm maintaining accuracy ± 0.1mm.
- Check the flatness and squareness with try square.
- Check the size with vernier caliper.
- Match part - 2 into part 1 as shown in Fig 1.
- Finish file in part 1 and 2 with flat smooth file and de burr in all the surface and corners of the job.
- Apply a little oil and preserve it for evaluation.

Fig 1

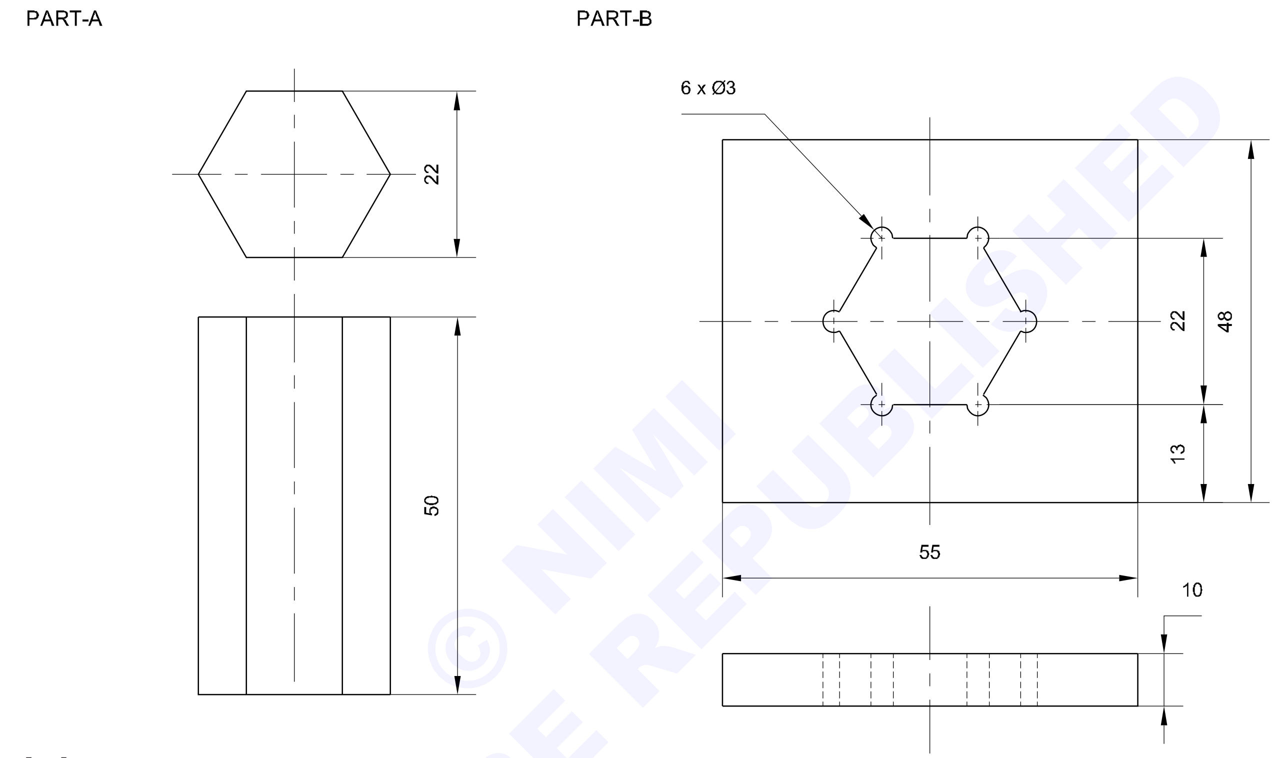


MATCH PART 1 & 2

— — — — — — — —

Make male and female Hexagon fitting with accuracy ± 0.1mm and 30 mins

Objectives: At the end of this exercise you shall be able to
- **prepare the part ‘B’ by filing and finish to the required size and shape**
- **prepare the part ‘A’ by filing and finish to the required size and shape**
- **fit part ‘A’ and ‘B’.**



Job sequence

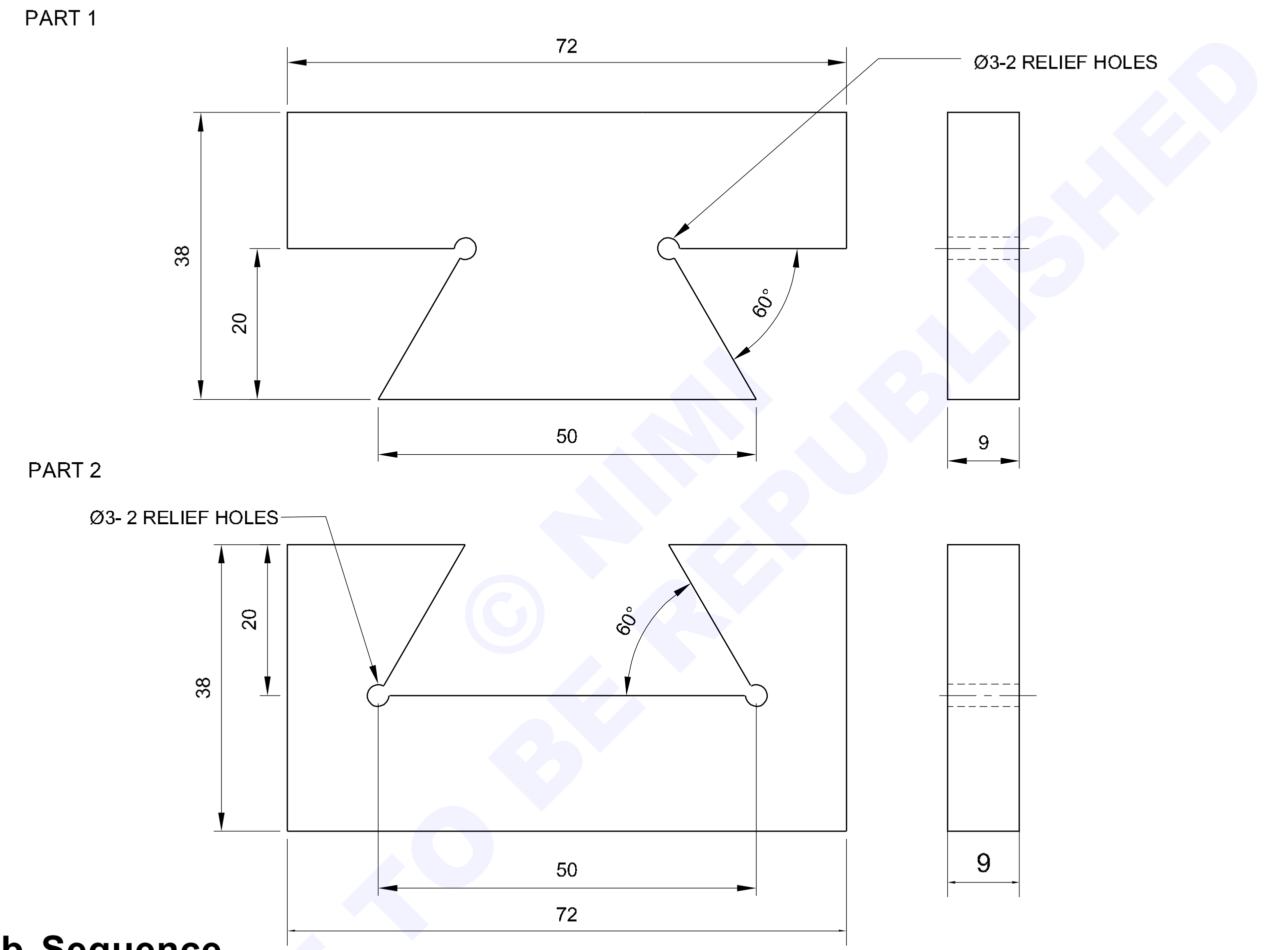
- File surface flat and parallel to an accuracy of ± 0.1mm
- File and finish angular surface to an accuracy of ±30’
- Mark sizes with vernier height gauge
- Drill relief holes
- Chip flat surface
- File angular and parallel surfaces to an accuracy of ± 0.1mm
- Check parallelism of filed surface with a try square
- File and fit male and female
- Check the angle of the external taper of tapered components using vernier bevel protractor

1	50 ISF 10 - 58	-	Fe310	-	-	
1	Ø28 - 53	-	Fe310	-	-	1.5.69
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**MAKE MALE & FEMALE HEXAGON FITTING WITH ACCURACY OF ±0.01 mm AND 30' MINUTES**	TOLERANCE ±0.06	TIME 20 Hrs
		CODE NO. MM20N1569E1	

Make male and female dovetail fitting scraping the surface with in an accuracy ± 0.1mm & 30min

Objectives: At the end of this exercise you shall be able to
- **prepare the part '1' by filing and finish to the required size and shape**
- **prepare the part '2' by filing and finish to the required size and shape**
- **fit part '1' and '2'.**



Job Sequence

- Check the raw material for its size.
- File and finish part 1 and 2 for the over all dimensions.
- Mark off lines part 1 and 2 with a vernier height gauge.
- Punch on witness marks and relief hole marks.
- Drill relief holes of ∅ 3 mm in both the parts 1 & 2 and also chain drill in part 2.

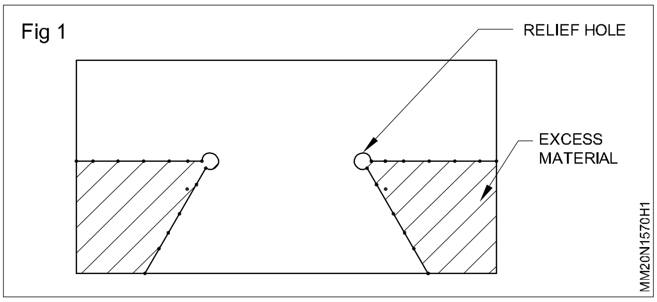
1	75 ISF 10 - 40	–	Fe310	–	2	1.5.70
1	75 ISF 10 - 40	–	Fe310	–	1	1.5.70
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : 1:1	**MAKE MALE AND FEMALE DOVETAIN FITTING SCRAPING THE SURFACE WITH ACCURACY ±0.1mm AND 30 MINUTES**	TOLERANCE : ±0.02	TIME: 20 Hrs
		CODE NO: MM20N1570E1	

Part - 1

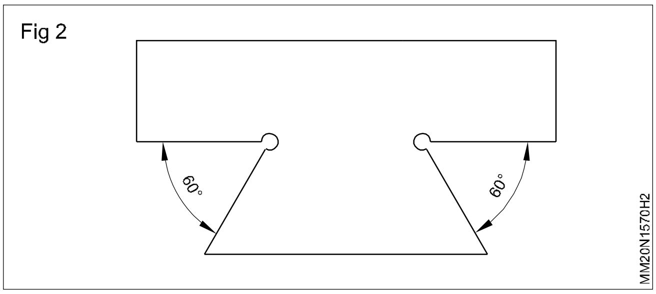
- Hacksaw on one side of dovetail of Part 1 to remove excess metal as shown in Fig 1.

Fig 1



- File and check the size with vernier caliper and anlge with vernier bevel protractor as shown in Fig 2.

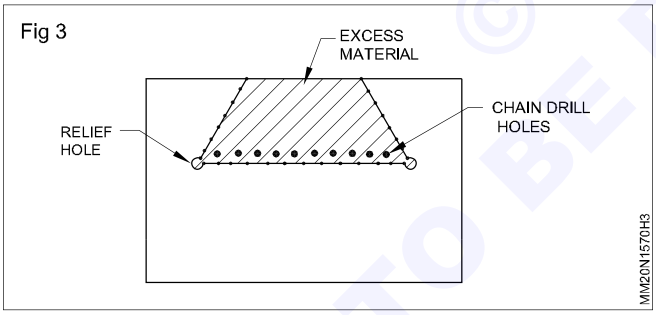
Fig 2



Part - 2

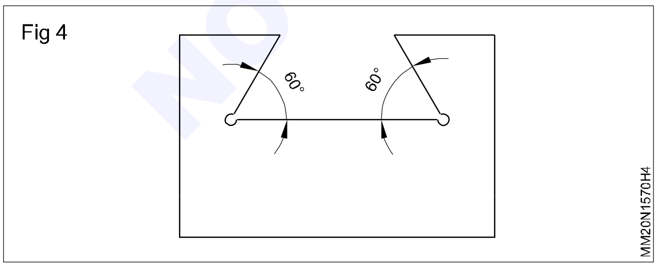
- Hacksaw on one side of dovetail to remove excess metal..
- Hacksaw and cut off along the chain drilled holes using web chisel and ball pein hammer and remove as shown in Fig 3.

Fig 3



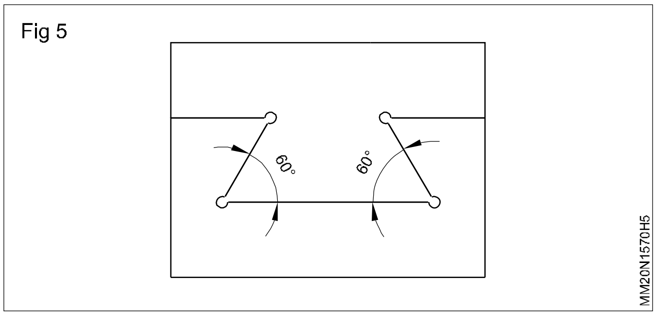
- File the internal dovetail of Part -2 to size and angle and check the size with vernier caliper and angle with vernier berel protractor Fig 4

Fig 4



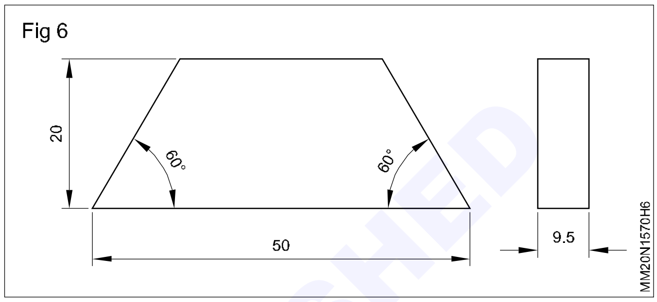
- Match part 1 and 2 to fit both dovetail profile as shown in Fig 5.
- Separate part 1 and 2, file and finish, de-burr all the corners of the job.
- Apply thin coat of oil and preserve it for evaluation.

Fig 5



Making angle gauge (Fig 6)

Fig 6



- Cut the raw material 55 IS F 10-25 F310
- Mark and cut the size as per drawing finish the angular portion and bottom portion by grinding.

Scraping the angle gauge

- Apply prusian blue evenly on the surface plate to check high spot on angular surface.
- Place the gauge of angular surfaces on surface plate and move gently.
- Hold the job in a bench vice, scrap and remove the high spots with a flat scraper.
- Repeat the same process until the prusian blue cover the entire angular surfaces.
- Similarly scrap the bottom portion.
- The angle gauge is ready to check the female dovetail.

Scraping the dovetail fitting.

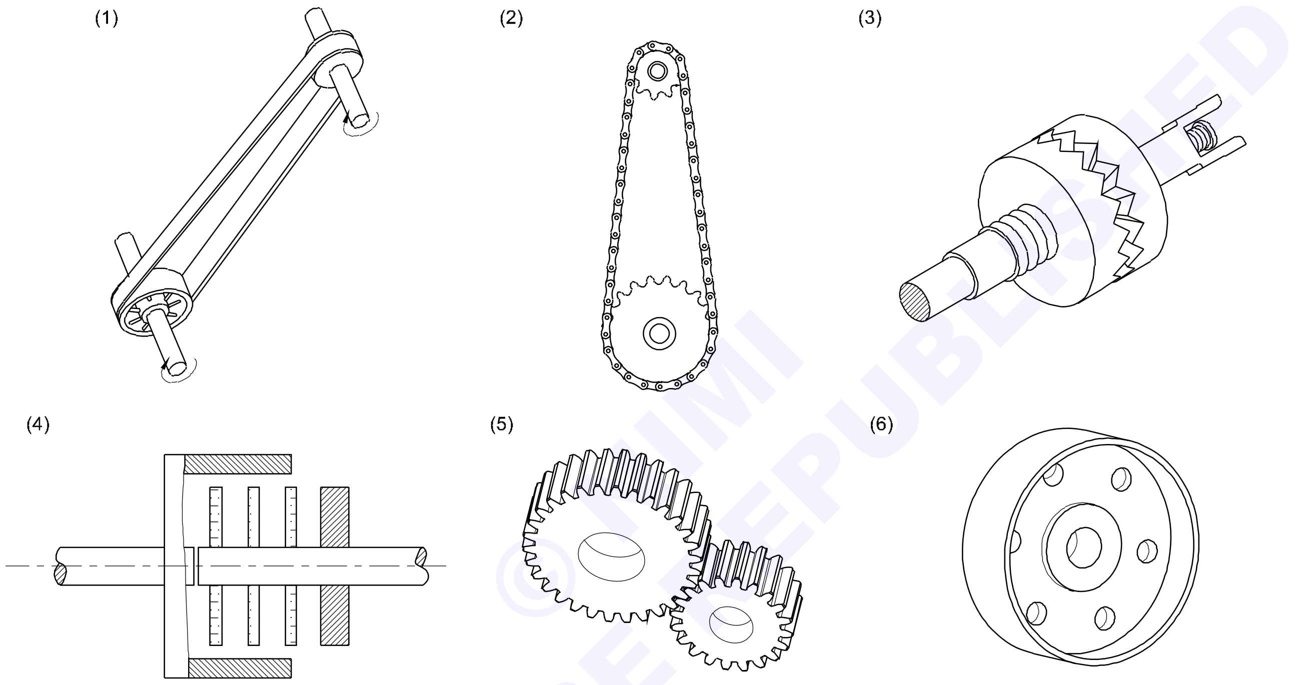
- First scrap the female part using angle gauge.
- Apply prusian blue evenly on the gauge.
- Move the angular gauge gently in the dove tail groove.
- Take the job from gauge and notice the high spot (prusian blue spotted marks) on angular surface and bottom surface.
- Hold the job in a bench vice, scrap and remove the high spots with triangular scraper.
- Repeat the process until the prusian blue cover the entire angular and bottom surface.
- Similarly scrap the male by reference of female part.
- Now the dove tail fitting is smoothly sliding.
- Apply thin coat of oil and preserve it for evolution.

Identify different components of power transmission

Objectives: At the end of this exercise you shall be able to
- **Identify power transmission components**
- **name the components and fill in table 1.**

Instructor should make necessary arrangements for displaying various types of power transmission elements on the work bench and insist the trainees to identify all by filling table 1 given in exercise.

Fig 1



IDENTIFY DIFFERENT COMPONENTB OF POWER TRANSMISSION

Table 1

Figure No	Name of the power transmission component
1	
2	
3	
4	
5	
6	

- Get it checked by the trainer

Dismantle and assemble different component of power transmission

Objectives: At the end of this exercise you shall be able to
- **dismantle of components of power transmission**
- **check the worn outs**
- **explain the parts damaged**
- **reassemble the components**
- **check the test run.**

Job Sequence

TASK 1: **Chain**

Dismantling (Fig 1 to 4)

Fig 1

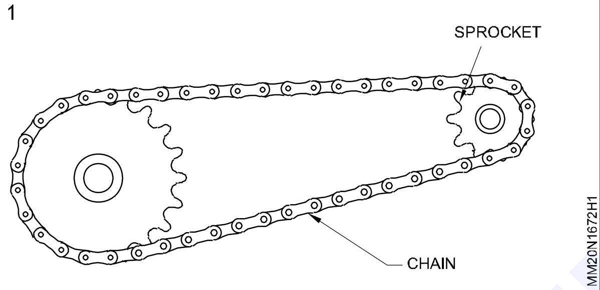
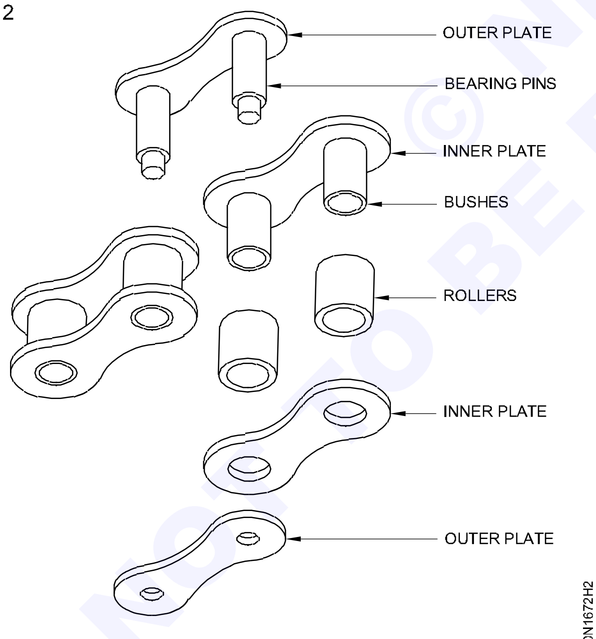
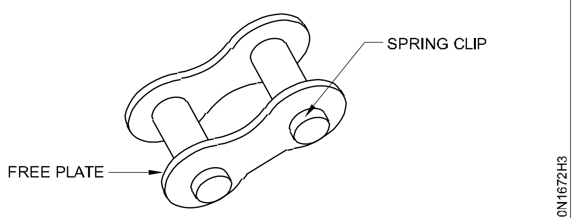


Fig 2



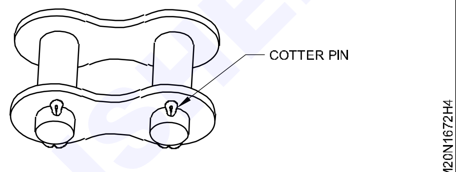
COMPONENT PARTS OF A SIMPLE ROLLER CHAIN

Fig 3



CONNECTING LINK ASSEMBLY SECURED WITH SPRING CLIP

Fig 4



CONNECTING LINK ASSEMBLY SECURED WITH COTTER PIN

- Remove the chain guard from the machine.
- Remove free plate of the chain connecting link by removing cotter (or) spring clip using nose plier.
- Remove connecting link and the chain from the sprockets
- Unscrew the set-screws in the hub of the sprockets.
- Dismantle the sprockets by gently slide out from the shafts.

Assembly

- Thoroughly clean all the parts using cleaning solvent (kerosine) to remove dirt and grit.
- Check key ways, keys chain bushes and sprockets for wear and tear.
- Replace worn-out parts as needed.
- Fit the keys in the shafts firmly.
- Assemble the sprockets on the shafts, tighten the setscrews in the hub to hold sprockets in its position.
- Install the chain on both the sprockets, bring the free chain ends together and connect using connecting link.

Skill sequence

Install chain over the sprockets

Objective: This shall help you to

- **connect, align and adjust the chain over the sprocket.**

Before installing the chain, inspect it to be sure it is free from dirt and grit. If it is dirty thoroughly clean it in a solvent. when dry, lubricate it, making sure the oil reaches the pin and bushing surfaces.

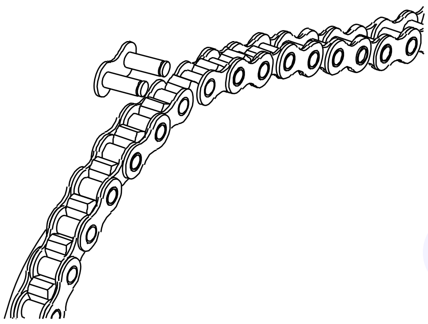
To install the chain, fit it on the both sprockets, bringing the free chain ends together on one sprocket.

Insert the pins of the connecting link in the two end links of the chain as shown in Fig 1 and then install the free plate of the connecting link.

Fastern the free plate with cotters or spring clip, depending on the type used.

After the fastener is in position, tap back the ends of the connecting link pins until the outside of the plate rests snugly against the fastener. This will prevent the connecitng link from squeezing the sprocket teeth.

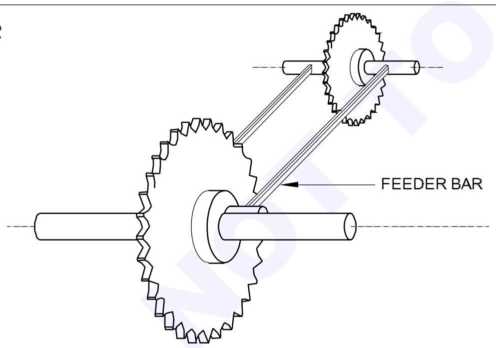
Fig 1



INSERTING CONNECTING LINK IN CHAIN

Horizontal & parallel alignment of shafts (Fig 2)

Fig 2



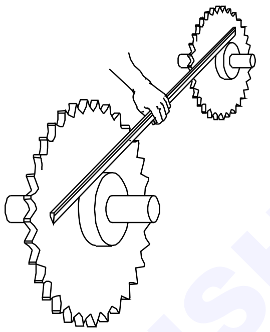
MEASURING TWO SHAFTS FOR BOTH HORIZONTAL &PARALLEL ALIGNMENT

Horizontal shafts of the sprockets may be aligned with aid of sprit level as shown in Fig 2. The bubble in the level will reveal when they are both in exact horizontal position.

Shafts can be adjusted for parallel alignment as shown in the Fig 2. Any suitable measuring device such as vernier, caliper, or feeler bar may be used. The distance between the shafts on tooth sides of sprockets should be equal. With an adjustable shaft drive, make the distance less than final operating distance for easier installlation. For drive with fixed shafts, the centre distance must be set at the exact dimension specified.

Alignment of sprockets (Fig 3)

Fig 3



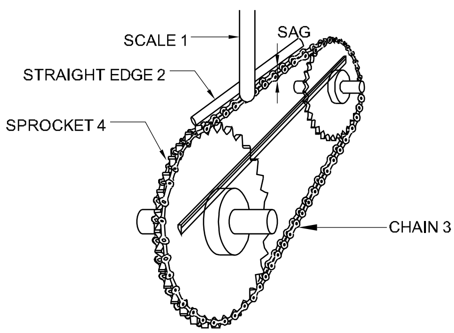
To ensure alignment of the sprockets, apply the straight edge to the mechanised side surface as illustrated in the Fig 3 Tighten the setscrews in the hubs to hold the sprockets and keys in position.

If one of the sprockets is subjected to end float, locate the sprocket so that it will be aligned when the shaft is in its normal running position.

If the centre distance is too great for the available straight edge, a tout piano wire may be used.

Adjust chain tension (Fig 4)

Fig 4



To determine the amount of sag, pull the bottom side of the chain tout, so that all of the “excess” chain will be in the top span. Pull the top tension free-plate of the chain down at its centre and measure the sag as illustrated in the fig than adjust the centres until the proper amount is obtained. (Fig 4)

On drives with an adjustable shaft, the shaft must be adjusted to provide proper chain tension. Horizontal and inclined drives should have an initial sag equal to 2 percent of the shaft centres.

Table 1 gives the measurement for various centre distance to obtain approximately 2 percent sag.

Table 1

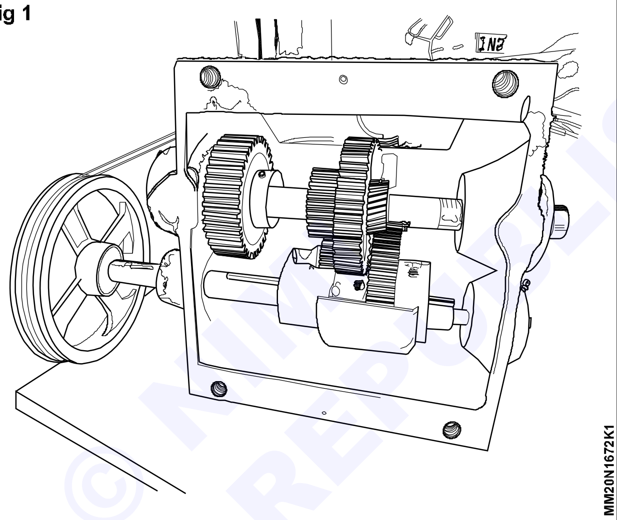
Sag for various centre distance

Shaft centres inches	Sag inches	Shaft centre inches	Sag inches
18	3/8	54	1 1/8
24	1/2	60	1 1/4
30	5/8	70	1 3/8
36	3/4	80	1 1/2
42	7/8	100	2
48	1	125	2 1/2

— — — — — — — — — — — —

TASK 2: **Gear**

Fig 1



Dismantling the gear box

- Switch of the main power supply
- Inspect the shaping machine gear box.
- Dismantle the guard and belts
- Support the gear box with wooden blanks
- Unscrew the fastener's by using suitable tools (Fig 1)

Fig 1

- Remove the gear box and keep it on the work table
- Remove the driven pulley from the driver shaft using puller. (Fig 2)

Fig 2

- Remove the key from the drive shaft.
- Remove bearing covers and internal circlips.
- Dismantle the driver shaft by tapping the shaft using copper rod and hammer.

- Remove the bearings and sliding gear unit from the gear box by disconnecting spring loaded shifting lever.
- Remove the end nut, bearing covers, circlips and grub screws in the spacer of the driven shaft. (Fig 3)
- Remove the driven shaft by tapping the shaft using copper rod and hammer then take out the gears, spacers from the gear box.
- Thoroughly clean all the parts using kerosene and wipped out with cotton cloth. (Fig 3 & 4)
- Check all the part for wear and tear.
- Replace the wornout and damaged parts as needed.
- Lubricate the parts before assemble (Fig 5)

Fig 3

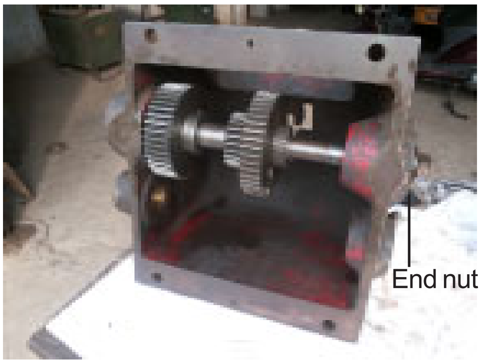


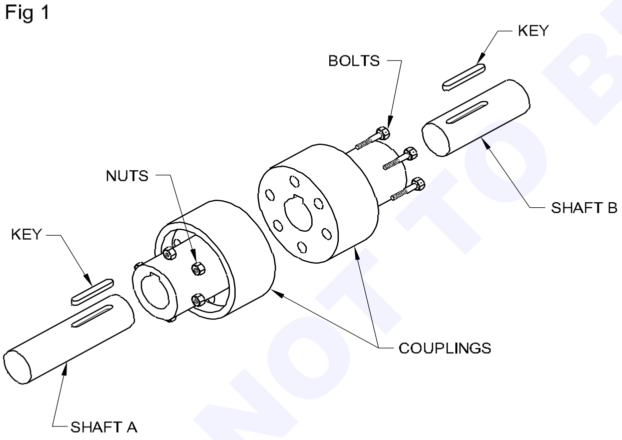
Fig 4

Fig 5

- Assemble the gear box in reverse manner of dismantle.
- Mount the gear box with the machine.
- Check the test run with different speeds (four speed).

TASK 3: **Coupling**

Fig 1

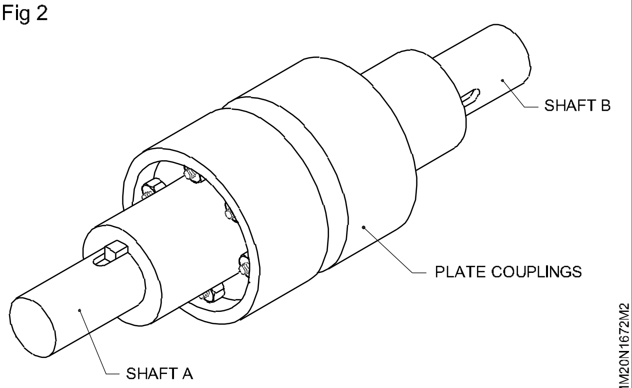


Dismantle the coupling (Fig 1)

- Loosen in the screws or bolt using suitable tools.
- Remove the coupling using puller.
- Remove the keys and shaft.
- Thoroughly clean each parts.
- Identify the wornout parts.
- Assemble the coupling.

Assembly of the coupling (Fig 2)

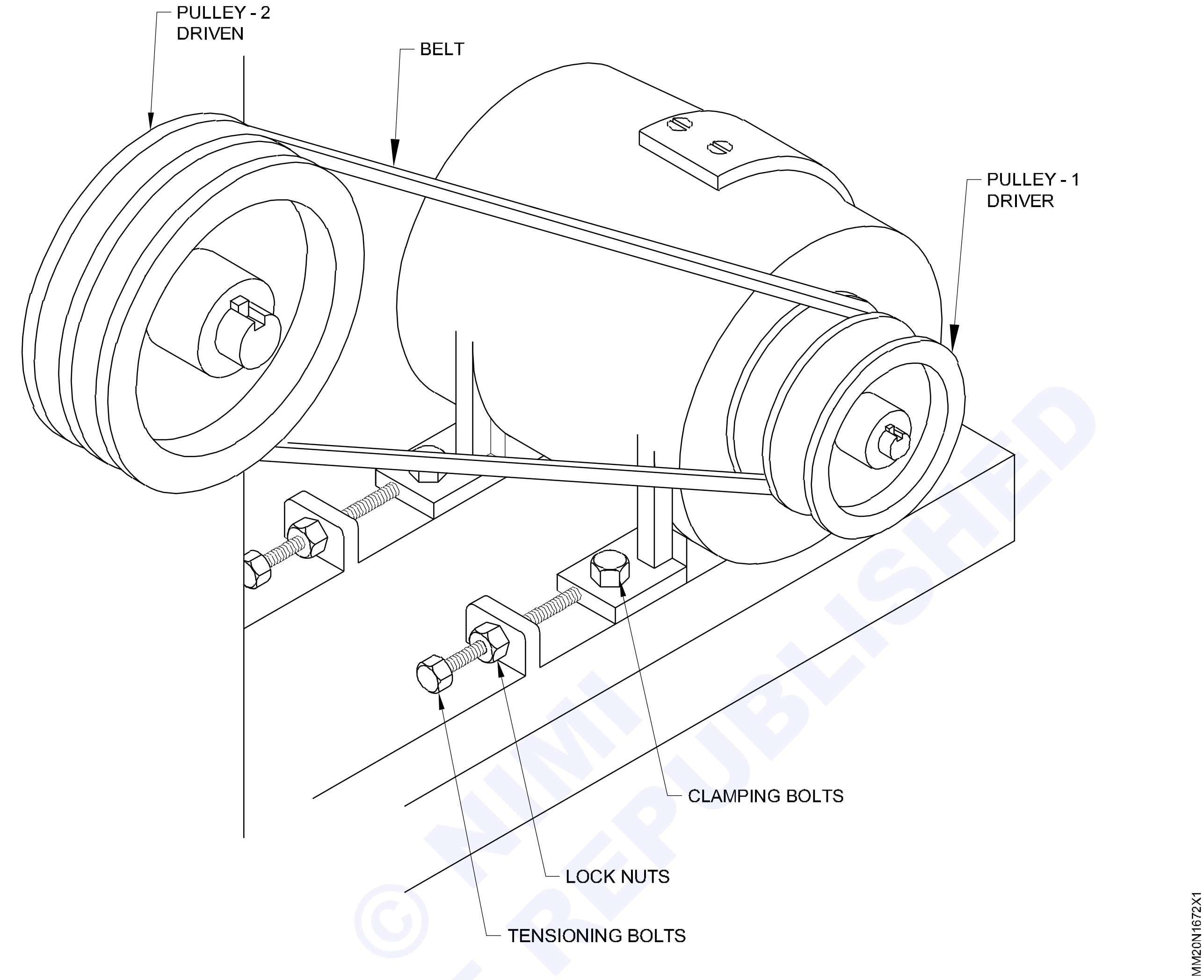
Fig 2



- Wornout parts are to be replaced/rectified.
- Assemble the feather keys in the shafts.
- assemble the coupling on the shaft.
- Place the bolts in place.
- Tighten the bolts, so that the coupling comes closer with out any clearance.
- Trial run the same.

TASK 4: **Belt**

Fig 1



- Measure the span length of a belt drive using a steel tape.
- Find the middle of the longest span of the belt between the pulleys.
- Put twine thread around the belt drive and tie it.
- Put the spring balance hook at the middle of the longest span of the belt.
- Pull the spring balance inwards to the required force and note the total deflection, using a steel rule.
- Adjust the tension as necessary, using tensioning bolts.

Safety precautions related to power transmission

Objective: At the end of this exercise you shall be able to
- **follow the safety precautions relates to power transmission.**

Job Sequence

TASK 1: **Safety related to belt**

Safety precautions related to belt (Fig 1)

1 Never touch moving belts

2 Make sure all tools and personal are clear of any moving parts before restarting the belt.

3 Keep belt surroundings clear of debris and clean up any lubricant spills before working on a belt or restarting it.

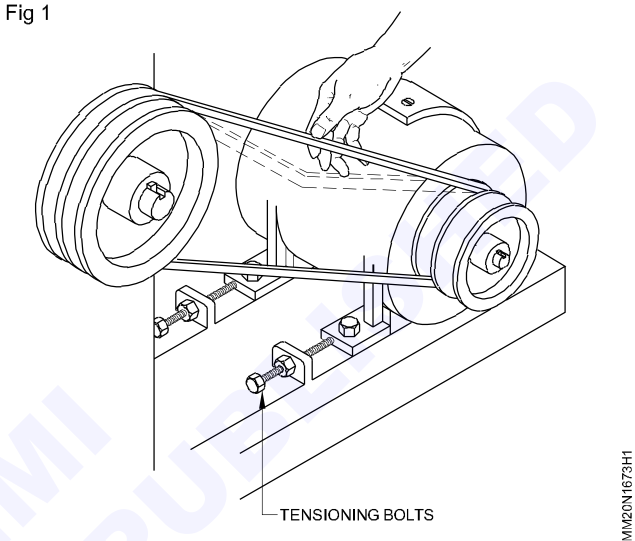
4 Always replace safety guards before placing a belt back in to service.

5 Never operate a belt with an open or missing chain or belt guard.

6 Look for and remove any sharp edges, protruding objects or other hazardous conditions.

7 Always shut down belt before removing any particles or foreign objects.

Fig 1



— — — — — — —

TASK 2: **Safety related to chain**

Safety precautions related to chain (Fig 1)

1 Never try to remove or replace chains while any part of equipments in motion.

2 Be careful while lifting the guard off the equipment with the rig floor hoist.

3 Attach the chain stretcher tool and tighten it to take slack off of the links you plan to separate.

4 When breaking a chain, it is advisable to warp looks of soft line through a number of the links and secure the end of the line.

5 Wear goggles while using a hammer and punch to drive out the connect or link never use hatchet.

6 Once the chain links are separated, loosen the chain stretcher tool and remove it from the chain. Then slowly give slack to the soft line that is holding the chain.

7 Use an air hoist or some type of hoisting device to remove chain from the equipment.

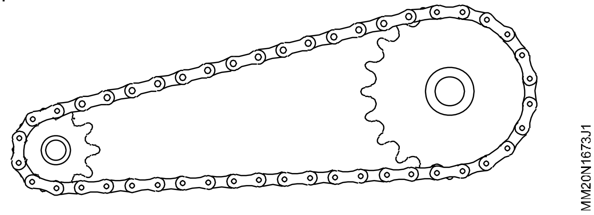
8 Be sure the chain clamp is properly installed.

9 Check the chain regularly for lubrication and make frequent checks on all keys.

10 Do not keep fingers from between chain and sprockets.

11 Replace the guards when the job is done and before putting the equipment back into service.

Fig 1



— — — — — — —

TASK 3: **Safety related to coupling**

Safety precautions related to coupling (Fig 1)

1 Coupling should be used with misalignment of not more than the allowable value. Use of the unit exceeding the allowable value may damage the product or affect peripheral devices.

2 The load torque generated by continuous operation must be not more than a rated torque of the coupling.

3 Use of the unit exceeding the allowable value may damage the product or affect peripheral devices.

4 In case of a device with large load fluctuation please apply adhesive agent or upgrade the part number of a coupling to use by one level to prevent screw loosening.

5 If any abnormal sound or vibration occurs during operation, immediately stop the operation and check the alignment, interference with peripheral devices, and loosening of screws.

6 Screws other than our specified ones (hex socket set screw or hex socket head cap screw) should not be used.

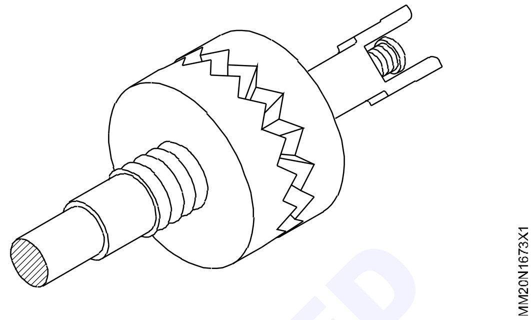
7 When discarding the used products, please ask a special dealer to discard them so as to prevent bad influence on environment.

8 Never touch the product immediately after stopping the operation. Heat transmission from peripheral devices may cause the product to be highly heated, which may cause the worker to be bumed.

9 The data in the technical information are for reference only. They are not guaranteed values. Carry out tests under conditions similar to actual operating conditions in advance.

10 After mounting the coupling perform a load test for about 10 minutes prior to continues operation.

Fig 1



— — — — — — —

TASK 4: **Safety precautions related to pulley**

1 Follow the weight limits before attaching anything to your pulley, check its safe working load. (Fig 1)

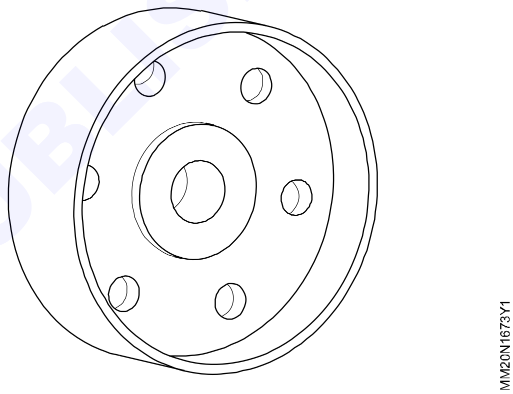
2 Check your anchoring system.

3 Watch the wind.

4 Don't let people work under or around the pulley.

5 Have your staff wear personal protective equipment.

Fig 1



— — — — — — —

TASK 5: **Safety related to gear (Fig 1)**

1 Gears all ways covered with guard or in box.

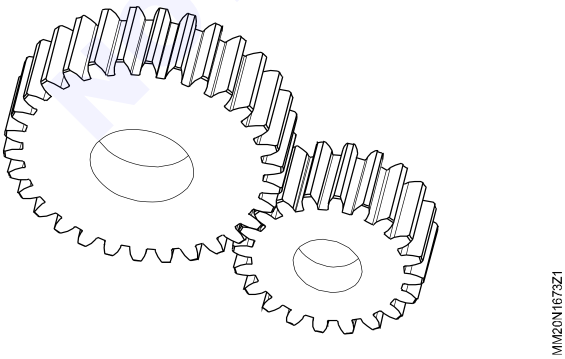
2 Do not touch the gear while it is in motion

3 Do not change the speed of gear while it is rotating

4 Lubricate the gear periodically

5 Do not push or insert any object in to the air vents or opening of gear box.

Fig 1



Safety Precautions

A Avoid use in wet or corrosive areas, unless the gear-box is specified for these environments.

B Ambient temperature in the area of the gearbox must be in the range of 0°-40°C, unless the gearbox is built to withstand a different temperature range.

C. The gearbox (with motor) must be firmly attached to a vibration-free frame or fixture.

D. The gearbox has been lubricated and can be operat- ed immediately.

E At initial operation, check the direction of shaft rotation, then apply the load gradually.

F Avoid excessive loads.

G Ensure that the motor speed does not exceed the maximum RPM specified for the gearbox.

H Watch for the following problems and discontinue motion immediately:

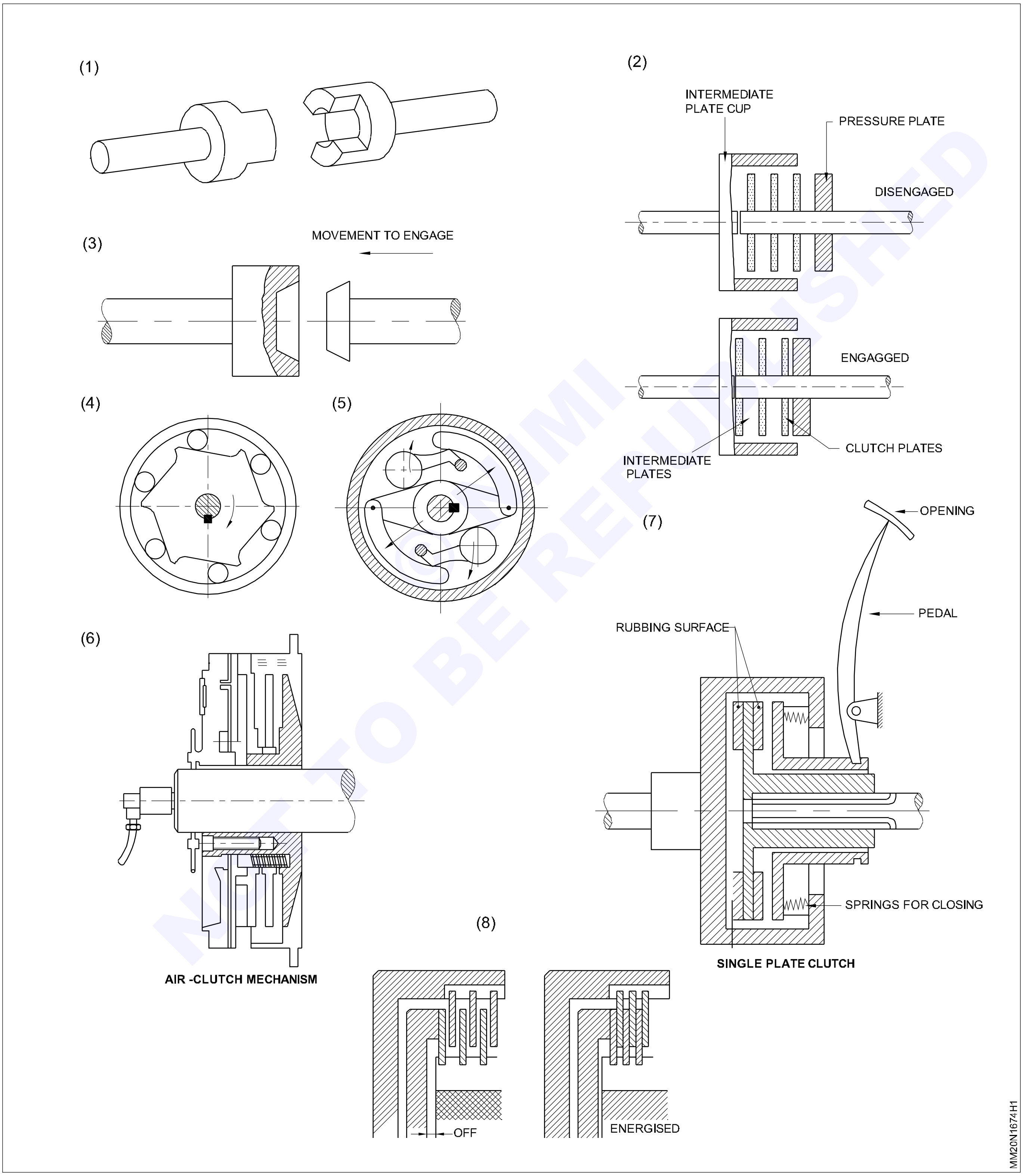
- a Sharp increase in temperature
- b Abnormal noise
- c Unstable output speed

I The gearbox is not designed to be disassembled.

J The gearbox is lubricated for its lifetime with appropriate grease. No re-lubrication is required.

Identify different types of clutches in machine tools and maintenance

Objectives: At the end of this exercise you shall be able to
- **identify the types of clutches**
- **maintaining the column table 1, name and maintenance.**



Note

Instructor should arrange various types of clutches and maintenance of each and insist the trainees to fill up table 1. Name and maintenance procedure.

Job Sequence

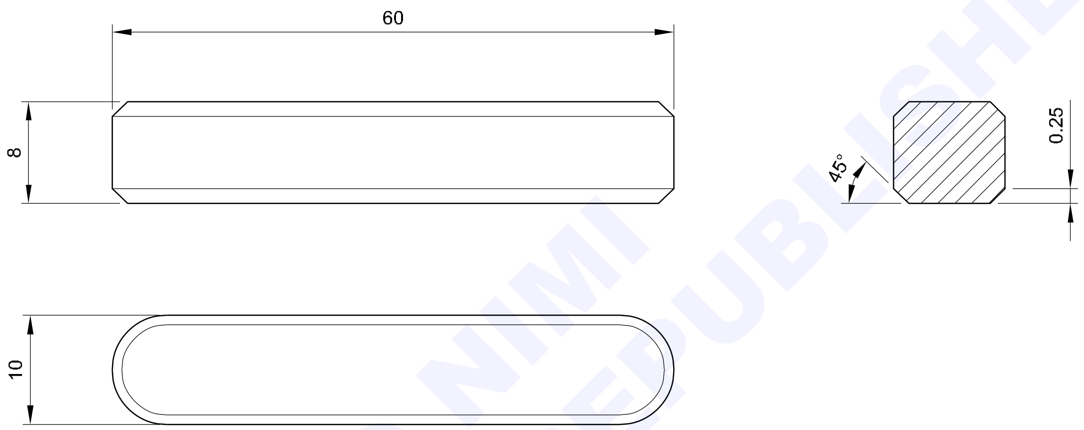
- Watch carefully the displayed types of clutches.
- Identify the types of clutches.
- Submit the filled table 1, to your instructor for checking.

Sl No	Name of clutch	Maintenance
1		
2		
3		
4		
5		
6		
7		
8		

Making key and mounting of coupling on the shaft with key

Objectives: At the end of this exercise you shall be able to
- **making of key as per dimension**
- **mounting the coupling on the shaft with key.**

TASK:1 MAKING KEY



Job Sequence

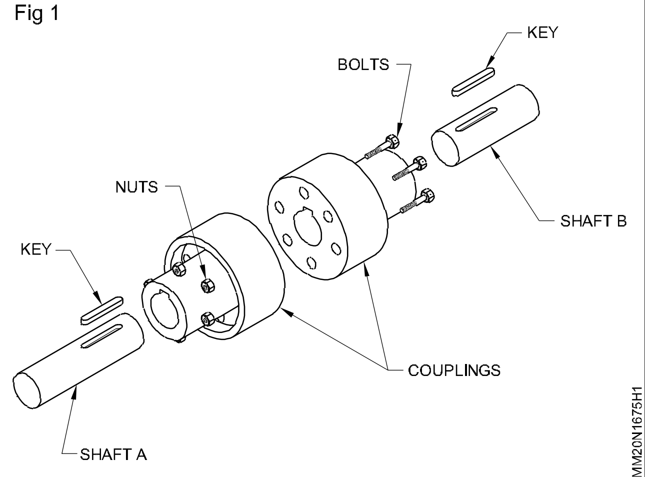
TASK 1: **Making key**

- Check the raw material
- File to the size 10x8x60
- Mark the radious on both end.
- File the radious
- Chamfer the 4 corner 0.25x45°
- Remove the burrs
- Now the key is ready to use.

1	Sq 12 x 65 mm	-	Fe310	-	-	1.6.75
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	MAKING KEY AND MOUNTING OF COUPLING ON THE SHAFT WITH KEY			TOLERANCE ±0.04	TIME 5Hrs	CODE NO. MM20N1675E1

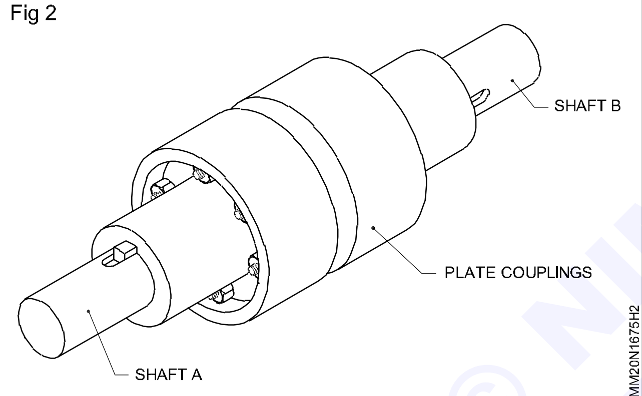
TASK 2: **Mounting coupling on the shaft with key (Figs 1 & 2)**

Fig 1



- Assembly of the coupling (Fig 2)

Fig 2

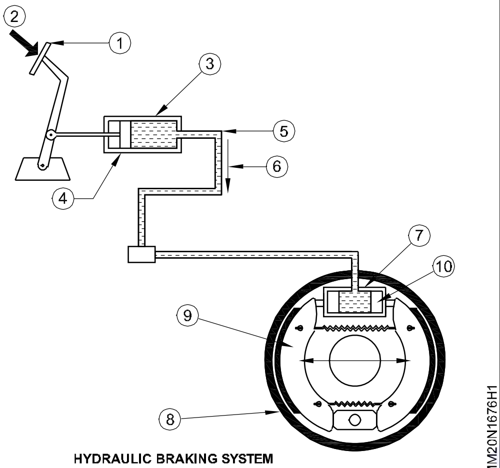


- Wornout parts are to be replaced/rectified.
- Assemble the feather keys in the shafts.
- Assemble the coupling on the shaft.
- Place the bolts in place.
- Tighten the bolts, so that the coupling comes closer with out any clearance.
- Trial run the same.

Identification and inspection of components of different types of brakes in machine tools

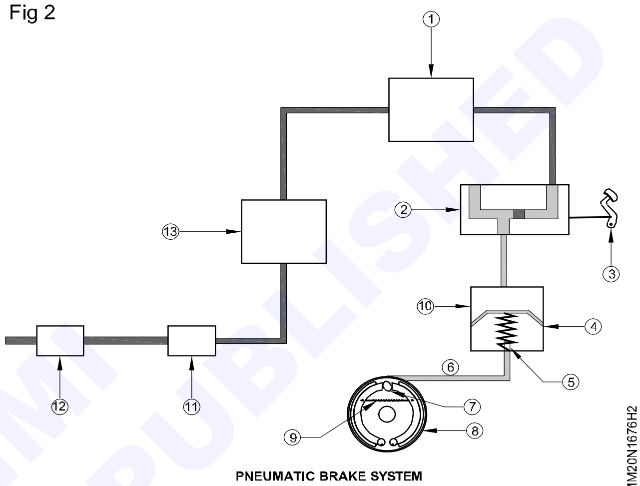
Objectives: At the end of this exercise you shall be able to
- **identify the components of hydraulic brake**
- **identify the components of pneumatic brake**
- **identify the components of drum brake**
- **identify the components of disc brake**
- **file the table 1 to 4 name of by components of each brake system.**

Fig 1



HYDRAULIC BRAKING SYSTEM

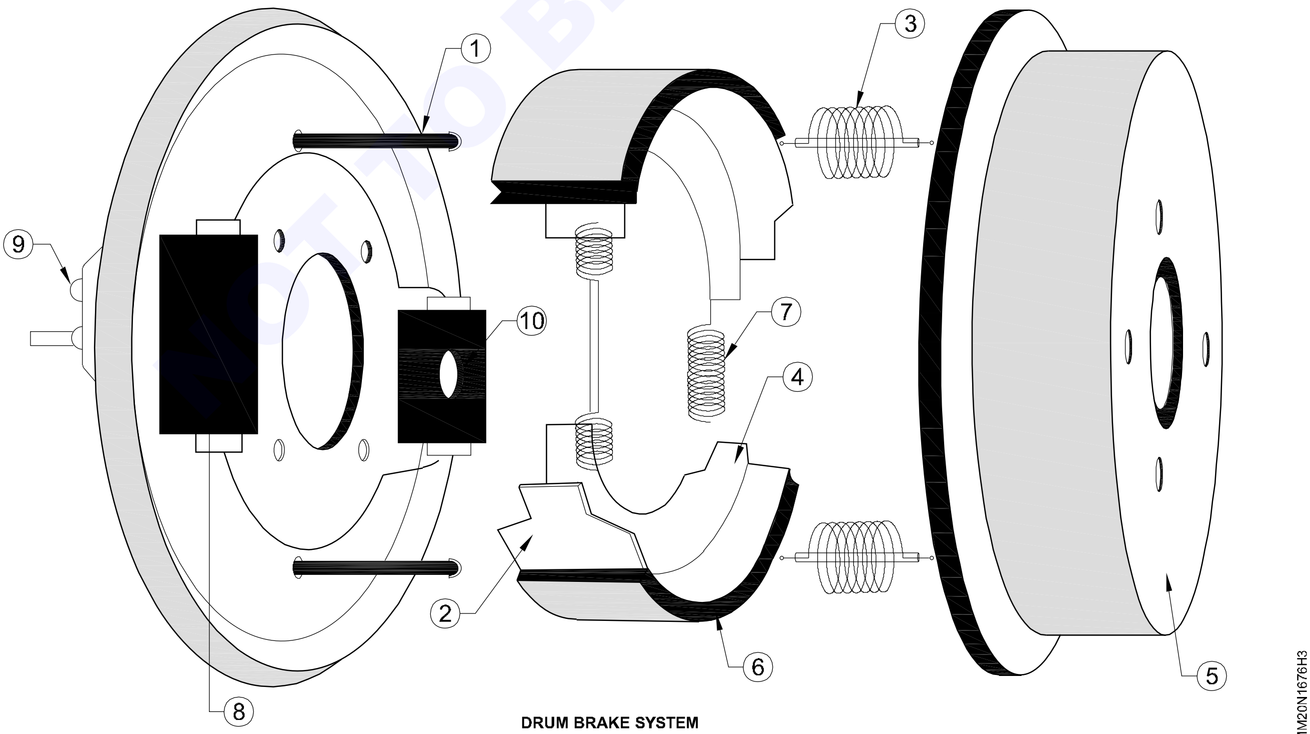
Fig 2



PNEUMATIC BRAKE SYSTEM

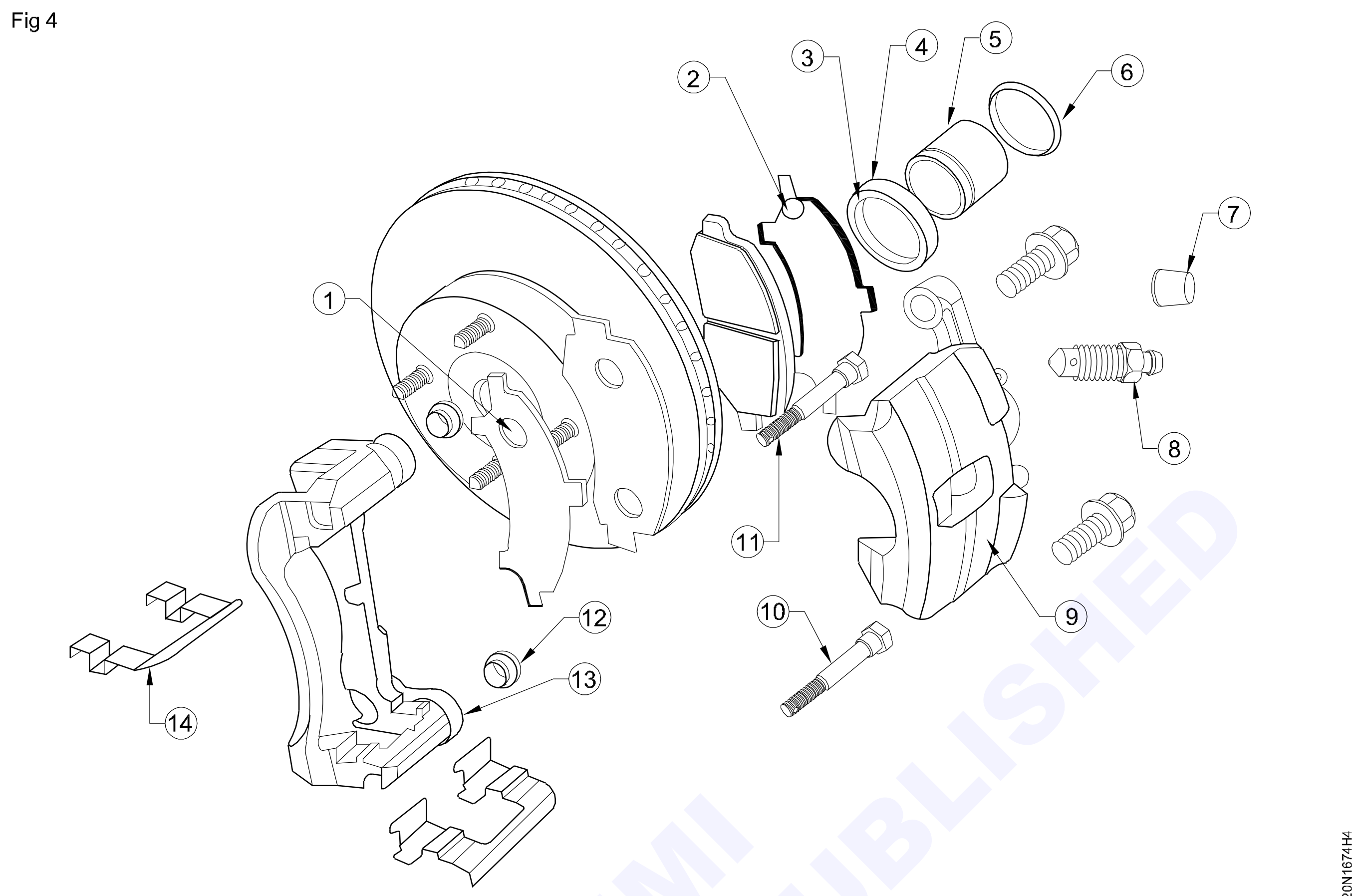
Note: Instructor should make necessary arrangements for displaying various, brake components or charts of the components explain the each component to the trainees insist trainees to fill in table 1 to 4

Fig 3



DRUM BRAKE SYSTEM

Fig 4



DISC BRAKE SYSTEM

Table 1

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

Table 2

Sl.No.	Name of component of pneumatic brake
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	

Table 3

Sl.No.	Name of component of drum brake
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Table 4

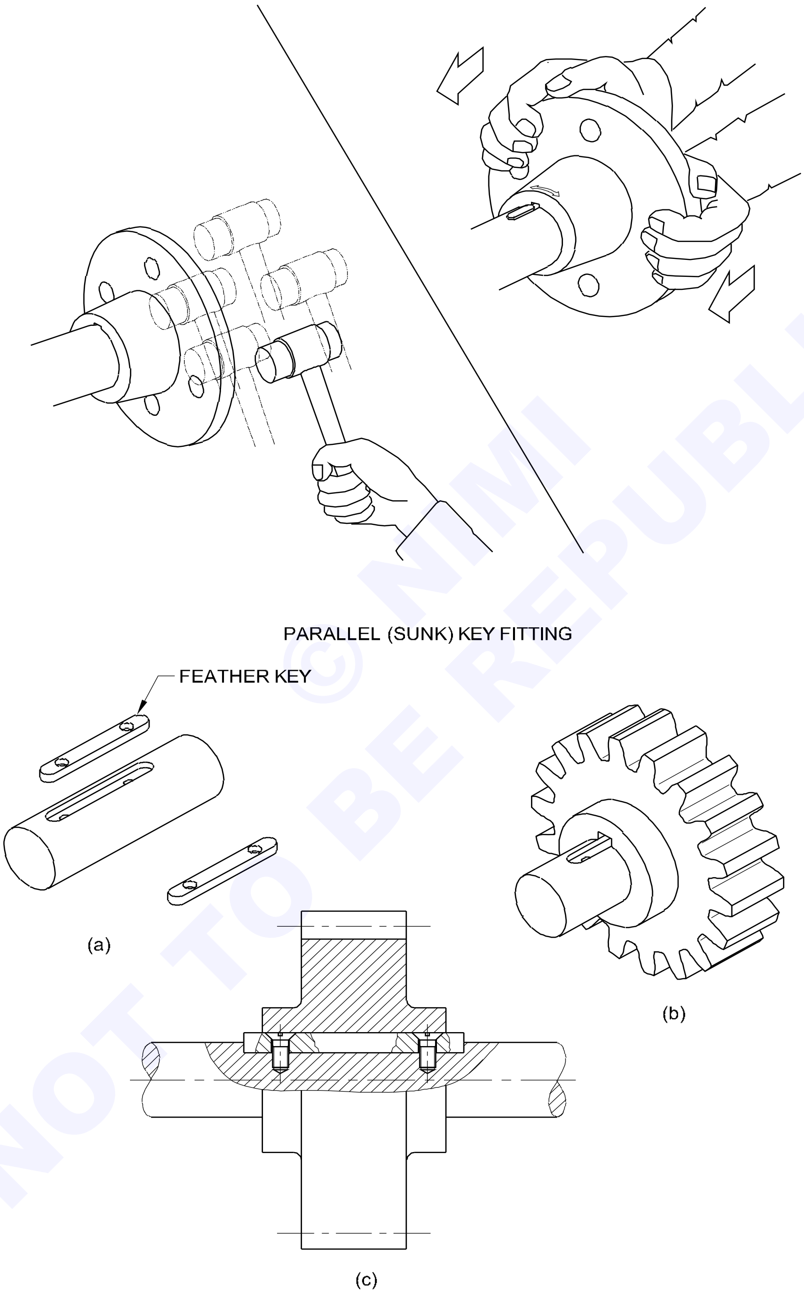
Sl.No.	Name of component of disk brake
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	

Job Sequence

- Watch carefully the displayed components of brakes
- List in table 1 for hydraulic brake
- List the component in table 2 for pneumatic brake
- List the name of component for drum brake in table 3.
- List the name of disc brake component in table 4.
- Submit the filled table 1 to table 4 to your instructor for checking.

Fitting of hub and shaft with key

Objectives: At the end of this exercise you shall be able to
- **assemble sliding hub and shaft with feather key**
- **assemble hub and shaft with parallel sunk key.**



–	–	–	–	–	–	1.6.77
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FITTING HUB AND SHAFT WITH KEY**	DEVIATIONS	TIME 5h
		CODE NO. MM20N1677E1	

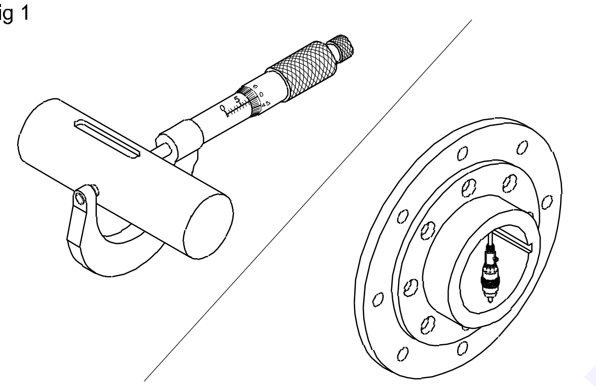
Job sequence

- Assemble hub and shaft with parallel key.
- assemble hub and shaft with feather key.

Parallel key fitting

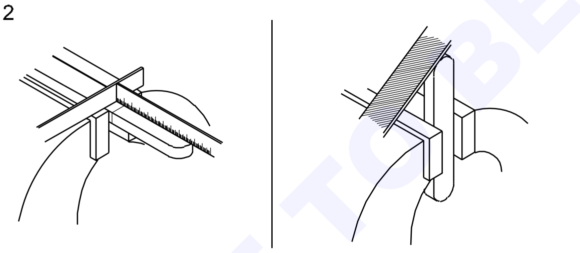
- Deburr the keyways in the shaft and the Hub, clean the keyways.
- Check the dimensions of shaft and Hub and keyways using precision instruments.
- (Outside dia of shaft, inside dia of hub, length, width and depth of keyway) as per the drawing (Fig 1)

Fig 1



- Select a length of key steel (St 60) of suitable cross section depending on the size of the keyway.
- File radius at one end of the key and cut to a length plus 1 mm of the keyway and file other end of the key. (Fig. 2)

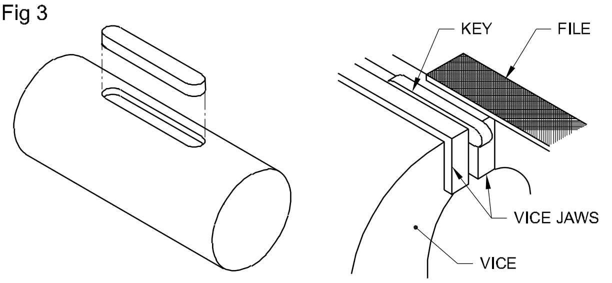
Fig 2



Ensure that the key is chamfered all around in its bottom side edges.

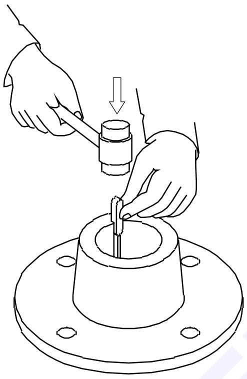
- Check the key width to suit the keyway in the shaft. Draw file the key, so that it is slight tap fit/light keying fit (K7-h6) with the keyway on the shaft. (Fig. 3).

Fig 3



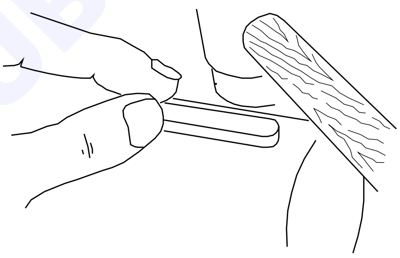
- Check the key for slight tap fit with the keyway in the Hub. (Fig 4)

Fig 4



- Apply Prussian blue on all sides and bottom portion of the key so that proper bearing of key on the keyway is ascertained.
- Insert the key in the keyway in the shaft and tap with a light weight soft hammer. (Fig 5)

Fig 5

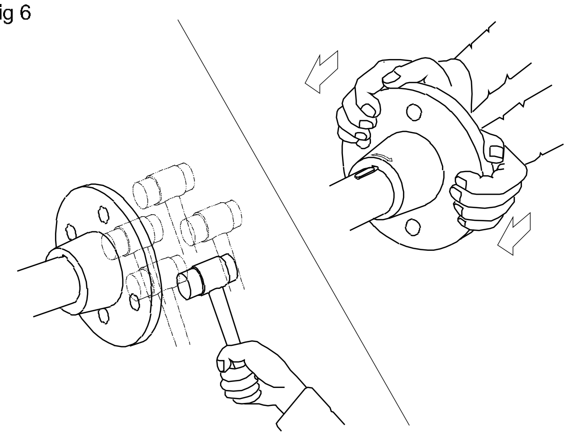


Tap the hub on the shaft, and remove the hub from the shaft, check the key and note the high spots where the key has made contact with the keyway of the hub. (Fig. 6)

Lightly file the high spots away, the top of the key should be approximately 0.1mm clear.

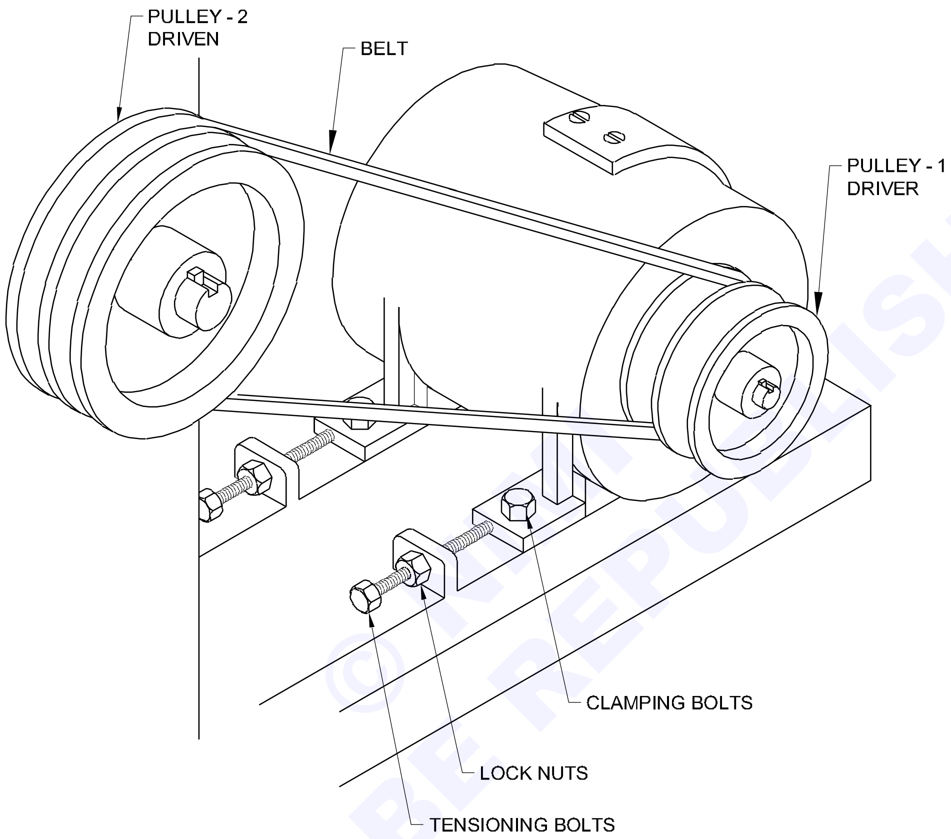
Repeat the fitting and filing operation until the hub is fit on to the shaft to the desired position. (Fig. 6)

Fig 6



Installation of belt for transmission with adjusting the tension

Objectives: At the end of this exercise you shall be able to
- **join the flat leather belt by alligator fastener**
- **fix a belt so over driver and driven pulley**
- **measure tension of belt drive**
- **adjust belt tension with a spring balance.**



Job sequence

- Measure the span length of a belt drive using a steel tape.
- Note the recommended deflection from the table.
- Find the middle of the longest span of the belt between the pulleys.
- Put twine thread around the belt drive and tie it.
- Put the spring balance hook at the middle of the longest span of the belt.
- Pull the spring balance inwards to the required force and note the total deflection, using a steel rule.
- Adjust the tension as necessary, using tensioning bolts.

-	–	–	–	–	–	1.6.78
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	BELT INSTALLATION	TOLERANCE: -	TIME : 12 Hrs
		CODE NO. MM20N1678E1	

Skill sequence

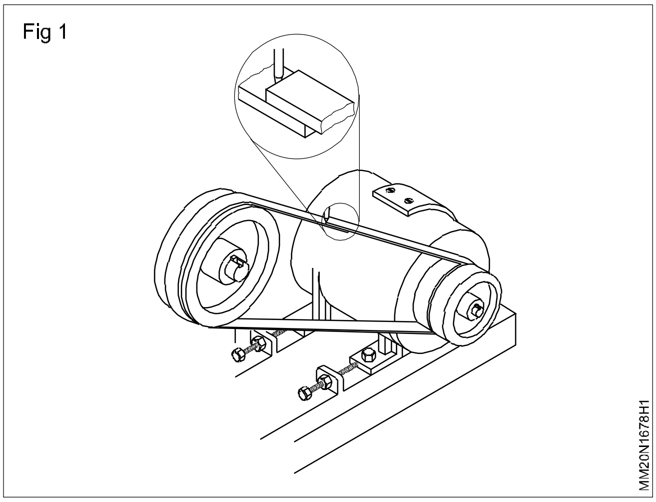
Joining flat leather belt using alligator fastener

Objective : This shall help you to

- **join a flat leather belt by an alligator fastener and fit the belt over the pulleys.**

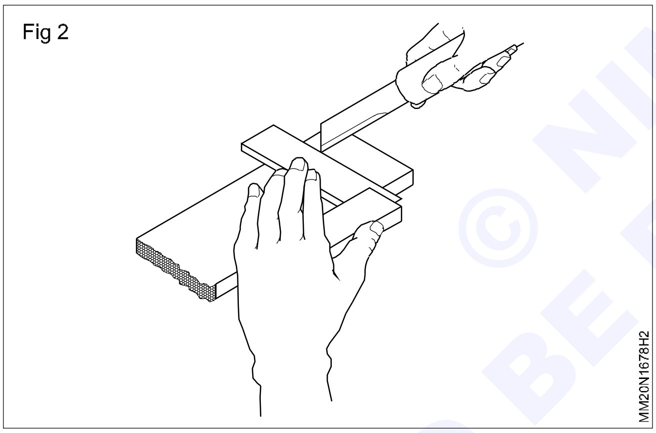
Mark and cut the belt to the required length. (Fig 1)

Fig 1



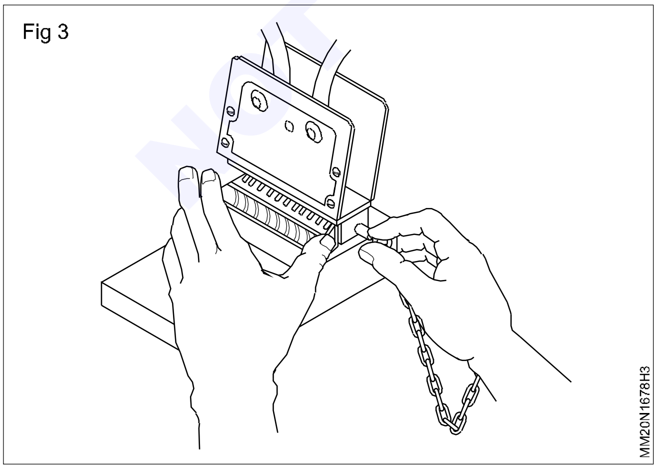
Trim both ends of the belt square. (Fig 2)

Fig 2



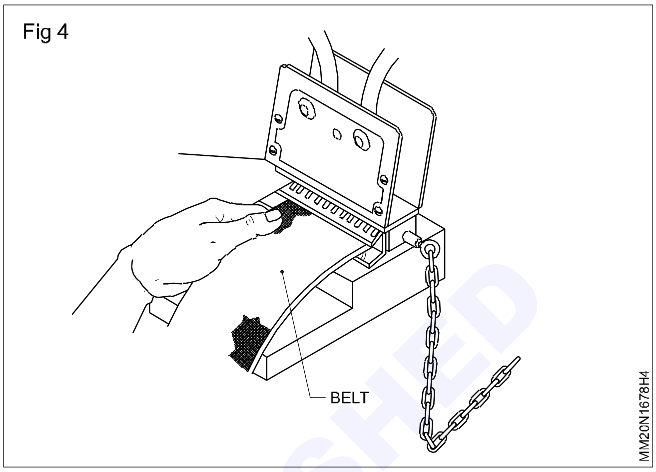
Fit an alligator fastener centrally into the jaws of the lacing machine and fit the pin into the side of the jaws to hold the fastener in the machine. (Fig 3)

Fig 3



Put the belt centrally between the jaws of the machine. (Fig 4)

Fig 4



Operate the machine to press the fastener into the belt until it is flush with the belt. (Fig 5 & 6) Trim the edges of the fastener.

Fig 5

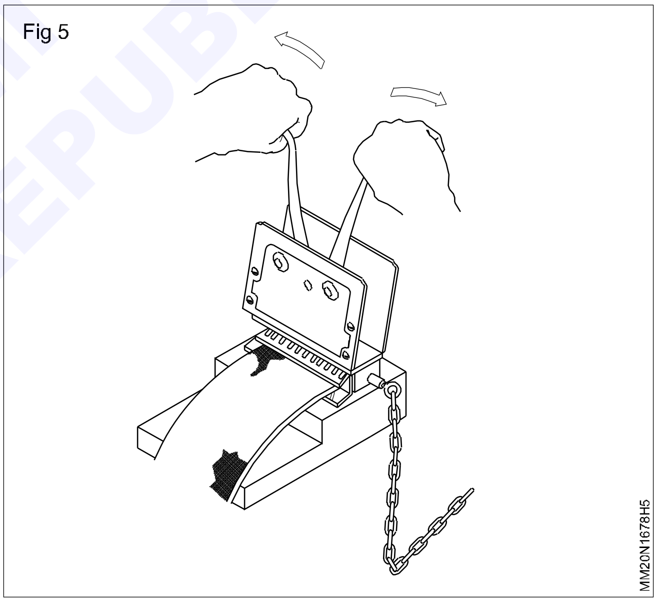
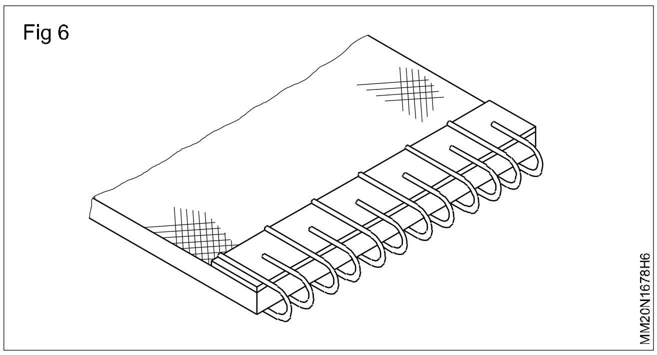
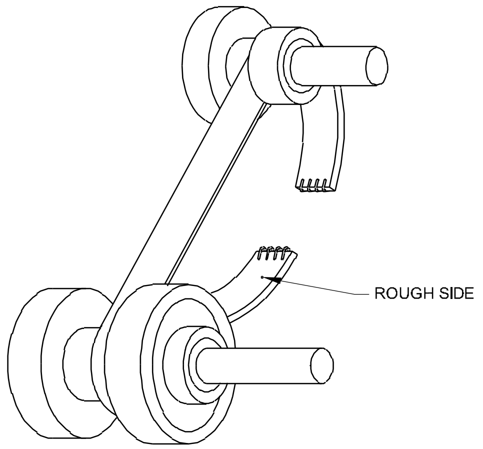


Fig 6



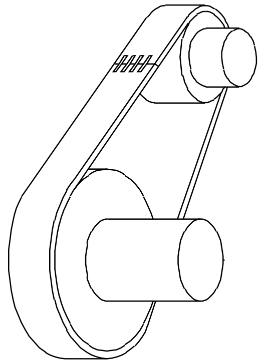
Place the belt around the shafts beside the pulleys with the rough side against the pulleys and join both ends by the pin. (Fig 7)

Fig 7



Fit the belt to the small pulley first and then run it on to the big pulley. (Fig 8)

Fig 8



Skill sequence

Adjust belt tension in 'v' belt drive

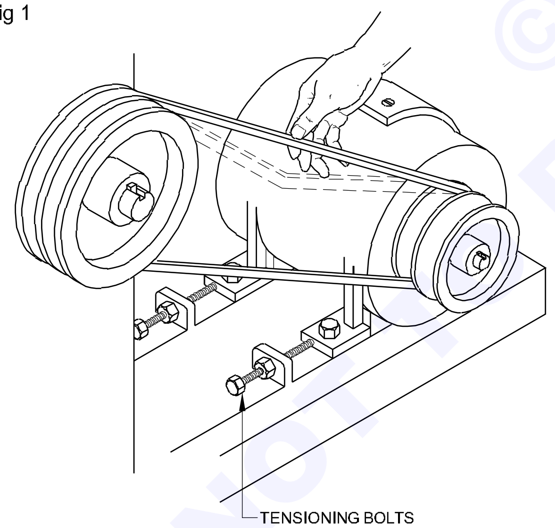
Objectives : This shall help you to
- **check belt tension using a spring balance**
- **adjust belt tension by tensioning bolts.**

Measure the longest span length of the belt between the pulleys, using a steel tape.

Find the middle of the longest span of the belt between the pulleys.

Push this mid-point inwards, then pull it out and note the total deflection. (Fig 1)

Fig 1



This indicates the existing tension of the belt.

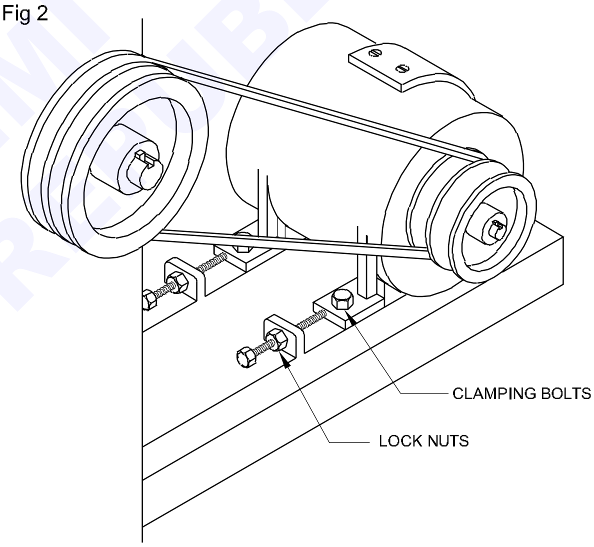
Loosen the lock-nuts. (Fig 2)

Slacken the clamping bolts. (Fig 2)

Move the pulley with the adjusting screws to alter the tension. (Fig 2)

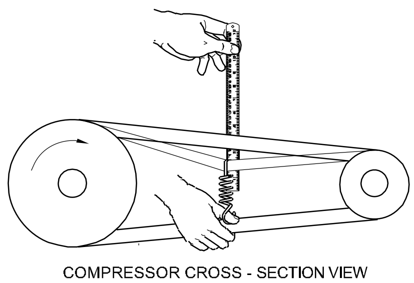
The adjusting screws must be turned equally to keep the pulleys correctly aligned.

Fig 2



Attach a spring balance and check the tension of the belt. (Fig 3)

Fig 3



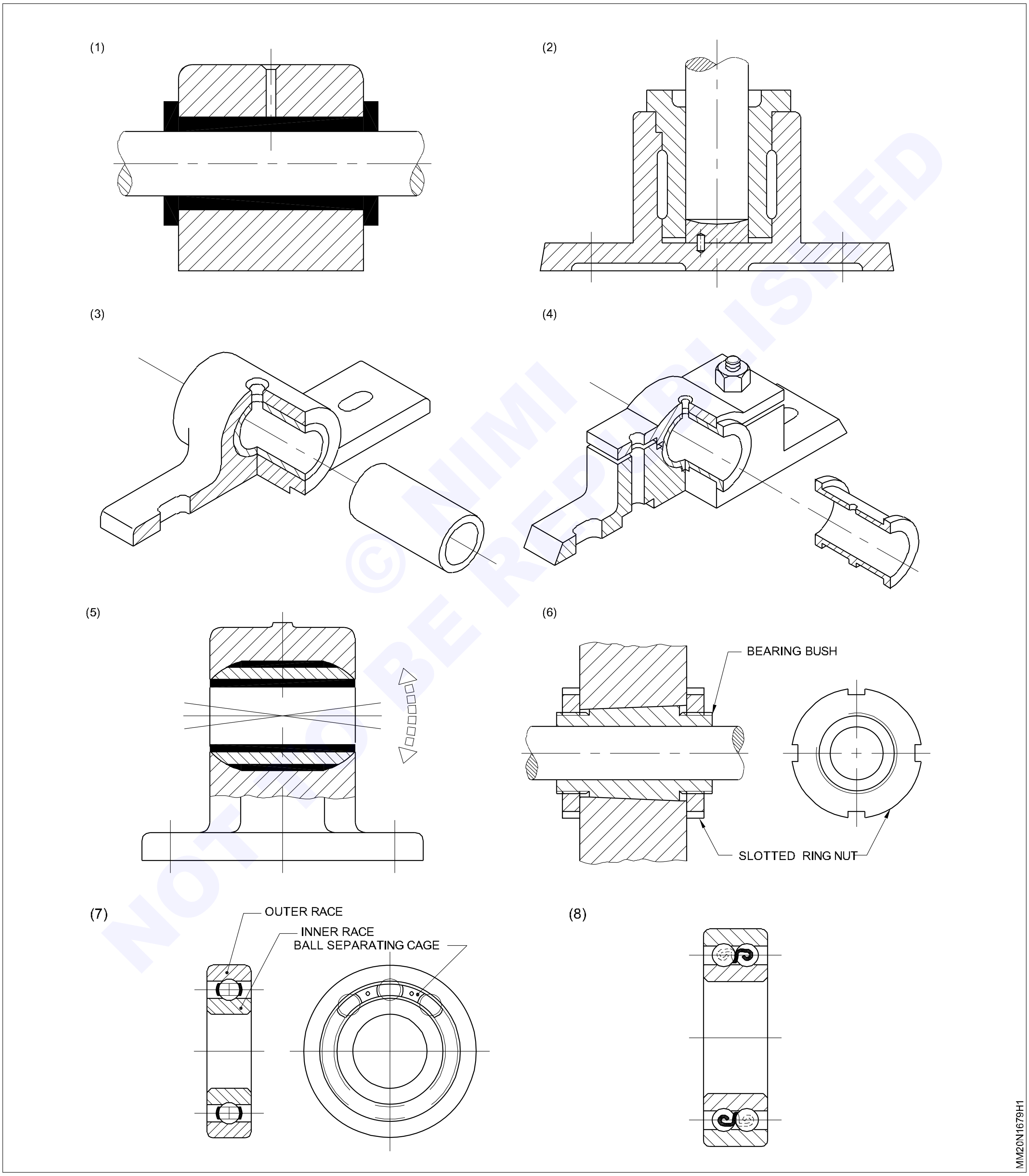
Readjust the adjusting screws untill the tension is correct.

Tighten the clamping bolts.

Tighten the lock-nuts.

Identification of various types of bearing in machine tools

Objectives: At the end of this exercise you shall be able to
- **identify the types of bearing**
- **record the name of bearing in table -1.**



Job Sequence

- Watch carefully the display of bearings.
- Identify the types of bearings and fill up in table 1
- Submit filled table 1 to your instructor for checking.

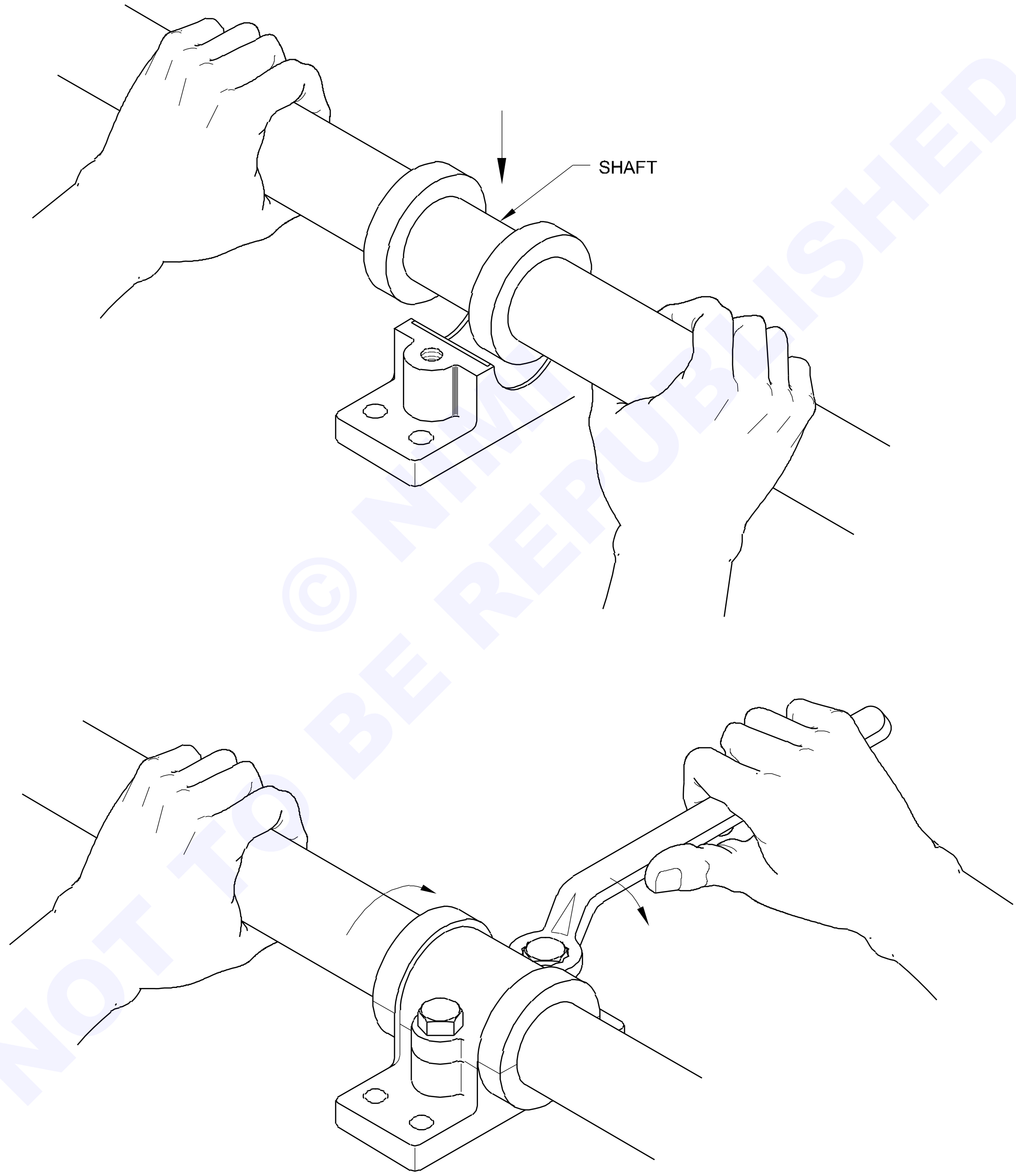
Note: Instructor shall display the various types of bearing or chart. Explain to the trainees and ask them to fill the name in Table 1

Table 1

Sl.No.	Name of the bearing
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Impression testing of split bush bearing for proper contact on journal & housing

Objectives: At the end of this exercise you shall be able to
- **assembling shaft and bearing**
- **dismantle shaft and bearing**
- **removing high spots using scraper.**



–	–	–	–	–	–	1.6.80
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

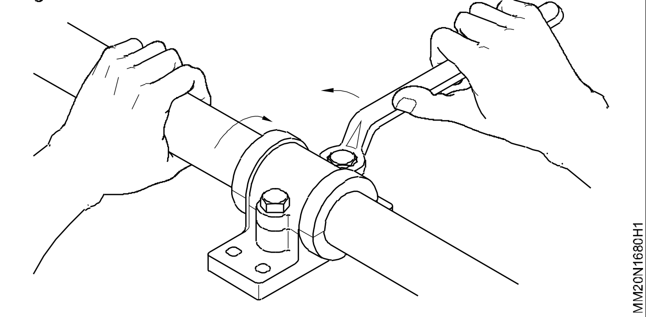
SCALE NTS	**IMPRESSION TEST OF SPLIT BUSH BEARING**	TOLERANCE	TIME Hrs
		CODE NO. MM20N1680E1	

Job sequence

TASK 1: **Dismantling and assembling bush bearing**

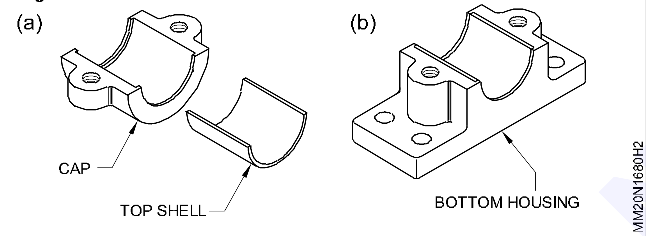
- Dismantle the cap of the block by using proper ring spanner. Hold the shaft with left hand and remove the fastening nut by right hand as shown in Fig 1.

Fig 1



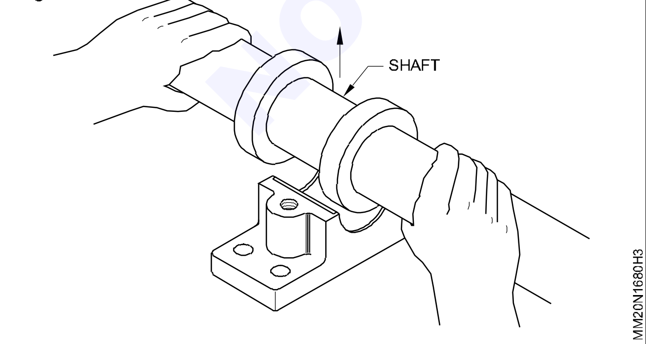
- Remove top shall along with cap Fig. 2a and then remove the shaft and bottom housing as shown in Fig. 2b.

Fig 2



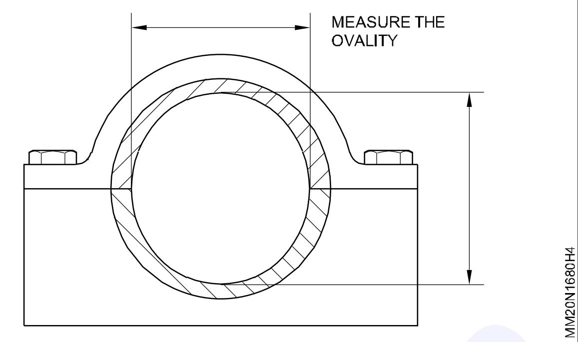
- Thoroughly clean shells, cap, shaft seating (Journal) and housing bottom with kerosene by using small brush. Wipe out all above components with clean banian cloth. Do not use cotton waste to wipe out component.
- Check shells and Journal for any damage, scoring mark etc. Check cap, bottom housing and fastening bolt and nut for any damage and wear. Replace the damaged components with new one before starts assembling. (Fig. 3). If it is not possible to replace shaft, it should be built by metal deposition and machined.

Fig 3



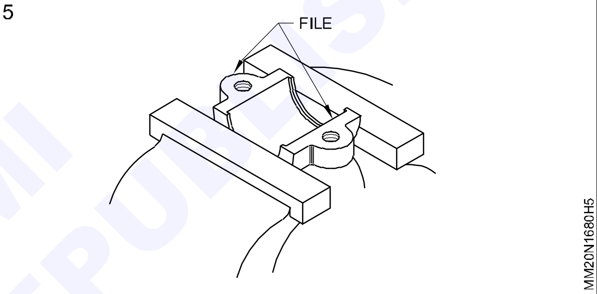
- Check ovality of the bearing bore by fixing cap on the bottom housing as shown in Fig. 4.

Fig 4



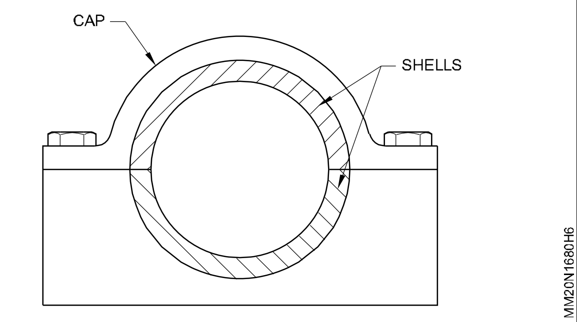
- To remove the ovality. Remove the cap by unscrewing fastening bolts. File the bearing caps equally with flat file to compensate for the ovality by holding the cap into the vice as shown Fig. 5.

Fig 5



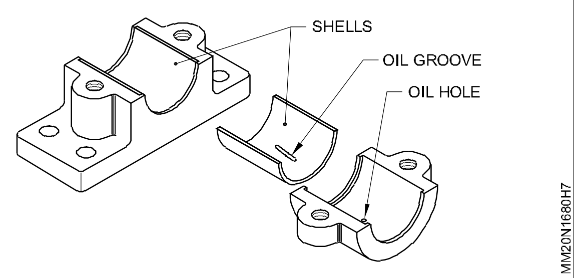
- Fit the two halves of the bearing back together and make sure that, when the bolts are fitted, the load is taken by the caps and not by shells. (Fig. 6)

Fig 6



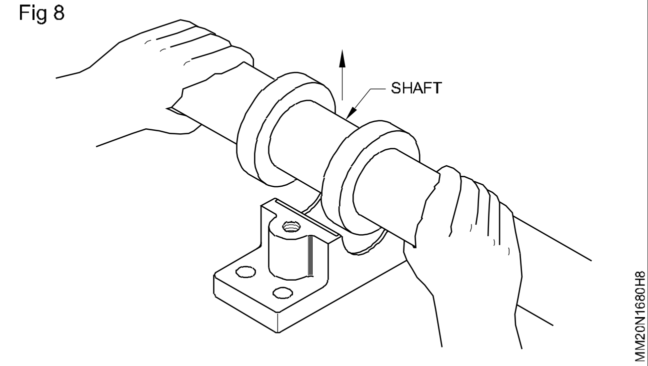
- Fit the shells to their housings. Check that they fit correctly and the oil holes align with those of the housings as shown in Fig. 7.

Fig 7



- Apply marking medium around the Journal area and place it into bottom shell for uniform contact. (Fig. 8)

Fig 8



- If the number of colour marking on the bottom shell is more, it indicate shaft having proper contact with bottom shell otherwise scrape the shell to have more number of colour marking. (Fig. 9)
- Coat all the parts with the correct grade lubricant. Place the Journal on the bottom housing, place top shell and cap on the shaft. Tighten the bolt firmly by holding the shaft. (Fig. 10).
- After mounting pedestal block clear all tools around the work spot..

Fig 9

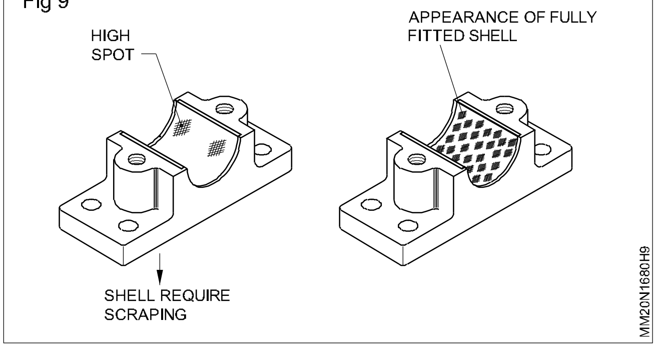
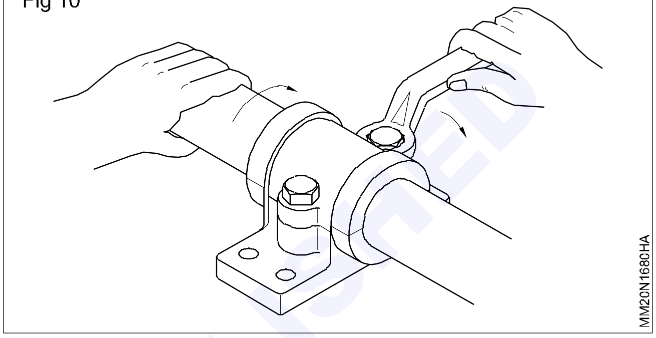
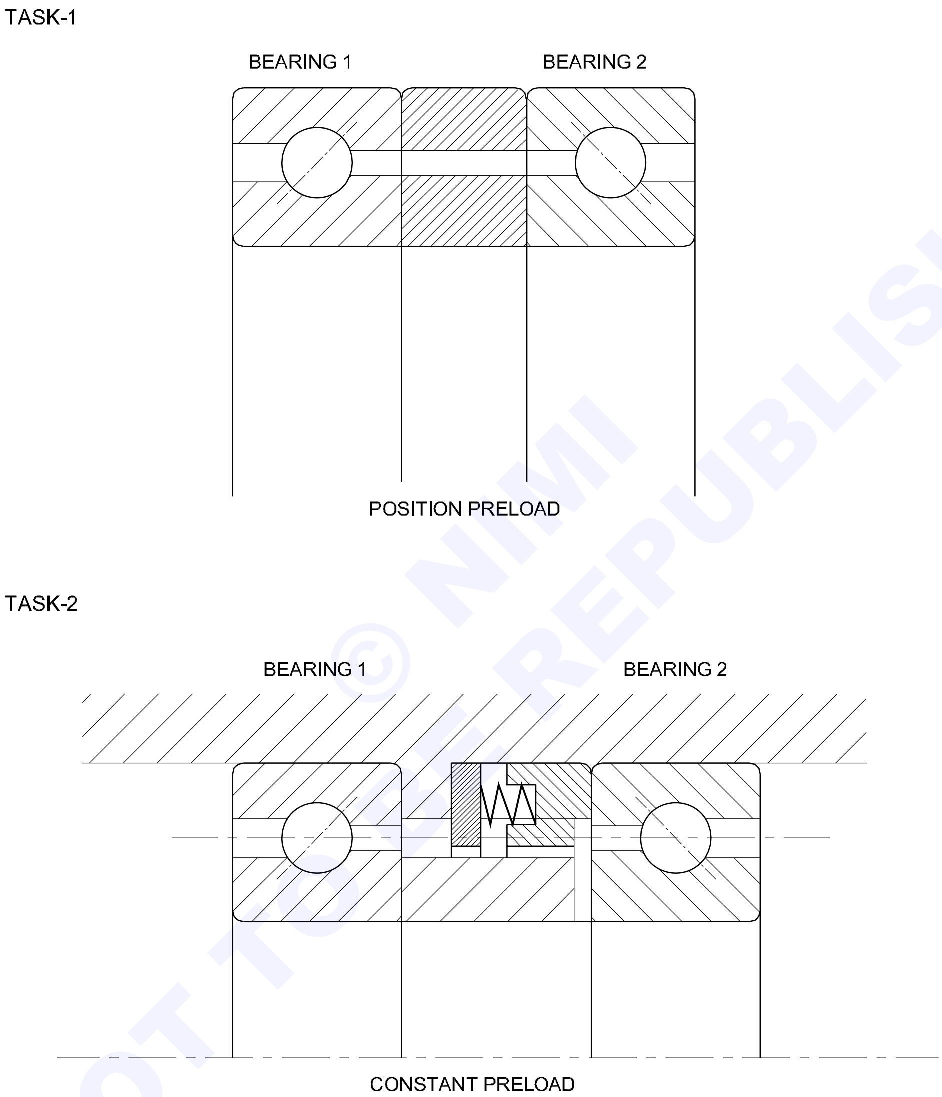


Fig 10



Preloading of precision angular contact bearing

Objectives: At the end of this exercise you shall be able to
- **preload the angular contact bearing by position method**
- **preload the angular contact bearing by constant methods.**



–	–	–	–	–	–	1.6.81
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**PRELOADING OF PRECISION ANGULAR CONSTANT BEARING**	TOLERANCE	TIME 4 Hrs
		CODE NO. MM20N1681E1	

Job Sequence

TASK 1: **Position preload**

1 Fix two axially opposed bearings in such a way that preload is imposed on them.

2 Their position, once fixed, remain unchanged while in operation.

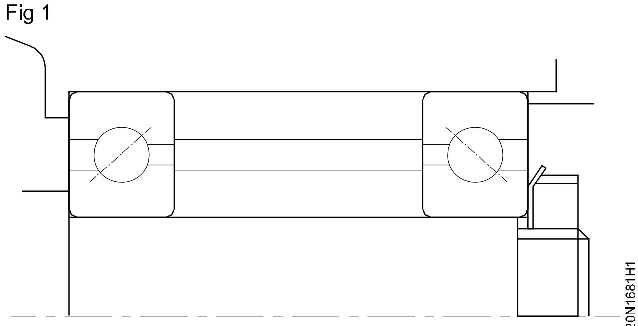
3 Follow one of the three methods are generally used to obtain a position preload.

4 Install a duplex bearing set with previously adjusted stand out dimensions.

5 Use a spacer or shim of proper size to obtain the required spacing and preload (Fig 1)

6 Utilize bolts or nuts to allow adjustment of the axial preload in this case, the starting torque should be measured to verify the proper preload.

Fig 1

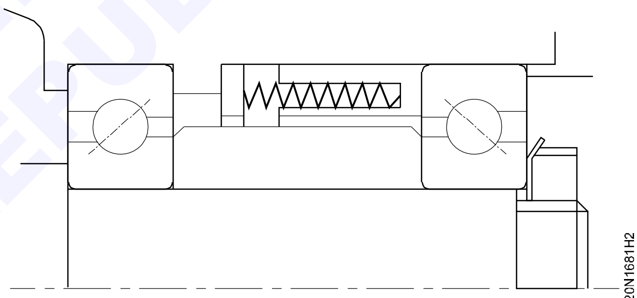


POSITION PRELOADED

TASK 2: **Constant preload**

- To achieve constant pressure preload use a coil or leaf spring (Fig 2)

Fig 2



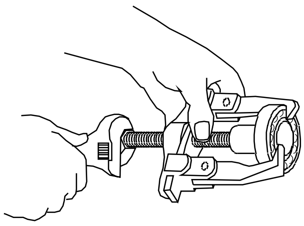
CONSTANT-PRESSURE PRELOAD

Dismantling inspection and mounting of ball bearing on shaft with press and pullers

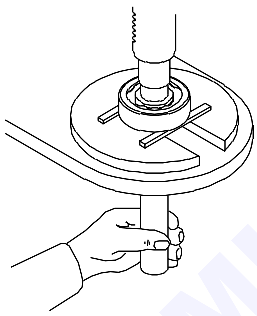
Objectives: At the end of this exercise you shall be able to
- **dismount ball bearing (interference fit on the shaft)**
- **dismount ball bearing (interference fit in the housing)**
- **mount ball bearing.**

* DISMOUNT BALL BEARING
(WITH INTERFERENCE FIT IN SHAFT)

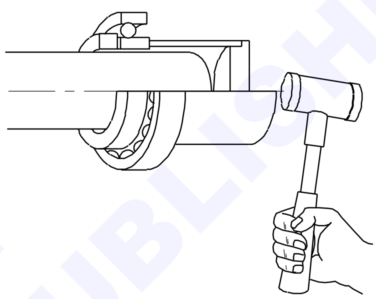
USING PULLER



USING ARBOR PRESS

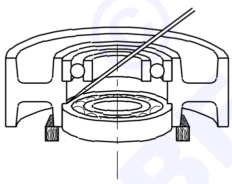


USING SLEEVE AND HAMMER

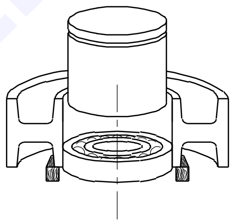


* DISMOUNT BALL BEARING
(WITH INTERFERENCE FIT ON HOUSING BORE)

USING DRIFT

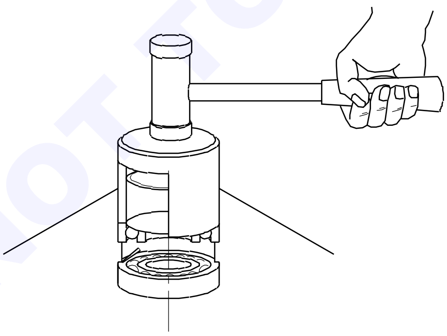


USING SLEEVE

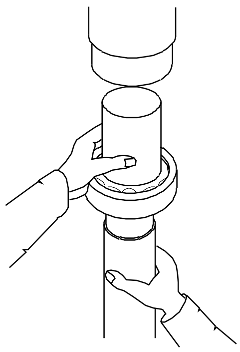


* MOUNT BALL BEARING

USING SLEEVE AND HAMMER



USING ARBOR PRESS



–	–	–	–	–	–	1.6.82
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**DISMANTLING, INSPECTION AND MOUNTING OF BALL BEARING ON SHAFT WITH PRESS AND PULLERS**	DEVIATIONS	TIME 10hrs
		CODE NO. MM20N1682E1	

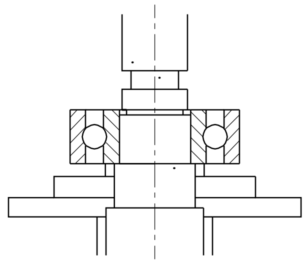
Job sequence

For ball bearings having interference fit on the shaft

Method I using press

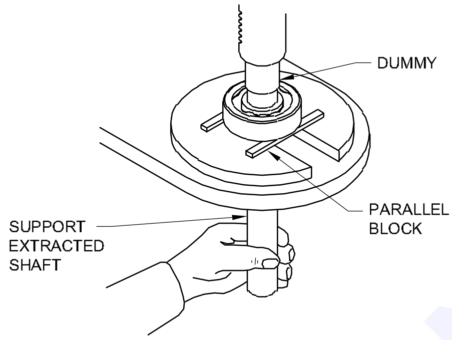
place the bearing with the shaft on a arbor press or hydraulic press. (Fig 1)

Fig 1



place a ring or two parallel blocks of equal size to support the inner ring of the bearing. (Fig 2)

Fig 2



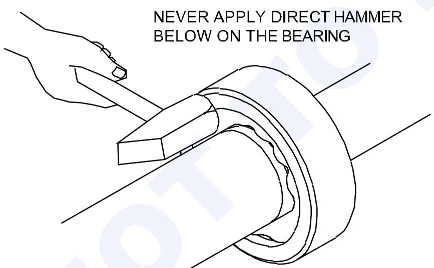
put a dummy between the ram and the shaft

Gently press the shaft to come out of the bearing. (Fig 2)

Support the extracted shaft by hand to prevent damage.

Never apply direct hammer blows on the bearing. (Fig 3)

Fig 3



Method II using bearing puller

Fit the bearing pullers spindle on the centre hole of the shaft. (Fig 4).

Place the legs of the bearing.

Slowly tighten the spindle of the puller by a spanner so that the puller is ready to take the strain (Fig 4)

For dismounting the bearing special type of puller with bracket attachment shown in (Fig 5) is used so that pulling force is applied on the inner ring of the bearing.

Fig 4

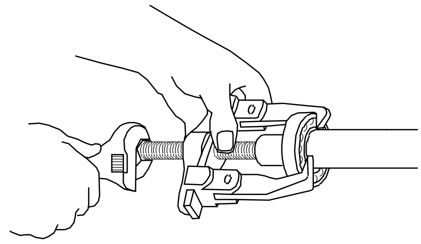
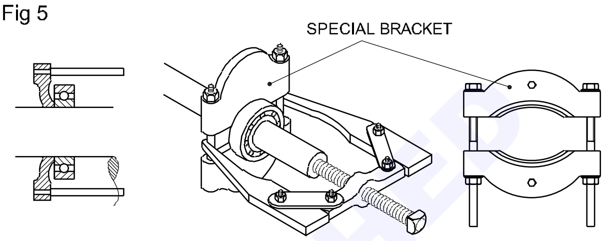
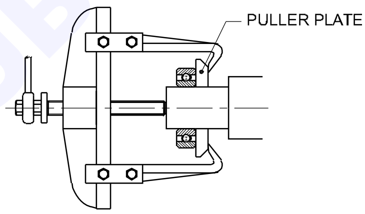


Fig 5



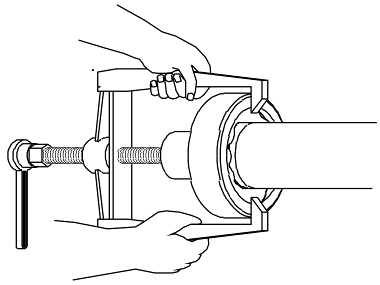
Use a keeper puller plate along with the puller when pullers legs tend to engage with the outer ring of the bearing. (Fig 6)

Fig 6



Rotate the outer ring or the puller during dismounting if the pullers legs has to engage the outer ring of the bearing, when the bearing is to be used again. (Fig 7)

Fig 7



Small bearings can be removed by using a puller or with a metallic sleeve using mild hammer blows.

To dismount small and medium size bearings, use a hammer and a sleeve a butting the lock nut or the inner ring. (Fig 8)

Place the sleeve against inner ring if the nut is located inward.

Use hammer blows for dismounting. (Fig 9)

Fig 8

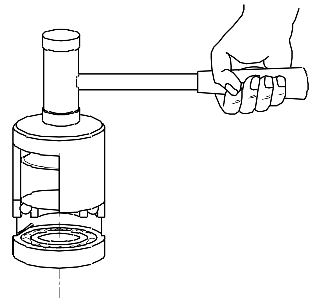
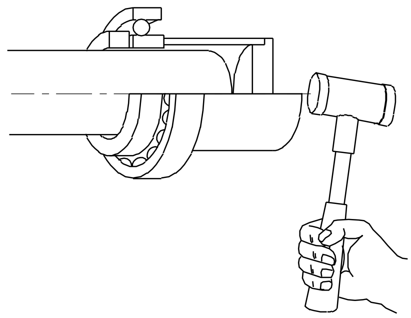


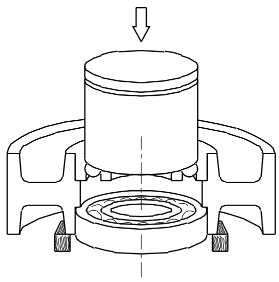
Fig 9



For all bearings having interference fit in the housing

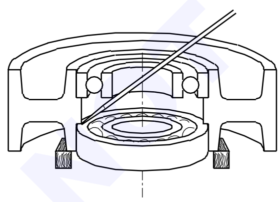
Place the wheel on two wooden blocks and fit a suitable sleeve on the face of the bearing. Apply pressure on the sleeve to drive out the bearing. This type of dismounting can be done for a housing without any shoulder. (Fig 10)

Fig 10



Similarly, for a housing with a shoulder between the bearings a soft metal drift is used to strike the bearing in different positions to drive out. (Fig 11). A suitable puller is also used for dismantling.

Fig 11



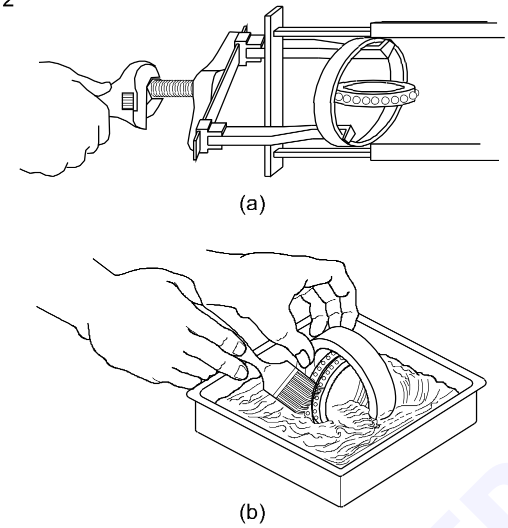
For dismounting self aligning ball bearing, swivel the inner race as shown in Fig 12a. Fit the legs of the puller on the outer race and tighten the screwed spindle to extract the bearing.

After dismounting clean the bearing with soft bristle brush using kerosene oil or naphtha. (Fig 12b)

Wipe off the bearing with banian cloth.

Do not use cotton waste for cleaning or wiping off bearings.

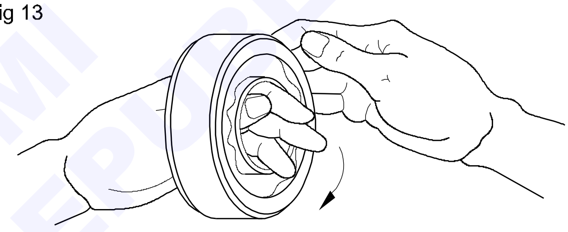
Fig 12



Inspect visually about corrosion, damage in cage, raceways, rolling elements and outer and inner races.

Insert the bearing around the fingers of your hand and rotate gently to check that the bearing to rotating smoothly without any distraction and noise. (Fig 13).

Fig 13



Lubricate the bearing.

Replace the seal, if any.

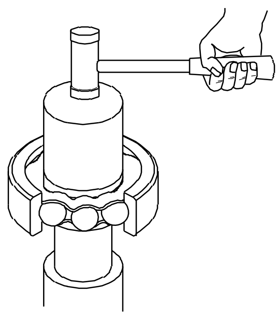
Mounting ball bearings

Clean and measure the shaft diameter (for shaft fit by vernier micrometer and for housing fit by vernier inside micrometer) to check the necessary interference fit.

Lubricate the shaft for mounting.

Place the correct size sleeve on the inner ring of the bearing. (Fig 14).

Fig 14

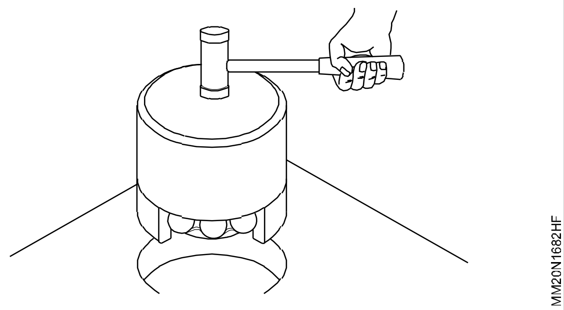


Apply hammer blows using common hammer.

Slowly drive in bearing until you get the metallic sound.

Similar process should be adopted for the housing fit by selecting proper sleeve to sit on the outer ring. (Fig 15)

Fig 15

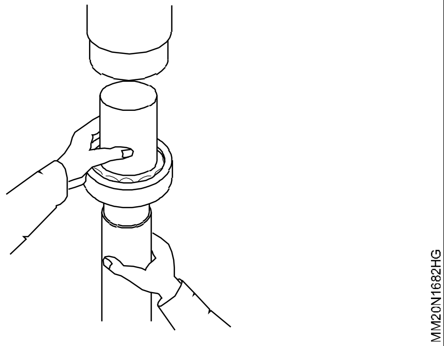


Use a arbor press whenever possible.

The use of a arbor press or hydraulic press is particularly suitable, when small bearings are frequently mounted. Lubricate the shaft and place a mounting sleeve between the bearing and press resting it on the ring with interference fit. The end faces should be flat, parallel and burr free.

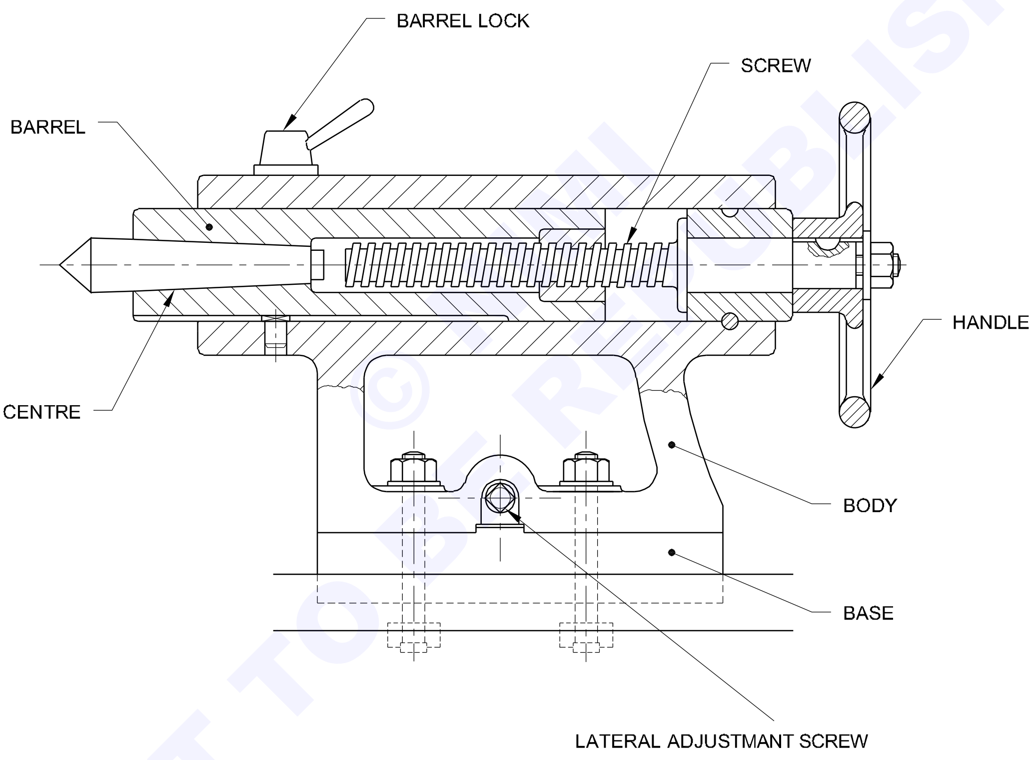
Drive in the bearing into the shaft, by applying the force by the press. (Fig 16)

Fig 16



Dismantling and assembly of tail stock of a lathe

Objectives: At the end of this exercise you shall be able to
- **dismantle the tailstock assembly**
- **inspect the parts for damage/wear and tear and rectify the damaged/worn out parts**
- **assemble the components after repair and check function of tailstock.**



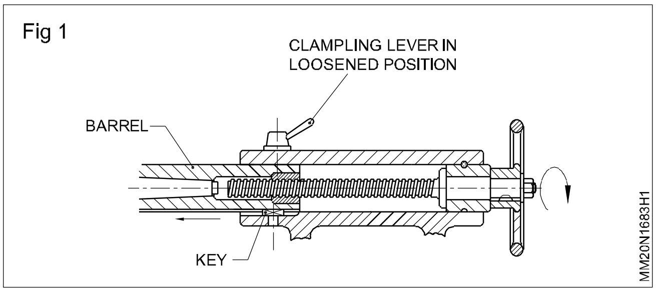
–	–	–	–	–	–	1.6.83
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**DISMANTLING AND ASSEMBLY OF TAILSTOCK OF LATHE**	DEVIATIONS	TIME 10Hrs
		CODE NO. MM20N1683E1	

Job sequence

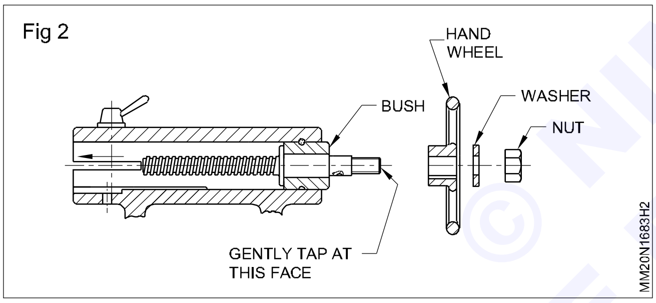
- Loosen the barrel clamping lever. Rotate the hand wheel in clockwise direction for the barrel to move forward to the maximum so that he screw rod is released from the nut. (Fig 1)

Fig 1



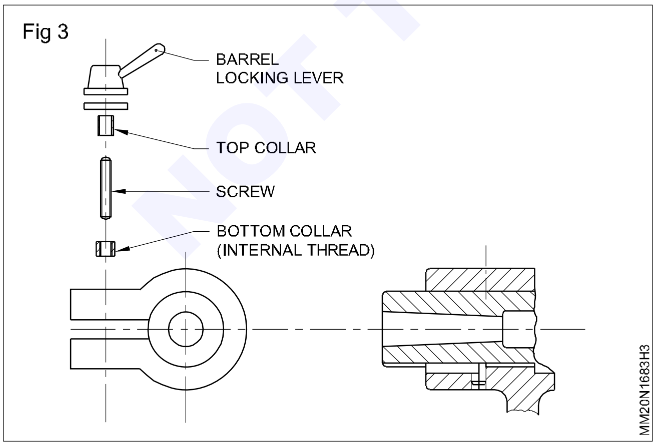
- Remove the key from the body of the tailstock and pull the quill out by hand.
- Dismantle the hand wheel from the screw rod by loosen ing the holding nut. (Fig 1)
- Remove the woodruff key from the screw rod.
- Gently tap the screw rod with a wooden mallet at the hand wheel end to get the screw rod released from the bearing bush, and remove the screw rod. (Fig 2)

Fig 2



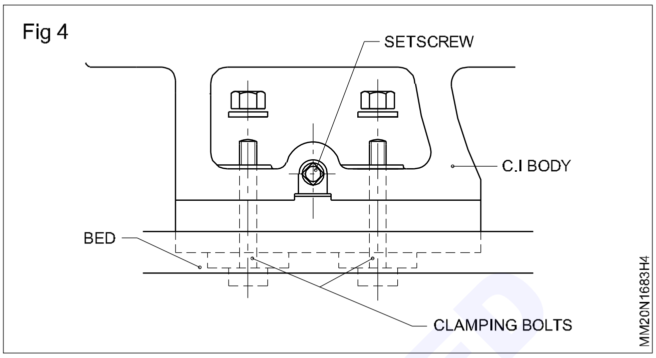
- Dismantle the bearing bush from the body bore of the tailstock.
- Remove the barrel locking lever by rotating it in anticlockwise direction, and then dismantle the top collar. (Fig 3)

Fig 3



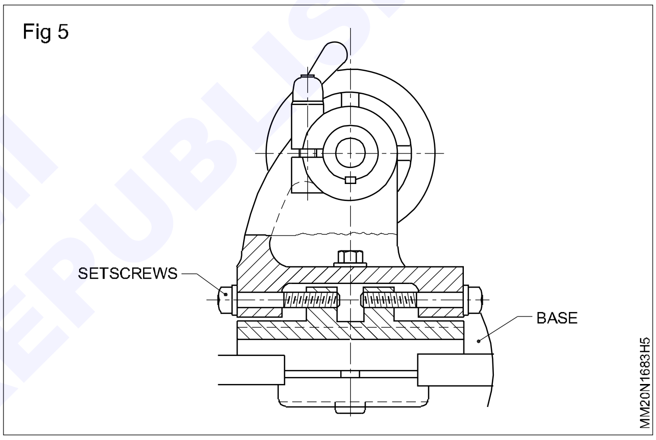
- Separate the bottom threaded collar from the screw.
- Loosen the nuts of the clamping bolts, and dismantle the clamping bolts with the clamping unit. (Fig 4)

Fig 4



- Unscrew the set screws to release them from the threaded holes in the base of the tailstock. (Fig 5)

Fig 5



- Separate the tailstock body from its base so that the tailstock unit may be completely dismantled.
- keep all the components in a tray systematically.

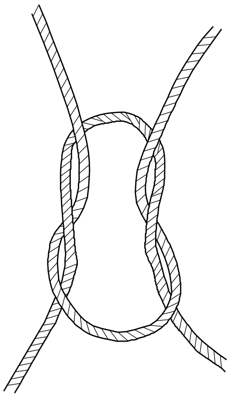
  Clean all the parts with kerosene oil.
- Check all the parts for wear, damage and rectify

  replace as needed.
- Lubricate, using S.S-32/57/68 of IOC, as recommended and assemble the parts in the reverse sequence to complete the overhauling procedure.
- Fit back the tailstock unit on the machine bed-ways.
- Check its function-movement -locking-play-looseness and alignment.

Demonstrate of different types of knots and hitches used in material handling

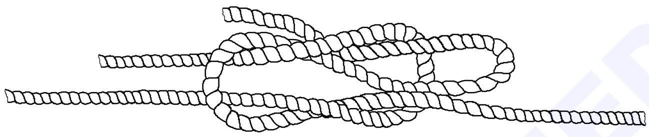
Objective: This shall help you to
- **tie five types of knots which is used in material handling.**

TASK 1



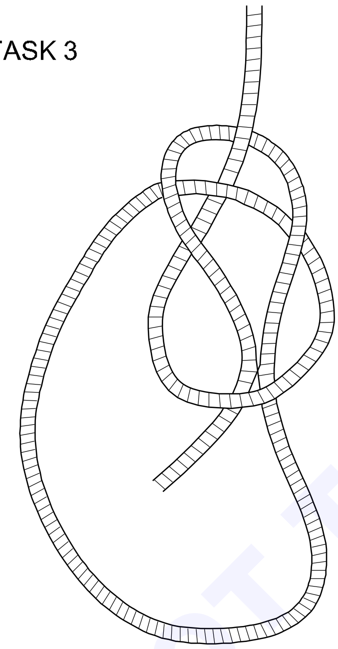
SQUARE KNOT

TASK 2



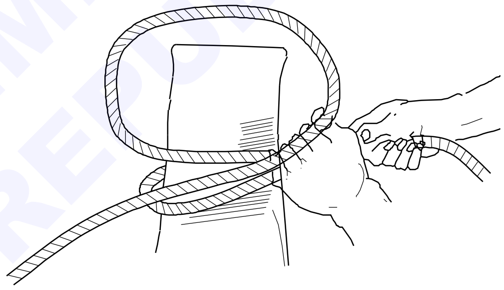
REEF KNOT

TASK 3



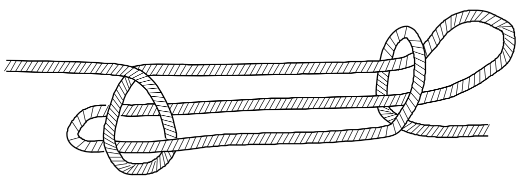
BOWLINE

TASK 4



CLOVE HITCH

TASK 5



SHEEP SHANK KNOT

-	-	-	-	-	-	1.6.84
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	BIND ROPE END AND PREPARE DIFFERENT TYPES OF KNOTS	DEVIATIONS	TIME
		CODE NO. MM20N1684E1	

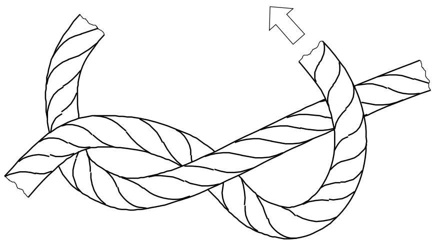
Note: Instructor should demonstrate the different types of knots, trainees should practice as per the sequence

Job Sequence

TASK1 & 2 : **Prepare square and reef knot**

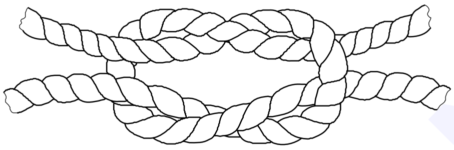
- Take two pieces of manila/cotton/polypropylene ropes of the same diameter
- Pass the ends of the ropes one above the other and bend in the opposite direction (Fig 1)

Fig 1



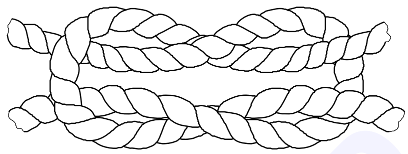
- Insert the bent ends one above the other in a similar way.(Fig 2)

Fig 2



- Pull the ends tight to get square knot (Fig 3)

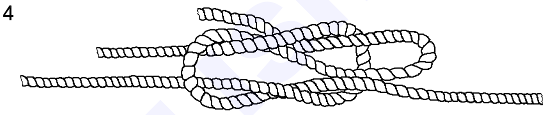
Fig 3



SQUARE KNOT

- Fig 4 shows the reef knot.

Fig 4



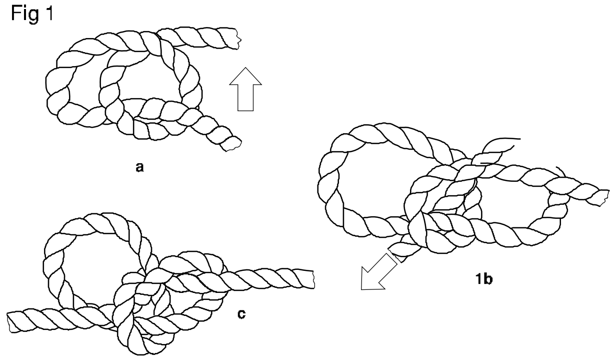
REEF KNOT

— — — — — —

TASK 3 : **Bowline knot**

- Hold the A end of the rope by the left hand (Fig 1a)
- Form a bight and a loop thereafter by the B end.
- Turn and hold end A by the right hand and end B by the left hand (Fig 1b)
- Pass end A of the rope through the loop formed by end B and pull it tight to form a bowline knot.(Fig 1c)

Fig 1



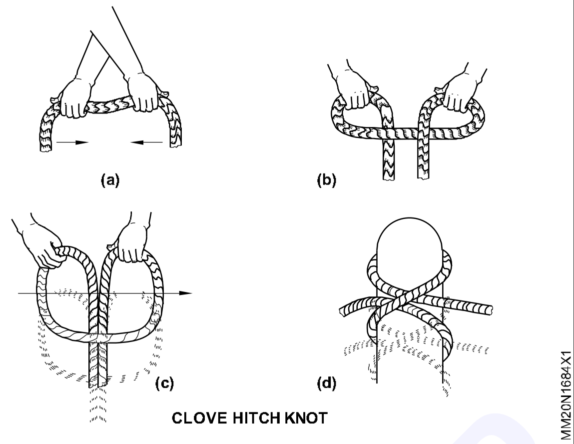
THE BOELINE KNOT

— — — — — —

TASK 4 : **Clove hitch knot**

- Hold the rope by both the hands in across way as shown in Fig1a.
- Turn round the hands to form loops in the rope as shown in Fig 1b.
- Close down the loops together as shown in fig 1c to put it around a post
- Fasten it to the post to make a clove hitch.

Fig 1



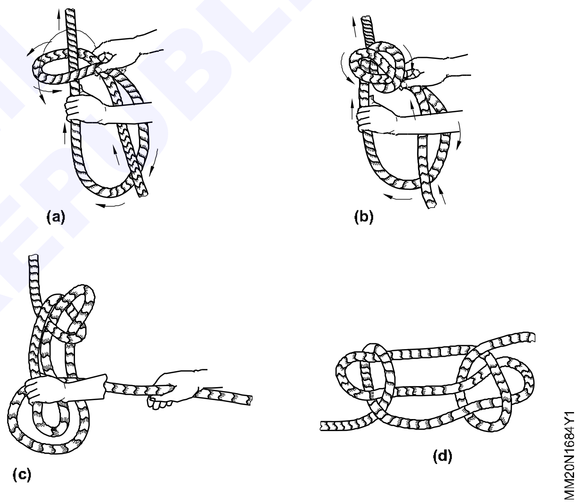
CLOVE HITCH KNOT

— — — — — —

TASK 5 : **Sheep shank knot**

- Hold the rope by both the hand and form a loop around one end of the rope (Fig 1a)
- Form a reverse loop around the former loop by the top end of the rope as directed by the arrows in Fig 1b.
- Turn the rope around as shown in Fig 1c to proceed in the final formation
- Turn the rope ends through the loops at the top and bottom ends as shown in Fig 1d to complete the sheep shank knot.

Fig 1

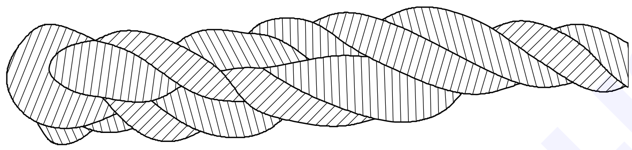


— — — — — —

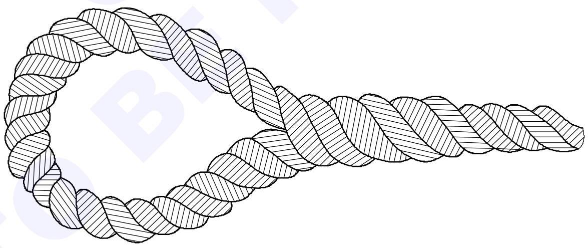
— — — — — — — — —

Splicing of manila rope

Objectives : At the end of this exercise you shall be able to
- **make back splice in manila rope**
- **make eye splice.**



BACK SPLICE



EYE SPLICE

						1.6.85
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	SPLICING OF MANILA ROPE	DEVIATIONS ± 0.06	TIME 2Hrs
		CODE NO. MM20N1685E1	

Job Sequence

Make a back splice

- Unlay sufficient length of rope to make the splice and spread the strand evenly. (Fig 1 & 2)
- Make a crown knot by bending each end over its adjacent strands in turn. (Fig 2)

Fig 1

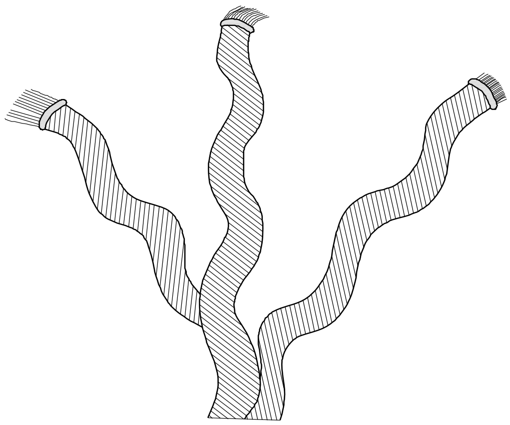
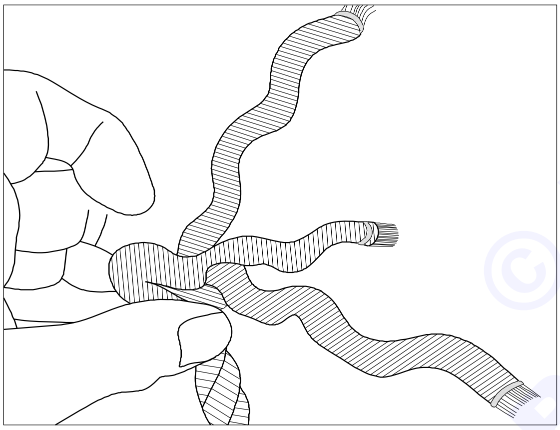
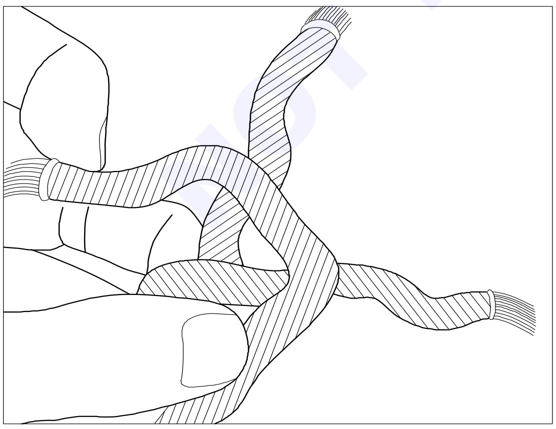


Fig 2



- Repeat the same way round as the lay of the rope. (Fig 3)

Fig 3



- Pull the crown knot into shape (Fig 4)
- Tighten it on the top of the rope. (Fig 5)

Fig 4

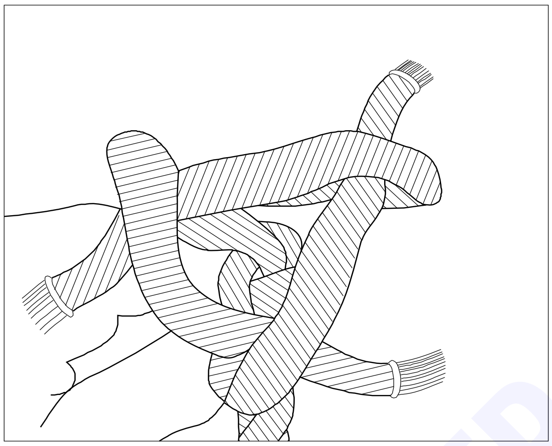
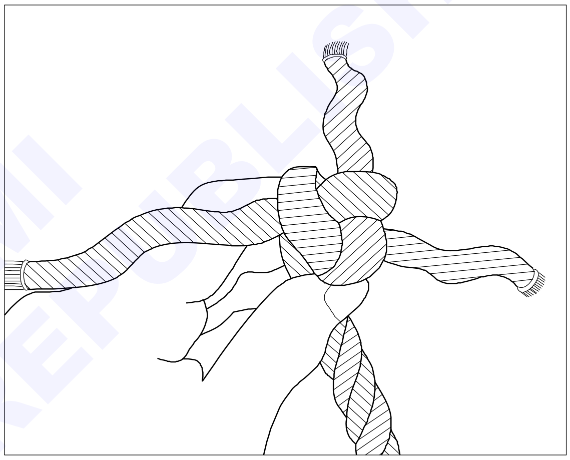
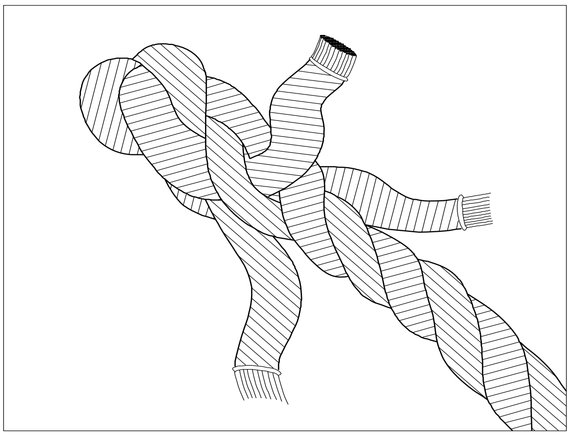


Fig 5



- Tuck each end in turn over the adjoining main strand under the next draw.
- Tight, close up to the crown knot. (Fig 6)

Fig 6



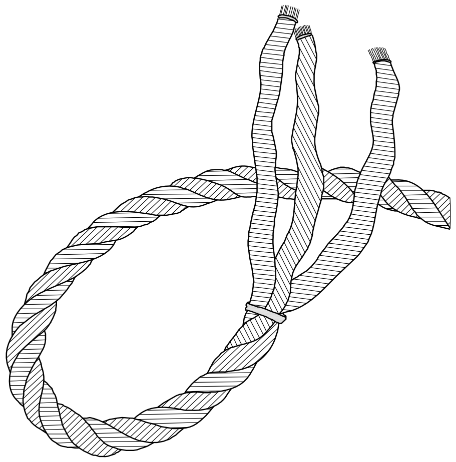
- Continue and make atleast three tucks.
- Draw the ends tight after each round tucks.

Back splice is made to prevent the end of the rope from ravelling.

Make a eye splice

- Unlay more than enough for tucking.(Fig 1)
- Lay out three strands one on left, one on middle and remaining on right. (Fig 1)

Fig 1

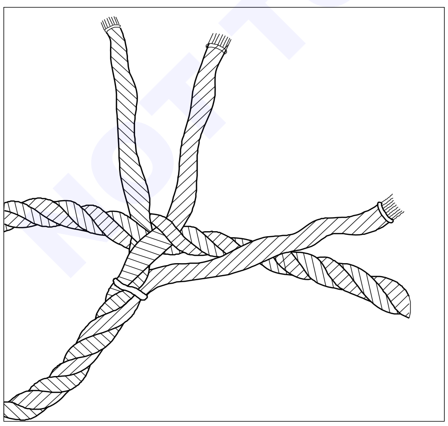


- Take the middle strand and tuck it under a strand at the proper distance to from the correct size Eye (Fig 2)

Fig 2

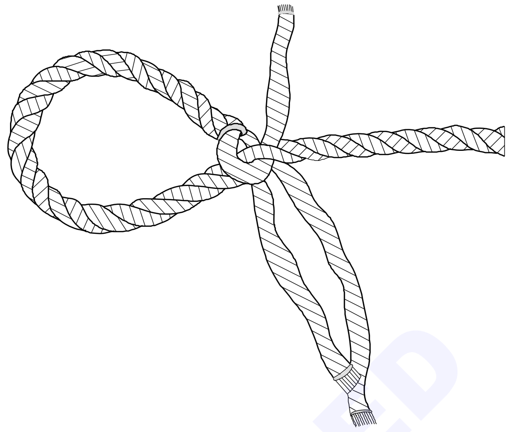
- Place the left strand under the rope as shown in Fig 3

Fig 3



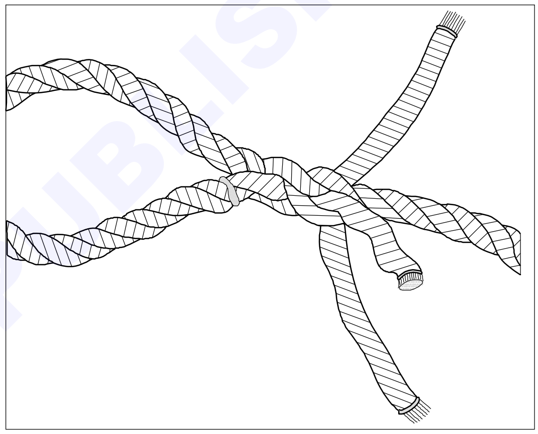
- Turn the splice over the tuck in the last strand so that it exits where the middle strand entered. (Fig 4)

Fig 4



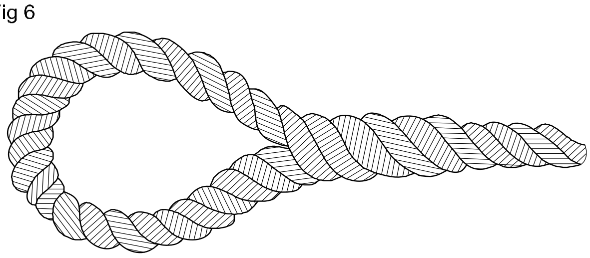
- Continue to tuck in each strand over and under. (Fig 5)

Fig 5



- Make a total three or more tucks.(Fig 6)

Fig 6



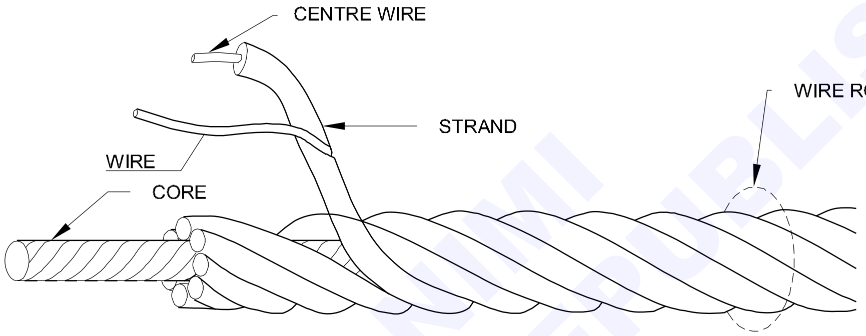
Three tucks for fibre rope and four for synthetic rope is generally recommended.

The eye splice creates a fixed loop at the end of the rope.

Inspection of wire rope / steel rope / belts

Objectives: At the end of this exercise you shall be able to
- **inspect wire rope**
- **do remedial actions for each defect**
- **prepare inspection report**
- **inspect the belt**
- **adjust the belt.**

TASK-1 INSPECTION OF WIRE / STEEL ROPE



Job Sequence

TASK 1: **Inspection of wire rope/steel rope**

- Place the rope in position, so that the inspector can see it fully.
- Clean the dirt, grease, etc. from the rope to be inspected with wire brush or cloth.
- Examine entire length of the rope throughly.
- Check the area of the rope next to the fittings for damage.
- Inspect worn out or damaged portions of the rope.
- Label the inspected rope and keep it separately.
- Prepare and maintain inspection reports with date, condition of the rope and remedial actions as in TABLE 1.
- Destroy immediately the rejected ropes.
- Store the ropes that can be re-use separately in a right place away from heat, dirt and damaging weather.

–	–	–	–	–	–	1.6.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	INSPECTION OF WIRE ROPE/STEEL ROPE/BELTS				DEVIATIONS	TIME 2Hrs
					CODE NO. MM20N1686E1	

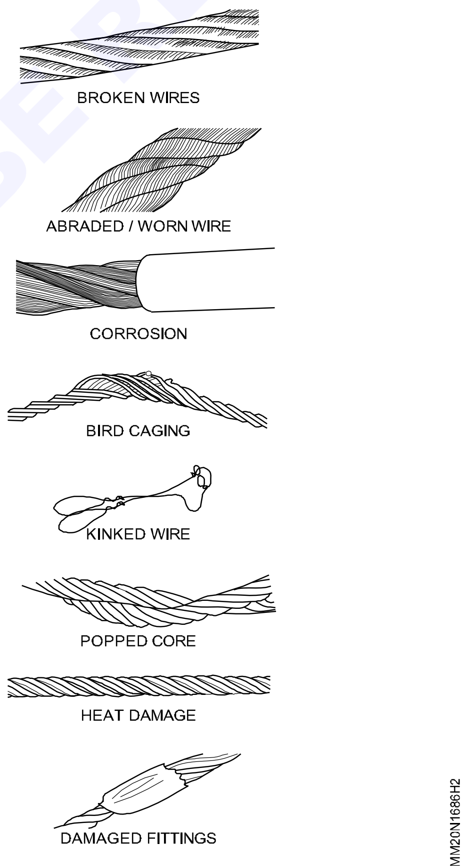
Table 1

Inspection report

Sl. No.	Conditions to be inspected	Date of Inspection	Recommended Remedies
1.	Broken wire		Replace wire, if there are i) 6 or more broken wires in one lay. ii) 3 or more broken wires in one strand of single lay.
2.	Worn out rope		Replace the rope, if the outer wire i) became flat due to friction. ii) became shiny due to wear.
3.	Inspect reduction in diameter		Replace the rope if wear an individual wires exceeds 1/3 of their diameter.
4.	Stretched rope		Replace the rope, if the diameter reduced due to stretch is more than 1/16 of original diameter
5.	Corrosion		For light rusting, clean and lubricate. Severe corrosion, replace it
6.	Cuts and burns		Replace the rope if any of its wires or strands cut or burnt.
7.	Bird-caging		Look whether strands open up in cage-like clusters, replace the rope.
8.	Core-protrusion		Replace rope when inner core starts poking through strands
9.	Kinks		Sections with kinks should be cut or discard the rope

Instructor should arrange some used ropes and insist the trainees to inspect for repair / replacement as required.

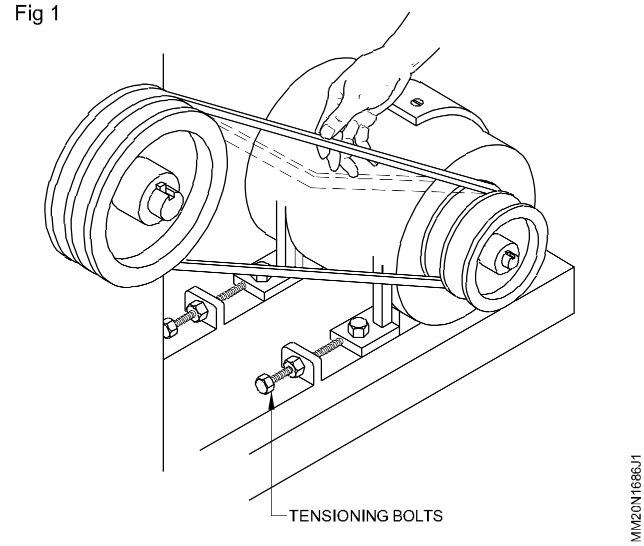
Fig 1



TASK 2: **Belt inspection**

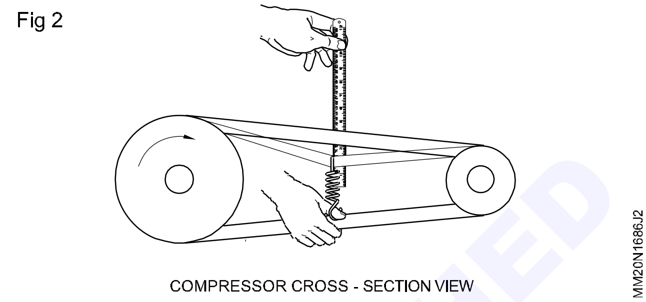
- Measure the longest span length of the belt between the pulleys, using a steel tape.
- Find the middle of the longest span of the belt between pulleys.
- Push the mid-point inwards, then pull it out and note the total deflection (Fig 1)

Fig 1



- This indicates the existing tension of the belt.
- Looser the lock-nuts.
- Shaken the clamping bolt
- Move pulley with the adjusting screw to alter the tension
- Attach the spring balance and check the tension of the belt (Fig 2)

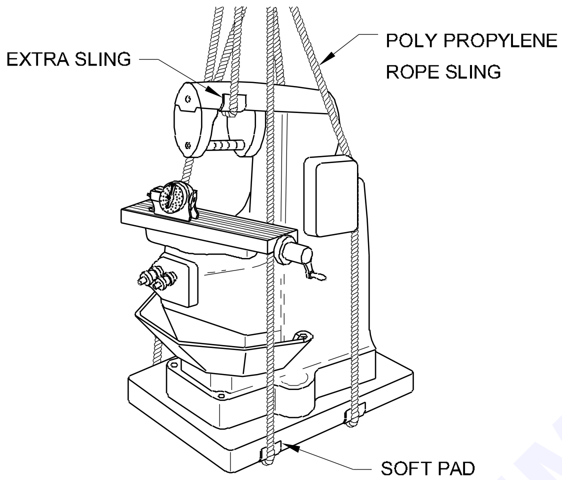
Fig 2



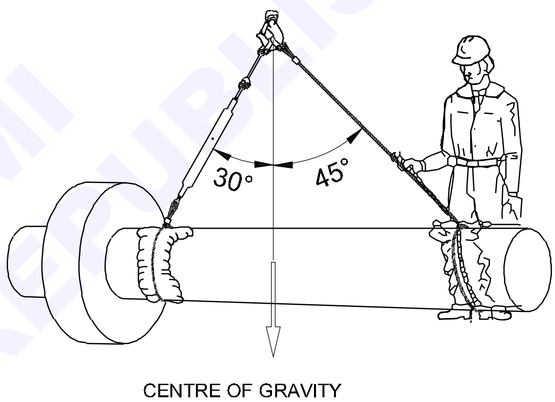
- Read just the adjusting screws until the tension is correct.
- Tighten the clamping bolt.
- Tighten the locknut.

Lift an object by using slings

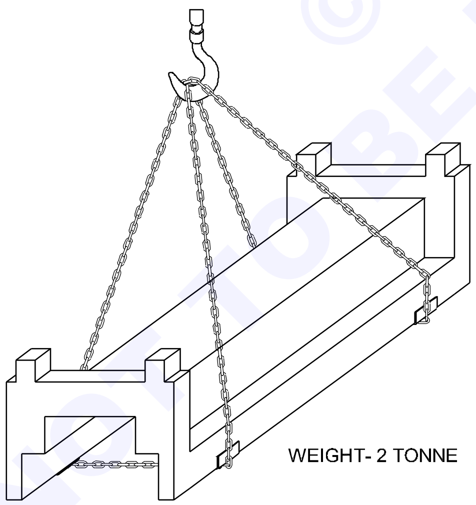
Objectives : At the end of this exercise you shall be able to
- **sling load with fibre rope**
- **sling load with wire rope using eye bolt, shackle and tension screw**
- **sling load using chain, hooks and clamps.**



SLING VERTICAL TYPE MACHINES
BY POLY PROPYLENE ROPE



SLING AN UNBALANCED LOAD
BY STEEL WIRE ROPE



SLING LOAD BY ENDLESS CHAINS

–	–	–	–	–	–	1.6.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

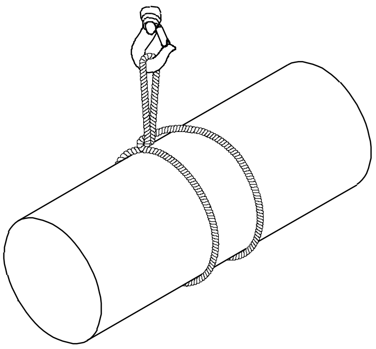
SCALE NTS	**LIFT AN OBJECT BY USING SLING**	DEVIATIONS ± 0.1mm	TIME 2hrs
		CODE NO. MM20N1687H1	

Job Sequence

Sling load with fibre rope

- Select the type and dia of fibre rope considering the shape and weight of the load.
- Prepare a square or reef knot on the rope to make it endless.
- Turn the rope around the cylindrical object as shown in Fig 1.

Fig 1

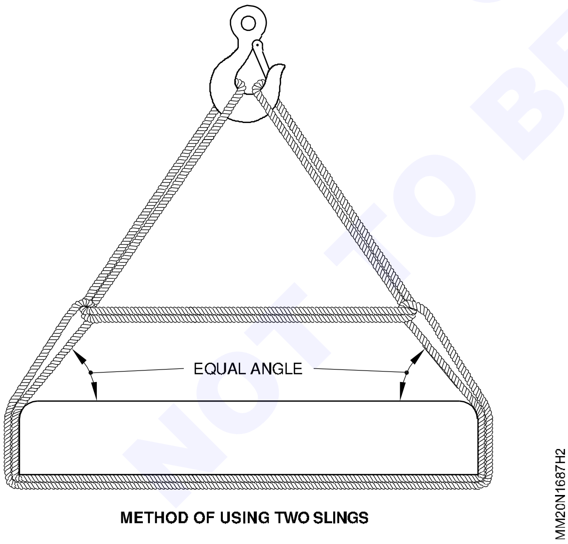


- Position the rope in the middle approximately to balance the load.
- Place the other end of the rope on the safety hook.
- Strain the rope to check the object is well balanced. If not shift it to the desired spot.

Method of using two manila rope sling

- Take two spliced rope to make them endless.
- Turn the rope around the load as shown in Fig 2.

Fig 2

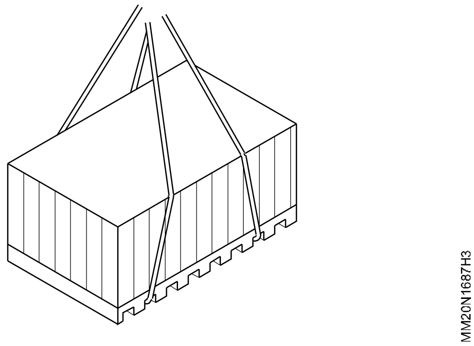


METHOD OF USING TWO SLINGS

- Insert both the ends of the second rope through the first one as in Fig 2 and fasten both the ends to the hook.
- Check whether it is balanced as before. If not, adjust the rope, slightly to make the angles equal.
- Lift and shift the load to desired position.

Sling rope using two ropes. (Fig 3) If it is well balanced, distribution of load will be even.

Fig 3

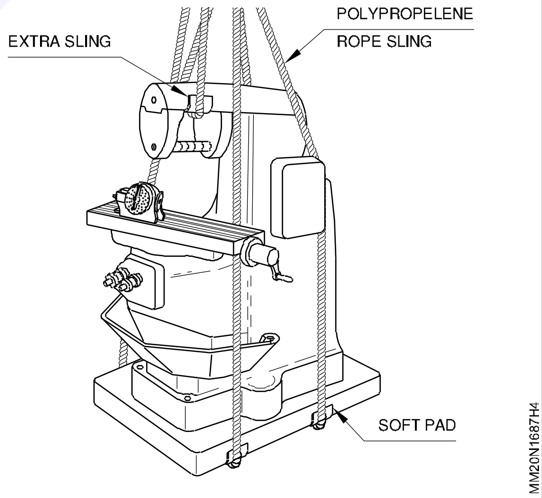


- Always put packing on sharp edges to prevent damage to the rope.
- Avoid putting a sling around a radius of less than three times the rope diameter
- When included angle of the sling is 120° or more, the SWL of sling must be reduced to half.

Vertical machine slinging

- Vertical machine is likely to be toppled easily due to a slight imbalanced condition.
- Use polypropylene rope sling of 25 mm dia which is strong reliable and durable for carrying load around 2 tone.
- Prepare two slings for the machine body and an additional one for the ram as shown in Fig 4.

Fig 4

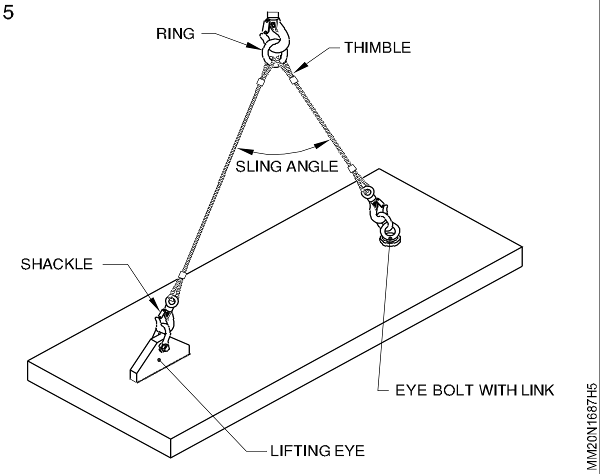


- Put soft packing bags on the sharp edges.
- Strain the rope to lift the machine about 50 mm from the ground to check well balanced condition.
- Shift the machine to the desired position, if it is well balanced.

Shift load by wire rope sling using shackle and eye bolt

- Fix up eye bolt with link in screwed hole and a bracket with "Dee" shackle/eye bolt with link on to the other hole as shown in Fig 5.

Fig 5

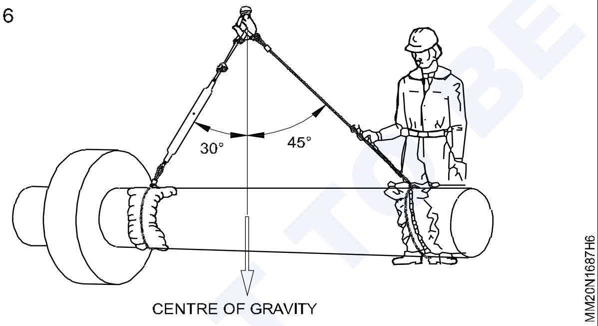


- Anchor safety hooks of the wire rope sling on eye bolt link and Dee shackle.
- Lift the load by inching to check the balancing of the load.
- Shift the load to its position and detach the links.

Shift unbalanced load by wire rope sling (Fig 6)

- Usually slinging marks are painted on components and machineries to sling in well balanced condition. If not, determine the possible centre of gravity to put the sling.
- Use union bolt/turn buckle/straining screws for unbalanced loads, which are adjustable for balancing the load.
- Select one short and another lengthy sling to suit the load.
- Fix up a turn buckle/union bolt to the shorter length sling for required adjustment.

Fig 6

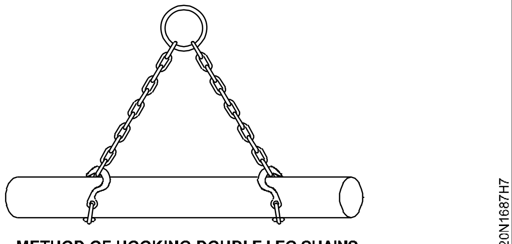


- Tie up the component with the slings using sack packing all around as shown in fig. Keep the crane hook right above the approximate centre of gravity point.
- Inch the crane to check the load for balancing. If not balanced, adjust the turn buckle by a tommy bar till proper balancing is achieved.
- Shift the load to its position.

Shift load by chain sling

- Put double legged chain sling for shifting cylindrical object as shown in Fig 7. Ensure that the open end of the hook must be always facing outside and job is well balanced.
- Shift the load to its position.

Fig 7

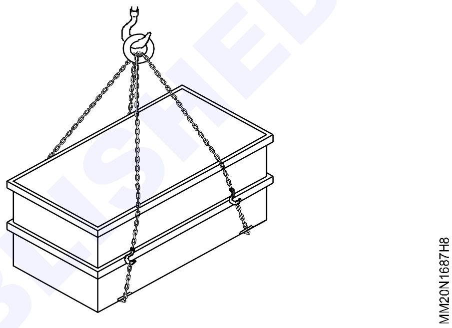


METHOD OF HOOKING DOUBLE LEG CHAINS

Shift load by four legged chain using two endless chains

- Select one four legged chain and two endless chain.
- Put the slings (endless) around the marked position of the object. Fasten four sling hooks, two in the front and two in the back side to the endless chains (Fig 8).

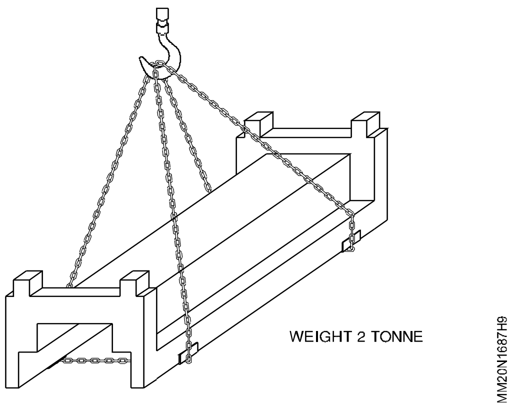
Fig 8



- Lift the load by inching. It is well balanced because slinging is made on the marked position.
- Shift the load to its position.
- Return the hooks to the master ring.

Sling an object/machine tool using only endless chain (Fig 9)

Fig 9



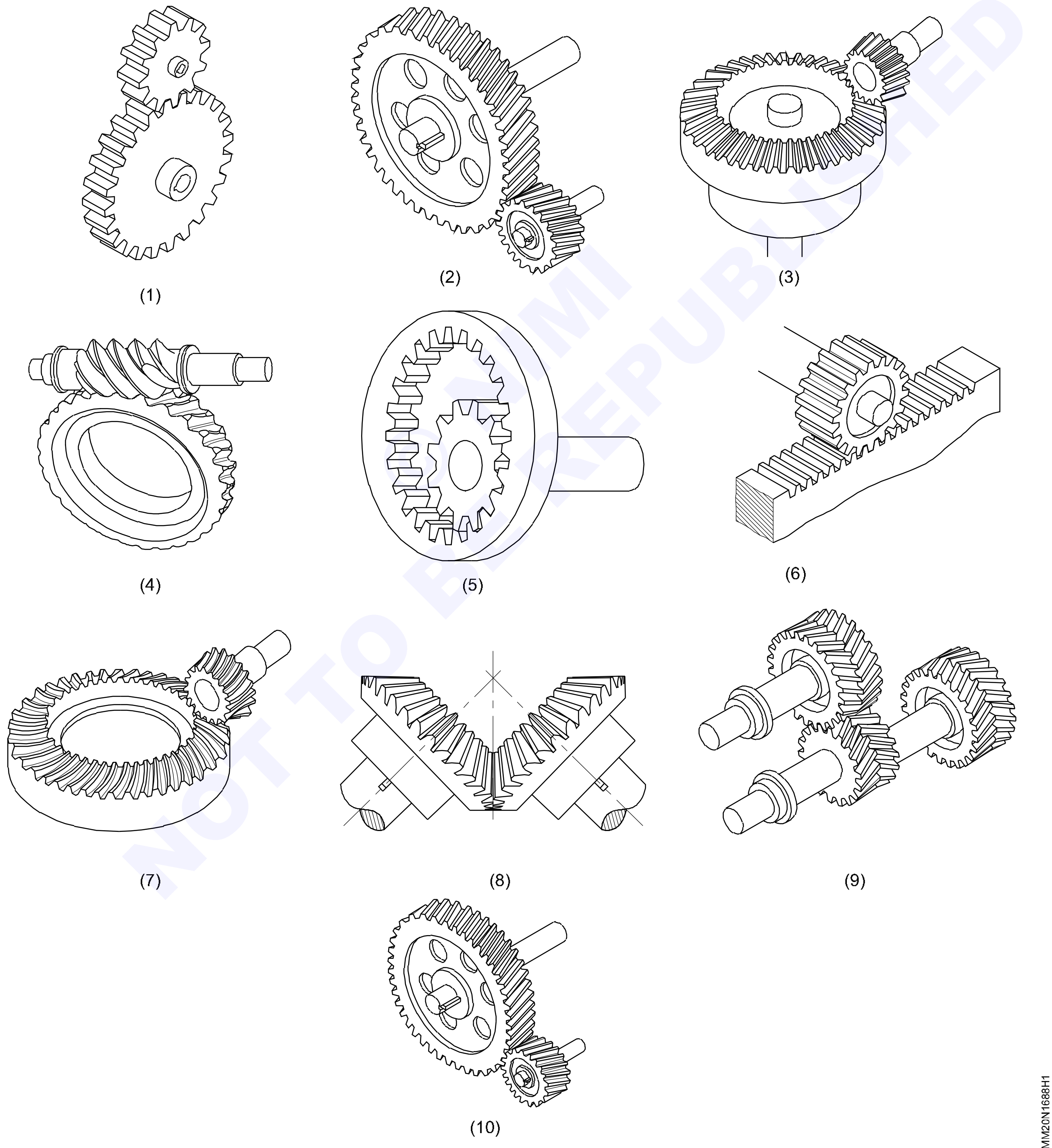
- Select two endless chain of proper length and capacity.
- Lift one side of the object frame by crow bar and insert a wooden block of 150 x 150 x 75 mm height approximately. Similarly insert wooden blocks in all the sides.
- Pass the chain through bottom side of the object/frame and pull it to fasten into the crane hook.
- Lift the crane by inching. Check whether the job/frame is well balanced, if so shift the load to the desired spot.
- Place two equal size wooden log as support and lower the job on the supports.
- Check for the stability of the job/frame as shown in Fig 9.

Identification different types of gears used in machine tools

Objectives: At the end of this exercise you shall be able to
- **identify the types of gears**
- **fill the names of gear in table 1.**

Instructor should make necessory arrangements for displaying various types of gears insist the trainees to fill table - 1.

Fig 1



Job sequence

- Watch carefully the displayed types of gears.
- List out all name of gear in table 1.
- Submit filled table 1 to your instructor for checking.

Table 1

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

— — — — — — — — — — —

Checking of Gear elements as PCD gear tooth thickness clearance concentricity

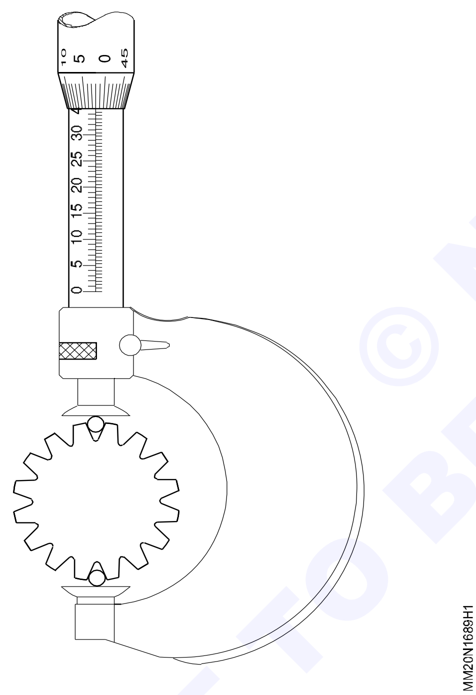
Objectives: At the end of this exercise you shall be able to
- **check the P.C.D of a given spur gear**
- **check the spur gear tooth thickness**
- **check the concentricity and wear of gears.**

Job sequence

Checking of the PCD of the gear

- Select the gear to be measured and place it on the work table.
- Choose the two standard cylindrical pins or balls for measuring the gear size.
- Hold the flange micrometer and of cylindrical pins or balls as shown in the Fig 1.

Fig 1



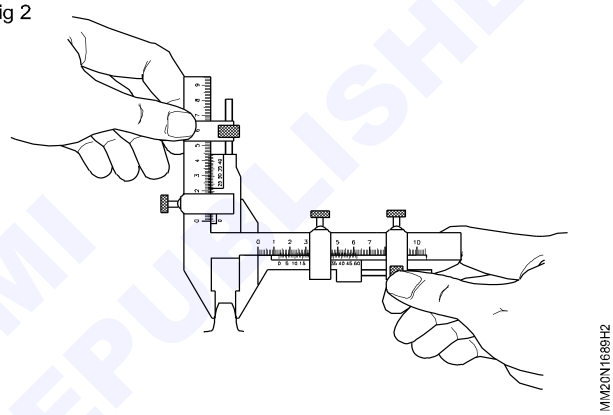
- Note down the flange micrometer reading by locking its thimble and barrel scales.
- Find out the PCD by subtracting the pin or ball diameter from the obtained micrometer reading.

> **This method is only suitable for gears having even numbers of teeth.**
>
> **Composite inspection as shown in the Fig 2 is a useful shop friendly tool to determine the gear size of having any number of teeth.**

Measuring the gear tooth thickness (Fig 2)

- Select the gear to be measured and hold it with a vice.
- Hold the gear tooth caliper properly as shown in the Fig 2.
- Adjust the adjustable tongue of the gear tooth caliper to touch it with the tooth side.
- Note down the reading directly from the caliper and it will be the tooth thickness.

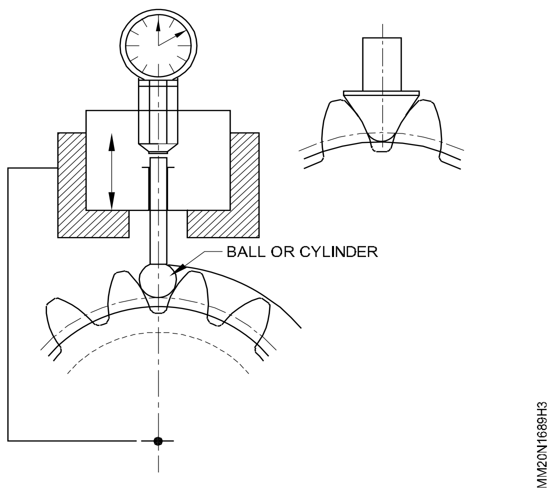
Fig 2



Checking the concentricity and wear of gears (Fig 3)

- Fix the gear to be measured in a mandrel as shown in the figure.
- Select suitable ball or cylindrical pin and place it in between the gap of two teeth.
- Hold the dial indicator in such a way that it will touch the outer periphery of cylindrical pin or ball.
- Note down the dial indicator reading.
- Repeat the same procedure for all the gear teeth and simultaneously note down the dial indicator reading.
- Calculate the total runout or concentricity by subtracting maximum and minimum dial gauge reading.

Fig 3



Checking of backlash and root clearance by feeler gauge, DTI & lead wire in gear meshing

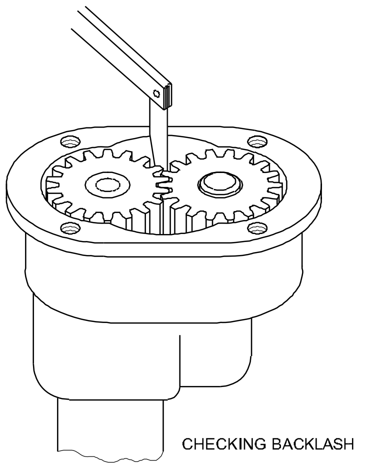
Objective: At the end of this exercise you shall be able to
- **check backlash using feeler gauge, DTI and lead wire in gear meshing.**

Job Sequence

TASK 1: **Checking by feeler gauge (Fig 1)**

Checking the teeth clearance between mating gears and backlash

Fig 1



- Arrange the gears to be measured as shown in the figure.
- Hold one gear regid and insert the feeler gauge through the gap between gear teeth of mating gears as shown.
- Note down the feeler gauge reading and it will be the backlash value.
- Compare the measured backlash value with the given table and ensure it within the permissible value (limit)

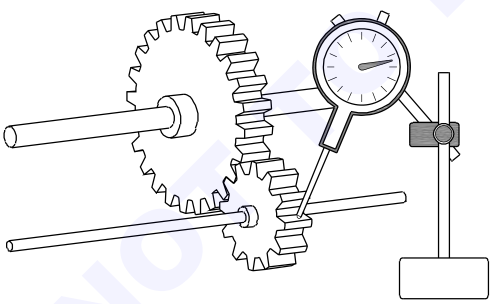
Table 1
Backlash Suggestions

Pitch	Backlash
3P	0.013
4P	0.010
5P	0.008
6P	0.007
7P	0.006
8-9 P	0.005
10-13P	0.004
14-32P	0.003
33-64P	0.0025

— — — — — — —

TASK 2: **Checking by DTI (Fig 1)**

Fig 1



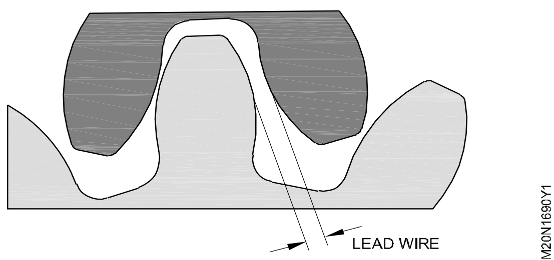
- Mount the base any where that works
- The plunger mounted square to the gear teeth.
- So that movement directly moves the plunger instead of it being more of an angular arrangement.
- If the pinion depth is correct and the backlash is correct the contract the contact pattern.
- It is the least important pattern part of setting the rear up.
- The contact pattern test is very subjective as opposed to all the other steps.

— — — — — — —

TASK 3: **Checking backlash using lead wire (Fig 1)**

- Keep the lead wire in between two faces of the matching gear and allow it to mesh.
- After lead wire compresses it measured with the micrometer.
- Which shows the backlash reading.

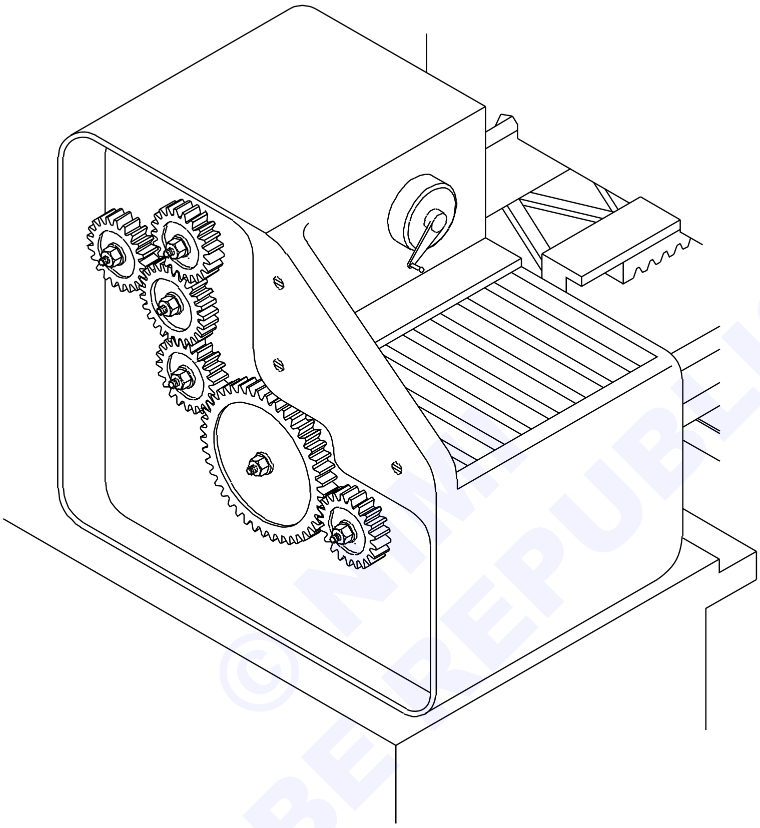
Fig 1



Inspection and replacing the lubricating oil of a given gear box

Objectives: At the end of this exercise you shall be able to
- **inspection of the lubrication oil of the gear box**
- **recheck the lubrication oil**
- **replace the lubrication oil.**

Fig 1



Job Sequence

- Check the oil level of the lubrication tank by apparent look.
- Check the colour of the oil by apparent look, change the oil if the colour of the oil is too black.
- Check the lubricating circuit breakage leakage of the copper tube etc.
- Clean the lubricating circuit nozzle if there, is any block.
- Check the lubricating circuit tubes (Copper tube) placed to lubricate each and every gears and bearing of the gear box.
- Clean the lubricating tank thoroughly and fill the recommended grade of lubricating oil.

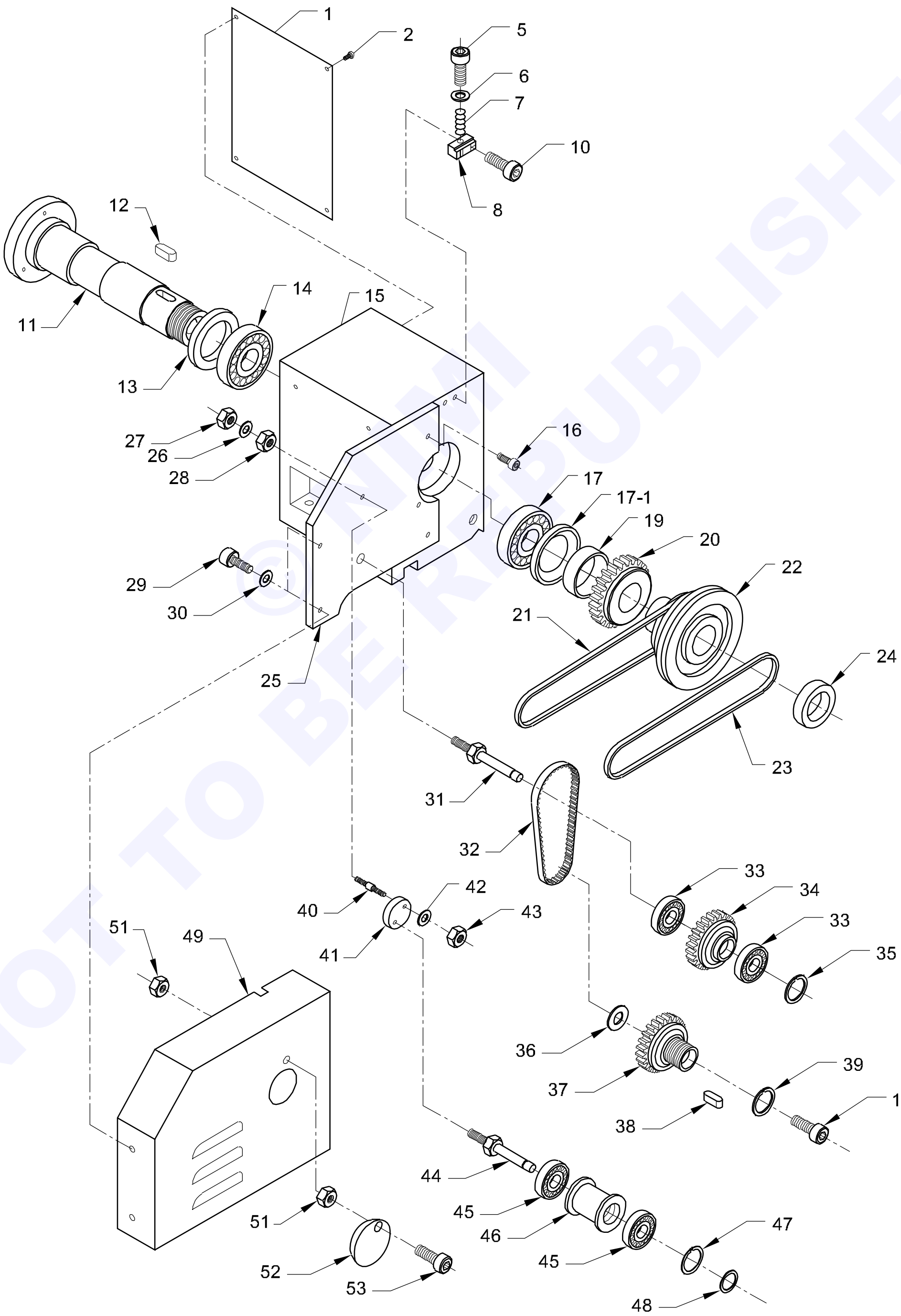
MMTM - Mechanical Power Transmission

Overhauling of gear box of lathe & milling machine

Objectives: At the end of this exercise you shall be able to
- **dismantle the gear box**
- **inspect and replace wornout or damaged parts**
- **assemble the gear box**
- **test run the machine.**

TASK 1: **Overhauling head stock of all gear lathe**

Fig 1



OVERHAULING OF HEAD STOKE

MM20N1692H1

Head stock parts list

Part No.	Description of item
1	Headstock Name plate
2	Phlp Hd Screw M4- 7 x 6
5	Caps Screw M6- 1 x 25
6	Flat washer 6mm
7	Compression Spring 8 x 8 x 20
8	Threaded block
10	Caps Screw M6- 1x 25
11	Spindle
12	Key 10 x 10 x 55
13	Spacer
14	Taper roller bearing 320009
15	Headstock casting
16	Cap Screw M8 - 1.25 x 20
17	Taper roller bearing 320009
17-1	Bearing cap
18	Philips head screw M6- 1 x 20
19	Spacer
20	Gear 45 teeth
21	V belt M 29 3L 290
22	Spindle pulley
23	V Belt M32 3L 320
24	Spanner nut M 30 - 3.5
25	Bracket plate
26	Lock washer 10mm
27	Hexagon nut M10 1.5
28	Flat washer 10mm
29	Cap screw M5 - 0.8 x 10
30	Flat washer 30mm
31	Idler shaft
32	Timing belt
33	Ball bearing 6001 2RS
34	Idler pulley
35	INT retaining ring 12mm
36	Pulley flat washer
37	Motor pulley
38	Key 6 x 6 x 6 x 40
39	INT retaining ring 10mm
40	Threaded handle rod
41	Pivot bracket
42	Flat washer 10mm
43	Hexogen nut M 10 - 1.5
44	Tensioning shaft
45	Ball bearing 6001 2 RS
46	Ideler roller
47	INT retaining ring 28 mm
48	Ext retaining ring 12 mm
49	Changer gear cover
51	Hexogen nut M 5 - 0.8
52	Outbound Spindle cover
53	PHLIPS HD screw M5 - 0.8 x 12

Job sequence

TASK 1 : **Overhauling lathe gear box**

- Switch off the machine and remove the belt guard
- Remove the 'V' belt from the main spindle pulley.
- Remove the head stock name plate (part no. 1, Fig 1)
- Remove the screws (part nos. 2,5,6,7,8,10, Fig 1) by suitable hand tool.
- Remove the change gear cover (part no 49, Fig 1)
- Remove the hexagonal nut (part 51, Fig 1) and screw (part no 53, Fig 1)
- Remove the outbound spindle cover (part no. 52, Fig1)
- Remove the extra cover (part no. 15, Fig 1)

a Removal of tension shaft

- Remove the retaining ring (part no. 48 and 47 Fig 1)
- Remove the threaded handle rod (pat no 40, Fig 1)
- Remove the pivot bracket (part no 41, Fig 1)
- Remove the tension shaft with bearing and idler roller assembly.
- Using a bearing puller and remove the to ball bearings (part no 45, Fig 1)
- Remove the idler roller (part no 46, Fig 1)

b Removal of Idler shaft (part no. 31, Fig 1)

- Remove the retaining ring (part no. 35, Fig 1)
- Disconnect the timing belt (part no. 32, Fig 1)
- Remove the lock nut and washer (part no 27, 26, 28, Fig 1)
- Remove the idler shaft with bearings and idler pulley (part no 31, Fig 1)
- Removing the ball bearings by using a bearing puller (part no 33, Fig 1)
- Remove the idler pulley and key from the idler shaft (part no 34, Fig 1)

c Removal of timing gear shaft with motor pulley timing gear assembly (part no 37, Fig 1)

- Remove the heavy duty screw with suitable hand tool (part no 18, Fig 1)
- Remove the retaining ring (part no 39, Fig 1)
- Remove the shaft with timing gear and motor pulley (part no 37, Fig 1)
- Remove the pulley flat washer with suitable hand tools (part no 36, Fig 1)
- Remove the motor pulley and timing gear with suitable tools (part no 37, Fig 1)
- Remove the timing belt (pat no 32, Fig 1)

d Removal of head stock main spindle (part no 11, Fig 1)

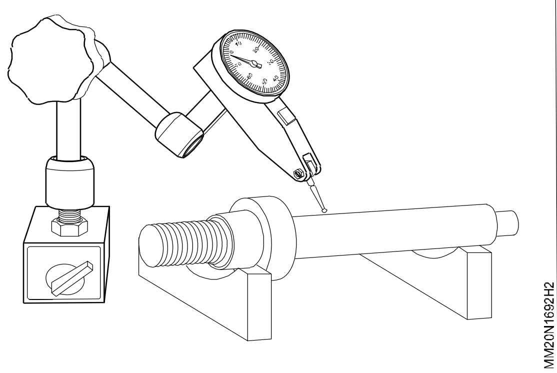
- Remove the spanner nut (part no 24, Fig 1)
- Remove the spindle pulley (part no 22, Fig 1) and key (part no 12, Fig 1)
- Remove the 45T gear (part no 20, Fig 1).
- Remove the spacer (part no 19, Fig 1).
- Remove the bearing cap (part no 17 -1, Fig 1) and then remove the taper roller bearing 32009 at rear end of main spindle. (part no 17, Fig 1)
- Remove the main spindle (part no 11, fig 1) with taper roller bearing.
- Remove the taper roller bearing 32009 at the front end of the main spindle (part no 14, Fig 1)
- Remove the spacer (part no 13, Fig 1)
- Clean all the dismantled parts and dry it.
- Keep all disassembled parts in a separate tray in proper order while dismantling

e Identification of wornout and damaged parts

- Check all the dismantled parts of head stock thoroughly and list out the damaged, wornout parts and drill up the table given in table 1.

Sl. No.	Name of the parts	Remarks

Fig 2



- Check the spindle runout as in Fig 2.

Ensure the free flow of lubricantion oil through the pipe provided in the head stock.

f Replacement of the wornout and damaged parts

Ensure the replacement bearings before assembling the head stock

- Replace the wornout or damaged parts other than bearings if required as per table 1

g Assembling of head stock•

- Assemble all the parts of the headstock in the reverse order and apply grease, oil at necessary parts.

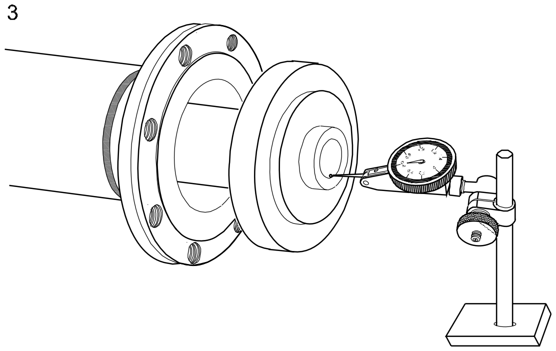
Care should be taken while fixing new bearings and the retaining ring.

- Mount the head stock change gear cover.

- Mount the pulley at the rear end of the main spindle.
- Connect the pulley and motor with belt.

h Checking the run out and face out of main spindle (Fig 3)

Fig 3



MM20N1692H3

- Check the run out of the spindle by using lever type dial test indicator with magnetic stand.
- Check the face out of the spindle by using the lever type dial test indicator with magnetic stand.
- Fill the correct quantity and graded oil.(original equipment manufacturer) as recommended by OEM in the head stock and ensure the oil level through oil level glass.
- Switch on the machine and check the oil circulation, performance of the head stock.

Figure shows the exploded view of a typical head stock assembly. parts mentioned here are sometimes having slight difference with the available head stock assembly in the shop floor.

Trainees shall be able to practice this exercise with the available head stock assembly in their shop floor.

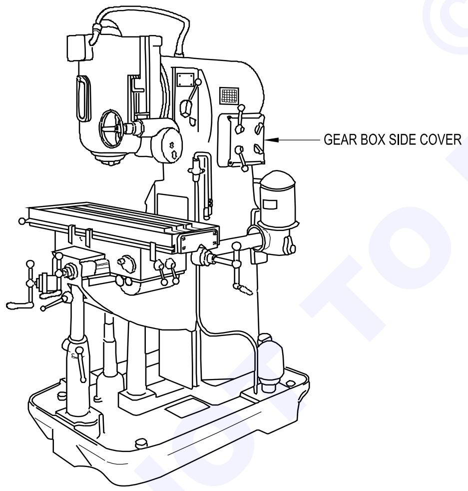
— — — — — — —

TASK 2 : **Overhauling of milling machine gear box**

Dismantle the gear box

- Switch off the machine.
- Drain the lubrication oil from the gear box sump.
- Clean the machine thoroughly with clean clothes.
- Remove the gear box side cover along with gear shifting livers and forks. (Fig 1)

Fig 1



MM20N1692J1

- Detach all the lubrication pipe lines from the gear box with proper tools.
- Remove the gear shaft end covers and static seals by unscrewing allen headed cap screws.
- Remove all circlips using circlip pliers.
- Remove the gear shaft by using pulling bolt and supports.
- Take out all the gears and spacers out from the gear box.

Notedown and give identification marks for all gears and spacers according to their sequence of arrangement while at the time of removing of gears and spacers from the gear box.

Identification marks will lead easy assembling of gear box.

Inspect and replace worn out parts

- Clean all the parts with kerosene.
- Inspect all the gears for teeth damage and wear, if needed replace it.
- Inspect and splines for wear, if needed replace it.
- Inspect all the bearings, if needed replace it.
- Inspect all the static seals and replace it, if necessary.

Assemble the gear box

- Assemble all the parts of the gearbox in reverse order as specified in the dismantling order.
- Fit all the lubrication pipe lines.
- Fill sufficient quantity of lubrication oil in the oil sump as recommended by the OEM.
- Fix the gear box side cover, forks and shift covers properly.

Test run the machine

- Switch on the machine.
- Run the machine at slow, medium and high speed atleast 15 minutes.
- Listen if any abnormal noise is hearing from gear box.
- Check if any excess heat is generating from the gear box, if so rectify the fault.

Write a inspection report for maintenance job

Objectives: At the end of this exercise you shall be able to
- **inspect a machine as per check list**
- **prepare the report for maintenance.**

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 carried out
Level of the machine			
Belt and its tension			
Bearing sound			
Driving clutch and brake			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Carriage & its travel			
Cross-slide & its movement			
Compound slide & its travel			
Tailstock's parallel movement			
Electrical controls			
Safety guards			

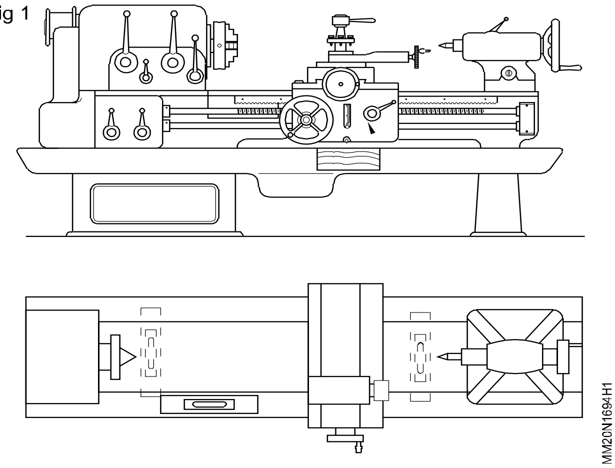
Prepare action plan for maintenance work

Objective: At the end of this exercise you shall be able to
- **inspect a machine as per check list.**

Job Sequence

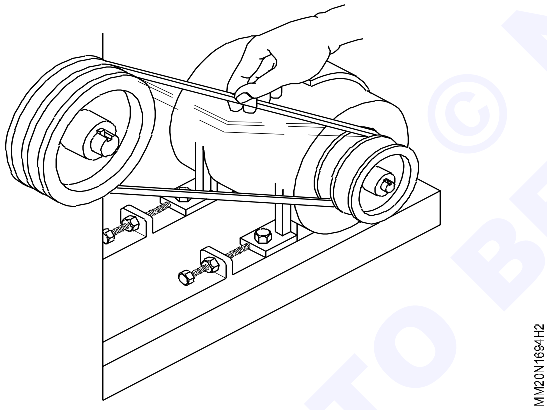
- Check the level of the lathe with a spirit level and adjust using wedges. (Fig 1)

Fig 1



- Check the tension of the belt and adjust. (Fig 2)

Fig 2



- Check the free movement of tailstock over the bed.
- Check the movement of the carriage of the lathe. (Fig 3)
- Run the machine on different spindle speeds and check the speed.
- Engage the power feed and check the longitudinal and transverse feed movements.
- Check the function of clutches by operating the clutch lever.
- Check the movement of the cross-slide and the compound slide. (Fig 4)
- Check the oil level and the functioning of the lubricating pump.
- Check the coolant level and the functioning of the coolant pump. (Fig 5)
- Check the safety guards. (Fig 6) and ensure they are in position.

Fig 3

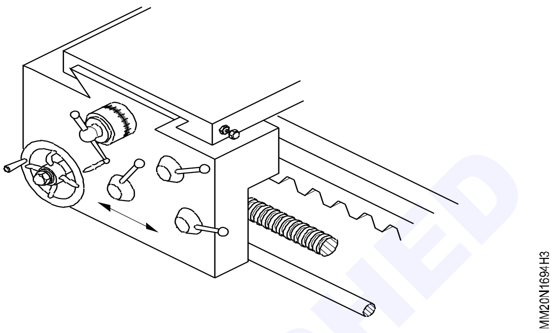


Fig 4

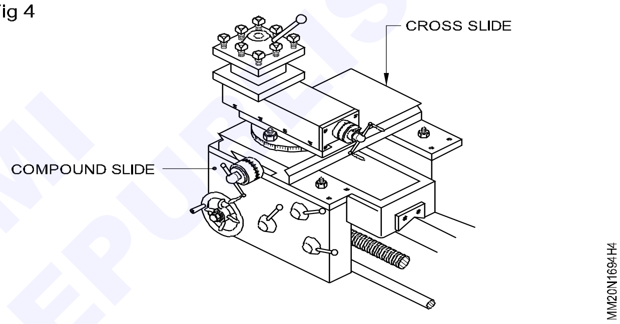


Fig 5

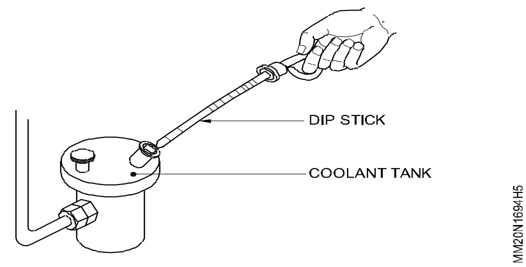
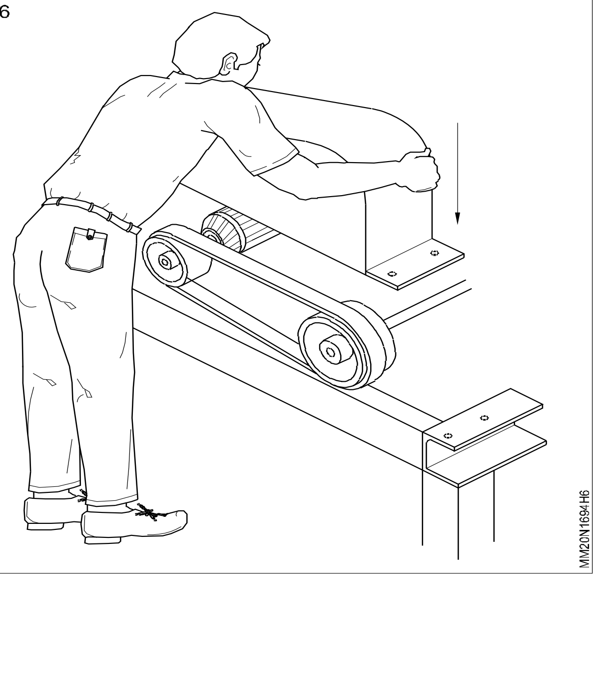


Fig 6



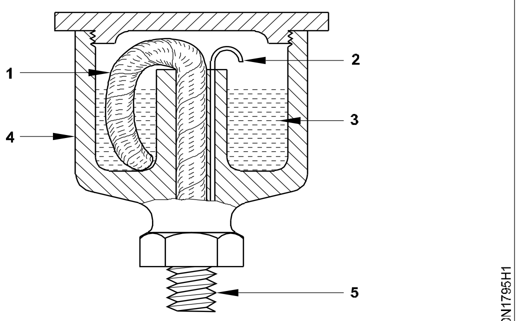
Identification of various types of lubrication system and their components

Objectives: At the end of this exercise you shall be able to
- **identify the types of lubrication system**
- **identify the different components of lubrication system.**

Job Sequence

TASK 1 : **Wick feed lubricator**

Fig 1



WICK FEED LUBRICATOR

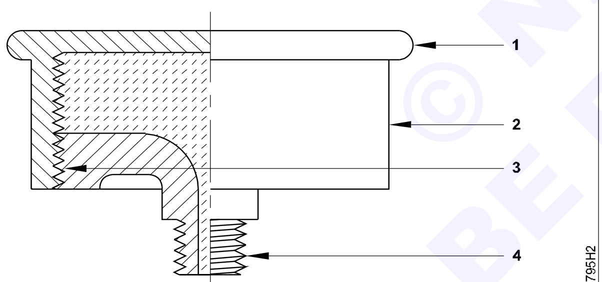
Table 1

SI.NO	Name of the component
1	
2	
3	
4	
5	

— — — — — — —

TASK 2 : **Screw down creaser**

Fig 2



SCREW DOWN GREASER

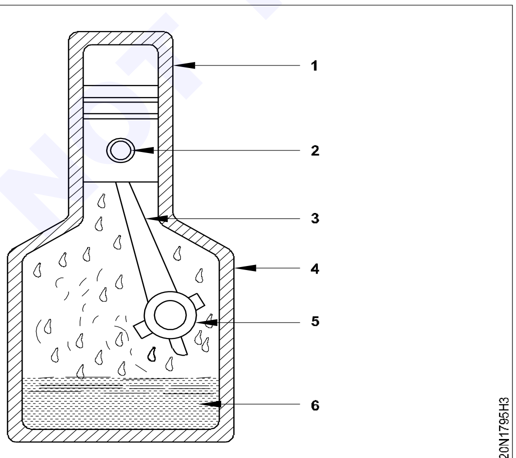
Table 2

SI.NO	Name of the component
1	
2	
3	
4	

— — — — — — —

TASK 3 :**Splash lubricator**

Fig 3



SPLASH-LUBRICATING SYSTEM

Table 3

SI.NO	Name of the component
1	
2	
3	
4	
5	
6	

— — — — — — — — —

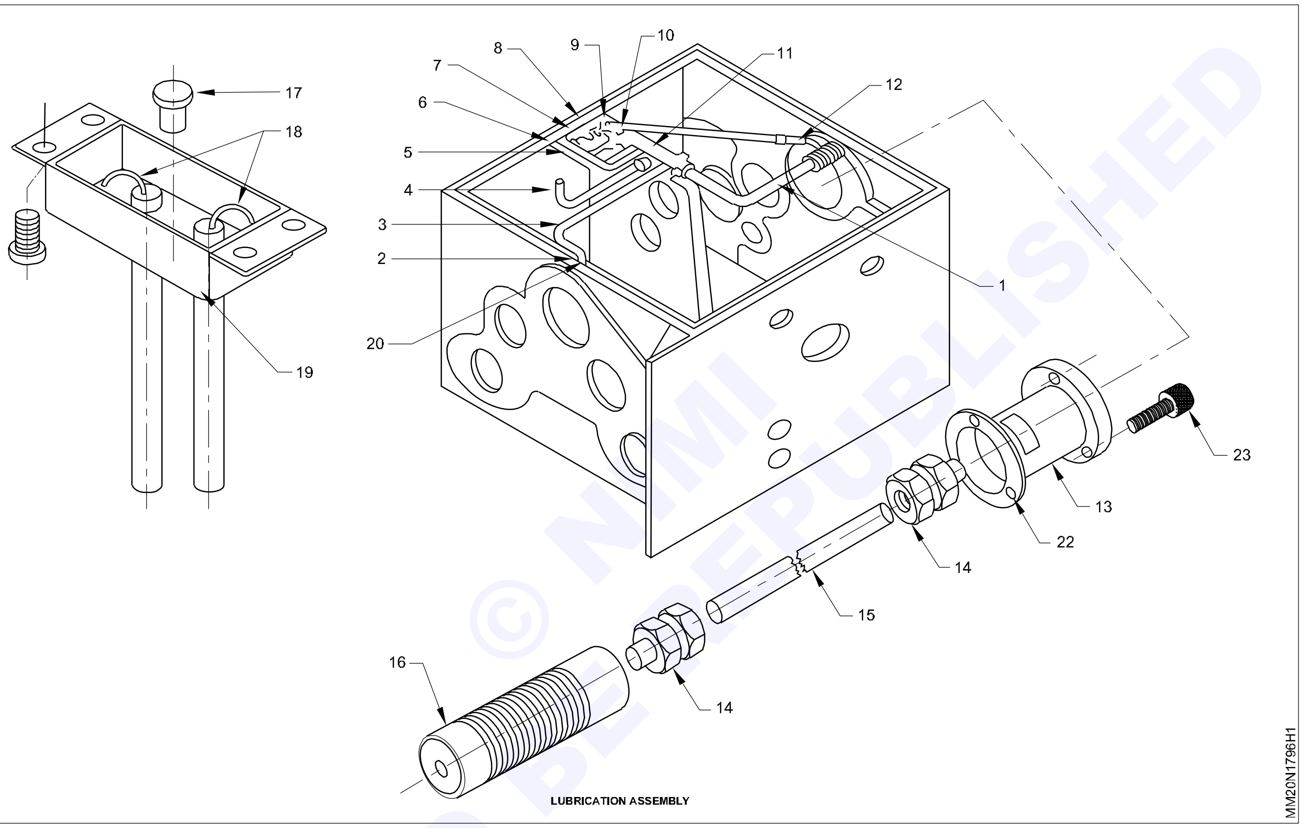
Note : The instructor should demonstrates the names of the components of lubrication system and ask the trainees to identify and note down the names in table - 1 to 3.

Cleaning of lubrication lines and oil filters

Objectives: At the end of this exercise you shall be able to
- **dismantle the lubricating system**
- **clean all the components**
- **replace any damaged part**
- **reassemble the lubricating in system**
- **remove, clean and assemble of inlet filter.**

TASK 1: **Cleaning lubrication system**

Fig 1



— — — — — — —

TASK 2: **Cleaning filter**

Fig 1

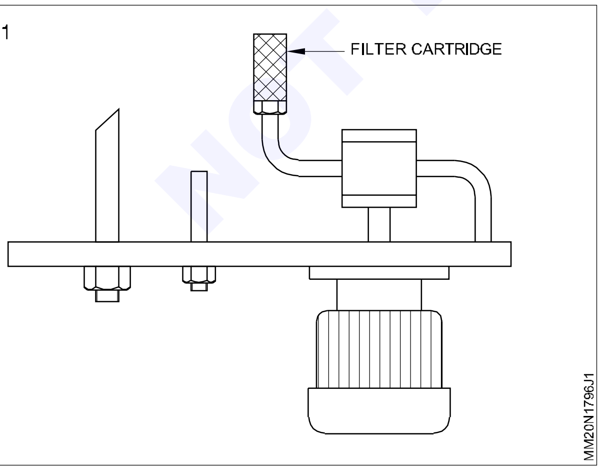
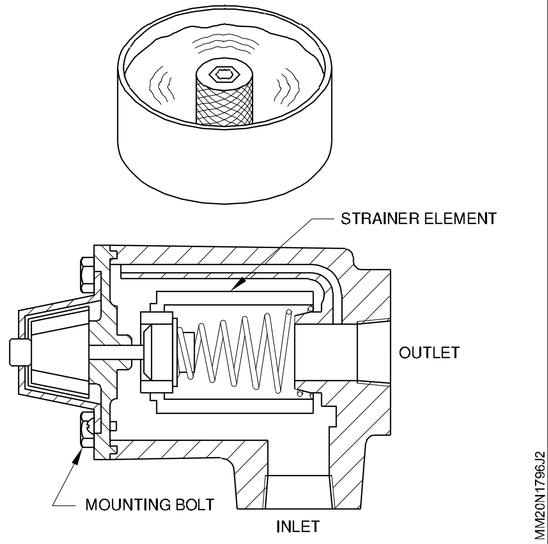


Fig 2



— — — — — — —

Job Sequence

TASK 1: **Lubricating cleaning**

- Check the lubrication oil level in the oil tray (part no 19)
- In case of any lubrication problem then remove the socket head cap screw (part no 9,10,23)
- Check the copper tubes through which oil is passing (part no's 1,3,4,5,6,7,15)
- Check the straight connector's condition (part no 2,8,14)
- Remove the suction plug (part no 13)
- Remove the gasket (part no 22)
- Check the strainer and clean it (part no 16)
- Remove the drain screw (part no 21) there is any oil drain is required. (Part No 17, 18)
- Remove and clean oiled (part no 17) felt wick (part no 18)
- Remove the swivell banjo (part no 12) and manifold (part no 11) clean it and fix it properly.
- Assembly all the parts of lubrication system.
- Refill the recommended grade of lubricant and ensure the oil level.
- Switch on the machine and check the performance of lubrication system.

Lubrication assembly

Sl. No.	Part Name
1	Copper tube 6
2	Straight connector 1/8" BSP
3	Copper tube 4
4	Copper tube
5	Copper tube
6	Copper tube
7	Copper tube
8	Straight connector F-SC-4T M8x1
9	Plug M10x1P
10	Soc. Head cap-screw
11	Manifold M-5
12	Swivel banjo FB-4 1/8" BSP x 4 OD
13	Suction block
14	Straight connector 61/4 x 6 mm
15	Copper tubes 6
16	Strainger
17	Oiler 5/16" with cap
18	Felt wick 1/8" x 50 L
19	Oil tray
20	Elbow 1/8: BSP
21	CH HD Screw M6 x 10
22	Gasket
23	Soc. Cap-Screw M6 x 20

Ensure the proper oil pumping by watching through oil sight glass provided at the gear box of the machine.

— — — — — — —

TASK 2: **Filter cleaning**

1 Inlet filter is normally called as suction strainer. Unscrew the inlet cartridge, wipe at the excess sludge collected on the filter.

2 Soak it in kerosene and removed the sludge.

3 Flush the strainer with clean kerosene Fig 1.

4 Blow compressed air on the mesh area.

5 Clean the mounting area of the strainer.

6 Unscrew both the cap nuts of the lines coming to the filter unit and going out of it.

7 Hold the filter unit in the benchvice and unscrew the mounting bolt (Fig 2).

8 Remove the filter insert clean/replace filter insert.

9 Clean the casing thoroughly.

10 Place the insert and screw the mounting bolt.

11 Mount the filter unit back in this position.

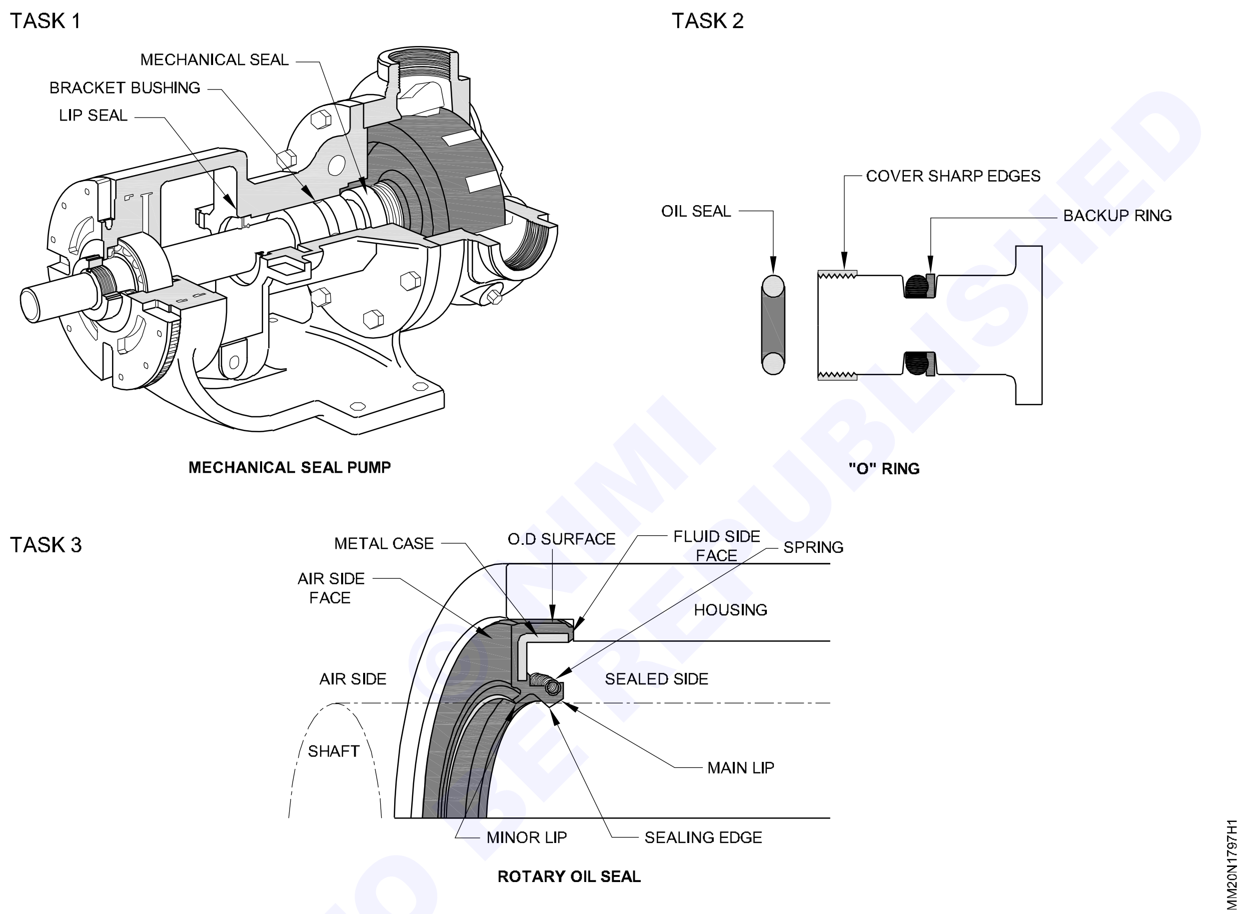
12 Confirm proper lightening of connections.

— — — — — — —

Fittings different types of seals and oil rings

Objectives: At the end of this exercise you shall be able to
- **fitting of mechanical scales**
- **fitting of 'O' ring**
- **fitting of rotary oil seal.**

Fig 1



Job Sequence

TASK 1: **Mechanical seal fitting**

- Power off the motor and shutdown the power supply.
- Shut both inlet and outlet valves and then drain the pump casing by removing casing drain plug.
- Remove the spacer element in the pump coupling.
- Disconnect the complete pump, after disconnecting the coupling between the pump and motor shaft.
- Remove the casing bolts and remove the casing.
- To remove the impulley rotate the impeller clockwise until it is completely un screwed.
- Remove the stationary part of the seal from the casing or seal chamber bore.
- Remove the wornout seal and replace new mechanical seal.

Caution

Always install mechanical seals in a clean working space. Dont touch the front of the seal faces, as it is susceptible to body oils and may not function properly if comprosible keep the seal in its packing until it's time to install

- Install the impeller.
- Reconnect the casing using the original casing bolts.
- Reconnect the pump.
- Restart the machine.
- Follow proper safety precautions.

TASK 2: **Fitting ' O' ring**

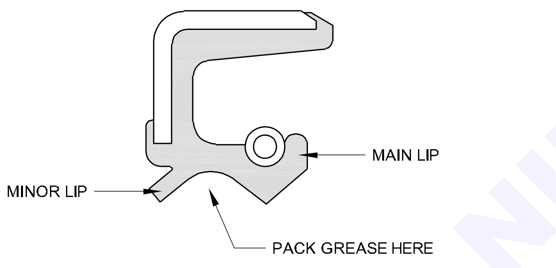
- Lightly coat the "O" ring with lubricant that is compatible with your system
- Cover any sharp edges upon installation so avoid cutting or damaging of the "o" ring seal.
- While installing the back up ring ensure it is installed on the low pressure side of the system that the way that high pressure side of the system pushes the 'O' ring against the backup ring.
- Upon installation of the 'O' ring ensure there is uniform stretching of the O ring and do not just pull only on one side of the 'O' ring.
- Minimise the installation stretch of the 'O' ring to less than 50%
- After installation of the 'O' ring ensure that the seal is not twisted in the 'O' ring groove or load.

— — — — — — —

TASK 3: **Fitting rotary oil seal**

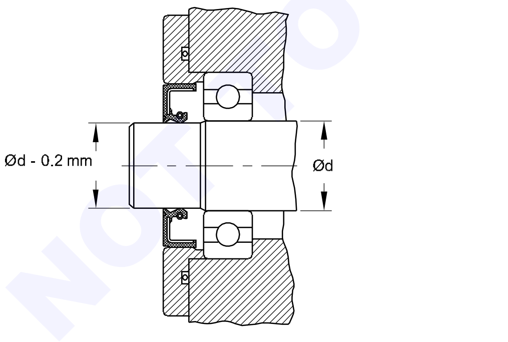
- Before mounting confirm that there is no damage no dirt or foreign particles on the seals
- Apply suitable, clear lubricant to the seal lip for initial lubrication. For oil seals with a minor lip. pack clear grease between main lip and minor lip (Fig 1).

Fig 1



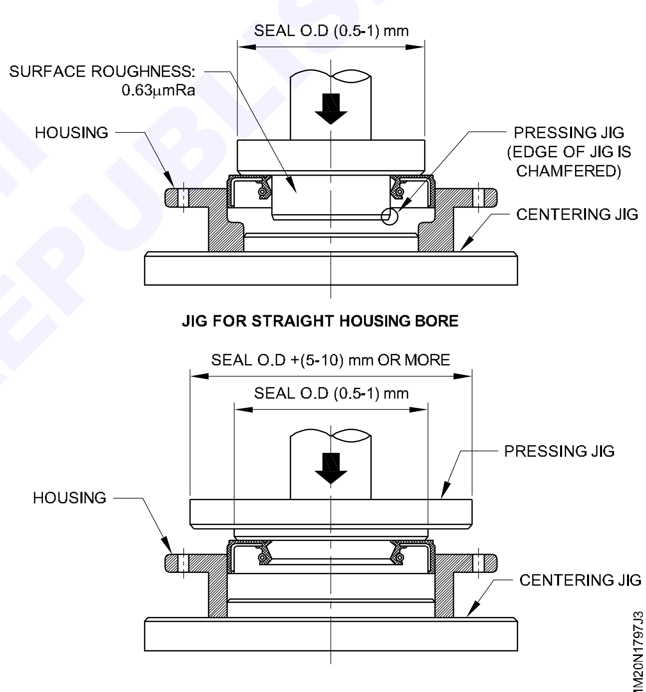
- When seal is mounted at cold area, warm seal up to have seal flexibility and then mount it.
- To avoid damage on seal lip and shaft surface when seal is mounted onto shaft edge should be chamfered. (Fig 2)

Fig 2



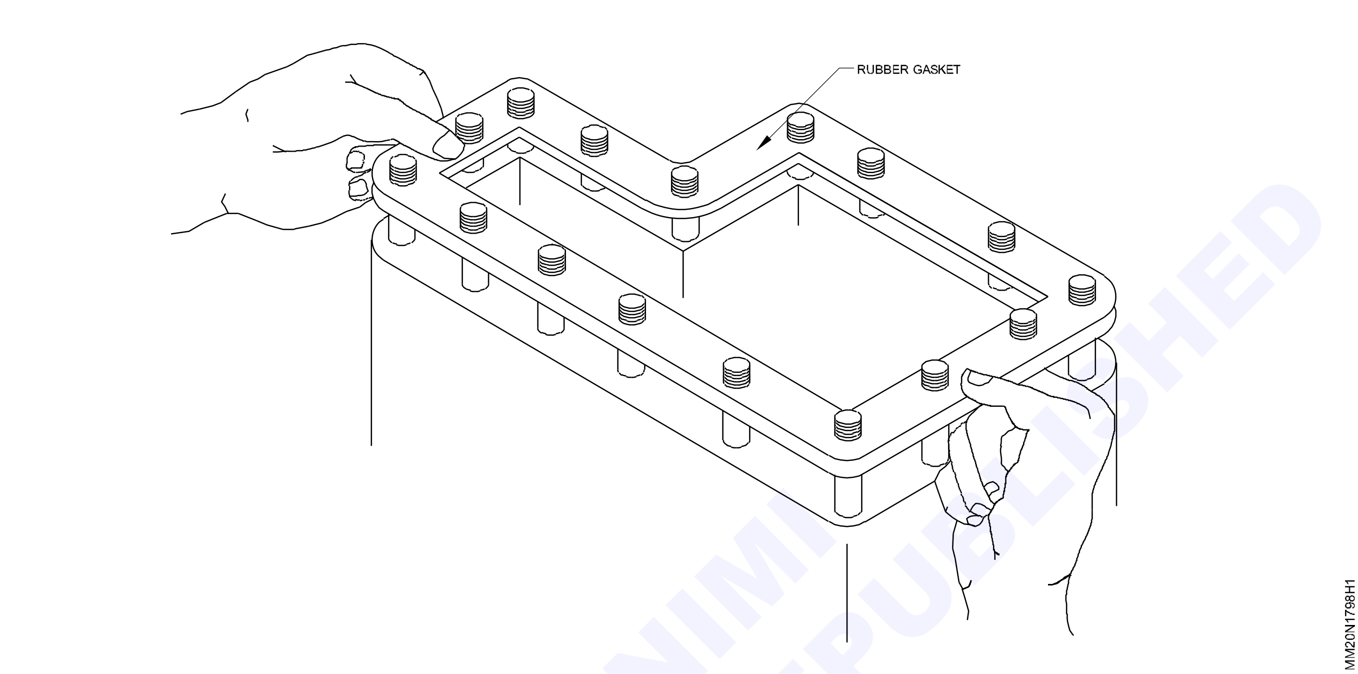
- When seal is pressed into housing bore, use pressing jig. When press-fitting an oil seal into the housing bore in the opposite direction use the pressing jig (Fig 3)

Fig 3



Preparing and fitting of gasket for different joint surface

Objectives: At the end of this exercise you shall be able to
- **mark and cut the profile and prepare gasket**
- **fit new gasket and test the joints for leakage.**



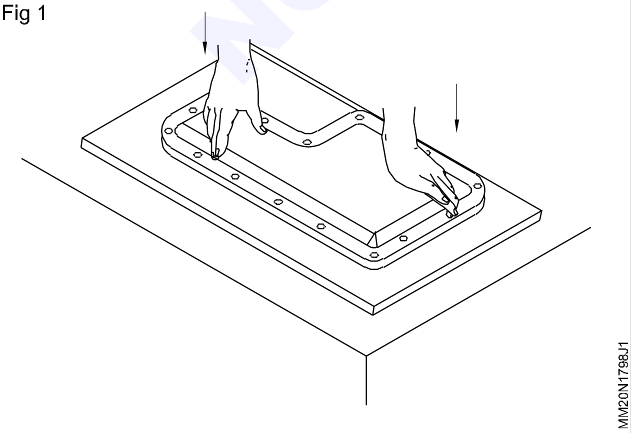
Job Sequence

- Remove the cover plate and take out the damaged gasket

> **Ensure that portion of the gasket remains on the surface**

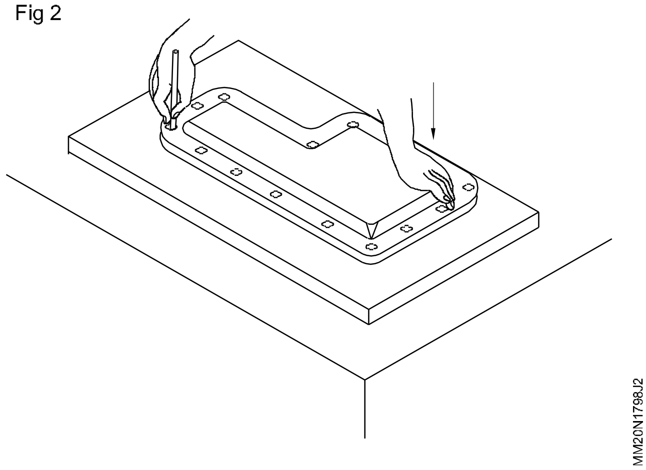
- Clean the surface of the base and the cover plate thoroughly.
- In the case of glue bonded gaskets, surfaces should be cleaned thoroughly using a blunt scraper.
- Smear marking medium or grease on the cover plate's base surface.
- Place the gasket on to the base of the cover plate and press firmly (Fig 1).

Fig 1



- Mark the geometrical shape of the gasket using a scriber or pencil (Fig 2)

Fig 2



- For smaller or handy objects the article can be placed on to the gasket for marking.
- Punch cut the holes using a hollow punch and a hammer or a little cover, size steel ball and a hammer (Fig 3 and 4)
- Cut out the unwanted portion of the gasket using scissors (Fig 5).

Fig 3

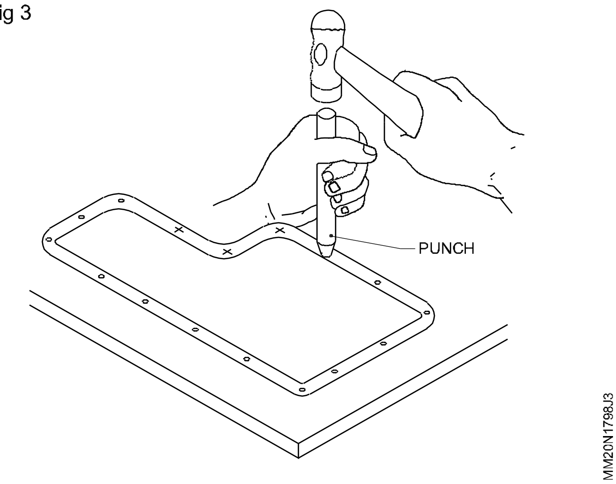


Fig 4

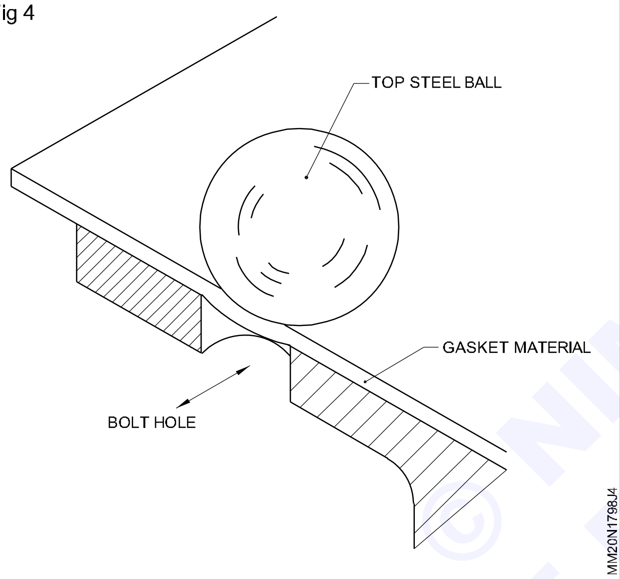
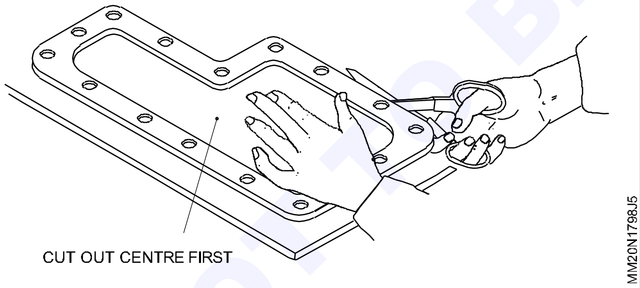


Fig 5



Cut out the centre portion first and then the external profile.

- Clean the corners of the studs (Fig 6)
- Fit the gasket in position (Fig 7)
- Replace the cover plate on to the gasket and tighten the screws evenly (Fig 8)
- Test the sealed joint for leaks and functional aspects.

Fig 6

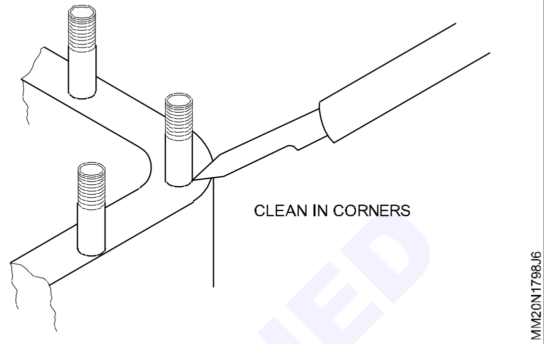


Fig 7

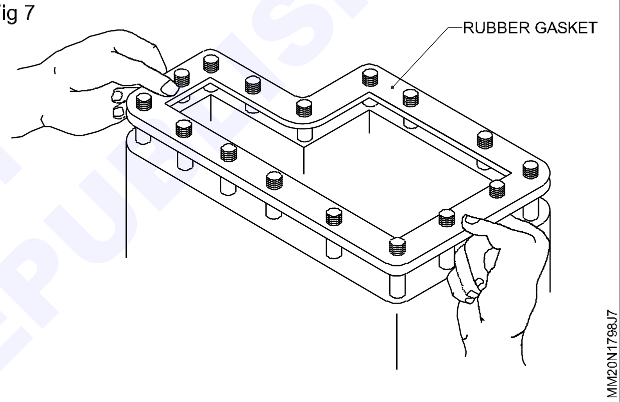
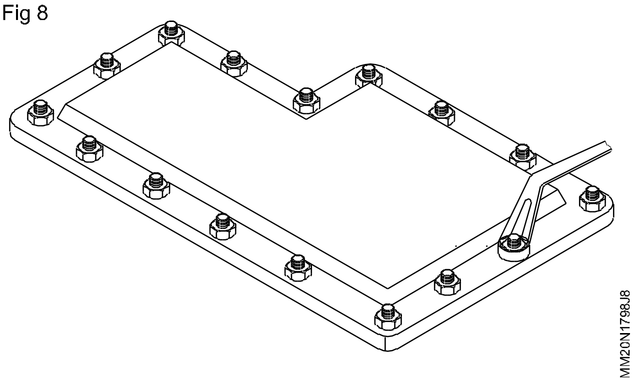


Fig 8



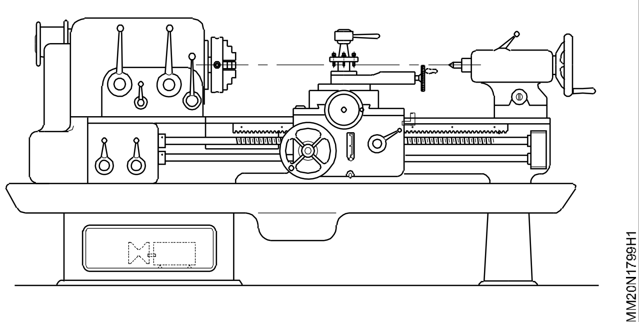
Preventive maintenance of lubrication system of lathe, drilling and grinding machine

Objectives: At the end of this exercise you shall be able to
- **perform maintenance of lathe lubrication system**
- **perform maintenance of drilling machine lubrication system**
- **perform maintenance of grinding machine lubrication system.**

Job Sequence

TASK 1: **Maintenance of lathe lubrication system (Fig 1)**

Fig 1

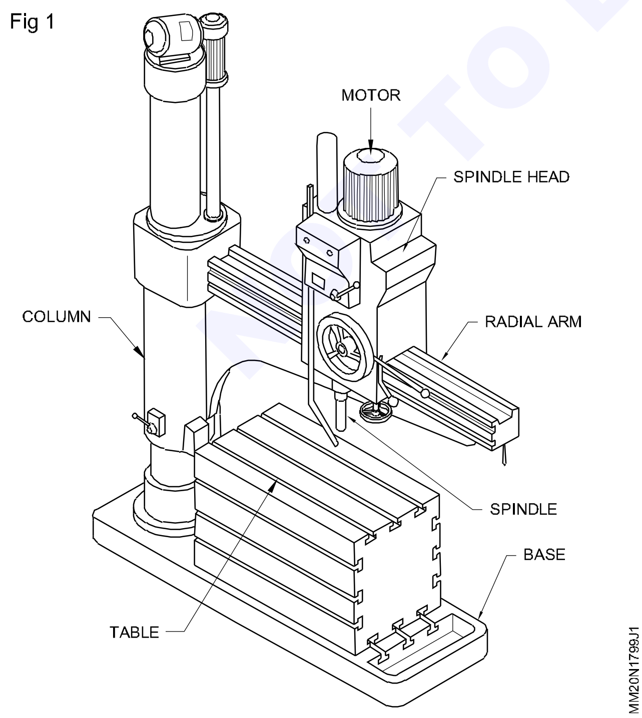


- Remove the head stock cover
- Check the oil level and condition of oil
- If the oil is contaminated drain the oil
- Clean the gear box with kerosene
- Fill the new lubricant as per the manufacturer recommendation
- Close the cover with gasket
- The head stock gear box oil may be changed once in the six months
- Clean the all slides of the bed ways, cross slide lead screw and feed shaft
- Oiling daily before starting the machine

— — — — — — —

TASK 2: **Maintenance of drilling machine lubrication system (Fig 1)**

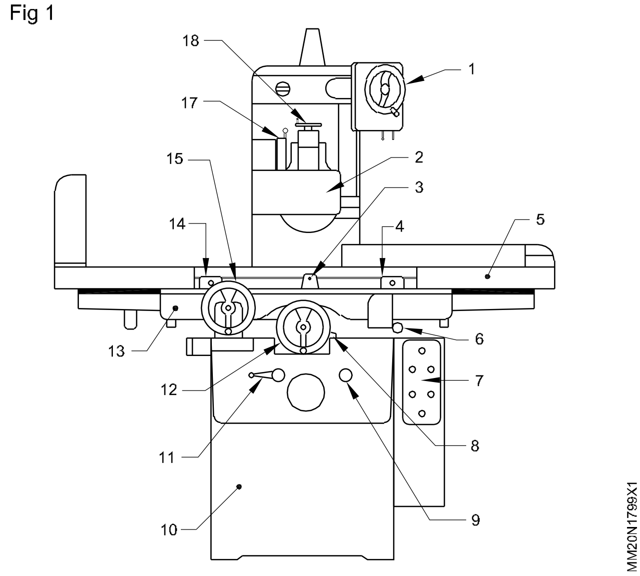
Fig 1



- Clean the speed charger gear box and refill the lubricant
- Clean the feed changing gear box and refill the lubricant periodically.
- Spindle, pillar and horizontal sliding may be lubricated daily.

TASK 3: **Maintenance of grinding lubrication system (Fig 1)**

Fig 1



1 Lubricate the following parts daily

2 Oil hole on each and or cross line (1)

3 Two nipples on hand wheels for cross screw threads bearing and hand wheel bearing (2)

4 Oil nipples for cross point weekly

5 Oiler for rear and of feed screw. Behind cross saddle(4)

6 One oil nipple of rear of the machine (5)

7 Five feed knob (6)

8 Ball oiler on feed arm step (7)

9 Worn box filling on fire. Fill to level or plug at rear of the machine (9)

10 Oil nipple (10)

11 Apply oil 10 lead screw (11)

12 Two oil nipples (12)

13 Bearing for table traverse hand wheel(15)

14 Ball bearing rollers (16)

15 Two oil nipples (21)

16 Two oil nipples (22)

17 Lubricate the following points monthly

18 Maintain level of oil in worm housing up to the plug (23)

19 Check and replenish if necessary through filler (24)

20 Maintain level of oil in clutch box up to the plug (25)

21 Check and replenish if necessary through filler (26)

Note table, saddle and bad wayes are automatically lubricated from the hydraulic system. The bearing for the table traverse hand wheel are also automatically lubricated from the hydraulic system.

Job Sequence

Lubrication system maintenance

General Procedure

- Clean lubrication reservoir periodically but do NOT use cotton or fiber rags
- Inspect suction filter and screens: filter should be replaced and screens should be cleaned annually.
- Remove and clean strainer regularly
- Change line filter (Pressure filter) annually
- Inspect flexible hoses for cracks, punctures and wear.
- Check tubing/pipe for flattening or breaks
- Check for leaking or “weeping” at all connections; check tightness of connections but avoid over - tightening.
- Monitor system for unusual drops or increases in operating pressure
- Only recommended lubricants should be used. Lubricants with additives that could clog filters or flow apportioning devices should be avoided.
- To avoid introducing air and contaminants into the system, follow recommended lubricant storage and filling procedures. Lubricant should be stored in a sealed container at all times. A permanently sealed container with a sump pump to pump out lubricant as needed is recommended. Contaminated lubricant will certainly cause problems.

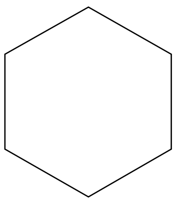
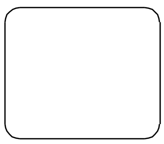
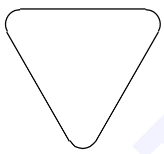
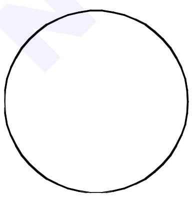
Lubrication schedule-Daily, weekly, monthly concept

Objectives: At the end of this exercise you shall be able to
- **identify the lubricating points**
- **make the schedule for lubrication.**

> **Note : Instructor shall identify the points of lubrication and schedule of lubrication, colour codes of lubrication**

Job sequence

- Trainees should observe the lubrication points and schedule of lubrication, colour codes each.
- Fill in the Table – 1.

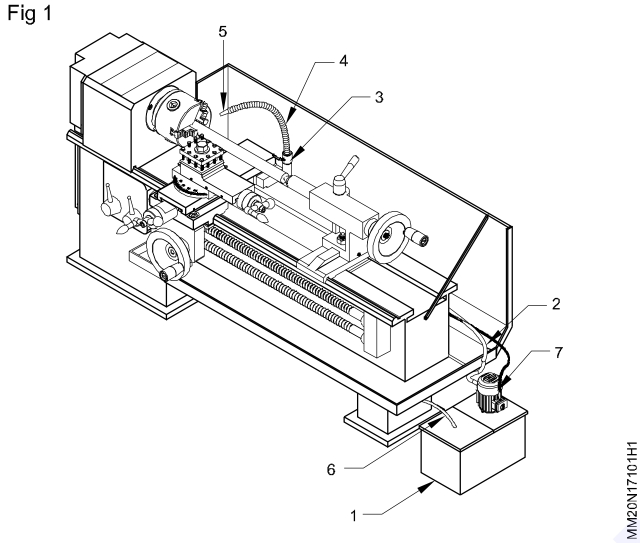
Sl.No	Symbol	Schedule	Colour code
1			
2			
3			
4			

- Get it checked by instructor.

Identification of components of coolant system

Objectives: At the end of this exercise you shall be able to
- **identify the components of coolant system**
- **filling the name of components in table 1.**

Fig 1



Job sequence

Instructor may brief the components of coolant system ask the trainees to record in the table -1.

- Trainees may observe then components
- Identify the components
- Record the name of the component in Table - 1.

TABLE 1

Sl.No	Component name
1	
2	
3	
4	
5	
6	
7	

- Get it checked by instructor.

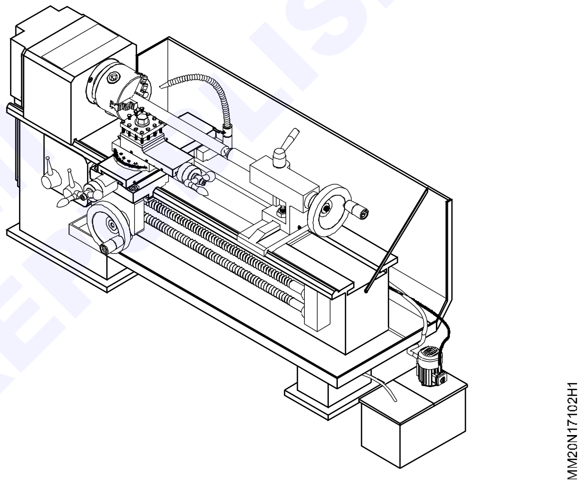
Preventive maintenance of coolant system

Objectives: At the end of this exercise you shall be able to
- **select the coolant suitable for work piece material**
- **prepare the coolant as per the procedure**
- **replace the coolant as per guide lines.**

Job Sequence

- Disconnect the power of coolant motor
- Open the coolant tank
- Check the coolant for its condition. If not clean and drain the coolant.
- Dismantle all the components of coolant system
- Dismantle the filter and remove the contaminants
- Clean the tank and dry it for some time.
- Clean all the components using kerosene
- Assemble the coolant system
- Select the suitable coolant for the work piece material and machines operation
- Use the recommended coolant to prevent damage to the machines
- Mix the coolant according to the manufacturer's instruction
- Check the cool and concentration regularly
- Fill the coolant tank
- Brings the filter with clean, soap water and dry.
- If the filter is damaged, replace it.
- Assemble all the component of coolant system
- Run the coolant and check for flow
- Change the coolant for appropriate period.

Fig 1



Breakdown maintenance of coolant system

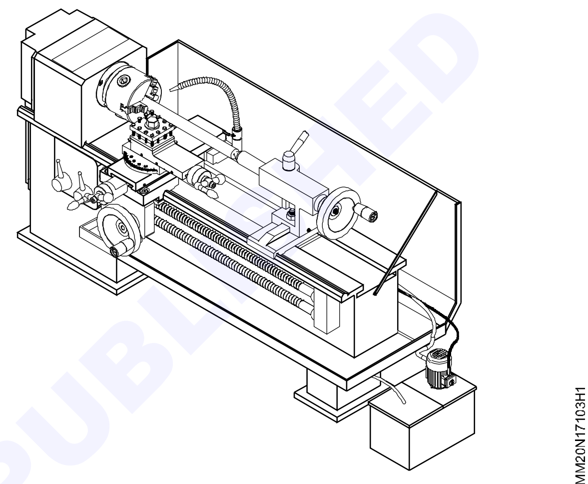
Objectives: At the end of this exercise you shall be able to
- **identify the nature of breakdown**
- **check the cause**
- **solve the breakdown.**

Job Sequence

Coolant not flow (Fig 1)

- Check the coolant tank
- If any dust clean the tank
- Refill the coolant
- Check the coolant hose for any crack
- Solve the hose is leaking, change the hose
- Check gate valve (opening / closing)
- If any problem in valve, repair or replace
- Check motor for low voltage and correct the voltage
- After attended the breakdown, check the flow of coolant

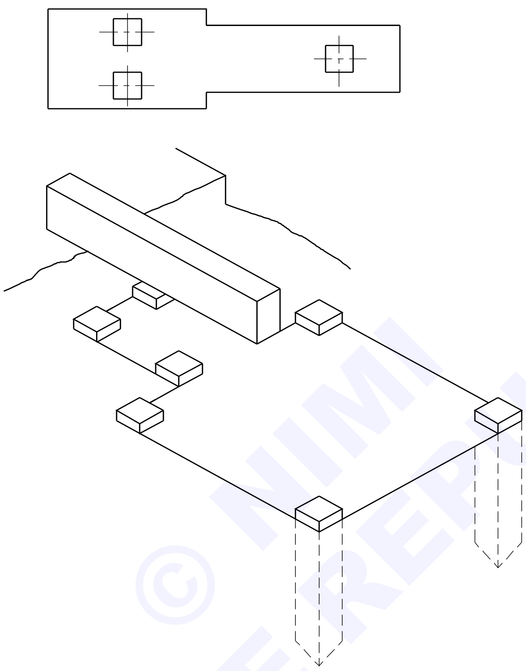
Fig 1



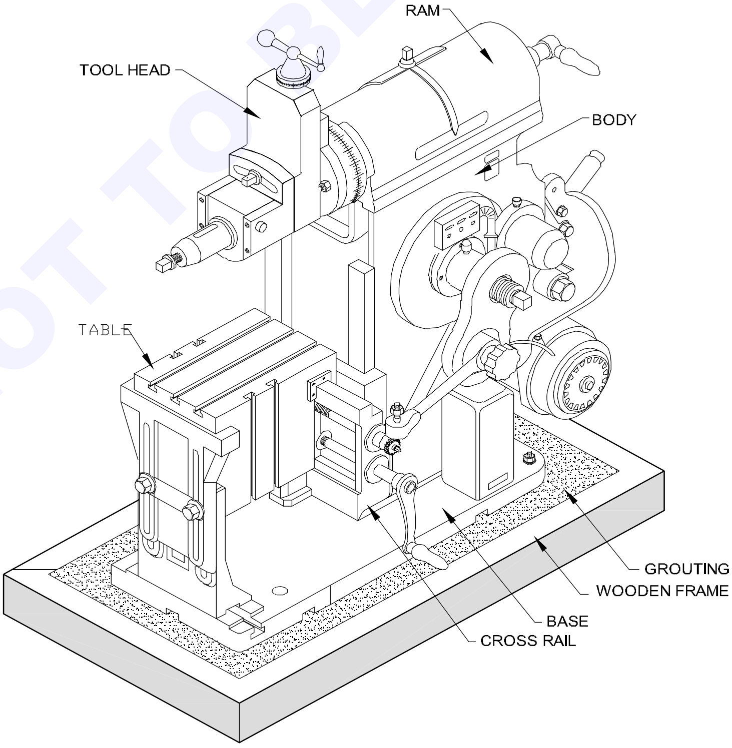
Marking, locate on grouting and installation of foundation bolts

Objectives: At the end of this exercise you shall be able to
- **excavate the soil for foundation**
- **prepare a template for foundation**
- **preparation concrete for foundation**
- **prepare the grouting material**
- **perform grouting under the machine.**

TASK-1



TASK-2



MM20N18104H1

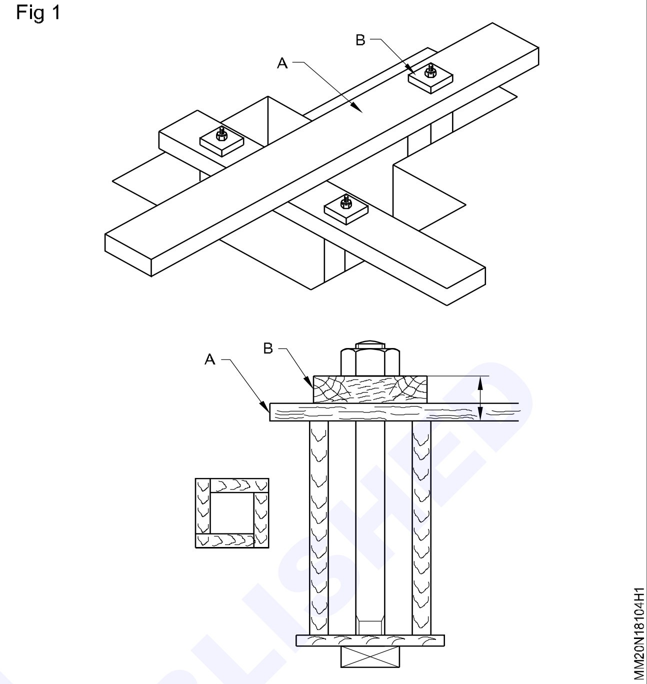
PROCEDURE

TASK 1: **Marking locating**

- Excavate the soil and driven wooden as per foundation plan drawing supplied by manufacturer.
- Prepare the template (Part 'A' in Fig 2).
- Place the template on the foundation floor.
- Anchor the foundation bolts in the template.
- Prepare the concrete and pour inside the foundation pit.

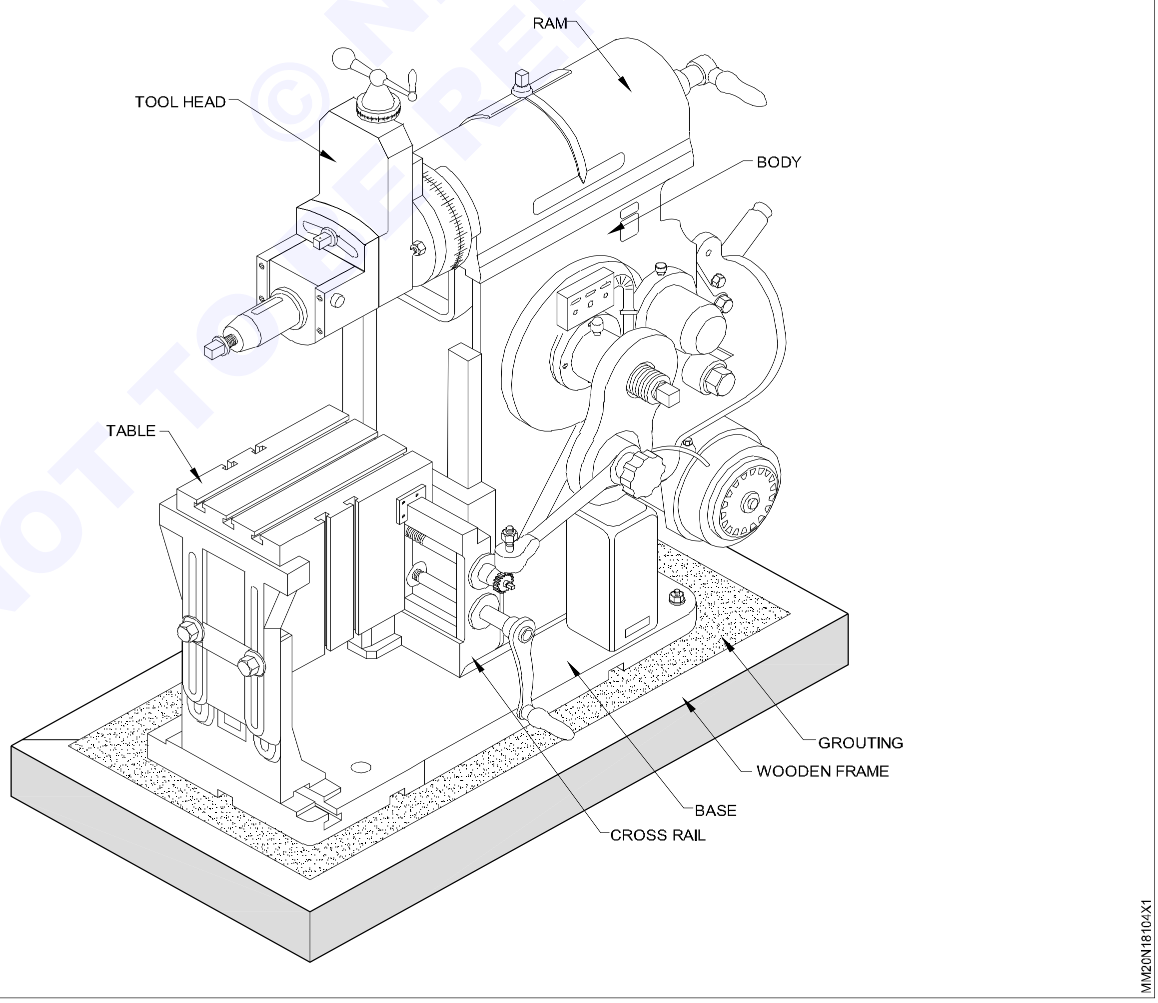
> **Ensure the bracing while at the time of template fixing.**
>
> **Ensure proper curing before removing template.**

Fig 1



TASK 2: **Grouting and installing**

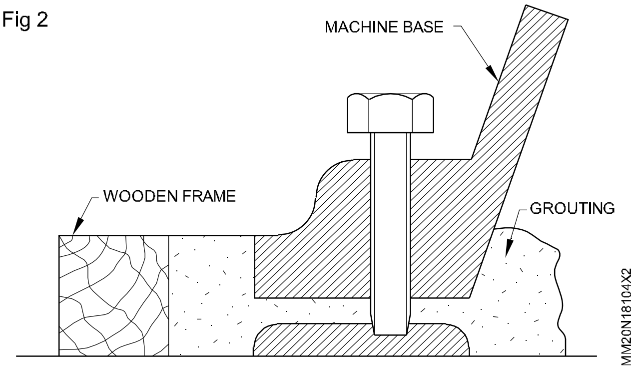
Fig 1



Job sequence

- Ensure proper levelling of the machine.
- Ensure proper tightness of foundation bolt and nut before grouting.
- Make a wooden frame around the machine base (Fig 1) leaving the gap as needed.
- Prepare required quantity of grouting material.
- Fill the grouting material around the gap in the machine base.
- Pack and level the grouting material by using trawol.
- Allow sufficient time for curing.
- Remove the wooden frame.

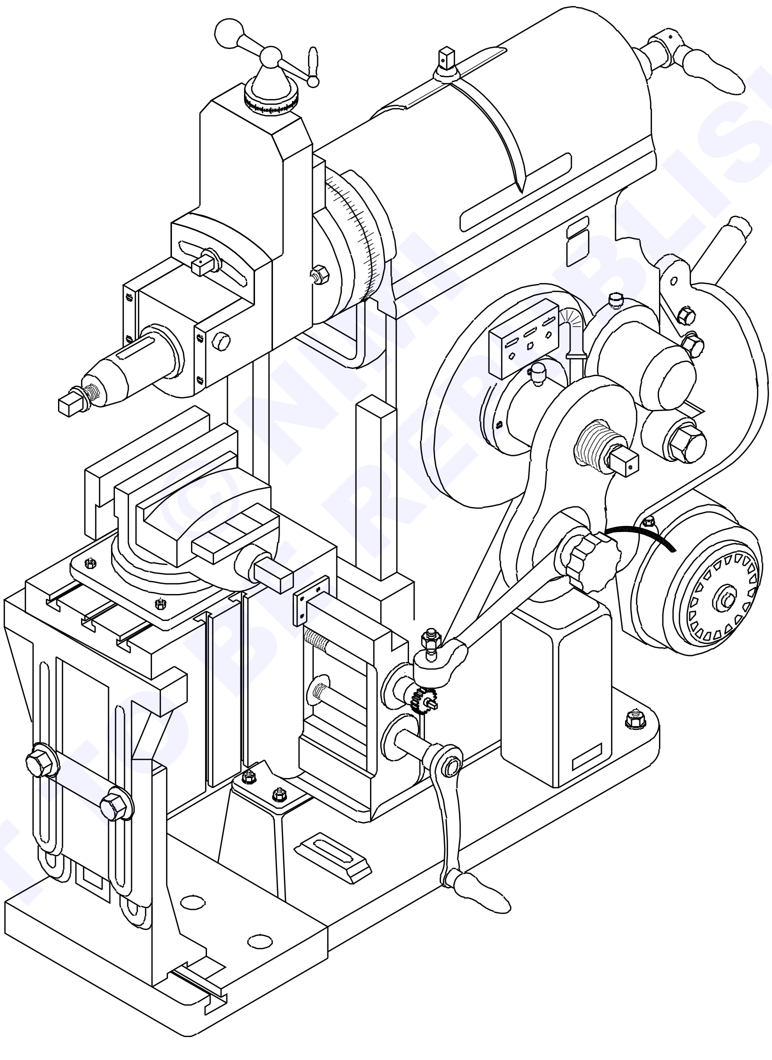
Fig 2



_ _ _ _ _ _ _ _ _ _

Erection and installation of a small machine like shaper/pedestal grinder machine

Objectives: At the end of this exercise you shall be able to
- **prepare the foundation plan for the machine**
- **alignments in the machine both longitudinal and crosswise direction using spirit level**
- **grouting procedure.**

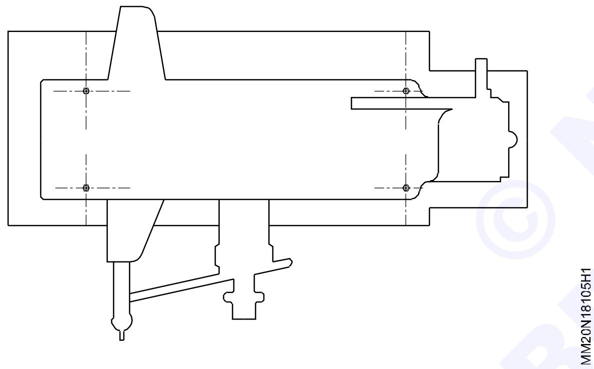


Job sequence

TASK 1: **Erection of sharper machine**

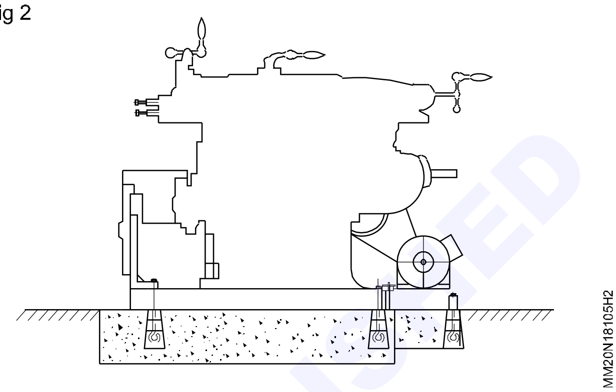
- Select the space for proper functioning of machines such that machines normally must be conveniently accessible.
- Prepare the foundation plane as per the manufacturer instruction.
- As per the plan foundation can be made.
- Insert the holding down bolt before the foundation set down.
- According to the weight of the machine the depth of the foundation be made.
- Machine may be placed in position for levelling and aligning.
- Before setting the foundation, a foundation bolt inserted through the holding down hole in the base of the machine.
- After setting the concrete the machine is put on the foundation bolt in floor. (Fig 1)

Fig 1



- Align the machine perfectly horizontal position using sprit level.
- The sprit level is applied to certain measuring areas, both in longitudinal and cross direction.
- Insert wedges must be driven into the gap under the machine bed.
- After inserting wedge check the level using sprit level.
- Grouting is carried out by pouring creamy mixture of almost pure cement. (Fig 2)

Fig 2



- After setting grouting the wedges may be removed.
- The machine base is then tightly screwed to the foundation bolts.
- After tightening the nuts, the correct position of the machine must once more be checked by means of the sprit level.
- Finally do the practical test and geometrical test.

Safety precautions

- When loading, slings should be protected from sharp edged by packing soft wood
- Before lifting ensure the load is securely slung before taking the lift.
- When unloading make sure that you have a firm foundation for your stack, and make provision for the removal of slings without disturbing the stack.

— — — — — — — — —

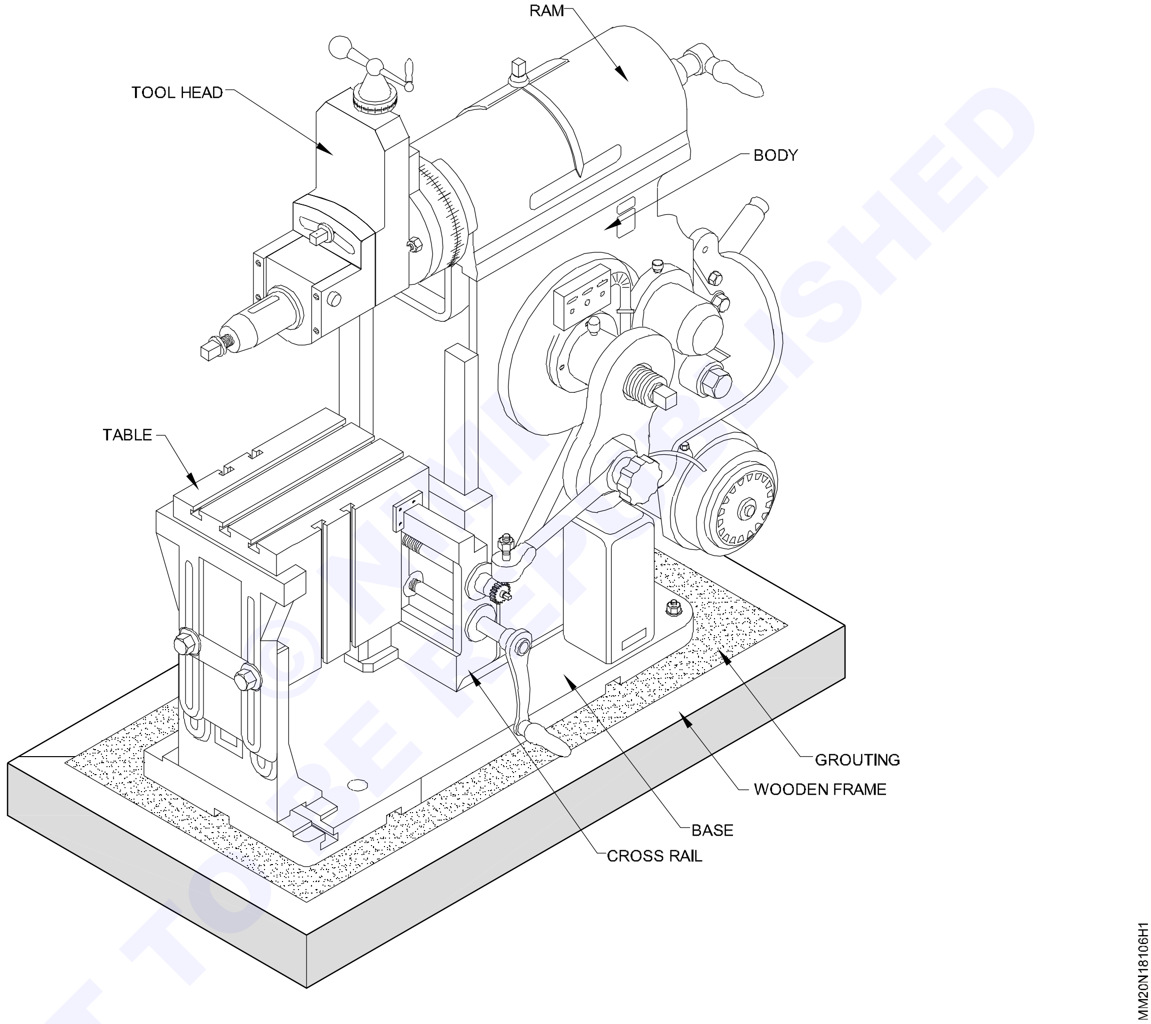
TASK 2: **Erection of pedestal grinder**

- Follow the job sequence of TASK 1.

Levelling of small machine like shaper

Objectives: At the end of this exercise you shall be able to
- **lift the machine using crow bar**
- **check metal wedges on four corners**
- **check the level using sprit level.**

Fig 1



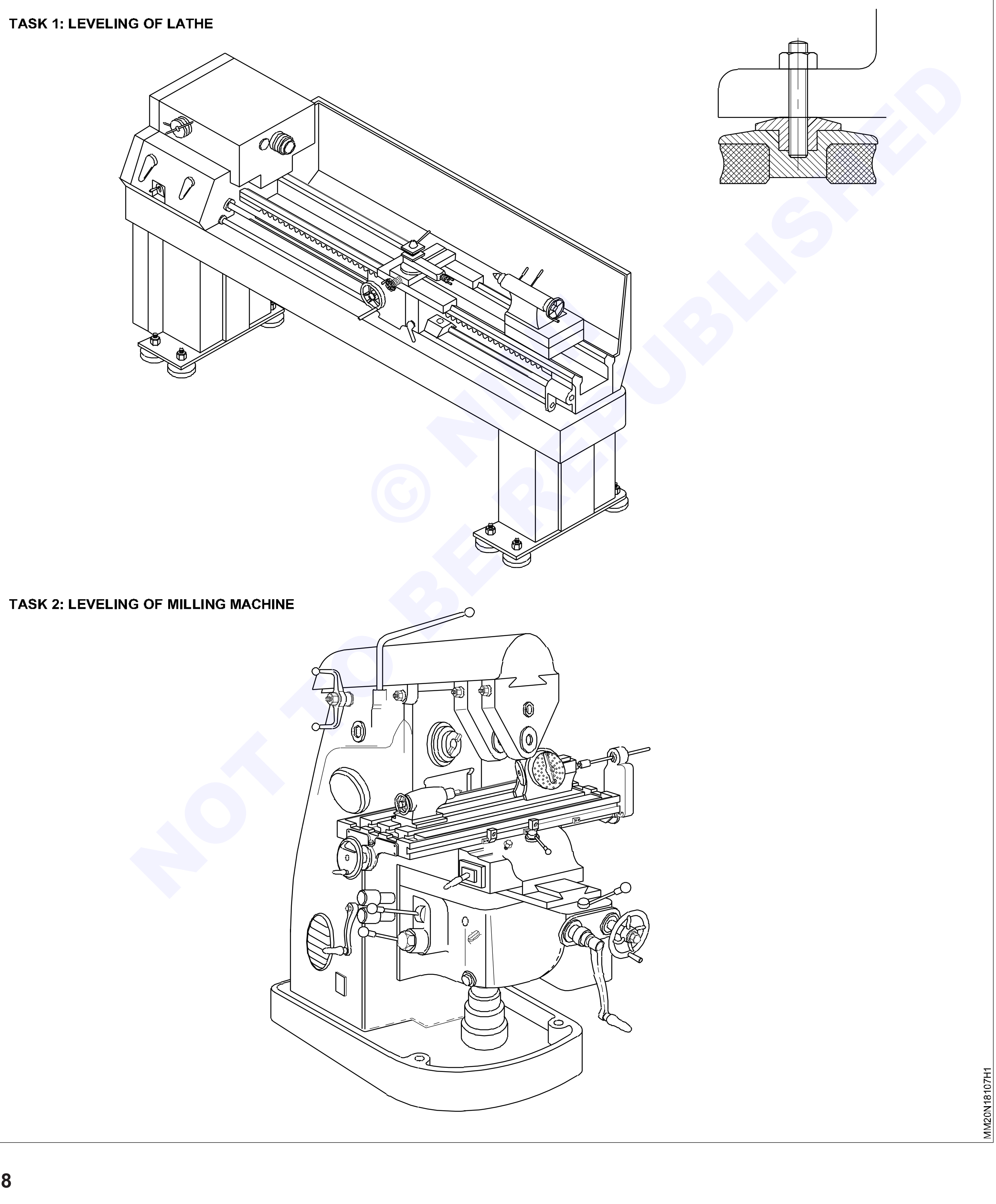
Job Sequence

- Place the machine on grouting grinding the foundation bolts
- Lift the machine using crow bars
- Place the metal wedge on four corners
- Check the level using sprit level
- Adjust the level by wedge and hammer
- After levelling tight the foundation bolt.

Levelling of lathe & milling machine

Objectives: At the end of this exercise you shall be able to
- **mount the machine on anti-vibration pads**
- **level the machine on anti-vibration pads.**

Fig 1



Job Sequence

TASK 1: **Levelling it Lathe**

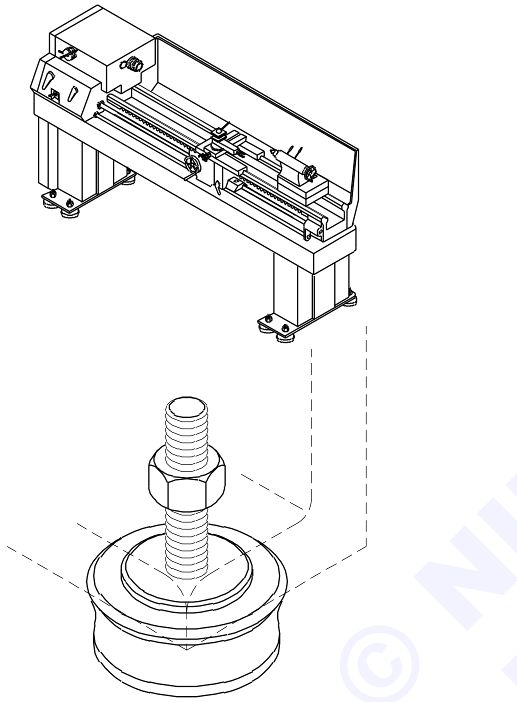
Lift the machine by crowbars and place wooden blocks under the machine at all the four corners.

Select suitable anti-vibration pads depending upon the weight of the machine.

Remove the levelling bolts from the metal casting.

Mount anti-vibration pads under the machine. (Fig 1)

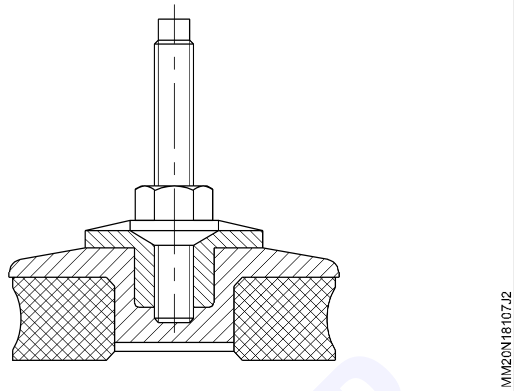
Fig 1



Fix levelling bolts to the metal casing through the foundation holes of the machine.(Fig 2)

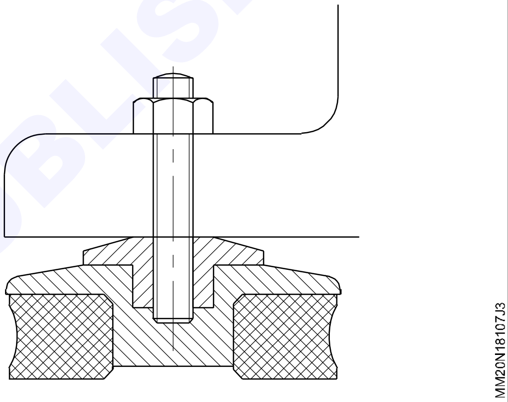
Lift the machine slightly by crowbars and remove the wooden blocks from the machine.

Fig 2



Level the machine both in longitudinal and transverse directions using a precision spirit level of accuracy 0.02 to 0.05 mm/meter. (Fig 3)

Fig 3



Adjust the level of the machine as required by screwing or unscrewing the levelling bolt.

Finally check the level of the machine with a spirit level.

Lock the position of the machine by levelling lock nuts after completion of work.

— — — — — — — — — —

TASK 2: **Levelling of Milling Machine**

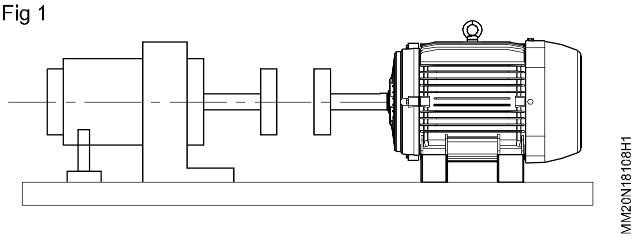
Refer TASK 1

— — — — — — — — — —

Alignment of shaft with help of feeler gauge, dial test indicator & taper gauge

Objectives: At the end of this exercise you shall be able to
- **identify the misalignment of shaft**
- **perform alignment using feeler gauge**
- **perform alignment using dial test indicator**
- **perform alignment using taper gauge.**

Fig 1

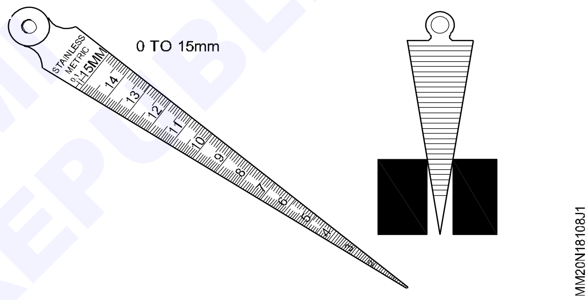


Job Sequence

TASK 1: **Aligning with taper gauge**

- Move the both shaft closer to each other and tighten it
- Check the gap between the shaft using taper gauge (Fig 1)
- If difference in dimension of taper gauge
- Keep the straight edge and absorb the gap between the straight edge surface and coupling surface.

Fig 1

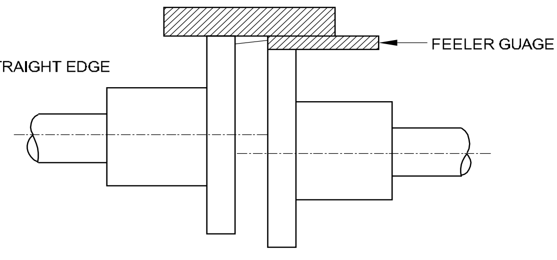


— — — — — — — —

TASK 2: **Aligning with feeler gauge**

- Found the gap size using feeler gauge (Fig 1).
- Adjust the gap by providing suitable shim in between basement and gear box/motor the motor/pump and observe the gap.
- If gap is found, adjust it by moving the motor.
- Tight the coupling bolts finally after doing the parallel alignment.

Fig 1

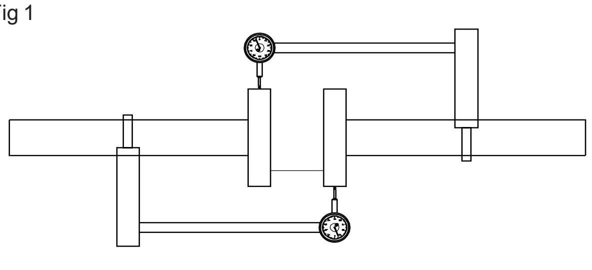


— — — — — — — —

TASK 3: **Aligning with dial test gauge**

- By using a dial gauge do the vertical alignment as shown in (Fig 1)
- While checking alignment hold any one of the shaft coupling rigidly and rotate the other.
- Tight the coupling bolt and nuts properly after performing both alignment.

Fig 1



— — — — — — — —

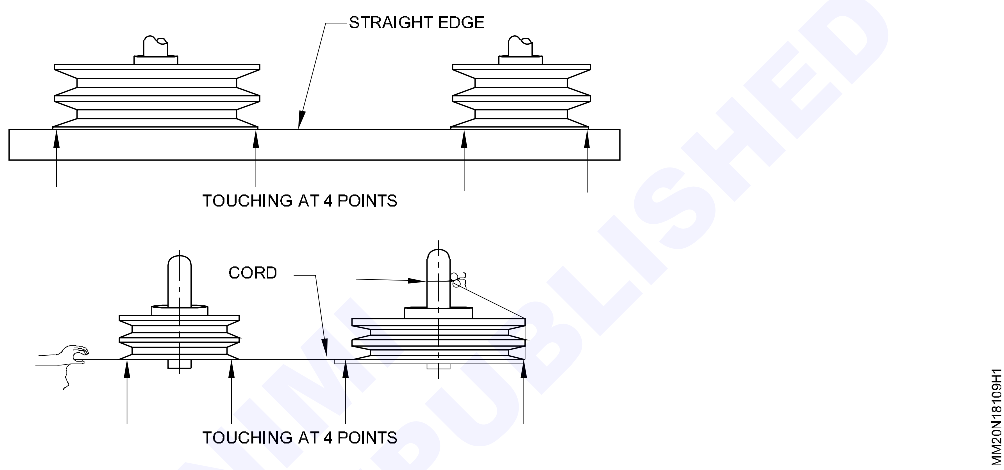
Alignment of pulley & sprocket with straight edge & thread

Objectives: At the end of this exercise you shall be able to
- **align the pulley using straight edge**
- **align the pulley using thread**
- **align the sprocket using thread.**

Job Sequence

TASK 1: **Pulley alignment**

Fig 1



Keep the pump pulley (Driven) is fixed of and motor pulley (driver) is adjustable

Using the straight edge check the alignment (Fig 1 & 2)

Fig 1

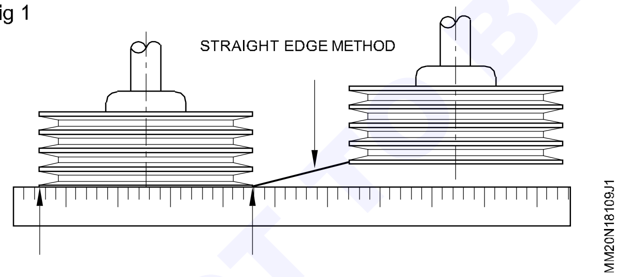
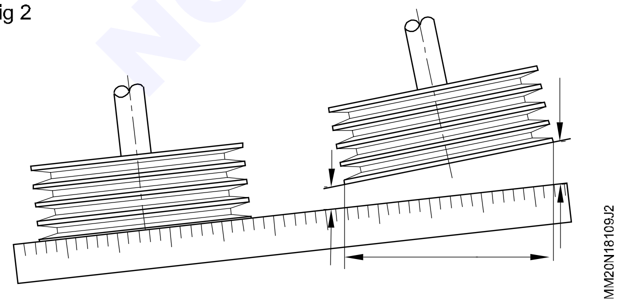


Fig 2



Adjust the motor pulley loosening the bottom bolt.

Check whether the straight edge touch the 4 points of both pulleys.

Tighten the motor pulley.

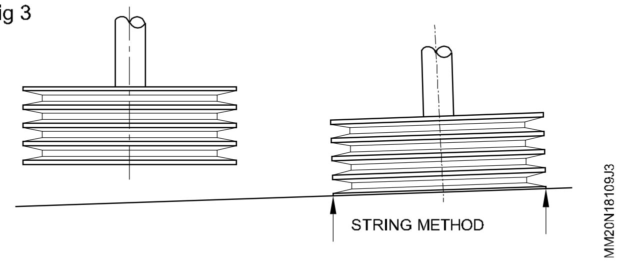
String method

Tie the string at any one of the shaft pulley.

And check the straightness.

If string is not touches the 4 points adjust the pulley (Fig 3)

Fig 3



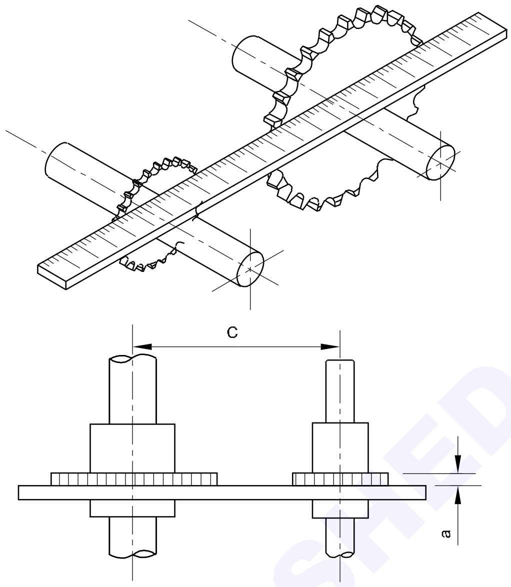
Adjust the motor pulley the string touches 4 points.

— — — — — — — — —

TASK 2: **Aligning sprocket (Fig 1)**

- The same method has to be followed for aligning sprockets using straight edge and string.

Fig 1



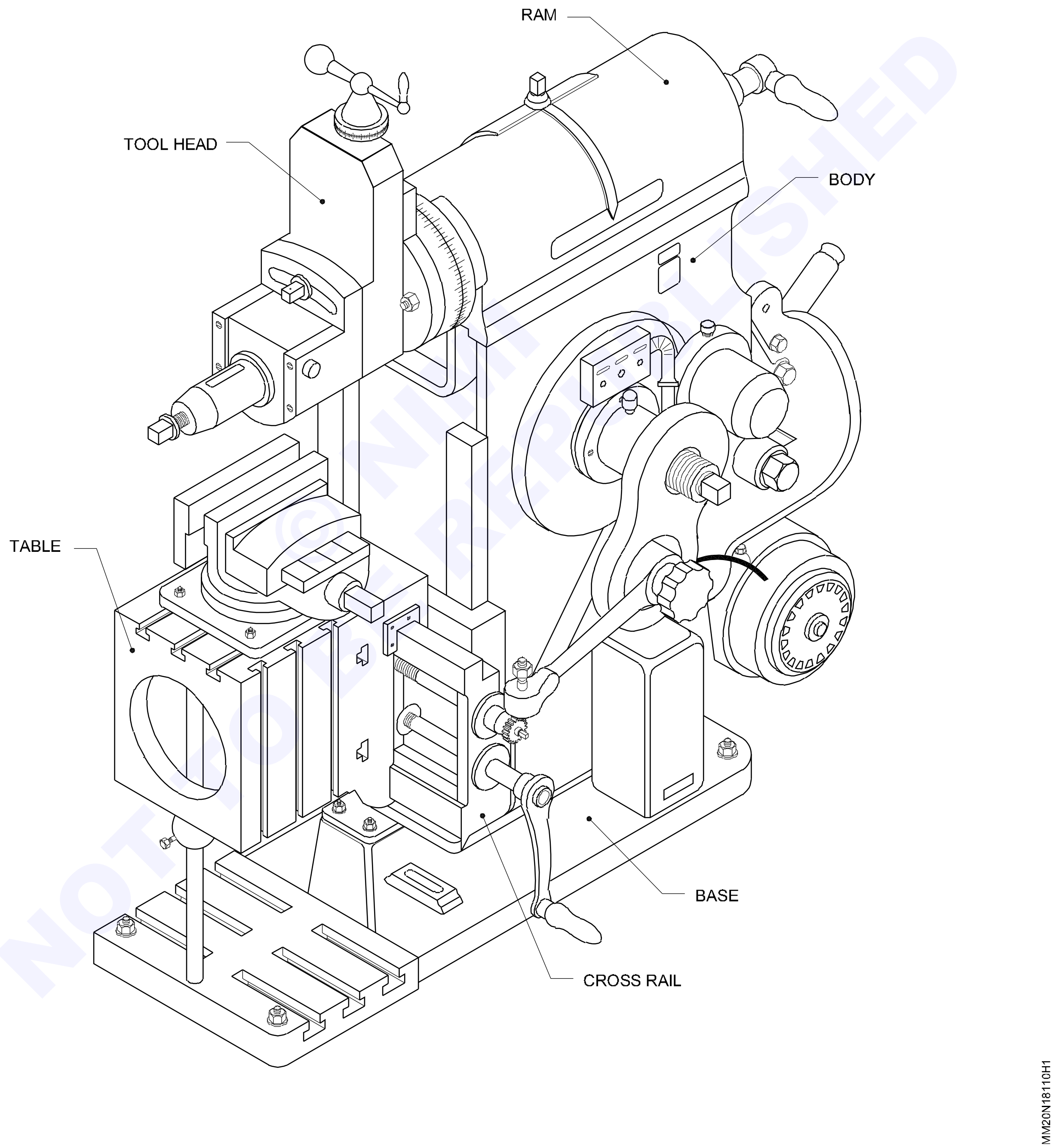
ALIGNMENT OF SPROCKET

— — — — — — — — —

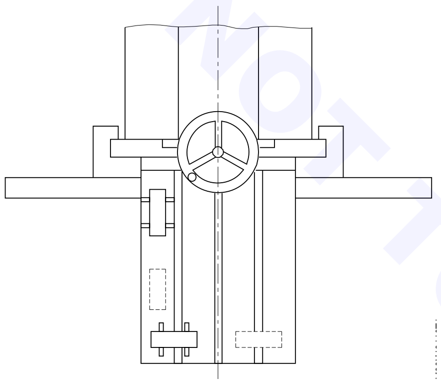
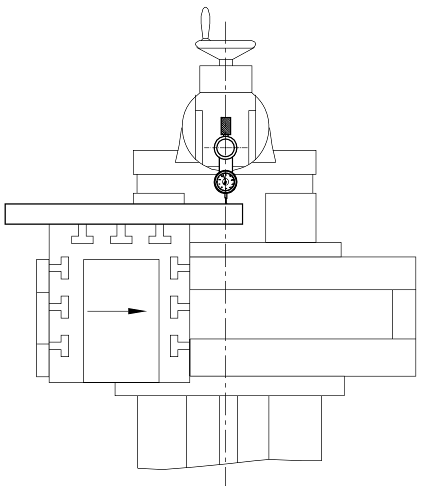
Geometrical alignment test of machine as per test chart

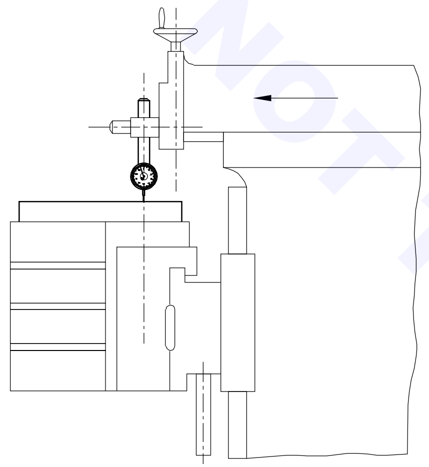
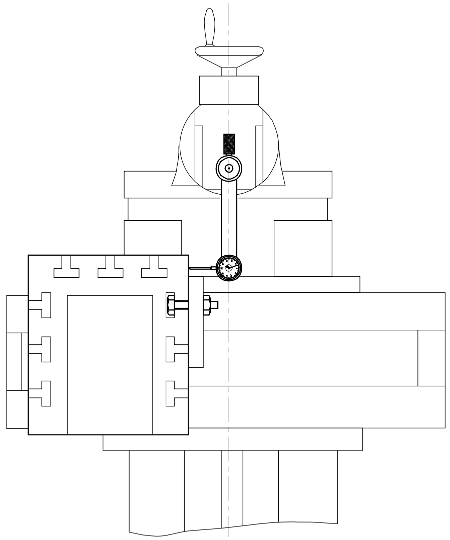
Objectives: At the end of this exercise you shall be able to
- **carry out geometrical test of shaping machine based on test chart**
- **perform practical test as per test chart.**

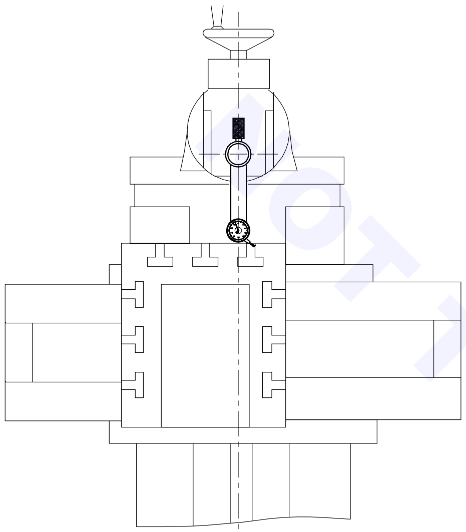
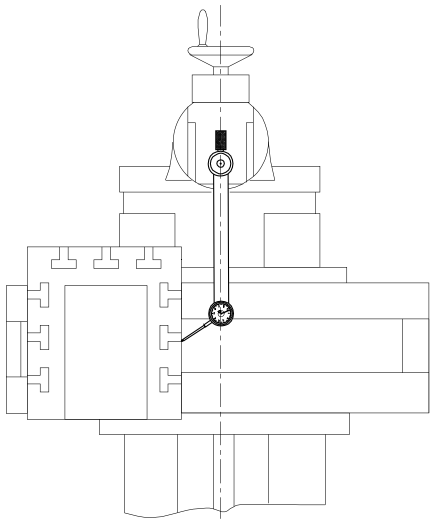
Fig 1

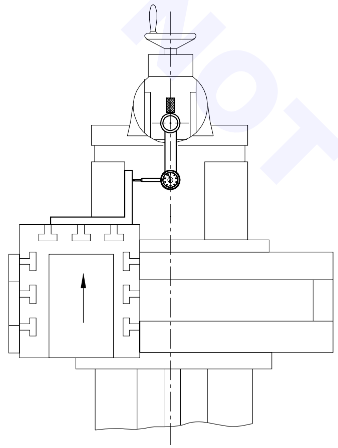
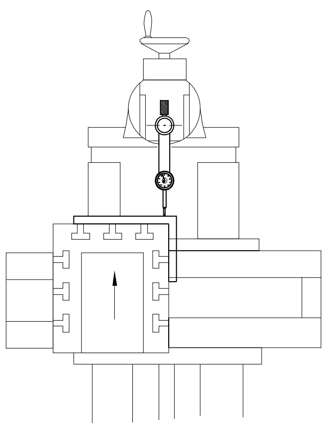


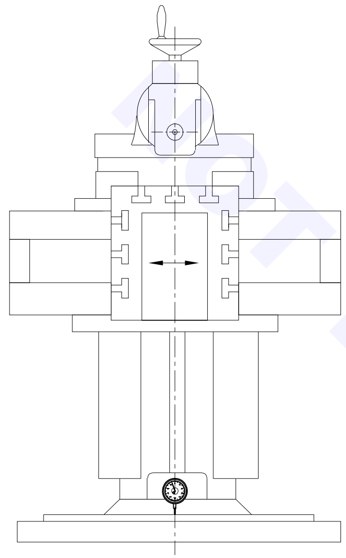
Test chart for Shaping Machines
I. Geometrical Tests

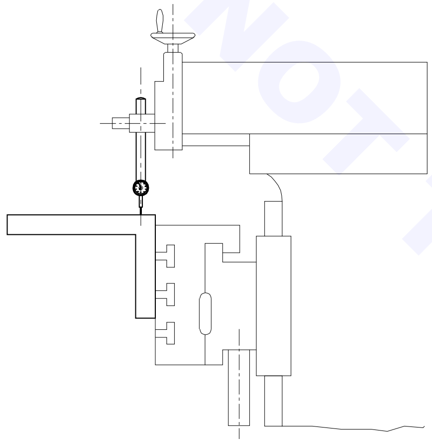
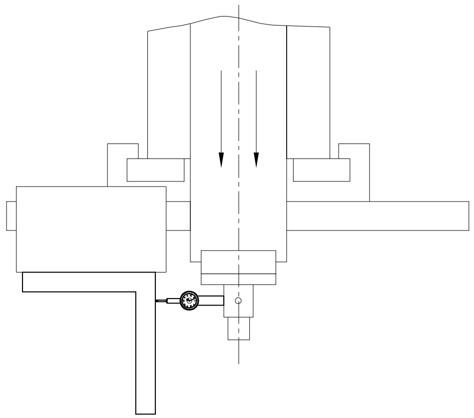
Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
1		Measurement of flatness of table top face	Spirit level and gauge blocks	Set the table in the central position. Place spirit level on top face on gauge blocks. Readings shall be recorded in longitudinal and transverse directions at various position (Note : Maximum distance between two successive position of level shall be between to the area of top face)	0.04 for 1000 mm Top face shall be concave only	
2		Measurement of parallelism of table top face to its transverse movement	Straight edge dial gauge	Set the straight edge in the direction of transverse movement. Mount the dial gauge on the ram. Move the table in the transverse direction. Note the readings of dial gauge. Note : the straight edge should be placed at mimimum 3 positions on the table top face (that is two ends, and centre) and readings noted.	i. 0.02 for 300 mm ii. Maximum 0.04 over entire movement of table.	

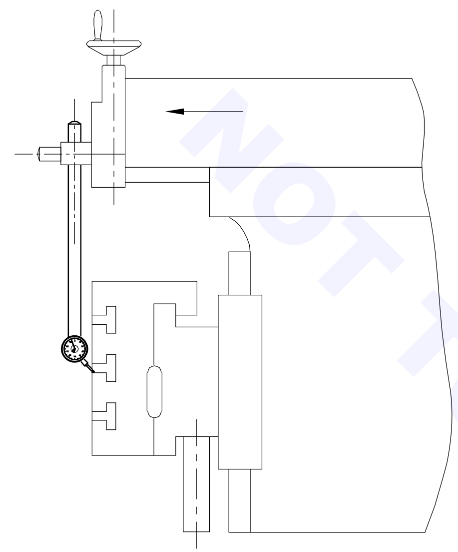
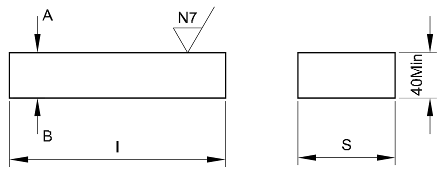
Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
3		Measurement of parallelism of table top face to the ram movement	Straight edge and dial gauge	Set the table in central position and ram to the end of the stroke position Mount straight edge on the table top face in the direction of movement of ram alternatively on the left and right side of table. Mount dial gauge on the ram. Move the ram and note the readings	i. 0.02 for 300 mm ii. Maximum 0.04 over the entire length of table. Table shall rise towards free end only.	
4		Measurement of parallelism of table side face to the movement of ram	dial gauge	Mount the dial gauge on the ram. Move the ram through the length of table by hand. Note the readings on dial gauge. Readings should be recorded at 3 position - 2 ends and centre. Repeat the process for other side	0.03 per 300 mm. Maximum 0.05 on entire length of table	

Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
5		Measurement of parallelism reference 'T' slot on top face to the movement of ram	Dial gauge	Set the dial gauge on the ram and measure the readings by moving the ram slowly through entire stroke length	i. 0.02 for 300 mm ii. Maximum 0.04	
6		Measurement of parallelism of reference 'T' slot on side face - to the movement of ram. (only for Tables with horizontal slots)	Dial gauge	Set the dial gauge on the ram and note the readings by moving ram slowly and through entire length	0.03 per 300 mm. Maximum 0.06 The slots to rise towards free and of table only	

Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
7		Measurement of squareness of table top face to its vertical movement (As well as to vertical travel of tool slide)	Dial gauge and square	Bring the table to its lower most position. Mount dial gauge on ram set the square on the top face. i. Move the table invertical direction and note the dial gauge readings ii Move the tool post by hand in vertical direction down and then up. Note the readings on dial gauge.	i. 0.02 for 300 mm ii. Maximum 0.05	
8		Measurement of squarness of side face of table to its transverse movement	Dial gauge and square	i. Set square on one of the side faces. Set dial gauge on ram and move the table in transverse direction. Note the dial gauge reading. ii Replace the procedure for other face.	0.02 per 300 mm. Maximum 0.06	

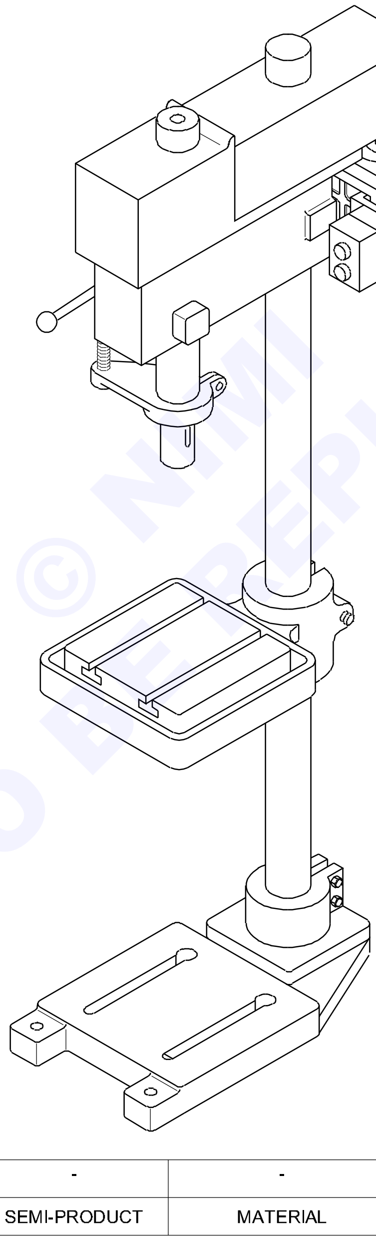
Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
9		Measurement of parallelism of guideways for table support to the transverse movement of table (Test shall be applicable to machines with table support)	Dial gauge and square	Set the dial gauge on table bottom and/ or front face. Remove table support. Move the table in the transverse direction and note the dial gauge reading.	0.03 per 300 mm Maximum 0.05.	

Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
10	 	Measurement of squareness of table fixing face to the ram movement (For machines with detachable tables only) a In vertical plane b In the horizontal plane	(a and b) Dial gauge and square	a Set the square on the fixing face, set dial gauge on the ram. Move the ram. Note the dial gauge readings. b Set the square on the fixing side face, set dial gauge. Move the ram and note the dial gauge readings.	a 0.02 per 300mm measuring ram of square to rise towards the free end only. b 0.03 per 300 mm	

Sl. No.	Figure	Object	Measuring Instruments	Instructions for Testing	Permissible Deviations	Actual Error
11		Measurement of parallelism of 'T' slot in table carriage to its transverse movements. (For machines with detachable tables only)	Dial gauge	Set the dial gauge on ram and engage pointer vertically on 'T' slot. Move table carriage and note the dial gauge readings. (If 'T' slots are not provided locating face shal be checked).	i. 0.03 for 300 mm ii. Maximum 0.04	
12		Measurement of parallelism of machined surface A to the bearing surface B.		i. The bottom face B shall be properly machined; if necessary shall be scraped. Machined face A with finishing cut. ii Note readings with micrometers at several points along length and width of work piece.	0.03 per 300 mm	

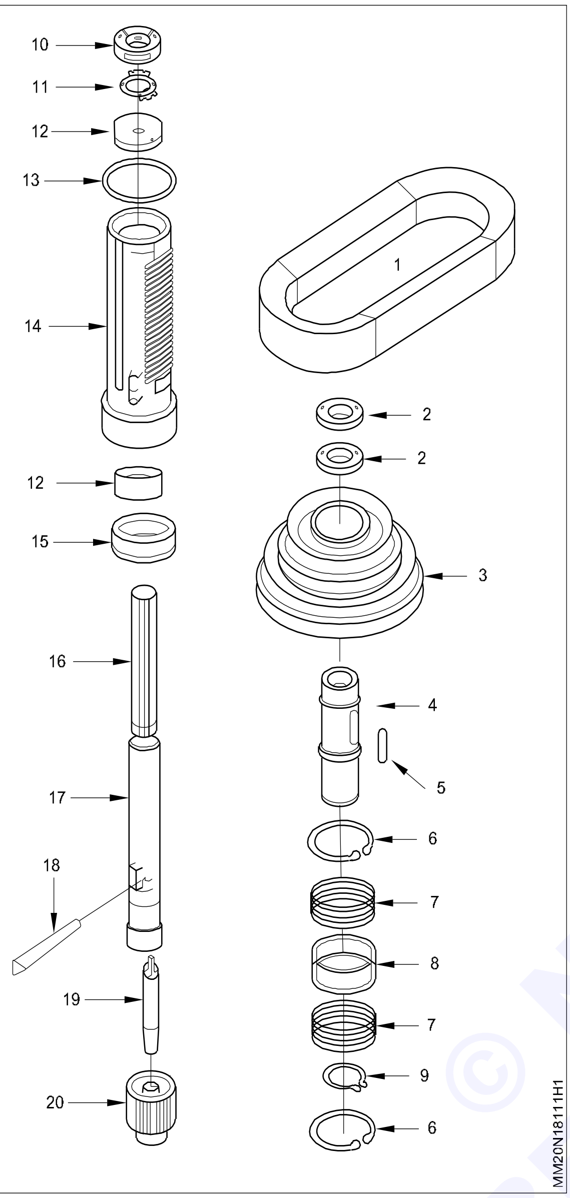
Dismantling, checking and assembly of various part of drilling machine such as motor, spindle head, gear box & arm

Objectives : At the end of this exercise you shall be able to
- **dismantle the spindle and spindle pulley from drilling head**
- **clean and inspect the parts for worn out and damage**
- **assemble the spindle and spindle pulley**
- **test the spindle and spindle pulley for proper function.**



-	-	-	-	-	-	1.8.111
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DISMANDLING CHECKING AND ASSEMBLING OF VARIOUS PART OF DRILLING MACHINE SUCH AS MOTOR,SPINDLE HEAD, GEAR & ARM**				DEVIATIONS	TIME 10hrs
					CODE NO. MM20N18111E1	

Fig 1



Parts

1 'V' Belt

2 Nut

3 Spindle pulley

4 Feather key

5 Spindle hub (Internal splines)

6 Internal circlip

7 Bearing

8 Spacer for bearing

9 External circlip

10 Nut

11 Washer

12 Bearing

13 O-Ring

14 Spindle sleeve

15 Thrust bearing

16 Splines on spindle

17 Spindle

18 Wedge slot

19. Chuck arbor

20. Drill chuck

Job sequence

- Remove the drill chuck and arbor (Part no 20 & 19) from the spindle.
- Switch off the machine and remove the belt guard.
- Remove the 'V' belt (Part no 1) from the pulley.

Removal of spindle pulley and Hub assembly

- Loosen the nuts (Part no 2) from the spindle hub. (Part no 5)
- Remove the stepped 'V' pulley (part no 3) from the spindle hub.
- Remove the feather key (part no 4).
- Remove the internal circlips (part no 6) from spacer (part no 8).
- Remove the external circlip (Part no 9) from the end spindle hub (part no 5).
- Remove the spindle hub and bearings(part no 7) from spacer.

Using aluminium or copper rod to avoid damage of hub and bearings.

Removal of spindle sleeve

- Remove the pinion with shaft from the machine.
- Straighten the toothed washer (Part no 11)
- Loosen and remove the nut (Part no 10) from spindle (Part no 17)
- Remove the toothed washer from the spindle.
- Remove the bearings (Part no 12) from the spindle sleeve (Part no 14)
- Remove the O - Ring (Part no 13)

- Remove the spindle sleeve. (Part no 14)
- Remove the spindle (Part no 17) from the spindle sleeve.
- Remove the thrust bearing (Part no 15) from spindle using hydraulic press.
- Clean all the dismantled parts and dry it.
- Keep all the disassembled parts in a separate tray in proper order while dismantling.

Identification of worn out and damaged parts

- Check all dismantled parts of spindle and pulley, thoroughly and list out the damaged, worn out parts and fill up the table given.

Sl. No.	Name of the parts	Remarks
1.		
2.		
3.		

- Replacement of the worn out and damaged parts assemble the spindle and pulley.
- Assemble all the parts of the spindle and pulley in the reverse order and apply, grease, oil at necessary parts.

Care should be taken while fixing new bearings and the circlips.

- Fix the 'V' belt and adjust to proper tension.
- Mount the belt guard.

Test run the machine

- Switch on the power supply.
- Check the run out of the spindle by using lever type dial test indicator with magnetic stand.
- Run the machine at slow, medium and high speed atleast 5 minutes.
- Listen if any abnormal noise hearing from spindle assembly.
- Check if any heat generating in the spindle assembly, if so rectify the fault.

— — — — — — —

Measure current, voltage and resistance using simple ohm's Law circuit and familiarizing multimeter

Objectives : At the end of this exercise you shall be able to
- **identify available ranges in the given multimeter**
- **set controls, choose suitable range for measurement**
- **measure voltages and currents.**

Requirements

Tools/Equipments/Instruments

- Regulated Dual DC power supply unit 0-30V, 5 Amps per batch -1 No .
- Multimeter with probes -1 No.

Materials/Components

- AA size (R-6), Zinc-Chloride 1.5V, primary cell - 2 Nos.
- Cell holder to hold 2 Nos. of AA cells - 1 No.

PROCEDURE

TASK 1: **To measure DC voltage**

1 In the given multimeter, check the available ranges, scales and other information and record these details in O&T sheet.

2 Check the symbol on meter indicating its placement position. Carryout mechanical zero setting of the meter.

3 Connect the meter probes ensuring proper colour of probe at meter terminals.

4 Get your work done in Steps 1,2 and 3 checked by your instructor.

5 Record the rated output voltages of the given pen torch (AA size) cells in O&T sheet.

6 Set the meter range switch to measure cell voltages and choose the scale for taking readings. Record the chosen range position and scale in O&T sheet.

7 Measure and record the voltage of each cell.

8 Place the two cells in the cell holder as shown in Fig 1.

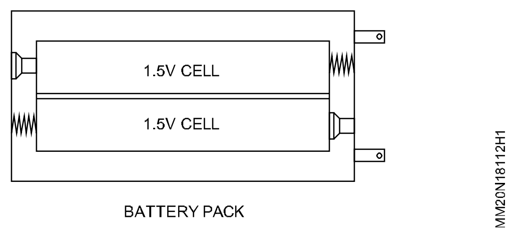
In the cell holder, the cells will be in series. Therefore across the terminals of the cell holder, the voltage will be sum of the voltages of each cell.

9 Set the meter range suitable to measure the cell pack voltage. Measure and record the voltage of the cell pack.

10 Set the meter range to measure the unknown DC voltage from the regulated DC power supply unit (RPSU) set by your instructor.

11 Measure the output voltage of RPSU. Change the set range if necessary to measure the set RPSU voltage more accurately. Record the measured voltage in O&T sheet.

Fig 1



Readings taken on meter will be more accurate, when the range selected is such that the pointer is pointing around the middle of the scale.

12 Ask your instructor to change the set RPSU output voltage and repeat steps 10 and 11.

13 Get your work checked by your instructor.

— — — — — — —

TASK 2: **To measure DC current**

The procedure given below should be carried out only after your instructor connects a component known as Resistor at the one of the terminal of the RPSU.

Never connect a current meter directly across the output terminal of RPSU. This will damage the meter as well as the RPSU.

1 Set the multimeter to measure an unknown DC current.

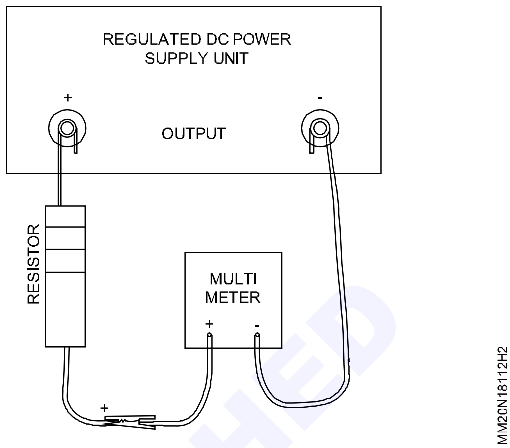
2 Connect the meter terminals as shown in Fig 2.

3 Measure and record the readings shown by the meter. Change the set range if necessary to measure the current more accurately. See note given at Step 11 of Task 1.

4 Ask your instructor to change the value of resistor such that a different valve of current flows. Repeat steps 1,2 and 3.

5 Get your work checked by your instructor.

Fig 2



Observation and Tabulation Sheet

1	Name of the given multimeter & model number:
2	Manufacturers name :
3	Position in which the meter should be kept during measurement:
4	List the input sockets available on the meter. i ii iii

5 List the available measuring ranges and scale marking on the meter:

DC voltage ranges

No. of ranges	Range setting	Suitable meter scale marking	Value of one ssd
Sample	1V	0-100	0.2 Volts

Resistors ranges

No. of ranges	Range setting	Value of one ssd

AC voltage ranges

No. of ranges	Range setting	Suitable meter scale marking	Value of one ssd

DC current ranges

No. of ranges	Range setting	Suitable meter scale marking	Value of one ssd

AC current ranges

No. of ranges	Range setting	Suitable meter scale marking	Value of one ssd

6 Give the maximum and minimum DC voltage that can be measured using the given meter.

Max. Min.

7 Give the maximum and minimum DC current that can be measured using the given meter:

Max. Min.

8 Give the maximum and minimum AC voltage that can be measured using the given meter:

Max. Min.

9 Give the maximum and minimum AC current that can be measured using the meter:

Max. Min.

10 Measured voltage of AA cells :

Cell 1 : _______ V Cell 2 : _______ V

11 Measured voltage of cell pack : _______ V

12 Measured voltages of RPSU output:

First setting : _______ V

Second setting : _______ V

13 Measured currents:

First setting : _______ V

Second setting : _______ V

— — — — — — — —

Soldering Techniques

Objectives : At the end of this exercise you shall be able to
- **solder lug in an aluminium cable**
- **solder copper conductor joints using a soldering iron and resin-cored solder.**

Requirements

Tools/Instruments

- Combination pliers 200 mm - 1 No.
- Electric soldering iron 60W, 250V, 50Hz. - 1 No.
- File flat, bastard 150mm - 1 No.

Materials

- Simple twist joint as prepared - 1 No.
- Sandpaper '00' grade - 9 sq.cm.
- Rosin cored solder - 25 gms.
- Cotton cloth 30cm x 30cm - 1 piece
- Wire brush - 1 No.
- Soldering iron stand with cleaning pad - 1 No.

PROCEDURE

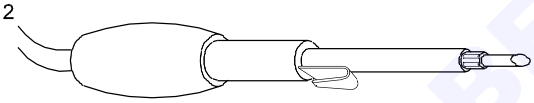
A finished soldered joint will look as shown in Fig 1.

Fig 1

SOLDERED JOINT

1 Select a 60W, 230V AC 50 Hz. soldering iron (Fig 2) and ensure that the iron has no physical damage, the body is well insulated from the element and is of the correct voltage and power rating.

Fig 2

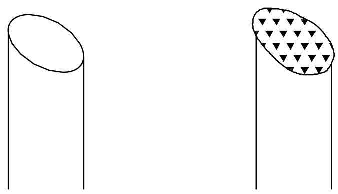


ELECTRIC SOLDERING IRON

A soldering iron should show continuity between its terminals. Insulation resistance between the terminal and the body should not be less than 2 mega ohms. Report to your instructor in case the insulation resistance is less than 2 mega ohms. Do not use the iron unless cleared by your instructor.

2 Check the bit (Fig 3) to see whether the surface is smooth and clean.

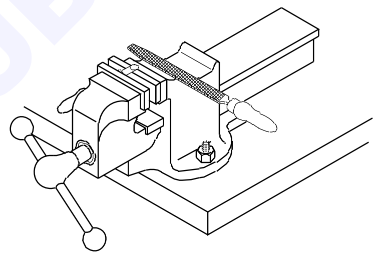
Fig 3



SOLDERING BITS

3 If found corroded, file the tip with a flat file, so that the surface is smooth and clean. (Fig 4)

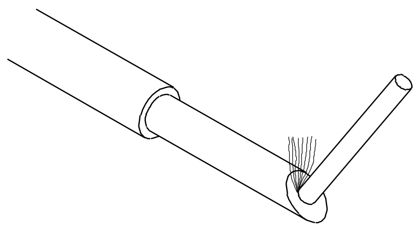
Fig 4



4 Connect the soldering iron to the supply and switch it 'ON'.

5 When the bit becomes sufficiently hot, apply a small quantity of resin cored solder, and tin the bit. (Fig 5)

Fig 5



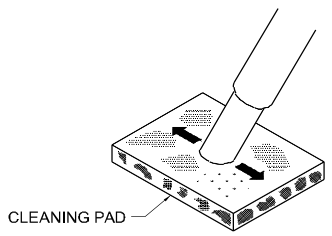
TINNING THE SOLDERING BIT

If the bit is not completely and evenly covered with solder, clean and tin it again.

Never flick excess solder off the bit. The hot solder may cause burns to someone or fall into part of the work, and cause a short circuit.

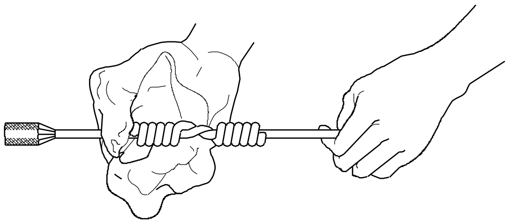
6 Wipe the bit gently on the cleaning pad to remove excess solder as shown in Fig 6.

Fig 6



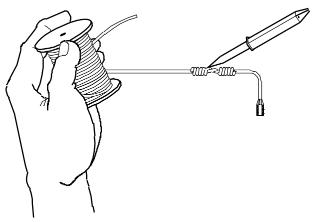
7 Clean the joint to be soldered with the help of sandpaper 'O O', grade as shown in Fig 7, and wipe the dust with a wire brush.

Fig 7



8 Keep the soldering iron bit on the joint and heat it for soldering as shown in Fig 8.

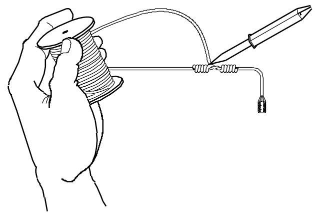
Fig 8



SOLDERING A SMALL SIZED JOINT

9 When the joint is heated, keep the resin cored solder on the joint and allow it to melt as shown in Fig 9.

Fig 9

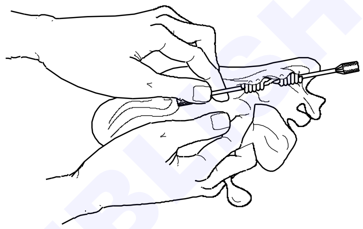


SOLDERING A SMALL SIZED JOINT

10 Melt the solder with the heat of the bit and make sure the solder flows freely and evenly on the joint.

11 Remove the soldering iron. use cotton cloth to wipe off the excess solder from the surface of the joint when it is still hot as shown in Fig 10.

Fig 10



12 Allow the joint to cool naturally. Do not blow air for cooling.

A shining solder surface ensures a good soldering. Do not move the joint until the solder solidifies.

Step up and step down transformers

Objectives : At the end of this exercise you shall be able to
- **identify the terminals of HT and LT winding**
- **connect step up transformer in single phase supply and measure the voltage**
- **connect step down transformer in single phase supply and measure the voltage.**

Requirements

Tools / Instruments

- Voltmeter M.I. 0 - 250/300V - 2 Nos
- Ohmmeter (0 - 500 ohms) - 1 No.

Materials

- Connecting cables - as reqd.

Equipment / Machines

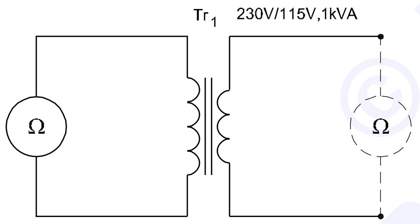
- Single phase transformer 415/230 volts, 1 KVA - 1 No.

PROCEDURE

1 Find out the corresponding terminals of two windings. (HT & LT) with ohm meter as shown in Fig 1.

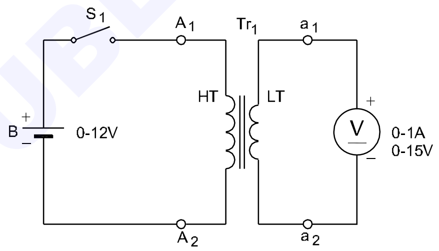
2 Determine HT and LT winding be measuring resistance with the ohm meter.

Fig 1



CIRCUIT FOR IDENTIFICATION OF TERMINALS OF SINGLE PHASE TRANSFORMER

Fig 2



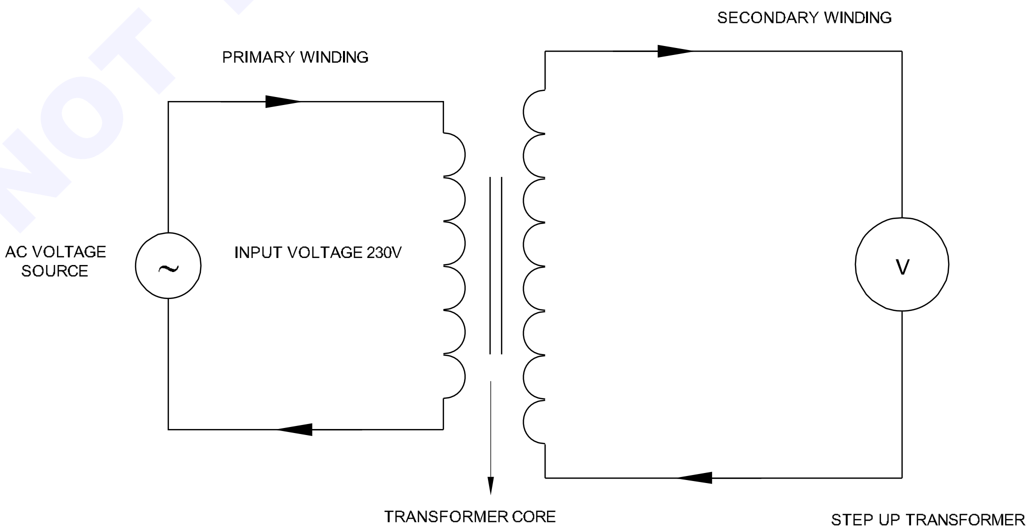
NOTE:
INSTEAD OF THE BATTERY DC STABILIZED POWER SUPPLY CAN BE USED

CIRCUIT FOR IDENTIFICATION OF POLARITY OF TRANSFORMER

LT windings will have low resistance mark accordingly.

3 Connect LT winding to the AC single phase 230 V and measure voltage on the HT winding and record the same in the Table - 1.

Fig 3



4 Switch the supply and disconnect the meters.

Table - 1

Step up Transformer	
LT	HT
230V	

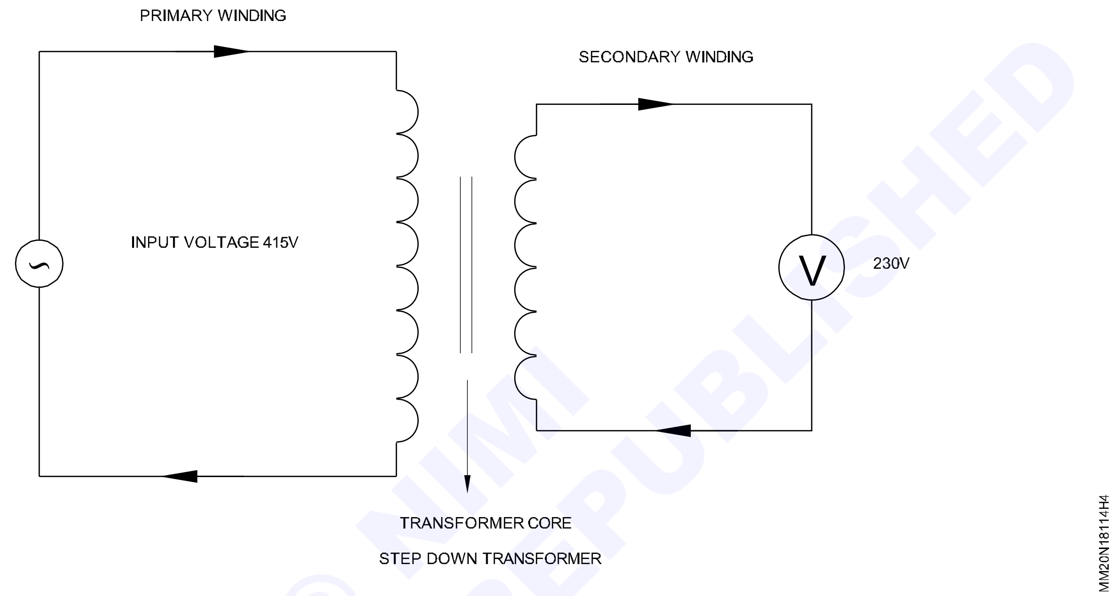
5 Then connect AC 3 phase 415V to the HT winding and measure voltage on the LT winding and record the same in Table - 2.

6 Disconnect the supply and keep all the meters and Transformer in the original plate.

Table - 1

Step down Transformer	
HT	LT
415V	

Fig 4



Working with solenoids and relays

Objectives : At the end of this exercise you shall be able to
- **check the continuity of solenoid winding**
- **test the solenoid**
- **identify the parts of relay**
- **ascertain the operation of the magnetic and thermal relays.**

Requirements

Tools / Instruments

• Packer metallic	- 1 No.
• DC ammeter 0 - 1A - 1 & 2A	- 1 No.
• DC voltmeter 0 - 30 VOC - 2A	- 1 No.
• Solenoid pulling power test Jig	- 1 No.
• Multimeter or ohm meter	- 1 No.
• Milliammeter 100 mA DC	- 1 No.

Equipments / Machines

• DC magnetic relay 6 V or 12 V	- 1 No.
• Variable DC power supply 0-30 V-2A	- 1 No.

Materials

• PVC flexible cable 14/0.2 mm	- 5 m
• Resistor 470 ohms, 5w	- 1 No.
• PVC insulated copper cable 45 mm 250 V graze	- 1 No.

PROCEDURE

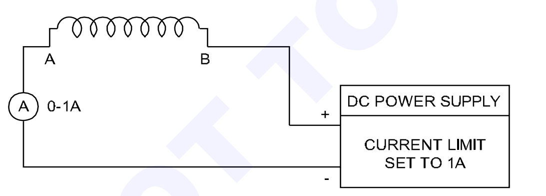
TASK 1: **Test solenoid**

1 Solder 0.5 meters wires at terminals A and B of the solenoid.

2 Place the solenoid on a wooden board and clamp the solenoid as shown in Fig 2.

3 Set current limit of PSU to 1A. Set output voltage to Zero. Switch OFF PSU. Make circuit connections as shown in Fig 1.

Fig 1



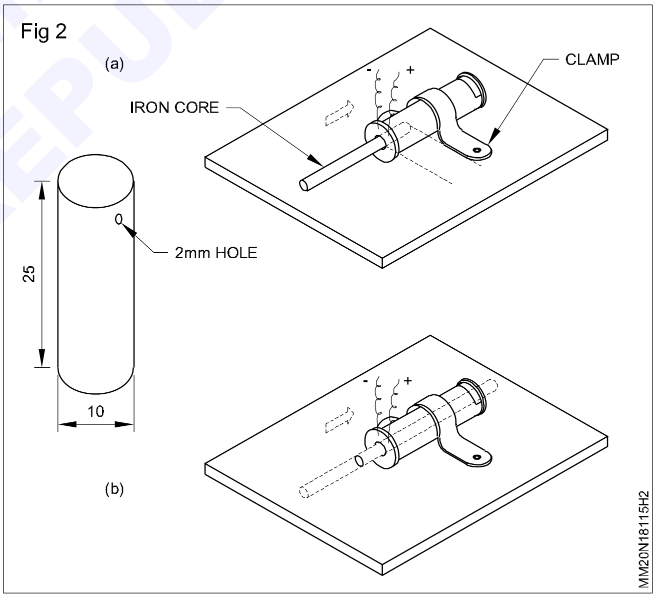
4 Place a soft iron rod slightly inside (10 to 15mm) the hole of the solenoid as shown in Fig 2a.

In case a 6mm soft iron rod is not available, use a thick & lengthy iron nail.

5 Switch ON PSU. Increase the output voltage of the PSU gradually from 0 volts till the soft iron rod gets attracted by the solenoid as shown in Fig 2b. Record the circuit voltage and current in O & T sheet.

Observe that the pulled iron rod rests at the center along the length of the solenoid (refer lesson).

Fig 2



If the soft iron is not attracted even when the circuit current is more than 250 mA, switch OFF PSU and consult your instructor.

6 Pull-out the iron rod slightly from the solenoid and release it. Check if the rod is pulled back inside the hole.

7 Repeat steps 5 and 6 a few more times till you are satisfied about the working of the solenoid. Get it checked by your instructor.

8 Switch OFF PSU. Remove circuit connections. Take out the solenoid by removing the clamp.

Observation & Tabulation Sheet

1 Total number of turns of coil :

2 Gauge of wire used :

3

Sl. No.	Applied DC voltage to solenoid	Current consumed by the solenoid	Initial reading of the spring balance (W_1)	Final reading of the spring balance (W_2)	Pulling power of the solenoid (W_2 - W_1)
1	12V				
2	15V				

4 Complete the sentences given below :

a With 12V DC applied, the mmf developed is __________ A.t.

b With 15V DC applied, the mmf developed is __________ A.t.

c The pulling power of the solenoid __________ as the mmf developed is increased.

d The pulling power of the solenoid can be increased by increasing the __________ and/or __________.

— — — — — — —

TASK 2: **Identify a relay**

1 Collect the relays along with the instruction booklet.

TABLE - 1

Data of the relay

Type of relay ____________________

Coil Voltage ____________________

Relay range ____________________

Back up fuse rating ____________________

2 Determine by inspection the terminal connection of the coil and the number contacts.

3 Also identify the normally open and closed contacts by using ohmmeter or multimeter.

4 Record the relay and contact terminal number in Table 2.

5 Draw the connection diagram of the relay in your record.

6 Measure the coil resistance and record in Table 2.

— — — — — — —

TASK 3: **Connect a relay in a circuit & test for its working**

1 Connect the relay as per diagram shown in Fig 1.

2 Adjust the power supply voltage to minimum.

3 Switch on the switch 'S'.

4 Slowly increase the DC voltage till the ohmmeter/ multimeter connected across the normally open contact shows deflection.

5 Observe the minimum current (pick up current) required to activate the relay and enter the value in Table 2.

6 Slowly reduce the voltage of the power supply till the ohmmeter/multimeter connected across the normally open contact shows infinity deflection.

7 Observe the minimum current (reset current) required to reactivate the relay and enter the value in Table 2.

8 Repeat steps 2 and 7 and verify the previous pick up and reset reading.

9 Repeat your working steps if necessary until your readings are constant.

TABLE - 2

	Relay characteristics	
Function	**Terminal connection**	**Relay characteristics**
Relay coil		Coil resistance __________ ohm
Normally open contacts		Pickup current __________ mA
Normally closed contacts		Reset current __________ mA

Working of motor and generators

Objectives : At the end of this exercise you shall be able to
- **connect 3-phase motor with the starter**
- **connect a DC shunt generator, field regulator, ammeter and voltmeter**
- **start the 3-phase AC motor**
- **adjust the field regulator and build up DC voltage**
- **determine combined efficiency of the M.G set.**

Requirements

Tools / Instruments

- Electrician Tool kit - 1 set
- Voltmeter MI 0-500V - 1 No.
- Ammeter MI 0-15A - 1 No.
- Ammeter MC 0 to 2.5A - 1 No.
- Ammeter MC 0 to 15A - 1 No.
- Voltmeter MC 0 to 250 volt - 1 No.
- Power factor meter 500V 15A 0.5 lag to 0.5 lead - 1 No.
- Tachometer multi-range 0-300/1000/3000 rpm - 1 No.

Equipment / Machines

- 3-phase squirrel cage induction motor 5 HP, 415V, 50 Hz - 1 No.
  - with star-delta starter 415V, 16A
  - DC shunt generator - 5 KW 220V with field regulator
- Lamp bank of 5 KW - 240 V - 1 No.

Materials

- ICDT switch 16A 415V - 1 No.
- ICTP switch 16A 415V - 1 No.
- Lamp holder pendent - 2 Nos.
- Lamp 240V, 60 or 100 watts bulb - 2 Nos.
- Stranded PVC insulated wire 7/1.5 aluminium cable - 4 m
- D.P.S.T. Switch 16A, 240V - 1 No.
- PVC insulated connecting cable - as reqd.
- ICDP switch 16A 240V - 1 No.
- ICTP switch 16A 415V - 1 No.
- Graph sheet - as reqd.

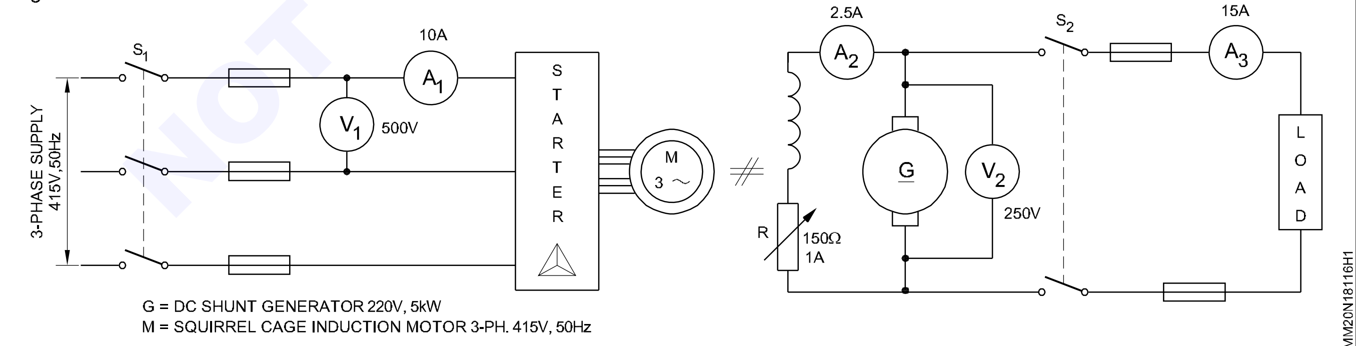
PROCEDURE

TASK 1: **Start, run and load a M.G. set**

1 Couple the 3-phase induction motor with the DC shunt generator and check for proper alignment.

2 Connect the AC motor and generator as shown in Fig 1.

Fig 1



Keep the field regulator at 'Zero/Minimum' position. Keep the load switch 'S_2' open.

3 Start the motor by operating star/delta starter (Y/Δ - starter) and note down the reading of V_2.

4 Slowly decrease the DC generator field resistance and increase the exciting current until the generated voltage builds up to its rated value.

5 Observe the voltmeter reading.

Take care not to exceed the excitation current beyond its rated value.

6 Read and record the excitation current and the induced voltage.

Excitation current : ____________________ A
Voltage : ____________________ Volt

7 Read the input current and AC supply voltage on no-load operation of M.G set.

Input current ______________________ A (AC)

Ac supply voltage V between lines ________

8 Calculate no-load input to M.G set.

9 Gradually reduce the excitation current to zero ampere.

10 Switch 'off' the motor, operating the stop switch of the starter and the supply switch (S_1).

11 Compare the no-load input to M.G set with that of no-load input of motor only in the earlier experiments on the AC machines. Why is there a difference?

— — — — — — —

TASK 2: **Determine the combined efficiency of the M.G. set**

1 Connect the AC motor and generator as shown in Fig 1.

Keep the field regulator at a position to include zero resistance in the circuit. Keep switch S_1 and S_2 in 'off' position.

2 Start the AC motor. Measure the speed using a tachometer.

3 Build up the DC generator terminal voltage to its rated value and observe the voltmeter (V_2) reading.

4 Switch 'ON' the load switch S_2.

5 Gradually increase the load by switching 'on' the lamps in steps up to the rated capacity of MG set.

6 Measure the speed of the generator for each load condition and record in Table 1.

7 Record input current, voltage and power factor in Table 1. Read and record the load current and terminal voltage of generator in Table 1.

8 Switch 'OFF' the load in steps and open the load switch S_2.

9 Calculate the input power.

10 Calculate the output power.

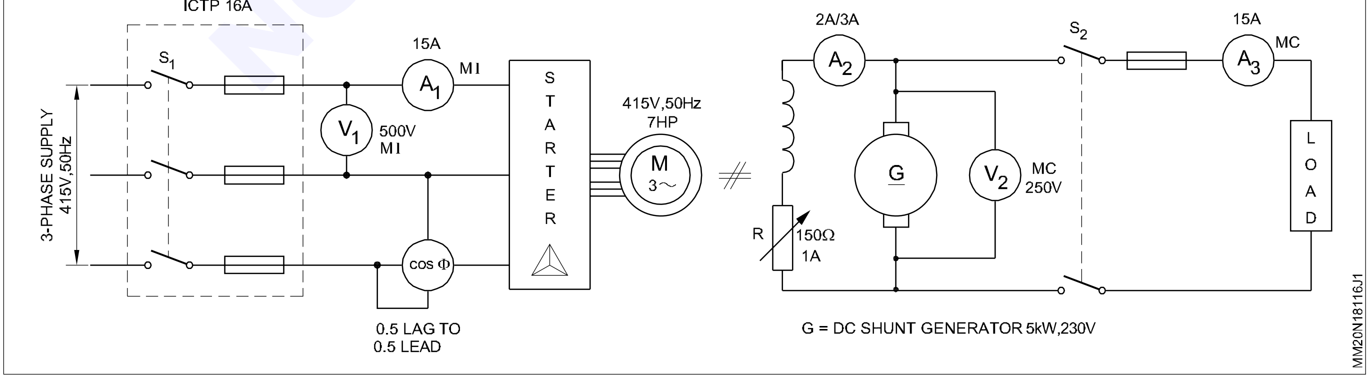
11 Calculate the total loss and the efficiency at full load.

12 Stop the prime mover of the M.G set and isolate supply.

CONCLUSION

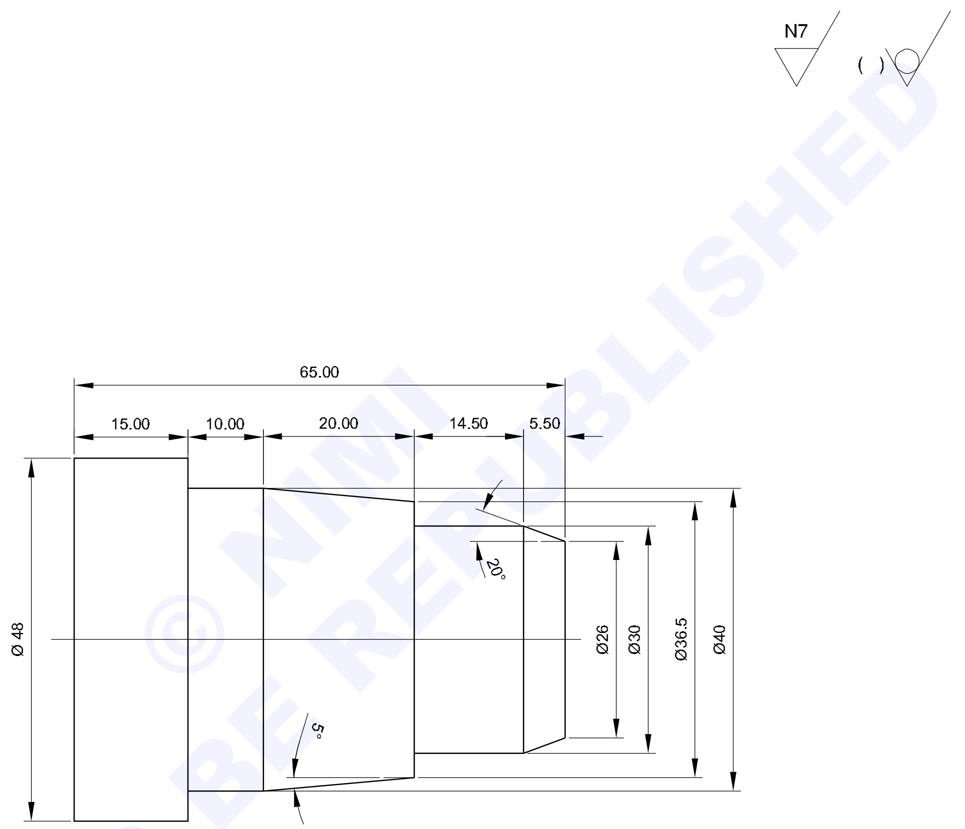
Observe from the readings in Table 1 that the terminal voltage drops with increase in load. State your reasons.

Fig 1



Perform taper turning in the lathe by different methods

Objectives: At the end of this exercise you shall be able to
- **taper turning by form tool**
- **taper turning by cross slide swiveling**
- **measure taper by vernier bevel protractor.**



1	Ø 50 X 70	–	Fe310	–	–	1.9.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**PERFORM TAPER TURNING IN THE LATHE BY DIFFERENT METHODS**	DEVIATIONS ±0.1	TIME
		CODE NO. MM20N19117E1	

Job Sequence

- Check the raw material size for the job
- Hold the job in the chuck protecting 20mm out size and true it
- Face the job
- Turn the job ϕ 48mm upto the possible length
- Reverse and hold the job ϕ 48 in chuck
- Face the job and maintain the total length 65mm
- Turn ϕ 40 to the length of 50mm
- Turn the step ϕ 30 to a length of 20 mm
- Set the angle in the compound rest for 5°
- Turn the taper by feeding the tool with the help of the top slide
- Grind the form tool for 20°
- Set the form tool on tool post perpendicular to the work axis to form taper by plunging
- Set the machine speed 1/3rd of rpm for form turning
- Feed the tool perpendicular to the axis of the work and form taper

Ensure slow, study and continuous feeding

- Deburr the job and check the angles using Vernier bevel protractor.

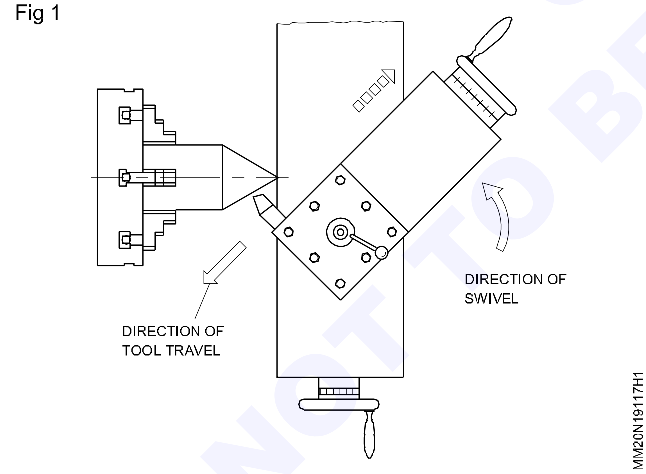
Skill Sequence

Turning taper by compound slide swiveling

Objectives : This shall help you to
- **set and swivel the top slide of the compound rest to the required taper angle**
- **set the tool in the tool post**
- **turn the taper**
- **check the taper with a Vernier bevel protractor.**

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

Fig 1



The procedure in sequence is as follows

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

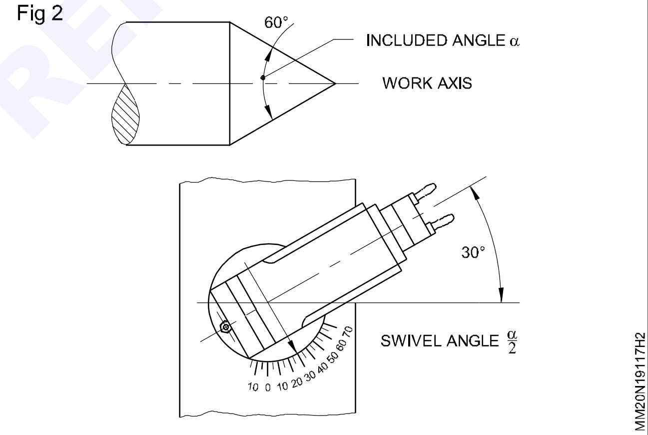
Set the machine to the required rpm

Loosen the top slide clamping nuts

Swivel the top slide to half the included angle of the taper away or towards the operator as required.

Tighten the clamping nuts firmly (Fig 2)

Fig 2



Ensure that equal pressure is exerted by the spanner for both the nuts

Fix the turning tool in the tool post to the correct centre height

Keep a minimum overhang of the tool

Position the top slide to cover the length of the taper turning

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

Lock the carriage in position

Touch the tool to the work surface during running and set the cross – slide graduated collar to zero.

Bring the tool clear off the work by the top slide hand wheel movement

Give a depth of cut by the cross – slide and feed the tool by the top slide hand wheel till the tool clears from the work

Feeding by the top slide must be uniform and continuous

Give successive cuts by the cross – slide, feeding by the top slide each time

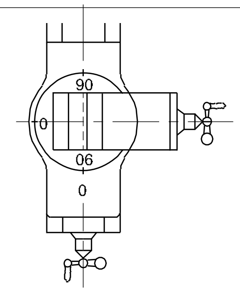
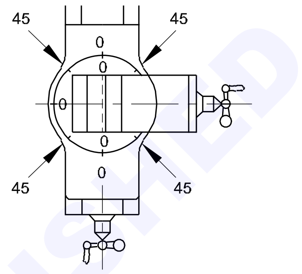
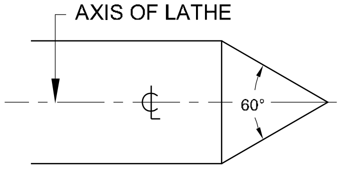
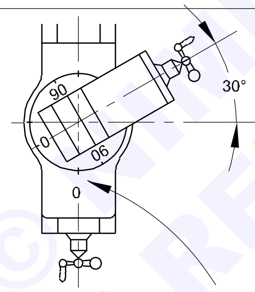
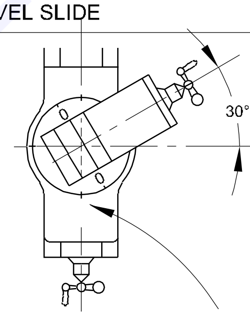
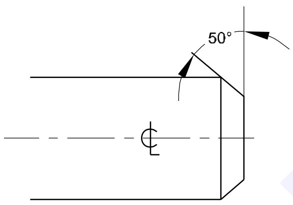
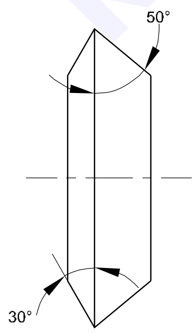
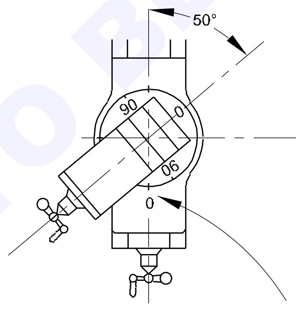
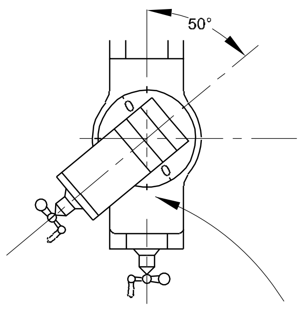
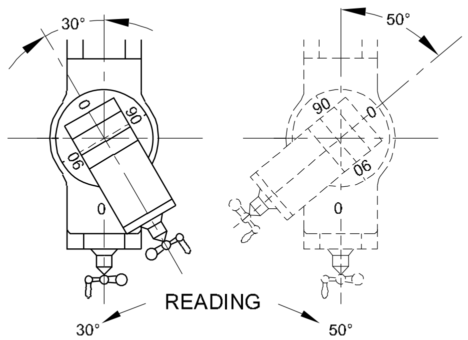
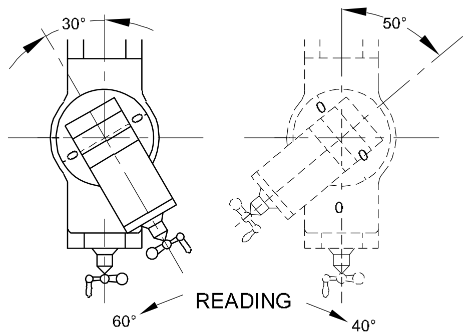
Check the angle of the turned job with a Vernier bevel protractor

Adjust the swivel if there is any difference

Continue the taper turning and finish the taper

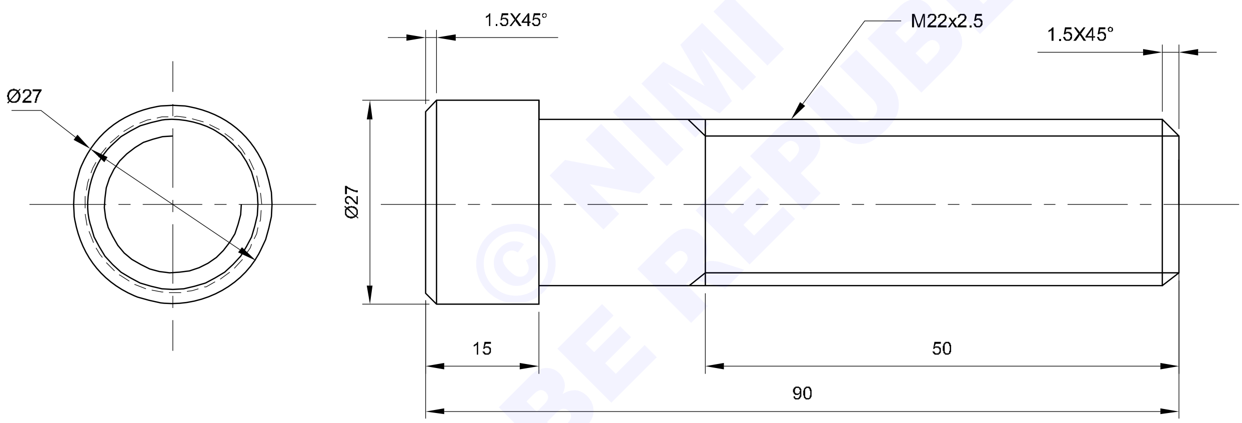
Compound rest setup for turning various angle is given in table 1.

TABLE 1

<table>
<tr><td rowspan="2">SPECIAL ANGULAR SETTING ON COMPOUND REST</td><td colspan="2">ARRANGEMENT OF GRADUATIONS ON SWIVEL SLIDE</td></tr>
<tr><td>
GRADUATED FROM 90-0-90</td><td>
GRADUATED FROM 0-45-0</td></tr>
<tr><td>EXAMPLES</td><td colspan="2">READINGS ON GRADUATED SWIVEL SLIDE</td></tr>
<tr><td>AXIS OF LATHE

INCLUDED ANGLE MEASURED IN HORIZONTAL PLANE</td><td>
READING ON SCALE 60°</td><td>
READING ON SCALE 30°</td></tr>
<tr><td rowspan="2">
ANGLE GIVEN FROM A LINE AT 90° TO AXIS OF LATHE
</td><td>
READING ON SCALE 50°</td><td></td></tr>
<tr><td></td><td></td></tr>
</table>

Perform external thread cutting operation on the lathe machine

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



1	Ø30 - 100	–	Fe 310	–	–	1.9.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PERFORM EXTERNAL THREAD CUTTING OPERATION ON LATHE MACHINE	TOLERANCE : ± 0.04mm	TIME : 8Hrs
		CODE NO. MM20N19118E1	

Job Sequence

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

Skill Sequence

Chamfering on lathe

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

Grind the tool to the given angle usually 45°.

Mount the tool and set centre height properly.

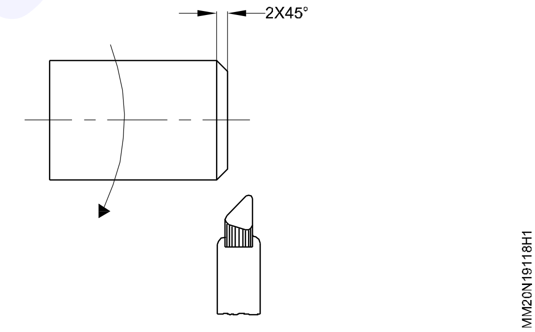
Set the speed, lock the carriage.

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

Check the length of chamfer by vernier caliper.

> **If the protruding length is greater, support with centre.**
>
> **Make sure the tool is perpendicular to the lathe axis.**

Fig 1



Grinding 60° threading tool

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

Set the pedestal grinder for tool grinding.

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

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

Fig 1

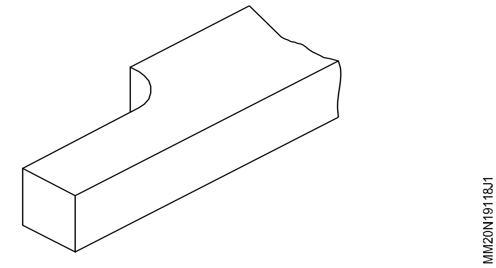
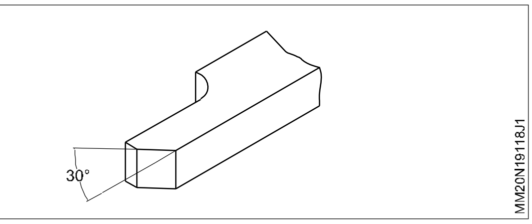
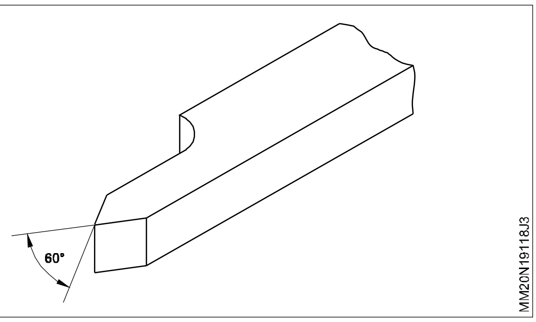


Fig 2



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

Fig 3



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

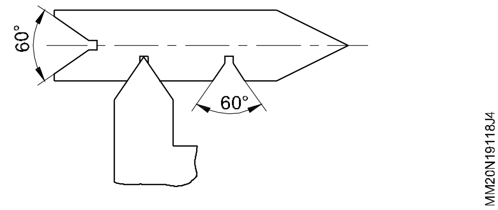
Grind 4° to 6° front clearance angle.

Finish all slides by using smooth grinding wheel.

Do not Grind Rake Angle

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

Fig 4



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

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

Safety precautions

Ensure grinding wheels are properly guarded.

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

Ensure cutting edge is visible to the operator while grinding.

Do not give too much pressure on the wheel face.

Frequently cool the tool in coolant.

Cutting 'V' thread by plunge cut method

Objective: This shall help you to

- **cut 'V' thread using a single point tool on a lathe by the plunge cut method.**

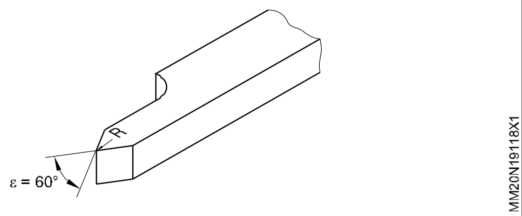
Thread has coarse and fine pitches according to their usage. Standard fine pitch threads, both external and internal, are generally cut by using taps and dies. When they are produced in large quantities, different methods are adopted on different machine tools. However, at times, it may be necessary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

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

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

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

Fig 1



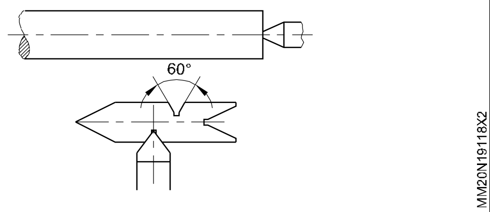
Ensure that the thread angle ground is symmetrical with respect to the axis of the tool.

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

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

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

Fig 2

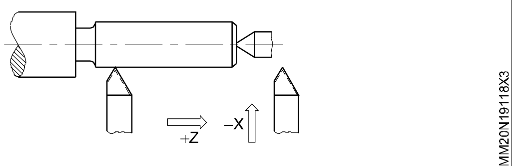


Ensure that the top slide is set at 0°, and slackness is removed by gab adjustment.

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

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

Fig 3



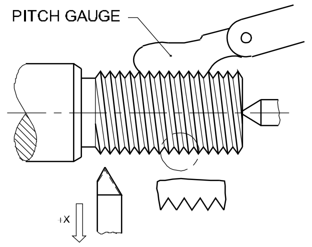
Bring the tool to the starting point and engage the half nut.

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

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

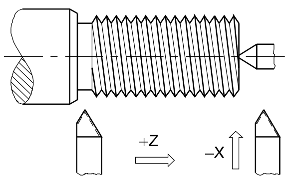
Check with the screw pitch gauge to confirm the gear box setting. (Fig.4)

Fig 4



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

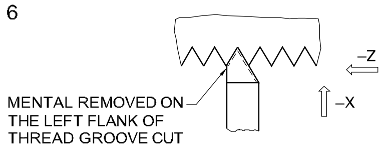
Fig 5



Give successive cuts.

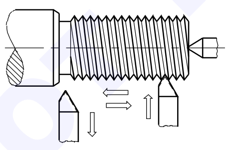
For every 3 depths of cuts by the cross-slide, give one axial cut by feeding the tool axially by half division of the compound slide. This relieves the load on the tool. (Fig.6)

Fig 6



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

Fig 7

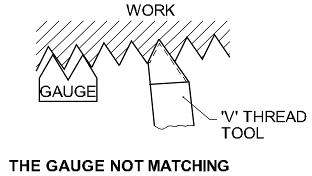


Check with the screw pitch gauge for the thread form.

Match the mating component to ensure the class of fit.

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

Fig 8



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

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

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

Fig 9

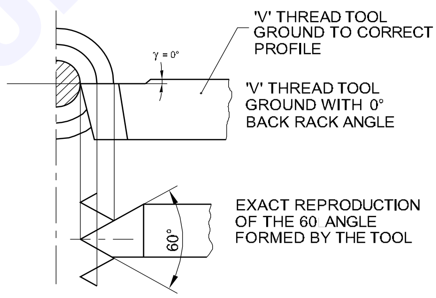
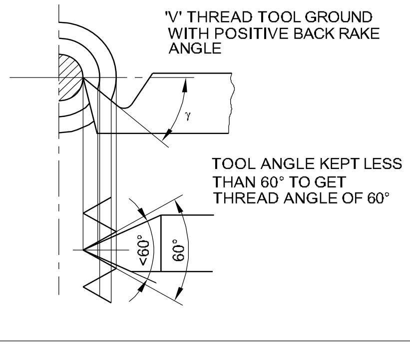


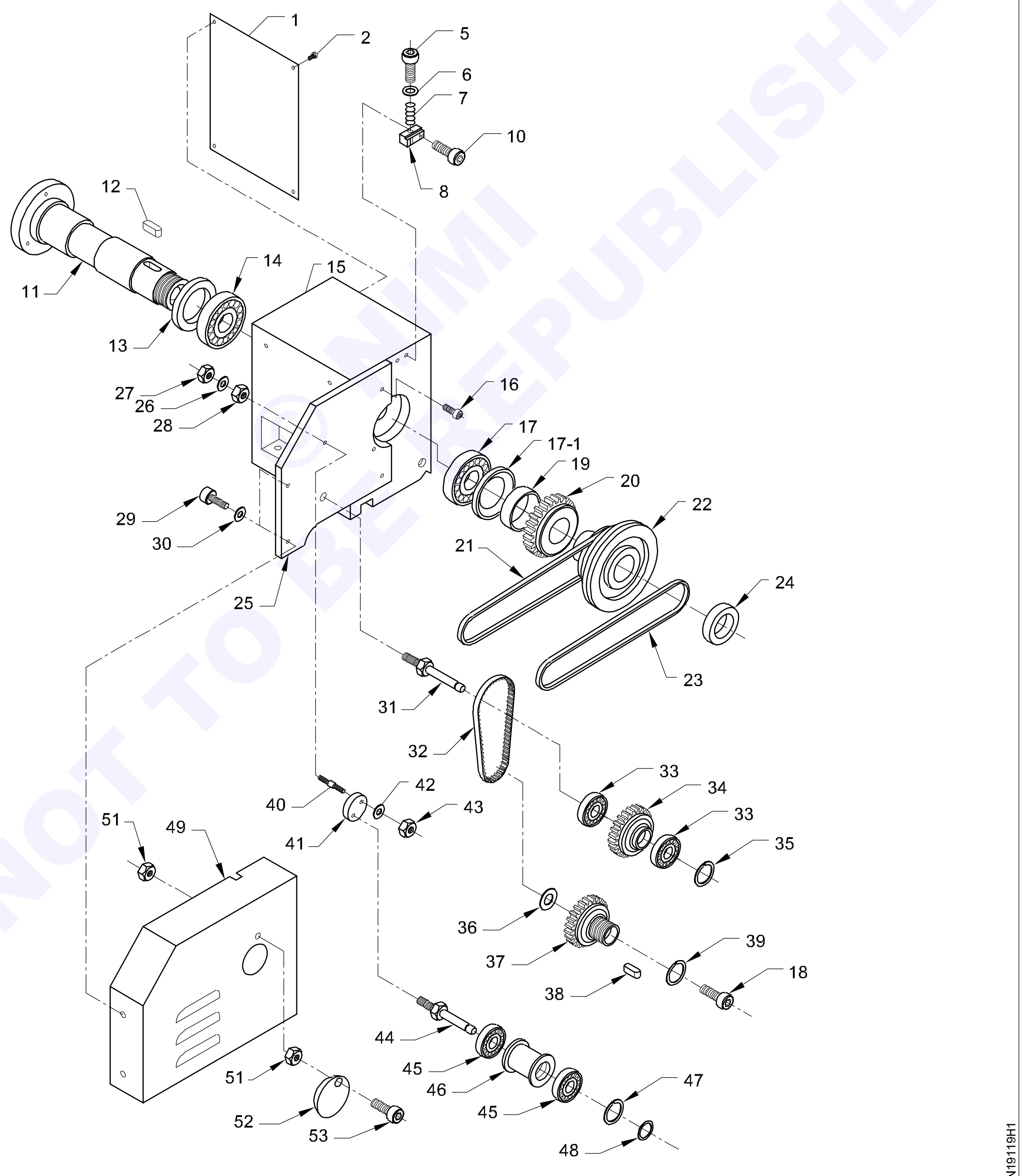
Fig 10



Dismantling and assembly of head stock, apron, saddle, tool post, tailstock removing broken studs/bolts of lathe machine

Objectives: At the end of this exercise you shall be able to
- **dismantling the gears and shaft from the head stock**
- **assemble the head stock**
- **dismantle apron unit of a centre lathe**
- **assemble the components and check for proper functioning**
- **dismantle the compound rest from the cross slide**
- **assemble and test for functions**
- **dismantle the tailstock assembly**
- **assemble the components after repair and check function of tailstock.**

Fig 1



OVERHAULING OF HEAD STOKE

Head stock parts list

Part No.	Description of item
1	Headstock Name plate
2	Phlp Hd Screw M4- 7 x 6
5	Caps Screw M6- 1 x 25
6	Flat washer 6mm
7	Compression Spring 8 x 8 x 20
8	Threaded block
10	Caps Screw M6- 1x 25
11	Spindle
12	Key 10 x 10 x 55
13	Spacer
14	Taper roller bearing 320009
15	Headstock casting
16	Cap Screw M8 - 1.25 x 20
17	Taper roller bearing 320009
17	-1 Bearing cap
18	Flip head screw M6- 1 x 20
19	Spacer
20	Gear 45 teeth
21	V belt M 29 3L 290
22	Spindle pulley
23	V Belt M32 3L 320
24	Spanner nut M 30 - 3.5
25	Bracket plate
26	Lockwasher 10mm
27	Hexagon nut M10 1.5

Part No.	Description of item
28	Flat washer 10mm
29	Capscrew M5 - 0.8 x 10
30	Flat washer 30mm
31	Idler shaft
32	Timing belt
33	Ball bearing 6001 2RS
34	Idler pulley
35	INT retaining ring 12mm
36	Pulley flat washer
37	Motor pulley
38	Key 6 x 6 x 6 x 40
39	INT retaining ring 10mm
40	Threaded handle rod
41	Pivot bracket
42	Flat washer 10mm
43	Hexogan nut M 10 - 1.5
44	Tensioning shaft
45	Ball bearing 6001 2 RS
46	Ideler roller
47	INT retaining ring 28 mm
48	Ext retaining ring 12 mm
49	Changer gear cover
51	Hexogan nut M 5 - 0.8
52	Outbound Spindle cover
53	PHLP HD screw M5 - 0.8 x 12

Job sequence

TASK 1: **Dismantling and assembly of head stock**

- Switch off the machine and remove the belt guard
- Remove the 'V' belt from the main spindle pulley.
- Remove the head stock name plate (part no. 1, Fig 1)
- Remove the screws (part nos. 2,5,6,7,8,10, Fig 1) by suitable hand tool.
- Remove the change gear cover (part no 49, Fig 1)
- Remove the hexagonal nut (part 51, Fig 1) and screw (part no 53, Fig 1)
- Remove the outbound spindle cover (part no. 52, Fig1)
- Remove the extra cover (part no. 15, Fig 1)

a Removal of tension shaft

- Remove the retaining ring (part no. 48 and 47 Fig 1)
- Remove the threaded handle rod (pat no 40, Fig 1)
- Remove the pivot bracket (part no 41, Fig 1)
- Remove the tension shaft with bearing and idler roller assembly.
- Using a bearing puller and remove the ball bearings (part no 45, Fig 1)
- Remove the idler roller (part no 46, Fig 1)

b Removal of Idler shaft (part no. 31, Fig 1)

- Remove the retaining ring (part no. 35, Fig 1)
- Disconnect the timing belt (part no. 32, Fig 1)
- Remove the lock nut and washer (part no 27, 26, 28, Fig 1)
- Remove the idler shaft with bearings and idler pulley (part no 31, Fig 1)
- Removing the ball bearings by using a bearing puller (part no 33, Fig 1)
- Remove the idler pulley and key from the idler shaft (part no 34, Fig 1)

c Removal of timing gear shaft with motor pulley timing gear assembly (part no 37, Fig 1)

- Remove the heavy duty screw with suitable hand tool (part no 18, Fig 1)
- Remove the retaining ring (part no 39, Fig 1)
- Remove the shaft with timing gear and motor pulley (part no 37, Fig 1)
- Remove the pulley flat washer with suitable hand tools (part no 36, Fig 1)
- Remove the motor pulley and timing gear with suitable tools (part no 37, Fig 1)
- Remove the timing belt (pat no 32, Fig 1)

d Removal of head stock main spindle (part no 11, Fig 1)

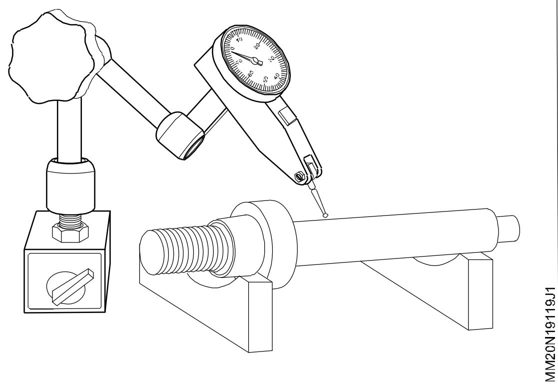
- Remove the spanner nut (part no 24, Fig 1)
- Remove the spindle pulley (part no 22, Fig 1) and key (part no 12, Fig 1)
- Remove the 45T gear (part no 20, Fig 1).
- Remove the spacer (part no 19, Fig 1).
- Remove the bearing cap (part no 17 -1, Fig 1) and then remove the taper roller bearing 32009 at rear end of main spindle. (part no 17, Fig 1)
- Remove the main spindle (part no 11, fig 1) with taper roller bearing.
- Remove the taper roller bearing 32009 at the front end of the main spindle (part no 14, Fig 1)
- Remove the spacer (part no 13, Fig 1)
- Clean all the dismantled parts and dry it.
- Keep all disassembled parts in a separate tray in proper order while dismantling

e Identification of wornout and damaged parts

- Check all the dismantled parts of head stock thoroughly and list out the damaged, wornout parts and fill up the given in table 1.

Sl. No.	Name of the parts	Remarks

Fig 1



- Check the spindle runout as in Fig 2.

Ensure the free flow of lubricantion oil through the pipe provided in the head stock.

f Replacement of the wornout and damaged parts

Ensure the replacement bearings before assembling the head stock

- Replace the wornout or damaged parts other than bearings if required as per table 1

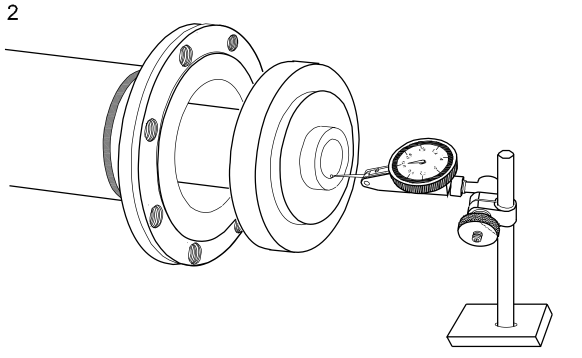
g Assembling of head stock

- Assemble all the parts of the headstock in the reverse order and apply grease, oil at necessary parts.

> **Care should be taken while fixing new bearings and the retaining ring.**

- Mount the head stock change gear cover.
- Mount the pulley at the rear end of the main spindle.
- Connect the pulley and motor with belt.

Fig 2



MM20N19119J2

h Checking the run out and face out of main spindle (Fig 2)

- Check the run out of the spindle by using lever type dial test indicator with magnetic stand.
- Check the face out of the spindle by using the lever type dial test indicator with magnetic stand. (Fig 2)
- Fill the correct quantity and gradeded oil.(original equipment manufacturer) as recommended by OEM in the head stock and ensure the oil level through oil level glass.
- Switch on the machine and check the oil circulation, performance of the head stock.

> **Figure 1 shows the exploded view of a typical head stock assembly. parts mentioned here are sometimes having slight difference with the available head stock assembly in the shop floor.**
>
> **Trainees shall be able to practice this exercise with the available head stock assembly in their shop floor.**

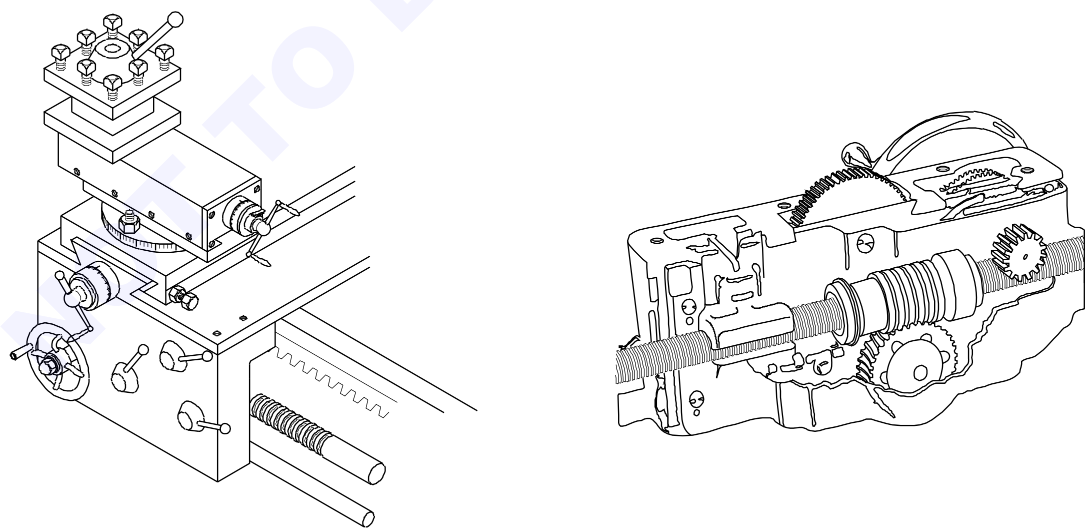
— — — — — — — — —

TASK 2: **Dismantling and assembly of apron**

1 Switch off the electrical power supply from the machine before you start the work.

2 Disengage the lead screw and feed rod (if both are in the mechanism or only lead screw) from the Norton gearbox, after removing the shear pin. (1).

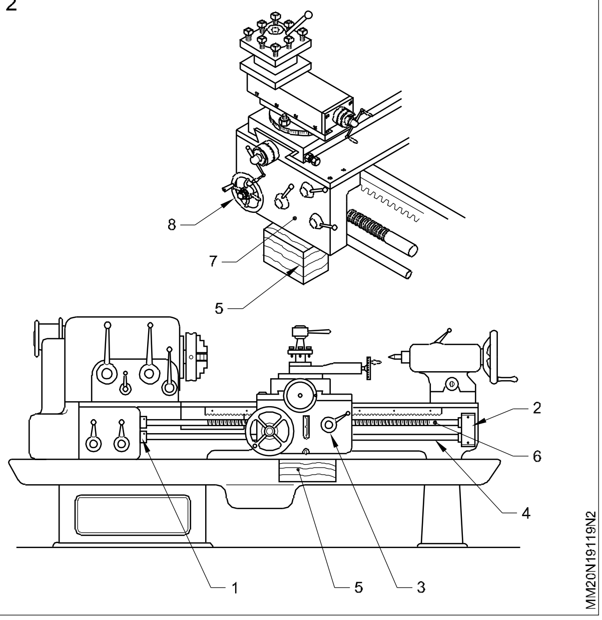
Fig 1



APRON UNIT

MM20N19119N1

Fig 2



3 Unscrew and take out the supporting bracket for the lead screw and feed rod from the tailstock end of the lathe. (2).

4 Keep the half-nut lever in disengaged (3) position.

5 Pull out the lead screw (6) and feed rod (4) from the tailstock end of the lathe.

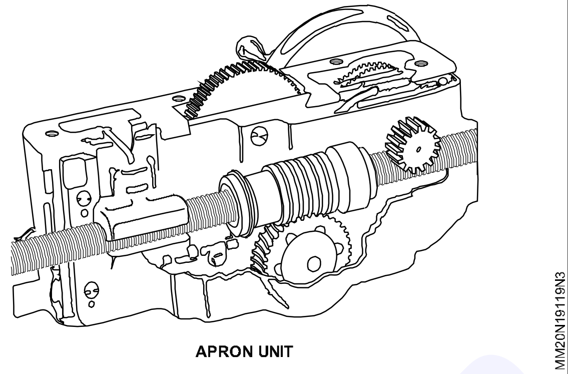
6 Keep the lead screw and the feed rod horizontally under the wooden vee block support.

7 Support the apron by wooden blocks. (5)

8 Remove the Allen screws and dowel pins from the saddle unit to disengage the apron unit (7) and place it on the work table.

9 Remove the locking pins from the traversing hand wheel (8), feed lever, lead screw engagement lever to dismantle the apron mechanism. (Fig 2)

Fig 3



10 Clean thoroughly all the components with kerosene or air-oil - mist in a tray and wipe off with a banian cloth.

11 Inspect the components for wear, damage etc and rectify/replace as required.

12 Lubricate the components

13 Assemble the parts in the reverse sequence to complete overhauling.

14 The final assembly of the apron unit is to be done after overhauling the saddle unit and checking for its functioning.

(Refer to the machine manual while dismantling the apron unit)

— — — — — — — —

TASK 3: **Dismantling and assembly of saddle & tool post**

- Unscrew the tool post locking handle (Fig 1A) and remove the tool post (1B) from the compound slide.
- Rotate the feed screw handle of the top slide (Fig 1C) in anticlock wise direction to get it released from the dovetails of the compound slide.
- Take out the jib from the dovetail of the top slide. (Fig 1D)
- Unscrew both the clamping nuts (Fig 2) from the T bolts, provided on the swivel base of the compound slide and take out the unit.
- Remove the graduated collar (Fig 2) of the compound slide by removing the taper pin.
- Disengage the lead screw from the cross-slide.
- Unscrew the lock nuts from the cross-slide feed screw to remove the graduated collar.
- Take out the jib strip from the dovetails of the cross-slide so that it can be made to slide out easily.
- Unscrew and remove the saddle clamp. (Fig 3)
- Slide way the tailstock unit and take it out of the bed.
- Slide away the saddle unit towards the right end to take it out of the machine bed.
- Clean the parts with kerosene, wipe them with banian cloth and keep the parts in tray.
- Inspect the components visually for damage and wear.
- Lubricate the parts with lubricating oil.
- Assemble the parts in the reverse sequence to complete the process of overhauling.
- Check the function.

Fig 1

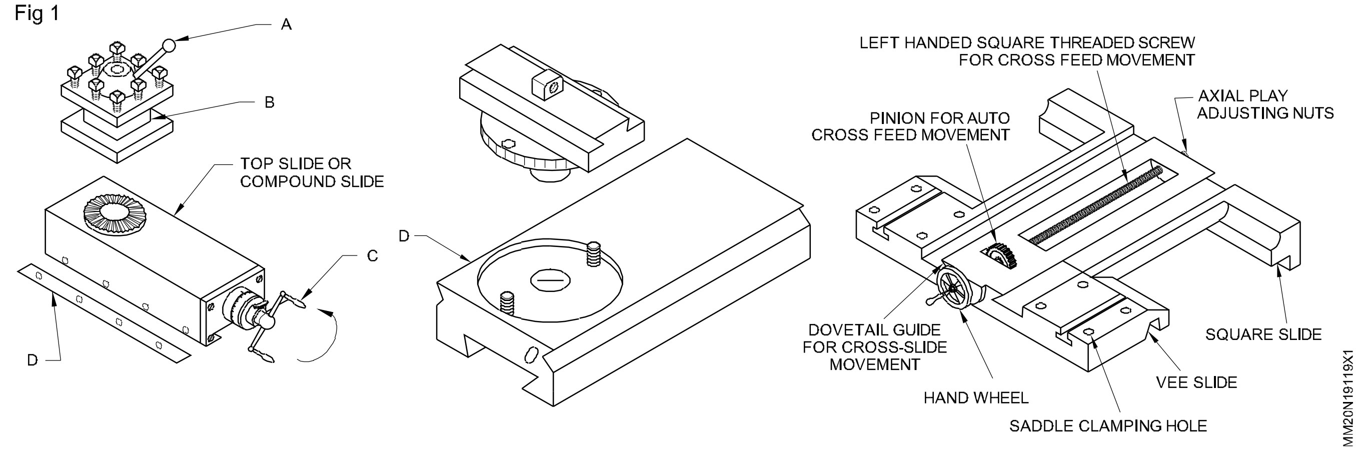


Fig 2

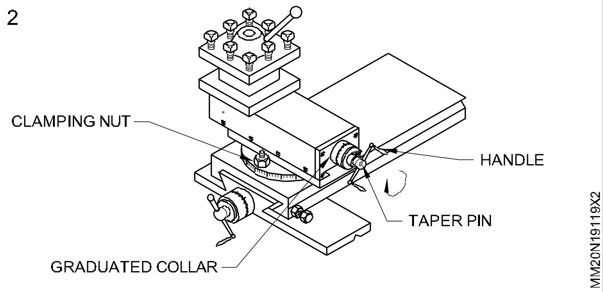
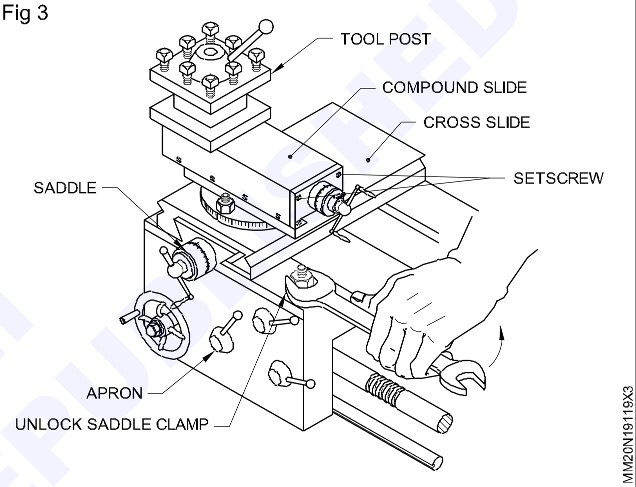


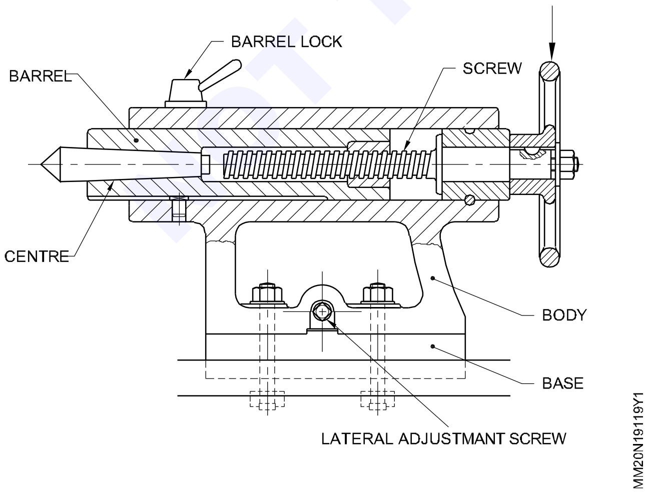
Fig 3



TASK 4: **Dismantling and assembly of tail stock**

1 Loosen the barrel clamping lever. Rotate the hand wheel in clockwise direction for the barrel to move forward to the maximum so that the screw rod is released from the nut. (Fig 1)

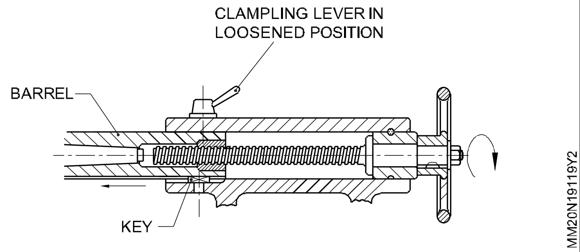
Fig 1



2 Remove the key from the body of the tailstock and pull the quill out by hand.

3 Dismantle the hand wheel from the screw rod by loosening the holding nut. (Fig 2)

Fig 2

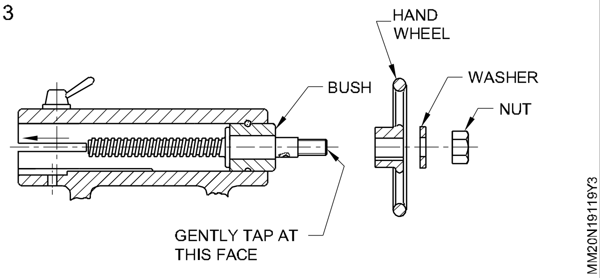


4 Remove the woodruff key from the screw rod.

5 Gently tap the screw rod with a wooden mallet at the hand wheel end to get the screw rod released from the bearing bush, and remove the screw rod. (Fig 3)

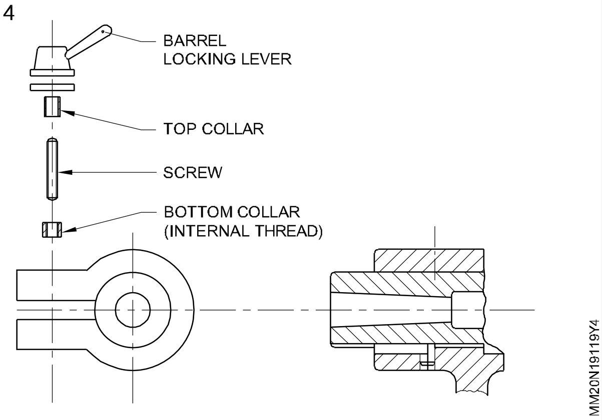
6 Dismantle the bearing bush from the body bore of the tailstock.

Fig 3



7 Remove the barrel locking lever by rotating it in anticlockwise direction, and then dismantle the top collar. (Fig 4)

Fig 4



8 Separate the bottom threaded collar from the screw.

9 Loosen the nuts of the clamping bolts, and dismantle the clamping bolts with the clamping unit. (Fig 5)

10 Unscrew the set screws to release them from the threaded holes in the base of the tailstock. (Fig 6)

11 Separate the tailstock body from its base so that the tailstock unit may be completely dismantled.

12 keep all the components in a tray systematically.

13 Clean all the parts with kerosene oil.

14 Check all the parts for wear, damage and rectify/replace as needed.

15 Lubricate, using S.S-32/57/68 of IOC, as recommended and assemble the parts in the reverse sequence to complete the overhauling procedure.

Fit back the tailstock unit on the machine bed-ways.

Check its function-movement-locking-play-looseness and alignment.

Fig 5

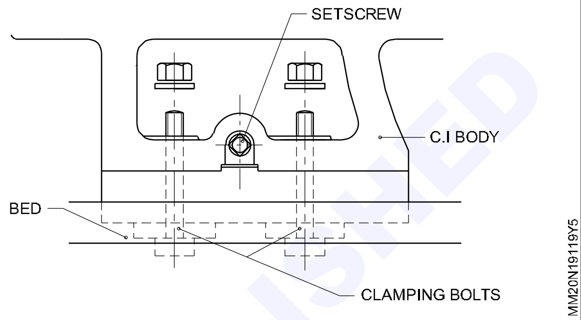
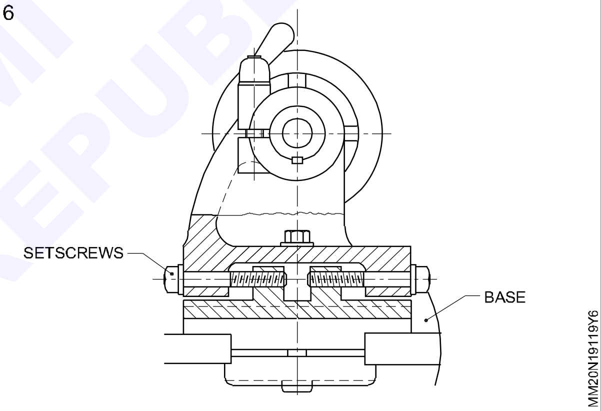


Fig 6

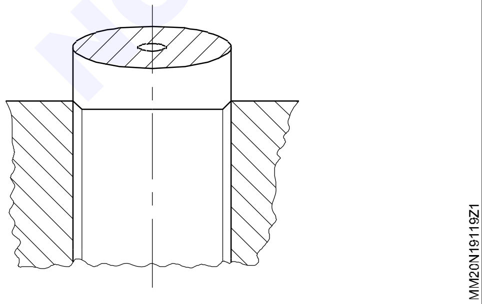


TASK 5: **Removing broken studs & bolts**

1 File flat on the top surface of the stud.

2 Locate the centre and centre punch it. (Fig 1)

Fig 1



3 Select the Ezy-out and the recommended drill size from Table 1.

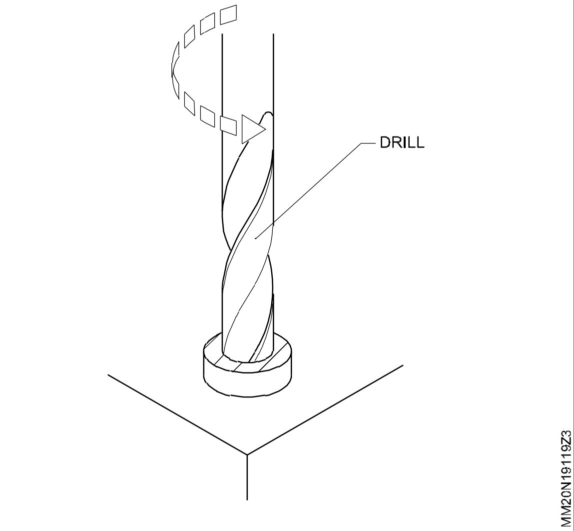
Recommended drill and Ezy-out size for the extraction of broken stud and bolt.

Table 1

Suitable for screw size	**Drill size to be used**	**Ezy-out No. to be used**
3 to 6mm	2mm	1
6 to 8mm	2.8mm	2
8 to 11mm	4mm	3
11 to 14mm	6.3mm	4
Over		
14 to 19mm	6.7mm	5

4 Drill hole on the centre punchmark (Fig 2).

Fig 2



5 Ensure the hole is perpendicular.

6 Set ezy-out (Stud extractor) on the drilled hole (Fig 3)

7 Turn it anticlockwise by a tap wrench (Fig 4).

As the ezy-out penetrates into the stud, the grip increased and gradually the broken stud portion unscrews.

Replace a new stud in position after lubricating its threads.

Fig 3

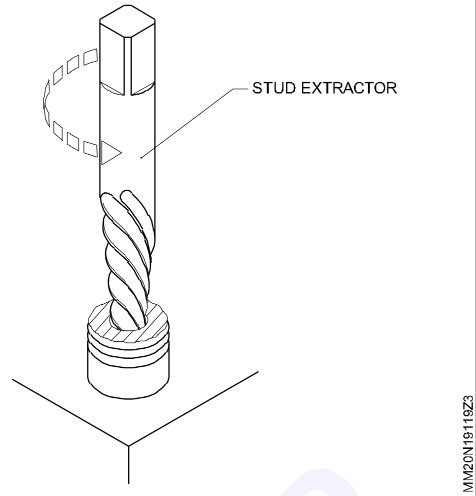
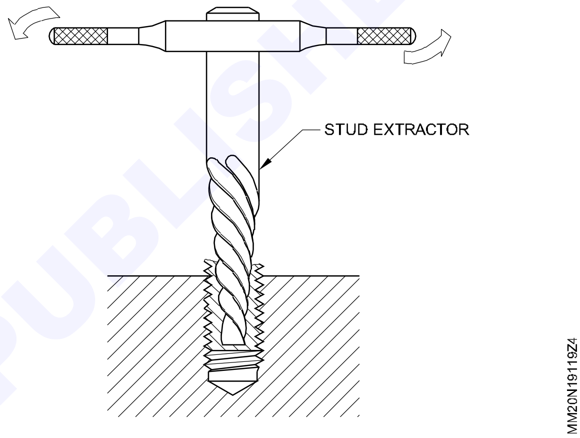


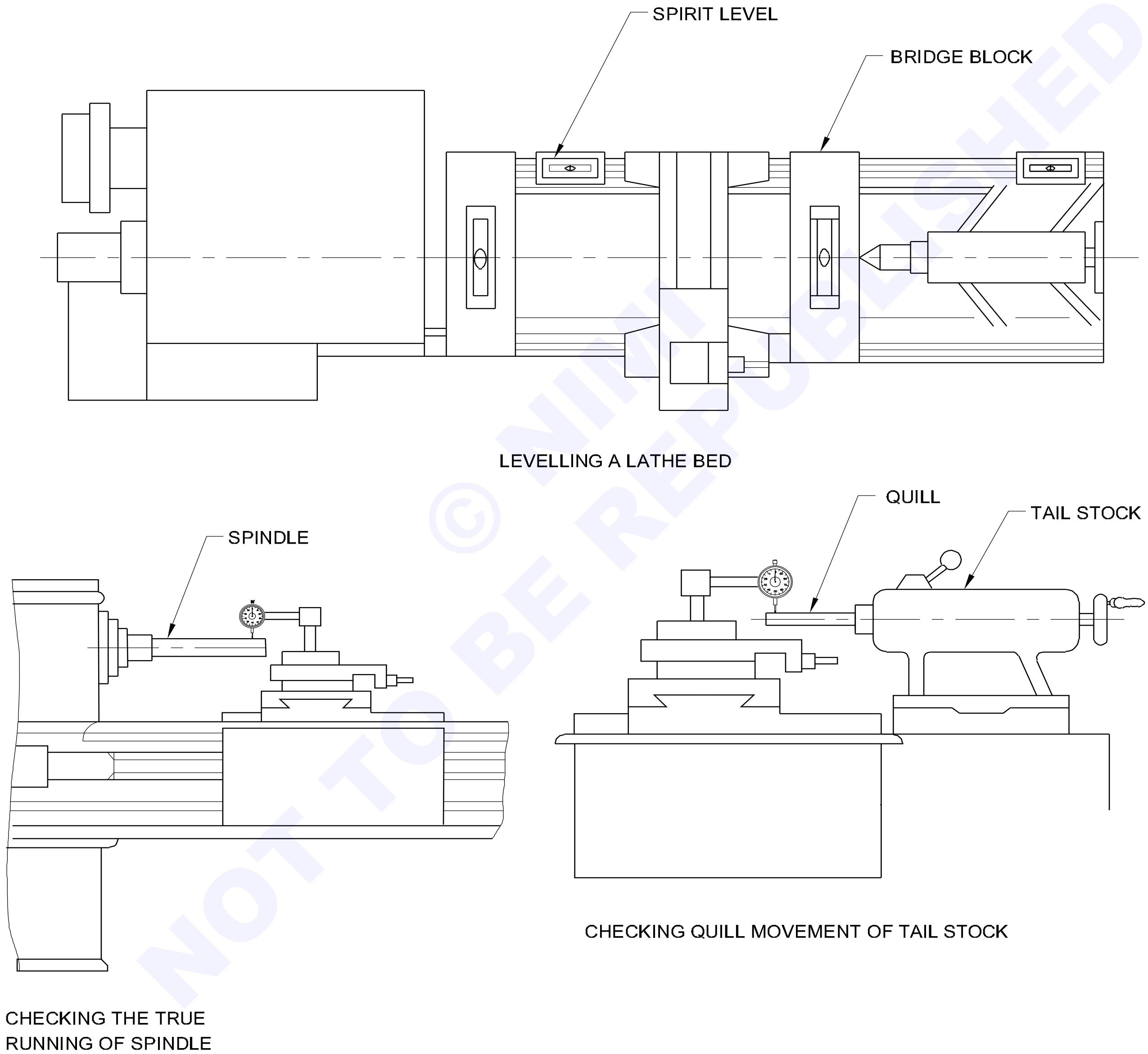
Fig 4



Accuracy checking of lathe machine after assembly

Objectives: At the end of this exercise you shall be able to
- **check the level of a centre lathe**
- **check the true running of a lathe spindle**
- **check the alignment of the main spindle and the tailstock spindle of a lathe**
- **check the parallelism of the tailstock sleeve with respect to bed ways.**

TASK:1



-	-	-	-	-	-	1.9.120
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

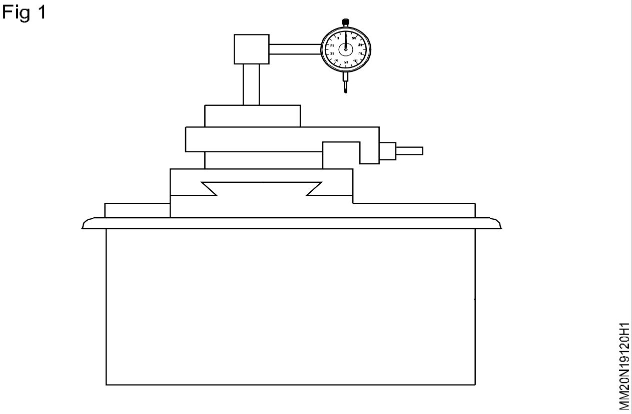
SCALE 1:1	ACCURACY CHECKING OF LATHE MACHINE AFTER ASSEMBLY	TOLERANCE	TIME 5hrs
		CODE NO. MM20N19120E1	

Job sequence

TASK 1: **Checking quill movement of tailstock**

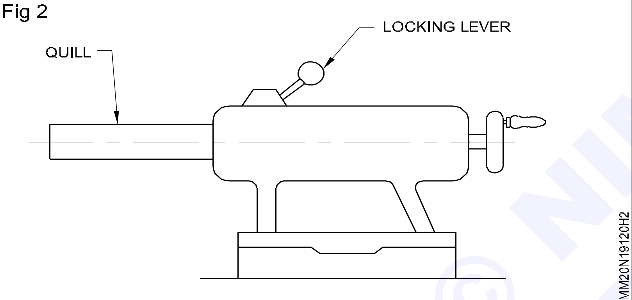
- Fix the dial gauge on the carriage. (Fig 1)

Fig 1



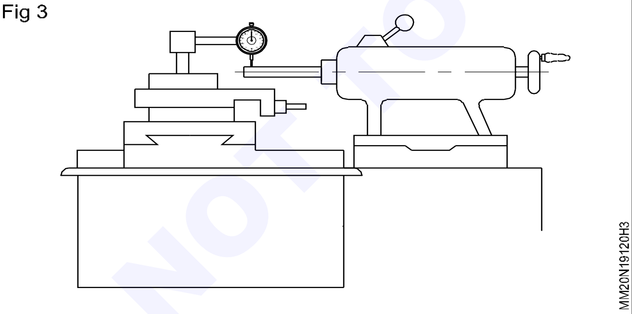
- Project the quill of the tailstock to the maximum extent possible and lock it. (Fig 2) Check the quill in the vertical and horizontal positions by a dial test indicator.

Fig 2



- Clamp the quill during each measurement. If it is not clamped it will affect the measurement.
- Place the dial plunger to contact over the free end of the quill in the vertical plane. (Fig 3)

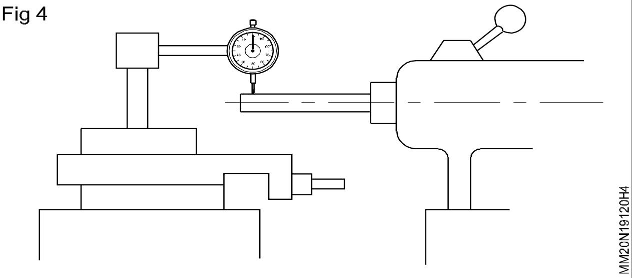
Fig 3



Ensure that the dial is set at the topmost point of the quill.

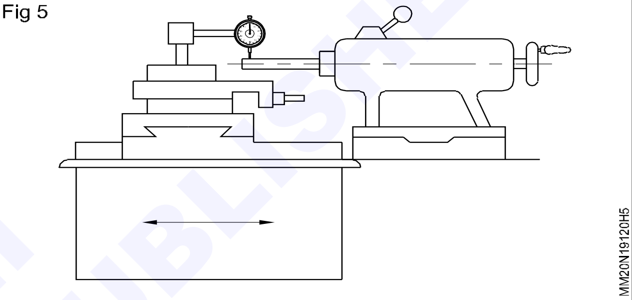
- Set the dial at the zero position. (Fig 4)

Fig 4



- Move the carriage slowly towards the entire length of the quill. (Fig 5)

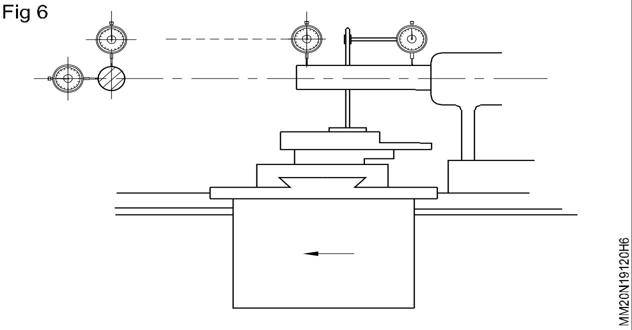
Fig 5



- Note the dial reading at the extreme end of the quill.
- Verify the deflection of the dial reading and compare the value with the test chart supplied. (IS: 6040)

For checking in the horizontal plane, set the dial horizontally and repeat the above procedure. (Fig 6)

Fig 6



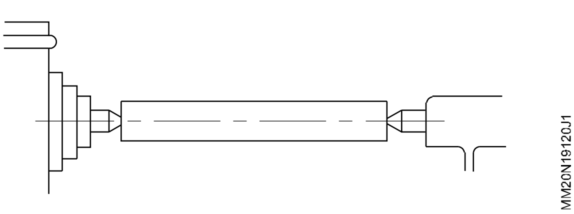
- Fix the test mandrel into the tailstock spindle. Repeat the same procedure to test the accuracy of the tailstock spindle bore in the vertical and horizontal positions as shown in the figure.

— — — — — — — —

TASK 2: **Checking the alignment of the main spindle and the tailstock spindle of a lathe**

Insert a hollow test mandrel (300 to 500 mm long) in between the centres. (Fig 1)

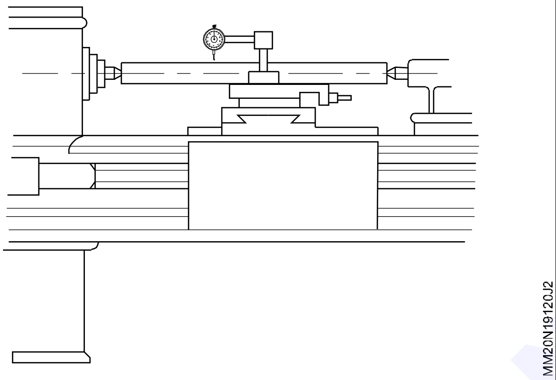
Fig 1



Ensure that the spindle bearing is at its working temperature.

Fix the dial gauge on the saddle, the plunger touching a position of the mandrel and set it to zero.(Fig 2)

Fig 2

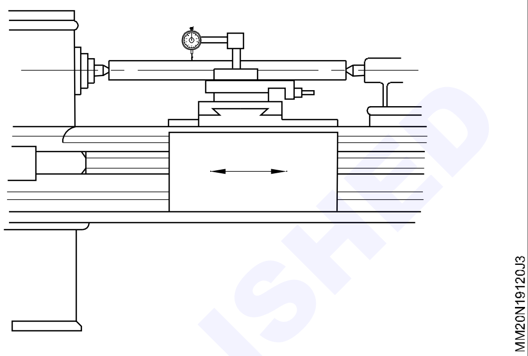


Move the carriage from one end to the other end of the mandrel to check the mandrel is in correct alignment in the horizontal position.

Rest the dial plunger at right angles (radially) to the surfaces to be tested.

Set the dial plunger at the top of the mandrel and move the saddle along the bed slowly to the entire length of the mandrel. (Fig 3)

Fig 3



Observe the reading of the dial as the saddle moves along the beds and note for variation, if any.

The tailstock centre must be higher than the spindle centre within the permissible limit.

Verify the deflection of the dial gauge reading and compare the value with the test chart. (IS: 6040)

— — — — — — — —

TASK 3: **Checking the true running of a spindle**

Locate the taper shank of the test mandrel in the spindle taper.

Hold a dial gauge, stationary in the carriage, its plunger contacting the mandrel near its free end (Fig 1) and set it to ‘0’ position.

Rest the dial gauge plunger at right angles (radially) to the surface to be tested.

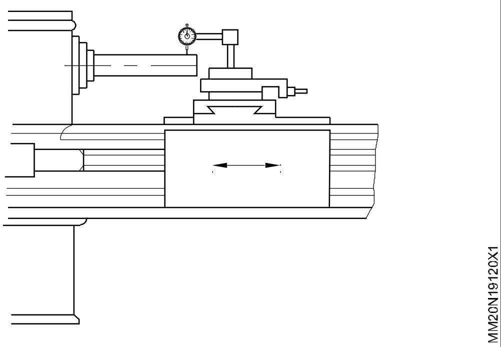
Rotate the spindle along with the mandrel slowly by hand.

Observe and note the reading of the dial gauge.

Move the dial gauge near the spindle nose. Rotate the spindle along with the mandrel slowly by hand and note the reading.

Take readings of the dial gauge while the spindle is slowly rotated. Verify the deflection of the dial reading and compare the value with the test chart. (IS: 6040)

Fig 1



— — — — — — — —

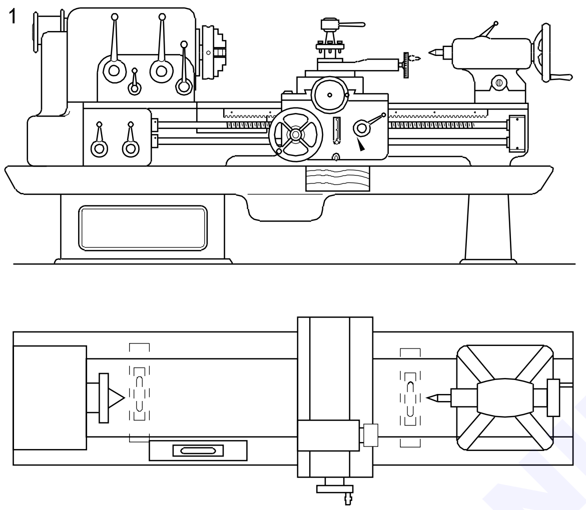
Perform preventive maintenance of lathe machine

Objectives: At the end of this exercise you shall be able to
- **inspect centre lathe as per check list and carry out preventive maintenance**
- **measure and adjust belt tension.**

Job sequence

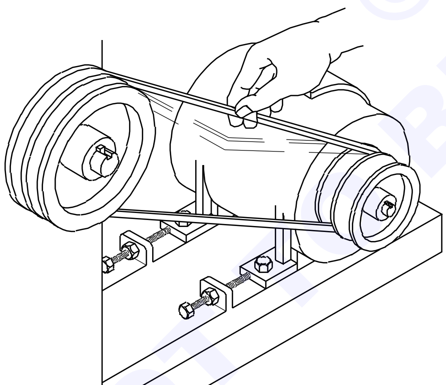
- Check the level of the lathe with a spirit level and adjust using wedges. (Fig 1)

Fig 1



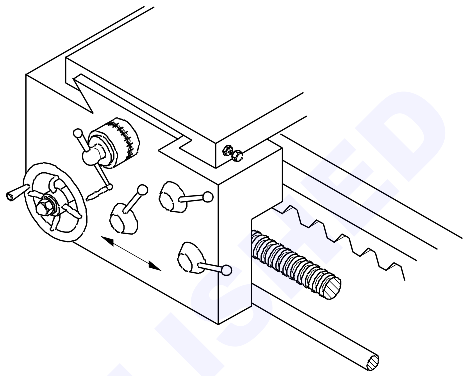
- Check the tension of the belt and adjust. (Fig 2)

Fig 2



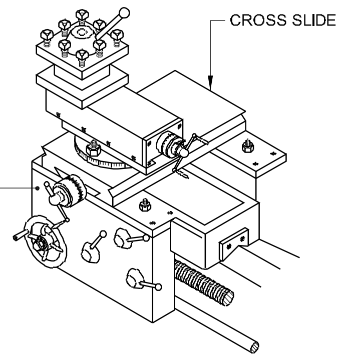
- Check the free movement of tailstock over the bed.
- Check the movement of the carriage of the lathe. (Fig 3)
- Run the machine on different spindle speeds and check the speed.
- Engage the power feed and check the longitudinal and transverse feed movements.
- Check the function of clutches by operating the clutch lever.

Fig 3



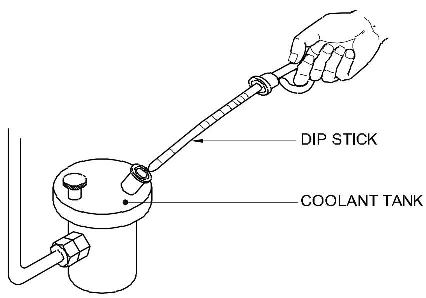
- Check the movement of the cross-slide and the compound slide. (Fig 4)
- Check the oil level and the functioning of the lubricating pump.

Fig 4



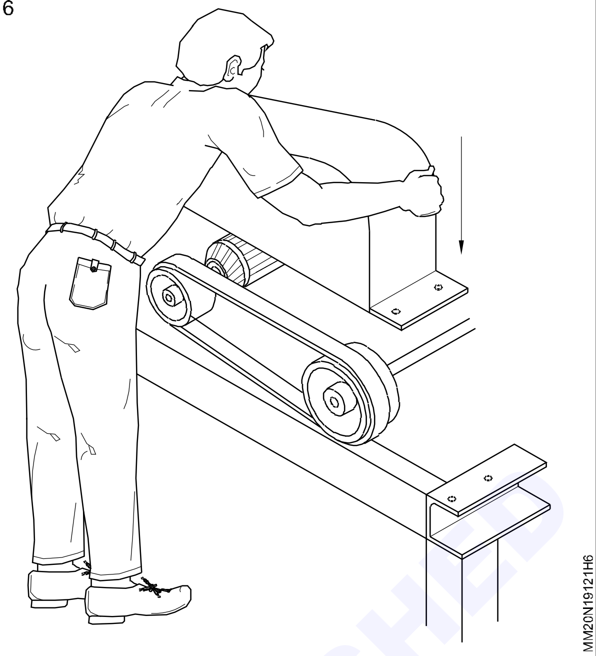
- Check the coolant level and the functioning of the coolant pump. (Fig 5)

Fig 5



• Check the safety guards. (Fig 6) and ensure they are in position.

Fig 6



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 carried out
Level of the machine			
Belt and its tension			
Bearing sound			
Driving clutch and brake			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Carriage & its travel			
Cross-slide & its movement			
Compound slide & its travel			
Tailstock's parallel movement			
Electrical controls			
Safety guards			

— — — — — — — —