FITTER

NSQF LEVEL - 4

1st Year

TRADE PRACTICAL

SECTOR: CAPITAL GOODS & MANUFACTURING

(As per revised syllabus July 2022 - 1200 Hrs)

Directorate General of Training

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

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

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

Sector : Capital Goods & Manufacturing

Duration : 2 Years

Trade : Fitter - 1st Year - Trade Practical - NSQF Level - 4 (Revised 2022)

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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 **Fitter - 1st Year - Trade Practical NSQF Level - 4 (Revised 2022) in CG & M Sector under** 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

Addl.Secretary / Director General (Training)
Ministry of Skill Development & Entrepreneurship,
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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)** for the trade of **Fitter** under the **CG & M** Sector for ITIs.

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

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

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

INTRODUCTION

TRADE PRACTICAL

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

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

Module 1	Safety
Module 2	Basic Fitting
Module 3	Sheet Metal
Module 4	Welding
Module 5	Drilling
Module 6	Fitting Assembly
Module 7	Turning
Module 8	Basic Maintenance

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

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

TRADE THEORY

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

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

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

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

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

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, Hacks awing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] **CSC/N0304**	1.1.01 - 1.2.41
2	Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting. **CSC/N0301**	1.3.42 - 1.3.51
3	Join metal components by riveting observing standard procedure. **CSC/N0304**	1.3.52 - 1.3.55
4	Join metal component by arc welding observing standard procedure. **CSC/N0304**	1.4.56
5	Cut and join metal component by gas (oxy-acetylene) **CSC/N0304**	1.4.57 - 1.4.60
6	Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate MeasuringInstrument - Vernier, Screw Gauge, M icrometer] **CSC/N0304**	1.5.61 - 1.5.78
7	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, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.] **CSC/N0304**	1.6.79 - 1.6.89
8	Produce components involving different operations on lathe observing standard procedure and check for accuracy. [Different Operations - facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)] **CSC/N0110**	1.7.90 - 1.7.107
9	Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines - Drill Machine, Power Saw, Bench Grinder and Lathe]N/A	1.8.108-1.8.114

SYLLABUS FOR FITTER

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 212 Hrs; Professional Knowledge 37Hrs	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, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm] **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). (5 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message. (1 hrs.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs.) 8. Use of Fire extinguishers. (7 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (2 hrs.) 10. Safe use of tools and equipments used in the trade. (1 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.)
		11. Identification of tools &equipment as per desired specifications for marking & sawing. (4 hrs.) 12. Selection of material as per application. (1 hrs.) 13. Visual inspection of raw material for rusting, scaling, corrosion etc. (1 hrs.) 14. Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions. (9 hrs.) 15. Sawing different types of metals of different sections. (6 hrs.)	Linear measurements- its units, dividers, calipers, hermaphrodite, centre punch, dot punch, prick punch their description and uses of different types of hammers. Description, use and care of 'V' Blocks, marking off table. Measuring standards (English, Metric Units), angular measurements. (04 hrs.)
		16. Filing Channel, Parallel. (5 hrs.) 17. Filing- Flat and square (Rough finish), (08 hrs.) 18. Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule. (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.

		19. Marking practice with dividers, odd leg calipers and steel rule (circles, ARCs, parallel lines). (4 hrs.)	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.)
		20. Marking off straight lines and ARCs using scribing block and dividers. (4 hrs.) 21. Chipping flat surfaces along a marked line. (9 hrs.) 22. Marking, filing, filing square and check using tri square. (9 hrs.)	Marking off and layout tools, dividers, scribing block, - description, classification, material, care & maintenance. Try square, ordinary depth gauge, protractor- description, uses and cares. Uses, care & maintenance of cold chisels- materials, types, cutting angles. (04 hrs.)
		23. Marking according to simple blueprints for locating, position of holes, scribing lines on chalked surfaces with marking tools. (8 hrs.) 24. Finding centre of round bar with the help of 'V' block and marking block. (2 hrs.) 25. Joining straight line to an ARC. (08 hrs.)	Marking media, marking blue, Prussian blue, red lead, chalk and their special application, description. Use, care and maintenance of scribing block. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. (03 hrs.)
		26. Chipping, Chamfering, Chip slots & oils grooves (Straight). (08 hrs.) 27. Filing flat, square, and parallel to an accuracy of 0.5mm. (07 hrs.) 28. Chip curve along a line-mark out, keyways at various angles & cut keyways. (1 hrs.) 29. Sharpening of Chisel. (2 hrs.) 30. File thin metal to an accuracy of 0.5 mm. (3 hrs.)	Physical properties of engineering metal: colour, weight, structure, and conductivity, magnetic, fusibility, specific gravity. Mechanical properties: ductility, malleability hardness, brittleness, toughness, tenacity, and elasticity. (04 hrs.)
		31. Saw along a straight line, curved line, on different sections of metal. (12 hrs.) 32. Straight saw on thick section, M.S. angle and pipes. (8 hrs.)	Power Saw, band saw, Circular saw machines used for metal cutting. (03 hrs.)
		33. File steps and finish with smooth file to accuracy of ± 0.25 mm. (12 hrs.) 34. File and saw on M.S. Square and pipe. (10 hrs.) 35. File radius along a marked line (Convex & concave) & match. (12 hrs.)	Micrometer- outside and inside - principle, constructional features, parts graduation, reading, use and care. Micrometer depth gauge, parts, graduation, reading, use and care. Digital micrometer. (03 hrs.)

		36. Chip sheet metal (shearing). (3 hrs.) 37. Chip step and file. (3 hrs.)	Vernier calipers, principle, construction, graduations, reading, use and care. Vernier bevel protractor, construction, graduations, reading, use and care, dial Vernier Caliper, Digital Vernier caliper. Vernier height gauge: material construction, parts, graduations (English & Metric) uses, care and maintenance. (03 hrs.)
		38. Mark off and drill through holes. (5 hrs.) 39. Drill and tap on M.S. flat. (8 hrs.) 40. Punch letter and number (letter punch and number punch) (3 hrs.) 41. Practice use of different punches. (5 hrs.)	Drilling processes: common type (bench type, pillar type, radial type), gang and multiple drilling machine. Determination of tap drill size. (03 hrs.)
Professional Skill 97Hrs; Professional Knowledge 21Hrs	Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting. **CSC/N0301**	42. Marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips. (12 hrs.) 43. Marking out of simple development (5 hrs.) 44. Marking out for flaps for soldering and sweating. (4 hrs.)	Safety precautions to be observed in a sheet metal workshop, sheet and sizes, Commercial sizes and various types of metal sheets, coated sheets and their uses as per BIS specifications. Shearing machine- description, parts and uses. (05 hrs.)
		45. Make various joints: wiring, hemming, soldering and brazing, form locked, grooved and knocked up single hem straight and curved edges form double hemming. (22 hrs.) 46. Punch holes-using hollow and solid punches. (5 hrs.) 47. Do lap and butt joints. (12 hrs.)	Marking and measuring tools, wing compass, tin man's square tools, snips, types and uses. Tin man's hammers and mallets type-sheet metal tools, types, specifications, uses. Trammel- description, parts, uses. Hand grooves- specifications and uses. Sheet and wire gauge. (07 hrs.)
		48. Bend sheet metal into various curvature form, wired edges- straight and curves. Fold sheet metal at angle using stakes. (6 hrs.) 49. Make simple Square container with wired edge and fix handle. (13 hrs.)	Stakes-bench types, parts, their uses. Various types of metal joints, their selection and application, tolerance for various joints, their selection& application. Wired edges. (04 hrs.)
		50. Make square tray with square soldered corner. (11 hrs.) 51. Practice in soft soldering and silver soldering. (7 hrs.)	Solder and soldering: Introduction- types of solder and flux. Composition of various types of solders and their heating media of soldering iron. Method of soldering, selection and application-joints. Hard solder- Introduction, types and method of brazing. (05 hrs.)

Professional Skill 19Hrs; Professional Knowledge 03Hrs	Join metal components by riveting observing standard procedure. **CSC/N0304**	52. Make riveted lap and butt joint. (6 hrs.) 53. Make funnel as per development and solder joints. (8 hrs.) 54. Drill for riveting. (1 hr.) 55. Riveting with as many types of rivet as available, use of counter sunk head rivets. (4 hrs.)	Various rivets shape and form of heads, importance of correct head size. Rivets-Tin man's rivets types, sizes, and selection for various works. Riveting tools, dolly snaps description and uses. Method of riveting, The spacing of rivets. Flash riveting, use of correct tools, compare hot and cold riveting. (03 hrs.)
Professional Skill 21Hrs; Professional Knowledge 04Hrs	Join metal component by arc welding observing standard procedure. **CSC/N0304**	56. Welding - Striking and maintaining ARC, laying Straight-line bead. (21 hrs.)	Safety-importance of safety and general precautions observed in a welding shop. Precautions in electric and gas welding. (Before, during, after) Introduction to safety equipment and their uses. Machines and accessories, welding transformer, welding generators. (04 hrs.)
Professional Skill 64Hrs; Professional Knowledge 16Hrs	Cut and join metal component by gas (oxy-acetylene) **CSC/N0304**	57. Making butt joint and joint-gas and ARC. (12 hrs.) 58. Do setting up of flames, fusion runs with and without filler rod, and gas. (8 hrs.)	Welding hand tools: Hammers, welding description, types and uses, description, principle, method of operating, carbon dioxide welding. H.P. welding equipment: description, principle, method of operating L.P. welding equipment: description, principle, method of operating. Types of Joints-Butt and fillet as per BIS SP: 46-1988 specifications. Gases and gas cylinder description, kinds, main difference and uses. (05 hrs.)
		59. Make butt weld and corner, fillet in ARC welding (22 hrs.)	Setting up parameters for ARC welding machines-selection of Welding electrodes. Care to be taken in keeping electrode. (05 hrs.)
		60. Gas cutting of MS plates (22 hrs.	Oxygen acetylene cutting-machine description, parts, uses, method of handling, cutting torch-description, parts, function and uses. (06 hrs.)
Professional Skill 143Hrs; Professional Knowledge 26Hrs	Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate	61. Mark off and drill through holes. (04 hrs.) 62. Drill on M.S. flat. (1 hrs.) 63. File radius and profile to suit gauge. (10 hrs.) 64. Sharpening of Drills. (1 hrs.) 65. Practice use of angular measuring instrument. (04 hrs.) 66. Counter sink, counter bore and ream split fit (three piece fitting). (04 hrs.) 67. Drill through hole and blind holes. (2 hrs.)	Drill- material, types, (Taper shank, straight shank) parts and sizes. Drill angle-cutting angle for different materials, cutting speed feed. R.P.M. for different materials. Drill holding devices- material, construction and their uses. (04 hrs.) Counter sink, counter bore and spot facing-tools and nomenclature, Reamer- material, types (Hand and machine reamer), kinds, parts and

	MeasuringInstrument - Vernier, Screw Gauge,Micrometer] **CSC/N0304**	68. Form internal threads with taps to standard size (through holes and blind holes). (3 hrs.) 69. Prepare studs and bolt. (13 hrs.)	their uses, determining hole size (or reaming), Reaming procedure. Screw threads: terminology, parts, types and their uses. Screw pitch gauge: material parts and uses. Taps British standard (B.S.W., B.S.F., B.A. & B.S.P.) and metric / BIS (coarse and fine) material, parts (shank body, flute, cutting edge). (03 hrs.)
		70. Form external threads with dies to standard size. (08 hrs.) 71. Prepare nuts and match with bolts. (15 hrs.)	Tap wrench: material, parts, types (solid &adjustable types) and their uses removal of broken tap, studs (tap stud extractor). Dies: British standard, metric and BIS standard, material, parts, types, Method of using dies. Die stock: material, parts and uses. (06 hrs.)
		72. File and make Step fit, angular fit, angle, surfaces (Bevel gauge accuracy 1 degree). (12 hrs.) 73. Make simple open and sliding fits. (08 hrs.) 74. Enlarge hole and increase internal dia. (2 hrs.) 75. File cylindrical surfaces. (5 hrs.) 76. Make open fitting of curved profiles. (15 hrs.)	Drill troubles: causes and remedy. Equality of lips, correct clearance, dead centre, length of lips. Drill kinds: Fraction, metric, letters and numbers, grinding of drill. (04 hrs.) Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing. Selection of grinding wheels. Bench grinder parts and use. (04 hrs.)
		77. Correction of drill location by binding previously drilled hole. (04 hrs.) 78. Make inside square fit. (16 hrs.)	Gauges- Introduction, necessity, types. Limit gauge: Ring gauge, snap gauge, plug gauge, description and uses. Description and uses of gauge- types (feeler, screw, pitch, radius, wire gauge). (05 hrs.)
Professional Skill 126Hrs; Professional Knowledge 28Hrs	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, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.] **CSC/N0304**	79. Make sliding 'T' fit. (21 hrs.)	Interchange ability: Necessity in Engg, field definition, BIS. Definition, types of limit, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone Different standard systems of fits and limits. British standard system, BIS system. (05 hrs.)

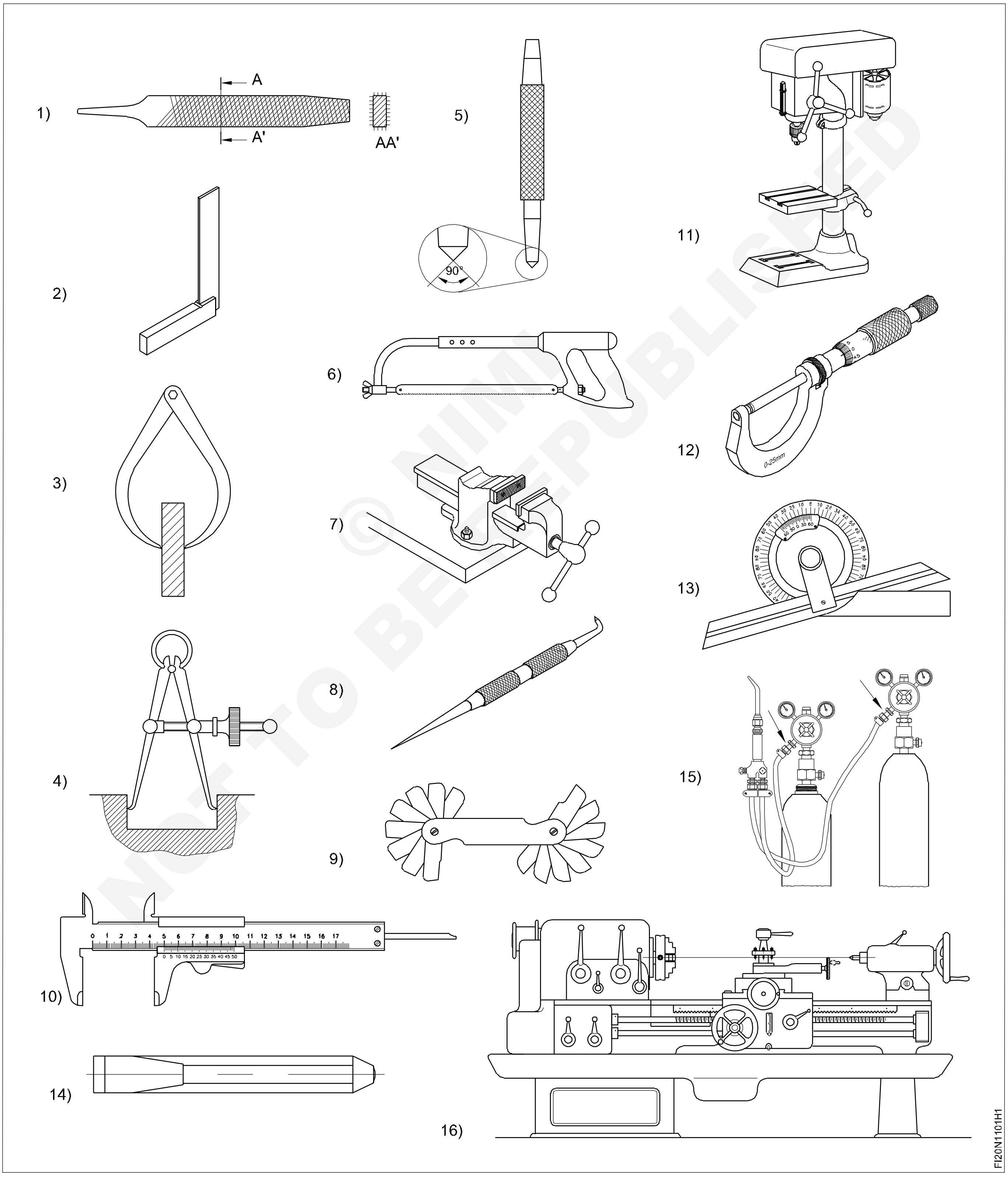
		80. File fit- combined, open angular and sliding sides. (08 hrs.) 81. File internal angles 30minutes accuracy open, angular fit. (12 hrs.)	Method of expressing tolerance as per BIS Fits: Definition, types, description of each with sketch. Vernier height gauge: material construction, parts, graduations (English & Metric) uses, care and maintenance. (04 hrs.)
		82. Make sliding fit with angles other than 90o (21 hrs.)	Pig Iron: types of pig Iron, properties and uses. Cast Iron: types, properties and usesWroughtiron:- properties and uses. Steel: plain carbon steels, types, properties and uses. Non-ferrous metals (copper, aluminium, tin, lead, zinc) properties and uses. (05 hrs.)
		83. Scrap on flat surfaces, curved surfaces and parallel surfaces and test. (04 hrs.) 84. Make & assemble, sliding flats, plain surfaces. (12 hrs.) 85. Check for blue math of bearing surfaces- both flat and curved surfaces by wit worth method. (5 hrs.)83. Scrap surfaces- both flat and curved surfaces by wit worth method. (5 hrs.)	Simple scraper- flat, half round, triangular and hook scraper and their uses. Blue matching of scraped surfaces (flat and curved bearing surfaces). Testing scraped surfaces: ordinary surfaces without a master plate. (04 hrs.)
		86. File and fit combined radius and angular surface (accuracy ± 0.5 mm), angular and radius fit. (15 hrs.) 87. Locate accurate holes & make accurate hole for stud fit. (2 hrs.) 88. Fasten mechanical components / sub-assemblies together using screws, bolts and collars using hand tools. (5 hrs.)	Vernier micrometer, material, parts, graduation, use, care and maintenance. Calibration of measuring instruments. Introduction to mechanical fasteners and its uses. Screw thread micrometer: Construction, graduation and use. (05 hrs.)
		89. Make sliding fits assembly with parallel and angular mating surface. (± 0.04 mm) (21 hrs.)	Dial test indicator, construction, parts, material, graduation, Method of use, care and maintenance. Digital dial indicator. Comparators- measurement of quality in the cylinder bores. (05 hrs.)
Professional Skill 95 Hrs; Professional Knowledge 15 Hrs	Produce components involving different operations on lathe observing standard procedure and check for accuracy. [Different Operations - facing, plain turning, step turning, parting, chamfering,	90. Lathe operations- 91. True job on four jaw chuck using knife tool. (5 hrs.) 92. Face both the ends for holding between centres. (06 hrs.) 93. Using roughing tool parallel turn ± 0.1 mm. (06 hrs.) 94. Measure the diameter using outside caliper and steel rule.(1 hr.)	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 centres, works with catch plate, dog, simple description of a facing and roughing tool and their applications. (04 hrs.)

	shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)] **CSC/N0110**		
		95. Holding job in three jaw chuck. (2 hrs.) 96. Perform the facing, plain turn, step turn, parting, deburr, chamfer-corner, roundthe ends, and use form tools. (08 hrs.) 97. Shoulder turn: square, filleted, beveled undercut shoulder, turning-filleted under cut, square beveled. (08 hrs.) 98. Sharpening of -Single point Tools. (1 hr.)	Lathe cutting tools- Nomenclature of single point & multipoint cutting tools, Tool selection based on different requirements and necessity of correct grinding, solid and tipped, throw away type tools, cutting speed and feed and comparison for H.S.S., carbide tools. Use of coolants and lubricants. (03 hrs.)
		99. Cut grooves- square, round, 'V' groove. (08 hrs.) 100. Knurl the job. (1 hr.) 101. Bore holes -spot face, pilot drill, enlarge hole using boring tools. (9 hrs.)	Chucks and chucking the independent four-jaw chuck. Reversible features of jaws, the back plate, Method of clearing the thread of the chuck-mounting and dismounting, chucks, chucking true, face plate, drilling - method of holding drills in the tail stock, Boring tools and enlargement of holes. (02 hrs.)
		102. Turn taper (internal and external). (10 hrs.) 103. Turn taper pins. (5 hrs.) 104. Turn standard tapers to suit with gauge. (5 hrs.)	General turning operations- parallel or straight, turning. Stepped turning, grooving, and shape of tools for the above operations. Appropriate method of holding the tool on tool post or tool rest, Knurling: - tools description, grade, uses, speed and feed, coolant for knurling, speed, feed calculation. Taper - definition, use and method of expressing tapers. Standard tapers-taper, calculations Morse taper. (03 hrs.)
		105. Turn taper (internal and external). (10 hrs.) 106. Turn taper pins. (5 hrs.) 107. Turn standard tapers to suit with gauge. (5 hrs.)	Screw thread definition - uses and application. Square, worm, buttress, acme (nonstandard-screw threads), Principle of cutting screw thread in centre lathe - principle of chasing the screw thread - use of centre gauge, setting tool for cutting internal and external threads, use of screw pitch gauge for checking the screw thread. (03 hrs.)

Professional Skill 63 Hrs; Professional Knowledge 12Hrs	Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines - Drill Machine, Power Saw, Bench Grinder and Lathe]N/A	108.Simple repair work: Simple assembly of machine parts from blueprints. (10 hrs.) 109.Rectify possible assembly faults during assembly. (14 hrs.) 110.Perform the routine maintenance with check list (08 hrs.) 111.Monitor machine as per routine checklist (3 hrs.) 112.Read pressure gauge, temperature gauge, oil level (1 hr.) 113.Set pressure in pneumatic system (2 hrs.)	**Maintenance** -Total productive maintenance -Autonomous maintenance -Routine maintenance -Maintenance schedule -Retrieval of data from machine manuals Preventive maintenance-objective 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. Installation, maintenance and overhaul of machinery and engineering equipment (10 hrs.)
		114.Assemble simple fitting using dowel pins and tap screw assembly using torque wrench. (15 hrs.)	Assembling techniques such as aligning, bending, fixing, mechanical jointing, threaded jointing, sealing, and torqueing. Dowel pins: material, construction, types, accuracy and uses. (02 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 equipment used in fitter section**
- **record the names of tools, do's and don't of each tool**
- **record the names of the industries where the fitters are employed.**



Job Sequence

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

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

Table 1

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

Instructor shall brief the role of a fitter in industries. Emphasis more on the assembly shop by providing the names of the private and public sector industries, where the fitters 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)

Scan the QR Code to view the video for this exercise

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

Fig 1

FI20N1102H1

Job Sequence

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

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

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

Ask the trainees to practice it.

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.

First aid method and basic training

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

Scan the QR Code to view the video for this exercise

Job Sequence

TASK 1: **Chocking**

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

Fig 1

CHOCKING

FI20N1103H1

- Stand behind them and slightly to one side. Support their chest with 1 hand. ...
- Give up to 5 sharp blows between their shoulder blades with the heel of your hand. ...
- Check if the blockage has cleared.
- If not, give up to 5 abdominal thrusts.

— — — — — — — — — —

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

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

- Locate the source of the bleeding.
- Wash your hands and, when possible, wear gloves or use a barrier between you and the wound.
- Remove any loose debris.
- Apply direct pressure on wound (FIg 1)

Fig 1

- Dress the wound with cotton bandage (Fig 2)

Fig 2

— — — — — — — — — —

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

Fig 1

Fig 2

Fig 3

Treating minor burns

- Cool the burn.
- Remove rings or other tight items from the burned area.
- Don't break blisters.
- Apply lotion.
- Bandage the burn.
- If needed, take a nonprescription pain reliever, such as ibuprofen (Advil, Motrin IB, others), naproxen sodium (Aleve) or acetaminophen (Tylenol, others).

— — — — — — — — —

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

Fig 1

Fig 2

Fig 3

- Stop the wound from bleeding by applying direct pressure with a clean, dry cloth.
- Wash the wound. ...
- Apply an antibacterial ointment to the wound. ...
- Put on a dry, sterile bandage.
- If the bite is on the neck, head, face, hand, fingers, or feet, call Doctor right away

— — — — — — — — —

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

Fig 1

Fig 2

- Ask patient to look up.
- Draw lower eyelid down. If object visible, remove with corner of moist cloth.
- If not visible, pull upper lid down.
- If unsuccessful, wash eye with sterile saline or clean water.
- If still unsuccessful, cover injured eye only and seek medical aid.

— — — — — — — — —

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

Fig 1

NOSE BLEED

FI20N1103O1

Fig 2

FI20N1103O2

- Make a patient to sit straight and bend forward the head portion only(This will reduce blood pressure in the Veins of your nose)
- Ask the patient to breathe out from the nose.
- Pinch the nose to take out the blood in the nose.
- To prevent re-bleeding, don't pick or blow your nose and don't bend down for several hours.
- If re-bleeding occurs, go through these steps again.

— — — — — — — — —

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

Fig 1

Fig 2

- Follow the Basic First Aid Plan to assess the casualty.
- Give high-energy foods or sugar.
- Only give food if the casualty is conscious.
- If medical aid is delayed give sugar every 15 minutes.
- The casualty will recover quickly if low blood sugar level is the cause.

— — — — — — — — —

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

Fig 1

Fig 2

FI20N1103V2

Heat Exhaustion

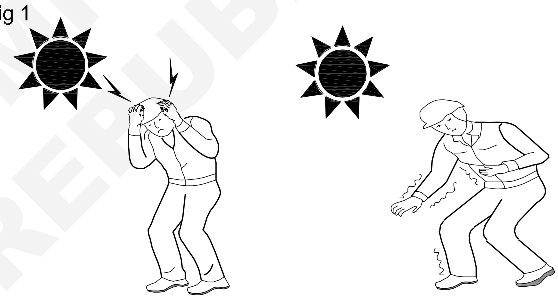
- Rest in a cool place. Getting into an air-conditioned building is best, but at the very least, find a shady spot or sit in front of a fan.
- Drink cool fluids. Stick to water or sports drinks.
- Try cooling measures.
- Loosen clothing.

— — — — — — — — —

TASK 9: **Heat Stroke**

- Put the person in a cool tub of water or a cool shower.
- Spray the person with a garden hose.
- Sponge the person with cool water.
- Fan the person while misting with cool water.
- Place ice packs or cool wet towels on the neck and armpits.
- Cover the person with cool damp sheets.

Fig 1



HEAT STROKE

FI20N1103W1

— — — — — — — — —

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

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

- 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

FIN1103JD

- Lay the victim on his back on a firm surface.
- Kneel alongside facing the chest and locate the lower part of the breastbone. (Fig 2)

Fig 2

FIN1103JE

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

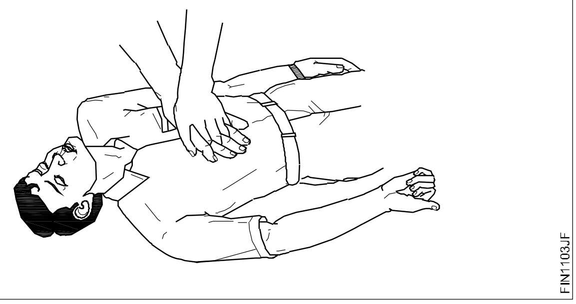


Fig 3

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

Fig 4

- Repeat step above, fifteen times at the rate of atleast once per second.
- Check the cardiac pulse. (Fig 5)

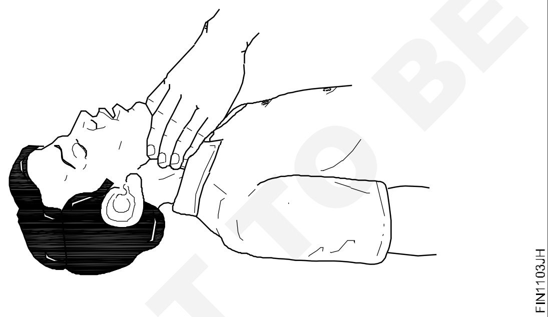


Fig 5

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

Fig 6

- 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.
- As soon as the heartbeat returns, stop the compressions immediately but continue with mouth-to-mouth resuscitation until natural breathing is fully restored.
- Place the victim in the recovery position as shown in Fig 7. Keep him warm and get medical help quickly.

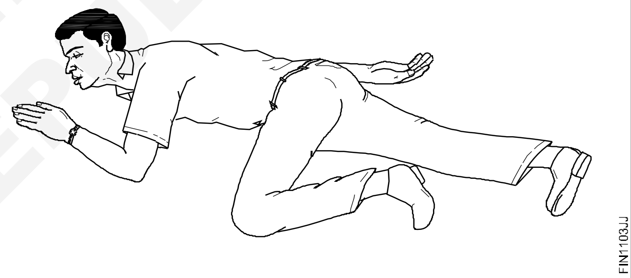


Fig 7

Other steps

- Send word for a doctor immediately.
- 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.

— — — — — — — — —

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.**

Scan the QR Code to view the video for this exercise

Fig 1

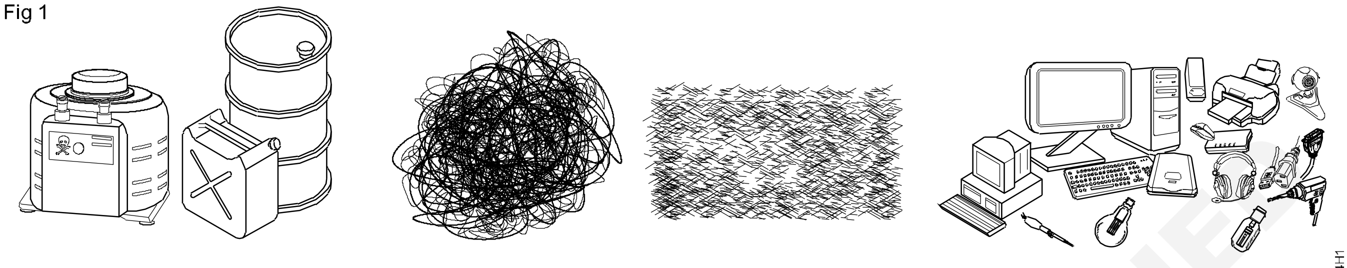
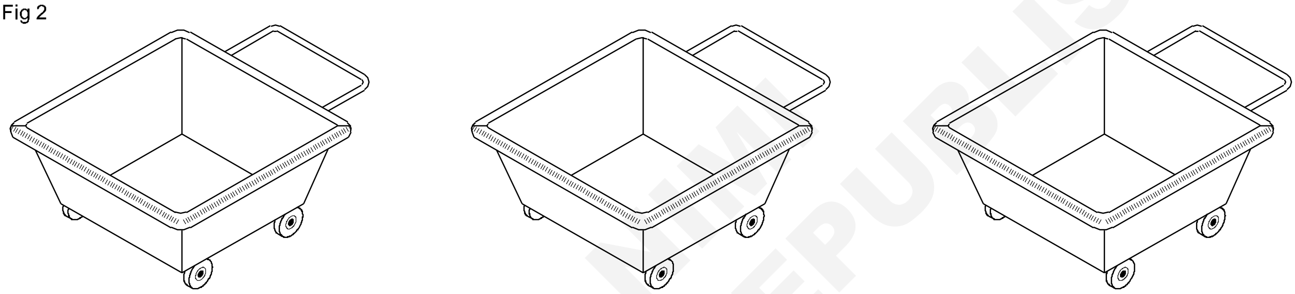


Fig 2



Job Sequence

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

Do not handle the chip by bare hand

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

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

Each bin should have name of the material.

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

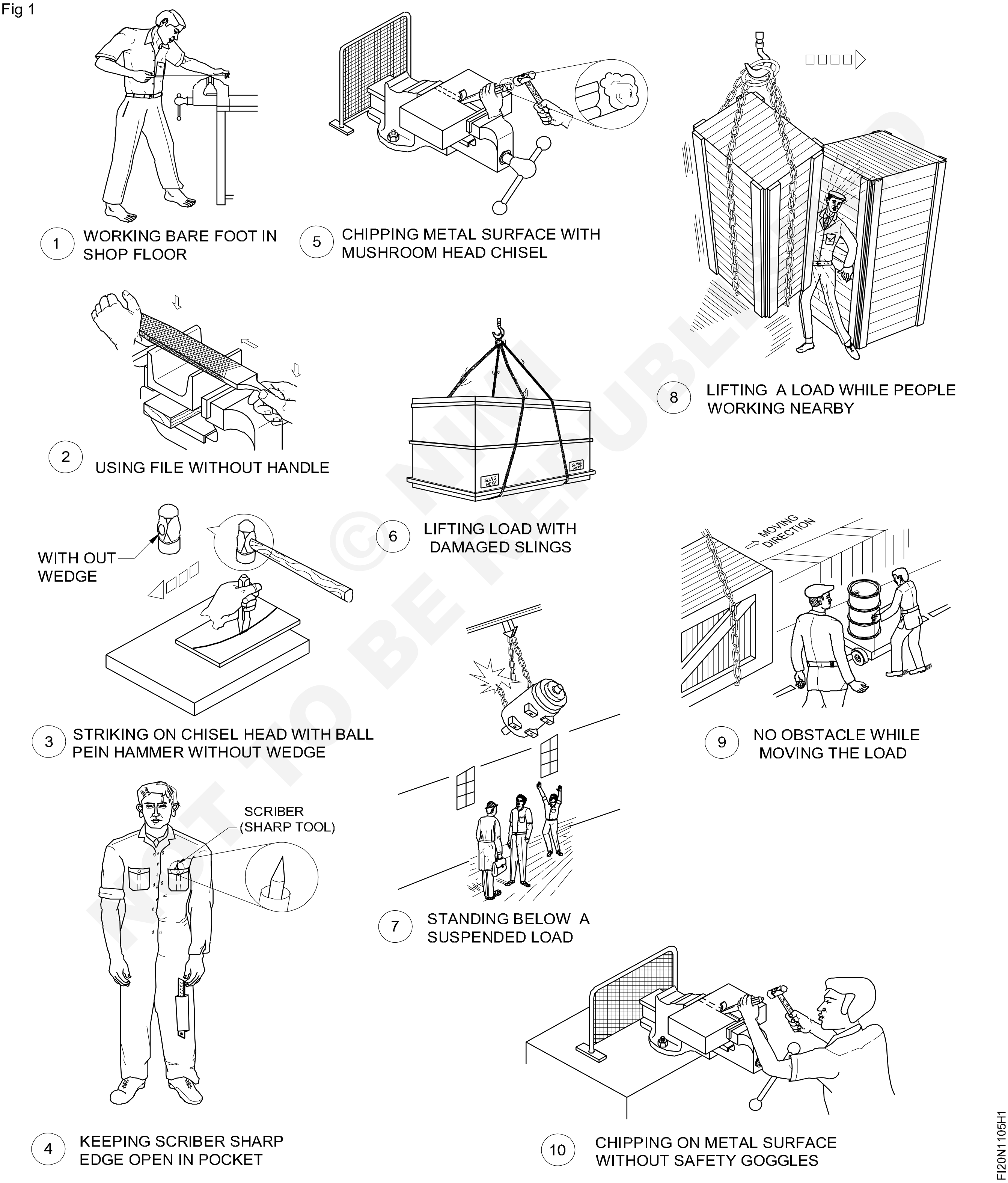
Table1

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

Hazard identification and avoidance

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

Fig 1



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

Scan the QR Code to view the video for this exercise

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

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

Fig 1

Job Sequence

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

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

Table 1

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

- Get it checked by your instructor.

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

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

Scan the QR Code to view the video for this exercise

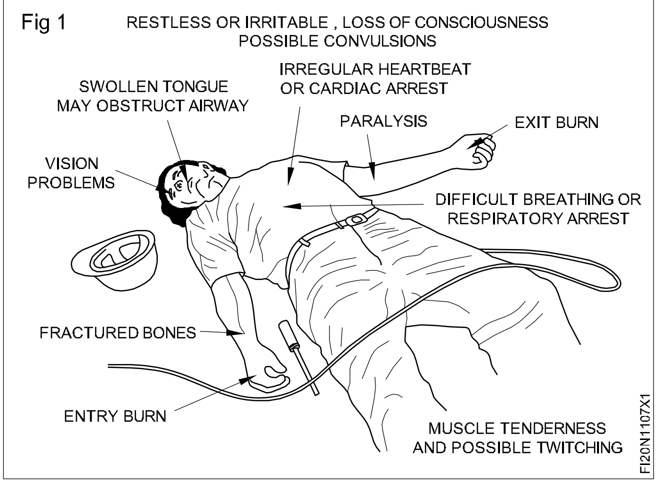
Note: The instructor shall arrange suitable electrical Safety poster/chart/slogan appropriate to this exercise

Preventive measures for electrical accidents

- Never touch any electrical apparatus /machinery with wet hands or while standing in water.
- If you get a tingle or shock when touching any electrical item, a sink, tub, or other wet area, turn off the power at the main panel and immediately call an electrician.
- Don't use damaged or broken cords/ wires or plug in anything with a missing prong.
- When unplugging, don't pull the cord; pull it by the plug.
- Don't overload sockets; use a power extension board with a safety switch.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.
- Avoid for water or chemical spills on or near electrical equipment. Wear rubber shoes in wet areas.
- Cover unused outlets and keep metal objects away from outlets. you should always take extra care to ensure that you do not come into contact with the exposed live wires as this runs the risk of shock and burns.
- Put a notice nearby to the appliance to inform others of the danger and to ensure that it is protected until you are able to schedule repairs.
- Use safe work practices every time electrical equipment is used.
- All electrical installations regardless of whether at home or in the workplace, must be grounded, which is otherwise known as earthing to track down any excess electricity, the most effective route to return to the ground without posing any safety risks.
- It is safe to work on the electrical equipment that is plugged in with only dry hand and wear non-conductive gloves and insulated-soles shoes.
- Disconnect the device from the source in the period of service or maintenance of the device.
- Disconnect the power source before servicing or repairing electrical equipment.
- All electrical cords should have sufficient insulation to prevent direct contact with wires.
- In a laboratory/workshop it is particularly important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.
- Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.
- Keep away from the energized or loaded circuits Arcing, sparking, or smoking from the equipment
- If the device interacts with water or other liquid chemicals, equipment must be shut off power at the main switch or circuit breaker and unplugged.
- If any individual comes in contact with a live electric line, do not touch the individual or equipment / source/ cord; disconnect the power source from the circuit breaker or pull out the plug using a leather belt.
- always stay at least ten feet away from the overhead power lines, carry highest voltage, which means that should anyone come into contact with them, there is a significant risk of not only electrocution but also severe burns.

First Aid for Accidental Electric Shock Victims (Fig 1)

Fig 1



- Ensure that you are taking sufficient safety precaution to protect yourself before going to help the other person met with accidental electric shock.
- Talk to the person and ask loudly, "Are you OK?"; make him feel comfortable.

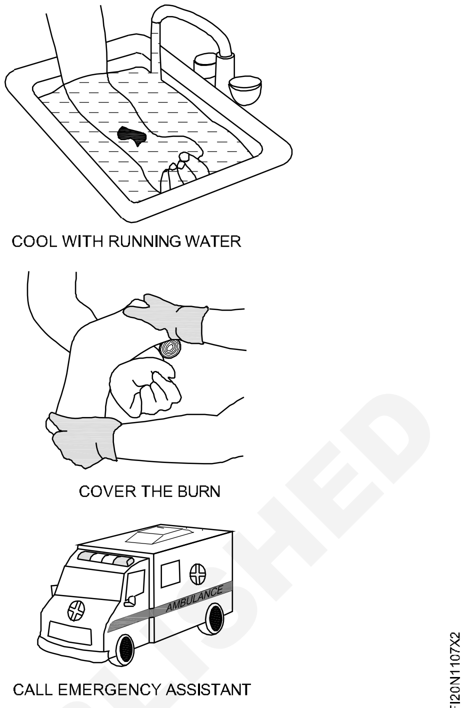
- Check for ventilation and airways; clear obstruction and provide fresh air flow.
- Check for signs of normal breathing; observe breathing.
- If not breathing normally, begin CPR
- Unplug the appliance or turn off the power at the control panel.
- If you can't turn off the power, use a dry wooden piece, like a broom handle, dry rope or dry clothing, to separate the victim from the electrical contact / power source.
- Do not try to move the victim touching a high voltage wire; Call for emergency help/immediate superior for assistance.
- Unconscious victims should be placed on their side to allow drainage of fluids; Keep the victim lying and observe for the symptoms shown in Fig.1
- Do not move the victim if there is a suspicion of neck or spine injuries call for the ambulance service.
- If the victim is not breathing, apply mouth-to-mouth resuscitation. If the victim has no pulse, begin cardiopulmonary resuscitation (CPR). Then cover the victim with a blanket to maintain body heat, keep the victim's head low and get medical attention.

First Aid for Accidental Electrical Burn Victims

Electrical burns vary in severity depending upon the following conditions

- how long the victim is in contact with the electric current;
- the strength of the current flow;
- the type of current AC or DC; and
- the direction of the current takes through the body.
- Observe the person, if the person is conscious and there are no signs of shock (such as being cold, clammy, pale and having a rapid pulse)
- Do not apply grease or oil to the burn.
- Cover the burn with a dry, sterile dressing.
- There may be more than one area burned.
- If the person has electrical burn, check for shock and follow the outlined points shown in Fig.2

Fig 2



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

Accidental Electrical Fire

- Keep flammable materials away: Electrical appliances or outlets that come into contact with flammable materials that may trigger a fire.
- Inspect electrical wiring: Have your electric wiring checked to prevent electrical fires. Wiring does not last forever, so it is a good idea to have your wiring checked
- Be wary of certain appliances: If an appliance blows a fuse, trips a circuit, or sparks while being used, unplug the appliance immediately, and check to see if it needs to behave it repaired or replaced.
- Check Switches or outlets that are hot to touch and/or emit an acid odour; Inspect and repair outlets and switches.
- In case of electrical fire, use only CO_2 type of Fire extinguisher.

Uses of fire extinguishers

Scan the QR Code to view the video for this exercise

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

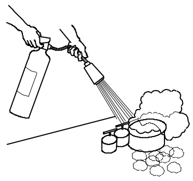
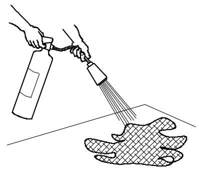
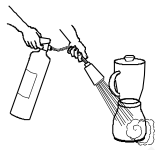
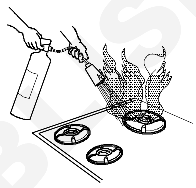
Job Sequence

Extinguishing fire

- Alert people surrounding by shouting fire, fire, fire.
- Inform fire service or arrange to inform immediately.
- Open emergency exist and ask them to go away.
- Analyze and identify the type of fire. Refer Table1.

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

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.

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

Operator: Operate the fire extinguisher

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

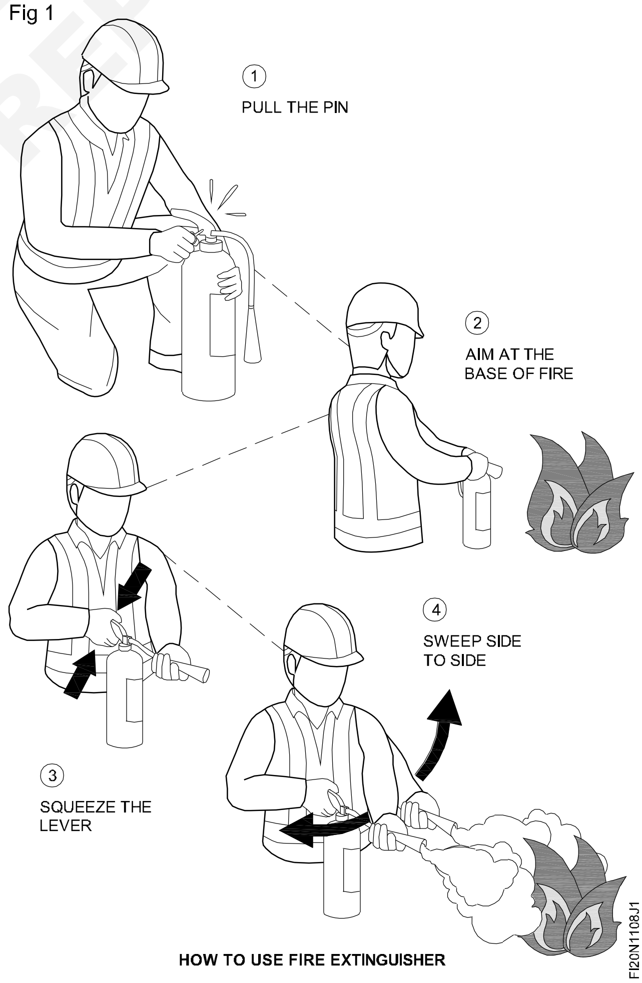
PULL the pin: This will allow you to discharge the extinguisher. (Fig 1)

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

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

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

Fig 1

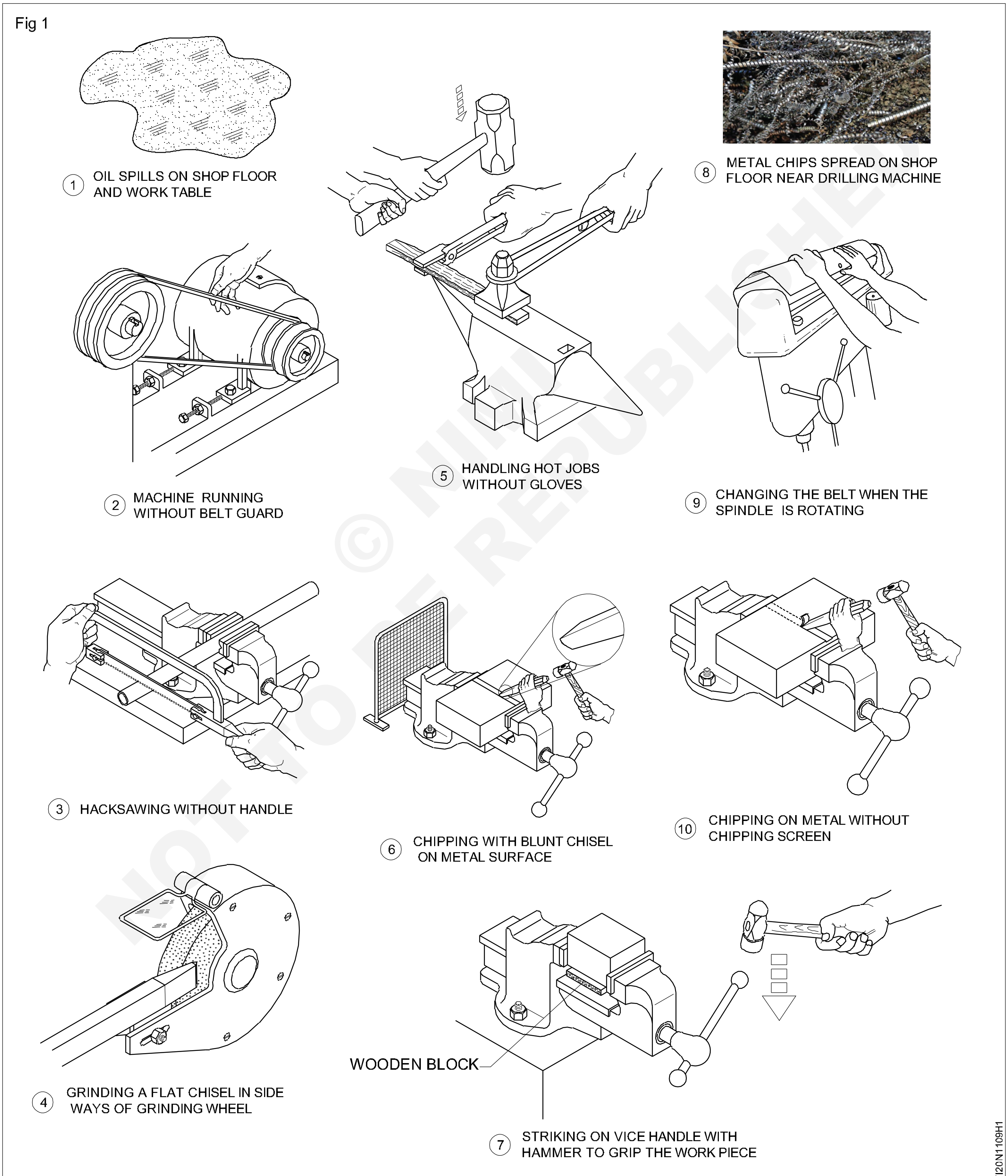


HOW TO USE FIRE EXTINGUISHER

Practice and understand precautions to be followed while working in fitting jobs

Objective: At the end of this exercise, you shall be able to
- **record the precaution to be followed while working in fitting jobs.**

Fig 1



Job Sequence

The instructor shall guide and demonstrate the students to practice and understand precautions to be followed while working in fitting jobs.

- Record the precautions to be followed while working in fitting job in Table 1

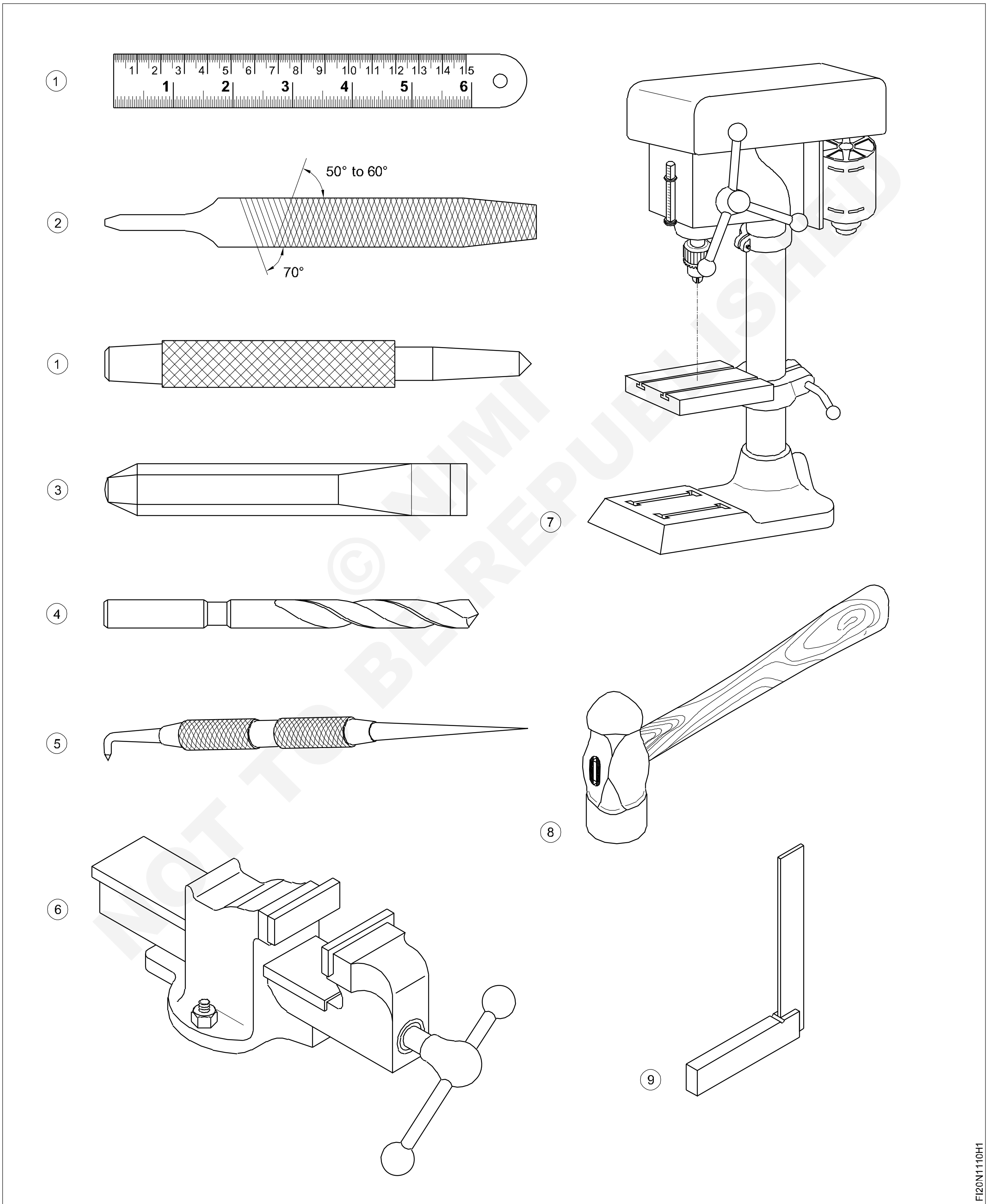
Table 1

Fig. No.	Description	Record precautions to be followed while working in fitting job
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

- Fill up and get it checked by your instructor.

Safe use of tools and equipment used in the trade

Objective: At the end of this exercise, you shall be able to
- **record the safety points while using the fitter trade tool and equipment.**



Job Sequence

The instructor shall emphasise the students about the safe use of tools and equipmment used in trade and guide them to record the safety points

- Record the precautions to be followed while working in fitting job in Table 1

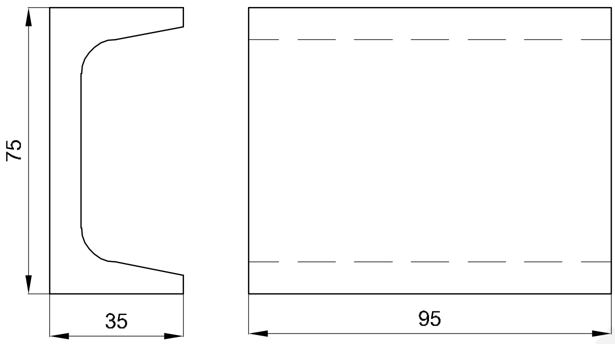
Table 1

Fig. No.	Description	Record precautions to be followed while working in fitting job
1		
2		
3		
4		
5		
6		
7		
8		
9		

- Fill up and get it checked by your instructor.

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.**

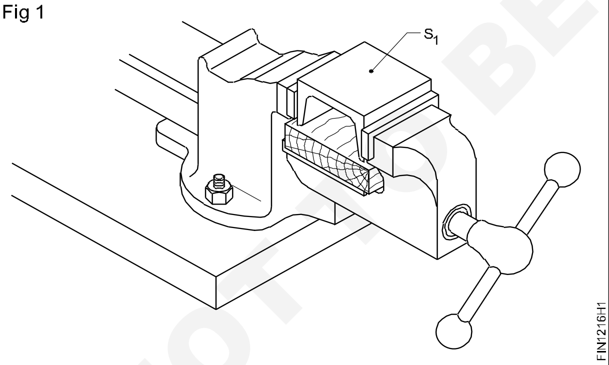


Job Sequence

- Check the stock size with a steel rule.
- Hold the job in bench vice, so that surface S_1 comes on top.(Fig 1)

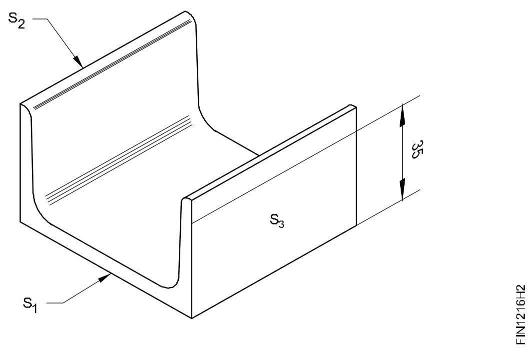
> **Apply only limited clamping force so that the ribs do not bend**

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



1	BISLC 75 - 95	-	Fe310	-	-	1.2.16
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**CHANNEL PARALLEL**	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1216E1	

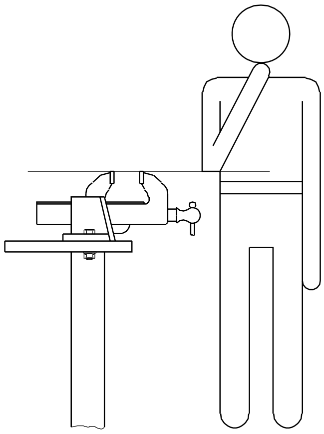
Skill Sequence

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

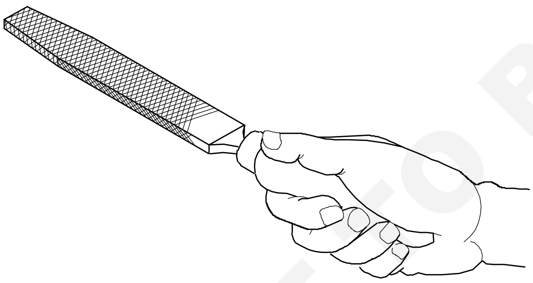


Hold the job in the bench vice with a projection of 5 to 10mm from the top of the vice jaw.

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)

For light filing. (Fig 4)

For removing local unevenness. (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 3

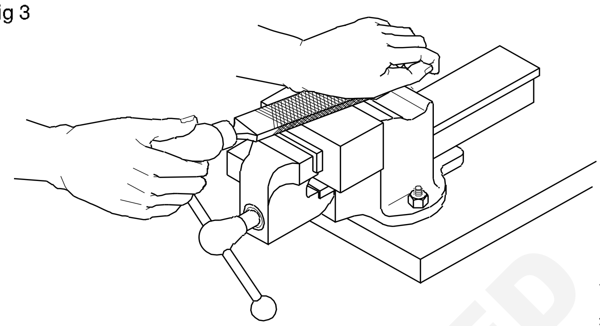


Fig 4

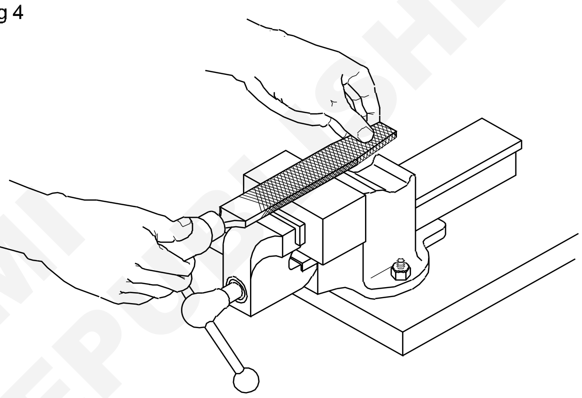


Fig 5

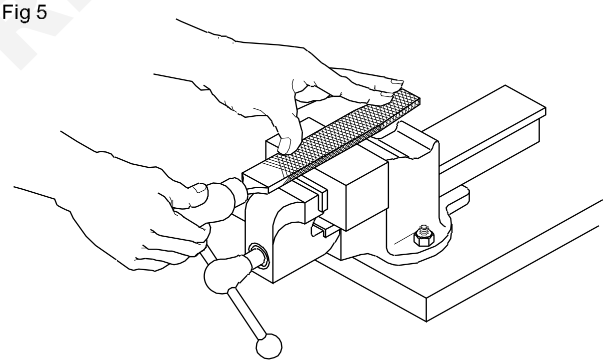
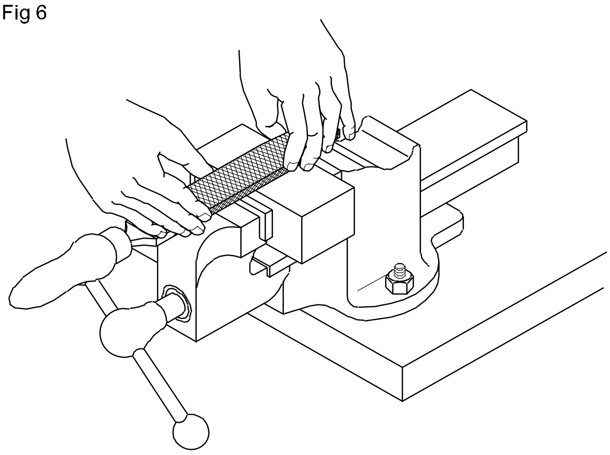


Fig 6



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

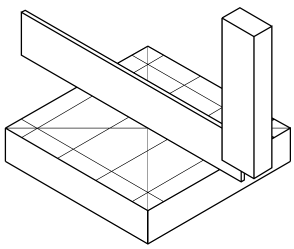
Continue giving strokes. Balance the pressure of the file in such a way that the file always remains flat and straight over the surface to be filed.

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)

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.

Fig 2

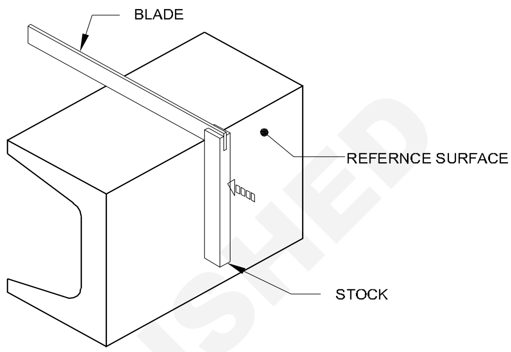
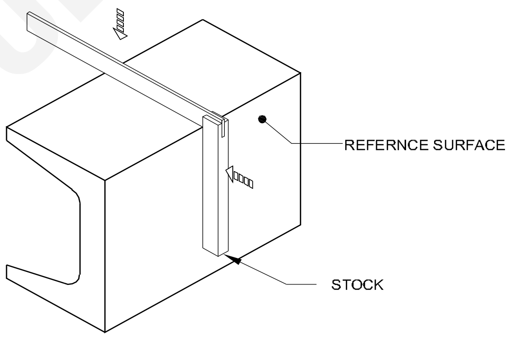


Fig 3



Scan the QR Code to view the video for this exercise

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)

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 1

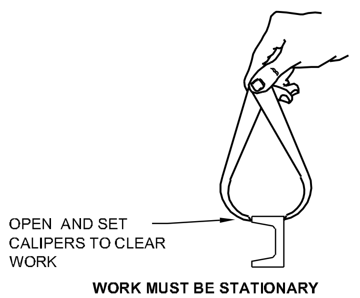
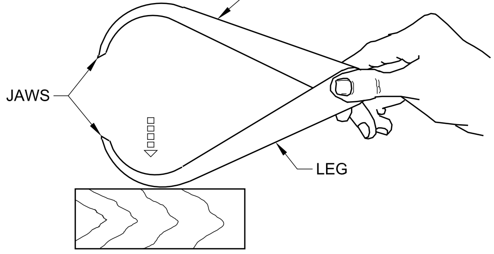


Fig 2



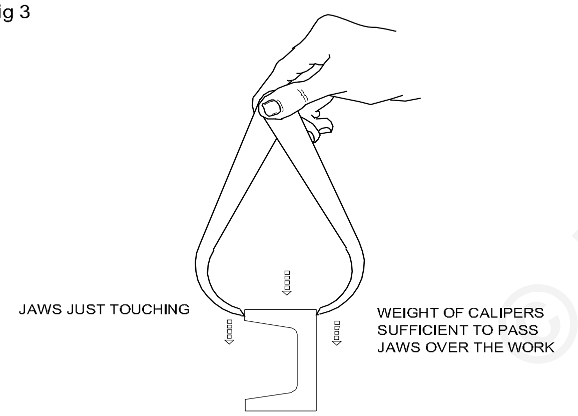
TAP GENTLY TO CLOSE CALIPERS

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)

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.

Fig 3



OBTAINING THE 'FEEL'

Checking parallelism with outside caliper. (Fig 4)

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

Fig 4

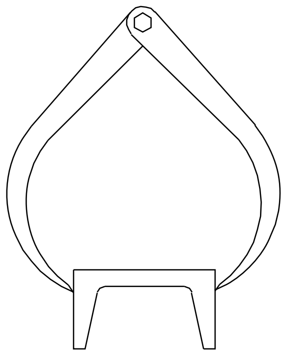
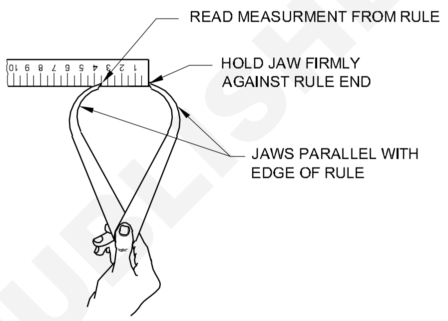


Fig 5



CHECKING THE DIMENSION

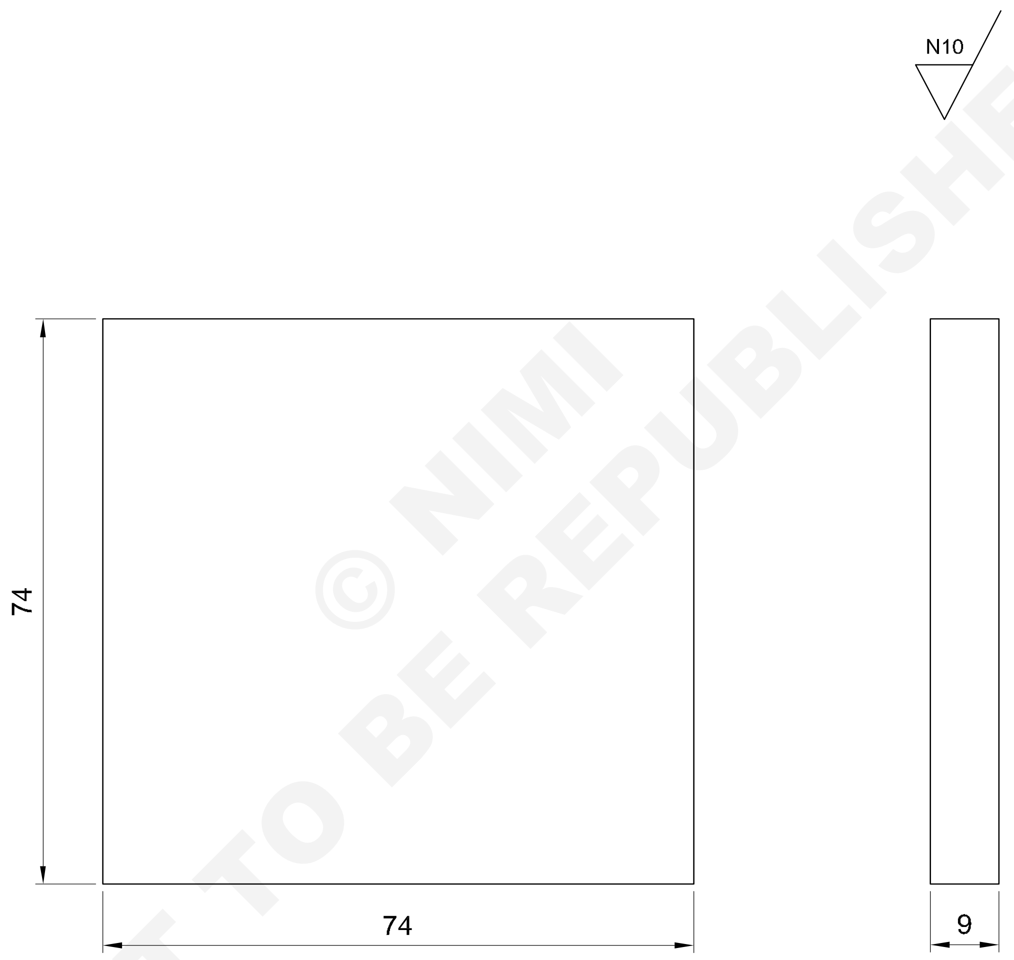
The point of one jaw must be placed over the graduation so that the point of the other jaw is parallel with the edge of the steel rule. (Fig 5)

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.

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	75 ISF 10-75	-	Fe310	-	1	1.2.17
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

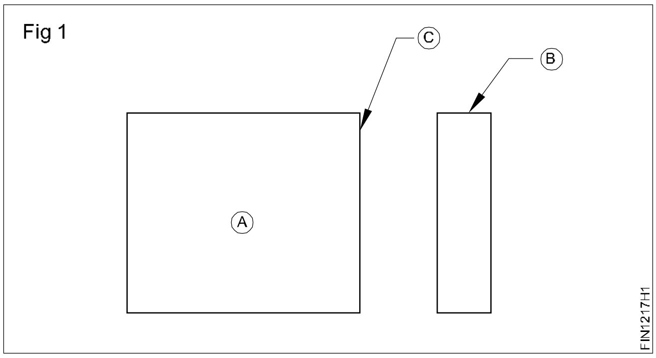
SCALE 1:1	**FITTING FLAT AND SQUARE (ROUGH FINISH)**	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1217E1	

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).
- Similarly file side (C)
- Check the squareness with a try square.

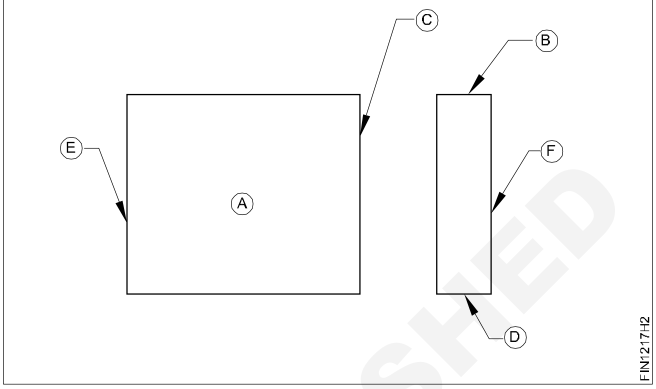
The side A,B and C are mutually perpendicular to each other (Fig 1)

Fig 1



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

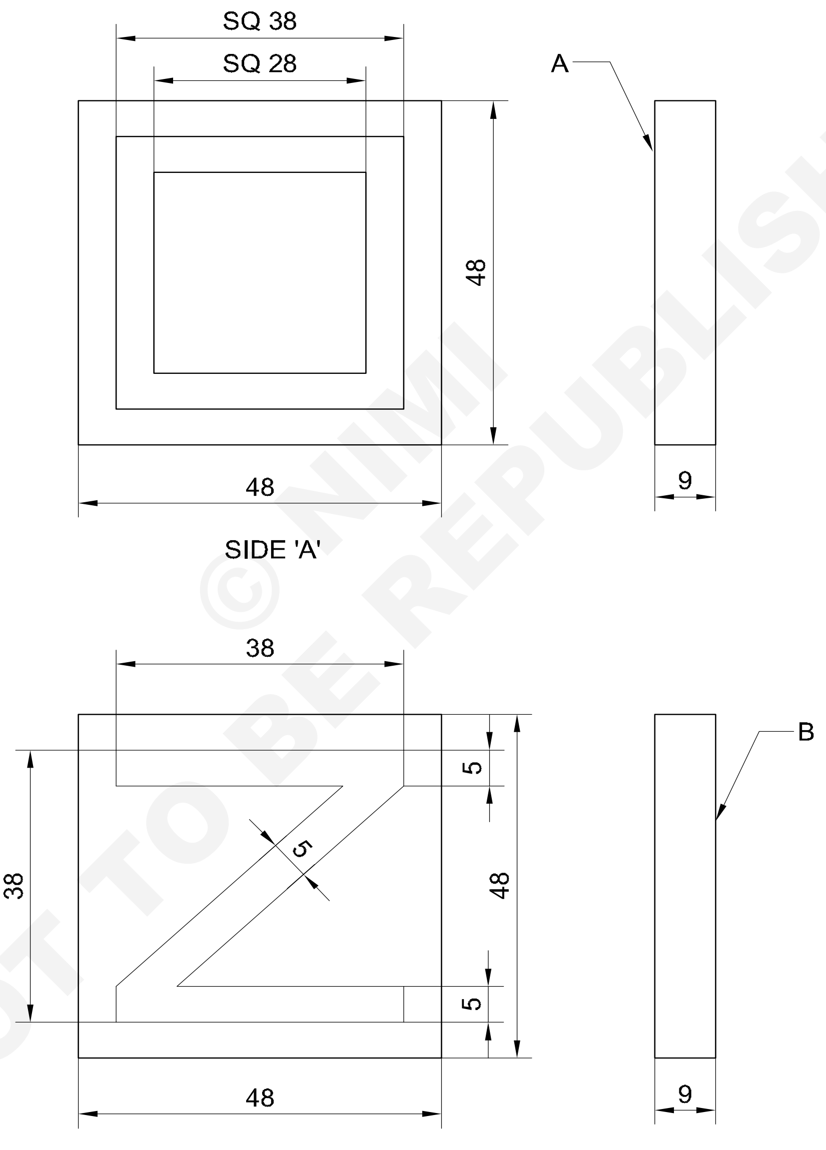
Fig 2



- 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.

Filing practice, surface filing, marking of straight and parallel lines with odd leg caliper 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.**



NOTE: Use same material for both the markings (Side A & B)

1	50 ISF 10-50	-	Fe310	-	-	1.2.18
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

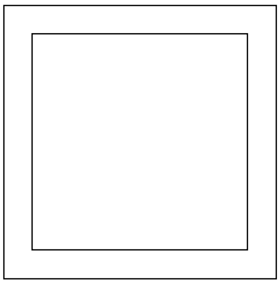
SCALE 1:1	**MARKING WITH ODD LEG CALIPER AND STEEL RULE**	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1218E1	

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)

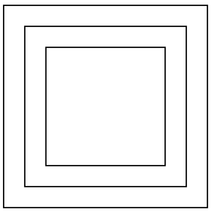
Fig 1



FI20N1218H1

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

Fig 2

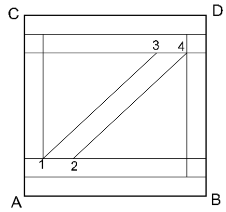


FI20N1218H2

Mark on side B

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

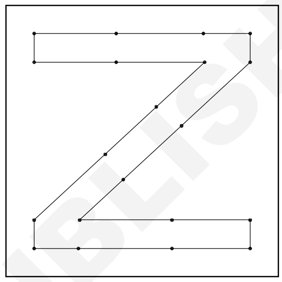
Fig 4



FI20N1218H3

- 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



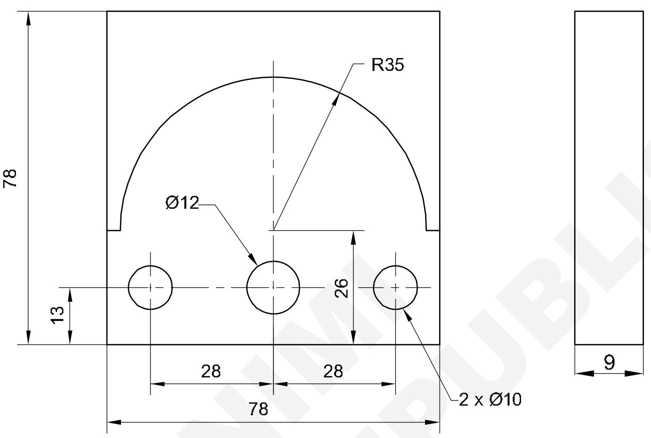
FI20N1218H4

- Join point 1 and 3, 2 and.4, and punch witness marks as shown in Fig 4 & Fig 5.
- Apply little oil and preserve it for validating the marking.

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

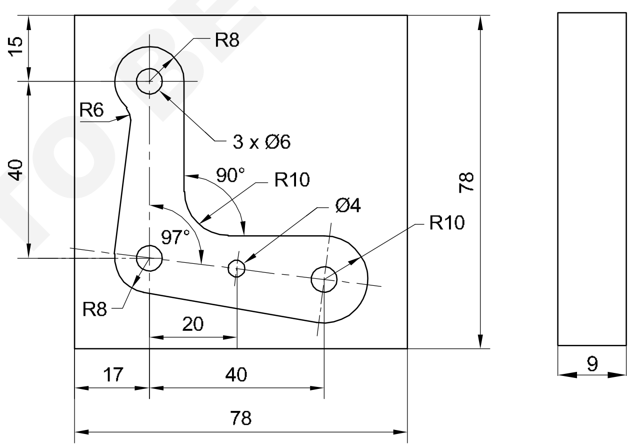
Objectives: At the end of this exercise you shall be able to
- **mark parallel lines with jenny caliper**
- **mark angular lines with a protractor and scriber**
- **mark arcs, circles and tangents with divider and scriber.**

TASK 1



MARKING CURVES & CIRCLES
(By Jenny caliper and divider)

TASK 2



MARKING TANGENTS & ARCS

NOTE: Use same material for both the tasks (side A & B)

1	80 ISF 10-80	-	FE 310	-	-	1.2.19
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

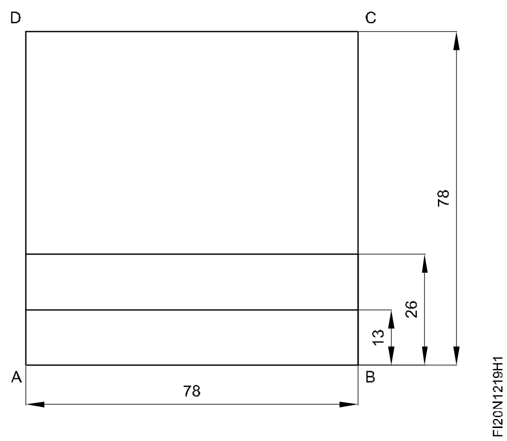
SCALE 1:1	**MARKING PRACTICE**	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1219E1	

Job Sequence

TASK1: **Marking curves & circles**

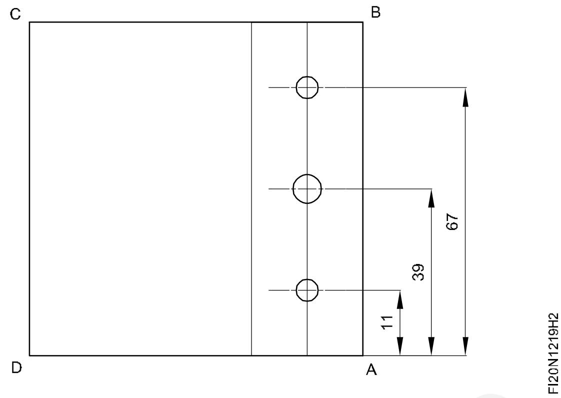
- Check the raw material size using steel rule
- File the raw material to size 78x78x9 mm
- Apply marking media cellulose lacquer on the surface of the Job.
- Set the dimension 13 mm in Jenny caliper and draw parallel line as per drawing with reference to 'AB'.Fig 1
- Similarly, set the dimensions 26mm and draw parallel line Fig 1

Fig 1



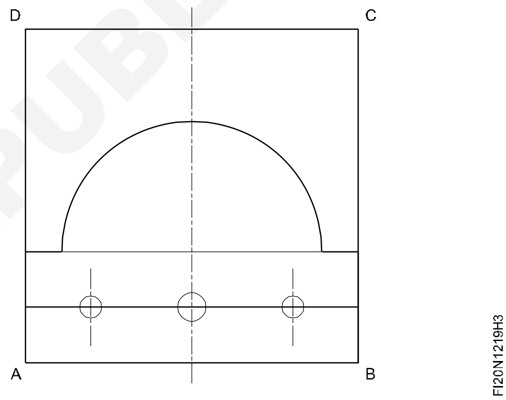
- Set the dimension 11 mm in Jenny caliper and draw parallel line as per drawing with reference to 'DA'. Fig 2
- Similarly, set the dimensions 39 mm, 67 mm and draw parallel lines. Fig 2
- Punch on the intersecting point of centre lines to draw circle and radius using prick punch 30°

Fig 2



- Set the radius 5mm, 6mm in divider and draw circles, as per drawing. (Fig 3)
- Set the radius 35 mm and draw arc as per drawing. (Fig 3)
- Punch witness marks on the circles and radius.
- Preserve it for evaluation.

Fig 3



TASK 2: **Marking tangents & arcs**

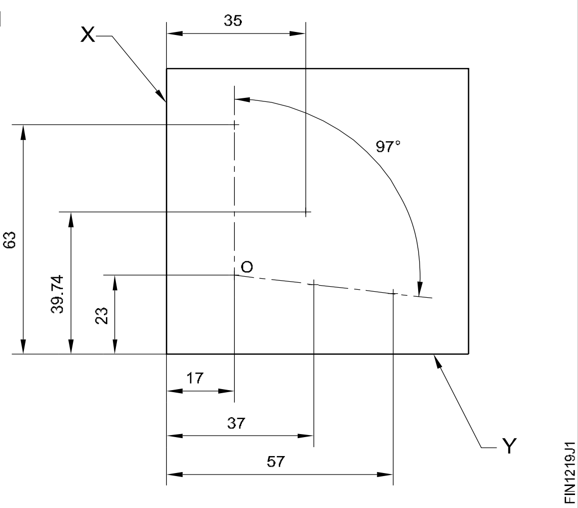
Step 1

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

Step 2

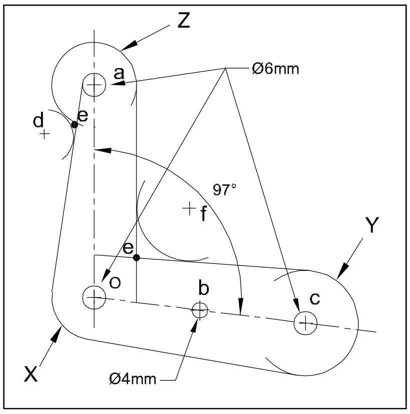
- Draw parallel lines of 17,35,37 and 57 from side 'X' (Fig 1).
- Mark parallel lines of 23,39.74 and 63mm from side 'Y' (Fig 1).
- Set 97° on the bevel protractor
- Mark 97° line through point 'O' and set the centres of other two circle
- Punch centre marks on all four circles

Fig 1



Step 3 (Fig 2)

Fig 2

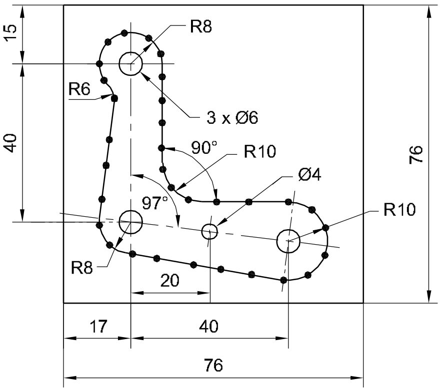


- Draw Ø6 mm circle at 'a','o','c' and Ø4 mm circle at 'b'.

Step 4 (Fig 2)

- Draw an arc, R8 mm from the centre ‘a’ and ‘o’
- Draw an arc, R10 mm from the centre ‘c’.
- Draw tangent lines to join X,Y and Z as shown in Fig 2.
- 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 2

Fig 3



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

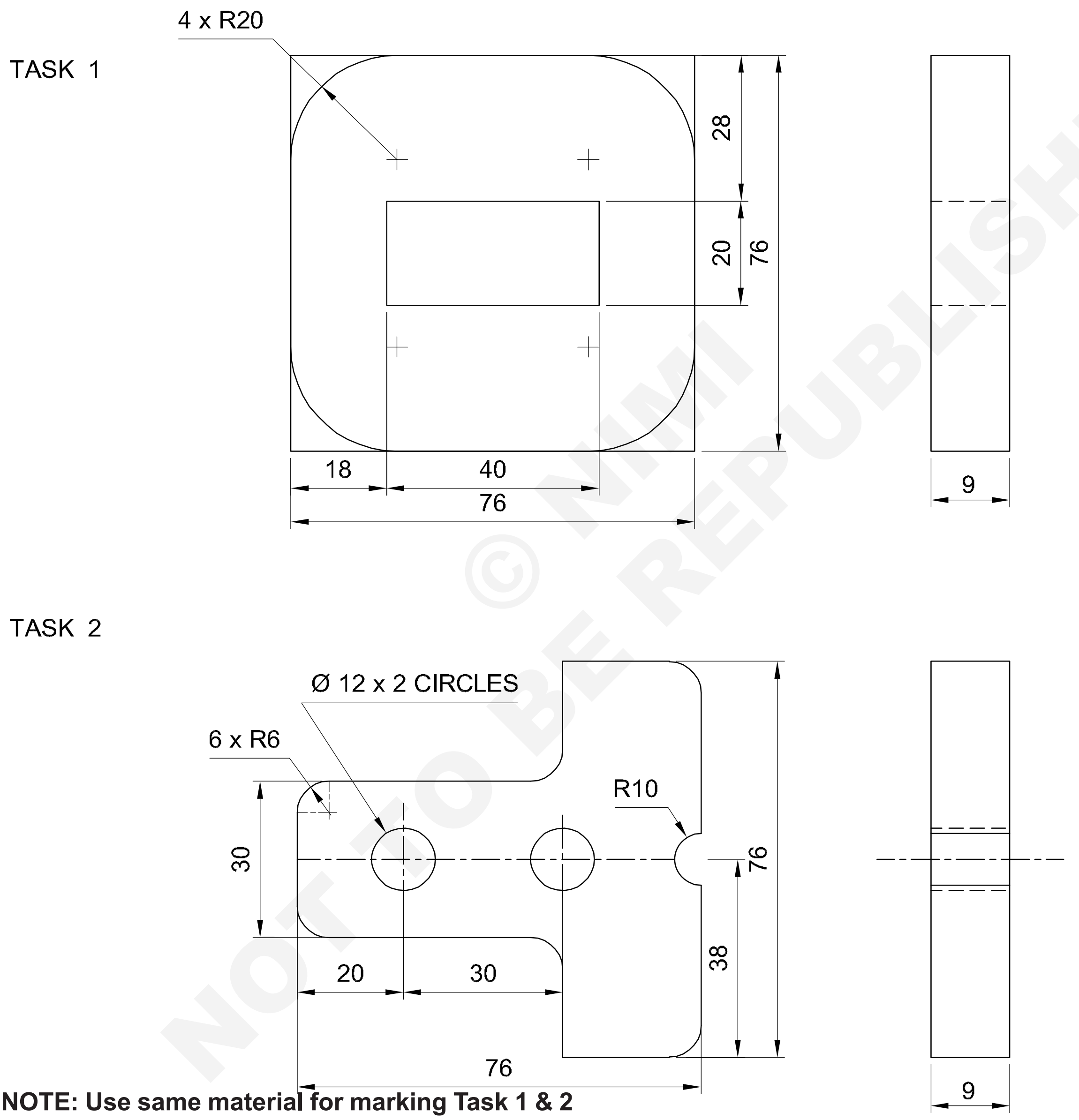
Step 5 (Fig 3)

- Punch on the marked lines with equal intervals Fig 3.
- Preserve the job for evaluation.

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.**

Scan the QR Code to view the video for this exercise



NOTE: Use same material for marking Task 1 & 2

1	80 ISF 10 - 80	-	Fe310	-	-	1.2.20
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

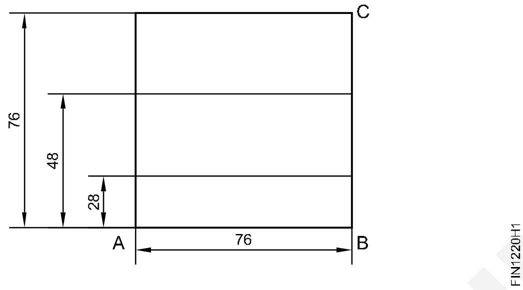
SCALE 1:1	**MARKING STRAIGHT LINES & ARCS USING SCRIBING BLOCK & DIVIDERS**	TOLERANCE : ±0. 5mm	TIME :
		CODE NO. FI20N1220E1	

Job Sequence

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

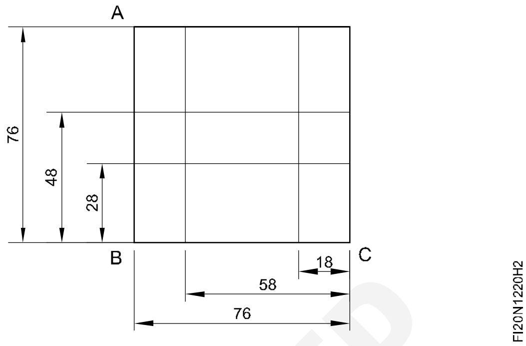
- Check the raw material size using steel rule.
- File three sides mutually perpendicular to each other.
- Mark and file to size of 76 x 76 x 9 mm
- Clean Marking Table, Angle plate, Scribing block and Steel rule with soft cloth.
- Place Scribing block, Angle plate and Steel rule on marking table.
- 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



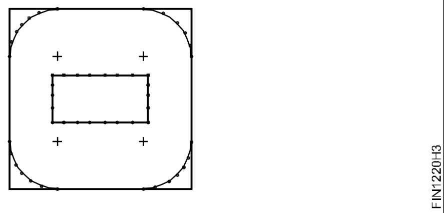
- Similarly, set 48 mm and scribe line with reference to side ‘AB.
- Turn and place the Job with reference to side ‘BC’.
- Set the size 18 mm and scribe line with reference to side ‘BC’ Fig 2.
- Similarly, set the size 58 mm and scribe line with reference to side ‘BC’

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

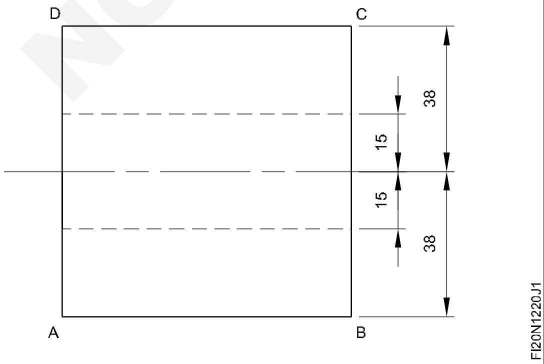


TASK 2: **Marking straight lines, arcs & edges**

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

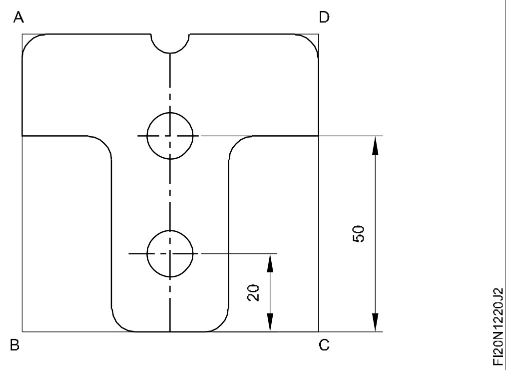
- Mark the centre line 38mm from reference surface AB.
- MArk 15mm above the centre line and 15mm below the centre line as per drawing. (Fig 1)

Fig 1



- Mark 20mm and 50mm on the centre line draw reference surface BC. (Fig 2)
- Mark radius R6 on 6 places.
- Join radius lines as per drawing.
- Draw ∅ 12mm circle on the marked reference of 20mm and 50mm.
- Mark corner of the centre R10mm as shown in Fig 2.
- Punch on the mark line by 60° dot punch.

Fig 2



Skill Sequence

Marking parallel lines using surface gauge

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

Scan the QR Code to view the video for this exercise

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

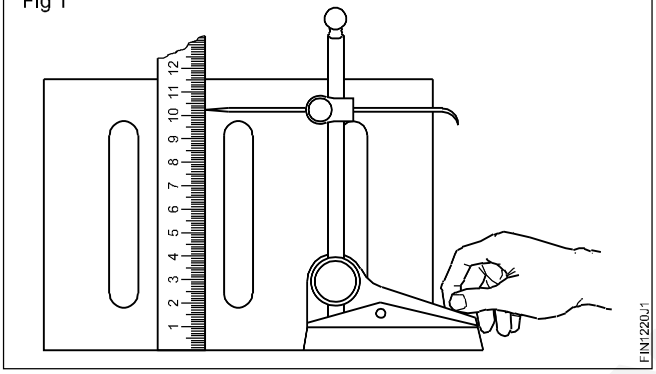
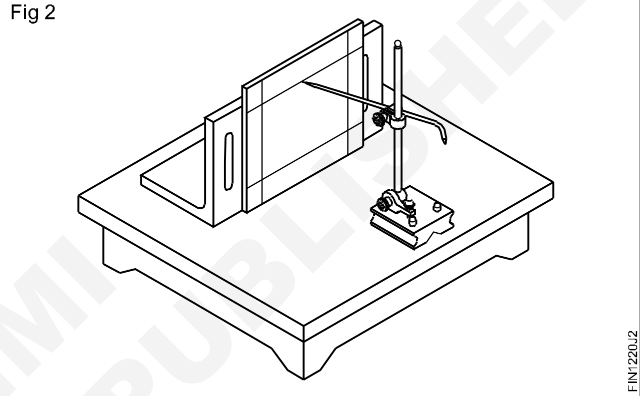


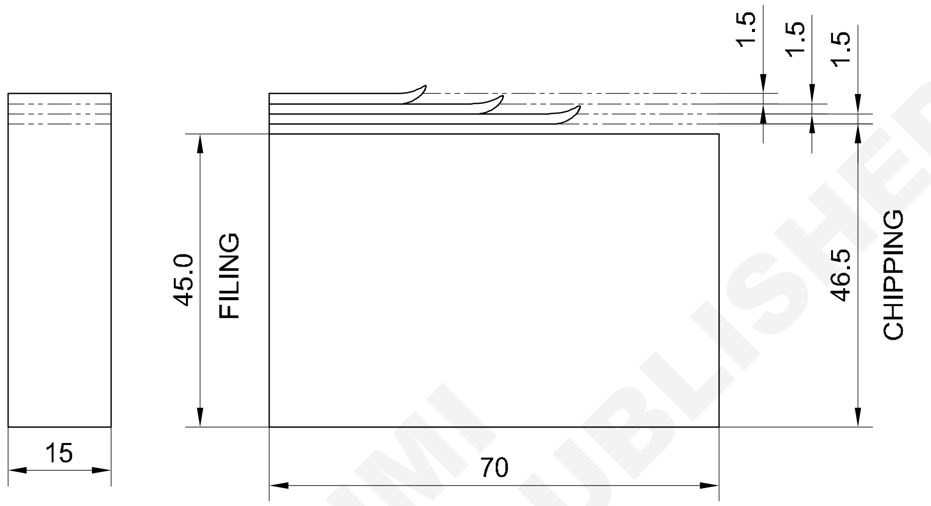
Fig 2



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	-	-	1.2.21
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	CHIPPING FLAT SURFACE	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1221E1	

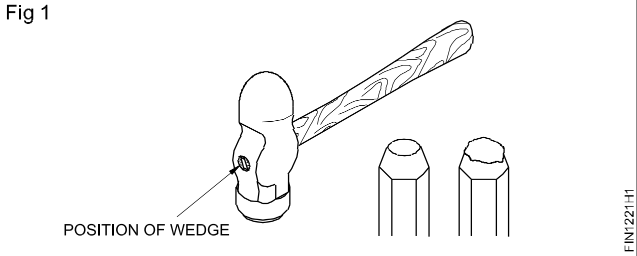
Skill Sequence

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

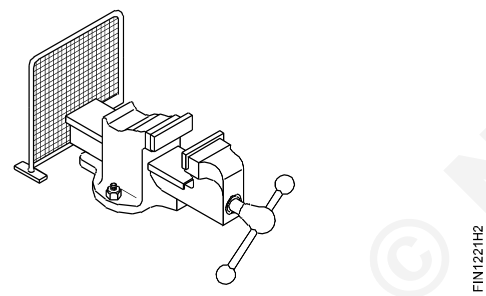


Wipe off oily substances, if any, from the face of the hammer.

Wear safety goggles.

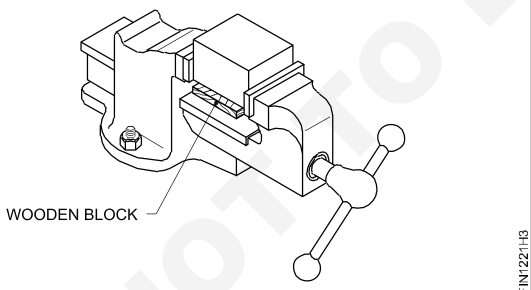
Install the chipping screen. (Fig 2)

Fig 2



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

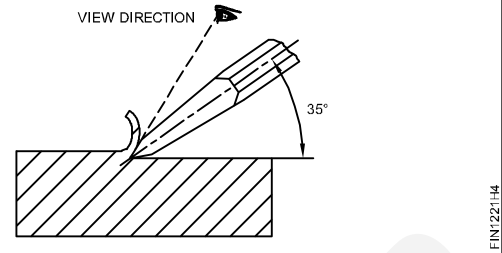
Fig 3



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

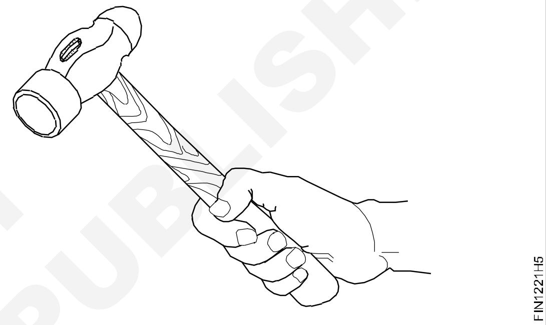
Hammer the head of the chisel by looking at the point of the chisel. (Fig 4)

Fig 4



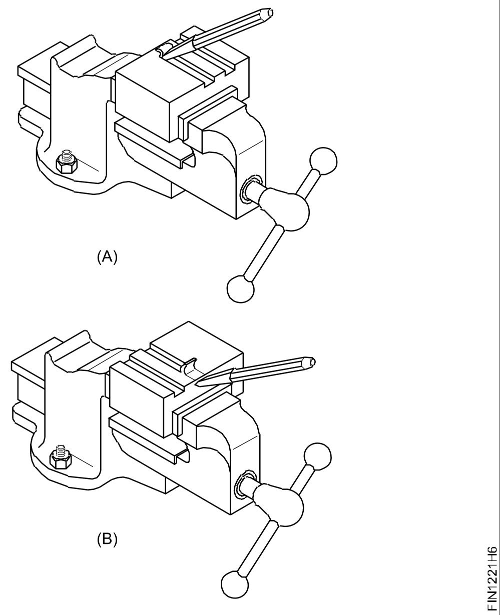
Hold the hammer at the end of the handle for maximum leverage. (Fig 5)

Fig 5



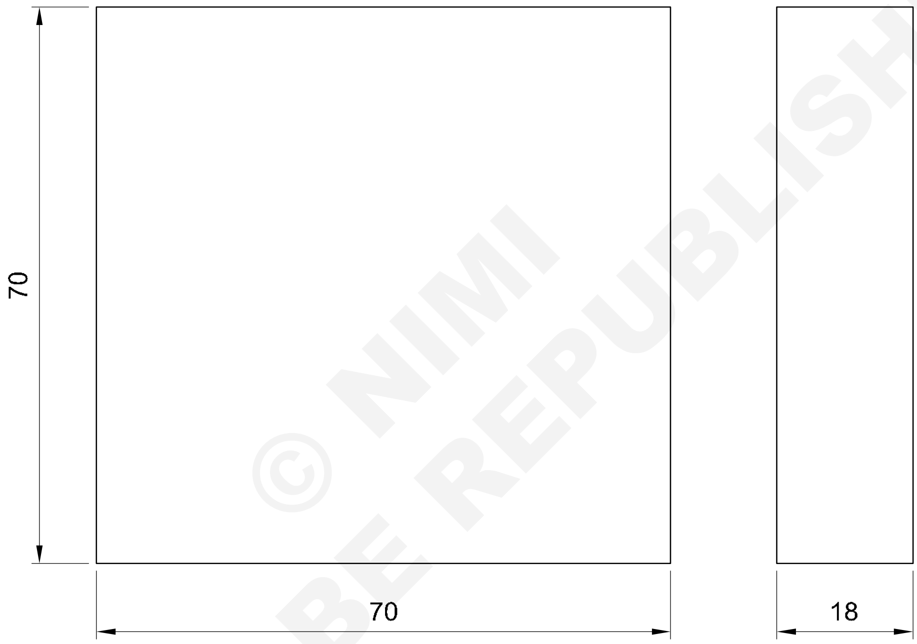
Stop chipping before the end of the surface; otherwise the edge of the job will break off. To prevent this, chip the end of the job from the opposite direction. (Figs 6A & B)

Fig 6



Marking, filing, flat, 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.**



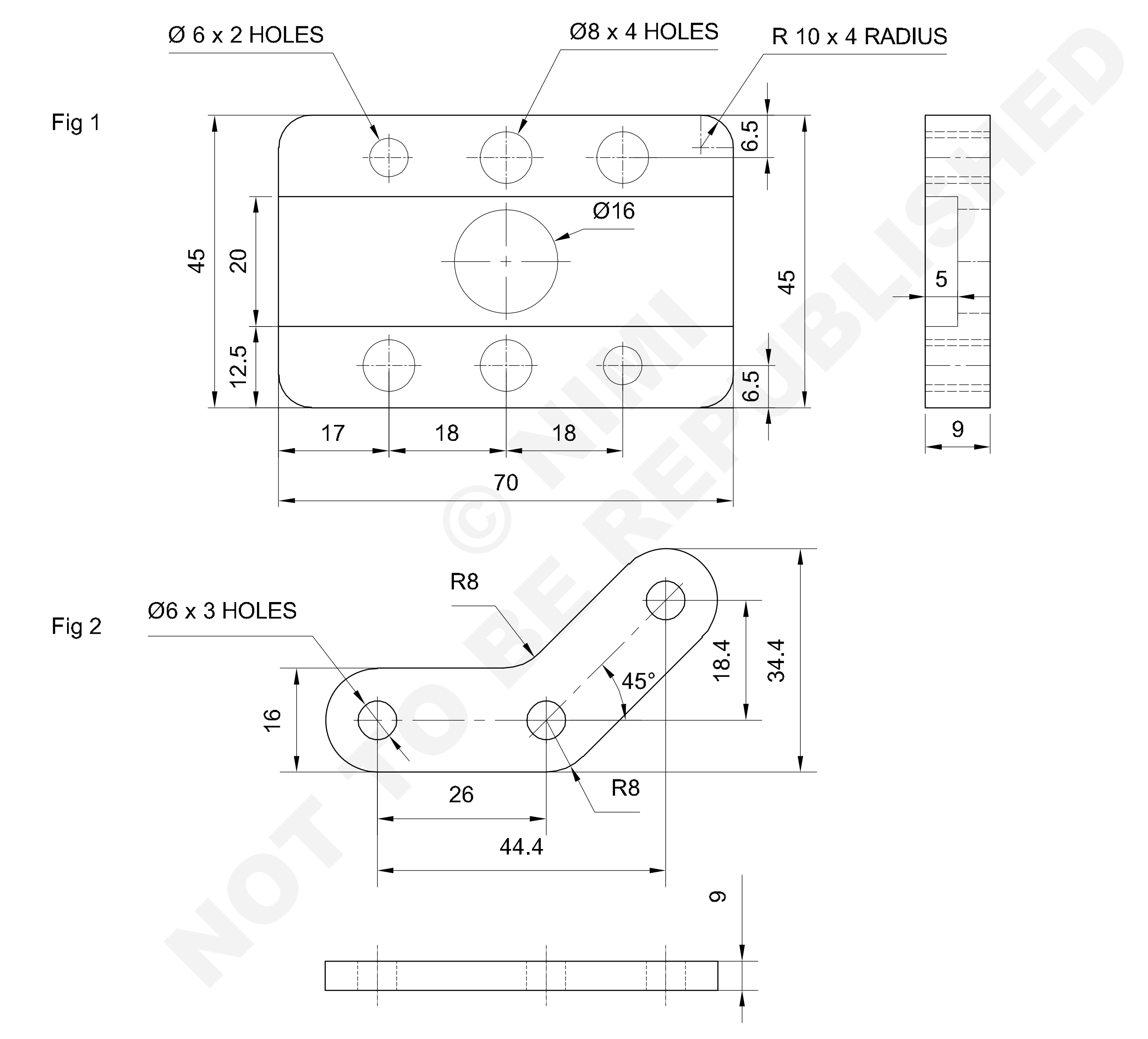
Job Sequence

- Check the raw material size using steel rule.
- File 3 sides mutullay 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	-	-	1.2.22
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	FILING FLAT AND SQUARE				TOLERANCE :- ±0.5mm	TIME :
					CODE NO. FI20N1222E1	

Marking according to simple blue prints 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.**



1	50 ISF 10-50	-	Fe 310	-	Fig 3	
2	50 ISF 10-75	-	Fe 310	-	Fig 1,2,4	1.2.23
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**MARKING PRACTICE**	TOLERANCE : - ±0.5mm	TIME :
		CODE NO. FI20N1223E1	

Fig 3

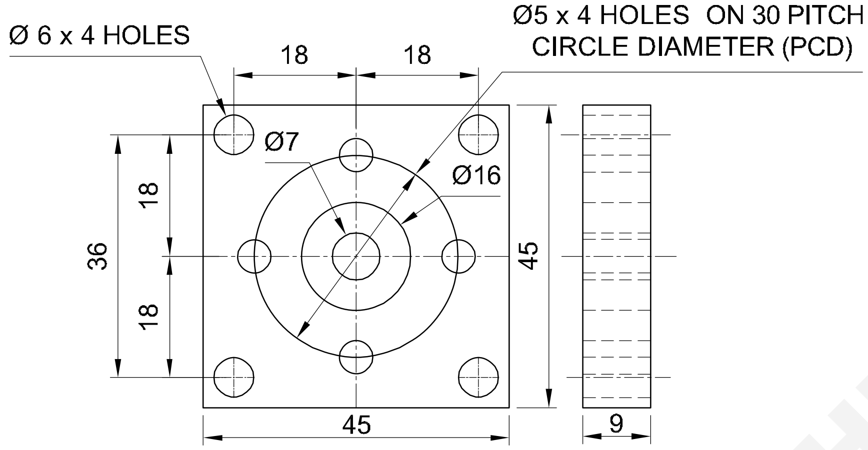
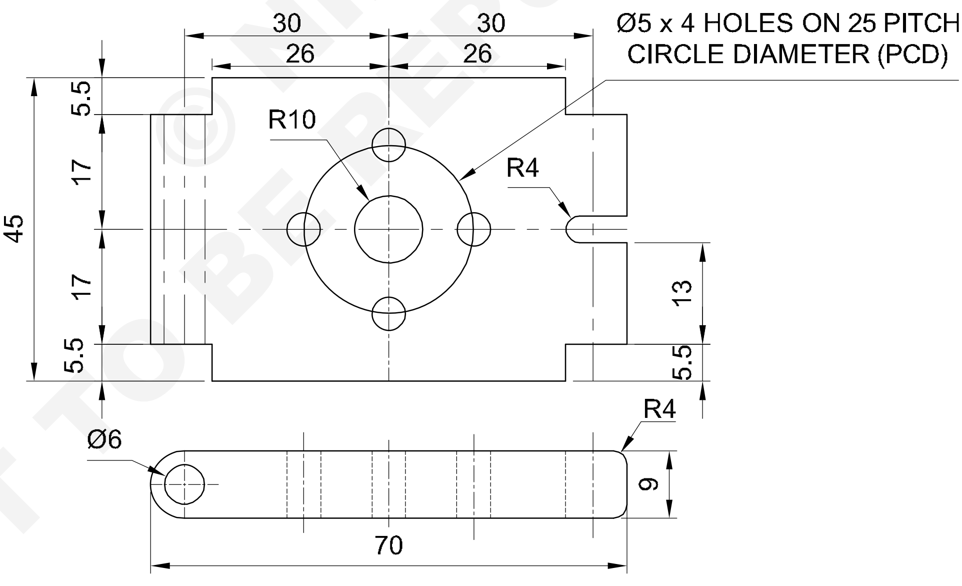


Fig 4



NOTE: Use both the surfaces of metal for marking Fig 1,2 & 4

-	-	-	-	-	-	1.2.23
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**MARKING PRACTICE**	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1223E2	

Job Sequence

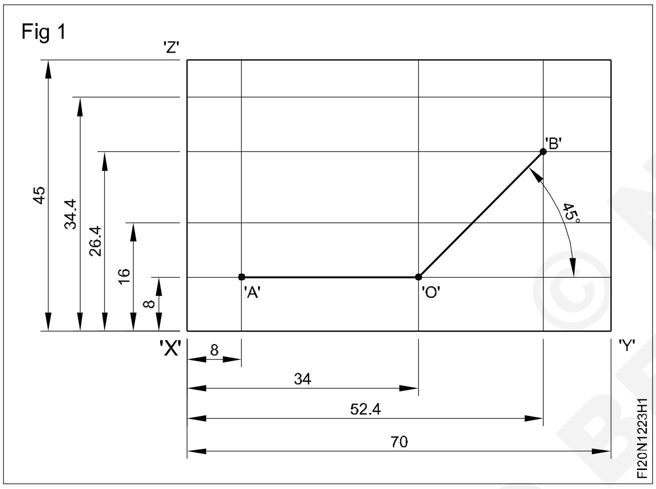
Figure: 1

- 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 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

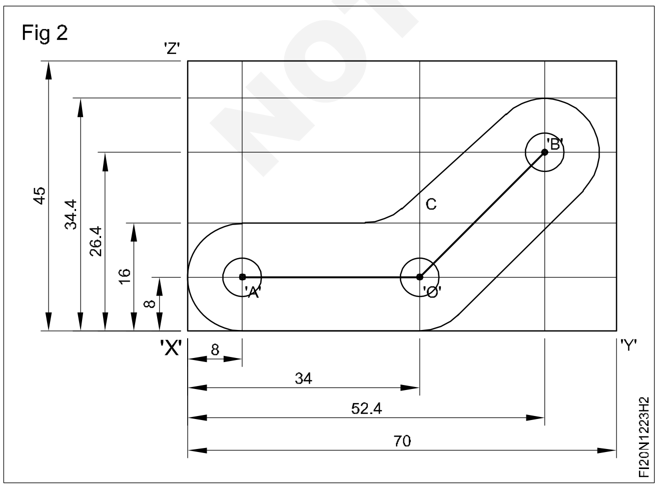
- Apply marking media on the another surface of the job.
- Mark 8mm, 16mm, 26.4 mm and 34.4 mm lines using Jenny caliper with reference to ‘xy’.
- Mark 8mm, 34 mm and 52.4 mm lines using Jenny caliper with reference to ‘xz’. fig 1.

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

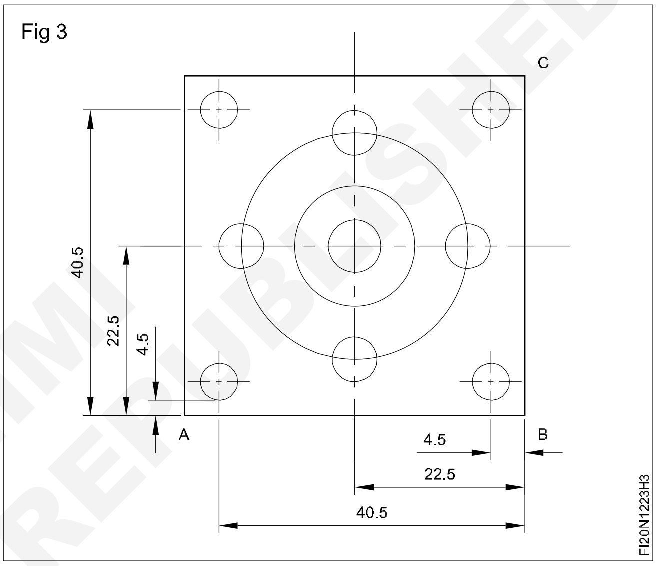
Fig 2



- Set the radius 3 mm in divider and draw circles Ø 6mm 3 holes at point 'A','O' and 'B' as shown in Fig 2
- 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.

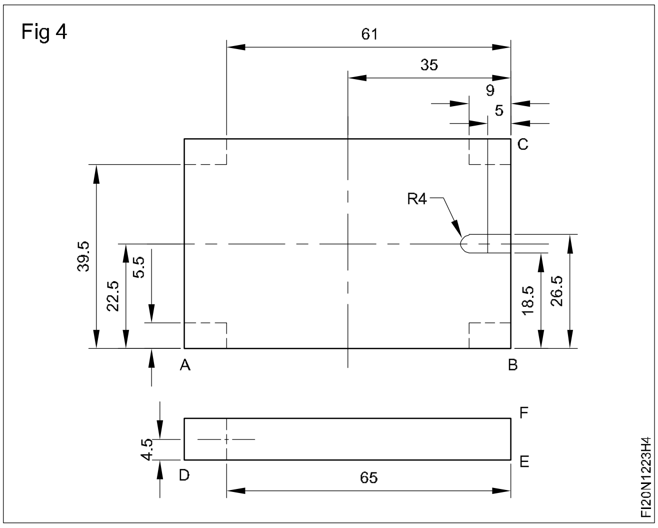
Figure 3

Fig 3



- Apply marking media on the surface of job (45x9x45mm)
- Mark job centreline 22.5mm with reference to AB
- Mark 4.5mm, 40.5mm lines using jenny caliper with reference to AB
- Mark job centreline 22.5mm with reference to BC.
- Punch on the intersection point of job centreline by using prick punch.
- Mark 4.5m, 40.5mm lines using jenny caliper with reference to BC.
- Set the radius 3mm, 3.5mm,8mm,15mm and draw circle as per drawing.
- Set the radius 2.5mm and draw 4 circles as per drawing.

Figure 4

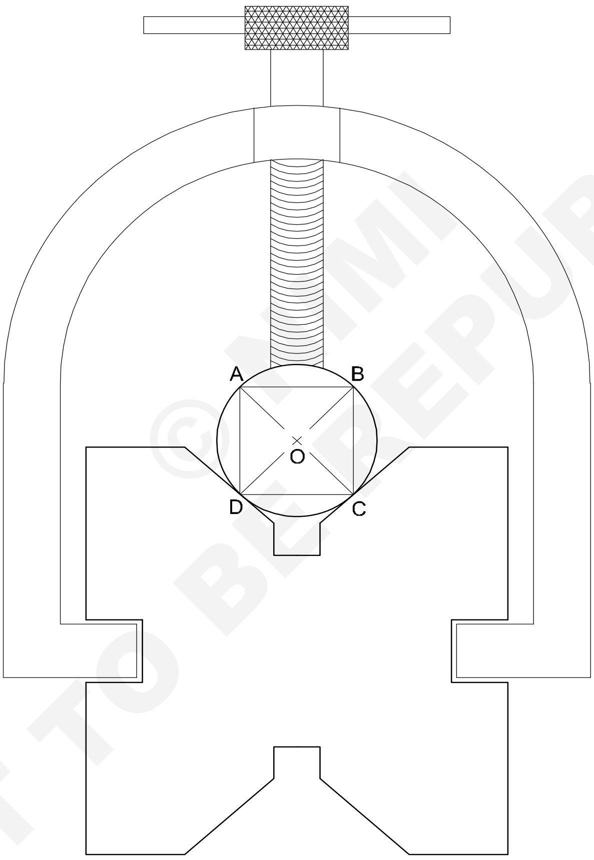


- Apply marking media on two surfaces of the job 70x9x45mm
- Mark 5.5mm centre line 22.5mm, 39.5mm and 20.5mm, 24.5mm with reference to AB.
- Mark 5mm, 9, centre line 35mm,61mm lines with reference to BC.
- Punch on the intersecting point of job centreline by using prick punch.
- Set the radius 5mm,12.5mm and draw circles as per drawing.
- Set the radius 4mm and draw the arc as per drawing.
- Set the radius 2.5mm and draw the circle at 4 places as per the drawing.
- Place the job in horizontal position.
- Mark 65mm with reference to EF and mark 4.5mm with reference to DE.
- Punch on the intersecting point using prick punch.
- Set radius 3mm and draw circle as per drawing.

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

Scan the QR Code to view the video for this exercise

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.**



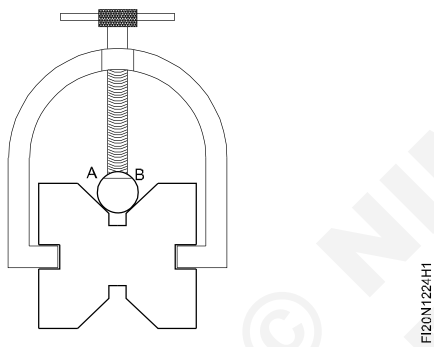
1	Ø50-50	-	Fe310	-	-	1.2.24
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	FINDING CENTER OF A ROUND BAR	TOLERANCE : - ±0.5mm	TIME :
		CODE NO. FI20N1224E1	

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 line AB to 90° using try square and Tighten the 'U' clamp and scribe line BC (Fig 2).
- Repeat the same procedure to scribe lines CD and AD Fig 3.

Fig 2

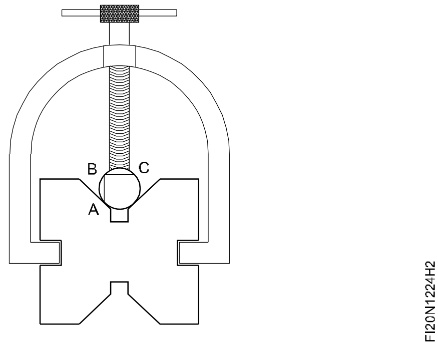
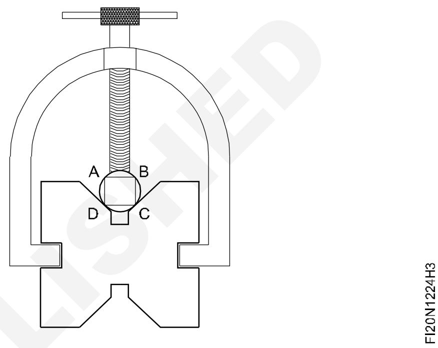
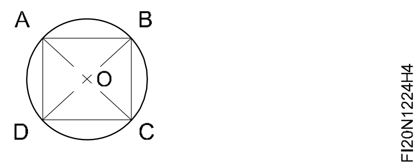


Fig 3



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

Fig 4

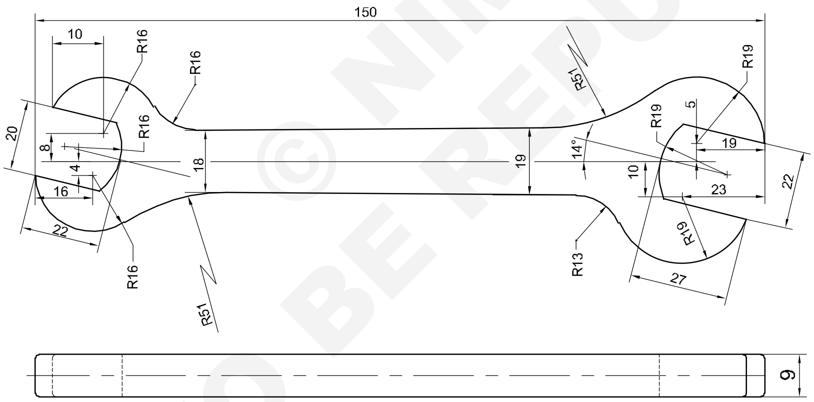


 Exercise 1.2.25

Joining straight line to an arc

Objectives: At the end of this exercise you shall be able to
- **mark lines on metallic surfaces with marking block**
- **mark lines with scriber**
- **mark angles with bevel protractor**
- **bisect the angles with divider**
- **draw circles, arcs and tangents with divider and scriber**
- **register the profile with dot punch.**

TASK 1



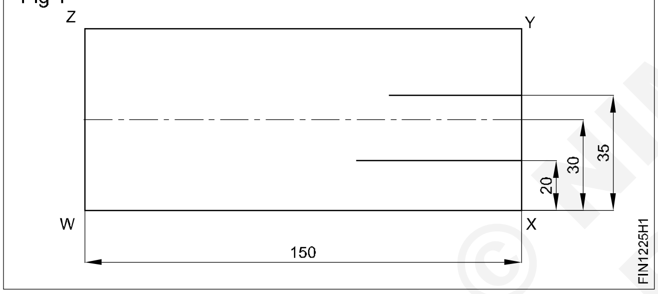
1	65 ISF 10-155	-	Fe310	-	TASK-1	1.2.25
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	JOINING STRAIGHT LINE TO AN ARC				TOLERANCE : - ±0.5mm	TIME
					CODE NO. FI20N1225E1	

Job Sequence

TASK 1: **Spanner**

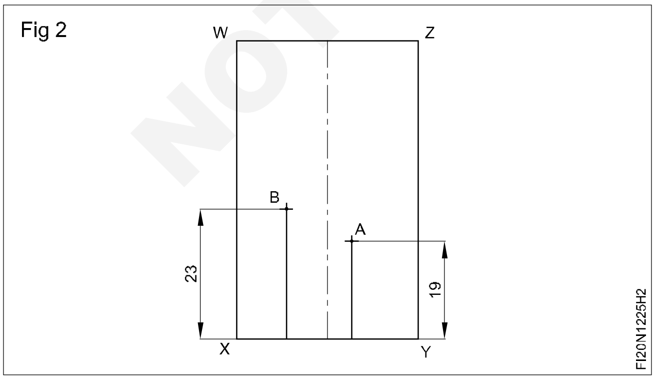
- Check the raw material size using steel rule.
- File metal to size 150 x 64 x 9 mm.
- Apply marking media on the surface of the job.
- Clean marking table, marking block, angle plate and steel rule.
- Set the size 30 mm in marking block using steel rule.
- Place the job on marking table and support it with angle plate.
- Mark centre line datum 30 mm with reference to side 'WX' Fig 1.
- Set the size 30 + 5 = 35 mm in marking block and scribe a line right side to 19 mm length as shown in job drawing with reference to side 'WX' Fig 1.
- Similarly, set the size 30 - 10 = 20 mm and scribe a line in right side to 23 mm length as shown in job drawing with reference to side 'WX' Fig 1.

Fig 1



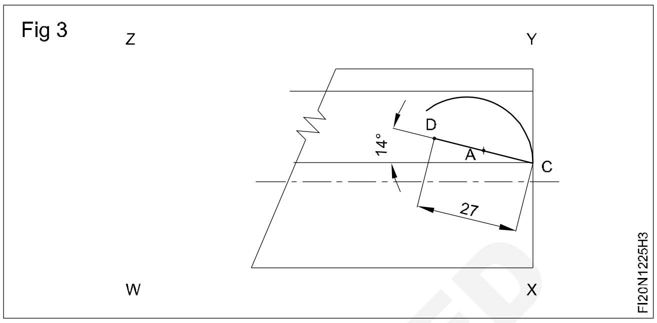
- Turn the job and support it with angle plate with reference to side 'XY' Fig 2.
- Set the size 19 mm and scribe a line with reference to side 'XY' and mark point 'A' at the intersecting line. Fig 2
- Similarly, scribe a line to size 23 mm with reference to side 'XY' and mark point 'B' at the intersecting lines. Fig 2

Fig 2



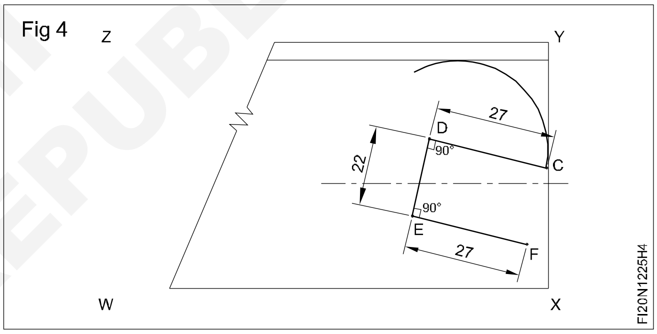
- Set the radius 19 mm and draw radius at point 'A'.
- Radius line intersect the object reference side 'XY' at point 'C.' Fig 3
- Mark 14° angle at point 'C' using bevel protractor and scribe a Angular line to the distance 27 mm and mark point 'D'. Fig 3

Fig 3



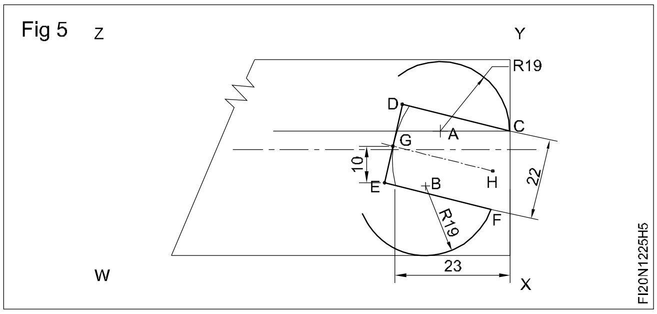
- Mark 90° Angular line with reference to line 'CD' to the distance 22 mm and mark point 'E' as shown in the job drawing. Fig 4
- Similarly, mark 90° Angular line with reference to line 'DE' to the distance 27 mm and mark point 'F'. Fig 4

Fig 4



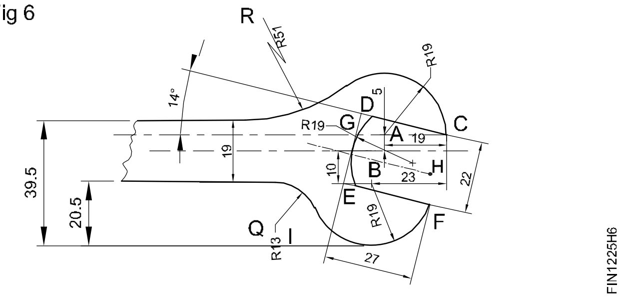
- Mark the centre line on line 'DE' and name it as 'G'. Fig 5
- From point 'G' draw a perpendicular line to the length of 19 mm downward and mark it as 'H'. Fig 5
- Draw radius of 19 mm from the point 'H' in such a way that the arc should meet point 'E' and 'D' through centre point 'G'. Fig 5

Fig 5



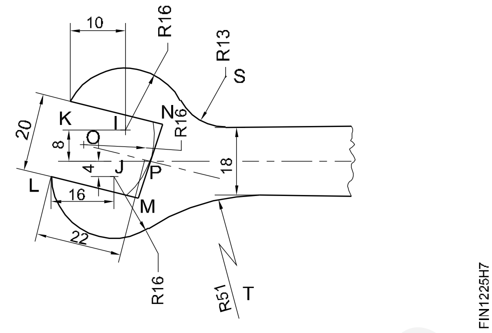
- Set the radius 19 mm and draw an arc at point 'B'.
- Radius line intersect the object reference side 'XY' at point 'F'. Fig 5
- Scribe a line 30 + 9.5 = 39.5 mm horizontal line with reference to side 'WX'. Fig 6
- Similarly, scribe a line 30 - 9.5 = 20.5 mm horizontal line with reference to side 'WX' to mark the width of spanner in right end. Fig 6
- Join the spanner object lines by drawing a radius of 13 mm from point 'Q' in downward side and radius 51 mm from point 'R' in upward side and complete the spanner as shown in job drawing. Fig 6

Fig 6



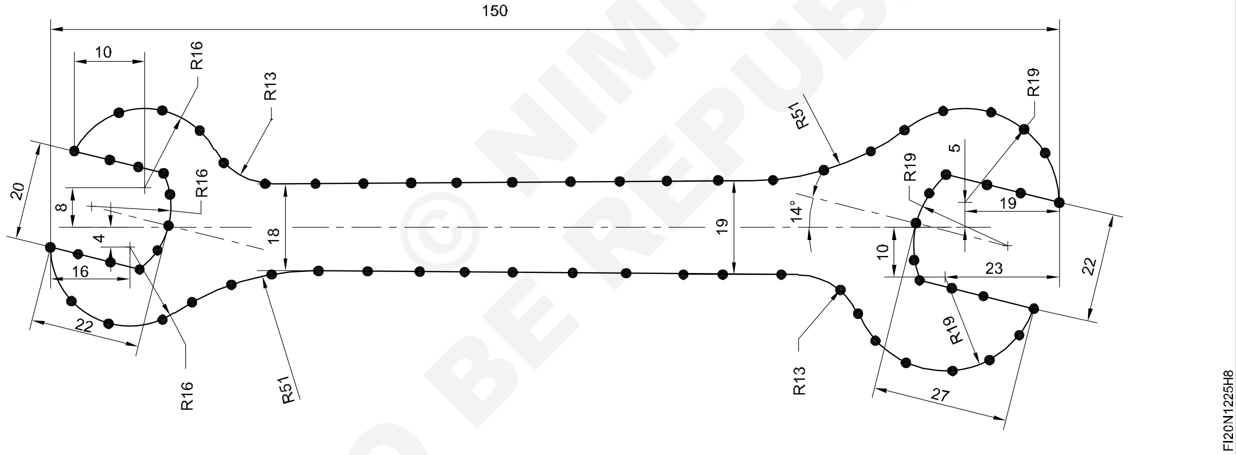
- Similarly, follow the above procedures to mark the left side end of the spanner from points I, J, K, L, M, N, O, P, S and T to complete the spanner profile marking. Fig 7

Fig 7



- Punch on the marked lines for prominent marks. Fig 8
- Check the size with steel rule.

Fig 8



Skill Sequence

Marking with a vernier height gauge

Objective: This shall help you to
- **mark with a vernier height gauge.**

What is the main function of the vernier height gauge?

One of the primary functions of the vernier height gauge is to scribe lines on a workpiece to known heights.

How to use a vernier height gauge?

The height gauge scriber must be checked against the reference surface to confirm whether the zero of the vernier coincides with the zero of the beam scale when the scriber contacts the reference surface. (Fig.1)

Check for free movements of the sliding unit.

Make sure that the workpiece has no burr and has been properly cleaned.

Workpiece necessiaties clamping to an angle plate. If thin, the application of the marking media should be light thin and even.

Keep the vernier height gauge base firmly on the suface plate.

Hold the scriber at an angle to the workpiece and pull the corner of the scriber across the work. (Fig.2)

Fig 1

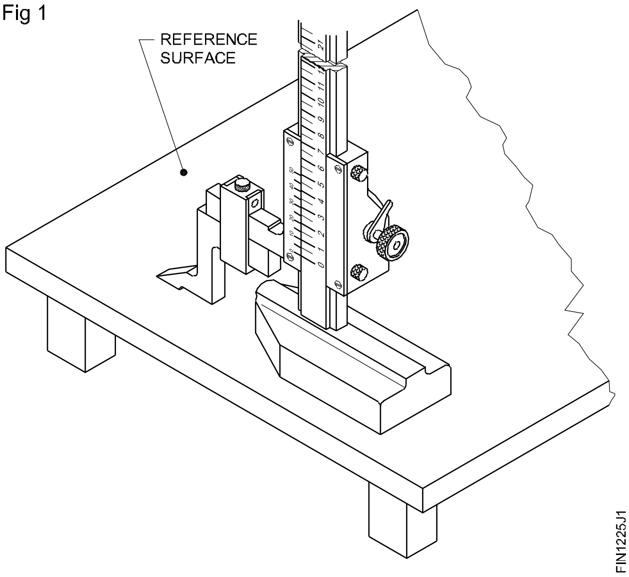
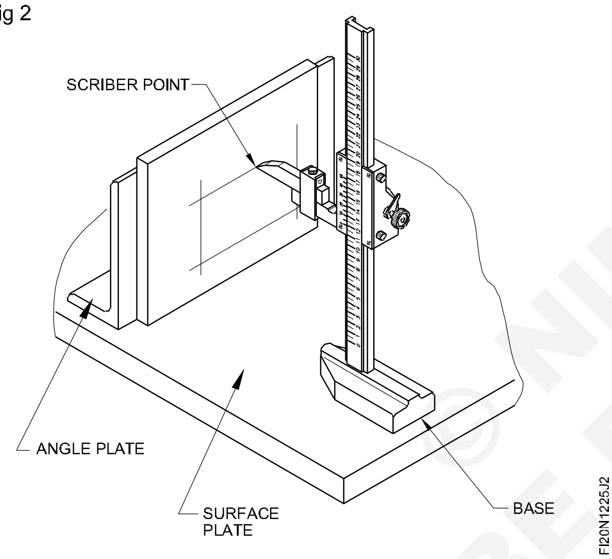


Fig 2



Do not allow the base to lift.

Do not apply too much pressure to peel off metal from the workpiece. This will avoid damage to the scriber point. Centre points can be located by scribing lines at right angles.

Scribe first all lines of dimensions in one direction. Secondly scribe all the lines in another direction. (Fig 2).

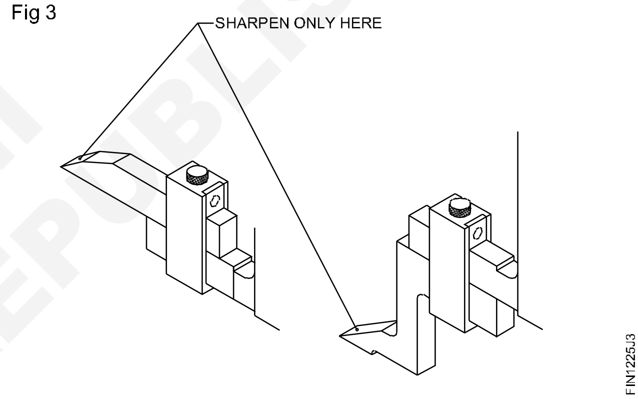
Place the work at 90° and scribe the lines to work. Job surfaces should be finished flat and smooth to avoid lifting during marking.

Precautions to get exact lines.

Ensure the scriber point is sharp always. Sharpen only the inclined surface of the scriber point. (Fig 3)

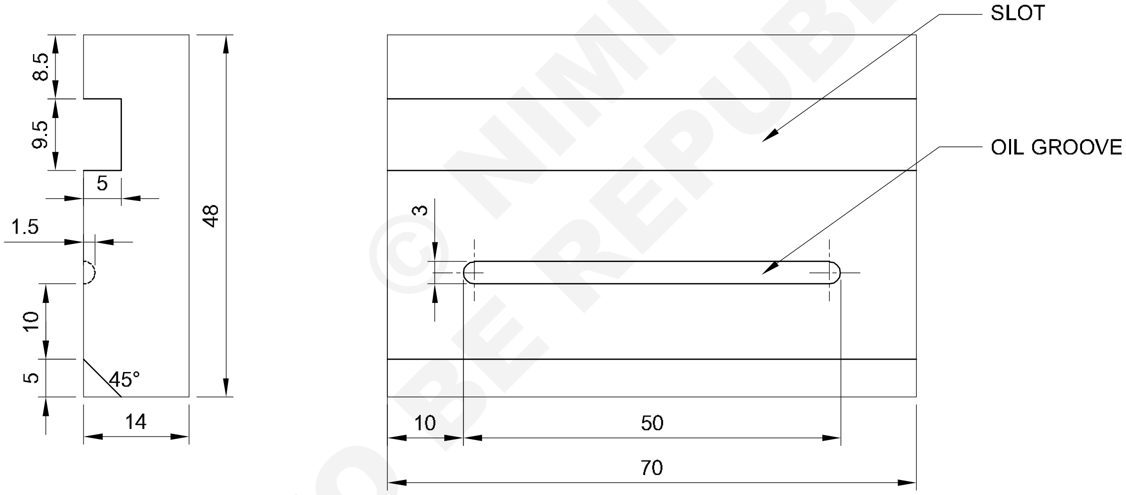
Frequent sharpening should be avoided. Ask the instructor to sharpen the scriber for you.

Fig 3



Chipping, chamfering, chip slots and oil grooves (straight)

Objectives: At the end of this exercise you shall be able to
- **mark slot, groove and chamfer as per drawing**
- **chip slot with cross cut chisel by maintaining the dimensions**
- **chip oil groove with round nose chisel and maintaining dimensions**
- **chip angular surface using flat chisel.**



1	50 ISF 15-72	-	Fe310	-	-	1.2.26
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	CHIPPING SLOT AND OIL GROOVE	TOLERANCE : ±0.5mm	TIME
		CODE NO. FIN1226E1	

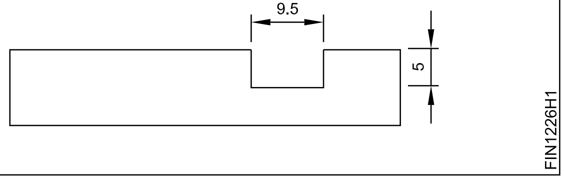
Job Sequence

- Check the raw material size with steel rule
- File and finish the raw metal to size 70x48x14 mm.
- Mark the Job as per drawing and punch the witness mark with dot punch 60°.

Chipping straight slot

- Hold the job in bench vice firmly.
- Chip the slot using cross cut chisel and maintain the dimension 9.5 mm width to the depth of 5 mm. Fig 1.

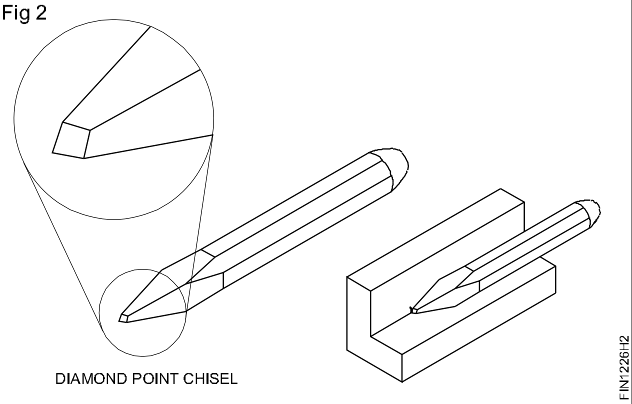
Fig 1



Keep a rag soaked in lubricating oil handy for intermittent cooling of the cutting edge of chisel.

- Chip the corners of the slot using diamond point chisel fig 2.

Fig 2



DIAMOND POINT CHISEL

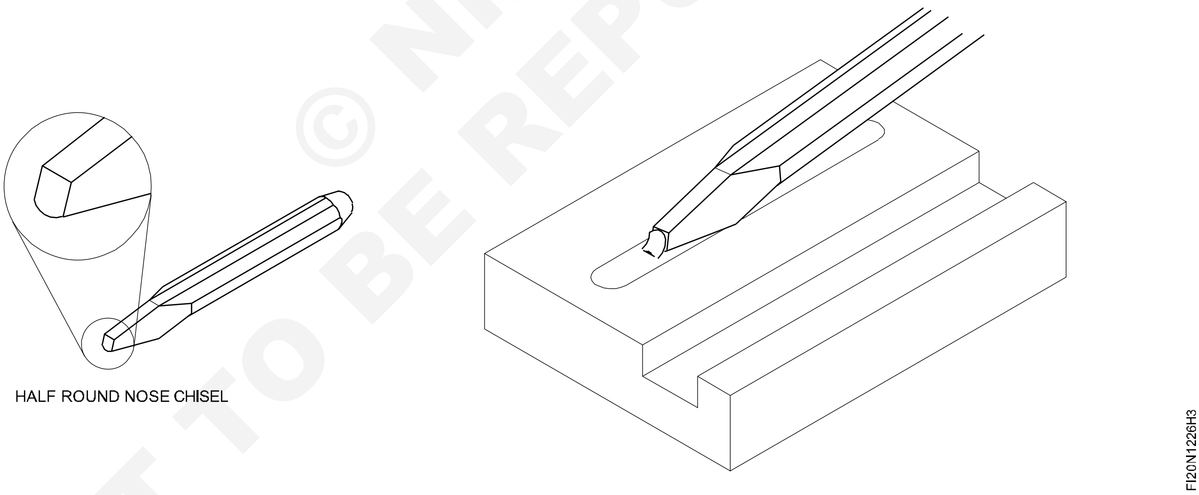
Chipping oil groove

- Similarly, chip oil groove width 3 mm x depth 1.5 mm with round nose chisel and Ball pein hammer fig 3.
- Check the width and depth of slot and oil groove with steel rule and depth gauge.

Chipping chamfer

- Chip the chamfered portion 5 x 45° using flat chisel and a Ball Pein hammer as shown in job drawing.
- De - burr all the faces and corners of the Job.

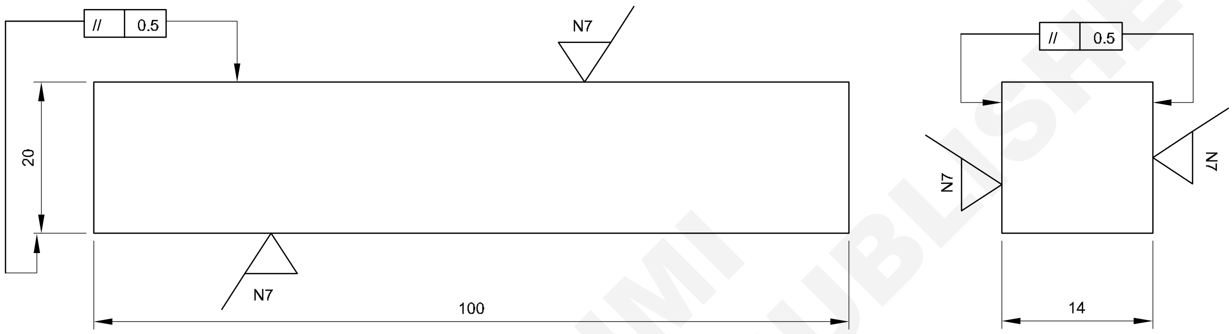
Fig 3



HALF ROUND NOSE CHISEL

Filing flat, square and parallel to an accuracy of ±0.5mm

Objectives: At the end of this exercise you shall be able to
- **file flat, parallel surfaces within an accuracy of ±0.5mm**
- **check dimensions with steel rule**
- **check parallelism with an outside caliper**
- **check right angle with try square.**



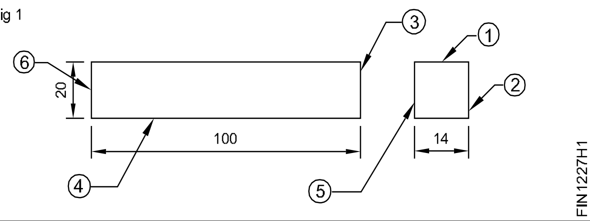
Job Sequence

- Remove burrs and check the size of the raw material.
- File diagonally (Fig.1) side 1 with a 350mm flat bastard file.
- Frequently check the flatness with a try square blade.
- File the same side with a flat second cut file and finish with a flat smooth file.
- File side 2, flat and at 90° to side 2 and side 1.
- File side 3, flat and at 90° to side 2 and side 1.
- Mark sizes as per drawing.
- File side 4 parallel to side 1. (use a caliper to check parallelism.
- File and finish side 5 parallel to side 2.
- File and finish side 6 parallel to side 3.
- Check the size with steel rule.

Remove the hard surface scale from the surface to be filed, using the edge of a flat bastard file.

- Clean, apply little oil and preserve it for evaluation.

Fig 1

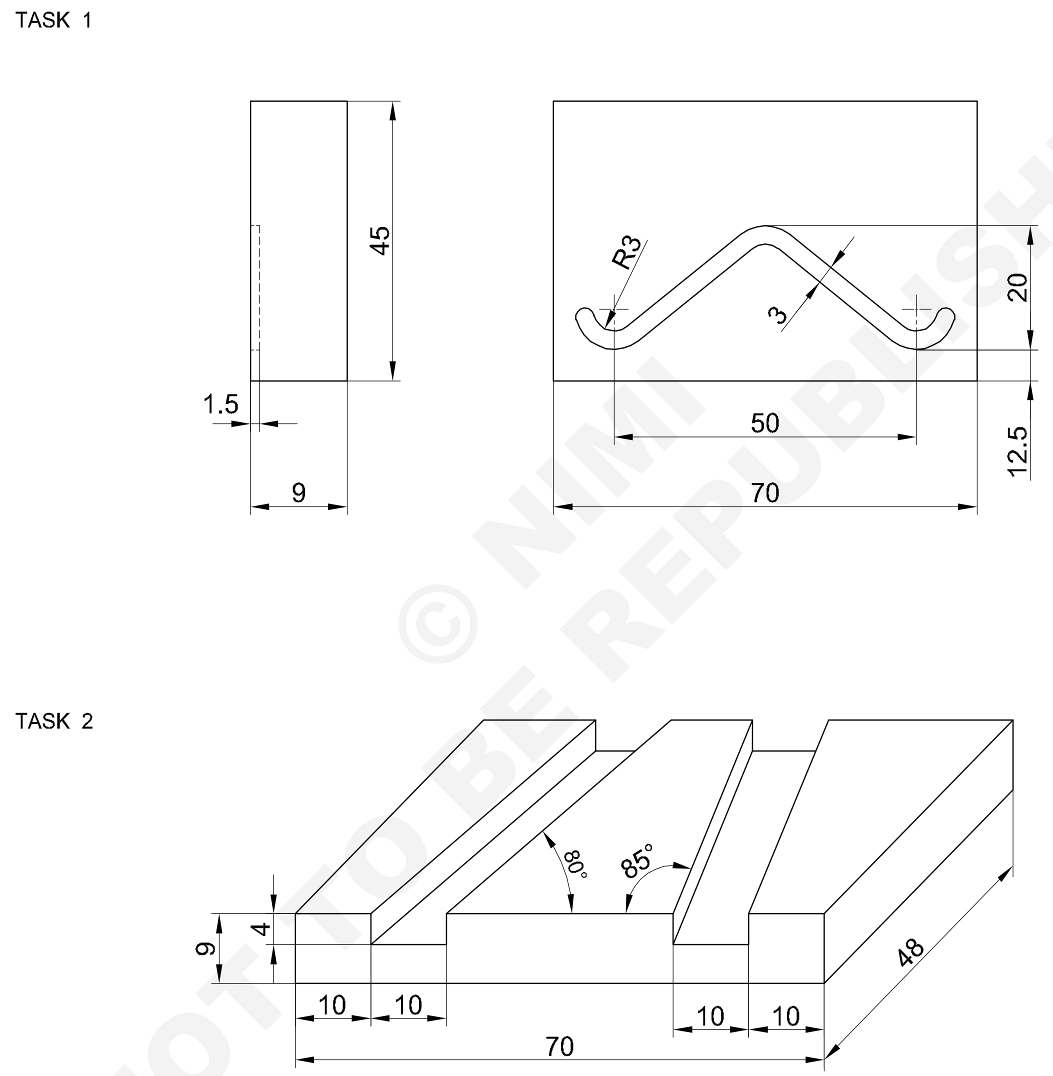


1	25 ISF 15-105	-	Fe310	-	-	1.2.27
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	FILING FLAT AND SQUARE (PARALLEL BLOCK)	TOLERANCE : ±0.5mm	TIME
		CODE NO. FI20N1217E1	

Chip curve along a line - mark out, keyways at various angles and cut key ways

Objectives: At the end of this exercise you shall be able to
- **chip curve on flat bearing surface with uniform crosssection using round nose chisel**
- **chip keyways at various angles with cross cut and diamond point chisel.**



2	75 ISF 10 - 50		Fe 310	--		1.2.28
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX.NO

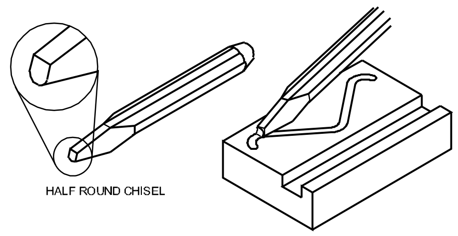
SCALE NTS	**CHIP RING OIL GROOVE AND KEYWAYS AT VARIOUS ANGLES**	TOLERANCE : ±0.5mm	TIME
		CODE NO. FI20N1228E1	

Job Sequence

TASK 1: **Chipping oil groove.**

- Check the raw metal with steel rule
- File and finish the raw metal to size 70 x 45 x 9mm
- Mark the oil groove curve as per drawing.
- Chip the oil groove with round nose chisel maintaining the dimension width 3 mm. (Fig .1)
- Check the size with steel rule.

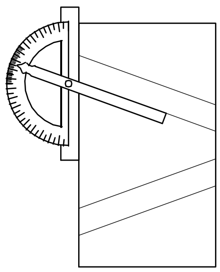
Fig 1



TASK 2: **Chipping keyways at various angles**

- Check the raw metal for its size
- File to size 70x48x9 mm
- Check the size with steel rule
- Check the squareness with try square
- Apply marking media and mark keyways using vernier height gauge and keyway angles using vernier bevel protractor. (Fig 2)

Fig 2



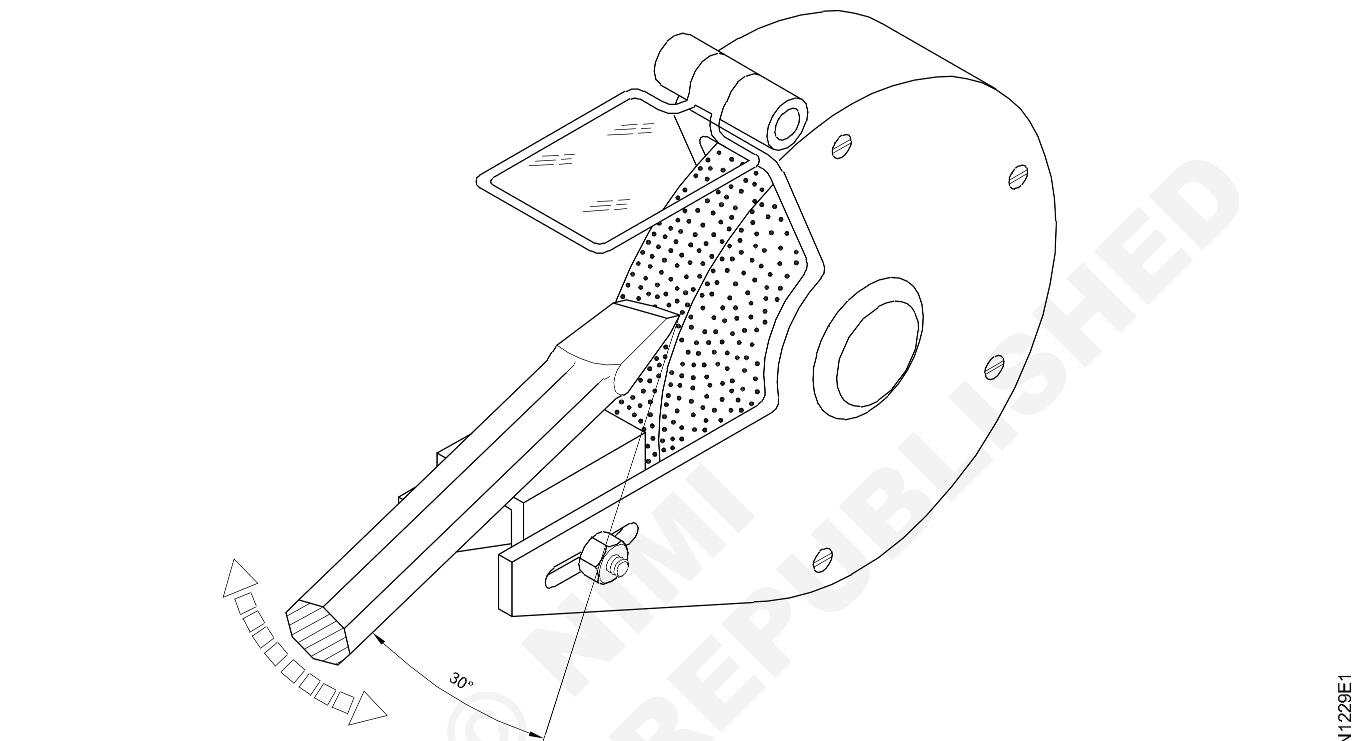
- Punch witness marks
- Hold the job in bench vice
- Chip keyways with cross cut chisel to the required depth
- Chip keyways sharp corners with a diamond point chisel
- Check the job size with steel rule
- Check the angles with bevel protractor
- Finish the job and deburr it.
- Apply thin coating of oil and preserve it for evaluation

Grind the chisels well

- **Look always at the cutting edge**
- **Cool the cutting edge from time to time**

Sharpening of chisel

Objectives: At the end of this exercise you shall be able to
- **re-sharpen the flat chisel using pedestal/bench grinder**
- **operate safely the pedestal or bench grinding machine.**



NOTE: Instructor shall provide chisels for resharpening

Skill Sequence

Grinding of flat chisel

Objective: This shall help you to
- **grind a flat chisel when they become blunt.**

Before grinding: Check the grinding wheel by,

– sliding the finger tip across the grinding wheel to detect glazing

– (In case of glazing, dress the wheel.) For dressing use silicon carbide sticks and seek the help of the instructor. (Fig 1)

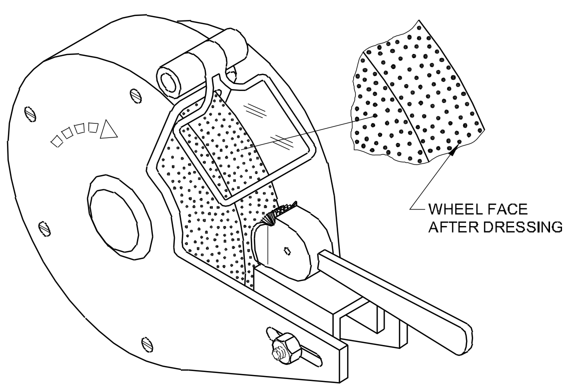
– visually check for cracks.

Switch on the grinder, 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.

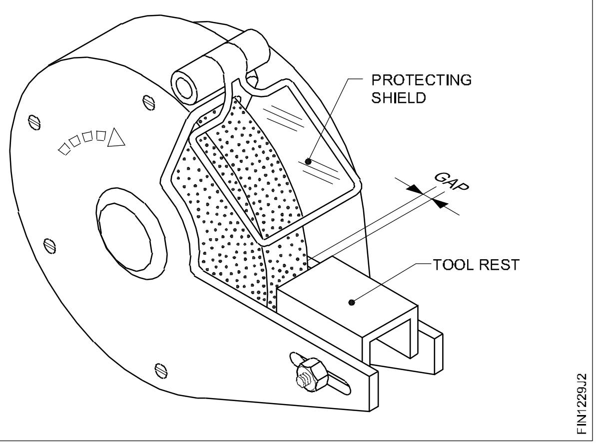
Protect your eyes with goggles or lower the protecting shield near the tool rest. (Fig 2)

Fig 1



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

Fig 2

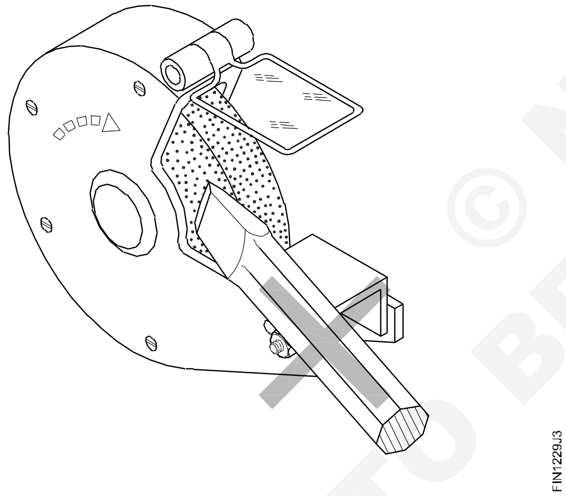


During grinding: Take a blunt chisel for re-grinding. Chisels will become blunt due to use. For efficient chipping, chisels are to be re-sharpened regularly.

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

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

Fig 3

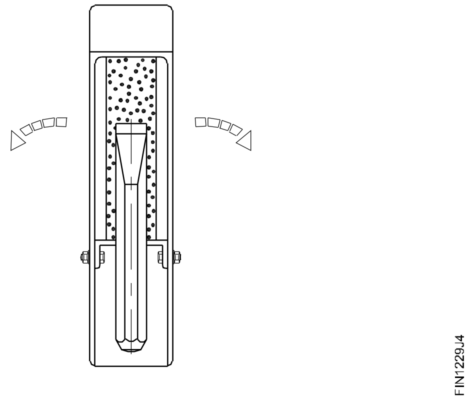


Switch on the grinder.

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) (Fig.5) and allow the point to touch the wheel. (Figs 4 & 5)

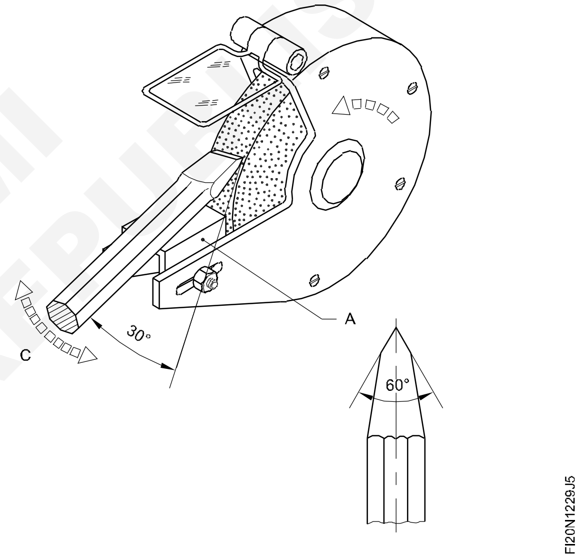
Fig 4



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

Fig 5



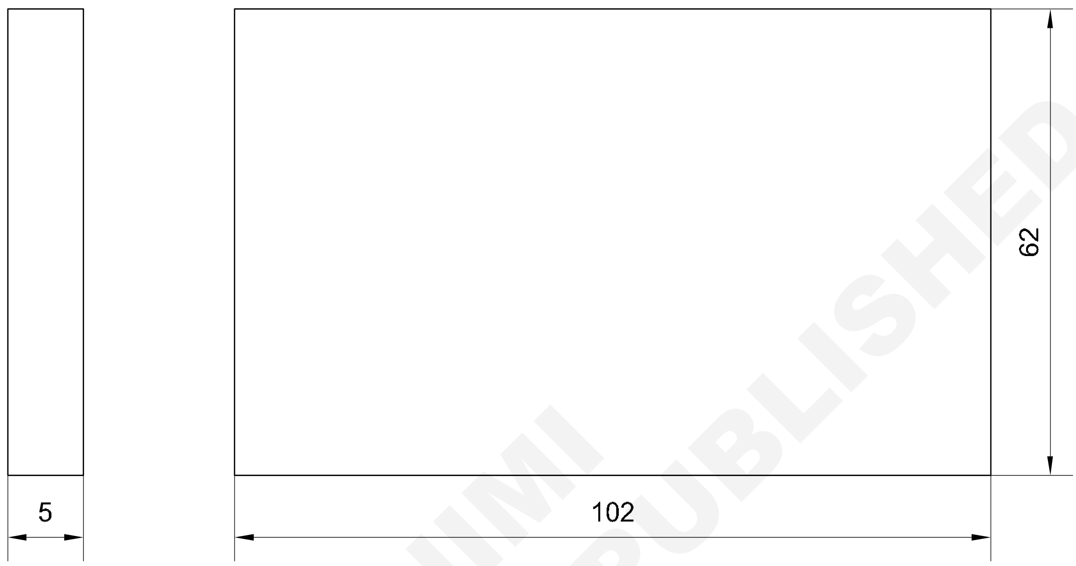
Dip the chisel in the coolant as and when it is required so as to avoid overheating.

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

Check the wedge angle with a bevel protractor.

File thin metal to an accuracy of 0.5mm

Objectives: At the end of this exercise you shall be able to
- **file surfaces flat and square within ±1mm using flat bastard and second cut file**
- **check flatness and squareness using a try-square**
- **check thickness using an outside caliper.**



Job Sequence

- Remove burrs, if any using a flat second cut file and ensure the metal surface is free from oil or grease.
- Check the raw material for its size with a steel rule 300mm.
- Hold the workpiece in a 125mm jaw bench vice on its ends.
- Ensure the work is held horizontally.

Do not over-tighten the workpiece.

- File the top surface with a flat bastard file 250mm.
- Check flatness with a try-square.
- File to medium finish using a flat second cut file 250mm.
- Hold the workpiece to file the longer side.
- File and check flatness and squareness with previously finished surfaces using a try-square 150mm.
- File the adjacent shorter side flat and square to both the finished surface.
- Remove burrs and mark sizes as per job drawing, using a steel rule, try-square and scriber.
- File the other two sides flat and square, maintaining the dimensions.

Use soft jaws to protect the finish filed surface while holding the workpiece in the benchvice.

- File the other flat surface parallel and check the thickness using an outside caliper.

1	65 ISF 6 x 105		Fe310-O	–	–	1.2.30
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	FILING THIN METAL				TOLERANCE: ±0.5mm	TIME
					CODE NO. FI20N1230E1	

Cleaning files

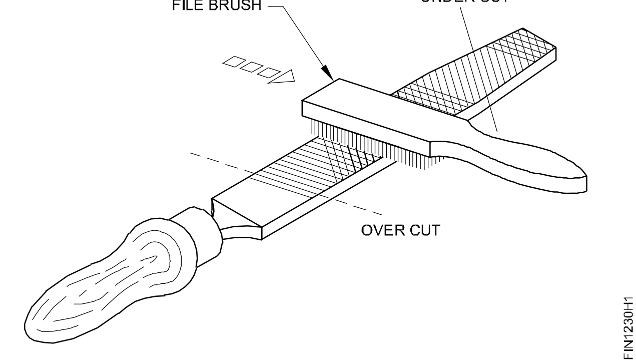
Objective: This shall help you to
- **clean files.**

Introduction

During filing, the metal chips (Filings) will clog between the teeth of the files. This is known as 'pinning' of files. Files which are pinned will produce scratches on the surface being filed, and also will not bite well.

Use a file brush to remove pinning of the files. (Fig.1)

Fig 1



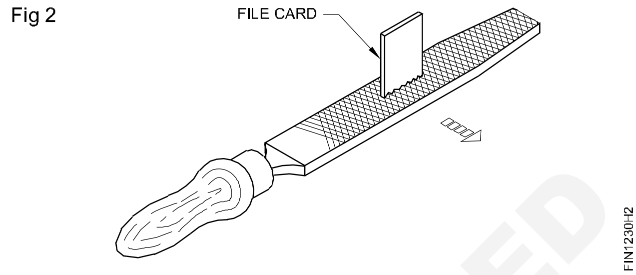
When filing a workpiece to a smooth finish more 'pinning' will take place because the pitch and depth of the teeth are less.

Application of chalk on the face of the file will help reduce the penetration of the teeth and 'pinning'.

Pull the file brush along the direction of the overcut.

Take out the filings which do not come out easily by the file card by a brass or copper strip. (Fig.2)

Fig 2



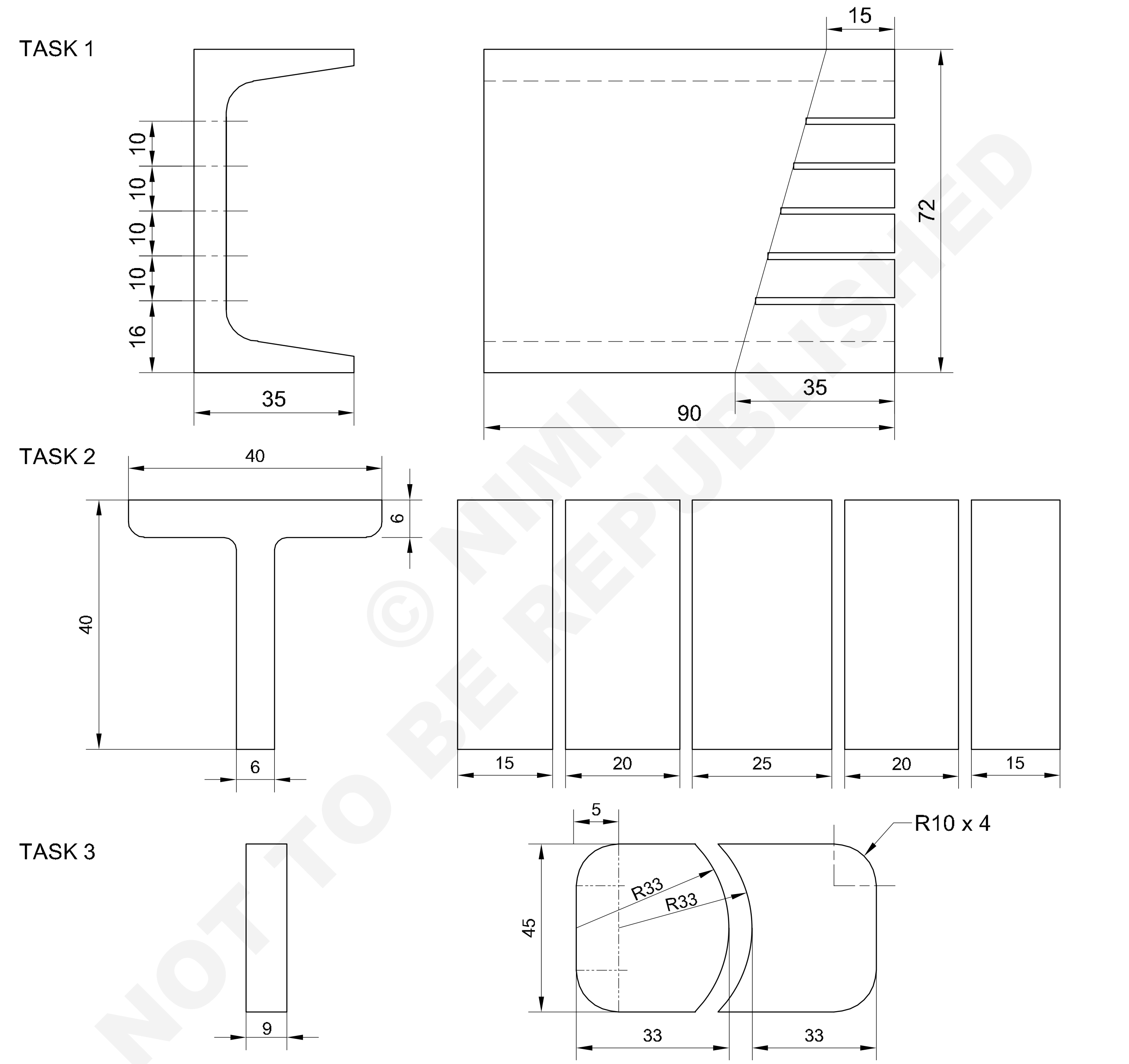
Use only soft metal strips (brass or copper) for cleaning new files.

The sharp cutting edges of the files will wear out quickly if a steel file card is used.

Clean the file frequently in order to remove the filings embedded in chalk powder.

Saw along a straight line, curved line, on different section of metals

Objectives: At the end of this exercise you shall be able to
- **saw in straight line on different sections of metals, channel and 'T' section**
- **saw in curved line on flat section of metal.**



NOTE : USE EX.NO : 1.2.16 FOR TASK 1

1	50 ISF 10 - 75		Fe 310		TASK 3	1.2.31
1	ISNT 40 - 100		Fe 310		TASK 2	1.2.31
1	-	1.2.16 ←	Fe 310		TASK 1	1.2.31
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO :

SCALE : 1.2	SAWING ON VARIOUS SECTION OF METAL IN STARAIGHT LINE AND CURVED LINE	TOLERANCE ±0.5mm	TAME :
		CODE NO. FI20N1231E1	

Job Sequence

TASK 1: **Hacksawing on channel**

- Check the material to size.
- File and finish to size 90x72x35mm
- Apply marking media on the surface.
- Mark the required number of saw cut with a jenny caliper and steel rule.
- Punch the marked line.
- Hold the workpiece firmly on the bench vice.
- Select the correct pitch blade (1.0mm pitch)
- Fix the blade in the hacksaw frame pointing teeth in the forward direction.
- Tighten the blade with required tension with the wing nut.
- File a notch at the point of cutting, to avoid slippage of the blade.
- Start cutting with a slight downward pressure.
- Release the pressure in the return stroke.
- Use full length of the blade.

Caution: In case the blade brakes in half the way, do not use a new blade. Finish the cut with a used blade.

Don't tilt the frame while sawing.

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TASK 2: **Hacksawing on 'T' section**

- Mark and hold the job in a bench vice.
- Punch witness marks
- File 'V' notch at the point of cutting to avoid slippage of blade
- Fix 1.4mm pitch hacksaw blade in hacksaw frame
- Start cutting with a slight downward pressure on 'T' section using hacksaw.
- Cut along the marked lines and separate the cutting portions.
- Cutting movement should be steady while sawing on 'T' section.
- While finishing a cut, slow down the pressure to avoid breakage of the blade and injury to you and others.
- Check the sizes of the cutting portions of the 'T' section with steel rule.

— — — — — — —

TASK 3: **Hacksawing on flat section**

- Check all the raw material size.
- File and finish raw material to size of 71x45x9mm.
- Apply lamp chalk and mark the profile as per drawing
- Punch witness marks on marked lines.
- Hold the job in bench vice
- File 'V' notch at the point of cutting to avoid slippage of the blade using triangular file.
- Fix 1.4 mm pitch flexible hacksaw blade in hacksaw frame.
- Start cutting with a slight downward pressure on metal using hack saw.
- Cut along the curved lines and separate the cutting portions
- Check the sizes of the cutting portions with steel rule.

— — — — — — —

Skill Sequence

Filing radius (external)

Objective: This shall help you to
- **file external radius.**

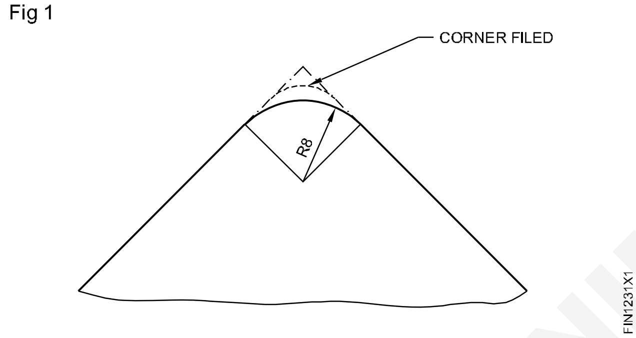
Filing radius is entirely a different technique, and needs considerable skill for filing accurately with a good finish.

In this type of filing, the file has to be held perfectly horizontal widthwise, and at the same time a rocking motion given lengthwise. The surface filed should not have any flat surface and should have a uniform curve. Radius filing of external surfaces is carried out in different steps.

Rough filing of corners

The corners are filed and brought closely to line using a flat bastard file. (Fig.1)

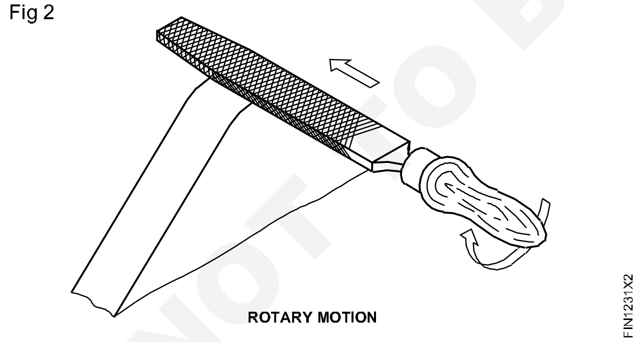
Fig 1



Rounding of corners

The flat surfaces are rounded and brought near about to finishing size, using a flat second cut file. In this, the file is moved forward across the curve with a turning motion. (Fig.2)

Fig 2

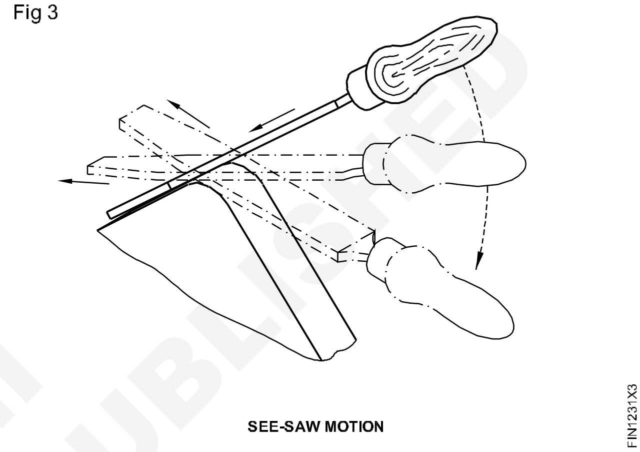


Check periodically with a radius gauge

Final finishing of radius

For finishing steps, a smooth file is used. The file is given a see-saw motion along the curved line until the required radius is formed. (Fig.3)

Fig 3



While filing make sure:

- to check the radius frequently with a radius gauge.
- to use the broad surface to the job as datum for checking the size.
- not to give excessive pressure while filing radius as the file is likely to slip.

Checking the radius

Objective: This shall help you to
- **check the radius with a radius gauge.**

Scan the QR Code to view the video for this exercise

Before checking with a radius gauge ensure the radius gauge is perfectly clean. Remove burrs, if any, from the workpiece. Check and make sure the profile of the gauge is not damaged.

The radius gauge should be held perpendicular to the radius to be checked. (Fig.1 and 2)

Fig 1

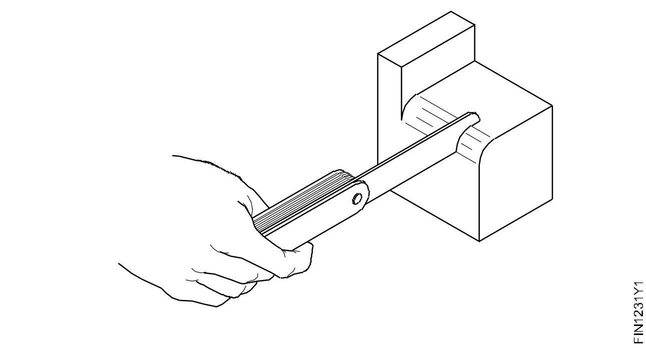
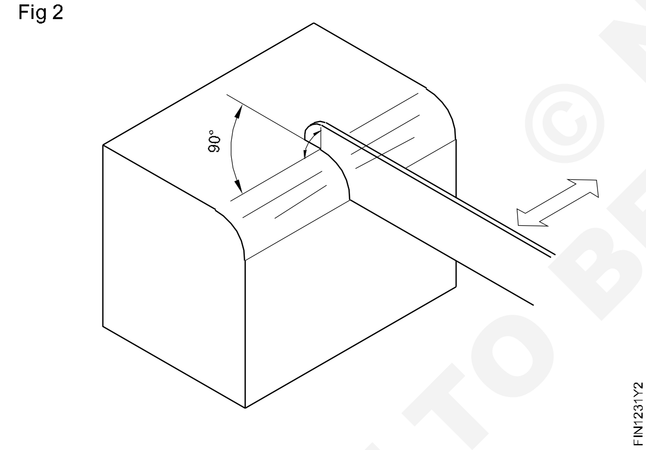


Fig 2



Observe the contact surfaces for any light passing through, check against the background of light. The gauge should be moved along the filed length of the radius for checking. (Figs 3 and 4)

Fig 3

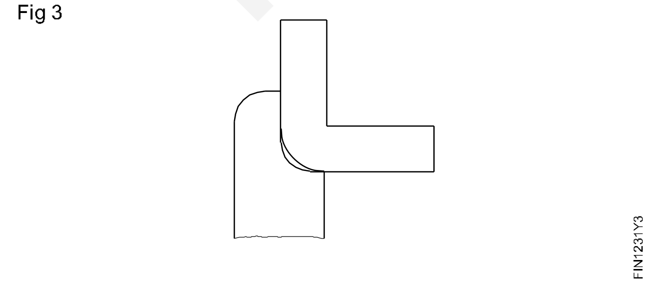
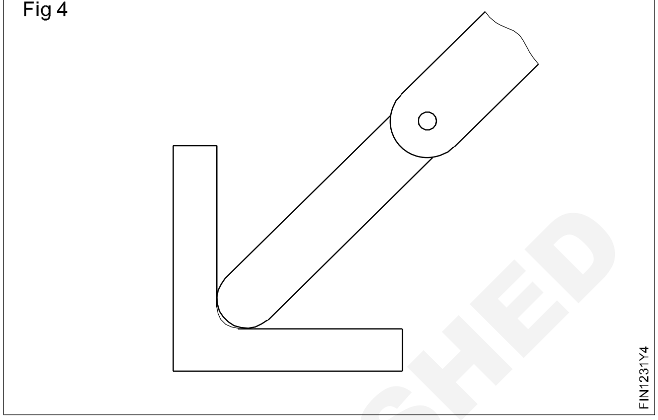


Fig 4

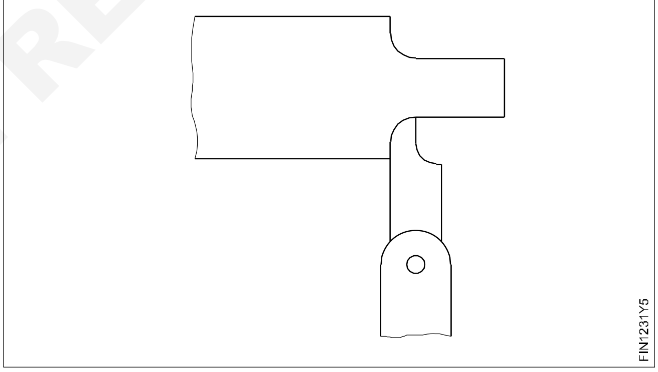


File and adjust the radius gradually according to the radius gauge.

The right radius is the one that matches correctly with the gauge. (Fig.5)

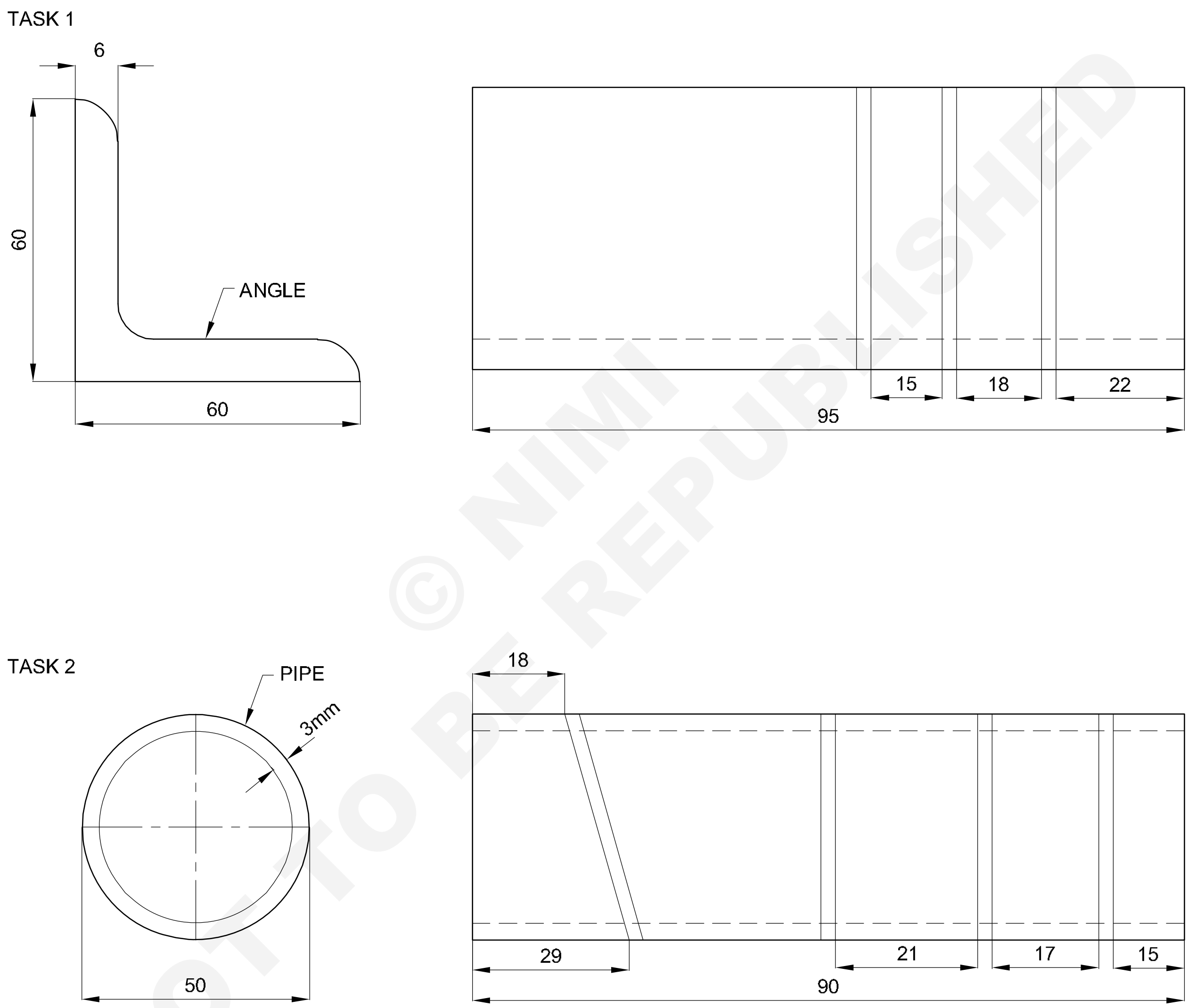
After using the radius gauges, wipe them, clean with a clean cloth and apply a light film of oil before storing.

Fig 5



Straight saw on thick section of M.S.angle and pipe

Objectives: At the end of this exercise you shall be able to
- **mark and cut pieces on equal angle section.**
- **mark and cut pieces on pipe.**



2	PIPE Ø 50 x 3 x 100mm	-	GI PIPE	-	TASK -2	1.2.32
1	ISA 60x 6 x100mm	-	Fe310	-	TASK -1	1.2.32
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	STRAIGHT SAW ON M.S ANGLE AND PIPES	TOLERANCE : ±0.5mm	TIME
		CODE NO. FI20N1232E1	

Job Sequence

TASK 1 : **Hacksawing on steel angle**

- Check the raw material using steel rule
- File the steel angle to size 100 mm length.
- Mark and punch the sawing the lines.
- Hold the job in bench vice as shown in Fig 1
- Fix 1.8 mm coarse pitch blade in hacksaw frame.
- Cut along the sawing lines with hacksaw.
- Check the size of the angles with steel rule.
- De-burr and preserve it for evaluation.

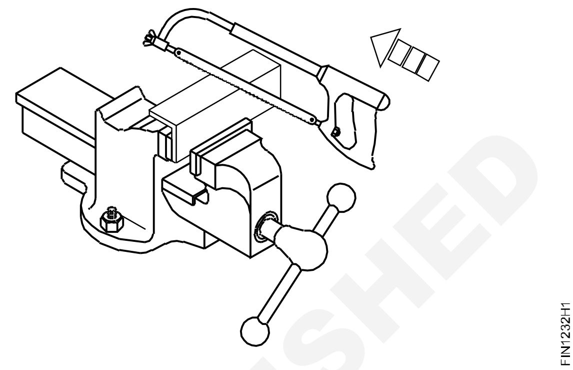
Scan the QR Code to view the video for this exercise

Caution

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

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

Fig 1



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TASK 2 : **Hacksawing on pipe**

- Check the pipe size using steel rule.
- File the pipe ends to size 90 mm length.
- Mark and punch the sawing lines.
- Hold the job in bench vice as shown in Fig 1.
- Fix 1.0 mm pitch blade in hacksaw frame.
- Cut along the sawing lines using hacksaw.
- Turn and change the position of the pipe while hacksawing
- Check the size of pipe using steel rule.
- De-burr and preserve it for evaluation.

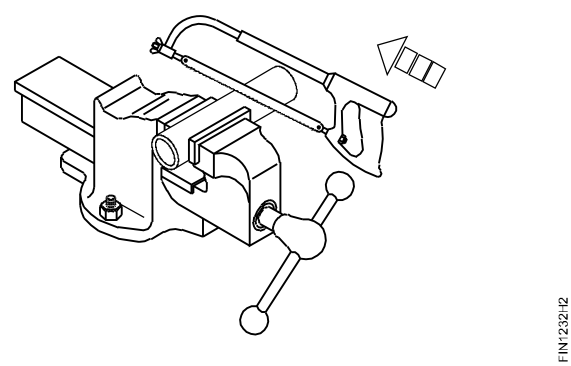
Caution

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

Do not cut too fast.

Cut very slow and reduce pressure while cutting through.

Fig 1



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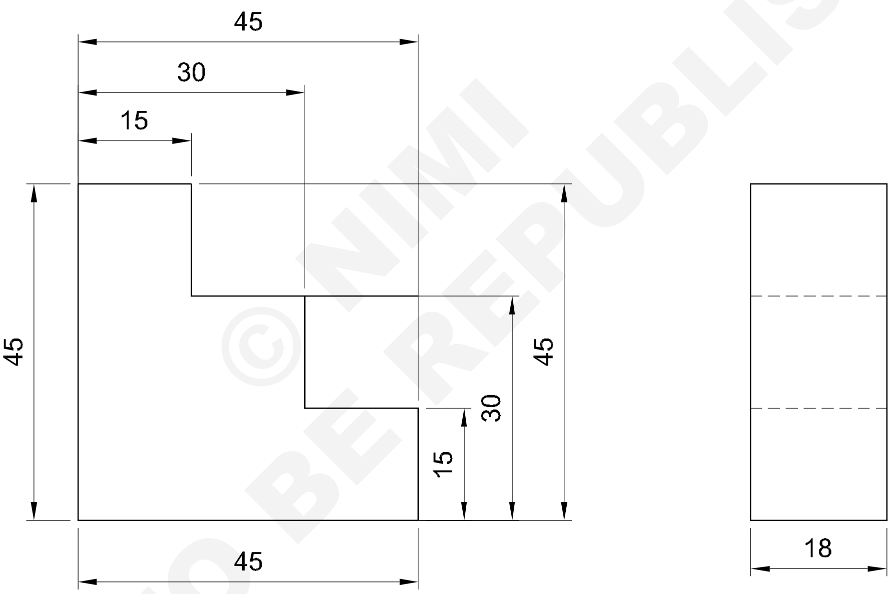
File steps and finish with smooth file to accuracy of ±0.25mm

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.**

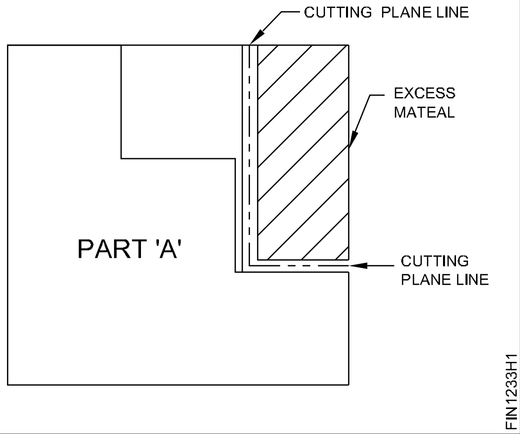


2	50 ISF 20 x 50	-	Fe310	-	1	1.2.33
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	STEP FILING AND MATCHING				TOLERANCE : ±0.25mm	TIME
					CODE NO. FIN1233E1	

Job Sequence

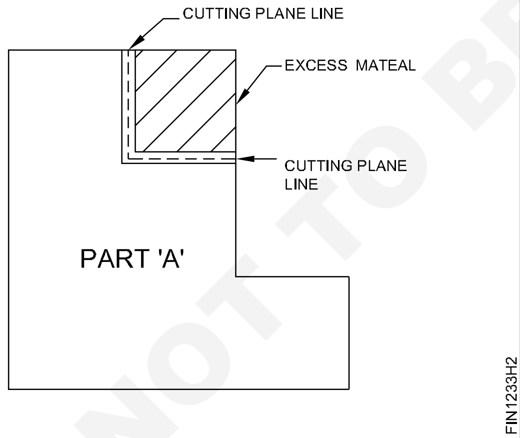
- Check the raw metal with steel rule.
- File and finish the raw metal to size 45x45x18 mm.
- Mark the steps with vernier height gauge as per drawing and punch witness marks.
- Cut and separate the excess material by sawing fig 1

Fig 1



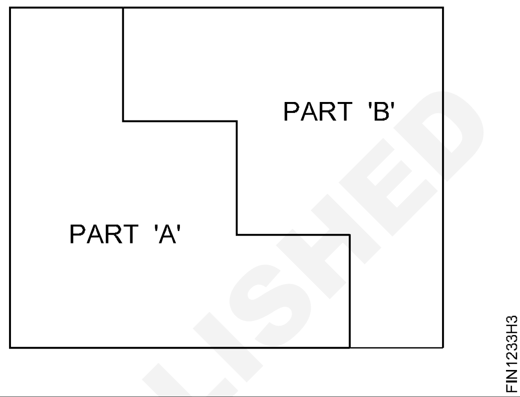
- File step with safe edge file using bastard, second cut and smooth grades.
- Measure the job sizes with outside micrometer maintaining the accuracy of ± 0.25 mm.
- Check the squareness with try square
- Similarly, cut and separate the excess material by sawing Fig 2

Fig 2



- File step with safe edge file using different grades
- Measure the job size with outside micrometer
- Check the squareness with try square
- Finish and de-burr the job
- Similarly, file and finish the another part 'B' and match with one another. Fig 3

Fig 3

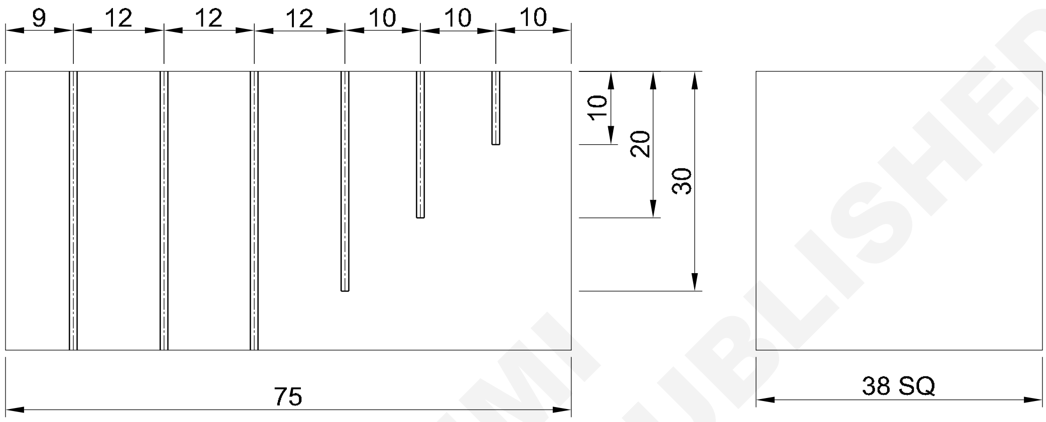


- Apply thin coat of oil and preserve it for evaluation.

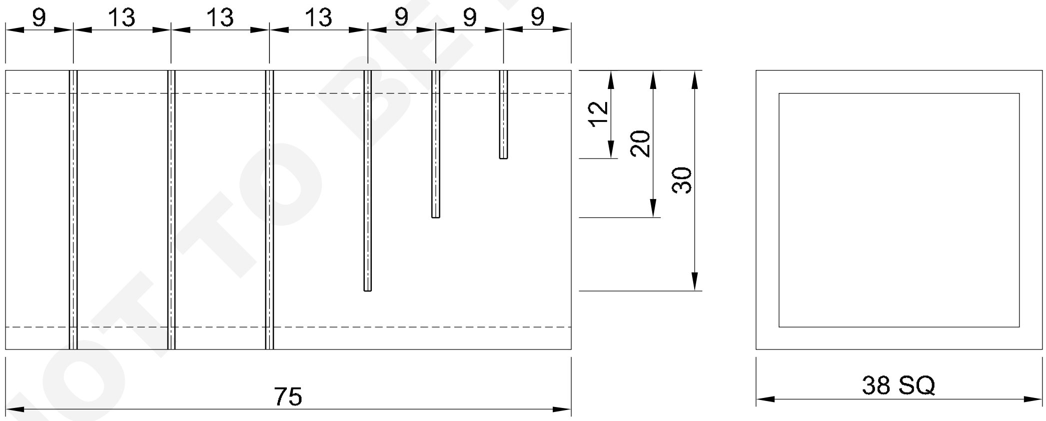
File and saw on M.S. square and pipe

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.**

TASK 1



TASK 2



1	◻ 40-78 HOLLOW PIPE	-	Fe310	-	TASK 2	1.2.34
1	■ 40-78	-	Fe310	-	TASK 1	1.2.34
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

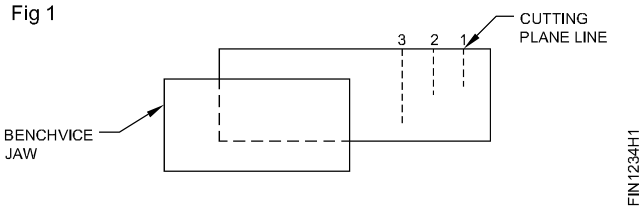
SCALE 1:1	FILE AND SAW ON M.S SQUARE AND PIPE	TOLERANCE : ±0.5mm	TIME
		CODE NO. FI20N1234E1	

Job Sequence

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

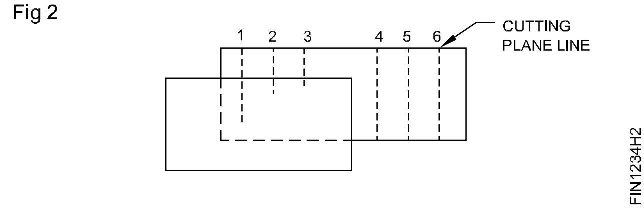
- Check the raw material size using steel rule.
- File and finish all sides of M.S. Square to 75x38x38mm and maintain parallelism and perpendicularity to each other.
- Mark and punch as per the drawing.
- Hold the job in bench vice, such that 35mm projecting outside jaw of bench vice
- Cut along the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

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

- Check the raw metal size using steel rule.
- File and finish of M.S round pipe to 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 sawn metal with steel rule.
- De-burr the job and preserve it for evaluation.

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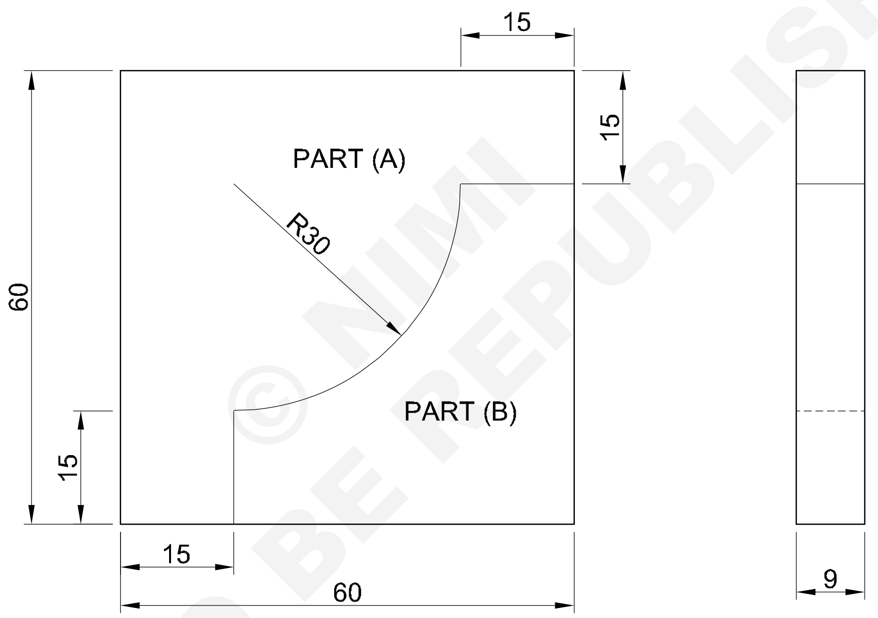
File radius along a marked line (convex and concave) and match

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.**



1	50 ISF 10-50	-	Fe310	-	PART 'B'	1.2.35
1	65 ISF 10-65	-	Fe310	-	PART 'A'	1.2.35
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

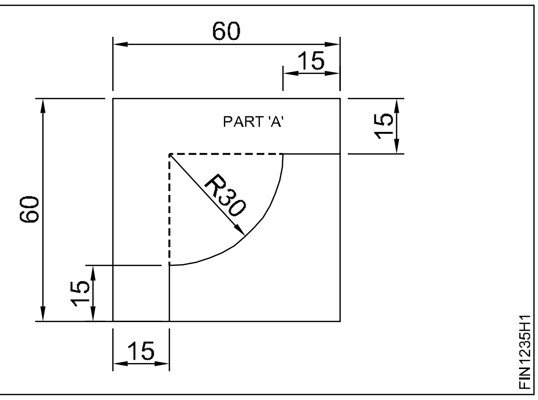
SCALE 1:1	**FILE CONVEX & CONCAVE RADIUS AND MATCH**	TOLERANCE : ±0.1 mm	TIME
		CODE NO. FI20N1235E1	

Job Sequence

Part 'A'

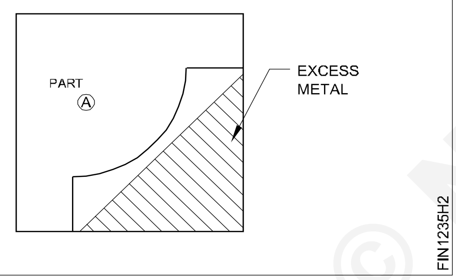
- Check the raw metal size using steel rule.
- File and finish to size 60x60x9 mm maintaining parallelism and perpendicularity.
- Mark and punch in part 'A' as shown in fig 1.

Fig 1



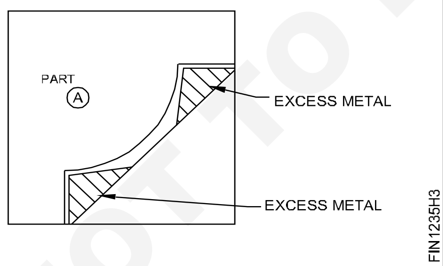
- Mark line as shown in fig 2 leaving the metal 1 mm away from the object line.

Fig 2



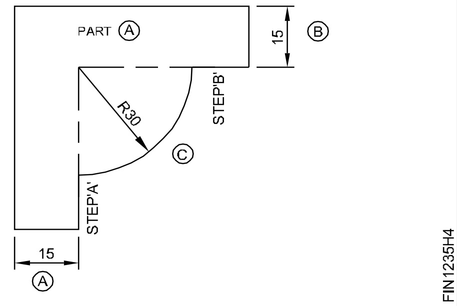
- Cut and remove, excess metal by sawing.
- Mark lines as shown in fig 3 and cut along the marked lines and remove excess metal.

Fig 3



- File step 'A' to 15 mm with safe edge file and half round file using different grades and check the size with vernier caliper fig 4.
- Similarly, file step 'B' and check the size fig 4.
- File convex radius 'C'to 30 mm with half round file using different grades and check the radius profile with template

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.

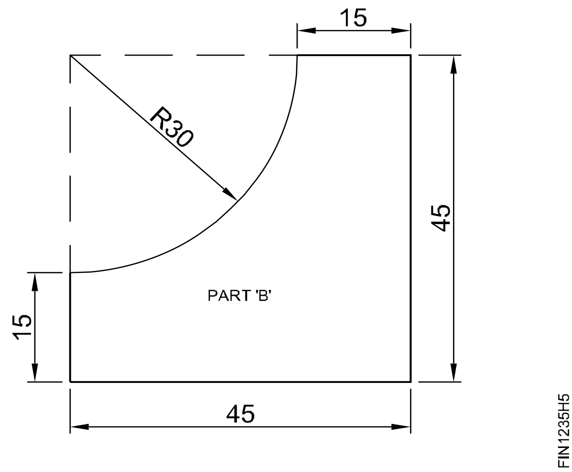
Check the radius frequently with a template.

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

Fig 6

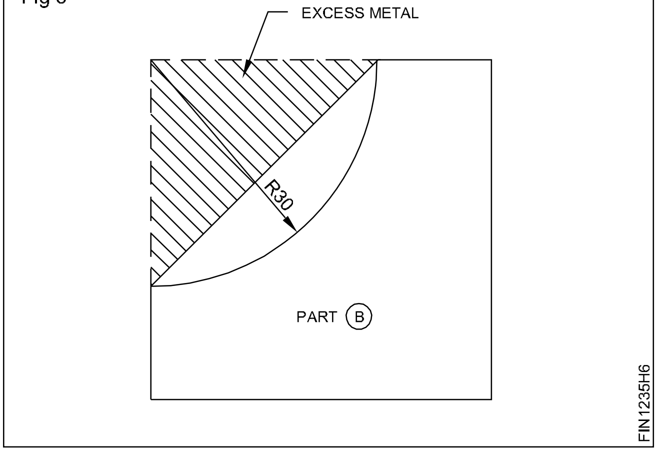
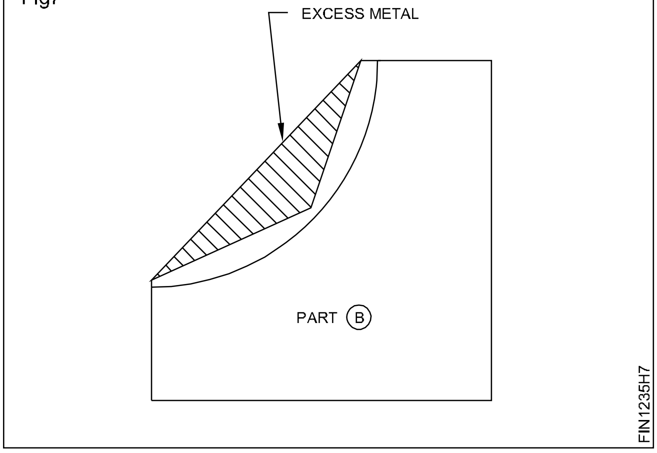


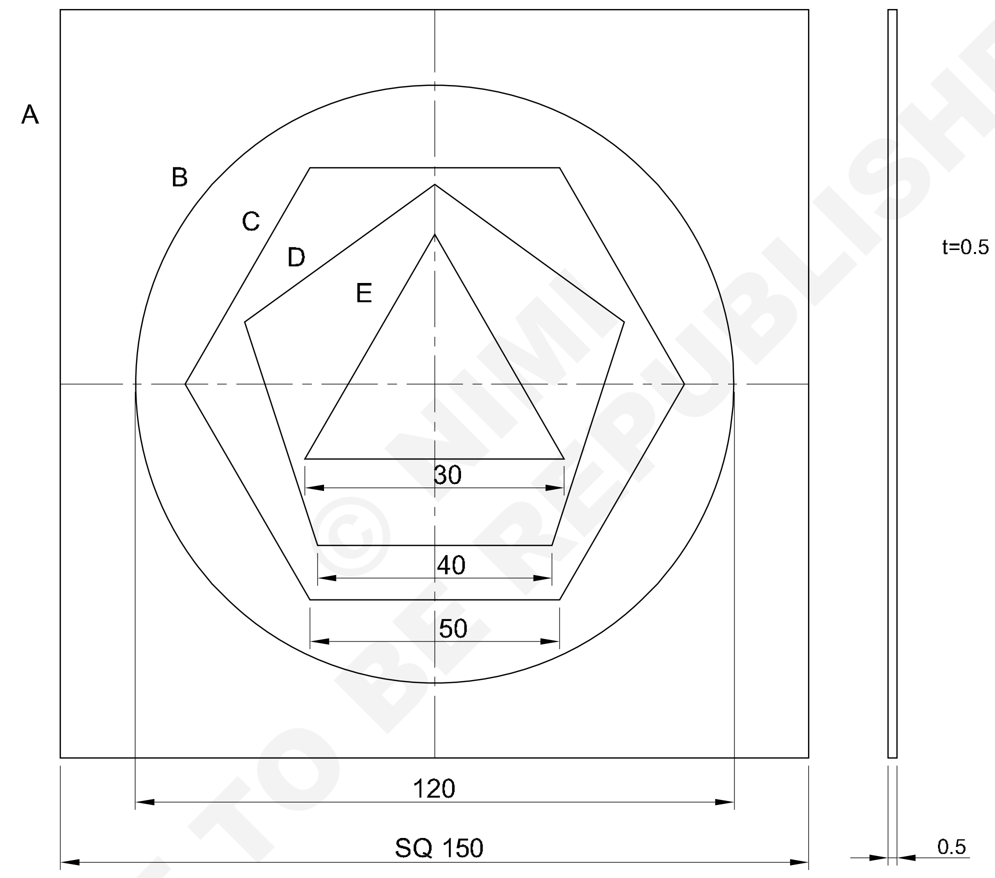
Fig7



- Match part 'A' and 'B' as shown in Job drawing.
- Apply a little oil and preserve it for evaluation.

Chip sheet metal (shearing)

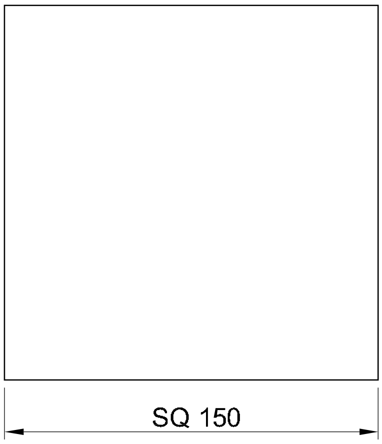
Objectives: At the end of this exercise you shall be able to
- **draw different types of geometrical shapes**
- **chip the different geometrical shapes by flat chisel.**



1	ISSH 160 x 160 x 0.5	-	G.I STEEL	-	-	1.2.36
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

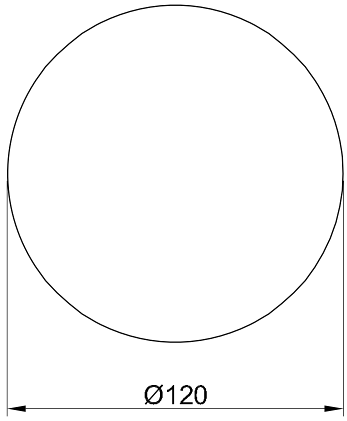
SCALE 1:1	**CHIPPING DIFFERENT GEOMETRICAL SHAPES**	TOLERANCE : ± 1mm	TIME
		CODE NO. FI20N1230E1	

Fig 1



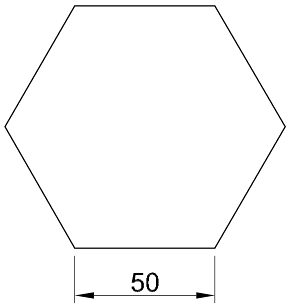
SQUARE

Fig 2



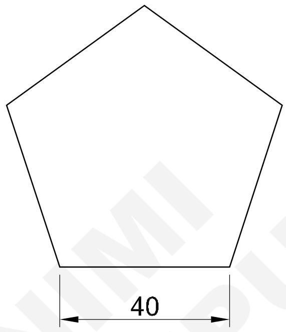
CIRCLE

Fig 3



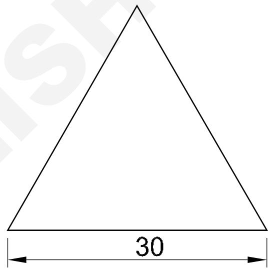
HEXAGON

Fig 4



PENTAGON

Fig 5

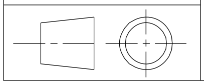


TRIANGLE

Job Sequence

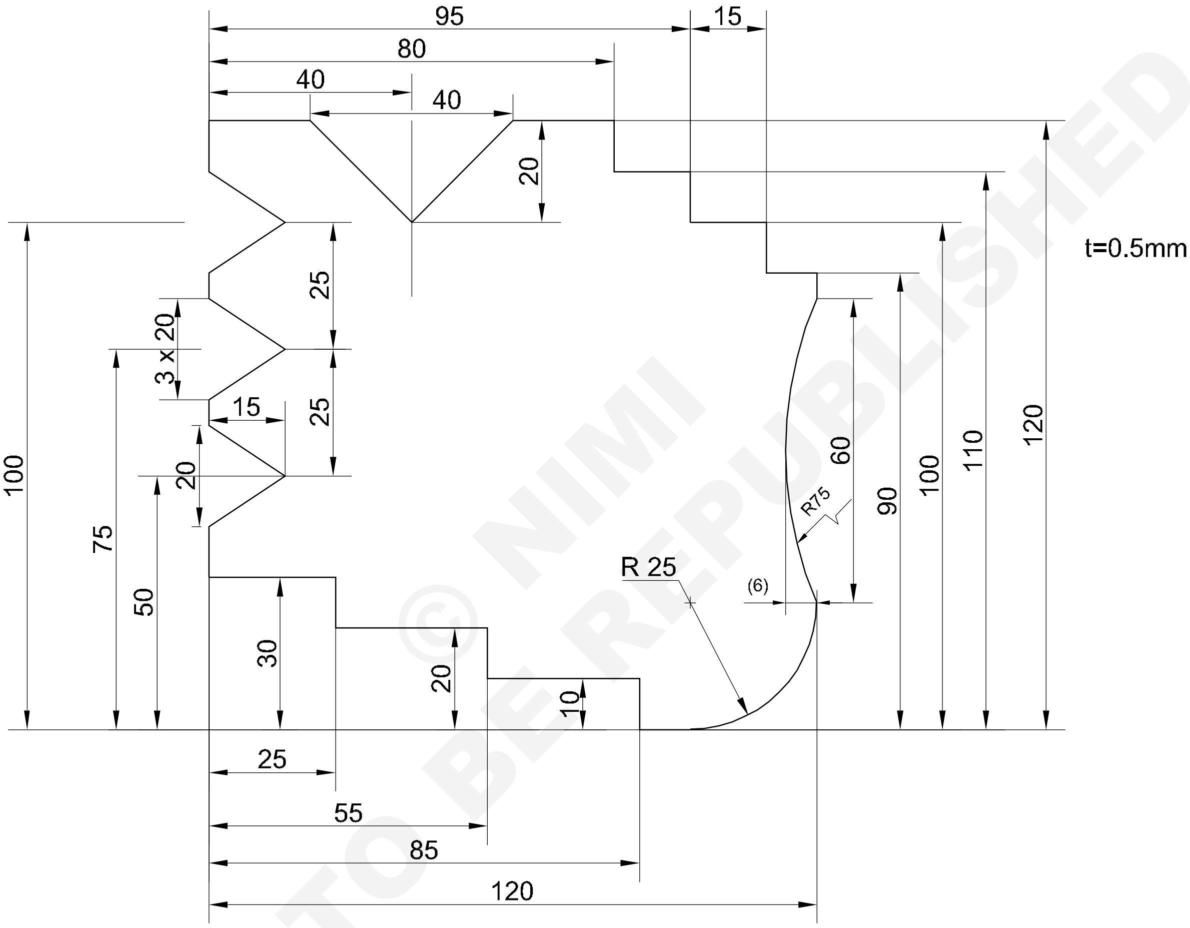
- Planish the sheet metal on a tin man's Anvil using mallet.
- Check the sizes of the sheet 150x150x0.5 mm using a steel rule.
- Mark the centre line as shown in job drawing.
- Punch the centre point using a prick punch 30° and a ball pein hammer.
- Mark a square of 150mm side using a steel rule, straight 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.

1	ISSH 160 x 160 x 0.5	-	G.I STEEL	-	-	1.2.36
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**CHIPPING DIFFERENT GEOMETRICAL SHAPES**	TOLERANCE : ± 1mm	TIME
		CODE NO. FI20N1236E2	

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.

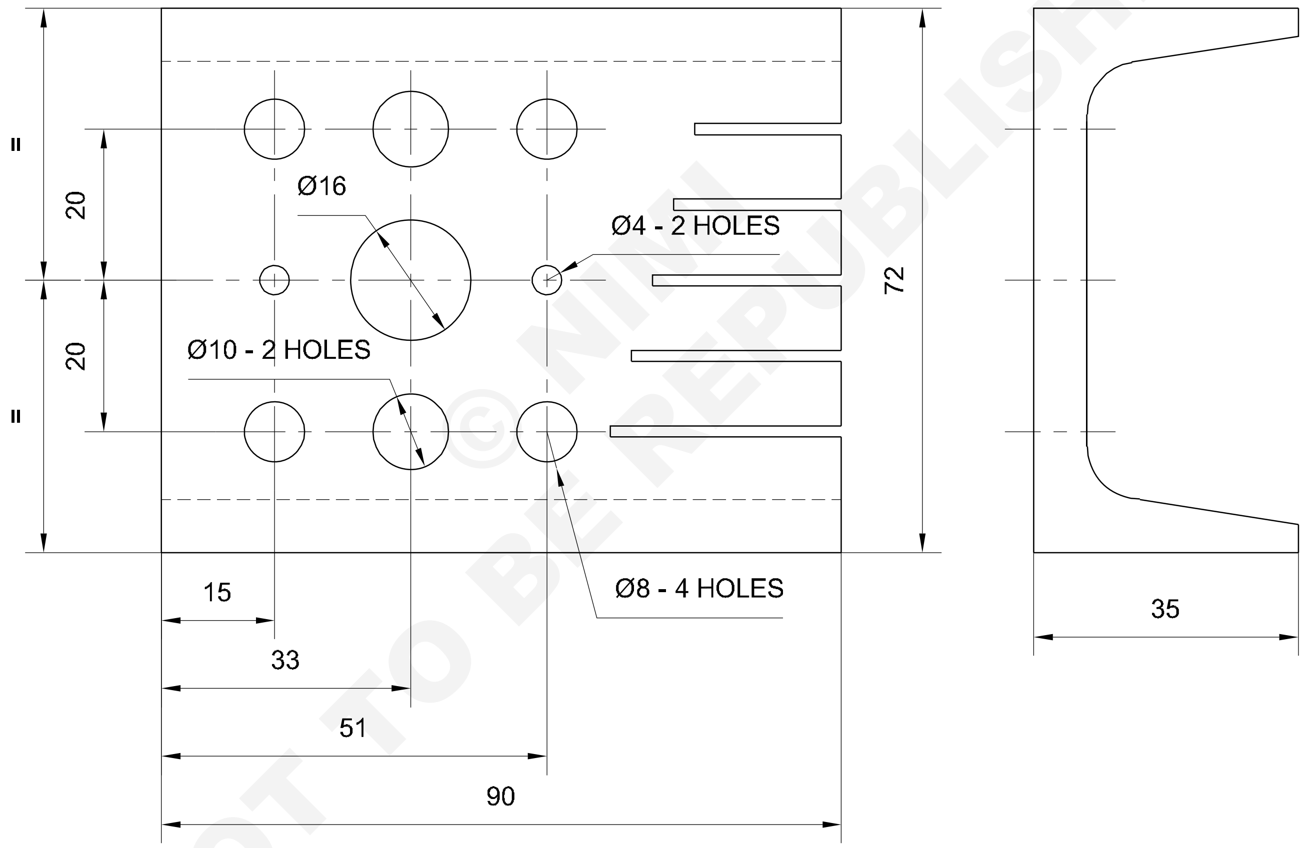
- Write the job sequence to do the work
- List out the tools and equipment required
- Mark and cut the profile using chisel and file the profile to an accuracy of ± 0.5 mm

1	ISSH 125 x 125 x 0.5	-	STEEL SHEET	-	-	1.2.37
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE 1:1	PROFILE MARKING AND CUTTING	TOLERANCE ±0.5mm	TIME
		CODE NO. FI20N1237E1	

Mark off and drill through holes

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



NOTE: USE EX.NO: 1.2.31 TASK 1

1		1.2.31	Fe310-O	-	-	1.2.38
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE 1:1	DRILLING THROUGH HOLES	TOLERANCE : ±0.1mm	TIME
		CODE NO. FI20N1238E1	

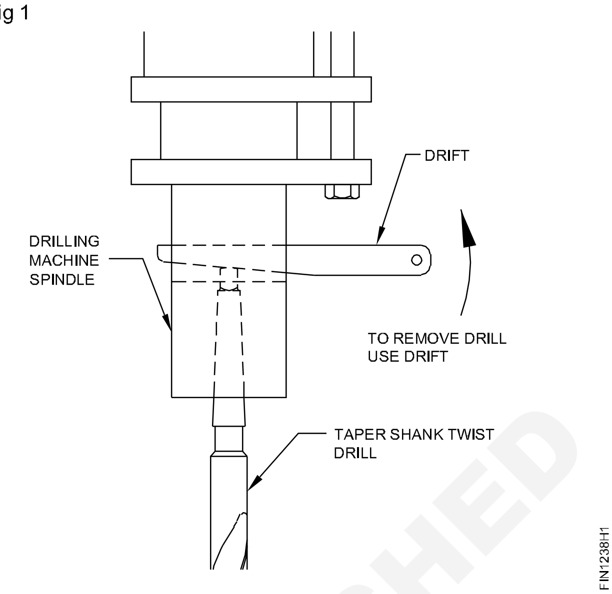
Job Sequence

- Check the raw material for its size.
- Apply marking media.
- Mark as per the drawing dimensions and punch the centre of holes with centre punch.
- Periphery of the big holes should be punched with prick punch 60°.
- Fix the job on the machine vice
- Fix centre drill in drill chuck, align with hole centre and centre drill to the required depth.
- Fix Ø 4mm drill in drill chuck
- Set the spindle speed for Ø 4 mm drill.
- Ø 4mm drill can be used as a pilot for all the holes.
- Fix Ø 8, Ø 10 and Ø 16 mm drill one by one and drill through holes as per job drawing.
- Use coolant while drilling

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

- Use drift to remove the taper shank drill from drilling machine spindle. (Fig 1)

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.

Skill Sequence

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 drills 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.

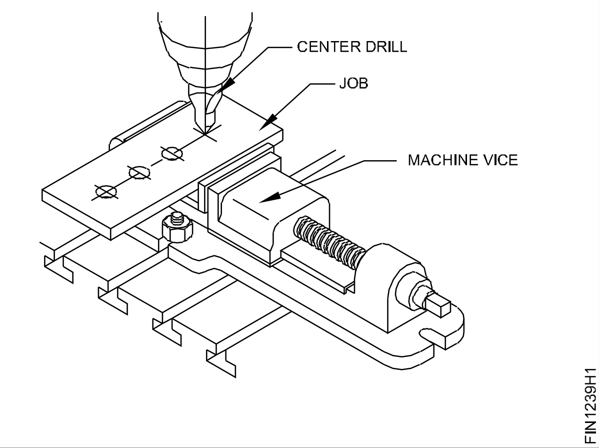
Adjust the job together with the vice and align with the centre punch mark. (Fig 1)

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. Fix of the required diameter twist drill. Check if it 'runs true'. Start drilling the through hole.

Fig 1



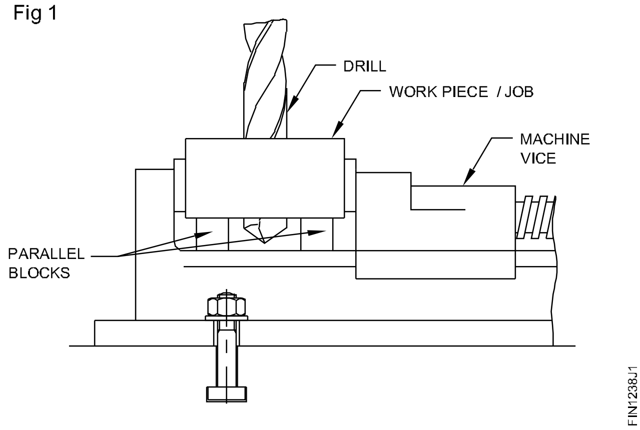
Drilling through holes

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 4mm 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.

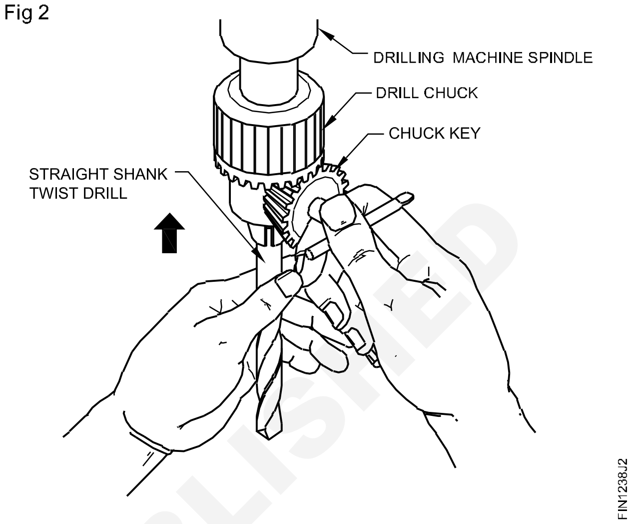
Remove the drill and drill chuck.

> **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)

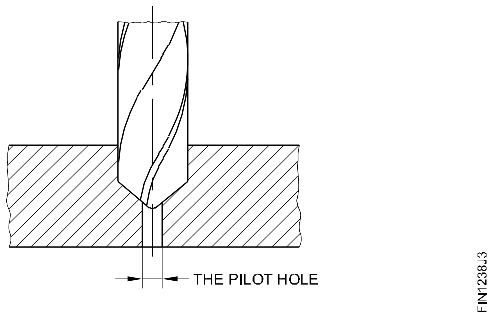
Fig 2



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.

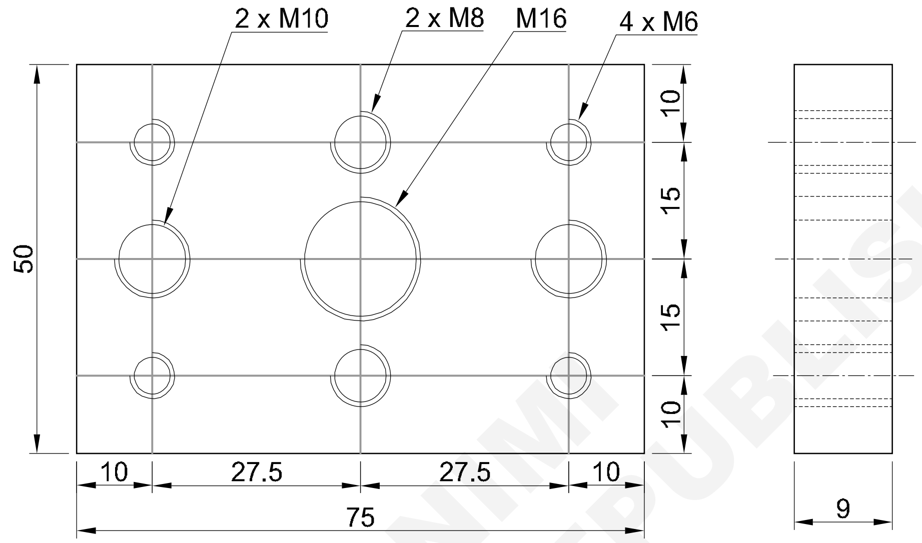
These problems can be overcome by drilling pilot holes initially. (Fig 3)

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 with centre location of hole and drill a centre hole..
- Fix Ø 5 mm drill in a drill chuck and drill all the centre drilled holes. (this serves 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	-	-	1.2.39
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	DRILLING AND TAPPING	TOLERANCE : ±0. 1mm	TIME
		CODE NO. FI20N1239E1	

Tapping through holes

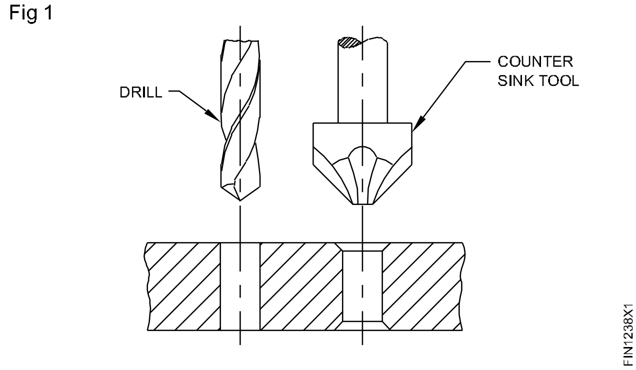
Objective: This shall help you to
- **cut internal threads using hand taps.**

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

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

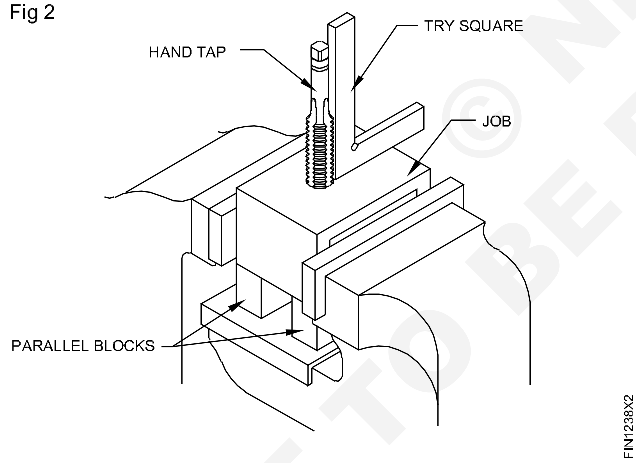
Chamfer the end of the drilled hole for easy aligning and starting of the tap. (Fig 1)

Fig 1



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

Fig 2



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

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

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

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

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

Fig 3

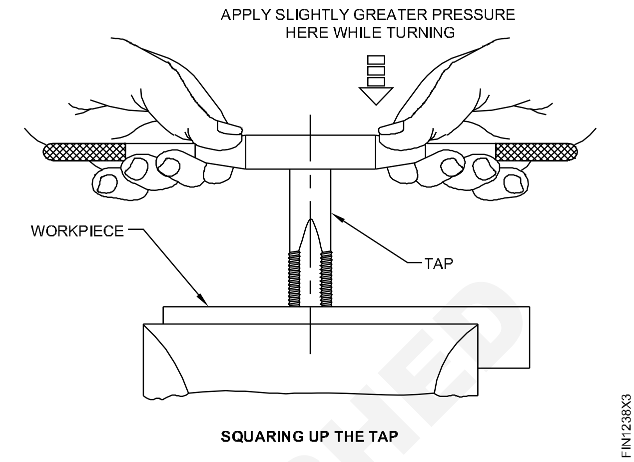


Fig 4

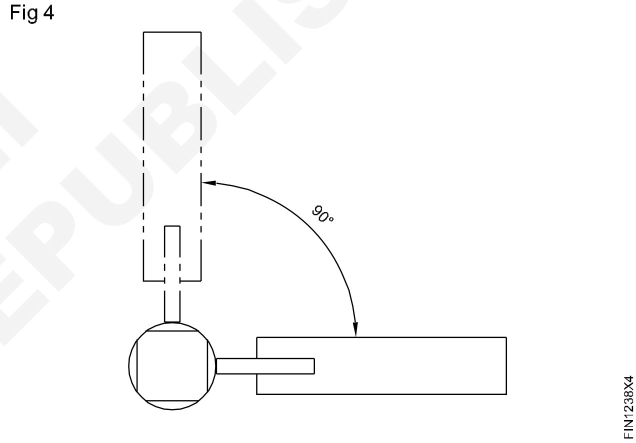
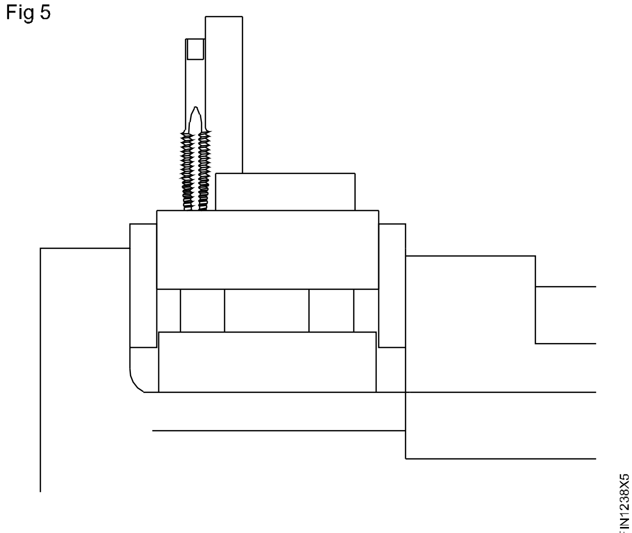


Fig 5

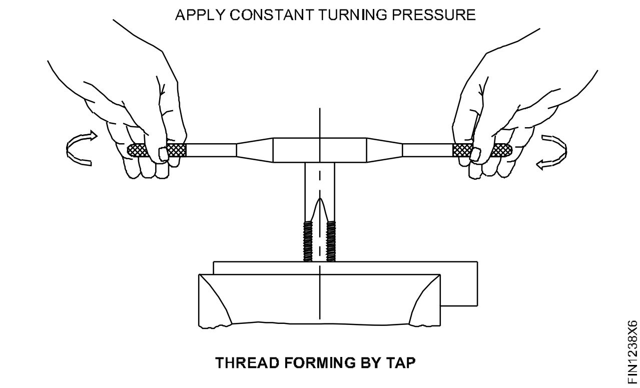


Make correction if necessary by exerting slightly more pressure on the opposite side of the tap inclination.

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.

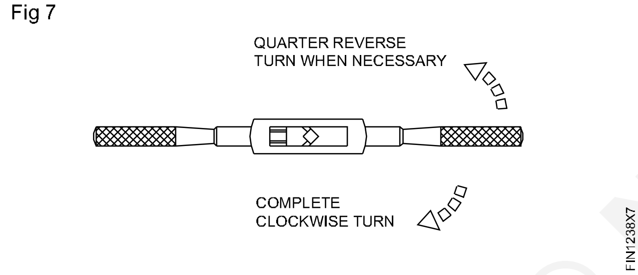
Turn the wrench lightly by holding at the ends without exerting any downward pressure after the tap is positioned vertically. The wrench pressure exerted by the hands should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap. (Fig 6).

Fig 6



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

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.

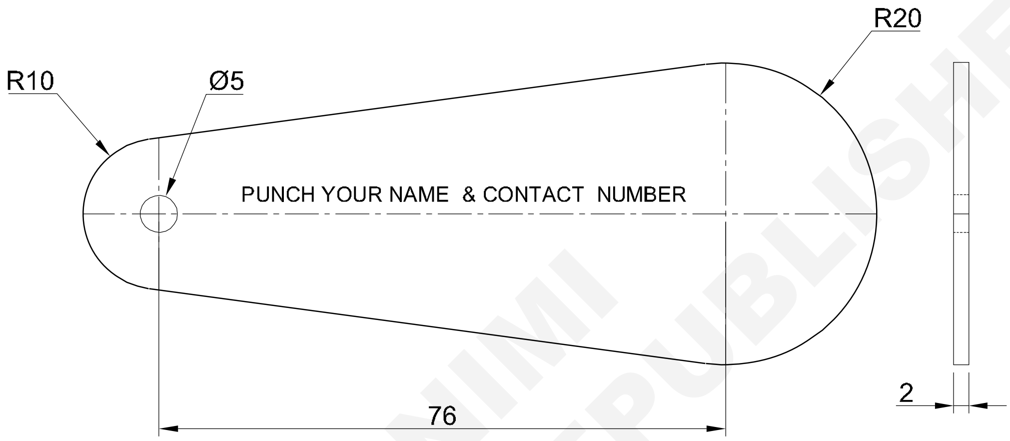
Make sure that the dia of the hole to be tapped is correct for the given size of the tap.

Turn backwards frequently about quarter turn to break the chips.

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

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.
- Count the letters on each line.
- Select the size of the letters according to space
- 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	-	-	1.2.40
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
		CODE NO. FI20N1240E1	

Skill Sequence

Objective: This shall help you to

- **punch letters and numbers.**

Letter and number punches

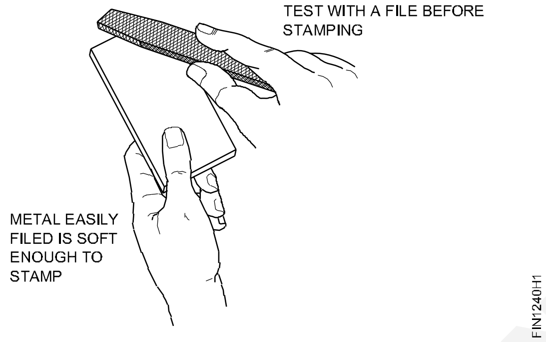
These hardened and tempered steel punches are used to stamp identifying symbols, letters or numbers as required on the work.

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.

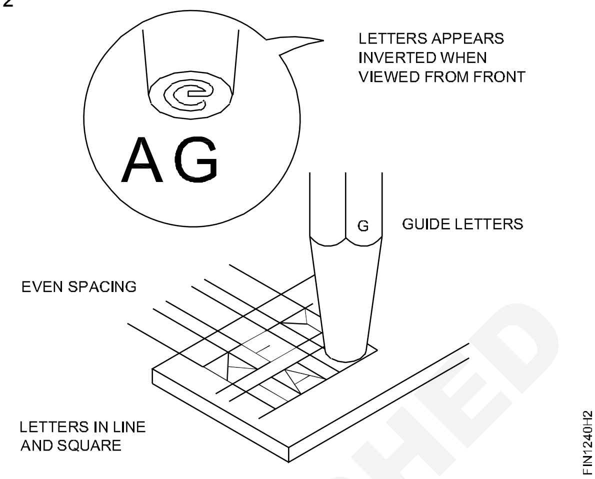
The depth of impression for a given blow varies with the softness of the material.

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)

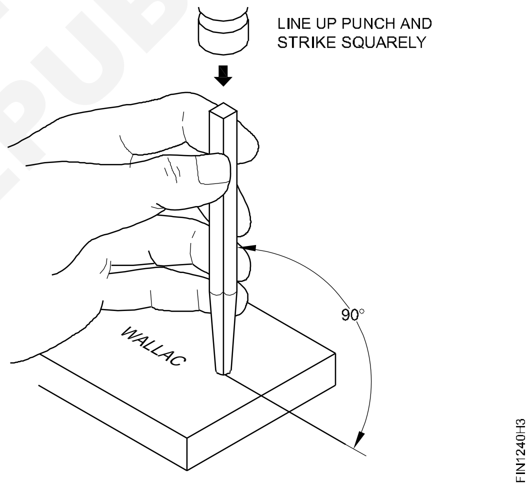
Fig 2



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

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

Fig 3



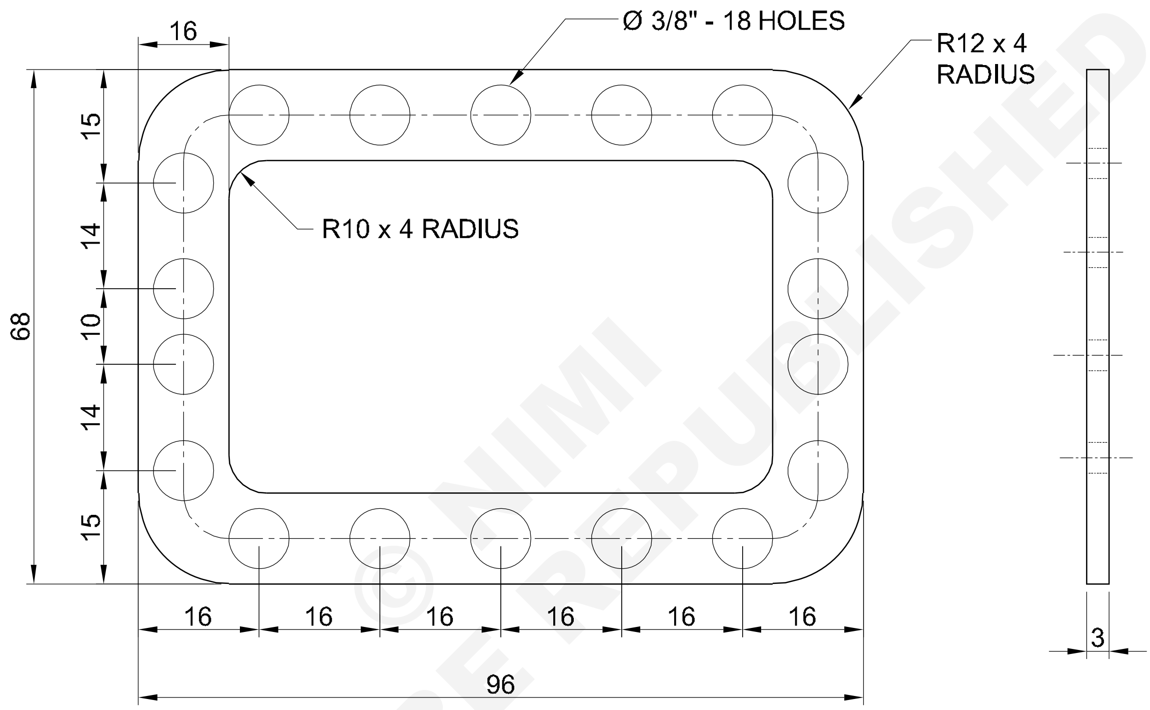
Watch the point of the punch.

Strike the punch squarely with one firm blow.

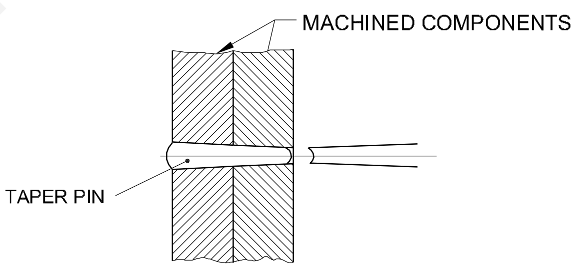
Practice use of different punches

Objectives: At the end of this exercise you shall be able to
- **mark and punch holes on gasket with hollow punch**
- **dismantle taper pin/dowel pin in an assembly.**

TASK 1



TASK 2



1	GASKET 100 x 70 x 3.0mm	-	RUBBER	-	-	1.2.41
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**PRACTICE WITH HOLLOW AND PIN PUNCH**	TOLERANCE : NIL	TIME
		CODE NO. FI20N1241E1	

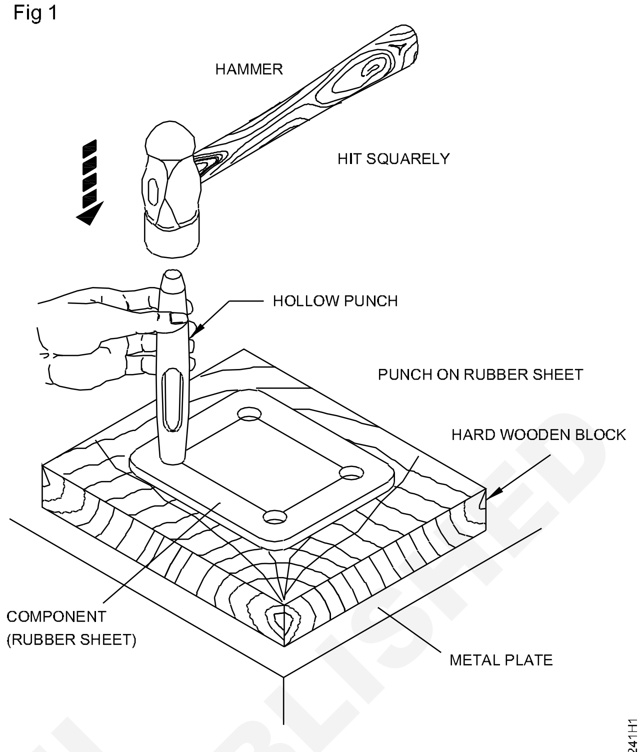
Job Sequence

TASK 1 : **Mark and punch holes on gasket**

- Mark as per drawing in Gasket.
- Locate the intersection of the hole point using pencil.
- Draw Ø 8 mm hole circles with divider.
- Punch and make a hole with Ø 8 mm Hollow punch - Fig 1.

> **For TASK 1 provisions may be made for Gasket/ Leatheroid sheet/Rubber or cork sheet for the practice.**

Fig 1

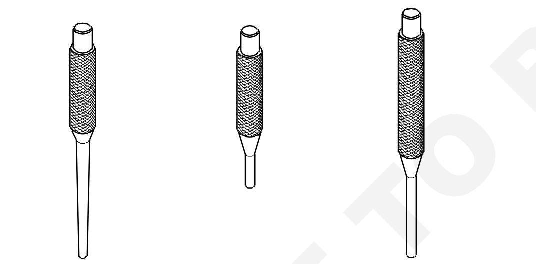


USING A HOLLOW PUNCH

TASK 2 : **Taper dowel pin dismantle**

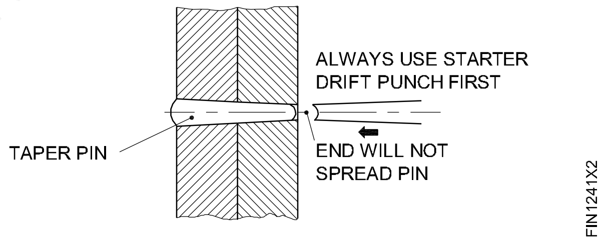
- Select a suitable pin punch according to the dismantling of taper pin fig 1.

Fig 1



- Always use starter drift punch first to dismantle the taper pin in machine assembly. (Fig 2)
- Use pin punch (short) or (long) also to dismantle the taper pin in assembly.
- While dismantling the dowel taper pin, strike with hammer on dowel pin with light blow.

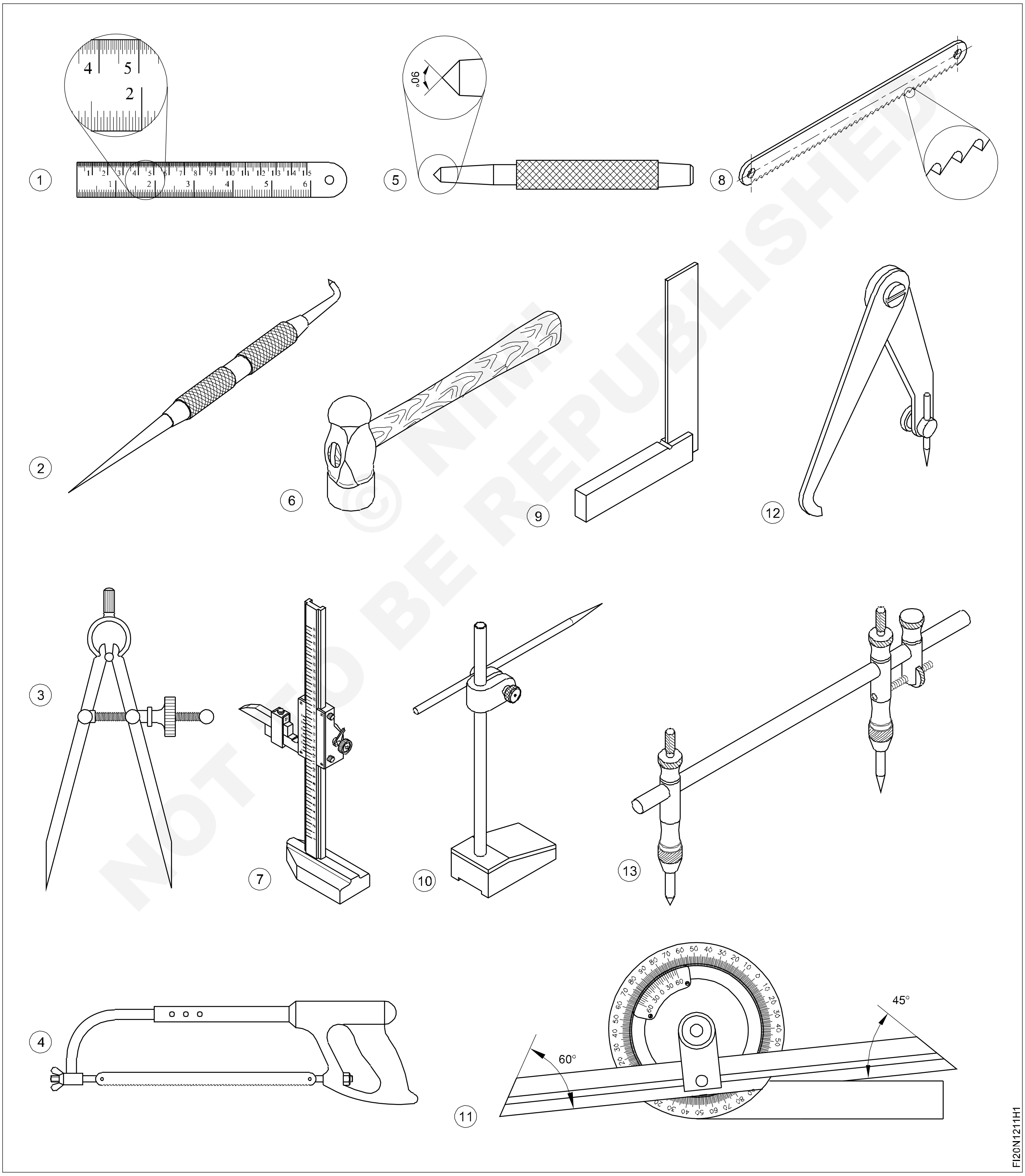
Fig 2



> **For TASK 2 provisions may be made for disassemble the fixtures of jigs where the dowel pins are provided for practice or removal of dowels.**

Identification of tools and equipments as per desired specifications for marking & sawing

Objectives : At the end of this exercise you shall be able to
- **identify the marking tools used in fitting shop**
- **identify the sawing tools used in fitting shop**
- **record the names of tools in table.**



Job Sequence

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

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

Table 1

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

Selection of material as per application

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

Job Sequence

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

Table 1

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

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 Scaled part

Job Sequence

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

Differentiate with one another

Ask the trainees to record it in the table

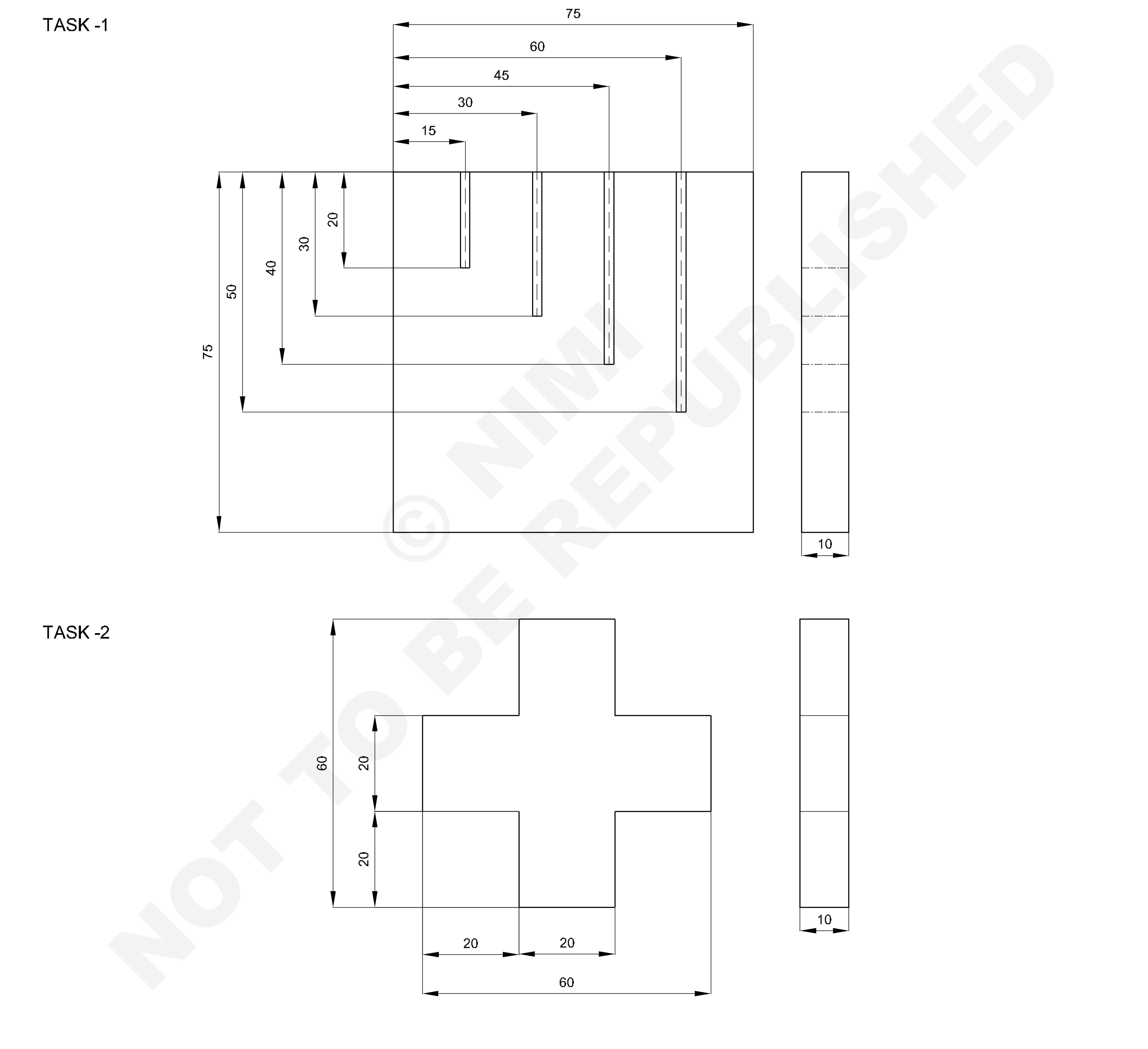
- Observe the given raw material
- Identify the formation of materials for rusting, corrosion and scaling
- Record the appearance of the defects in Table1. Get it checked by the instructor

Table 1

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

Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions

Objectives : At the end of this exercise you shall be able to
- **mark out lines using jenny caliper**
- **hold the job in bench vice**
- **cut along marked lines.**



1	60 x ISF10 - 60	-	Fe310 PRE - MACHINED	-	TASK - 2	1.2.14
1	75 ISF10 - 75	-	Fe310 PRE - MACHINED	-	TASK - 1	1.2.14
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

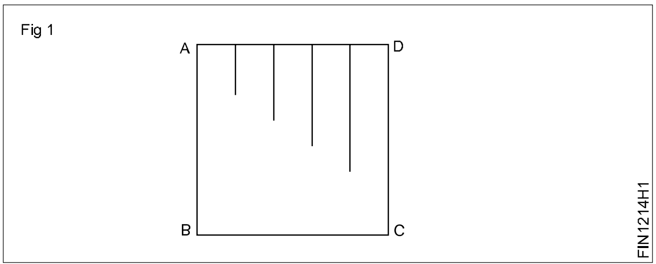
SCALE 1:1	MARKING AND SAWING	TOLERANCE : ±0.5mm	TIME : 10Hrs
		CODE NO. FIN1214E1	

Job Sequence

TASK 1: **Marking and hacksawing**

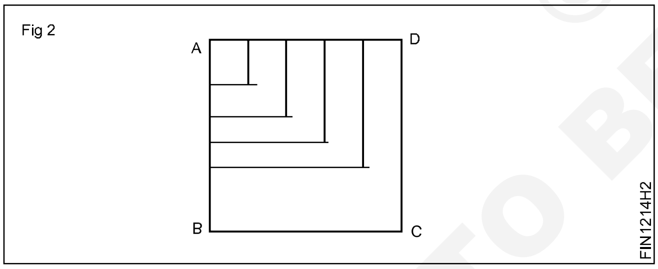
- Check the pre - machined size of 75x75x10 mm using steel rule.
- Apply marking media cellulose lacquer evenly on the surface of the Job.
- Place the job in levelling plate.
- Set the measurement 15 mm in Jenny caliper using steel rule.
- Draw parallel line of 15 mm to the side "AB" with the help of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

Fig 1



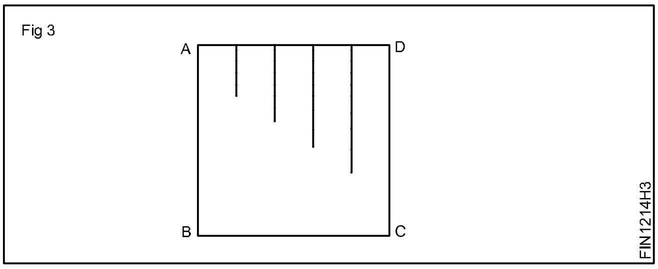
- Set the measurement 20 mm in jenny caliper using steel rule.
- Draw parallel line to side "AD" using Jenny caliper.
- Similarly, set 30 mm, 40 mm and 50 mm and draw parallel lines to side "AD" as shown in Fig 2.

Fig 2



- Punch witness marks on hacksawing lines using a dot punch and a ball pein hammer Fig.3

Fig 3

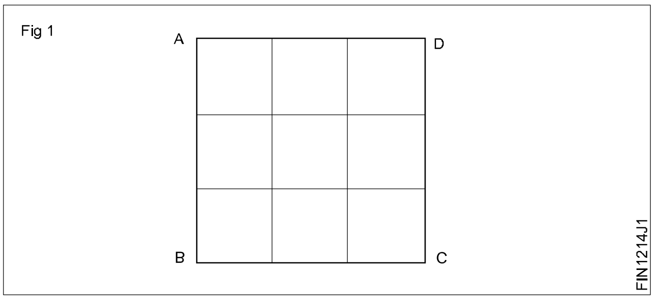


- Hold the Job firmly in Bench vice, keeping side "AD" parallel to vice Jaws.
- Select 1 mm pitch Hacksaw blade, fix the blade in hack saw frame, pointing teeth in the forward direction.
- Tighten the blade to the required tension with the wing nut.
- File a notch at the point of hacksawing to avoid slippage of the blade.
- Start cutting with a slight downward pressure using Hacksaw.
- Saw along the lines up to punch marks.
- Apply pressure in the forward stroke.
- Release the pressure in the return stroke.
- Use full length of the blade while sawing.
- Check the size with steel rule.

TASK 2: **Marking and hacksaw cutting**

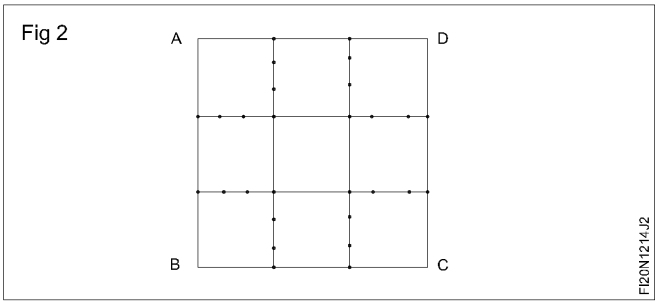
- Check the pre-machined size of 60x60x10mm using steel rule.
- Apply marking media cellulose lacquer evenly on the surface of the Job.
- Place the job on levelling plate.
- Set the measurement 20 mm in Jenny caliper using steel rule.
- Draw parallel line of 20 mm to the side "AB" using jenny caliper Fig.1
- Similarly, with the same setting of the dimension 20 mm in Jenny caliper, draw parallel lines to "BC", "CD", and "AD". As shown in Fig 1.

Fig 1



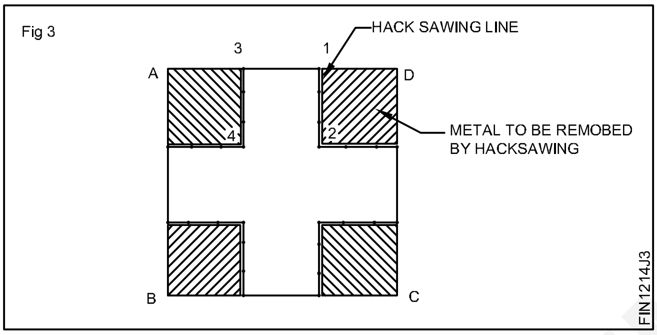
- Punch witness marks on the profile of Job using a dot punch and a Ball peen hammer as shown in Fig 2.

Fig 2



- Hold the Job firmly in Bench vice, keeping side "AD" parallel to vice Jaws. (Fig 3)
- Start cutting on side "AD", cut the line 1 to 2 upto the marked length 20 mm in right side. Fig.3

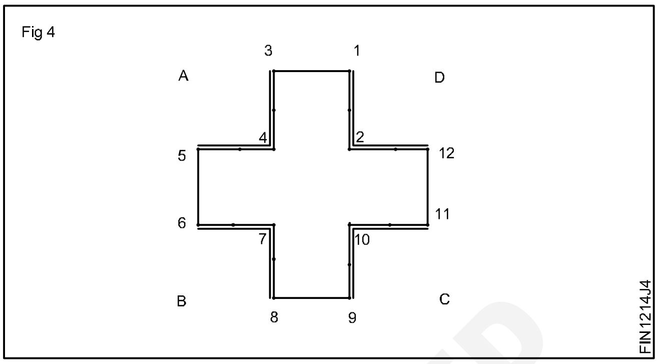
Fig 3



Ensure that half of the punch marks to be visible while sawing.

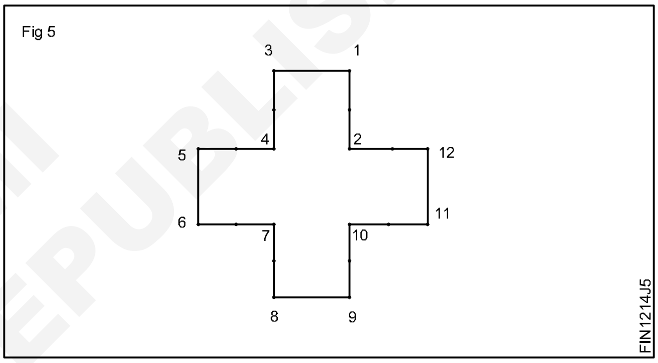
- In the same setting, without changing the position of the job cut the line 3 to 4 upto the marked length 20mm in left side as shown in Fig 3.
- Similarly, turn the job and cut the line 5 to 4, 6 to 7, 8 to7, 9 to 10, 11 to 10 and 12 to 2 as shown in Fig 4.

Fig 4



- After sawing profile of the Job shown in fig 5, check the size with steel rule.

Fig 5



Skill Sequence

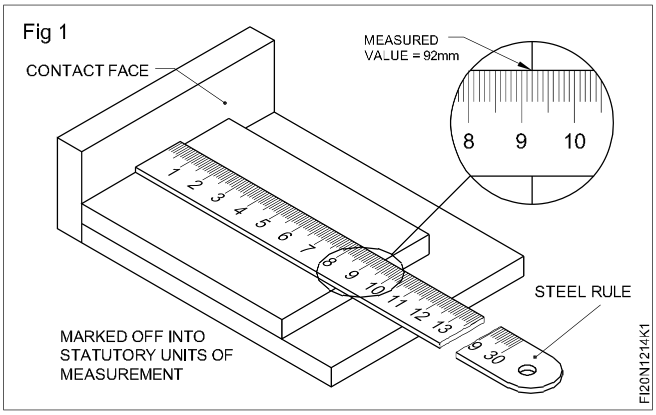
Measuring with a steel rule

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

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

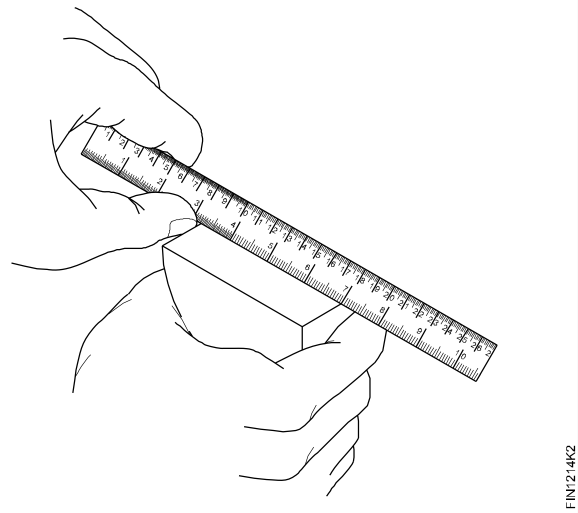
Use a contact face, if possible and read off measurements by looking at the steel rule directly. (Fig.1)

Fig 1



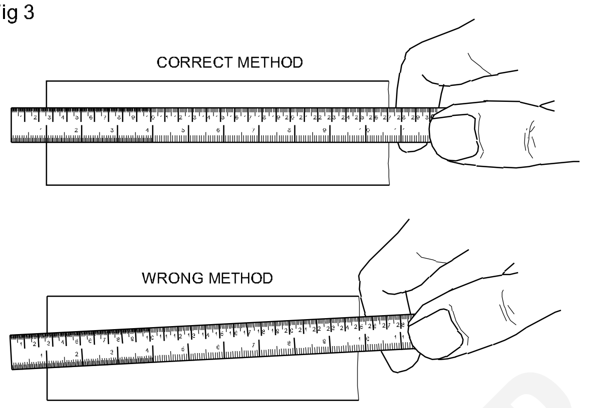
Measure with a rule starting off from the 1cm line if the edge of the rule is worn out or damaged. (Fig.2)

Fig 2



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

Fig 3



Always keep the steel rule away from the cutting tools to avoid scratches/damages.

Marking lines parallel to the edge of the job

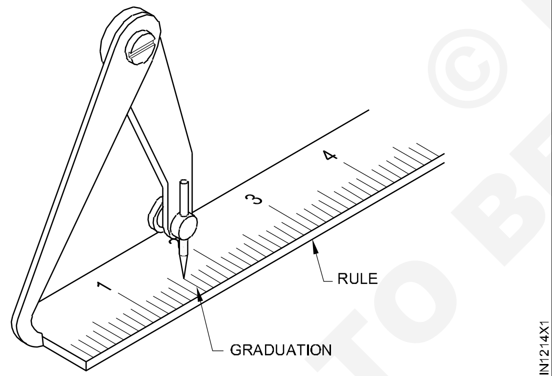
Objective: This shall help you to

- **mark parallel lines using a jenny caliper.**

Apply marking medium on the surface to be marked.

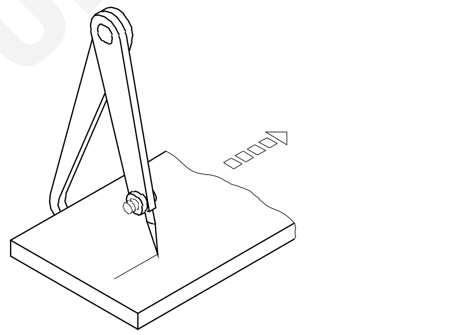
Set the jenny caliper to the size to be marked (i.e. dimension) with the help of a steel rule. (Fig.1)

Fig 1



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

Fig 2



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

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

Punching the marked line

Objective: This shall help you to

- **punch the line using prick punch.**

Place the job on levelling plate, such that marked lines should be approximately perpendicular to the operator.

Hold the punch between the thumb and the first two fingers of the hand where possible, rest the little finger and the edge of your hand on the marked centre point as shown in Fig.1.

Bring up the dot punch in the vertical position and strike with a ball peen hammer on the head of the dot punch lightly.

Watch the point of the punch and strike its head with the ball pein hammer Fig.2. This dot punch marks prevent the wing compass leg from slipping while scribing curved lines from the centre point.

Fig 1

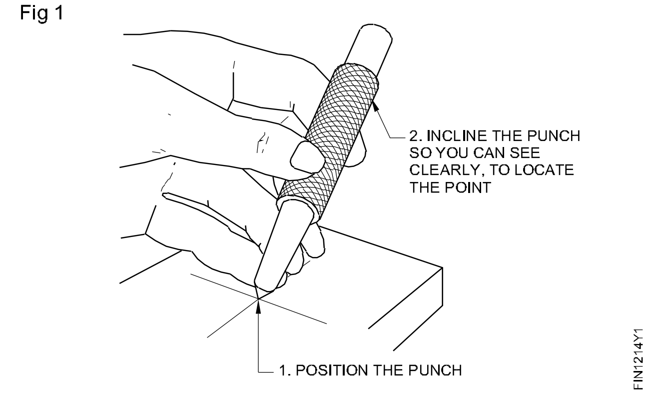
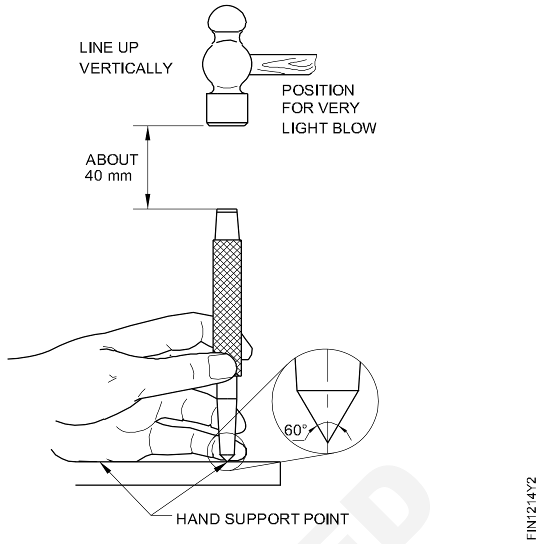


Fig 2



Sawing along a line

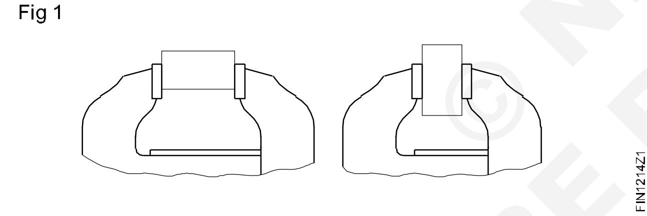
Objective: This shall help you to

- **cut along a straight line by hacksaw.**

Clamp the job to be cut according to the cross-section for sawing.

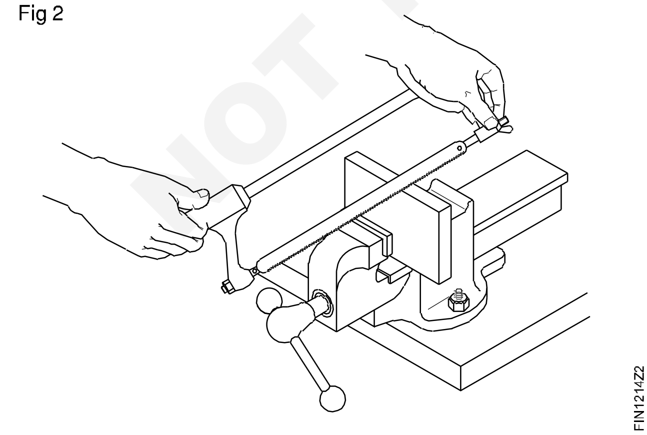
As far as possible hold the job in such a way that the flat or long side can be cut rather than the edge. (Fig.1)

Fig 1



In case the job has a profile (like steel angle), clamp the job so that sawing can be done towards the overhanging end. (Fig.2)

Fig 2



Clamp the job as long as possible on the vice and make sure that the marked sawing line is close to the side of the vice jaws in order to achieve maximum firmness.

Tighten the jaws firmly to avoid tilting and shifting of the job.

Whenever the section being cut shows chattering effect or vibration, the clamping needs improvement.

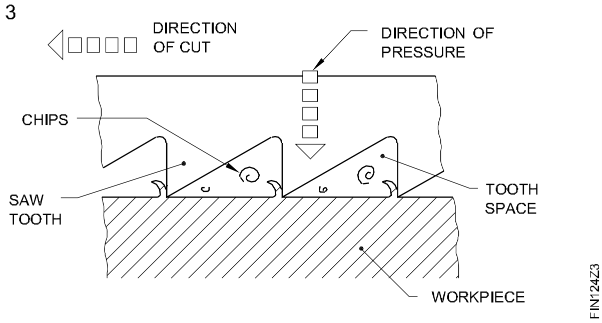
Select the correct pitch blade for cutting.

Shorter the cutting section is, finer the blade pitch. Make sure that atleast four teeth are cutting at a time.

Harder the material finer the blade pitch should be.

Fix the blade in such away that the teeth are in the direction of cut. (Fig.3)

Fig 3



Tighten and tension the blade by hand using only the wing nut.

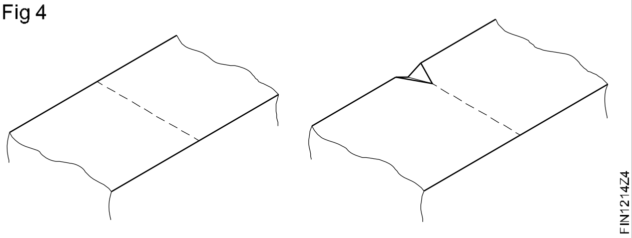
Caution

Insufficient blade tension-cut will not be straight.

Over tension-blade will break.

File a notch at the starting point on smooth and hard jobs to avoid slipping of the hacksaw. (Fig.4)

Fig 4



Apply a little downward hand force as long as only a few teeth are cutting. Press down only during forward (cutting) stroke.

Use the full length of the blade in order to avoid early dulling of the teeth in the middle portion of the blade.

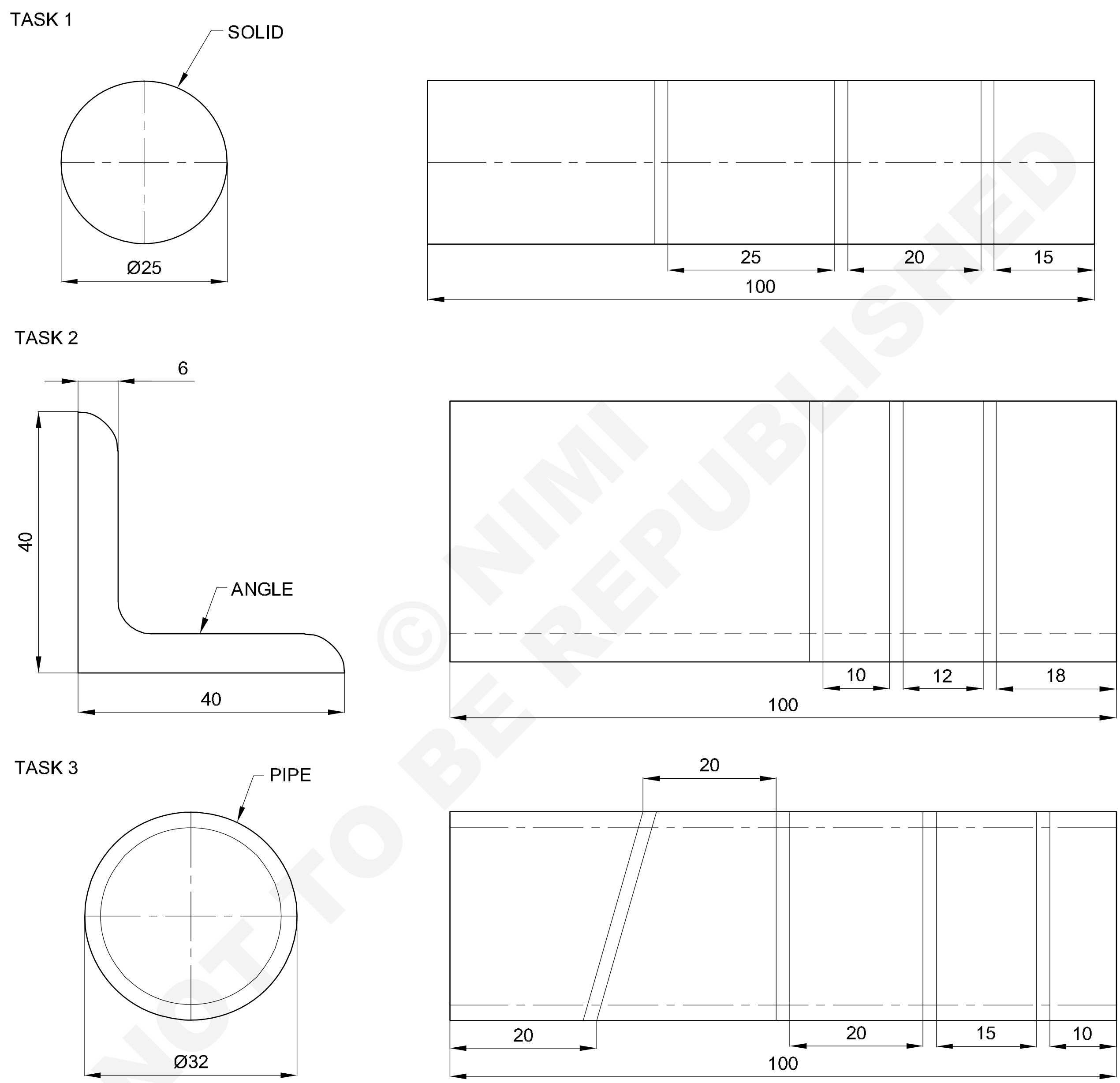
Move the blade strictly in line with the marked direction. Do not tilt the frame while sawing because bending ot the blade can cause sudden breakage of the blade.

Resort to cutting from the opposite side in case the deviation from the marked line is excessive.

Slow down the cutting while completing the cut to avoid breakage of the blade and injury to yourself.

Sawing different types of metals of different sections

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



1	Ø32 x 3.2 - 100 IS:1161		Fe310	05	3	1.2.15
1	ISA 40x40x6 - 100		Al310	05	2	1.2.15
1	Ø25 - 100	-	Co310	05	1	1.2.15
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SAWING DIFFERENT TYPES OF METAL OF DIFFERENT SECTIONS**	TOLERANCE : ±0.5mm	TIME :
		CODE NO. FI20N1215E1	

Job Sequence

TASK 1: **Sawing on round rod**

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

Selection of hacksaw blade

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

— — — — — — —

TASK 2: **Sawing on steel angle**

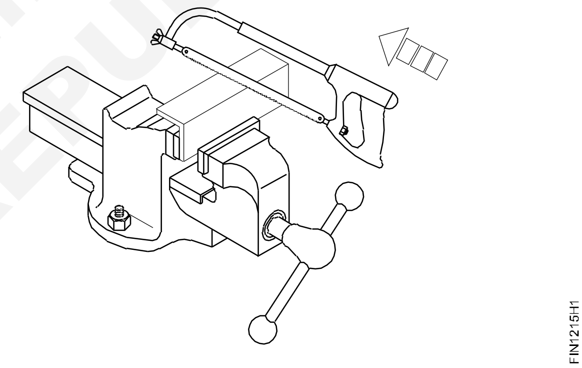
- Mark and punch the sawing lines.
- Hold the job in bench vice as shown in Figure.1
- Fix 1.8 mm coarse pitch blade in hacksaw frame.
- Cut along the sawing lines with hacksaw.
- Check the size of the angles with steel rule

Caution

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

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

Fig 1



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TASK 3: **Sawing on pipe**

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

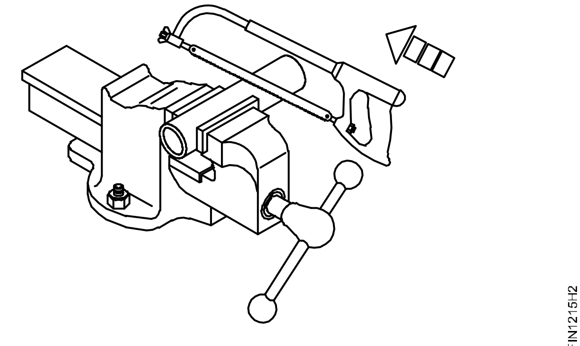
Caution

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

Do not cut too fast.

Cut very slow and reduce pressure while cutting through

Fig 1



Skill Sequence

Hacksawing (holding-pitch selection)

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

Holding the workpiece

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

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

Fig 1

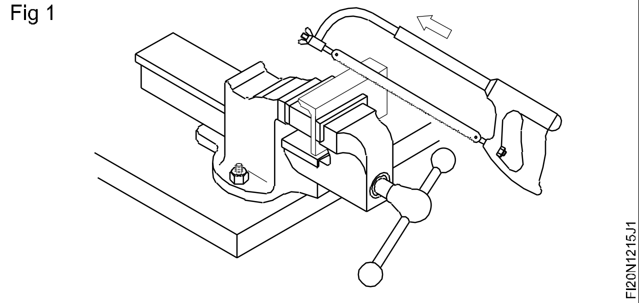


Fig 2

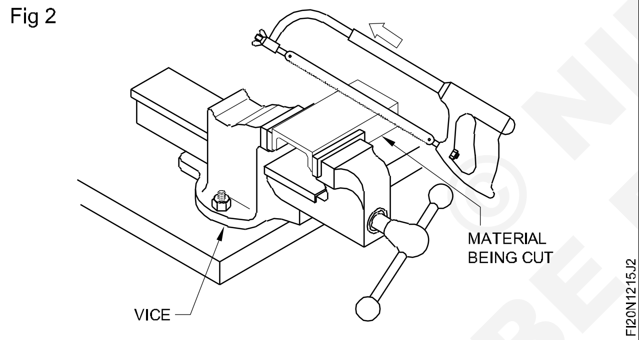
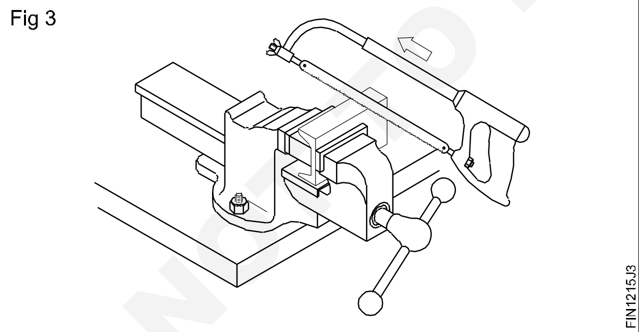


Fig 3

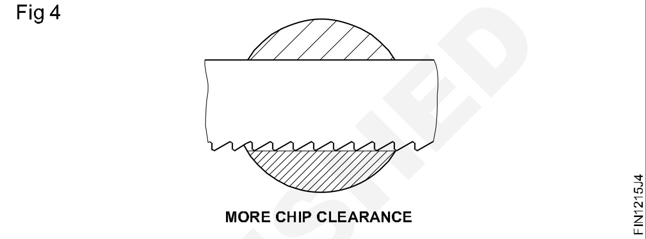


The selection of the blade depends on the shape and hardness of the material to be cut.

Pitch selection

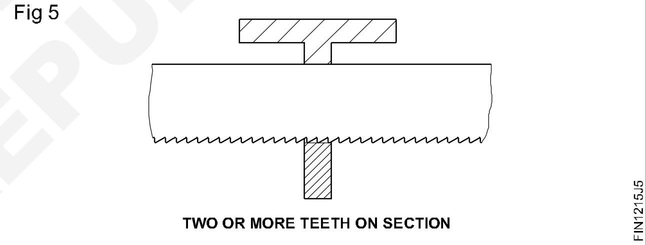
For soft materials such as bronze, brass, soft steel, cast iron, heavy angles etc. use a 1.8mm pitch blade. (Fig.4)

Fig 4



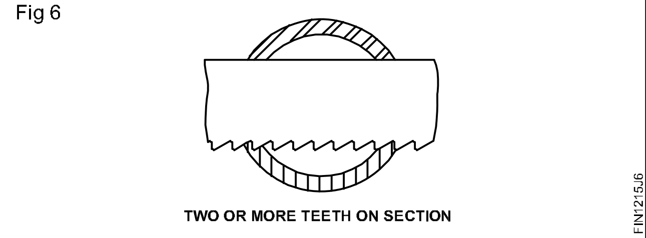
For tool steel, high carbon, high speed steel etc. use a 1.4mm pitch. For angle iron, brass tubing, copper, iron pipe etc. use a 1mm pitch blade. (Fig.5)

Fig 5



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

Fig 6



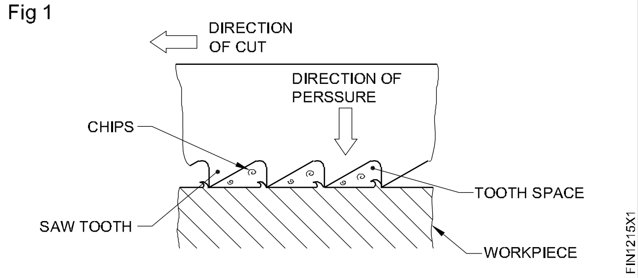
Hacksawing

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

Fixing of hacksaw blades

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

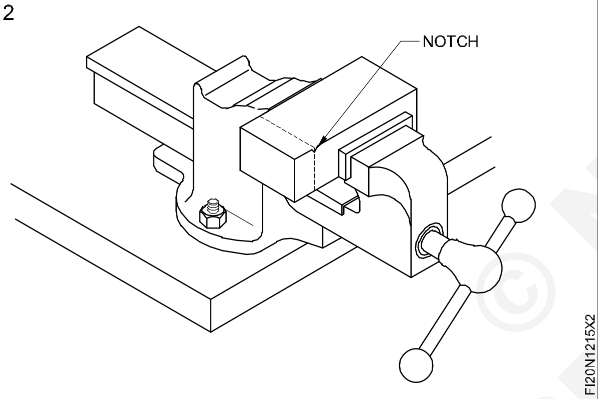
Fig 1



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

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

Fig 2

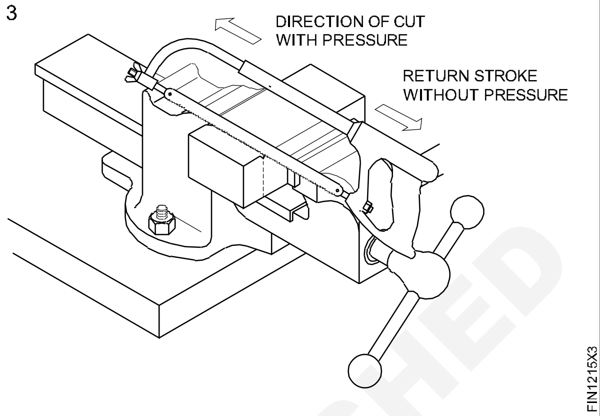


File 'V' notch using a triangular file.

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

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

Fig 3



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

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

Fig 4

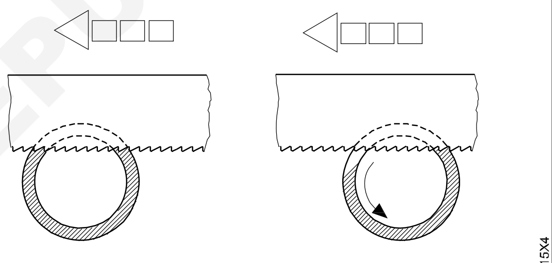


Fig 4 Fig 5

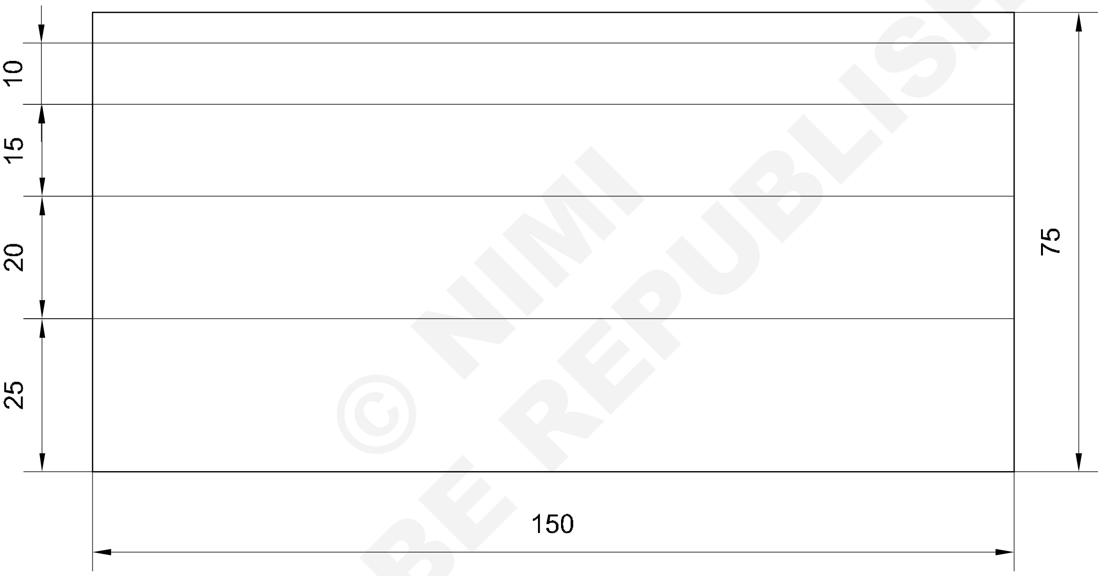
Normally, a coolant is not necessary while hacksawing by hand. However, to saw in heavy stock, intermittent coolant to be applied.

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

Marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips

Objectives: At the end of this exercise you shall be able to
- **flatten a sheet using wooden mallet**
- **mark parallel lines, curved lines, circles and geometrical shapes**
- **cut sheet metal on straight lines using straight snips**
- **cut sheet metal on curved lines using curved snips**
- **cut sheet metal on various geometrical shapes.**

Task 1

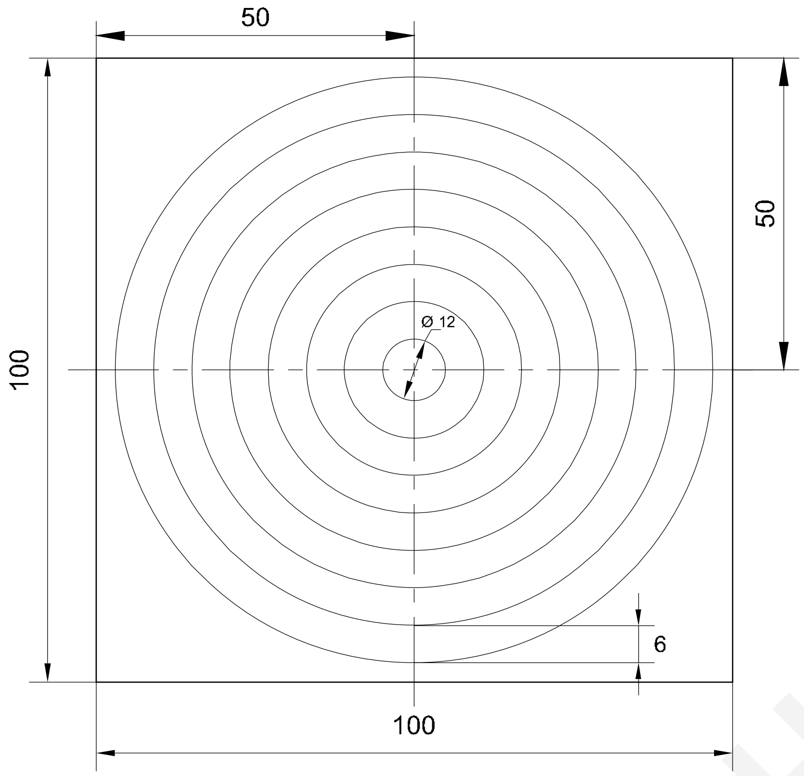


MARKING AND CUTTING ON STRAIGHT LINES

NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	ISSH 105 x 105 x 1.00mm	-	G.I. SHEET	-	TASK 6	
1	ISSH 75 x 75 x 1.00mm	-	G.I. SHEET	-	TASK 5	
1	ISSH 75 x 75 x 1.00mm	-	G.I. SHEET	-	TASK 4	
1	ISSH 125 x 125 x 1.00mm	-	G.I. SHEET	-	TASK 3	
1	ISSH 105 x 105 x 1.00mm	-	G.I. SHEET	-	TASK 2	
1	ISSH 155 x 80 x 1.00mm	-	G.I. SHEET	-	TASK 1	1.3.42

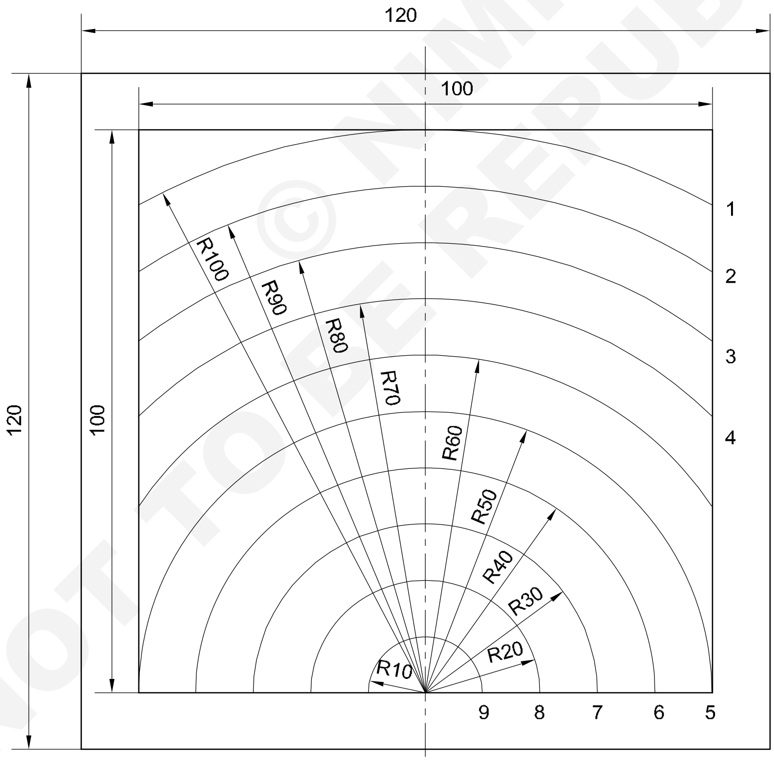
SCALE 1:1	TITLE: MARKING AND CUTTING VARIOUS GEOMETRICAL SHAPES IN G.I. SHEET	DEVIATIONS ±1.00mm	TIME
		CODE NO. FI20N1342E1	

TASK 2



MARKING AND CUTTING ON CIRCLES

TASK 3

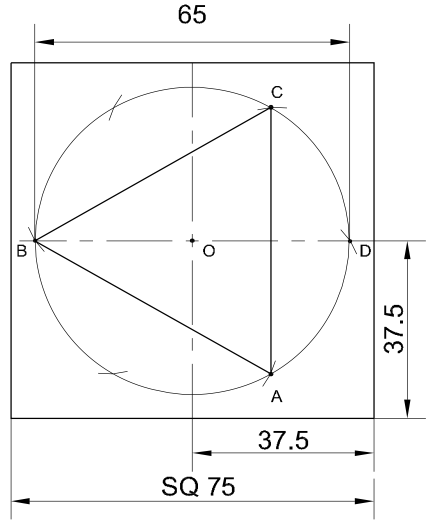


MARKING AND CUTTING ON CURVED LINES

		–	-	–	–	1.3.42
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

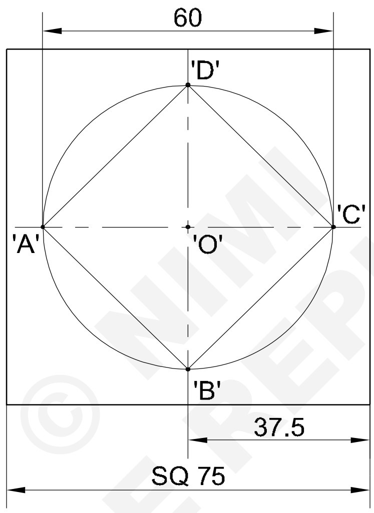
SCALE 1:1	MARKING AND CUTTING VARIOUS GEOMETRICAL SHAPES IN G.I. SHEET	DEVIATIONS ±1mm	TIME
		CODE NO. FI20N1342E2	

Task 4



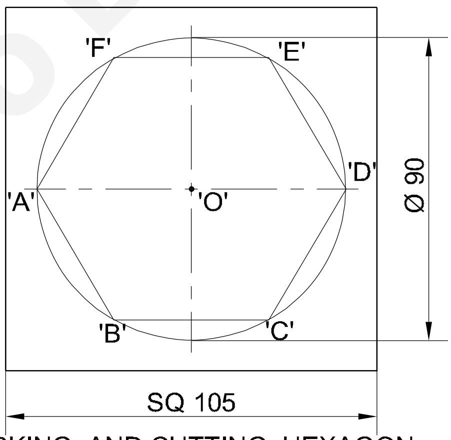
MARKING AND CUTTING TRIANGLE

Task 5



MARKING AND CUTTING SQUARE

Task 6



MARKING AND CUTTING HEXAGON

1	-	-	-	-	-	1.3.42
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	TITLE: MARKING AND CUTTING VARIOUS GEOMETRICAL SHAPES IN G.I. SHEET	DEVIATIONS ±1mm	TIME
		CODE NO. FI20N1342E3	

Job Sequence

TASK 1: **Marking and cutting on straight lines**

Check the size of the sheet steel as per sketch using a steel rule.

Level the sheet on the workbench or a bench stake using a mallet.

Mark a rectangle on the sheet metal as per sketch using 'L' square, steel rule and scribe.

Set the steel rule on the outline of the sheet for 25mm.

Mark off two 'V' marks at 25mm from each long side.

Scribe a line through the 'V' marks, throughout the length of 150mm.

Similarly, mark other lines 20mm, 15mm, 10mm and 5mm apart from each other.

Hold the sheet by left hand.

Cut the sheet by the right hand on the line, using straight snips.

— — — — — —

TASK 2: **Marking and cutting on circles**

Check the size of the square sheet as per sketch, using a steel rule.

Level the sheet on a levelling plate using a mallet.

Mark a square on sheet metal as per sketch.

Mark and punch the centre of the square sheet.

Draw ∅12mm concentric circle at the centre of square.

Similarly, scribe other 7 concentric circles with equi distant radius.

Cut the circle lines using bend snips.

— — — — — —

TASK 3: **Marking and cutting on curved lines**

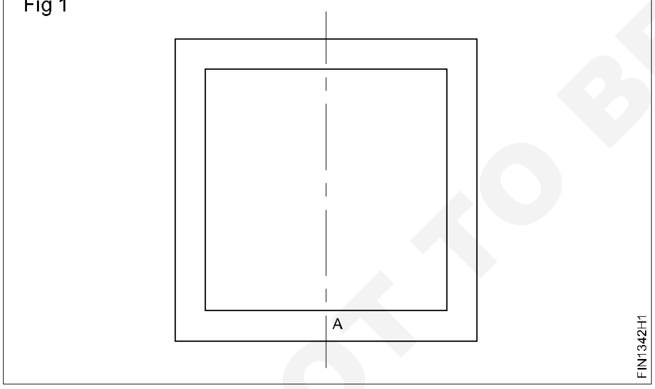
Flatten the sheet metal using a wooden mallet and a tinman's anvil stake.

Check the size of the sheet using a steel rule.

Mark square 100 x 100 using a steel rule, a straight edge and a 'L' square.

Mark the centre line as shown in Fig.1

Fig 1



Mark point 'A' and punch using a dot punch and a ball pein hammer.

Taking point 'A' as the centre, mark curved line radius 10mm using a wing compass.

Similarly, mark other curved lines as per job drawing.

Check the marked curved lines using a steel rule.

Cut along the marked outside curved lines 1 to 4 using straight snips. (Fig.2)

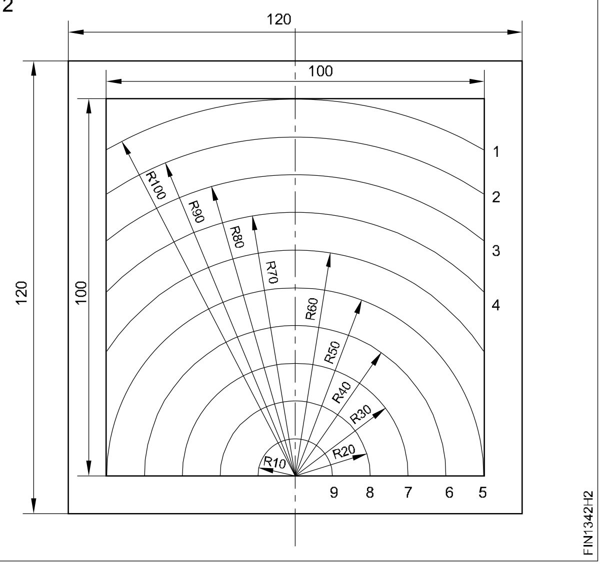
Cut along the marked inside curved lines 5 to 9 using bend snips. (Fig.2)

Check the dimensions of the cut pieces using a steel rule.

Flatten the sheet on anvil stake with wooden mallet.

Check surface flatness with edge of steel rule.

Fig 2



— — — — — —

TASK 4: **Marking and cutting triangle**

Check the size of the sheet as per sketch using a steel rule.

Level the sheet on the bench stake using a mallet.

Punch the centre of the sheet by a prick punch.

Draw a ∅ 65mm circle using a divider on the sheet.

Punch a dot on the circumference of the circle by a prick punch.

Mark three arcs equal to the side of the equilateral triangle and join the arcs by lines.

Cut along the marked lines using straight snips.

Check the triangle size with steel rule.

— — — — — —

TASK 5: **Marking and cutting square**

Check the size of sheet as per sketch using a steel rule.

Mark the centre lines.

Punch the centre of the sheet by a prick punch.

Draw a ∅ 60 mm circle using divider on the sheet at point 'O'.

Join points A,B,C,D and inscribe the square.

Cut along the marked lines using straight snips.

— — — — — —

TASK 6: **Marking and cutting hexagon**

Check the size of the sheet as per sketch using a steel rule.

Level the sheet on a levelling plate.

Mark centre lines.

Punch at the centre of the sheet 'o'.

Draw ∅ 90mm circle.

Scribe arcs on the circumference, each arc being equal to the radius of the circle.

Join points A,B,C,D,E & Fand construct the hexagon.

Cut along the marked lines using straight snips.

— — — — — —

Skill Sequence

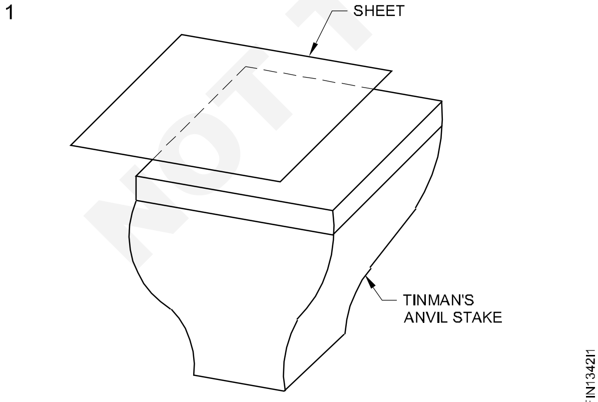
Flattening the sheet metal

Objective: This shall help you to
- **flatten the sheet metal of various sizes.**

Clean the tinman's anvil stake and the job.

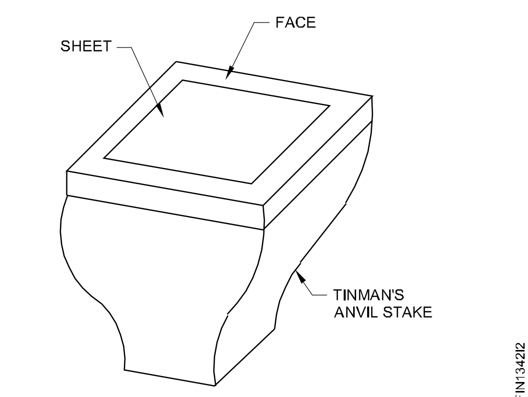
Place the job on the anvil stake top. (Fig 1)

Fig 1



If the size of the sheet metal is smaller than the face of the stake, place the sheet somewhere in the middle of the stake face. (Fig 2)

Fig 2



If the size of the sheet is bigger than the face of the stake, place the edge of the sheet at the center of the stake face.

Strike the sheet with the mallet from front to back and back to front, till the entire surface of the sheet is flat. (Fig 3)

Fig 3

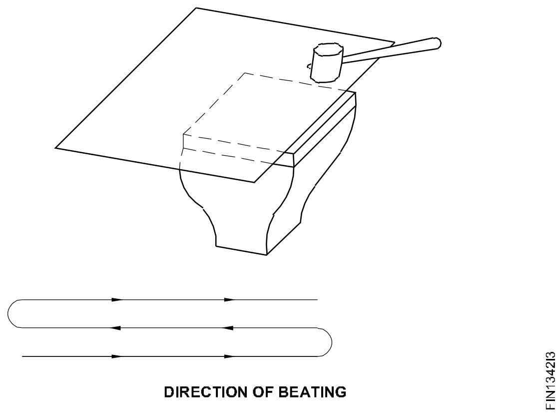
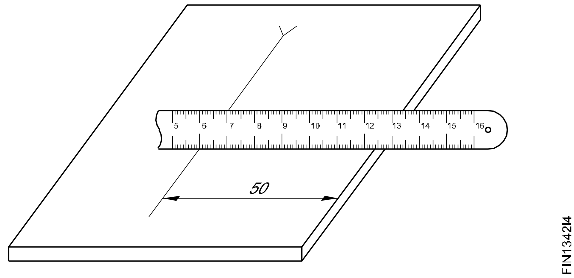


Fig 4



Check the flatness of the sheet metal with the edge of the steel rule. While checking the flatness, place the edge of the steel rule on the surface of the sheet and observe the gap between the steel rule edge and the surface of the sheet metal. (Fig 4)

If a gap is not observed, then the sheet is perfectly flat.

If a gap is observed, then the sheet is not flat at the points of the gap.

Flatten the surface at the points of the gap if a gap is observed.

Measuring and marking the sheet metal

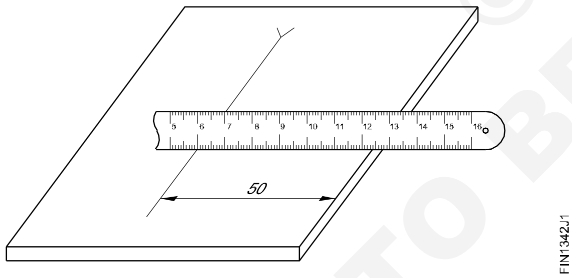
Objectives: This shall help you to
- **measure the linear dimensions of the sheet metal using a steel rule**
- **mark parallel lines using a steel rule, a straight edge and a scriber.**

Measuring

– Clean the edges of the steel rule using a waste cloth.

– Place the graduated edge of the steel rule on the workpiece such that the edge is perpendicular to the lines or the edges. (Fig 1)

Fig 1



– Coincide one line with a large graduated line (Centimeter lines) on the steel rule.

– Taking this as a reference dimension, note the dimension on the scale coinciding with the line/edge between which the distance is to be checked.

– Determine the distance between the two lines. For example, if 50 mm is the reference dimension and 100 mm is the dimension coinciding with the line between which the distance is to be checked, then 100-50 = 50 mm is the distance between the two lines.

Mark a straight line on the sheet: Mark off two 'V' marks from the datum 'xx' at a distance as required for measurement, using a steel rule and a scriber. Datum 'xx' is at right angle to datum 'yy'. (Fig 2)

Set the straight edge in between the 'V' marks and press the straight edge with your fingers. (Fig 3)

Fig 2

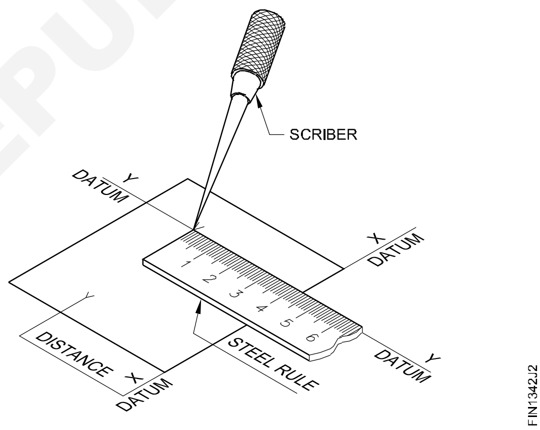
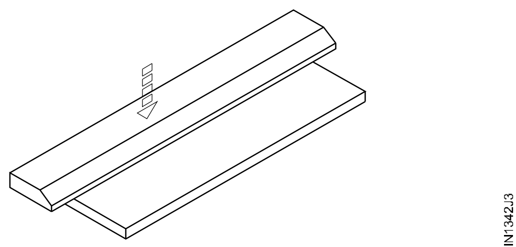


Fig 3



While scribing lines, hold the scriber close to the straight edge as shown in Fig 4.

Incline the scriber at an angle of 45^0 approximately as shown in Fig 5 and scribe a line towards you along the edge of the straight edge.

If the inclination is opposite from you, it will cause damage to the sheet and will remove the top layer of the metal.

Don't apply excessive pressure while scribing lines using the scriber to avoid the removal of the metal. Fig 6.

Fig 4

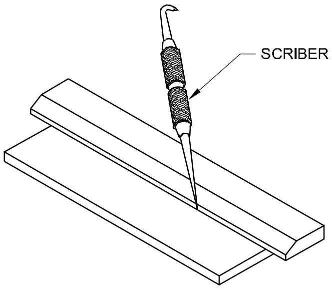


Fig 5

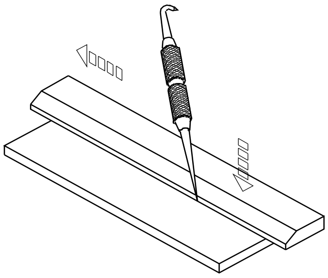
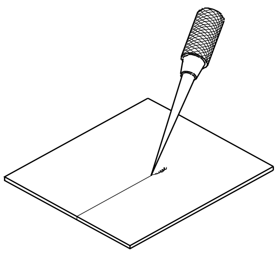


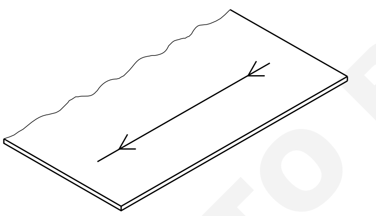
Fig 6



The line AB is the parallel line to the datum xx. (Fig 7)

For economical marking

Fig 7



To avoid wastage, always scribe lines from left hand bottom corner as shown in Fig 8 but not as in Fig 9.

Draw parallel lines as in Fig 10 as per the dimensions shown in Job drawing. (Ref. Job sequence for Ex.No.1.3.42 Task 1.

Fig 8

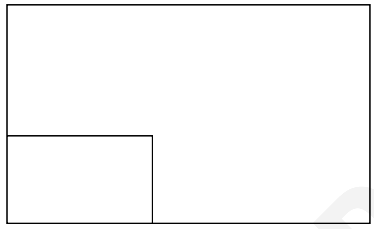


Fig 9

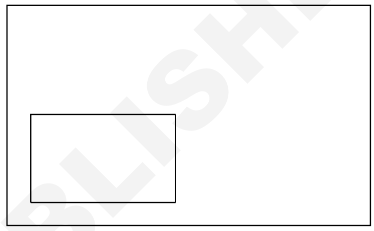
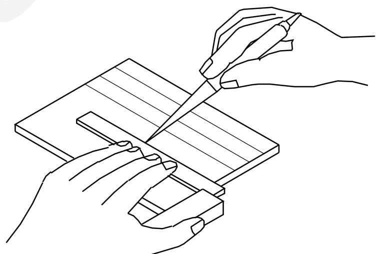


Fig 10



Marking with wing compass

Objectives : This shall help you to
- **set the required dimension on a wing compass**
- **draw circles and arcs with a wing compass.**

Wing compass

Verify that the legs of the compass are of the same length. (Fig 1)

If not, grind the leg and sharpen with an oilstone.

Punch at the intersection of the marked lines. (Fig 2)

Only a small dot is needed to prevent the compass from slipping.

Fig 1

For small lengths, loosen the wing nut and open the compass wider and then squeeze with your right hand to adjust and match the required length on the rule. (Fig 3)

While adjusting the compass opening, use the middle of the rule and not the edge.

For larger lengths, place the rule on the worktable and adjust the compass opening, with both tips on the rule.

To close the legs fractionally, tap the outside of the leg lightly.

Fig 2

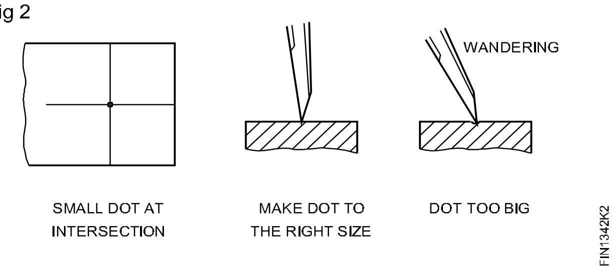
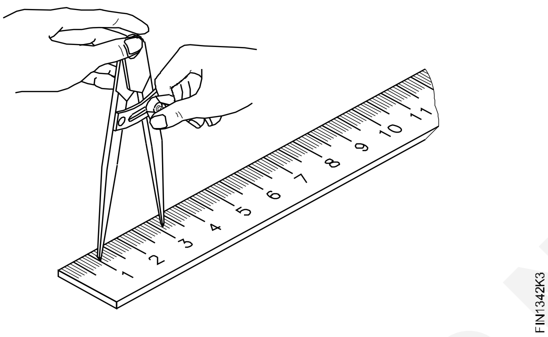


Fig 3



To open them fractionally, turn the compass upside down and tap the head lightly. (Fig 4)

After setting the dimensions, lock the legs with the wing nut and check the dimensions again.

Hold the compass head with the palm of your hand to prevent the compass point from slipping from the centre of the circle.

Do not press the wing nut.

Draw an upper half circle from the lower left to the right, using thumb pressure. (Fig 5)

Fig 5

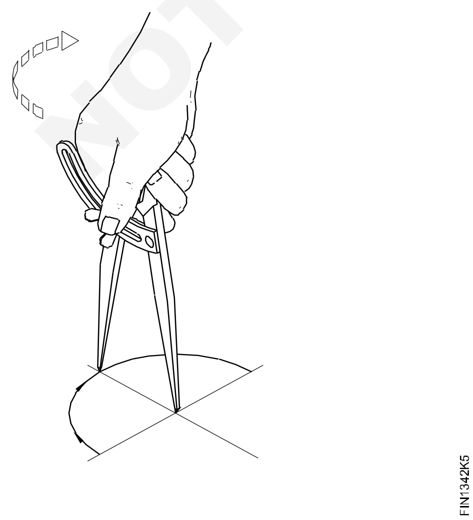
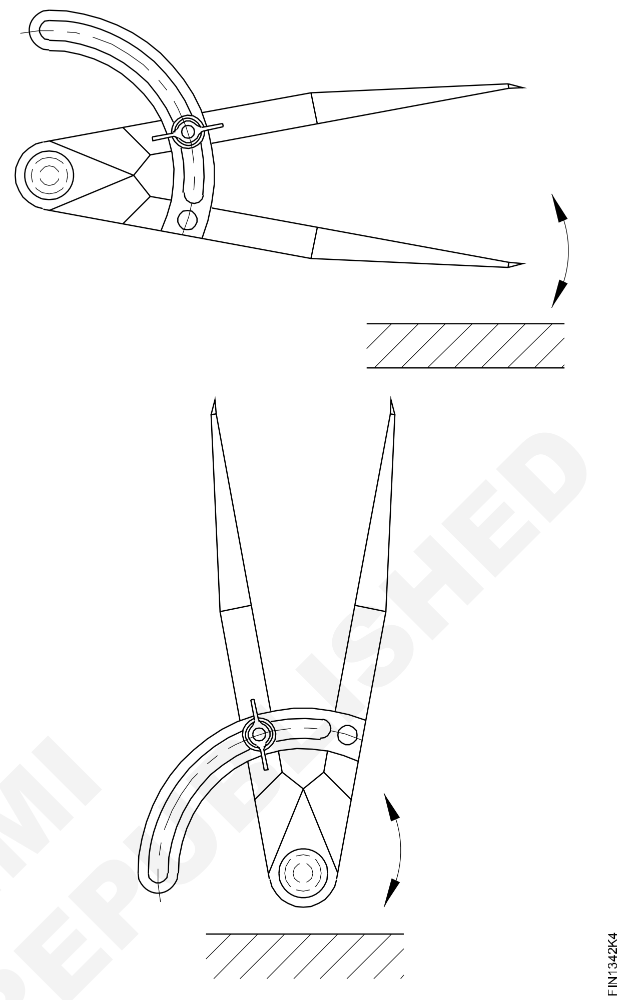


Fig 4

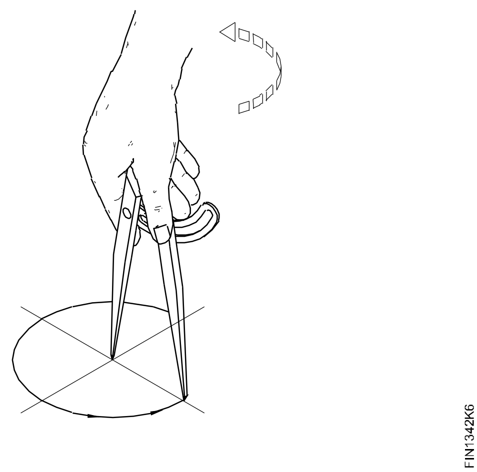


Change the thumb position on the compass, and draw the rest of the circle from the lower left. (Fig 6)

When drawing, tilt the compass slightly in the direction of rotation.

Draw clearly the first time itself.

Fig 6



Mark curved lines

Objectives: This shall help you to
- **mark the centre line using a scriber and a steel rule**
- **punch a dot mark using a dot punch**
- **mark curved lines using a wing compass.**

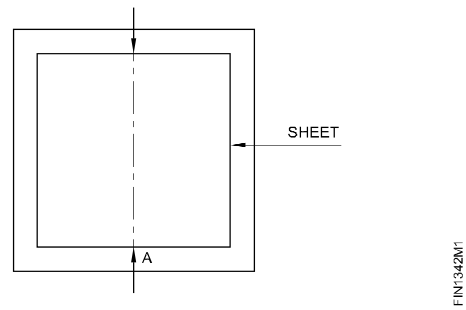
Clean the tinman's stake and the sheet metal surface.

Flatten the sheet metal using a wooden mallet.

Check the size of the sheet metal using a steel rule.

Mark 'V' at the centre of the workpiece on opposite sides and join it using a steel rule and a scriber. (Fig 1)

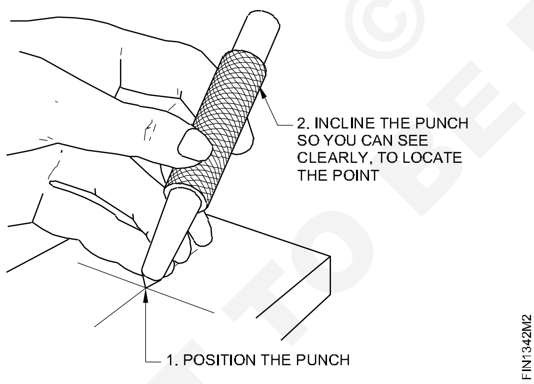
Fig 1



Mark the centre point on the centre line.

To punch the centre point use a dot punch. Place the sheet on the anvil stake. Hold the punch between the thumb and the first two fingers of the hand where possible, rest the little finger and the edge of your hand on the marked centre point as shown in Fig 2.

Fig 2



Bring up the dot punch in the vertical position and strike with a ball pein hammer on the head of the dot punch lightly.

Watch the point of the punch and strike its head with the ball pein hammer Fig 3. This dot punch marks prevent the wing compass leg from slipping while scribing curved lines from the centre point.

Only a small dot is needed to prevent the wing compass from slipping. If the dot is too big, compass leg will wander as shown in Fig 4.

Now set the wing compass to the required dimension. Set one leg of the wing compass at the centre point, and scribe a curved line (arc) by rotating the wing compass as shown in Fig 5.

Safety: While striking the head of the dot punch, the hammer face must be free of burrs and oil substances. The hammer head must be held tight on to the handle by wedge.

Fig 3

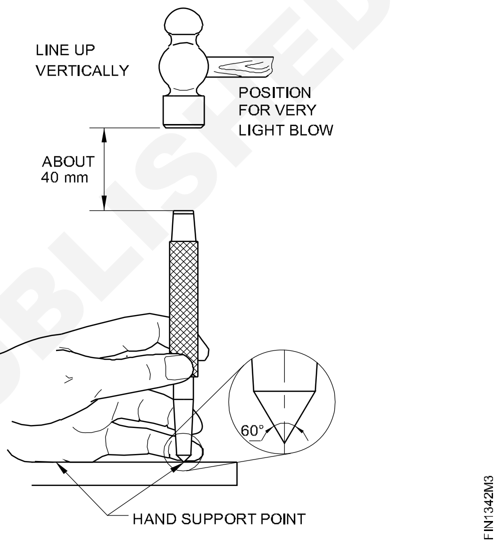


Fig 4

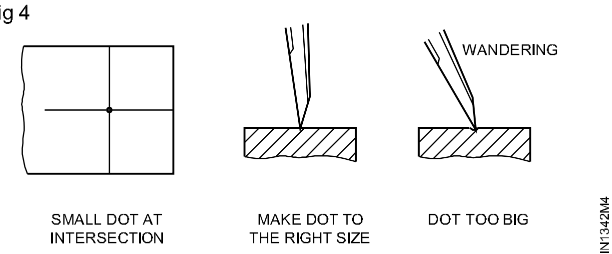
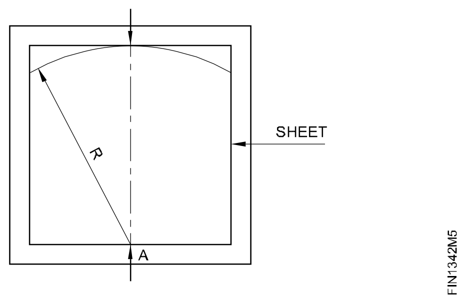


Fig 5

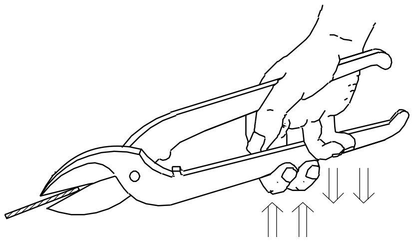


Cutting the sheet metal along straight line by straight snips

Objective: This shall help you to
- **cut the sheet metal along a straight line by straight snips.**

Hold the sheet in one hand and snip with the other hand, hold the snips handle at the end and place the upper blade of the snips on the line by keeping a smaller opening angle. (Fig.1)

Fig 1



CORRECT GRIP OF SNIPS WHILE CUTTING

Grip the snips so that both the blades are engaged with each other without any clearance between the blades.

Maintain the gap in between the blades, to less than 20° (Fig 2 & 3)

Fig 2

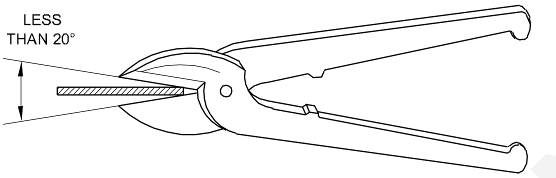
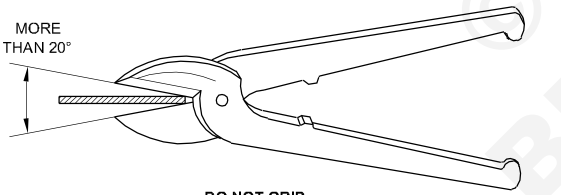


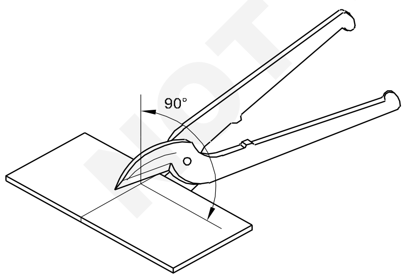
Fig 3



DO NOT GRIP

Keep the blade perpendicular to the surface of the sheet metal and hold the snips straight. (Fig 4)

Fig 4

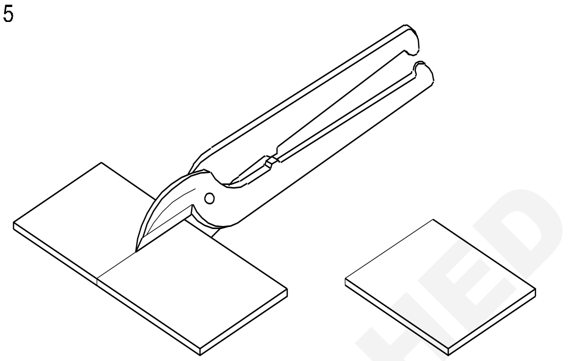


Do not use the full length of the blade for a single stroke.

If you use the full length of the blade for a single stroke, the cutting line will not be straight and also the blade corner will damage the sheet. (Fig 5)

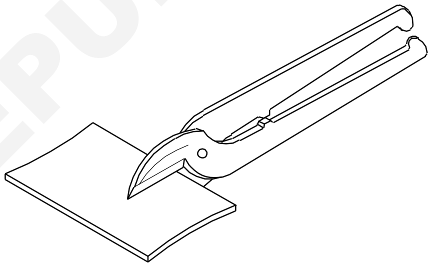
As far as possible, keep a small part of the sheet on the left hand side at the time of cutting the sheet. (Fig 6)

Fig 5



If stops are not provided in snips, care should be taken while cutting the sheet, not to pinch the palm of the hand between the bent ends of the snip handles while closing. (Fig.7)

Fig 6



Cut the material along the scribed lines. (Fig.8)

Fig 7

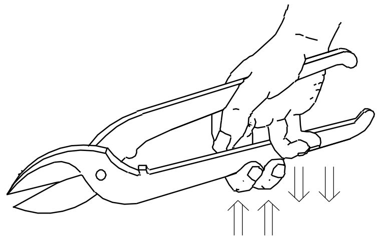
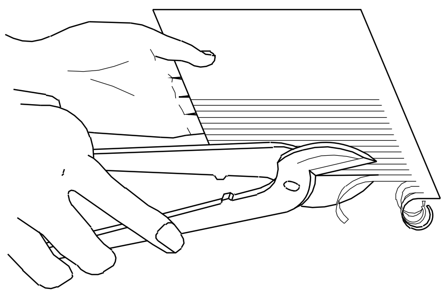


Fig 8



Cutting along curved lines

Objectives: This shall help you to
- **cut outside curves on sheet metal by straight snips**
- **cut inside curves on sheet metal by bend snips.**

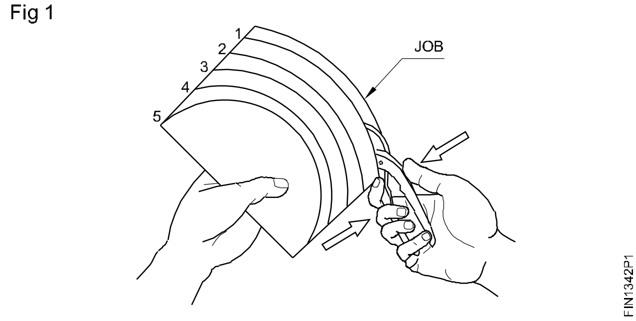
Cutting outside curves by straight snips

Hold the workpiece in one hand.

Hold the straight snips by the other hand at the handle end.

Keep the straight snips blade on the outside curved line at 90^0 angle and gently press the handle. This produces the shearing force which cuts the material. (Fig 1)

Fig 1



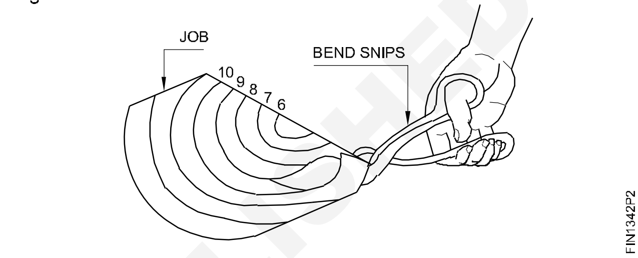
While cutting, move the snips forward along the curved line and the workpiece towards you. This motion should be synchronised to get a correct curved shape.

Accordingly, continue the process along the total length of the curved line, point by point, till the curved line ends.

Use small length of blade, while cutting outside curved lines to get correct curved shape.

Cutting inside curves by bend snips: The skill sequence is similar to that of cutting external curves except bend snips are used for cutting along internal curved lines. (Fig 2)

Fig 2

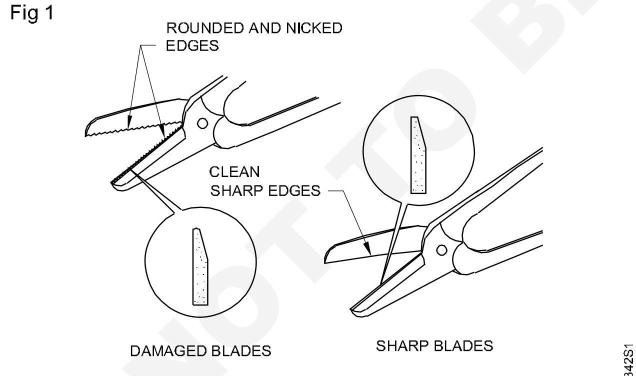


Sharpening of snips

Objective: This shall help you to
- **sharpen the blunt snips.**

Introduction: After continuous use, the cutting edge of the snips gets worn out and requires resharpening. (Fig.1)

Fig 1



DAMAGED BLADES NEED SHARPENING

Ways of sharpening snips

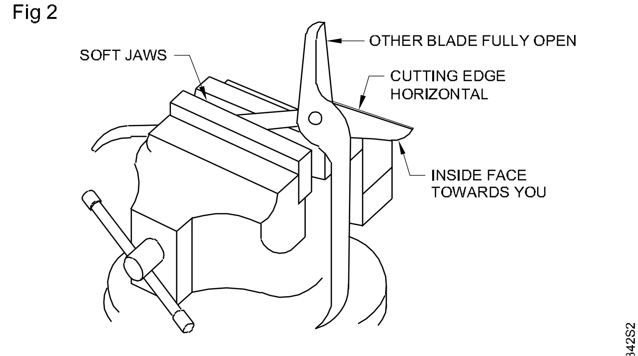
1 Sharpening by files

2 Sharpening by oilstone

3 Sharpening by grinding wheel

Sharpening by files: Clamp the handle of the blade to be sharpened as shown in Fig 2.

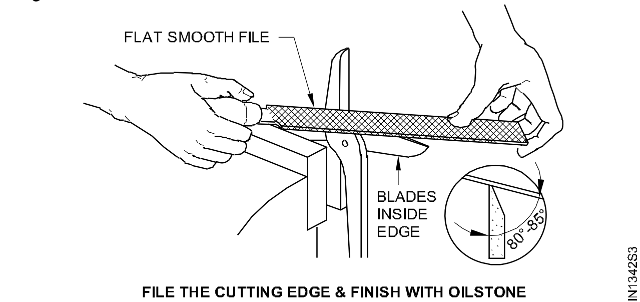
Fig 2



CLAMP THE HANDLE IN A VICE

File the cutting face of the blade using a flat smooth file as shown in Fig 3.

Fig 3



FILE THE CUTTING EDGE & FINISH WITH OILSTONE

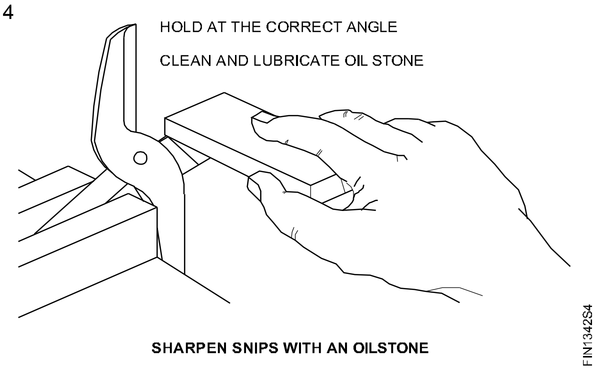
Remove the snips from the vice, clamp the other handle in the vice as done before.

Sharpen the second blade by file.

Sharpening by oilstone: Clamp one handle of the snips in a benchvice.

Use the oil stone the same way as you use a file. (Fig 4)

Fig 4



SHARPEN SNIPS WITH AN OILSTONE

Use the coarse side of the oil stone first. Use the fine side of the oil stone for finishing.

Remove the snips from the vice and repeat the same for the other blade.

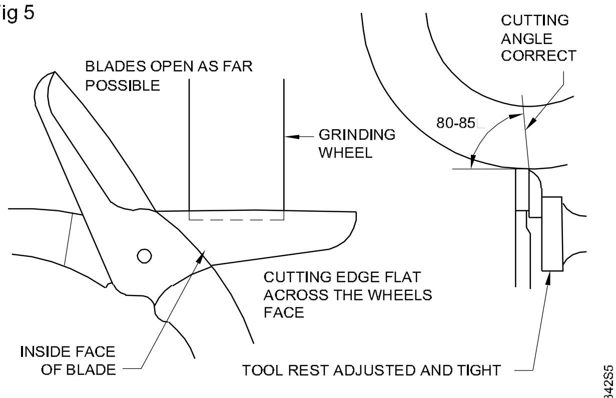
Sharpening by grinding wheel

Switch on the off hand grinder.

Open the blades of the snips as far as possible.

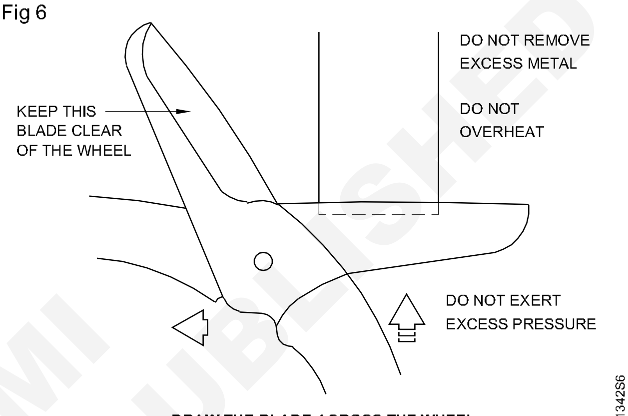
Lay each blade to the grinding wheel as shown in Fig 5. Start grinding from the pivot joint and draw the blade across the grinding wheel. (Fig 6)

Fig 5



PRESENT THE BLADE TO THE GRINDER

Fig 6



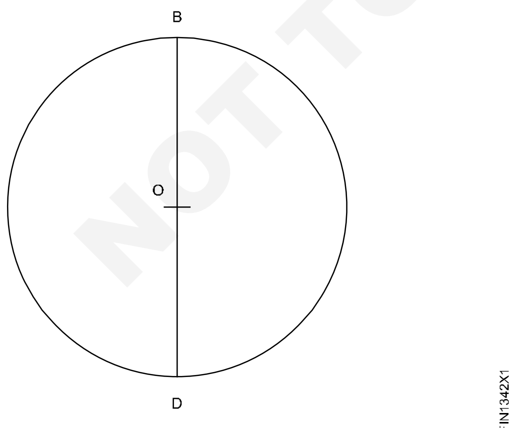
DRAW THE BLADE ACROSS THE WHEEL

Marking triangle in a given circle

Objective : This shall help you to
- **draw a triangle inside a given circle.**

Draw the diameter BD of the circle. (Fig 1)

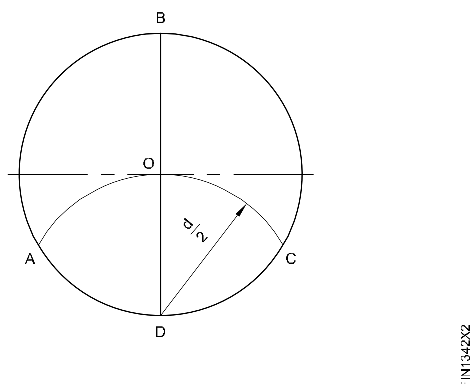
Fig 1



Draw an arc d/2 as radius and D as centre.

Let this arc intersect the circle at A and C. (Fig 2)

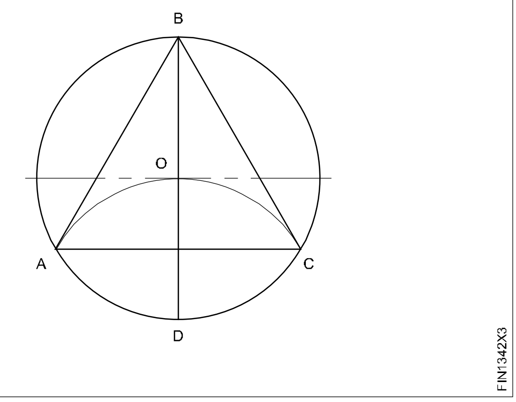
Fig 2



Join AB, BC, and AC to each other.

ABC is the triangle drawn inside the given circle. (Fig 3)

Fig 3

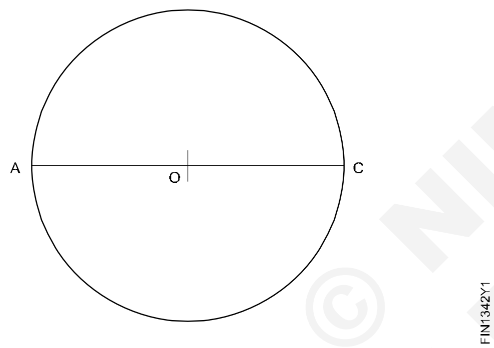


Marking square in a given circle

Objective : This shall help you to
- **inscribe a square in a given circle.**

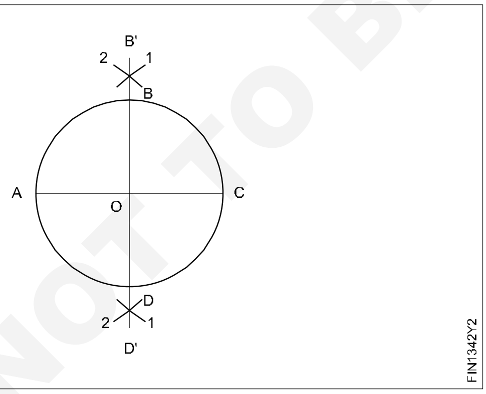
Draw the diameter AC of the circle. (Fig 1)

Fig 1



Bisect AC. (Fig 2)

Fig 2



Draw two arcs 1 and 2 with A and C as centres on the top and bottom of the line BD. (Fig 3)

Let the arcs meet at B and D.

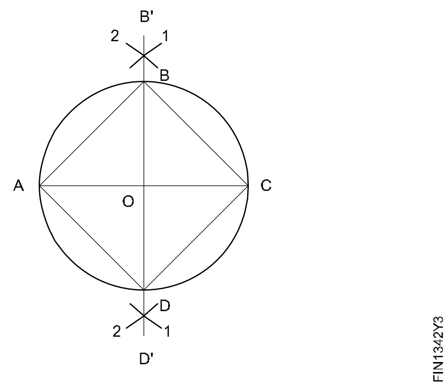
Join the points B and D

BD is the bisector of AC.

Join AB, BC, CD and DA to each other.

ABCD is the square drawn inside the given circle. (Fig 3)

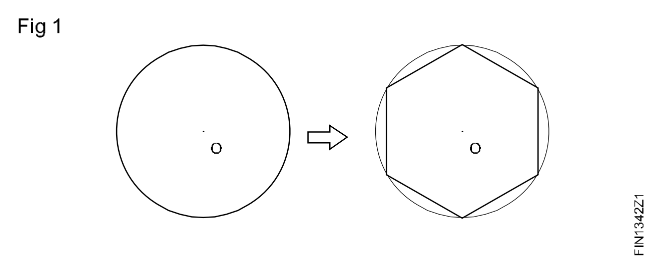
Fig 3



Marking a regular hexagon

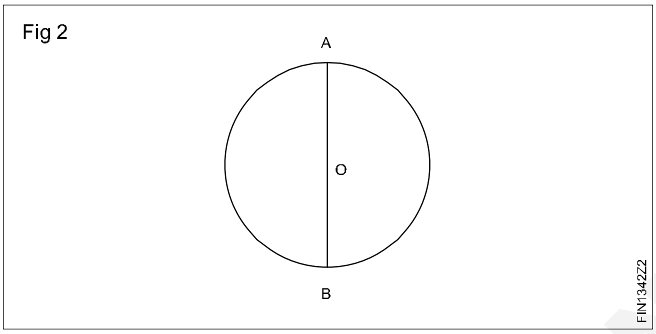
Objective : This shall help you to
- **inscribe a regular hexagon in a circle.**

Inscribe a regular hexagon in a circle. (Fig 1)

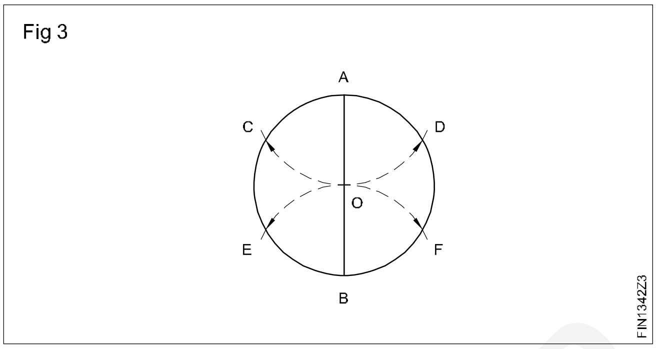


Draw the diameter vertically to the given circle whose centre is 'O'.

Let A and B be the intersecting points on the circumference. (Fig 2)

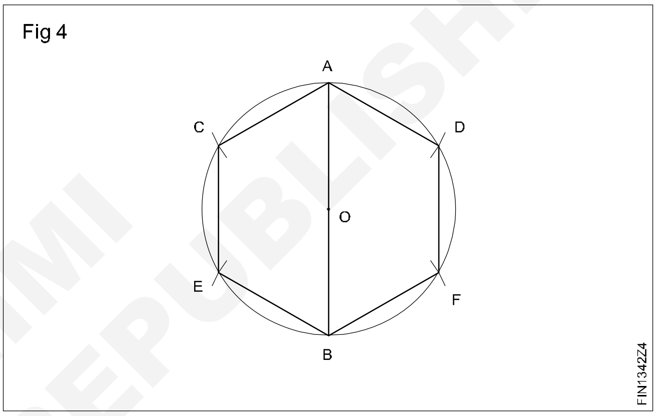


With AO as radius and A and B as centre, draw two arcs CD and EF respectively with the help of a compass. Let C,D,E,F be the intersecting points on the circumference. (Fig 3)



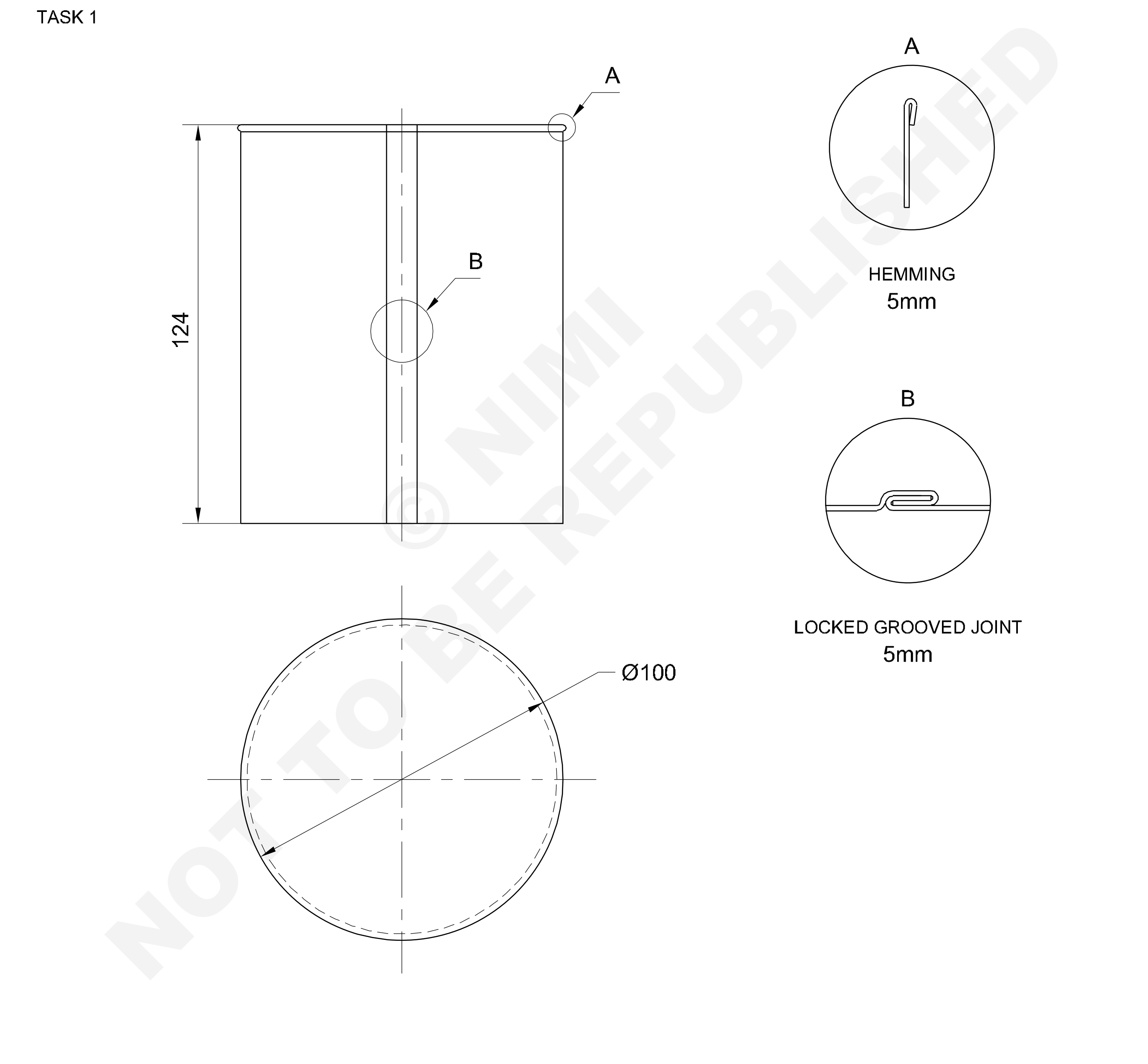
Connect points A,D,F,B,E and 'C' to each other. (Fig 4)

Now a regular hexagon is inscribed in the circle.



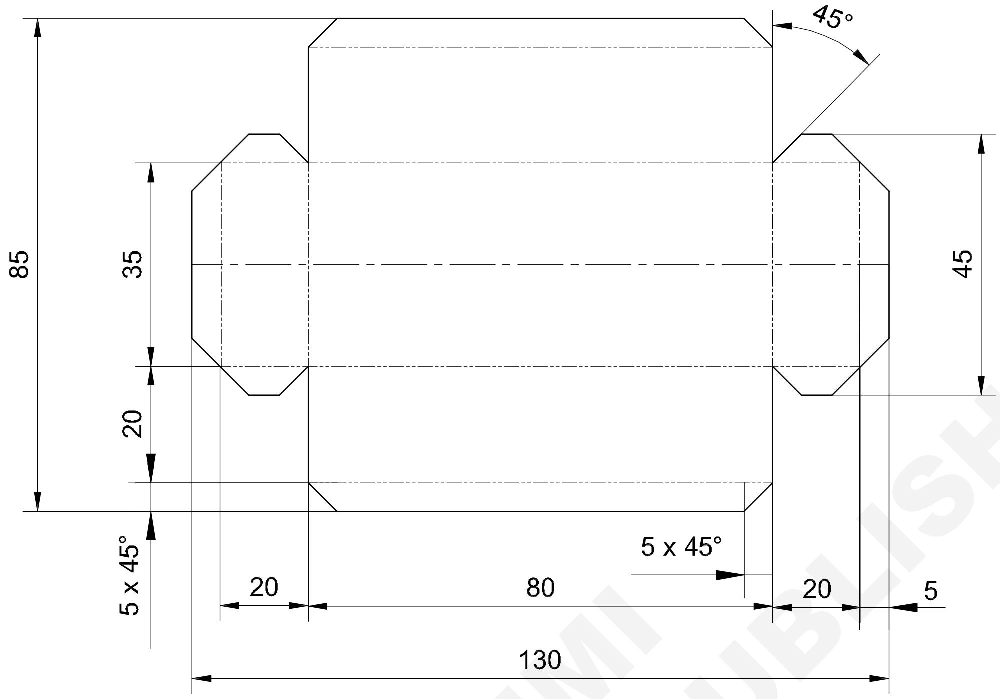
Marking out of simple development

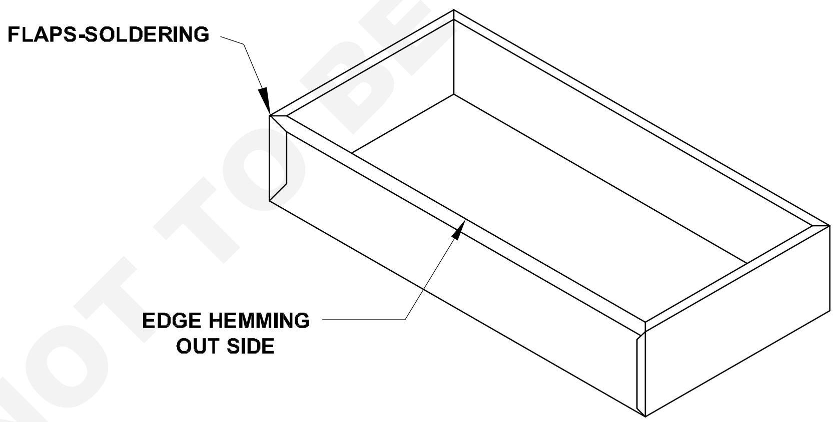
Objectives: At the end of this exercise you shall be able to
- **prepare development of cylinder in parallel line method**
- **prepare development of rectangular tray in parallel line method**
- **mark out the flaps for hemming.**



1	ISSH 335 x 135 x 1.00	-	G.I. SHEET	-	-	1.3.43
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	PARALLEL LINE DEVELOPMENT OF CYLINDER				DEVIATIONS ±1mm	TIME
					CODE NO. FI20N1343E1	

TASK 2





1	ISSH 135 x 90 x 1.0mm	-	G.I.SHEET	-	-	1.3.43
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:8	**PARALLEL LINE DEVELOPMENT OF RECTANGULAR TRAY**	DEVIATIONS ±1mm	TIME:
		CODE NO. FI20N1343E2	

Job Sequence

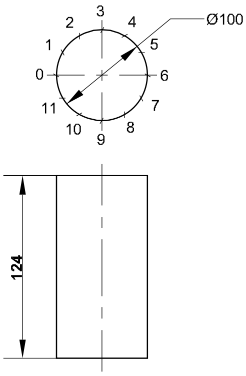
TASK 1: **Parallel line development of cylinder**

Develop and layout the pattern for the cylinder with all allowance for joining and hemming on drawing sheet by parallel line method.

Draw the elevation and plan of the object as per the given dimensions on drawing sheet (A3)

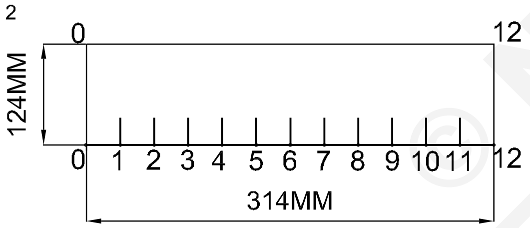
Divide the periphery of the circle into 12 equal parts. (Fig.1)

Fig 1



Extend the line from the base to the maximum length, i.e more than the circumference of the cylinder. (Fig.2)

Fig 2



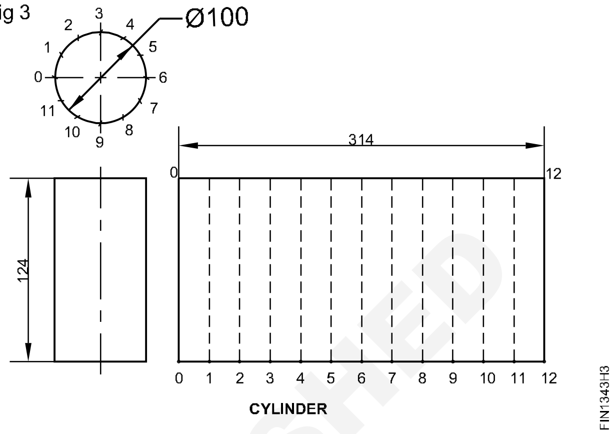
Draw line parallel to base line to the height of 124mm (Height of cylinder) and draw perpendicular line at the end of 314mm base line.

Transfer the distance from 0 to 1, using a compass on the base line as per shown in Fig.2 and continue to mark 1 to 2, 2 to 3 upto 11 to 12.

Draw perpendicular lines from base line through points.

0,1,2,3,4,5,6,7,8,9,10,11 and 12 are already drawn base line (Fig.3)

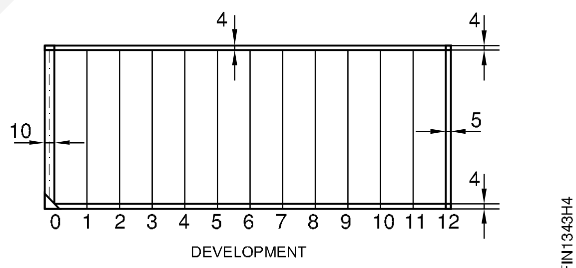
Fig 3



Mark the lines at 4mm distance on the top and bottom of the pattern for hemming at the top edge and joining at the bottom edges. (Fig.4)

Draw the lines parallel to '00' and 12 12' at a distance of 5mm and 10mm on both sides respectively for seaming. Complete the development of cylinder as per the given dimension.

Fig 4



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TASK 2: **Parallel line development of rectangular tray**

Calculate developed length and width of a rectangular box.

Developed length=Base length +2(side height+single hemming allowance)

=80+2(20+5)=130mm

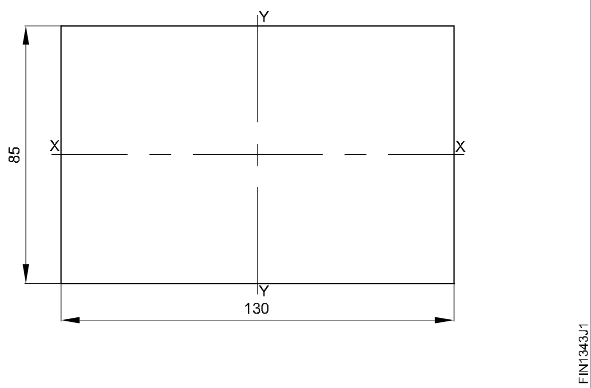
Developed width=Base width + 2(side height+single hemming allowance)

=35+2(20+5)=85mm

Mark and cut the sheet metal work piece to the size of 130x85mm maintain sqaureness.

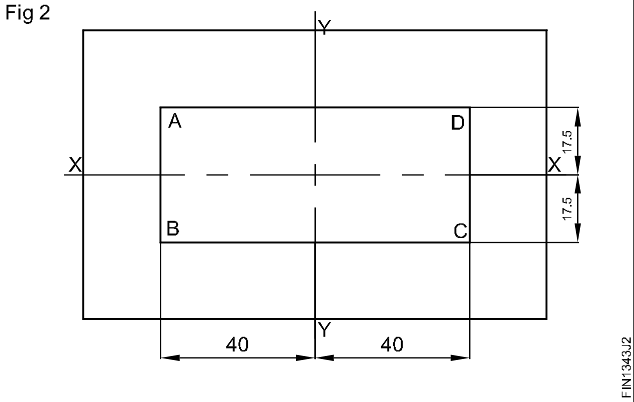
Draw the centre lines of the length and width XX and YY. (Fig.1)

Fig 1



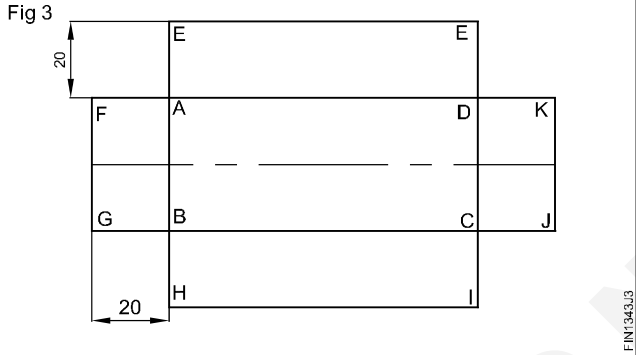
Draw the base length and width at the centre of the work piece from centre line. Mark lines at 40mm on both sides of YY and 17.5mm on both sides of XX (Fig.2)

Fig 2



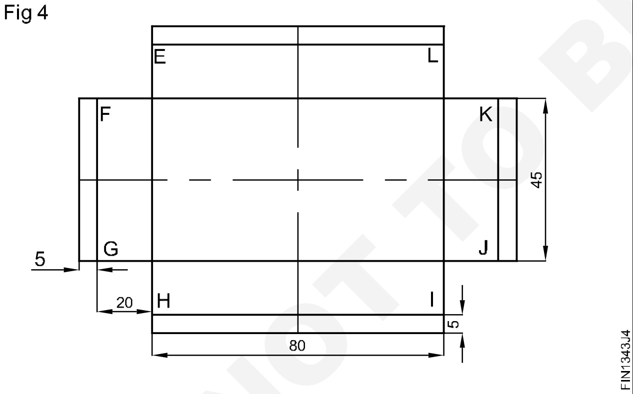
Draw lines for 20mm height of the four sides of the rectangular box parallel to AB, BC, CD and DA as shown in the fig.3.

Fig 3



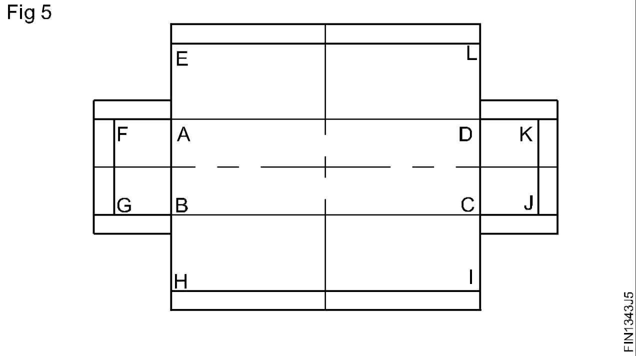
Draw lines for 5mm single hemming allowance on the four sides parallel to FG, HI, JK and LE as shown in Fig.4.

Fig 4



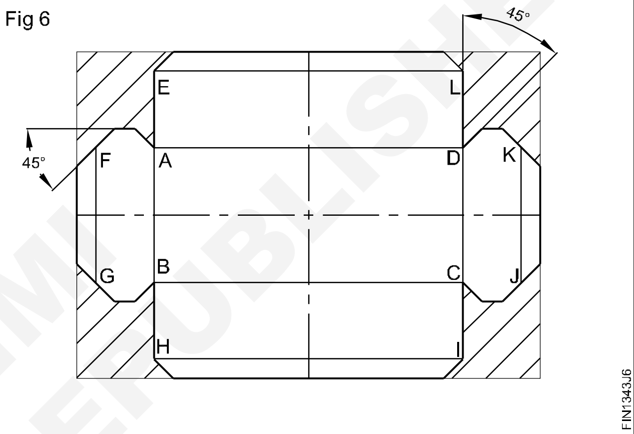
Draw lines on 20mm lap for the solder joint at the corners of the rectangular box parallel to GB, AF, CJ and DK as shown in fig.5.

Fig 5



Draw lines for 45° slant notches at points H,I, J, K, L, E, F, G, A, B, C and D as shown in the fig.6.

Fig 6



Complete the development of rectangular tray as per the given dimension.

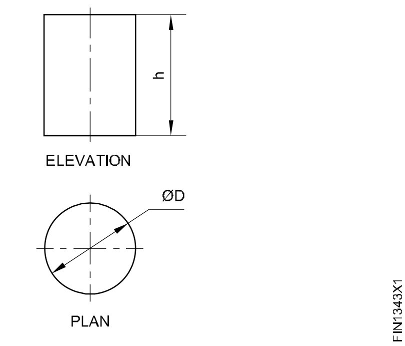
Skill Sequence

Parallel line development of a cylinder

Objective: This shall help you to
• **develop and layout a pattern for a cylinder by parallel line development method.**

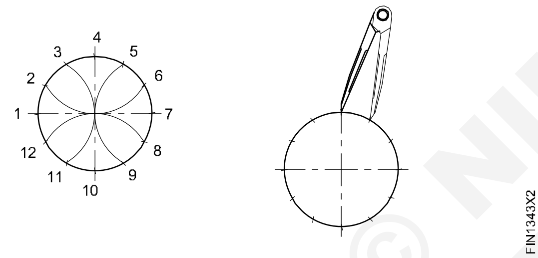
Draw the front elevation and the plan of the cylinder on a paper. (Fig 1)

Fig 1



Divide the periphery of the circle into 12 equal parts and check each division. (Fig 2)

Fig 2

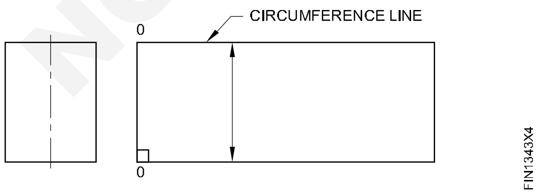


Extend the lines to a length slightly more than the circumference of the circle (pd) plus the allowances for the locked grooved joint. (Fig 3)

Fig 3

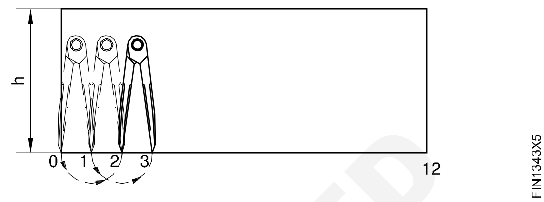
Draw a line 00' perpendicular to the parallel line through the left end. (Fig 4)

Fig 4



Transfer equal distances 0,1,2,3,4 upto 12 of the plan on the circumferential line without disturbing the equal lengths with compass. (Fig 5)

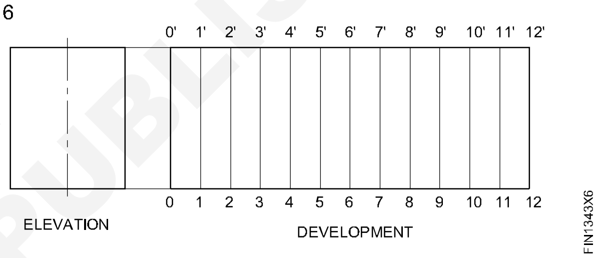
Fig 5



Draw a perpendicular at the end of the twelfth point of layout to the base line. (Fig 6)

Draw parallel lines to line 00' at points 1,2,3,4 upto 12. (Fig 6)

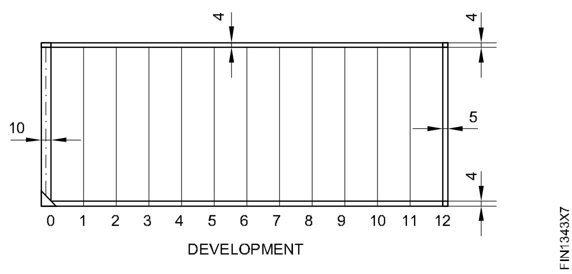
Fig 6



Mark the lines at 4 mm distance on the top and bottom of the pattern for hemming at the top edge and joining at the bottom edge. (Fig.7)

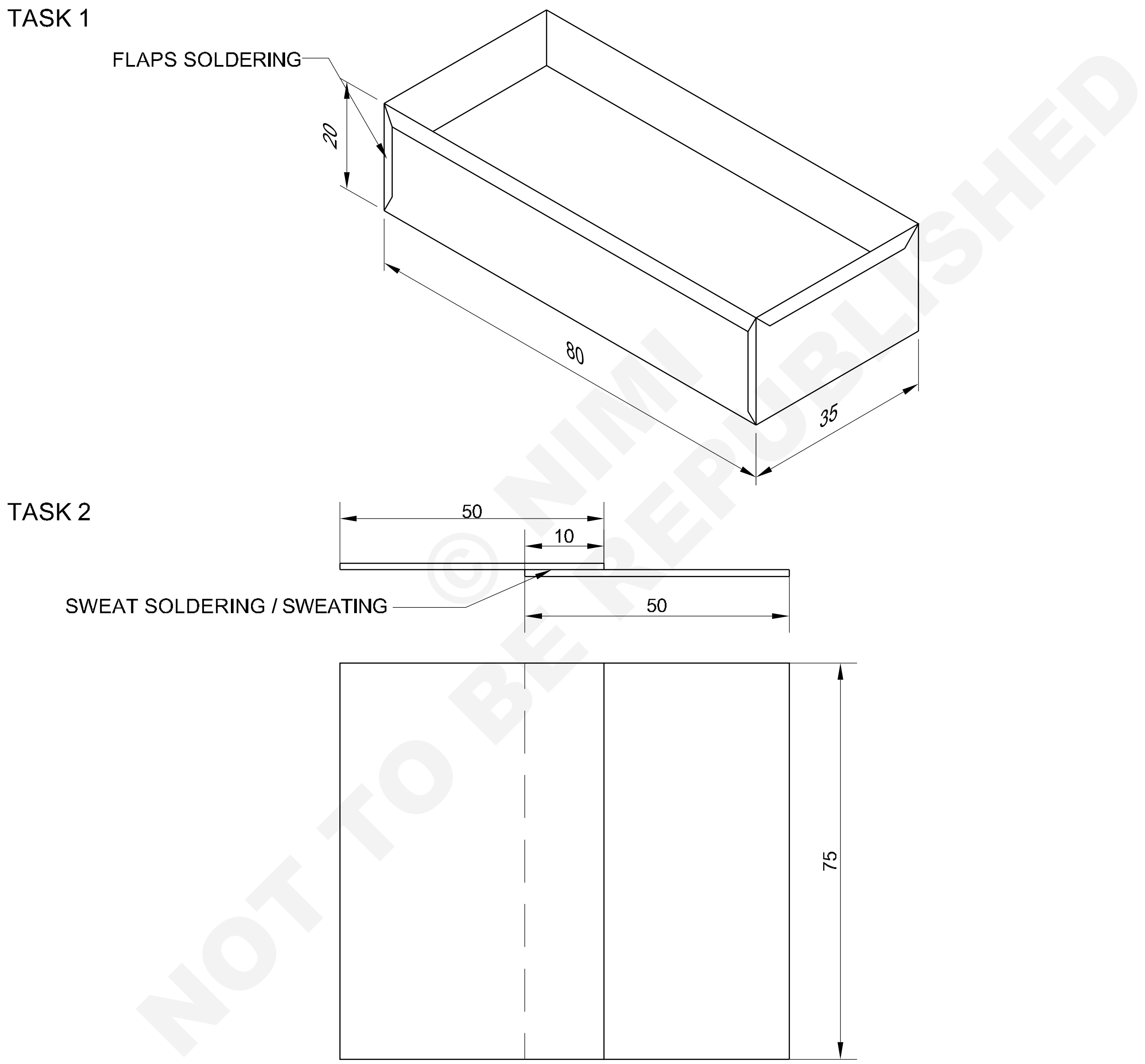
Draw the lines parallel to 00' and 12 12' at a distance of 5mm and 10mm on both sides respectively for seaming. (Fig.7) Now the pattern is completed.

Fig 7



Marking out for flaps for soldering and sweating

Objectives: At the end of this exercise you shall be able to
- **make rectangular tray as per given dimensions**
- **develop the pattern by parallel line method**
- **cut as per the required dimensions and make the rectangular tray**
- **solder and sweat soldering.**



2	ISSH 75 x 50 x 1mm	--	G.I SHEET	-	TASK 2	
-	-	1.3.43 ←	-	-	TASK 1	1.3.44
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX NO.

SCALE 1:1	MAKING RECTANGULAR TRAY AND FLAPS SOLDRING	DEVIATIONS ±0.4	TIME
		CODE NO. FI20N1344E1	

Job Sequence

TASK 1: **Making rectangular tray and flaps soldering**

Check the size of sheet as per sketch using a steel rule.

Level the sheet on the leveling plate using a mallet.

Develop the tray by the parallel line method.

Cut the unwanted area shown in shadow using a straight snip (Fig.1)

Cut the notches at 45° using a straight snips (Fig.1)

Deburr the edges of the sheet metal pattern using a smooth flat file.

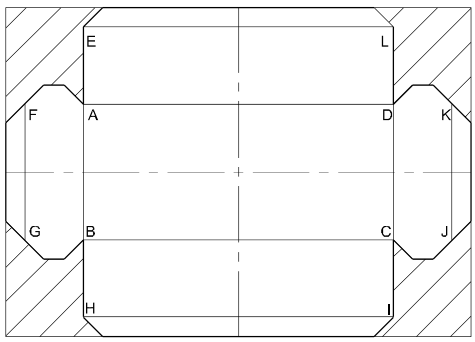
Form a single hemming on four sides of the tray.

Bend the four sides to 90° using a Tinman's anvil.

Bend all the flaps to 90°. (Fig.2)

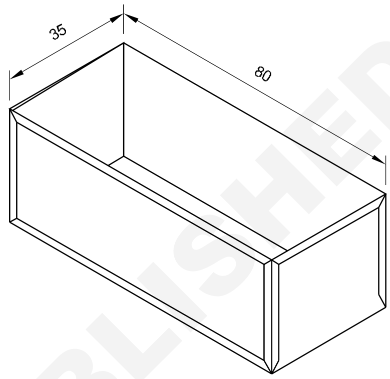
Join the four corners by soft soldering.

Fig 1



FIN1344H1

Fig 2



FIN1344H2

TASK 2: **Soldering and sweating**

Cut two pieces to the size 75 x 50mm.

Flatten the sheets on Tinman's anvil.

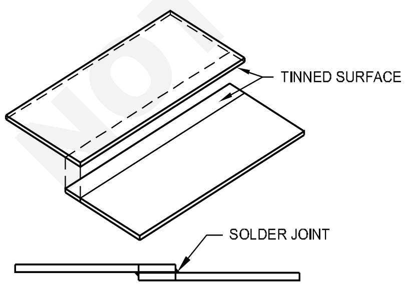
Clean the surfaces to be joined thoroughly with abrasive cloth and a dry cloth.

Apply flux on surface of the sheets.

Place the surfaces to be joined in correct alignment as shown in Fig 3.

Heat the soldering iron bit in forge or blow lamp, hot enough to melt the solder.

Fig 3



FIN1344H3

Dip the point of the soldering bit into a dipping solution to avoid oxidation.

Apply solder to the bit.

Place the bit in correct position, over the lap opening at one end of the joint.

Lift the bit from the joint to get a smooth tack of solder.

Similarly tack at regular intervals along the joint.

> **Tacking provides temporary holding of the sheets.**

Move the bit steadily along the joint in one direction.

Continue the soldering until the joint is completed.

Similarly, solder other side of the lap joint following above procedures.

Allow the joint to cool.

Wash off all traces of flux with running water.

Clean the job with rag.

Skill Sequence

Preparing the soft solders

Objective: This shall help you to
- **prepare soft solder in varying proportion in the form of stock to suit the metal to be joined.**

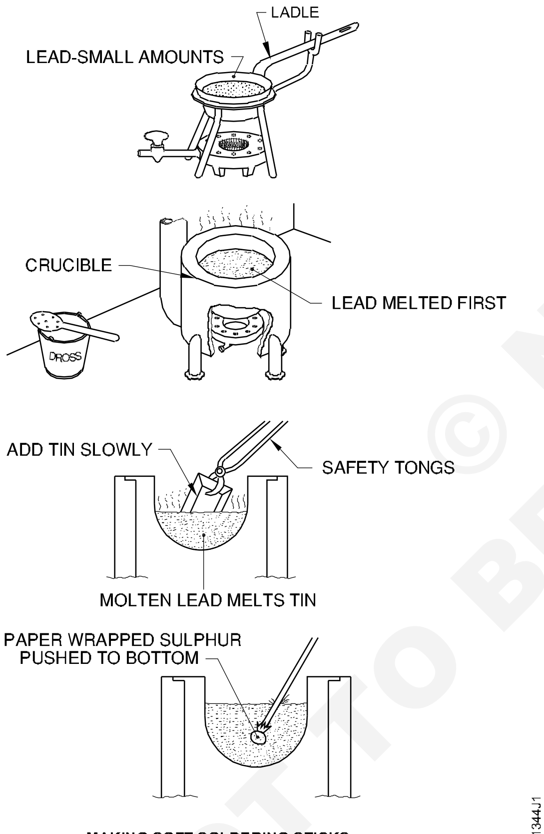
In soft soldering process, soft solder is required to be prepared in the required proportion of tin and lead, when tin and lead are supplied in pure form.

They are generally prepared in the form of triangular sticks.

First measure required quantities of tin and lead in kilograms. For example to prepare 60/40 soft solder, take 600 gms of tin and 400 gms of lead to prepare 1 kg of soft solder.

Melt the lead first in a crucible, cast iron pan or ladle. (Fig.1) Lead is melted first because its melting temperature is higher than tin. (327^{0}C)

Fig 1



MAKING SOFT SOLDERING STICKS

Add tin slowly to the molten lead and blend by stirring the mixture. (Fig 1)

Reduce the temperature of solder until the mixture will not flow readily.

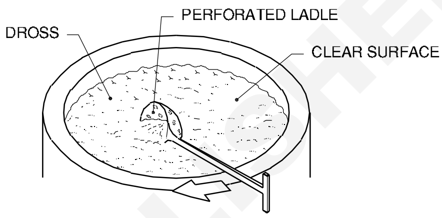
Add little amount of sulphur to the mixture as flux and clean the alloy. (5 gm of sulphur/kg of solder)

Restirr the mixture and increase the temperature until the alloy is free flowing.

Sulphur unites with impurities which rise to the surface, burns and forms a dross.

Remove the dross with a perforated ladle. (Fig 2)

Fig 2



REMOVING DROSS

Use angle iron as a mould.

Clean the angle iron and pour the molten solder carefully and continuously as shown in Fig 3.

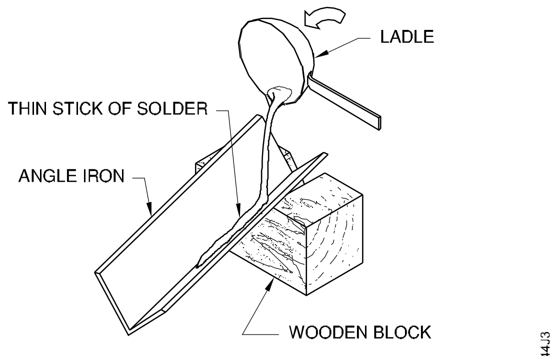
WARNING

Molten solder will splatter violently in contact with moisture. The moulds must be preheated.

Allow the solder to set.

Remove the stick after getting cooled.

Fig 3



MAKING THIN STICKS OF SOLDER

Preparing the working point of soldering bit

Objective: This shall help you to
- **tin a soldering bit for free and uniform flow of solder on to the workpiece without oxidation.**

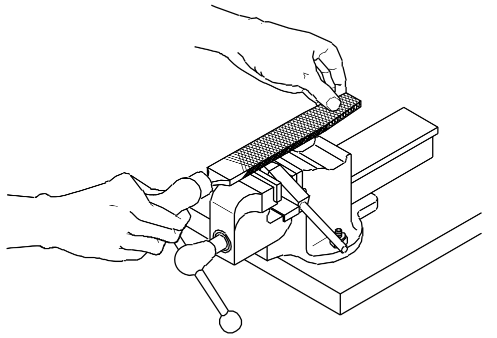
In case of a new bit, hold the bit in a vice and file the burrs from the face and edges and lightly round off the point with a file.

In case of a bit in use, clean the bit point with a file, remove the pitted faces and rough edges. (Fig.1)

If the soldering bit is too hard to file, heat it till it melts the solder freely and then cool it by dipping into cold water.

Heat the bit until colours appear on the faces, Don't over heat the bit.

Fig 1



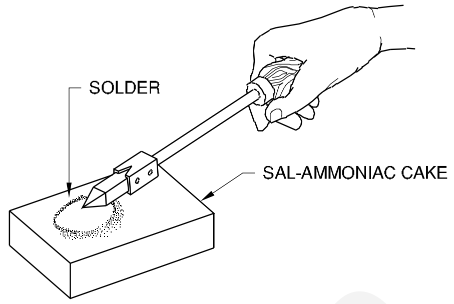
Rub all faces on sal-ammoniac cake. (Fig 2)

Apply stick solder to each working face, as it is rubbed on the sal-ammoniac cake.

Spread the solder uniformly over the faces and remove the excess solder by wiping with a piece of rag. (Fig 3)

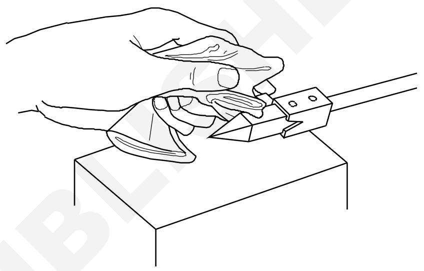
Now a thin bright film called “tin” is formed on the faces of the copper bit. This is called tinning.

Fig 2



RUBBING THE BIT IN SAL-AMMONIAC CAKE

Fig 3



SPREADING THE SOLDER ON FACES OF BIT

Avoid breathing fumes from the sal-ammoniac which causes headache and is injurious to the lungs.

Tacking and soldering the joint

Objective: This shall help you to
- **set and tack the lap joint in correct alignment**
- **solder a lap joint with uniform flow of solder, in flat position**
- **inspect a lap joint, to ensure strong joint.**

Check the size of the material using steel rule and trysquare. Select a suitable type of soldering bit. (Copper)

Tin the soldering bit.Select the suitable flux for the job.

Select the suitable solder for the job.

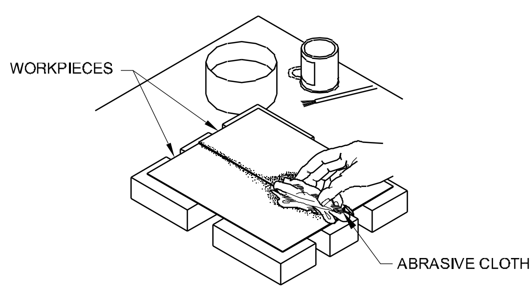
Clean the surface to be joined with an abrasive cloth and then with a dry cloth, making it free from dirt, rust, oil, grease etc. (Fig 1)

Apply flux to the joint as shown in Fig.2.

Place the surfaces to be joined in correct alignment.

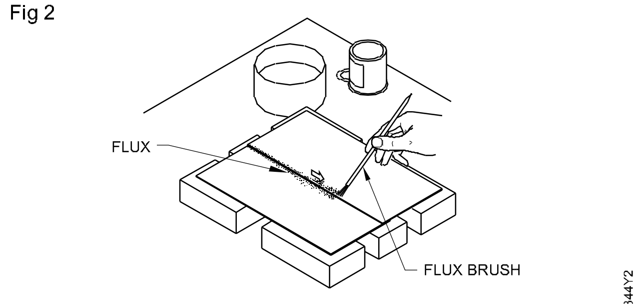
Heat the bit in forge or blow lamp, hot enough to melt the solder readily. The effect of heating the bit is shown in Fig 3.

Fig 1



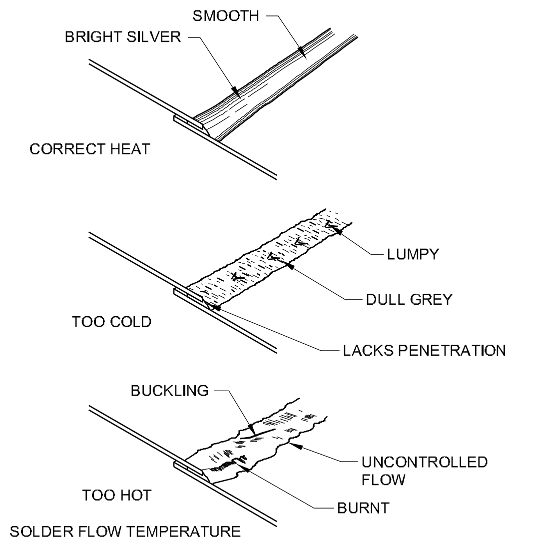
CLEAN THE SURFACES TO BE JOINED

Fig 2



APPLY FLUX

Fig 3

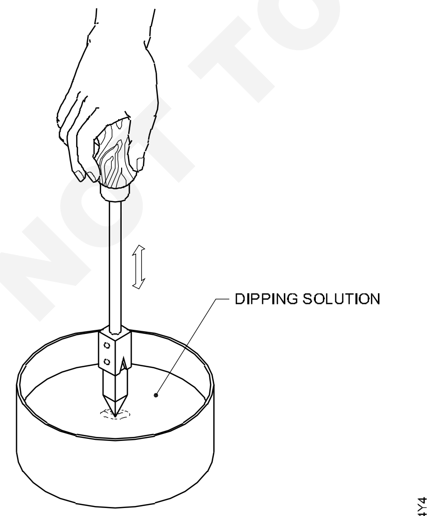


HEATING THE BIT

Do not allow it to become red hot otherwise tinning gets burnt off or it will form a bronze coating over the tip, on which solder will not stick properly.

Dip the point of the bit into a dipping solution to avoid oxidation. (Fig 4)

Fig 4



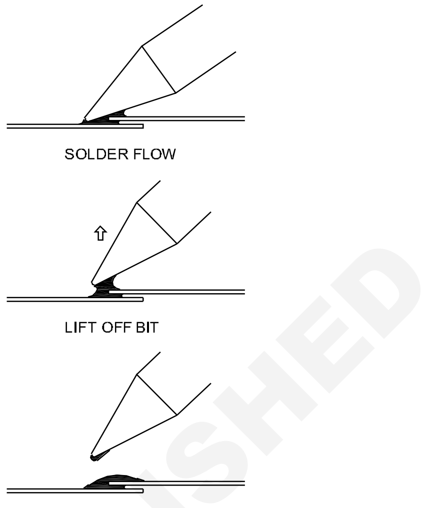
DIP THE BIT

Apply solder to the bit.

Place the bit in correct position, over the lap opening at one end of the joint. (Fig 5) Hold the bit steady till the solder flows onto the workpiece and covers the lap opening. (Fig.5)

Lift the bit from the joint to get a smooth tack of solder. (Fig 5)

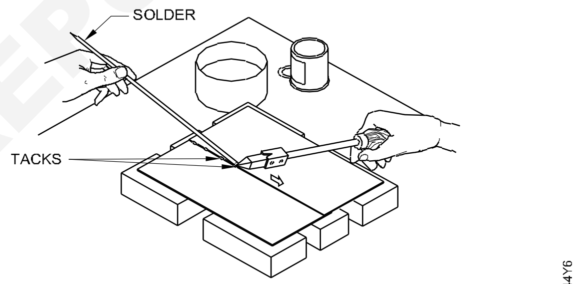
Fig 5



TACK SOLDERING

Similarly, tack at regular intervals along the joint. Tacking provides temporary holding of the sheets. (Fig 6)

Fig 6



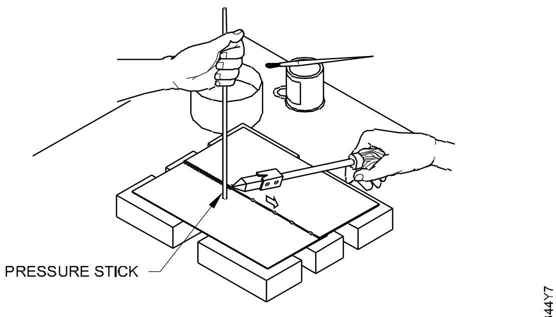
TACKING THE JOINT

Re-heat the bit, if necessary. Place the bit on one end of the seam, add solder to the bit and allow the solder to melt and flow into the joint, which takes place by capillary action.

While soldering, to prevent the lap joint from springing apart, the joint is held in place by a stick of wood.

Move the bit steadily along the joint with a consistent movement, in one direction. (Fig 7)

Fig 7



DIRECT SOLDERING

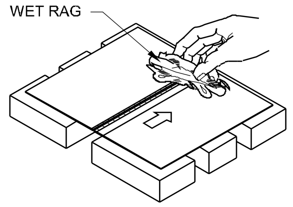
Add solder as required.

Continue the soldering until the joint is completed.

The joint will not be satisfactory if the solder is just 'struck on' or 'melted on'. Solder should flow freely.Allow the joint to cool.

Wash off all traces of flux with running water and clean the job with rag. (Fig 8)

Fig 8



CLEANING OF FLUX RESIDUE

FIN1344Y8

Inspect the lap joint for the penetration of the solder into the lapped surfaces.

Ensure that the opening is sealed with a neat, smooth fillet of solder.

Upper surfaces of the seam should show a smooth, thin coatings of solder, uniform in width with tidy solder margins.

Never file the soldered joint.

Sweating or sweat soldering

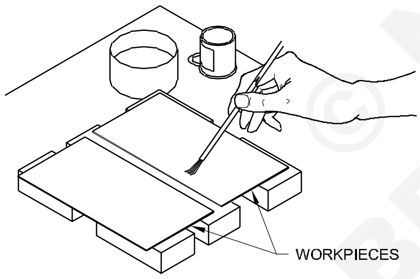
Objective: This shall help you to
- **sweat solder a lap joint, using a blow lamp.**

Cut the sheet or pieces to the required size and mark.

Clean the surfaces to be joined thoroughly free of dust, dirt and oily surface.

Coat the surface to be joined with flux. (Fig 1)

Fig 1

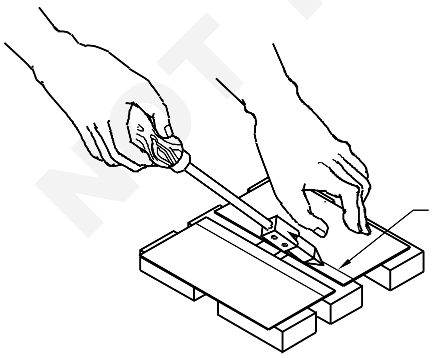


APPLY FLUX

FIN1344Z1

Apply an uniform coating of solder to each of the surface to be joined. (Fig 2)

Fig 2



FIN1344Z2

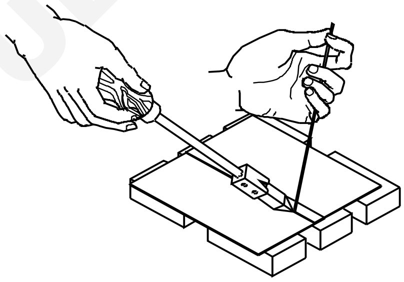
Place and align the tinned surfaces one on the top of the other.

Ensure that the tinned surfaces are in contact.

Place the flat side of the heated copper bit on one end of the joint.

Press down the joint with a rod, as the solder in between the two surfaces begins to melt and flow. (Fig 3)

Fig 3



SWEATING WITH SOLDERING IRON

FIN1344Z3

Draw the bit copper slowly along the joint and follow with the hold down piece.

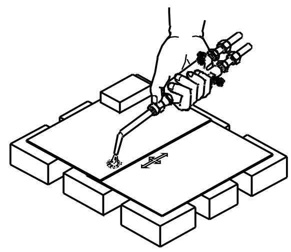
While moving the copper bit forward, ensure that the solder melts. Otherwise, the joint will not be proper.

Constant supply of heat will produce a successful sweat soldered joint.

Hence, it is advisable to use two copper bits for this operation whereby, when one is in use, the other can be heated and kept ready for continuous operation.

Sweat soldering can also be done using a blow pipe as shown in Fig 4.

Fig 4

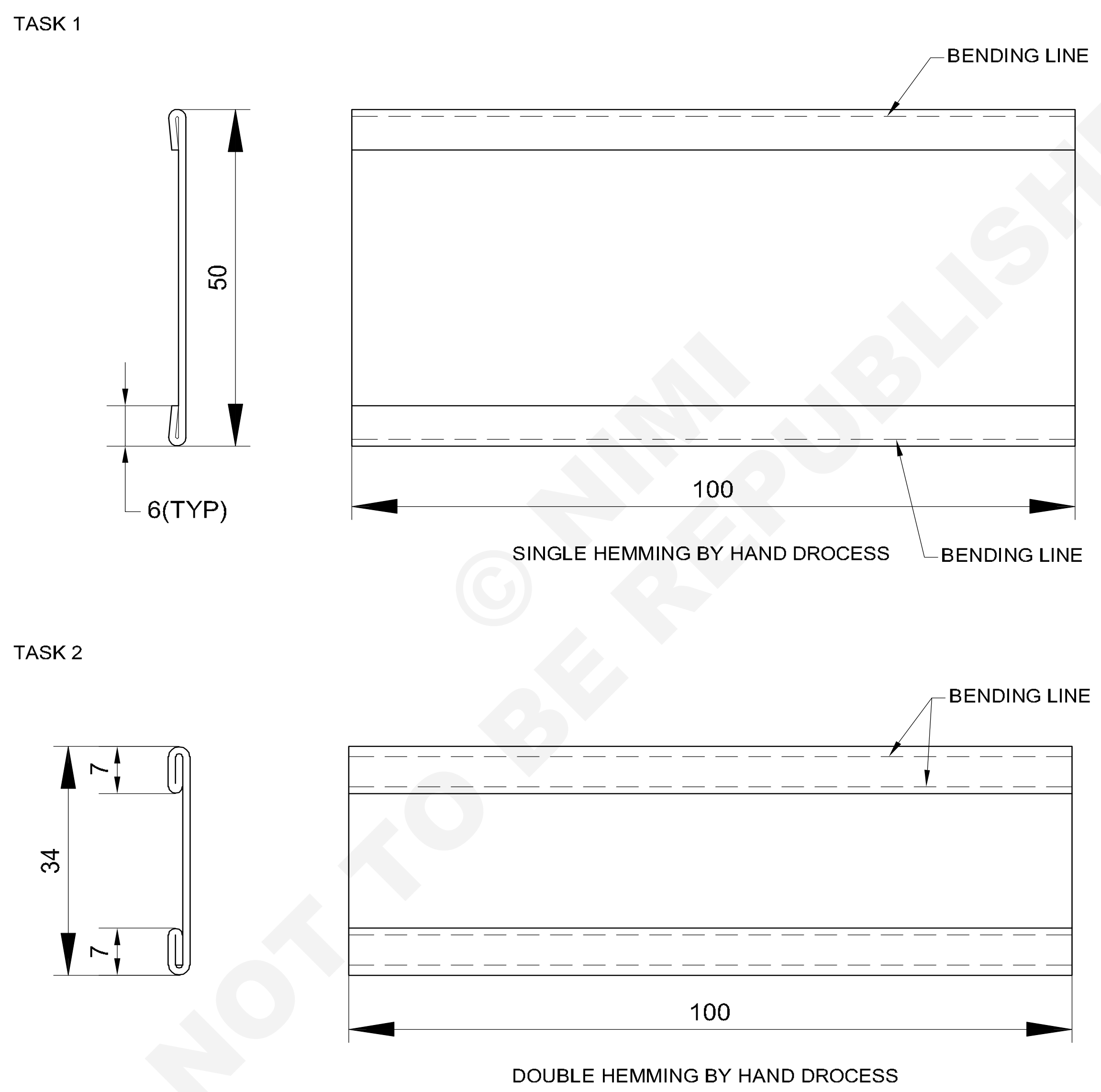


HEAT THE JOINT

FIN1344Z4

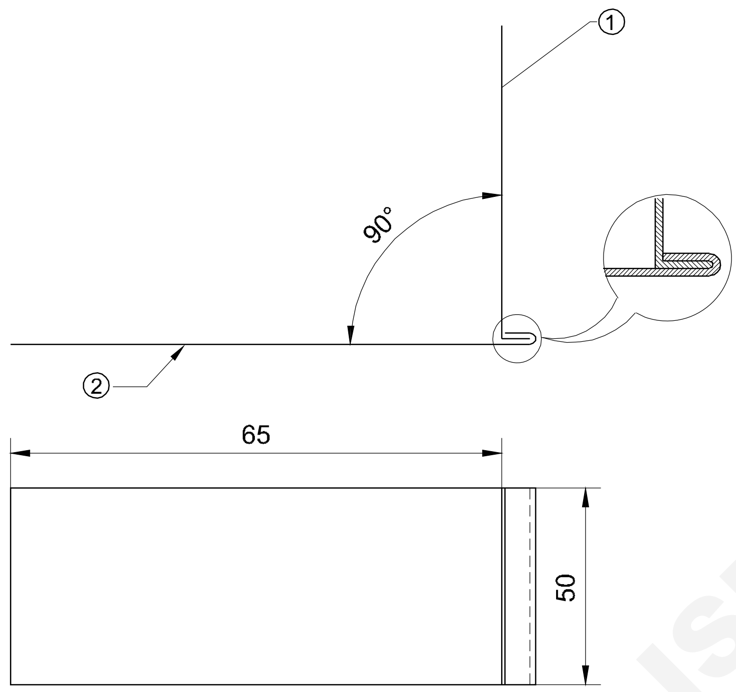
Various sheet metal joints

Objectives: At the end of this exercise you shall be able to
- **make a single hemming and double hemming joints**
- **make a paned down seam joint by using hand tools**
- **make a knocked up seam joint by using hand tools**
- **make a locked groove joint using hand grooves**
- **make a straight edge wired joint by hand process.**



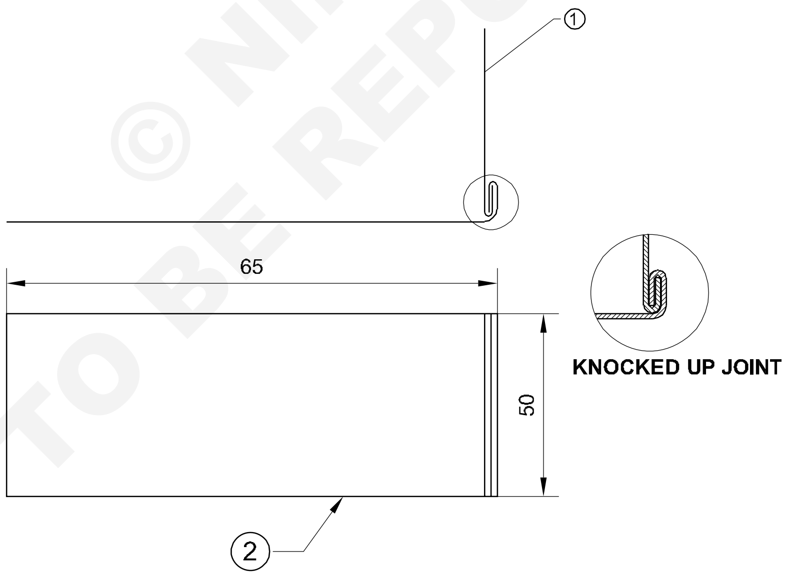
1	ISSH 105 x 70 x 0.6		G.I SHEET		TASK 1	
2	ISSH 105 x 70 x 0.6		G.I SHEET		TASK 2	1.3.45
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SHEET METAL JOINTS				DEVIATIONS ±0.04	TIME
					CODE NO. FI20N1345E1	

TASK 3



PANE DOWN SEAM JOINT

TASK 4

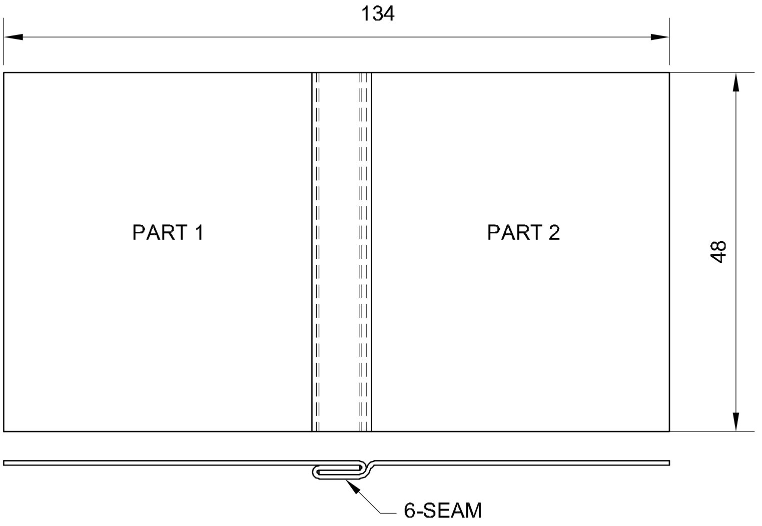


KNOCKED UP SEAM JOINT (SINGLE SEAM)

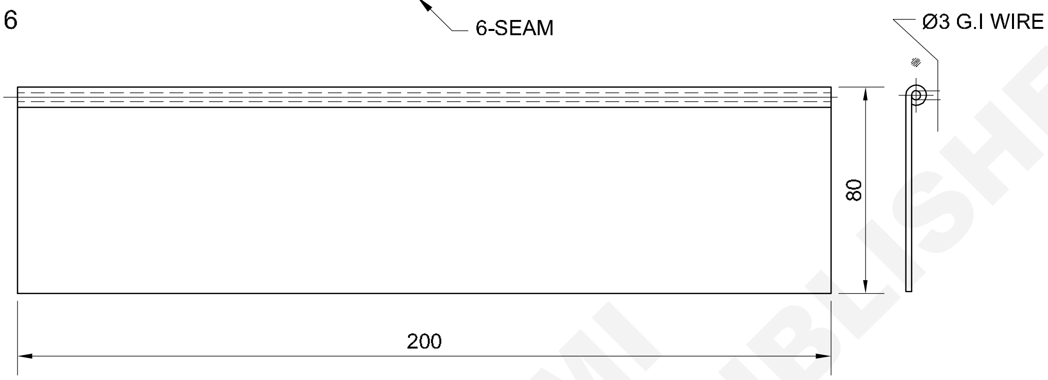
1	ISSH 75 x 50 x 0.6		GI SHEET			TASK 3
1	ISSH 75 x 50 x 0.6		GI SHEET			TASK 3
1	ISSH 75 x 50 x 0.6		GI SHEET			TASK 4
1	ISSH 75 x 50 x 0.6		GI SHEET			TASK 4
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO. 1.3.04

SCALE 1:1	**SHEET METAL JOINTS**	DEVIATIONS	TIME
		CODE NO. FI20N1345E2	

TASK 5

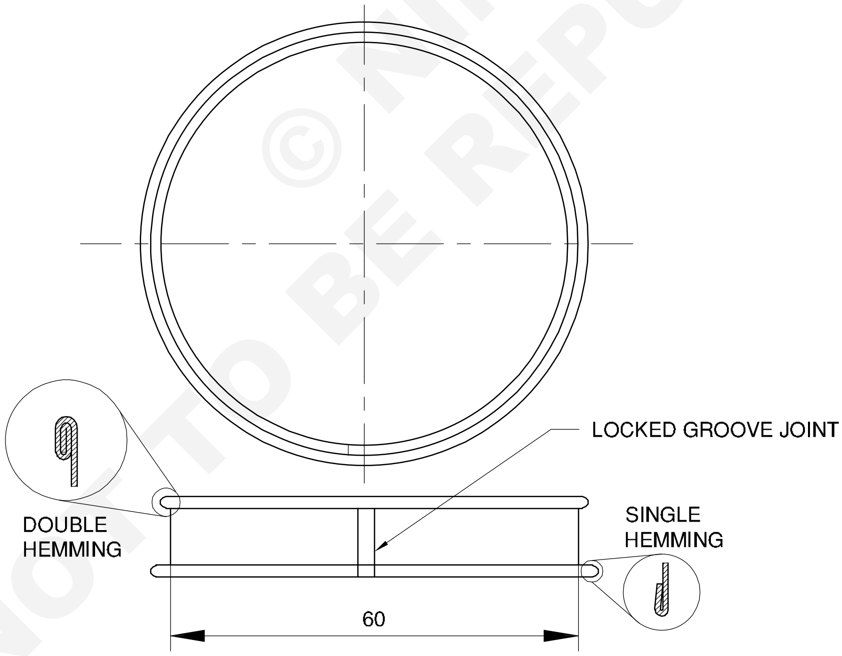


TASK 6



MARKING A STRAIGHT EDGE WIRED JOINT (BY HAND PROCESS)

TASK 7



SINGLE HEMMING AND DOUBLE HEMMING ON CURVED EDGES

1	ISSH 204 x 34 x 0.5		G.I SHEET			TASK 7
2	ISSH 100 x 160 x 0.508		G.I SHEET			TASK 5
1	Ø3 - 205		G.I SHEET			TASK 6
1	ISSH 210 x 95 x 0.5		G.I SHEET			TASK 6
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO. 1.3.45

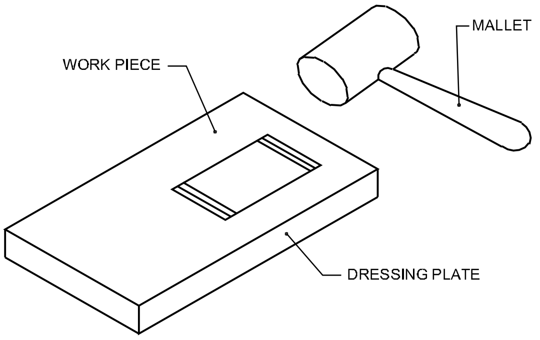
SCALE 1:1	**LOCKED GROOVED JOINT MARKING A STRAIGHT EDGE JOINT (BY HAND PROCESS)**	DEVIATIONS ±0.04	TIME
		CODE NO. FI20N1345E3	

Job Sequence

TASK 1: **Single hemming by hand process**

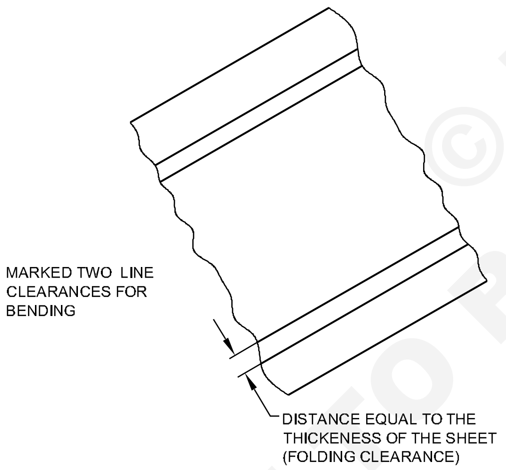
- Mark and cut the sheet as per drawing (ISSH 100 x 62 x 0.6mm GI sheet)
- Flatten the sheet using a mallet on a dressing plate. (Fig.1)

Fig 1



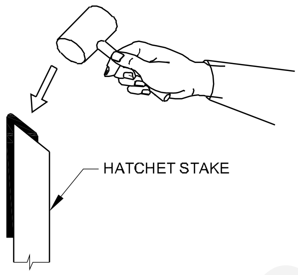
- Remove burrs on edges of the sheet with flat smooth file.
- Mark two lines at a distance of 6mm from both edges for single hemming with folding clearance. (Fig.2)

Fig 2



- Fold one edge of the sheet using a hatchet stake and a mallet for single hemming. (Fig.3)

Fig 3



- Flatten the single hemmed edge of the job sheet metal on the dressing plate using a mallet. (Fig.4)

Fig 4

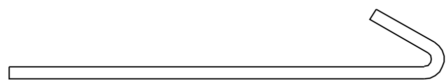
- Similarly, repeat the above process in another edge for single hemming.
- Check the flatness and the straightness of the single hemmed job of sheet metal.
- Examine the single hemming edges without gap.

— — — — —

TASK 2: **Double hemming by hand process**

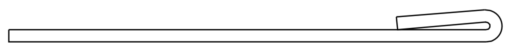
- Mark and cut the sheet as per drawing. (ISSH 100x66x0.6mm G.I. sheet)
- Flatten the sheet using a mallet on a dressing plate.
- Remove burrs on edges of the sheet with flat smooth file.
- Mark two lines at a distance of 6mm from both edges for single hemming with folding clearance.
- Fold one edge of the sheet using a hatchet stake and a mallet for single hemming. (Fig.1)

Fig 1



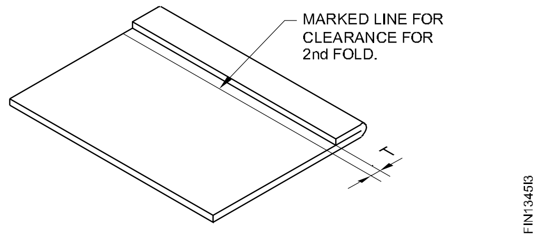
- Flatten the single hemmed edge of the job sheet metal on the dressing plate using a mallet. (Fig.2)

Fig 2



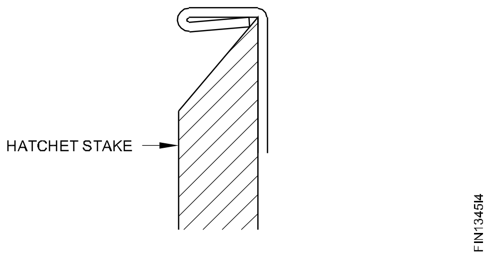
- Mark again, the two lines at a distance of 6mm from the single hem for double hemming. (Fig.3)

Fig 3



- Fold the single hemmed edge of the job sheet metal using a hatchet stake and a mallet for double hamming. (Fig.4)

Fig 4



- Flatten the double hemmed edge of the sheet metal on the dressing plate using a mallet (Figs 5 & 6)

Fig 5

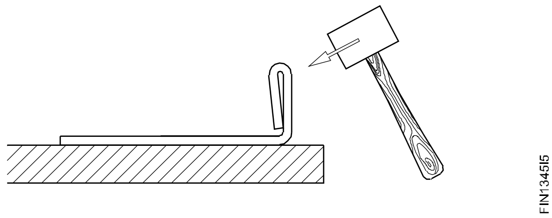
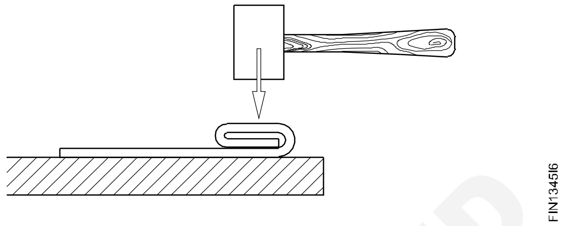


Fig 6



- Similarly, repeat the above process in another edge for double hemming.
- Check the flatness and the straightness of the double hemmed job of sheet metal.
- Examine the double hemming edges without gap.

— — — — —

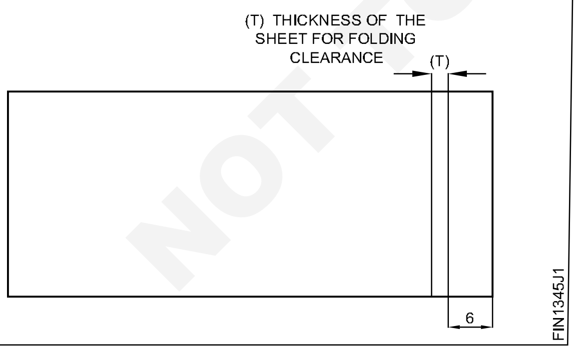
TASK 3: **Paned down seam joint**

- Mark and cut sheet to the size as per drawing

  (Part I ISSH 60 x 50 x 0.6mm G.I. sheet)

  (Part II ISSH 80x50x0.6mm G.I. sheet)
- Flatten the sheets using a mallet on a dressing plate.
- Remove burrs on edges of the sheet with flat smooth file.
- Mark the setting down operation for the single seam (paned down joint) in part 1.

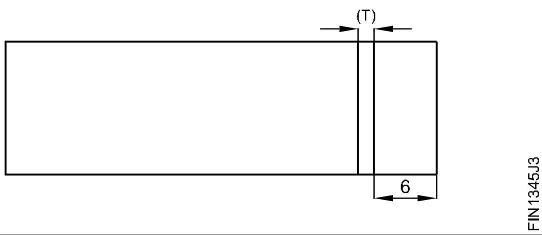
Fig 1



- Fold edge of the sheet to 90° using a hatchet stake and a mallet for single seam in part 1 (Fig.2)
- Mark the setting down operation for the single seam in part 2 (paned down joint) (Fig.3)

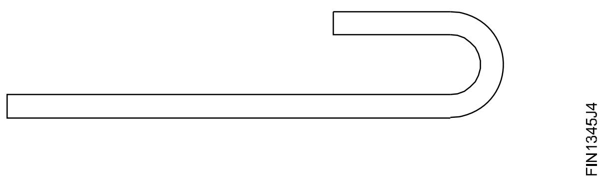
Fig 2

Fig 3



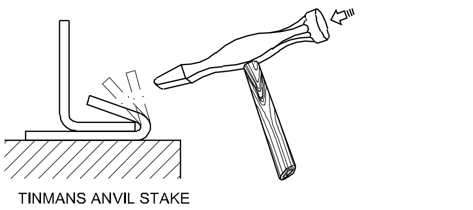
- Fold edge of the sheet using a hatchet stake and a mallet for single hemming in part 2 (Fig.4)

Fig 4



- Set the part 1 and 2 using try square as per shown in the sketch for single seam pane down joint. (Fig.5)

Fig 5



- Strike on the edge of the flange and complete, the operation for the paned down joint. (Figs 6 & 7)
- Examine the paned down joint, without gap.

Fig 6

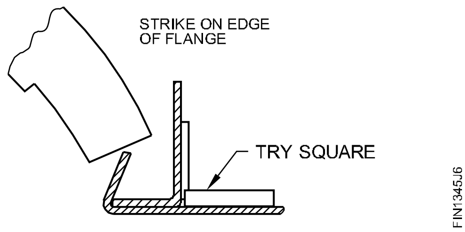
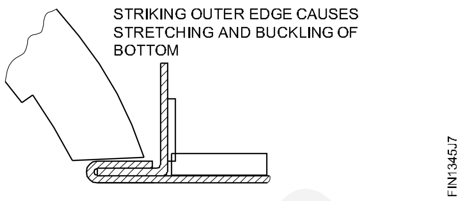


Fig 7



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TASK 4: **Knocked up seam joint (single seam)**

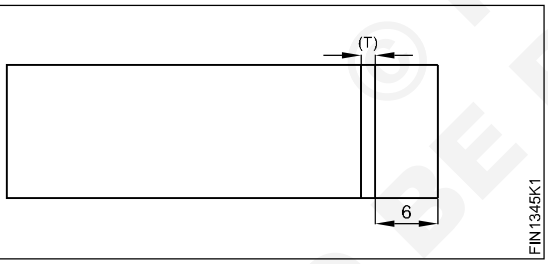
- Mark and cut sheet to the size as per drawing.

  (Part 1 ISSH 65x50x0.6 G.I SHEET)

  (Part 2 ISSH 85x50x0.6 G.I SHEET

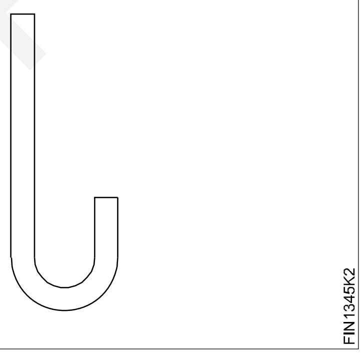
- Flatten the sheet using a mallet on a dressing plate.
- De-burr on edges of the sheet with flat smooth file.
- Mark the setting down operation for the single seam in part 1 (knocked up seam joint) (Fig.1)

Fig 1



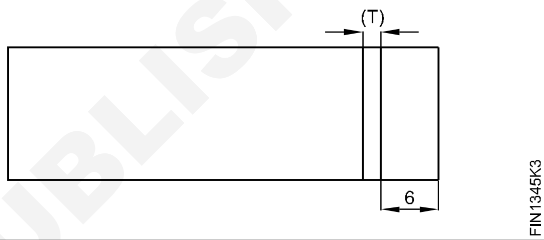
- Fold to form the edge of the sheet using a hatchet stake and a mallet for single seam in part 1. (Fig.2)

Fig 2



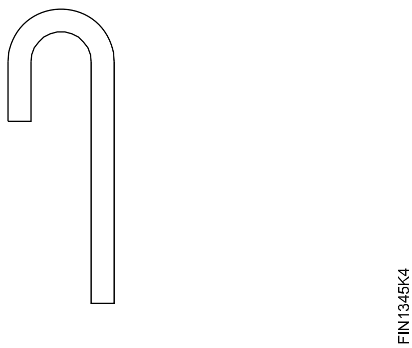
- Mark the distance in part 2 for single seam (Fig.3)

Fig 3



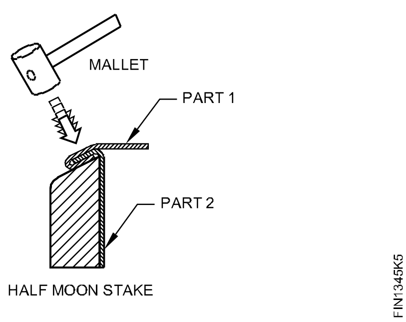
- Form the edge of the sheet using a hatchet stake and a mallet for single seam in part 2. (Fig.4)

Fig 4



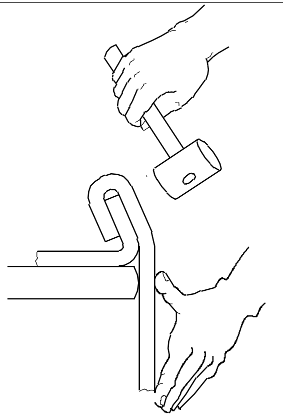
- Set the job part 1 and part 2 on a half moon stake and join bent leg with a mallet as shown in figure. (Fig.5)

Fig 5



- Support the job by hand and strike with the mallet all around to an angle as shown in figure to form knocked up joint. (Fig.6)

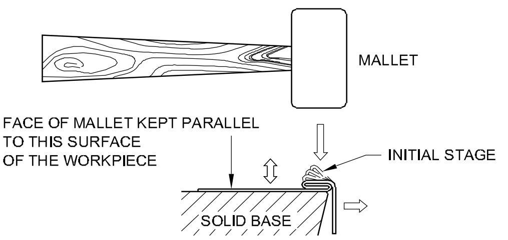
Fig 6



FIN1345K6

- Increase the angle of the bend gradually while striking with the mallet all around the seam as shown in figure to form knocked up joint. (Fig.7)

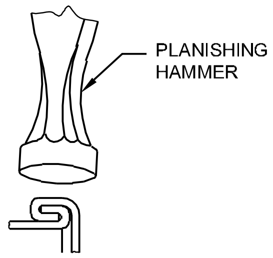
Fig 7



FIN1345K7

- Tighten the double seam (knocked up joint) using the planishing hammer as shown in figure. (Fig.8)

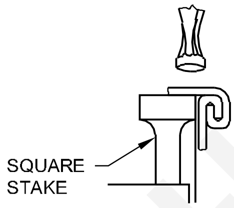
Fig 8



FIN1345K8

- Place the edge of the joint on the square stake and lightly dress the bottom with the planishing hammer as shown in figure and finish the knocked up joint. (Fig.9)
- Examine the knocked up joint.

Fig 9



FIN1345K9

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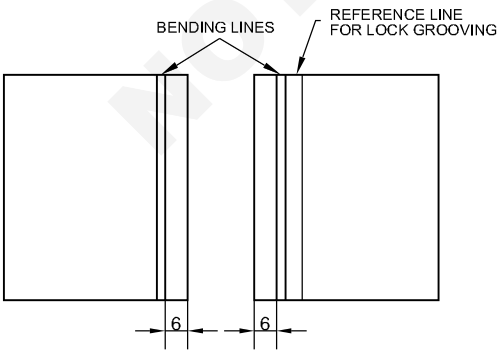
TASK 5: **Locked grooved joint**

- Mark and cut the sheet into two pieces as per drawing

  Part 1 and Part 2 - ISSH 75x60x0.6 mm each one
- Flatten the sheet metal.
- De-burr on edges of the sheet.
- Determine the fold size of the given seam.
- Mark the straight lines for folding on the two sheets using a steel rule and a scriber as shown in fig.1

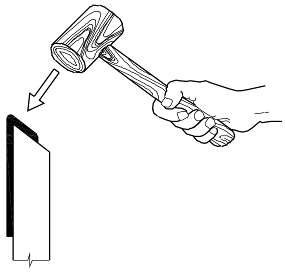
Fig 1



FIN1345M1

- Fold the two sheets to an acute angle on the marked line using a hatchet stake, steel plate / hammering block and a mallet to form the hooks as shown in fig.2.

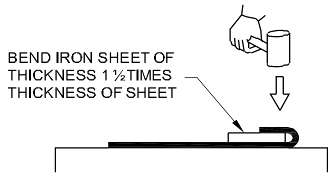
Fig 2



FIN1345M2

- Make the folded widths flat by filling with a scrap bend sheet of approximately 1.5 times thickness of sheet and pressing with a mallet to get the pocket for lock in two sheets. (Fig.3)

Fig 3



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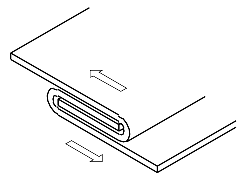
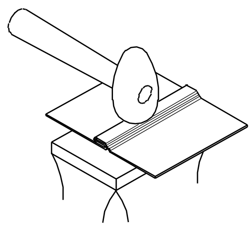
- Inter lock the folded sheets and place the sheets on the dressing plate. (Fig.4)

Fig 4



- Press the joint to close down using the wooden mallet, to get the grooved joint (seam) as shown in fig.5

Fig 5



- Select the correct size of hand groover of a given width of lock (seam), as shown in fig.6.
- Place the groover over the fold and strike it using a ball pein hammer, lock the joint and finish. (Fig 7)

Fig 6

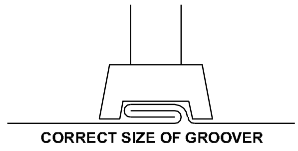
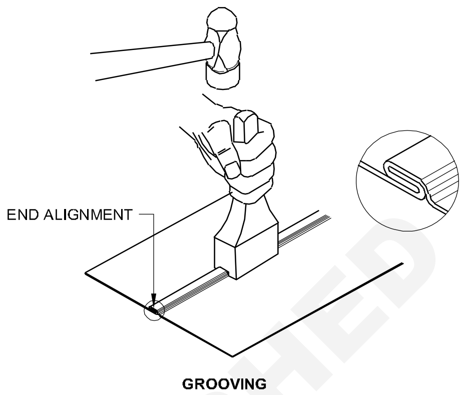


Fig 7



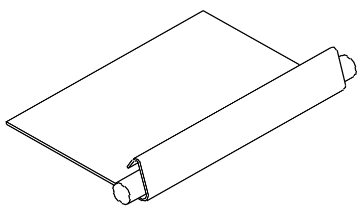
- Check the locked grooved joint to its requirement.

— — — — —

TASK 6: **Making a straight edge wired joint by hand process**

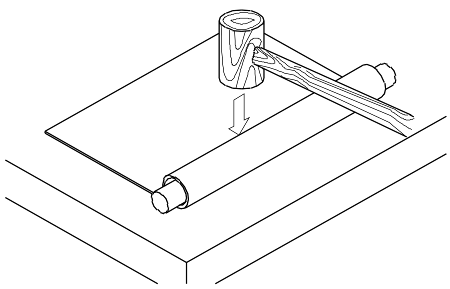
- Mark and cut sheet as per drawing (ISSH 215 x 95 x 0.6mm G.I. sheet)
- Flatten the sheet using a mallet on a dressing plate.
- De-burr on edges of the sheet.
- Determine the total length of the sheet for edge wired joint.
- Mark two lines parallel to the edge of the sheet metal at a distance of 1/4th of the total wiring allowance.
- Fold at the first line nearer to the edge at right angle on the steel plate or the hatchet stake using a wooden mallet.
- Make an another fold at the second marked line to 30° on a hatchet stake using a wooden mallet.
- Use a wire of given diameter slightly longer than the length of the edge to be wired.
- Place the wire at the folded edge and tap the edge by a wooden mallet using an anvil or anvil stake as base as shown in fig.1

Fig 1



- Form the edge around the wire by striking the wooden mallet as shown in fig.2

Fig 2



- Finish the wired edge, on the edge of the anvil or anvil stake by striking the wooden mallet in different direction as shown in the fig.3 & 4.

Fig 3

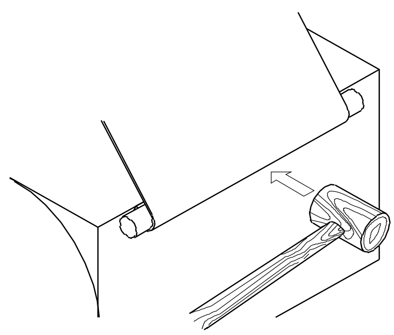
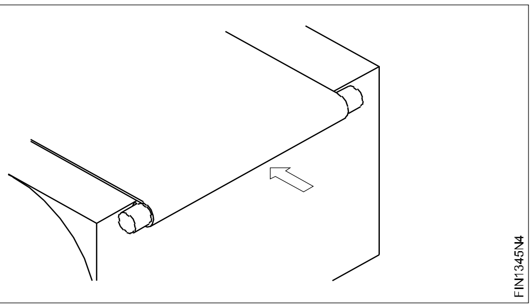
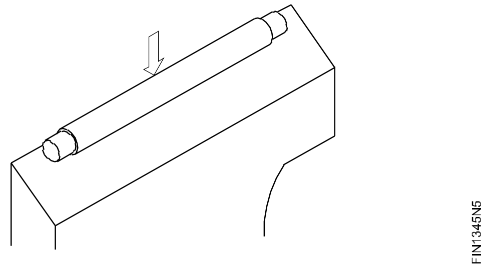


Fig 4



- Finally, finish the wired edge on a hatched stake as shown in the fig.5
- Cut off the surplus wire at the ends using hacksaw (Hacksaw blade fitted with hacksaw frame).

Fig 5



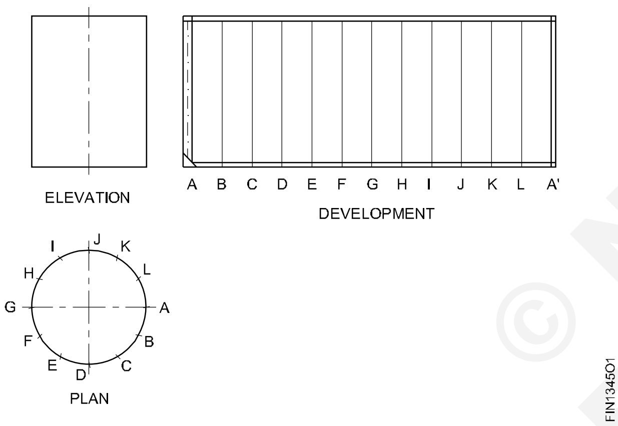
- File the wire ends by a flat smooth file.
- Examine the straight edge wired joint.

— — — — —

TASK 7: **Single hemming and double hemming on curved edge**

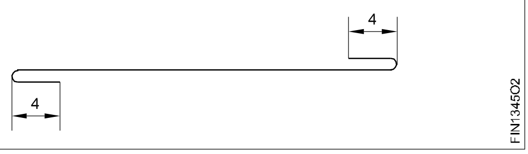
- Develop and layout the pattern for the cylinder (Fig 1) with all allowances for joining and hemming on drawing sheet by parallel line method.

Fig 1



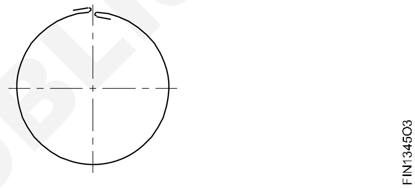
- Check the pattern for its correctness.
- Ensure the correct size of the material.
- Cut the pattern and paste it on the given sheet metal with gum.
- Cut the pattern with notches using 12" straight snips.
- Deburr the edges using a flat smooth file 150 mm long.
- Fold the edges of the sheet metal pattern using a hatchet stake and a mallet in the form of hooks for making the lock grooved joint. (Fig 2) (Ref. Skill Sequence)

Fig 2



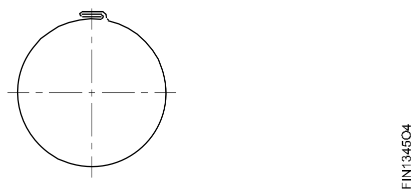
- Form the sheet metal pattern to cylindrical shape using a round mandrel stake and a mallet. (Fig 3) (Ref. Skill Sequence)

Fig 3



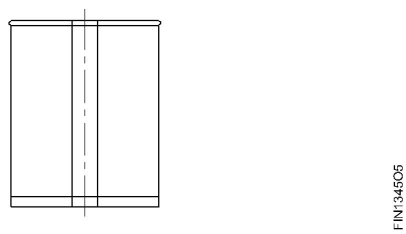
- Hook the folded edges and make the lock grooved joint using a hand groover. (Fig 4) (Ref. Skill Sequence)

Fig 4



- Make single hemming on one end and double hemming on the other end of the cylinder using a hatchet stake and Tinman's anvil. (Ref. Skill Sequence)
- Dress the cylinder to regular round shape using a round mandrel stake and a mallet. (Fig 5)
- Check the roundness of the inside diameter of the cylinder using gauge.

Fig 5



Skill Sequence

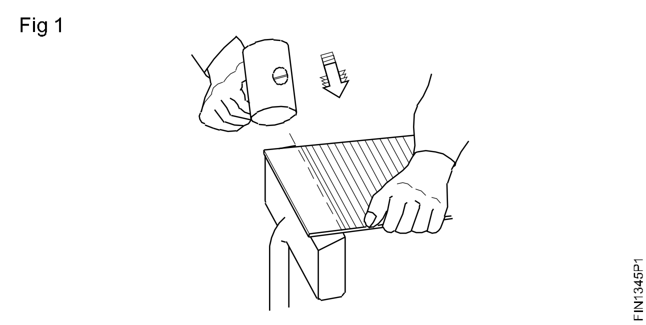
Folding at right angle using a hatchet stake

Objective: This shall help you to
- **fold the sheet metal at right angle using a hatchet stake and a mallet.**

Mark the folding line on the workpiece.

Hold the workpiece horizontal by one hand as shown in Fig 1.

Fig 1



Position the marked folding line on the bevelled edge of the hatchet stake.

By other hand, strike the edge of the workpiece at both ends by the wooden mallet, using slightly angular motion.

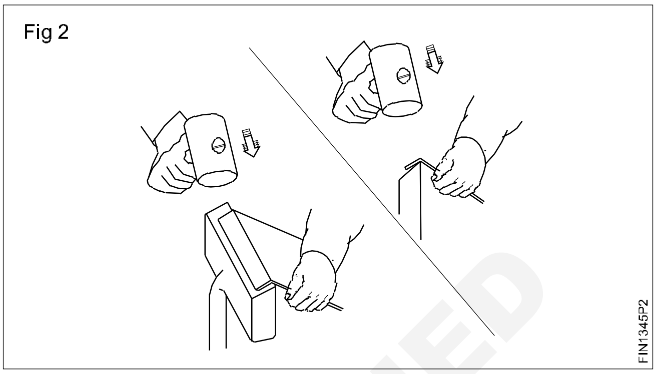
Ensure that folding takes place at the marked folding lines at both ends.

Lower the end of the workpiece slightly. (Fig 2)

Strike the edge of the workpiece using the same angle of striking.

Strike the edge of the workpiece from one end, progressing gradually, towards the other end. This will give uniform folding.

Fig 2

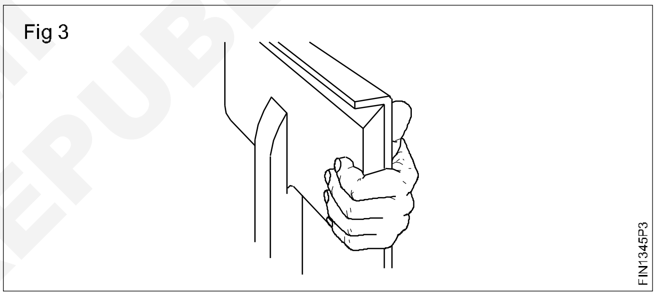


Now place the workpiece vertically as shown in Fig 3 and Fold the edge to approximately 90^0.

Check the perpendicularity using a trysquare.

Rectify if necessary, by the previous method.

Fig 3



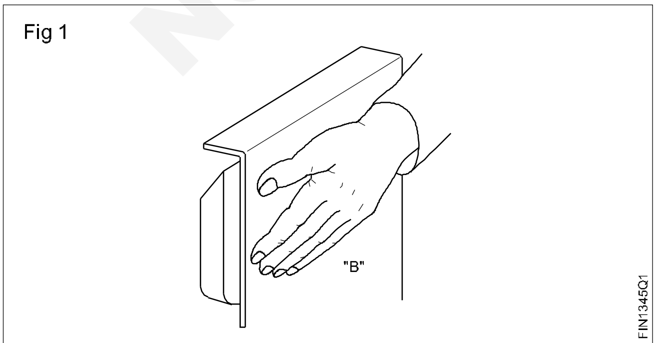
Single hemming

Objective: This shall help you to
- **make single hemming at the edge of the sheet using a hatchet stake.**

Fold the edge of the workpiece to approximately 90° using a hatchet stake and a wooden mallet. (Ref. Skill sequence of folding at right angle using a hatchet stake)

Placing the workpiece vertically on the hatchet stake as shown in Fig 1, increase the angle of bend, by striking with the wooden mallet. (Fig 2)

Fig 1



Place a piece of waste sheet and flatten the edge as shown in Fig 3.

Fig 2

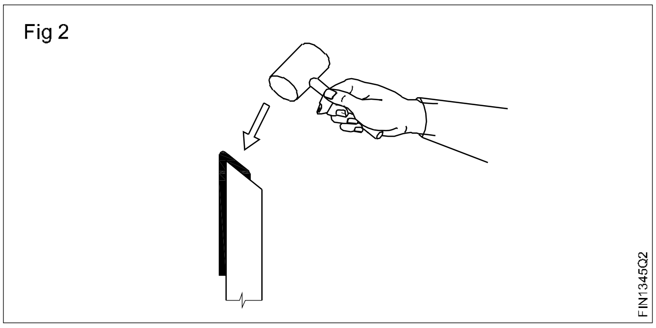
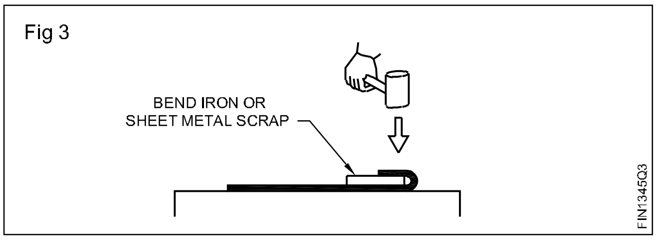
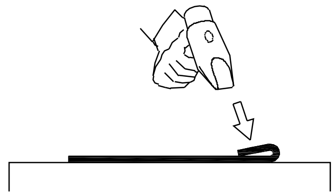


Fig 3



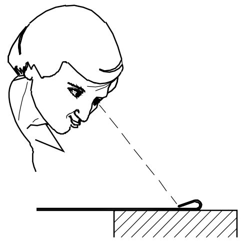
Remove the waste piece and edge down the fold by striking it with end faced mallet in angular position as shown in Fig 4.

Fig 4



Examine the edge for any gap between the edge and the surface of the workpiece. (Fig.5)

Fig 5



If any, finish the edge to get uniform hemming.

Do not crush the folded portions excessively while bending otherwise it may crack.

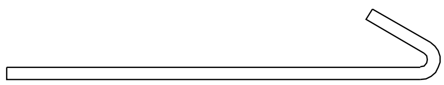
Marking and folding

Objectives: This shall help you to
- **mark the allowance for double hemming**
- **do double hemming on the edges of the sheet using a hatchet stake.**

Mark the first hemming allowance equal to double hemming dimensions ie., 2 times the thickness of the sheet to be used.

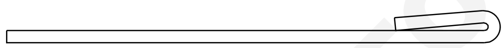
Fold the sheet metal; edge to be folded more than 90^0 on the hatchet stake using a mallet. (Fig 1)

Fig 1



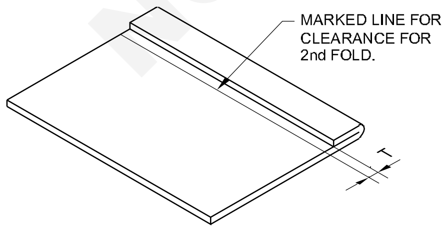
Flatten the folded edge on the dressing plate using the mallet. Ensure that there is no gap between the folded edges. (Fig.2)

Fig 2



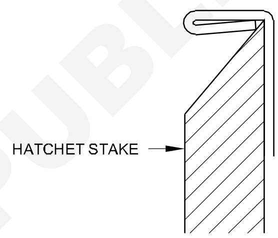
Mark a line from the folded edge at a distance equal to the thickness of the sheet, providing clearance for the second fold. (Fig 3)

Fig 3



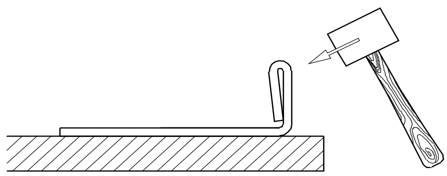
Hold the workpiece vertical, set the marked line matching with the beveled edge of the hatchet stake and fold the edge to approximately 90^0 using a mallet. (Fig 4)

Fig 4



Now fold the edge further on the dressing plate using the mallet. (Fig 5)

Fig 5

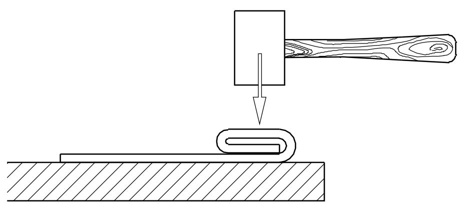


Flatten the edge, without any gap, using the mallet. (Fig.6)

Check the double hemmed edge for flatness and straightness.

Rectify, if necessary.

Fig 6



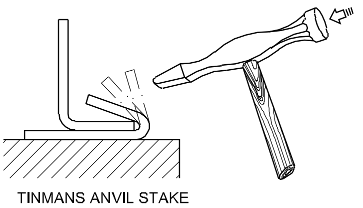
Paned down joint

Objective: This shall help you to

- **set the part and finish the paned down joint (single seam).**

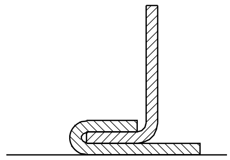
The setting down operation for the single seam (paned down joint) should be carried out stage by stage as shown in (Fig 1)

Fig 1



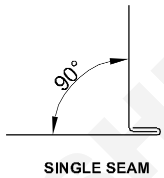
While striking, stretching and buckling of the metal is occured at the bottom edge (Fig 2)

Fig 2



The finished single seam (paned down joint) is shown in (Fig 3)

Fig 3



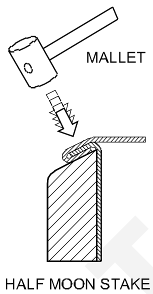
Setting and double seaming

Objectives: This shall help you to

- **place the joint on half moon stake and square stake**
- **finish the knocked up joint (double seam)**

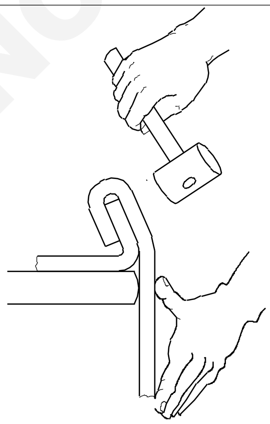
For knocked up seam, the paned down joint is turned up. Place the paned down joint on a half moon stake and join by a mallet as shown in Fig 1.

Fig 1



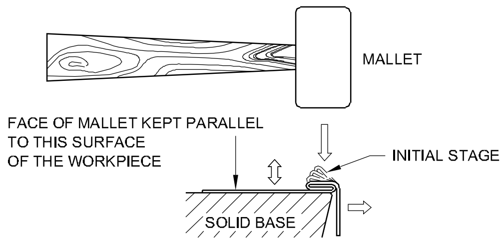
Support the job by hand and strike with the mallet all around to an angle as shown in Fig 2.

Fig 2



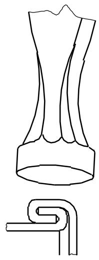
Increase the angle of the bend gradually, while striking with the mallet all around the seam as shown in Fig 3.

Fig 3



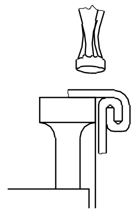
Tighten the double seam (knocked up joint) using the planishing hammer s shown in Fig 4.

Fig 4



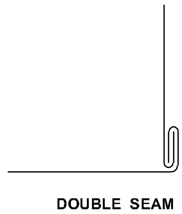
Place the edge of the joint on the square stake and lightly dress the bottom with the planishing hammer as shown in Fig 5.

Fig 5



The Finished double seam (knocked up joint) is shown in Fig 6.

Fig 6



Marking and forming lock grooved joint

Objectives: This shall help you to
- **mark the allowance for double hemming**
- **make double hemming at the edges of a sheet metal using a hatchet stake.**

First determine the fold size for the given width of the seam.

Fold size = Width of the lock - 3 times the material thickness.

Now from the fold size determine the total allowance for the locked grooved joint.

Total allowance = (3 x the fold size) + (6 x the thickness of the sheet)

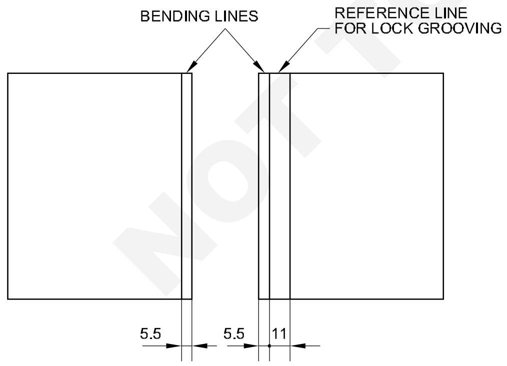
For example, if the width of the lock is 6mm and the thickness is 0.5 mm then, the fold size = 6-(3x0.5) = 4.5mm

The total allowance = (3x4.5) + (6 x 0.5) = 13.5+3=16.5mm.

Mark the line at a distance of 1/3rd of the total allowance on one sheet and two lines at a distance of 1/3rd and 2/3rd of the total allowance on another sheet.

For example, if the total allowance is 16.5 mm then, mark the line at a distance of 5.5mm from the edge on one sheet and two lines at a distance of 5.5mm and 11.00mm from the edge on another sheet (Fig 1)

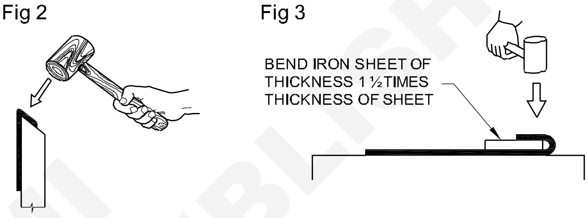
Fig 1



Fold the workpiece to more than 90^0 on the hatchet stake using a wooden mallet (Fig 2) and then place the bend sheet of 1.5 times the thickness as shown in Fig 3 and flatten the edge using the wooden mallet. This looks like a hook.

Make a similar hook on the other workpiece also.

Fig 2 Fig 3

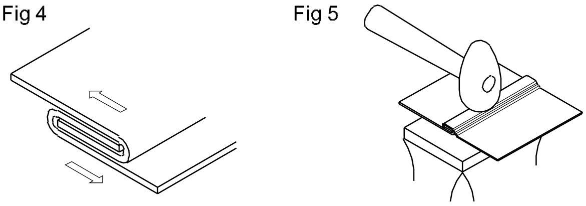


Interlock and place the workpiece on the dressing plate. (Fig 4)

While interlocking, ensure that the interlock is parallel and tight at both ends visually.

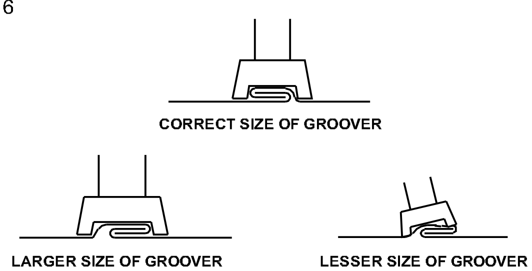
Press the joint to close down using the wooden mallet, to get the grooved joint (seam). (Fig 5)

Fig 4 Fig 5



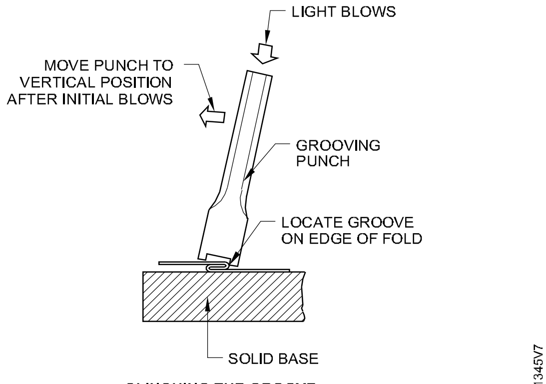
Select the hand groover of a given width of the lock (seam). If proper size groover is not used, it may cause improper locking of the grooved joint (Fig 6)

Fig 6



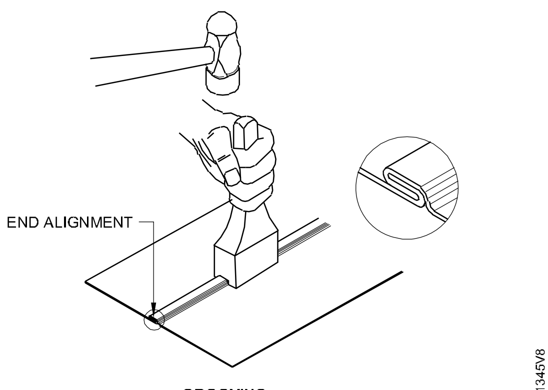
Place the groover over the fold at one end as shown in Fig.7

Fig 7



CLINCHING THE GROOVE

Fig 8



GROOVING

Hold the hand groover in one hand and strike the top of the groover with ball pein hammer by the other hand and clinch the groove. Similarly clinch the groove at the other end.

Advance this work every 1/3 of the groover length, until the entire groove is clinched down (Fig 8)

Finish the locked grooved joint (seam) with the hand groover and the hammer.

Making wired straight edge for stiffening by hand process

Objectives: This shall help you to
- **calculate the wiring allowance and total length**
- **form the edge around the wire and finish as a hatchet stake.**

Calculate the wiring allowance for the given wire of diameter ‘d’ and sheet thickness ‘t’.

Wiring allowance = 2.5 times the diameter of the wire + the sheet thickness.

Determine the total length of the side.

Total length = length of the side + wiring allowance.

Cut the sheet metal to the required size using a straight snip.

Flatten the sheet on the dressing plate by a mallet and deburr the cut edges by a flat smooth file.

Mark two lines parallel to the edge of the sheet metal at a distance of 1/4th of the total wiring allowance.

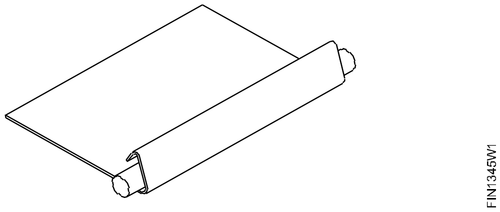
Fold at the first line nearer to the edge at right angle on the steel plate or the hatchet stake using a wooden mallet.

Make an another fold at the second marked line to 30° on a hatchet stake using a wooden mallet.

Take a wire of given diameter slightly longer than the length of the edge to be wired.

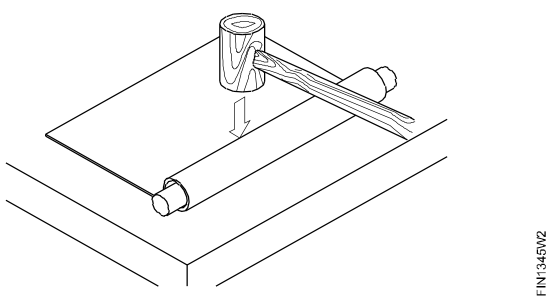
Place the wire at the folded edge and tap the edge by a wooden mallet using an anvil or anvil stake as base. (Fig 1)

Fig 1



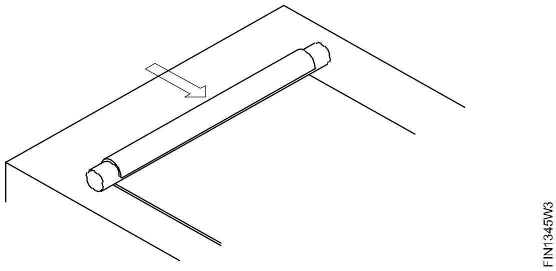
Form the edge around the wire by striking the wooden mallet. (Fig 2)

Fig 2



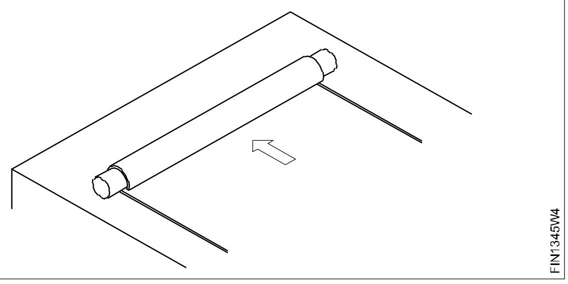
If the edge is too narrow, give blows in the direction shown in Fig 3.

Fig 3



If the edge is too wide give blows in the direction shown in Fig 4.

Fig 4



Finish the wired edge on the edge of the anvil or anvil stake by striking the wooden mallet in different directions. (Figs 5&6)

Fig 5

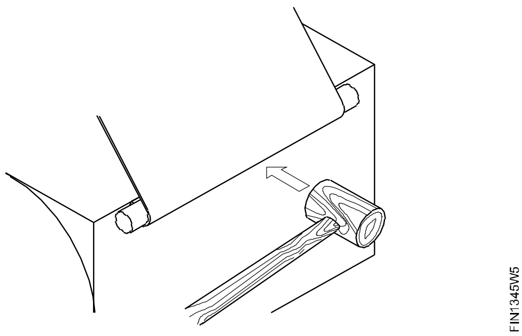
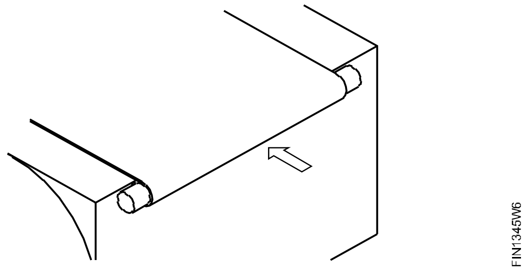
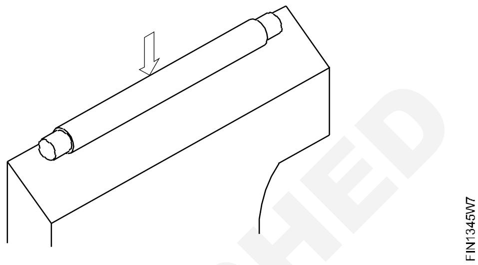


Fig 6



Finally finish the wired edge on a hatchet stake as shown in the Fig 7.

Fig 7



Cut off the surplus wire at the ends.

File the ends of wire using a flat smooth file.

Forming cylindrical shape by hand process

Objective: This shall help you to

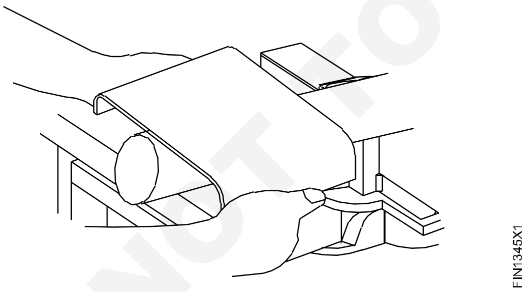
• **form a plain sheet to a cylindrical shape by hand process.**

Ensure for the correct size and shape of the pattern. (Workpiece)

Fix the mandrel stake on to the bench plate.

Set and bend the workpiece ends parallel to the axial line of the mandrel. (Fig 1)

Fig 1



Gradually rotate and form the entire workpiece to cylindrical shape by hand. (Fig 2 & 2A)

Check the formed cylinder for the roundness of the external diameter using an external gauge. Fig 2 of skill sequence of checking the roundness.

Fig 2

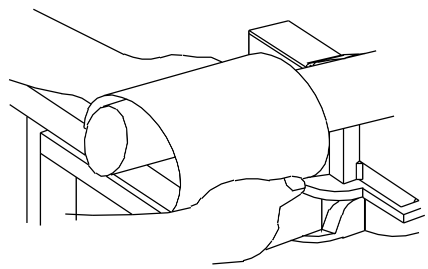
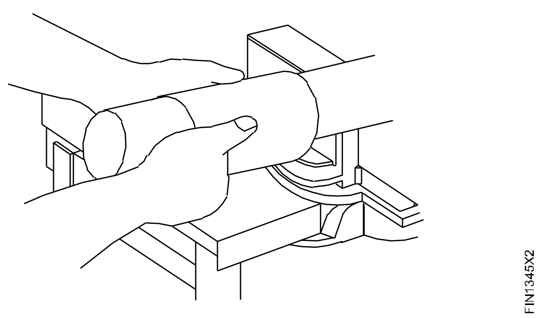
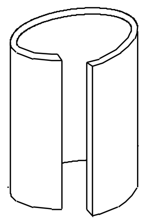


Fig 2A



Set the workpiece parallel to the axial line of the stake. If not the edges will not match with each other as shown in Fig 3.

Fig 3



Making lock grooved joint on a cylinder by hand process

Objective: This shall help you to

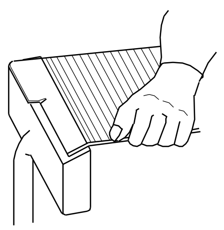
- **make a lock grooved joint on a cylindrical object using hand groover.**

Ensure for correct marking on the pattern, for allowances for making the locked grooved joint.

Fix the hatchet stake in the vice or the bench plate.

Place and set the bending line along the beveled edge of the hatchet stake. (Fig 1)

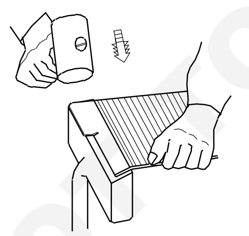
Fig 1



Set the bending line correctly on the bevelled edge of the hatchet stake, to avoid unequal folding.

Form the hooks at both ends in opposite direction using a hatchet stake and a mallet.

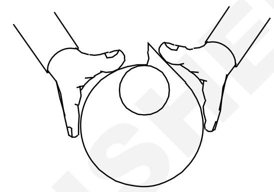
Fig 2



Form the sheet to cylindrical shape using a round mandrel stake. (Refer previous skill sequence).

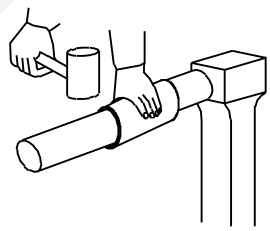
Interlock the hooks at the ends as shown in Fig 3.

Fig 3



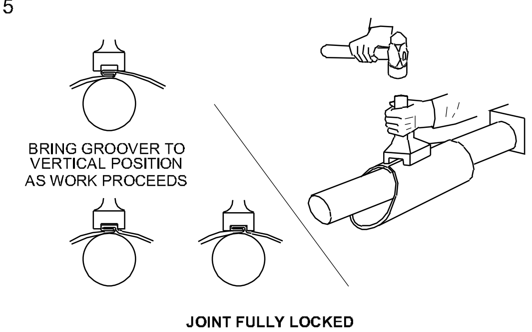
Close down the hooks by light blows using a mallet. This is the grooved seam. (Fig 4)

Fig 4



Lock the grooved seam with a hand groover and a hammer as shown in Fig 5.

Fig 5



Dress the formed cylinder to a regular round shape using a round mandrel stake and a wooden mallet.

Make a single hemming on a curved edge

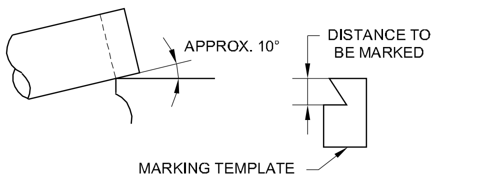
Objective: This shall help you to
- **make a single hemming on a curved edge using anvil stake and setting hammer.**

Mark the hemming allowance on the formed body using a marking template.

Fix the anvil stake on to the vice or bench plate.

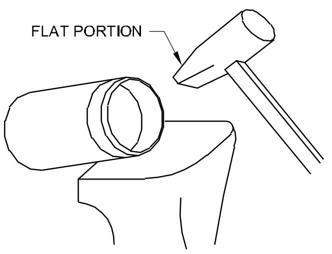
Hold the workpiece such that the marked line coincides with the edge of the stake approximately inclined at an angle of 10^0 as shown in (Fig 1).

Fig 1



Strike and rotate the workpiece gradually along the marked line to form a small flange using a setting hammer. (Fig 2)

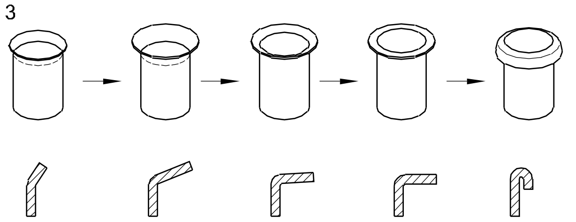
Fig 2



SETTING HAMMER

Gradually increase the angle of inclination while forming the flange as shown in Fig 3.

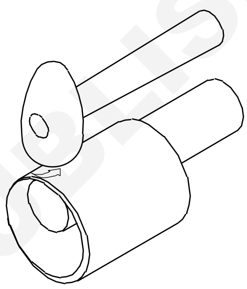
Fig 3



Finish the hemmed edge on a round mandrel stake by a mallet. (Fig 4)

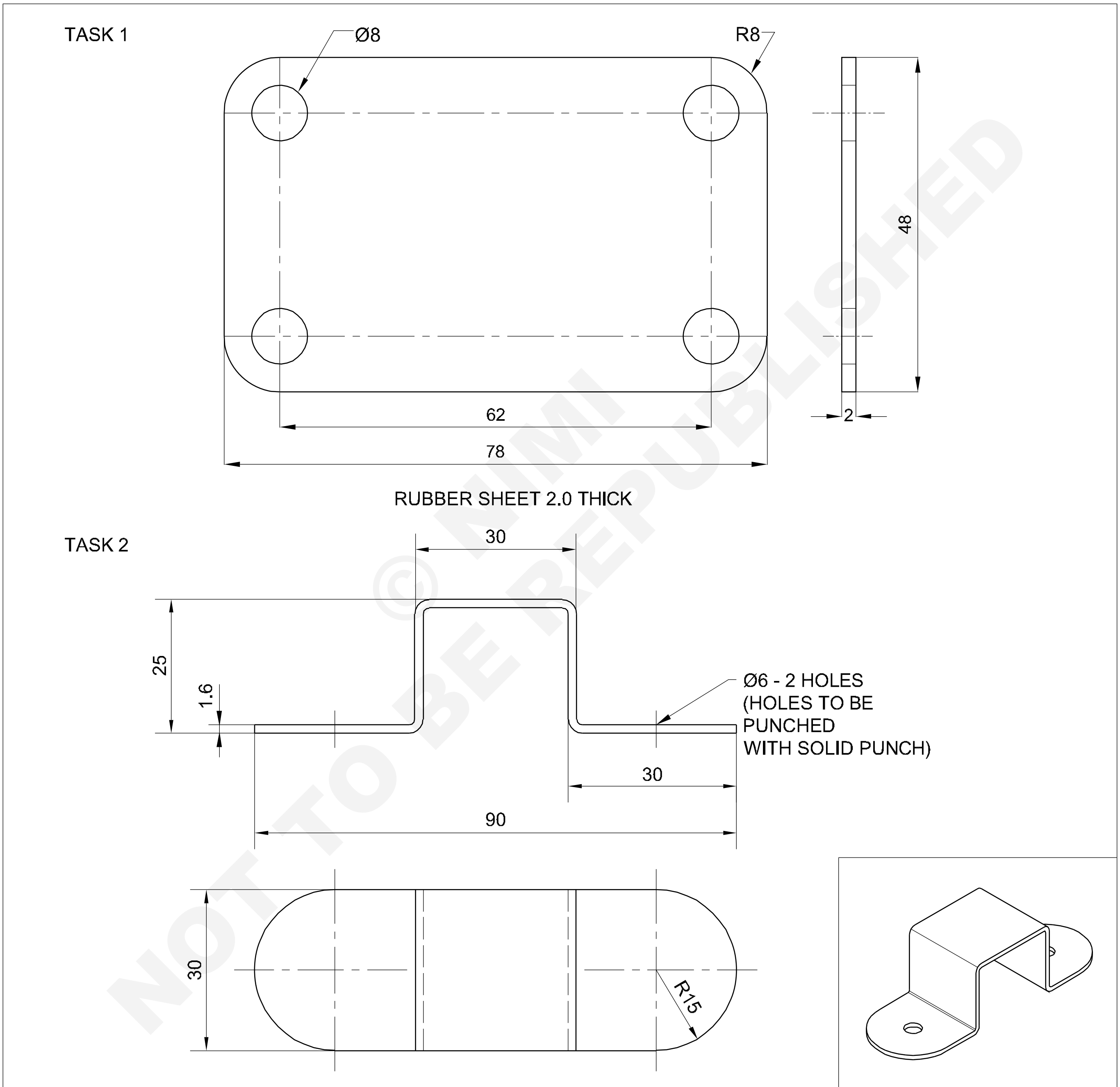
Dress the disturbed body of the cylinder to a round shape using a round mandrel stake and a mallet.

Fig 4



Punch holes using hollow and solid punches

Objectives: At the end of this exercise you shall be able to
- **punch holes using hollow punches**
- **replace damaged gasket**
- **punch holes using solid punch.**



1	ISSH 145 x 40 x 1.6		G.I SHEET			1.3.46
1	78x48x2.0	-	RUBBER	01	-	1.3.46
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

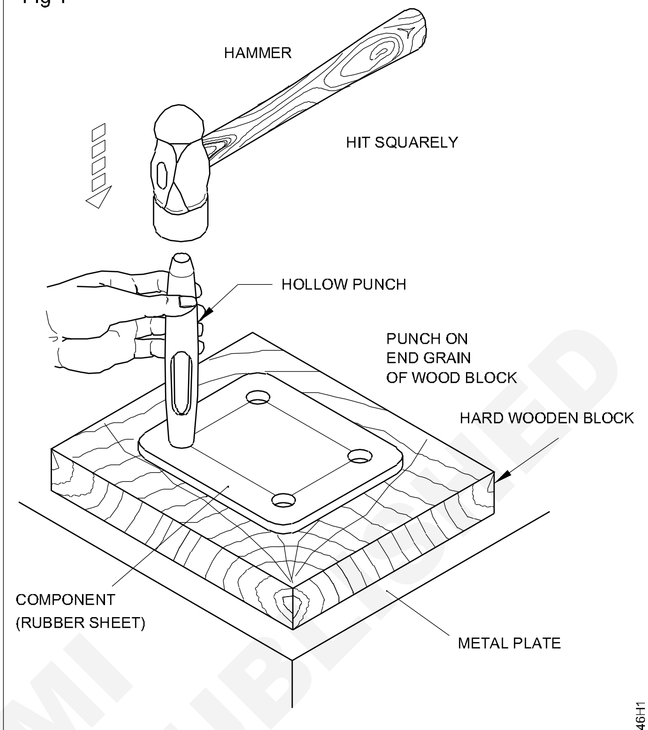
SCALE 1:1	**PUNCH HOLE USING HOLLOW AND SOLID PUNCH**	TOLERANCE :	TIME
		CODE NO. FI20N1346E1	

Job Sequence

TASK 1: **Punch holes using hollow punch**

- Cut the rubber sheet to the size of 78x48x2mm.
- Mark the dimensions to locate the hole centres using steel rule and pencil.
- Mark the geometrical shape of gasket as shown in Task 1.
- Draw the circles (holes) and arcs using a compass.
- Mark the geometrical shape of gasket as shown in Task 1.
- Locate the hollow punch cutting edge, to seat on the periphery of the circles marked for holes. (Fig.1)
- Strike on hollow punch to cut the holes using a ball pein hammer.
- Cut the periphery of the gasket using scissors.
- Check for the correctness of dimensions.

Fig 1

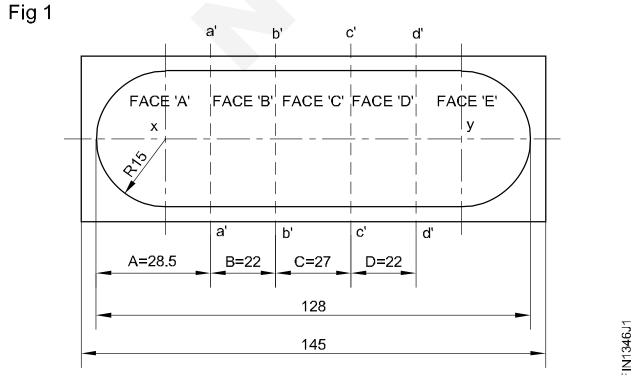


USING A HOLLOW PUNCH

TASK 2: **Punch holes using solid punch**

- Check the size of the raw material using a steel rule.
- File the burrs on the cut edges of the sheet metal workpiece by a flat file smooth 250 mm.
- Flatten the job material on a Tinman's anvil using a wooden mallet Ø75.
- Check the flatness of the job material by a trysquare.
- Mark straight lines with a scriber using a steel rule.
- Mark bend lines a'a', b'b', c'c', d'd' on both sides of the workpiece, reducing for face A and E one time thickness of sheet and face B, C and D, 2 time thickness of sheet from the clamp dimensions as shown in Fig 1.

Fig 1



- Mark points 'X' and 'Y' and indent with center punch and ball pein hammer. Mark curved lines using wing divider. (Fig 1)
- Cut along straight and curved lines by straight snips.
- File the burrs on the cut edges of the job by flat file smooth 250 mm.
- Clamp the face B of the job the folding line just above 1/2 time thickness of sheet in folding bars, hold in bench vice and fold the face A at right angles using the wooden mallet Ø75. (Fig 2&3)
- Remove the job, by loosening the jaws of the vice.
- Similarly, clamp face D of the job in folding bars held in benchvice and fold face E at right angle using the wooden mallet ø75. (Fig 4)

Fig 2

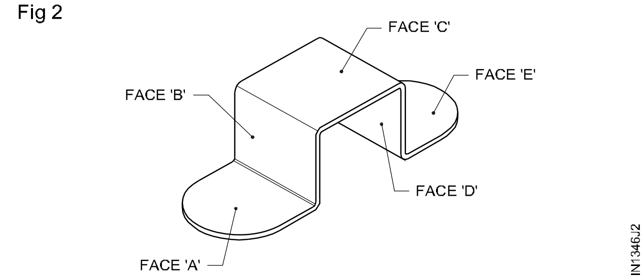
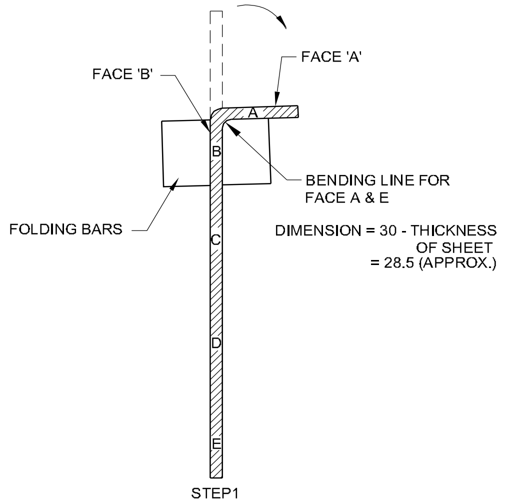


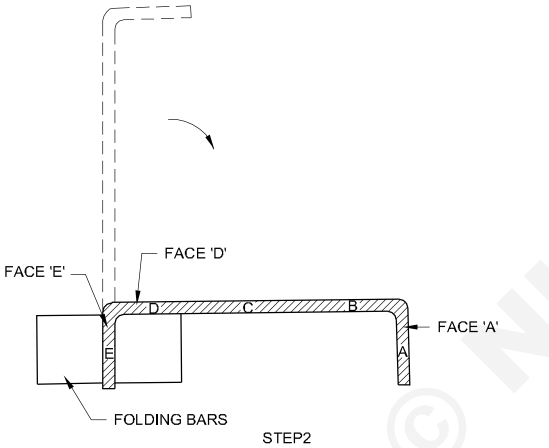
Fig 3



FOLDING FACE 'A' USING FOLDING BARS

FIN1346J3

Fig 4

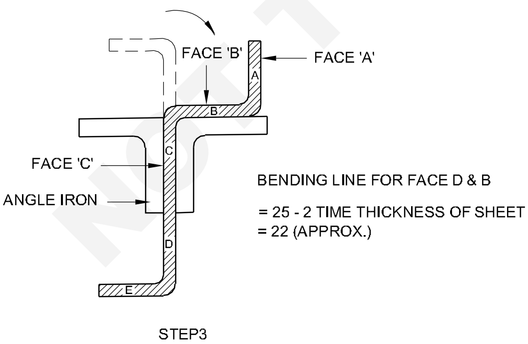


FOLDING FACE 'D' USING FOLDING BARS

FIN1346J4

- Remove the job, by loosening the jaws of the vice.
- Clamp face C of the job in a pair of angle irons, held in benchvice and fold face B at right angle using the wooden mallet ø 75. (Fig 5)

Fig 5

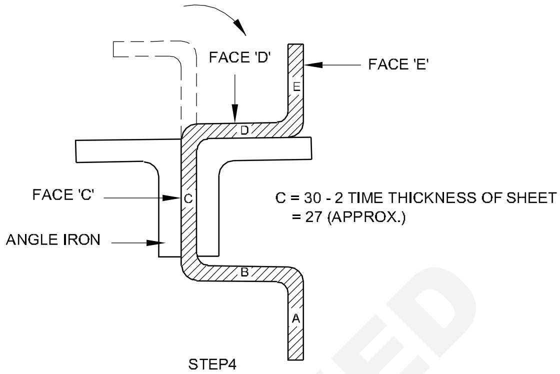


FOLDING FACE 'B' USING ANGLE IRONS

FIN1346J5

- Remove the job, by loosening the jaws of the bench vice.
- Similarly, clamp face 'C' of the job in angle irons held in bench vice and fold face 'D' at right angle using the wooden mallet ø75 (Fig 6)

Fig 6

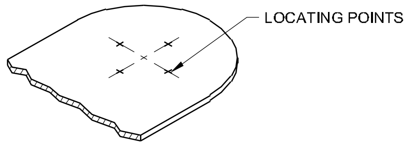


FOLDING FACE 'D' USING ANGLE IRONS

FIN1346J6

- Check the perpendicularity of all the bends using a trysquare.
- Rectify the perpendicularity, using a wooden mallet and a suitable wooden support, if folds are not perpendicular.
- Mark locating points with a scriber and punch using a dot punch and a ball pein hammer. (Fig.7)

Fig 7



MARKING LOCATING POINTS ON JOB

FIN1346J7

- Place the job over a lead cake.
- Hold the solid punch ø6mm on the located points in vertical position by one hand.
- Strike the head of the solid punch with the ball pein hammer by other hand, with sufficient striking force.
- Repeat striking the hammer, till you get the hole.
- File the burr on both sides of the job, using a smooth round file.
- Planish the punched area of sheet on a tinman's anvil for flatness.

Skill Sequence

Positioning the punch and finishing the punch holes

Objectives: This shall help you to
- **position the centre of the punch hole**
- **planish the bulging of punched hole.**

Punching is an operation of producing holes on a thin section material using a punch.

Hold the solid punch in vertical position on locating marks on the workpiece by one hand and strike the head of the punch by ball pein hammer in other hand till you get the hole. (Fig 1)

> **Position the punch such that the four locating points, coincide with the circular cutting edges of the punch, otherwise the centre of the punched hole will get displaced.**

Use a lead cake or a cross grained wooden block as a supporting base.

While striking, watch the cutting point and not the head of the punch.

While striking the hammer, ensure that, the hammer strikes at the centre of its bottom face and top face of the punch. Otherwise, the position of the punch gets disturbed and oblong hole is produced. Sometimes, the punch may slip off from its position and cause accident.

While using wooden block as the supporting base, the sheet should be placed at gross grained end of the wood, otherwise, distortion is caused. (Fig 2)

Fig 1

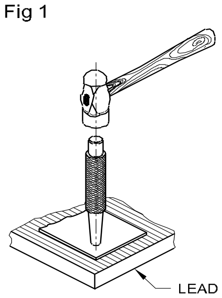
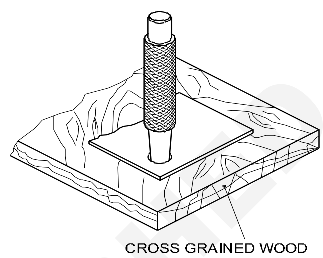
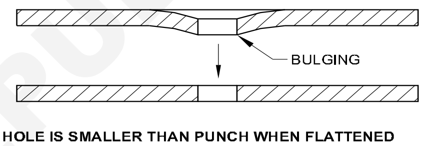


Fig 2



A punched hole diameter reduces slightly, when the sheet is flattened after punching. Finish the punched hole, file the burr, then planish the bulging caused due to punching. (Fig 3)

Fig 3



Resharpening of a solid punch

Objective: This shall help you to
- **resharpen the blunt cutting edges of a solid punch on a bench grinder and pedestal grinder.**

Introduction

After continuous use, the cutting edges of a solid punch gets blunt. In order to get the punch for reuse, the punch is resharpened.

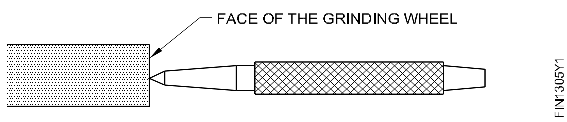
Resharpening is done on a bench or a pedestal grinder. Grinding is done on face and tapered diameter of the solid punch.

Before grinding, ensure that the grinding wheel is properly dressed and the wheel is true.

Ensure that the gap between the grinding wheel face and the tool rest is approximately 2 mm.

Hold the solid punch on the tool rest, perpendicular to the face of the grinding wheel. (Fig 1)

Fig 1



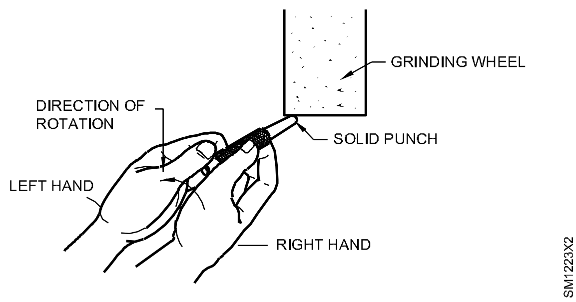
Grind the face of the punch slowly by rotating it in clockwise direction.

While rotating, hold the punch rigidly on the tool rest and see that excessive force is not applied while grinding.

Continue grinding till the face of the punch becomes flat.

Now hold the punch at an angle as shown in Fig 2 and grind slowly the diameter of the solid punch by rotating the punch clockwise. While grinding see that the punch is held tangential and the diameter of the punch is just touching with light force to the face of the grinding wheel. Rotate the punch uniformly for proper grinding of the diameter.

Fig 2

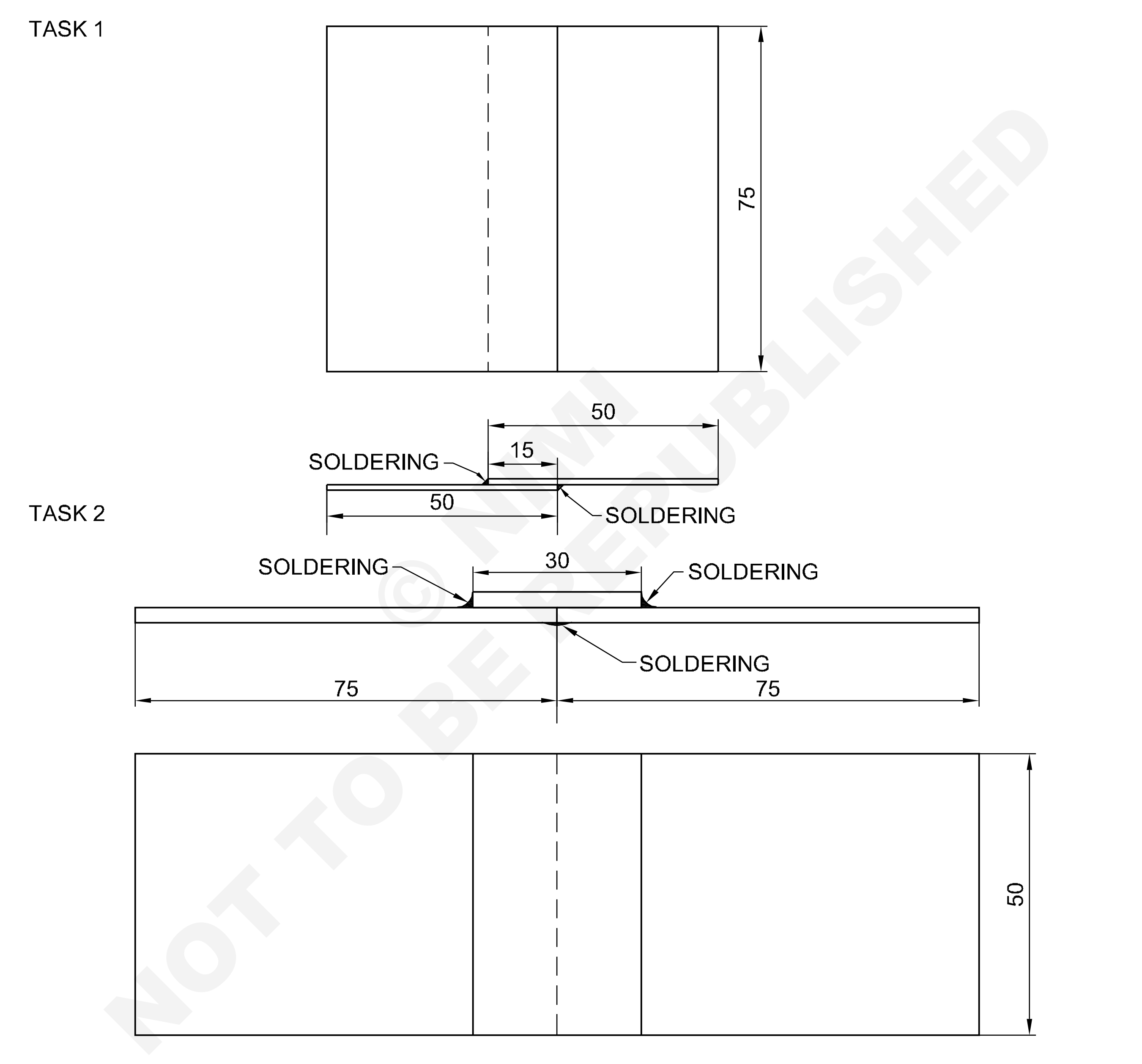


> **Don't use sides of grinding wheel for grinding diameter or face of the punch.**

Don't apply excess pressure while grinding, otherwise it will damage the punch or even it may cause accident.

Do lap and butt joints

Objectives: At the end of this exercise you shall be able to
- **set and tack lap joint in correct alignment**
- **solder a lap joint, in flat position using soft solder**
- **solder a fillet and butt joint in flat position using electric soldering iron.**



1	ISSH 50 x 30 X 0.6	–	TINNED SHEET	–	TASK-2	1.3.47
2	ISSH 75 x 50 X 0.6	–	TINNED SHEET	–	TASK-2	1.3.47
2	ISSH 75 x 50 X 0.6	–	G.I SHEET	–	TASK-1	1.3.47
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SOLDERING LAP JOINT AND BUTT JOINT**	DEVIATIONS ±0.5	TIME 15h
		CODE NO. FIN1347E1	

Job Sequence

TASK 1: **Soldering lap joint**

- Cut two pieces of sheet metal to the size 75x50x0.5mm.
- Check the size of the material using a steel rule and squareness with a try square.
- Place two pieces one over the other as shown in job drawing. Prepare the portable hand forge with charcoal and fire with blower.
- Heat the soldering copper bit and tin the working point of it.
- Tack and solder the joint.
- Clean the joint using water to remove the oxides.

— — — — — —

TASK 2: **Soldering butt joint**

- Cut the material in three pieces as per the job drawing.
- Make the single plated butt joint using an electric soldering iron as per the job drawing.
- Clean the job using water to remove the oxides.

Skill Sequence

Method of soft soldering

Objective: This shall help you to
• make a joint by soft soldering.

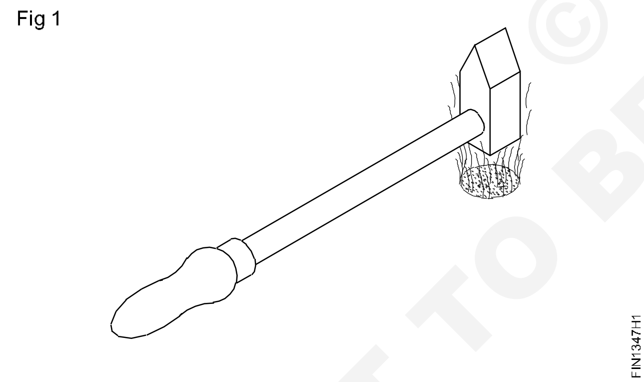
Soft soldering

Clean the area to be joined thoroughly

> **Where a lap joint is required on mild steel, both sides of the top lap should be cleaned and tinned, to assist heat transfer when soldering.**

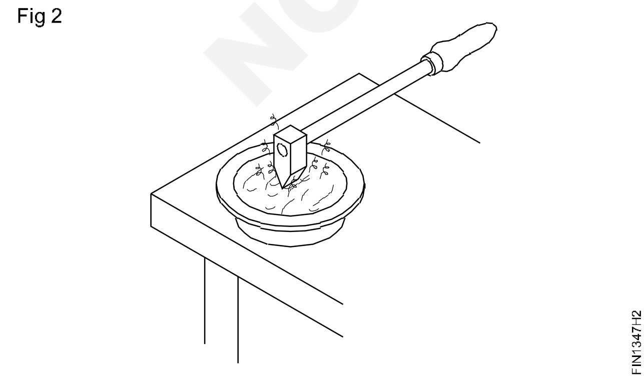
Heat the copper of the soldering iron until the flame is bright green. Keep the edge of the copper bit upward. (Fig.1)

Fig 1



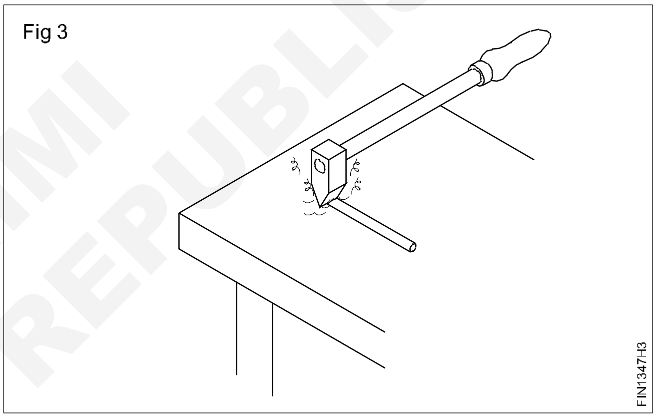
Dip the edge of the bit in flux solder-acid. (Fig.2)

Fig 2



The tip is tinned by rubbing it along the solder. (Fig.3)

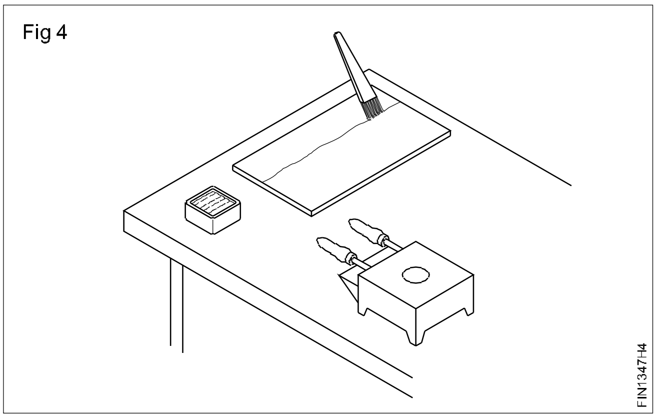
Fig 3



Place the sheet on a soldering bench.

Apply the flux on the area to be joined. (Fig.4)

Fig 4



Dip the point into the flux. This will remove the oxide film from the finned faces.

Apply the solder to the point. (Fig.5)

Apply the bit to the work.

Spread the solder evenly on the surfaces.

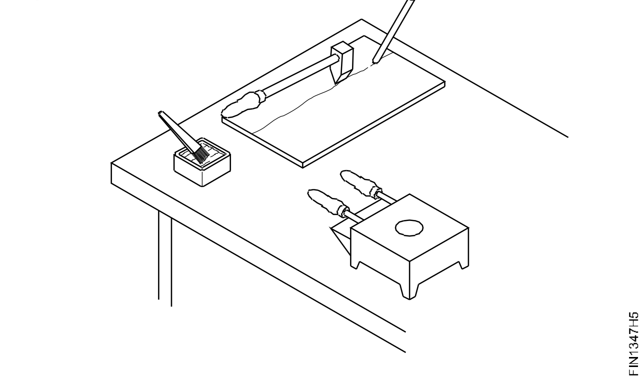


Fig 5

Keep the tinned face of the bit flat, to obtain maximum heat transfer.

Apply more solder as required.

Turn the sheet over and tin the other lap area in the same manner.

Using a wet rag, clean off the excess flux.

Making a single plated soldered butt joint

Objectives: This shall help you to

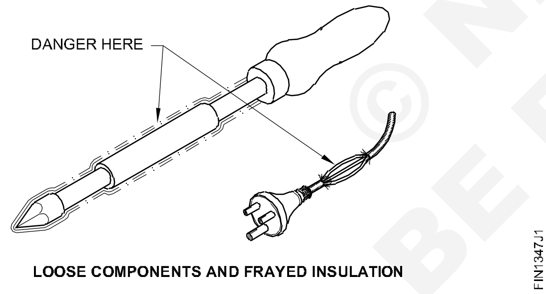
- **set and tack single plated butt joint in correct alignment using electric soldering iron**
- **solder a fillet and butt joint of correct size in flat position using electric soldering iron.**

Check the size of three sheet metal pieces by using a steel rule.

Select a suitable type of an electric soldering iron.

Check if it has loose components connections, frayed or damaged insulation. If found, replace the soldering iron. Short circuiting because of the above faults may cause shocks and fires. (Fig 1)

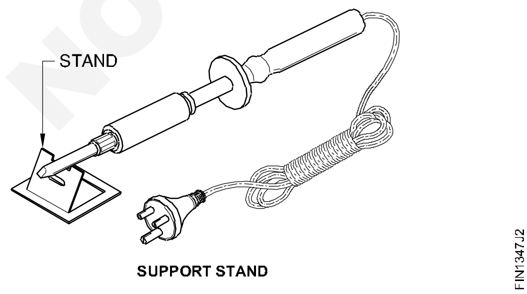
Fig 1



Do not attempt yourself to repair it. Repairs should be carried out by a qualified electrician.

Plug it in the socket of the switch board and switch 'ON'. Place the electric soldering iron on a suitable support stand. (Fig 2)

Fig 2



Select the suitable flux for the job.

Select the suitable solder for the job.

Clean the surface to be joined.

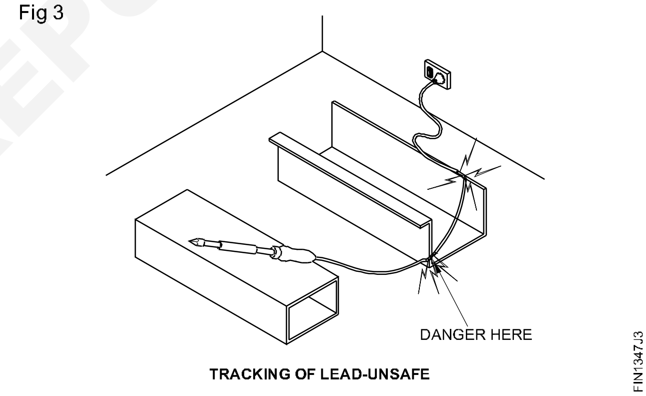
Apply the flux to the joint by using a brush.

Layout three sheet metal pieces to obtain single plated butt joint as per the job drawing.

Place the electrical soldering iron such that its lead does not come across sharp edges of the metal pieces. (Fig 3)

Tin the point of electric soldering iron by rubbing it on a soft solder.

Fig 3

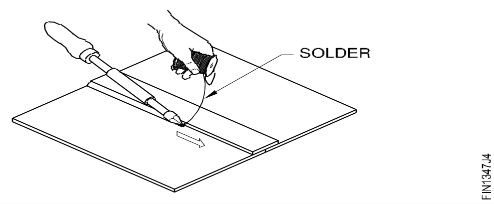


Tinning on the bit should be bright and should cover the faces of the tip completely.

Set and tack the three metal pieces in correct alignment.

Solder the butt edge at the bottom and cover the plate edges at the top. (Fig 4)

Fig 4



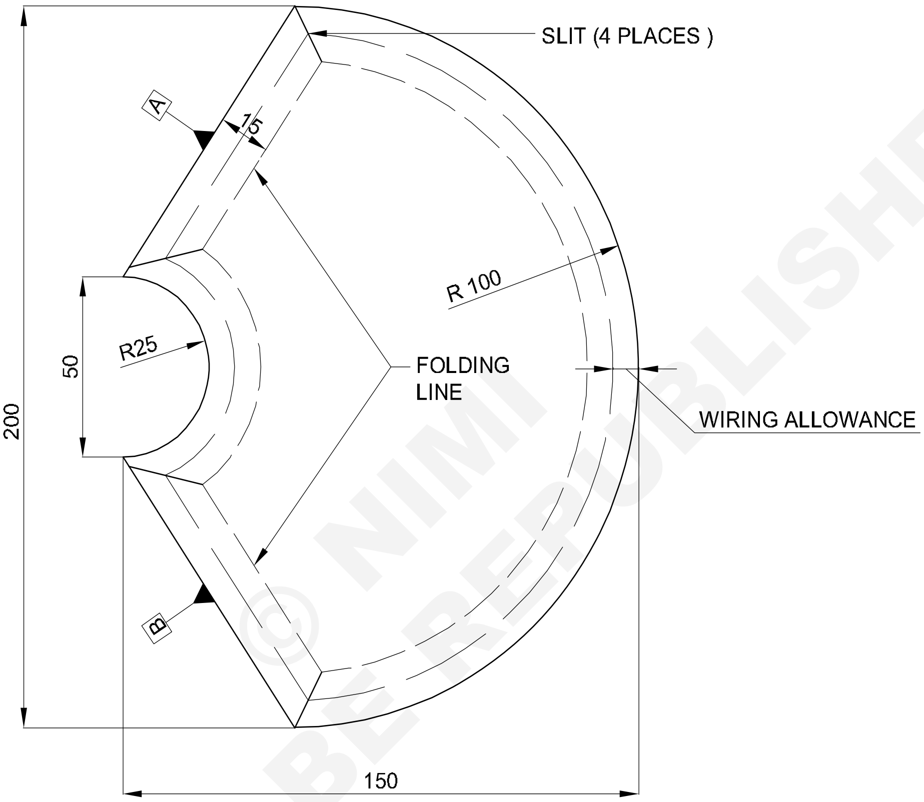
Switch off the power, then remove the plug from the switch board after soldering is completed.

Clean the job in cold water to remove the oxides.

Check the joint and rectify, if required.

Bend sheet metal into various curvature forms - Funnel Wired edges - Straight and curves, fold sheet metal at angle using stakes

Objectives: At the end of this lesson you shall be able to
- **make straight wired edge**
- **make curved wired edge**
- **fold sheet metal at angle using.**



Job Sequence

ISSH 205x155x0.6 G.I-Sheet

- Cut 0.6mm thickness G.I Sheet to the required size as mentioned in the drawing.
- Mark the profile, folding line and wiring allowance as per the drawing.
- Make a slit at 4 places using straight snip.
- Use ϕ 2mm wire and make straight wired edge at side A and B (Follow the procedure mentioned in exercise 1.3.45 for straight wired edge).
- Use ϕ2mm wire and make curved wired edge at R100 and R25.
- Use hatchet stake and fold the sides A & B to 90° angle.
- Use half moon stake having radius 100 and 25mm for folding to curved shape.

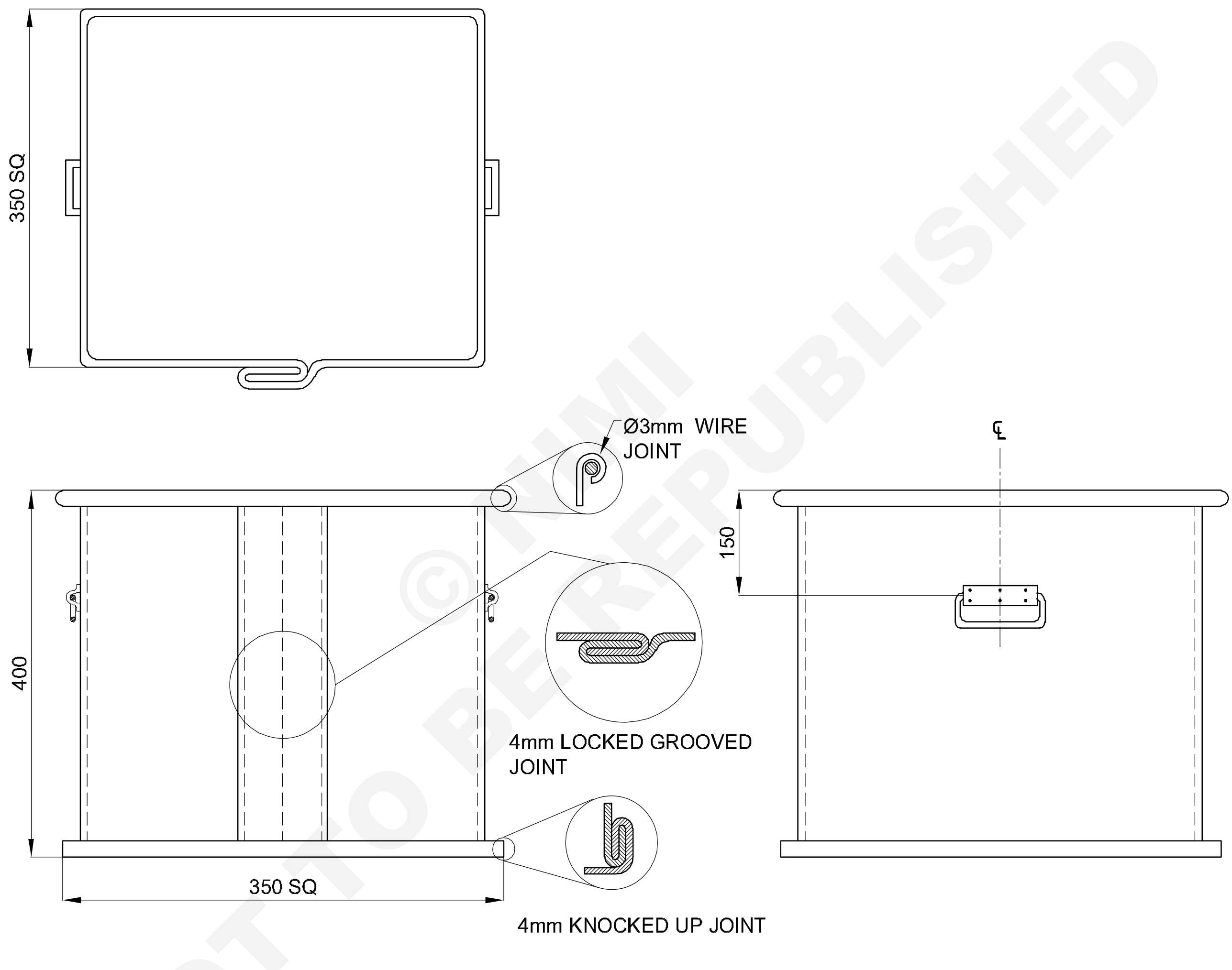
1	ISSH 205 x 155 x 0.6		G.I SHEET			1.3.48
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	FUNNEL WIRED EDGES-STRAIGHT AND CURVES, FOLD SHEET METAL AT ANGLE USING STAKES	DEVIATIONS ±0.04	TIME.
		CODE NO. FI20N1348E4	

Make simple square container with wired edge and fix handle

Objectives: At the end of this exercise you shall be able to
- **develop the pattern for square container**
- **prepare the square container with lid by knocked up joint and locked grooved joints**
- **make the cover plate and handles for container**
- **finish the container with wired joint.**

TASK 1

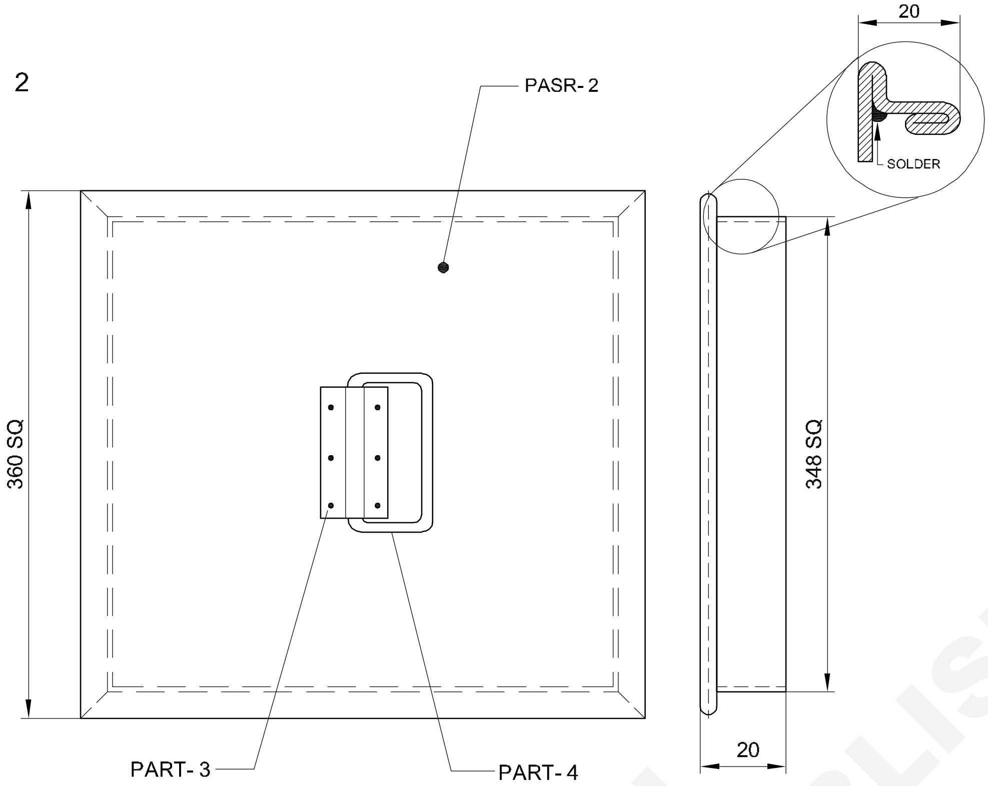


BODY

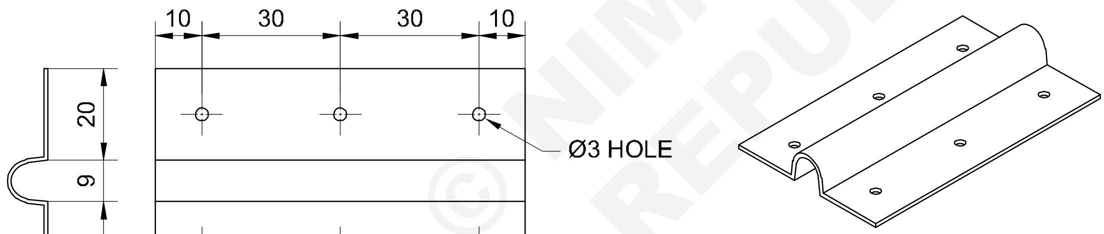
3	Ø6x270mm	-	GI SHEET	-	TASK-4	-
3	ISSH 80x65x0.6	-	GI SHEET	-	TASK-3	-
1	ISSH 370x370x0.6	-	GI SHEET	-	BOTTOM SHEET	-
1	ISSH 400x400x0.6	-	GI SHEET	-	TASK-2	-
1	ISSH 420x420x0.6	-	GI SHEET	-	TASK-1	1.3.49
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SQUARE CONTANER**	TOLERANCE :	TIME :
		CODE NO. FI20N1349E1	

TASK 2

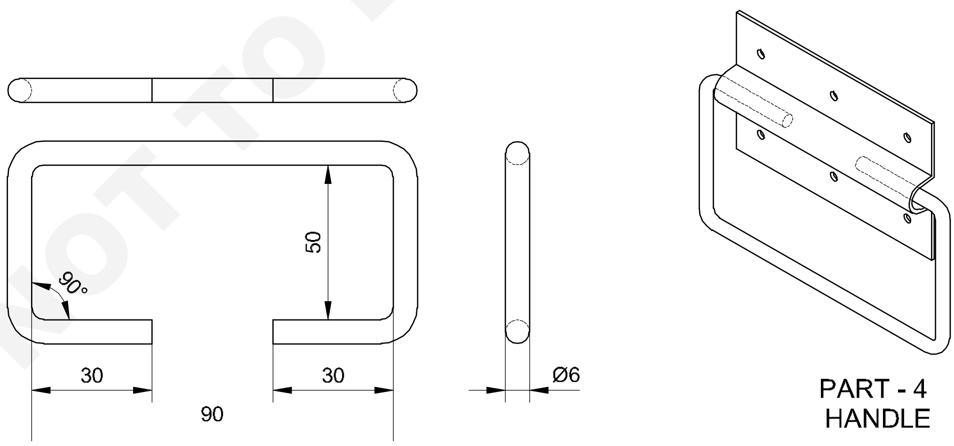


TASK 3



PART - 3
HANDLE COVER PLATE

TASK 4



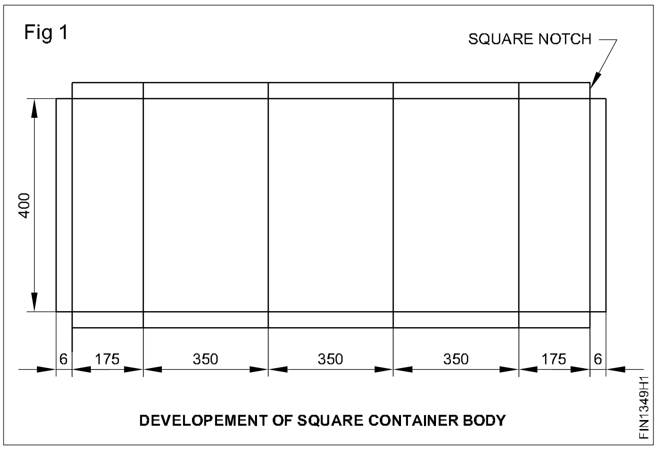
PART - 4
HANDLE

-	-	-	-		-	1.3.49
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SQUARE CONTAINER				TOLERANCE : ± 1mm	TIME :
					CODE NO. FI20N1349E2	

Job Sequence

TASK 1: **Development of square container body**

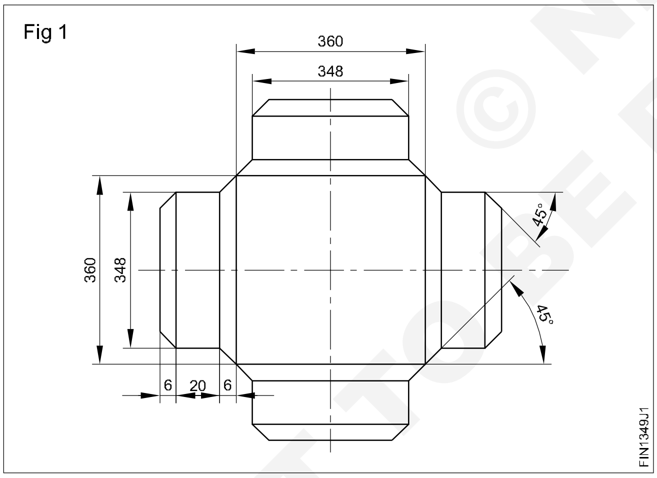
- Develop and layout the pattern by parallel line method, considering the wiring allowance. Locked grooved joint and knocked up joint for the body and bottom as shown in the fig.1.



- Cut the layout pattern using scissors for body and bottom.
- Paste the pattern on sheet metal.
- Cut the sheet metal on the outline of layout pattern pasted to the sheet using straight snips.
- Cut straight notch at bend line upto the hemming line at both ends of the body.
- Prepare the hem at bottom of the body to fix bottom sheet and locked grooved joint.
- Prepare the hem to fold as flange for knocked up joint.
- Fold the sheetmetal against the angle iron/folding bar/ square stakes suitably clamped.
- Strike with wooden mallet, gradually along the bend line.
- Check using a try square/steel square and continue to form the square body of the container.

TASK 2: **Development of square container lid**

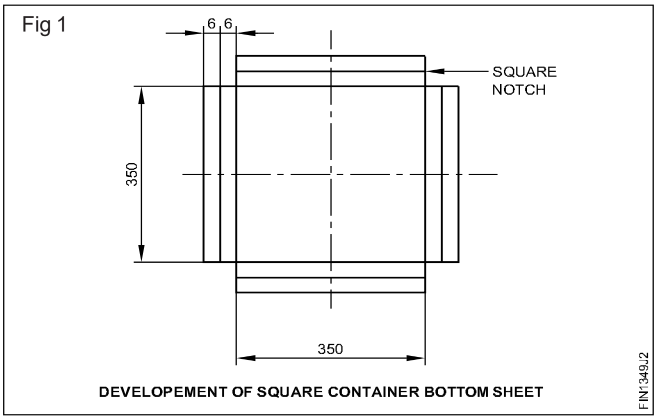
- Develop and layout the pattern by parallel line method, considering the hemming allowance and also fit into the body. (Fig.1)



- Cut the layout pattern, square cover using scissors.
- Paste the pattern on sheet metal.
- Cut out the sheetmetal on the outline of layout pattern pasted to the sheet using straight snips.
- Cut the notch at 45° in four sides for hemming as shown in figure.
- Bend the hemming on four sides of the cover sheet using square stakes.
- Bend the flange on four sides of the cover sheet using square stakes.
- Solder the four corners using soft solder.

TASK 3: **Development of square container bottom sheet**

- Develop and layout the pattern by parallel line method, considering the hemming allowance and also to fit into the body as shown in Fig 1.
- Cut the layout pattern of square container bottom sheet using scissors.
- Paste the pattern on sheet metal.
- Cut out the sheet metal on the outline of layout pattern pasted to the sheet using straight snips.
- Cut the square notch all four sides for hemming as shown in figure.



- Prepare the hemming on four sides of the bottom sheet using square stakes, so to make knocked up joint with the body of squrae container.
- Fix the body of the square container on the bottom sheet to fold seam.
- Fold the four sides of bottom to form the knocked up joint using square stakes.
- Fix the handle cover plate along with front handle 3 Nos
- Complete and finish the as per sketch.
- Ensure the lid is in proper fit against the container body.

Body wired edge

- Place the wire on top of the body edge and form the wired edge on four sides of the body continuously as shown in Job Sequence.
- Finish the wired edge on hatchet stake and cut off the surplus wire at the ends.

Handle fixing

- Prepare handle cover plate as shown in job drawing part 3.
- Prepare front handle as shown in job drawing part 4.
- Fix the handle cover plate along with front handle 3 Nos
- Complete and finish as per job drawing.
- Ensure the lid is in proper fit against the container body.

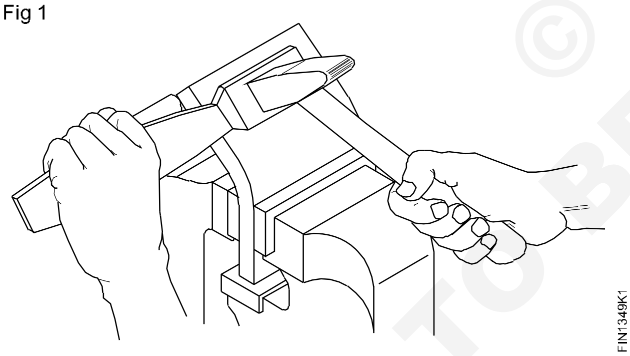
Skill Sequence

Calculate the length of material for bending

Objectives: This shall help you to
- **state the effects due to bending**
- **calculate the required length of metal for bending.**

While bending a rod, sheet or pipe, due to the tensile force in the outer part of the material at the bending point, the material is stretched. (Figs 1 and 2) Due to the force of pressure in the inner part of the material at the bending point, the material is compressed.

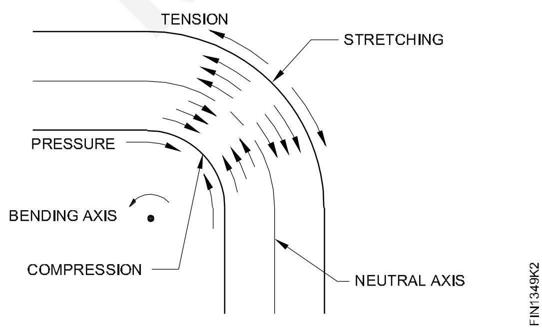
Fig 1



The layer in the middle of the material is not subjected to either tension or compression.

This is called the neutral axis. (Fig.2)

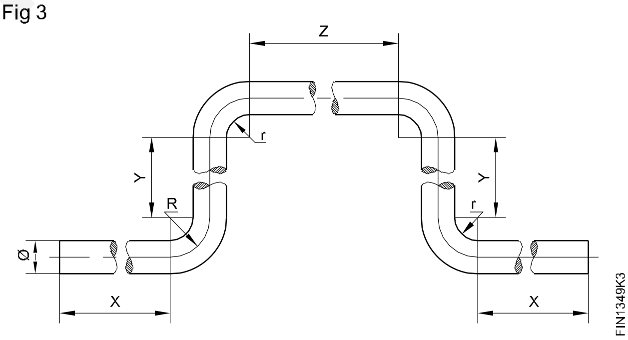
Fig 2



For calculating the length of material for bending, the material length at the neutral axis is taken into account.

The length of the blank/rod/pipe is the stretched length before bending. The stretched length is determined along the neutral axis. For calculating the stretched/elongated length of a rod/sheet/pipe while bending (Fig.3), first add all straight portions together.

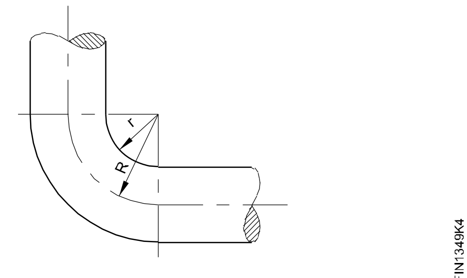
Fig 3



$x+y+z+y+x=2x+2y+z$

Then add the bent space distance together. For calculating this: take the radius of the bent up to the neutral axis and also take the angle of the bend into consideration. (Fig.4)

Fig 4



Radius of the bend up to neutral axis

= inner radius+(0.5 x thickness of sheet OR diameter of rod or pipe. Angle of the bend with respect to Figs 3 & 4 is 90.

Radius of the bend up to neutral axis.

Radius of the bend up to neutral axis = inner radius + (0.5x thickness of sheet OR diameter of rod or pipe) angle of the

Fig 5

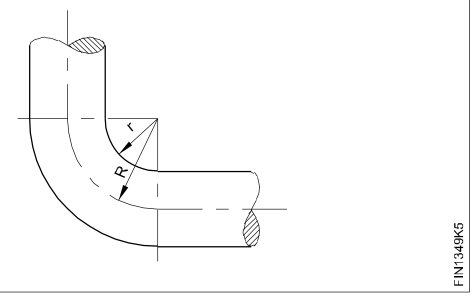
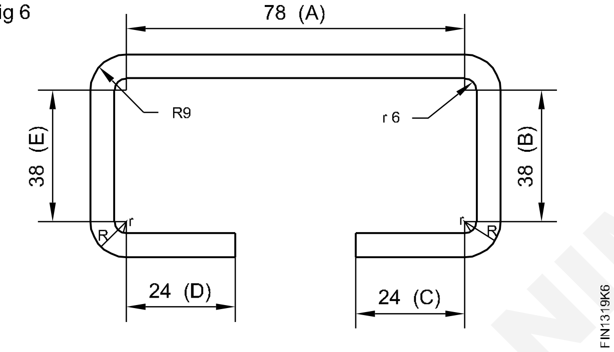


Fig 6



bend with respect to 90°. (Figs 5 & 6)

Radius of the bend up to neutral axis,

=Inner radius +(0.5 x thickness of round rod)

Radius of the bend upto neutral axis.

=6+(0.5x6)mm

6+3.0mm

=9mm

∴ Radius of the bend up to neutral axis =9mm

Length of the curved portion = $\dfrac{\text{Angle of curve} \times 2\pi R}{360}$

Where 'R' is the radius of curve at the neutral axis.

∴ Stretch length of one bend = $\dfrac{\text{Angle of curve} \times 2\pi R}{360}$

∴ Stretch length of four bends = $4\text{x} \dfrac{90^0}{360^0} \text{x}2\text{x} \dfrac{22}{7} \text{x}9\text{mm}$

= 56.57mm

Straight portion length,

For the length of 'A'

A = 90-(6+6) mm

= 90-12mm

78mm

For the length of 'B',

B = 50-(6+6)mm

= 50-12mm

= 38mm

Total length

For the length of 'C'

C = 30-6mm

= 24mm

For the length of 'D'

D = 30-6mm

= 24mm

For the length of 'E'

E = 50-(6+6)mm

= 50-12mm

38mm

Total length of the ∅6mm round rod=length of A+B+C+D+E+stretch length of four bends.

=78+38+24+24+38+56.57mm

=258.57mm

Total length of the round rod = 258.57mm.

Front handles

Calculate the length of the round rod to make front handles 3 Nos. as shown in the figures.

Mark the length of rod required as per calculation.

Cut the length rod using hack saw. (Fig 7)

File the ends of rounded rod to remove the burrs.

Mark the dimension for bending length. (Fig 8)

Set the round rod in bending fixture.

Instructor to arrange suitable bending fixture

Bend the round rod to form 90° (Fig 9)

Fig 7

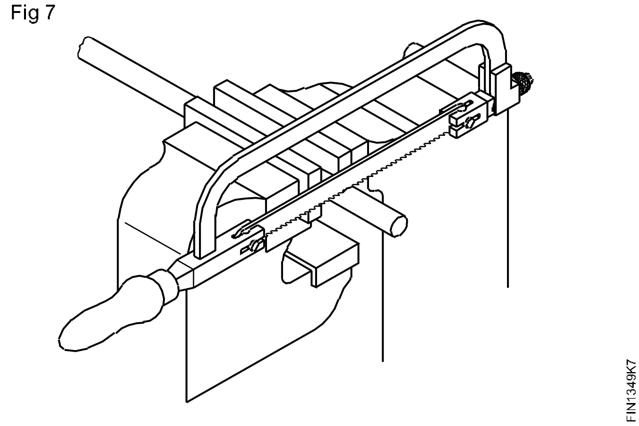


Fig 8

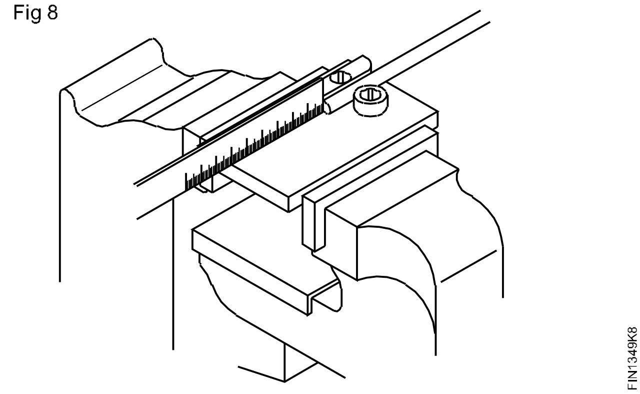
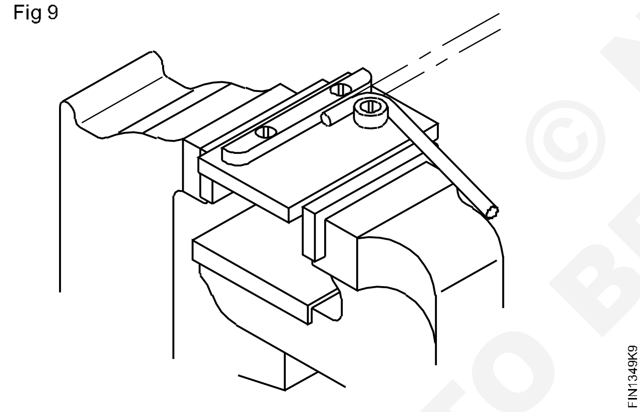
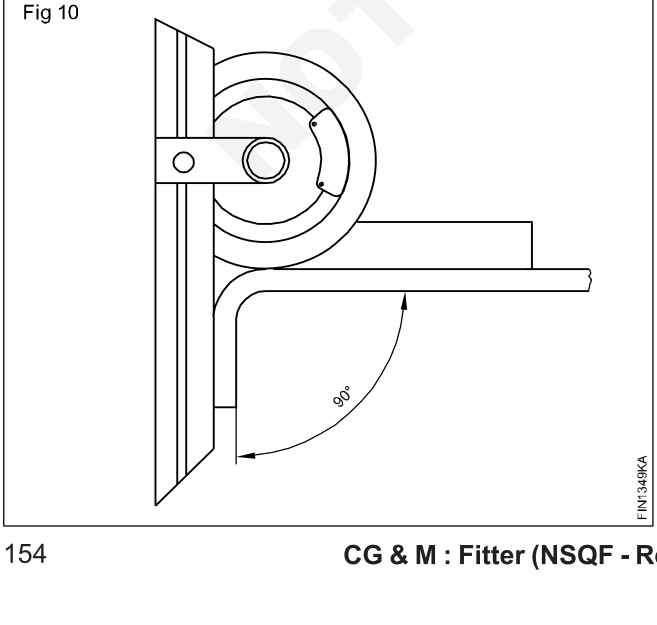


Fig 9



Check the bent angle 90° using bevel protractor. (Fig 10)

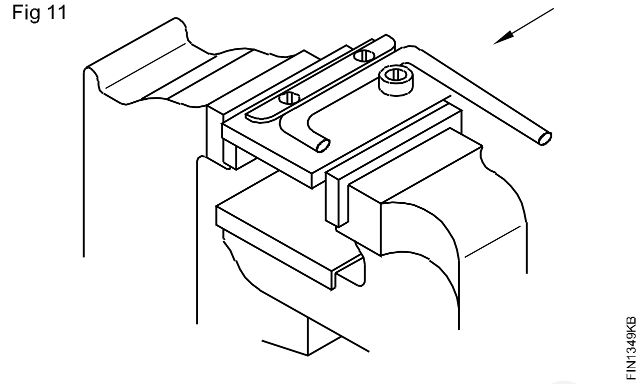
Fig 10



Set the round rod to 50mm from the bent leg to 90°.

Bend the round rod to 50mm as per shown in Fig.11.

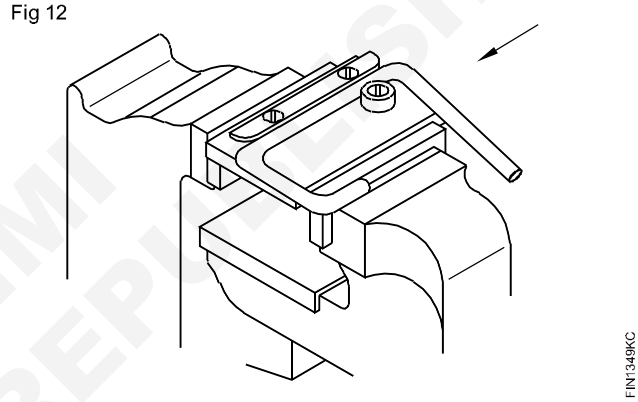
Fig 11



Set the round rod to 90mm from the bent leg to 90°.

Bend the round rod to 90mm as per shown in the fig 12.

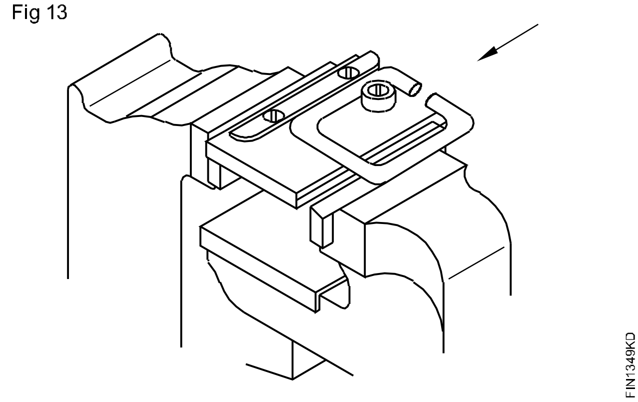
Fig 12



Set the round rod to 50mm from the bent leg to 90°.

Bend the round rod to 50mm as per shown in the figure. (Fig.13)

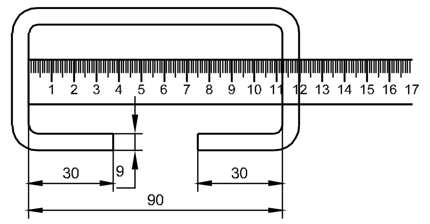
Fig 13



Check the dimension of front handle using steel rule. (Fig.14)

Similarly, complete the remaining two front handles following the above job sequences.

Fig 14



Handle cover plate

Calculate the length and width required to make the handle cover plate.

Mark centres of holes as per job drawing.

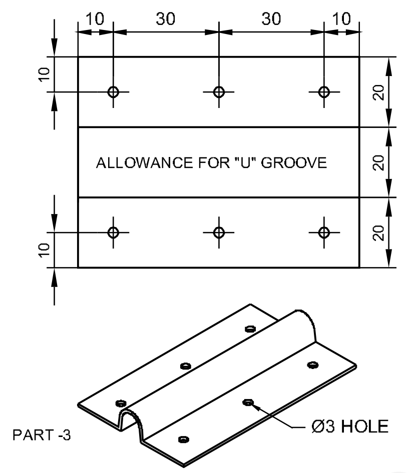
Cut the sheet using straight snip.

Deburr the edge.

Form 'U' groove in the middle of the sheet using suitable round rod.

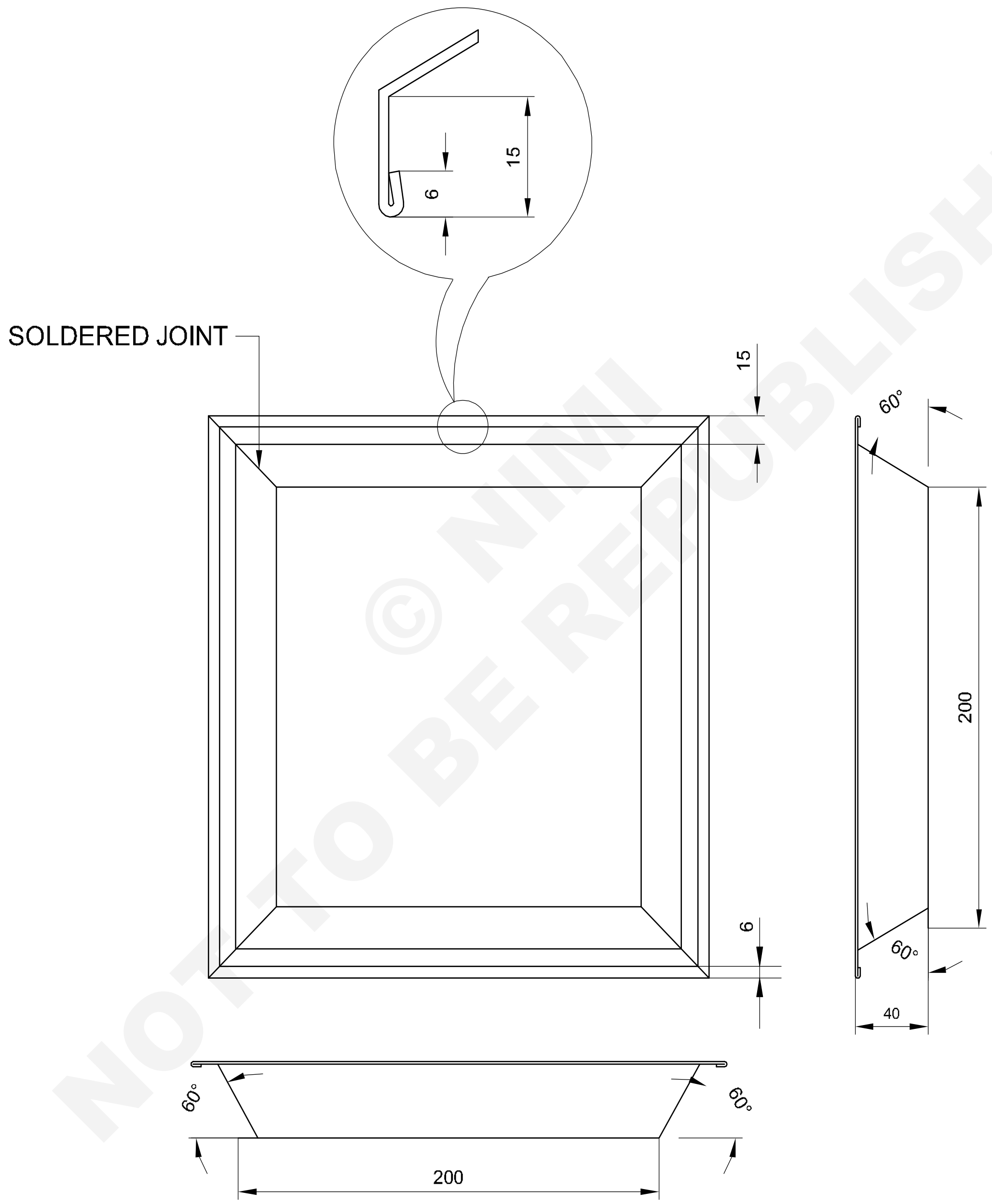
Drill ∅3mm hole on the centres as shown in fig.15

Fig 15



Make square tray with square soldered corners

Objectives: At the end of this exercise you shall be able to
- **develop layout the pattern of square taper tray**
- **make a single hem on the edges using folder bar**
- **fold the sides of taper tray at 60° using pair of angle iron**
- **solder the four corner of square taper tray.**



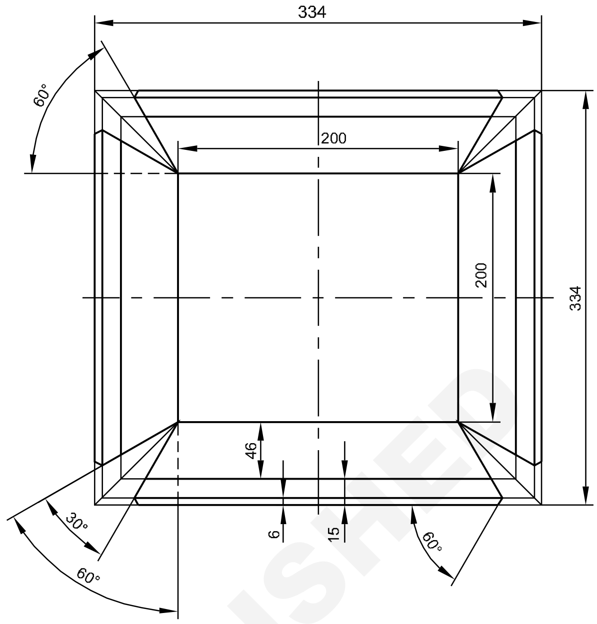
1	ISSH 350 x 350 x 0.61	–	G.I SHEET	–	–	1.3.50
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**TITLE ; SQUARE TAPER TRAY**	DEVIATIONS ±1	TIME :
		CODE NO. FI20N1350E1	

Job Sequence

- Check the size of the sheet metal as per job drawing using a steel rule.
- Flatten the sheet metal piece on the dressing plate using a wooden mallet.
- Develop and layout the pattern for the tray, considering allowance for the flanges and single hem, on sheet metal by geometrical construction method using a scriber, steel rule, protractor and divider. (Fig.1)
- Cut the sheet metal as per the pattern layout on the sheet metal using a straight snip.
- Fold 6mm edges to make single hems on the four sides on the barfolder.
- Fold 15mm sides at 60° to make flanges on the four sides of the taper tray on the barfolder.
- Fold 46mm four sides, at 60° as shown in the job drawing, using a pair of angle iron, a benchvice, a 'C' clamp and a wooden mallet.
- Check the angle of the tapered sides using a bevel protractor and rectify, if necessary.
- Solder four corners of square tray.

Fig 1



SQUARE TAPER TRAY PATTERN

FIN1350H1

Skill Sequence

Preparing the pattern layout

Objectives: This shall help you to
- **calculate the developed length and width for square taper tray**
- **develop the pattern layout.**

Let us take the same job for better illustration.

Calculate the developed dimension of a square taper tray.

Given

Side of square 200mm

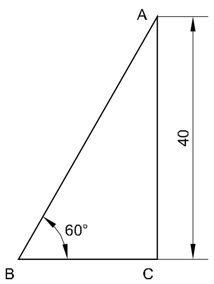
Flange length = 15mm

Let us take the single hem as 6mm and calculate the slant height.

AB is the slant length.

Given AC=40mm (Fig.1)

Fig 1



FIN1350J1

Sin 60°=AC/AB

0.866=AC/AB

AB=40/0.866

AB=46.18mm

Developed size=Side length of square + 2(slant height+flange length + single hem allowance)

=200+2(46+15+6)

=200+2(67)

200+134

=334mm

Mark and cut the sheet metal to the size square 334mm. (Fig.2)

Draw the centre line of length and width XX and YY respectively. (Fig.3)

Draw the base length and width at the centre of the sheet metal workpiece, marking lines at 100mm on both sides of YY and 100mm on both sides of XX. (Fig.3)

Fig 2

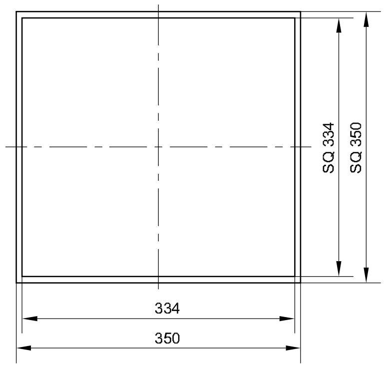
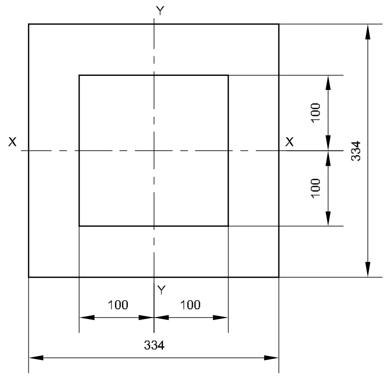
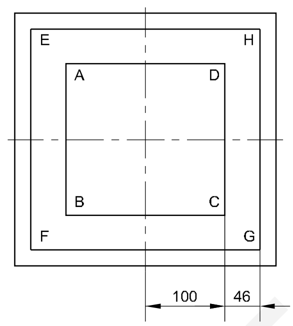


Fig 3



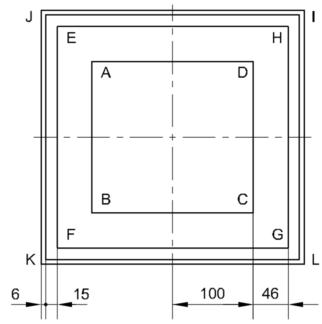
Draw lines for 46mm slant height of the four sides of square taper tray parallel to AB, BC, CD and DA shown in the Fig.4.

Fig 4



Draw lines for 15mm flange and 6mm single hem allowance on the four sides parallel to EF, FG, GH and HE as shown in the Fig.5.

Fig 5

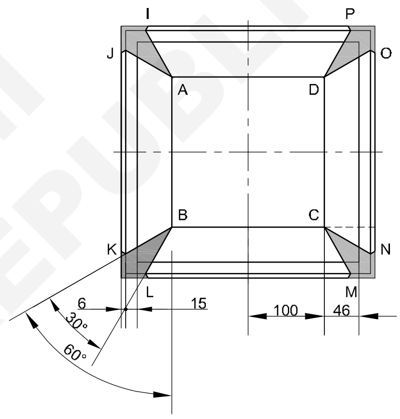


Draw lines at an angle of 30° at points A,B,C,D at both ends of lines AB,BC, CD and DA as shown in Fig.6.

Draw lines at an angle of 60° at points I,J, K, L M, N, O, P as shown in Fig.6

Cut the unwanted portion of the pattern shown by shadow in Fig.6.

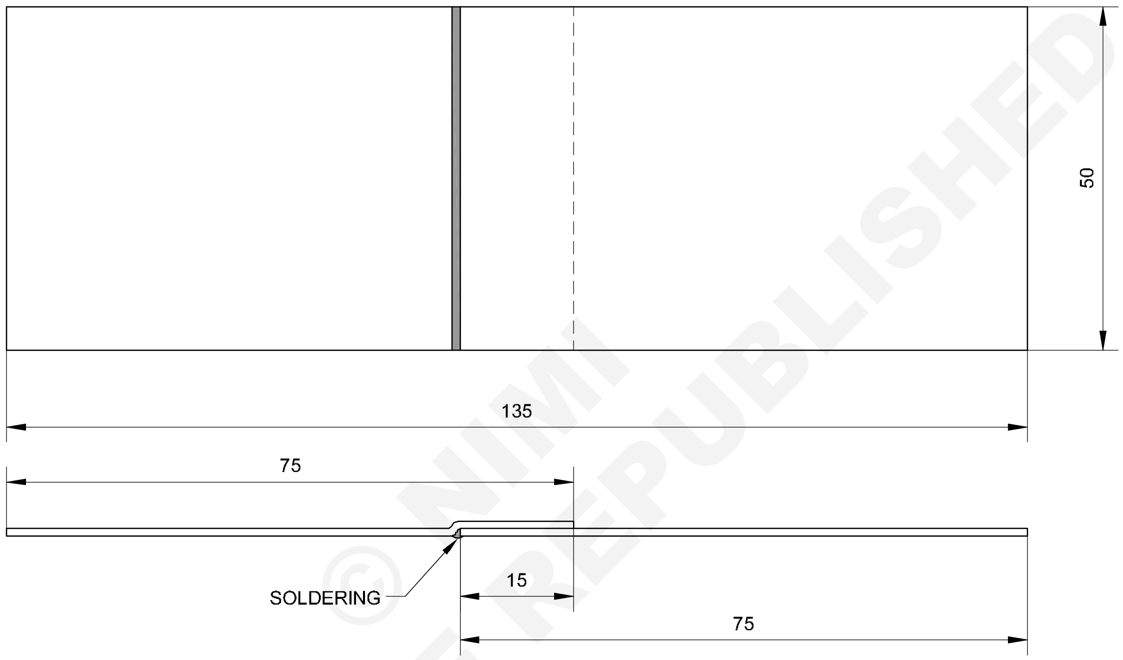
Fig 6



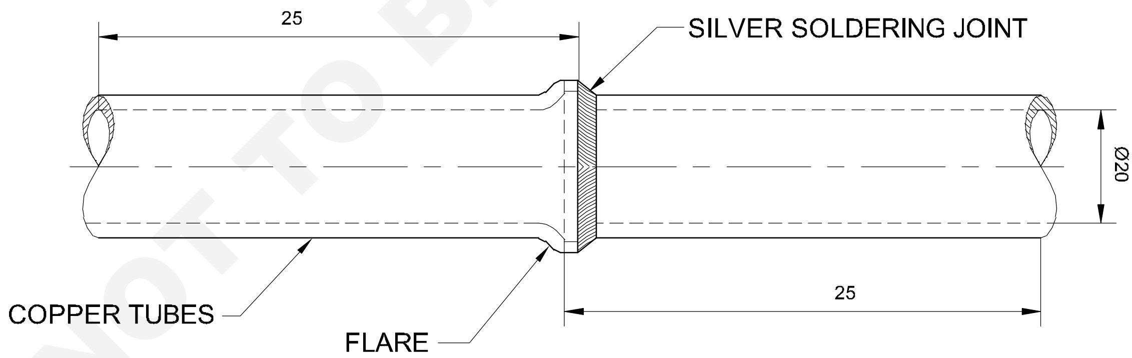
Practice on soft soldering and silver soldering

Objectives: At the end of this exercise you shall be able to
- **heat the copper bit of soldering iron using blow lamp**
- **set and tack a sunk lap joint in correct alignment**
- **solder a sunk lap fillet of correct size in flat position**
- **prepare the copper tube joints with bell mouth**
- **solder with silver brazing rod.**

TASK-1



TASK-2



1	Ø1.6 x 1 m	–	SILVER BRAZING FILLER ROD	–	–	-
2	IS 2378 - Ø20 x 1 - 25	–	CUDPA-0	–	–	-
1	–	–	SOFT SOLDER 60:40	–	–	-
1	ISSH 170 x 55 x 0.5mm	–	G.I SHEET	–	–	1.3.51
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SOLDERED SUNK LAP JOINT**	DEVIATIONS ±0.4	TIME :
		CODE NO. FI20N1351E1	

Job Sequence

TASK 1: **Sunk lap joint**

- Check the size of the material.
- Make the sunk lap joint by using hatchet stake, a wooden mallet and a setting hammer.
- Light the blow lamp.
- Heat the copper bit using a blow lamp.
- Solder the joint.
- Wash the job using water to remove the oxides.

TASK 2: **Silver soldering**

- Obtain the pipe pieces as per drawing and clean them.

Ensure the use of all safety devices.

- Make a bell-mouth (Flare) at one end of the pipe and insert the other pipe in.

Ensure the fitting of pipes is in alignment.

- Apply silver brazing flux along the root of the joint.
- Hold the joint in a vertical position in a bench-vice on a welding table.
- Set the gas welding plant with a small size nozzle.
- Adjust the soft carburising flame.

Ensure that the length of the feather is 1.5 times the length of the cone.

- Slightly pre-heat around the joint.

Colour change is restricted to dull red.

- Melt and spread the filler rod around the joint with the use of the flux.
- Apply the flame gently around the joint to make the filler metal penetrate in the joint.

Never apply a direct flame on the molten metal.

- Add more filler rods around the joint, if needed.
- Allow the joint to cool for a few seconds.
- Clean the joint and inspect.
- Repeat the same until you are able to make well-penetrated smooth silver-brazed weld.

Avoid overheating the joint.

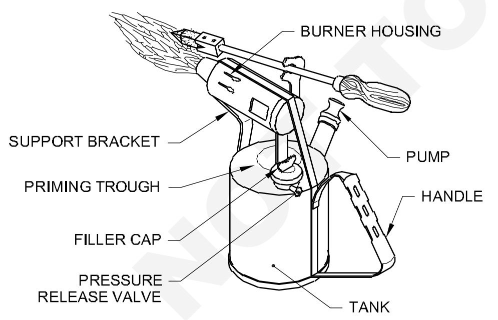
Skill Sequence

Lighting the blow lamp safely

Objective: This shall help you to
- **heat the soldering iron using a blow lamp.**

Blow lamp (Fig 1)

Fig 1



BLOWLAMP AND SOLDERING IRON

Check the level of kerosene in the tank. Refill if necessary. Make the tank 3/4th full for safety.

Clean the jet with pricker.

Close the pressure relief valve.

Fill the priming trough with methylated spirit.

Take care not to overfill the spirit to avoid fire hazards.

Give two to three strokes to pump for priming the lamp.

Light the spirit.

Operate the pump about six to eight times to pressurize the tank after the spirit gets burnt.

If the liquid kerosene is emitted from the jet at this stage, quickly open the pressure relief valve.

Recommence the starting procedure.

Light the lamp at the top of burner housing.

Activate the pump during use, to maintain constant flame.

If the lamp is blown out by wind or extinguished, open the pressure relief valve immediately. This prevents the inflammable kerosene vapour from escaping in the air.

Do not direct the flame at flammable material.

After the work is over, extinguish the flame by pressure relief valve.

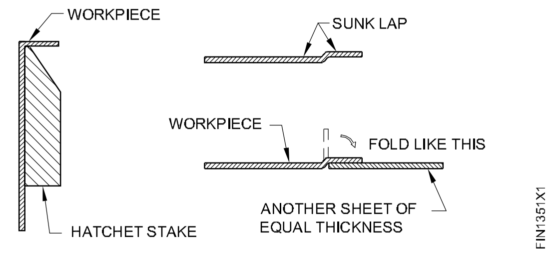
Forming and soldering the sunk lap joint

Objectives: This shall help you to
- **form a sunk lap using a hatchet stake**
- **solder the sunk lap joint.**

Check the size, cut if required, and mark the allowance for sunk lap.

Sunk lap using the hatchet stake as shown in Fig 1.

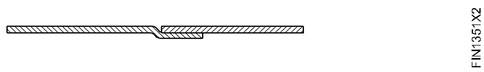
Fig 1



Clean the surface to be joined by an emery paper.

Apply suitable flux and place two pieces as shown in Fig 2.

Fig 2

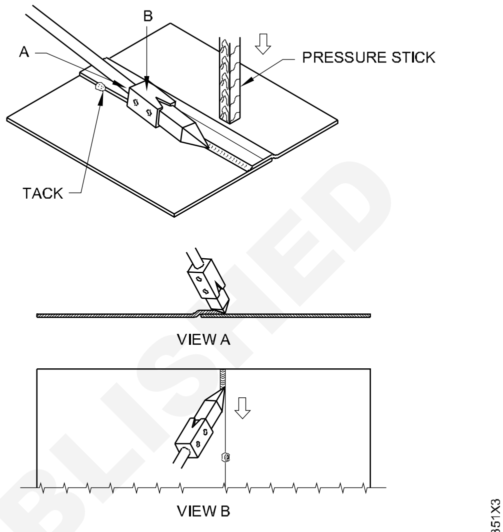


Heat the copper bit using a blow lamp.

Solder the sunk lap joint with uniform flow and proper penetration. (Fig 3).

Clean the job with wet rag.

Fig 3



SOLDERING A SUNK LAP JOINT

Silver brazing of copper pipes by gas

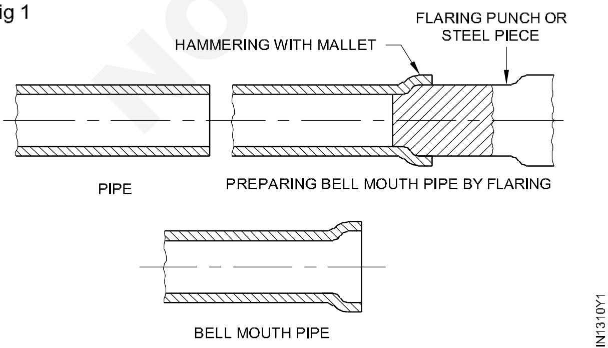
Objectives: This shall help you to
- **prepare the edges of copper tubes for bell-mouth butt joints**
- **silver braze copper tubes**
- **clean and inspect the silver-brased weld.**

Copper tubes are mostly used in a number of fields such as automotive sheet metal trades, airconditioning and refrigeration.

Silver-brazing is the proper method to join the copper tube joints.

Cleaning and preparing the edges (Fig-1)

Fig 1

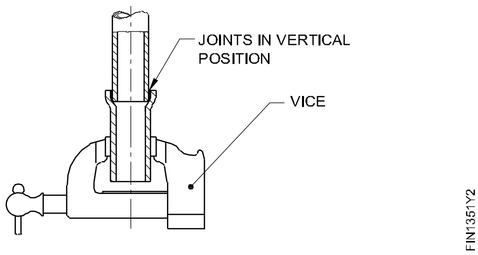


Clean the joining edges by rubbing with an emery paper or steel wool.

Use a steel rod to form bell mouth shape in one end of pipe and hammer around it with a mallet.

Setting the joint pieces (Fig 2)

Fig 2



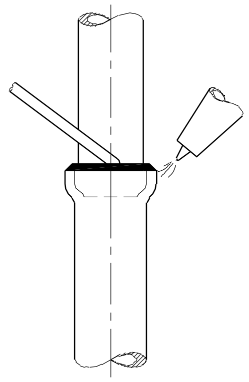
Apply sliver-brazing flux on the joining edges.

Set the joint pieces as bell-mouth butt joint maintaining alignment.

Hold the joint pieces in a vertical position in a bench nick Fig.3.

Making silver brazing weld (Fig 3)

Fig 3



Use a soft carburising flame, produced by nozzle No.1 a silver brazing filler rod Ø1.6mm (Type BA-Cu-Ag 16A conforming to IS: 2927 - 1975) and silver-brazing flux.

Heat around the joint to a dull red colour (melting of flux).

Apply, melt and spread the filler rod around the joint by scratching its end with the use of a flux.

Apply the flame gently around the joint and make the filler metal penetrate in the joint.

Never apply a direct flame on the molten filler metal or overheat the joint.

Add more filler rod around the joint, if needed.

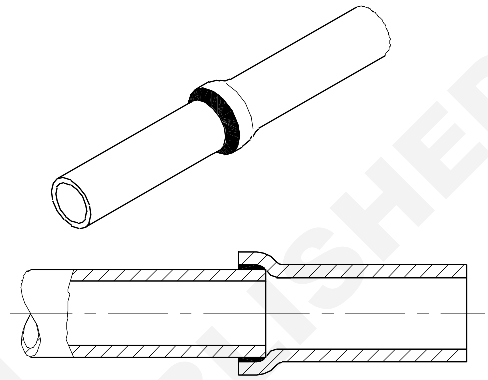
Remove the flame and allow the filler metal cool for 10-15 seconds.

Cleaning and inspection (Fig 4)

Clean the joint by rubbing with an emery paper.

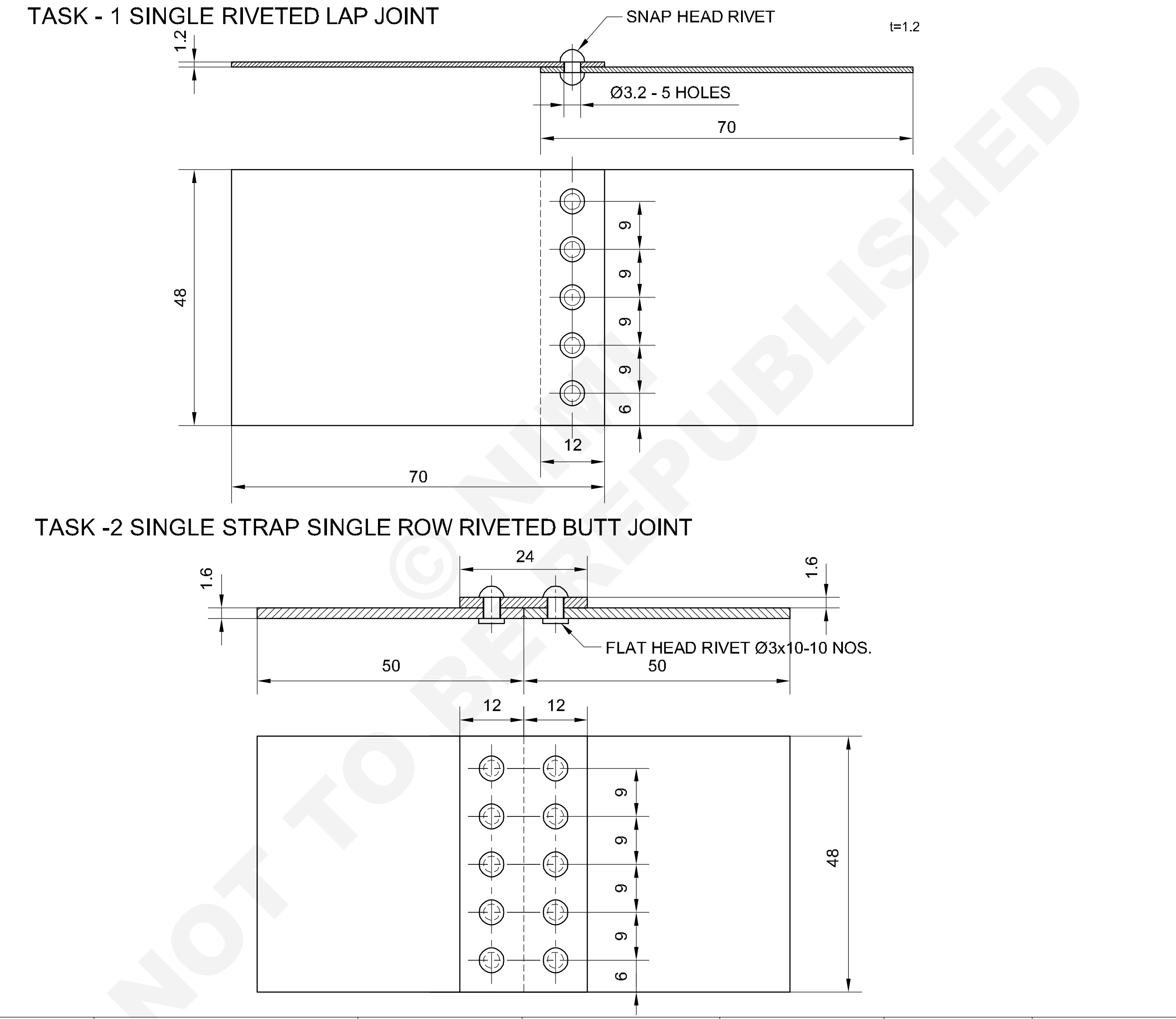
Inspect for a smooth and evenly filled, brazed joint without any pin- holes.

Fig 4



Make riveted lap and butt joint

Objectives: At the end of this exercise you shall be able to
- **layout the spacing for rivet holes to make single riveted lap & butt joint**
- **punch the correct size holes using a solid punch**
- **rivet the snap head rivets with the help of rivet set, a rivet snap, a dolly using ball pein hammer, to make single riveted lap and butt joint.**
- **form the rivet heads of snap head and flat head rivets.**



10	IS: 2155 - Ø3 - 6	--	M.S. FLAT HEAD RIVET	--	--	-
1	ISSH 100 x 50 x1.6	--	MILD STEEL SHEET	--	--	-
5	IS:2155 - Ø3 - 5	--	M.S. SNAP HEAD RIVET	--	--	-
1	ISSH 140 x 48 x1.2	--	MILD STEEL SHEET	--	--	1.3.52
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

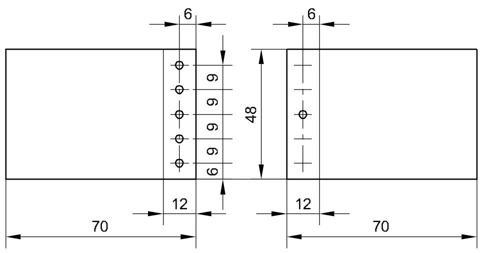
SCALE 1:1	**SINGLE RIVETED LAP JOINT & SINGLE STRAP SINGLE RIVETED JOINT**	DEVIATIONS ±0.5mm	TIME :
		CODE NO. FI20N1352E1	

Job Sequence

TASK 1: **Single riveted lap joint**

- Cut and check the given raw material to the size 140 x 48 mm using a steel rule.
- Flatten the sheet on the dressing plate by a mallet.
- Deburr the edges using a flat smooth file.
- Mark the centre line of length 140 mm and cut the sheet into two pieces of size 70 x 48 using straight snips.
- Layout the spacing for rivet holes to make single riveted lap joint using a scriber and a steel rule on both pieces of the sheet, and mark the centre points of rivet holes using a centre punch and a setting hammer. (Fig 1 & 2 of Skill sequence)
- Punch and make ϕ 3.2 holes on all centre points on one piece of the sheet and one central hole on another piece of sheet using a solid punch (Fig.1)

Fig 1



- Deburr the holes with larger sized drill rotating it on drilled holes, by hand. (Fig 2)
- Place the piece of sheet having all holes punched above another, such that the overlapped edges of the sheets coincide with the marked lines.
- Insert 3 mm dia snap head rivet in the centre hole. (Fig.3)
- Form the rivet head, with the help of the rivet snap and dolly using ball pein hammer.

Fig 2

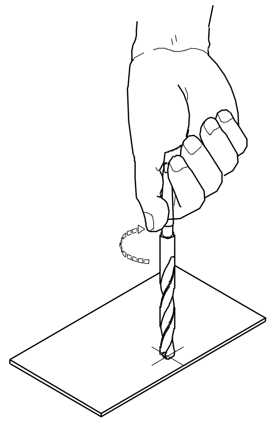
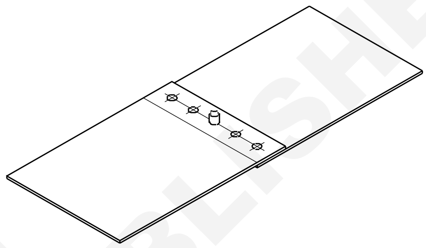


Fig 3

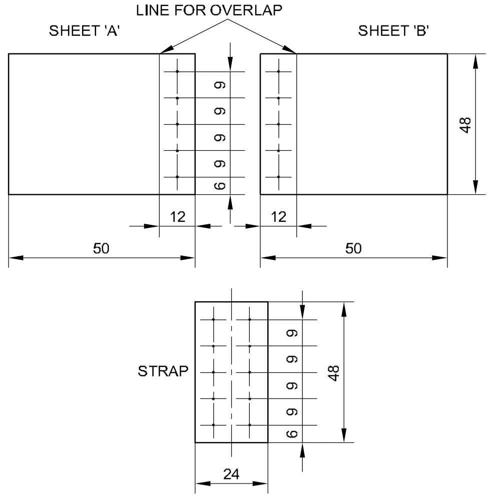


- Punch the remaining four holes on the bottom piece of the sheet, through the holes, already punched on the upper piece of the sheet.
- Deburr the holes with the larger sized drill, rotating it on the punched holes, by hand.
- Insert the rivets in alternate holes and form the rivet heads, one by one to make a single riveted lap joint, with the help of a rivet set, rivet snap, a dolly and a ball pein hammer.

TASK 2: **Single strap single row riveted butt joint**

- Cut the given material into three pieces, two to sizes of 50 x 48mm and the third piece of size 24 x 48 mm using a straight snip and check the size using a steel rule. (Fig.1)
- Flatten the sheet on the dressing plate by a mallet.
- Deburr the edges using a flat smooth file.
- Layout the spacing for rivet holes to make single strap single riveted butt joint using a scriber, a divider and a steel rule on the pieces of sheets. (Fig.1)
- Mark the centre point for the rivet holes using a centre punch and a ball pein hammer.
- Drill ϕ 3.2 mm holes at all the points on the strap and the centre holes on the two workpieces to be joined.
- Deburr the holes with larger sized drill by rotating it on the drilled holes by hand.

Fig 1



LAYOUT OF RIVET SPACING

- Butt the edges of the workpieces to be joined and place the strap over them and set it correctly as per the job drawing.
- Insert a ϕ 3 mm flat head rivet in the centre hole of the butt pieces and strap rivet it using a rivet set, rivet snap and a ball pein hammer placing the job on the flat steel plate.
- Check whether the workpieces to be joined and the cover sheet are properly aligned on a marked line.
- Drill the remaining holes on the bottom piece of the sheet through the holes already drilled on a cover sheet.
- Deburr the holes with a larger sized drill, by rotating it on the drilled holes by hand.
- Insert the rivets in alternate holes and form the rivet heads one by one to make the single strap single row riveted butt joint.

Skill Sequence

Layout the spacing for rivet holes to make a single riveted lap joint

Objectives: This shall help you to
- **calculate the distance of the lap, the distance between centre of first rivet and edges and the distance of pitch as per BIS standard**
- **layout the spacing for rivet holes to make a single riveted lap joint.**

Ensure the edges of the workpieces to be joined are free of burr and straight.

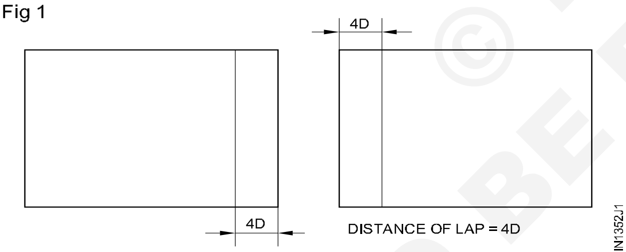
Calculate the distance of the lap.

Distance of the lap = 4 x Dia of the rivet (D)

Diameter of the rivet = 2.5 or 3times from the known thickness, calculate the dia of the rivet, and calculate the distance of the lap.

Mark the line of distance of the lap parallel to the edge, on both workpieces using a scriber and a steel rule. (Fig 1)

Fig 1



Calculate distance of the rivet line from the edge of the sheet.

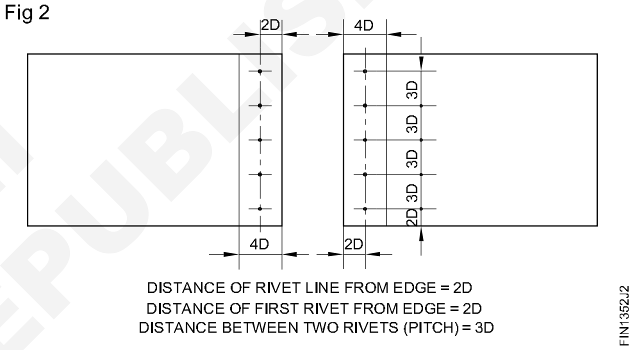
Distance of the rivet line from the edge = 2 x the diameter of the rivet (D)

Mark the rivet lines parallel to the edge, on both workpieces (Fig 2).

Calculate the distance of the first rivets from the side edge.

Distance of the first rivet from the edge = 2 x dia of rivet (D)

Fig 2



Mark the distance of the first rivets from the side edges on the rivet line, on both the workpieces using a divider.

Calculate the distance between two rivets i.e. pitch.

Pitch = 3 x the dia of rivet (D)

Mark the pitch of the rivets on the rivet lines, on both workpieces (Fig 2) using a divider.

Punch on the centre points of the reivets using a centre punch and a ball pein hammer.

Riveting snap head rivet

Objective: This shall help you to
- **make proper use of the dolly, rivet set and rivet snap to perform correct riveting**
- **form the rivet head in round shape, by applying the hammer blows properly by the ball pein hammer**
- **rivet snap head rivet to make the riveted joint tight without damaging the base metal.**

Ensure that all the rivet holes are drilled on one sheet and only one hole for the centre rivet is drilled on another sheet.

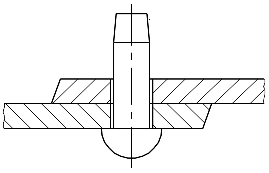
Ensure that the drilled holes are deburred and the sheets are flat.

Hold vice dolly rigidly in the bench vice.

Place the sheet having all holes drilled over the other, align the drilled hole and coincide the marked lines for lap with the edges.

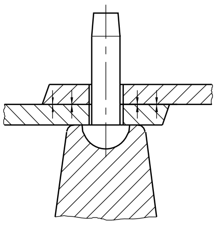
Insert the rivet in the centre hole and place the rivet head on the vice dolly, to avoid deformation, while hammering. (Fig 1 & 2)

Fig 1



FIN1352X1

Fig 2

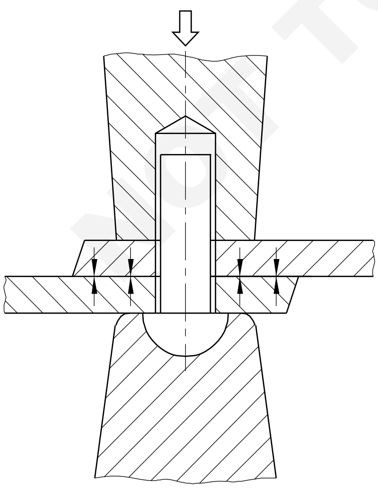


FIN1352X2

Place the deep hole of the rivet set over the shank of the rivet. (Fig 3)

Strike the rivet set with a ball pein hammer to bring the sheets closer, to set the joint firmly for riveting. (Fig 3)

Fig 3

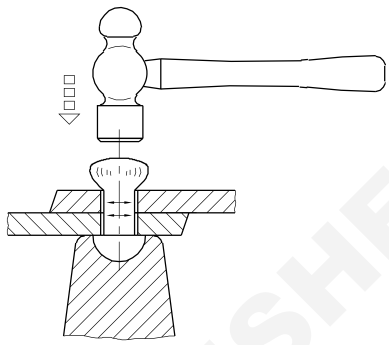


FIN1352X3

Remove the rivet set over the shank of the rivet.

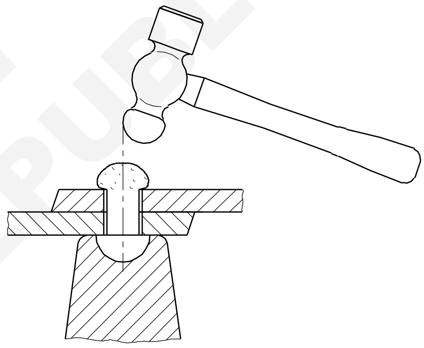
Form the rivet head roughly by hammering it down initially and then rounding the head using a ball pein hammer. (Fig 4 & 5)

Fig 4



FIN1352X4

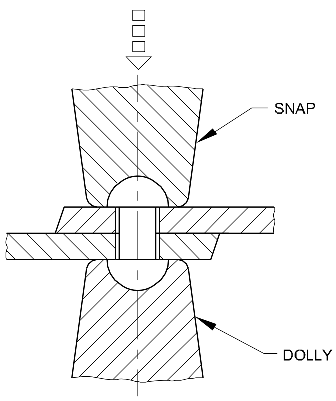
Fig 5



FIN1352X5

Place the rivet snap over the rounded head of the rivet and strike with a hammer over it to form and finish the rivet head using a ball pein hammer. (Fig 6)

Fig 6



FIN1352X6

Layout the spacing for rivet holes to make single strap single riveted butt joint

Objectives: This shall help you to
- **calculate the breadth of a cover plate. Distance between the centre of first rivet and the edges and distance of pitch as per BIS Standard**
- **layout the spacing for rivet holes to make single strap single row riveted butt joint.**

Ensure that the edges of the workpieces to be joined are free from burr and straight. First layout the spacing of rivet holes on the workpieces to be joined.

Calculate the dia of the rivet.

Diameter of the rivet (D) = 2.5 T or 3T, where T = Total thickness of sheets to be joined.

Calculate the distance of lap.

Distance of lap = 8 x D

Mark the line of distances of lap on both workpieces using a scriber and a steel rule. (Fig 1)

Calculate the distance of the rivet line from the edge of the sheet.

Distance of the rivet line from the edge = 2 x the diameter of the rivet (D).

Mark the rivet lines parallel to the edge on workpieces. (Fig.1)

Calculate the distance of the first rivet from the side edge of a butt.
Distance of first rivet from the side edge = 2 x dia of Rivet (D)

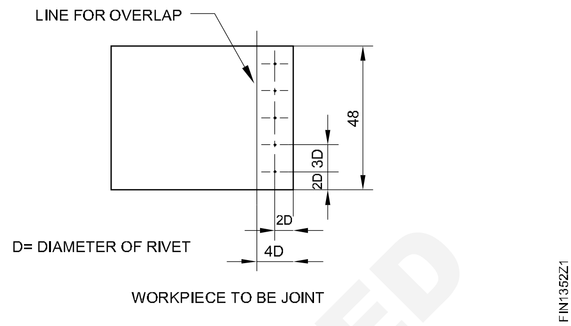
Mark the distance of first rivets from side edges on the rivet line, on the workpieces.

Calculate the distance between the two rivets i.e the pitch.

Pitch = 3 x dia of the rivet

Mark the pitch of the rivet on the rivet lines on workpieces using a divider. (Fig 1)

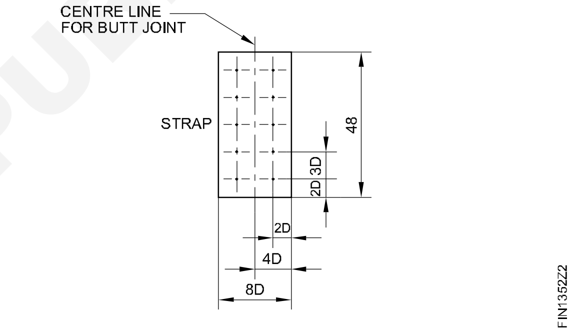
Fig 1



Punch on the centre point of the rivets using a centre punch and a ball peen hammer.

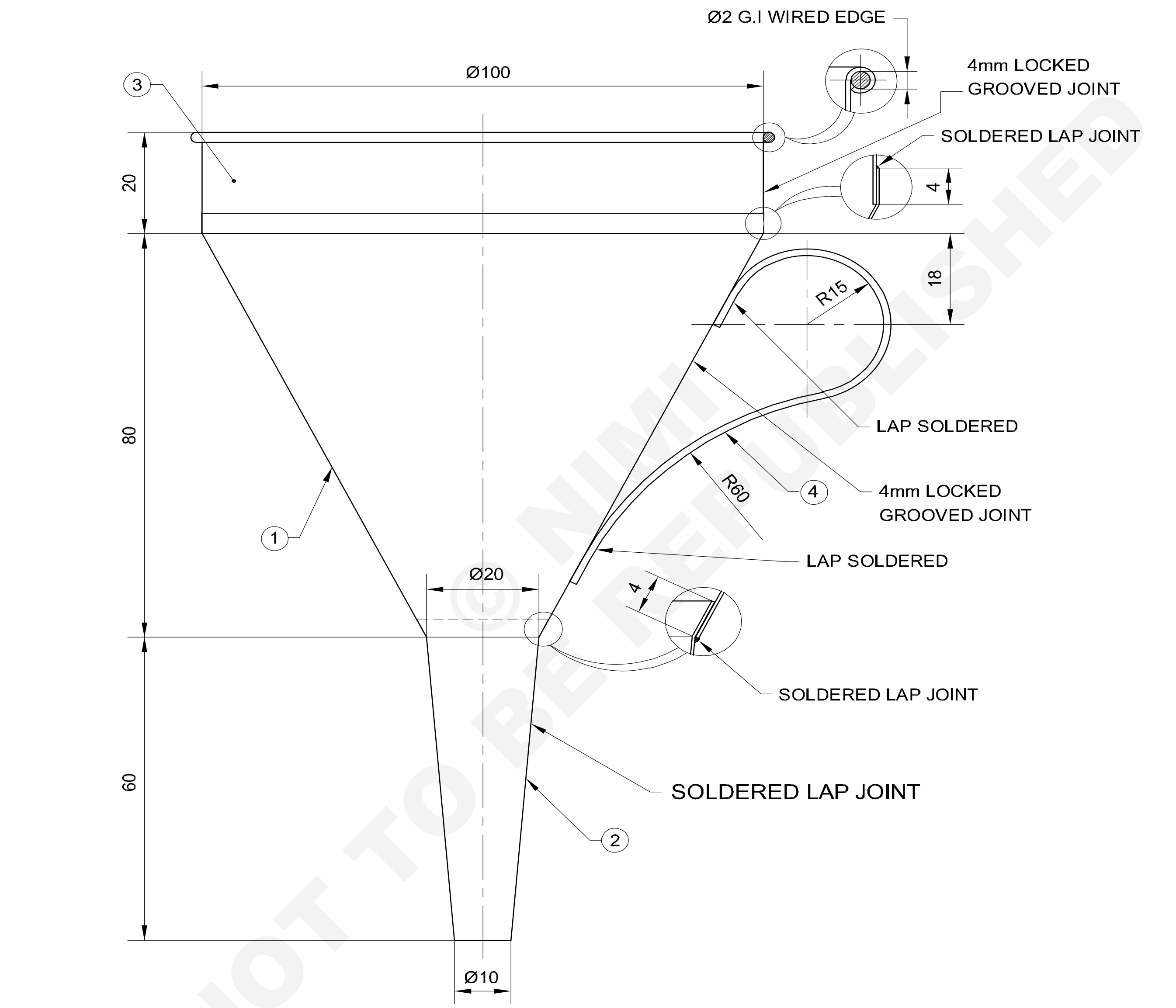
Layout the spacing of rivet holes on strap: Similarly, as mentioned above, mark two rows of rivet holes at a distance of 4D on strap Fig.2

Fig 2



Make funnel as per development and solder joints

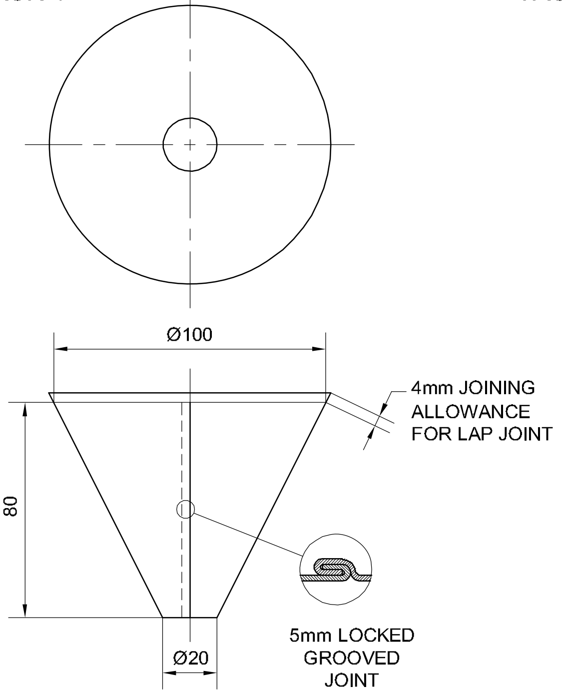
Objectives: At the end of this exercise you shall be able to
- **make straight wired edge**
- **make curved wired edge**
- **fold sheet metal at angle using.**



–	–	–	SOFT SOLDER 60:40	-	–	-
1	Ø2 - 360	–	G.I WIRE	-	–	-
1	ISSH 160 x 25 x 0.5	–	G.I SHEET	-	4	-
1	ISSH 335 x 30 x 0.5		–	-	3	-
1	ISSH 125 x 80 x 0.5		TINNED SHEET	-	2	-
1	ISSH 250 x 140 x 0.5		TINNED SHEET	-	1	1.353
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE: NTS	**MAKE A FUNNEL** (BY SOLDERING)	DEVIATIONS ±1	TIME :
	PROJECT: FUNNEL PART: **1, 2, 3 & 4**	CODE NO. FI20N1353E1	

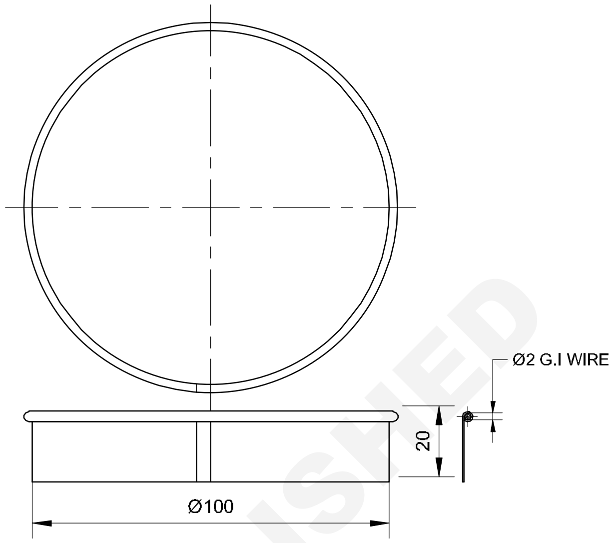
TASK-1



PART 1 - BODY

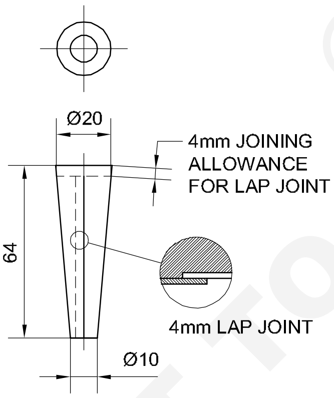
FUNNEL BODY

TASK-3



FUNNEL FERRULE

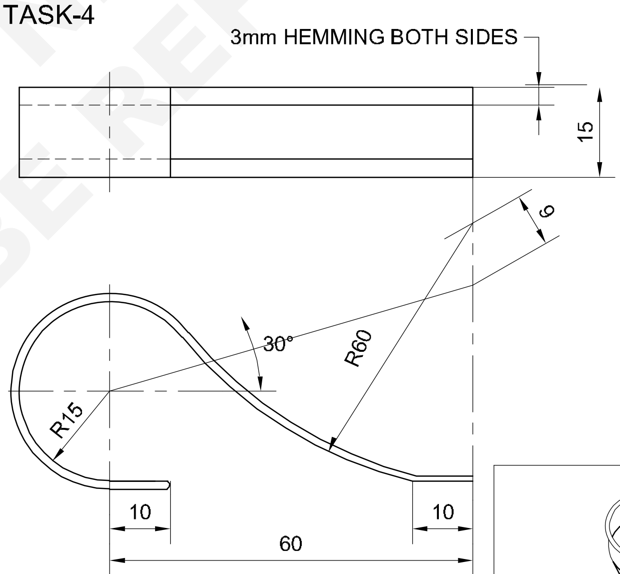
TASK-2



PART 2 - TAIL

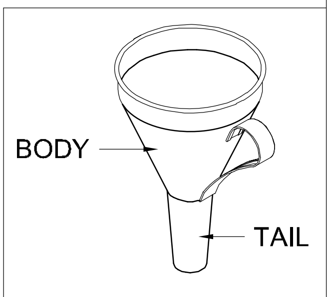
FUNNEL TAIL

TASK-4



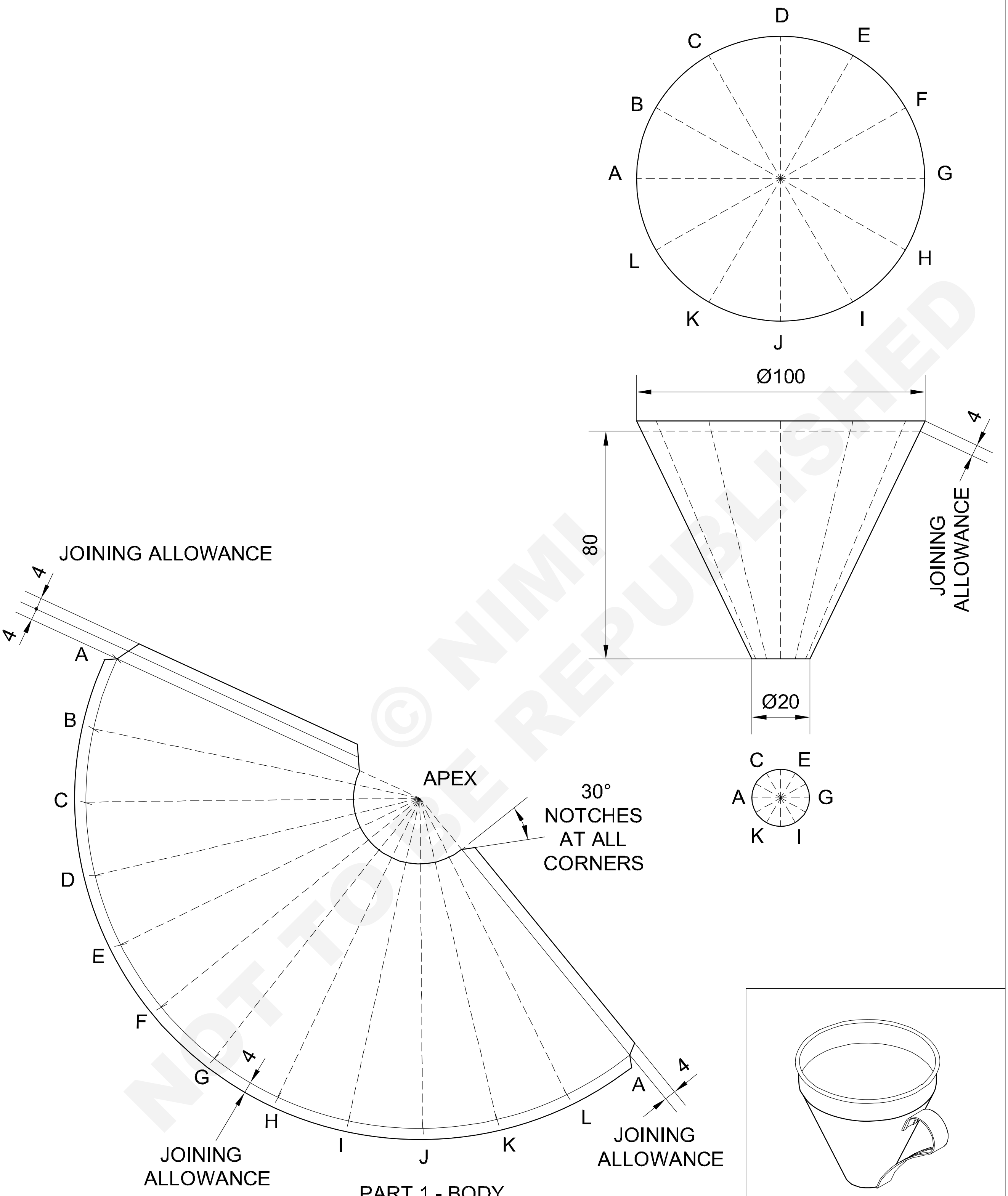
FORMING THE HANDLE

FUNNEL HANDLE



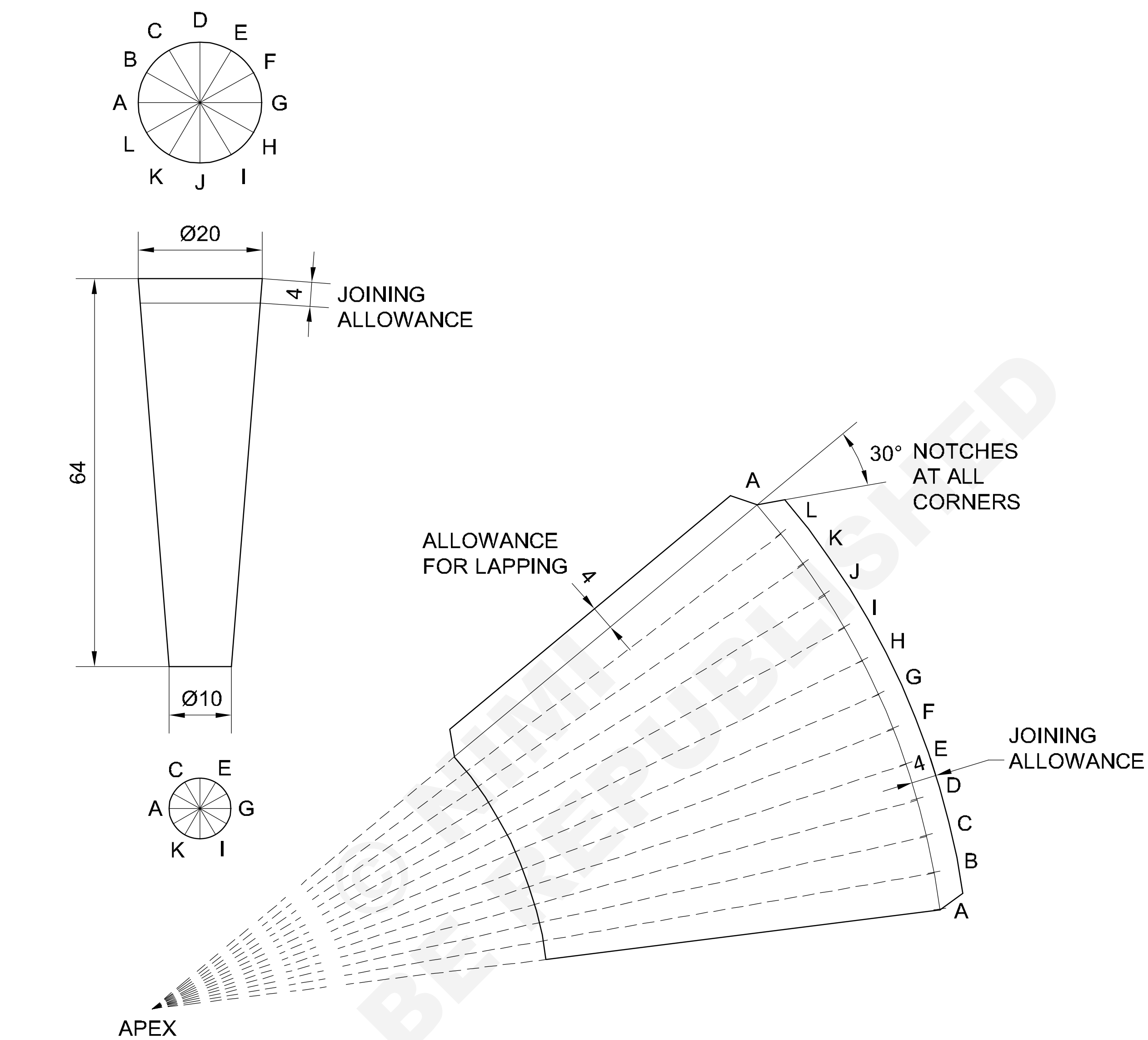
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
-	–	–	-	-	-	1.3.53

SCALE 1:2	**MAKE A FUNNEL** (SEAMING THE BODY AND THE TAIL)	DEVIATIONS ±1 / TIME
	PROJECT: FUNNEL PART: **1. BODY 2. TAIL**	CODE NO. FI20N1353E2

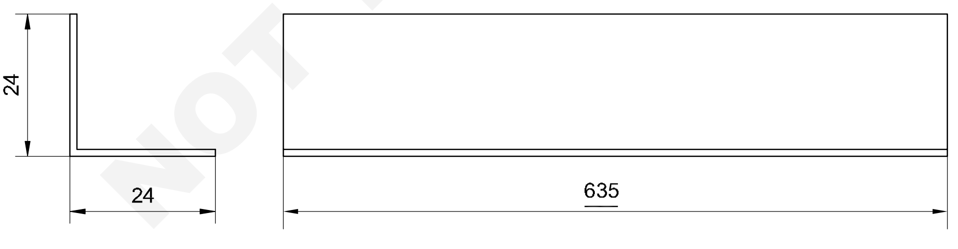


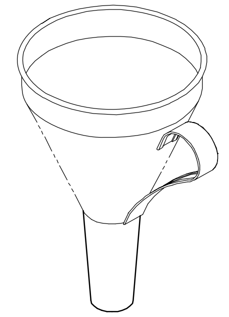
-	-	-	-	-	-	1.3.53
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:2	**MAKING A FUNNEL** (BODY PATTERN CUTTING)	DEVIATIONS ±1	TIME
	PROJECT: FUNNEL PART: **BODY**	CODE NO. FI20N1348E5	



TASK-5





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

SCALE 1:1	**MAKING A FUNNEL** (TAIL PATTERN CUTTING)	DEVIATIONS ±1	TIME :
	PROJECT: FUNNEL PART: **TAIL**	CODE NO. FI20N1348E6	

Job Sequence

TASK 1: **Make a funnel PART 1 (Funnel Body)**

- Develop and layout the pattern for the body of a funnel (frustum of a cone) with joining allowances on a plain drawing paper using a geometry box (instrument box)
- Cut the layout pattern using scissors and paste it on the given raw material (sheet metal) using fevicol/gum.
- Cut the sheet metal on the outlines of the layout pattern of the paper so pasted, using a straight and bend snips.

TASK 2: **PART 2 (Funnel Tail)**

- Develop and layout the pattern for the tail of funnel (frustrum of a cone) with all allowances for joining on a plain drawing paper using a geometry box. (Instrument box)
- Cut the layout pattern using scissors and paste it on the given sheet metal using fevicol/gum.
- Cut the sheet metal on the outlines of the layout pattern of the paper so pasted, using a straight and bendsnips.

TASK 3: **PART 3 (Funnel Ferrule)**

- Cut the sheet metal to the size 335x30, flatten the sheet and deburr the cut edges.
- Refer the skill sequence for development 1.3.43 of cylinder.
- Develop the pattern layout on sheet considering the wiring allowance for 2mm dia. wire, the seaming allowance for 4mm locked groove joint and cut the pattern with clips using a straight snip.
- Form the circular shape with locked grooved joint using a round mandrel stake, a hand groover, a ball pein hammer and a mallet.
- Make a 2mm dia wired edge along the circular edge of the ring using a half moon stake and a setting hammer.
- Dress and check the ring for shape and dimensions.

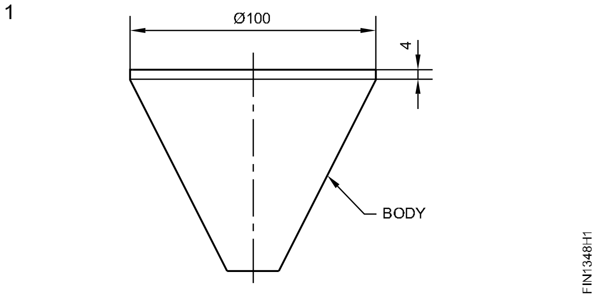
TASK 4: **PART 4 (Funnel handle)**

- Make a handle (Part 4) as per drawing using funnel stake and mallet.

Assembly of funnel

- Bend the joining allowance at larger end of body (Part 1) using anvil stake and mallet. (Fig.1)
- Insert the ferrule (Part 3) in body (Part 1) and solder.
- Solder the lap joint of the tail. (Part 2)
- Flare 4mm edge of the larger dia end of the tail (Part 2) to position it securely into the body.
- Insert the tail in the body and solder.
- Position the handle (Part 4) and solder as per job drawing.
- Inspect the finished article for sharp edges, burr or any irregularity and rectify if necessary.
- Wash the article with cold water.

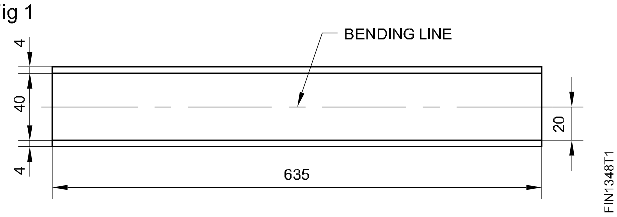
Fig 1



TASK 5: **Folding the sheet metal to 90°**

- Cut the job material 135x48 mm using a straight snip.
- Mark the job material with a scriber using a steel square. (Fig 1)

Fig 1



- Mark the folding line to bend at 90°.
- Position the marking line to the edge of the bevelled hatchet stake.
- Strike the edge using mallet by holding the other end of the job.
- Ensure the folding takes place on the bend line as required.
- Continue to strike the job to fold at 90° angle.
- Check the perpendicularity of the job by a try square.
- Rectify the perpendicularity, using a wooden mallet, supporting the job on a hatchet stake, if required.

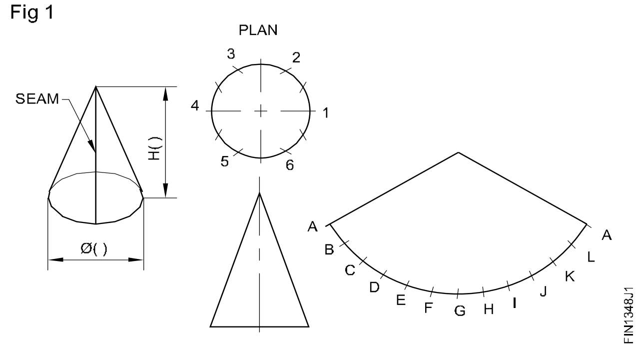
Skill Sequence

Development for a circular cone

Objective: This shall help you to
- **develop a circular cone by the radial line development**

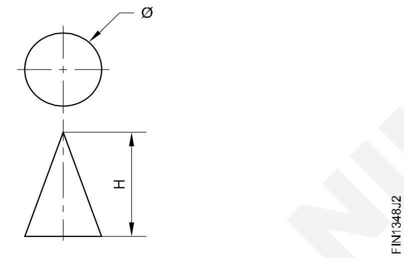
develop a circular cone by the radial line development (Fig 1)

Fig 1



Circular cone: Draw the front elevation and the plan. (Fig.2)

Fig 2

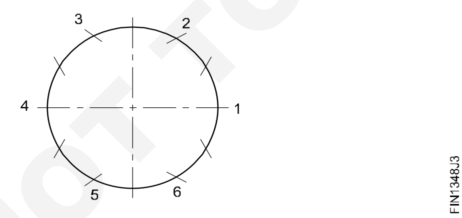


While drawing the plan, the neutral plane (outer diameter plate thickness) of the base circle is taken as the diameter.

The neutral plane size is negligible, if the plate thickness is less than 0.5 mm.

Divide accurately the circumference of the plan into 12 equal parts. (Fig 3)

Fig 3

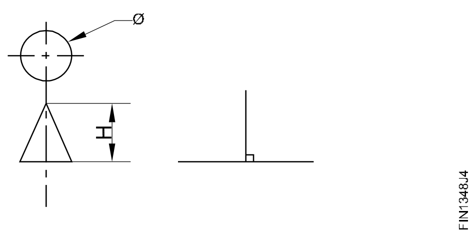


With the radius of the circle, first divide the circumference into 6 equal parts.

Then divide each part into two.

Draw a perpendicular line on the material. (Fig 4)

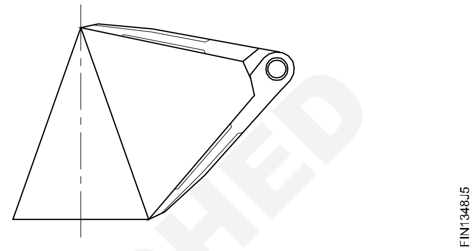
Fig 4



Draw a perpendicular line to the centre of the material blank space.

Transfer the length of the edge line (slant height) to the compass. (Fig 5)

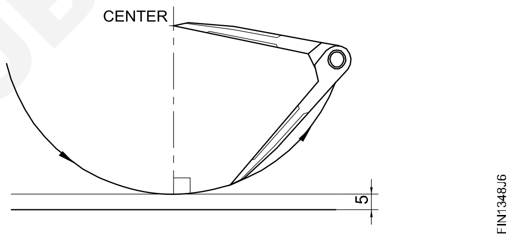
Fig 5



Transfer it accurately.

Draw an arc with the centre at a point on the perpendicular line (Fig 6) and the slant height as the radius.

Fig 6



Check the opening of the compass with each equally divided points, to minimise errors.

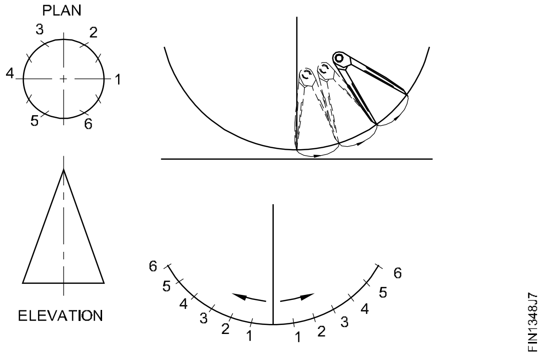
Open the compass points to one of the 12 equally divided parts of the circumferential length.

Open the compass by checking each equally divided point to minimise errors.

Scribe 12 opening points of the compass on the arc.

Scribe six points on both the right and left sides of the perpendicular respectively. (Fig 7)

Fig 7

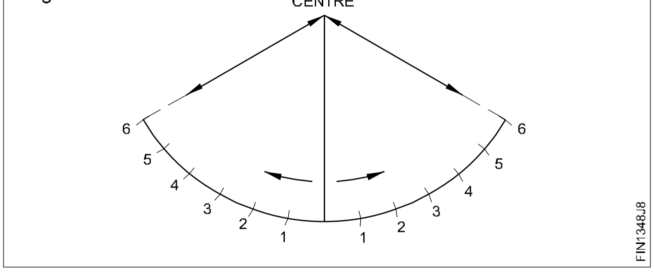


Use the compass points alternately while scribing points, without removing the compass from the arc at a time.

Connect the right and left ends of the arc to the centre. (Fig.8)

Fig 8 shows the development for the given cone.

Fig 8



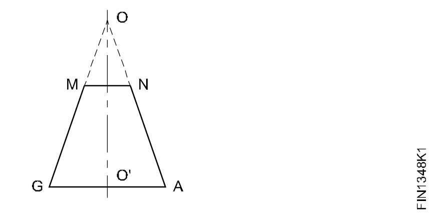
Develop and layout the pattern for the frustum of a cone by radial line method

Objective: This shall help you to
- **develop and layout the pattern for the frustum of a cone by radial line method.**

Get a plain drawing paper large enough to make the flat pattern layout.

Draw the elevation of the frustum of a cone in full size 'AGMN' in Fig 1.

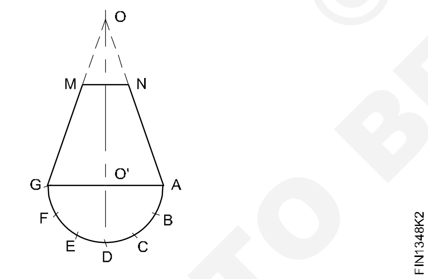
Fig 1



Continue the lines showing taper sides of the body till they intersect at a point 'O'. 'O' is called as an 'Apex'. (Fig 1)

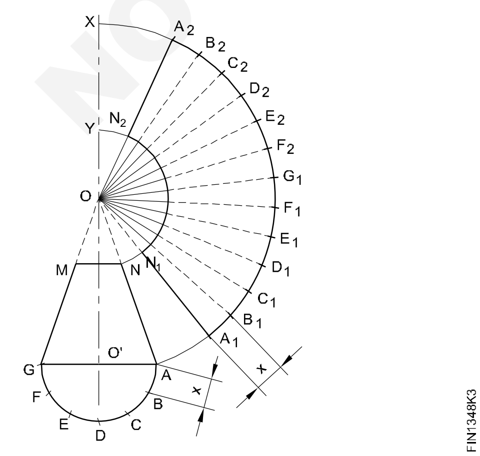
Taking O' as the centre and O'A as radius, draw an arc AG and divide it into six equal parts A-B-C-D-E-F-G. (Fig 2)

Fig 2



With centre 'O' draw arcs 'AX' and 'NY'. X&Y are the points on the centre line of the frustum of a cone. (Fig 3)

Fig 3



Take distance 'X' and mark off twelve lines along the arc AX to obtain A^1-B^1-C^1-D^1.... to D^2-C^2-B^2....A^2. (Fig 3)

Join the points A^1, B^1, C^1, ... C^2, B^2, A^2 to the point 'O'

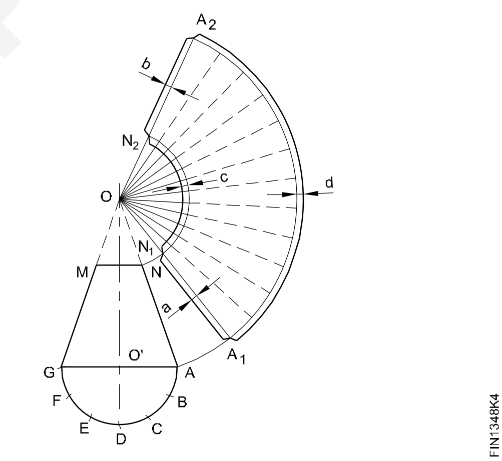
The development required is A^1 A^2 N^1 N^2.

This is the development of a frustum of a cone without a joining allowance.

Now add joining allowances 'a' & 'b' by drawing lines parallel to A^1N^1 & A^2 N^2. (Fig 4)

Add hemming or wiring or joining allowance 'c' & 'd' by drawing arc inside the arc N^1 N^2 and outside the arc A^1 A^2. (Fig 4)

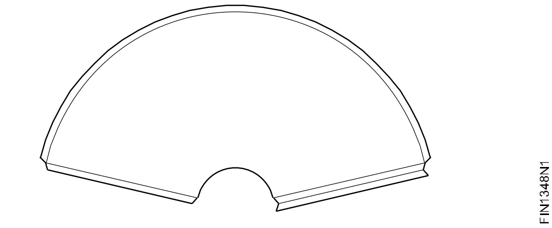
Fig 4



PART 1 (Body)

- Flatten the sheet metal using a wooden mallet and a Tinmans anvil stake. Fig 1)

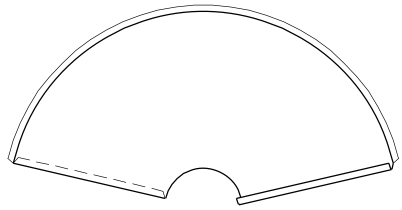
Fig 1



- Check the allowances for the locked grooved joint using a steel rule.

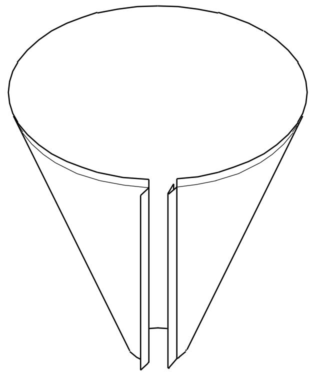
- Form hooks on both the ends in opposite directions by using a hatchet stake, a wooden mallet and a 1/2 Ib ball pein hammer.

Fig 2



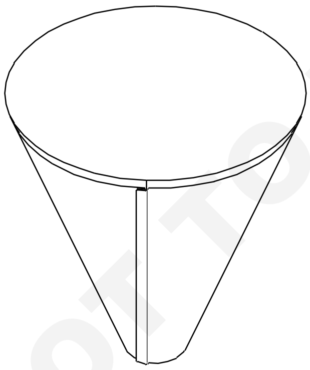
- Form the sheet metal to the frustum of cone by using a funnel stake. (Fig 3)

Fig 3



- Make a locked grooved joint by using a funnel stake, a hand groover and a 1 1/2 Ibs ball pein hammer. (Fig 4)
- Finish the job using a wooden mallet.
- Check the dimensions of the job by using a steel rule.

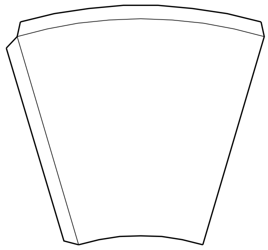
Fig 4



Part 2 (Tail)

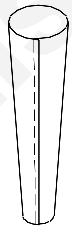
- Flatten the sheet metal using a wooden mallet and a Tinmans anvil stake. (Fig 5).

Fig 5



- Check the allowance for the lap joint by using a steel rule.
- Form the sheet metal into frustum of cone using a long tapered beak frustum of cone with a long tapered beak horned iron stake. (Fig 6)

Fig 6



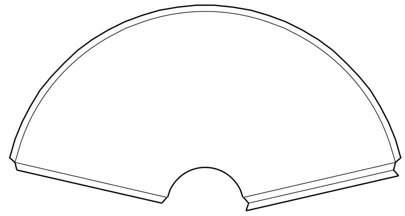
Forming a frustum of a cone with locked grooved joint

Objectives: This shall help you to

- **form a frustum of cone using a funnel stake and a wooden mallet**
- **make locked grooved joint on tapered curved surface using a funnel stake, hand groover and a ball pein hammer.**

Check the pattern and ensure that all the required allowances are provided by using a steel rule as per the job drawing. (Fig 1)

Fig 1

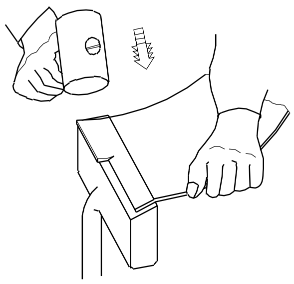


Remove burrs by using a flat file. Mount the hatchet stake on the bench plate.

Place the sheet horizontally on the hatchet stake edge at the line marked previously for folding.

With a wooden mallet strike the edge of the job on both ends. (Fig 2) Observe break or fold mark formed.

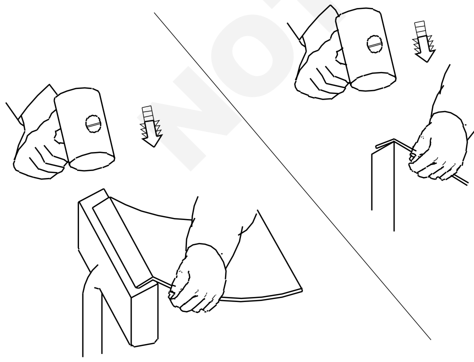
Fig 2



Lower the end of the work slightly using the same angle of striking, increasing the angle of turning.

Repeat the above operation till the edge is turned to the required angle. (Fig 3)

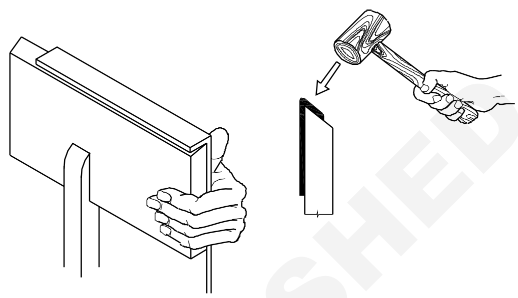
Fig 3



For turning more than 90^{0}, support the work flat against the face of the stake.

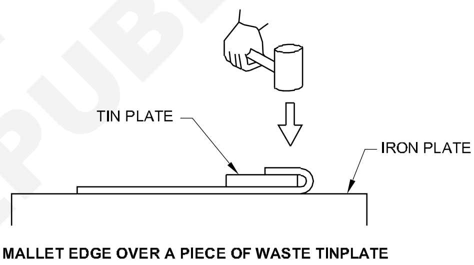
Grip the stake with fingers at 'A' and hold the work in position with the thumb. (Fig 4)

Fig 4



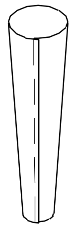
Mallet the edge over a piece of waste tin plate. (Fig 5)

Fig 5



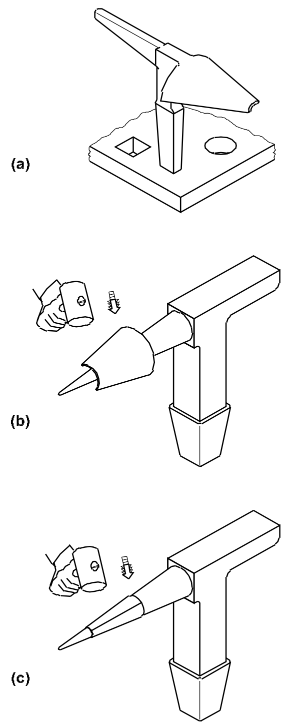
Repeat the same operation on the other edge of the sheet and form hooks. (Fig 6)

Fig 6



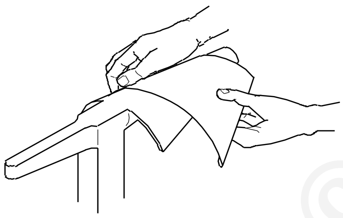
Mount the funnel stake on a bench plate. (Fig 7a) Use "long tapered beak horned iron stake" for the cones having small radius, plate. (Fig 7b & 7c)

Fig 7



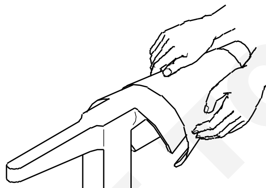
Place one end of the work piece on the funnel stake parallel to the axial line of the stake and bend as shown in Fig 8.

Fig 8



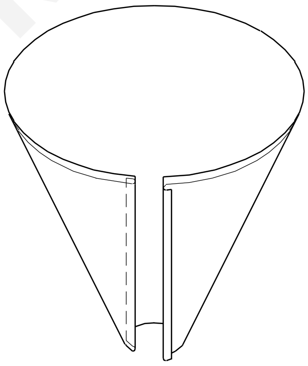
Repeat the same operation on the other end of the workpiece. Bend the workpiece evenly as shown in (Fig 9).

Fig 9



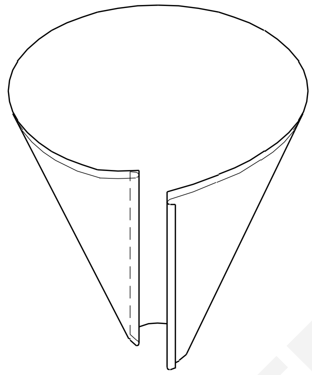
Check the turned up edge of the circular disc and curve it gradually and make both ends to meet together. (Fig 10)

Fig 10



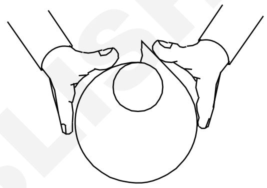
Ensure that the folded edges of the workpiece are parallel, if not the edges will not match as shown in (Fig 11)

Fig 11



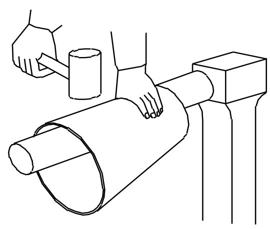
Hook the folded edges as shown in Fig 12.

Fig 12



Slowly lock the edges by light blows using a mallet as shown in (Fig 13) Start blows from one end of the joint to the other end to tighten the joint. (Now grooved seam is formed)

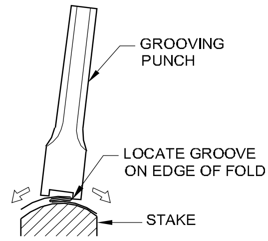
Fig 13



Select the correct size of the groover.

Place the groover over the grooved joint as shown in (Fig 14)

Fig 14



Position the groover at a very slight angle. The edge of joint acts as a guide to the groover. (Fig 15)

Bring the groover to vertical position. (Fig 16)

Fig 15

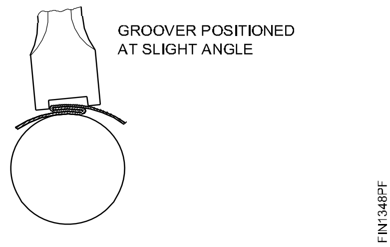
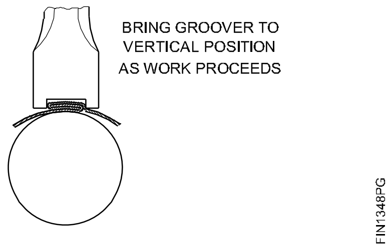
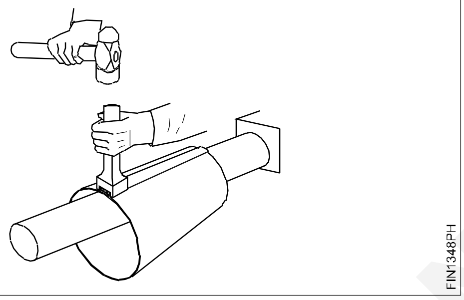


Fig 16



Strike the top of the groover firmly with ball pein hammer and lock same on the other end. (Fig 17)

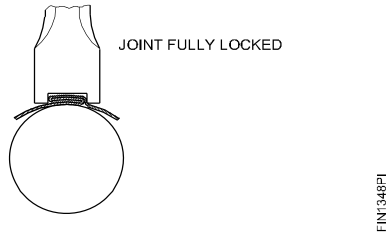
Fig 17



Check the ends again to ensure that they are in line. Continue to lock the seam along the line with the hand groover.

Now the joint is fully locked. (Fig 18)

Fig 18



Finally smoothen with a mallet all over the body and check the dimensions as per the job drawing by using a steel rule.

In order to get proper setting of seam of the required size, it is necessary to use the correct size of a groover. If not, the seam is set too wide or too narrow. Figs 19, 20 & 21.

Fig 19

Fig 20

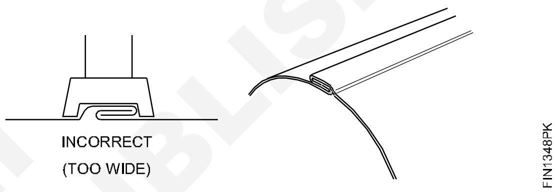
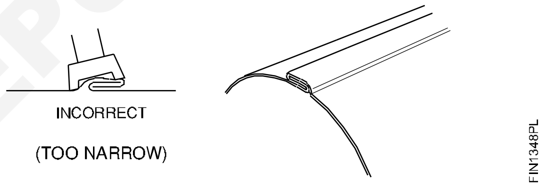
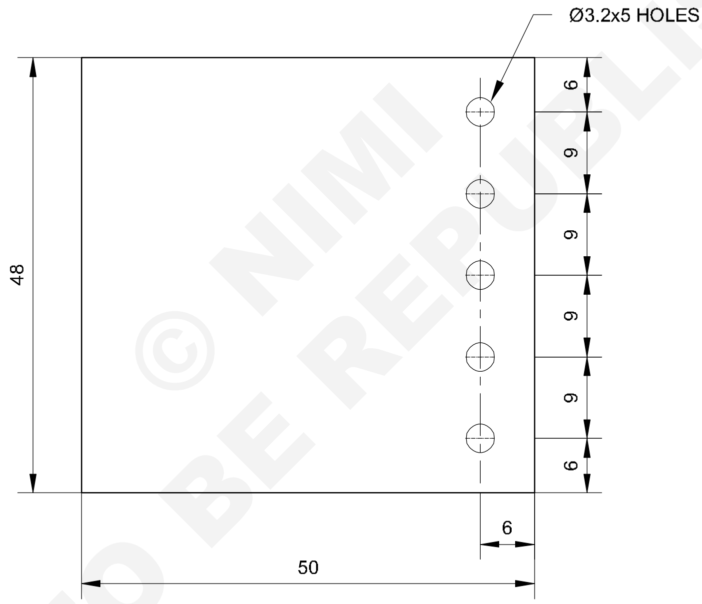


Fig 21



Drill for riveting

Objectives: At the end of this exercise you shall be able to
- **mark the drill holes as per drawing**
- **clamp and drill holes in sheetmetal for riveting using electric portable drilling machine.**



2	ISSH 50 x 48 x1.2	–	G.I SHEET	–	–	1.3.54
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	DRILL FOR RIVETING	DEVIATIONS ±0.5mm	TIME :
		CODE NO. FI20N1354E1	

Job Sequence

- Check the size of sheet 48x50mm using a steel rule.
- Flatten the sheet on dressing plate using mallet.
- Layout the spacing for drill holes and mark the centre points of drill holes using a centre punch and a ball pein hammer.
- Hold the sheet firmly using 'C' clamp.
- Drill Ø 3.2mm through holes as per drawing.
- De-burr the holes with larger sized drill by rotating it on the drilled holes by hand.

Skill Sequence

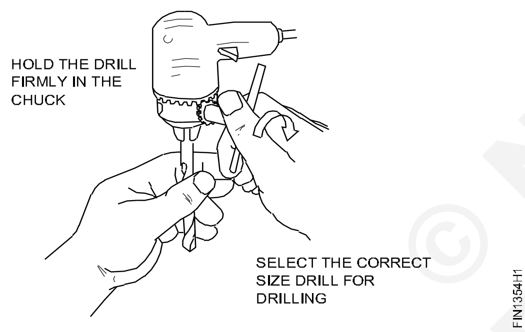
Drilling on sheetmetal by power operated portable drilling machine

Objective: This shall help you to
- **drill correct size hole on sheetmetal by operating power operated portable drilling machine properly.**

Punch the marked centre points of the holes to be drilled lightly using a centre punch and a ball pein hammer.

Insert a straight shank, drill bit in the drill chuck of the portable drilling machine and tighten with the chuck key. (Fig 1)

Fig 1



Before inserting the drill in the drill chuck of the power operated portable drilling machine, be sure that the switch is off and earthing is provided.

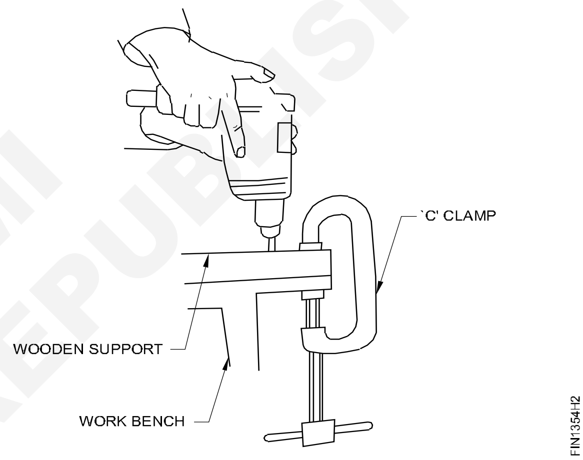
Place the workpiece on a suitable wooden support and clamp with the help of a ‘C’ clamp. (Fig 2)

Hold the portable drilling machine in one hand and grasp the gun with fore finger and thumb of the other hand, such that the drill is perpendicular to the surface of the metal to be drilled. (Fig 2)

Switch ‘ON’ the trigger switch with second finger.

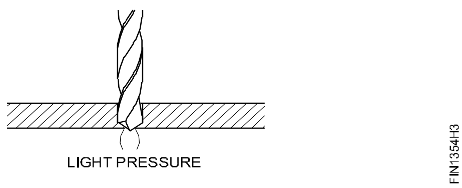
Apply pressure on the drilling machine till hole is drilled.

Fig 2



While drilling by electric operated portable drilling machine on a sheet metal, light pressure should be applied otherwise, the drill will get struck to the workpiece. (Fig.3)

Fig 3

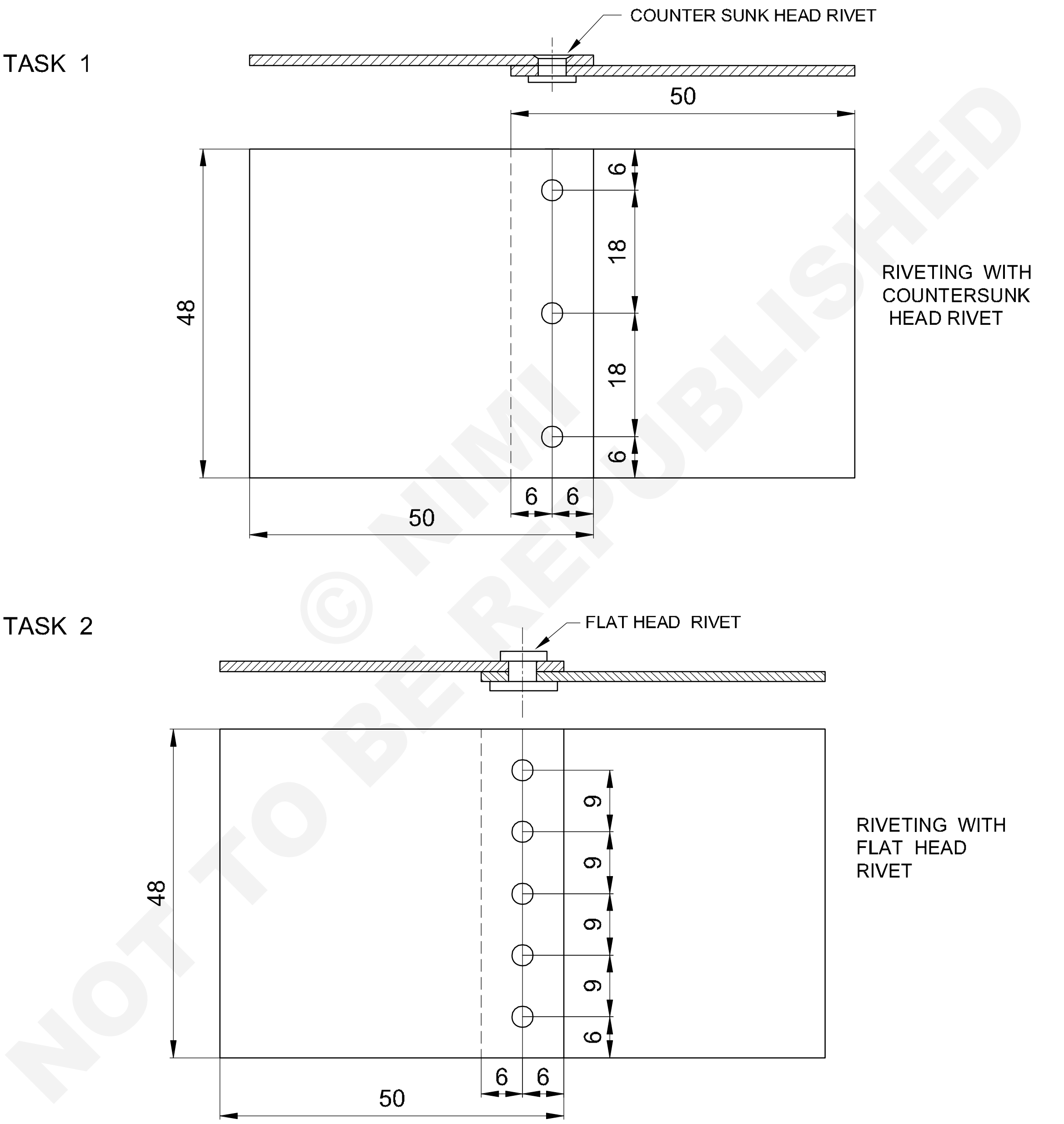


Switch off the drilling machine after the drilling is completed.

De-burr the holes by larger sized drill by rotating it on the drilled hole by hand.

Riveting with as many types of rivet as available, use of counter sunk head rivets

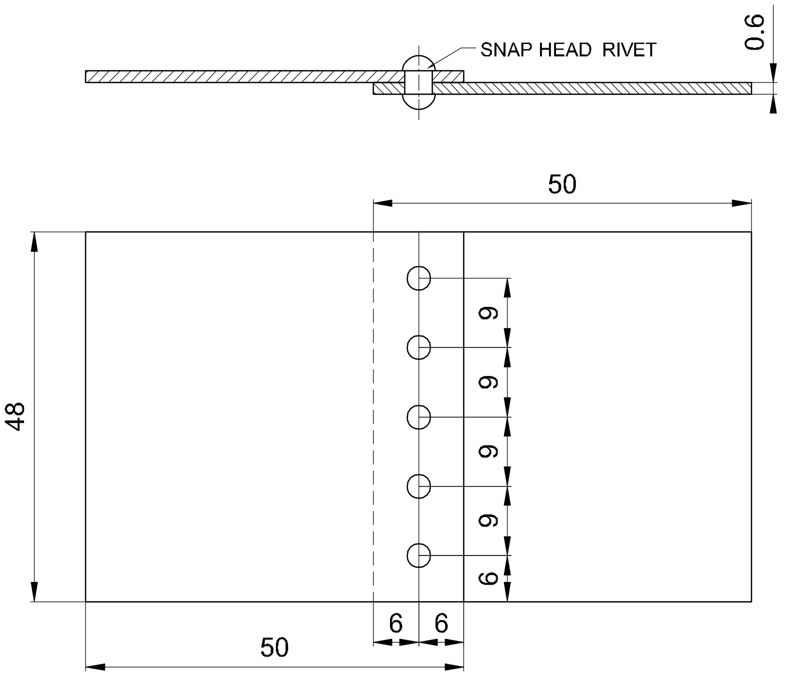
Objectives: At the end of this exercise you shall be able to
- **mark and drill hole for riveting as per drawing**
- **rivet counter sunk head rivet, flat head rivet, snap head rivet and pan head rivets.**



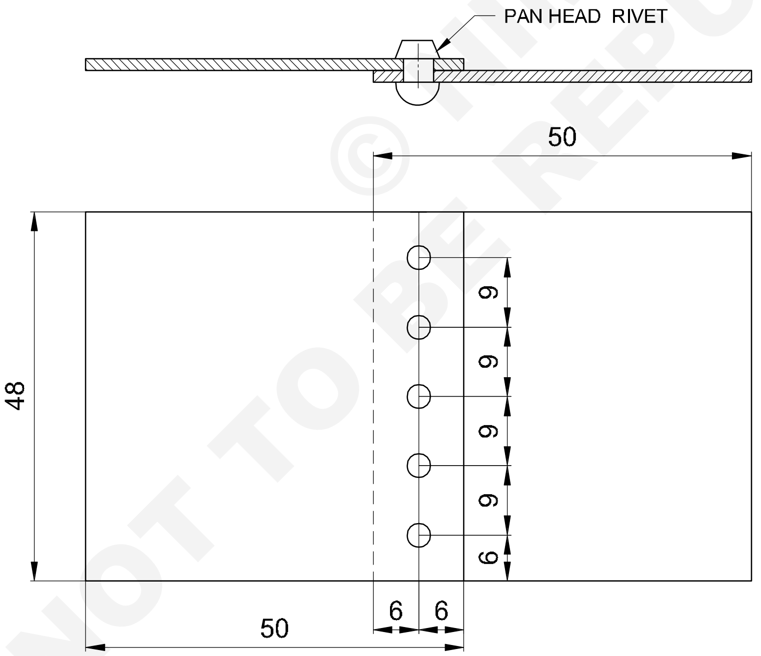
2	ISSH 50 x 48x 1.2	–	G.I SHEET	–	TASK 2	-
2	ISSH 50 x 48x 1.2	–	G.I SHEET	–	TASK 1	1.3.55
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**RIVETING WITH TYPES OF RIVETS** (COUNTER SUNK HEAD AND FLAT HEAD RIVETS)	DEVIATIONS ±0.5mm	TIME :
		CODE NO. FI20N1355E1	

TASK 3



RIVETING WITH SNAP HEAD RIVET



TASK 4

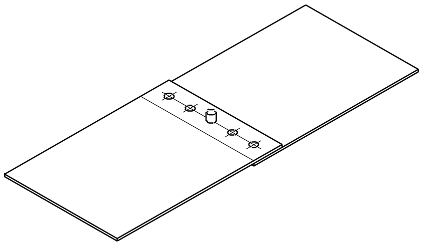
RIVETING WITH PAN HEAD RIVET

SCALE 1:1	**RIVETING WITH MANY TYPERS OF RIVETS**	DEVIATIONS ±0.5	TIME:
	(SNAP HEAD AND PAN HEAD RIVETS)	CODE NO. FI20N1355E2	

Job Sequence

- Check the size of sheets 50x48mm using a steel rule.
- Flatten the sheets on dressing plate using mallet.
- Mark and drill holes as per drawing.
- Place the piece of sheet having all holes drilled above another, such that the overlapped edges of the sheets coincide with the marked lines.
- Align the drilled holes in centre.
- Insert 3mm dia counter sunk head rivet in the centre hole. (Fig.1)

Fig 1

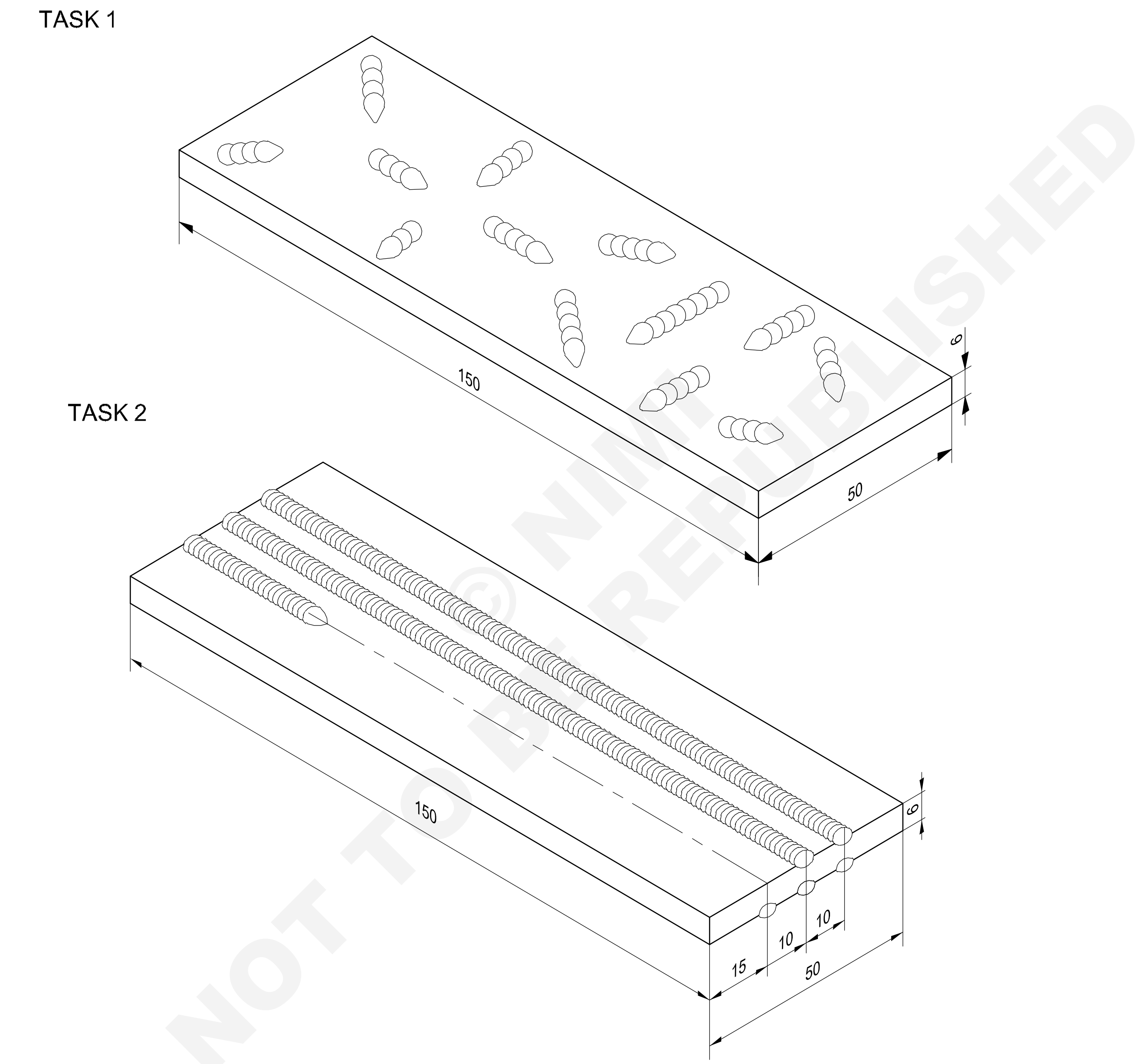


- Form the rivet head with the help of a rivet set using a ball pein hammer.
- Drill the remaining holes on the bottom piece of sheet through the holes, already drilled on the upper piece of sheet.
- Deburr the holes with larger sized drill, rotating it on the drilled holes by hand.
- Insert the rivets in alternate holes and form the rivet heads one by one to make single riveted lap joint (chain) with the help of a rivet set, and a ball pein hammer.
- Similary, drill and rivet using flat head rivet in TASK 2, snap head rivet in TASK 3 and pan head rivet in TASK 4 and complete the riveting.

To form countsunk head rivet, pan head rivet, snap head rivet and flat head rivet, use dressing plate, rivet set, rivet snap and a ball pein hammer and complete the riveting.

Striking and maintaining arc, laying straight - line bead

Objectives: At the end of this exercise you shall be able to
- **strike and maintain the arc by scratching and tapping method**
- **deposit uniform straight weld beads and inspect for faults.**



1	50 ISF 6-150	-	Fe310-O	-	-	-
1	50 ISF 6 -150	-	Fe310-W	-	-	1.4.56
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**STRIKING AND MAINTAINING ARC LAYING STRAIGHT LINE BEADS BY ARC WELDING**	DEVIATIONS : ± 0.5mm	TIME :
		CODE NO. FI20N1456E1	

Job Sequence

TASK 1 : **Striking and maintaining arc**

- Check the size of the raw material.
- Mark and file to size.
- Clean the metal surface with a steel wire brush and wipe off the oil and grease if any.

Dirt or rust makes poor connections.

- Wear safety apparel (Protective clothing)
- Connect the welding cables with the machine and the job.

Check the cables for damage and loose connections. Check whether the earth-clamp is properly attached.

- Fix a ∅ 4mm M.S. electrode in the holder.

Ensure the electrode is firmly held in the holder from the bare end.

- Set the welding current (amperage) 140-150 amps.

If the welding machine is a D.C. one, connect the electrode to the negative.

- Start the welding machine.
- Strike and maintain the arc by the scratching method.

Use a welding screen fitted with proper coloured glasses while arc-welding.

- Hold a correct arc for a short distance and break by quickly withdrawing the electrode up.

The correct arc burning will give steady, sharp, crackling sound.

Repeat this exercise until the arc can be struck every time without the electrode freezing.

If the electrode freezes (sticks) to the plate, it should be freed immediately by a quick twist of the wrist motion to avoid overheating or spoiling.

— — — — — — — — —

TASK 2 : **Laying straight line beads by arc welding**

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Set the work piece on the welding Table in a flat position
- Set the arc-welding plant and connect the welding cables.
- Select and fix M.S. Electrode ∅4mm in the holder.

Ensure that the electrode-holder JAWS are clean.

- Set a welding current 140-150 amps on a AC or DC machine.

If the power source is D.C. connect the electrode with the negative straight polarity.

- Wear the complete safety apparel and check the filter lens of the welding screen.
- Strike the arc on a scrap piece for trial and observe the current setting.

Ensure that the burning of the electrode is normal.

- Strike the arc on the job-piece at one edge and maintain a uniform normal short arc.
- Move the electrode in a straight line and complete the bead at the other edge of the plate.
- During welding maintain a correct angle of the electrode at 70° - 80°.
- Arc length producing a steady sharp crackling sound.
- Travel speed approx. at the rate of 150mm per minute.
- Remove the slag from the weld bead and inspect for:
  - Uniform width and height - slag inclusion.
  - Normal depth of fusion.
  - Straightness.
- Repeat the exercise till you achieve good results.

— — — — — — — — —

Skill Sequence

Setting of arc welding machine for welding

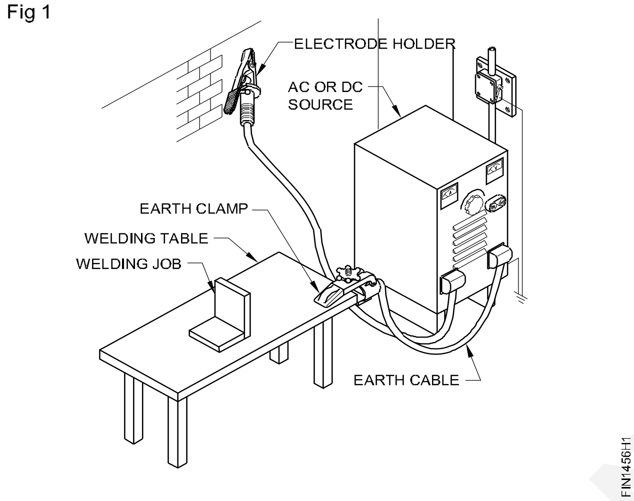
Objectives: This shall help you to
- **set the arc-welding plant**
- **set the current according to the size of electrode**
- **strike and maintain the arc by the scratching and tapping method.**

Striking an arc is a basic operation in arc welding. It will occur every time the welding is to be started.

It is an essential basic skill to learn in arc welding.

Setting of arc-welding plant (Fig 1)

Fig 1



Check the working of power source for the welding machine.

Remember electricity is a good servant but a bad master.

Call an electrician for solving any electrical problems.

Connect the welding cables with the welding machines.

Ensure that the cable connections are clean, dry, tight and are attached to the proper terminals of the machine.

Attach tightly the earth cable with the welding table at the proper place.

Keep the electrode-holder at a safe place.

If the machine is on DC power, connect the cables in correct POLARITY.

Setting a welding current

Set the welding current as per the diameter of the electrode to be used. (Table 1)

Select the electrode as per the thickness of the metal to be welded or as recommended. (Table 1)

Use alternative electrodes of nearest size in the case of non availability of the exact size of electrodes.

The electrodes diameter should not be more than the thickness of the metal to be welded.

Striking and maintaining an arc

Scratching method (Fig 2)

Hold the electrode about 25mm above the job-piece at one end, perpendicular to the surface.

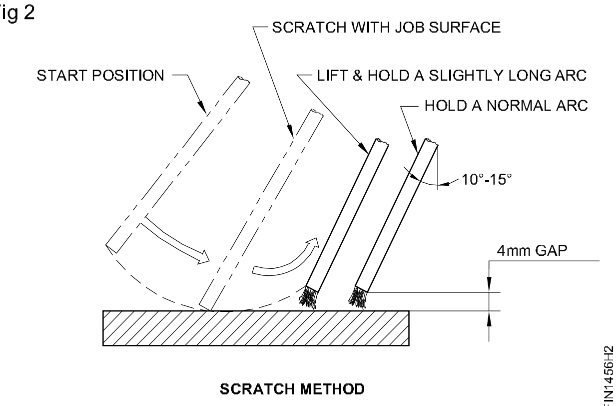
Bring the welding screen in front of your eyes.

Ensure safety apparel is worn.

Table 1

Plate Thickness in mm (approx.)	Electrode Size mm	Current Range (amperes)
1.6	1.6	40-60
2.5	2.5	50-80
4.0	3.2	90-130
6.0	4.0	120-170
8.0	5.0	180-270
25.0	6.0	300-400

Fig 2



Strike the arc by dragging the electrode quickly and softly across the welding job, using wrist movement only.

Withdraw the electrode approximately 6mm from the surface for a few seconds, and then lower it to (approx) 4mm distance.

If the arc has been properly struck, a burst of light with a steady sharp crackling sound will be produced.

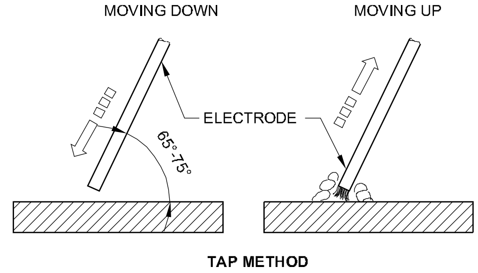
Tapping method (Fig 3)

Strike the arc by moving the electrode down to touch the job surface lightly.

Move the electrode slowly up, approximately 6mm for a few seconds, and then lower it to approx. 4mm from the surface.

The tapping method is generally recommended as it does not produce pit marks on the job surface.

Fig 3



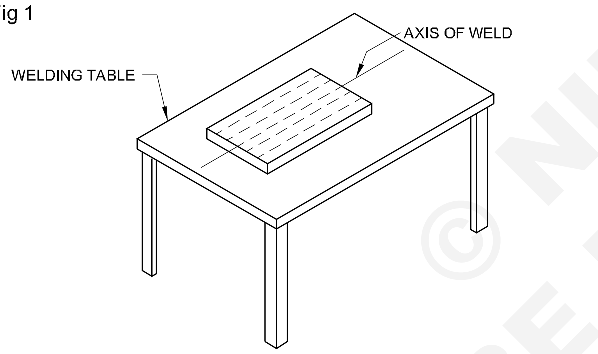
Straight line beading by arc (Flat position)

Objectives : This shall help you to
- **deposit straight beads in a flat position**
- **clean the weldment and inspect for faults.**

Job setting

Set the job in a flat position on the welding table. (Fig 1)

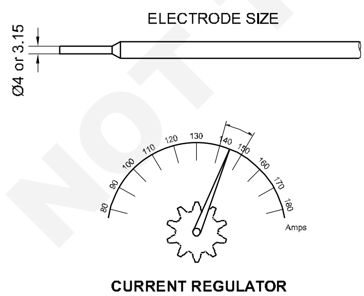
Fig 1



Ensure there is a good electrical contact between the job and the welding table.

Current setting (Fig 2)

Fig 2



Set the current on the welding machine, 140-150 amps for Ø4mm M.S. Electrode.

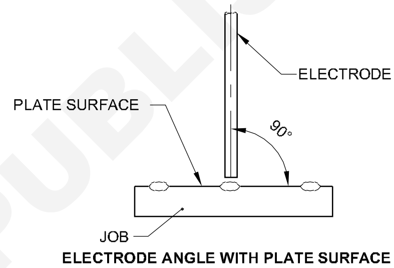
Always follow the current range chart for the electrodes in use.

Electrode position (Fig.3a&b)

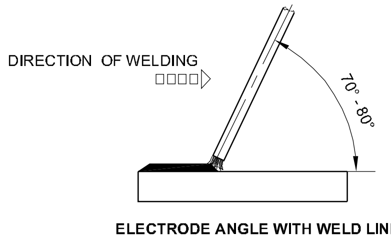
Hold the electrode at an angle of 70° - 80° with the weld line and 90° with the adjoining plate surface.

Fig 3

(a)

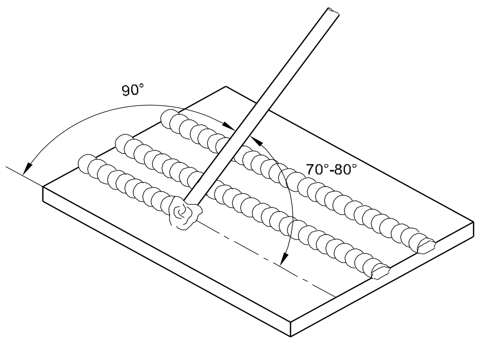


(b)



Depositing straight beads (Fig 4)

Fig 4



Deposit straight beads by following the punched line and maintaining arc

- Correct arc length
- Correct travel speed
- Correct angle of electrode.

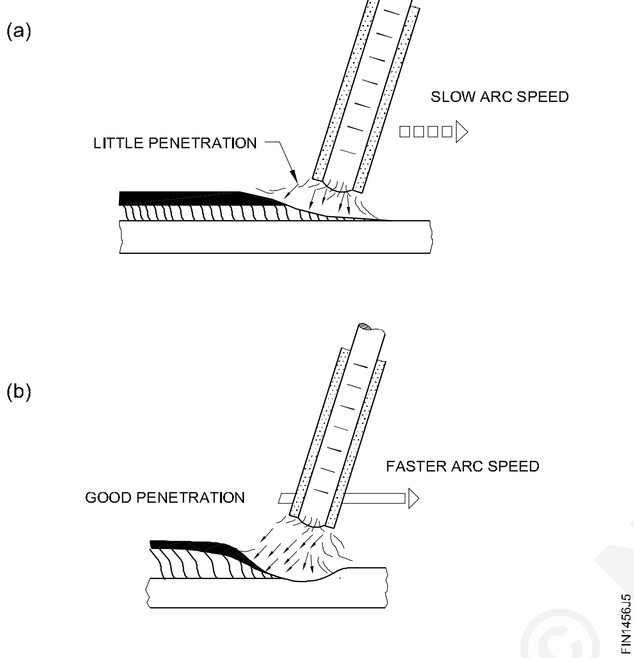
Ensure that the welding screen lens is clean so that you can see the arc and the weld line.

Replace the plain glass, if spattered.

LISTEN to the arc. It produces a steady sharp crackling SOUND.

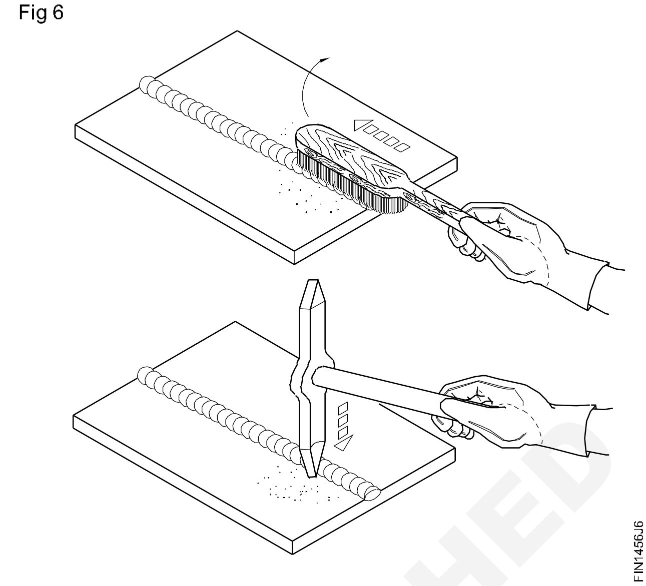
Adjust the travel speed by watching the electrode melting and flowing through the molten pool to form a deposited metal. (Fig 5a & b)

Fig 5



Weldment Inspection (Fig 6)

Fig 6



Remove the slag from the weldment using a chipping hammer and a wire brush.

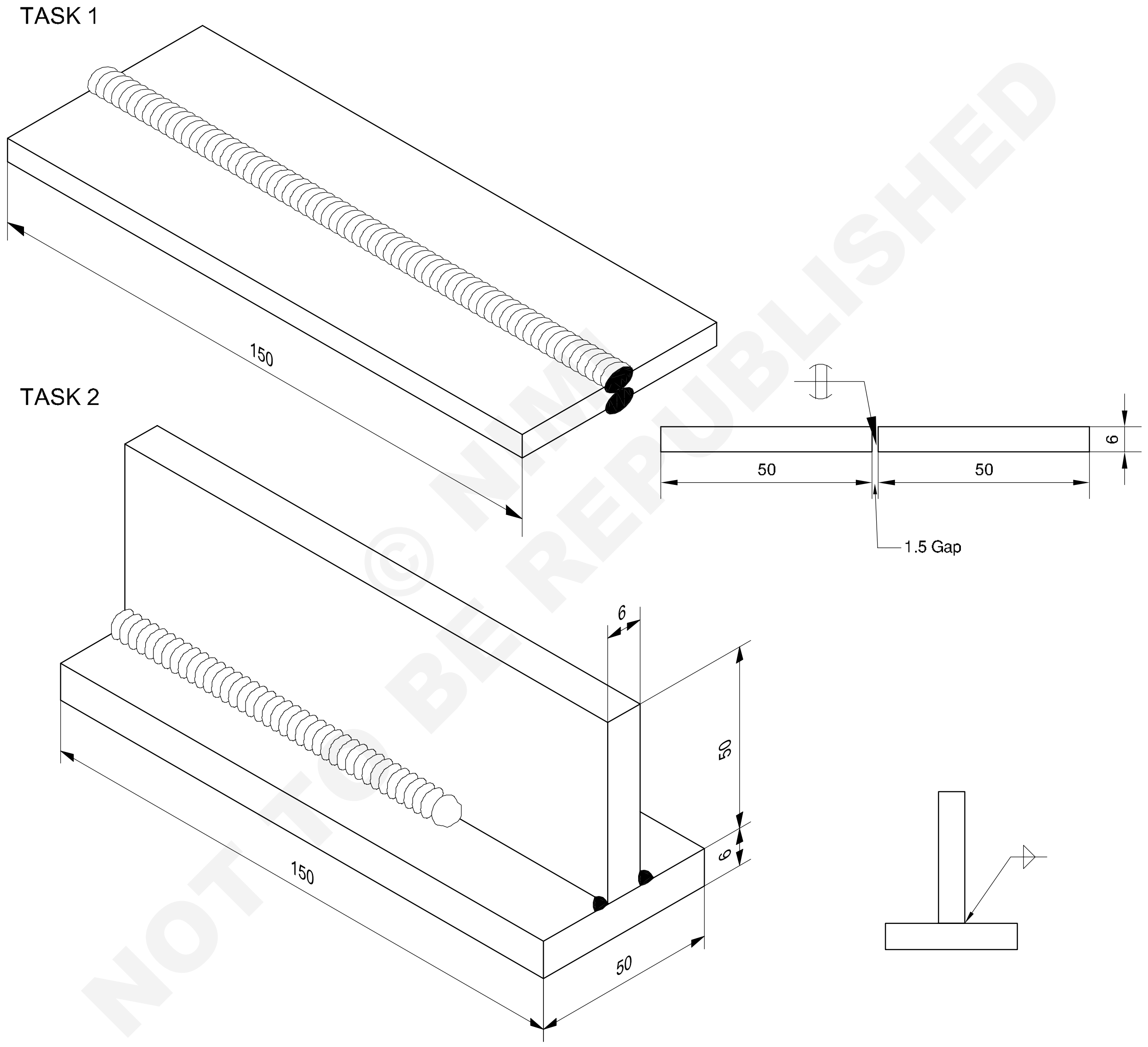
Use goggles during slag removal.

Inspect the deposited beads and note any variations in the:

- Width and height
- Depth of fusion
- Length of run. (Straightness)

Making butt joint and 'T' joint using gas and ARC welding process

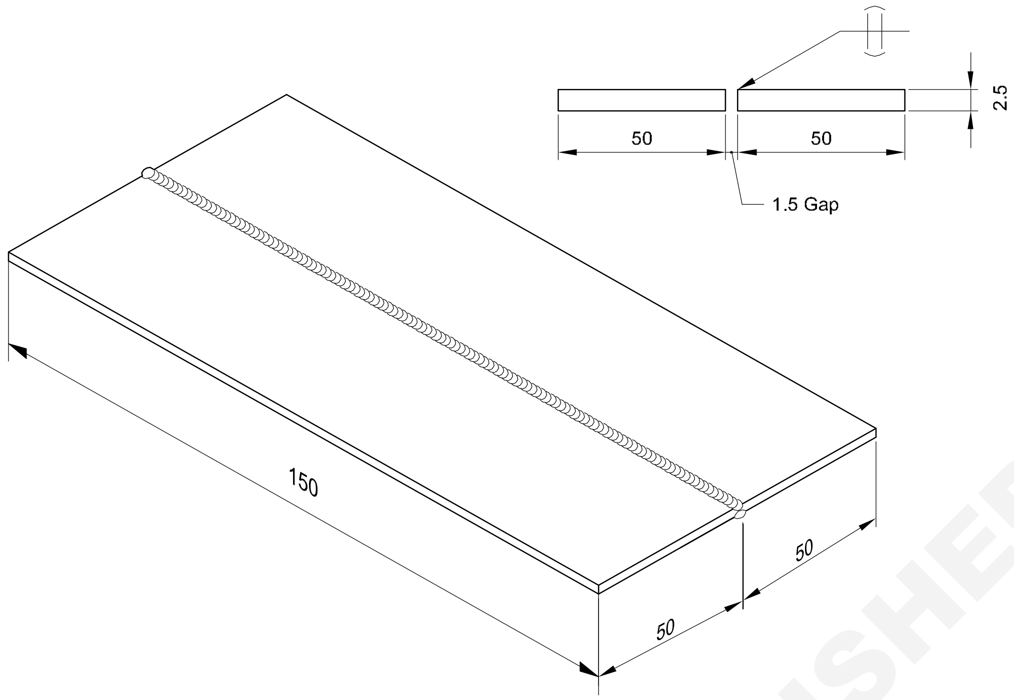
Objectives: At the end of this exercise you shall be able to
- **set and weld the workpiece to form a square butt and 'T' fillet joints in correct alignment in arc**
- **weld a 'T' fillet and square butt joint using recommended electrode, filler rod and nozzle size**
- **remove distortion from the joint**
- **clean the weldment and inspect for the surface defects.**



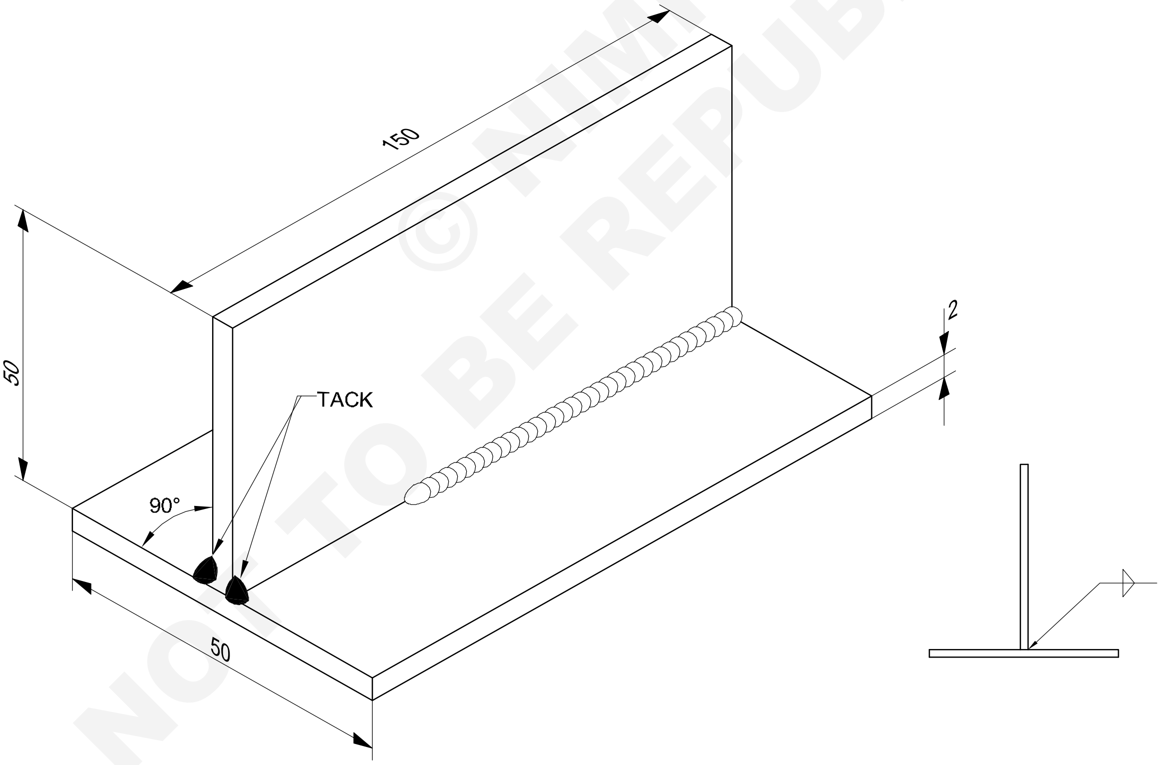
2	50 ISF 6 -150	-	Fe310 - W	-	TASK 2	-
2	50 ISF 6 -150	-	Fe310-W	-	TASK 1	1.4.57
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	**SQUARE BUTT AND 'T' FILLET JOINT IN FLAT POSITION BY ARC WELDING**	DEVIATIONS : ±0.5mm	TIME :
		CODE NO. FI20N1457E1	

TASK 3



TASK 4



2	ISSH 150 x 50 x 2		Fe310 - W		TASK 4	-
2	ISSH 150 x 50 x 2.5	-	Fe310 - W	-	TASK 3	1.4.57
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	**SQUARE BUTT AND FILLET WELD 'T' JOINT IN FLAT POSITION BY GAS WELDING**	DEVIATIONS: ±0.5mm	TIME :
		CODE NO. FI20N1457E1	

Job Sequence

TASK 1 : **Square butt joint in flat position by arc welding**

- Check the size of the raw material.
- Mark and file to size for square.
- Set the pieces on the welding table for square butt joint with 1.5mm gap in alignment. (Refer to drawing)
- Select a ∅ 3.15mm M.S. electrode and set a 120 amps current.

Connect the electrode to negative, if the power source is D.C.

- Tack the pieces at both ends and also in the centre.

Ensure safety apparel is worn.

- Check the alignment of the tacked pieces, and reset, if necessary.
- Place the joint in a flat position on the welding table, well grounded. (Tacks side down)
- Select a ∅ 4.0mm M.S. electrode and set a 150-160 amps current.
- Deposit the first bead along the joint line with a:
  - Correct arc length
  - Correct electrode angle
  - Correct welding speed.
- Chip the slag from the bead, brush and inspect.

Use tongs to hold the hot job, chipping hammer and wire brush for chipping and cleaning, goggles for the protection of the eyes.

- Clean the back side of the first bead thoroughly and grind tacks flush.
- Deposit the second bead on this side, using the same settings.
- Chip the slag from the bead, brush and inspect for faults.
- Practice this exercise until you can produce a sound butt weld.

While but joint welding 1/3rd of gap to be maintained according to the thickness of plate or flat section of metal.

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TASK 2 : **'T' Fillet joint in flat position by arc welding**

- Check the size of the raw material
- Mark and file to size
- Set and tack the job-pieces at both ends as 'T' fillet joint . (Refer to drawing).
- Ensure that a ∅ 3.15mm electrode and a 130 amps current are used. Safety apparel should be worn.
- Clean the tacks, check alignment and reset the job, if necessary.
- Place the joint on a welding table in a flat position. (Tack side down)
- Select a ∅ 4mm M.S. electrode and set a 150-160 amps current.
- Deposit the first bead along the joint line with a correct and uniform
  - Arc length
  - Travel speed
  - Electrode angle.

Ensure the electrode angle is 45° with the corner and 70° to 80° with the welding line in the direction of travel.

Clean the weldment and inspect for faults.

- Clean the other side of the joint and grind the tacks flush.
- Set the joint in a flat position (weld side down).
- Make a second weld along the joint line with the same setting and technique as used for the first bead.

Clean the weld and inspect for the following weld characteristics.

  - Smooth and close ripple appearance. Uniform width and height equal leg lengths
  - Good fusion at the toe of the weld without undercut and overlap
  - Leg length of the fillet weld equal to the plate thickness
- Repeat the exercise until you can produce good welds.

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TASK 3 : **Square butt joint in flat position by gas welding**

- Check the size of the raw material.
- Mark and file to size.
- Set the job pieces on a welding table to form a square butt joint (open) with a root cap 1.5 mm.
- Set a gas welding plant, attach nozzles No.5 and set a pressure of 0.15kg/cm^2 for both the gases.
- Select a C.C.M.S. filler rod ∅1.5mm for tacking and ∅3.00mm for welding.
- Wear safety apparel.
- Set the neutral flame.
- Tack the pieces at both the ends and also in the centre using a ∅ 1.5mm filler rod. (Keep a shrinkage allowance of 2)

Tacks should be well fused and penetrated.

- Check the alignment and gap between the pieces, and reset, if necessary.
- Clean the tacks and reset the job on the welding table in a flat position.
- Start welding, using the leftward technique with the correct angle of the blowpipe and filler rods of ∅3mm.
- Fuse the edges uniformly and add filler metal. (maintain a correct travel speed and motion of the blowpipe and filler rod, to produce a uniform weld bead)
- Stop at the left edge, fill the crater to complete the weld.
- Extinguish the flame, cool the nozzle and place the blowpipe at a safe place.

Clean the welded joint and visually inspect for

- a slight convex uniform width and height of bead.
- a slight penetrating bead on the reverse side of the ripples joint near the root.

- Repeat the exercise till you get good results.

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Task 4 : **Fillet weld 'T' joint in flat position by gas welding**

- Prepare job pieces as per drawing.
- Clean the surface and edges of the sheets to be welded.
- Set the sheets in the form of a 'Tee' joint on the gas welding table.
- Wear safety apparels and gas welding goggles.
- Set the gas welding plant, fix nozzle No.5 and set pressure at 0.15 kgf/cm^2 for both the gases.
- Set the neutral flame, tack at both ends of the joint and also in the centre with a 1.6 mm C.C.M.S rod.
- Check the alignment of the joint with a try square and clean the tacked portion.
- Keep the job on the welding table in a flat position.
- Start welding with the leftward technique and melt the right hand end of the joint.
- Fuse the area to be welded (i.e. equally the part of the horizontal sheet and the vertical sheet) and apply the filler rod in the molten pool to form a fillet weld at the joint.
- Maintain correct travel speed, manipulate the blowpipe and filler rod to produce a uniform weld bead.
- Stop the weld at the left hand end of the joint after filling up the crater at the end of the weld.
- Extinguish the flame, cool the nozzle and place the blowpipe at its place.
- Clean the weldment and inspect for defects in the fillet weld.

Visual inspection

- Slight convexity, uniform width, uniform ripples indicate a good weld bead. A weld without undercut, overlap,porosity, etc. will ensure a good quality weld.
- Weld on the other side of the joint for more practice

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Skill Sequence

Square butt joint by arc in flat position (TASK 1)

Objectives : This shall help you to
- **weld a square butt joint in a flat position**
- **inspect the completed butt weld.**

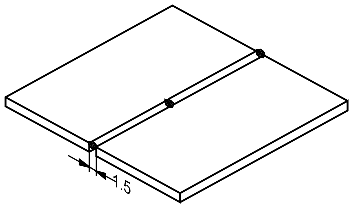
This type of joint is used very extensively in industry. If welded from both the sides (6 mm plate thickness), a sound weld can be obtained.

Setting and tacking

Set the pieces as butt joints with a 3 mm gap in a welding.

Tack at both the ends and one in the centre. (Fig 1)

Fig 1

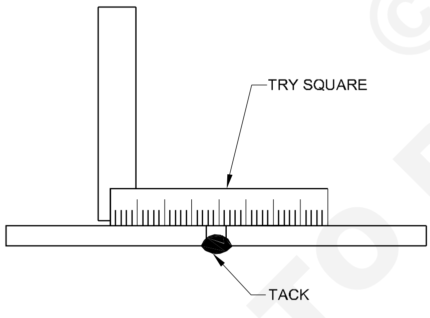


Use a ∅ 3.15mm M.S electrode. Set the current 120-130 amps and length of the tack 15 mm.

Ensure the tacks are fused.

Check the alignment after tacking, and reset, if necessary (Fig 2).

Fig 2



Check the tack-welds thoroughly.

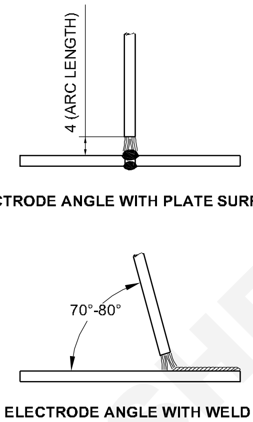
Welding butt joint

Place the joint in a flat position.

Deposit the first bead, using a ∅4mm M.S. electrode and 150-160 amps current with a correct:

- Electrode angle
- Travel speed, and
- Arc length. (Fig 3)

Fig 3



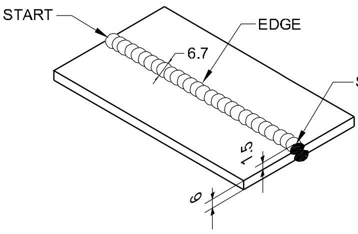
Move the electrode forward and backward along the line of the weld to

- Pre-heat the metal ahead of the weld
- Minimize the tendency to burn through
- Force the slag back over the top of the weld and control slag inclusion.

Inspection of the weld

Remove the slag from the weld and inspect for the following weld characteristics. (Fig 4)

Fig 4



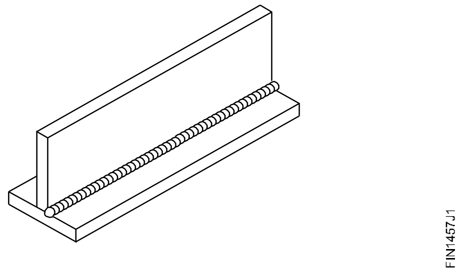
- Width and height of bead should be uniform.
- Appearance should be smooth with close ripples.
- The face of the weld should be slightly convex.
- Edge of the welds should have good fusion, no overlap and undercut.
- The starting and stopping points should be free of depressions and high spots.
- The root of the weld and plate surface should have good fusion and penetration.
- The surface of the plate should be free of spatters.

‘T’ fillet joint by arc in flat position

Objectives : This shall help you to
- **weld ‘T’ fillet joint by arc in flat position free of distortion and weld defects**
- **inspect the fillet for weld characteristics.**

The weld deposited on a 'T' or lap joint is called a fillet weld. Often the 'T'joint is called a fillet joint. (Fig 1) This joint is mostly used in industrial fabrication work.

Fig 1

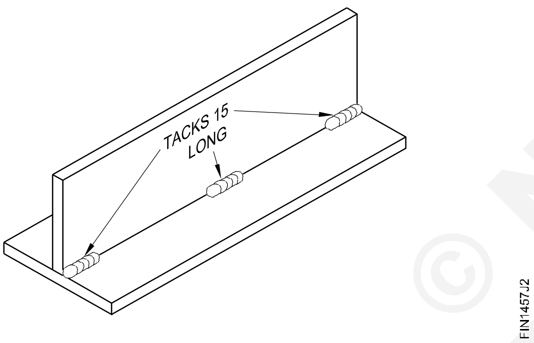


Setting and tacking (Fig 2)

Set the pieces in alignment, forming a 90° 'T'.

Tack the pieces at both ends.

Fig 2



Use ∅ 3.15mm M.S. electrodes.

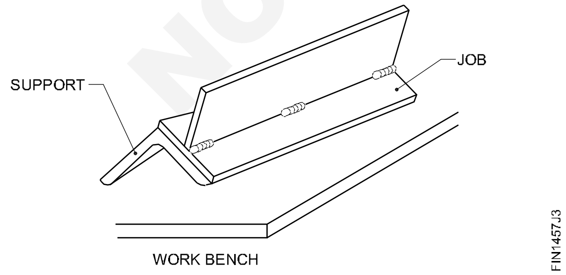
Set current at 150-160 amps.

> **Ensure the tacks are well fused having a 15 mm length**

Check the alignment after tacking.

Welding a fillet joint

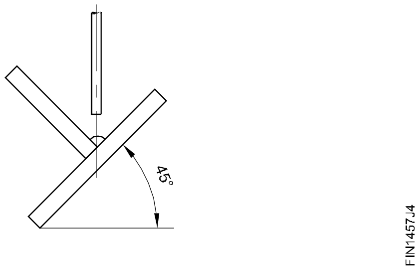
Fig 3



Place the joint for flat position welding. (Fig 3)

Hold the electrode, pointing at the corner of the joint at an angle of 45° to the plate surface. (Fig 4)

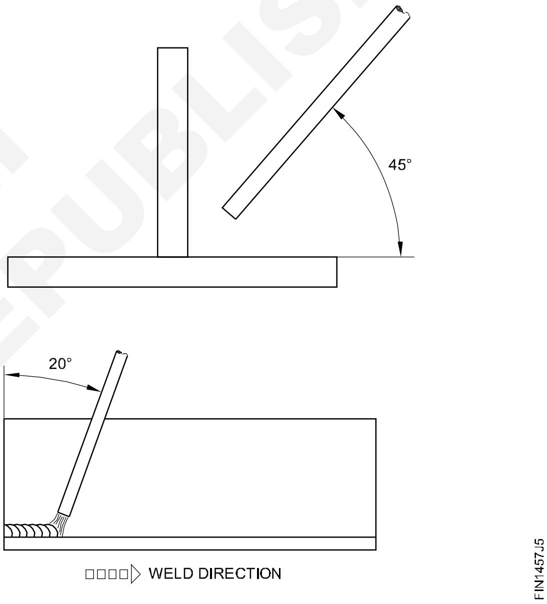
Fig 4



Incline the electrode 10°- 20° in the direction of travel. (Fig 5)

Proceed to weld along the joint with a uniform travel speed. (Fig 5)

Fig 5



> **Watch the molten pool and freezed bead carefully for excessive build up or undercut (faults).**
>
> **Increase the speed or change the angle of the electrode to correct the above faults, if they appear.**

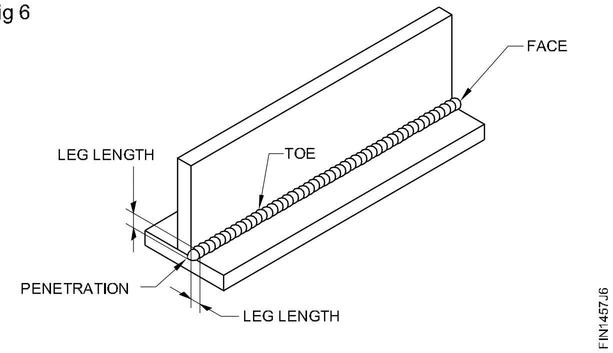
Inspect the weld

Clean the weld thoroughly.

Inspect the fillet for correct shape and size.

No undercut and overlap at the toe of the weld. (Fig 6)

Fig 6



Leg lengths of the fillet almost equal to the plate.

Penetration of the weld complete to the root.

Face of the weld slightly convex.

— — — — — — — — —

Setting up OXY-Acetylene plant

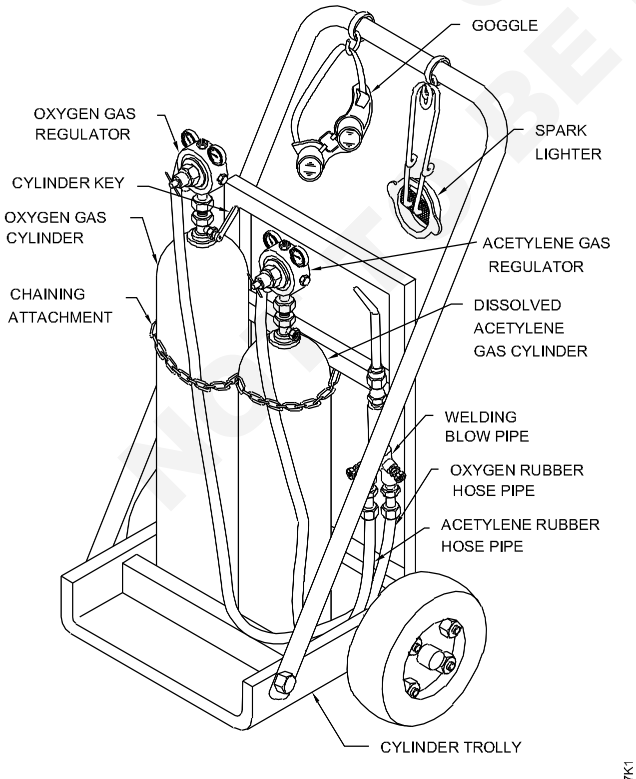
Objective : This shall help you to
- **set up the oxy-acetylene plant.**

Move oxygen and acetylene cylinders with the caps from the store to the gas welding area. An oxygen cylinder is identified by the black colour painted on it. An acetylene cylinder is identified by the maroon colour painted on it. Also the oxygen cylinder will be taller than an acetylene cylinder and the diameter of oxygen cylinder will be less than the diameter of an acetylene cylinder.

Ensure cylinders are kept separately from the empty cylinders.

Position the gas cylinders in a trolley and secure them with a chain.

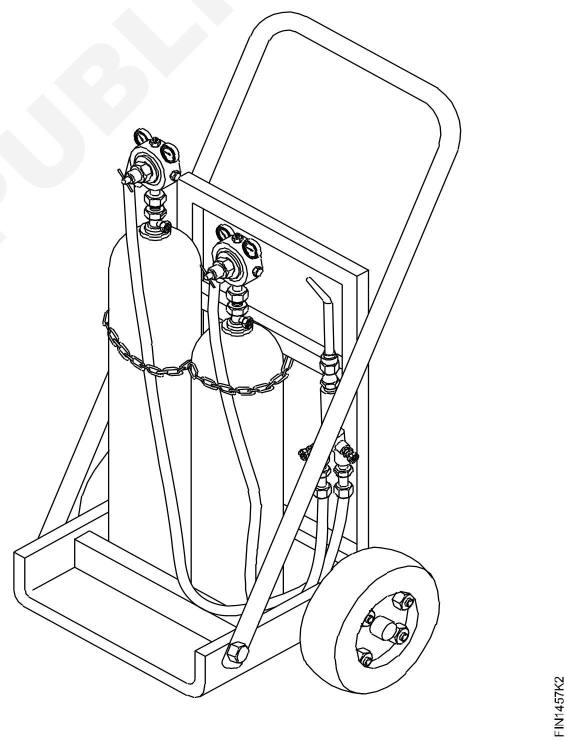
Fig 1



SETTING OF OXY-ACETYLENE PLANT

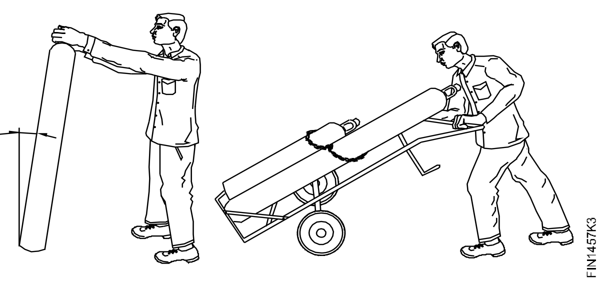
Always keep the cylinders upright/vertically in the cylinder stand/on the floor (Fig 2)

Fig 2



While moving, the gas cylinders should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves. (Fig 3)

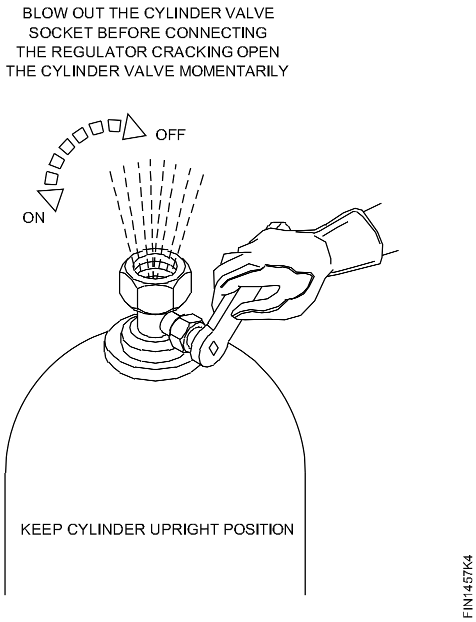
Fig 3



Do not roll the cylinders horizontally on the ground.

Remove the cylinder caps. Crack the gas cylinder valves by qucikly opening and closing them using the cylinder key. Fig 4

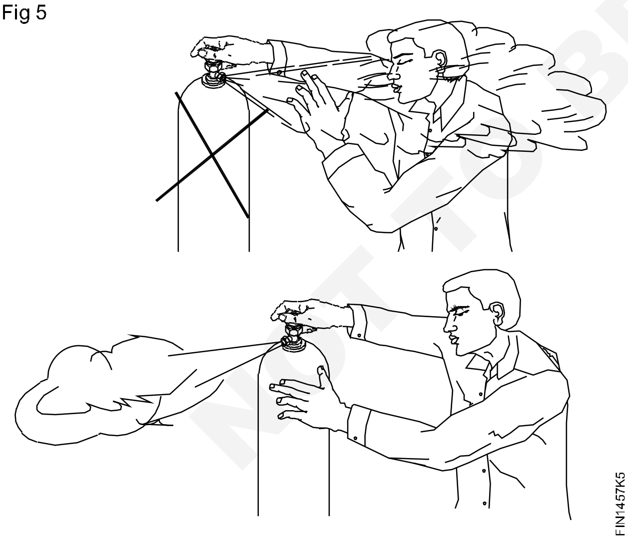
Fig 4



Dirt dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

Always stand opposite to the valve outlet while cracking the cylinders. (Fig 5)

Fig 5



Ensure that your hands are free from grease or oil.

Connect the oxygen regulator to the oxygen gas cylinder (right hand threads).

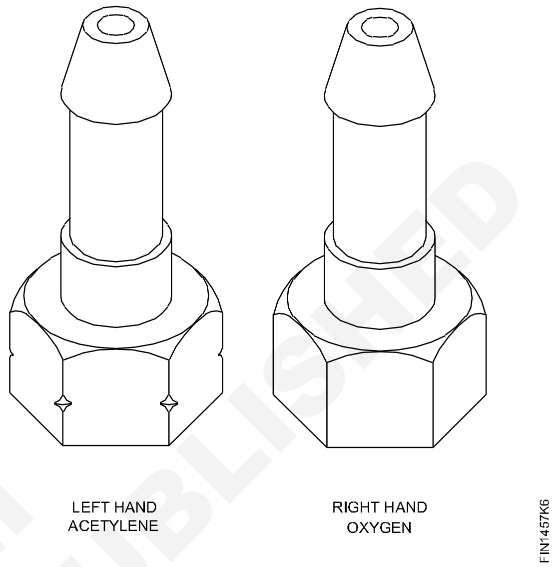
Connect the acetylene regulator to the acetylene gas cylinder (left hand threads)

Ensure the pressure adjusting screws of both regulators are in a released condition.

Be sure to connect the correct regulator on cylinders, Acetylene connections have left hand thread and oxygen has right hand thread.

The acetylene regulator connecting nut will have a groove cut on it (Fig 6) and the pressure gauge dial will be of maroon colour.

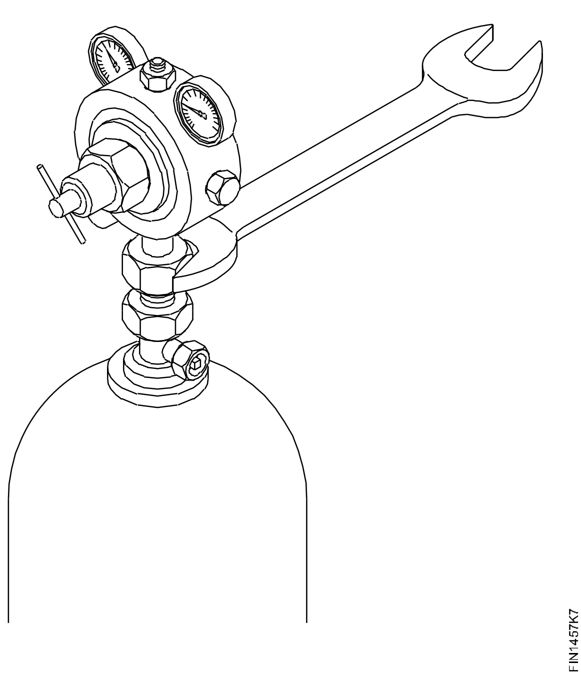
Fig 6



All threaded connections should be fixed intially by tightening by hands and then only a spanner should be used. This will help to avoid assembly with cross thread leading to damage to threads.

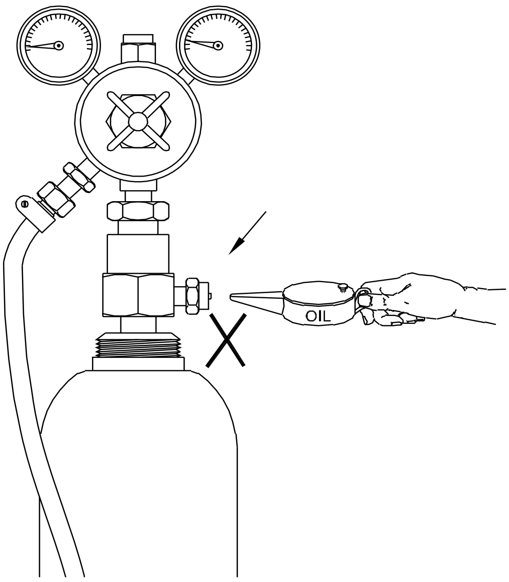
Always use the correct size spanner to prevent damage to the threads (Fig 7)

Fig 7



It is dangerous to apply lubrications in the threaded assemblies of gas welding equipment as it can cause fire (Fig 8)

Fig 8



while tightening avoid undue force. The connections should be just tight.

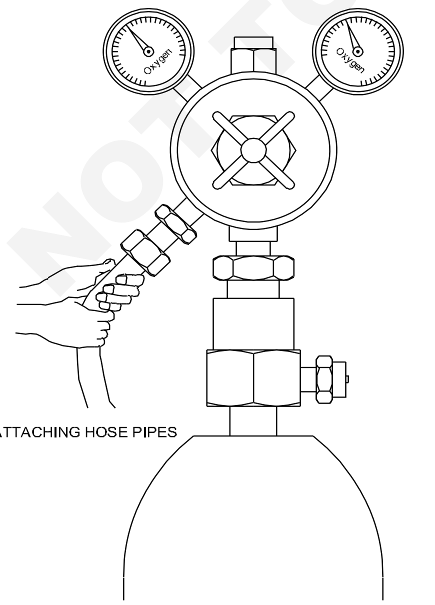
connect the hose connector at the regulator end and the hose-protectors at the blowpipe end.

(use black hose for oxygen line and maroon hose for acetylene line.)

Acetylene connections have left hand threads with a cut on the corners of the nut while oxygen connections have right hand thread without a cut.

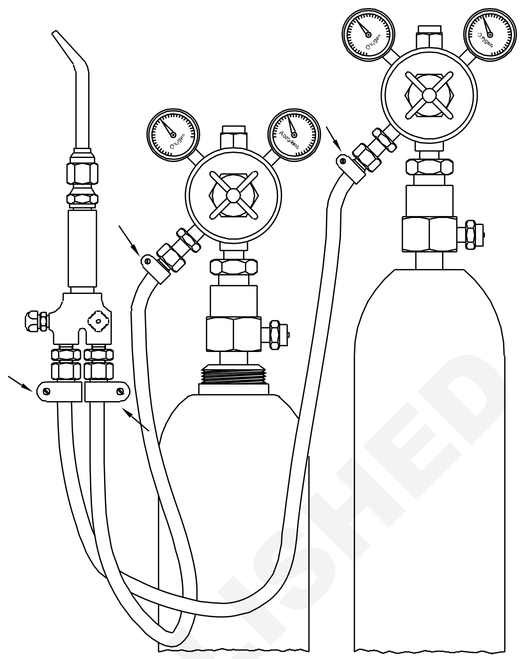
Attach one end of the black hose-pipe to the oxygen regulator outlet and the maroon coloured hose-pipe to the acetylene regulator outlet (Fig 9)

Fig 9



Secure the joints using hose-clips to ensure good grip and to avoid gas leakage (Fig 10)

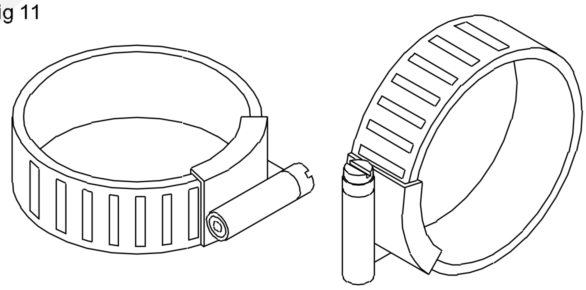
Fig 10



Use a screwdriver to tighten the hose- clips.

Always use the correct size hose-clips (Fig 11)

Fig 11



Turn on the pressure adjusting screw of the regulator to which the oxygen hose pipe is connected (Fig 12)

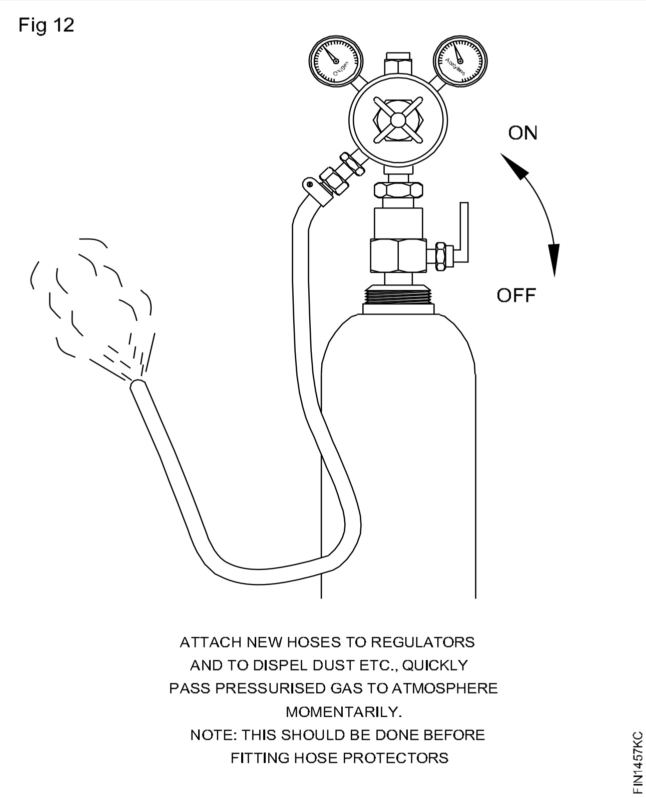
Exert sufficient pressure to blow out dust or dirt particles if any are tapped inside the hose-pipe and then release the pressure adjusting screw.

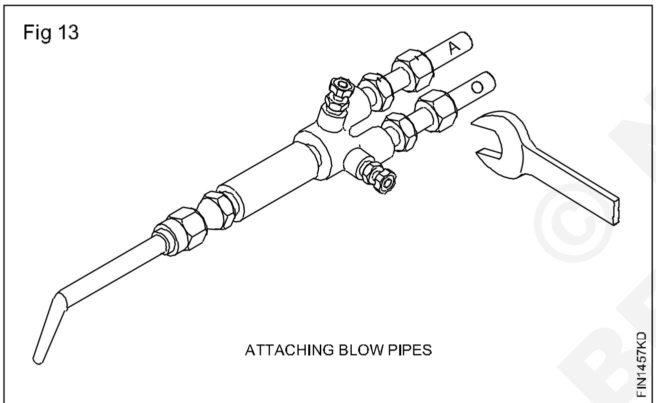
Repeat the same for the acetylene hose also.

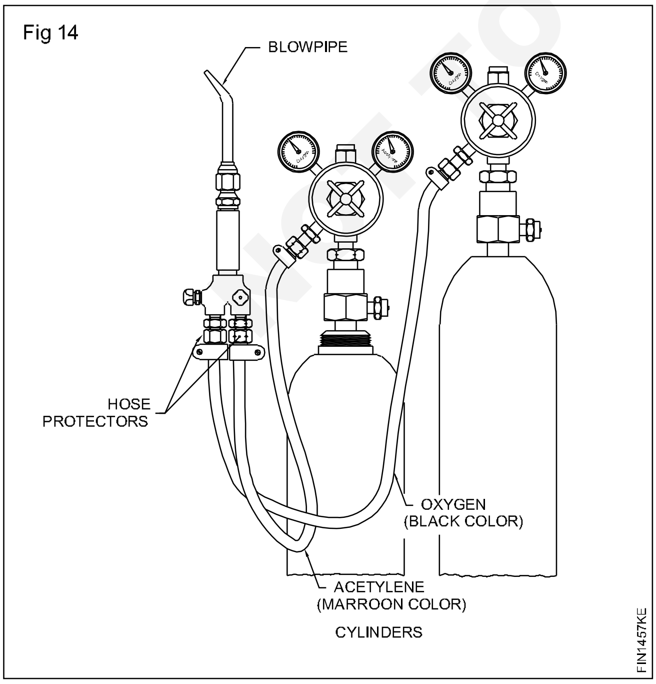
Attaching blowpipe

The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig 13)

Fix the hose-protectors at the blowpipe ends. The hose-protectors with a groove at the corners are fixed on the acetylene hose-pipe and connected to the acetylene inlet of the blowpipe. The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig 14)







The hose-protectors protect against the return flow of gas from the blowpipe to the rubber hoses. They act as non-return valves.

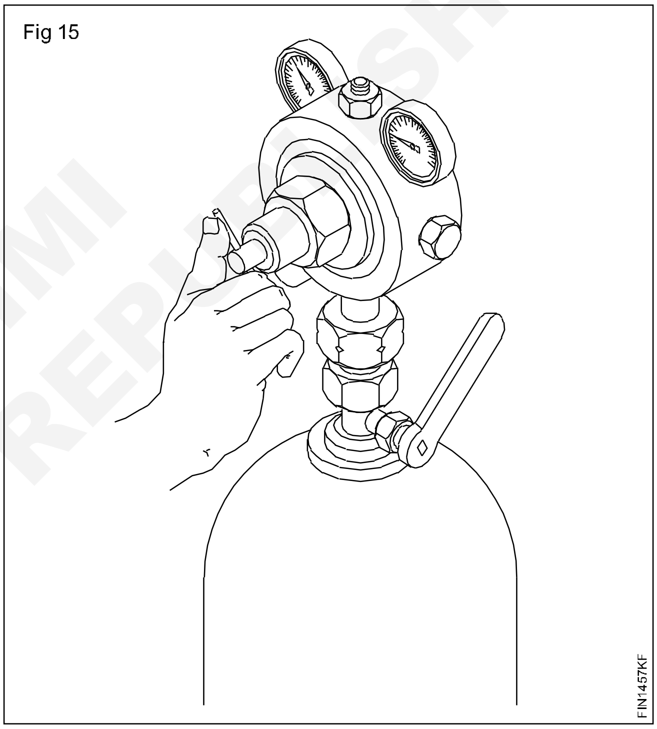
Adjusting the gas pressure

The gas pressure for both oxygen and acetylene has to be adjusted at regulators according to the size of the nozzle.

The size of the nozzle is selected according to the job material and thickness.

For adjusting the gas pressure, open the valves of both the cylinders slowly by one turn and set the pressure on both regulators as 0.15 kg /cm^2 for small size nozzles, by tightening the pressure adjusting screws. (Fig 15) Ensure the blow pipe control valves are kept open while setting the gas pressure.

The pressure can be read on the working pressure gauge of gas regulators



Testing for leakage

All connections must be tested for leakage.

Apply soap water solution for acetylene connections and fresh water for oxygen connections (Fig 16).

Use of soap water on oxygen connections may lead to fire hazards.

Never use matches or flame light during leakage test.

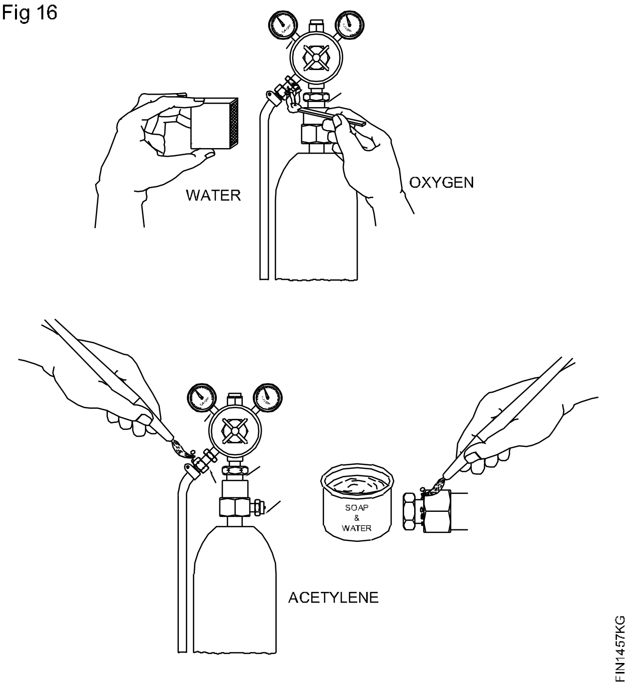
Lighting the flame

Attach the recommended size of nozzle to the neck of the welding blowpipe i.e nozzle No.3.

Open the gas cylinders and adjust the recommended gas pressures on the regulators.

The pressure of oxygen and acetylene is 0.15 kg/cm^2 for nozzle no.3

Fig 16

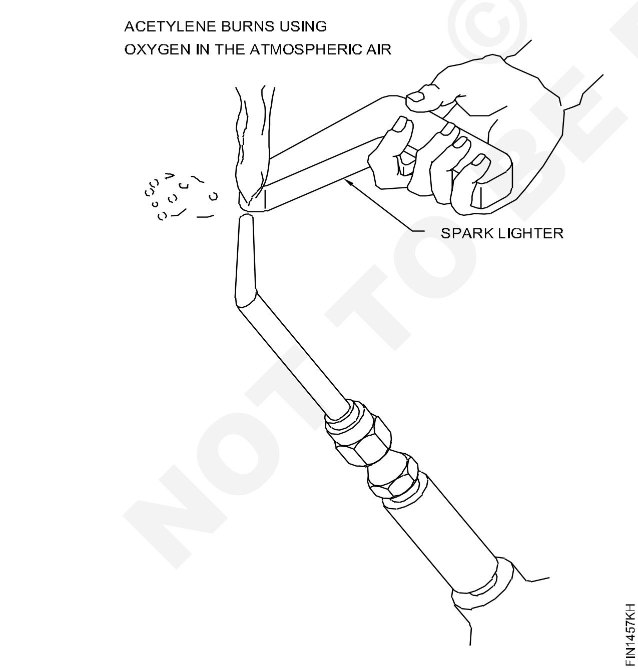


Open cylinder valves very slowly.

while setting pressure on the regulator, keep the blowpipe control valve open for accurate setting.

Open the acetylene control valve 1/4 turn on the blowpipe and ignite with a spark lighter. (Fig 17) Acetylene burns using the oxygen in the atmospheric air with a black smoke.

Fig 17

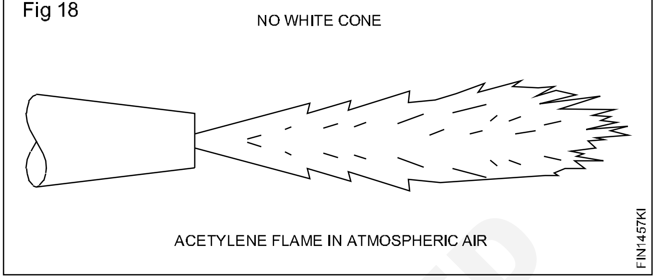


Avoid using any other source of fire other than the spark lighter.

Point the blowpipe in a safe direction in the open space, away from you and others.

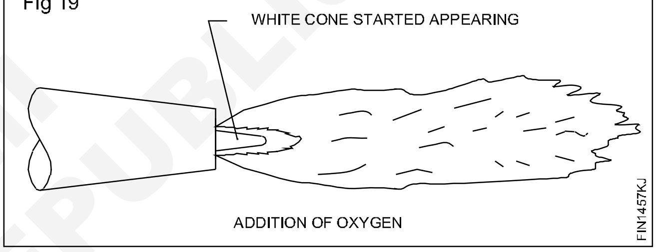
Increase the acetylene till the black smoke disappears. (Fig 18)

Fig 18



Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle (Fig 19)

Fig 19



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Square butt joint in flat position by gas

Objectives : This shall help you to
- **set and tack the workpieces in alignment for a square butt joint**
- **produce a uniform and well penetrated bead on an open square butt joint in a flat position**
- **visually inspect the completed joint.**

The requirements of a good welded joints are:

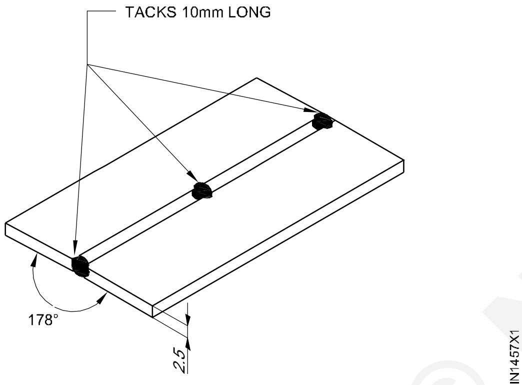
The joint must be in correct alignment (distortion free)

The weld must be well fused, well penetrated, uniform in width and height, of correct size and free from internal or external faults.

Setting and tacking

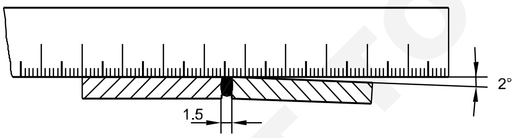
Set and tack the job-pieces in correct alignment with a proper gap and for distortion allowance. (Fig 1)

Fig 1



Check the alignment after tacking, and reset, if necessary. (Fig 2)

Fig 2

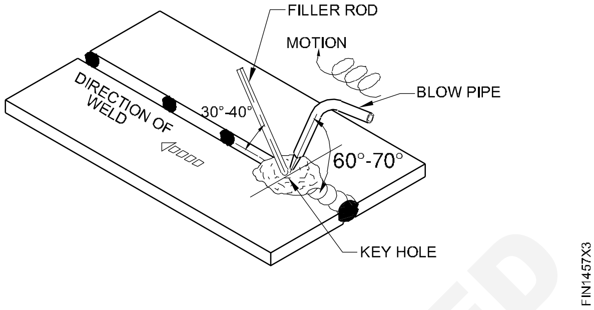


Welding

Produce a well-fused uniform bead with complete penetration using a leftward technique (Fig 3) by;

- Holding and manipulating the blowpipe and filler rod in the recommended angles.
- Maintain a uniform travel speed and feed.
- Forming a correct size keyhole.

Fig 3

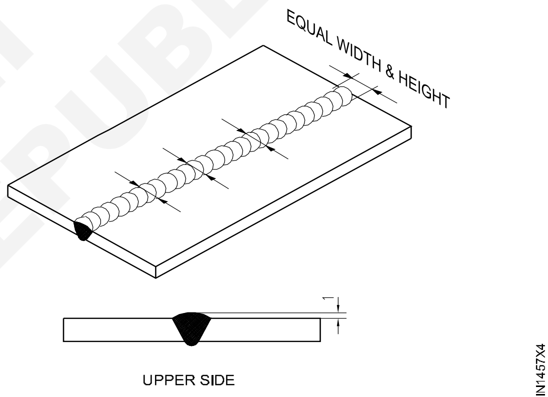


Finish the job.

Check alignment - remove distortion, if required, and inspect for:

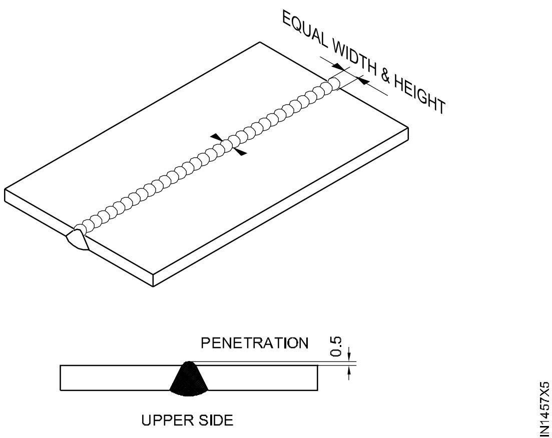
Uniform width and height of weld bead in size. (Fig 4)

Fig 4



- Uniform ripples and fusion, complete penetration. (Fig 5)
- Absence of faults such as undercut, lack of fusion, unfilled crater etc.

Fig 5



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Fillet weld 'T' joint in flat position by gas welding

Objectives: This shall help you to
- **set and tack the workpiece in alignment for a fillet weld tee joint**
- **weld a tee fillet joint using recommended filler rod and nozzle size**
- **visually inspect the completed joint.**

'T' fillet joints are used extensively in industry i.e., fabrication of underframes, vertical supporters for oil and water containers and other similar structural work.

It is an economical joint with very little edge preparation but difficult to weld without defects (i.e. unequal leg length, undercut, etc.) unless the operator gets proper practice.

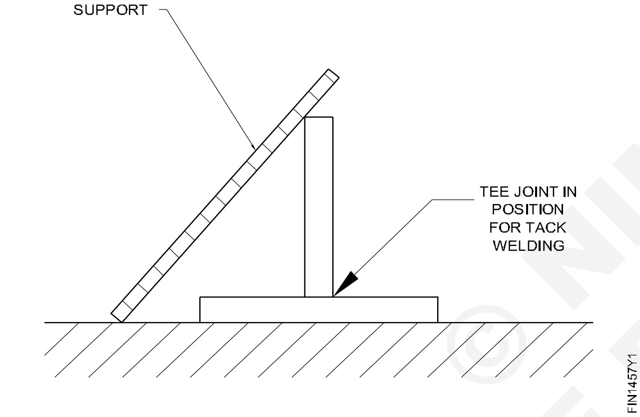
Root penetration must be obtained completely and undercut is to be avoided.

Setting and tacking the job pieces

Place the pieces on the welding table for Tee joint.

Hold the pieces in position using support. (Fig 1)

Fig 1

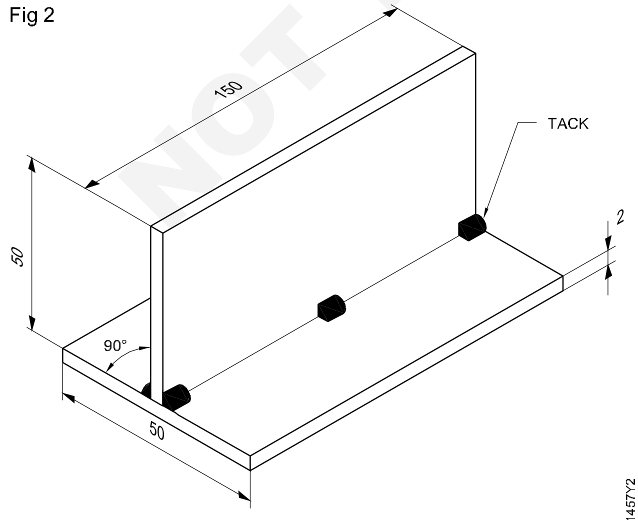


Ensure the vertical piece is perpendicular to the horizontal piece without gap of the joint.

Check with a try square for perpendicularity.

Tack-weld the joint at both ends (Fig 2) on one side of the joint.

Fig 2

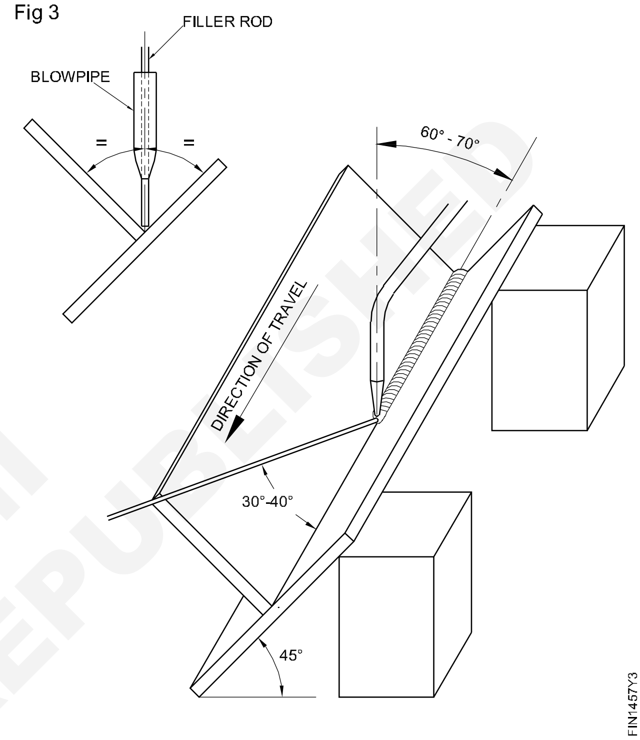


TACK WELDING A TEE JOINT

Welding of fillet 'T' joint in flat position (Fig.3)

Place the tacked joint in flat position by tilting and supporting it. (Fig.3)

Fig 3



Start welding at the right hand end of the joint by fusing the tack-weld and the parent metal to form a molten pool. Keep the blowpipe in the leftward direction at an angle of 60° to 70° and the filler rod at an angle of 30° to 40° to the line of travel. The blow pipe and filler rod should be held at 45° between the 2 surfaces of the joint. This will ensure root penetration. Watch the molten metal closely to make sure that both pieces melt uniformly. Change the angle of the blow pipe if the pieces do not melt uniformly. When the molten pool is formed add the filler rod in the centre of molten pool. Give slight side-to-side movement to the flame (blowpipe) and a piston like motion to the filler rod.

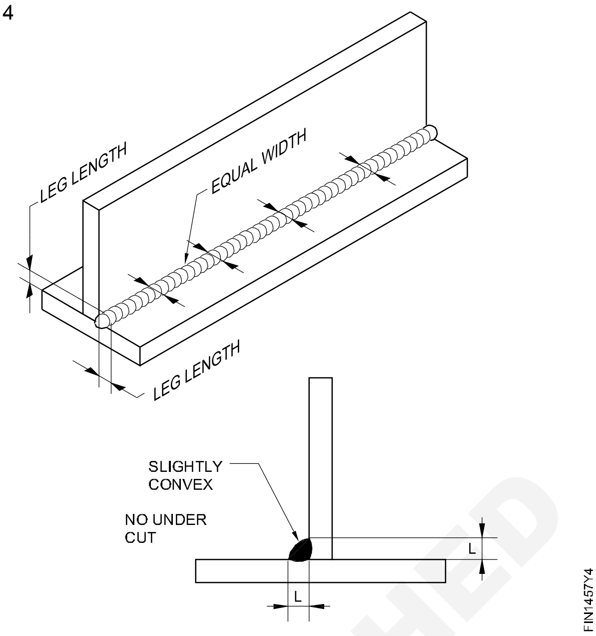
Adust the rate of travel of the blowpipe and the filler rod to secure even penetration at the root and into both sheets and to produce a fillet weld of equal leg length.

Visual inspection (Fig 4)

Clean the weldment and inspect for:

- Uniform weld size and shape of bead (reinforcement and contour slightly convex)
- Equal leg length, no undercut at the toes of the weld
- no porosity, overlap

Fig 4



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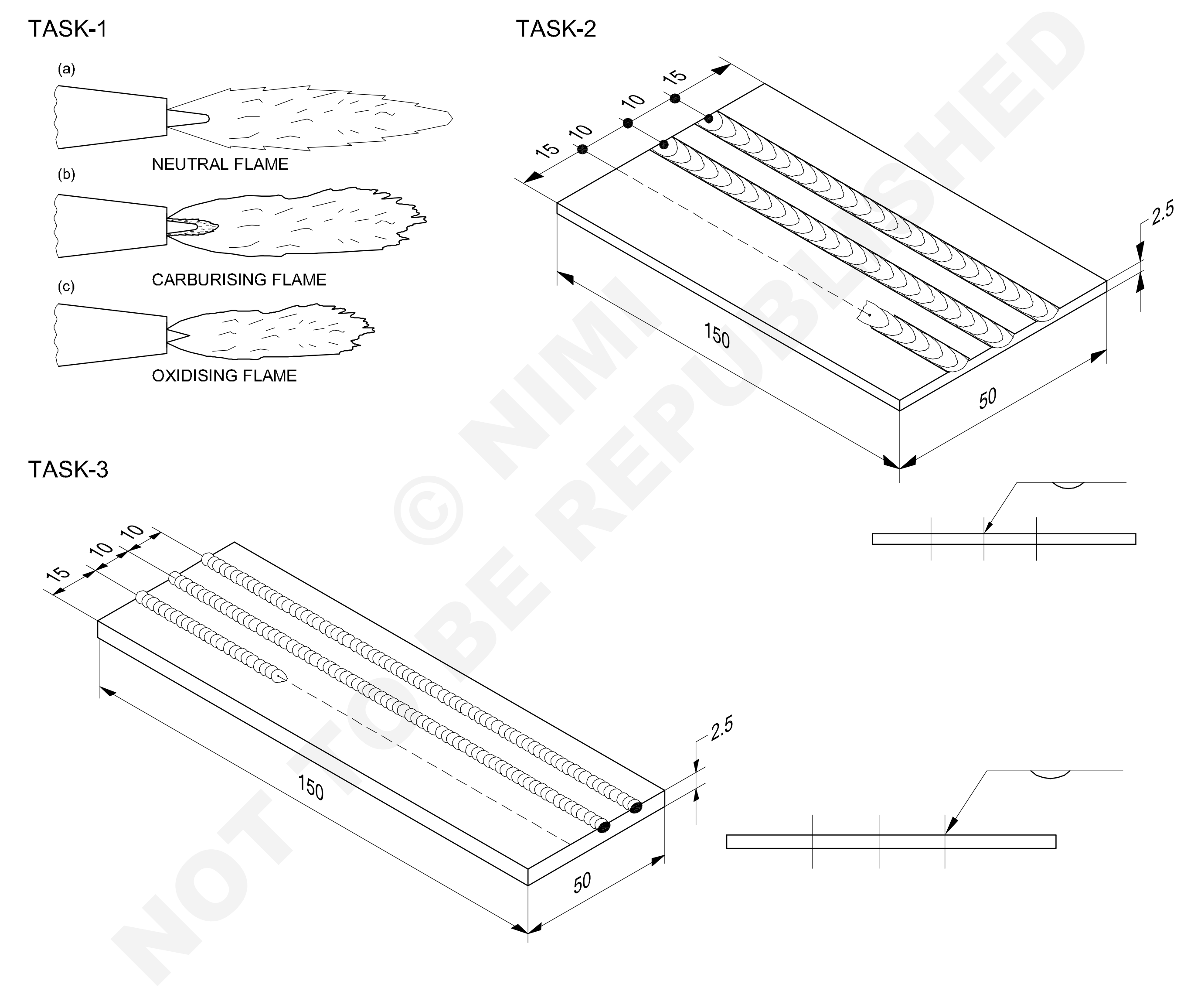
Setting up of flames, fusion runs with and without filler rod and gas

Objectives: At the end of this exercise you shall be able to
- **set gas pressure according to the nozzle size**
- **select and fit the correct size nozzle according to the job thickness**
- **set job for flat position, weld fusion run with and without filler rod using leftward technique**
- **ignite, adjust and extinguish oxy-acetylene flame**
- **shut the oxy acetylene plant for stopping work**
- **clean the weldment and visually inspect for weld defects.**



1	ISSH 150 x 2.5-50	-	Fe310-W	-	TASK 3	-
1	ISST 150 x 50 x 2.5	-	Fe310-W	-	TASK 2	1.4.58
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE	TITLE: **SETTING OF OXY-ACETYLENE FLAME (NEUTRAL, CARBURISING AND OXIDISING FLAMES)**	DEVIATIONS	TIME:
		CODE NO. FI20N1458E1	

Job Sequence

TASK 1 : **Oxy - acetylene flame setting**

- Wear safety apparel
- Open the gas cylinders and adjust the gas pressures on the regulators
- Open the control valve of the acetylene gas in the blowpipe
- Ignite the flame by using a spark lighter.

Avoid using any other source of fire

- Adjust the acetylene flow till the black smoke goes away
- Open the oxygen gas till a proper round inner cone is established without any sound in the flame. This is known as a neutral flame.
- Adjust the oxidizing flame by increasing the oxygen gas (with sharp inner cone and little hissing sound)
- Set the neutral flame again and adjust the carburizing flame by increasing the acetylene gas with the soft inner cone covered with an outer feather without any sound
- Repeat the setting of the flames till you manage to set the flame without any backfire or flash-back

Flame extinguishing and stopping work

- Extinguish the flame by closing the acetylene valve first and then the oxygen valve
- Dip the blowpipe nozzle in water to cool down by opening a little oxygen gas
- Close the cylinder valves and release all the pressure from the line

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TASK 2 : **Fusion runs without filler rod in flat position by gas**

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Clean the surface
- Set the job piece on the welding table with the left edge raised about 15mm.
- Select and attach nozzle size 5 with a blowpipe (Indian Oxygen make)
- Set the acetylene and oxygen pressure at 0.15kg/cm^2 on the regulators.
- Wear safety apparel and set the NEUTRAL flame.
- Hold the blowpipe in position with the job at the right edge with the nozzle angle 60° - 70° with the welding line (marked with punches) nozzles angle 90° with the adjoining surface distance of the flame cone 1.5mm to 3.0mm from the surface, pointing leftward.
- Start heating and fusing the surface with a slight circular motion of the blowpipe.
- Move the blowpipe in a leftward direction keeping a uniform speed as you get local fusion (small round pool of molten metal).

Avoid excessive concentration of heat. If the metal becomes too hot, lift the blowpipe momentarily away from the molten pool.

Keep the molten pool in correct size by adjusting the rate of travel and the circular motion of the blowpipe.

- Stop at the left edge and lift the blowpipe quickly.
- Extinguish the flame and cool the blowpipe in water.
- Clean the fused surface with a steel-wire brush and inspect the uniformity of fusion runs.

If the speed of travel and the blowpipe motion are correct, the FUSION RUNS will appear in uniform width and even ripples.

- Repeat the exercise till you achieve uniform FUSION.

— — — — — — — —

TASK 3 : **Fusion run with filler rod in flat position by gas**

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Set the workpiece on the welding table with the left edge raised about 15mm.
- Select the nozzles size 5 (IOL make-saffire type) and set the acetylene/oxygen pressure at 0-15 kg/cm^2.
- Select a mild steel copper coated (C.C.M.S) filler rod of Ø1.6mm.
- Wear safety apparel and set a neutral flame.
- Hold the blowpipe at an angle of 60° - 70° on a punched line of sheet and make a small molten pool at the right hand edge.

Keep a flame cone distance of 2.0 to 3.0mm from the job surface.

- Hold the filler rod in the left hand, pointing near the molten pool with an angle of 30°- 40° with the line of weld.
- Dip the end of the filler rod into the molten pool and add the filler metal on the job surface to form a weld bead.
- Move towards the left with a uniform speed along the punched line with a slight circular motion of the blowpipe and piston-like motion of the filler rod.

Add enough rod into the molten pool to build up the bead evenly in height and width.

Coordinate the rate of travel with the filler rod to control the size of the bead and the required penetration.

- Stop at the left edge, extinguish the flame and cool the nozzle.
- Clean the weld surface. Inspect for even ripples and uniform width/height of the weld bead.
- Repeat the exercise till you get good results.

— — — — — — — — —

Skill Sequence

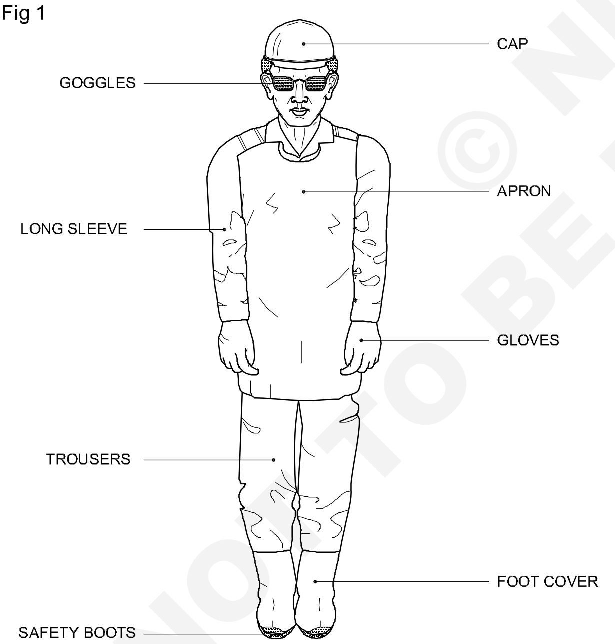
Ignite, setup and extinguish oxy-acetylene flame for gas welding (TASK 1)

Objectives: This shall help you to
- **ignite, set and extinguish an oxy-acetylene flame for gas welding correctly**
- **shut the oxy-acetylene plant for stopping work.**

Flame lighting

The safety apron, gloves and goggles are worn as shown in (Fig 1).

Fig 1



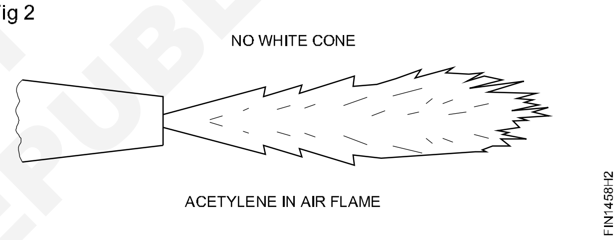
Set the pressure of oxygen and acetylene at 0.2kgf/cm^2 for a small size nozzle. (No.3)

While setting the pressure on the regulator, keep the blowpipe control valve open for accurate setting.

Open the acetylene control valve ¼ turn of the blowpipe and ignite with the help of the spark-lighter. Adjust the acetylene flow till the black smoke goes away. (Fig 2)

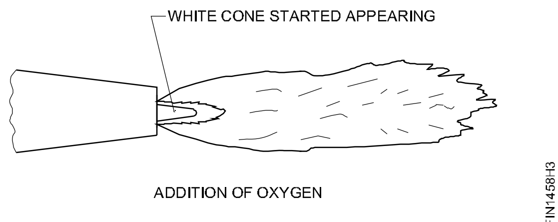
Avoid back fire or flash-back of blow pipe.

Fig 2



Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. (Fig 3)

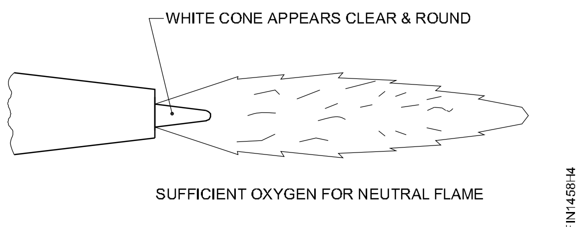
Fig 3



Flame adjustment

To adjust the neutral flame, add sufficient oxygen to make the white cone clear and round. (Fig 4)

Fig 4



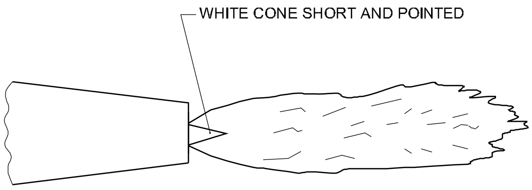
The gas mixture from the blowpipe consists of oxygen and acetylene in equal volumes.

To adjust the oxidising flame, add more oxygen.

The white cone will become short and sharp.

The flame will produce a hissing sound and will have a short length. (Fig 5)

Fig 5



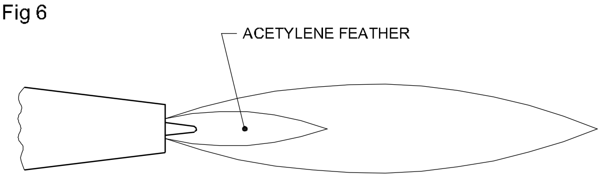
MORE OXYGEN FOR OXIDISING FLAME

To adjust a carburising flame, adjust the flame to neutral and then add acetylene.

The white cone will become long, surrounded by a feather-like portion.

The flame will burn quietly and have more length. (Fig 6)

Fig 6



MORE ACETYLENE FOR CARBURISING FLAME

Extinguishing the flame

To extinguish the flame, close the acetylene valve (blowpipe) first and then the oxygen valve.

Shutting off the plant

At the end of the work, shut off the plant as stated below.

Close the acetylene cylinder valve.

Open the blowpipe acetylene valve and release all pressure.

Release the acetylene regulator pressure adjusting screw.

Close the blowpipe acetylene valve.

Repeat the above four steps for shutting off oxygen also.

Fusion runs without filler rod in flat position by gas (TASK 2)

Objectives : This shall help you to

- **hold the blowpipe and flame in correct position to obtain proper fusion of metal**
- **make fusion runs without filler rod to produce uniform beeds**
- **visually examine the quality of fusion beeds.**

Fusion runs

Homogeneous joints are produced in gas welding by melting and fusing the metal edges with the help of a gas flame.

The beginner in gas welding must practice the following steps correctly.

Fusing of a metal using a proper gas flame.

Holding the blowpipe in a correct position.

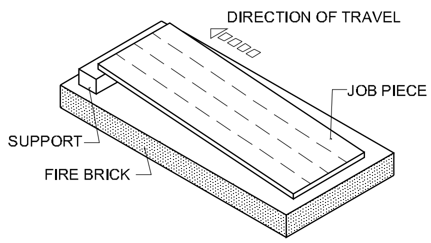
Fusion run in a straight line using the leftward technique.

Cleaning and setting the job-piece

Clean the job-piece surface with a steel-wire brush and emery paper.

Set the job-piece on a fire-brick welding table, raising the left edge app. 15mm. (Fig 1)

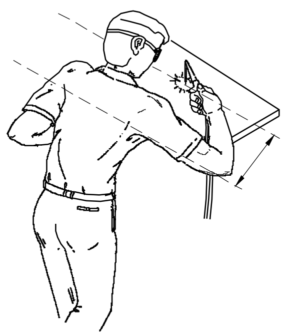
Fig 1



Holding the blowpipe and flame in correct position for proper fusion.

Hold the blowpipe and flame in such a position that the axis of the joint is parallel to the operator's body (Fig 2)

Fig 2

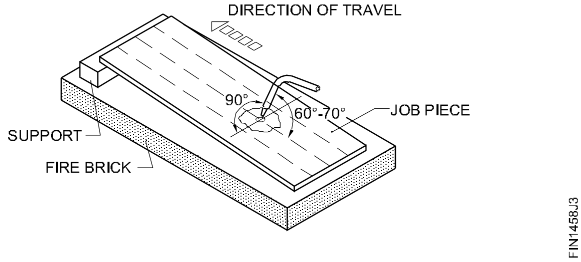


The angle of the nozzle with welding line 60°-70° (Fig.3) the fuse metal forms a small puddle on the molten pool on the job surface at the right edge (Fig 3) give a slight circular motion to the blowpipe.

Making fusion run without a rod

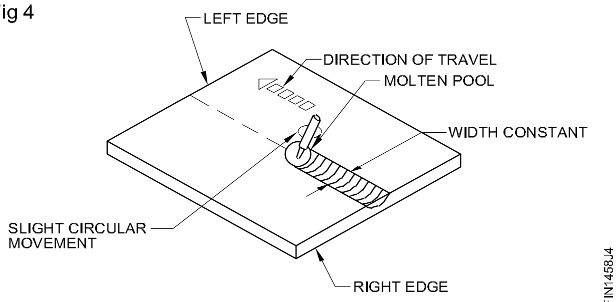
Move the blow pipe in a leftward direction as you get local fusion.

Fig 3



Keep the molten pool on the punch line. (Fig 4)

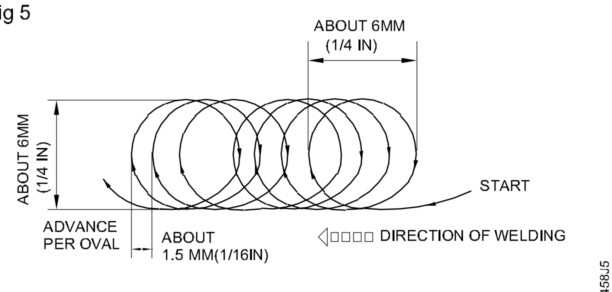
Fig 4



Maintain a constant speed of travel with a slight circular motion to the blowpipe. (Fig 5)

Maintain a constant 2-3mm of distance between the white cone of the flame and the sheet surface for a proper HEAT INPUT and avoidance of BACKFIRE.

Fig 5



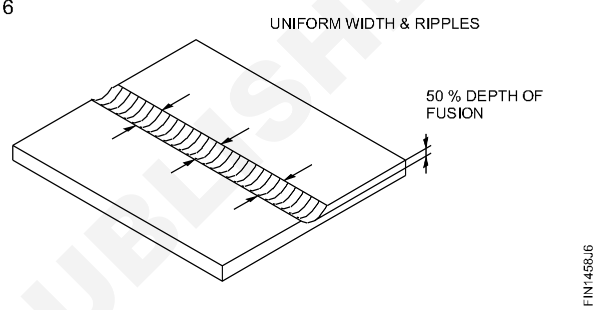
CIRCULAR MOVEMENT OF BLOW PIPE

Visual examination of fusion run

Clean the fusion run with a steel-wire brush at the end of the weld.

Inspect visually for uniform width, and ripples with the uniform depth of fusion in job thickness. (Fig 6)

Fig 6



Fusion runs with filler rod on steel plate in flat position by gas (TASK 3)

Objectives : This shall help you to
- **make fusion runs with filler rod in a straight line using leftward technique**
- **clean and inspect the weldment for faults.**

During gas welding, most of the joints require filler metal to obtain a proper, strong weld.

The feeding of the filler metal in the molten pool requires special skill, which is outlined here.

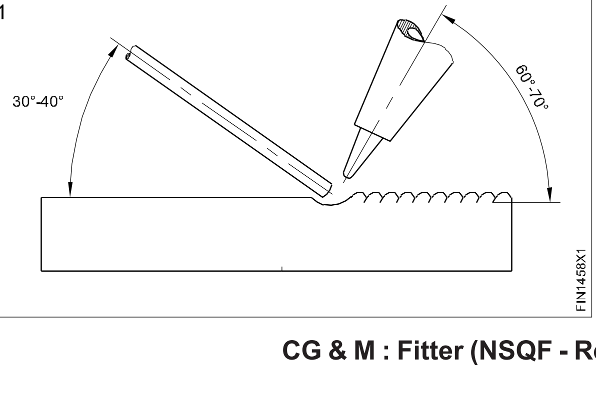
Correct position of the blowpipe and filler rod.

Hold the blowpipe and the filler rod in the correct position in respect of the job.

The blowpipe angle should be 60° - 70° with the weld line (towards right).

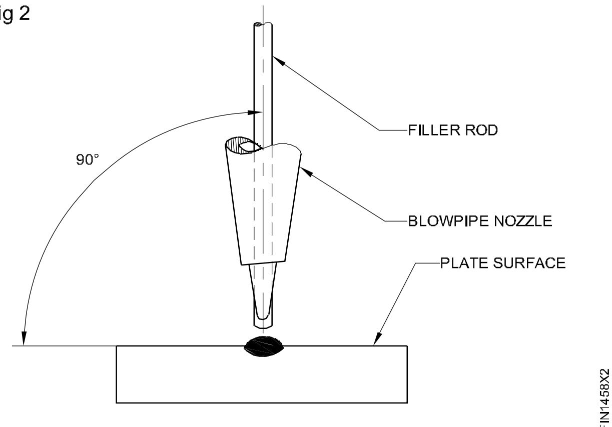
The filler rod angle should be 30° - 40° with the weld line (towards left). (Fig 1)

Fig 1



Keep the blowpipe and the filler rod at 90° to the plate surface. (Fig 2)

Fig 2

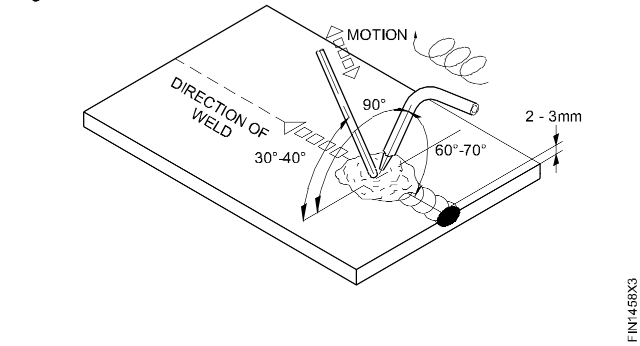


Surface fusion and filler rod addition

Fuse the metal surface and add the filler metal with proper motions; circular motion for the blowpipe, and piston-like motion for the filler rod. (Fig 3)

Maintain a flame cone distance from 2 to 3mm from the metal surface.

Fig 3



Direction of welding

Move the blow pipe in a leftward direction along as straight line to complete the weld. (Fig 4)

> **Maintain a constant 2-3mm of distance between the white cone of the flame and the sheet surface for a proper HEAT INPUT and avoidance of BACKFIRE.**

Inspection of weld

Inspect the weld bead after cleaning properly with a wire brush, for a uniform width and height of the bead, uniform ripples, and proper depth of fusion. (Fig5)

Fig 4

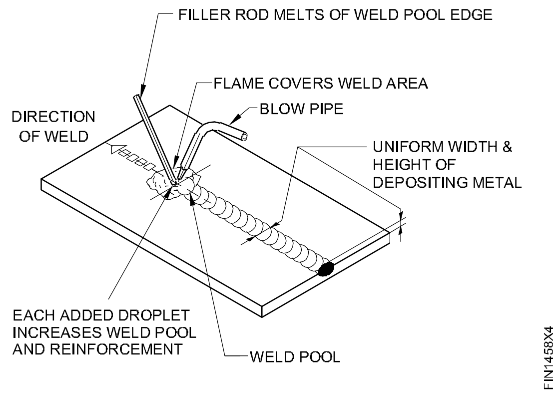
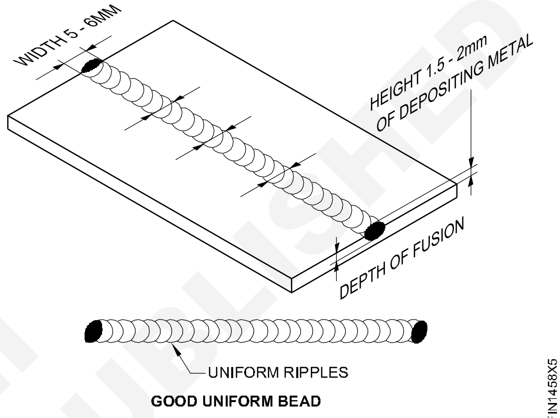


Fig 5



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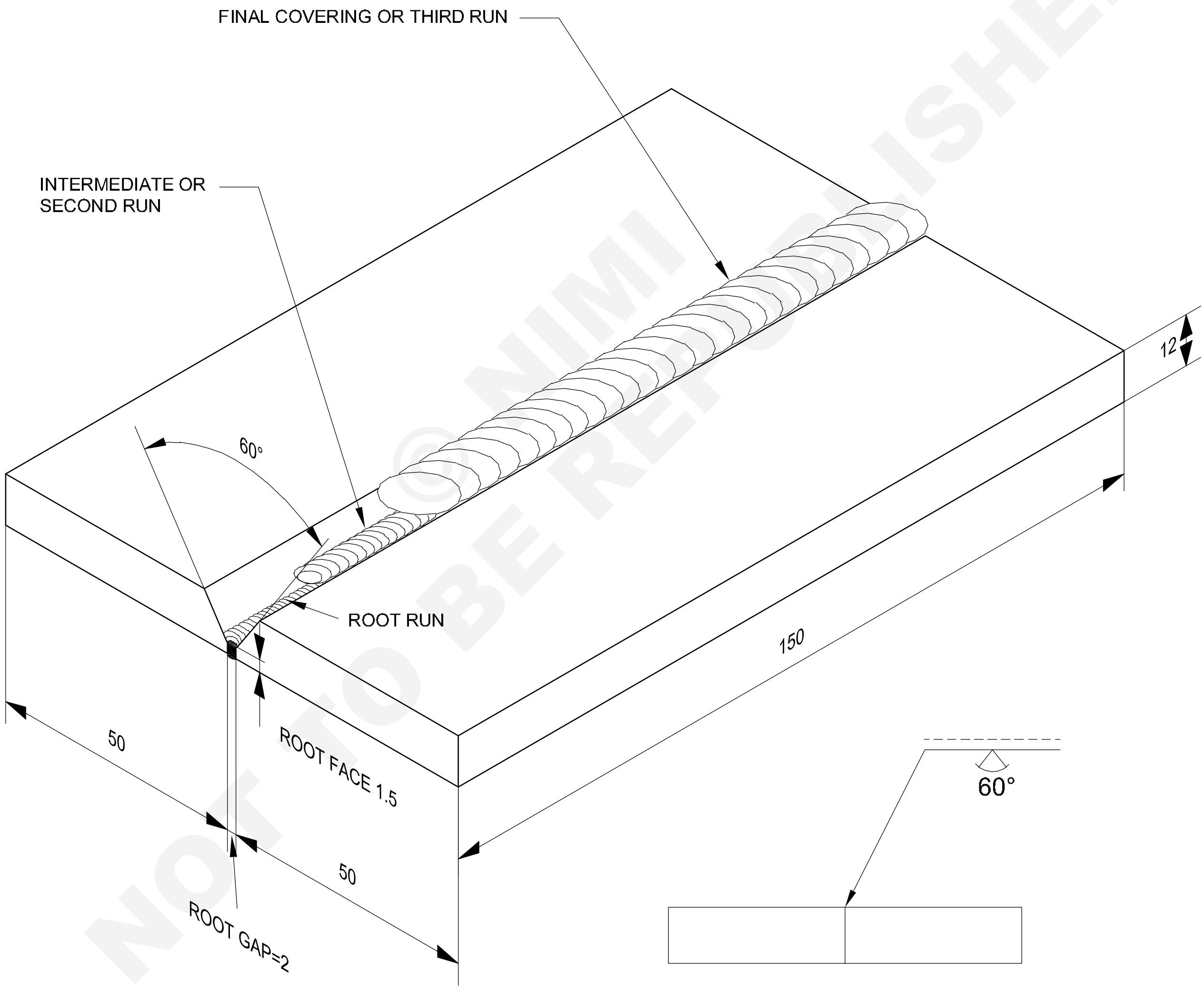
Make butt weld and corner, fillet in arc welding

Objectives: At the end of this exercise you shall be able to
- **bevel the plate edges by gas cutting for single vee butt joint**
- **grind the gas-cut bevel edges with proper root face for single Vee butt joint**
- **set the plates with a root gap of 2mm and proper distortion allowance for single Vee butt joint**
- **control arc blow**
- **deposit root run in single Vee butt joint to ensure complete penetration**
- **deposit intermediate and final covering runs in single Vee butt joint to obtain proper fusion and reinforcement**
- **clean and inspect the groove weld for surface defects and uniform root penetration.**

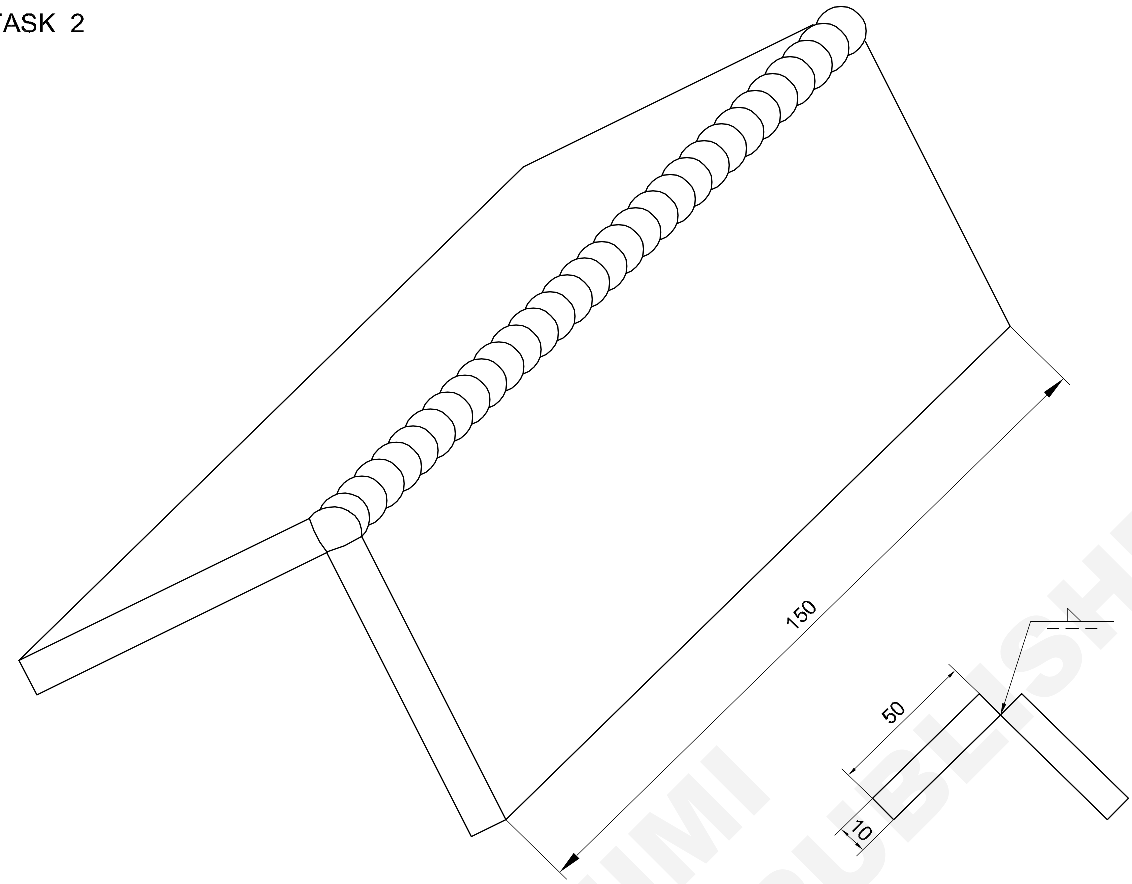
TASK 1



2	50 ISF 12 - 150		Fe 310 - W		TASK 1	1.4.59
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SINGLE 'V' BUTT JOINT IN FLAT POSITION BY ARC WELDING	TOLERANCE ±0.5mm	TIME
		CODE NO: FI20N1459E1	

TASK 2

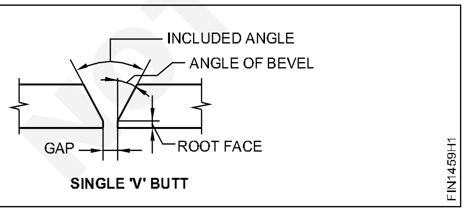


Job Sequence

TASK 1 : **Single 'V' butt joint in flat position by arc welding**

- Straight cut two 12mm thick plates by gas cutting as per drawing and grind them to size.
- Mark the bevel to 30° angle using bevel protractor in two plates.
- Punch witness marks
- Bevel the edges of each plate to 30° angle by gas cutting and file the root face as per drawing for edge preparation single 'V' Butt of joint. (Fig.1)

Fig 1



- Clean the plates from dirt, water, oil grease, paint etc.
- Keep the plates inverted in the form of a butt joint with proper root gap.
- Maintain a distortion allowance of 1.5° on each side of the joint.
- Wear all protective clothings.
- Use a 3.15mm medium coated MS electrode and set 110 amperes current. In case of DC welding machine connect the electrode cable to the negative terminal of the machine.
- Tack weld on the back side of the plates at the ends. The length of tack should be 20mm.
- De-slag the tack weld and clean.

2	50 ISF 10 - 150		Fe 310		TASK 2	1.4.59
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FILLET WELD IN OPEN CORNER JOINT IN FLAT POSITION BY ARC WELDING**	TOLERANCE: ±0.5mm	TIME :
		CODE NO. FI20N1459E1	

- De-slag and clean the root run and inspect root penetration.
- Position the tack welded job on the table in flat position (the single V portion facing up)
- Deposit the root run and fill the crater as done for welding square butt joint.
- Take special care to maintain key hole to ensure proper melting of root face and root penetration.
- Deposit the second run/intermittent run using 4mm medium coated electrode and 150-160 ampere current, short arc and proper weaving of the electrode. Avoid excessive weaving and ensure normal travel speed.
- Fill the crater wherever necessary.
- De-slag.
- Deposit the third run/covering run using the same parameter and technique used for 2nd run. Ensure a proper reinforcement of 1 to 1.5mm and avoid undercut.
- Inspect for any surface weld defect.

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TASK 2 : **Fillet weld in open corner joint in flat position by arc welding**

- Prepare job plates to size as per drawing.
- Clean the joining edges and surfaces of plates.
- Set the plates as an open corner joint with a root gap of 2.5 mm using an angle iron jig.
- Select correct polarity, if a DC generator is used.
- Tack the joint pieces at both ends using Ø 3.15 mm medium coated MS electrode and 100-110 amps current from inside of the joint.
- Ensure safety apparels are worn. Use a proper method to control distortion.
- Clean the tacks, check alignment and reset the joint, if required.
- Set the joint on the welding table in a flat position.
- Deposit root run in the joint by forming a keyhole and obtain complete penetration.
- De-slag and clean the root run and inspect root penetration.

Ensure the crown of penetration is not more than 1.6 mm in height.

- Grind and dress the face of the root run, if required.
- Set the welding current 160 amps for ∅ 4mm medium coated M.S. electrode.
- Deposit an intermediate layer i.e. second run over the root run with slight weaving motion using ∅4mm electrode.
- Clean the intermediate layer thoroughly and inspect for faults. Rectify the defects, if any.
- Deposit the final layer to the weld size using the same current setting, electrode and weaving motion as used for the second layer.
- Clean the final layer for inspection.
- Inspect the corner fillet weld:
  – to ensure uniform and correct reinforcement
  – to ensure that the weld face is free from porosity, slag inclusion, unfilled crater, overlap and edge of plate melted off/insufficient throat thickness.

Skill Sequence

Single 'Vee' butt joint in flat position by arc (TASK 1)

Objectives: This shall help you to
- **single 'vee' butt joint in flat position by welding**
- **prepare the plate edges for single vee butt joint**
- **set the plates with a root gap of 2mm and proper destortion allowance for single 'vee' butt joint**
- **deposit root bead in termediate and final covering runs in single 'vee' butt joint**
- **clean and inspect the weld for surface defects.**

Preparation of the pieces (Fig 1)

Cut a 30^0 bevel on each pieces using oxy-acetylene cutting.

Grind the edges to remove oxide deposits on the bevel.

Prepare a uniform root faces of 1.5mm by filing on both the bevelled edges.

Setting the single Vee butt joint and tacking

Keep the bevel edges upside down with a root gap of 2mm, and 3^0 distotion allowance. (Fig 2) using suitable support i.e. 1.5^0 on each side of the joint.

Tack-well on both ends. (20mm long)

Ensure safety apparels are worn.

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Fig 1

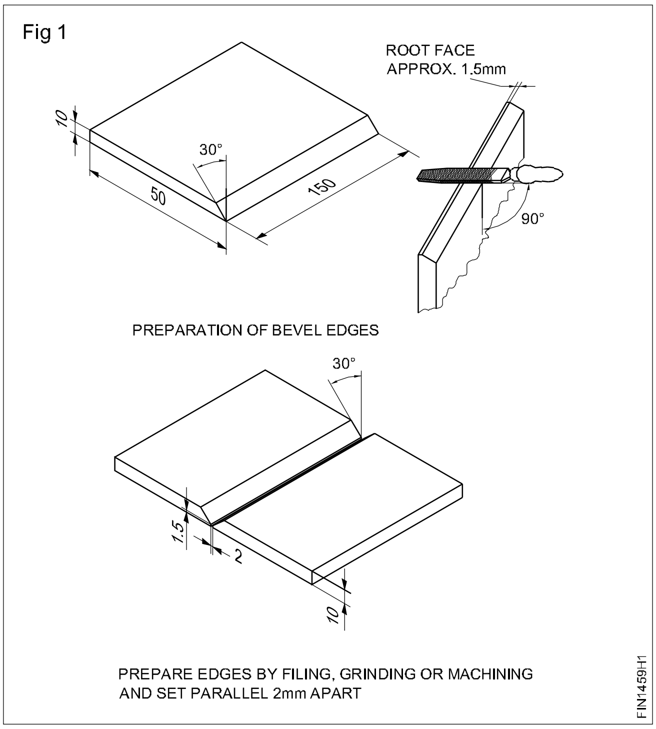
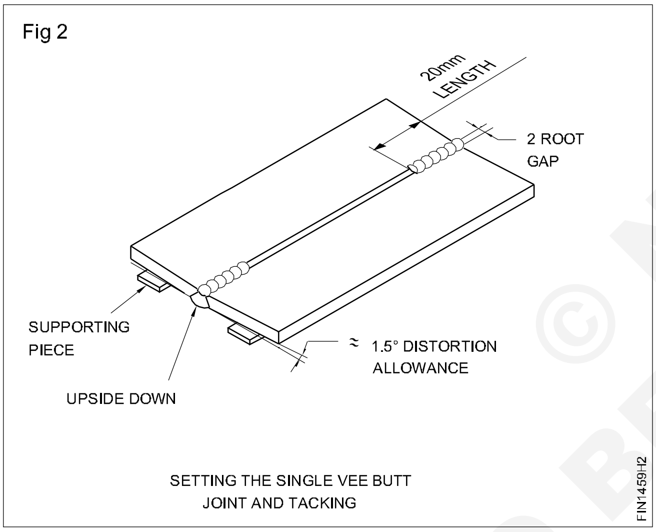


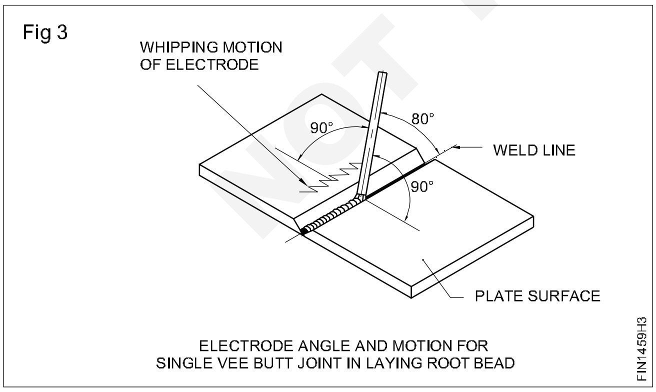
Fig 2



Place the joint in flat position after tacking.

Deposition of root bead (Fig 3)

Fig 3



Deposit root bead using a Ø3.15 M.S. electrode and 110 amps welding current.

Proceed with a uniform normal speed holding a short arc.

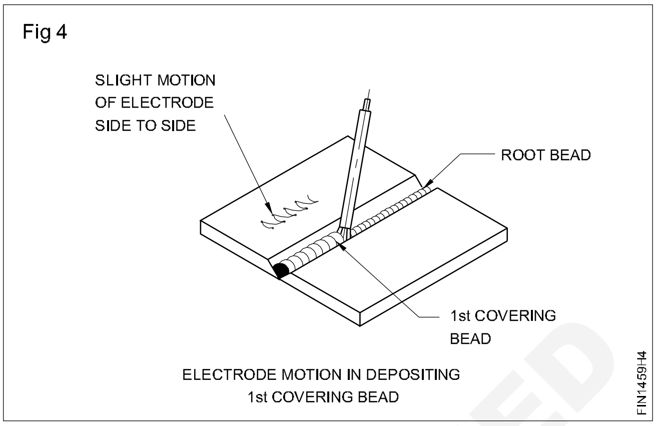
Keep the electrode angle (as shown in Fig 3) at 80^0 to the line of weld.

Give a whipping motion to the electrode to maintain the size of the KEYHOLE for correct penetration.

Clean the root bead, and observe penetration.

Deposition of hot pass & caping beads (Fig 4)

Fig 4



Deposit the 1st covering bead using a 4.00mm dia medium coated M.S.electrode and 160 amps welding current.

Proceed with a uniform speed, holding a normal short arc and a side-to side weaving motion to the electrode.

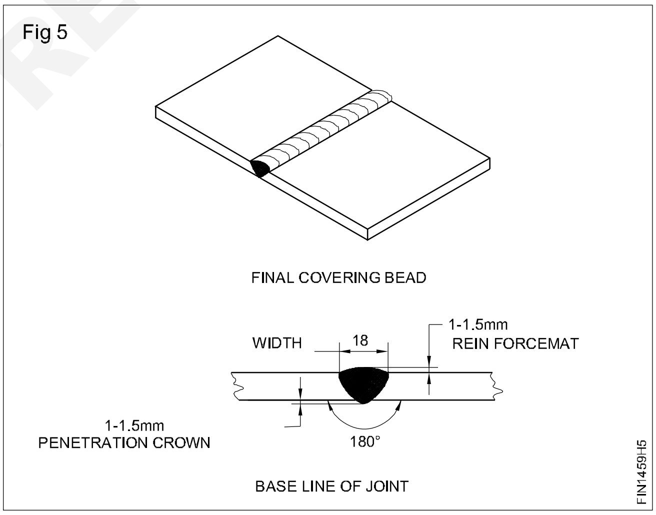
Ensure the electrode angle is the same as it was for the root bead.

Clean the bead thoroughy and grind the humps in beads (if present).

Rectify possible defects, if any.

Deposition of final/caping bead (Fig 5)

Fig 5



Deposit the final covering bead using a Ø5.mm M.S. electrode, 220 amps welding current, and imparting a wider side-to-side weaving motion to the electrodes. Pause (stop) the electrode weaving at the toes of the weld so that undercut defect will get eliminated.

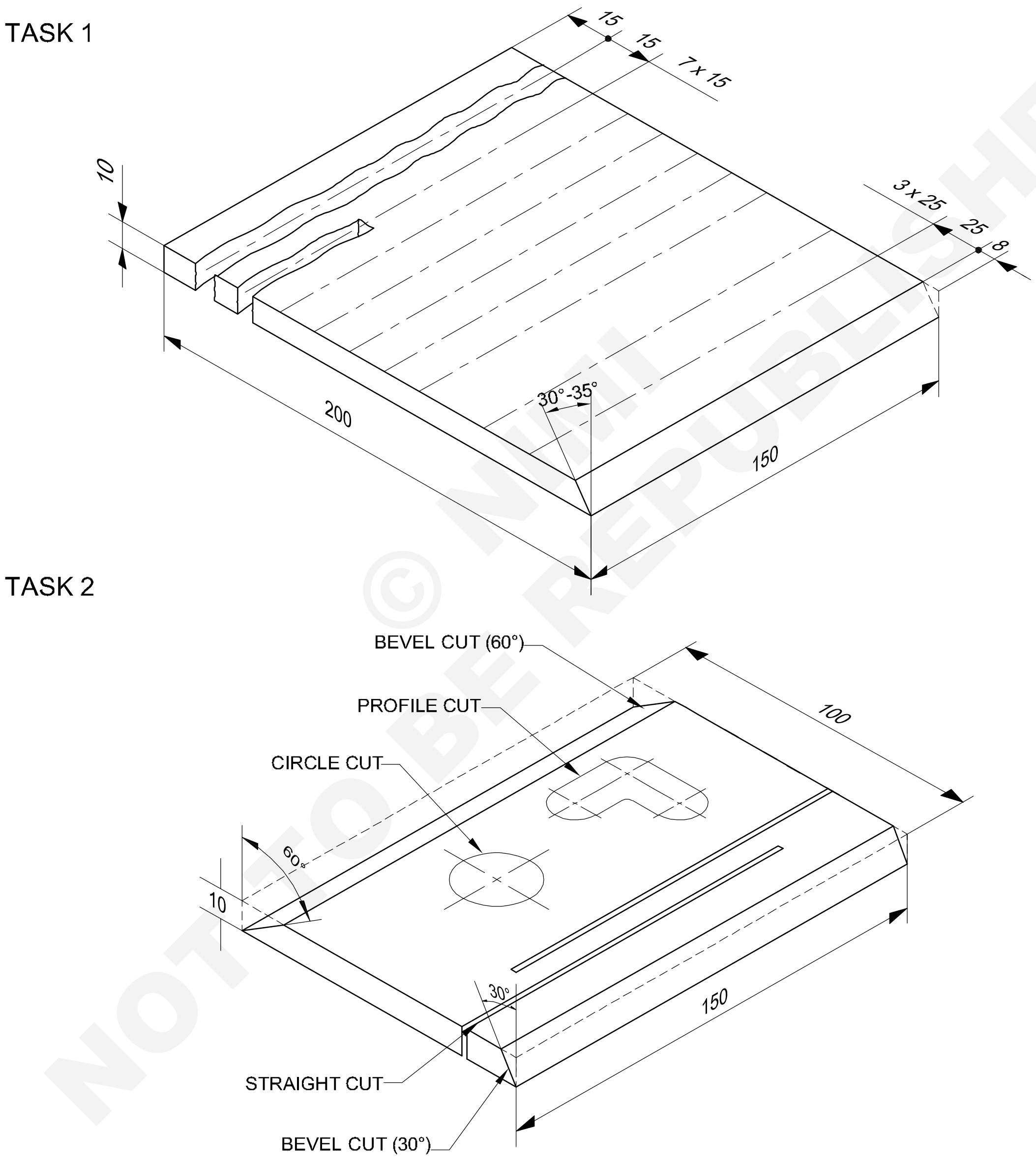
Cleaning and inspection

Clean the welded jont thoroughly from both sides.

Inspect the weld size, surface defects, root penetration and distortion.

Gas cutting of MS plates

Objectives: At the end of this exercise you shall be able to
- **mark cutting lines on the plate by keeping proper cutting allowance**
- **set the job for straight, bevel, circle and profile cutting**
- **select the cutting nozzle number and the cutting oxygen pressure for different plate thickness**
- **adjust the preheating flame and preheat the metals**
- **cut straight line bevel, circle and profile by hand and machine**
- **clean the gas cut edges and inspect for defects.**



1	100 ISF 10 - 150		Fe310 - W		TASK 2	-
1	150 ISF 10 - 200		Fe 310 - W		TASK 1	1.4.60
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**OXY-ACETYLENE HAND CUTTING STRAIGHT ,BEVEL CUT,CIRCLE AND PROFILE**	TOLERANCE ±0.5mm	TIME :
		CODE NO : FI20N1460E1	

Job Sequence

TASK 1 : **Oxy - acetylene hand cutting straight and bevel cut**

- Wear all safety clothing.
- Set the gas welding plant with a cutting blowpipe, and cutting oxygen regulator.
- Fit the correct cutting nozzle according to the thickness of the metal to be cut (for M.S. plate 10mm thickness use 1.2mm dia. orifice cutting nozzle)
- Adjust both oxygen and acetylene gas pressure according to the cutting nozzle size. (Oxygen 1.6 kgf/sq.cm and acetylene 0.15 kgf/sq.cm)

While adjusting the pressure keep the cutting blow pipe walls open

- Check the size of the raw material
- Mark and file to size 200x150x10
- Clean the plate from dirt, oil, grease paint, water etc.
- Mark gas cutting lines as per drawing.
- Punch witness marks on cutting lines
- Set the job on cutting table.
- Set the neutral flame.
- Wear the gas welding goggles.
- Hold the blowpipe at an angle of 90^0 between the line of cut and the cutting nozzle axis is between the nozzle and the surface of the plate.
- Heat one end of the punched line up to cherry red hot condition.
- Keep the distance between the workpiece and the tip of the nozzle about 5mm.
- Place the preheat cone approximate 1.6mm above the plate.
- Move the flame in circle a little larger than the tip size. When metal is heated to Cherry red, move the tip to the edge of the plate.
- Operate the cutting oxygen lever immediately and move the torch slowly along cutting direction.
- Maintain correct torch speed and distance between the plate surface and the nozzle up to the end of the cut.
- If long plates are to be cut, to get a good straight gas cut surface, clamp a straight edged flat parallel to the line of cut and use a spade guide attached to the cutting torch. Move the torch uniformly along the clamped flat and pressing the spade guide against the flat.
- On completion of the cut release the cutting oxygen lever and shut off the flame.
- Clean the cut surface by wire brush after chipping off any slag sticking to the cut edge.

Making bevel cuts

- The best method for obtaining a good bevel with a minimum slag is to cut and bevel at the same time.
- Mark and punch straight lines 25mm apart.
- For cutting a bevel keep one or two flats on the plates to be bevelled and angle the cutting nozzle by resting the nozzle over the flats.
- Hold the torch in left hand, light it, tilt it to 30-35^0 of the perpendicular.
- Preheat and start the cut holding the torch on both hands as done in straight line-cutting. Avoid kerf filling by increasing travel speed.
- On reaching the end, cutting should continue for another 6mm or more to get a complete cut.
- Shut off the torch at the end and dip it in water and chip off the slag.
- Repeat the exercise till a good and smooth cut is achieved.
- To bevel the edge of a long plate with a clean and good gas cut surface, use a bevelling attachment to the torch and tilt the nozzle of the torch to the required angle of bevel.

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TASK 2 : **Oxy - acetylene machine cutting**

- Check the size of the raw material.
- Mark and file to size
- Mark the gas cutting lines atraight bevel, circle and profile as per drawing.
- Punch witness marks on the gas cutting marked line.
- Set the cutting machine and connect the oxygen and acetylene cylinders, regulators to the hoses of the machine and fix a suitable cutting nozzle.
- Fit the circular and profile template on the cutting machine table.
- Clean the surface of the metal plate to be cut.
- Select and fix the nozzle as per the thickness of the plate to be cut.
- Clean the track on which the cutting torch assembly unit is mounted and the circular and profile templates and make sure that there is no dirt on them.
- Check the starting lever and ensure that it is in neutral position.
- Set the required pressure of oxygen and acetylene according to the size of the nozzle.

- Set the required speed in the speed control dial according to the thickness of the metal to be cut.
- Adjust the nozzle to a height such that the inner cone of the preheating flame is 3 mm from the surface of the metal to be cut.
- Place the cutting machine at the starting point.
- Ignite and set the neutral flame.
- Allow for sufficient preheating, and then switch 'on' the jet of oxygen.
- Simultaneously switch 'on' the machine to move the cutting unit forward with the correct speed on the rails to make a straight line cut.
- Stop the machine and turn the switch to neutral position at the end of the cut.
- Set the cutting nozzle to 30^0 angle and cut the bevel similar to the straight line cut.
- Turn the job plate by 180^0 and cut the 60^0 bevel angle by setting the cutting nozzle to 60^0.
- Arrest the linear movement of the cutting unit of the machine with the rails using a clamp and attach it to the pivot block used for cutting circle and profiles.
- Set the pivot block to get the required diameter and fix it on the machine table.
- Set the cutting nozzle perpendicular to the job plate and ignite it and set the preheating flame.
- When the plate becomes red hot, open the stream of cutting oxygen and cut the circle.
- For profile cutting, attach the template of the profile to the machine table and make the cutting head unit to follow the profile.
- After the cut is over stop all machine movements and remove the slag from all the gas cut surfaces.
- Use tongs while handling the gas cut job.
- Ensure that the molten slag during cutting, and solidified hot slag chipped after cutting, fall into a collecting trough kept below the table.
- Clean the cutting edges from slag and inspect the cut for gas cutting defects.

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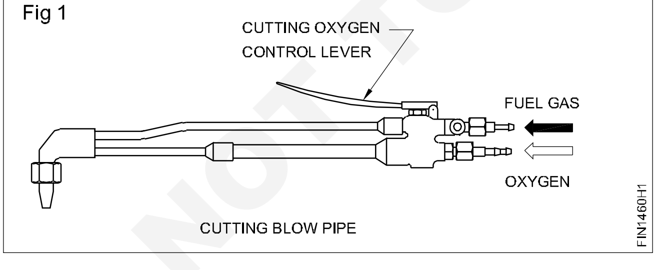
Skill Sequence

Oxy-acetylene hand cutting straight and bevel cut

Objectives: This shall help you to
- **set the gas cutting plant**
- **set the job for cutting**
- **adjust the cutting flame for gas cutting.**

Setting the gas cutting plant: Set the oxy-acetylene gas cutting plant in the same way as was done for welding and connect the cutting blowpipe in the place of the welding blowpipe. (Fig 1) Also change the oxygen welding regulator with oxygen cutting regulator.

Fig 1

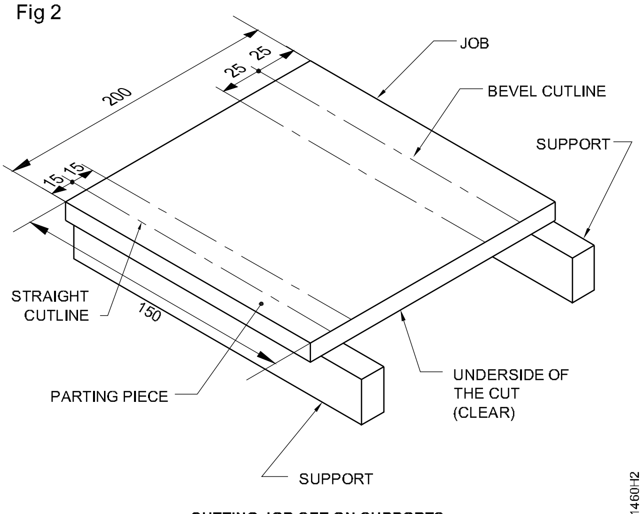


Setting the job for straight line cutting (Fig 2): Mark and punch 7 straight lines on the plate 15 mm apart for a straight line cut and 3 lines 25mm apart for bevel cutting on other edge.

Set the job on the cutting table so that the parting piece is free to fall.

Ensure that the underside of the cutting line is clear and no combustible materials are lying nearby.

Fig 2



CUTTING JOB SET ON SUPPORTS

Adjusting cutting flame: Select the cutting nozzle and set the gas pressure as per the cutting job thickness. (Table 1)

The bevel thickness will be more for bevel cut, when compared with a square cut for same thickness.

TABLE 1

Data for cutting

Diameter of cutting oxygen orifice nozzle	Thickness of steel plate	Cutting oxygen pressure
(1) mm	(2) mm	(3) kgf/cm^2
0.8	3.6	1.0 - 1.4
1.2	6.19	1.4 - 2.1
1.6	19 - 100	2.1 - 4.2
2.0	100 - 150	4.2 - 4.6
2.4	150 - 200	4.6 - 4.9
2.8	200 - 250	4.9 - 5.5
3.2	250 - 300	5.5 - 5.6

Acetylene pressure should be 0.15 kgf/cm^2 for all thickness of plates.

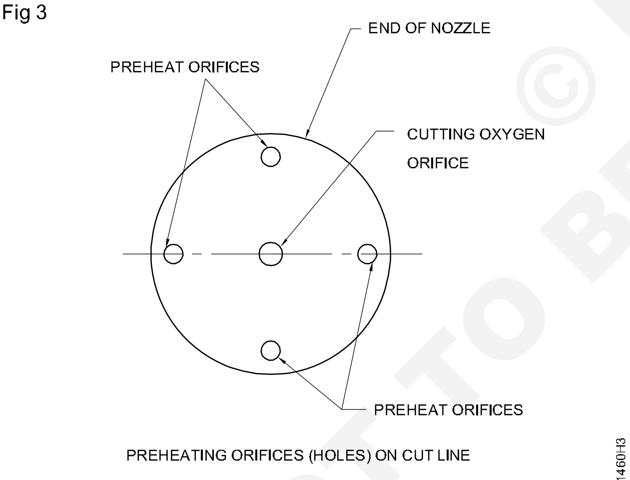
Select ø1.2 mm (orifice) cutting nozzle for cutting a 10 mm thick plate.

Set 1.6 kgf/sq.cm pressure for the cutting oxygen and 0.15 kgf/sq.cm pressure for the acetylene gas.

Ensure safety apparel is worn.

Fix the cutting nozzle into the cutting blowpipe correctly. (Fig 3)

Fig 3

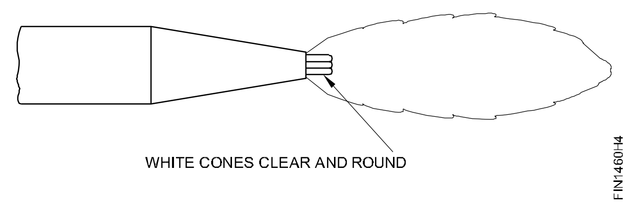


SETTING OF CUTTING NOZZLE

Check for leakage in the blowpipe connections of oxygen and actylene gas lines.

Adjust the neutral flame for preheating. (Fig 4)

Fig 4



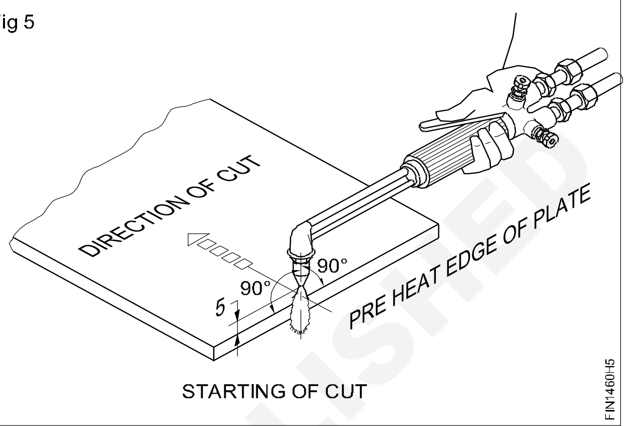
Ensure that the flame adjustment is not disturbed while operating the cutting oxygen lever.

Straight line cutting: Keep the hand cutting blowpipe at 90° angle with the plate surface and start cutting a straight line. (Fig 5)

Preheat the starting point to red heat before pressing the cutting oxygen lever. (Fig 5)

Keep the distance between the workpiece and the nozzle about 5 mm to avoid backfire. (Fig 5)

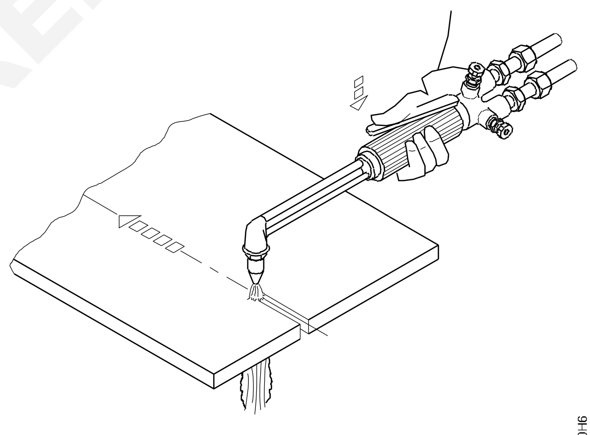
Fig 5



STARTING OF CUT

Release the cutting oxygen by pressing the cutting oxygen control lever and start the cutting action and move the blowpipe along the punched line with uniform speed. (Fig 6)

Fig 6



CUT IN PROGRESS

Ensure straight travel without any side-to-side movement.

The nozzle angle is 90° with the plate surface till the completion of cut.

Open the cutting oxygen valve fully.

If possible fix a straight edge or template to the plate and fix a support to the cutting nozzle so as to ensure constant distance between the tip of the nozzle and the plate surface and maintain a uniform straight cut. (Fig 7)

Inspect the cutting for

– uniform and smooth cut or drag line
– straightness, sharpness.
– width of the cut (Kerf) Fig 8

Fig 7

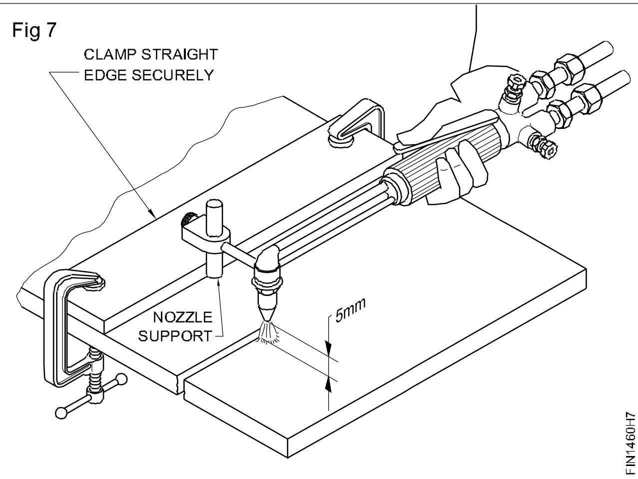
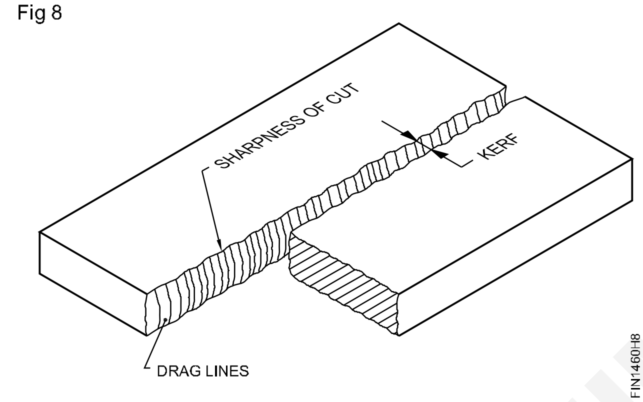
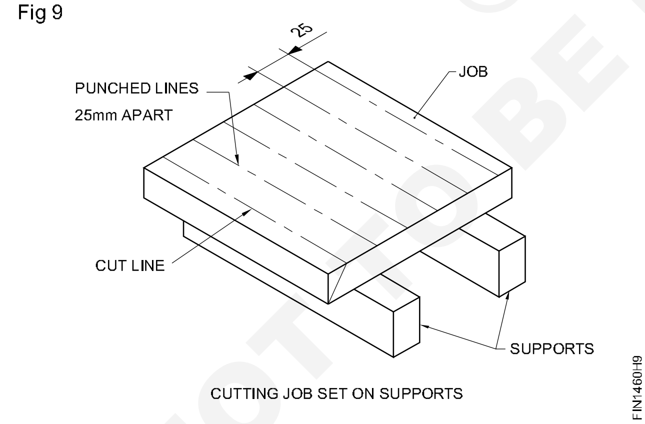


Fig 8



Bevel cutting: Set the job as shown in Fig 9. Hold the cutting blowpipe (nozzle) at (required) 60 - 55° angle so that the bevel angle on the plate will be 30 - 35^0. (Fig 10)

Fig 9

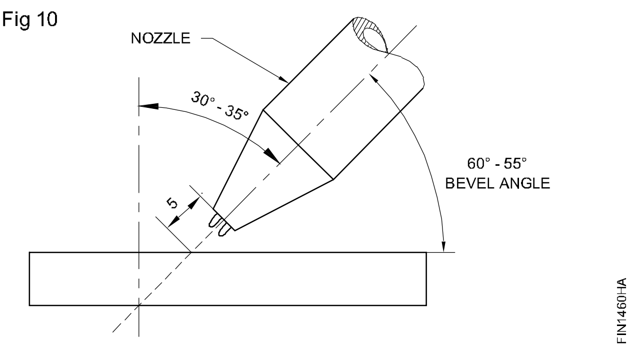


There should not be any obstruction at the underside of the cutline and the parting piece from the job should be free to fall.

Preheat the starting point to cherry red colour.

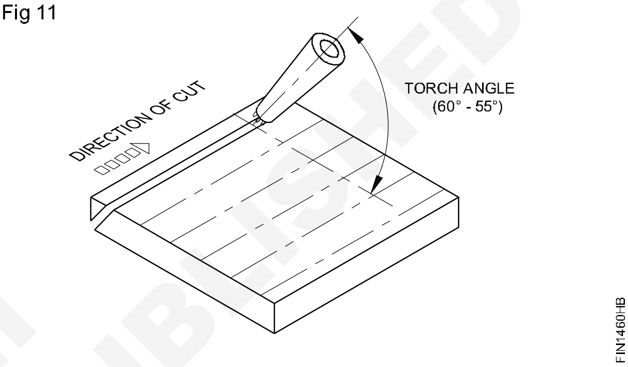
Keep the distance between the workpiece and the nozzle about 5mm to avoid backfire. (Fig.10)

Fig 10



Release extra oxygen by pressing the cutting oxygen lever, observe the cutting action and start moving along the punched line with uniform speed. (Fig 11)

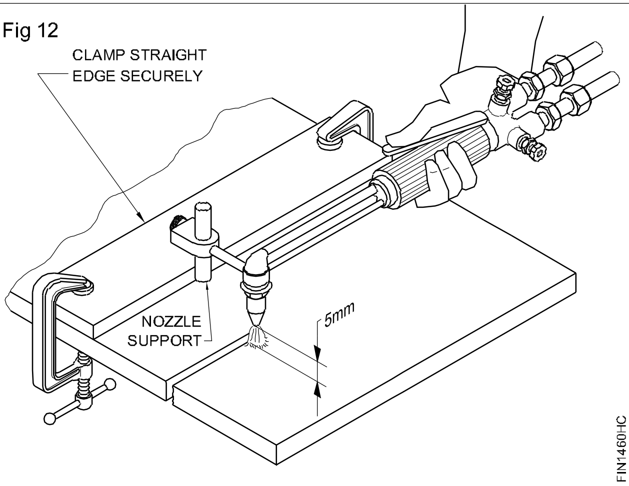
Fig 11



Keep less cutting speed than you would use for a straight cut for the same thickness.

Fix one or more straight bar to the cutting job to ensure the cut is along the straight line and also able to maintain the correct angle. (Fig 12)

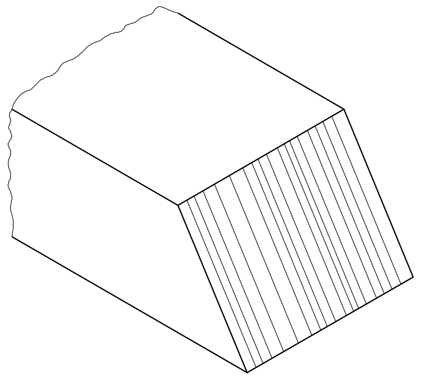
Fig 12



Inspection of bevel cut: Clean the slag if sticking to the cut surface by a chipping hammer and wire brush and inspect for any gas cutting defects.

GOOD QUALITY is shown by excellent top edge and extremely smooth cut face. The cut part is dimensionally accurate. (Fig 13)

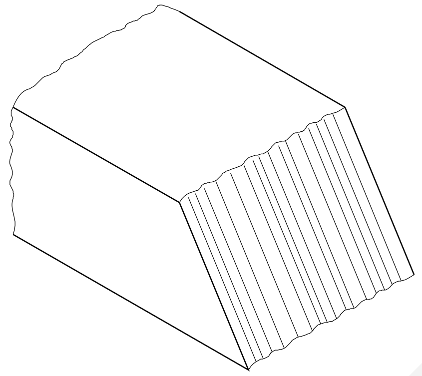
Fig 13



FIN1460HD

POOR QUALITY results in gouging which is a most common fault. This is caused either by excess speed or too low a preheat flame. (Fig 14)

Fig 14



FIN1460HE

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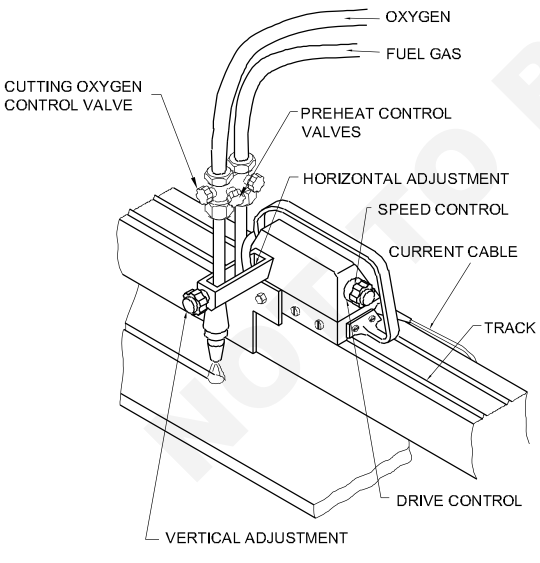
Oxy-acetylene machine cutting (straight, bevel, circle and profile) (TASK 2)

Objectives: This shall help you to
- **assembly of the portable cutting machine**
- **set the gas pressure to the size of nozzle**
- **cut the profiles by portable cutting machine.**

The assembly of the machine, the use of templates or systems of reproduction, the position of the work, the speed range and cutting nozzles vary according to the type of the machines.

Assemble the accessorises like cutting head for straight and bevel cutting with the cutting machine. (Fig.1)

Fig 1



PORTABLE CUTTING MACHINE

FIN1460J1

Select the 1.2mm size of the cutting nozzle for 10mm thick plate.

Set the correct gas pressure of 0.15kgf/cm^2 for acetylene and 1.4 to 2 kgf/cm^2 for oxygen for 1.2mm size nozzle.

Set the machine to run freely as per the regulated speed i.e 50cm/min for 10mm thick plate.

Ignite the flame and adjust the neutral flame.

Set the nozzle tip to a correct distance from the surface of the plate to be cut i.e. about 7 to 8mm.

Start the machine and run to the required distance to cut the metal.

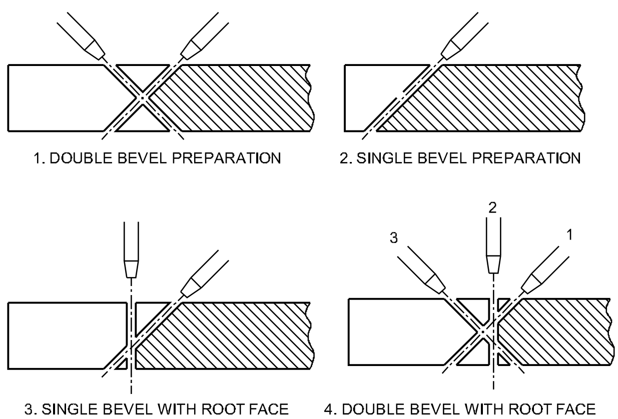
Switch 'off' the machine and extinguish the flame at the end of the cut.

Remove the plate, clean the iron oxide slag and inspect the cut surface.

For cutting a bevel edge tilt the cutting torch nozzle to the required angle and follow the same skill sequence followed for straight line cutting. (Fig.2)

Fig 2

PLATE EDGE PREPARATIONS PRODUCED BY ARRANGEMENT OF CUTTING HEADS SHOWN



FIN1460J2

Start the machine and run to the required distance to cut the metal.

Switch 'off' the machine and extinguish the flame at the end of the cut.

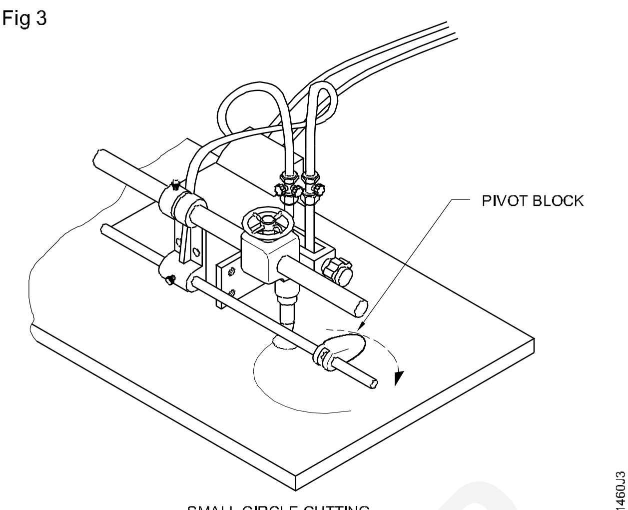
Remove the plate, clean the iron oxide slag and inspect the cut surface.

For cutting a bevel edge tilt the cutting torch nozzle to the required angle and follow the same skill sequence followed for straight line cutting. Fig 2.

For cutting a circle, attach cutting torch nozzle to the pivot block (Fig.3) and follow the same method used to cut straight line and bevel. It is important to pierce a small hole inside the circumference of the circle to be cut and then move the torch to the nearest point on the circumference. Then use the pivot block to move the flame along the circumference of the circle.

To cut a profile the same sequence used for circle cutting is followed except that a template similar to the profile to be cut is mounted on the table and a tracer attached to the cutting head will follow the template profile. The torch flame will cut the profile on the job.

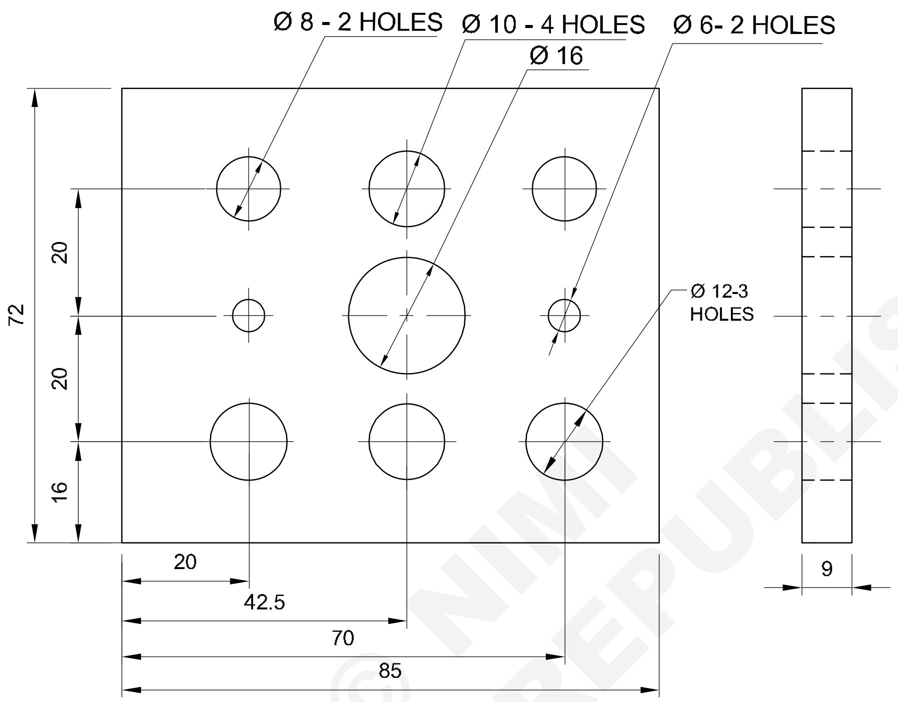
Fig 3



SMALL CIRCLE CUTTING

Mark off and drill through holes

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



Job Sequence

- Check the raw material for its size.
- File and finish to size 85 x 72 x 9 mm maintaining parallelism and perpendicularity.
- Mark drill holes as per drawing.
- Punch on drill hole centres using centre punch 90°
- Make centre drill in all drill hole centres.
- Fix Ø 6 mm drill and drill pilot holes in all centre drilled holes.
- Similarly fix Ø 8 mm, Ø 10 mm, Ø 12 mm, and 16mm drill in drilling machine and drill holes as per drawing.
- Finish de - burr in all the corners of the job.
- Check the size with vernier caliper.
- Apply a thin coat of oil and preserve it for evaluation.

1	75 ISF 10-90	-	Fe310	-	-	1.5.61
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE NTS	MARK OFF AND DRILL THROUGH HOLES				TOLERANCE : ± 0.04	TIME :
					CODE NO : FI20N1561E1	

Skill Sequence

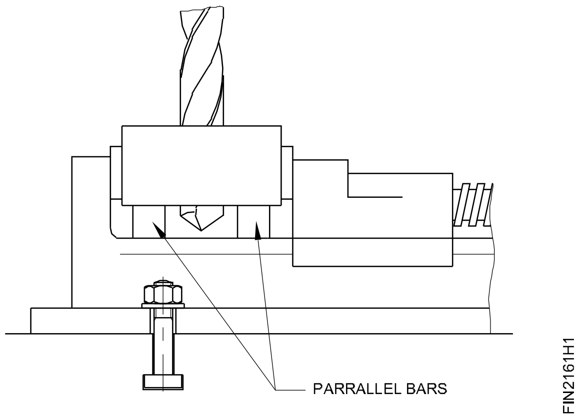
Drilling through holes

Objective: This shall help you to
- **drill through holes**

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 centre drill and drill in all hole centres.

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

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

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

Similarly, drill Ø 8mm hole, then drill 10 mm, 12 mm holes.

Remove the drill and drill chuck.

Fix Ø 16 mm taper shank drill in the drilling machine spindle.

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

> **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)

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 2

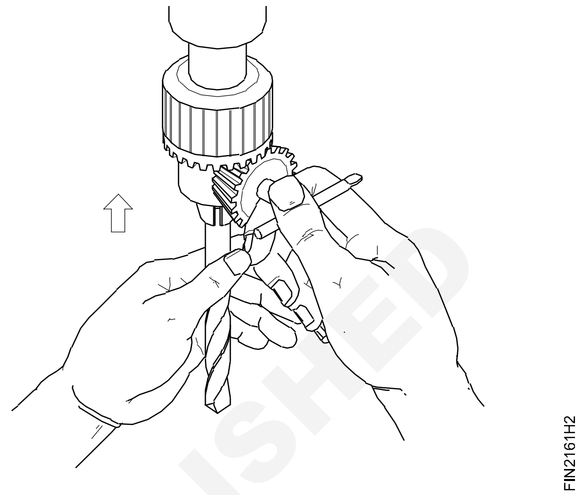
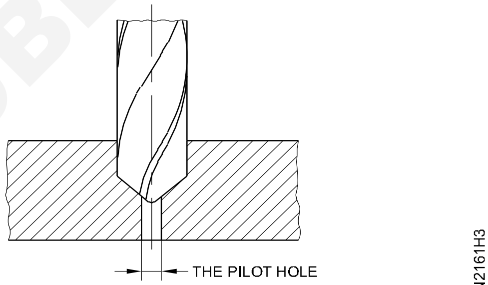


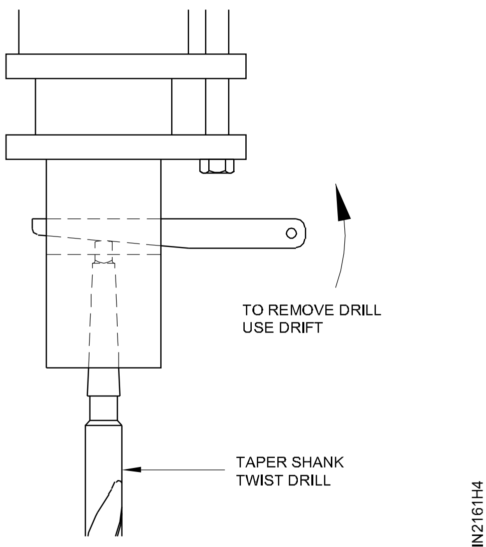
Fig 3



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

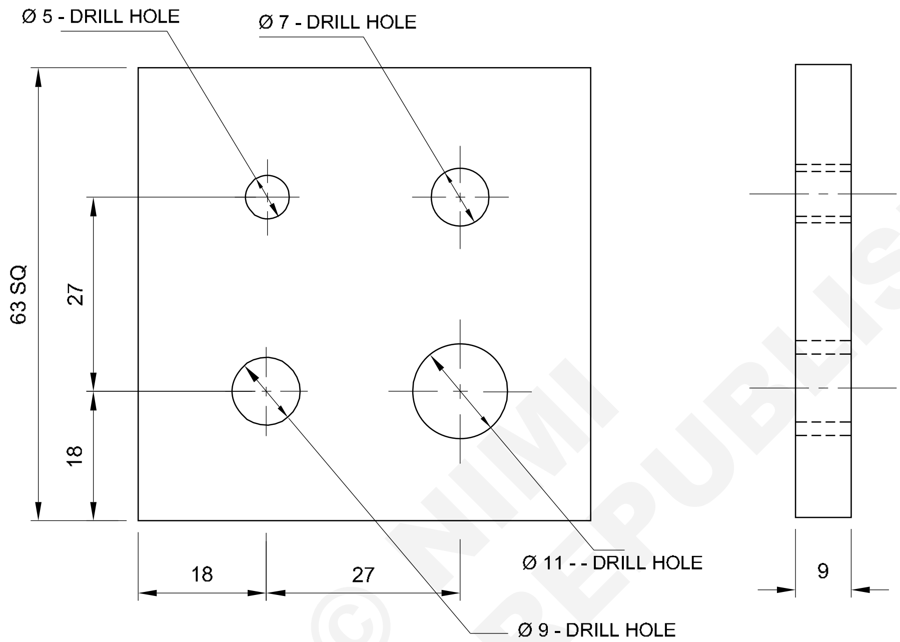
Set the spindle speed according to the diameter of drills. For smaller diameter drill keep the spindle speed in higher R.P.M and for larger diameter of drill keep the spindle speed in lower R.P.M.

Fig 4



Drill on M.S Flat

Objectives: At the end of this exercise you shall be able to
- **mark drill hole centres**
- **hold the job in drilling machine table using machine vice**
- **set the spindle speed according to the diameter of drill**
- **drill through holes as per drawing**
- **finish and de-burr.**



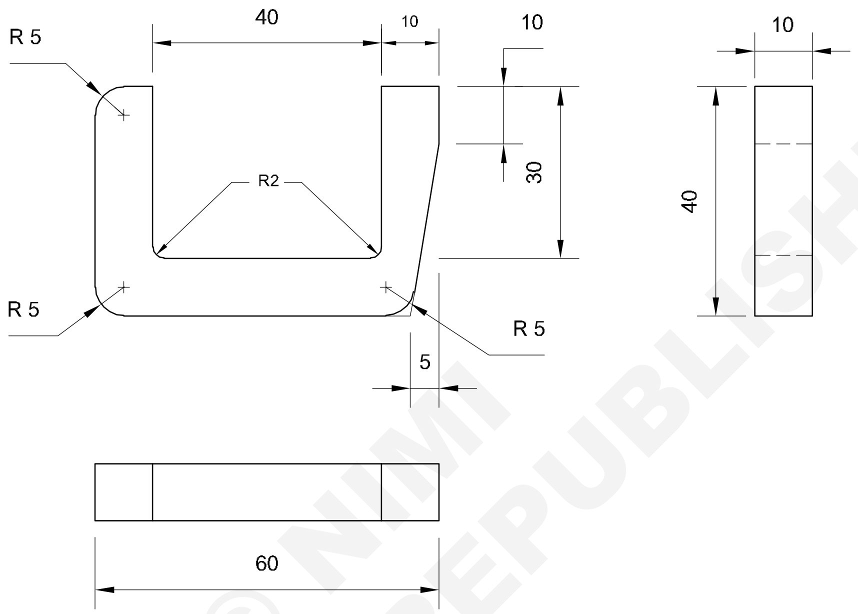
Job Sequence

- Check the raw material for its size.
- File surface to flatness.
- File right angle to squareness.
- File metal to size 63 x 63 x 9 mm maintaining parallelism and perpendicularity
- Check the flatness and squareness with try square and size with vernier caliper.
- Apply marking media, mark dimension lines as per drawing and punch the witness marks using dot punch.
- Punch on the drill holes centre using centre punch.
- Hold the job in drilling machine table using machine vice for drilling.
- Fix Ø 5 mm drill in drilling machine spindle through drill chuck.
- Set suitable spindle speed according to the size of drill.
- Drill Ø 5 mm through hole in job.
- Remove Ø 5 mm drill from drill chuck.
- Similarly, fix Ø 7, Ø 9 and Ø 11mm drill in drill chuck and drill through holes as per drawing.
- Check the size with vernier caliper.
- Finish and de - burr all the corners of the job.
- Apply a little oil on the job and preserve it for evaluation.

1	65 ISF 10-65	-	Fe310	-	-	1.5.62
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	DRILL ON M.S FLAT				TOLERANCE : ± 0.04	TIME :
					CODE NO : FI20N1562E1	

File radius and profile to suit gauge

Objectives: At the end of this exercise you shall be able to
- **file and mark as per job drawing**
- **file internal and external radius**
- **check the radius using radius gauge.**

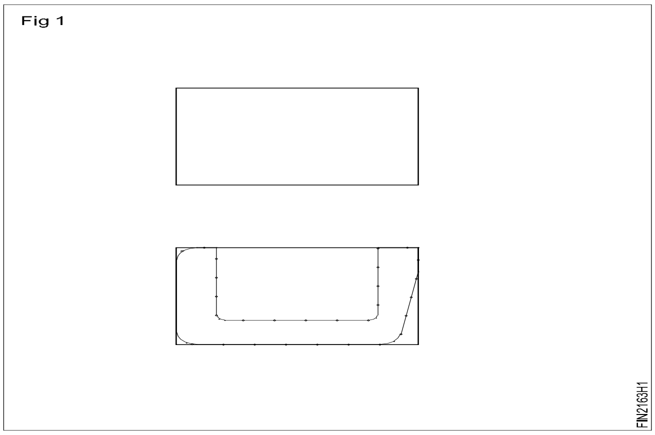


Job Sequence

- Check the raw material for its size.
- File metal to overall size 60x40x10 mm maintaining parallelism and perpendicularity and check flatness and squareness.
- Mark off all dimensions as per drawing.
- Mark the radius using divider and punch the identification marks. (Fig 1)
- Drill Ø 4mm to form internal radius 2 mm.
- Chain drill holes for parting off excess material from inside. (Hold the job rigidly, use a coolant and set correct RPM for drilling.)
- Hacksaw along the inner edges.
- Separate the excess material from inside using a web chisel and Ball pein hammer.
- File inside slot as per drawing.
- Hacksaw, file and finish angle and outside surfaces.
- File and finish external radius and check with the radius gauge.
- File and smooth finish all sides maintaining ±0.04 mm.

1	65 ISF 12 - 45	-	Fe310			1.5.63
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	FILE RADIUS AND PROFILE TO SUIT GAUGE				TOLERANCE : 0.04	TIME :
					CODE NO : FI20N1563E1	

Fig 1



- Apply a little oil on the job and preserve it for evaluation.

> **While chain drilling ensure 1 mm space between drilling holes and witness marks.**

Skill Sequence

Parting off by chain drilling

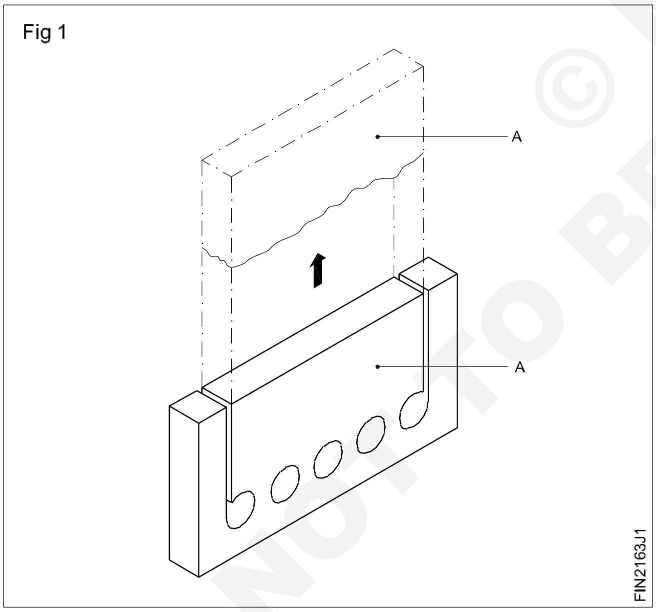
Objective: This shall help you to
- **part off metal by chain drilling.**

The shape of certain job features is such that metals are to be cut in places which are inaccessible for hacksawing by hand.

While there are many methods for doing this, the most common method adopted in bench fitting is to chain drill in such places, and hacksaw other sides, if possible.

After chain drilling and hacksawing the other sides, a chisel is used to part off the metal A. (Fig 1)

Fig 1



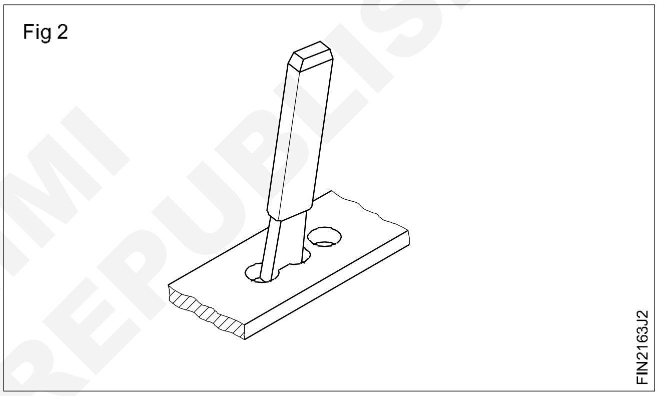
If the workpiece is not thick enough, parting with an ordinary flat chisel will cause distortion to the workpiece.

The best method is to use a PUNCHING CHISEL or WEB CHISEL to remove the metal web between the drilled holes.

The web chisel (punching chisel) has a double cutting edge, and this reduces the possibility of distortion to workpieces.

While cutting the web, the chisel is kept at an angle. (Fig 2)

Fig 2

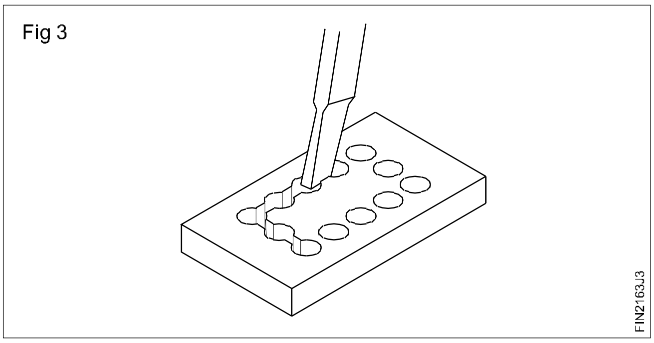


Remove only thin chips of equal thickness.

Thick workpieces need cutting with a web chisel from both sides.

While marking for chain drilling, place the location of drill centres in such a way that the web is not too thick. (Fig 3)

Fig 3



About 1 mm thick web is convenient for drilling and separating with a chisel.

If the web thickness is kept too small, a slight inaccuracy in drilling will draw the drill to the hole already drilled and cause damage to the drill.

For easier parting off, select suitable hole size to permit the chisel to enter and leave minimum material for filing.

Cutting with a web chisel will produce sharp cutting edges. Handle the workpieces carefully.

Filing radius (external)

Objective: This shall help you to
- **file external radius.**

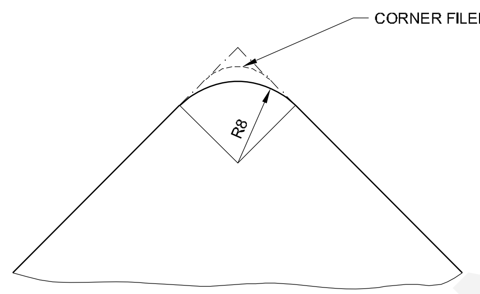
Filing radius is entirely a different technique, and needs considerable skill for filing accurately with a good finish.

In this type of filing, the file has to be held perfectly horizontal widthwise, and at the same time a rocking motion given lengthwise. The surface filed should not have any flat surface and should have a uniform curve. Radius filing of external surfaces is carried out in different steps.

Rough filing of corners

The corners are filed and brought closely to line using a bastard file. (Fig 1)

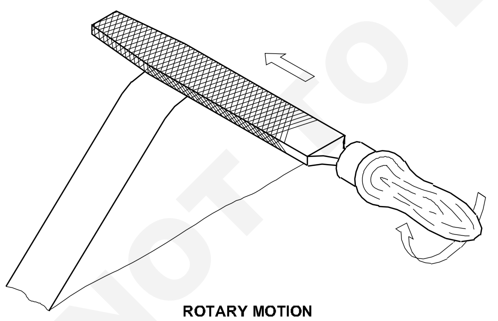
Fig 1



Rounding of corners

The flat surfaces are rounded and brought near about to finishing size, using a second cut file. In this, the file is moved forward across the curve with a turning motion (Fig 2)

Fig 2

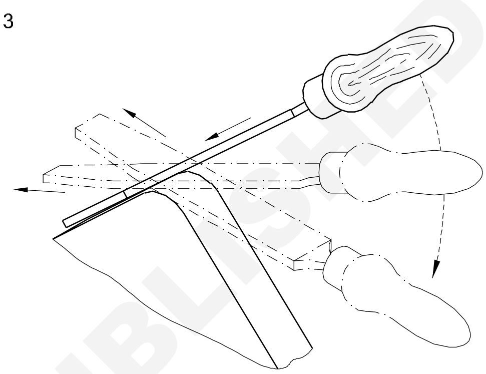


Check periodically with a radius gauge.

Final finishing of radius

For finishing steps, a smooth file is used. The file is given a see-saw motion along the curved line until the required radius is formed. (Fig 3)

Fig 3



While filing make sure

- to check the radius frequently with a radius gauge
- to use the broad surface to the job as datum for checking the size
- not to give excessive pressure while filing radius as the file is likely to slip.

Checking the radius

Objective: This shall help you to
- **check the radius with a radius gauge.**

Before checking with a radius gauge ensure the radius gauge is perfectly clean. Remove burrs, if any, from the workpiece. Check and make sure the profile of the gauge is not damaged.

The radius gauge should be held perpendicular to the radius to be checked. (Fig 1 and 2)

Fig 1

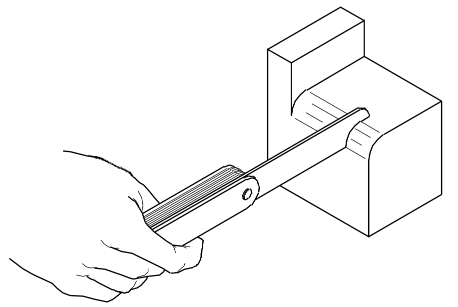
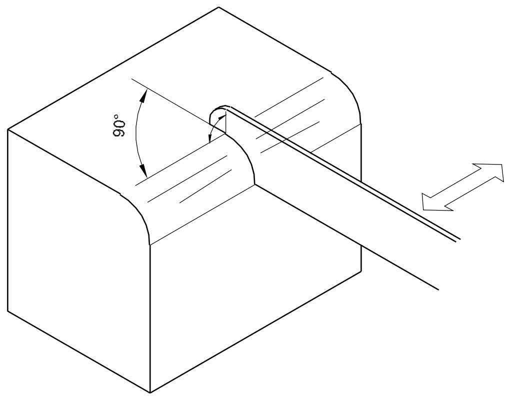


Fig 2



Observe the contact surfaces for any light passing through. Check against the background of light. The gauge should be moved along the filed length of the radius for checking. (Fig 3 and 4)

Fig 3

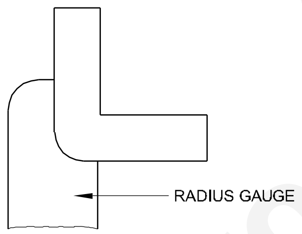
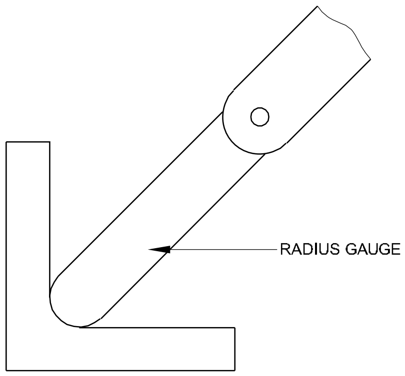


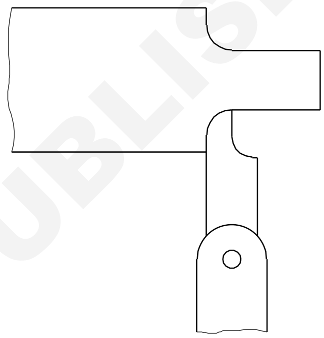
Fig 4



File and adjust the radius gradually according to the radius gauge.

The right radius is the one that matches correctly with the gauge. (Fig 5)

Fig 5



After using the radius gauges, wipe them clean with a clean cloth and apply a light film of oil before storing.

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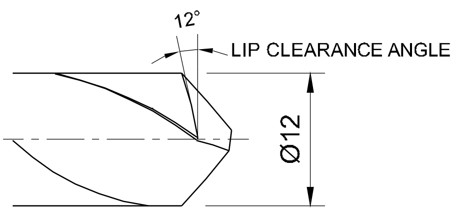
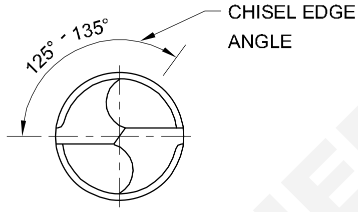
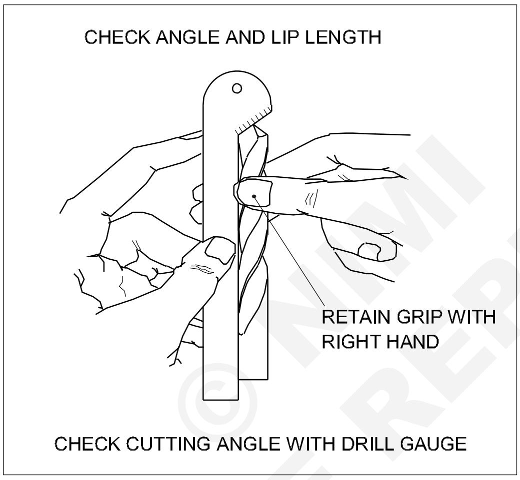
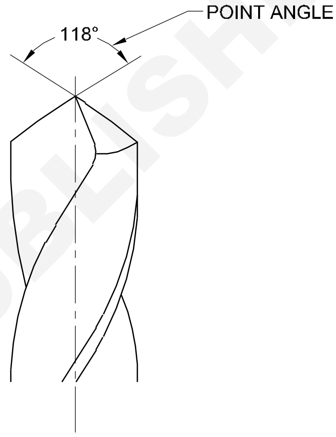
Sharpening of drills

Objectives: At the end of this exercise you shall be able to
- **dress the grinding wheel**
- **sharpen the drill in pedestal grinder**
- **check the drill angle using drill gauge.**









Job Sequence

- Hold the blunt twist drill properly in both hands.
- Place the drill on tool rest.
- Touch the cutting edge of a twist drill in grinding wheel face maintaining 31°angle from grinding stone.
- Twist the drill slightly on wheel face and grind one cutting edge to the required angle to get 59°.
- Similarly, grind the other cutting edge to the required angle to get 59° maintaining the cutting edges length equal.

Swing the shank of the drill slightly downwards while grinding.

While sharpening drill, the cutting edges length and angles should be equal.

- Check the cutting angle and cutting edge length in drill grinding gauge.
- Switch off the grinding machine and clean properly.

Wear safety goggles while sharpening twist drills.

–	–	–	–	–	–	1.5.64
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SHARPENING OF DRILLS				TOLERANCE : ± 30 mm	TIME :
					CODE NO : FI20N1564E1	

Skill Sequence

Off - Hand grinding with bench and pedestal grinders

Objectives: This shall help you to
- **identify the grinding machine and parts.**

Off - hand grinding is the operation of removing material which does not require great accuracy in size or shape. This is carried out by pressing the workpiece by hand against a grinding wheel.

Off - hand grinding is performed for rough grinding of jobs and resharpening wheel.

Scribers

Punches

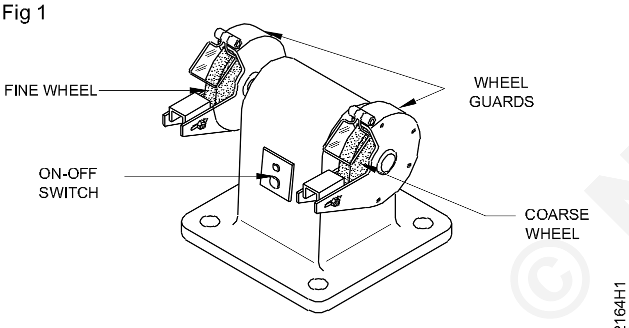
Chisels

Twist drills

Single point cutting tools etc.

Off - hand grinding is performed with a bench or pedestal grinder. (Fig 1 and 2)

Fig 1



BENCH TYPE GRINDER

Bench grinders

Bench grinders are fitted to a bench or table, and are useful for light duty work.

Pedestal grinders

Pedestal grinders are mounted on a base (pedestal), which is fastened to the floor. They are used for heavy duty work.

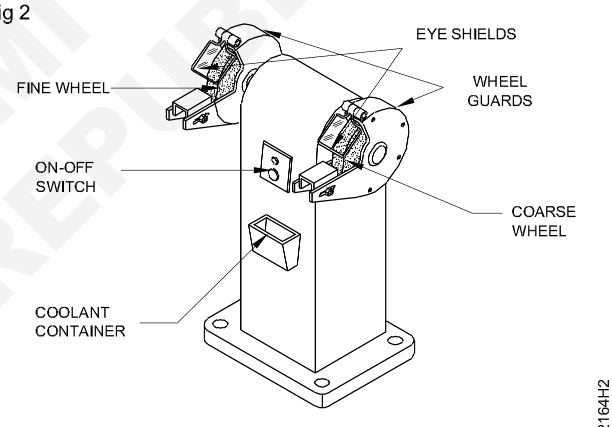
These grinders consist of an electric motor and two spindles for mounting grinding wheels. On one spindle a coarse - grained wheel is fitted, and on the other, a fine grained wheel. For safety, while working, wheel guards are provided. (Fig 1 and 2)

A coolant container is provided for frequent cooling of the work. (Fig 2)

Adjustable work - rests are provided for both wheels to support the work while grinding. These work - rests must be set very close to the wheels.

Extra eye - shields are also provided for the protection of the eyes. (Fig 2)

Fig 2



PEDESTAL TYPE GRINDER

Re-sharpening a twist drill

Objective : This shall help you to
- **re-sharpen a twist drill.**

A twist drill can be successfully sharpened on a bench or pedestal grinder by adopting the following procedure.

Check that the surface of each wheel is running true and that the wheels are dressed clean.

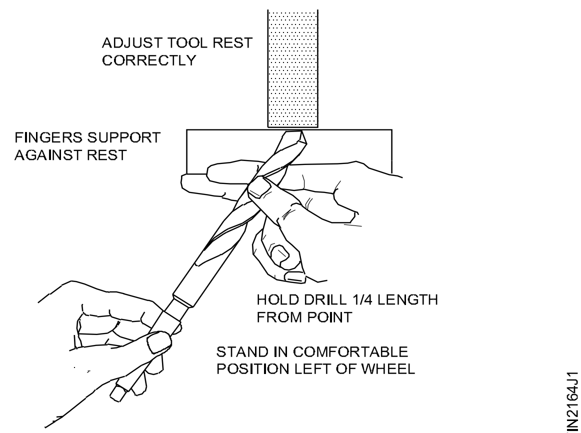
Ensure that the tool-rest are adjusted correctly and tightened.

Wear safety goggles.

Stand in a comfortable position in front of the machine.

Hold the drill at about one quarter of its length from the point, between the thumb and the first finger of the right hand. (Fig 1)

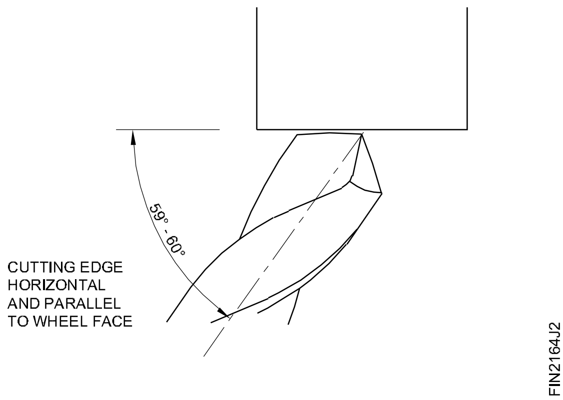
Fig 1



Keep both elbows against the side.

Position yourself in such a way that the drill makes an angle of 59° to 60° to the wheel face. (Fig 2)

Fig 2



Hold the drill level. Twist it until one cutting edge is horizontal and parallel to the wheel face.

Swing the shank of the drill slightly downwards and to the left with the left hand. The right hand is on the tool-rest.

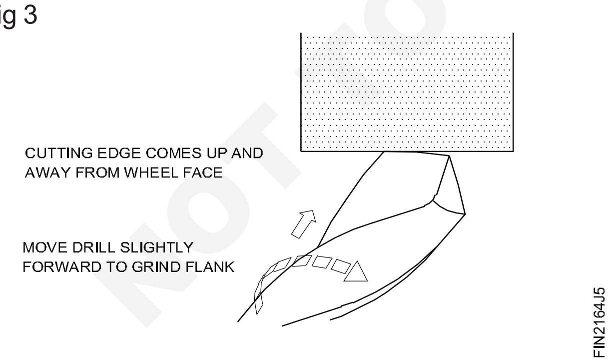
Watch the cutting edge against the wheel. Note that, as the shank, swings down, the cutting edge comes slightly upwards and away from the wheel face. (Fig 3)

Apply a slight forward motion to your hands.

This will bring the flank of the point against the wheel to produce a lip clearance.

Coordinate the three movements of swinging down, twisting clockwise and forward movement. These movements should not be heavy movements. If they are performed correctly, they will produce a cutting edge that has the correct lip clearance and cutting angle.

Fig 3



Practice these movements against a stationary wheel, using a new or correctly sharpened drill.

Notice how only a small movement is required to produce the required clearance.

Also note that, if the drill is twisted too far, the other cutting edge will swing down to contact the wheel face.

Proceed now to sharpen one edge, removing as little metal as possible.

Procedure to obtain equal angles

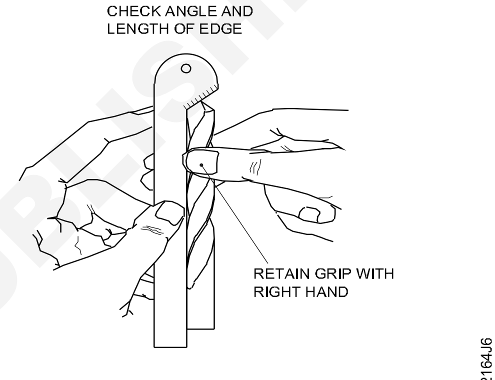
Move the drill back, clear of the wheel face.

Turn the drill over without moving the position. This presents the second edge to the wheel face at the same angle as the first cutting edge.

Proceed to sharpen the second cutting edge, using the same amount of drill movement as before. When these actions are carried but carefully, the drill will be sharpened with equal cutting angles. The lip clearance will be correct and equal.

Use a drill angle gauge to check that the cutting angle is correct (118° for mild steel), the cutting edges are of equal length and the lip clearances are equal and correct (about 12°). (Fig 4)

Fig 4



CHECK CUTTING EDGE WITH DRILL GAUGE

Lift the drill off the wheel face. Retain the grip on the drill with the right hand.

Make such inspection or checks as are necessary. Move the right hand back on-the tool-rest in the same position as before.

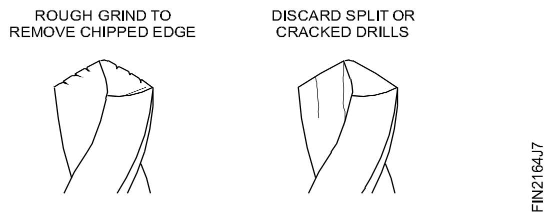
Hold the drill shank again in the left hand with the elbows against the side. The drill will locate back against the wheel face in the same position and at the same angle as before.

Points to be considered when sharpening drills

Grind as little as possible from the drill. Remove only enough to sharpen the cutting edges.

Rough down the drill point with a coarse grit wheel when the edges are badly chipped.(Fig 5)

Fig 5



Never re-sharpen a cracked or split drill.

Avoid overheating the drill.

Apply light pressure against the wheel face. Lift the edge clear of the wheel face frequently. This allows the air stream produced by the wheel to cool the drill point.

Cooling a drill rapidly by quenching in cold water may cause cracking of the cutting edge.

Re-sharpening of very small drills requires great skill. They require proportionally less movement to produce the cutting angles.

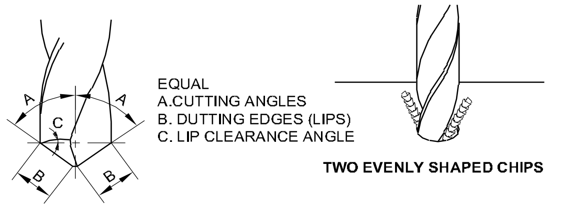
Testing a re-sharpened twist drill for its performance

Objective : This shall help you to
- **test the drill that has been re-sharpened by drilling a through hole.**

Set the spindle revolution of the drilling machine to give a cutting speed of 25 to 30 meters per minute. A drill that has been re-sharpened correctly will:

- Produce two evenly curled chips from its cutting edges (Fig 1)

Fig 1



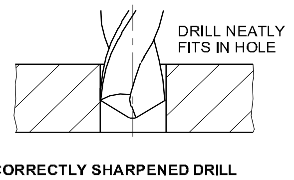
FIN2164X1

- Require only moderate pressure to feed it into the work.

When the hole has been drilled through, take the drill out of the machine and try it by inserting into the hole.

If the drill fits without any play it means that (Fig 2):

Fig 2



FIN2164X2

- The cutting edges and angles are equal
- The drill has produced a hole of the correct size.

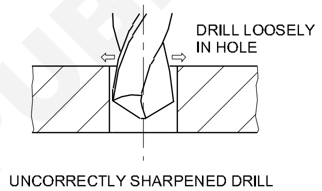
Any looseness of the drill in the hole means (Fig 3)

- The cutting edges are of uneven length
- The drill has produced an oversized hole.

A drill that has been ground with uneven or too great a lip clearance will

- Tend to chatter during starting
- Produce an out-of-round hole.

Fig 3



FIN2164X3

Safe working on off - hand grinders

Objective : This shall help you to
- **work safely on an off - hand grinder.**

How to work on an off - hand grinder?

While working on off - hand grinder, it is important to observe the following safety measures.

Before starting

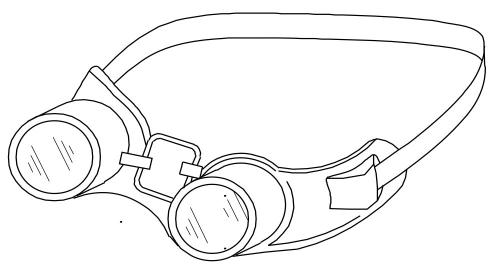
Make sure the grinding wheel guards are in place.

Wear safety goggles while grinding. (Fig 1)

Stand on one side of the machine while starting.

Adjust the tool - rest as close to the wheel as possible.

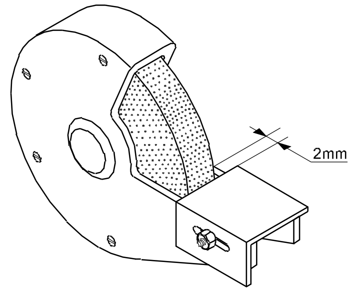
Fig 1



FIN2164Y1

The maximum recommended gap is 2 mm. This will help to prevent the work from being caught between the tool rest and the wheel. (Fig 2)

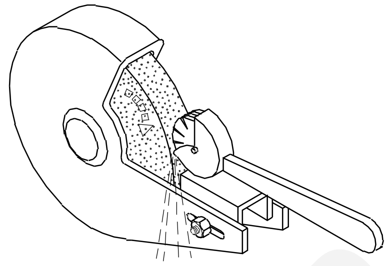
Fig 2



Do not work on grinding wheels which are loaded or glazed. Dress and true wheels whenever necessary. (Fig 3)

Caution: If any abnormal sound is noticed, stop the machine. Cracked or improperly balanced wheels are dangerous.

Fig 3



Dressing a grinding wheel

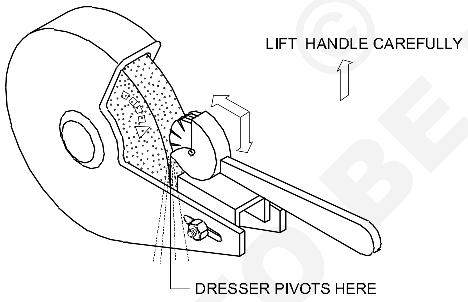
Objective : This shall help you to
- **dress a grinding wheel.**

When grinding wheels are loaded or glazed, they are rectified by dressing.

Dressing of pedestal grinder wheels is carried out by a star - wheel dresser.

For correct setting of the star - wheel dresser, the work - rest should be adjusted so that the dresser pivots get positioned between the wheel and the work - rest. (Fig 1)

Fig 1



Make the dresser come in contact with the wheel by slowly lifting the handle.

As the dresser star - wheel starts rotating, there can be a jerk. This can be overcome by pressure exerted on the work - rest.

Press the dresser firmly against the grinding wheel and move it across the face.

Do not run off the edge of the wheel while moving across.

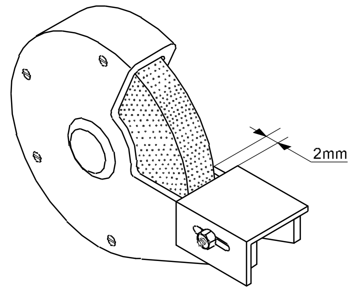
Do not release the downward pressure on the work - rest while lifting the handle.

Do not exert excessive pressure; it can crack the grinding wheel.

Move the dresser across the face of the grinding wheel until all the metal particles are removed, and the face is straight.

Adjust the work - rest as close to the grinding wheel as possible. (Fig 2)

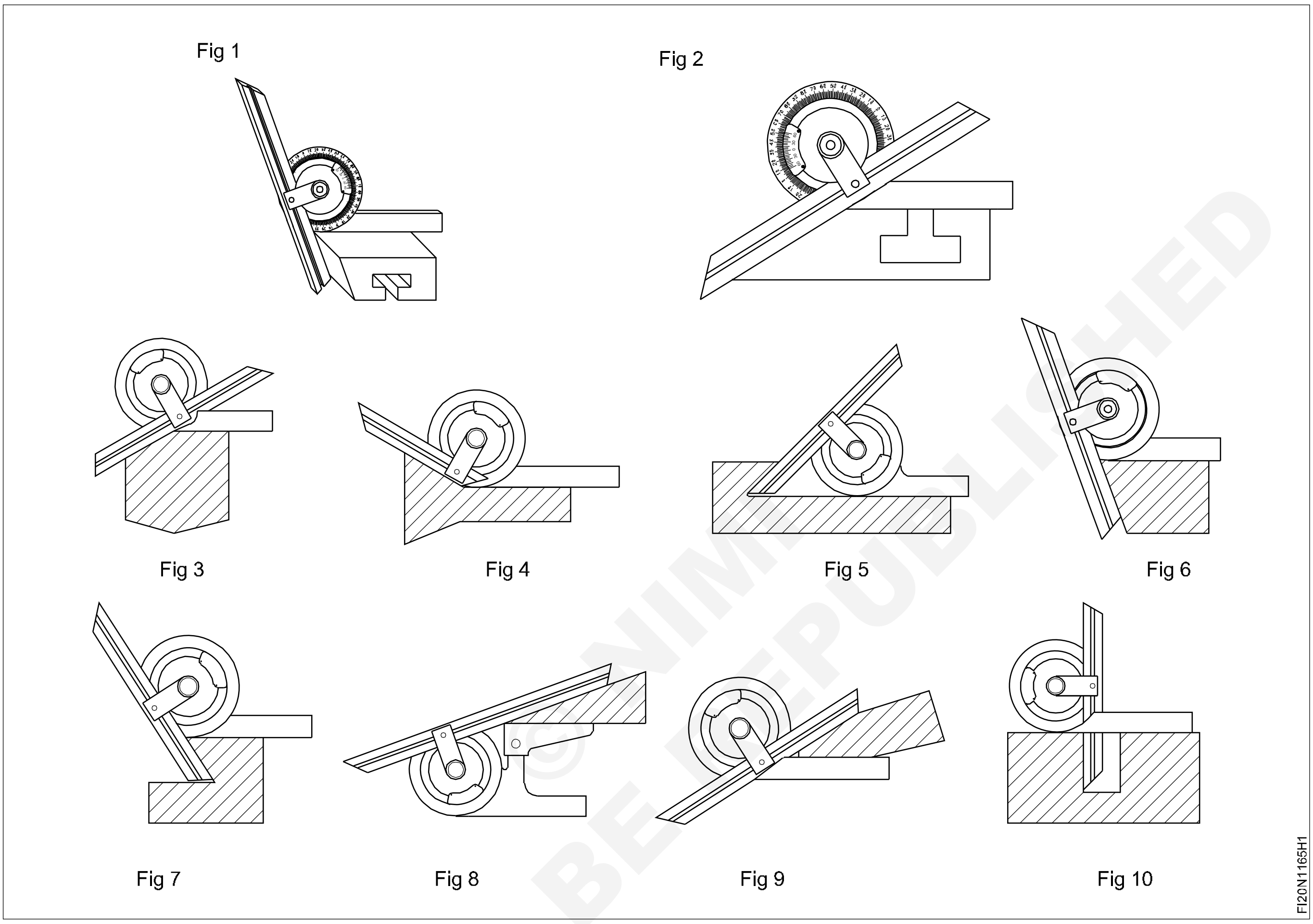
Fig 2



Wear safety goggles and gloves while dressing a grinding wheel. Stand on one side of the grinder while starting. Hold the dresser firmly while dressing. Do not put excessive pressure on the grinding wheels.

Practice use of angular measuring instrument

Objective: At the end of this exercise you shall be able to
- **measure the different acute angle and obtuse angle of components using vernier bevel protractor.**



Job Sequence

> **Note: Instructor shall arrange the different angular components for practicing with angular measuring instruments.**

- Measure the different angle using vernier bevel protractor.
- Enter the angle in Table 1.

TABLE - 1

Component No.	Angle measured
1	
2	
3	
4	
5	

Component No.	Angle measured
6	
7	
8	
9	
10	

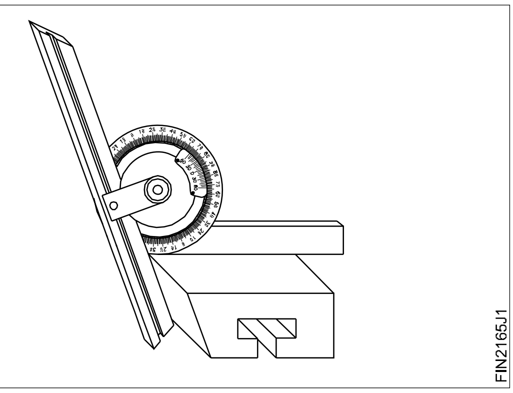
Get it checked by your instructor.

Reading of vernier bevel protractor

Objectives: This shall help you to
- **read vernier bevel protractor for acute angle setting**
- **read vernier bevel protractor for obtuse angle setting.**

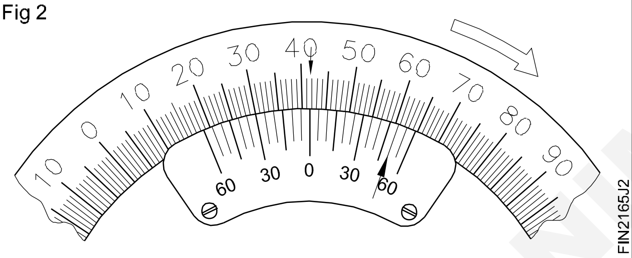
For reading acute angle set up (Fig 1)

Fig 1



First read the number of whole degrees between zero of the main scale and zero of the vernier scale. (Fig 2)

Fig 2



Note the line on the vernier scale that exactly coincides with any one of the main scale divisions and determine its value in minutes.

To take the vernier scale reading, multiply the coinciding divisions with the least count.

Example: 10 x 5' = 50'

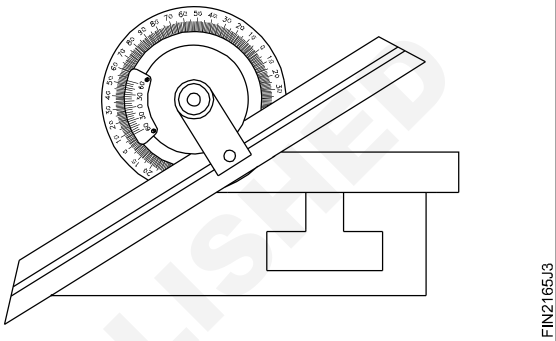
Total up both the readings to get the measurements = 41° 50'

If you read the main scale in an anticlockwise direction, read the vernier scale also in an anticlockwise direction from zero.

If you read the main scale in a clockwise direction, read the vernier scale also in a clockwise direction from zero.

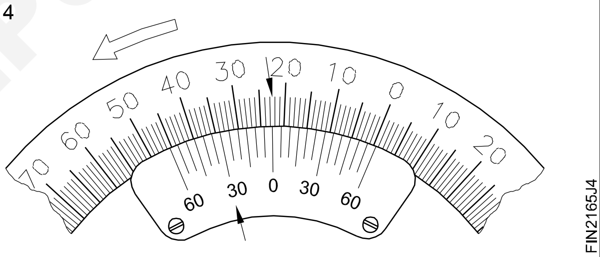
For obtuse angle set up (Fig 3)

Fig 3



The vernier scale reading is taken on the left side as indicated by the arrow. (Fig 4) The reading value is subtracted from 180° to get the obtuse angle value.

Fig 4



Reading 22°30'

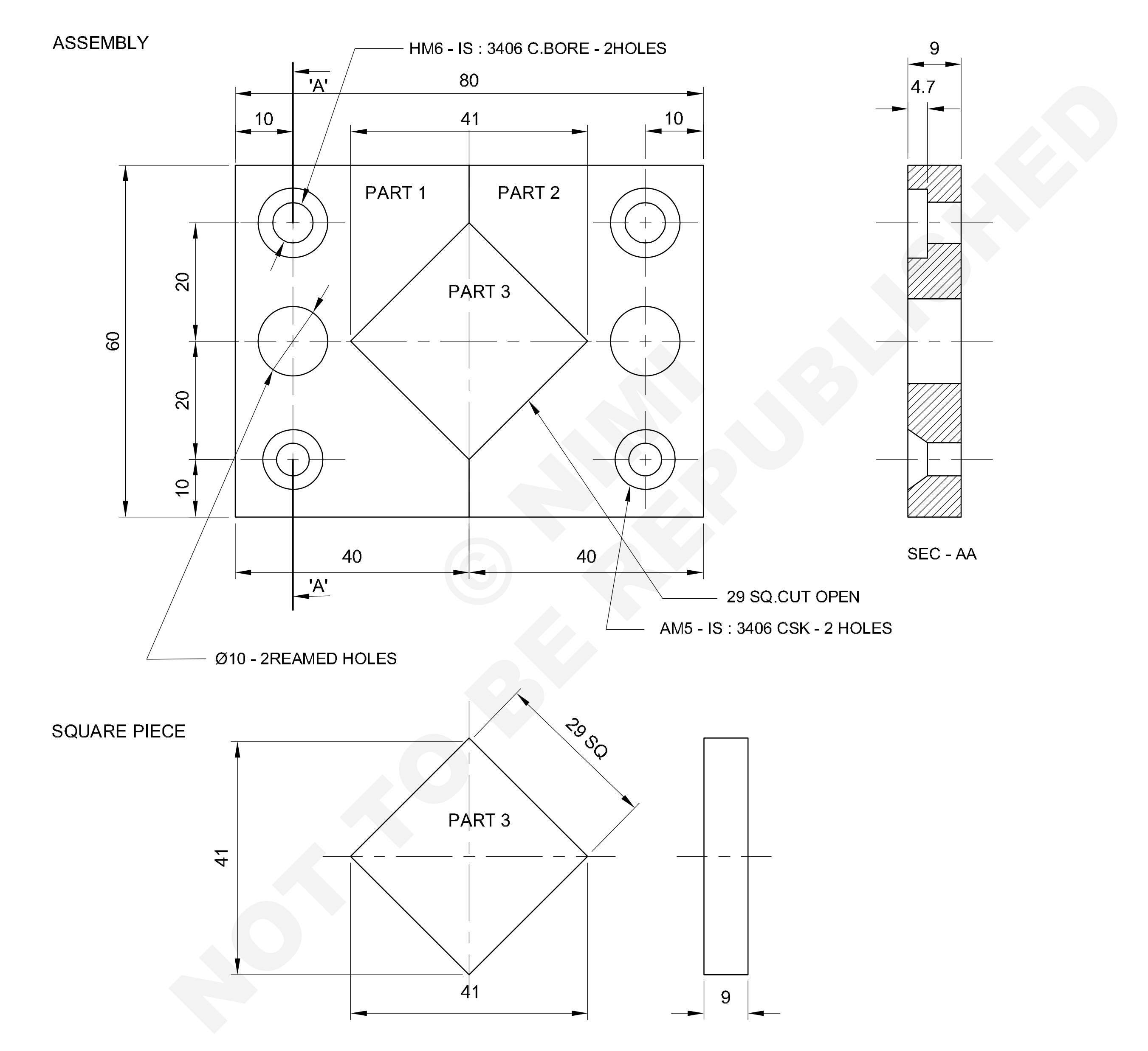
Measurement

180° - 22°30' = 157°30'

— — — — — — — —

Counter sink, counter bore and ream split fit (three piece fitting)

Objectives: At the end of this exercise you shall be able to
- **mark the lines as per job drawing**
- **drill, counter sink, counter bore and ream the holes as per drawing**
- **cut and remove excess metal in part 1 and 2**
- **file and finish to size and shape, make split fit as per drawing.**



1	45 ISF 10-45		Fe310		3	
1	65 ISF 10-45		Fe310		2	
1	65 ISF 10-45		Fe310		1	1.5.66
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE: 1:1	COUNTER SINK, COUNTER BORE, REAM SPLIT FIT (THREE PIECE FITTING)	TOLERANCE : ±0.04	TIME :
		CODE NO: FI20N1566E1	

Job Sequence

- Check the raw material for its size.
- File and finish to over all size of part 1 and 2 to 60 x 40 x 9 mm, part 3 to the size of 29 x 29 x 9mm maintaining parallelism and perpendicularity.
- Mark the hole centres and punch in part1 and 2 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 in 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.
- Hold part 1 in bench vice.
- Cut and remove excess metal by hacksawing.
- File to size and shape as per job drawing.
- Similarly, repeat the above process in part 2 and complete the job.

PART - 3

- Mark the dimension lines as per drawing and punch witness marks in part 3.
- Cut and remove excess metal by sawing and file to size and shape as per drawing.
- Match part 1, 2 ,3 and make three pieces as split fit.
- 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.**

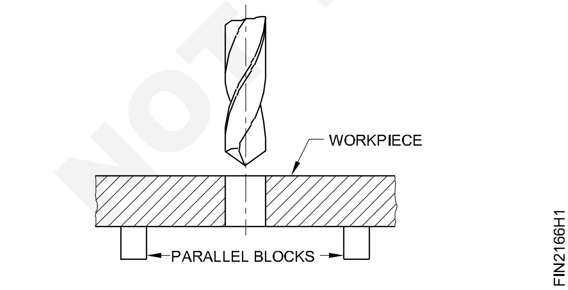
Selection of countersinks

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)

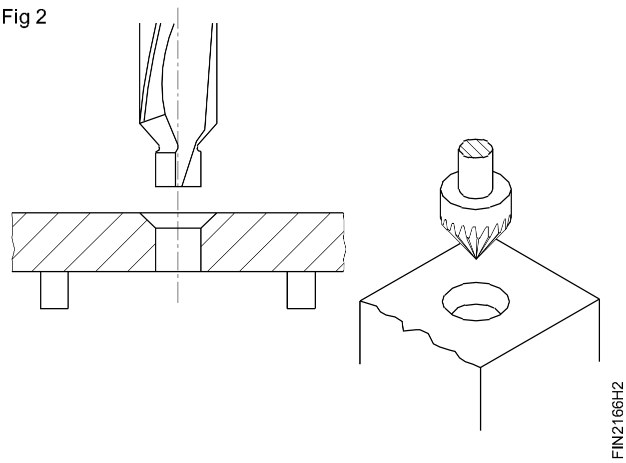
Fig 1



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

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

Fig 2

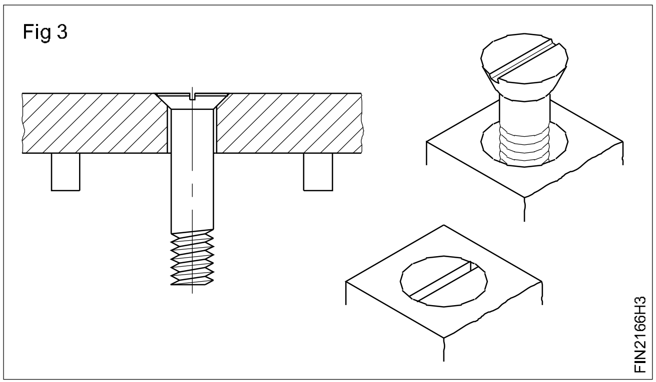


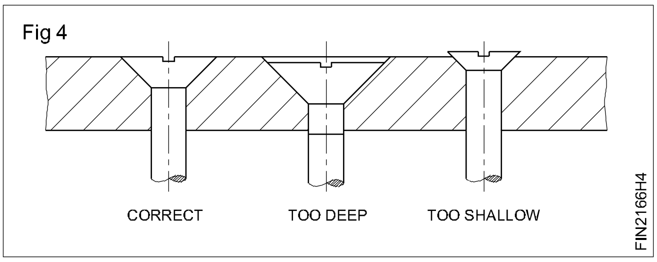
Substitute the recommended speed of the countersink.

(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)

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





Counterboring

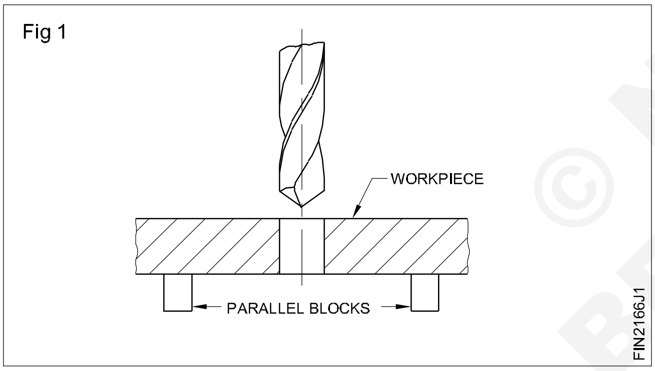
Objective : This shall help you to
- **counterbore holes of different sizes concentric to the drilled holes.**

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.

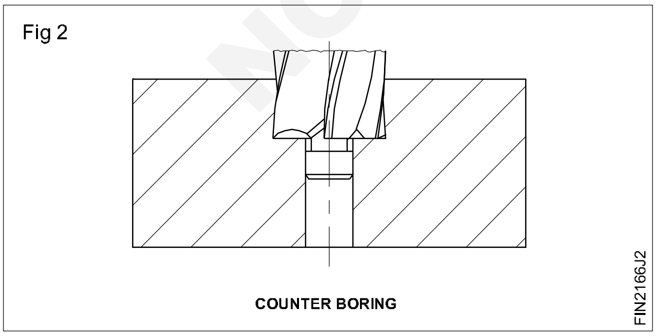
Fix the job in the machine vice, square to the axis of the machine spindle. Use parallel blocks. (Fig 1)



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)

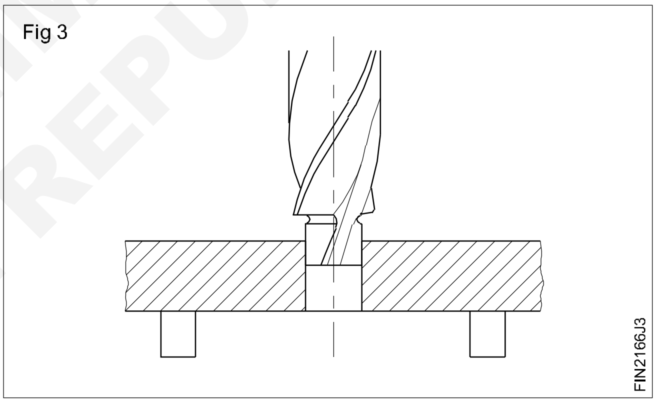


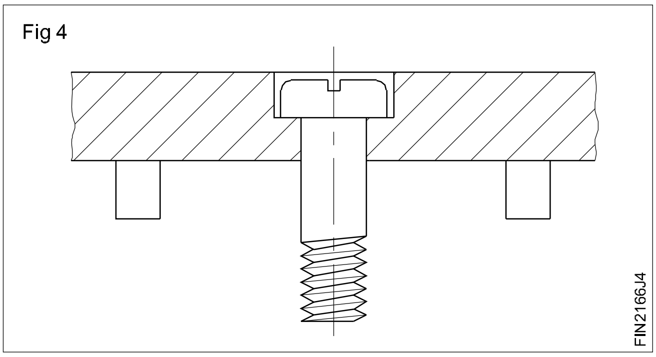
Set the spindle speed of the driling machine to the nearest calculated RPM. Use the formula

$$V = \frac{\pi \times d \times n}{1000}$$

(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)





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)

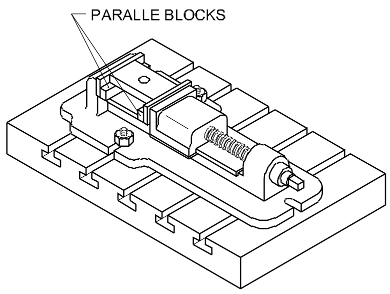
Refer to the table for the recommended under sizes in Related Theory on DRILL SIZES FOR REAMING.

Hand reaming

Drill holes for reaming as per the sizes determined.

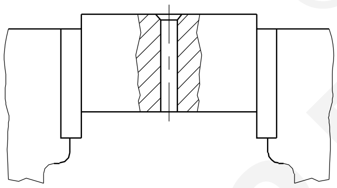
> **Place the work on parallels while setting on the machine vice. (Fig 1)**

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.

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 3

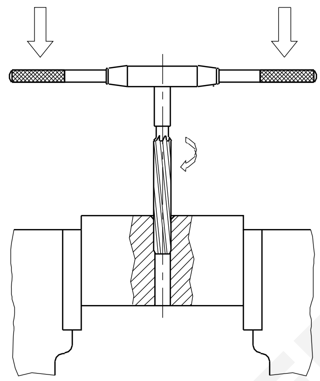
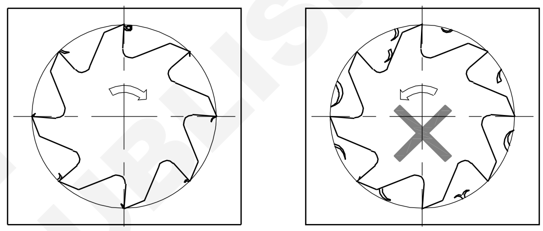


Fig 4



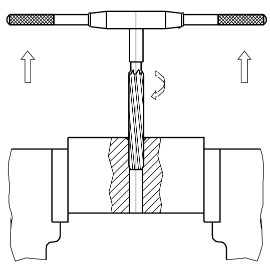
Ream the hole through. Ensure that the taper lead length of the reamer comes out well and clear from the bottom of the work. Do not allow the end of the reamer to strike on the vice.

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

Remove the burrs from the bottom of the reamed hole.

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

Fig 5



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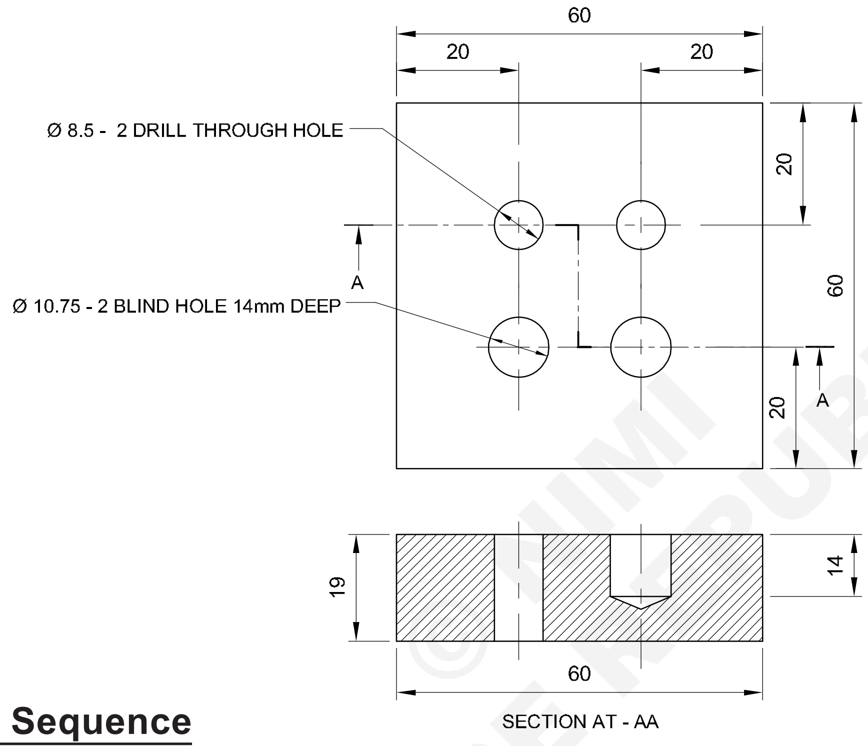
Drill through hole and blind holes

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



Job Sequence

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

–	65 ISF 20 - 65	–	Fe310	–	–	1.5.67
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	DRILL THROUGH HOLE AND BLIND HOLES	TOLERANCE : ± 0.04	TIME :
		CODE NO : FI20N1567E1	

Skill sequence

Drilling blind holes

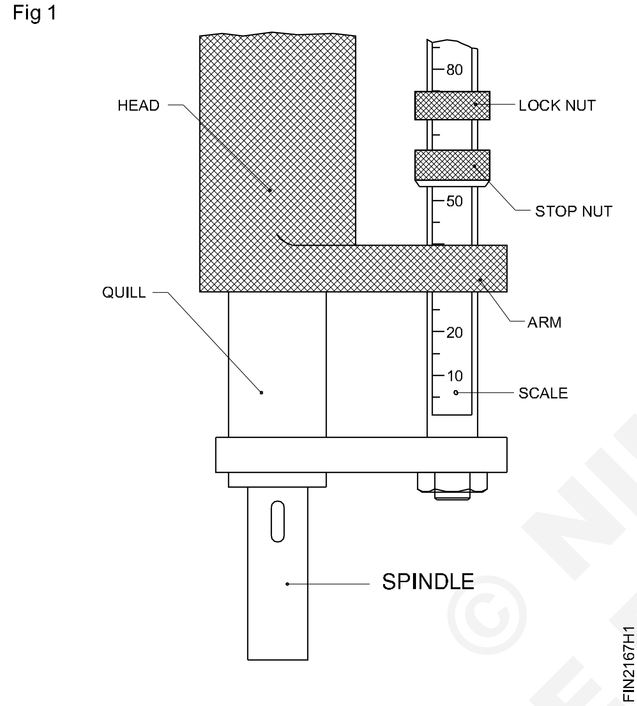
Objective: This shall help you to

- **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 graduations by which the advancement of the spindle can be observed.

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

Setting for drilling blind holes

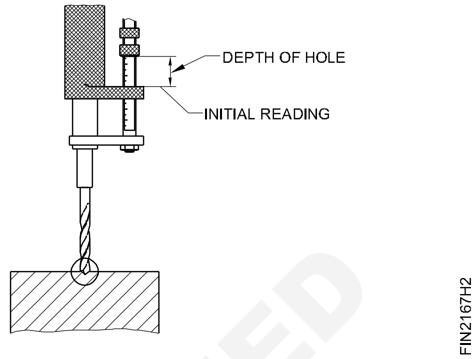
For blind hole - depth setting, first the work is held on the machine and the hole is located correctly.

The drill is started, and 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

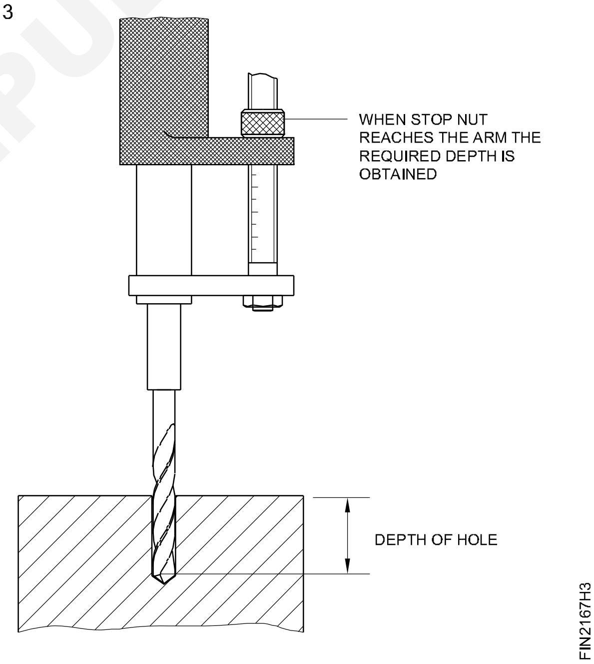


Adjust the stop next to the required setting, using the scale.

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)

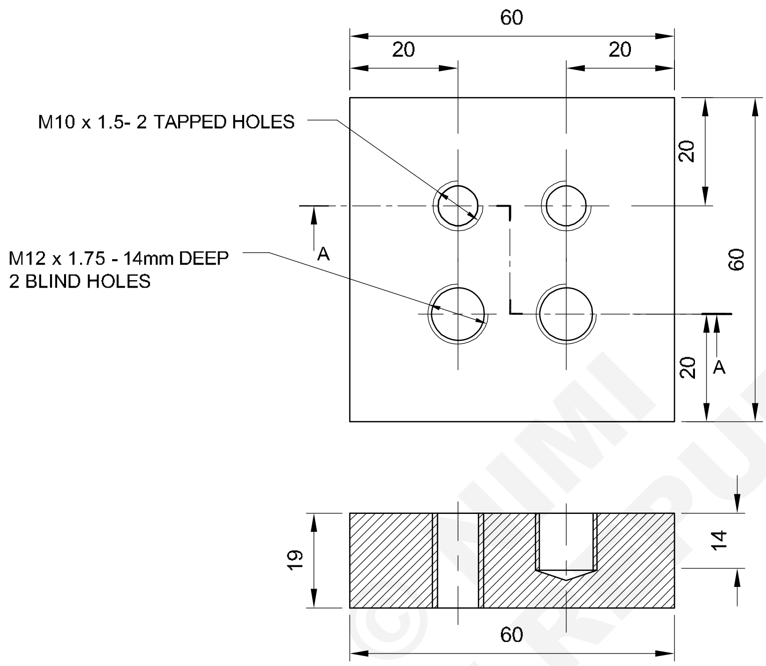
Fig 3



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

Form internal threads with taps to standard size (through holes and 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 through and blind holes using hand tap and tap wrench.**



SECTION - AA

Job Sequence

Cut internal thread in through hole

- Use work piece of Ex.No 1.5.67 for this exercise.
- Fix the job in bench vice.
- Fix M 10 first tap in tap wrench and cut internal thread in through hole.
- Similarly, fix M 10 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 through hole.

Cut internal thread 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 M 12 first tap in tap wrench.
- Screw a matching nut on the first tap to the required distance for 14 mm to act as a depth stop.

2		→ EX.NO.1.5.88	Fe310	–	–	–
1		EX.NO.1.5.67 ←	Fe310	–	–	1.5.68
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	FORM INTERNAL THREADS WITH TAPS TO STANDARD SIZE (THROUGH HOLES AND BLIND HOLES)	TOLERANCE : ±0.04	TIME :
		CODE NO : FI20N1568E1	

- Cut internal thread in blind hole to the required depth 14 mm.
- Remove the metal chips, if any from the threaded blind hole.
- Similarly, fix M 12 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 pressure it for evaluation.

Use cutting fluid while cutting the thread.

Internal threading of through holes using hand taps

Objectives: This shall help you to
- **determine the tap drill sizes for internal threading**
- **cut internal threads using hand taps.**

Determining the tap drill size

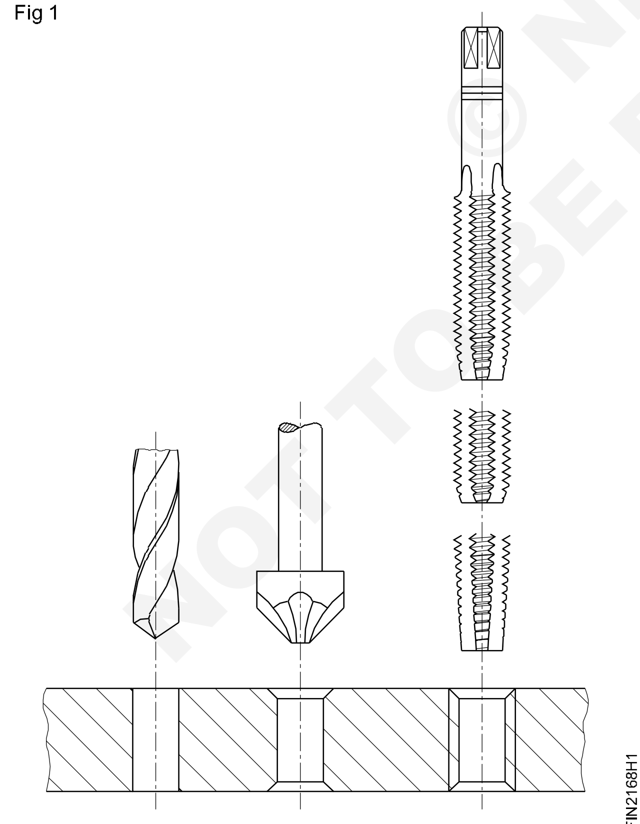
For cutting internal threads, it is necessary to determine the size of the hole (tap drill size). This can be calculated using the formula or can be chosen from the table of the tap drill sizes.

Procedure

Drill the hole to the required tap drill size.

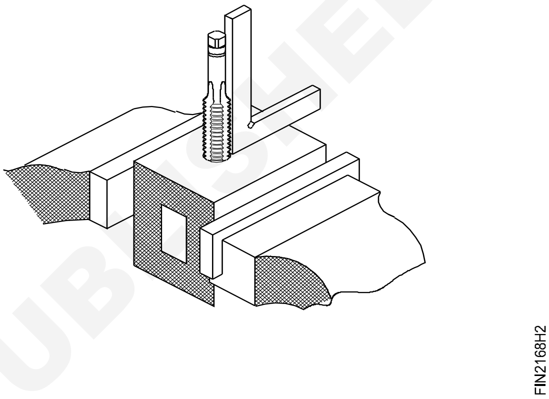
Do not forget to give the chamfer required for aligning and starting the tap. (Fig 1)

Fig 1



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

Fig 2



Use soft jaws while holding the finished surface on the vice.

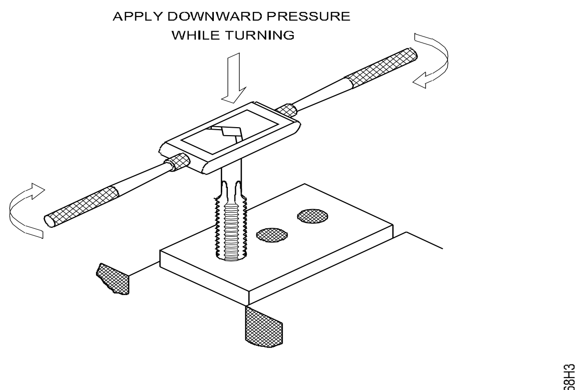
Fix the first tap (taper tap) in the wrench.

Too small a wrench will need a greater force to turn tap. Very large and heavy tap wrenches will not give the feel required to turn the tap slowly as it cuts.

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

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

Fig 3

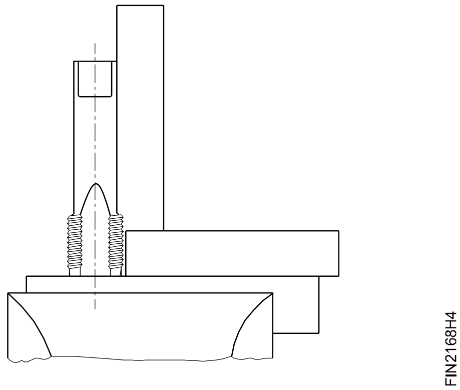


STARTING THE TAP

When you are sure of starting of the thread, remove the tap wrench without disturbing the tap alignment.

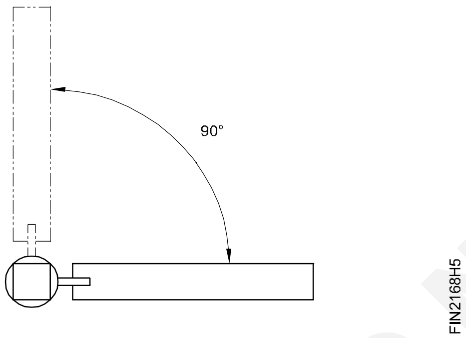
Check and make sure the tap is vertical. Use a small try square for help. (Fig 4)

Fig 4



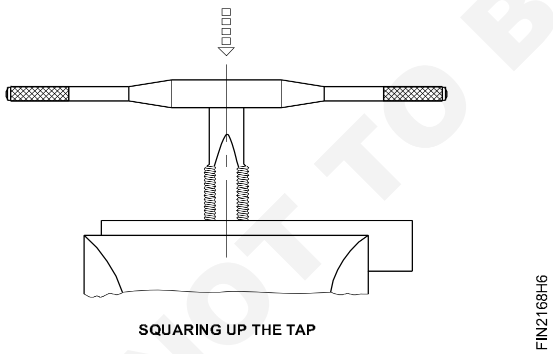
Place the try square in two positions, 90° to each other. (Fig 5)

Fig 5



Make corrections, if necessary. This is done by exerting slightly more pressure on the opposite side of the tap inclination. (Fig 6)

Fig 6



Never apply side pressure without giving a turning motion to the tap.

Check the tap alignment again with a try square.

Fit the tap wrench, and tighten without disturbing the tap alignment.

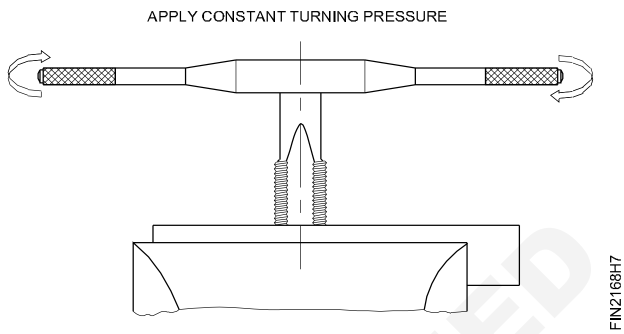
Make one or two turns and check the alignment.

The tap alignment should be corrected within the first few turns. Afterwards this cannot be done for the threads will break.

After the tap is positioned vertically, turn the wrench lightly by holding the ends of the wrench handles without exerting any downward pressure. (Fig 7)

While turning the wrench, the movement should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap.

Fig 7

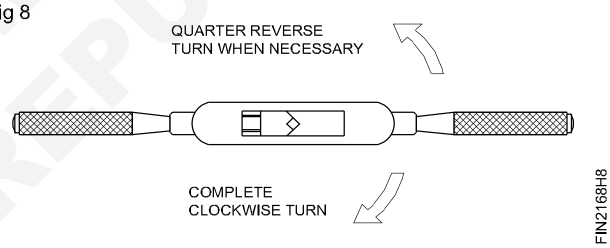


Continue cutting the thread. Turn backwards frequently, about quarter turn, to break the chip. (Fig 8) Stop and turn backwards also when some obstruction to movement is felt.

Use a cutting fluid while cutting the thread.

Cut the thread until the tap is fully inside the hole being threaded.

Fig 8



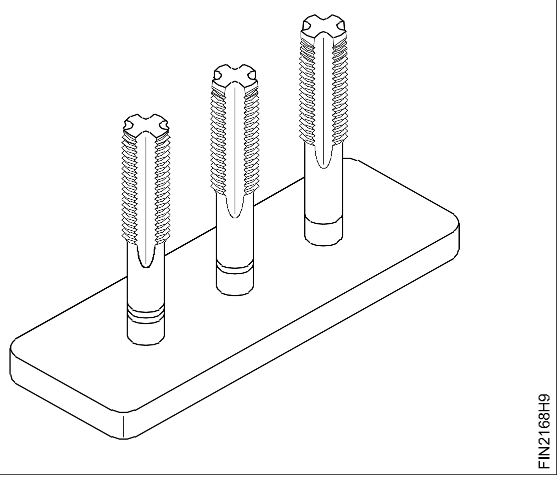
Finish and clean up using intermediate and plug tap. The intermediate and plug tap will not cut any thread if the tap has entered the hole fully.

Remove the chips from the work with a brush.

Check the threaded hole with a matching screw.

Clean the tap with a brush, and place it back on the stand (Fig 9)

Fig 9



Internal threading blind holes using hand taps

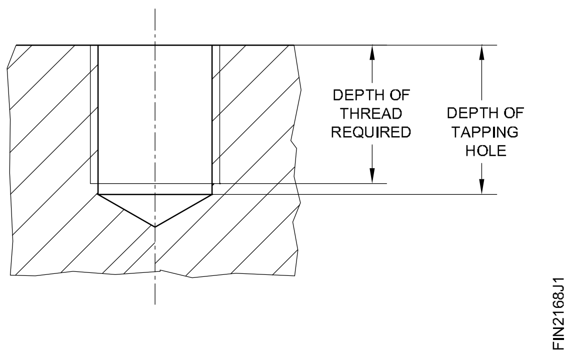
Objective: This shall help you to
- **cut internal threads using hand taps.**

Drilling a blind hole

Determine the tapping drill size using the table for tapping drill sizes.

Drill a blind hole using the depth stop arrangement. The depth of the tapping hole should be slightly more than the depth of the required thread. (Fig 1)

Fig 1



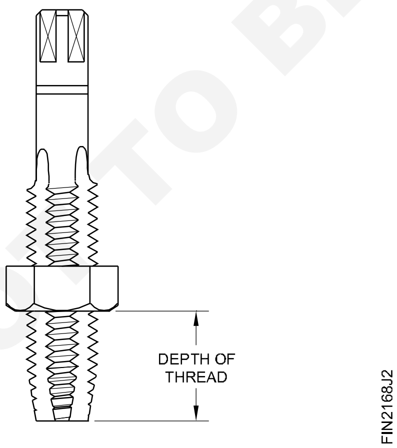
Procedure for threading

Remove metal chips, if any, from the blind hole by turning 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 2)

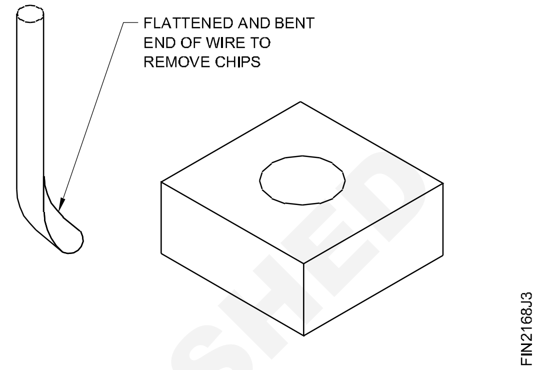
Fig 2



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

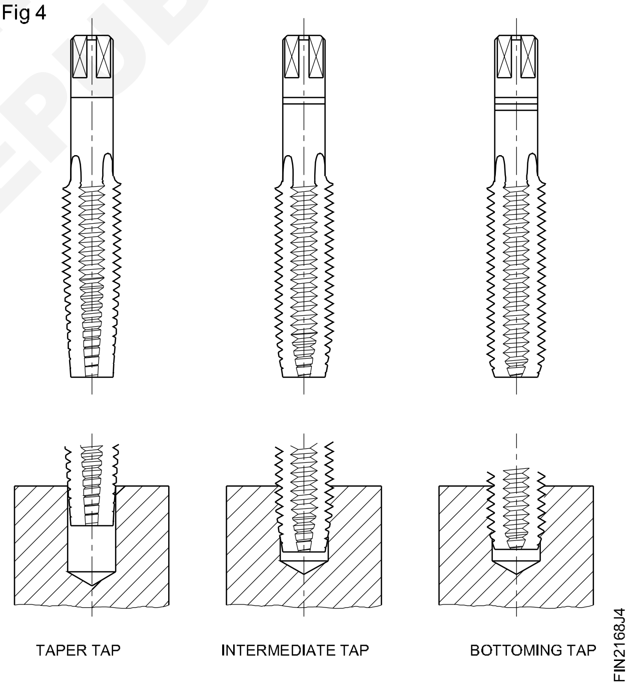
Remove the chips from the hole frequently, using a flattened and bend wire. (Fig 3)

Fig 3



Finish tapping the hole with intermediate and bottoming tap. Set the nut to control the depth of the thread. (Fig 4)

Fig 4



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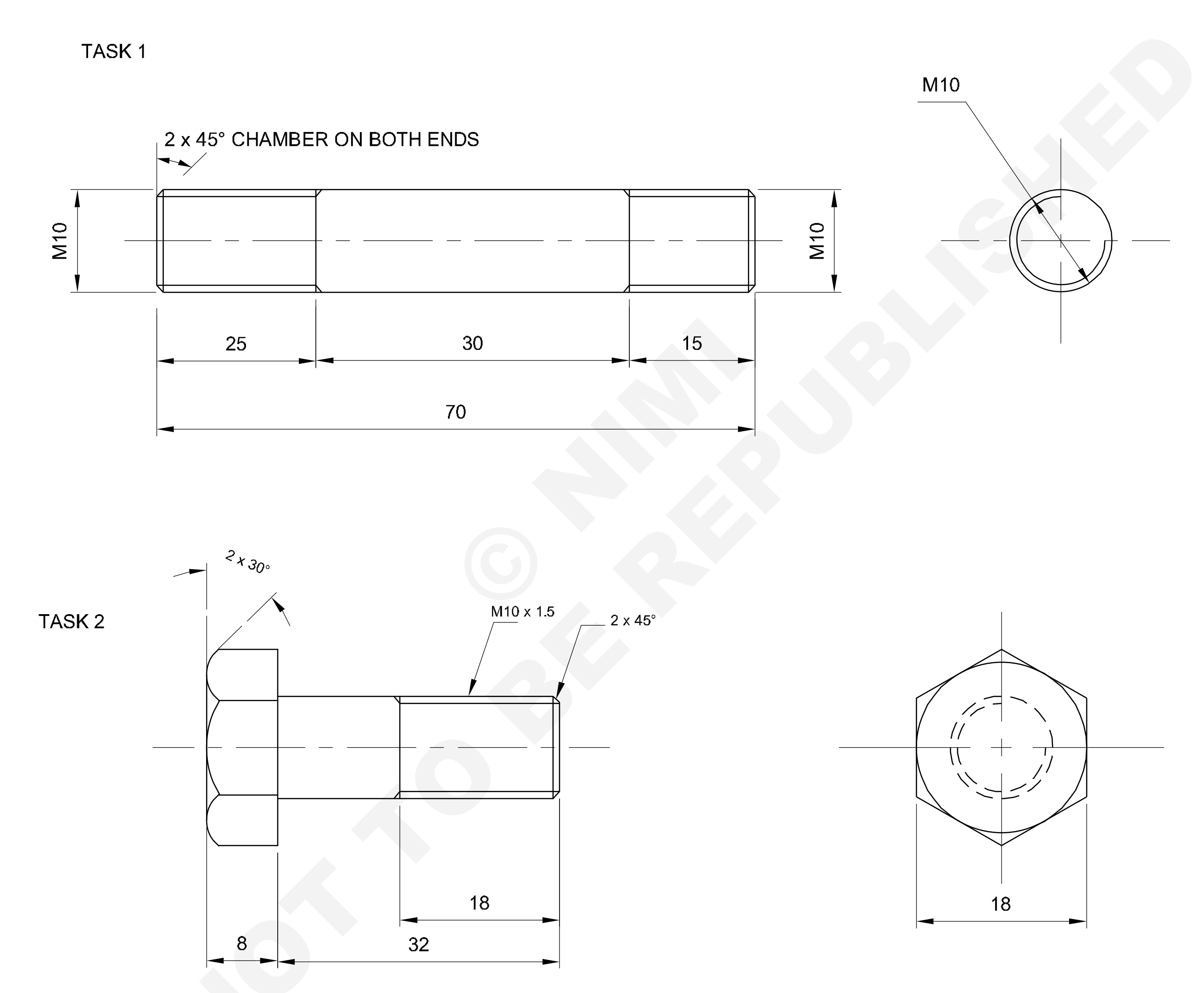
Prepare studs and bolt

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 bolt**
- **cut external thread using die and die stock in studs and bolt**
- **check the external thread using screw pitch gauge and matching nuts.**



1	HEX A/F 18 - 45	→ 1.5.88	Fe310	–	2	1.5.69
1	Ø10 - 75	→ 1.5.88	Fe310	–	1	1.5.69
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PREPARE STUDS AND BOLT	TOLERANCE : ±0.04	TIME :
		CODE NO : FI20N1569E1	

Job Sequence

TASK 1: **Prepare stud**

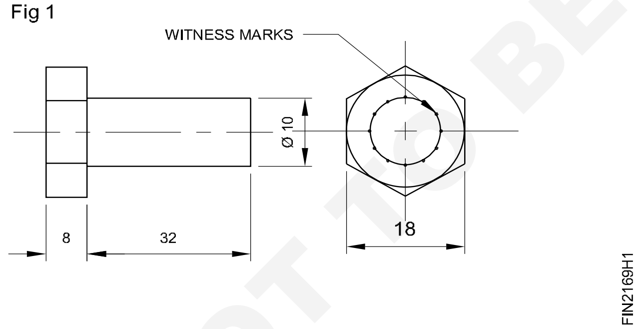
- Check the raw material size.
- File the round rod ends to flatness and squareness maintaining size Ø 10 mm x 70 mm length.
- File round rod cylindrical profile to Ø 9.85 mm blank size to cut external thread as per drawing.
- File chamfer in both ends of the round rod to 2 mm x 45°
- Apply marking media 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 screws 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 and ensure without burrs and apply little oil and preserve it for evaluation.

— — — — — — — —

TASK 2: **Prepare bolt**

- Check the raw material for its size.
- turn hexagon rod ends to flatness and squareness maintaining size Ø 10 mm x 40 mm length in lathe
- Apply marking media and mark dimensions to prepare hexagonal head bolt blank as per job drawing.
- Punch witness marks using dot punch 60°. (Fig 1)

Fig 1



- Cut and remove excess metal by sawing.
- File hexagonal rod cylindrical blank size to Ø 9.9 mm x 18 mm length to cut external thread. (Fig 2)
- File chamfer in both ends of hexagon 2 mm x 45°
- Hold the Hexagonal head bolt in bench vice to 90°along with aluminium vice clamps.
- 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 2

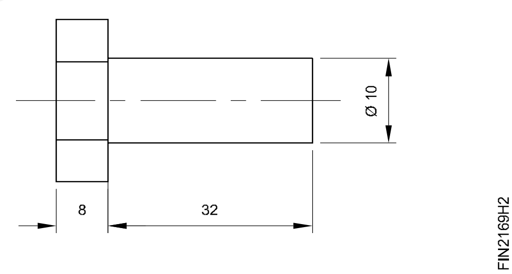
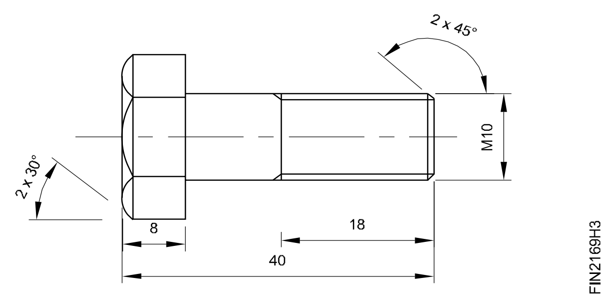


Fig 3



- 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

Skill Sequence

External threading using dies

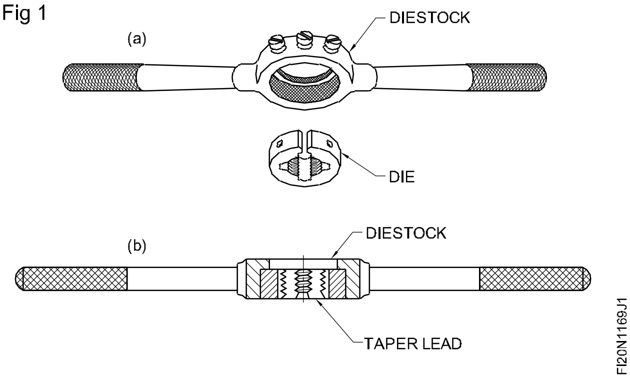
Objective: This shall help you to
- **Cut external threads using dies.**

Check blank size.

Blank size = Thread size - 0.1 x pitch of thread

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

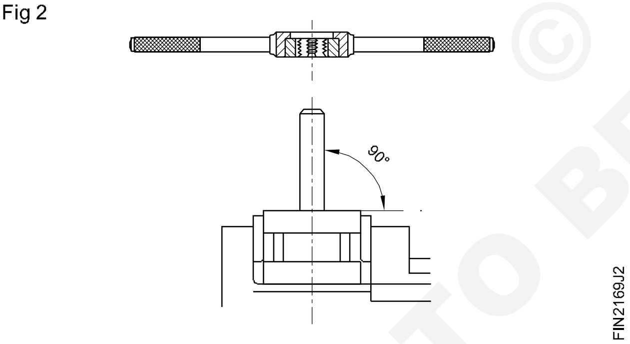
Fig 1



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

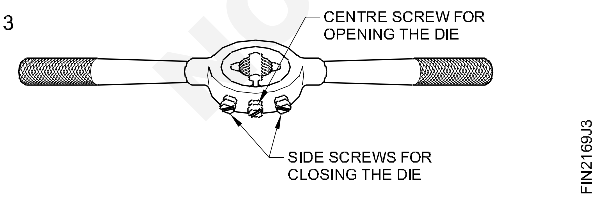
Project the blank above the vice - just the required thread length only.

Fig 2



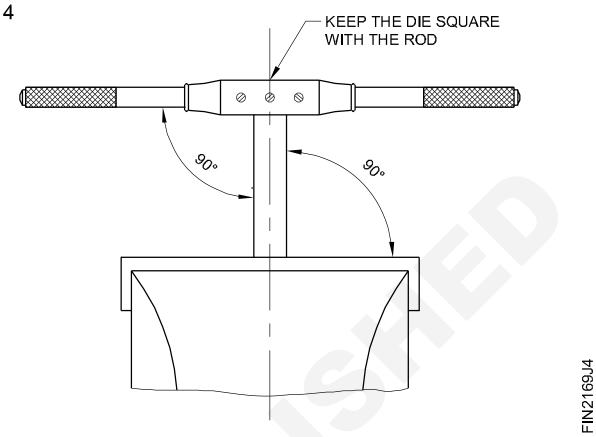
Place the leading side of the die on the chamfer of the work. (Fig 3)

Fig 3



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

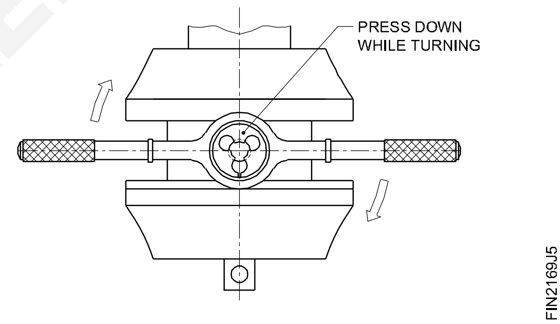
Fig 4



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

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

Fig 5



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

Use a cutting lubricant

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

Check the thread with a matching nut.

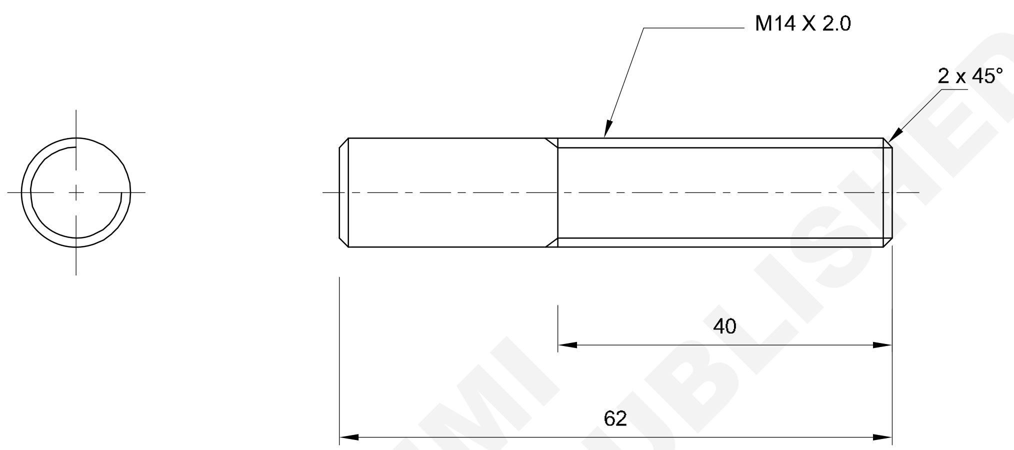
Repeat the cutting until the nut matches.

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

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

Form external threads with dies to standard size

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



Job Sequence

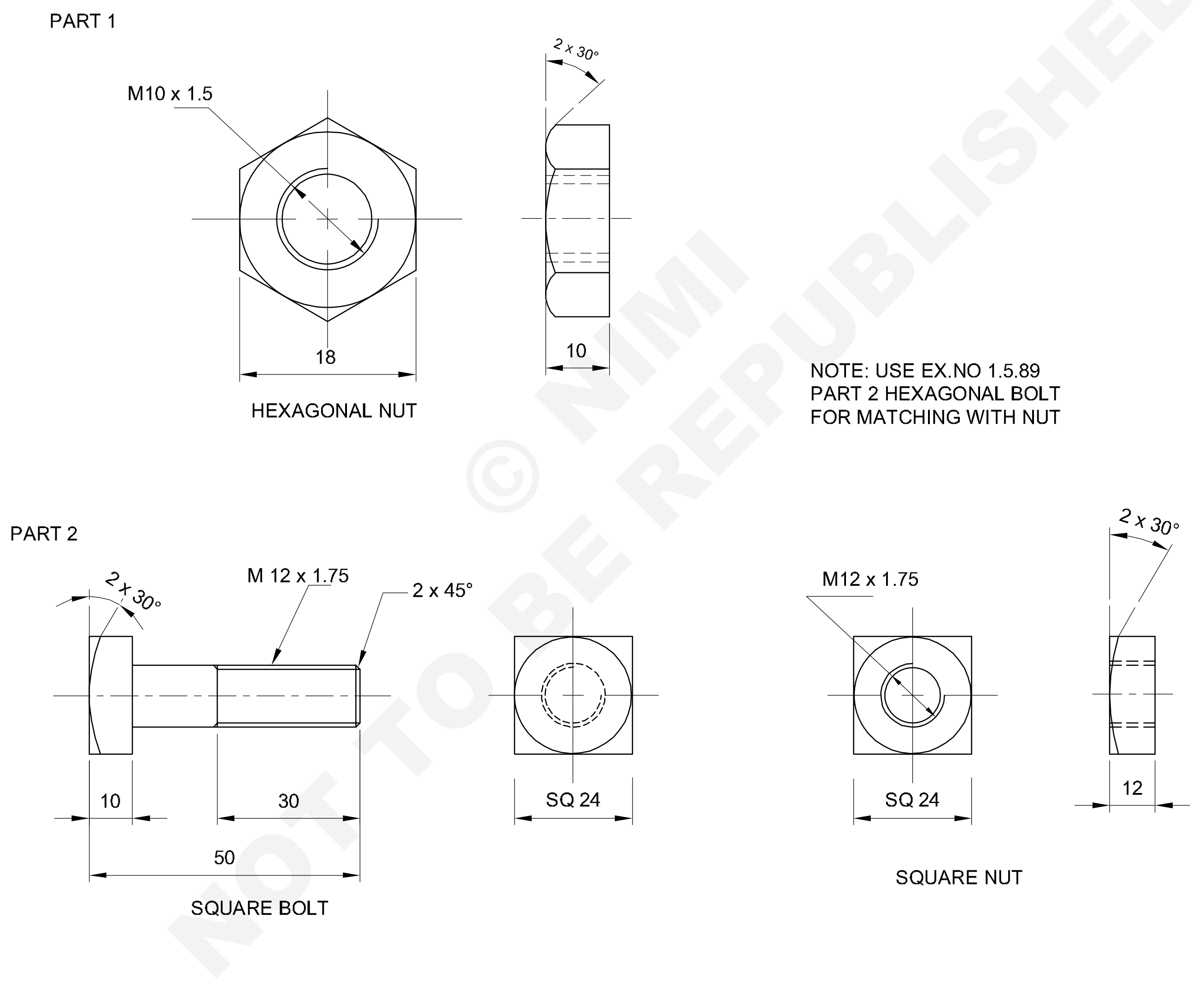
- Check the raw material for its size.
- File blank size to Ø 13.9 mm x 40 mm length as per drawing.
- File chamfer in both ends to 2 mm x 45°
- Hold the job at 90° in bench vice.
- Set M14 split die in die stock.
- Set the die on the blank end and press down evenly and turn in clockwise direction slowly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

Use cutting lubricant while cutting thread

1	ISR Ø 14 - 65	–	Fe310	–	–	1.5.70
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	FORM EXTERNAL THREADS WITH DIES TO STANDARD SIZE				TOLERANCE : ±0.04	TIME :
					CODE NO : FI20N1570E1	

Prepare nuts and match with bolts

Objectives: At the end of this exercise you shall be able to
- **cut and turn square rod to blank size to cut external threads**
- **file square bolt and nut to correct size and shape as per drawing**
- **determine tap drill sizes for hexagonal and square nut**
- **drill holes for tapping holes, to cut internal threads in hexagon and square nut**
- **cut external threads on square head bolt using die and die stock**
- **cut internal threads on hexagon and square nuts using tap and tap wrench**
- **match nuts with bolts.**



1	SQUARE 25 - 68 (BOLT & NUT)	–	Fe310	–	2	
1	HEX A/F 18 - 15 (NUT)	1.1.69 PART 2 (BOLT)	Fe310	–	1	1.5.71
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PREPARE NUTS AND MATCH WITH BOLTS	TOLERANCE : ±0.04	TIME :
		CODE NO : FI20N1571E1	

Job Sequence

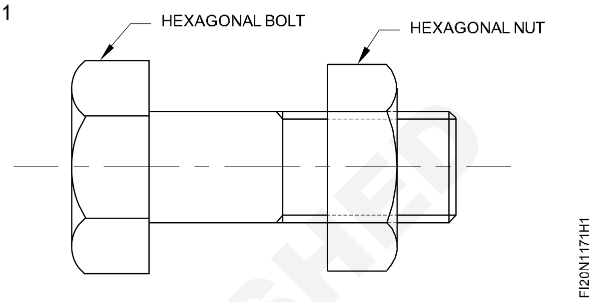
PART - 1 Hexagonal head bolt

Note: Use Ex:No 2.1.69 Task 2 hexagonal bolt for matching with hexagonal nut.

Hexagonal nut

- Check the raw material for its size
- File nut to size 10 mm thickness in 18 mm across flat hexagonal rod
- File chamfer in one end to 2 mm x 30°
- Determine tap drill size for M 10 tap.
- Mark centre of hole for tap drill size Ø 8.5 mm
- Punch on tap drill hole centre with centre punch 90°
- Make centre drill to locate hole centre
- Drill pilot hole Ø 5 mm in hexagonal nut
- Drill Ø 8.5 mm hole for M 10 tap.
- Chamfer both ends of drilled hole to 2 mm x 45°
- Hold the nut in bench vice parallel to vice jaws.
- Fix M10 first tap in tap wrench and cut internal thread as per drawing.
- Similarly, fix M10 second tap, third tap and cut and form the full thread.
- Check the threaded hole with screw pitch gauge and matching bolt.
- Clean the thread in bolt and nut.
- Match the nut with bolt as shown in Fig 1.

Fig 1



- Apply a little oil and preserve it for evaluation.

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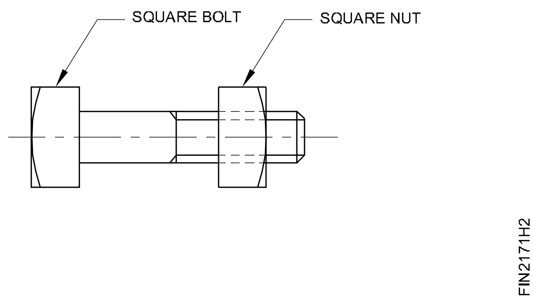
PART - 2 Square head bolt

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

Square Nut

- Check the raw material size 15mm.
- File nut to size 12 mm thickness in 25 mm side square rod.
- File chamfer in one end to 2 mm x 30°.
- Determine tap drill size for M 12 tap.
- Mark centre of hole for tapping hole.
- Punch on the tap drill hole centre with centre punch 90°
- Make centre drill to locate hole centre.
- Drill Ø 6 mm pilot hole in square nut
- Drill Ø 10.8 mm for tapiping hole.
- Chamfer both ends of drilled hole to 2 mm x 45°
- Hold the nut in bench vice parallel to vice jaws.
- Fix M 12 first tap in tap wrench and cut internal thread as per drawing.
- Similarly, fix M 12 second tap, third tap and cut and form full internal thread.
- Check the threaded hole with screw pitch gauge and matching bolt.
- Clean the thread in bolt and nut.
- Match the nut with bolt as shown in Fig 2.
- Apply a little oil and preserve it for evaluation.

Fig 2



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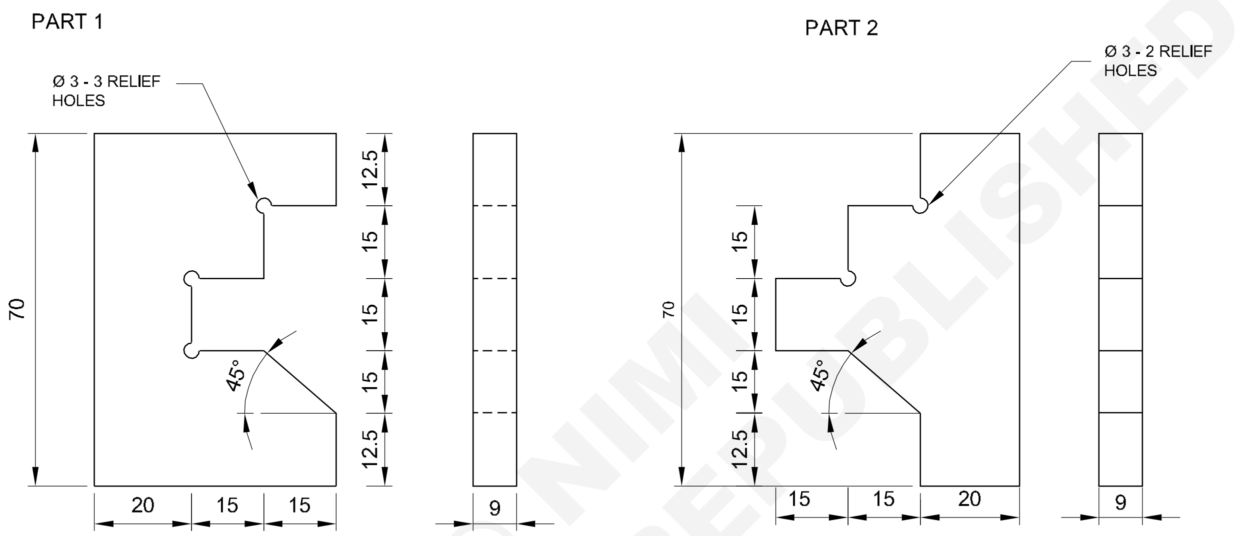
File and make step fit, angular fit, angle surfaces (bevel gauge accuracy 1 degree)

Objectives: At the end of this exercise you shall be able to
- **mark off lines using vernier height gauge**
- **file steps maintaining accuracy ± 0.04 mm**
- **mark 45° angle using vernier bevel protractor**
- **file angle maintaining 1°accuracy**
- **make step and angular fit, finish and de - burr.**

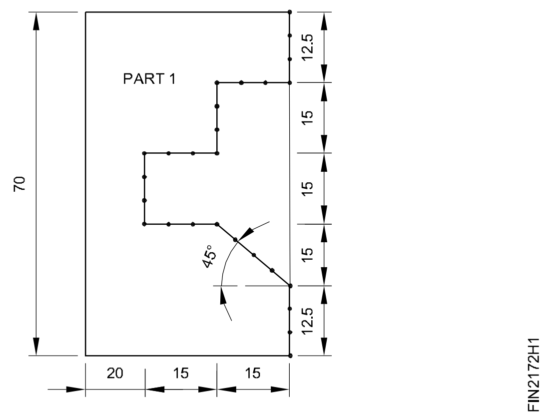


Job Sequence

PART - 1

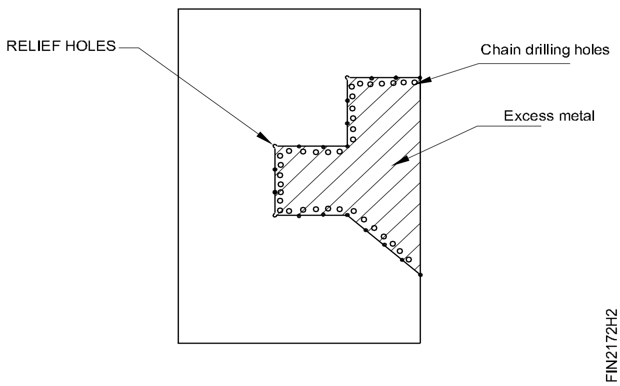
- Check the raw material for its size.
- File and finish to size 70 x 50 x 9 mm maintaining parallelism and perpendicularity.
- Mark and punch in part '1' as shown in Fig - 1.
- Drill Ø 3 relief holes as shown in job drawing.
- Chain drill holes for parting off excess material from part '1' as shown in Fig 2.
- Cut and remove excess material using web chisel and ball pein hammer.

Fig 1



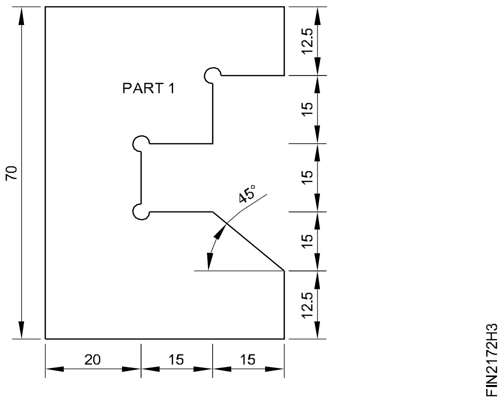
2	75 ISF 10 - 55	–	Fe310	–	1 & 2	1.5.72
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	FILE AND MAKE STEP FIT, ANGULAR FIT, ANGLE, SURFACES(BEVEL GAUGE ACCURACY 1 DEGREE)			TOLERANCE : ±0.04		TIME
				CODE NO : FI20N1572E1		

Fig 2



- File steps to size maintaining accuracy ± 0.04 mm and angle to 45° maintaining 1° accuracy using safe edge different grades of files as shown in Fig 3.

Fig 3

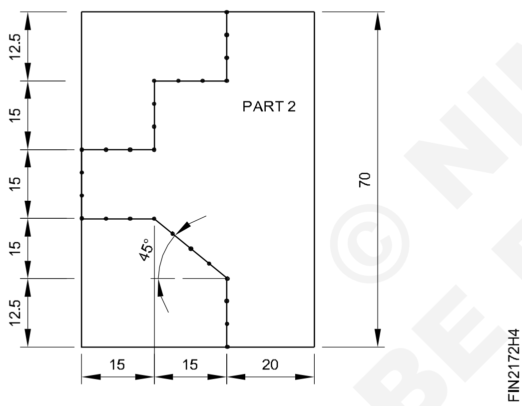


- Check the size with vernier caliper and angle with bevel gauge.

PART- 2

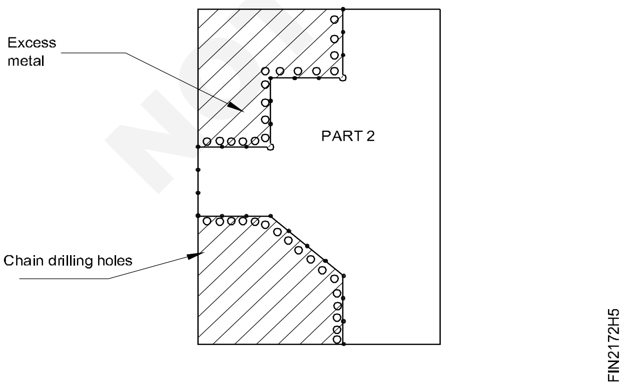
- File and finish to size 70 x 50 x 9 mm maintaining parallelism and perpendicularity.
- Mark and punch in part -2 as shown in Fig 4.

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.

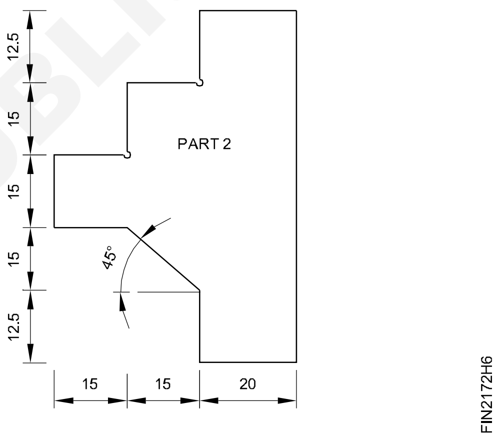
Fig 5



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

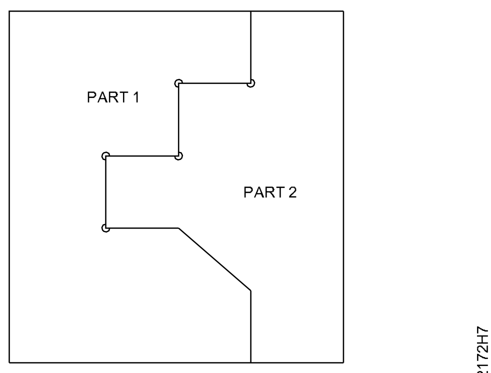
- File steps to size and angle to 45° using safe edge file different grades as shown Fig 6.

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, 2 and de - burr in all the surfaces.
- Apply a little oil and preserve it for evaluation.

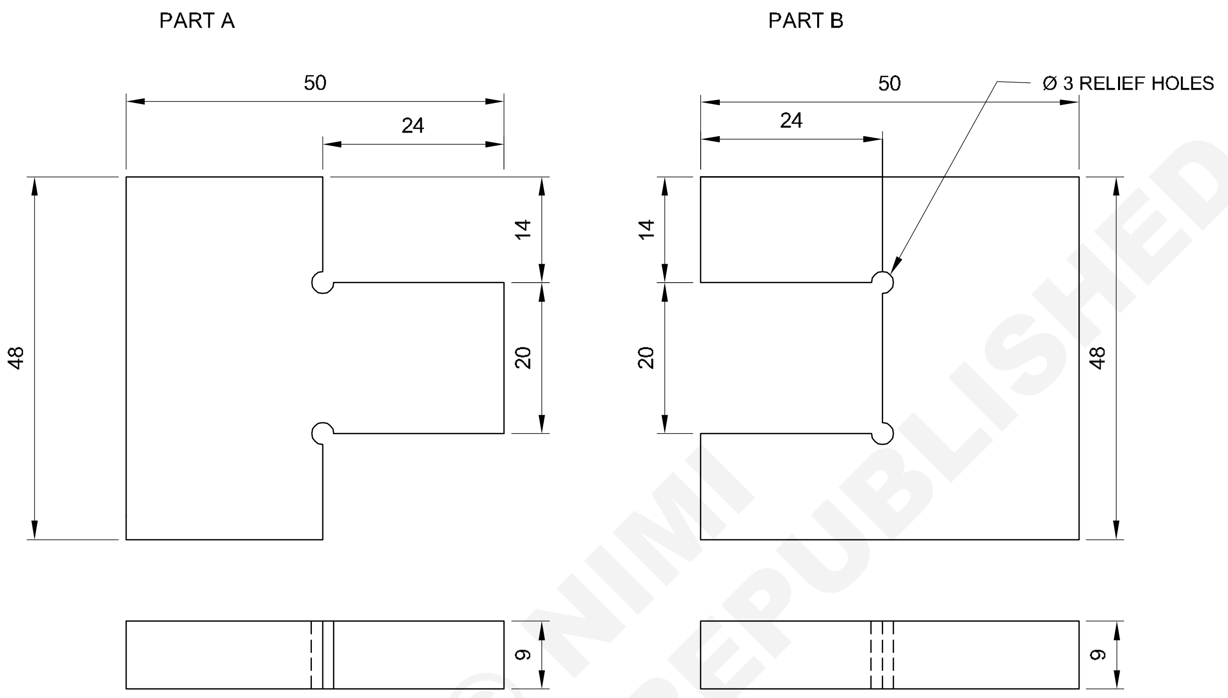
Fig 7



MATCH PART 1 & 2

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 within an accuracy of ± 0.04 mm**
- **file and assemble the tongue and groove, and obtain the required class of fit.**

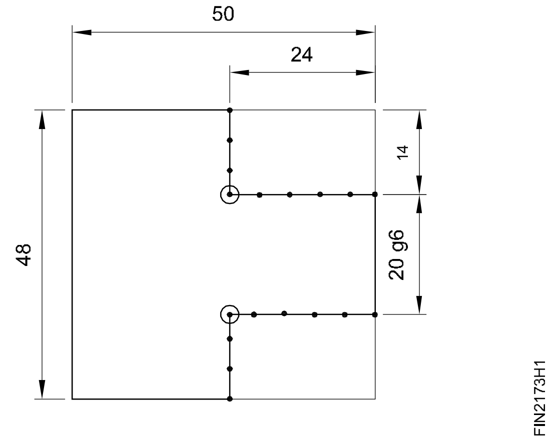


Job Sequence

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.
- Drill relief hole Ø 3 mm as per job drawing in part A.

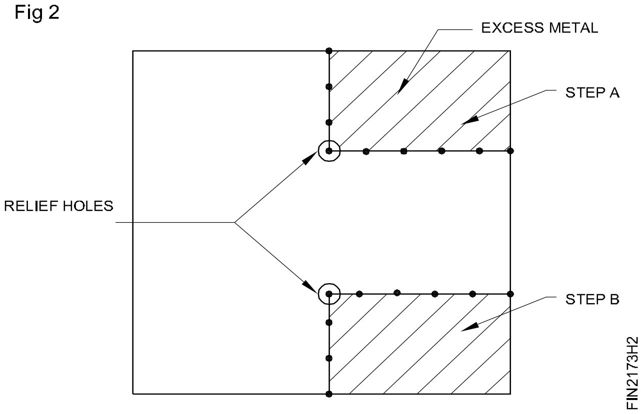
Fig 1



2	50 ISF 10 - 55	-	Fe310	-	A&B	1.5.73
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 :
					CODE NO : FI20N1573E1	

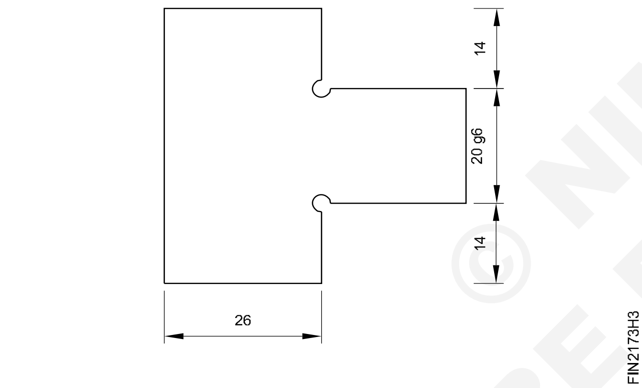
- Mark lines as shown in Fig 2 leaving the metal 1 mm away from the object line and cut and remove the excess metal by hacksawing.

Fig 2



- File part A as per drawing to size 14 mm x 24 mm with safe edge file and check the size with vernier caliper.
- Similarly cut and remove the excess metal and file step B to size and shape and check the size with vernier caliper as shown in Fig 3.

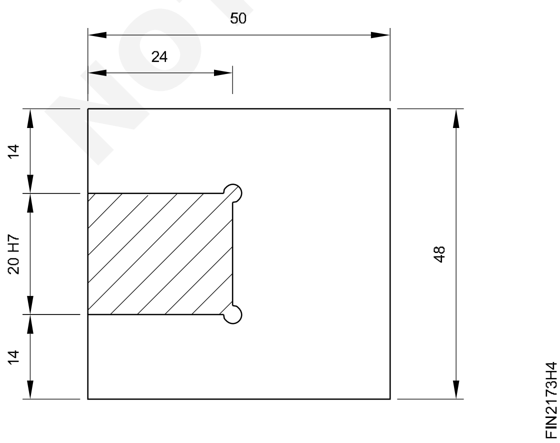
Fig 3



Part B

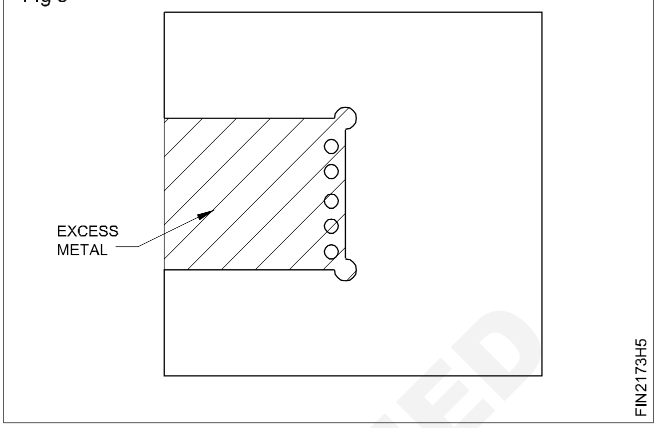
- File and finish to size 50 x 48 x 9 mm maintaining parallelism and perpendicularity.
- Apply marking media, mark and punch as shown in Fig 4.

Fig 4



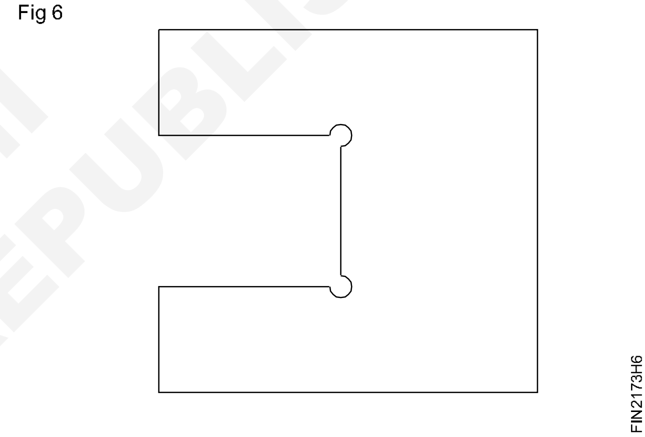
- Drill relief hole Ø 3 mm on part B
- Chain drill holes, chip, hacksaw and remove the excess metal as shown in Fig 5.

Fig 5



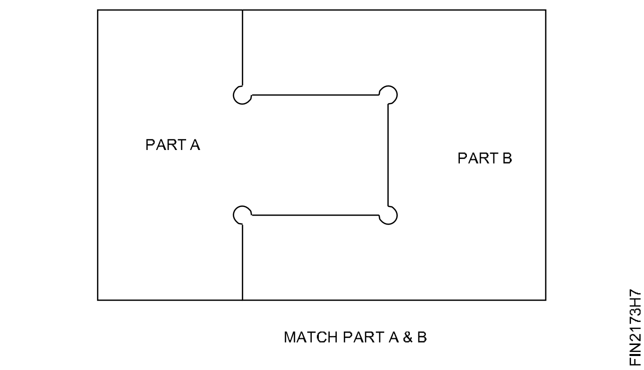
- File to size and shape maintaining the flatness and squareness as shown in Fig 6.

Fig 6



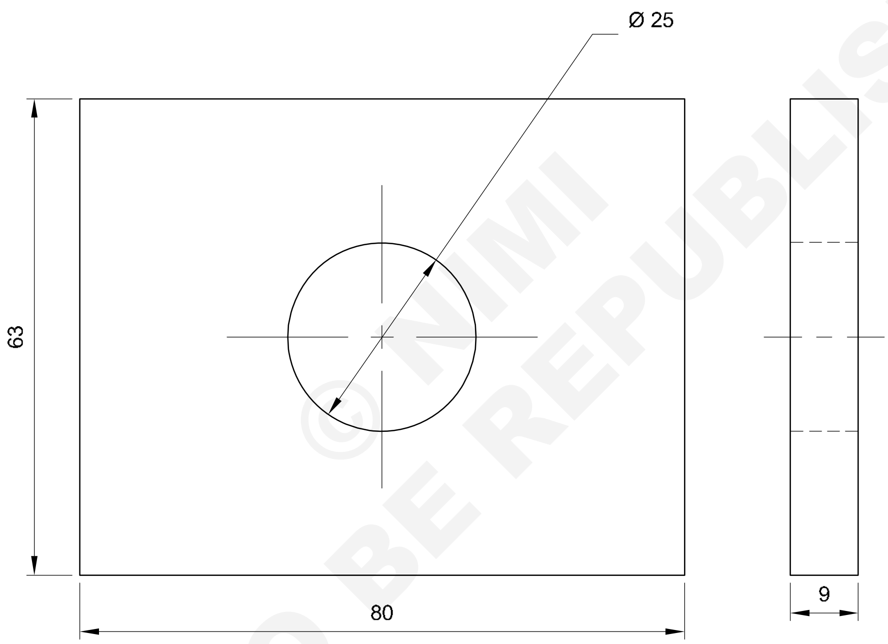
- Check the size with vernier caliper.
- Match part 'A' and 'B' as shown in Fig 7
- Finish de - burr in all the corners of the job.
- Apply a thin coat of oil and preserve it for evaluation.

Fig 7



Enlarge hole and increase internal dia

Objectives: At the end of this exercise you shall be able to
- **mark drill hole centre as per drawing**
- **drill centre drill and pilot hole**
- **enlarge the drilled holes to Ø 25 mm by filing.**

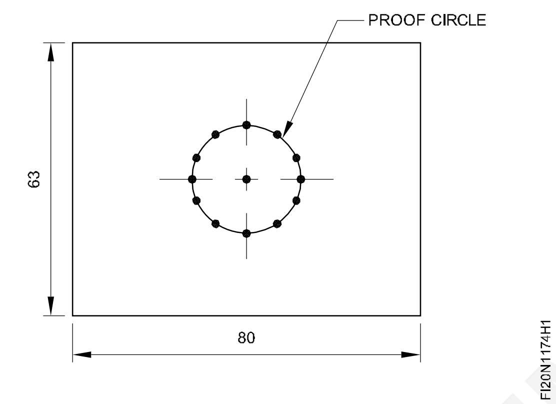


1	65 ISF 10 - 82	-	Fe310	-	-	1.5.74
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
SCALE 1:1	ENLARGE HOLE AND INCREASE INTERNAL DIA				TOLERANCE : ± 0.04	TIME :
					CODE NO : FI20N1574E1	

Job Sequence

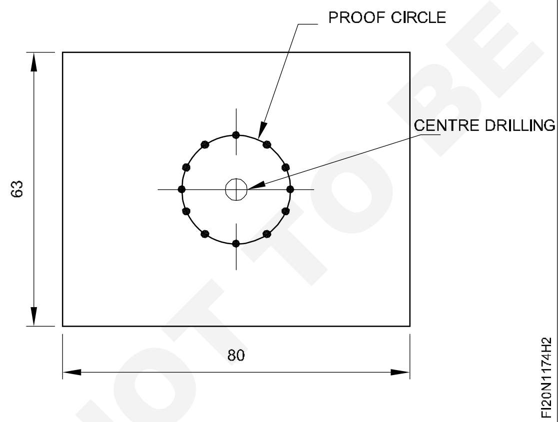
- Check the raw material for its size
- File and finish to size 80x63x9 mm and maintaining parallelism and perpendicularity.
- Apply marking media, mark off centre lines and locate the centre of drill hole as per drawing.
- Punch on the intersecting lines using prick punch 30°, set 12.5 mm in divider using steel rule and draw Ø 25 mm circle.
- Punch the Ø 25 mm circle using prick punch as shown in Fig 1.

Fig 1



- Fix the job on the drilling machine table.
- Fix centre drill in drill chuck and locate the drill hole in centre of the work piece. (Fig 2)

Fig 2



- Fix Ø 6 mm drill in drilling machine and drill pilot hole in the centre drilled hole. (Fig 3)
- set the drilling machine speed according to the diameter of drill.
- Similarly, fix Ø 10 mm, Ø 16 mm and Ø 20 mm drills in different diameters one by one in drilling machine and enlarge the previously drilled holes as shown in Fig 4.

Fig 3

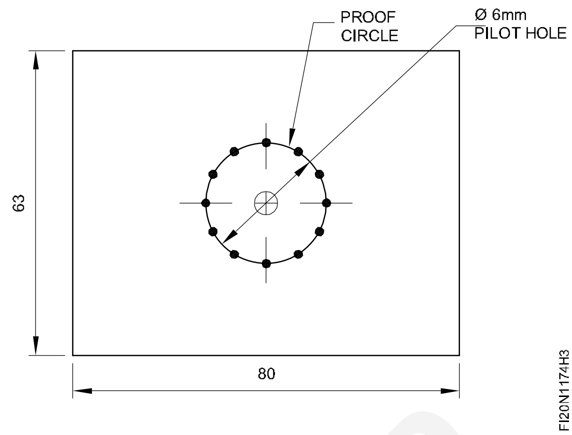
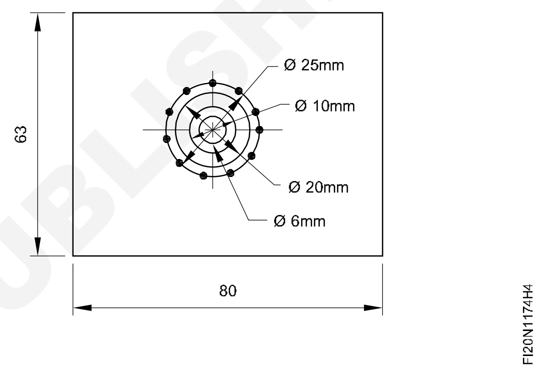
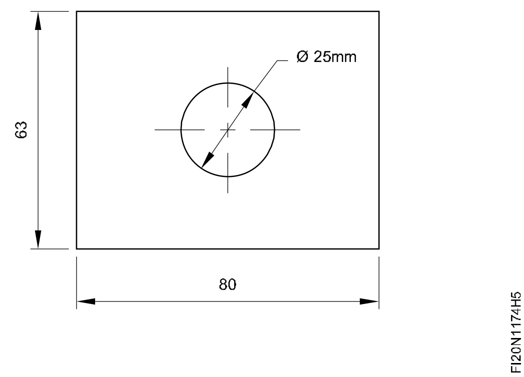


Fig 4



- Finally, enlarge the previously drilled hole to Ø 25 mm by filing as shown in Fig 5.
- Finish file on the job and de-burr in all the corners.
- Apply a thin coat of oil and preserve it for evaluation.

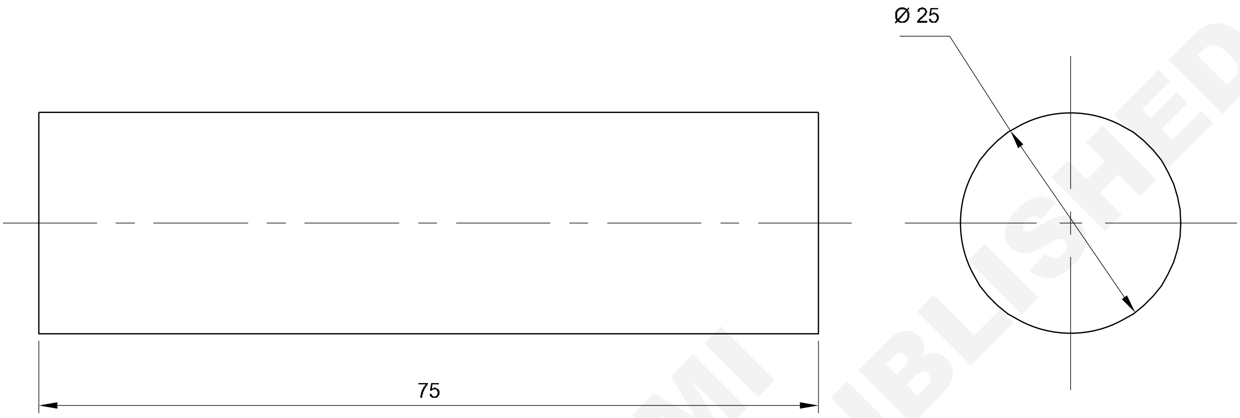
Fig 5



Use coolant while drilling

File cylindrical surfaces

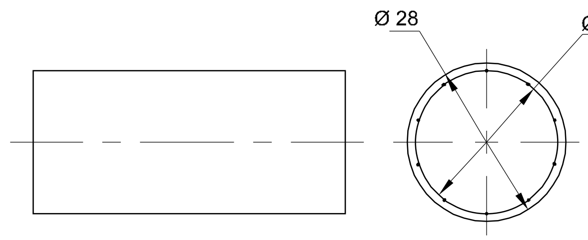
Objectives: At the end of this exercise you shall be able to
- **hold cylindrical rod in a bench vice**
- **file cylindrical surface an accuracy of ± 0.04 mm**
- **finish and de - burr.**



Job Sequence

- Check the raw material for its size
- File round rod both ends to flatness and squareness maintaining 75 mm length.
- Check the flatness squareness and parallelism.
- Apply marking media in both ends of round rod.
- Mark C/L of round rod. With reference to C/L mark the diameter Ø 25 mm on both ends using divider and steel rule to file cylindrical profile as shown in Fig 1.
- Punch witness marks on marked diameter.
- Hold the cylindrical rod in bench vice and file cylindrical profile to Ø 25 mm using flat file of different grades in see saw motion.
- Check the length and diameter of cylindrical rod with vernier caliper.
- Rotate the cylindrical rod and file circular profile to Ø 25 mm.
- Check the diameter with out side micrometer.
- Debur in both ends of round rod.
- Apply little oil and preserve it for evaluation.

Fig 1

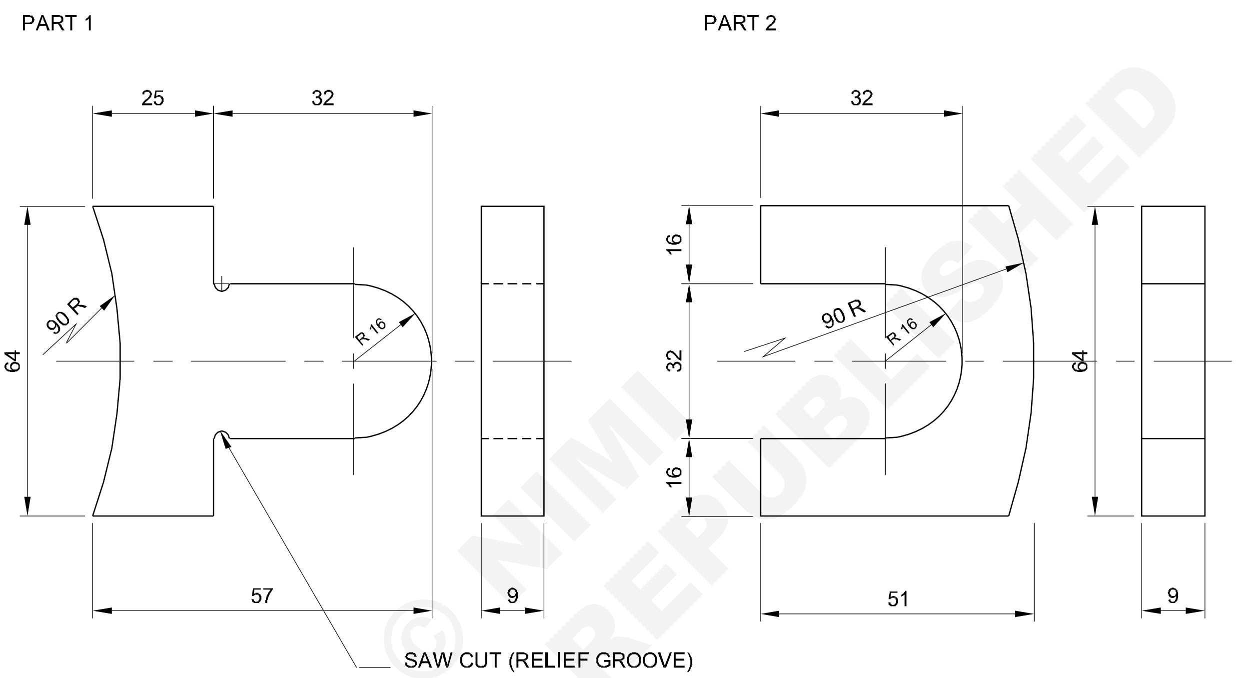


1	Ø28 - 80	–	Fe310	–	–	1.5.75
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	FILE CYLINDRICAL SURFACES	TOLERANCE : ±0.04	TIME :
		CODE NO : FI20N1575E1	

Make open fitting of curved profiles

Objectives: At the end of this exercise you shall be able to
- **file surfaces to flat and parallel to an accuracy of ± 0.04 mm**
- **mark curved profiles as per drawing**
- **file radius and curved profiles to size and shape**
- **match open fitting of curved profile.**



Job Sequence

PART - 1

- Check the raw metal size using steel rule.
- File and finish to overall size 64 x 57 x 9 mm maintaining parallelism and perpendicularity.
- Apply marking media, mark in part 1 as per job drawing.
- Punch witness marks as shown in Fig 1
- Cut and remove the hatched portion of excess metal in one side and file to size and shape as shown in Fig 2.
- Check the size with vernier caliper.
- Similarly, cut and remove the hatched portion of excess metal on otherside and file to size and profile as shown in Fig 3.

1	65 ISF 10 - 55	–	Fe310	–	2	1.5.76
1	65 ISF 10 - 60	–	Fe310	–	1	1.5.76
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	MAKE OPEN FITTING OF CURVED PROFILES				TOLERANCE : ±0.04	TIME :
					CODE NO : FI20N1576E1	

Fig 1

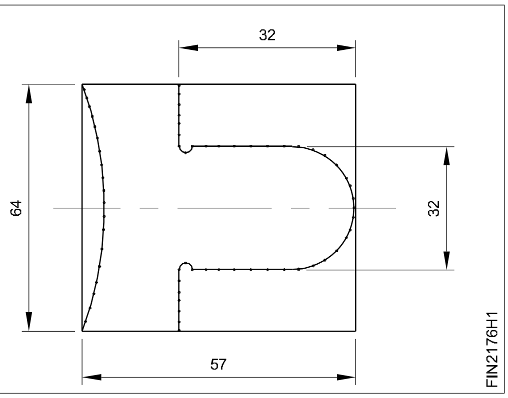


Fig 2

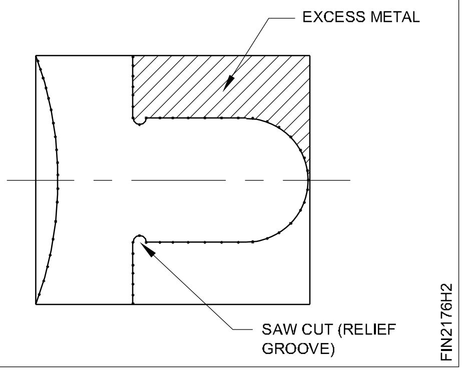
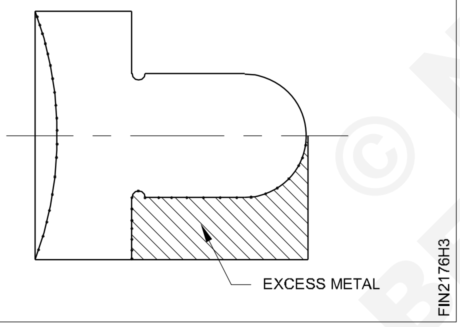


Fig 3



- Cut relief grooves by hacksaw.
- Cut and remove the hatched portion of excess metal on curvature side (fig 4) and file the curved profile to size and check the curved profile with template and check the sizes with vernier caliper as shown in Fig 5.

Fig 4

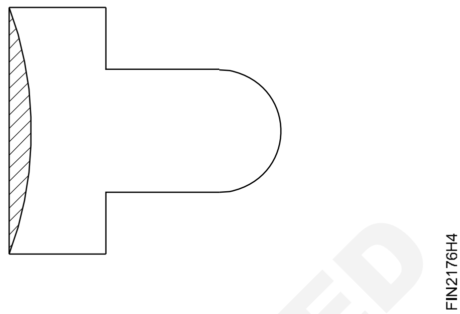
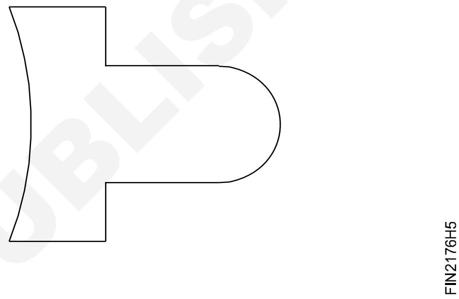


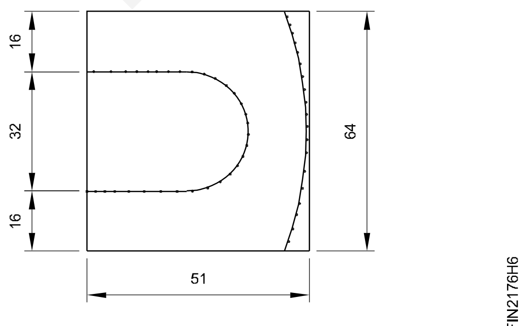
Fig 5



Part - 2

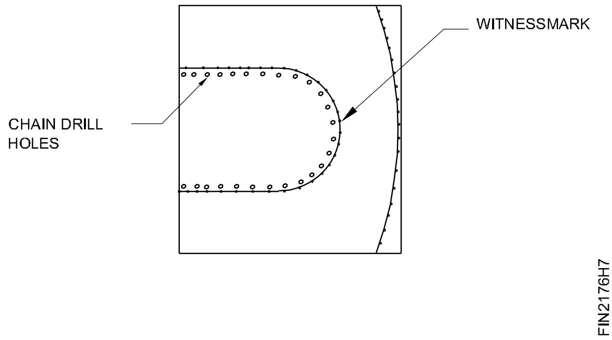
- Check the raw metal size using steel rub.
- File and finish to size 64 x 51 x 9 mm maintaining parallelism and perpendicularity.
- Apply marking media, mark as per job drawing.
- Punch witness marks in part 2 as shown in Fig 6.

Fig 6



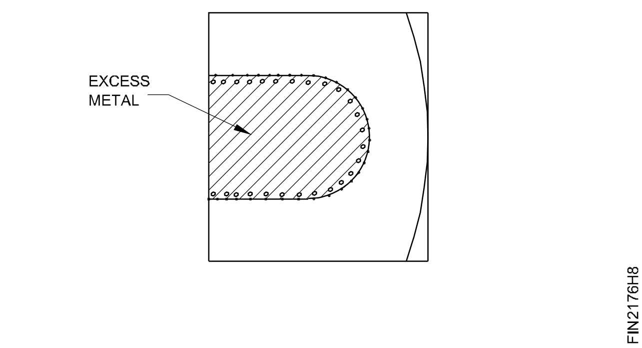
- Chain drill holes to remove excess metal as shown in Fig 7.

Fig 7



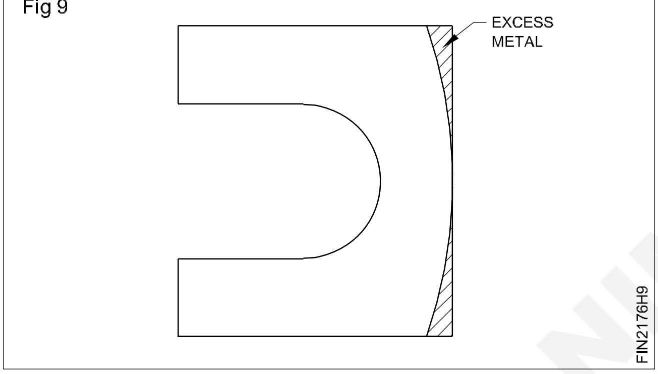
- Cut and remove the hatched portion of excess metal and file to size and shape as shown in Fig 8.

Fig 8



- Similarly, cut and remove the hatched portion of excess metal on curved profile side with hacksaw and file the profile to size and shape as shown in Fig 9.

Fig 9



- Check the curved profile with template and the size with vernier caliper as shown in Fig 10.
- Match part 1 and 2 as shown in Fig 11 & 12 in both sides.
- Finish file in part 1 and 2 and remove burrs in all the surfaces and corners.
- Apply a little oil and preserve it for evaluation.

Fig 10

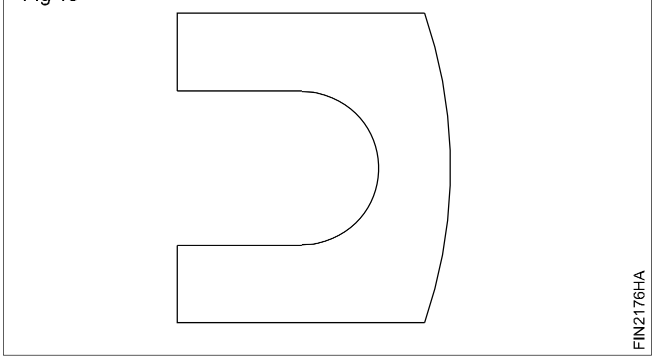


Fig 11

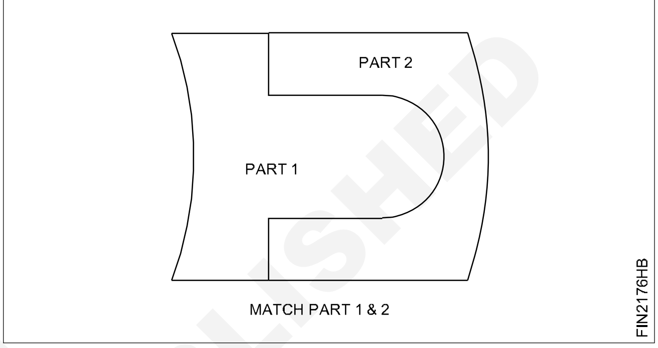
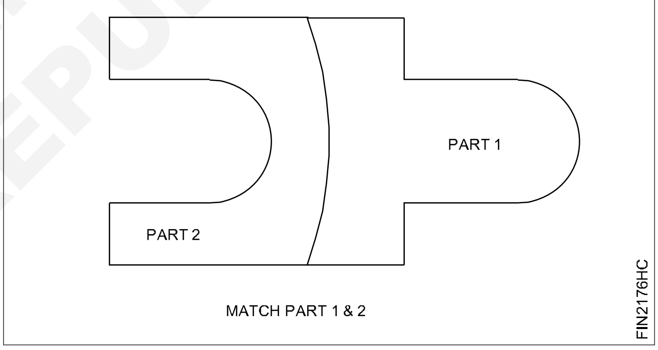
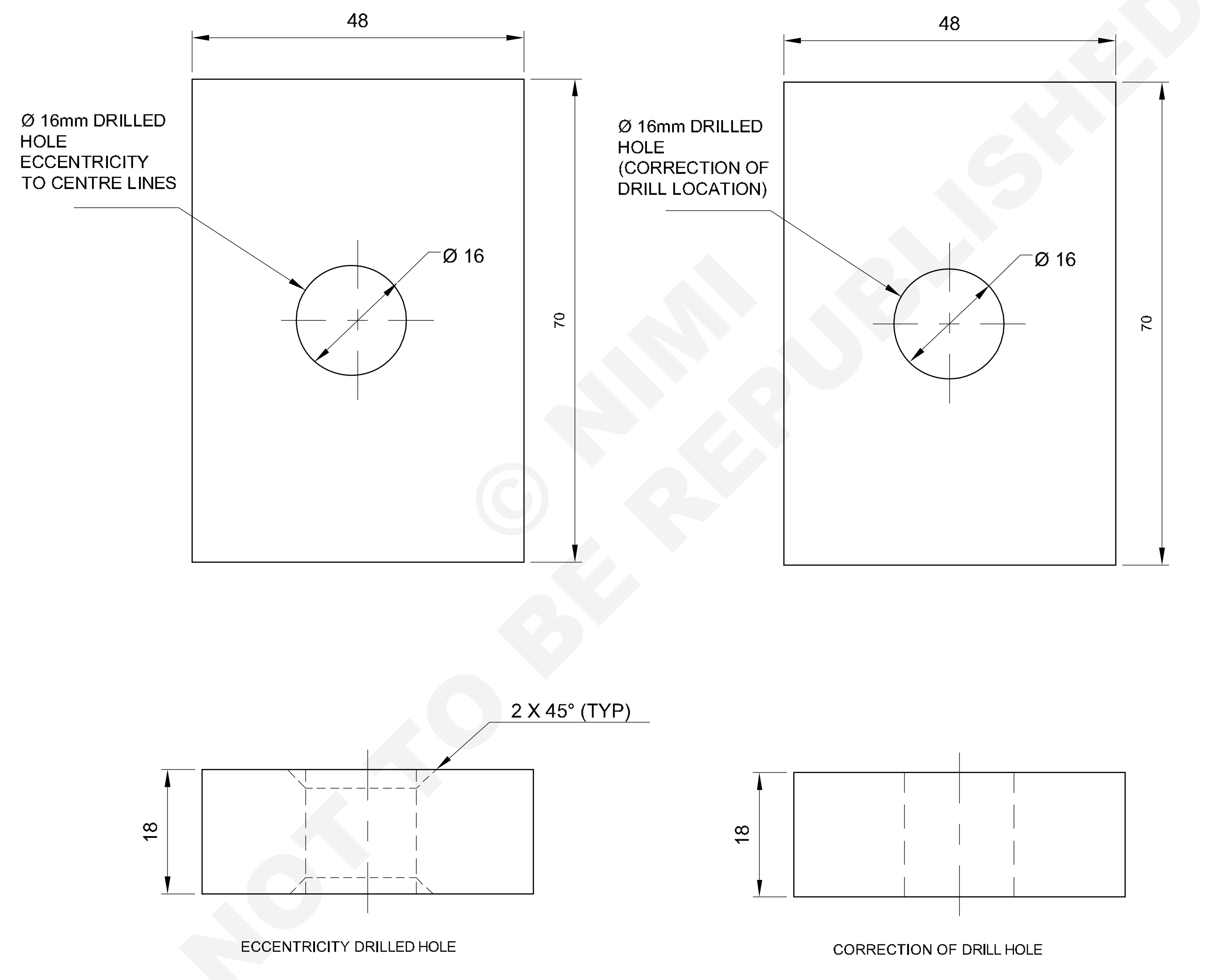


Fig 12



Correction of drill location by binding previously drilled hole

Objectives: At the end of this exercise you shall be able to
- **prepare round rod more than the hole size**
- **plug the hole as tight fit**
- **file the plugged surface on both sides flat and square**
- **mark the hole location concentricity to centre lines**
- **drill pilot and correct drill hole concentricity to the centre lines.**



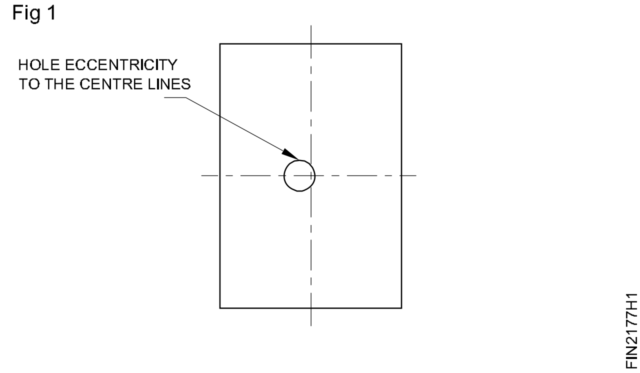
1	50 ISF 20 - 75	–	Fe310	–	1	1.5.77
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	CORRECTION OF DRILL LOCATION BY BINDING PREVIOUSLY DRILLED HOLE	TOLERANCE : ±0.04	TIME :
		CODE NO : FI20N1577E1	

Job Sequence

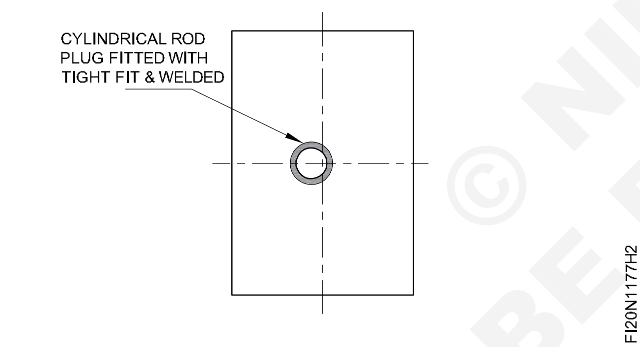
- Check the given material hole size Fig 1.

Fig 1



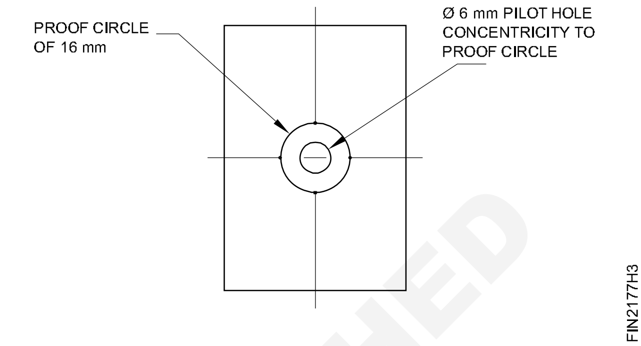
- Chamfer 2x45° at both ends of hole
- Prepare round rod more than 0.050 mm actual size of drilled hole (16.000 + 0.050 = 16.050 mm) and chamfer 2 x 45° at both ends of round rod
- Plug the hole as tight fit with prepared round rod using ball pein hammer (Fig 2)
- Weld both ends of plug fitted round rod

Fig 2



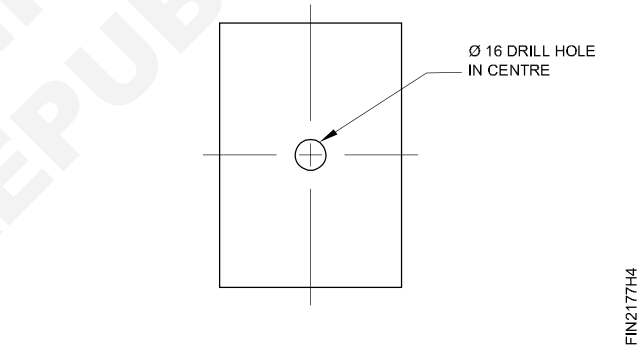
- File the plug surface on both sides to flat and square.
- Apply marking media on surface.
- Mark correct centre for drill hole with vernier height gauge (Fig 3)
- Punch on the drill hole centre mark with centre punch 90°.
- Fix centre drill in drill chuck and make centre drill hole.
- Fix Ø 6 mm drill and drill hole as a pilot hole (Fig 3).
- Similarly fix Ø 9 mm, Ø 13 mm drill and enlarge the previously drilled holes.

Fig 3



- Finally, fix Ø 16 mm drill and enlarge the previously drilled hole Fig 4.
- Finish file, de-burr, clean and check with vernier caliper.

Fig 4



- Apply a little oil and preserve it for evaluation.

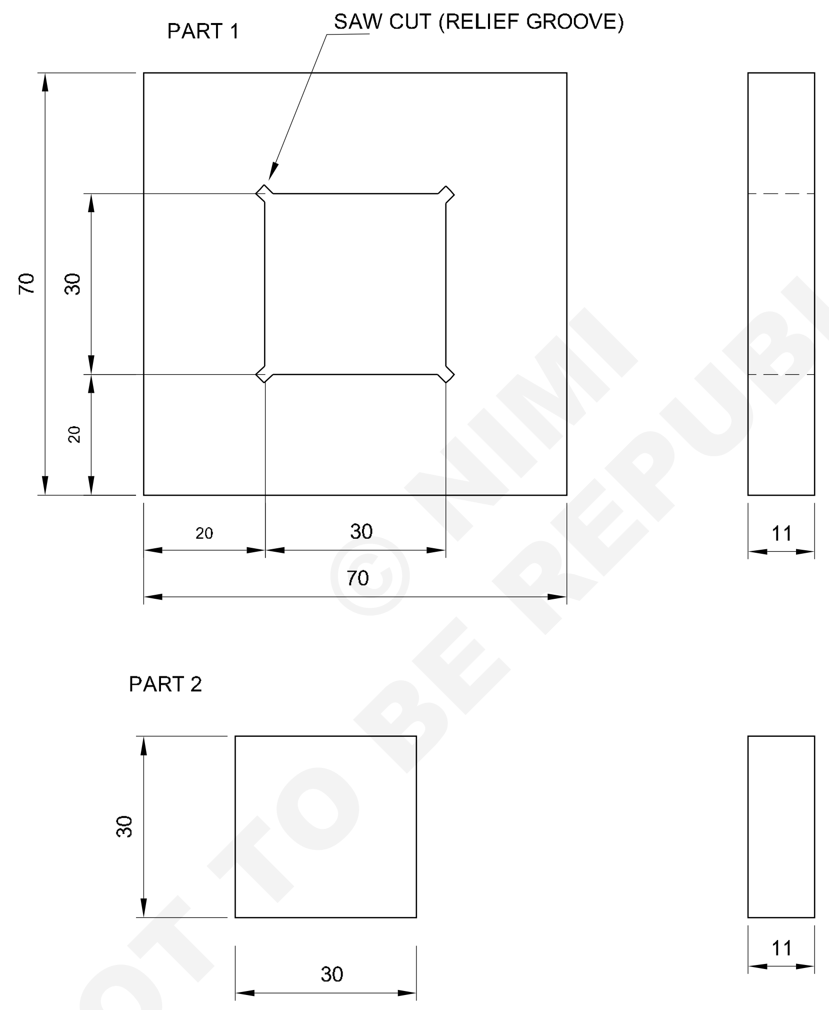
Incase of minor eccentricity to center lines follow the procedure given below

- Fix the work piece in machine vice
- Align the center with locating pin
- Fix the slot drill in drill chuck
- Slot drill it (now the center is in the location) with the same setting drill Ø 16 mm hole.

— — — — — — —

Make inside square fit

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 ± 0.04 mm**
- **match square in square slot.**



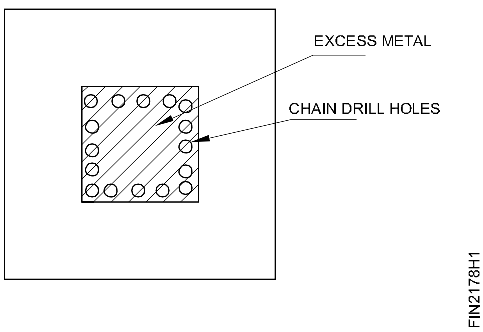
1	35 ISF 12- 35	–	Fe310	–	2	1.5.78
1	75 ISF 12 - 75	–	Fe310	–	1	1.5.78
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	MAKE INSIDE SQUARE FIT				TOLERANCE : ±0.04	TIME :
					CODE NO : FI20N1578E1	

Job Sequence

PART - 1

- Check the given raw material for its size.
- Rough and finish file on surfaces flat and square to over all size 70x70x11 mm maintaining accuracy ± 0.04mm.
- 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 Fig 1.

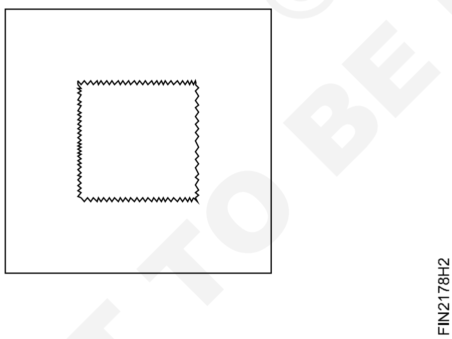
Fig 1



Pheriphery of the drill should not touch the witness marks

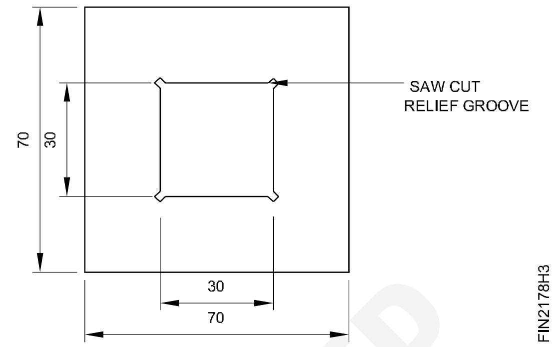
- Cut and remove the chain drilled hatched part using web chisel and ball pein hammer as shown in Fig 2.

Fig 2



- File the chipped portion to size and shape using safe edge file of different grades maintaining accuracy of ± 0.04 mm and check the size with vernier caliper.
- Cut relief grooves using hacksaw at four inside corners as shown in Fig 3.

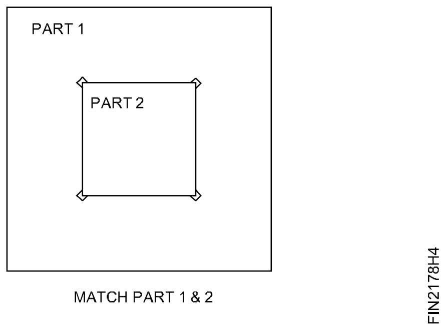
Fig 3



PART - 2

- File to size 30x30x11 mm maintaining accuracy ± 0.04 mm.
- Check the flatness and squareness with try square.
- Check the size with vernier caliper.
- Match part - 2 into part1 as shown in Fig 4.

Fig 4

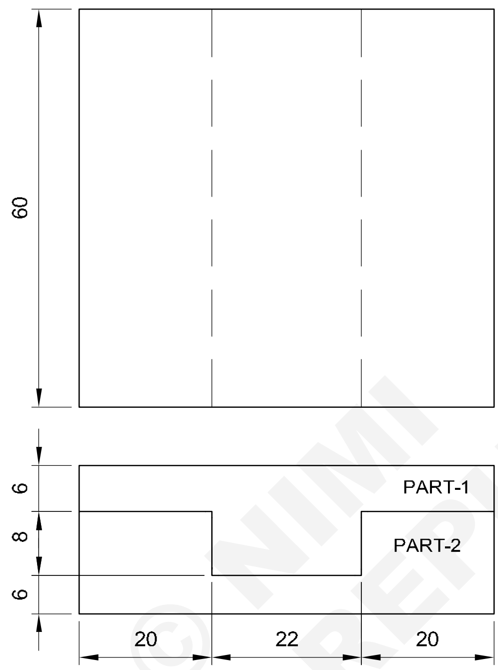


MATCH PART 1 & 2

- Finish file in part 1 and 2 with flat smooth file and de-burr in all the surfaces and corners of the job.
- Apply a little oil and preserve it for evaluation.

Make sliding 'T' fit

Objectives: At the end of this exercise you shall be able to
- **file flat surfaces to flat and square maintaining accuracy ± 0.04 mm**
- **mark dimension lines as per drawing**
- **file to size, shape and make sliding fit.**



Job Sequence

PART - 1

- Check the raw metal size using steel rule
- File and finish to overall size of 62x60x14 mm maintaining parallelism and perpendicularity and to the accuracy of ± 0.04 mm.
- Check the size with vernier caliper.
- Apply marking media, mark as per drawing and punch witness marks as shown in Fig 1.
- Hacksaw and remove the hatched portion of excess metal in one side of the job as shown in Fig 2.
- File the cut portion to size and shape maintaining flatness and squareness to the accuracy of ± 0.04mm.
- Similarly, cut and remove the excess metal in other side, file and check the size with vernier aliper as shown in Fig 3.

2	65ISF15-65	-	Fe 310	-	-	1.6.79
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	MAKE SLIDING 'T' FIT	TOLERANCE ±0.04mm	TIME:
		CODE NO. FI20N1679E1	

Fig 1

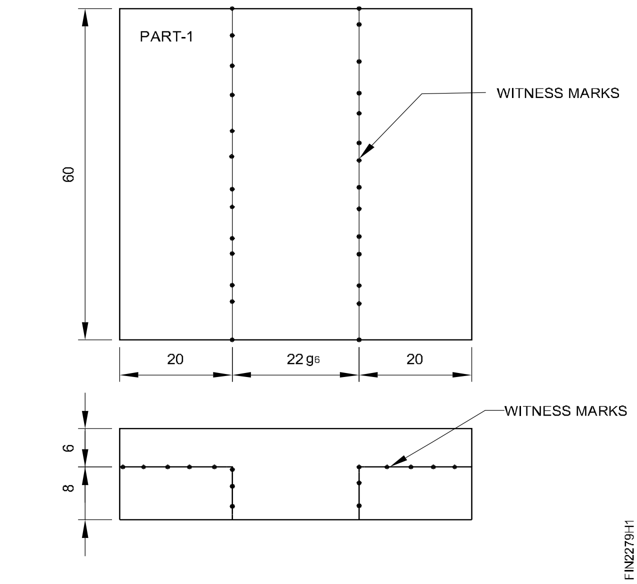


Fig 2

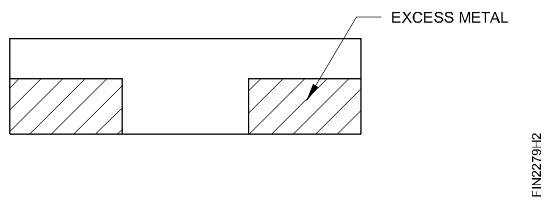
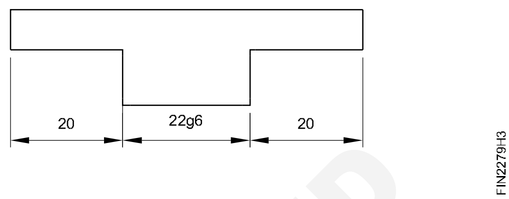


Fig 3

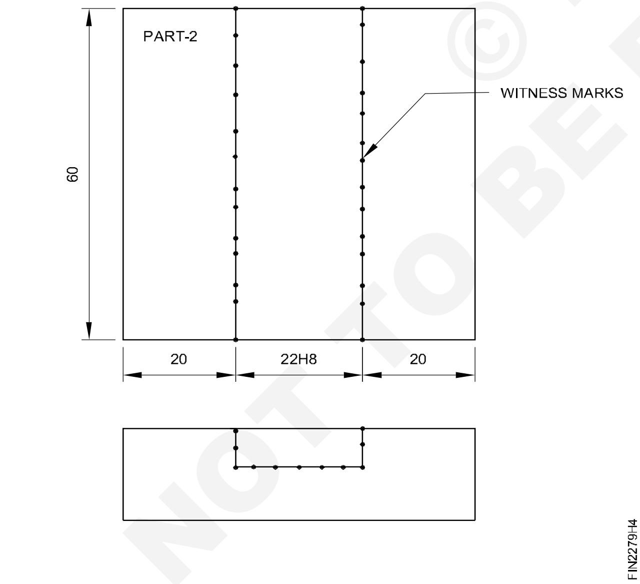


PART - 2

Check the raw metal size using steel rule

- File and finish to size 62x60x14 mm maintaining parallelism and perpendicularity to the accuracy of ± 0.04 mm
- Apply marking media, mark and punch the dimension lines as shown in Fig 4.

Fig 4



- Hacksaw chip and remove the hatched portion of excess metal as shown in Fig 5.
- File to size and shape maintaining flatness and squareness as shown in Fig 6.
- Match part 1 and 2 and slide it as shown in Fig 7.
- Finish file part 1 and 2 and de-burr all the surfaces and corners of the job.
- Apply a little oil and preserve it for evaluation.

Fig 5

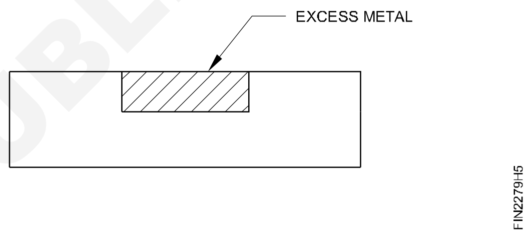


Fig 6

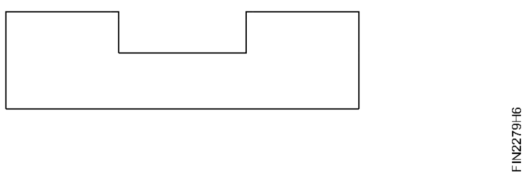
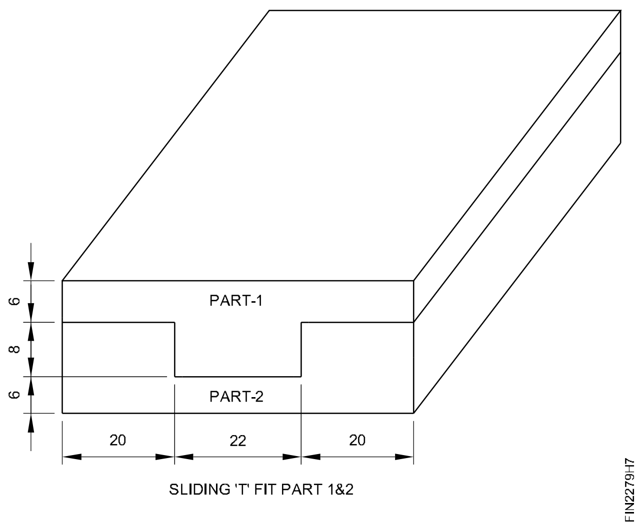
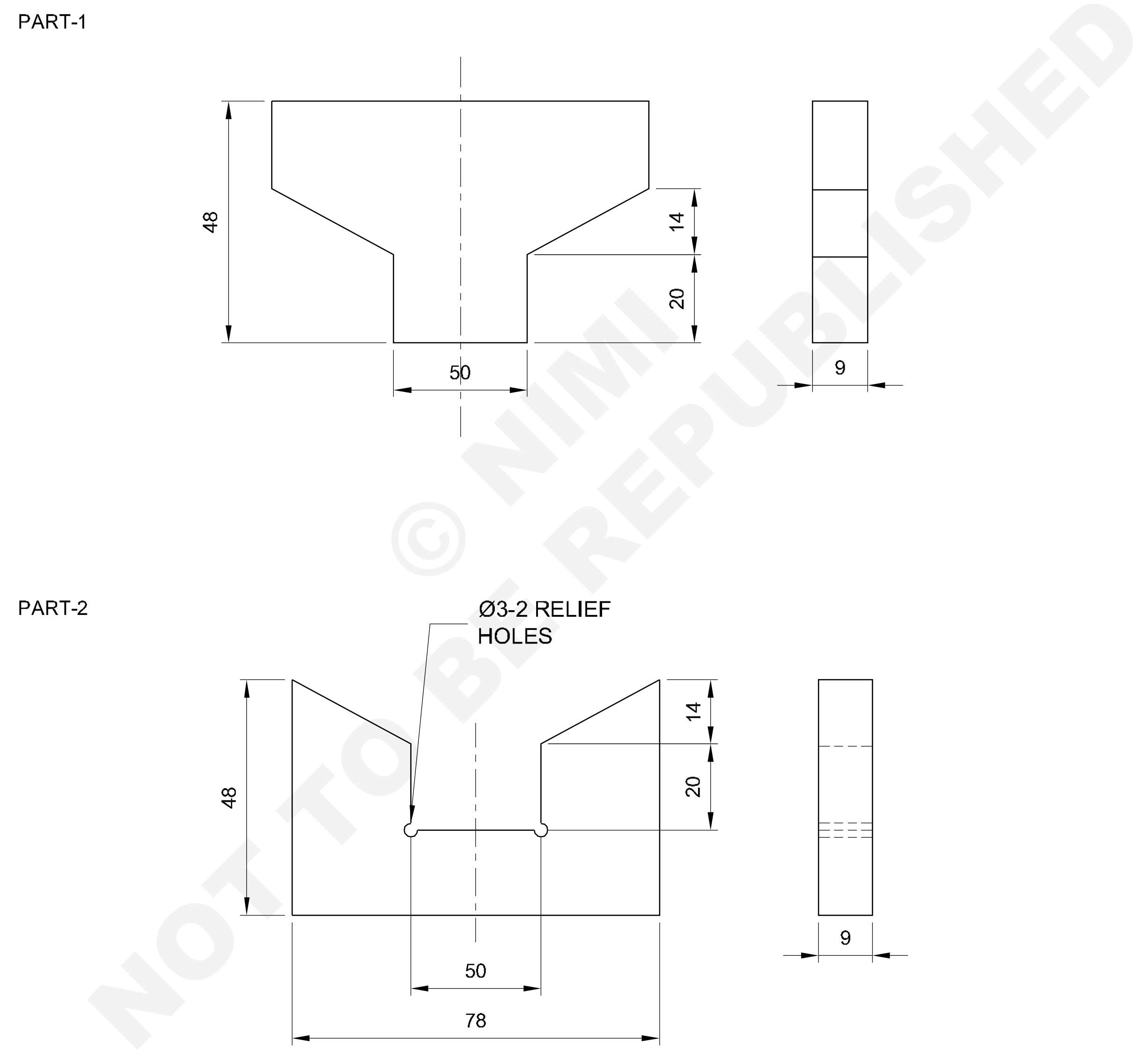


Fig 7



File fit - combined, open angular and sliding sides

Objectives: At the end of this exercise you shall be able to
- **file surfaces flat and square to the accuracy of ± 0.04 mm**
- **mark dimension lines as per drawing**
- **file flat and angular surfaces as per drawing**
- **measure the angle using vernier bevel protractor**
- **fit combined open, angular sliding sides, finish and de-burr.**



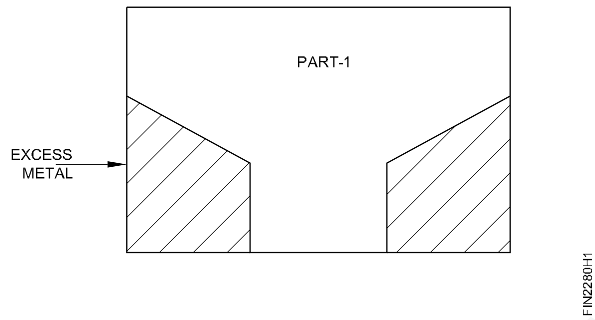
2	50ISF10-80	-	Fe 310	-	1&2	1-6-80
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	FILE FIT-COMBINED ,OPEN ANGULAR AND SLIDING SIDES	TOLERANCE LINEAR ±0.04mm ANGLE ±30 minutes	TIME:
		CODE NO. FI20N1680E1	

Job Sequence

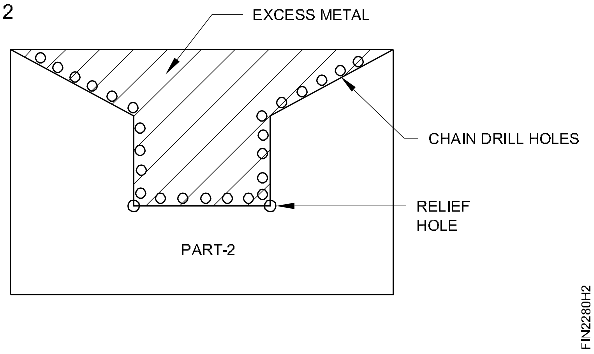
- Check the raw matal for its size.
- File part 1 and 2 to over all size 78 x 48 x 9 mm maintaining parallelism and perpendicularity.
- Check the size with vernier caliper.
- Apply marking media and mark dimension lines on part 1 and 2 as per job drawing.
- Punch witness marks on part 1 and 2.
- Hacksaw and remove the excess metal in part 1 and file to size and shape maintaining accuracy ± 0.04 mm and angle 30 minutes as shown in Fig 1.

Fig 1



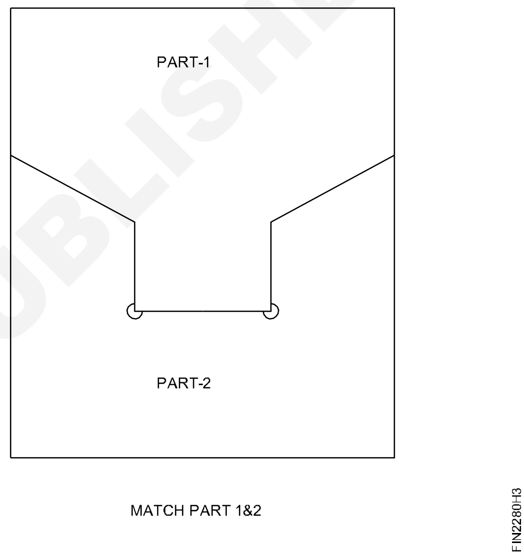
- Drill Ø 3 mm relief hole in part 'B'
- Chain drill, chip, remove the excess metal in part 'B' and file to size and shape as shown in Fig 2.
- Check the size with vernier caliper and angles with vernier bevel protector.
- Finish file on part 1 and 2 and de-burr in all corners.

Fig 2



- Match part 1 and 2 as shown Fig 3.
- Apply a little oil and perserve it for evaluation.

Fig 3



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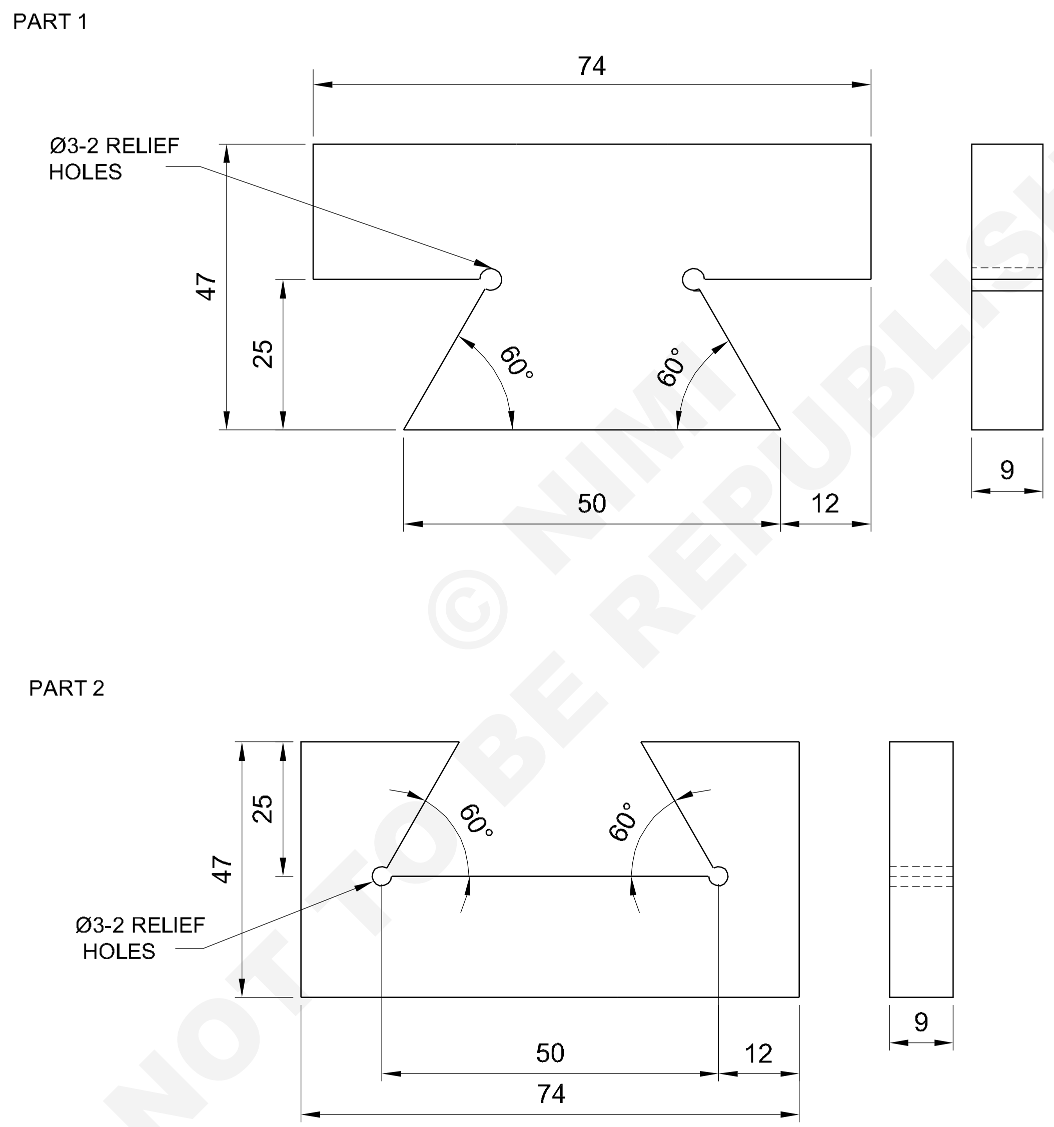
File internal angles 30 minutes accuracy open, angular fit

Objectives: At the end of this exercise you shall be able to
- **file surfaces parallel and square within an accuracy of ± 0.04 mm**
- **mark dimension and angular lines as per drawing**
- **file flat and angular surfaces as per drawing**
- **check the angle using vernier bevel protector to an accuracy of 30 minutes**
- **fit angular surfaces as per drawing, finish and de-burr.**

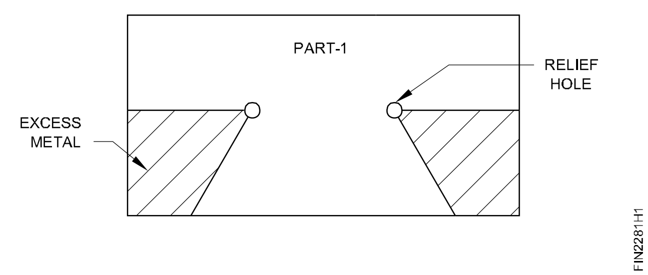


2	50ISF10 - 80	–	Fe310	–	1&2	1.6.81
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : 1:1	FILE INTERNAL ANGLES 30 MINUTES ACCURACY OPEN , ANGULAR FIT				TOLERANCE LINEAR ±0.04 mm ANGLE ±30	TIME: 15Hrs
					CODE NO: FI20N1681E1	

Job Sequence

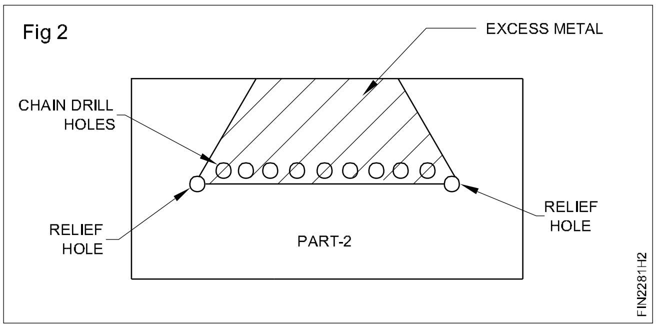
- Check the raw material size.
- File part 1 and 2 to over all size 74 x 47 x 9 mm maintaining flat and squareness.
- Apply marking media on the surface and mark dimension lines on part 1 and 2 as per job drawing.
- Punch witness marks on part 1 and 2.
- Drill Ø 3 mm relief holes in part 1 and 2.
- Hacksaw and remove the excess metal in part 1 and file the cut portion to size and shape maintaining the accuracy ± 0.04 mm and angles 30 minutes as shown in Fig 1.

Fig 1



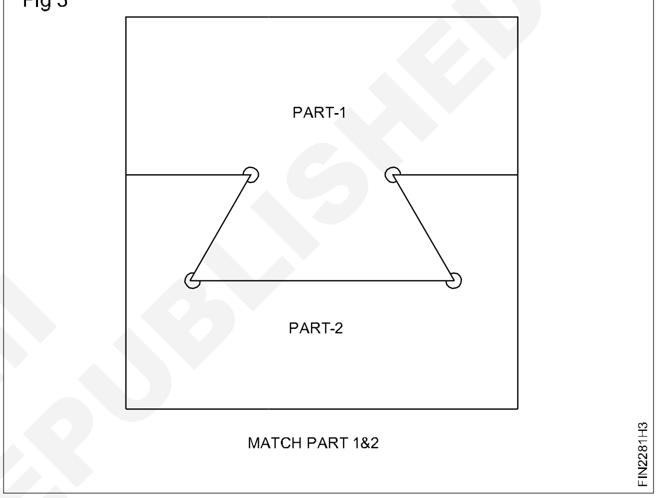
- Chain drill, chip, hacksaw and remove the excess metal in part 2 and file to size and shape as shown in Fig 2.
- Check the size with vernier caliper and angles with vernier bevel protector.

Fig 2



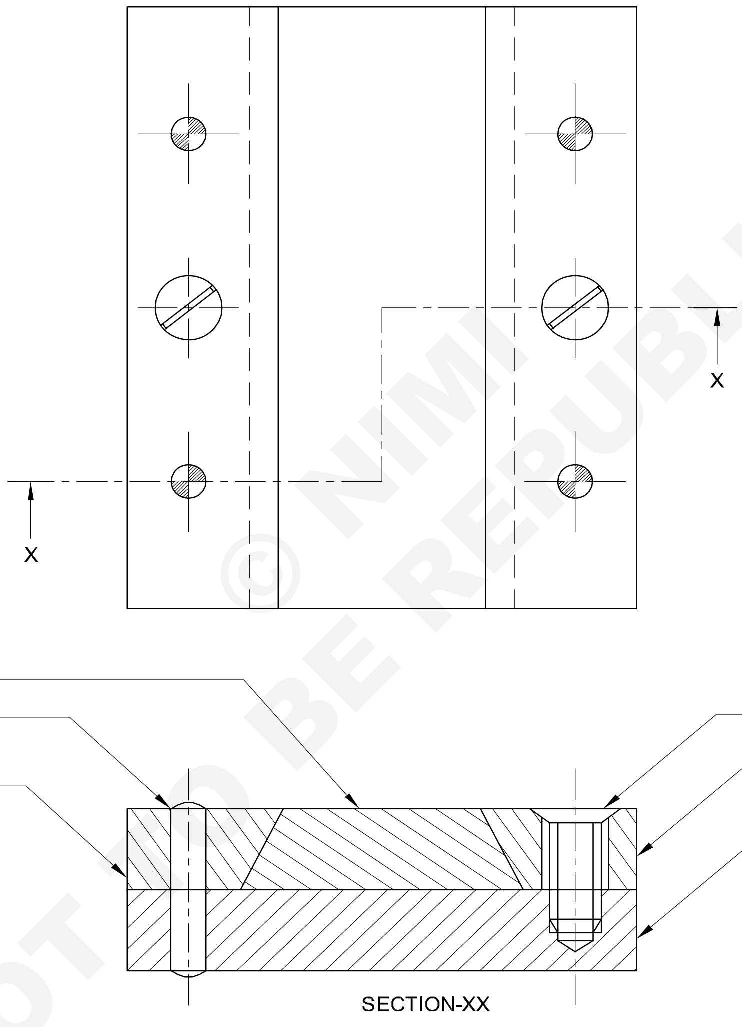
- Match part 1 and 2 as shown in Fig 3.
- Apply a little oil and preserve it for evaluation.

Fig 3



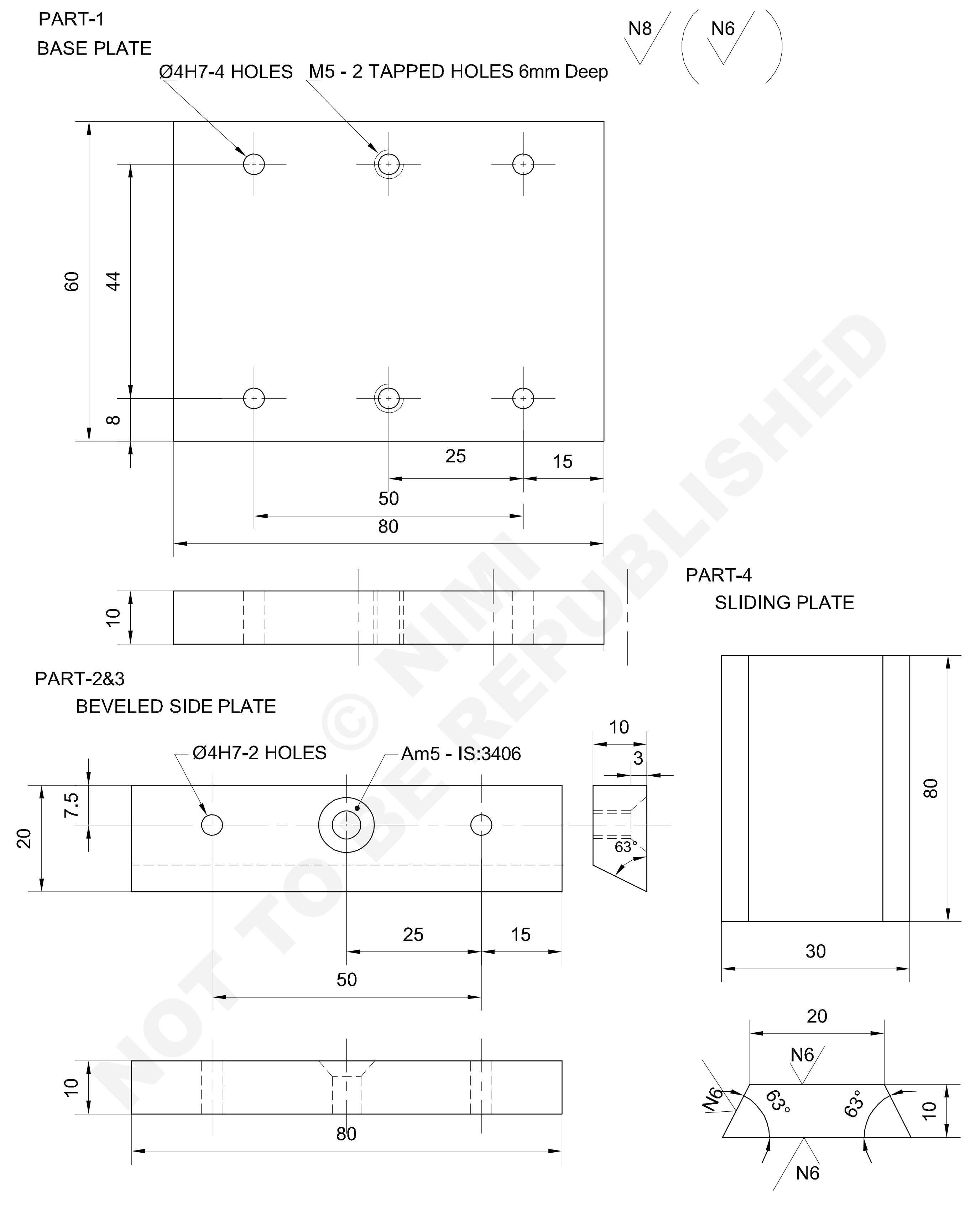
Make sliding fit with angles other than 90°

Objectives: At the end of this exercise you shall be able to
- **file and finish flat and angular surfaces within an accuracy of ± 0.04 mm and ± 30 minutes**
- **mark and drill holes as per drawing**
- **cut internal thread to assemble countersink screws**
- **prepare and assemble components using screws and dowel pins**
- **assemble components to achieve sliding fit with angular mating surfaces.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
2	AM5-15IS:1365	CSK SCREW	30CB		6	
4	4H8x20IS:2393	CYLINDRICAL PIN	40CB		5	
1	35ISF12-85	SLIDING PLATE	Fe310		4	
2	25ISF12-85	BEVELED SIDE PLATE	Fe310		2&3	
1	65ISF12-85	BASE PLATE	Fe310	–	1	1.6.82

SCALE NTS	MAKE SLIDING FIT WITH ANGLES OTHER THAN 90°	TOLERANCE ±0.04 mm	TIME:
		CODE NO: FI20N1682E1	

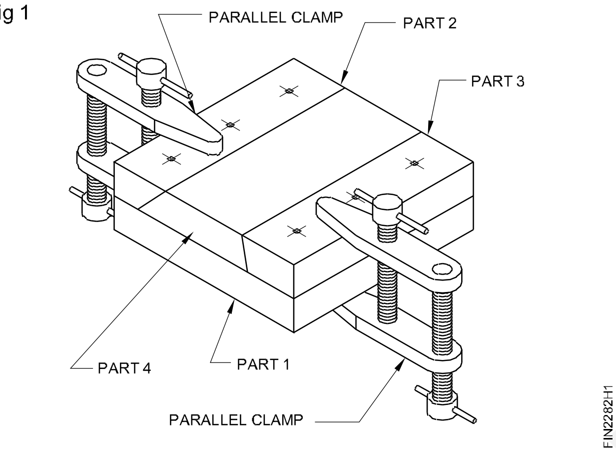


SCALE 1:1	BASE PLATE & BEVELED SIDE PLATES	DEVIATIONS	TIME
		CODE NO. FI20N1682E2	

Job Sequence

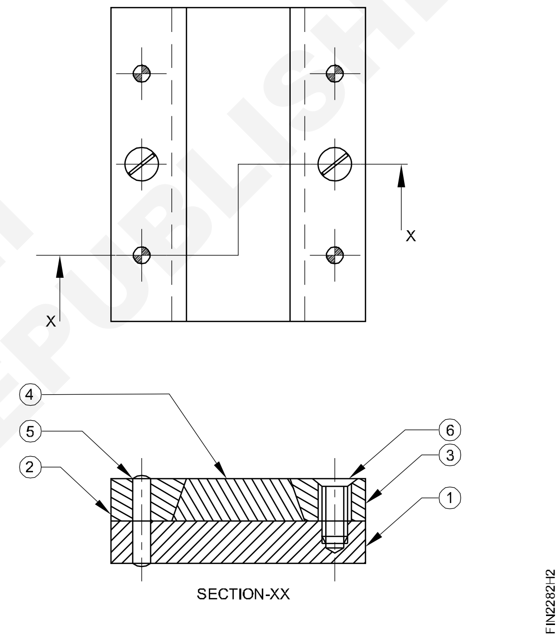
- Check the raw material for its size.
- File the material of part 1, 2, 3 and 4 to over all sizes maintaining the accuracy of ± 0.04 mm.
- Apply marking media on part 1, 2, 3 and 4 surfaces and mark lines as per drawing.
- Punch witness marks.
- Hacksaw and file in part 2, 3 and 4 and file to size and shape as per job drawings.
- Assemble and clamp part 1,2,3 and 4 together in drilling machine table with parallel clamps as shown in Fig 1.

Fig 1



- Fix Ø 3.8 mm drill in drilling machine spindle through drill chuck and drill through hole.
- Fix Ø 4 mm hand reamer in tap wrench and ream the drilled hole to fix Ø 4 mm dowel pin without disturbing the assembly setting.
- Clean the reamed hole and insert Ø 4 mm dowel pin.
- Similarly, drill other dowel pin holes one by one and ream the drilled hole one by one and fix the dowel pins without disturbing the assembly.
- Fix Ø 4.2 mm drill in drilling machine spindle through drill chuck and drill holes for cutting internal thread to fix counter sink screws in assembly without disturbing the setting.
- Separate the assembly parts 1,2,3 and 4 and chamfer the tapping holes both ends in part 1 using countersink tool.
- Drill free hole Ø 5.5 mm for CSK screw in part 2 and 3.
- Counter sink the drilled holes to seat the counter sink head screws in part 2 and 3.
- Hold the part 1 in bench vice.
- Cut internal thread using M5 hand tap and tap wrench.
- Clean the threads with out burrs.
- Cut and file in part 2, 3 and 4 to size and shape as per job drawing and check the size with vernier caliper and angles with vernier bevel protractor.
- Assemble part 1,2,3 and 4 as per job drawing along with dowel pins and counter sink screws.
- Fit and slide part 4 in the assembly as shown in Fig 2.

Fig 2



- Disassemble all the parts from assembly.
- Finish file on part 1,2,3 and 4 and remove burrs in all the corners of the job.
- Re-assemble all the parts together as per job drawing.
- Apply a little oil and preserve it for evaluation.

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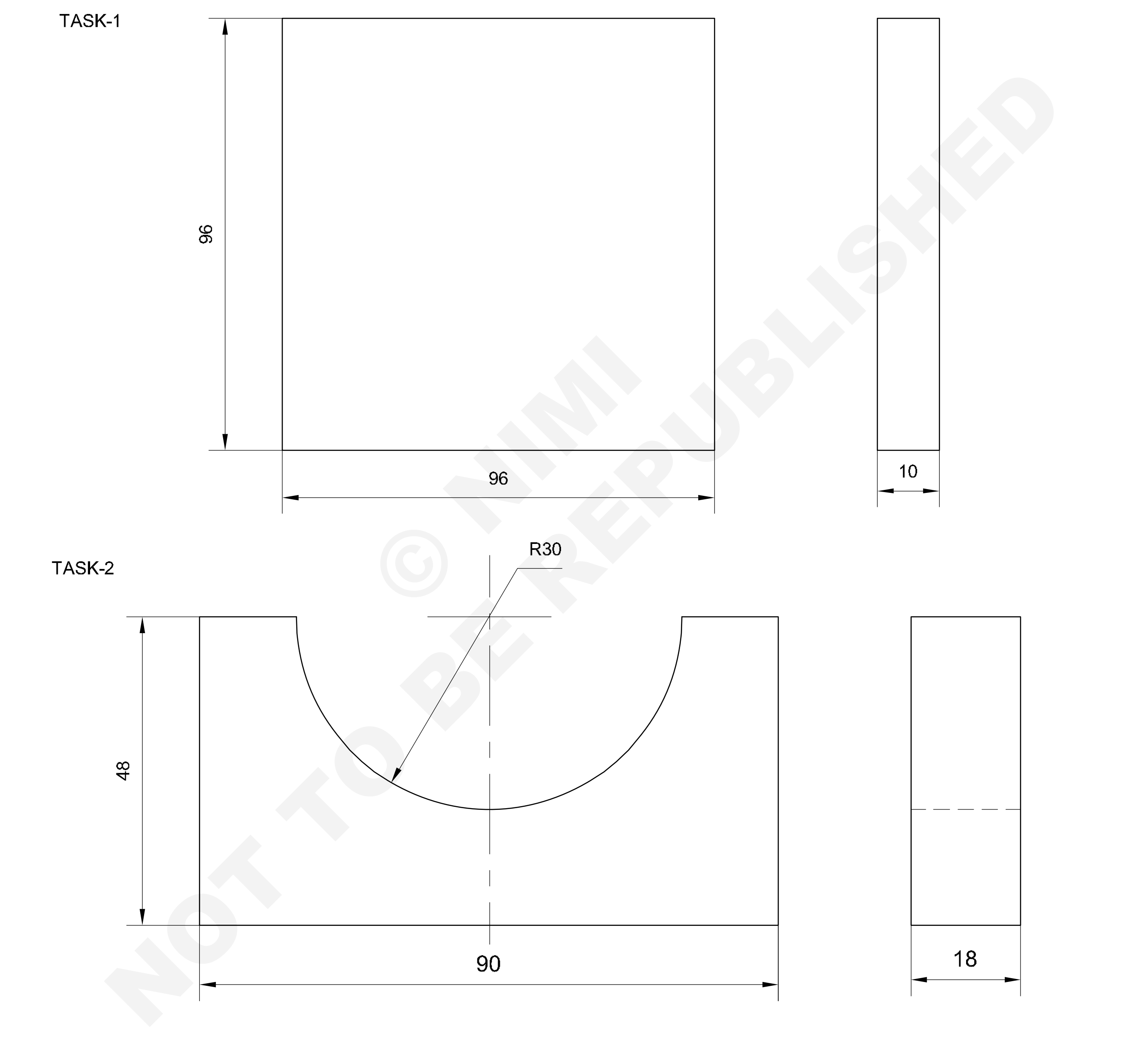
Scrap on flat surfaces, curved surfaces and parallel surfaces and test

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	→ 1.6.85	Fe310	-	TASK-1	1.6.83
1	100ISF20-50	→ 1.6.85	Fe310	-	TASK-2	1.6.83
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

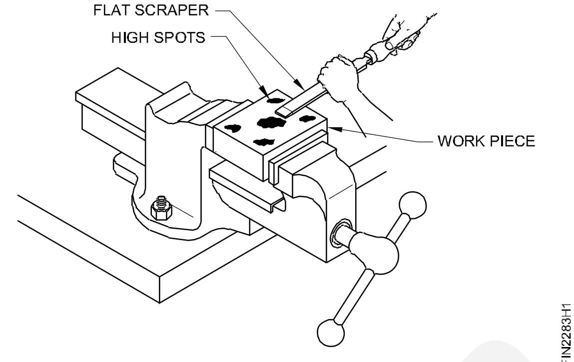
SCALE NTS	SCRAP ON FLAT SURFACES , CURVED SURFACES AND PARALLEL SURFACES AND TEST	TOLERANCE ±0.04 mm	TIME :
		CODE NO. FI20N1683E1	

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

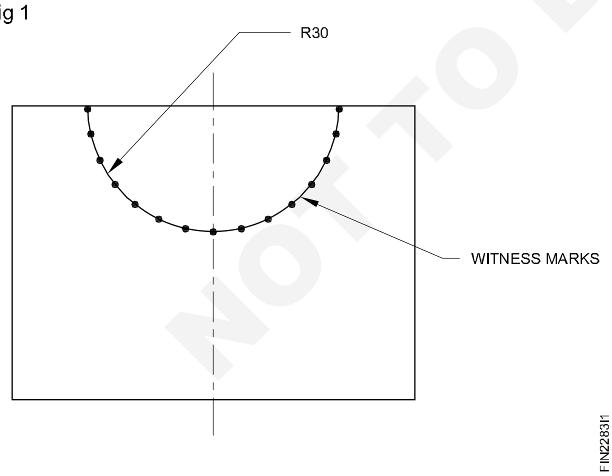


- Repeat the scraping process untill the prussion blue spotted marks spread over the entire surface of the job.
- Wipe off the scraped surface with soft cloth.
- Apply thin coat of oil and pressure it for evaluation.

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

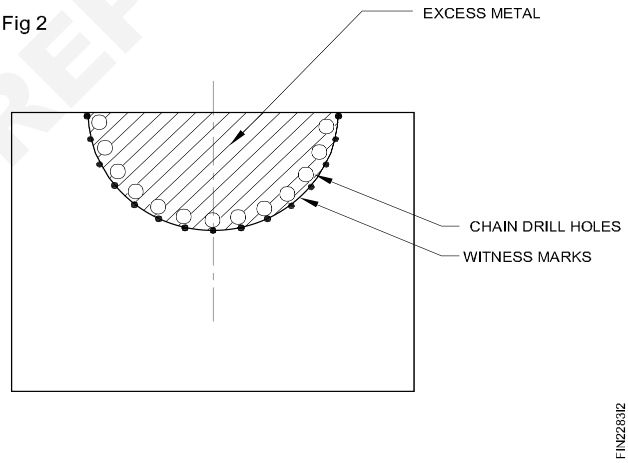
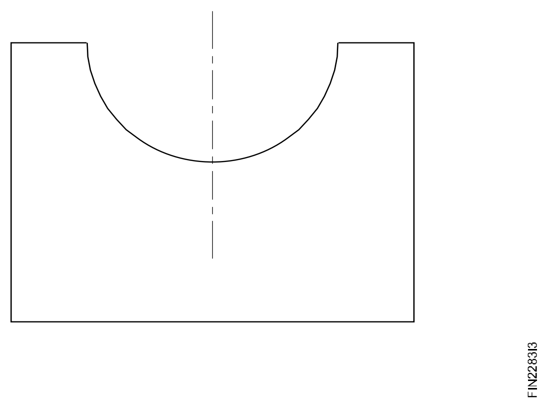


Fig 3



- File curved surface with half round file and check the curved profile with template.
- Hold the round test bar Ø 60 mm in bench vice along with aluminium vice clamps.
- Apply thin coat of prussion blue on the one end of cylindrical surface of test bar.
- Place the curved surface of the job on prussion 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 prussion 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 prussion 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

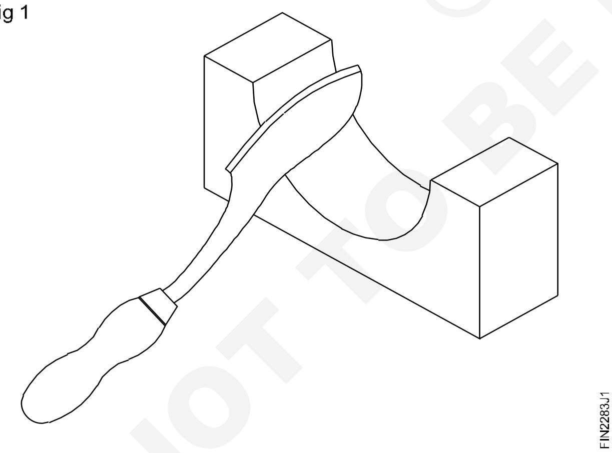
- **scrap and test curved surfaces.**

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



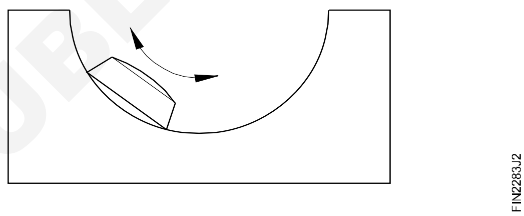
Pressure is exerted with the other hand on the shank for cutting.

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

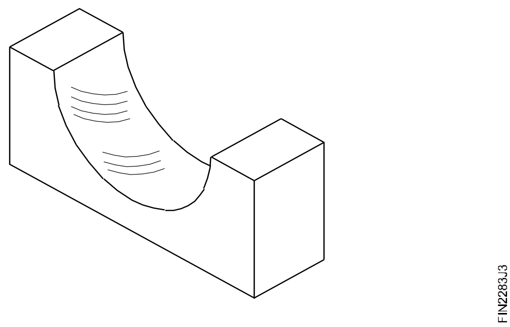
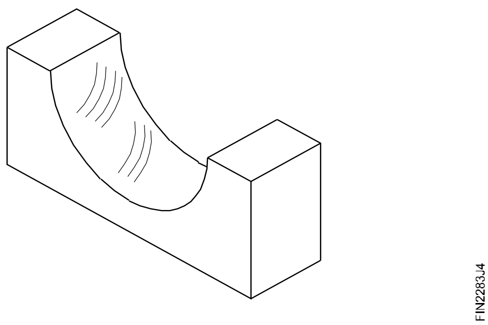


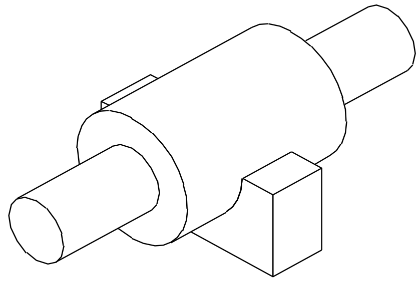
Fig 4



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

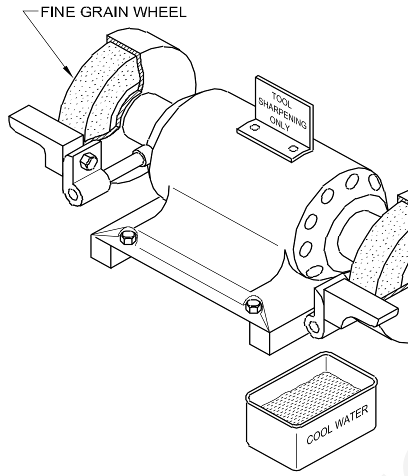
Objective: This shall help you to
• **sharpen a flat scraper by grinding and honing.**

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

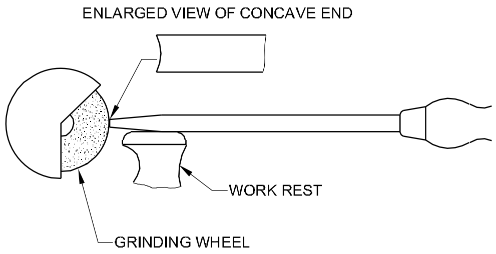


Soft grade aluminium oxide grinding wheel with large diameter gives best results.

Check for gap between the work-rest and the grinding wheel, and adjust, if necessary.

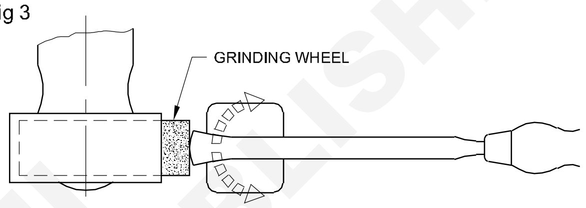
For grinding the cutting edges, hold the scraper horizontal and flat on the tool rest. (Fig 2)

Fig 2



Move the scraper in an arc to provide a slightly concave surface on the cutting edge. (Fig 3)

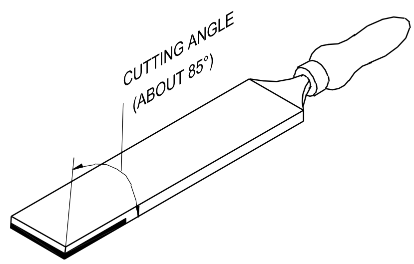
Fig 3



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



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

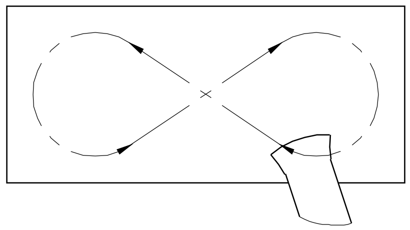


Fig 6

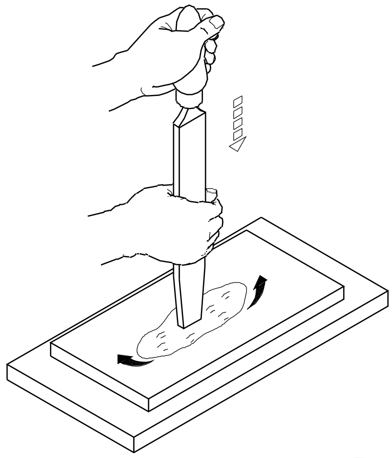
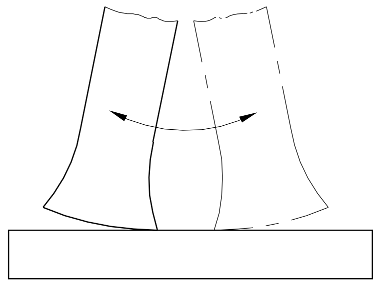


Fig 7



Sharpening half round scrapers

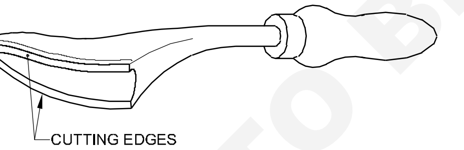
Objective: This shall help you to
- **sharpen a half round scraper.**

Scrapers are usually re-sharpened on oilstones. When cutting edges are badly damaged, they are ground on pedestal grinders.

Sharpening half round scrapers

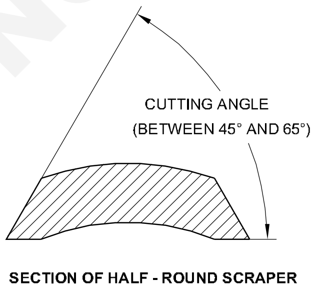
Half round scrapers have two cutting edges on the rounded back. (Fig 1)

Fig 1



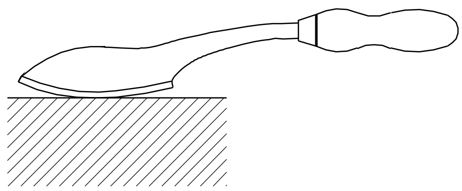
The cutting edges are formed by the bottom surface, and the flat surfaces are ground on the rounded back of the scraper. (Fig 2)

Fig 2



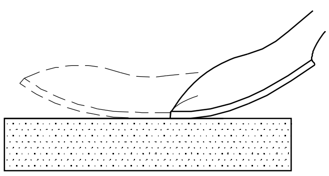
Grind the bottom surfaces with a slight curve. This helps the cutting edges to make point contact on the surfaces being scraped. (Fig 3)

Fig 3



Rub the bottom surface with a rocking motion on the oli stone for re-sharpening. (Fig 4)

Fig 4

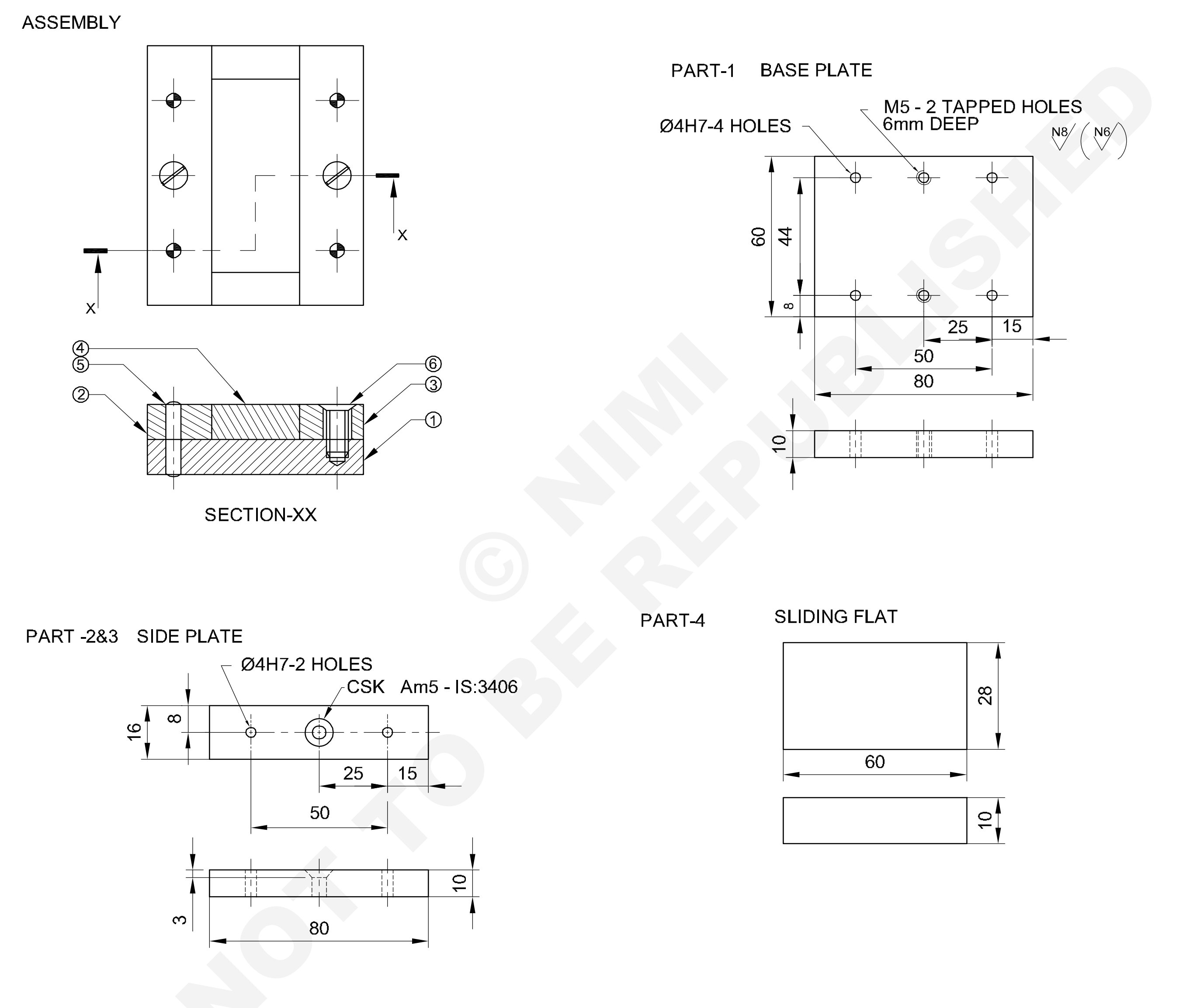


When the cutting edge is blunt it can be re-sharpened by grinding the bottom surface.

> **As far as possible avoid grinding of the edges. (Flat surface ground on the rounded back.)**

Make and assemble, sliding flats, plain surfaces

Objectives: At the end of this exercise you shall be able to
- **file surfaces to flat and square to the accuracy of ± 0.04 mm**
- **mark dimension lines as per drawing**
- **prepare all the parts as per drawing**
- **drill dowel pin holes, counter sink screw holes**
- **assemble and slide flat in plain surfaces.**



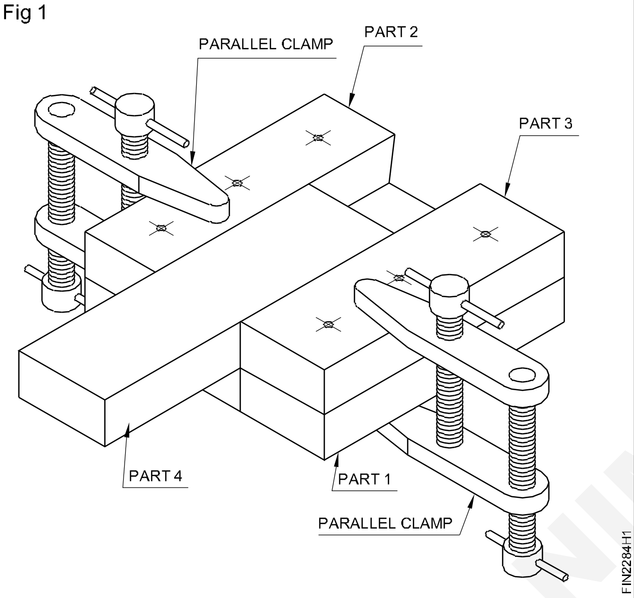
2	M5-16	COUNTER SUNK SCREW	-	-	6	-
4	Ø4-20	DOWEL PIN	-	-	5	-
1	65 ISF 12-32	SLIDING FLAT	Fe310	-	4	-
2	20 ISF 12-85	SIDE PLATE	Fe310	-	2&3	-
1	65 ISF 12-85	BASE PLATE	Fe310	-	1	1.6.84
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SLIDING FIT	TOLERANCE ±0.04 mm	TIME:
		CODE NO. FI20N1684E1	

Job Sequence

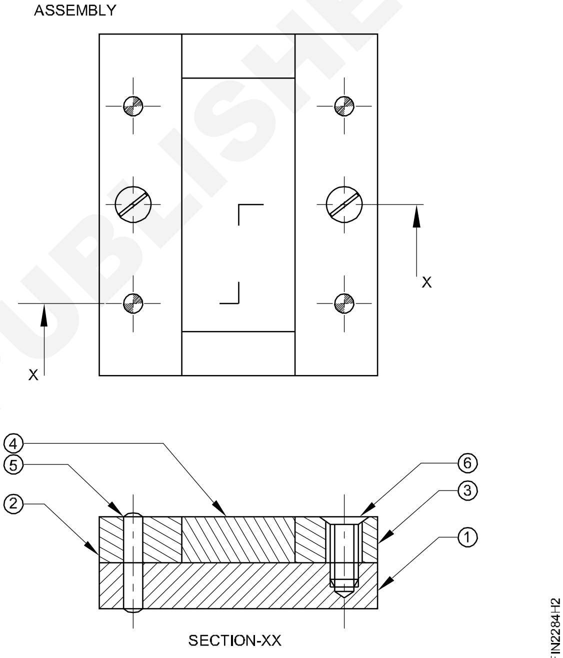
- Check the raw material for its size.
- File job for part 1,2 3 and 4 to size and shape as per drawing.
- Apply marking media on part 2 and 3 and mark to locate the dowel pin holes, countersink screw holes as per drawing.
- Assemble and clamp part 1,2 3 and 4 together in drilling machine table with parallel clamps as shown in Fig 1.

Fig 1



- Fix Ø 3.8 mm drill in drilling machine spindle through drill chuck and drill through hole.
- Fix Ø 4 mm hand reamer in tap wrench and ream the drilled hole to fix Ø 4 mm dowel pin without disturbing the assembly setting.
- Clean the reamed hole and insert Ø 4 mm dowel pin.
- Similarly, drill holes for other 3 dowel pin holes one by one and ream the drilled holes one by one and fix the dowel pins without disturbing the assembly.
- Fix Ø 4.2 mm drill in drilling machine spindle through drill chuck and drill holes for tap drill holes for fixing counter sink screws in assembly without disturbing the setting.
- Separate the assembly parts 1,2 3,4 and chamfer the tapping holes both ends in part 1 using countersink tool.
- Hold part 1 in bench vice.
- Drill free hole Ø 5.5 for countersink screw on part 2and 3 and countersink the hole to seat ountersink head screw .
- Cut internal thread using M5 hand tap and tap wrench.
- Clean the thread without burrs
- Assemble part 1, 2,3 and 4 as per job drawing along with dowel pins and countersink screws.
- Fit and slide part 4 in the assembly as shown in Fig 2.

Fig 2

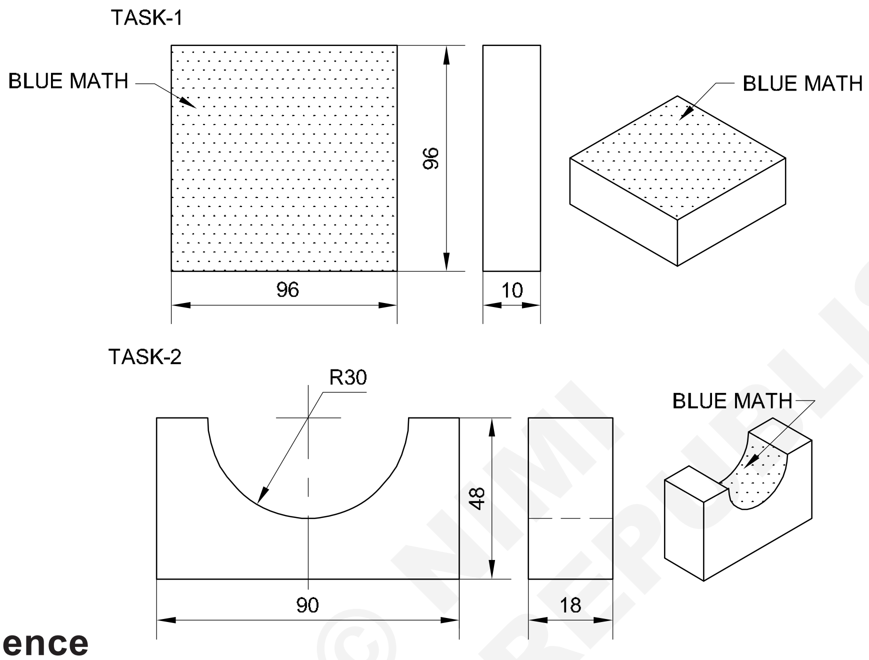


- Disassemble all the parts from assembly.
- Finish file on the surface of part 1,2,3,4 and remove burrs in the corners of the job.
- Re-assemble all the parts together as per job drawing.
- Apply thin film of oil and preserve it for evaluation.

— — — — — — — —

Check for blue match of bearing surfaces - both flat and curved surfaces by whit worth method

Objectives: At the end of this exercise you shall be able to
- **apply prussion blue on surface plate and cylindrical test bar**
- **check the blue match of high spots on flat surface using surface plate**
- **check the blue match of high spots on curved surface using test bar.**



Job Sequence

TASK 1: **Checking blue math on flat surface**

- Use exercise no:1-6-83 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 match spreaded over entire the flat surface.

— — — — — — — — —

TASK 2: **Checking blue math on curved surface**

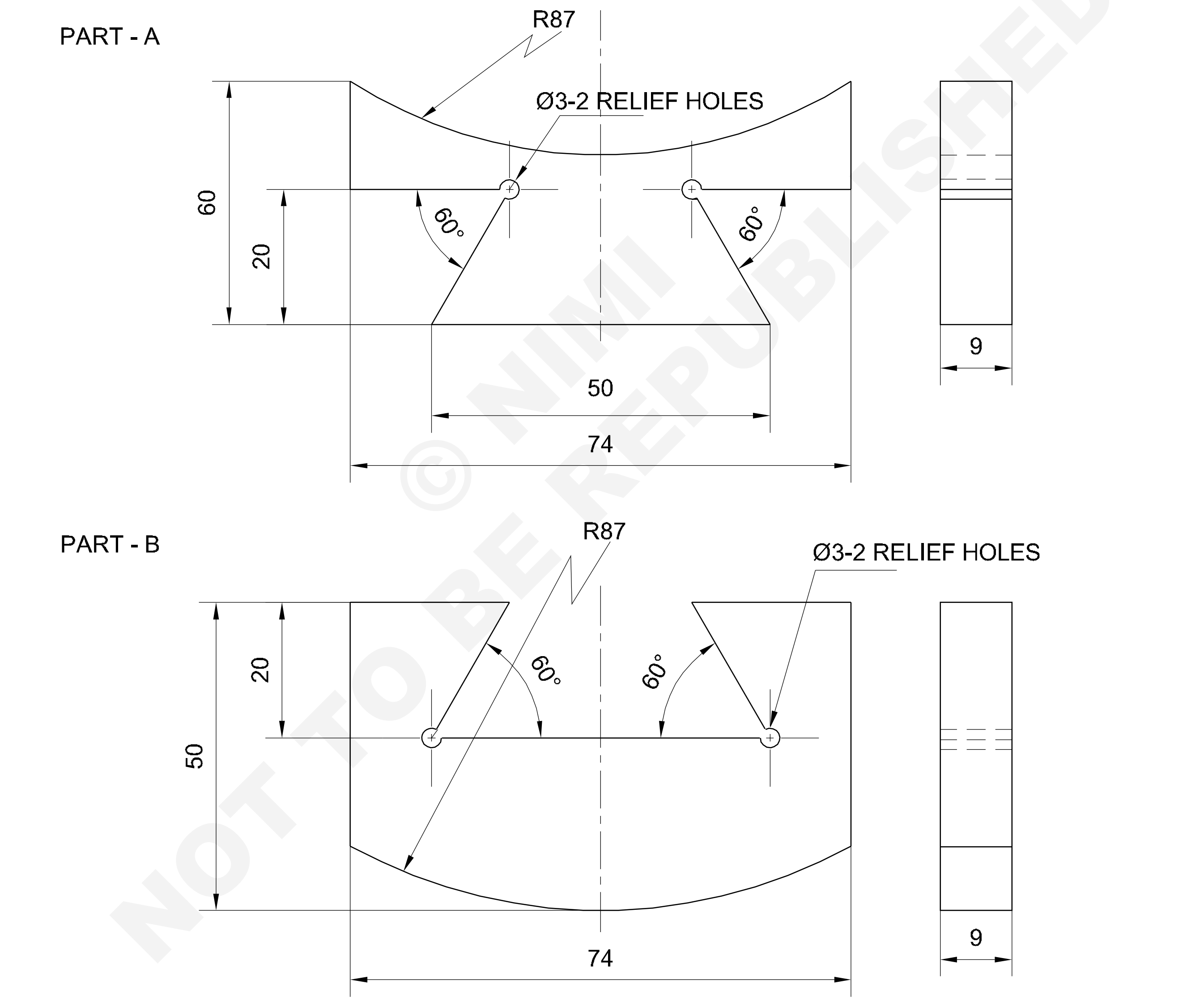
- Use exercise no: 1-6-83 Task 2 job exercise.
- Clean the cylindrical test bar with soft cloth.
- Hold the test bar in bench vice along with aluminium vice clamp.
- Apply prussion blue evenly on the curvature of the test bar.
- Place the curved surface of the job on test bar and rotate slightly on back and forth.
- Notice the blue match spreaded over the entire curved surface.

-	-	1.6.83 ←	-	-	TASK-1	1.6.85
-	-	1.6.83 ←	-	-	TASK-2	1.6.85
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	CHECK FOR BLUE MATH OF BEARING SURFACES-BOTH FLAT AND CURVED SURFACES BY WHIT WORTH METHOD	TOLERANCE ±0.04 mm	TIME:
		CODE NO. FI20N1685E1	

File and fit combined radius and angular surface (accuracy ± 0.5 mm) angular and radius fit

Objectives: At the end of this exercise you shall be able to
- **file flat and parallel surface to an accuracy of ± 0.04 mm**
- **mark dimension lines as per drawing**
- **chain drill, chip to remove excess material**
- **file dovetail and curved profile as per drawing and check the angles with vernier bevel protractor and curved surface with template**
- **fit combined radius and angular surface.**



1	75 ISF 10 - 55	-	Fe310	-	B	1.6.86
1	75 ISF 10 - 65	-	Fe310	-	A	1.6.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

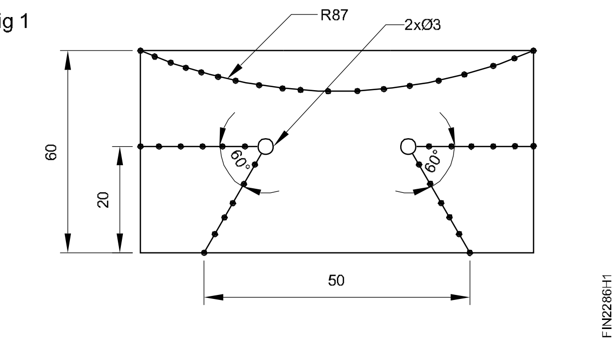
SCALE 1 :1	FILE AND FIT COMBINED RADIUS AND ANGULAR SURFACE (ACCURACY±0.5mm), ANGULAR AND RADIUS FIT	TOLERANCE ±0.04mm ANGLE 30 MINUTES	TIME:
		CODE NO FI20N1686E1	

Job Sequence

PART A

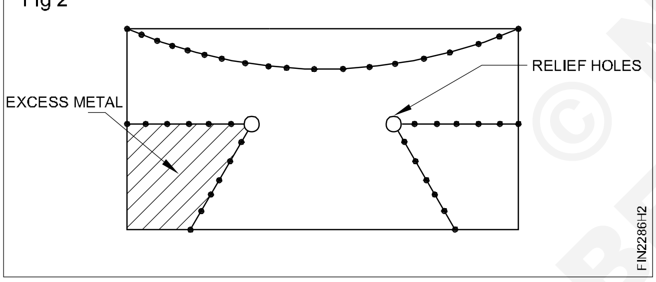
- Check the raw metal size using steel rule.
- File and finish to overall size of 74x60x9 mm maintaining parallelism, perpendicularity and to the accuracy of ± 0.04 mm
- Check the size with vernier caliper.
- Apply marking media, mark as per drawing and punch witness marks as shown in Fig 1.

Fig 1



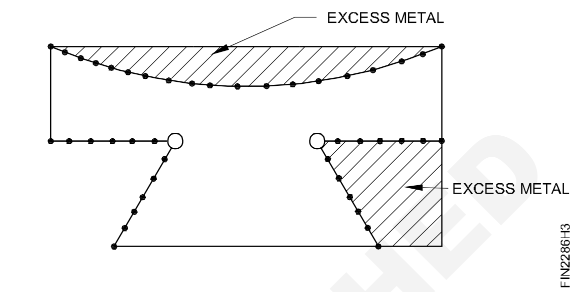
- Drill relief holes Ø 3 mm as shown Fig 2.
- Hacksaw and remove the hatched portion of excess metal in one side as shown in Fig 2.

Fig 2



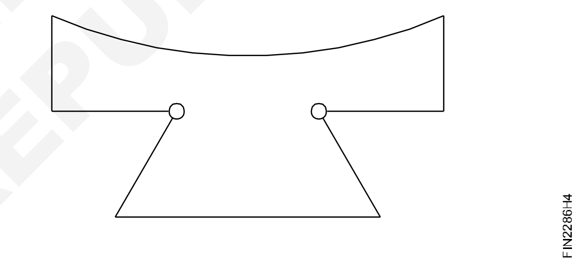
- File to size maintaining accuracy of ± 0.04 mm for linear dimension and 30 minutes accuracy for angular dimension.
- Check the size with vernier caliper and angle with vernier bevel protector.
- Similarly, cut and remove excess metal in other side and file to size and shape as shown in Fig 3.

Fig 3



- Cut and remove the excess metal in curvature side and file curved profile to size and shape as shown in Fig 4.
- Check the curved profile with template.

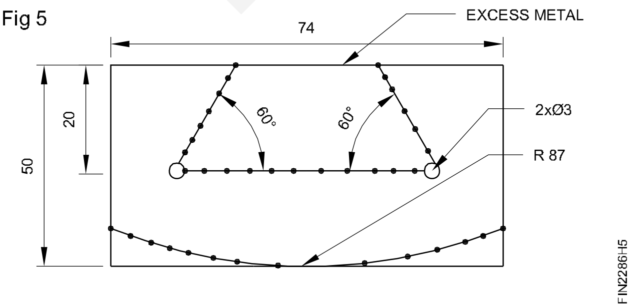
Fig 4



PART B

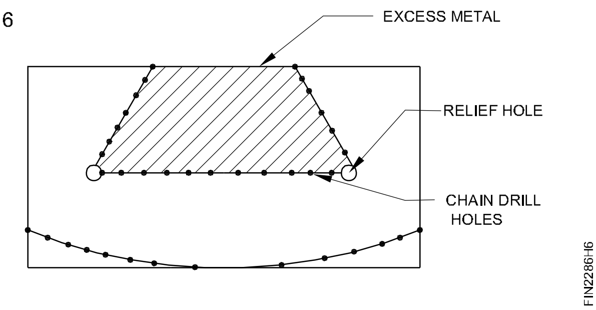
- File and finish to overall size of 74x50x9 mm maintaining parallelism and perpendicularity and to the accuracy of ± 0.04 mm.
- Check the size with vernier caliper.
- Apply marking media, mark as per drawing and punch witness marks as shown in Fig 5.

Fig 5



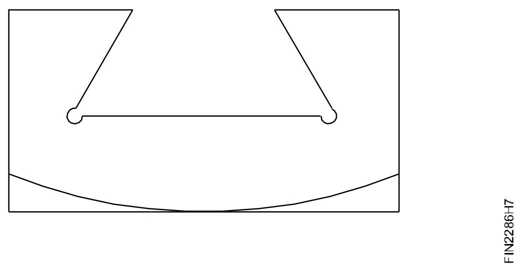
- Drill relief holes Ø 3 mm and drill chain drill holes to remove excess metal as shown Fig 6.

Fig 6



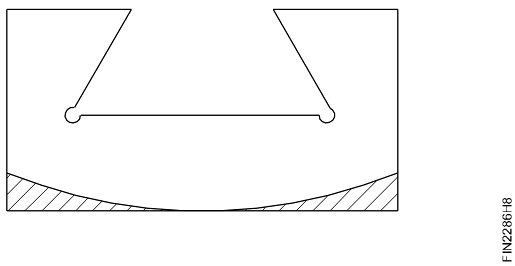
- Hacksaw, chip and remove the hatched portion of excess metal and File the chipped portion to size and shape as shown in Fig 7.

Fig 7



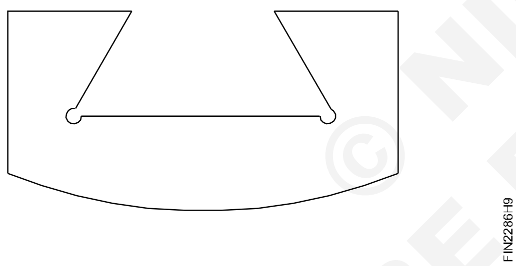
- Hacksaw and remove the hatched portion of excess metal on curved surface shown in Fig 8.

Fig 8



- File the curved portion to size and shape as shown in Fig 9.

Fig 9



- Check the curved profile with template.
- Match part A and B as shown in Fig 10 and 11
- Finish file in part A,B and remove the burrs in all the corners.

Fig 10

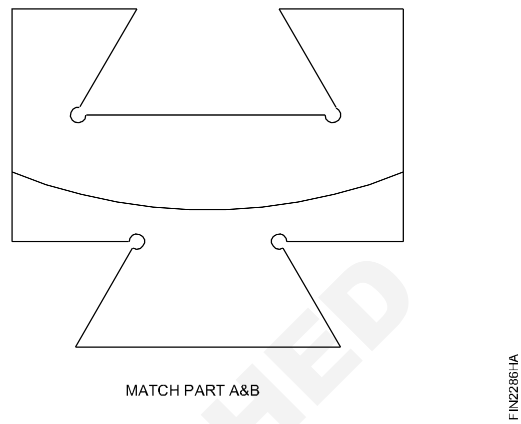
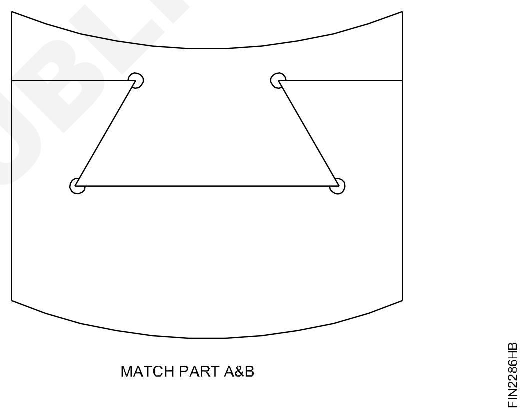


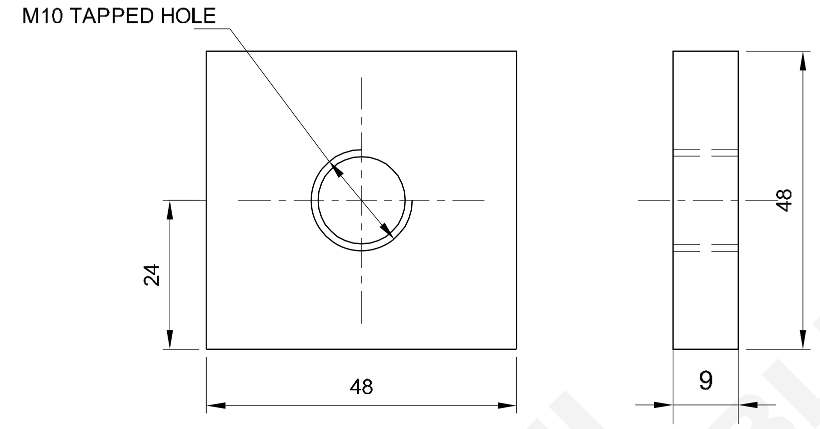
Fig 11



- Apply a little oil and preserve it for evaluation

Locate accurate holes and make accurate hole for stud fit

Objectives: At the end of this exercise you shall be able to
- **file surfaces flat and square**
- **determine tap drill size for tapping hole and drill the hole**
- **cut M10 internal thread using tap with wrench**
- **fit stud in the threaded hole.**

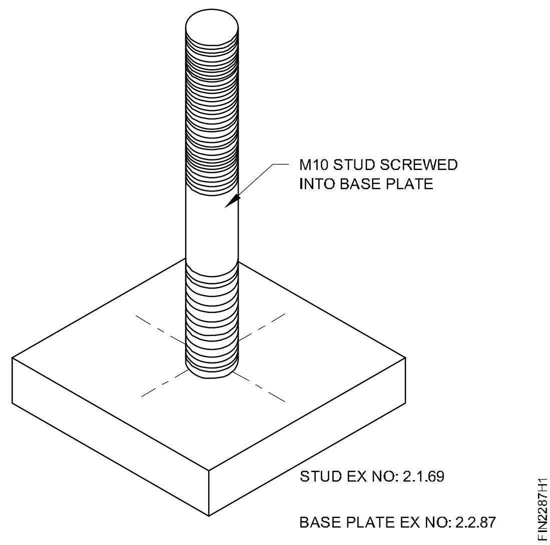


NOTE: USE EX NO: 2.1.69 STUD FOR FIT

Job Sequence

- Check the raw material for its size.
- File metal to size 48x48x9 mm maintaining flatness and squareness.
- Check the size with vernier caliper.
- Mark drill hole at the centre of the job as per drawing.
- Determine the tap drill size for M10 tap.
- Hold job in bench vice
- Fix centre drill in drill chuck and drill centre drilling to locate the drill hole centre.
- Similarly, fix Ø 6 mm drill and drill pilot hole.
- Fix Ø 8.5 mm drill and drill through hole for tapping.
- Chamfer on both ends of the drilled hole using countersink tool.
- Hold the job in bench vice.
- Cut M10 internal thread using hand tap and tap wrench.
- Clean the thread to remove the burrs.
- Check the thread with screw pitch gauge.
- Fit stud in the threaded hole Fig 1.
- Use the stud in Ex No. 1.5.69 TASK 1
- Apply a little oil and preserve it for evaluation

Fig 1

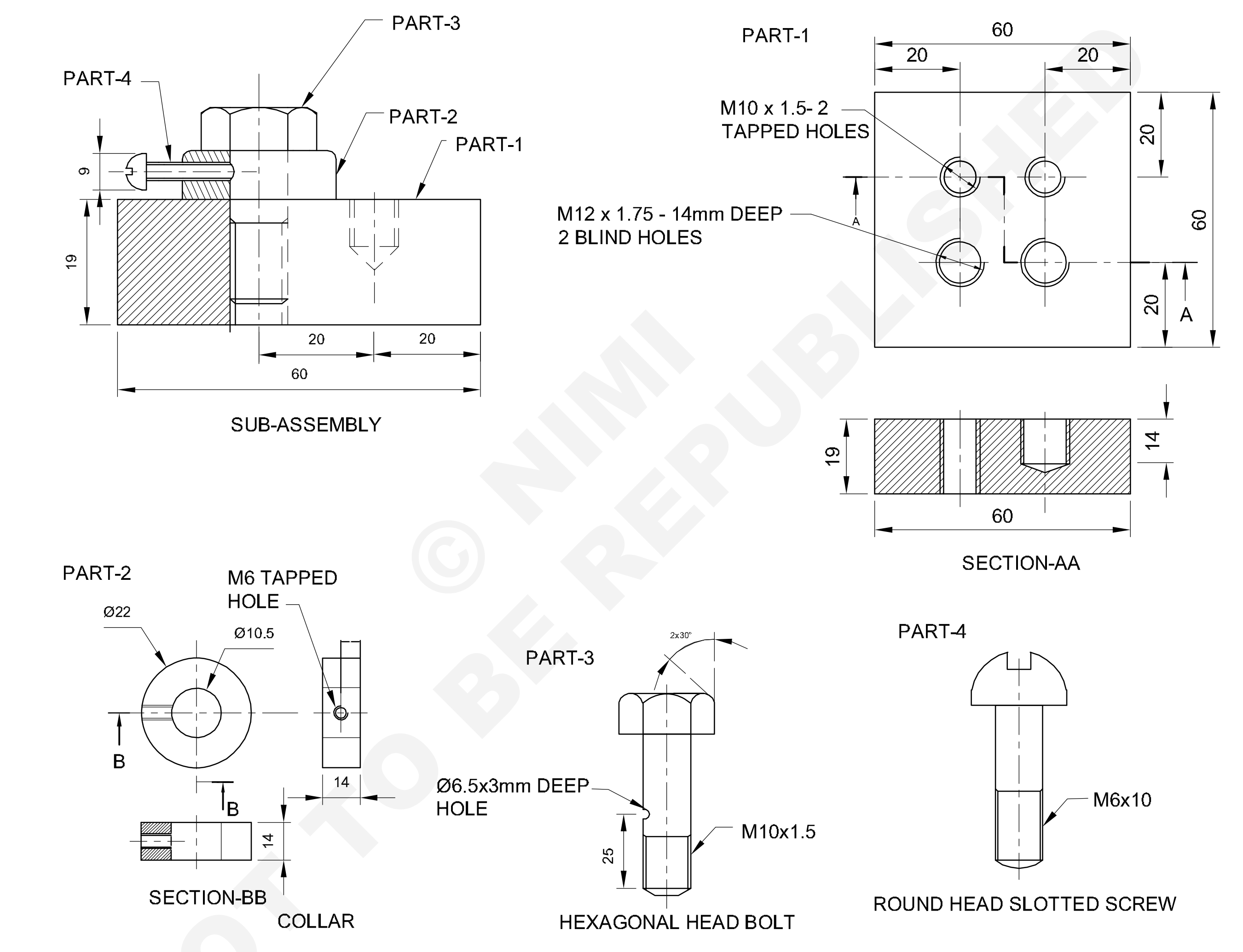


1	50 ISF 10 - 50	-	Fe310	-	-	1.6.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1 :1	LOCATE ACCURATE HOLES & MAKE ACCURATE HOLE FOR STUD FIT	TOLERANCE ±0.04mm	TIME :
		CODE NO. FI20N1687E1	

Fasten mechanical components/sub-assemblies together using screws, bolts and collars using hand tools

Objectives: At the end of this exercise you shall be able to
- **file surface flat and square**
- **mark drill holes as per drawing**
- **cut M6 internal thread using hand tap and tap wrench**
- **assemble together all the parts as per drawing.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	ROUND HEAD SLOTTED SCREW M6x10	-	Fe310	-	4	
1	-	1.5.69 PART-2	Fe310	-	3	
1	25 ISF15-25	-	Fe310	-	2	
1	-	1.5.68	Fe310	-	1	1.6.88

SCALE 1 :1	FASTEN MECHANICAL COMPONENTS/SUB-ASSEMBLIES TOGETHER USING SCREWS,BOLTS AND COLLARS USING HAND TOOLS	TOLERANCE ±0.04mm	TIME :
		CODE NO. FI20N1688E1	

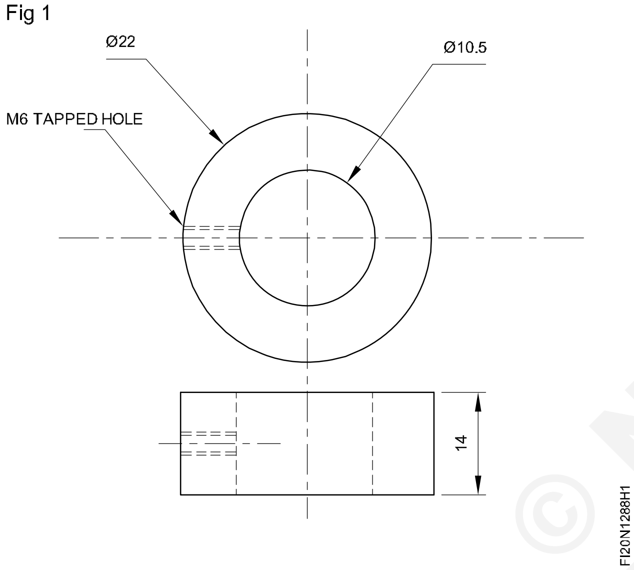
Job Sequence

- Use Ex: No 2.1.68 for part 1 and Ex.No 2.1.69 part 2 for part 3.

Prepare collar: (Part 2)

- Check the raw material size.
- File flatness and squareness
- Mark in collar as per job drawing and punch the hole centre and the outer circumference of collar.
- Drill the centre of hole Ø 10.5 mm and chamfer sink the drilled hole both sides.
- Hold the job in bench vice and file the circumference of collar to Ø 22 mm and thickness 14mm. Fig 1

Fig 1



- Check the size with vernier caliper.
- Clean the parts 1,2 and 3.
- Assemble the parts 1 and 2 using hexagonal bolt and tighten the bolt using suitable double ended spanner/ ring spanner.
- Mark the tap drill hole centre on middle of the collar as shown in job drawing
- Set the assembly in drilling machine table using suitable clamping device.
- Make drill hole collar Ø 5.2 mm for M6 tap and drill upto opening of ID 10.5mm in hexagonal bolt as shown in job drawing.
- Separate the parts 1,2, and 3.
- Fix counter sink tool in drilling machine and chamfer the Ø 5.2 mm drilled hole.
- Hold the collar in bench vice
- Cut M6 internal thread using hand tap and tap wrench.
- Re-assemble the parts 1,2 and 3 and tighten the hexagon bolt using suitable double ended spanner / ring spanner.
- Screw the round head slotted screw in collar as shown job drawing and make it tight using suitable screw driver and complete the sub-assemblies.
- Apply thin coat of oil and preserve it for evaluation.

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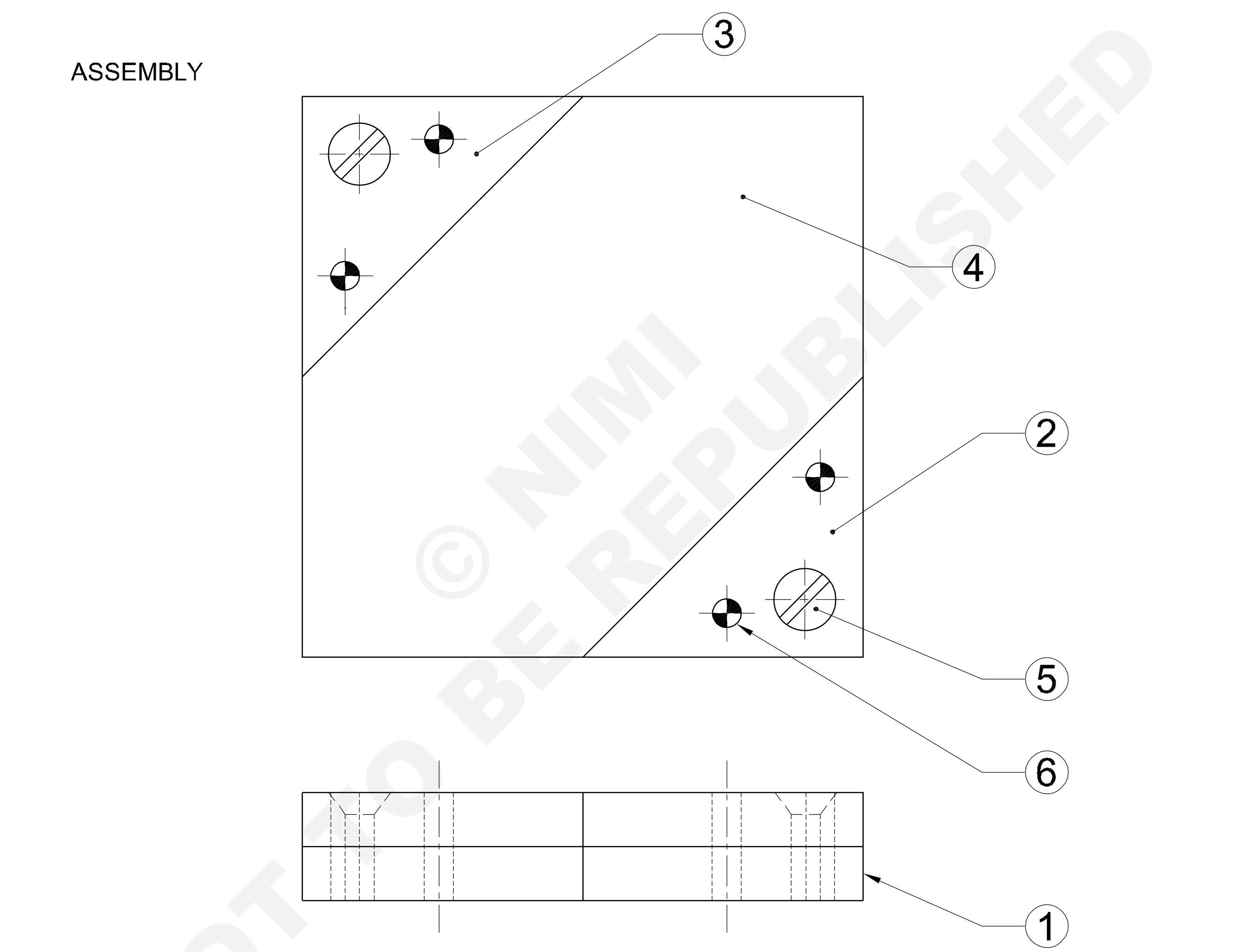
Make sliding fits assembly with parallel and angular mating surface

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

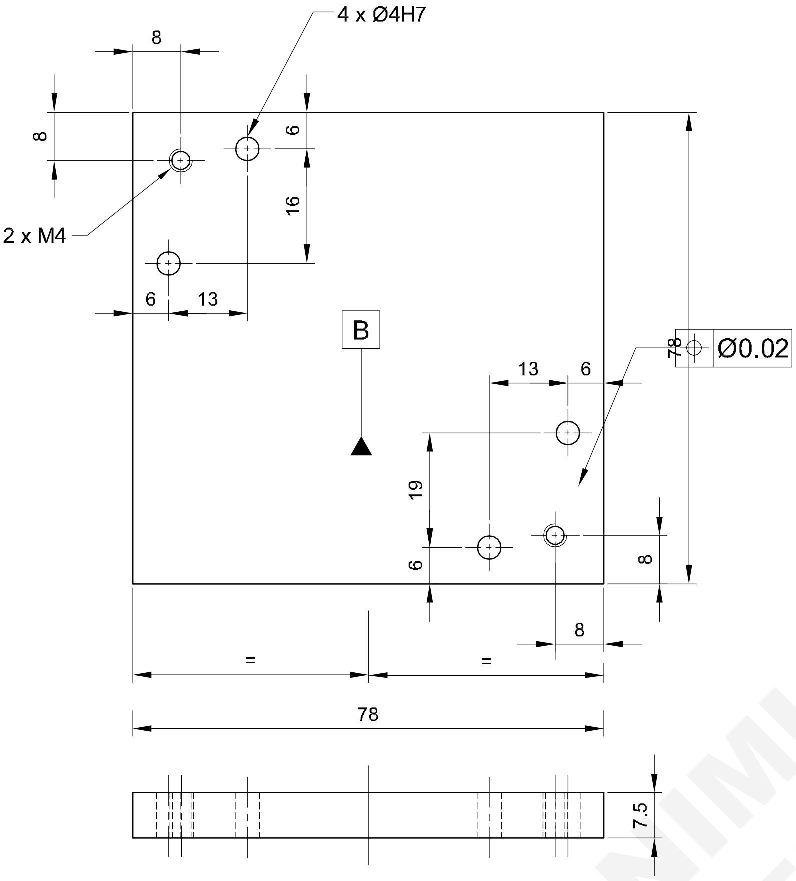
- **file surface flat and parallel to the accuracy of ± 0.04 mm**
- **mark dimension lines as per drawing**
- **file and prepare all the parts for assembly**
- **drill holes for dowel pins and countersink screws**
- **assemble components using dowel pins and counter sink screws**
- **fit and slide the angular mating surface, finish and de-burr.**



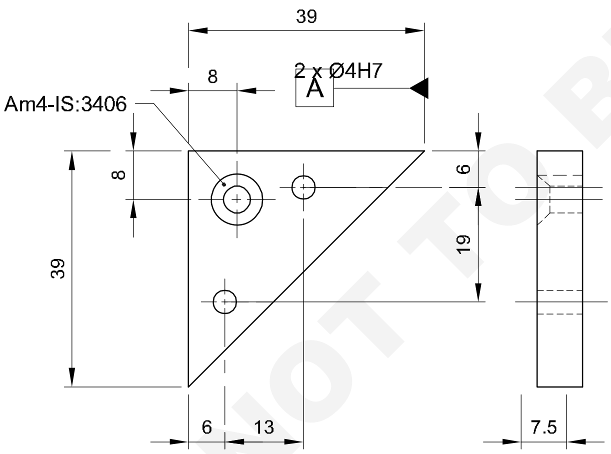
4	4h8 x 14 IS:2393	CYLINDRICAL PIN	Std	-	6	-
2	AM4 x 14 IS:1365	CSK HEAD SCREW	Std	-	5	-
1	80ISF8 - 80	-	Fe310	-	4	-
2	40ISF8 - 42	-	Fe310	-	2&3	-
1	80ISF8 - 80	-	Fe310	-	1	1.6.89
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	MAKE SLIDING FITS ASSEMBLY WITH PARALLEL AND ANGULAR MATING SURFACE.(±0.04mm)	DEVIATIONS: ±0.04mm	TIME :
		CODE NO. FI20N1689E1	

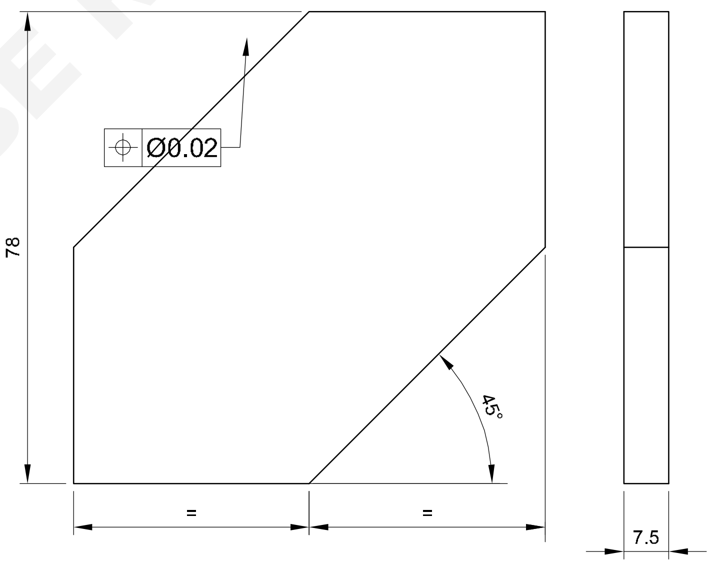
PART-1 BASE PLATE



PART-2&3 SIDE PLATES



PART-4 SLIDING PLATE

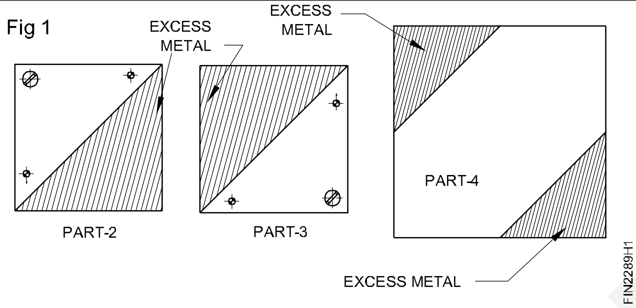


SCALE 1:1	BASE PLATE	TOLERANCE	TIME
		CODE NO. FI20N1689E2	

Job Sequence

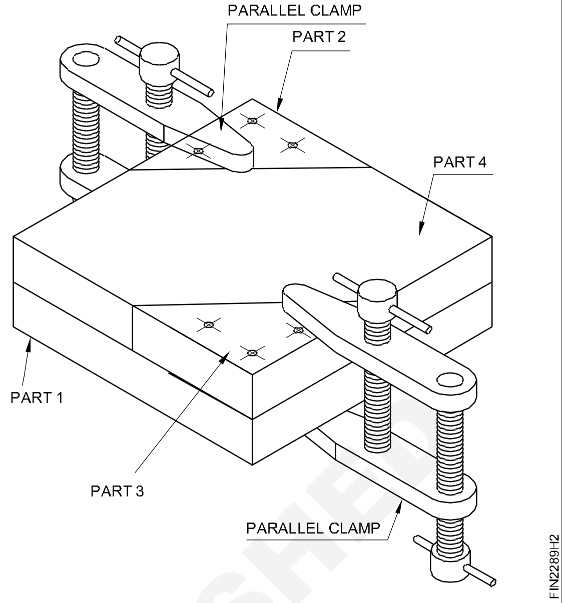
- Check the raw material for its size.
- File the materials for part 1,2,3 and 4 to overall sizes maintaining the accuracy ± 0.04 mm.
- apply marking media on part 2,3 and 4 and mark linear dimensional lines with vernier height gauge and angular lines with vernier bevel protector.
- Punch witness marks on part 2,3 and 4.
- Punch on drill hole marks for dowel pins and counter sink screws assembly using centre punch.
- Cut and remove the excess metal from part 2,3,4 and file to size and shape as per job drawing and check the size with vernier caliper and angles with vernier bevel protractor. (Fig 1)

Fig 1



- Assemble and clamp part 1,2 and 3 together in a drilling machine table with parallel clamps as shown in Fig 2.
- Fix Ø 3.8 mm drill in drilling machine spindle through drill chuck and drill through holes for dowel pin assembly.
- Fix Ø 4 mm hand reamer with tap wrench and ream the drilled hole to fix Ø 4 mm dowel pins without disturbing the assembly setting.
- Clean the reamed hole with soft cloth and insert Ø 4 mm dowel pin.
- Similarly, drill for other dowel pin holes one by one and ream drilled holes to fix Ø 4 mm, 3 dowel pins, one by one without disturbing the assembly setting.

Fig 2



- Determine tap drill size for M4 internal thread
- Fix Ø 3.3 mm drill in drilling machine spindle through drill chuck and drill tap drill two holes as shown in job drawing.
- Seperate the assembly part 1,2,3 and 4.
- Fix counter sink tool in drilling machine and chamfer in both ends of drilled holes to cut internal thread in part 1.
- Hold the part 1 in bench vice and cut internal thread using M4 tap and tap wrench.
- Fix counter sink tool and counter sink the drilled holes in part 2 and 3 to seat the counter sink head screws and drill a clearance hole for M4 counter sink screws.
- Finish file on part 1,2,3, 4 and remove burrs in all corners of the job and assemble the parts all together using dowel pins, counter sink screws as shown in job drawing.
- Apply a thin coat of oil and preserve it for evaluation.

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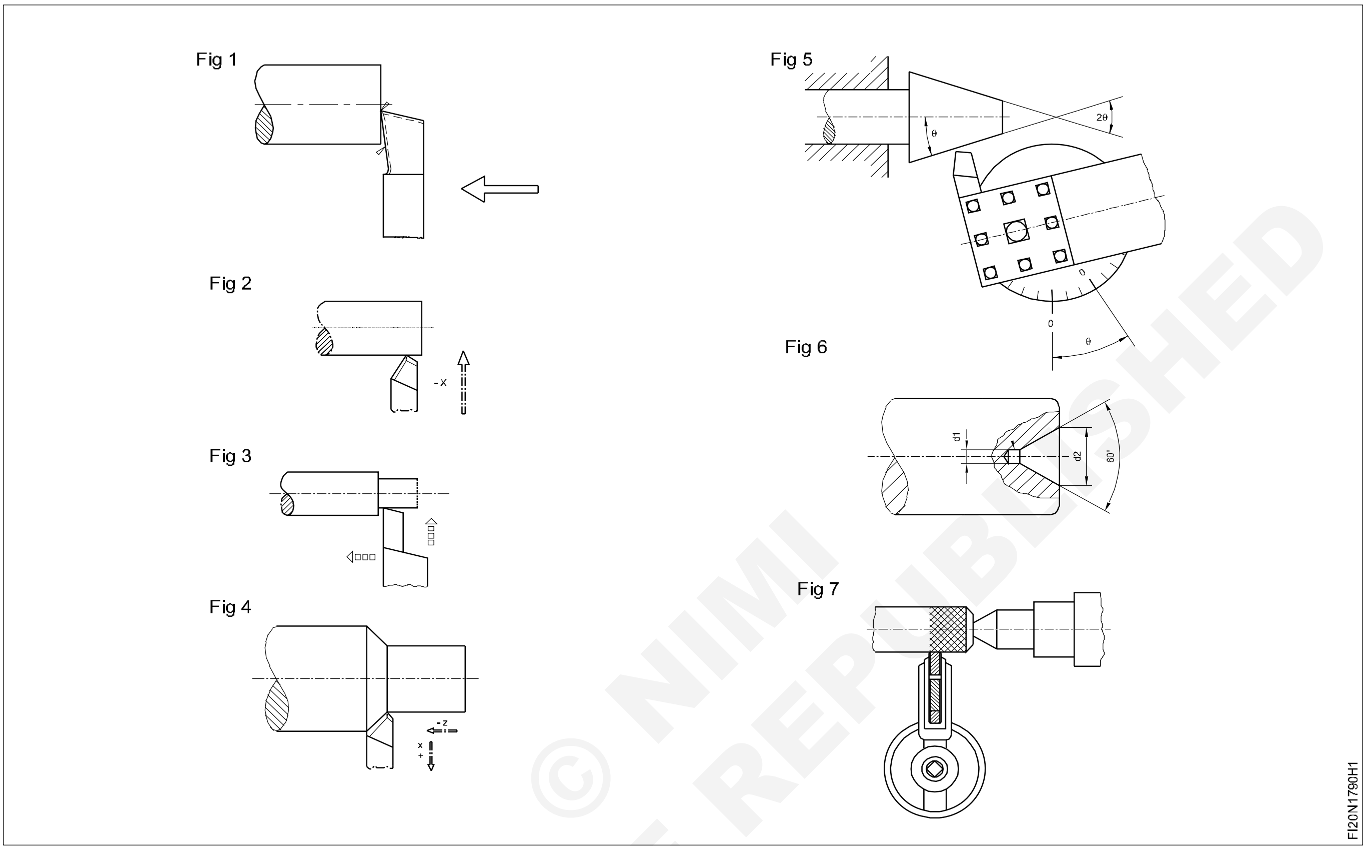
Lathe operations

Objective: At the end of this exercise you shall be able to
- **record the different lathe operations in table 1.**



Note: Instructor shall demonstrate to the trainees regarding the different lathe operation performed in lathe.

Record the lathe operations in Table 1

TABLE 1

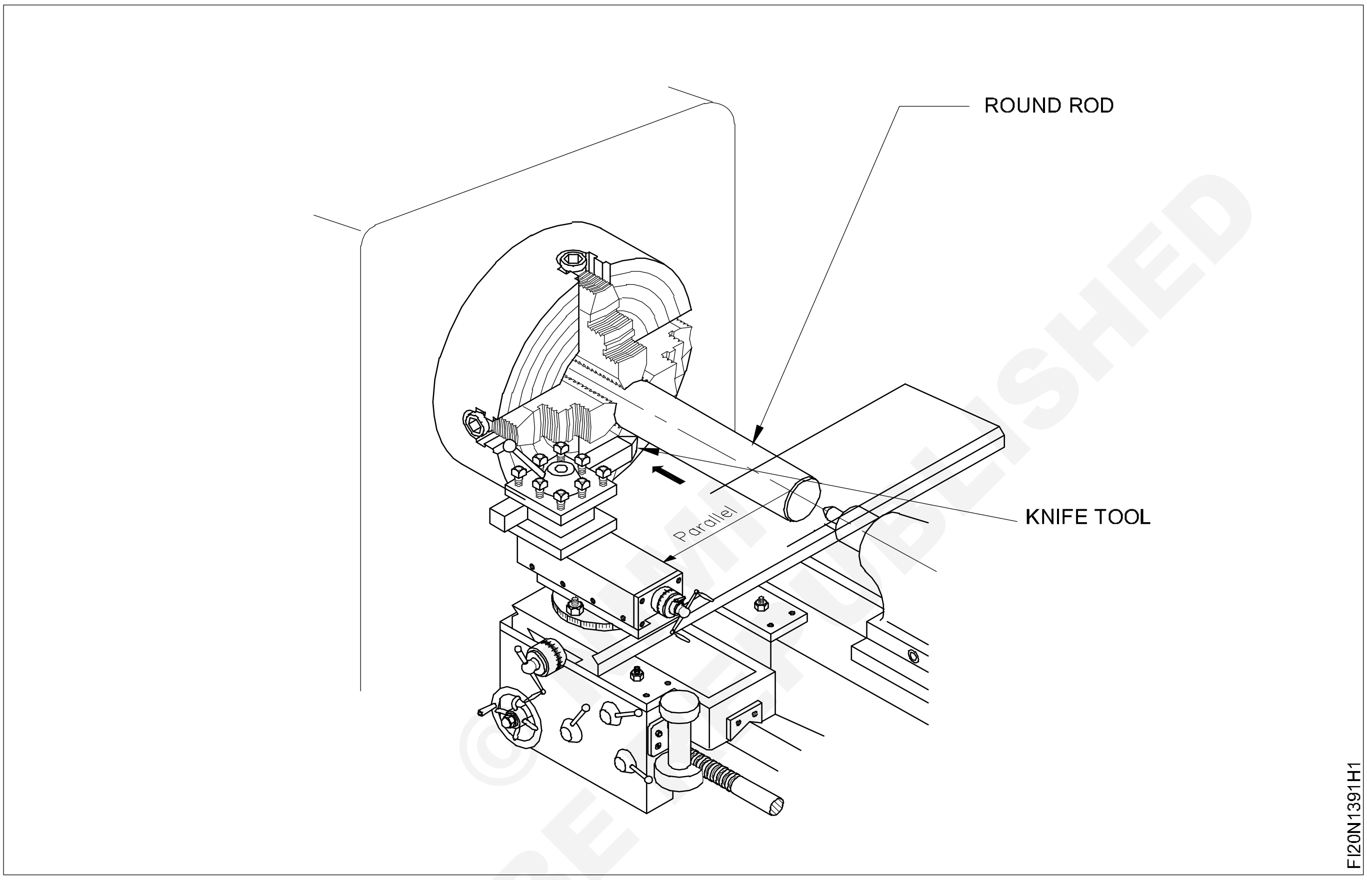
Fig.No.	Name of the operation
1	
2	
3	
4	
5	
6	
7	

Get it verified by your instructor.

— — — — — — —

True job on four jaw chuck using knife tool

Objectives: At the end of this exercise you shall be able to
- **set the round rod/job in four jaw chuck**
- **true the round rod/job using knife tool.**



Job Sequence

- Open one jaw by chuck key.
- Turn the chuck and open the opposite jaw
- Open all jour jaws approximately more than job diameter
- Keep the job inside the jaws
- Make jaws close and hold the job
- Check the job trueness by knife tool.
- Tighten all the jaws.
- Check the trueness of the job by rotating the chuck in neutral position using knife tool.
- Knife tool should touch the job evenly.
- Check once again for the true running of the job.

Skill Sequence

Truing work in a four jaw chuck with the help of a surface gauge

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

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

Uneven load on the cutting tool.

For the same depth more metal will be removed from the out of centre portion.

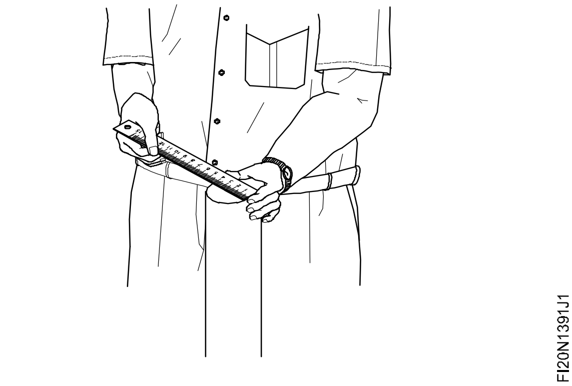
Surface turned may not be cylindrical.

During truing

Keep the main spindle in a neutral position.

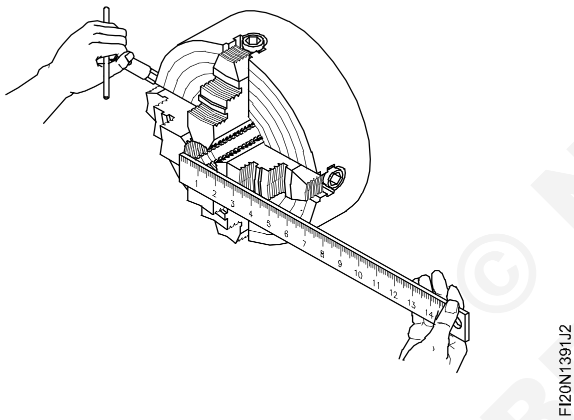
Measure the job diameter with an outside caliper or with a steel rule. (Fig 1)

Fig 1



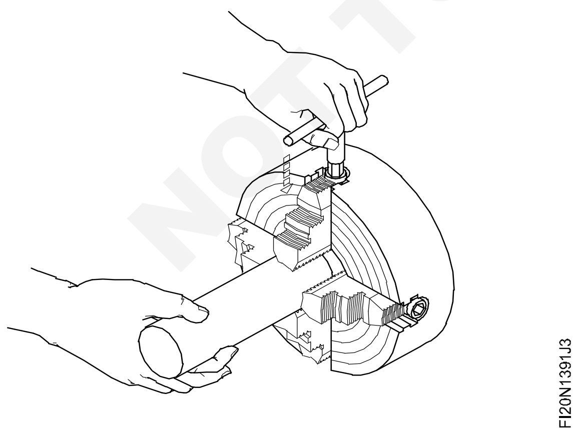
Position the four jaws of the independent chuck, equidistant from the centre. The distance between the inner face of the opposite jaws is equal to the diameter of the work. (Fig 2)

Fig 2



Open the adjacent jaws sufficiently enough to insert the work. (Fig 3)

Fig 3



Place the work inside the chuck, keeping sufficient portion outside the chuck for turning, and tighten the two adjacent jaws, enough to grip the work**.**

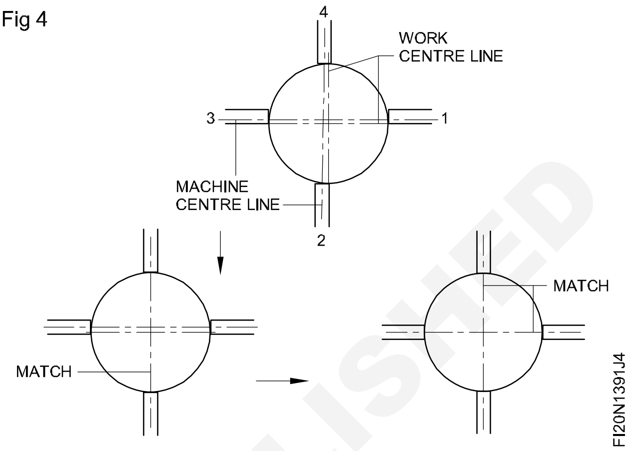
Fix the knife tool on the bed-ways close to the chuck.

Adjust the tool to make its tip move close to the top or side portion of the work with a minimum gap.

Rotate the chuck by hand and observe the gap between the tool and work surface for the position of the two opposite jaws.

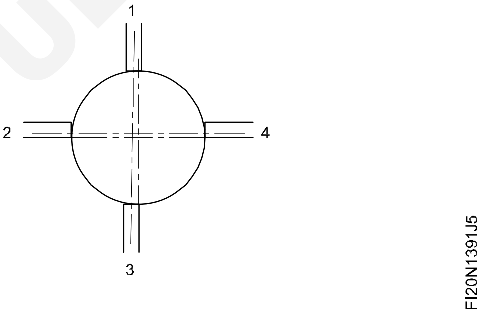
Open the jaw slightly where the gap is more, and tighten the opposite jaw. (Fig 4).

Fig 4



Repeat until the gap is the same. (Fig 5)

Fig 5



Repeat the above sequences for the other set of opposite jaws.

Bring the tool point tip closer to the work surface.

Rotate the chuck by hand and observe the gap.

Engage the spindle levers at about 250 rpm and run the machine.

Touch the tool point on the job.

If the line on the job is uniform tighten the jaw.

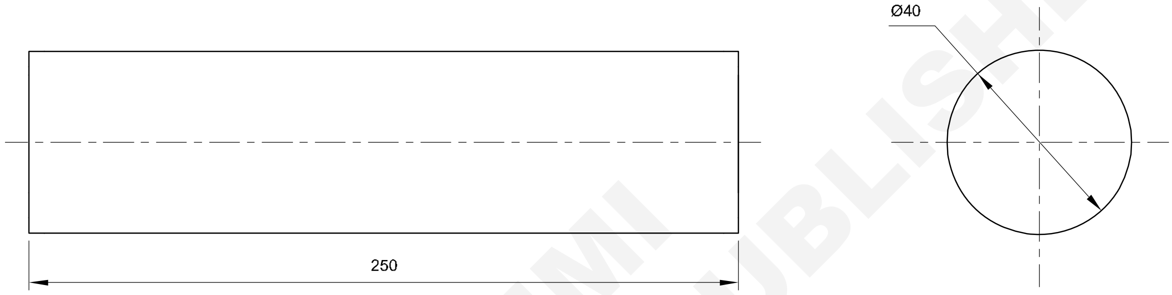
Repeat till a uniform line is formed.

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

Check once again for the true running of the work.

Face both the ends for holding between centres

Objectives: At the end of this exercise you shall be able to
- **set the job on a four jaw chuck**
- **set the tool on the tool post**
- **face the job**
- **measure the length with vernier caliper.**



Job Sequence

- Check the raw material for its size.
- Hold the job in a four-jaw independent chuck with 25 mm overhang and true it.
- Set the R.H. facing tool in the tool post.
- Set the R.P.M.
- Face one end of the work.
- Mark the job 250mm long and punch witness marks on the circumference.
- Reverse the job, clamp it in the chuck and true it again.
- Set the spindle speed closer to 318 revolution per minute.
- Face the length up to the half punch mark level and maintain 250 mm long.
- deburr and check the job.

1	Ø40 X 260	→ 1.7.93	Fe310	–	–	1.7.92
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	FACE BOTH THE ENDS FOR HOLDING BETWEEN CENTERS	DEVIATIONS : ± 0.04mm	TIME :
		CODE NO. FI20N1792E1	

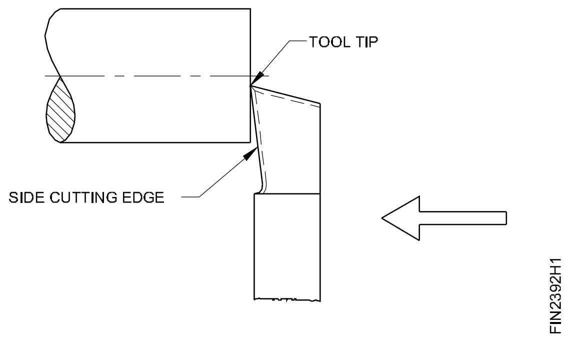
Skill Sequence

Finish-facing the work with a right hand facing tool

Objective: This shall help you to
- **finish-facing the work using a right hand facing tool.**

When more metal is to be removed on the face of work, we prefer to do rough facing by an L.H. facing tool or a L.H. roughing tool, feeding the tool from the periphery of the work towards the centre. Finish-facing is done to get a better surface finish on the face of the work by removing the rough facing. The normal R.H. facing tool, having its cutting edge straight, may be kept slightly inclined to the face of the work during facing. A tool, having its cutting edge itself ground at an angle, may be used. (Fig 1)

Fig 1



The procedure of the finish-facing the work with such a tool is given in sequence below.

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

Set the machine to about 500 rpm. (Calculate the spindle speed by choosing the recommended cutting speed for finish-facing and the mean diameter of the work).

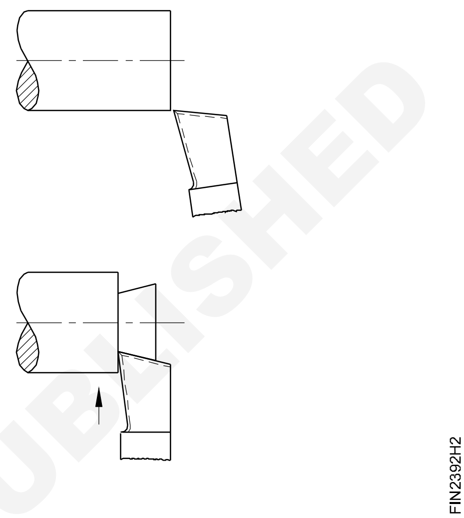
Start the machine and touch the tool point to the work-face by moving cross slide and carriage movement. Move the tool away from the work (Fig 2a) and set the top slide graduated collar to zero, eliminating backlash. Lock the carriage.

Feed the tool about 0.5 mm by the top slide.

Feed the tool towards the centre of the work by the cross-slide till the tool point crosses the centre. (Fig. 2b) Move back the tool to the starting position (Fig. 2a).

Fig 2a

Fig 2b



Advance the tool by a further 0.5 mm inside the work by the top slide.

Engage the power feed (set at 0.05 mm/rev.) and allow the tool to travel towards the centre of the work, removing the metal.

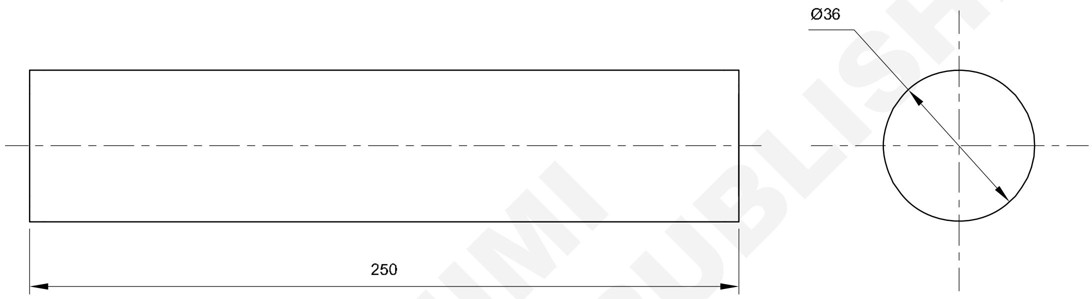
Repeat the sequence until the required amount of material is removed.

Observe the finish obtained.

— — — — — — —

Using roughing tool parallel turn ± 0.1 mm

Objectives: At the end of this exercise you shall be able to
- **hold the work in lathe chuck**
- **grind RH turning tool**
- **set the turning tool in tool post**
- **set the machine spindle speed for turning**
- **parallel turn the work by hand feed method with various depths of cuts.**



Job sequence

- Hold the work in four jaw chuck.
- Grind and fix RH turning tool and turn ∅36 to maximum length of job with the R.P.M. close to 318.
- Check the diameter by using vernier caliper
- Chamfer the end 3×45° and deburr.
- Reverse the job and hold in four jaw chuck.
- Turn the remaining length to ∅36 mm by parallel turning.
- Chamfer the end and deburr.

1	EX.NO.2.3.92	→ 1.7.92	Fe310	—	—	1.7.93
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE :NTS	**USING ROUGHING TOOL PARALLEL TURN ± 0.1mm.**	DEVIATIONS : ± 0.1mm	TIME :
		CODE NO. FI20N1793E1	

Skill Sequence

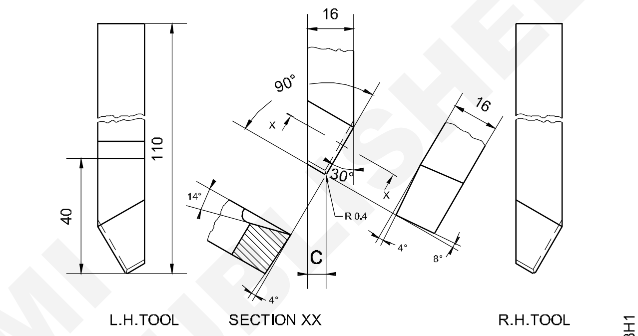
Rough turning tool grinding

Objective: This shall help you to

- **grind rough turning tool with various angle.**

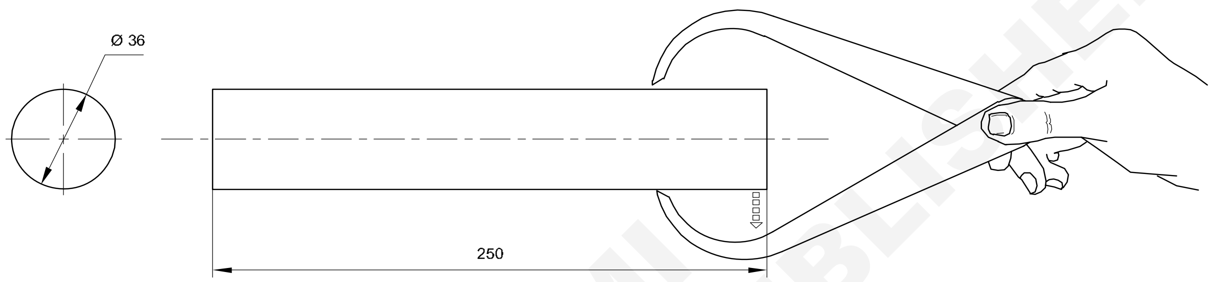
- Rotate the wheel by hand and observe for free rotation.
- Check the grinding wheels for true running.
- Wear goggles.
- Dress the wheels by a wheel dresser.
- Adjust the tool-rest to maintain a minimum gap from the wheel face to a minimum of 2 to 3 mm.
- Hold and apply the side flank of the tool to 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 5° simultaneously.
- Hold the top flank of the tool against the wheel face inclined at 14°, the rear the 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 a oilstone.
- The top rake (back rake) angle should be kept at 0°.

Fig 1



Measure the diameter using outside caliper and steel rule

Objectives: At the end of this exercise you shall be able to
- **check the diameter using outside caliper**
- **measure diameter with steel rule.**



TAP GENTLY TO CLOSE THE CALIPER LEGS

Job Sequence

- Hold the out side caliper
- Open the caliper legs approximately more than job diameter
- Adjust the outside caliper leg to touch the diameter of the job.
- Adjust the caliper legs to just touch outer diameter of the job.
- Repeat the same procedure in different position of the job
- Measure the diameter by using steel rule.

1	—	1.7.93 ←	Fe310	—	—	1.7.94
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	MEASURE THE DIAMETER USING OUTSIDE CALIPER AND STEEL RULE	TOLERENCE: ±0.5mm	TIME:
		CODE NO: FI20N1794E1	

Skill Sequence

Measuring with outside calipers

Objectives: This shall 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.**

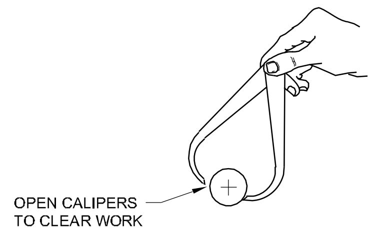
Outside calipers

Select a caliper based on the diameter to be measured.

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

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

Fig 1

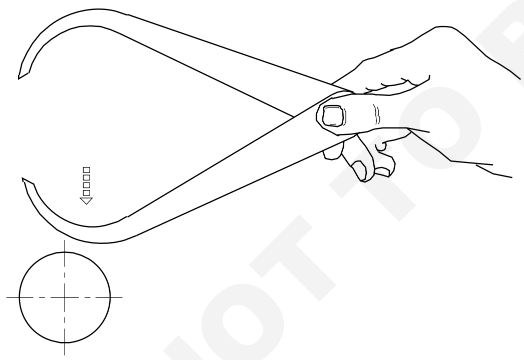


WORK MUST BE STATIONARY

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 so that it just slips from the external diameter of the workpiece to give the right sense of `feel'. (Fig 2)

Fig 2

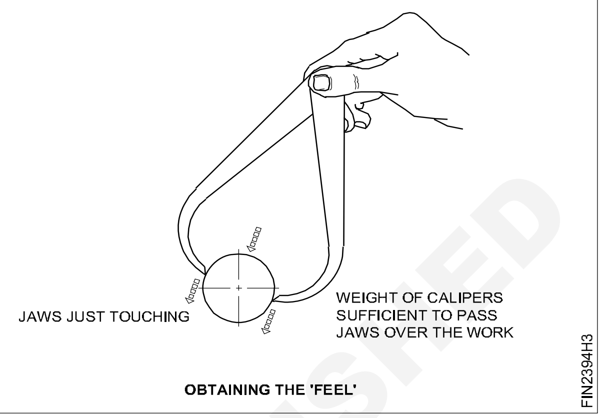


TAP GENTLY TO CLOSE CALIPERS

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. (Fig 3)

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

Fig 3

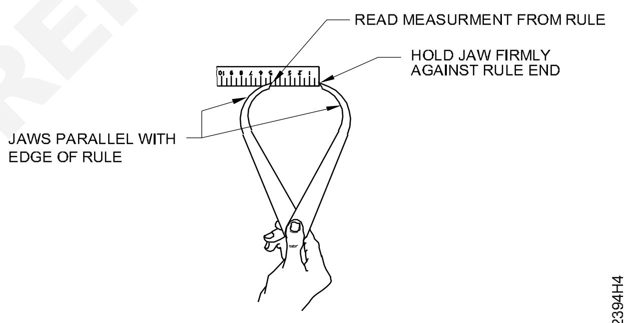


OBTAINING THE 'FEEL'

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 leg firmly against the rule end. (Fig 4)

Fig 4



CHECKING THE DIMENSION

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

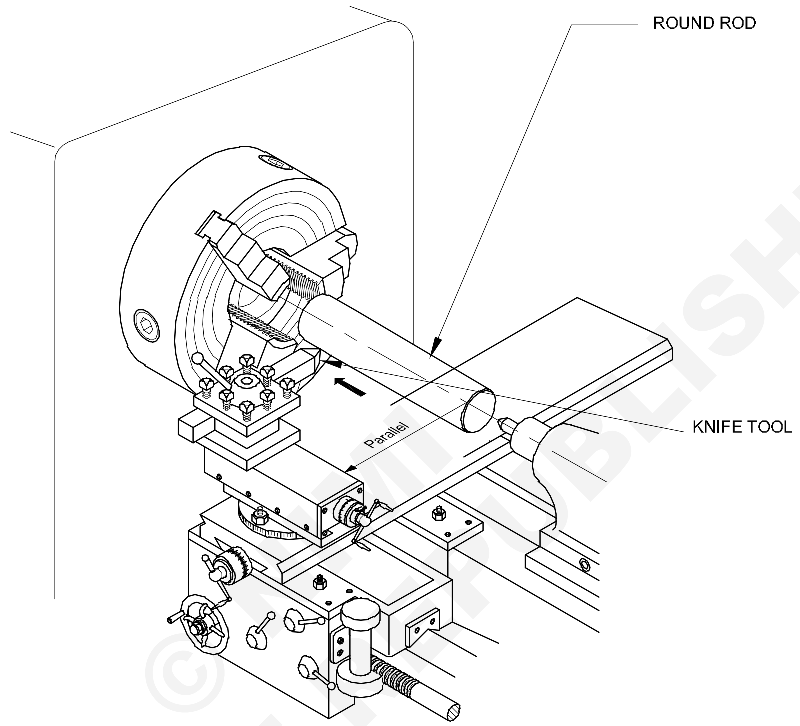
Record the reading to an accuracy of ± 0.5 mm.

In the case of precision measurements, transfer the measurements over an inside micrometer or vernier caliper. This measurement will give an accuracy of ± 0.01 or ± 0.02 mm. Here, the sense of feel of the user is very important in deciding the reading.

Holding job in three jaw chuck

Objective: At the end of this exercise you shall be able to
- **hold the job in three jaw chuck.**

Fig 1



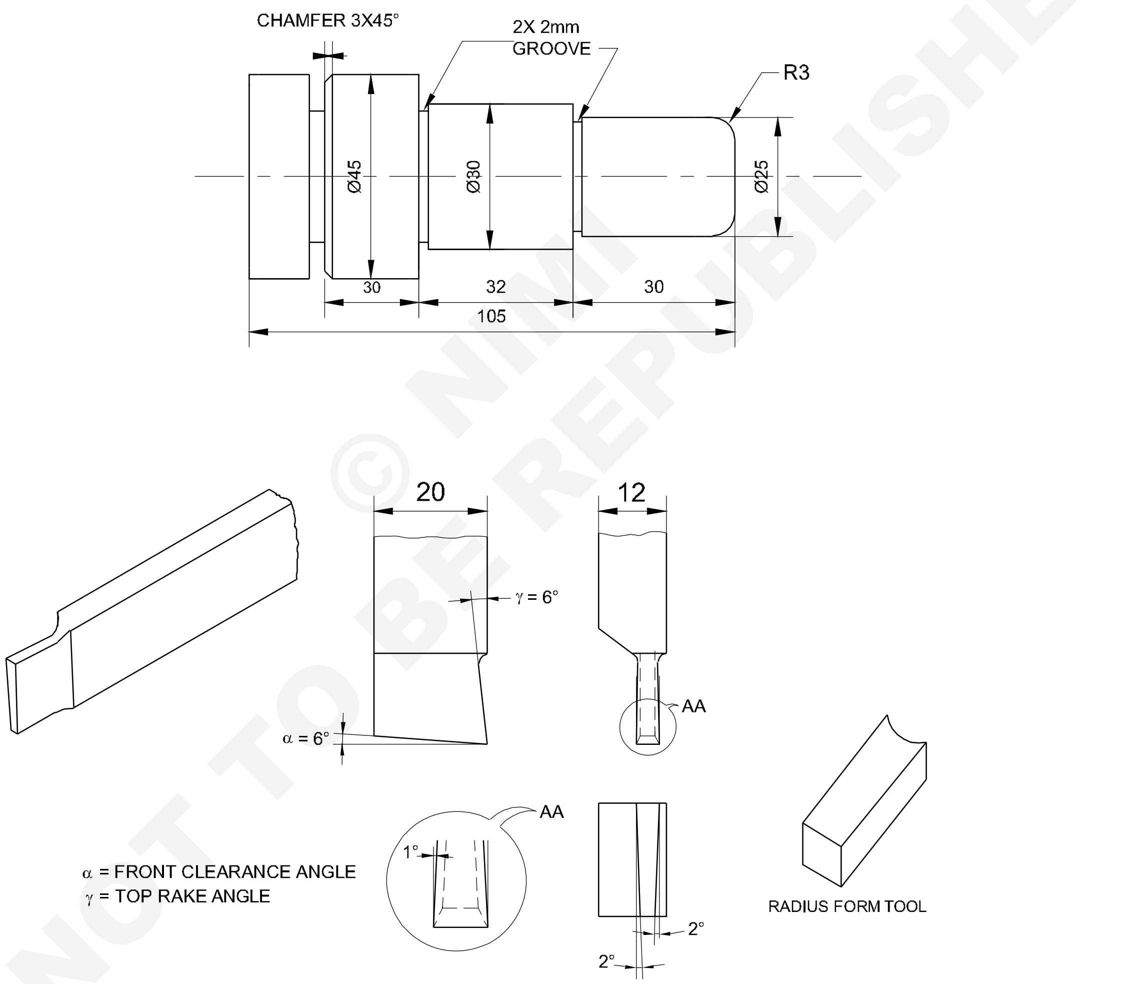
Job Sequence

- Check the raw material size.
- Open the jaws by chuck key
- Open the jaws approximately more than job diameter
- Keep the job in the chuck with overhang of 75 mm
- Tighten the jaws as required
- Check the trueness of the job

— — — — — — —

Perform the facing, plain turn, step turn, parting, deburr, chamfer corner, round the ends, and use form tools

Objectives: At the end of this exercise you shall be able to
- **hold the work in three jaw chuck**
- **face the end and plain turning**
- **step turn job ± 0.1 using power feed and a knife tool**
- **form turning using form tool**
- **parting off using parting tool**
- **grind parting tool and make under cut to the required size.**



1	Ø50-105	–	Fe 310-O	–	–	1.7.96
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	PERFORM THE FACING ,PLAIN TURN, STEP TURN,PARTING,DEBURR, CHAMFER CORNER, ROUND THE ENDS AND USE FORM TOOLS	TOLERANCE ±0.04mm	TIME :
		CODE NO. FI20N1796E1	

Job Sequence

- Check the raw material for its size.
- Hold the job in a 3 jaw chuck keeping about 75mm outside the chuck.
- Set the tool to the correct centre height.
- Select and set the correct spindle R.P.M.
- Face one side first and turn the outer diameter to ∅ 45mm for the maximum possible length.
- Turn ∅ 30 mm x 32 mm length as shown in job drawing.
- Turn ∅ 25 mm x 30 mm length.
- Set the under cut tool, radius tool, to the correct centre height and hold it rigidly.
- Form a square groove 2 mm depth x 2 mm width at 30 mm and 62mm from the end face.
- Form a radius 3 mm at ∅ 25mm x width 30 mm at the end face.
- Reverse and hold the job at ∅ 30mm x width 32mm inside the three jaw chuck keeping about 40mm length outside the chuck and true the job.
- Turn ∅ 45mm x 40mm length.
- Set the 2mm width parting tool to the correct centre height
- Part the job using plunge cut method at ∅ 45 mm x width 8mm from the end face.
- Face the other end to a total length of 92mm.
- Set the chamfering tool to the correct centre height.
- Chamfer the ∅ 45mm corner to 3x45°.
- Remove the sharp edge.
- Check the dimensions.

Skill Sequence

Turning steps of different diameters

Objectives: This shall help you to
- **turn steps of different diameters for definite length on a shaft.**

When the width of step to be turned is more than the width of the tool, it is turned by using a R.H. knife-edge tool.

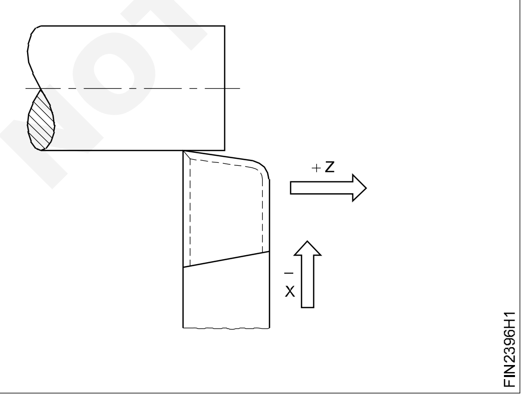
Hold the previously turned shaft in three jaw chuck and true it at both ends (near the chuck and overhanging end).

Hold the RH Knife-edge tool in the tool post with its cutting edge at centre height and at right angle.

Set the machine to 300 r.p.m.

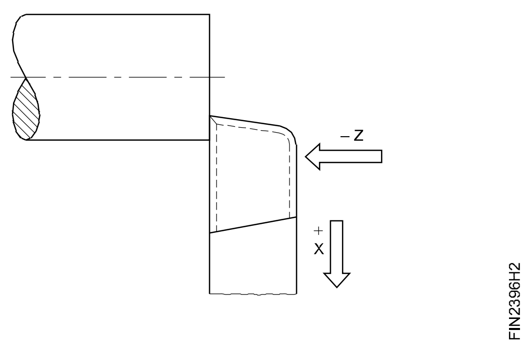
Start the machine and touch the tool tip on the surface of work to set the cross-slide graduated collar to zero with the backlash eliminated. (Fig 1)

Fig 1



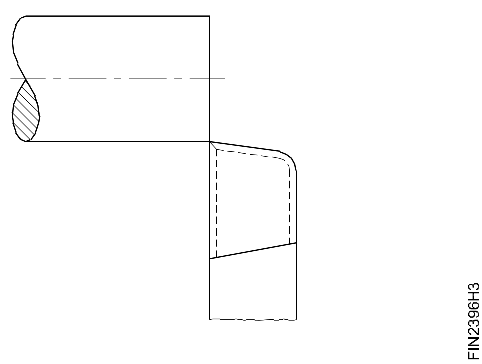
Withdraw the tool from work and make the cutting edge contact the face of the work to set the top slide graduated collar to zero with a backlash eliminated. (Fig.2)

Fig 2



Position the tool tip near the edge of the work. (Fig.3)

Fig 3



Give a depth of cut to turn steps progressively. (Fig.4)

Advance the tool axially to the required length by rotating the top slide hand wheel.

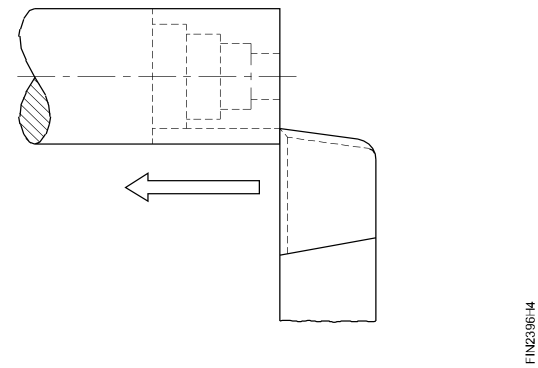
(The rotation of the top slide hand wheel should be continuous and uniform till the required length is reached).

Restrict the depth of cut to a maximum of 3 mm for each cut.

Repeat the depth of cuts till the required diameter is reached.

Keep the carriage in the locked position.

Fig 4



Corner forming tool

Objective: This shall help you to
- **grind the corner forming tool.**

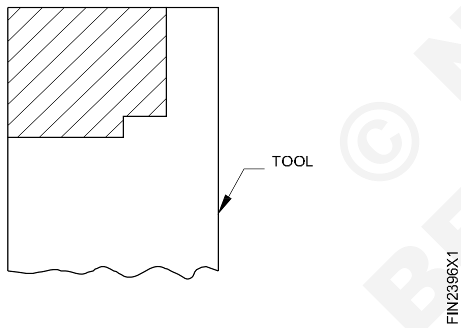
Procedure for grinding corner forming tool (for external operation).

Set the pedestal grinder for tool grinding.

Wear goggles.

Dress rough wheel, grind the tool approximately to a depth of 10.00 mm, maintaining a wall thickness of 3 to 4 mm. (Fig 1)

Fig 1



Prepare a template out of M.S. sheet to check positional accuracy. (Fig 2)

Now dress smoother wheel to form 2R at the corner.

Carborundum dresser is used to form corner radius.

Check the dressed wheel with template.

Grind 4°-6° front clearance angle at the front and 3°-4° side clearance. (Fig.3)

Fig 2

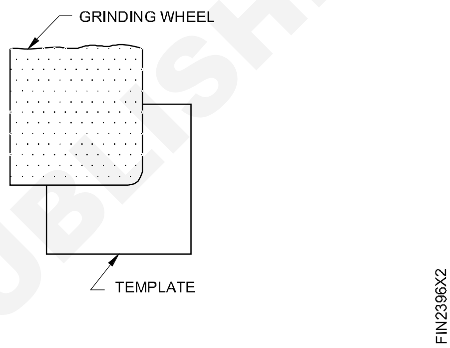
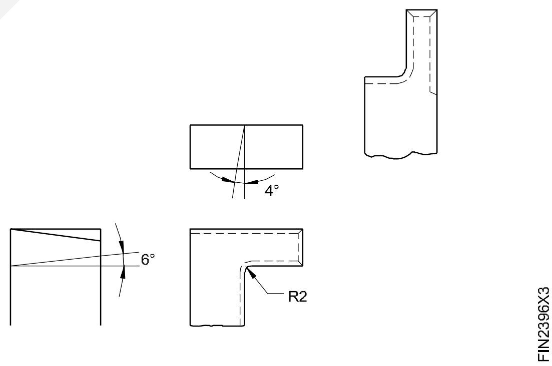


Fig 3



Remove the step and form 2R and check with template.

Deburr with oil stone.

No rake angle is given.

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.**

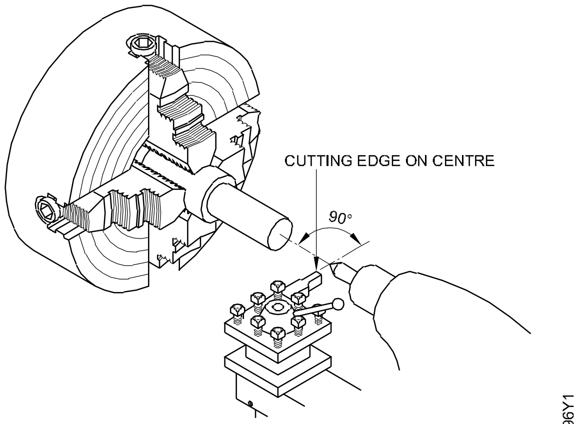
Parting off operation

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

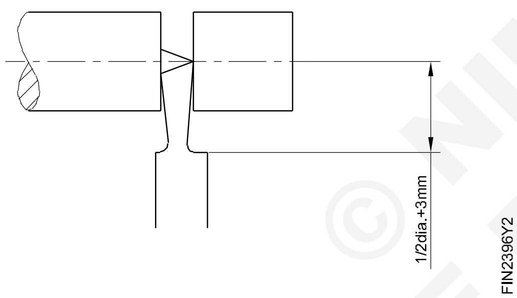


CORRECT CUTTING EDGE POSITION

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 work piece. If it is too low, the work may be bent and the cutting tool 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

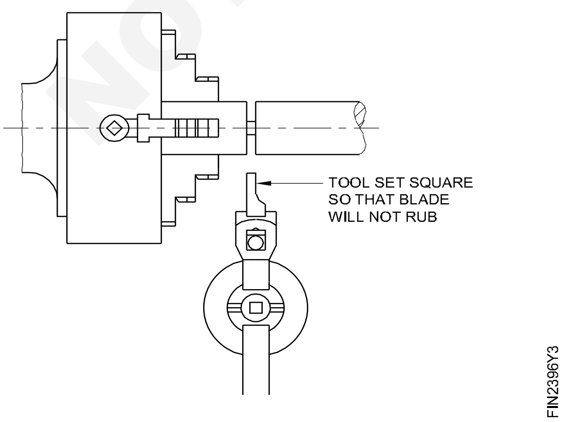
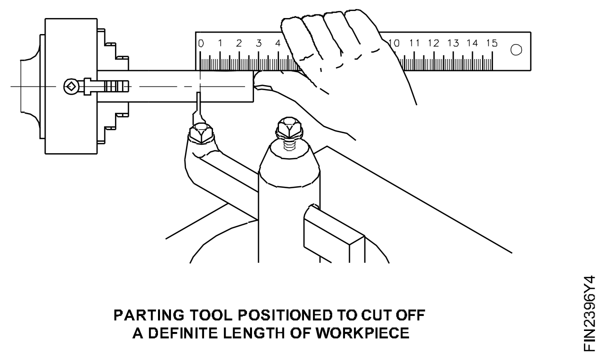


Fig 4



PARTING TOOL POSITIONED TO CUT OFF A DEFINITE LENGTH OF WORKPIECE

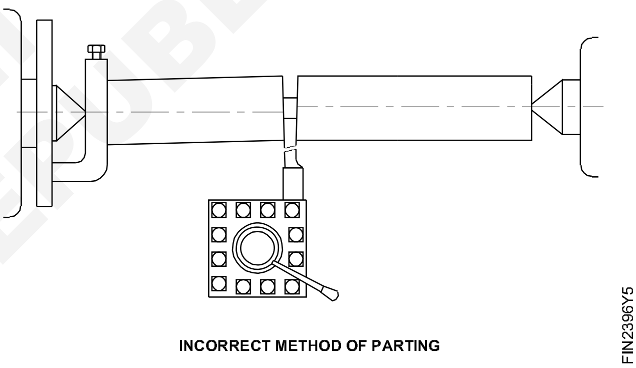
Set the spindle speed to half the speed for turning.

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)

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.

Fig 5



INCORRECT METHOD OF PARTING

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.

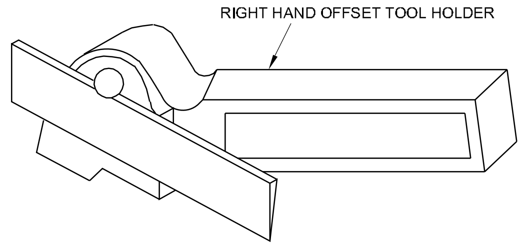
If the workpiece is held between centres, it may bend or break and fly out of the lathe during parting off. (Fig 5)

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

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

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

Fig 6



INSERTED-BLADE TYPE PARTING TOOL

Heavy feed causes jamming and tool breakage.

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.

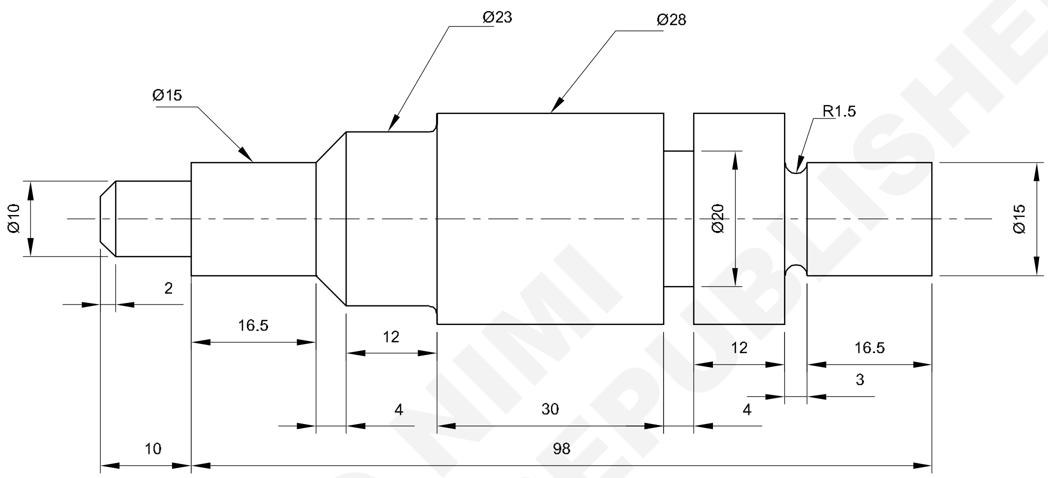
The above operation should be repeated frequently to minimise the tendency of the tool to dig in and cause trouble.

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

— — — — — — — —

Shoulder turn : Square , filleted, beveled under cut shoulder, turning-filleted under cut, square beveled

Objectives: At the end of this exercise you shall be able to
- **set and true the job in a 3-jaw chuck**
- **face, plain and step turn the work by hand tool to an accuracy of ± 0.1 mm**
- **form square filleted under cut**
- **set and true the job to the run out accuracy of 0.1 mm**
- **turn square filleted shoulder**
- **turn bevel shoulder.**



Job Sequence

- Check the raw material size.
- Hold the job in three jaw chuck with minimum overhang.
- Set the R.H. facing tool rigidly to the correct centre height with a minimum overhang.
- Set the machine to the predetermined R.P.M.
- Lock the carriage and face one end.
- Set the R.H. turning tool in the tool post rigidly.
- Turn the job to ∅ 28 mm to the maximum possible length.
- Step turn ∅ 15 mm to a length of 19.5 mm.
- Check the dimensions with a vernier caliper.
- Do filleted under cut R1.5x1.5 depth
- Make under cut of 4mm width and 4mm depth.
- Reverse the job and hold it on the finished surface.
- Face the job to 108 mm length.
- Check the length with a vernier caliper.
- Turn the job to ∅ 23 mm to the 16 mm length.
- Step turn ∅ 15 mm to a length of 26.5 mm.
- Bevel the ∅ 23 mm step to an angle of 4x45°.
- Turn ∅ 10 mm x 10 mm length
- Chamfer the ∅ 10 mm step to an angle of 2X30°
- Remove burrs from the job.
- Check the angle with a vernier bevel protractor.
- Check the dimensions with a vernier caliper.

1	Ø 30-120	—	Fe310	—	—	1.7.97
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	SHOULDER TURN: SQUARE, FILLETED, BEVELED UNDER CUT SHOULDER, TURNING- FILLETED UNDER CUT,SQUARE BEVELED	DEVIATIONS LINEAR ± 0.04mm ANGULAR ± 30'	TIME
		CODE NO. FI20N1797E1	

Skill Sequence

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.

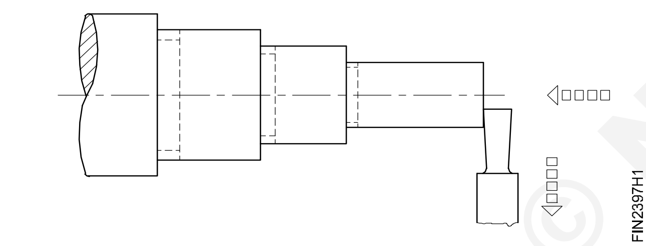
To form an undercut shoulder at the junction, the following procedure is to be followed.

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

Set correct spindle speed, and start the machine.

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

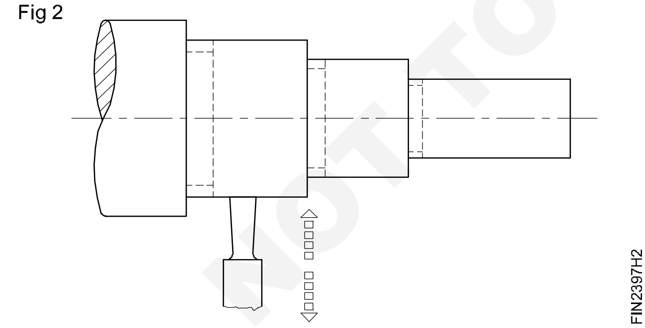
Fig 1



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

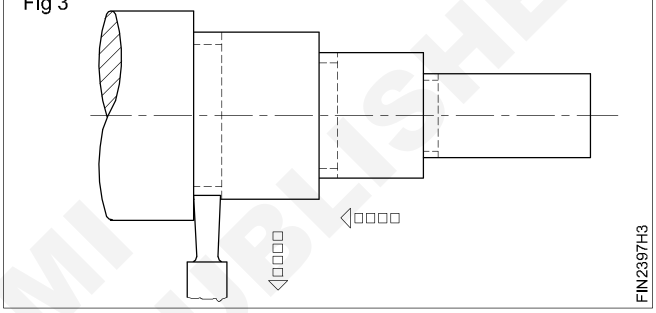


Rotate the top slide handle until the tool marks the shoulder lightly. (Fig 3)

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

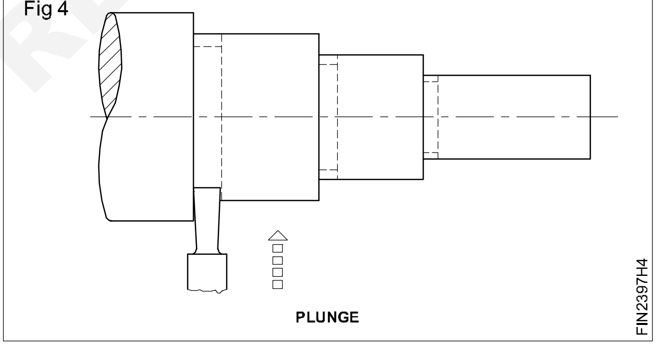
Apply cutting fluid

Fig 3



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

Fig 4



Stop the lathe and check the undercut for its dimensions.

Remove sharp corners, if any.

Machining various shoulders

Objective: This shall help you to
- **machining various shoulders.**

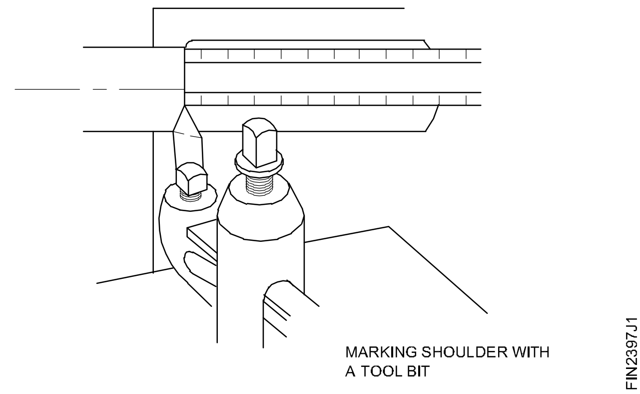
Machining a square shoulder

Face the end of the work to provide a reference surface point from which to take measurements.

Lay out the position of the shoulder by one of the following methods.

Cut a light groove with the point of a sharp tool bit around the circumference of the work to mark the required length. (Fig 1)

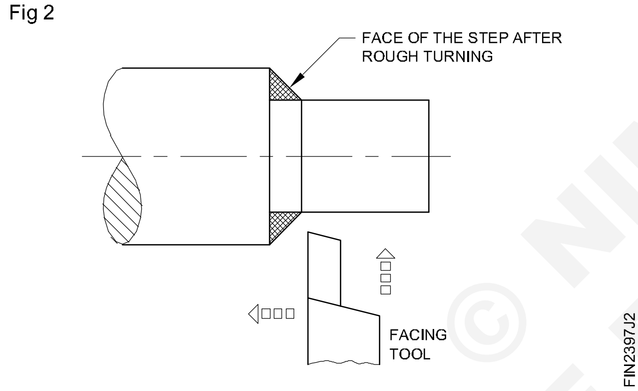
Fig 1



Rough and finish turn the diameter to within about 1 mm of the required length.

Mount a facing tool bit in the tool-holder and set it to centre. (Fig 2)

Fig 2



Make sure that the tool bit is set up with the point close to the work, and with a slight space along the side cutting edge.

Apply chalk or lay out dye to the small diameter, as close to the shoulder as possible.

Before starting the lathe, the tool bit should be brought fairly close to the diameter, by using a piece of paper or thin stock between the tool bit point and the work diameter.

Start the lathe and bring the facing tool in until it just removes the chalk or the layout dye.

Note the reading on the graduated collar of the cross-slide screw.

Bring the tool bit towards the shoulder with the carriage hand wheel until a cut is started.

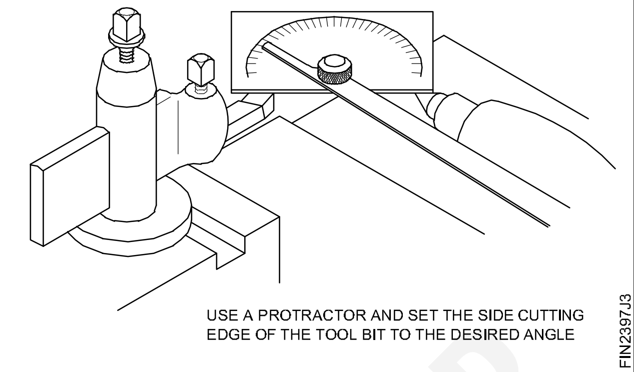
Face the shoulder by turning the cross-slide handle anti-clockwise, thus cutting from the centre to the outside.

For successive cuts, return the cross-slide screw to the same graduated collar setting. Repeat the above procedure until the shoulder is machined to the correct length.

Machining a beveled shoulder (Fig 3)

Lay out the position of the shoulder along the length of the workpiece, and set the tool as shown in Fig 3.

Fig 3



Rough and finish turn the small diameter to size.

Mount a side cutting tool in the tool-holder and set it to centre.

Apply chalk or layout dye to the small diameter as close as possible to the shoulder location.

Bring the point of the tool bit in until it just removes the chalk or layout dye.

Turn the carriage hand wheel by hand to feed the cutting tool slowly into the shoulder.

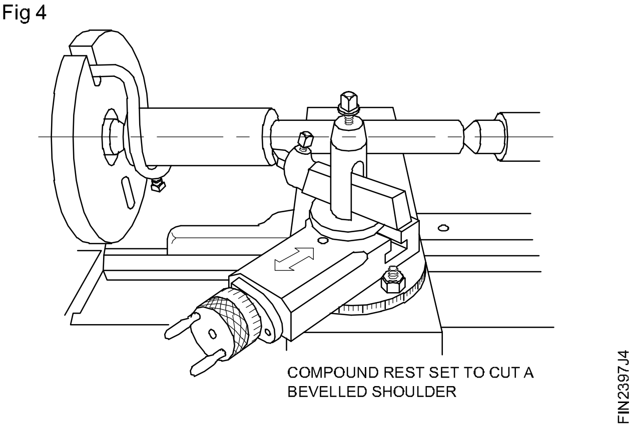
Apply a cutting fluid to assist the cutting action and to produce a good surface finish.

Machine the beveled shoulder until it is to the required size.

If the size of the shoulder is large, and chatter occurs when cutting with the side of the tool bit, it may be necessary to cut the beveled shoulder using the compound rest.

Set the compound rest to the desired angle. (Fig 4)

Fig 4



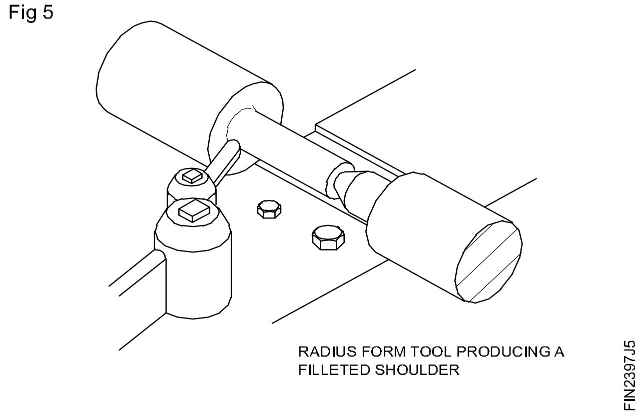
Adjust the tool bit so that only the point will cut.

Apply a cutting fluid to assist cutting action. Progressively machine the bevel. Always cut outwards and start each cut near the outermost edge of the face of the shoulder. Be careful not to damage the small diameter when preparing to make each new cut. At the start of the final cut, bring the point of the tool bit in, until it just removes the chalk or layout dye at the innermost edge of the original shoulder face.

Machining a filleted shoulder (Fig 5)

Lay out or mark the location of the shoulder on the workpiece.

Fig 5



When laying out for a filleted shoulder make allowance for the radius to be cut. If a filleted shoulder has a 4 mm radius and is 60 mm from the end of the workpiece, the layout should be 56 mm from the end. This would leave material for cutting the radius.

Rough and finish turn the small diameter to size.

Mount a radius tool in the holder and set it to centre. Check the tool bit with a radius gauge to be sure that it has the correct radius.

Apply a layout dye or chalk to the small diameter as close as possible to the shoulder location.

Set the lathe spindle speed to approximately one half of the turning speed.

Start the lathe and bring the tool bit in until it just removes the layout dye or chalk.

Note the reading on the graduated collar of the cross-slide screw.

Retract the cutting tool by turning the cross-slide handle anticlockwise one half turn.

Turn the cross-slide handle clockwise until it is within approximately 1 mm of the original collar setting. The point of the round nose tool bit should now be about 1 mm away from the work diameter. This prevents the cutting tool from undercutting while roughing out the filleted corner.

Turn the carriage hand wheel slowly to start the radius tool cutting the filleted shoulder. If chattering occurs while machining the filleted corner, reduce the lathe speed and apply a cutting fluid to improve the finish of the fillet. (Fig 5)

Continue turning the carriage hand wheel slowly and carefully until the length of the shoulder is correct.

When stopping the lathe to measure the shoulder distance, do not move the cutting tool setting by withdrawing it from the diameter. (Fig 6)

Fig 6

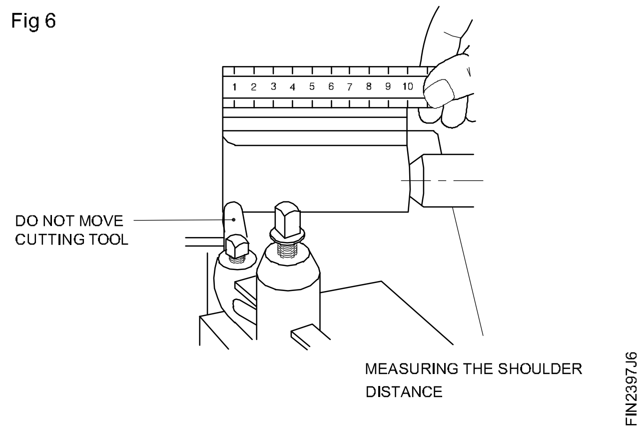
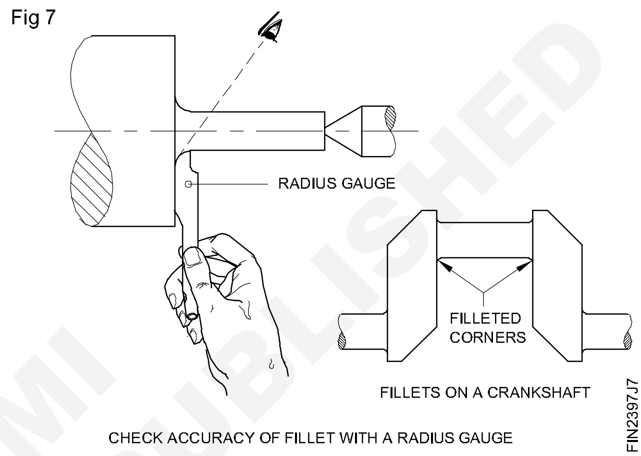


Fig 7



Turn the carriage hand wheel to move the cutting tool away from the shoulder slightly.

Turn the cross-slide handle anticlockwise about 1 mm back to the original collar setting.

Finish the filleted corner by carefully advancing the radius tool bit with the carriage hand wheel.

If the radius is too large for a form tool bit, or too much chattering occurs, cut the fillet in steps, using the largest radius tool that does not cause chattering. Check the accuracy of the fillet with a radius gauge. (Fig 7)

Machining an undercut shoulder

Lay out the position of the undercut shoulder along the length of the workpiece.

Rough and finish turn the small diameter to size.

Mount the undercut tool in the tool-holder and set it to the centre.

Apply chalk or layout dye to the small diameter as close as possible to the undercut shoulder location and also on the face of the larger diameter.

Set the lathe spindle to approximately one half of the turning speed.

Bring the point of the tool bit in until it just removes the chalk or layout dye on the face and set the top slide graduated collar to zero.

Apply a cutting fluid to assist the cutting action and produce a good surface finish.

Retract the cutting tool by turning the cross-slide handle anticlockwise.

Repeat the above procedure until the undercut shoulder is machined to the correct depth.

Bring the tool tip clear off the large diameter face and advance the tool axially by 1 division of the top slide.

Feed the tool into the work from the edge of the larger diameter face, till it just removes the chalk mark applied on the small diameter.

Note the cross-slide graduated collar reading and advance the tool into the work to the number of divisions required according to the depth.

Ensure that the tool cutting edge is parallel to the work axis.

Ensure that the carriage is locked during the undercutting operation.

Apply a cutting fluid to assist the cutting action and to produce a good surface finish.

Retract the cutting tool by turning the cross-slide handle anticlockwise.

Repeat the above procedure until the undercut shoulder is machined to the correct depth.

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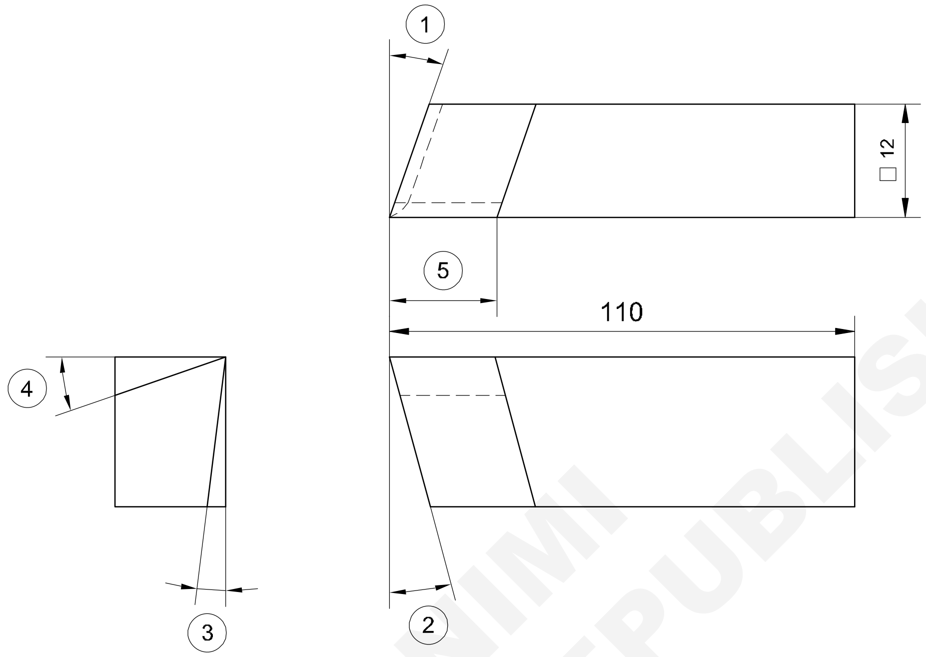
Sharpening of - single point tools

Objective: At the end of this exercise you shall be able to
- **grind side cutting tool for machining steel.**



1 End cutting edge angle - 25°
2 Front clearance angle - 6°
3 Side rake angle - 6°
4 Side rake angle - 14°
5 Cutting edge - equal to tool thickness

Job Sequence

- Before starting wear safety goggles.
- 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 the 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 0.5 mm R.

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

1	SQ12 - 110	–	Fe310	–	–	1.7.98
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SHARPENING OF - SINGLE POINT TOOLS	TOLERANCE :±30'	TIME :
		CODE NO. FI20N1798E1	

Skill Sequence

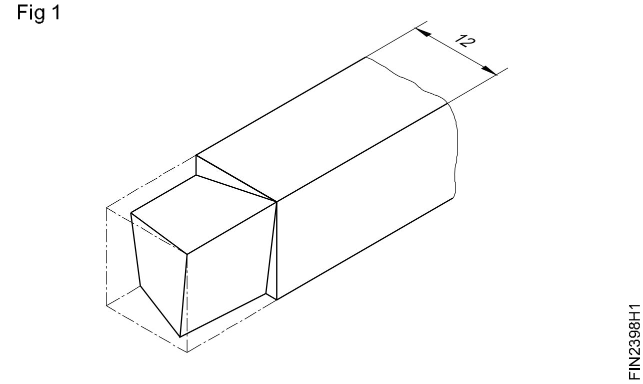
Grinding a side cutting tool for machining steel

Objective : This shall help you to

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

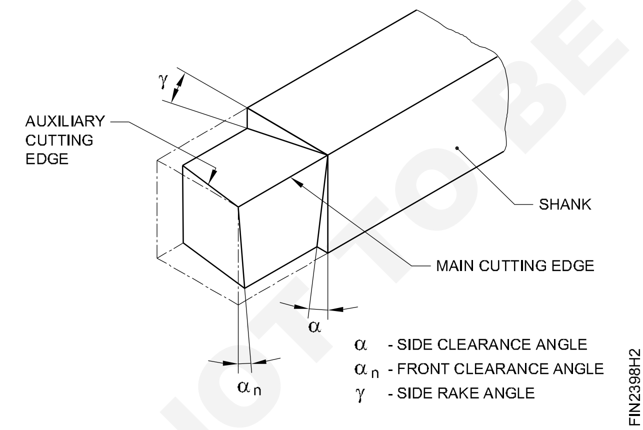
The side cutting tool to be used on steel is illustrated in Figure 1. The portion illustrates the tool blank in dotted lines before grinding, and the ground tool by thick lines. (Fig 1)

Fig 1



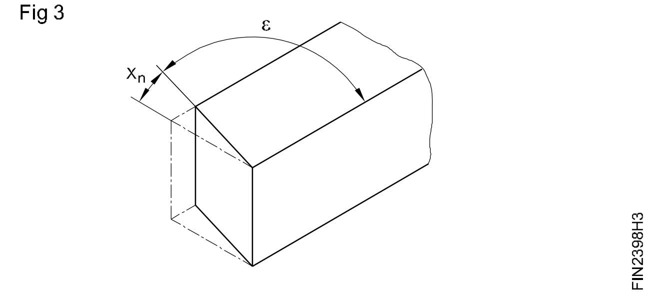
The side cutting edge is in line with the blank edge and the end cutting edge is inclined at an angle of 25°. The side rake angle is 14°. The front and side clearances are ground 6°. The length of the side cutting edge is maintained equal to the size of the square cross-section of the tool blank, i.e. 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 2



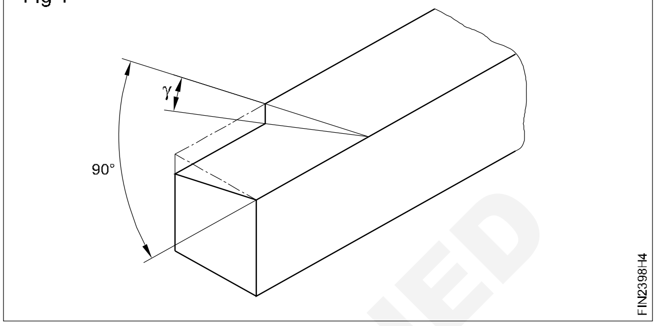
Grind the end cutting edge angle 25°. Angle 'x_n' (Fig 3)

Fig 3



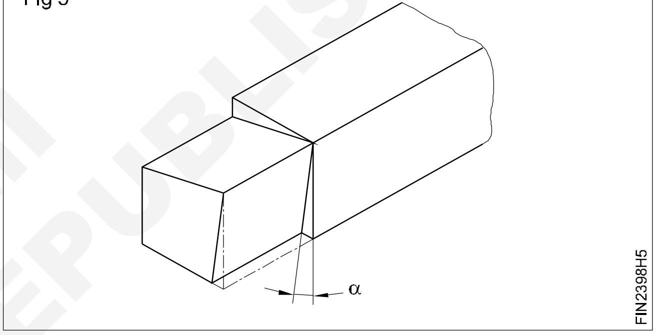
Grind the side rake angle of 14°. Angle 'r'. (Fig 4)

Fig 4



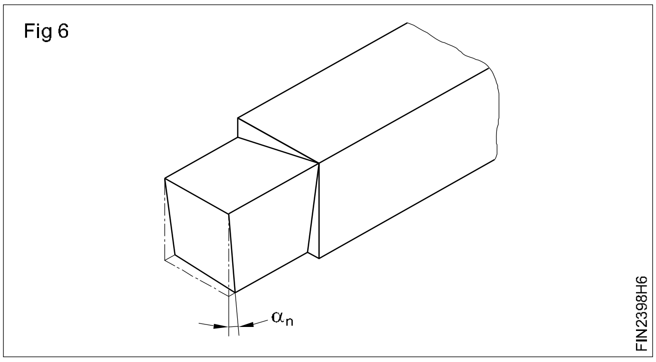
Grind the side clearance angle of 6°. Angle (Fig 5)

Fig 5



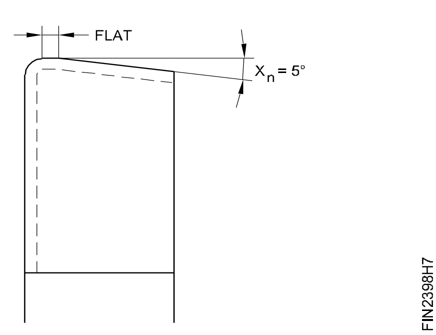
Grind the front clearance angle of 6°. Angle ∅ (Fig 6)

Fig 6



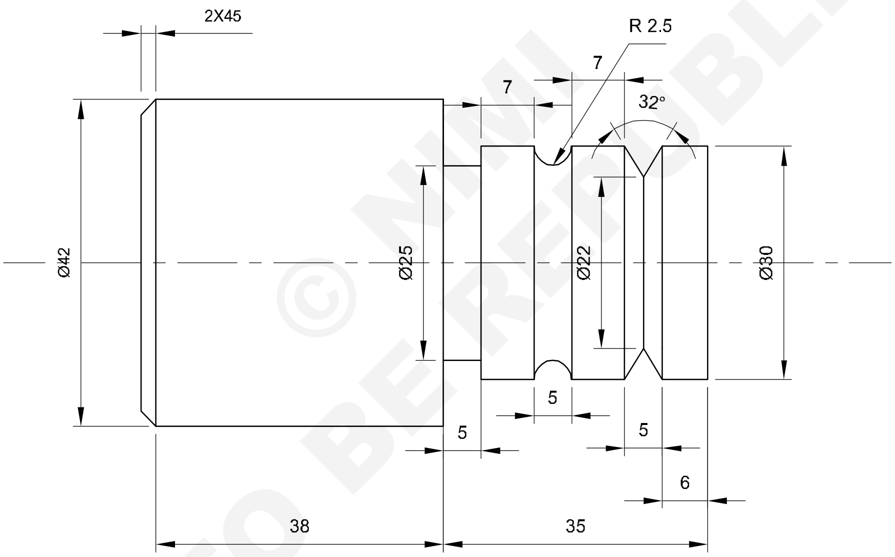
Grind and provide a nose radius of R 0.4 to R 0.6 mm at the point of tool. Grind a flat for a short length of 0.2 to 0.3 mm as shown in Fig 7. For the sake of clarity the figure is magnified.

Fig 7

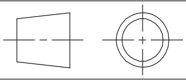


Cut grooves - square, round 'V' groove

Objectives: At the end of this exercise you shall be able to
- **hold the job in lathe chuck**
- **set the turning tool**
- **set the machine spindle speed**
- **parallel turn the work piece by hand feed**
- **set the tool for groove turning -'V' tool, radius tool and square tool.**



1	Ø50-80	—	Fe310	—	—	1.7.99
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	CUT GROOVES - SQUARE, ROUND, 'V' GROOVE	TOLERENCE: ±0.04mm
		TIME:
		CODE NO : FI20N1799E1

Job Sequence

- Check the raw material for its size.
- Hold the job in 3 jaw chuck keeping about 50mm outside the chuck
- Set the tool to the correct centre height.
- Select and set the correct spindle R.P.M.
- Face one side first and turn the outer diameter to ∅ 42mm for the maximum possible length.
- Turn ∅ 30 mm x 35 mm length.
- Set the under cut tool, radius tool, 'V' groove tool to the correct centre height and hold it rigidly.
- Form a square groove 2.5 mm depth x 5mm width at 30 mm from the end face.
- Form a radius groove 2.5 mm depth x 5mm width at 18 mm from the end face.
- Plunge the 'V' groove tool to form a 'V' groove 5mm width at 6mm from the end face.
- Reverse and hold the job.
- Face the other end to a total length of 75mm.
- Turn ∅ 42 mm x 40 mm length
- Champers 2 x 45° at the 2 x 45° end
- Remove the sharp edge
- Check the dimensions.

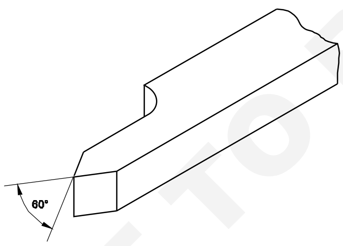
Skill Sequence

Grind 60° 'V' tool

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

1 Grind the tool to the given angle of 60°
  - Mount the tool and set centre height properly
  - Set the speed, lock the carriage
  - Move the cross slide and plunge the tool to the required size.
  - Check the depth of the 'V' groove. (Fig 1)

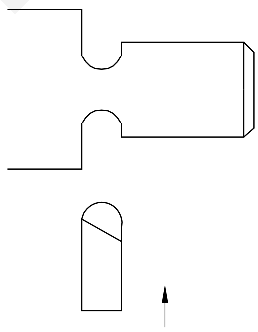
Fig 1



FIN2399H1

2 Grind the tool 4 mm radius
  - Mount the tool and set centre height properly
  - Set the speed, lock the carriage
  - Move the cross slide and plunge the tool to the required size. (Fig 2)

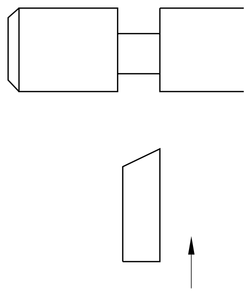
Fig 2



FIN2399H2

3 Grind the tool to the required width of 4 mm
  - Mount the tool and set centre height properly.
  - Set the speed, lock the carriage.
  - Move the cross slide and plunge the tool to the required size. (Fig 3)

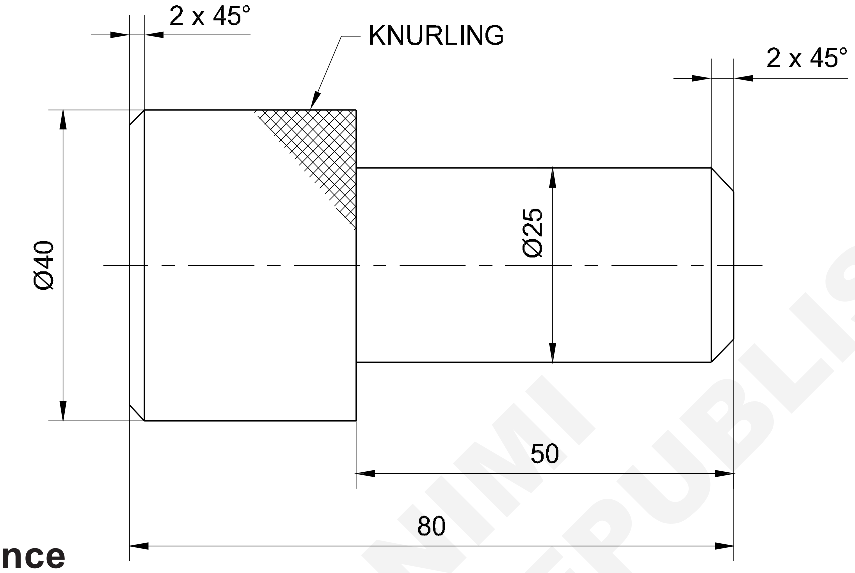
Fig 3



FIN2399H3

Knurl the job

Objectives: At the end of this exercise you shall be able to
- **hold the job in lathe chuck**
- **set a knurling tool in the tool post**
- **knurl on the cylindrical surface.**



Job Sequence

- Check the raw material size
- Hold the material securely in a 3 jaw chuck projecting 50 mm outside the chuck.
- Face the one end.
- Turn the job to ∅ 40-0.2 for more than the required for knurling
- Hold the diamond knurling tool securely and set it to the centre height.
- Select the suitable speed for the knurling operation.
- Knurl the surface till a diamond shape is formed
- Chamfer 2x45° at the end.
- Reverse and hold the job in the chuck and true the job.
- Face the end and maintain the length of 80 mm.
- Turn the job ∅ 25 x 50 with a side knife tool. (Use a vernier caliper for measuring dimensions.)
- Chamfer to 2x45° at the end with a 45° chamfering tool.
- Deburr all sharp edges.

Remember

- Avoid overhanging of the tool.
- Use aluminium pieces for packing, to avoid marks on the knurled surface.

Safety precautions

- Never operate a lever when the machine is in motion.
- Do not keep any tools on the moving parts of the machine.
- Use a suitable coolant.

1	Ø45 - 85	–	Fe 310	–	–	1.7.100
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	KNURL THE JOB	TOLERANCE : ± 0.04mm	TIME :
		CODE NO. FI20N17100E1	

Skill Sequence

Knurling on lathe

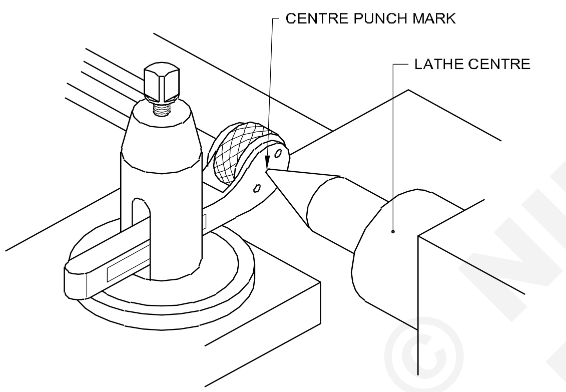
Objectives: This shall help to you
- **prepare the work for knurling**
- **set the speed for knurling**
- **set the knurling tool in the tool post**
- **knurl the job using the required grade of knurl.**

For better grip and for a good appearance on cylindrical surfaces, a portion of the component is knurled. The procedure of knurling, in sequence, is as follows.

Reduce the diameter of the portion to be knurled depending upon the grade of knurl and material of the job. Reduce 0.1 mm for fine knurling, 0.2 mm for medium knurling and 0.3 mm for coarse knurling approximately.

Set the knurling tool in the tool post and align with the centre or tail stock (Fig 1)

Fig 1

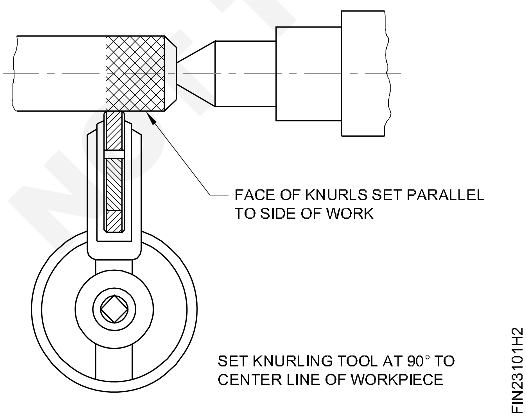


SETTING THE KNURLING TOOL ON CENTRE

Set the machine for a low speed, preferably 1/3 to 1/4 of the turning speed. Mark off the length to be knurled.

Adjust the knurling tool so that it is at right angles to the axis of the work; tighten it firmly. (Fig 2)

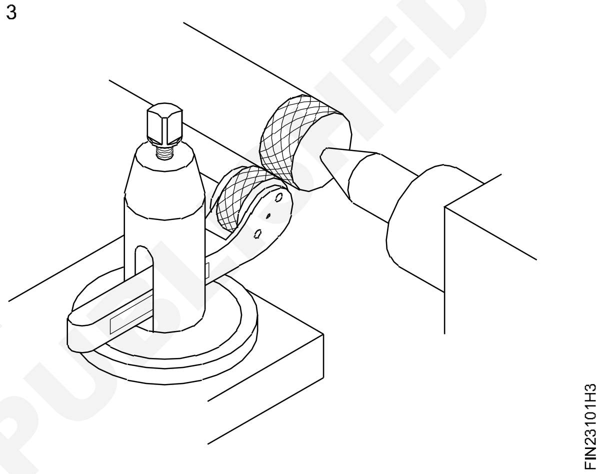
Fig 2



Feed the knurl and make the knurls to contact the work periphery by the cross-slide hand wheel.

Move the carriage until about the face of the knurling roll overlaps the end of the workpiece which helps to produce a true pattern.(Fig 3)

Fig 3



Start the lathe and feed the knurling tool into the work by the cross-slide.

Stop the lathe and reset the knurling tool, if necessary.

Feeding the knurl into the workpiece, before it is rotated, may damage the knurl.

Move the knurling tool longitudinally with a uniform movement by the carriage hand wheel up to the required length of the work to be knurled.

Give the depth by the cross-slide without drawing the tool back. Feed the knurling tool to the other end.

Until the correct pattern is obtained, do not withdraw the knurling tool back.

Ample coolant is to be applied to the workpiece being knurled. This washes away any metal particles, and provides lubrication for the knurling rolls.

Use a fine feed for knurling hard metals and a coarse feed for knurling soft metals.

Clean the knurl with a brush for subsequent cuts.

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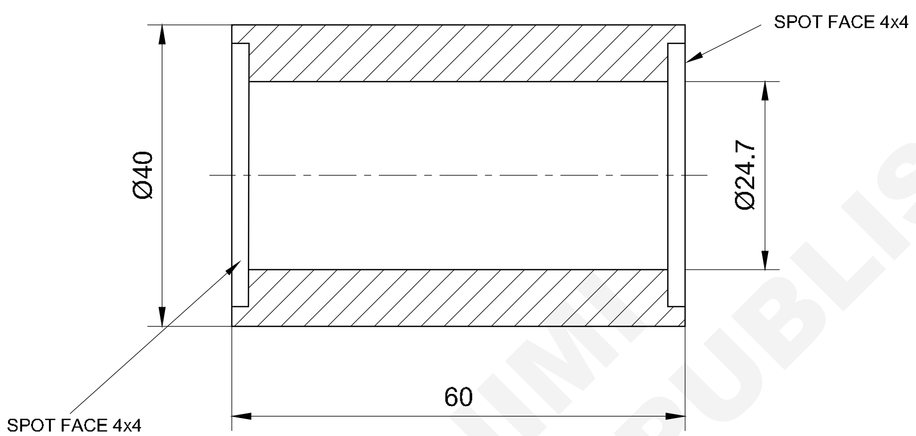
Bore holes - spot face, pilot drill, enlarge hole using boring tools

Objectives: At the end of this exercise you shall be able to
- **drill through hole**
- **bore a hole to an accuracy of ± 0.04 mm with boring tool**
- **measure the bore by using a vernier caliper**
- **re-shapen a twist drill**
- **check the twist drill for its performance**
- **spot face the end of bored hole.**



Job Sequence

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

1	Ø45 - 65	–	Fe 310	–	–	1.7.101
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	BORE HOLES - SPOT FACE, PILOT DRILL, ENLARGE HOLE USING BORING TOOLS.	TOLERANCE : ± 0.04mm	TIME :
		CODE NO. FI20N17101E1	

- Make spot face by boring tool 4x4 mm

Safety precautions

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

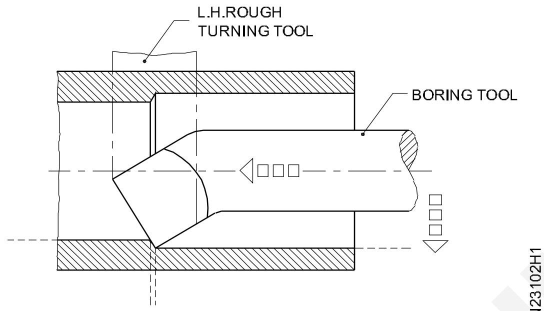
Skill Sequence

Boring a drilled hole

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

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

Fig 1



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

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

Set the lathe to the proper spindle speed for boring.

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

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

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

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

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

Choose a proper feed for rough boring.

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

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

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

Fig 2

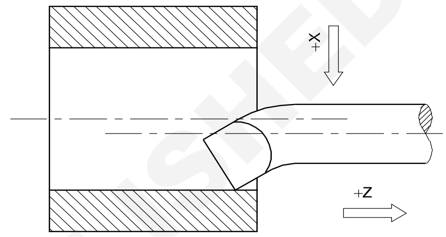
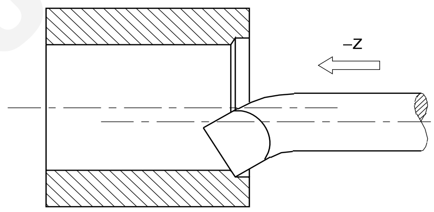


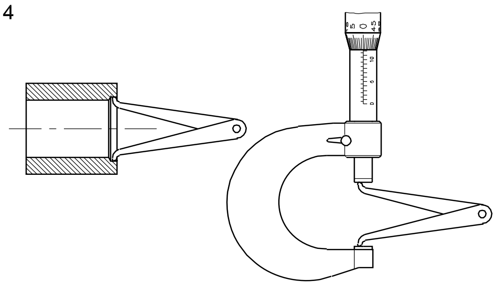
Fig 3



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

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

Fig 4



Leave about 0.5 mm undersize for a finish cut.

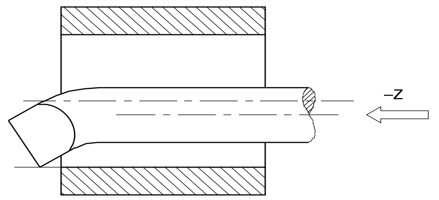
Take a roughing cut for the required length. (Fig 5)

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

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

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

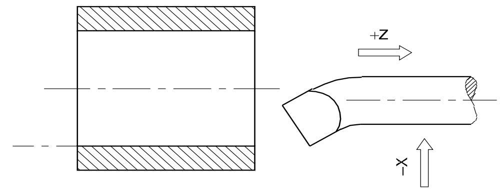
Fig 5



Use the cross-slide graduated collar.

Finish the boring operation and measure with a vernier caliper.

Fig 6



To avoid bell mouth, repeat the same cut.

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

Remove the sharp corners.

Inside caliper & outside micrometer used for bore measurement

Objective: This shall help you to
- **take the measurement of a bored hole with an inside caliper, transfer it to an outside micrometer and read the measurement.**

Bores are checked for their dimensional accuracy by using:

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

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

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

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

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

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

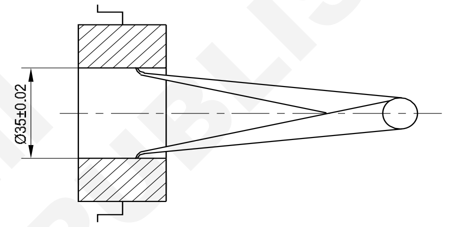
Position one leg in contact with the bottom of the bore.

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

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

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

Fig 1



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

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

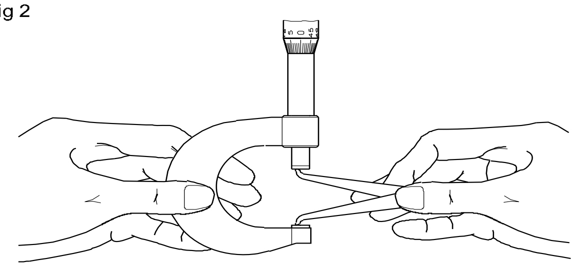
Ensure that the position of the legs is not disturbed, once the correct feel is obtained.

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

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

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

Fig 2



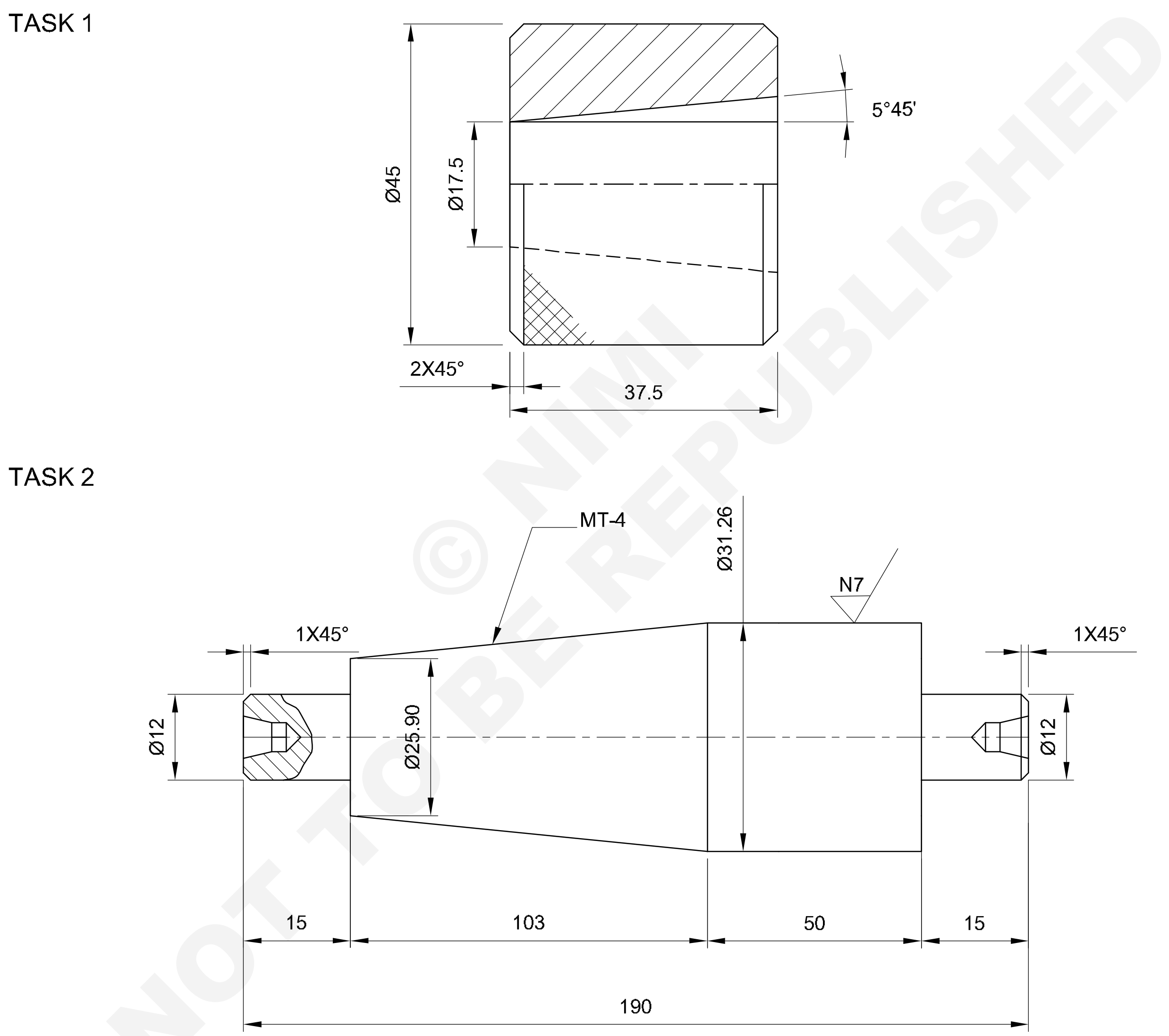
Ensure you get the same 'feel' as before.

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

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

Turn taper (internal and external)

Objectives: At the end of this exercise you shall be able to
- **hold the work in between centres**
- **produce taper bore by compound slide**
- **set the compound rest to the specified angle**
- **turn the external taper by the compound rest method**
- **check the taper with a vernier bevel protector.**



1	Ø50 - 45		Fe 310		TASK 1	
1	Ø36 - 200	–	Fe 310	–	TASK 2	1.7.102
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	TURN TAPER (INTERNAL AND EXTERNAL)	TOLERANCE : ± 0.04mm	TIME :
		CODE NO. FI20N17102E1	

Job Sequence

TASK 1: **Taper turning internal**

- Hold the job in a 4 jaw chuck and true it.
- Set the tool to correct centre height.
- Face one end of the job.
- Turn ∅ 45 mm to a length of 45 mm.
- Drill pilot hole ∅ 16 mm by drilling
- Chamfer 2x45°.
- Set the parting tool to centre height and cut off to a length of 40 mm.
- Hold the knurled job and face the ends to maintain a length of 37.5 mm.
- Chamfer the end to 2x45°.
- Set the compound rest to the 5° 45' with the help of a vernier bevel protractor.
- Set the boring tool, to the correct centre height.
- Turn taper as per drawing.
- Match the taper.

Safety precautions

- Remove all sharp comers.
- Use slow speed while knurling.
- Use plenty of coolant while drilling, taper turning and knurling.

— — — — — — —

TASK 2: **Taper turning external**

- Check the raw material size.
- Hold the job in between centres.
- Turn the step Ø12 x 15 mm long at the taper end.
- Reverse and refit between centres.
- Turn the step Ø 12 x 15 mm long from the other end of job.
- Calculate the setting angle of the compound rest using the formula
- Swivel the compound rest slide to the above angle using a vernier bevel protractor.
- Turn the taper by using the top slide feed and maintain the major dia. to 31.26 mm. minor dia to 25.90 mm and length to 103 mm.
- Check the size of the job with a vernier bevel protractor and vernier caliper.

Skill Sequence

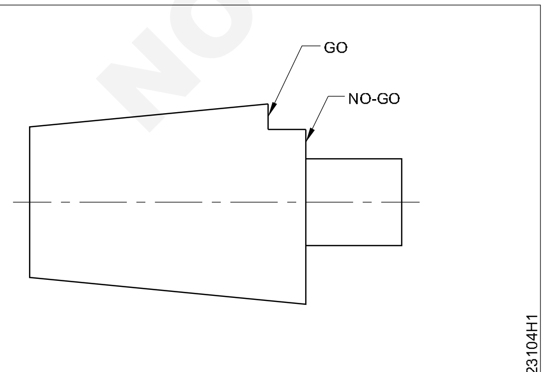
Checking a tapered bore using a taper limit plug gauges

Objective: This shall help to you
- **check the internal taper with taper plug gauge.**

A taper limit plug gauge ensures the accuracy of the angle and the linear dimensions of the taper bore. (Fig 1)

Clean the tapered bore.

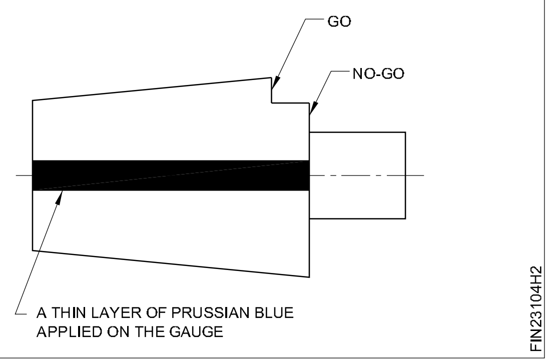
Fig 1



TAPER LIMIT PLUG GAUGE

Apply a thin layer of prussion blue on the traper limit plug gauge along its length. (Fig 2)

Fig 2

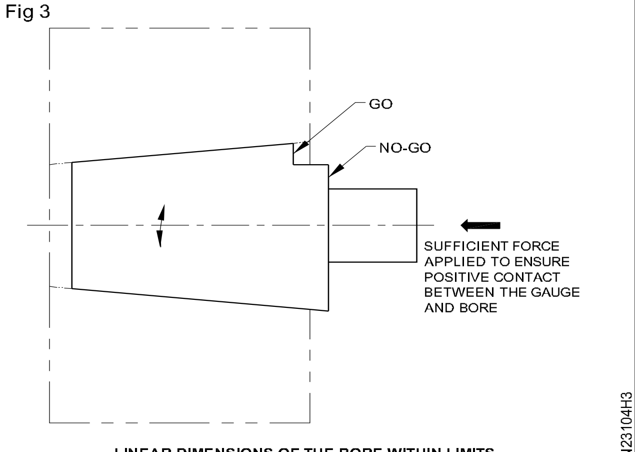


Assemble the taper plug gauge inside the tapered bore carefully with sufficient force to ensure positive contact between the gauge and the bore, and give one quarter twist to the plug gauge.

Carefully remove the taper limit plug gauge and check if the prussion blue is rubbed off uniformly, atleast to about 75% of its area. This ensures the accuracy of the angle required.

Then once again insert the taper plug gauge inside the taper bore and check, if the big dia, end of the bore falls within the 'Go' and 'No-Go' limits marked on the gauge, this ensures the dimensional accuracy of this tapered bore. (Fig 3)

Fig 3



LINEAR DIMENSIONS OF THE BORE WITHIN LIMITS

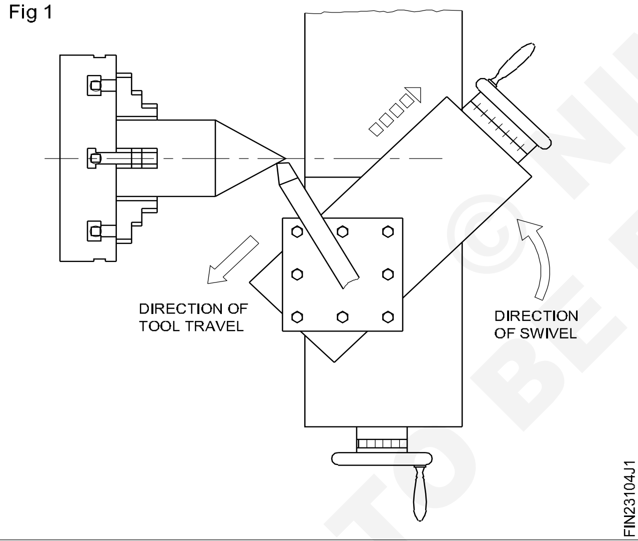
Turning taper by compound slide swivelling

Objectives: This shall help you to

- **turn the taper using a compound slide**
- **check the taper with a vernier bevel protractor.**

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

Fig 1



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

Set the machine to the required rpm.

Loosen the top slide clamping nuts.

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

> **Ensure that equal pressure is exerted by the spanner for both the nuts.**

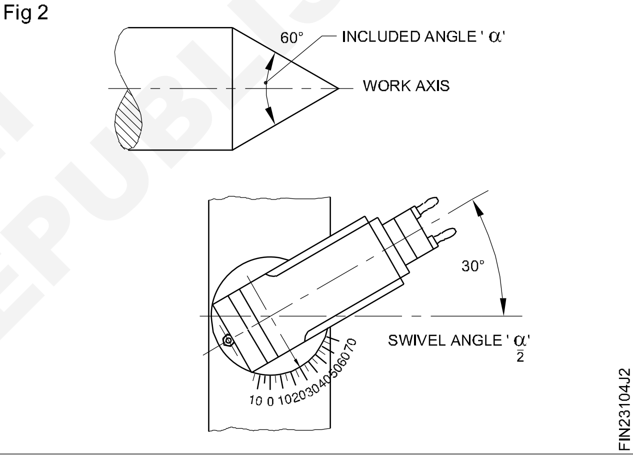
Fix the turning tool in the tool post to the correct centre height.

Keep a minimum overhang of the tool.

Set the top slide to the rearmost position.

Position the saddle such that the tool is able to cover the full length of the taper to be turned.

Fig 2



Ensure that the top slide does not travel beyond the edge of the base.

Lock the carriage in position.

Touch the tool to the work - surface during running and set the cross-slide graduated collar to zero.

Bring the tool to clear off the work by the top slide hand wheel movement.

Give a depth of cut by the cross-slide and feed the tool by the top slide hand wheel till the tool clears from the work.

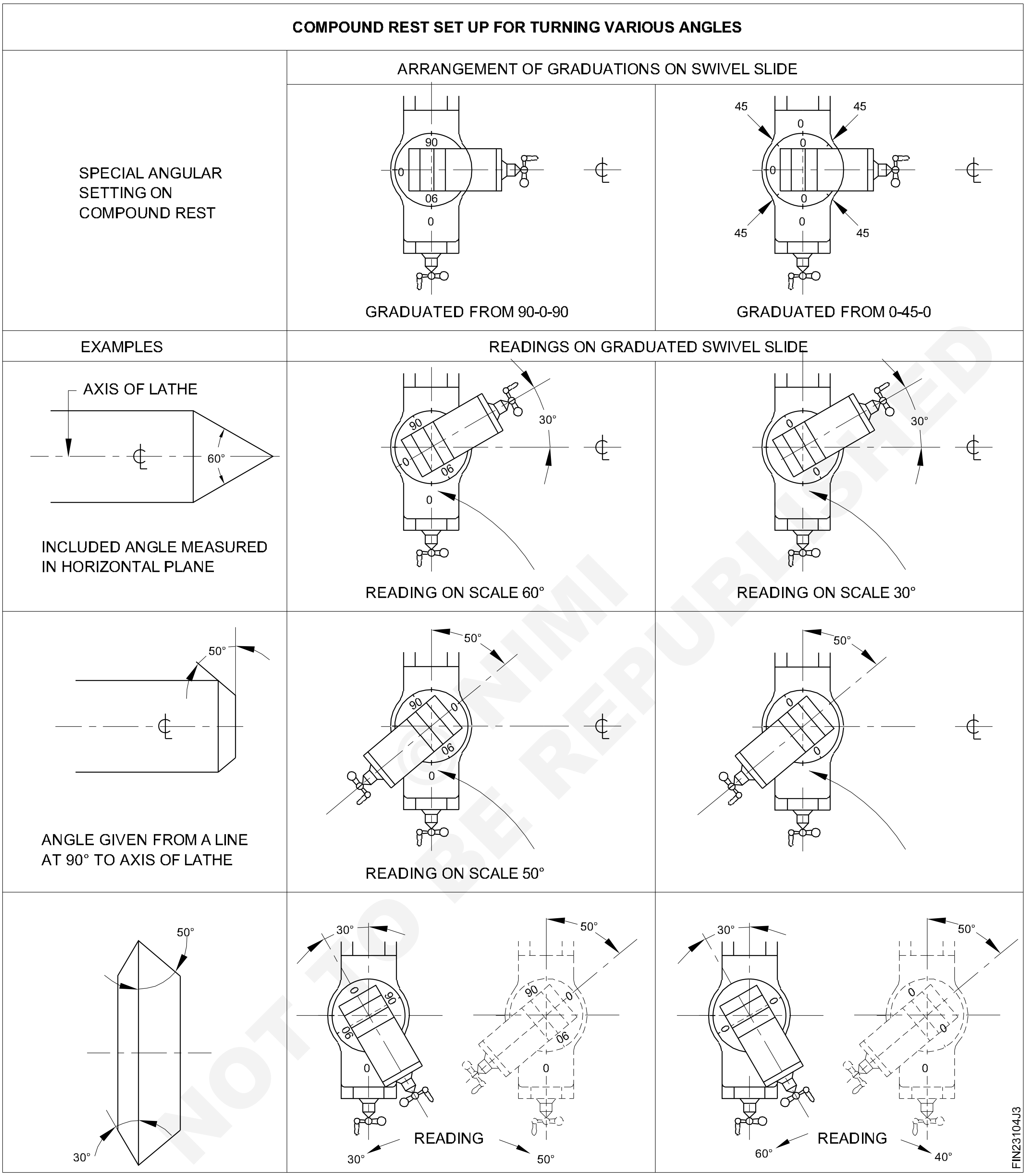
> **Feeding by the top slide must be uniform and continuous.**
>
> **Give successive cuts by the cross-slide and feed the top slide each time.**

Check the angle of the turned job with a 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 angles



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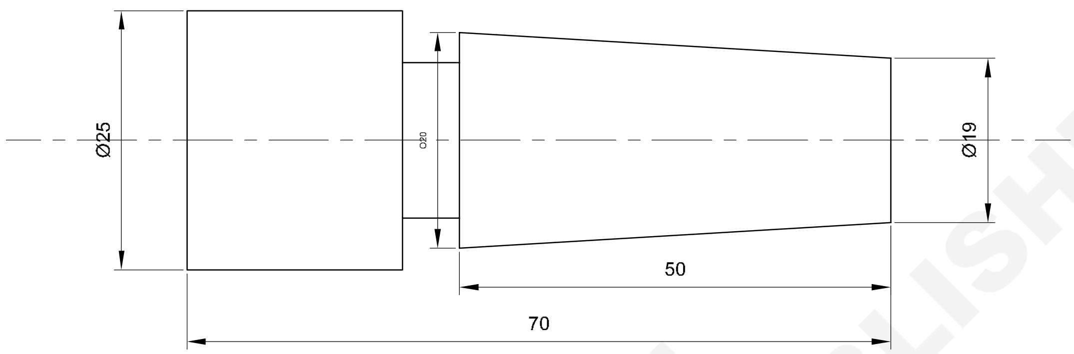
Turn taper pins

Objectives: At the end of this exercise you shall be able to
- **set the job on a four jaw chuck**
- **set the tool in the tool post**
- **set the taper turning attachment to the required angle**
- **turn the job in diameter 1:50 taper ratio.**



Job Sequence

- Check the raw material size.
- Set the job on a four jaw chuck.
- True the job
- Turn the job ∅ 20 mm up to the length of 55 mm
- Calculate the compound rest setting angle the 1:50 taper.

$$\frac{\text{opposite side}}{\text{adjacent side}} = \text{Tan}\,\varphi$$

$$\frac{1}{50} = \text{Tan}\varphi$$

$$0.02 \quad = \text{Tan}\,\varphi$$

$$\text{Tan}^{-1}.002 = 1.14°$$

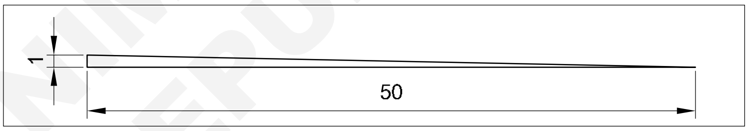
convert 0.14 degrees= minute

$$1° = 60^1$$

$$0.14 = x$$

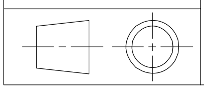
$$x = \frac{0.14x60}{1} = 8.4^1$$

$$\text{settingangle} = 1°,8^1$$



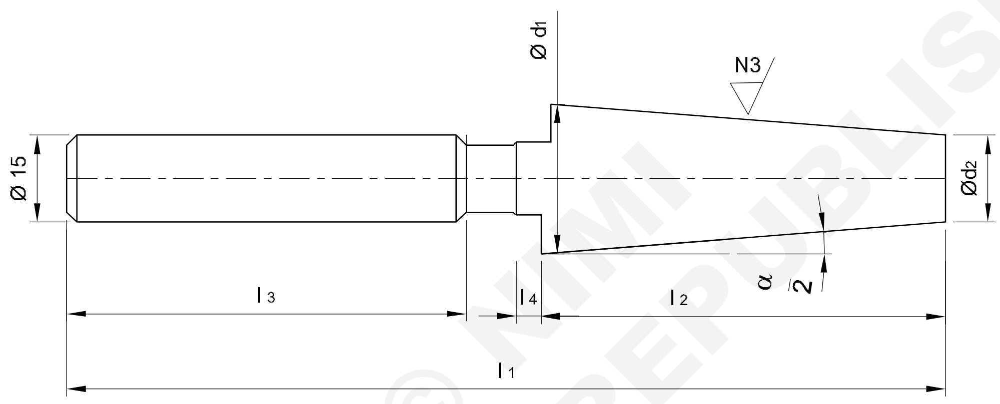
- Set the angle in compounds slide
- Turn the diameter taper ration of 1:50
- Check the diameter of both end as ∅ 20 and ∅ 19
- Set the parting tool
- Feed the cut and remove the length of 50 mm.

1	Ø25 - 75	–	Fe 310	–	–	1.7.103
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	TURN TAPER PINS	TOLERANCE : ± 0.04mm	TIME :
		CODE NO. FI20N17103E1	

Turn standard tapers to suit with gauge

Objectives: At the end of this exercise you shall be able to
- **set the job on a four jaw chuck**
- **set taper turning attachment to turn taper**
- **set the tool in the tool post**
- **turn standard taper MT3**
- **check the taper with gauge.**



DESIGNATION OF TAPER	d_1 js5	d_2	l_1	l_2 js8	l_3	l_4	Z ±0.05	$\frac{\alpha}{2}$	AT_D µm
MT3	23.825	17.5	176	81	80	5	1.0	1°26'16"	+5.1

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

1	Ø25 - 180	–	Fe 310	–	–	1.7.104
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	TURN STANDARD TAPERS TO SUIT WITH GAUGE	TOLERANCE ± 0.04mm	TIME :
		CODE NO. FI20N17104E1	

Job Sequence

- Set the job in four jaw chuck projecting [(l_1 - l_2 + 10 mm)] outside the chuck.
- True it by universal surface gauge.
- Set the carbide tip tool to the correct centre height for facing with offset facing tool.
- Set offset side cutting tool for turning.
- Set the spindle speed as per the cutting speed chart.
- Face the one end.
- Turn dia 15mm for a length equal to (l_1 - l_2).
- Form grooving, after leaving l_3 from the end and maintain dia.
- Chamfer the two ends of ∅ 15 to 1x45°.
- Reverse the job and hold turned dia 15mm by giving aluminium/copper sheet as a packing.
- True the job by using surface gauge.
- Face the end to maintain a length of l_1 .
- Turn dia d1 and check by using vernier micrometer.
- Set the taper turning attachment to turn a taper of 1°26'16".
- Turn taper MT3 and check the dimensions as per the drawing by using vernier micrometer and vernier bevel protractor.
- Check the taper with gauge.

Skill Sequence

Producing taper by using taper turning attachment

Objectives: this shall help you to
- **set the taper turning attachment to the required angle**
- **produce taper by using a taper turning attachment.**

A taper turning attachment provides a quick and accurate means of turning tapers.

The following procedure is to be followed during turning taper using a taper turning attachment.

Check for backlash between the guide bar and the sliding block, and adjust, if necessary.

Clean and oil the guide bar.

Loosen the locking screws, then swivel the guide bar to the required angle.

Tightern the locking screws.

Adjust the base plate until the ends of the guide bar are equidistant from the cross-slide extension.

Set up the cutting tool on exact centre.

Any error will result in an incorrect taper

Mount the workpiece on the chuck or between centres.

Adjust the carriage until the cutting tool is approximately opposite to the centre of the tapered section.

Lock the clamping bracket to the lathe bed to secure the taper turning attachment in this position.

When using a plain taper turning attachment, follow the steps given below at this stage.

Adjust the top slide so that it is parallel with the cross-slide, i.e at 90° to the work.

Set up the cutting tool for the correct position.

Wear safety goggles.

Set the required r.p.m

Feed the cutting tool in until it is about 6 mm from work surface.

Remove the locking screws which connect the cross-slide and the cross -slide nut.

Use the blinding lever to connect the cross-slide extension and sliding block.

Insert a suitable plug in the hole on the top of the cross slide to protect the cross-slide screw from dirt and chips.

The compound slide must now be used to feed the cutting tool into the work.

Move the carriage to the right until the cutting tool is 12 mm away from the right hand end of the workpiece.

This removes any play in the moving parts of the taper turning attachment.

Switch on the lathe.

Take a light cut of about 2 mm long and check the end taper for size.

Set the depth of the roughing cut.

Machine the work as with plain turning.

Remove the play by moving the cutting tool 12 mm beyond the right hand end of the work at the beginning of each cut.

Check the taper for fit.

Readjust the taper turning attachment, if necessary a light cut and recheck the taper.

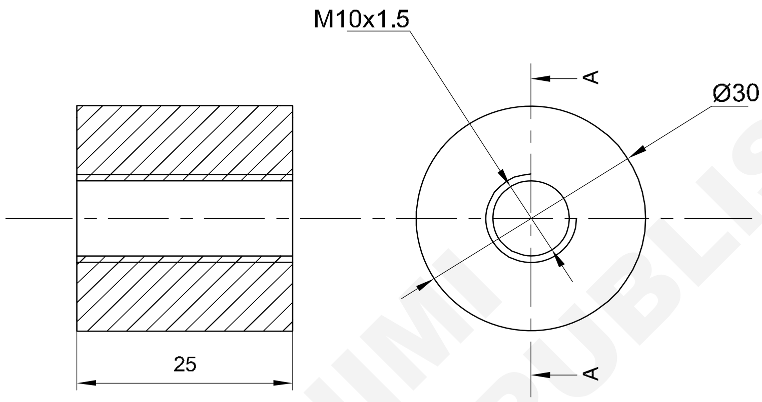
Finish the taper to size and fit it to the taper gauge.

— — — — — — —

Practice threading using taps, dies on lathe by hand

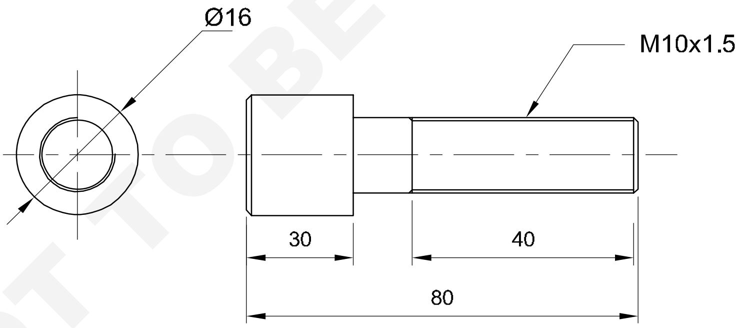
Objectives: At the end of this exercise you shall be able to
- **set the job in a three jaw chuck**
- **drill through hole**
- **cut internal thread in a lathe using tap and tap wrench**
- **set the pre machined round rod with three jaw chuck**
- **cut external thread in a lathe using die and die stock.**

TASK 1



SECTION -A A

TASK 2



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	Ø16 - 85	–	PRE-MACHINED ROUND ROD	–	TASK 2	
1	Ø30 - 30	–	PRE-MACHINED ROUND ROD	–	TASK 1	1.7.105

SCALE 1:1	PRACTICE THREADING USING TAPS,DIES ON LATHE BY HAND	TOLERANCE : ± 0.04mm	TIME :
		CODE NO. FI20N17105E1	

Job Sequence

TASK 1:

- Check the raw material size.
- Hold the job in a 3 jaw chuck
- Turn and finish out side dia meter and length
- Centre drill and drill ∅ 8.5 mm for M10
- Chamfer the drilled hole on both sides.
- Fix the tap wrench to the square end of first tap
- Place the first tap taper lead in hole and support other end with tail stock dead centre.
- Form thread by first tap, second tap and third tap one by one by hand rotate clock wise slowly and half rotation to release chips till you get the full formation of internal thread.
- Apply oil and clean burrs
- Check the thread hole by M10 bolt.

— — — — — — —

TASK 2:

- Check the raw material for its size.
- Hold the job in a 3 jaw chuck
- Turn the job for blank size of ∅ 9.85 mm to 50 mm length
- Chamfer the end of the job.
- Hold the die parallel to job face.
- Rotate the die for a thread forward and for half thread backward with appropriate push to cut thread and remove chips.
- Increase the depth of cut gradually and cut thread to match M10 nut by adjusting the screws provided in the die stock.
- Check the thread with the matching round nut (Task 1).
- Clean the threads without burrs.
- Apply a little oil and preserve it for evaluation.

Note: The tap wrench and die stock handle must be short enough to ensure to rotate on lathe bed.

Skill sequence

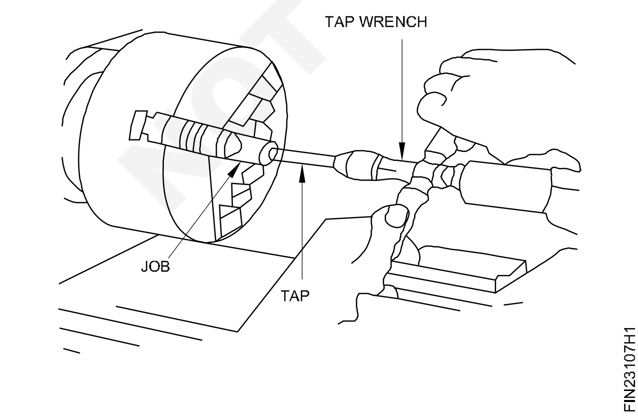
Cutting internal and external thred using

Objective: This shall help you to
- **cut internal and external thread in lathe using tap and die.**

TASK 1:

Cutting internal thread using tap and tap wrench in lathe. (Fig 1)

FIG 1



TASK 2:

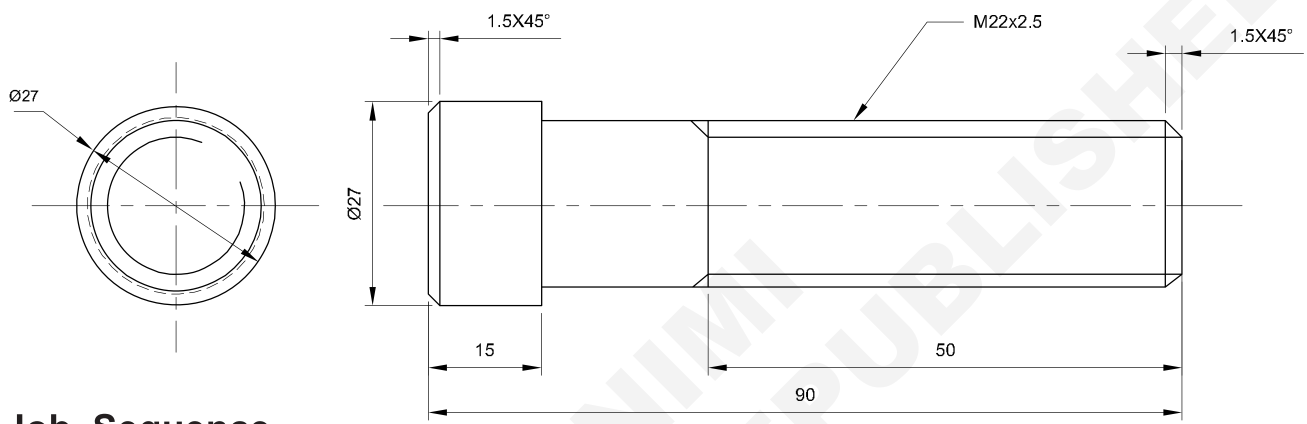
Cutting external thread using die and die stock in lathe. (Fig 2)

Fig 2

— — — — — — —

Make external 'V' thread

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



Job Sequence

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

1	Ø30 - 100	–	Fe 310	–	–	1.7.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	MAKE EXTERNAL 'V' THREAD	TOLERANCE : ± 0.04mm	TIME :
		CODE NO. FI20N17106E1	

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.

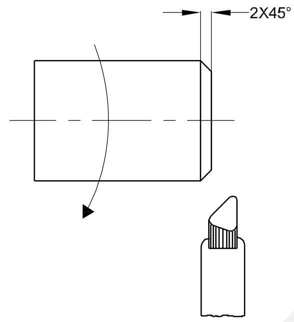
Set the speed, lock the carriage.

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



FIN23108H1

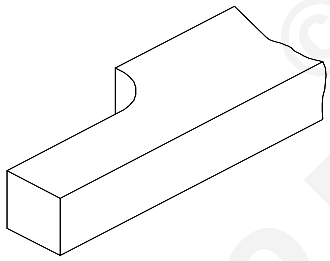
Grinding 60° threading tool

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

Set the pedestal grinder for tool grinding.

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

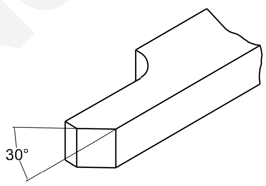
Fig 1



FIN23108J1

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

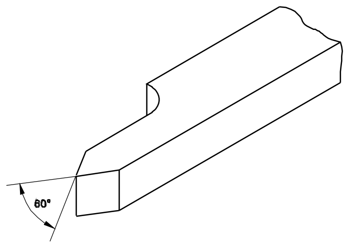
Fig 2



FIN23108J2

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



FIN23108J3

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

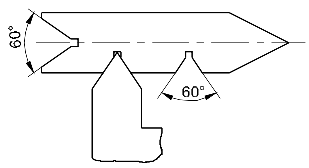
Grind 4° to 6° front clearance angle.

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



FIN23108J4

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

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

Safety precautions

Ensure grinding wheels are properly guarded.

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

Ensure cutting edge is visible to the operator while grinding.

Do not give too much pressure on the wheel face.

Frequently cool the tool in coolant.

Cutting 'V' thread by plunge cut method

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

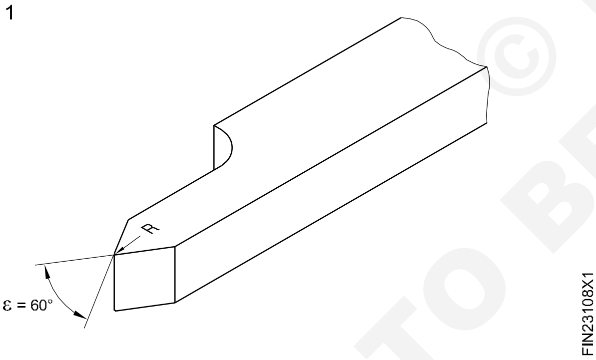
Thread has coarse and fine pitches according to their usage. Standard fine pitch threads, both external and internal, are generally cut by using taps and dies. When they are produced in large quantities, different methods are adopted on different machine tools. However, at times, it may be necessary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

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

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

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

Fig 1



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

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

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

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

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

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

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

Fig 2

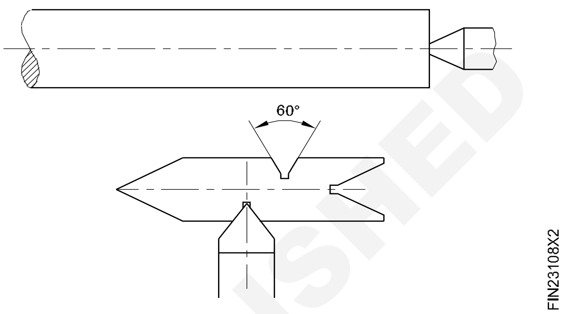
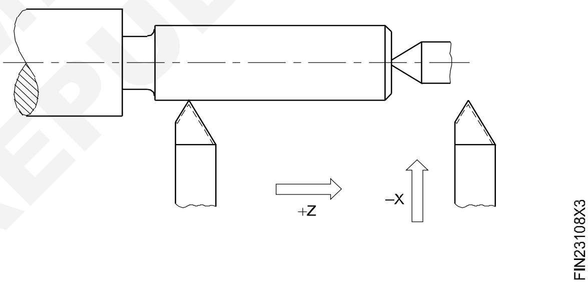


Fig 3



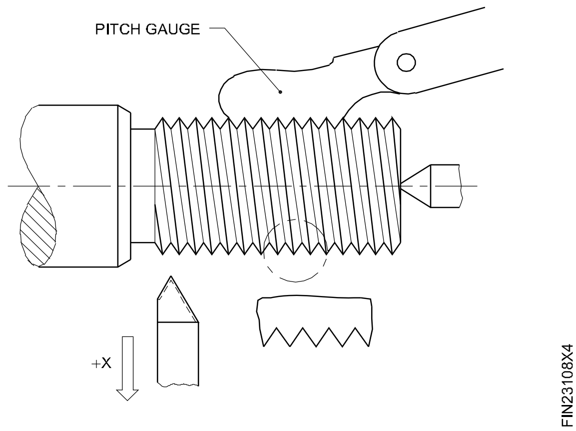
Bring the tool to the starting point and engage the half nut.

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

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

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

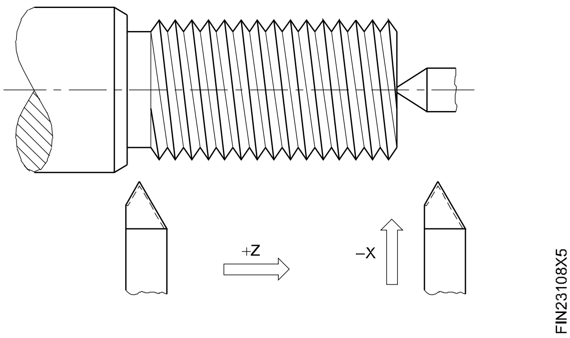
Fig 4



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

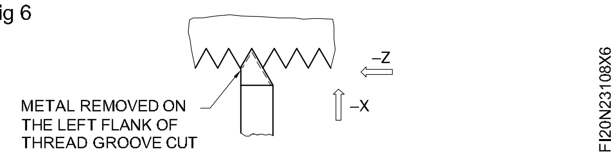
Give successive cuts.

Fig 5



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

Fig 6

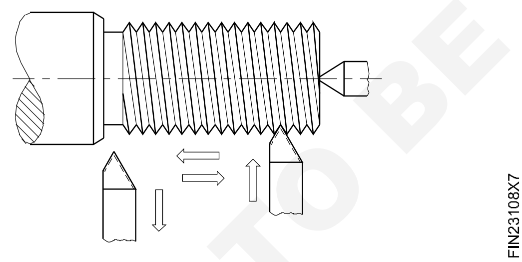


Continue the sequence till the thread profile is formed. (Fig 7)

Check with the screw pitch gauge for the thread form.

Match the mating component to ensure the class of fit.

Fig 7



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

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

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

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

Fig 8

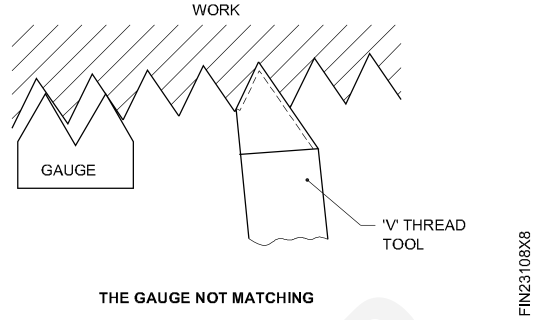


Fig 9

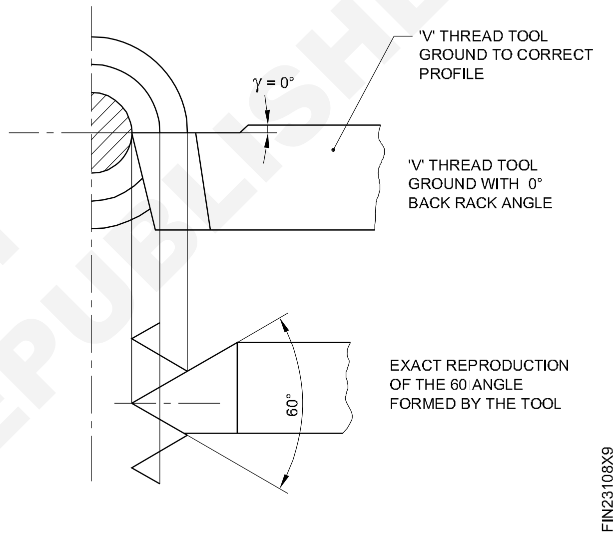
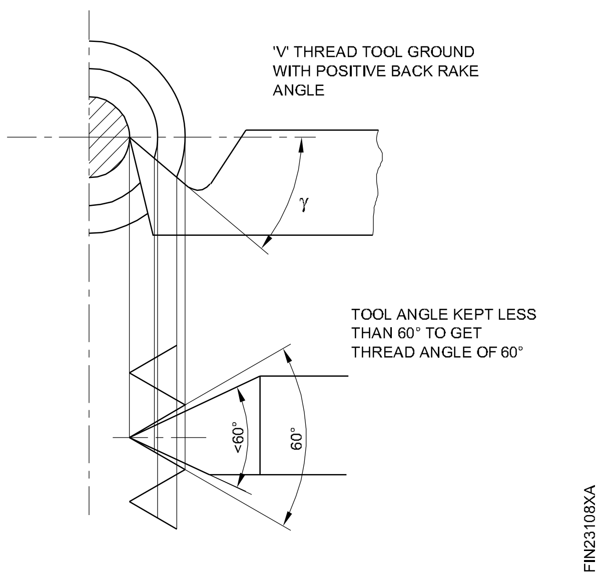
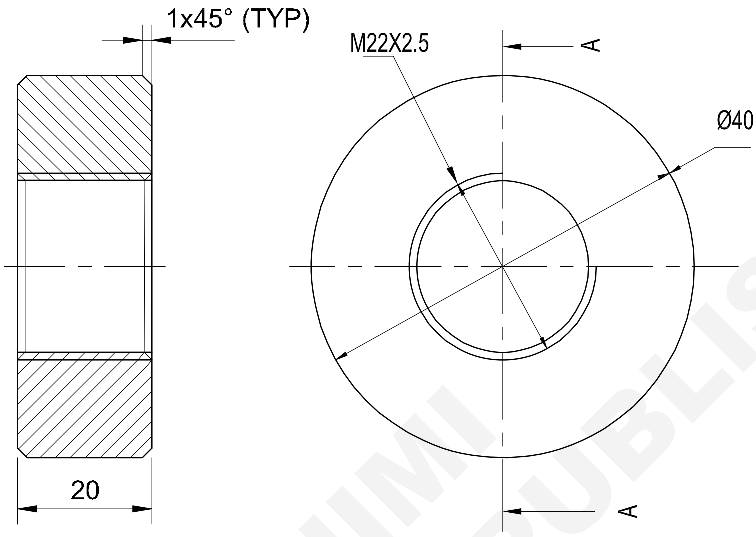


Fig 10



Prepare a nut and match with the bolt

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



SECTION - AA

Job Sequence

- Check the given material for its size by steel rule.
- Hold the work in a three jaw chuck about 10 mm inside the chuck.
- Turn the outer dia to 40 mm to possible length.
- Chamfer the edge 1x45° by chamfering tool.
- Centre drill, and drill a pilot of ∅ 10 mm through hole.
- Enlarge the drilled hole dia 10 mm ∅ 18 mm by drilling.
- Bore the drilled hole to the core (root) diameter of the thread i.e.19.2 mm.
- Set the machine to cut 2.5 mm pitch internal thread.
- Cut the internal thread.
- Check the thread with screw pitch gauge.
- Check the thread with external thread mating parts Ex.106
- Reverse and hold the work on ∅ 40 mm and true it.
- Face the end of the work, and maintain a total length of 20 mm.
- Chamfer 1x45° on the outer edge.
- Remove the sharp edges and have a final check.

1	Ø45 - 25	–	Fe310	–	–	1.7.107
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PREPARE A NUT AND MATCH WITH THE BOLT	ACCURACY ±0.04mm	TIME:
		CODE NO. FI20N17107E1	

Skill Sequence

Cutting an internal thread

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

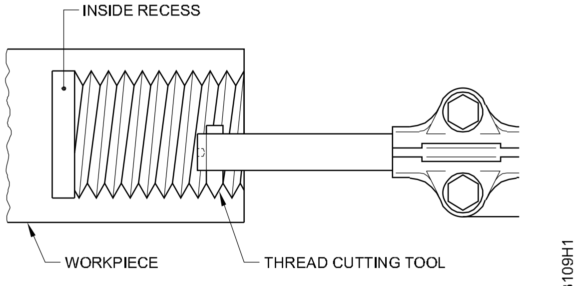
Mount the job on four jaw chuck / three jaw chuck/ collet.

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

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

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

Fig 1

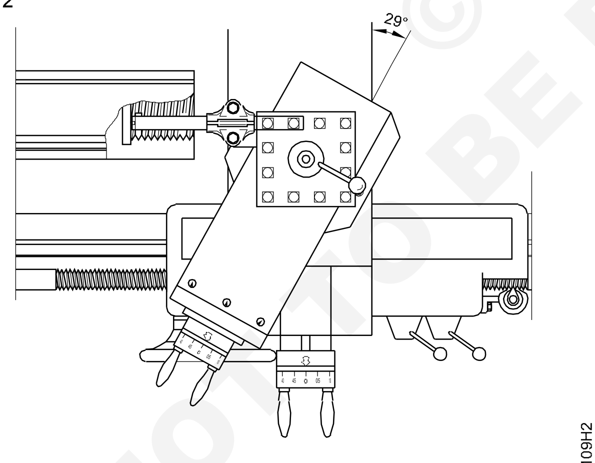


CUTTING AN INTERNAL THREAD

Chamfer the front end to 2×45°.

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

Fig 2



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

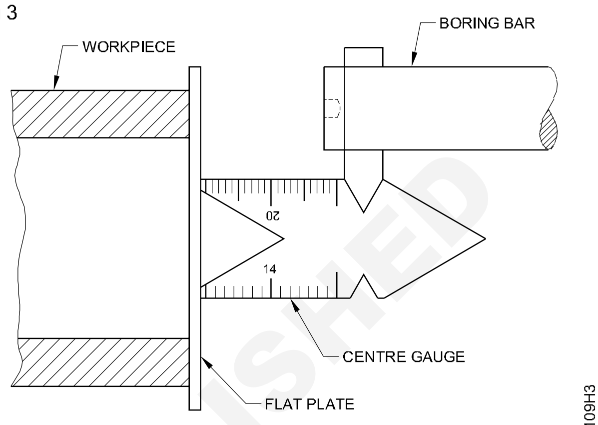
Set the gear box levers to the required pitch.

Fix the correctly ground threading tool in a boring bar.

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

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

Fig 3



ALIGNING THE CUTTING TOOL WITH A CENTRE GAUGE

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

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

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

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

Withdraw the cutting tool from the bore.

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

Start the machine.

Adjust the depth of cut to 0.1 mm.

Engage the half nut.

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

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

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

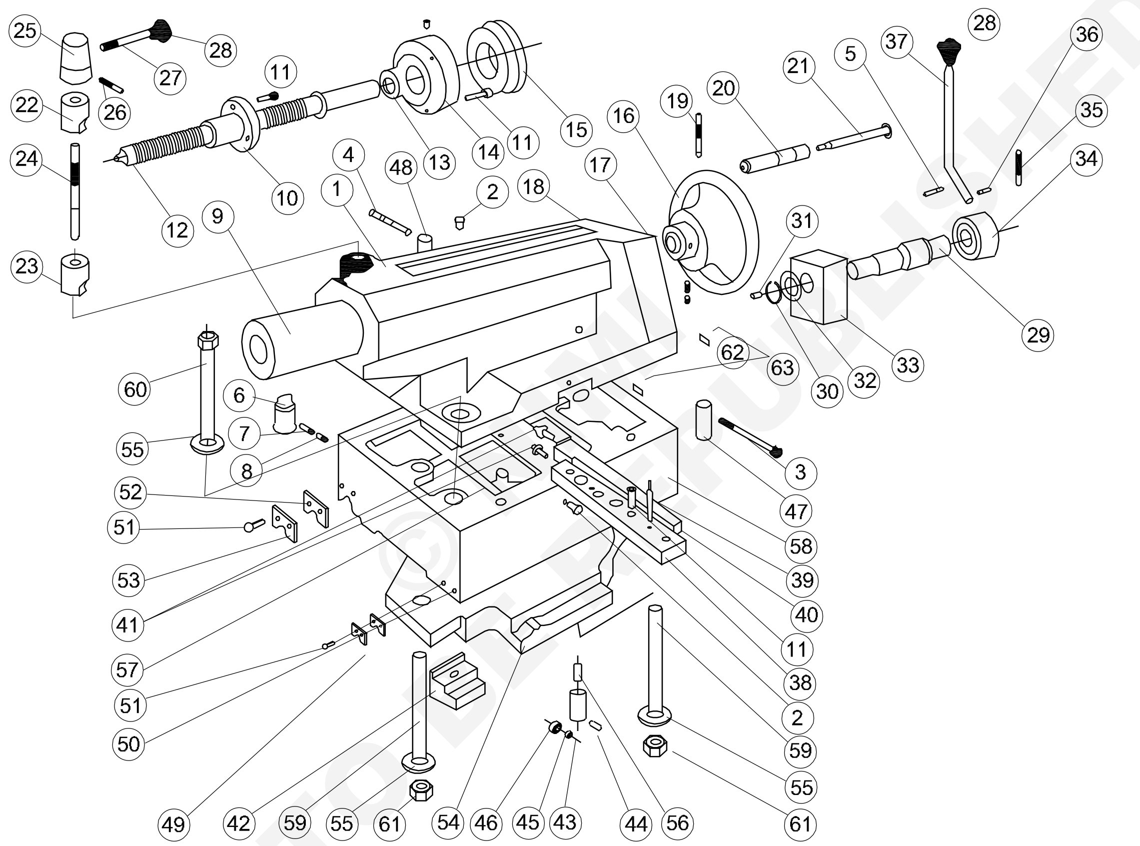
Give the depth of cut and run the machine in forward direction. Similarly finish the thread until final depth is achieved.

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

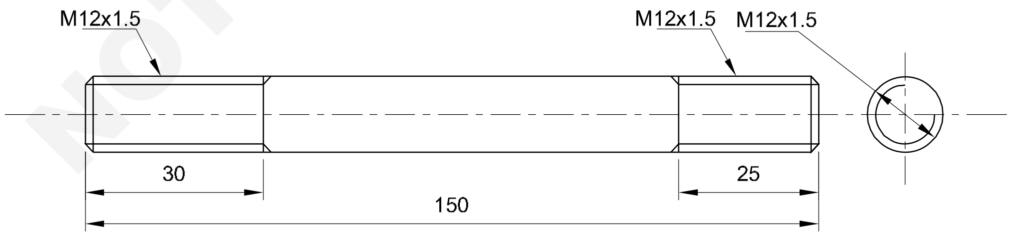
Simple repair work - simple assembly of machine parts from blue prints

Objectives: At the end of this exercise you shall be able to
- **identify the defects in tail stock assembly**
- **dismantle the tail stock assembly**
- **identify the defective/worn out parts**
- **prepare the defective parts**
- **assemble in the tail stock**
- **check the tail stock performance.**

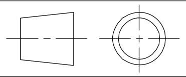
TASK-1 DISMANTLE THE TAIL STOCK AND KEEP THE PARTS IN A SEPARATELY AND IDENTIFY THE DAMAGED WORNOUT PARTS



TASK-2 PREPARE A NEW SCREW ROD INSTEAD OF WORNOUT SCREW ROD



1	Ø14-155	SCREW ROD	Fe310	TAIL STOCK REPAIR WORK	24	1.8.108
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**SIMPLE REPAIR WORK:SIMPLE ASSEMBLY OF MACHINE PARTS FROM BLUE PRINTS**	DEVIATIONS ±0.04 mm	TIME
		CODE NO. FI20N18108E1	

Job Sequence

Identification of defects in a tail stock

- Identify defect in a tail stock.
- Rotate the tail stock hand wheel for moving the spindle.
- Lock the spindle using the locking lever.
- Rotate the tail stock hand wheel and check the spindle movements and locking position. If the spindle is not locked properly it will move.
- Hence, it is known as screw rod spindle lock is not working properly.
- Dismantle the spindle locking unit from the tail stock.
- Prepare the new screw rod instead of defective screw rod.
- Assemble the prepared screw rod instead of wornout screw rod.
- Check the tail stock performance and lock the spindle in the proper position.

Tailstock

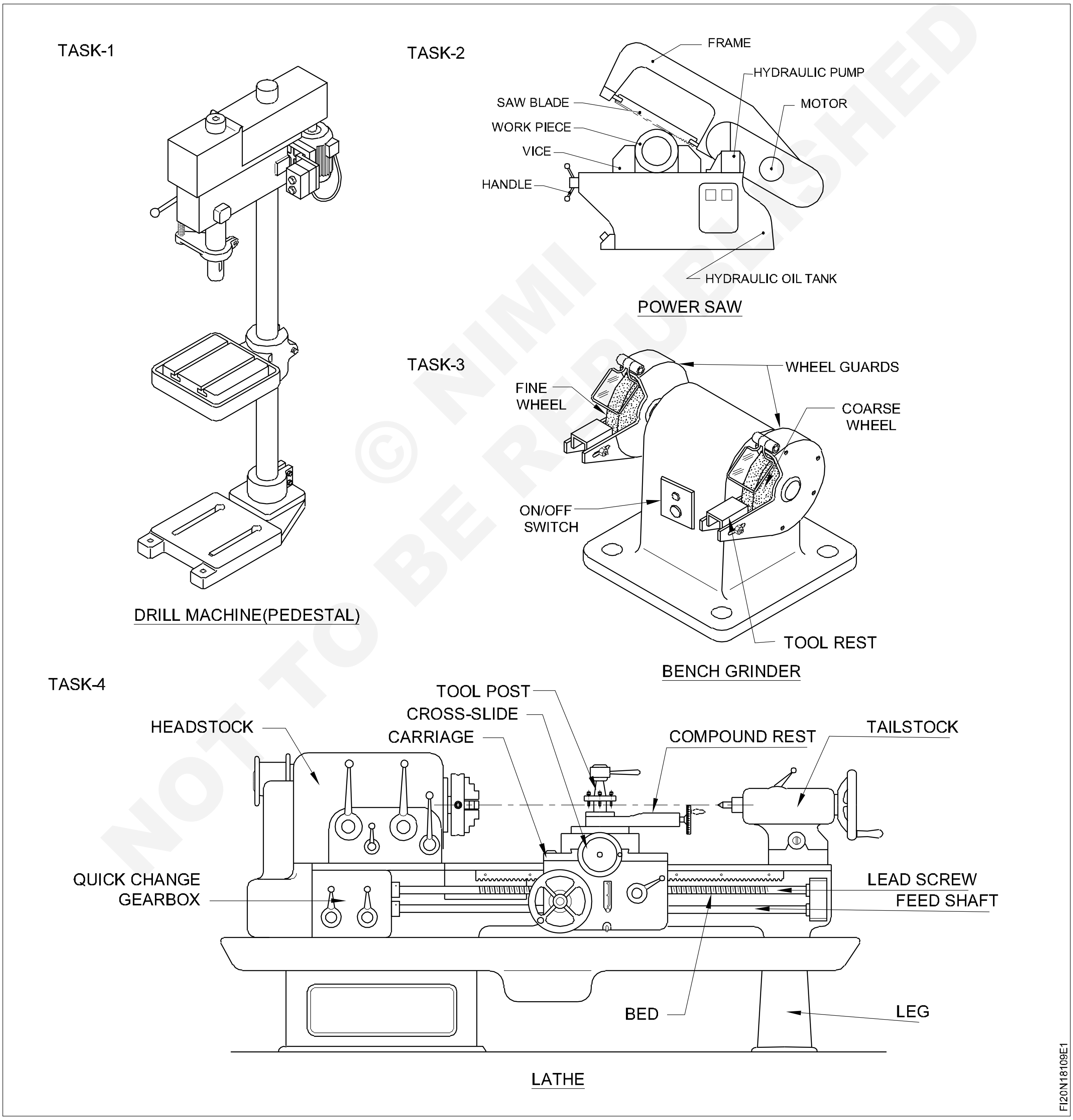
Group Assembly Drawing

No.On DRG	Qty/Group	Description	Size
1	1	Tailstock	
2	6	Oil nipple	C8
3	1	Hex. Soc. hd. cap. screw	M8 x 100
4	1	Hex. Soc. hd. cap. screw	M8 x 60
5	1	Cyl.pin	10 x 50
6	1	Key	
7	1	Grub Scr. 'G'	M8 x 16
8	1	Grub Scr. 'A'	M8 x 10
9	1	Sleeve	
	1	Sleeve (with tenon slot)	
10	1	Nut	
11	10	Hex. Soc. hd. cap. screw	M8 x 25
12	1	Screw	
13	1	Th. ball bearing (51205)	25/47 x 15
14	1	Flange	
15	1	Graduated collar	
16	1	Hand wheel	
17	3	Compression spring	
18	3	Steel Ball Class V	5/16" class V
19	1	Taper pin	6 x 60
20	1	Handle	
21	1	Handle rod	
22	1	Clamp piece	
23	1	Clamp piece	
24	1	Screw rod	
25	1	Cap	
26	1	Taper pin	6 x 50
27	1	Handle rod	
28	2	Knob	
29	1	Eccentric shaft	
30	1	External circlip	A 30
31	1	Cyl. plug	6
32	1	Spacer	
33	1	Clamp nut	

No.On DRG	Qty/Group	Description	Size
34	1	Cap	
35	1	Taper pin	6 x 80
36	1	Taper pin	4 x 30
37	1	Handle rod	
38	1	Tenon	
39	2	Int. Thrd. taper pin	8 x 50
40	1	Gib	
41	2	Spec. screw	
42	1	Clamp piece	
43	3	Bearing holder	
	3	Hex. soc. grub screw	M6 x 10
44	3	Spec. pin	
45	3	Needle roller bearing DL-810	8/14 x 10
46	3	Bearing bush	
47	1	Shaft	
48	1	Shaft	
49	2	Wiper	
50	2	Plate	
51	8	Slotted ch. hd. scr. ‘A’	M6 x 18
52	2	Wiper	
53	2	Plate	
54	1	Clamp plate	
55	3	Spec. washer	
56	3	Compression spring	
57	3	Spec. grub screw	
58	1	Tailstock base (For NH22)	
	1	Tailstock base (For NH26)	
	1	Tailstock base (For NH32)	M20 x 130
59	2	Stud ‘B’ (For NH22)	
	2	Stud ‘B’ (For NH26)	M20 x 170
	2	Spec stud (For NH 32)	
60	1	Hex. bolt (For NH22)	M20 x 140
	1	Hex. bolt (For NH26)	M20 x 180
	1	Hex. bolt (For NH32)	M20 x 220
61	2	Self locking nut	0, 8d x M20

Rectify possible assembly faults during assembly

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**
- **rectify the hydraulic faults in power saw**
- **dismantle and assemble the wornout grinding wheel**
- **dismantle and assemble the gib from the cross slide of lathe.**



Job Sequence

TASK 1: **Dismantle and assembly of spindle and pulley of drilling machine**

- 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 4).
- Remove the stepped 'V" pulley (part no 3) from the spindle hub.
- Remove the feather key (part no 5).
- Remove the internal circlips (part no 6) from spacer (part no 8).
- Remove the external circlip (part no 9) from the end of spindle hub (part no 4).
- Remove the spindle hub and bearings (part no 7) from spacer.

Use 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.
- Replace the worn out and damaged parts and 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

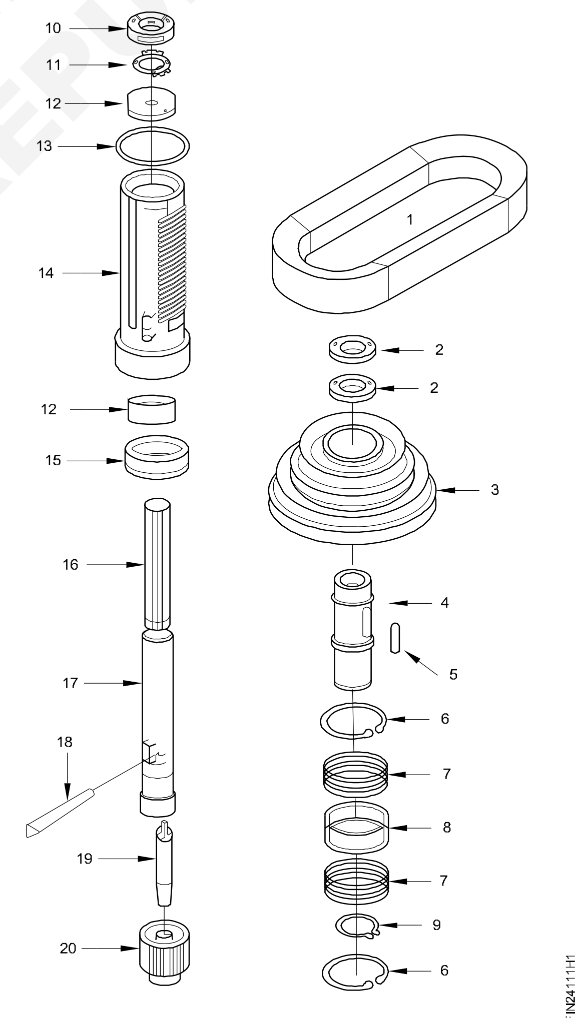
- Switch on the power supply.
- Check the run out of the spindle by using lever type dial test indicator with magnetic stand.

Table

Sl.No.	Name of the parts	Remarks
1		
2		
3		

Parts of spindle and pulley

Fig 1



- Run the machine at slow, medium and high speed atleaset 5 minutes.
- Listen if any abnormal noise hearing from spindle assembly.
- Check if any noise generating in the spindle assembly if so rectify the fault and run the machine without noise.

Parts

1 'V' Belt
2 Nut
3 Spindle pulley
4 Spindle hub (Internal splines)
5 Feather key
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

— — — — — — —

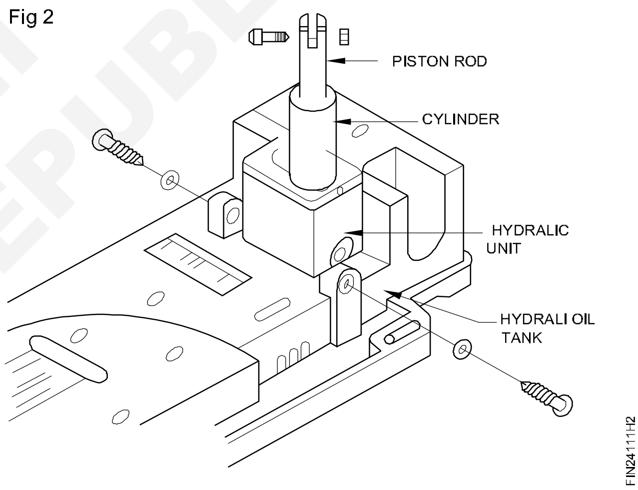
TASK 2: **Rectification of hydraulic fault in power saw**

- Switch off the machine and remove the belt guards.
- Support the arm properly.
- Drain the hydraulic oil and keep it safely.
- Remove the connecting pin/circlip/split pin and loosen the fasteners in the hydraulic unit.
- Disconnect the oil lines and remove the hydraulic unit from the m/c.
- Dismantle the hydraulic unit and keep it in a separate tray Fig 2.
- Clean all the parts and dry it.
- Inspect oil flow part with compressed air.
- Inspect the oil seal/ 'o' rings/filter control valves/ valve seat.
- Replace / repair the worn out/damaged parts.

Assemble the hydraulic unit in the reverse manner of dismantling.

- Fix unit to the machine.
- Check the condition of drained oil if contaminated fill as per manufacturers recommended grade oil.

Fig 2



- Connect the oil lines & drive system and remove the arm support.
- Trail run the machine and observe the performance.
- Check any leakage in the oil line, if found arrest them.
- Adjust the control valve and verify to arm lifting & descending performance.
- Fix the belt guards.

— — — — — — —

TASK 3: **Dismantling and assembling of a worn out grinding wheel**

- Switch-off the electrical power supply.
- Dismount the safety glass bracket.
- Remove the grinding wheel covers.
- Unscrew the nuts from the spindle of the grinding wheel.
- Remove the tool rest.
- Remove the grinding wheels from the spindle.
- Remove the belts from the motor pulley.
- Disengage the grinding wheel head unit from the main body.
- Dismantle the wheel spindle from the wheel head.

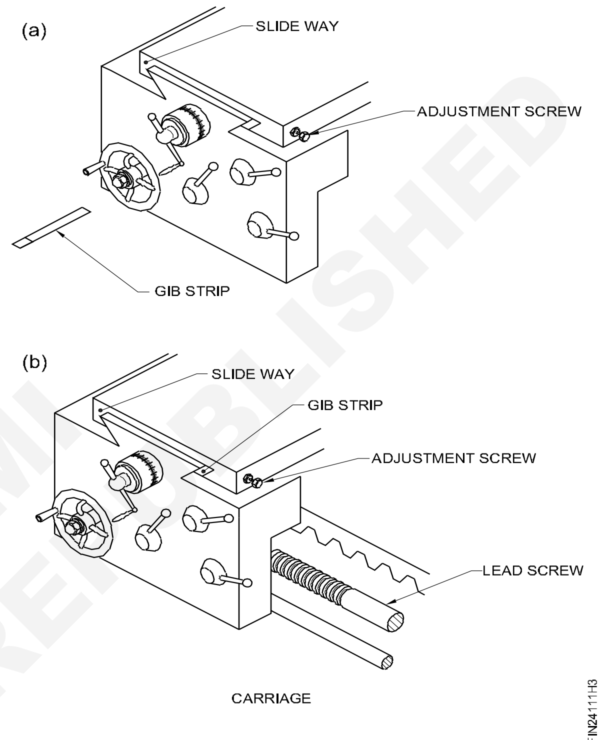
- Extract the ball bearings from the housings/spindle.
- Clean the ball bearings and other parts.
- Inspect the bearings and other parts.
- Replace the bearings, if necessary.
- Change the belts, if damaged.
- Lubricate the bearings and other parts.
- Assemble the parts in the reverse sequential order.
- Replace the grinding wheels, if necessary.
- Check the smooth running of the bench grinder.

— — — — — — —

TASK 4: **Dismantling and assembling of gib from the cross slide of a lathe**

- Remove the adjusting screws from the dovetail slide.
- Dismantle the gib from the cross slide.
- Clean the slide surfaces.
- Check and inspect all the parts.
- Damaged parts of gib strip and adjustment screws should be replaced.
- Lubricate the slide ways.
- Assemble the gib and check the gib seating.
- If you find any defects, rectify it.
- Check adjusting screws thread.
- Lubricate the slide ways of gib strip.
- Assemble slide way, gip strip with saddle.
- Tighten the adjusting screws to give the correct freedom required in the assembly.
- Lock the movement of the adjusting screw by the check - nut.
- Check the slide ways smooth movement without any shake.
- If taper gib is provided in the assembly, properly position the gib by end screws.

Fig 3



Skill Sequence

Fit a new grinding wheel -Task 3

Objective: This shall help you to
- **fit a new grinding wheel in pedestal grinding machine.**

Switch off the power supply to the machine

Clean the machine and remove any loose metal or abrasive particles.

Loosen the work rest clamp and remove the rest Fig 1.

Remove the outer plate of the wheel guard Fig 1.

The wheel clamping nut is now accessible.

Check the nut direction before loosening.

Loosen the nut using a spanner of the correct size Fig 2.

Remember that when facing the front of the machine, the spindle on the left has a left-hand thread. Turn the nut clockwise to loosen it.

Fig 1

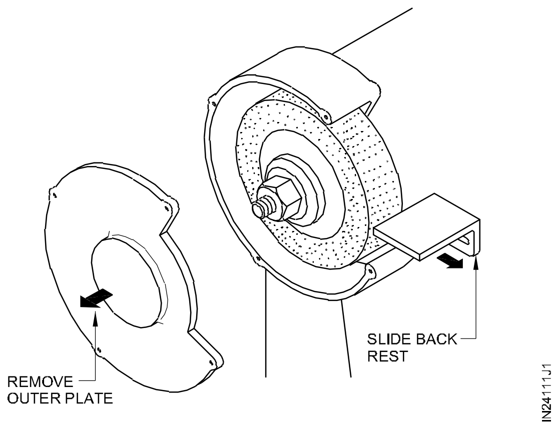
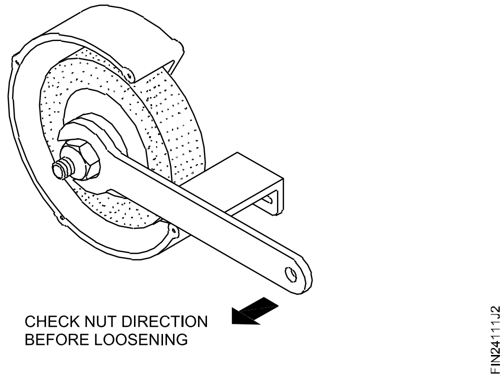


Fig 2



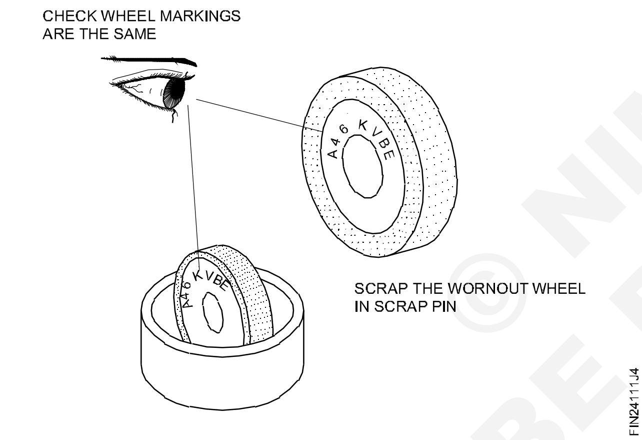
Remove the nut and the outer flange.

A light blow with a soft hammer may be needed to free it from the wheel.

Remove the worn out wheel from the spindle and place it in the scrap bin.

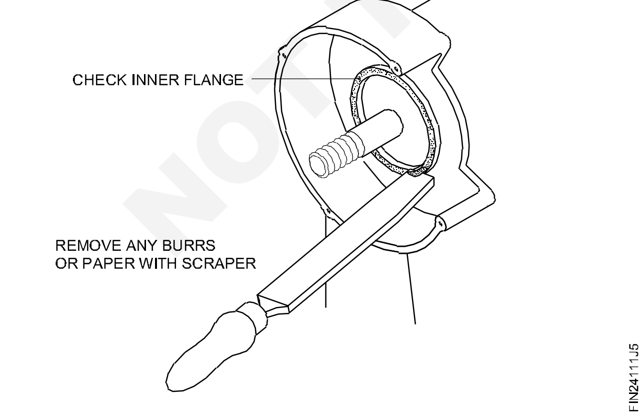
Check that the markings on the old wheel are the same as those on the new wheel Fig 3.

Fig 3



Remove any paper, washer that has adhered to the flange Fig 4.

Fig 4



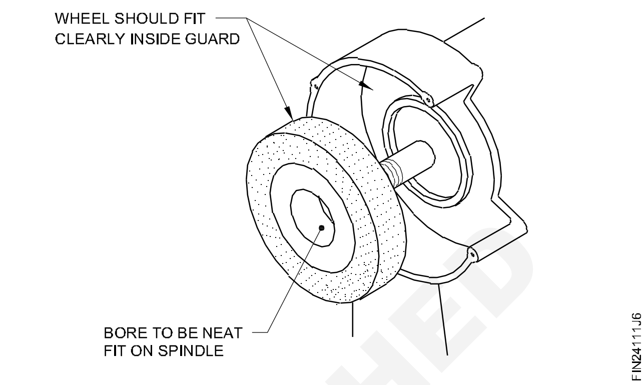
Clean the flange, spindle, thread and inside the guard.

Check that both the paper washers are intact in the new wheel.

Try the new wheel on the spindle Fig 5.

Scrape the lead bush to abstain a correct fit. The outer diameter of the new wheel should fit neatly inside the wheel guard, but with adequate clearance.

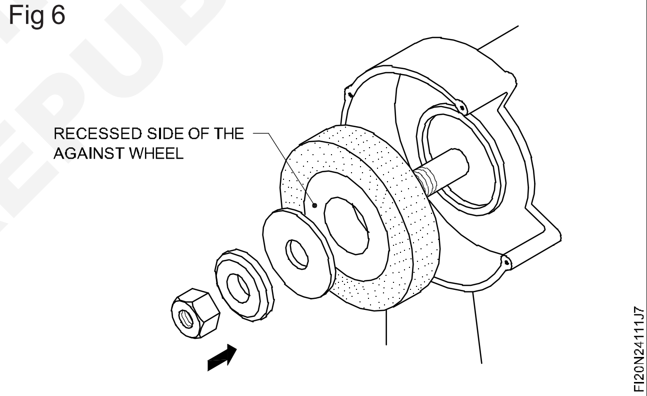
Fig 5



Push the wheel carefully against the driving flange and place the outer flange in position.

Screw up the clamping nut by hand, firmly enough to hold the wheel in position Fig 6.

Fig 6



Turn the spindle and wheel a complete revolution.

Ensure that the wheel is running true, by rotating hand and it is clear of the inner part of the guard.

Tighten the nut sufficiently enough to ensure that the flanges will drive the wheel without slipping. (Fig 7 & 8)

Fig 7

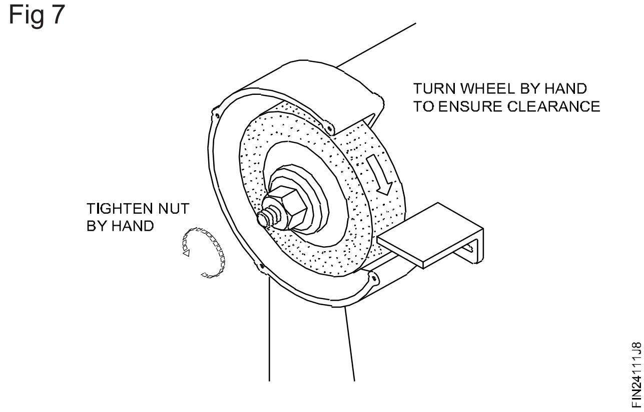
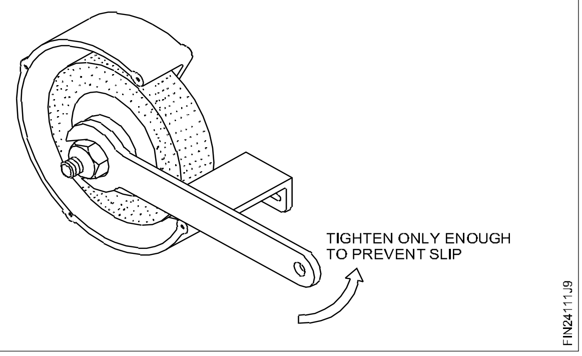


Fig 8



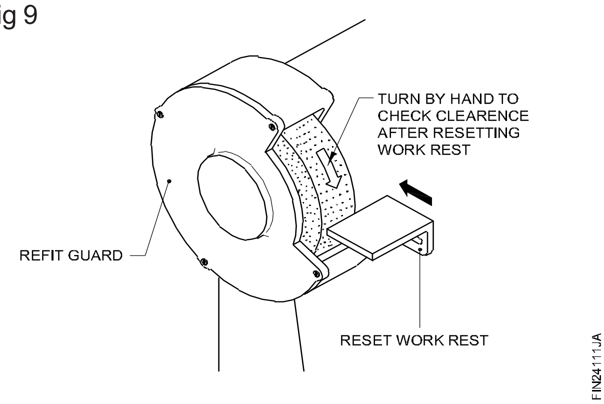
Refit the outer plate of the wheel guard Fig 9.

Reset the work rest as close to the wheel face as possible.

Tighten the work rest clamp firmly.

Rotate the wheel again by hand ensure that the wheel runs freely and true.

Fig 9



(Switch on the power supply and start the machine).

Allow the wheel to operate for one minute at full operating speed.

The machine is now ready for grinding operations.

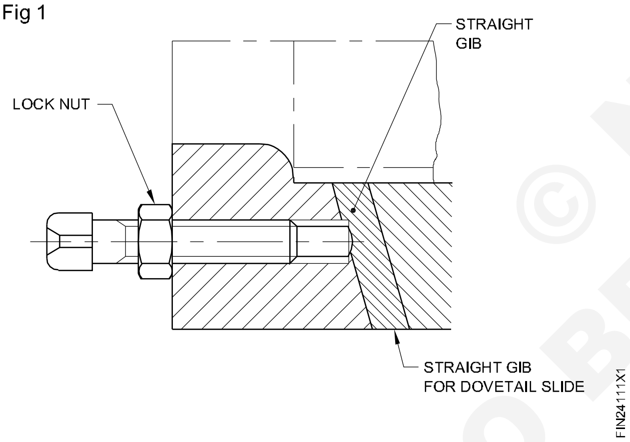
Adjust the gib strip - Task 4

Objective: This shall help you to

- **adjust and align the gib strip in a lathe.**

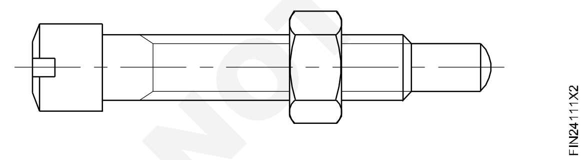
Loosen the lock-nuts. (Fig 1)

Fig 1



Remove the set screws. (Fig 2)

Fig 2



Pull the gib out. (Fig 3)

Clean all the parts.

Check the straightness of the gib using Prussian blue.

Scrape the gib to get even surface to prevent stick-slip motion of the cross-slide.

Lubricate all the parts.

Assemble the gib into the dovetail slide and position it. (Fig 4)

Fig 3

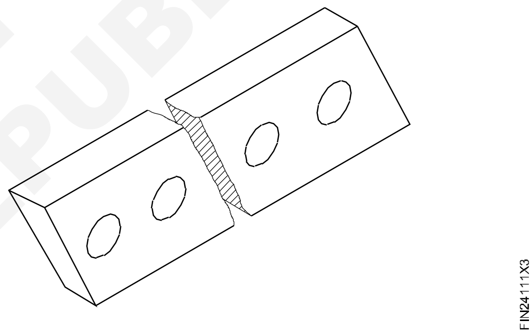
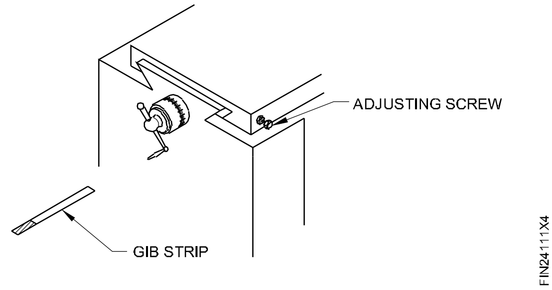


Fig 4



Adjust the screws and eliminate the clearance between the slides for getting the correct freedom required in the assembly.

Lock the movement of the adjusting screws by the check-nut.

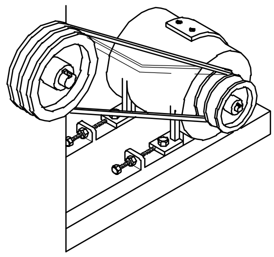
Hold the gib in correct position firmly while locking with check-nuts.

Check the function of the cross-slide.

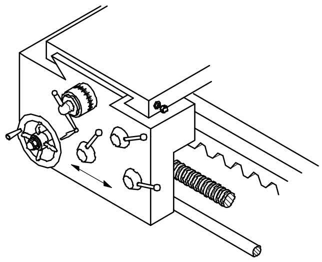
Perform the routine maintenance with check list

Objectives: At the end of this exercise you shall be able to
- **perform the routine maintenance with check list**
- **rectify the defective items found.**

Job sequence

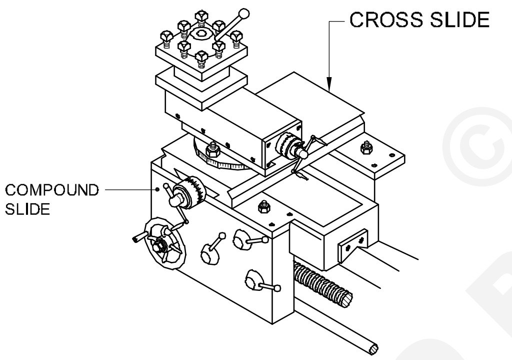


1 Check the tension of the belt and adjust

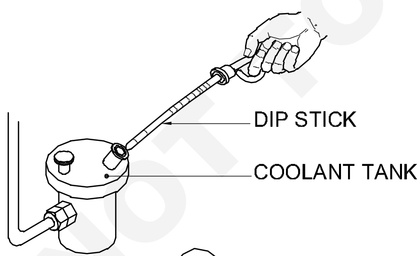


2 Check the movement of the carriage of the lathe

- 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.

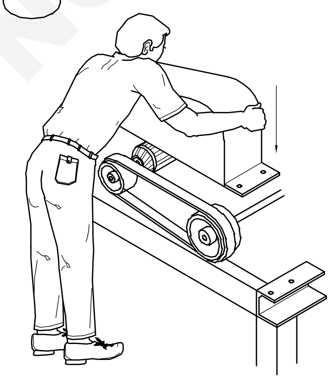


3 Check the movement of the cross-slide and the compound slide.



4 Check the oil level and the functioning of the lubricating pump.

- Check the coolant level and the functioning of the coolant pump.



5 Check the safety guards and ensure that they are in postion.

FI20N18110E1

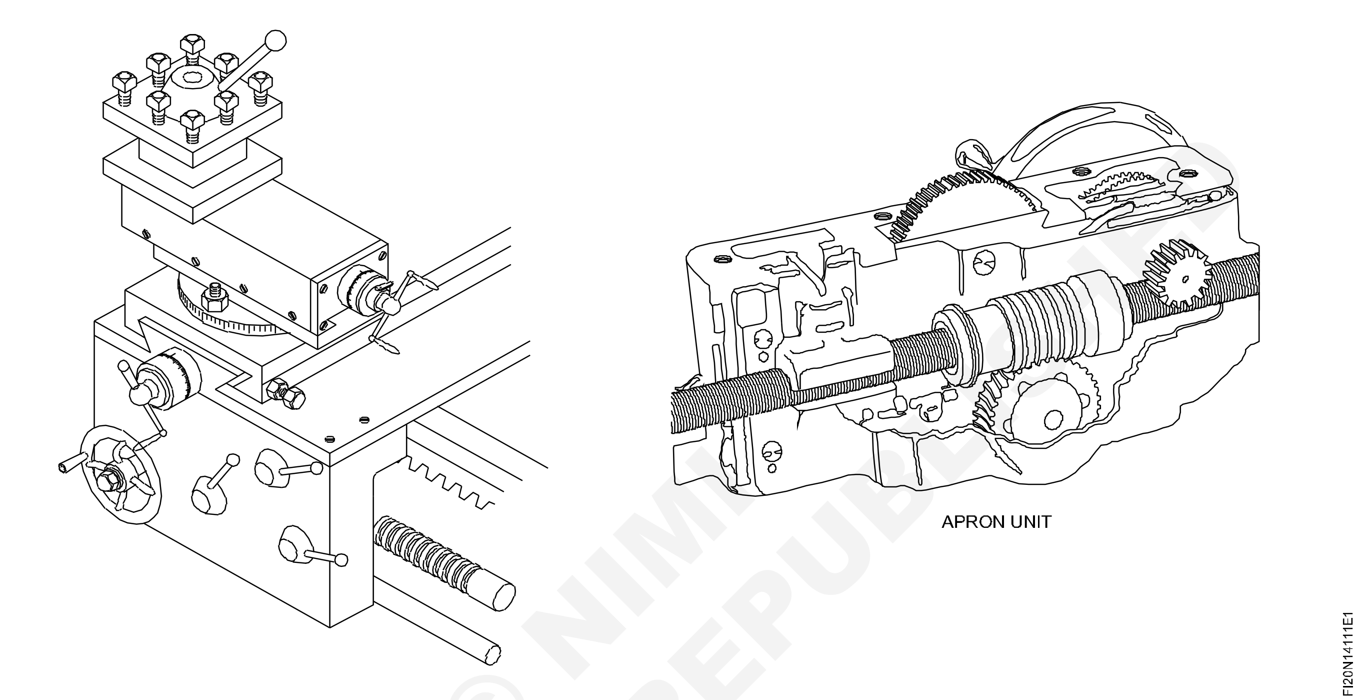
Inspect the following check list items of centre lathe and tick it in appropriate column.

Table

Items to be checked	Good working/Satisfactory	Defective	Remedial measures to be carried out
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 gaurds			

Monitor machine as per routine check list

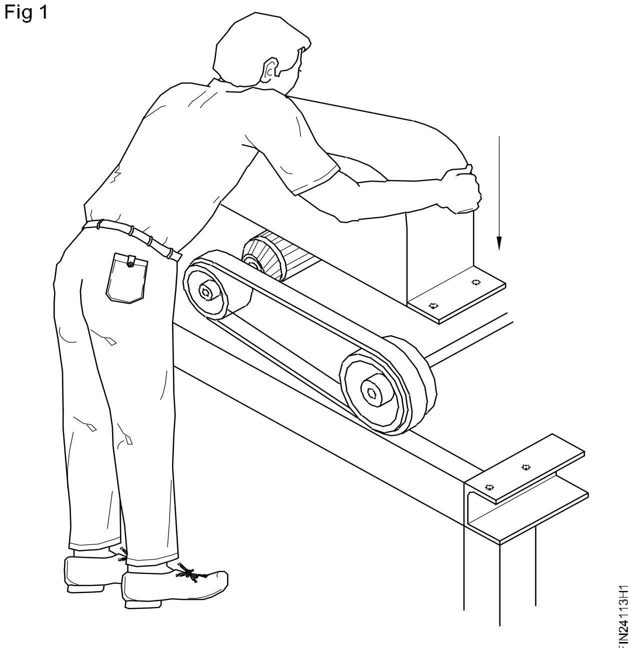
Objectives: At the end of this exercise you shall be able to
- **inspect the lathe parts**
- **applying lubrication to lathe parts**
- **operate and check the movements of the machine parts, before machining.**



Job Sequence

- Clean the machine.
- Check the safety guards (Fig 1) and ensure that they are in position.
- Check the tension of belt.
- Check the free movement of carriage, tailstock of the lathe.
- Run the machine on different spindle speeds and check.
- 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 cross slide and the compound slide.
- Check the oil level and functioning of the lubrication.
- Check the coolant and the functioning of the coolant pump.
- Check the exposed gears are fitted properly switch ON and check the running condition of machine before machining.

Fig 1



Routine check list of lathe

Table

Items to be checked	Description	Remarks
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		
Safety guards		
Adjustment screw		
Quick change gear box		
Feed selector		

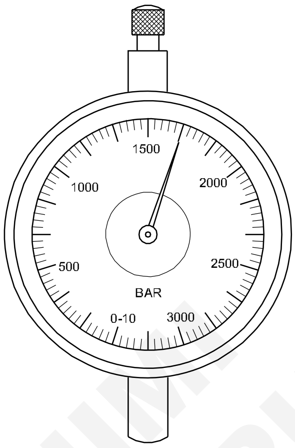
— — — — — — —

Read pressure gauge, temperature gauge, oil level

Objectives: At the end of this exercise you shall be able to
- **read pressure gauge**
- **read temperature gauge**
- **check the oil level.**

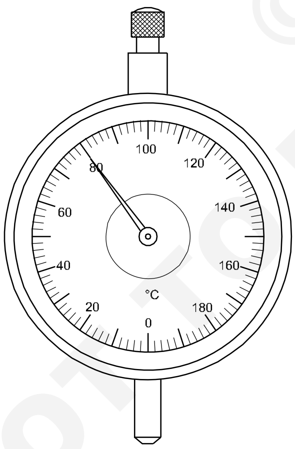
TASK-1

PRESSURE GAUGE

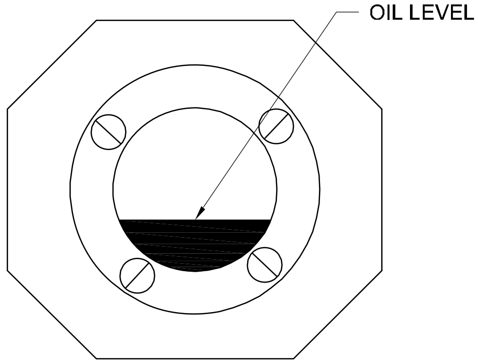


TASK-2

TEMPERATURE GAUGE



TASK-3



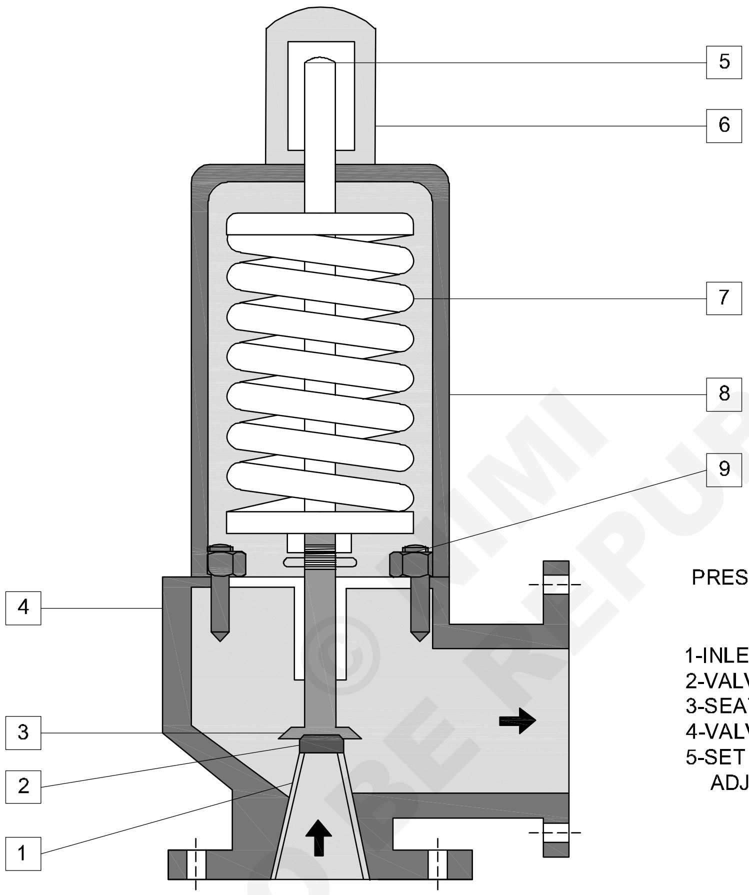
Note: Instructor shall demonstrate to the trainees regarding, reading of pressure gauge, temperature gauge and oil level.

-	-	-	-	-	-	1.8.112
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	READ PRESSURE GAUGE, TEMPERATURE GAUGE,OIL LEVEL	DEVIATIONS	TIME
		CODE NO. FI20N18112E1	

Set pressure in pneumatic system

Objectives: At the end of this exercise you shall be able to
- **set the pressure relief valve**
- **check the function of relief valve.**



PRESSURE RELIEF VALVE

1-INLET NOZZLE	6-CAP
2-VALVE SEAT	7-SPRING
3-SEAT HOLDER	8-BONNET
4-VALVE BODY	9-SEAL
5-SET PRESSURE ADJUSTING SCREW	

Job Sequence

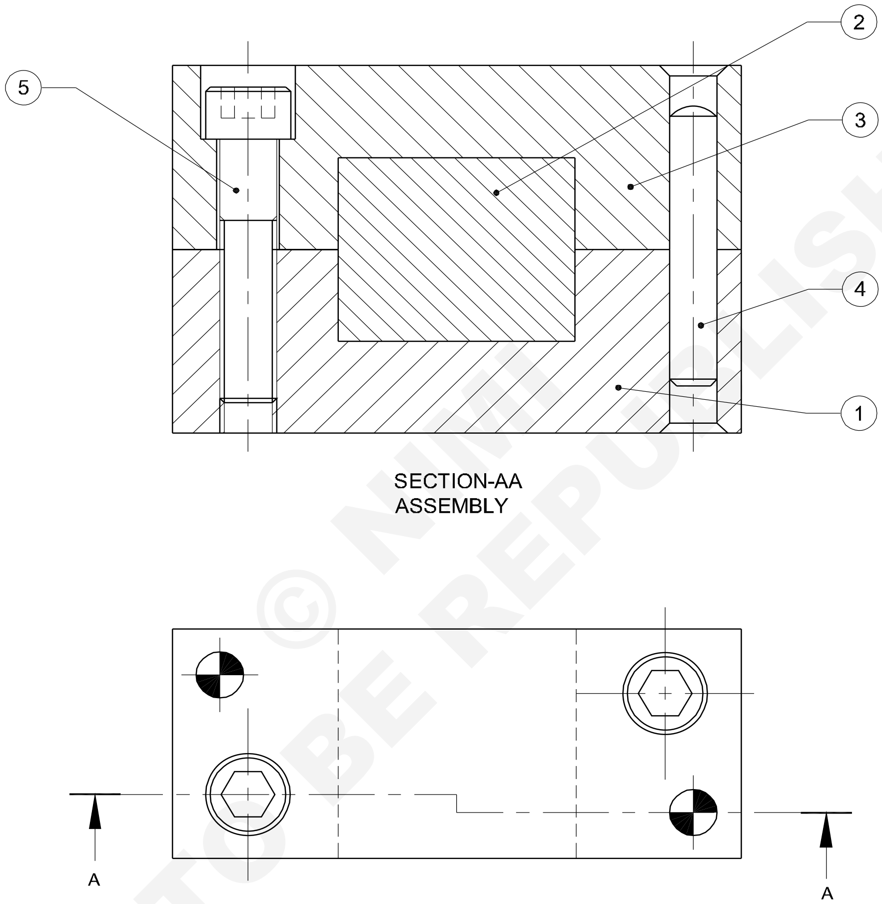
- Switch on the compressor
- Read the pressure gauge in the compressor tank.
- Close the outlet line.
- Check the relief valve function according to the working pressure system
- It not functioning properly, do the following.
- Open the cap
- Adjust the set screw No.5 in the Fig.
- Adjust the set screw according to the required pressure.
- Check the function of the pneumatic system

-	-	-	-	-	-	1.8.113
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SET PRESSURE IN PNEUMATIC SYSTEM	DEVIATIONS	TIME
		CODE NO. FI20N18113E1	

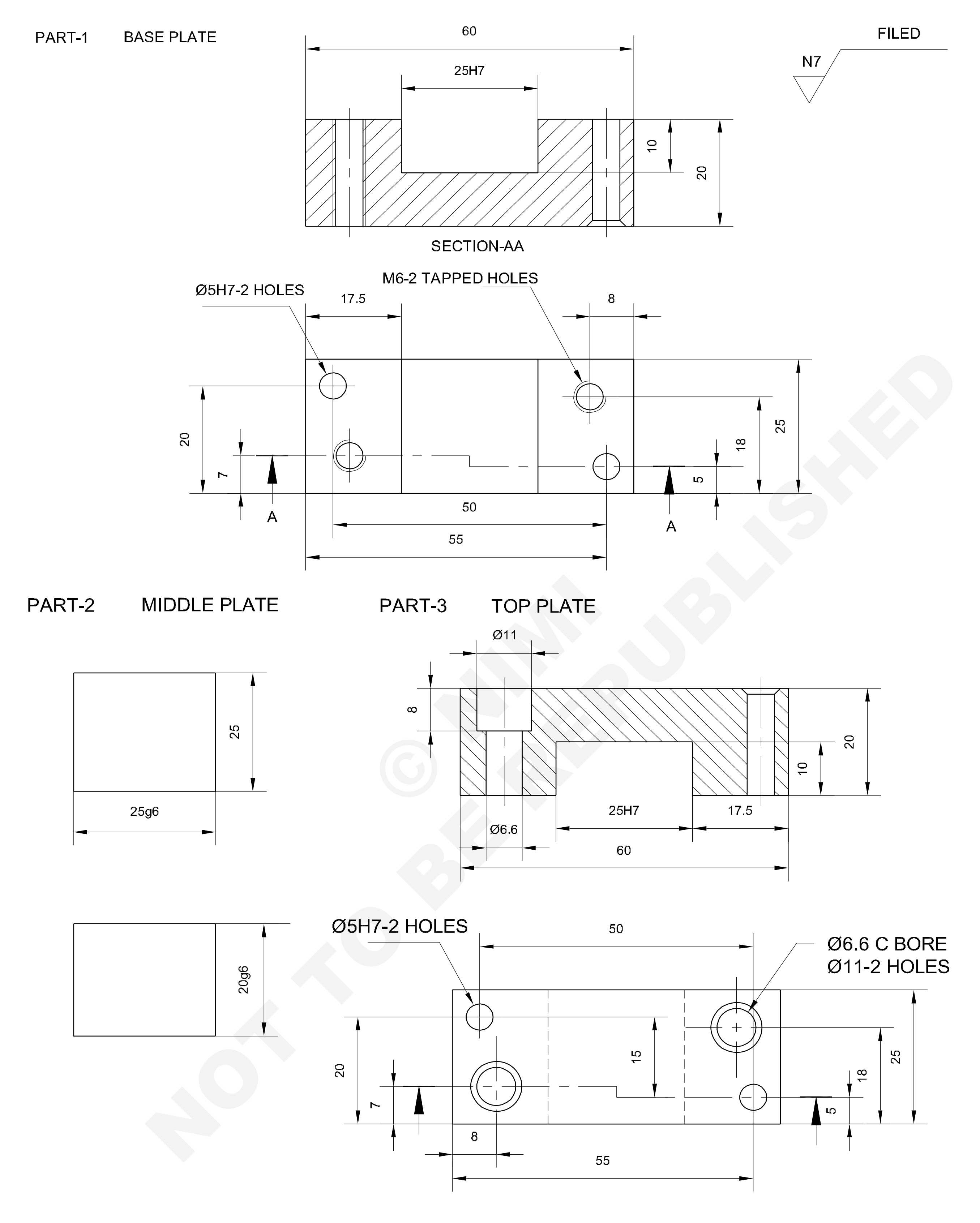
Assemble simple fitting using dowel pins and cap screw assembly using torque wrench

Objective: At the end of this exercise you shall be able to
- **prepare and assemble the assembly fit using dowel pins and cap screws.**



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
2	M6x30	CAP SCREW	Fe310	-	PART-5	1.8.114
2	Ø5x30	DOWEL PIN	Fe310	-	PART-4	
1	65 ISF 30 - 25	-	Fe310	-	PART-3	
1	SQUARE 28-30	-	Fe310	-	PART-2	
1	65 ISF 30 - 25	-	Fe310	-	PART-1	

SCALE 1:1	ASSEMBLE SIMPLE FITTING USING DOWEL PINS AND CAP SCREW ASSEMBLY USING TORQUE WRENCH	DEVIATIONS ±0.04mm	TIME
		CODE NO. FI20N18114E1	



-	-	-	-	-	-	1.8.114
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	BASE PLATE	DEVIATIONS	TIME
		CODE NO.FI20N18114E2	

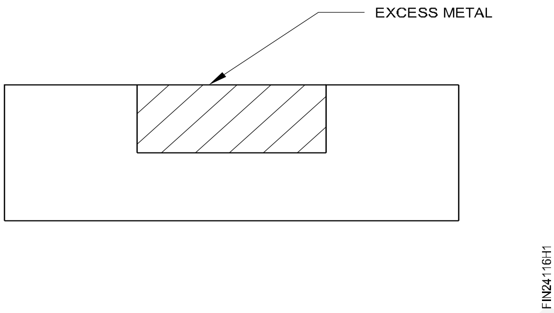
Job Sequence

- Check the raw materials size
- File part 1, 2 and 3 to over all size maintaining parallelism and perpendicularity.
- Check the faultness and squareness with try square and dimensions with vernier caliper.
- Apply marking media on part 1 and 3 and mark the dimensional lines as per drawing.
- Punch witness mark and drill hole marks

Part 1 & 2

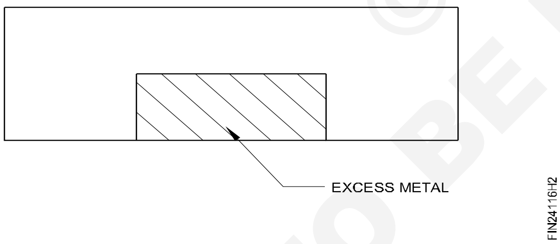
- Chain drill, cut and remove the excess metal and file to size and shape as shown Fig 1.

Fig 1



- Similarly, chain drill, cut and remove the excess metal in part 3 and file to size and shape as shown in Fig 2.

Fig 2



- Fit, part 2 in part 1 and 3 maintaining tolerance ± 0.04mm.
- Assemble, part 1, 2 and 3 all together and clamp it using parallel clamps maintaining squareness.
- Hold the assembly setting in drilling machine table along with suitable fixtures.
- Drill, counter sink and ream the hole as per drawing and fix ∅ 5mm dowel pin without disturbing the assembly setting.
- Similarly, drill, counter sink and ream the other dowel pin hole without disturbing the assembly setting and fix other ∅ 5mm dowel pin.
- Drill holes for tapping in part 1 and 3 without disturbing the assembly setting.
- Separate the assembly setting, drill ∅ 6.6mm through hole and ∅ 11mm counter bore to the depth of 8mm in part 3 to enter the cap head screws as shown in job drawing.
- Hold part 1 in bench vice and cut M6 internal thread in two holes to fix cap head screws.
- Clean the threads without burrs.
- Finish file in part 1, 2, 3 and de-burr in all corners of the job.
- Re-assemble part 1 and 3 along with dowel pins and cap screws.
- Fix the cap screws using torque wrench.
- Fit, part 2 in part 1 and 3 opening slot.
- Apply a little oil and preserve it for evaluation.

Skill Sequence

Fixing of dowel

Objectives: This shall help you to
- **fix dowel pins**
- **remove dowel pins.**

Keep position 1 and position 2 as shown in Fig 1.

Tighten the socket head screw such that there is a gap of one pitch of the socket head screw as shown in Fig 1.

Drive the dowel using a hammer such that about 5 mm of the chamfer side of the dowel enters into the reamed hole as shown in Fig 2.

Fig 1

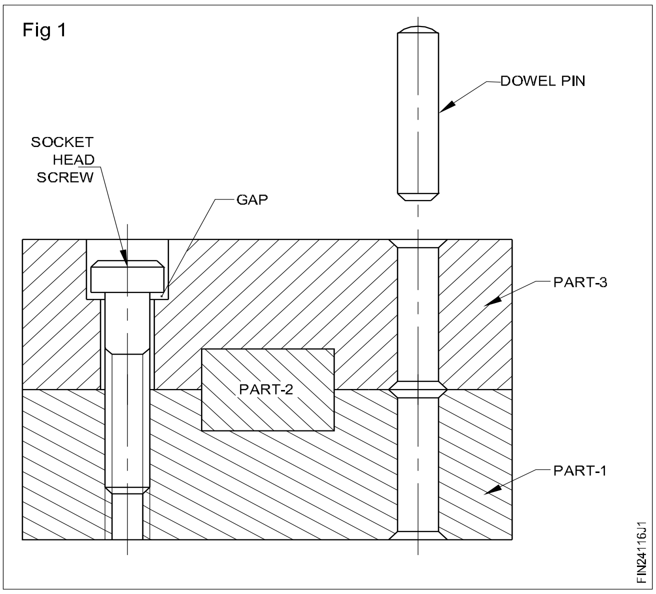
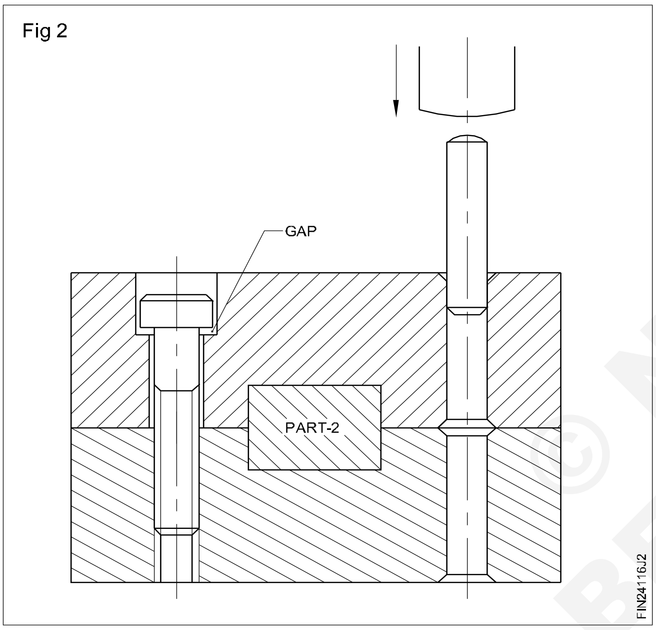


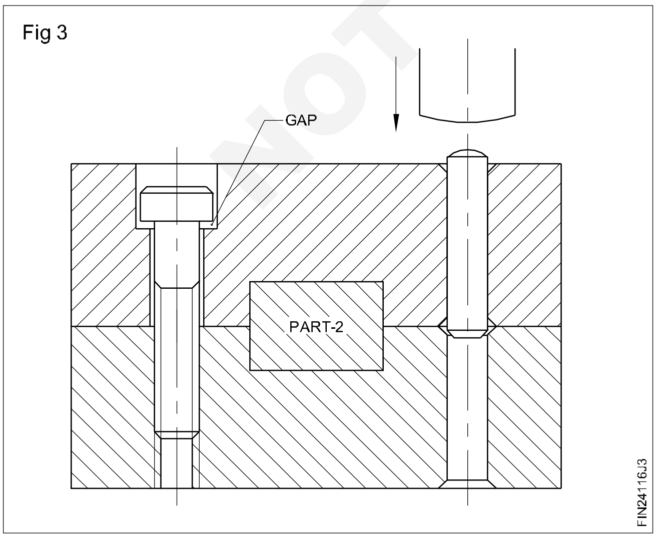
Fig 2



Check for the perpendicularity.

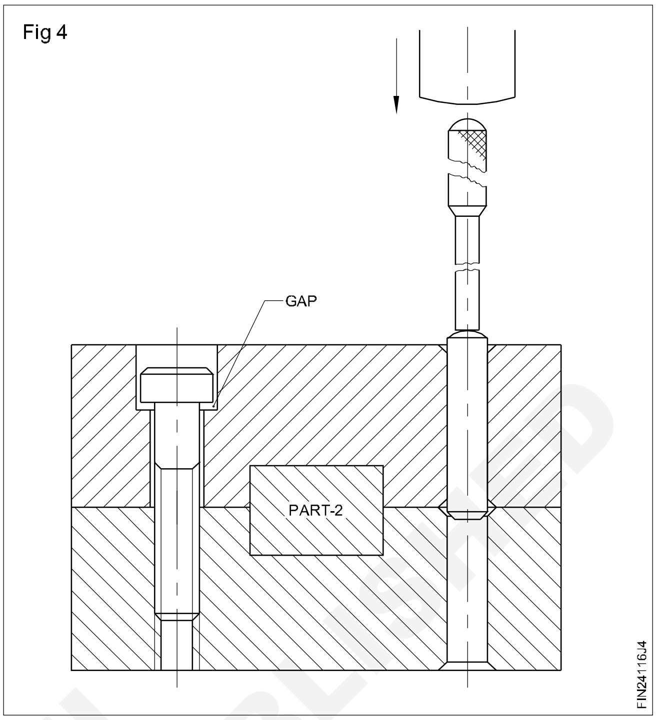
Drive the dowel into the reamed hole such that chamfered end of the dowel enters fully into the position 1 as shown in Fig 3.

Fig 3



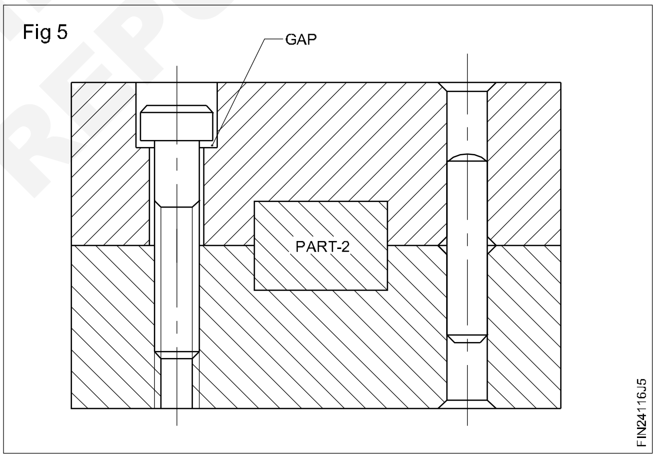
Drive the dowel keeping pin punch dia 5.8 over the radius of the end of the dowel such that the chamfered end of the dowel into position 2 as shown in Fig 4.

Fig 4



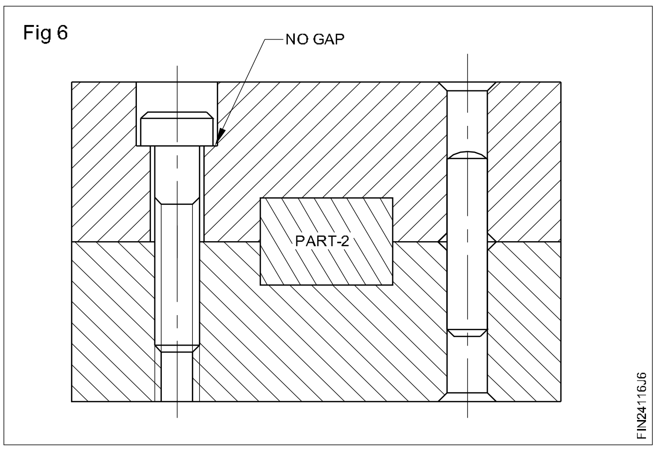
Drive the dowel in about 10 mm into position 2 as shown in Fig 5.

Fig 5



Tighten the socket head screw such that there is no gap exists as shown in Fig 6.

Fig 6

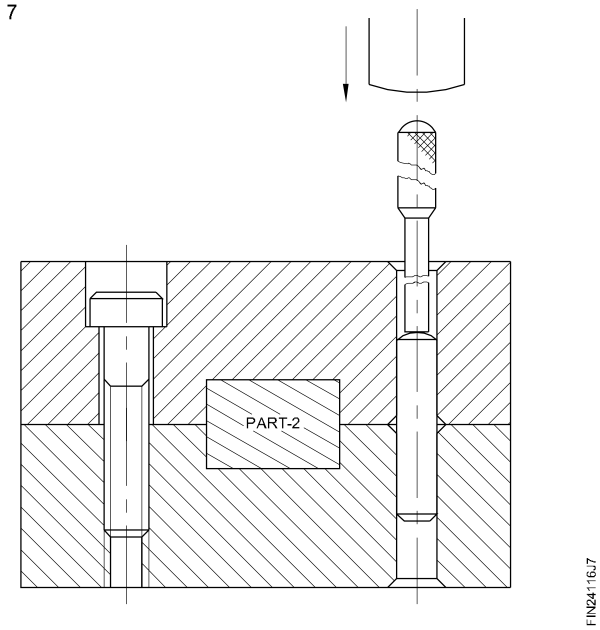


Removal of the dowel

Removal of the dowel should be in the same direction as driving.

Insert pin punch into the reamed hole such that it sits over the radius end of the dowel as shown in Fig 7.

Fig 7



Knock the dowel out using the hammer as shown in Fig 8.

Fig 8