FITTER

NSQF LEVEL - 5

2nd Year (Volume II of II)

TRADE PRACTICAL

SECTOR: Production & Manufacturing

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

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Duration : 2 - Years

Trade : Fitter - 2nd Year (Volume II of II) - Trade Practical - NSQF level 5

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P. B. No.3142, CTI Campus, Guindy Industrial Estate,
Guindy, Chennai - 600 032.
Phone : 044 - 2250 0248, 2250 0657, 2250 2421
Fax : 91 - 44 - 2250 0791
email : chennai-nimi@nic.in, nimi_bsnl@dataone.in
Website: www.nimi.gov.in

FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 2020 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 Mentor Councils comprising various stakeholder's 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 - 2nd Year (Volume II of II) Trade Practical NSQF Level - 5 in Production & Manufacturing Sector under Semester Pattern.** The NSQF Level - 5 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 - 5 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 5 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these 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

RAJESH AGGARWAL
Director General/ Addl. Secretary
Ministry of Skill Development & Entrepreneurship,
Government of India.

New Delhi - 110 001

PREFACE

The National Instructional Media Institute (NIMI) was established in 1986 at Chennai by then Directorate General of Employment and Training (D.G.E & T), Ministry of Labour and Employment, (now under Directorate General of Training, Ministry of Skill Development and Entrepreneurship) Government of India, with technical assistance from the Govt. of the 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.

R. P. DHINGRA
EXECUTIVE DIRECTOR

Chennai - 600 032

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 organisations to bring out this Instructional Material **(Trade Practical)** for the trade of **Fitter** under Production & Manufacturing Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. T. Janakiram	–	Assistant Director (Retd.), Govt RIC, North Chennai - 21
Shri. M. Sampath	–	Training officer (Retd.) CTI, Chennai-32.
Shri. M. Sangarapandian	–	Training officer (Retd.) CTI, Chennai - 32
Shri. K. Kesavan	–	Asst. App. Advisor Junior (Retd) DET, Tamilnadu
Shri. C.C. Subramanian	–	Training officer (Retd.) Balamandir PHM ITI, Chennai - 17

NIMI CO-ORDINATORS

Shri. K. Srinivasa Rao	–	Joint Director, NIMI, Chennai - 32
Shri. G. Michael Johny	–	Assistant Manager, NIMI, Chennai - 32
Shri. V. Gopalakrishnan	–	Assistant Manager, NIMI, Chennai - 32

NIMI records its appreciation for 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 NIMI staff who have contributed towards the development of this Instructional Material.

NIMI is also grateful to everyone who has directly or indirectly helped in developing this Instructional Material.

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 2nd Year (Volume II of II) 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 - 5 syllabus are covered.

The manual is divided into six modules. The distribution of time for the practical in the six modules are given below.

Module 1	Drill jig	25 Hrs
Module 2	Repairing technique	200 Hrs
Module 3	Hydraulics and pneumatics	100 Hrs
Module 4	Preventive maintenance	75 Hrs
Module 5	Erection and testing	75 Hrs
Module 6	Project work/ In plant training	50 Hrs
	Total	525 Hrs

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 Fourth Semester Course of the Fitter Trade. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 5 syallabus on Trade practical. 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 atleast 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

- **Make drill jig & produce components on drilling machine by using jigs and check for correctness.**
- **Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality of mechanical components like Pulley, Gear, Keys, Jibs and Shafts.**
- **Identify, dismantle, replace and assemble different pneumatics and hydraulics components like Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.**
- **Construct circuit of pneumatics and hydraulics observing standard operating procedure & safety aspect.**
- **Plan & perform basic day to day preventive maintenance, repairing and check functionality of Drill Machine, Power Saw and Lathe.**
- **Plan, erect simple machine and test machine tool accuracy of Drill Machine, Power Saw and Lathe.**

SYLLABUS

2nd Year (Volume II of II) **Duration: Six Months**

Week No.	Ref. Learning Outcome	Professional Skills with Indicative hrs.	Professional Knowledge
79	Make drill jig & produce components on drill machine by using jigs and check for correctness.	159. Make a simple drilling jig. (20 hrs.) 160. Use simple jigs and fixtures for drilling. (5 hrs.)	Drilling jig-constructional features, types and uses. Fixtures-Constructional features, types and uses.
80	Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. [Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]	161. Marking out for angular outlines, filing and fitting the inserts into gaps. (10 hrs.) 162. Exercises on finished material such as aluminium/ brass/ copper / stainless steel, marking out, cutting to size, drilling, tapping etc. without damage to surface of finished articles. (15 hrs.)	Aluminium and its alloys. Uses, advantages and disadvantages, weight and strength as compared with steel. Non-ferrous metals such as brass, phosphor bronze, gunmetal, copper, aluminium etc. Their composition and purposes, where and why used, advantages for specific purposes, surface wearing properties of bronze and brass.
81	-do-	163. Making an adjustable spanner: - Marking out as per Blue print, drilling, cutting, straight and curve filing, threading, cutting slot and cutting internal threads with taps. (25 hrs.)	Installation, maintenance and overhaul of machinery and engineering equipment. Power transmission elements. The object of belts, their sizes and specifications, materials of which the belts are made, selection of the type of belts with the consideration of weather, load and tension methods of joining leather belts
82-84	-do-	164. Dismantling and mounting of pulleys. (10 hrs.) 165. Making & replacing damaged keys. (15 hrs.) 166. Dismounting, repairing damaged gears and mounting and check for workability. (15 hrs.) 167. Repair & replacement of belts and check for workability. (10 hrs.)	Vee belts and their advantages and disadvantages, Use of commercial belts, dressing and resin creep and slipping, calculation. Power transmissions- coupling typesflange coupling,-Hooks couplinguniversal coupling and their different uses. Pulleys-types-solid, split and „V? belt pulleys, standard calculation for determining size crowning of faces-loose and fast pulleys-jockey pulley. Types of drives-open and cross belt drives. The geometrical explanation of the belt drivers at an angle.
85	-do-	168. Making of template/gauge to check involute profile. (25 hrs.)	Power transmission –by gears, most common form spur gear, set names of some essential parts of the set-The pitch circles, Diametral pitch, velocity ratio of a gear set.

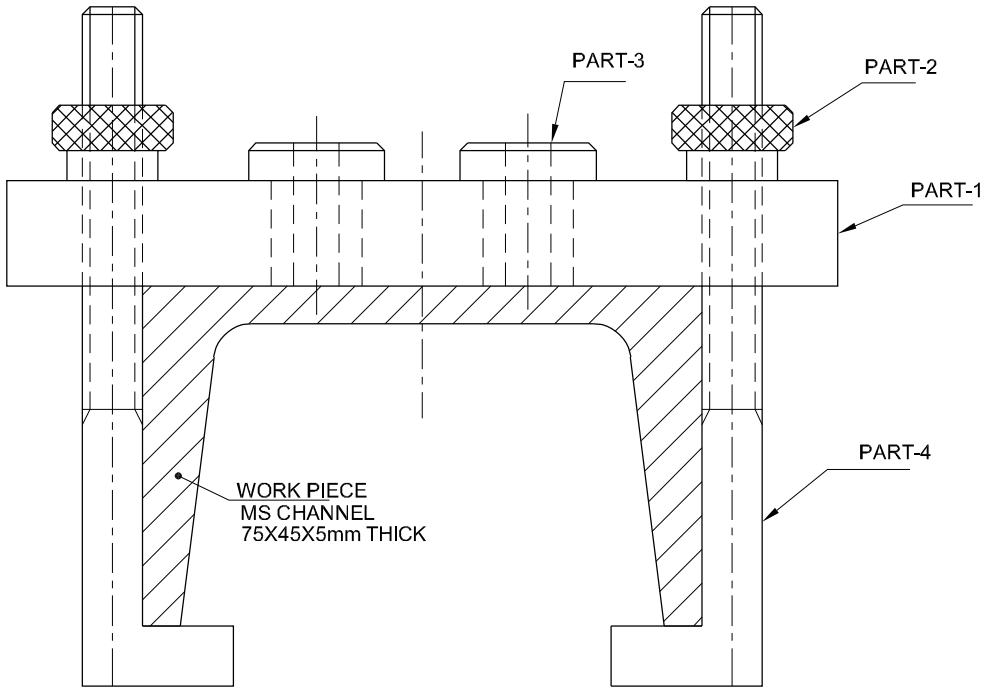
86	-do-	169. Repair of broken gear tooth by stud and repair broker gear teeth by dovetail. (25 hrs.)	Helical gear, herring bone gears, bevel gearing, spiral bevel gearing, hypoid gearing, pinion and rack, worm gearing, velocity ratio of worm gearing. Repair of gear teeth by building up and dovetail method.
87	-do-	170. Make hexagonal slide fitting. (20 hrs.) 171. Prepare different types of documentation as per industrial need by different methods of recording information. (5 hrs.)	Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation,cycle time, productivity reports, job cards.
88	-do-	172. Marking out on the round sections for geometrical shaped fittings such as spline with 3 or 4 teeth. Finishing and fitting to size, checking up the faces for universality. (25 hrs.)	Fluid power, Pneumatics, Hydraulics, and their comparison, Overview of a pneumatic system, Boyle's law. Overview of an industrial hydraulic system, Applications, Pascal's Law.
89	Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.	173. Identify pneumatic components – Compressor, pressure gauge, Filter-Regulator-Lubricator (FRL) unit, and Different types of valves and actuators. (2 hrs.) 174. Dismantle, replace, and assemble FRL unit(5 hrs.) 175. Demonstrate knowledge of safety procedures in pneumatic systems and personal Protective Equipment (PPE)(2 hrs.) 176. Identify the parts of a pneumatic cylinder (1 hrs.) 177. Dismantle and assemble a pneumatic cylinder (8 hrs.) 178. Construct a circuit for the direction & speed control of a small-bore single-acting (s/a) pneumatic cylinder(7 hrs.)	Compressed air generation and conditioning, Air compressors, Pressure regulation, Dryers, Air receiver, Conductors and fittings, FRL unit, Applications of pneumatics, Hazards & safety precautions in pneumatic systems. Pneumatic actuators:- Types, Basic operation, Force, Stroke length, Singleacting and double-acting cylinders.
90	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	179. Construct a control circuit for the control of a d/a pneumatic cylinder with momentary input signals(5 hrs.) 180. Construct a circuit for the direct & indirect control of a d/a pneumatic cylinder with a single & double solenoid valve(10 hrs.) 181. Dismantling &Assembling of solenoid valves(10 hrs.)	Pneumatic valves:- Classification, Symbols of pneumatic components, 3/2way valves (NO & NC types) (manually actuated & pneumatically-actuated) & 5/2-way valves, Check valves, Flow control valves, Oneway flow control valve Pneumatic valves: Roller valve, Shuttle valve, Two-pressure valve Electro-pneumatics: Introduction, 3/2way single solenoid valve, 5/2-way single solenoid valve, 5/2-way double solenoid valve, Control components Pushbuttons (NO & NC type) and Electromagnetic relay unit, Logic controls

91	Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]	182. Demonstrate knowledge of safety procedures in hydraulic systems (Demo by video) (5 hrs.) 183. Identify hydraulic components – Pumps, Reservoir, Fluids, Pressure relief valve (PRV), Filters, different types of valves, actuators, and hoses (5 hrs.) 184 Inspect fluid levels, service reservoirs, clean/replace filters(5 hrs.) 185. Inspect hose for twist, kinks, and minimum bend radius, Inspect hose/tube fittings(5 hrs.) 186. Identify internal parts of hydraulic cylinders, pumps/motors(5 hrs.)	- Symbols of hydraulic components, Hydraulic oils –function, properties, and types, Contamination in oils and its control - Hydraulic Filters – types, constructional features, and their typical installation locations, cavitation, Hazards & safety precautions in hydraulic systems - Hydraulic reservoir & accessories, Pumps, Classification – Gear/vane/ piston types, Pressure relief valves – Direct acting and pilot-operated types - Pipes, tubing, Hoses and fittings – Constructional details, Minimum bend radius, routing tips for hoses
92	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	187. Construct a circuit for the control of a s/a hydraulic cylinder using a 3/2-way valve (Weight loaded d/a cylinder may be used as a s/a cylinder), 4/2 & 4/3 way valves. (10 hrs.) 188. Maintenance, troubleshooting, and safety aspects of pneumatic and hydraulic systems (The practical for this component may demonstrated by video) (15 hrs.)	- Hydraulic cylinders –Types - Hydraulic motors –Types - Hydraulic valves: Classification, Directional Control valves – 2/2- and 3/2-way valves - Hydraulic valves: 4/2- and 4/3-way valves, Centre positions of 4/ 3-way valves - Hydraulic valves: Check valves and Pilot-operated check valves, Load holding function - Flow control valves: Types, Speed control methods – meter-in and meterout - Preventive maintenance & troubleshooting of pneumatic & hydraulic systems, System malfunctions due to contamination, leakage, friction, improper mountings, cavitation, and proper sampling of hydraulic oils
93	Plan & perform basic day to day preventive maintenance, repairing and check functionality.[Simple Machines – Drill Machine, Power Saw and Lathe]	189. Dismantle, overhauling & assemble cross-slide & handslide of lathe carriage. (25 hrs.)	Method or fixing geared wheels for various purpose drives. General cause of the wear and tear of the toothed wheels and their remedies, method of fitting spiral gears, helical gears, bevel gears, worm and worm wheels in relation to required drive. Care and maintenance of gears.

94-96	-do-	190. Simple repair of machinery: - Making of packing gaskets. (5 hrs.) 191. Check washers, gasket, clutch, keys, jibs, cotter, Circlip, etc. and replace/repair if needed. (5 hrs.) 192. Use hollow punches, extractor, drifts, various types of hammers and spanners, etc. for repair work. (15 hrs.) 193. Dismantling, assembling of different types of bearing and check for functionality. (15 hrs.) 194. Perform routine check of machine and do replenish as per requirement. (10 hrs.)	Method of lubrication-gravity feed, force (pressure) feed, splash lubrication. Cutting lubricants and coolants: Soluble off soaps, suds-paraffin, soda water, common lubricating oils and their commercial names, selection of lubricants. Clutch: Type, positive clutch (straight tooth type, angular tooth type) . Washers-Types and calculation of washer sizes. The making of joints and fitting packing. Chains, wire ropes and clutches for power transmission. Their types and brief description.
97	Plan, erect simple machine and test machine tool accuracy. [Simple Machines – Drill Machine, Power Saw and Lathe]	195. Inspection of Machine tools such as alignment, levelling. (10 hrs.) 196. Accuracy testing of Machine tools such as geometrical parameters. (15 hrs.)	Lubrication and lubricants-purpose of using different types, description and uses of each type. Method of lubrication. A good lubricant, viscosity of the lubricant, Main property of lubricant. How a film of oil is formed in journal Bearings.
98-99	-do-	197. Practicing, making various knots, correct loading of slings, correct and safe removal of parts. (5 hrs.) 198. Erect simple machines. (45 hrs.)	Foundation bolt: types (rag, Lewis cotter bolt) description of each erection tools, pulley block, crow bar, spirit level, Plumb bob, wire rope, manila rope, wooden block. The use of lifting appliances, extractor presses and their use. Practical method of obtaining mechanical advantage. The slings and handling of heavy machinery, special precautions in the removal and replacement of heavy parts.
100-101	In-plant training/ Project work 1. Pulley Extractor 2. Cam Vice 3. Link Mechanism 4. Adjustable Fixture 5. Slider Crank 6. Hand Lever Punch 7. Setup hydraulic and pneumatic circuit and test the functioning of piston movement.		
102-103	Revision		
104	Examination		

Make a simple drilling jig

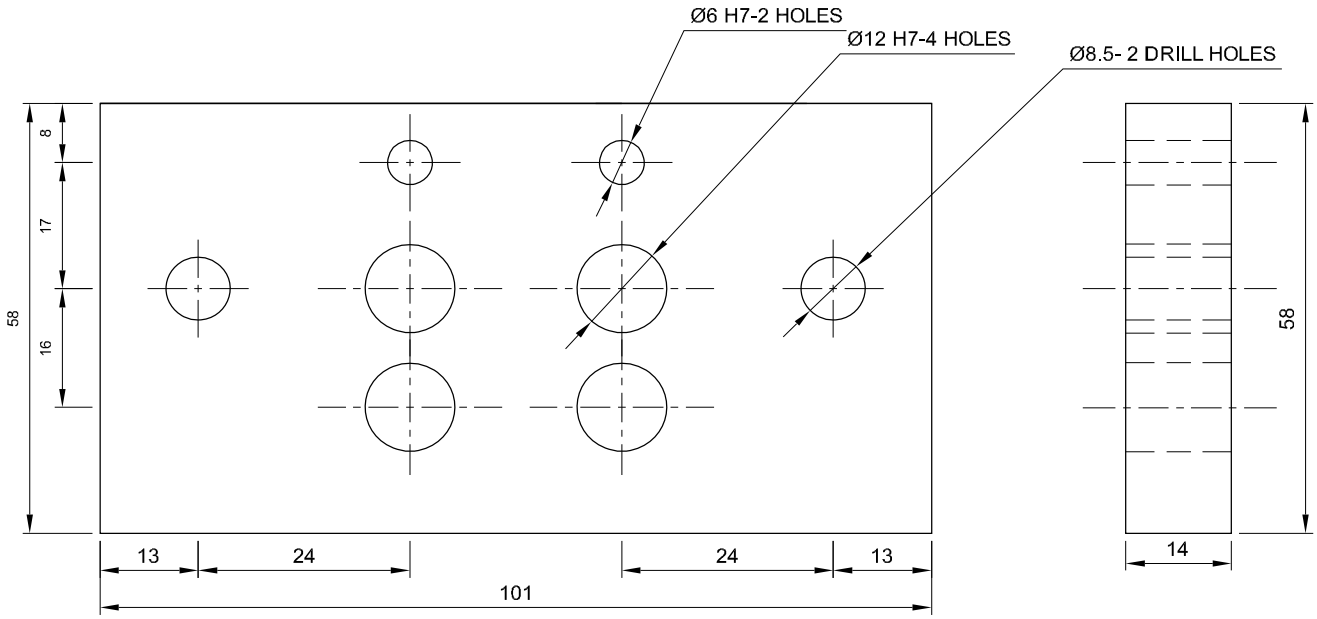
Objectives: At the end of this exercise you shall be able to
- **machine the parts of a drill jig and maintain the same for size**
- **assemble the parts of a drill jig as per assembly drawing**
- **check the dimensions and locations.**



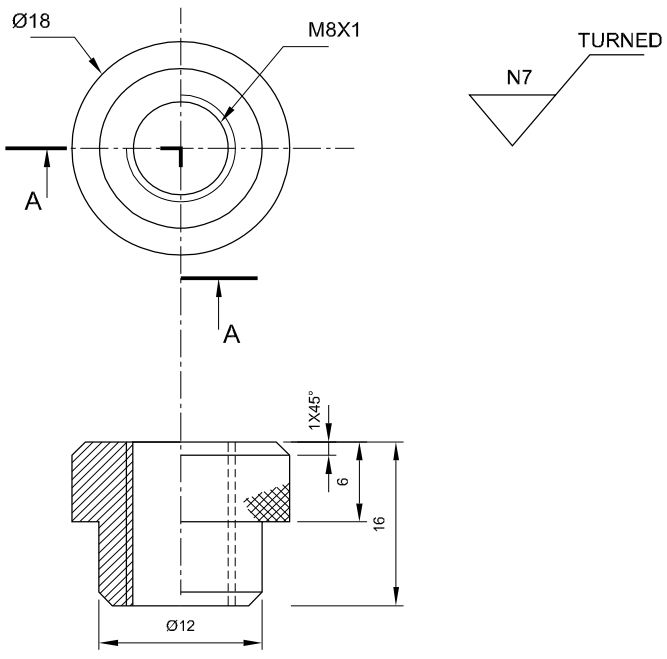
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
2	Ø6-20	DOWEL PIN	Fe310	-	5	4.1.159
2	Ø10-120	-	Fe310	-	4	
4	Ø22-25	-	Fe310	-	3	
2	Ø20-18	-	Fe310	-	2	
1	60 ISF 15 -105	-	Fe310	-	1	

SCALE 1:1	MAKE A SIMPLE DRILLING JIG	TOLERANCE ±0.02	TIME : 20Hrs
		CODE NO. FIN41159E1	

PART-1: TOP PLATE

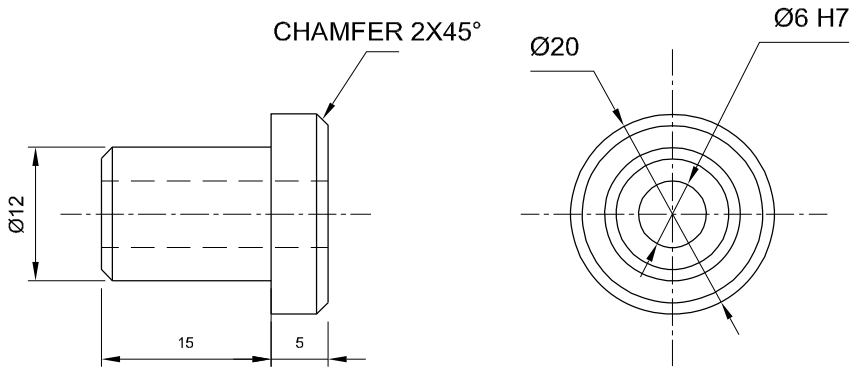


PART-2 : KNOB

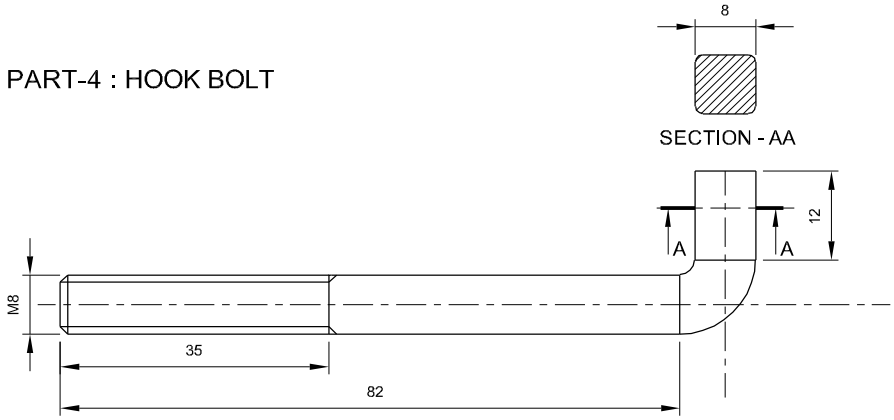


-	-	-	-	-	1 & 2	4.1.159
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**TOP PLATE AND KNOB**				TOLERANCE ±	TIME :
					CODE NO. FIN41159E2	

PART-3: DRILL JIG BUSH



PART-4 : HOOK BOLT



-	-	-	-	-	3 & 4	4.1.159
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS					TOLERANCE ±	TIME :
	DRILL JIG BUSH AND HOOK BOLT				CODE NO. FIN41159E3	

Job sequence

TASK 1: **Making top plate**

- Check the raw material.
- File and finish the job 52 X 110 X 14mm as per drawing.
- Mark the hole centres.
- Set the job on drilling machine.
- Drill the holes ∅ 5.8mm for reaming.
- Ream the hole using 6mm reamer.
- Drill 2 holes of ∅ 8.5mm for inserting hook bolt.
- Drill 4 nos of ∅ 11.8mm for fixing bush.
- Ream the ∅ 11.8mm hole using 12mm reamer to get H7 finish.
- Remove burr in the sharp corner.

— — — — — — —

TASK 2: **Making knob**

- Check the raw material.
- Hold the job in 3 jaw chuck.
- Make centre drill and enlarge the hole to ∅ 7mm ± 0.1.
- Turn dia $18^{\pm 0.1}$ to a length of 20mm.
- Turn step dia $12^{\pm 0.1}$ to length of 10mm.
- Knurl as per drawing.
- Reverse the job hold the knurled portion with soft packings.
- Face to a length of 16 mm.
- Chamfer as per drawing.
- Remove the job from lathe, hold on bench vice and make the thread of M8 using tap.
- Remove the burrs.
- Repeat the above for other knob.

— — — — — — —

TASK 3: **Making jig bush**

- Check the raw material.
- Hold the job in three jaw chuck.
- Face, centre drill and enlarge the hole to dia 5.8mm.
- Ream the hole ∅ 6mm.
- Turn dia 18mm to required length.
- Turn step of dia 12mm to a length of 15mm.
- Chamfer the end of dia 12mm.
- Part to a length of 21mm.
- Repeat the same for 4 pieces.
- Hold the dia 12mm and face the other side to a length of 20mm.
- Chamfer as per drawing.
- Remove the burrs.

TASK 4: **Making hook bolt**

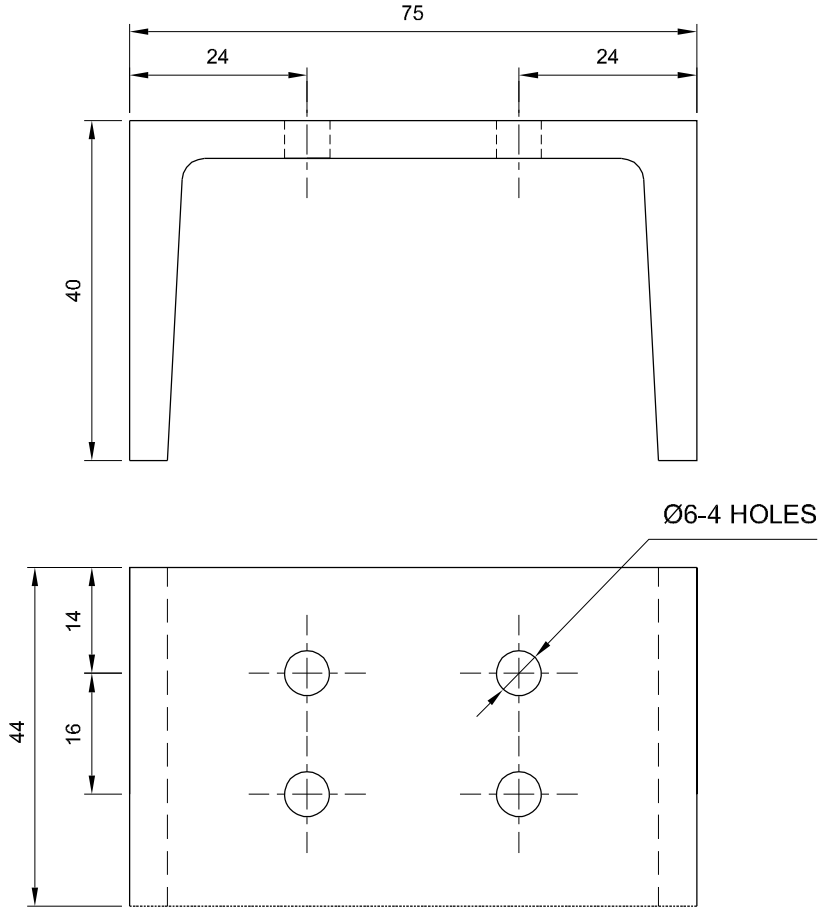
- Check the raw material.
- Bend the rod as per drawing using anvil and hammer.
- File flat surface as per section ‘AA’.
- Chamfer the length side for threading.
- Make thread using 8mm hand die with stock.
- Check the thread using ∅ 8mm nut
- Finish as per drawing.

Drill jig assembly

- Clean all the parts.
- Deburr sharp corners if any.
- Fit the bush (Task 3) in the top plate (Task 2).
- Fix the ∅ 6mm X 16mm dowel pin on the top plate.
- Fix the hook bolt 2 nos.
- Screw the knob in hook bolt.
- Insert the channel to be drilled.
- Now the drill jig is ready for drilling.

Use simple jigs and fixtures for drilling

Objectives: At the end of this exercise you shall be able to
- **locate the work piece in a jig**
- **drill the hole on MS Channel**
- **check for the accuracy.**



1	ISMC 75X40-50	-	Fe310	-	-	4.1.160
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**USE SIMPLE JIGS AND FIXTURES FOR DRILLING**				TOLERANCE ±0.02	TIME : 5Hrs
					CODE NO. FIN41160E1	

Job sequence

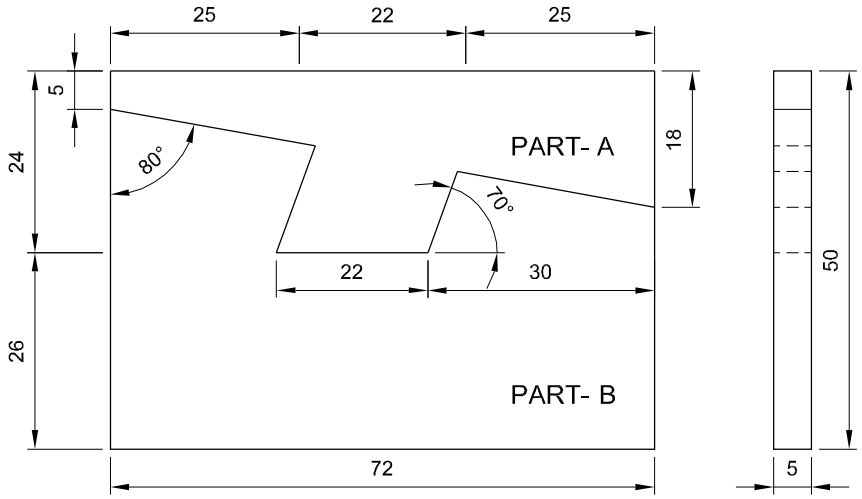
Plate jig - trial

- Use previous Ex.No. 4.1.159 drill jig.
- Remove the top plate from the plate jig.
- Locate component between the hook bolt and touch with stopper pin.
- Clamp the top plate with the knobs.
- Drill dia 6 x 4 Nos.
- Remove the top plate.
- Take out the component from the jig.
- Check the component with a vernier caliper.

Marking out for angular outlines, filing and fitting the inserts into gaps

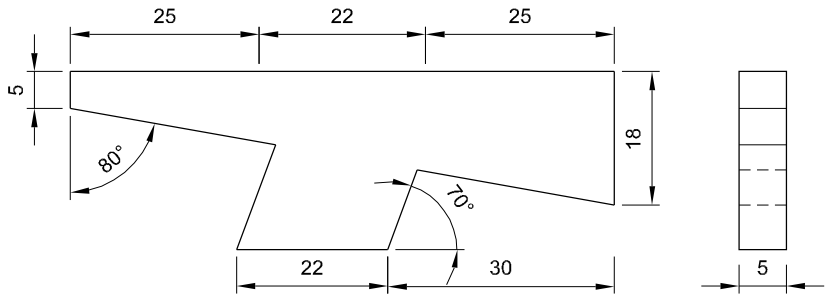
Objectives: At the end of this exercise you shall be able to

- **mark an angular out lines on part A & B with an accuracy of ± 0.02mm**
- **file part A & B maintain the accuracy of H7/g6 for fitting**
- **fit inserts.**

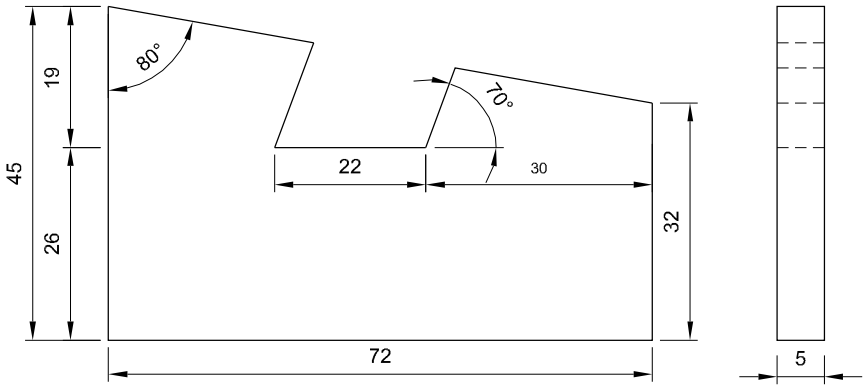


1	75 ISF 6 - 50	-	Fe310	-	B	4.2.161
1	75 ISF 6 - 28	-	Fe310	-	A	
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**MARKING OUT FOR ANGULAR OUTLINES,FILING AND FITTING THE INSERTS INTO GAPS**				TOLERANCE ±0.02	TIME : 10Hrs
					CODE NO. FIN42161E1	

PART - A



PART - B



-	-	-	-	-	A & B	4.2.161
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ANGULAR OPEN FITTING**				TOLERANCE : ±	TIME
					CODE NO. FIN42161E2	

Job sequence

- Cut the raw materials as per the dimensions
- File right angle and mark off part A & B with vernier height gauge and vernier bevel protractor
- Punch on the marked lines / out lines
- Remove unwanted materials by hacksawing and chain drilling
- File Part A&B with a linear accuracy of ± 0.02mm and angular of ± 5'
- Checking the angular dimensions by vernier bevel protractor
- Fit Part : A & B and finish

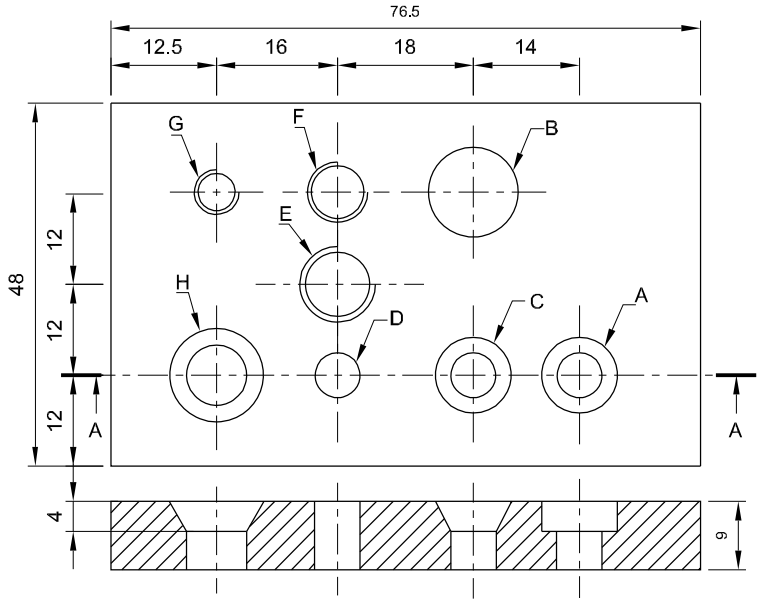
Safety

- Do not mark angular dimensions / angle by scale / set square while marking
- Do not use hammer for fitting

Exercises on finished material, such as aluminium/ brass/ copper/ stainless steel, marking out, cutting to size, drilling, tapping etc. without damage to surface of finished articles

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

- **mark on the Aluminium, Brass, Copper with vernier height gauge**
- **cut extra metal using hacksaw**
- **drill counter sink, counter bore and ream**
- **tap, finish and de- burr.**



A - Counter Bore	-	∅ 6	F - Tap	-	M8	
B - Drilling	-	∅12	G - Tap	-	M6	
C - Counter Sunk	-	∅10	H - Counter Sunk	-	∅12.5	
D - Ream	-	∅ 6				
E - Tap	-	M10				

NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	75 ISF 10-52	-	COPPER	-	-	4.2.162
1	75 ISF 10-52	-	BRASS	-	-	4.2.162
1	75 ISF 10-52	-	ALUMINIUM	-	-	4.2.162

SCALE : NTS	**EXERCISES ON FINISHED MATERIALS,SUCH AS ALUMINIUM/BRASS/ COPPER/STRAINLESS STEEL, MARKING OUT, CUTTING TO SIZE, DRILLING, TAPPING ETC. WITHOUT DAMAGE TO SURFACE OF FINISHED ARTICLES**	TOLERANCE ±0.02	TIME : 15Hrs
		CODE NO. FIN42162E1	

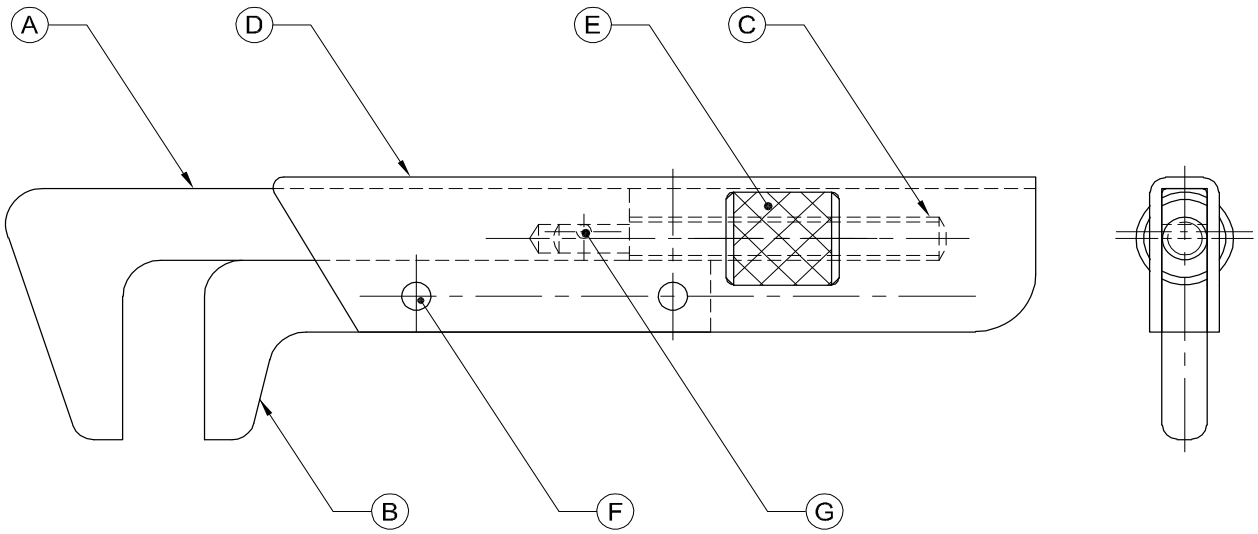
Job sequence

- Check raw material
- File two adjacent side and on flat surface.
- Mark the size of 74 X 48 outer line.
- Punch identification mark.
- Remove the excess material using hacksaw.
- Mark the centre as per dimension
- Set the job on drilling machine
- Make drill holes as per standard chart
- Make Reaming, Counter boreing and tapping
- Make counter sinking as per dimensions.

Making an adjustable spanner: Marking out as per Blue print, drilling, cutting, straight and curve filing, threading, cutting slot and cutting internal threads with taps

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

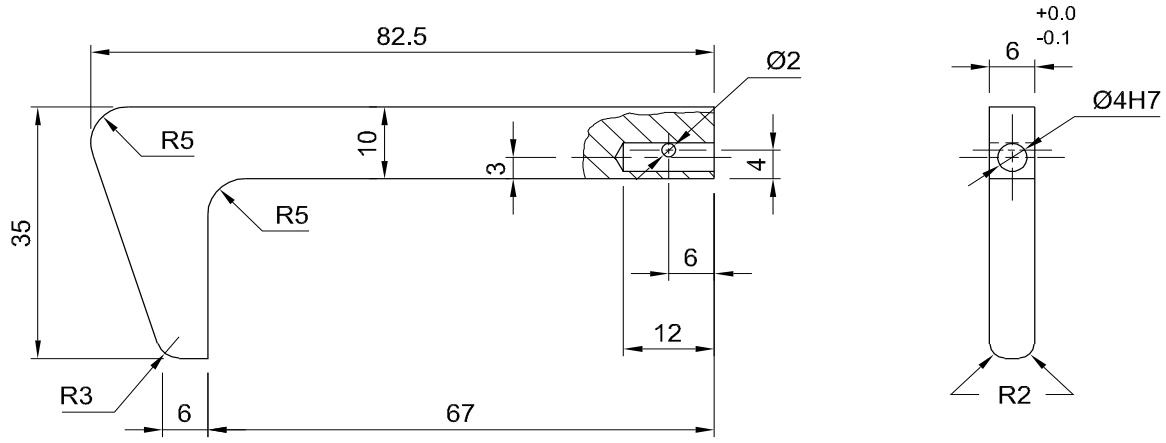
- **prepare different parts referring to the drawing**
- **prepare for assembly**
- **assemble all the parts**
- **check for the accuracy.**



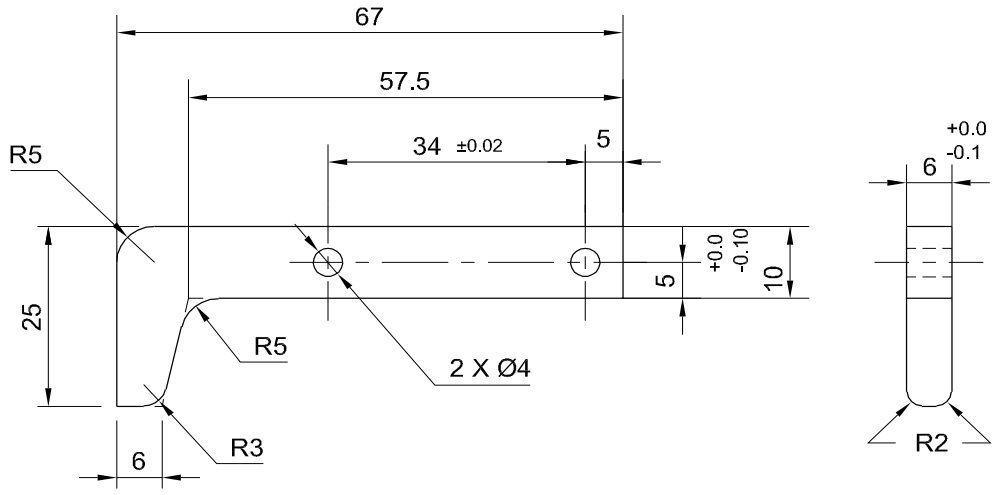
NO.OFF	STOCK SIZE	DESCRIPTION	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	Ø2h8 x 10 IS : 2393	CYLINDRICAL PIN	Fe310		G	
2	Ø4 x 18 IS : 2155	FLAT CSK HEAD RIVET	Fe310		F	
1	Ø14 - 18	KNURLED NUT	Fe310		E	
1	ISST 125 x 1.6 - 55	SLIDING PLATE	Fe310		D	
1	Ø6 - 58	SPECIAL SCREW	Fe310		C	
1	30 ISF 8 - 70	SLIDING JAW	Fe310		B	
1	40 ISF 8 - 85	FIXED JAW	Fe310		A	4.2.163

SCALE 1:1	**MAKING AN ADJUSTABLE SPANNER:- MARKING OUT AS PER BLUE PRINT, DRILLING, CUTTING, STRAIGHT AND CURVE FILING, THREADING, CUTTING SLOT AND CUTTING INTERNAL THREADS WITH TAPS**	TOLERANCE ± 0.02	TIME 25Hrs
		CODE NO. FIN42163E1	

PART- A FIXED JAW

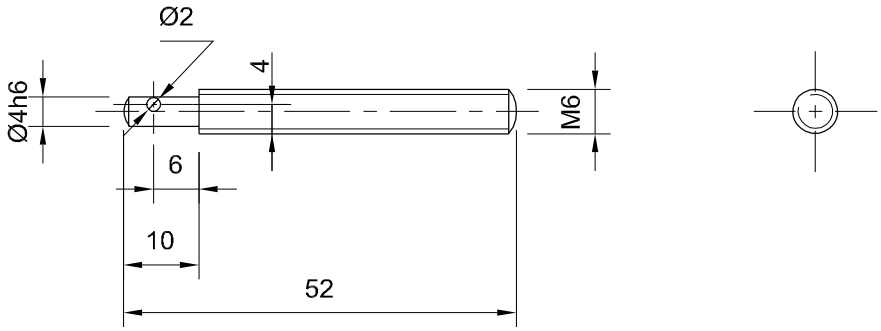


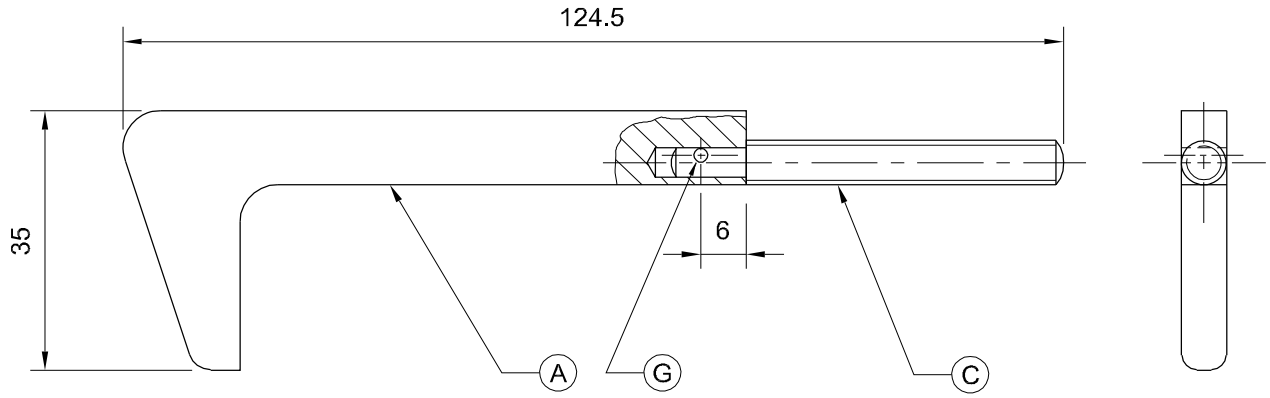
PART - B SLIDING JAW



-	-	-	-	-	A & B	4.2.163
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**FIXED JAW AND SLIDING JAW**				TOLERANCE ±	TIME:
					CODE NO. FIN42163E2	

PART - C SPECIAL SCREW

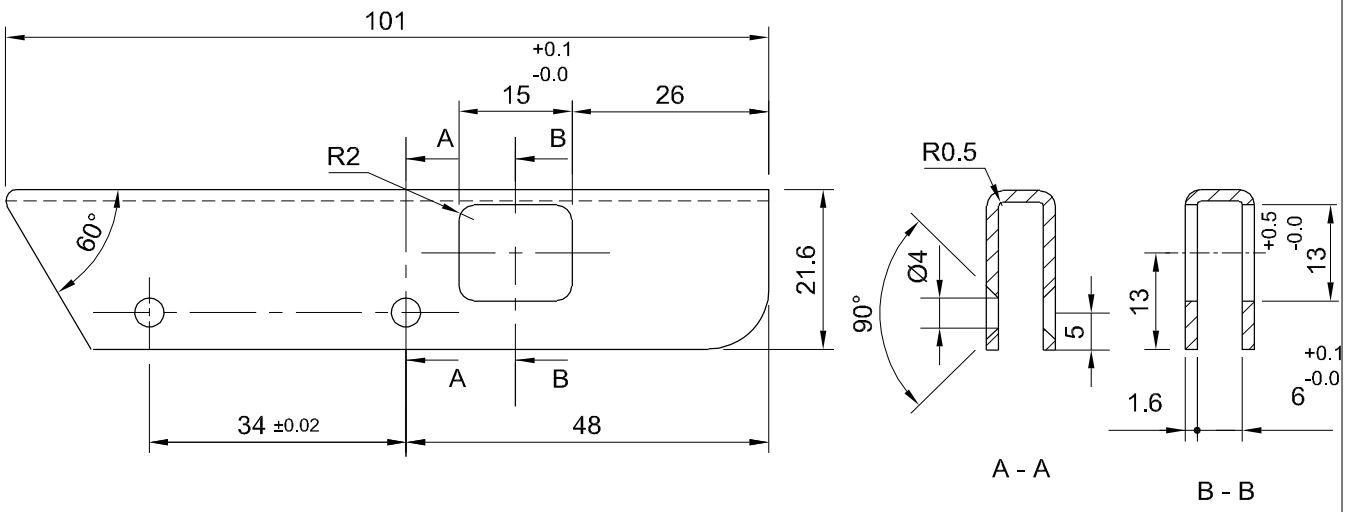




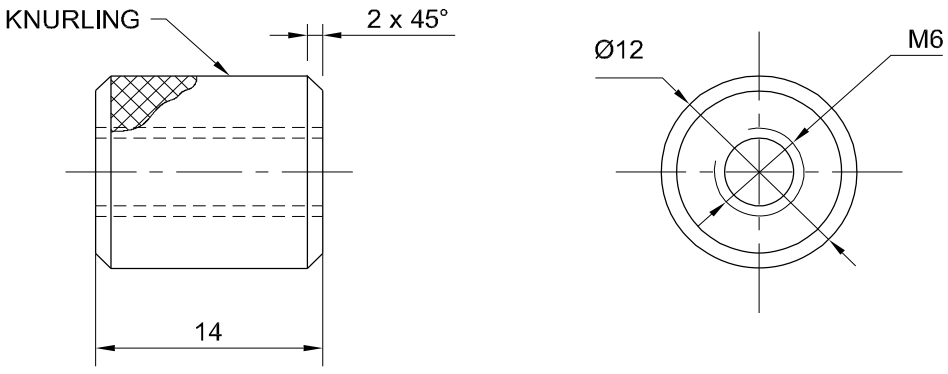
SPECIAL SCREW ASSEMBLED WITH FIXED JAW

-	-	-	-		C	4.2.163
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**SPECIAL SCREW AND ASSEMBLED WITH FIXED JAW**				TOLERANCE ±	TIME:
					CODE NO. FIN42163E3	

PART - D SLIDING PLATE



PART - E KNURLED NUT



-	-	-	-	-	D & E	4.2.163
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	**SPECIAL SCREW AND ASSEMBLED WITH FIXED JAW**				TOLERANCE: ±	TIME:
					CODE NO. FIN42163E4	

Job sequence

TASK 1:

Part 'A' - Fixed jaw

- Check the raw material for the given size
- File the surface and side for straightness
- File the adjacent side for right angle
- Do the marking as per drawing with vernier height gauge
- Remove the excess material by hacksawing or chain drilling
- Drill ∅10 hole for the R5 concave
- File and check for the dimension as per drawing
- Check the radius with radius gauge R5 & R3
- Drill the hole ∅ 3.8 mm from the side to the depth of 12mm and ream ∅ 4
- Drill ∅ 2 as per the drawing dimension
- De - burr and finish smooth surface

TASK 2:

Part 'B' - sliding jaw

- Check the raw material for the given size
- File the surface and side for straightness
- File the adjacent side for right angle
- Mark the job as per the drawing with vernier height gauge
- Remove the excess material by hacksawing or chain drilling and ∅4, 2 hole
- File the job for the dimension and check the dimension
- File for the radius edges
- File the edges and deburr the job

TASK 3:

Part - 'C' - Special screw

- Check the rod for ∅6 x 58 mm
- Turn the rod holding in 3 jaw chuck for ∅4mm, 10mm length with h6 finish
- Do the threading M6 for the entire length
- Check with the die nut for threaded portion

Fixed jaw assembly

- Insert the rod into the fixed jaw and position it.
- Drill ∅2mm hole along with the fixed jaw
- Fit the cylindrical pin ∅2,
- Check the dimensions

TASK 4:

Part 'E' Knurled Nut

- Check the raw material as per the drawing size
- Hold the rod in the three jaw chuck and true
- Turn the round for ∅12mm
- Knurled the outer surface with knurling tool upto 15mm length
- Drill ∅5 mm and tap the drilled hole by M6 Tap
- Chamfer the side 2 x 45°
- Do the parting off and chamfer the other side.

Part D: Sliding plate

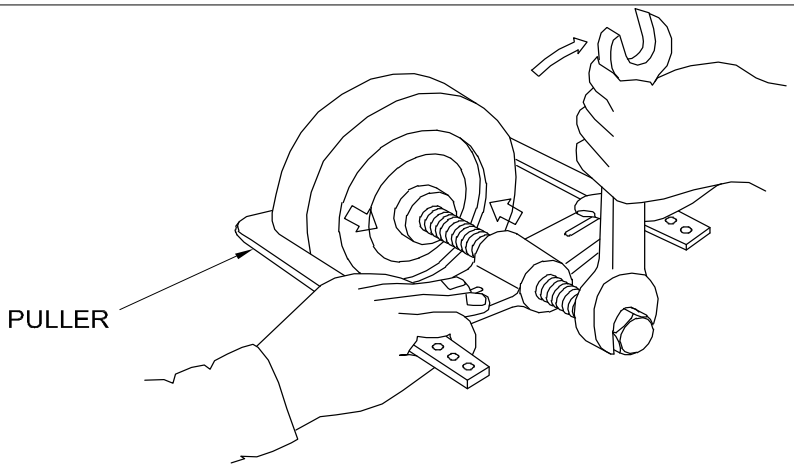
- Check the metal sheet for the dimension
- File the sheet metal for straightness and right angle by draw filing
- Mark the layout as per drawing and punch
- Bend the sheet metal with the help of 6mm flat by hammering
- Check for the dimension after bending
- Drill the ∅ 4 hole for the slot opening
- Chain drilling for the slot opening remove excess metal
- File the slot for the dimensions
- Drill ∅4mm in the position as per drawing
- File for 60° angle and check with bevel protractor
- Do the radius filing and remove the burr's

Spanner assembly

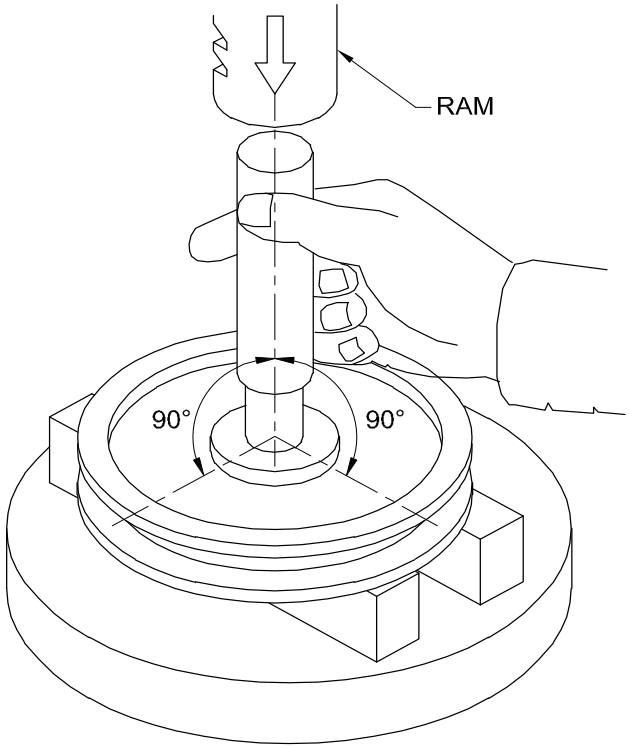
- Check material size for all the parts
- File, mark and finish parts A & B to size
- Bend Part 'D' as per drawing
- Remove excess metal and finish to size
- File and finish square slot
- Drill and counter sink holes
- Turn, drill, tap, knurl and part off part E to size
- Step turn, cut external thread using and part off part 'C' to size
- Assemble part C & A
- Rivet and join part B and D
- Assemble all the parts together

Dismantling and mounting of pulleys

Objectives: At the end of this exercise you shall be able to
- **extract pulley using puller**
- **extract pulley using arbor press**
- **mount pulley on shaft.**



EXTRACT PULLEY USING PULLER



EXTRACT PULLEY USING ARBOR PRESS

–	–	–	–	–	–	4.2.164
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**DISMANTLING AND MOUNTING OF PULLEYS**	TOLERANCE: –	TIME : 10 Hrs
		CODE NO. FIN42164E1	

Job sequence

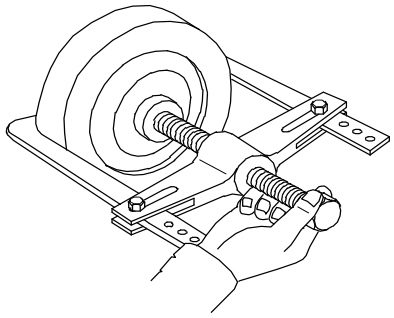
Extract pulley from shaft

- Remove pulley using puller.
- Remove pulley using arbour press.

Extract pulley using puller

- Select correct size of puller, depending upon the size of the shaft and pulley.
- Clean end of the shaft using flat file, to remove any burrs or bulging on the end of the shaft.
- Place the legs of the puller diagonally opposite sides of the pulley to hold the pulley firmly (Fig 1).

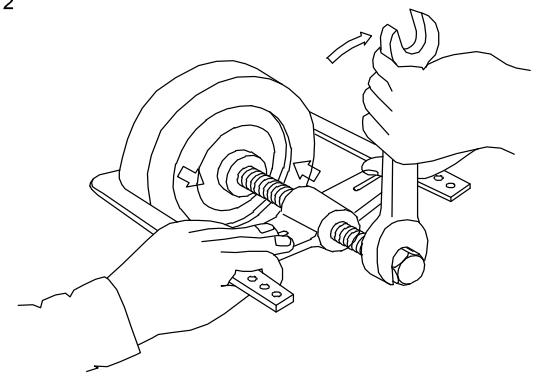
Fig 1



FIN42:164-I1

- Position the centre screw of the puller by hand screwing, so that, sufficient centre screw length is available for complete removal of the pulley from the shaft.
- Apply few drops of oil, around the shaft before removing.
- Tighten the centre screw gradually using correct size spanner and check whether the pulley is coming out freely from the shaft, if not slightly hammer on the head of the centre screw, this will cause the pulley to come out from the shaft freely.(Fig.2)

Fig 2



FIN42:164-I2

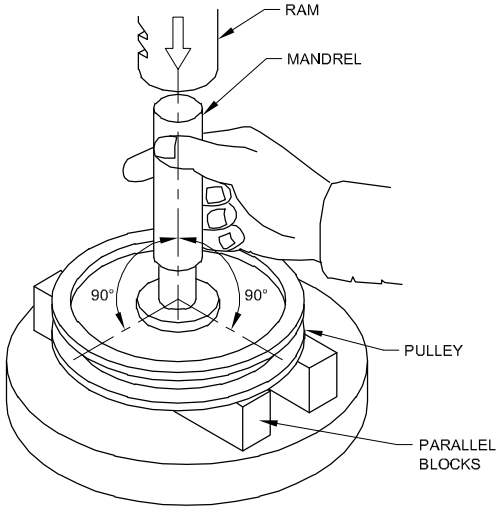
For removing pulley from smaller shaft use Arbor press.

For removing pulley from longer shaft or from the shaft attached to the machine. Use proper puller.

Extract pulley using Arbor press

- Clean the end of the shaft with flat file to remove any burrs or bulging from the end of the shaft.
- Set the Arbor press according to the shaft it should be less than the diameter of the shaft.
- Select the mandrel according to the shaft it should be less than the diameter of the shaft.
- Select a pair of parallel blocks and position them on the bed of the press.
- Place the pulley with shaft on the parallel blocks, such that the shaft in the pulley is in line with the ram of the press. Ensure that the parallel blocks are as close as to the shaft to give maximum support.
- Apply few drops at oil around the shaft to reduce friction during removal.
- Position the mandrel on the shaft and position the ram of the press on the mandrel (Fig 3).

Fig 3



FIN42:164-I3

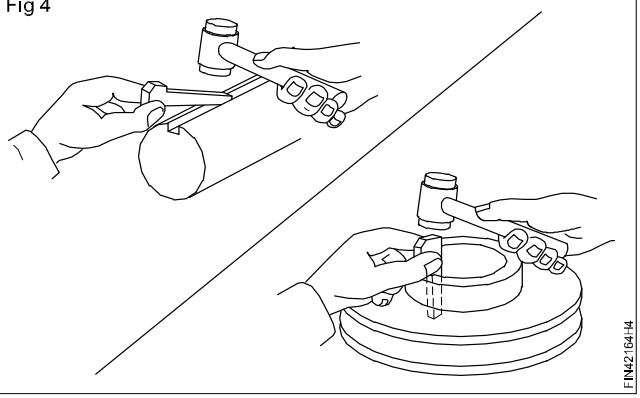
- Apply light pressure with the ram on the mandrel gradually so that the shaft is extracted out of the pulley. Apply same pressure on the ram still the shaft is completely ejected out from the pulley.
- Bring back the ram to its original position gradually and remove the mandrel.

Assemble pulley and shaft

- Deburr the keyway in the shaft and the hub and clean the keyways.
- Check the dimensions of the shaft and the hub and the keyways.

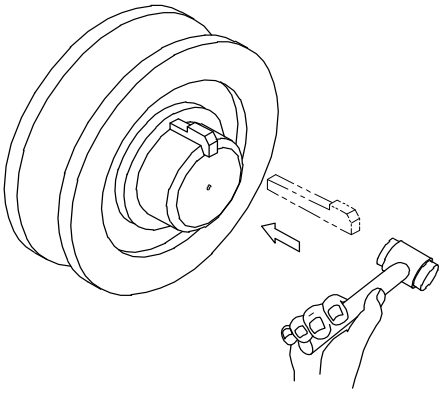
- Check, by inserting the hub on the shaft, so that it is a tight push fit with the hands on to the shaft. Polish the shaft or scrap bore of the workpiece until this fit is obtained.
- Select a Gib head key of the correct section and length.
- Check the key for width by inserting into the keyway of the shaft, draw file the key until it is a light tap fit in the keyway. Similarly, check the key in the keyway of the hub. (Fig. 4)

Fig 4



- Fit the hub on to the shaft by taping slightly with a soft hammer.
- Tap the key in to the keyway. Remove the key and check for any high spots, and file away the high spots. Repeat the above operation until the key head is approximately 15mm away from the boss of the hub. (Fig 5).

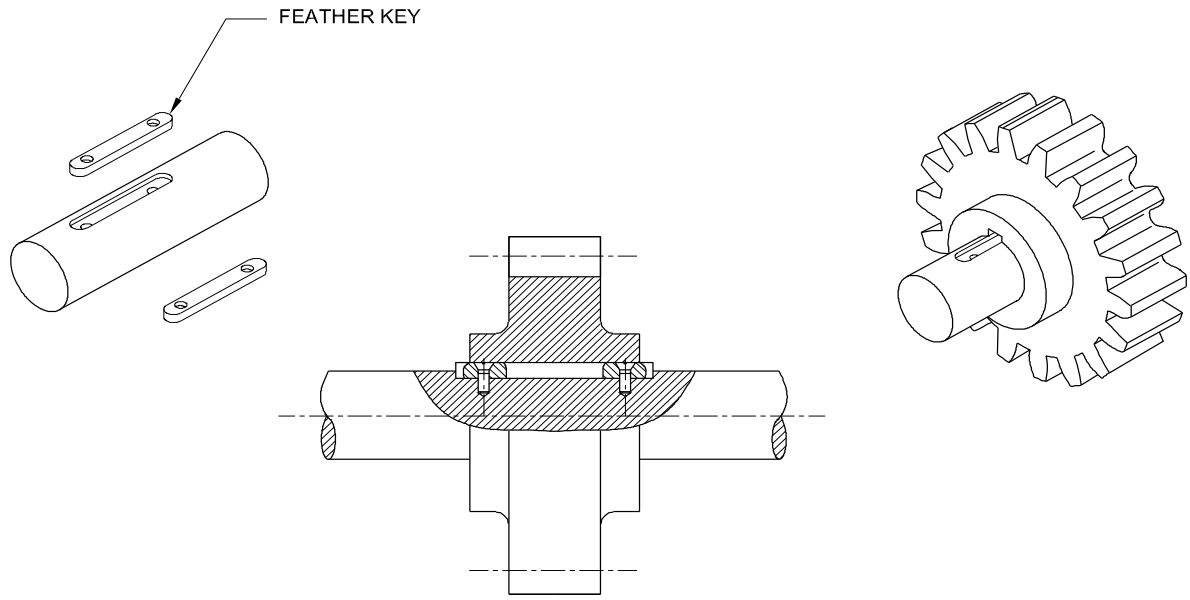
Fig 5

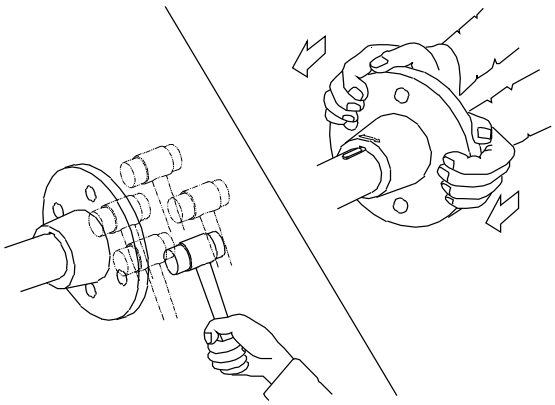


- Remove the key and check the fit on the faces.
- Fit key with a firm blow with a hammer.

Making and replacing damaged keys

Objectives: At the end of this exercise you shall be able to
- **assemble using feather key in hub and shaft**
- **assemble using tapered key in hub and shaft.**





PARALLEL (SUNK) KEY FITTING

–	–	–	–	–	–	4.2.165
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**MAKING AND REPLACING DAMAGED KEYS**				DEVIATIONS	TIME 15Hrs
					CODE NO. FIN42165E1	

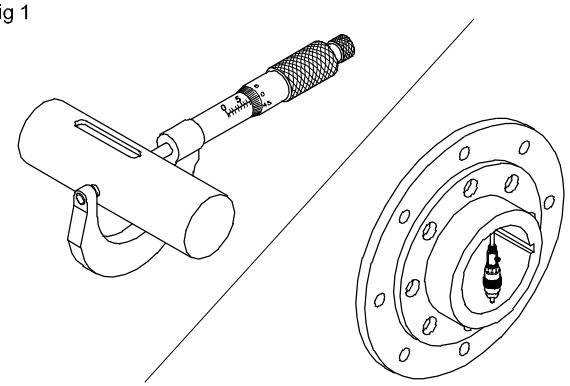
Job sequence

- Assemble hub and shaft with parallel key.
- Assemble hub and shaft with tapered (Gib Head) key.

Parallel key fitting

- Deburr the keyways in the shaft and the Hub, clean the keyways.
- Check the dimensions of shaft and Hub and keyways using precision instruments. (Outside dia of shaft, inside dia of hub, length, width and depth of keyway) as per the drawing (Fig 1).

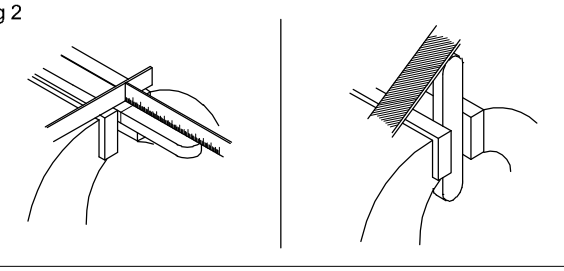
Fig 1



FIN42165H1

- Select a length of key steel (St 60) of suitable cross section depending on the size of the keyway.
- File radius at one end of the key and cut to a length plus 1 mm of the keyway and file other end of the key (Fig 2).

Fig 2

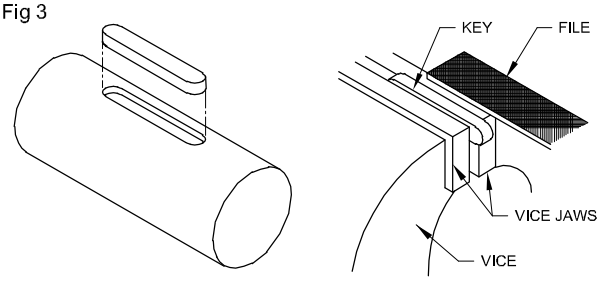


FIN42165H2

Ensure that the key is chamfered all around in its bottom side edges.

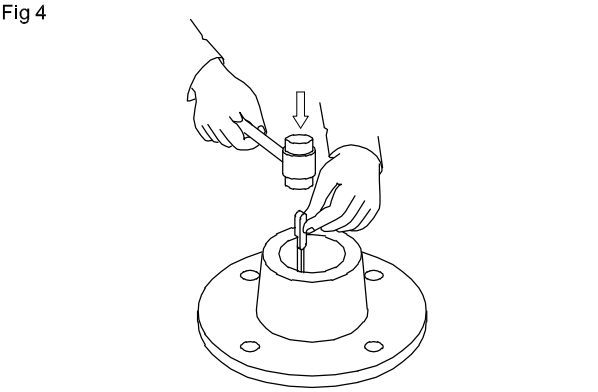
- Check the key width to suit the keyway in the shaft. Draw file the key, so that it is slight tap fit/light keying fit (K7-h6) with the keyway on the shaft (Fig 3).
- Check the key for slight tap fit with the keyway in the Hub (Fig 4).
- Apply Prussian blue on all sides and bottom portion of the key so that proper bearing of key on the keyway is ascertained.
- Insert the key in the keyway of the shaft and tap with a light weight soft hammer (Fig 5).

Fig 3



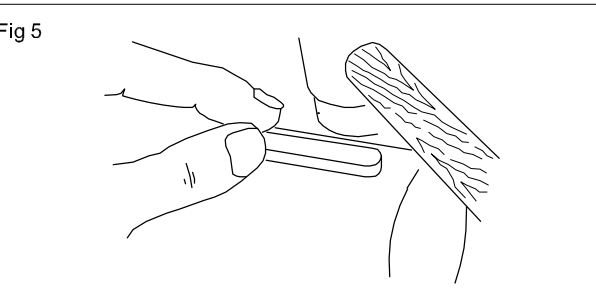
FIN42165H3

Fig 4



FIN42165H4

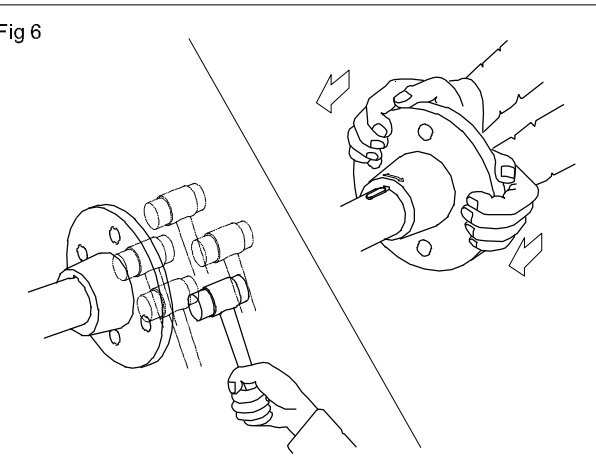
Fig 5



FIN42165H5

- Tap the hub on the shaft, and remove the hub from the shaft, check the key and note the high spots where the key has made contact with the keyway of the hub.
- Lightly file the high spots away, the top of the key should be approximately 0.1mm clear.
- Repeat the fitting and filing operation until the hub is fit on to the shaft to the desired position (Fig 6).

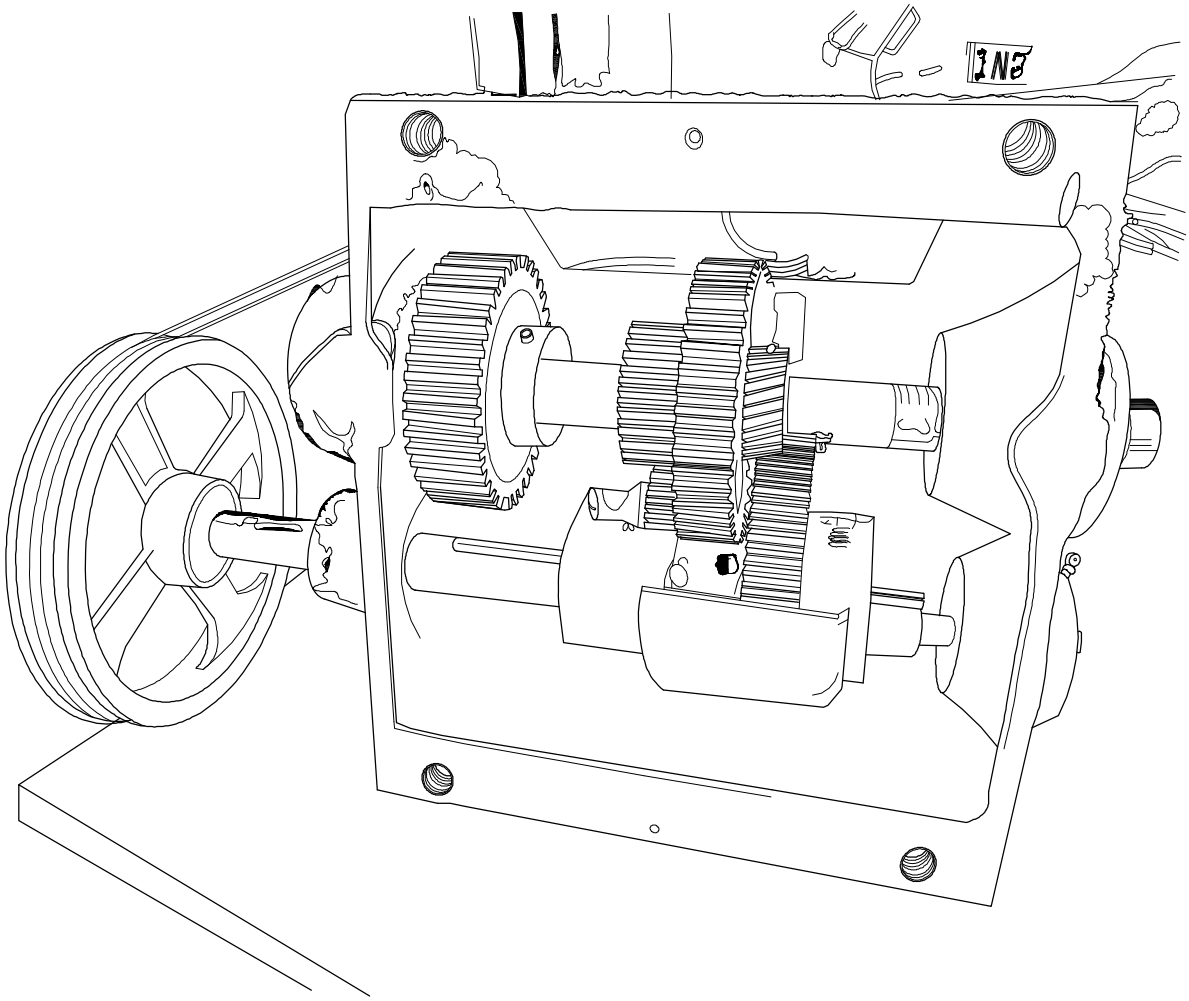
Fig 6



FIN42165H6

Dismounting, repairing damaged gears and mounting and check for work-ability

Objectives: At the end of this exercise you shall be able to
- **dismantle gear box from the machine**
- **check out and replace wornout or damaged parts**
- **assemble the gear box**
- **mount the gear box to the machine, check the test run.**



-	-	-	-	-	-	4.2.166
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	**DISMOUNTING,REPAIRING,DAMAGED GEARS AND MOUNTING AND CHECK FOR WORKABILITY**				TOLERANCE: -	TIME : 15Hrs
					CODE NO. FIN42166E1	

Job sequence

Dismantling the gear box

- Switch of the main power supply
- Inspect the shaping machine gear box.
- Dismantle the guard and belts
- Support the gear box with wooden blanks
- Unscrew the fastener's by using suitable tools (Fig 1).

Fig 1

FIN42166H1

- Remove the gear box and keep it on the work table
- Remove the driven pulley from the driver shaft using puller. (Fig 2)

Fig 2

FIN42166H2

- Remove the key from the drive shaft.
- Remove bearing covers and internal circlips.
- Dismantle the driver shaft by tapping the shaft using copper rod and hammer.
- Remove the bearings and sliding gear unit from the gear box by disconnecting spring loaded shifting lever.
- Remove the end nut, bearing covers, circlips and grup screws in the spacer of the driven shaft. (Fig 3)
- Remove the driven shaft by tapping the shaft using copper rod and hammer then take out the gears, spacers from the gear box.
- Thoroughly clean all the parts using kerosene and wipped out with cotton cloth. (Fig 3 & 4)

Fig 3

FIN42166H3

Fig 4

FIN42166H4

- Check all the part for wear and tear.
- Replace the wornout and damaged parts as needed.
- Lubricate the parts before assemble (Fig 5)

Fig 5

FIN42166H5

- Assemble the gear box in reverse manner of dismantle.
- Mount the gear box with the machine.
- Check the test run with different speeds (four speed).

Skill sequence

Inspection of gear tooth elements

Objectives : This shall help you to
- **check the P.C.D of a given spur gear**
- **check the spur gear tooth thickness**
- **check the teeth clearance between mating gears and backlash**
- **check the concentricity and wear of gears.**

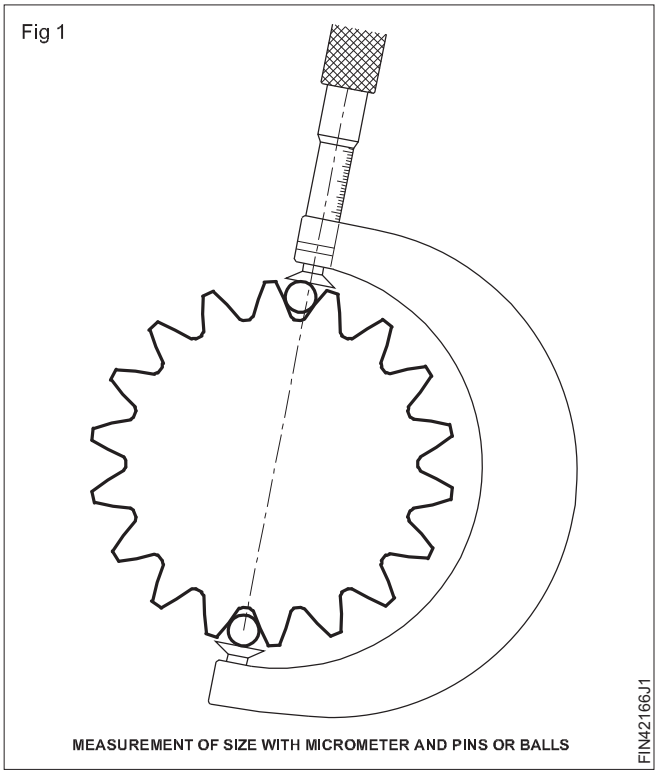
Checking of the PCD of the gear

- Select the gear to be measured and place it on the work table.
- Choose the two standard cylindrical pins or balls for measuring the gear size.
- Hold the flange micrometer, select and place cylindrical pins or balls as shown in the figure 1.
- Note down the flange micrometer reading by locking its thimble and barrel scales.
- Find out the PCD by subtracting the pin or ball diameter from the obtained micrometer reading.

This method is only suitable for gears having even numbers of teeth.

Composite inspection as shown in the figure 2 is a useful shop friendly tool to determine the gear size of having any number of teeth.

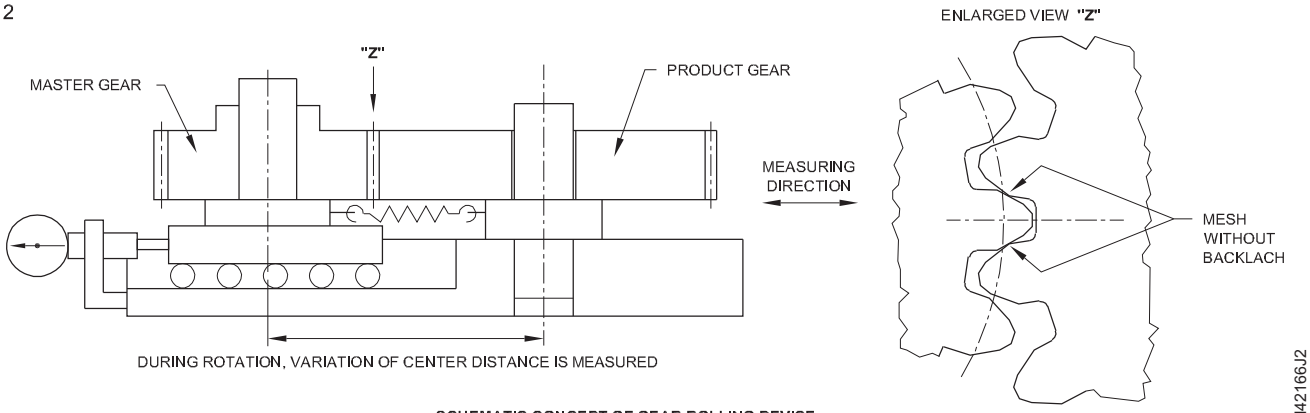
Fig 1



MEASUREMENT OF SIZE WITH MICROMETER AND PINS OR BALLS

FIN42166J1

Fig 2

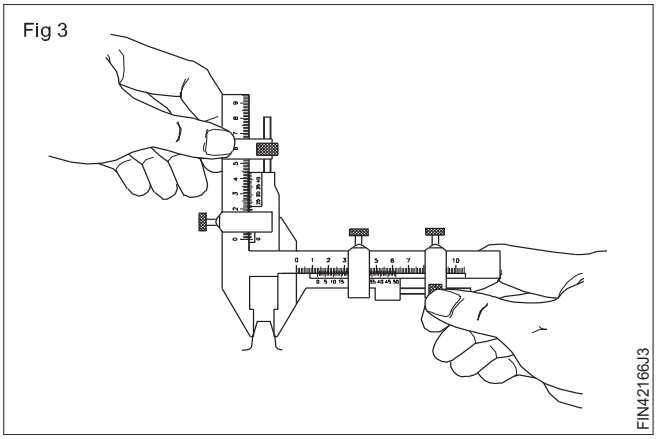


SCHEMATIC CONCEPT OF GEAR ROLLING DEVICE

FIN42166J2

Measuring the gear tooth thickness (Fig 3)

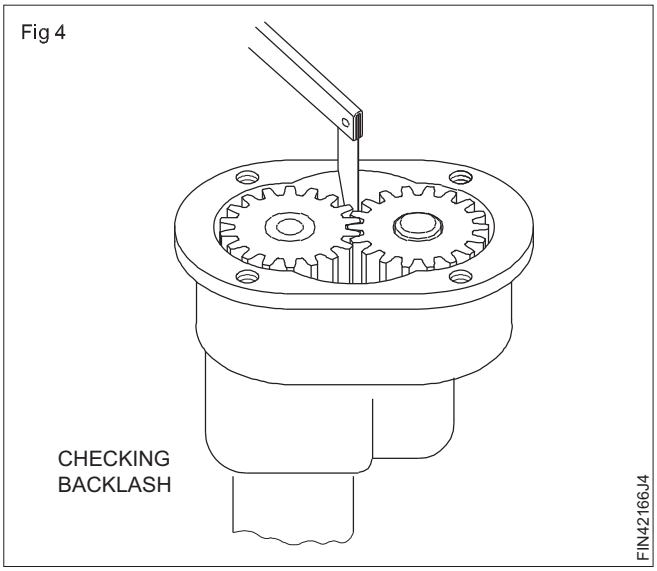
Fig 3



- Select the gear to be measured and hold it with a vice.
- Hold the gear tooth caliper properly as shown in the figure 3.
- Adjust the adjustable tongue of the gear tooth caliper to touch it with the tooth side.
- Note down the reading directly from the caliper and it will be the tooth thickness.

Checking the gear teeth clearance between mating gears and backlash (Fig 4)

Fig 4



- Arrange the gears to be measured as shown in the figure.
- Hold one gear rigid and insert the feeler gauge through the gap between gear teeth of mating gears as shown.
- Note down the feeler gauge reading and it will be the backlash value.
- Compare the measured backlash value with the given table and ensure it within the permissible value (limit).

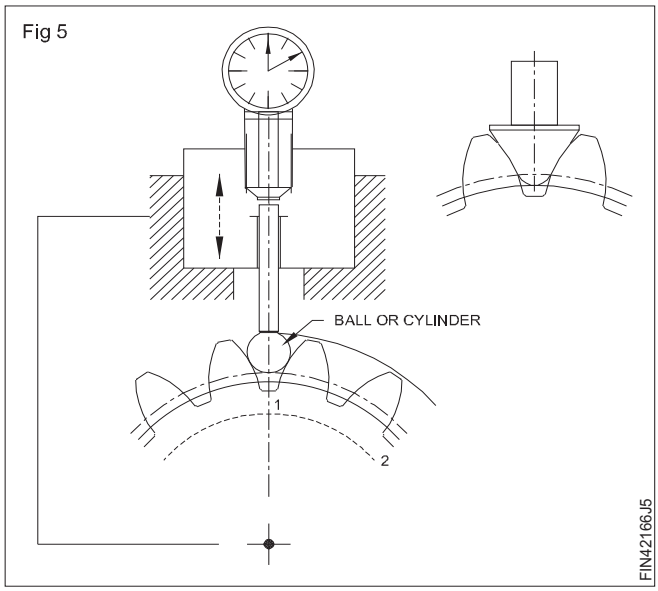
Table 1

Backlash Suggestions

Pitch	Backlash
3P	0.013
4P	0.010
5P	0.008
6P	0.007
7P	0.006
8-9 P	0.005
10-13P	0.004
14-32P	0.003
33-64P	0.0025

Checking the concentricity and wear of gears (Fig 5)

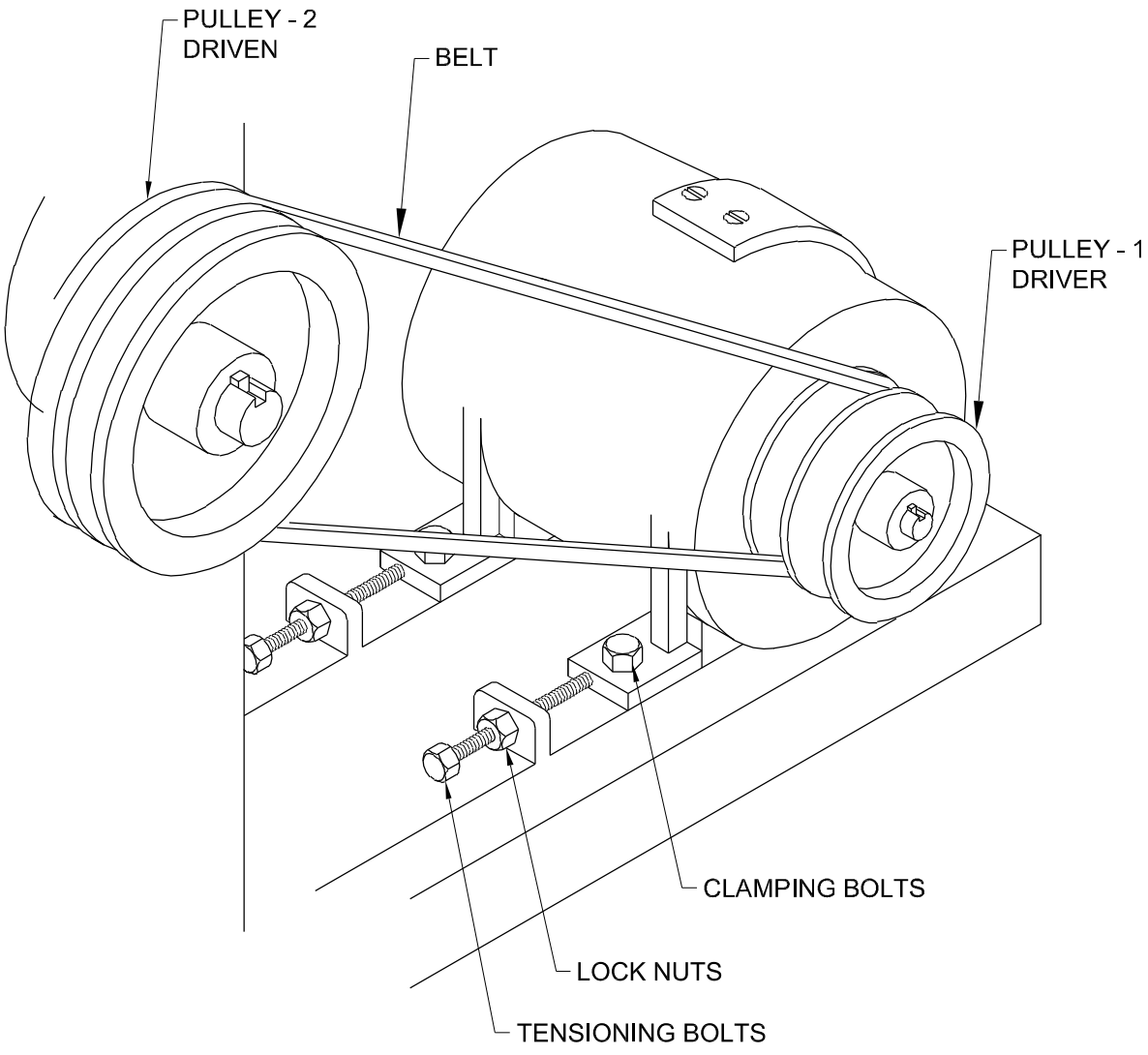
Fig 5



- Fix the gear to be measured in a mandrel as shown in the figure.
- Select suitable ball or cylindrical pin and place it in between the gap of two teeth.
- Hold the dial indicator in such a way that it will touch the outer periphery of cylindrical pin or ball.
- Note down the dial indicator reading.
- Repeat the same procedure for all the gear teeth and simultanously note down the dial indicator reading.
- Calculate the total runout or concentricity by subtracting maximum and minimum dial gauge reading.

Repair & replacement of belts and check for workability

Objectives: At the end of this exercise you shall be able to
- **fix a belt on driver and driven pulley**
- **measure tension of a 'V' belt drive**
- **adjust belt tension with a spring balance.**

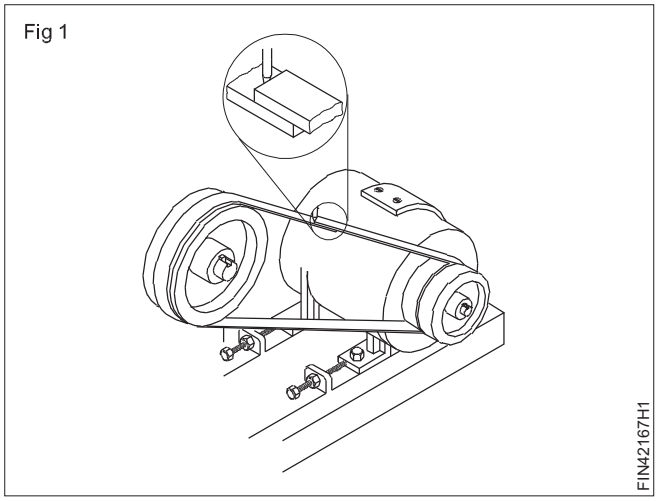


-	–	–	–	–	–	4.2.167
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	**REPAIR & REPLACEMENT OF BELTS AND CHECK FOR WORKABILITY**				TOLERANCE: -	TIME : 10 Hrs
					CODE NO. FIN42167E1	

Job sequence

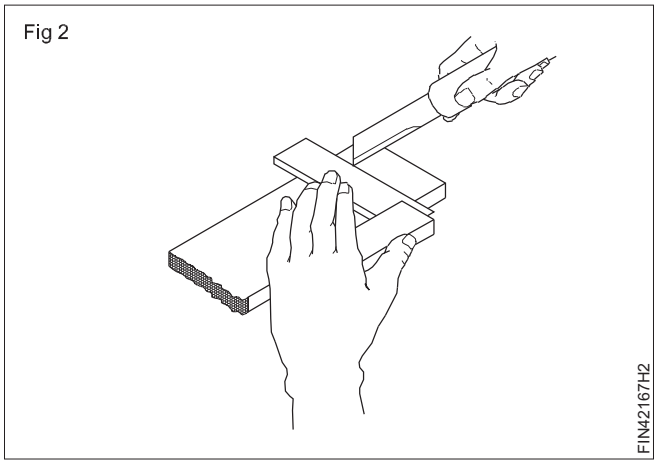
- Mark and cut the belt to the required length (Fig 1).

Fig 1



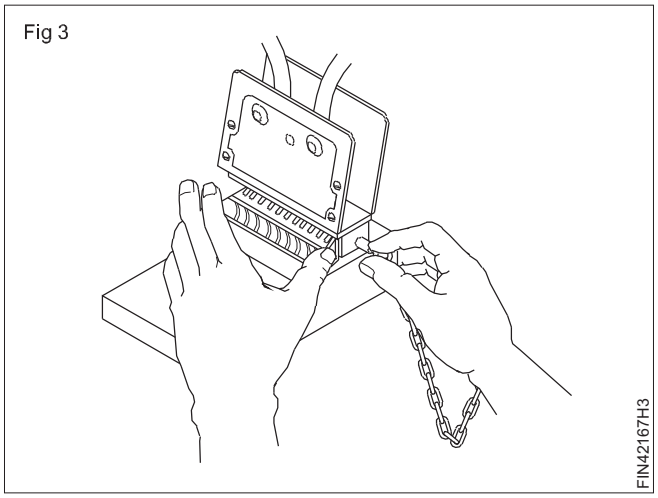
- Trim both ends of the belt square (Fig 2).

Fig 2



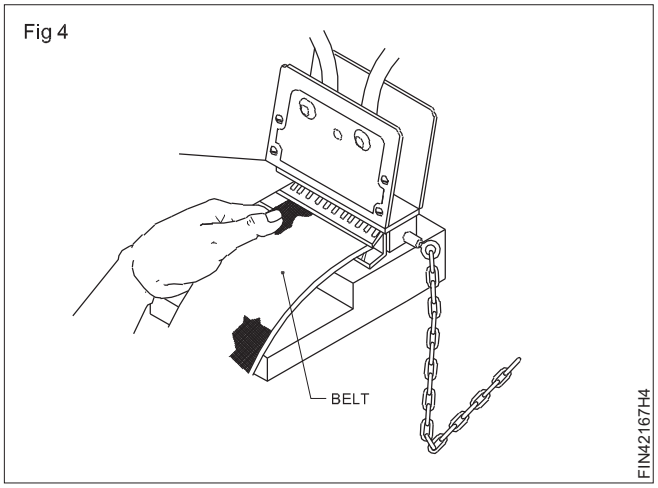
- Fit an alligator fastener centrally into the jaws of the lacing machine and fit the pin into the side of the jaws to hold the fastener in the machine (Fig 3).

Fig 3



- Put the belt centrally between the jaws of the machine. (Fig 4)

Fig 4



- Operate the machine to press the fastener into the belt until it is flush with the belt (Fig 5 & 6). Trim the edges of the fastener.

Fig 5

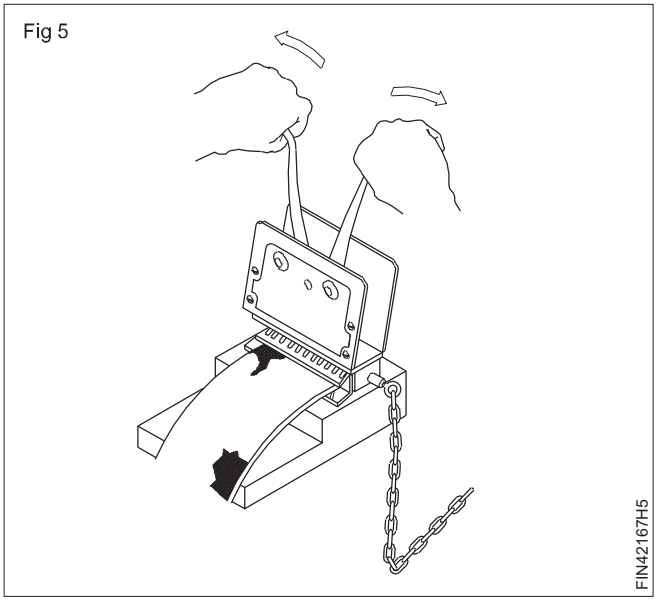
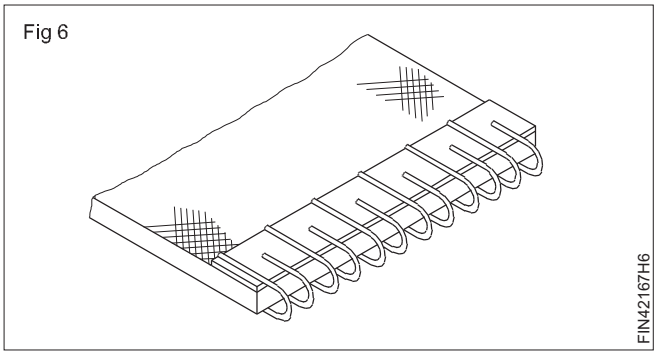
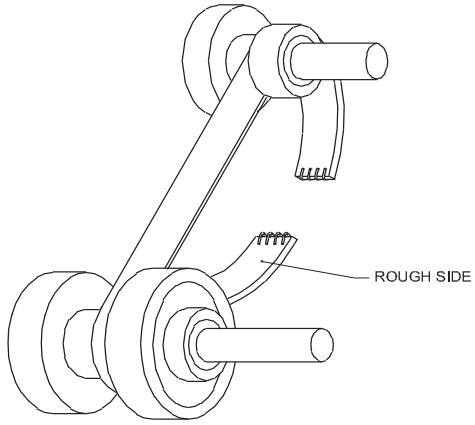


Fig 6



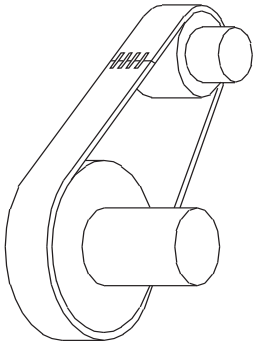
- Place the belt around the shafts beside the pulleys with the rough side against the pulleys and join both ends by the pin (Fig 7).
- Fit the belt to the small pulley end first and then run it on to the big pulley (Fig 8).

Fig 7



FIN42167H7

Fig 8



FIN42167H8

Skill sequence

Adjust belt tension in ‘v’ belt drive

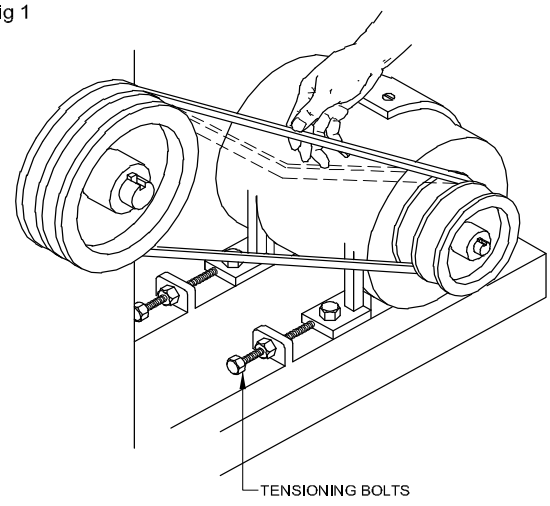
Objectives : This shall help you to
- **check belt tension using a spring balance**
- **adjust belt tension by tensioning bolts.**

Measure the longest span length of the belt between the pulleys, using a steel tape.

Find the middle of the longest span of the belt between the pulleys.

Push this mid-point inwards, then pull it out and note the total deflection. (Fig 1)

Fig 1



FIN42167J1

This indicates the existing tension of the belt.

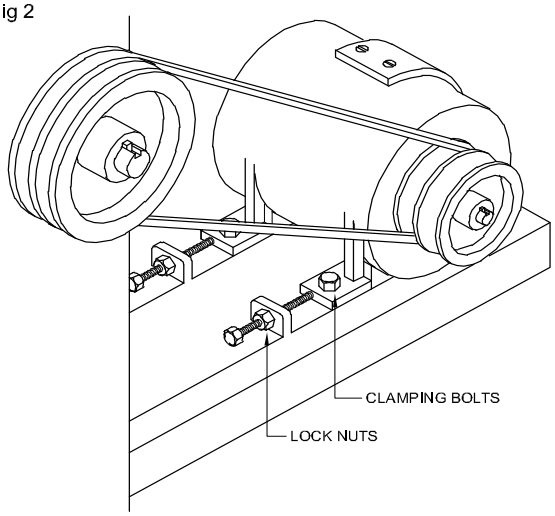
Loosen the lock-nuts. (Fig 2)

Slacken the clamping bolts. (Fig 2)

Move the pulley with the adjusting screws to alter the tension. (Fig 2)

The adjusting screws must be turned equally to keep the pulleys correctly aligned.

Fig 2



FIN42167J2

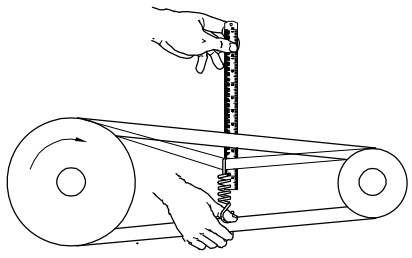
Attach a spring balance and check the tension of the belt. (Fig 3)

Readjust the adjusting screws untill the tension is correct.

Tighten the clamping bolts.

Tighten the lock-nuts.

Fig 3



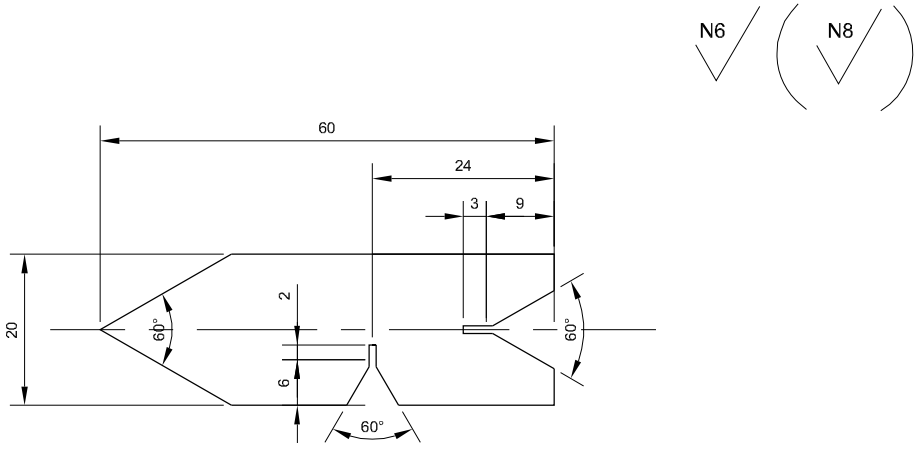
COMPRESSOR CROSS - SECTION VIEW

FIN42167J3

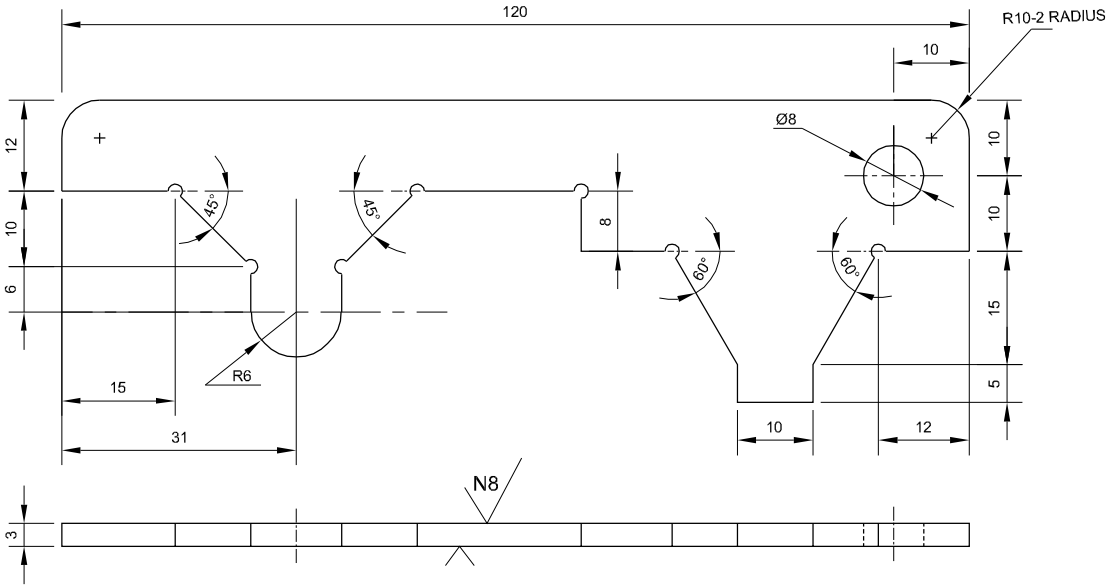
Making of template / gauge to check involute profile

Objectives: At the end of this exercise you shall be able to
- **mark dimensions with a vernier height gauge for Task 1 and 2**
- **mark angles with a vernier bevel protractor for Task 1 and 2**
- **make relief by hacksawing**
- **file external and internal 'V' to an accuracy of ± 10 minutes.**

TASK 1



TASK 2



1	50 ISF 4-125	–	Fe-310	–	TASK 2	4.2.168
1	25 ISF 4-63	–	Fe-310	–	TASK 1	
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**MAKING OF TEMPLATE / GAUGE TO CHECK INVOLUTE PROFILE**	TOLERANCE LINEAR :±0.02 ANGULAR :5'	TIME : 25 Hrs
		CODE NO. FIN42168E1	

Job sequence

TASK 1: **Angle gauge**

- Check the raw material for its size
- File and finish the plate to size 60 x 20 x 3.8mm (0.4mm thick for grinding allowance
- Mark centre lines for the 60° external Vee and relief grooves.
- Mark centres for 2 mm relief hacksawing.
- Cut off excess metal with a hacksaw from the plate, for the two 'V' grooves.
- Ensure that punch marks are visible and sufficient metal is left for finish filing
- File and finish the sides of the groove with a knife edge file
- Ensure that the width of the remaining metal on both sides of the 'V' grooves end is equal.
- Check the accuracy of the 60° angle with the template / gauge supplied.
- Repeat the steps for the 'V' groove.
- Cut off excess metal from the plate for external 'Vee' on one side.
- File and finish the side of the 'VEE' correct to the centre line.
- Cut off excess metal from the other side of 'Vee'
- File and finish the 'Vee' to the centre line
- Check the 60° & 45° angle with a vernier bevel protractor file, and finish all the edges.
- Remove burrs and check the dimensions.

– – – – – – – –

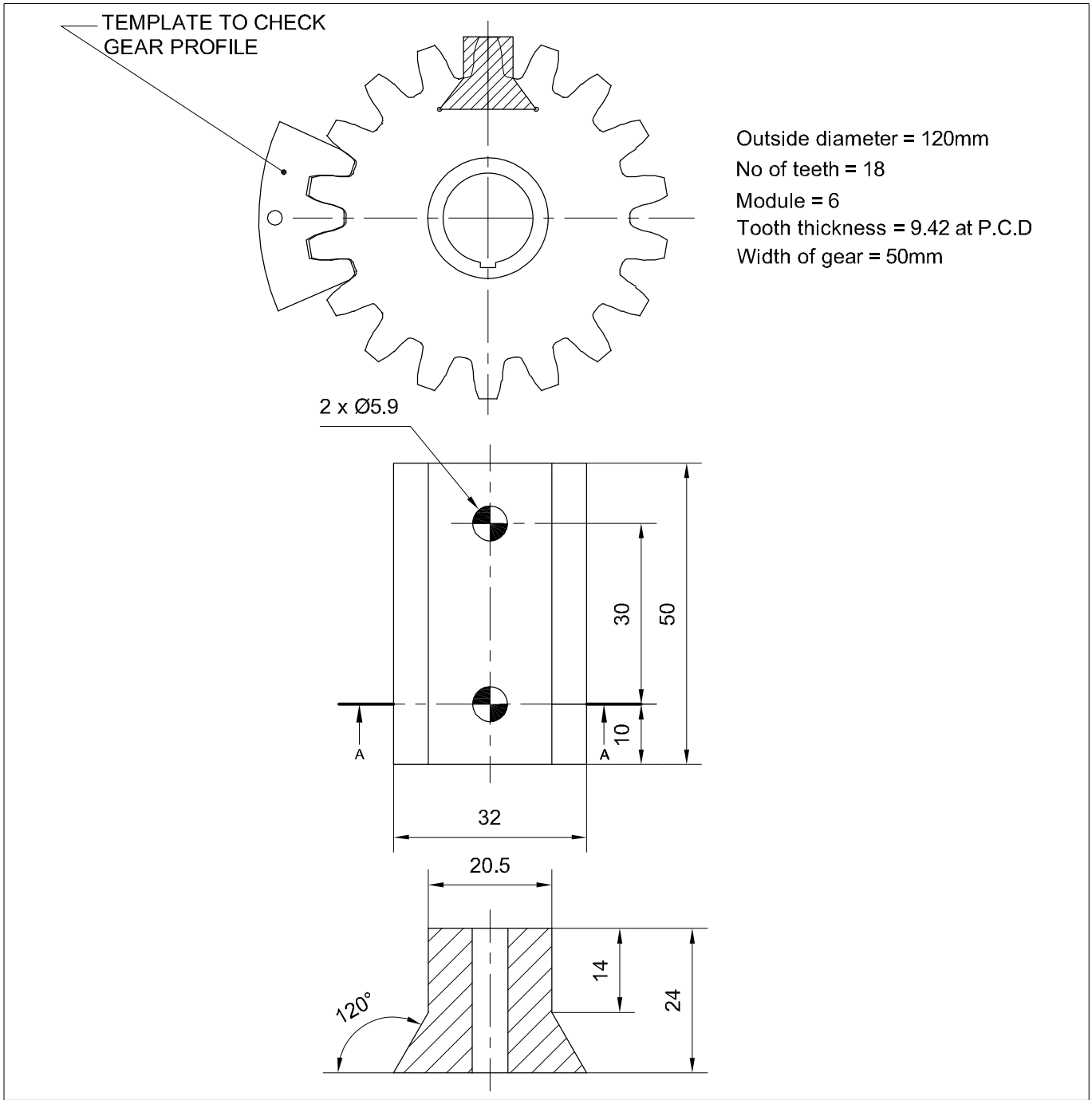
TASK 2: **Template of different profiles**

- Check the raw material for it s size
- Remove burrs and check the raw material size.
- File the large surface with a 200mm flat second cut file (Hold the sheet on the wooden block)
- File two adjacent sides - flat and square.
- Make relief hole by drilling as per drawing.
- Mark dimensions as per drawing.
- Hacksawing and remove the excess material.
- File and finish the remaining surfaces (60mm) to size and check the size.
- File and finish external and internal 60° angles and radius check with vernier bevel protractor and gauge.
- File and finish thickness to 3 mm, by fixing work on the wooden block.

Care should be taken to maintain the correct length

Repair of broken gear tooth by stud and repair broken gear teeth by dove-tail

Objectives: At the end of this exercise you shall be able to
- **repair gear tooth by stud and welding method**
- **repair gear tooth by dovetail method.**



1	□36-55	-	FG 15	-	-	4.2.169
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

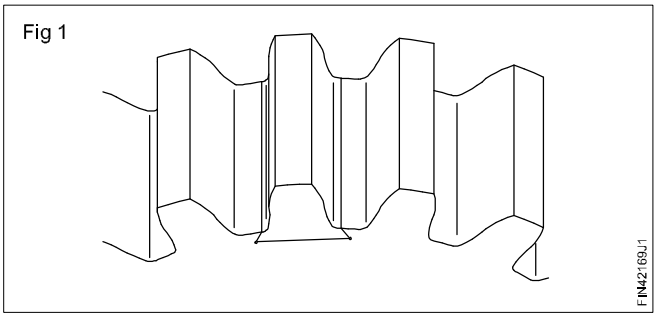
SCALE 1:1	REPAIR OF BROKEN GEAR TOOTH BY STUD AND REPAIR BROKEN GEAR TEETH BY DOVETAIL	TOLERANCE : ±0.02	TIME : 25h
		CODE NO. FIN42169E1	

Job sequence

TASK 1: **Repair broken gear tooth (dovetail blank method)**

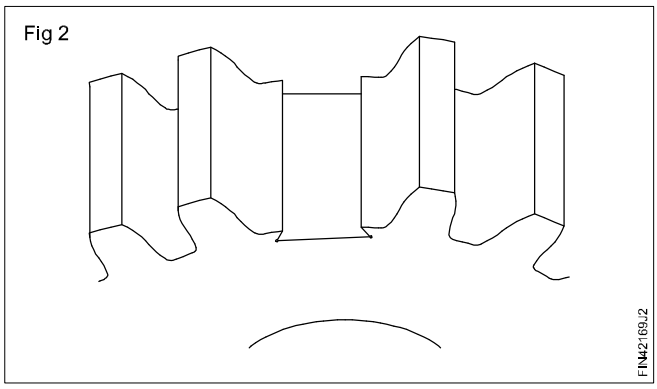
- Support the gear against a Vee block and clamp it by parallel clamp.
- Mark the dovetail groove on the gear wheel from both sides using a vernier height gauge and vernier bevel protractor.
- Punch the marking lines (Fig 1).

Fig 1



- Drill 3mm dia. relief holes one each on the corner of the dovetail.
- Remove material from the gear to shape and size of dovetail as per marking (Fig 2).

Fig 2



- File the blank to the profile of the gear tooth as per punch mark.
- File the dovetail portion of the blank.
- Fit the blank into the dovetail groove of the gear wheel. If necessary, file the blank till it fits in.
- Apply Prussian blue on the dovetail groove to check the high spots in the blank piece.
- Remove the high spots and make a snug fit in the dovetail groove.
- Drill 5.9mm dia. - 2 holes up to a depth of 33mm on the blank and gear wheel in assembled condition.
- Ream the holes using a hand reamer.

Dismantle the assembly and remove the chips from the holes of the gear and the blank.

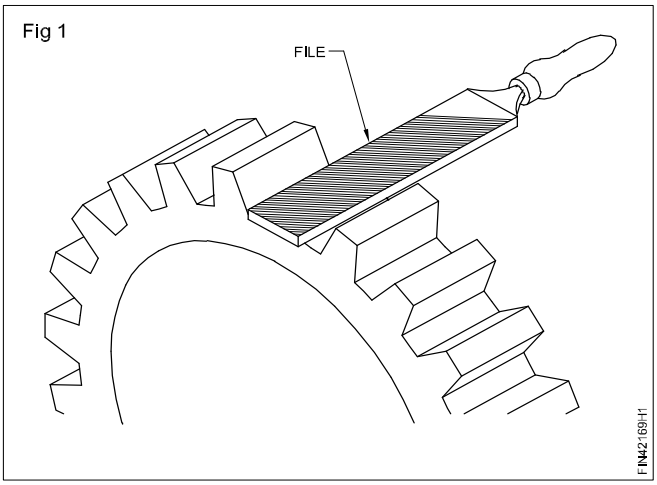
- Assemble again and fit the dowel pins in the holes by a slight tapping.
- File the profile of the gear tooth to the correct shape.
- Use a template to check the profile.

File the sides of the blank, flush with the gear.

TASK 2: **Repair broken gear tooth (Welding method)**

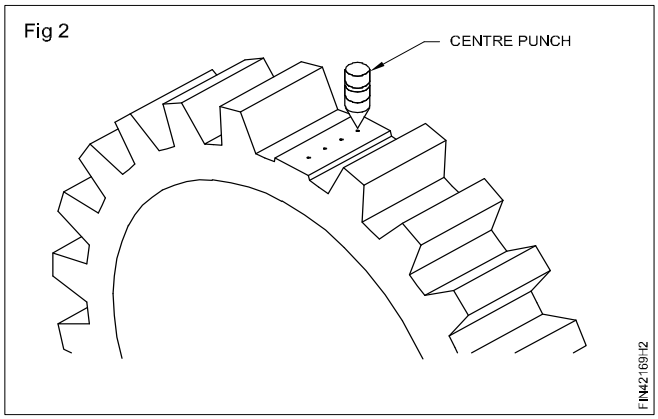
- File the broken tooth surface flat (Fig 1).

Fig 1



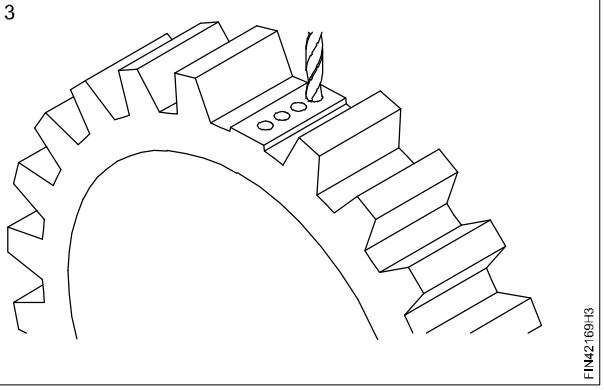
- Mark for four holes on the surface with 10mm centre distance between the holes.
- Punch the centres for drill holes (Fig 2).

Fig 2



- Drill 5 mm dia. holes on the centres to a depth of 9 mm. (Fig 3).

Fig 3

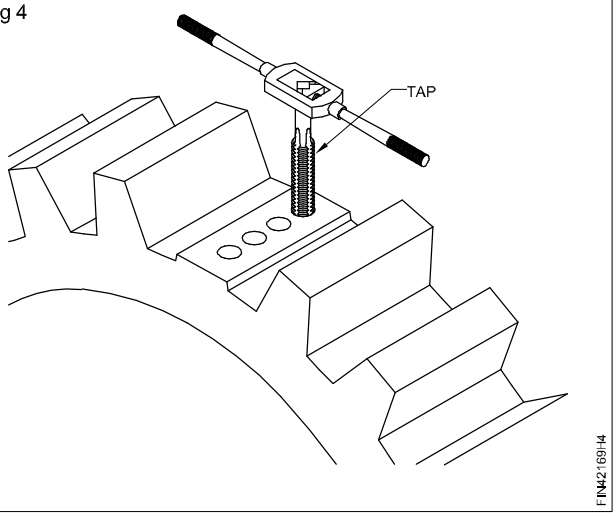


FIN42169-H3

Remove the chips from the holes.

- Tap the holes using a M6 hand tap (Fig 4)

Fig 4

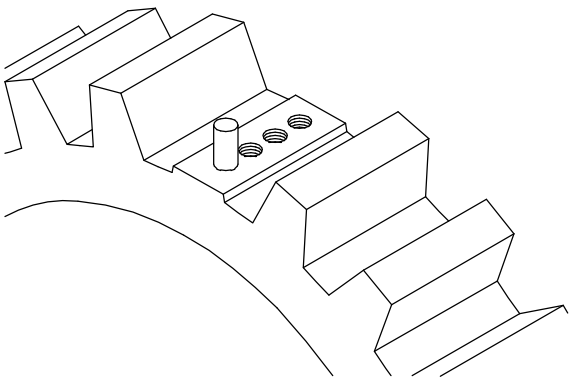


FIN42169-H4

Remove the chips and clean the tapped holes.

- Fix up four hexagonal headed M6 bolts into the tapped holes and tighten them securely (Fig 5)

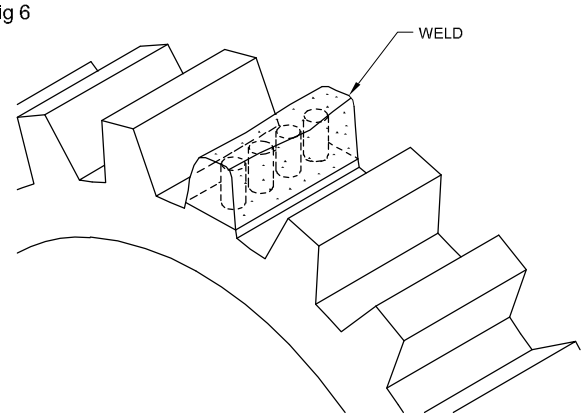
Fig 5



FIN42169-H5

- Cut off the hexagonal head of the bolts by hacksawing.
- Build up material by welding just enough to make the tooth profile by filing (Fig 6).

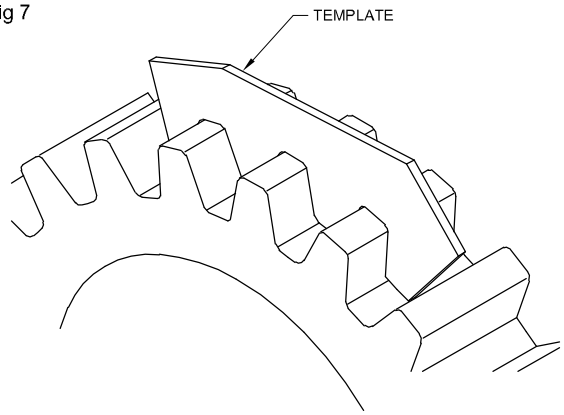
Fig 6



FIN42169-H6

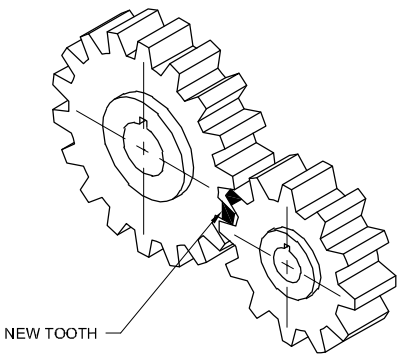
- File the built up material to tooth profile. Use a template frequently to check the profile to have correct shape and pitch (Figs 7 & 8).

Fig 7



FIN42169-H7

Fig 8

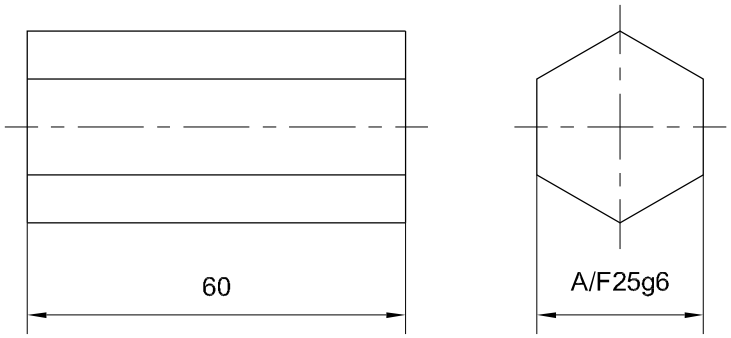


FIN42169-H8

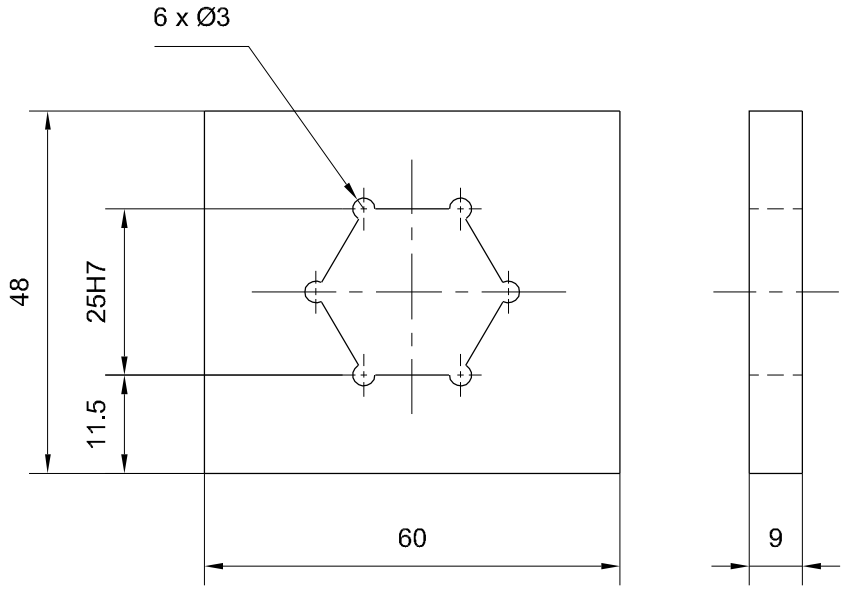
Make hexagonal slide fitting

Objectives: At the end of this exercise you shall be able to
- **file and finish matting parts within ±0.02 mm using O.S.micrometer**
- **file and finish mating parts having angular surfaces within ±10' accuracy using vernier bevel protractor.**

PART - (1)



PART - (2)

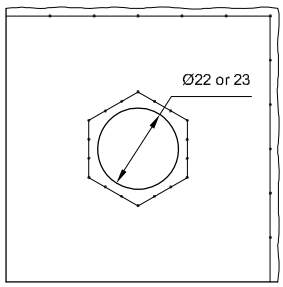


1	65 ISF 10 - 52	-	Fe310	-	2	4.2.170
1	HEX A/F 27 - 63	-	Fe310	-	1	
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	MAKE HEXAGONAL SLIDE FITTING				TOLERANCE ±0.02	TIME 20Hrs
					CODE NO. FIN42170E1	

Job sequence

- File the surface and two adjacent edges at right angle to each other.
- Check the squareness.
- Refer the job drawing and do the marking as per the dimensions given (Fig 1).

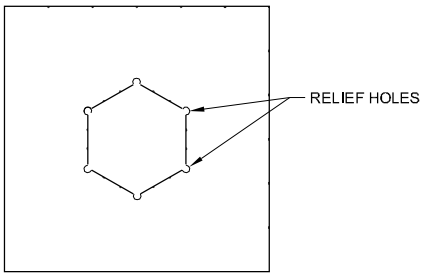
Fig 1



FIN42170H1

- File the excess material and maintain the dimension 70mm with vernier caliper.
- Check the squareness with square head.
- To make the hexagonal cut out, drill a 22 or 23mm dia. drill hole in the centre. File the hexagonal shape with a square file or triangular file (Fig 1).
- At this stage make 6 relief hole in the corners by ∅3 mm drill.

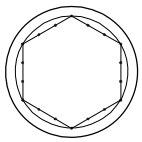
Fig 2



FIN42170H2

- Finish the hexagonal shape and check the angle by the help of protractor head. (120°)
- Check the dimension in side and parallelism of faces with a vernier caliper.
- File the end of the given rod at right angle to the axis.
- Mark the hexagon as per the dimensions given in the drawing (Fig 3).

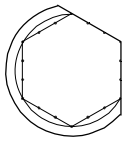
Fig 3



FIN42170H3

- File one side up to the marked line. Check the parallelism through out the length.
- File the adjacent side and check the angle (120) by protractor head.
- File and finish the other sides also (Fig 4).

Fig 4



FIN42170H4

- Finally check the flat dimension and other sizes and assemble in the hexagonal slot.
- Place the female part on a wooden block. File and finish both surfaces with a smooth file and maintain the thickness.
- Remove the burrs from the edges. `

Skill sequence

Marking using vernier height gauge

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

What is the main function of a vernier height gauge?

One of the main 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 references surfaces to confirm whether the zero of the vernier coincides with the zero of the beam scale when the scriber contacts the references surfaces. (Fig 1)

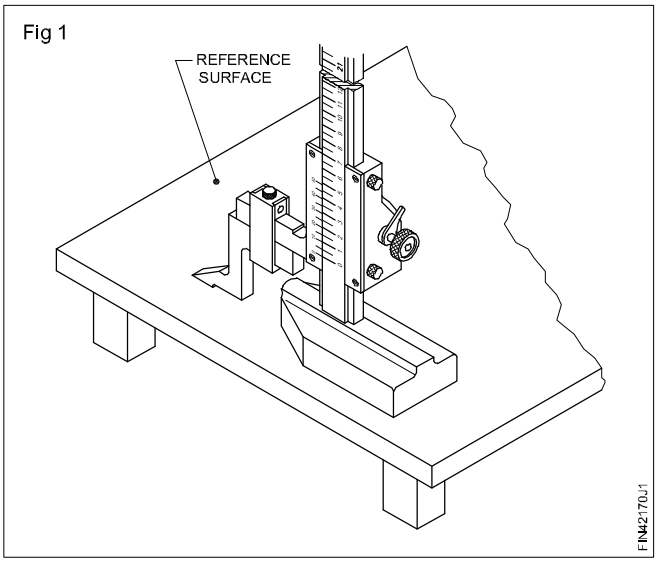
Check the free movements of the sliding unit.

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

Workpiece necessitates clamping to an angle plate if it is thin.

The application of the marking media sholud be light, thin and even.

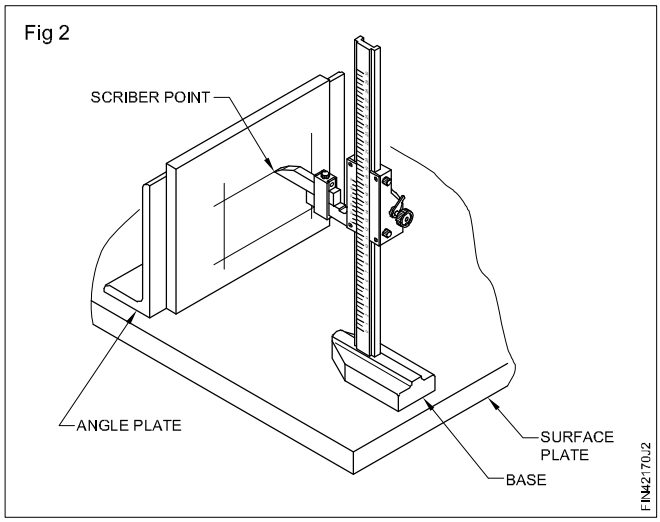
Fig 1



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

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

Fig 2

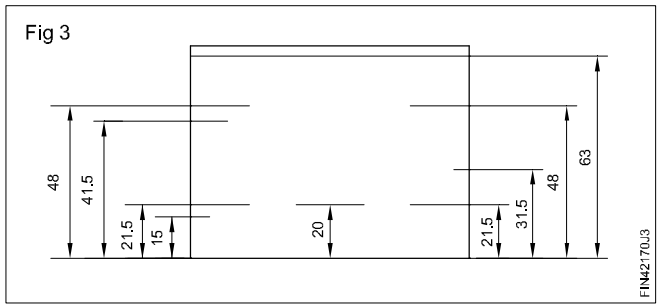


Do not allow the base to lift.

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.

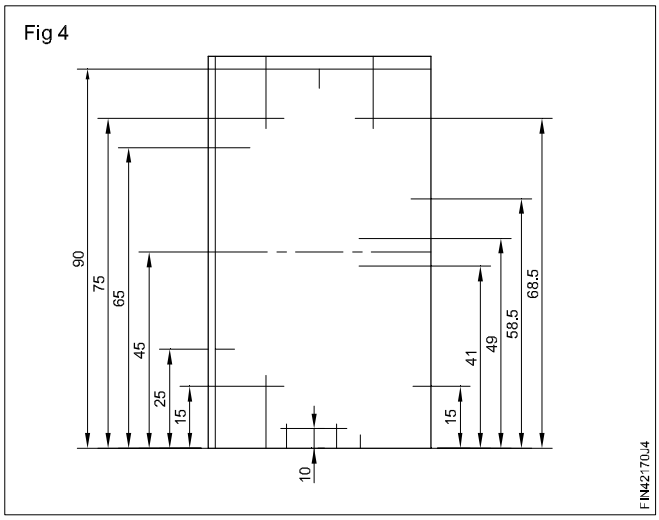
Scirbe first all lines of dimensions in one direction (Fig 3).

Fig 3



Place the work at 90 degrees and scribe the lines to dimensions to intersect one another. (Fig 4)

Fig 4

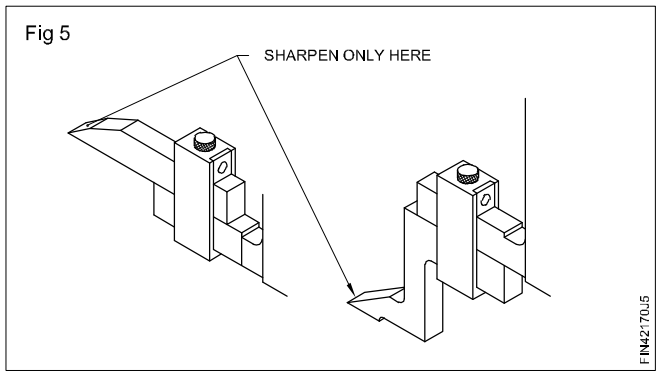


Work surfaces should be finished flat and smooth to avoid lifting during marking.

Precautions to get exact lines

Ensure the scriber point is sharp always. Sharpen only the inclined surface of the scriber point (Fig 5).

Fig 5



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

Prepare different types of documentation as per industrial need by different methods of recording information

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

TASK 1: **Documentation 1**

Note:

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

Job sequence

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

-	-	-	-	-	-	4.2.171
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	PREPARE DIFFERENT TYPES OF DOCUMENTATION AS PER INDUSTRIAL NEED BY DIFFERENT METHODS OF RECORDING INFORMATION				TOLERANCE ±	TIME 5Hrs
					CODE NO. FIN42171E1	

BATCH PROCESSING RECORD - FORMAT - 1

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

BILL OF MATERIAL (BOM)- FORMAT-2

(as per IS: 11666 - 1985)

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

Date:

Place: Incharge

PRODUCTION CYCLE TIME - FORMAT-3

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

Operator:									Machine Cycle Time	Notes
Operations Sequence	Observed Times							Lowest Repeatable		

DAILY PRODUCTION REPORT - FORMAT- 4

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

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

Signature of section Incharge

MANUFACTURING STAGE INSPECTION REPORT - FORMAT-5

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

TASK 2: **Documentations - 2**

Objectives : At the end of this exercise you shall be able to
- **prepare and fill job card in format**
- **prepare and fill work activity log in format**
- **prepare and fill batch production record**
- **prepare and fill estimation sheet in format**
- **prepare and fill maintenance log in format**
- **prepare and fill the history sheet of machinery and equipment in format**
- **prepare and fill maintenance record in format.**

Note:

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

Job sequence

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

-	-	-	-	-	-	4.2.171
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	PREPARE DIFFERENT TYPES OF DOCUMENTATION AS PER INDUSTRIAL NEED BY DIFFERENT METHODS OF RECORDING INFORMATION				TOLERANCE ±	TIME
					CODE NO. FIN42171E2	

JOB CARD - FORMAT-1

Job Card	Doc No.	
	Rev No.	
	Date	

Order Starting Date	
Customer	
Work Order No.	

Details

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

WORK ACTIVITY LOG - FORMAT-2

Organisation Name:

Department:

Section:

Employee Name:

Supervisor Name:

Date:

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

BATCH PRODUCTION RECORD - FORMAT-3

Batch Production Record in accordance with batch processing record

Manufacturing Organisation Name: _____

Description of job: _____

Name of part: _____

Batch No.: _____

The following deviations have appeared (continued)

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

ESTIMATION SHEET - FORMAT-4

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

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

Prepared by: _____ Date: _____

Approved by: _____

MAINTENANCE LOG - FORMAT-5

Organisation Name :

Department :

Section :

Name of the machine :

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

MACHINERY AND EQUIPMENT RECORD - FORMAT-6

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

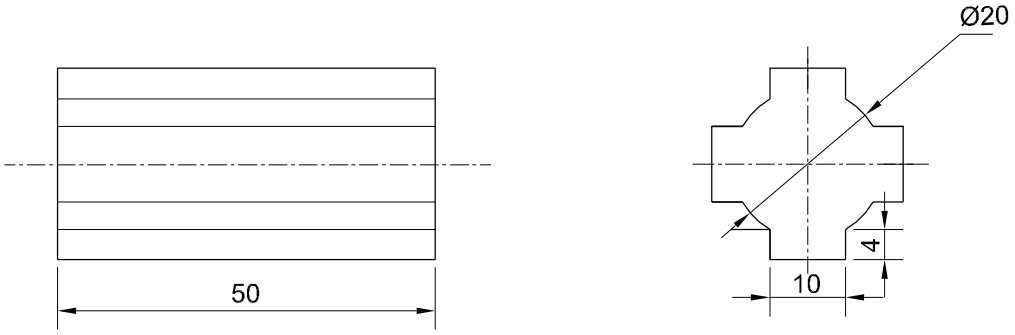
PREVENTIVE MAINTENANCE RECORD - FORMAT-7

Organisation Name :			
Department :			
Section :			
Name of the Machine :		Location of the machine :	
Machine Number :			
Model No. & Make :			
Check list for machine inspection			
Inspect the following items and tick in the appropriate column and list the remedial measures for the defective items.			
Items to be checked	**Good working/ satisfactory**	**Defective**	**Remedial measures**
Level of the machine			
Belt/chain and its tension			
Bearing condition (Look, feel, listen noise)			
Driving clutch and brake			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication and its system			
Coolant and its system			
Carriage & its travel			
Cross-slide & its movement			
Compound slide & its travel			
Tailstock's parallel movement			
Electrical controls			
Safety guards			
Inspected by Signature Name: Date:			Signature of in-charge

Marking out on the round sections for geometrical shaped fittings such as spline with 3 or 4 teeth. Finishing and fitting to size, checking up the faces for universality

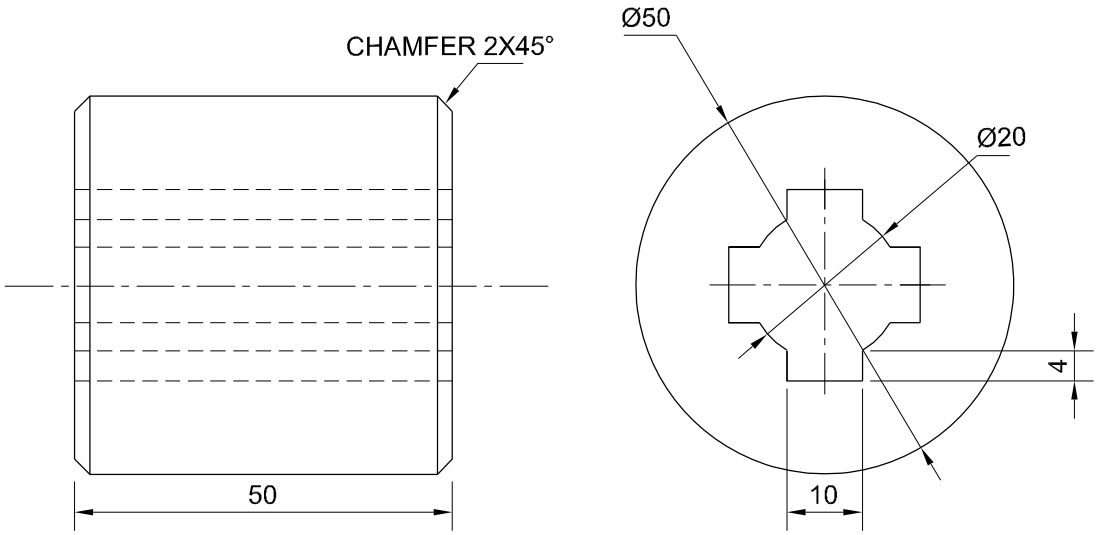
Objectives: At the end of this exercise you shall be able to
- **mark and file spline on the shaft**
- **mark and file internal spline in the hub**
- **file and assemble hub and spline shaft.**

PART - 1



SPLINE SHAFT

PART - 2



SPLINE HUB

1	Ø50-55		Fe 310	-	2	4.2.172
1	Ø28-55		Fe 310	-	1	
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**MARKING OUT ON THE ROUND SECTIONS FOR GEOMETRICAL SHAPED FITTINGS SUCH AS SPLINE WITH 3 OR 4 TEETH. FINISHING AND FITTING TO SIZE, CHECKING UP THE FACES FOR UNIVERSALITY**				TOLERANCE:±0.02	TIME : 25Hrs
					CODE NO. FIN42172E1	

Job sequence

- Check the raw material size using steel rule.
- File raw metal to over all size part 1 ∅ 28 - 50mm and part - B ∅ 50 - 50mm.
- Apply marking media on part 1 and part 2.
- Mark off spline key ways on part 1 and 2 by keeping on 'V' blocks using vernier height gauge and try squre as per job drawing.
- Punch witness mark on part 1 and part 2.

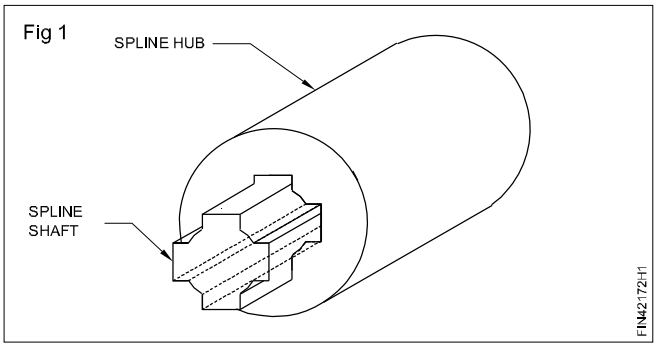
Part 1

- Cut and remove the excess metal in Part 1 by Hacksawing and chipping and file to size and shape using flat file, safe edge file, square file and half round file bastard, second cut and smooth grade of files.
- Check the spline shaft size using vernier caliper.

Part 2

- Hold the part 2 in drilling machine table.
- Fix centre drill in drilling machine spindle.
- Drill centre drill, to locate centre of the round rod.
- Remove centre drill and fix ∅ 6mm drill in drilling machine spindle and drill pilot of the hole.
- Similarly, enlarge the pilot hole using different diameter drill and finally drill ∅ 20mm and enlarge the hole.
- Hold the job in benchvice and file key way slot size 10mm width X 4mm depth using square file bastard, second cut and smooth grade of file.
- Similarly, file other three keyways slot to the size as per job drawing.
- Check the key way slots sizes using vernier caliper.
- Finish file on part 1 and 2 as shown in job drawing and slide it (Fig 1).

Fig 1



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

Skill sequence

Marking of a job with vernier height gauge

Objective : This shall help you to
- **mark concentric and eccentric centre lines of a job by using a vernier height gauge.**

The height gauge marking is more accurate than the scribing block marking.

The marking surface must be free from sharp edges and unevenness.

Clamp the finish turned rod in the 'V' block with the help of the clamps.

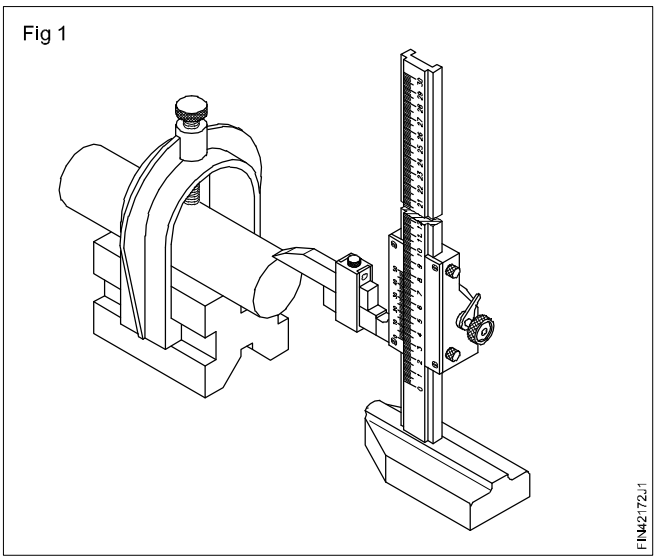
Apply marking media on both faces of the job.

Set the scriber point on the top edge of the job (Fig 1).

Move the height gauge scriber over the round surface to get a feel that the scriber bottom face is contacting the work periphery (Fig 1).

Lock the slides and note down the reading of the scales.

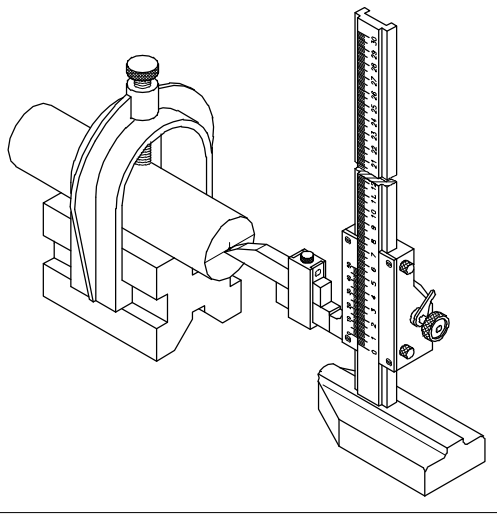
Fig 1



Subtract half the diameter from the reading and set the height gauge for that reading. (Fig 2)

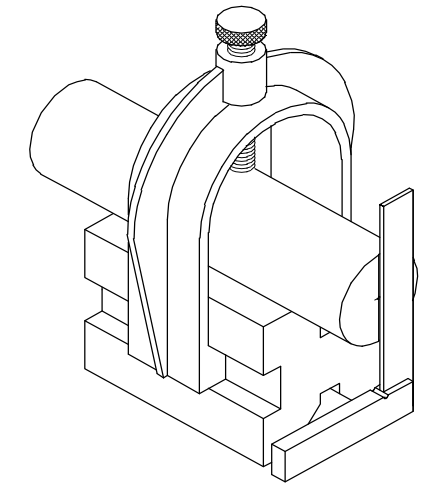
Scribe a horizontal line on both faces. (Fig 2)

Fig 2



Release the workpiece from the clamp and rotate the workpiece through 90°. Set the line at 90° with the help of a try–square. (Fig 3)

Fig 3



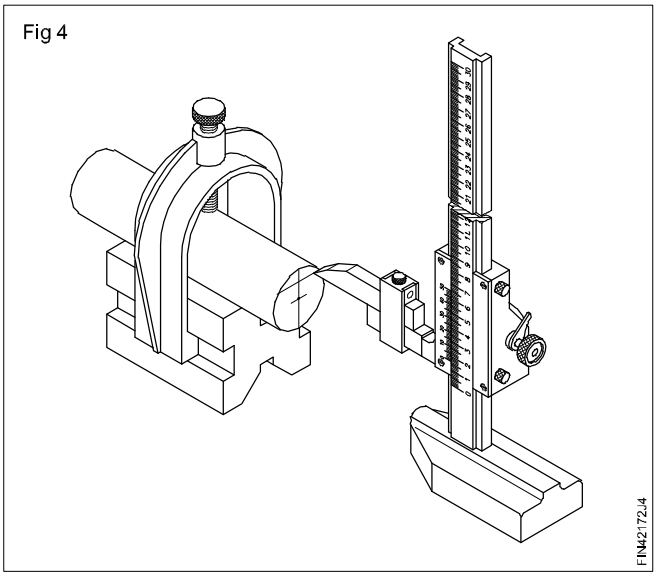
Clamp the workpiece to the 'V' block.

Scribe horizontal lines on both faces with the same reading which is set for centre position. (Fig 4)

Add eccentricity amount to the above reading and reset the height gauge for the new reading. (Fig 4)

Scribe horizontal lines on both faces. (Fig 4)

Fig 4



Release the workpiece from the 'V' block.

Punch mark on both sides both concentric and eccentric centre points.

Checking parallelism using dial test indicator

Objective : This shall help you to
- **check parallelism of faces using a dial test indicator.**

Checking Parallelism

For checking parallelism and flatness of surfaces, dial test indicators are mostly used.

Procedure

Assemble the dial test indicator on the stand.

Ensure that the surface plate and the dial test indicator stand base are cleaned.

Remove burrs from work surface, and clean.

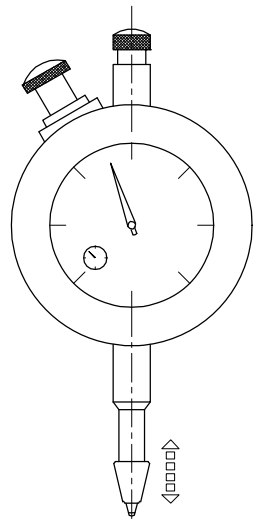
Use fine cotton cloth for cleaning.

Check the free movement of the plunger. (Fig 1)

Place the workpiece below the dial test indicator and set the plunger.

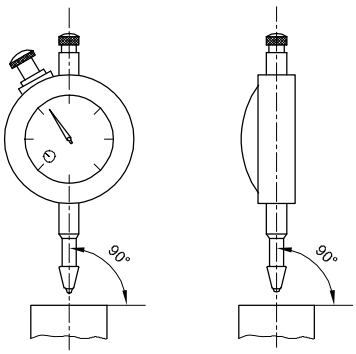
A half-turn pressure of the pointer will be adequate. The plunger should be perpendicular to the work surface. (Fig 2)

Fig 1



FIN42172X1

Fig 2

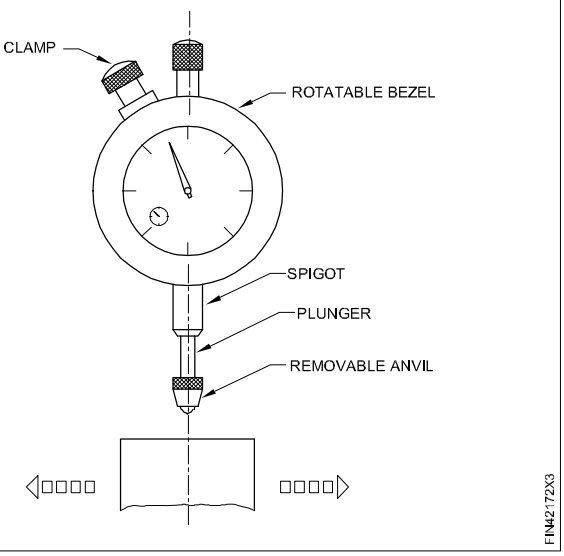


FIN42172X2

Unlock the bezel clamp. Set the reading to zero.

Slide the workpiece on the surface plate below the dial test indicator. (Fig 3)

Fig 3



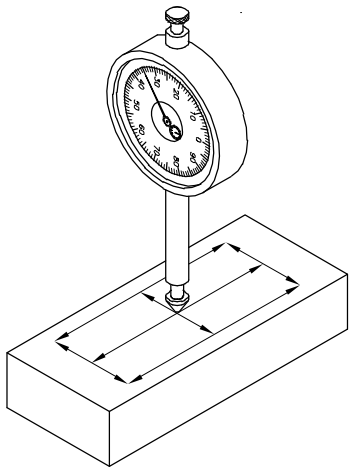
FIN42172X3

Note the reading.

Repeat the same step at three places longitudinally and transversely.

Note the reading and determine the differences. (Fig 4)

Fig 4



FIN42172X4

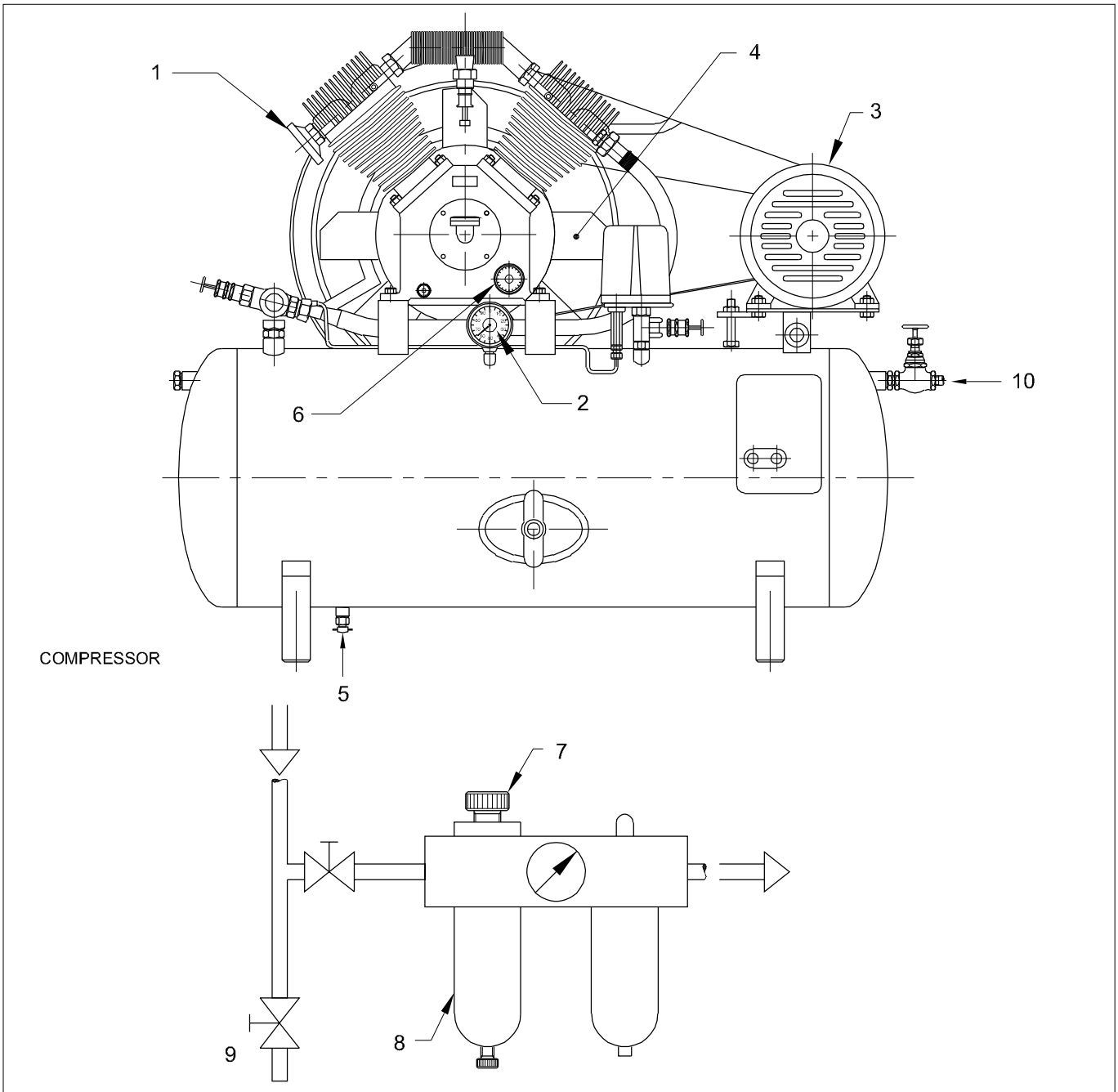
Precaution

Do not apply oil on the plunger of the dial test indicator.

Avoid sudden jerks to the plunger.

Identify pneumatic components - Compressor, Pressure gauge, Filter - Regulator- Lubricator (FRL) unit - Different types of valves and actuators

Objectives: At the end of this exercise you shall be able to
- **identify the pneumatic components**
- **enter the name of the parts in table 1.**



–	–	–	–	–	–	4.3.173
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	**IDENTIFY PNEUMATIC COMPONENTS-COMPRESSOR,PRESSURE GAUGE,FILTER-REGULATOR-LUBRICATOR(FRL) UNIT - DIFFERENT TYPES OF VALVES AND ACTUATORS**				DEVIATIONS	TIME : 2Hrs
					CODE NO. FIN43173E1	

Job sequence

Instructor shall arrange and show the compressure to trainees and give demo explaining all the parts. Ask the trainee to record in the Table 1.

- Observe the compressor.
- Identify the parts.
- Record the parts name in Table 1.

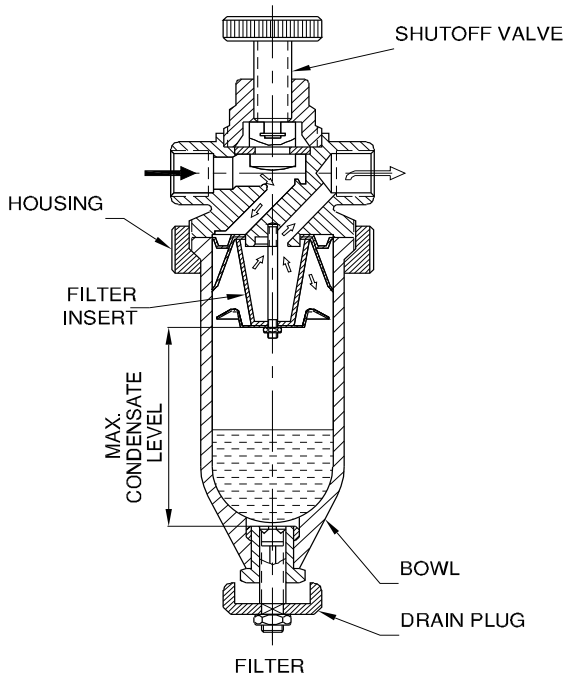
Table 1

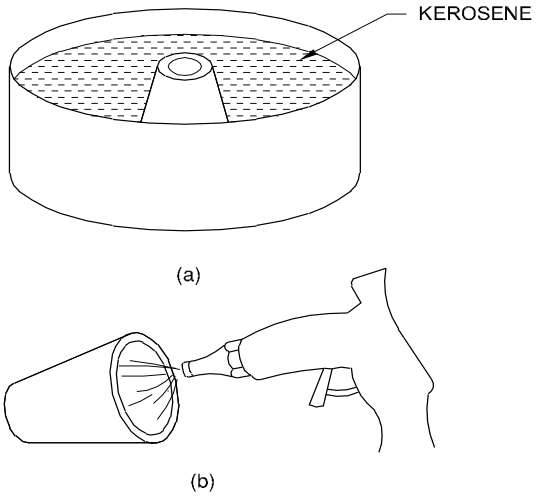
Serial No	Name of the parts
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

- Get it checked by your instructor.

Dismantle, replace and assemble FRL unit

Objectives: At the end of this exercise you shall be able to
- **overhaul FRL unit**
- **mount and read pressure on the pressure gauge.**





–	–	–	–	–	–	4.3.174
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	DISMANTLE,REPLACE AND ASSEMBLE FRL UNIT	TOLERANCE	TIME 5Hrs
		CODE NO. FIN43174E1	

Job sequence

- Overhauling a filter of FRL unit and Lubricator.
- Drain the water from the filter unit. (Fig 1)
- Hold the FRL unit in a bench vice in a horizontal position between soft jaws.
- Drain water from lubricator, by rotating drain plug. (Fig 1)
- Hold the filter bowl with hand and unscrew it.
- Do not use pipe wrench since bowl (mostly of plastic) may break/damage.
- Use a spanner and remove the filter insert.
- Rinse the filter in clean kerosene.
- Blow the inner side of filter using compressed air.
- Rinse the bowl in soap solution and dry it with clean cloth.
- Place the filter insert and tighten the nut.
- Screw the bowl to the housing.
- Confirm the drain plug is in closed condition.

Skill sequence

Overhauling a lubricator of FRL unit

Objective: This shall help you to
- **overhaul lubricator**.

Hold the lubricator body and unscrew the bowl by hand. (Fig 1)

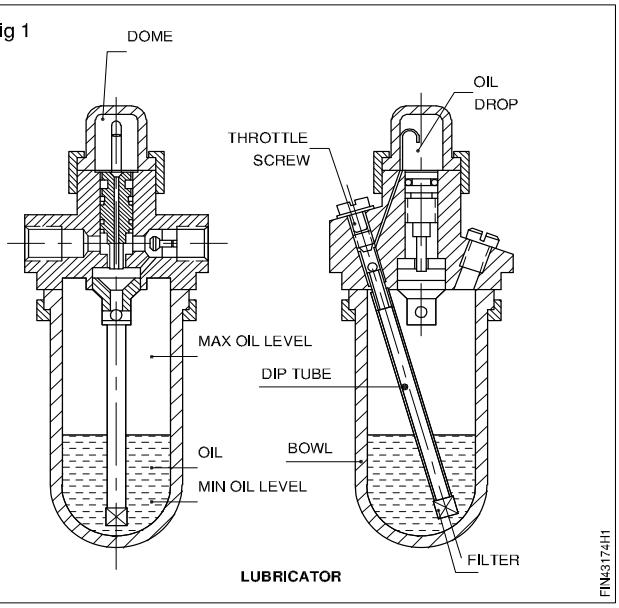
Drain oil from bowl.

Clean the bowl and rinse it in soap solution.

Dry it with a clean cloth.

Clean the filter at the tip of the dip tube. (Fig 1)

Fig 1



Ensure dip tube in its location.

Screw the bowl into it position tightly.

Open the inlet valve.

Observe the pressure gauge.

Fill it with correct grade of oil as per manufacturers recommendation to the level marked.

Maintain oil level.

Do not fill above or below the marked level. (Fig 1)

Mounting and reading of pressure

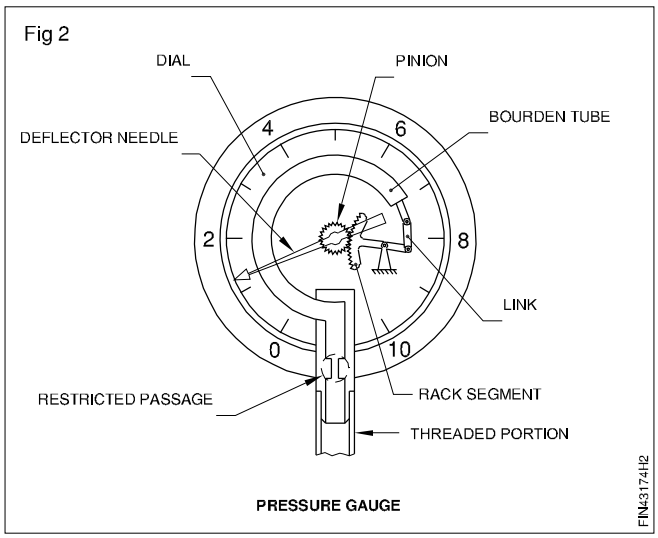
Mount the FRL unit on the trainer kit.

Ensure the flow of air is in line with arrow mark on the FRL unit.

Needle of pressure gauge indicates the pressure on the dial behind it. (Fig 2)

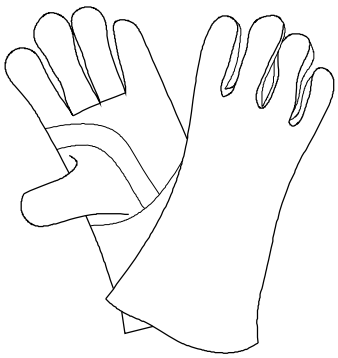
Pressure is measured in kg/cm^2 or kgf/cm^2.

Fig 2



Demonstrate knowledge of safety procedures in pneumatic systems and personal protective equipment (PPE)

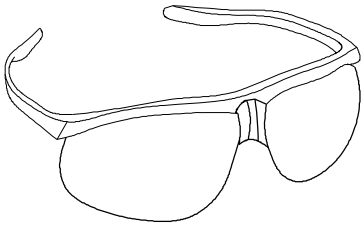
Objectives: At the end of this exercise you shall be able to
- **follow the safety while working in pneumatic system**
- **select the personal protective equipment.**



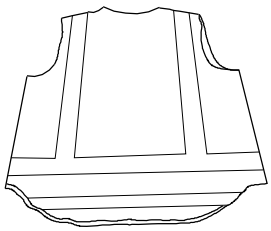
HAND
GLOVES

SHOES

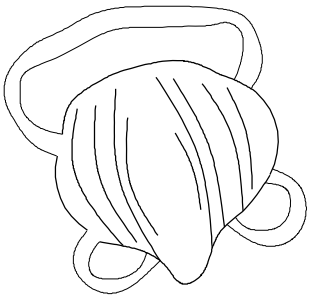
HELMET



GOGGLES



APRON



DUST MASK

EAR MUFFS

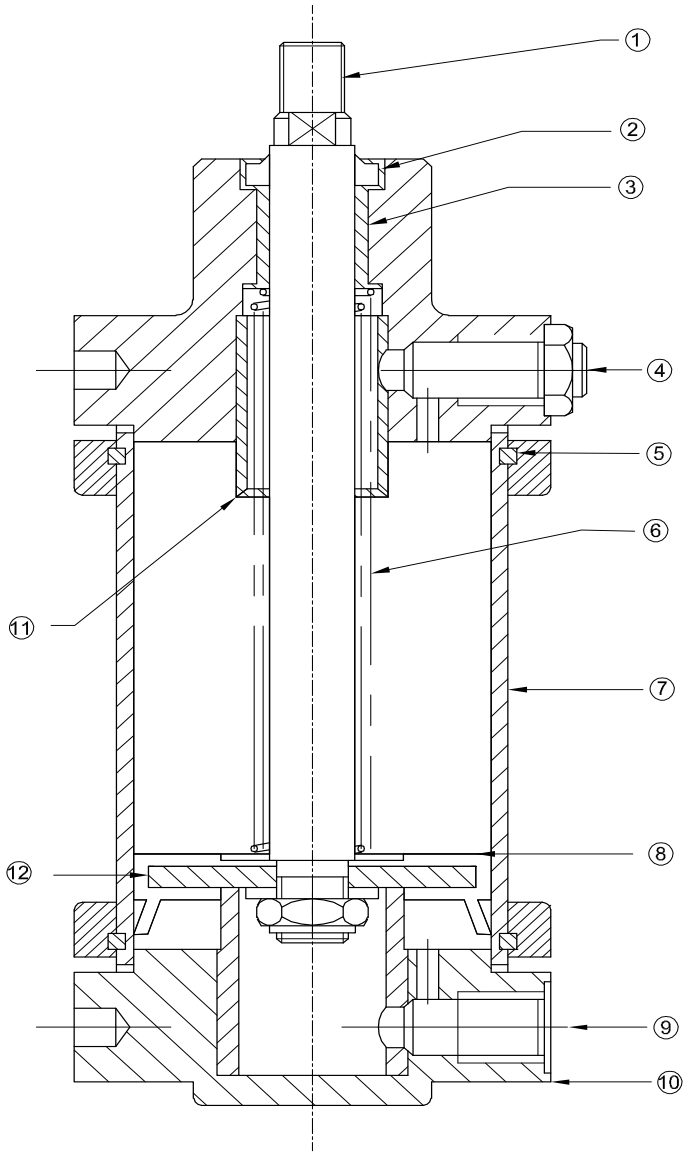
–	–	–	–	–	–	4.3.175
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE: NTS	**DEMONSTRATE KNOWLEDGE OF SAFETY PROCEDURES IN PNEUAMATIC SYSTEMS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)**				TOLERANCE	TIME: 2Hrs
					CODE NO. FIN43175E1	

Job sequence

- Should not operate pneumatic machine without knowledge.
- Protect your self and others from the damaging effect of compressed air.
- Inspect the air hose for cracks or other defects.
- Before opening the control valve,see that nearby personnel are not in the path of the air blow.
- Never stay near to compressed air.
- Do not turn the main air supply on make sure that, the disconnected pipes are connected properly, otherwise disconnected pipe can whip around and cause injury.
- If air is leaking from a joint, close the air valve immediately.
- Always turn air off before altering the circuit.
- Keep your hands away from the piston rods.
- Wear personnel protective equipment. The detailed information has been aiready given in safety precautions.

Identify the parts of a pneumatic cylinder

Objectives: At the end of this exercise you shall be able to
- **identify pneumatic elements from their outlook**
- **enter the name of the part in table - 1.**



–	–	–	–	–	–	4.3.176
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**IDENTIFY THE PARTS OF A PNEUMATIC CYLINDER**				DEVIATIONS	TIME 1Hrs
					CODE NO. FIN43176E1	

Job sequence

Instructor shall arrange and display the pneumatic cylinder and give demo to trainees showing all the parts. Ask the trainees to record in the table-1.

- Observe the given pneumatic cylinder.
- Identify the parts.
- Record the part name in Table. 1

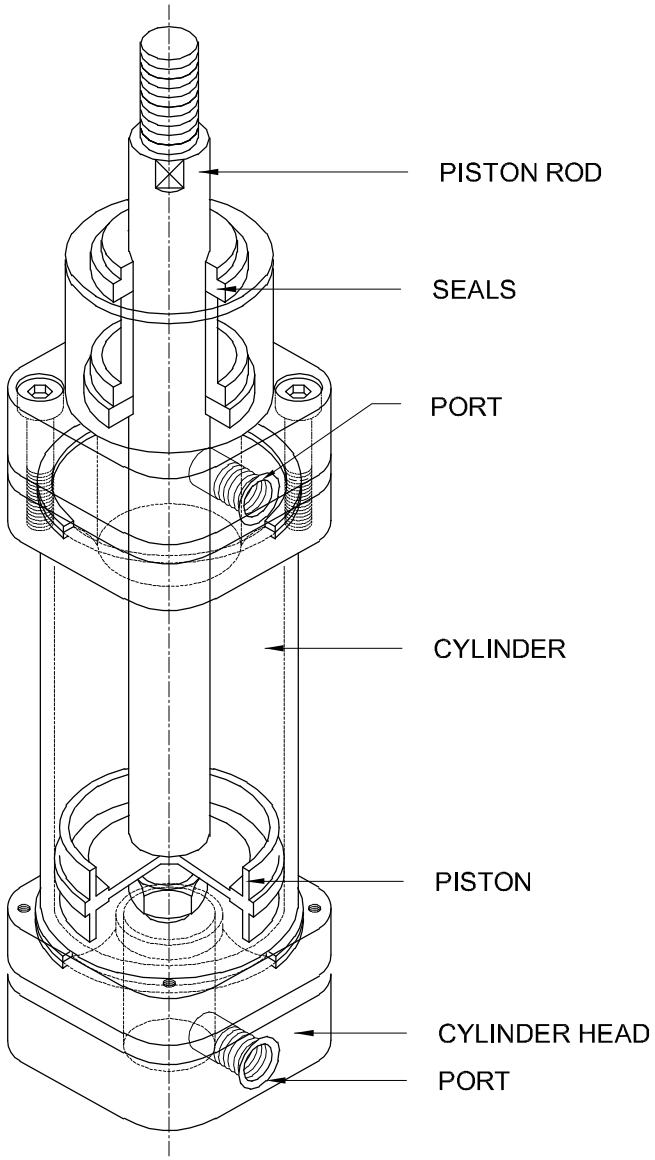
Table. 1

Serial No	Part Name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

- Get it checked by your instructor.

Dismantle and assemble a pneumatic cyclinder

Objectives: At the end of this exercise you shall be able to
- **dismantle the pneumatic cylinder**
- **clean and inspect the parts for wornout and damage parts**
- **assemble the pneumatic cylinder**
- **test the cylinder for proper function.**



CYLINDER

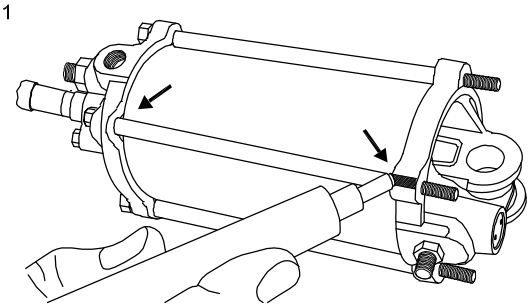
–	–	–	–	–	–	4.3.177
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**DISMANTLE AND ASSEMBLE A PNEUMATIC CYLINDER**				TOLERANCE	TIME:8Hrs
					CODE NO. FIN43177E1	

Job sequence

Disassembly

- Disconnect air and electrical connections to the cylinder assembly and remove the cylinder from machine.
- Remove and retain air lines and any other accessory items(solenoid valve, flow controls, etc.) from the cylinder assembly.
- Scribe an index mark on both end caps to show orientaiton to each other. These marks will assist when re-assembling the cylinder (Fig 1).

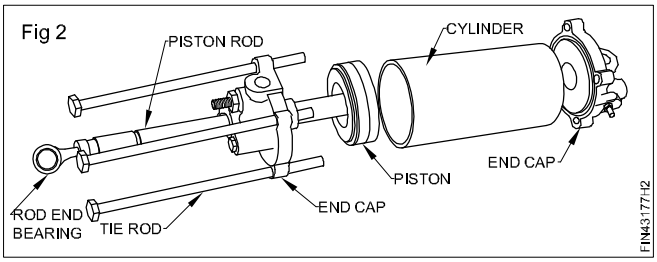
Fig 1



FIN43177-H1

- Remove and retail all the rod nuts, lock washers and tie rods from the cylinder end caps. Remove the end caps from the cylinder tube and discard the cylinder gaskets. (Fig 2).

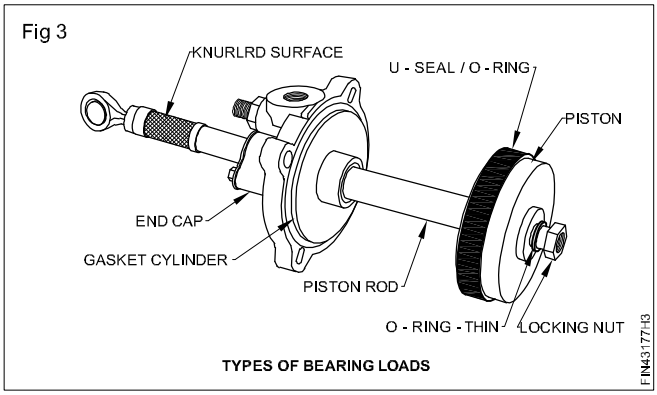
Fig 2



FIN43177-H2

- **For single-acting cylinders :** Use a strap wrench or soft-jaw wrench to hold the piston rod at the knurled surface. Remove and discard the self-locking nut, O-ring, and piston. (Fig 3)

Fig 3

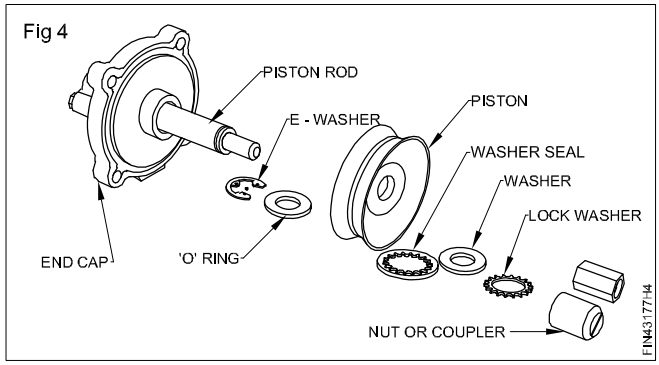


TYPES OF BEARING LOADS

FIN43177-H3

- **For double-acting cylinders :** Use a strap wrench or soft-jaw wrench to hold the piston rod and remove and retain the nut and washers. Note two different styles of piston nut in figure. Discard the piston (Fig 4).

Fig 4



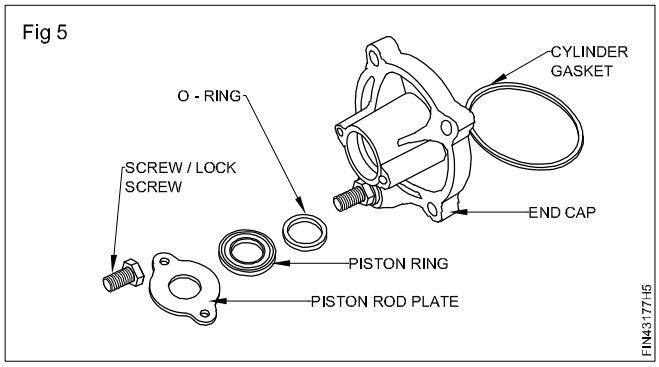
FIN43177-H4

- Remove and retain the E-ring and miscellaneous hardware from the piston rod and pull the front end cap from the piston rod (Fig 4).

Prior to removing the end cap, remove any burrs or nicks from the piston rod surface with fine emery cloth (400 grit). Remove all emery dust before removing the front end cap.

- Remove and retain the two screws, lock washers and the piston rod plate from the front end cap. Remove and discard the packing ring and the O-ring (Fig 5).

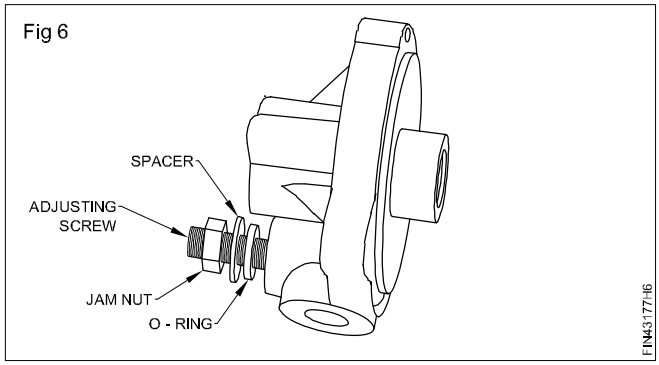
Fig 5



FIN43177-H5

- Remove and retain the jam nut and spacer from the speed adjusting screw in the front end cap. Do not remove the adjusting screw. Remove and discard the O-ring.(Fig 6)

Fig 6



FIN43177-H6

- Some rear end caps on single-acting cylinders may contain speed adjusing screws. If so, remove and retain the jam nut and spacer from both adjusting screws. Do not remove the adjusting screws. Remove and discard the O-rings.
- Clean all metallic parts thoroughly with a solvent(mineral sprits recommended).
- Do not soak parts in solvent. Do not clean the spherical rod end bearing with solvent as this will remove lubricant from the bearing.

Do not use trichlorethylene or chlorinated hydrocarbon solvents. Do not clean or soak O-rings or other rubber components in solvent.

- Inspect the inside surface of the cylinder tube and replace if the I.D. is worn out or if there are deep scratches or grooves on the inner surface.

Re-assembly

- Install a new O-ring to the speed adjusting screw on the front end cap. Replace the spacer and jam nut.
- If equipped with speed adjusting screws on the rear end cap; install new O-rings. Replace the spacers and jam nuts.
- Install a new packing ring and O-ring and attach the piston rod plate to the front end cap with lock washers and screws.
- Be sure the piston rod is free of nicks and burrs. Slide the front end cap onto the rod and install the E-ring.
- Assemble the new U-seal and O-ring on the piston, then mount the piston and O-ring on the piston rod and secure with a new lock nut. See Fig 3.
- Mount 'E' ring, washer, piston, washer seal, washer and lock washer on the piston rod. The rubber face of the piston should face towards the rod and bearing. (Fig 4)
- Apply a light coat of grease to the cylinder tube I.D., completely around the U-seal, (if double-acting, apply around piston edge), the front end cap gasket, and working length of the piston rod.
- Install new cylinder gaskets on the end caps.
- Assemble the cylinder tube, rear end cap and front end cap assembly. Install the tie rods, tie rod nuts and lock washers. Finger tighten the nuts. Then cross tighen the nuts equally and then tightened to a final torque. (Fig 2)

Before tightening the nuts, be sure the tie rods are parallel to the long axis of the cylinder. Tie rods must be positioned properly to obtain a good seal at both end caps.

- Re-attach accessory items and aiir lines to the cylinder.
- Re-install the cylinder in the machine and connect air and electrical lines.
- Verify proper operation of the cylinder.

Testing the cylinder

- Apply air to the inlet port on the front end cap. Use a brush with a soap and water solution to check for leaks. Do not submerge the cylinder.
- With air applied to the speed fitting and the piston rod fully extended, open the air passage in the speed fitting and observe that the piston moves to the rear cap. Check for leakage at the front cap adjustment screw; at the front cap ppiston rod seal; at the rear cap adjustment screw and adjacent ports (if equipped); from the piping between the speed fitting and the front end cap; from both ends of the cylinder at the cap gaskets; and from the speed fitting exhaust port. Repair any leaks and recheck.

Construct a circuit for the direction & speed control of a small bore single acting (s/a) pneumatic cylinder

Objectives: At the end of this exercise you shall be able to
- **select the components, to operate Single Acting Cylinder using 3/2 way valve**
- **draw circuit diagram on paper**
- **assemble circuit on the trainer board**
- **check function of the circuit.**

Requirements

Tool / Instrument / Equipment / Machines

- Trainer board - 1 No.
- Pneumatic source - 1 No.

Material / Component

- P U Tube - as req
- Paper - as req.
- Pencil - as req
- Single Acting Cylinder - 1 No
- 3/2 way valve - 1 No
- FRL - 1 No

Job sequence

TASK 1 **List the components,to operate Single Acting cylinder using 3/2 way valve.**

1 Identify the components and list using ISO 1219 symbol in the table.

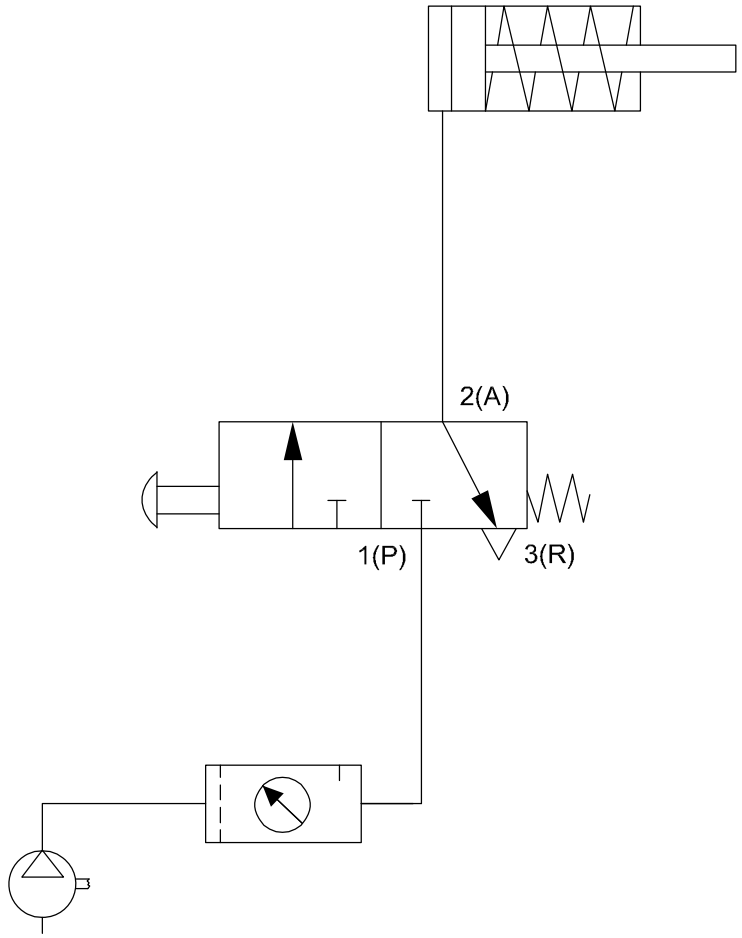
The instructor shall arrange trainer board with components mentioned

Component	Symbol
Pneumatic Source	
Single Acting Cylinder	
3/2 Way valve	
FRL	

–	–	–	–	–	–	4.3.178
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	CONSTRUCT A CIRCUIT FOR THE DIRECTION & SPEED CONTROL OF A SMALL BORE SINGLE ACTING (S/A) PNEUMATIC CYLINDER				TOLERANCE	TIME:7Hrs
					CODE NO. FIN43178E1	

TASK 2: **Draw circuit diagram. (Fig 1)**

Fig 1



TASK 3: **Assemble circuit on the trainer board**

1 Arrange component on trainer board as shown.

2 Connect source to FRL

3 Connect FRL to input port “1” of 3/2 Way valve.

4 Connec t output port “2” of 3/2 Way valve to input port of single acting cylinder.

5 Ensure proper connections.

6 Supply air.

Correct the assembly if air leaks through joints

TASK 4: **Check function of the circuit per the table**

Action	Expected Result	Confirm Result (Put)
Press Push Button	Piston moves forward	
Release push Button	Piston retracts	

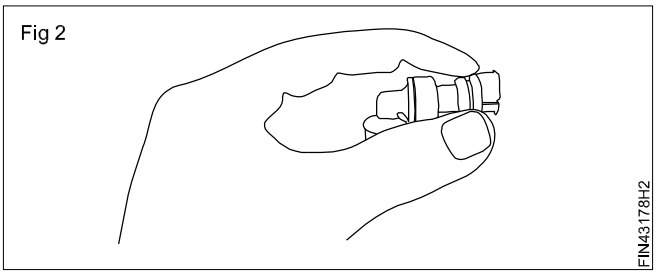
Conclusion

Conclusion drawn	Remarks
Motion of Single Acting cylinder can be controlled by 3/2 Way valve.	

Connect tube using push in fitting

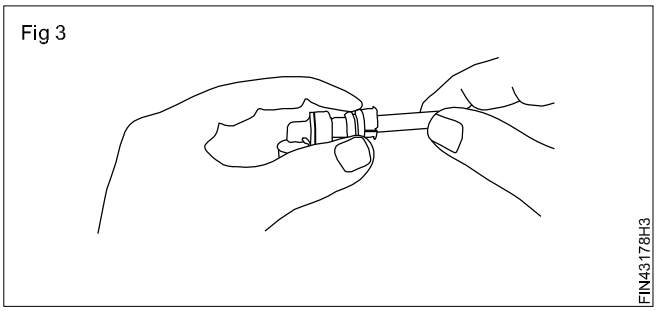
1 Grip pull back ring. (Fig 2)

Fig 2



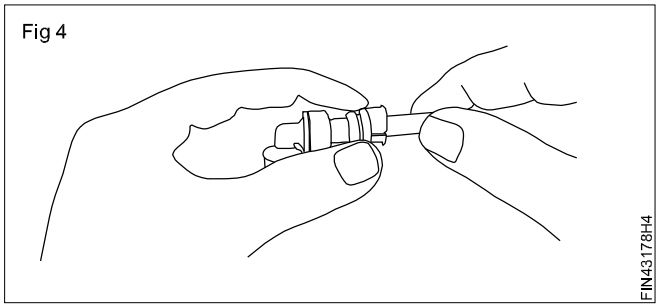
2 Pull the ring. (Fig 3)

Fig 3



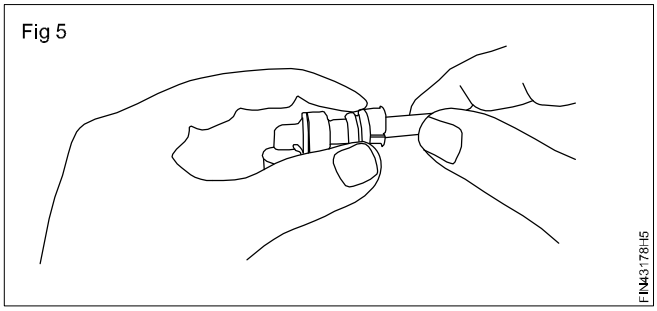
3 Push the P U (poly (Urethene) tube into fitting. (Fig 4)

Fig 4



4 Push lock ring forward to lock. (Fig 5)

Fig 5



Construct a control circuit for the control of a d/a pneumatic cylinder with momentry input signals

Objectives: At the end of this exercise you shall be able to
- **select the components,to operate single acting cylinder using 5/2way valve**
- **draw circuit diagram**
- **check function of the circuit.**

Requirements

Tool/ Instrument/ Equipment/ Machines

- Trainer board - 1 No.
- Pneumatic source - 1 No.

Material/ Component

- P U Tube - as req
- Paper - as req.
- Pencil - as req
- FRL - 1 No
- 5/2 way valve - 1 No

PROCEDURE

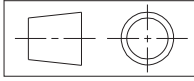
TASK 1:**Select and list the components,to operate double acting cylinder using 5/2 way valve.**

1 Identify the components and list using ISO 1219 symbol in the table.

The instructor shall arrange trainer board with components mentioned

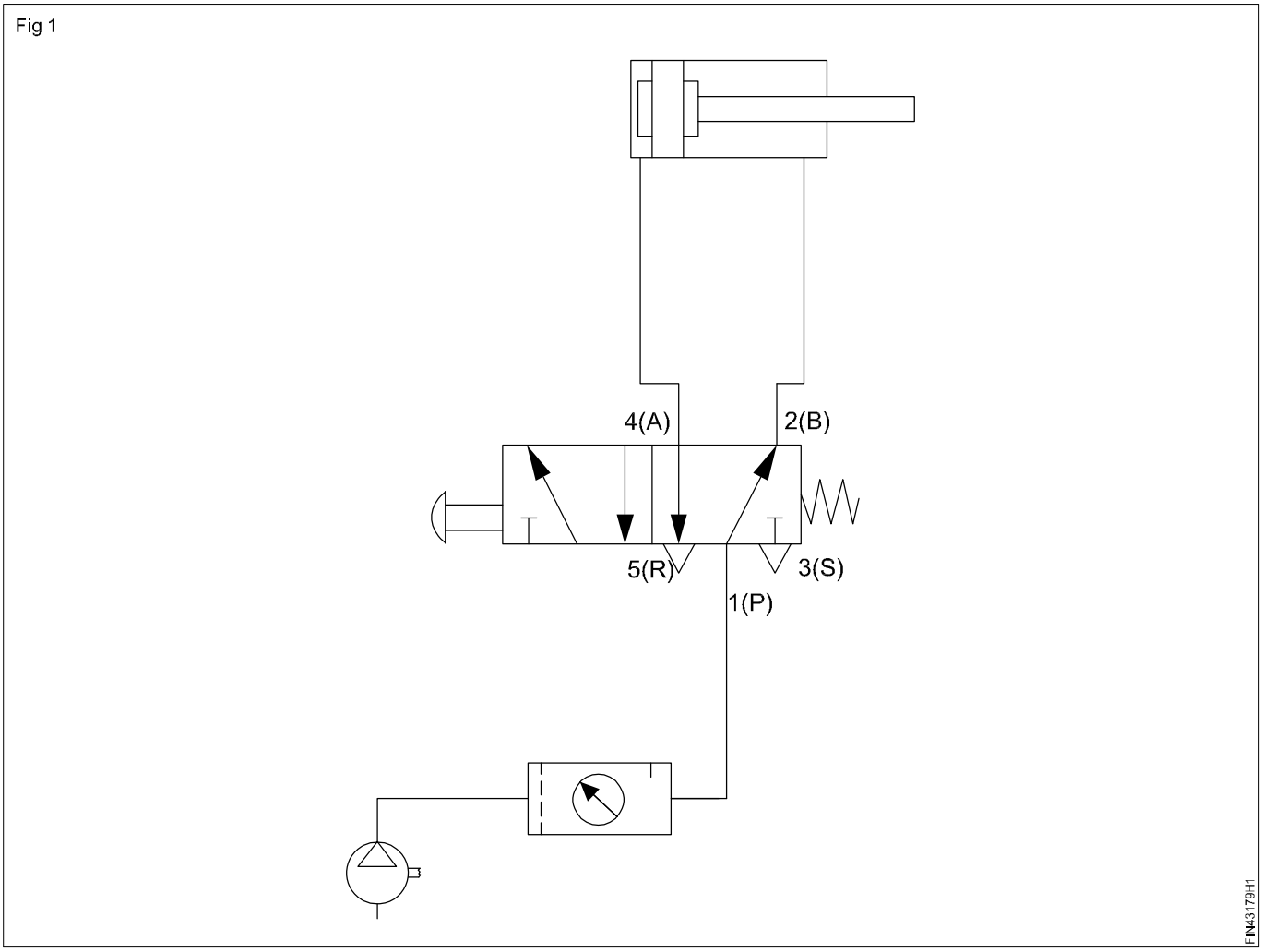
Component	Symbol
Pneumatic Source	
Single Acting Cylinder	
3/2 Way valve	
FRL	

–	–	–	–	–	–	4.3.179
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE: NTS	CONSTRUCT A CONTROL CIRCUIT FOR THE CONTROL OF A D/A PNEUMATIC CYLINDER WITH MOMENTARY INPUT SIGNALS	TOLERANCE	TIME:5Hrs
		CODE NO. FIN43179E1	

TASK 2: **Draw circuit diagram. (Fig 1)**

Fig 1



TASK 3: **Assemble circuit on the trainer board**

1 Arrange component on trainer board as shown.

2 Connect source to FRL

3 Connect FRL to input port “1” of 5/2 Way valve.

4 Connect output port “2” & “4” of 5/2 Way valve to input port “A & “B” of double acting cylinder.

5 Ensure proper connections.

6 Supply air.

Correct the assembly if air leaks through joints

TASK 4: **Check function of the circuit. (Table I)**

Action	**Expected Result**	**Confirm Result (Put)**
Press push button	Piston moves forward	
Release push button	Piston retracts	

Conclusion

Conclusion Drawn	**Remarks**
Motion of double acting cylinder can be controlled by 5/2 way valve.	

Construct a circuit for the direct & indirect control of a d/a pneumatic cylinder with a single & double solenoid valve

Objectives: At the end of this exercise you shall be able to
- **construct a circuit**
- **select the component**
- **assemble the circuit on the trainer board**
- **check the function of the circuit.**

Requirements

Tool/ Equipment/ Machines / Component

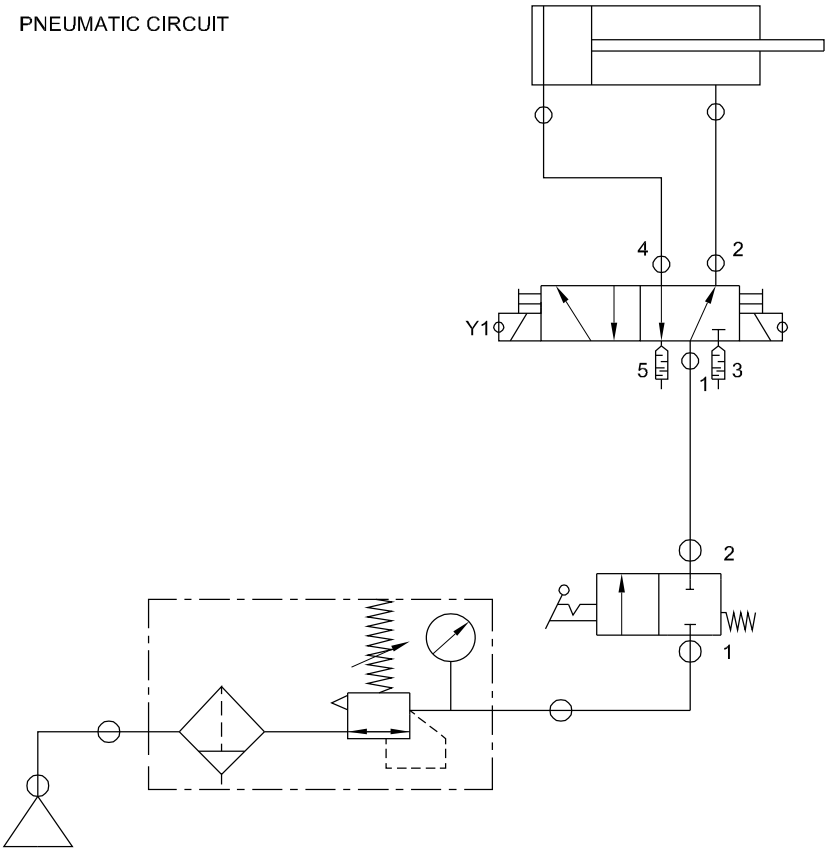
- Double acting cylinder
- 5/2 DC double solenoid valve (y_1 y_2)
- Shut - off value
- Filter regulator unit
- Pneumatic power source
- Push button (PB_1, PB_2)
- Relay (K_1,K_2)

PROCEDURE

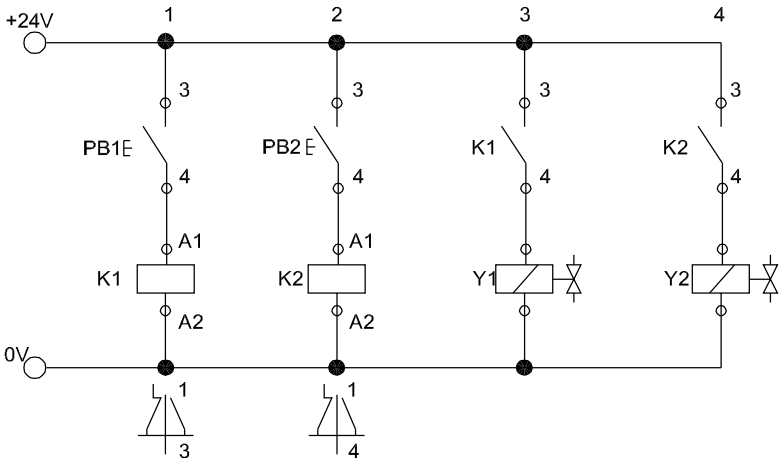
TASK 1: **Construct a circuit for the indirect control of a double - acting pneumatic cylinder with a double solenoid valve.**

TASK 1

PNEUMATIC CIRCUIT



ELECTRICAL CIRCUIT

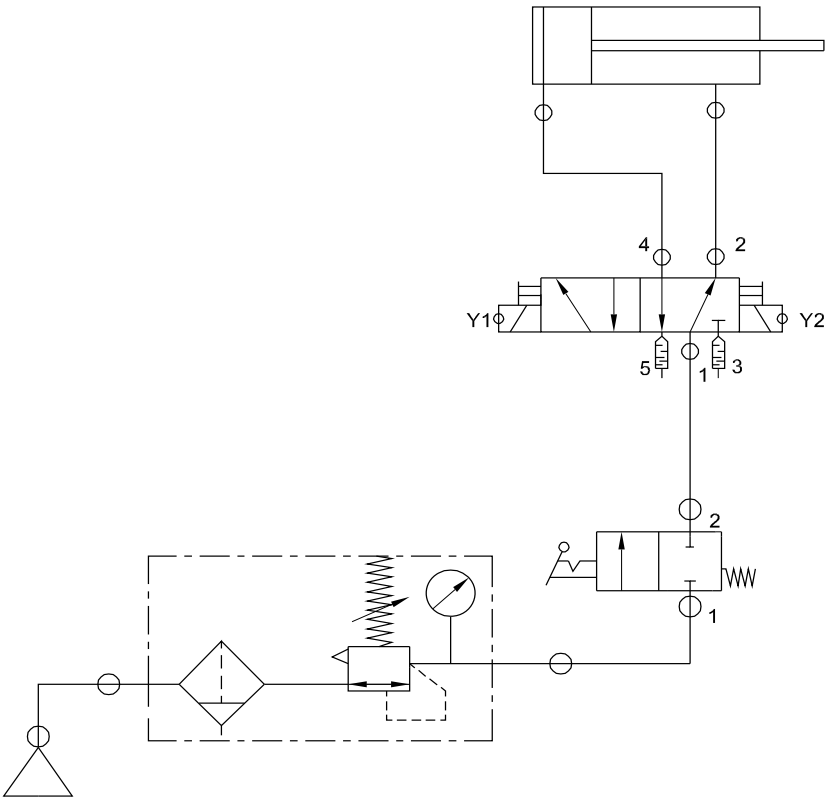


-	-	-	-	-	-	4.3.180
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**CONSTRUCT A CIRCUIT FOR THE DIRECT & INDIRECT CONTROL OF A D/A PNEUMATIC CYLINDER WITH A SINGLE AND DOUBLE SOLENOID VALVES**				TOLERANCE	TIME: 10Hrs
					CODE NO. FIN43180E1	

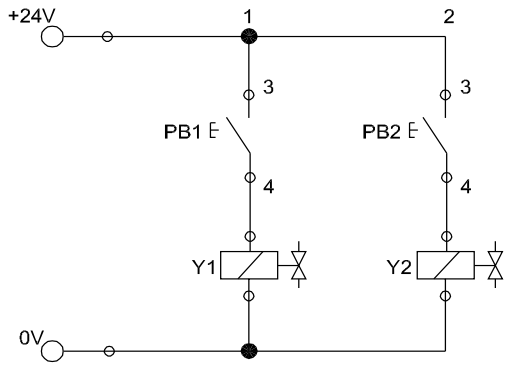
TASK 2 : **Construct a circuit for the direct control of a double-acting pneumatic cylinder with a double solenoid valve.**

TASK 2

PNEUMATIC CIRCUIT



ELECTRICAL CIRCUIT

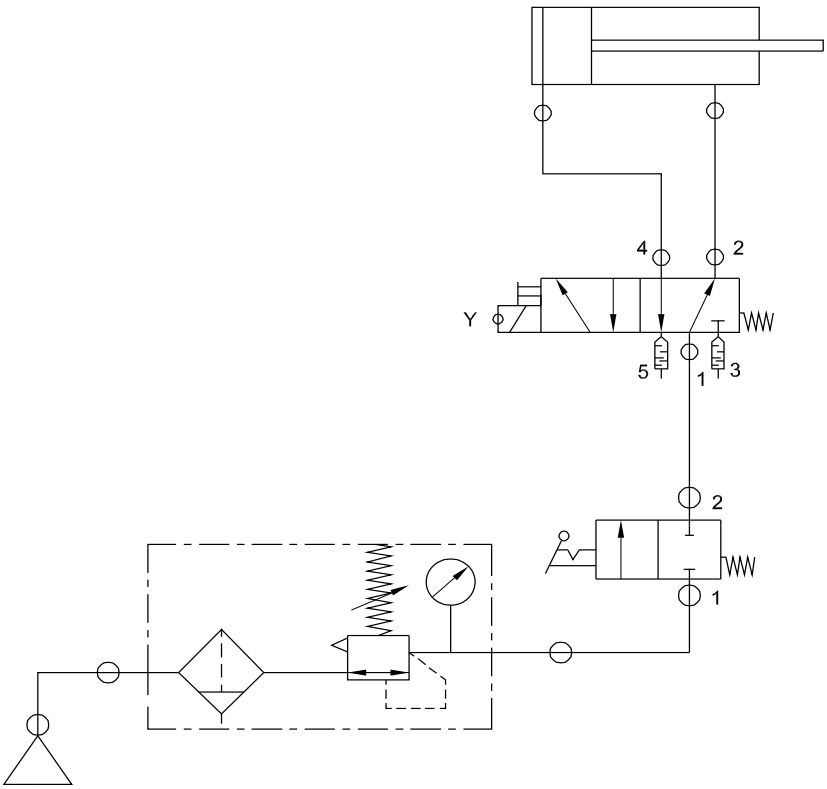


FIN43180E2

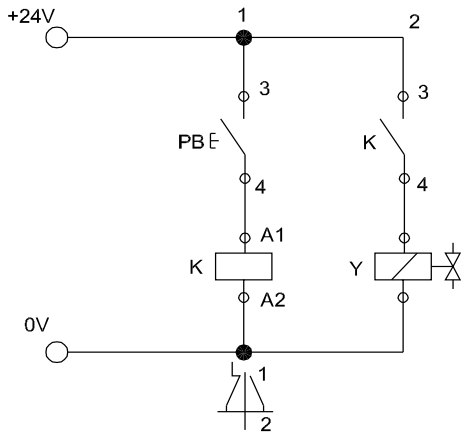
TASK 3 : **Construct a circuit for the indirect control of a double-acting pneumatic cylinder with a single solenoid valve.**

TASK 3

PNEUMATIC CIRCUIT



ELECTRICAL CIRCUIT

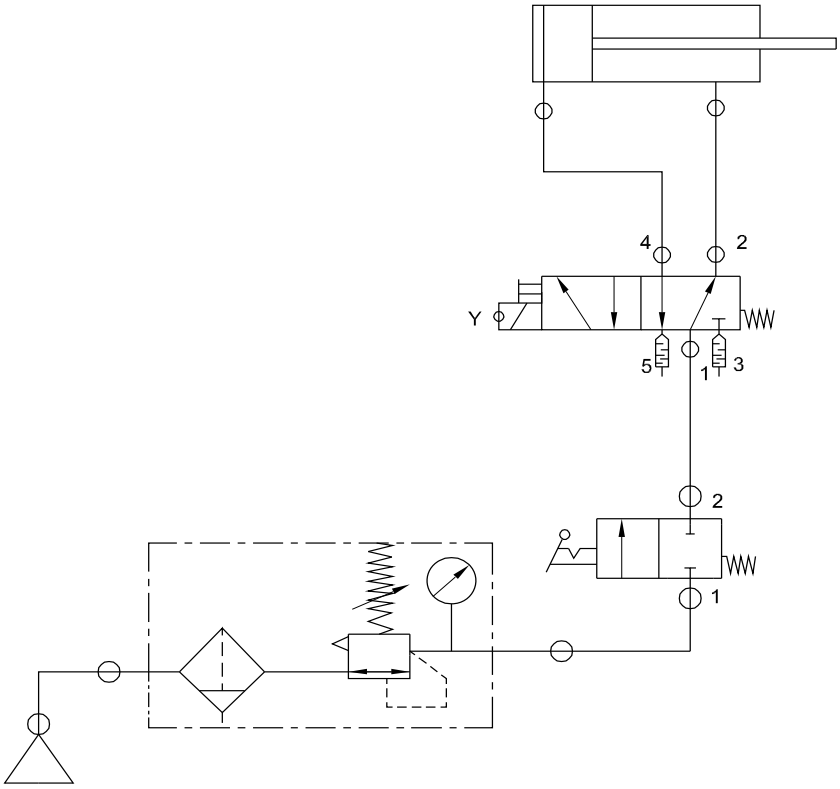


FIN43180E3

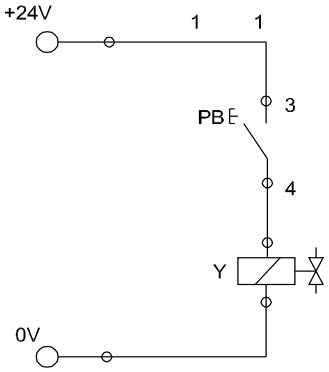
TASK 4: **Construct a circuit for the direct control of a double - acting pneumatic cylinder with a single solenoid valve.**

TASK 4

PNEUMATIC CIRCUIT



ELECTRICAL CIRCUIT



FIN43180E3

Job sequence

- construct circuit diagram
- Assemble circuit according to circuit diagram
- carry out the exercise

Practice exercise

Set the following

- operating pressure p (50 bar)
- one - way throttle valve,position 2

Enter the following in the table

- flow paths,operating positions
- pressures p_{o2} and p_{o3}
- forces F_1 and F_2 and ΔF (to be calculated)

Hydraulic cylinder	**4/2 way valve I**		**pressure bar**		**force kgf or daN**		**effective force kgf or daN** $d F = F_1 - F_2$
	flow paths	**operating positions**	**ρ_{o2}**	**ρ_{o3}**	**piston rod side F_1**	**piston rod side F_2**	
forward stroke							
return stroke							

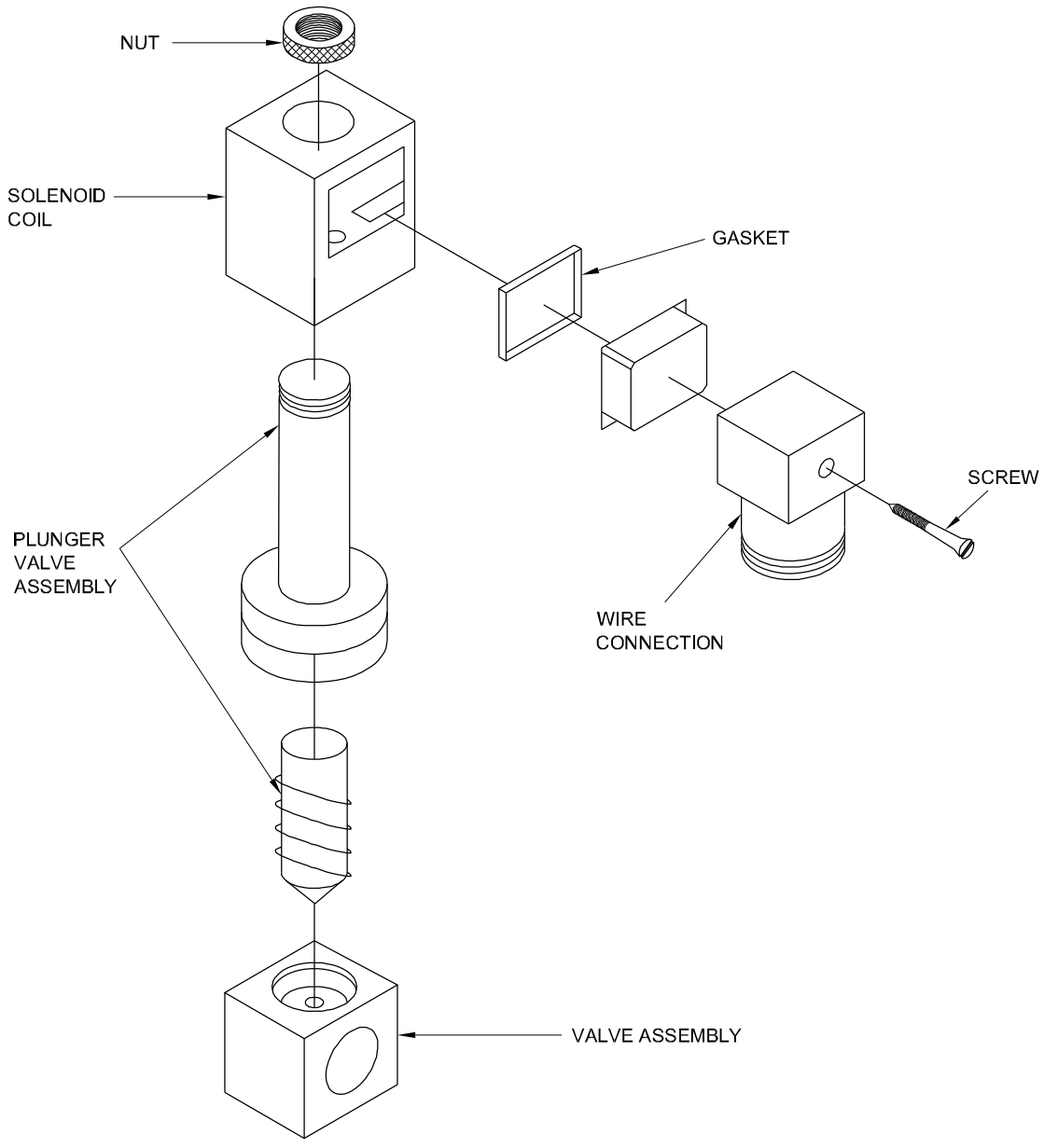
Safety precautions

Only switch on the power unit upon directions from the instructor.

Make sure the standing area is safe. Do not spill any oil. Do not work with oily hands (danger of slipping off). Fault finding and dismantling only when the system has been depressurized.

Dismantling and assembling of solenoid valves

Objectives: At the end of this exercise you shall be able to
- **remove the nut to remove the coil**
- **remove the cores / metal plate**
- **remove the valve**
- **check for scratches**
- **clean and reassemble.**



1	-	-	-	-	1	4.3.181
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	**DISMANTLING AND ASSEMBLING OF SOLENOID VALVES**				TOLERANCE -	TIME : 10Hrs
					CODE NO. FIN43181E1	

Job sequence

- If you ever need to disassemble a 2P025-08 Solenoid Valve,here's a step by step pictorial.

The assembled valve looks like

- First thing to note is that the valve actually is two major components. The coil and the valve mechanism. You can safety remove the coil even while the valve itself is connected to the water supply and under itself is connected to the water supply and under pressure. Removal of the coil itself will not cause the water to flow and will not cause the valve to leak water.

Fig 1

Remove the top nut to remove the coil

- For the following steps are disassembling the valve itself. For this you need the water turned off and even then you will get a slight amount of water out of the system when you take the valve apart.

Fig 2

- Here,note the two screws holding the metal plate on. We will remove these to disassemble the valve.

Fig 3

- Now remove the two screws.

Fig 4

- Now remove the metal plate.
- Now with a twisting motion,grab the valve stem and pull it upward.
- The valve with the stem removed.

Fig 5

- Now the stem itself can be disassembled (and cleaned). Note that the plunger (with the spring) should just fall out of the stem.
- Observe inside the stem and the surface of the plunger and clean any trace of foreign objects.

Fig 6

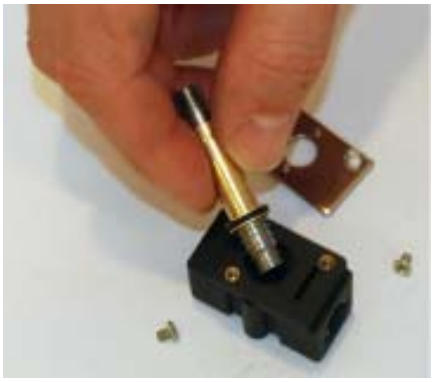


Fig 7

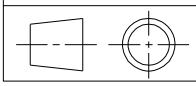
Fig 8

Fig 9

Demonstrate knowledge of safety procedures in hydraulic systems (demo by video)

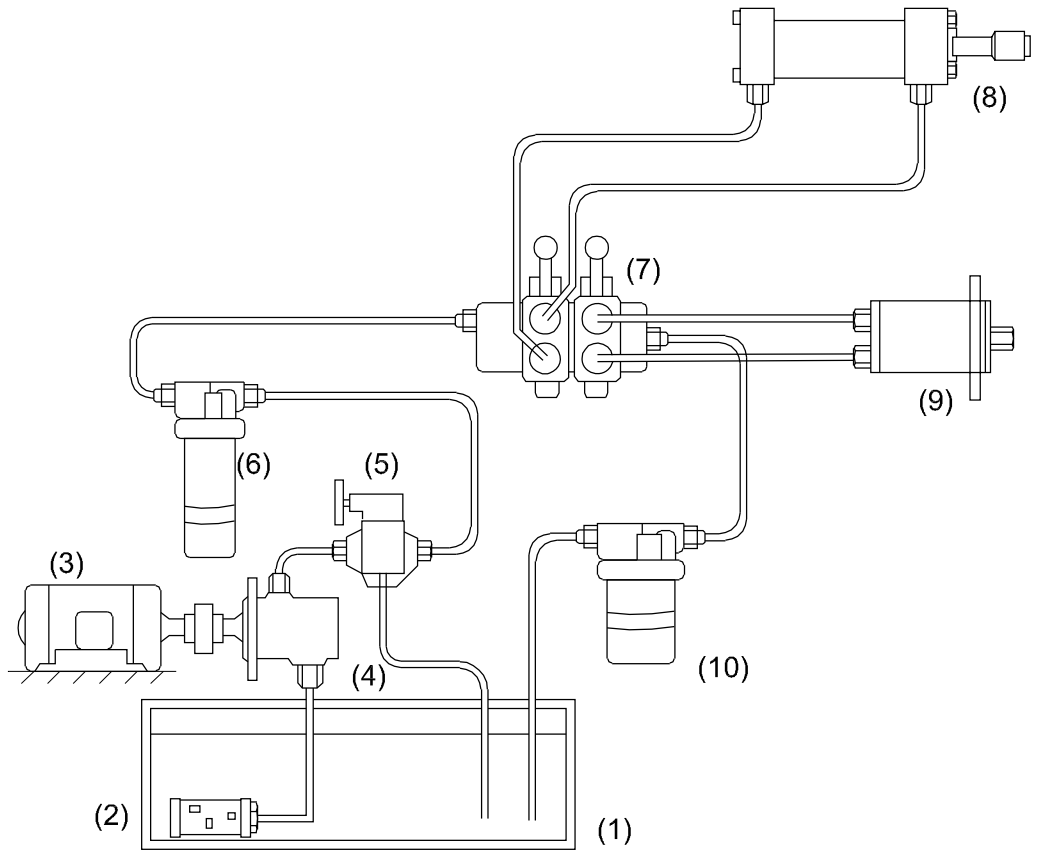
Objectives: At the end of this exercise you shall be able to
- **follow all the safety knowledge**
- **ensure safety for personal and machine.**

Instructor shall arrange video locally and demonstrate to the trainees.

-	-	-	-	-	-	4.3.182
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE : NTS	**DEMONSTRATE KNOWLEDGE OF SAFETY PROCEDURES IN HYDRAULIC SYSTEM (DEMO BY VIDEO)**				TOLERANCE	TIME : 5Hrs
					CODE NO. FIN43182E1	

Identify hydraulic components - Pumps, Reservoir, Fluids, Pressure relief valve (PRV), Filters, different types of valves, actuators and hoses

Objectives: At the end of this exercise you shall be able to
- **identify and locate the element in a hydraulic circuit**
- **draw symbols as per ISO 1219.**



–	–	–	–	–	–	4.3.183
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**IDENTIFY HYDRAULIC COMPONENTS-PUMPS, RESERVOIR,FLUIDS,PRESSURE RELIEF VALVE(PRV), FILTERS,DIFFERENT TYPES OF VALVES, ACTUATORS AND HOSES**				TOLERANCE	TIME:5Hrs
					CODE NO. FIN43183E1	

Job sequence

Instructor shall arrange and display the circuit and demonstrate to trainees.

- Study the circuit and record the part name in Table - 1
- Draw the symbol against the part name.

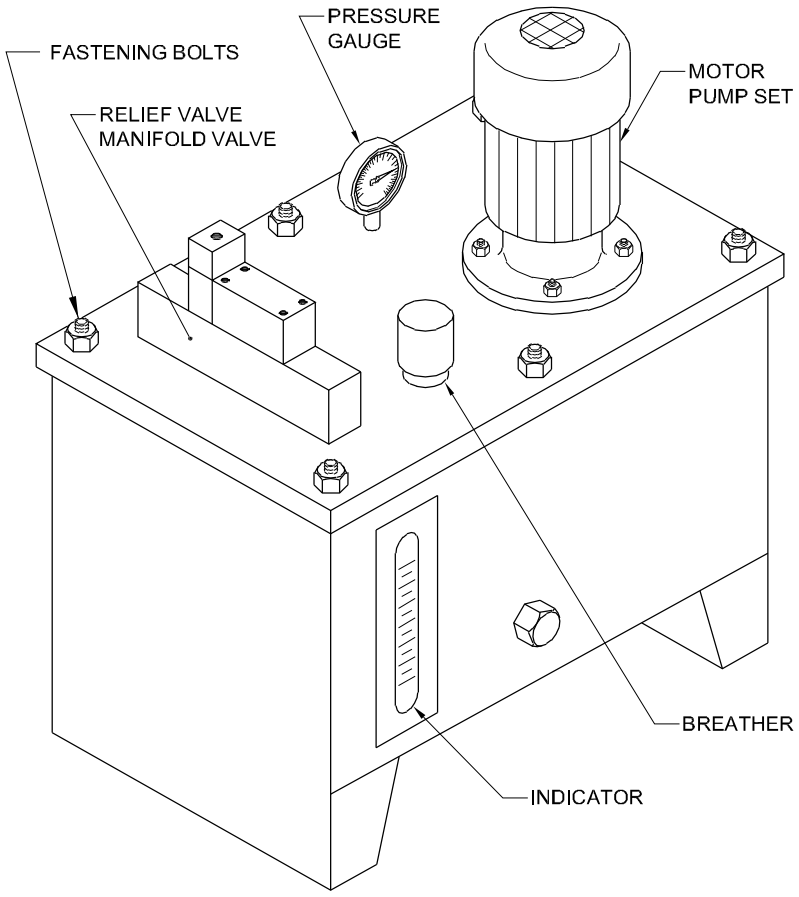
Table. 1

Serial No	Part Name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

- Get it checked by your instructor.

Inspect fluid levels, service reservoirs, clean/ replace filters

Objectives: At the end of this exercise you shall be able to
- **identify the various hydraulic elements used in power pack**
- **remove, clean and assembe of inlet filter**
- **preparing the power pack for operation**
- **start and set the pressure in the power pack.**



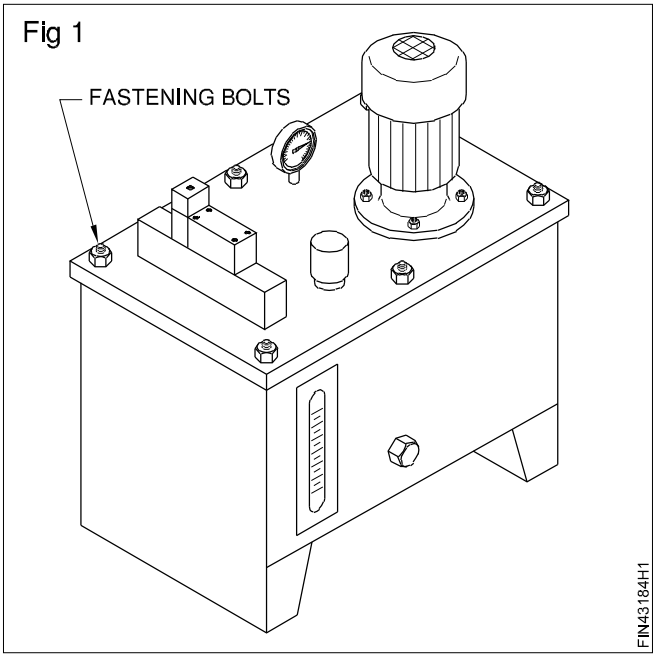
-	-	-	-	-	-	4.3.184
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	INSPECT FLUID LEVELS ,SERVICE RESERVOIRS,CLEAN/REPLACE FILTERS	TOLERANCE -	TIME : 5Hrs
		CODE NO. FIN43184E1	

Job sequence

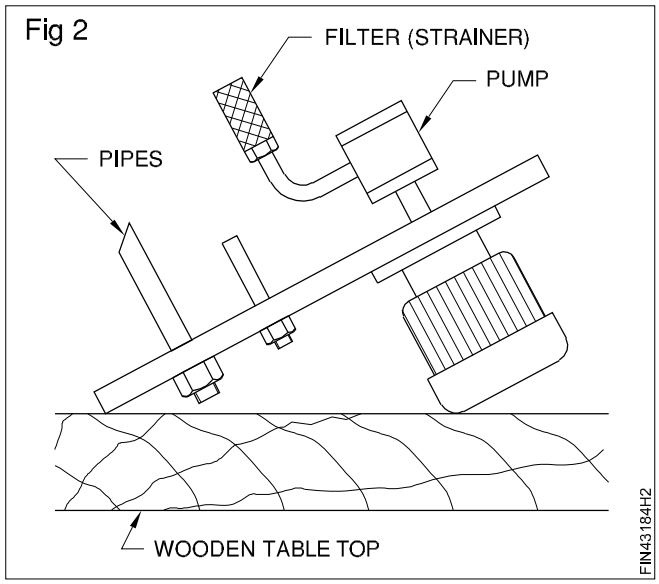
- Locate the power pack of the hydraulic system.
- Ensure the system is in 'off' condition.
- Remove the top cover of the power pack after unscrewing the fastening bolts (Fig 1).

Fig 1



- Pipes are provided below the top cover; place it carefully.
- Place the top cover upside - down with the various elements mounted on it carefully on the workbench (Fig 2).

Fig 2



- Identify the various elements, their names and function. Also observe the order of connection.
- Keep the reservoir closed with a plastic cover to aviod contamination. Remove clean and assemble the inlet fitter. Prepare the power pack for operation. Set the pressure of relief valve.

Skill sequence

Removing, cleaning and assembling of inlet filter (for a closed type of reservoir with removable top cover)

Objective: This shall help you to

- **dismantle, clean and assemble inlet tilter.**

Inlet filter is normally called as suction strainer. Unscrew the inlet cartridge (Fig. 3), wipe at the excess sludge collected on the filter.

Soak it in kerosene and remove the studge.

Flush the strainer with clean kerosene (Fig 4).

Fig 1

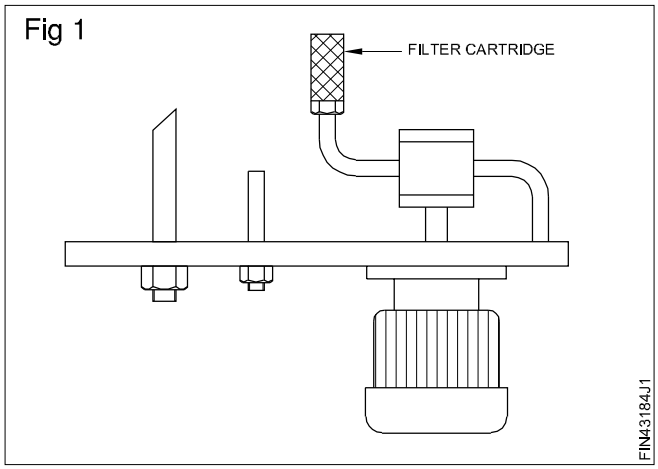
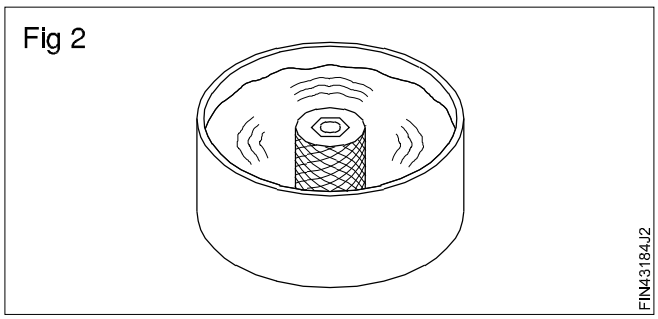


Fig 2



Blow compressed air on the mesh area.

Clean the mounting area of the strainer.

Screw the strainer back in its location.

Strainer/Filters should be clean periodically as per recommendation.

Replace with new filter, if the existing filter damaged.

While replacing new strainer, care should be taken to select the correct strainer.

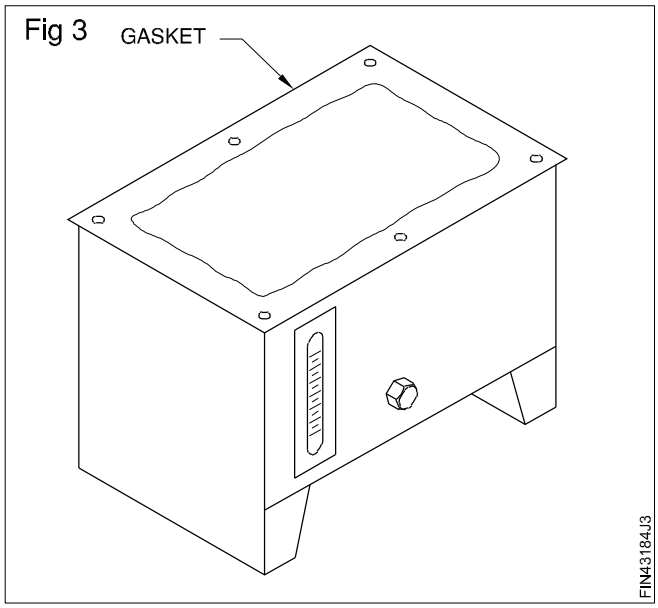
Checking the gasket of the top, cover of the reservoir for proper seating (Fig 5).

Place the top cover of the reservoir in its place.

Mount the cover by screwing the fastening screws.

Now inspect the cover for proper seating all over.

Fig 3



Preparing the power pack for an operation

Objective: This shall help you to
- **prepare the power pack for an operation.**

A power pack can perform well only if it is in an ideal condition. So before putting on a hydraulic system, the power pack should be checked for it prepareness.

Check the proper mounting of all units.

Check the coupling between motor and pump for freeness, before mounting the top plate.

Check and confirm oil level (Fig 6).

If oil level is less than the mark, fill the correct grade of oil.

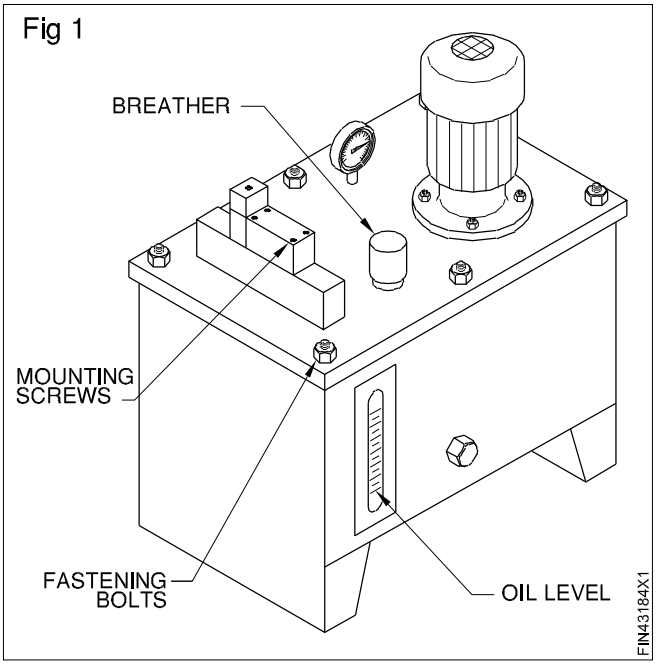
Keep the reservoir clean and clear all unnecessary things around and underneath the reservoir.

Check for proper tightening of all connecting hoses.

Check whether the breather is placed properly.

Oil drain hole is plugged and no oil leakage.

Fig 1



Starting and setting the pressure in a power pack

Objective: This shall help you to
- **starting and setting the pressure in a power pack.**

Switch on the electric motor of the power pack.

Confirm no loose ends of pipes exist before switch on the motor.

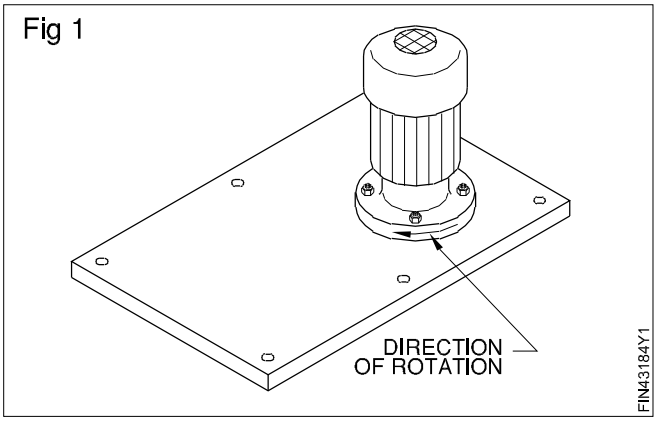
Observe and confirm the direction of rotation of the motor as indicated in the motor body (Fig 7).

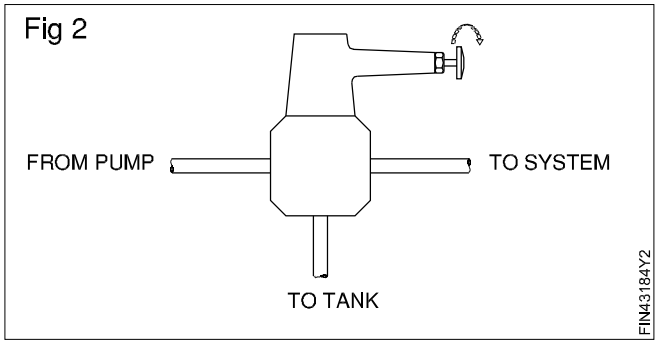
Put off the motor if it rotates in the opposite direction and call electrician.

Observe the pressure in the pressure gauge.

Now get the required pressure on the pressure relief valve (Fig 8).

Rotate clockwise to increase pressure and vice versa.



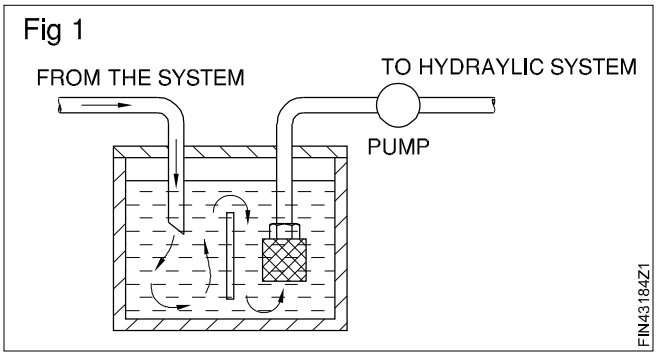


Removal of an inlet filter

Objective: This shall help you to
- **removal of an inlet filter.**

The procedure for removing the inlet filter depends on the construction of the power pack. The suction strainer is usually placed immersed in the oil and locating it needs some experience.

Open type of reservoir (Fig 9)



In a open type reservoir, the steps to be followed are

Put off hydraulic system.

Remove the top cover plate.

Keep your hand clean.

Insert your hands inside the oil and locate the suction strainer.

Use a suitable spanner and loose the suction strainer.

Clean the strainer using kerosene and blow with compressed air.

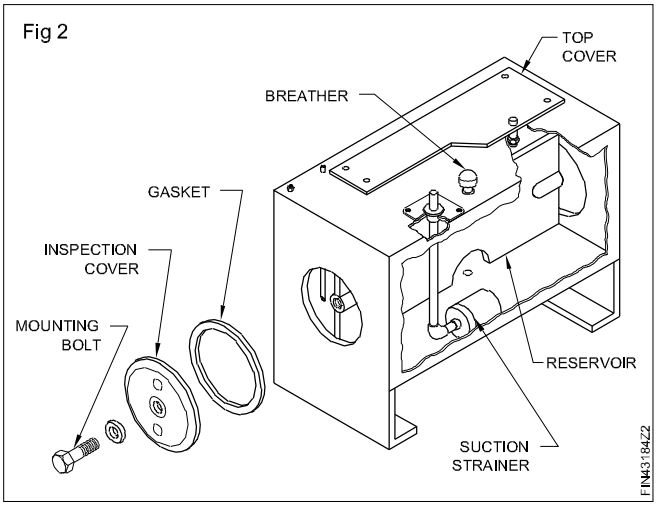
Check for damages, if any replace with new filter.

Screw on the clean filter back into position.

Removal of filter in a closed type of reservoir

Already the procedure for the filter of a closed type of reservoir with removable top cover has been explained. Other type of reservoir is explained below.

All sides welded reservoir (Fig 10)



Put off the hydraulic system.

Drain the oil from the reservoir.

Remove the inspection cover after unscrewing mounting.

Locate and unscrew the suction strainer.

Clean, strainer with kerosene and blow it with compressed air.

Clean inside of the reservoir thoroughly.

Screw the suction strainer after inspecting it for damages.

Replace inspection cover and gasket, tighten mounting screws.

Refill the oil in the reservoir after filtering the oil using mesh.

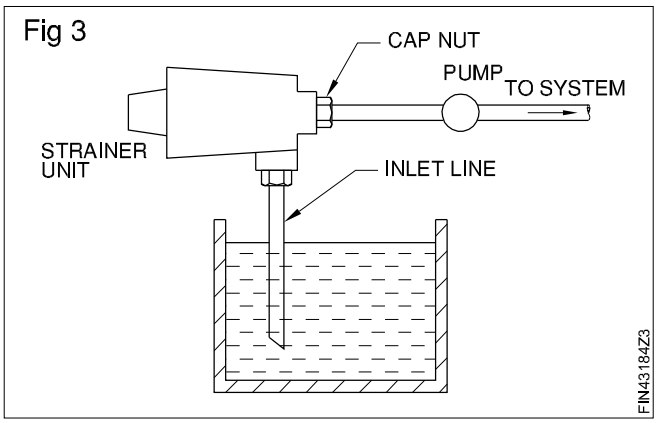
Check for oil leakage through inspection cover. Confirm no leakage of oil.

Check for oil level.

Now the system is ready for use.

Externally mounted suction strainer (Fig 11)

Fig 3



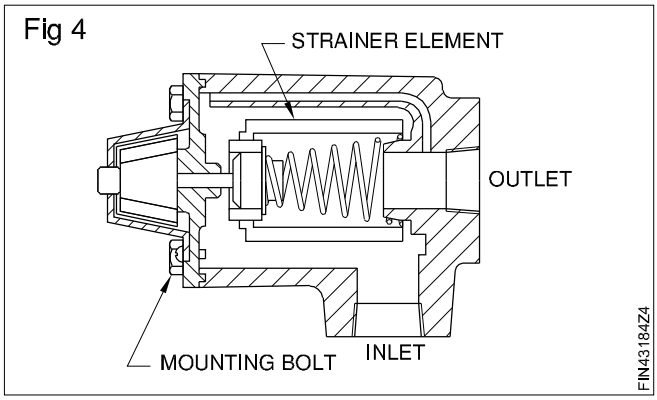
To dismantle this type of suction strainer the steps are as follows

Put off the hydraulic system.

Unscrew both the cap nuts of the lines coming to the filter unit and going out of it.

Hold the filter unit in the benchvice and unscrew the mounting bolt. (Fig 12)

Fig 4



Remove the filter insert clean/replace filter insert.

Clean the casing thoroughly.

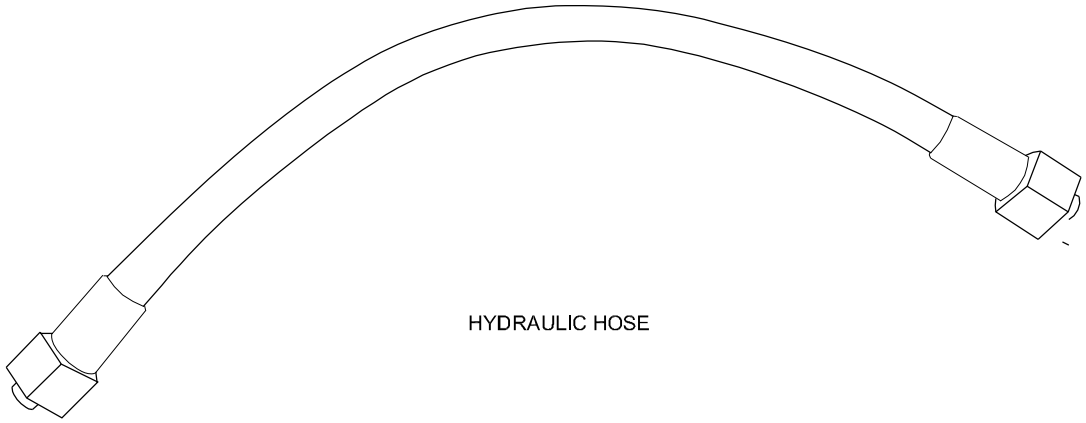
Place the insert and screw the mounting bolt.

Mount the filter unit back in this position.

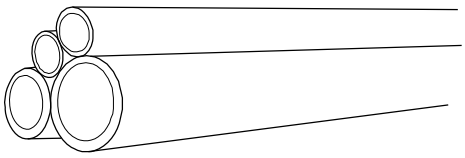
Confirm proper tightening of connectors.

Inspect hose for twist, kinks and minimum bend radius. Inspect hose/ tube fittings

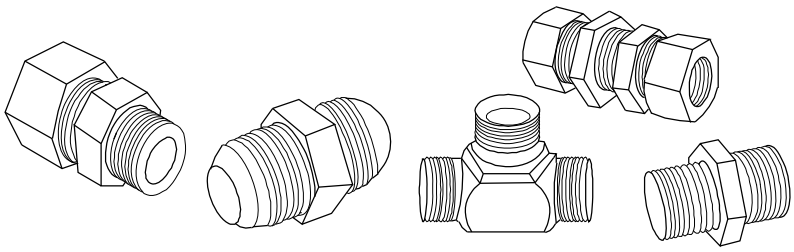
Objectives: At the end of this exercise you shall be able to
- **check the hydraulic hose**
- **check the hydraulic pipe**
- **check the hydraulic pipe fittings.**



HYDRAULIC HOSE



HYDRAULIC PIPE



HYDRAULIC PIPE FITTINGS

–	–	–	–	–	–	4.3.185
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**INSPECT HOSE FOR TWIST, KINKS AND MINIMUM BEND RADIUS. INSPECT HOSE/TUBE FITTINGS**				TOLERANCE	TIME:5Hrs
					CODE NO. FIN43185E1	

Job sequence

1 Checking hydraulic hose

- Visually check the hose for any crack.
- Keep the finger over the hose and slowly move along the hose and check for the kinks and twists.
- Check the bend radius according to the diameter of the hose.

2 Checking of hydraulic pipe

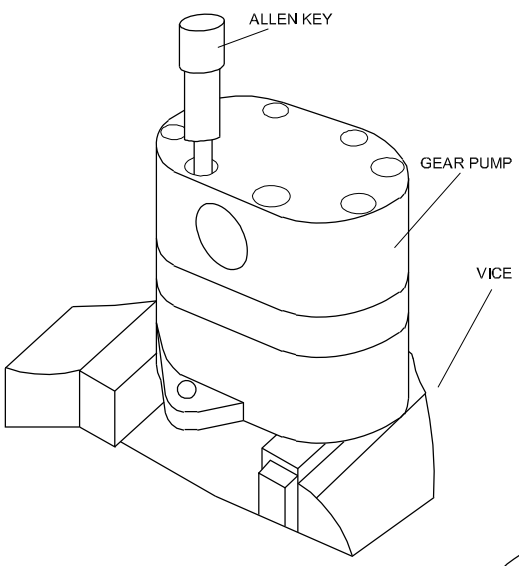
- Visually check the pipe for any crack or damage.
- Visually check the pipes for kinks, flat and twist.
- Check the bend radius according to the diameter of the pipe.
- Check the mouth of the pipe for burr.

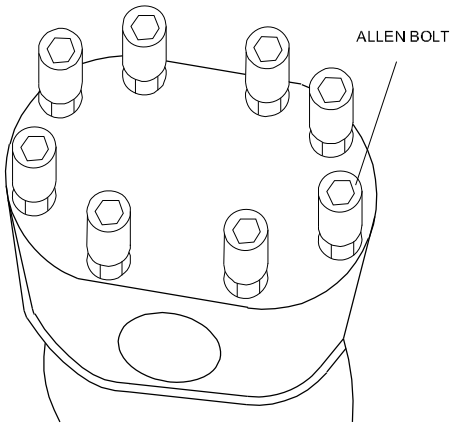
3 Checking the pipe fittings

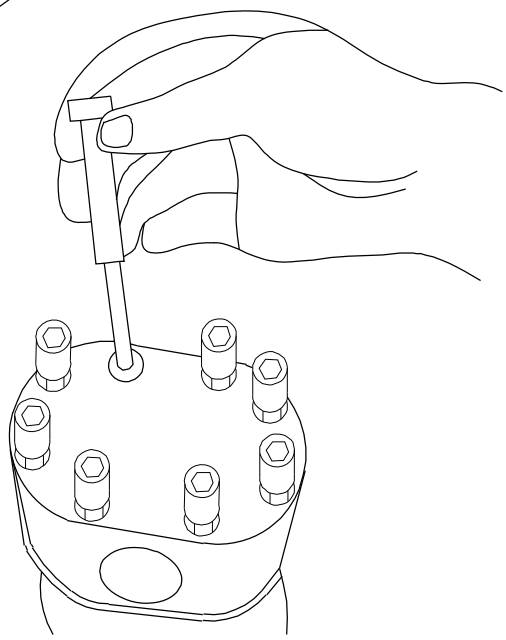
- Visually check the fitting for any damage.
- Check the pitch of the thread using screw pitch gauge.
- Check the fittings on inner edge and outer edge are made chamfer.

Identify internal parts of hydraulic cylinders, pumps/ motors

Objectives: At the end of this exercise you shall be able to
- **dismantle the gear pump**
- **replace the worn out component and reassemble the gear pump**
- **test the pump for proper functioning.**







–	–	–	–	–	–	4.2.186
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	IDENTIFY INTERNAL PARTS OF HYDRAULIC CYLINDERS,PUMPS/MOTORS	TOLERANCE	TIME:5Hrs
		CODE NO. FIN43186E1	

Requirements

Tools / Instruments

- Bech Vive
- Allen head socket wrench
- Internal snap ring plier

Equipment/ Machine

- Gear Pump - 1 No.

Material/Components

- O ring - as req.
- Oil seal - as req.

Instructor shall give the proper instruction before dismantling of pump

Job sequence

TASK 1: **Dismantle the gear pump**

1 Clamp the unit in a vice from the flange side. (Fig 1)

Make sure the vice jaws are clean and have smooth surfaces

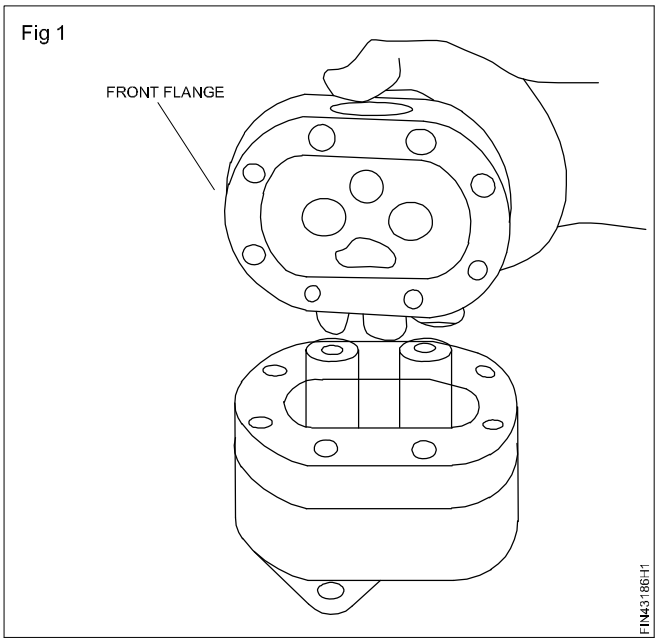
2 Use an Allen head socket wrench to loosen the bolts on the cover assembly. (Fig 2)

3 Unscrew the bolts completely and remove them. (Fig.3)

Inspect the threads for damage

4 Remove the cover assembly carefully.(Fig1)

Fig 1

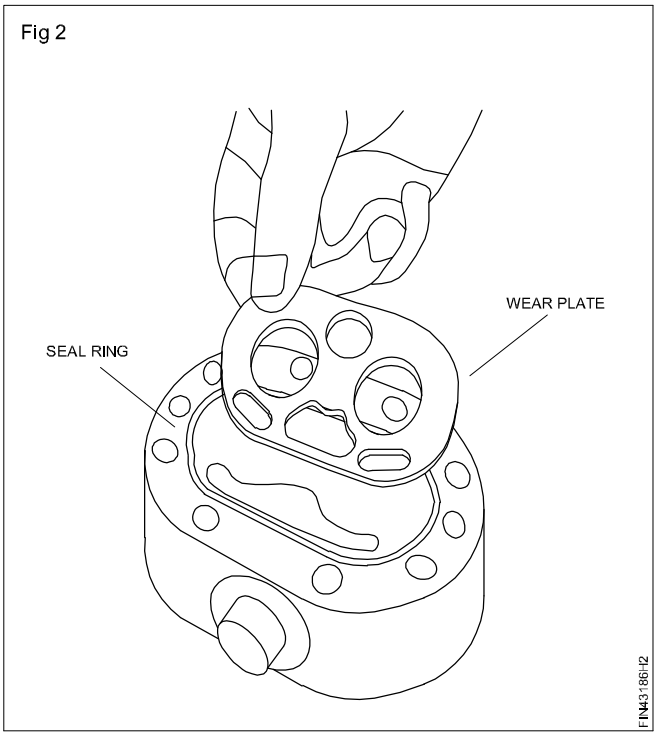


Some of the pumps may have a shaft seal, in such a case remove the cover assembly with care to prevent any damage to the seal.

5 Place the cover assembly on the work bench. Inspect the wear plate for wear and tear.

Remove the wear plate and seal ring from the cover assembly.(Fig 2)

Fig 2



Do not use sharp tools to remove the seal

6 Carefully remove the gear plate and remove the dowel pins.(Fig 3)

During disassembling the unit,mark the relative positions of the gear mesh and the body that helps during reassembly.

7 Remove the idler shaft and drive shaft from it's bearing bore (Fig 4 & 5).

Fig 3

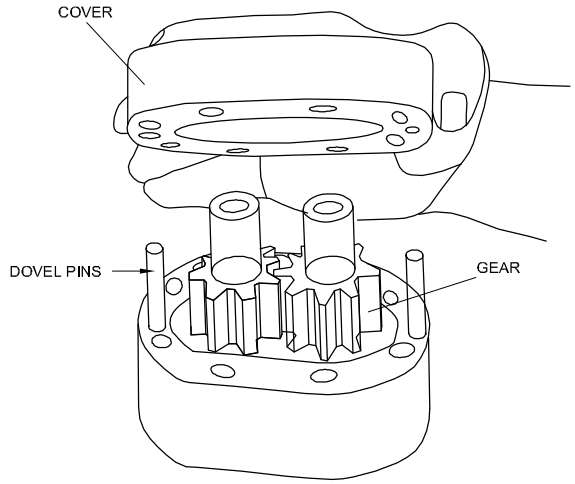


Fig 4

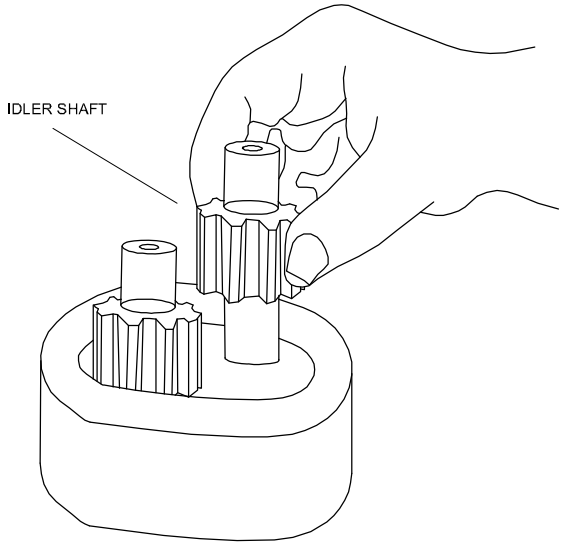
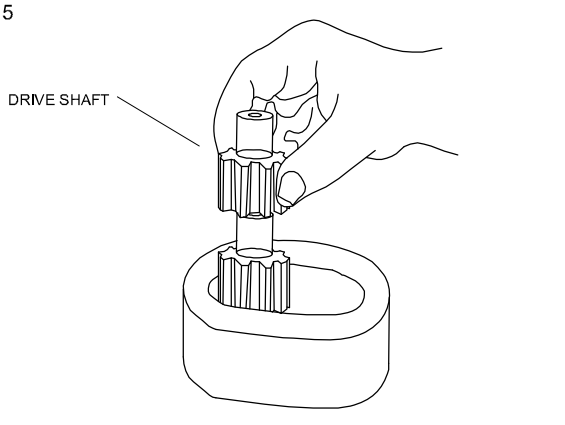


Fig 5

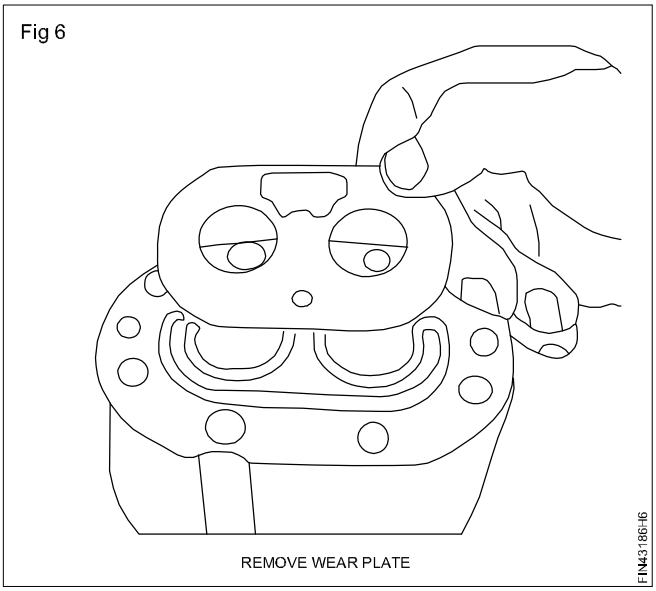


Inspect the journals and the flat faces top and bottom of the gears. Ensure these surfaces are free from burrs or scratches. If scratches are found, clean them with very fine emery cloth.

8 Rewash the gears with light oil.

9 Remove the wear plate from the assembly. (Fig 6)

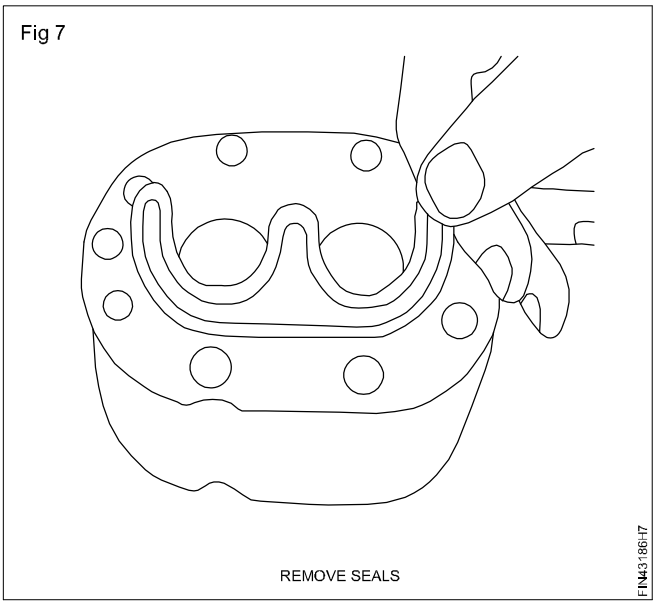
Fig 6



- **Inspect the lower wear plate for wear, or marks caused by overheating.**
- **Replace if necessary.**

10 Remove the shaft seal and snap ring from the body assembly. (Fig 7)

Fig 7



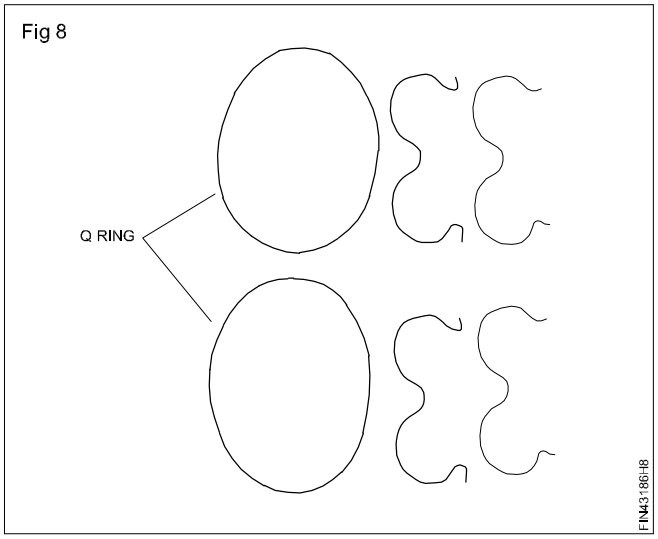
Use internal snap ring pliers to remove snap ring

Keep all the components of pump in proper manner and in clean place.

TASK 2: **Replace the worn out components and reassemble the gear pump**

1 Take the entire seal kit requied and compare the old seal kit to the new one to ensure you have the correct one. (Fig 8)

Fig 8



Apply grease in all seals before use it

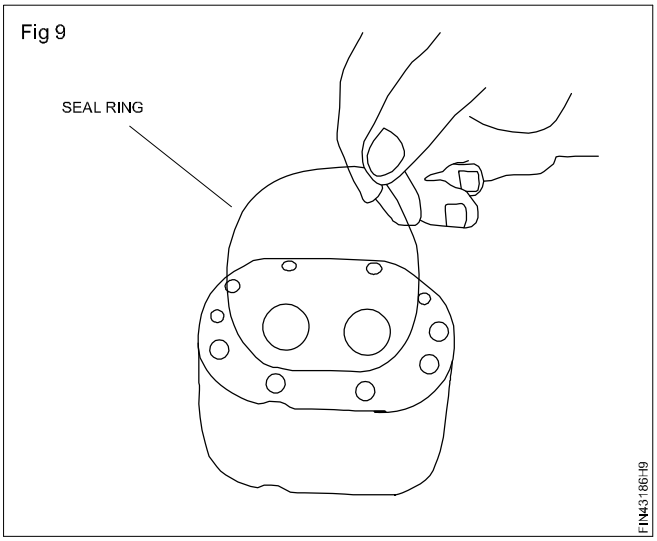
2 Prepare the body by cleaning it. Inspect the internal and mating surfaces.

Ensure the surfaces are free of burrs an scratches

3 Install the shaft seal into the body assembly.

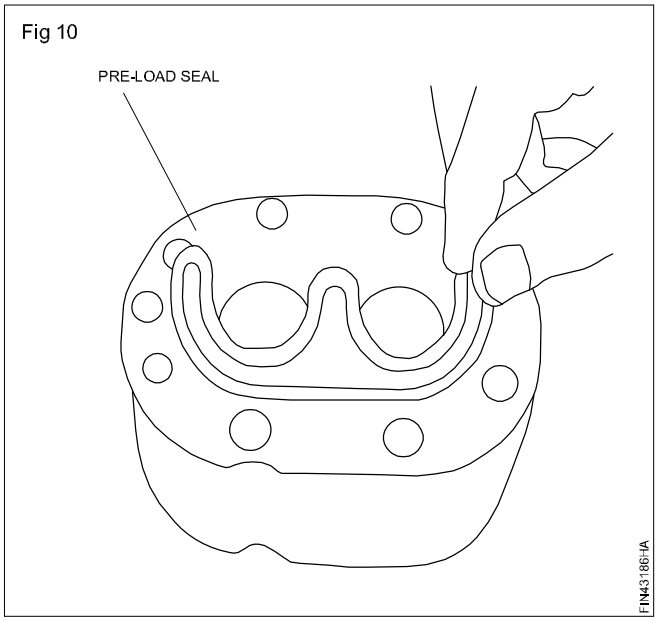
4 Apply light lubricant in the body and shaft seal. Place the seal in the body assembly by hand. Then, press the seal using a shaft seal installation tool. This will insure the seal is in proper depth. (Fig 9)

Fig 9



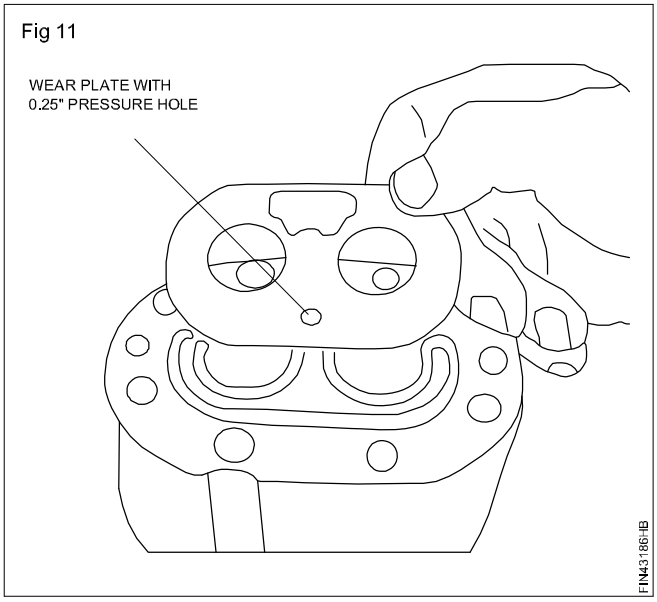
5 Place the body assembly, with the E- ring seal grooves facing up.(Fig 10)

Fig 10



6 Place the wear plate on top of the E- ring with the bronze side facing up towards the gear. The 0.25" pressure hole is to be positioned on the E-ring side of the body. (Fig 11)

Fig 11



7 Lubricate the spline end of the drive shaft with grease. Insert the drive shaft and the idler shaft in the correct bearing bore.(Fig 12)

8 Inspect gear teeth for alignment. Lubricate the complete gear set using clean light oil.

9 Insert the two dowel pins into the body assembly. Place the gear plate over the dowel pins.(Fig 13)

Fig 12

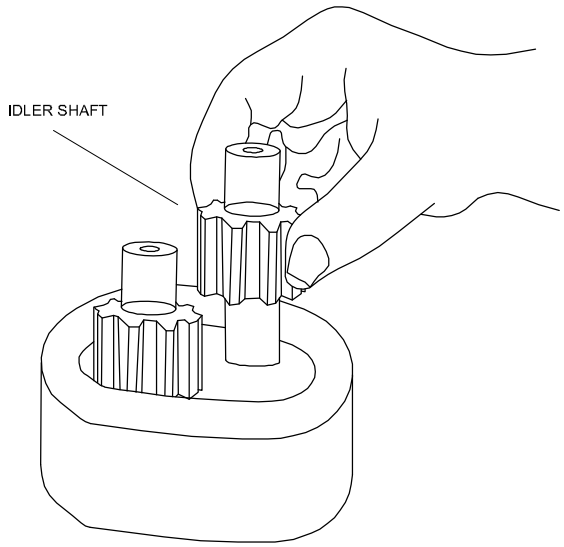
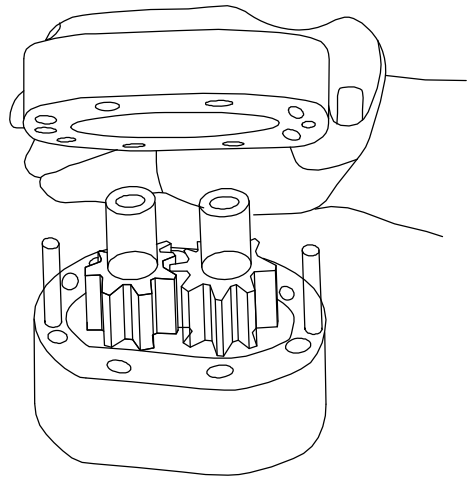
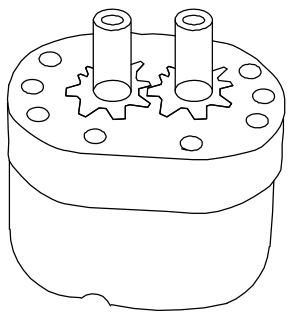


Fig 13



Make sure the gear plate is seated properly. (Fig 14)

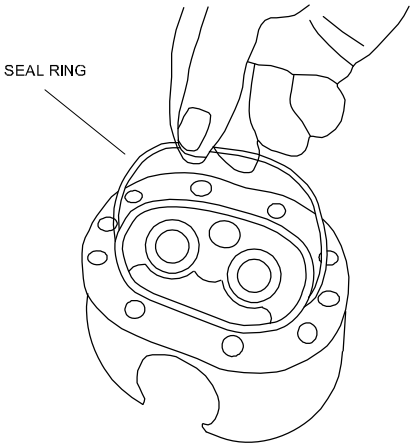
Fig 14



10 Place the cover assembly on a bench with the machined surface facing up.

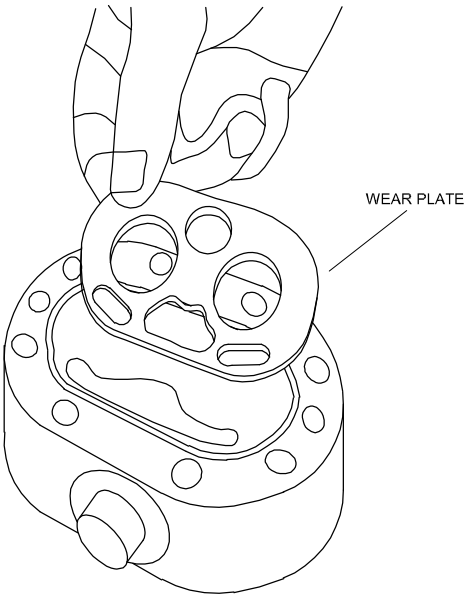
11 Place the rubber seal ring in the cover seal ring groove. (Fig 15)

Fig 15



12 Position the wear plate in the cover with the bronze side facing up (towards gears). (Fig 16)

Fig 16



Pressure hole located over the circular holes in the cover.

13 Place cover assembly over the body assembly. (Fig 17).

14 Fasten assembly using torque wrench. (Fig 18)

If componants are replaced by new componant, run the pump in idle for some time dismantle and wash with solvent to clear off pre-setting wear particles.

Fig 17

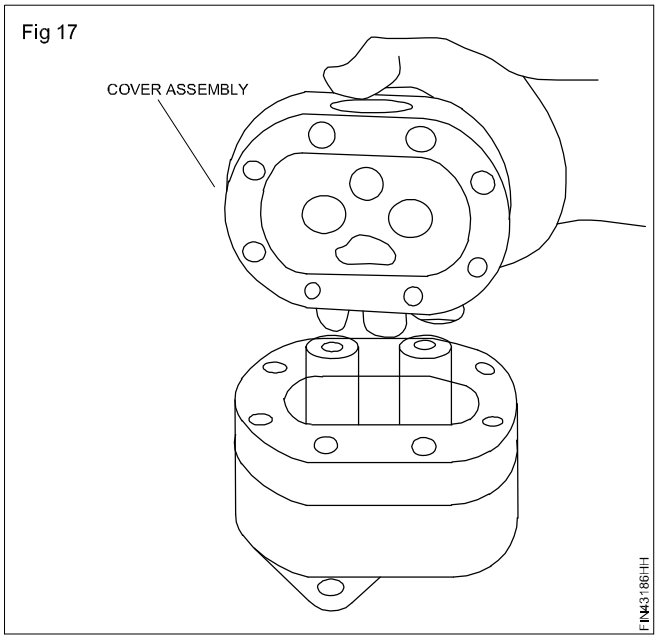
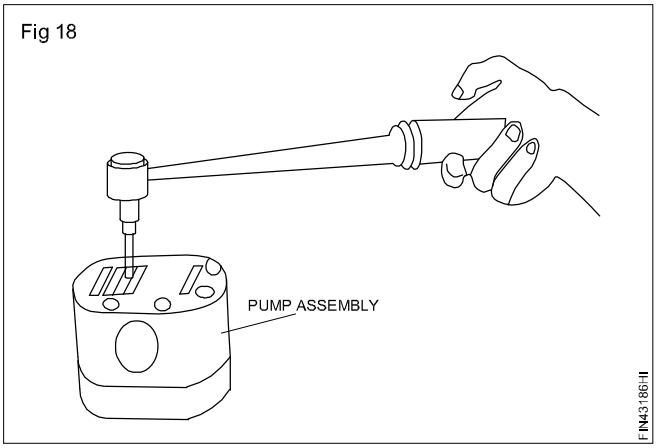


Fig 18



TASK3 : **Test the pump for proper functioning**

Rotate the pump and check the flow rate, smoothness of rotation and sound of pump.

Observation

1 Flow rate of pump as per specification.

2 Operation of pump should be smooth.

Conclusion: _____

_____

_____

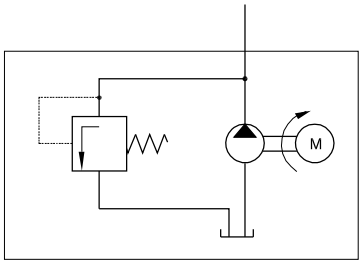
Construct a circuit for the control of a s/a hydraulic cylinder using a 3/2 way valve (Weight loaded d/a cylinder may be used as a s/a cylinder), 4/2 and 4/3 way valves

Objectives: At the end of this exercise you shall be able to
- **design a circuit to actuate a single acting cylinder**
- **design a circuit to actuate double acting cylinder**
- **design a circuit to actuate hydromotor**
- **select the various elements as per the circuit**
- **construct the above circuits**
- **test the above circuits for its function, duly arresting and leakage.**

TASK - 1

TABLE - 1

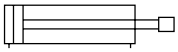
POSITION OF	
VALVE	CYLINDER

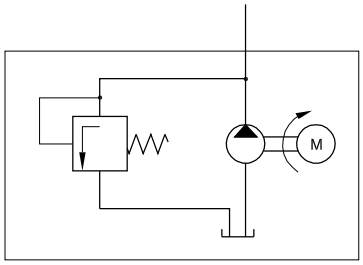


TASK - 3

TABLE - 3

POSITION OF	
VALVE	CYLINDER

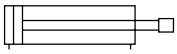


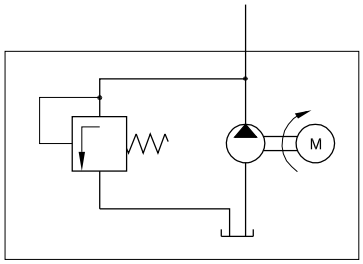


TASK - 2

TABLE - 2

POSITION OF	
VALVE	CYLINDER

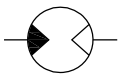


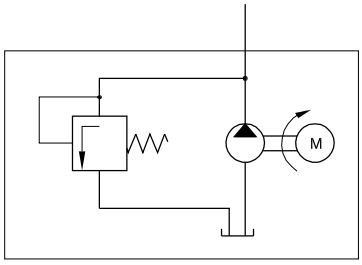


TASK - 4

TABLE - 4

POSITION OF	
VALVE	CYLINDER





–	–	–	–	–	–	4.3.187
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**CONSTRUCT A CIRCUIT FOR THE CONTROL OF A S/A HYDRAULIC CYLINDER USING A 3/2 - WAY VALVE (WEIGHT LOADED D/A CYLINDER MAYBE USED AS A S/A CYLINDER),4/2 & 4/3 WAY VALVES**				TOLERANCE	TIME: 10Hrs
					CODE NO. FIN43187E1	

Job sequence

- Designing, constructing and testing circuits to actuate a single acting cylinder/double acting cylinder/ hydrometer.

TASK 1 : **Circuit for single acting cylinder**

Design, construct and test a circuit to actuate a single acting cylinder.

TASK 2 : **Circuit for double acting cylinder in 4/2 valves**

Design, construct and test a circuit to actuate a double acting cylinder using 4/2 directional control valve.

TASK 3 : **Circuit for double acting cylinder in 4/3 valves**

Design, construct and test a circuit to actuate a double acting cylinder using 4/3 directional control valve.

TASK 4 : **Circuit activate hydrometer**

Design, construct and test a circuit to actuate a hydrometer using a 4/3 D.C. Valve.

— — — — — —

TASK 1: **Design, construct and test a circuit to activate a single acting cylinder.**

Draw a circuit diagram to actuate a single acting cylinder in the given format and get the approval of instructor.

Include elements to actuate cylinder and also to monitor pressure at various points in the circuit.

Select the hydraulic elements as per the approved circuit diagram drawn.

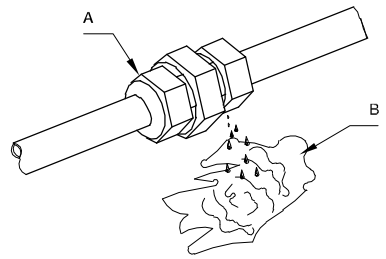
Mount and connect the elements on the trainer kit.

Get the approval of your instructor before switching "ON" hydraulic pump.

Switch ON the hydraulic pump.

Inspect the circuit for any leakages. (Fig 1)

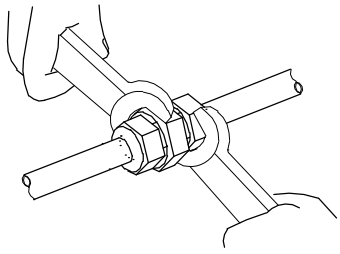
Fig 1



Eliminate any leakages by (Fig 2) retightening connectors pipes.

Put off hydraulic pump, while tightening connector and pipes.

Fig 2



Note the position of valve and position of cylinder in the table 1. (Table given along with circuit diagram)

Actuate the direction control valve and note the new position of valve and cylinder.

Note it in the table 1.

Put off hydraulic pump.

Disconnect the valves and other elements and place it in respective places.

Repeat the above sequence for task 2, 3 and 4 with respective circuit diagram and table.

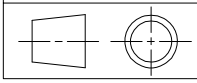
Maintenance, trouble shooting and safety aspects of pneumatic and hydraulic systems (The practical for this component may be demonstrated by video)

Objectives: At the end of this exercise you shall be able to
- **to maintain pneumatic and hydraulic**
- **to know about trouble shooting**
- **follow safety on pneumatic and hydraulic.**

The practical for this, component may demonstrated by video.

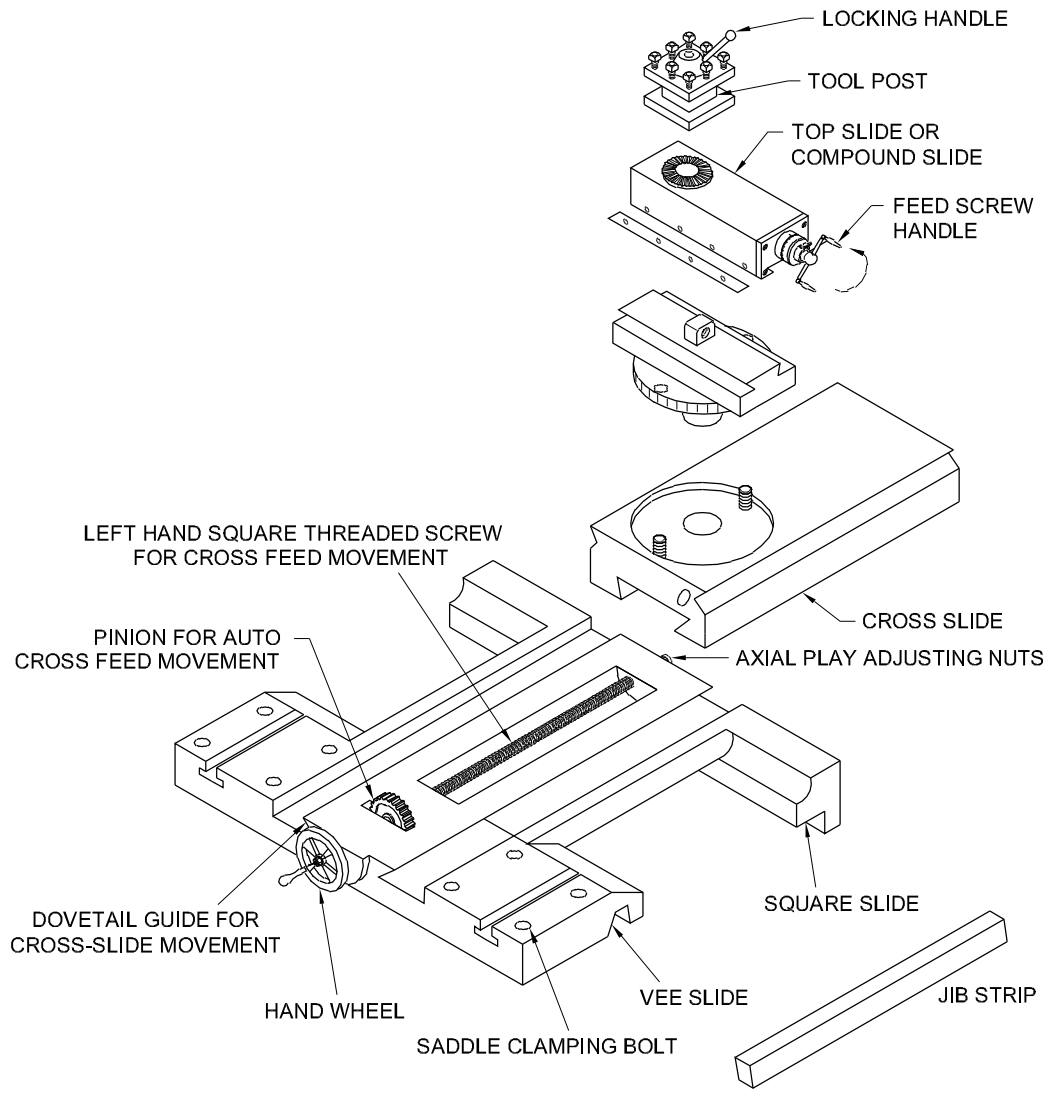
Instructor may arrange video's locally and demonstate to the trainees.

–	–	–	–	–	–	4.3.188
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	MAINTENANCE,TROUBLE SHOOTING AND SAFETY ASPECTS OF PNEUMATIC AND HYDRAULIC SYSTEMS(THE PRACTICAL FOR THIS COMPONENT MAYBE DEMONSTRATED BY VIDEO)	TOLERANCE	TIME: 15Hrs
		CODE NO. FIN43188E1	

Dismantle, overhauling & assemble cross slide & hand slide of lathe carriage

Objectives: At the end of this exercise you shall be able to
- **dismantle the compound rest from the cross slide**
- **remove out the carriage unit from the machine bed**
- **assemble and test for functions.**

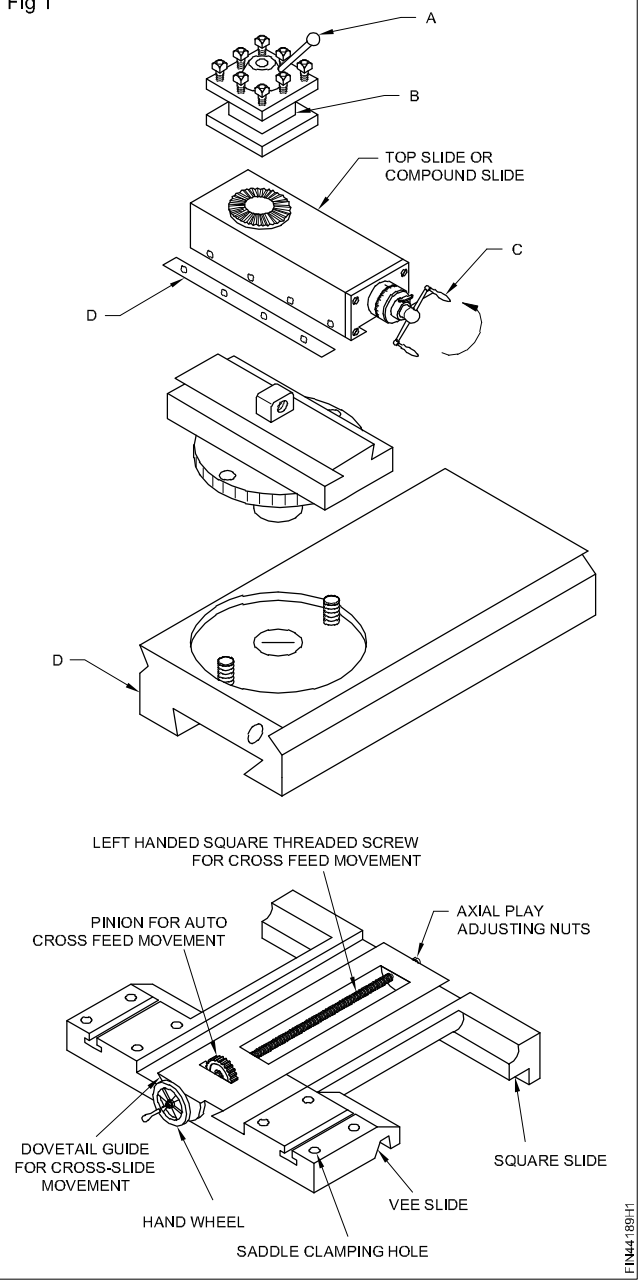


–	–	–	–	–	–	4.4.189
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**DISMANTLE, OVERHAULING & ASSEMBLE CROSS-SLIDE & HAND SLIDE OF LATHE CARRIAGE**				TOLERANCE : ±	TIME: 25Hrs
					CODE NO. FIN44189E1	

Job sequence

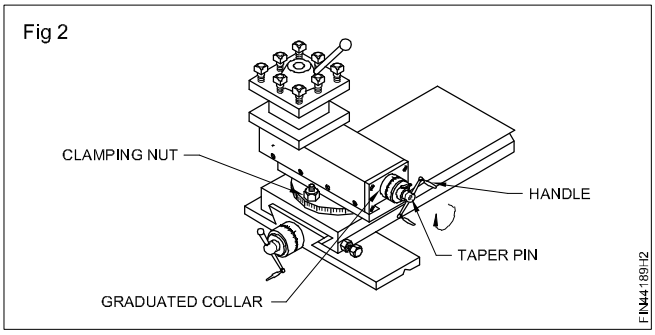
- Unscrew the tool posts locking handle (Fig. 1A) and remove the tool post (1B) from the compound slide.
- Rotate the feed screw handle of the top slide (Fig. 1C) in anticlock wise direction to get it released from the dovetails of the compound slide.
- Take out the jib from the dovetail of the top slide. (Fig. 1D)

Fig 1



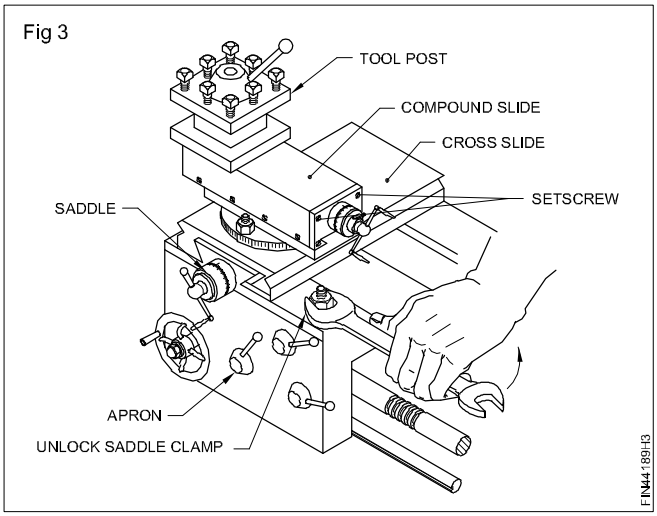
- Unscrew both the clamping nuts (Fig. 2) from the T.bolts, provided on the swivel base of the compound slide and take out the unit.
- Remove the graduated collar (Fig. 2) of the compound slide by removing the taper pin.

Fig 2



- Disengage the lead screw from the cross-slide.
- Unscrew the lock nuts from the cross-slide feed screw to remove the graduated collar.
- Take out the jib strip from the dovetails of the cross-slide so that it can be made to slide out easily.
- Unscrew and remove the saddle clamp. (Fig. 3)

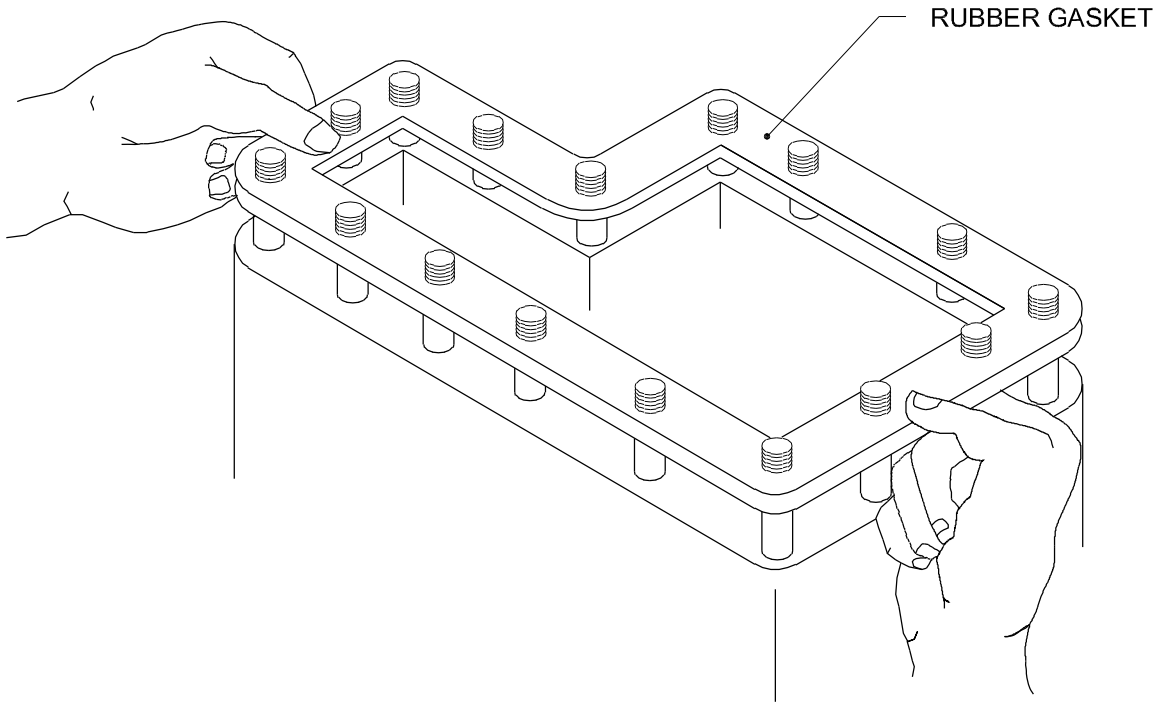
Fig 3



- Slide way the tailstock unit and take it out of the bed.
- Slide away the saddle unit towards the right end to take it out of the machine bed.
- Clean the parts with kerosene oil, wipe them with banian cloth and keep the parts in tray.
- Inspect the components visually for damage and wear.
- Lubricate the parts with lubricating oil.
- Assemble the parts in the reverse sequence to complete the process of overhauling.
- Check the function.

Simple repair of machinery: Making of packing gaskets

Objectives: At the end of this exercise you shall be able to
- **mark and cut the profile and prepare gasket**
- **fit new gasket and test the joints for leakage.**



1	100X75X2mm	-	RUBBER GASKET	-	-	4.4.190
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SIMPLE REPAIR OF MACHINERY:MAKING OF PACKING GASKETS**	RTOLERANCE: ±1	TIME : 5Hrs
		CODE NO. FIN44190E1	

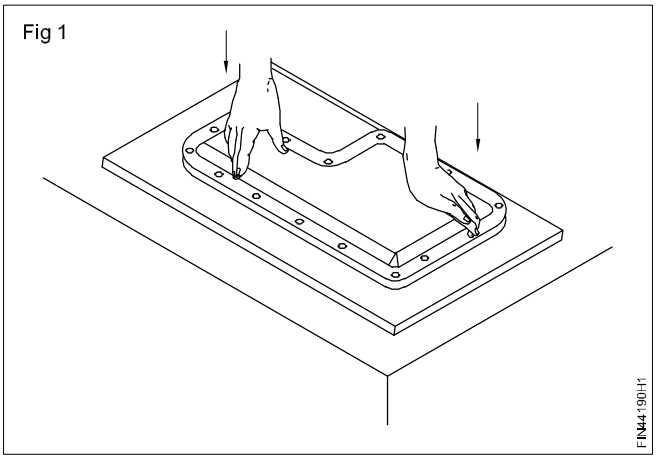
Job sequence

- Remove the cover plate and take out the damaged gasket.

Ensure that no portion of the gasket remains on the surface.

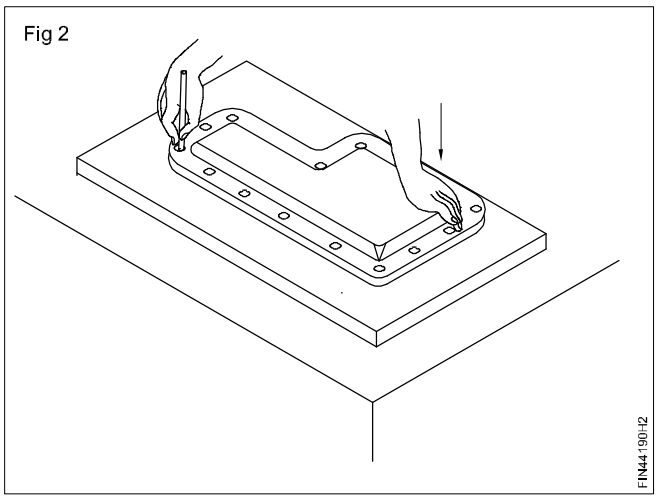
- Clean the surface of the base and the cover plate thoroughly.
- In the case of glue-bonded gaskets, surfaces should be cleaned thoroughly using a blunt scraper.
- Smear marking medium or grease on the cover plate's base surface.
- Place the gasket on to the base of the cover plate and press firmly. (Fig 1)

Fig 1



- Mark the geometrical shape of the gasket using a scriber or pencil. (Fig 2)

Fig 2



For smaller or handy objects the article can be placed on to the gasket for marking.

- Punch out the holes using a hollow punch and a hammer or a little over- size steel ball and a hammer. (Figs 3 and 4).

Fig 3

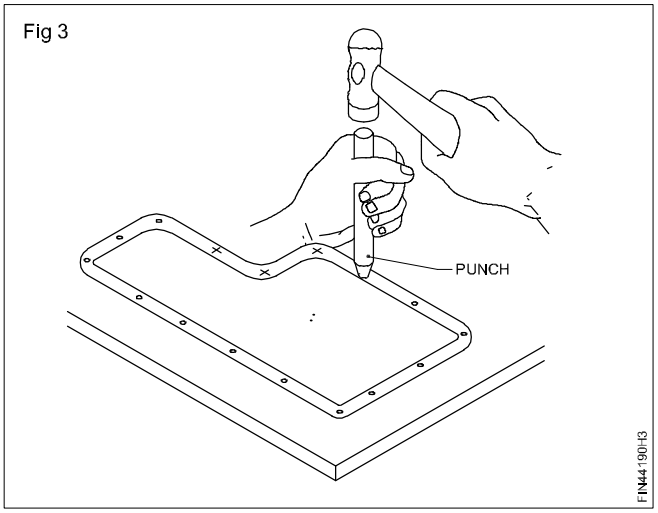
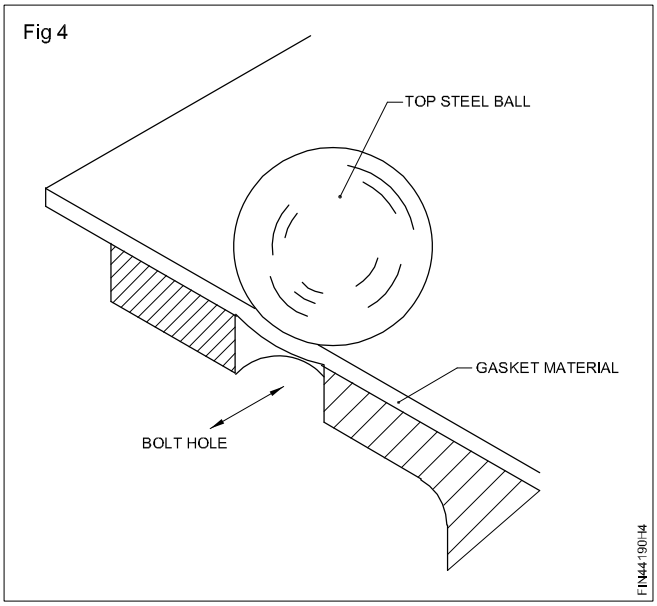
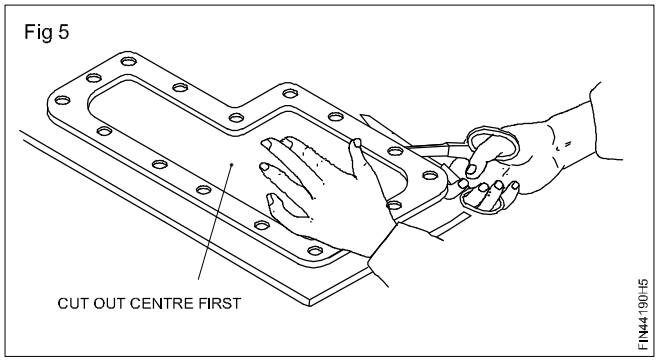


Fig 4



- Cut out the unwanted portion of the gasket using scissors. (Fig 5)

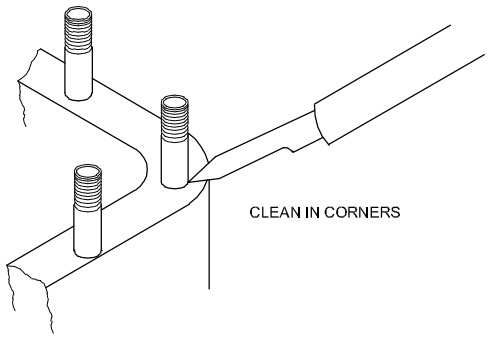
Fig 5



Cut out the centre portion first and then the external profile.

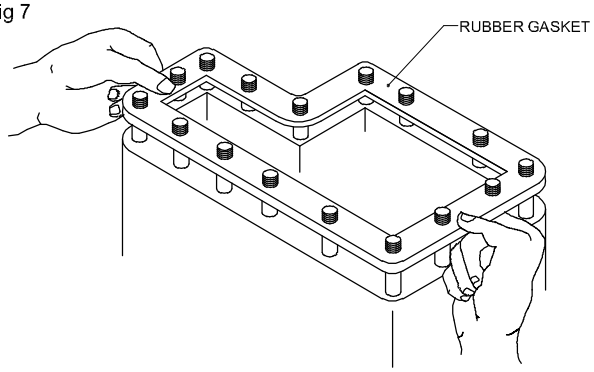
- Clean the corners of the studs. (Fig 6)
- Fit the gasket in position. (Fig 7)

Fig 6



FIN44190H6

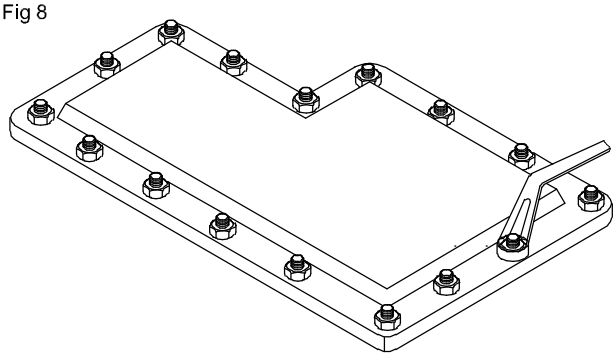
Fig 7



MM3229J7

- Replace the cover plate on to the gasket and tighten the screws evenly. (Fig 8)

Fig 8



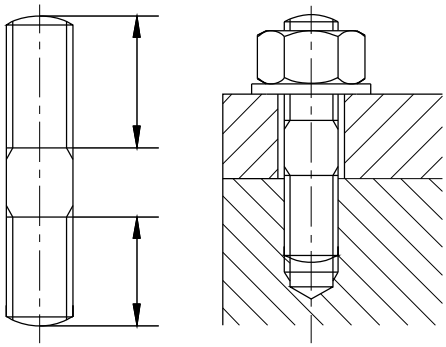
FIN44190H8

- Test the sealed joint for leaks and functional aspects.

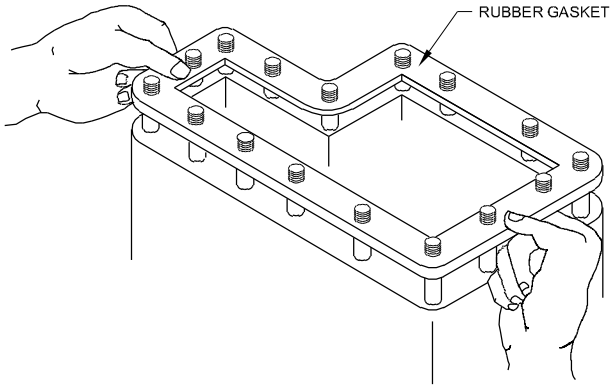
Check washers, gasket, clutch, keys, jibs, cotter, Circlip etc and replace / repair if needed

Objectives: At the end of this exercise you shall be able to
- **replace washer on gasket**
- **replace clutch and keys**
- **replace jib, cotter and circlip**
- **replacing the above components.**

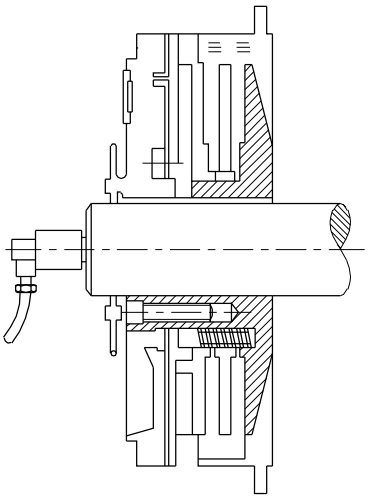
TASK 1



TASK 2

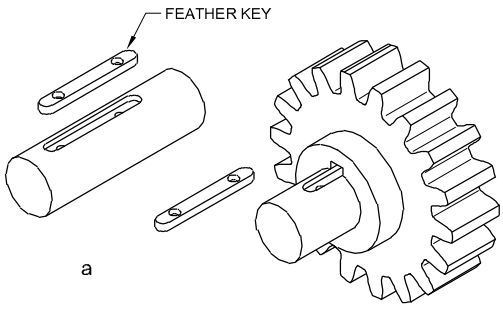


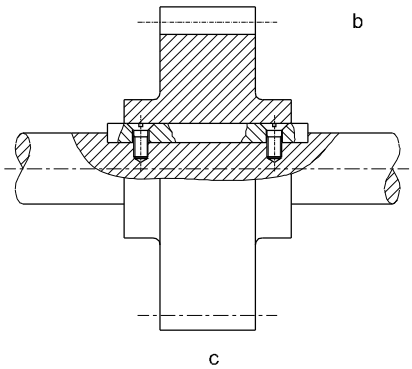
TASK 3



AIR -CLUTCH MECHANISM

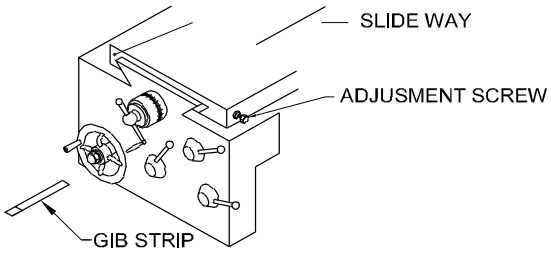
TASK 4

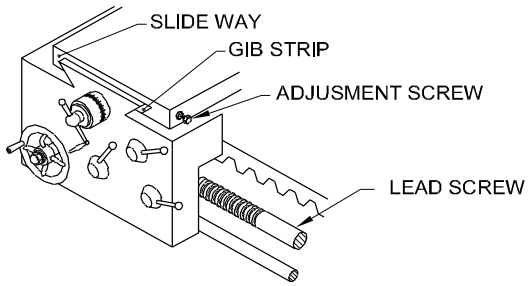




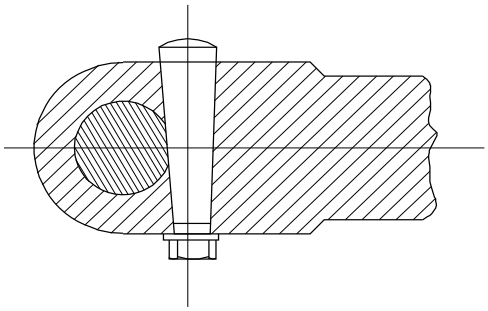
-	-	-	-	-	-	4.4.191
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**CHECK WASHERS,GASKET,CLUTCH,KEYS,JIBS, COTTER,CIRCLIP,ETC., AND REPLACE AND REPAIR IF NEEDED**				TOLERANCE ±	TIME : 5Hrs
					CODE NO. FIN44191E1	

TASK 5

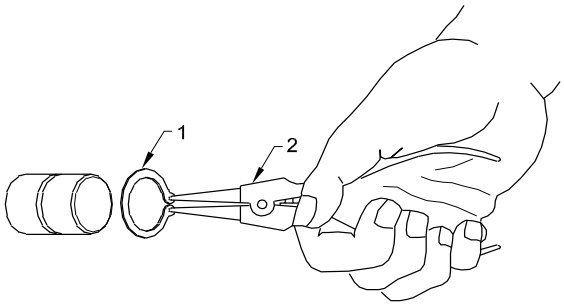


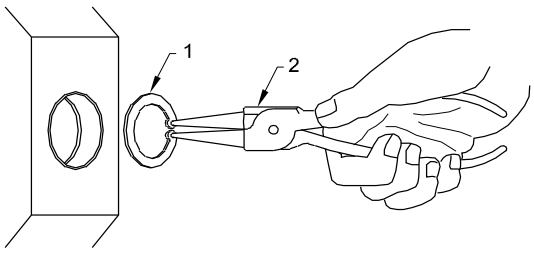


TASK 6



TASK 7





-	-	-	-	-	-	4.4.191
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					TOLERANCE ±	TIME :
					CODE NO. FIN44191E2	

Job Sequence

TASK 1: **Replacing washer**

- Remove nut using correct size spanner.
- Remove the worn out washer from the assembly.
- Place the correct size washer.
- Tight the nut with washer.

– – – – – – – –

TASK 2: **Replacing gasket**

- Remove the damaged gasket.
- Clean the surface of the base and the cover plate.
- Place the gasket on the base plate and press firmly.
- Assemble the unit.
- Detailed assemble explained in Ex. No. 4.4.190.

– – – – – – – –

TASK 3: **Adjusting the clutch**

- Remove the both side covers of feed gear box using allen keys after switch off the power supply.
- Remove the terminals by using suitable spanner.
- Use a bend tubular spanner to remove the carbon brushes.
- Remove the circlip form the spline shaft.
- Take out the clutch with spline shaft from the unit by using M 12 bearing puller set.
- Place the assembly on work bench, clean it properly.
- If not getting proper engaging and disengaging of clutch, dismantle the clutch unit and remove clutch plate.
- Identify the following electrical and mechanical faults.
- Check the gap with feeler gauge between clutch plates and ensure that the gap should be as mentioned by the original equipment manufacturer.
- Check the spline shaft and ensure that the splines are proper.
- Assemble all the parts and once again check the unit on a work bench.
- If found satisfactory working of clutch assembly mount it in to the feed gear box of machine.
- Seated the circlip, carbon brushes and terminal.
- Fix the side covers by using allen key and check the working of clutch assembly by switch on the machine.

– – – – – – – –

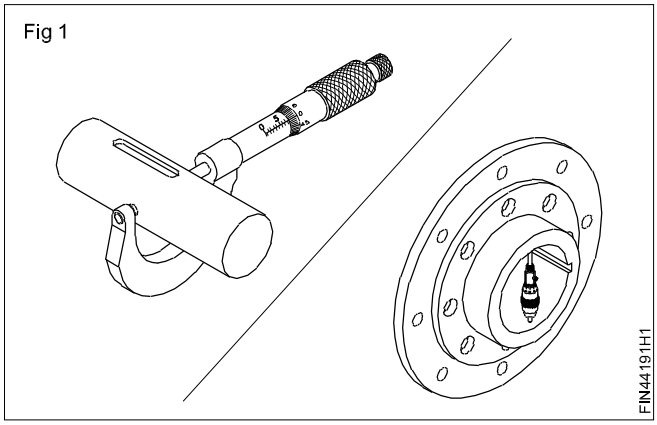
TASK 4: **Replacing key**

- Assemble hub and shaft with parallel key.
- Assemble hub and shaft with tapered (Gib Head) key.

Parallel key fitting

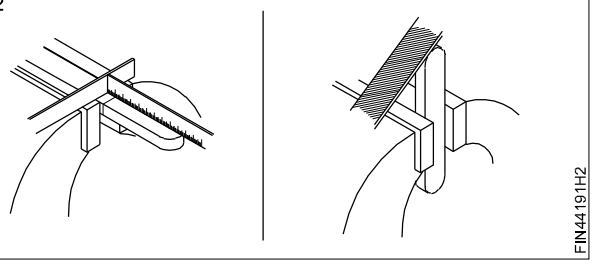
- Deburr the keyways in the shaft and the Hub, clean the keyways.
- Check the dimensions of shaft and Hub and keyways using precision instruments. Outside dia of shaft, inside dia of hub, length, with and depth of keyway as per the drawing (Fig 1).
- Select a length of key steel of suitable cross section depending on the size of the keyway.

Fig 1



- File radius at one end of the key and cut to a length plus 1 mm of the keyway and file other end of the key. (Fig 2)

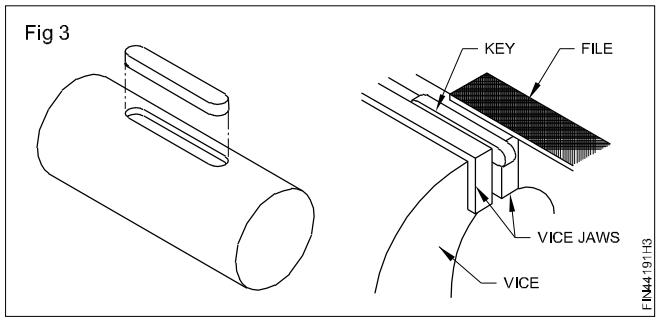
Fig 2



Ensure that the key is chamfered all around in its bottom side edges.

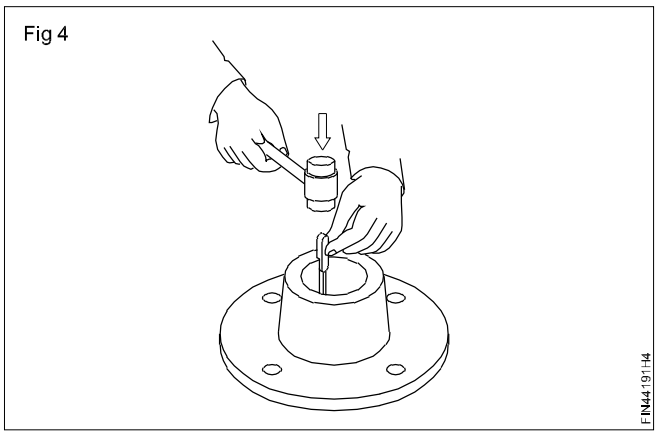
- Check the key width to suit the keyway in the shaft. Draw file the key, so that it is slight tap fit/light keying fit (K7-h6) with the keyway on the shaft. (Fig 3)

Fig 3



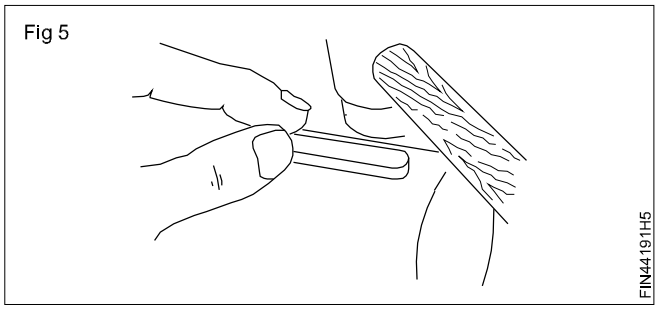
- Check the key for slight tap fit with the keyway in the Hub. (Fig 4)

Fig 4



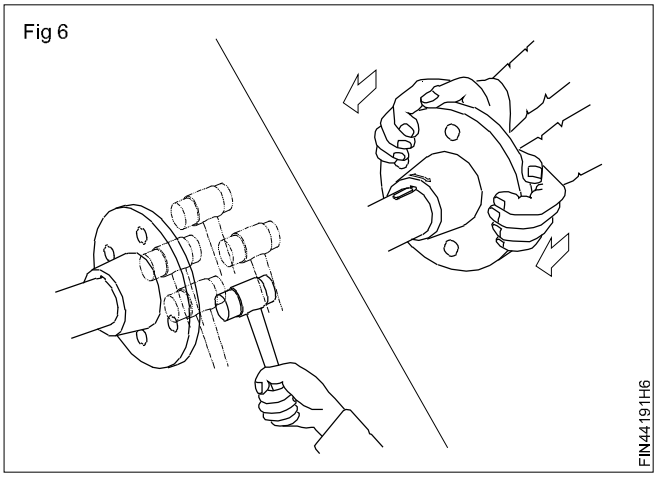
- Apply Prussian blue on all sides and bottom protion of the key so that proper bearing of key on the keyway is ascertained.
- Insert the key in the keyway of the shaft and tap with a light weight soft hammer. (Fig 5)

Fig 5



- Tap the hub on the shaft, and remove the hub from the shaft, check the key and note the high spots where the key has made contact with the keyway of the hub.
- Lightly file the high spots away, the top of the key should be approximately 0.1mm clear.
- Repeat the fitting and filing operation until the hub is fit on to the shaft to the desired position. (Fig 6)

Fig 6



TASK 5: **Replace/ adjust jib**

- Remove the adjusting screws from the dovetail slide.
- Dismantle the gib from the cross-slide.
- Clean the slide surfaces, adjusting screws, nuts and gib thoroughly.
- Inspect all the parts for and check any damage.
- Lubricate the slideways.
- Assemble the gib.
- Tighten the adjusting screws to give the correct freedom required in the assembly.
- Lock the movement of the adjusting screw by the check- nut.

– – – – – – – –

TASK 6: **Replace cotter**

- For removing cotter from work unit, loose the nut slightly then slowly strike with soft hammer.
- Then loose the nut completely pull the cotter pin.
- Insert the new cotter pin in the hole strike with hammer.
- After tightening the pin fix the nut.

– – – – – – – –

TASK 7: **Replace circlip**

- Assemble external circlip using cone and compresson bush.
- Assemble internal circlip using cone and compression pin.
- Assemble external and internal circlips using pliers.
- Dismantle external and internal circlips using pliers.

During assembly, circlip is to be spread or closed as far as it is necessary for positioning on the shaft or installing in the housing bore.

Assemble external circlip using cone and compressor bush

- Circlips without assembly holes are best assembled by means of cones Figs (1) & (2)

Fig 1

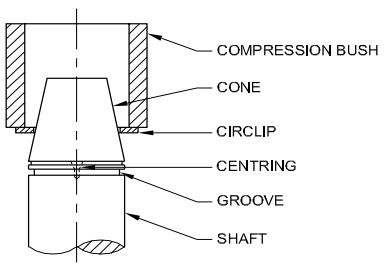
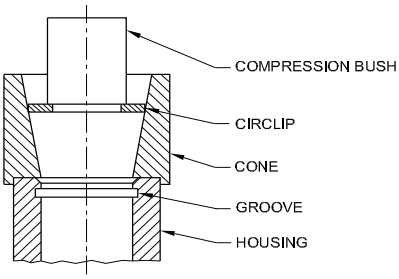


Fig 2



- Place the cone over the shaft in which the circlip is to be fixed.
- Place the circlip over the cone.
- Place the compressions bush over the circlip.
- Press the compression bush by suitable means depending upon the size of the circlip, slowly and smoothly until the circlip is seated in the groove.

Assemble internal circlip using cone and compression pin

- Place the cone over the bore in which circlip is to be provided as shown in Fig 2
- Place the internal circlip in the tapered bore of the cone.
- Place the compression pin over the circlip.
- Press the compression pin slowly and smoothly until the circlip is seated in the groove in the bore.

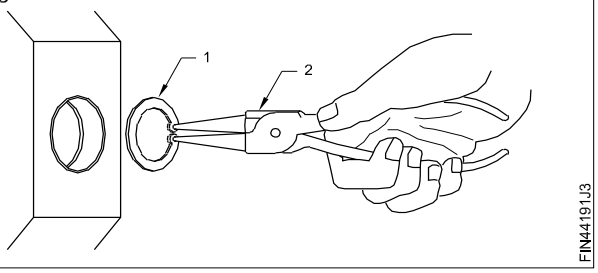
Assemble and dismantle circlip using pliers

- Select suitable circlip pliers depending upon the circlips to be used. (External or Internal)
- Remove all sharp edges from the circlip and check for the crack, if any.

Assemble internal circlip (Fig 3)

- Hold the internal circlip (1) with help of an internal circlip piler (2).
- Press the circlip (1) with the help of the plier (2) so that its diameter will be smaller than the hole diameter.

Fig 3

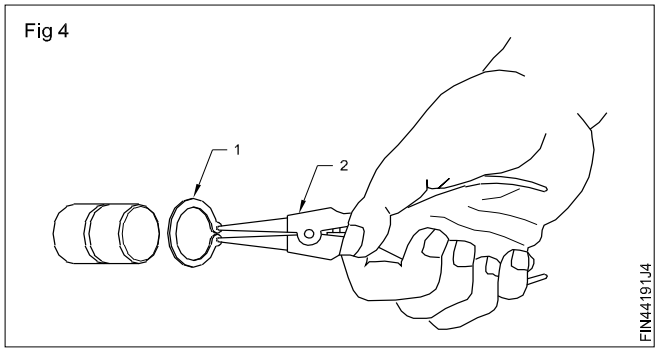


- Insert the circlip in this position, in such a manner that it will sit squarely in the groove.
- Take out the plier (2).

Assemble external circlip (Fig 4)

- Hold an external circlip (1) with the help of an external circlip plier (2).
- Press the external circlip plier (2) so that the circlip (2) will enlarge in diameter.

Fig 4



- Slide the circlip on the shaft in the enlarge position, until it is set in the shaft groove.
- Ensure that the circlip sits squarely in groove (3).
- Take out the plier.
- For dismantling the internal and external circlips the above procedure can be reversed and applied.

Skill Sequence

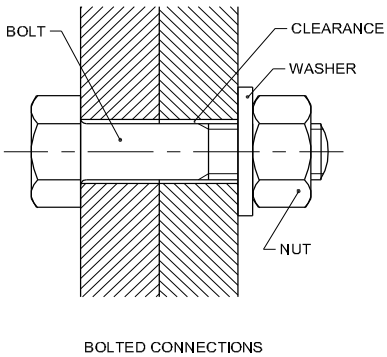
Types of washers

Objectives: This shall help you to
- **state the purpose of washers**
- **identify the types of washers**
- **state the uses of each type of washers.**
- **specify the washers as per B.I.S.**

Purpose

It is a common practice to provide washers under the note in bolted joints (Fig 1).

Fig 1



Washers help to

- Increase the frictional grip
- Prevent damage to the workpiece,and distribute force over a larger area.
- Prevent loosening of nuts due to vibrations.

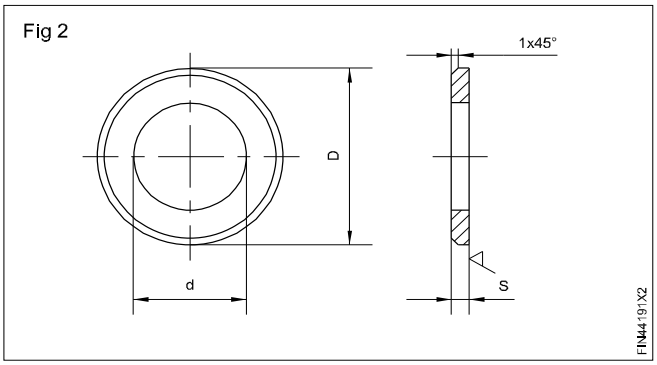
Types of washers

There are different types of washers available. They are plain or flat washers

- Taper washers
- Spring washers
- Tab washers
- Toothed lock washers.

Plain or flat washers (Figs 2 and 3)

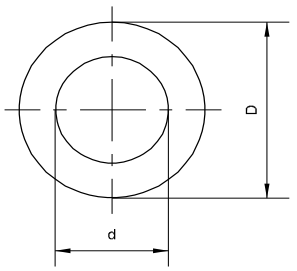
Fig 2



These washers are used for bolting assemblies with fial surfaces. The diameter,thickness and the bore diameter are proportional to the diameter of the bolt (I.S.2016)

Plain washers are available as machined or punched washers.

Fig 3



FIN44191X3

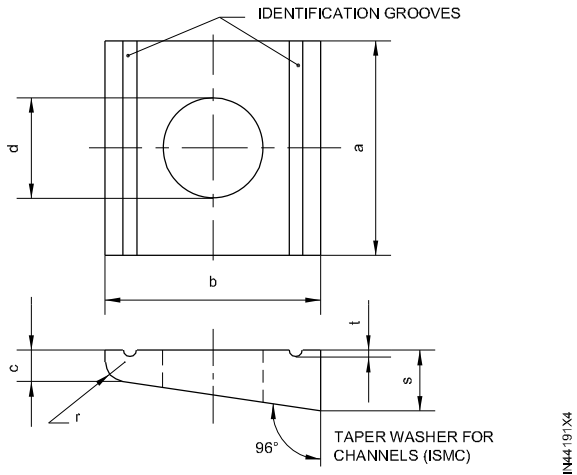
Machined washers

These washers are used for assemblies using machine components. These washers are available with chamfer on one side or on both sides. They are heat treated are ground punched washers

These do not have chamfers and are commonly used in structural fabrication work.

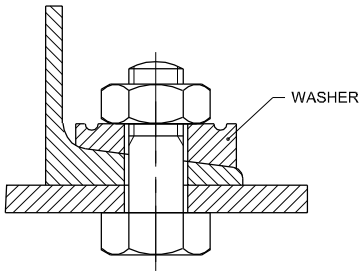
Tapered washers (Figs 4 and 5)

Fig 4



FIN44191X4

Fig 5



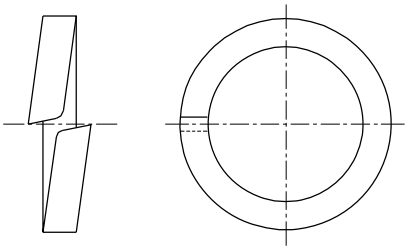
FIN44191X5

These are used in structural assembiles with tapered surfaces like inside of I - Beams,channels,etc,These washers help the bolt head or nut to seat square to the hole.

Spring washers (Fig 6 and 7)

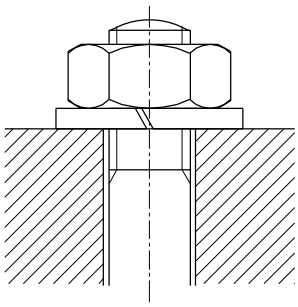
Spring washers are used under nuts to prevent slackening of the nuts due to vibrations. They are made of spring steel,and when compressed they create tension between the bolt and the nut.

Fig 6



FIN44191X6

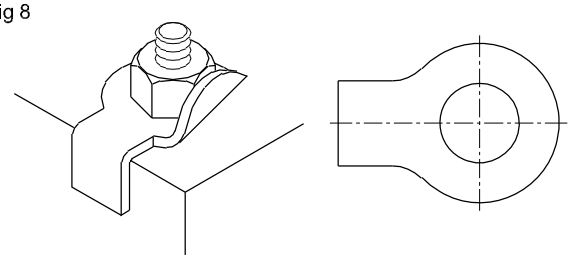
Fig 7



FIN44191X7

Tab washers (Fig 8)

Fig 8

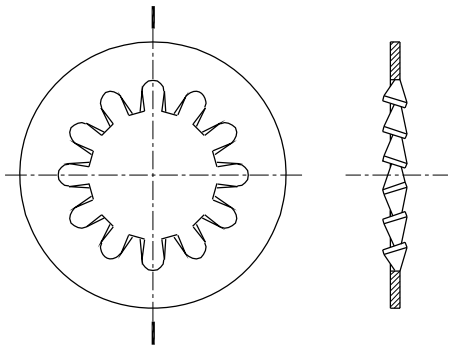


FIN44191X8

These washers are used for locking the nuts.

Toothed locked washers (Figs 9,10 and 11)

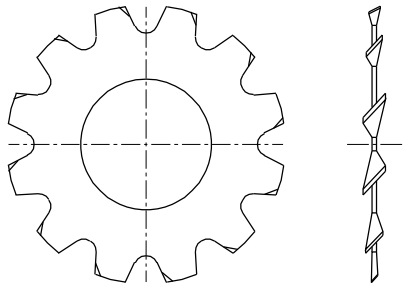
Fig 9



FIN44191X9

These washers have serrations,cut and twisted. When placed between the nut and the assembly,this washer exerts friction on both the contacting surfaces. This prevents the nuts from slackening.

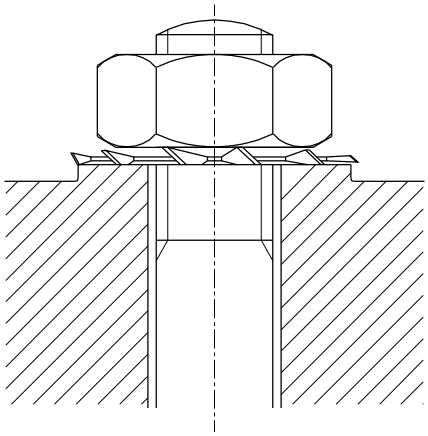
Fig 10



EXTERNALLY TOOTHED

FIN44191XA

Fig 11



FIN44191XB

Specifications

The Indian Standard IS: 2016- 1967 designates a washer by name, type, size and number of the standard and material.

Example

A machined washer of size 10.5 mm made of brass shall be designated as Machined washer 10.5 IS: 2016 - Brass.

Note

For detailed specification of different types of washers,refer to the following IS specifications.

Taper washer - IS: 5374 and IS: 5372

Tab washer - IS: 8068

Toothed lock washer IS: 5371

Plain washer IS: 2016

Adjust clutch pressure

Objective: This shall help you to

- **adjust the pressure of a multi - disc clutch.**

Switch off the electrical mains of the lathe before opening the lid of the headstock.

Remove the top lid of the lathe headstock by unscrewing the Allen had bolts. Take out the clutch lever along with the lid.

Release the index pin from the annular disc.

Rotate the annular ring to get the desired friction. If the nut is tightened too much the friction will be more and vice versa.

Insert the index pin to the annular disc hole through the adjusting nut firmly.

Replace the gasket of the top lid.

Assemble the top lid by keeping the clutch lever in position.

Tighten the Allen screws of the lid using the Allen key.

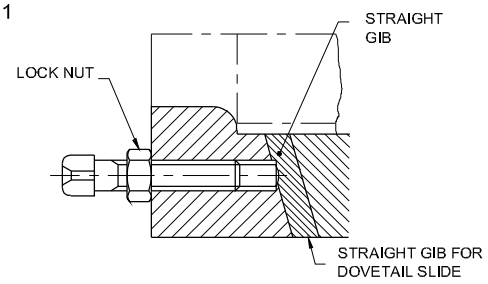
Test the functioning of the clutch in engaging and disengaging positions.

Adjust the gib strip

Objective: This shall help you to
- **adjust and align the gib strip in a lathe.**

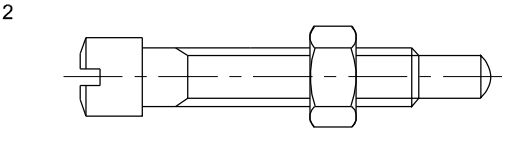
Loosen the lock- nuts. (Fig 1)

Fig 1



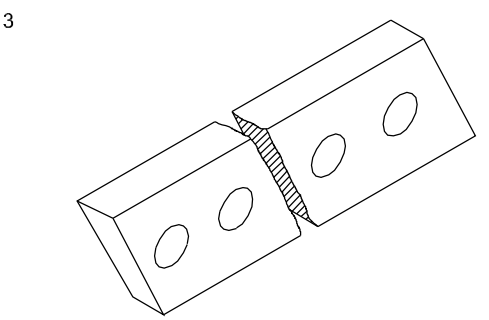
Remove the set screws. (Fig 2)

Fig 2



Pull the gib out. (Fig 3)

Fig 3



Clean all the parts.

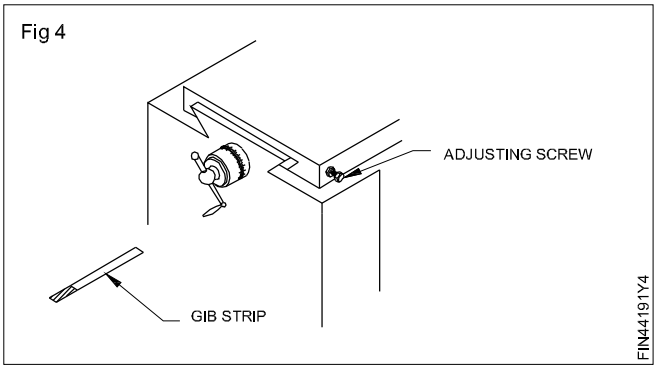
Check the straightness of he gib using Prussian blue.

Scrape the gib to get even surface to prevent stick- slip motion of the coss - slide.

Lubricate all the parts.

Assemble the gib into the dovetail slide and position it. (Fig 4)

Fig 4



Adjust the screws and eliminate the clearance between the slides for getting the correct freedom required in the assembly.

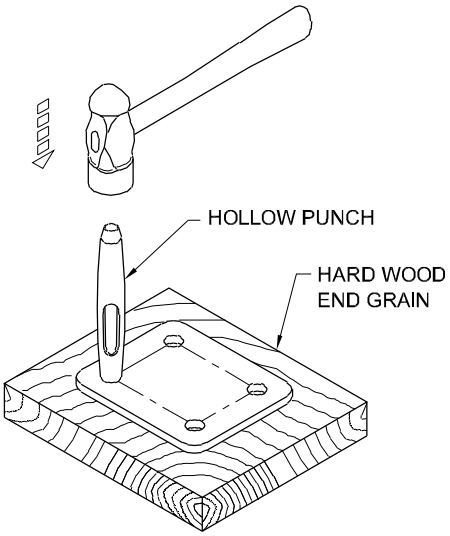
Lock the movement of the adjusting screws by th echeck nut.

Hold the gib in correct position firmly while locking with check-nuts.

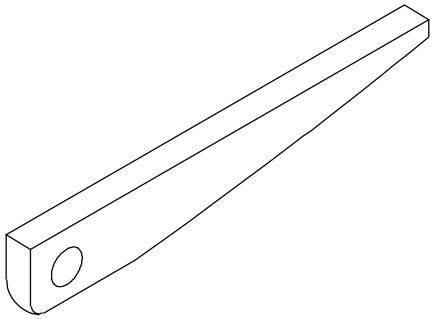
Check the function of the cross- slide.

Use hollow punches, extractor, drifts, various types of hammer and spanners etc for repair work

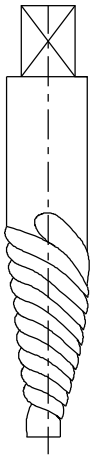
Objectives: At the end of this exercise you shall be able to
- **select the holes for repairing**
- **use the types of spanners**
- **use the types of hammers**
- **use of extractor and punches.**



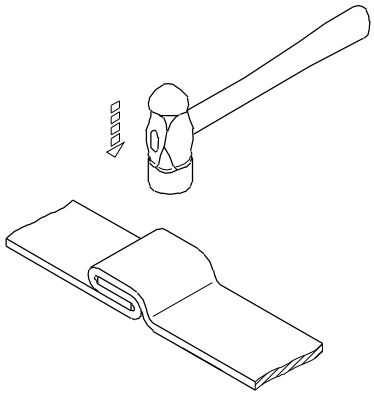
USING A HOLLOW PUNCH



DRIFT

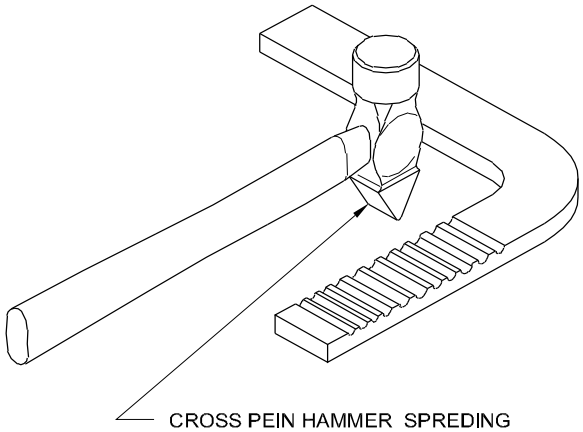


EXTRACTOR

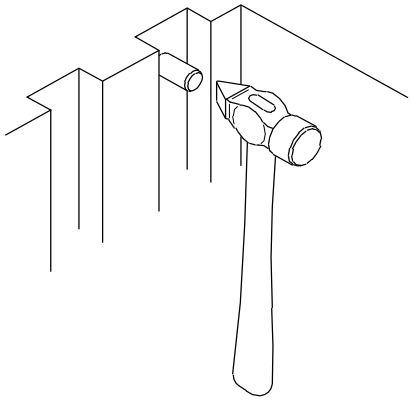


HAMMER

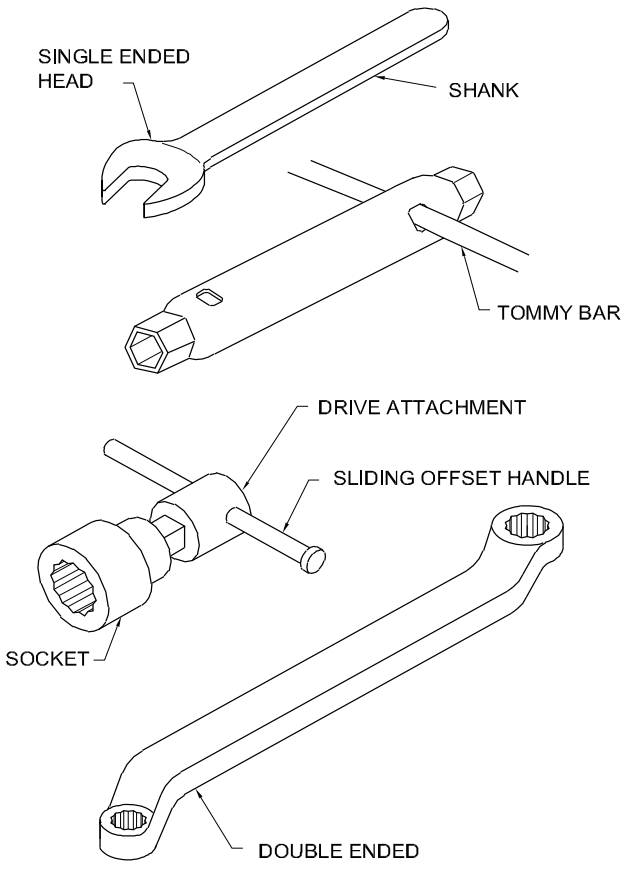
1	-	-	-	-	-	4.4.192
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**USE HOLLOW PUNCHES,EXTRACTOR, DRIFTS,VARIOUS TYPES OF HAMMERS AND SPANNERS ETC FOR REPAIR WORK**				TOLERANCE: -	TIME : 15Hrs
					CODE NO. FIN44192E1	



CROSS PEIN HAMMER SPREDING METAL IN ONE DIRECTION



STRAIGHT PEIN HAMMER BEING USED IN A CORNER



1	-	-	-	-	-	4.4.192
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**USE HOLLOW PUNCHES,EXTRACTOR, DRIFTS,VARIOUS TYPES OF HAMMERS AND SPANNERS ETC FOR REPAIR WORK**				TOLERANCE: -	TIME :-
					CODE NO. FIN44192E2	

Job sequence

Instructor shall display all the tool shown in Fig 1 - 10 in the section and brief their names and uses.

- Trainees will note down all the tools names and thier uses.
- Record it in Table 1.

Table 1

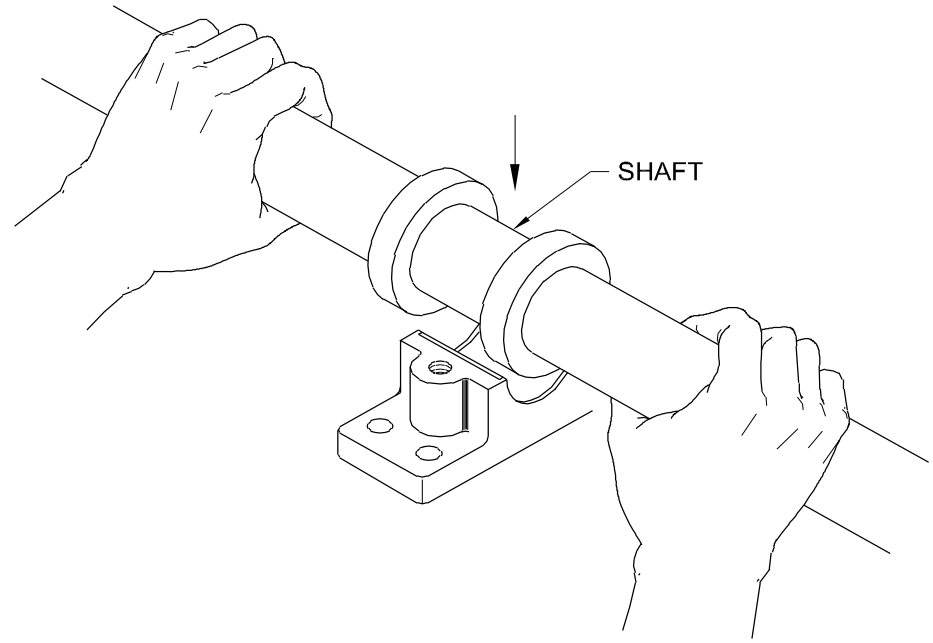
Sl.No	Name of the tool	Uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

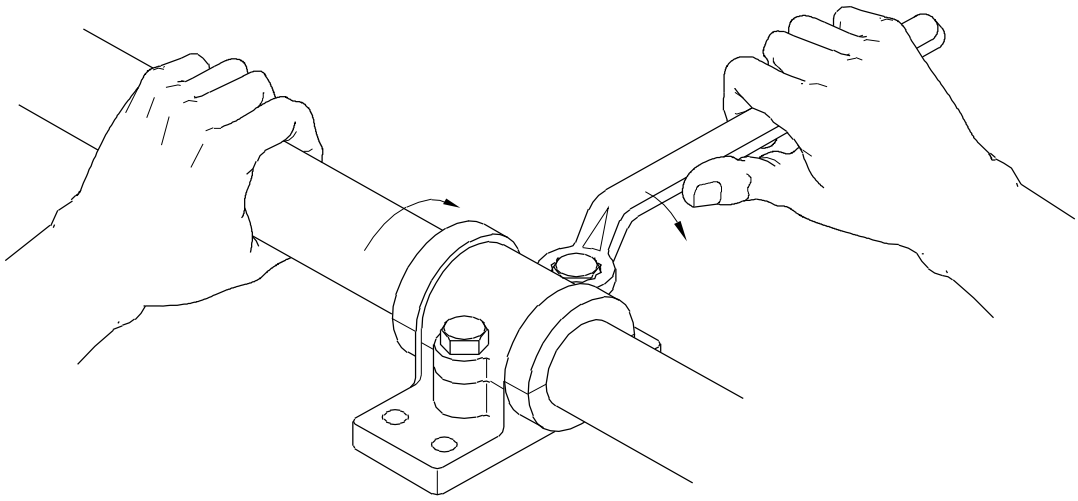
- Get it checked by the instructor.

Dismantling, assembling of different types of bearing and check for functionality

Objectives: At the end of this exercise you shall be able to
- **dismount a shaft from pedestal block**
- **mount a shaft on pedestal block**
- **dismount ball bearing (interference fit on the shaft)**
- **dismount ball bearing (interference fit in the housing)**
- **mount ball bearing.**

TASK 1





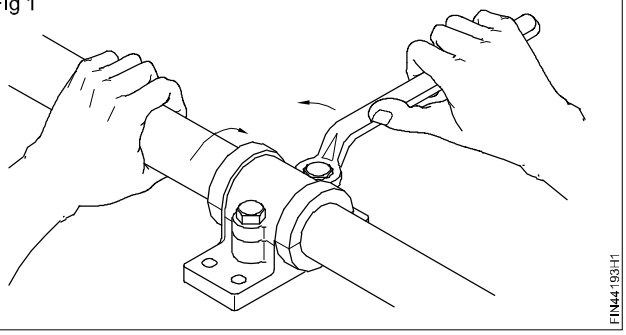
–	–	–	–	–	–	4.4.193
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**DISMANTLING,ASSEMBLING OF DIFFERENT TYPES OF BEARING AND CHECK FOR FUNCTIONALITY**				TOLERANCE	TIME 15Hrs
					CODE NO. FIN44193E1	

Job sequence

TASK 1: **Dismatling and assembiling bush bearing**

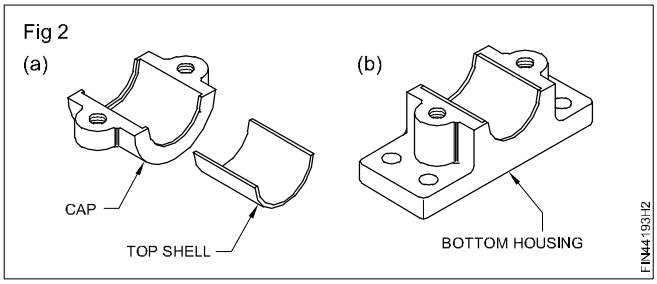
- Dismantle the cap of the block by using proper ring spanner. Hold the shaft with left hand and remove the fastening nut by right hand as shown in Fig. 1.

Fig 1



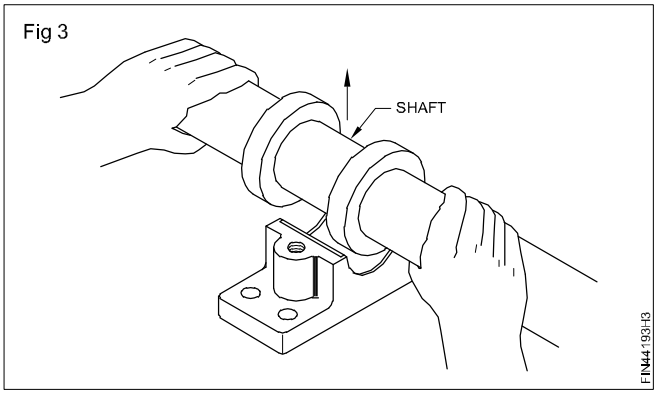
- Remove top shall along with cap Fig. 2a and then remove the shaft and bottom housing as shown in Fig. 2b.

Fig 2



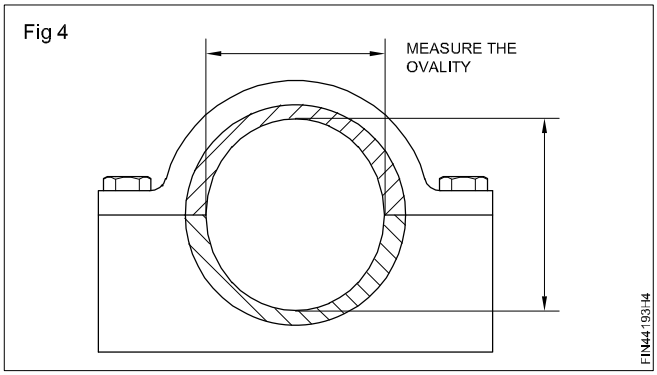
- Thoroughly clean shells, cap, shaft seating (Journal) and housing bottom with kerosene by using small brush. Wipe out all above components with clean banian cloth. Do not use cotton waste to wipe out component.
- Check shells and Journal for any damage, scoring mark etc. Check cap, bottom housing and fastening bolt and nut for any damage and wear. Replace the damaged components with new one before starts assembling. (Fig. 3). If it is not possible to replace shaft, it should be built by metal deposition and machined.

Fig 3



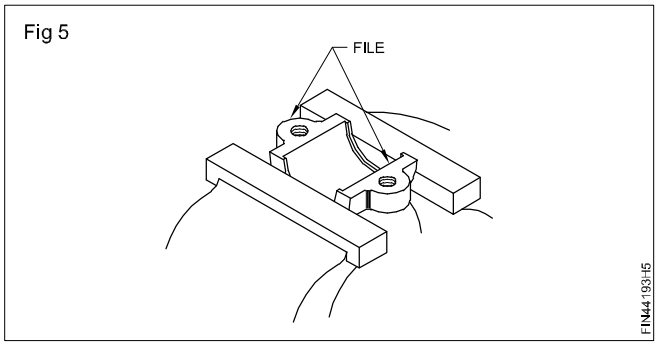
- Check ovality of the bearing bore by fixing cap on the bottom housing as shown in Fig. 4.

Fig 4



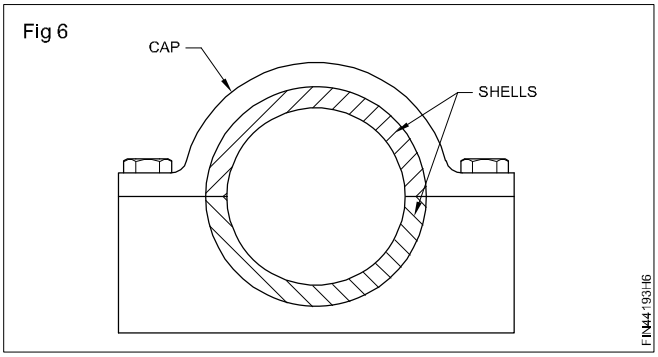
- To remove the ovality. Remove the cap by unscrewing fastening bolts. File the bearing caps equally with flat file to compensate for the ovality by holding the cap into the vice as shown Fig. 5.

Fig 5



- Fit the two halves of the bearing back together and make sure that, when the bolts are fitted, the load is taken by the caps and not by shells. (Fig. 6)

Fig 6



- Fit the shells to their housings. Check that they fit correctly and the oil holes align with those of the housings as shown in Fig. 7.
- Apply marking medium around the Journal area and place it into bottom shell for uniform contact. (Fig. 8)
- If the number of colour marking on the bottom shell is more, it indicate shaft having proper contact with bottom shell otherwise scrape the shell to have more number of colour marking. (Fig. 9)

Fig 7

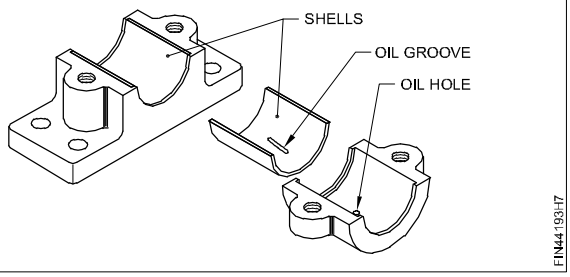


Fig 8

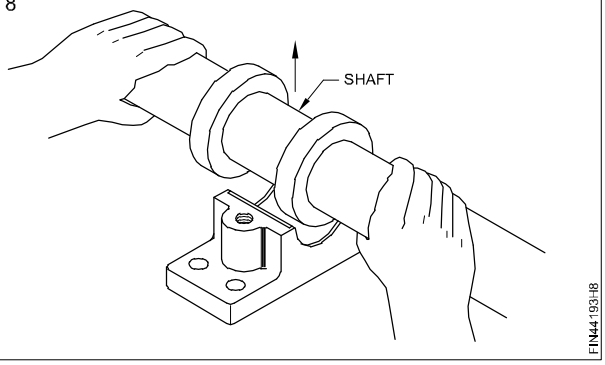
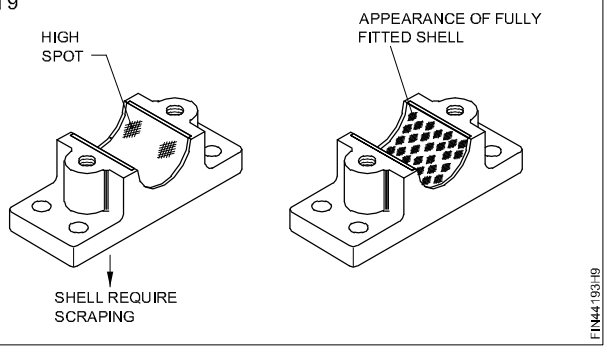
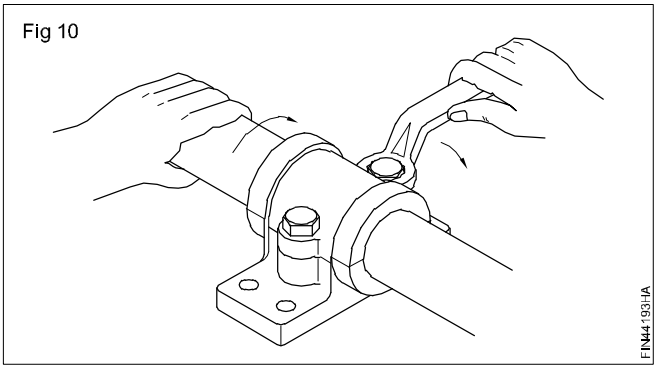


Fig 9



- Coat all the parts with the correct grade lubricant. Place the Journal on the bottom housing, place top shell and cap on the shaft. Tighten the bolt firmly by holding the shaft. (Fig. 10).

Fig 10

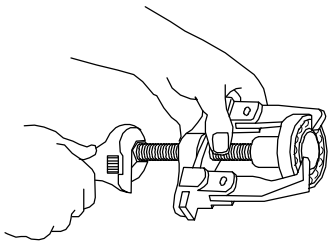


- After mounting pedestal block clear all tools around the work spot.

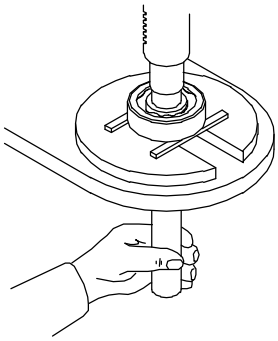
TASK 2: **Dismantling and assembiling ball bearing**

* DISMOUNT BALL BEARING
(WITH INTERFERENCE FIT IN SHAFT)

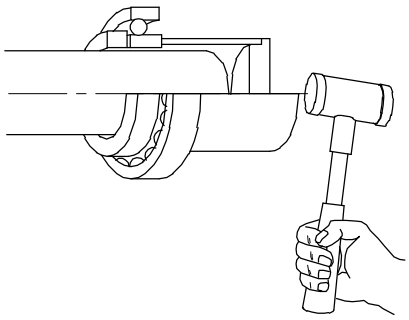
USING PULLER



USING ARBOR PRESS

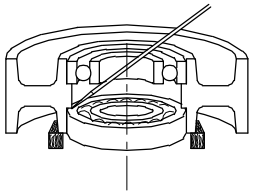


USING SLEEVE AND HAMMER

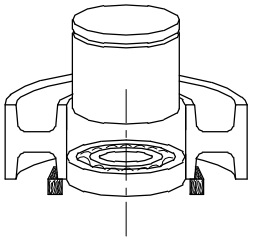


* DISMOUNT BALL BEARING
(WITH INTERFERENCE FIT ON HOUSING BORE)

USING DRIFT

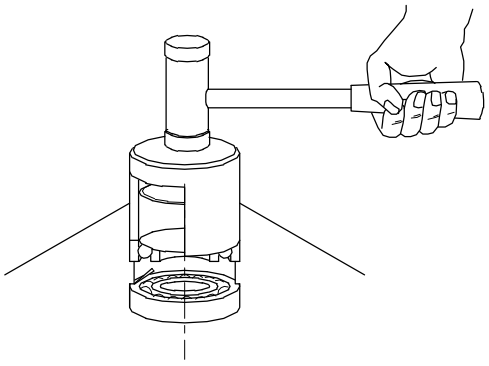


USING SLEEVE

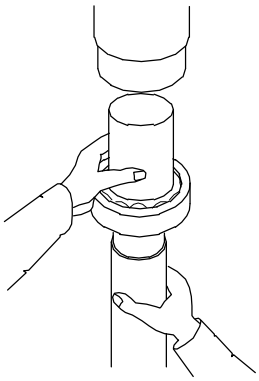


* MOUNT BALL BEARING

USING SLEEVE AND HAMMER



USING ARBOR PRESS



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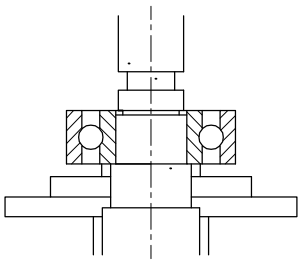
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**DISMANDLING AND ASSEMBLING OF DIFFERENT TYPES OF BEARING**				DEVIATIONS	TIME 15Hrs
					CODE NO. FIN44193E2	

- For ball bearings having interference fit on the shaft

Method I using press

- place the bearing with the shaft on a arbour press or hydraulic press. (Fig 1)

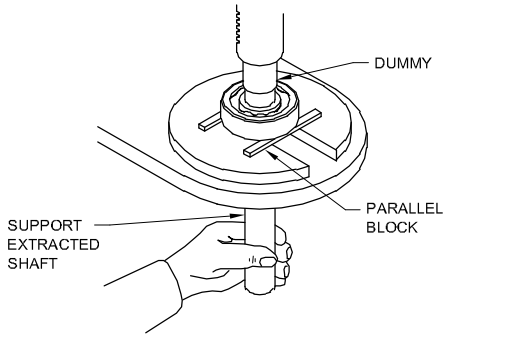
Fig 1



FIN44193J1

- place a ring or two parallel blocks of equal size to support the inner ring of the bearing. (Fig 2)
- put a dummy between the ram and the shaft
- Gently press the shaft to come out of the bearing. (Fig 2)

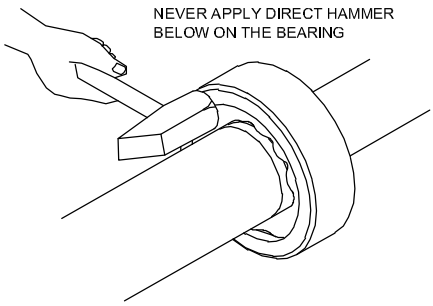
Fig 2



FIN44193J2

- Support the extracted shaft by hand to prevent damage.
- Never apply direct hammer blows on the bearing. (Fig 3)

Fig 3

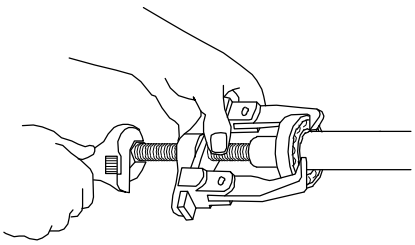


FIN44193J3

Method II using bearing puller

- Fit the bearing pullers spindle on the centre hole of the shaft. (Fig. 4).
- Place the legs of the bearing.
- Slowly tighten the spindle of the puller by a spanner so that the puller is ready to take the strain (Fig. 4)

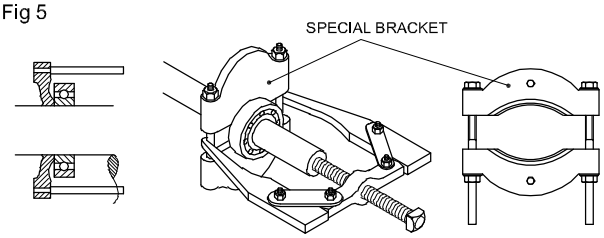
Fig 4



FIN44193J4

- For dismounting the bearing special type of puller with bracket attachment shown in (Fig. 5) is used so that pulling force is applied on the inner ring of the bearing.

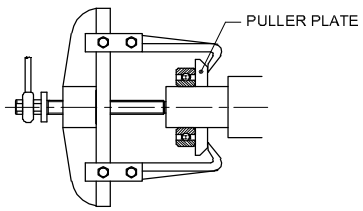
Fig 5



FIN44193J5

- Use a keeper puller plate along with the puller when pullers legs tend to engage with the outer ring of the bearing. (Fig. 6)

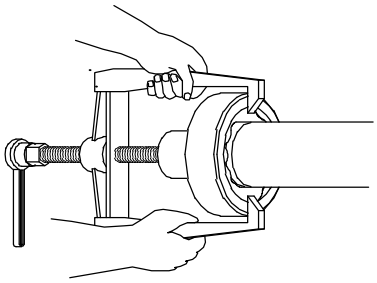
Fig 6



FIN44193J6

- Rotate the outer ring or the puller during dismounting if the pullers legs has to engage the outer ring of the bearing, when the bearing is to be used again. (Fig. 7)

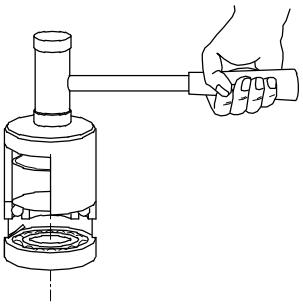
Fig 7



FIN44193J7

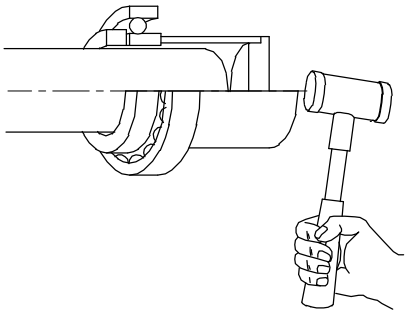
- Small bearings can be removed by using a puller or with a metallic sleeve using mild hammer blows.
- To dismount small and medium size bearings, use a hammer and a sleeve a butting the lock nut or the inner ring. (Fig. 8)
- Place the sleeve against inner ring if the nut is located inward.
- Use hammer blows for dismounting. (Fig. 9)

Fig 8



FIN44193J8

Fig 9

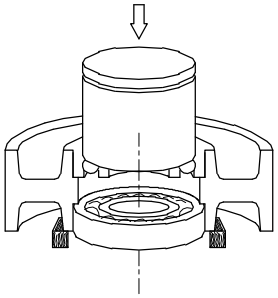


FIN44193J9

For all bearings having interference fit in the housing

- Place the wheel on two wooden blocks and fit a suitable sleeve on the face of the bearing. Apply pressure on the sleeve to drive out the bearing. This type of dismounting can be done for a housing without any shoulder. (Fig 10)

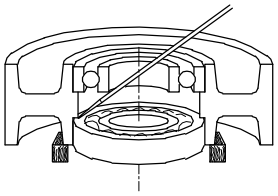
Fig 10



FIN44193JA

- Similarly, for a housing with a shoulder between the bearings a soft metal drift is used to strike the bearing in different positions to drive out. (Fig. 11). A suitable puller is also used for dismantling.

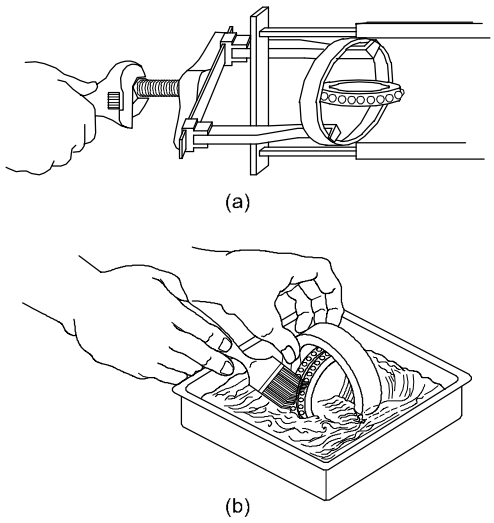
Fig 11



FIN44193JB

- For dismounting self aligning ball bearing, swivel the inner race as shown in Fig. 12a. Fit the legs of the puller on the outer race and tighten the screwed spindle to extract the bearing.
- After dismounting clean the bearing with soft bristle brush using kerosene oil or naphtha. (Fig. 12b)

Fig 12



(a)

(b)

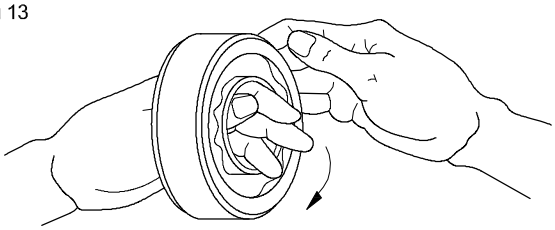
MM1312HC

- Wipe off the bearing with banian cloth.

Do not use cotton waste for cleaning or wiping off bearings.

- Inspect visually about corrosion, damage in cage, raceways, rolling elements and outer and inner races.
- Insert the bearing around the fingers of your hand and rotate gently to check that the bearing to rotating smoothly without any distraction and noise. (Fig. 13).

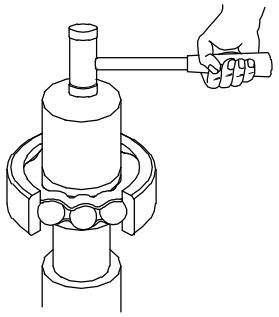
Fig 13



FIN44193JD

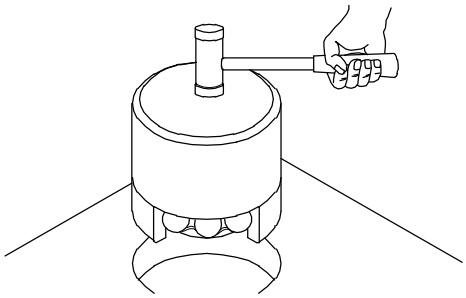
- Lubricate the bearing.
- Replace the seal, if any.
- Mounting ball bearings
- Clean and measure the shaft diameter (for shaft fit by vernier micrometer and for housing fit by vernier inside micrometer) to check the necessary interference fit.
- Lubricate the shaft for mounting.
- Place the correct size sleeve on the inner ring of the bearing. (Fig. 14).
- Apply hammer blows using common hammer.
- Slowly drive in bearing until you get the metallic sound.
- Similar process should be adopted for the housing fit by selecting proper sleeve to sit on the outer ring. (Fig. 15)
- Use a arbour press whenever possible.

Fig 14



FN44193JE

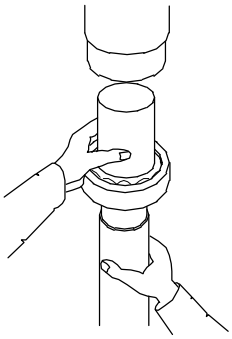
Fig 15



FN44193JF

- The use of a arbour press or hydraulic press is particularly suitable, when small bearings are frequently mounted. Lubricate the shaft and place a mounting sleeve between the bearing and press resting it on the ring with interference fit. The end faces should be flat, parallel and burr free.
- Drive in the bearing into the shaft, by applying the force by the press. (Fig. 16)

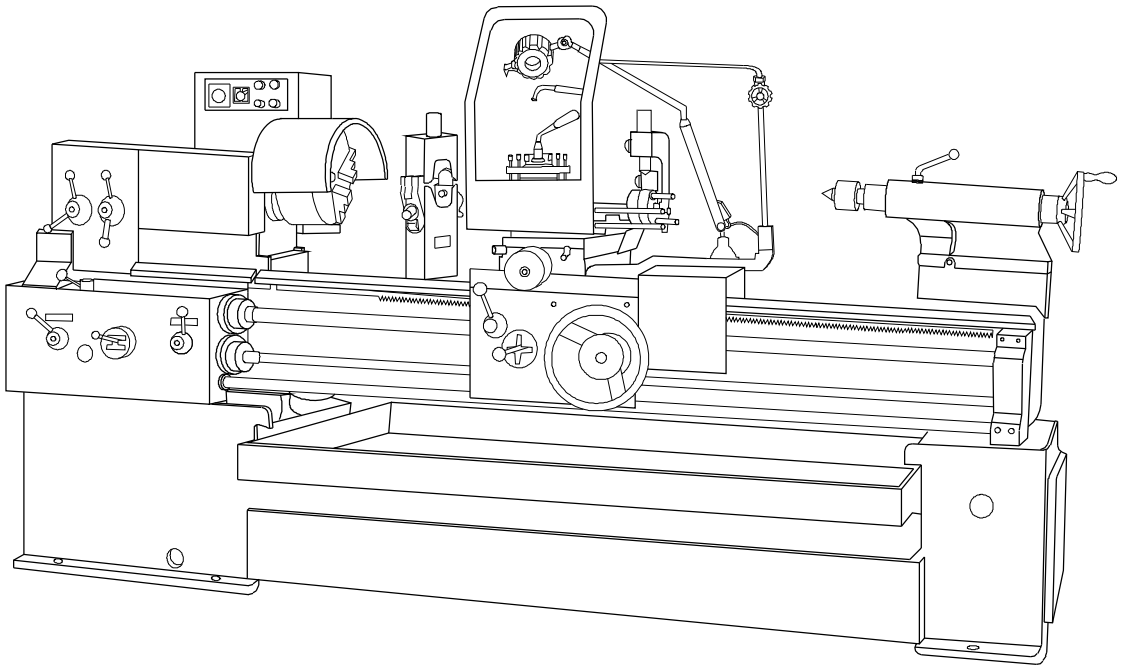
Fig 16



FN44193JG

Perform routine check of machine and do replenish as per requirement

Objectives: At the end of this exercise you shall be able to
- **check the machine running condition**
- **check the oil level**
- **check the sliding movement.**



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

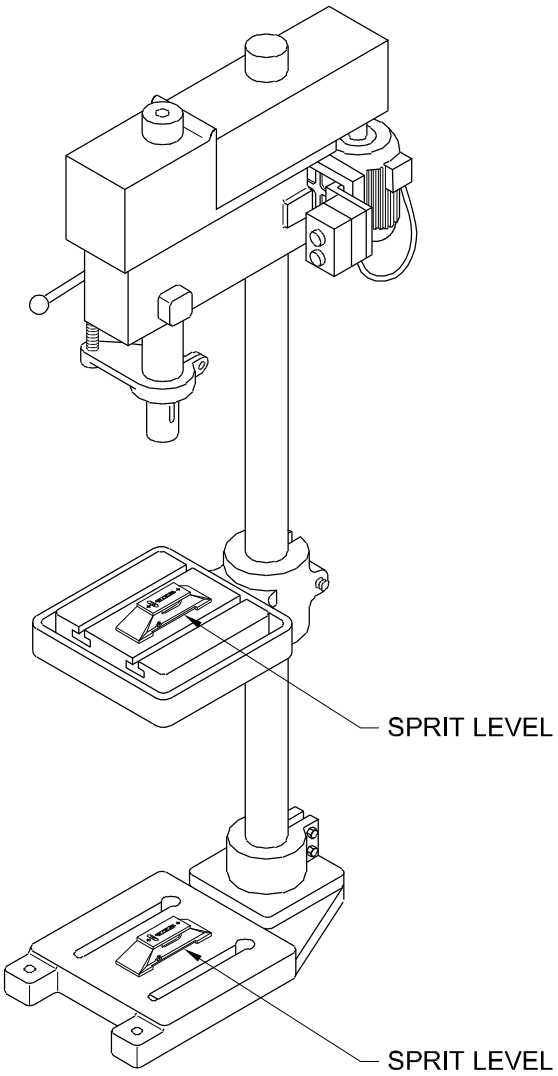
SCALE NTS	PERFORM ROUTINE CHECK OF MACHINE AND DO REPLENISH AS PER REQUIREMENT	TOLERANCE	TIME 10Hrs
		CODE NO. FIN44194E1	

Job sequence

- Turn the machine off from the main power point and fit your tag, Out of order, to avoid someone can try to use the machine during your maintenence procedure.
- **Open side cover and check:**
  - Driving belts, if the belts are damaged, excessive cracks, or an excessive wear, they must be replaced.
  - Check tension of belts.
  - Check brake conditions (on models with pedel brake).
- **Turn the lathe ON and:**
  - Run the lathe for a couple of minutes.
  - Check level of lubricant oil on vison main gear box.
  - Refill if required with gear oil.
- **During running test check that:**
  - All the automatic feeding movement are working properly.
  - Check tail stock locking condition.
  - Both lever must lock properly.
  - Check top bench lubrication manual pump.
  - Pull or pouch lever to verify that oil is coming to the sliding bench.
  - Check level of lubricant oil of tank bench lubrication.
- **Check level of coolant, refill if required:**
- **Lubrication, period - lubricant:**
- **Some point will be required to lubricate with gun oiler.**
  - Head stock - twice a year.
  - Compound sildes, by gun oiler - daily.
  - Apron & carriage- handle pump - daily.
  - Tail stock nipple - by gun oiler - daily.
  - Change gear nipple - by gun oiler - daily.
  - Lead screw nipple - by gun oiler - daily.
  - Bed ways - by gun oiler - daily.
- **Coolant:**
  - Empty tank and fill up with new coolant every 4 months.
  - Avoid contact with coolant during the refilling process, you must wear rubber gloves.
  - Test bottom of coolant tank to verify if there are solids.
  - Remove solids and try always to keep coolant tank clean.
  - Run the lathe and test coolant is supplied properly.
- **Electric:**
  - Check the main power cable for its conditions. If it is damaged, must be replaced.
  - Verify conditions of all external switches.
  - All switch with damage must be repair or replace it.
  - Check conditions of all limit switches. They must be strong in position. A loose or damage limit switch can generate a continuous fault on the machine.
- **Centre point alignment:**
  - Once a year, depending the precision required would be convenient to verify alignment of centre tailsotck with centre of headstock.
  - Alignment can be obtain by fitting a total parallel bar between cantres, and the with a dial indicator verify paralleism between centres.

Inspection of machine tools such as alignment, levelling

Objective: At the end of this exercise you shall be able to
- **inspect drilling machine tool such as alignment, levelling**



1	-	-	-	-	-	4.4.195
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**INSPECTION OF MACHINE TOOLS SUCH AS ALIGNMENT,LEVELLING**				DEVIATIONS	TIME: 10 Hrs
					CODE NO. FIN44195E1	

Job sequence

- Lock the table of the pillar drilling machine in mid - position.
- Level the machine using a precision spirit level and a straight edge.
- Check the flatness of the table surface and the base plate of the machine.
- Check the run out of the internal taper of the spindle using a dial test indicator and test mandrel.
- Check the straightness of the pillar in two different planes.
- Check the squareness of the table surface in two different planes.

Skill sequence

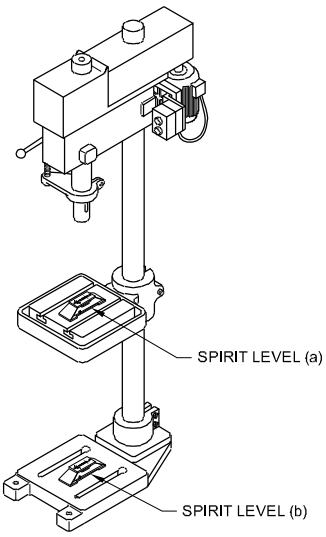
Geometrical test for pillar type drilling machine

Objective: This shall help you to

- **carry out the preventive maintenance of drill machine.**

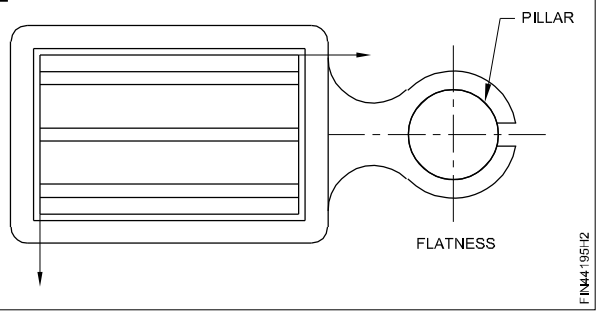
Levelling of the machine at two different positions (a) and (b) should be done before conducting the geometrical test. The permissible deviation is 0.03 per 300 mm. (Fig 1)

Fig 1



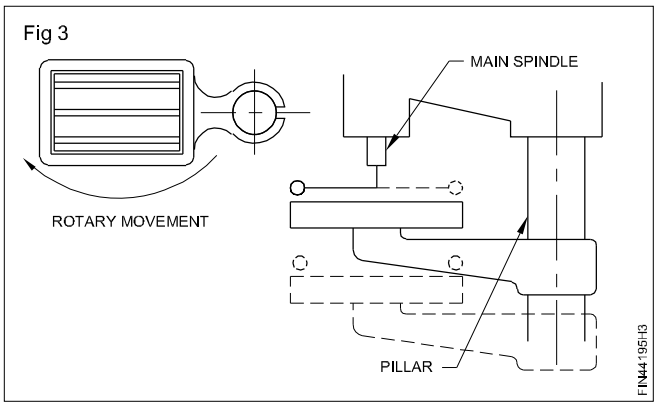
Check the flatness of the work table surface and the base plate if it is machined. (Fig 2)

Fig 2



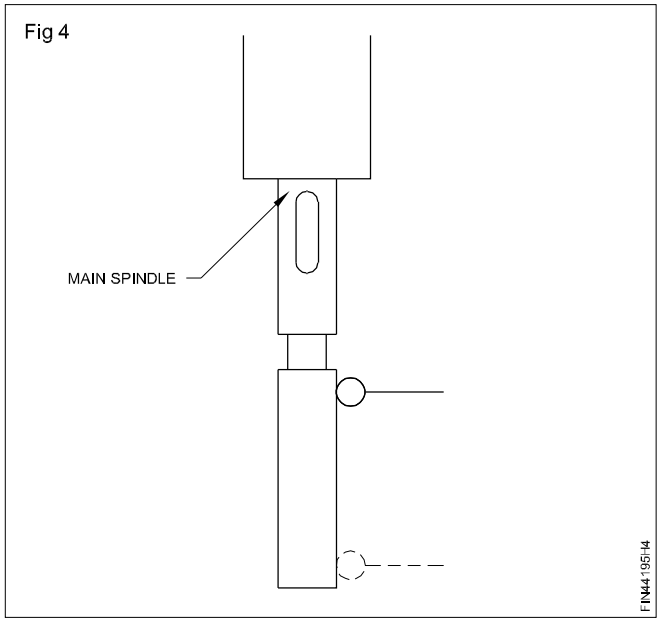
Check the camming of the rotating table, if the machine is provided with rotary movement. (Fig 3)

Fig 3



Check the run out of the spindle internal taper at two positions.(Fig 4)

Fig 4



Check the straightness of the pillar and squareness of the spindle axis to the table surface (Fig 5) in two different planes.

Fig 5

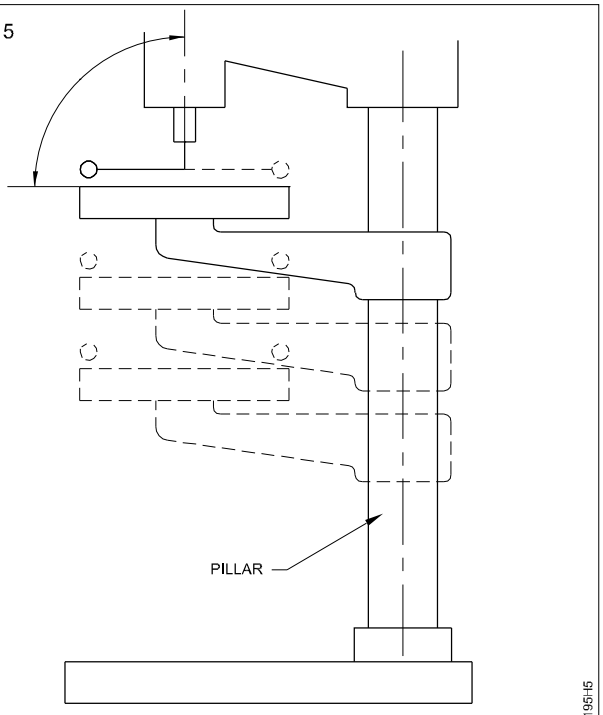
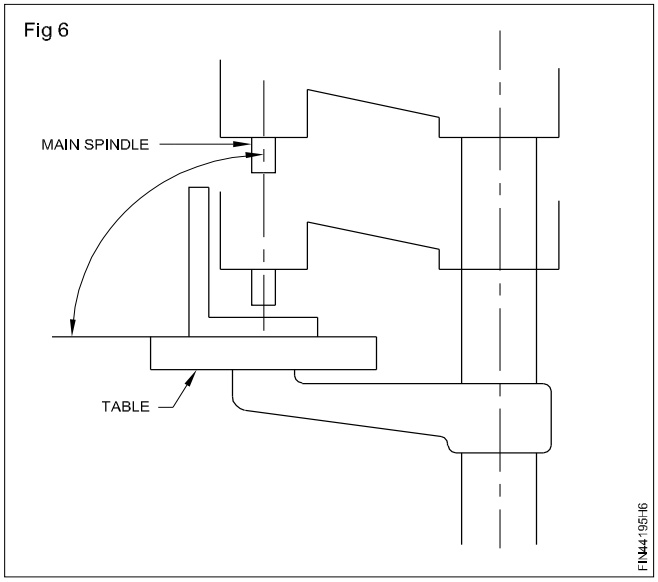


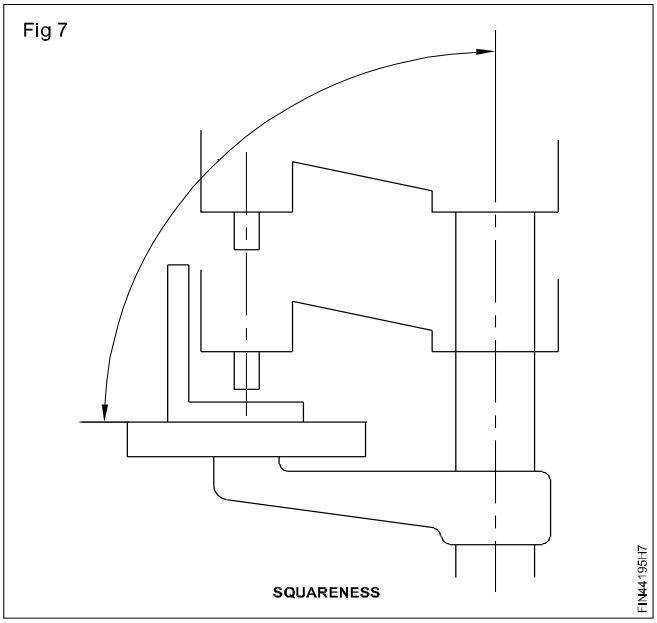
Fig 6



Check the squareness of the table surface to the vertical movement of the spindle housing in two planes. (Fig 6)

Check the squareness of the table surface to the vertical movement of the spindle head of machines having an elevated spindle head. (Fig 7)

Fig 7



Lubricating the parts

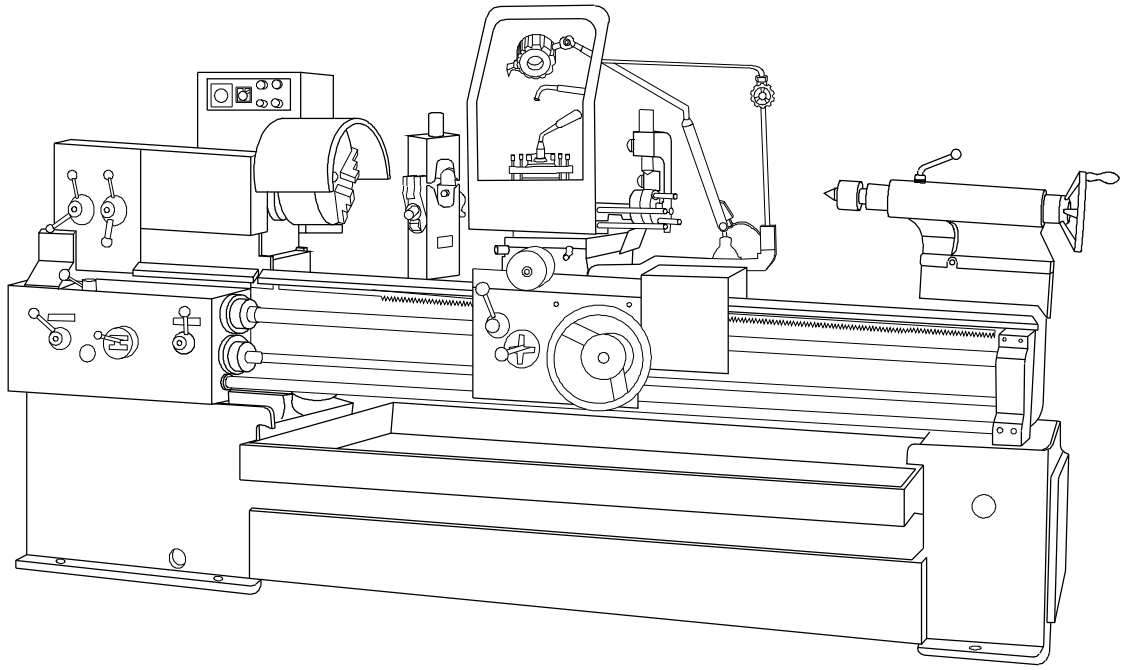
Apply lubrication oil in main spindle, cam of rotating table, gear box and pillar. Daily by using a oil can with oil.

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

Items to be checked	Good working/Satisfactory	Defective	Remedial measures carried out
Level of the machine			
Belt and its tension			
Bearing sound			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Spindle & its travel			
Arm & its movement			
Electrical controls			
Safety gaurds			

Accuracy testing of machine tools such as geometrical parameters

Objectives: At the end of this exercise you shall be able to
- **check the level of a centre lathe**
- **check the true running of a lathe spindle**
- **check the alignment of the main spindle and the tailstock spindle of a lathe**
- **check the parallelism of the tailstock sleeve with respect to bedways.**
- **perform practical test on turned component.**



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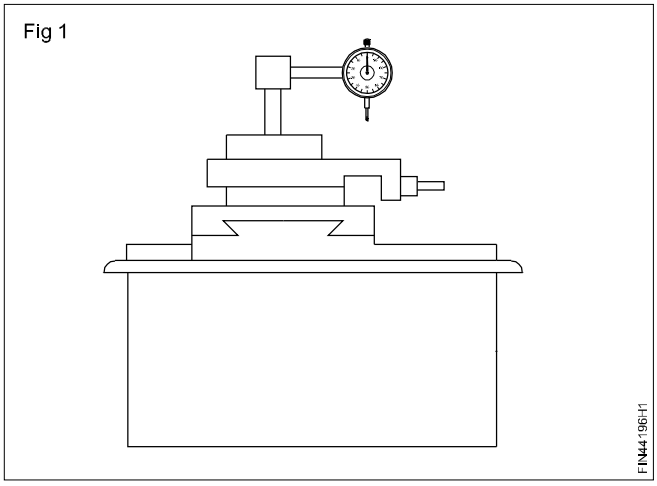
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**ACCURACY TESTING OF MACHINE TOOLS SUCH AS GEOMETRICAL PARAMETERS**				TOLERANCE	TIME: 15Hrs
					CODE NO. FIN44196E1	

Job sequence

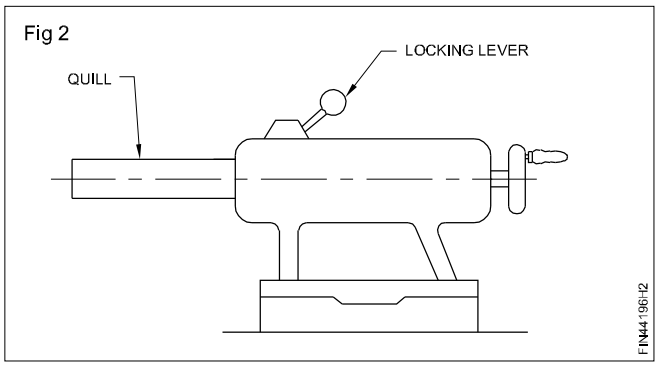
- Fix the dial gauge on the carriage. (Fig 1)

Fig 1



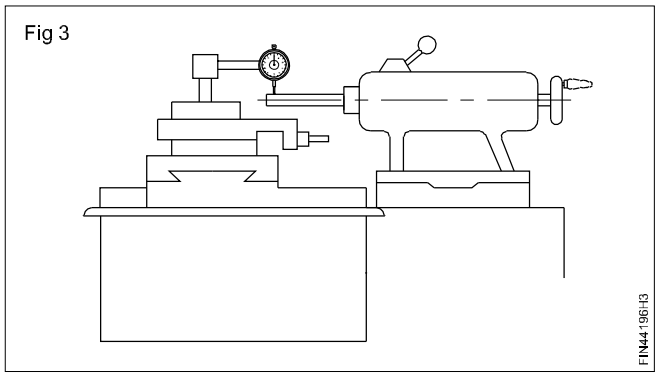
- Project the quill of the tailstock to the maximum extent possible and lock it. (Fig 2) Check the quill in the vertical and horizontal positions by a dial test indicator.

Fig 2



- Clamp the quill during each measurement. If it is not clamped it will affect the measurement.
- Place the dial plunger to contact over the free end of the quill in the vertical plane. (Fig 3)

Fig 3



Ensure that the dial is set at the topmost point of the quill.

- Set the dial at the zero position. (Fig 4)
- Move the carriage slowly towards the entire length of the quill. (Fig 5)

Fig 4

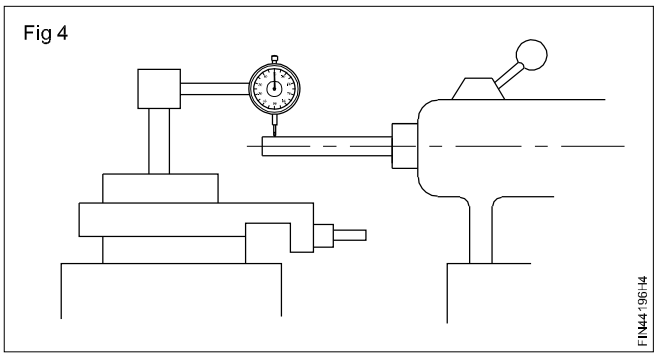
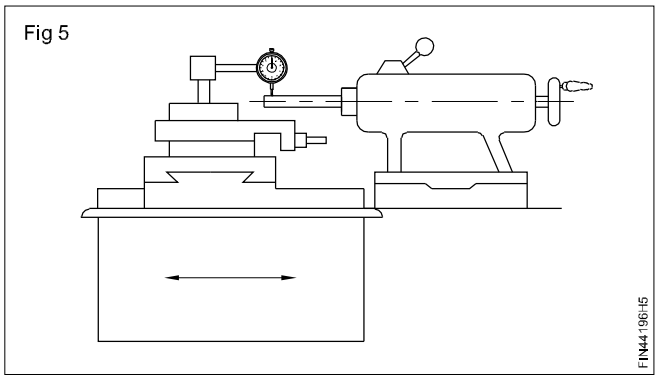


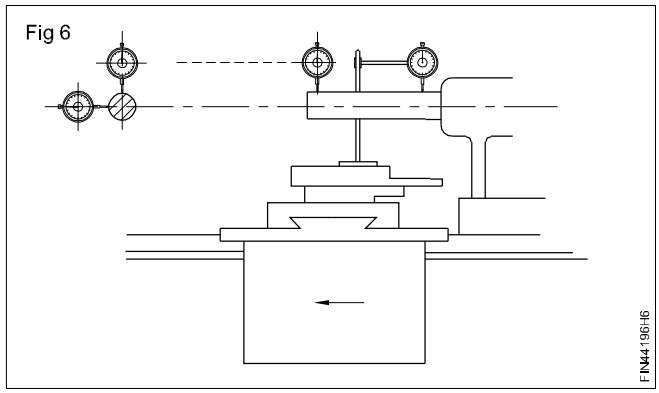
Fig 5



- Note the dial reading at the extreme end of the quill.
- Verify the deflection of the dial reading and compare the value with the test chart supplied. (IS: 6040)

For checking in the horizontal plane, set the dial horizontally and repeat the above procedure. (Fig 6)

Fig 6



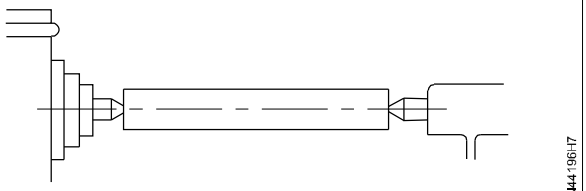
- Fix the test mandrel into the tailstock spindle. Repeat the same procedure to test the accuracy of the tailstock spindle bore in the vertical and horizontal positions as shown in the figure.

Checking the tail stock

- Insert a hollow test mandrel (300 to 500 mm long) in between the centres. (Fig 7)

Ensure that the spindle bearing is at its working temperature.

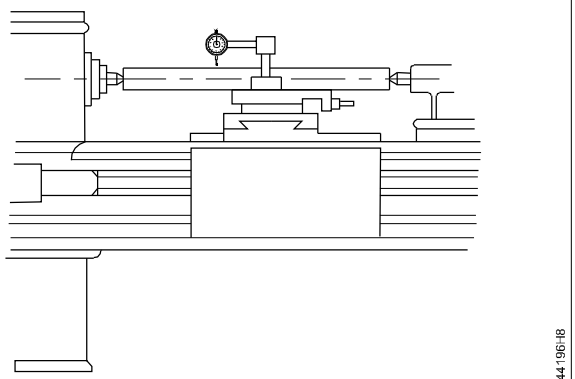
Fig 7



FIN44196-I7

- Fix the dial gauge on the saddle, the plunger touching a position of the mandrel and set it to zero.(Fig 8)

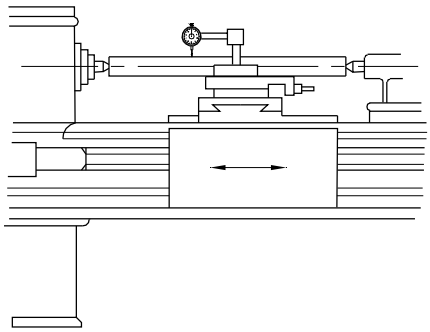
Fig 8



FIN44196-I8

- Move the carriage from one end to the other end of the mandrel to check the mandrel is in correct alignment in the horizontal position.
- Rest the dial plunger at right angles (radially) to the surfaces to be tested.
- Set the dial plunger at the top of the mandrel and move the saddle along the bed slowly to the entire length of the mandrel. (Fig 9)

Fig 9



FIN44196-I9

- Observe the reading of the dial as the saddle moves along the beds and note for variation, if any.

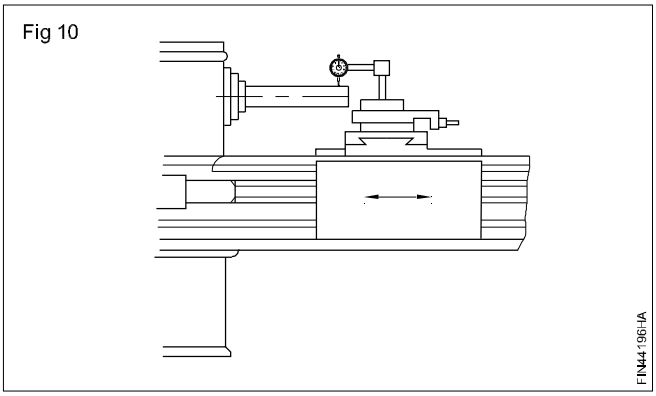
The tailstock centre must be higher than the spindle centre within the permissible limit.

- Verify the deflection of the dial gauge reading and compare the value with the test chart. (IS: 6040)

Checking the true running of a spindle

- Locate the taper shank of the test mandrel in the spindle taper.
- Hold a dial gauge, stationary in the carriage, its plunger contacting the mandrel near its free end (Fig 10) and set it to '0' position.

Fig 10



FIN44196-IHA

Rest the dial gauge plunger at right angles (radially) to the surface to be tested.

- Rotate the spindle along with the mandrel slowly by hand.
- Observe and note the reading of the dial gauge.
- Move the dial gauge near the spindle nose. Rotate the spindle along with the mandrel slowly by hand and note the reading.
- Take readings of the dial gauge while the spindle is slowly rotated. Verify the deflection of the dial reading and compare the value with the test chart. (IS: 6040)

Skill sequence

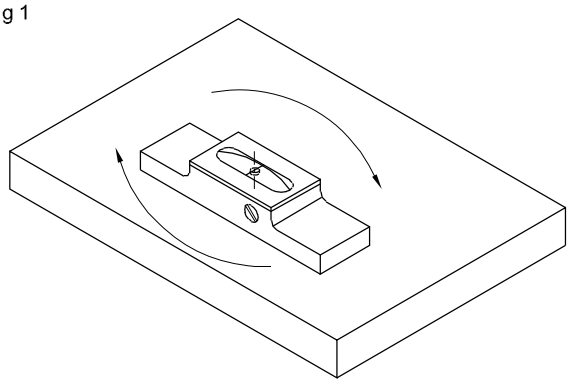
Adjustment of the spirit level with the plane surface

Objective: This shall help you to
- **adjust the spirit level with the plane surface.**

Move the spirit level on the plane surface until the bubble is in the centre of the scale.(Fig 1)

Place a straight edge against the level and clamp to the plate.(Fig 2)

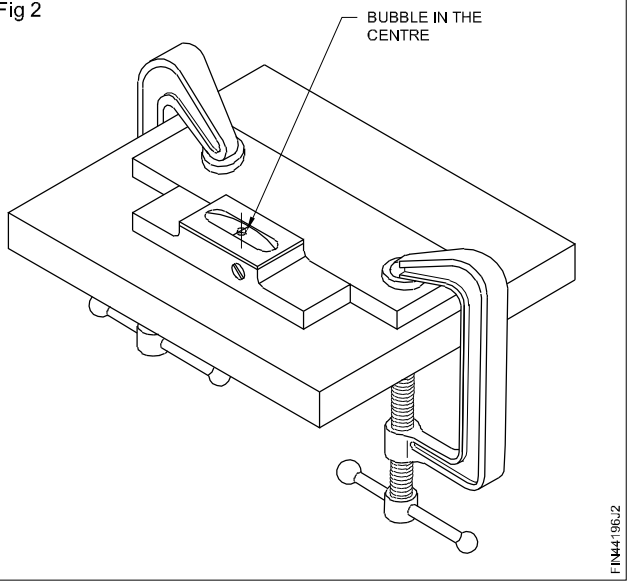
Fig 1



SPIRIT LEVEL

FIN44196J1

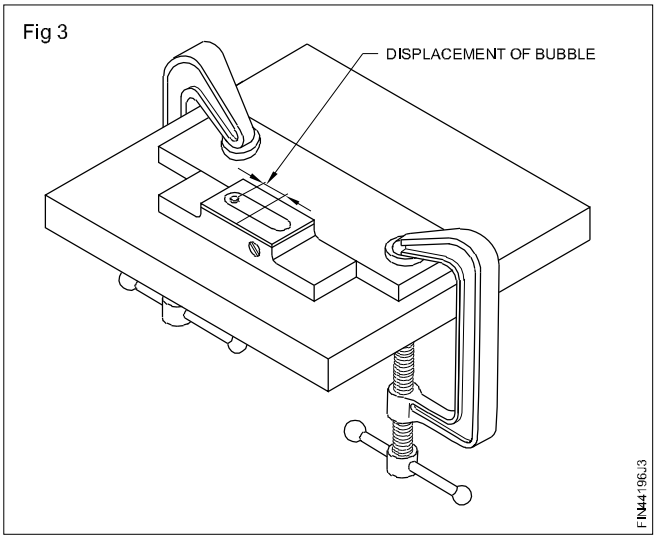
Fig 2



FIN44196J2

Turn the level through 180° (end for end) and place against the straight edge and note the displacement of the bubble. (Fig 3)

Fig 3

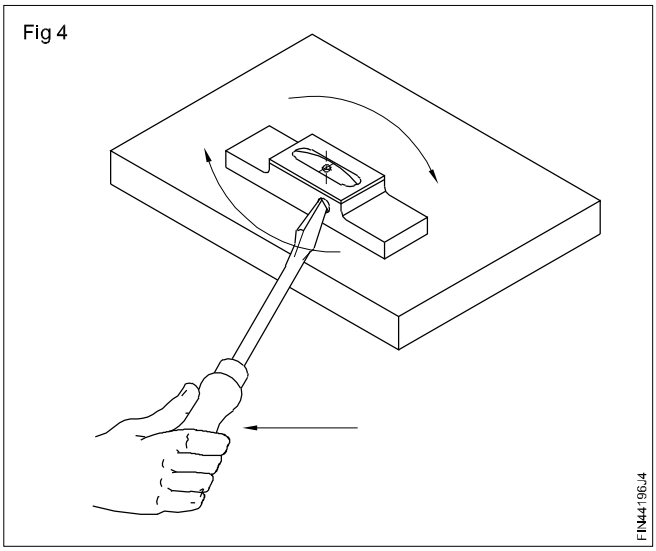


FIN44196J3

Adjust the vial to half of the total displacement of the bubble. (Fig 4)

Repeat the above sequence until the level is turned end for end without displacement of the bubble.

Fig 4



FIN44196J4

Level the lathe bed

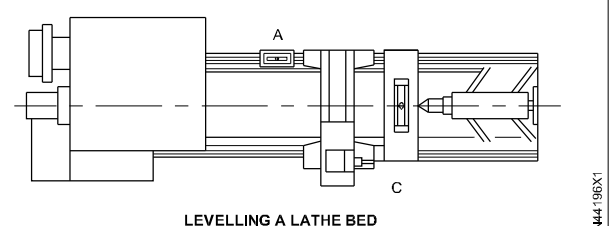
Objectives: This shall help you to

- **level the lathe horizontally with the help of a spirit level.**

Position the carriage in the middle of the bed.

Keep the spirit level on the rear slideway (i.e. the slideway opposite the operator's side) longitudinally at the position 'A'.(Fig 1)

Fig 1



LEVELLING A LATHE BED

FIN44196X1

Keep the second spirit level transversally at the position 'C'. (Fig 1)
Take the readings of both the spirit levels.

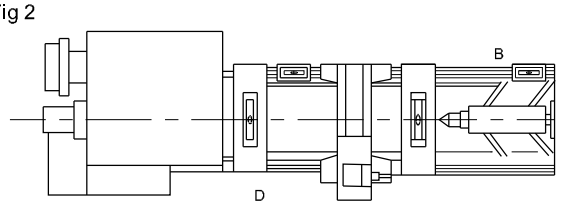
Adjust the level of the bed till both the spirit levels show the same readings.

Keep the spirit levels longitudinally and transversally at positions 'B' and 'D'. (Fig 2)

Adjust the bed till both the spirit levels show the same readings.

Repeat the sequence of operation till both the spirit levels show the same reading in all the positions A, B, C & D. (Fig 3)

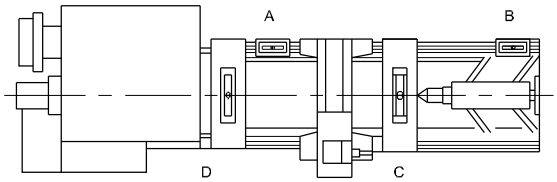
Fig 2



LEVELLING A LATHEBED

FIN44196X2

Fig 3

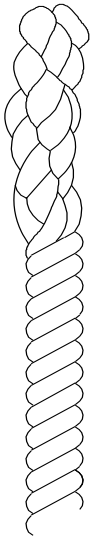


LEVELLING A LATHE BED

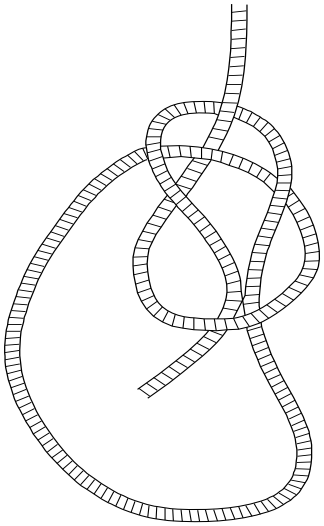
FIN44196X3

Practicing, making various knots, correct loading of slings, correct and safe removal of parts

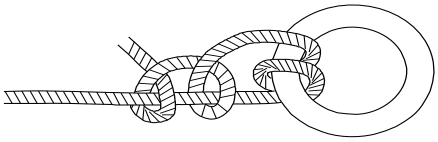
Objectives: At the end of this exercise you shall be able to
- **bind the rope ends with binding wire**
- **tie six type of knots which is used in material handling using manila rope.**



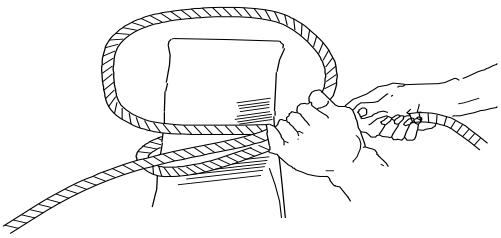
CROWNING



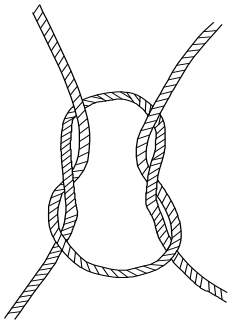
BOWLINE



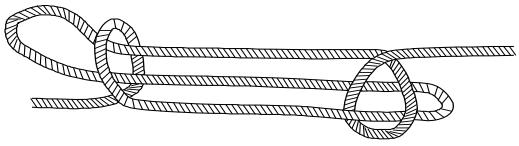
DOUBLE HITCH



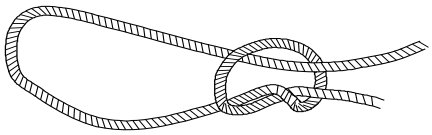
CLOVE HITCH



SQUARE KNOT



HEEP SHANK KNOT



SLIP KNOT

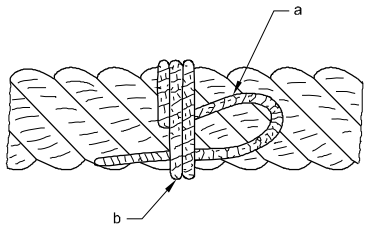
-	-	-	-	-	-	4.5.197
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PRACTICING,MAKING VARIOUS KNOTS,CORRECT LOADING OF SLINGS,CORRECT AND SAFE REMOVAL OF PARTS	TOLERANCE	TIME 5Hrs
		CODE NO. FIN45197E1	

Job sequence

- Place one end of the soft copper or iron wire along the axis of the rope by forming a loop. (Fig 1a)

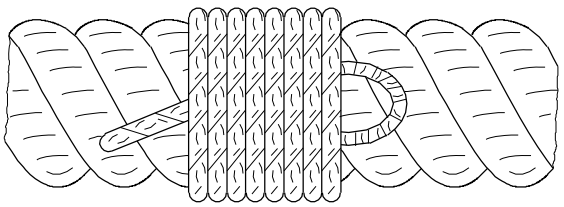
Fig 1



FIN45197-H1

- Wind the other end of the wire around the rope 10 to 15 turns towards the rope end. (Fig 1b)
- Pass the end of the wire through the loop formed by the first end. (Fig 2)

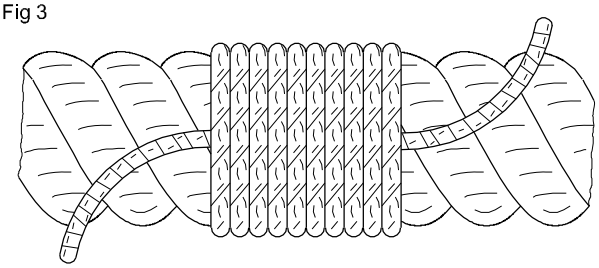
Fig 2



FIN45197-H2

- Pull the first end to make it tight. (Fig 3)

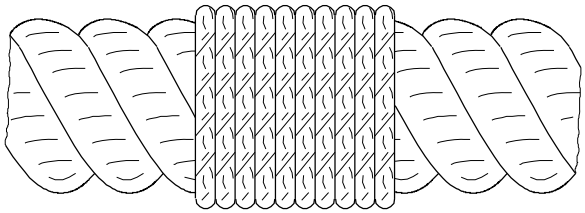
Fig 3



FIN45197-H3

- Cut off the excess wire ends to make simple seizing. (Fig 4)

Fig 4

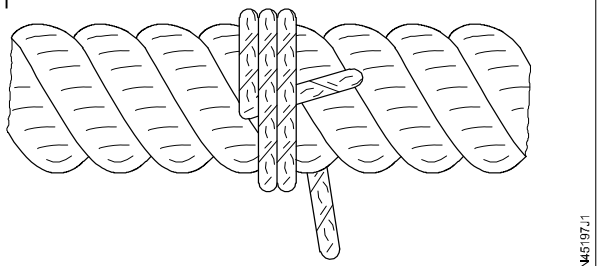


FIN45197-H4

Binding of rope ends by wire adopting self-tightening seizing method

- Take a soft wire and pull one end of the wire between the strands of the rope. (Fig 1)

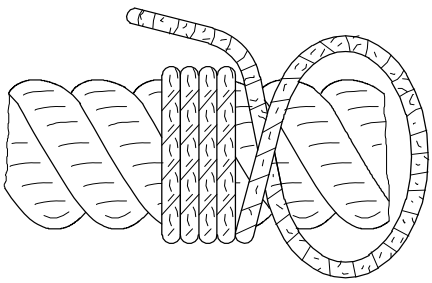
Fig 1



FIN45197-J1

- Wind around the rope for 5 to 6 turns towards the rope end. (Fig 2)

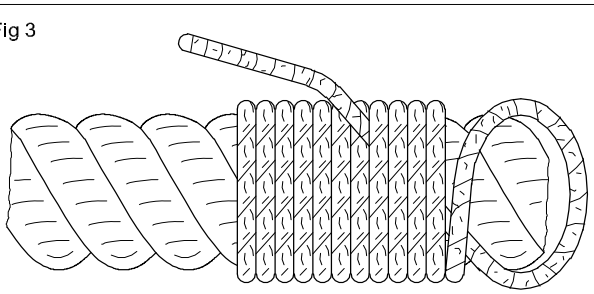
Fig 2



FIN45197-J2

- Place the second end of the wire along the rope between the strands and wind around by the bights 5 to 6 turns after forming a loop. (Fig 3)

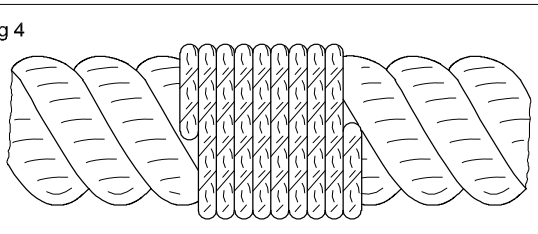
Fig 3



FIN45197-J3

- Pull the free end of the loop under the bights to make it tight (Fig 4).

Fig 4



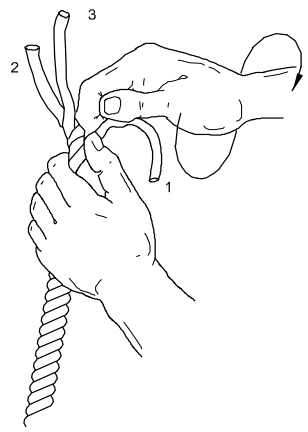
FIN45197-J4

- Cut off the excess wire to form self-tightening seizing.

Binding of rope ends by wire using crowning method

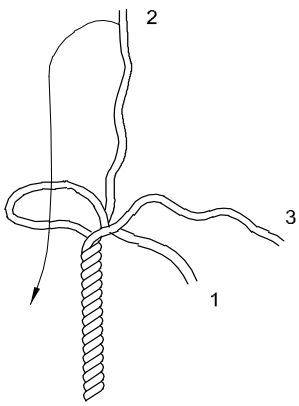
- Unwind the wire strands to separate themselves to a length of 250 to 300mm. (Fig 1)

Fig 1



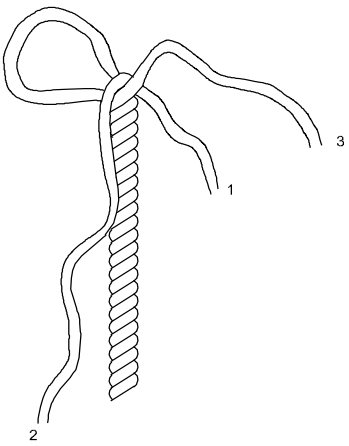
- Take strand No.1 to form a loop and pass the end in between the strands of the rope. (Fig 2)

Fig 2



- Pass strand No.2 in between the strands as shown in Fig 3.

Fig 3



- Insert strand No.3 through the loop formed by the No.1 strand and pull it tight. (Fig 4)
- Put a spike inbetween the strands to form a passage. (Fig 5)

Fig 4

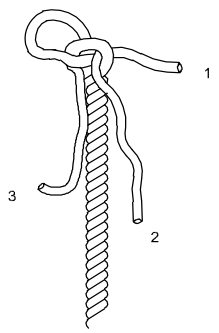
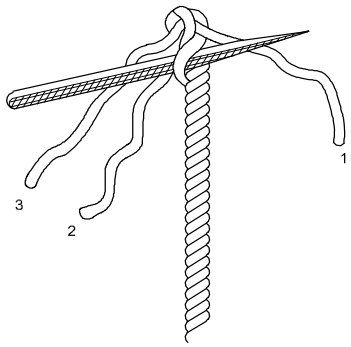
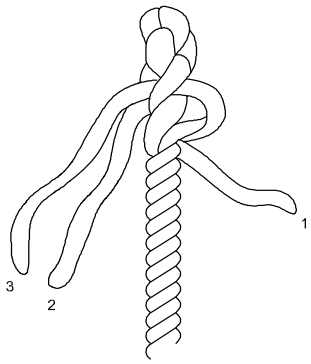


Fig 5



- Spike is a tool with pointed end. It is used to poke in as shown in Fig 5 to make room for inserting rope strand end for binding.
- Insert the No.1 strand through the opening passage and pull tight. (Fig 6)

Fig 2



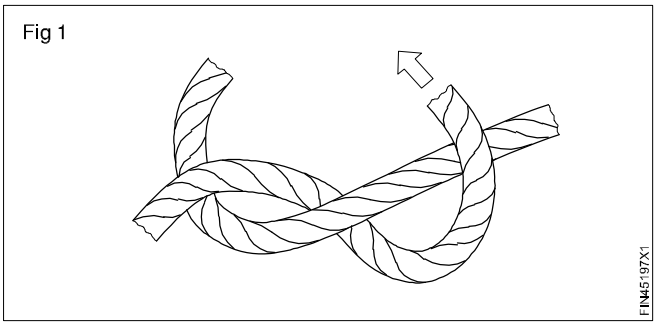
- Insert also strand No.2 in a similar way and pull tight to form crowned binding of rope end. (Fig 7)

Fig 7

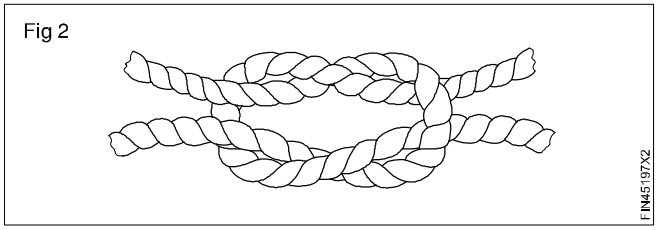
- This method is used for fibre and cotton rope binding.

Prepare square and reef knot for slinging

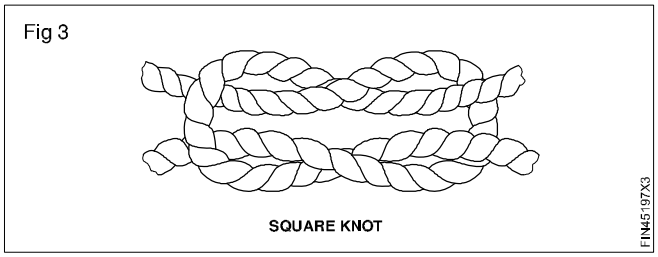
- Take two pieces of manila/cotton/polypropylene ropes of the same diameter. Pass the ends of the ropes one above the other and bend in the opposite direction. (Fig 1)



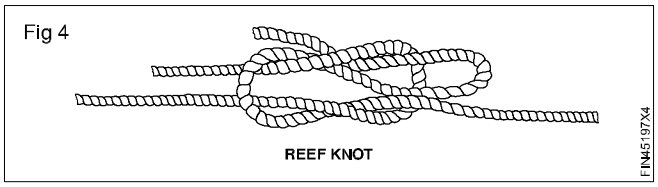
- Insert the bent ends one above the other in a similar way. (Fig 2)



- Pull the ends tight to get square knot Fig. 3.

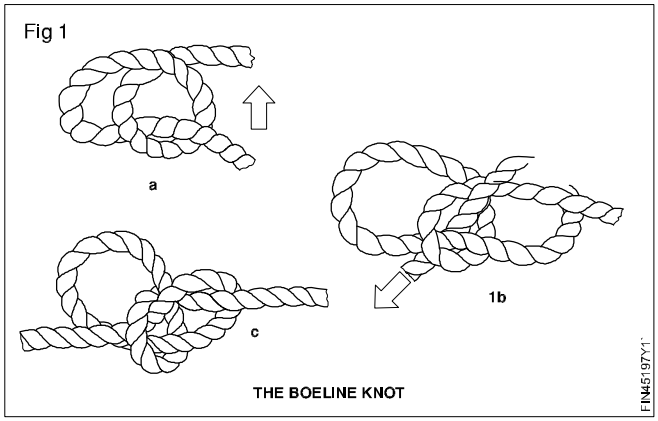


- Fig. 4. Shows the reef knot.



Prepare a bowline knot with a reef knot

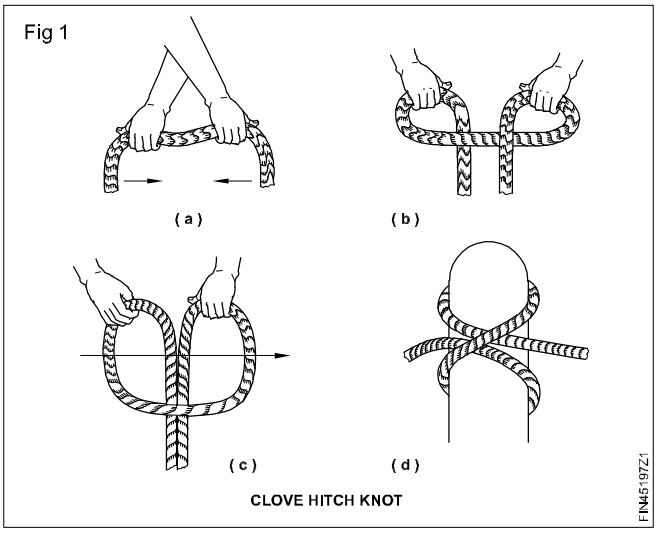
- Hold the A end of the rope by the left hand. (Fig 1a)
- Form a bight and a loop thereafter by the B end.
- Turn and hold end A by the right hand and end B by the left hand. (Fig 1b)
- Pass end A of the rope through the loop formed by end B and pull it tight to form a bowline knot. (Fig 1c)



Forming clove hitch knot using rope and sheep shank knot

Clove hitch knot

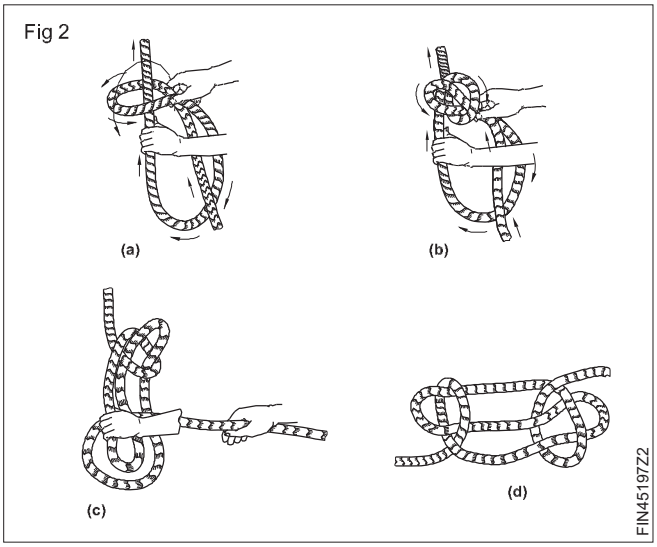
- Hold the rope by both the hands in across way as shown in Fig 1a.
- Turn round the hands to form loops in the rope as shown in Fig 1b.
- Close down the loops together as shown in Fig.1c to put it around a post
- Fasten it to the post to make a clove hitch. (Fig 1d)



Sheep shank knot

- Hold the rope by both the hand and form a loop around one end of the rope (Fig. 2a).
- Form a reverse loop around the former loop by the top end of the rope as directed by the arrows in Fig. 2b.
- Turn the rope around as shown in Fig. 2c to proceed in the final formation
- Turn the rope ends through the loops at the top and bottom ends as shown in Fig.2d to complete the sheep shank knot.

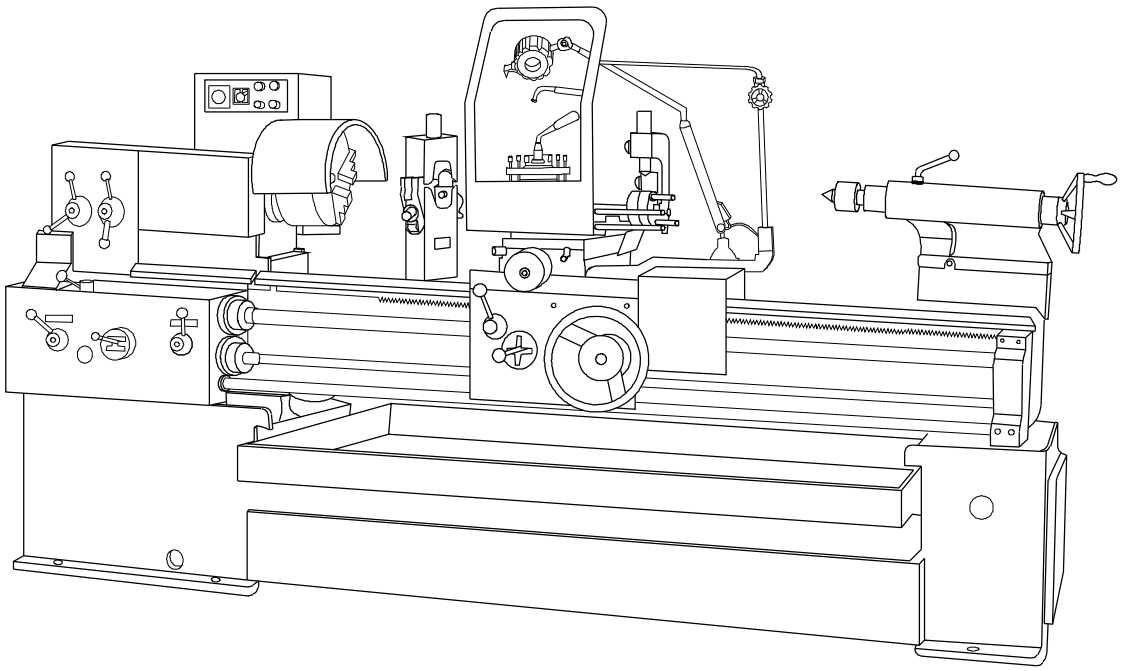
Fig 2



Erect simple machines

Objectives: At the end of this exercise you shall be able to
- **erection of lathe machine**
- **erection of drilling machine**
- **erection of power hacksaw machine**
- **testing the machines after erection.**

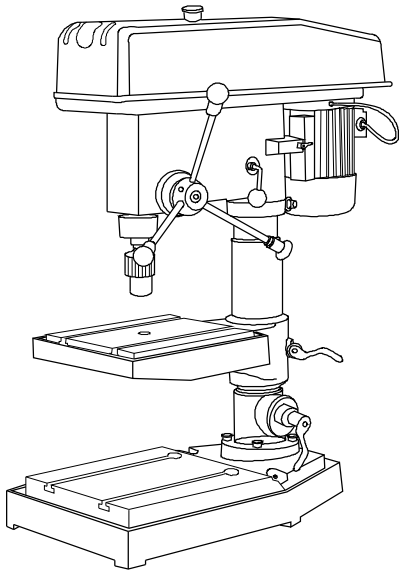
TASK 1



LATHE MACHINE

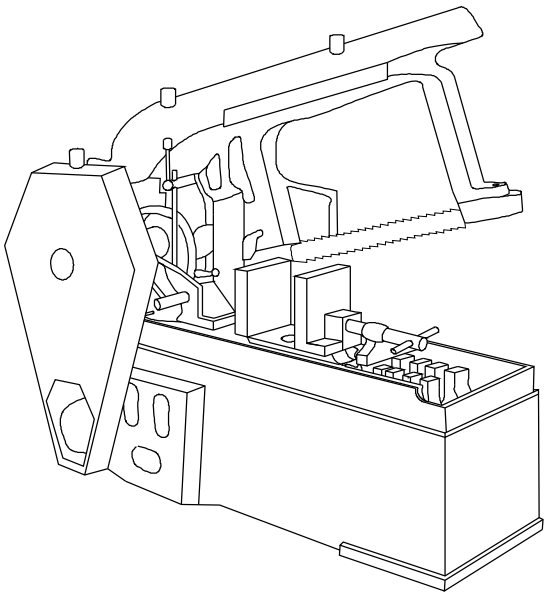
–	–	–	–	–	TASK 1	4.5.198
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**ERECT SIMPLE MACHINES (LATHE MACHINE)**				TOLERANCE	TIME :45Hrs
					CODE NO. FIN45198E1	

TASK 2



DRILL MACHINE

TASK 3



POWER SAW MACHINE

–	–	–	–	–	TASK 2 & 3	4.5.198
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**ERECT SIMPLE MACHINES (DRILL MACHINE AND POWER SAW MACHINE)**				TOLERANCE	TIME :45Hrs
					CODE NO. FIN45198E2	

Job sequence

TASK 1: **Erection of lathe machine**

- Select the space for proper functioning of machines such that machines normally must be conveniently accessible.
- Prepare the foundation plane as per the manufacturer instruction.
- As per the plan foundation can be made.
- Insert the holding down bolt before the foundation set down.
- According to the weight of the machine the depth of the foundation be made.
- Machine may be placed in position for levelling and aligning.
- Before setting the foundation, a foundation bolt inserted through the holding down hole in the basic of the machine.
- After setting the concrette the machine is put on the foundation bolt in floor.
- Align the machine perfectly horizontal position using sprit level.
- The sprit level is applied to certain measuring areas, both in longitudinal and cross direction.
- Insert wedges must be driven into the gap under the machine bed.
- After inserting wedge check the level using sprit level.
- Grouting is carried out by pouring creamy mixture of almost pure cement.
- After setting grouting the wedges may be removed.
- The machine base is then tightly screwed to the foundation bolts.
- After tightening the nuts, the correct position of the machine must once more be checked by means of the sprit level.
- Finally do the practical test and geometrical test.

Safety precautions

- When loading, slings should be protected from sharp edged by packing soft wood
- Before lifting ensure the load is securely slung before taking the lift.
- When unloading make sure that you have a firm foundation for your stack, and make provision for the removal of slings without disturbing the stack.

– – – – – – – –

TASK 2: **Erection of drilling machine**

TASK 3: **Erection of power hacksaw**

- Follow the job of TASK 1.

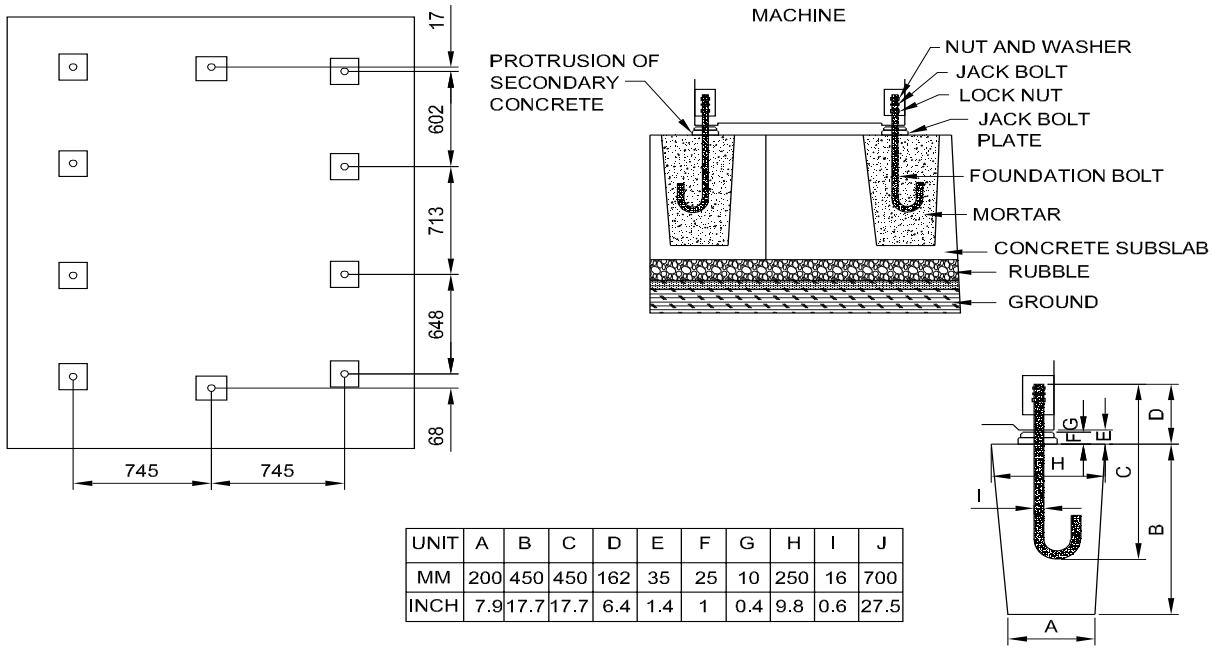
Skill sequence

Foundation plan

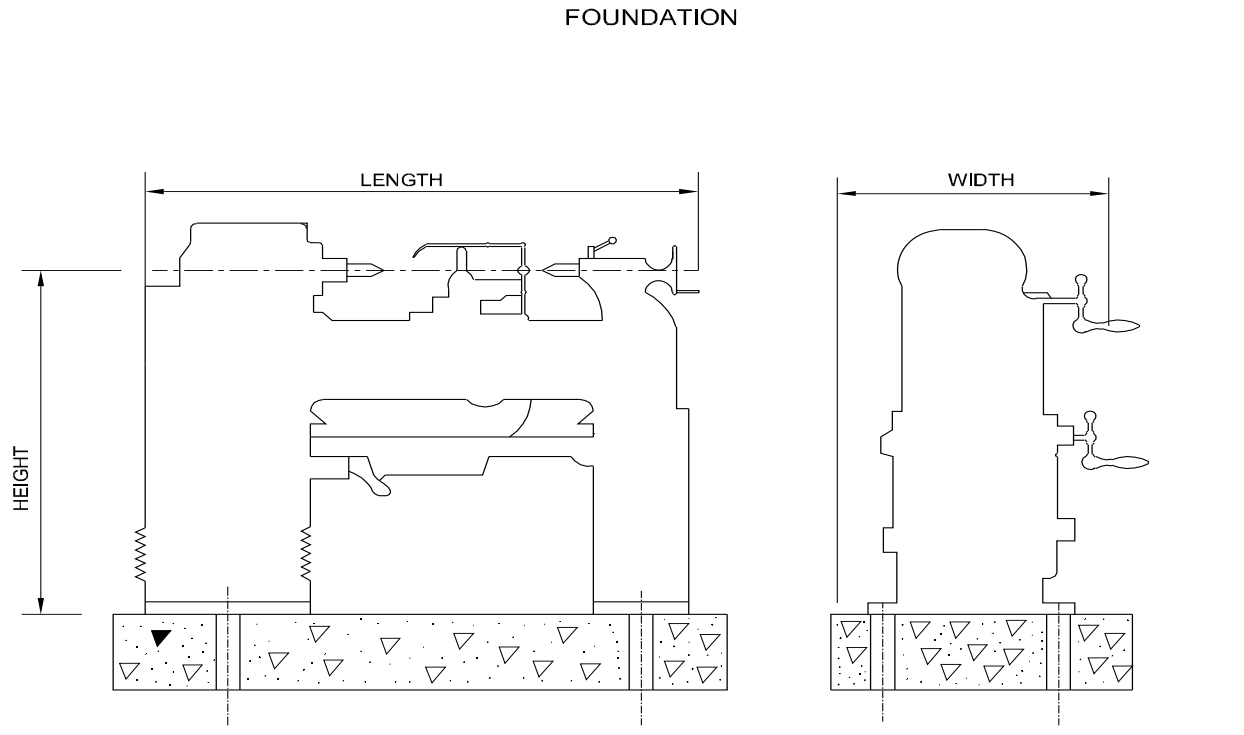
Objective: This shall help you to.

- **mark foundation layouts.**

Fig 1



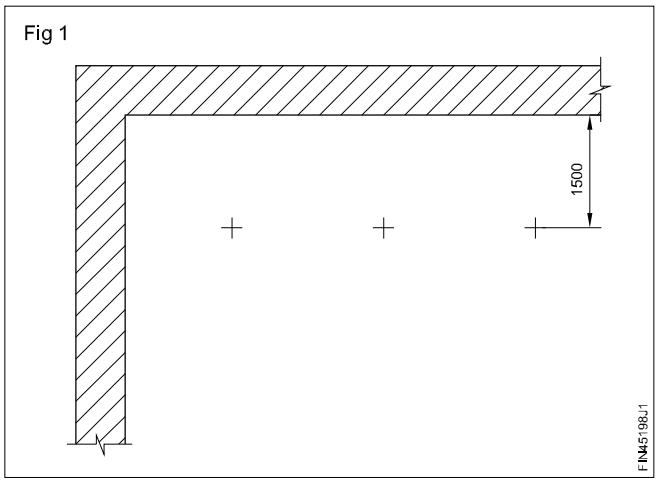
UNIT	A	B	C	D	E	F	G	H	I	J
MM	200	450	450	162	35	25	10	250	16	700
INCH	7.9	17.7	17.7	6.4	1.4	1	0.4	9.8	0.6	27.5



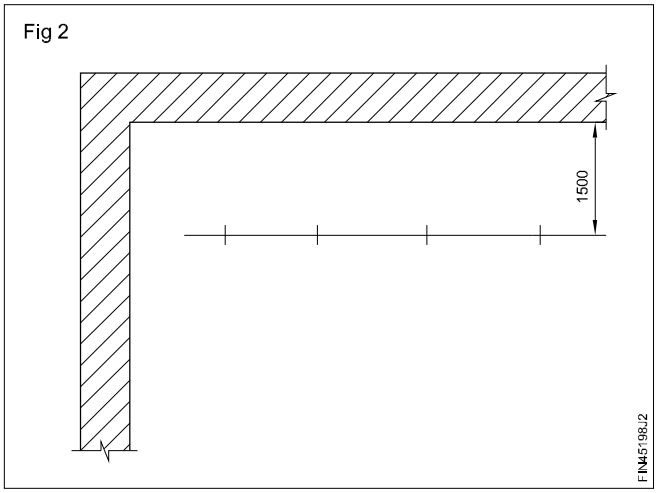
FIN45198H1

Select the space for the erection of a centre lathe machine.

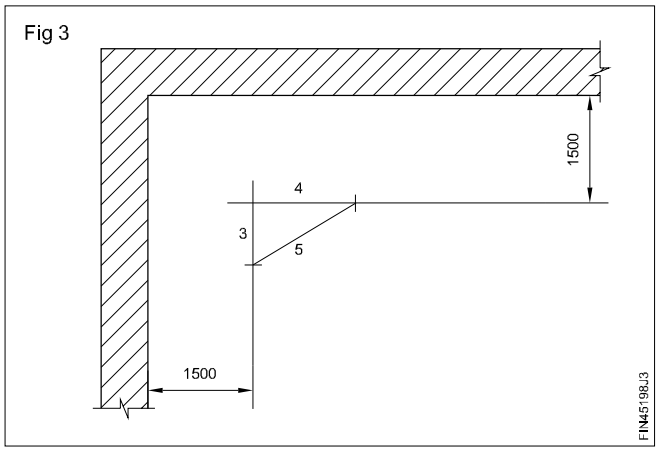
Mark points at a distance of 1.5 m (maximum) from the pillar or wall. (Fig 1)



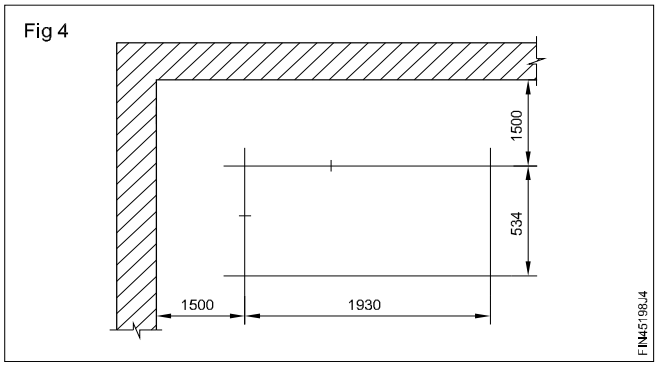
Draw the base line with the help of twine thread dipped in chalk powder or chalk solution. (Fig 2)



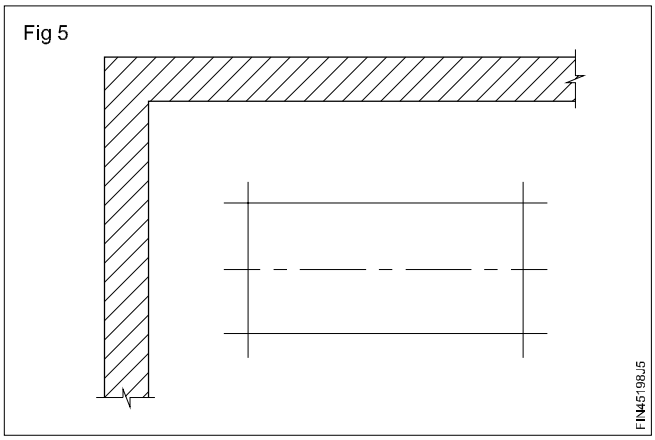
Construct the vertical base line using 3, 4, 5 method (Fig 3) as in a right angled triangle.



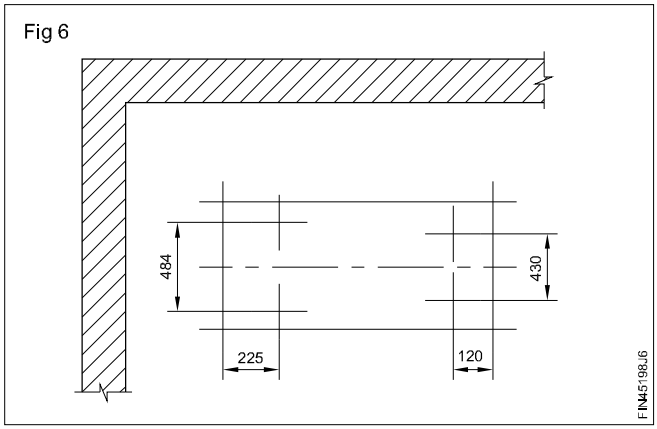
Mark the total base area of the machine. (Fig 4)



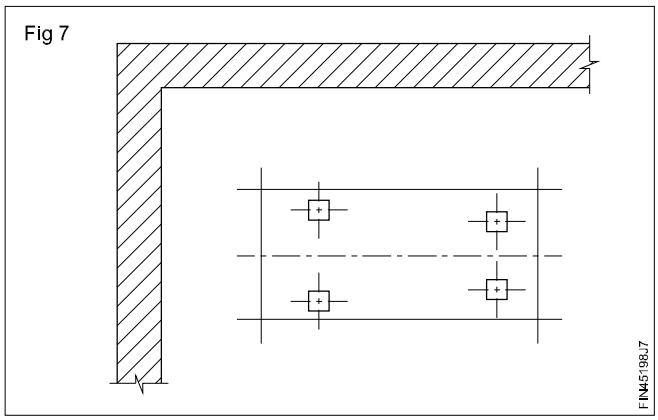
Draw the central line of the base horizontally. (Fig 5)



Locate the position of the holes. (Fig 6)



Mark the foundation holes for grouting. (Fig 7)



Mount and level machine on anti - vibration pads

Objective: This shall help you to.

- **level the machine on anti - vibration pads.**

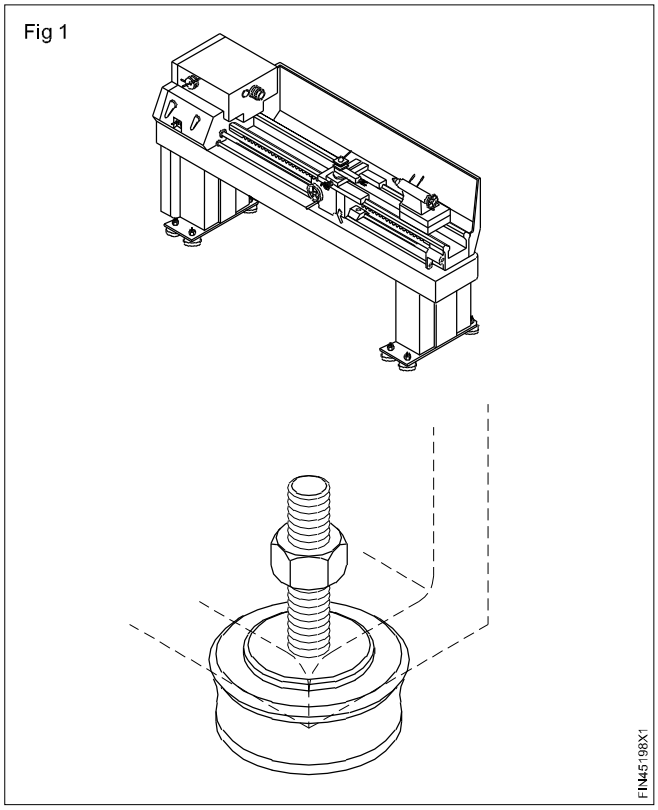
Lift the machine by crowbars and place wooden blocks under the machine at all the four corners.

Select suitable anti-vibration pads depending upon the weight of the machine.

Remove the levelling bolts from the metal casting.

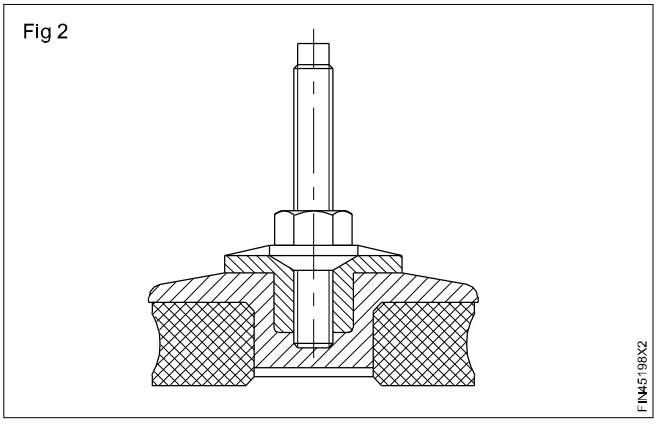
Mount anti-vibration pads under the machine. (Fig 1)

Fig 1



Fix levelling bolts to the metal casing through the foundation holes of the machine.(Fig 2)

Fig 2



Lift the machine slightly by crowbars and remove the wooden blocks from the machine.

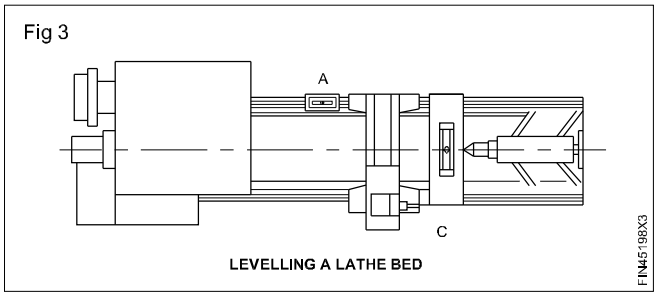
Level the machine both in longitudinal and tranverse directions using a precision spirit level of accuracy 0.02 to 0.05 mm/metre.

Position the carriage in the middle of the bed.

Keep the spirit level on the rear slideway (i.e. the slideway opposite the operator's side) longitudinally at the position 'A'. (Fig 3)

Keep the second spirit level transversally at the position 'C' (Fig 3)

Fig 3

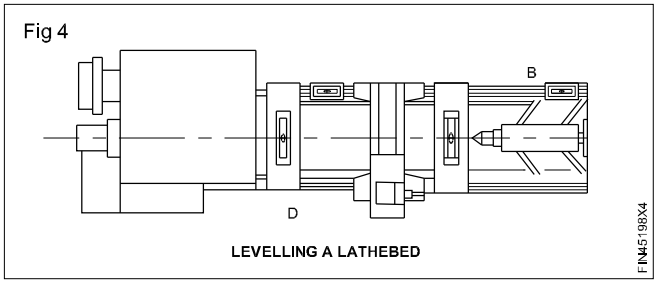


Take the readings of both the spirit levels.

Adjust the level of the bed till both the spirit levels show the same readings.

Keep the spirit levels longitudinally and transversally at positions 'B' and 'D' (Fig 4)

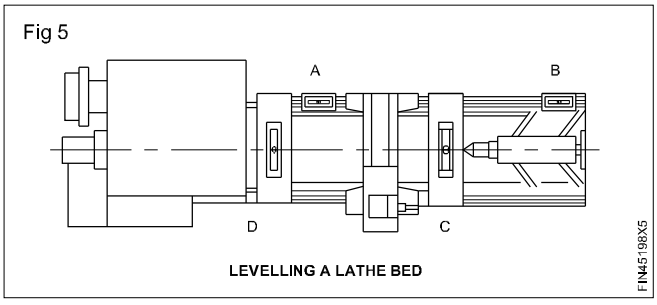
Fig 4



Adjust the bed till both the spirit levels show the same readings.

Repeat the sequence of operation till both the spirit levels show the same reading in all the positions A, B, C & D. (Fig 5)

Fig 5

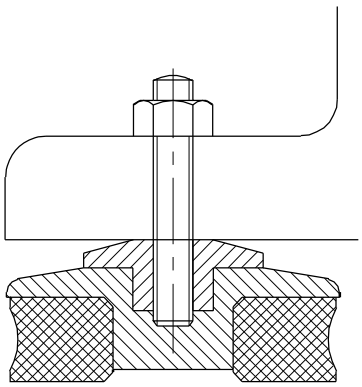


Adjust the level of the machine as required by screwing or unscrewing the levelling bolt.

Finally check the level of the machine with a spirit level.

Lock the position of the machine by levelling lock-nuts after completion of work. (Fig 6)

Fig 6



FIN45198X6

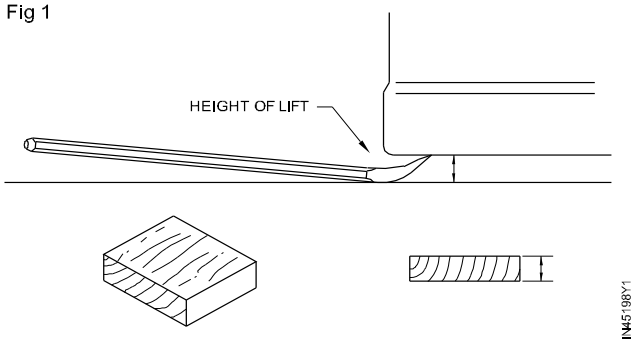
Moving machine on rollers (Drill Machine & Power Saw Machine)

Objective: This shall help you to.

- **lift and move a drill machine and power saw machine to the desired location using rollers.**

Keep a wooden block ready to be placed under base of the machine when it is lifted. (Fig 1)

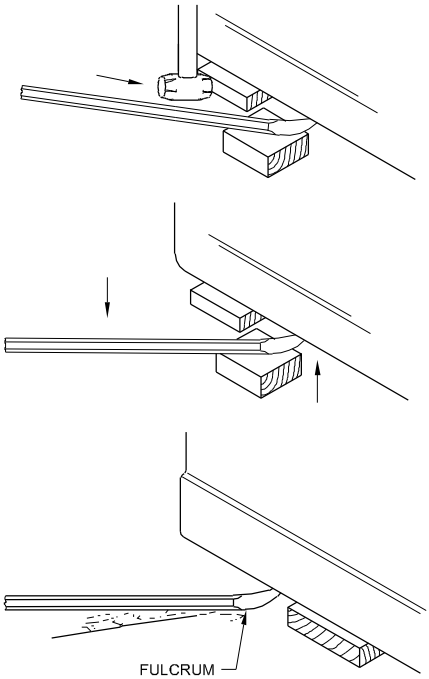
Fig 1



FIN45198Y1

Lift one corner of the machine using crowbars and place the wooden block under the machine. (Fig 2)

Fig 2



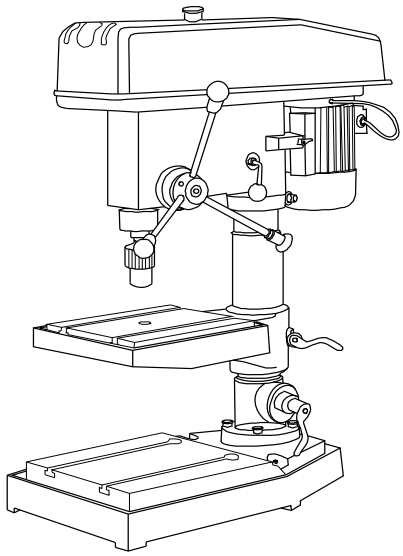
FIN45198Y2

Lower the machine on to the wooden block.

Repeat the same procedure for the opposite corner of the machine.

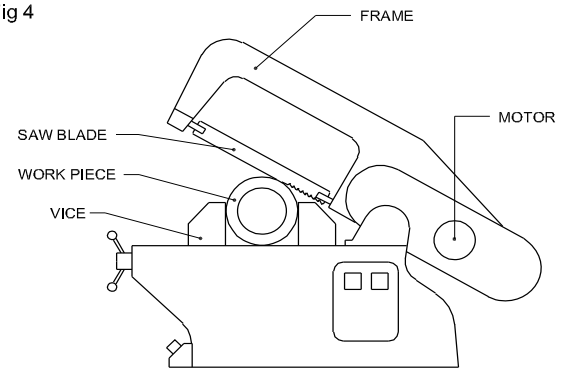
Place three or four rollers evenly distributed under the machine. (Fig 3 & 4)

Fig 3



FIN45198Y3

Fig 4



FIN45198Y4

Lift the machine with crowbars and remove the wooden blocks.

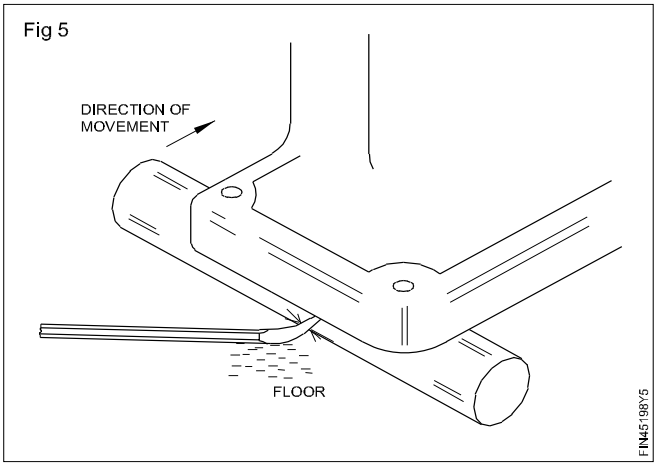
Lower the machine evenly on to the rollers. (Fig 3 & 4)

Check that the route is clear of obstacles before moving.

Place a roller in front of the machine.

Push the load forward slowly with the crowbars upto located place. (Fig 5)

Fig 5



As and when a roller is left behind the load, take it out and place the same in front of the load.

Note: Fig. 6 shows the correct and incorrect method of handling crow bar.

Fig 6