TOOL AND DIE MAKER (Dies & Moulds)

NSQF LEVEL - 4

2nd Year

TRADE PRACTICAL

SECTOR : CAPITAL GOODS & MANUFACTURING

(As per revised syllabus July 2022 - 1200 Hrs)

Directorate General of Training

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

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

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

Sector : Capital Goods & Manufacturing

Duration : 2 Years

Trades : Tool and Die Maker (Dies & Moulds) - 2nd Year - Trade Practical - NSQF Level - 4 (Revised 2022)

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, by 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 Media Development Committee members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Tool and Die Maker (Dies & Moulds) 2nd Year - Trade Practical NSQF Level - 4 (Revised 2022) in CG & M** Sector under Yearly Pattern**.** The NSQF Level - 4 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

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

August 2023
New Delhi - 110 001

PREFACE

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

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

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

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

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

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

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

Chennai - 600 032 **EXECUTIVE DIRECTOR**

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP **(Trade Practical)** for the trade of **Tool and Die Maker (Dies & Moulds)** under the **CG & M** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

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NIMI - COORDINATORS

Shri.Nirmalya Nath	-	Deputy Director of Training NIMI- Chennai - 32.
V. Gopala Krishnan	-	Assistant Manager NIMI - Chennai -32.

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

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

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

INTRODUCTION

TRADE PRACTICAL

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

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

Module 1	Wire Cut EDM
Module 2	CNC Lathe
Module 3	CNC Milling
Module 4	Hand injection mould
Module 5	Cavity injection mould
Module 6	Hydraulic & Pneumatics
Module 7	Machine Maintenance
Module 8	Two Cavity Injection Mould

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

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

TRADE THEORY

The manual of trade theory consists of theoretical information for the course of the **Tool and Die Maker (Dies & Moulds)** Trade. The contents are sequenced according to the practical exercise contained in the manual on Trade practical. Attempt has been made to relate the theortical aspects with the skill covered in each exercise to the extent possible. This co-relation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

The Trade theory has to be taught and learnt along with the corresponding exercise contained in the manual on trade practical. The indicating about the corresponding practical exercise 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 the purpose of self learning and should be considered as supplementary to class room instruction.

CONTENTS

LEARNING OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref. Ex.No.
1	**Produce components of high accuracy by different operations using Electric Discharge machine (EDM) and Wire EDM with accuracy of ± 0.02mm. NOS:CSC/N9493**	**83 - 84**
2	**Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme. NOS:CSC/N0316**	**85 - 89**
3	**Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. NOS:CSC/N0316**	**90 - 94**
4	**Construct a Hand Injection Mould and try out/ test the mould assembly. NOS:CSC/N9494**	**95 - 96**
5	**Construct of two cavity injection mould and try out component. NOS:CSC/N 9495**	**97 - 98**
6	**Construct single cavity mould (Compression mould/ plunger type transformer mould). NOS:CSC/N9496**	**99 - 99A**
7	**Construct circuit of pneumatics and hydraulics observing standard operating procedure & safety aspect. NOS:CSC/N9497**	**100 - 101**
8	**Plan and perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, milling machine and Lathe] NOS:CSC/N9498**	**102 - 106**
9	**Develop isometric drawing and construct two cavity moulds with side core. NOS:CSC/N9499**	**107 - 109**

SYLLABUS FOR TOOL & DIE MAKER

Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
Professional Skill 50 Hrs.; Professional Knowledge 06 Hrs.	Produce components of high accuracy by different operations using Electric Discharge machine (EDM) and Wire EDM with accuracy of ± 0.02mm. NOS:CSC/N9493	83.EDM machining practice/ observation on EDM machine exercises. (25 hrs.) 84. Machining practice on Wire EDM machine. (25 hrs.)	Electrical discharge machine (EDM) introduction principle of operation, advantages and disadvantages and its applications. Introduction principle of operation advantaged and disadvantaged and applications. (06 hrs.)
Professional Skill 70 Hrs.; Professional Knowledge 10 Hrs.	Set (both job and tool) CNC lathe and produce components as per drawing by preparing part programme. NOS:CSC/N0316	85Study of CNC lathe, key board and specifications. (06 hrs.) 86 Machine starting & operating in Reference Point, JOG, and Incremental Modes. (04 hrs.) 87.Co-ordinate system points, assignments and simulations Absolute and incremental programming assignments and simulations. (20 hrs.) 88. Co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. (20 hrs.) 89. Work and tool setting. Automatic Mode operation: facing, profile turning, drilling, tapping, reaming, thread cutting etc. (20 hrs.)	Safety Precautions: Safe handling of tools, equipment & CNC machines, CNC turning with FANUC CNC CONTROL- (Fanuc-OiT latest) CNC Machine and Control specifications. CNC system organization Fanuc-0i-T. Coordinate systems and Points. CNC lathe, Types, Machine axes. (10 hrs.)
Professional Skill 62 Hrs.; Professional Knowledge 10 Hrs.	Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme. NOS:CSC/N0316	90. Study of CNC Machining centre, keyboard and specifications. (16 hrs.) 91. Machine starting & operating in Reference Point, JOG, and Incremental Modes. (06 hrs.) 92. Co-ordinate system points, assignments and simulations Absolute and incremental programming assignments and simulations. (10 hrs.) 93. Polar co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. (12 hrs.) 94. Work and tool setting. Automatic Mode operation: Face Milling, profile milling, drilling, tapping, reaming etc. (18 hrs.)	Safety Precautions: Safe handling of tools, equipment & CNC machines, CNC Mill with FANUC CNC CONTROL- (Fanuc-0i-M latest) CNC Machine &Control specifications. CNC system organization Fanuc-0i-M. Coordinate systems and Points. CNC Machines Milling, Types, Machine axes. (10 hrs.)

Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
Professional Skill 75 Hrs.; Professional Knowledge 18 Hrs.	Construct a Hand Injection Mould and try out/ test the mould assembly. NOS:CSC/N9494	95. Manufacture hand injection mould. (May use the plates used in turning, milling and grinding exercise). (70 hrs.) 96. Try out and rectification. (05 hrs.)	Hand injection mould Introduction to plastic material: Types of plastics, differentiation of plastics, Properties, application, fillers and additives and reinforced plastics. Mould terminology: Core, cavity, impression, runner, gate, sprue bush, mould base etc. Parting line: Types of parting line, mould matching (Bedding down), vent and relief. Requirement for ejection: Types of ejector grids, ejector elements and ejector system. Feed System: Sprue, runner, gate, types, design and calculations, vent design, balancing, etc. (18 hrs.)
Professional Skill 150 Hrs.; Professional Knowledge 48 Hrs.	Construct two cavity injection mould and try out component. NOS:CSC/N 9495	97. Develop isometric drawing and manufacture 2 cavity injection moulds in a group of 5 trainees using various tool room machines (conventional and nonconventional machines). (130 hrs.) 98. Try out component and rectification. (20 hrs.)	Shrinkage: Introduction mould life, cavity/core dimensions, and various shrinkage values for different plastic materials. Temperature controlling of moulds: Introduction, factors effecting the cooling of moulds, layout and sizing of cooling channel, cooling integer type mould plate (core cavity, Bolster), cooling core and cavity inserts and sub inserts, mould cooling requirements and calculations. Injection moulding machines: Introduction, clamping system/ injection system terminologies and specifications, screw terminology construction of screw, types of moulding machines, and sequence in the moulding cycle. Selection of mould base, material and no. of cavities: Introduction, Selection of mould base and material, advantages and disadvantages of single/ multicavity mould, calculation of no. of cavities. Splits: External undercut components, methods of operation, split locking methods, splits safety arrangements. Side cores and side cavities: Introduction, moulding embedded side holes/ recess/slots, Design requirements for side core/ side cavities, internal side core/side cavities. Moulding internal under cuts/ threads: Definition, form pin/ split core/ side core, stripping internal under cuts purpose of threads in plastics, moulding internal threads, power and transmission system layout of impression, and moulding of external threads. (48 Hrs.)

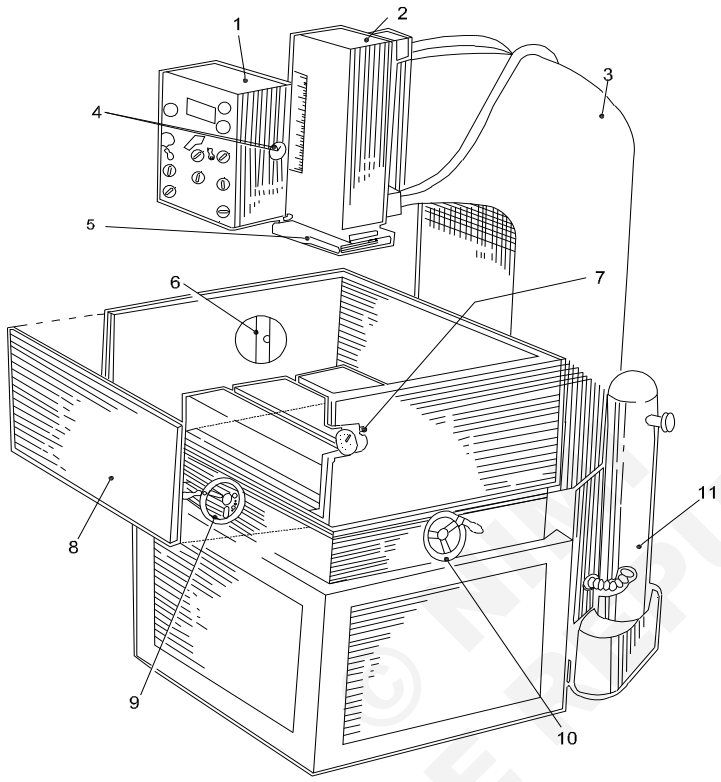
Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
Professional Skill 100 Hrs.; Professional Knowledge 28 Hrs.	Construct single cavity mould (Compression mould/ plunger type transformer mould).	99. Manufacture single cavity plunger type transfer mould in a group of 5 trainees using various tools room machine (conventional and nonconventional) OR Manufacture multi cavity compression mould construct a single cavity compression mould in a group of 5 trainees using various tool room machine (conventional and nonconventional) (100 hrs.) 126. Identification and familiarisation of various types of hydraulic & pneumatic elements such as cylinder, valves, actuators and filters. (15 hrs.)	Moulding of thermoset materials: Introduction, processing method, compression moulding, definition, pellet, compression moulding types, advantages and disadvantages of semi positive and fully positive mould, automatic compression mould, mould heaters and thermo couples, etc., Transfer moulding, types of transfer moulding, advantages and disadvantages of transfer moulding, Injection moulding of thermo set material, Advantages and disadvantages of injection moulding of thermo set material, Compression/ transfer moulding defects. Surface finish: Mould polishing, different types and appearance required after finishing, overview of the process, standard specification of finish, mechanical equipment of mould polishing, finishing process, problems in mould polishing and solutions, surface treatment method. Multi day light mould: Introduction, under feet mould with reverse tapered sprue, floating runner plate, working system for floating cavity plate, other standard designs, some non-standard latch/ locks, some sample multi-day light design. Introduction of blow moulding, types of blow moulding advantage and disadvantage of blow moulding. Material used in blow moulding, blow moulding fault & remedy. (28 Hrs.)
Professional Skill 35 Hrs; Professional Knowledge 08 Hrs.	Construct circuit of pneumatics and hydraulics observ-ing standard operating procedure& safety aspect. NOS:CSC/N9497	100. Identification and familiarisation of various types of hydraulic & pneumatic elements such as cylinder, valves, actuators and filters. (10 hrs.) 101. Study of simple hydraulic & pneumatic circuit. (25 hrs.)	Basic principles of hydraulics/ pneumatics system, advantages and disadvantages of hydraulics and pneumatics systems, theory of Pascal's law, Brahma's press, Pressure and flow, types of valves used in hydraulics and pneumatics system. (08 Hrs.)

Professional Skill 43 Hrs.; Professional Knowledge 08 Hrs.	Plan and perform simple repair, over-hauling of different machines and check for functionality. [Different Machines – Drill Machine, milling machine and Lathe] NOS:CSC/ N9498	102. Perform Periodic maintenance of lubrication system on Machines. (06 hrs.) 103. Perform simple repair work. (12 hrs.) 104. Perform the routine maintenance with check list. (05 hrs.) 105. Inspection of Machine tools such as alignment, levelling etc. (10 hrs.) 106. Accuracy testing of machine tools such as geometrical parameters. (10 hrs.)	Lubricating system-types and importance Maintenance: Definition, types and its necessity. System of symbol and colour coding. Possible causes for failure and remedies. (08 Hrs.)
Professional Skill 255 Hrs.; Professional Knowledge 90 Hrs.	Develop isometric drawing and con-struct two cavity moulds with side core. OR Construct an injection mould with side cavities (with cam pin) (two cavities rounded square bobbin) NOS:CSC/N9499	107.Develop isometric drawing and manufacture 2 cavity injection moulds with side cavities in a group of 5 trainees using various tool room machines (conventional and nonconventional) (220hrs.) 108. Assemble all the parts of mould and try-out and find out fault of component and rectification. (15 hrs.) 109.Prepare different types of documentation as per industrial need by different methods of recording information for the project. (20 hrs.)	Hot runner mould: Definition, runner less mould, advantages and disadvantages of hot runner moulding system, type of hot runner system, valve system, selecting a hot runner system, advantages and disadvantages of insulated runner mould and modified insulated runner mould, starting/ restarting nozzles in a manifold application. Injection moulding defects: Introduction, common faults, possible problems and remedies, analysis of moulding problems and solutions. Other moulding processes: Blow moulding, Extrusion moulding, rotational moulding, thermo forming, sheet and film forming. Multi-color moulding: Introduction, multi-color moulding, multi-material moulding and multi-process moulding. Maintenance of mould: Introduction, upkeep and maintenance, types of maintenance of idle moulds, maintenance control, and frequency of maintenance. Die cast mould: Introduction to Die casting, Die casting, gating system design, force calculation, defects and remedies. Die and mould economics: Estimation and casting of mould raw material, machining hour rate, business transactions, cost of components, activity-based costing, estimation of moulds and standard items. (90 Hrs.)

EDM machining practice/ observation on EDM machine exercise

Objectives: At the end of this exercise you shall be able to
- **identify the parts of EDM machine**
- **familiarise the control panel of EDM machine**
- **set the workpiece and electrode on EDM machine**
- **make cylinderical and square hole on EDM machine.**

Fig 1



1. POWER CONTROL BOX
2. SERVO CONTROL HEAD
3. COLUMN
4. DIAL INDICATOR SCALE FOR DEPTH OF CUT
5. ELECTRODE PLATEN AND HOLDER
6. OVERFLOW UNIT
7. DIELECTRIC FLUID PRESSURE GAUGE
8. FRONT TANK CLAMPS FLUID TIGHT SEAL
9. TRANSVERSE HAND WHEEL
10. LONGITUDINAL HAND WHEEL
11. DIELECTRIC FLUID FILTER

TD20N2183H1

Job Sequence

Electrical discharge machine (EDM)

TASK 1**: Identify the EDM machine parts (Fig 1) and record it in table 1**

- Get it verified by the trainer

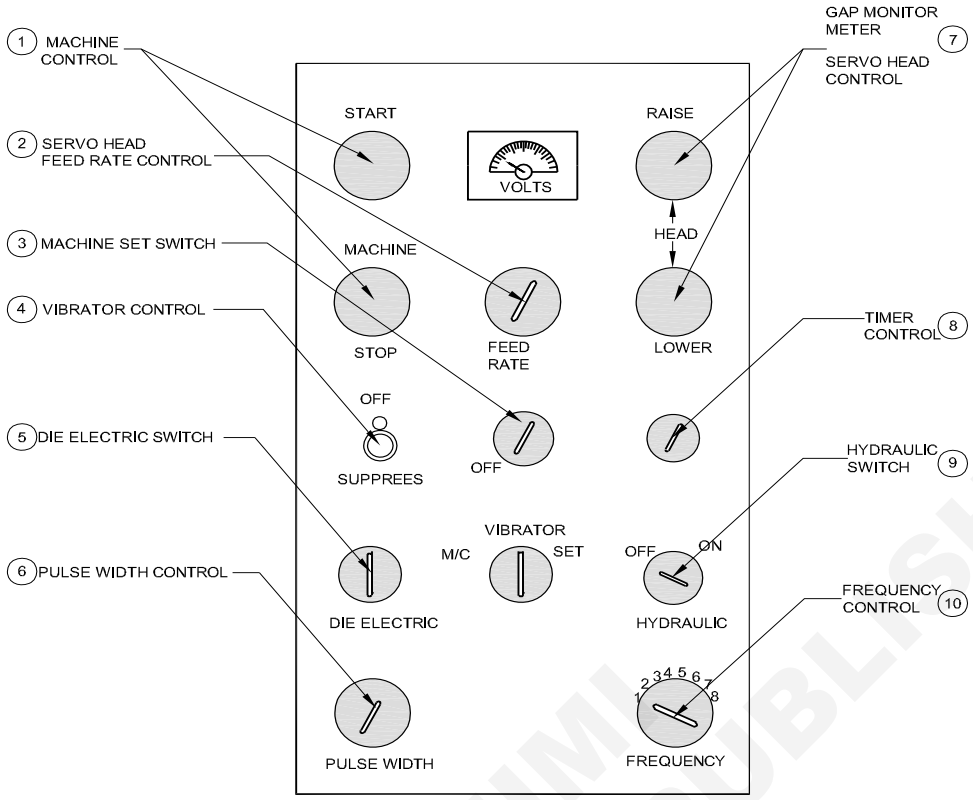
Table 1

S.No	Name of Parts
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

TASK 2**: Observe the control panel (Fig 2) and record the names of switches on the panel**

- Get it verified by the trainer

Fig 2



POWER CONTROL PANEL

TD20N2183H2

Table 2

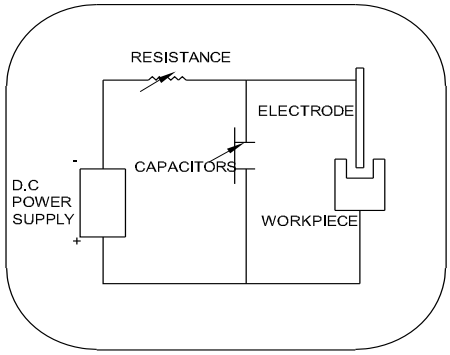
S.No	Description	Remark
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Circuits

Spark erosion circuits are of two general types.

- Relaxation type - depends upon capacitors and a resistance to provide the spark discharge. The circuit generally gives a higher electrode wear rate and lower metal removal than 2. (Fig 3)
- Pulse Type - this can be a valve circuit or translatorised circuit to switch power into the working gap under accurate control. This enables precise amounts of energy to be metered into each spark discharge. (Fig 4)

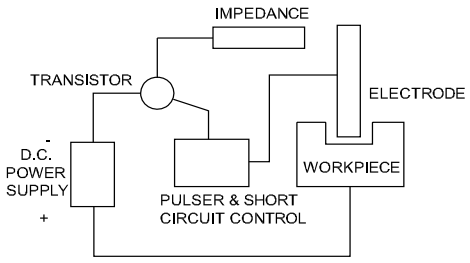
Fig 3



RELAXATION TYPE CIRCUIT

TD20N2183H3

Fig 4



TRANSISTORISED PULSE TYPE CIRCUIT

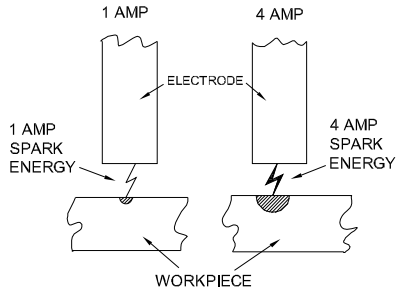
Current density

The size of crater left by an eroded particle governs the surface finish on the workpiece and is dependent upon the energy passed in the spark discharge. A high potential difference across the gap will produce large craters giving a rough surface but also rapid removal of metal. A low potential difference across the gap will produce small craters and a fine surface texture but with a slow rate of metal removal.

e.g. With similar machining conditions, the 4 amp. spark will remove four times the volume of the workpiece than the 1 amp. spark. (Fig 5)

As the machining current is increased, metal removal rate increases.

Fig 5



METAL REMOVAL FOR ONE DISCHARGE

TASK 3: **Starting EDM**

- Switch ON main supply
- Stablizer ON
- Machine main ON
- Release the emergency switch.

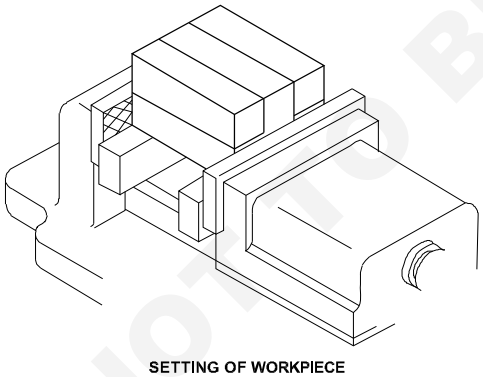
TASK 4: **Manual movements**

- Press control key on manually
- Use hand wheel to move X/Y co ordinator
- Use 'Z' up/down switch to move quill upward / down ward.

TASK 5: **Setting work piece and electrode**

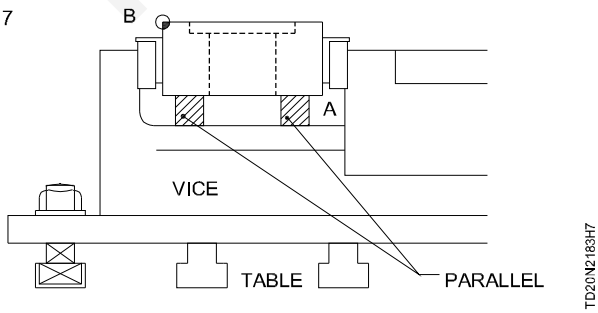
Setting of work piece (Fig 6 & 7).

Fig 6



SETTING OF WORKPIECE

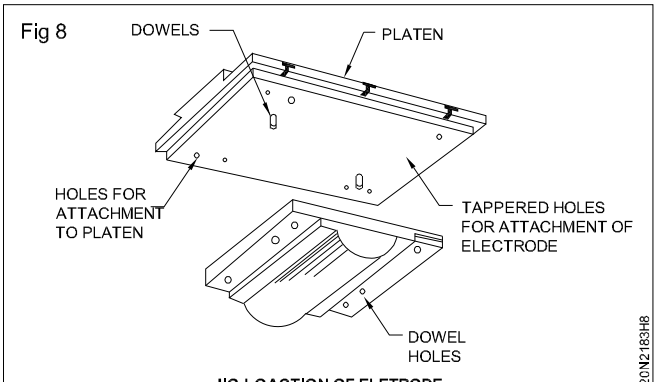
Fig 7



Methods of holding electrodes

- Electrodes are replaced in the electrode holder at least once during a normal machining operation. i.e., Roughing and Finishing electrodes. The electrodes must therefore be held and located accurately in repeatable positions (Fig 8).

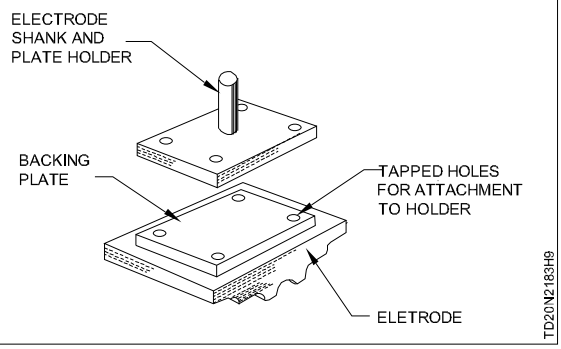
Fig 8



JIG LOACTION OF ELETRODE

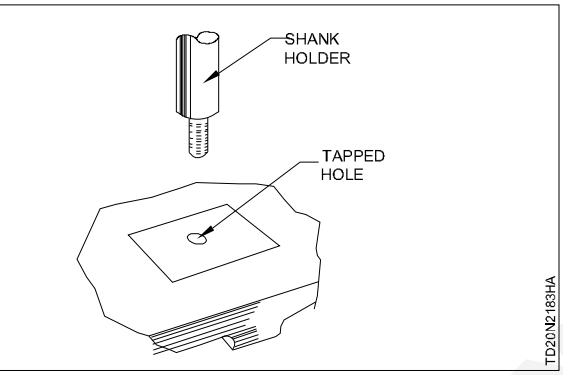
- Large electrodes designed for cavity dies are held on a dowelled plate which is attached to the platen of the spark erosion machine (Fig 8). The dowelled plate and electrodes are drilled and reamed from a master template to ensure accurate location (Fig 9).

Fig 9



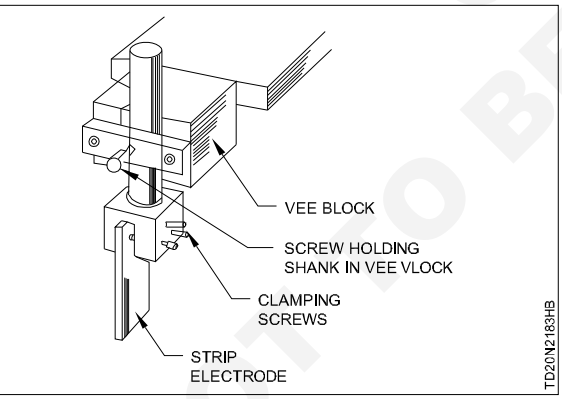
- Flat backed electrodes can be bonded or screwed to a backing plate which is drilled and tapped for attachment to the platen or to a plate that has a shank attached.
- Sprayed electrodes can be held by a screwed hole tapped in the brass plate inserted in the zinc backing. A shank is screwd into the tapped hole (Fig 10).

Fig 10



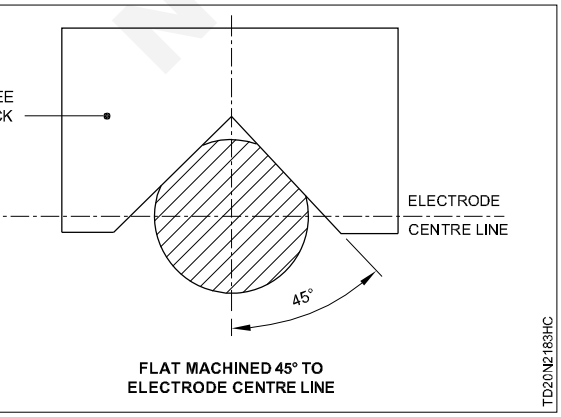
- Shanked electrodes can be held in a number of ways (Fig 11 & 12).
- Strip Clamp

Fig 11



- Vee Block

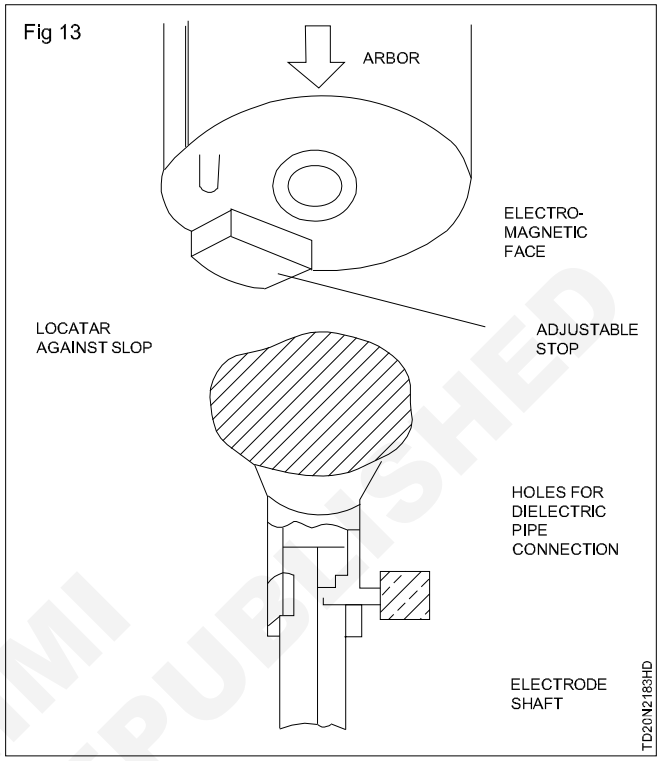
Fig 12



The shank can have 45° flat machined to assist accurate location and interchangeability of electrodes.

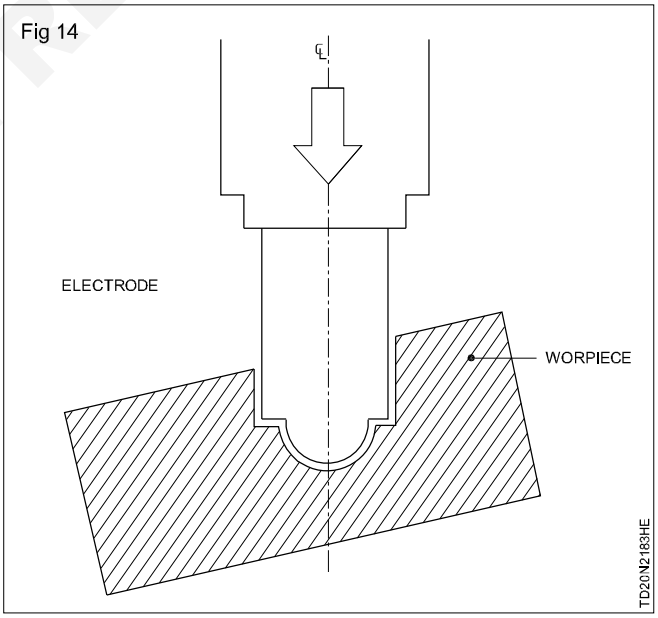
- Various Chuks including magnetic attachment (Fig 13).
- It is essential that the electrode, workpiece and electrode holder are accurately aligned.

Fig 13



- Workpiece in misalignment with electrode (Fig 14).

Fig 14



- Electrode in misalignment with electrode holder and workpiece (Fig 15).
- Dielectric fluid flush holes must be considered when determining the method of holding the electrode - see section on Dielectric Fluid (Fig 16 to 18).

Fig 15

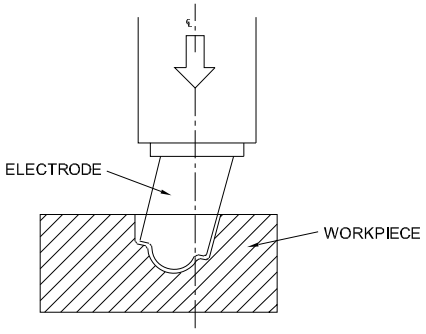
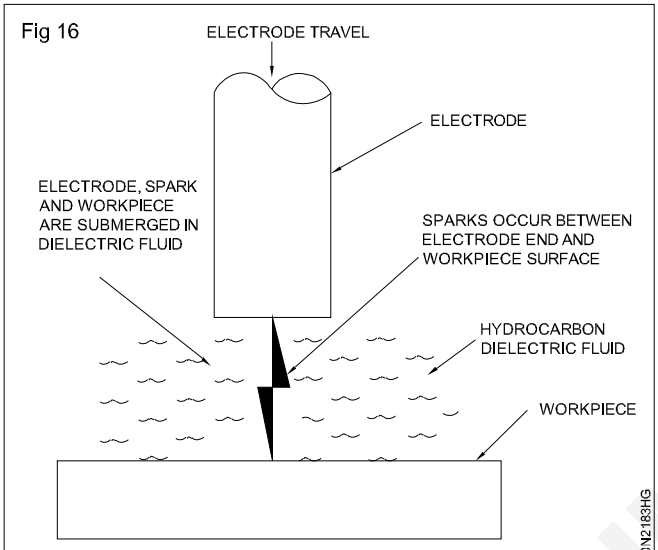
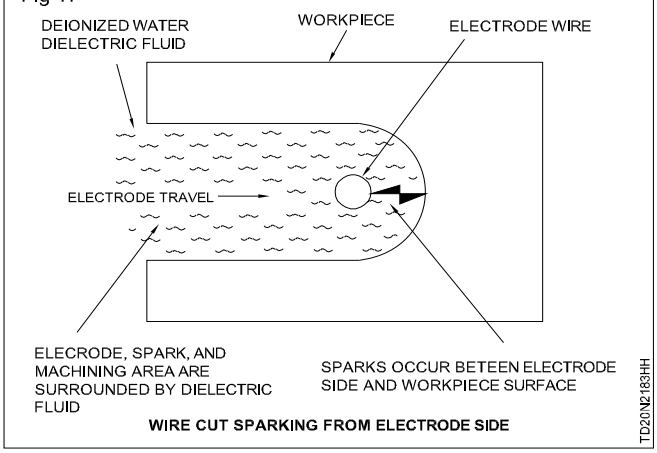


Fig 16



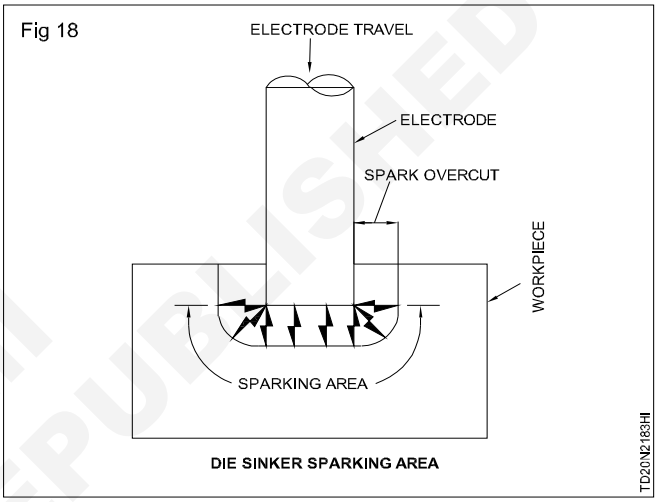
DIE- SINKER SPARKING FROM ELECTRODE END

Fig 17



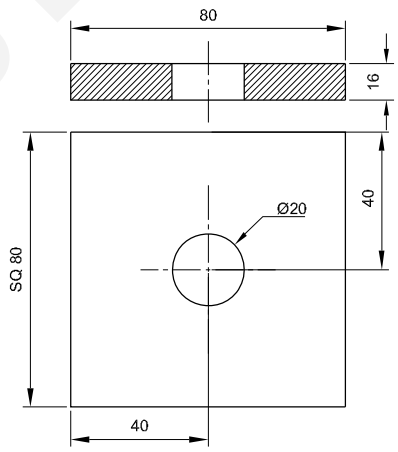
WIRE CUT SPARKING FROM ELECTRODE SIDE

Fig 18



DIE SINKER SPARKING AREA

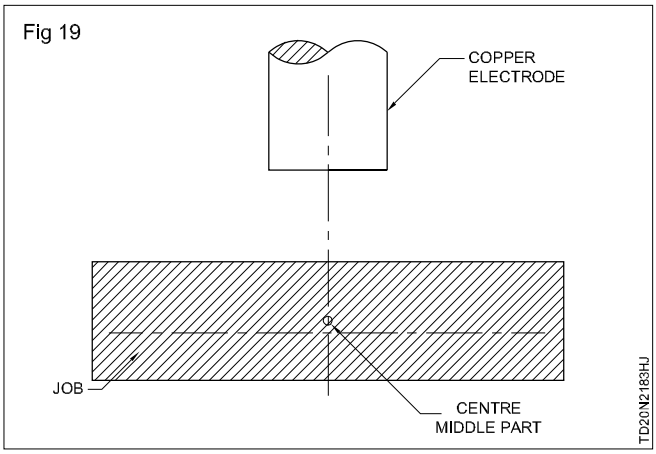
TASK 6: **Making a cylindrical hole by using copper electrode**



1	PRE-MACHINED 80x80x16	-	Fe 310	-	1	2.1.83
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**CYLINDRICAL HOLE BY USING COPPER ELECTRODE**				DEVIATIONS ±0.1	TIME
					CODE NO. TD20N2183E1	

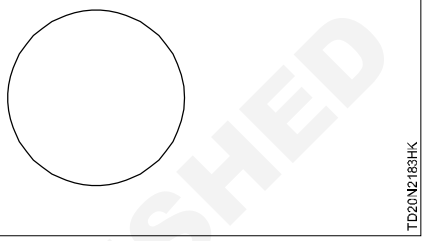
- Prepare the machine
- Set and align the job on the table of EDM machine
- Prepared copper electrode (round shape ∅ 20 mm) set on the ram.
- Align the electrode parallel to the job.
- Position the electrode at the centre of the job marking as shown in Fig 19.

Fig 19



- Fill up the dielectric fluid up to the level (sight glass).
- Dielectric fluid is continuously over fill.
- Start the machine to bring the electrode near the job.
- Maintain the gap between work and electrode.
- Touch the job and cut with suitable depth of cut.
- Simultaneously feed gradually increase cut and maintain the drilling round hole of 20 mm through hole as shown in Fig 20.
- Check the dimension of job with vernier caliper.
- Deburr the sharp edges.

Fig 20

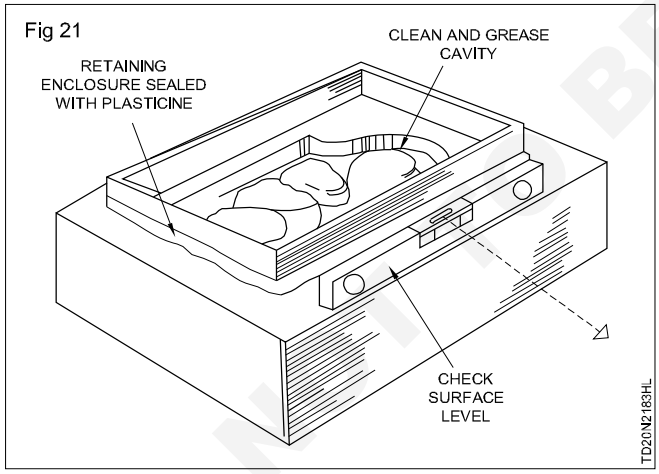


TASK 7: **Manufacture of graphite electrode from epoxy resin mould**

Safety: Take correct precautions when handling epoxy resin.

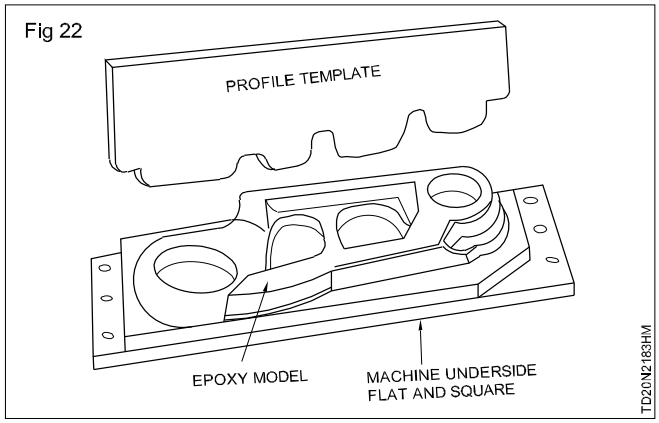
- Clean and check accuracy of the die cavity to be used as the mould.
- Set up die keeping top face level - check with spirit level (Fig 21).

Fig 21



- Attach steel retaining enclosure - seal with plasticine.
- Grease mould surface and retaining enclosure to ensure easy removal.
- Mix epoxy resin to manufacturer's instructions .
- Pour mix gently into mould allowing to fill to required level - ensure no air is trapped and that backing is deep enough to prevent warping.
- Allow to set - see manufacturer's instructions.
- Remove retaining enclosure and withdraw epoxy model from die block.
- Machine back of epoxy model to produce flat surface. This can be done with model seated in die impression using die face as datum to ensure that surface is square with profile.
- Check epoxy model from with die profile templates (Fig 22).

Fig 22



- Select suitable stylus and cutting tool to suit depth, profile and angle of draft (Fig 23).

To produce a roughing electrode .030 inch. under finish size, use a cutting tool .060 inch larger than diameter of stylus.

- Clamp epoxy model and graphite blank to copy milling machine tables taking into account stylus and cutting tool centres (Fig 24).

Fig 23

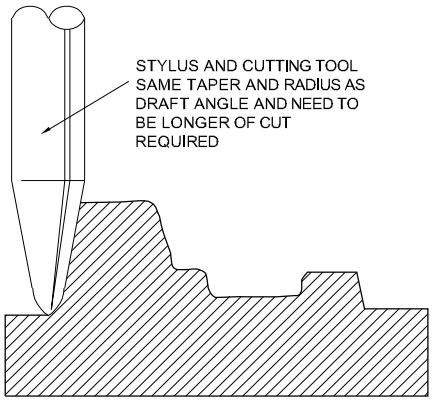
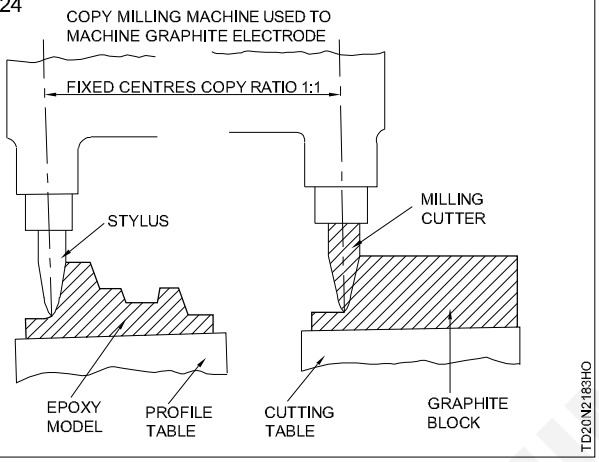


Fig 24



0.03 inch	=	0.762 mm
0.06 inch	=	1.524 mm

The graphite blank should be roughed out and soaked in paraffin overnight to reduce cutting dust.

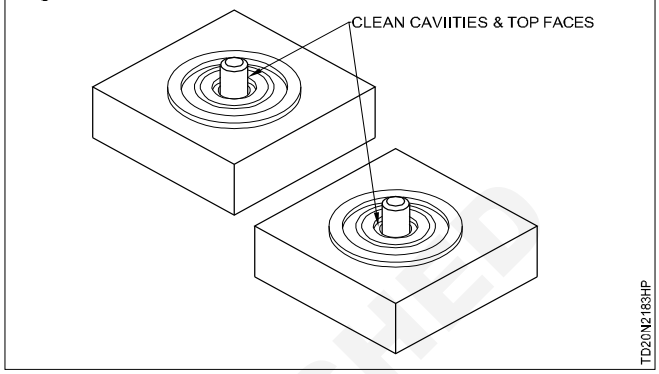
Safety : Goggles and face masks should be used to protect against graphite dust and chippings. When available extractor should be used.

- Select and set machine speed.
- Machine graphite to profile of epoxy model.
- Polish machined electrode with wire wool or wet and dry paper to remove machining marks.
- Drill dielectric flush holes in electrode

Manufacture of electrode by copper spraying

- Clean and remove grease from die using crystic solution or suitable cleanning agent (Fig 25).

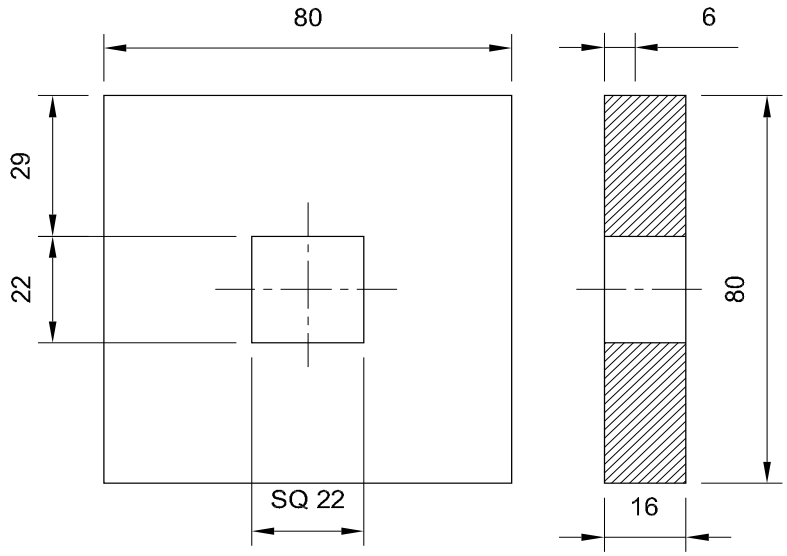
Fig 25



- Place die blocks in spray booth taking care not to handle any part of the cavity or surface on which copper is to be sprayed.
- Feed copper wire into gun and ignite, adjust gun until globules of copper leave gun at correct density. (See manufacturer's instructions for correct use of spray gun).
- Commence spraying over the die top surface. It is advisable to spray two dies thus reducing the danger of over heating.

  cover the whole of the surface area with a light flash of copper before attempting to concentrate heavy deposits.
- Continue spraying holding the gun with one hand and move the dies by means of the rotating table with the other hand. This gives access to all parts of the cavity and reduces risk of over spraying causing overheating and possible breaking away of the copper from the walls of the cavity.
- When the required deposit of copper is reached the electrode is backed off with zinc.

TASK 8: **Making a square hole by using graphite electrode**

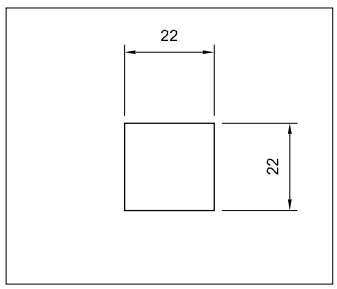


-	PRE-MACHINED 80x80x16	-	Fe 310	-	-	2.1.83
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:2	MAKING A SQUARE HOLE BY USING GRAPHITE ELECTRODE	DEVIATIONS ±0.5	TIME
		CODE NO. TD20N2183E1	

- Prepare the machine.
- Set and align the job on the table.
- Set prepared graphite electrode (square 22 mm) on the ram.
- Align the electrode parallel to the job.
- Position the electrode at the centre of the job.
- Fill up the dielectric fluid up to the level.
- Check dielectric fluid continuous over fill.
- Start the machine bring the electrode to keep close to job.
- Maintain the square shape with the size of 22 mm as shown in Fig 26.
- Check the dimension of square hole with vernier caliper.
- Deburr the sharp edges.

Fig 26



Skill Sequence

Flusing Methods

Objective: This shall be help you to

- **design various methods of flushing depending upon the situation.**

Flushing (Fig 1)

Since eroded particles can assist the spark discharge, high fluid pressures can be undesirable. Also, the rapid passage of fluid can prevent ionisation.

High pressures should be avoided. (Fig 2)

Too little pressure allows a build up of particles and can cause arcing. (Fig 3)

Fig 1

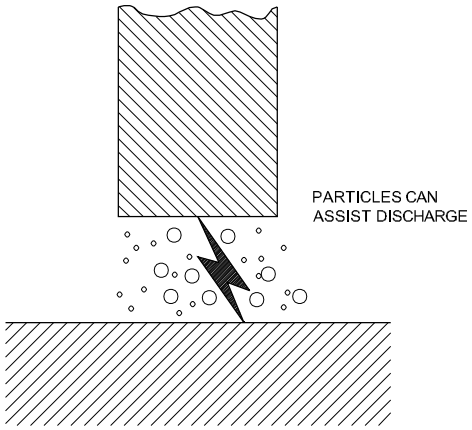


Fig 2

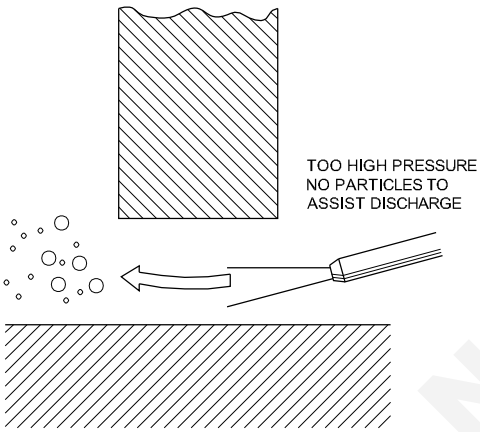
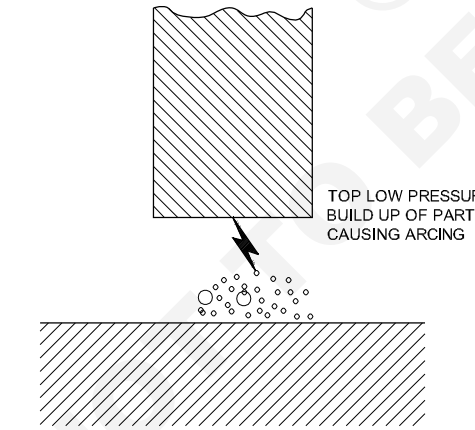


Fig 3



Low pressure should be used initially and progressively increased until the most favourable conditions exist.

When drilling flush holes

The smallest practicable diameter hole should be used to minimise the core left in the die cavity. (Fig 4)

Flush holes may be drilled at an angle to decrease the height of the cores. (Fig 5)

Fig 4

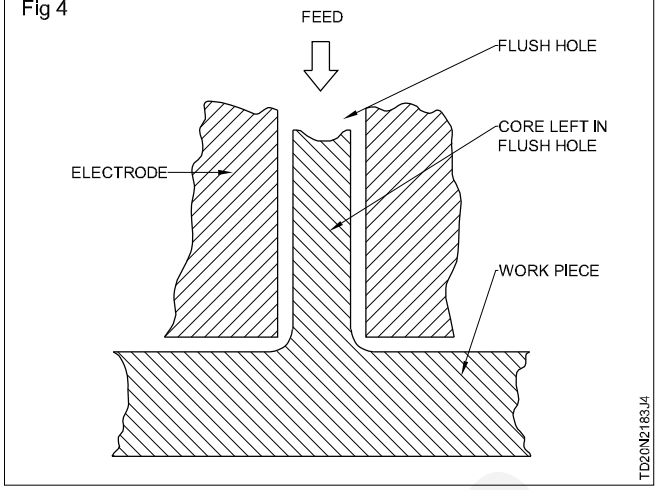
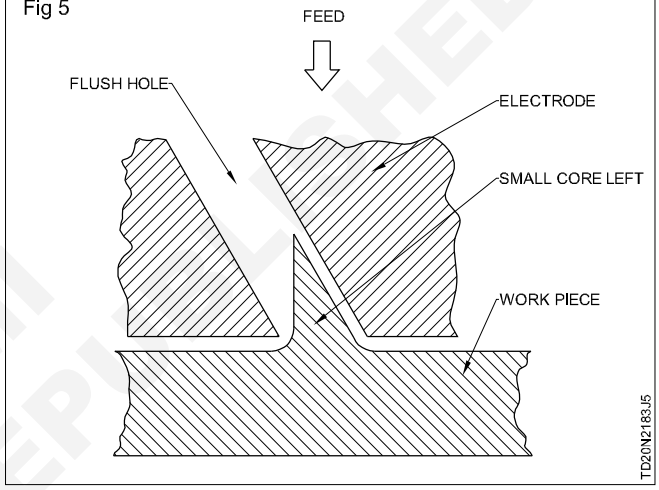


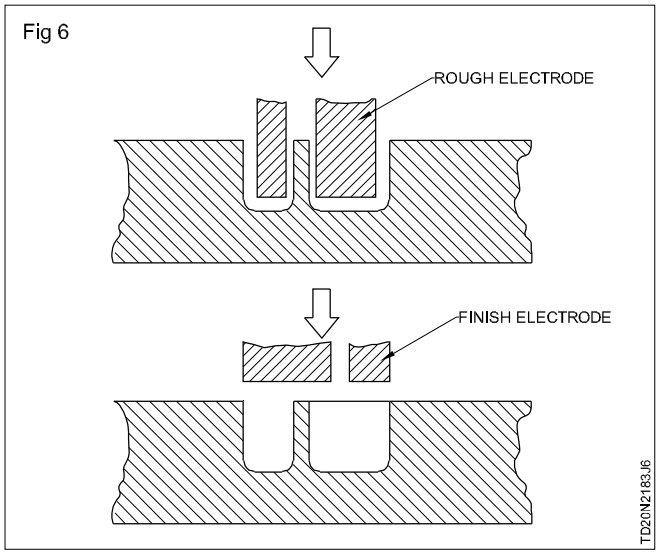
Fig 5



When using a roughing and a finishing electrode, holes should be drilled in different positions in order that cores left by roughing electrode are removed by the finishing electrode. (Fig 6)

Cores should be removed by breaking off when accessible.

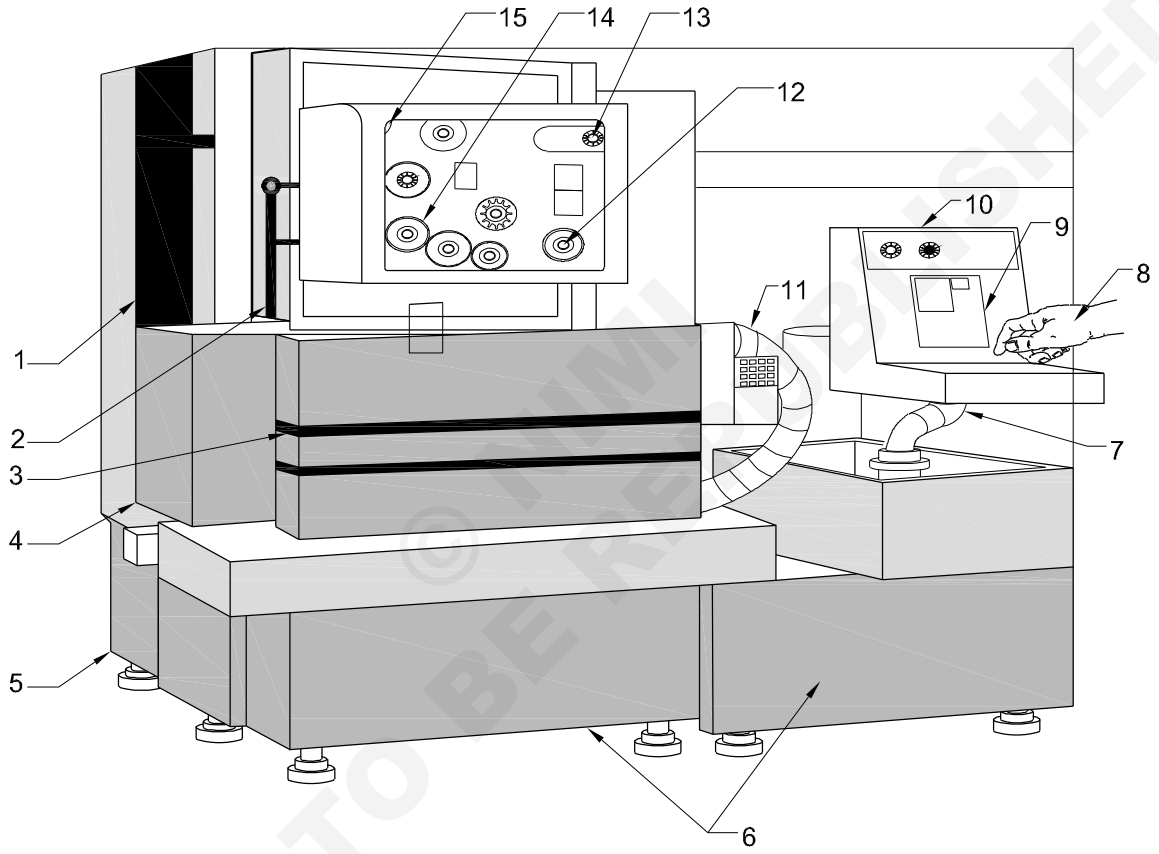
Fig 6



Identification of wire cut EDM parts

Objectives: At the end of this exercise you shall be able to
- **identify the name of the main parts of wire cut EDM**
- **tabulate the parts in the given table**
- **observe the wire cut EDM and record the observation**
- **start and referance the machine**
- **prepare programme**
- **run the programme.**

Fig 1



Job Sequence

TASK 1:

- Identify the parts of wire cut
- Tabulate the parts in the given table 1.

Trainer shall arrange for demo on wire cut EDM machine.

Table 1

S. No.	Name of the parts	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
Signature of trainer		

TASK 2: **Observation on wire cut EDM machine and record it Table 2.**

Table - 2

S. No.	Activity	Observation	Remarks
1	About wire erosion		
2	**Find out the following** Range and capacity of the machine		
3	Material of the wire		
4	Accuracy of the machine		
5	Material of the die used		
6	Material of wire guide		
7	Maximum angular length		
8	Operating system of the computer		
9	Machine manufacturer name		
10	Name of the program language		
11	Name the Dielectric fluid used in operation		

— — — — — — —

TASK 3: **Machine Starting**

- Switch ON main power supply
- Stablizer ON
- Machine main switch ON
- Release emergency switch
- Machine ON
- Wait for system initilization

Screen display will apear (Fig 1)

- Press control key or menu key

Which enables manual modle of X,Y,Z

- Move X,Y,Z towards the middle of the table
- Press homing or referancing switch.
- Now the machine it ready for operations.

Fig 1

ALARMS	GOTO	Z DEPTH	POSITION mm	FLAGS
	X 0.000 Y 0.000 Z -4.648	-4.50 -4.85	X 0.000 Y 0.000 Z -4.595 ADS	JUMP 00 SAFE 00 BUZZER ON Z LOCK OFF SERVO NOR DWELL 0 NOMAN OFF DISPLAY ADS

PROG PROGRAM 01 BLOCK 02 M/C TIME 00:00 Z LIFT 00.0

BLOCK	X	Y	Z	I_P	B	TON	t	V_g	SEN	ASEN	TW	R_d
1	0.000	0.000	-4.440	25	3	500.00	10	50	10	3	0.8	1.0
2	0.000	0.000	-4.440	15	2	100.00	10	50	10	3	0.8	1.0
3	0.000	0.000	-4.665	6	1	100.00	10	50	10	3	0.8	1.0
4	0.000	0.000	-4.748	6	1	50.00	10	50	10	3	0.8	1.0
5	0.000	0.000	-4.828	3	1	50.00	10	75	6	3	0.8	1.0
6	0.000	0.000	-4.850	3	1	20.00	10	75	6	3	0.8	1.8

USE NUMERIC KEYS TO PROGRAM VALUES.
PROGRAM RUNNING...

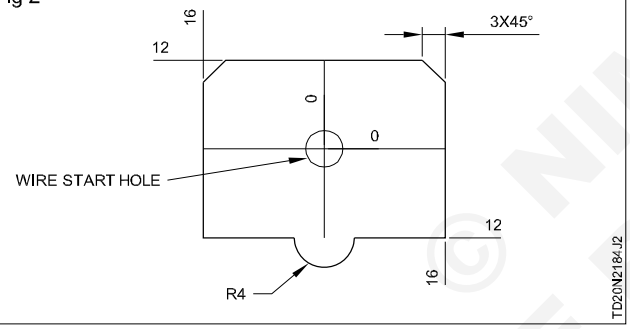
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
PRG NO	ST BLK	ENDBLK	ABORT	EzGURU	TECH	SAVEAS	MARK BLK		FLAGS

TD20N218-J1

TASK 4: **Programme writing**

- Write the programme for Fig 2 using function key as shown in the screen.

Fig 2



TD20N218-J2

All the G code's & M codes are to be familiar for manual programing. Simple software shall also be used to convert the AutoCAD drawing into program. Sample program for familiarization of program structure.

N10 (Name.iso)

N20 G92 X 0.0 Y 0.0 R12.0 W0.0

N30 G01 X 0.0 Y 12.0

N40 G41 D0

N50 G01-X 13.0 Y 12.0

N60 X-16.0 Y 9.0

N70 Y-12.0

N80 X- 4.0

N90 G03. X4.0 Y-12.0 I 0.0 J-12.0

N100 G01 X 16.0

N110 Y 9.0

N120 X 13.0 Y 12.0

N130 X 0.0

N140 G40

N150 G01 Y 0.0

N160 M02

- Prepare the job for a good surface finish on the referance area & aligning (dialing) face. Clean the referance area (hole).
- Set the job on top of the clamping system, aligning the top surface parallel & any one ground face inline with the x / y axis.
- Centralise the hole & enter the co ordinate values at its centre.
- Move to the (x0, y0) position.
- Call for program,
- Select technology according to the job material (steel) wire material (Plain Brass), Wire dia 0.25mm.
- Move "Z" axis as close as possible near to the job top surface.
- Dry run
- Insert the wire & start the program
- Remove the slug immediately after the roughing operation,
- Continue with the process for finishing pass
- Check for dimension (centralising / edge reference)
- Ensure the quality (size & finish)
- Remove the job.
- Clean the part free from water particles (mild air blow).
- Apply thin oil on ferrous materials.

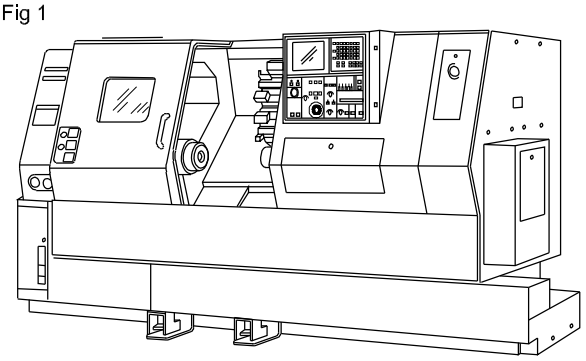
Study of CNC lathe, key board and specification

Objectives: At the end of this exercise you shall be able to
- **identify CNC lathes**
- **familiarise the machine control panel key board and system key board**
- **specify the CNC turning machine.**

CNC lathe identification

A CNC lathe is a machine that rotates a work piece on a spindle to cut away material, using cutting tools and drill bits to produce a symmetrical object. CNC laths comes in either 1. Horizontal type (Fig 1). 2. Vertical type (Fig 2).

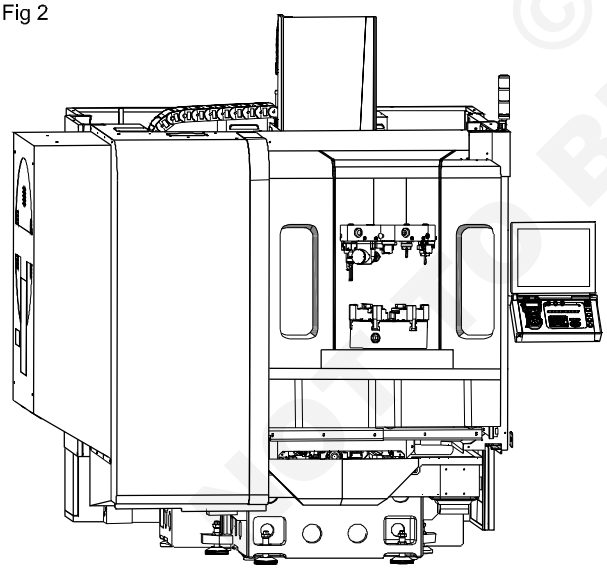
Fig 1



HORIZONTAL TURNING CENTER

TD20N2285H1

Fig 2



VERTICAL TURNING CENTER

TD20N2285H2

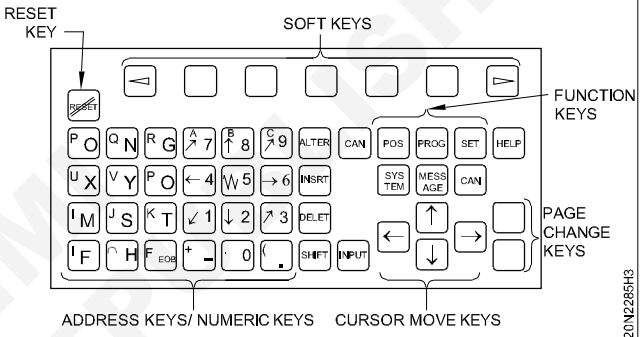
In horizontal turning center the chuck is horizontal in position.

In vertical turning center the chuck is vertical in position. The turret moves up and down movement. (Fig 2).

The system key board are shown in (Fig 3).

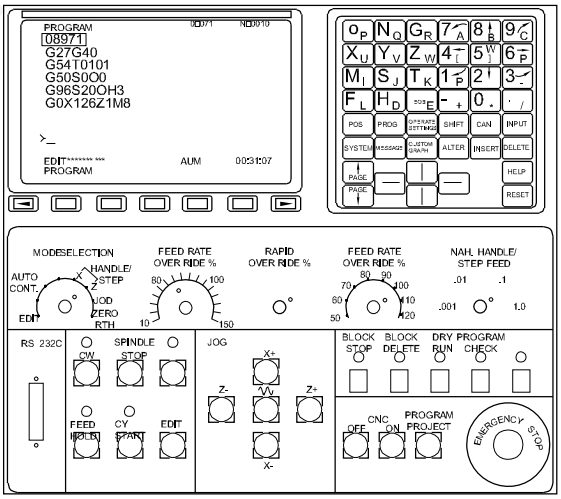
Machine control panel keys are shown in (Fig 4).

Fig 3



TD20N2285H3

Fig 4

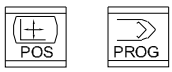


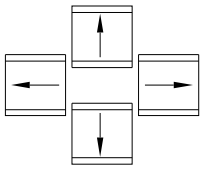
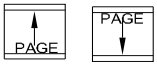
MACHINE CONTROL PANEL KEYS

TD20N2285H4

The definition of system keys are tabulated below (Table 1)

Table 1

Number	Name	Expoaration
1	RESET key 	Press this key to reset the CNC to cancel an alarm etc
2	HELP key 	Press this key to use the help function when uncertain about the operation of an MDI key (help function)
3	Soft keys	The soft keys have various functions, according to the applications. The soft key functions are displayed on the display unit
4	Address and numeric keys 	Press these keys to input alphabetic, numeric and other characters
5	SHIFT keys 	Some address keys or numeric keys have two characters on their top faces. Pressing the <SHIFT> key switches the characters. Special character ^is displayed on the screen when a character indicated at the upper left corner on the keytop can be entered.
6	INPUT key 	When an address key or a numerical key is pressed, the date is input to the key input buffer, and it is displayed on the screen. To copy the data in the key input buffer to the offset register, etc., press the  key. This is equlvalent to the (INPUT) key of the soft keys,and either can be pressed to produce the same result.
7	CANCEL (CAN) key 	Press this key to delete the last character or symbol input to the key input buffer Example) when the key input buffer displays >ND01x100Z and the cancel key  is pressed Z is canceled and >ND01x100_ is displayed
8	Edit keys 	Press these keys when editing the program ALTER  INSERT  DELETE 
9	Function keys 	Press theses keys to switch display screens for each function.

10	Cursor keys 	These are four different cursor move keys  This key is used to move the cursor to the right in the forward direction. The cursor is moved in short units in the forward direction.  This key is used to move the cursor to the left or in the reverse direction.  The cursor is moved in short units in the reverse direction This key is used to move the cursor in a downward or forward direction. The cursor is moved in large units in the forward direction.  This key is used to move the cursor in an upward or reverse direction. The cursor is moved in large units in the reverse direction.
11	Page change keys (Page keys) 	 Two kinds of page change keys are described below This key is used to changeover the page on the screen in the forward direction.  This key is used to changeover the page on the screen in the reverse direction.

CNC Turning Machine specification in table 2

This is the sample machine specification chart (Table 2)

Item	Unit	CAK630
Headstock center height	mm	315
Max.swing dia over bed	mm	ϕ450
Max.swing dia over carriage	mm	ϕ180
Spindle bore dia	mm	ϕ47
Max. Turning Length	mm	100
Spindle speed	r/ min	300-3000
Spindle inner cone		39°
Max travel	mm	X 260
	mm	Z 300
Min setting unit	mm	X 0.00
	mm	Z 0.001
Max rapid movement speed	m/min	X 18
	m/min	Z 24
Chuck type		Manual 3 jaw and pneumatic collet
Turret type		Gang type tool post
Turret repeatability accuracy	mm	< 0.004
Turning pitch range	mm	0.3-5
Main motor power	kw	3
Mahine dimension (LxWxH)	mm	1800*1350*1600
Net Weight (Approx)	kg	1200

Job Sequence

- Trainee will observe the CNC machine and identify the machines.
- Observe the machine control panel keys and system key board.
- Make a record of machine control keys and function keys.
- Get it checked by the trainer.

Machine starting & operating in reference point jog and incremental modes

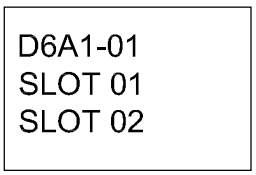
Objectives: At the end of this exercise you shall be able to
- **start and reference the CNC lathe machine**
- **operate the CNC lathe in jog, incremental and manual data input modes.**

Job Sequence

Practice starting referencing and manual mode operations till you become familiar.

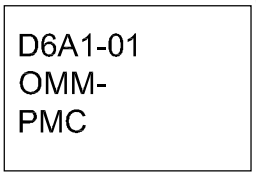
- Switch on the main power connection to the machine
- Switch on the voltage stablizer
- Switch on the isolation switch
- Press “NC ON” push button
- Wait for the screen to indicate module setting status. (Fig 1).

Fig 1



- Display of software configuration (Fig 2).

Fig 2



- Now press “CONTROL ON” push button LCD display will be on
- The machine will be in “MDI” mode by default
- Note “release EMG switch, if pressed” and press control on
- Press “reset” switch on the control panel
- Press “jog” mode switch
- Keep the feed rate switch open
- Press X-
- Press Z-
- Press “reference” mode switch
- Select X axis and press + button
- Wait till the display indicate the completion of X axis referencing
- X = 260mm
- Select Z axis press + button wait till the display indicate the completion of Z axis referencing
- Z = 450mm.

The display and the X and Z value may be different for different machine.

— — — — — — —

Fig 3

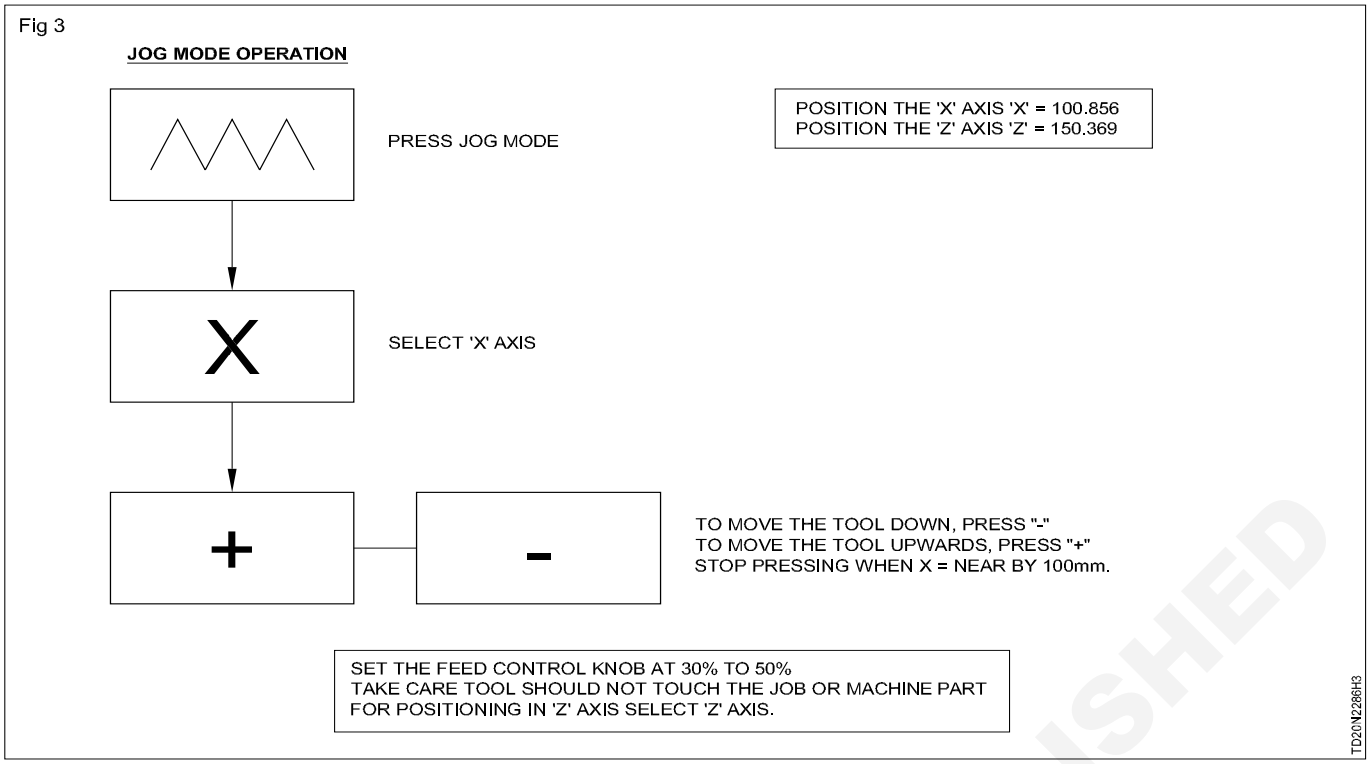
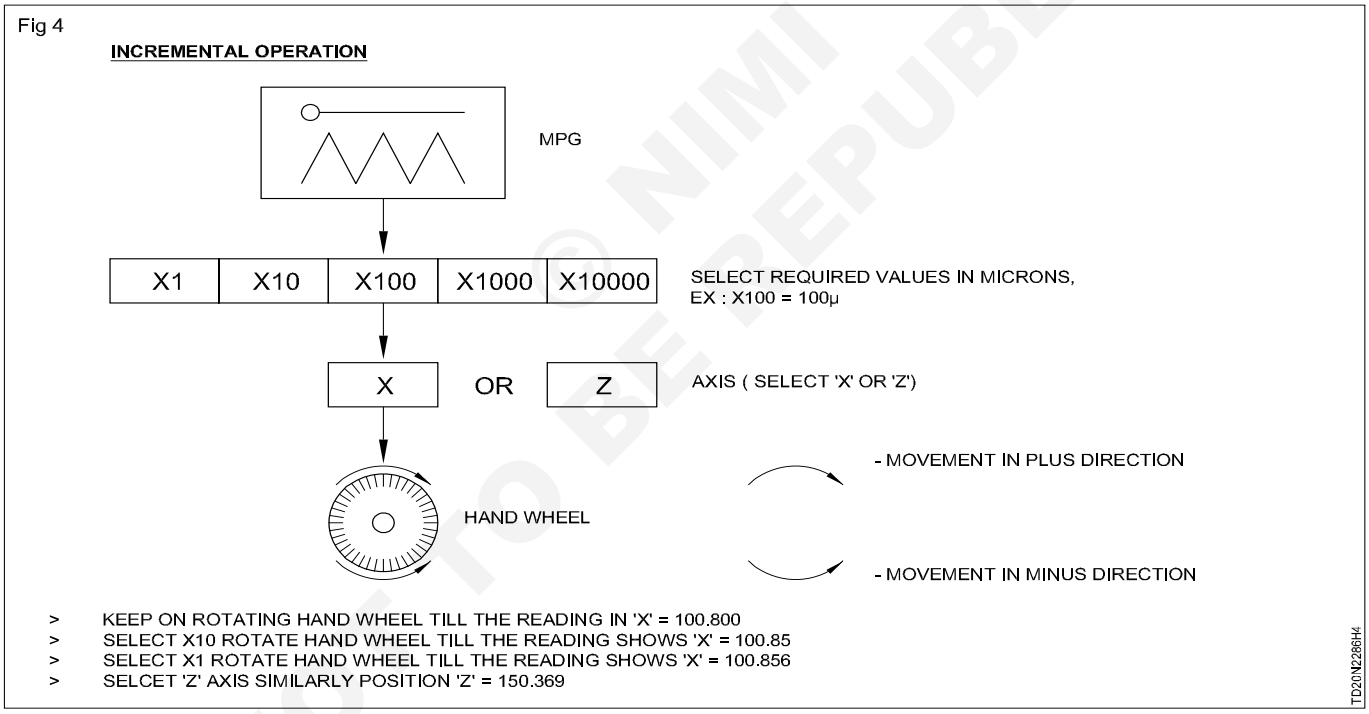


Fig 4



MDI MODE operation

- Set mode switch to MDI selection
- Select program soft key the new empty screen appear.
- Enter G0 G91 X 100.0. Then press insert button
- Press the Cycle start button.
- The Axis X will move 100 mm in (+) direction from the previous tool position
- Repeat the step and give X-100.0 then
- The Axis X will move 100mm in (-) direction
- Now the tool will reach the programmed position.

Co-ordinate system point assignment and simulations. absolute and incremental programming assignment

Objectives: At the end of this exercise you shall be able to
- **plot the point in absolute coordinate system and check by simulation**
- **plot the point in incremental coordinate system and check by simulation**
- **write the programme using G0, G01 in absolute and incremental system**
- **check the programme using simulator.**

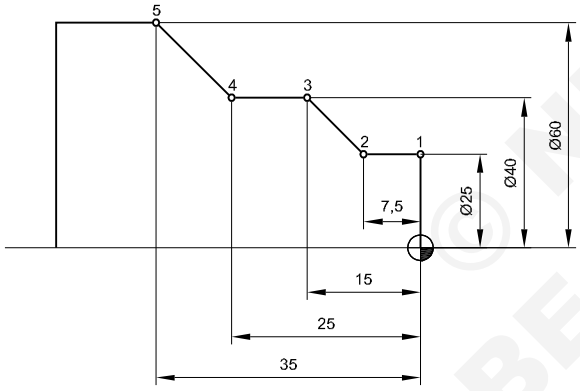
Job Sequence

- Observe Task 1 and Task 2
- Read the drawing and plot the point as in Tasks
- Record the axis points respective tables.
- Switch on the simulator, and select the machine as turning in selecting mode
- Enter the point on the screen and select the simulation screen it shows the plot line based on the point we entered.

Any changes in profile will indicate the points are not correct.

TASK 1: **Absolute programming (G90)**

Fig 1



ABSOLUTE PROGRAMMING (G90)

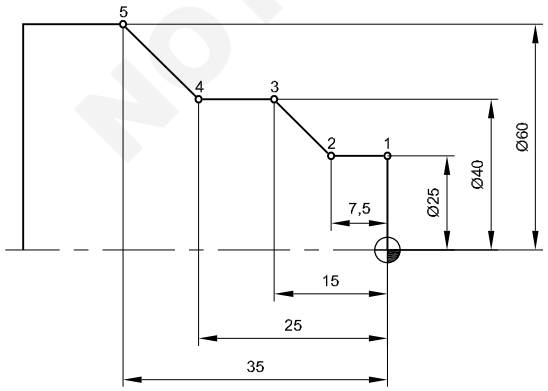
START POINT AT ORIGIN X0,Z0

POS. NO	X axis	Z axis
1	25	0
2	25	-7.5
3	40	-15
4	40	-25
5	60	-35

TD20N2287H1

TASK 2: **Incremental programming (G91)**

Fig 2



INCREMENTAL PROGRAMMING (G91)

START POINT AT ORIGION X0,Z0

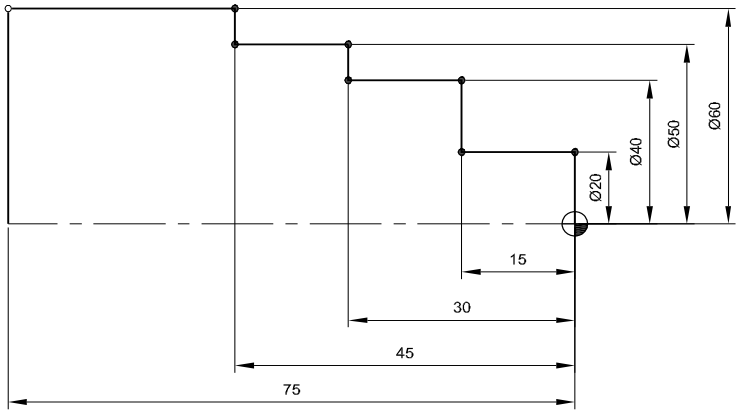
POS. NO	X axis	Z axis
1	12.5	0
2	0	-7.5
3	7.5	-7.5
4	0	-10
5	10	-10

TD20N2287H2

TASK 3: **Plot the points in absolute and incremental modes for Fig 3,4,5 & 6**

- Get it checked by the simulator

Fig 3



(G90)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		

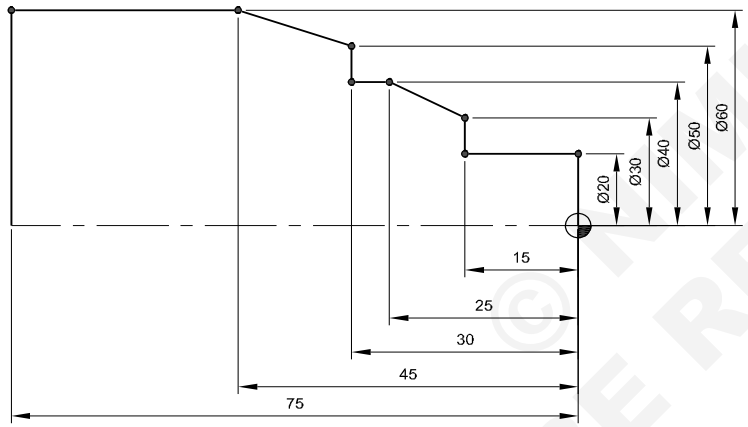
(G91)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		

TD20N2287H3

TASK 4: **Plot the point in absolute and incremental mode**

Fig 4



(G90)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		

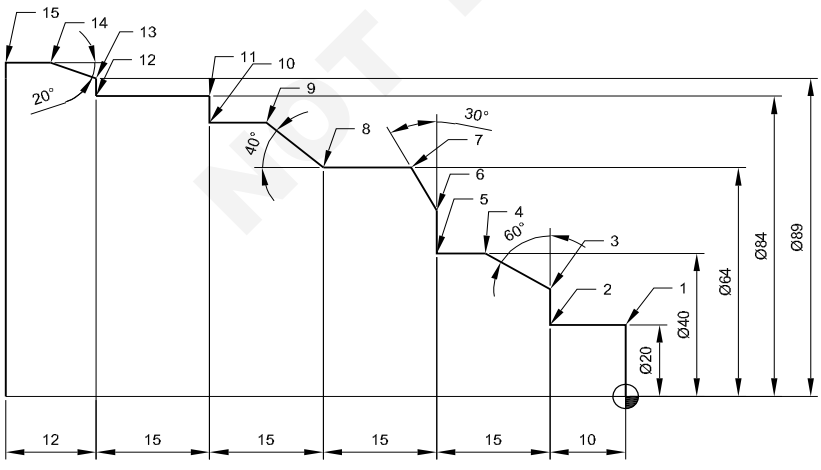
(G91)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		

TD20N2287H4

TASK 5: **Assignment in G90 & G91 (Fig 5)**

Fig 5



(G90)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

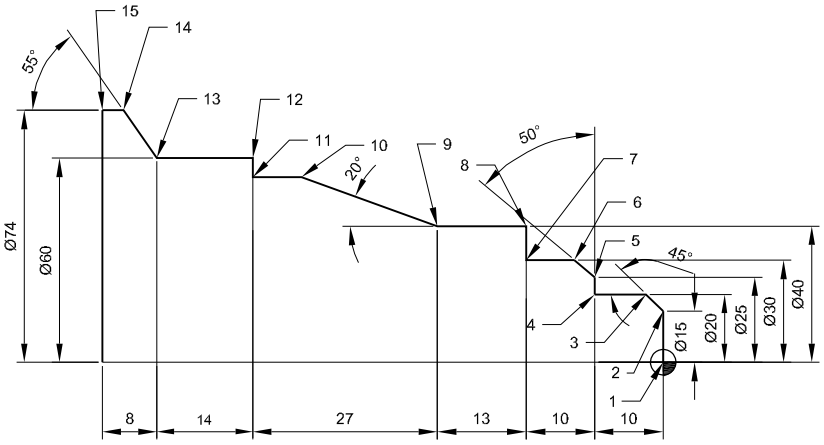
(G91)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

TD20N2287H5

TASK 6: **Assignment in G90 & G91 (Fig 6)**

Fig 6



(G90)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

(G91)

SL NO	X axis	Z axis
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

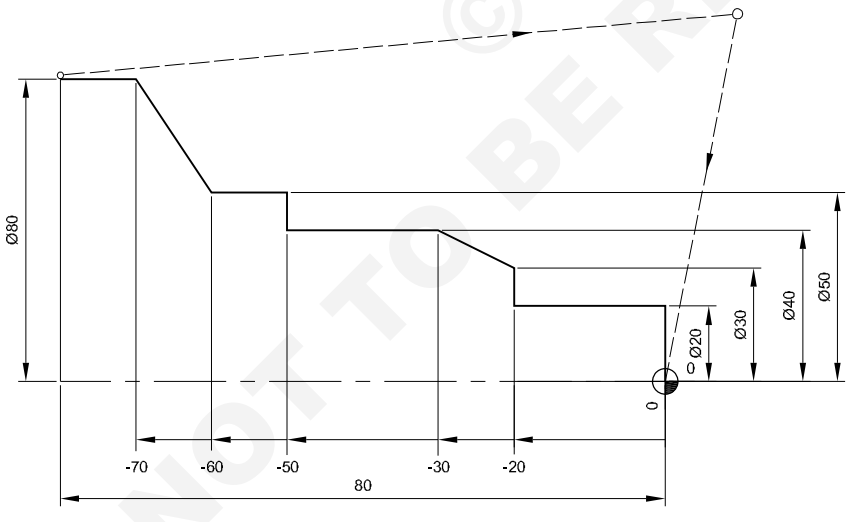
TD20N2287H6

TASK 7: **Write the tool path G00, G01 with 90. (Fig 7,8,9,10,11&12)**

1 Program dotted lines with G00 and continuous lines with G01

G90 is always the switch-on status and therefore, need not be programme

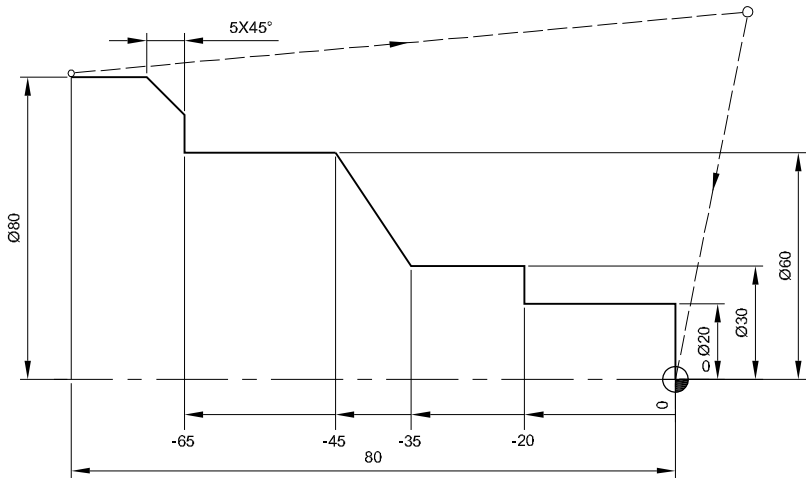
Fig 7



N	G	X	Z
N1	G0	X0	Z1
N2	G1		Z0
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12	G1	X82	
N13	G0	X120	Z10

TD20N2287H7

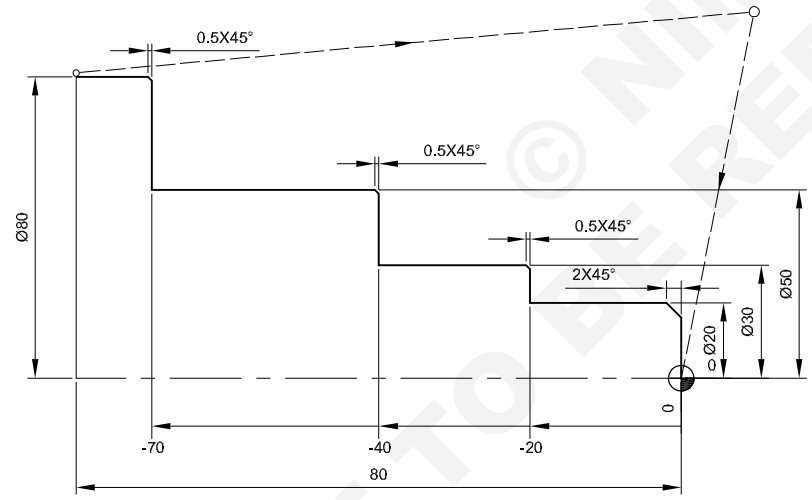
Fig 8



N	G	X	Z
N1			
N2			
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12			
N13			

TD20N2287H8

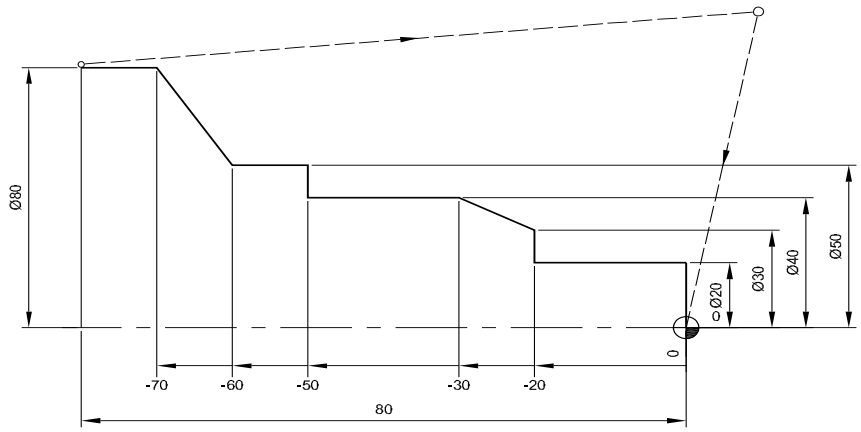
Fig 9



N	G	X	Z
N1			
N2			
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12			
N13			
N14			
N15			
N16			

TD20N2287H9

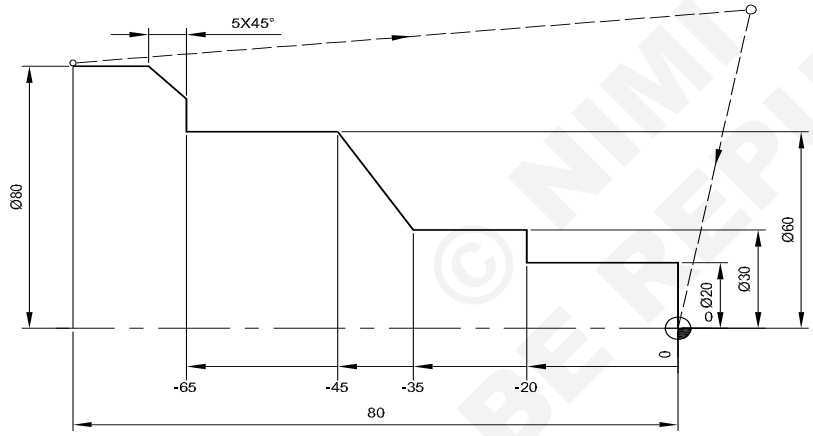
Fig 10



N	G	X	Z
N1	G91		
N2			
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12			
N13			
N14			
N15	G90		

TD20N2287HA

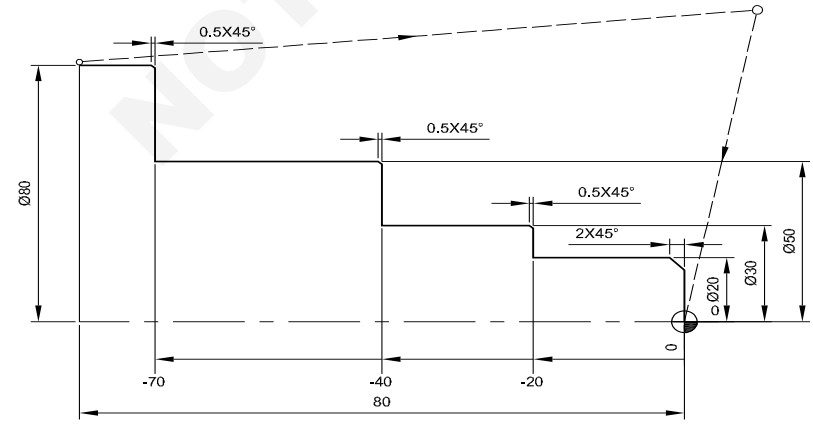
Fig 11



N	G	X	Z
N1			
N2			
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12			
N13			
N14			
N15	G90		

TD20N2287HB

Fig 12



N	G	X	Z
N1			
N2			
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12			
N13			
N14			
N15			
N16			
N17			
N18	G90		

TD20N2287HC

Skill Sequence

Simulator

Objective: This shall help you to

- **verify the manually written tool path in G90 & G91 modes.**

Creating new file

Invoke the CNC simulator

Select the menu with G code verify.

Select the option create new programme.

Select option main programme.

Enter the 'G' codes as per the programme.

After entering press verify.

If the screen will show that tool bath.

If there in any error it will indicator the line number and the type of error.

Note: The instructor shall demo on how to use the CNC simulator whichis available in your ITI.

Geometry programs

NC programs contain geometric commands (move to target point) and technological commands (e.g rotational speed). In this chapter you will familiarise yourself with the geomatric basics and learn how to create geometry programs according to DIN 66025.

Geometric basics

The geometric in CNC technology include coordinate systems, absolute dimensioning (G90) and incremental dimensioning (G91). furthemore the linear path conditions (G0/G1) and the circular path conditions (G2/G3).

The ability to allocate the correct coordinate values to points in the drawing is the important basis to operate CNC technology.

Machine zero point and workpiece zero point

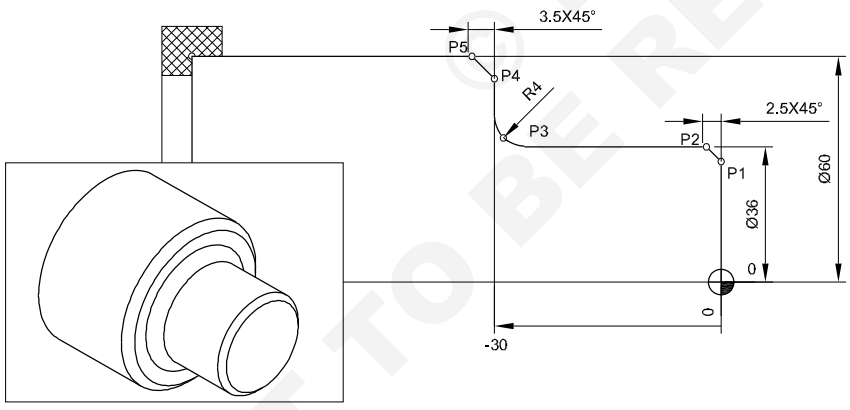
The machine zero point was defined by the manufacturer and cannot be changed . It resides in the origin of the machine coordinate system. Symbol for the machine zero point (MZP).

The workpiece zero point in the origin of the workpiece coordinate system. It can be freely selected.

Symbol for the workpiece zero point (WZP).

The workpiece zero point should be the point to which most of the dimension refer. The workpiece zero point is mostly located on the plane surface. The value X is always the diameter with G90.

Fig 1

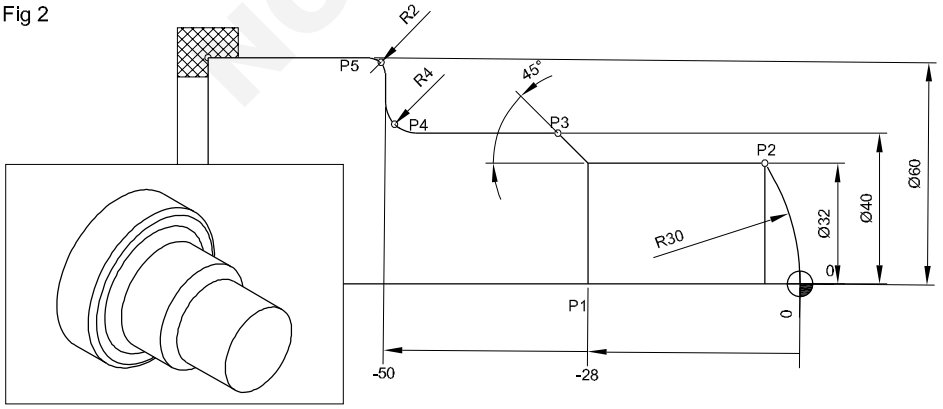


ENTER THE VALUES (the values X is always the diameter with G90)

	X axis	Z axis
P1		
P2		
P3		
P4		
P5		

TD20N2287J1

Fig 2



ENTER THE VALUES:

	X axis	Z axis
P1		
P2		
P3		
P4		
P5		

TD20N2287J2

Paths with G0/G1

Absolute dimensions G90 (reference dimensions).

The individual points in a coordinate system were explained in the previous chapter. There, the values always referred to the workpiece zero point.

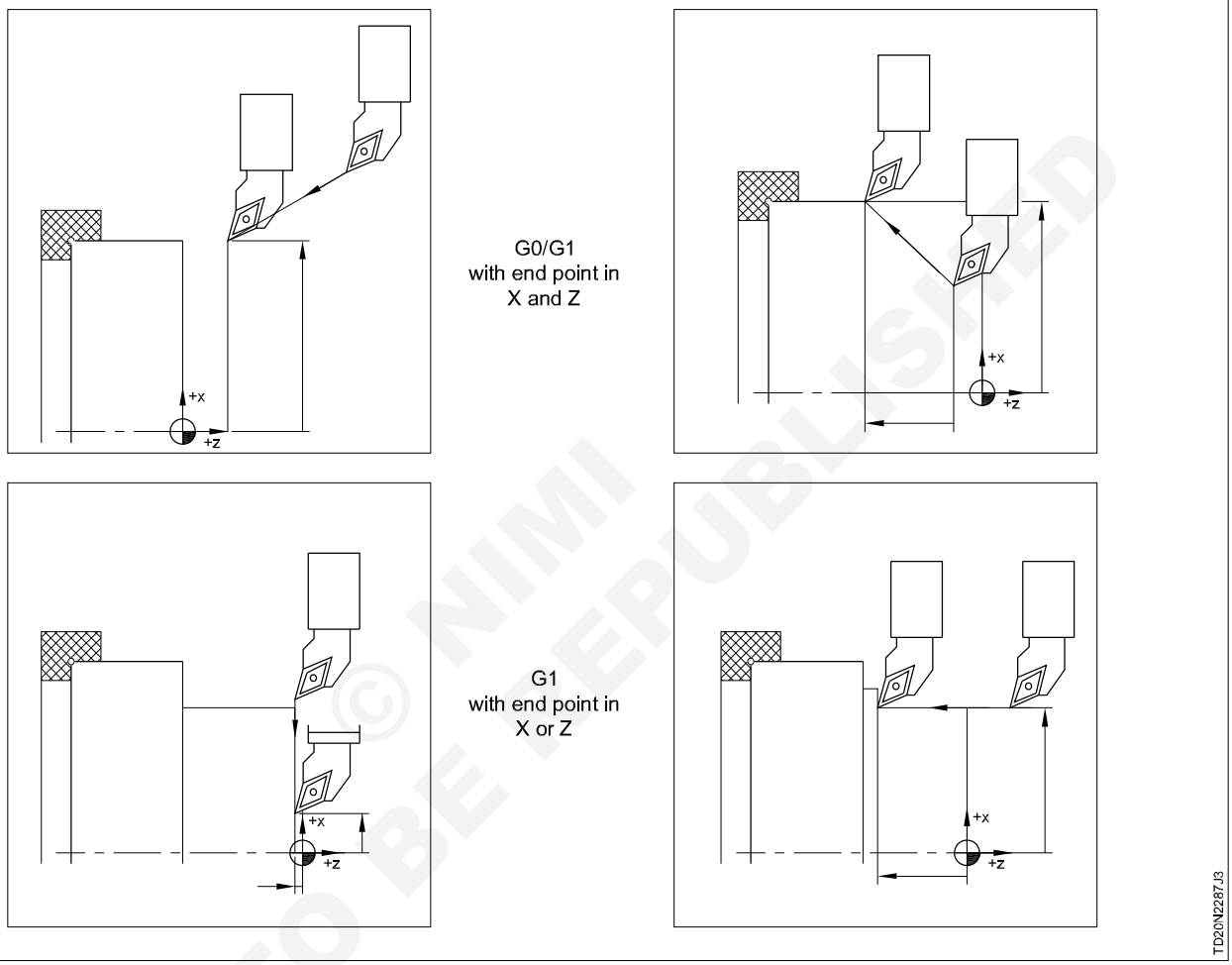
In CNC technology, the abbreviation G90 is used when refer to the WZP. The end point to which the tool is to move, is indicated with reference to this tool zero point.

A 'G' function decides how to move to the points.

When moving on a straight line, a differentiation is made between G0 = rapid traverse and G1 = feed.

Enter the addresses X and Z including their prefixes, then check your entries on the baiss of the information picture in Fig 3.

Fig 3



Tick

With G90 the current position (actual position) - is taken into account ☐

- not taken into account ☐

Advantages of the absolute the dimensions:

Following an interruption, the program can be continued at any desired point

Tracking of the interruption, the program steps is notably simpler, because the absolute coordinates show the current tool position.

An incorrect dimension entered once will not lead to consequential errors.

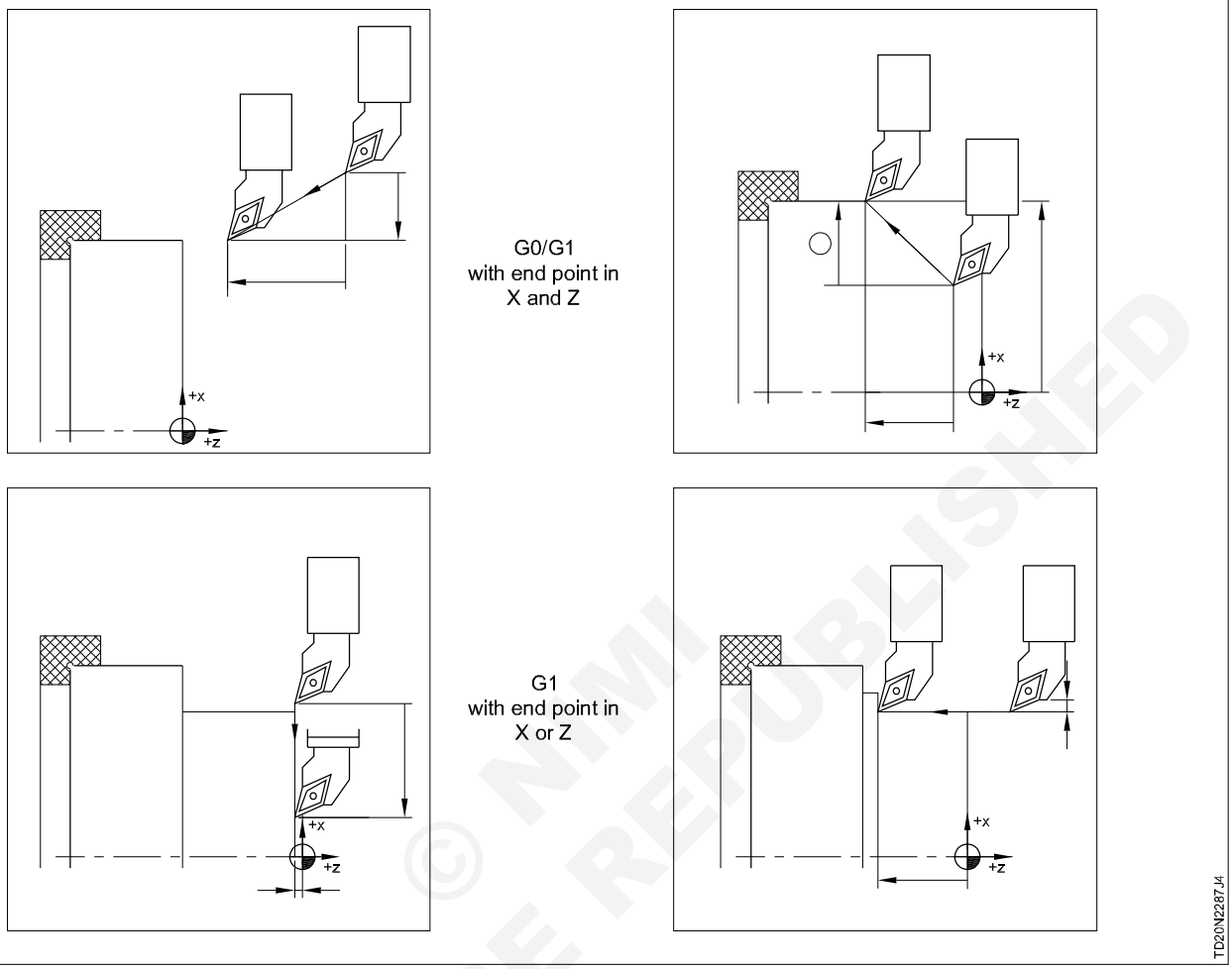
Tolerances will not cumulate.

Incremental dimensions G91 (string dimensions).

If in CNC technology the end point to be moved to is indicated with reference to the current tool position, the path condition G91 is valid (the tool moves BY...).

Enter the addresses X and Z including their prefixes, then check your entries on the basis of the information picture in Fig 4.

Fig 4



Tick

With-G91 the-current position (actual position)
- is taken into account ☐
- is not taken into account ☐

With G91, the entry X0 / Z0 can
- never result in a movement ☐
- possibly result in a movement ☐

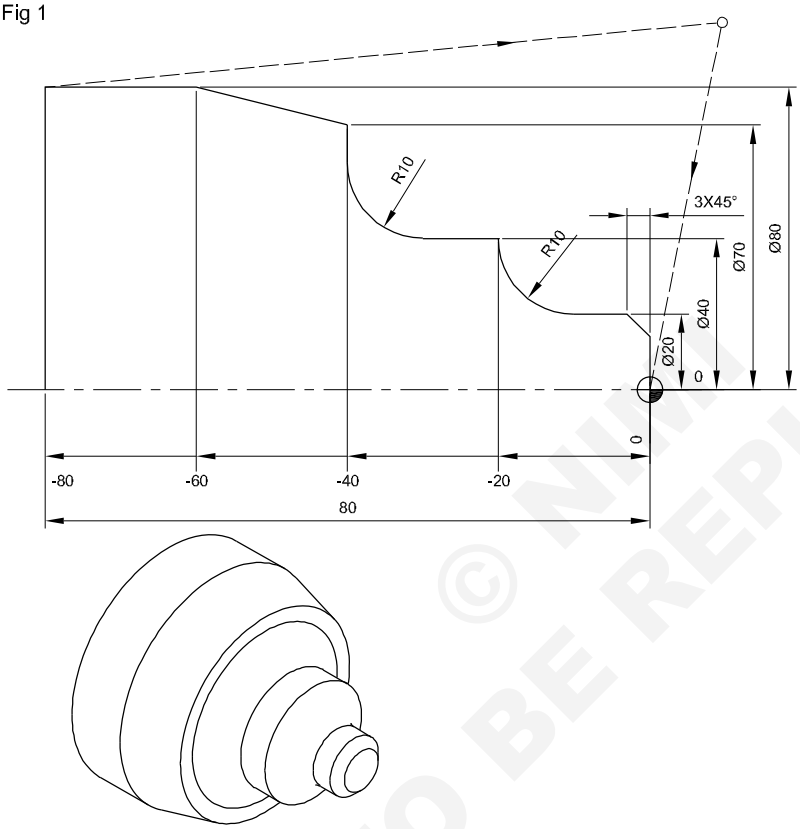
Coordinate point assignment and simulation, identification of machine over travel limit and emergency stop

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

- **write programme with G01, G02 and G03 in absolute and incremental coordinate system**
- **check the programme with simulator**
- **identification of machine over travel limit**
- **identification of emergency stop push button.**

TASK 1: **Programme with G2/G3 with G90 (Fig 1)**

Fig 1



N	G	X	Z	I	K
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					

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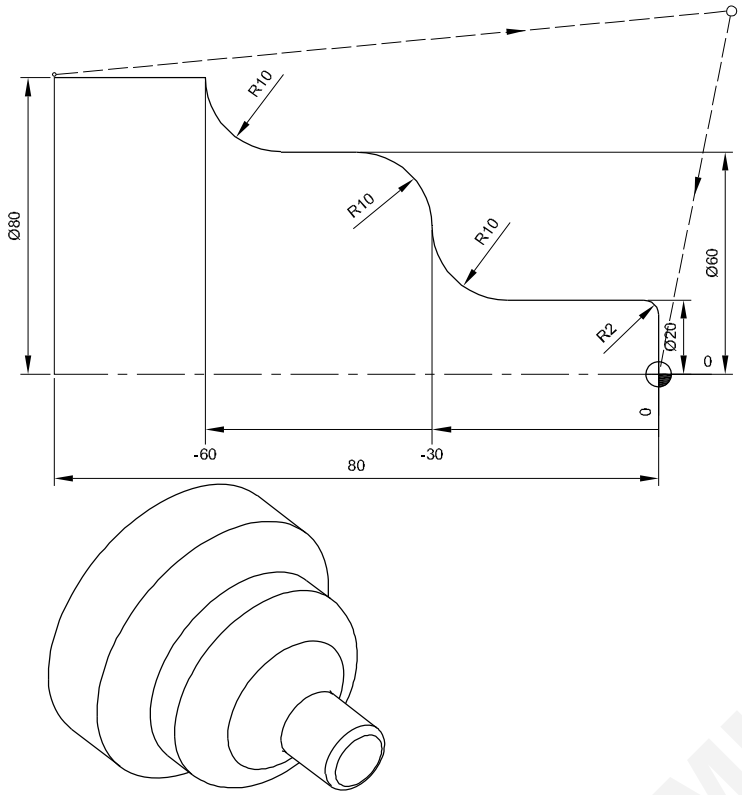
TASK 2: **Check the programme with simulator**

Fig 2

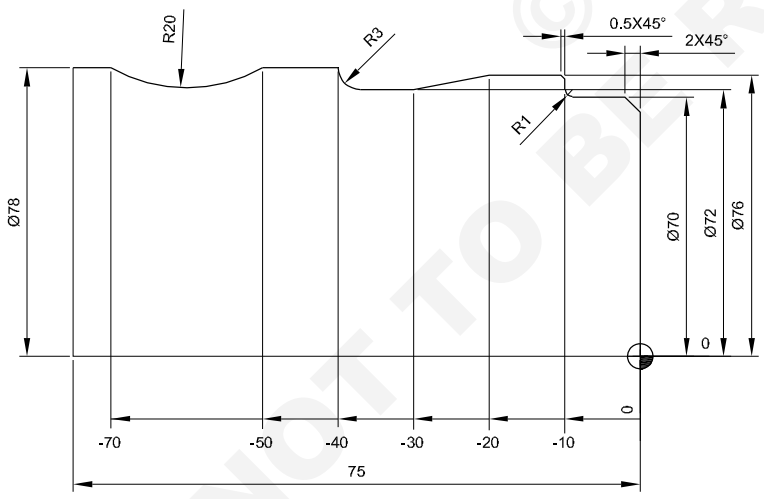


N	G	X	Z	I	K
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					

TD20N2288H2

TASK 3: **Complete the geomatry program**

Fig 3

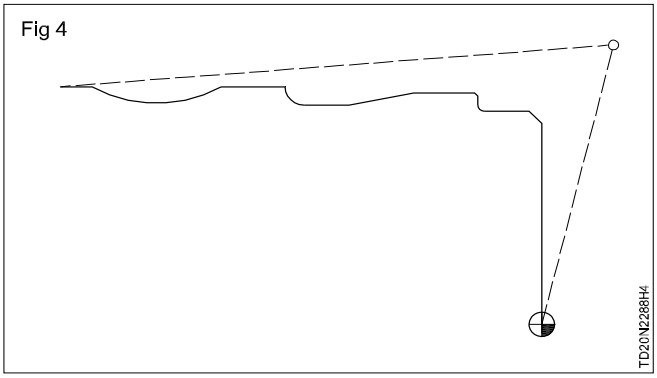


N	G	X	Z	I	K
N1	G0	X82*	Z0		
N2	G1	X0			
N3	G1		Z1		
N4	G0	X64			
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					
N14					
N15					
N16					
N17					
N18	G0	X120	Z10		

TD20N2288H3

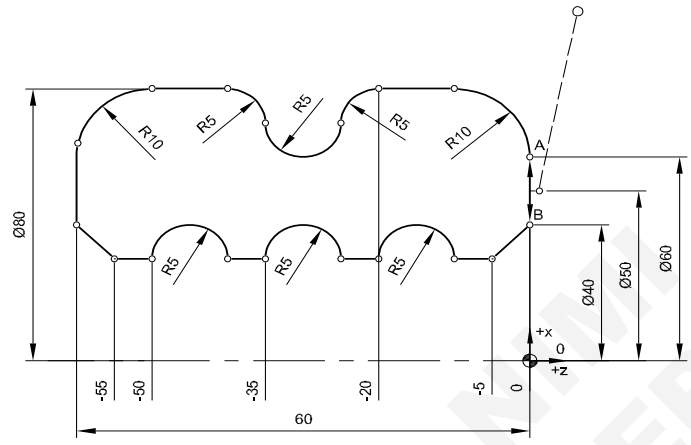
- Because a raw part (80) is later machined (Fig 4).

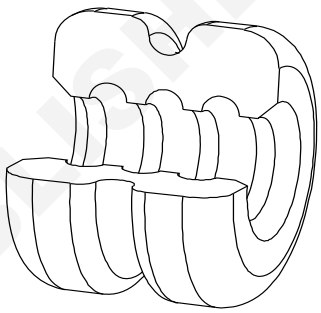
Fig 4



TASK 4: **(Direction A) and exercise 16 (direction B)**

Fig 5





(A)

N	G	X	Z	I	K
N1	G0	X50	Z1		
N2	G1		Z0		
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					
N14					
N15					
N16					
N17					
N18					
N19					
N20					
N21					
N22	G1		Z1		
N23	G0	X120	Z10		

(B)

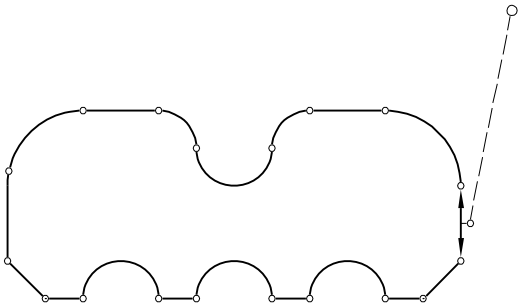
N	G	X	Z	I	K
N1	G0	X50	Z1		
N2	G1		Z0		
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					
N14					
N15					
N16					
N17					
N18					
N19					
N20					
N21					
N22	G1		Z1		
N23	G0	X120	Z10		

TD20N2288H5

TASK 5: **Complete the geometry program (Fig 6)**

First of all, programme the geometry on paper. Then check while entering.

Fig 6



(A)

N	G	X	Z	I	K
N1					
N2					
N3	G91				
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					
N14					
N15					
N16					
N17					
N18					
N19					
N20					
N21					
N22					
N23	G90				
N24					
N25					

(B)

N	G	X	Z	I	K
N1					
N2					
N3	G91				
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					
N14					
N15					
N16					
N17					
N18					
N19					
N20					
N21					
N22					
N23	G90				
N24					
N25					

TD20N2288H6

Job Sequence

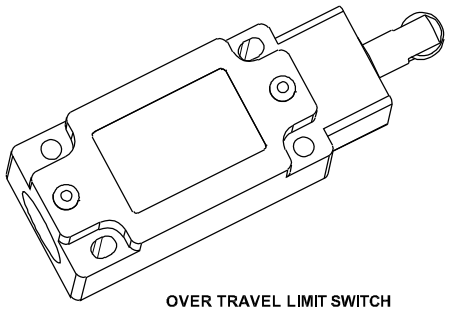
- Study the job drawing
- Fix the work zero point
- Plot the points on the profile
- Write tool path with G00,G01
- Entry the tool path on the simulator
- Verify the tool path by simulating on the simulator
- Similarly write the tool path G02, G03 and verify it in simulator.

TASK 6: **Identification of machine over travel limits**

There are two types of over travel limit

- **Software over travel**
- **Hardware over travel**
- Software over travel can be controlled by the specific parameter.
- **Hardware over travel limit is controlled by limit switch open the machine axis safe cover**
- In axis limit end there will be a fixed limit switch.
- One taper dog fixed on movabble axis frame.
- If the dog pressed the fixed limit switch, over travel alarm appear on the screen.
- Fig 7 shows the over travel limit switch.

Fig 7



OVER TRAVEL LIMIT SWITCH

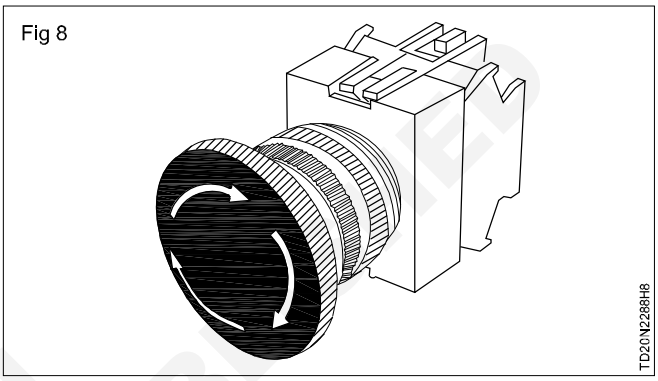
TD20N2288H7

- **Emergency stop push button**

  Emergency stop buttons are designed in such a manner in which their role is more physical, such as interrupting a power supply to the machine control system. It is a basic big red pushbuttons fixed on Machine control panel.

Emergency stop pushbutton that has mechanical plastic or metal tabs and grooves internally such that when you push it (interrupting the circuit), it is held in that position untill you twist it. They are designed to be large, hard to miss, and easy to push, sample is given in Figure 8.

Fig 8

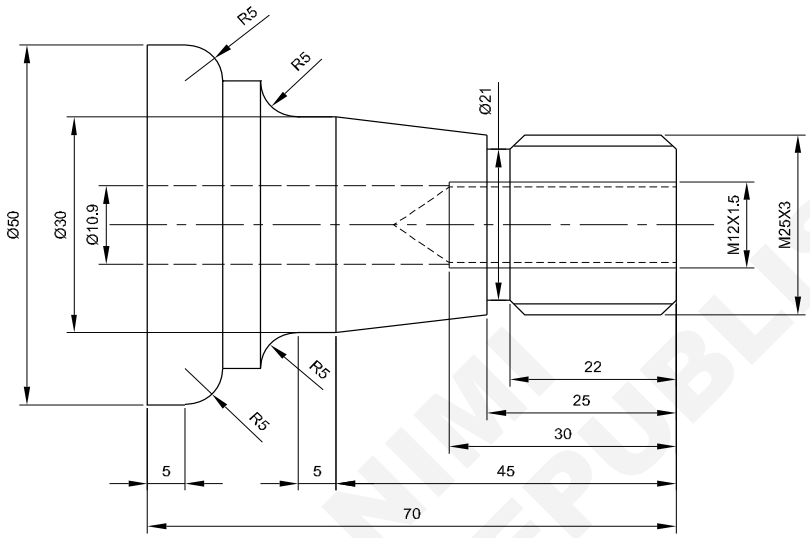


TD20N2288H8

Work and tool setting, auto mode operation

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

- **set the workpiece in CNC lathe**
- **measure work offset and enter in work offset area**
- **measure tools offset and enter on tool offset page**
- **write the CNC programme and enter on machine**
- **verify the programme by simulation**
- **run the programme in auto mode & check the dimensions.**



1	Ø55X80	-	ALUMINIUM	-	-	2.2.89
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**WORK AND TOOL SETTING, AUTO MODE OPERATION**				DEVIATIONS ± 0.02 mm	TIME 8hrs
					CODE NO. TD20N2289E1	

Job Sequence

- Check the raw material size and confirm with the part drawing
- Hold the job on chuck by projecting 40mm length in turning
- Enter the part programme in CNC machine (or) transfer the programme by simulator to CNC machine
- Set the tool to required turret station
- Set the tools in turret by positioning the tool holders such that the turret is in balanced manner
- Measure work offset in X and Z direction and enter in work offset page say G54/G55
- Measure the tool offset for all tools in X and Z direction and enter in tool geometry offset page
- Enter the tool type and tool nose radius
- Check the work offset and tool offset

If there is any misstate, correct the programme ask your instructor for guidance.

- Run the programme in single block by setting the offset away form the work zero.

Observe the spindle direction speed tool position carefully.

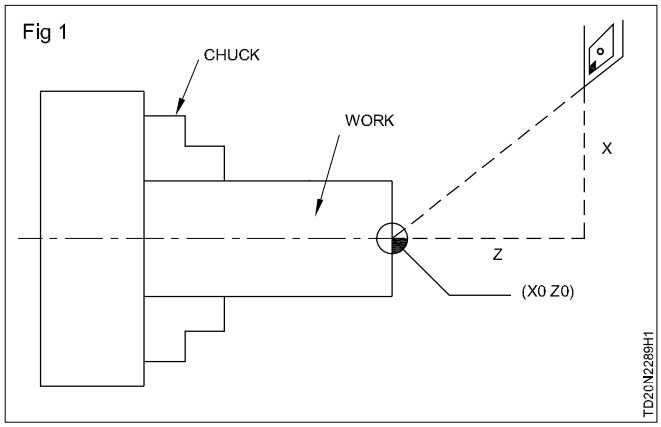
- Run the programme in auto mode in original work offset
- Check the dimension. If there is any correction change the wear offset and run the programme
- Check the dimension and surface finish
- Remove the job from the machine, check all the dimension once again
- Switch off the machine.

Skill Sequence

Work off set measurement

Objective: This shall help you to
- **measure work off set and enter in off set page.**

Work off set measurement (Fig 1)



Ensure the work secured firmly in chuck

Index the tool in MDI mode with tool offset cancel and set tool offset X0,Z0, and tool type

Switch 'ON' spindle

Carry out slight facing of the job

After the finish cut move the tool back in X direction only

Now switch off spindle

Go to Tool off set mode

Press GEOM soft key and position the cursor using cursor movement button and select the offset number G54

Enter the Z-axis valveZ0.0

Press soft key

Now rotate the spindle in appropriate direction and machine the outside diameter ('OD')

Do not disturb X-axis

Take tool away in Z-direction only

Stop the spindle

Measure the outer diameter of the job using micrometer

Go to OFFSET soft key

Press GEOM soft key

Position the cursor to the required work offset number and enter the measured value. (eg: X32.62)

Press soft key

Note: The tool used for measuring work off set the tool offset is zero in X and Z direction

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

Objectives : This shall help you to
- **measure the tool offset in x direction and enter in the tool offset.**
- **measure the tool offset in z direction and enter in the tool offset page.**

FANUC control

Tool offset method (Fig 1).

X axis tool offset method

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

Clamp job in chuck.

Select MDI mode. Press in MDI prog-screen.

Enter tool number: T0200 (Turning tool).

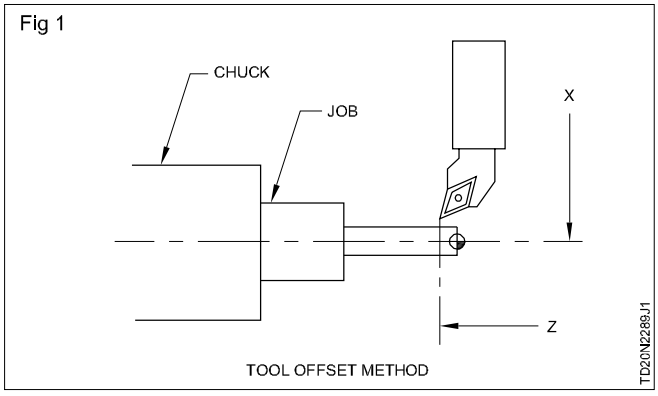
Insert button ® Press ® Cycle start button ® Press

Tool cutting edge position with spindle ON CW or CCW in MDI mode.

Enter MO3 SI500 ® Reset button press ® Cycle start button.

To select jog mode or MPG mode to move x and z axis.

Touch the job in x axis just clean OD turning to ensure no disturbance in x axis. (Fig 1)



Then stop spindle button.

Measure job OD diameter, use vernier (or) micrometer. Example X28.62 mm.

Select Offset button ® Press ® displayed in geometry mode.

Using cursor in geomentry screen select Tool no : 2 x axis select.

Enter job diameter

Ex: x28.62 ® Measure button ® Press in soft key

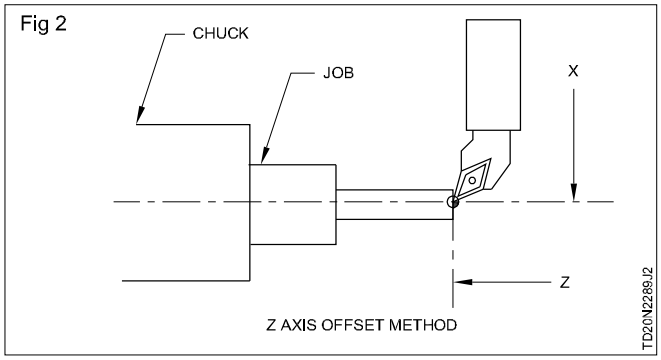
Now tool cutting edge in job centre is OK.

Tool offset in X axis is saved

Z axis offset method

Spindle ON rotate the job.

Select jog mode or MPG mode to move axis. Manually turning job facing position no disturbance Z axis. (Fig 2).



Select offset button press in geomentry mode.

Use cursor select tool no 2 and z axis.

Enter Z0.

Enter Z0 ® Measure ® Press in soft key

Now z axis tool offset OK.

Tool offset is Z axis is saved

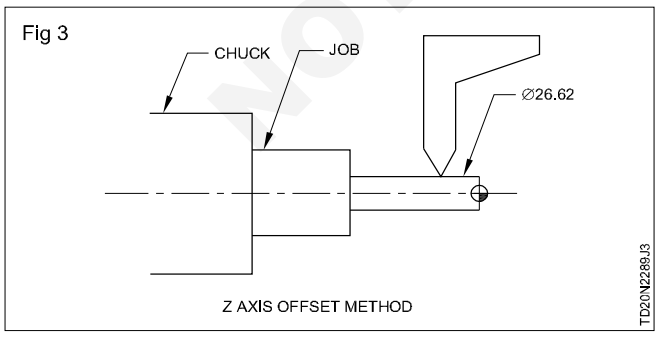
Second tool offset

Select MDI mode ® Press ® MDI Prog ® Screen.

Enter tool no (Threading tool) T0300 ® Reset button ® Press ® Cycle start.

Select jog mode or MPG mode then move axis.

Same procedure MPG mode incremental touch job in x axis with piece of paper Do not distrub X axis (Fig 3).



Select offset button press in geomentry mode.

Use cursor to select tool no 3 and x axis.

Enter constant same dia.

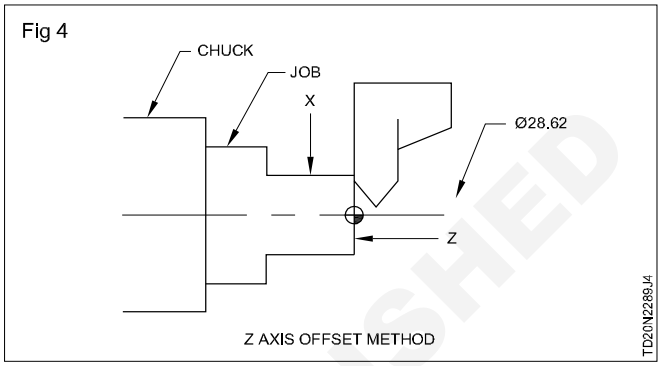
Ex: x28.62 ® Measure button ® Press in soft key

Threading tool offset measurement

Z axis offset

Select MPG mode in incremental variation. To move axis z position.

To check by inserting a piece of paper between tool and the job ensuring that there is no disturbance in Z axis (Fig 4).



Select offset button ® Press in geomentry mode.

To use cursor select tool no 3 and z axis.

Enter Z0.

Ex : Z0 ® Measure ® Press in soft key

Now second tool z axis offset saved.

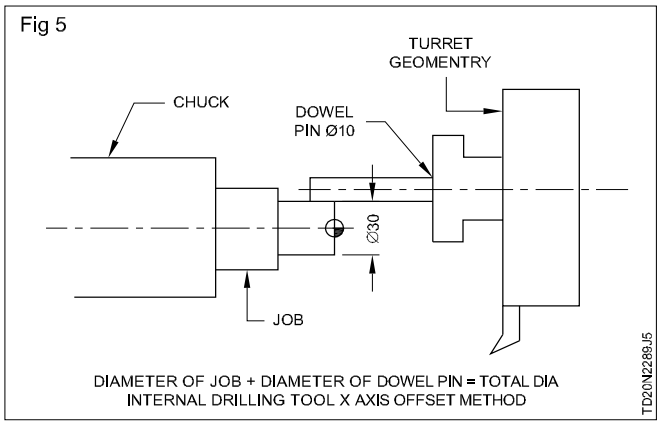
Internal drilling tool x axis offset method

Fix the turned job in chuck

Select MDI mode press ® Enter tool no T0400 ® Cycle start.

Select jog or MPG mode to move axis on the job of top side.

Check with piece of paper whether contact of dowel pin with the job is proper. (Fig 5)



Select offset screen in geomentry mode.

Use cursor to select x mode and tool number.

Enter dia.

Ex : Job dia + Dowel pin dia = Total dia

30 + 10 = 40

Enter dia x40 ® Measure button ® Press in soft key

Drill cutting point in job centre point.

Then fix the drill.

Touch the job face a piece of paper whether contact of drill with the job in proper.

Enter Z0 ® Measure ® Press in soft key

Drilling tool off set is saved

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

Program Entry in C.N.C Lathe

Objective : This shall help you to

- **enter the programme in FANUC control.**

Write the programme for the given job drawing and enter the programme in fanue control

Fanuc Control

Go to JOG Mode

↓

Press Part Program

↓

Press edit

↓

Enter % and new program number of Job

↓

Press Select Program

↓

(Blank space open for entry of program)

↓

Write program using numerical key and edit key

03001 (Facing and Turning)

N5 G90 G55, G95;

N10 T0505 M04 S500;

N15 G00 X 56.00 Z0.0;

N20 G01 X 0.1 Z0.0 F0.1;

N25 G0 X-0.1 Z5.0;

N30 G00 X 52.0 Z5.00;

N35 G01 X 52.0 Z-70.0;

N40 G01 X 56.0 Z-70.0;

N45 G28 G91 G00 X 0.0 Z0.0 T0500 M05;

N50 G90;

N55 M30;

3002 (Profile Turning)

N1 G90 G55 G95;

N2 T0T07 M04 S1000;

N3 G00 X 60.00 Z5.00;

M4 G71 U0.5 R 2.0;

M5 G74 P6 Q15 U0.100 W0.100 F0.15 S1000;

M6 G01 X 21.0 Z0.0;

M7 G01 X 25.0 Z-2.0;

M8 G01 X 25.0 Z-25.0;

M9 G01 X 30.0 Z-45.0;

M10 G01 X 30.0 Z-50.0;

M11 G02 X 40.0 Z-55 I-5 K0.0;

M12 G01 X 40.0 Z-60;

M13 G03 X 50.00 Z-65 I5 K0.0;

M14 G01 X 50.00 Z-70.0;

M15 G01 X 55.00 Z-70.0;

M16 G70 P 6Q15;

M17 G00 G28 G91 x 0.0Z0.0 M05,

M18 M30;

03003 (Grooving)

N1 G55 G90 G95;

M2 T0303 S700 M04: (Grooving tool width 3mm);

M3 G00 x 35.00 Z-25.0;

M4 G01 x 21.00 Z-25.0 F0.1 M08;

M5 G04 x 4.0;

M6 G00 x 35.00 x Z-25.0 M05 M09;

M7 G28 G91, G00 x 0.0 Z0.00 T0300;

M8 G90;

M9 M30;

O3004 (Straight threading)

M1 G55 G90 G95;

M2 T0404 S400 M03 (Threading tool 60°);

M3 G00 x 30.0 Z5.0 M08;

M4 G76 P020060 Q200 R100;

M5 G76 X 21316 Z:23000 P1842 Q100 R000 F3.0;

M6 G28 U0 W0 T0400;

M7 G90 M09;

M8 M30;

O3005 (Centre drilling)

N1 G55 G90 G95;

N2 T0606;

N3 S700 M03;

N4 G0 X 0.0 Z5.00 M08;

N5 G01 X 0.0 Z-2.00;

N6 G00 X 0.0 Z5.00 M05 M09;

N7 G28 U0W0 T0600;

N8 G90;

N9 M30;

O3006 (Drilling)

N1 G55 G90 G95;

N2 T0202;

N3 G00 X 0.0 Z50.0 S300 M03 M08;

N4 G74 R;

N5 G74 Z-T5.00 Q1000 F0.1;

N6 G00 Z 10.00 M05 M09;

N7 G28 G91 x 0.0Z0.0 T0200;

N8 G90 G80;

N9 M30;

O 3007 (Tapping M12 x 15)

M1 G55 G90 G95;

M2 T0606;

M3 G00 X 0.0 Z20.0 S200 M03 M08;

M4 G84 X 00 Z.30.0 R5.0 P00 F1.5;

M5 G00 X 0.0 Z 10.00 M05 M09;

M6 G28 G91 x 0.0 Z0.00 T0600;

M7 G80;

M8 M30;

Job Sequence

Auto mode operation

- Press the MEMORY mode selection switch
- Select a program from the registered programs. To do this, follow the steps below
- Press “prog” to display the program screen
- Press address “O”
- Enter the program number using the numeric keys
- Press “O SRH soft key
- Press the cycle start key switch on the machine control pane. Automatic operation starts and the cycle start LED goes on. When automatic terminates, the cycle start led goes off

To stop or cancel memory operation

press the feed hold switch on the machine operator’s panel. The feed hold LED goes off. The machine responds as follows. When the machine was moving, feed operation decelerates and stops.

When dwell was being performed, dwell is stopped. When M,S or T was being executed, the operation is stopped after M,S or T is finished.

When the cycle start switch on the machine operators panel is pressed while the feed hold LED is on the machine operation starts.

Terminating memory operation

Press the “reset” key on the MDI panel. Automatic operation is terminated and the reset state is entered. When a reset is applied during movement, movement decelerates then stops

Study of CNC machining centre

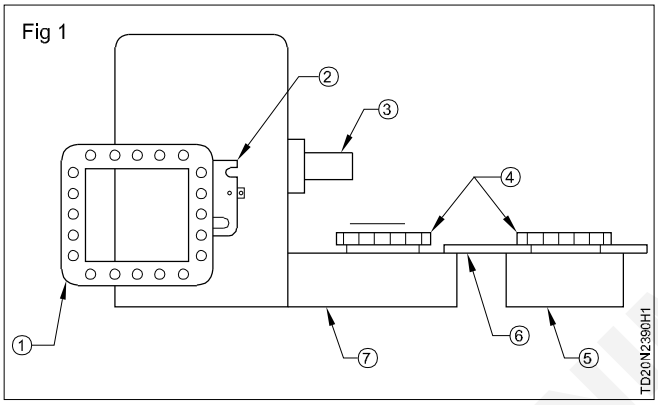
Objectives: At the end of this exercise you shall be able to
- **identify the CNC machining centre**
- **name the parts of machining centre**
- **familiarise the machine control panel key board**
- **familiarise the system control key board**
- **specify the CNC machining centres.**

Job Sequence

TASK 1: **Observe and name the machine (Fig 1)**

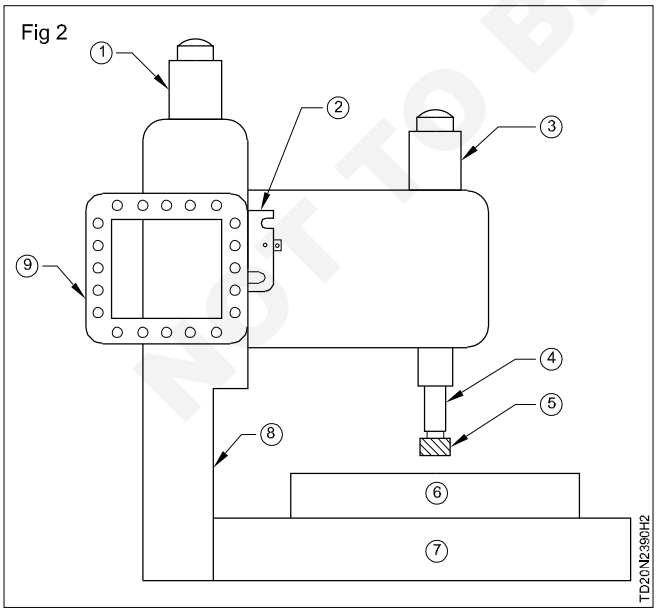
- Identify the parts of the machine and record it.

Fig 1



TASK 2: **Observe and name the machine and record it (Fig 2)**

Fig 2



TASK 3: **Identify the machine control key board and familarise the functions of each keys in the machine control panel**

Fig 3

TDN23106H3

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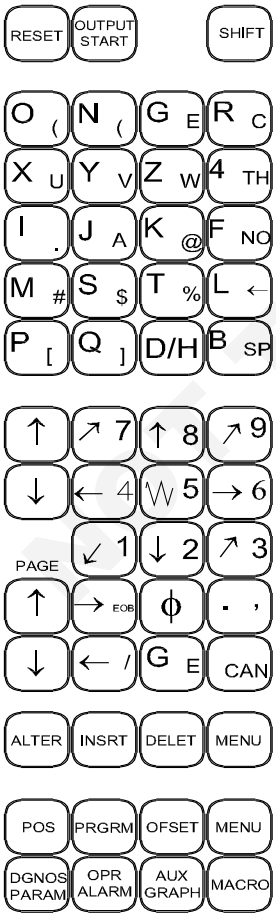
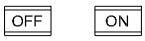
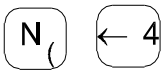
TASK 4: **Observe the system control panel and familiarise the functions of each keys**

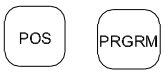
Fig 4



TD20N2390H4

Explanation of the Keyboard

Number	Name	Explanation
1	Power ON and OFF buttons 	Press these buttons to lurn CNC power ON and OFF.
2	RESET key 	Press this key to reset the CNC to cancel an alarm etc.
3	START key 	This key is used to start MDI operation or automatic operation, depending on the machine. Refer to the manual provided by the machine tool builder. This key is also used to output data to an input/output device.
4	Soft keys (option)	The soft keys have various functions, according to the applications. The soft key functions are displayed at the bottom of the CRT screen. Soft key of left edge  Return menu key Soft key of right edge  Continuous menu key
5	Address and numeric keys 	Press these keys to input alphabetic, Numeric and other characters.
6	SHIFT key 	Some keys have two characters on their keytop. Pressing the <SHIFT> key switches the characters. Special character ^ is displayed on the screen when a character indicated at the bottom right coner on the keytop can be entered.
7	INPUT key 	When an address or a numerical key is pressed the data is input to the buffer and it is displayed on the CRT screen. To copy the data in the key input buffer to the offset reglator, etc., process the key  This key is also used to input data from an input/output device.
8	Cancel key 	Press this key to delete the input data or the last character in the key input buffer.
9	Program edit keys 	Press these keys when editing the program. : Alteration  : Insertion  : Deletion 

10	Function keys 	Press these keys to switch display screens for each function.
11	Cursor move keys 	There are two different cursor move keys  : This key is used to move the cursor in an upward or reverse direction.  : This key is used to move the cursor in a downward or forward direction.
12	Page change keys 	Two kinds of page change keys are available.  : This key is used to changeover the page on the CRT screen in the reverse direction.  : This key is used to changeover the page on the CRT screen in the forward direction.
13	MMC/CNC change key 	Selects whether the MMC screen or CNC screen is displaced on the CRT.

Machine specifications

A typical specification of a CNC vertical machining centre and CNC horizontal machining centre.

Description	Vertical machining centre	Horizontal machining centre
Number of axis	3 axes	4 axes
Number of tools	20	36
Table dimensions	780 x 400mm	500 x 500mm
Maximum travel -x axis	575mm	725mm
Maximum travel -y axis	380mm	560mm
Maximum travel -z axis	470mm	560mm
Spindle speed	60-8000rpm	40-4000rpm
Spindle taper	BT 40	BT 50
Power	7.0 kw	15.0 kw
Feed rate range	2-5000mm/min	1-5000mm/min
Rapid traverse rate	30 m/min (X,Y), 24 m/min (Z)	30 m/min (X,Y), 24 m/min (Z)
Maximum tool diameter	80mm	105mm
Maximum tool length	300mm	350mm
Maximum tool weight	6kg	10kg

Job Sequence

TASK 1: **Identify the parts of the machine and record it**

- Identify the parts of horizontal machining centre
- list out the names of the parts shown in Fig 1 in the given table 1

Get it checked by the instructor

Instructor shall demonstrate the parts of horizontal machining centre.

Table 1

S.No.	Name of the elements of the horizontal machining centre
1	
2	
3	
4	
5	
6	
7	

— — — — — — —

TASK 2 : **Identify the parts of the machine and record it**

- Identify the parts of CNC vertical machining centre
- List out the name of the parts shown in figure 2 and record it in table 2.

Get it checked by the instructor

Instructor shall demonstrate the parts of CNC vertical machining centre.

Table 2

S.No.	Name of the parts of different element of CNC vertical machining centre
1	
2	
3	
4	
5	
6	
7	
8	
9	

— — — — — — —

TASK 3 : **Identify the machine control key board and familarise the functions of each keys in the machine control panel**

The instructor shall demonstrate all the keys and its function.

- Identify the numerical keys and practice on it.
- Identify the address keys and practice by inputting some data.
- Use functional keys and practice on it.
- Use editing keys and practice on editing.
- Practice on soft keys with soft key menu.
- Press the power on button on the machine.
- Release the emergency button.
- Switch ON the control panel.
- Do the referencing operation.

— — — — — — —

TASK 4 : **Observe the system control panel and familiarise the functions of each keys**

The instructor shall demonstrate all the keys on the system control panel.

- Trainee will make a note of it and familiarise all the keys and its functions

— — — — — — —

TASK 5 : **Interpret the machine specification**

- Read the given CNC machine specification and compare with your machine.

— — — — — — —

Machine starting, referencing and manual mode operations

Objectives: At the end of this exercise you shall be able to
- **start the CNC machining centre**
- **reference the machine axes**
- **operate in jog mode**
- **operate in incremental and MDI modes.**

Job Sequence

TASK 1**: Starting the CNC machining centre**

- Switch on the stabilizer main switch
- Make sure the stabilizer is in servo mode
- Check the stabilizer output voltage is in between 400-430v
- Switch on machine main switch
- Switch on control panel switch, machine computer screen will start working
- The axis display and other details appears and emergency indication flickering on the screen
- Realise the emergency push button and reset the machine
- Now the machine is ready for referencing.

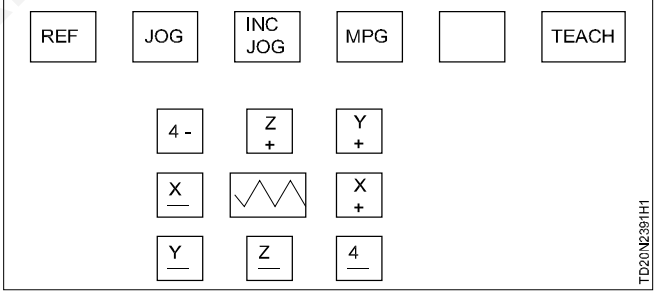
TASK 2: **Reference position return**

- Start the machine
- Go to jog mode by pressing jog switch
- Move all the axis towards the centre of the machine table by selecting appropriate axis switches
- Go to reference point return by pressing the "ref switch. (Fig 1)
- Press the "X +" "Y+" "Z+ and "C+" switches. All the axes are referred to reference point level and the reference position return completion LED will glow
- Now the display shows the following position X=0.000 Y=450.00 Z = 420.00

Display and steps may varey machine to machine

- The reference position may be reached by giving the following command by selecting the MDI mode in between the operation after first time reaching the reference point position GO G91 G28 XO YO ZO BO.

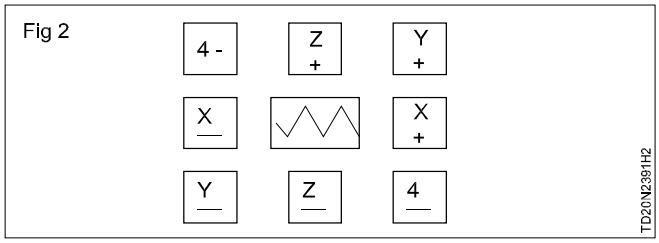
Fig 1



TASK 3: **Jog mode operation**

- Press the "Jog" switch in the keyboard
- Keep the feed over ride switch near to 50% position
- Press the appropriate axis with direction switch "continuously" until the desired movement is achieved. (Fig 2)
- To movement may be made rapid by simultaneously pressing the axis and rapid switch

Fig 2



A If the finger is released from the switch the movement is stopped immediately

B The feed rate may be increased or decreased as desired by changing the feed override switch position

The axis may be stopped at '0' position.

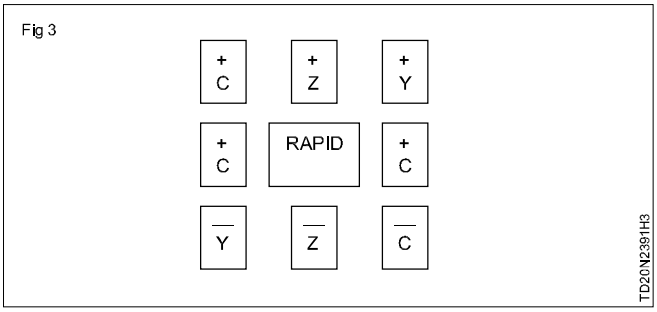
Feed rate may be increased or decreased depending upon.

TASK 4: **Incremental JOG / MPG mode**

- Press "Inc Jog" switch
- Press any one of the inc x1, inc 10, inc 100, inc 1000, inc 10000
- Press the axis switch (+) or (-) to move for the particular incremental feed (Fig 3).

  (or)
- Activate MPG (manual pulse generator) switch
- Press any one of the inc x1……x10.000 switch as desired
- Press the axis with direction + or
- Rotate the MPG knob. The movement Per division is equal to the selection of inc switch.

Fig 3



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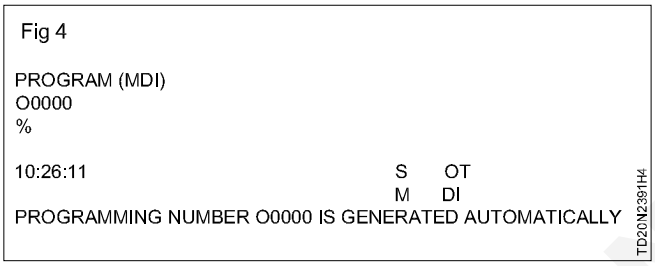
TASK 5: **MDI mode - operation**

- Press the MDI key.
- Press the ‘program’ key.

  The following screen appear (may varey machine to machine) (Fig 4)

Fig 4



- Prepare the program blocks with a block M 99 at the end to return to beginning the block.
- To erase the program created in MDI either press “Reset” key or enter address O0000 then press the “Delete” key in the MDI panel.
- Place curser in the first block and push cycle start key for executing position.
- To stop the operation press “Reset” key (or) rotate the “Feed holed” key to “0” position (or) press the emergency switch.

— — — — — — —

Co-ordinate systems points, assignmetns and simulation

Objectives: At the end of this exercise you shall be able to
- **plot the point in absolute co-ordinate system and check by simulator**
- **plot the point in incremental co-ordinate system and check by simulator**
- **write the programme using G0, G01, G02, G03 in absolute and incremental system**
- **check the programme using simulator.**

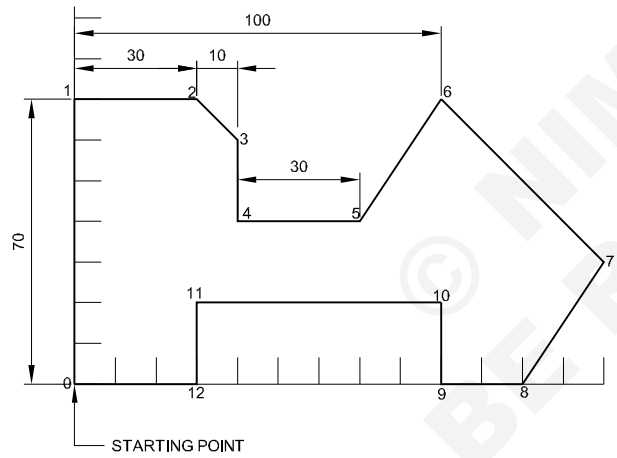
Job Sequence

- Read the given drawings and plot the points given in tasks.
- Record the axes points in tables
- Switch on the simulator, and select the machine as machining centre in selection made.
- Enter the points on the screen and select the simulation.
- Observe the ploted line based on the points entered.

Any change in profile will indicate the points are not correct.

TASK 1 : **Plot the points in absolute and incremental co-ordinate system (Fig 1) in table 1 and table 2 repectively**

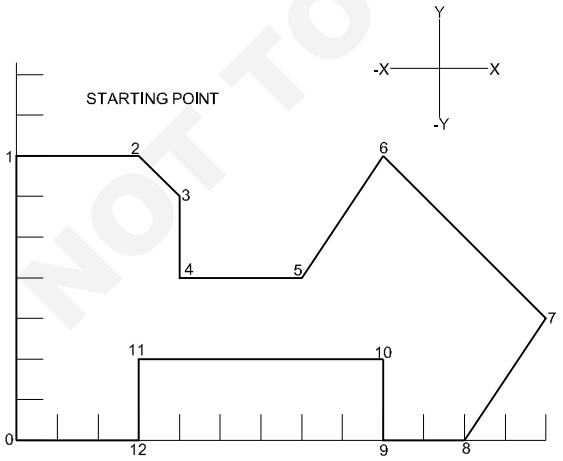
Fig 1



ABSOLUTE CO-ORDINATE

TABLE -1

S.NO	X	Y	S.NO	X	Y



INCREMENTAL CO-ORDINATE

TABLE -2

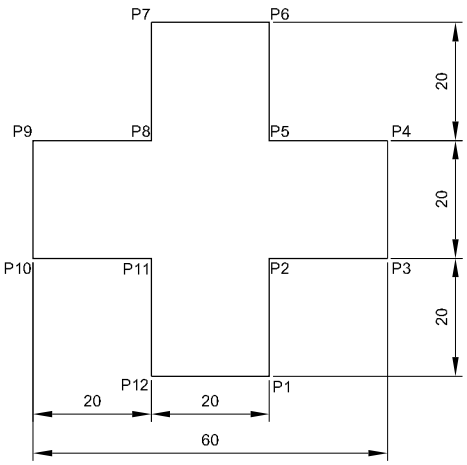
S.NO	X	Y	S.NO	X	Y

TD20N2392H1

TASK 2 : **Plot the points in absolute and incremental system for Fig 2 and record it in table 3 & 4, verify the recorded points in simulator**

- Study the drawing (Fig 2)
- Take the point P1 as origin
- For absolute co-ordinate system take P1 co-ordinates as (0,0)
- Tabulate the co-ordinate value of the point P1 to P12
- Co-ordinate value are taken with respect to the reference point (0,0) for absolute co-ordinate system.
- Take the reference point P1 as 0,0 for incremental co-ordinate system
- Take the co-ordinate value of P2 with respect to point P1
- Take the co-ordinate values of point P3, P4 etc, with reference to the previous point for incremental co-ordinate system.
- Tabulate the values in the respective table 3 & 4
- Check the correctness of the values by instructor.
- Plot the points in absolute and incremental system for fig 2 and record it in table 3 & 4.
- Verify the record record points in simulator.

Fig 2



ABSOLUTE CO-ORDINATE

TABLE - 3

POINTS		
P1		
P2		
P3		
P4		
P5		
P6		
P7		
P8		
P9		
P10		
P11		
P12		

INCREMENTAL CO-ORDINATE

TABLE - 4

POINTS		
P1		
P2		
P3		
P4		
P5		
P6		
P7		
P8		
P9		
P10		
P11		
P12		

DIMENSION ARE IN mm

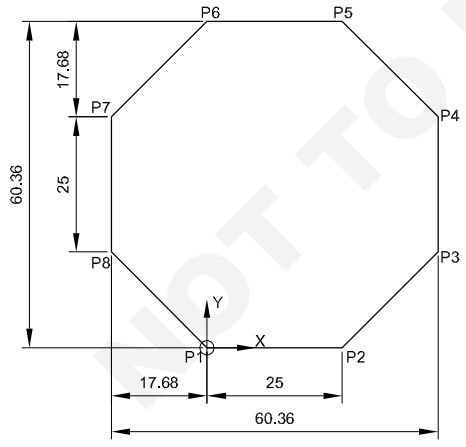
TD20N2392H2

— — — — — — —

TASK 3 **: Plot the points in absolute and incremental system for (Fig 3) record it in table 5 & 6.**

- Verifty with simulator.

Fig 3



ABSOLUTE CO-ORDINATE

TABLE - 5

POINTS		
P1		
P2		
P3		
P4		
P5		
P6		
P7		
P8		

INCREMENTAL CO-ORDINATE

TABLE - 6

POINTS		
P1		
P2		
P3		
P4		
P5		
P6		
P7		
P8		

DIMENSION ARE IN mm

TD20N2392H3

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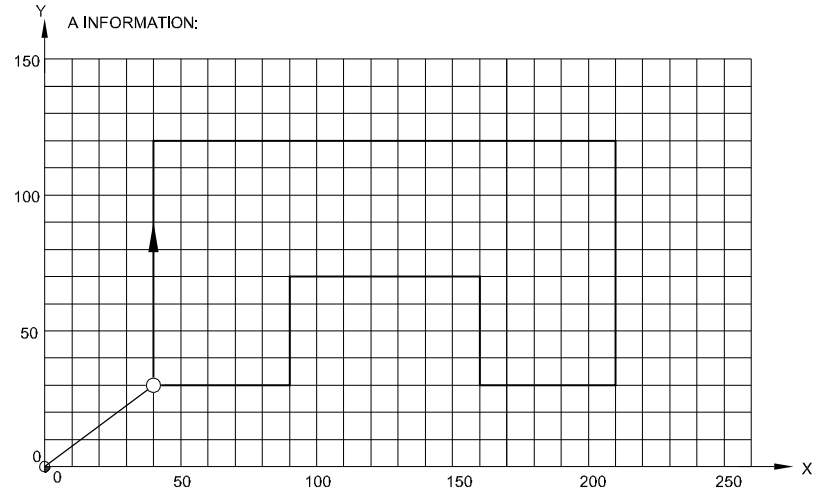
TASK 4: **Assignment in G90, G00 & G01 in absolute system and check the result with simulator**

- **A information:** study the programme and the contour.

Fig 4 (A)

A INFORMATION:



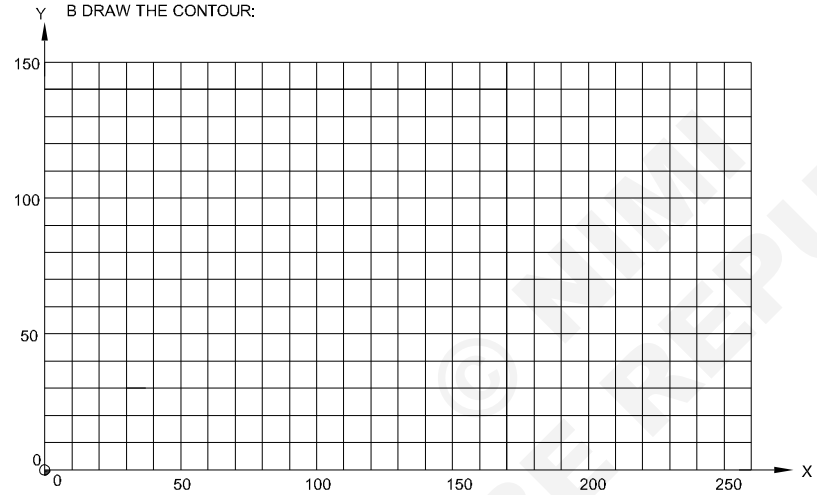
ABSOLUTE

G90 = ON - POSITION

N	1	G0	X40	Y30	Z0
N	2	G1			Z-5
N	3	G1		Y120	
N	4	G1	X210		
N	5	G1		Y30	
N	6	G1	X160		
N	7	G1		Y70	
N	8	G1	X90		
N	9	G1		Y30	
N	10	G1	X40		
N	11	G0			Z100
N	12	G0	X0	Y0	

(B)

B DRAW THE CONTOUR:

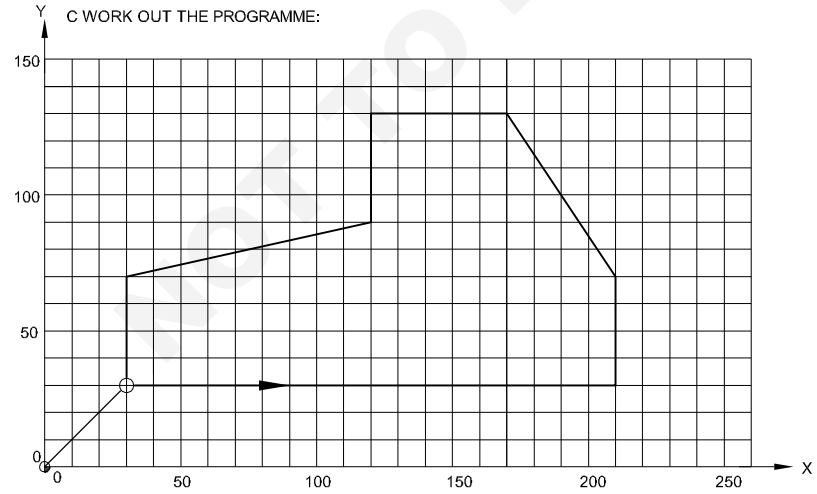


G90 = ON - POSITION

N	1	G0	X50	Y50	Z0
N	2	G1			Z-5
N	3	G1	X200		
N	4	G1		Y80	
N	5	G1	X170	Y110	
N	6	G1	X80		
N	7	G1	X50	Y80	
N	8	G1		Y50	
N	9	G0			Z100
N	10	G0	X0	Y0	

(C)

C WORK OUT THE PROGRAMME:



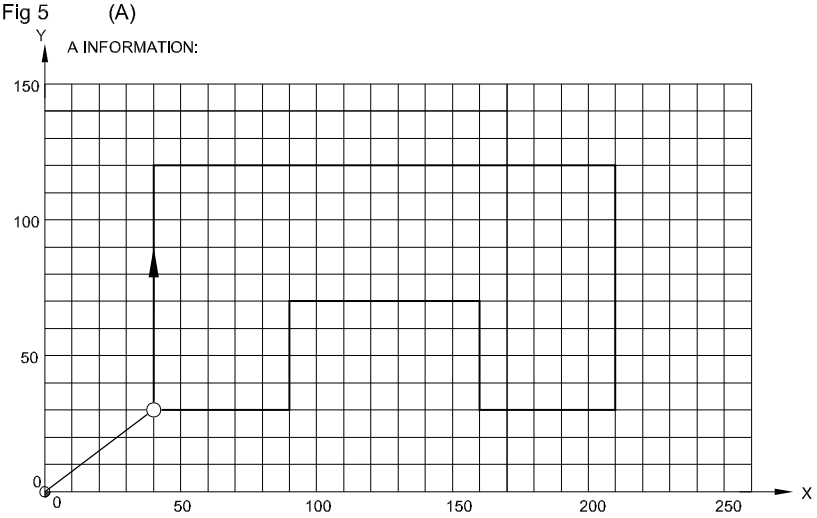
G90 = ON - POSITION
(DEPTH OF MILLING : 8mm)

TD20N2392H4

TASK 5: **Assignment in G00, G01 in incremental system (Fig 5A, B & C) and check with result with simulator**

Fig 5 (A)

A INFORMATION:



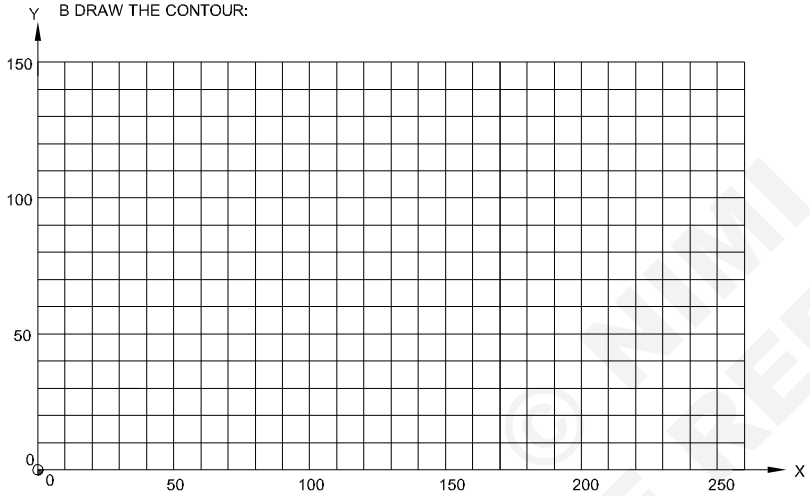
INCREMENTAL

G91 = ON - POSITION

N	1	G0	X40	Y30	Z00
N	2	G1			Z-2
N	3	G1	X0	Y90	
N	4	G1	X160	0	
N	5	G1	X0	Y-90	
N	6	G1	X-50	-	
N	7	G1	X0	Y40	
N	8	G1	X-70	Y0	
N	9	G1	X0	Y-40	
N	10	G1	X-50	Y0	
N	11	G0			Z0
N	12	G0	X-40	Y-30	

(B)

B DRAW THE CONTOUR:

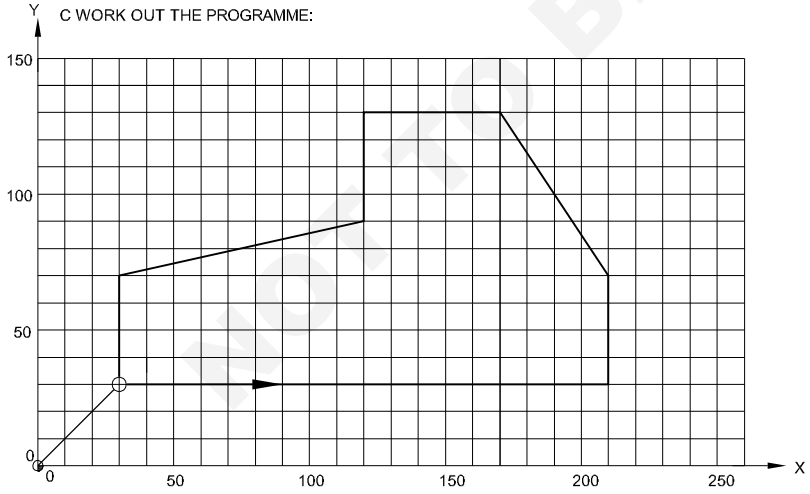


G91 = ON - POSITION

N	1	G1			Z-2
N	2	G1	X180	Y0	
N	3	G1	X0	Y40	
N	4	G1	X-40	Y60	
N	5	G1	X-50	Y0	
N	6	G1	X0	Y-40	
N	7	G1	X-90	Y-20	
N	8	G1	X0	Y-40	
N	9	G0			Z0
N	10	G0	X-30	Y-30	

(C)

C WORK OUT THE PROGRAMME:



G91 = ON - POSITION
(DEPTH OF MILLING : 8mm)

TD20N2392H5

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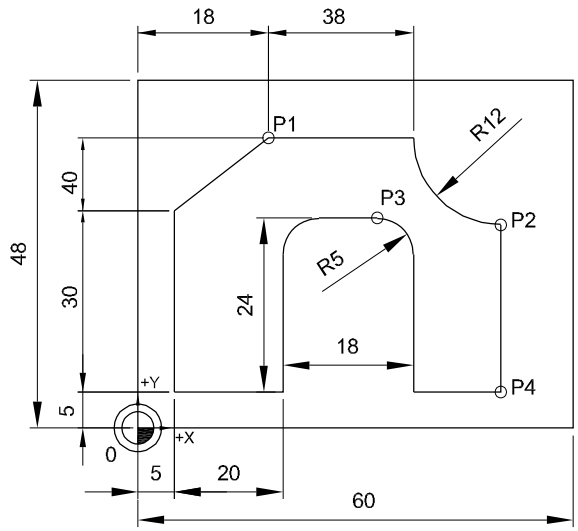
TASK 6: **Plot the point in both absolute and incremental system in table 7 & 8 (Fig 6). Check with simulator**

Fig 6



DIMENSION: IN mm

ABSOLUTE CO-ORDINATE

Table - 7		
POINTS	X	Y
P1		
P2		
P3		
P4		

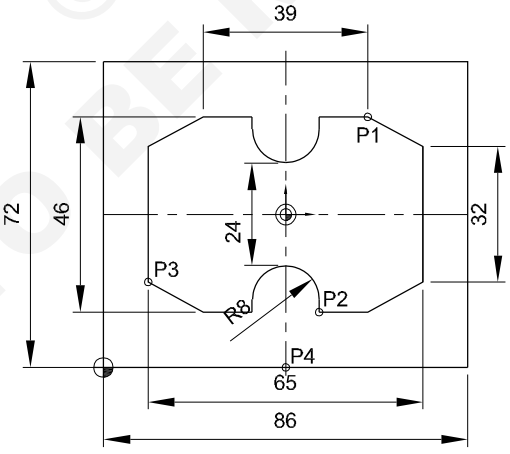
INCREMENTAL CO-ORDINATE

Table - 8		
POINTS	X	Y
P1		
P2		
P3		
P4		

TD20N2392H6

TASK 7: **Plot the point in both absolute and incremental system in table 9 & 10 (Fig 7)**

Fig 7



DIMENSION: IN mm

ABSOLUTE CO-ORDINATE

Table - 9		
POINTS	X	Y
P1		
P2		
P3		
P4		

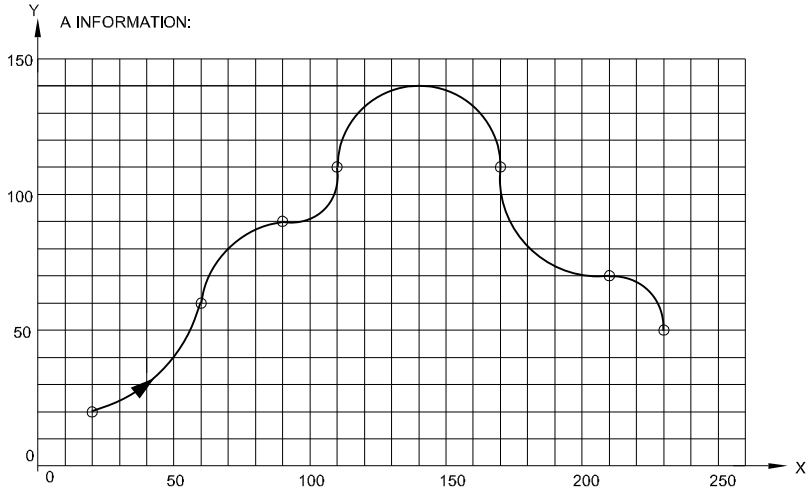
INCREMENTAL CO-ORDINATE

Table - 10		
POINTS	X	Y
P1		
P2		
P3		
P4		

TD20N2392H7

TASK 8: **Assignement (Fig 8A, B & C) programming with G2 & G3 in absolute system, check the result with simulator in absolute system.**

Fig 8A

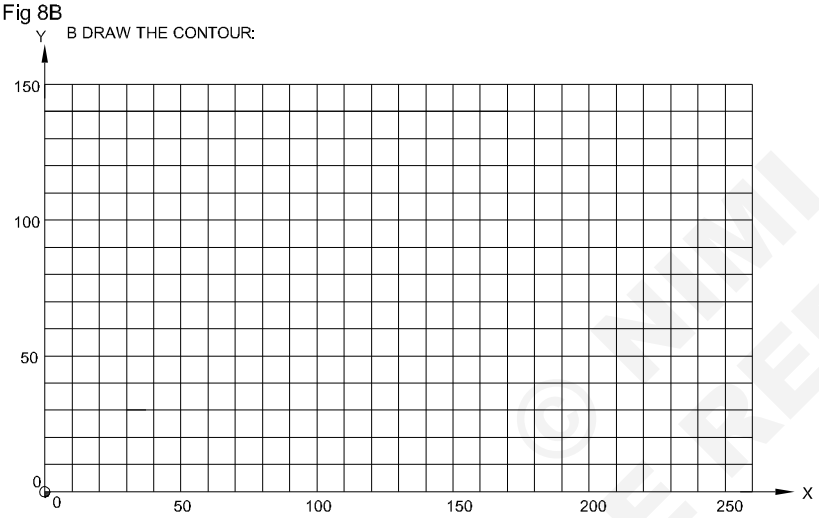


ABSOLUTE

STARTING POINT: X20 Y20

N1	G3	X60	Y60	I 0	J40
N2	G2	X90	Y90	I30	J0
N3	G3	X110	Y110	I 0	J20
N4	G2	X170	Y110	I30	J0
N5	G3	X210	Y70	I40	J0
N6	G2	X230	Y50	I 0	J-20

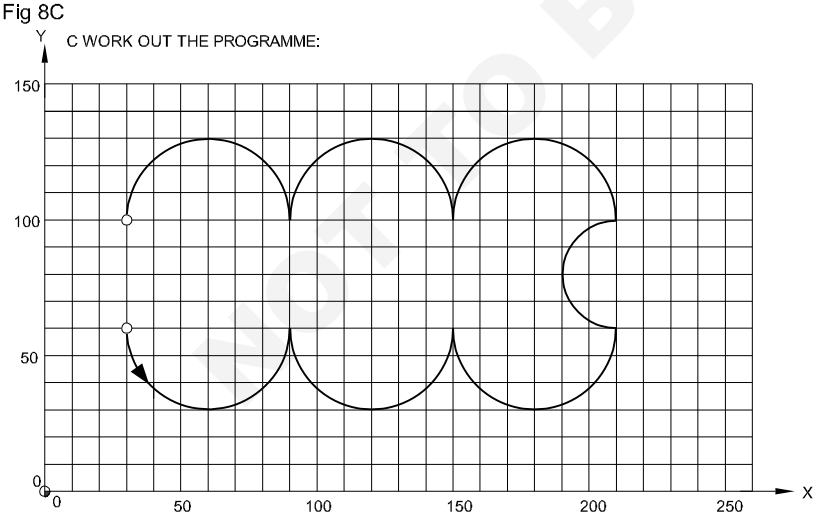
Fig 8B



STARTING POINT: X165 Y40

N1	G2	X185	Y60	I 20	J0
N2	G3	X185	Y90	I 0	J15
N3	G2	X165	Y110	I 0	J20
N4	G3	X85	Y110	I-40	J0
N5	G2	X65	Y90	I-20	J0
N6	G3	X65	Y60	I 0	J-15
N7	G2	X85	Y40	I 0	J-20
N8	G3	X165	Y40	I 40	J0

Fig 8C



TD20N2392H8

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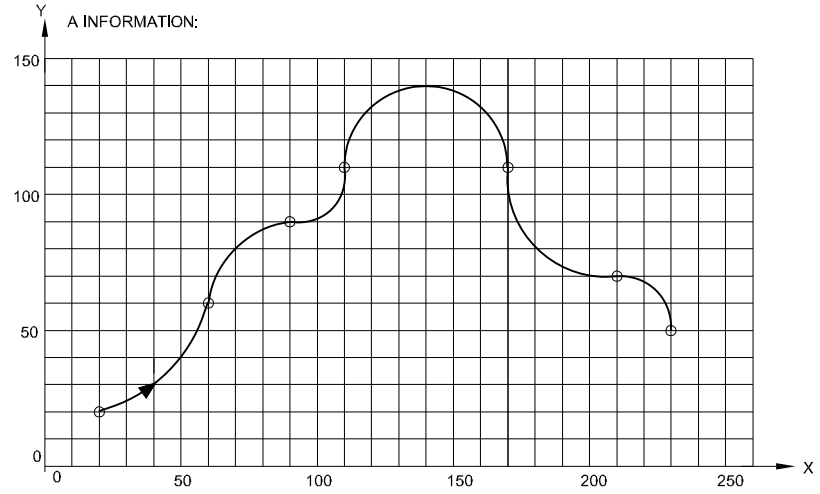
TASK 9 : **Assignement (Fig 9A, B & C) programming with G2 & G3 in incremental system check the result with simulator**

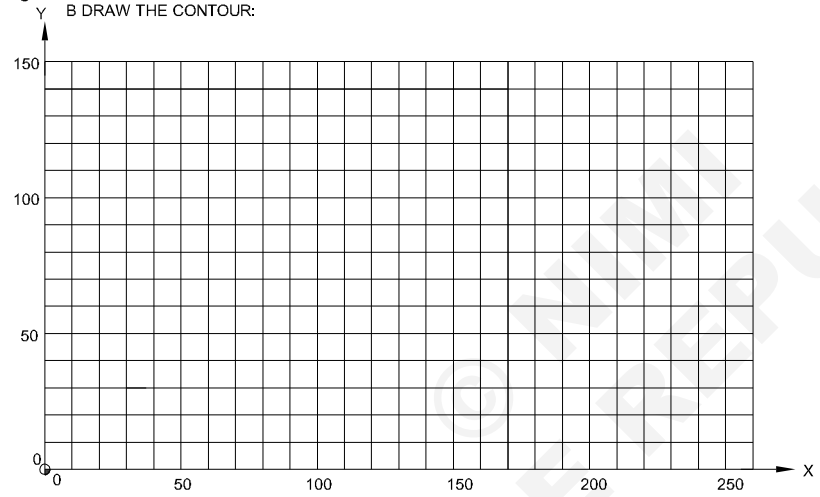
Fig 9A



INCREMENTAL

N1	G91				
N2	G3	X40	Y40	I 0	J40
N3	G2	X30	Y30	I30	J0
N4	G3	X20	Y20	I0	J20
N5	G2	X60	Y0	I30	J0
N6	G3	X40	Y-40	I40	J0
N7	G2	X20	Y-20	I 0	J-20

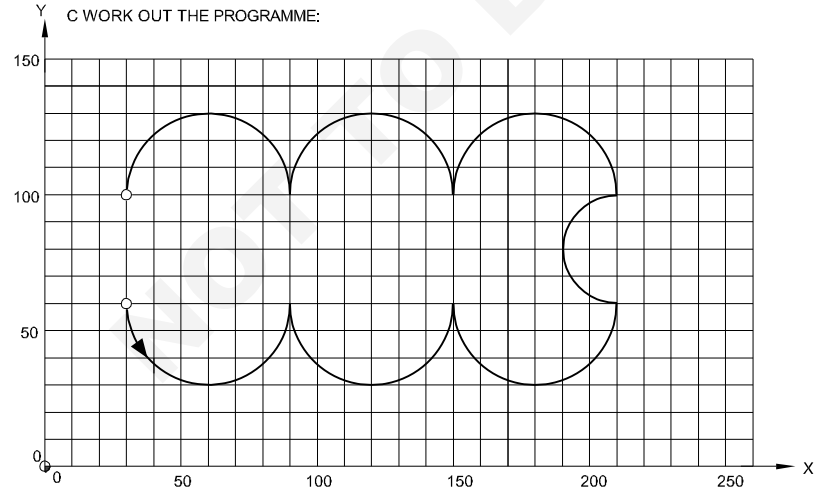
Fig 9B



STARTING POINT: X80 Y100

N1	G91				
N2	G3	X-20	Y-20	I-20	J0
N3	G2	X-20	Y-20	I0	J-20
N4	G3	X40	Y0	I20	J0
N5	G2	X0	Y0	I20	J0
N6	G2	X0	Y0	I20	J0
N7	G3	X0	Y0	I40	J0

Fig 9C



N1 G91

TD20N2392H9

— — — — — — —

TASK 10: **Write tool path for Fig 10 and record it in table 11 check with simulator**

Fig 10

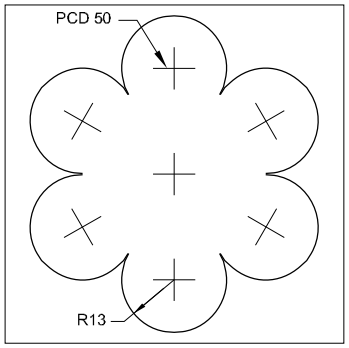


TABLE 11

N	G	X	Y	I	J

TD20N2392HA

TASK 11: **Write tool path for (Fig 11) and record it in table 12 check the result with simulator**

Fig 11

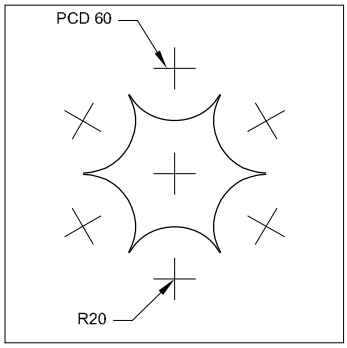


TABLE 12

N	G	X	Y	I	J

TD20N2392HB

TASK 12: **Write tool path for (Fig 12) and record it in table 13, check the result with simulator**

Fig 12

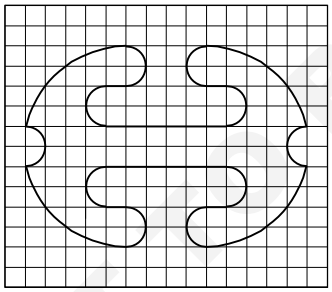


TABLE 13

N	G	X	Y	I	J

TD20N2392HC

TASK 13: **Write tool path for (Fig 13) and record it in table 14, check the result with simulator**

Fig 13

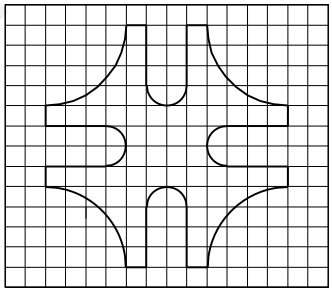


TABLE 14

N	G	X	Y	I	J

TD20N2392HD

Polar co-ordinate points, assignemnt and simulation

Objectives: At the end of this exercise you shall be able to
- **plot the point in polar co-ordinate system for the given drawing**
- **check the plotted points with simulator**

Job Sequence

TASK 1: **Plot the points for fig1 in polar co-ordinate system in table 1 check the plotted point with simulator**

Fig 1

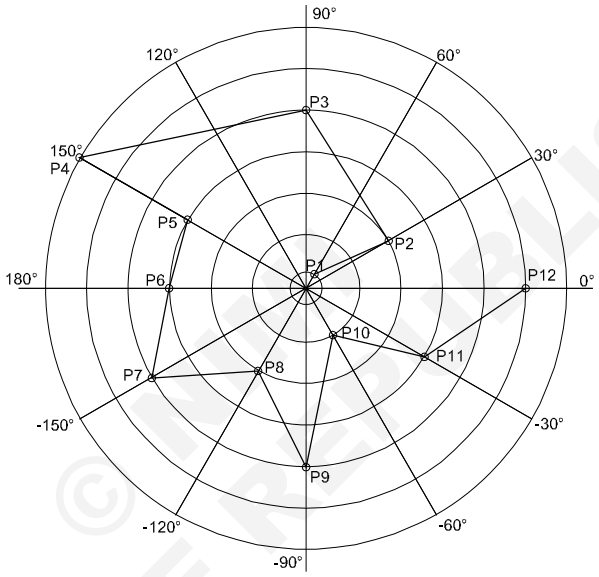
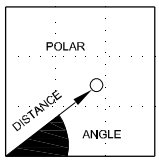


TABLE 1

P	PR	PA	P	PR	PA

(a)



POLAR CO-ORDINATE SYSTEM

TD20N2393H1

TASK 2: **Plot the ploar co-ordinate for Fig 2 and record it in table 2, verify with simulator.**

Fig 2

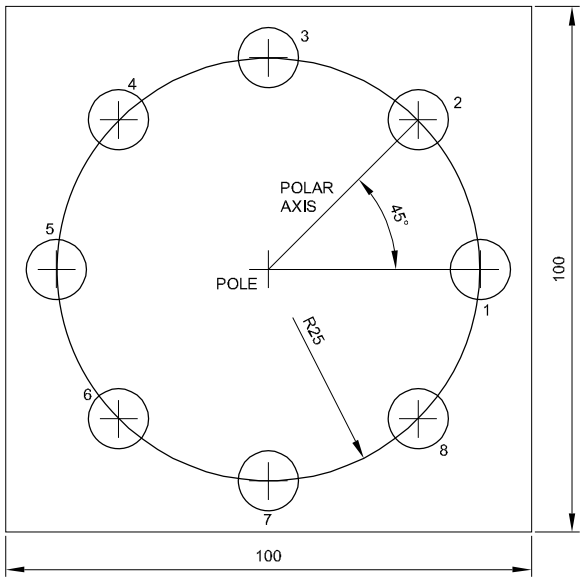


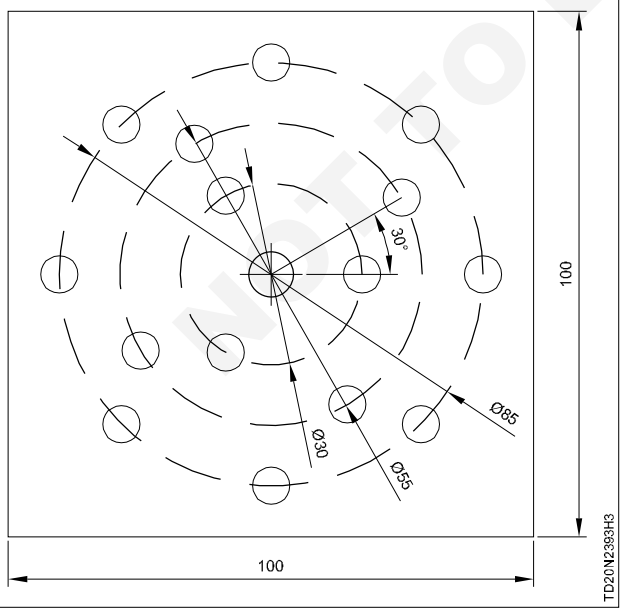
TABLE 2

P		
1		
2		
3		
4		
5		
6		
7		
8		

TD20N2393H2

TASK 3: **Assignment on polar co-ordinate system write the position tool path in polar co-ordinate system for Fig 3 and draw table and record it and verify recorded position with simulator.**

Fig 3

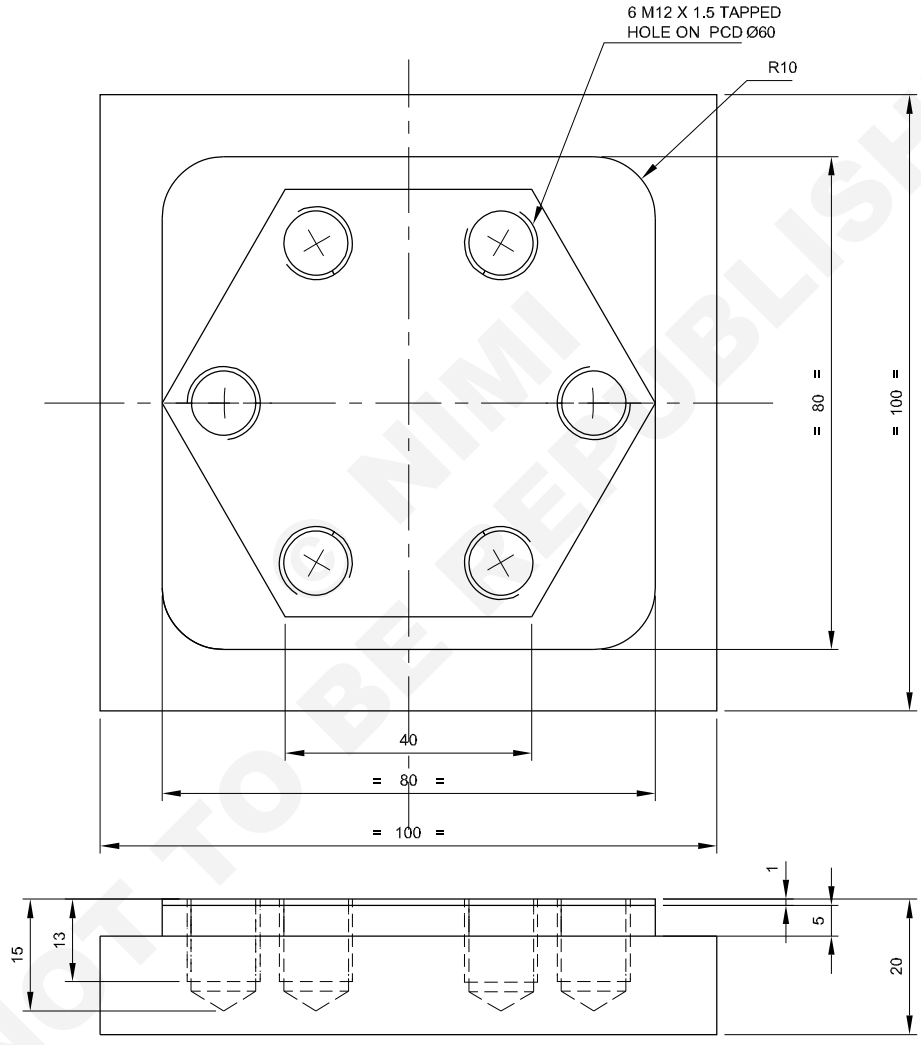


TD20N2393H3

Work and tool setting, auto mode operation, face milling, profile milling drilling, tapping and remainig

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

- **measure the work offset in x,y axes and enter in work offset data area**
- **measure the tool offset and enter in tool offset data area**
- **write the programme for the given job (face milling, profile milling, drilling, tapping and reaming operartion)**
- **enter the programme in machine and edit the programme**
- **verify the programme and run in auto mode operation**
- **correct if their any size variation in workpiece.**



NOTE: PRE - MACHINED WORKPIECE 100X100X22 mm MATERIAL ALUMINIUM

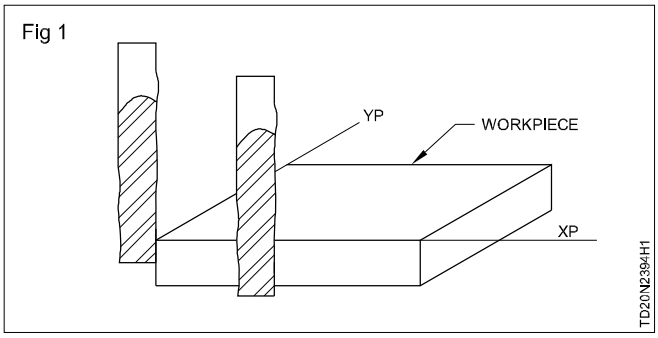
-	-	-	-		-	2.3.94
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	**WORK AND TOOL SETTING, AUTO MODE OPERATION, FACE MILLING, PROFILE MILLING, DRILLING, TAPPING AND REAMING**				DEVIATIONS	TIME :
					CODE NO. TD20N2394E1	

Job Sequence

TASK 1**: Measurement of work offset**

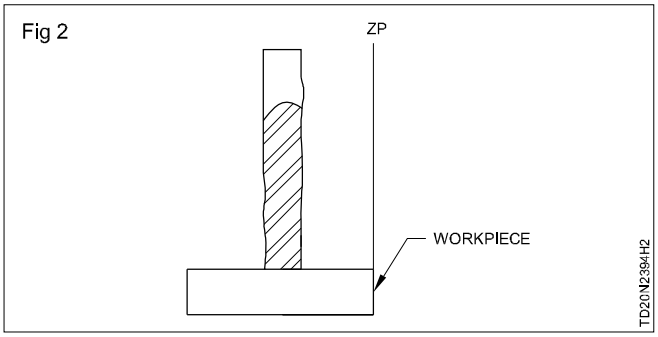
- Call tool number one in MDI mode.
- Go to jog mode. Remove the available tool if any/
- Mount one referencce tool / cylindrical pin of about 100mm length / position finder. Make the zero offset value G54 X0, Y0, Z0.
- Just touch the X surface of the workpiece as shown in Fig1 and take the absolute display reading of X-axis.

Fig 1



- Just touch th Y surface of the workpiece as shown in Fig 1 and take the absolute display reading of Y-axis.
- Just touch th Z surface of the workpiece as shown in Fig 2 and take the absolute display reading of Z-axis.

Fig 2



- Reduce the radius value of the tool / cylindrical pin from the noted X and Y value. This given the zero offset of the corner of the job as shown. This may be entered under X and Y in one of the zero offset value i.e., in G55-G59.
- Enter the same absolute display value in 'Z'.
- Every time a new job is mounted, new 'Z' value should be taken through the reference tool.

  As explained above and must be entered in the appropriate zero offset number i.e., G55 to G59.

— — — — — —

TASK 2: **Tool offset measurement**

- **If tool measuring system is available we can measure the tool offset through the tool pre setter.**
- **If the tool pre setter is not available then reference tool method can be used to find out the tool offset**.

- Designate always. Tool No 01 as reference tool and avoid changing the tool.
- Bring this tool and just touch the machined surface of the job.
- Note down the Abs. value of Z at the time when the G54 Z-value is 'O' - say A

Use this 'Z' value for subsequent measurement of tool - (A)

- Bring the next tool (No 02) for which measurement is to be set.
- Touch the tool on the same workpiece surface.
- Note the display value and subtract the ref. Tool 'Z' value (A).
- This will be the Tool offset value for Tool No 02.
- The same procedure can be adopted for other tools.
- Enter all the value of length offsets in the CNC, against the Tool No.,

The tool-offset can be measurent directly if the value A is entered against G54 Z value.

Tool Name, offset number along with the length offset may be kept seprarately & safely in a tool register for further use and reference.

- **The value A** should be taken as zero offset Z-value for G55-G59
- To set zero offset of 'Z' for a new job just touch the reference tool in 'Z' direction and note down the Z value in the required offset number from G55 to G59. Please note that G54, z-value is 0. This avoids measuring of Tool offset for other Tools again.

Face milling (program)

Cutter dia 50 work piece 100 x 100

O0001; (Face milling)

N5 G40 G49 G50 G80 G69;

N10 G90 G21 G94;

N15 T06 M19; (Tool change command)

N20 S600 M03;

N25 G00 G55 G43 H06 X20 Y-30 Z50;
(Tool length copensation in '+' direction)

N30 G00 Z0 F100 M07;

N35 G01 X20 Y130;

N40 G00 X65 Y130 Z0;

N45 G01 X65 Y-30;

N50 G00 X110 Y-30;

N55 G01 X110 Y130;

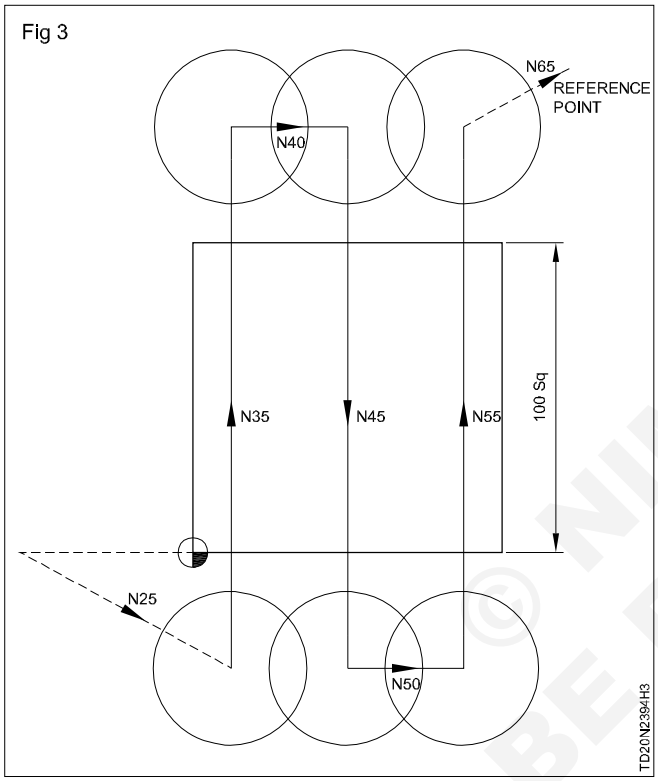
N60 G00 Z50;

N65 G91 G28 X0 Y0 Z0 M09;(Return to reference point)

N70 M30;

Tool path for face milling is shown in Fig 3.

Fig 3



N = Indicate line number in programme

Dotted line indicates the movement with rapid (G00)

Thick line indicate movement with feed rate (G01)

O0002 (rectangle milling)

N1 G40 G49 G80 G69;

N2 G90 G55;

N3 T05 M90;

N4 G94 S750 M03;

N5 G55 G43 X-50. Y-50. Z50. M07 H05;

N6 G01 Z-5. F150

N7 G41 G01 X 10. Y20. F100 D105;

N8 G01 Y80;

N9 G02 X20. Y90. R10;

N10 G01 X80;

N11 G02 X 90. Y80. R10;

N12 G01 Y20. F100;

N13 G02 X80.Y10.R10.F150;

N14 G01 X 20;

N15 G02 X10. Y20. R10.

N16 G01 Z5;

N17 G40 G01 X-50. Y40. F300;

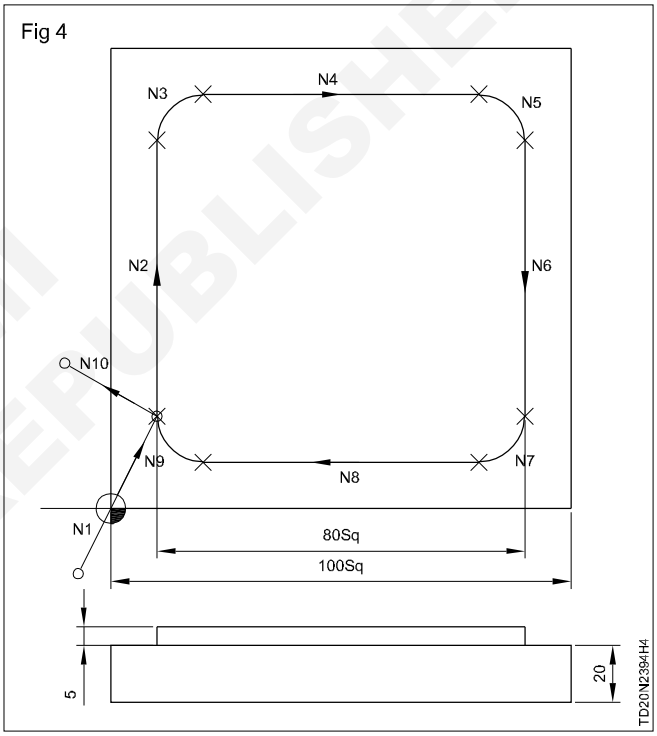
N18 G0Z100. M09;

N19 G00 G28 X0 Y0 Z0 M05.

N20 M30;

Note: N indicate the line number in the programme and its movement in Fig 4.

Fig 4



Hexagonal milling: (Fig 5)

Cutter dia - 32, work piece - 100 x 100mm

O0003(Main):

N5 G40 G49 G69 G80 G99;

N10 G90 G21 G94;

N15 T08 M90;

N20 M03 S900;

N25 G55 G00 X-30 Y-90 Z50 G43 H08 M07;

N30 G52 X50 Y50 Z0; (Local co-oridinate shifting)

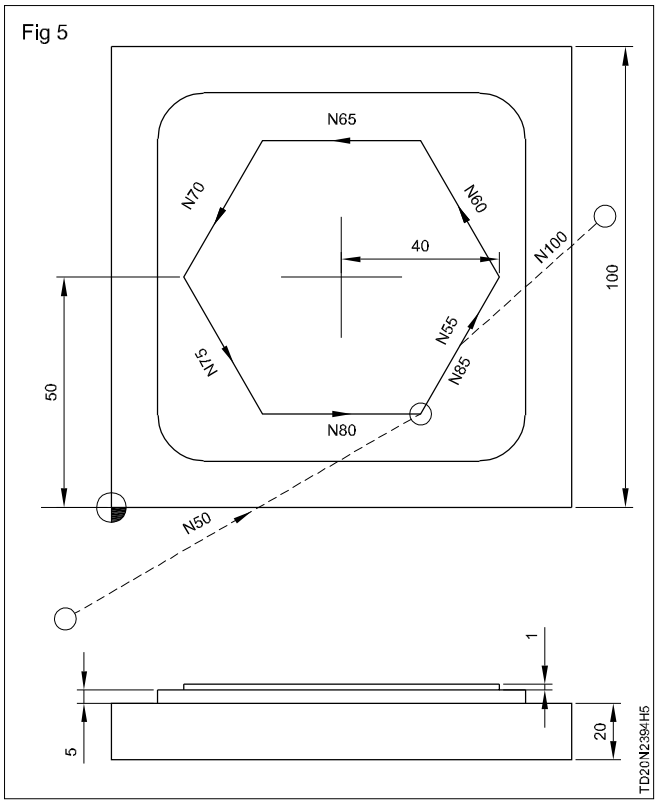
N35 G01 Z-1;

N40 G42 G90 D108 G17 G01 X-30 Y-60 F100; (CRC-ON)

N45 G16 G90 G17; (polar co-ordinate on)

N50 G01 X40 Y-60;

Fig 5



N55 Y0;

N60 Y60;

N65 Y120;

N70 Y180;

N75 Y240;

N80 Y300;

N85 Y330;

N90 G15; (polar co-ordinate - cancel)

N95 G00 Z50 M05;

N100 G40 G00 X120 Y80 M09;(CRC - cancel)

N105 G00 Z100;

N110 G91 G28 X0 Y0 Z0;

N115 M30;

Centre drilling

O004 (centre drilling);

N25 G40 G49 G80 G69;

N50 G90 G94 G21;

T04 M90; (Centre drill)

N75 S1000 M03;

N80 G55 G43 G0 X50 Y50 Z50 H4;

N85 G52 X50 Y50 Z0;

N90 G17 G90 G16;

N95 G99 G81 X32 Y0 R5 Z-4 F50;

N100 Y60;

N105 Y120;

N110 Y180;

N115 Y240;

N120 G98 Y300;

N125 G80 G15;

N130 G91 G28 G00 X0 Y0 Z0;

N135 M30;

O0005 (Drilling)

N25 G40 G49 G80 G69;

N50 G90 G94 G21;

T05 M90; (Drill Ø 10.2)

N75 S1000 M03;

N80 G55 G43 G0 X50 Y50 Z50 H5;

N85 G52 X50 Y50 Z0;

N90 G17 G90 G16;

G95 G99 G81 X32 Y0 R5 Z-15 F50;

N100 Y60;

N105 Y120;

N110 Y180;

N115 Y240;

N120 G98 Y300;

N125 G80 G15,

N130 G91 G28 G00 XO Y0 Z0;

N135 M30,

O0006 (Tapping)

N25 G40 G49 G80 G69;

N50 G90 G94 G21;

T06 M90 (M 12 X 1.75)

N75 S1000 M03;

N80 G55 G43 G0 X50 Y50 Z50 H6;

N85 G52 X50 Y50 Z0;

N90 G17 G90 G16;

N95 G99 G84 X32 Y0 R5 Z-13 F1.5;

N100 Y60;

N105 Y120;

N110 Y180;

N115 Y240;

N120 G98 Y300;

N125 G80 G15;

N135 G91 G28 G00 X0 Y0 Z0;

N140 M30;

Programs can be created in the edit mode using the program editing functions.

Creating programs using the MDI panel

Procedure creating programs using the MDI panel.

Procedure 1 Enter the EDIT mode.

2 Press the PRGRM key.

3 Press address key O and enter the program number.

4 Press the INSRT key

Explanations

Comments in a program

For the full key type MDI panel, comments can be written in program using the control in/out codes.

Example O0001 (Fanuc series 0);

M08 (Coolant ON);

- When the INSRT key is pressed after the control-out code ("comments, and control- in code") have been typed, the typed comments are registered.
- When the INSRT key is pressed midway through comments, to enter the rest of comments later, the data typed before the INSRT Key is pressed may not be correctly registered (not entered, modified, or lost) because the data is subject to an entry check which is performed in normal editing.

Note the following to enter a comment:

- Control-in code ")" cannot be registered by itself.
- Comments entered after the key is pressed must not begin with a number, space, or address O.
- If an abbreviation for a macro is entered, the abbreviation is converted into a macro word and registerd
- Address O and subsequent number, or a space can be entered but are omitted when registered.

Automatic operation

- Press "Auto" mode switch.
- Select the program number required. To select the particular program number.
  - A Press "program" key to display the program.
  - B Press Address "O" and the enter the program number using numerical keys.
  - C Press this ⇩ curser key. Now the selected program will appear on the screen.
- Press cycle start switch to start the program.
  - A By pressing SINGLE BLOCK key the program will run in single block.
  - B By pressing OPT STOP key the optional stop MDI in activated.
  - C BY pressing AUX FUNC LOCK M/C LOCK Z AXIS LOCK

Simulation of the program may be seen by releasing the feed hold.

MDI - MODE - OPERAION

Press the MDI key,

Press the "program" key.

The following screen appear (Fig 6)

Fig 6

PROGRAM (MDI)
O0000
%

10:26:11 S OT
M DI

PROGRAMMING NUMBER O0000 IS GENERATED AUTOMATICALLY

TD20N2394H6

- Prepare the program blocks with a block M 99 at the end to return to beginning the block.
- To erase the program created in MDI either press "Reset" key or enter address O0000 then press the "Delete" key in the MDI panel.
- Place curser in the first block and push cycle start key for executing position.
- To stop the operation press "Reset" key (or) roatate the "Feed holed" key to "0" position (or) press the emergency switch.

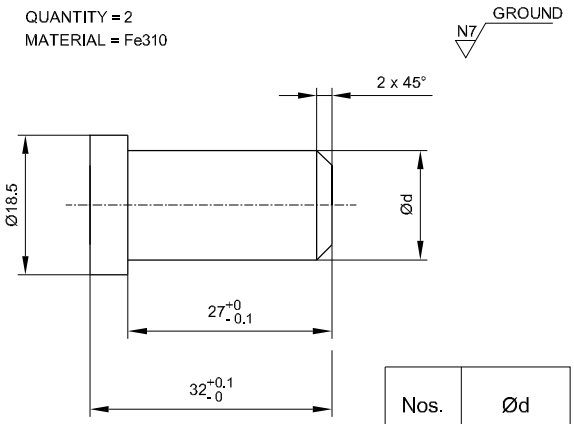
— — — — — — —

Manufacture hand injection mould

Objectives: At the end of this exercise you shall be able to
- **manufacture the various components of moulds**
- **maintain the dimensional and geometrical telerance as per drawing.**

TASK 1

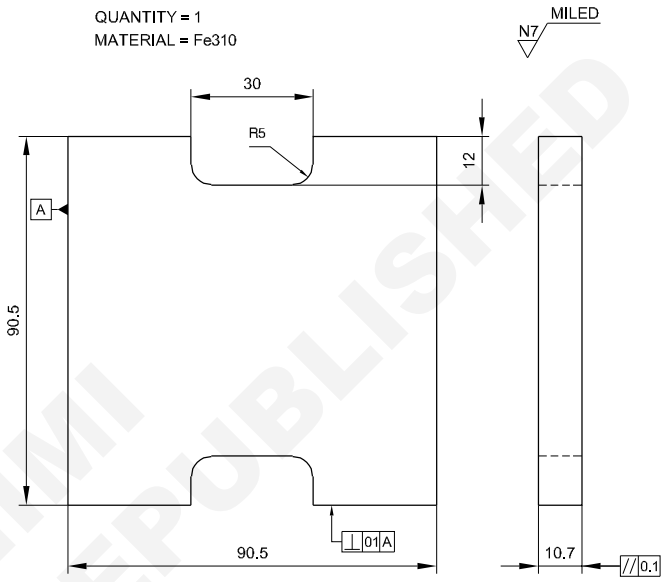
GUIDE PIN
QUANTITY = 2
MATERIAL = Fe310



Nos.	Ød
1	14.5
2	12.5

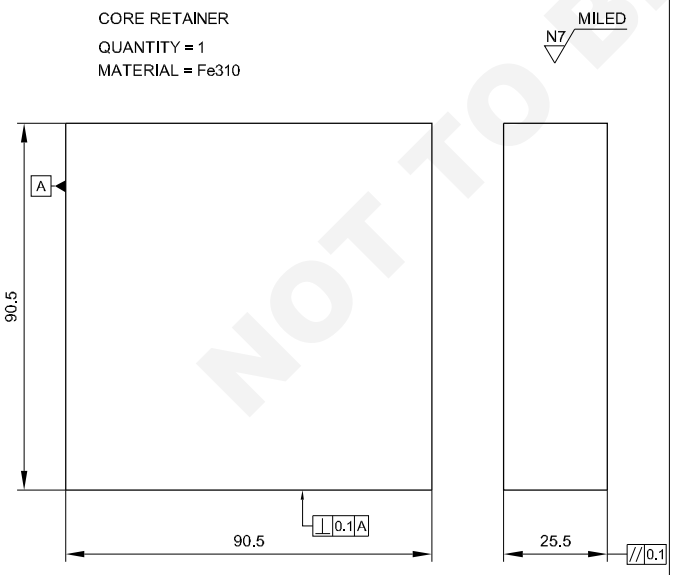
TASK 2

CAVITY PLATE
QUANTITY = 1
MATERIAL = Fe310



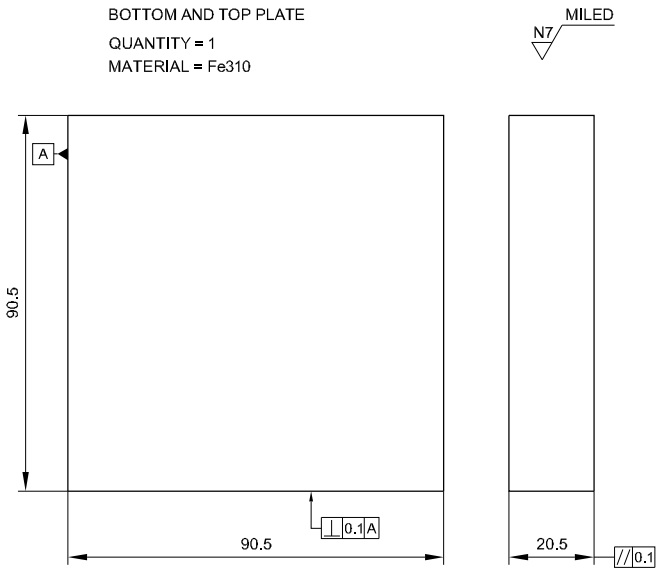
TASK 3

CORE RETAINER
QUANTITY = 1
MATERIAL = Fe310



TASK 4

BOTTOM AND TOP PLATE
QUANTITY = 1
MATERIAL = Fe310



TD20N2495H1

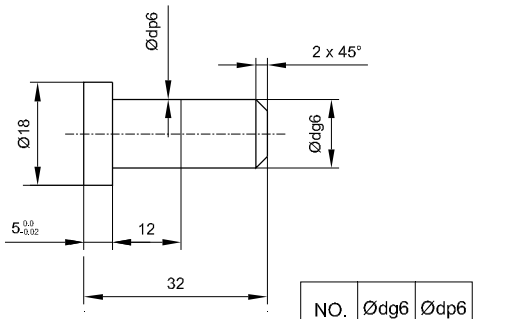
TASK 5

GUIDE PIN

QUANTITY = 2

MATERIAL = Fe310

GROUND N7



NO.	Ødg6	Ødp6
1	Ø12	Ø12
2	Ø14	Ø14

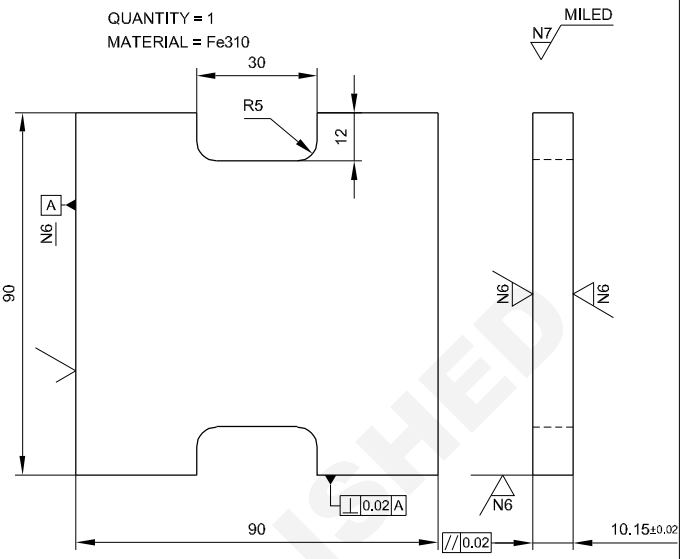
TASK 6

CAVITY PLATE

QUANTITY = 1

MATERIAL = Fe310

MILED N7



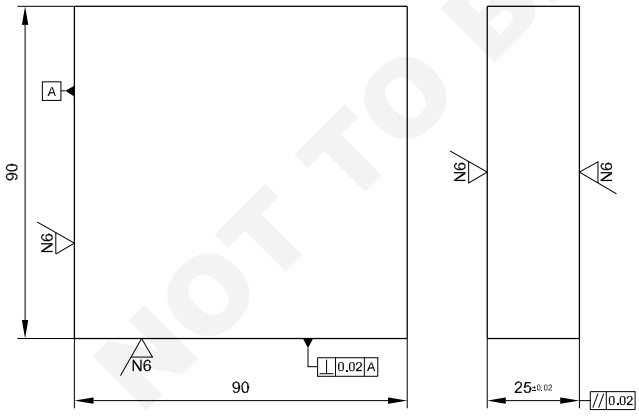
TASK 7

CORE RETAINER

QUANTITY = 1

MATERIAL = Fe310

GROUND N6



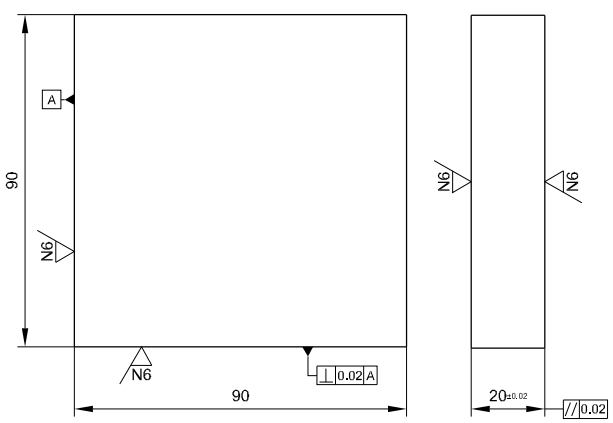
TASK 8

BOTTOM AND TOP PLATE

QUANTITY = 1+1

MATERIAL = Fe310

MILED N7



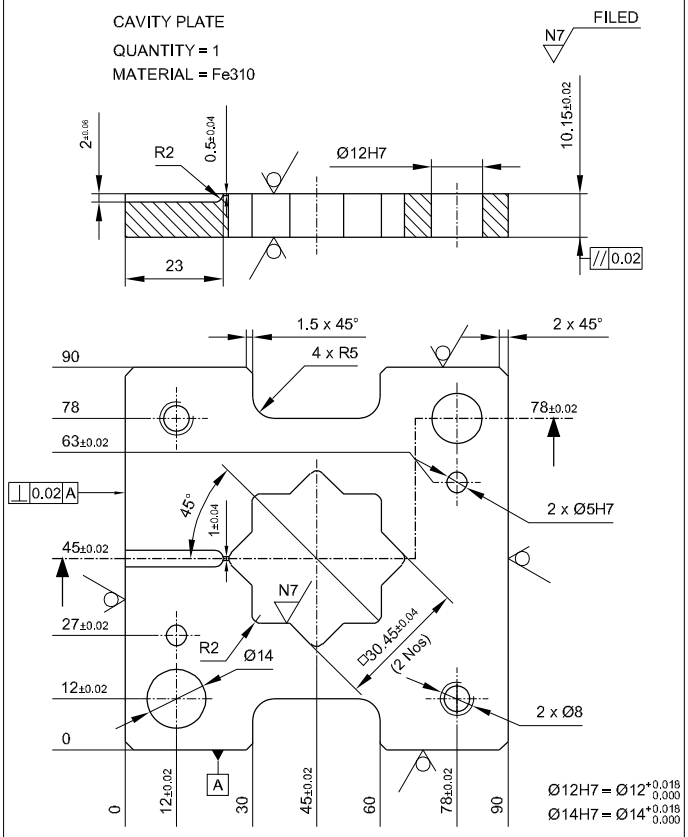
TD20N2495H2

TASK 9

CAVITY PLATE

QUANTITY = 1

MATERIAL = Fe310

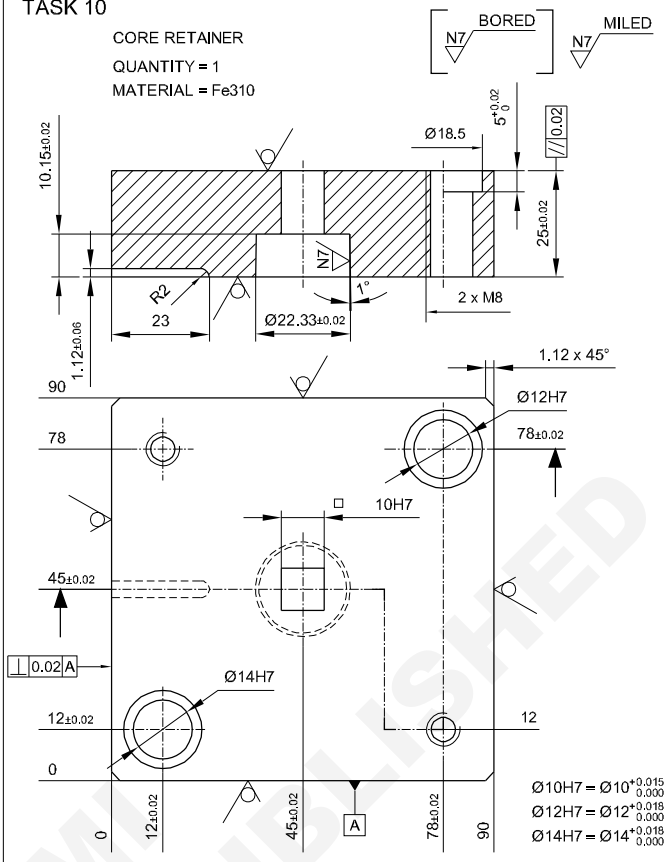


TASK 10

CORE RETAINER

QUANTITY = 1

MATERIAL = Fe310

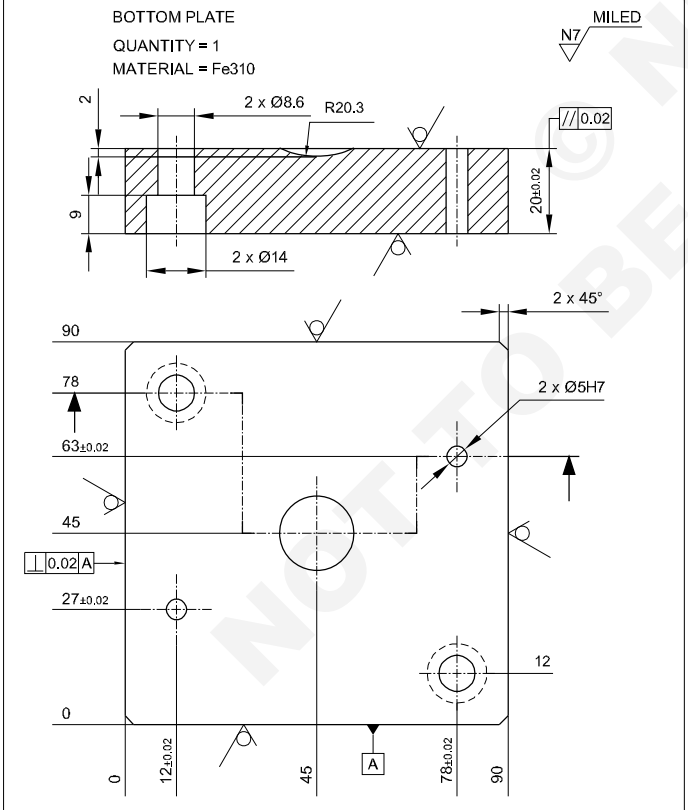


TASK 11

BOTTOM PLATE

QUANTITY = 1

MATERIAL = Fe310

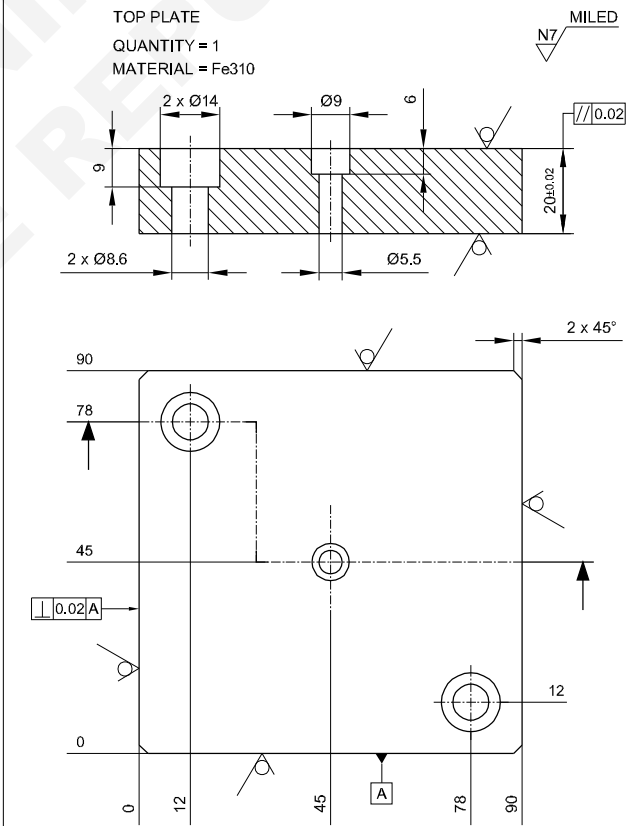


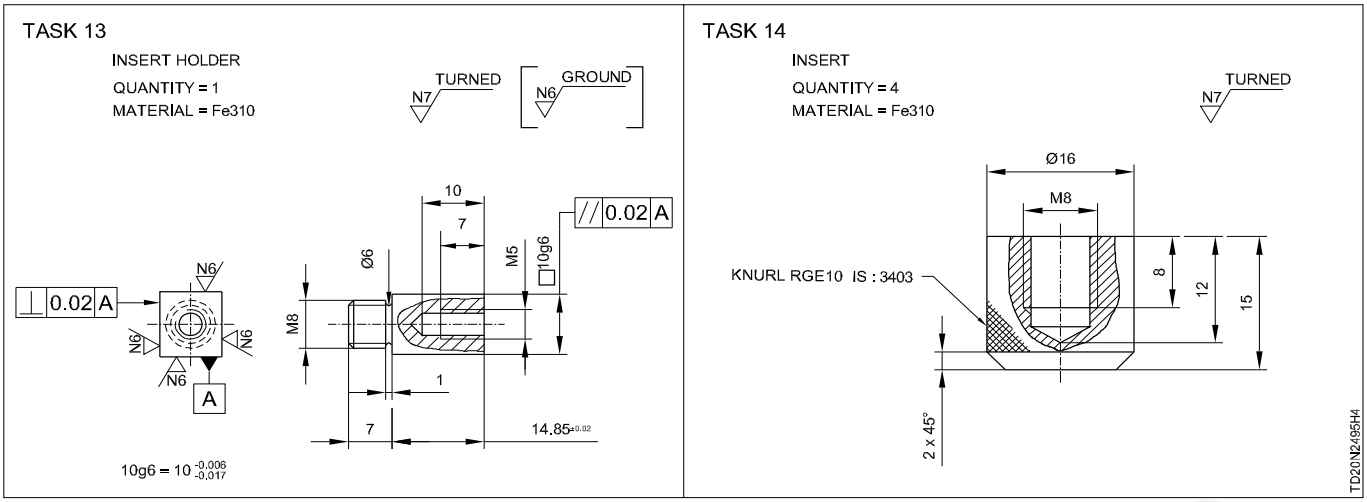
TASK 12

TOP PLATE

QUANTITY = 1

MATERIAL = Fe310





Job Sequence

TASK 1: **Hand injection mould - guid pin - 2 Nos**

- Check the raw material Ø20 and length of 80 mm
- Hold the job in a 3-jaw chuck such that length 35mm project out.
- Face to get perpendicularity.
- Turn dia. 18.5 ± 0.1 to a length 33.5 ± 0.1 mm.
- Turn dia 14.5 ± 0.1 to length 27 - 0.1 mm.
- Turn chamfer as per drawing .
- Hacksaw the job on length 33 ± 0.5 mm
- Reverse the job and hold dia 14.5 such that dia 18 mm project out.
- Face dia. 18.5 to length 5.2 ± 0.1mm (The dimension can vary between 5 to 5.2 depending on other actual dimensions)
- Repeat the same procedure and turn dia 12.5 ± 0.1 mm guide pin as per drawing.

The finished product of this exercise is the raw material for Task 5

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TASK 2 : **Hand injection mould - cavity plate**

- Check the raw material 100 ISF 16-95 mm.
- Mill the block to 10.7 ± 0.1 x 90.5 ± 0.1 x 90.5 ± 0.1 mm. Perpendicular within 0.1 and parallel within 0.1 mm.
- Mark the openings.
- Mount dia. 10 mm end mill.
- Mill the openings as per drawing.

The finished product of this exercise is the raw material for Task 6

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TASK 3**: Hand injection mould - Core retainer**

- Check the raw material 100 ISF32 - 95mm.
- Mill the block to 25.5 ± 0.1 x 90.5 ± 0.1 x 90.5 ± 0.1 mm.

The finished product of this exercise is the raw material for Task 7

— — — — — — —

TASK 4 : **Hand injection mould - Bottom plate and top plate**

- Check the raw material 100 ISF32 - 95mm.
- Mill the block to 20.5 ± 0.1 width 90.5 ± 0.1 mm. Length 90.5 ± 0.1 perpendicular within 0.1 and parallel within 0.1 mm.
- Repeat the same procedure for milling the second plate.

The finished product of this exercise is the raw material for Task 8

— — — — — — —

Task 5 : **Hand injection mould - guide pin - 2 nos (Grinding)**

- Check the dimensions of the turned guide pins (Task 1)
- Set the job on a 4-jaw chuck such that Ø14.5 mm projects out.
- Grind Ø14g6 and Ø14p6 as per drawing.
- Reserve the job and hold in the collect.

Care to be taken while using collects

- Collect are used for holding small high precision parts quickly.
- They are available in standard sizes.
- The size of the collect will be marked on it.
- The dimension of the workpiece should be within ± 0.05 to -0.08 mm of the collect size.
- Concentricity can be achieved to an accuracy of 0.1mm.
- Collects should be cleaned regularly to ensure longer life and accuracy.
- Rough and inaccurate workpieces should not be held in the collects. This will spoil the gripping surface of the collect and also lead to inaccurate jobs.
- In collects the machining length of the bar cannot be set accurately, as the collect while closing, wiill draw the bar slightly inward. Therefore necessary allowance should be provided to overcome this.
- Grind shoulder to Ø18 ± 0.1 and length of $5^{+0.0}_{-0.02}$ mm
- Repeat the same procedure and grind second guide pin as per drawing

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Task 6 : **Hand injection mould - cavity plate (Grinding)**

- Check the dimensions of the milled block (Task 2)
- Grind the thickness to 10.15 ± 0.02 parallel within 0.02mm.

— — — — — — —

Task 7 : **Hand injection mould - core retainer (Grinding)**

- Check the dimensions of the millled block, (Task 3).
- Grind thickness to 25 ± 0.02 parallel within 0.02 mm.
- Grind reference side (adjacent sides) perpendicular within 0.02 mm.

— — — — — —

Task 8 : **Hand injection mould - bottom and top plate (Grinding)**

- Check the dimensions of the milled block (Task 4)
- Grind thickness to 20 ± 0.02 parallel within 0.02 mm.
- Grind the reference sides (adjacent sides perpendicular within 0.02mm.
- Repeat the same procedure and grind the second plate.

— — — — — — —

Task 9 : **Hand injection mould - cavity plate**

- Check the material (Task 6). Mark and punch the coordinates for the holde centres.
- Mark the cavity profile
- Mill the profile as per marking. Keep 0.5 ± 0.1 allowance for filing.
- File cavity as per marking.
- Drill holes dia. 6.8mm (2 Nos.) tap M8 (2 Nos.)
- Grind air-vents opposite to runner to width 3 ± 0.2 and to depth 0.05 ± 0.01 mm (not shown in the drawing)
- File gate to width 1 ± 0.04 and to depth 0.5 ± 0.04 as per drawing.
- Chamfer as per drawing.

Dowel holes dia 5H7 to be drilled and reamed in assembly with the bottom plate

- Drill and ream dia. 12H7 and 14H7 holes in assembly
- Drill dia. 4 to depth 23 ± 0.1 in assembly as per drawing.

— — — — — — —

Task 10 : **Hand injection mould - core retainer**

- Check the material (Task 7)
- Mark and punch the coordinates for the hole centres and profile centre.
- Drill dia 6.8mm (2 Nos).
- Drill dia. 9 mm on centre of profile.
- Tap M 8 (2 Nos).
- File cavity square 10H7 as per drawing.
- Hold the job in a 4-jaw independent chuck and set with reference to square 10H7.
- Bore to dia 22.33 ± 0.02 to depth 10.15 ± 0.02 mm with draft 1°.
- Drill and ream dia 12H7 and 14H7 holes in assembly.
- Counter bore dia. 18.5 to depth 5±0.02mm as per drawing.
- Drill dia 4 to depth 23 ± 0.1mm [for runner] in assembly as per drawing.
- Chamfer as per drawing.

— — — — — — —

Task 11 : **Hand injection mould - Bottom plate**

- Check the material. (Task 8)
- Mark and punch the coordinates for screw, dowel hole centres and profile centre.
- Drill dia 8.6 holes and counter bore dia. 14 to depth 9 ± 0.1mm.
- Mill concave radius to R 20.3 ± 0.1mm.
- Chamfer as per drawing.

Dowel holes dia .5H7 to be drilled and reamed in assembly with the cavity plate.

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Task 12 : **Hand injection mould - Top plate**

- Check the material. (Task 8)
- Mark and punch coordinates for hole centres.
- Drill holes dia.8.6mm (2 Nos.) and counter bore to dia. 14mm to depth 9± 0.1mm as per drawing.
- Drill hole dia.5.5 and counter bore to dia.9 to depth 6 ± 0.1 mm as per drawing.
- Chamfer as per drawing.

— — — — — — —

Task 13 : **Hand injection mould - Insert holder**

- Check the material square 12mm to a length of 25mm.
- Mill to square 10.3 ±0.1 to length 24 ± 0.1 perpendicular within 0.1 and parallel within 0.1mm.
- Grind square 10g6 to length 15.5 ± 0.1 perpendicular within 0.02 and parallel within 0.02mm.
- Hold the finished portion of the job in a 4 - jaw independent chuck and set (hold with soft packing to avoid jaw marks on finished portion)
- Face to get perpendicularity.
- Turn dia.7.8 ± 0.1 to a length of 7 ± 0.1 mm.
- Turn groove as per drawing.
- Chamfer as per drawing.
- Pass die.M8.
- Reverse and set the job.
- Face square length to 14.85 ± 0.02 mm.
- Centre drill dia.2.5mm.
- Drill dia.4.2 to a depth 10 ± 0.1 mm.
- Tap M5 to a depth 7 ± 0.1mm.

— — — — — — —

Task 14: **Hand injection mould - Insert - 4 Nos.**

- Check the raw material dia.20mm to length of 25mm.
- Hold the job in a 3-jaw chuck such that length 20 mm project out.
- Face to get perpendicularity.
- Turn dia.15.8 ± 0.1 to length 19 ± 0.2 mm.
- Knurl length 17 ± 0.5 mm as per drawing.
- Centre drill dia. 2.5mm.
- Drill dia.6.8 to depth 12 ± 0.2 mm.
- Tap M8 to depth 8 ± 0.2 mm.
- Reverse the job and hold with soft packing.
- Face the length ± 15 0.2 mm.
- Chamfer as per drawing.
- Repeat the same procedure and turn the remaining three numbers.

— — — — — — —

Skill Sequence

Hand Injection Mould - Setting, drilling and reaming in assembly

Objective : This shall help you to
- **set drill and ream in position.**

Mark and punch the co-ordinates for hole centers.

Place the two plates on surface plate such that the ground reference side (length side) butts against the surface plate.

Introduce 10 x 20 x 100 mm parallel blocks (2 Nos) in between the plates as shown in Fig 1.

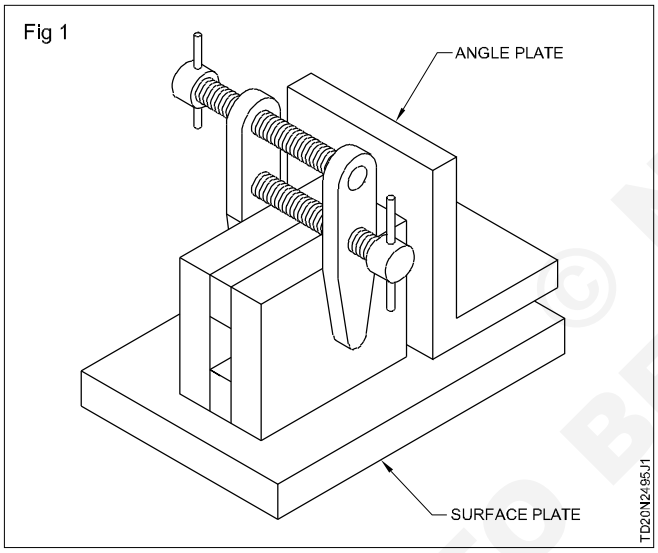
Clamp the two plates together using tool makers clamp. Clamp should be in the middle of the plates take care not to overtighten the clamp.

Keep angle plate (Fig 1) on surface plate butt the reference surface (width side) to the angle plate. Adjust the plates such that both plates butt against the angle plate.

In this position tighten the tool makers clamp

Turn the plates through 90° such that the reference side (width side) butts against the surface plate (Fig 1).

Fig 1



Fix one more tool makers clamp on the opposite side the first clamp.

Keep parallel blocks 40x40x100 on the table of vertical milling machine (Fig 2)

Clamp the assembled plates (along with tool clamp) on the table using strap clamps (Fig 3)

Place the strap clamps diagonally across the plates.

Set the plates assembly top surface parallel to the both of the assembly (machine table) using dial indicator.

Fig 2

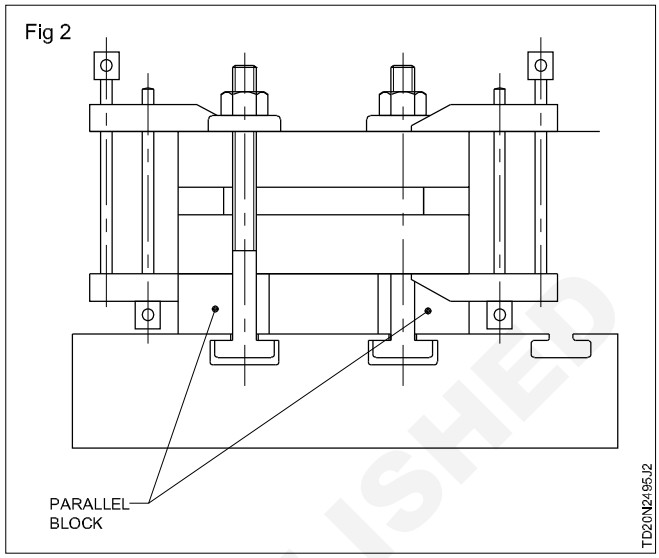
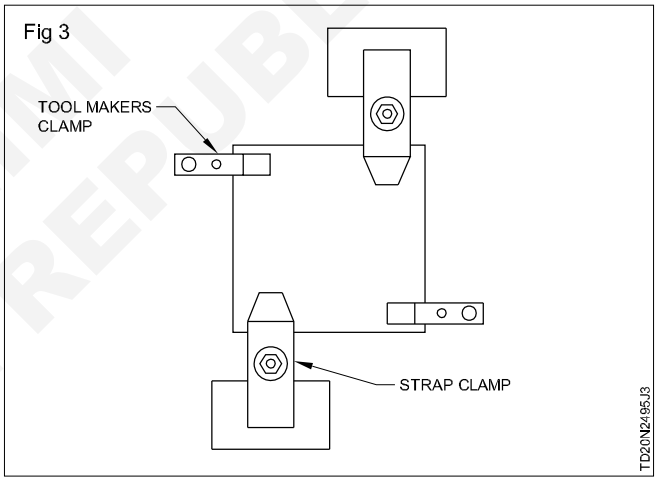


Fig 3



Set the reference side (width side) of assembly parallel to longitudinal movement (y-axis) of machine table using the dial indicator .

Obtain datum using centre finder.

Move the machine table to locate the hole centre.

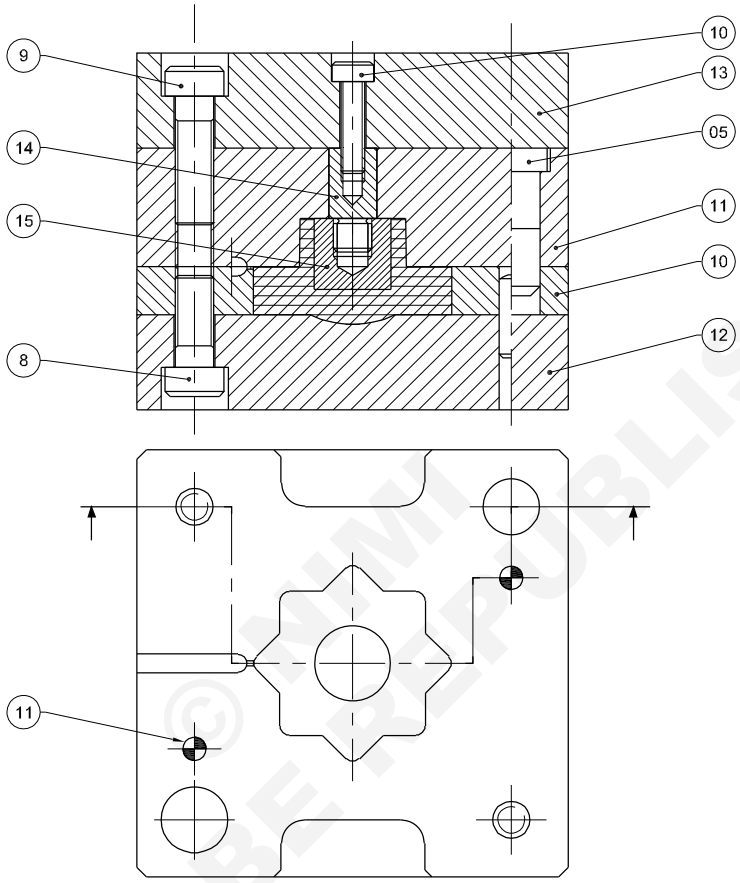
Drill and ream to size.

Move the machine table to locate the other hole centre.

Drill and ream the hole to size.

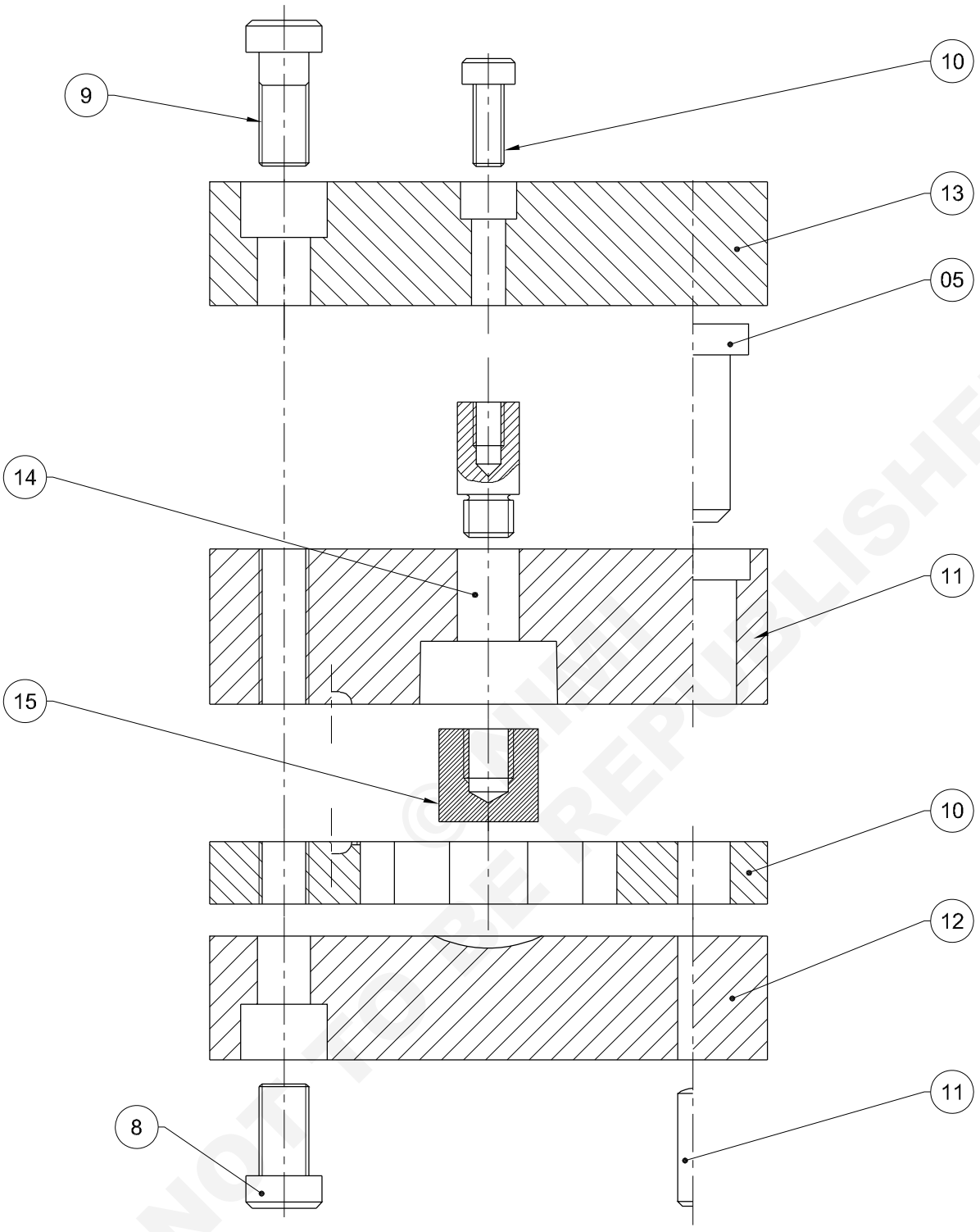
Try out and rectification

Objectives: At the end of this exercise you shall be able to
- **assemble the components of hand injection mould**
- **try out and rectify the faults in the injection mould.**



NO.OFF	SEMI-PRODUCT	STOCK SIZE	MATERIAL	TASK	PART NO.	EX. NO.
4	INSERT	DIA 20 x 25	Fe310	14	15	
1	INSERT HOLDER	SQUARE 12 x 25	Fe310	13	14	
2	DOWEL	Ø5 x 20	STD		11	
1	SHCS	M5 x 20	STD		10	
2	SHCS	M8 x 25	STD		09	
2	SHCS	M8 x 20	STD		08	
1	TOP PLATE	-	Fe310	4	04	
1	BOTTOM PLATE	-	Fe310	4	04	
1	CORE RETAINER	-	Fe310	3	03	
1	CAVITY PLATE	-	Fe310	2	02	
2	GUIDE PIN	-	Fe310	1	01	2.4.96

SCALE	HAND INJECTION MOULD ASSEMBLY	DEVIATIONS	TIME : hrs
		CODE NO. TD20N2496E1	



-	-	-	-	-	-	2.4.96
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS					DEVIATIONS	TIME
	ASSEMBLY				CODE NO. TD20N2496E2	

Job Sequence

Hand injection mould

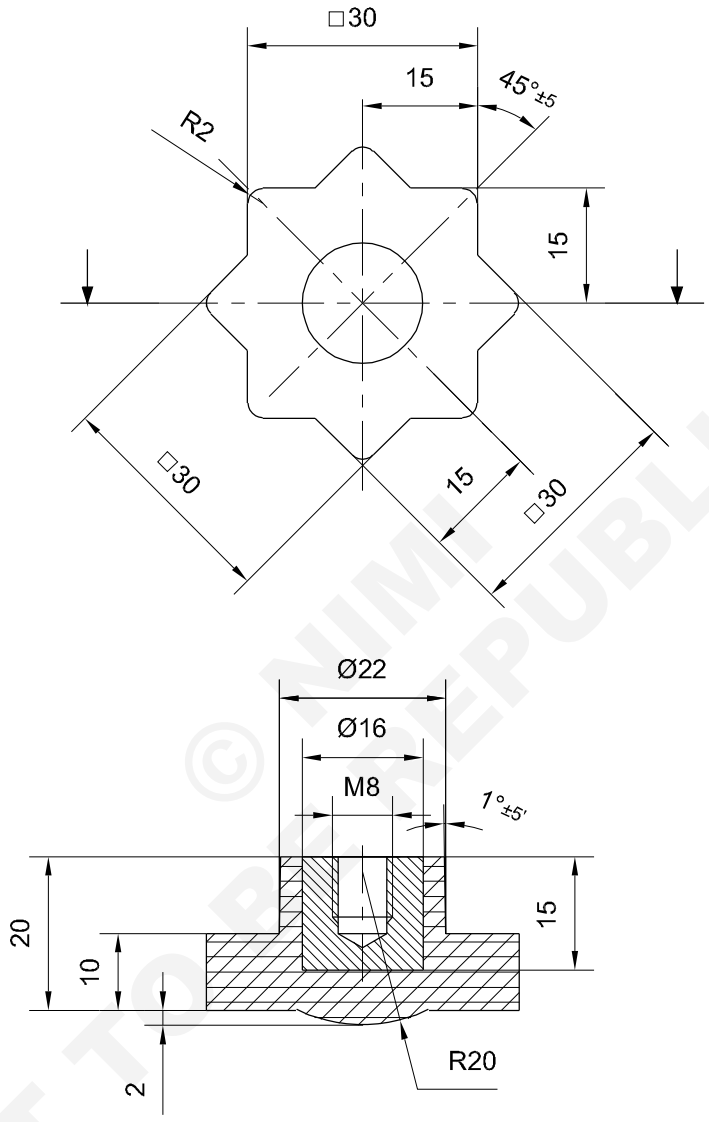
- Clean all the parts.
- Deburr the sharp edges, if any,
- Clean all the screw holes.
- Fix the cavity plate on the bottom plate with SHCS M8 x 20mm depth (2Nos) such that the references of both the plates are in one line.
- Drill and ream holes to dia 5H7.
- Disassemble the parts, countersink the dowel holes and deburr.
- Keep the cavity plate on the bottom plate and drive dowels dia 5 x 20mm depth (2 Nos) into the reamed holes.
- Clamp the cavity plate to the bottom plate with SHCS M8 x 20mm depth (2 Nos.)
- Fit the guide pin into the core retainer.
- Fit the insert holder to the core retainer.
- Clamp the top plate to core retainer with SHCS M8 x 25mm depth (2 Nos)
- Clamp the insert holder to the top plate with SHCS M5 x 20mm depth.
- Clamp the insert to the insert holder.
- Close the mould halves.

Hand injection mould trial

- Load the assembled mould on the vertical hand injection moulding machine.
- Place the mould such that the position of runner is on top position.
- Clamp the mould using clampling arrangement of the machine.
- Keep the machine nozzle and mould runner in one line.
- Use packing pieces, if necessary.
- Set the nozzle above the mould face.
- Heat the barrel to the required temperature (depending on material)
- Inject the material to the mould.
- Allow material to cool and solidify.
- Open the mould.
- Take out the component by unscrewing it from the core.
- Fix new insert.
- Close the mould.
- Repeat the same procedure to get the second component.

MATERIAL POLY PROPLENE

SHRINKAGGE 1.5%



-	-	-	P.P	-	-	2.4.96
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**COMPONENT**				DEVIATIONS ±0.2	TIME
					CODE NO. TD20N2496E3	

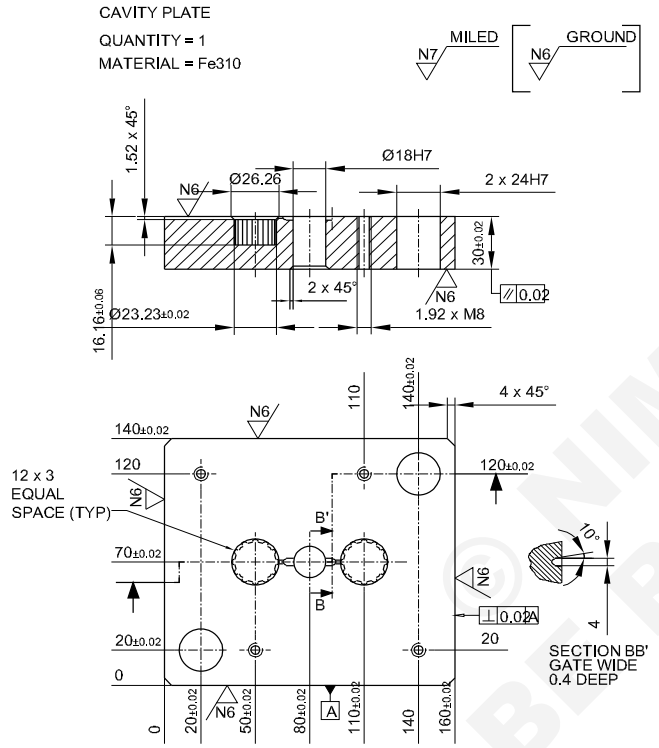
Develop isometric drawing and manufacture 2 cavity injection mould

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

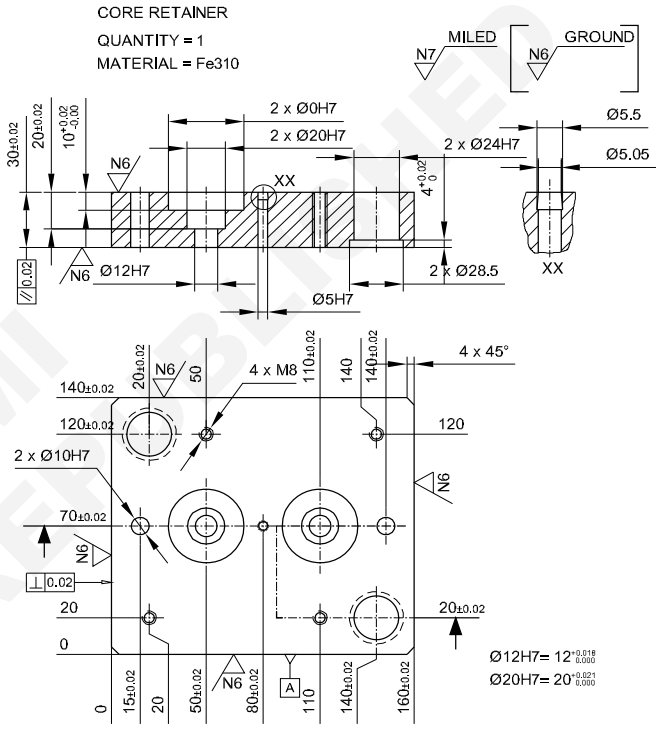
- **draw the isometric drawing of the 2 cavity injection mould**
- **manufacture the componenets of the 2 cavity injection mould**
- **maintain the dimensional and geometrical tolerance as per drawing.**

Note : Group activity (5 traineer per group)

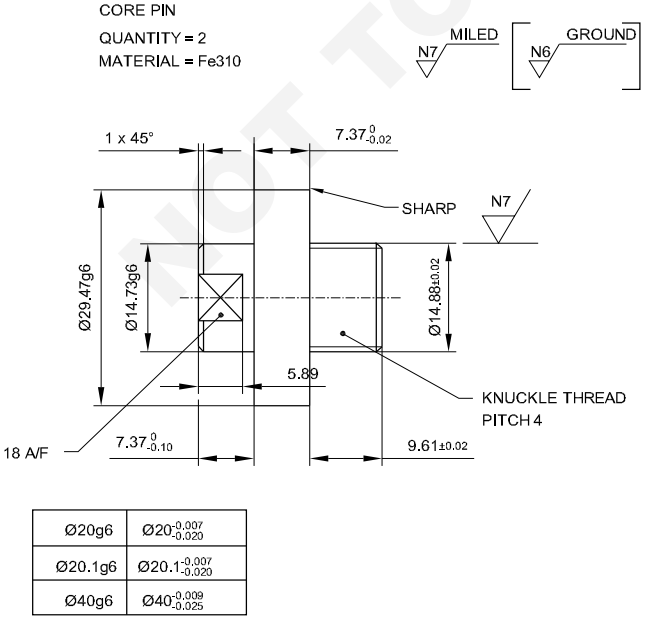
TASK 1



TASK 2

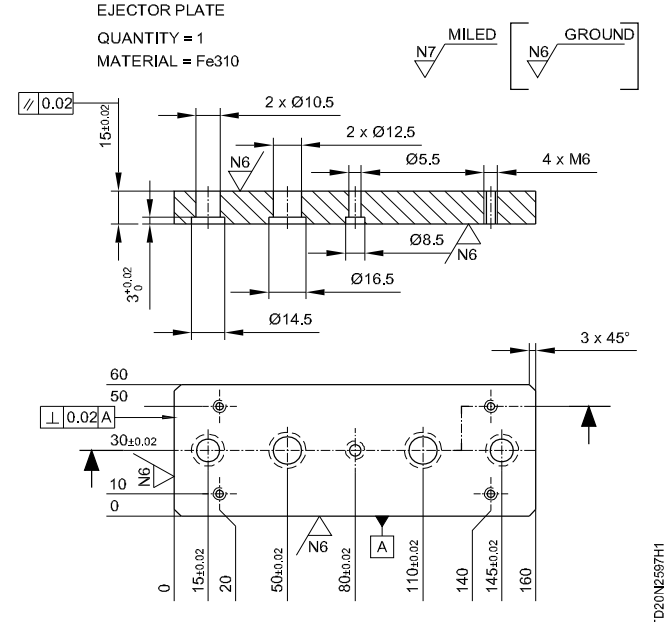


TASK 3



Ø20g6	$Ø20^{-0.007}_{-0.020}$
Ø20.1g6	$Ø20.1^{-0.007}_{-0.020}$
Ø40g6	$Ø40^{-0.009}_{-0.025}$

TASK 4

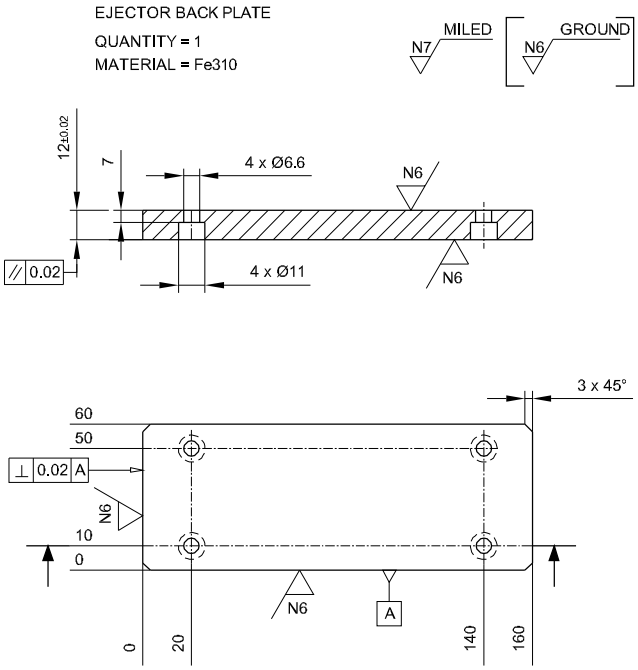


TASK 5

EJECTOR BACK PLATE

QUANTITY = 1

MATERIAL = Fe310

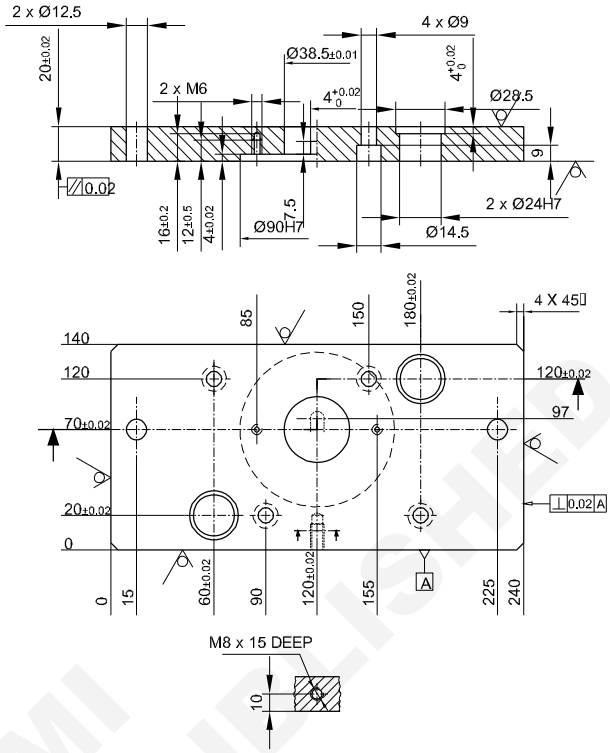


TASK 6

TOP PLATE

QUANTITY = 1

MATERIAL = Fe310

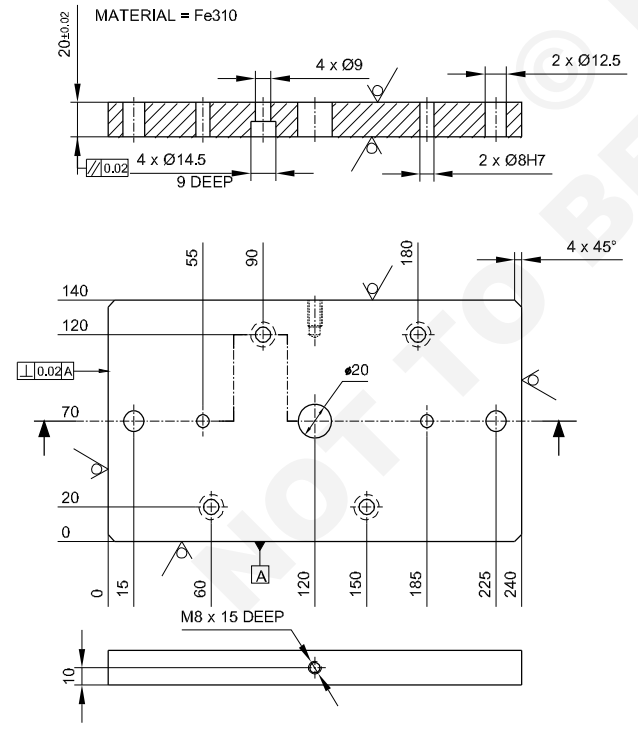


TASK 7

BOTTOM PLATE

QUANTITY = 1

MATERIAL = Fe310

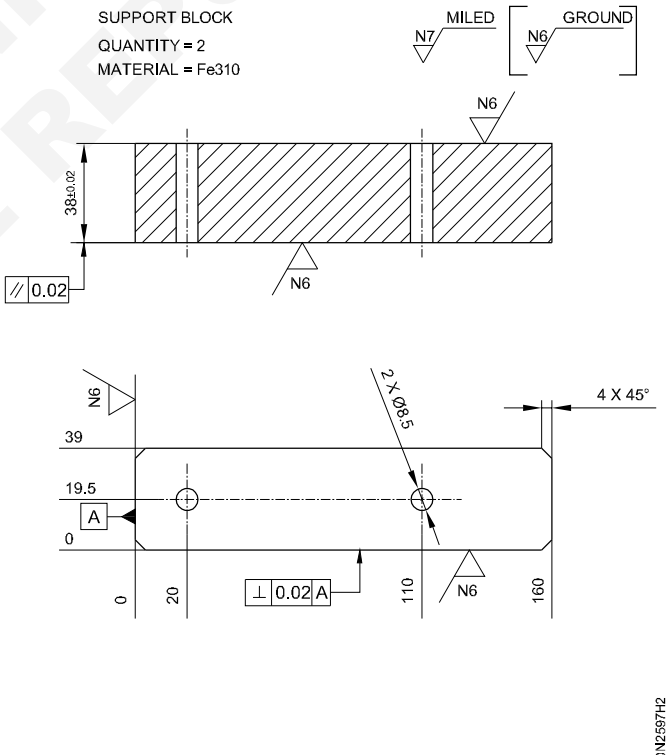


TASK 8

SUPPORT BLOCK

QUANTITY = 2

MATERIAL = Fe310



TD20N2597H2

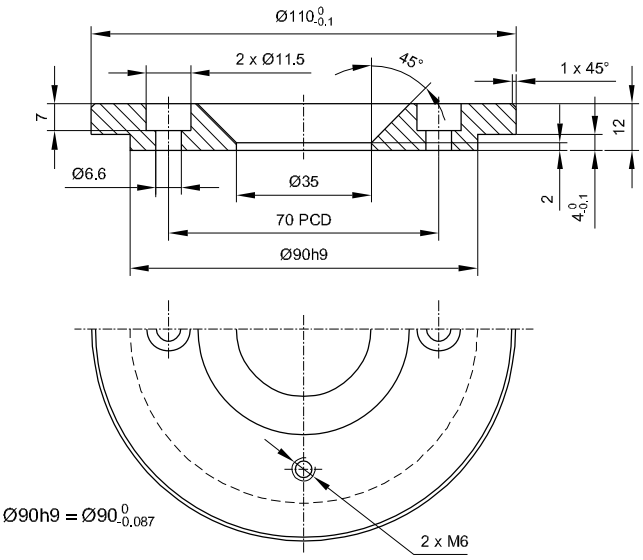
TASK 9

REGISTER RING

QUANTITY = 1

MATERIAL = Fe310

TURNED N7

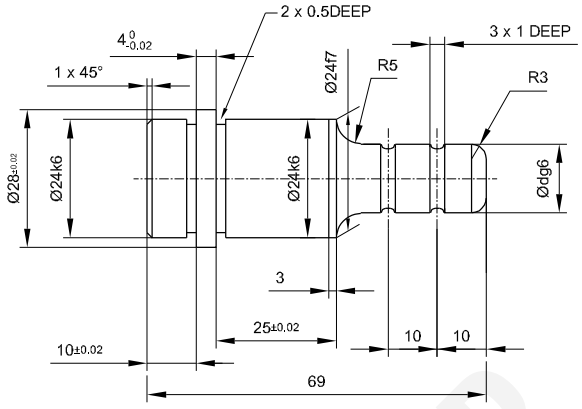


TASK 10

GUIDE PIN (TURNING)

QUANTITY = 1+1

MATERIAL = Fe310



Ø24k6	24 +0.015 +0.002
Ø24f6	24 -0.020 -0.041
Ø15g6	15 -0.006 -0.017
Ø16g6	16 -0.006 -0.017

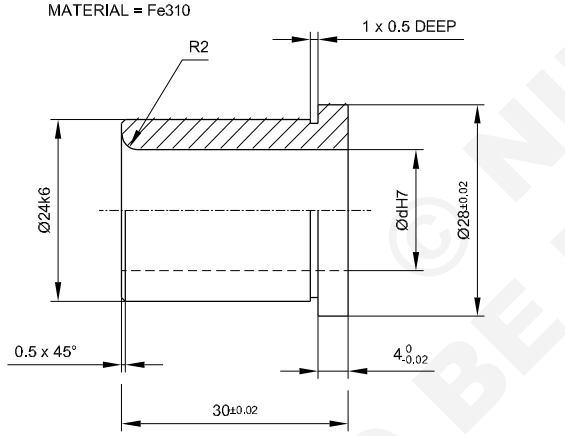
NO.	1	2
Ødg6	15	16

TASK 11

GUIDE BUSH (TURNING)

QUANTITY = 1+1

MATERIAL = Fe310



Ø24k6 = 24 +0.015 +0.002

Ø15H7 = 15 -0.018 -0.000

Ø16H7 = 16 -0.018 -0.000

NO.	1	2
ØdH7	15	16

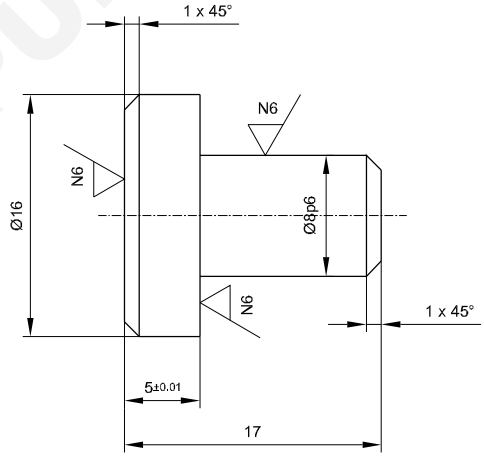
TASK 12

REST BUTTON

QUANTITY = 2

MATERIAL = Fe310

MILED N7 GROUND N6



Ø8p6 = Ø8 +0.024 +0.015

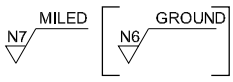
TD20N2597H3

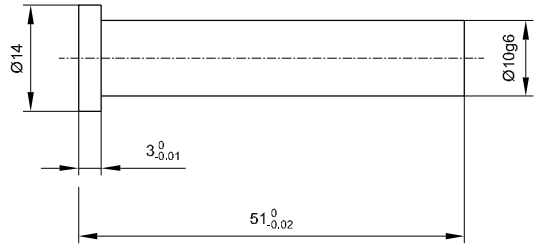
TASK 13

RETURN PIN

QUANTITY = 2

MATERIAL = Fe310





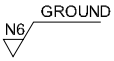
$Ø10g6 = Ø10\ ^{0}_{-0.014}$

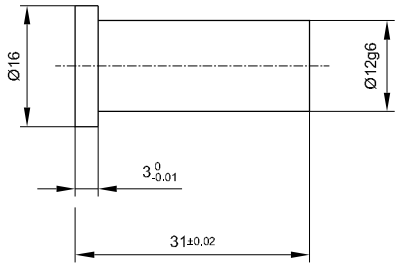
TASK 14

EJECTOR PIN

QUANTITY = 2

MATERIAL = Fe310





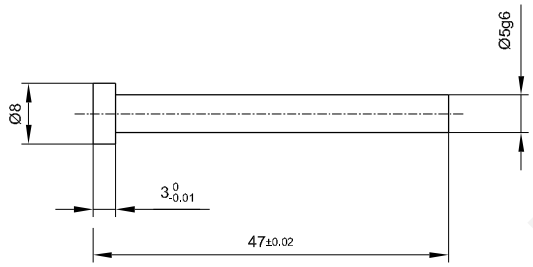
$Ø12g6 = Ø12\ ^{-0.006}_{-0.017}$

TASK 15

EJECTOR PIN-2

QUANTITY = 1

MATERIAL = Fe310



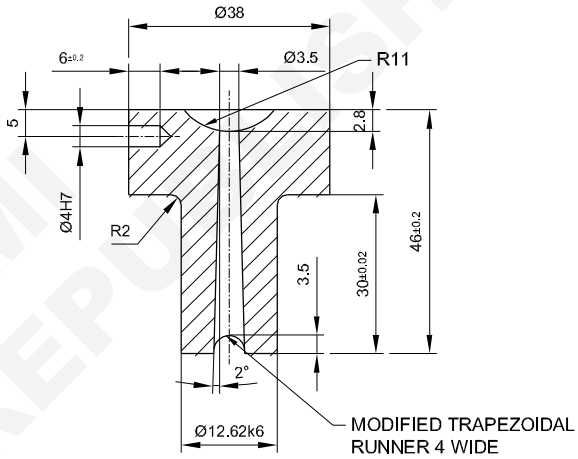
$Ø5g6 = Ø5\ ^{-0.005}_{-0.014}$

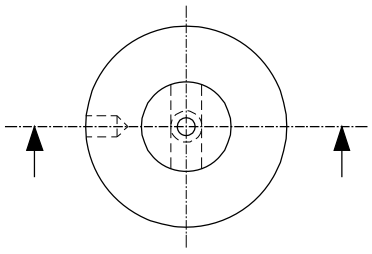
TASK 16

SPRUE BUSH

QUANTITY = 1

MATERIAL = Fe310





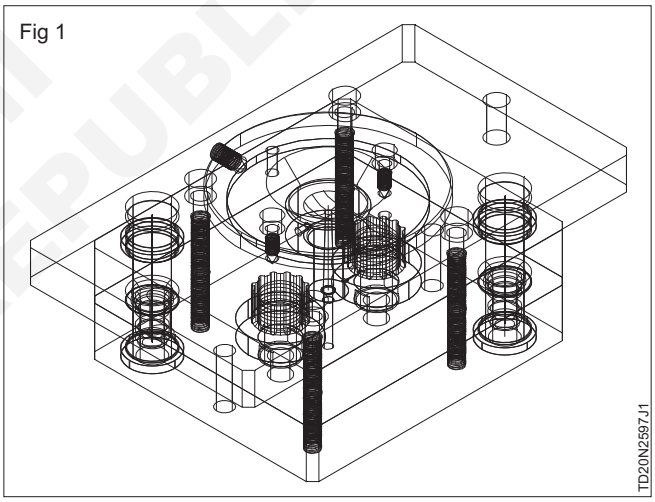
TD20N2597H4

Job Sequence

Two cavity injection mould

- Draw the isometric drawing of the parts of two cavity injection mould in AutoCAD 3D modeling.
- The drawing procedure of the cavity plate
- First open the AutoCAD window and change the workspace as 3D modeling.
- Select the view control and change the "top view" and select the visualize style control as "wire frame"
- Type command "Rec" and draw the rectangle as per the dimensions (160, 140). Type the command "CHA" for chamfering the angle as per the dimensions (4 x 45°) at four corners.
- Type command "c" to draw the circle. Then draw the circles as per the top view of the cavity plate by using circle command.
- Changing the view control as "SW isometer". Then type the command "EXT" extrude the rectangle. Select the rectangle the click the enter, then extrude -30 in 2 direction ('-' downward direction)
- Extrude all the circle (except the circle of Ø 26.26 & 3 x 12) by using same procedure as per the dimensions.
- Type command "Sub" to subtract the extruded holes from the solid object (Rectangle plate). Select the rectangle then click enter, then select the extruded circles. Now created the holes in the cavity plate.
- Now chamfering the circle edge of Ø 23.23 as per the dimension as (1.52 x 45°). Now extruded the 12 No. of circle 3 then subtract from the solid object.
- Now chamfering the hole of Ø18H7 as per the dimension as (2x45°). Draw the gate as per the dimension in front view of middle of the cavity plate.
- Type command "rev" to revolve the Gate and then subtract the revolved Gate from the solid object.
- Now the cavity plate is created in isometric view. The same procedure will follow for all the remaining parts.
- Assembly of two cavity injection mould
- Keep the view control as "SW isometric" view and visualize style as "wire frame" insert (001) copy and paste the all parts in one window.
- The center of the circle of Ø20.2 of the core pin is coincident with the center of the circle of Ø23.23 in cavity plate. Click Shift+Right click of the mouse. Then click the option center then move the cursor to the circle 20.2 the center point will shown then click the center the same procedure is use to the circle Ø23.23 and joint the cavity plate and core pin.
- Click Shift+Right click in the mouse. Select the option "mid point". Then move to the cursor to the chamfering of the core retainer and the same procedure is use to the chamfering edge of the cavity plate and join the cavity plate and core retainer. (The bottom view of the cavity plate coincident with the top view of the core retainer).
- The same way the center of the circle of Ø38.5 of the top plate is joined with the center of the circle of Ø18H7 of the cavity plate. (Bottom view of the top plate is coincident with the top view of the cavity plate)
- The center of the circle of Ø 28 of the guide pin is coincident with the center of the circle of Ø28.5 of the top plate. (The same procedure is used to another guide pin)
- The center of the circle of Ø3.5 of the sprue brush is joined with the water of the circle of Ø38.5 of the top plate.
- The center of the wide of 35 of the register ring is joined with the center of the circle of Ø38.5 of the top plate.
- Then the center of the wide of Ø28 of the guide bush is joined with the center of the circle of Ø28.5 of the core retainer.
- The same procedure is followed for standard parts (Part 17 & 19)
- Now the assembly of top portion of the two cavity injection mould is complied. (Fig 1)

Fig 1



- The center of the circle of 14 of the return pin is joined with the center of the circle of 14.5 of the ejector plat. In the same way ejector pin 1 & 2 is joined with the ejector plate.
- The center of the circle of M6 x of the ejector plate is joined with the center of the circle of 6.6 of the ejector back plate. (The bottom view of the ejector plate coincident with the top view of the ejector back plate) (Front face of the ejector plate parallel to the front face of the ejector back plate)
- Then the standard part 10 is joined with the ejector back plate.
- The center of the circle of 8 of the rest button is joined with the center of the circle of Ø8 of the bottom plate. (The top face of the rest button coincident with the bottom face of the ejector back plate) Now the standard part 20 is joined with the bottom plate.
- The center of the circle of Ø8.5 of the support block is joined with the center of the circle of 9 of the bottom

plate. (The front face of the support block parallel to the front face of the bottom plate. In the same way another support block is assembled).

- Now the bottom portion of the two cavity injection mould is assembled (Fig 2).
- The center of the circle of Ø8.5 of the cuppart block is joined with the center of the circle of M8 of the core retainer (Fig 3).
- Now the isometric view of two cavity injection mould is assembled. (Fig 4).

Fig 2

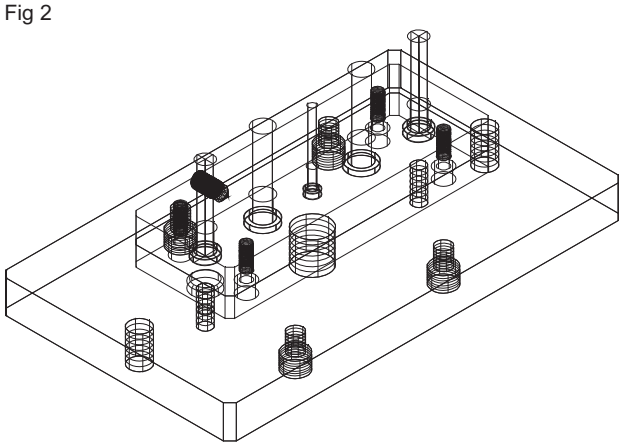


Fig 3

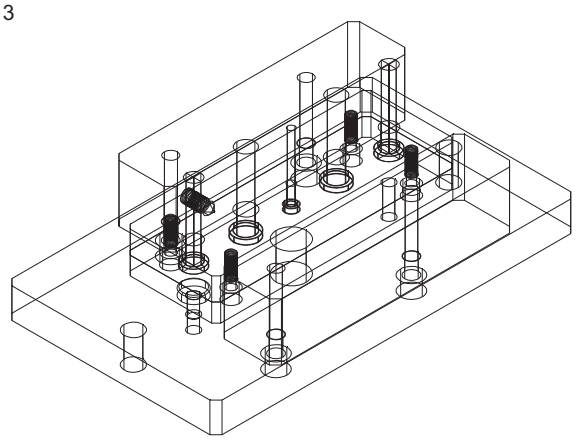
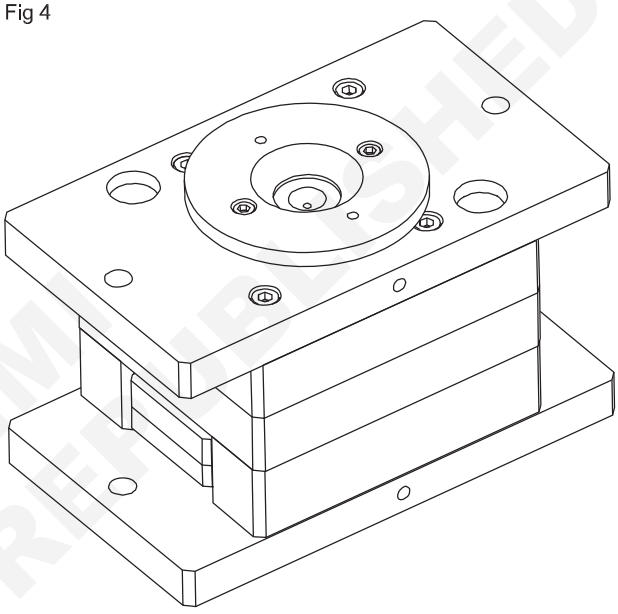


Fig 4



ASSEMBLY

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TASK 1: **Single cavity injection mould - cavity plate**

- Check the raw material 160 ISF 45-165.
- Hold the job in a machine vice.
- Mill the blank to 30.5 ± 0.1 x 140.5 ± 0.1 x 160.5 ± 0.1 mm, perpendicular within 0.1 and parallel within 0.1 mm.
- Grind the thickness to 30 ± 0.02 parallel within 0.02 mm.
- Grind reference sides (adjacent sides) perpendicular within 0.02 mm.
- Grind the blank to width 140 ±0.02 and to length 160±0.02 mm.
- Mark and punch the coordinates for the hole centres.
- Mark and punch the coordinates for the equal spaced holes, dia.3 x 12 for both cavities.
- Set the job on a milling machine.
- Obtain datum using center finder
- Move the machine table to locate hole centers.
- Drill hole dia.2.7mm (24 Nos.) to depth 13 ± 0.2 and increase the depth to 16.16 ± 0.06 using a flat drill dia.2.7mm.
- Ream hole to dia 3 H7 to depth 16.16 ± 0.06mm. (24 Nos.)
- Hold the job in a 4-jaw chuck.
- Locate the cavity centre and bore to dia.23.23 ± 0.02 to depth 16.16 ± 0.06mm.
- Chamfer the cavity as per drawing.
- Locate the centre of the job.
- Drill and enlarge the hole to dia.17.5 mm.
- Ream the hole to dia.18H7.

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- Reverse the job and chamfer 2 x 45°.
- Drill hole dia 6.8 mm (4 Nos.)
- Tap holes M8 (4 Nos.)
- Mill runner as per drawing using a runner formed single lip cutter dia 4mm.
- File the gate as per drawing.
- Chamfer as per drawing
- Repeat the same procedure for the second cavity.

Guide pin holes dia.24 H7 (2 Nos.) to be drilled and reamed in assembly with the top plate task 6 and the core retainer task 2.

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TASK 2: **Two cavity injection mould - core retainer**

- Check the raw material 160 ISF 45-165.
- Mill block to 30.5 ± 0.1 x 140.5 ± 0.1 x 160.5 ± 0.1 parallel within 0.1 mm and perpendicular within 0.1 mm.
- Grind thickness to 30 ± 0.02 parallel within 0.02mm.
- Grind reference sides (adjacent sides) perpendicular within 0.02 mm.
- Grind the blank to width 140 ± 0.02 and to length 160 ± 0.02 mm.
- Mark and punch the coordinates for hole centres.
- Drill holes dia 6.8 mm (4 Nos.)
- Tap M8 (4 Nos.)
- Set the job on a milling machine.
- Obtain the datum using the centre finder.
- Move the machine table to locate cavity centre as per drawing.
- Drill and ream dia 12H7.
- Bore and enlarge dia 20H7 to depth 20 ± 0.02 mm.
- Bore and enlarge dia 40H7 to depth 10 + 0.02mm.
- Move the machine table to locate the second cavity centre as per drawing. $^{0.01}$
- Repeat the same procedure and bore as first cavity.
- Drill and ream holes dia 10H7 (2 Nos.)
- Drill and ream hole dia 5H7.
- Set the job in a 4 - jaw independent chuck on the lathe.
- Locate dia 5H7 hole.
- Turn reverse taper to maximum dia 5.5, minimum dia. 5.05 to depth 4 ± 0.2 mm.
- Chamfer as per drawing.

Dia. 24H7 holes to be drilled and reamed in assembly with the cavity plate (Task 01) and top plate Task 06.

- Set dia. 24H7 (2 holes) individually and counter bore to dia. 28.5 to depth 4 + 0.02 mm.

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TASK 3: **Two cavity injection mould - core pin**

- Check the raw material dia.45 x 50mm (2 Nos.)
- Hold the job in a 3-jaw chuck on the lathe.
- Face and centre drill dia.2.5 mm.
- Reverse the job and hold in the chuck.
- Face to length 45 ± 0.1 mm.
- Centre drill dia.2.5 mm.
- Hold the job in between centres.
- Turn dia.40.3 ± 0.1 to length 22 ± 0.5 mm.
- Turn dia.20.3 to length 9.8 ± 0.1 mm.
- Chamfer as per drawing.
- Reverse the job and hold in between centres.
- Turn dia.20.5 to length 24.8 ± 0.1 mm.
- Chamfer as per drawing.
- Hold the job in between centres on the cylindrical grinder.
- Grind dia.20g6 to length 10.2 ± 0.1 mm.
- Grind dia.40g6.
- Reverse the job and grind dia. 20.2 ± 0.02 to length 25 ± 0.02 such that 40g6 step length measures 10 – 0.02 mm.
- Hold the job in between centres on the lathe.
- Cut knuckle threads as per drawing.
- Face to total length 33.5 ± 0.1 mm as per drawing.
- Chamfer as per drawing.
- Hold the job in the V-block on the surface grinder using U-clamp.
- Grind on dia.20.2 top face to get depth 13.05 mm.
- Reverse the job and hold in the V-block using U -clamp
- Grind on dia.20g6 top face to length of 10 – 0.1 mm.

- Grind across flat as per drawing.
- Repeat the same procedure for the second core pin.

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TASK 4: **Two cavity injection mould - Ejector plate**

- Check the raw material 65 ISF 20-165.
- Mill block to 15.5 ± 0.1 x 60.5 ± 0.1 x 160.5 ± 0.1 parallel within 0.1 and perpendicular within 0.1 mm.
- Grind thickness to 15 ± 0.02 parallel within 0.02 mm.
- Grind reference sides (adjacent sides) perpendicular within 0.02 mm.
- Mark and punch the coordinate for hole centres.
- Obtain datum using the centre finder.
- Drill holes dia.10.5mm (2 Nos.) and counter bore dia.14.5 to depth 3. $0^{+0.02}$ mm.
- Drill holes dia.12.5 mm (2 Nos.) and counter bore dia.16.5 to depth $3^{+0.02}_{+0.00}$ mm
- Drill hole dia.5.5 and counter bore dia.8.5 to depth
- Drill holes dia.5 mm (4 Nos.)
- Tap M6 (4 Nos.)
- Chamfer as per drawing.

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TASK 5: **Two cavity injection mould - Ejector back plate**

- Check the raw material 65 ISF 16 - 165.
- Mill block to 12.5 ± 0.1 x 60.5 ± 0.1 x 160.5 ± 0.1 parallel within 0.1 and perpendicular within 0.1 mm.
- Grind thickness to 12 ± 0.02 parallel within 0.02 mm.
- Grind reference sides (adjacent sides) perpendicular within 0.02 mm.
- Mark and punch the coordinates for hole centres.
- Drill holes dia.6.6 mm (4 Nos.)
- Counter bore holes dia.11 to depth 7 ± 0.1 mm.
- Chamfer as per drawing.

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TASK 6: **Two cavity injection mould - Top plate**

- Check the raw material.
- Mark and punch the coordinates for the hole centres.
- Drill hole dia. 5 mm (2 Nos.) depth 16 ± 0.2 mm.
- Drill hole dia. 9 mm (4 Nos.) and counter bore to dia.14.5 and to depth 9 ± 0.1 mm.
- Drill and enlarge the hole to dia.12.5 mm (2 Nos.)
- Hold the job in a 4-jaw independent chuck.
- Locate the centre of the job.
- Drill and enlarge the hole to dia.30 mm.
- Bore to dia.38.5± 0.01 and counter bore to dia.90H7 to depth 4 ± 0.02 mm.
- Mill the groove for the keyway as per drawing.
- Tap M6 (2 Nos) to depth 12 ± 0.5 mm.
- Drill hole dia. 6.8 to deep 20 ± 0.2 mm.
- Tap hole M8 to deep 15 mm as per drawing.
- Chamfer as per drawing.
- Set dia.24H7 (2 holes) individually and counter bore to dia.28.5 and to depth 4 + 0.02 mm.

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TASK 7: **Two cavity injection mould - Bottom plate**

- Check the raw material.
- Mark and punch the coordinates for the hole centres.
- Drill hole 9mm (4 Nos). and counter bore to dia. 14.5 to depth 9 ± 0.1mm.
- Drill and enlarge the hole to dia.12.5 mm (2 Nos.)
- Drill a hole to dia 7.7mm (2 Nos).
- Ream the hole to dia.8H7 (2 Nos.)
- Drill and enlarge the hole to dia.20mm.
- Drill hole dia. 6.7 to deep 20 ± 0.2mm.
- Chamfer as per drawing.

— — — — — — —

TASK 8: **Two cavity injection mould - Support block-2 Nos**

- Check the raw material square 45 mm to length 165 mm.
- Hold the job in the machine vice.
- Mill the block to 38.5± 0.1 x 39.5 ± 0.1 x 160.5 ± 0.1, perpendicular within 0.1 mm and parallel within 0.1 mm.
- Grind the thickness to 38 ± 0.02 parallel within 0.02mm.
- Grind the reference sides (adjacent sides) perpendicular within 0.02 mm.
- Mark and punch coordinates for hole centres.
- Drill hole dia.8.5 mm (2 Nos.)
- Chamfer as per drawing.
- Repeat the same procedure for making the second piece.

— — — — — — —

TASK 9: **Two cavity injection mould - Register Ring**

- Check the raw material dia.150 mm to a length of 17 mm.
- Hold the job in a 3-jaw chuck such that 13 length project out.
- Turn dia. $11^{+0.10}_{+0.0}$ to a length 12.5 ±0.1 mm.
- Turn dia.90H9 to a length 4 0 $^{+0.1}_{-0.1}$ mm
- Centre drill dia.2.5 mm.
- Pre-drill dia.5 and enlarge to dia.30 mm.
- Bore the job to dia.35 ± 0.1 mm.
- Bore taper by the swivelling compound slide to 45°± 5' as per drawing.
- Reverse the job and hold dia.90 mm such that dia.110 mm project out.
- Face dia.110 to a length 8 ±0.1 mm.
- Chamfer as per drawing.
- Drill hole dia.6.6 mm (2 Nos) and counter bore to dia.11.5 mm (2 Nos).
- Drill hole dia.5 mm (2 Nos).
- Tap M6 (2 Nos).

— — — — — — —

TASK 10 to 15: **Two cavity injection mould**

- Check the raw material size
- Study the part drawing and list out the tools required.
- Prepare the CNC programme for turning
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Get it checked by the trainer.
- Set hte workpiece on CNC turning center.
- Set the tool in turret in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page, tool nose radius and style of tool.
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single block by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

— — — — — — —

TASK 16: **Two cavity injection mould - Sprue bush**

- Check the raw material - dia. 40 mm to length of 50 mm.
- Hold the job in a 3-jaw chuck such that length 35 mm project out.
- Face to get perpendicularity.
- Turn to dia.22 ± 0.01 to length 30 ± 0.1 mm.
- Turn to dia.18.5 ± 0.1 to length 28 ± 0.1 mm.
- Turn radius R2 using form tool.
- Center drill dia.2.5 mm.
- Drill hole dia.3.3 mm.
- Ream hole dia.3.3 using the taper reamer (1:50).
- Reverse the job and face to total length 47 ±0.1 mm.
- Turn remaining length to dia.38.5 ± 0.1 mm.
- Turn radius R 11 using form tool.

- Hold the job on milling machine in vice using a 'V' block.
- Mill the runner as per drawing using form single lip cutter.
- Drill hole dia.3.7 perpendicular to the runner axis to depth 6 ± 0.2 mm.
- Ream hole dia.4H7.
- Hold the job in a 4-jaw chuck on cylindrical grinding machine.
- Grind dia 18k6 to length 30.5 ± 0.1 mm.
- Grind remaining length to dia. 38 ± 0.1 mm.
- Hold the job in the V-block using a U-clamp on surface grinder.
- Grind 0.5 ± 0.02 mm from both the faces as per drawing.

Skill Sequence

"Cutting knuckle thread" on Lathe

Objective: This shall help you to
- **form a knuckle thread cutting on a lathe.**

Check the raw material size 63 x 138.

Hold the job about 85 mm inside the 4 jaw chuck and true it.

Turn 58 mm to a length of 40 mm.

Chamfer the end to 3 x 45°.

Reverse the job and hold 58 mm side and true it.

Finish the face at the over hanging end to given length of 35 mm and centre drill.

Support the job with centre.

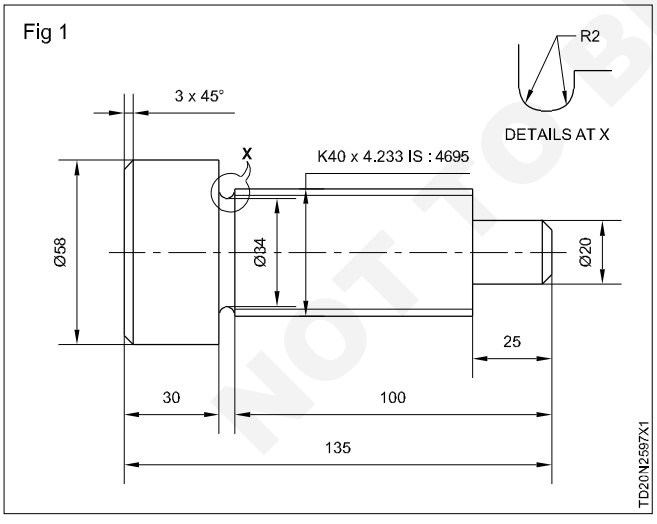
Rough turn to 58 mm to the maximum possible length.

Step turn 40 mm to 100 mm length.

Step turn 20 mm to 25 mm length.

Under cut 34 x 5 as shown in the sketch. (Fig 1)

Fig 1

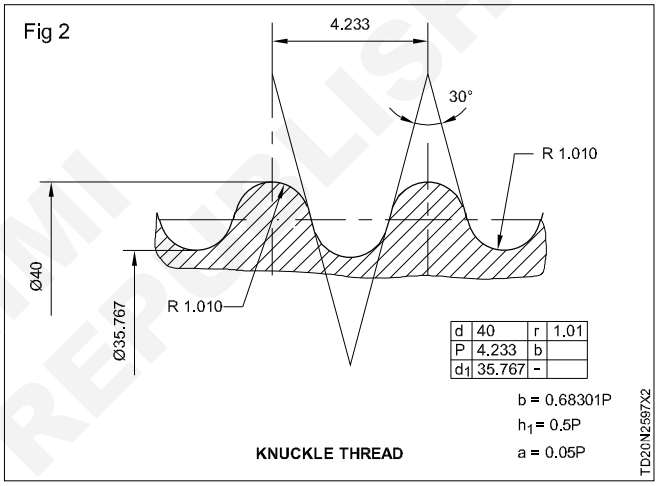


Chamfer the end of 20 mm side 3 x 45°.

Set the ground knuckle threat tool in the tool post, square to the axis of the work.

Set the machine for 4.233 mm pitch/6 TPI right hand. (Fig 2)

Fig 2

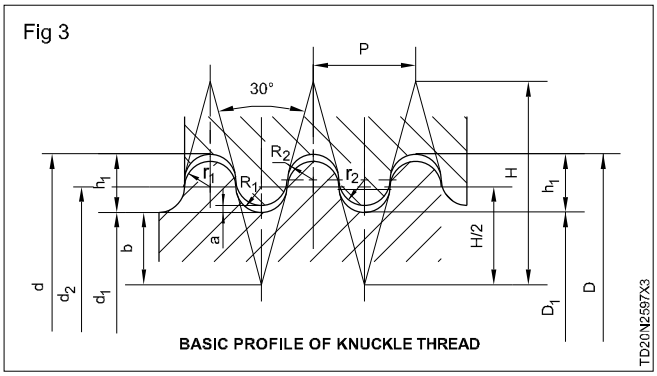


Cut and finish the right hand knuckle thread to given depth by plunge cut method.

As tool goes into depth reduce the depth of cut.

Finish the thread to given size (Root dia). (Fig 3)

Fig 3

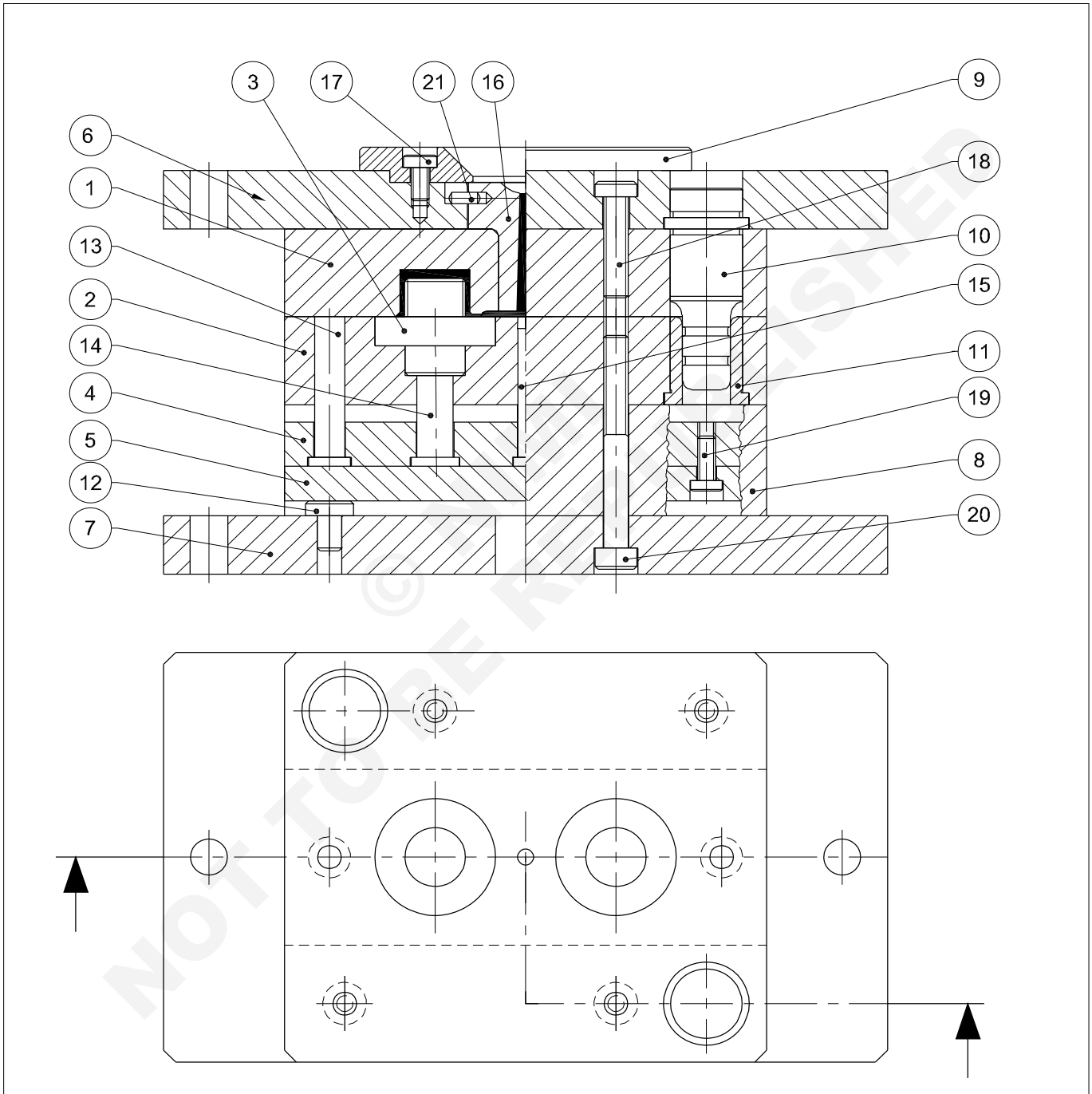


Use the same cut for finishing the thread three or four times.

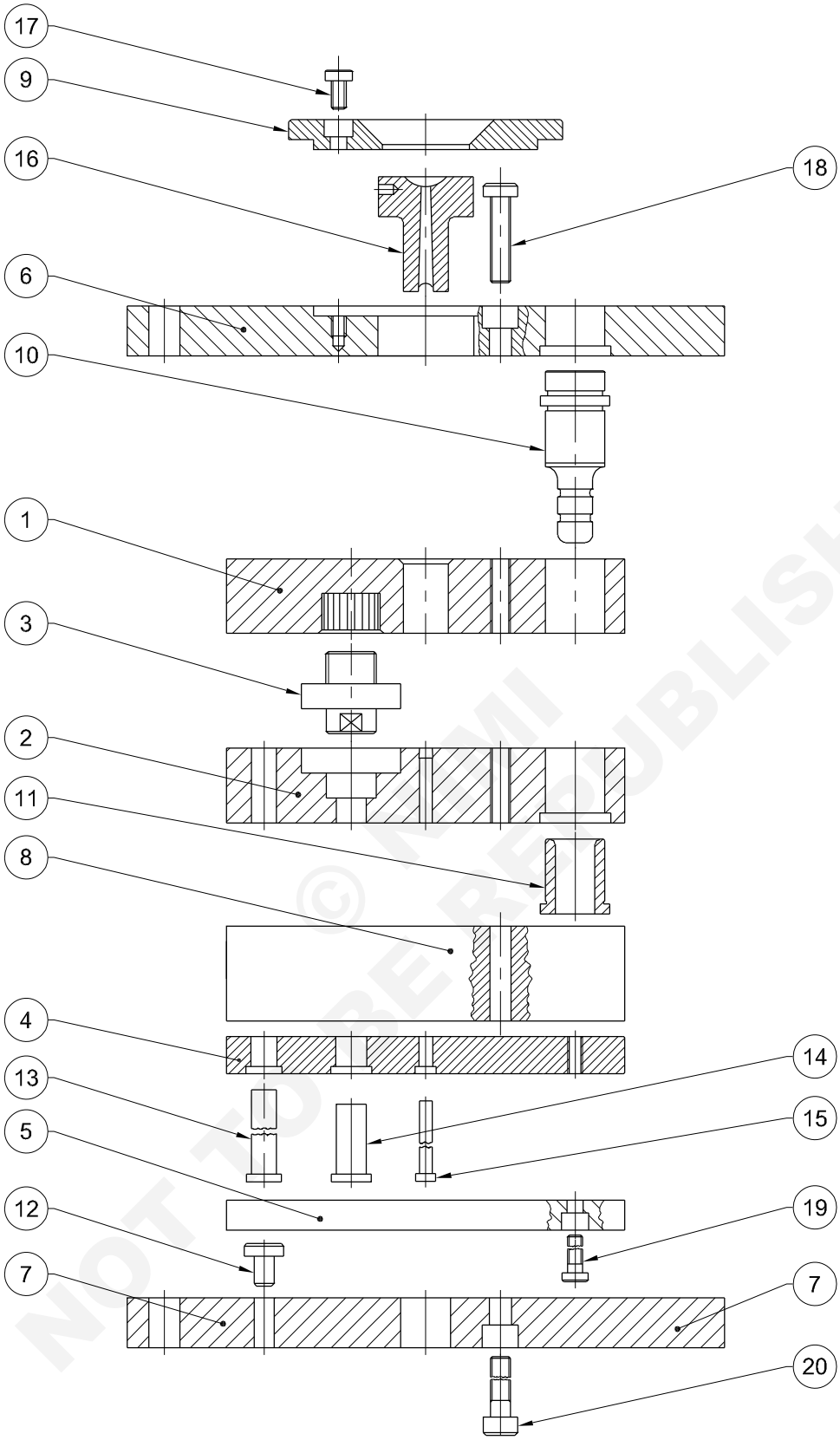
Set the "form tool" in the tool post and finish the thread of cuter profile and check.

Two cavity injection mould

Objectives: At the end of this exercise you shall be able to
- **assemble a two cavity injection mould as per drawing**
- **try out the 2 cavity injection mould**
- **rectify the faults.**

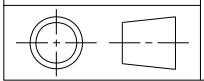


-	-	-	-		-	2.5.98
NO.OFF	STOCK SIZE	PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ASSEMBLY**				DEVIATIONS	TIME : hrs
					CODE NO. TD20N2598E1	



-	-	-	-		-	2.5.98
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ASSEMBLY**				DEVIATIONS ± 0.1	TIME
					CODE NO. TD20N2598E2	

1	DOWEL	DIA 4 x 10	STD		21	
4	SHCS	M8 x 70	STD		20	
4	SHCS	M6 x 15	STD		19	
4	SHCS	M8 x 30	STD		18	
2	SHCS	M6 x 10	STD		17	
1	SPRUE BUSH	DIA 40 x 50	Fe310	16	16	
1	EJECTOR PIN	DIA 10 x 52	Fe310	15	15	
2	EJECTOR PIN	DIA 18 x 36	Fe310	14	14	
2	RETURN PIN	DIA 20 x 55	Fe310	13	13	
2	REST BUTTON	DIA 20 x 22	Fe310	12	12	
2	GUIDE BUSH	Ø32-35	Fe310	11	11	
2	GUIDE PIN	Ø32-74	Fe310	10	10	
1	REGISTER RING	DIA 150 x 17	Fe310	09	09	
2	SUPPORT BLOCK	□ 45 x 165	Fe310	08	08	
1	BOTTOM PLATE	150 ISF 25 - 245	Fe310	07	07	
1	TOP PLATE	150 ISF 25 - 245	Fe310	06	06	
1	EJECTOR BACK PLATE	65 ISF 16 - 165	Fe310	05	05	
1	EJECTOR PLATE	65 ISF 20 - 165	Fe310	04	04	
2	CORE PIN	DIA 45 x 50	Fe310	03	03	
1	CORE RETAINER	150 ISF 40 - 165	Fe310	02	02	
1	CAVITY PLATE	150 ISF 40 - 165	Fe310	01	01	
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	TASK	PART NO.	EX. NO.

SCALE	**TWO CAVITY INJECTION MOULD**	DEVIATIONS	TIME
		CODE NO. TD20N2598E3	

Job Sequence

- Clean all the parts.
- Clean all the screw holes.
- Fit dowel dia.4 x 10 mm in the sprue bush.
- Fit the guide pin in the cavity plate.
- Locate the sprue bush in the top plate such that the dowel fitted to the sprue bush aligns with the slot milled in top plate.
- Fit top plate assembly over the cavity plate assembly such that guide pin aligns to the respective bores in top plate and fasten with S H C S M8 x 30mm (4 Nos.)
- Assemble the register ring and the top plate with S H C S M6 x 10mm (2 Nos.)
- Fit bushes in the core retainer.
- Insert the core pin in the core retainer.
- Reverse the core retainer.
- Place the ejector plate over the core retainer.
- Insert the return pin and the ejector pin.
- Assemble the ejector plate and the ejector back plate with S H C S M6 x 15mm.
- Press fit the buttons on the bottom plate.

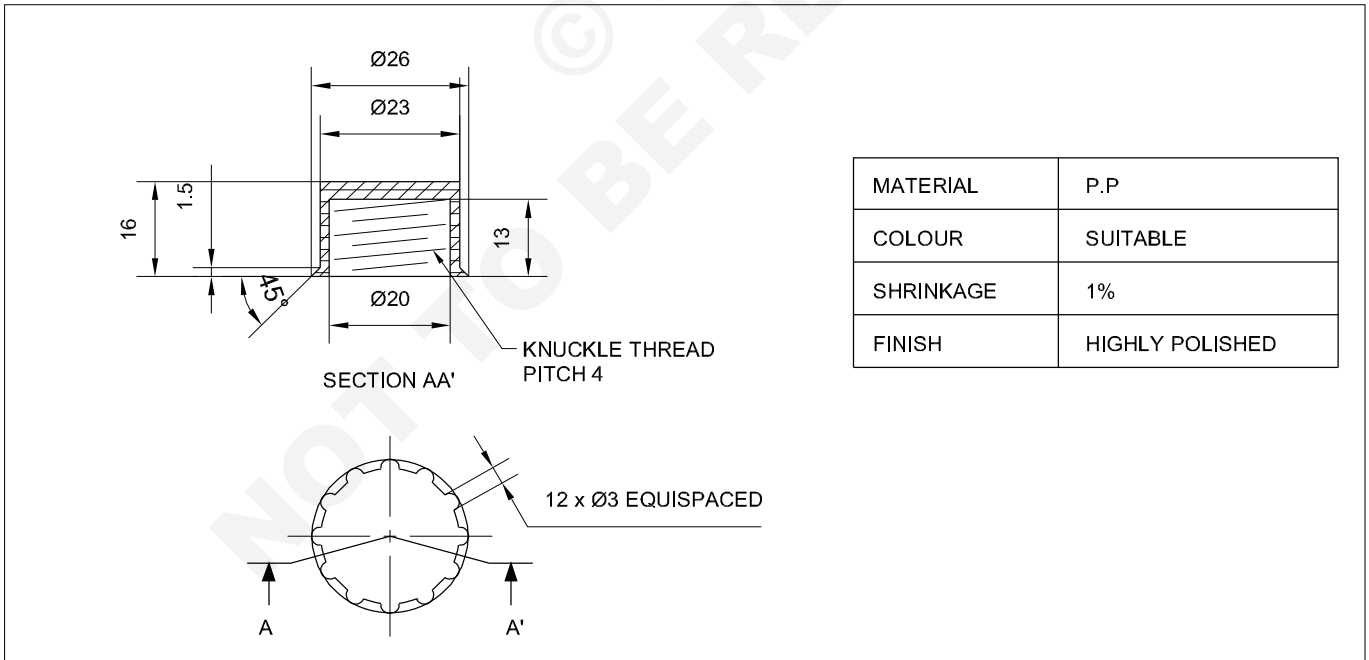
All rest buttons should have the same height.

- Place support block over core retainer in alignment with the screw holes.
- Place the bottom plate over the support block and clamp with S H C S M8 x 70 mm (4 Nos).
- Reverse the assembly and check the height of the ejector pins and return pin.
- Close both the mould halves.
- Fix the tie bar.
- Fix eye bolt.

Two cavity injection mould trial

Refer single cavity injection mould trials.

Unscrew the moulding from threaded insert. Fix inserts before closing the mould for the next shot.



MATERIAL	P.P
COLOUR	SUITABLE
SHRINKAGE	1%
FINISH	HIGHLY POLISHED

NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
-	-	-	P.P		-	2.5.98

SCALE 1:1	COMPONENT	DEVIATIONS ±0.2	TIME
		CODE NO. TD20N2598E4	

Single cavity plunger type transfer mould

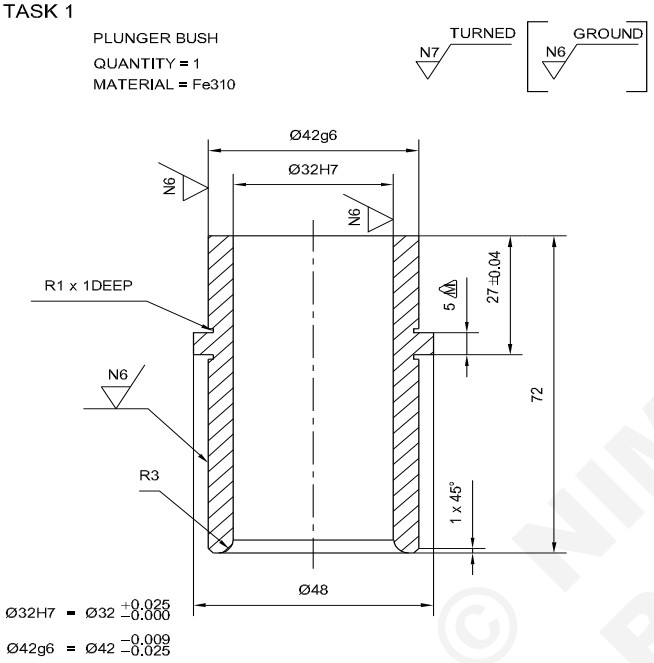
Objectives: At the end of this exercise you shall be able to

- **manufacture the various components of mould**
- **maintain the dimentional tolerance and geometrical tolarence as per drawing.**
- **assembly the mould and try out.**

Note : Group activity (5 traineer per group)

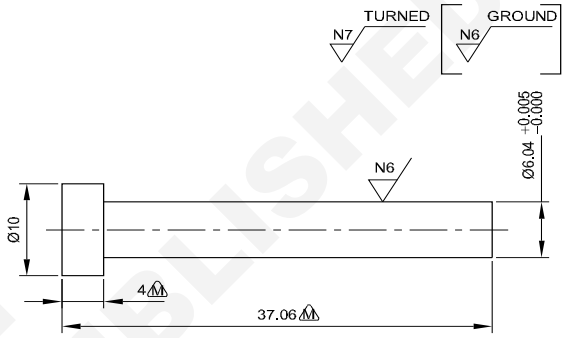
TASK 1

PLUNGER BUSH
QUANTITY = 1
MATERIAL = Fe310



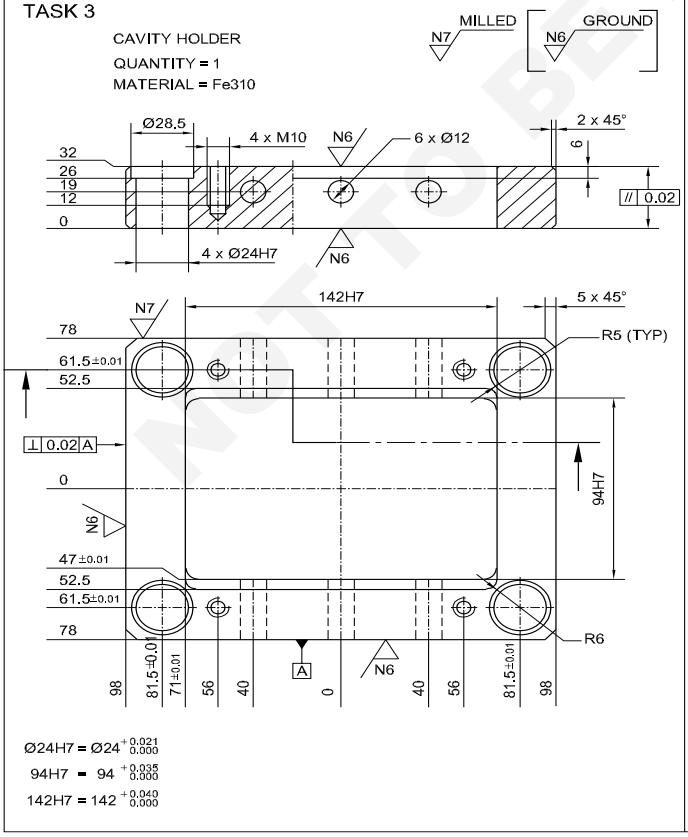
TASK 2

CORE INSERT
QUANTITY = 2
MATERIAL = Fe310



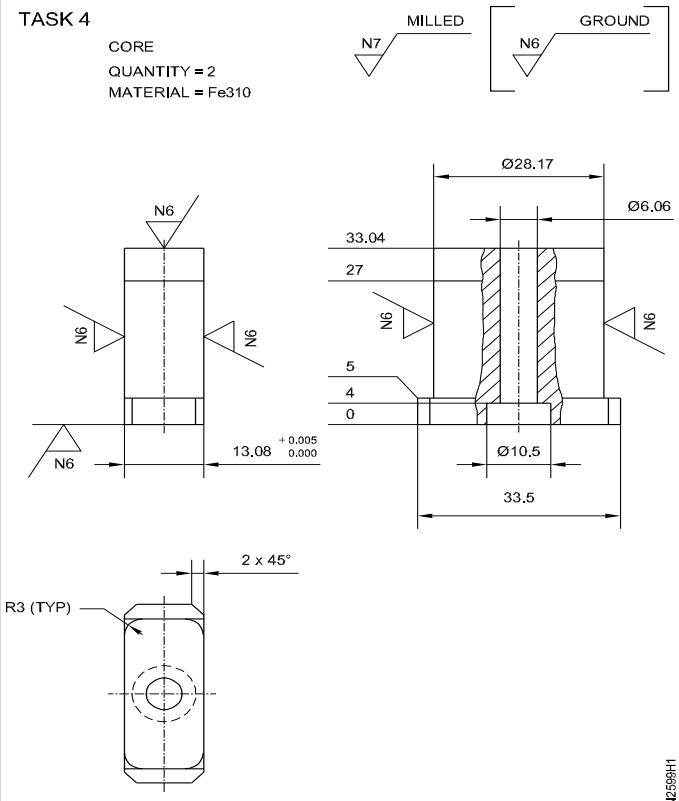
TASK 3

CAVITY HOLDER
QUANTITY = 1
MATERIAL = Fe310



TASK 4

CORE
QUANTITY = 2
MATERIAL = Fe310



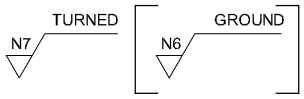
TD20N2598H1

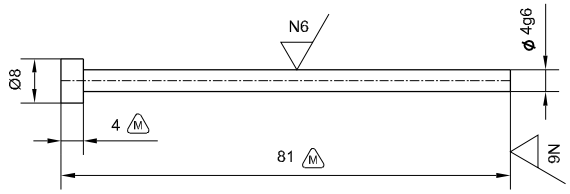
TASK 5

EJECTOR PIN

QUANTITY = 8

MATERIAL = Fe310





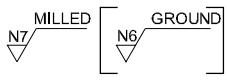
Ø4g6 = Ø4 $^{-0.004}_{-0.012}$

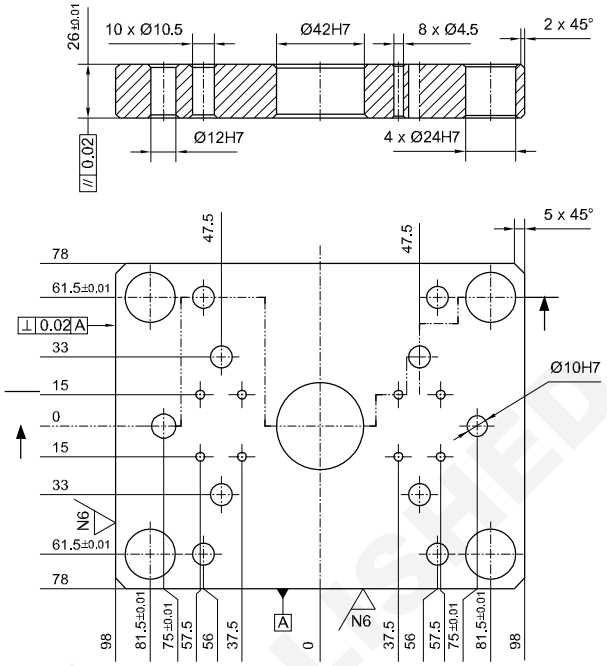
TASK 6

CORE BACK PLATE

QUANTITY = 1

MATERIAL = Fe310



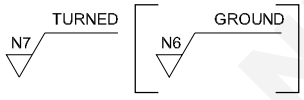


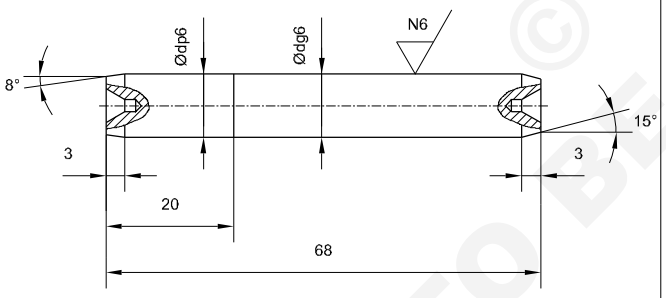
TASK 7

GUIDE PIN

QUANTITY = 2

MATERIAL = Fe310





Ød	QTY
Ø10	01
Ø12	01

Ø10p6 = Ø10 $^{+0.024}_{-0.015}$

Ø10g6 = Ø10 $^{+0.005}_{-0.014}$

Ø12p6 = Ø12 $^{+0.029}_{-0.018}$

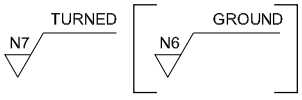
Ø12g6 = Ø12 $^{+0.006}_{-0.017}$

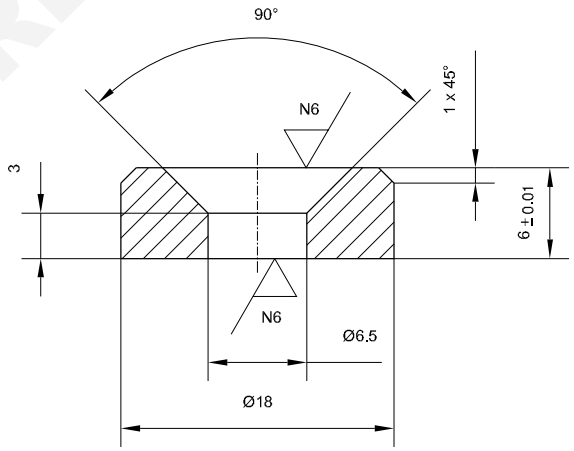
TASK 8

WEAR PLATE

QUANTITY = 4

MATERIAL = Fe310





TD20N2599H2

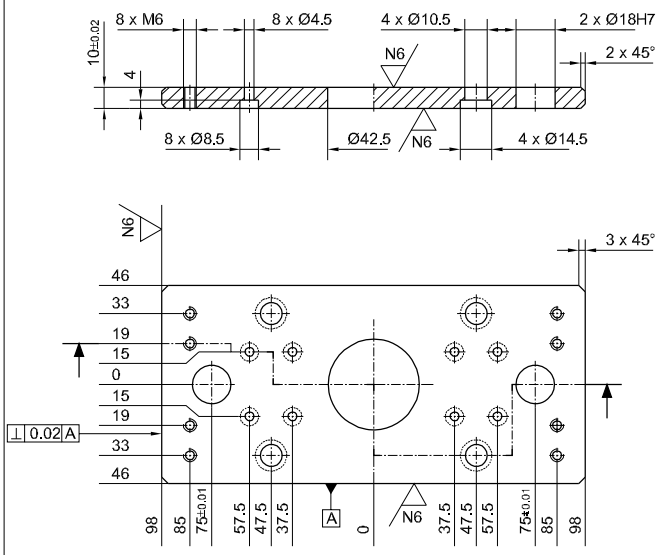
TASK 9

EJECTOR PLATE

QUANTITY = 1

MATERIAL = Fe310

MILLED N7 GROUND N6



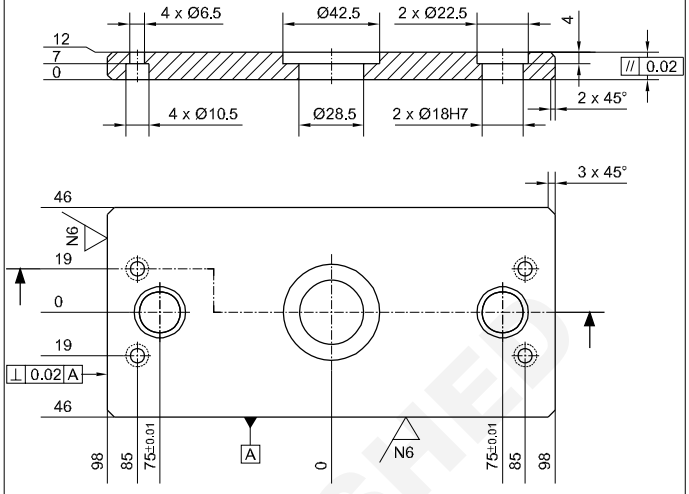
TASK 10

EJECTOR BACK PLATE

QUANTITY = 1

MATERIAL = Fe310

MILLED N7 GROUND N6



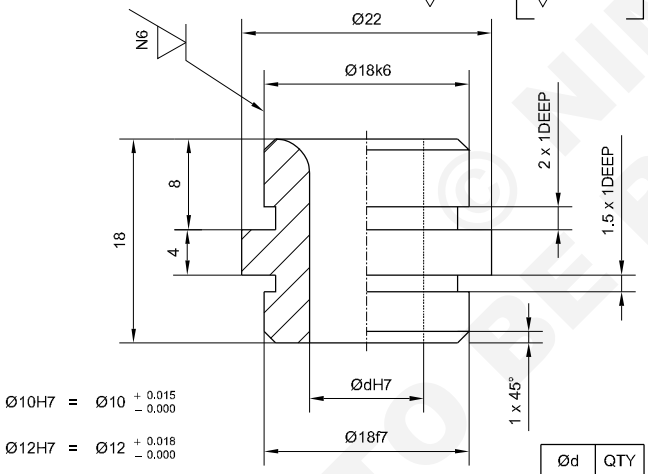
TASK 11

EJECTOR GUIDE BUSH

QUANTITY = 1

MATERIAL = Fe310

MILLED N7 GROUND N6



Ø10H7 = Ø10 $^{+0.015}_{-0.000}$

Ø12H7 = Ø12 $^{+0.018}_{-0.000}$

Ød	QTY
Ø10	01
Ø12	01

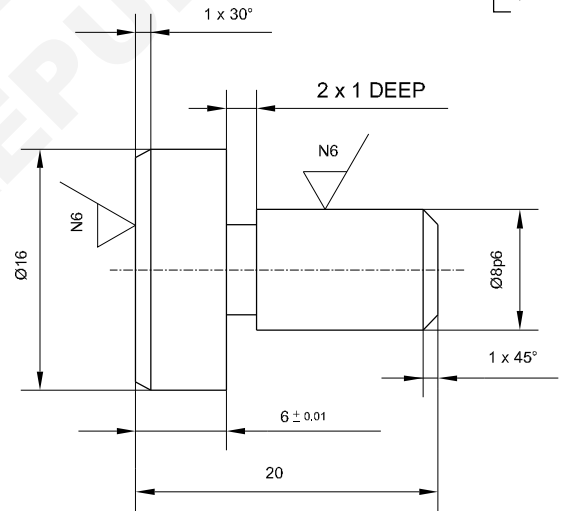
TASK 12

REST BUTTON

QUANTITY = 4

MATERIAL = Fe310

MILLED N7 GROUND N6



Ø8p6 = Ø8 $^{+0.024}_{+0.015}$

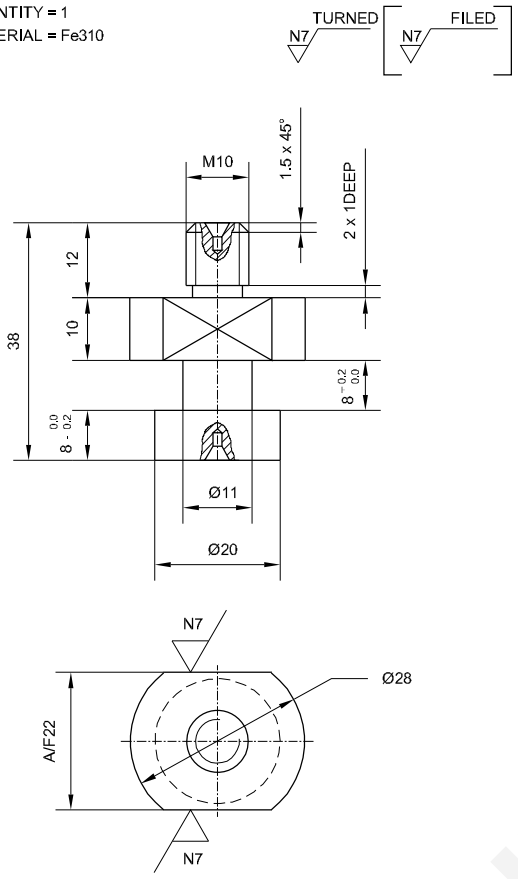
TD20N2599H3

TASK 13

ADAPTER

QUANTITY = 1

MATERIAL = Fe310

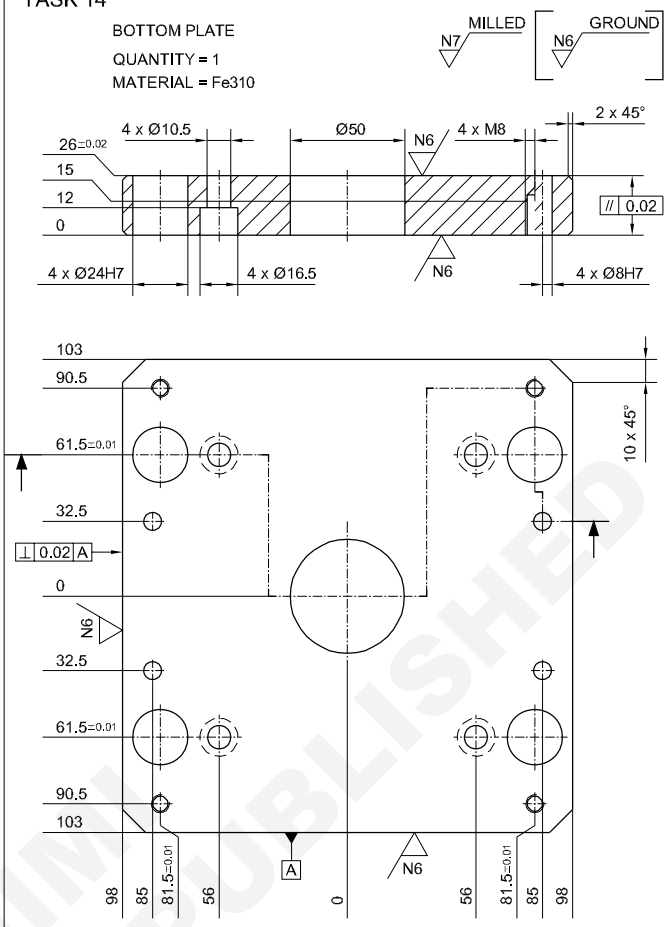


TASK 14

BOTTOM PLATE

QUANTITY = 1

MATERIAL = Fe310

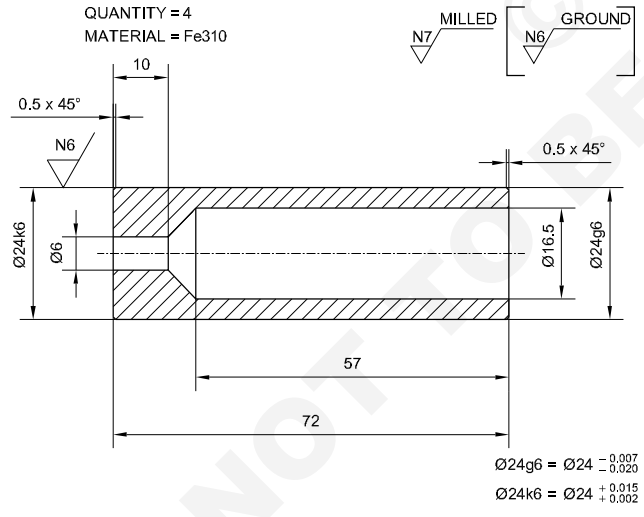


TASK 15

ALIGNMENT BUSH

QUANTITY = 4

MATERIAL = Fe310

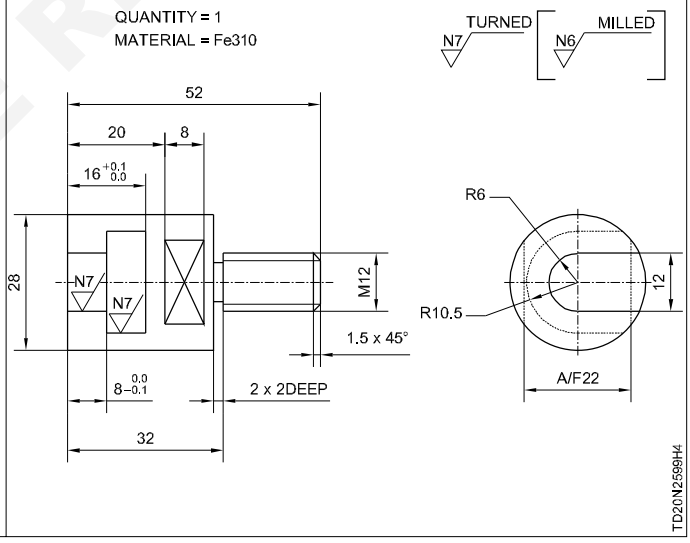


TASK 16

COUPLER

QUANTITY = 1

MATERIAL = Fe310

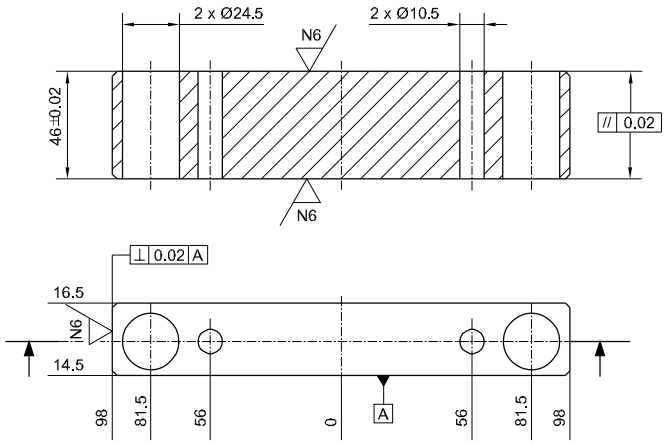


TASK 17

SUPPORT BLOCK

QUANTITY = 2

MATERIAL = Fe310

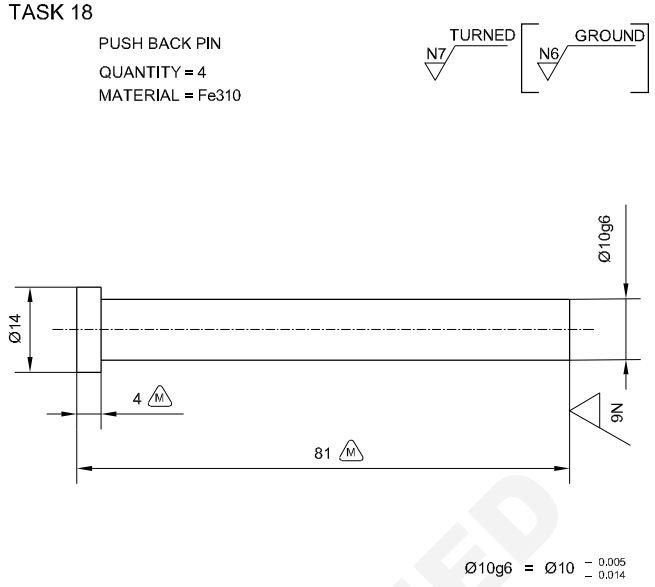


TASK 18

PUSH BACK PIN

QUANTITY = 4

MATERIAL = Fe310

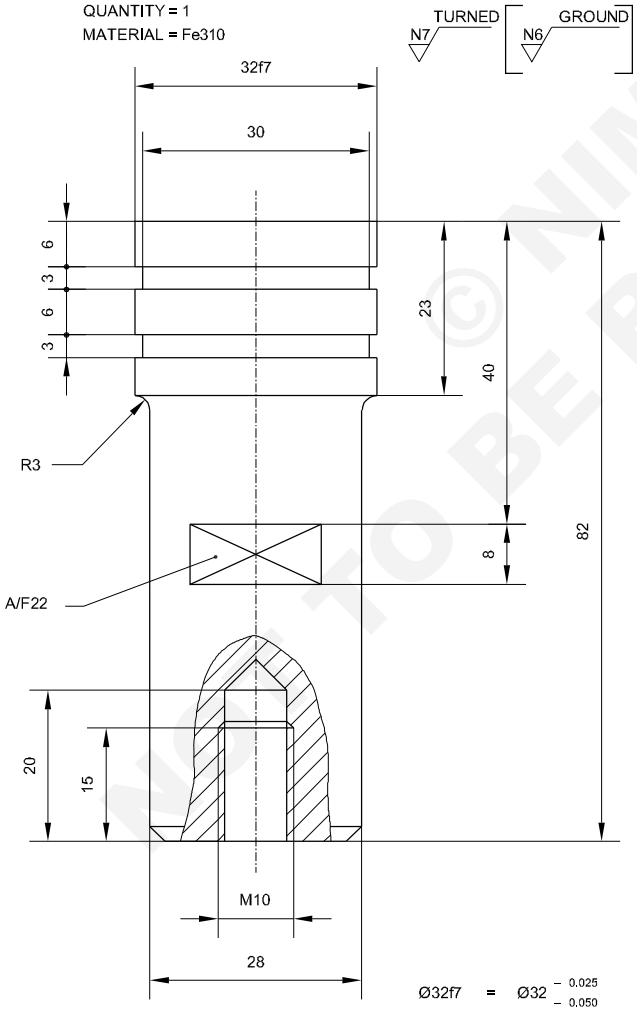


TASK 19

PLUNGER

QUANTITY = 1

MATERIAL = Fe310

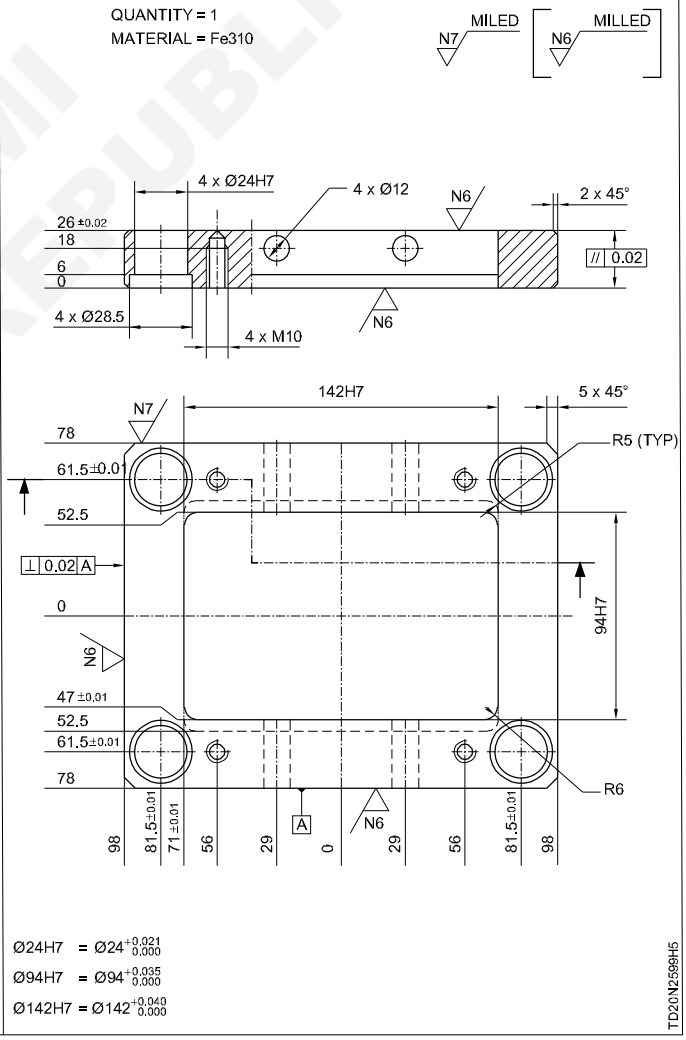


TASK 20

CORE HOLDER

QUANTITY = 1

MATERIAL = Fe310



TD20N2599H5

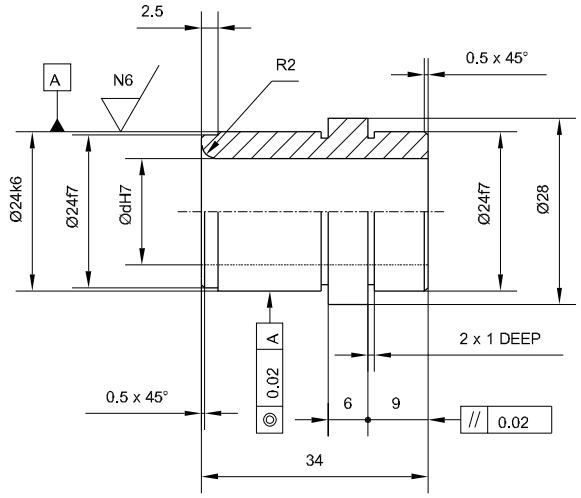
TASK 21

GUIDE BUSH

QUANTITY = 4

MATERIAL = Fe310

TURNED N7 GROUND N6



Ø24k6 = Ø24 $^{+0.015}_{+0.002}$

Ø24f7 = Ø24 $^{+0.020}_{-0.041}$

Ø15H7 = Ø15 $^{+0.018}_{0.000}$

Ø16H7 = Ø16 $^{+0.018}_{0.000}$

S.No	d	Qty
1	Ø15	1
2	Ø16	3

TASK 22

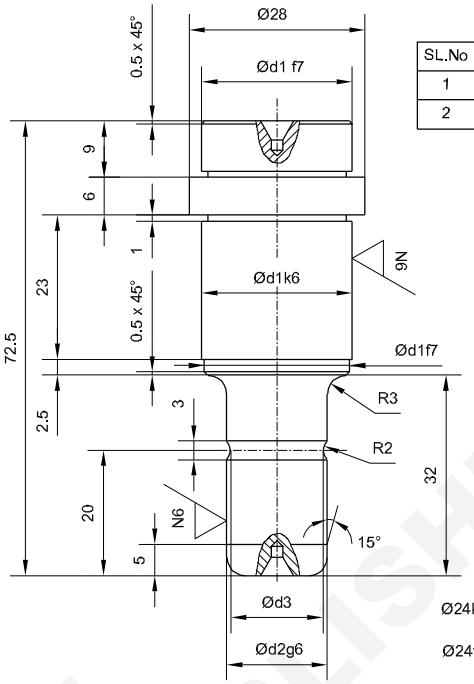
GUIDE PILLAR

QUANTITY = 4

MATERIAL = Fe310

TURNED N7 GROUND N6

SL.No	Ød1	Ød2	Ød3	Qty
1	24	16	15.5	03
2	24	15	14.5	01



Ø24k6 = Ø24 $^{+0.015}_{+0.002}$

Ø24f7 = Ø24 $^{-0.020}_{-0.041}$

Ø16g6 = Ø16 $^{-0.006}_{-0.017}$

Ø15g6 = Ø15 $^{-0.006}_{-0.017}$

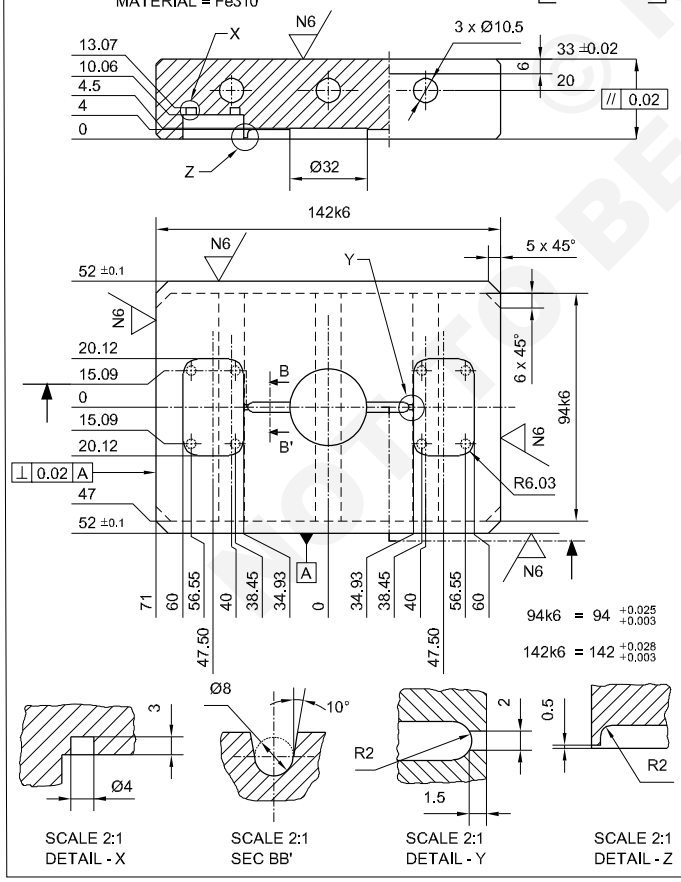
TASK 23

CAVITY INSERT

QUANTITY = 1

MATERIAL = Fe310

MILED N7 GROUND N6



94k6 = 94 $^{+0.025}_{+0.003}$

142k6 = 142 $^{+0.028}_{+0.003}$

SCALE 2:1 DETAIL - X

SCALE 2:1 SEC BB'

SCALE 2:1 DETAIL - Y

SCALE 2:1 DETAIL - Z

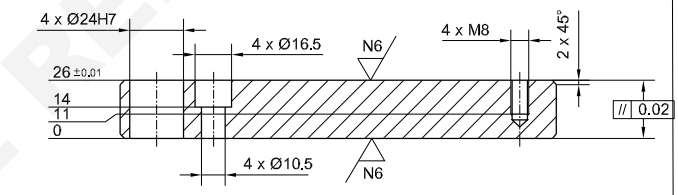
TASK 24

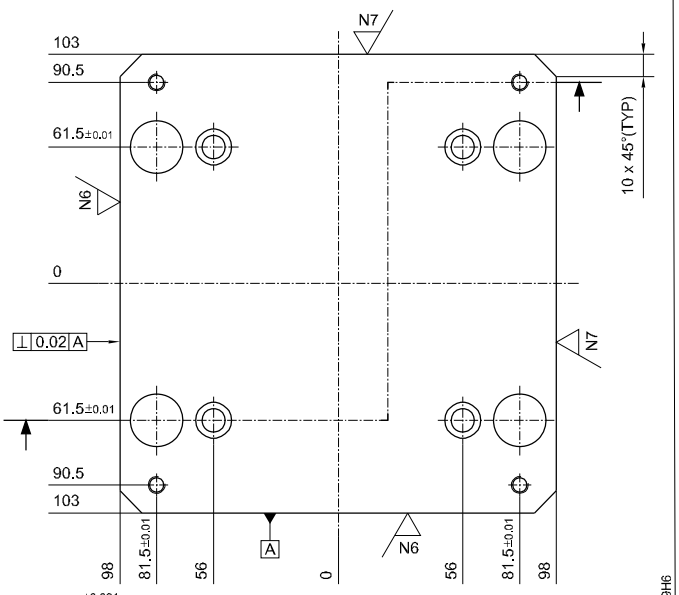
TOP PLATE

QUANTITY = 1

MATERIAL = Fe310

MILED N7 MILLED N6





24H7 = 24 $^{+0.021}_{+0.000}$

TD20N2599H6

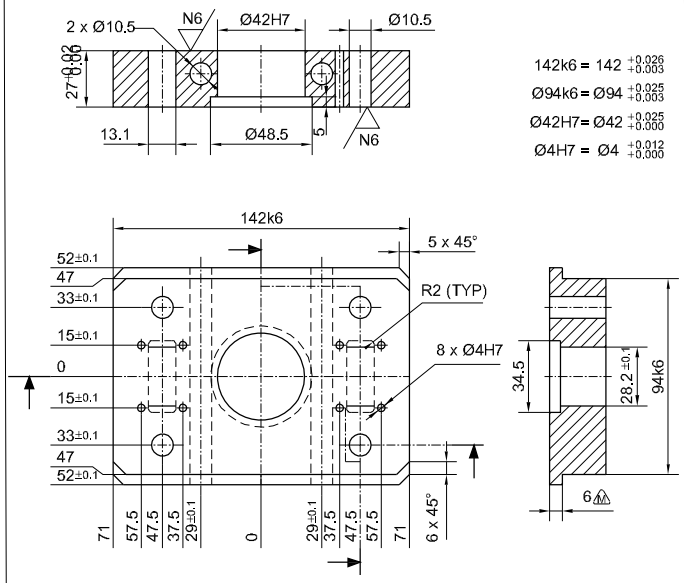
TASK 25

CORE HOLDER INSERT

QUANTITY = 1

MATERIAL = Fe310

MILED N7 GROUND N6



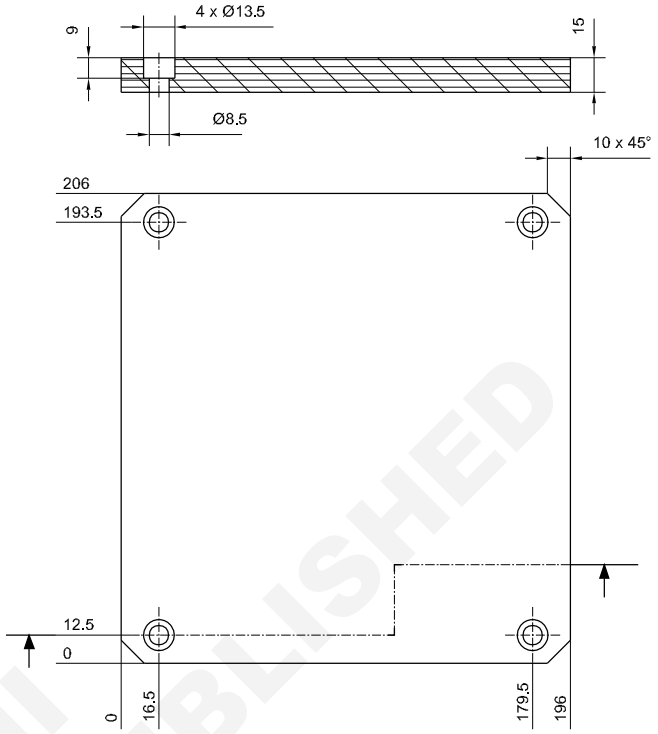
TASK 26

SYNDANIUM SHEET (TOP)

QUANTITY = 1

MATERIAL = Fe310

MILED N7



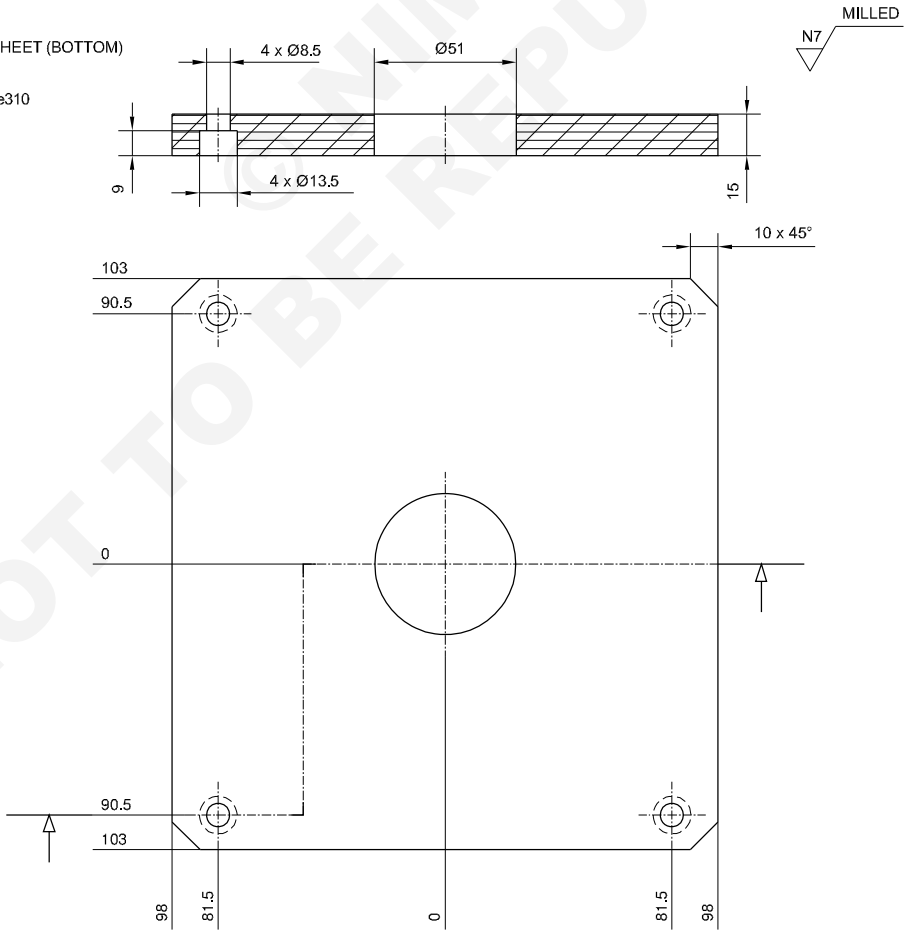
TASK 27

SYNDANIUM SHEET (BOTTOM)

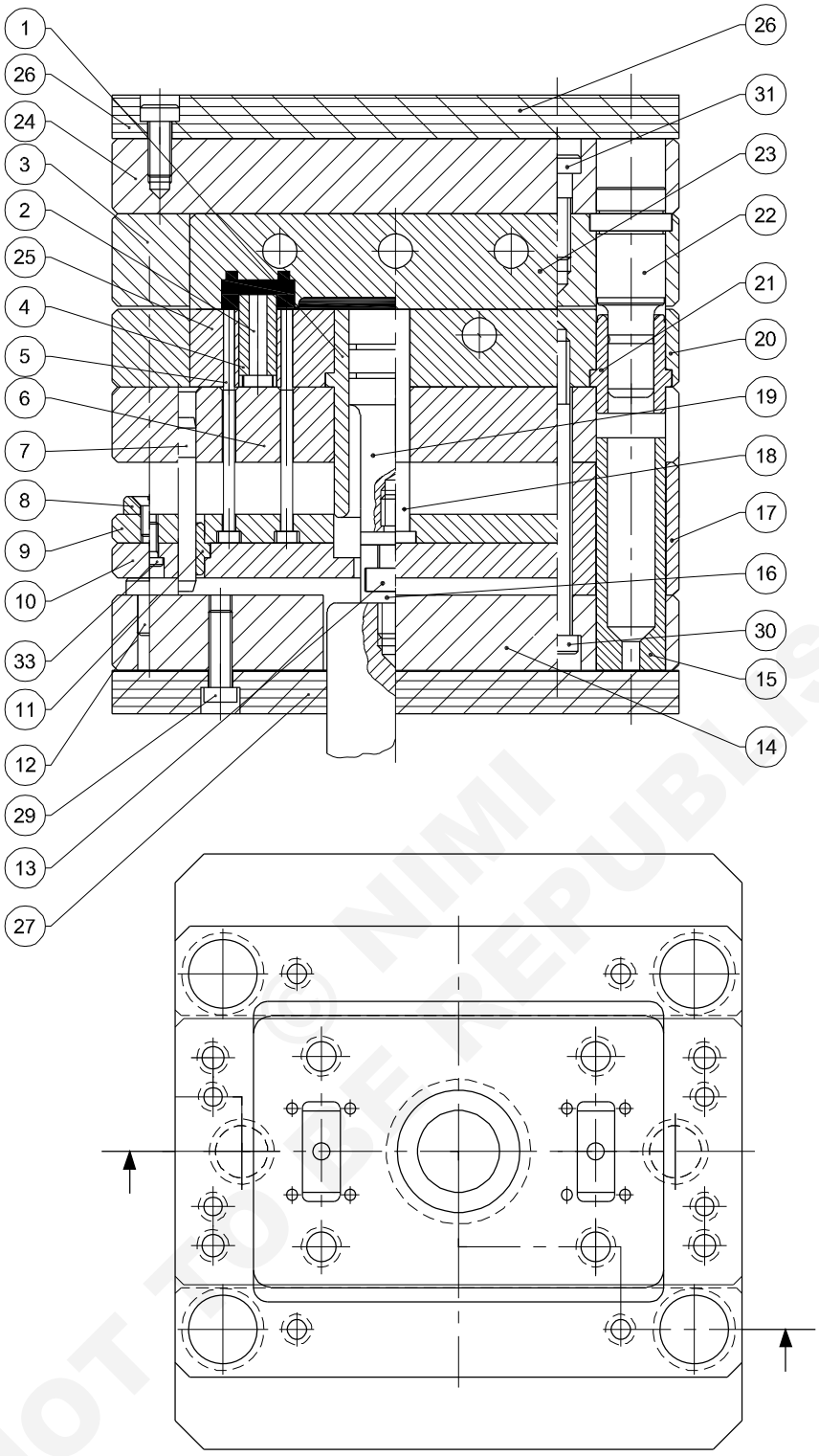
QUANTITY = 1

MATERIAL = Fe310

MILLED N7

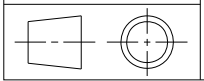


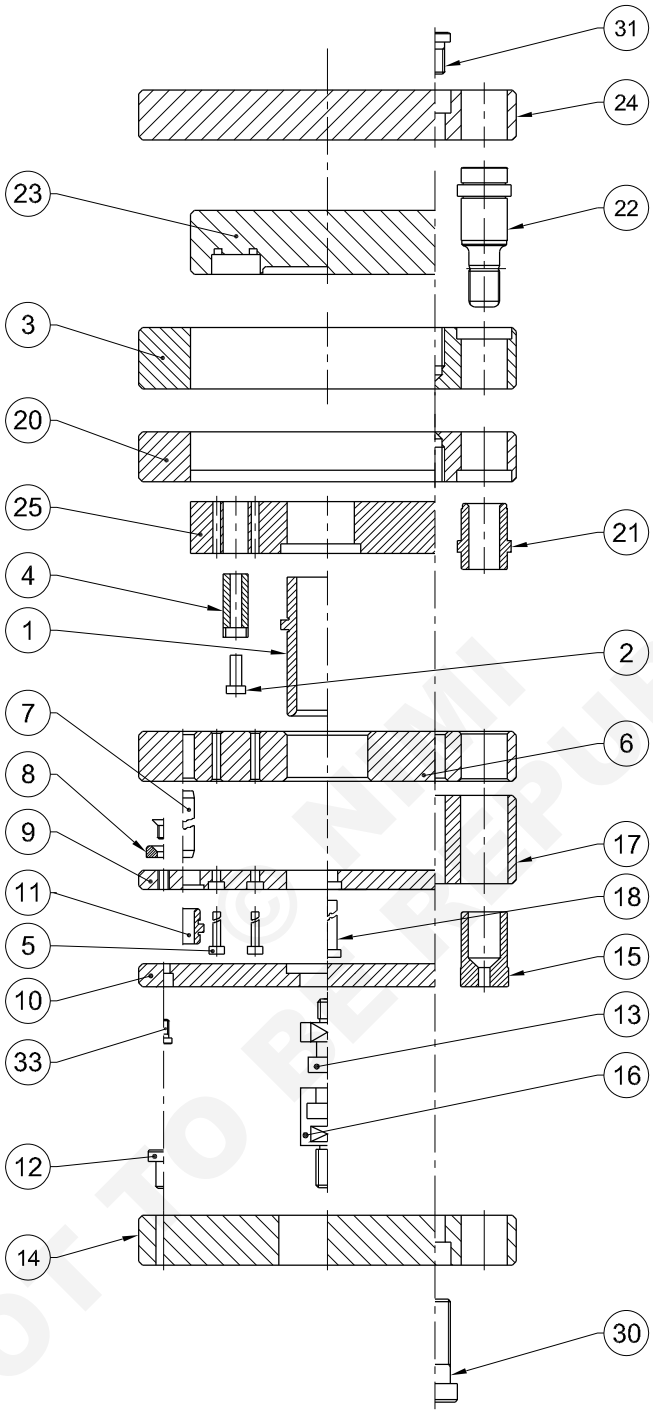
TD20N2599H7



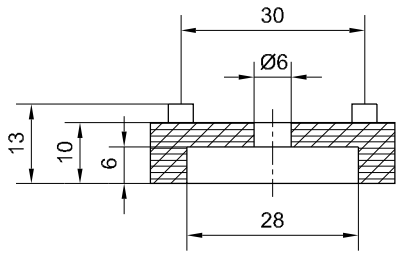
-	-	-	-	-	-	2.5.99
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	**ASSEMBLY**				DEVIATIONS	TIME :
					CODE NO. TD20N2599E1	

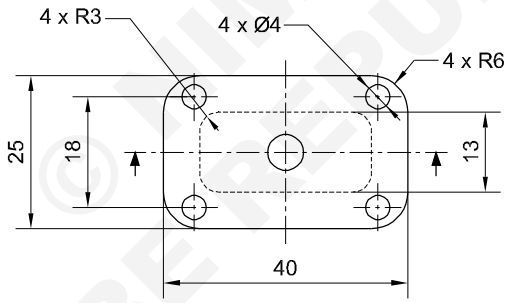
4	SKTHD	M6 x 15	STD	28		
4	SKTHD	M8 x 20	STD			
4	SKTHD	M10 x 40	STD			
4	SKTHD	M10 x 110	STD			
4	SKTHD	M8 x 20	STD			
4	CSK SCREW	M6 x 10	STD			
1	SYNDANIUM SHEET(BOTTOM)	15 x 200 - 210	-	27	27	
1	SYNDANIUM SHEET(TOP)	15 x 200 - 210	-	26	26	
1	CORE HOLDER INSERT	30 ISF 120 - 150	Fe310	25	25	
1	TOP PLATE	30 ISF 200 - 210	Fe310	24	24	
1	CAVITY INSERT	40 ISF 120 - 150	Fe310	23	23	
4	GUIDE PILLAR	ISRO 32 x 77	Fe310	22	22	
4	GUIDE BUSH	ISRO 32 x 40	Fe310	21	21	
1	CORE HOLDER	30 ISF 160 - 200	Fe310	20	20	
1	PLUNGER	ISRO 40 x 87	Fe310	19	19	
4	PUSH BACK PIN	ISRO 16 x 86	Fe310	18	18	
2	SUPPORT BLOCK	40 ISF 50 - 200	Fe310	17	17	
1	COUPLER	ISRO 32 x 57	Fe310	16	16	
4	ALIGNMENT BUSH	ISRO 32 x 77	Fe310	15	15	
1	BOTTOM PLATE	30 ISF 200 - 210	Fe310	14	14	
1	ADAPTOR	ISRO 32 x 43	Fe310	13	13	
4	REST BUTTON	ISRO 20 x 25	Fe310	12	12	
2	EJECTOR GUIDE BUSH	ISRO 28 x 25	Fe310	11	11	
1	EJECTOR BACK PLATE	15 ISF 100 - 200	Fe310	10	10	
1	EJECTOR PLATE	15 ISF 100 - 200	Fe310	09	09	
4	WEAR PLATE	ISRO 20 x 10	Fe310	08	08	
2	GUIDE PIN	ISRO 16 x 73	Fe310	07	07	
1	CORE BACK PLATE	30 ISF 160 - 200	Fe310	06	06	
8	EJECTOR PIN	ISRO 10 x 85	Fe310	05	05	
2	CORE	ISRQ 40 x 16	Fe310	04	04	
1	CAVITY HOLDER	40 ISF 160 - 200	Fe310	03	03	
2	CORE INSERT	ISRO 16 x 42	Fe310	02	02	
1	PLUNGER BUSH	ISRO 56 x 77	Fe310	01	01	
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	TASK	PART NO.	EX. NO.

SCALE	**PROJECT: PLUNGER TYPE TRANSFER MOULD**	DEVIATIONS	TIME
		CODE NO. TD20N2599E2	



-	-	-	-	-	-	2.5.99
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ASSEMBLY**				DEVIATIONS	TIME
					CODE NO. TD20N2599E3	





MATERIAL - H x 5211
SHRINKAGE - 0.006 mm/mm

-	-	-	-	-	-	2.5.99
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**COMPONENT (TRIAL)**	DEVIATIONS ±0.1	TIME
		CODE NO. TD20N2599E4	

PROCEDURE

TASK 1,2,5,12,15,18,21, & 22: **Single cavity plunger type transfer mould**

- Check the raw material size
- Study the part drawing and list out the tools required.
- Prepare the CNC programme for turning
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Get it checked by the trainer.
- Set the workpiece on CNC turning center.
- Set the tool in turret in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page, tool nose radius and style of tool.
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single b lock by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

— — — — — — —

TASK 3,6,9,10,14,20,23 & 25: **Single cavity plunger type transfer mould**

- Check the raw material size
- Study the part drawing and list out the tools required
- Face mill and side mill the workpiece as per drawing and maintain the sites with grinding allowances.
- Charmful the workpiece as shown in the drawing.
- Grind the thickness and maintain the oaralleism.
- Grind any two adjacent sidea perpendicular to each other
- Prepare the CNC programme for drilling and boring operations
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Get it checked by the trainer.
- Hold the workpiece on machine vice or with required clamping devise properly by keeping ground surfaces in X and Y axes
- Set the tool in ATC in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page, tool nose radius and style of tool.
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single block by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

— — — — — — —

TASK 4,7,8,11,13,16,,17,19,24,26 & 27 :

Trainee may be asked to write the job sequence and machine the workpiece on conventional machines and maintain dimensional tolerances, geometrical tolerances and surface finish.

— — — — — — —

TASK 28: **(Assembly)**

- Clean all the parts.
- Deburr the sharp edges if any.
- Clean all the screw holes.
- Fit cavity insert in cavity holder.
- Fit the guide pillar in cavity holder
- Fit the top plate over the cavity holder such that guide pillar (3.6.22) locates the boe in top plate.
- Clamp the top plate to cavity plate with SKT HD M 10 x 40mm depth (4 Nos.)
- Clamp the syndanium sheet (top) to top plate with SKT HD M8 to depth of 20mm (4Nos.)
- Fit core insert in core.
- Fit core holder insert assembly into core holder.
- Fit guide bush in core holder.
- Fit the plunger bush into core insert.
- Fit core back plate below the core holder such that guide bush fits inside the bore.
- Fit punger in plunger bush.
- Clamp wear plate to ejector plate with CSK screws M6 x 10mm depth (4 Nos.)
- Fit guide pin in core back plate.
- Fit guide bush in ejector plate.
- Guide the guide pin in guide bush.
- Insert the ejector pins and the return pins.
- Place the ejector back plate below the ejector plate such that guide bush fits inside the bore.
- Clamp the ejector back plate and ejector plate with SKT HD M6 x 15mm depth (4 Nos.)
- Fit the rest buttons on bottom plate.
- Fit aligning bush to bottom plate.
- Insert the support blocks in aligning bush.
- Place the bottom plate assembly under the core back plate in alignment with aligning bush and screw holes.
- Clamp the bottom plate support block core back plate and core plate with SKT HD M10 x 110 mm depth (4 Nos.)
- Clamp the syndanium sheet (bottom) to bottom plate (3.6.14) with SKT HD M8 x 20 mm depth (4 Nos.).
- Close both the mould halves.

— — — — — — —

Single cavity compression mould

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

- **manufacture the various components of single cavity compression mould**
- **maintain the dimentional tolerance and geometrical tolerance as per drawing**
- **assembly the single cavity compression mould**
- **try out the mould and rectify the faults.**

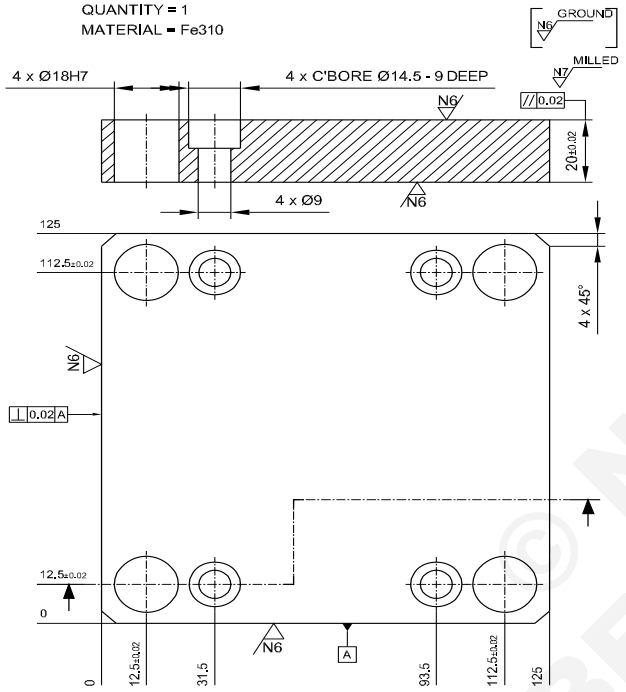
Note : Group activity (5 traineer per group)

TASK 1

TOP PLATE

QUANTITY = 1

MATERIAL = Fe310

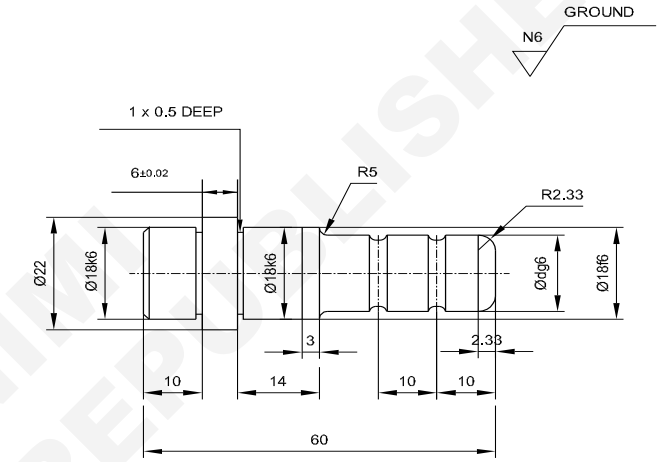


TASK 2

GUIDE PIN

QUANTITY = 1+3

MATERIAL = Fe310



Ø18k6	$18^{+0.012}_{+0.001}$
Ø18f6	$18^{-0.016}_{-0.034}$

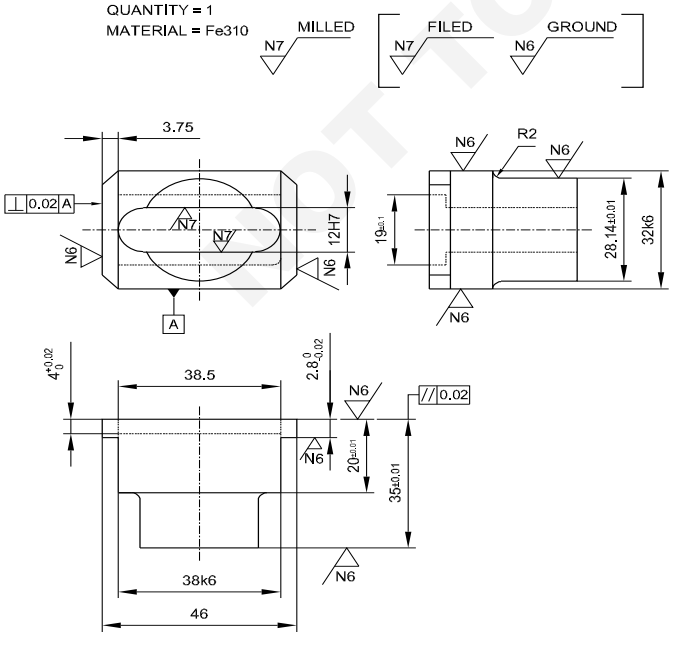
QTY	1	3
Ødg6	10	11

TASK 3

CORE

QUANTITY = 1

MATERIAL = Fe310

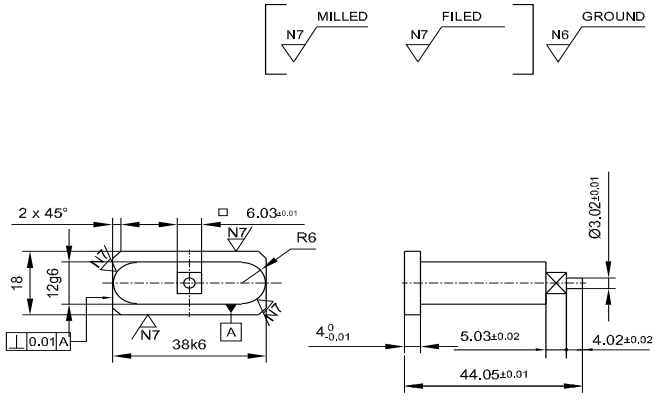


TASK 4

CORE INSERT

QUANTITY = 1

MATERIAL = Fe310



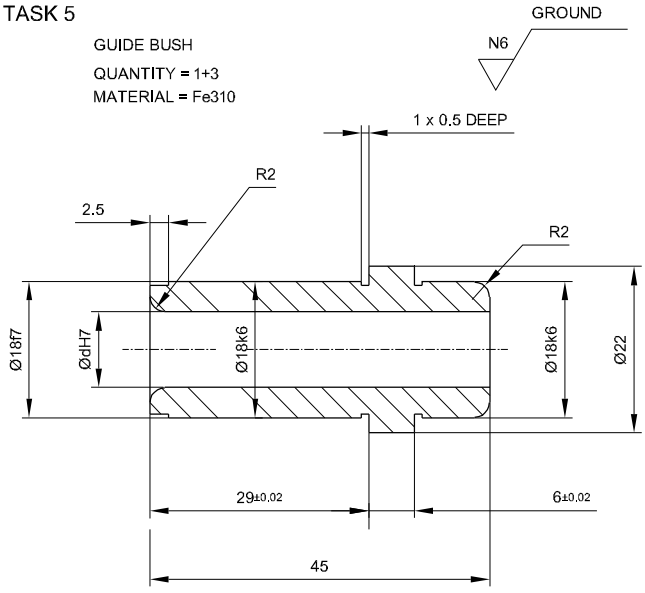
TD20N2599H8

TASK 5

GUIDE BUSH

QUANTITY = 1+3

MATERIAL = Fe310



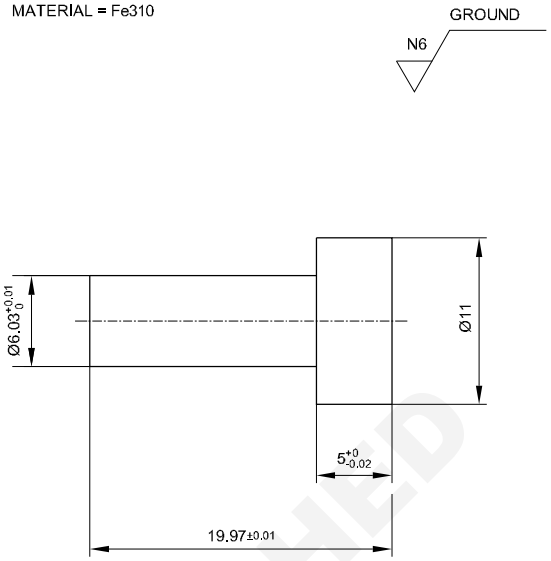
QTY	1	3
ØdH7	10	11

TASK 6

CORE PIN

QUANTITY = 1

MATERIAL = Fe310

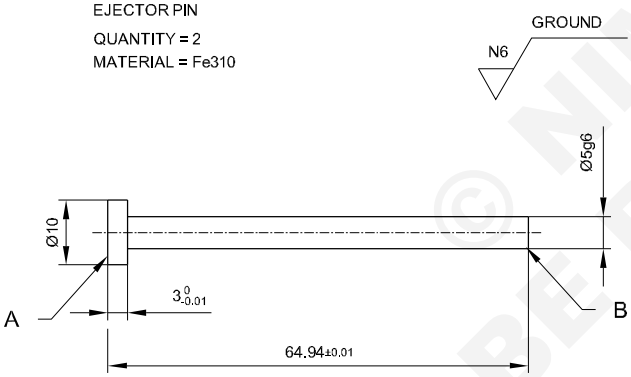


TASK 7

EJECTOR PIN

QUANTITY = 2

MATERIAL = Fe310

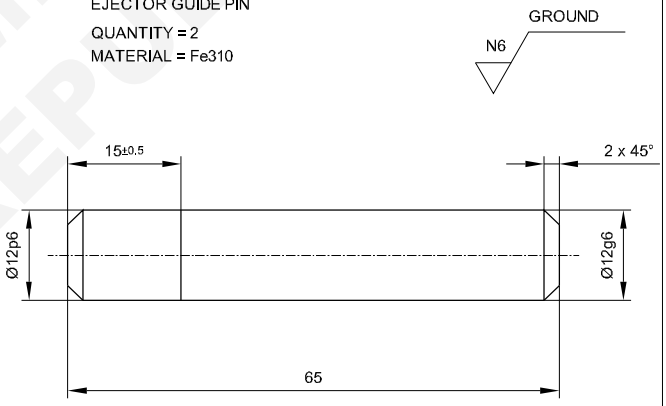


TASK 8

EJECTOR GUIDE PIN

QUANTITY = 2

MATERIAL = Fe310



$Ø12p6 = Ø12\ ^{+0.029}_{+0.018}$

$Ø12g6 = Ø12\ ^{-0.006}_{-0.017}$

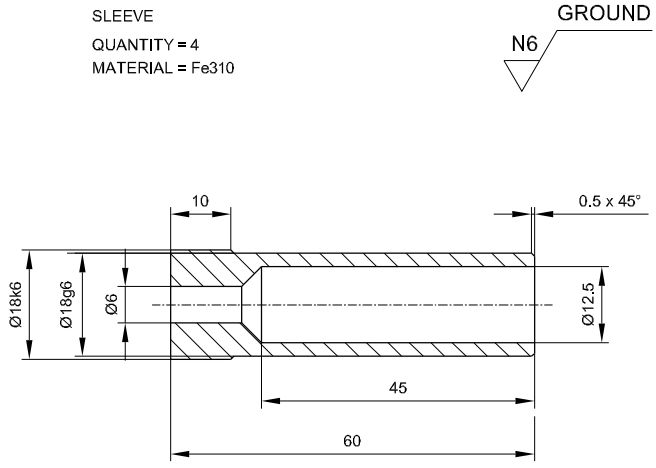
TD20N2598H9

TASK 9

SLEEVE

QUANTITY = 4

MATERIAL = Fe310

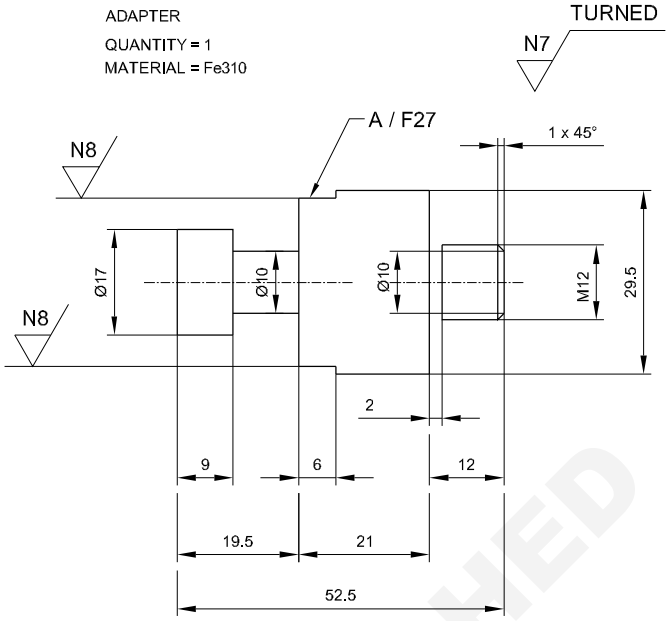


TASK 10

ADAPTER

QUANTITY = 1

MATERIAL = Fe310

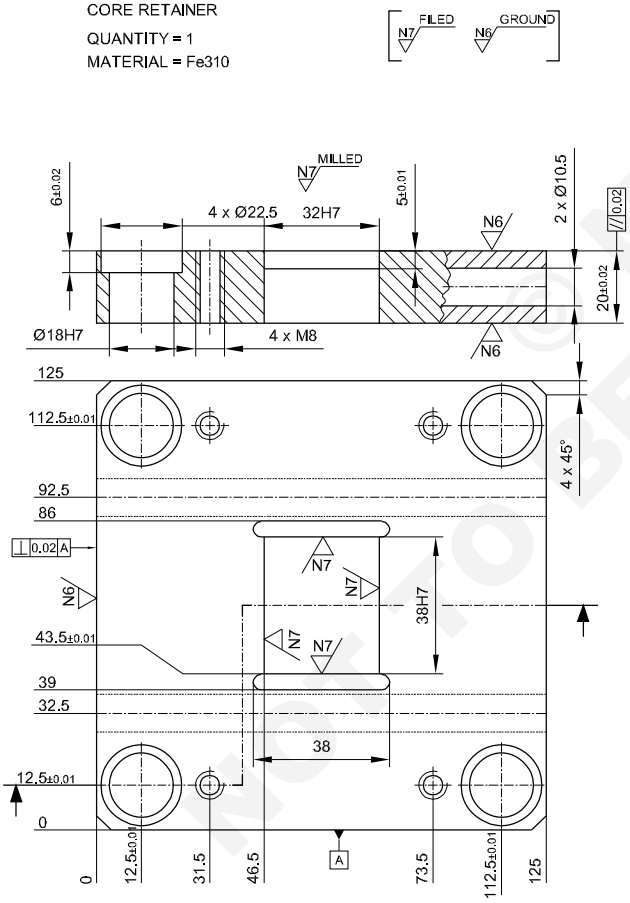


TASK 11

CORE RETAINER

QUANTITY = 1

MATERIAL = Fe310

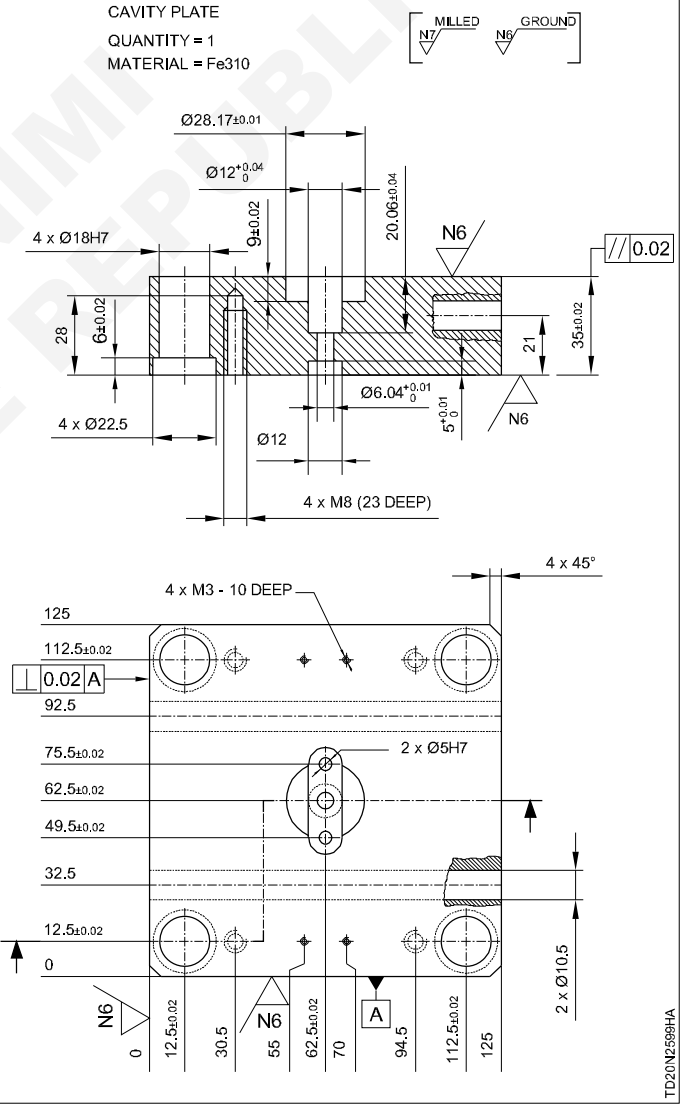


TASK 12

CAVITY PLATE

QUANTITY = 1

MATERIAL = Fe310



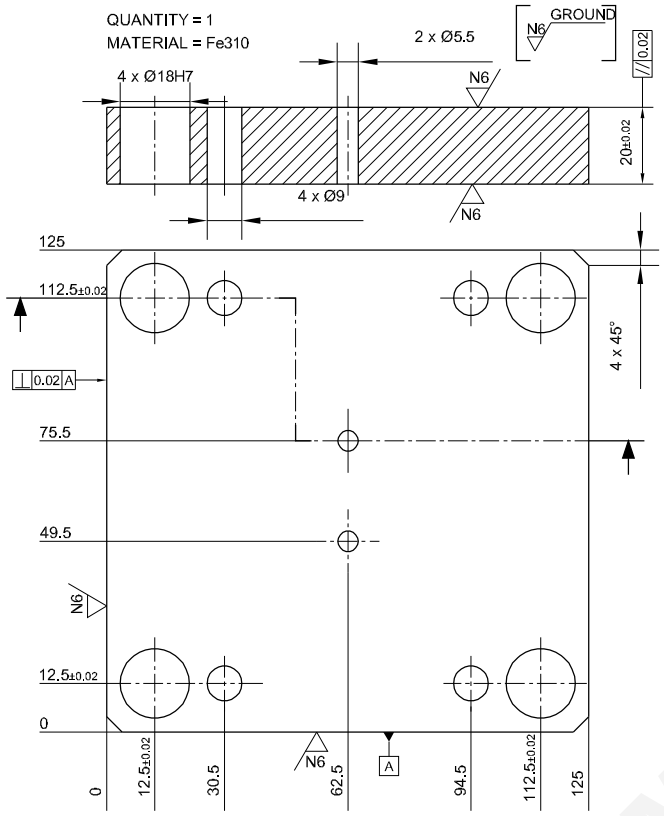
TD20N2599HA

TASK 13

CAVITY BACK PLATE

QUANTITY = 1

MATERIAL = Fe310

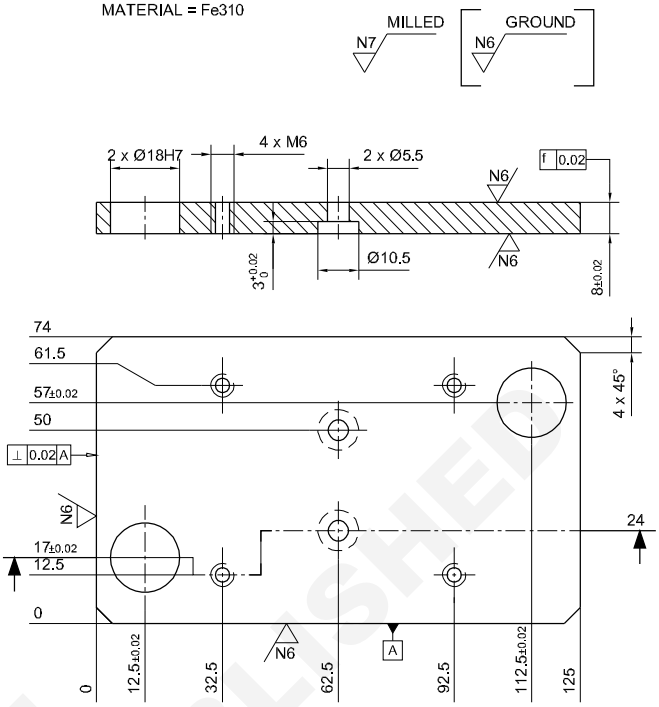


TASK 14

EJECTOR RETAINER

QUANTITY = 1

MATERIAL = Fe310

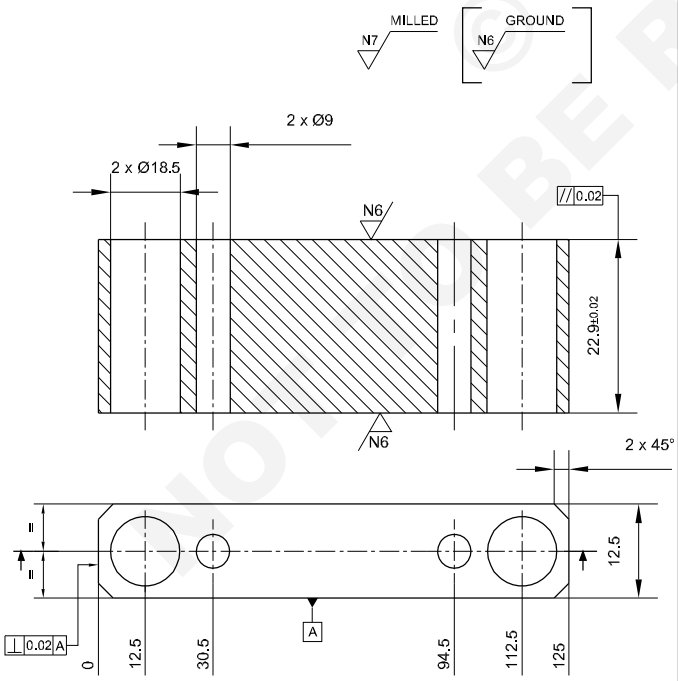


TASK 15

SUPPORT BLOCK

QUANTITY = 2

MATERIAL = Fe310

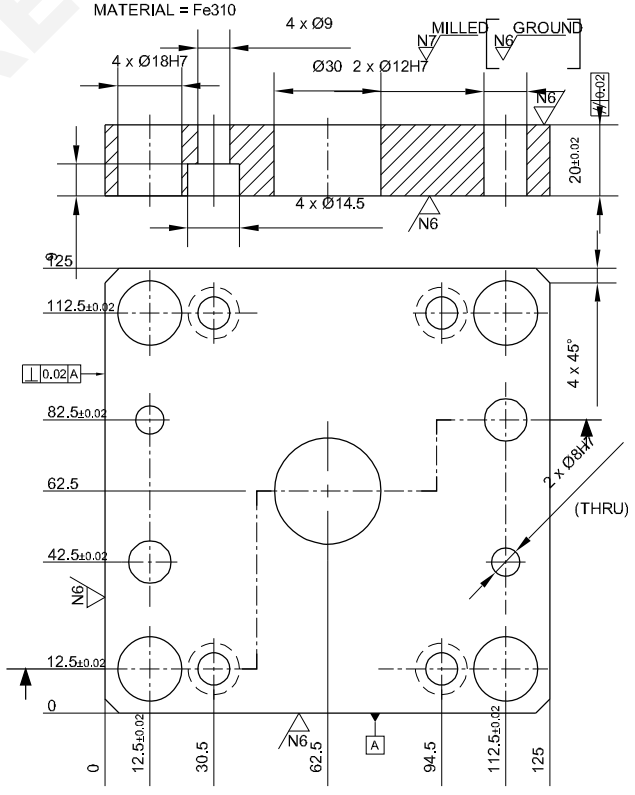


TASK 16

BOTTOM PLATE

QUANTITY = 1

MATERIAL = Fe310



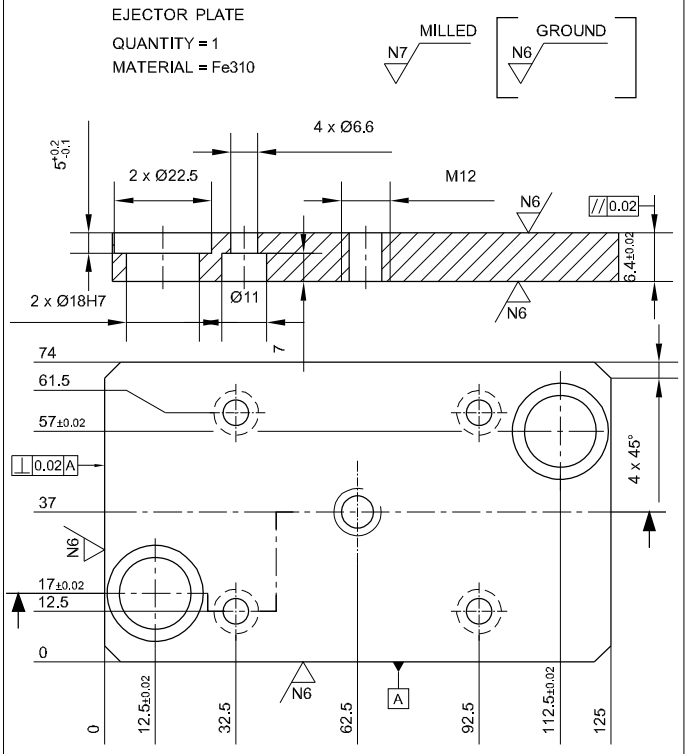
TD20N2599HB

TASK 17

EJECTOR PLATE

QUANTITY = 1

MATERIAL = Fe310

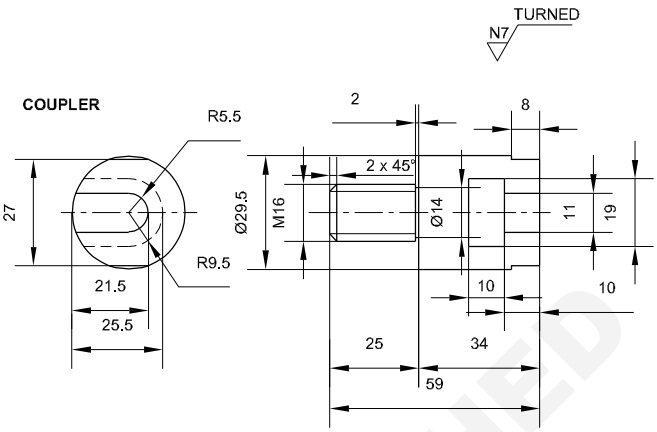


TASK 18

COUPLER

QUANTITY = 1

MATERIAL = Fe310

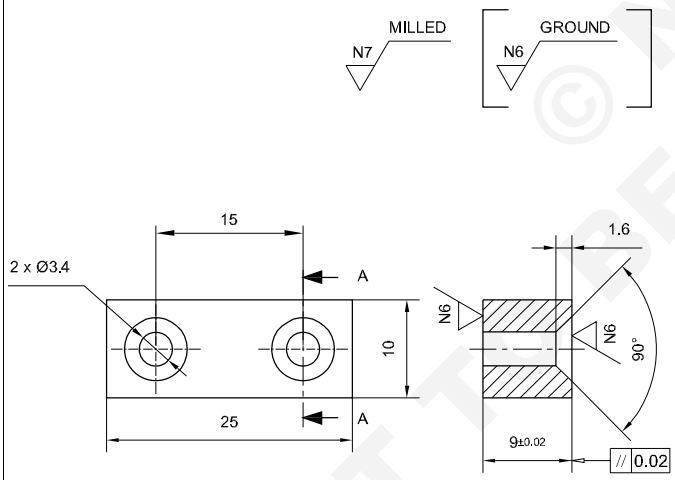


TASK 19

REST PAD

QUANTITY = 1

MATERIAL = Fe310

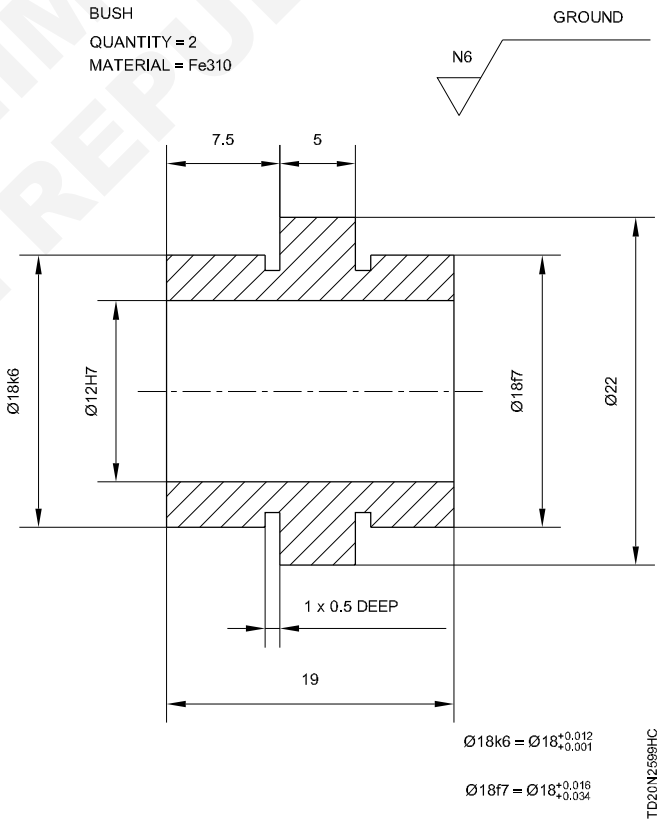


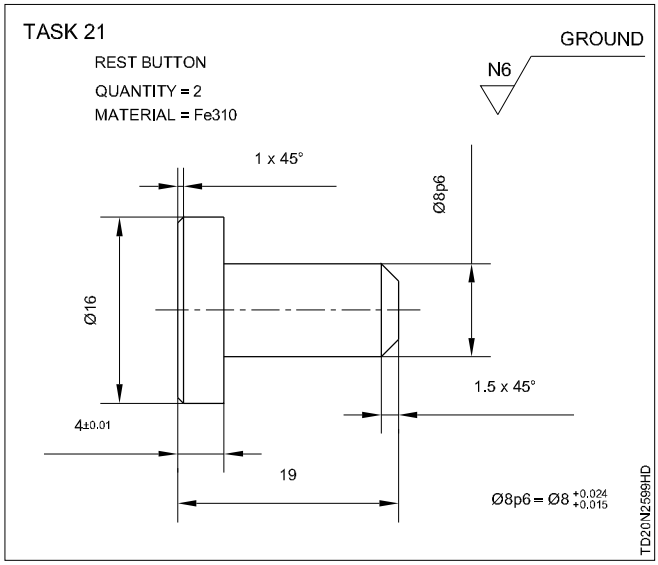
TASK 20

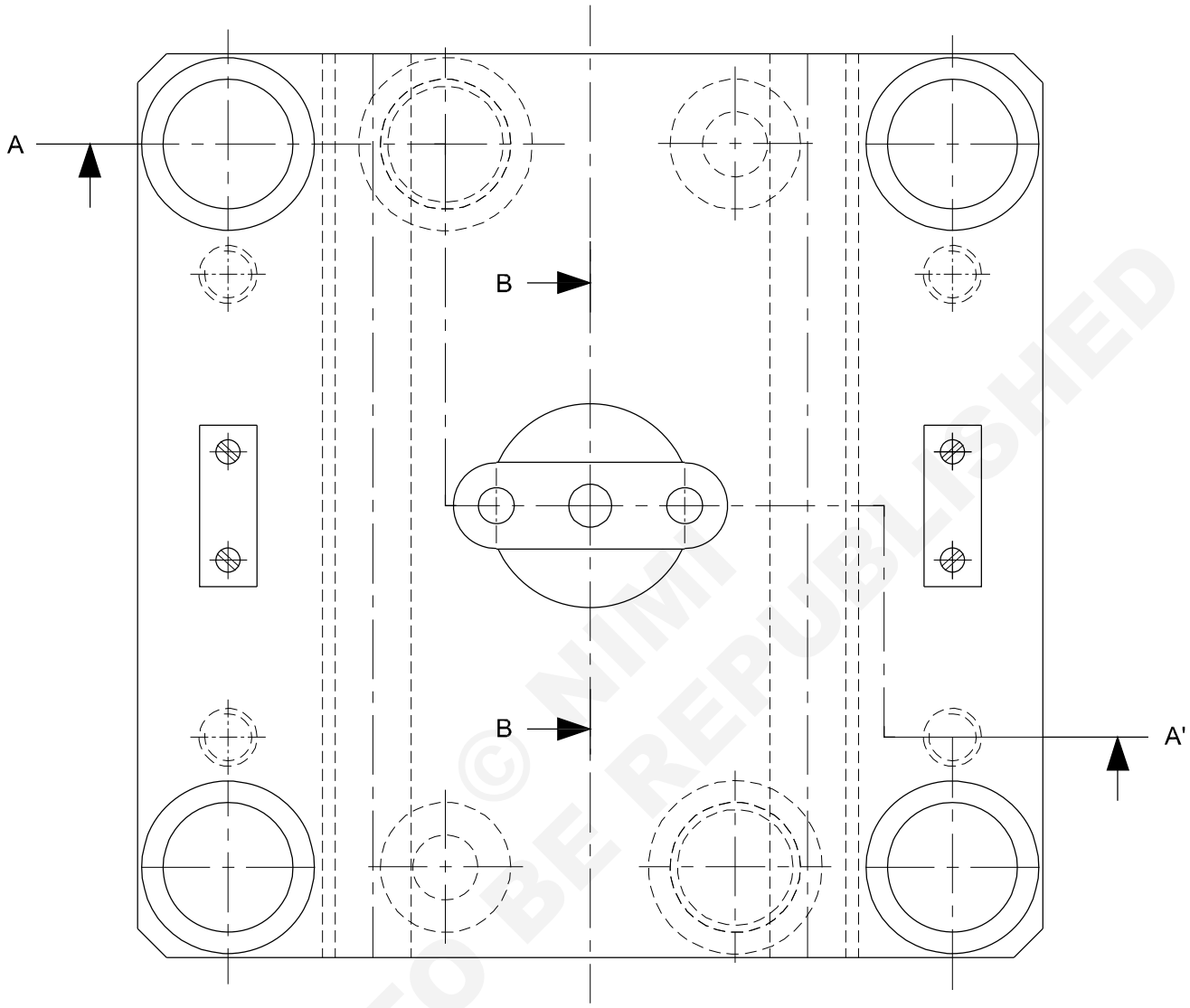
BUSH

QUANTITY = 2

MATERIAL = Fe310

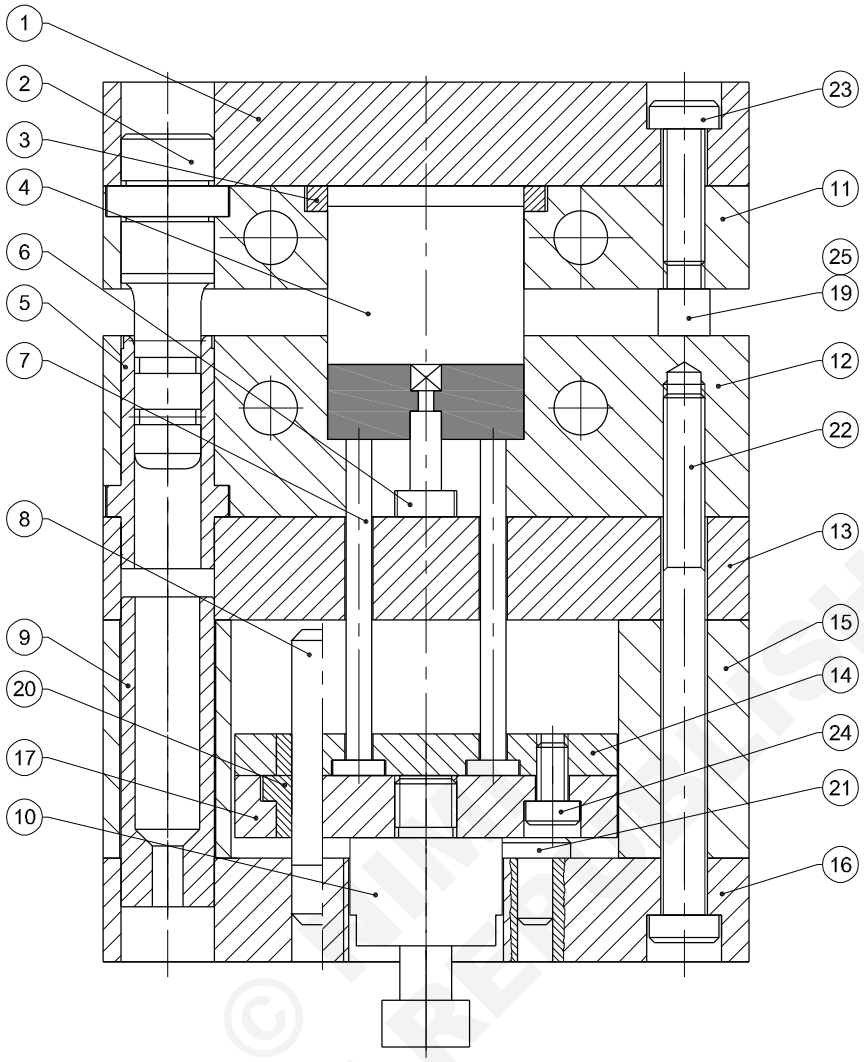




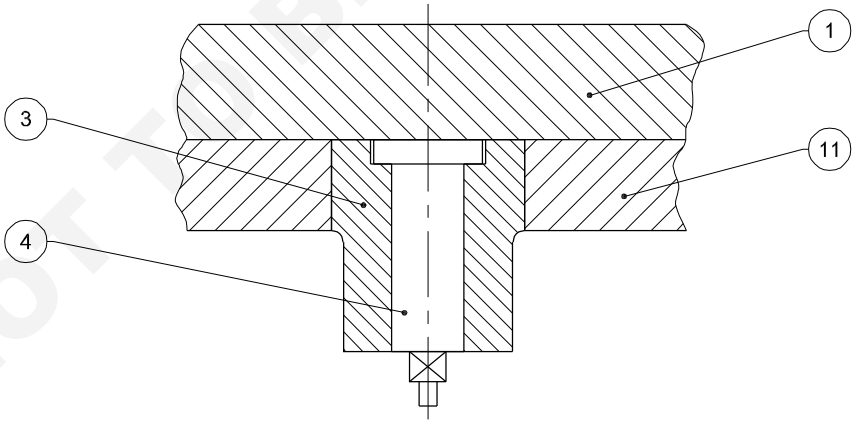


-	-	-	-	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 2:1	**ASSEMBLY**	DEVIATIONS ± 0.1	TIME
		CODE NO. TD20N2599E5	



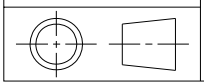
SECTION AA'

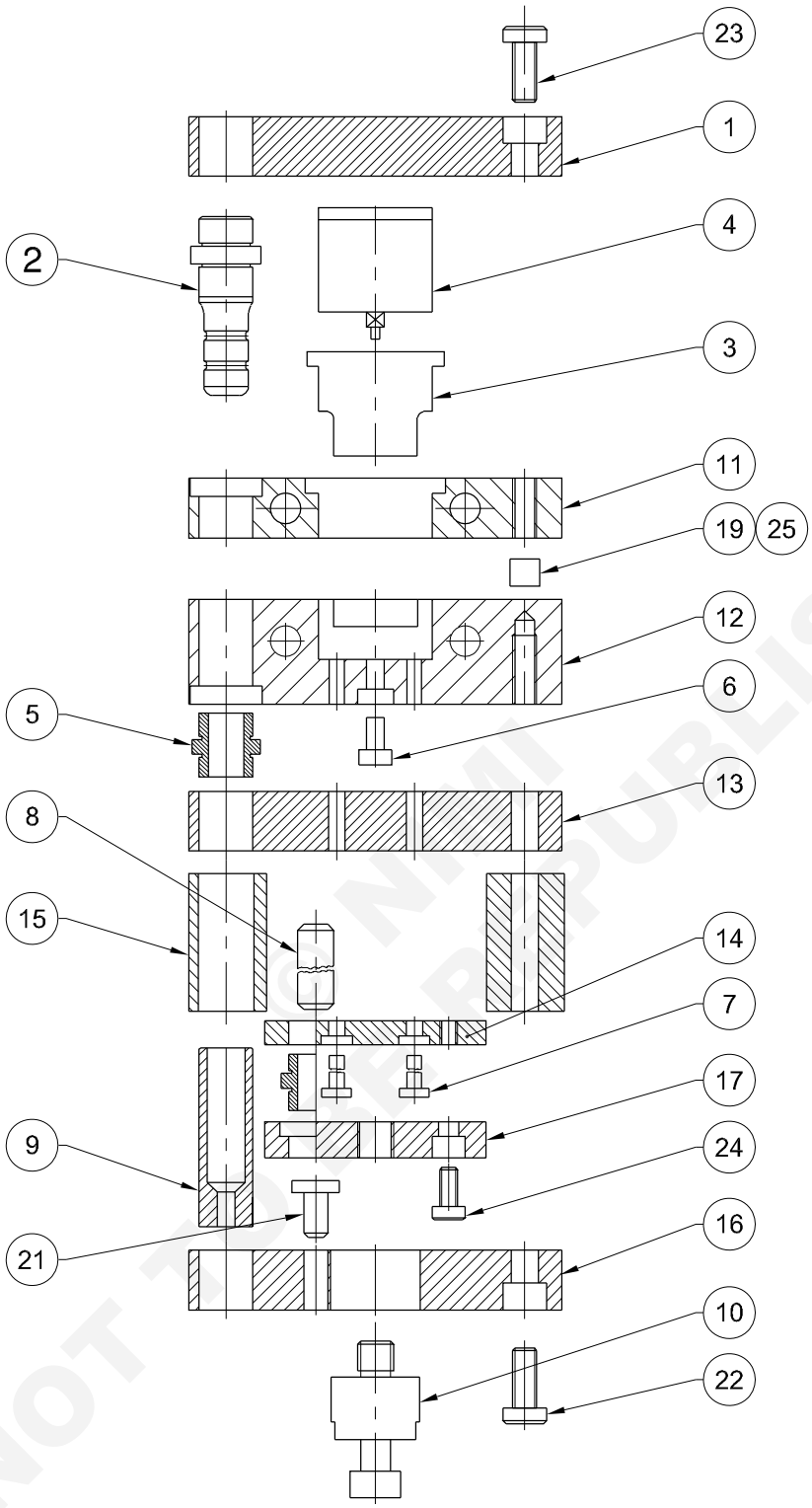


SECTION 'BB'

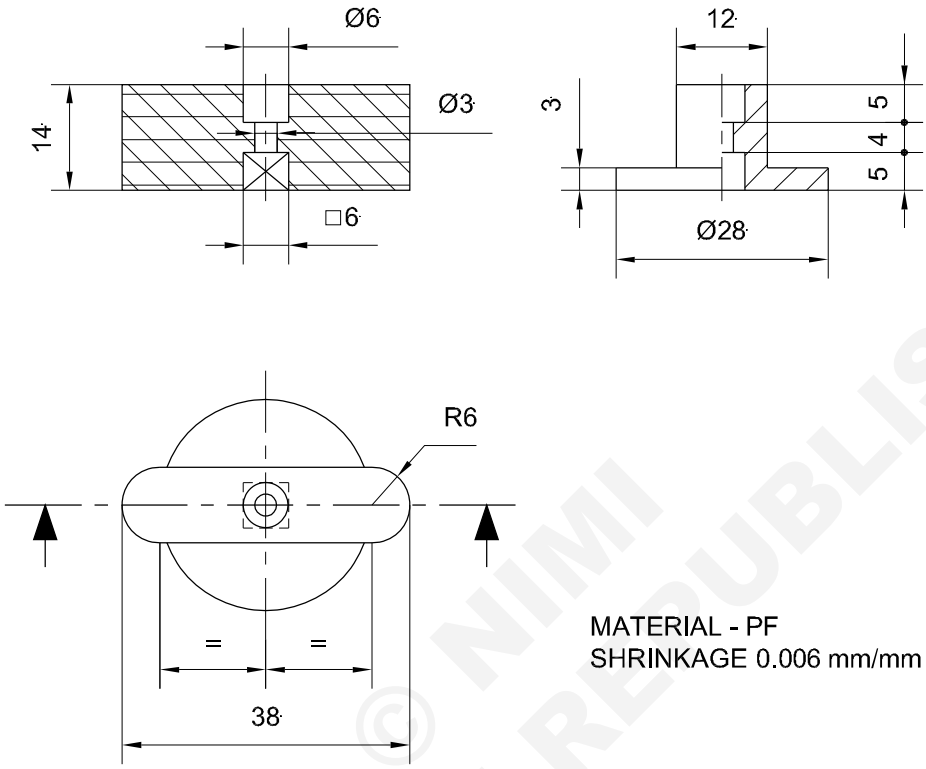
-	-	-	-		-	2.5.99A
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ASSEMBLY**				DEVIATIONS	TIME :
					CODE NO. TD20N2599E6	

NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO.
4	COUNTER SUNK SCREW	M3 x 15	STD		25	
4	SHCS	M6 x 10	STD		24	
4	SHCS	M8 x 25	STD		23	
4	SHCS	M8 x 95	STD		22	
2	REST BUTTON	DIA 20 x 50	Fe310		21	
2	BUSH	DIA 25 x 25	Fe310		20	
2	REST PAD	SQUARE 14 x 30	Fe310		19	
1	COUPLER	DIA 36 x 65	Fe310		18	
1	EJECTOR PLATE	80 ISF 15 - 130	Fe310		17	
1	BOTTOM PLATE	130 ISF 25 - 130	Fe310		16	
2	SUPPORT BLOCK	130 ISF 30 - 50	Fe310		15	
1	EJECTOR RETAINER	80 ISF 12 - 130	Fe310		14	
1	CAVITY BACK PLATE	130 ISF 25 - 130	Fe310		13	
1	CAVITY PLATE	130 ISF 40 - 130	Fe310		12	
1	CORE RETAINER	130 ISF 25 - 130	Fe310		11	
1	ADAPTER	DIA 36 x 57	Fe310		10	
4	SLEEVE	DIA 20 x 64	Fe310		09	
2	EJECTOR GUIDE PIN	DIA 16 x 70	Fe310		08	
2	EJECTOR PIN	DIA 16 x 73	Fe310		07	
1	CORE PIN	DIA 16 x 23	Fe310		06	
4	GUIDE BUSH	DIA 32 x 48	Fe310		05	
1	CORE INSERT	40 ISF 25 - 51	Fe310		04	
1	CORE	SQUARE 40 x 50	Fe310		03	
4	GUIDE PIN	DIA 32 x 65	Fe310		02	
1	TOP PLATE	130 ISF 25 - 130	Fe310		01	

SCALE		DEVIATIONS	TIME
	**COMPRESSION MOULD**	CODE NO. TD20N2599E7	



-	-	-	-		-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ASSEMBLY**				DEVIATIONS	TIME
					CODE NO. TD20N2599E8	



MATERIAL - PF
SHRINKAGE 0.006 mm/mm

Job Sequence

- Trainee may be asked to write the job sequence and machines the workpiece on conventional and non conventional machines, maintain dimentional tolerances, geometrical tolerences and surface finish has mentioned drawing.

-	-	-	-		-	2.5.99A
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**COMPONENT**				DEVIATIONS ± 0.1	TIME
					CODE NO. TD20N2599E9	

Identification and familiarization of various types of hydraulic & pneumatic elements such as cylinder, valves, actuators and filters

Objectives: At the end of this exercise you shall be able to
- **identify the basic pneumatic components & their symbols**
- **identify the basic hydraulic components & their symbols.**

Job Sequence

TASK 1: **Identify the basic components & their symbols**

Display all the pneumatic components on the work table

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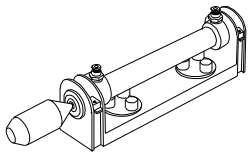
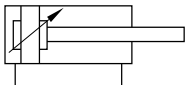
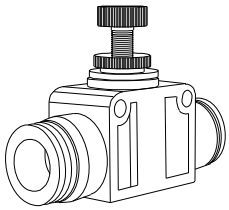
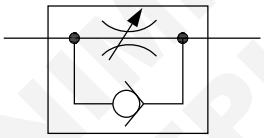
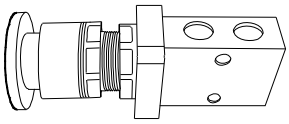
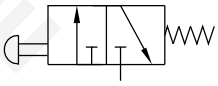
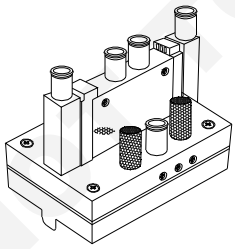
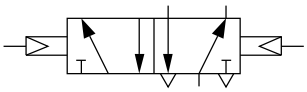
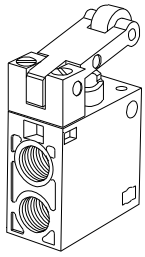
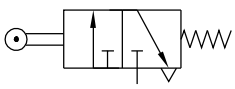
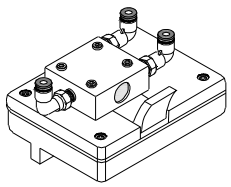
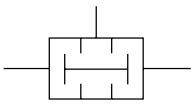
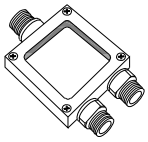
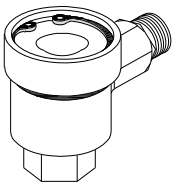
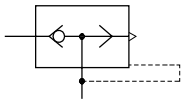
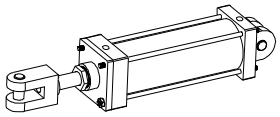
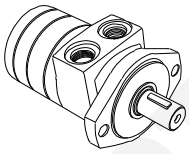
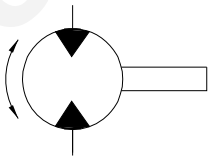
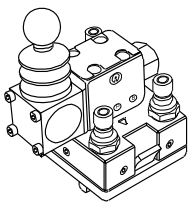
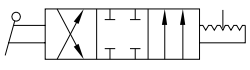
1				
2				
3				
4				
5				

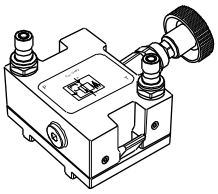
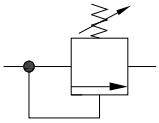
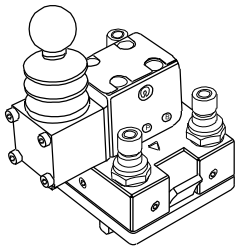
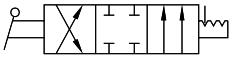
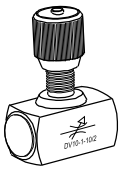
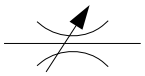
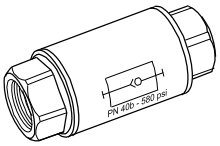
- Ask the trainee to name the components and record it in the table

6				
7				
8				

TASK 2: **Identify the basic hydraulic components & their symbols**

Note: Display all the hydraulic component on the work table ask the trainee to name the components and record it in the table

S. No	Components	Symbol	Name	Remarks
1				
2				
3				

4				
5				
6				
7				

Study of simple hydraulic & pneumatric circuits

Objectives: At the end of this exercise you shall be able to
- **construct and analyse simple logic circuits using pneumatics**
- **construt and analyse simple logic circular using hydraulics.**

Requirements

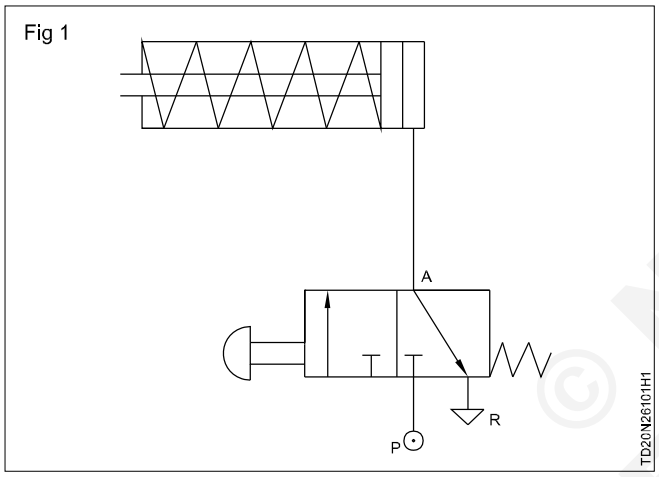
Tools/Equipments

- Pneumatic tool kit - 1 No.
- Hydraulic tool kit - 1 No.

Job Sequence

TASK 1: **Construct a pneumatic circuit as shown in Fig 1**

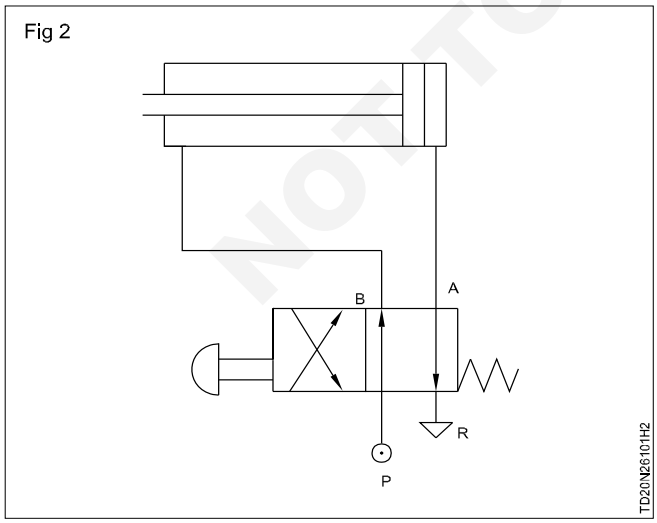
Fig 1



- The piston of a single acting cylinder is to move out when the plunger of the DC valve is actuated. On releasing the DC valve, the piston is to return to the end position immediately.
- Pneumatic circuit No.1 (Fig 1)
- A 3/2 way valve with "normal" position "closed" is the DC valve required for control of cylinder.
- When the plunger of the 3/2 way valve is actuated compressed air flows from P to A. This makes the piston to move forward. The exhaust line R is blocked. Once the valve plunger is released the reset spring brings the valve to NC position. The compressed air connection P is blocked. The air in the cylinder flows through A to R. The spring in the cylinder pushes the piston back to end position.

TASK 2: **Construct a pneumatic circuit as shown in Fig 2**

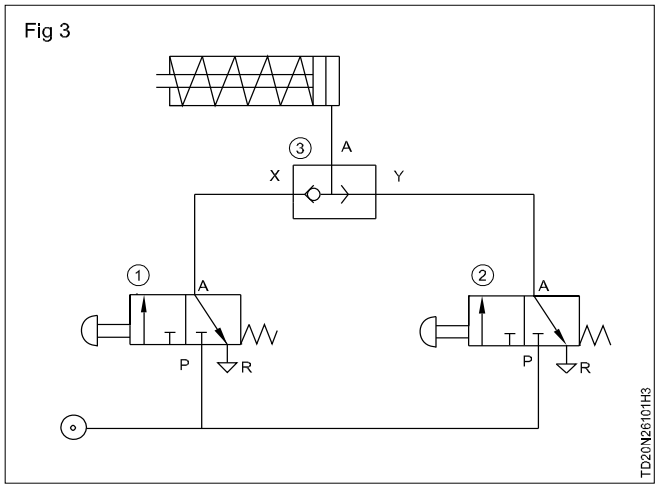
Fig 2



- The piston of the double acting cylinder is to move out or in by actuating a DC valve.
- The cylinder can be controlled by a 4/2 way valve. The line connection is from P to B and A to R. The compressed air (P to B) keeps the piston in the rear end position. On operating the plunger of the 4/2 way valve the connections are changed to P to A and B to R. The piston will move forwards in this condition. On releasing the plunger of the valve, the reset spring causes the valve to resume its original position. The connection is from P to B and A to R. This makes the piston of the cylinder to travel back to the rear end position.

TASK 3: **Construct a pneumatic circuit as shown in Fig 3**

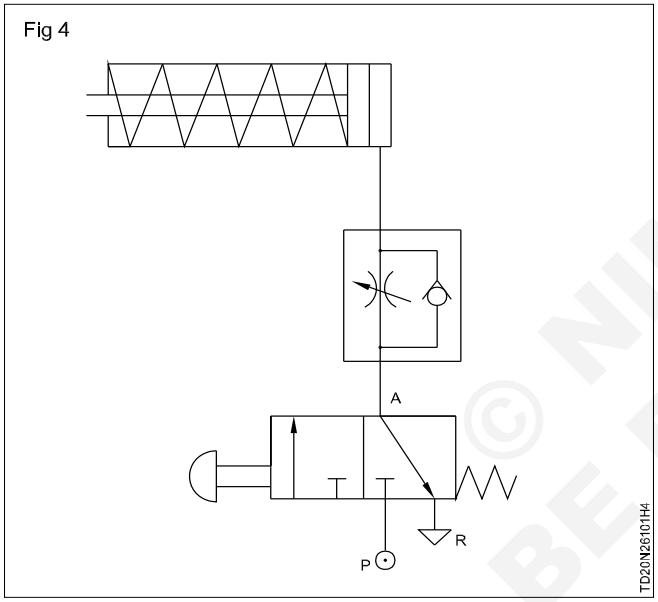
Fig 3



- A single acting cylinder is to be controlled from two different positions independently.
- Two 3/2 way valves (1 and 2) and a shuttle valve (3) are used for this purpose. Compressed air should flow from P to A and X to A to operate the cylinder. This can be done independently by operating the 3/2 way valve (1) or through valve (2).

TASK 4: **Construct a pneumatic circuit as shown in Fig 4**

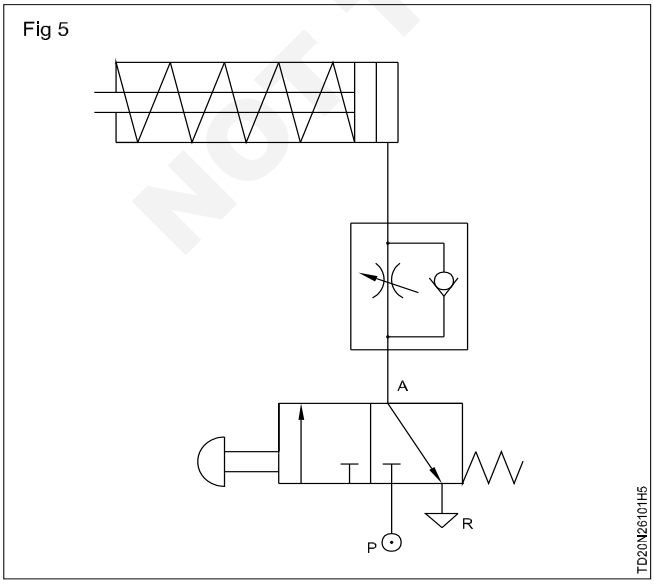
Fig 4



- The piston speed of a single acting cylinder is to be adjusted for the advance movement.
- A 3/2 way valve is used to control the movement of the piston. A throttle relief valve is used to control the speed of the piston. The air has to flow through the adjustable restriction in the throttle relief valve. By adjusting the valve the amount of air flow and thus the speed of the piston can be controlled.
- The throttle relief valve allows free flow of air during the return movement of the spring. In this case supply air throttling is applied.

TASK 5: **Construct a pneumatic circuit as shown in Fig 5**

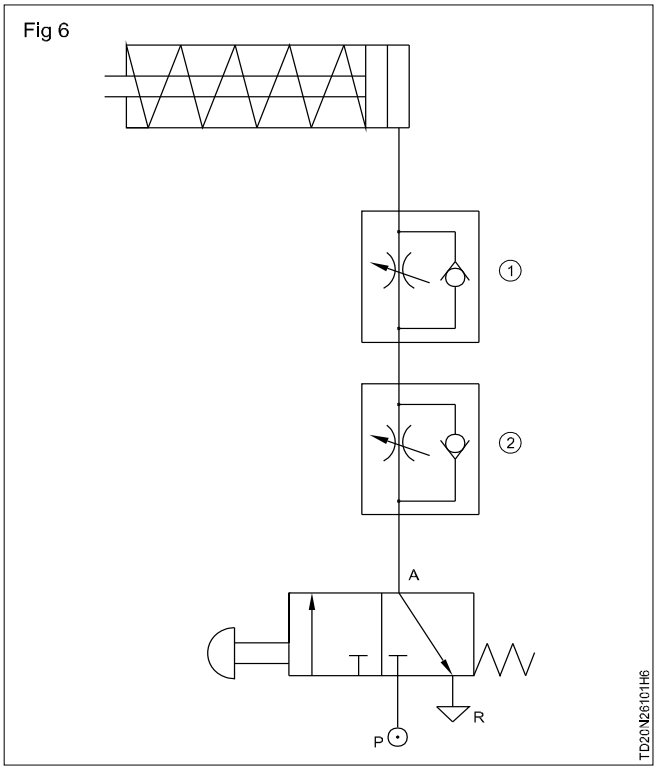
Fig 5



- The piston speed of a single acting cylinder is to be adjusted for the return movement.
- A 3/2 way valve is used to control the movement of the piston. A throttle relief valve is used to control the speed of the piston. The throttle relief valve allows free flow of air during the forward stroke of the piston.
- During return stroke the air has to flow through the adjustable restriction in the throttle relief valve. By adjusting the valve the amount of air flow and thus the speed of the piston can be controlled. In this case exhaust air throttling is applied.

TASK 6: **Construct a pneumatic circuit as shown in Fig 6**

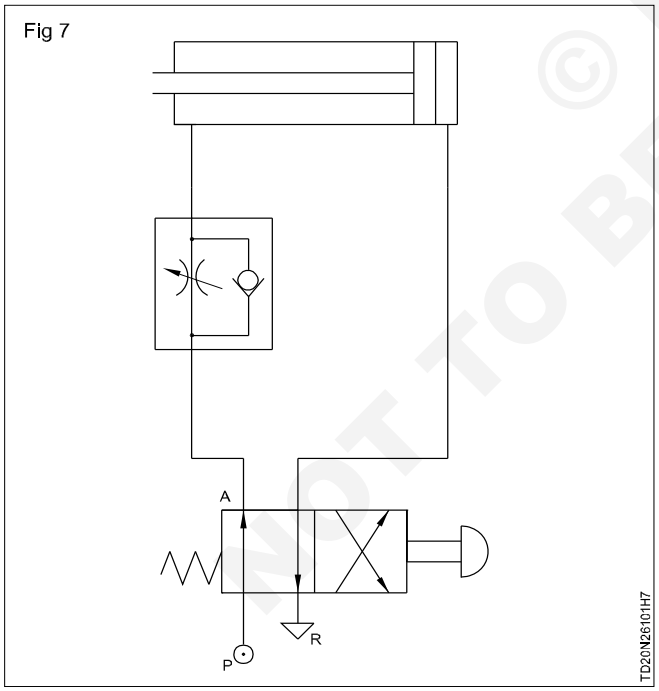
Fig 6



- The piston speed of a single acting cylinder is to be adjusted separately for the advanced and return movement.
- One 3/2 way valve and two throttle relief valves are used (1 and 2).
- The throttle relief valves are connected in reverse direction to each other.
- Throttle relief valve 1 will control the forward movement of the piston and the valve 2 will control the return movement of the piston.

TASK 7: **Construct a pneumatic circuit as shown in Fig 7**

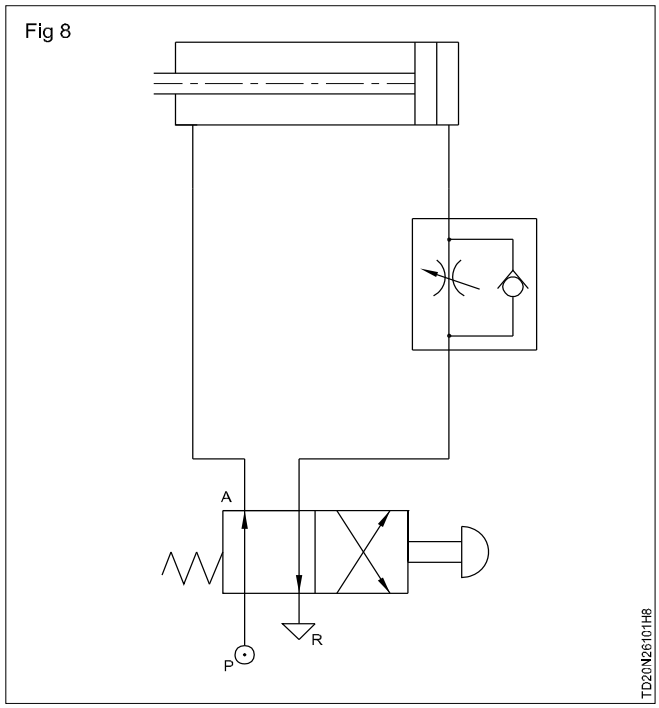
Fig 7



- The piston speed of a double acting pneumatic cylinder is to be adjusted for the advance movement.
- A 4/2 way valve and a throttle relief valve is used. The throttle relief valve controls the flow of exhaust air during the forward stroke of the cylinder. By adjusting the throttle relief valve the forward speed of the piston can be controlled. There is no restriction for air flow during the return stroke.

TASK 8: **Construct a pneumatic circuit as shown in Fig 8**

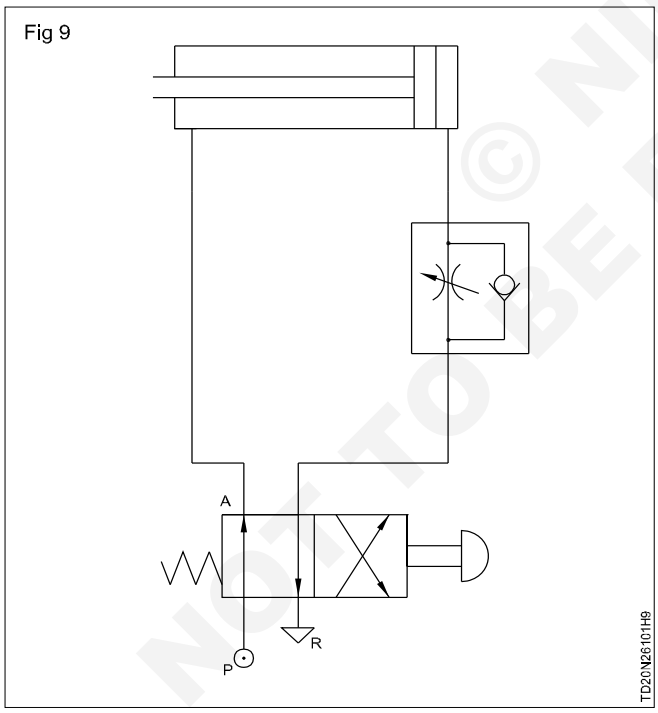
Fig 8



- The piston speed of a double acting pneumatic cylinder is to be adjusted for the advance movement.
- Circuit No.8 shows another possibility for the above requirement.
- Trainee to explain.

TASK 9: **Construct a pneumatic circuit as shown in Fig 9**

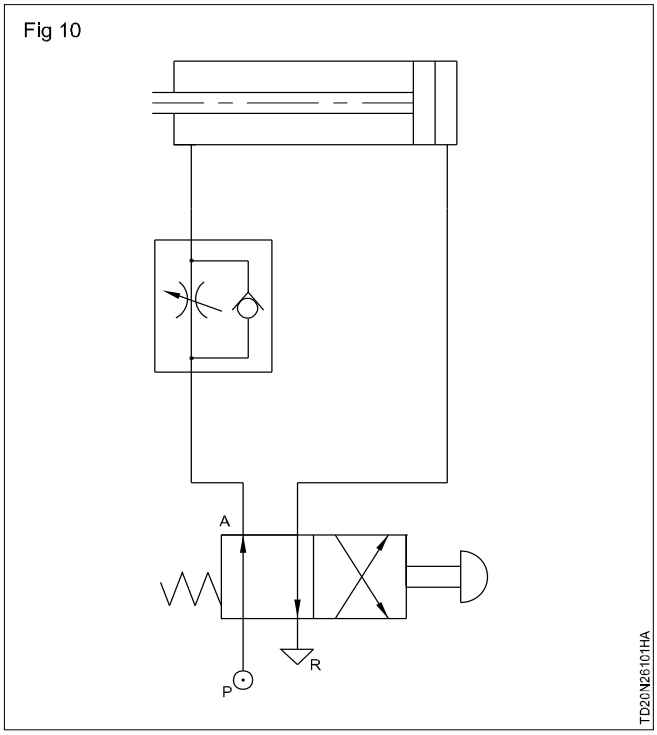
Fig 9



- The piston speed of a double acting pneumatic cylinder is to be adjusted for the return movement.
- Trainee to explain.

TASK 10: **Construct a pneumatic circuit as shown in Fig 10**

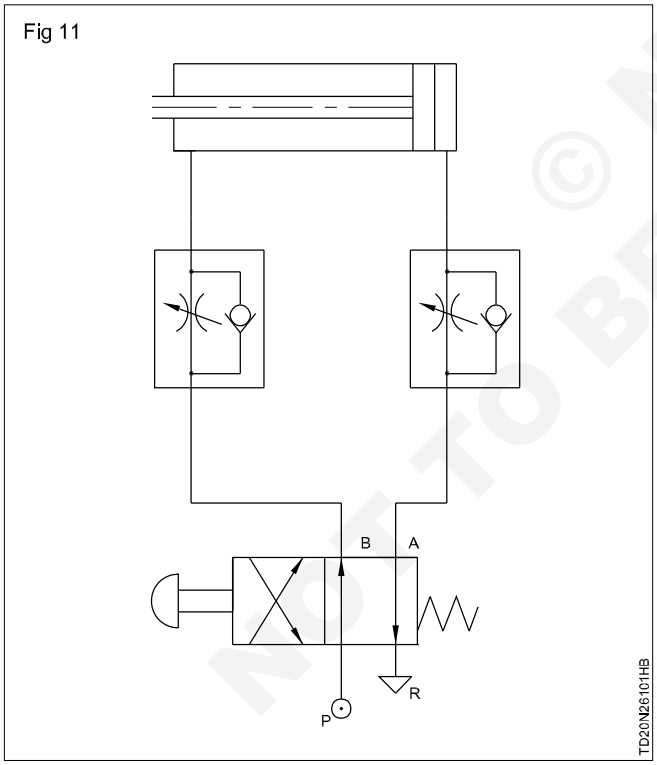
Fig 10



- The piston speed of double acting Pneumatic cylinder is to be adjusted for the return movement.
- Circuit No.10 shows another possibility for the above requirement.
- Trainee to explain.

TASK 11: **Construct a pneumatic circuit as shown in Fig 11**

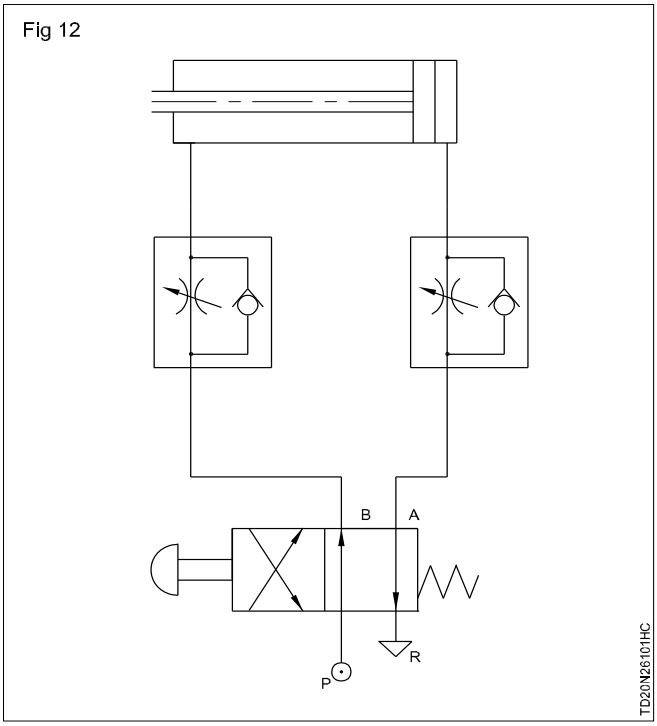
Fig 11



- The forward and return movements of a double acting cylinder are to be controlled.
- A 4/2 way valve and two throttle relief valves are used. Here the flow of exhaust air is throttled to adjust the forward and return movements of the piston.

TASK 12: **Construct a pneumatic circuit as shown in Fig 12**

Fig 12



- Circuit No.12 shows another possibility for the above requirement.
- A 4/2 way valve and two throttle relief valves are used. Here the flow supply air is throttled to adjust the forwards and return movements of the piston.

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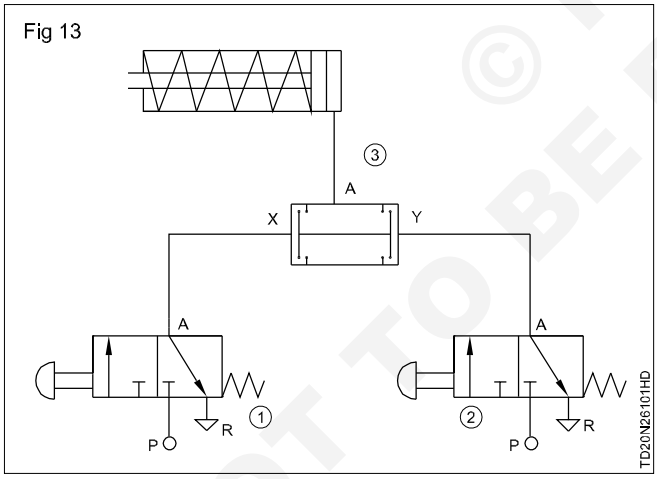
TASK 13: **Construct a pneumatic circuit as shown in Fig 13**

Fig 13



- The piston of a single acting cylinder should move out only if two 3/2 way valves are actuated simultaneously.
- A two pressure valve 3 and two 3/2 way valves 1 and 2 are used. If only valve (1) is operated compressed air will not flow to the cylinder because shuttle valve will be blocking it. In case only valve 2 is operated, the same will be the result, Only if valves 1 and 2 are operated simultaneously, the piston will move forwards.

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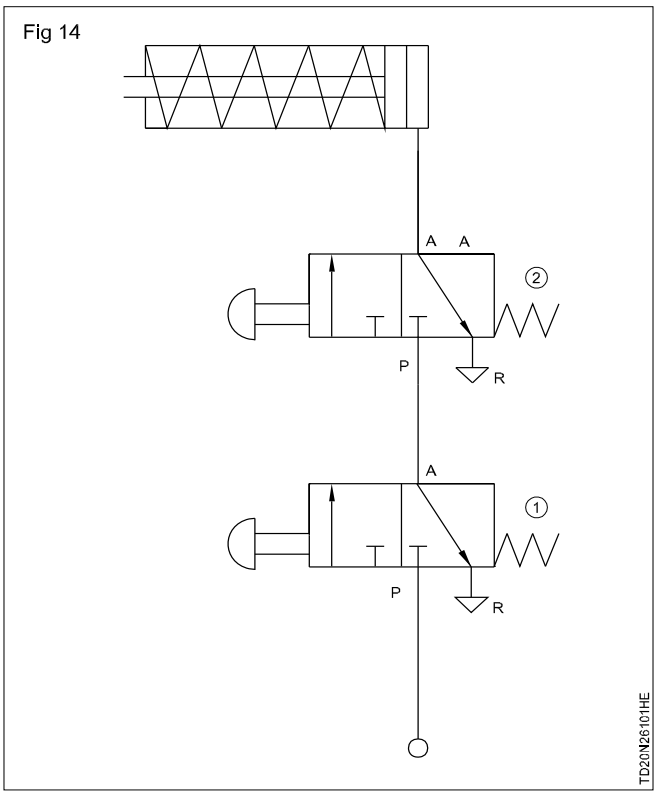
TASK 14: **Construct a pneumatic circuit as shown in Fig 14**



- Circuit No.14 shows another possibility for the above requirement.
- In this case also only simultaneous operation of the 3/2 way valves will result in the forward movement of the single acting cylinder.
- Operation of valve 1 will not allow air flow to the cylinder as the air will be stopped at valve 2. By operating only valve 2, no compressed air can be supplied to cylinder.

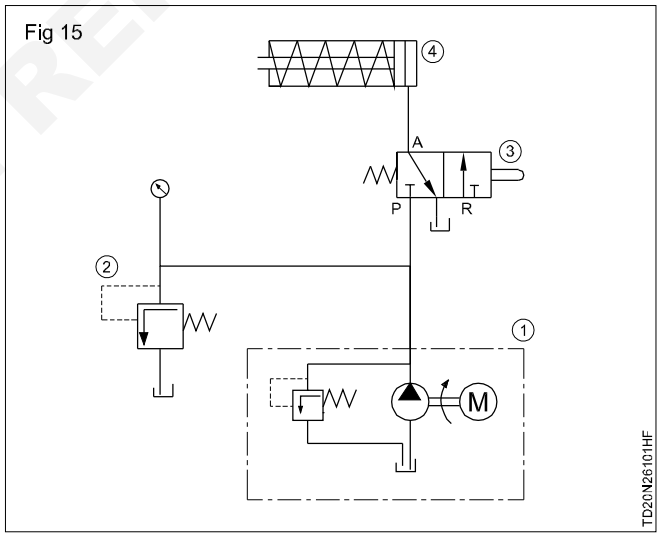
TASK 15: **Construct a hydraulic circuit as shown in Fig 15**

- The piston of a single acting cylinder is to move out when the plunger of a DC valve is actuated (Directional Control). On releasing the DC valve the piston is to return to the end position immediately.

  1 Is the power pack for the hydraulic system

  2 Is a pressure relief valve

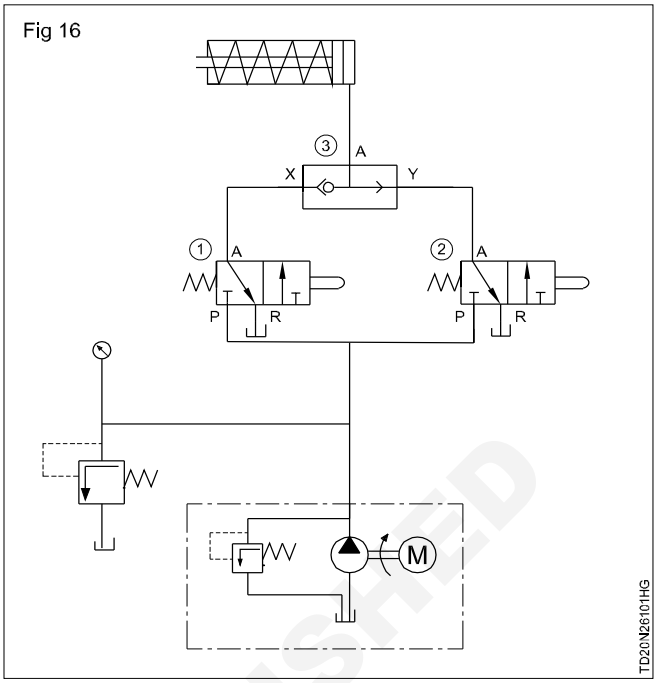
- The functioning of this circuit is similar to a pneumatic circuit.
- The return oil is drawn back to the oil sump in the power pack. This symbol indicates it.
- A 3/2 way valve with "normal" position "closed" is the DC valve required for control of cylinder. When the plunger of 3/2 way valve is actuated oil flows to the cylinder, this makes the piston to move forward. The return line is blocked. Once the valve plunger is released, the reset spring brings the valve to NC position. The supply oil connection is blocked. The oil in the cylinder flows back to the oil sump through return line.



TASK 16: **Construct the hydraulic circuit as shown in Fig 16**

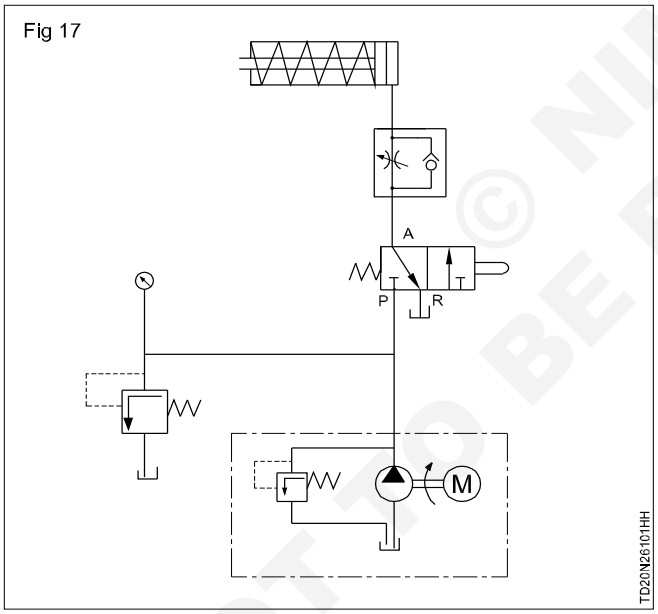
- A single acting cylinder is to be controlled from two different positions independently.
- Two 3/2 way valves (1 and 2) and a shuttle valve (3) are used for this purpose. Hydraulic oil should flow from P to A and X to A to operate the cylinder. This can be done independently through 3/2 way valve (1) or through valve (2).

Fig 16



TASK 17: **Construct a pneumatic circuit as shown in Fig 17**

Fig 17



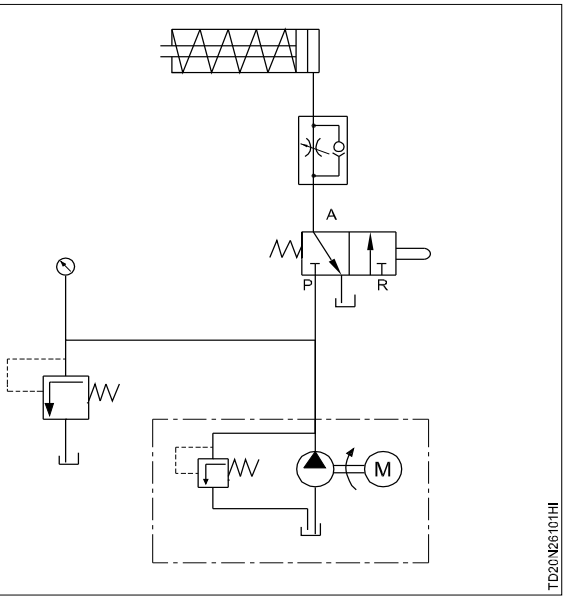
- The piston speed of a single acting cylinder is to be adjusted for the advance movement.

In this case the throttle valve controls the flow of hydraulic oil.

- A 3/2 way valve is used to control the movement of the piston. A throttle relief valve is used to control the speed of the piston. The oil has to flow through the adjustable restriction in the throttle relief valve. By adjusting the valve the amount of oil flow and thus the speed of the piston can be controlled.
- The throttle relief allows free flow oil during the return movement of the spring. Only supply oil throttling can be applied.

TASK 18: **Construct a hydraulic circuit as shown in Fig 18**

Fig 18



- The piston speed of a single acting cylinder is to be adjusted for the return movement.
- **Hydraulic circuit (Fig 18)**

  A 3/2 way valve is used to control the movement of the piston. A throttle relief valve is used to control the speed of the piston. The throttle relief valve allows free flow of oil during the forward stroke of the piston.
- During return stroke the oil has to flow through the adjustable restriction in the throttle relief valve. By adjusting the valve the amount of oil flow and thus the speed of the piston can be controlled. Only return oil throttling can be applied.

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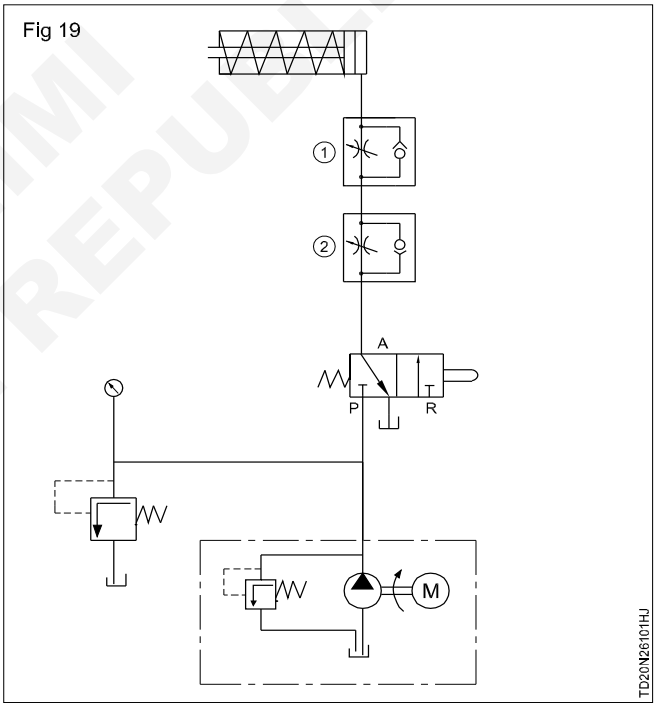
TASK 19: **Construct a hydraulic circuit as shown in Fig 19**

- The piston speed of a single acting cylinder is to be adjusted separately for the advance and return movement.
- One 3/2 way valve and two throttle relief valves 1 and 2 are used. The throttle relief valves are connected in reverse direction.
- Throttle relief valve 1 will control the return movement of the piston and the valve 2 will control the return movement of the piston.

Fig 19



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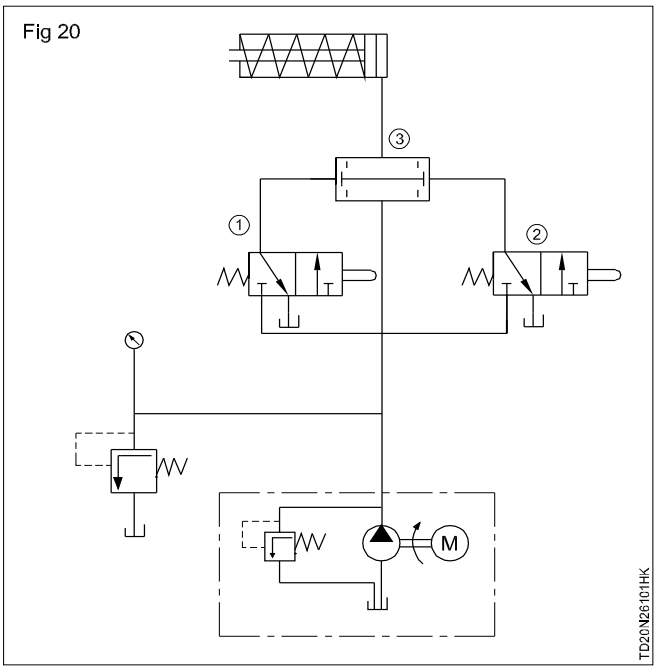
TASK 20: **Construct a hydraulic circuit as shown in Fig 20**

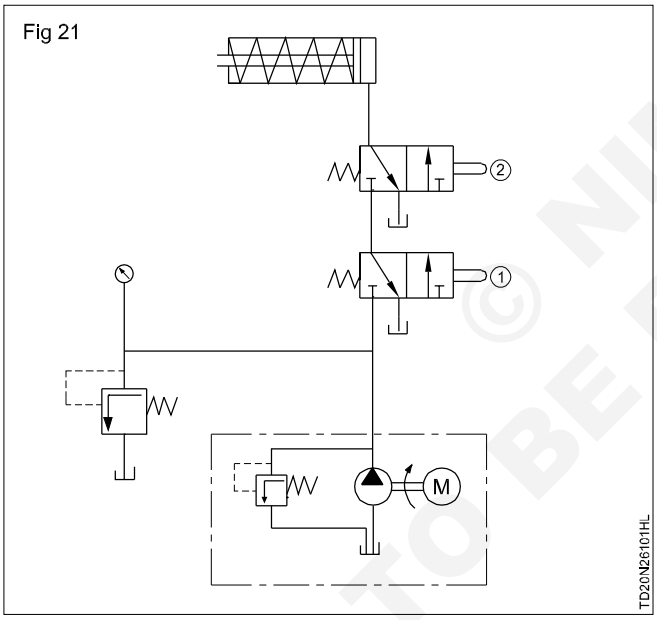
- The piston of single acting cylinder should move out only if two 3/2 way valves are actuated simultaniously.
- A two pressure valve 3 and two 3/2 way valve 1 and 2 are used. If only valve 1 is operated Hydraulic oil will not flow to the cylinder because two pressure valves will be blocking it. In case only valve 2 is operated, the same will be the result. Only if valve 1 and 2 are operated simultaneously, the piston will move forwards.

Fig 20



TASK 21: **Construct a hydraulic circuit as shown in Fig 21**

Fig 21

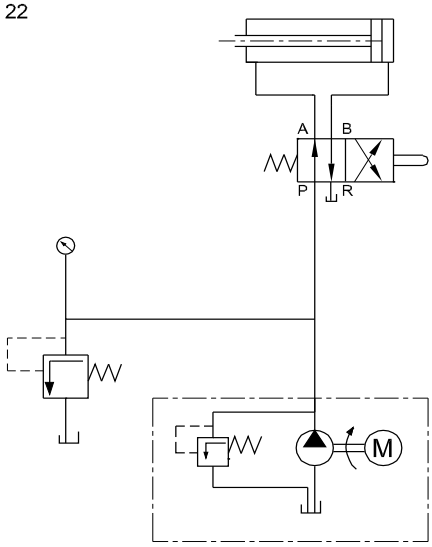


- Fig 21 shows another possibility for the above requirement.
- In this case also simultaneous operation of the 3/2 way valves will result in the forward movement of the single acting cylinder. Operation of valve 1 will not allow oil flow to the cylinder as the oil will be stopped at valve 2. By operating only valve 2 no oil can be supplied to cylinder. Simultaneous operation of valve (1) and (2) will allow oil from to the cylinder.

TASK 22: **Construct a hydraulic circuit as shown in Fig 22 (double acting cylinder actuaion by control valves)**

- The piston of a single acting cylinder is to move out when the plunger of a DC valve is actuated (Directional Control). On releasing the DC valve the piston is to return to the end position immediately.
- The piston of a double acting cylinder is to move out or in by actuating a DC valve.
- The cylinder can be controlled through a 4/2 way valve. The line connections are from P to B and A to R. The high pressure oil (P to B) keeps the piston in the rear end position. On operating the plunger of the 4/2 way valve the connections are changed to P to A and B to R. The piston will move forwards in this condition.
- On releasing the plunger of the valve, the reset spring causes the valve to resume its original position. The connections are from P to B and A to R. This makes the piston to travel back to the rear end position.
- The piston speed of a single acting hydraulic cylinder is to be adjusted for the advance movement.

Fig 22



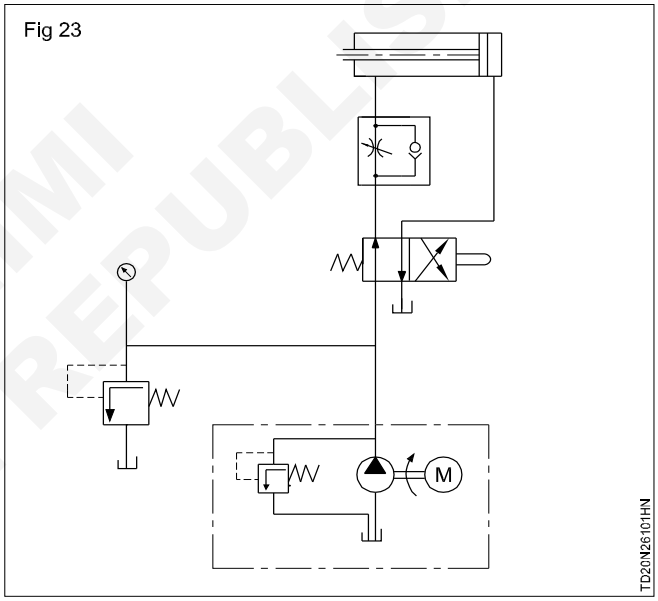
TASK 23: **Construct hydraulic circuit as shown in Fig 23**

In this case the throttle valve controls the flow of hydraulic oil.

- The piston speed of a double acting hydraulic cylinder is to be adjusted for the advance movement.
- Trainee to explain

Return oil flow is throttled

Fig 23

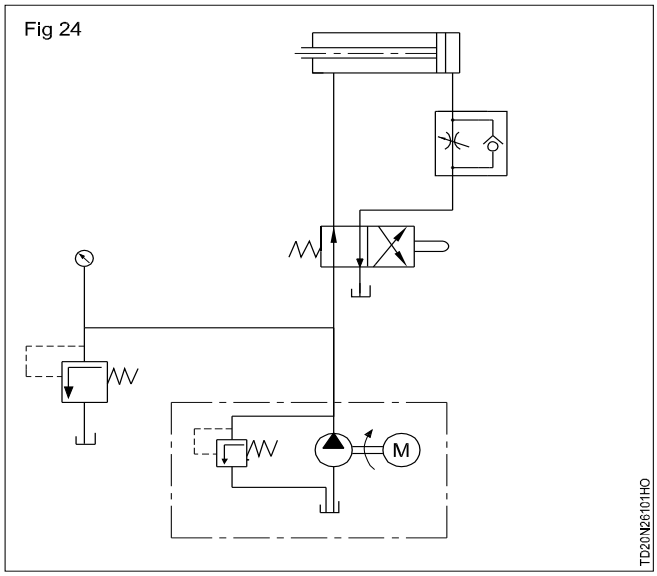


TASK 24: **The piston speed of a double acting hydraulic cylinder is to be adjusted for the advance movement**

- Fig 24 shows another possibility for the above requirement.
- Trainee to explain.

Supply oil flow is throttled.

Fig 24

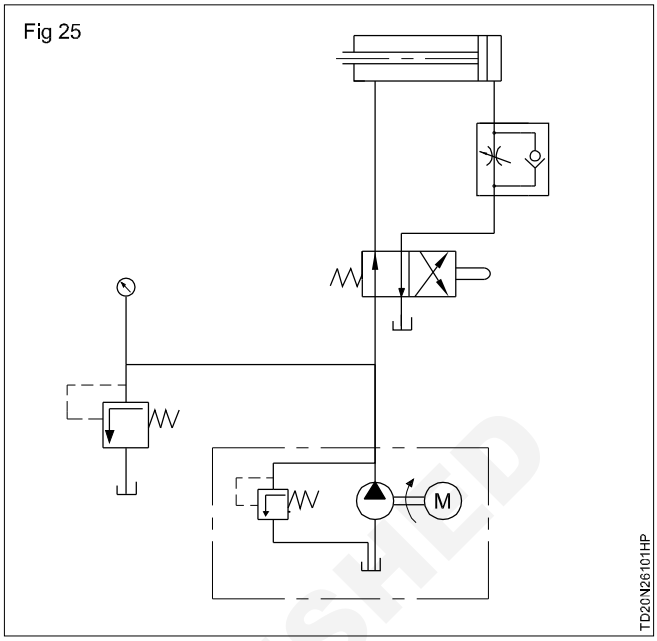


TASK 25: **The piston speed of a double acting hydraulic cylinder is to be adjusted for the return movement (Fig 25)**

- Trainee to explain.

Return oil flow is throttled

Fig 25



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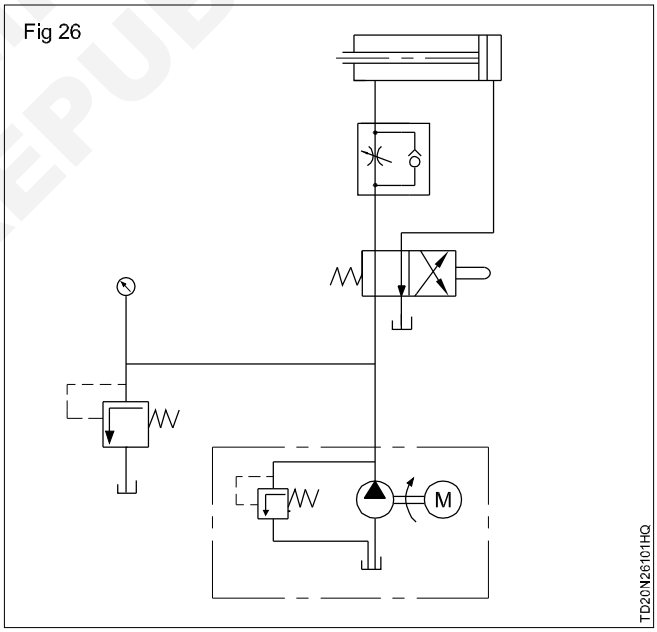
TASK 26: **The piston speed of a double acting hydraulic cylinder is to be adjusted for the return movement**

- Fig 26 shows another possibility for the above requirement.
- Trainee to explain.

Supply oil flow is throttled

Fig 26



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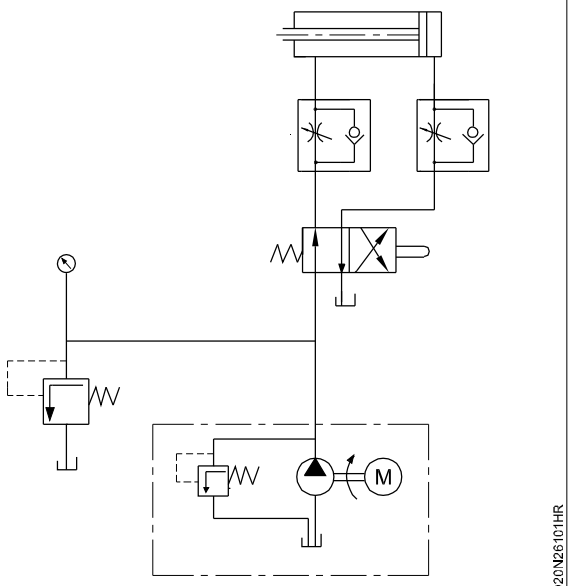
TASK 27: **The forward and return movements of double acting cylinder are to be controlled (Fig 27)**

- A 4/2 way valve and two throttle relief valves are used. Here the flow of the return oil is throttled to adjust the forward and return movements of the piston.

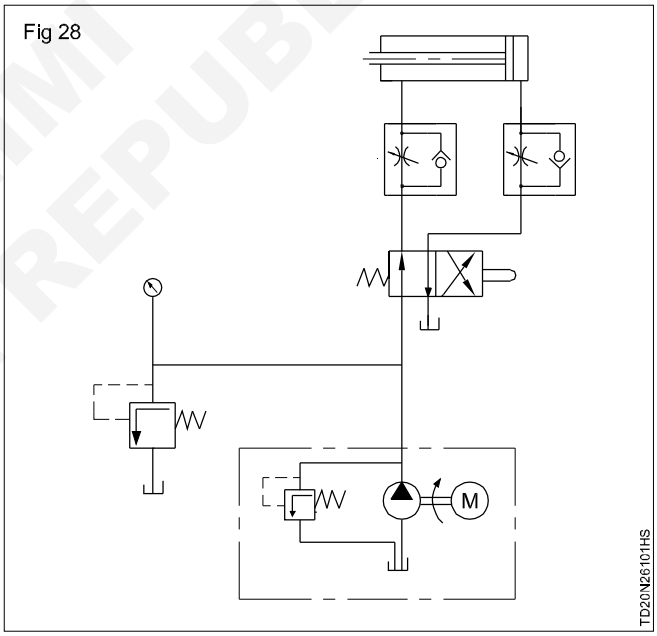
Fig 27



TASK 28: **Circuit 28 shows another possibility for the above requirement (Fig 28)**

- A 4/2 way valve and two throttle relief valves are used. Here the flow of supply oil is throttled to adjust the forward and return movements of the position.

Fig 28



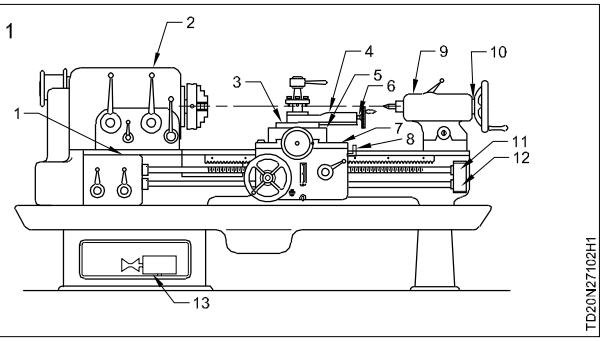
Perform periodic lubrication system on machines

Objectives: At the end of this exercise you shall be able to
- **clean and apply lubrication as recommended by machine builder**
- **maintain the centralized lubricating system**
- **service the power pack system.**

Job Sequence

TASK 1: **Lubrication of centre lathe (Fig 1)**

Fig 1

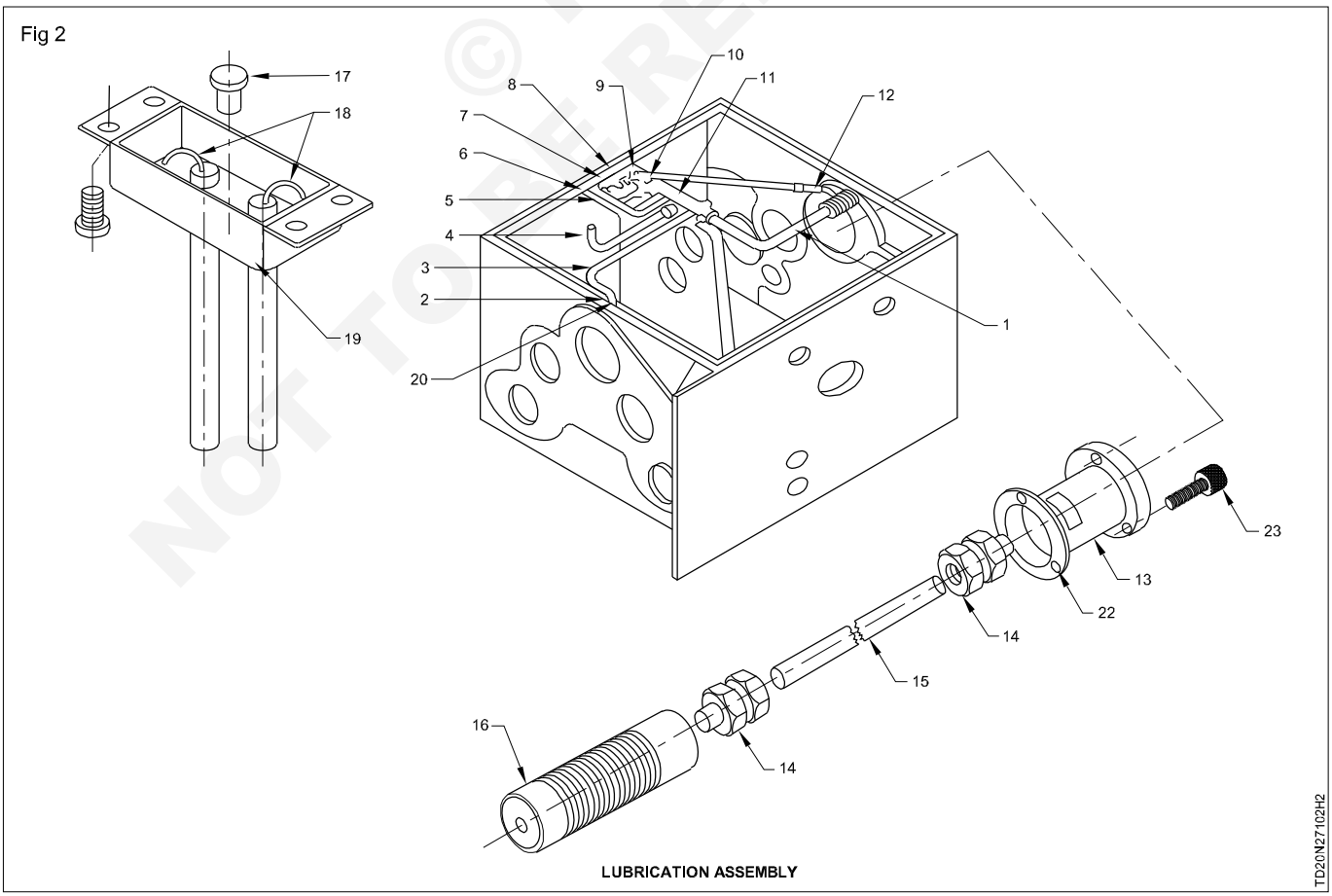


- Clear the machine throughly
- Apply oil with oil cane on sliding surfaces
- Clean, move clean apply oil and move (Carriage, tail stock, compound slide, cross slide and etc).
- Apply all the oil point with oil gun
- Apply grease point with greace gun
- Check the oil level on head stock.
- Check the condition of oil.
- Oil level is low top oil up to the mark.
- Oil condition is not good change the oil.

Use only the machine builder recommended oil or equavalant of that.

TASK 2: **Maintanance of lubricating system**

Fig 2



LUBRICATION ASSEMBLY

- Check the lubrication oil level in the oil tray (part no 19).
- In case of any lubrication problem then remove the socket head cap screw (part no 9,10,23).
- Check the copper tubes through which oil is passing (part nos 1,3,4,5,6,7,15)
- Check the straight connector's condition (part no 2,8,14).
- Remove the suction plug (part no 13).
- Remove the gasket (part no 22).
- Check the strainer and clean it (part no 16).
- Remove the drain screw (part no 21) there is any oil drain is required (Part No 17,18).
- Remove and clean oiled (part no 17) felt wick (part no 18).
- Remove the swivell banjo (part no 12) and manifold (part no 11) clean it and fix it properly.
- Assembly all the parts of lubrication system.
- Refill the revommended grade of lubricant and ensure the oil level.
- Switch on the machine and check the performance of lubrication system.

Lubrication assembly

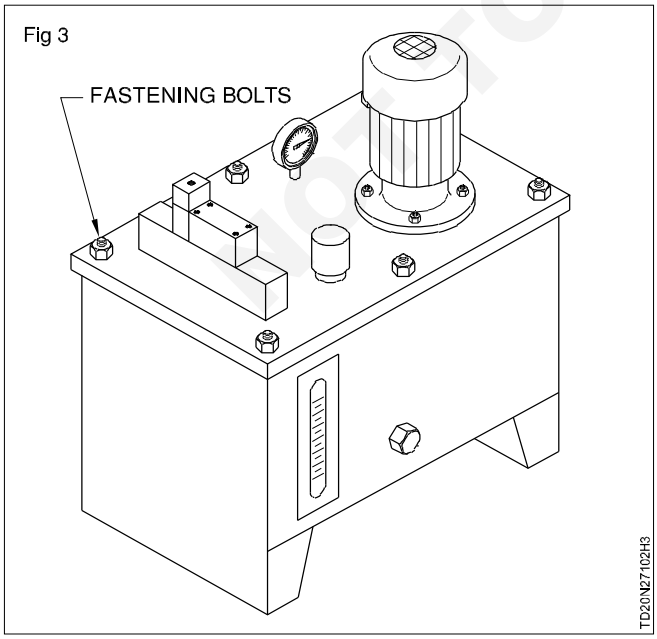
Sl. No.	Part Name
1	Copper tube 6
2	Straight connector 1/8" SSp
3	Copper tube 4
4	Copper tube
5	Copper tube
6	Copper tube
7	Copper tube
8	Straight connector F-SC-4T M8x1
9	Plug M10x1P
10	Soc. Head cAp-screw
11	Manifold M-5
12	Swivel banjo FB-4 1/8" BSP x 4 OD
13	Suction block
14	Straight connector 61/4 x 6mm
15	Copper tubes 6
16	Strainger
17	Oiler 5/16" with cap
18	Felt wick 1/8" x 50 L
19	Oil tray
20	Elbow 1/8 BSP
21	CH HD Screw M6 x 10
22	Gasket
23	Soc. Cap-screw M6 x 20

Ensure the proper oil pumbing by watching through oil glass provided at the gear box of the machine

TASK 3 **Servecing of power pack system**

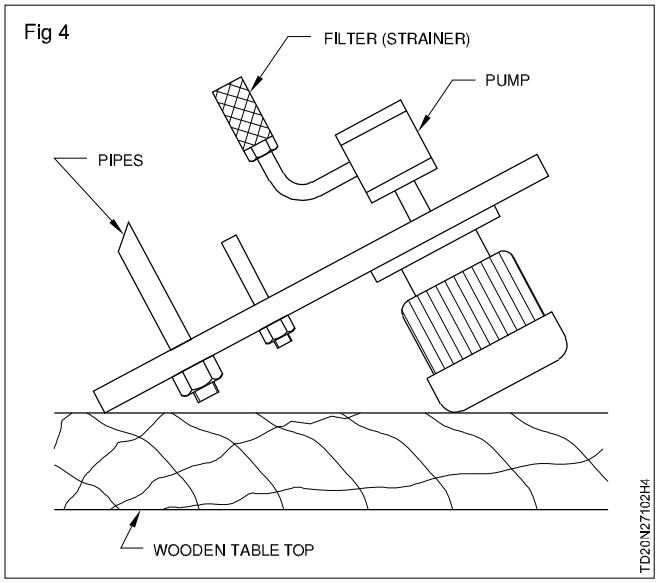
- Locate the power pack of the hydraulic system.
- Ensure the system is in 'off' condition.
- Remove the top cover of the power pack after unscrwing the fastening bolts. (Fig 3)

Fig 3



- 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 work bench. (Fig 4)

Fig 4



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

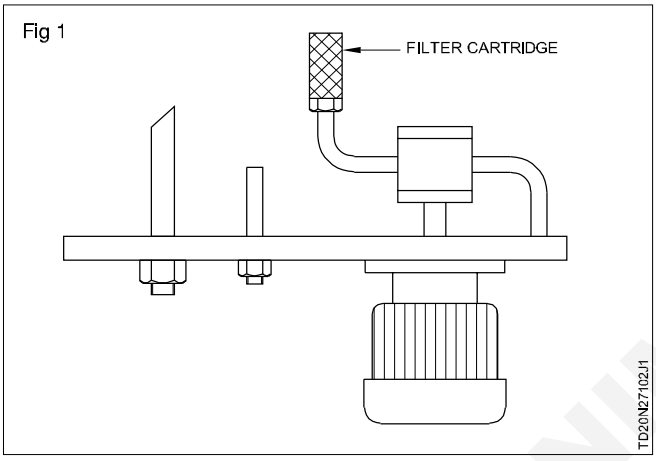
Skill Sequence

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 1) wipe of the excess sludge collected on the filter.

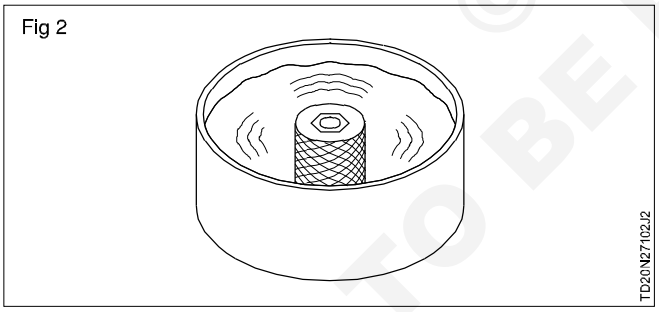
Fig 1



Soak it in kerosence and remove the sludge.

Flush the strainer with clean kerosene (Fig 2)

Fig 2



Blow compressed air on the mesh area.

Clean the mounting area of the strainer.

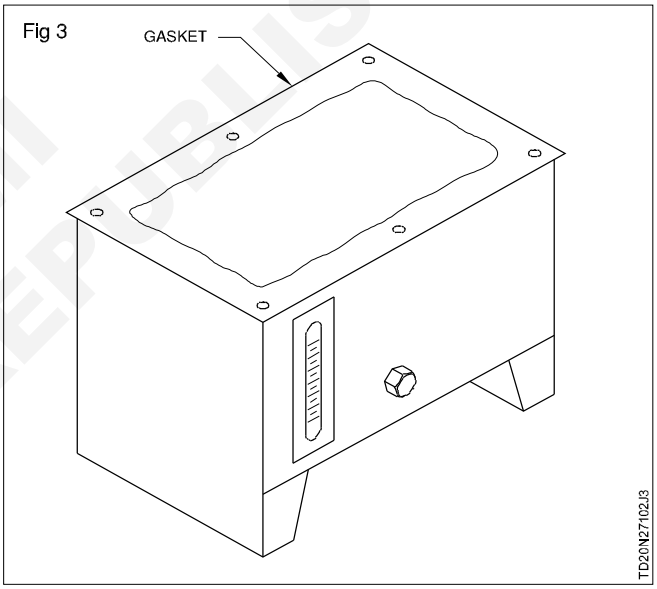
Screw the strainer back in its location.

Strainer/Filters should be clean periodically as per recommendation

Replace with new strainer, care shoud be taken to select the correct strainer.

Checking the gasket of the top, cover of the reservoir for proper seating. (Fig 3)

Fig 3



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.

Preparing the power pack for an operatin

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

A power pack can perform well only if it is 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 4)

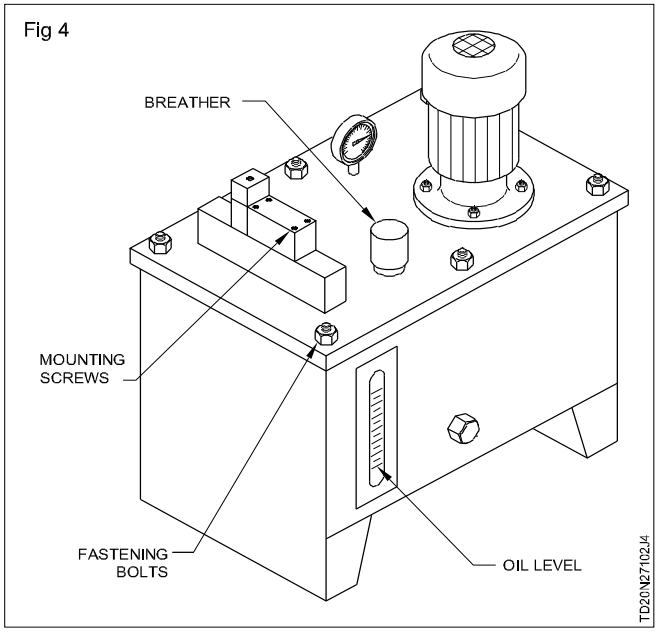
If oil level is less than the mark, fill the correct grade of oil.

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

Check for proper tightening of all connecting hoses.

Check whether the breather is placed properly.

Oil drain hole is plugged and no oil leakage.



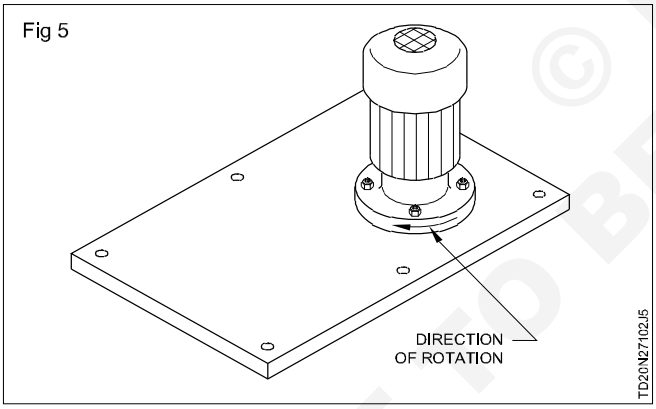
Starting and setting the pressure in a power pack

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 rotaion of the motor s indicated in the motor body. (Fig 5)

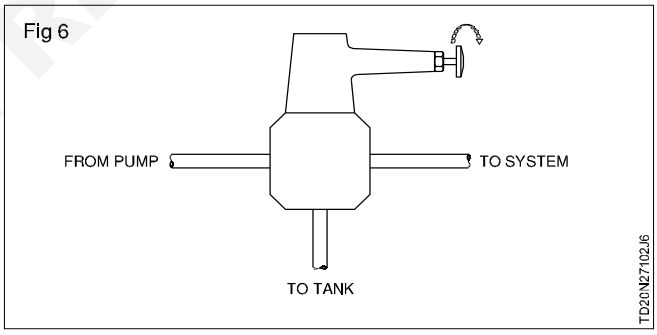


Put off the notor if it rotates inthe opposite direction and call electrician.

Observe the pressure in the pressure gauge.

Now get the required pressure on the pressure relief valve. (Fig 6).

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 reservior (Fig 7)

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

Put off hydraulic system.

Remove the top cover plate.

Keep your hand clean.

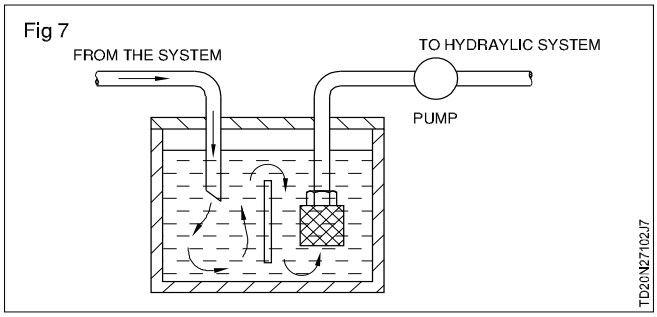
Insert your hands inside the oil and locate the suction strainer.

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.

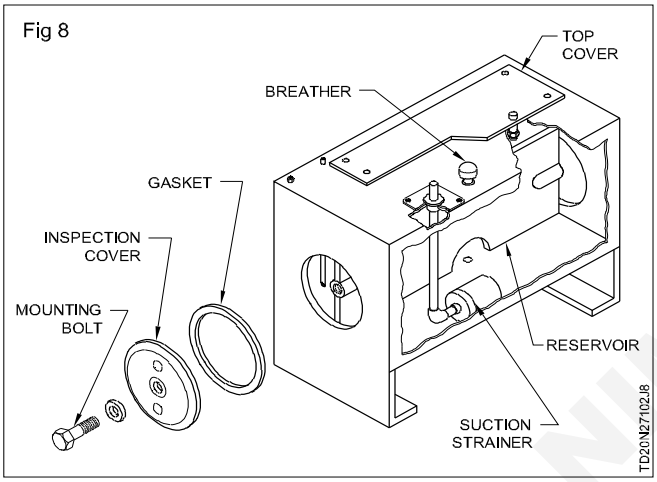
Screw on the clean filter back into position.



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 8)



Put off the hydraulic system.

Drain the oil from the reeervoir.

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 9).

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

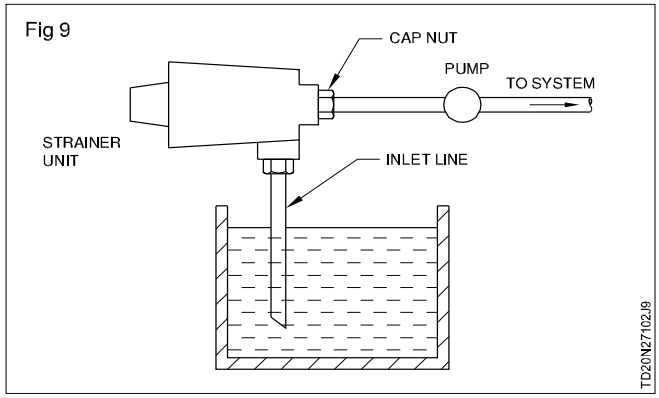
Put off the hydraulic system.

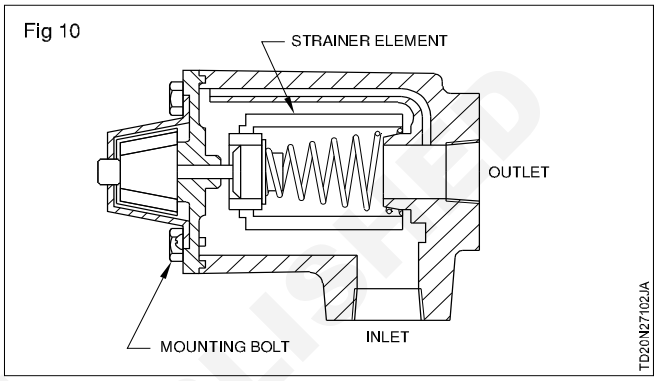
Unscrew both the cap nuts of the lines coming to the filter unit and going out of it.

Hold the filter unit in the benchvice and unscrew the mounting bolt (Fig 10).

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.

Checklist for preventive maintenance of centralized lubricating system

Daily requirements

1 Manually activate system and abserve cycle completion, warning devices and system operating pressures.

2 Visually check level of lubricant in reservoir and record. Note the brand in use.

3 Check condition of lubricant visually.

4 Check settings on time clock.

5 Check control cabinet for cleanliness and damage. Make sure the doors are closed and latched.

6 Fill the air line lubricator on pneumatic supply line (pneumatic pumps only) using recommended lubricant.

Weekly or monthly requirements

1 Check and clean filters, strainers or screens as required.

2 Check piping and hoses on primary and secondary distribution system for broken lines, leaks and blockage or kinks.

3 Visuaaly check metering devices for proper operation.

4 Check distribution lines between metering devices and lubrication points for leaks or damage.

Quarterly or Annual Requirements

1 Clean interior of electrical panels and controls.

2 Check for loose electrical connections.

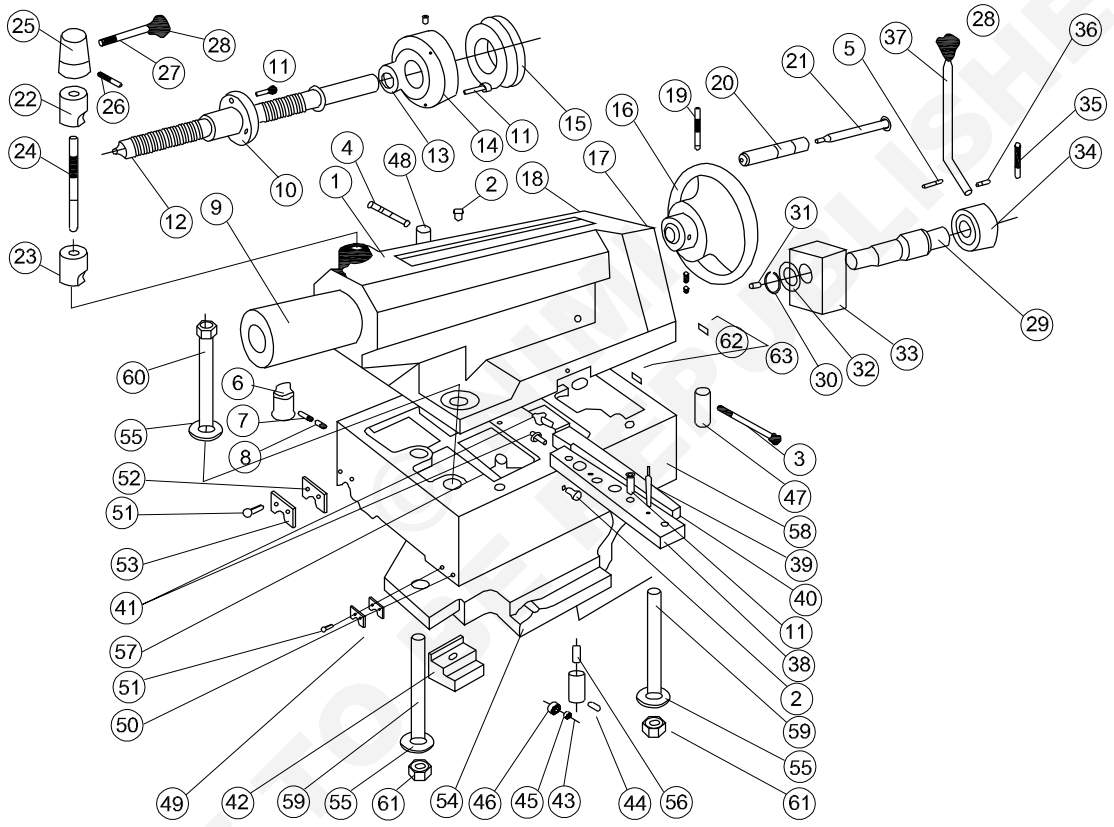
3 Check the pressure gauges and calibrate as needed.

4 Check the operation of warning and safety devices.

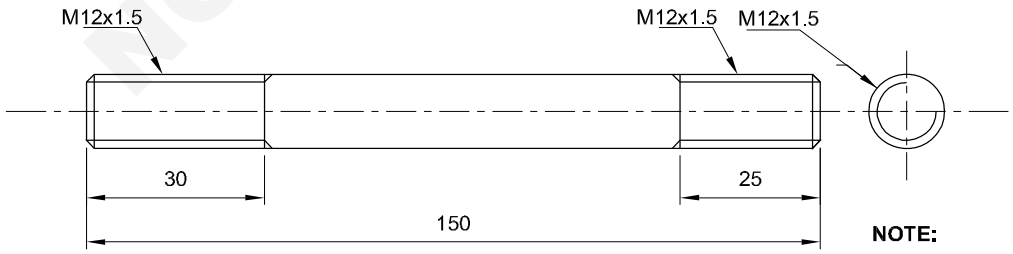
Perform repair work

Objectives: At the end of this exercise you shall be able to
- **identify the defects in tail stock assembly**
- **dismantle the tail stock assembly**
- **identify the defective/worn out parts**
- **prepare the defective parts**
- **assemble in the tail stock**
- **check the tail stock performance.**

TASK-1 DISMANTLE THE TAIL STOCK AND KEEP THE PARTS IN A SEPARATELY AND IDENTIFY THE DAMAGED WORNOUT PARTS



TASK-2 PREPARE A NEW SCREW ROD INSTEAD OF WORNOUT SCREW ROD



NOTE:

STOCK SIZE : Ø16 X 155mm
MATERIAL : Fe310

ALL DIMENSION ARE IN mm

TD20N27103H1

Job Sequence

Identification of defects in a tail stock

- Identify defect in a tail stock.
- Rotate the tail stock hand wheel for moving the spindle.
- Lock the spindle using the locking lever.
- Rotate the tail stock hand wheel and check the spindle movements and locking position. If the spindle is not locked properly it will move.
- Hence, it is known as screw rod spindle lock is not working properly.
- Dismantle the spindle locking unit from the tail stock.
- Prepare the new screw rod instead of defective screw rod.
- Assemble the prepared screw rod instead of wornout screw rod.
- Check the tail stock performance and lock the spindle in the proper position.

Tailstock

Group Assembly Drawing

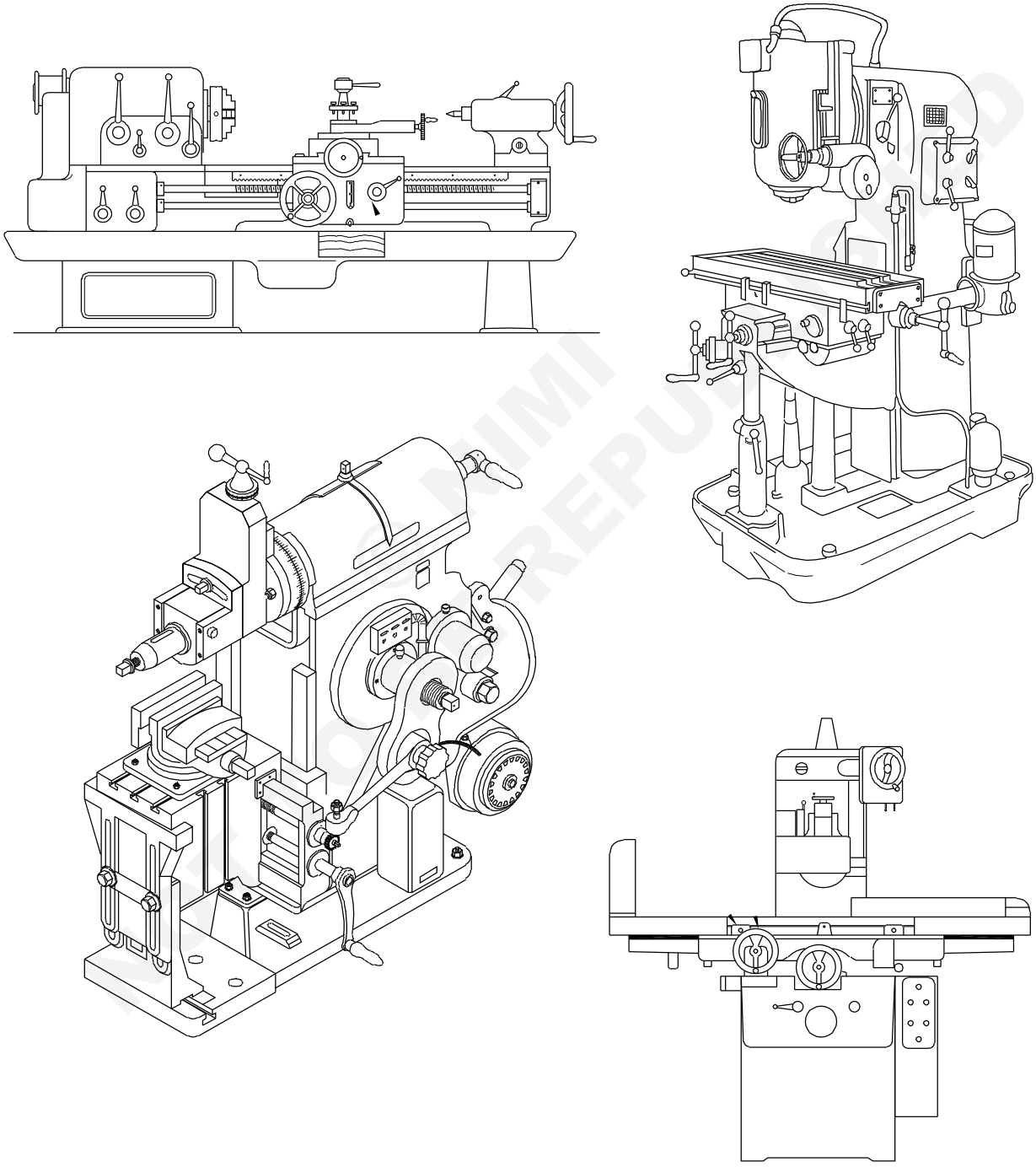
No. On DRG	Qty / Group	Description	Size
1	1	Tailstock	
2	6	Oil nipple	C8
3	1	Hex. Soc. hd. cap. screw	M8 x 100
4	1	Hex. Soc. hd. cap. screw	M8 x 60
5	1	Cyl.pin	10 x 50
6	1	Key	
7	1	Grub Scr. 'G'	M8 x 16
8	1	Grub Scr. 'A'	M8 x 10
9	1	Sleeve	
	1	Sleeve (with tenon slot)	
10	1	Nut	
11	10	Hex. Soc. hd. cap. screw	M8 x 25
12	1	Screw	
13	1	Th. ball bearing (51205)	25/47 x 15
14	1	Flange	
15	1	Graduated collar	
16	1	Hand wheel	
17	3	Compression spring	
18	3	Steel Ball Class V	5/16" class V
19	1	Taper pin	6 x 60
20	1	Handle	
21	1	Handle rod	
22	1	Clamp piece	
23	1	Clamp piece	
24	1	Screw rod	
25	1	Cap	
26	1	Taper pin	6 x 50
27	1	Handle rod	
28	2	Knob	
29	1	Eccentric shaft	
30	1	External circlip	A 30
31	1	Cyl. plug	6
32	1	Spacer	
33	1	Clamp nut	

No. DRG	Qty / Group	Description	Size On
34	1	Cap	
35	1	Taper pin	6 x 80
36	1	Taper pin	4 x 30
37	1	Handle rod	
38	1	Tenon	
39	2	Int. Thrd. taper pin	8 x 50
40	1	Gib	
41	2	Spec. screw	
42	1	Clamp piece	
43	3	Bearing holder	
	3	Hex. soc. grub screw	M6 x 10
44	3	Spec. pin	
45	3	Needle roller bearing DL-810	8/14 x 10
46	3	Bearing bush	
47	1	Shaft	
48	1	Shaft	
49	2	Wiper	
50	2	Plate	
51	8	Slotted ch. hd. scr. 'A'	M6 x 18
52	2	Wiper	
53	2	Plate	
54	1	Clamp plate	
55	3	Spec. washer	
56	3	Compression spring	
57	3	Spec. grub screw	
58	1	Tailstock base (For NH22)	
	1	Tailstock base (For NH26)	
	1	Tailstock base (For NH32)	M20 x 130
59	2	Stud 'B' (For NH22)	
	2	Stud 'B' (For NH26)	M20 x 170
	2	Spec stud (For NH 32)	
60	1	Hex. bolt (For NH22)	M20 x 140
	1	Hex. bolt (For NH26)	M20 x 180
	1	Hex. bolt (For NH32)	M20 x 220
61	2	Sef locking nut	

Perform the routine maintenance with check list

Objective: At the end of this exercise you shall be able to
- **perform the routine maintenance of general machine shop machines with check list.**

Fig 1

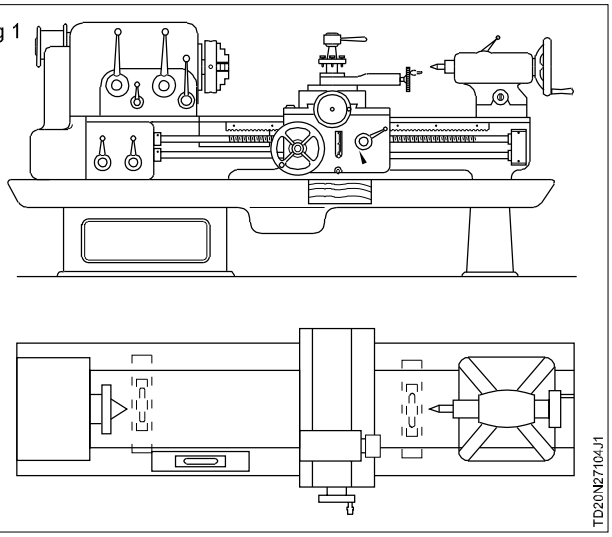


TD20N27104H1

Job Sequence

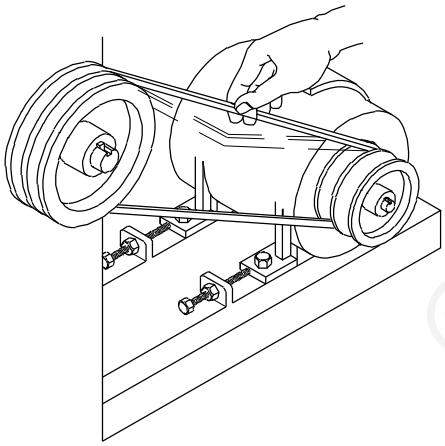
- Check the level of the lathe with a spirit level and adjust using wedges. (Fig 1)

Fig 1



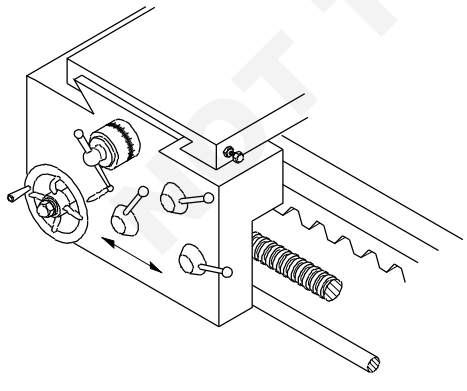
- Check the tension of the belt and adjust. (Fig 2)

Fig 2



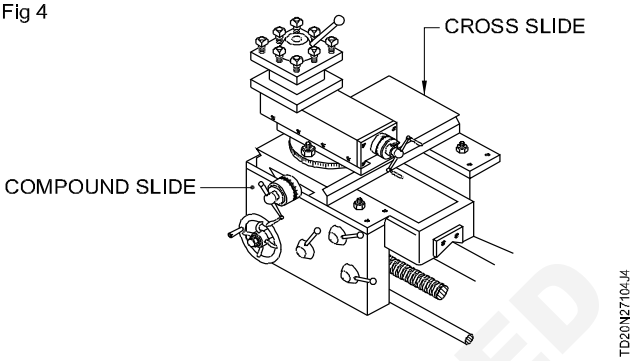
- Check the free movement of tailstock over the bed.
- Check the movement of the carriage of the lathe. (Fig 3)

Fig 3



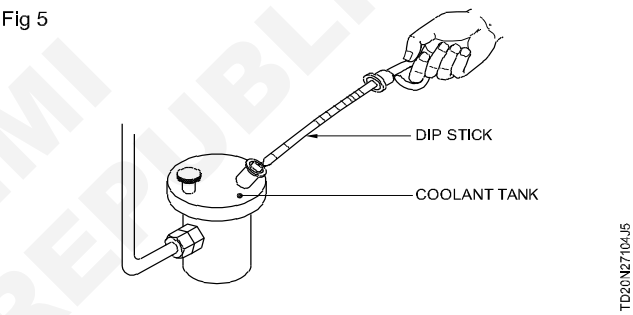
- Run the machine on different spindle speeds and check the speed.
- Engage the power feed and check the longitudinal and transverse feed movements.
- Check the function of clutches by operating the clutch lever.
- Check the movement of the cross-slide and the compound slide. (Fig 4)

Fig 4



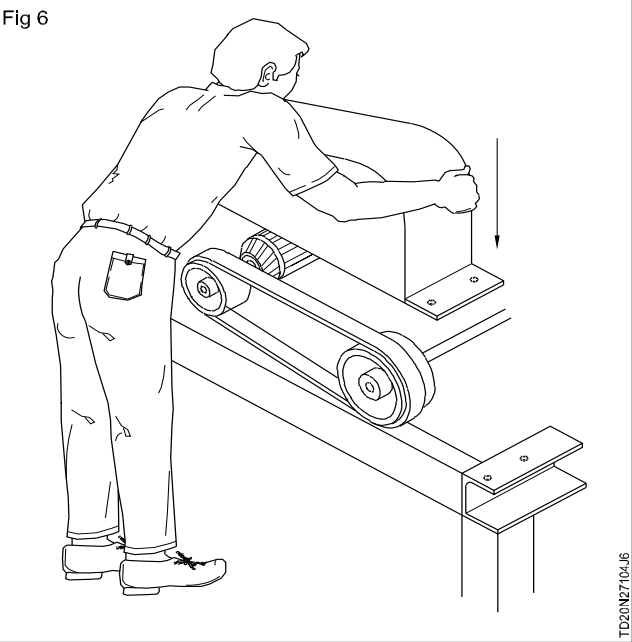
- Check the oil level and the functioning of the lubricating pump.
- Check the coolant level and the functioning of the coolant pump. (Fig 5)

Fig 5



- Check the safety guards. (Fig 6) and ensure they are in postion.

Fig 6



- Inspect the machines as per check list and record it accordingly.

Inspect the following items and tick in the appropriate column and list the remedial measures for the defective items.			
Items to be checked	**Good working/Satisfactory**	**Defective**	**Remedial measures carried out**
Level of the machine			
Belt and its tension			
Bearing sound			
Driving clutch and brake			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Carriage & its travel			
Cross-slide & its movement			
Compound slide & its travel			
Tailstock's parrallel movement			
Electrical controls			
Safety gaurds			

— — — — — — —

Preventive Maintenance Programme **Annexure I - B**

Name of the Machine : Location of the machine:

Machine Number :

Model No & Make :

CHECK - LIST FOR MACHINE INSPECTION (Milling machine)

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 and its tension			
Bearing sound			
Driving clutch			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Table travel			
Cross - slide & its movement			
Saddle & its travels			
Knee up & down movement			
Electrical controls			
Safety gaurds			

Inspection by

Signature

Name :

Date : Signature of in - charge

Preventive Maintenance Programme **Annexure I - C**

Name of the Machine : Location of the machine:

Machine Number :

Model No & Make :

CHECK - LIST FOR MACHINE INSPECTION (Shaping)

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 and its tension			
Bearing sound			
Table elevation			
Exposed gears			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Ram and its travel			
Saddle & its movement			
Tool head angle rotation			
Stroke length adjustment			
Position of the stroke			
Safety guards			

Inspection by

Signature

Name :

Date :

Signature of in - charge

Name of the Machine : Location of the machine:

Machine Number :

Model No & Make :

CHECK - LIST FOR MACHINE INSPECTION (Surface grinding)

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 and its tension			
Bearing sound			
All feed movements			
Condition of bellows			
Dust collecting system			
Lubrication system			
Coolant system			
Condition of magnetic chuck			
Electrical controls			
Safety guards			

Inspection by

Signature

Name :

Date :

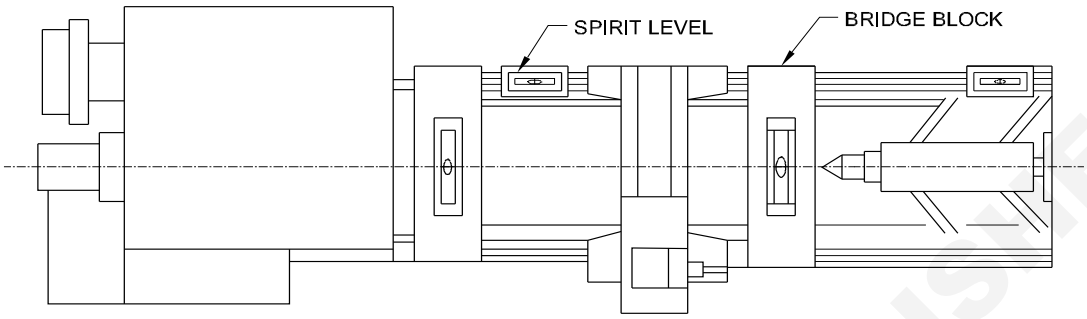
Signature of in - charge

Inspection of machine tool such as alignment and levelling

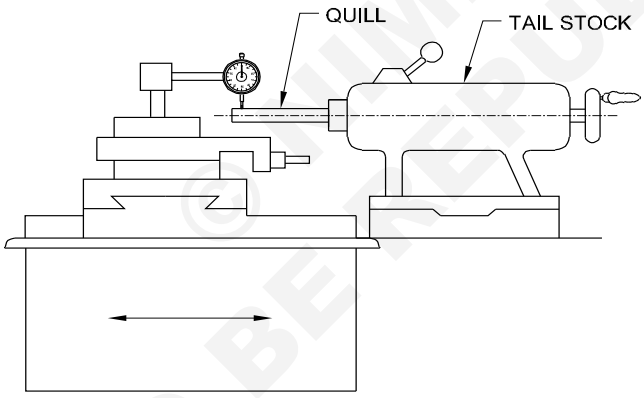
Objectives: At the end of this exercise you shall be able to

- **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.**

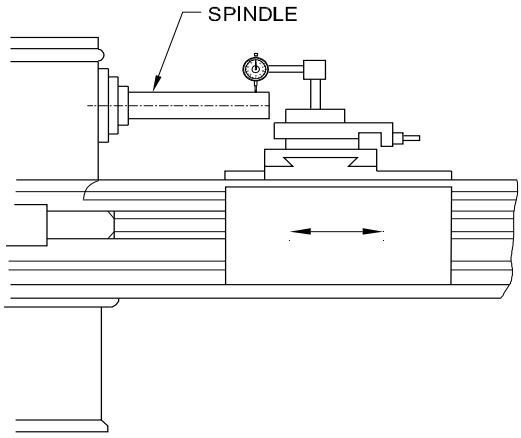
Fig 1



LEVELLING A LATHE BED



CHECKING QUILL MOVEMENT OF TAIL STOCK



CHECKING THE TRUE RUNNING OF SPINDLE

TD20\N2710SH1

Skill Sequence

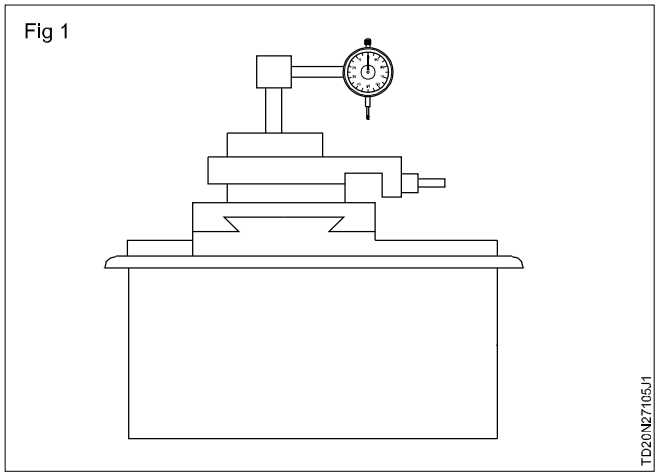
Checking quill movement of tailstock

Objective: This shall help you to

- **test the tailstock sleeve movement relative to the carriage guideways.**

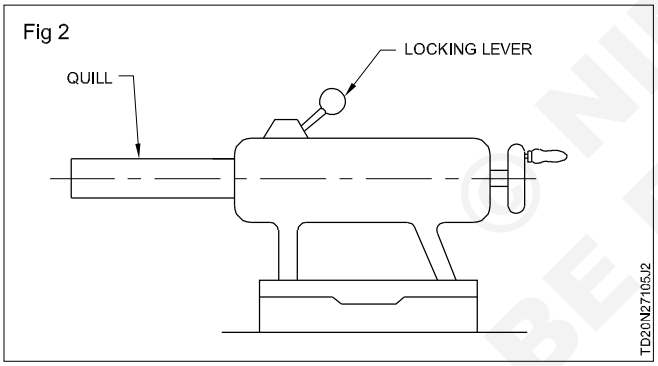
Fix the dial gauge on the carriage. (Fig 1)

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

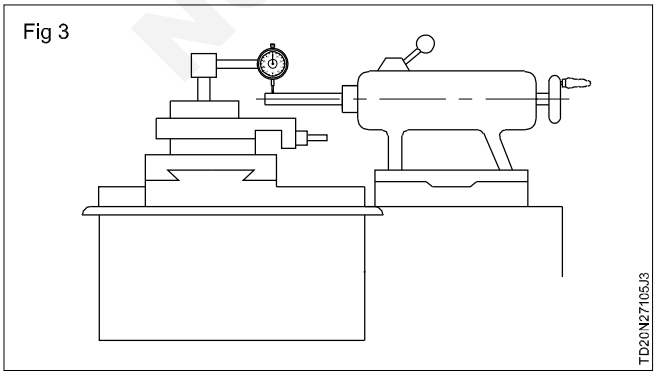


Clamp the quill during each measurement. If it is not clamped it will affect the measurement.

Place the dial plunger to contact over the free end of the quill in the vertical plane. (Fig 3)

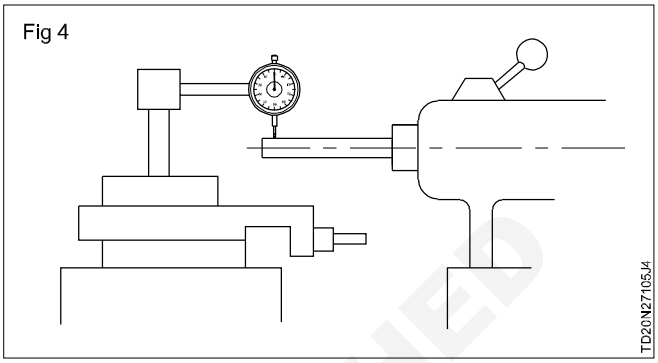
Ensure that the dial is set at the topmost point of the quill.

Fig 3



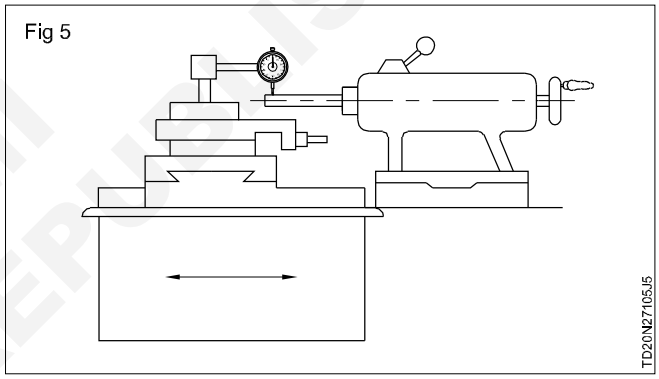
Set the dial at the zero position. (Fig 4)

Fig 4



Move the carriage slowly towards the entire length of the quill. (Fig 5)

Fig 5



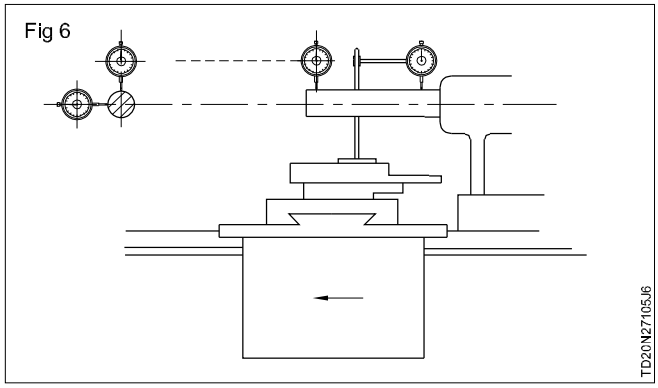
Note the dial reading at the extreme end of the quill.

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

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

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 Fig 6.

Fig 6



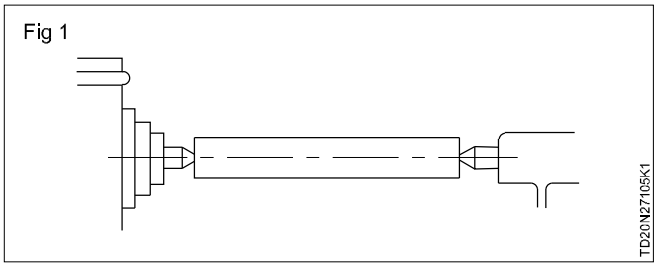
Checking the alignment of the main spindle and the tailstock spindle of a lathe

Objectives: This shall help you to
- **to check the alingment of the spindle and the**
- **tailstock sleeve.**

Insert a hollow test mandrel (300 to 500 mm long) in between the centres. (Fig 1)

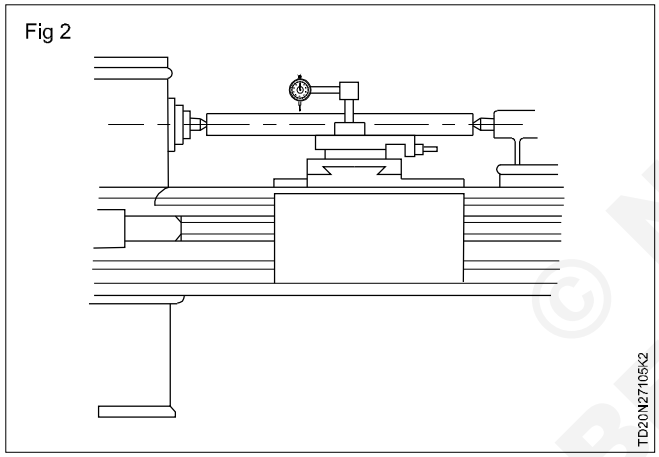
Ensure that the spindle bearing is at its working temperature.

Fig 1



Fix the dial gauge on the saddle, the plunger touching a position of the mandrel and set it to zero.(Fig 2)

Fig 2

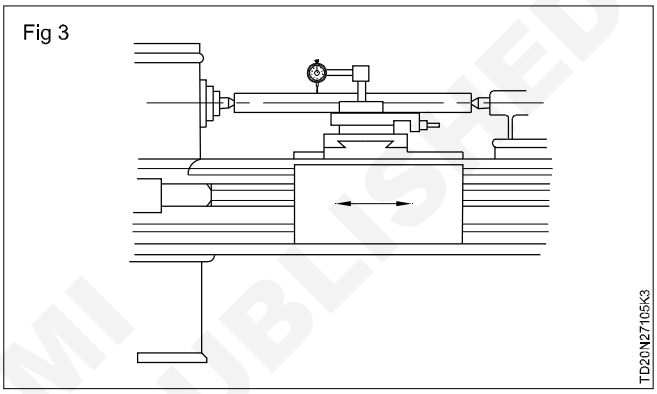


Move the carriage from one end to the other end of the mandrel to check the mandrel is in correct alignment in the horizontal position.

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

Set the dial plunger at the top of the mandrel and move the saddle along the bed slowly to the entire length of the mandrel. (Fig 3)

Fig 3



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

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

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

Checking the true running of a spindle

Objective: This shall help you to
- **test the true running of a lathe spindle with a test mandrel.**

Locate the taper shank of the test mandrel in the spindle taper.

Hold a dial gauge, stationary in the carriage, its plunger contacting the mandrel near its free end (Fig 1) and set it to '0' position.

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

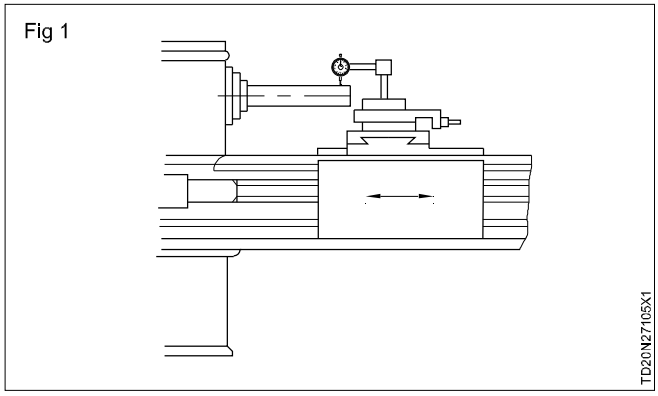
Rotate the spindle along with the mandrel slowly by hand.

Observe and note the reading of the dial gauge.

Move the dial gauge near the spindle nose. Rotate the spindle along with the mandrel slowly by hand and note the reading.

Take readings of the dial gauge while the spindle is slowly rotated. Verify the deflection of the dial reading and compare the value with the test chart. (IS: 6040)

Fig 1

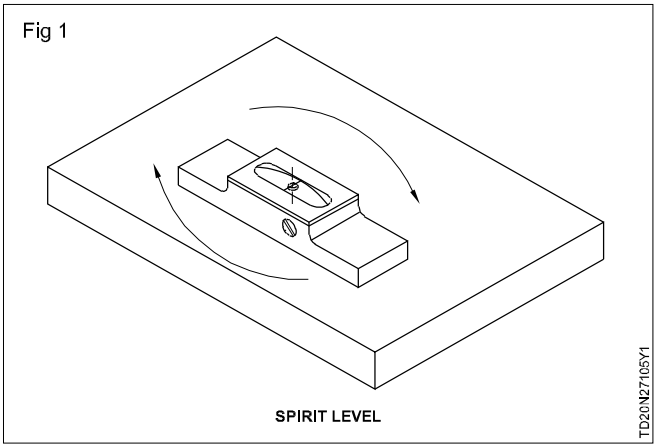


Adjustment of the spirit level with the plane surface

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)

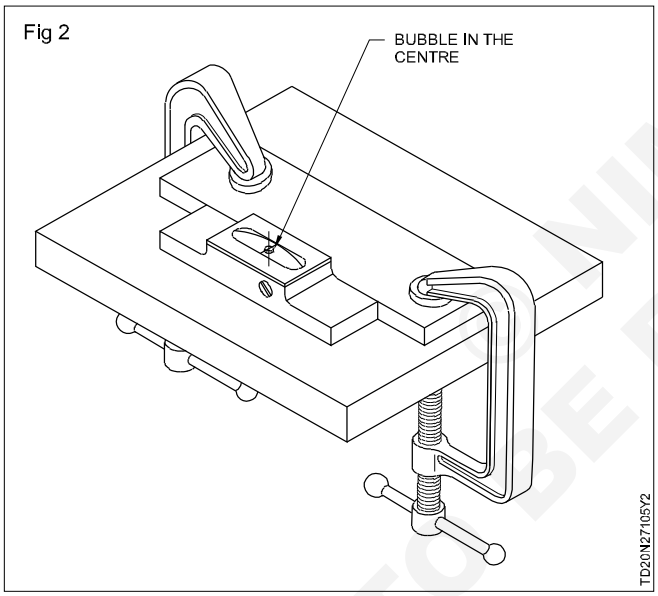
Fig 1



SPIRIT LEVEL

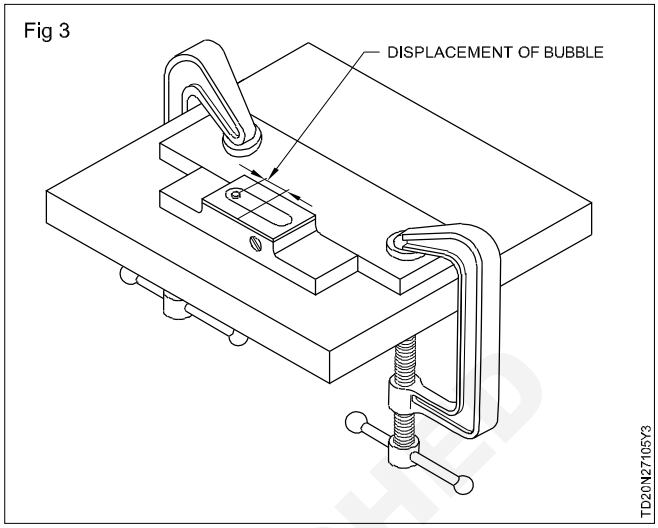
Place a straight edge against the level and clamp to the plate. (Fig 2)

Fig 2



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

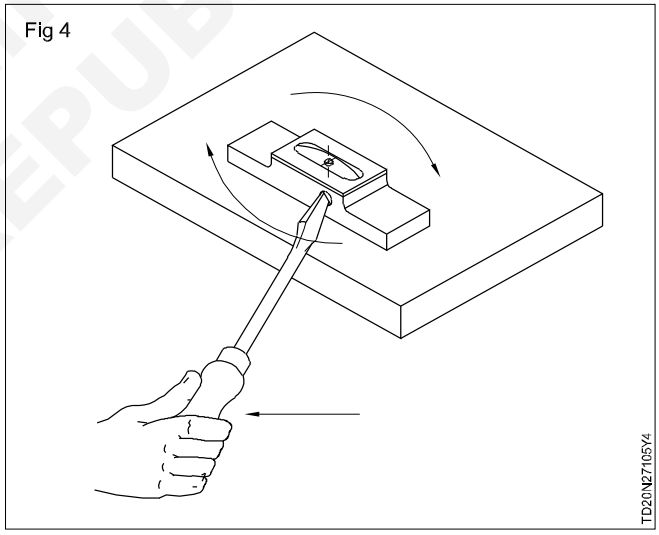
Fig 3



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



Level the lathe bed

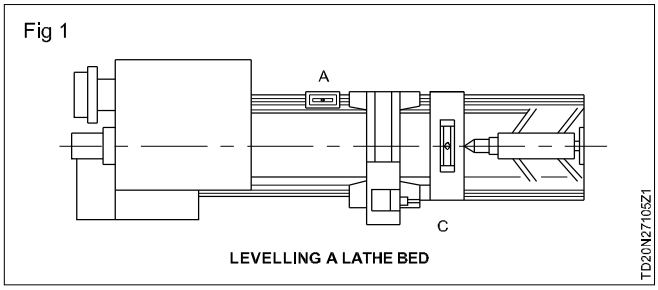
Objectives: This shall help you to
- **level the lathe horizontally with the help of a spirit level.**

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)

Keep the second spirit level transversally at the position 'C'. (Fig 1)

Fig 1



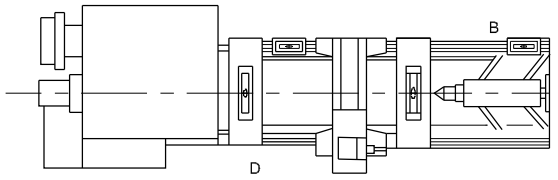
LEVELLING A LATHE BED

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)

Fig 2



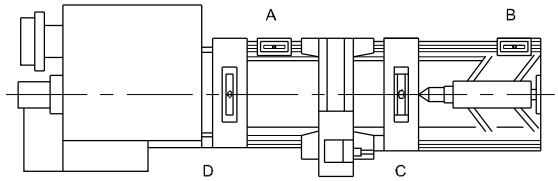
LEVELLING A LATHE BED

TD20N27105Z2

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 3



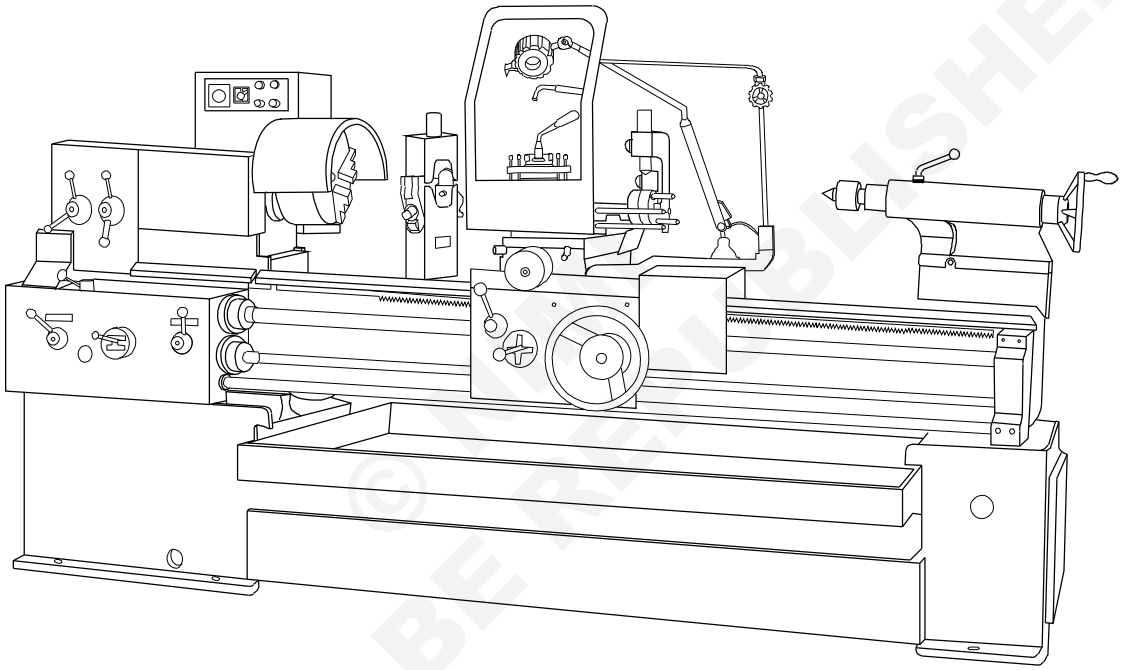
LEVELLING A LATHE BED

TD20N27105Z3

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.**

Fig 1



Trainees may be asked to write the job sequence and record the tested values for

1 Levelling

2 True running of spindle

3 Alignment of mainspindle and the tailstock spindle

4 Parallelism of tailstock sleeve with respect to bedways

5 Test the machine by producing component.

TD20N27106H1

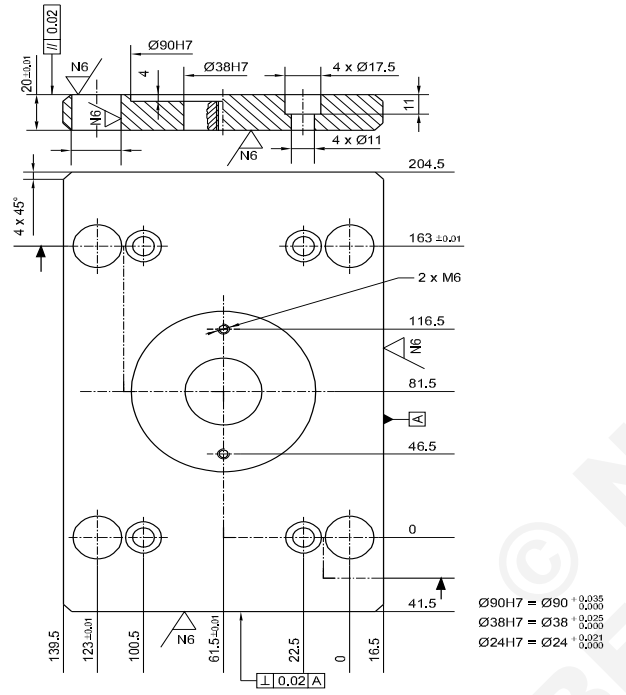
Two cavity injection mould with side cavities

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

- **develop isometric drawing of two cavity injection mould with side cavities**
- **manufacture all components of two cavity injection mould using conventional and non conventional machines**
- **maintain dimensional tolerances, geometrical tolerances and surface finish mentioned in the drawin.**

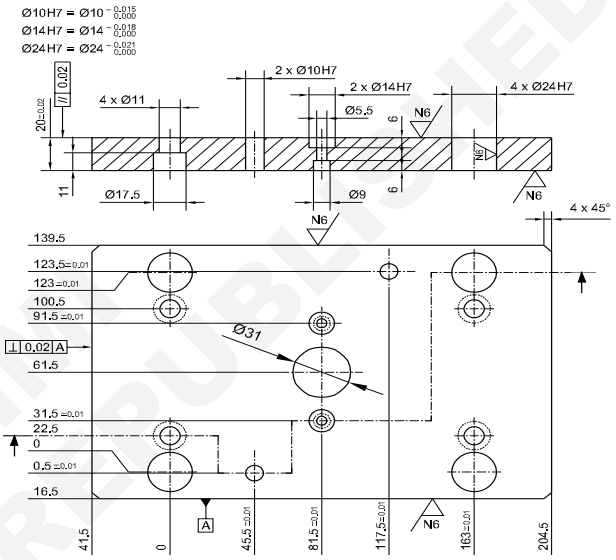
TASK 1

TOP PLATE
QUANTITY = 1
MATERIAL = Fe310



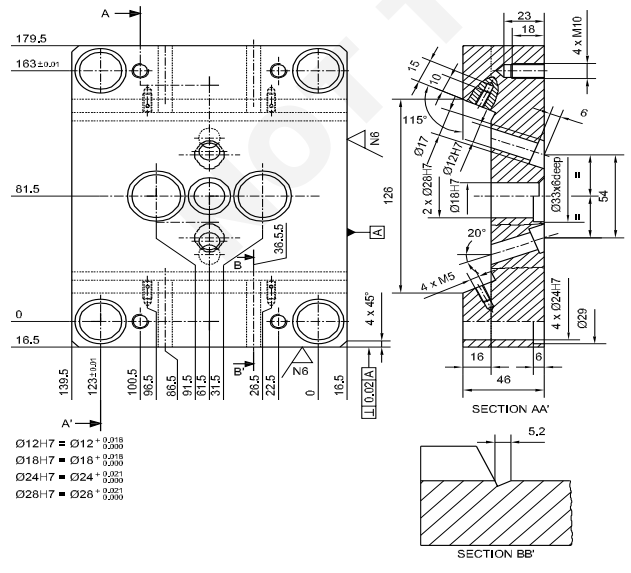
TASK 2

BOTTOM PLATE
QUANTITY = 1
MATERIAL = Fe310



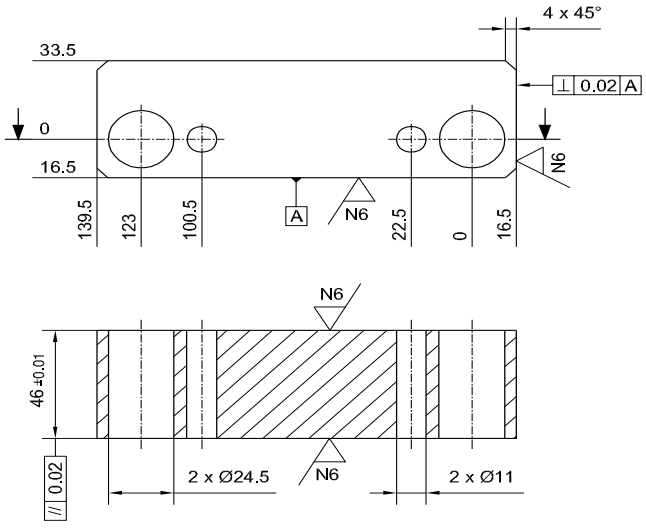
TASK 3

CAM HOLDER PLATE
QUANTITY = 1
MATERIAL = Fe310



TASK 4

SUPPORT BLOCK
QUANTITY = 2
MATERIAL = Fe310



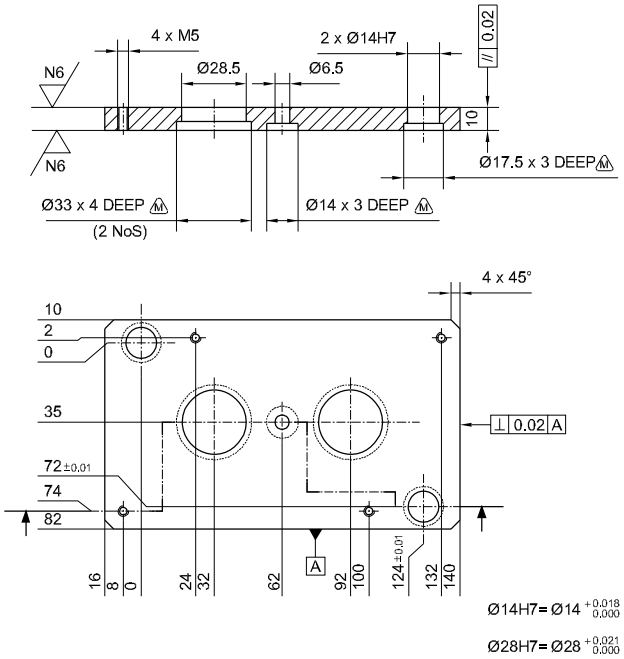
TD20\N28107H1

TASK 5

EJECTOR RETAINER PLATE

QUANTITY = 1

MATERIAL = Fe310

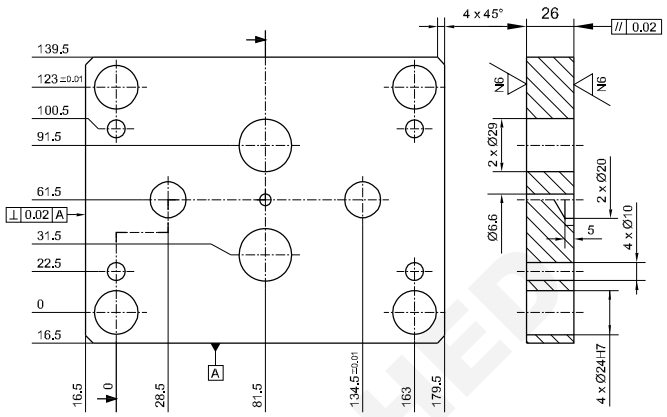


TASK 6

CORE BACK PLATE

QUANTITY = 1

MATERIAL = Fe310

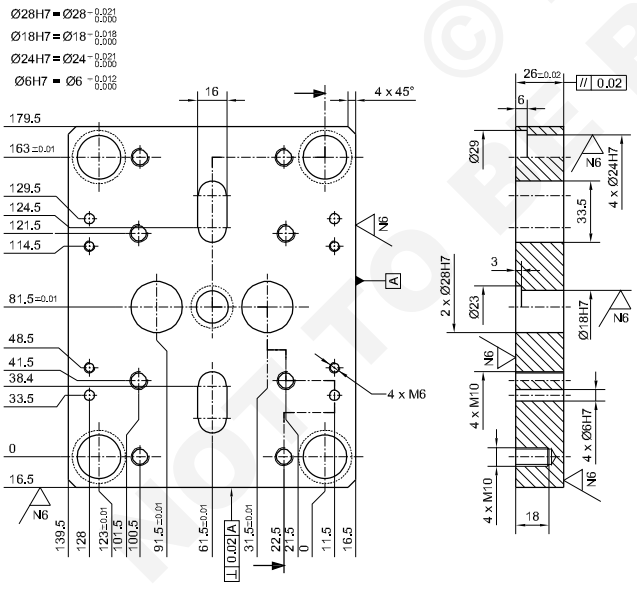


TASK 7

CORE PLATE

QUANTITY = 1

MATERIAL = Fe310

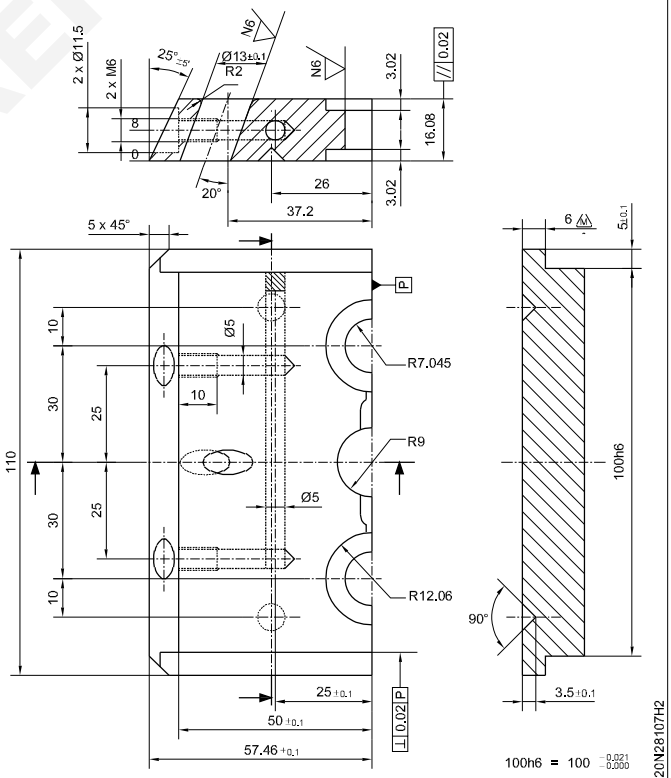


TASK 8

SIDE CORE

QUANTITY = 2

MATERIAL = Fe310

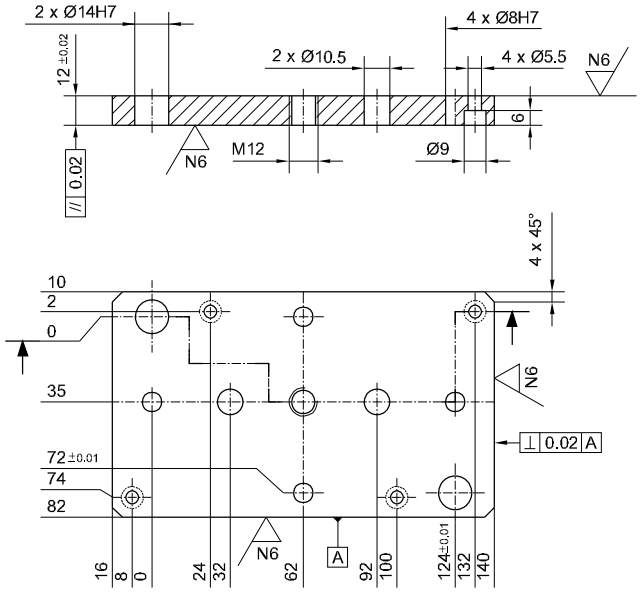


TASK 9

EJECTOR PLATE

QUANTITY = 1

MATERIAL = Fe310



Ø14H7= $Ø14^{+0.018}_{0.000}$

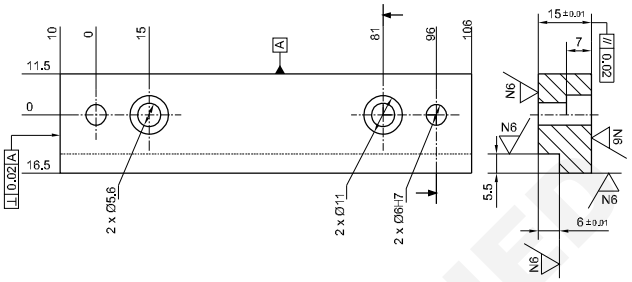
Ø8H7 = $Ø8^{+0.015}_{0.000}$

TASK 10

GUIDE BLOCKS

QUANTITY = 2

MATERIAL = Fe310

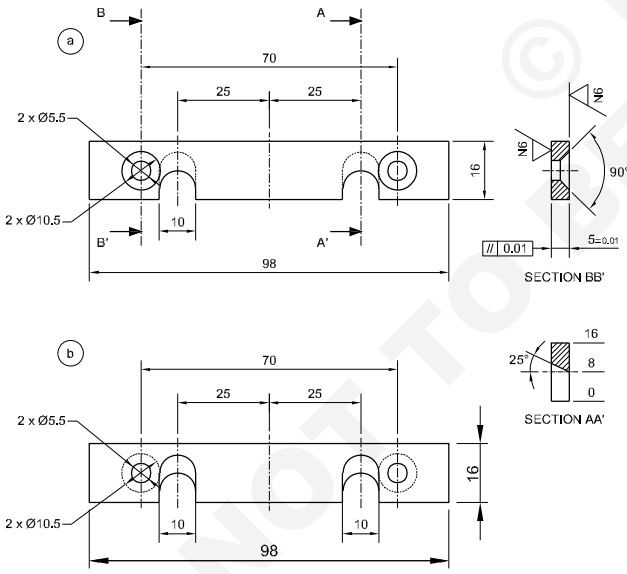


TASK 11

WEAR PLATE

QUANTITY = 1+1

MATERIAL = Fe310

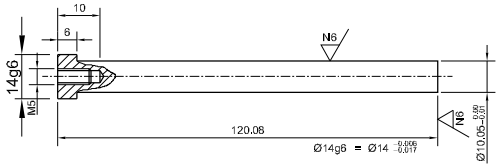


TASK 12

CORE

QUANTITY = 2

MATERIAL = Fe310



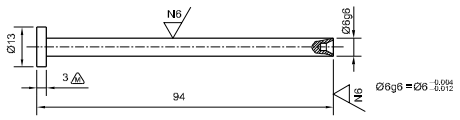
TD20N28107H3

TASK 13

EJECTOR PIN

QUANTITY = 2

MATERIAL = Fe310

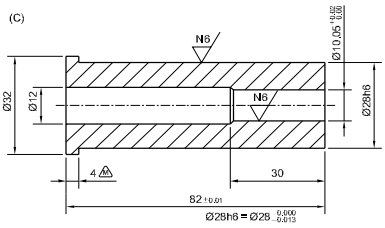


TASK 14

EJECTOR SLEEVE

QUANTITY = 2

MATERIAL = Fe310

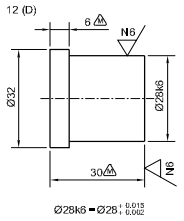


TASK 15

CORE INSERT

QUANTITY = 2

MATERIAL = Fe310

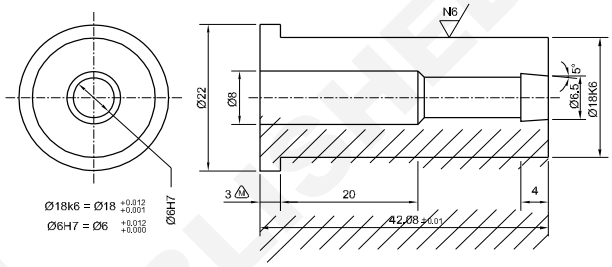


TASK 16

EJECTOR GUIDE PIN

QUANTITY = 1

MATERIAL = Fe310



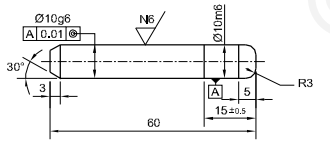
TD20N28107H4

TASK 17

SPRUE PULLER

QUANTITY = 2

MATERIAL = Fe310

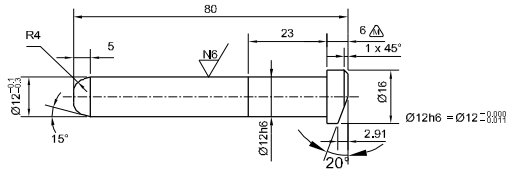


TASK 18

FINGER CAM

QUANTITY = 2

MATERIAL = Fe310

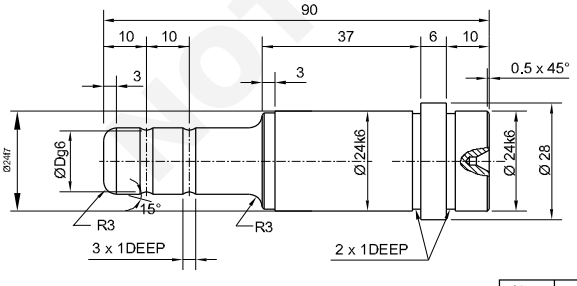


TASK 19

GUIDE PILLAR

QUANTITY = 4

MATERIAL = Fe310



Nos	ØDg6
1	15
3	16

Ø24k6 = Ø24 +0.015 +0.002

Ø24f7 = Ø24 -0.020 -0.041

Ø16g6 = Ø16 -0.006 -0.017

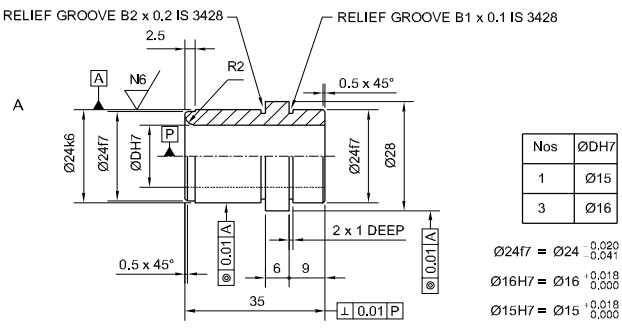
Ø15g6 = Ø15 -0.006 -0.017

TASK 20

GUIDE BUSH

QUANTITY = 4

MATERIAL = Fe310



Nos	ØDH7
1	Ø15
3	Ø16

Ø24f7 = Ø24 -0.020 -0.041

Ø16H7 = Ø16 +0.018 0.000

Ø15H7 = Ø15 +0.018 0.000

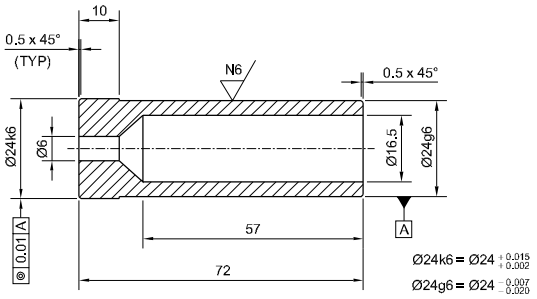
TD20N28107H5

TASK 21

ALIGNMENT BUSH

QUANTITY = 4

MATERIAL = Fe310

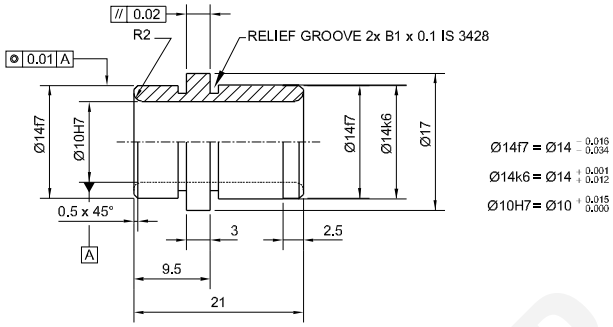


TASK 22

EJECTOR GUIDE BUSH

QUANTITY = 1

MATERIAL = Fe310

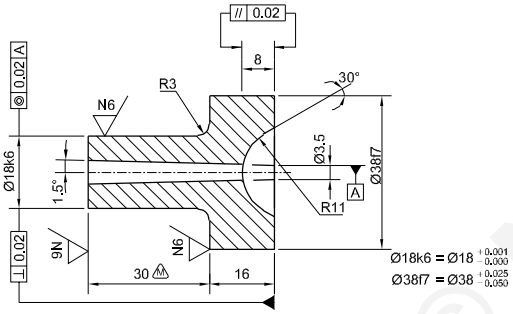


TASK 23

EJECTOR SPRUE BUSH

QUANTITY = 1

MATERIAL = Fe310

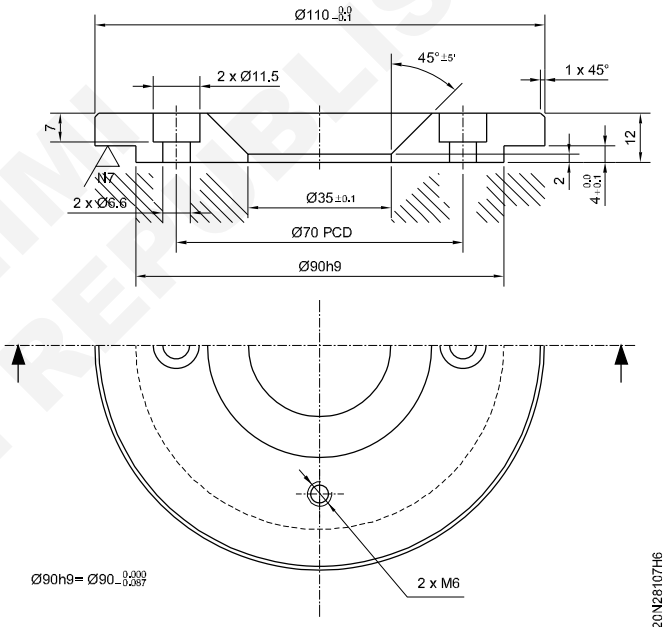


TASK 24

REGISTER RING

QUANTITY = 1

MATERIAL = Fe310



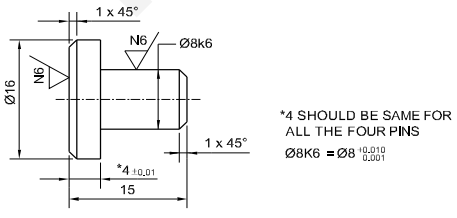
TD20\N28107H6

TASK 25

REST BUTTON

QUANTITY = 4

MATERIAL = Fe310

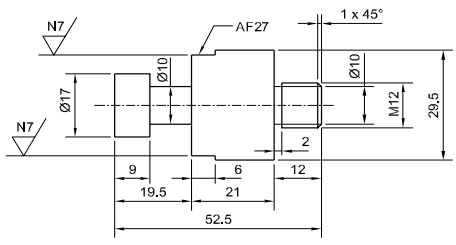


TASK 26

ADAPTOR

QUANTITY = 1

MATERIAL = Fe310

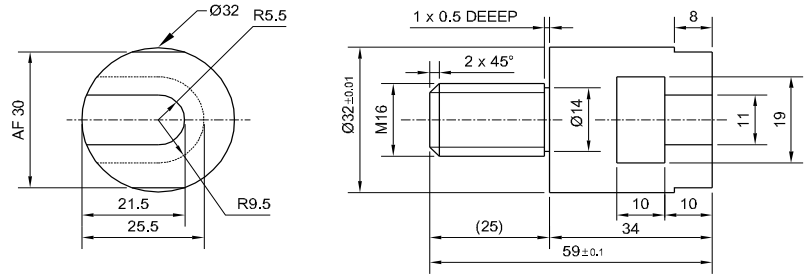


TASK 27

ADAPTOR

QUANTITY = 1

MATERIAL = Fe310



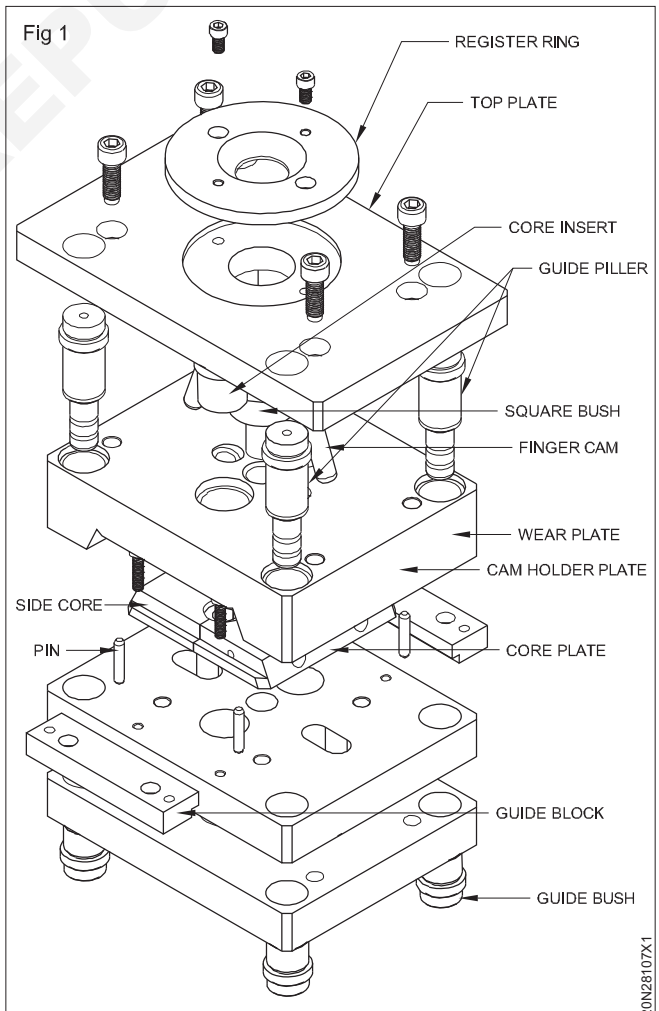
TDN29133H7

Job Sequence

Assembly of two cavity injection mould with side core.

- First open the Auto CAD window and change the workspace as 3D modeling.
- Keep the view control as "SW isometric" view and visualize style as "Wire frame" insert (or) copy and paste the all parts in one window.
- First assemble the core back plate with core plate. The center of the circle of 6.6 of the core back plate coincident with the center of the circle of 23 of the core plate. Check shift + Right click of the mouse. Then click the option center then move the corner to the circle of 6.6 the center point will shown the click the center the same procedure is use to the circle 23 and join the bottom view of the core plate coincident with the top view of the core back plate.
- The same way the center of the circle of R9 of the side core in joined with the center of the circle of 18 of the core plate. (The bottom view of the side core is coincident with the top view of the core plate.
- The same way another side of the side core is assembled.
- Then rotate the wear plate for 65° from the x axis. The center of the circle 10.5 of the wear plate is joined with the center of the circle of 11.5 of the side core. (The top face of the wear plate coincident with the side view of the side core).
- Now fuse above assembly is join with the core plate. The center of the circle core is coincident with the center of the circle of 8 of the core plate. (The bottom face of the side core assembly is coincident with the top face of the core plate).
- Now the support puller joined with the bottom of the core plate, then core back plate joined with the core plate.
- Then cam holder joined with the top face of the side core. Then core insert assembled with the top face of the side core. The finger cam joined with the cam holder.
- Then top plate assembled on the cam holder. The center of the top plate in joined with the center of the cam holder.
- Then core back plate assembled with the core plate. (The top face of the core back plate is coincident with the bottom face of the core plate).
- Then guide puller is joined with four corners of the top plate. Then the center of the sprue bush is joined with the center of the top plate, and then register ring is joined with the center of the sprue bush.
- Then insert the M6X12, M10X25 bolts are assembled as per the position.
- Now the top assembly of the two cavity injection mould with side core is completed (Fig 1).

Fig 1

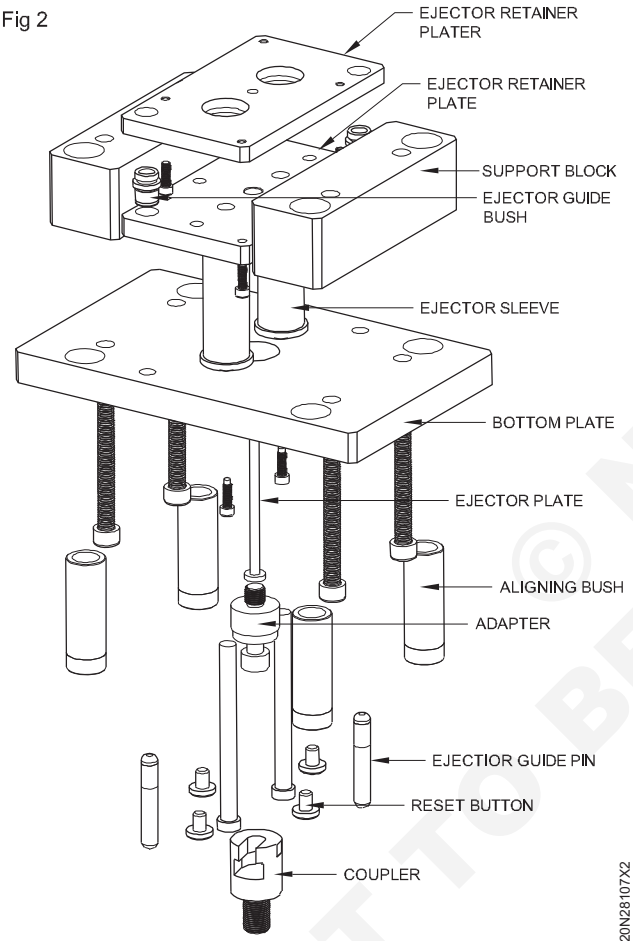


TOP ASSEMBLY

TD20N28107X1

- In the same way bottom assembly is assembled.
- The injection plate is joined with the ejector retainer plate. Then injection guide bush assembled as per the position the rest button is joined on the bottom face of the eject retainer plate then those assembly is joined with the bottom plate. Now the support block joined on the two sides of the injection plate.
- Then aligning bush is joined on the support block and then ejector sleeve and ejector center is joined on the injection plate, then ejection guide pin is joined on the ejector guide bush.
- Then the standard parts are assembled as per the position, the bottom assembly is completed (Fig 2).

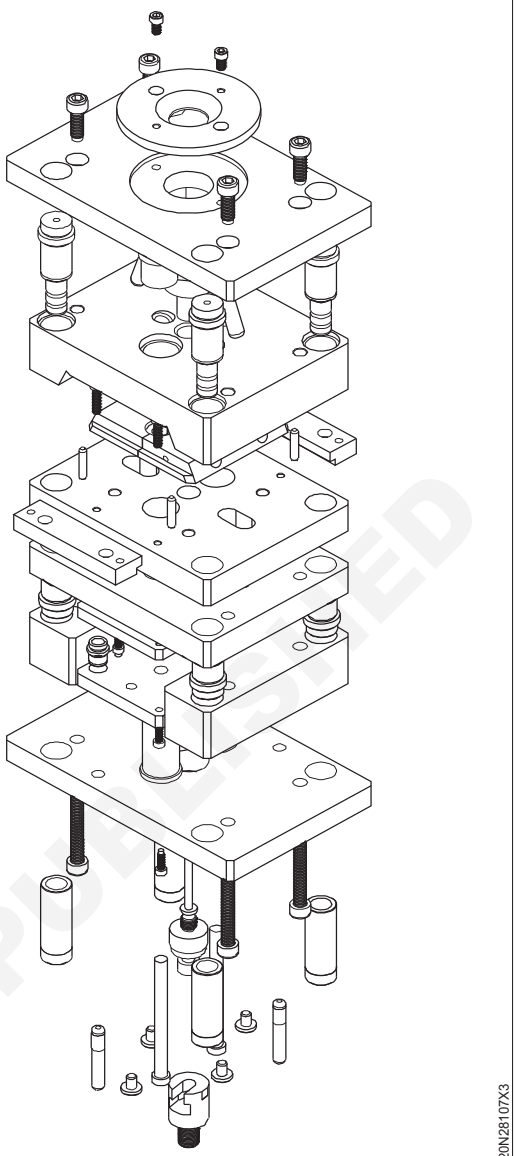
Fig 2



BOTTOM ASSEMBLY

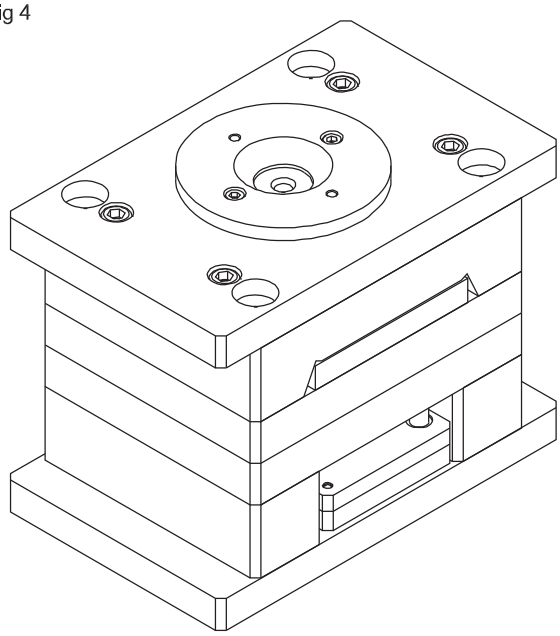
- The bottom assembly is joined with the top assembly. Now the two cavity injection mould with side core is assembled.
- Finally the adapter and coupler assembled on the bottom face of the bottom plate (Fig 3 & 4).

Fig 3



ASSEMBLY

Fig 4



TASK 1: **Top plate for side cavity mould**

- Check the raw material size
- Study the part drawing and list out the tools required.

  Face mill and side mill the workpiece as per drawing and maintain the sizes with grinding allowances
- Chamfer the workpiece as shown in the drawing
- Grind the thickness and maintain the parallelism
- Prepare the CNC programme for drilling and boring operation.
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Get it checked by the trainer.
- Hold the workpiece on machine vice or with required clamping devise properly by keeping ground surfaces in X and Y axes
- Set the tool in ATC in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page,
- Enter cutter radius compensation.
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single block by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

— — — — — — —

TASK 2: **Bottom plate for side cavity mould**

- Check the raw material size
- Study the part drawing and list out the tools required.
- Face mill and side mill the workpiece as per drawing and maintain the sizes with grinding allowances.
- Chamfer the workpiece as shown in the drawing
- Grind the thickness and maintain the parallelism
- Grind any two adjacent for drilling and boring operations
- Prepare the CNC programme for drilling and boring operation.
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Get it checked by the trainer.
- Hold the workpiece on machine vice or with required clamping devise properly by keeping ground surfaces in X and Y axes.
- Set the tool in ATC in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page,
- Enter cutter radius compensation.
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single block by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

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TASK 3: **Cam holder plate for side cavity mould**

- Check the raw material size
- Study the part drawing and list out the tools required.
- Face mill and side mill the workpiece as per drawing and maintain the sizes with grinding allowances.
- Chamfer the workpiece as shown in the drawing
- Grind the thickness and maintain the parallelism
- Grind any two adjacent sides perpendicular to each other.
- Mark the workpiece as per drawing.
- Set and mill slot as per drawing and maintain the dimensions and shape
- Mill slot 8x16mm deep 4 numbers as shown in drawing.

- Drill dia 8.5 x 4 Nos
- Set the workpiece on vertical milling machine for angular drilling.
- Swivel vertical head to 65 degree in anti clockwise direction and drill dia 4.1 x 2 Nos on angular surface.
- Drill and ream dia 28H7 x 2 Nos as shown in drawing
- Counter bore to dia 33mm to 6mm deep
- Set the workpiece on the vertical machine bed such that the slot surface rest on the machine table
- Swivel the vertical head to 20 degree in clockwise direction and drill and ream dia 12mm and couter bore to dia 17mm deep
- Deburr and clean the workpiece and machine.

— — — — — — —

TASK 4 to 6: **Support block, Ejector retainer plate, core back plate for side cavity mould**

Trainee may be asked to write the job sequence and machine the workpiece on conventional machines.

— — — — — — —

TASK 7: **Bottom plate for side cavity mould**

- Check the raw material size
- Study the part drawing and list out the tools required.
- Mill and Face mill the workpiece as per drawing and maintain the sizes with grinding allowances.
- Chamfer the workpiece as shown in the drawing
- Grind the thickness and maintain the parallelism
- Grind any two adjacent sides for drilling and boring operations
- Prepare the CNC programme for drilling and boring operations.
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Get it checked by the trainer.
- Hold the workpiece on machine vice or with required clamping devise properly by keeping ground surfaces in X and Y axes
- Set the tool in ATC in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page.
- Enter cutter radius compensation.
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single block by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

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TASK 8: **Side core for side cavity mould**

Side core for side cavity mould

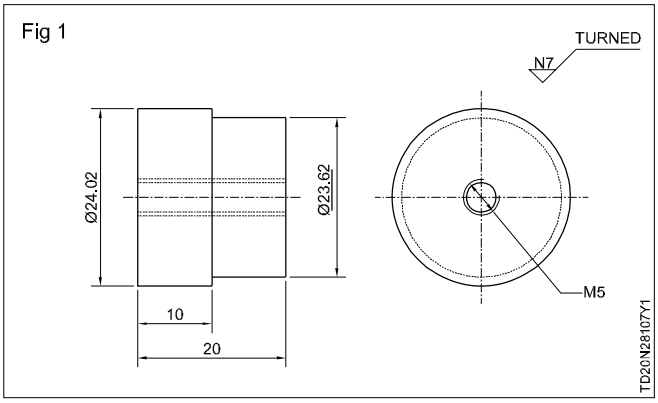
- Check the raw material 20 ISF 65-115.
- Mill block to 16.5 0.1 x 58 0.1 x 110.4 0.1
- Mill the step to a width of 4.5 0.1 depth to 10 0.1 on both the sides as per drawing, parallel within 0.1 and perpendicular within 0.1.
- Grind thickness to 16.08 0.01.
- Grind reference sides (Adjacent sides) perpendicular within 0.01.
- Mark and punch the co-ordinates for the hole centers.
- Drill hole dia 5 as per drawing for cooling system.

Care to be taken while drilling, since drilling should not be at an angle).

- Drill the impression for the ball catch to a depth of 3.5 0.1 as per drawing.
- Fix the block on vertical milling machine.
- Swivel vertical head to 25° and mill the angular surface as per drawing.
- Swivel the vertical head to 20° and drill hole dia 13.

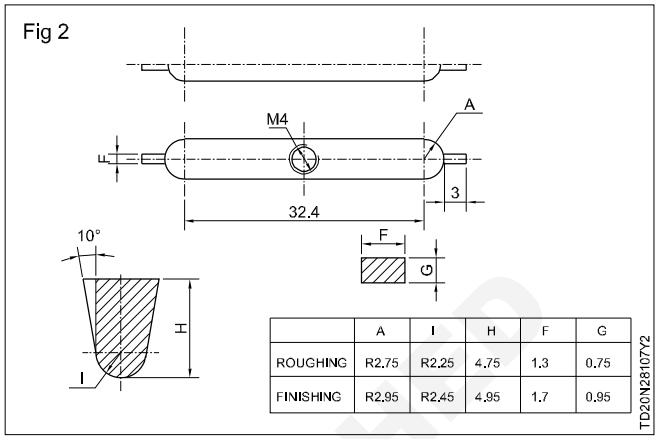
- Repeat the same procedure and make the second side core.
- Hold both the side core on the milling machine.
- Bore hole dia 18H7 and dia 14.08 0.01x2 Nos as per drawing.
- Set the aside core on the spark erision machine.
- Prepare electrode as shown in Fig 1.

Fig 1



- Erde the cavity to dia 24.12x3.02 deep as per drawing.
- Spark runner profile as per drawing.
- Reverse the side cores and spark to dia 24x12x3.02 deep as per drawing.
- Prepare electrode as shown in Fig 2.
- Erde the cavity as shown in drawing.
- File the gate to 1.8 width and to a depth of 1 0.1.

Fig 2



	A	I	H	F	G
ROUGHING	R2.75	R2.25	4.75	1.3	0.75
FINISHING	R2.95	R2.45	4.95	1.7	0.95

(Gate size may have to be varried during trials)

Plug the dia 5 cooling hole with a copper piece of dia 5 x 8 as per drawing.

Angle 25 to be matched during final assembly.

Chamfer as per drawing.

— — — — — — —

TASK 9 to18:

Trainee may be asked to write the job sequence and machine the workpiece on conventional machines.

— — — — — — —

TASK 19 to 21:

- Check the raw material size
- Study the part drawing and list out the tools required.
- prepare the part programme for turning
- Verify the part programme using simulator.
- Enter the part programme in CNC machine operator console.
- Set the workpiece in CNC turning centre.
- Get it checked by the trainer.
- Set the tool in turret in position as per programme.
- Measure the work offset and enter in G54.
- Measure the tool offset for all the tools and enter in the tool geometry page, tool nose radius and style of tool
- Check the work and tool offsets.

If there is any mistake correct it or ask the trainer for guidance.

- Run the programme in single block by dry run or setting the offset away from work zero.

If any corrections, correct it accordingly and run the programme.

- Check all the dimensions.
- Remove the workpiece from the machine.
- Switch off the machine.

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TASK 22

- Check the raw material size
- Study the part drawing and list out the tools required.
- Hold the workpiece in center lathe
- Face the workpiece, drill and ream dia 10mm
- Make a suitable mandrel
- Fix the workpiece in mandrel and set the mandrel in centre lathe
- Turn the external features and check the dimensions
- Remove the workpiece and clean the machine and workpiece.

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TASK 23:

Trainee may be asked to write the job sequence and machine the workpiece on conventional machines and maintain dimensional tolerances, geometrical tolerances and surface finish.

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TASK 24:

Turning

- Check the raw material size
- Study the part drawing and list out the tools required.
- Hold the workpiece in center lathe
- Face and turn dia 110 to maximum possible length.
- Drill and bore inside dia of 35mm
- Turn internal taper of 45 degree and maintain the taper length and taper angle
- Reverse the workpiece set and turn step dia of 90mm
- Face and maintain the thickness of 12mm
- Turn dia 90mm to 4mm length
- Remove the workpiece from machine.

Milling

- Set the vertical indexing head on vertical milling machine
- Align the both centers (indexing head and machine spindle in one line)
- Set the workpiece in vertical indexing head to drill on 70mm PCD.
- Position the workpiece 35mm away from the center of the spindle
- Drill and counter bore as per drawing in 180 degree part
- Similarly drill and tap M6 as shown in drawing.
- Remove the workpiece, clean both the workpiece and machine.

— — — — — — —

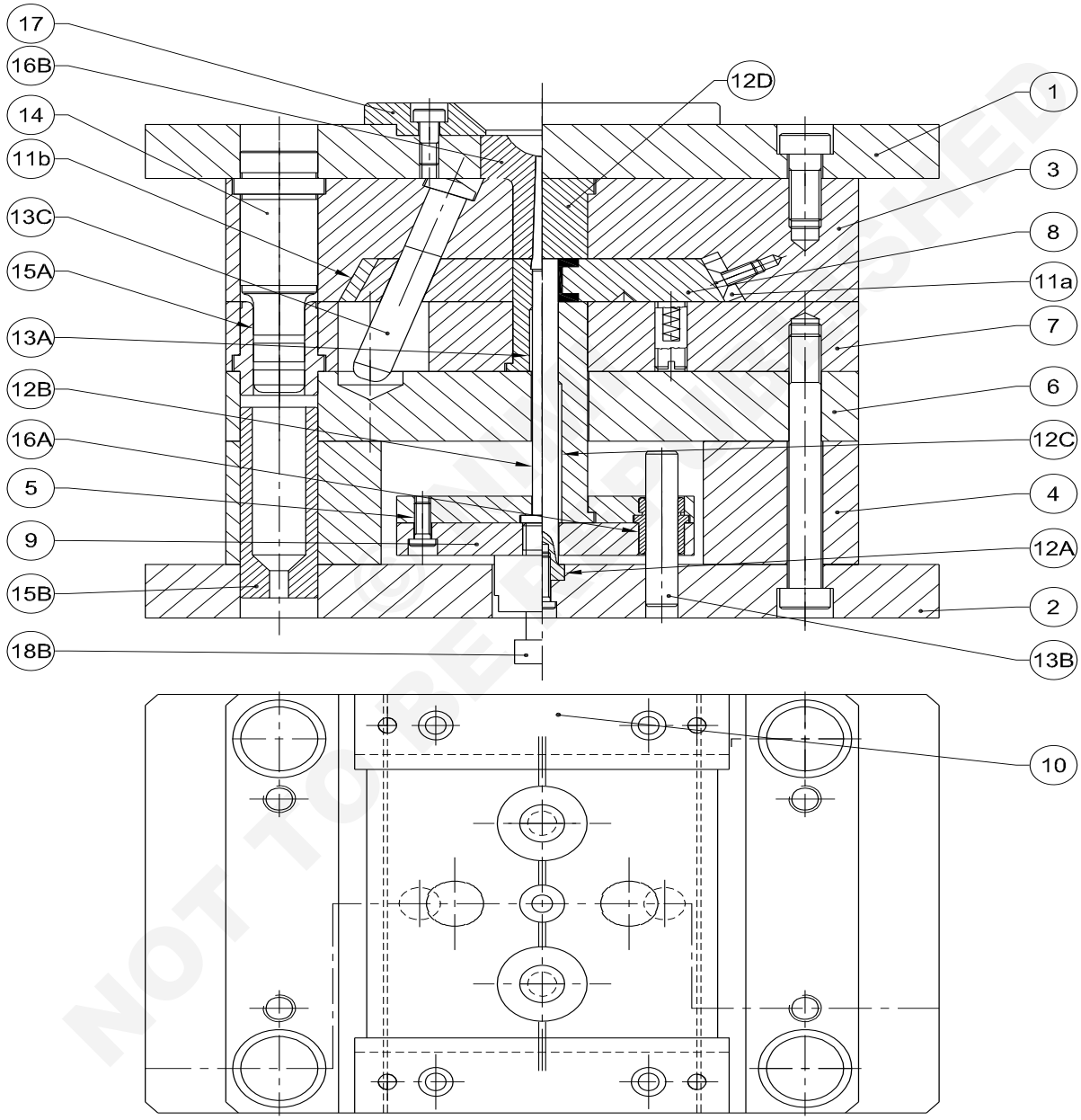
TASK 25 to 27

Trainee may be asked to write the job sequence and machine the workpiece on conventional machines and maintain dimensional tolerances, geometrical tolerances and surface finish.

— — — — — — —

Two cavity injection mould

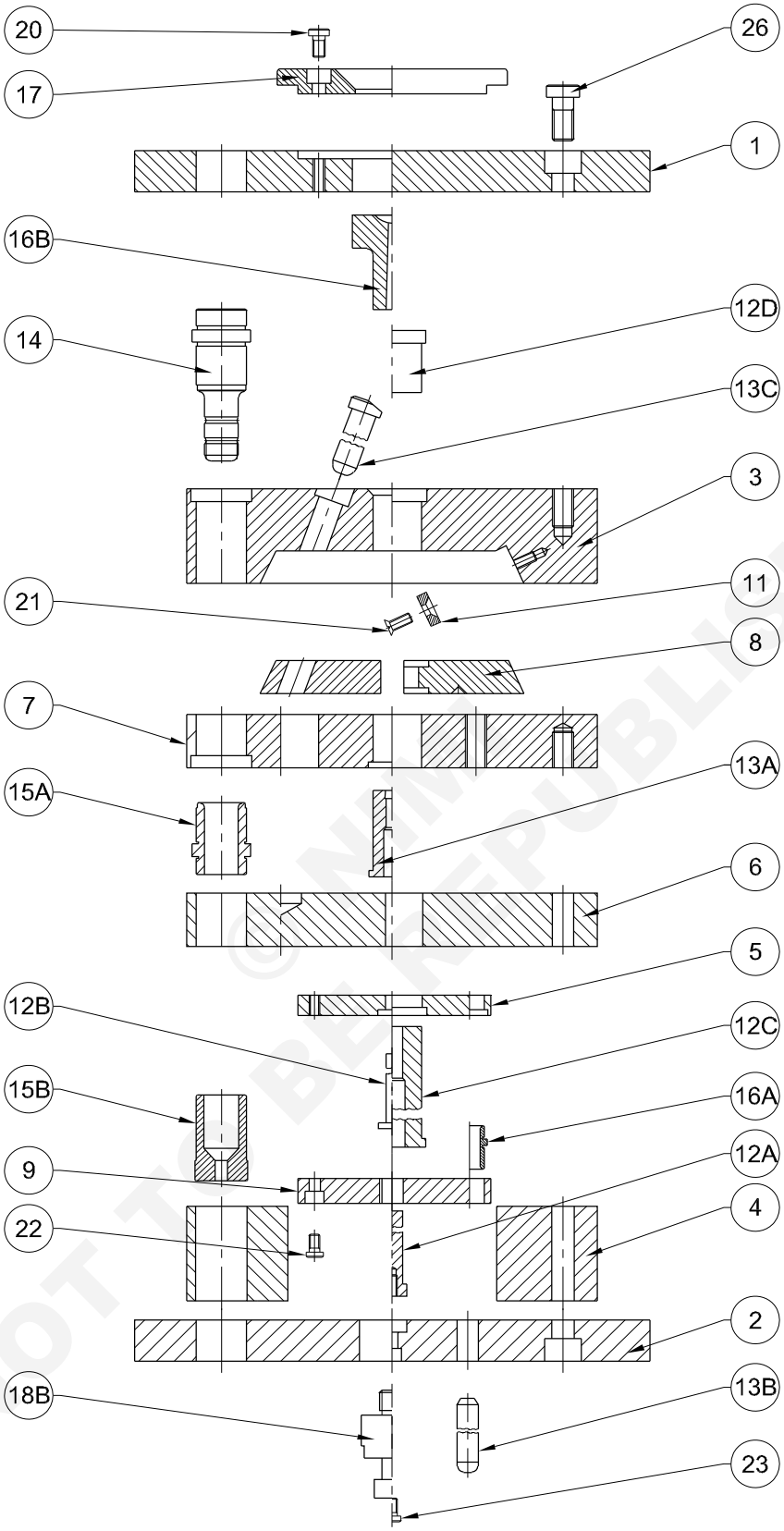
Objectives: At the end of this exercise you shall be able to
- **assemble the parts of two cavity injection mould side core**
- **trial run the output components.**



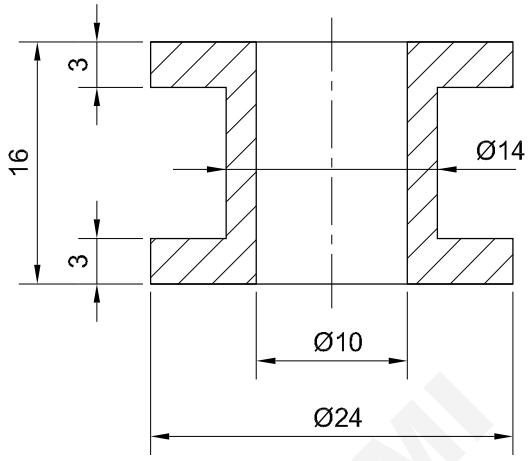
-	-	-	-	3P2	-	2.8.108
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	**ASSEMBLY OF TWO CAVITY INJECTOR MOULD IN SIDE CORE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TD20N28108E1	

4	DOWEL	6 x 30	STD	28	
4	BALL CATCH	M10 x 20	STD	27	
4	SKTHD	M10 x 25	STD	26	
4	SKTHD	M10 x 95	STD	25	
2	SKTHD	M6 x 25	STD	24	
4	SKTHD	M6 x 20	STD	23	
4	SKTHD	M5 x 15	STD	22	
4	CSK	M5 x 12	STD	21	
2	SKTHD	M6 x 12	STD	20	
2	ELECTRODE	10 - 35 - 55	COPPER	19B	
1	ELECTRODE	Ø28 x 25	COPPER	19A	
1	ADAPTOR	ISRO 36 x 65	Fe310	18C	
1	ADAPTOR	ISRO 32 x 58	Fe310	18B	
4	REST BUTTON	ISRO 22 x 25	Fe310	18A	
1	REGISTER RING	ISRO 115 x 17	Fe310	17	
1	SPRUE BUSH	ISRO 45 x 51	Fe310	16B	
2	EJECTOR GUIDE BUSH	ISRO 25 x 26	Fe310	16A	
4	ALIGNING BUSH	ISRO 28 x 75	Fe310	15B	
4	GUIDE BUSH	ISRO 32 x 40	Fe310	15A	
4	GUIDE PILLAR	ISRO 32 x 95	Fe310	14	
2	FINGER CAM	ISRO 22 x 85	Fe310	13C	
2	EJECTOR GUIDE PIN	ISRO 18 x 65	Fe310	13B	
1	SPRUE PULLER	ISRO 28 x 50	Fe310	13A	
2	CORE INSERT	ISRO 36 x 35	Fe310	12D	
2	EJECTOR SLEEVE	ISRO 36 x 90	Fe310	12C	
2	EJECTOR PIN	ISRO 16 x 100	Fe310	12B	
2	CORE	ISRO 20 x 125	Fe310	12A	
1	WEAR PLATE	10 ISF 20 - 103	Fe310	11b	
1	WEAR PLATE	10 ISF 20 - 103	Fe310	11a	
2	GUIDE BLOCKS	20 ISF 35 - 121	Fe310	10	
1	EJECTOR PLATE	15 ISF 100 - 160	Fe310	09	
2	SIDE CORE	20 ISF 65 - 115	Fe310	08	
1	CORE PLATE	30 ISF 160 - 201	Fe310	07	
1	CORE BACK PLATE	30 ISF 160 - 201	Fe310	06	
1	EJECTOR RETAINER PLATE	15 ISF 100 - 160	Fe310	05	
2	SUPPORT BLOCK	50 ISF 160 - 55	Fe310	04	
1	CAM HOLDER PLATE	50 ISF 160 - 200	Fe310	03	
1	BOTTOM PLATE	25 ISF 160 - 251	Fe310	02	
1	TOP PLATE	25 ISF 160 - 251	Fe310	01	
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	PART NO.	EX. NO.

SCALE	**SIDE CAVITY MOULD BILL OF MATERIAL**	DEVIATIONS ± 0.1	
		CODE NO. TD20N28108E2	



-	-	-	-	3P2	-	2.8.108
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	**SIDE CAVITY MOULD ASSEMBLY**				DEVIATIONS ± 0.1	TIME
					CODE NO. TD20N28108E3	



MATERIAL: ABS
SHRINKAGE: 0.5%

-	-	-	-	3P2	-	2.8.108
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**SIDE CAVITY MOULD COMPONENT (TRIAL)**				DEVIATIONS ± 0.1	TIME
					CODE NO. TD20N28108E4	

Job Sequence

- Clean all the parts
- Remove the sharp corners if any.
- Clean all the screw holes.
- Fit the sprue bush in cam holder plate.
- Fit the core inserts in cam holder plate.
- Fit the guide pillars in cam holder plate.
- Place the wear plates on cam holder plate and clamp with CSK screws M5 x 13-4 Nos.
- Fit the finger cam in cam holder plate.
- Place top plate on the cam holder plate such that guide pillars locates the bored in top plate.
- Clamp the top plate to the cam holder plate with the SKT HD M6 M10 x 25.
- Fit the register ring over the top plate and clamp with the SKT HD M6 x 12.
- Fit the sprue pillar in core plate.
- Fit the guide bush in core plate.
- Fix the ball catch in core plate.
- Place the core back plate on core plate, such that the guide bush locates the bore in core plate.
- Fit ejector guide bush in ejector retainer plate.
- Place ejector retainer plate on core back plate.
- Insert ejector sleeve and ejector pin in ejector retainer plate such that ejector sleeve and ejector pin enters through core plate.
- Place the ejector plate over the ejector retainer plate such that the ejector guide bush locates the bore in ejector plate.
- Clamp the ejector to ejector retainer plate with SKT HD M5 x 15.
- Insert core through ejector sleeve.
- Fit the ejector guide pin in bottom plate.
- Insert the aligning bush in the support blocks.
- Place the bottom plate assembly on core back. Plate aligning with aligning bush and screw holes.

See that the ejector guide pin should be guided in ejector guide bush.

- Clamp the bottom ejector guide pin should be guided in ejector guide bush.
- Clamp the bottom plate support block core back plate and core plate with SKT HD M10 x 95.
- Fix core to bottom plate with SKT HD M6 x 20-2 nos.
- Fix the guide blocks on to core plate with SKT HD M6 x 25-4 nos.
- Insert side core into the guide blocks.
- Check for the movement.
- Dowel guide blocks to core plate.
- Position the side cores such that they engage witht the ball catch.
- Close both the mould halves.

Documentation-1

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

- **Trainer may arrange for a industrial visit near by your institute, collect inputs and fill up format as required.**
- **Trainees will be guided by the concerned trainer.**
- **Collect necessary information, forms and instruct the trainees to reproduce the forms and guide them to fill it up.**

Job Sequene

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

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)		

BILLS OF MATERIALS (BOM) FORMAT

BOM Level	Part Number	Part Name	Code	Quantity	Unit	Date of Procurement	Designators	Remarks

Date

Incharge

Place

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

Documentation-2

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

- **Trainer may arrange for a industrial visit near by your institute, collect inputs and fill up format as required.**
- **Trainees will be guided by the concerned trainer.**
- **Collect necessary information forms and instruct the trainees to reproduce the forms and guide them to fill it up.**

Job Sequene

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

JOB CARD - FORMAT-1

Job Card		Doc No.	
		Rev No.	
		Date	
Order Starting Date			
Customer			
Work Order No.			

Details

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

WORK ACTIVITY LOG - FORMAT-2

Organisation Name:

Department:

Section:

Employee Name:

Supervisor Name:

Date:

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

BATCH PRODUCTION RECORD - FORMAT-3

Batch Production Record in accordance with batch processing record

Manufacturing Organisation Name: _____

Description of job: _____

Name of part: _____

Batch No.: _____

The following deviations have appeared (continued)

No. process step	Name of processing step	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