TOOL & DIE MAKER

(PRESS TOOLS, JIGS & FIXTURES)

NSQF LEVEL - 4

2nd Year

TRADE PRACTICAL

Sector: Capital Goods & Manufacturing

(As per revised syllabus July 2022 - 1200Hrs)

Directorate General of Training

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

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

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

Sector : Capital Goods & Manufacturing

Duration : 2 Years

Trade : Tool & Die Maker (Press Tools, Jigs & Fixtures) - Trade Practical - 2nd Year NSQF level - 4

Developed & Published by

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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 Mentor Councils comprising various stakeholder's viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai has now come up with instructional material to suit the revised curriculum for **Tool & Die Maker (Press Tools, Jigs & Fixtures) - Trade Practical - 2nd Year NSQF Level - 4 in Capital Goods & Manufacturing Sector.** The NSQF Level - 4 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 trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

ATUL KUMAR TIWARI., I.A.S.,
Director General / Additional Secretary
Directorate General of Training
Ministry of Skill Development & Entrepreneruship
Government of India..

January 2024
New Delhi - 110 001

PREFACE

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

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

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

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

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

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

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

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

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 organisations to bring out this Instructional Material **(Trade Practical)** for the trade of **Tool & Die Maker (Press Tools, Jigs & Fixtures)** under **Capital Goods & Manufacturing** Sector for ITIs.

MEDIA DEVELOPMENT COMMITTEE MEMBERS

Shri. A. Vijayaraghavan	-	Assistant Director of Training (Retd.), ATI, Chennai - 32.
Shri. M. Sampath	-	Training officer (Retd.), CTI, Chennai - 32.
Shri. H.A. Manukumar	-	Training officer (NSTI), Chennai - 32.

NIMI CO-ORDINATORS

Shri. Nirmalya Nath	-	Deputy Director, NIMI, Chennai - 32.
Shri. V. Gopalakrishnan	-	Manager, NIMI, Chennai - 32.

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

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

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

INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intended to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the course of **Tool & Die maker (Press Tools, Jigs & Fixtures)** 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 syllabus are covered.

The manual is divided into Ten modules. The Ten modules are given below:

Module No	Module Name
Module 1	Jigs & Fixtures
Module 2	CNC Turning
Module 3	CNC Machine Centre
Module 4	CAM/EDM
Module 5	Blanking/ piercing Tool
Module 6	Hydraulics and Pneumatics,
Module 7	Compound Tool
Module 8	Progressive Tool
Module 9	Machine Tool Maintenance
Module 10	Bending Tool/ Draw Tool

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

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

TRADE THEORY

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

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

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

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

CONTENTS

LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

Sl.No.	Learning / Outcome	Refer Ex:No
1.	Manufacturing of drill Jig and produce component on drill machine by using Jigs and check for correctness. (Simple template and Plate Jig)	Ex. 2.1.84 - 85
2.	Manufacturing of fixtures (milling, and grinding)	Ex. 2.1.86 - 87
3.	Set (both job and tool) CNC lathe and produce components as per drawing by preparing part programme.	Ex. 2.2.88 - 92
4.	Set (both job and tool) CNC machining centre and produce components as per drawing by preparing part programme.	Ex. 2.3.93 - 97
5.	Perform 2D and 3D machining with CAM software.	Ex. 2.4.98
6.	Produce components using Electric Discharge machine (EDM) and Wire EDM as per drawing by preparing part programme with accuracy of ± 0.02mm.	Ex. 2.4.99 - 103
7.	Manufacturing of blanking (simple) die set for square/ round/ rectangular/ elliptical component and verify the component. (individual)	Ex. 2.5.104 - 106
8.	Construct a Piercing and Blanking tool, test and verify the component. (Individual)	Ex. 2.5.107
9.	Construct circuit of pneumatics and hydraulics observing standard operating procedure and safety aspect.	Ex. 2.6.108
10.	Construct a compound tool, test and verify the component. (Group of 5 trainees)	Ex. 2.7.109
11.	Construct a Progressive tool, test and verify the component. (Group of 5 trainees)	Ex. 2.8.110 - 111
12.	Plan and perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, milling machine and Lathe]	Ex. 2.9.112 - 116
13.	Manufacture “V” bending tool & test. (5 trainees in a group)	Ex. 2.10.117
14.	Construct a draw tool (single stage) and test to verify the component. (5 trainees in a group)	Ex. 2.10.118

SYLLABUS

Duration	Reference Learning Outcome	Professional Skill (Trade Practical) (With indicative hour)	Professional Knowledge (Trade Theory)
Professional Skill 22 Hrs; Professional Knowledge 15 Hrs	Manufacturing of drill Jig and produce component on drill machine by using Jigs and check for correctness. (Simple template & Plate Jig) (NOS: CSC/N0316)	84. Make simple drilling jig (12 hrs.) 85. Manufacturing of ring jigs, box jigs, and diameter jigs. (10 hrs.)	Introduction to tooling. Introduction to Jigs and Fixtures, Plane of movements, possible movements of work piece, location of work piece, types of Jigs, Types of Fixtures, Jigs/ fixture and machine relations. Method of restricting the possible movement (principle, 3-2-1 pin method). Locating method. Introduction of locating devices, its material, types of locators, locator for flat, surface, internal diameter and external profile. Clamping and work holding devices: Clamping devices, types of clamps for jig and fixture. Material for and clamps. Drill Bushes Type of drill jigs. Type of fixture. Fixture and machine relations, cutting force on jigs and fixtures, elements of jigs and fixtures, jigs and fixture cutting tool relations, design of jigs and fixtures, failure of jigs and fixtures. (15 hrs.)
Professional Skill 37 Hrs; Professional Knowledge 18 Hrs	Manufacturing of fixtures (milling, turning and grinding). (NOS: CSC/N0316)	86. Manufacturing of milling fixture and application. (12 hrs.) 87. Manufacturing of grinding fixture and application. (25 hrs.)	Types of press Tools/ Operations: Guide Plate tool, piercing tool, blanking tool, progressive tool, compound tool, cut off tool, parting tool, etc. Theory of Shearing: Shearing Theory Description in Press Tool (18 hrs.)
Professional Skill 62 Hrs; Professional Knowledge 17 Hrs	Set (both job and tool) CNC lathe and produce components as per drawing by preparing part programme. (NOS: CSC/N0120)	88. Study of CNC lathe, key board and specifications. (05hrs.) 89. Machine starting & operating in Reference Point, JOG, and Incremental Modes. (12 hrs.) 90. Co-ordinate system points, assignments and simulations Absolute and incremental programming assignments and simulations.(15 hrs.)	Safety Precautions: Safe handling of tools, equipment & CNC machines, CNC turning with FANUC CNC CONTROL- (Fanuc-Oi-T latest) CNC Machine & Control specifications. CNC system organization Fanuc 0i-T. Coordinate systems and Points. CNC lathe, Types, Machine axes.(17 hrs.)

		91. Co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. (10hrs.) 92. Work and tool setting. Automatic Mode operation: facing, profile turning, drilling, tapping, reaming, thread cutting etc. (20 hrs.)111 Work and tool setting. Automatic Mode operation: facing, profile turning, drilling, tapping, reaming, thread cutting etc. (25hrs.)	
Professional Skill 69 Hrs; Professional Knowledge 17 Hrs	Set (both job and tool) CNC machining centre and produce components as per drawing by pre-paring part programme. (NOS: CSC/N0123)	93. Study of CNC Machining centre, key board and specifications. (05 hrs.) 94. Machine starting & operating in Reference Point, JOG, and Incremental Modes. (08 hrs.) 95. Co-ordinate system points, assignments and simulations Absolute and incremental programming assignments and simulations. (15 hrs.) 96. Polar co-ordinate points, assignments and simulations. Identification of machine over travel limits and emergency stops. (18 hrs.) 97. Work and tool setting. Automatic Mode operation: Face Milling, profile milling, drilling, tapping, reaming etc. (23 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. Co ordinate systems and Points. CNC Machines Milling, Types, Machine axes. (17 hrs.)
Professional Skill 40 Hrs; Professional Knowledge 12 Hrs	Perform 2D & 3D machining with CAM software. (NOS: CSC/N0115)	98. 2D and 3D machining with CAM software. (40 hrs.)	Preparing for contour and profile machining. (12 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 12 Hrs	Produce components using Electric Discharge machine (EDM) and Wire EDM as per drawing by preparing part programme with accuracy of ± 0.02mm. (NOS: CSC/N0118)	99. Identify different parts of EDM/ wire cutmachining centres and read specification. (08 hrs.) 100. Perform machine starting and operating in reference point. (08 hrs.) 101. Identification of machine over travel limits on emergency. (10hrs.)	Safety precaution – Safe handling of tools, equipment of EDM/ wire cut machine. Control specification and machine axes. Describe machine tool elements, feed drives. Advantage and disadvantage of wire cut machine. (12 hrs.)

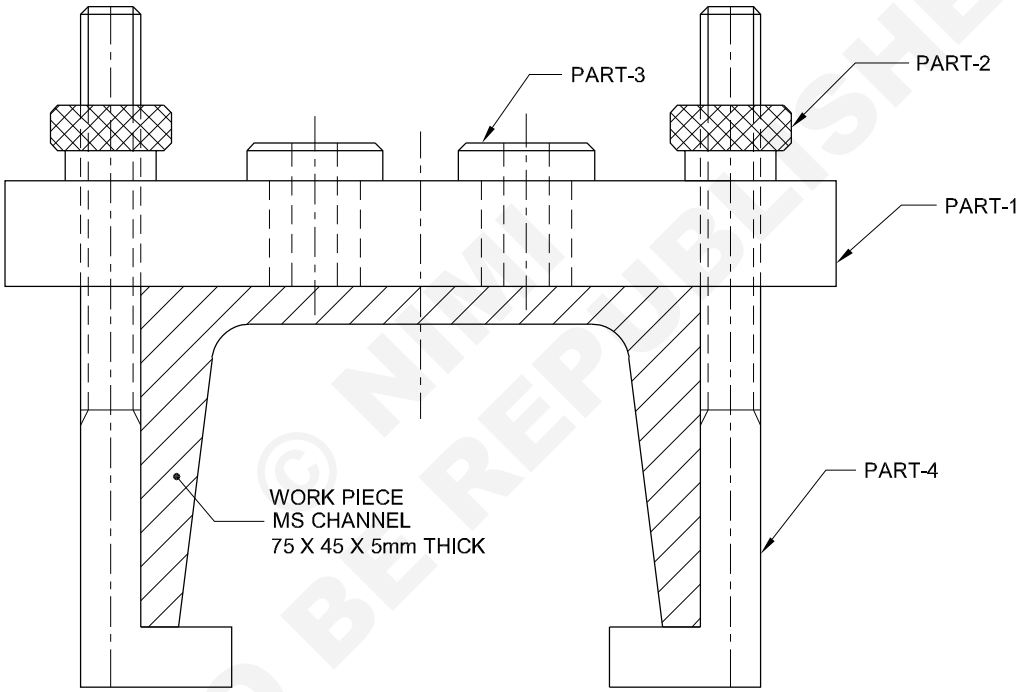
		102. Part program preparation entry, editing, and simulation on wire cut machine software of wire cut machine. (20 hrs.) 103. Carry out tool path tool path simulation. (4 hrs.)	
Professional Skill 75 Hrs; Professional Knowledge 25 Hrs	Manufacturing of blanking (simple) die set for square/ round/ rectangular/ elliptical component and verify the component. (individual) (NOS: CSC/N9478)	104. Manufacturing die as per drawing dimension and maintain die clearance and die land, provide angular clearance after die land. (25 hrs.) 105.Manufacturing of Punch as per drawing dimension. (15 hrs.) 106. Manufacturing stripper plate bottom plate (die press) tap plate, punch holder, gauges and shank, thrust plate, stop pin. (35hrs.) (May use the plates from turning, milling and grinding exercises)	Cutting clearance: Importance of cutting clearance, typical appearance characteristics, determination of punch and die dimensions. Land and angular clearance: Importance if angular clearance, methods of providing angular clearance. Basic design of guide plate tool. Alignment technique between Punch and Die while assembly. Guide Plate Tool: Construction, function of elements, related design. Cutting force: calculation of cutting force for press tool operations, selection of suitable press, method of reducing cutting force. Stock material: Relation of piece part and stock strip, stock material used in press work, differentiate stock strip and unit stock. Strip layout: Importance of strip layout, different types of strip layout, economic layout. Punch: Cutting punches, noncutting punches, hybrid punches, types of punches, selection of punches. Buckling of punches: Buckling theorem, problems, types of loading coming on a punch, determining of the size of the punch. Die Block: Types of dies, requirement of die block. (25 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Construct a Piercing & Blanking tool & test and verify the component. **(Individual)** (NOS: CSC/ N9479)	107. Construct a piercing and blanking tool as per the design given. (all components of tool to be the exercises of other machines) Press safety shut height (50 hrs.)	Stoppers: Function, basic stop principles, construction of different types of stoppers. Strippers: Function, types of stripper, constructional **details Gauge:** Function of gauge, types of gauge. Pilots: Purpose of pilot, types of pilot, function of pilot, different methods of piloting. Side cutter Shank and positioning Die Set: Different types of die set, die set components, die set material, types of die set, shut height, day light.

			Presses: Classification of press, types of a press, parts of a press, press selection, strip feeding arrangement, die cushion. **Blanking Tool:** Construction, function of elements, related design. **Piercing Tool:** Construction, function of elements, related design. **Ejector and shedders** Progressive tool: Construction, function of elements, related design of progressive too. (18 hrs.)
Professional Skill 10 Hrs; Professional Knowledge 05 Hrs	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect. (NOS: CSC/ N9480)	108 Identification and familiarisation of various types of hydraulic & pneumatic elements such as cylinder, valves, actuators and filters. (10 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. (05 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 15 Hrs	Construct a Compound Tool & test and verify the component. (Group of 5 trainees) (NOS: CSC/ N9481)	109. Construct a compound tool as per the drawing using various tool room machines and equipments. (75 hrs.)	Compound Tool: Introduction, description of different parts and their function, calculation of clearance, construction. (15 hrs.) Sensors for Distance and Displacement -LVDT-Linear Potentiometer -Ultrasonic and Optical Sensors-Industrial Application. (18 hrs.)
Professional Skill 150Hrs; Professional Knowledge 30 Hrs	Construct a Progressive tool & test and verify the component. (Group of 5 trainees) (NOS: CSC/ N9482)	110. Construct a progressive tool as per the drawing (145 hrs.) 111. Prepare different types of documentation as per industrial need by different methods of recording information for the project.(05 hrs.)	Bending tool: Principles of bending, plastic deformation due to bending, bending elements, blank length, bending stress, bending force, spring back, stripping "U" bend, effect of grain direction. (30 hrs.)

Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Plan and perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, milling machine and Lathe] (NOS: CSC/ N0901)	112 Perform Periodic Lubrication system on Machines. (10 hrs.) 113. Perform simple repair work. (15 hrs.) 114. Perform the routine maintenance with check list. (05 hrs.) 115. Inspection of Machine tools such as alignment, levelling etc. (10 hrs.) 116. 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. (10 hrs.)
		117. Construct a “V” bending tool as per the drawing (75 hrs.)	Forming tool: Construction, function of elements, related design Drawing Tool: Description of drawing and deep drawing, deep drawing cylindrical cup, force acting on a component while drawing, metal flow during drawing, wrinkling and puckering, blank development, drawing force, press capacity, blank holding force, die and punch radius, draw beeds, air vents, lubrication, number of draws drawing flanged components, metal flow in rectangular shells, fault occurring during deep drawing. (20 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 12 Hrs	Construct a draw tool (single stage) and test to verify the component. (5 trainees in a group) (NOS: CSC/N9484)	118. Construct a draw tool (single stage) as per the drawing given using various machine tools and equipments.(75 hrs.)	Factors effecting tool life Fine Blanking Tool. (12 hrs.)

Make a simple drilling jig

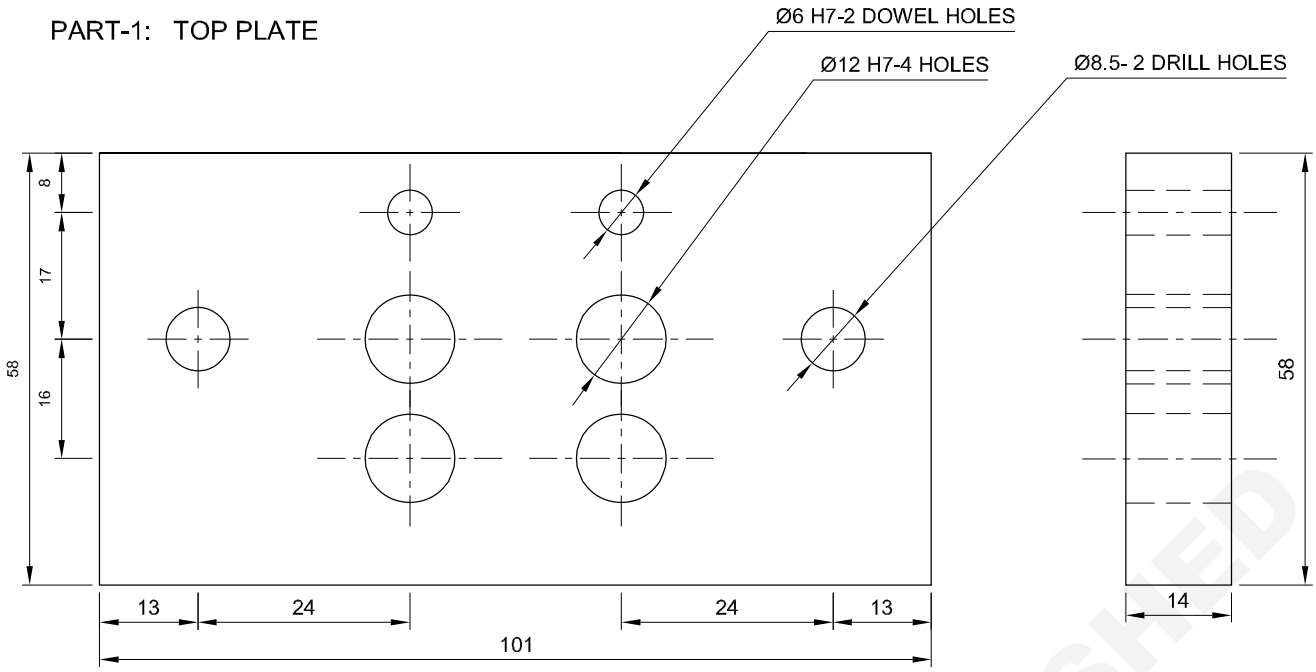
Objectives: At the end of this exercise you shall be able to
- **machine the parts of a drill jig**
- **assemble the parts of a drill jig as per assembly drawing**
- **check the dimensions and locations.**



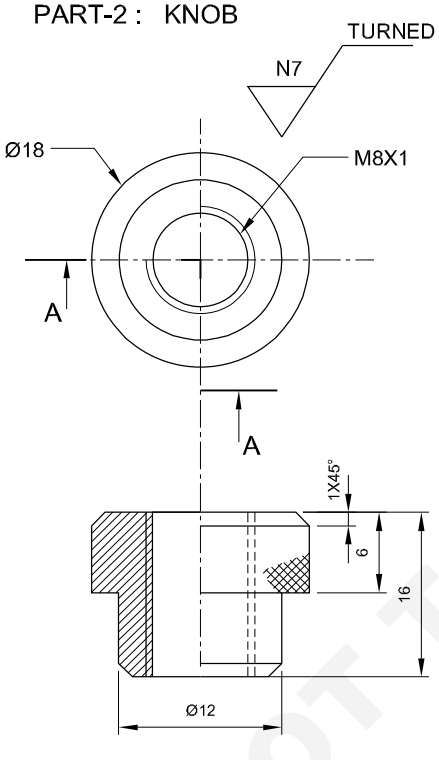
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
2	Ø6-20	DOWEL PIN	Fe310	-	5	2.1.84
2	Ø10-120	-	Fe310	-	4	
4	Ø22-25	-	HCS	-	3	
2	Ø20-18	-	Fe310	-	2	
1	60 ISF 15 -105	-	Fe310	-	1	

SCALE 1:1	**MAKE A SIMPLE DRILLING JIG**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2184E1	

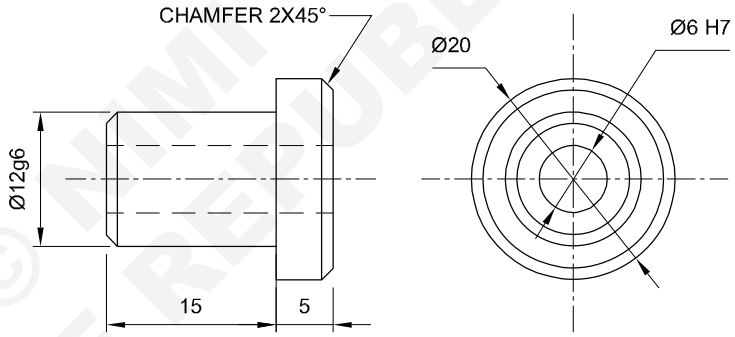
PART-1: TOP PLATE



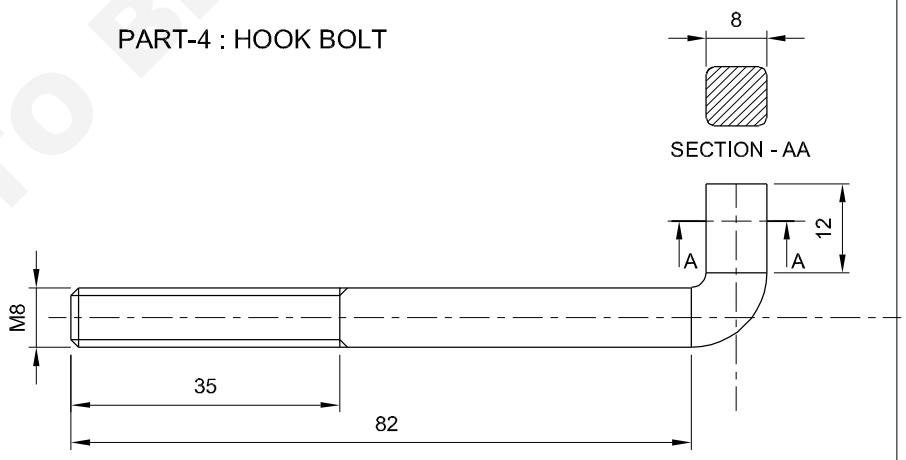
PART-2 : KNOB



PART-3: DRILL JIG BUSH



PART-4 : HOOK BOLT



NOTE:

Ø6H7 - 6 $^{+0.015}_{+0.000}$
Ø12H7 - 12 $^{+0.018}_{+0.000}$
Ø12g6 - 12 $^{-0.006}_{-0.017}$

N7 - SMOOTH MACHINING

-	-	-	-	-	1 - 4	2.1.84
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**TOP PLATE AND KNOB**				TOLERANCE ±	TIME :
					CODE NO. TJ20N2184E2	

PROCEDURE

TASK 1: **Making top plate**

1 Check the raw material.
2 File and finish the job 52 x101x14mm as per drawing.
3 Mark the hole centers.
4 Set the job on drilling machine.
5 Drill the holes ∅5.8mm for reaming.
6 Ream the hole using 6mm reamer.
8 Drill 2 holes of ∅8.5mm for inserting hook bolt.
9 Drill 4 nos of ∅11.8mm for fixing bush.
10 Ream the ∅11.8mm hole using 12mm reamer to get H7 Finish.
12 Remove burr in the sharp corner.

— — — — — — — —

TASK 2: **Making knob**

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

— — — — — — — —

TASK 3: **Making jig bush**

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

— — — — — — — —

TASK 4: **Making hook bolt**

1 Check the raw material.
2 Bend the rod as per drawing using anvil and hammer.
3 File flat surface as per section 'AA'.
4 Chamfer the length side for threading.
5 Make thread using 8 mm hand die with stock.
6 Check the thread using ∅8 mm nut.
7 Finish as per drawing.

— — — — — — — —

TASK 5: **Drill jig assembly**

1 Clean all the parts.
2 Deburr sharp corners if any.
3 Fit the bush (TASK 3) in the top plate. (TASK 2)
4 Fix the 6mm x 16mm dowel pin on the plate.
5 Fix the hook bolt 2 nos.
6 Screw the knob in hook bolt.
7 Insert the channel to be drilled.
8 Now the drill jig is ready for drilling.

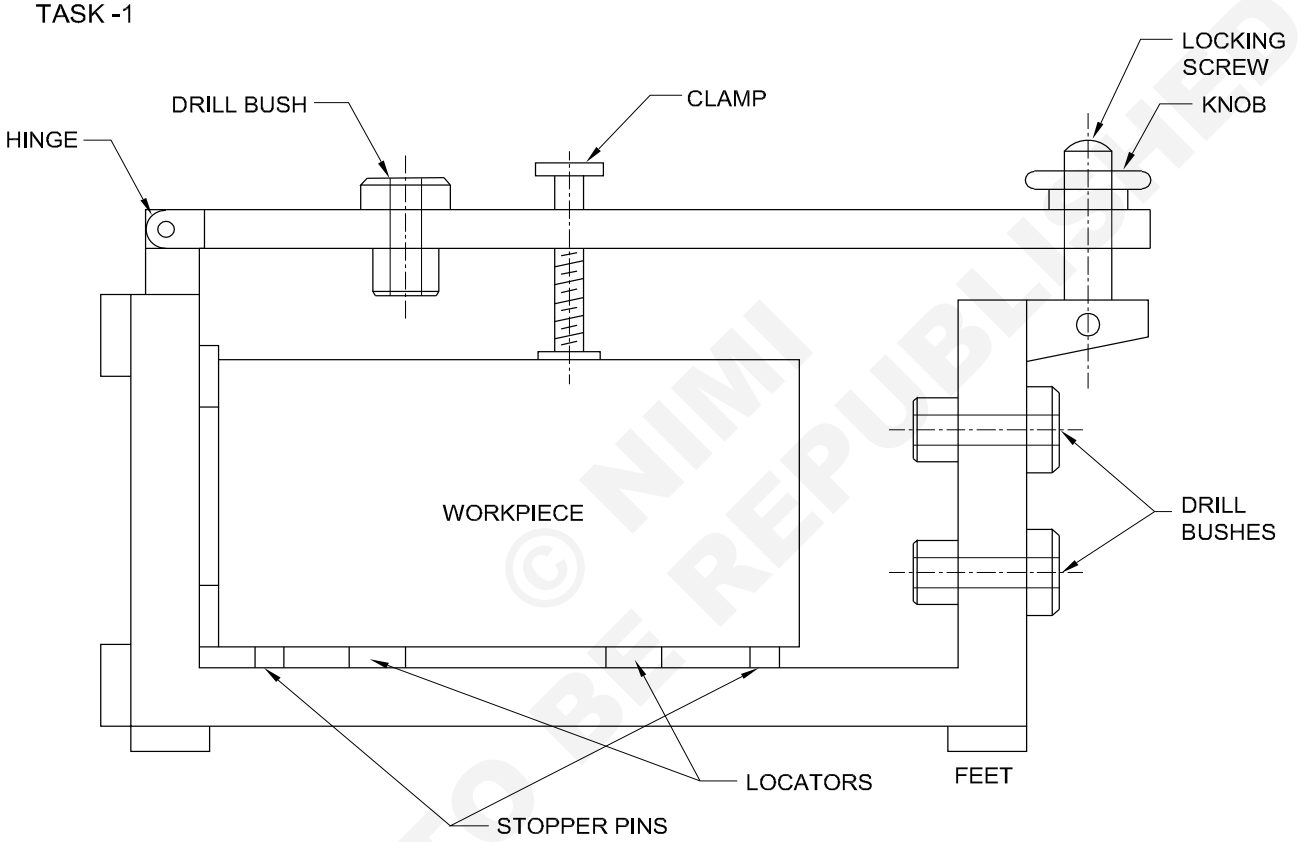
— — — — — — — —

Manufacturing of box jig, ring jig and diameter jig

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

- **make the different parts of box jig**
- **assemble box jig**
- **make the parts of diameter jig**
- **assemble diameter jig**
- **make the parts of ring jig**
- **assemble ring jig**

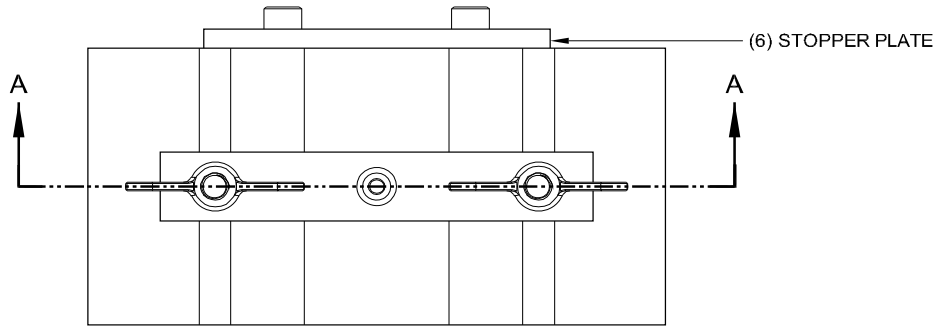
TASK -1

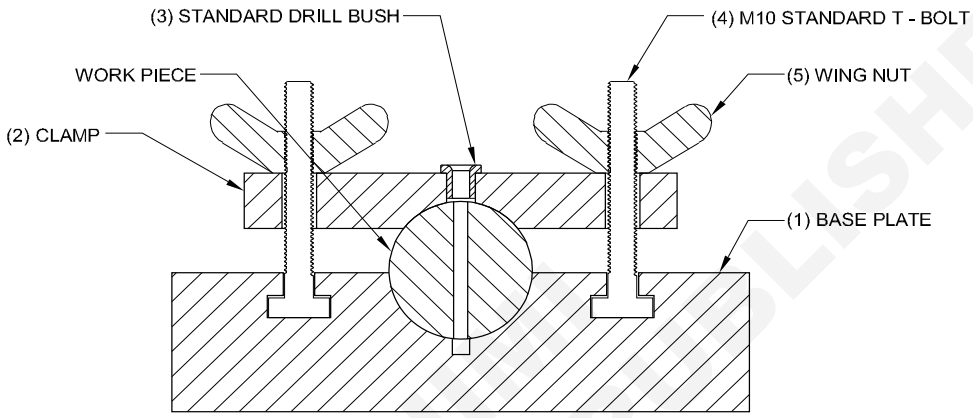


1	ISRO 12-35	-	Fe310	-	10	
1	ISRO 20-60	-	Fe310	-	9	
8	20 ISF 15x15	-	Fe310	-	8	
4	ISRO 20-30	-	Fe310	-	7	
1	ISRO 20-20	-	Fe310	-	6	
3	ISRO Ø25x25	-	HCS	-	5	
1	105 ISF 80-16	-	Fe310	-	4	
1	75 ISF 55-16	-	Fe310	-	3	
1	55 ISF 55-16	-	Fe310	-	2	
1	85 ISF 75-16	-	Fe310	-	1	2.1.85
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

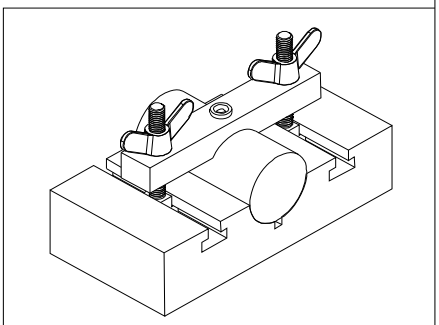
SCALE 1:1	BOX JIG	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2185E1	

TASK : 2





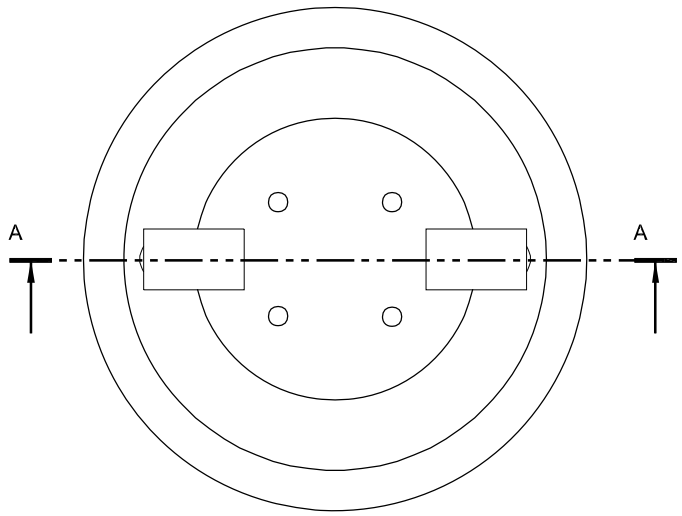
SECTION A-A

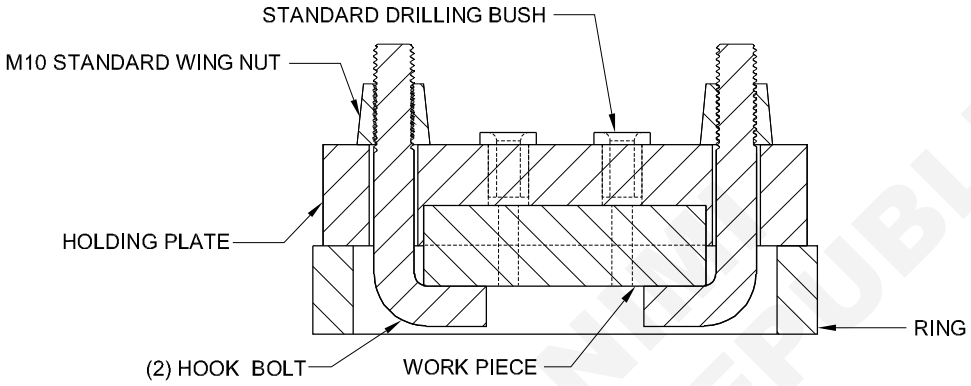


NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	STOPPER PLATE	-	Fe310	-	6	-
2	M10 WING NUT STANDARD SIZE	-	STANDARD	-	5	-
2	T BOLT STANDARD SIZE	-	STANDARD	-	4	-
1	STANDARD SIZE	-	STANDARD	-	3	-
1	155 x 30 x 25	-	Fe310	-	2	-
1	205 X 105 X 55	-	Fe310	-	1	2.1.85

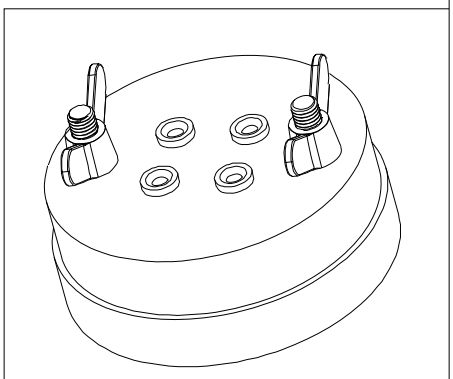
SCALE 1:2	**DIAMETER JIG ASSEMBLY**	DEVIATIONS : ±0.02 mm	TIME :
		CODE NO. TJ20N2185E2	

TASK : 3





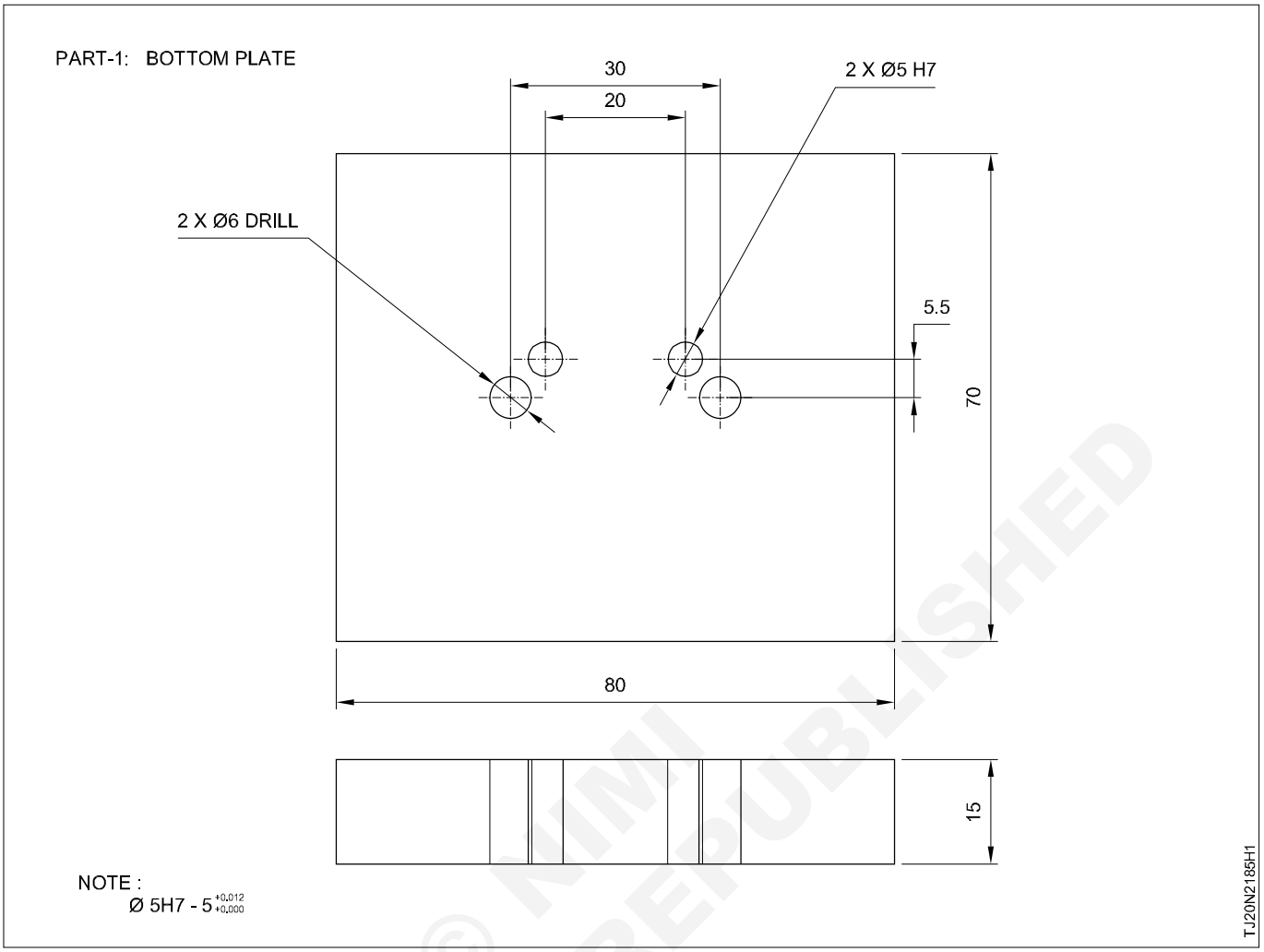
SECTION A-A



2	WING NUT STANDARD SIZE	-	STANDARD	-	5	-
4	STANDARD SIZE	-	STANDARD	-	4	-
1	Ø 130 X 27	-	Fe310	-	3	-
2	70 X 30 X 20	-	Fe310	-	2	-
1	Ø 125 X 30	-	Fe310	-	1	2.1.85
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:2	**RING JIG ASSEMBLY**	DEVIATIONS : ±0.02 mm	TIME :
		CODE NO. TJ20N2185E3	

TASK 1 **: Box jig**



Job sequence

Part 1

Bottom plate

- Machine the size of 80 x 70 x 15mm
- Apply marking media.
- Mark and punch the drill center as per drawing.
- Drill ∅ 4.9mm holes for 5H7 reamer hole.
- Drill ∅ 6mm for locating pin.

Part 2

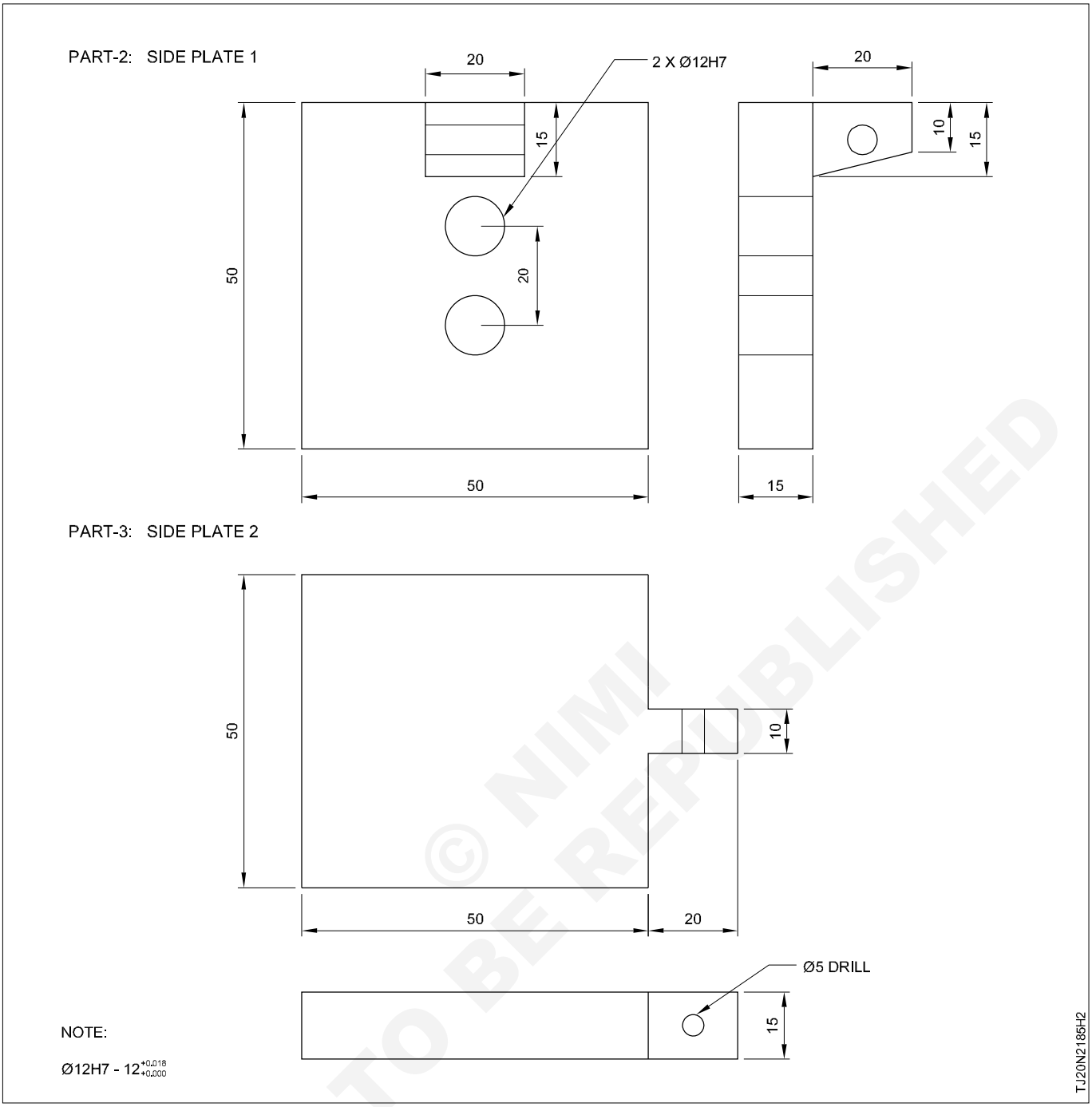
Side plate -1

- Check the raw material 55 1SF 55 - 16
- Mill flat to 50 x 50 x 15mm
- Weld the piece as per drawing.
- Drill ∅ 6mm in edge piece
- Drill and ream 12 H7 for bush as per drawing.

Part 3

Side plate -2

- Check the raw material size 751SF 55 - 16mm
- Mill the size as per drawing.
- Set the job on drilling.
- Drill ∅5mm hole.



Part 4

Top plate

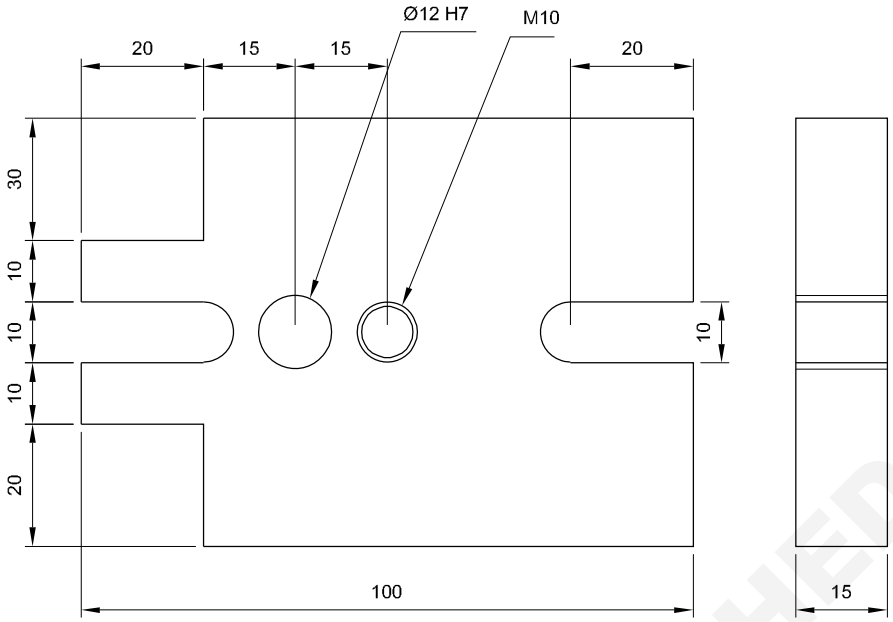
- Check the raw material 105 1SF 55 x 16
- Mill the size as per drawing.
- Make the slots and steps using vertical milling machine.
- Drills and tap m10 for clamping screw.
- Drill and ream for drill bush.

Part 5

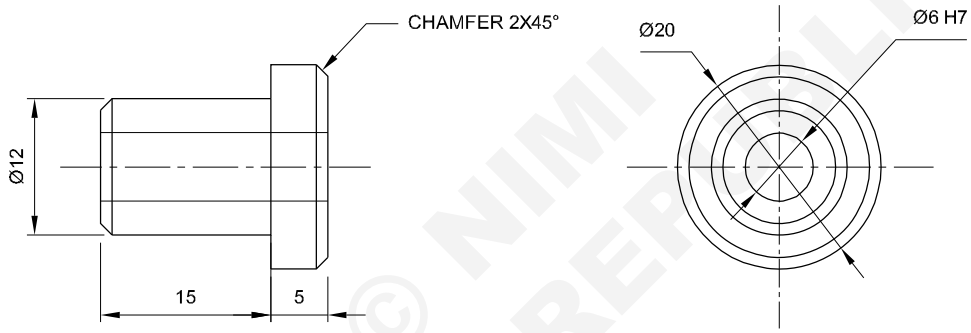
Drill bush

- Check the raw material.
- Hold the job in three jaw chuck.
- Face, center drill and enlarge the hole to ∅ 5.8mm.
- Ream the hole ∅6mm.
- Turn ∅18mm to required length.
- Turn step of ∅12mm to a length of 15mm.
- Chamfer the end of ∅12mm.
- Part to a length of 21mm
- Repeat the same for 3 pieces.
- Hold the ∅12mm and face the other side to a length of 20mm
- Chamfer as per drawing.
- Remove the burrs.

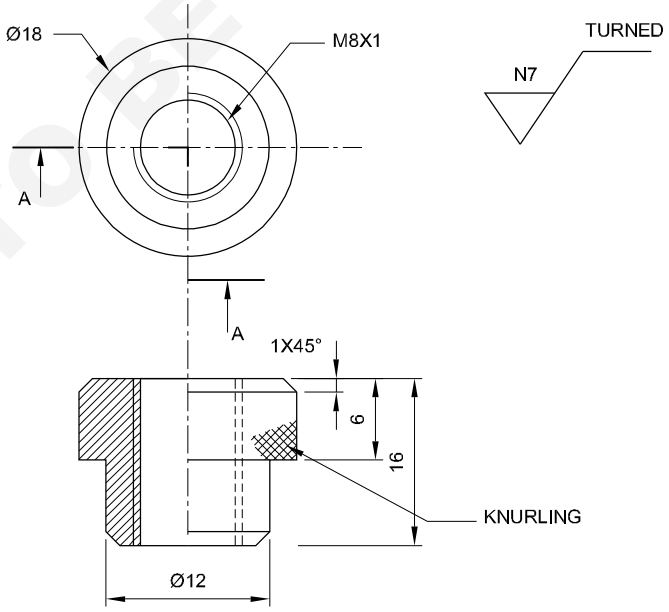
PART - 4: TOP PLATE



PART - 5: DRILL JIG BUSH



PART-6 : KNOB



NOTE:

Ø12H7 - $12^{+0.018}_{+0.000}$

Ø6H7 - $6^{+0.012}_{+0.000}$

TJ20N2185H3

Part 6 & 7

Knob

- Check the raw material ISR0 ∅20 - 20.
- Hold the job in three jaw chuck.
- Make center drill and enlarge the hole to ∅ 7mm ± 0.1
- Turn ∅18 ± 0.1 to a length of 20mm.
- Turn step ∅12 ± 0.1 to length of 10mm.

- Knurl as per drawing.
- Reverse the job hold the knurled portion with soft packing's.
- Face to a length of 16mm.
- Chamfer as per drawing.
- Remove the job from lathe, hold on bench vice and make the thread of M8 using tap.
- Remove the burrs.
- Turn the part 7 locating pins as per the drawing 4nos.

Part 8, 9 & 10

8 Feet

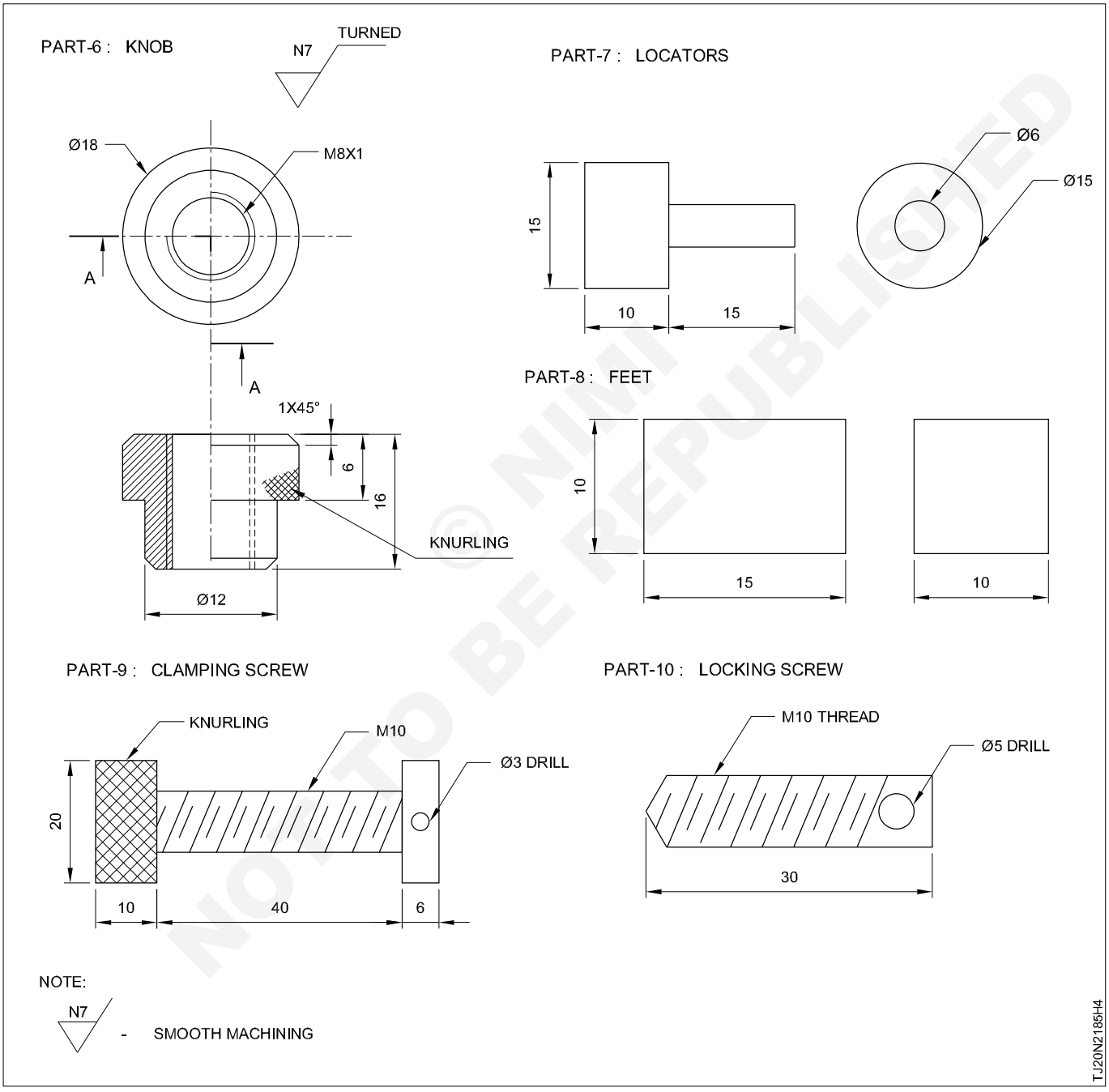
- Prepare the 8 pieces as per the drawing for feet.

9 Clamping screw

- Make the screw by hand die.

10 Locking screw

- Pivot the round piece for seating with job after inserted on the top plate
- Make external thread on the rod M10
- Drill dia 5mm for pivoting



Assembling box jig

- Bottom plate (part 1) side plates (part 2 & 3) are welded together perpendicular to each other.
- Weld the feet 8 nos.
- 4 nos feet at the bottom plates.
- 4 nos feet at the side plates.
- Insert the 2 bushes in side plates - 2.
- Insert the clamping screw on top plate part 4 and rivet the edge using round piece.

- Fix the locating pin (part - 7) at bottom plate and side plate (part - 2).
- Fix the stopper at the bottom plate
- Join the top plate and side plate - 1 using hinge
- Fit the locking screw with side plate - 2 (part - 3)
- Close the top plate tight knob.
- Loose the knob opens the side plate for fixing the component.
- Jig is ready for drilling operation.

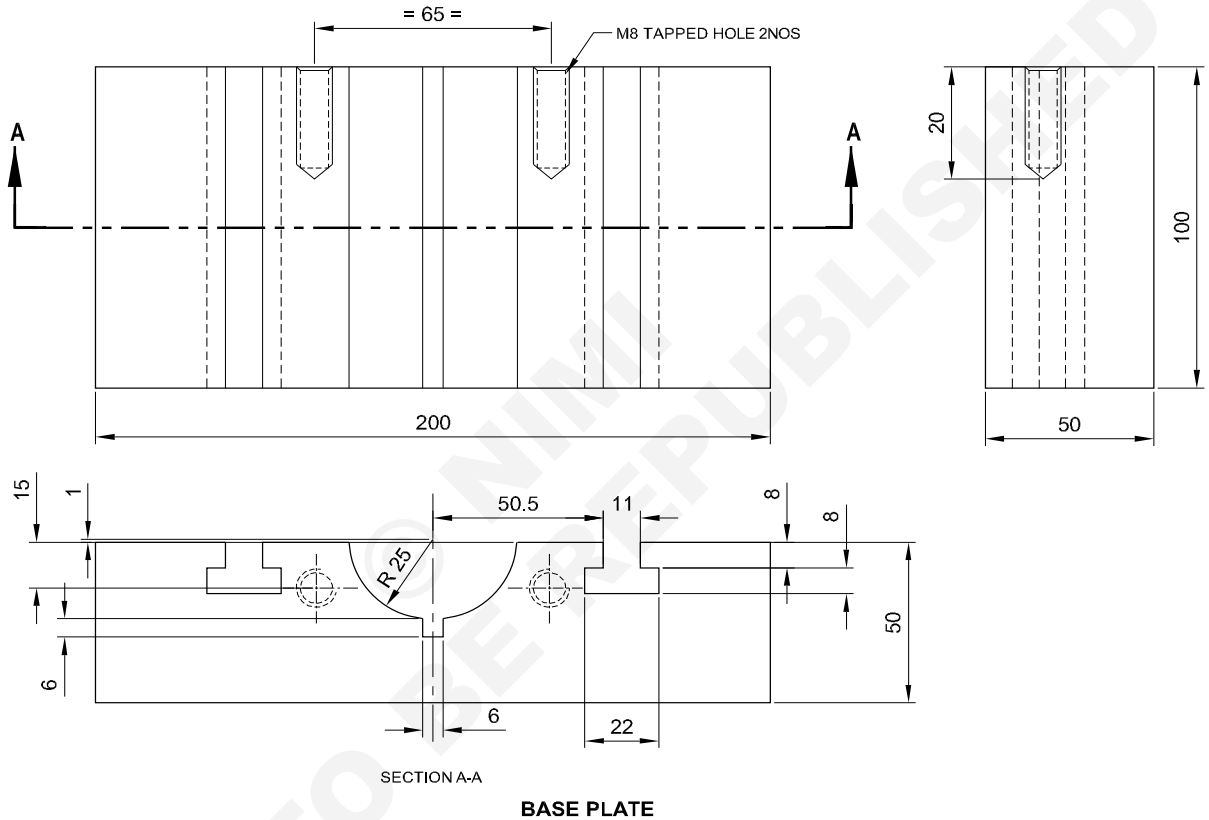
TASK 2**: Diameter jig**

Part 1

Base plate

- machine the base plate to size 200 x 100 x 50
- mill the 'T' Slot as the drawing
- make bore using vertical millings machine
- measure all dimensions using micrometer.

Fig 1



BASE PLATE

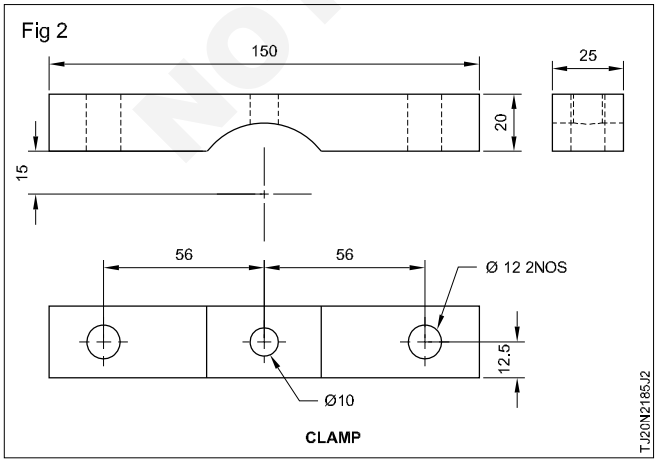
T.J20N2185.J1

Part 2

Clamp

- make drill holes and radius
- Drill the holes and machine the radius as required.

Fig 2



CLAMP

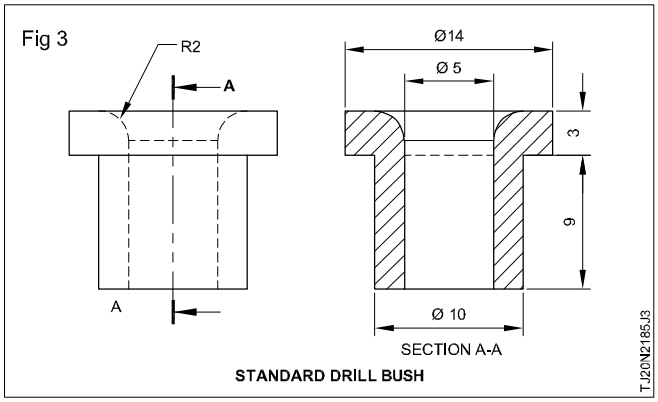
T.J20N2185.J2

- machine the plate 150 x 25 x 20

Part 3

Drill Bush

Fig 3



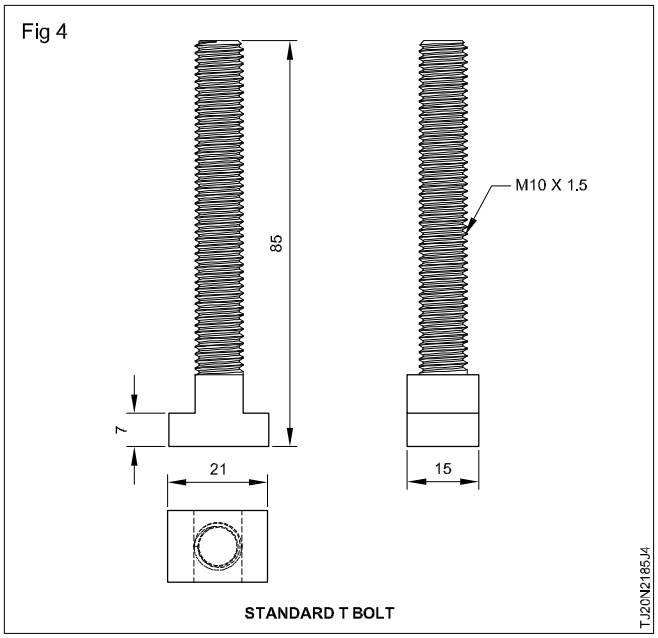
STANDARD DRILL BUSH

T.J20N2185.J3

Part 4

'T' Bolt

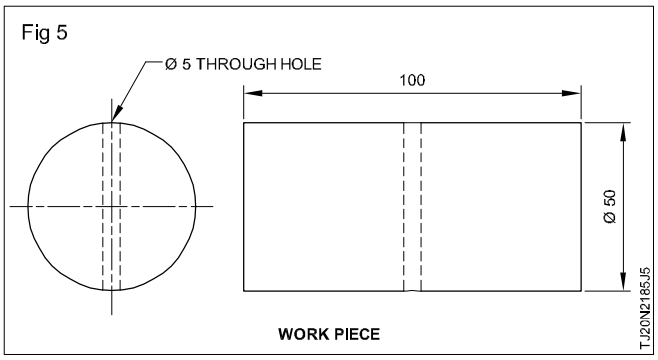
Fig 4



Part 5

work piece

Fig 5

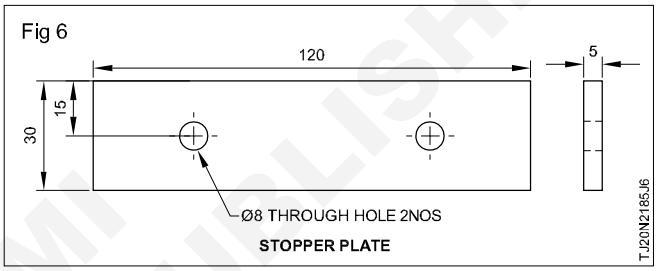


Part 6

Stopper plate

- machine the plate size 120 x 30 x5mm mark the drill holes' drill dia 8mm 2 holes

Fig 6



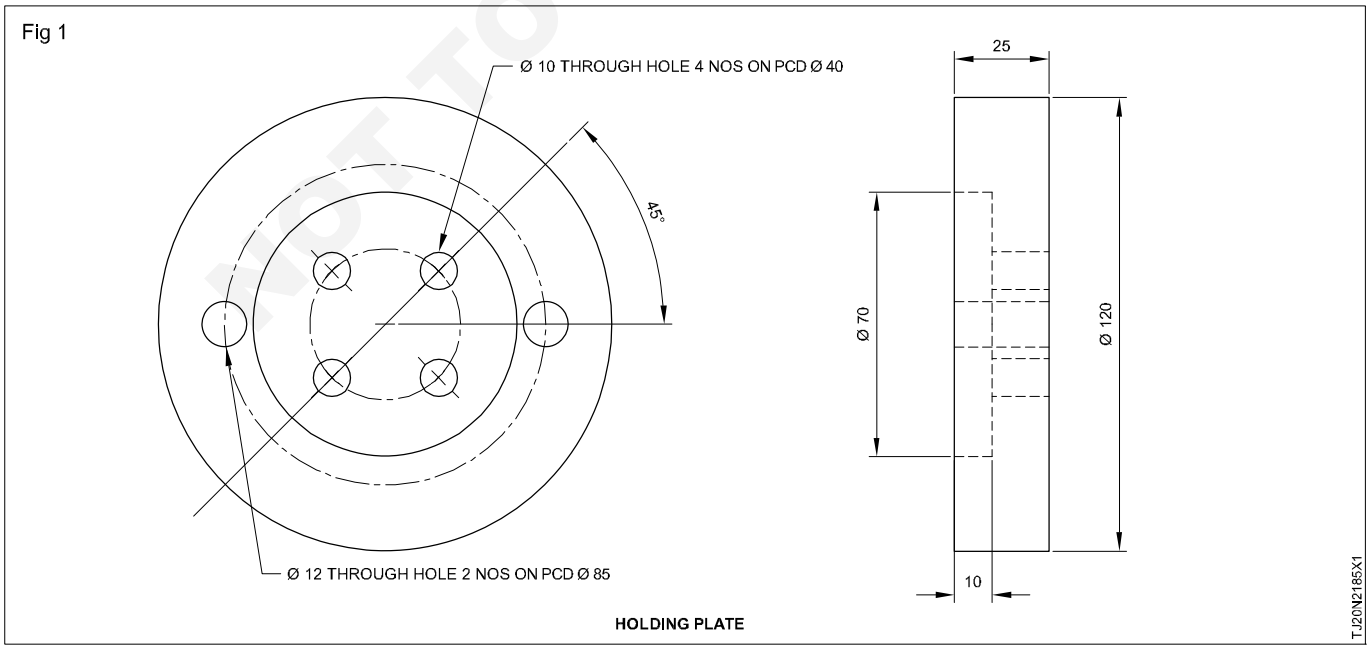
TASK 3**: Ring jig**

Part I

Holding plate (Fig 1)

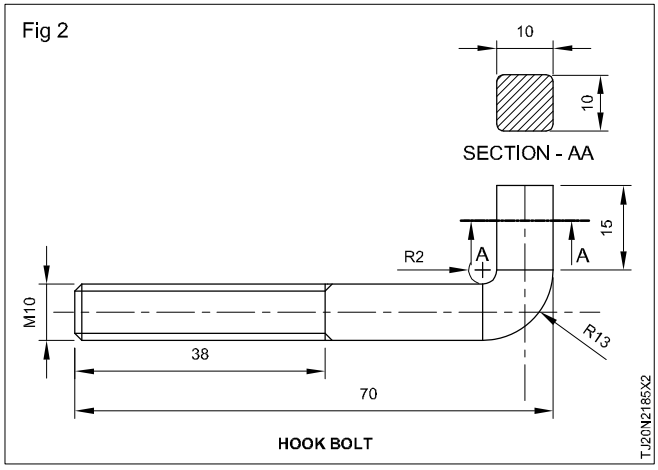
- Turn the job as per drawing
- drill the holes as per drawing

Fig 1



Part 2

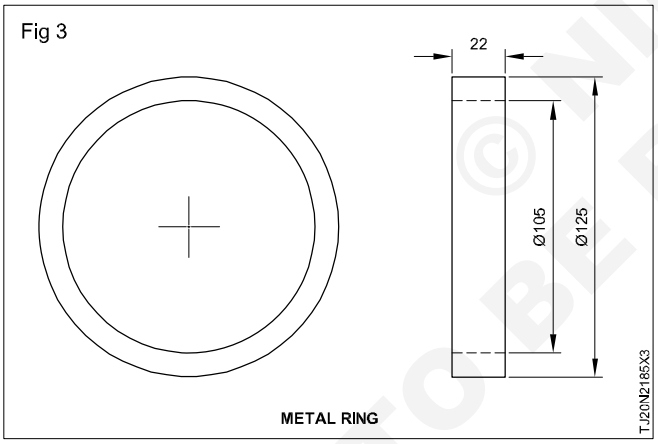
Hook plate (Fig 2)



- Hold the job on lathe
- Step turn the job for ∅10
- Bend the rod as per drawing
- File the small end and make square of 10mm
- make the external thread using hand die.

Part 3

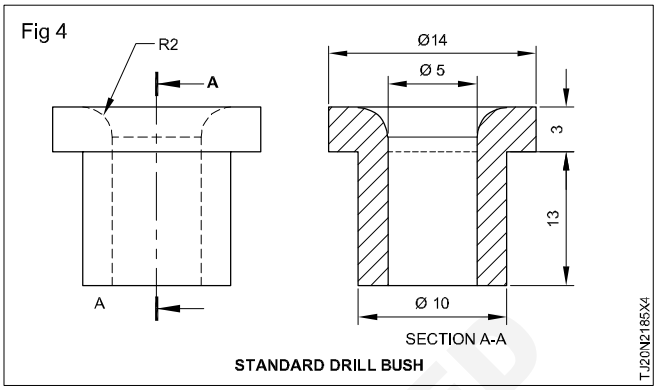
Metal Ring (Fig 3)



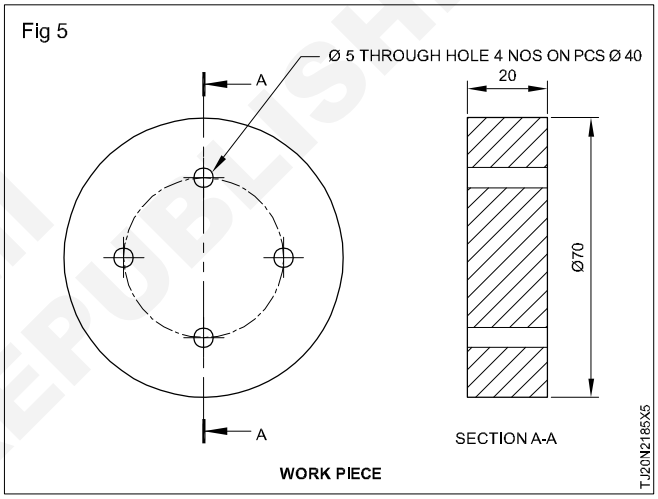
- Hold the job on lathe
- Face, turn and bore the job as per drawing.

Part 4

Drill bush (Fig 4)



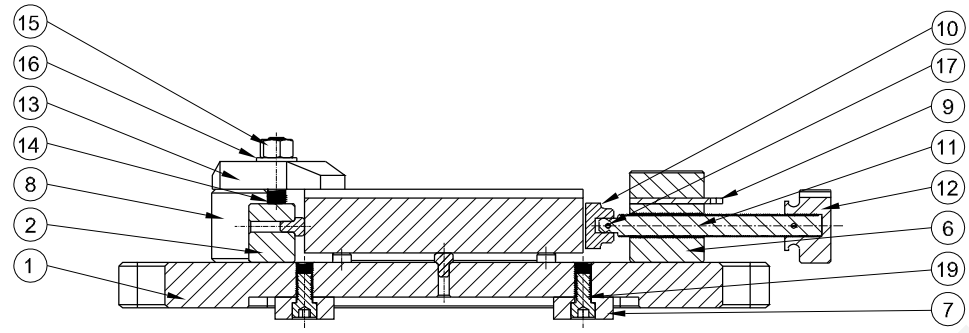
Work piece (Fig 5)



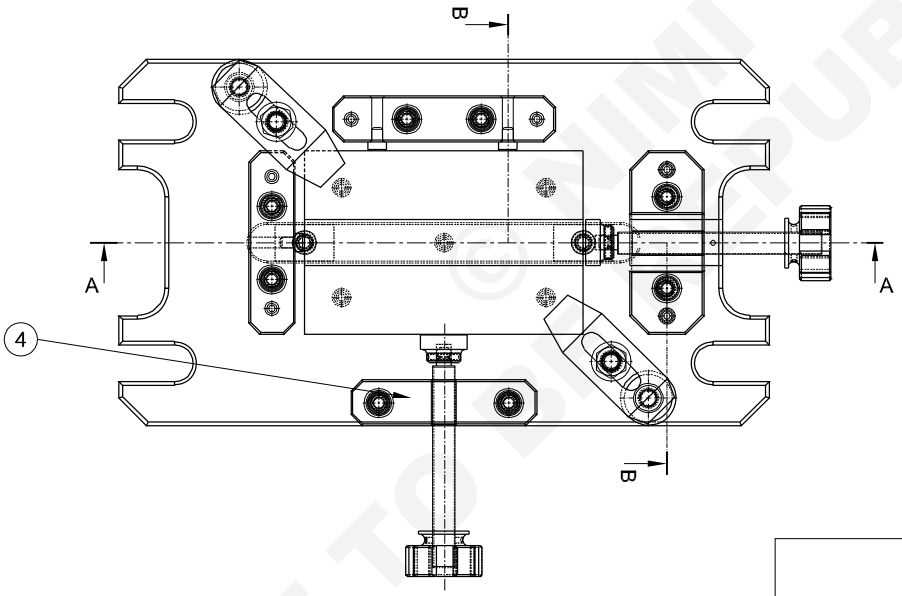
Milling fixture

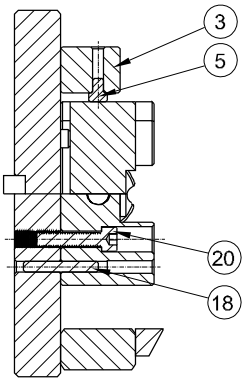
Objectives: At the end of this exercise you shall be able to

- **make the parts of milling fixture**
- **assemble the milling fixture.**
- **machine the job in milling using milling fixture.**

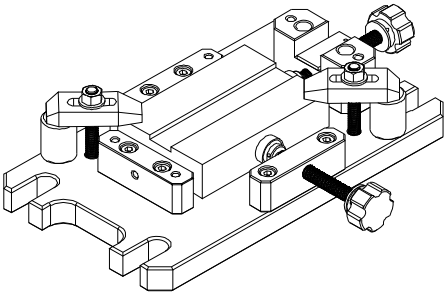


SECTION A-A





SECTION B-B



1	-	-	-	-	-	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**MILLING FIXTURE**				TOLERANCE ±0.02	TIME :
					CODE NO. TJ20N2186E1	

10	SHCS	M8 x 35	STD		20	
2	SHCS	M8 x 15	STD		19	
6	DOWEL	Ø6 x 40	STD		18	
4	DOWEL	Ø3 x 15	STD		17	
2	WASHER	OD=22,ID=11,T=2	STD		16	
2	NUT	M10 x 10	STD		15	
2	CLAMPING STUD	M10 x 80	STD		14	
2	STRAP CLAMP	15x30x80	STD		13	
2	HANDLE	Ø40 x25	STD		12	
2	STUD	M12 x 110	STD		11	
2	PRESSURE PAD	Ø25 x 15	STD		10	
1	FILLER GAUGE	3x25x50	OHNS	60-62NRC	09	
2	RESTING BLOCK	Ø30 x 40	OHNS	45-50NRC	08	
2	TENON	12x20x32	OHNS	45-50NRC	07	
1	CUTTER SETTER	50x40x100	OHNS	60-62NRC	06	
8	LOCATOR PIN	Ø10 x 13	OHNS	45-50NRC	05	
1	SUPPORT PLATE	32x25x100	MS		04	
1	LOCATOR PLATE 2	32x25x120	MS		03	
1	LOCATOR PLATE 1	32x25x100	MS		02	
1	BASE PLATE	25x200x350	MS		01	EX 2.1.86
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO.

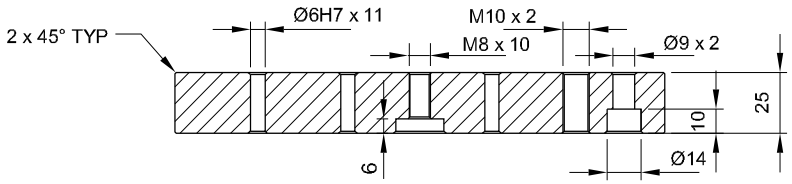
SCALE	PROJECT: MILLING FIXTURE ASSEMBLY REFERENCE	DEVIATIONS	TIME
		CODE NO. TJ20N2186E2	

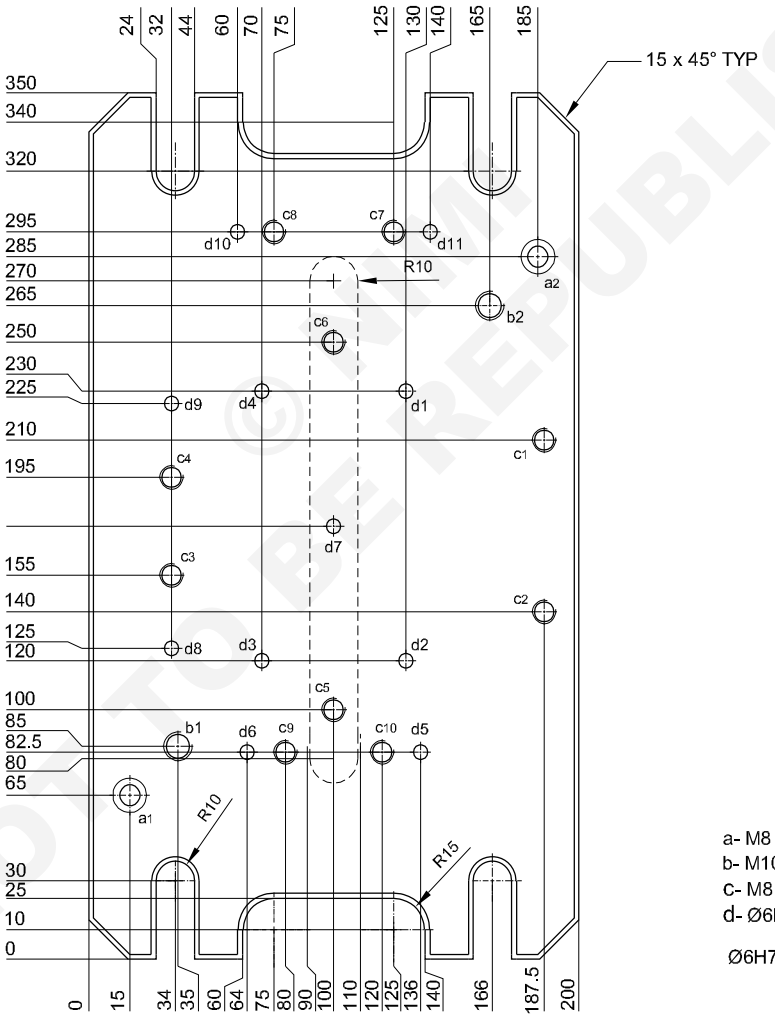
Job sequence

1 Base plate

- Check the raw material for its size.
- Blocking up to a size of 350 x 200 x 25 mm
- Mark the hole center slots and tapers and punch.
- Hold the job in vertical milling machine, mill the slots and edge taper as per drawing.
- Hold the job in drilling machines.
- Make dia 5.8 mm drill for reamer hole of 11 Nos of ∅ 6 h 7
- Drill 8.5 mm for M10 tap of 2 holes.
- Drill 7 mm for M8 tap 10 holes.
- Drill 9 mm for counter bore to required depth.

PART : 1





a- M8 C.BORE 2 NOS
b- M10 TAPPED HOLE 2 NOS
c- M8 TAPPED HOLES 10 NOS
d- Ø6H7 DOWEL HOLE 11 NOS

Ø6H7 - $6^{+0.015}_{+0.000}$

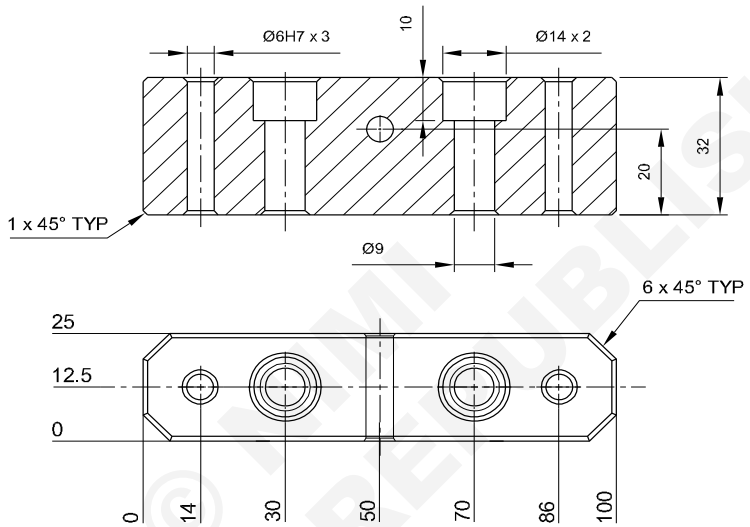
1	350X200X25	-	C45	-	1	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		**BASE PLATE**			TOLERANCE ±0.02	TIME :
					CODE NO. TJ20N2186E3	

- Reverse the job enlarge the 9 mm drill to ∅14 for a depth of 10 mm.
- Tap all the tap hole as per the size.
- Deburr all the sharp corners.

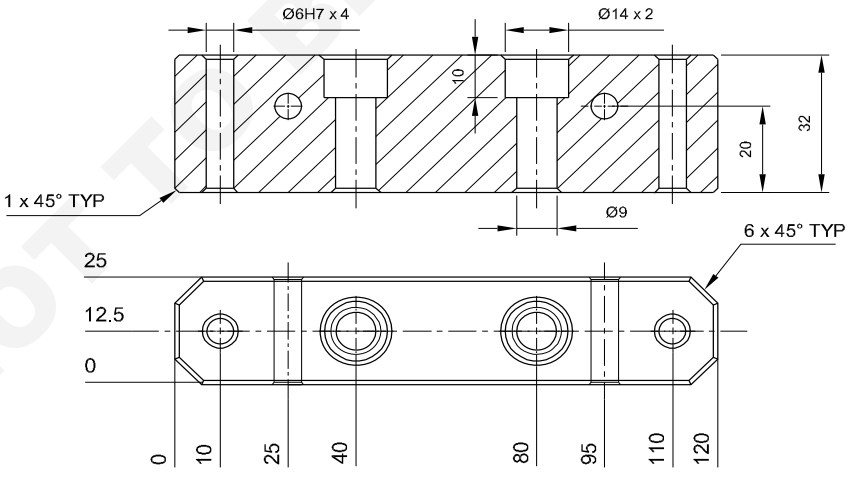
2 Locator plate

- Machine the block of size 120 x 32 x 25 mm.
- Mark the holes and edge tapers as per drawing.
- Set the job on drilling machine.
- Drill ∅9 mm through hole.
- Same center make counter bore ∅14 to a depth of 10 mm.
- Turn the job 90° hold in drilling machine.
- Drill ∅ 6.8 mm hole for M 8 tap.
- Make the internal thread using M 8 tap and wrench.
- Hold the job in vertical milling machine.
- Machine 6 x 45° taper at the four corners.

PART: 2



PART: 3



1	32X25X120	-	MS	-	3	2.1.86
1	32X25X100	-	MS	-	2	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**LOCATOR PLATE 1 AND LOCATOR PLATE 2**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2186E4	

- Remove the sharp corner.

3 Support plate (2 Nos)

- Check the raw material.
- Machining the size of 100 x 50 x 40 mm.
- Mark the holes and corner tapper as per drawing.
- Drill the holes and counter bore as per size.
- Mill the 4 corners 10 x 45°.

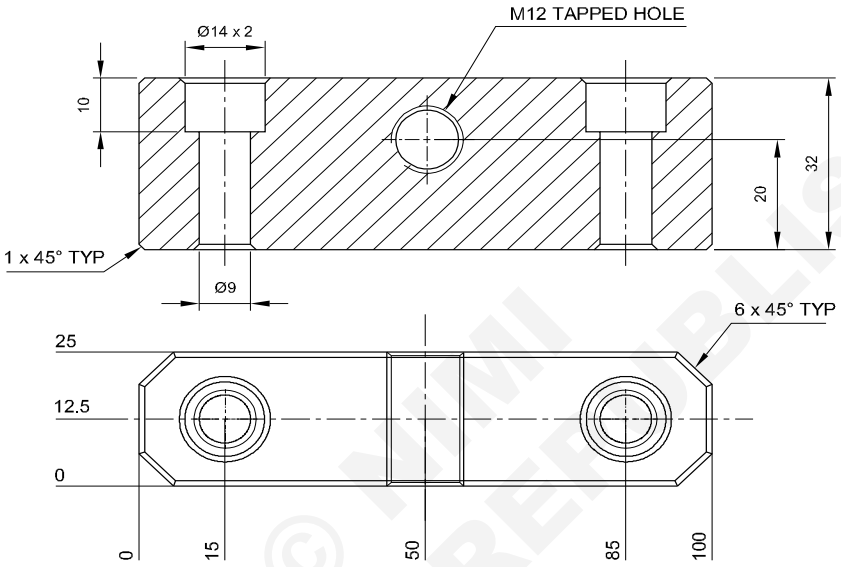
4 Resting block (2 Nos.)

- Check the raw material.
- Hold the job on lathe chuck.
- Face the job and turn to dia 30 mm of length 40 mm.
- Drill ∅ 6.8 mm for M 8 tap to a depth of 22 mm.
- Tap the hole to a depth of 18 mm.
- Chamfer both the edge to 2 x 45°.

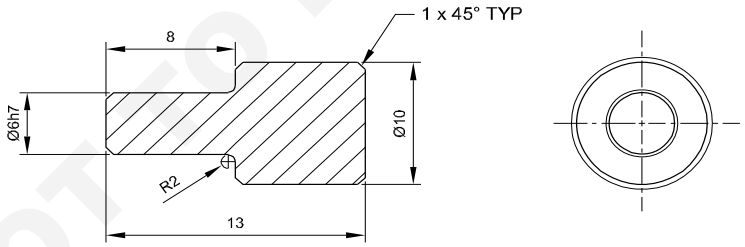
5 Filler gauge

- Check the raw material for its size.
- Finish the dimensions 50 x 25 x 3 mm.
- Mark and punch the center for ∅3 mm hole.
- Drill the hole.

PART : 4



PART : 5



NOTE:

Ø6h7 - 6 $^{+0.000}_{-0.015}$

8	Ø10 X 13	-	OHNS	-	5	2.1.86
1	32X25X100	-	MS	-	4	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**SUPPORT PLATE AND LOCATING PIN**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2186E5	

6 Stud

- Check the raw material as per size.
- Hold the job on lathe.
- Turn as per size.
- Make the external thread of M12 to a length of 110 mm.
- Drill ∅3 mm holes 2 Nos.
- Reverse the job make the radius as per drawing.

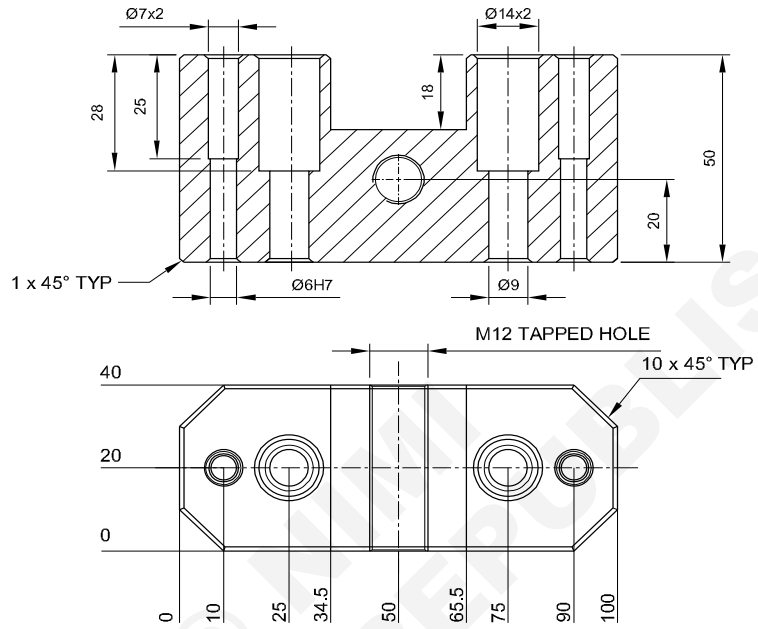
7 Clamping stud (2 Nos.)

- Check the raw material as per size.
- Set the job on lathe turn to ∅10 mm.
- Make external thread to required length.
- Reverse the job made the thread to required length.

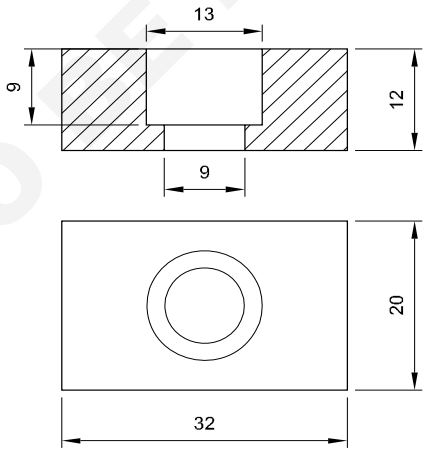
Assembling

- Assemble the parts 1 to 19 as per drawing.

PART : 6



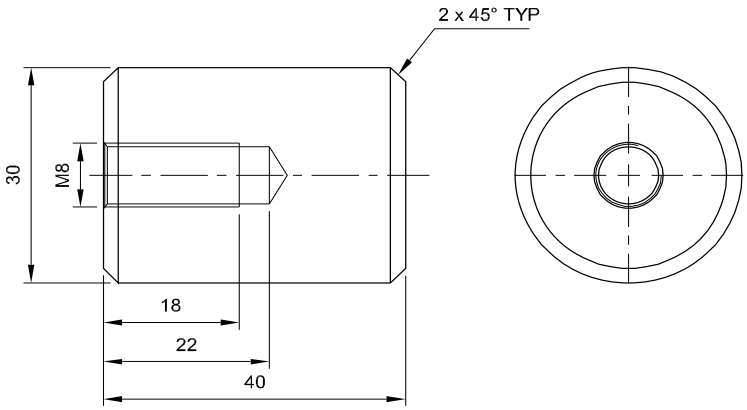
PART : 7



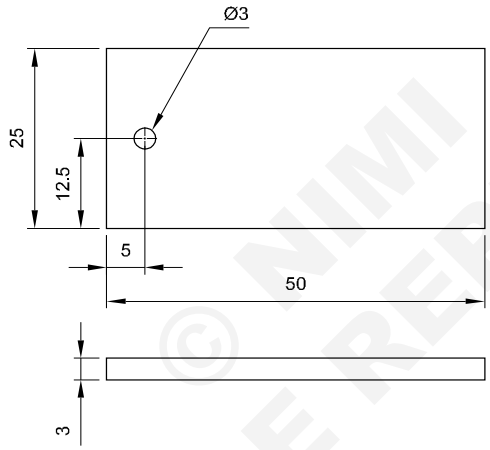
2	12 X 20 X 32	-	OHNS	-	7	2.1.86
1	50 X 40 X 100	-	OHNS	-	6	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**CUTTER SETTER AND TENON**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2186E6	

PART : 8



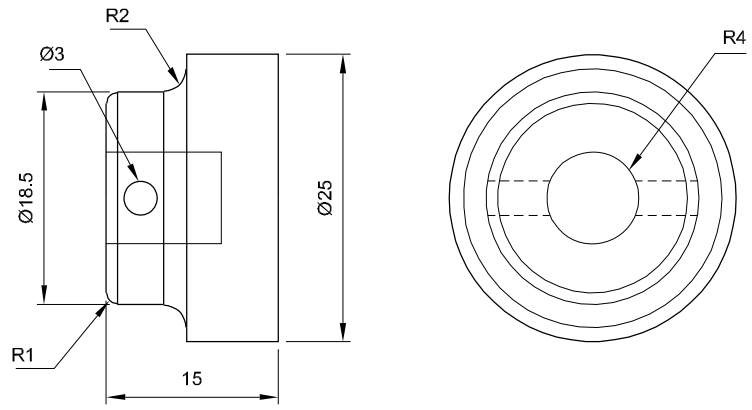
PART : 9



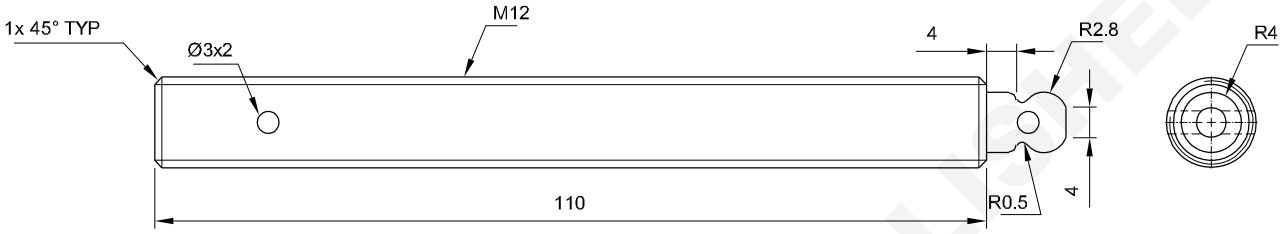
1	3 X 25 X 50	-	OHNS	-	9	2.1.86
2	Ø30 X 40	-	OHNS	-	8	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**RESTING BLOCK AND FILLER GAUGE**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2186E7	

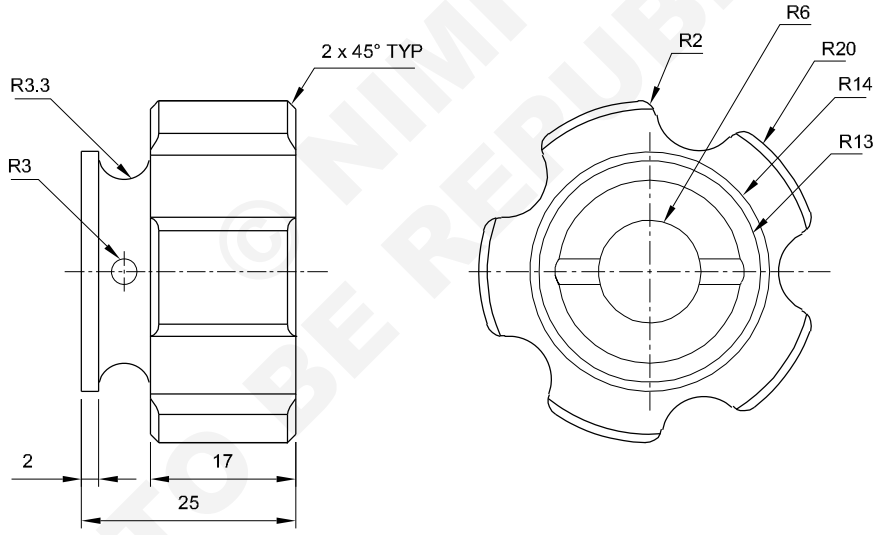
PART : 10



PART : 11



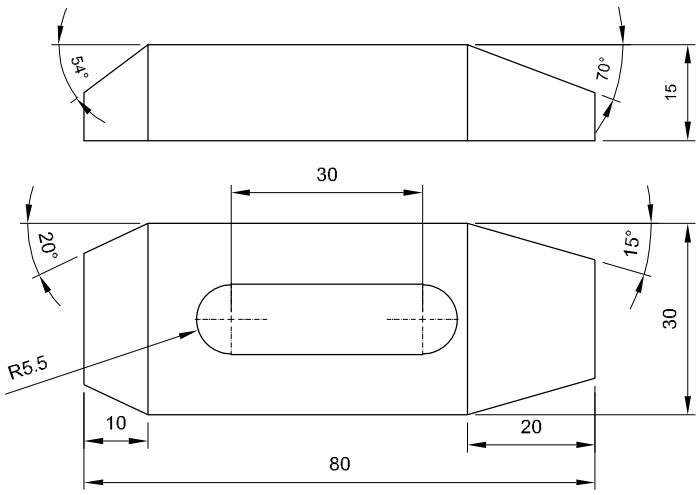
PART : 12



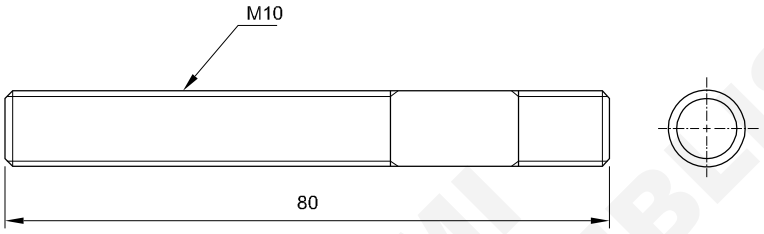
2	Ø40X25	-	STD	-	12	2.1.86
2	Ø25X15	-	STD	-	11	2.1.86
2	15X30X80	-	STD	-	10	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	**PRESSURE PAD, STUD AND HANDLE**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2186E8	

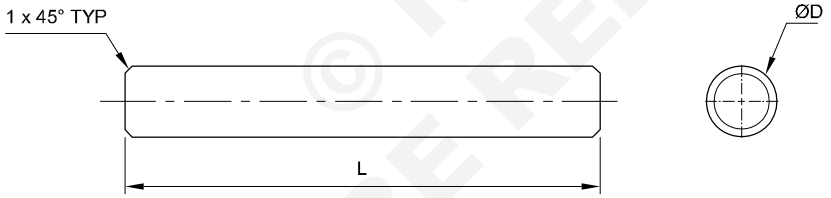
PART : 13



PART : 14



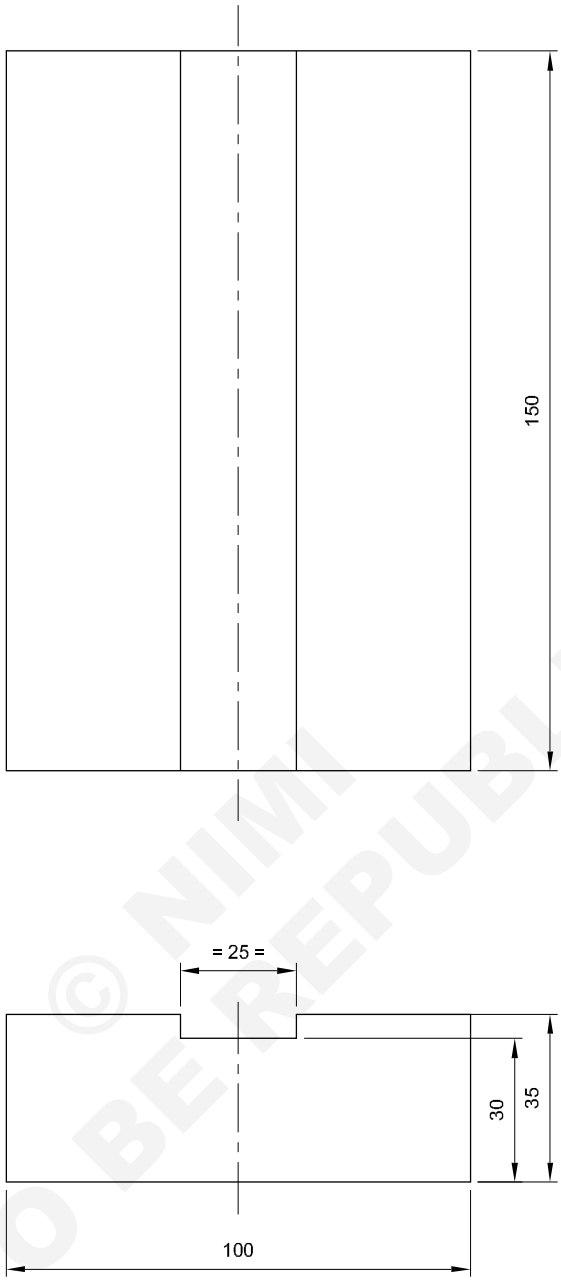
PART : 17 & 18



ØD	L	Qty
3	15	4
6	40	6

6	Ø6X40	-	STD	-	18	2.1.86
4	Ø3X15	-	STD	-	17	2.1.86
2	M10X80	-	STD	-	14	2.1.86
2	15 X 30 X 80	-	STD	-	13	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

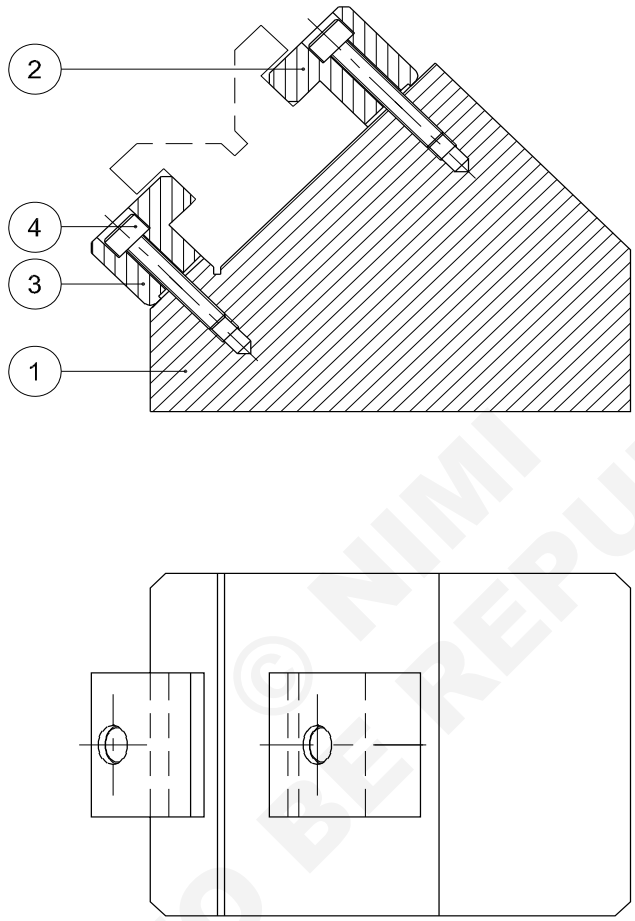
SCALE 1:1	**STRAP CLAMP,CLAMPING STUD AND DOWEL PIN**	TOLERANCE ±0.02	TIME :
		CODE NO. TJ20N2186E9	



1	-	-	-	-	-	2.1.86
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**COMPONENT**				TOLERANCE ±0.02	TIME :
					CODE NO. TJ20N2186EA	

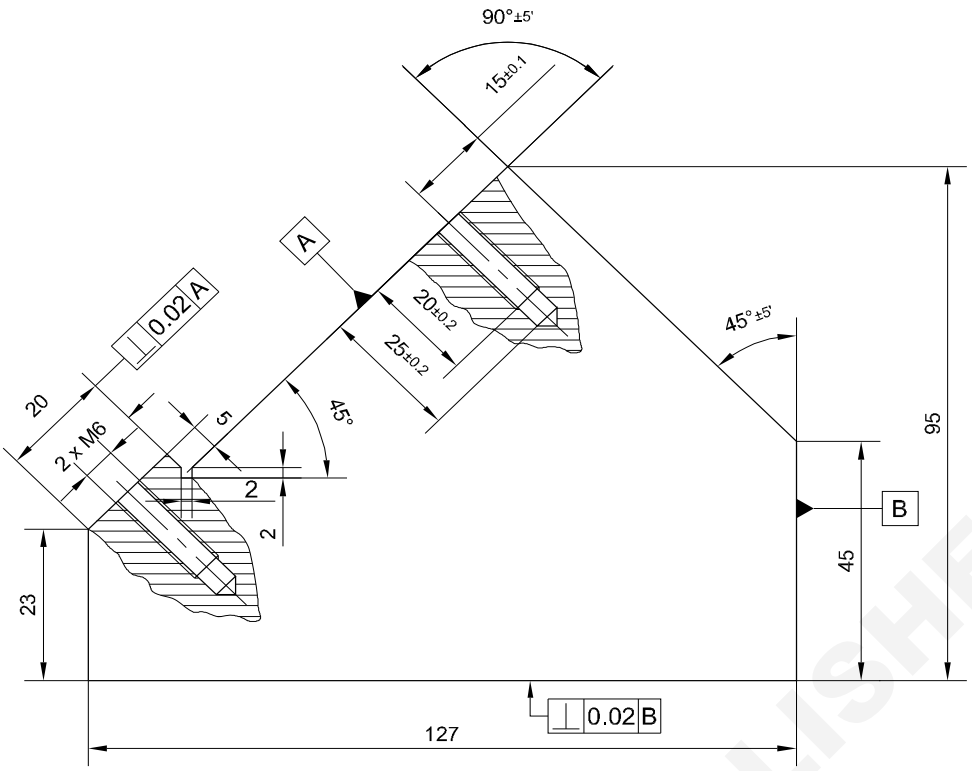
Grinding fixture

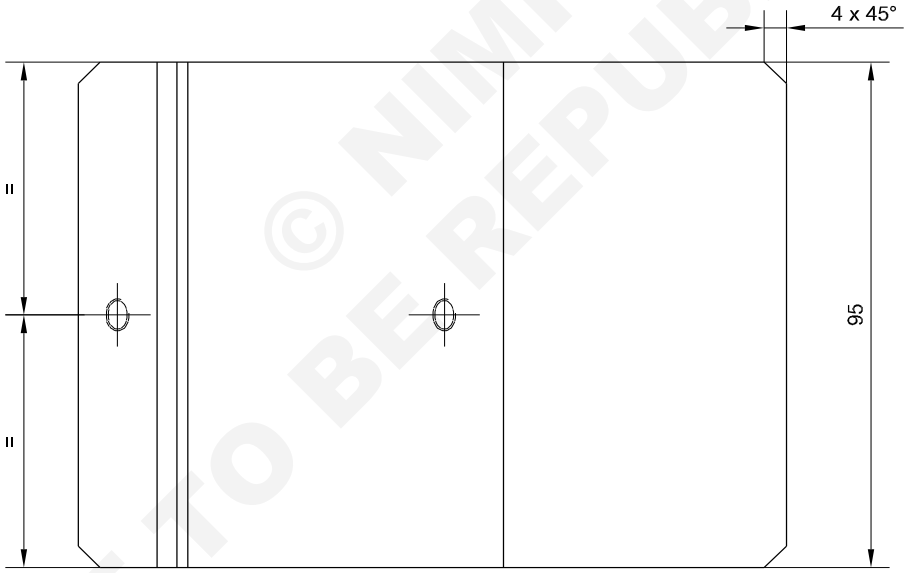
Objectives: At the end of this exercise you shall be able to
- **drill an angular surface**
- **prepare a base plate for a v-block grinding fixture.**



2	M6 x 30 SHCS	-	STD	-	4	-
1	45 ISF 32-35	-	Fe310	-	3	-
1	□ 36 x 45 mm	-	Fe310	-	2	-
1	□ 100 x 132 mm	-	Fe310	-	1	2.1.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE	**V - BLOCK GRINDING FIXTURE**	DEVIATIONS	TIME :
		CODE NO. TJ20N2187E1	





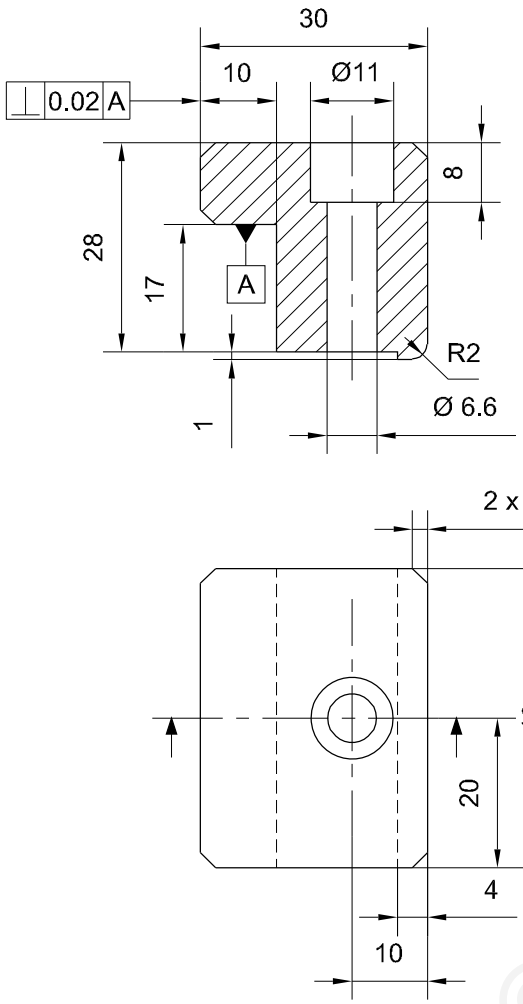
Job sequence

V-block grinding fixture-base plate

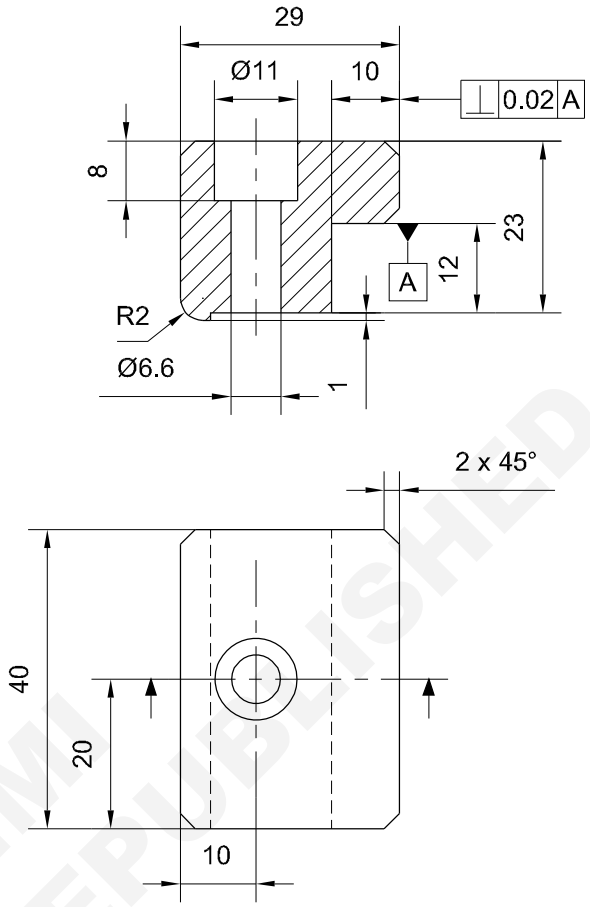
- Check the raw material.
- Mark and punch the coordinates for the hole
- Drill screw holes dia.5 x 2 Nos. (Refer SS attached)
- Tap M6 x 20 ± 0.2.
- Chamfer as per drawing.

1	-	-	-	-	1	2.1.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		BASE PLATE			TOLERANCE ±0.02	TIME :
					CODE NO. TJ20N2187E2	

PART - 2



PART - 3

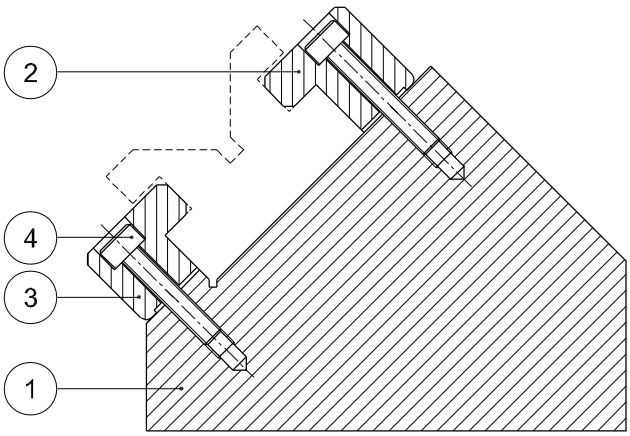


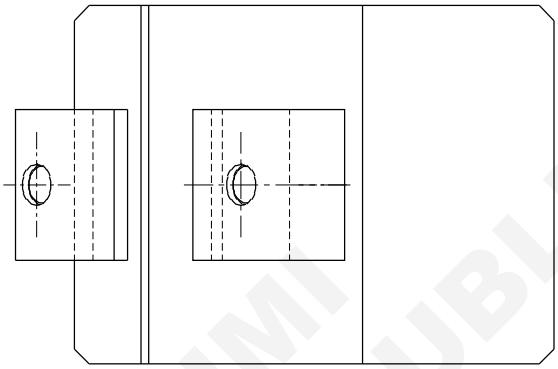
Job sequence

- V-block grinding fixture – clamping step block
- Check the raw materials.
- Mark and punch the coordinates for the hole centers.
- Drill dia. 6.6 and counter bore to dia. 11 to deep 8 as per drawing.
- File the radius R2
- Chamfer as per drawing.

- V-Block grinding fixture-clamping step block
- Check the raw materials
- Mark and punch the coordinates for the hole center.
- Drill and counter bore as per drawing.
- File the radius. R2
- Chamfer as per drawing.

1	-	EX: 2-41	Fe310	2P1	2	2.1.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**CLAMPING STEP BLOCK (RIGHT & LEFT)**				TOLERANCE ±0.02	TIME :
					CODE NO. TJ20N2187E3	





V-block grinding fixture-assembly

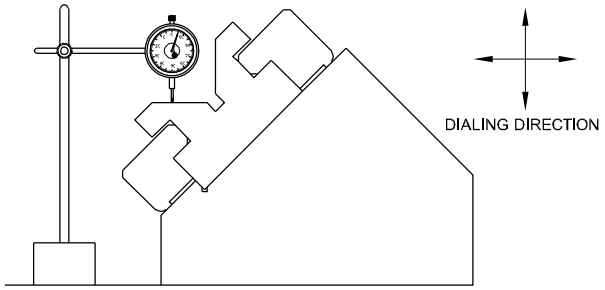
- Assemble a V-block grinding fixture as per drawing
- Clean all the parts
- Deburr sharp comers, if any.
- Clean the screw holes
- Fasten parts of the assembly as per drawing.

1	-	-	-	2P1	-	2.1.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PROJECT: V-BLOCK GRINDING FIXTURE PART: ASSEMBLY**				TOLERANCE ±0.02	TIME :
					CODE NO. TJ20N2187E4	

V-block grinding fixtures checking

- Clamp the V-block on the base plate
- Keep the base plate on the surface plate
- Dial the V-block as in the figure
- If dial deflection is within 0.01mm the fixture is acceptable.

Fig 1



Milling on vertical milling machine using end mill

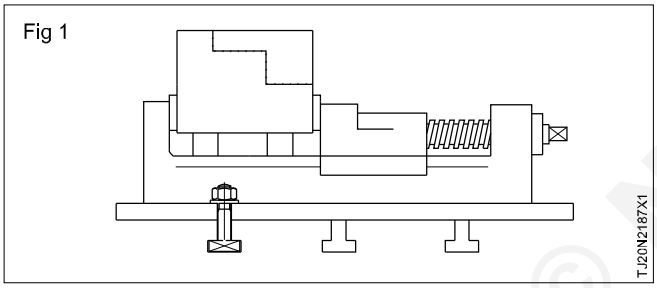
Objective: At the end of this exercise you shall be able to
- **mill steps on vertical milling machine using the end mill.**

Mark the job as per drawing for step milling and punch the witness marks.

Set the machine vice on the machine such that the vice jaws are parallel to the column.

Clamp the job in the machine vice such that all the steps can be machined in one setting. (Fig 1)

Fig 1



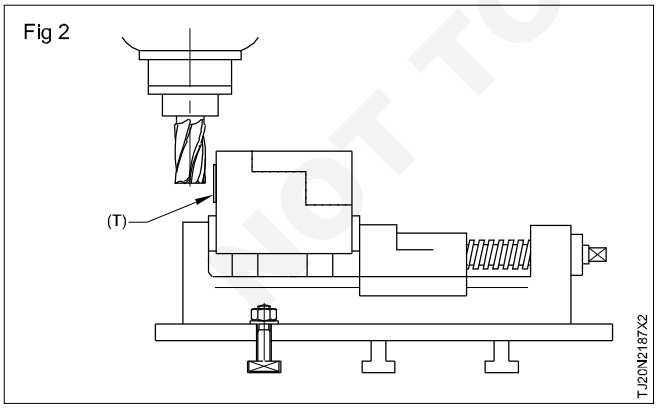
Mount the end mill in the collet adopter using the collet.

Ensure that the end mill is gripped without any webbing to avoid breakage of the cutter.

Set the r.p.m and clockwise cutter rotation.

Stick tissue paper (T) on the side face of the job. (Fig 2)

Fig 2



Raise the vertical slide such that the upper surface of the job is 10 to 15 mm above the cutter.

Be sure that when even depth of cut or selling is carried out the cutter is away from the job.

Move the table and bring the tissue paper side of the job parallel to the side of the end mill with a gap of 5 to 6 mm.

Start the spindle.

Move the cross-slide slowly till the tissue paper is just displaced from its position.

Step the machine as soon as the tissue paper slips.

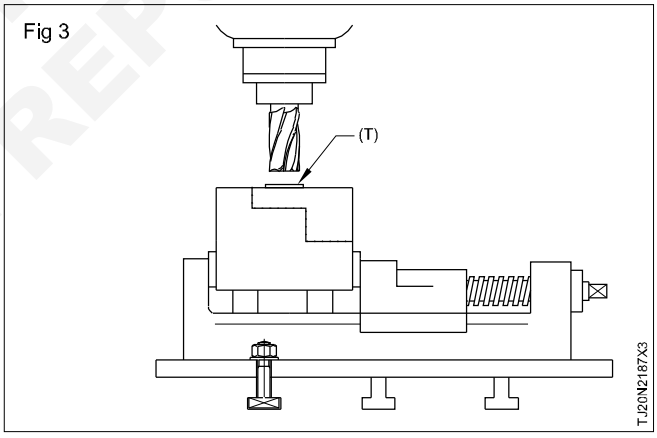
Lock the cross-slide.

Adjust the graduated scale to zero of the cross-slide.

This is the datum in one axis.

Stick the tissue paper on the top surface of the job. (Fig 3)

Fig 3



Clear the work piece from the end mill and set the mill 5 to 6 mm above the top surface of the job.

Start the machine.

Raise the work piece slowly till the job just touches the cutting edges and the tissue paper slips.

Stop the machine as soon as the tissue paper slips.

Adjust the graduated scale to zero of the vertical slide.

This is the datum in another axis.

Unlock the vertical slide.

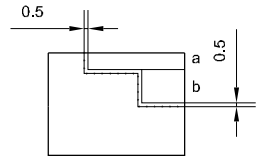
Clear the job from the cutter.

Set the coolant nozzle towards the cutter.

Start the spindle and the coolant pump.

Rough mill the steps a, b in that order. (Fig 4)

Fig 4



Leave 0.5 mm allowance of material on both the axes for the final finish.

Clear the job from the cutter and deburr the job.

Measure the job and confirm that 0.5 material is left for final finishing.

Complete the steps to the final dimension.

Stop the machine and deburr the job.

Remove the job and measure for its size.

Skill sequence

V - block grinding fixtures-base plate

Objective: This shall help you to
- **setting job for angular milling**

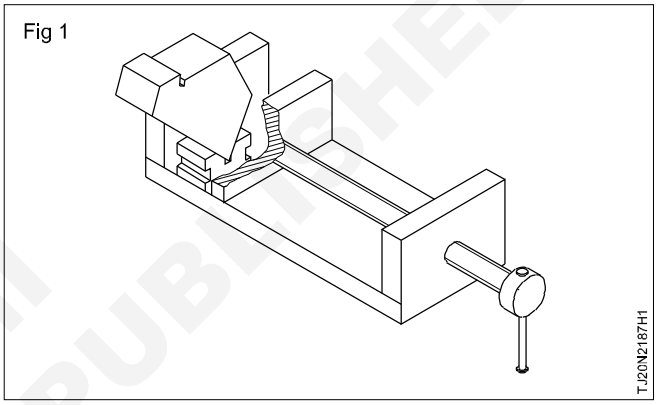
Mark the coordinates for the screw holes

Hold the job in the drilling vice with the help of the V-block. (Fig 1) (keep V-block at the bottom of the job to get the angular surface which is to be drilled parallel to the base)

Drill as per drawing.

Prepare a clamping step block for a V-block grinding fixture.

Fig 1



Study of CNC lathe, key board and specification

Objective: At the end of this exercise you shall be able to
- **identify each keys on keyboard.**

CNC lathe definition and types of CNC lathe

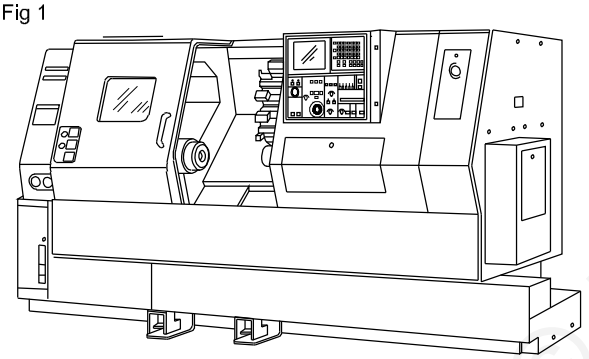
A CNC lathe is a machine that rotates a work piece on a spindle to cut away material, using cutting tools and drill bits to produce a symmetrical object. CNC lathes come in either.

1 Vertical type

2 Horizontal type

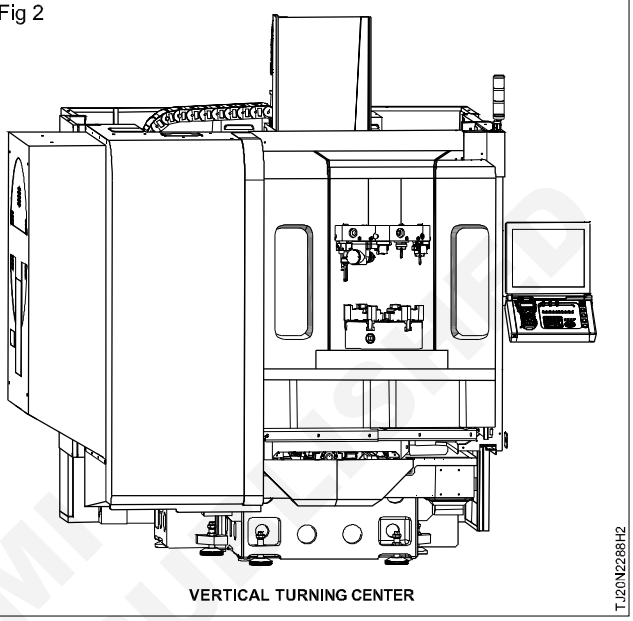
In Horizontal turning center the chuck is horizontal in position. The below is the sample of horizontal turning center. (Fig 1)

Fig 1



In vertical turning center the chuck is vertical in position. The turret moves up and down movement. The below Fig 2 is the sample of vertical turning center.

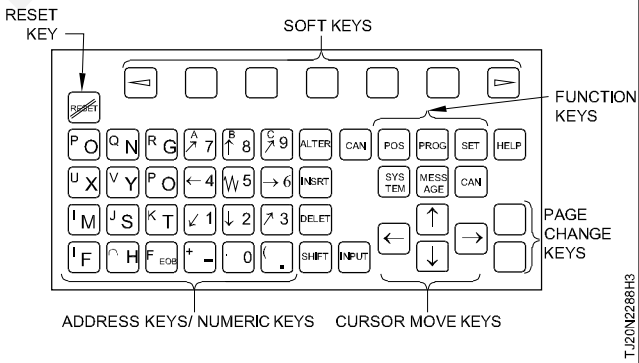
Fig 2



Machine operating key board

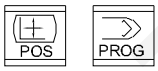
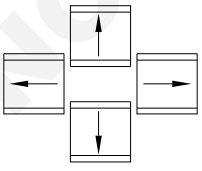
The machine operating key board is shown below (Fig 3)

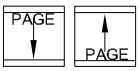
Fig 3



The definition of each keys are tabulated below (Table1)

No.	Name	Exploration
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 key top 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 equivalent 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

Specifications

Capacity	**Unit**	
Type of Bed	type	Slant 45° to Horizontal
Swing over max.	mm	400
Max. turning dia	mm	200
Turning distance between Centers	mm	350
Spindle		
Spindle nose	-	A2-6
Bore through the spindle	mm	50
Spindle speed (Max.)	rpm	4000
Clamping chuck size	mm	200
Type of spindle drive		AC variable speed
Slides/Feed Drive		
Traverse: X - axis	mm	160
Z-axis	mm	350
C - axis	deg.	360 (0.001 degree)
Feed Range:		
X - axis	mm/min	1- 5000
Z-axis	mm/min	1 - 5000
Rapid Traverse Rate:		
X - axis	m/min	15
Z - axis	m/min	15
Type of drive X & Z axes		AC Servo
Live Tool Turret		**Bi-directional**
No. of stations	-	8
Tool Holder Shank		VDI-30
Turning Tool Shank		20 x 20
Tailstock		
Base Travel Automatic	mm	560
Taper (Centre size)	type	MT-4
Thrust (max.)	N	4000
Power		
Spindle drive motor	kW	5.5/7.5 (30 mins)
Lubrication motor	kW	0.12

Coolant motor	kW	0.3
Hydraulic motor	kW	1.1
CNC System - FANUC OI-TB		
Overall Dimensions		
Height of Centre above floor	mm	1000
Length	mm	3500
Breadth	mm	1800
Height	mm	1850
Weight		
Weight of the basic machine	Kg	3600

Machine starting and operating, reference point, JOG and incremental mode

Objectives: At the end of this exercise you shall be able to
- **switching on the machine and operating the machine**
- **moving the machine to machine reference point'**
- **operating the machine in JOG mode.**

Switching on the machine and operating the machine

1 Switch on the stabilizer main switch.

2 Make sure the stabilizer is in serve mode.

3 Check the stabilizer output voltage is in between 400-430v.

4 Switch on machine main switch.

5 Switch on control panel switch, machine computer screen will start working.

6 The axis displays and other details appears and emergency indication flickering on the screen.

7 Realize the emergency push button and reset the machine.

8 Do the machine reference of all axis by selecting the mode switch (X and Z).

9 Now the machine is ready for operation.

Machine control panel

The mode selecting switch, feed control, speed control, tool count, emergency push button etc. are available in machine control panel is shown below (Fig 1)

Fig 1

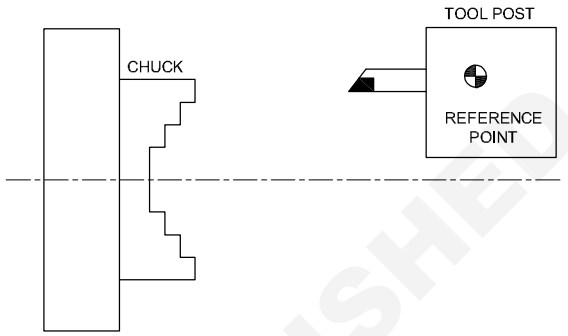
MACHINE CONTROL PANEL KEYS

TJN22108H1

Machine reference point (Refer Fig 2)

It is also called as home position or machine reference point. It is the origin of a machine coordinate system. On all CNC machines, machine zero is located at the positive end of each axis travel range.

Fig 2



TJ20N2289H2

Procedure for machine reference

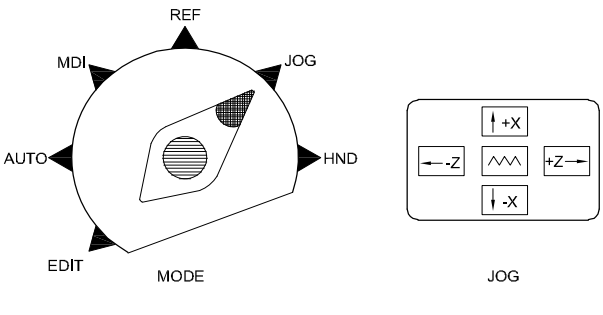
- Check the all axis are in safe position or move axis by hand mode to safe level.
- Set mode selector switch to zero ref.
- Select the axis 'Z 'press the soft key +Z, the axis moves to pre-defined home position Z.
- Select the axis 'X' press the soft key +X, the axis moves to pre-defined home position X.
- LED blows when the axis reaches the home position.

The above sketch shows the machine is in home position.

JOG mode operation (Fig 3)

- Set the mode switch to jog position.
- Minimize the feed control selection switch to 20% then adjust if needed.
- Press and hold the soft key +Z -Z +X -X for the required direction.
- It is shown Fig 3.

Fig 3



TJ20N2289H3

Incremental mode

- In incremental mode the axis moves with respect to previous point. The sample given below
- Set mode switch to MDI selection
- Select program soft key the new empty screen • appears.
- 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-10 then
- The axis X will move 10 mm in (-) direction
- Now the tool will reach the first position.

Note: The above operation sequence may demonstrated by the instruct or. Ask trainees to operate in front of instructor.

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

Objectives: At the end of this exercise you shall be able to
- **demonstrate the point assignment and simulation**
- **demonstrate absolute and incremental programming method.**

For the coordinate system point do the following.

Read the drawing and plot the point 12345 as shown in (Fig 1)

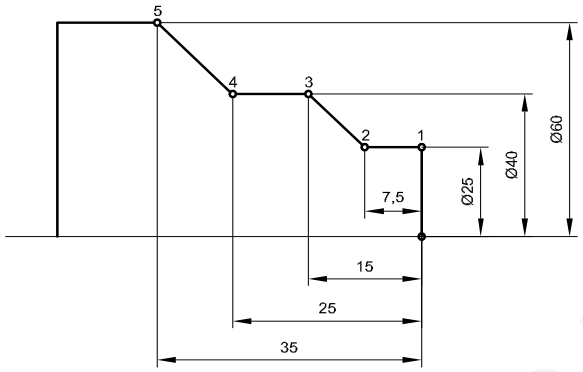
Plot the table and marked the axis points respectively.

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.

Sample drawing is given (Fig 1)

Fig 1



START POINT AT HORIZONTAL

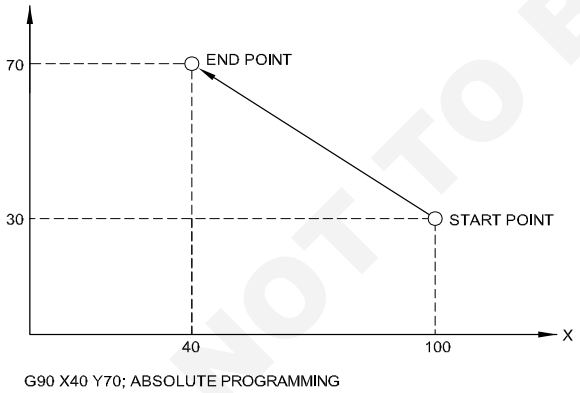
POS. NO	X axis	Z axis
1	25	0
2	25	-7.5
3	40	-15
4	40	-25
5	60	-35

ABSOLUTE PROGRAMMING (G90)

T.J20N2290H1

Absolute and incremental programming (Fig 2)

Fig 2



T.J20N2290H2

There are two ways to command travels of the tool; the absolute programming, and the incremental programming. G90 and G91 are used to programming absolute or incremental programming, respectively.

Absolute programming (G90)

In absolute programming, all measurements are made from the part origin. Any programmed coordinate has the absolute value in respect to the fixed zero point.

The sample program is given based on (Fig 2)

NI G90 G0 X28 Z0

N2 GI X25 Z-7.5

N3 X40 Z-15

N4 X40 Z-25

N5 X60 Z-35

Incremental programming (G91)

NI G91 X25 Z0

N2 G91 GI X0 Z-7.5

N3 X15 Z-7.5

N4 X0 Z-10

N5 X20 Z-10

Program simulation in machine

After enter the program in EDIT mode, check the simulation in machine.

Select the GRAPH soft key, graph window will appear in screen.

Set the graph limit. Lock the machine and dry run by activating the respect soft key in machine control panel.

Press cycle start button; tool path will appear in screen.

Co-ordinate 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

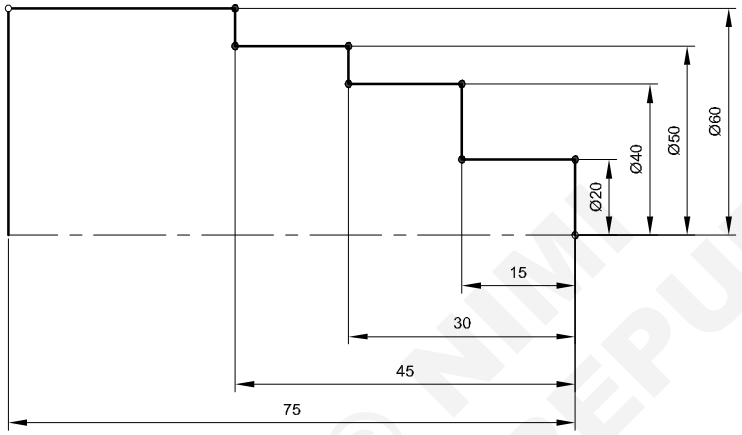
- **demonstrate the point assignment and simulation**
- **familiarize with simulation software and simulate the plotted points**
- **identification of machine over travel limit**
- **identification of emergency stops push button.**

Absolute coordinate

Sample (Fig 1)

Tool path 1-2-3-4-5-6-7-8-9

Fig 1



(G90)

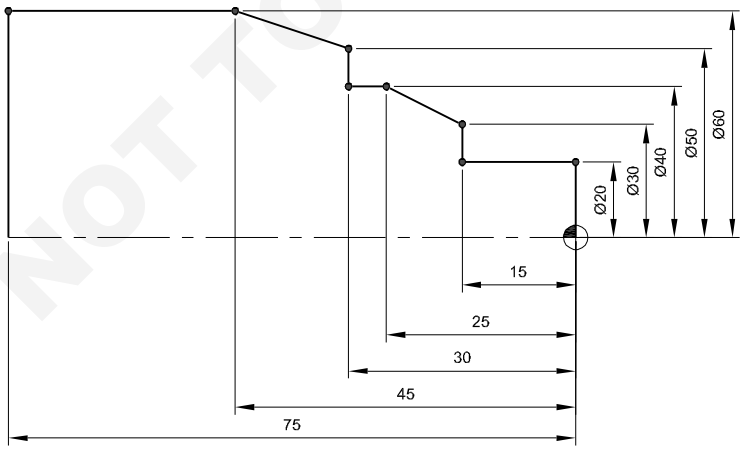
SL NO	X axis	Z axis
1	0	0
2	20	0
3	20	-15
4	40	-15
5	40	-30
6	50	-30
7	50	-45
8	60	-45
9	60	-75

TJ20N2291H1

Sample (Fig 2)

Tool path 1-2-3-4-5-6-7-8-9

Fig 2



(G90)

SL NO	X axis	Z axis
1	0	0
2	20	0
3	20	-15
4	30	-15
5	40	-25
6	40	-30
7	50	-30
8	60	-45
9	60	-75

TJ20N2291H2

Incremental coordinate (G91)

Sample (Table 1)

Tool path 1-2-3-4-5-6-7-8-9

Table 1

Tool position	X Axis	Z Axis
1	0	0
2	20	0
3	0	-15
4	20	0
5	0	-15
6	10	0
7	0	-15
8	10	0
9	0	- 30

Sample (Table 2)

Tool path 1-2-3-4-5-6-7-8-9

Table 2

Tool position	X Axis	Z Axis
1	0	0
2	20	0
3	0	-15
4	10	0
5	10	-10
6	0	-5
7	10	0
8	10	-15
9	0	-30

Identification of machine over travel limits

There are two types of over travel limit

1 Software over travel

2 Hardware over travel

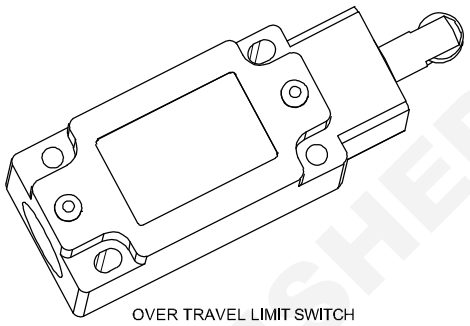
Software over travel can be controlled by the specific parameter.

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 movable axis frame.
- If the dog pressed the fixed limit switch, over travel alarm appear on the screen.

Below shown the over travel limit switch (Fig 3)

Fig 3



OVER TRAVEL LIMIT SWITCH

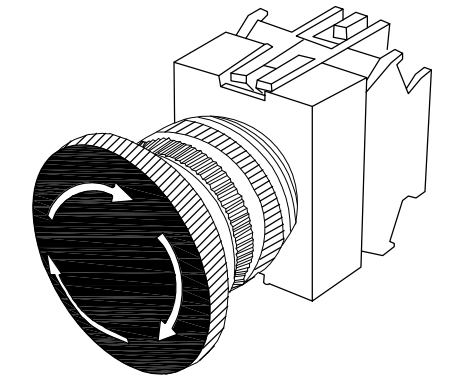
TJ20N2291H3

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 until you twist it. They are designed to be large, hard to miss, and easy to push. Sample is given. (Fig 4)

Fig 4



TJ20N2291H4

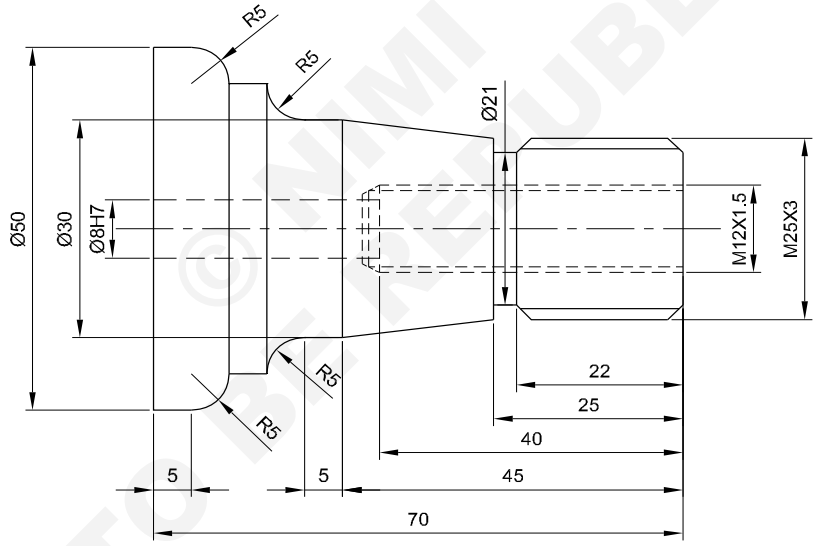
Work, tool setting and turning operations

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

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

Task 1 to 8: **Tool setting**

Task 9: **Prepare program and run in auto mode for the given drawing**



NOTE :

Ø8H7 - 8 $^{+0.022}_{-0.000}$

1	Ø52 X 100	-	ALUMINIUM	-	-	2.2.92
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
					CODE NO. TJ20N2292E1	

Job sequence

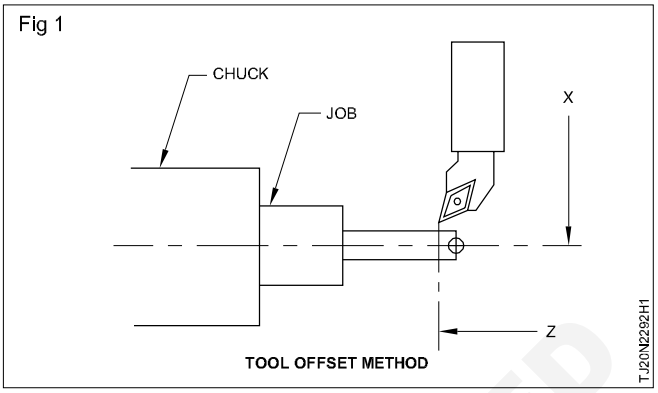
Fanuc control Tool off set method

TASK 1: **X axis tool off set method.**

Reference tool is T01 and off set is zero in X and Z axis.

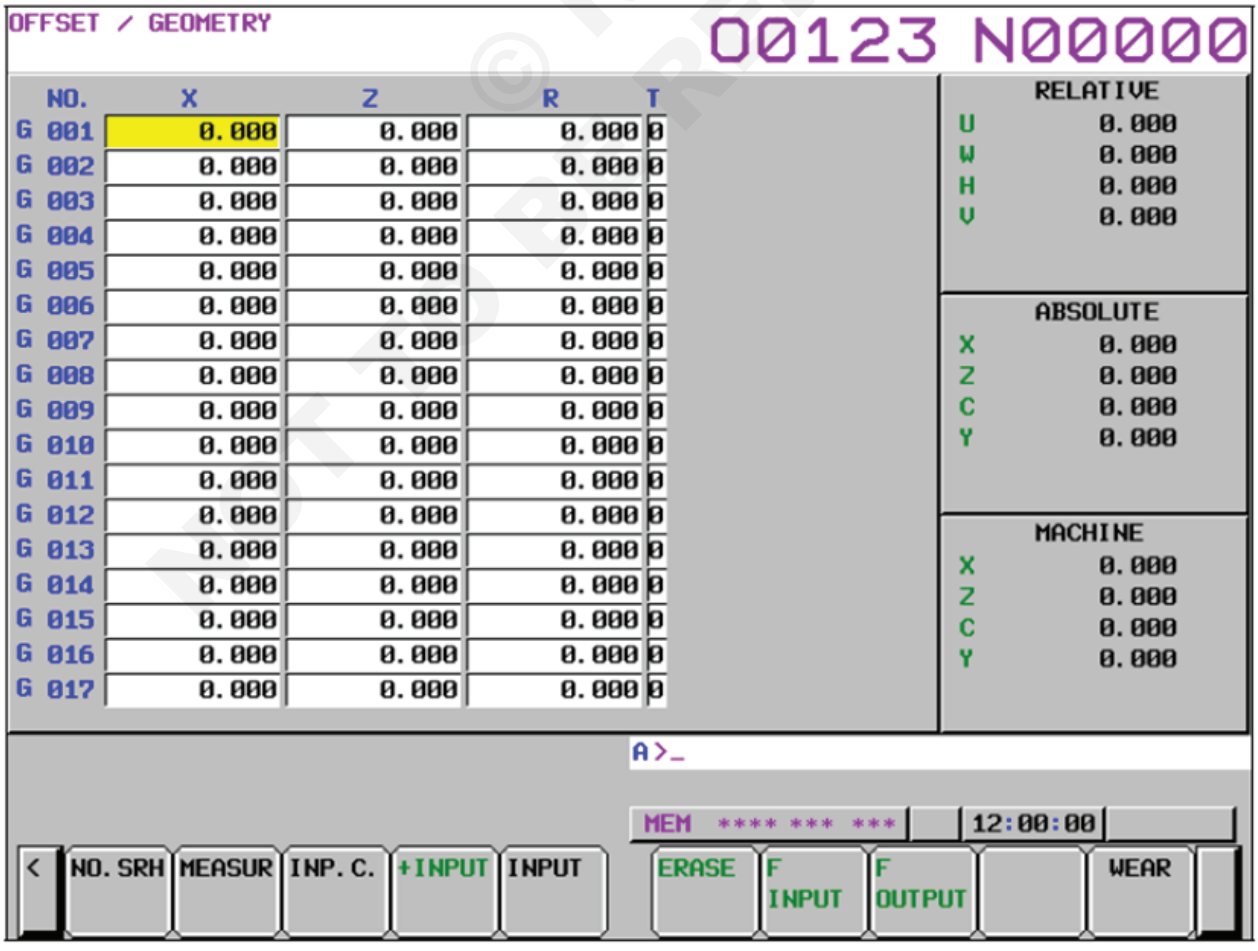
- Clamping job in chuck.
- Select MDI mode from Mode Selection Knob.
- Enter tool number: T0202 (Example for a Turning tool). Press Insert button press cycle start button.
- Enter M03 S800 Press Reset button &press cycle start button Now; the Spindle rotates at the RPM mentioned.
- Select Jog Mode and bring the Tool closer to the Job.
- Select X10 speed for MPG/Handle mode using mode selection knob to move Tool in x and z axis towards the Job.
- Touch the job in x, axis just clean OD by turning on OD & ensure no disturbance in x axis bring the Tool slightly away from the Job without disturbing in X - Axis. (Fig 1)
- Then Stop the Spindle by pressing the Spindle Stop Button.

Fig 1



- Measure the Diameter Turned using a Vernier Caliper / Micro meter. Example The measured value of the Diameter shows 28.62mm.
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Figure.
- Use cursor select tool no 2 and x axis Position as highlighted in the (Fig 2)

Fig 2



- Enter ‘X measured Diameter Value’.
- For Example: X 28.62 Press measure button soft key.
- Now Tool Cutting Edge with Reference to the X - Axis is saved.

TASK 2: **Z axis tool off set method.**

- Spindle ON rotates the Job.
- Select Jog Mode and bring the Tool closer to the Job.
- Select X10 speed for MPG/Handle mode using mode selection knob to move Tool in x and z axis towards the Job.
- Touch the job in Z axis just clean Face of the Job by Facing & ensure no disturbance in Z axis bring the Tool slightly away from the Job without disturbing in Z - Axis. (Fig 1)
- Then Stop the Spindle by pressing the Spindle Stop Button.
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Fig 2

Fig 1

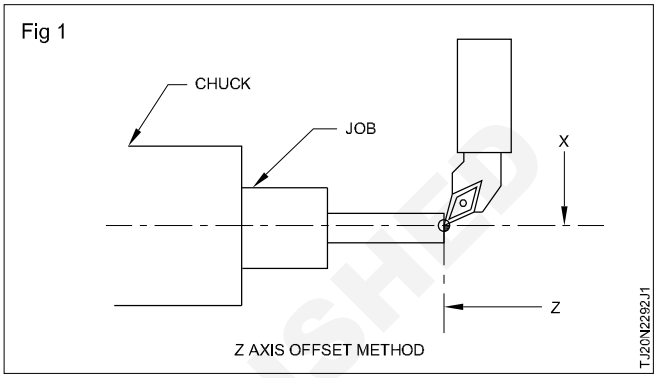
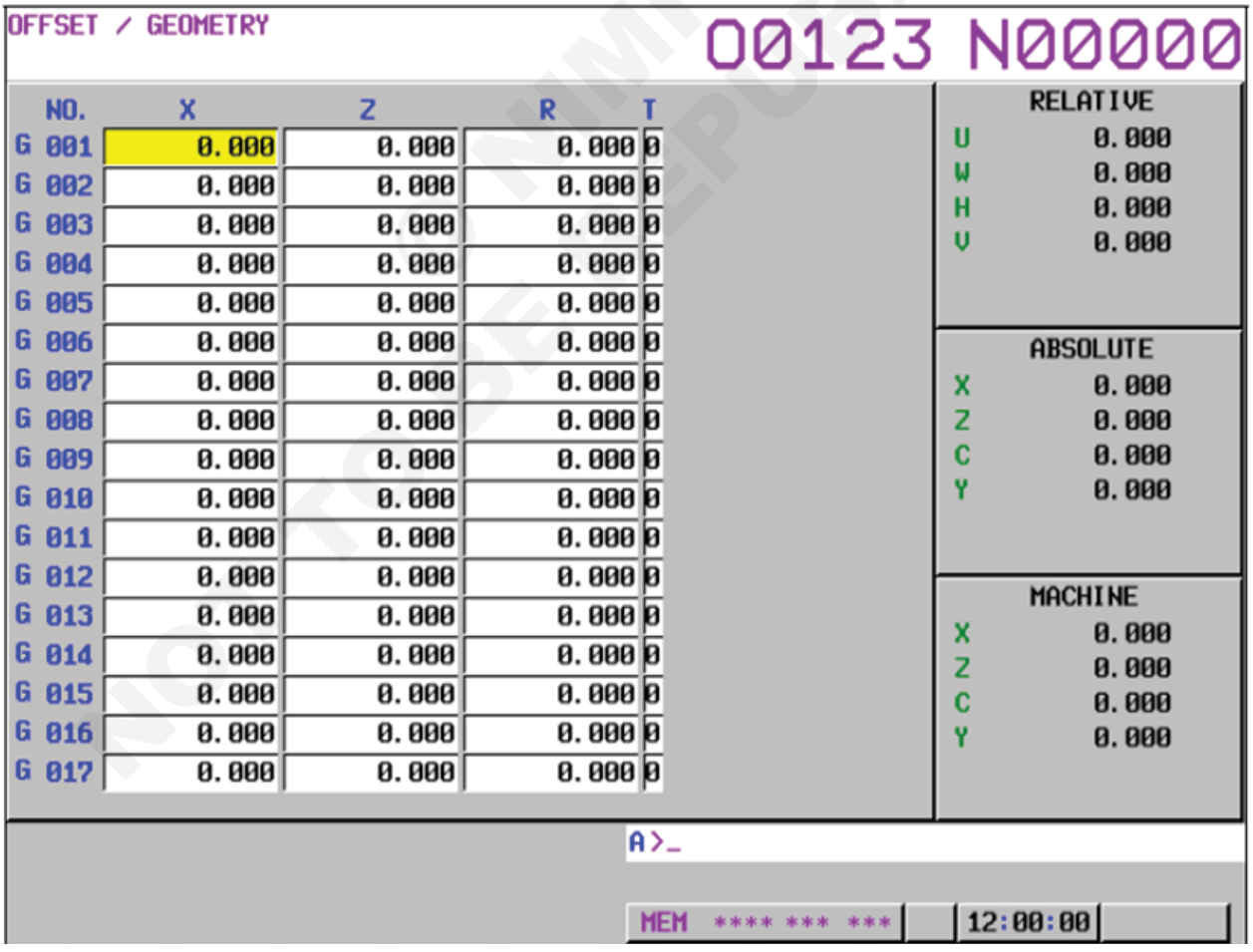


Fig 2

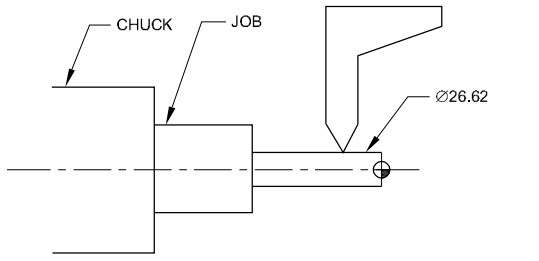


- Use cursor select tool no 2 and Z Axis Position as highlighted in the Figure.
- Enter ‘Z0” and Press Measure Button Soft Key.
- Now Tool Cutting Edge with Reference to the Z - Axis is saved.

TASK 3: **Second Tool Offset**

- Select MDI mode from Mode Selection Knob.
- Enter tool number: T0303 (Example for a Threading tool). Press Insert button press cycle start button.
- Enter M03 S800 Press Reset button &press cycle start button Now; the Spindle rotates at the RPM mentioned.
- Select Jog Mode and bring the Tool closer to the Job.
- Select X10 speed for MPG/Handle mode using mode selection knob to move Tool in x and z axis towards the Job.
- Touch the job in x, axis just clean OD by turning on OD & ensure no disturbance in x axis bring the Tool slightly away from the Job without disturbing in X - Axis. (Fig 1)
- Then Stop the Spindle by pressing the Spindle Stop Button.
- Measure the Diameter Turned using a Vernier Caliper / Micrometer. Example The measured value of the Diameter shows 28.62mm.

Fig 1

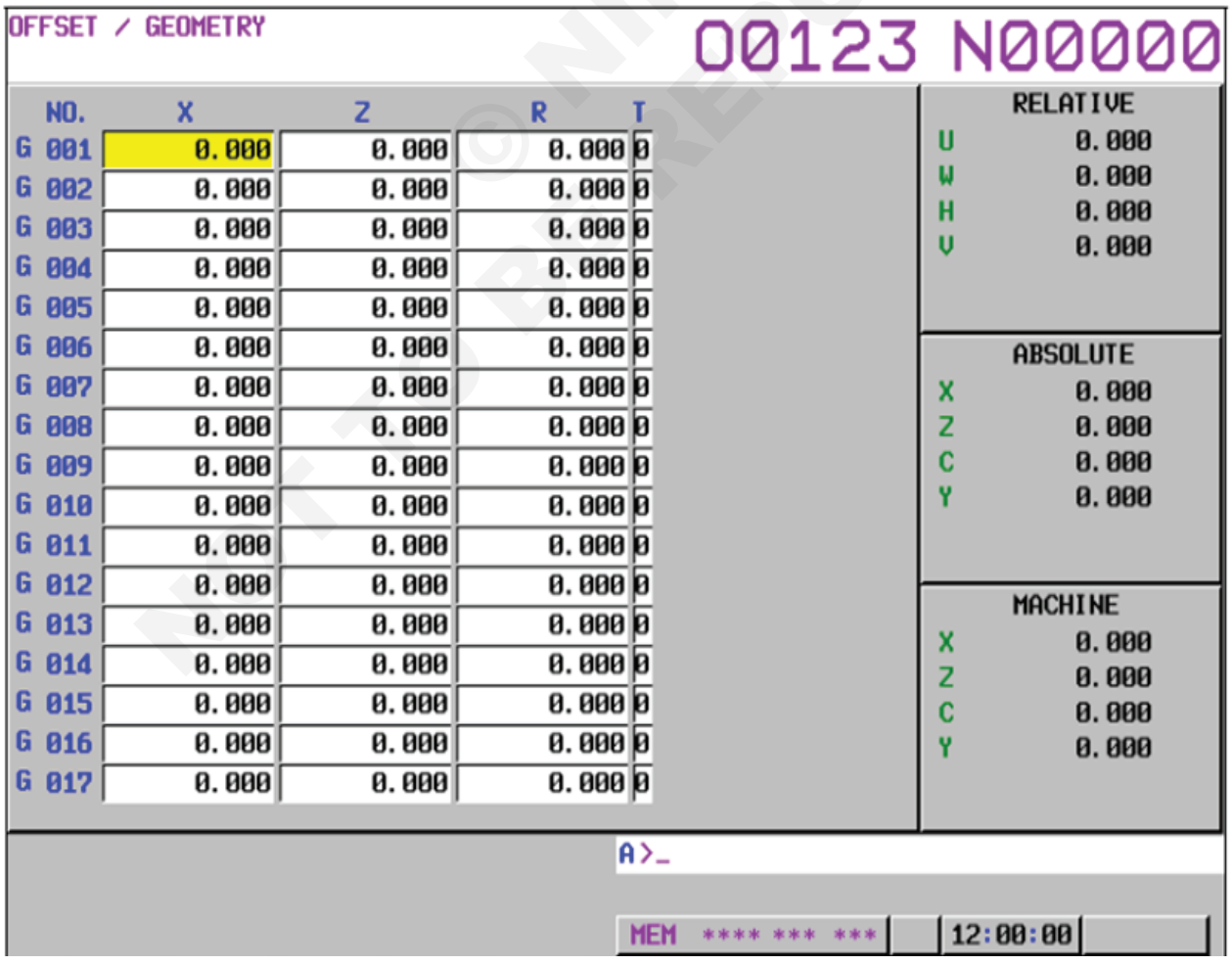


Z AXIS OFFSET METHOD

T.I20N2292K1

- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Fig 2
- Use cursor select tool no 3 and x axis Position as highlighted in the Figure.
- Enter 'X measured Diameter Value'.
- For Example: X 28.62 Press measure button soft key.
- Now Tool Cutting Edge with Reference to the X - Axis is saved.

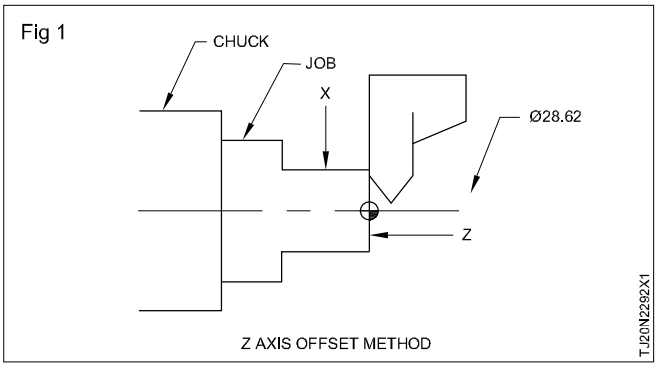
Fig 2



TASK 4: **Z axis tool off set method.**

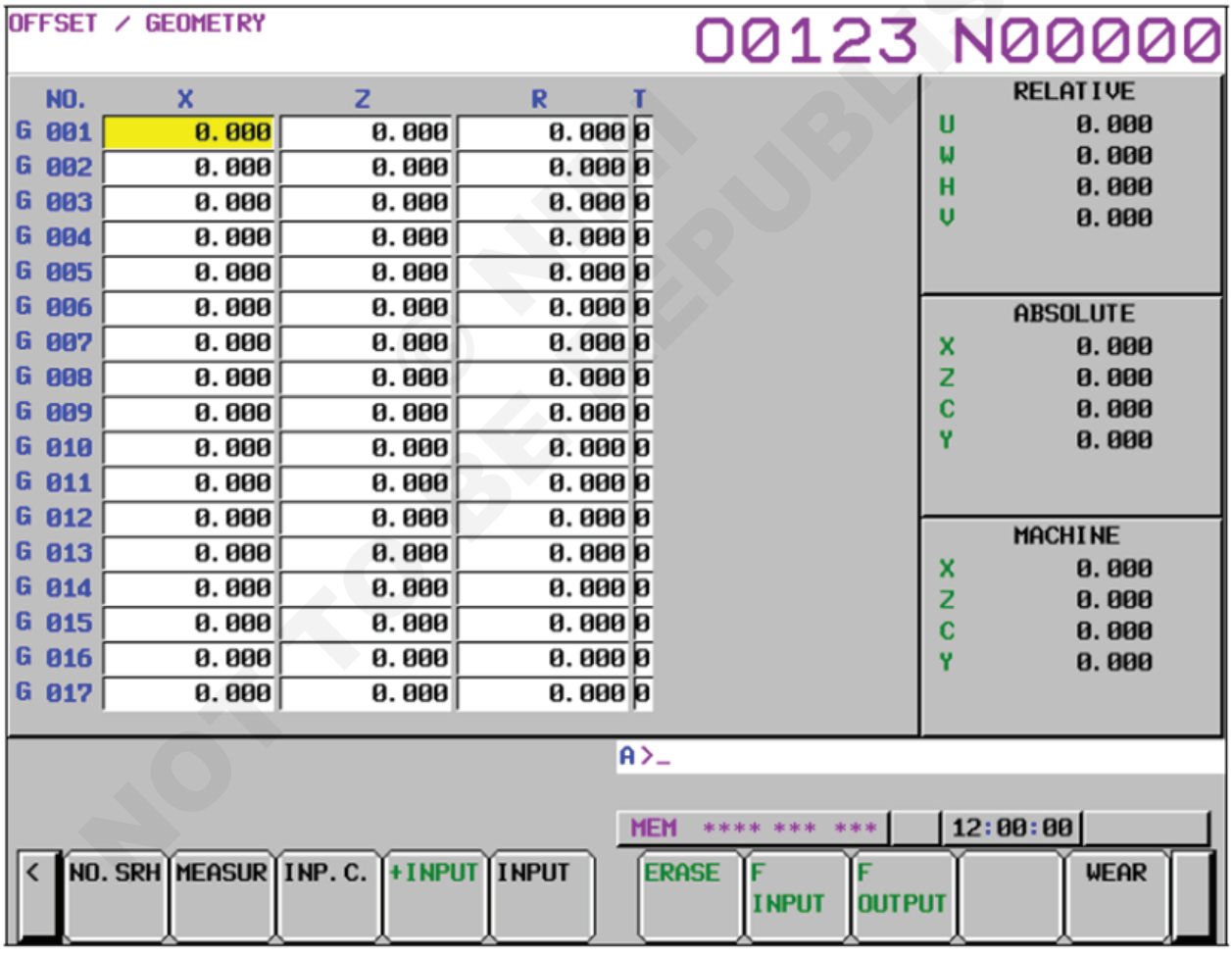
- Spindle ON rotates the Job.
- Select Jog Mode and bring the Tool closer to the Job.
- Select X10 speed for MPG/Handle mode using mode selection knob to move Tool in x and z axis towards the Job.
- Touch the job in Z axis just clean Face of the Job by Facing & ensure no disturbance in Z axis bring the Tool slightly away from the Job without disturbing in Z - Axis. (Fig 1)
- Then Stop the Spindle by pressing the Spindle Stop Button.
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Figure.

Fig 1



- Use cursor select tool no 3 and Z Axis Position as highlighted in the Figure.
- Enter 'Z0" and Press Measure Button Soft Key.
- Now Tool Cutting Edge with Reference to the Z - Axis is saved.

Fig 2

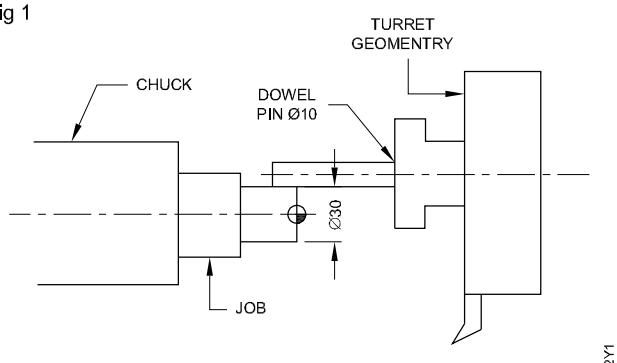


TASK 5: **Drilling tool x axis off set method**

- For placing the Drill in 4th position
- Select MDI mode type T0404 and press cycle start
- Place the Drill holder with dowel pin in the 4th position
- Measure the exact diameter of the Turned Job already placed in the Chuck.
- Select the Known Diameter of Dowel Pin set in the Tool Holder.

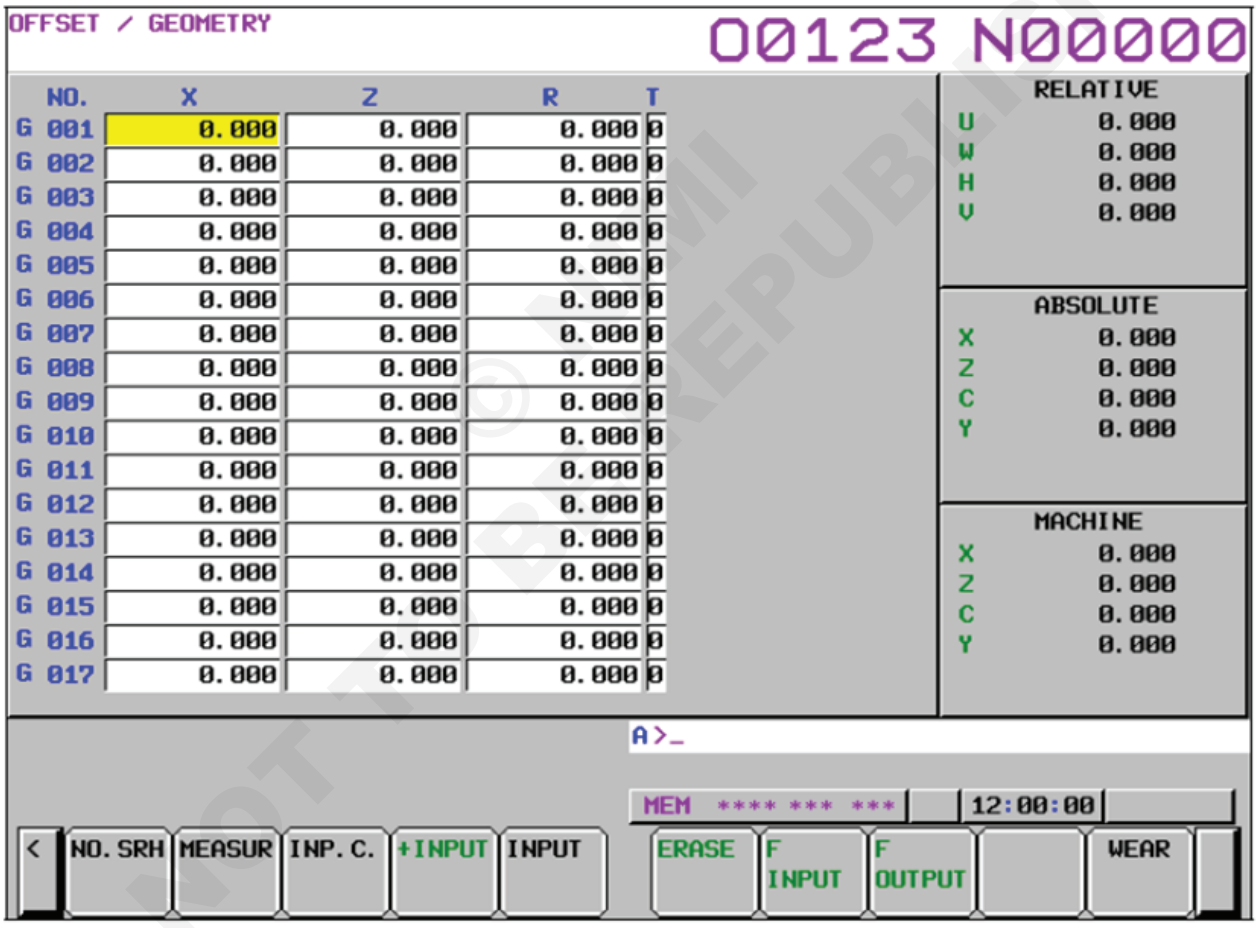
- Using MPG or Handle mode similar to the Other Tools Touch the Job on the measured diameter with Dowel Pin by moving in X & Z axis as shown in Fig 1

Fig 1



- Make use of Feeler Gauge 0.02mm or Paper to ensure the Dowel Pin has touched the Diameter of the Job.
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Fig 2
- Use cursor select tool no 4 and x axis Position as highlighted in the Figure.
- Enter 'X (Diameter of the Job + Drill or dowel Pin diameter)
- For example, the dia of the Job is 30.2 and dowel pin diameter is 10.02
- Then Type 'X40.22' Press measure Button soft key.
- Now Tool Cutting Edge with Reference to the X - Axis is saved.

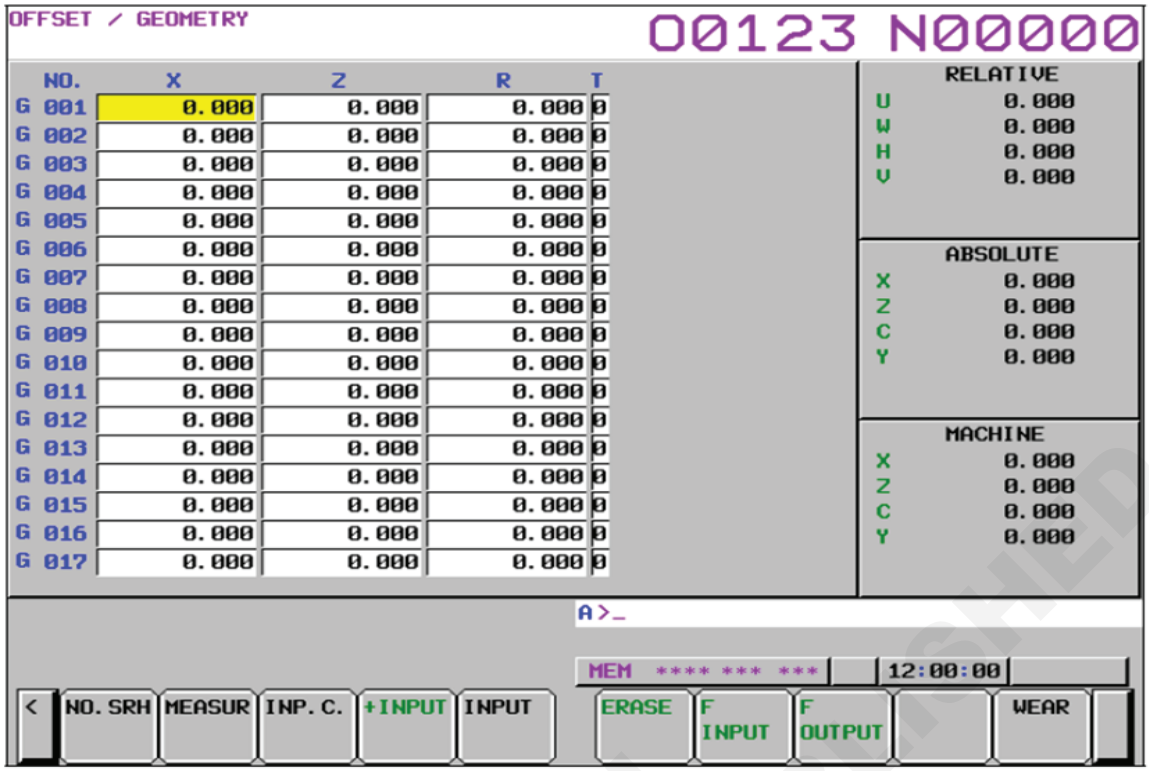
Fig 2



TASK 6: **Drilling tool Z axis off set method**

- Similar to X – axis in MPG mode touch the Job Front face using the Drill face cutting edge use paper or feeler Gauge for ensuring the Proper Touch.
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Fig 1
- Use cursor select tool no 4 and Z Axis Position as highlighted in the Figure.
- Enter 'Z0" Press measure Button soft key.
- Now Tool Cutting Edge with Reference to the Z - Axis is saved.

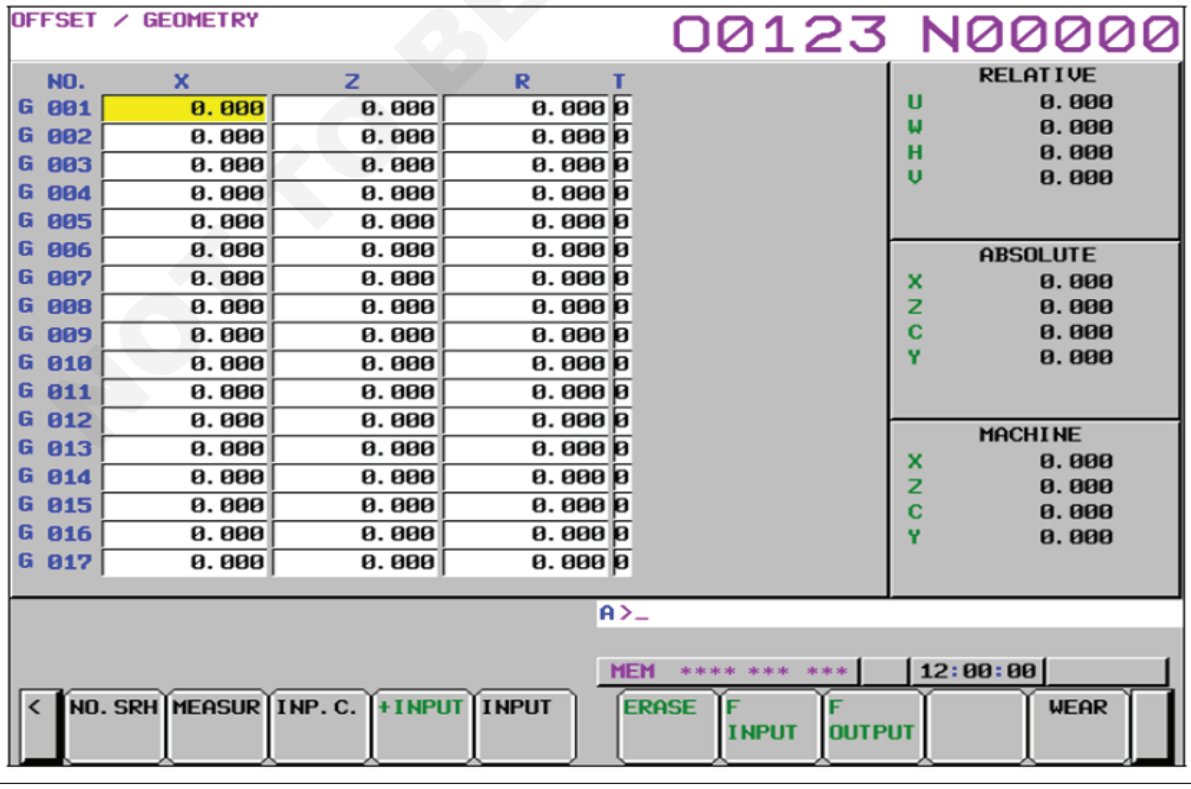
Fig 1



TASK 7: **Entering of Tool Nose Radius**

- From the Tool & Insert Nomenclature details find the Corner Radius of the Insert.
- For Example: If the Insert Nomenclature says CNMG 120408 the Last 2Digit 08 signifies the Insert Corner Radius as 0.8
- Select Edit mode
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Fig 1

Fig 1

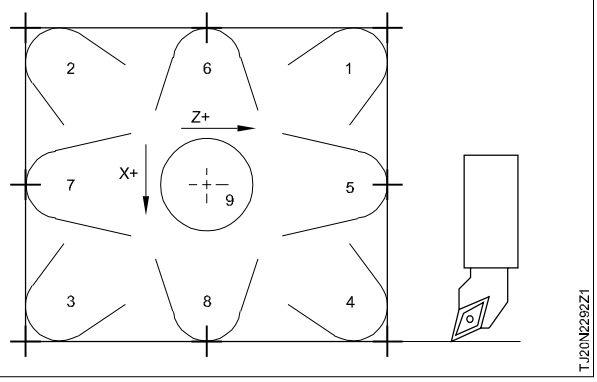


- Use cursor to select tool no 2 and R Position as highlighted in the Figure.
- Type 0.8 and Press Input Button Soft Key.
- Now Tool Nose Radius for the respective Tool is saved.

TASK 8: **Orientation of the Tool**

- The above Figures describes the Direction of the Tool for Turning Center
- Select the Position of the Tool for Example If I am using Tool No. 2 which is a OD Turning Tool. The position 3 can be obtained from the Fig 1

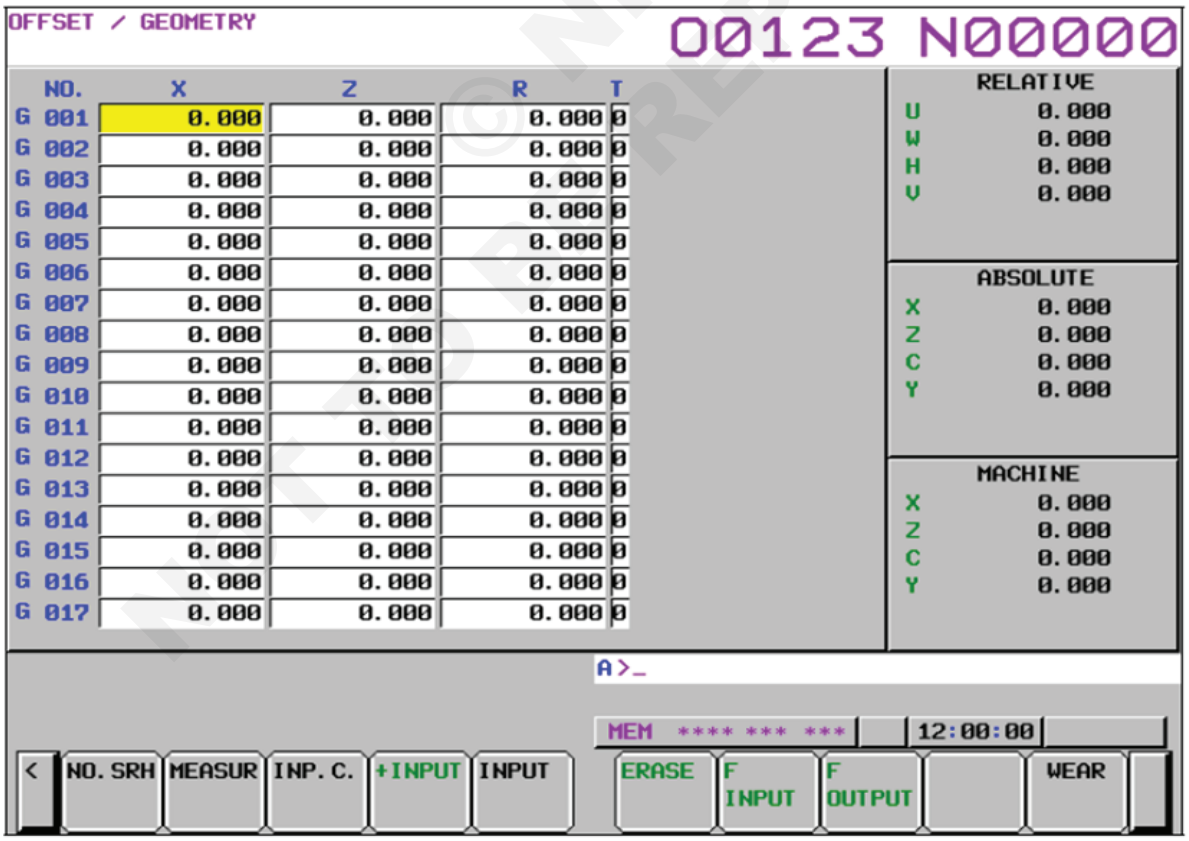
Fig 1



- To enter the Tool Orientation
- Press off set Button select Geometrical Offset Soft key in the Display.
- Now, the Geometrical Offset page opens in the display as shown in the Fig 2
- Use cursor to select tool no 2 and T Position as highlighted in the Figure.
- Type 3 and Press Input Button Soft Key.
- Now Tool Orientation for the respective Tool is saved.
- Using the same method by the Direction of the Tool Orientation for the Different Tools can be set.

Note: Work offset should be zuro Both in X & Z Tool offset method followed.

Fig 2



TASK 9: **Prepare programme run auto mode for the job**

- Write the programme for the given work piece
- Enter the programme in simulator and verify it
- Enter the programme in machine control panel and verify it
- Set the work piece
- Measure the tool offset and verify it
- Test the programme in dry in run mode
- Run the programme in auto mode
- Check the dimension of any error in the dimensions corrected it by wear offset method
- Get it checked by your trainer
- Example program

O3001 [Facing]

G90 G95 G80 G18 G21;

T0101; [Facing Tool]

M04 S1500;

G0 X56 Z0;

G01 X -1 F0.1;

G0 Z5;

G0X52;

G01 Z-70 F0.1;

G00X56;

G00Z20

G28 U0 W0;

M5;

M30;

O3002 [Profile Turning with stock Removal on OD]

T0202; [Turning Tool]

M04 S1200;

G00 X52 Z5;

G71 U0.5 R1;

G71 P10 Q20 U0.25 W0.25 F0.15;] Stock Removal cycle on Diameter

N10 G01 X21 Z0;

G01 X25 Z -2;

G01 X25 Z -25;

GO1 X30 Z -45;

G01 X30 Z-50;

G02 X40 Z-55 R5;

GO1 X40 Z -60;

G03 X50 Z-65 R5;

G01 X50 Z-70;

N20 G01 X 60 Z-70;

G70 P10 Q20 F0.1; [Finishing cycle]

G0 X 100;

G0 X 20;

G28 U0 W0;

M5;

M30;

O3003; [Grooving operation]

T0303; [Grooving Tool with width 2 mm]

M04 S800;

G00 Z-24;

G00 X 32;

G75 R2;

G75 X 21 Z-25 P200 Q1000 F0.2; [Grooving cycle]

G0X32;

G0 Z 20;

G28 U0 W0;

M5;

M30;

O3004; [Straight Threading]

T0404; [Threading Tool]

M04 S800;

G00 X 32 Z 10;

G76 P100060 Q100 R0.04;

G76 X 21.322 Z – 24 P1839 Q 200 F3;

G00 X 32;

G0 Z 20;

G28 U0 W0;

M5;

M30;

O3005; [Center Drilling]

T0505;

M03 S1000;

G00 X0 Z5;

G01 Z-2 F0.1;

G00 Z5;

G28 U0 W0;

M5;

M30;

O3006; [Drilling]

T0606; [Drill dia 10.5]
M03 S1000;
G00 X0 Z5;
G74 R5;
G74 Z-38 Q10000 F0.1;[Peck Drilling cycle].
G00 X0 Z5;
G28 U0 W0;
M5;
M30;
O3007; [Tapping M12 X 1.5]
T0707; [M12 Tap]
M03 S800;
G00 X0 Z10;
G84 X 0 Z-30 R5 P3 F1.5; [Front Tapping Cycle]
G00 X0 Z10;
G28 U0 W0;
M5;
M30;
O3008; [Pre Drill for 8H7 Reame] Φ 7.8
T0808; [Φ7.8 Drill]
M03 S1000;
G0 X0 Z10;
G01 Z-45 F0.1
G0 X0 Z10
G28 U0 W0;
M5;
M30;
O3009; [8H7 Reaming]
T0909; [Φ8H7 Reamer]
M03 S1000;
G0 X0 Z10;
G01 Z-40 F0.1;
G01 Z 10; F0.1;
G0 X0 Z10;
G28 U0 W0;
M5;
M30;

Study of CNC machining center

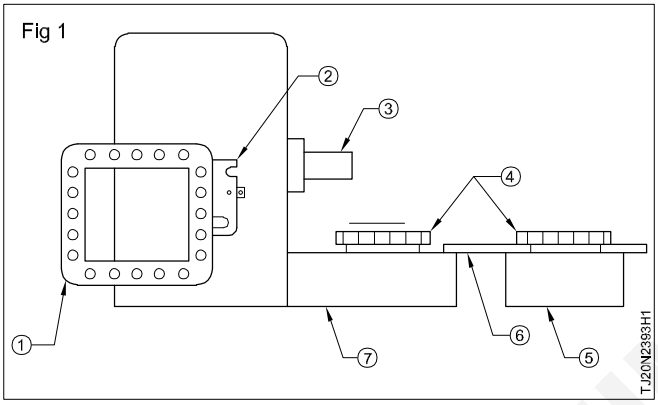
Objectives: At the end of this exercise you shall be able to

- **identify the CNC machining centers**
- **name the parts of machining centers**
- **familiarize the machine center panel key board**
- **familiarize the system control key board**
- **specify the CNC machining centers.**

PROCEDURE

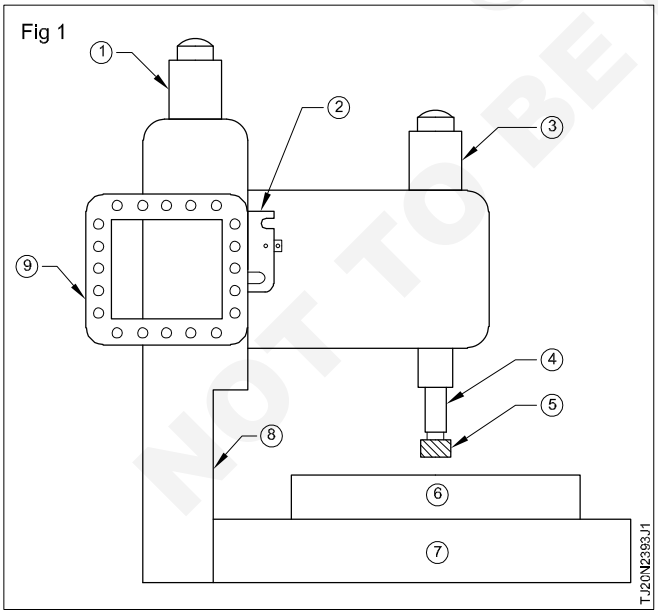
TASK 1: **Observe and name the machine (Fig 1)**

Fig 1



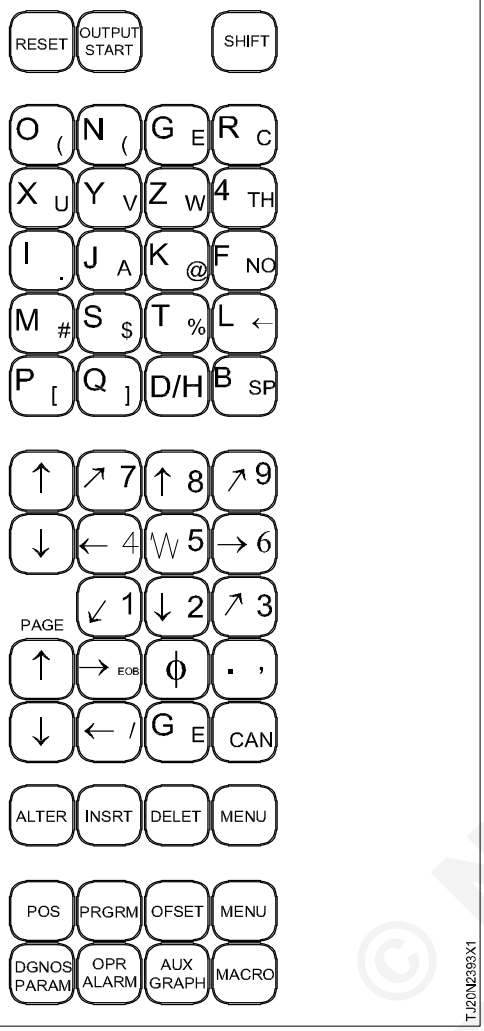
TASK 2: **Identify the parts of the machine and record it (Fig 1)**

Fig 1

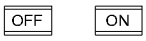
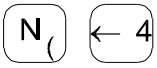


TASK 3: **identify the machine control key board and familiarize the functions of each keys in the machine control panel**

Fig 1



Explanation of the keyboard

Number	Name	Explanation
1	Power ON and OFF buttons 	Press these buttons to turn CNC power ON and OFF
2	RESET key 	Press this to reset the CNC, to cancel 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 on 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 SHIFT (Full MDI key board)	Some keys have two char actors on their keyl op. Pressing the <SHIFT> key switches the char actors Special charactor A is displayed on the screen. When a character *** at the bottom right cannot on the key lop can be entered.
7	INPUT key INPUT	When an address or a numerical key is prosed, 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 regulator, etd... press the INPUT Key This key is also used to input data from on input/ output device.
8	Cancel key CAN	Press this key to delete the input data or the last character in the key input buffer.
9	Program edit keys ALTER INSRT DELET	Press these keys when editing the program. ALTER : Alteration INSRT : Insertion DELET : Deletion

10	Functions keys POS PRGRM	Press these keys to switch display screens for each function.
11	Cursor move keys CURSOR ⇧ ⇩	There are two different cursor moved 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	M M C / C N C change key MMC/ CNC	Selects whether the MMC screen or CNC screen is displayed on the CRT.

Machine specifications:

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

Description	Vertical machining center	Horizontal machining center
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	40-4000rmp
Spindle taper	BT 40	BT 50
Power	7.0kw	15.0kw
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

- Identify the parts of horizontal machining center.
- List out the names of the parts shown in figure in the given table 1.

Instructor will demonstrate the parts of horizontal machining center.

Get it checked by the instructor

TABLE - 1	
Sl.No	**Name of the elements of the horizontal machining center**
1	
2	
3	
4	
5	
6	
7	

- Identify the parts of CNC vertical machining center.
- List out the name of the parts shown in figure in the given table 2.

Instructor will demonstrate the parts of CNC vertical machining center.

Get it checked by the instructor

TABLE - 2	
Sl.No	**Name of the elements of the vertical machining center**
1	
2	
3	
4	
5	
6	
7	

The instructor shall demonstrate all the X.

- 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 machines.
- Release the emergency button.
- Switch ON the control panel.
- Do the referencing operation.
- Keys and its function.

The instructor shall demonstrate all the keys in the system control panel

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 center**
- **reference the marine axis**
- **operate in JOG, incremental and MDI modes.**

PROCEDURE

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

1 Switching on the machine and operating the machine.

2 Moving the machine to 'machine reference point.

3 Operating the machine in JOG mode.

Switching on the machine and operating the machine

1 Switch on the stabilizer main switch.

2 Make sure the stabilizer is in servo mode.

3 Check the stabilizer is in servo mode.

4 Check the stabilizer output voltage is in between 400-430v.

5 Switch on machine main switch.

6 Switch on control panel switch, machine computer screen will start working.

7 The axis displays and other details appears and emergency indication flickering on the screen.

8 8 Realize the emergency push button and reset the machine.

9 Do the machine reference of all axis by selecting the mode switch. (X and Z).

10 Now the machine is ready for referencing.

— — — — — — — —

TASK 2: **Reference position return**

1 Start the machine.

2 Go to jog mode by pressing jog switch.

3 Move all the axis towards the center of the machine table by selecting appropriate axis switches.

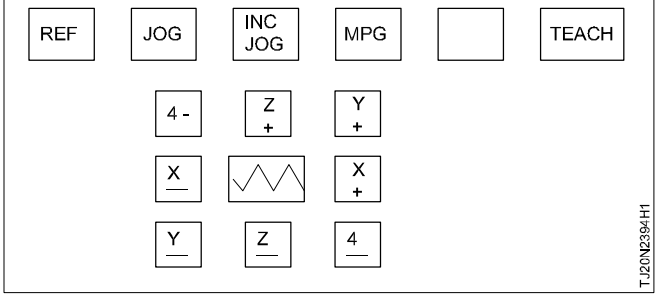
4 Go to reference point return by pressing the 'Ref switch.

5 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 slow.

6 Now the display shows the following position.

Note: Display and steps may vary machine to machine

Fig 1



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. G0 G91 G28 X0 Y0 Z0 B0;

— — — — — — — —

TASK 3: **Jog mode operation**

1 Press the 'JOG' switch in the keyboard.

2 Keep the feed over ride switch near to 50% position.

3 Press the appropriate axis with direction switch "continuously until the desired movement is achieved.

4 The movement may be made rapid by simultaneously pressing the axis and rapid switch.

Note:

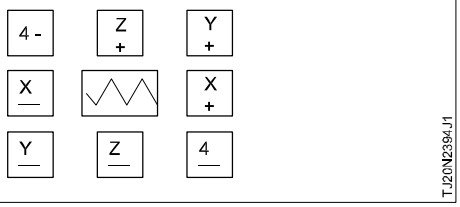
If the finger is released from the switch the movement is stopped immediately

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

Fig 1



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

1 Press "inc JOG" switch.

2 Press any one of the inc x 1, inc 10, inc 100, inc 1000, inc 10000

3 Press the axis switch (+) or (-) to move for the particular incremental feed.

(or)

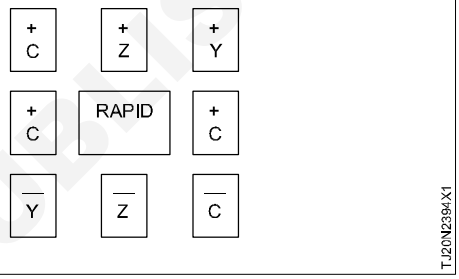
1 Activate MPG (manual pulse generator) siwtch

2 Press any one of the inc x 1 ..... x 10,000 switch as desired.

3 Press the axis with direction + 'or' -.

4 Rotate the MPG knob. The movement per division is equal to the selection of inc. switch as per the above instruction in (2).

Fig 1



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TASK 5: **MDI - Mode - operation**

1 Press the MDI key.

2 Press the "program" key.

The following screen appear (may vary machine to machine)

Program (MDI)

O0000

%

10:26:11 S OT

MDI

Programming number O0000 is generated automatically

3 Prepare the program blocks with a block M 99 at the end to return to beginning the block.

4 To erase the program created in MDI either press "Reset" key or enter address O0000 then press the "Delete" key in the MDI panel.

3 Prepare the program blocks with a block M 99 at the end to return to beginning the block.

4 To erase the program created in MDI either press "Reset" key or enter address O0000 then press the "Delete" key in the MDI panel.

5 Place curser in the first block and push cycle start key for executing position.

6 To stop the operation press "Reset" key (or) rotate the "Feed hold" key to "0" position (or) press the emergency switch.

— — — — — — — —

Co-ordinate system points absolute and incremental programming and simulations

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

- **plot the point in absolute coordinate system and checking simulator**
- **plot the point in incremental coordinate system and checked simulator**
- **write the programme using G01, G02, G03 in absolute and incremental system**
- **checked the programme using simulator.**

Job sequence

- Read the drawing and plot the point given in tasks.
- Record the axis points in tables.
- Switch on the simulator, and select the machine as machining center in selection mode.
- Enter the points on the screen and select the simulation screen to see the plotted line based on the point interred.

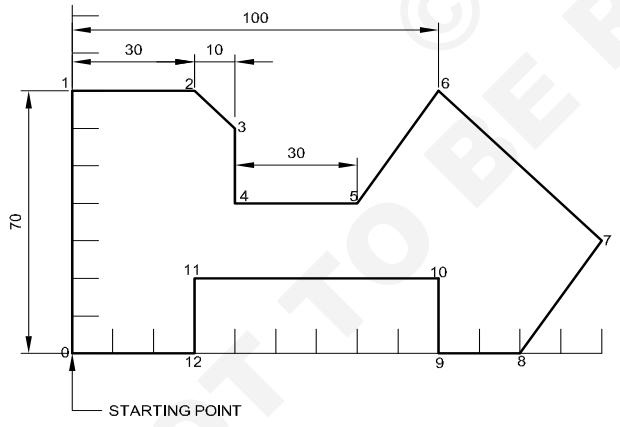
Any change in sportive will indicate the point are not correct

- Study the drawing.
- Take the point P1 as origin.
- For absolute co-ordinate system take P1 co-ordinate as (0.0)
- Tabulate the co-ordinate value of the points. P1 to P12
- Co-ordinate value are taken with respect to the reference point (0.0) for absolute co-ordinate system for table 1.

PROCEDURE

TASK 1: **Plot the points in absolute and incremental coordinate system (Fig 1) in table 1 and table 2.**

Fig 1



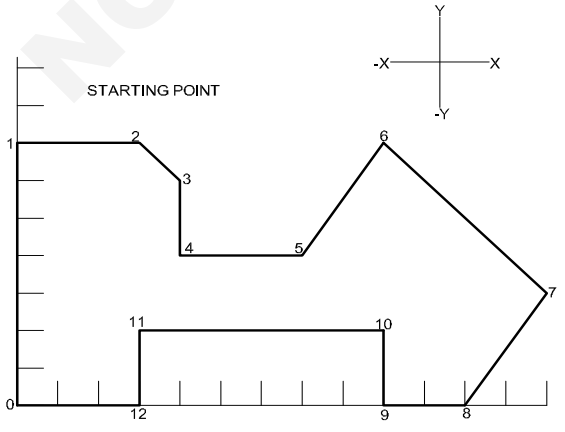


TABLE 1

ABSOLUTE CO-ORDINATE

S.NO	X	Y	S.NO	X	Y

TABLE 2

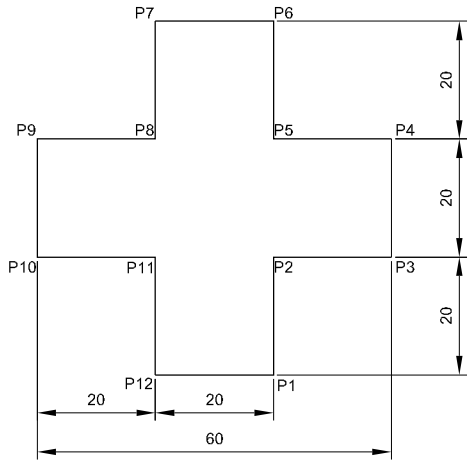
INCREMENTAL CO-ORDINATE

S.NO	X	Y	S.NO	X	Y

TJ20N2395H1

TASK 2: **Plot the points in absolute and incremental system for (Fig 2) and record it in table 3 & 4. Verify the record points in simulator**

Fig 1



ABSOLUTE CO-ORDINATE

TABLE - 3		
POINTS		
P1		
P2		
P3		
P4		
P5		
P6		
P7		
P8		

INCREMENTAL CO-ORDINATE

TABLE - 4		
POINTS		
P1		
P2		
P3		
P4		
P5		
P6		
P7		
P8		

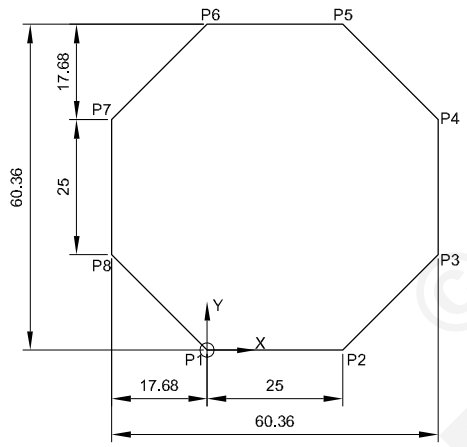
DIMENSION ARE IN mm

T.J20N2395J1

— — — — — — — —

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

Fig 1



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

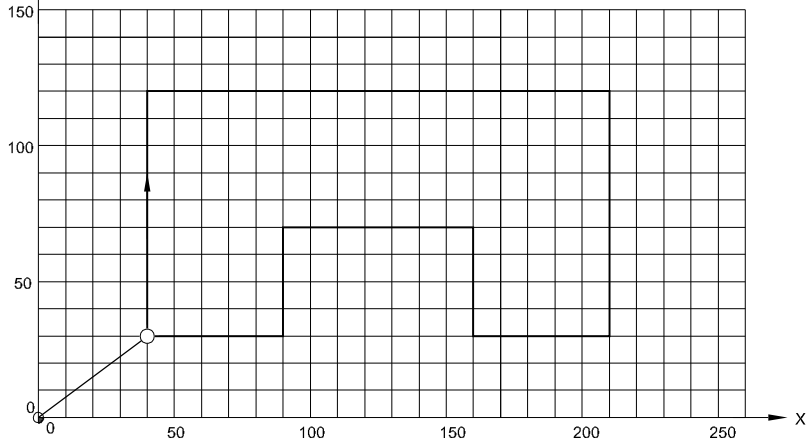
T.J20N2395K1

— — — — — — — —

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

Fig 1

A INFORMATION:

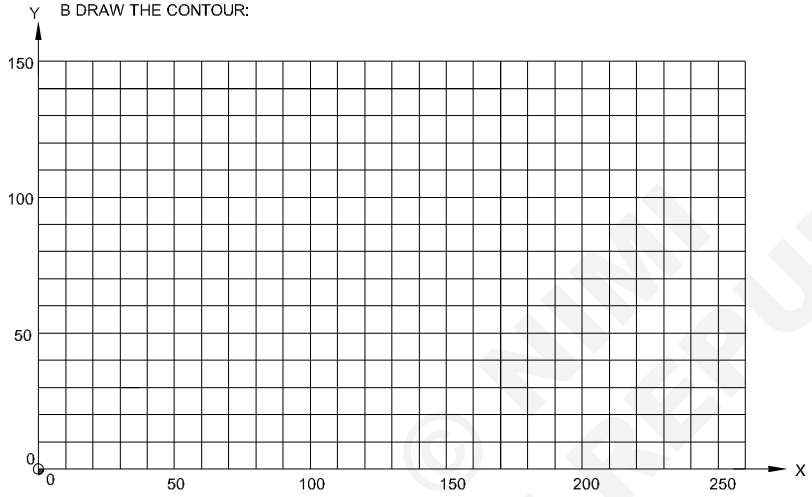


ABSOLUTE

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	

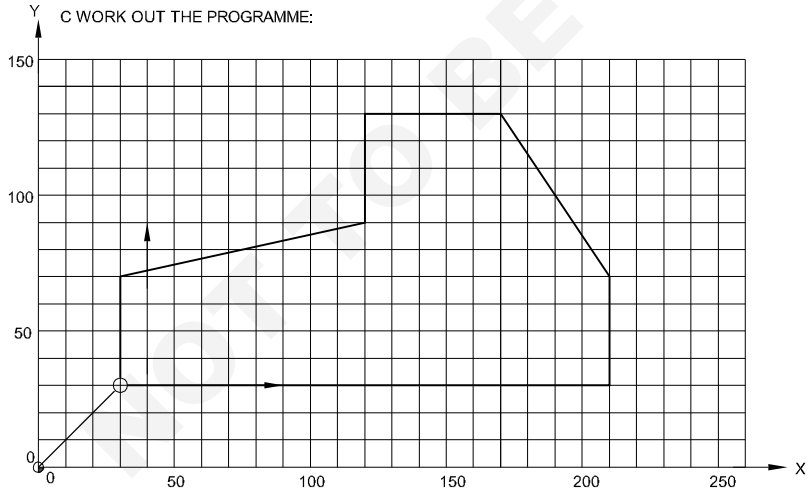
B DRAW THE CONTOUR:



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	X90	Y50	
N	9	G1			Z100
N	10	G1	X0	Y0	

C WORK OUT THE PROGRAMME:



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

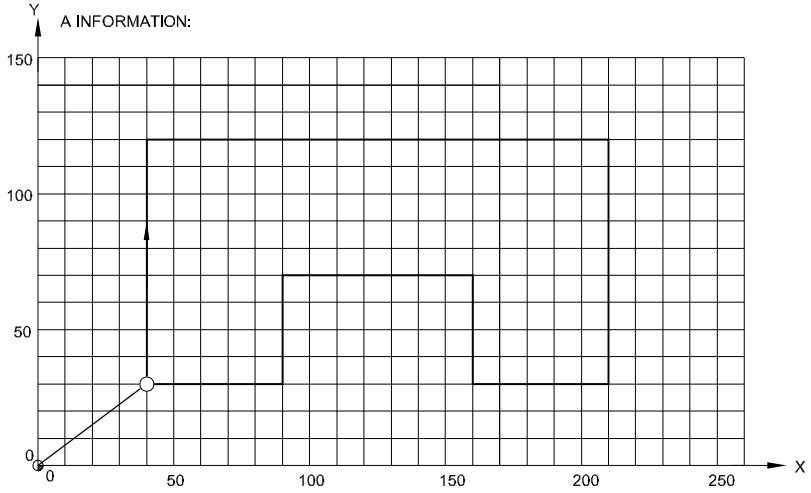
TJ20N2396L1

— — — — — — — —

TASK 5: **Assignment in G90, G00 & G01 incremental system (Fig 5A, 5B & 5C) and check with result with simulator**

Fig 1

A INFORMATION:

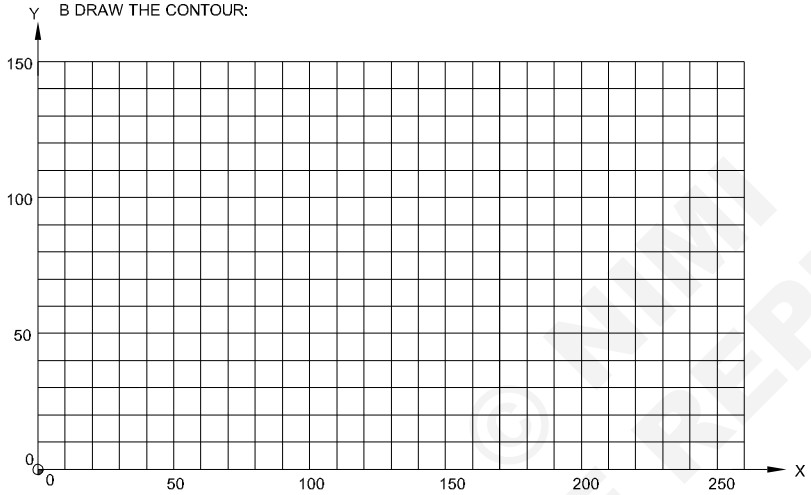


INCREMENTAL

G91 = ON - POSITION

N	1	G0			
N	2	G1			
N	3	G1			
N	4	G1			
N	5	G1			
N	6	G1			
N	7	G1			
N	8	G1			
N	9	G1			
N	10	G1			
N	11	G0			
N	12	G0			

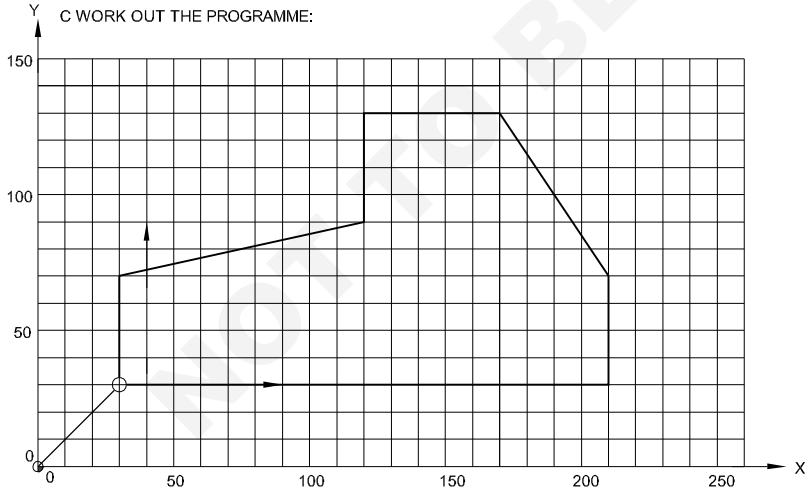
B DRAW THE CONTOUR:



G91 = ON - POSITION

N	1	G0			
N	2	G1			
N	3	G1			
N	4	G1			
N	5	G1			
N	6	G1			
N	7	G1			
N	8	G1			
N	9	G1			
N	10	G1			

C WORK OUT THE PROGRAMME:



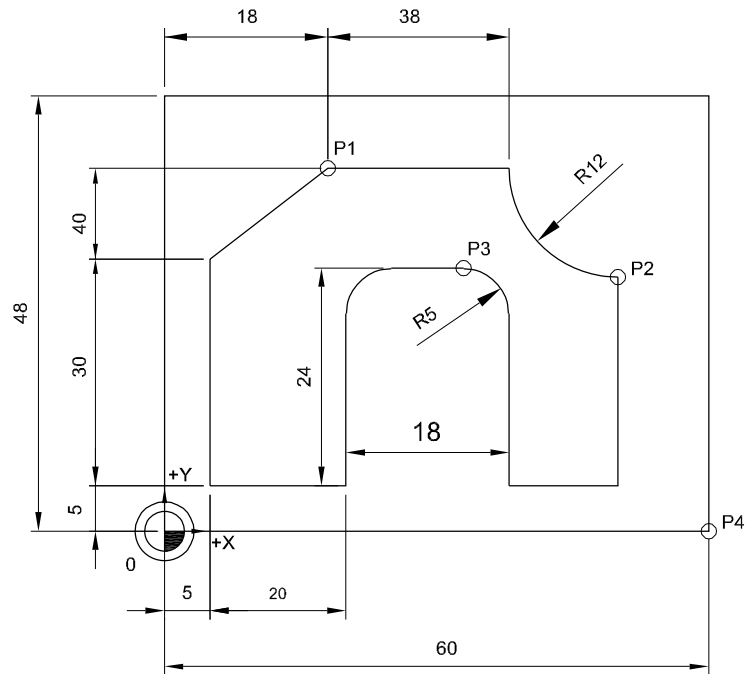
G91 = ON - POSITION
(DEPTH OF MILLING : 8mm)

T.I20N2395M1

— — — — — — — —

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

Fig 1



DIMENSION: IN mm

INCREMENTAL CO-ORDINATE

Table - 8		
POINTS	X	Y
P1		
P2		
P3		
P4		

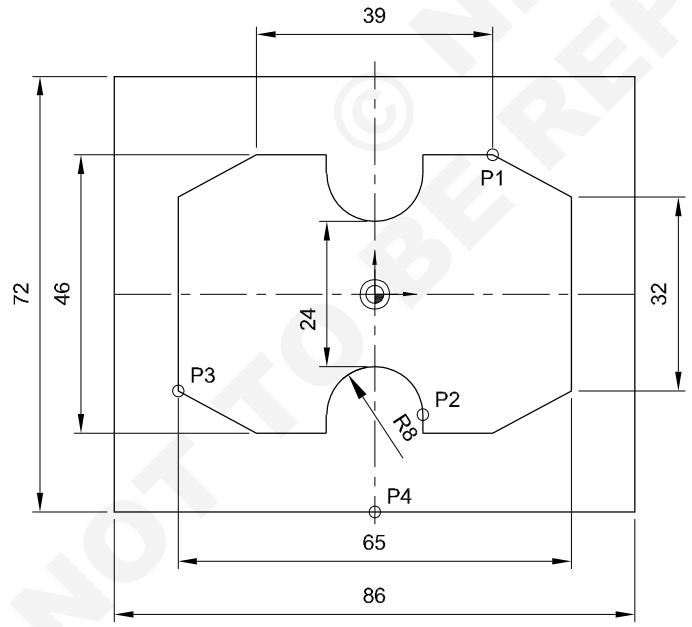
ABSOLUTE CO-ORDINATE

Table - 7		
POINTS	X	Y
P1		
P2		
P3		
P4		

TJ20N2395N1

TASK 7: **Plot the point in both absolute and incremental system in table 1 & 2. Check with simulator (Fig 7)**

Fig 1



DIMENSION: IN mm

INCREMENTAL CO-ORDINATE

Table - 2		
POINTS	X	Y
P1		
P2		
P3		
P4		

ABSOLUTE CO-ORDINATE

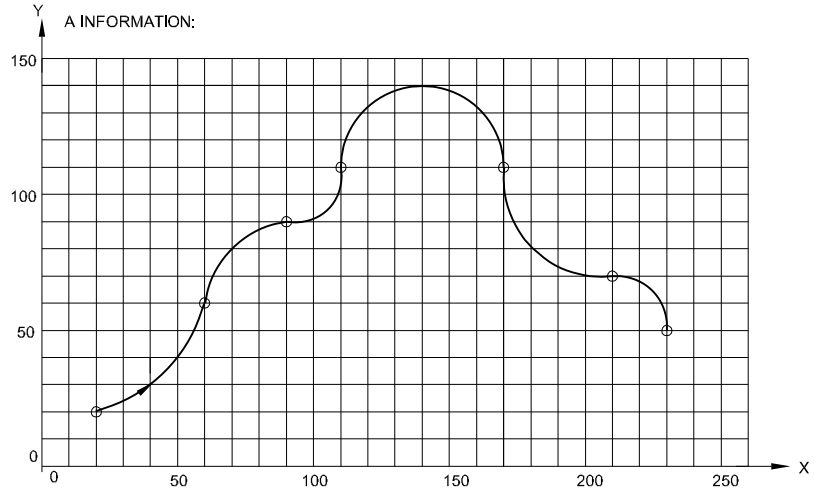
Table - 1		
POINTS	X	Y
P1		
P2		
P3		
P4		

TJ20N2395O1

TASK 8: **Assignment (Fig 8A, B & C) programming with G2 & G3 check the result with simulator**

Fig 1

A INFORMATION:

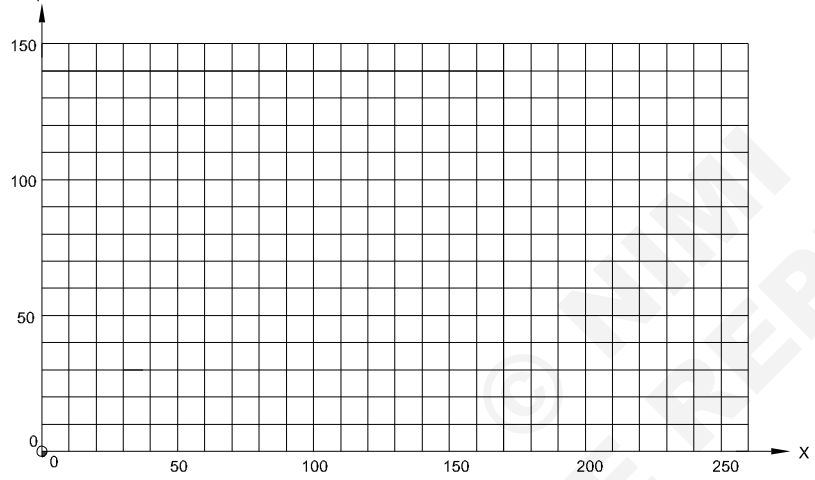


ABSOLUTE

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	J20

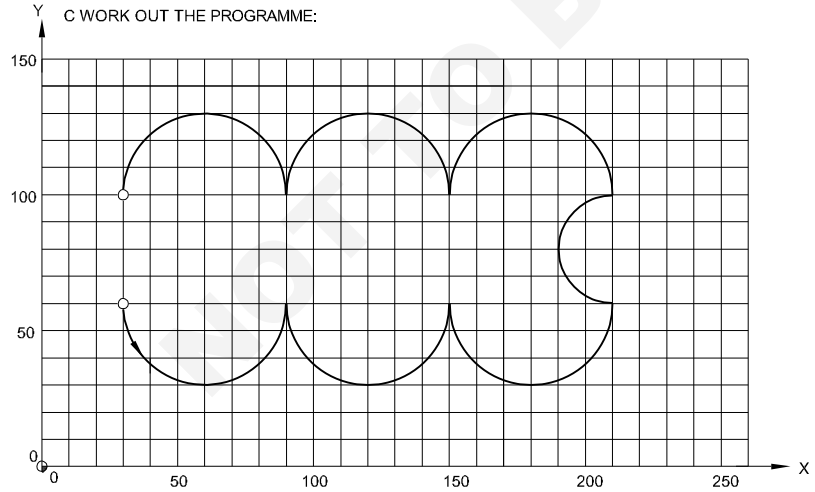
B DRAW THE CONTOUR:



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	J15
N7	G2	X85	Y40	I 0	J20
N8	G3	X165	Y40	I 40	J0

C WORK OUT THE PROGRAMME:

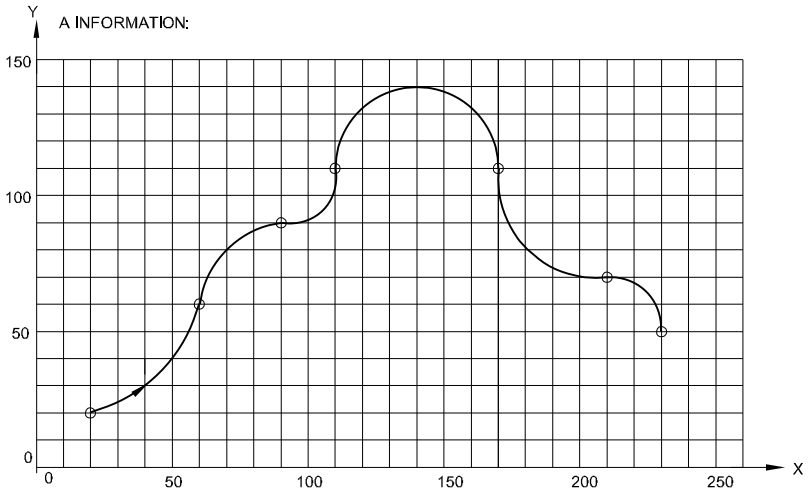


TJ20N2395Q1

TASK 9: **Assignment (Fig 9A, B & C) programming with G2 & G3 in incremental system. Check the result with simulation**

Fig 1

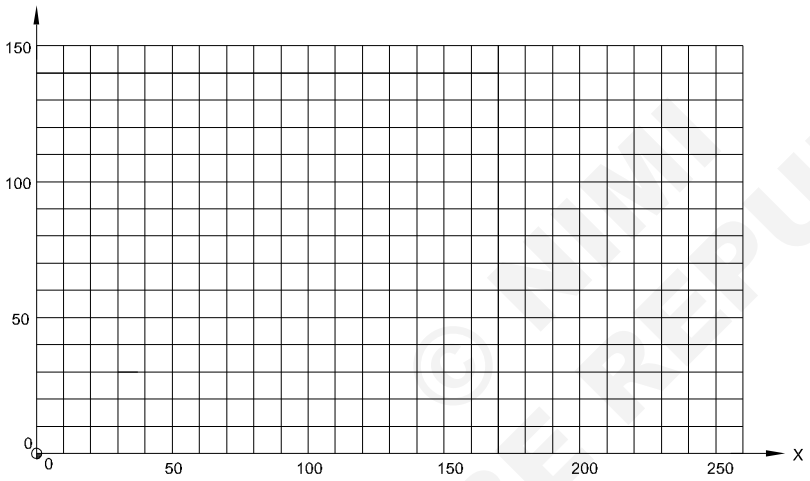
A INFORMATION:



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

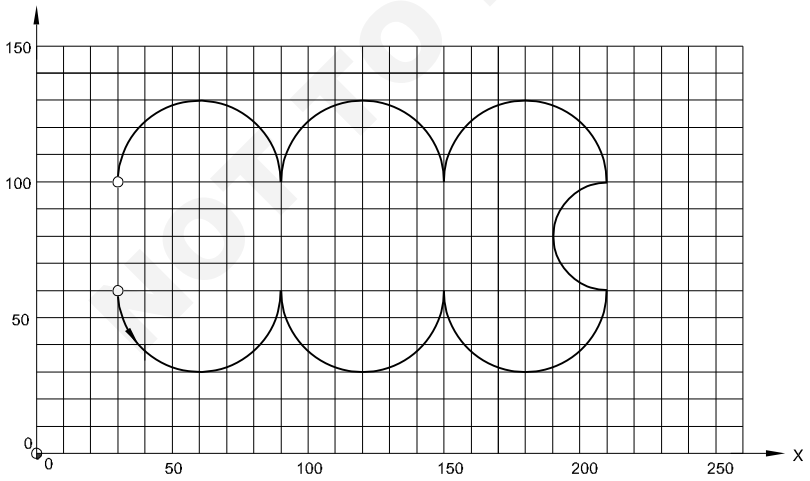
B DRAW THE CONTOUR:



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

C WORK OUT THE PROGRAMME:



N1 G91

T-J20N2395S1

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TASK 10: **Write tool path for (Fig 10) and record it in table 11. Check with simulator**

Fig 1

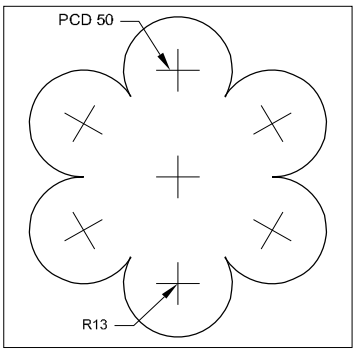


TABLE 11

N	G	X	Y	I	J

TJ20N2395X1

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

Fig 1

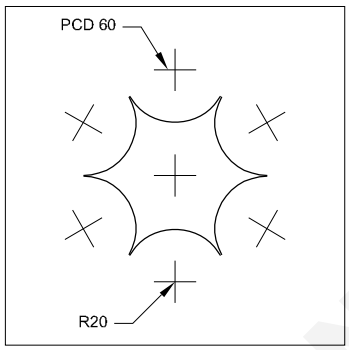


TABLE 12

N	G	X	Y	I	J

TJ20N2395Y1

TASK 12: **Write tool path (Fig 12)**

Fig 1

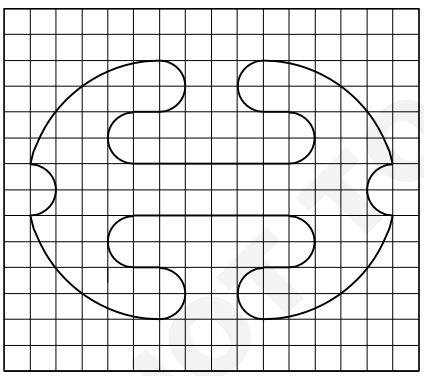


TABLE 13

N	G	X	Y	I	J

TJ20N2395Z1

Fig 2

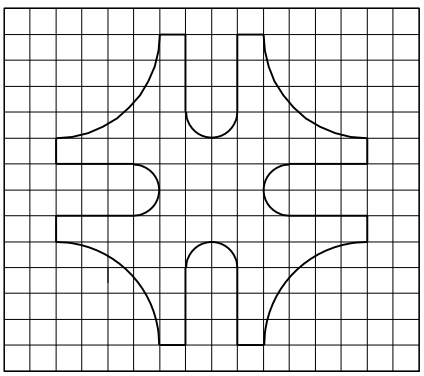


TABLE 14

N	G	X	Y	I	J

TJ20N2395Z1

Polar co-ordinate points, assignments and simulator

Objectives: At the end of this exercise you shall be able to
- **plot the point in polar coordinate system for the given drawing**
- **check the plotted points with simulator**
- **identify the over travel limit and emergency stops.**

PROCEDURE

TASK 1: **Plot the points for fig 1 in polar co-ordinate system in table 1. Check the plotted point with simulator**

Fig 1

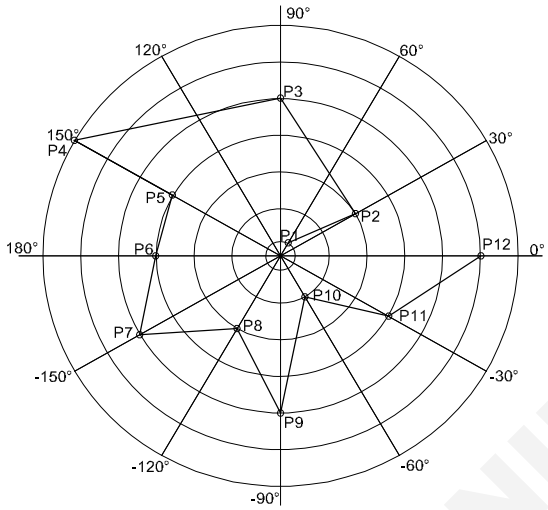
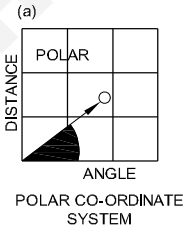


TABLE 1

P	PR	PA	P	PR	PA



POLAR CO-ORDINATE SYSTEM

T.I20N2396H1

— — — — — — — —

TASK 2: **Plot the points for fig 1 in polar co-ordinate system in table 1. Check the plotted point with simulator**

Fig 1

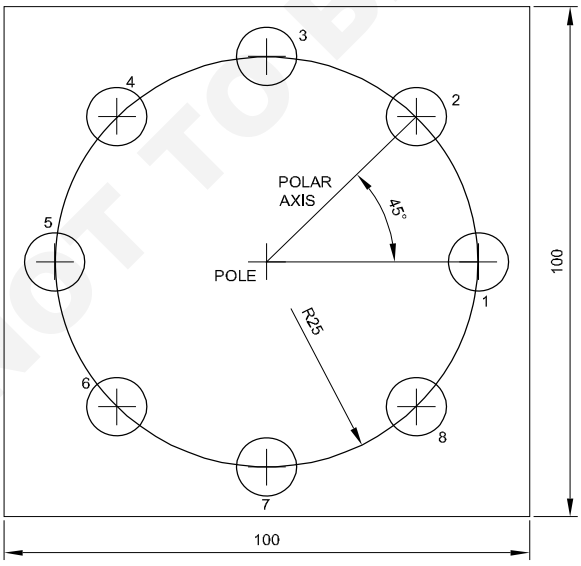


TABLE 2

P		
1		
2		
3		
4		
5		
6		
7		
8		

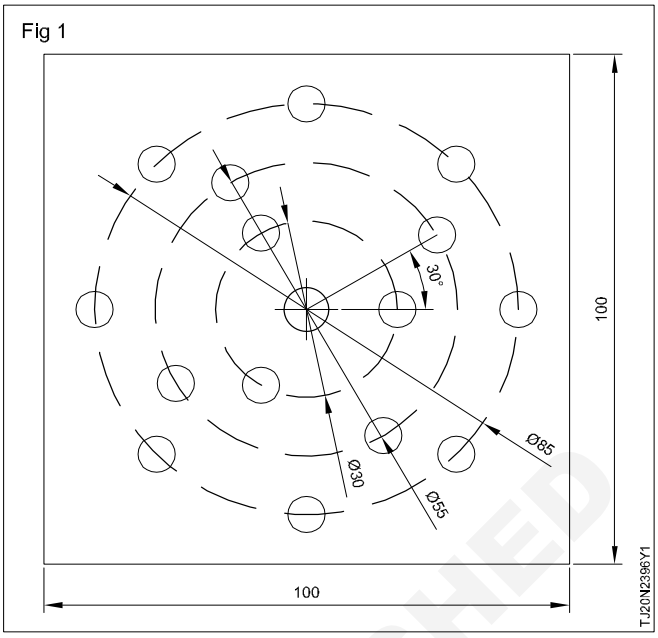
T.I20N2396J1

— — — — — — — —

TASK 3: **Assignment on polar co-ordinate system**

- Write the positional tool path in polar co-ordinate system for Fig 1 and draw table and record it.
- Verify the record position with simulator.

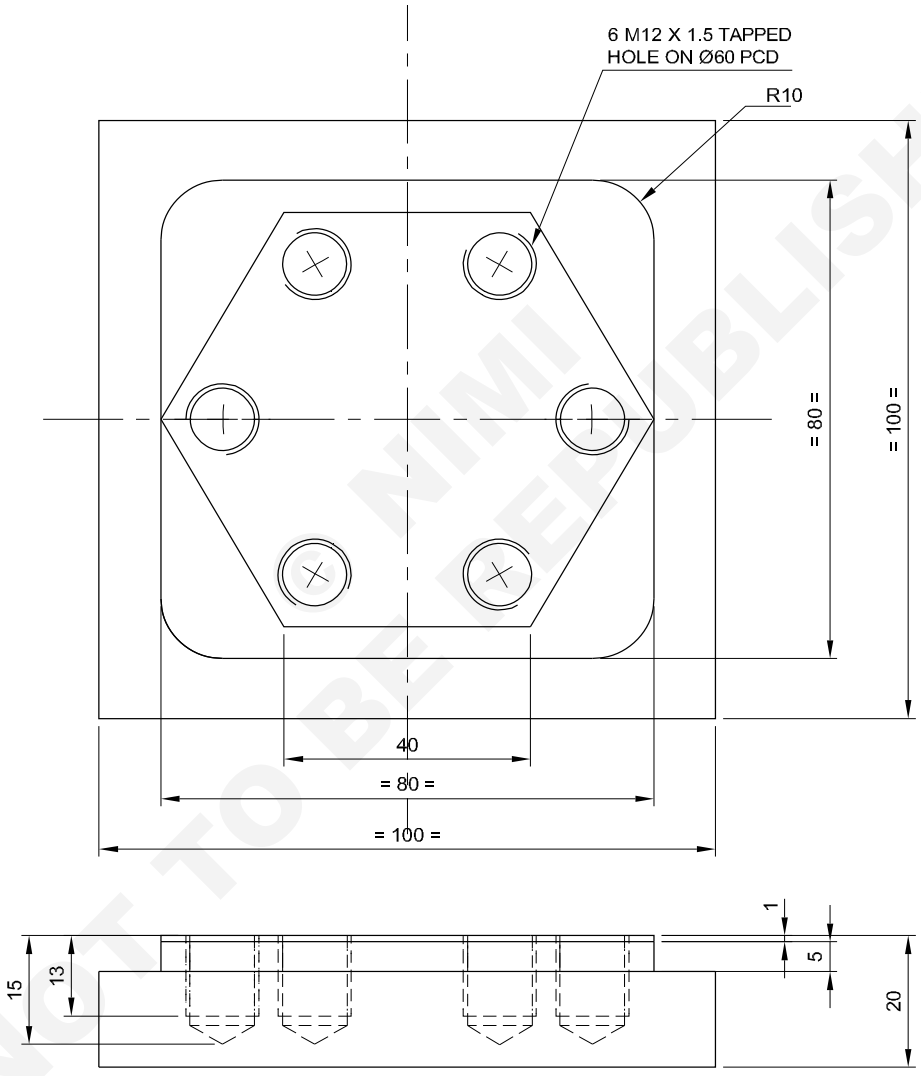
Fig 1



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

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 operation)**
- **enter the programme in machine and edit the programme**
- **verify the programme and run in auto mode operation**
- **correct if there any size variation in work piece.**



1	100 X 100 X 22	PRE-MACHINED	ALUMINIUM		1	2.3.97
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. TJ20N2397E1	

PROCEDURE

TASK 1: **Measurement of work offset**

1 Call tool number one in MDI mode.

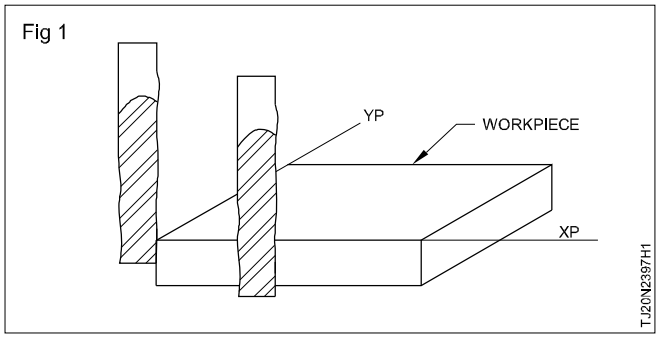
2 Go to jog mode. Remove the available tool if any/

3 Mount one reference tool / cylindrical pin of about 100mm length / position finder. Make the zero offset value G54 X0, Y0, Z0.

4 Just touch the X surface of the work piece as shown in Fig1 and take the absolute display reading of X-axis.

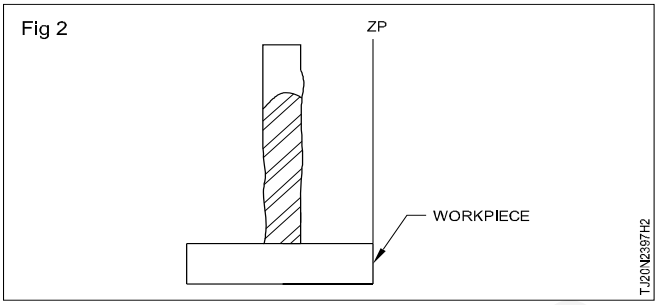
5 Just touch the Y surface of the work piece as shown in Fig 1 and take the absolute display reading of Y-axis.

Fig 1



6 Just touch the Z surface of the work piece as shown in Fig 2 and take the absolute display reading of Z-axis.

Fig 2



7 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.

8 Enter the same absolute display value in 'Z'.

9 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.

1 Designate always. Tool No 01 as reference tool and avoid changing the tool.

2 Bring this tool and just touch the machined surface of the job.

3 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)

4 Bring the next tool (No 02) for which measurement is to be set.

5 Touch the tool on the same work piece surface.

6 Note the display value and subtract the ref. Tool 'Z' value (A).

7 This will be the Tool offset value for Tool No 02.

8 The same procedure can be adopted for other tools.

9 Enter all the value of length offsets in the CNC, against the Tool No.,

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

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

10 **The value A** should be taken as zero offset Z-value for G55-G59

11 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 compensation 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;

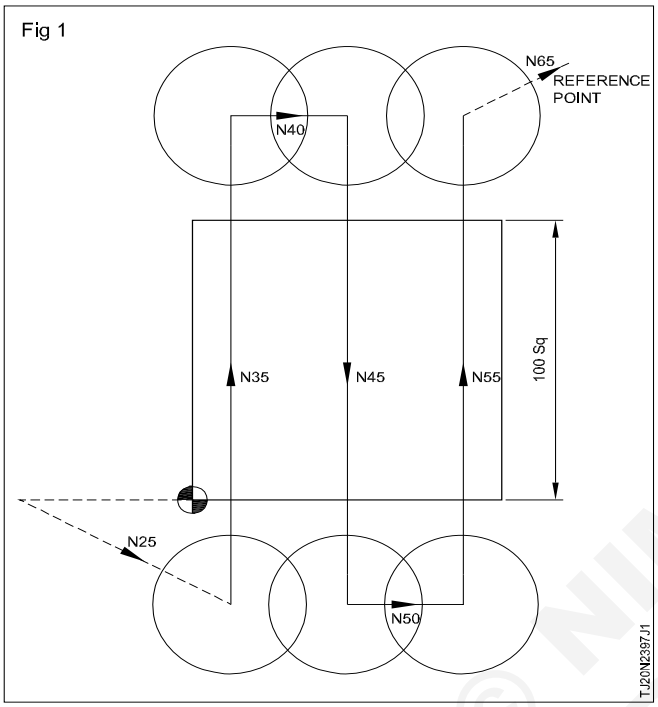
N60 G00 Z50;

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

N70 M30;

Tool path for face milling is shown in Fig 1

Fig 1



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;

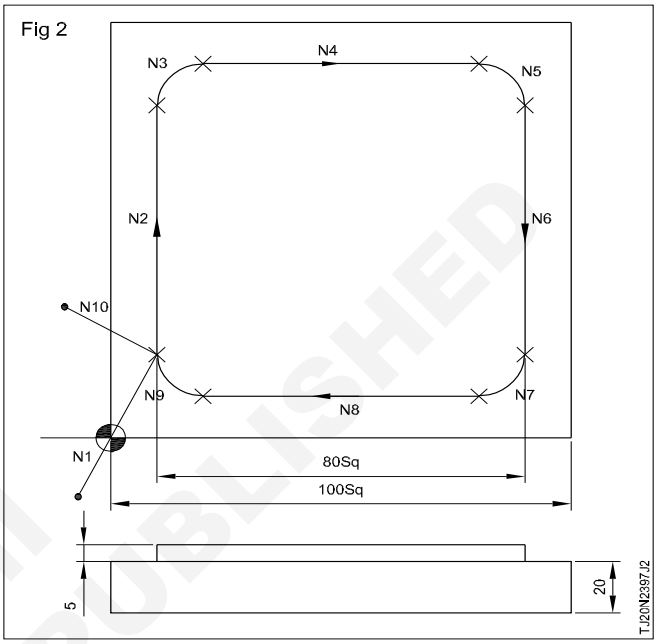
N18 G0Z100. M09;

N19 G00 G28 X0 Y0 Z0 M05.

N20 M30;

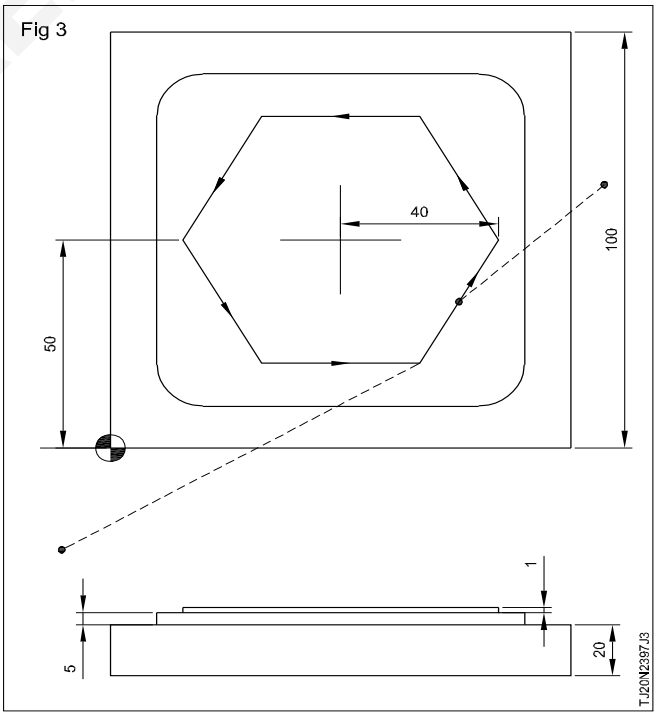
Note: N indicate the line number in the programme and its movement in Fig 2

Fig 2



Hexagonal milling: (Fig 3)

Fig 3



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;

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 Insert 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);

1 When the INSRT key is pressed after the control-out code (“comments, and control- in code “) have been typed, the typed comments are registered.

2 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:

3 Control-in code “)” cannot be registered by itself.

4 Comments entered after the INSRT key is pressed must not begin with a number, space, or address O.

5 If an abbreviation for a macro is entered, the abbreviation is converted into a macro word and registered

6 Address O and subsequent number, or a space can be entered but are omitted when registered.

Automatic operation

1 Press “Auto” mode switch.

2 Select the program number required. To select the particular program number.

- Press “program” key to display the program.
- Press Address “O” and the enter the program number using numerical keys.
- Press this ⇩ curser key. Now the selected program will appear on the screen.

2 Press cycle start switch to start the program.

- By pressing single block key the program will run in single block.
- By pressing OPT Stop key the optional stop MDI in activated.
- BY pressing AUX FUNC LOCK | Z axis LOCK | M/c LOCK

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

MDI - MODE - OPERAION

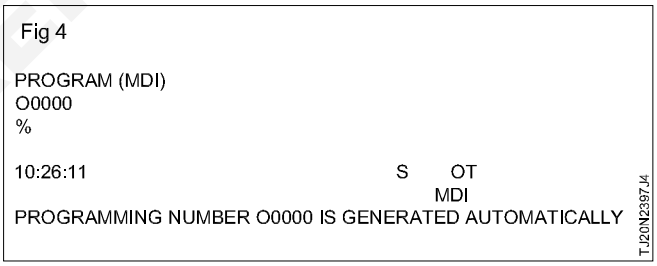
Press the MDI key,

Press the “program” key.

The following screen appear (Fig 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.

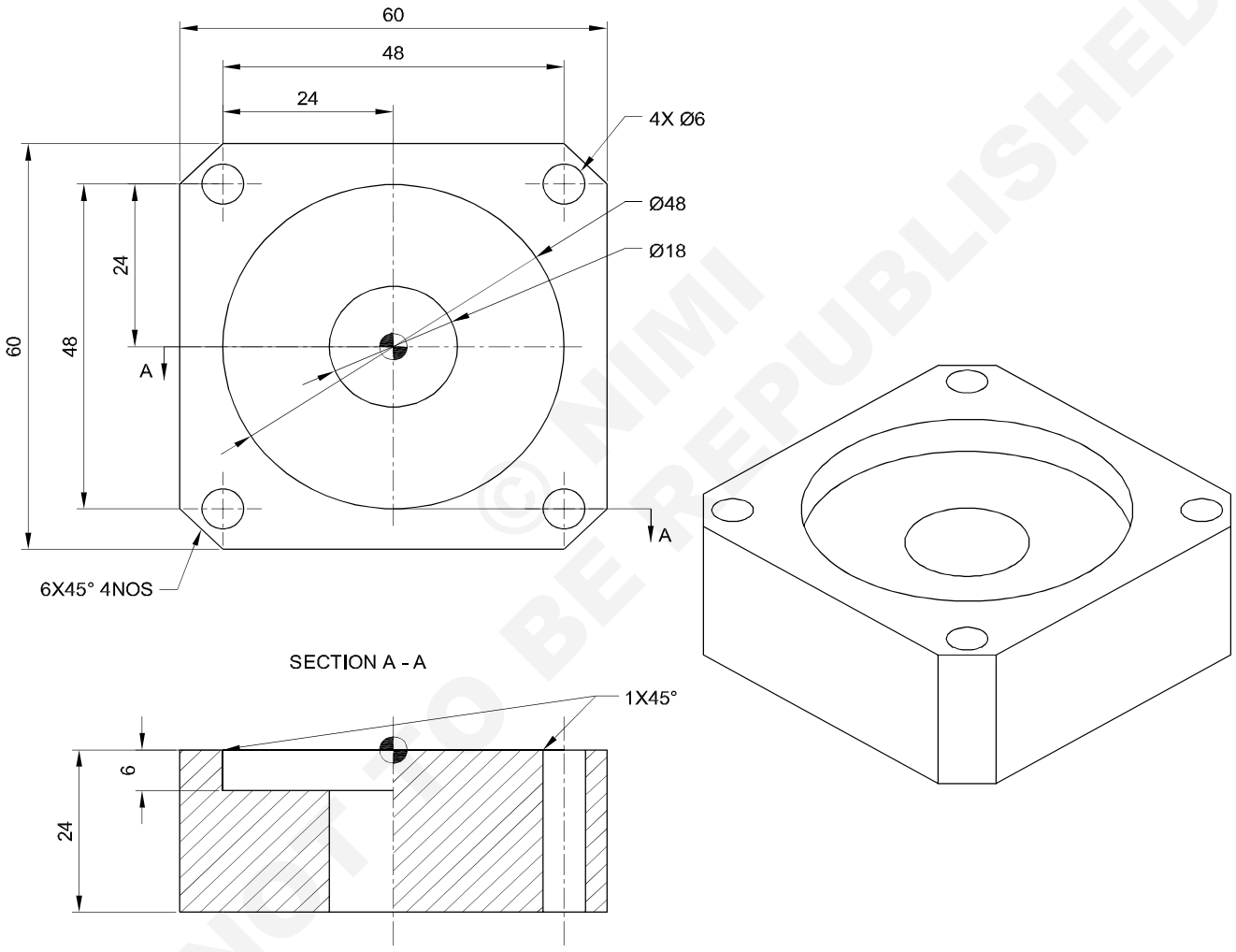
Fig 4



2D and 3D machining with CAM software

Objectives: At the end of this exercise you shall be able to
- **create 2D profile in CAM software**
- **creation of 2D tool path**
- **generate A/C program for machining.**

TASK - 1 2D MACHINING



SECTION A - A

1	60X60X26	-	CI BLOCK	-	-	2.4.98
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	2D MACHINING				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N2498E1	

PROCEDURE

TASK 1: **2D machining**

1 Setting up the graphical user interface

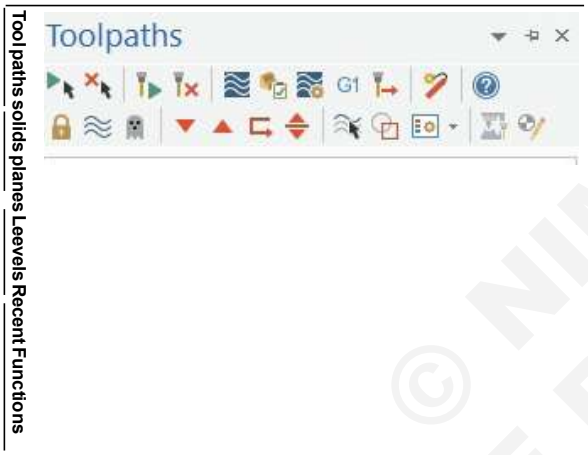
Note: Please refer to the Getting Started section for more info on how to set up the graphical user interface. In this step, you will learn how to hide the manager panels to gain more space in the graphics window.

- Use Auto Hide icon to hide all Manager panels.(Fig 1)

Fig 1

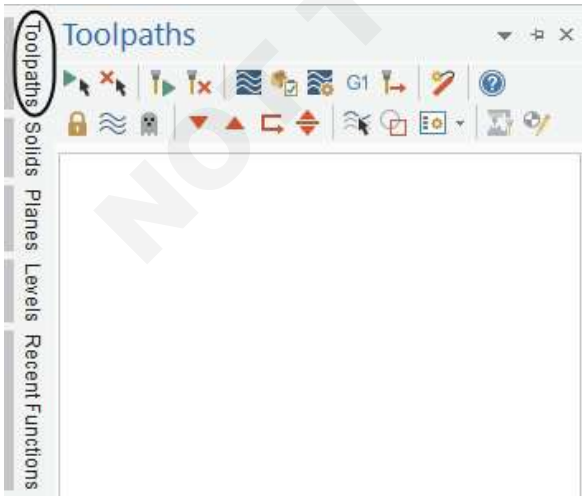
- The panels will be hidden to the left of the graphics window as shown in Fig 2

Fig 2



Note: To un−hide them temporally, you can click on one of the Managers to open it as shown in Fig 3

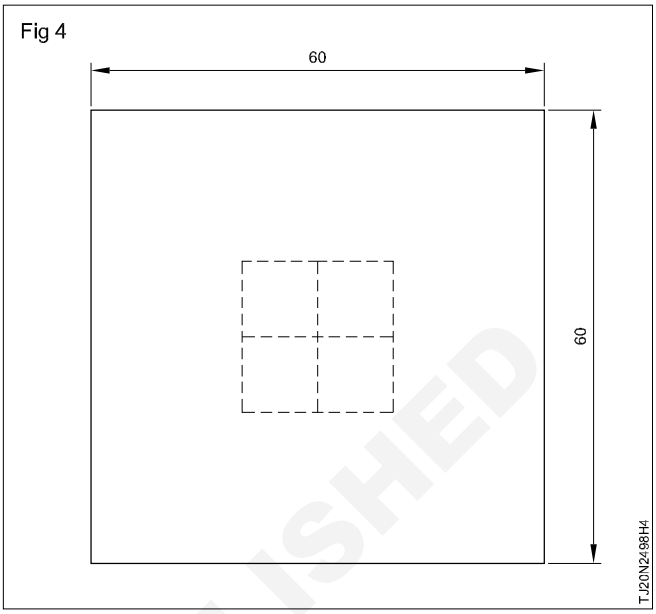
Fig 3



While creating the geometry, keep the Manager panels hidden. This ensures more space in the graphics window for the geometry.

2 Create one rectangle (Fig 4)

Fig 4

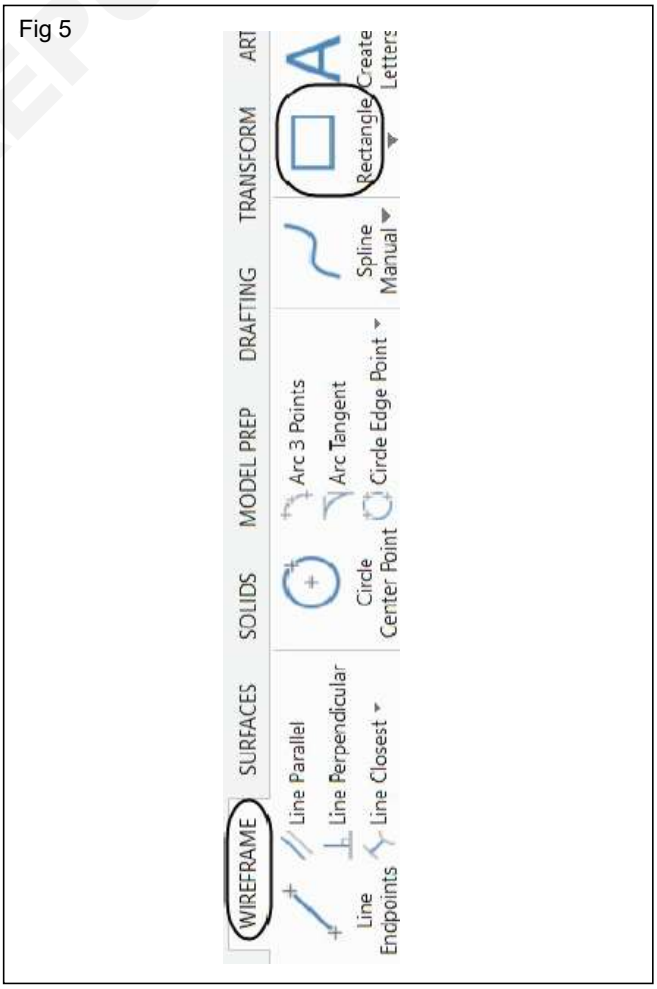


Create a 60 mm by 60 mm Rectangle

WIREFRAME

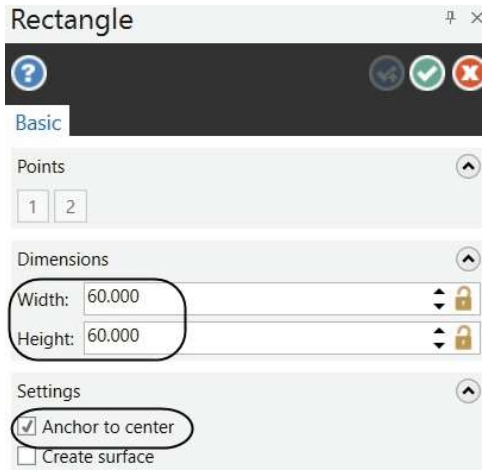
- From the Shapes group, select Rectangle. (Fig 5)

Fig 5



- In the Rectangle panel, enter the Width and Height and enable Anchor to center as shown in Fig 6

Fig 6

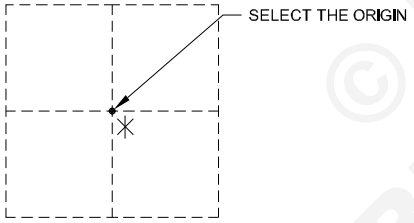


Note: Make sure that Create surface is not selected. Anchor to center sets the base point of the rectangle to its center and draws the rectangle outward from the center. Create surface creates a surface inside of the rectangle.

Surface creation and Surface toolpath are covered in Mill Advanced.

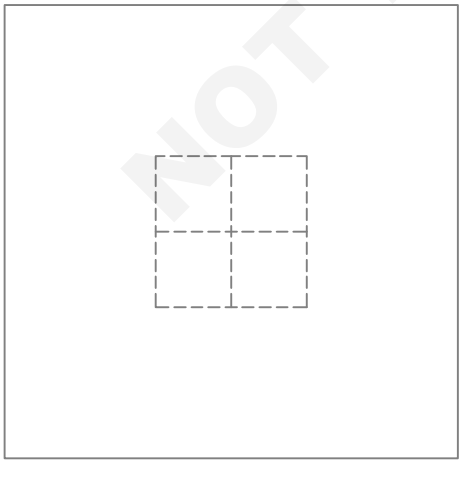
- Select the position of the base point as shown in Fig 7

Fig 7



- A preview of the geometry should look as shown in Fig 8

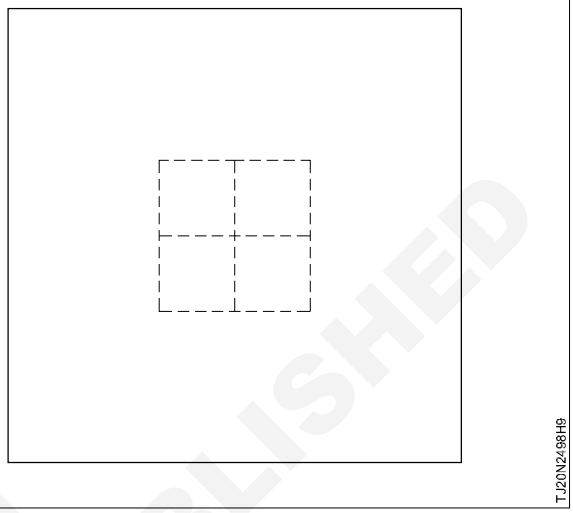
Fig 8



Note: The geometry should appear in cyan blue color which is the color for the live entities. While the rectangle is live, you can adjust the dimensions or select a new base point.

- Select the OK button to exit the Rectangle command.
- The geometry should look as shown in Fig 9

Fig 9



Note: While creating geometry for this tutorial, if you make a mistake, you can undo the last step using the

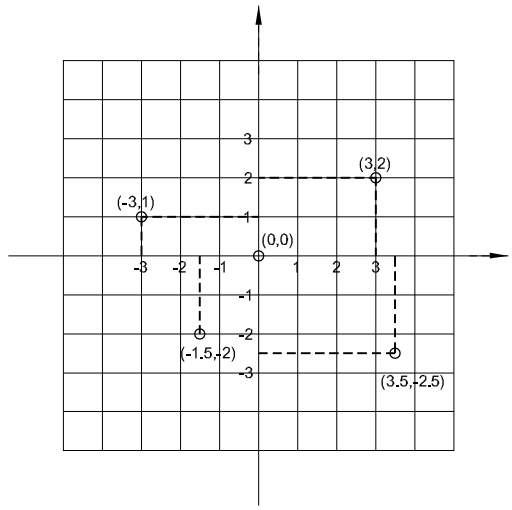
Undo icon. You can undo as many steps as needed. If you delete or undo a step by mistake, just use the

Redo icon. To delete unwanted geometry, select the geometry first and then press Delete from the keyboard. To zoom or un−zoom, move the cursor in the center of the geometry and scroll up or down the mouse wheel.

3 create the 6mm diameter circles

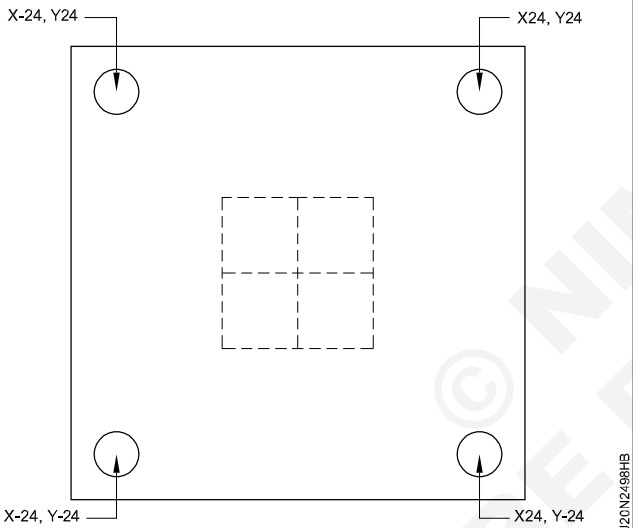
In this step, you will create circles for which you know the diameter and the locations. To use Circle Center Point, you need to know the center point and the radius or the diameter of the circle. To complete this step, you will need to know the Cartesian Coordinate System. A Cartesian Coordinate System is a coordinate system that specifies each point uniquely in a plane by a pair of numerical coordinates, which are the signed distances from the point to two fixed perpendicular directed lines, measured in the same unit of length as shown in Fig 10.

Fig 10



Step preview (Fig 11)

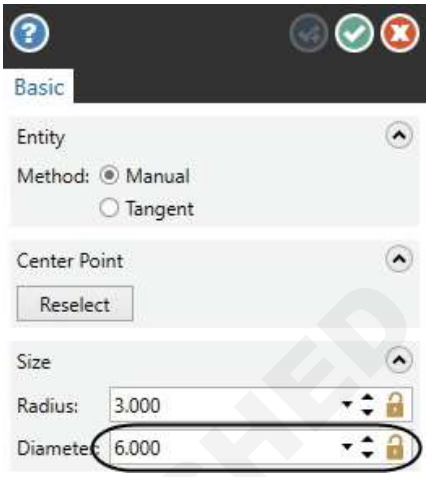
Fig 11



WIREFRAME

- From the Arcs group, select Circle Center Point. (Fig 12)
- Enter a Diameter of 6.0 in the panel as shown in Fig 13
- To create all four circles, click on the locker icon to lock the value.

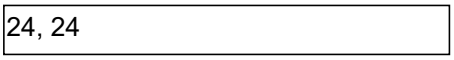
Fig 13 Circle center point



- [Enter the center point]: Select the Auto Cursor Fast Point icon from the General Selection toolbar and the field where you can type the coordinates will open at the upper left side of the graphics window as shown in Fig 14

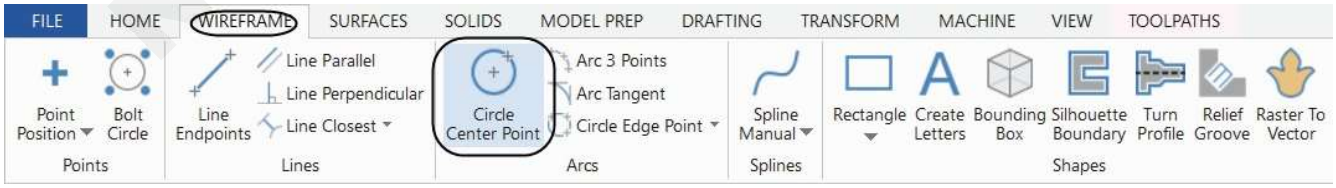
Fig 14

Type 24, 24 as shown



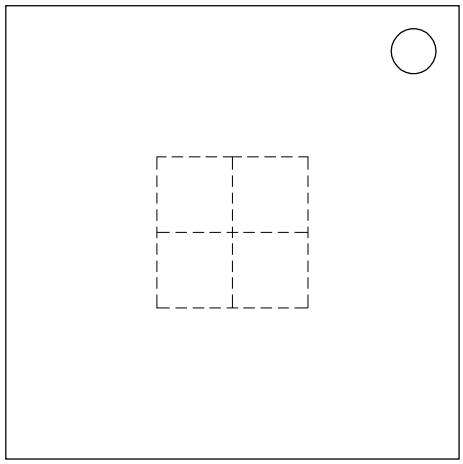
Note: When entering the coordinates for the center point, the first value is the X coordinate value, then the Y value followed by the Z value only if it is different from zero. The coordinate values are separated with commas. You do not need to use the coordinate labels if you enter the values in this order.

Fig 12



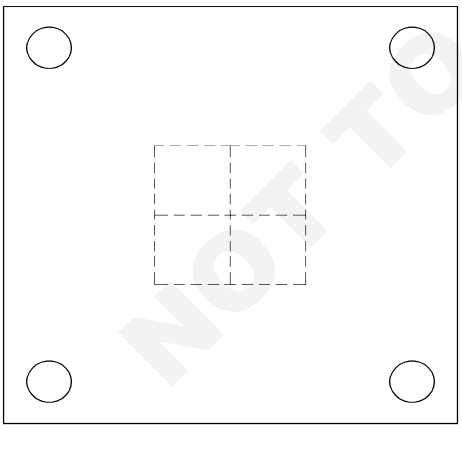
- Press Enter and the circle will be placed as shown in Fig 15

Fig 15



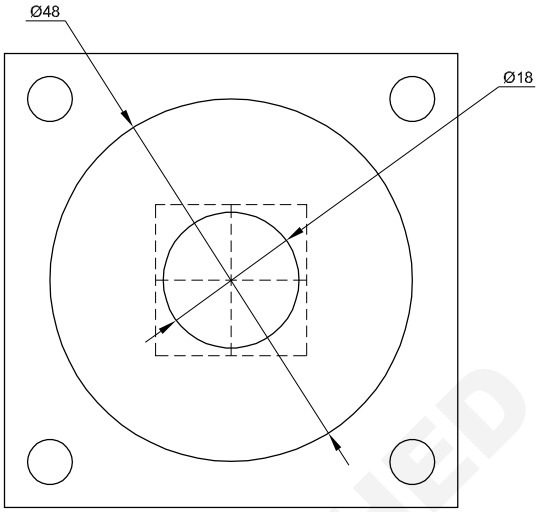
- **[Enter the center point]:** Select the Auto Cursor Fast Point icon again and enter 24,-24.
- Press Enter to place the circle.
- **[Enter the center point]:** Select the Auto Cursor Fast Point icon again and enter -24,24.
- Press Enter to place the circle.
- **[Enter the center point]:** Select the Auto Cursor Fast Point icon again and enter -24,-24.
- Press Enter to place the circle.
- Once complete choose the OK button to exit the command.
- The geometry should look as shown in Fig 16

Fig 16



4 **Create the 48mm and 18mm diameter circles (Fig 17)**

Fig 17



In this step, you will use the same Circle Center Point to create circles that you know the diameters and the locations.

WIREFRAME

- From Arcs group, select Circle Center Point. (Fig 18)
- Enter the Diameter 18.0 in the panel and disable the locker icon as shown in \Fig 19

Fig 18

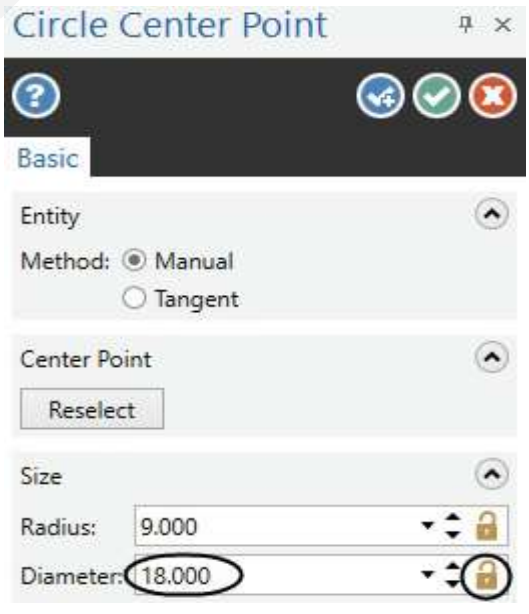
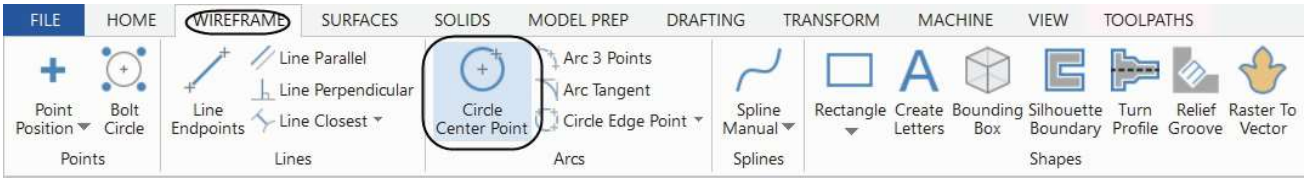


Fig 19

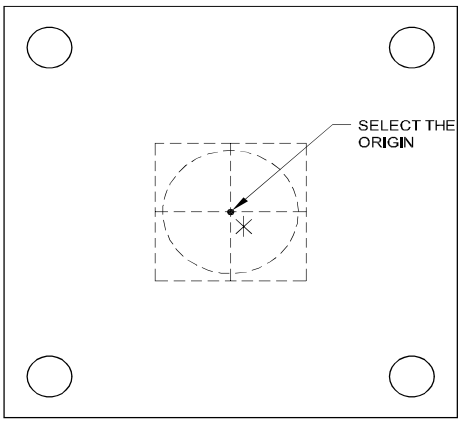


- Press Enter to see the circle preview.
- [Enter the center point]: Move the cursor to the center of the rectangle until the cursor cue tip changes to the

Origin as shown. 

- Click to select the Origin. (Fig 20)

Fig 20

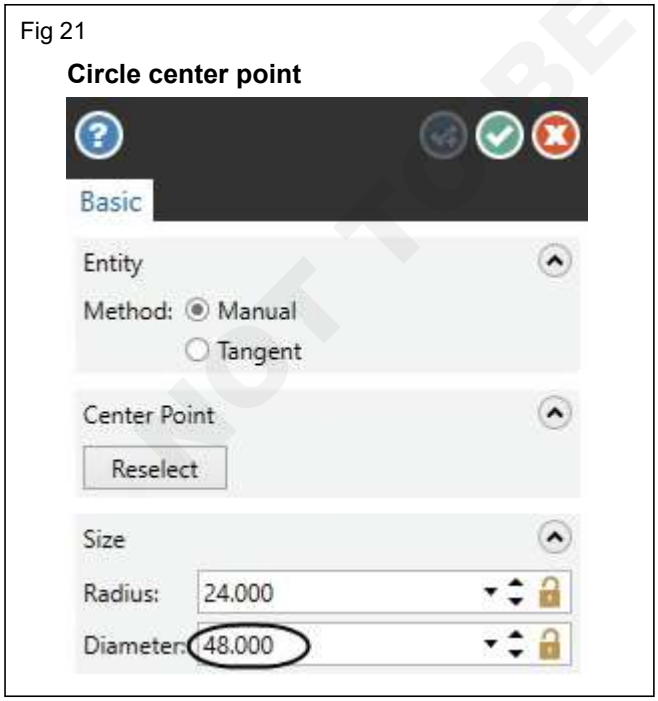


- Press Enter again to finish the circle.

Note: While the circle is live, cyan color, the circle diameter and its location can be modified. To avoid this, you need to press Enter to finish the circle.

- In the Diameter field of the Circle Center Point panel, type 48 and press Enter.
- The panel should look as shown in Fig 21

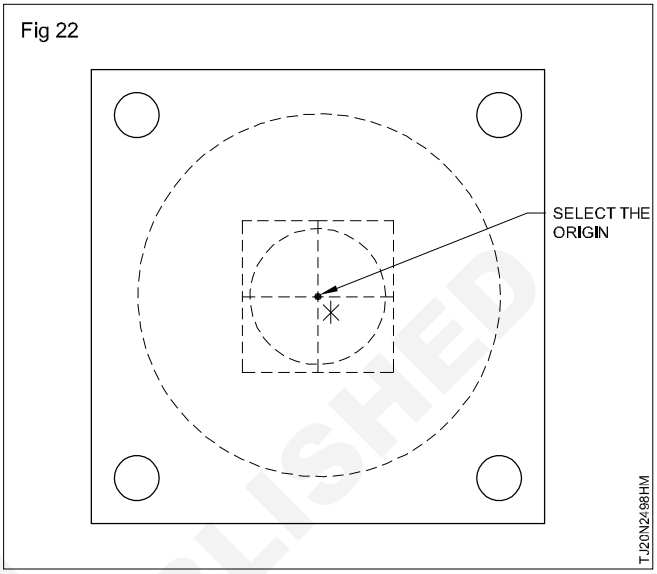
Fig 21



- Enter the center point]: Select the Origin as shown in Fig 22

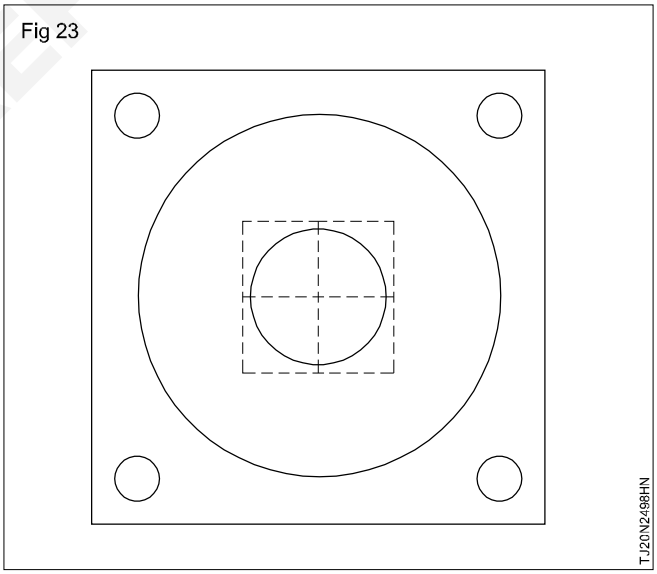
Note: Because the center of the 18mm diameter circle is in the Origin, you could also select the point when the cursor center cue tip appears as shown.

Fig 22



- Once complete, choose the OK button to exit the command.
- The geometry should look as shown in Fig 23

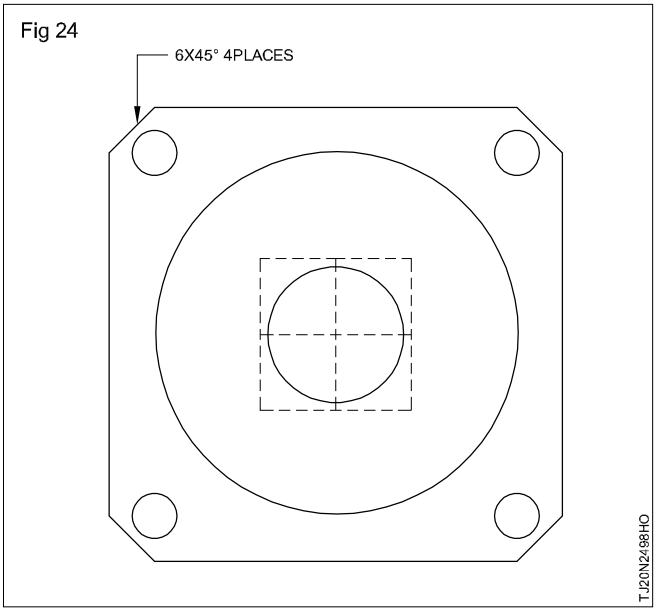
Fig 23



5 Create the chamfers (Fig 24)

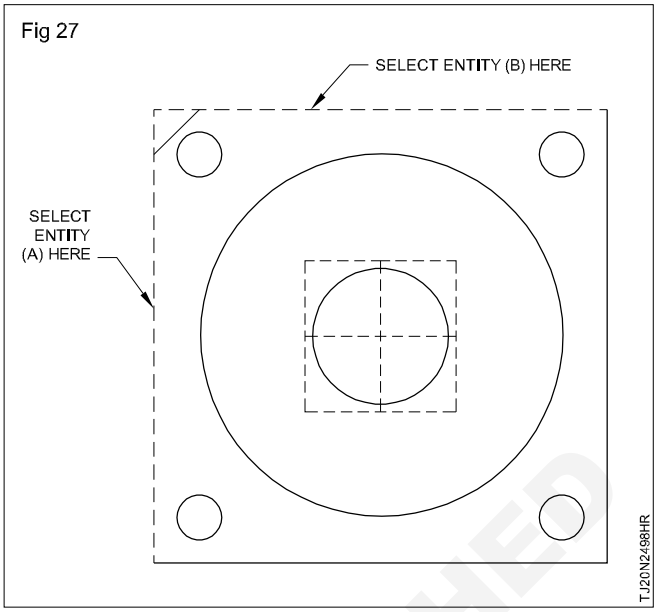
In this step, you will create 45 degree chamfers at the corners of the rectangle. You will use the Chamfer Entities command.

Fig 24



- Select the lines as shown in Fig 27

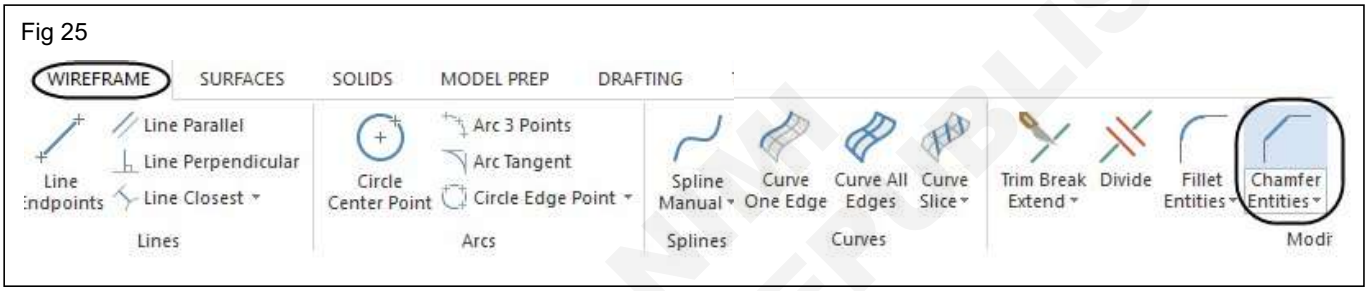
Fig 27



WIREFRAME (Fig 25)

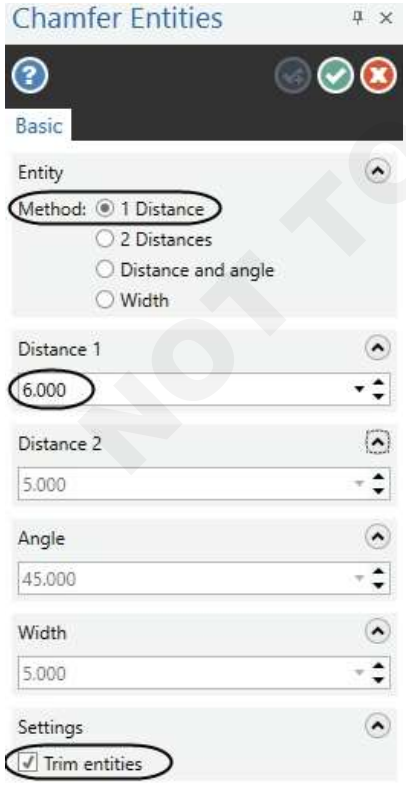
- From the Modify group, select Chamfer Entities.

Fig 25



- In the Chamfer Entities panel, make sure that 1 Distance and Trim entities are enabled and Distance 1 is set to 6.0 as shown in Fig 26

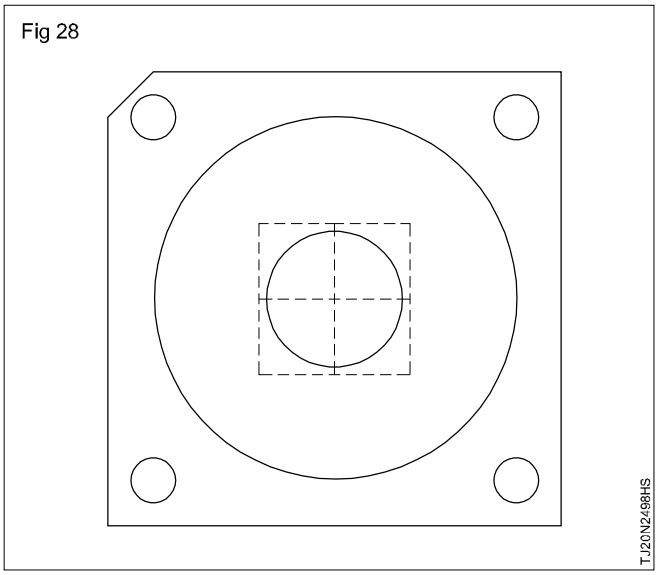
Fig 26



Note: A preview of the chamfer should appear when you hover the cursor above the second line (Entity B).

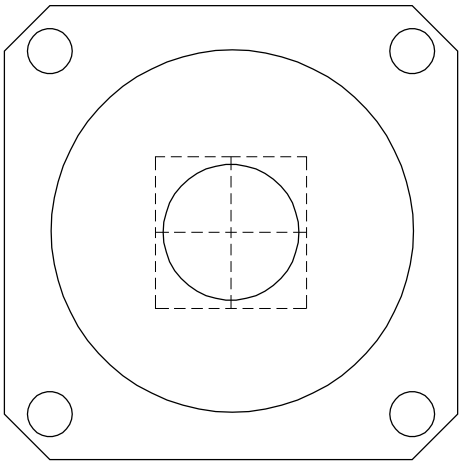
- The geometry should look as shown.
- The part will appear as shown in Fig 28

Fig 28



- Follow the same steps to chamfer the rest of the corners.
- The geometry should look as shown when completed. (Fig 29)

Fig 29



- Select the OK button to exit the command. 

6 Save the File

FILE

- Save As.

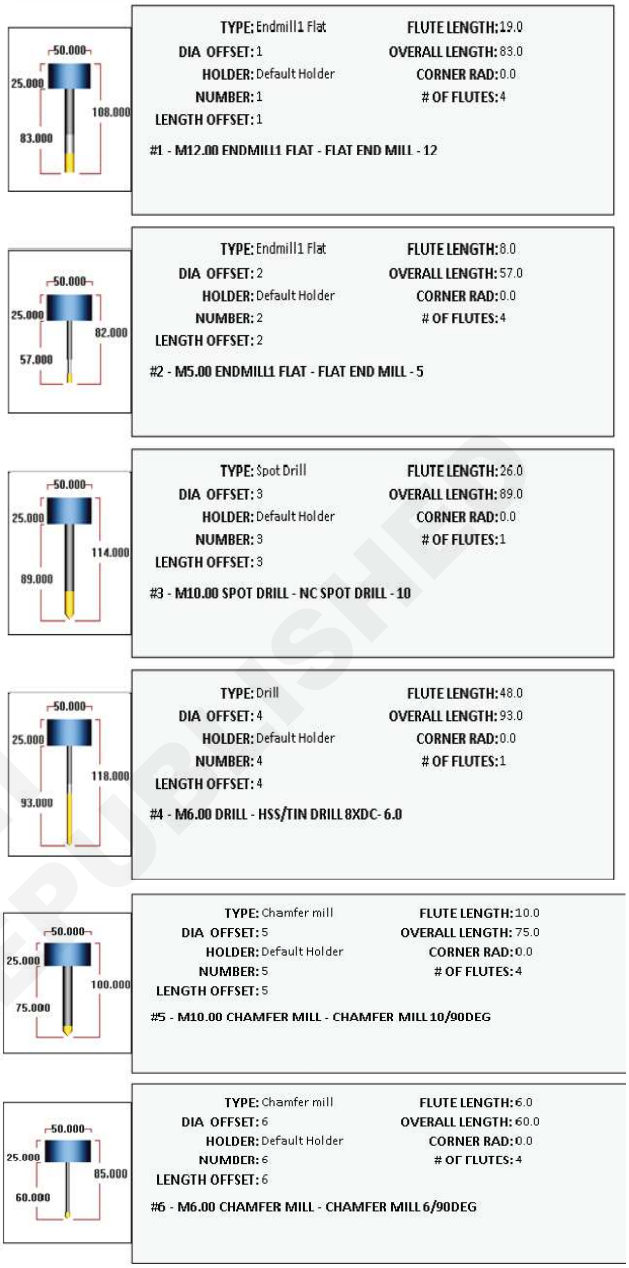
Note: You can also click on the Save As icon from the Quick Access Toolbar

- Click on the Browse icon as shown. 

- Find a location on the computer to save your file. File name: “Your Name_1”.

Note: It is highly recommended to save the file from time to time when going through the tutorial. Click on the Save icon from the Quick Access Toolbar at the upper left corner to save the file.

Setup sheet



TASK 2: **Select the machine and set up the stock**

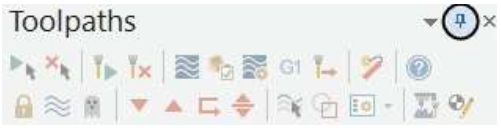
Select a Machine Definition before creating any toolpath. The Machine Definition is a model of your machine’s capabilities and features. It acts like a template for setting up your machine. The machine definition ties together three main components: the schematic model of your machine’s components, the control definition that models your control capabilities, and the post processor that will generate the required machine code (G−code). For a Mill Essentials exercise (2D toolpaths), we need just a basic machine definition.

Note: For the purpose of this tutorial, we will be using the Default Mill MM machine.

1 Unhide the Toolpaths Manager panel

- From the left side of the graphics window, click on the Toolpath's tab as shown.

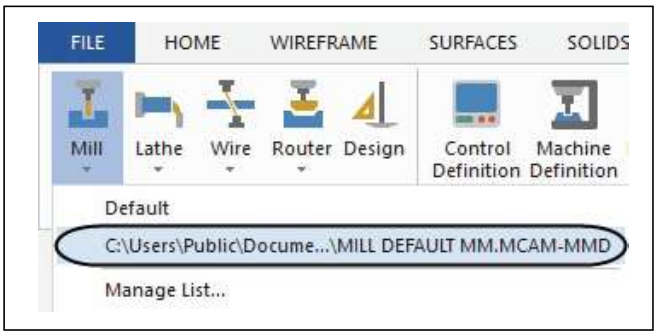
- Pin the Toolpath's Manager by clicking on the Auto Hide icon as shown.



Select the machine

MACHINE

- From the Machine Type group, select the drop down arrow below Mill. Select Manage List. (Fig 1)
- Select MILL DEFAULT MM.MCAM-MMD from the list and press Add. (Fig 2)
- Select the OK button to exit Machine Definition Menu Management.



- From the Machine Type area, click on the drop down arrow and select MILL DEFAULT MM.MCAM-MMD as shown.

Note: Once you select the MILL DEFAULT MM.MCAM -MMD the ribbon bar changes to reflect the toolpaths that can be used with this machine.

- Select the plus sign (+) in front of Properties in the Toolpath's Manager to expand the Toolpath's Group Properties

Fig 1

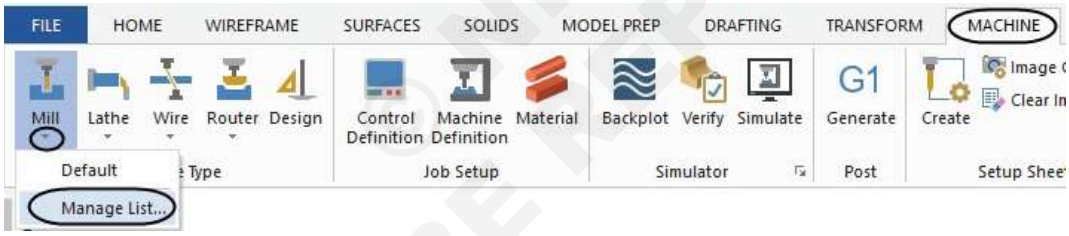
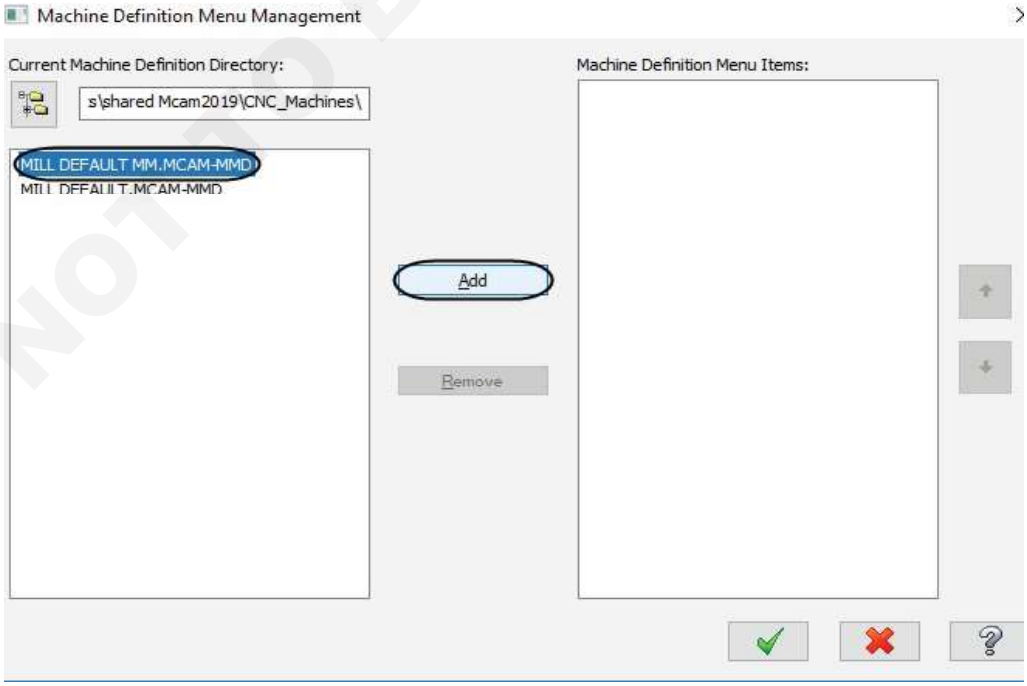
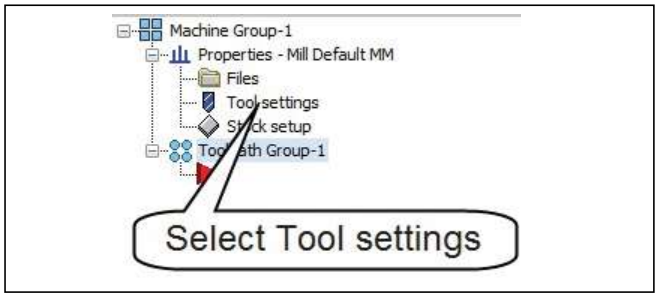


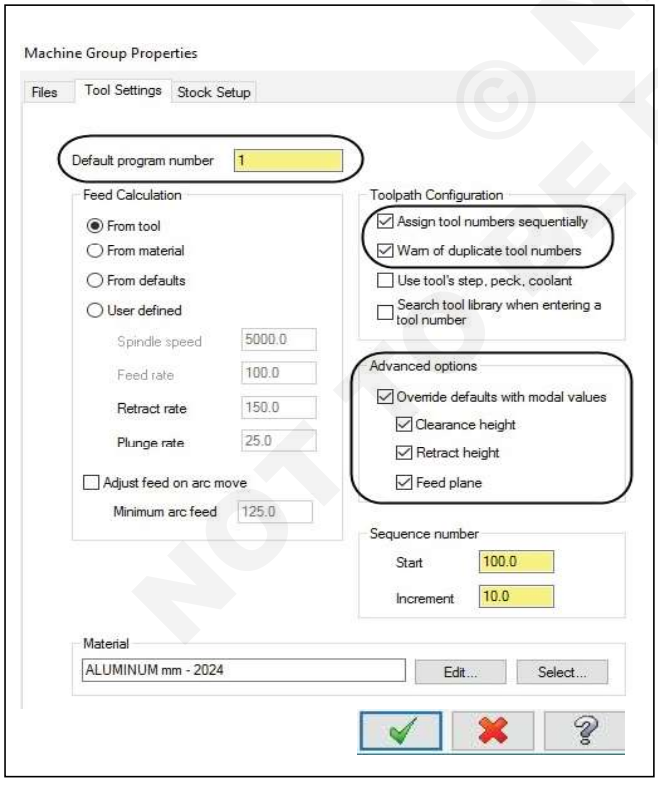
Fig 2



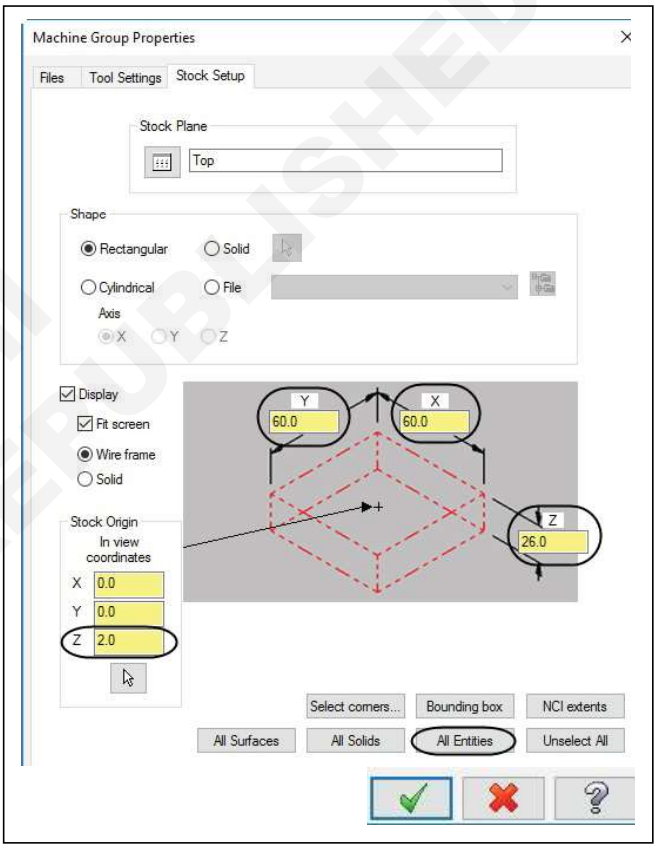
- Select tool settings to set the tool parameters.



- Change the parameters to match the screen shot as shown.
  - Defaults program number is used to enter a number if your machine requires a number for a program name.
  - Assign tool numbers sequentially allows you to overwrite the tool number from the library with the next available tool number. (First operation tool number 1; second operation tool number 2, etc.).
  - Warn of duplicated tool numbers allows you to get a warning if you enter two tools with the same number.
  - Override default's with modal values enables the system to keep the values that you enter.
  - Feed Calculation set to From tool uses feed rate, plunge rate, retract rate, and spindle speed from the tool definition.



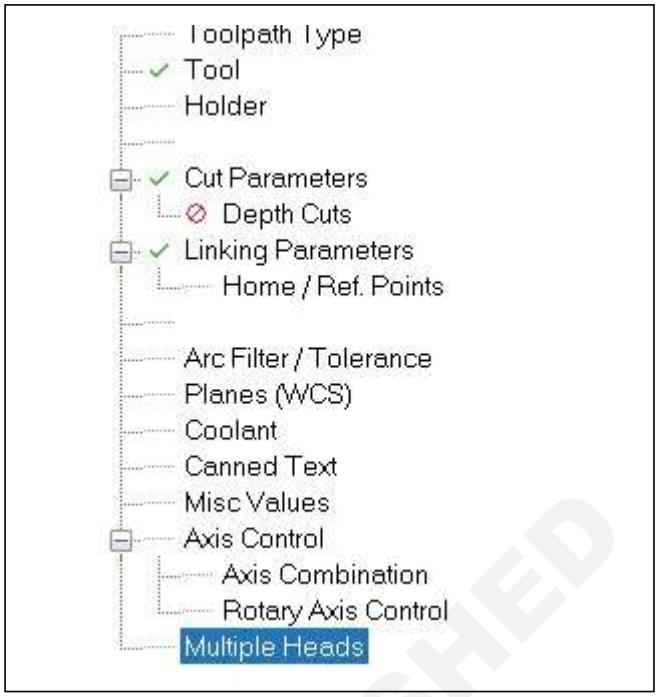
- Select the Stock Setup tab to define the stock.
- Select the All Entities button near the bottom of the Stock Setup page as shown.
- In the Stock Setup, enter in the Z field 26 and the Z Stock Origin 2. Make sure that the rest of the parameters are as shown
  - The X, Y, Z values in the graphics area are the dimensions of the stock model. They are always positive values.
  - The Stock Origin values adjust the positioning of the stock, ensuring that you have an equal amount of extra stock around the finished part. In the graphics screen, the plus sign (+) shows you where the stock origin is. The default position is the middle of the stock.
  - Display options allow you to set the stock as Wireframe and to fit the stock to the screen. (Fit Screen)



Note: The stock model that you create is displayed when viewing the file or the toolpaths, during back plot, and while verifying toolpaths.

- Select the OK button to exit Machine Group Properties.
- In the Toolpath Type page, the Facing icon will be automatically selected.

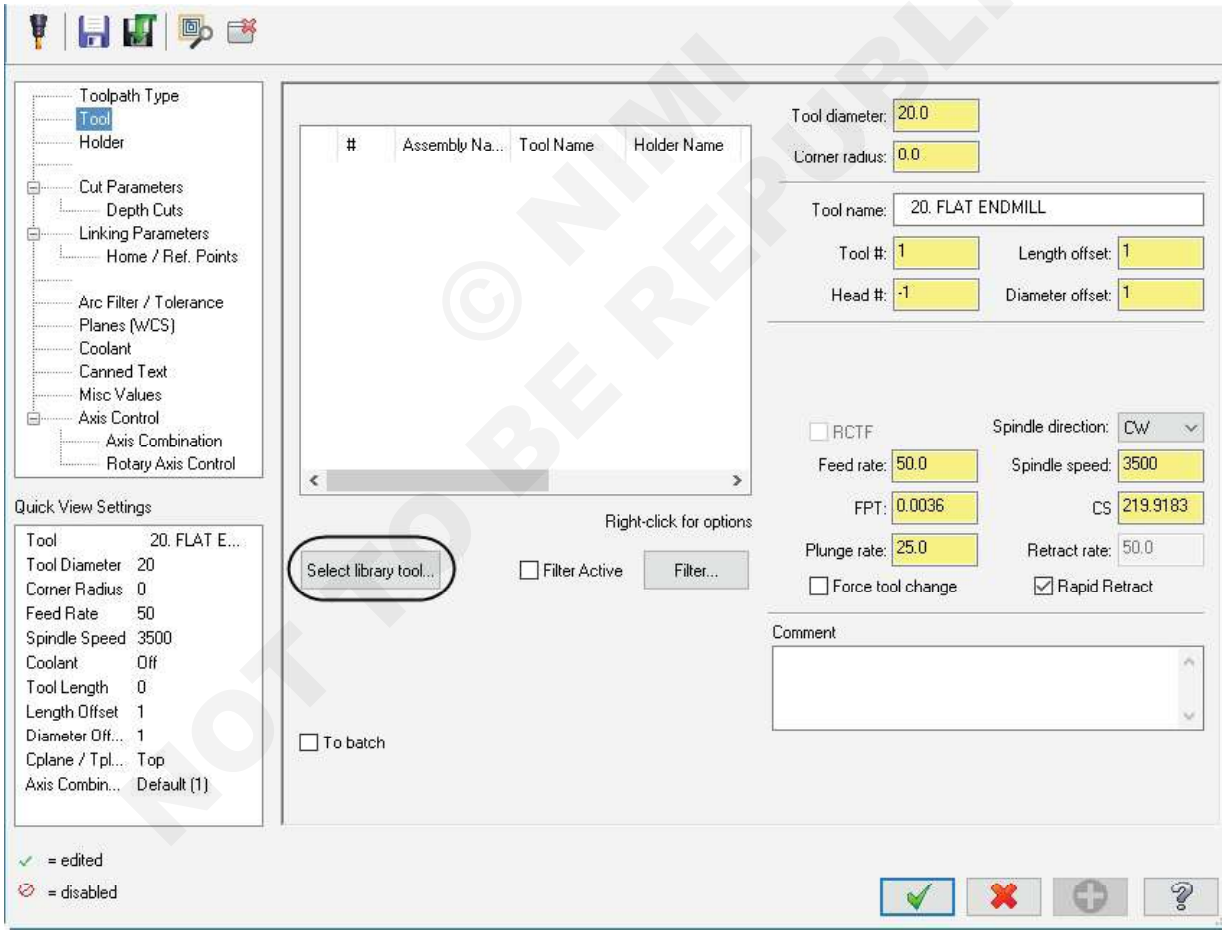
Note: Master cam updates the pages as you modify them and then marks them, in the Tree View list, with a green check mark. Pages that are not enabled are marked with a red circle and slash.



Select a 50mm Face Mill from the library and set the Tool parameters

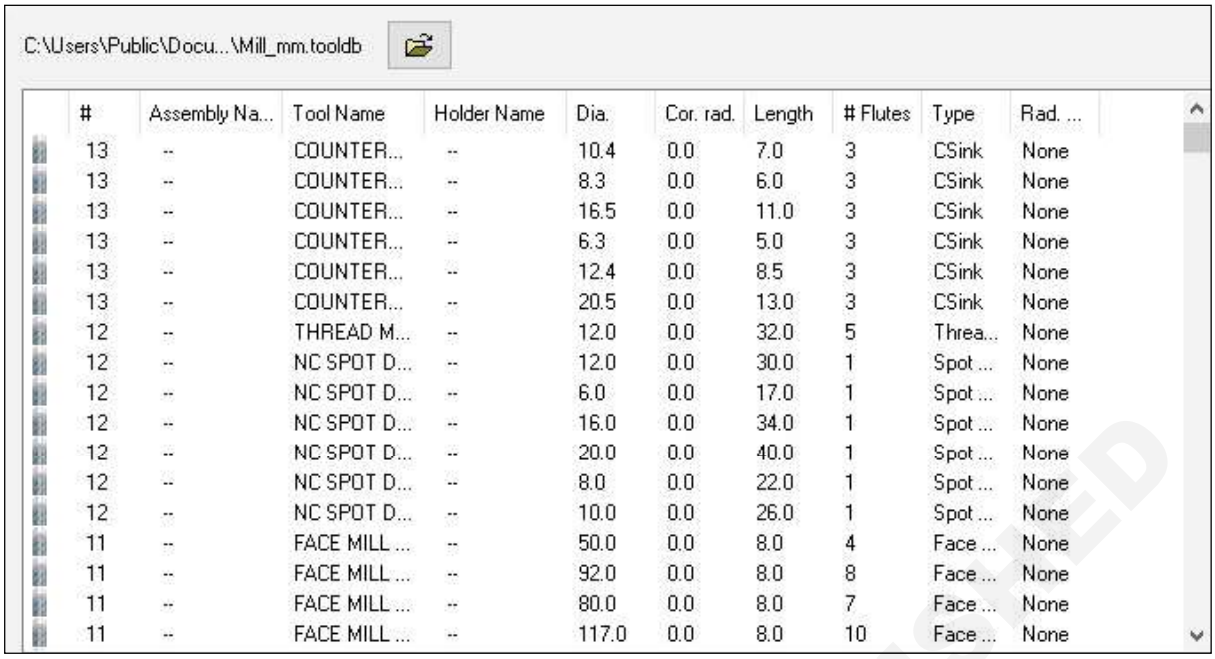
- Select Tool from the Tree View list.
- Click on the Select Library tool button. (Fig 3)

Fig 3



- To be able to see all of the tools from the library, disable Filter Active. (Fig 4)

Fig 4



#	Assembly Na...	Tool Name	Holder Name	Dia.	Cor. rad.	Length	# Flutes	Type	Rad. ...
13	--	COUNTER...	--	10.4	0.0	7.0	3	CSink	None
13	--	COUNTER...	--	8.3	0.0	6.0	3	CSink	None
13	--	COUNTER...	--	16.5	0.0	11.0	3	CSink	None
13	--	COUNTER...	--	6.3	0.0	5.0	3	CSink	None
13	--	COUNTER...	--	12.4	0.0	8.5	3	CSink	None
13	--	COUNTER...	--	20.5	0.0	13.0	3	CSink	None
12	--	THREAD M...	--	12.0	0.0	32.0	5	Threa...	None
12	--	NC SPOT D...	--	12.0	0.0	30.0	1	Spot ...	None
12	--	NC SPOT D...	--	6.0	0.0	17.0	1	Spot ...	None
12	--	NC SPOT D...	--	16.0	0.0	34.0	1	Spot ...	None
12	--	NC SPOT D...	--	20.0	0.0	40.0	1	Spot ...	None
12	--	NC SPOT D...	--	8.0	0.0	22.0	1	Spot ...	None
12	--	NC SPOT D...	--	10.0	0.0	26.0	1	Spot ...	None
11	--	FACE MILL ...	--	50.0	0.0	8.0	4	Face ...	None
11	--	FACE MILL ...	--	92.0	0.0	8.0	8	Face ...	None
11	--	FACE MILL ...	--	80.0	0.0	8.0	7	Face ...	None
11	--	FACE MILL ...	--	117.0	0.0	8.0	10	Face ...	None

- Select the Face Mill - 50/58 as shown in Fig 5

Fig 5

#	Assembly...	Tool Name	Holder Name	Dia.	Cor. r...	Length	# Flu...	Type	Rad....
5	–	FLAT END MILL - 18	–	18.0	0.0	29.0	4	End...	None
5	–	FLAT END MILL - 16	–	16.0	0.0	26.0	4	End...	None
5	–	FLAT END MILL - 14	–	14.0	0.0	22.0	4	End...	None
5	–	FLAT END MILL - 12	–	12.0	0.0	19.0	4	End...	None
5	–	FLAT END MILL - 10	–	10.0	0.0	16.0	4	End...	None
11	–	FACE MILL - 92/100	–	92.0	0.0	8.0	8	Fac...	None
11	–	FACE MILL - 80/88	–	80.0	0.0	8.0	7	Fac...	None
11	–	FACE MILL - 72/80	–	72.0	0.0	8.0	7	Fac...	None
11	–	FACE MILL - 63/71	–	63.0	0.0	8.0	6	Fac...	None
11	–	FACE MILL - 55/63	–	55.0	0.0	8.0	5	Fac...	None
11	–	FACE MILL - 50/58	–	50.0	0.0	8.0	4	Fac...	None
11	–	FACE MILL - 42/50	–	42.0	0.0	8.0	4	Fac...	None
11	–	FACE MILL - 125/133	–	125.0	0.0	8.0	10	Fac...	None
11	–	FACE MILL - 117/125	–	117.0	0.0	8.0	10	Fac...	None
11	–	FACE MILL - 100/108	–	100.0	0.0	8.0	8	Fac...	None

- Select the tool in the Tool Selection page and then select the OK button to exit.
- Input a comment and make all the necessary changes, as shown in Fig 6

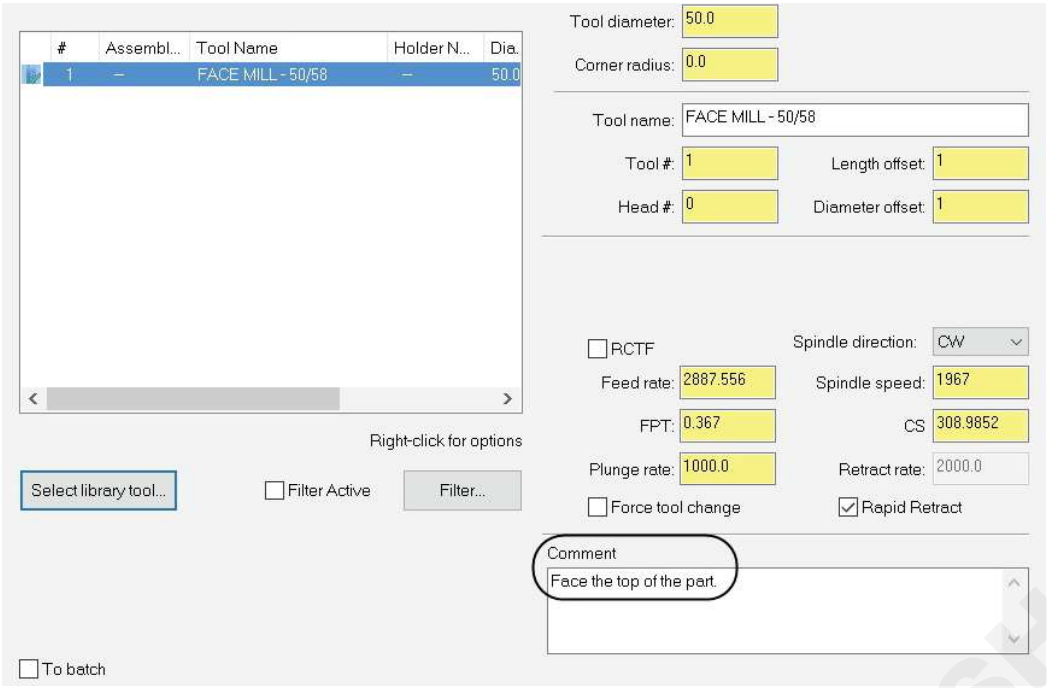
The Feed rate, Plunge rate, retract rate and Spin dle speed are based on the tool definition as set in the Tool Settings. You may change these values as per your part material and tools.

In the Comment field, enter a comment such as the one shown above to help identify the toolpath in the Toolpath's Manager.

Note: The Feed rate, Plunge rate, retract rate, and Spindle speed are based on the tool definition as set in the Tool Settings. You may change these values as per your part material and tools.

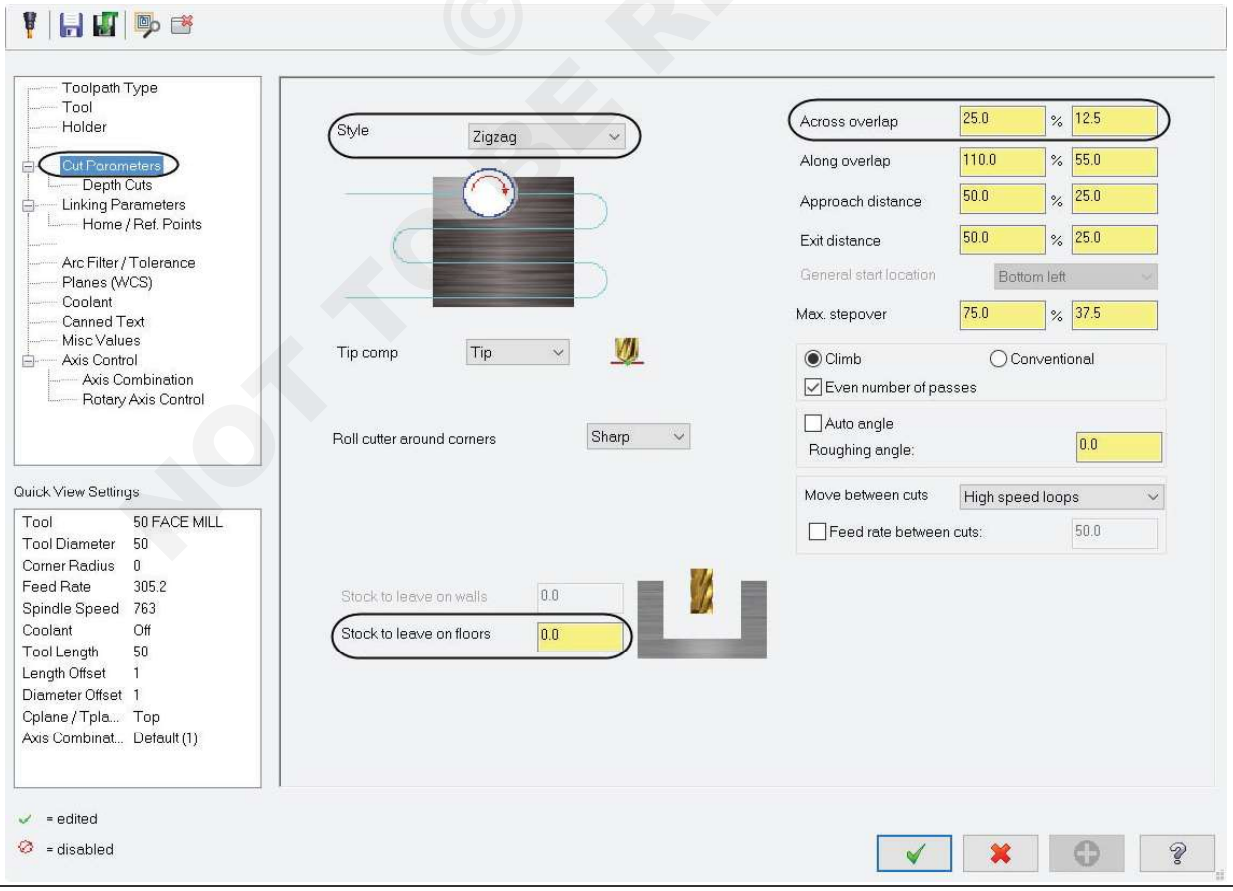
If by mistake you click the OK button, the toolpath will be generated without all the parameters set properly. To return and set the parameters, click on the Parameters in the Toolpaths Manager as shown below.

Fig 6



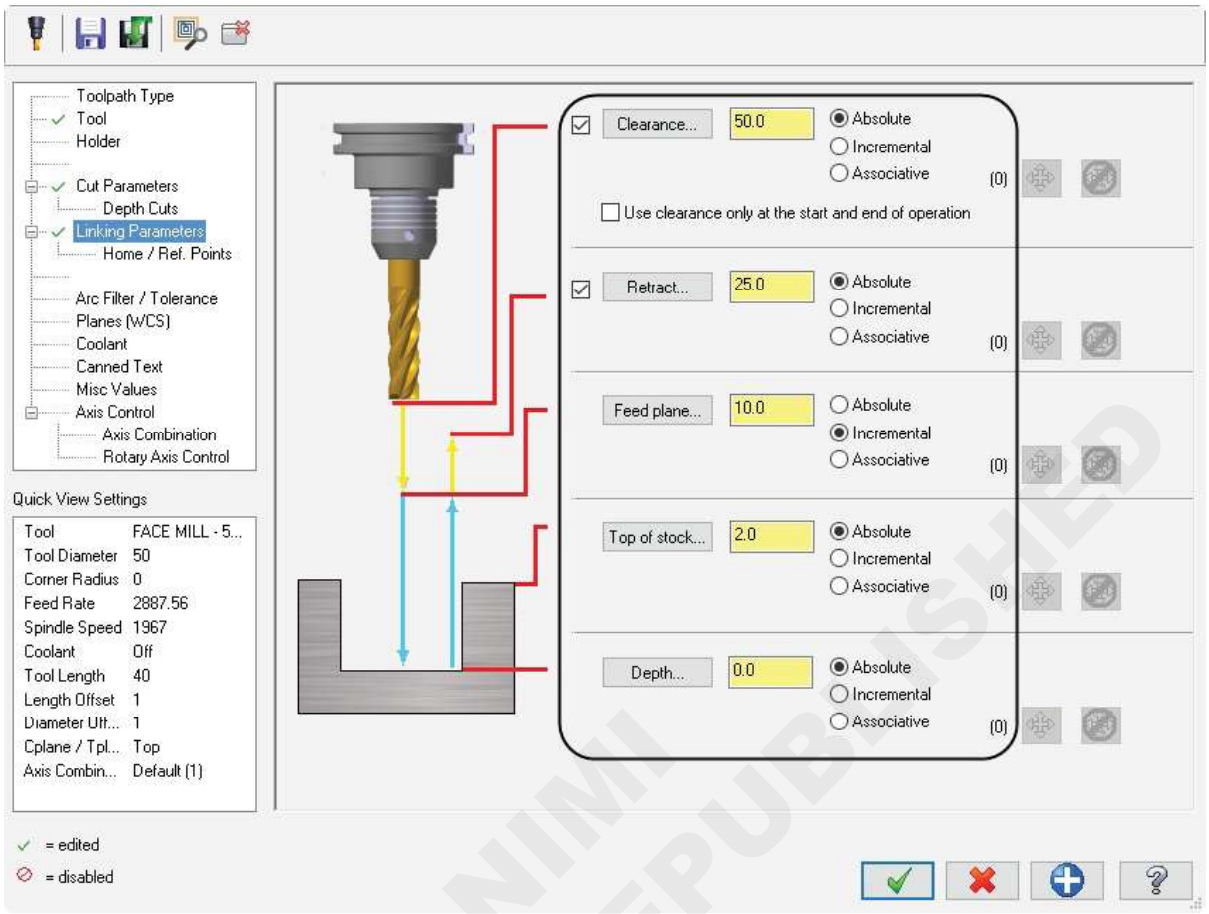
- Select Cut Parameters and make the necessary changes as shown in Fig 7
- The Style (facing cutting method) Zigzag creates a back and forth cutting motion.
- Move between cuts determines how the tool moves between each cut. This is only available if you select the zigzag cutting method.

Fig 7



- High speed Loops create 180 degree arcs between each cut.
- Select the Linking Parameters page and make the necessary changes as shown in Fig 8

Fig 8



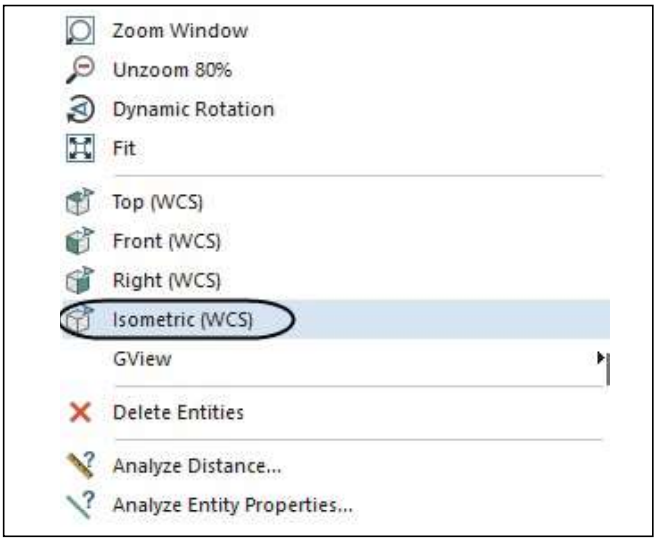
- **Clearance** sets the height at which the tool moves to and from the part.
- **Retract** sets the height that the tool moves up to before the next tool pass.
- **Feed Paine** sets the height that the tool rapids to before changing to the plunge rate to enter the part.
- **Top of stock** sets the height of the material in the Z axis.
- **Depth** determines the final machining depth that the tool descends into the stock.

Note: The Top of stock is set to 2mm because the Stock Origin was set to 2mm above the origin. The depth is set to 0.0mm because this is the finish depth. The majority of the values are set to absolute (measured from Z zero which is set at the top of the finished part). Feed plane set to incremental is measured from the Top of stock.

Preview the Toolpath

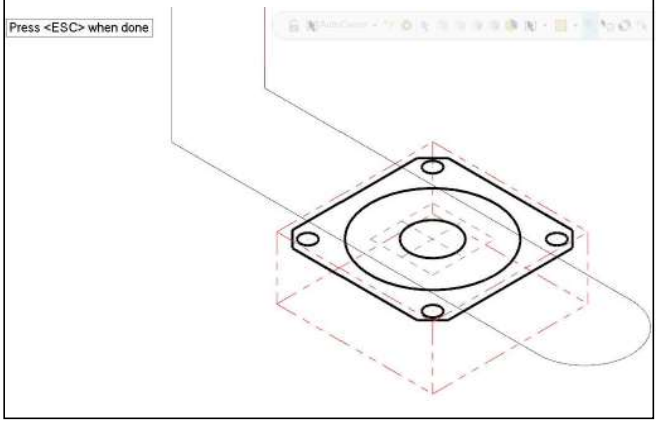
- To quickly check how the toolpath will be generated, select the Preview toolpath icon as shown.

- To hide the dialog box, click on the Hide dialog icon as shown.



- To see the part from an Isometric view, right mouse click in the graphics window and select Isometric as shown.
- The toolpath should look as shown in Fig 9

Fig 9



- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

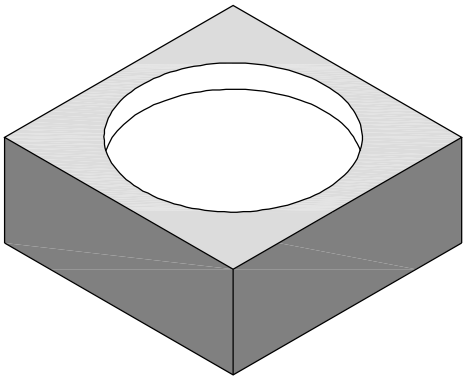
- Select the OK button to exit the Facing Parameters.

Note: If you exit the toolpath in the middle of setting the parameters, in the Toolpaths Manager, you will have a red X on the Face Toolpath as shown in This shows that you modified the toolpath and you need to update it. You will have to select the Regenerate all dirty operations icon each time you change something in the toolpath parameters.

2 Circle mill the large hole (Fig 10)

Circle Mill Toolpaths remove circular pockets based on a single point. You can select either point entities or center points of arcs. Mastercam will then pocket out a circular area of the diameter to the depth that you specify.

Fig 10



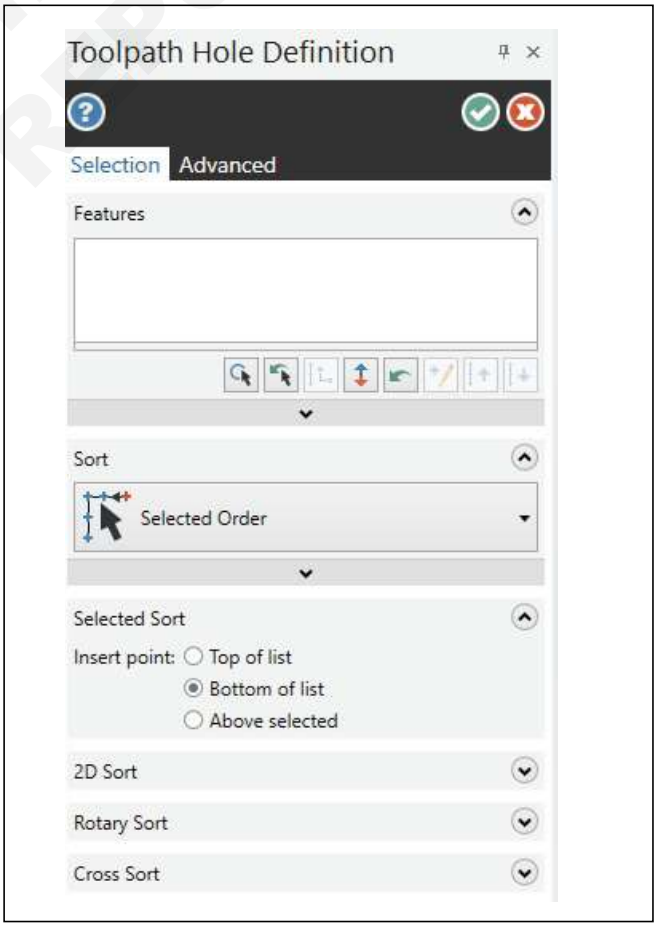
Drill Point Selection

- Press Alt + T to remove the toolpath display.

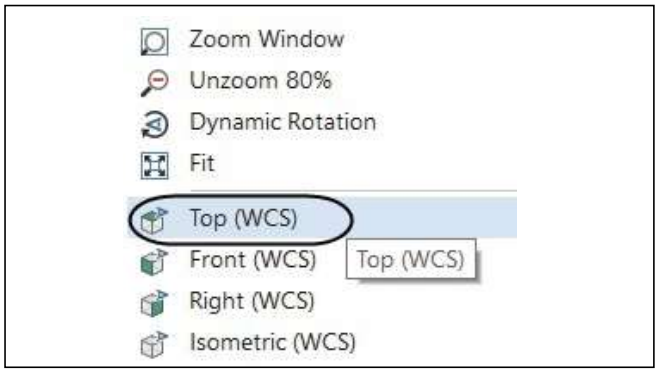
Toolpaths

- From the 2D group, click on the drop down arrow until the Circle Mill toolpath appears as shown.
- Click on the Circle Mill icon.

- The Toolpath Hole Definition should appear as shown.

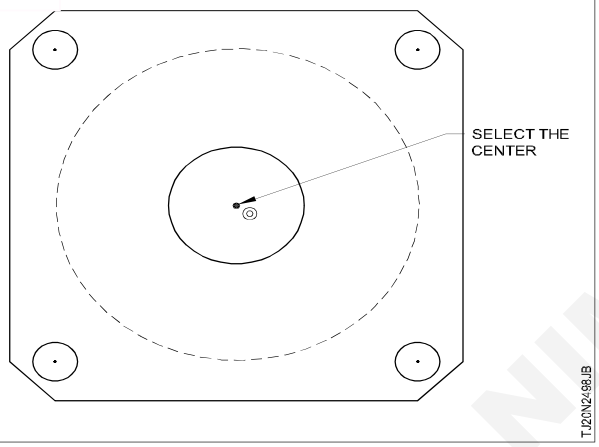


- Right click and select the Top view.

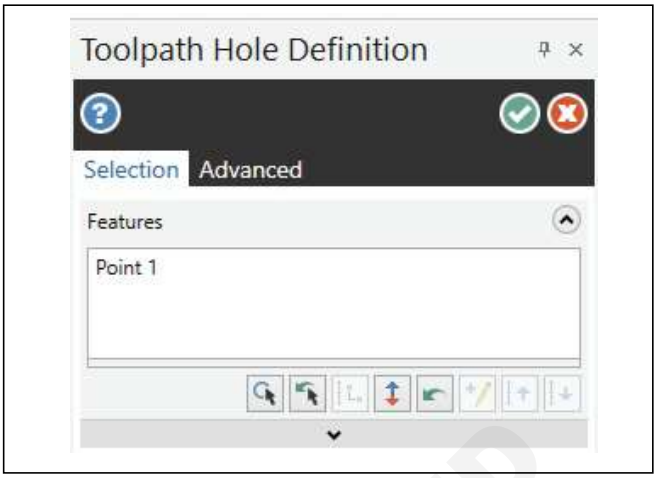


- **Select one or more entities to add or remove from the features list**: Select the center of the 48mm diameter circle as shown in Fig 11

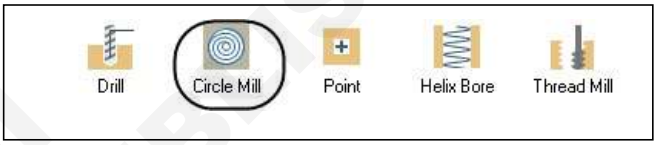
Fig 11



- The Point will be displayed in the Features list as shown.



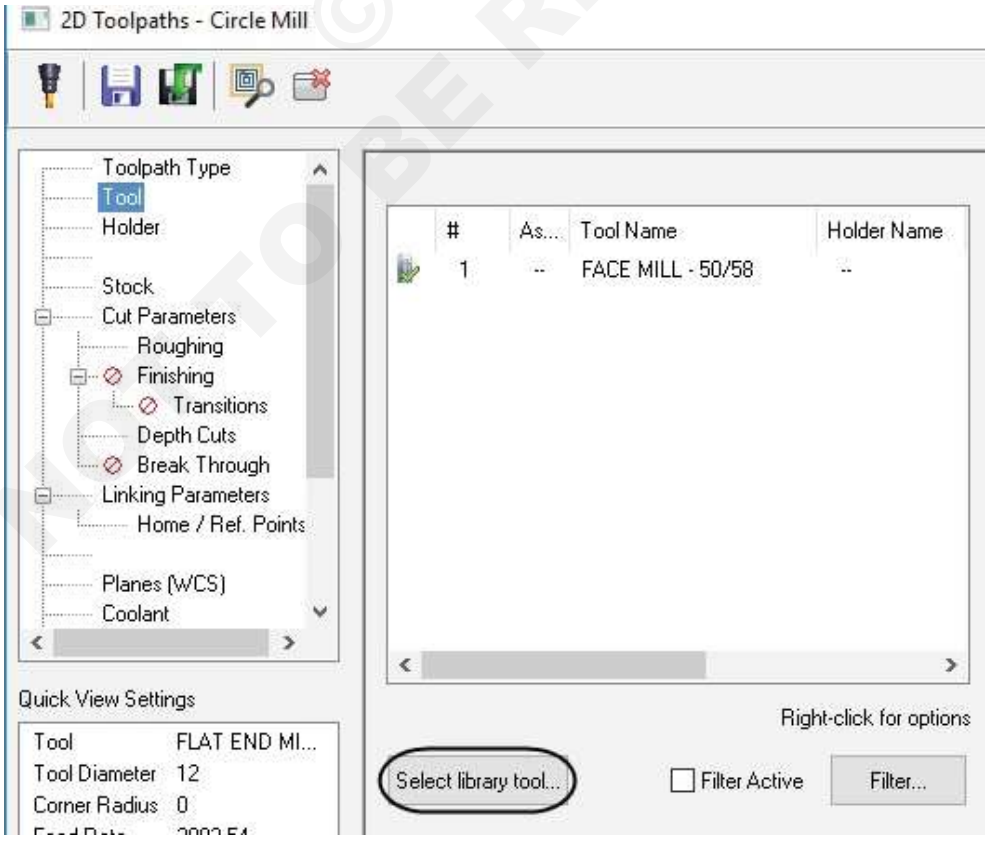
- Select the OK button to finish the selection and exit Toolpath Hole Definition.
- In the Toolpath Type page, the Circle Mill icon will be selected.



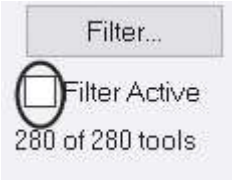
Select a 12mm Flat End mill from the library and set the Tool parameters

- Select Tool from the Tree View list.
- Click on Select Library tool button. (Fig 12)

Fig 12



- To be able to see all the tools from the library, disable Filter Active.



- Scroll down and select the 12mm Flat Endmill as shown in Fig 13

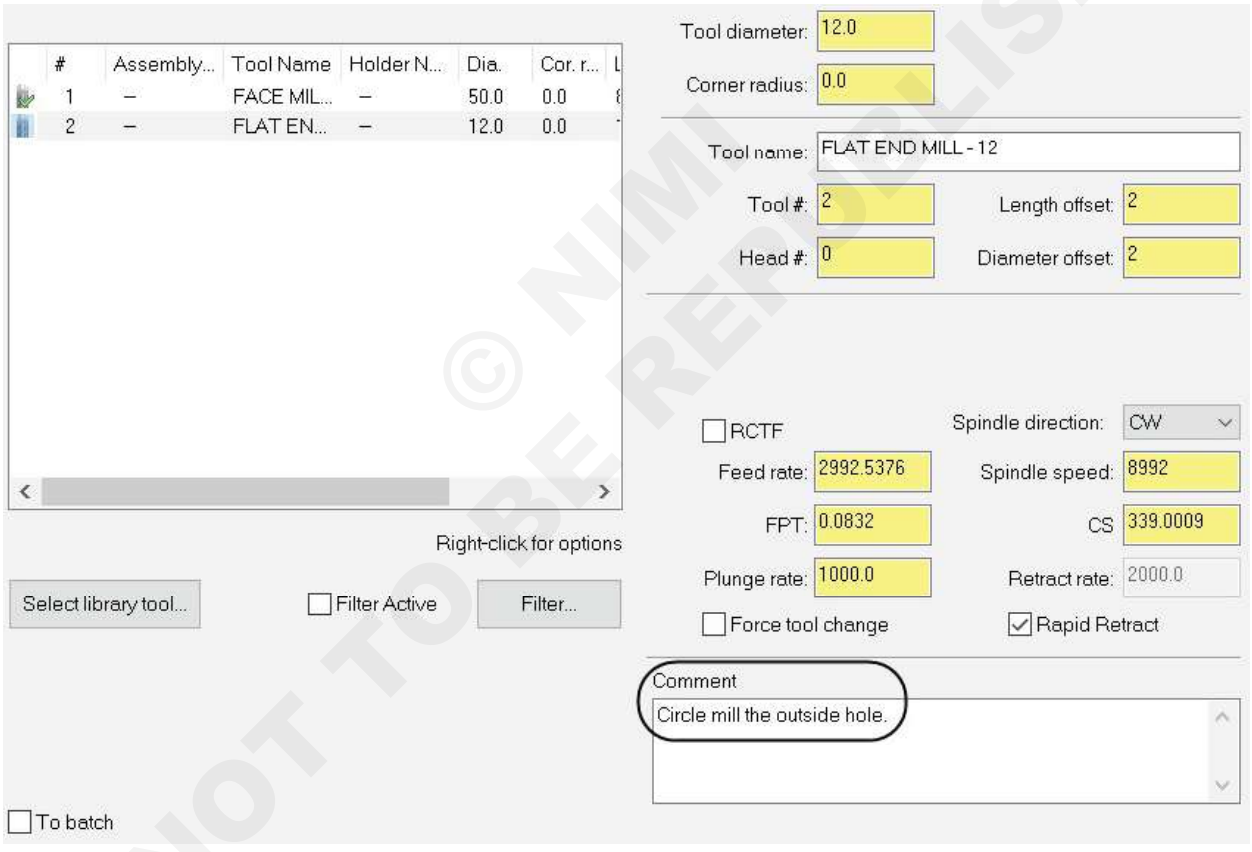
Fig 13

	#	Assembly...	Tool Name	Holder Name	Dia.	Cor. r...	Length	# Flut...	Type	Rad....
	5	–	END MILL WITH RADIU...	–	8.0	2.0	13.0	4	End...	Corn...
	5	–	FLAT END MILL - 14	–	14.0	0.0	22.0	4	End...	None
	5	–	END MILL WITH RADIU...	–	12.0	0.5	19.0	4	End...	Corn...
	5	–	FLAT END MILL - 12	–	12.0	0.0	19.0	4	End...	None
	5	–	FLAT END MILL - 8	–	8.0	0.0	13.0	4	End...	None
	5	–	END MILL WITH RADIU...	–	16.0	0.5	26.0	4	End...	Corn...

- Select the tool in the Tool Selection page and then select the OK button to exit.

- Input a comment and make all the necessary changes, as shown in Fig 14

Fig 14

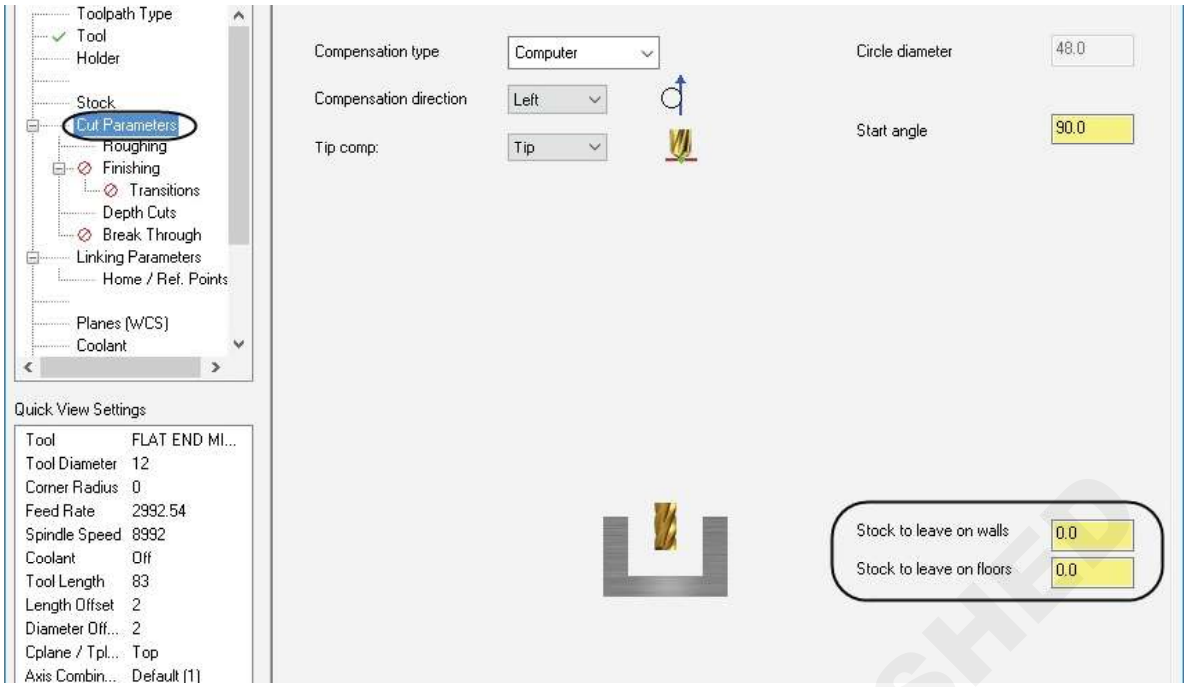


Note: The Feed rate, Plunge rate, retract rate, and Spindle speed are based on the tool definition as set in the Tool Settings. You may change these values as per your part material and tools.

Cut Parameters

- From the Tree View List, select Cut Parameters and ensure the settings appear as shown in Fig 15

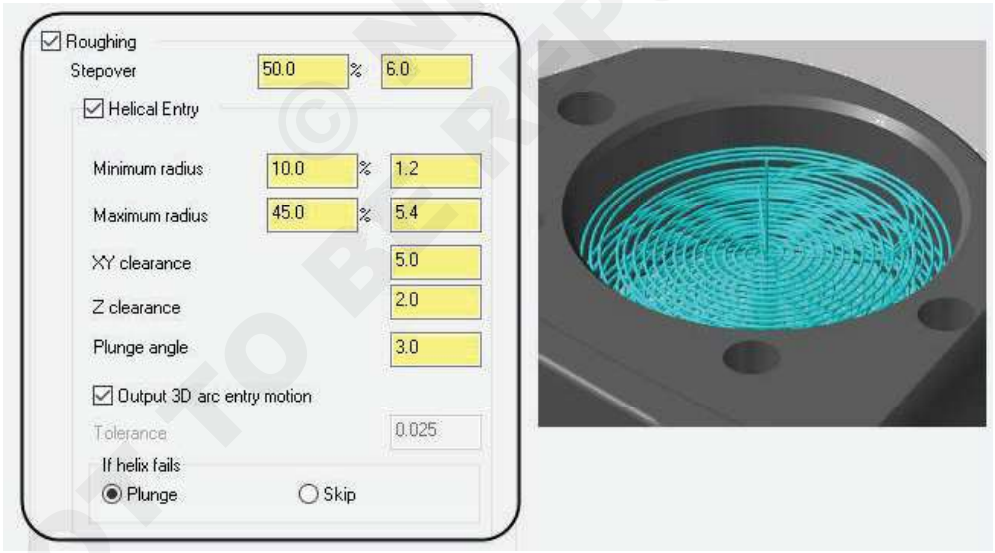
Fig 15



Roughing

- From the Tree View list, select Roughing and enable it. Set the Stopover to 50%, enable heliacal Entry, and specify the other parameters as shown in Fig 16

Fig 16



Stopover sets the distance between cutting passes in the X and Y axes as a percentage of the tool diameter.

Heiical Entry creates a helix at the center of the circle to begin the roughing motion. If this option is turned off, the tool plunges to start the toolpath.

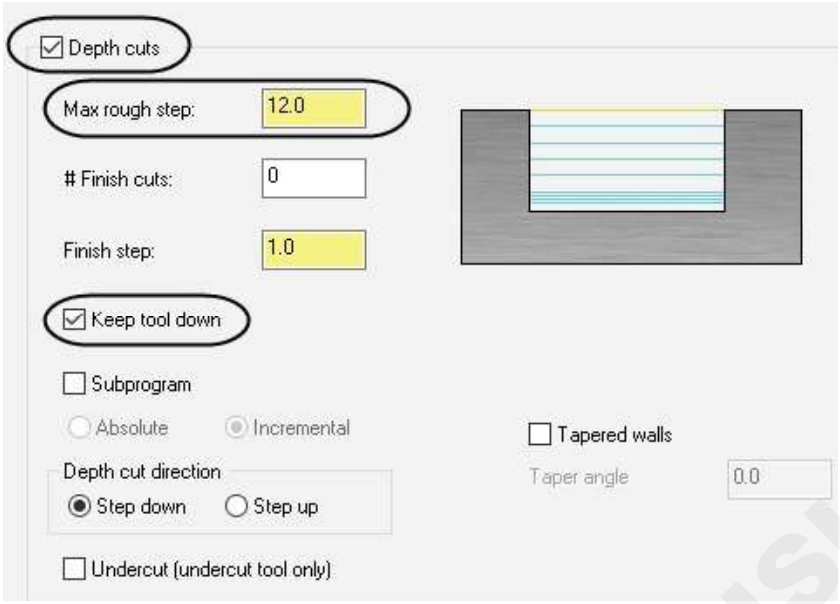
Depth Cuts

- From the Tree View List, select Depth Cuts. On the Depth Cuts page, enable Depth cuts, set the Max rough step to 12 and enable Keep tool down.

- Make any necessary changes as shown in Fig 17

Depth Cuts sets the steps the tool takes along the Z axis. Master cam will take the total depth and divide it into separate depth cuts. Mastercam never performs unequal depth cuts.

Fig 17



Max rough step sets the maximum amount of material removed in the Z axis with each rough cut. Mastercam will calculate equal rough cuts no larger than the maximum rough step until it reaches the final Z depth.

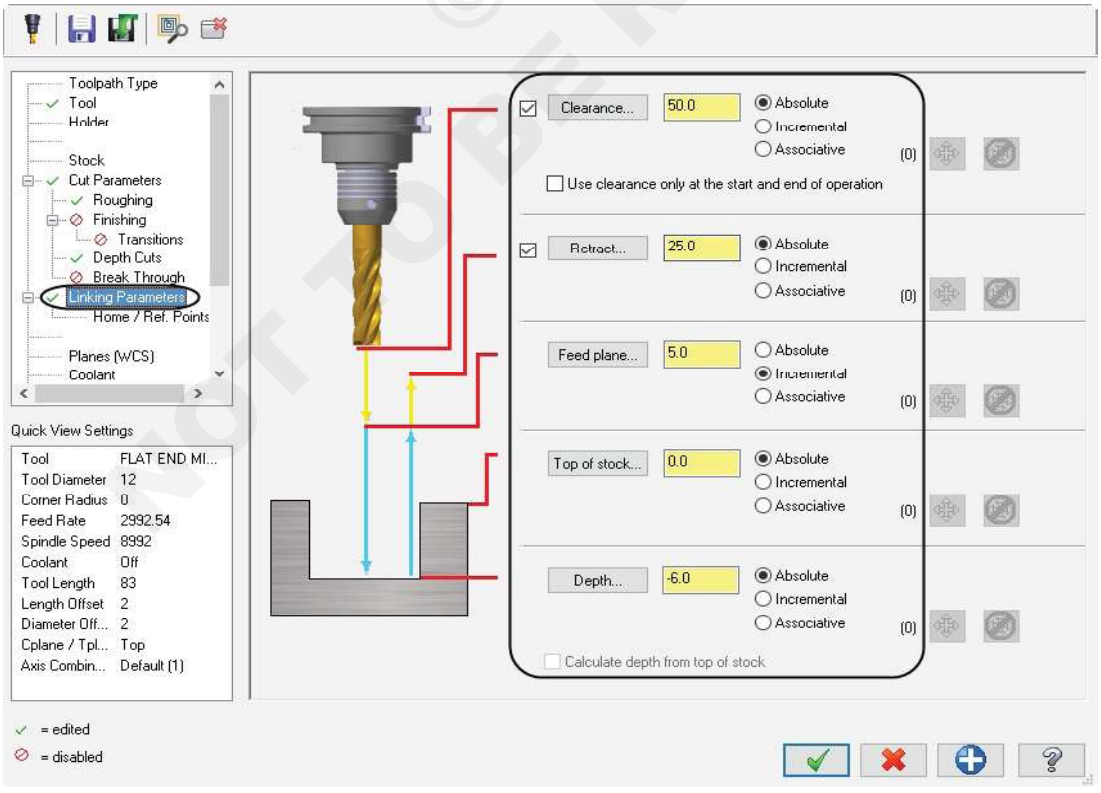
Keep tool down determines whether or not to retract the tool between depth cuts.

Depth cut direction: Step down sets the depth of cuts in − Z direction, starting from the top. Step up will start the first depth cut at the bottom of the part and adds the cutting passes in +Z. Undercut enabled allows you to machine undercut areas when using an undercut tool.

Linking Parameters (Fig 18)

- Select Linking Parameters from the Tree View list.

Fig 18



- Change the Top of stock to 0.0 and set the Depth to -6.0. Ensure all the values are set the same as shown.

Absolute values are always measured from the origin 0,0,0.

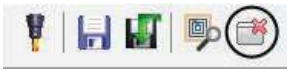
Incremental values are relative to other parameters or chained geometry.

Associative option allows you to select points from the existing geometry from where the values will be measured.

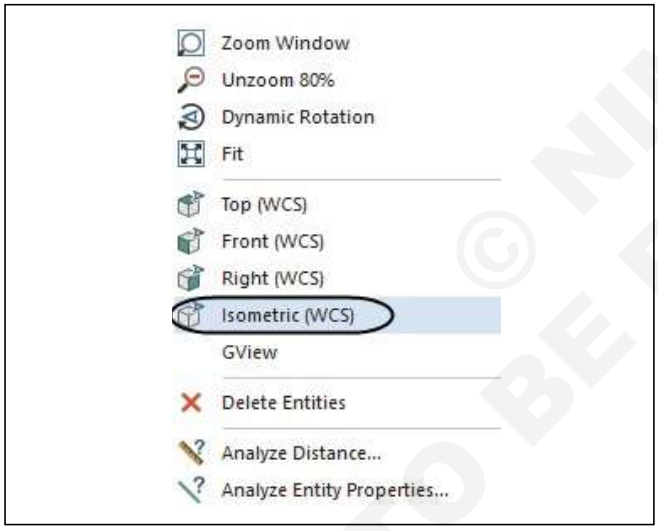
Preview the Toolpath

- To quickly check how the toolpath will be generated, select the Preview toolpath icon as shown.

- To hide the dialog box, click on the Hide dialog icon as shown.

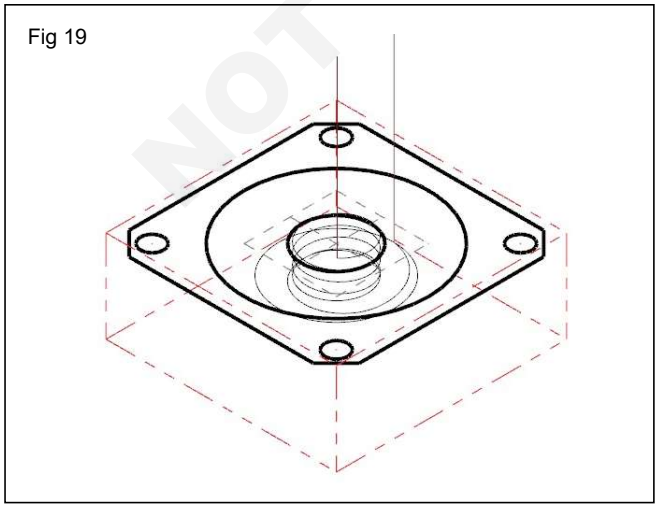


- To see the part from an Isometric view, right mouse click in the graphics window and select Isometric as shown.



- The toolpath should look as shown in Fig 19

Fig 19



- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

- Select the OK button to exit the 2D Toolpath's - Circle Mill parameters.

3 Backplot the toolpaths

Backplotting shows the path the tools take to cut the part. This display lets you spot errors in the program before you machine the part. As you backplot toolpaths, Mastercam displays additional information such as the X, Y, and Z coordinates, the path length, the minimum and maximum coordinates, and the cycle time.

- Make sure that the toolpaths are selected (signified by the green check mark on the folder icon). If both operations are not selected, choose the Select all operations icon.

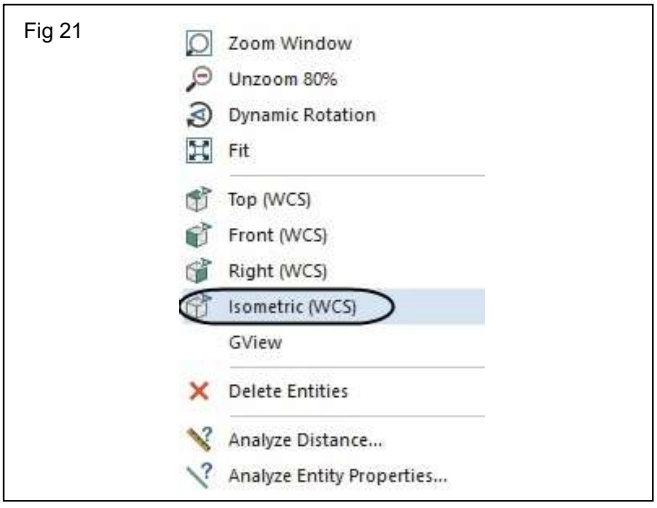
- Select the Backplot selected operations button.

- In the Backplot panel, enable Display with color codes, Display tool and Display rapid moves icons as shown in Fig 20

Fig 20

- To see the part from an Isometric view, right mouse click in the graphics window and select Isometric as shown in Fig 21

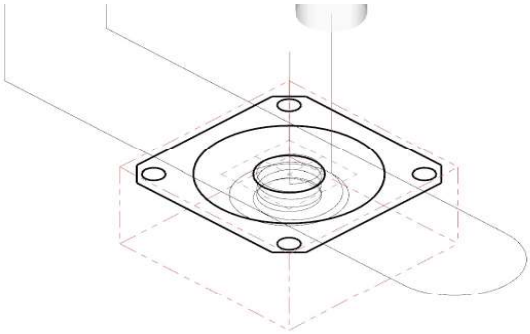
Fig 21



- To fit the work piece to the screen, if needed, right mouse click in the graphics window again and select the Fit.
- You can step through the Backplot by using the Step forward or Step back buttons.
- You can adjust the speed of the backplot.
- Select the Play button to run Backplot.

- The toolpath should look as shown in Fig 22

Fig 22

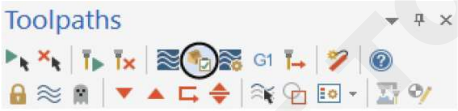


- Select the OK button to exit Backplot.

4 Simulate the toolpath in verify

Verify shows the path the tools take to cut the part with material removal. This display lets you spot errors in the program before your machine the part. As you verify toolpaths, Mastercam displays additional information such as the X, Y, and Z coordinates, the path length, the minimum and maximum coordinates, and the cycle time. It also shows any collision between the work piece and the tool.

- From the Toolpaths Manager, select Verify selected operations icon as shown.

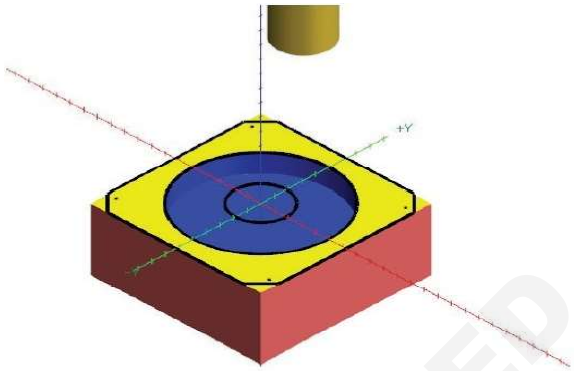


Note: Mastercam launches a new window that allows you to check the part using Backplot or Verify.

- In Mastercam Simulator, verify should be enabled and change the settings as shown in Fig 23
- Select the Play button to run Verify.

- The part should appear as shown in Fig 24

Fig 24



Note: To rotate the part, move the cursor to the center of the part and click and hold the mouse wheel and slowly move it in one direction. To zoom in or out, hold down the mouse wheel and scroll up or down as needed.

- Right mouse click in the graphics window and select Isometric. Then right mouse click again and select Fit to see the part in the original position.
- To check the part step−by−step, click first on the Start button.
- Click on the Step Forward to see the tool moving one step at a time.

- The part should look as shown after several steps in (Fig 25)

Fig 25

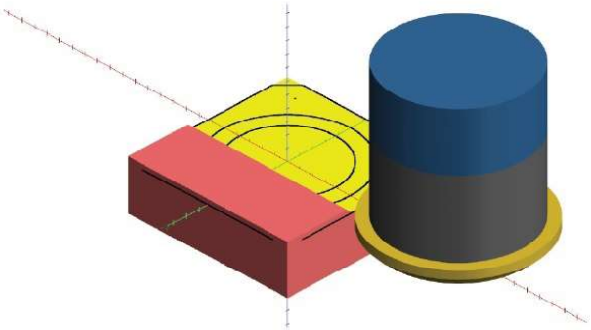
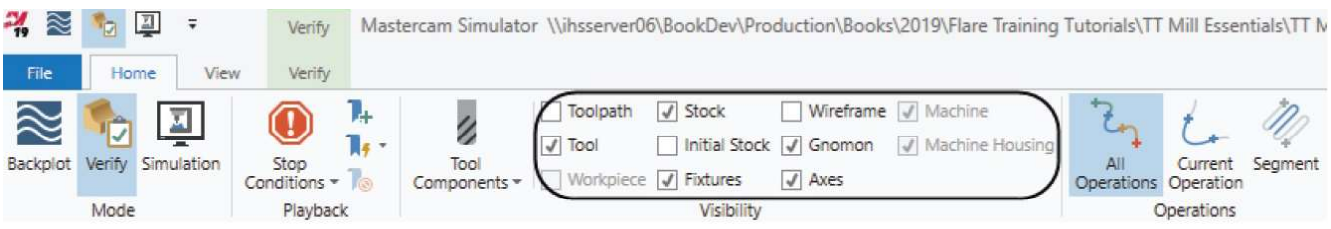


Fig 23



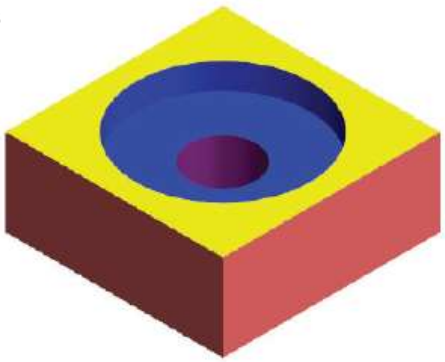
- Click on the Step Forward until the toolpath is completed.
- To go back to Mastercam window, minimize Mastercam Simulator window as shown.

5 Circle mill the inside hole

Circle Mill Toolpath's remove circular pockets based on a single point. You can select either point entities or center points of arcs. Mastercam will then pocket out a circular area of the diameter to the depth that you specify.

Toolpath Preview (Fig 26)

Fig 26



Drill Point Selection

- Hover the cursor in the Toolpaths Manager and press T or press Alt + T to remove the toolpath display.

Toolpaths (Fig 27)

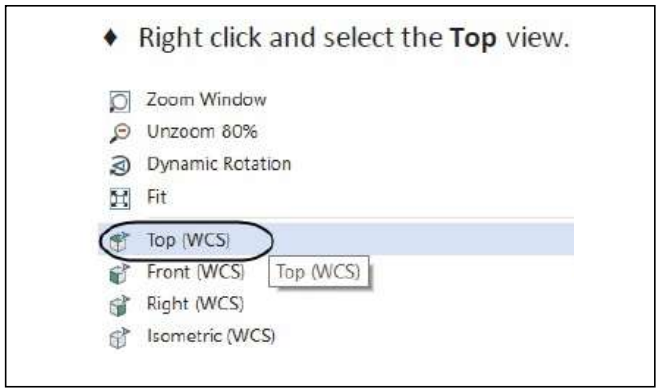
- From the 2D group, click on the Circle Mill icon.

Fig 27

- The Toolpath Hole Definition should appear as shown in Fig 28

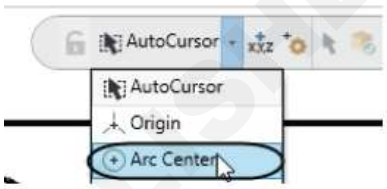
Fig 28

- Right click and select the Top view.



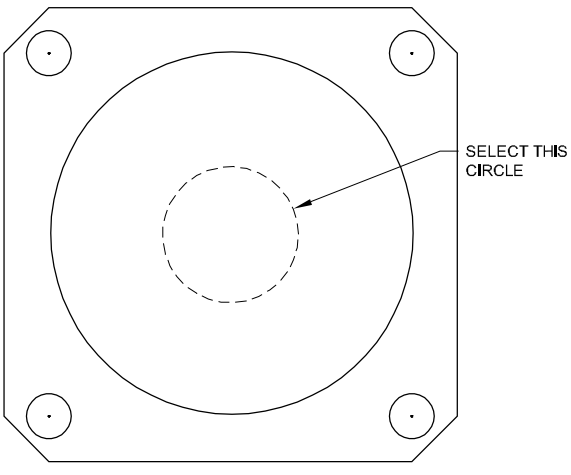
- **Select one or more entities to add or remove from the features list**: From the General Selection Bar, click on the Auto Cursor arrow and select Arc Center as shown in Fig 29

Fig 29



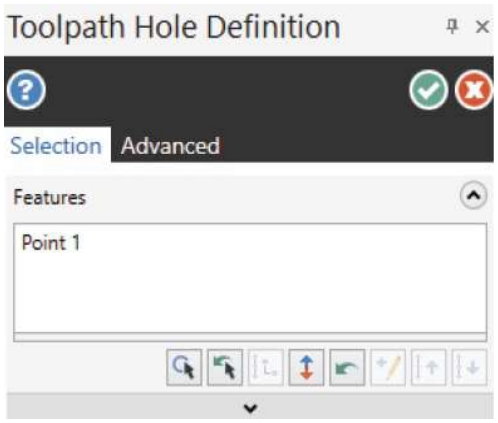
- Select the 18mm diameter circle as shown in Fig 30

Fig 30



- The Point will be displayed in the Features list as shown in Fig 31

Fig 31

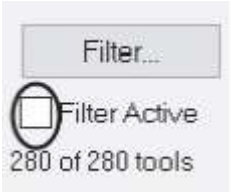


- Select the OK button to finish the selection and exit Toolpath Hole Definition.

- In the Toolpath Type page, the Circle Mill icon will be selected.

Select a 6mm Flat End mill from the library and set the Tool parameters (Fig 32)

- Select Tool from the Tree View list.
- Click on Select Library tool button. Select library tool...
- To be able to see all the tools from the library, disable Filter Active.

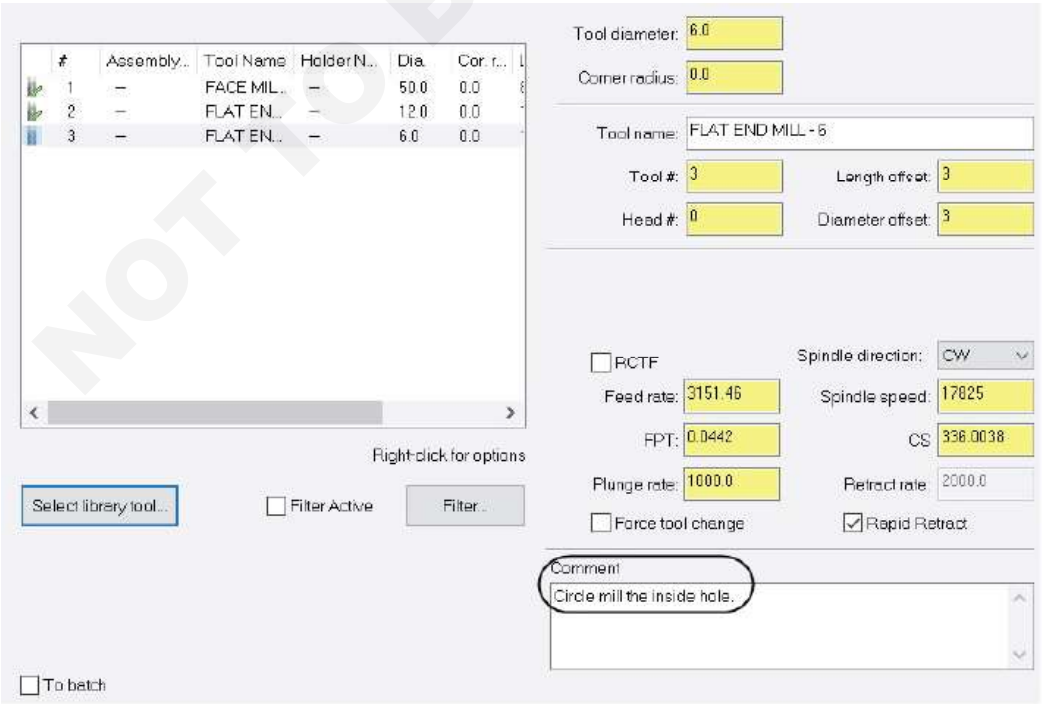


- Scroll down and select the 6mm FlatEndmill as shown.
- Select the tool in the Tool Selection page and then select the OK button to exit.
- Input a comment and make all the necessary changes, as shown in Fig 33

Fig 32

#	Assembly...	Tool Name	Holder Name	Dia.	Cor. r...	Length	# Flut...	Type	Rad....
5	–	FLAT END MILL - 16	–	16.0	0.0	26.0	4	End...	None
5	–	END MILL WITH RADIU...	–	10.0	1.0	16.0	4	End...	Corn...
5	–	END MILL WITH RADIU...	–	4.0	0.2	7.0	4	End...	Corn...
5	–	FLAT END MILL - 12	–	12.0	0.0	19.0	4	End...	None
5	–	FLAT END MILL - 6	–	6.0	0.0	10.0	4	End...	None
5	–	END MILL WITH RADIU...	–	16.0	2.0	26.0	4	End...	Corn...
5	–	END MILL WITH RADIU...	–	6.0	1.0	10.0	4	End...	Corn...

Fig 33



Cut Parameters

- From the Tree View list, select Cut Parameters and ensure the settings appear as shown in Fig 34

Roughing

- From the Tree View list, select Roughing and enable it. Set the Stopover to 50%, enable Helical Entry, and specify the other parameters as shown in Fig 35

Fig 34

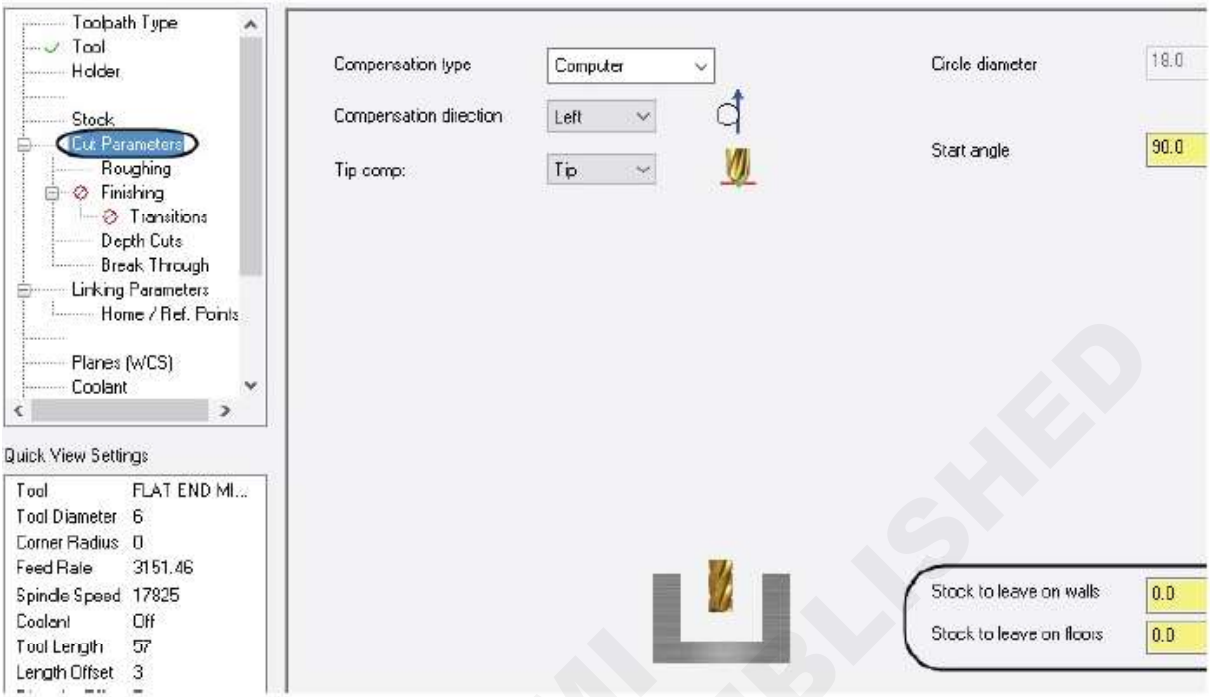
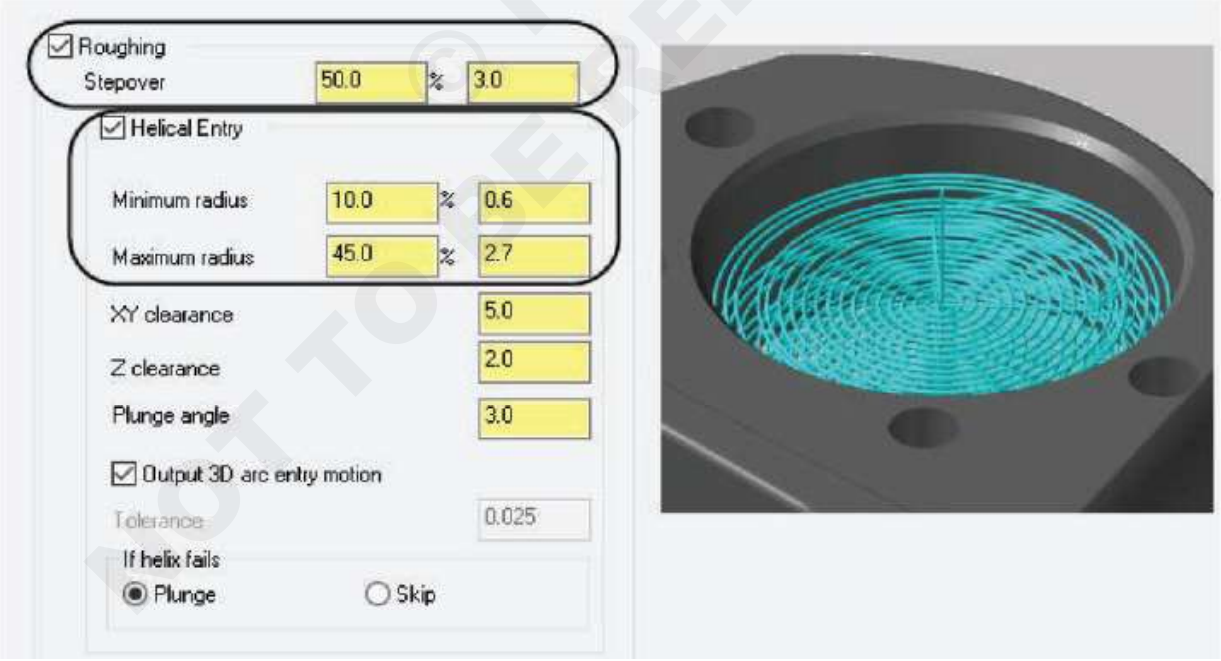


Fig 35



Stopover sets the distance between cutting passes in the X and Y axes as a percentage of the tool diameter.

Helical Entry creates a helix at the center of the circle to begin the roughing motion. If this option is turned off, the tool plunges to start the toolpath.

Depth Cuts

- Make any necessary change as shown in Fig 36

Fig 36

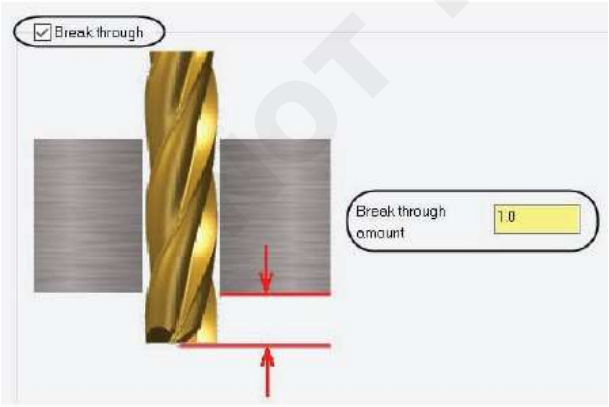
Depth Cuts sets the steps the tool takes along the Z axis. Mastercam will take the total depth and divide it into separate depth cuts. Mastercam never performs unequal depth cuts.

Max rough step sets the maximum amount of material removed in the Z axis with each rough cut. Mastercam will calculate equal rough cuts no larger than the maximum rough step until it reaches the final Z depth.

Set the Break Through

- From the Tree View list, select Break Through and set the parameters to completely cut through the material by an amount that you specify as shown in Fig 37

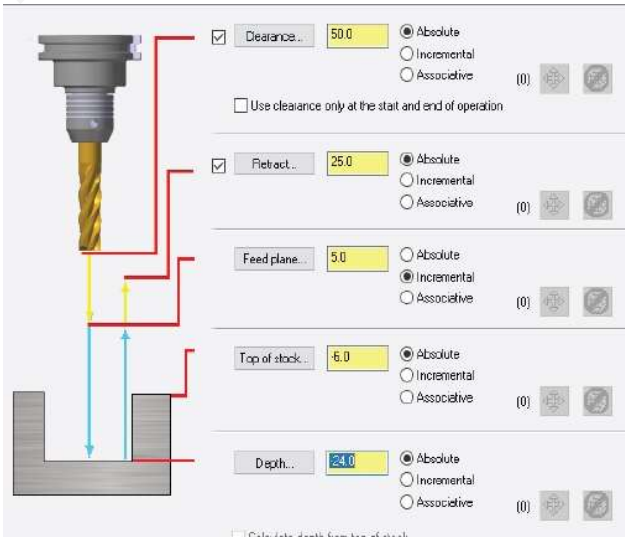
Fig 37



Linking Parameters

- Select Linking Parameters from the Tree View list.
- Change the Top of stock to -6.0 and set the Depth to -24.0. Ensure all the values are set the same as shown in Fig 38

Fig 38



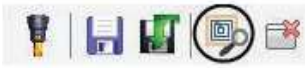
Absolute values are always measured from the origin 0,0,0.

Incremental values are relative to other parameters or chained geometry.

Associative option allows you to select points from the existing geometry from where the values will be measured.

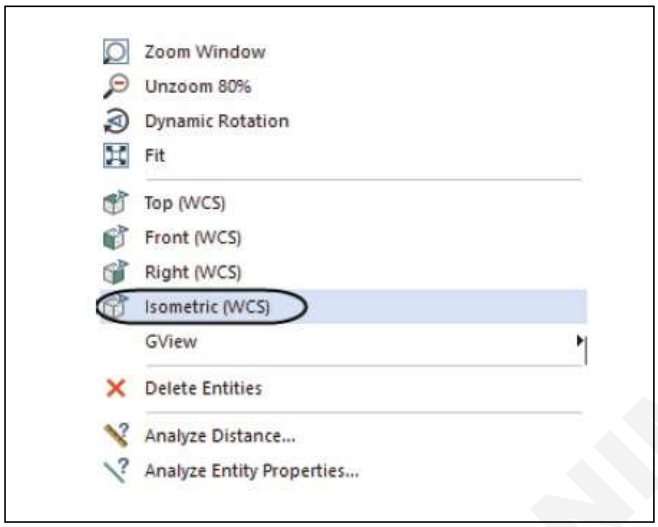
Preview the Toolpath

- Select the Preview toolpath icon as shown.



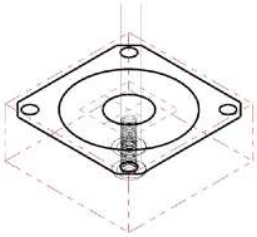
- Click on the Hide dialog icon as shown.

- To see the part from an Isometric view, right mouse click in the graphics window and select Isometric as shown.



- The toolpath should look as shown in Fig 39

Fig 39



- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

- Select the OK button to exit the 2D Toolpaths - Circle Mill parameters.

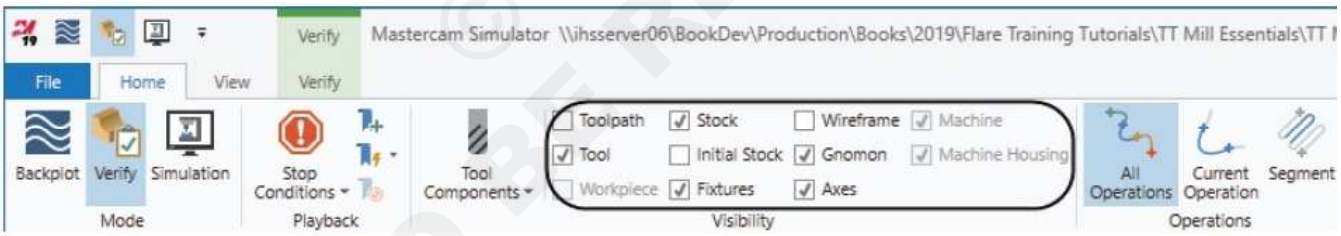
Verify the Toolpaths

- From the Toolpaths Manager, click on the select all operations icon.

- Click on the Verify selected operation icon.

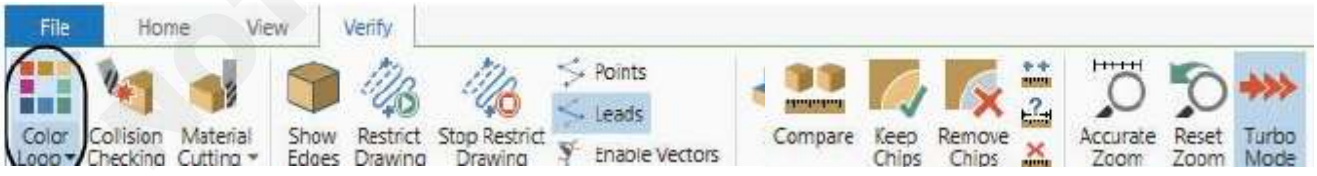
- For information on how to set the Verify parameters and how to simulate the toolpath,
- Disable Wireframe as shown in Fig 40

Fig 40



- Select the Verify tab, and enable Color Loop as shown in Fig 41

Fig 41

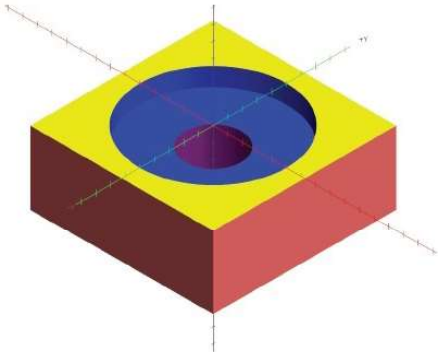


Note: This option will change the material removal color. This can be set based on the operation or on the tool number used to machine the part. This makes it easier to spot if you forget to leave the stock in the finish operations

- Select the Play button as shown.

- The part will appear as shown in Fig 42

Fig 42



- To go back to Mastercam window, minimize Mastercam Simulator window as shown.

6 Spot drill the 6mm holes

Spot Drilling the holes allows you to start the hole. In this operation, we will use the spot drill to chamfer the hole before drilling it.

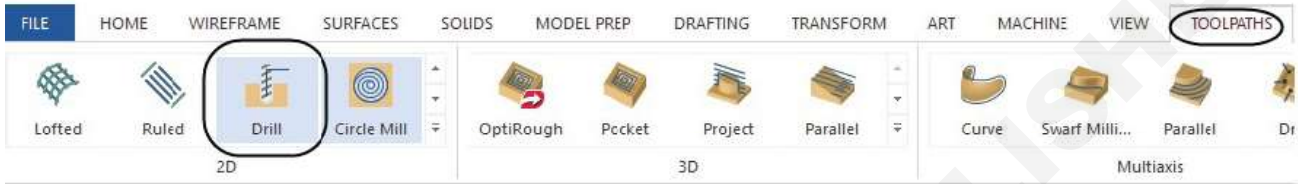
Toolpath Preview:

- Select all toolpaths and press T to remove the toolpath display if needed.

Toolpaths

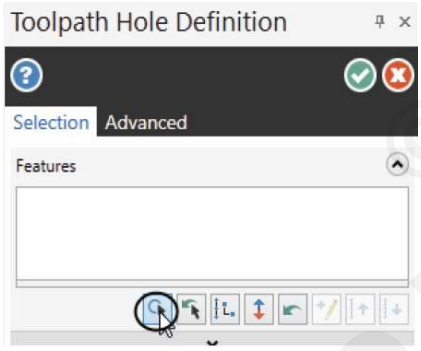
- In the 2D group, select the Drill icon as shown in Fig 43

Fig 43



- In the Toolpath Hole Definition panel, choose the option Mask on Arc. (Fig 44)

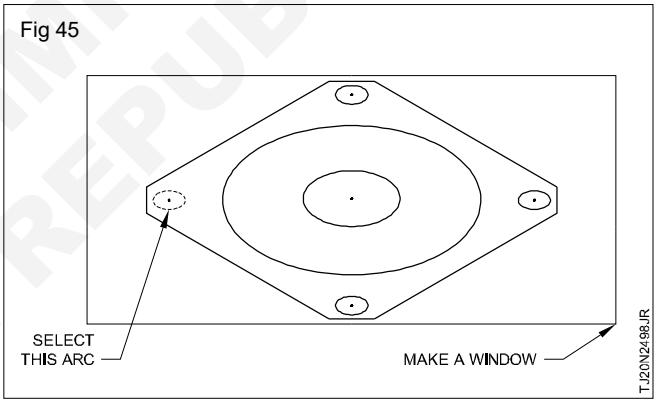
Fig 44



Note: Mask on Arc is a tool for selecting arcs whose diameters match the one that you select within a specified tolerance.

- Hover the cursor above the center of the geometry and scroll down the mouse wheel to un zoom the geometry as shown in Fig 45
- **Select an arc to match:** Select one of the four arcs as shown in Fig 45
- **Draw a window to select entities:** Left click in the upper left corner of the graphics window, hold the left button down and drag a rectangle to the lower right corner of the part to include all entities, as shown in Fig 45

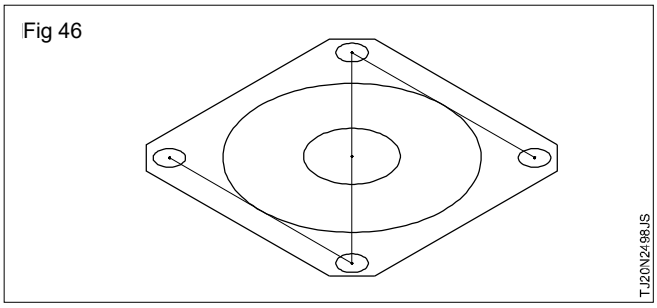
Fig 45



- Release the left mouse button and click it again once you have created a window encompassing the entire part.

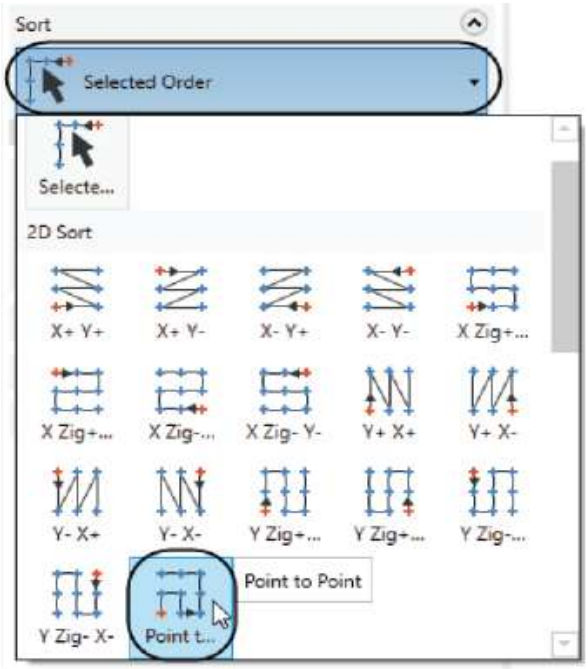
Note: Only the four arcs that have the same diameter will be selected. The order in which the holes are selected follows a zigzag pattern as shown in Fig 46

Fig 46



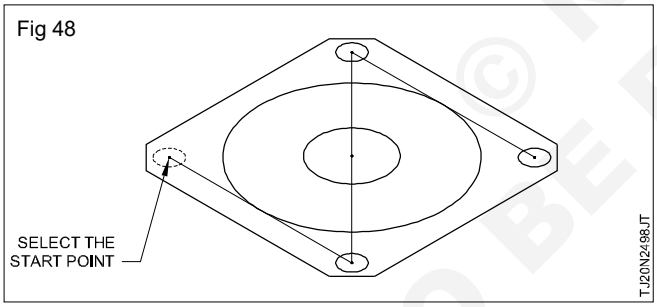
- To change the order in which the holes are drilled, in the Toolpath Hole Definition click on the Selected Order and select the Point to Point icon as shown in Fig 47

Fig 47



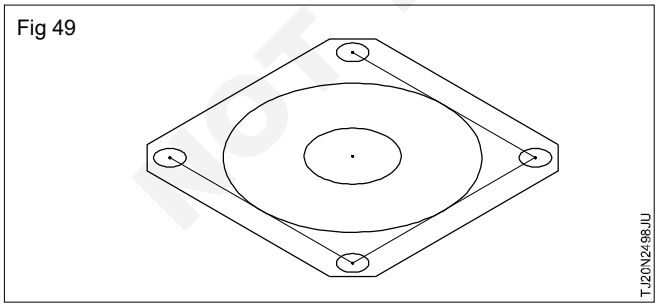
- The system will prompt you to select the start point. Reselect the first hole as shown in Fig 48

Fig 48

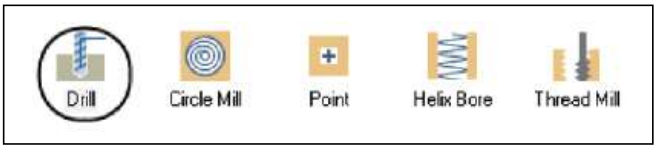


- The order in which the holes will be drilled should look as shown in Fig 49

Fig 49



- Select the OK button in the Toolpath Hole Definition panel to accept the 4 center points.
- In the Toolpath Type page, the Drill toolpath should already be selected.



Select a 20mm Spot Drill from the library and set the Tool Parameters

- Select Tool from the Tree View list.
- Click on the select library tool button. 

- To view only the spot drill, select the Filter button.

- Under Tool Types, select the None button to unselect any unwanted tool.
- Hover the cursor over each icon and the tool type will be displayed. Choose the Spot Drill icon as shown in Fig 50

Fig 50

- Select the OK button to exit the Tool List Filter dialog box.
- At this point you should only see Spot Drills.
- From that list select the 20mm NC Spot Drill as shown in Fig 51

Fig 51

#	Assembly...	Tool Name	Holder Name	Dia.	Cor. r...	Length	# Flut...	Type	Rad...
12	–	NC SPOT DRILL - 12	–	12.0	0.0	30.0	1	Spot...	None
12	–	NC SPOT DRILL - 8	–	8.0	0.0	22.0	1	Spot...	None
12	–	NC SPOT DRILL - 16	–	16.0	0.0	34.0	1	Spot...	None
12	–	NC SPOT DRILL - 20	–	20.0	0.0	40.0	1	Spot...	None
12	–	NC SPOT DRILL - 10	–	10.0	0.0	26.0	1	Spot...	None
12	–	NC SPOT DRILL - 6	–	6.0	0.0	17.0	1	Spot...	None

- Select the tool in the Tool Selection page and then select the OK button to exit.
- Input a comment and make the necessary changes to the Tool page as shown in Fig 52

Set the Cut Parameters

- Select Cut Parameters and make sure the parameters are set as shown in Fig 53

Fig 52

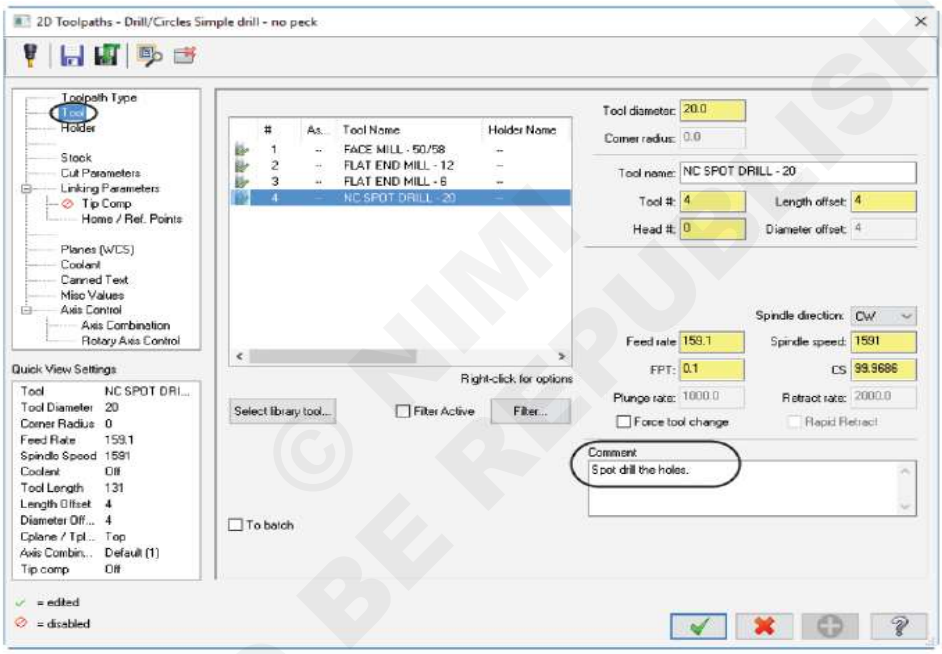
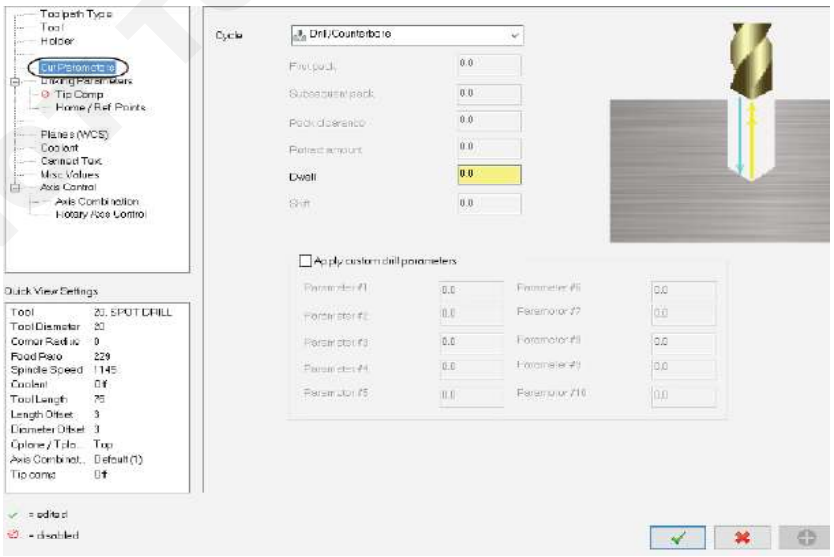


Fig 53



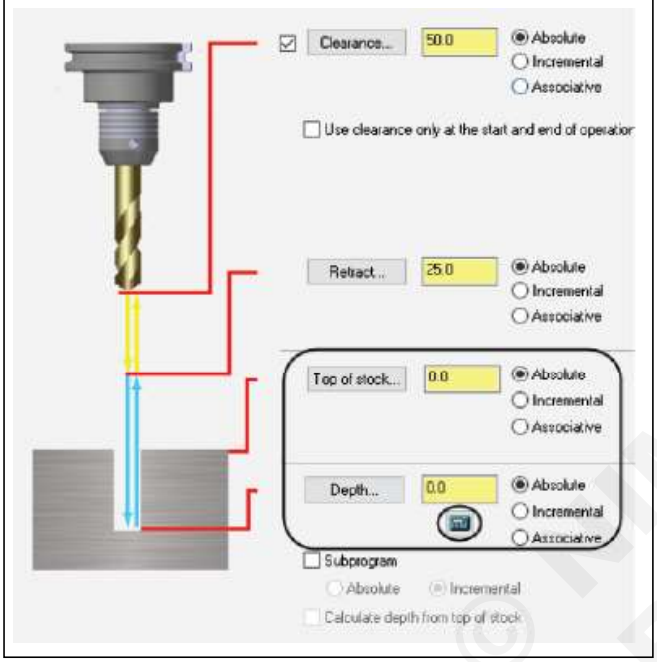
Drill / Counter bore is recommended for drilling holes with depths of less than three times the tool's diameter.

Dwell sets the amount of time in seconds that the tool remains at the bottom of a drilled hole.

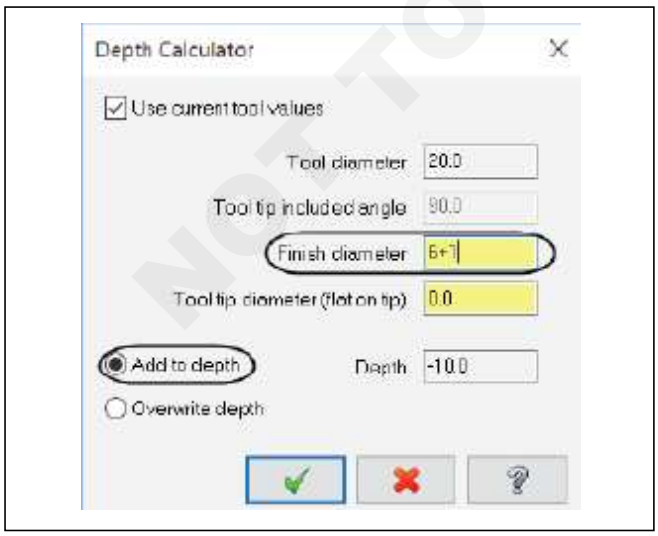
Linking Parameters

- Choose Linking Parameters and ensure Clearance is enabled. Set the Top of stock and the Depth to Absolute and 0.0 as shown.
- Select the Calculator icon on the right hand side of the Depth icon as shown in Fig 54

Fig 54



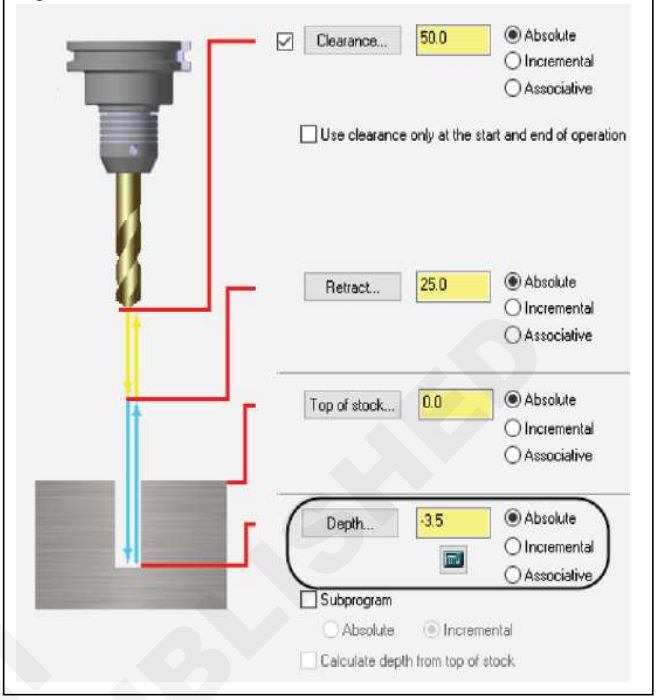
- To generate a 1.0 chamfer, input the following equation in the Finish diameter area: 6+1 (diameter of the finished hole + 2 X the chamfer size) and hit Enter to calculate the Depth, as shown. Make sure that Add to depth is enabled.



- Select the OK button to exit the Depth Calculator.

- You will now see the Depth for this spot drilling operation is updated after we specify the finish diameters of the holes including the chamfer. Change the rest of the parameters as shown in Fig 55

Fig 55

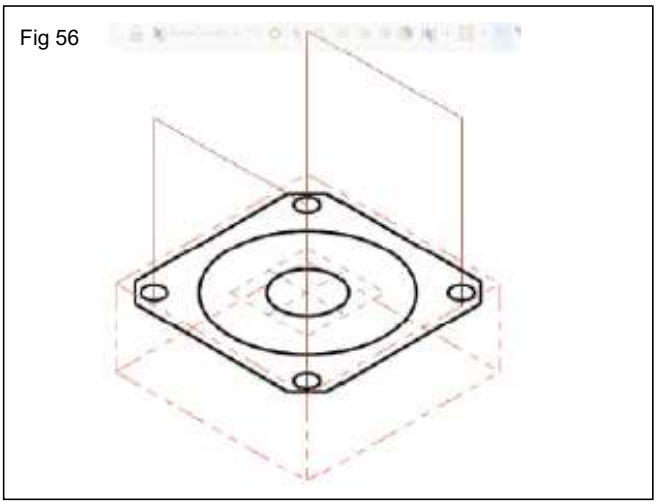


Preview the Toolpath

- To quickly check how the toolpath will be generated, select the Preview toolpath icon as shown.

- to review the procedure.
- The toolpath should look as shown in Fig 56

Fig 56



- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

- Select the OK button to exit the 2D Toolpaths - Drill/ Circles Simple drill - no peck parameters.

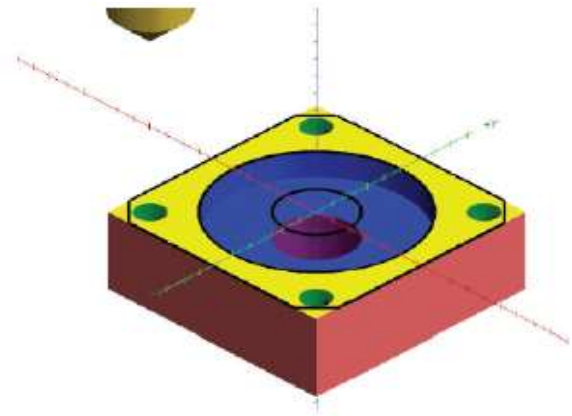
Verify the toolpaths (Fig 57)

- From the Toolpaths Manager, click on the select all operations icon.

- Click on the Verify selected operation icon.

- to review the procedure.

Fig 57



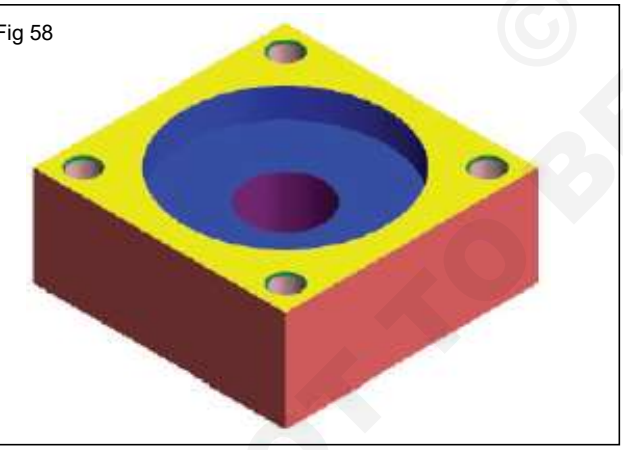
- To go back to the Mastercam window, minimize the Mastercam Simulator window as shown

7 Drill the 6mm holes

In this step, we will drill the holes to a specified depth.

Toolpath Preview Fig 58

Fig 58

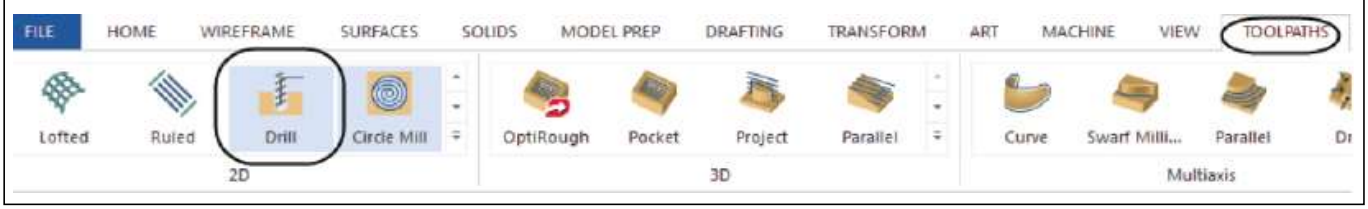


- Move the cursor in the Toolpaths Manager and press Alt + T until the toolpath display is removed

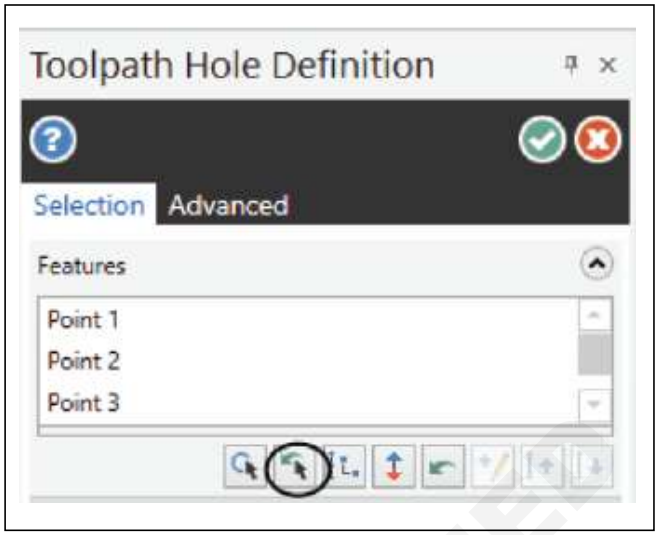
TOOLPATHS

- From the 2D group, select Drill. (Fig 59)

Fig 59



- In the Toolpath Hole Definition panel, choose the option Copy previous points icon as shown.



- This option will automatically select the 4 holes from the previous drill operation.
- Select the OK button in the Toolpath Hole Definition panel to accept the 4 drill points. 
- In the Toolpath Type page, the Drill toolpath will be selected as shown.

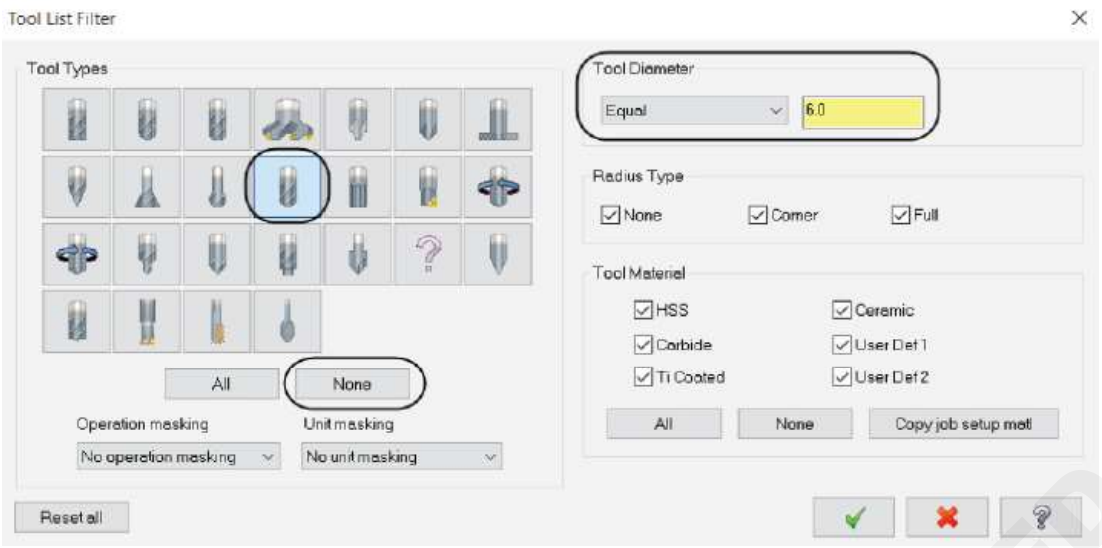
Select a 6mm Drill from the library and set the Tool Parameters

- Select Tool from the Tree View list. 

- Click on the select Library tool button.
- To view only the drill tools, select the Filter button.

- Under Tool Types, select the None button and then choose the Drill icon. Under the Tool Diameter section, select Equal and input a value of 6.0. (Fig 60)

Fig 60



- Select the OK button to exit the Tool List Filter panel. 

- At this point you should see a 6mm HSS/TIN Drill. (Fig 61)

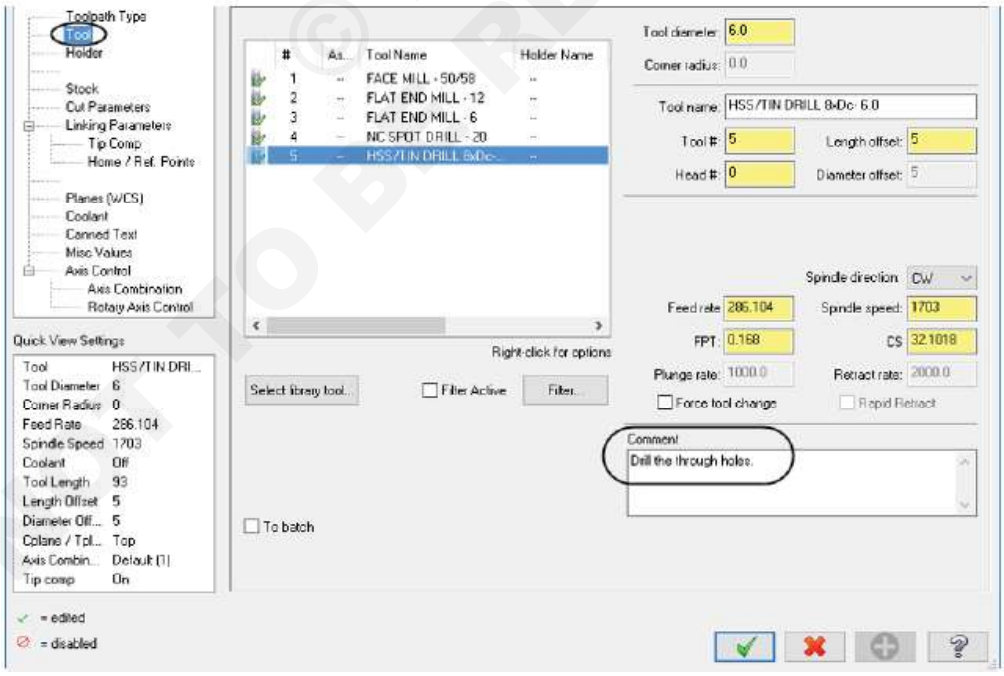
Fig 61

#	Assembly...	Tool Name	Holder Name	Dia.	Cor. r...	Length	# Flut...	Type	Rad....
1	–	HSS/TIN DRILL 8xDc- 6.0	–	6.0	0.0	48.0	1	Drill	None
2	–	SOLID CARBIDE DRILL ...	–	6.0	0.0	35.0	1	Drill	None

- Select the tool in the Tool Selection page and then choose the OK button to exit. 

- Make the necessary changes to the Tool page as shown in Fig 62

Fig 62

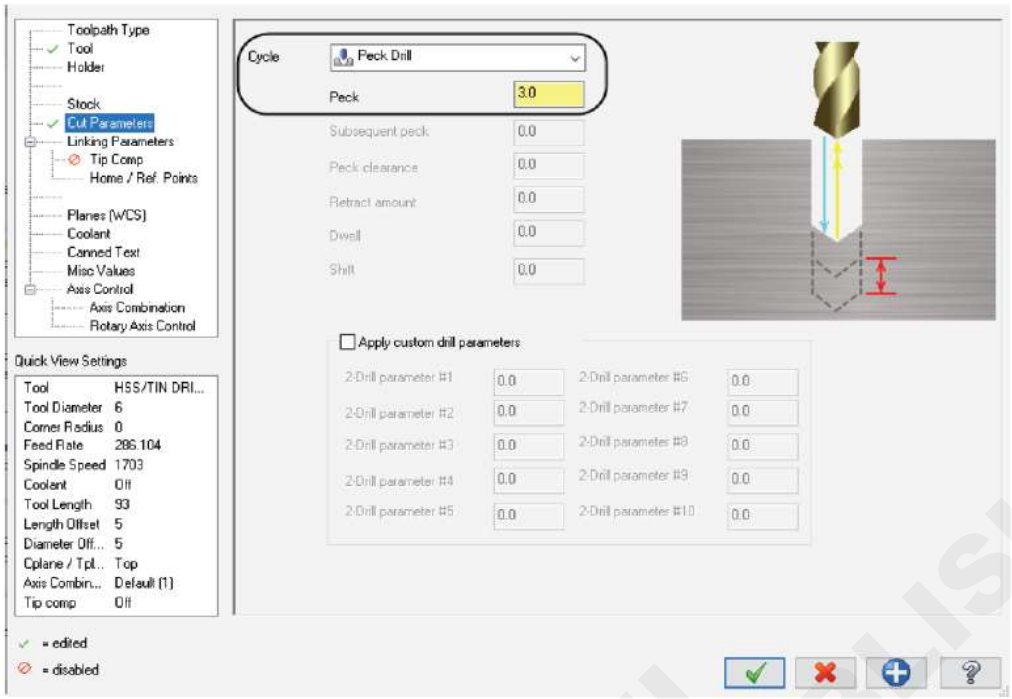


Note: The Feed rate, Plunge rate, retract rate, and Spindle speed are based on the tool definition as set in the Tool Settings. You may change these values as per your part material and tools.

Cut Parameters

- Select Cut Parameters and change the drill Cycle to Peck Drill as shown in Fig 63

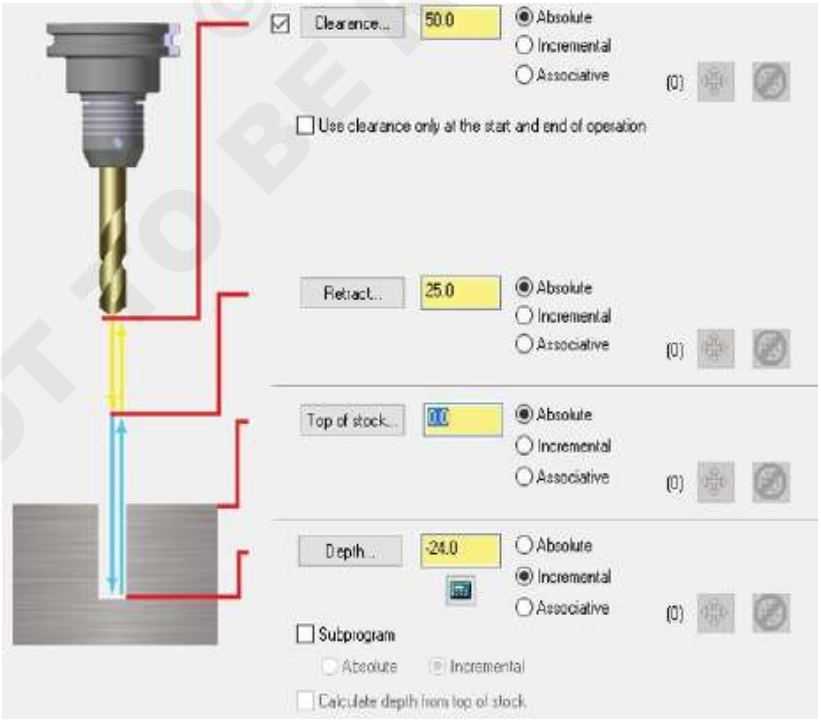
Fig 63



Linking Parameters

- Choose Linking Parameters and set the Top of stock to 0.0. Input a Depth value of -24.0 as shown in Fig 64

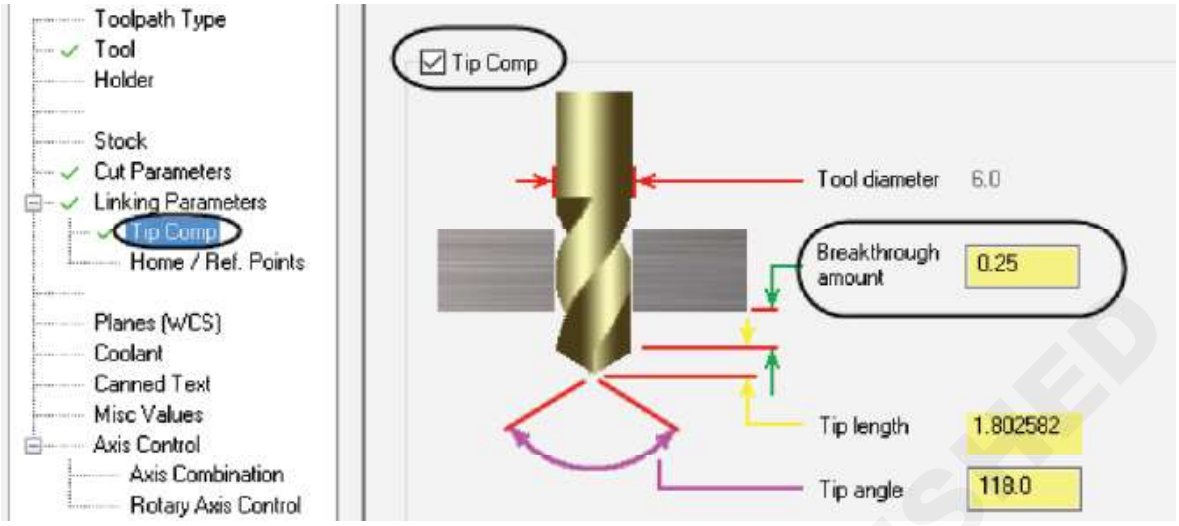
Fig 64



Set the Tip Compensation

- Select Tip Comp and enable it.
- Set the Breakthrough amount to 0.25 as shown in Fig 65

Fig 65

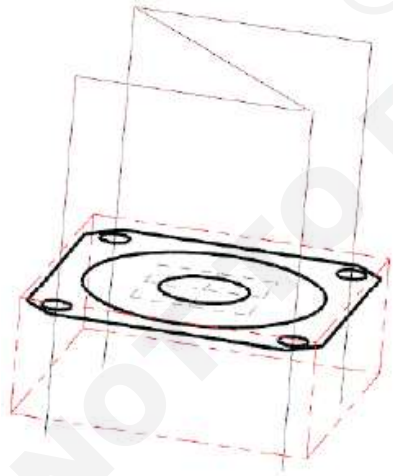


Preview the Toolpath

- To quickly check how the toolpath will be generated, select the Preview toolpath icon as shown.

- Click with the mouse wheel and drag to slightly rotate the part.
- The toolpath should look as shown in Fig 66

Fig 66



- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

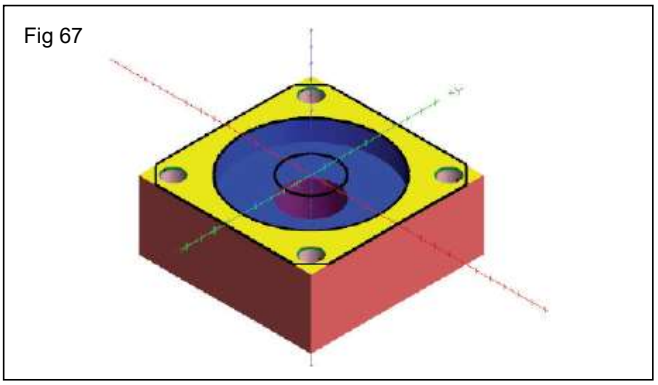
- Select the OK button to exit the 2D Toolpaths - Drill/ Circles Peck drill - full retract parameters.

Verify the toolpaths (Fig 67)

- From the Toolpaths Manager, click on the select all operations icon.

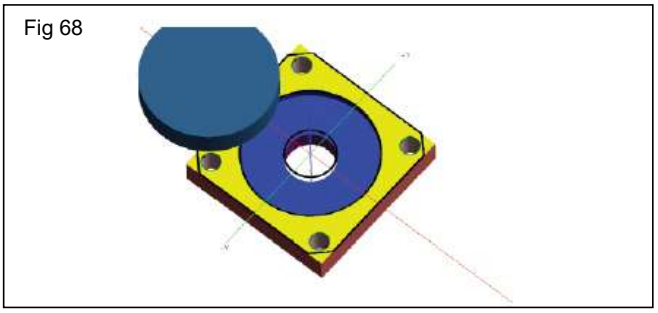
- Click on the Verify selected operation icon. to verify the tool path

Fig 67



- To rotate the part, click in the center of the part with the mouse wheel. Hold down the mouse wheel and slightly drag the cursor to rotate. (Fig 68)

Fig 68



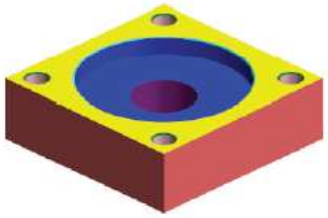
- To go back to the Mastercam window, minimize the Mastercam Simulator window as shown.

8 Chamfer the large hole

Chamfer Toolpath automatically cuts a chamfer around a contour using a chamfer mill.

Toolpath Preview: (Fig 69)

Fig 69



Chain selection

A Chain of entities consists of one or more entities linked together in order and direction. The distance between the endpoints of two consecutive entities of the chain has to be equal or less than the chaining tolerance (0.0001). In an open chain, the start point is placed at the end of the chain closest to the selection point and the chain direction points to the opposite end of the chain. See Help for more information on chaining.

- Hover the cursor in the Toolpaths Managers and press Alt + T to remove the toolpath display.

TOOLPATHS

- From the 2D group, click on the upper arrow until the Contour toolpath appears as shown.
- Click on the Contour icon. (Fig 70)

Fig 70

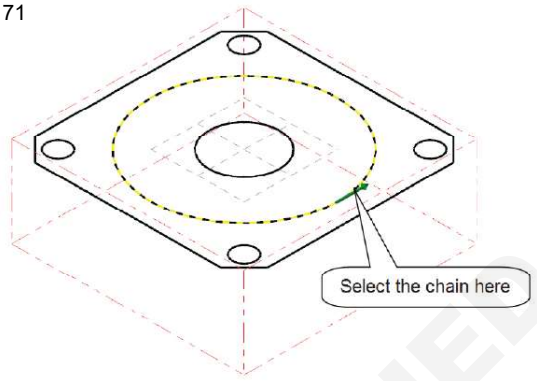
- Leave the default settings in the Chaining dialog box as shown in Fig 72

Fig 72

Note: The Chain button is enabled in the Chaining dialog box. This lets you chain the entire contour by clicking on one entity.

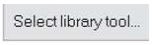
- Select the chain and ensure the chaining direction is the same as shown in Fig 71

Fig 71



- Select the OK button to exit the Chaining dialog box.
- In the Toolpath Type page, the Contour toolpath should already be selected.

Select a 10mm Chamfer Mill from the library and set the Tool parameters

- Select Tool from the Tree View list.
- Click on the select library tool button. 

- To be able to see just the spot drill, select the Filter button.

- Under Tool Types, select the None button and then choose the Chamfer mill icon. (Fig 73)
- Select the OK button to exit the Tool List Filter dialog box.
- At this point you should only see a list of chamfer mills.
- From the Tool Selection list, select the 10/90DEG Chamfer Mill. (Fig 74)

Fig 73

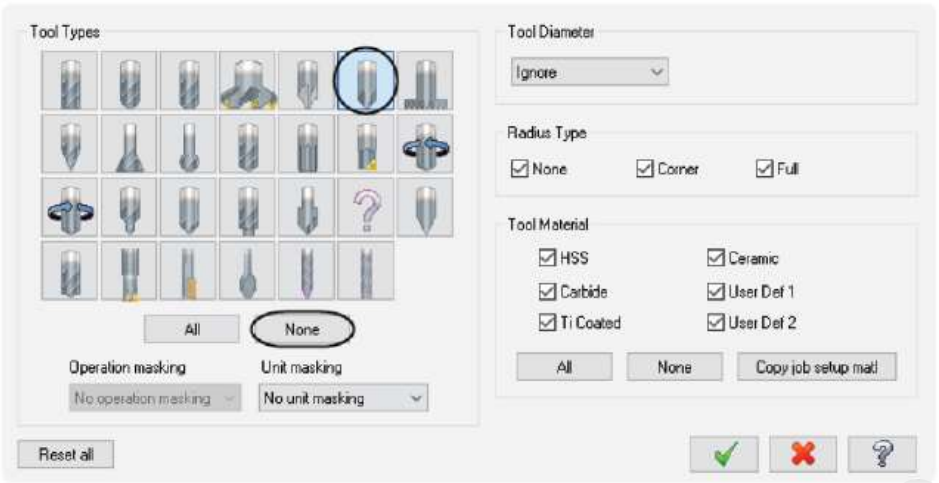


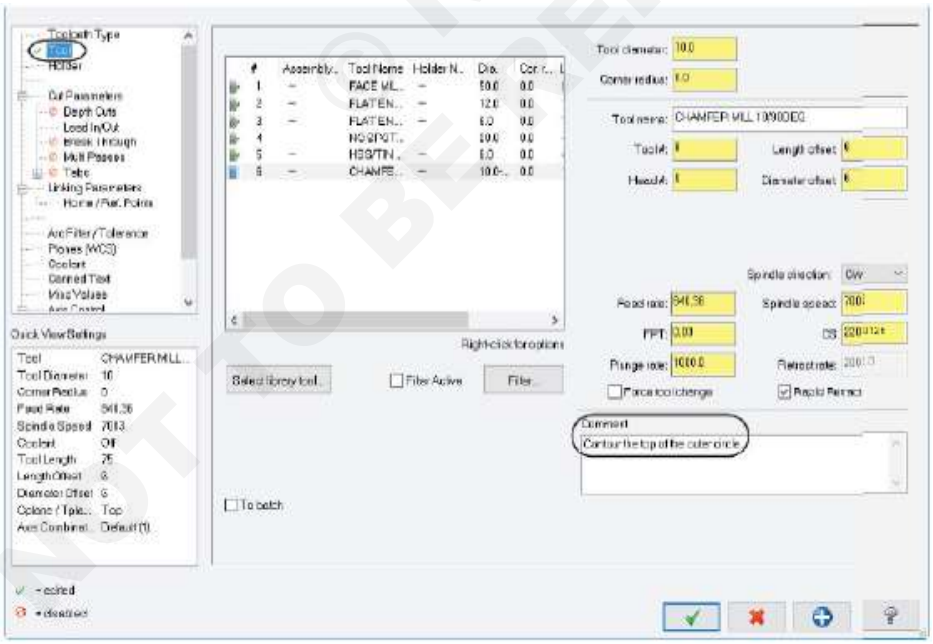
Fig 74

- In the Tool Selection page, choose the OK button to exit.
- A warning message might appear on the screen telling that the tool selected is not defined as being capable of both roughing and finishing.

Note: The chamfer mill is defined for finish operation only. For chamfer toolpath, we only need a finish operation.

- Select the OK button to continue.
- Input a comment and make the necessary changes as shown in Fig 75

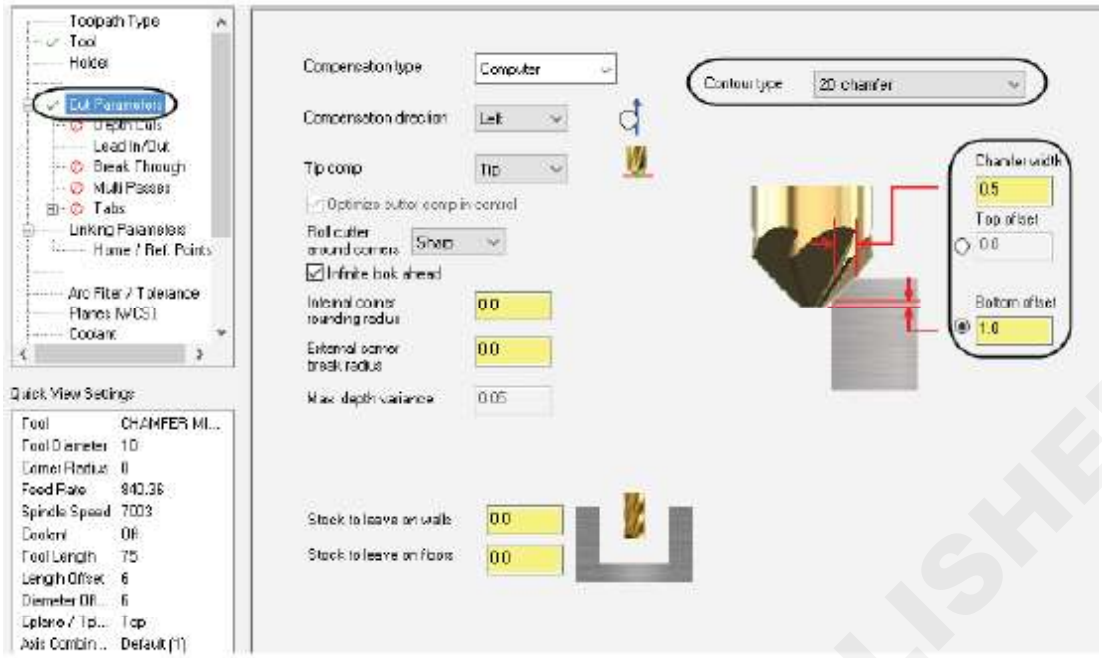
Fig 75



Cut Parameters (Fig 76)

- Select the Cut Parameters page and change the Contour type to 2D chamfer.
- Input a Chamfer width of 0.5 and a Bottom offset of 1.0 as shown.

Fig 76



2D chamfer cuts chamfers around a contour

Chamfer width sets the chamfer width. Mastercam measures the width from the chained geometry adjusted by the cut depths defined on the Linking Parameters page.

Bottom offset is an amount to ensure that the tip of the tool clears the bottom of the chamfer.

Roll cutter around corners inserts arc moves around corners in the toolpath.

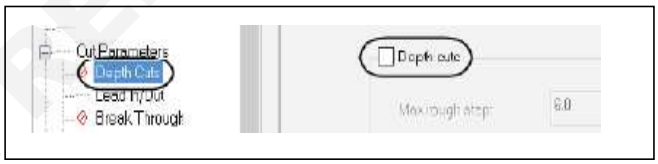
None guarantees all sharp corners.

Sharp rolls the tool around sharp corners (135 degrees or less).

All rolls the tool around all corners and creates smooth tool movement.

Depth Cuts

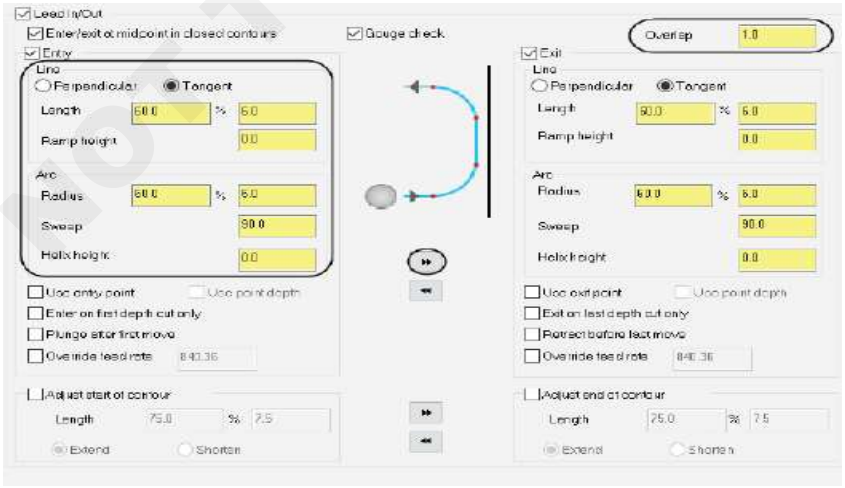
- Select Depth Cuts and disable it as shown.



Lead in/Out

- From the Tree View list, select Lead in/Out. Change the Lead in /Out parameters and input an Overlap value as shown in Fig 77

Fig 77



Lead in/Out allows you to select a combination of a Line and an Arc at the beginning and/or end of the contour toolpath for a smooth entry/exit while cutting the part.

Length is set to 60% of the tool diameter to ensure that the linear movement is greater than the tool radius in case

Cutter Compensation in Control was used.

Radius is set to 60% of the tool diameter to ensure that the arc movement is greater than the tool radius to generate an arc output.

Overlap sets how far the tool goes past the end of the toolpath before exiting for a cleaner finish.

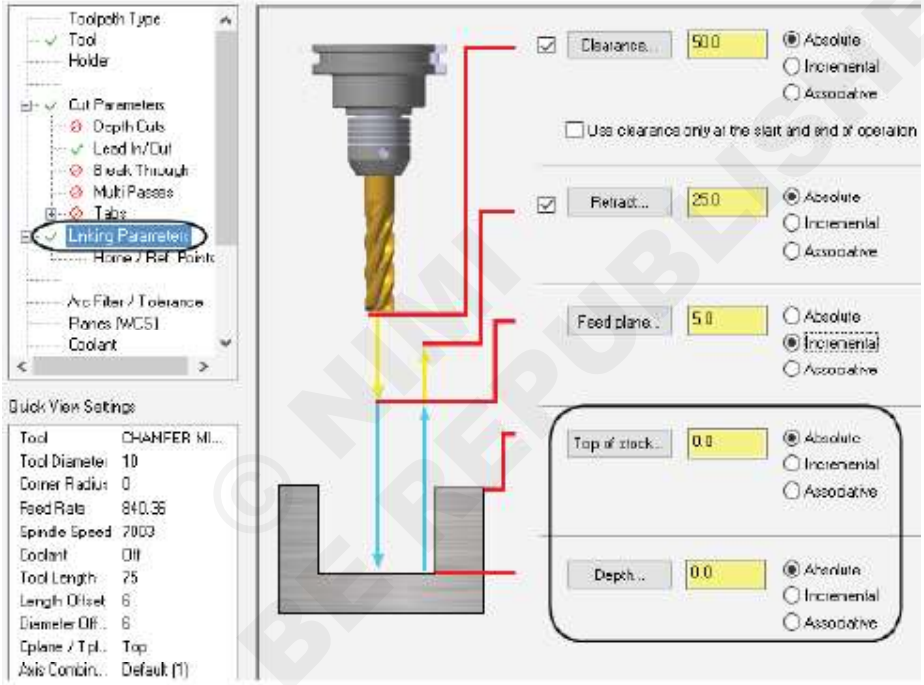
Multi Passes (Fig 78)

- Select Multi Passes from the Tree View list. Disable Multi Passes as shown.

Linking Parameters

- Select Linking Parameters from the Tree View list. Set the Top of stock to 0.0 and the Depth to 0.0 as shown. Enable Clearance if needed, and set it to 50.0.

Fig 78

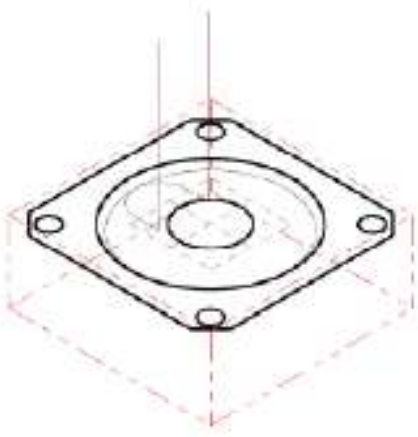


Preview the Toolpath

- To quickly check how the toolpath will be generated, select the Preview toolpath icon as shown.

- See Page 68 to review the procedure.
- The toolpath should look as shown in Fig 79

Fig 79



- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

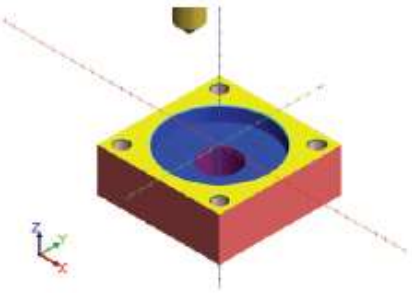
- Select the OK button to exit the 2D Toolpaths - Contour parameters.

Verify the Toolpaths

- From the Toolpaths Manager, click on the Select all operations icon.
- Click on the Verify selected operation icon.

- Verify the toolpaths,
- The part will appear as shown in Fig 80

Fig 80



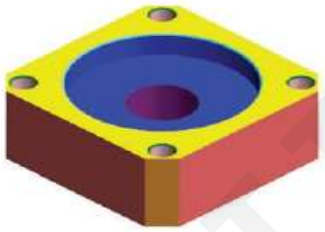
- To go back to Mastercam window, minimize Mastercam Simulator window as shown.

9 Machine the chamfers at the corners using contour toolpath

In this step, you will machine the corners of the part using Contour Toolpath.

Toolpath Preview: (Fig 81)

Fig 81



- To remove the toolpath display, hover the cursor in the Toolpaths Manager and press T until the toolpaths disappear or press Alt + T.

TOOLPATHS

- From the 2D group, select Contour as shown in Fig 82

- To select only one entity at a time, select the Single button in the Chaining dialog box as shown below. (Fig 83)

Fig 83

- Right mouse click in the graphics window and select the Top view as shown.

- Select the chains and ensure the chaining direction is the same as shown in Fig 84

Note: Select the contour as shown in Figure: 10.0.1 to ensure that the chaining directions for all four chains are correct. Use the Reverse button to flip the chains if needed. The green color arrow shows the chain's start location and the red color arrow shows the end of the chain. The chain selection arrows will disappear when you select the next chamfer.

Fig 84

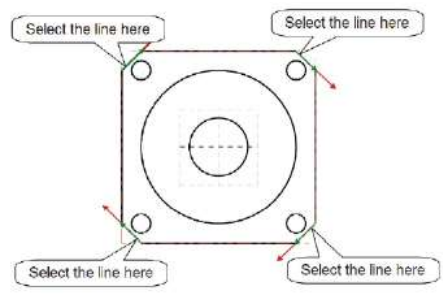
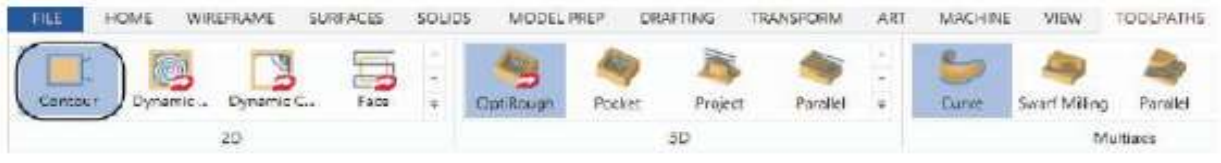


Fig 82

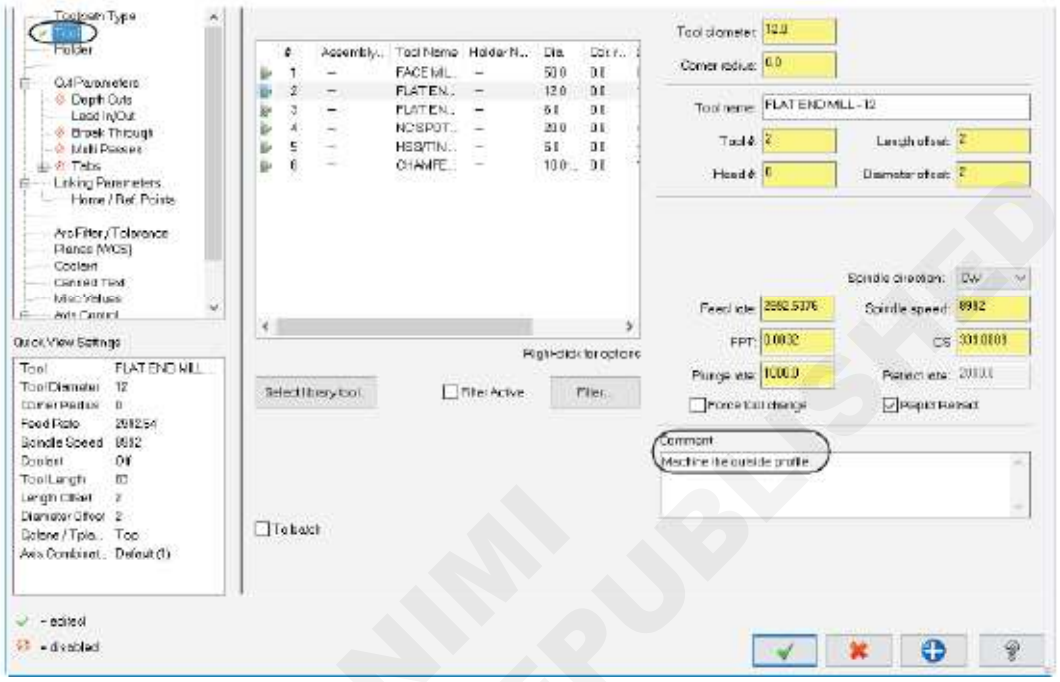


- Select the OK button to exit the Chaining dialog box.
- In the Toolpath Type page, the Contour toolpath will be selected.

Select the 12mm Flat Endmill and set the Tool parameters

- Select the 12mm Flat Endmill and make all the necessary changes as shown in Fig 85

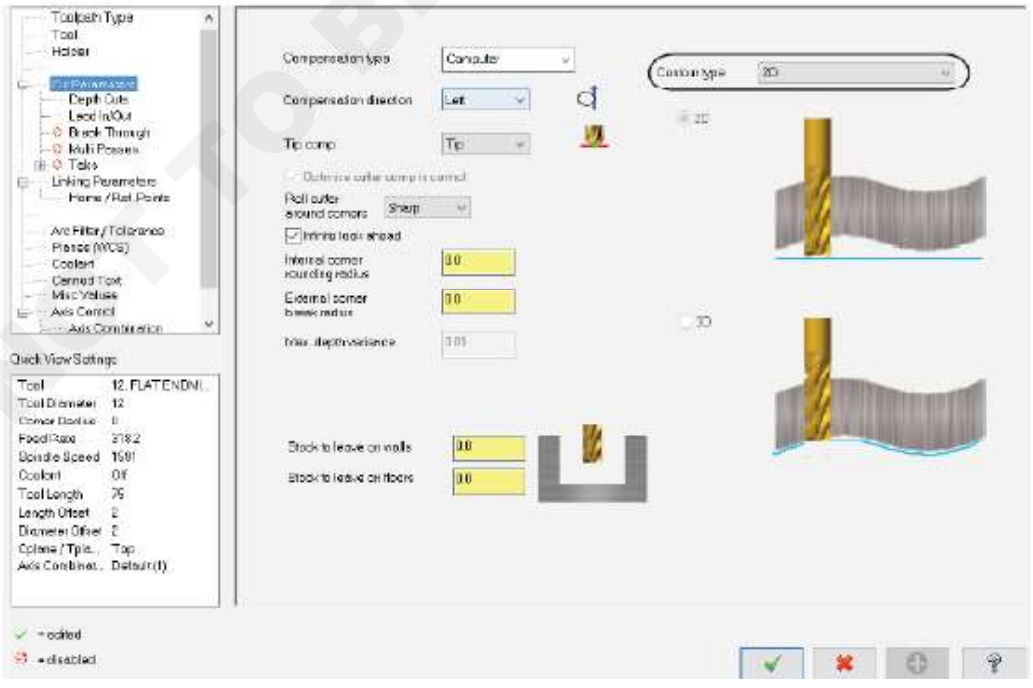
Fig 85



Cut Parameters

- Select the Cut Parameters page and change the Contour type to 2D as shown in Fig 86

Fig 86



Compensation type allows you to choose the compensation between Computer, Control, Wear, Reverse wear or Off.

Compensation type set to Computer instructs Mastercam to compute the compensated toolpath and does not output control codes for compensation.

Roll cutter around corners inserts arc moves around corners in the toolpath.

Internal corner rounding radius allows you to enter a radius value to create a smoother tool motion in sharp corners. Corner smoothing reduces tool wear and makes your tool motion more efficient.

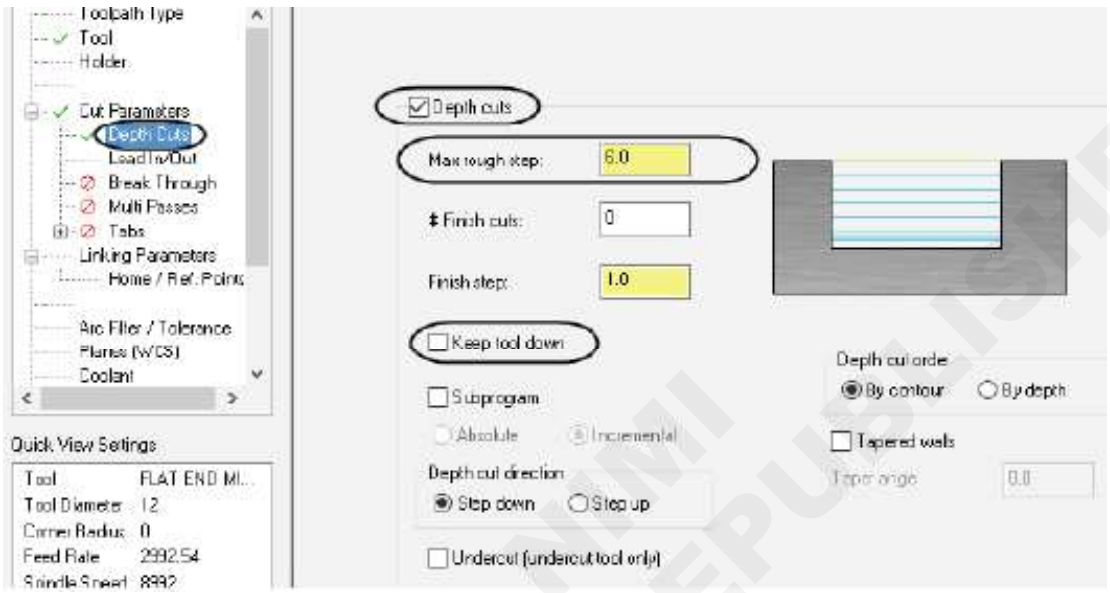
External corner break radius allows you to enter a radius value to break external sharp corners defined within a chain to create a smooth, rounded corner.

Stock to Leave on walls/floors allows you to enter a value to leave material for a finish toolpath.

Depth Cuts

- Select Depth Cuts and enable it as shown.
- Make sure that the parameters are set as shown in Fig 87

Fig 87

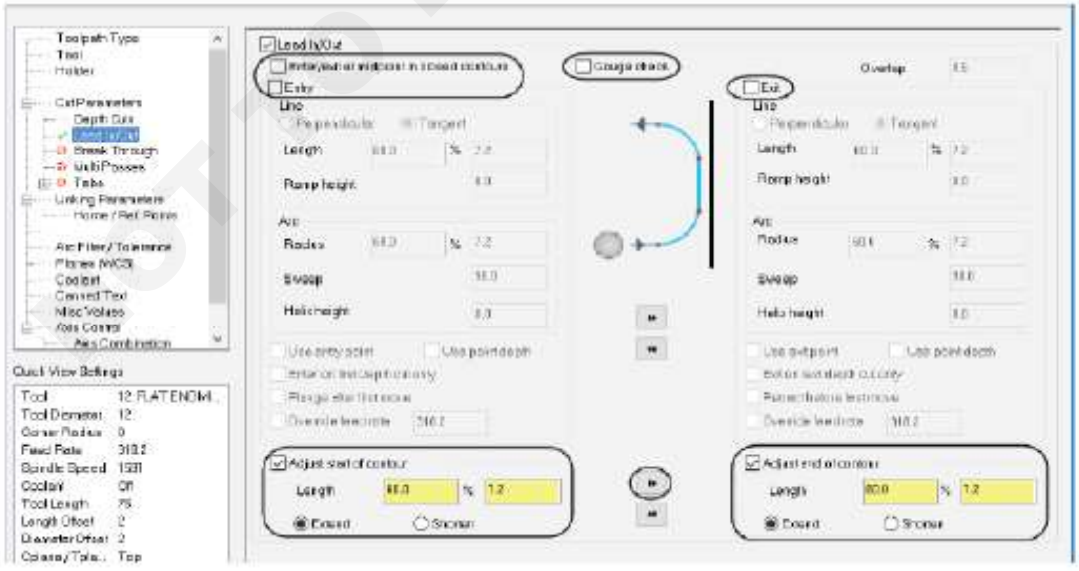


Lead in/Out

- Select Lead in/Out from the Tree View list. Make sure the parameters are set as shown in Fig 88

Adjust start/end of contour moves the starting/ending position in open contours by adding (Extend) or removing (Shorten) the specified length.

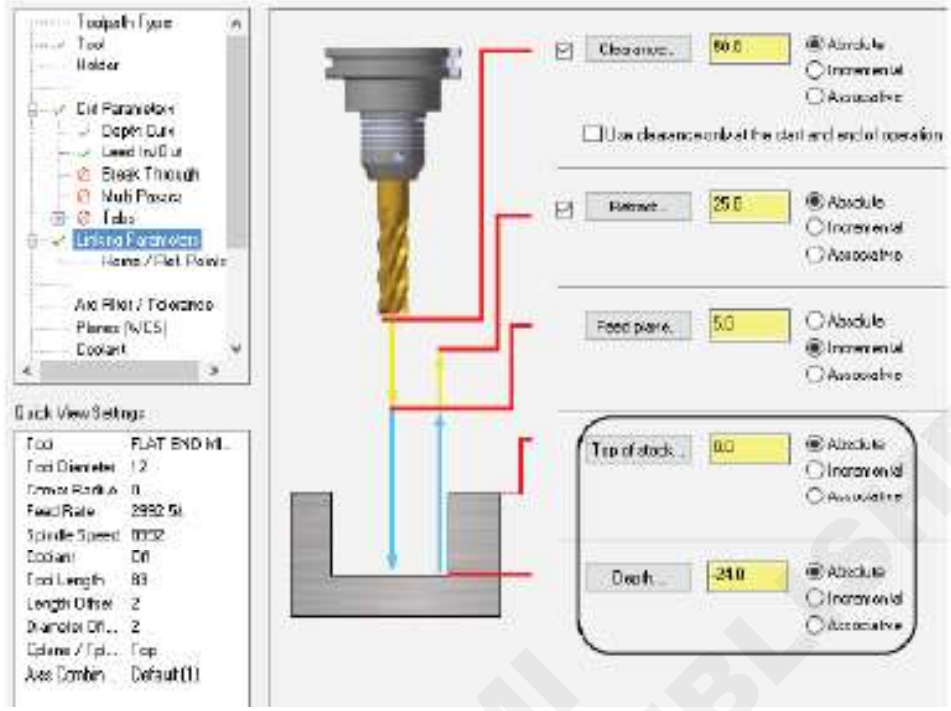
Fig 88



Linking Parameters

- Select Linking Parameters from the Tree View list. Set the Top of stock and the Depth as shown in Fig 89

Fig 89

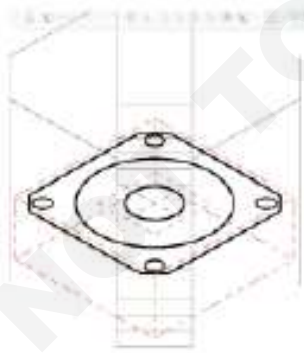


Preview the Toolpath

- To quickly check how the toolpath will be generated, select the Preview toolpath icon as shown.

- to review the procedure.
- The toolpath should look as shown in Fig 90

Fig 90



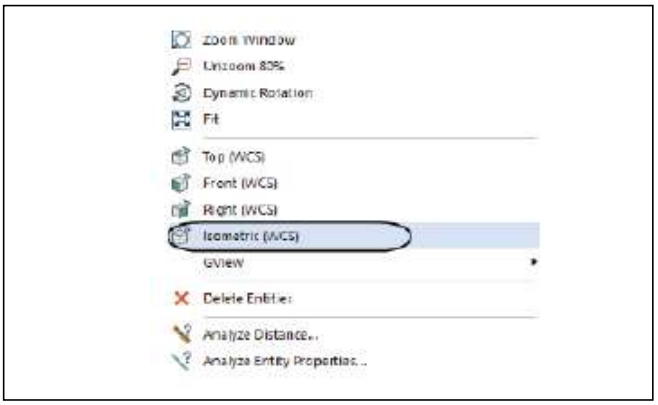
- Press Esc key to exit the preview.

Note: If the toolpath does not look as shown in the preview, check your parameters again.

- Select the OK button to exit 2D Toolpaths - Contour

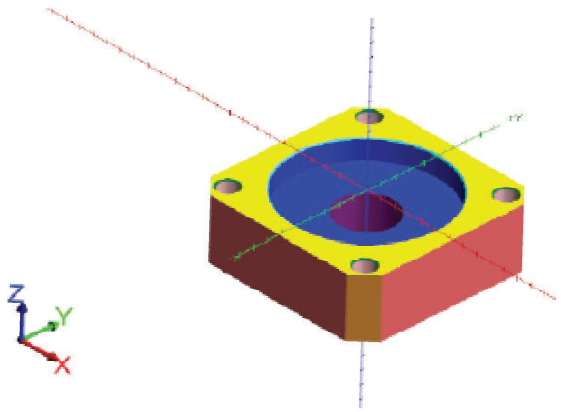
Verify the toolpaths

- To Verify the toolpaths, to review the procedure.
- Ensure all operations are selected; if not, use the button select all operations in the Toolpaths Manager.
- Right mouse click in the graphics window and select the Isometric option.



- Your part will appear as shown in Fig 91

Fig 91



- To go back to the Mastercam window, close Mastercam Simulator window as shown.

10 Post the file

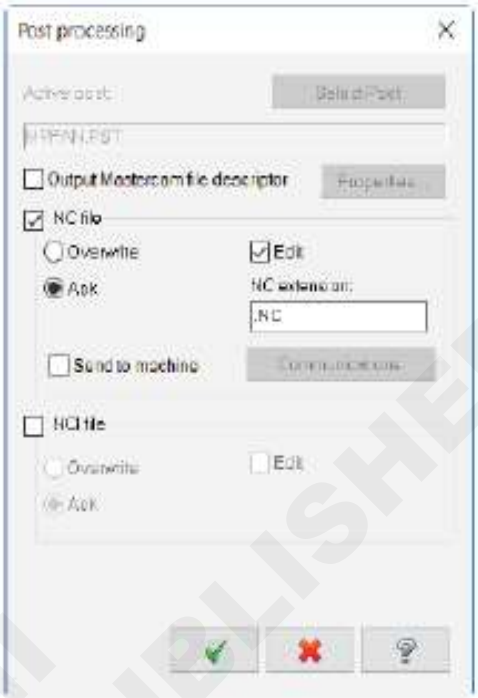
- Ensure all operations are selected. If not, use the button Select all operations in the Toolpaths Manager.
- select the Post selected operations icon from the Toolpaths Manager as shown.

Note: The HLE/Demo version of Master cam does not support post processing. The G1 button does not work and no G−code can be created in the HLE/Demo version.

- In the Post processing window, make necessary changes as shown.

NC file enabled allows you to keep the NC file and to assign the same name as the MCAM file.

Edit enabled allows you to automatically launch the default.

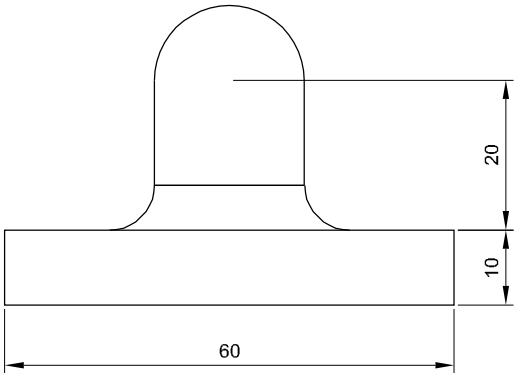


- Select the OK button to continue.
- Save the NC file.

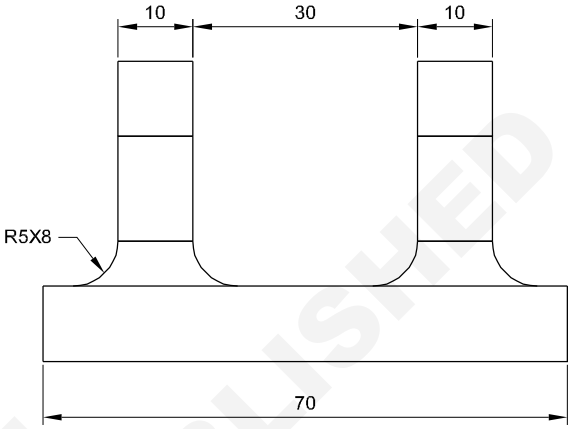
3D machining

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

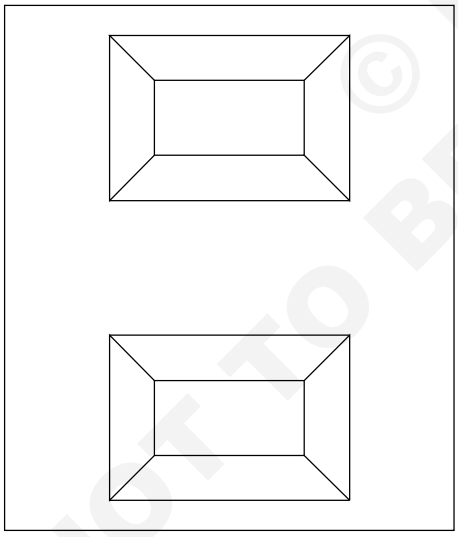
- **prepare 3D solid model**
- **perform 3D rough milling operation on the solid model**
- **perform 3D finish milling operation on the solid model**
- **generate the programs for the roughs and finishing tool paths**



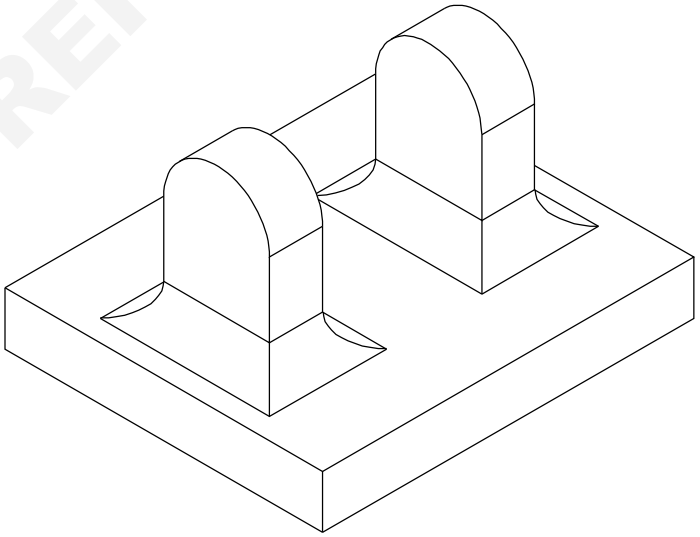
FRONT VIEW



SIDE VIEW



TOP VIEW



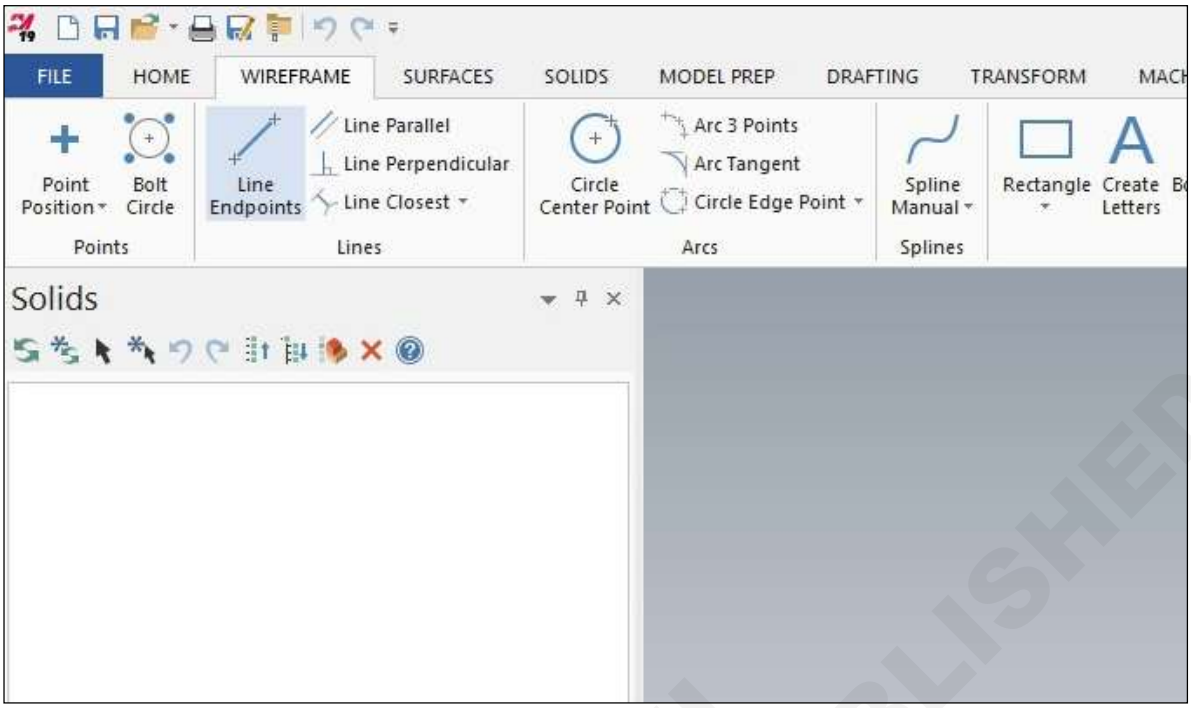
ISOMETRIC VIEW

1	60X70X42	-	CI BLOCK	-	-	2.4.98
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	3D MACHINING				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N2498E2	

Prepare a 3D model

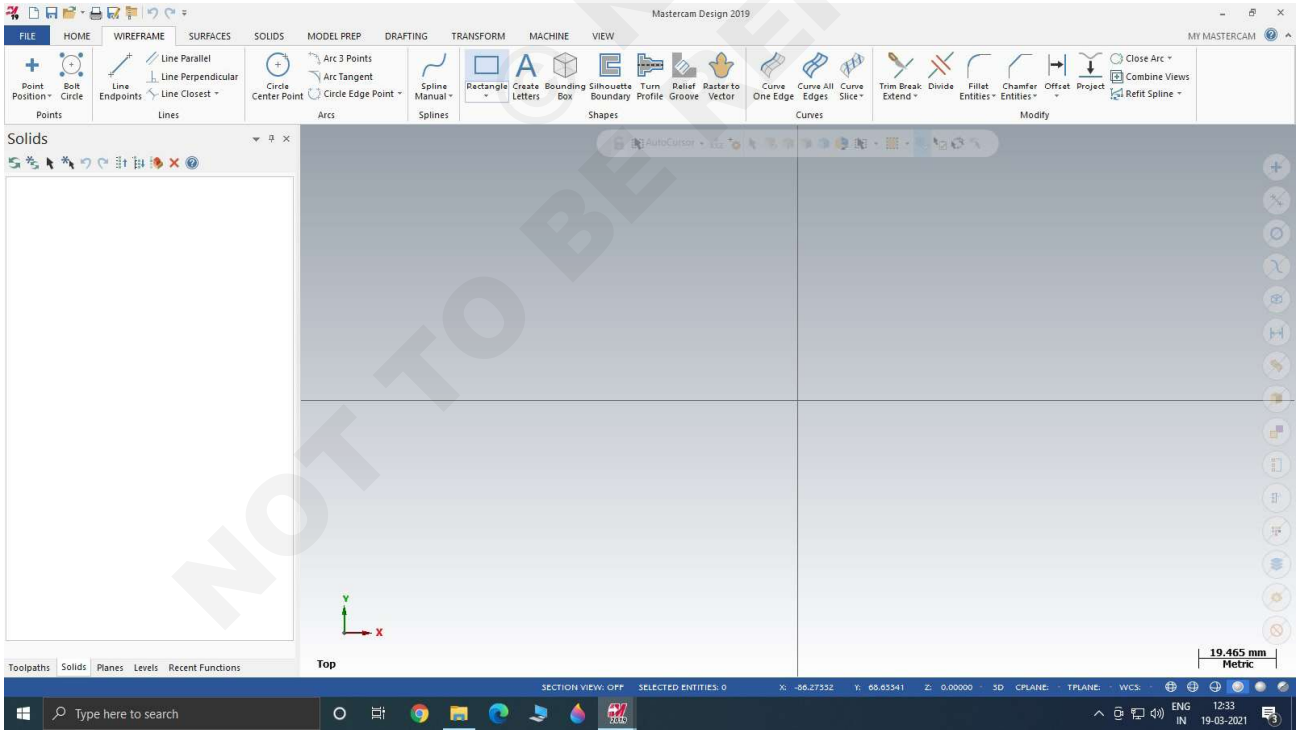
1 Double click and open master cam software (Fig 1)

Fig 1



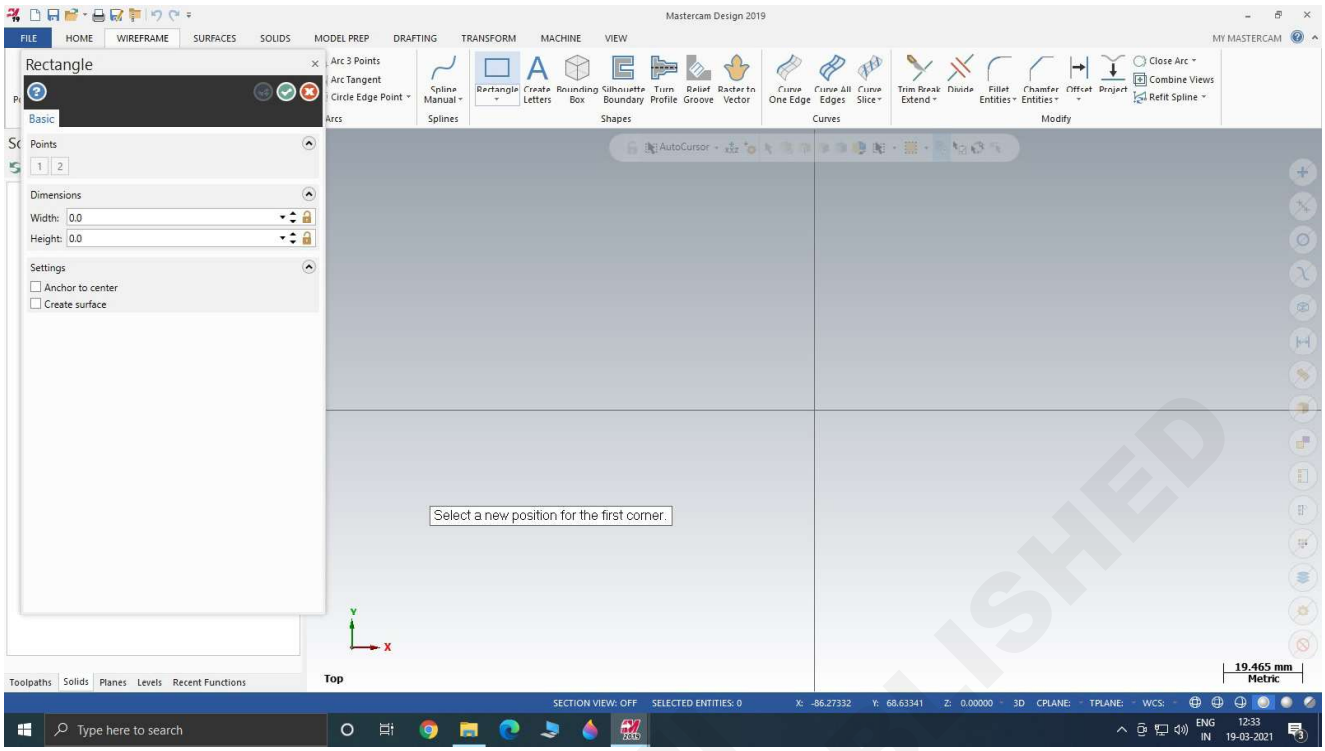
2 Select wireframe option (Fig 2)

Fig 2



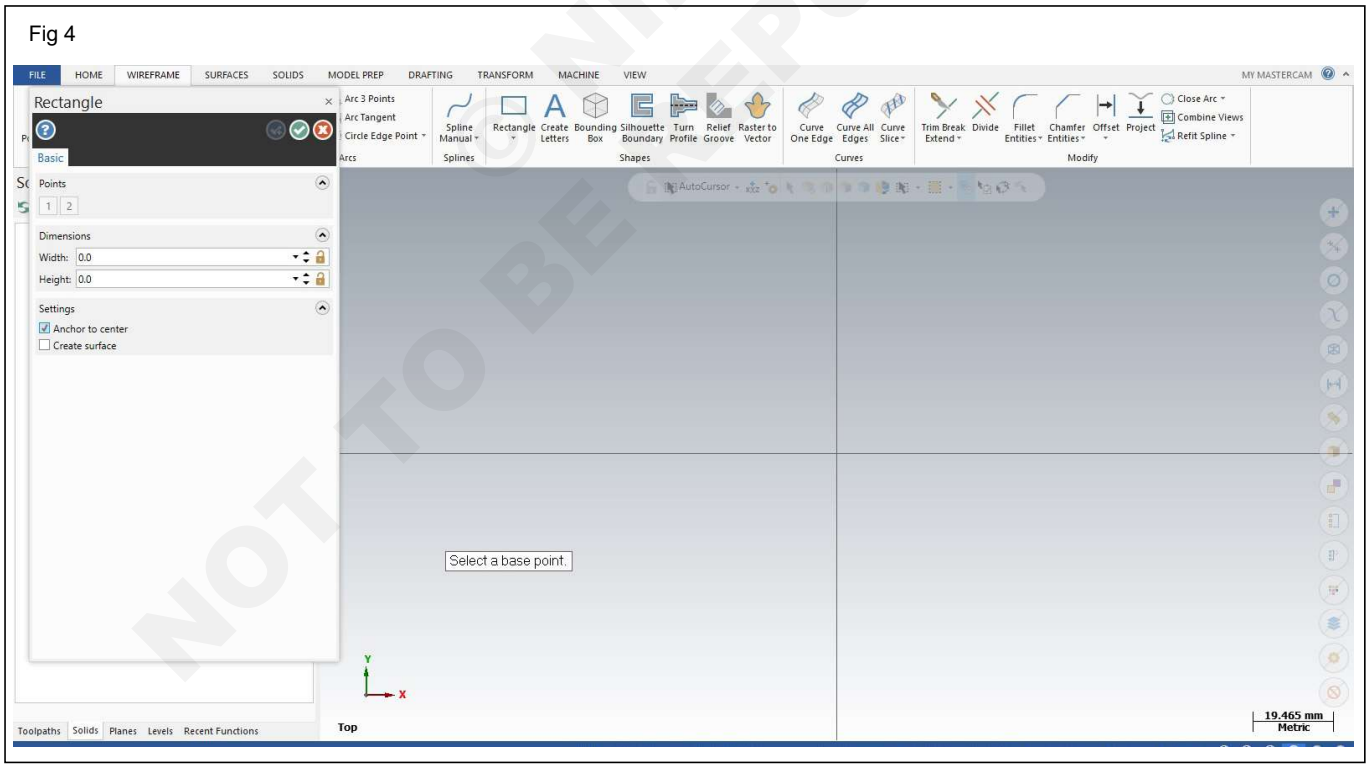
3 Select rectangle (Fig 3)

Fig 3



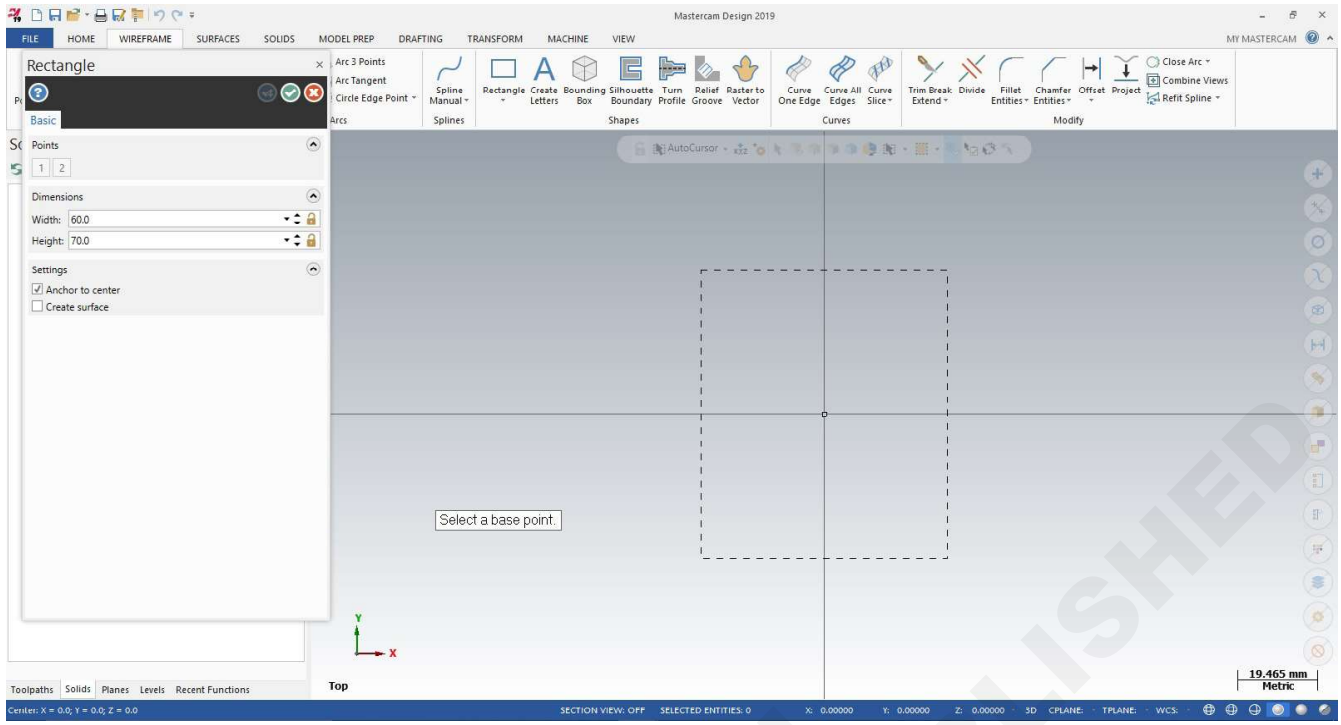
4 In the dialog box click anchor to center (Fig 4)

Fig 4



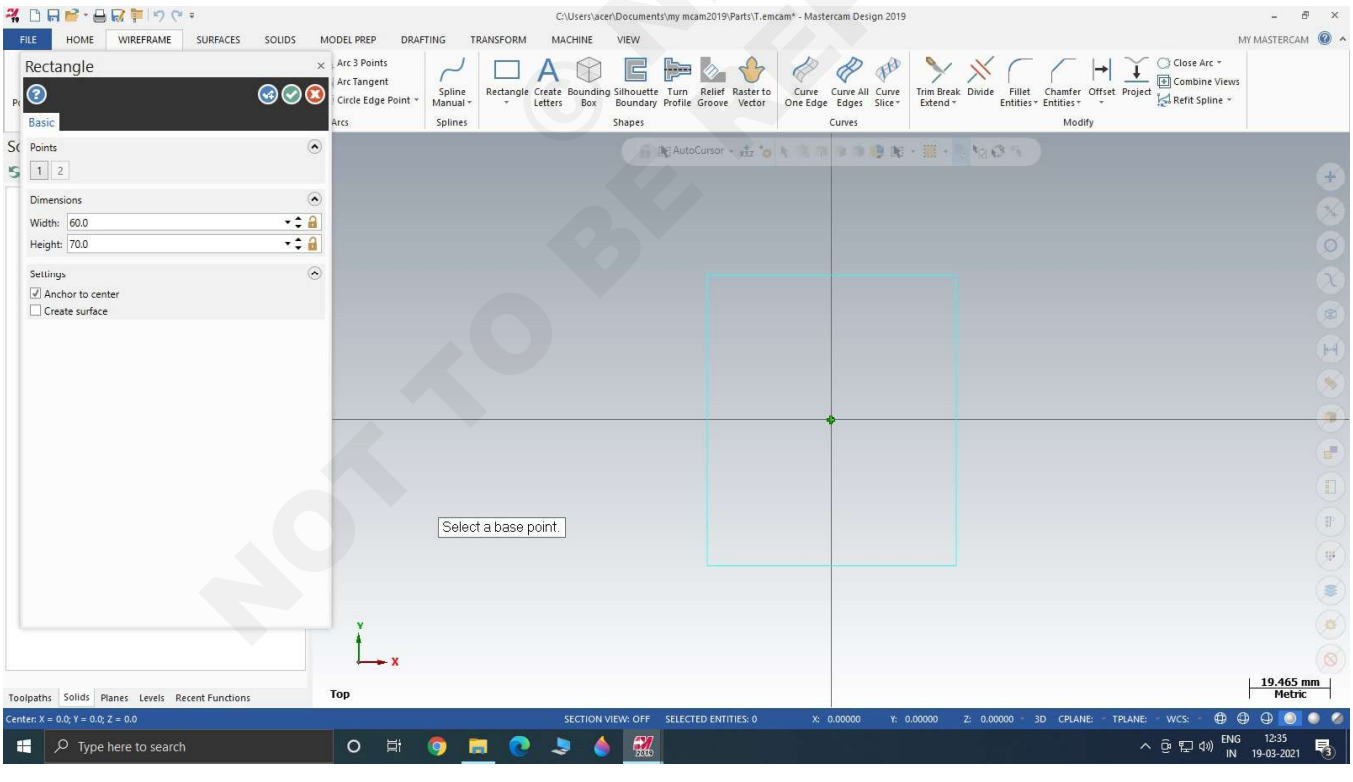
5 Enter width 60, Enter height 70 (Fig 5)

Fig 5



6 place the cursor at the centre so, Rectangle IS placed at the center (Fig 6)

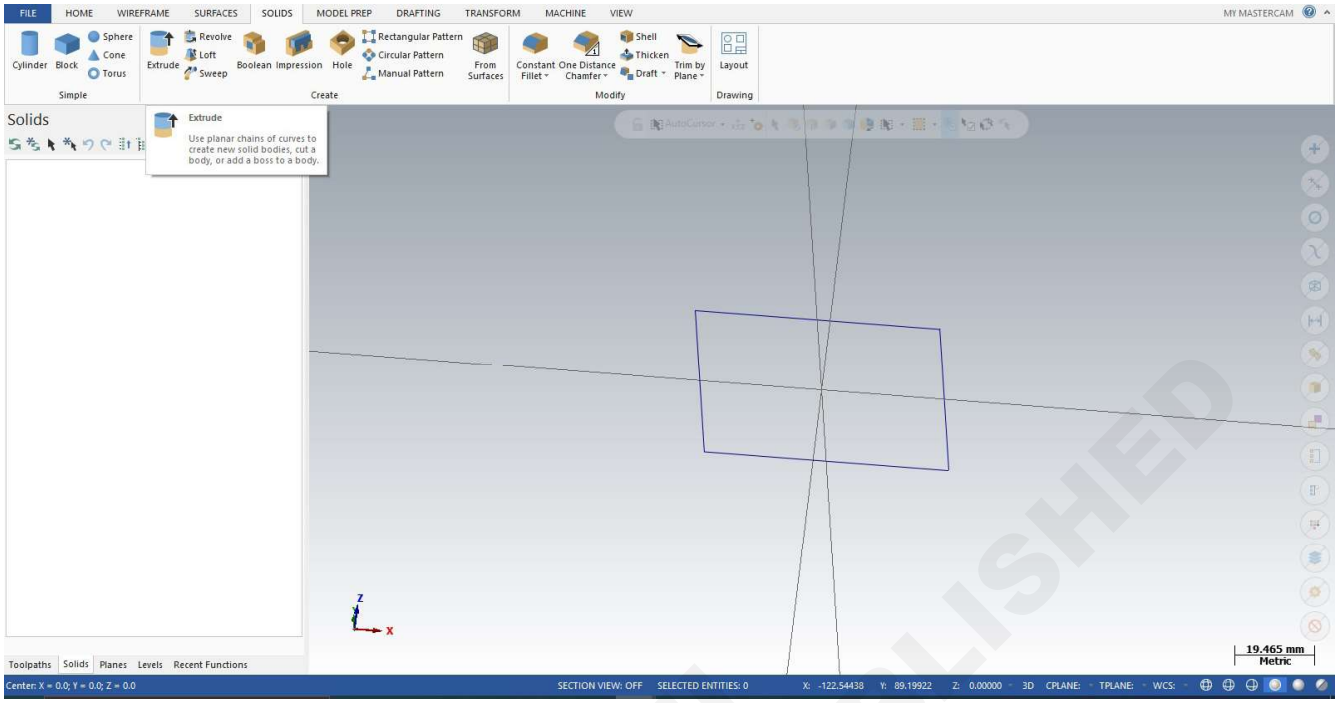
Fig 6



7 Select ok

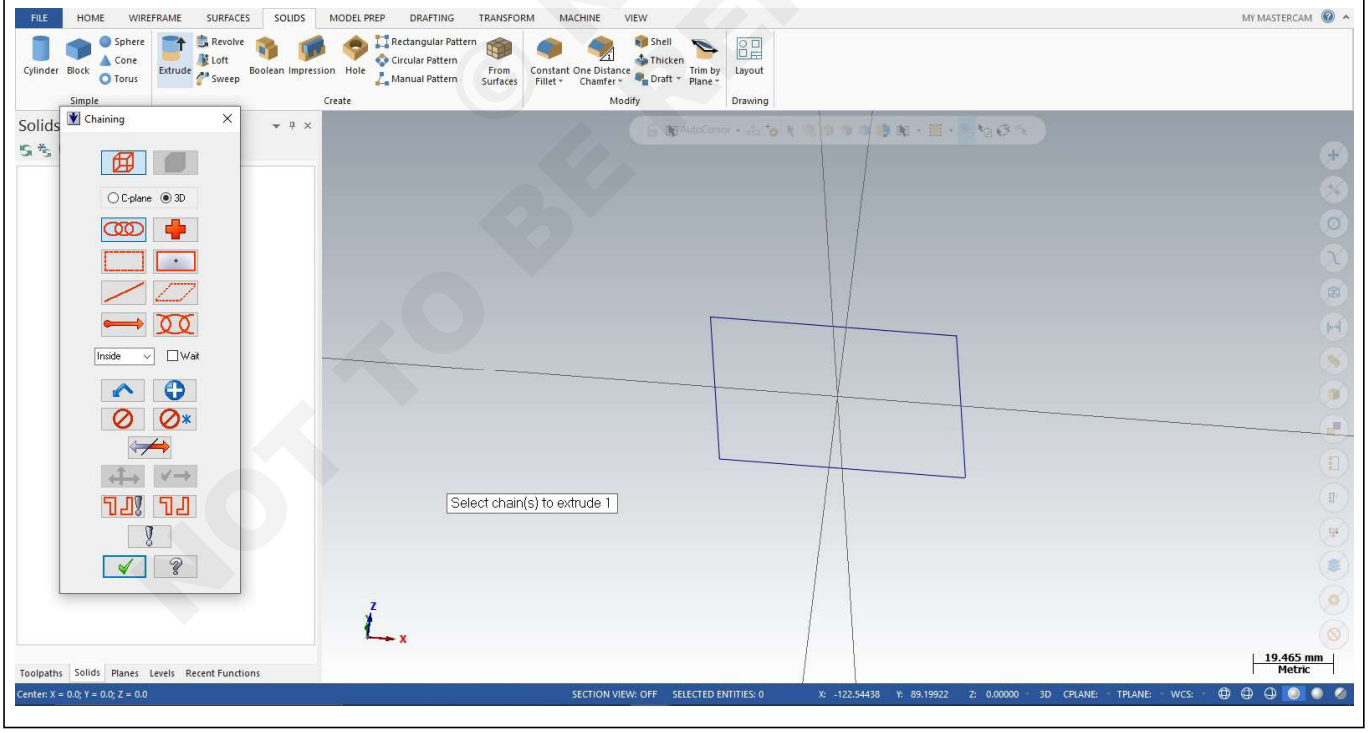
8 Select solid option from menu tool bar (Fig 7)

Fig 7



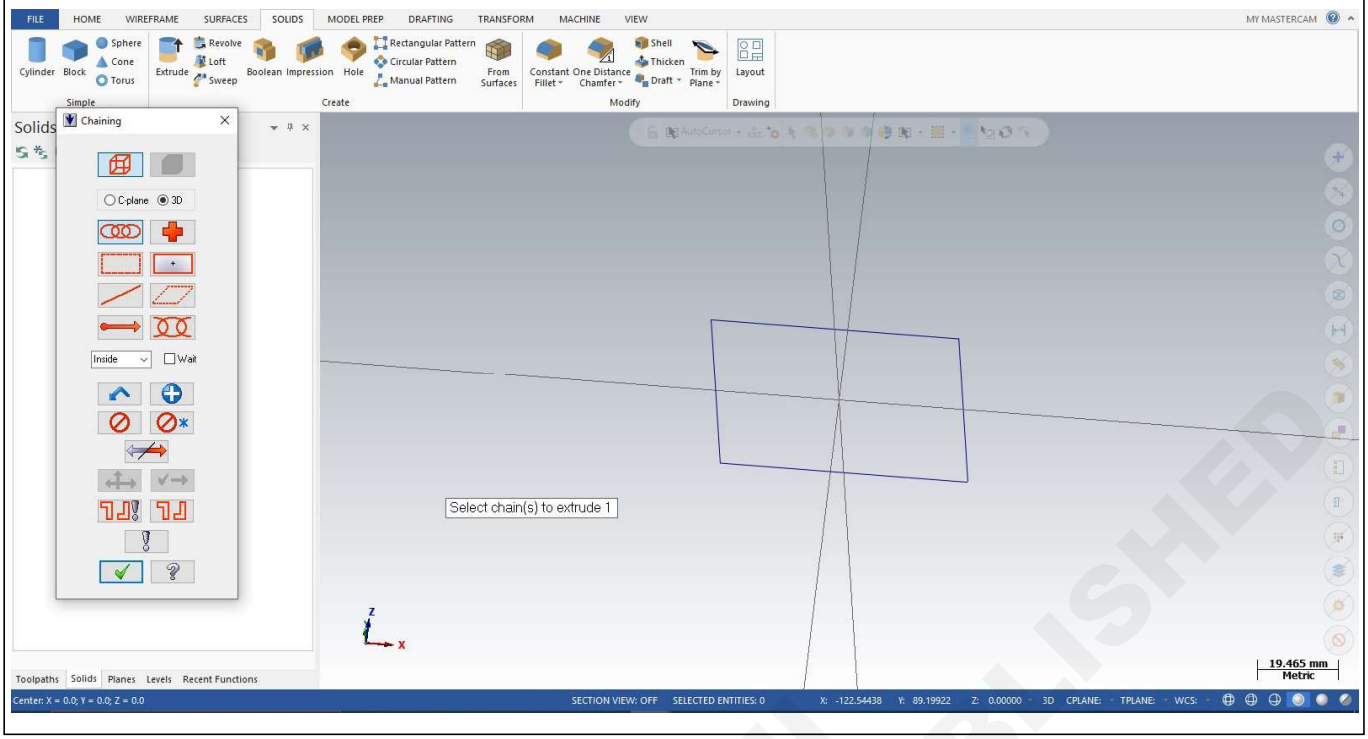
9 Select extrude option (Fig 8)

Fig 8



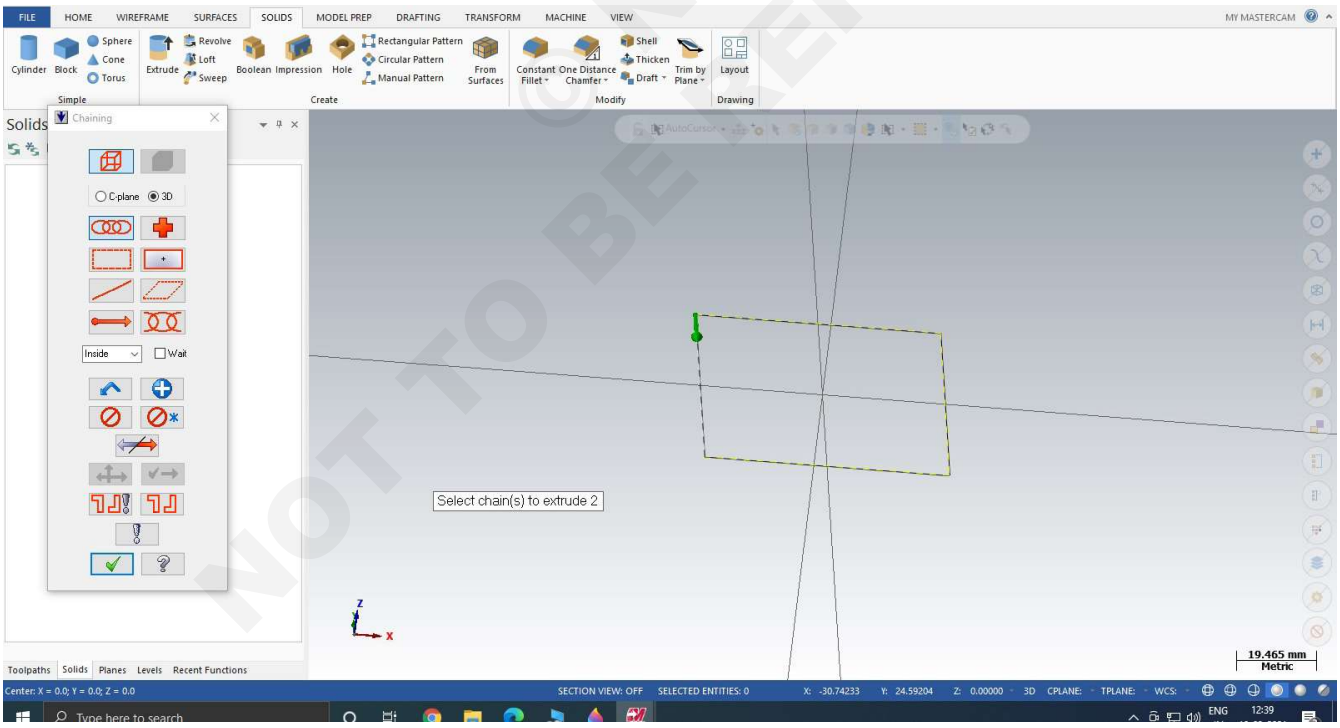
10 From the dialog box select chain option (Fig 9)

Fig 9



11 Select rectangle as shown in (Fig 10)

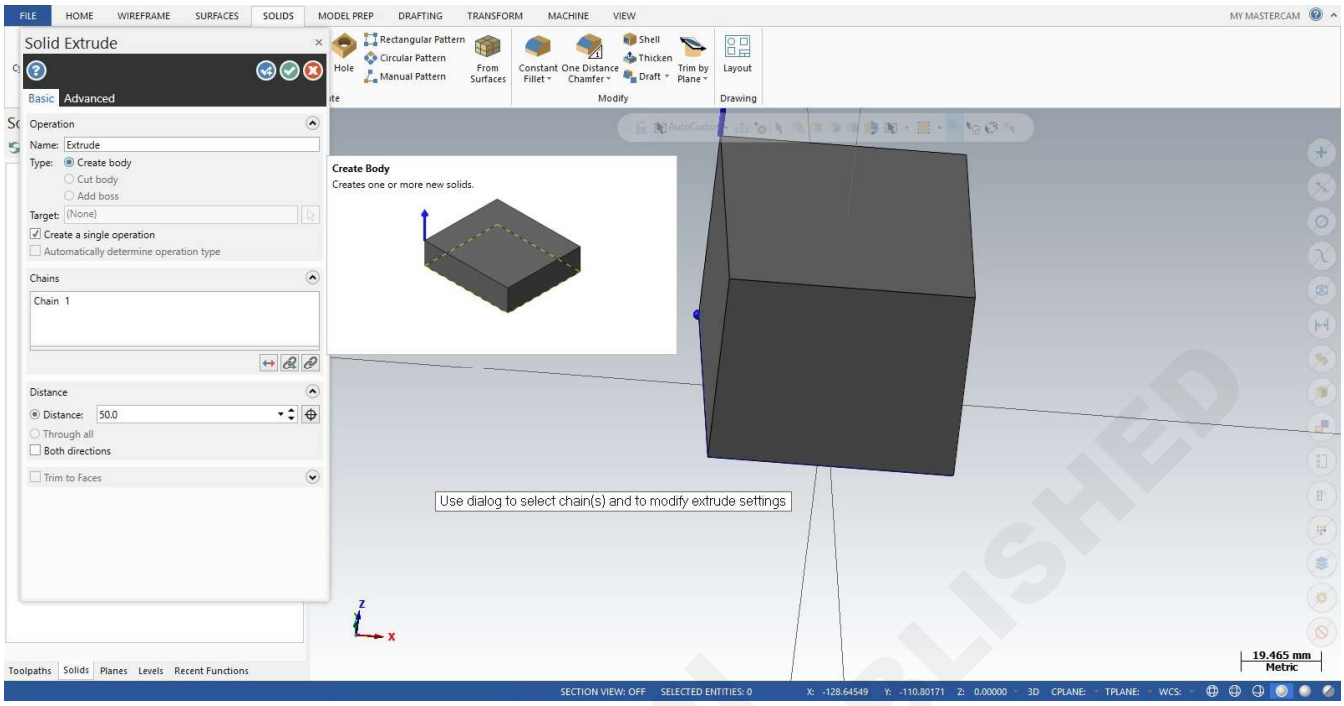
Fig 10



12 Press ok

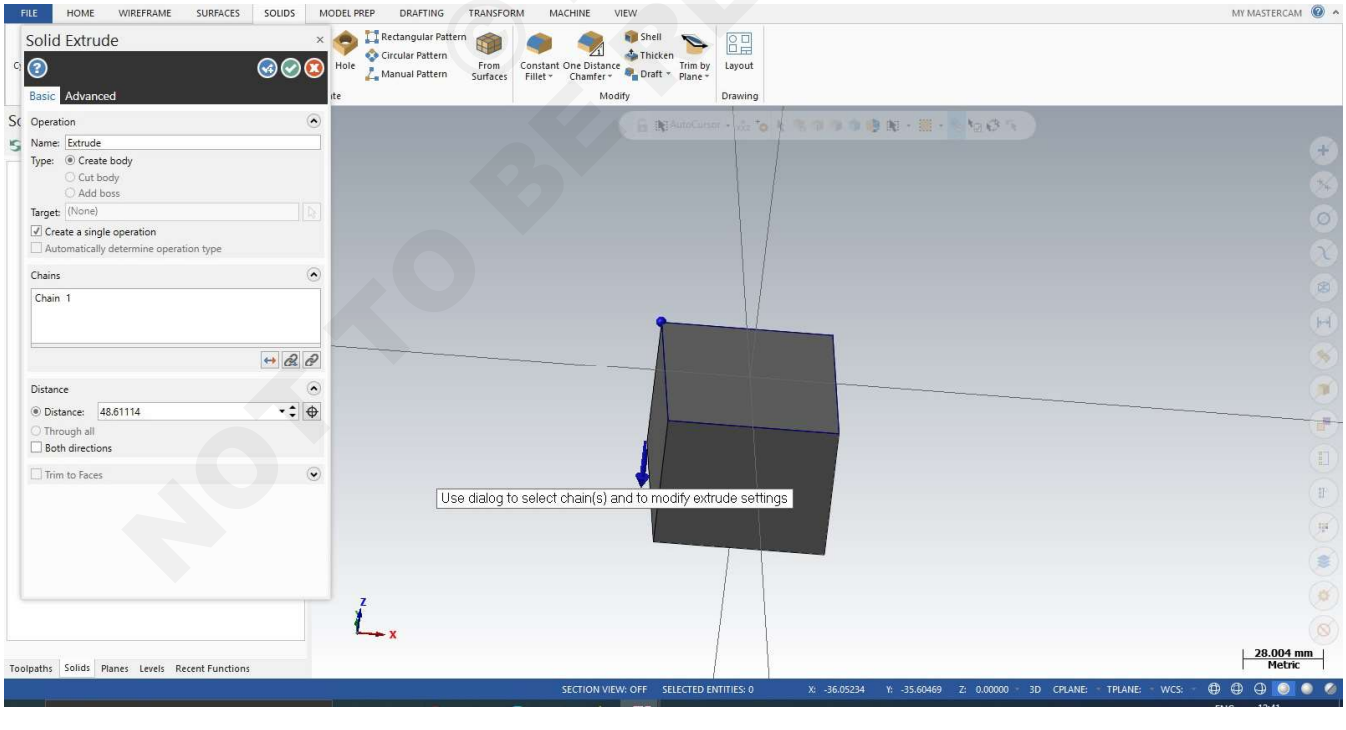
13 In the dialog box select create body option (Fig 11)

Fig 11



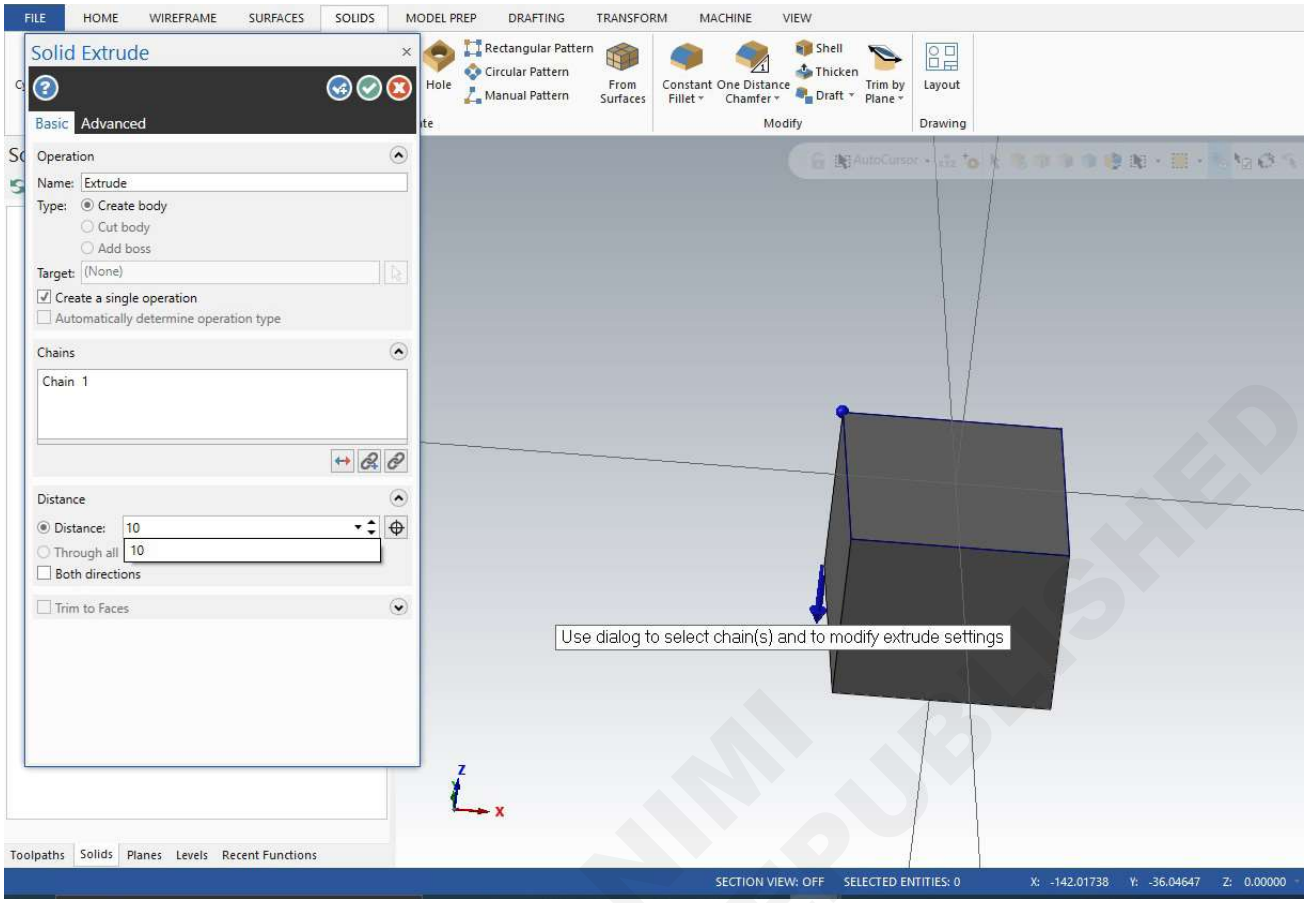
14 Select the direction of extrusion by moving the arrow on the screen (Fig 12)

Fig 12



15 In the distance option of the dialogue box enter 10mm value and press ok (Fig 13)

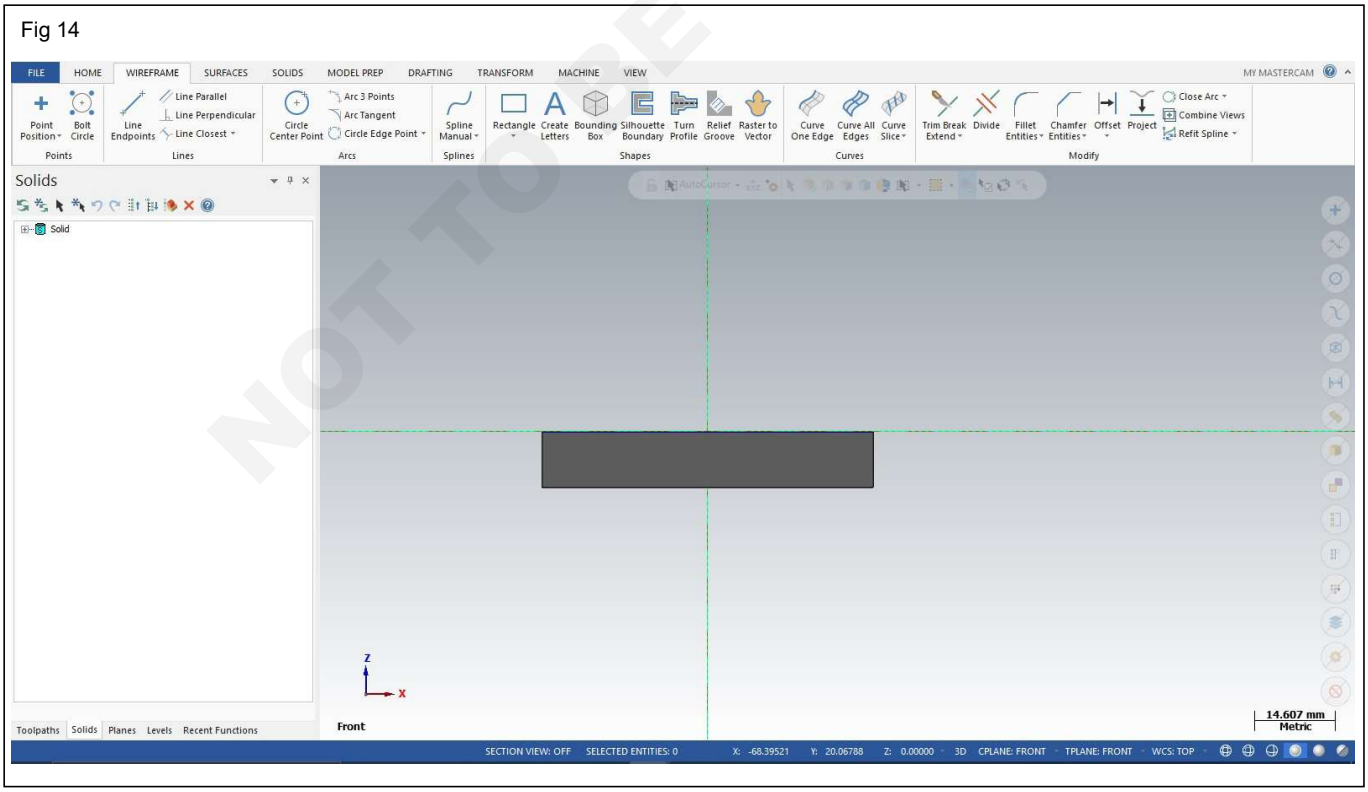
Fig 13



16 Draw the profile of the rib

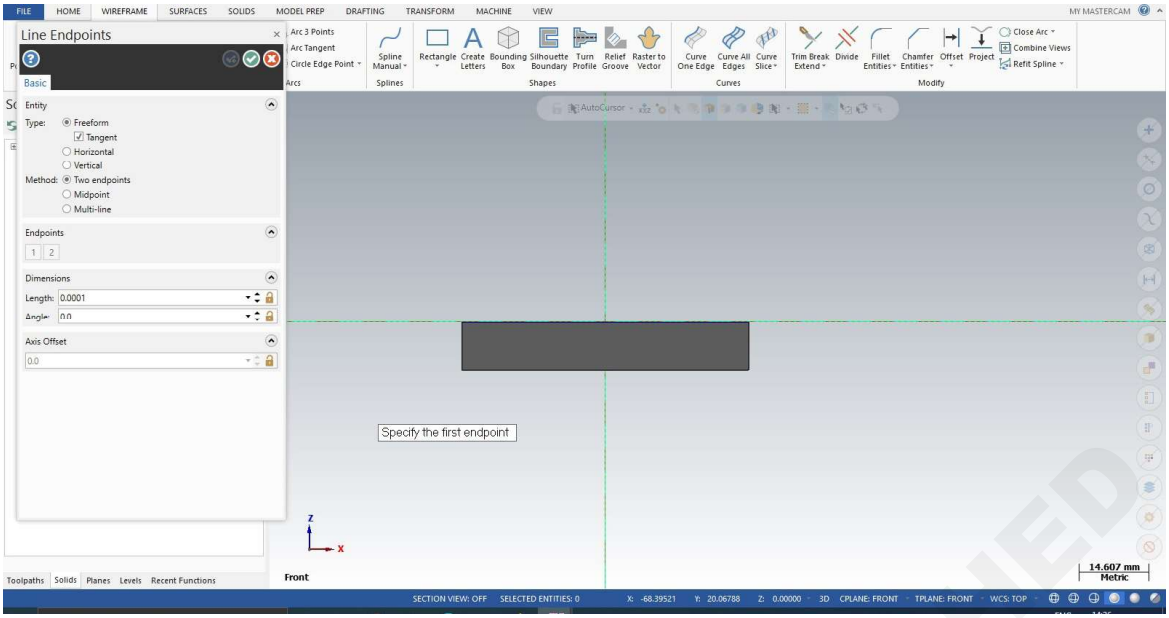
a Select the wireframe (Fig 14)

Fig 14



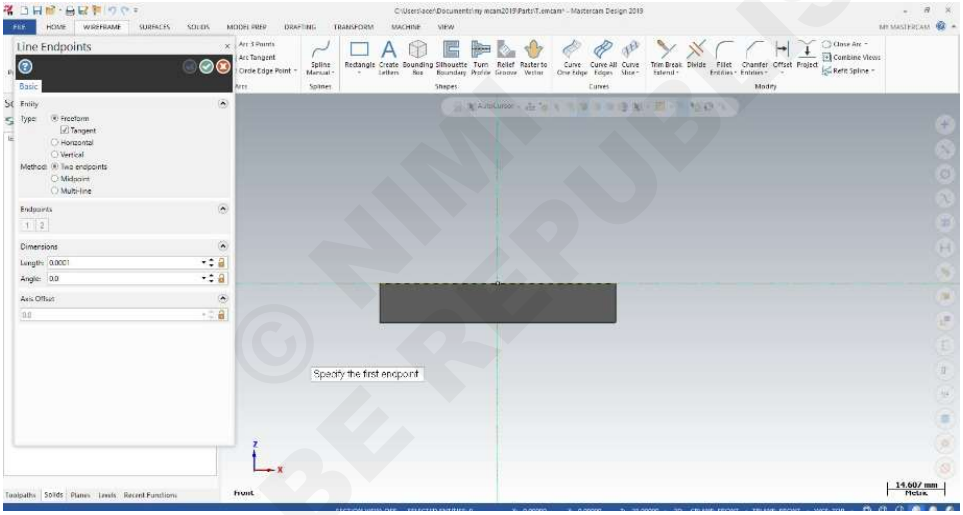
b Select the line option (Fig 15)

Fig 15



c Click on the middle point (Fig 16)

Fig 16

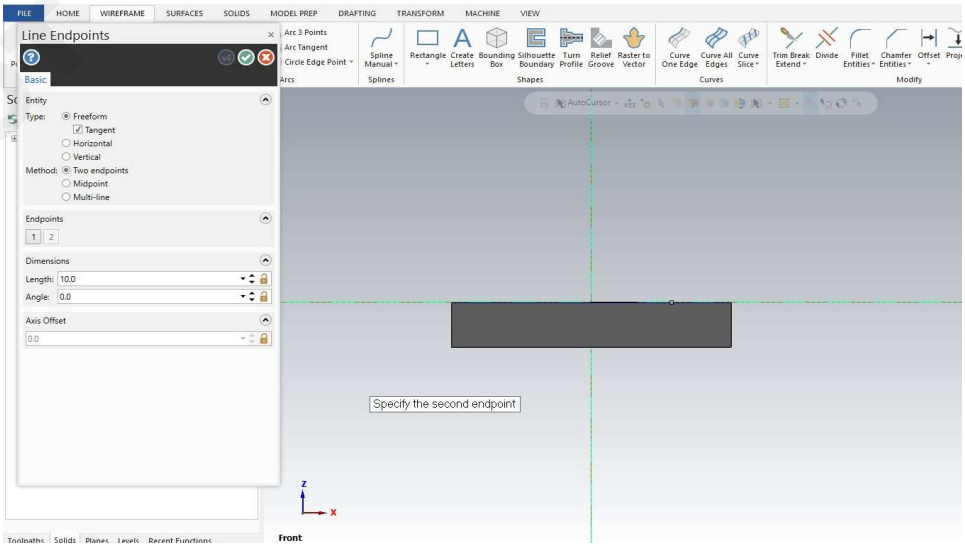


d Draw the horizontal line

e Click on the length in the dialogue box enter 10 mm (Fig 17)

f Click horizontally point on the right hand side

Fig 17



g Repeat the same step but click on the left side (Fig 18)

h Repeat same step and draw vertical lines both sides from end point of the previous line (Fig 19-21)

Fig 18

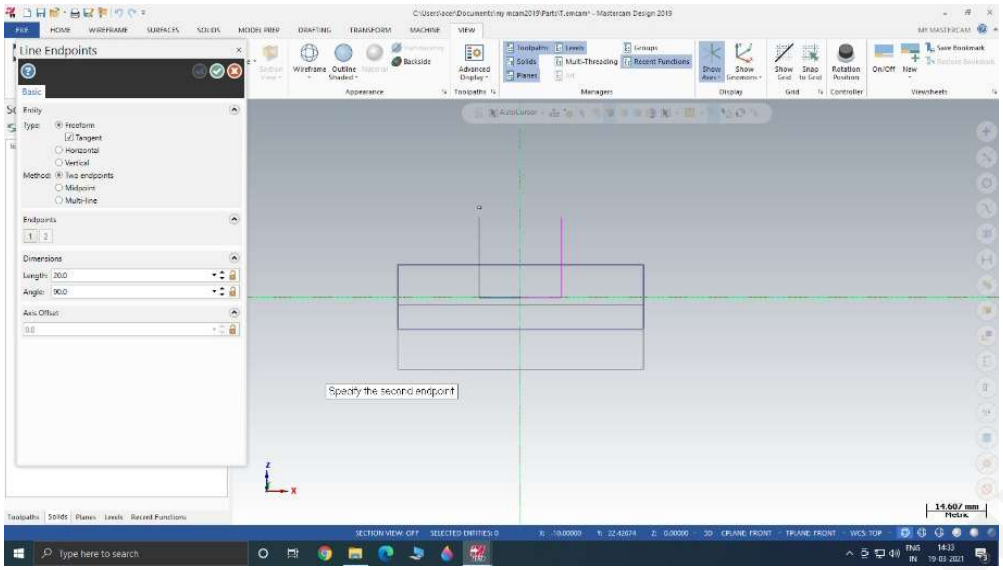


Fig 19

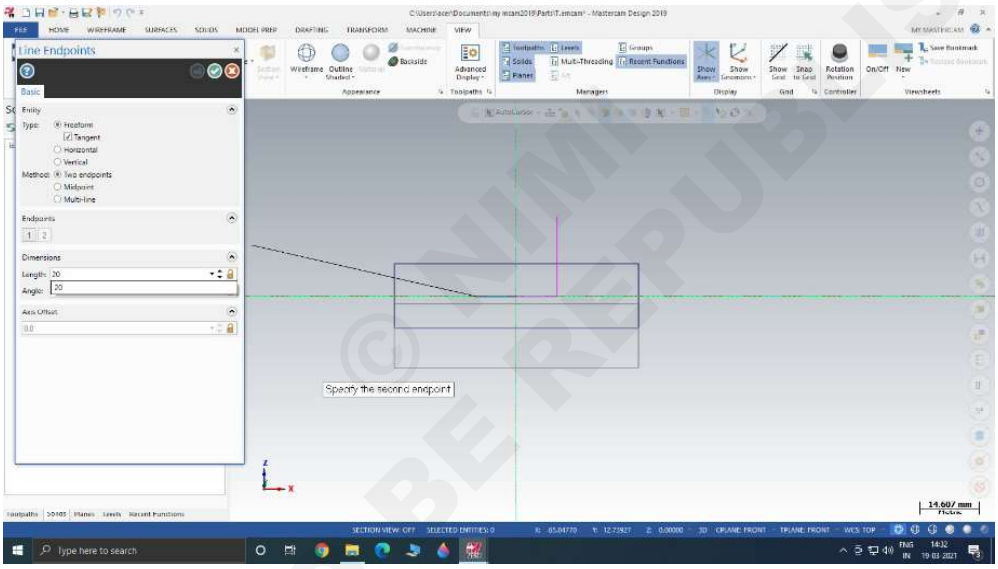


Fig 20

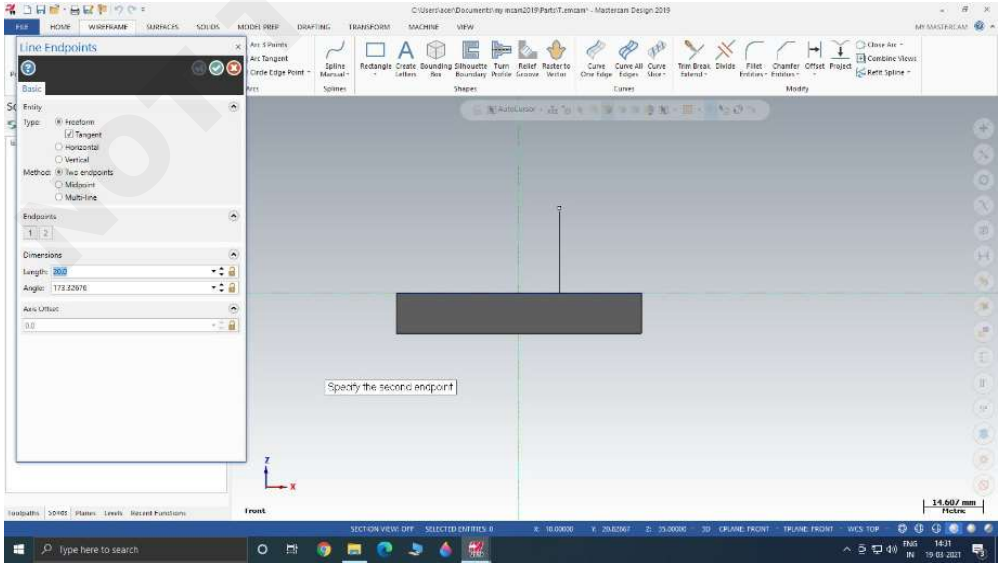
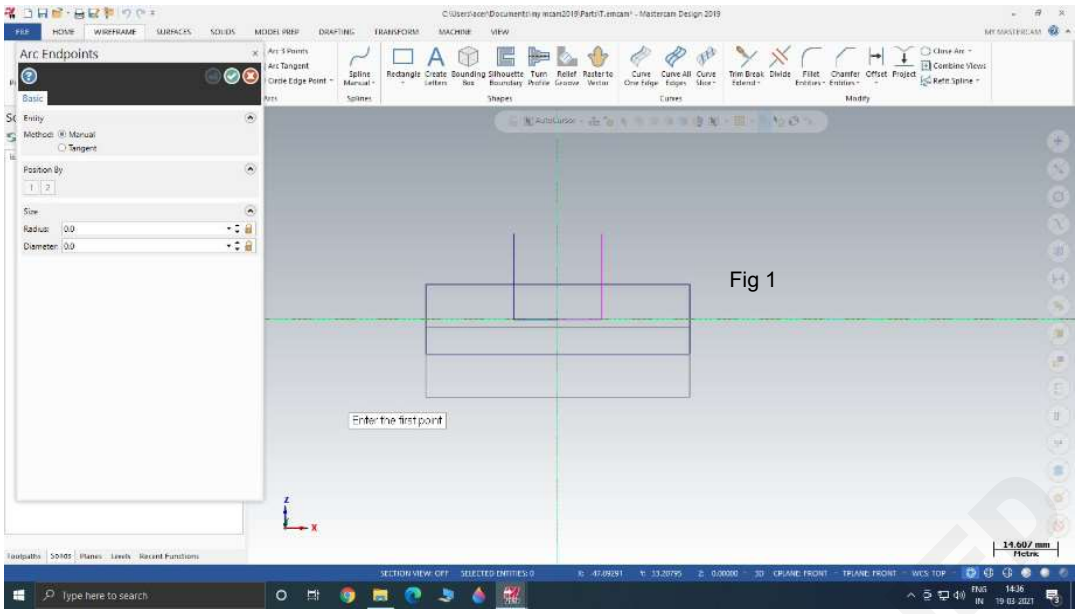


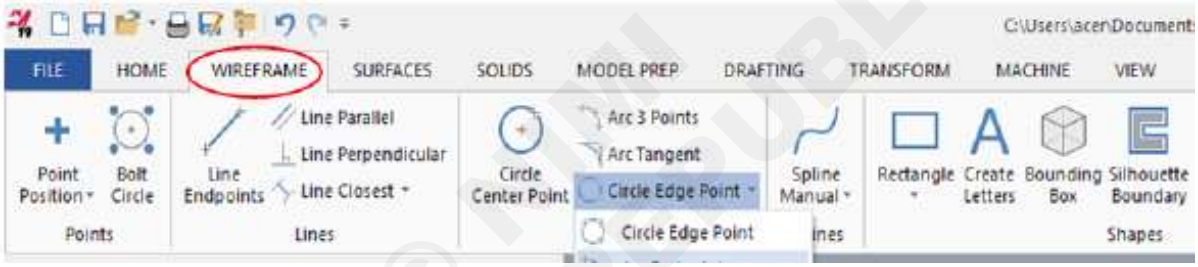
Fig 21



i Then figures appear as shown

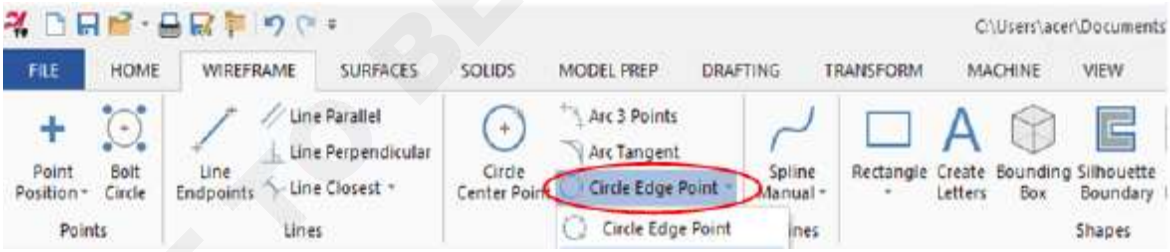
j Select the wireframe (Fig 22)

Fig 22



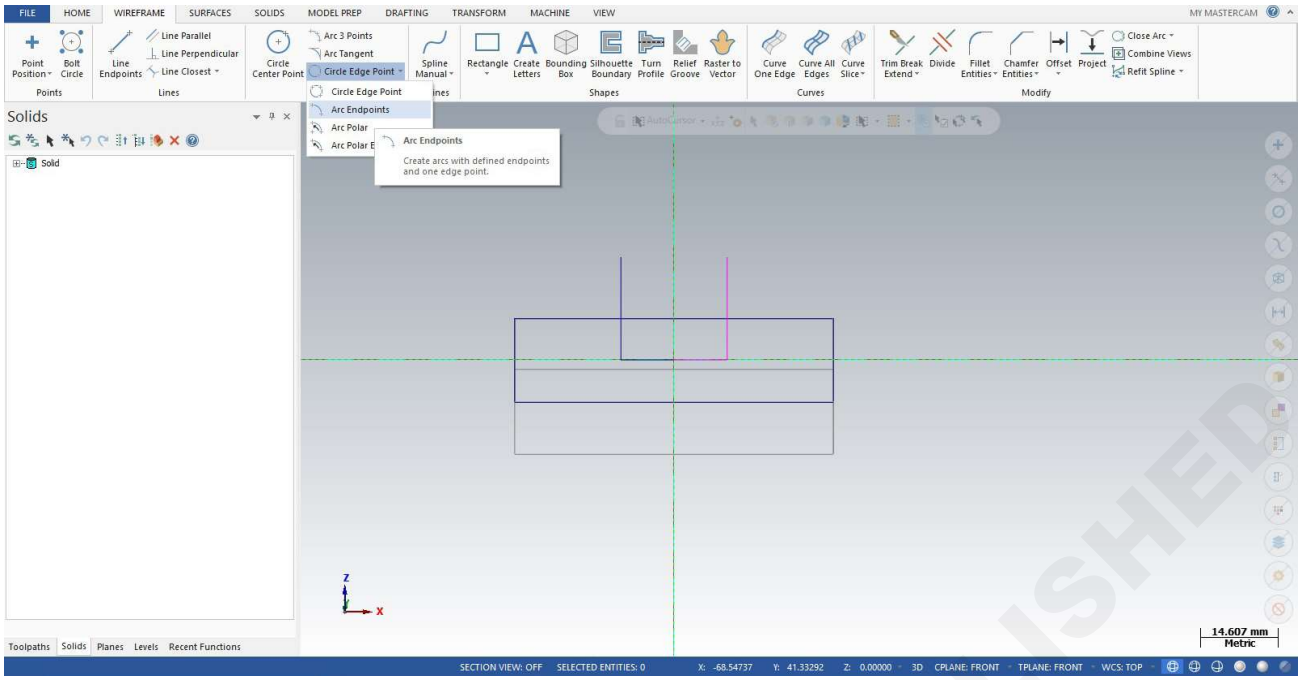
k Select circle edge point option with shows option (Fig 23)

Fig 23



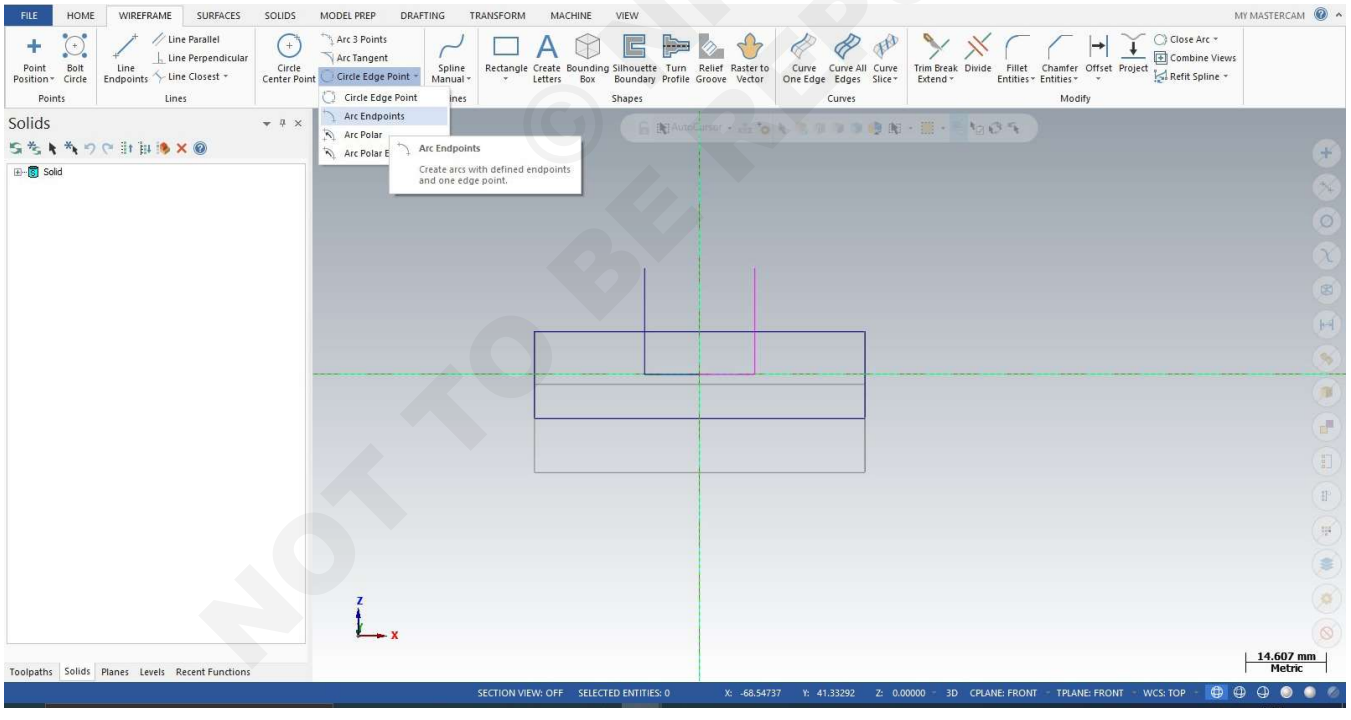
l Select arc end point (Fig 24)

Fig 24



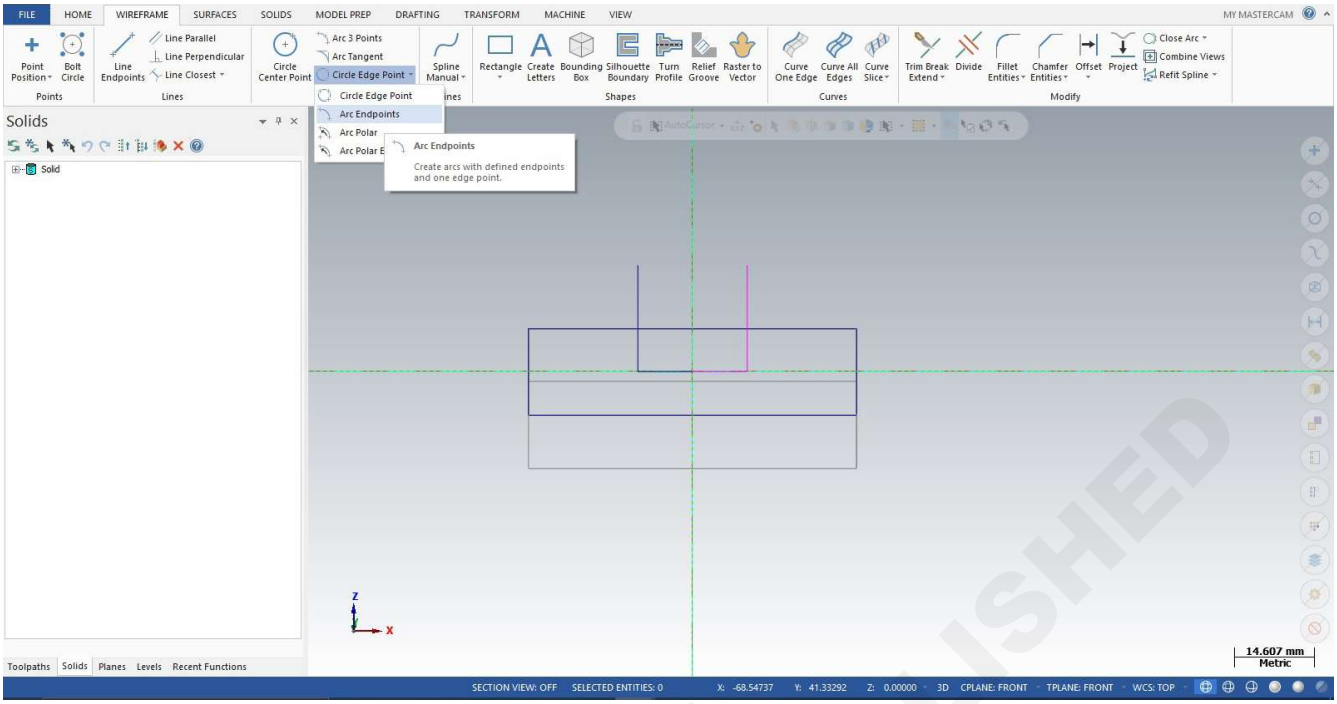
m Select the first edge (Fig 25)

Fig 25



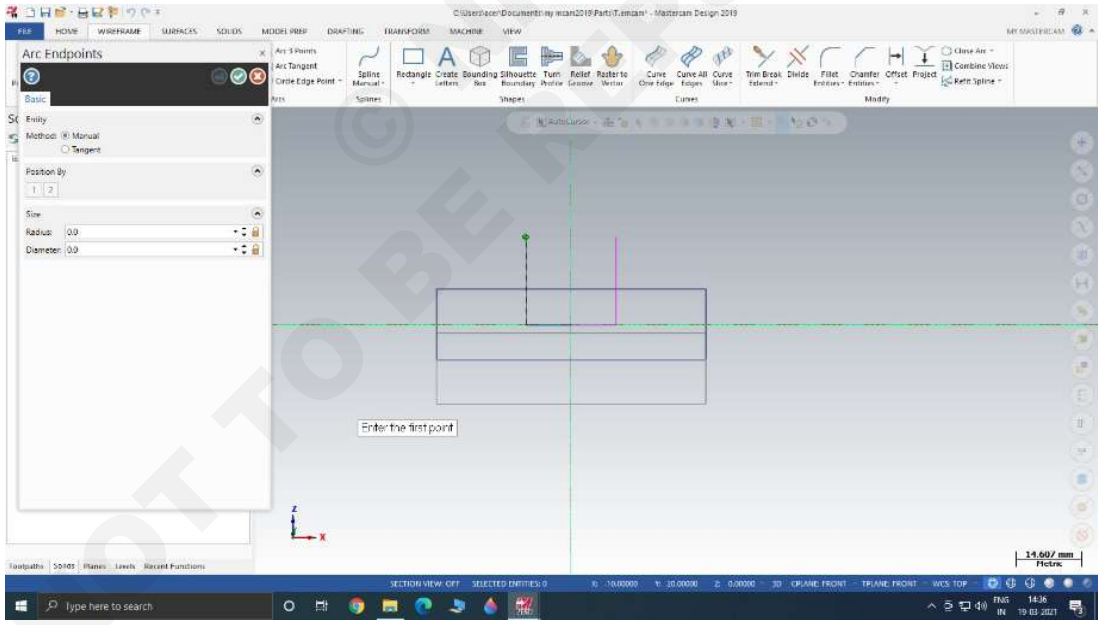
n Select the second edge (Fig 26)

Fig 26



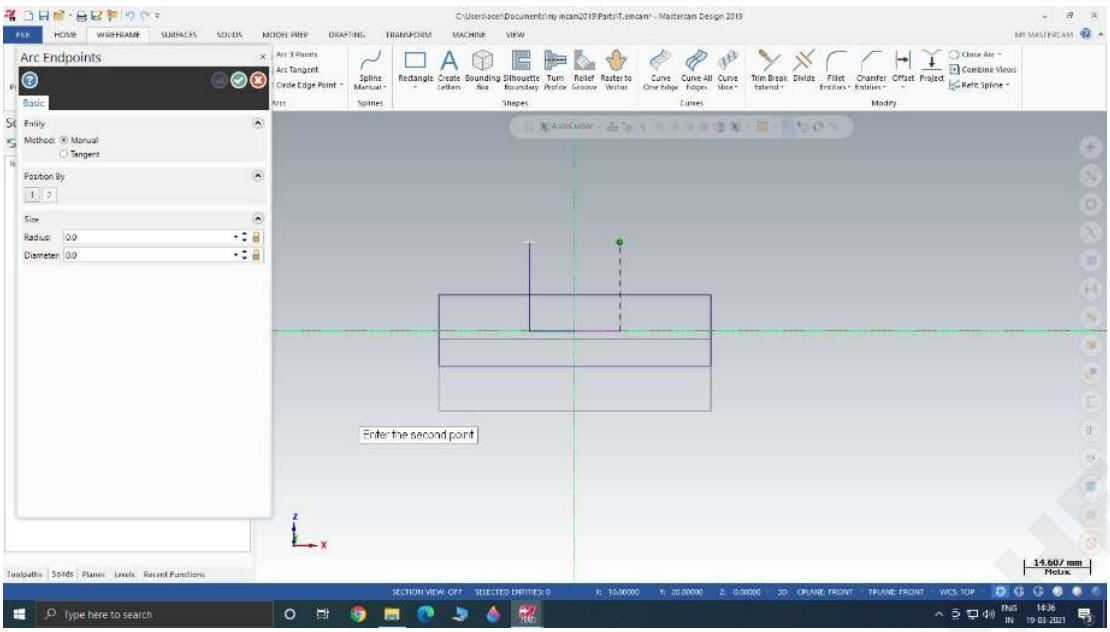
o Enter the radius 10 or diameter 20 in the dialogue box (Fig 27)

Fig 27



p Then arc appears on both sides select the upper arc (Fig 28)

Fig 28



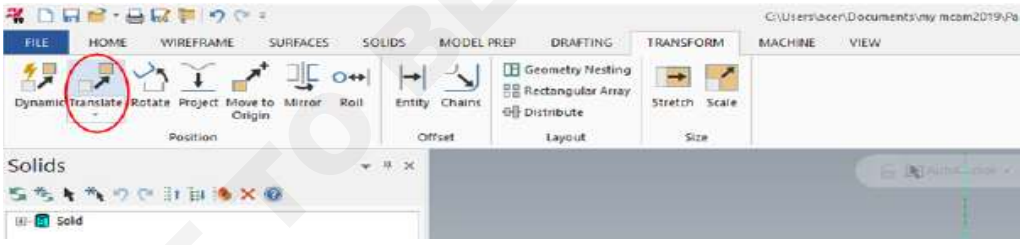
q Press ok

r Then select transform from the window (Fig 29)

Fig 29

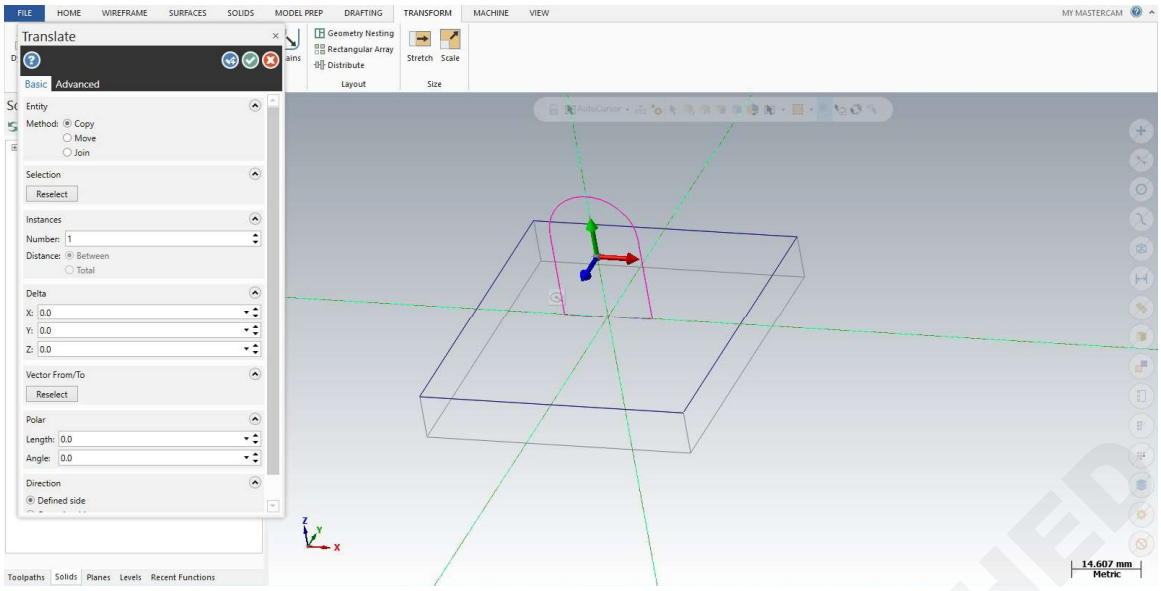
s Then select translate option (Fig 30)

Fig 30



t Click all the entities of the rib (Fig 31)

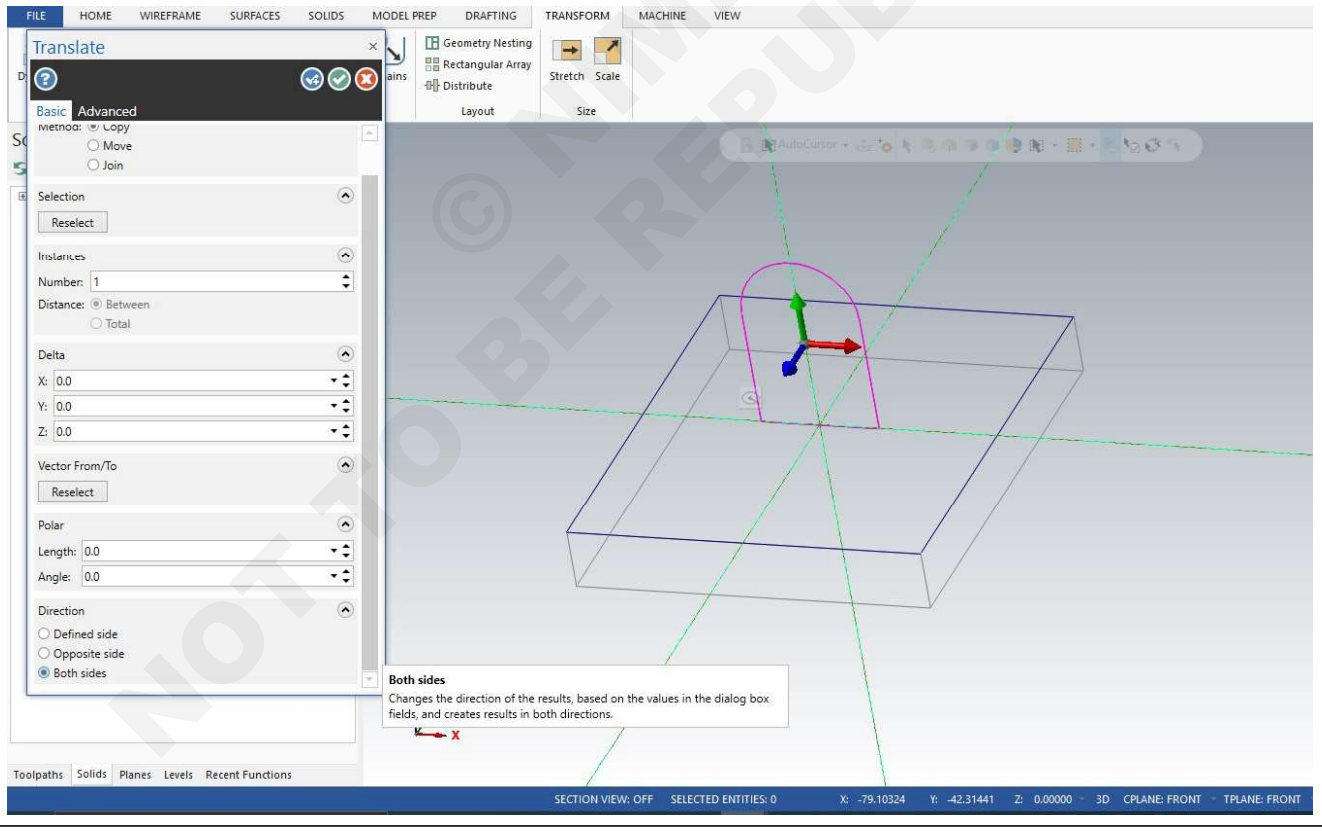
Fig 31



u Press enter

v In the dialogue box in direction select both sides option (Fig 32)

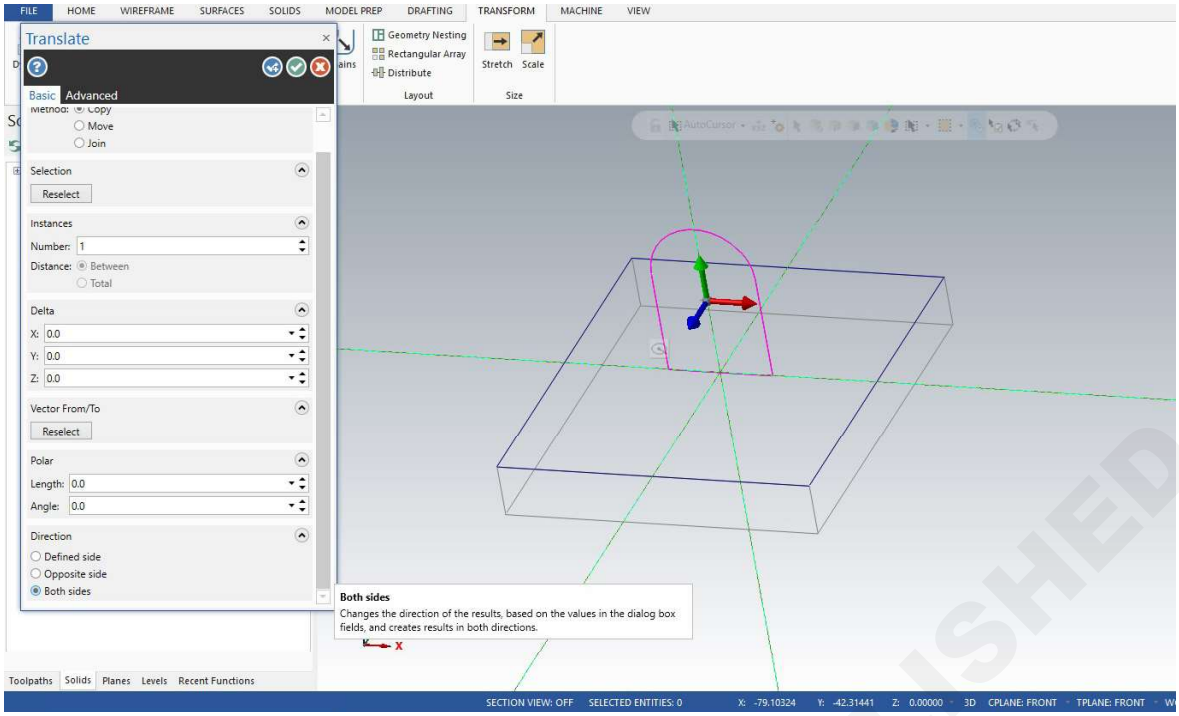
Fig 32



w In delta option in y enter 25 mm distance (Fig 33)

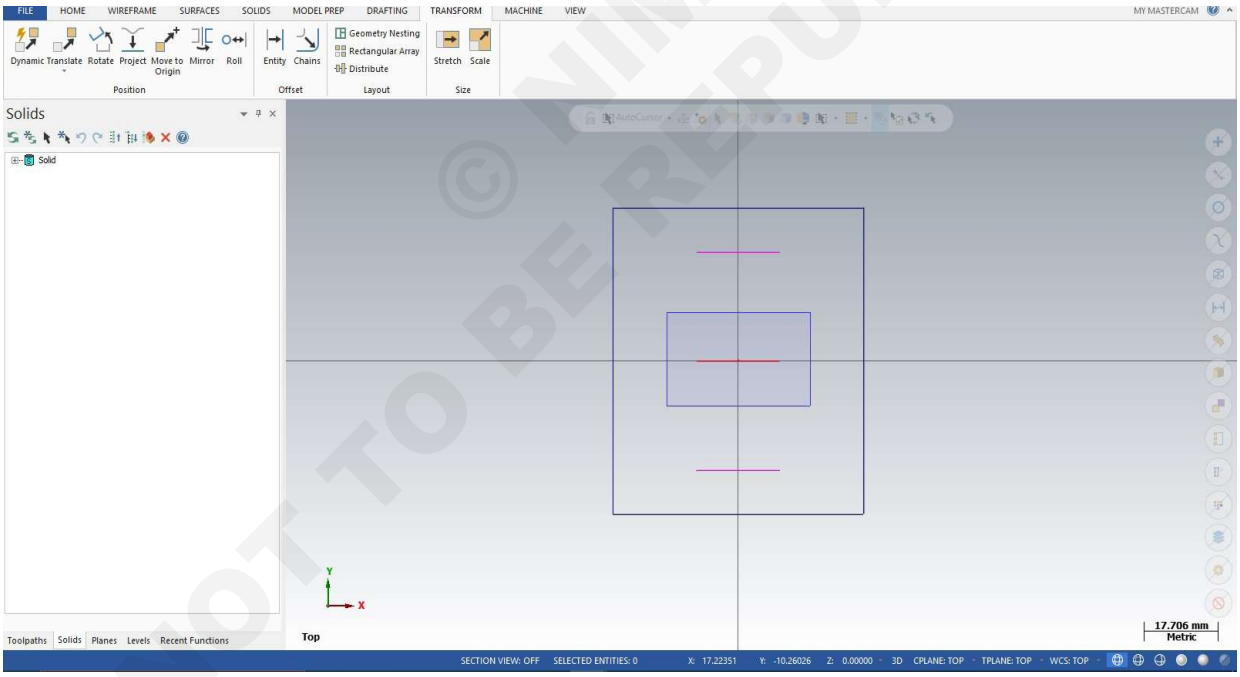
x Click ok

Fig 33



y Right click mouse on the screen select top view (Fig 34)

Fig 34

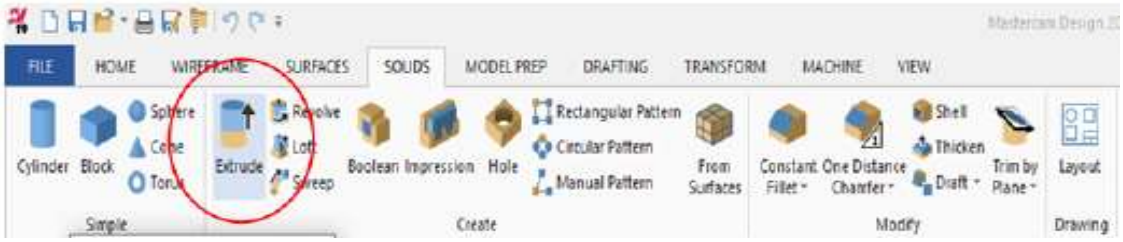


z Using mouse select middle rib and press delete key in the keyboard (Fig 35)

Fig 35

z1 Click on the solids option (Fig 36)

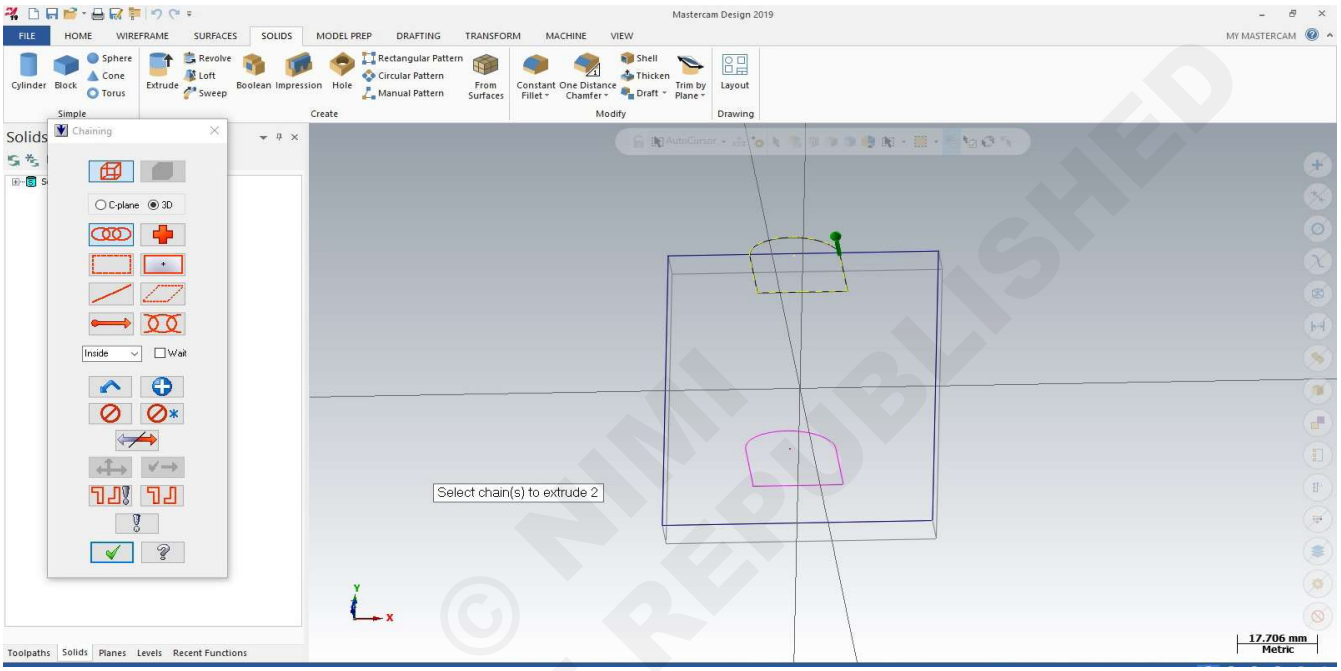
Fig 36



A Select the extrude (Fig 37)

B Select chain as shown

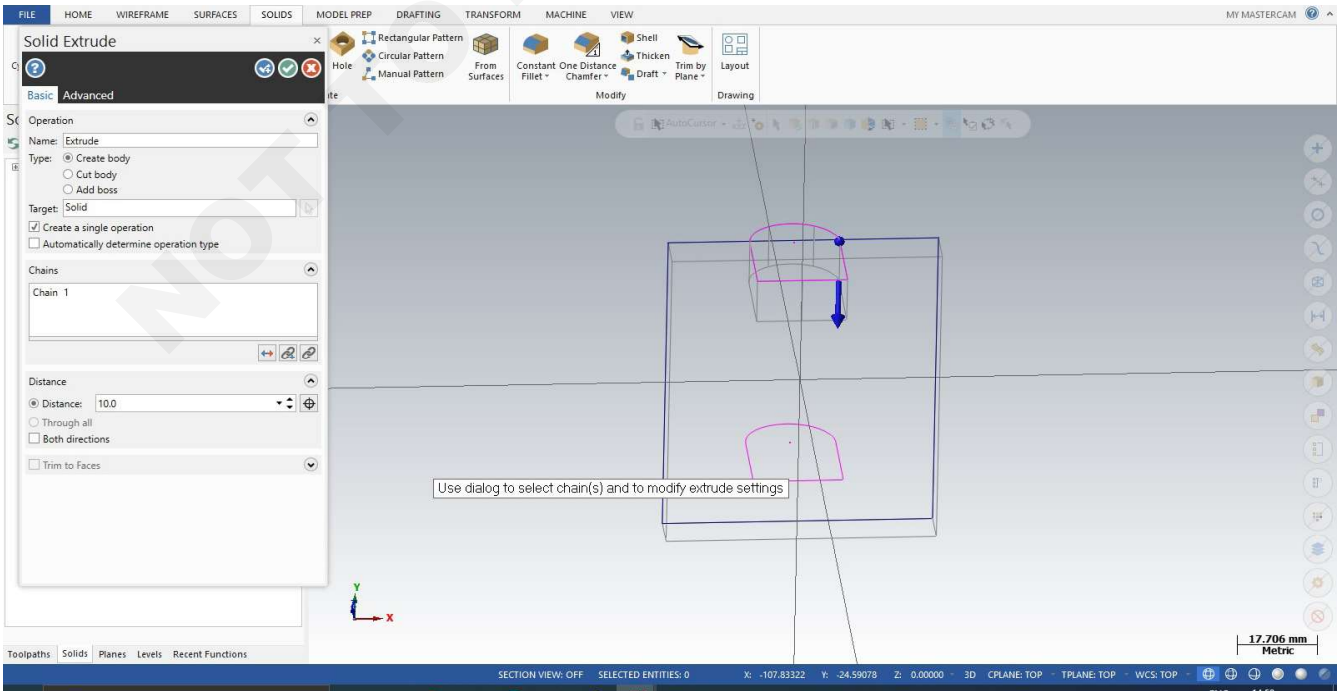
Fig 37



C Press ok.

D Give distance in the dialogue box as 10 mm (Fig 38)

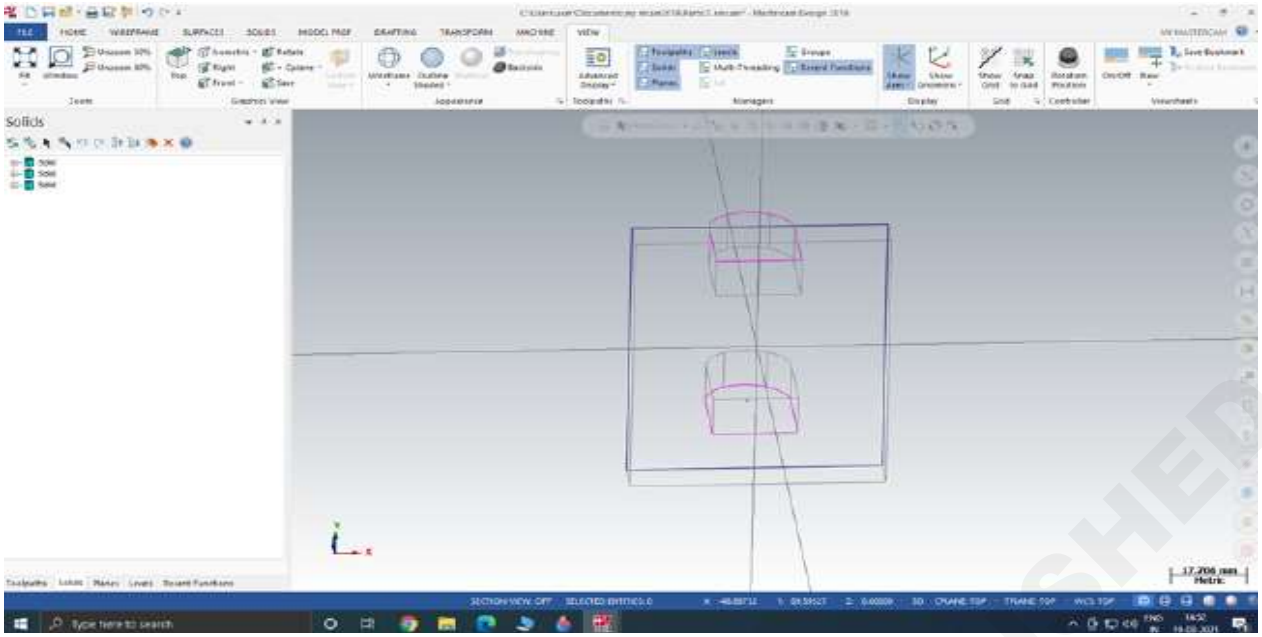
Fig 38



E Press ok

F Repeat this for the other rib press ok (Fig 39)

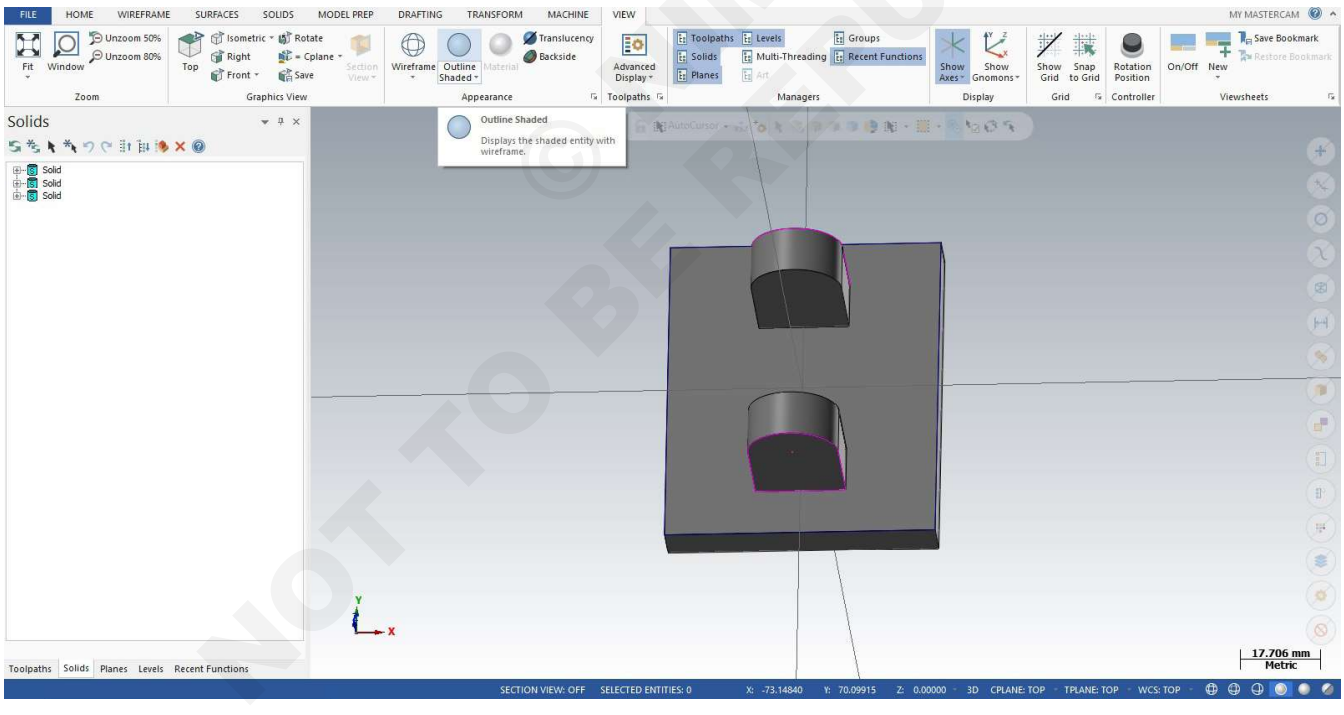
Fig 39



G Select view option

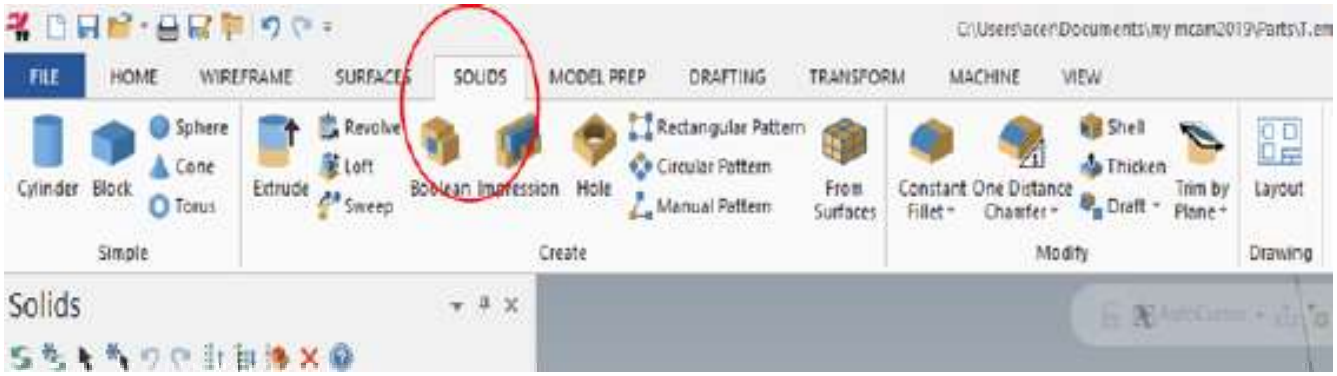
H Select outline shaded option (Fig 40)

Fig 40



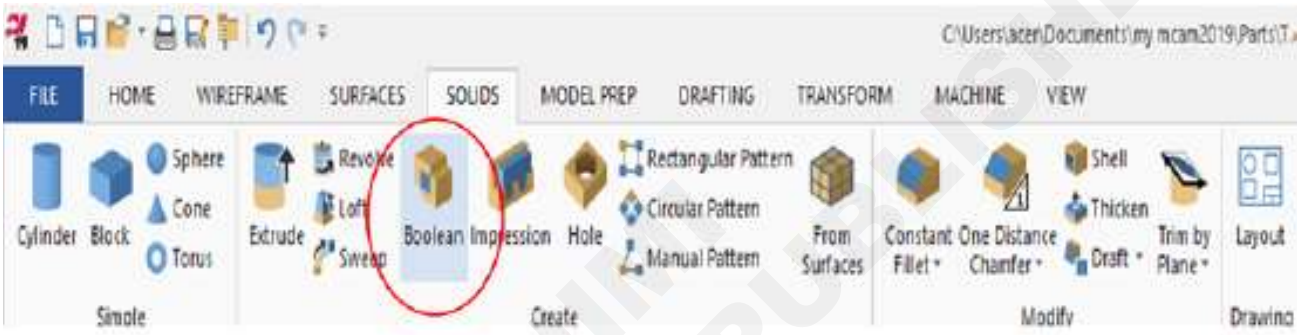
I Select solids (Fig 41)

Fig 41



J Select Boolean option (Fig 42)

Fig 42



K In target dialogue select target body and select the bottom as shown (Fig 43 & 44)

Fig 43

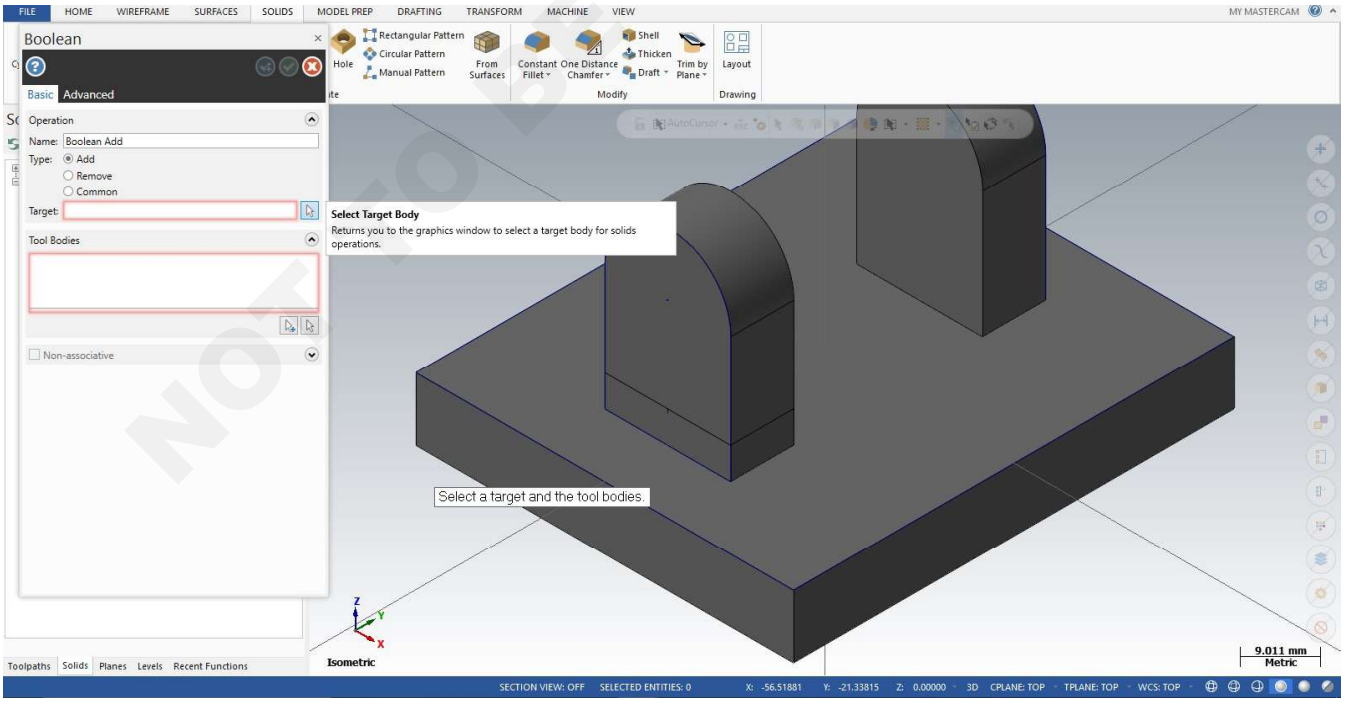
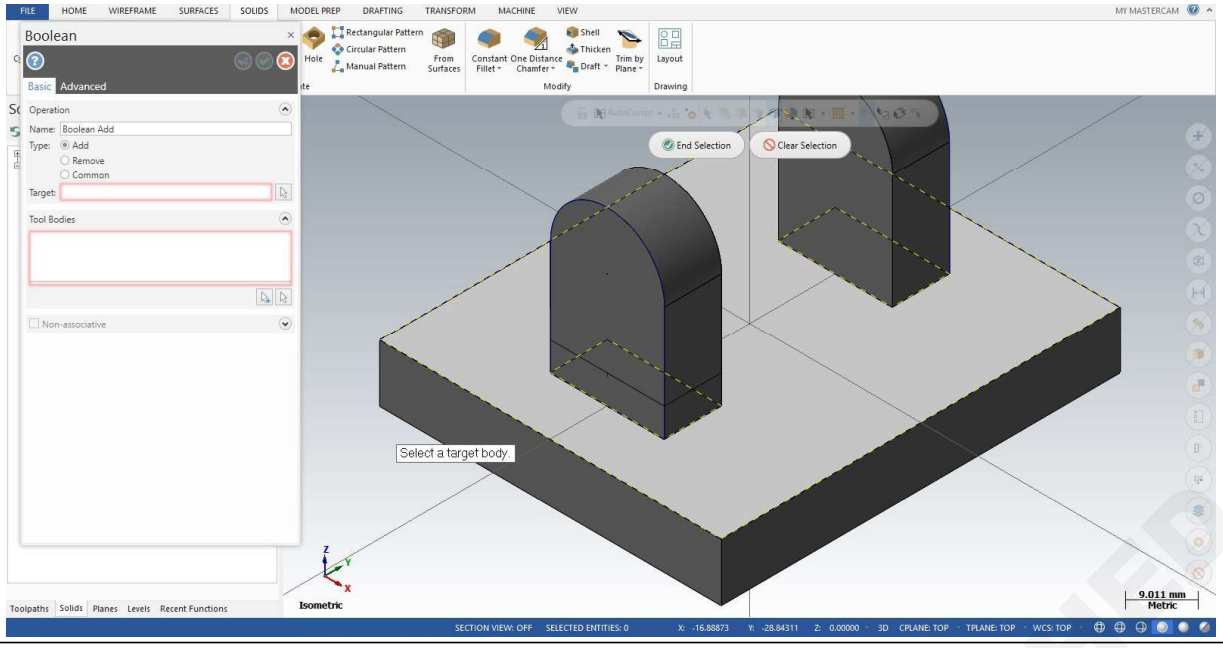


Fig 44



L In tool bodies select add selection and click on both the rib and press enter and close the dialogue (Note: This Converts all the sub bodies into a single solid body) (Fig 45 & 46)

Fig 45

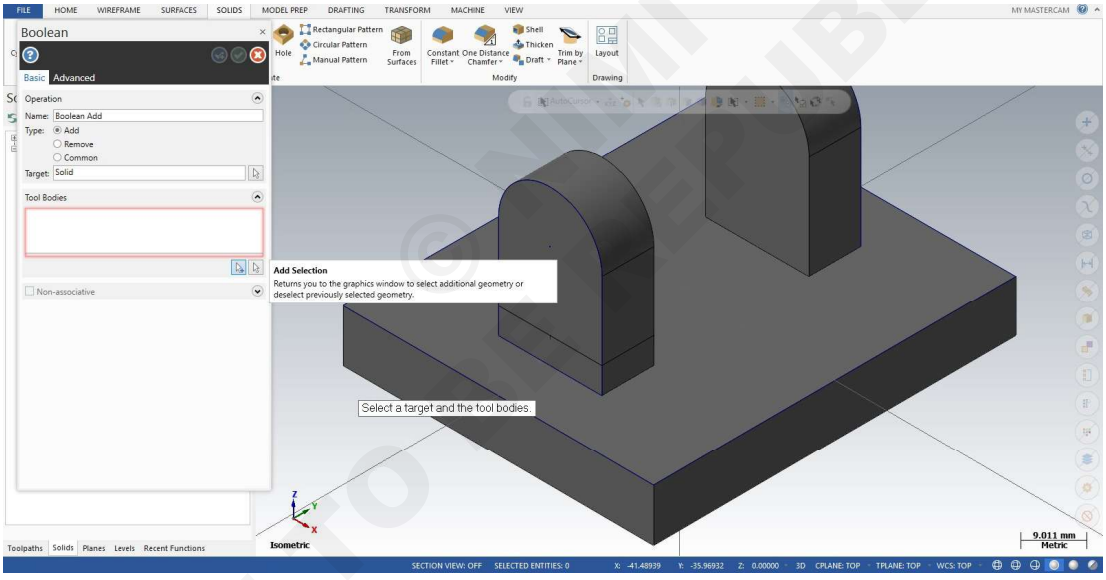
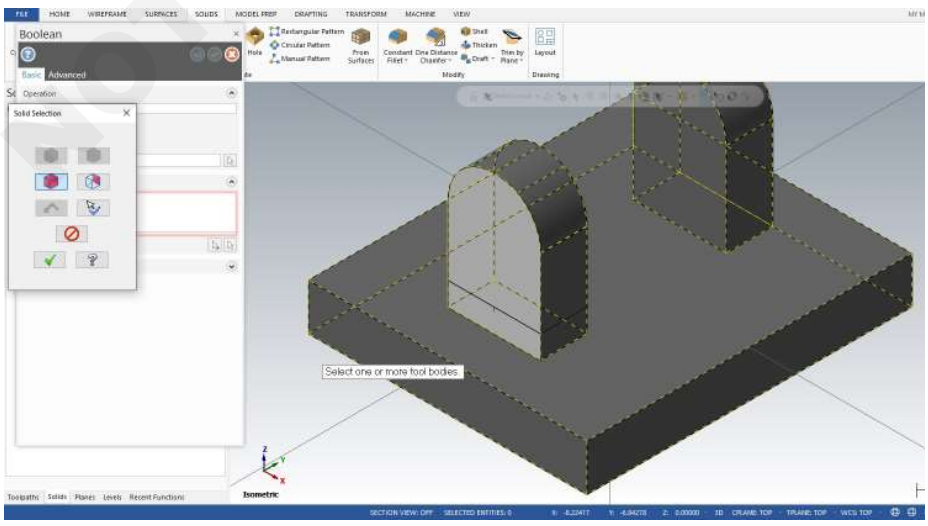
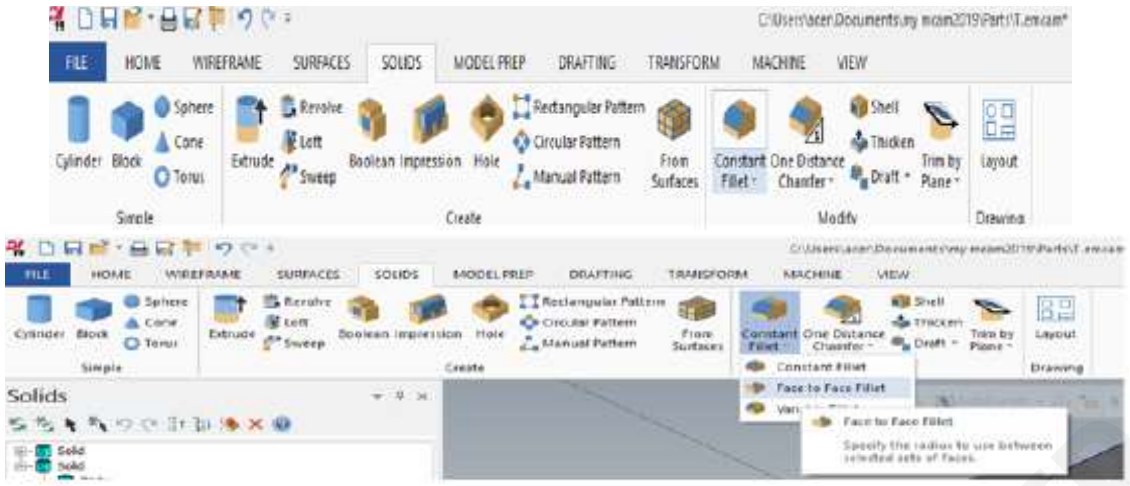


Fig 46



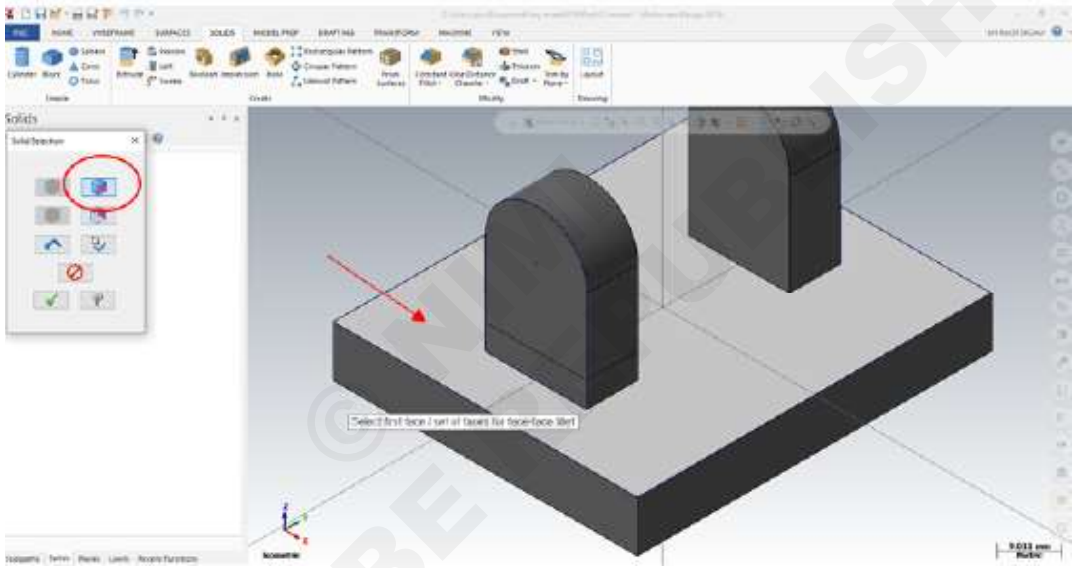
M Now click on constant fillet option and select face to face fillet (Fig 47)

Fig 47



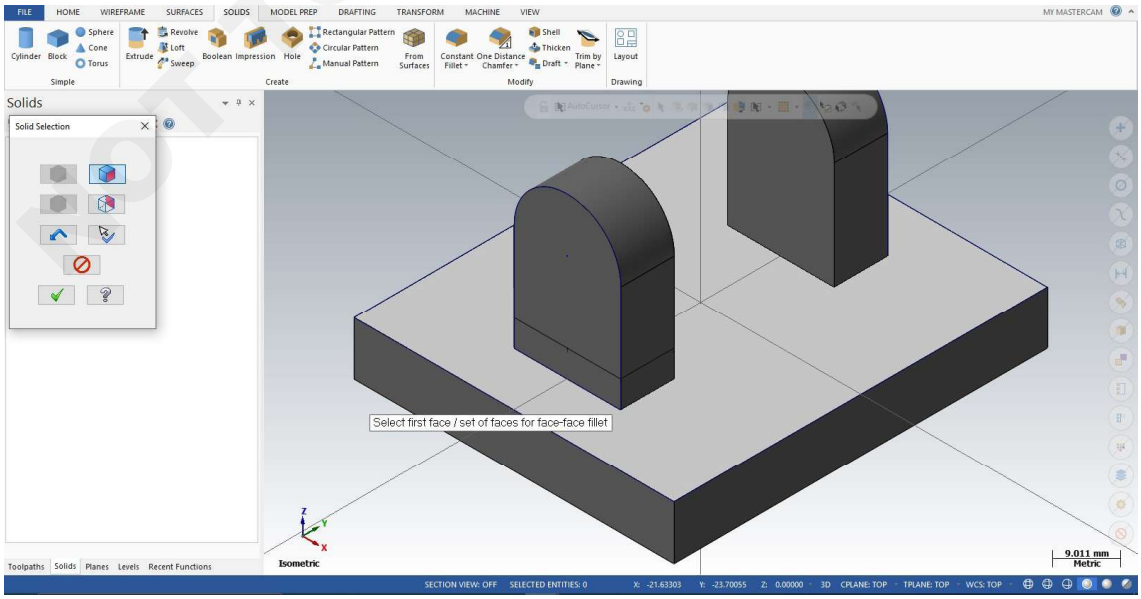
N Select the 1st face and press enter (Fig 48)

Fig 48



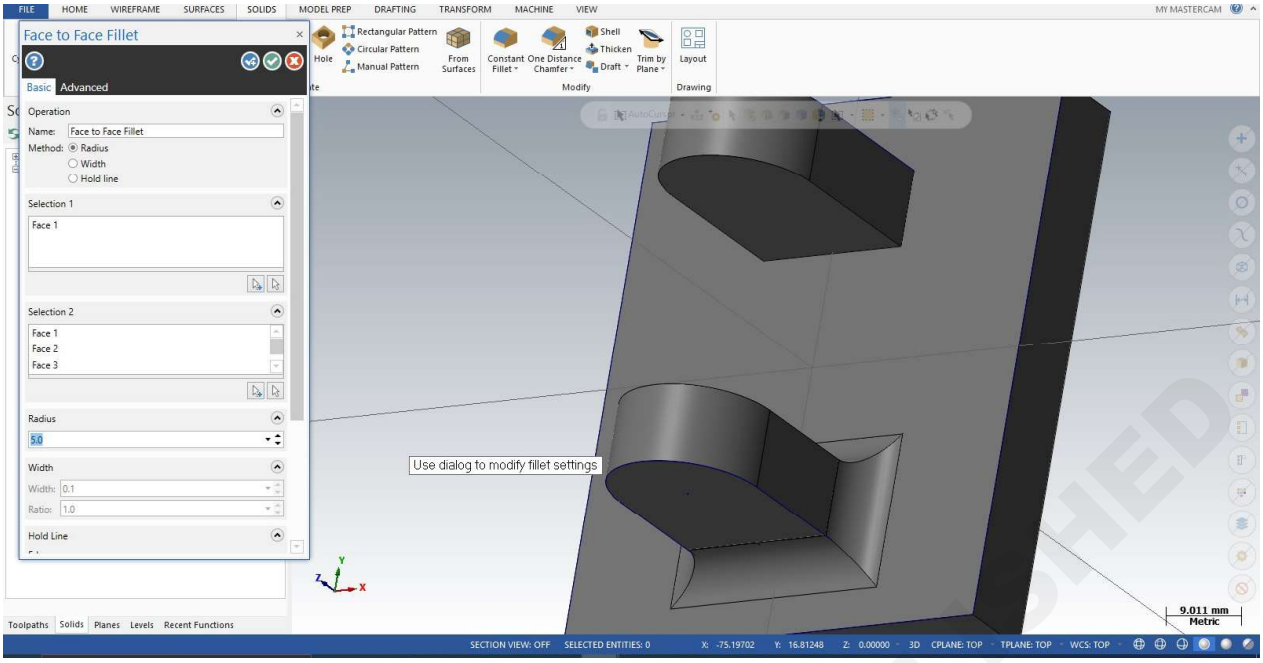
O Select the side faces (as shown) of the rib and press enter (Fig 49)

Fig 49



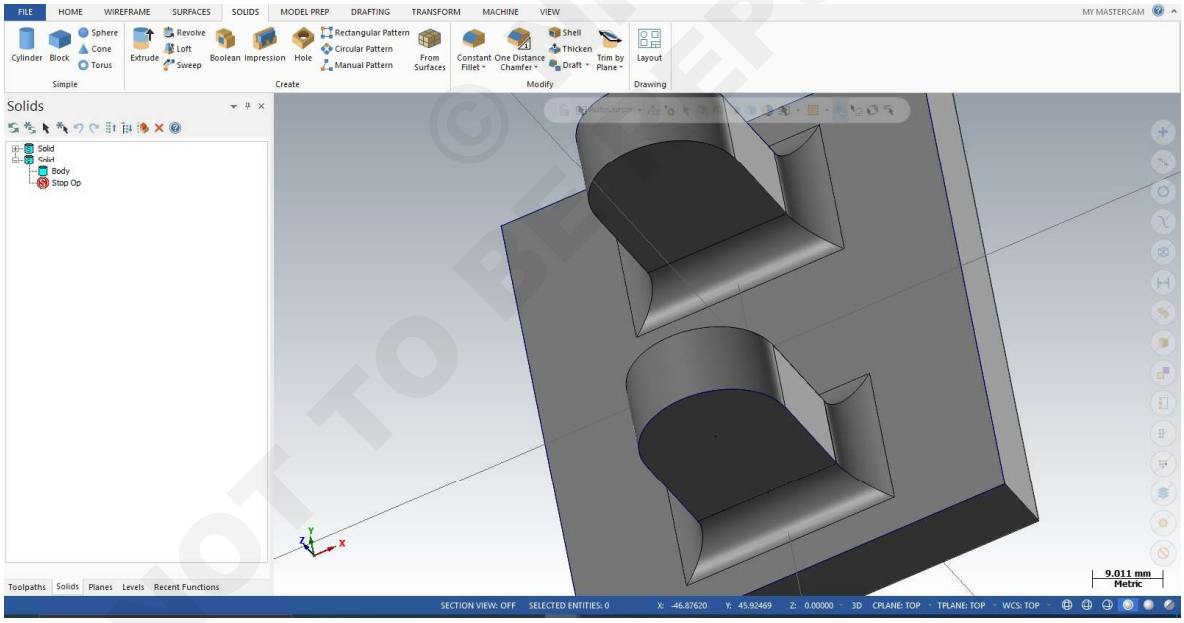
P In the radius of the dialogue box enter 5 and click ok (Fig 50)

Fig 50



Q Repeat this for the other rib as shown in the figure now the model is ready. The Model looks as shownin (Fig 51)

Fig 51



Program for Machining:

1 Select machine option (Fig 52)

Fig 52

2 Select mill option (Fig 53)

Fig 53

3 Select Fanuc control post processor (Fig 54)

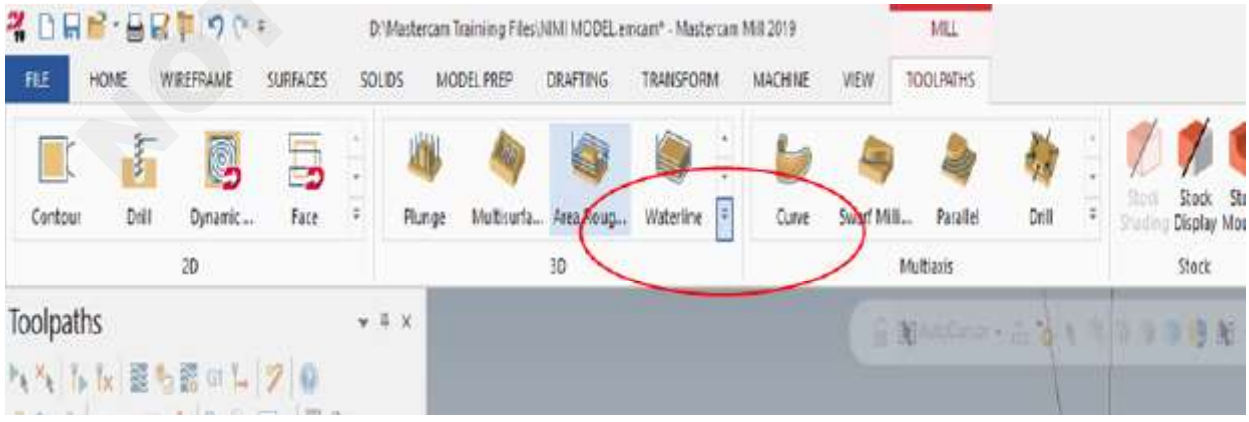
Fig 54

4 Select tool path (Fig 55)

Fig 55

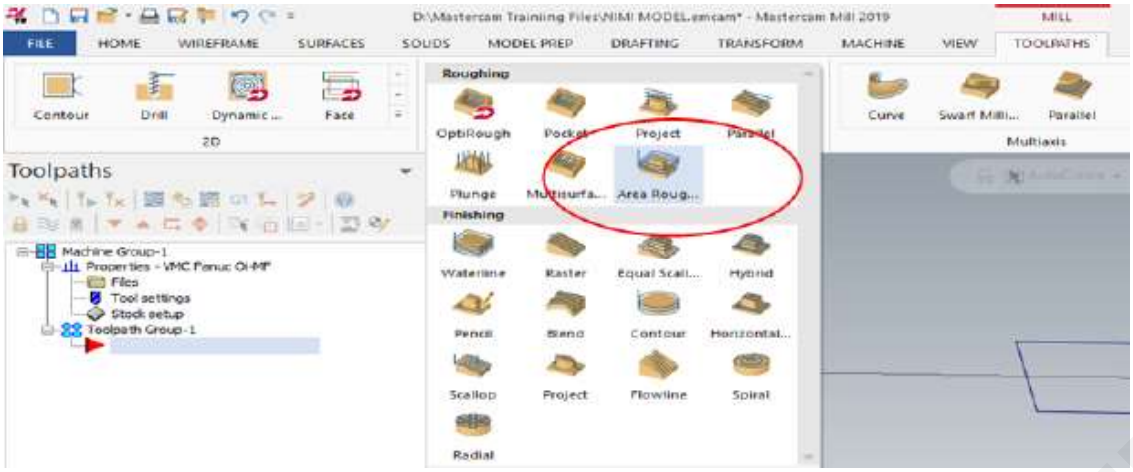
5 Select to see options under 3d (Fig 56)

Fig 56



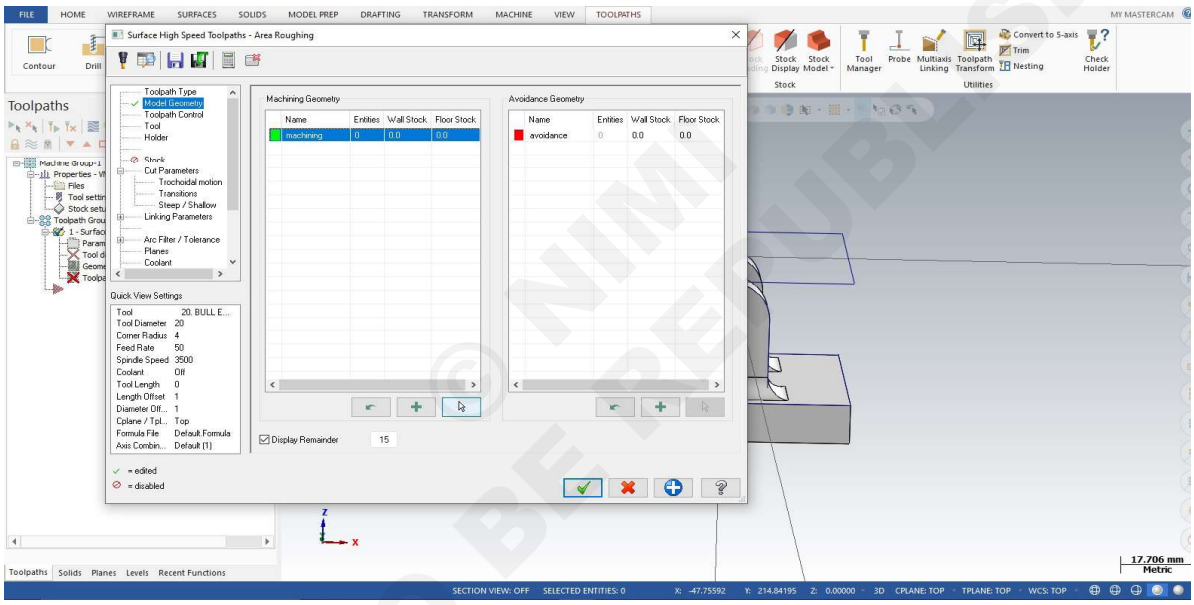
6 Select area roughing which opens a dialogue box (Fig 57)

Fig 57



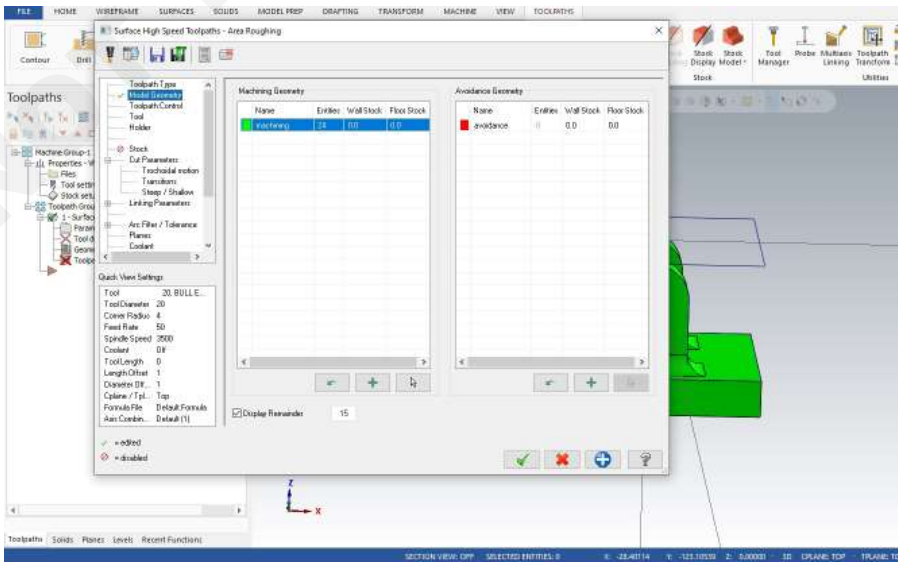
7 Under machining geometry select (Fig 58)

Fig 58



8 Click 3 times to select a full solid body (Fig 59)

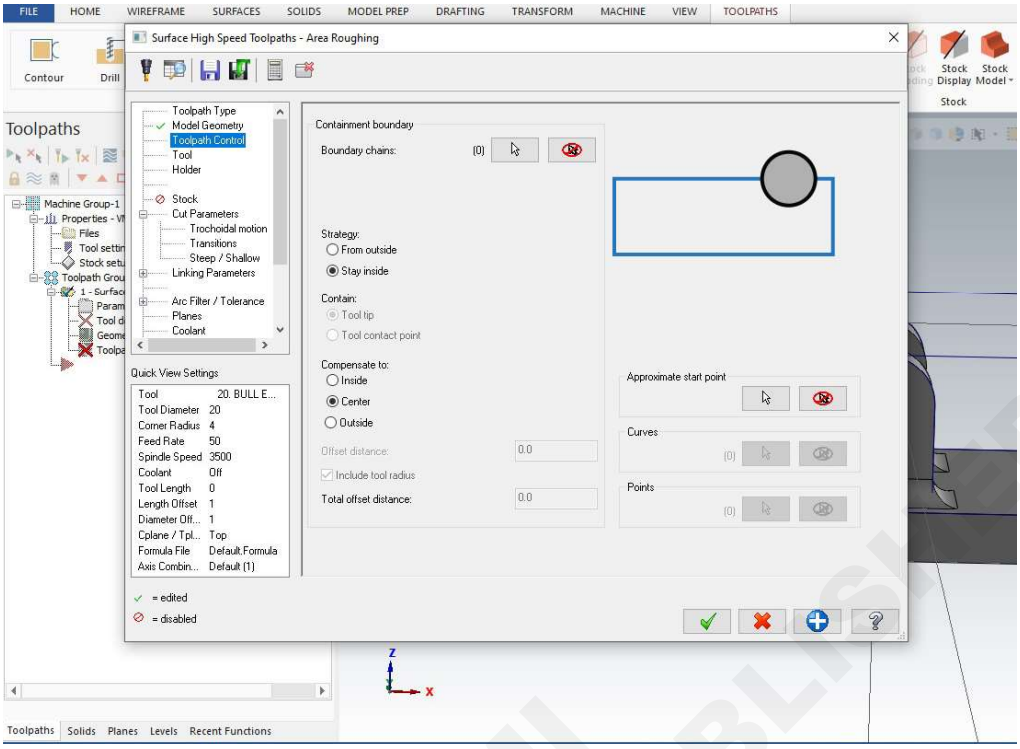
Fig 59



9 Press enter

10 Select tool path control in the dialogue (Fig 60)

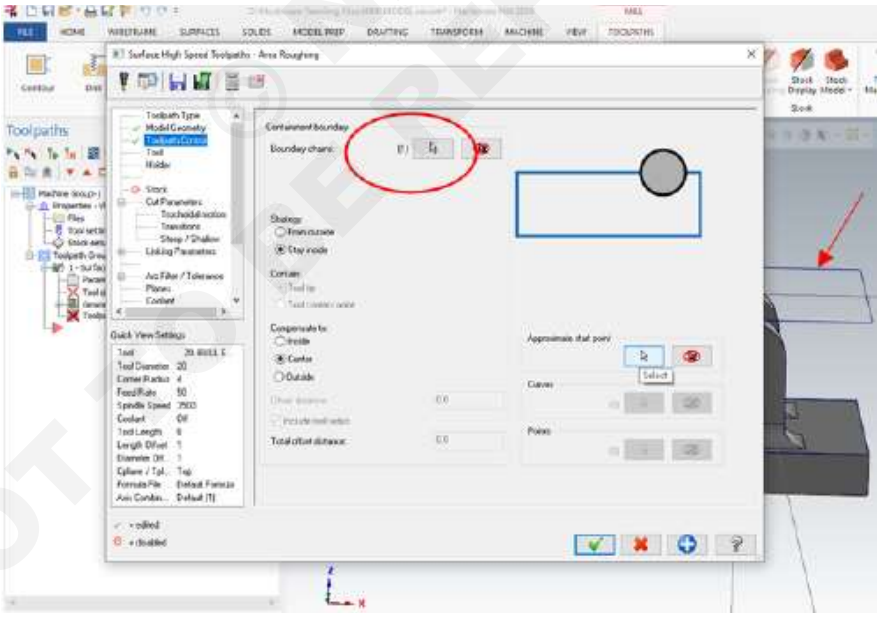
Fig 60



11 Select the rectangle constructed at the top for containment body (Fig 61)

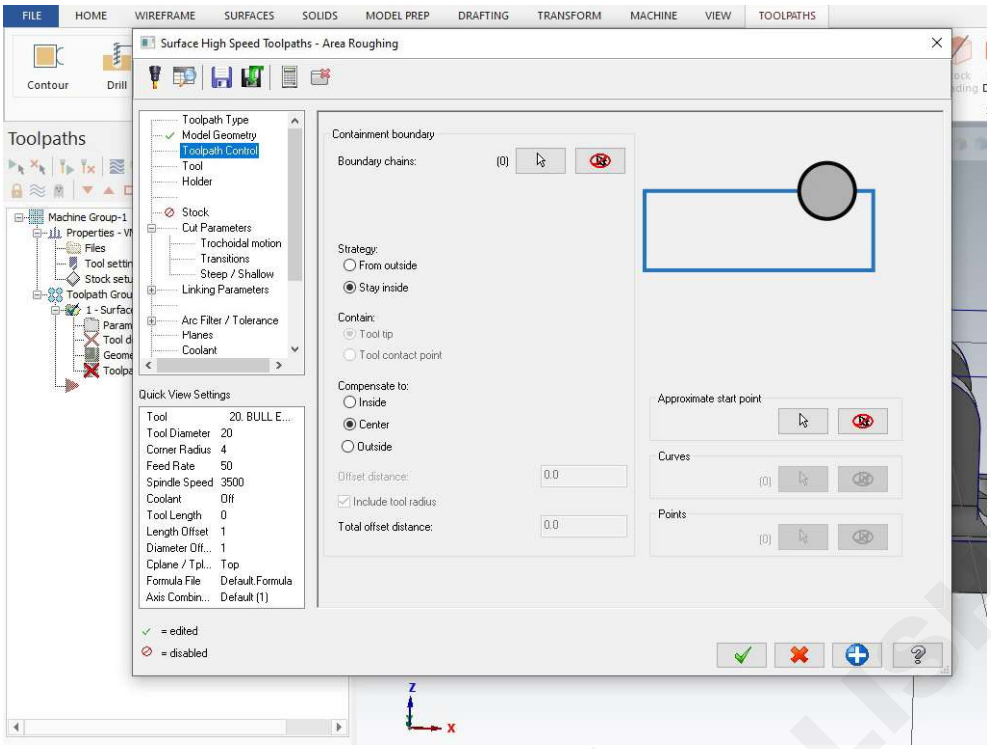
12 Press enter

Fig 61



13 Select approximate start point option (Fig 62)

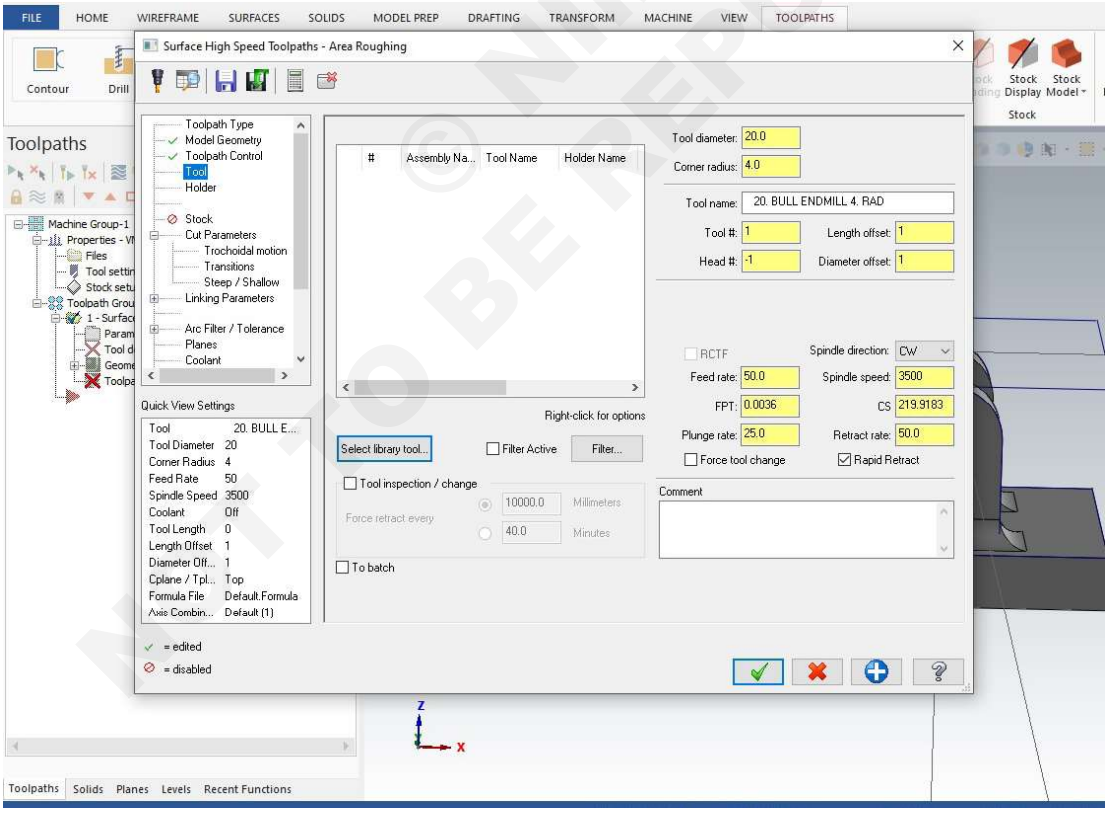
Fig 62



14 Select the center of the model (Fig 63)

15 Press enter

Fig 63

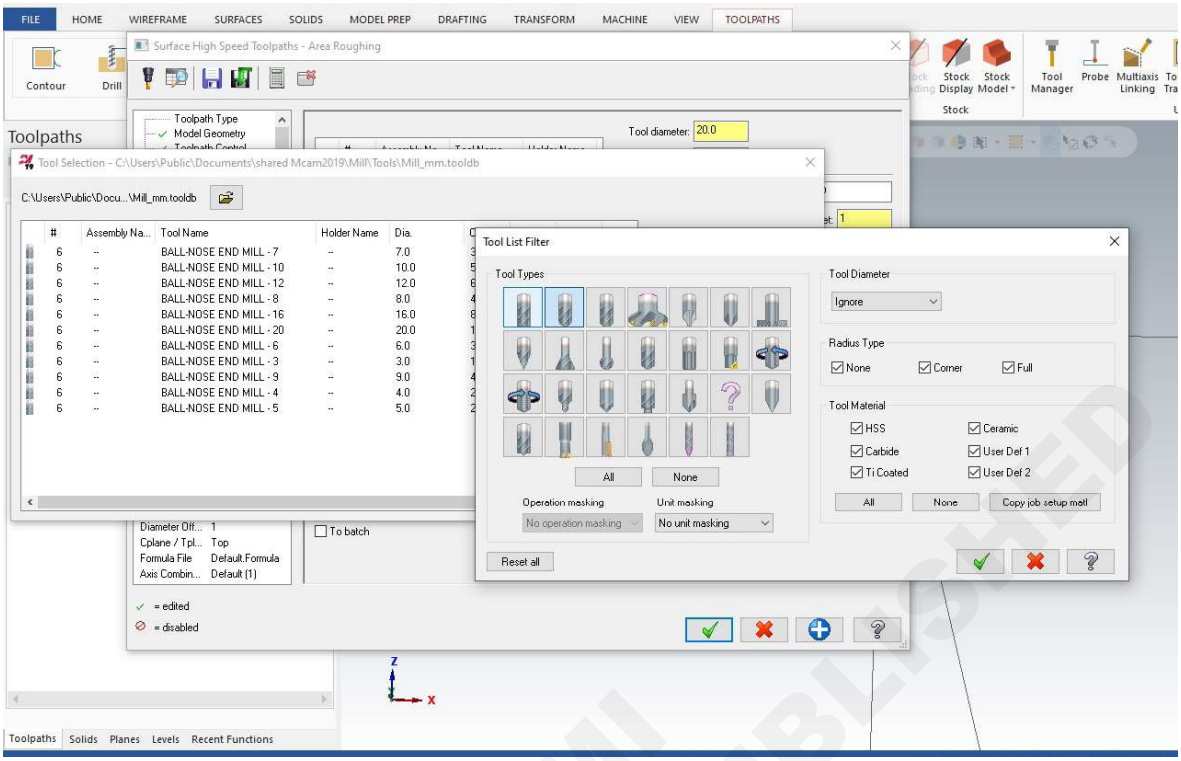


16 Select tool option

17 Select library tool option (Fig 64)

18 Select filter option

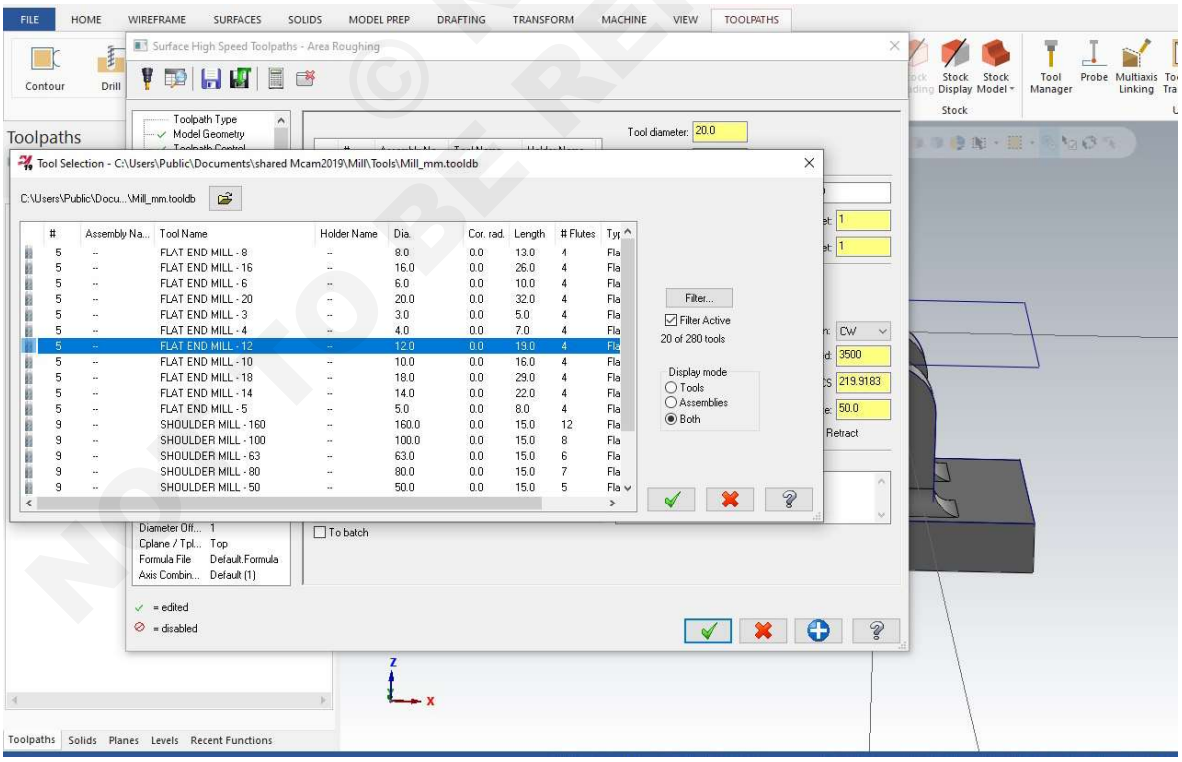
Fig 64



19 Select flat end mill (Fig 65)

20 Press ok

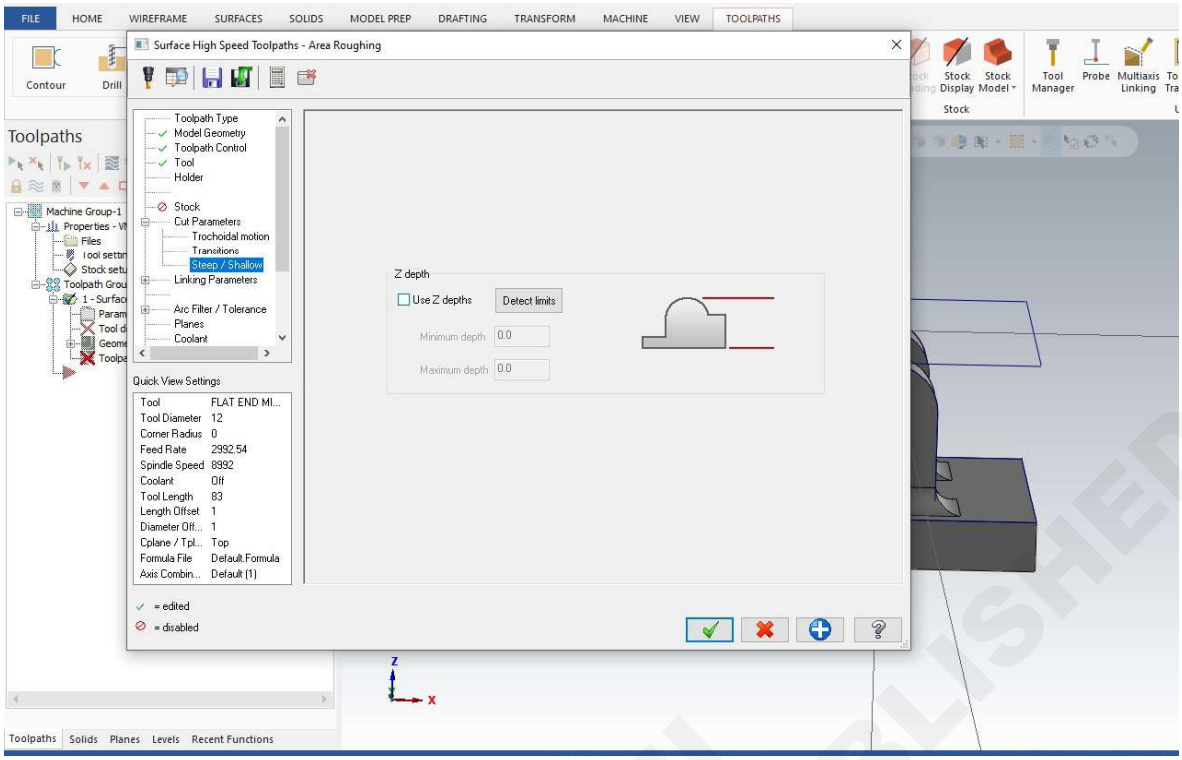
Fig 65



21 From the list of tool table select dia 12 flat end mill

22 Click ok (Fig 66)

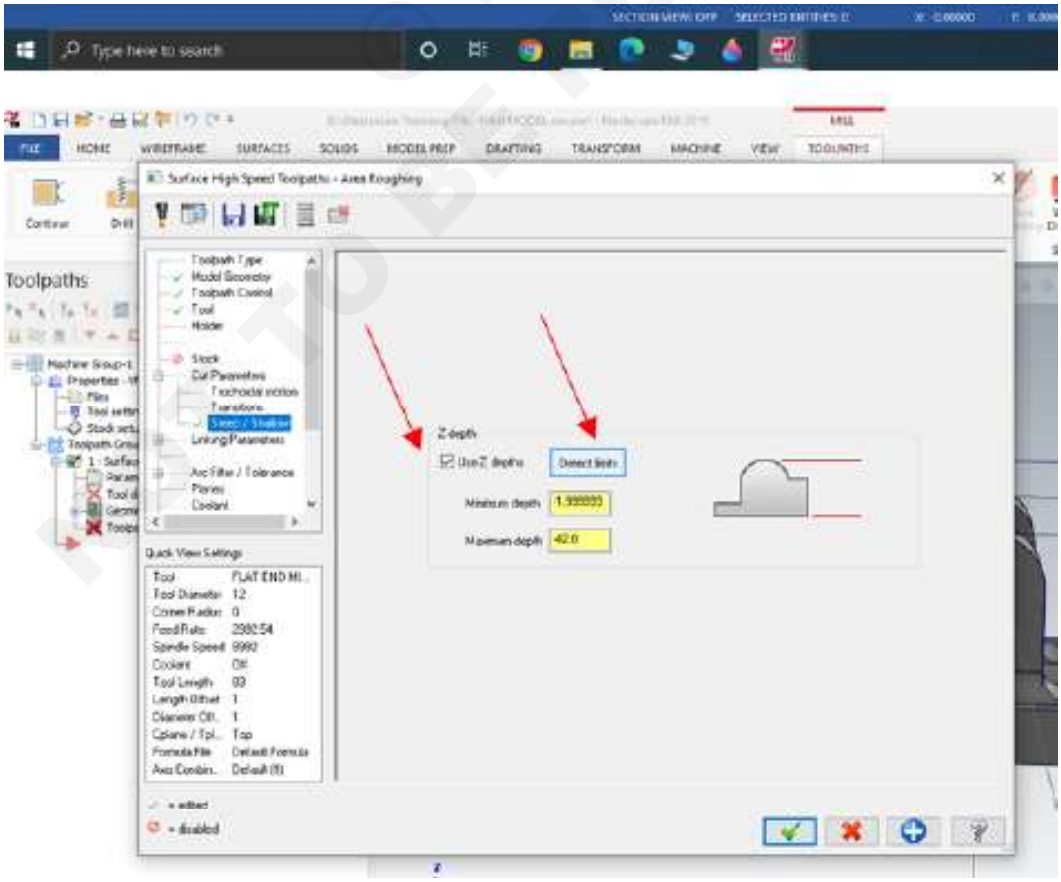
Fig 66



23 Click in the select box of use depths and click on detect limits (Fig 67)

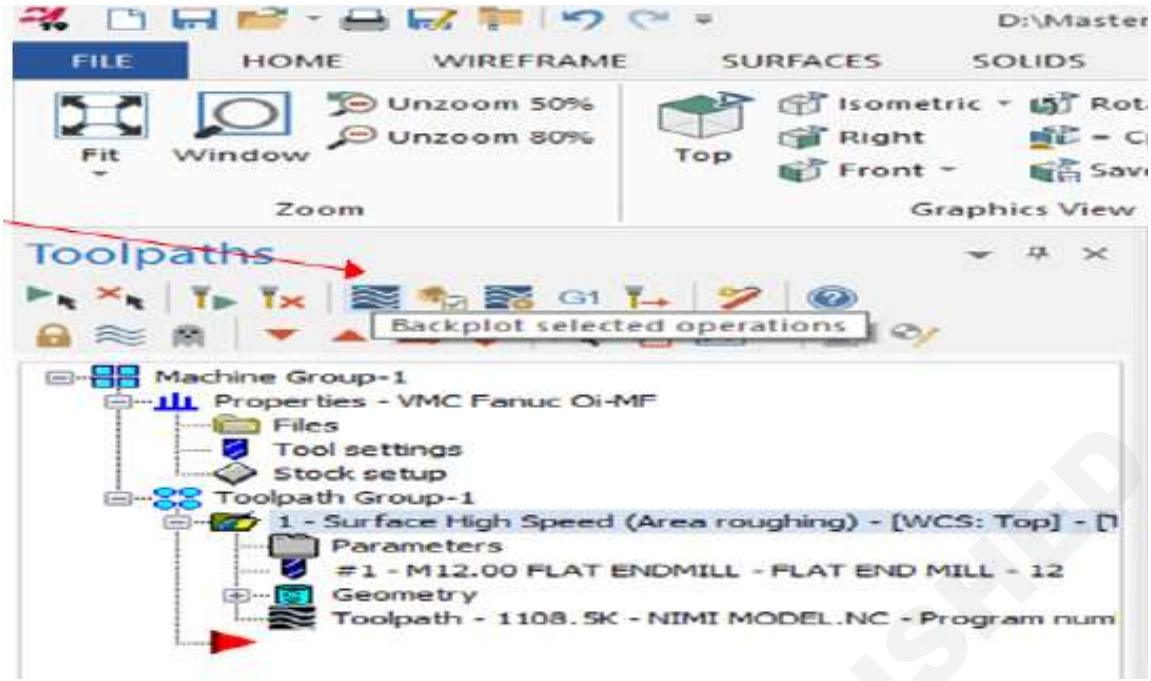
24 Then select linking parameters and press ok

Fig 67



25 Select back plot the operation (Fig 68)

Fig 68



26 Now press play symbol to check the simulation

27 Now click ok

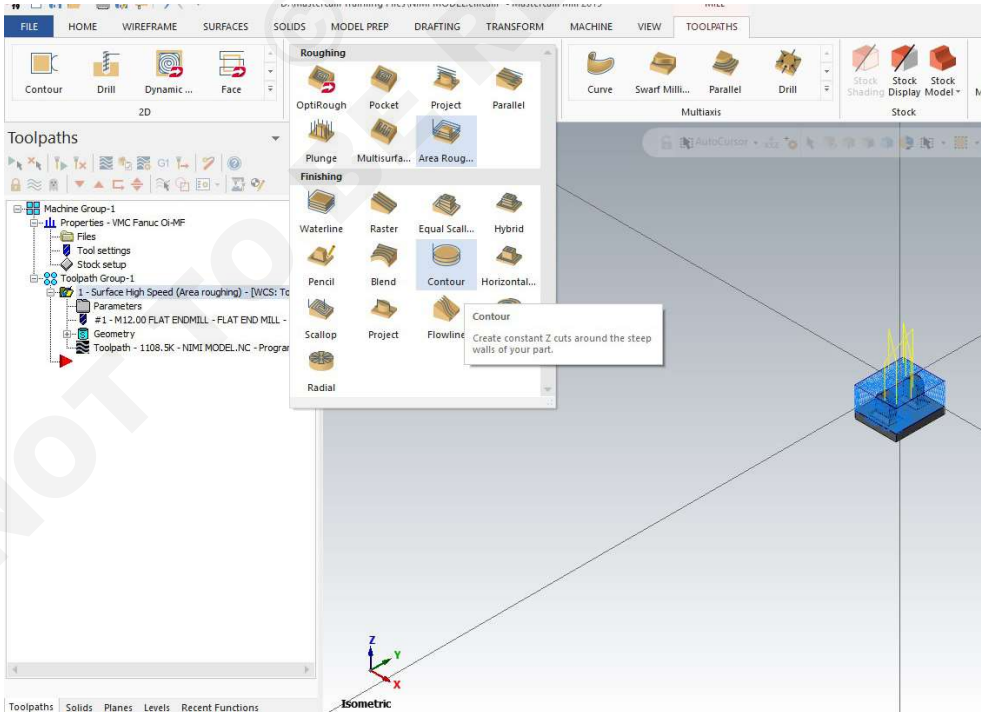
Creating a Finishing 3D Contour Toolpath for Finishing the Job (Fig 69)

1 Select tool path option

2 Select the drop down menu to open the options for 3d

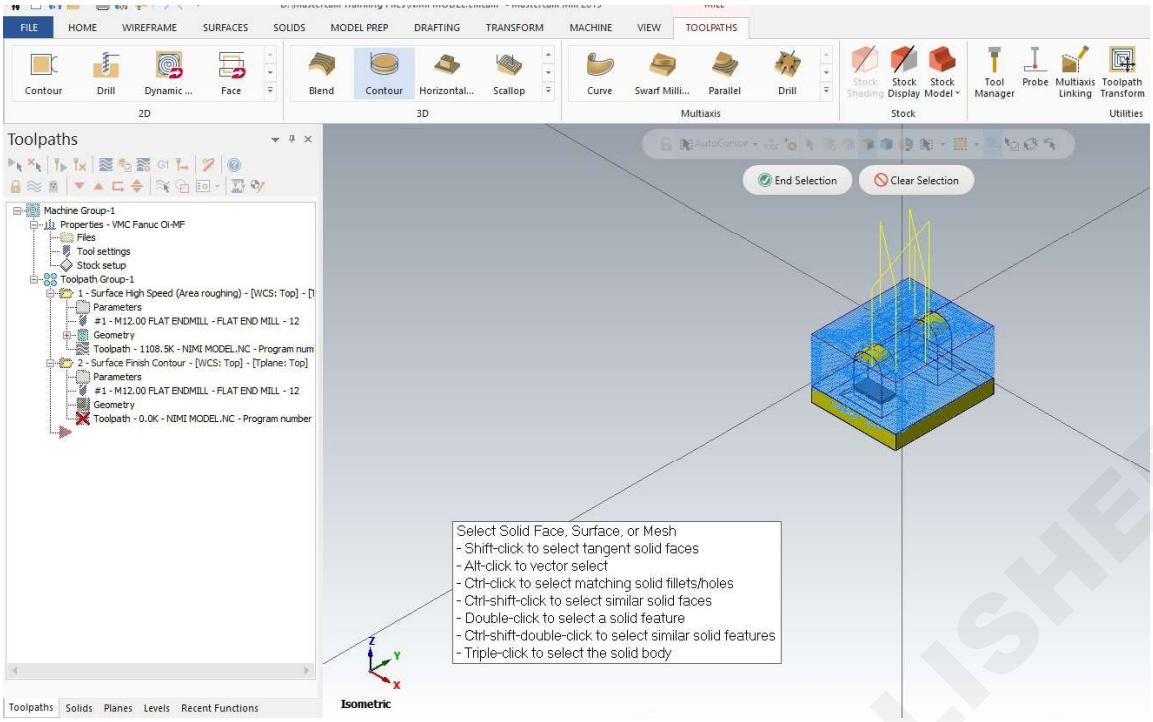
3 Select contour under finishing

Fig 69



4 Click left hand mouse button 3 times on the model to select completely and press enter (Fig 70)

Fig 70



5 Select containment in the dialogue box

6 Select the recant angular chain and press ok

7 Select approximate starting point option (Fig 71 & 72)

Fig 71

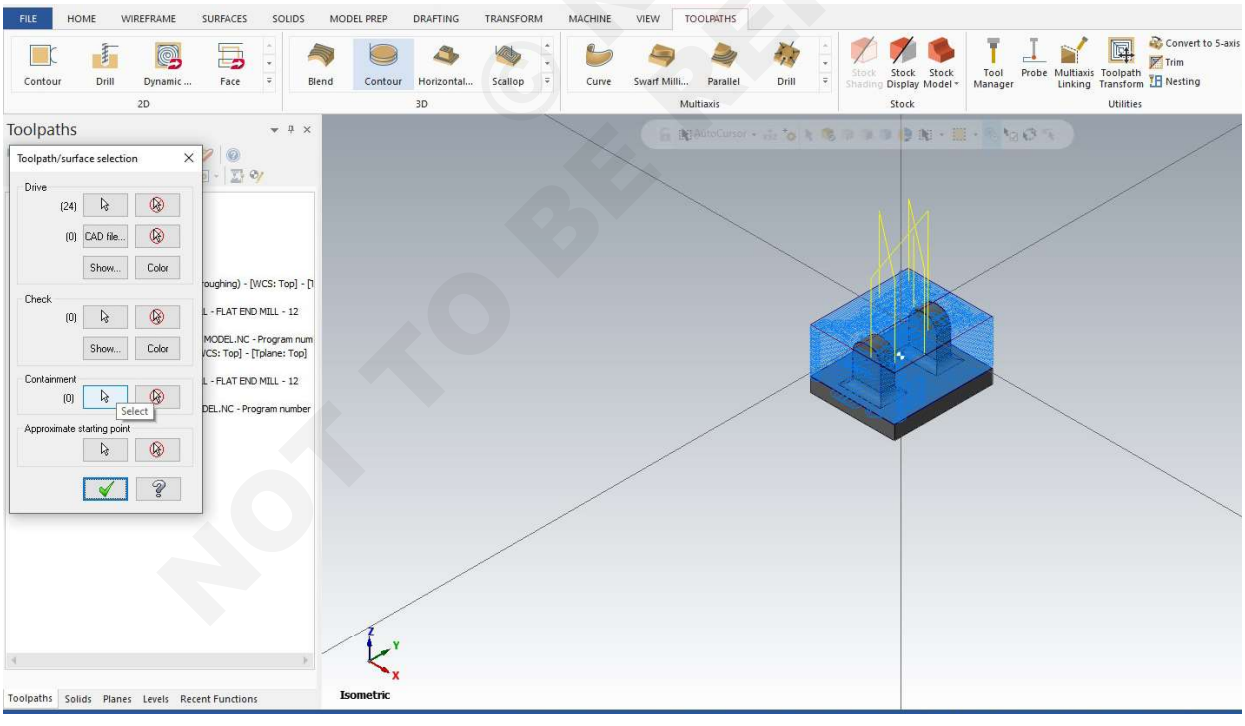
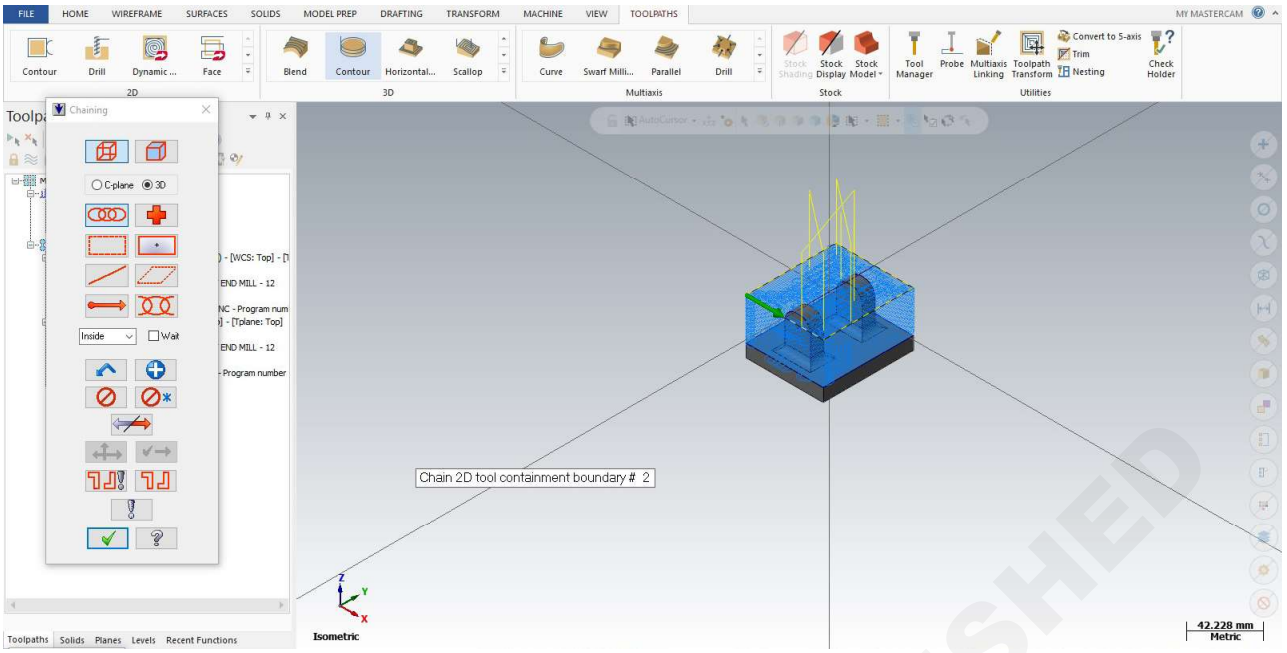
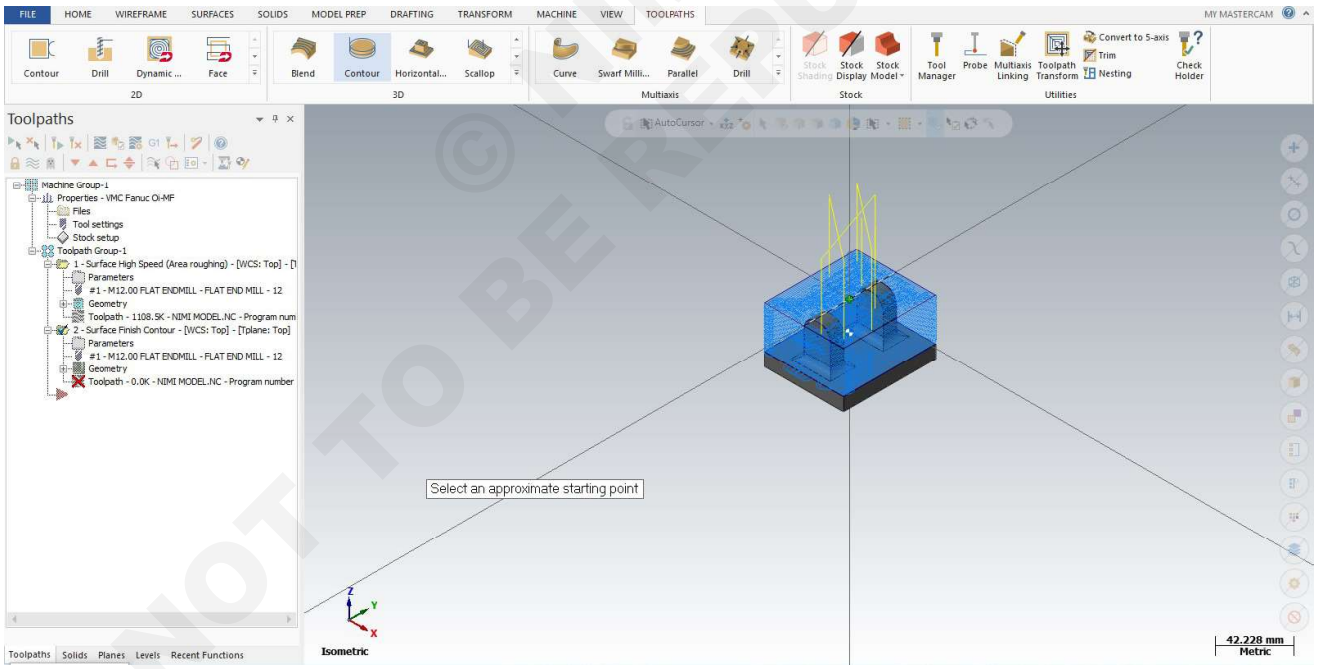


Fig 72



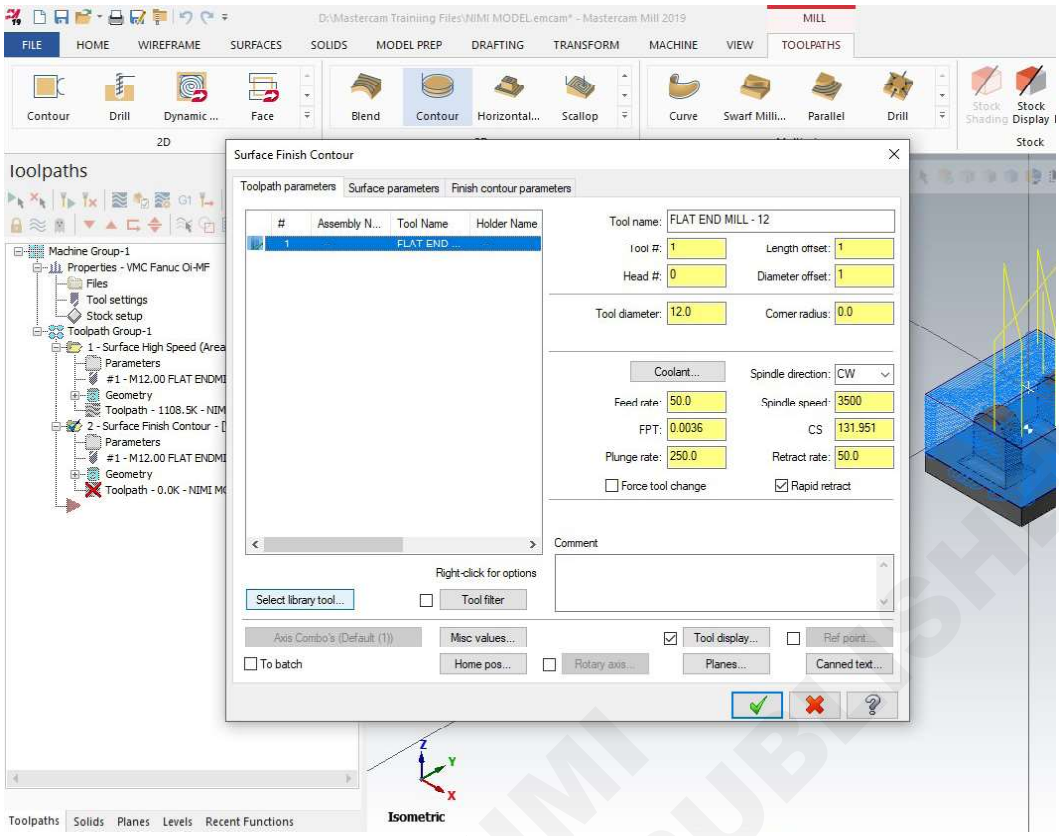
8 Click the centre of the model and press ok (Fig 73)

Fig 73



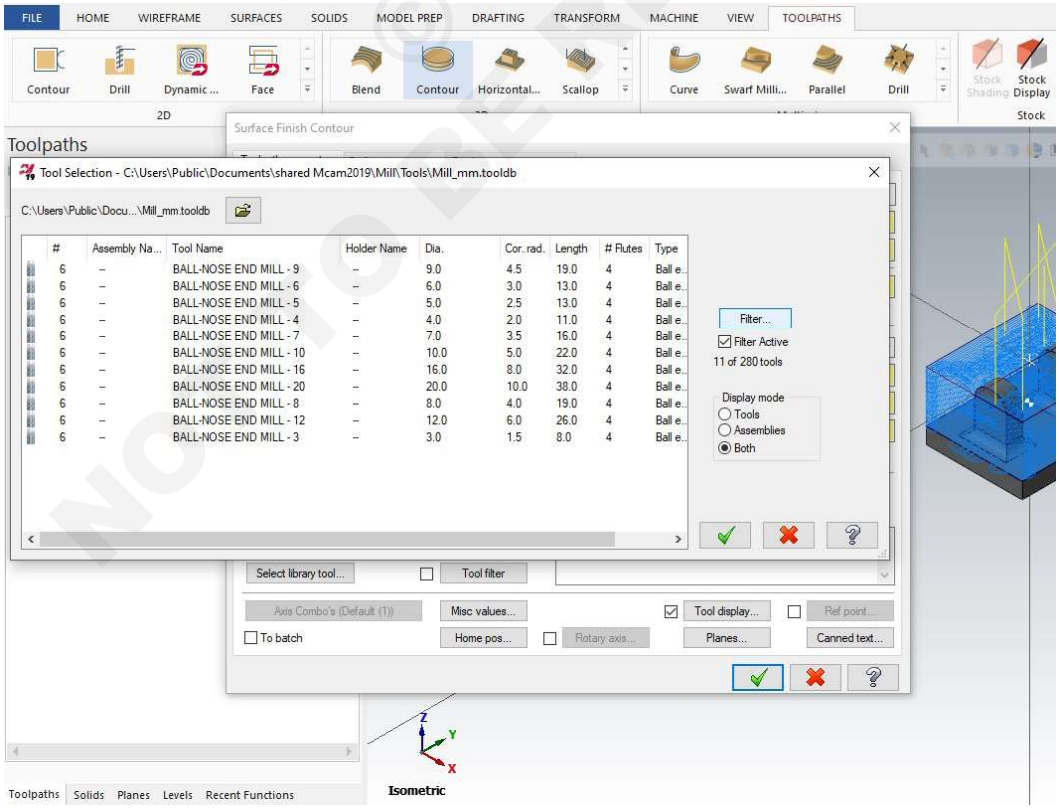
9 Select library tool from the appeared dialogue box (Fig 74)

Fig 74



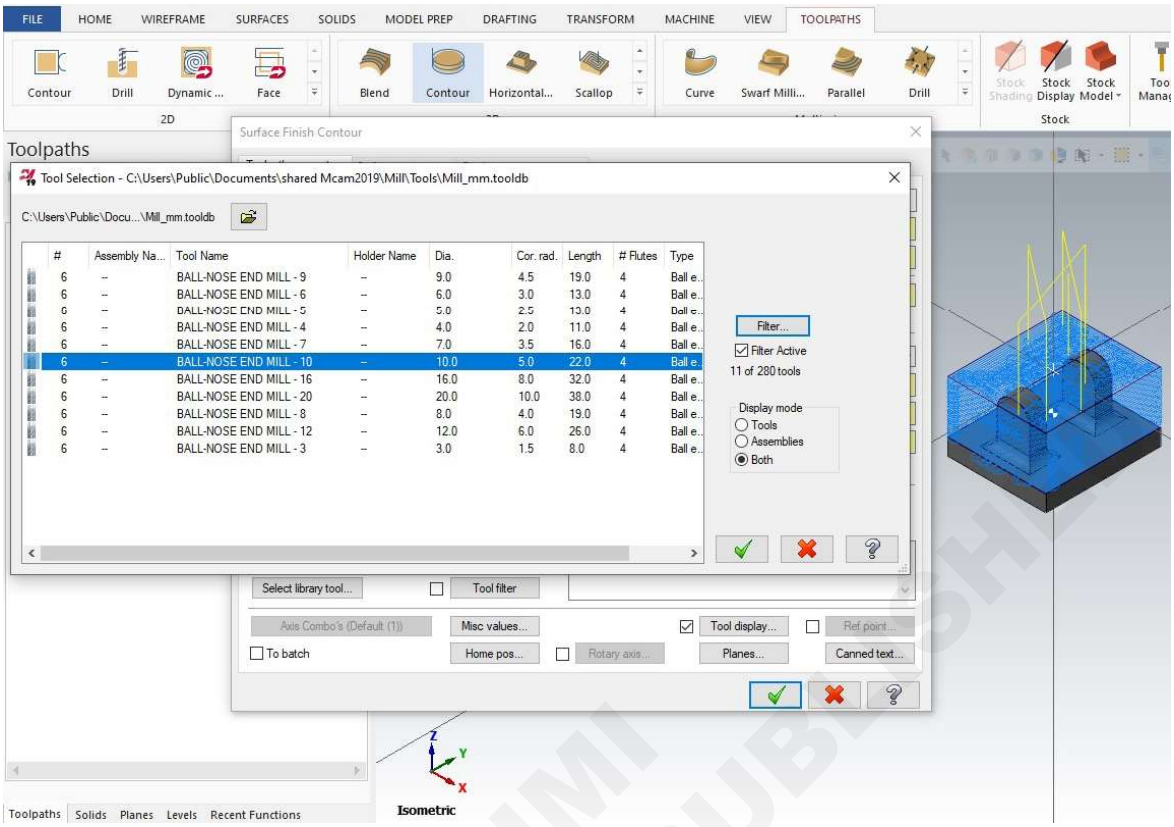
10 Select filter and select ok (Fig 75)

Fig 75



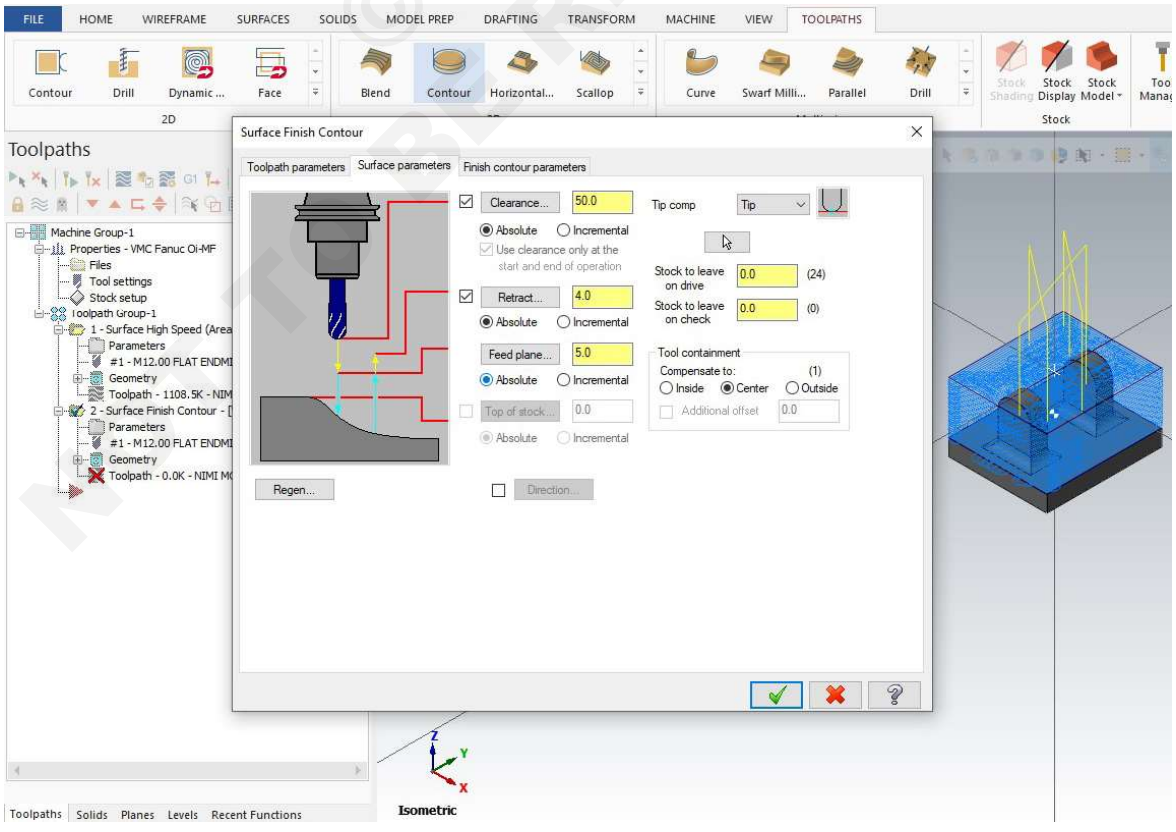
11 Select dia 10mm ball nose end mill tool and click ok (Fig 76)

Fig 76



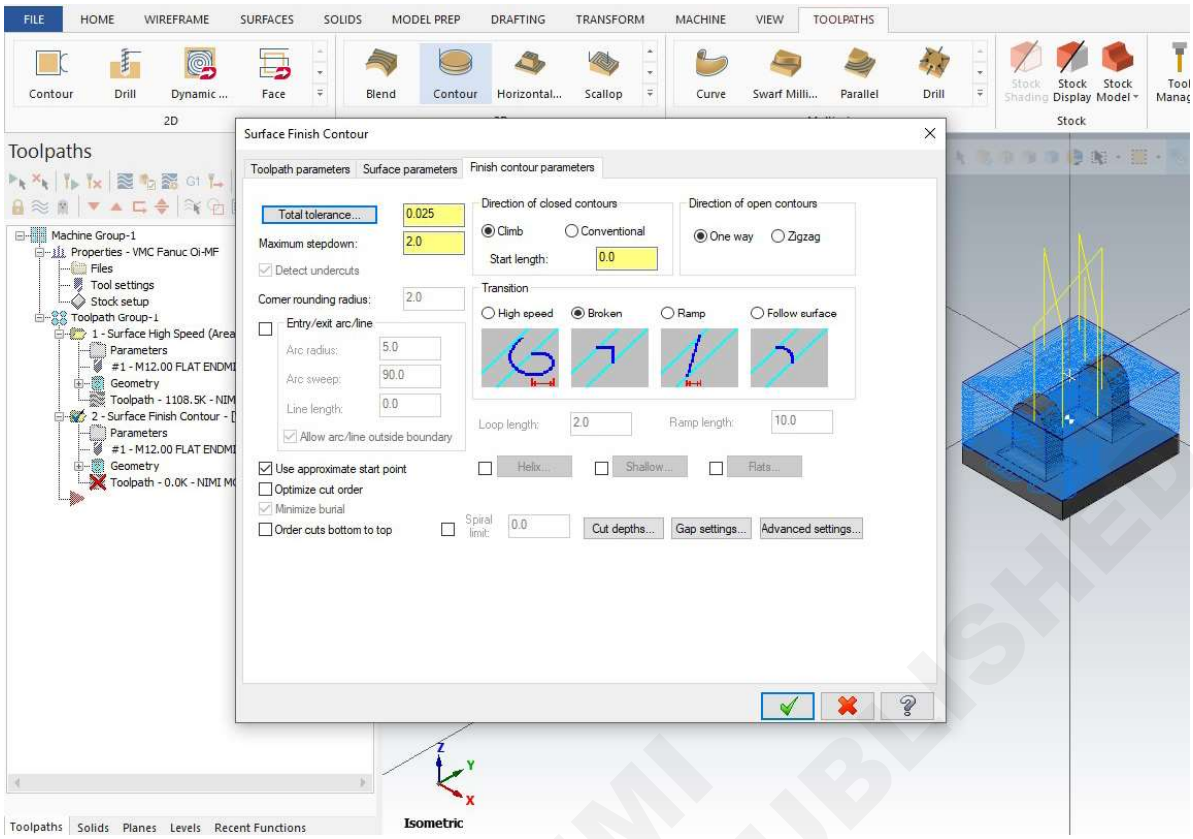
12 Click on surface parameter click in retract absolute in feed plane absolute (Fig 77)

Fig 77



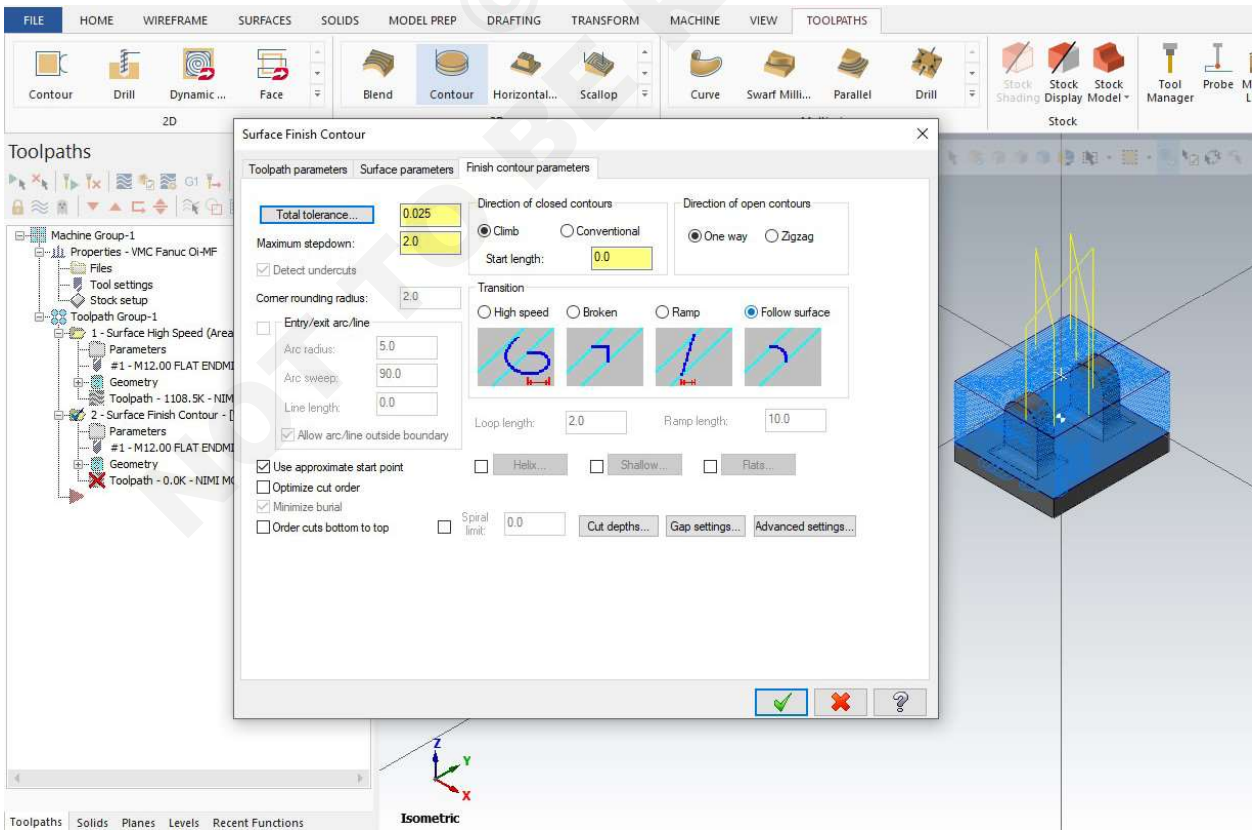
13 Click on finish contour parameters (Fig 78)

Fig 78



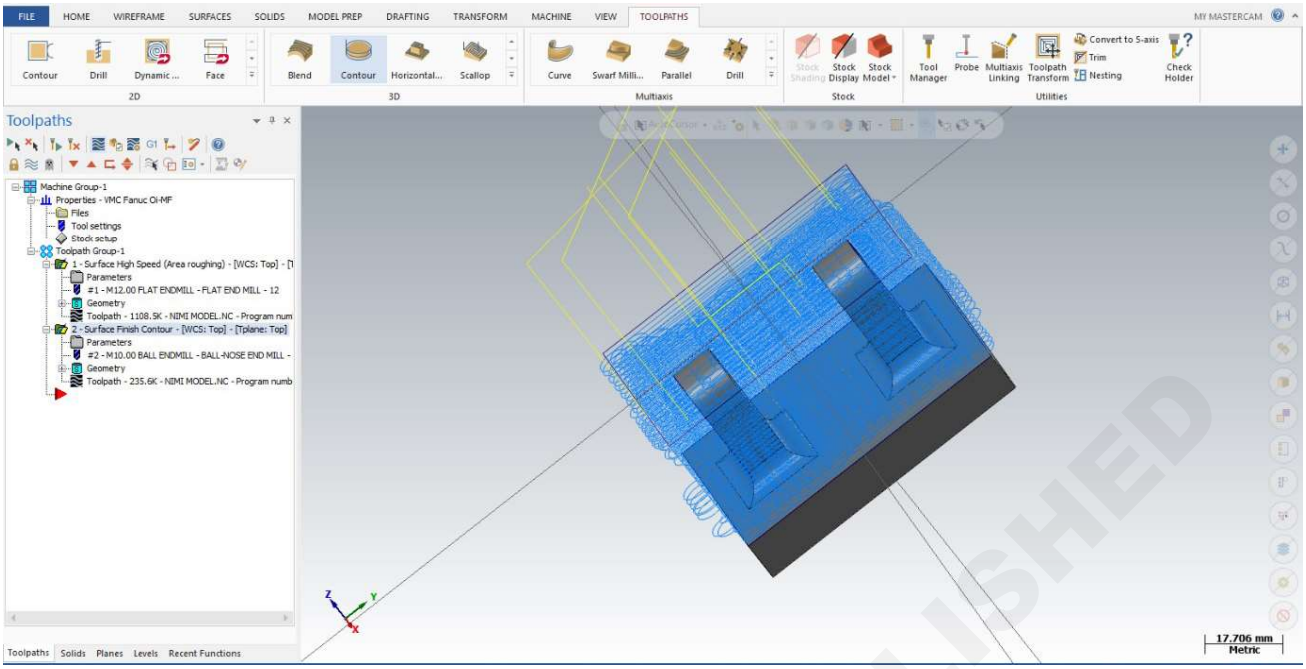
14 Select follow surface check in box and click ok (Fig 79)

Fig 79



15 Select back plot selected operation (Fig 80)

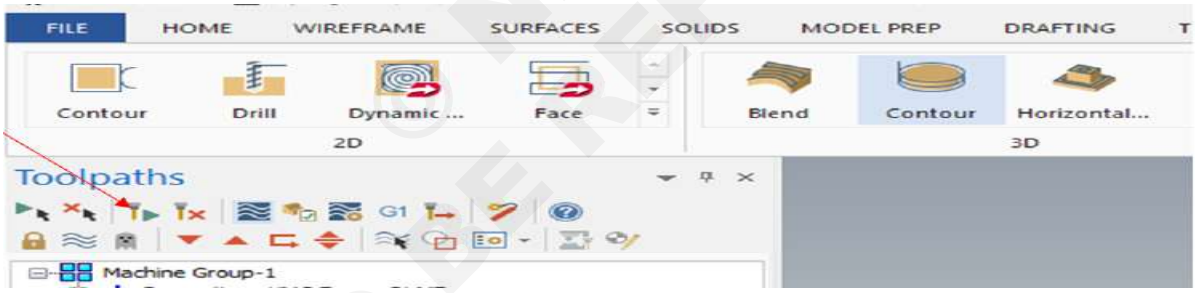
Fig 80



16 Click play symbol to check the simulation

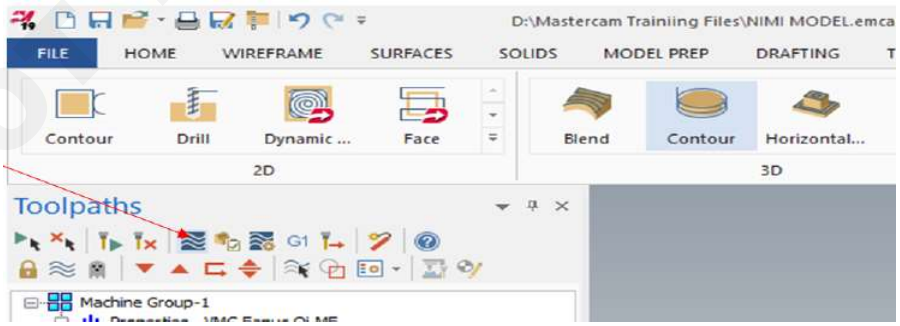
17 Now select both operations using select all operations (Fig 81)

Fig 81



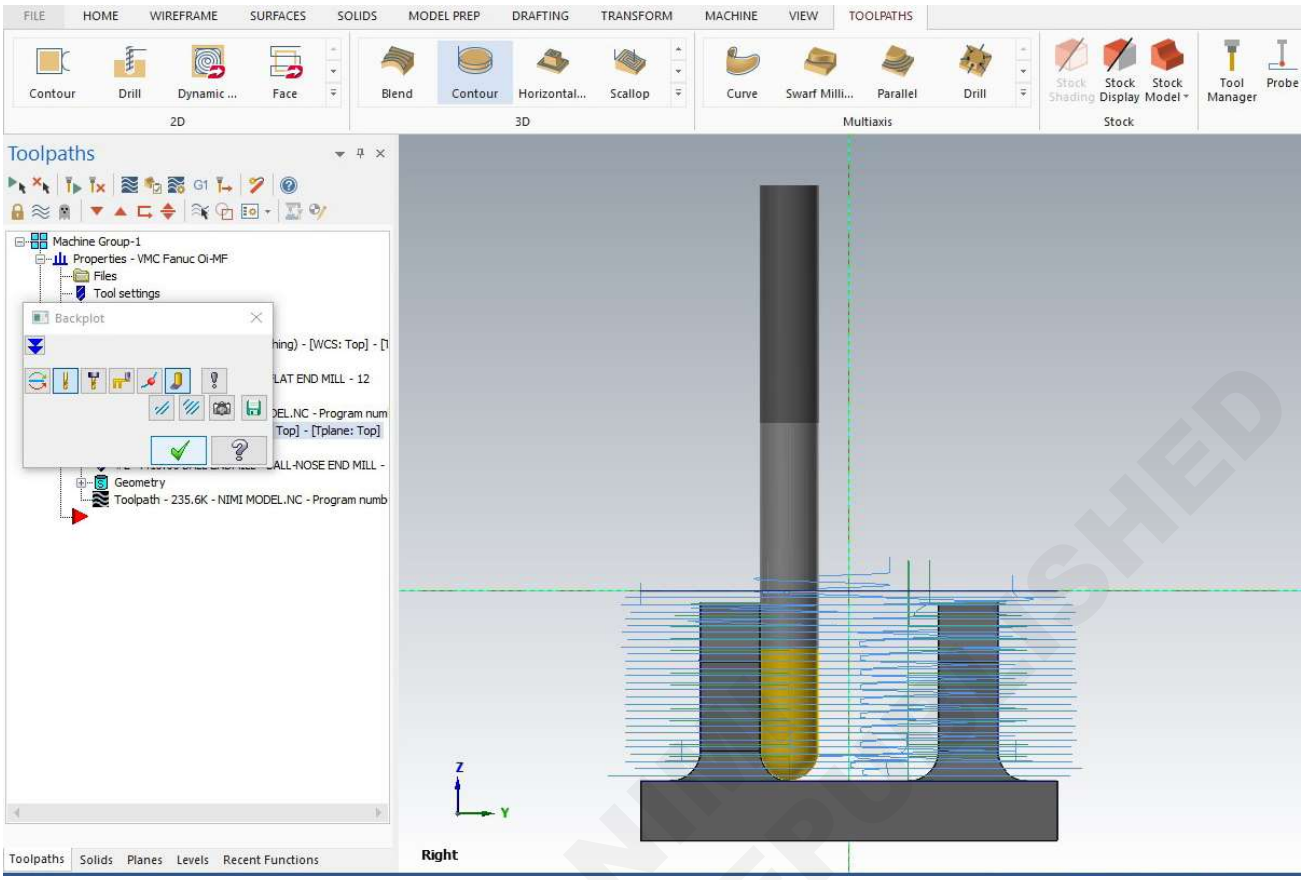
18 Backplot all the operations and press play symbol to check simulation (Fig 82)

Fig 82



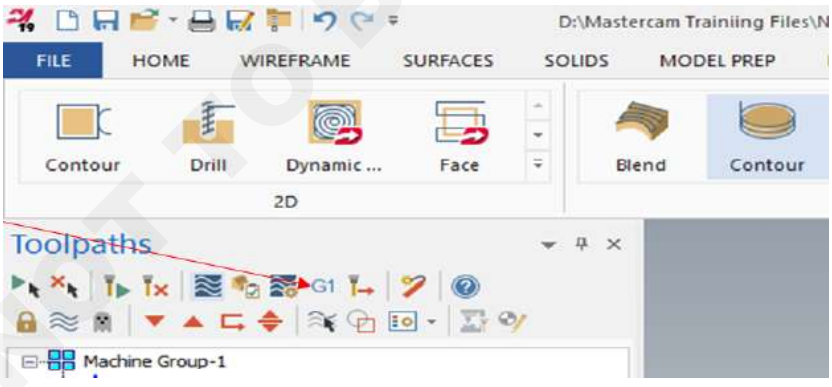
19 After the simulation click ok (Fig 83)

Fig 83



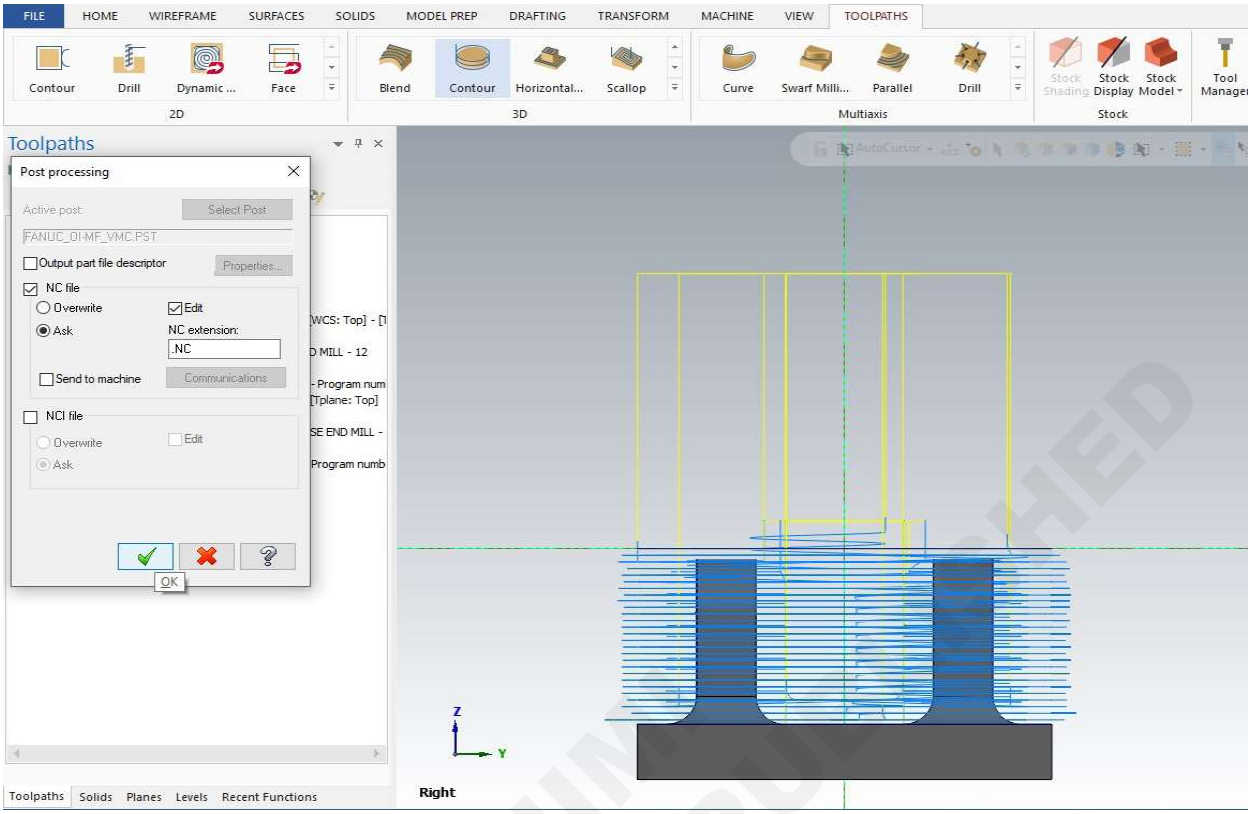
20 Now Click on G1-post selected operation to generate the program for both 3d area roughing and 3d finish contour tool path and click ok on the dialogue box (Fig 84)

Fig 84

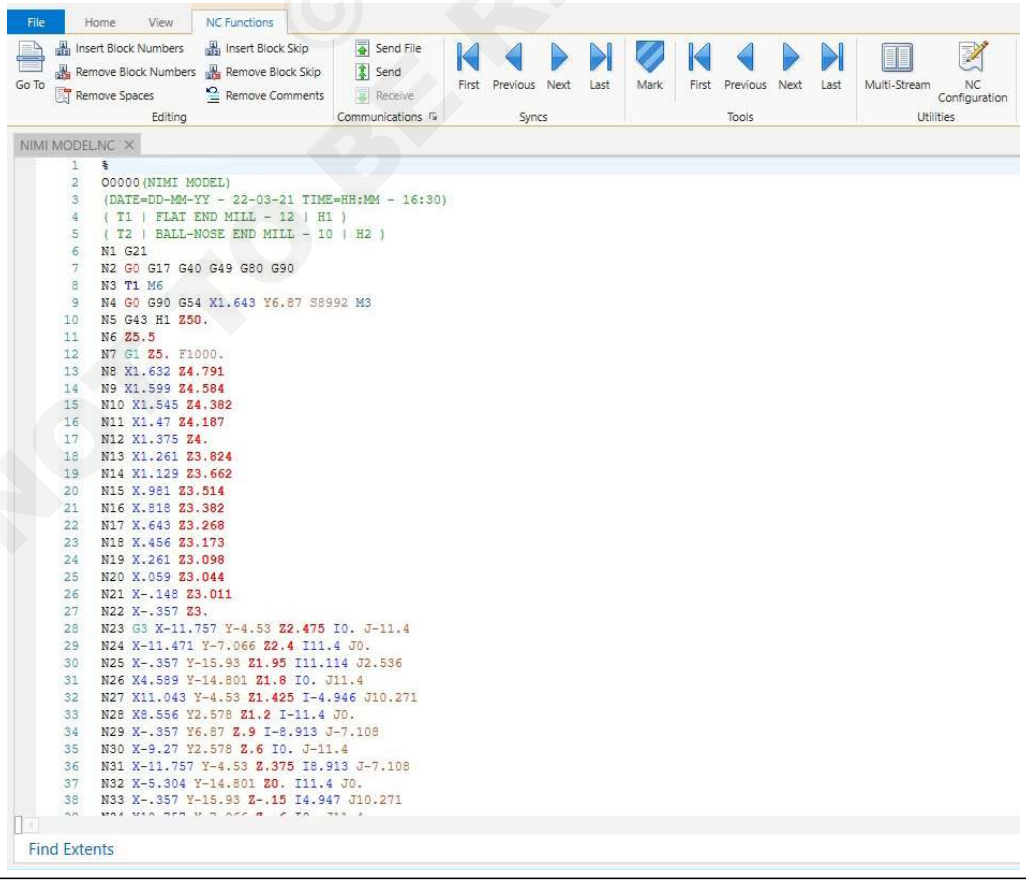


21 Save the file in the respective folder you need and Press enter (Fig 85)

Fig 85



22 The program generates as shown



Identify different parts of EDM/Wire cut machining centres and read specification

Objectives : At the end of this exercise you shall be able to
- **identify each parts of EDM machine reading specification of EDM**
- **identify the name of parts and EDM wire cut machine**
- **reading the specification wire cut and EDM circuit machine.**

Job Sequence

TASK 1: **EDM machine parts**

Trainer will demonstrate the parts of EDM machine and record in Table 1. (Fig 1)

Fig 1

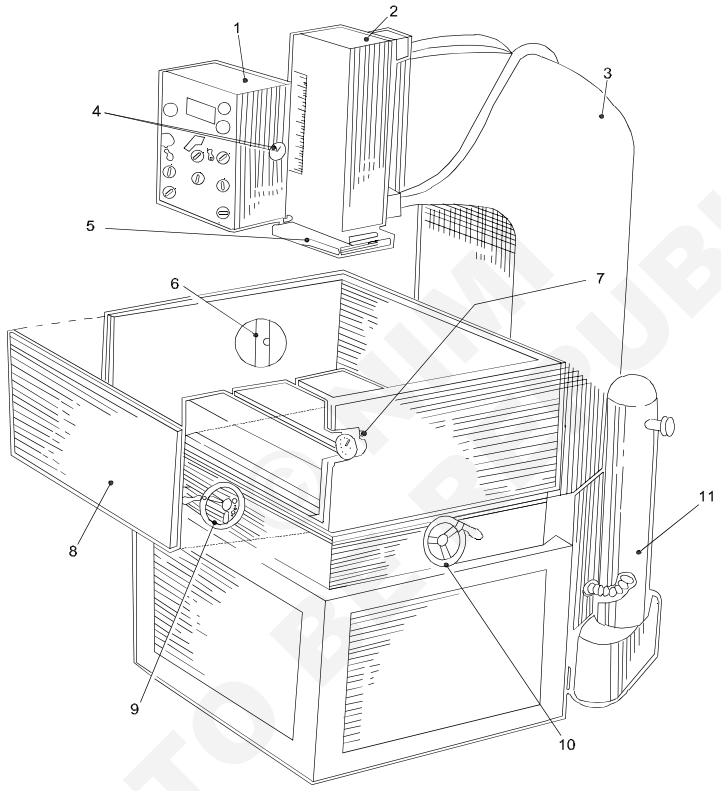


Table 1

Sl.No.	Parts name	Remarks
1		
2		
3		
4		
5		

6		
7		
8		
9		
10		
11		

TASK 2: **Specification of EDM**

1 Study the Sinification given in table 2

2 Compare with the machine

Table 2

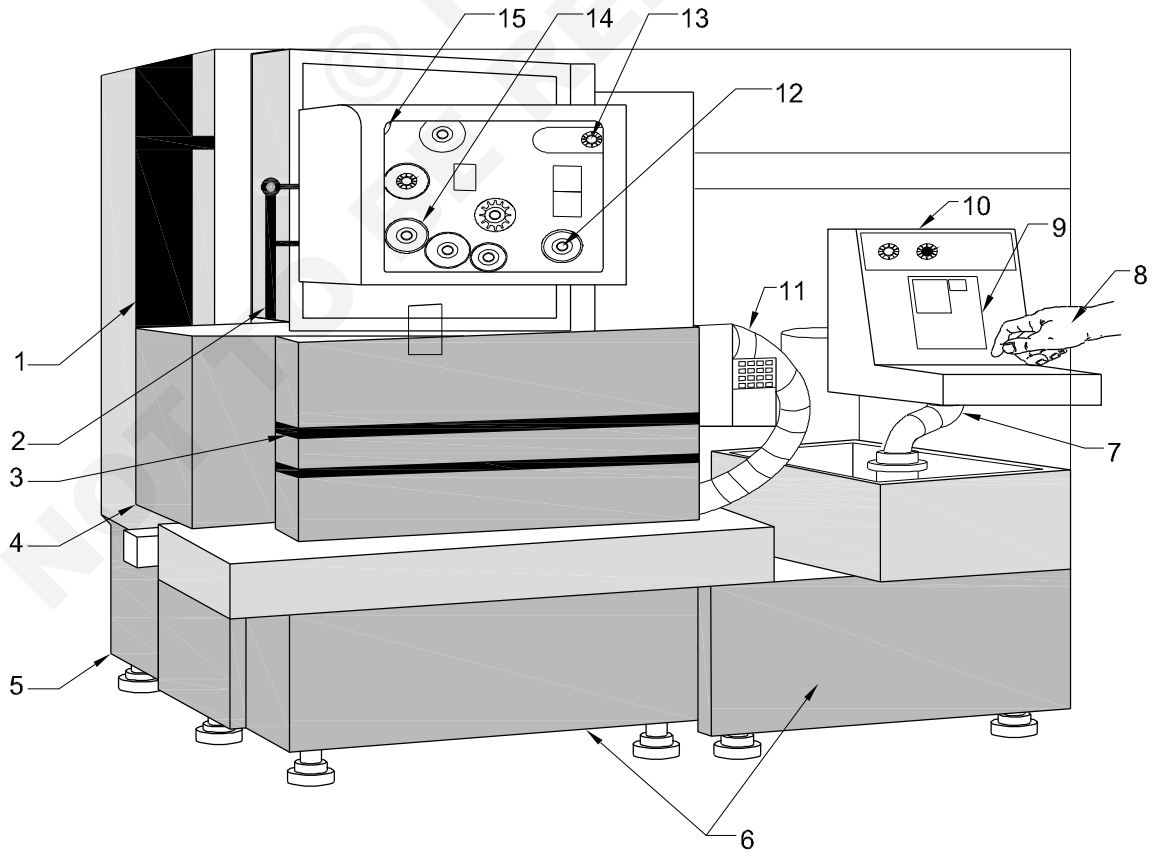
Parameter	Ranger
Frequency (FR)	0-200 kHz
Pulse width (WH)	1-10us
Gap % of voltage (GP)	60-100%
Gain (GN)	0-100
Pulse peak current (IP)	40A
Output voltage (UT)	60-250 V
Dwell time (TT)	0-20s
Polarity	+/-
Hole diameter	0.05 – 1.0mm
Spindle speed	100-1000 rev/min

TASK 3: **EDM wire cut machine parts (Fig 1)**

Note: Trainer will demonstrate the parts of the EDM wire cut machine

Trainers will hear all and verify with machine

Fig 1



NOTE : TRAINER SHALL ARRANGE FOR DEMO ON WIRE CUT EDM MACHINING

T-J20N2-99-J1

Table 1

Sl.No.	Parts name	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
Sigunature of instructor:		

— — — — — — — —

TASK 4: **Specification in EDM wire cut**

1 Study the specification given in Table 4

2 Compare the speciation with machine

Specification of EDM wire cut machine

Table 4

Parameter	Unit	ELTECH- W380
Axis travel		
X/Y travel	mm	380 x 260
U/V	MM	80 x 80
Z travel	mm	250
Maximum work place thickness	mm	240
Max, Taper cut		NA
X/Y/U/V/Z motor and driver		Japanese high quality AC servo system
Worktable		
Worktable size (L x W)	mm	630 x 400
Max. workplace weight	Kg	500
Wire system		
Range of wire diameter	mm	0,15 – 0.3
Wire speed	m/mm	0.15 – 0.3
Wire tension	N	0.2 – 2.0
AWT		NA
Machine tool (L x W x H)	mm	1780 x 1170 x 1950
Weight of machine tool	Kg	2010

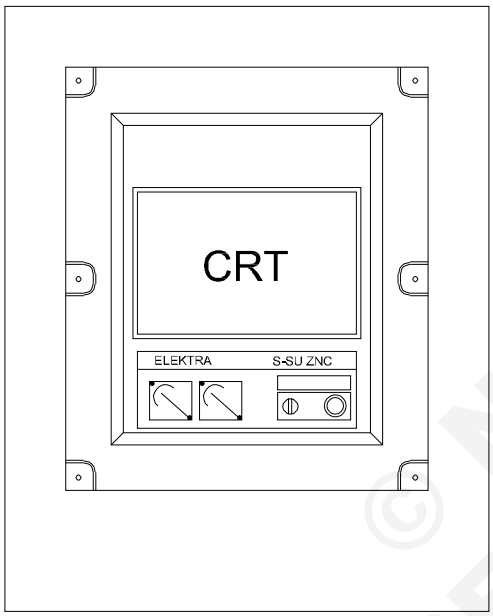
Perform machine starting and operating in reference point

Objectives : At the end of this exercise you shall be able to
- **switch "ON" EDM machine**
- **start the machine and operating in manual mode**
- **switch "ON" wire cut machining centre**
- **start the machine and operate in manual mode.**

PROCEDURE

TASK 1: **Front view of SZNC controller panel is as shown in following (Fig 1)**

Fig 1



Switch ON (main power supply)

↓

Stabilizer ON

↓

Machine main switch ON (located at the rear side of the machine)

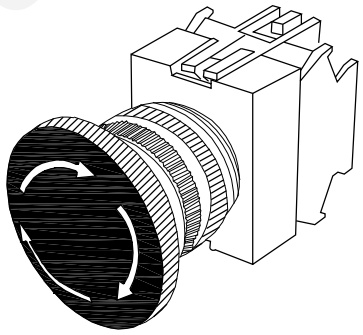
↓

Release emergency button (by rotating clockwise direction)

↓

Machine "ON" (three position switch turn the knob clock wise to "power ON the machine, whit for the system initialization, (Z single screen display) (Fig 2**)**

Fig 2



— — — — — — — —

TASK 2: **Control key or menu key**

1 Press control key or menu key (to enable the manual movements halt the process like sparking)

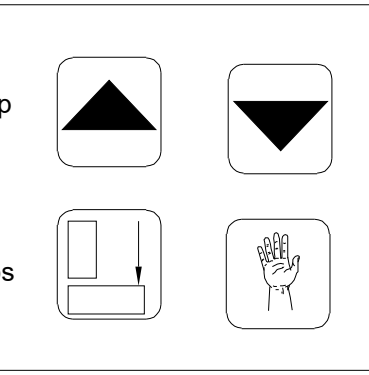
2 Use hand wheel to move "X/Y" Co-ordinates

(With this movements, you shall be able to set the job / Electrode move the table for taking job reference)

3 Use "Z" Up/down switch to move the quill upwards/ downwards

4 To enable the process of auto positioning (Fig 1)

Fig 1



— — — — — — — —

TASK 3: **Main power supply**

Switch on (main power supply)

↓

Stabilizer ON

↓

Machine main switch ON (located at the front side of the machine)

↓

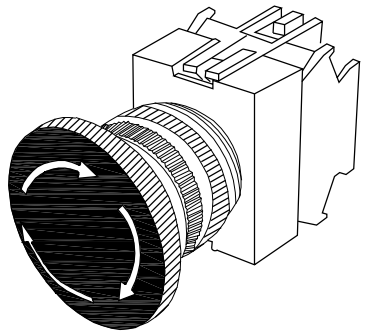
Release emergency button (by rotating clockwise direction)

↓

Machine “ON”

(Press the green color switch, then press “Esc” (keep pressed Until the system gets initialized (Basic screen display refer (Fig 1) for front panel layout)

Fig 1



EMERGENCY SWITCH

TJ20N24100X1

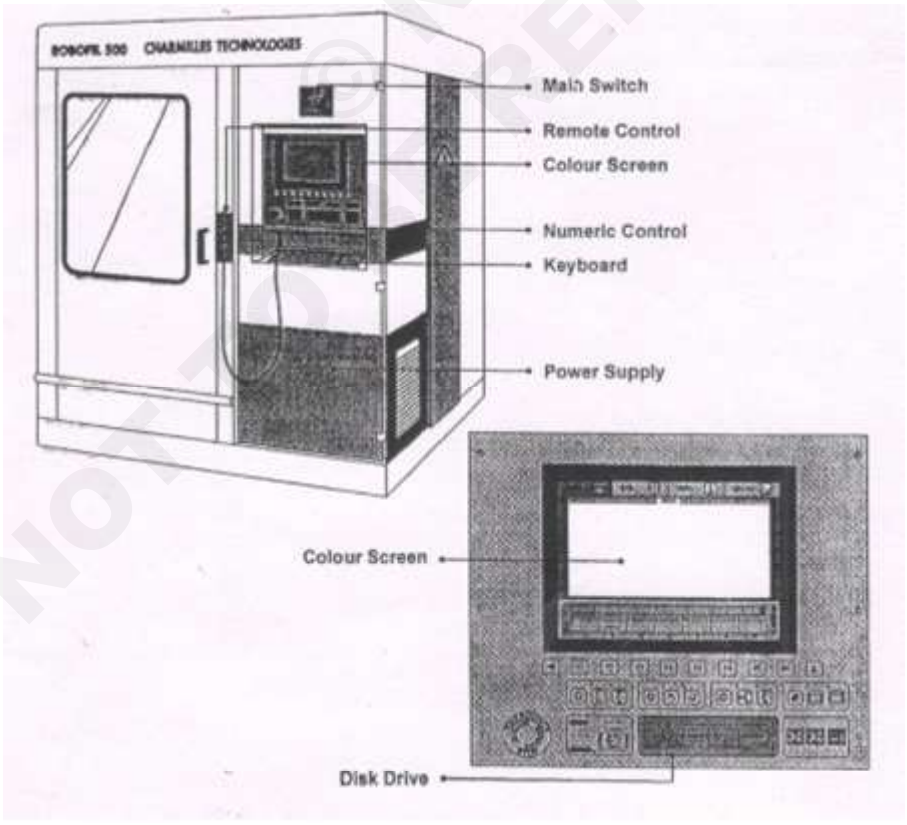
— — — — — — — —

TASK 4: **Name of the function keys**

Name of the function keys (Fig 1)

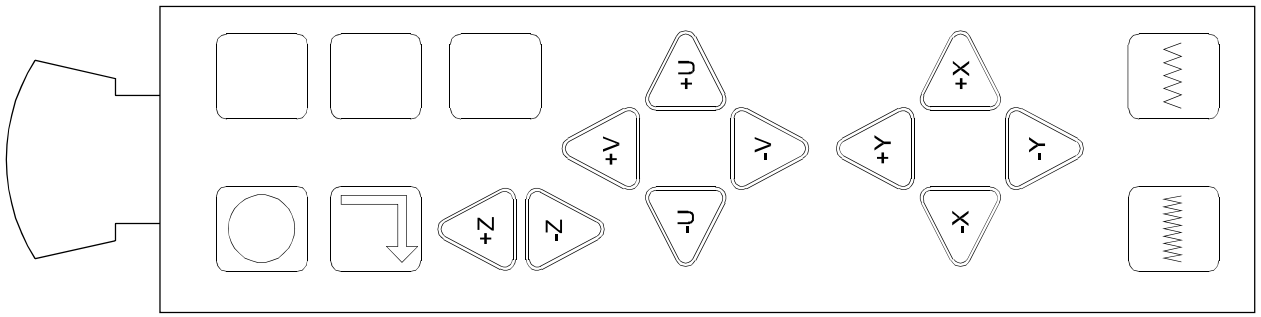
Press control key or menu key

Fig 1



(to enable the manual movements in “X, Y, Z” at variable speeds on Jog mode/ continuous) (Fig 2)

Fig 2



Identification of machine over travel limits on emergency

Objectives : At the end of this exercise you shall be able to
- **machine travel limits in EDM machine**
- **machine travel limits in wire cut machine.**

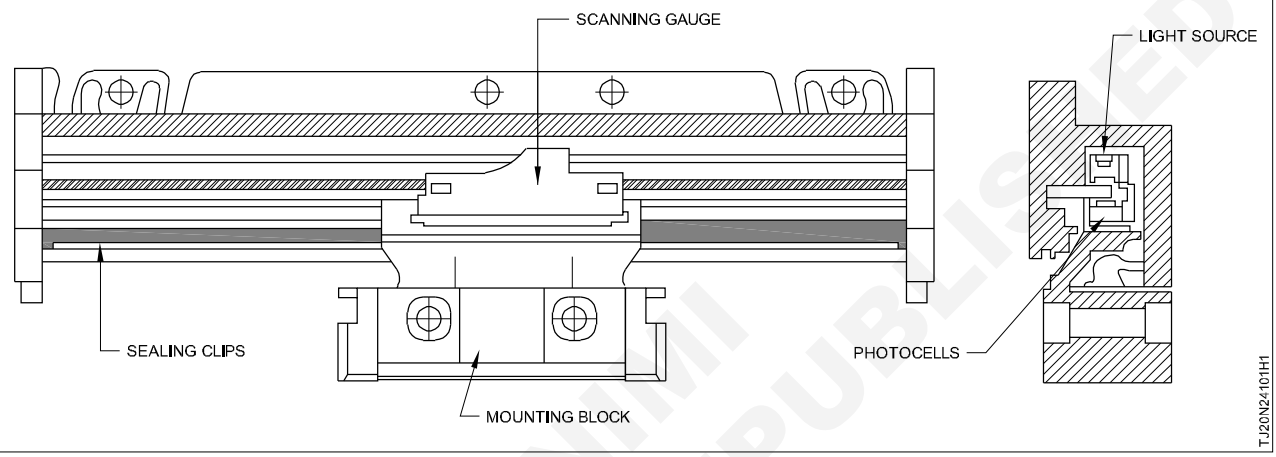
PROCEDURE

TASK 1: **Machine travel limits in EDM machine**

1 All manual movements of axis are measured by liner scale (Fig 1)

4 Move the co-ordinates and fill the tabular column.

Fig 1



2 Reading will be displayed in the monitor

3 If the limits are crossed the limit switch will give warning alarm.

Axis moved	Distance travelled
"X"	
"Y"	
"Z"	

TASK 2: **Machine travel limits in wire cut machine**

1 All manual movements of axis is measured by a linear scale

2 Reading will be displayed in the monitor.

3 If the limits are crossed the limit switch will give warning alarm,

4 Apart from the limit switch mechanical stopper is provided to avoid collision/damage to the part.

5 Any forced movement should be informed to maintenance for releasing it back to normal function by the maintenance professionals.

6 Move to the extreme positions and fill the column below.

Axis moved	Distance travelled
"X"	
"Y"	
"Z"	

Part program preparation entry, editing, and simulation on wire cut machine software of wire cut machine

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

- **choose the electrical parameters for EDM machining**
- **edit the variables to achieve best results in EDM machining**
- **enter the program and edit in preparation mode of wire cut machine**
- **choose the electrical parameters in execution mode of wire cut machine.**
- **verify the parameters in information mode of wire cut machine.**

PROCEDURE

Alarms	Goto	Z-Depth	Position mm	Flags	
	X 0. 000	– 4.59	X 0.000	JUMP	89
	Y 0. 000		Y 0.000	SAFE	00
	Z – 4.640	-4.85	Z – 4.595	Buzzer	ON
			ABS	Z Lock	OFF
				Servo	NOR
				Dwell	0
				Noman	OFF
				Display	ABS

PROG program 01 block 02 M/C Time 00:00 Z Lift 00.0

Block	X	Y	Z	IP	IB	Ton	t	Vg	SEN	ASEN	TW	Rd
s 1	0.000	0.000	-4.440	25	3	500.00	10	50	10	3	0.0	1.0
2	0.000	0.000	-4.640	15	2	100.00	10	50	10	3	0.0	1.0
3	0.000	0.000	-4.665	6	1	100.00	10	50	10	3	0.0	1.0
4	0.000	0.000	-4.748	6	1	50.00	10	50	10	3	0.0	1.0
5	0.000	0.000	-4.820	3	1	50.00	10	75	6	3	0.0	1.0
E 6	0.000	0.000	-4.050	3	1	20.00	10	75	6	3	0.0	1.0

Use numeric keys to program calue
program running

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
PRG NO	ST BLOCK	ENDBLOCK	ABORT	EZ GURU	TECH	SAVE AS	MARK BLK		FLAGS

1 Any block can be marked as s (star) block and E (END) block.

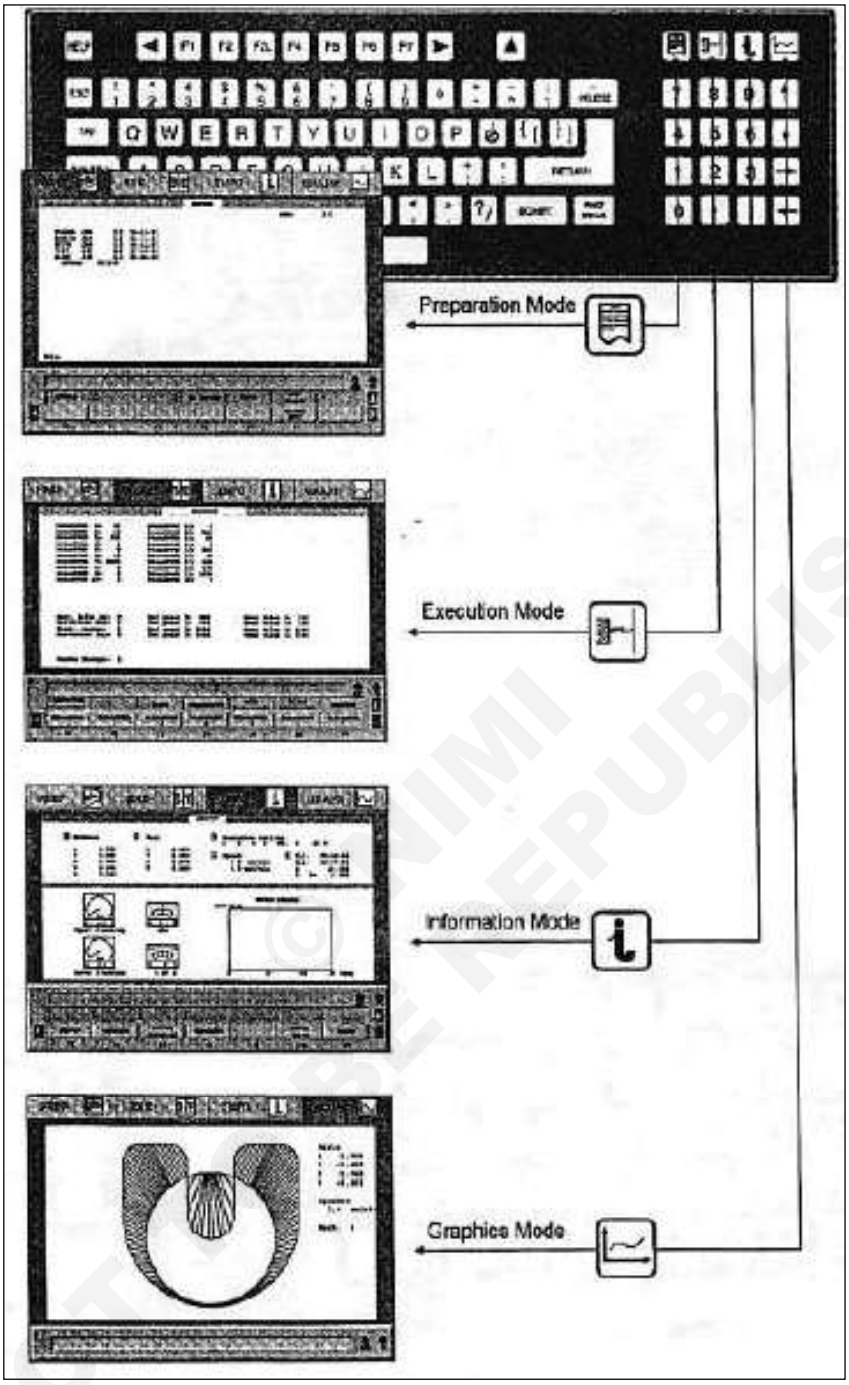
2 The program is executed from S to E.

3 Any change in the parameters are saved automatically.

4 Practice the sequence to get familiarize

5 Control panel layout showing function keys and mode keys change the modes and familiarize the location. Visualize every screen and practice (Fig 1)

Fig 1



Carry out tool path simulation

Objectives : At the end of this exercise you shall be able to
- **perform machining operation and check the result in EDM machine**
- **practice the simulation and execute the work in wire cut machine.**

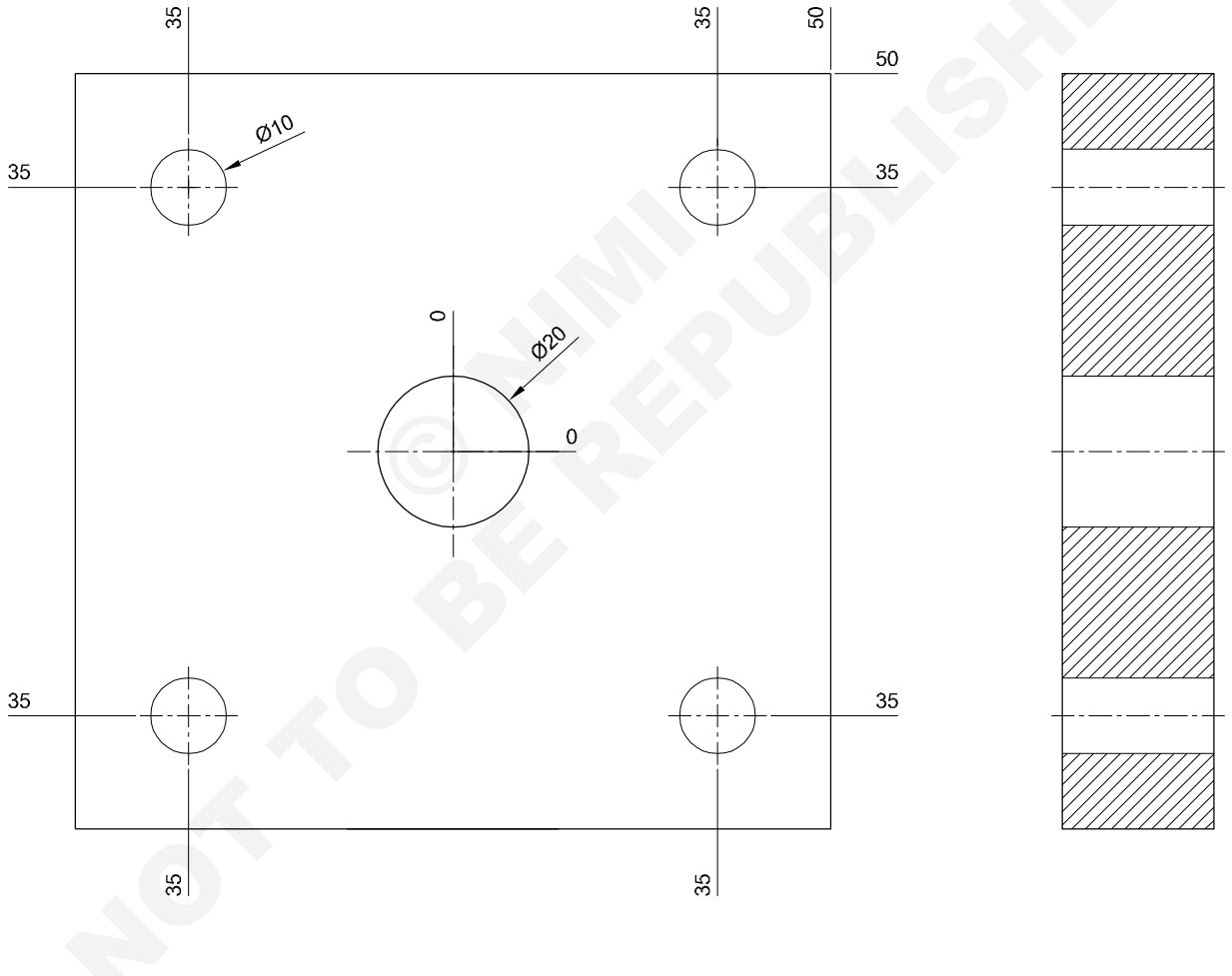
PROCEDURE

TASK 1: **Perform machining operation and check the result in EDM machine**

1 Follow the procedure as in the theory

2 Often stop the process and clean the accumulated carbon to get uninterested progress. Before finishing check for all dimensions expected. (Fig 1)

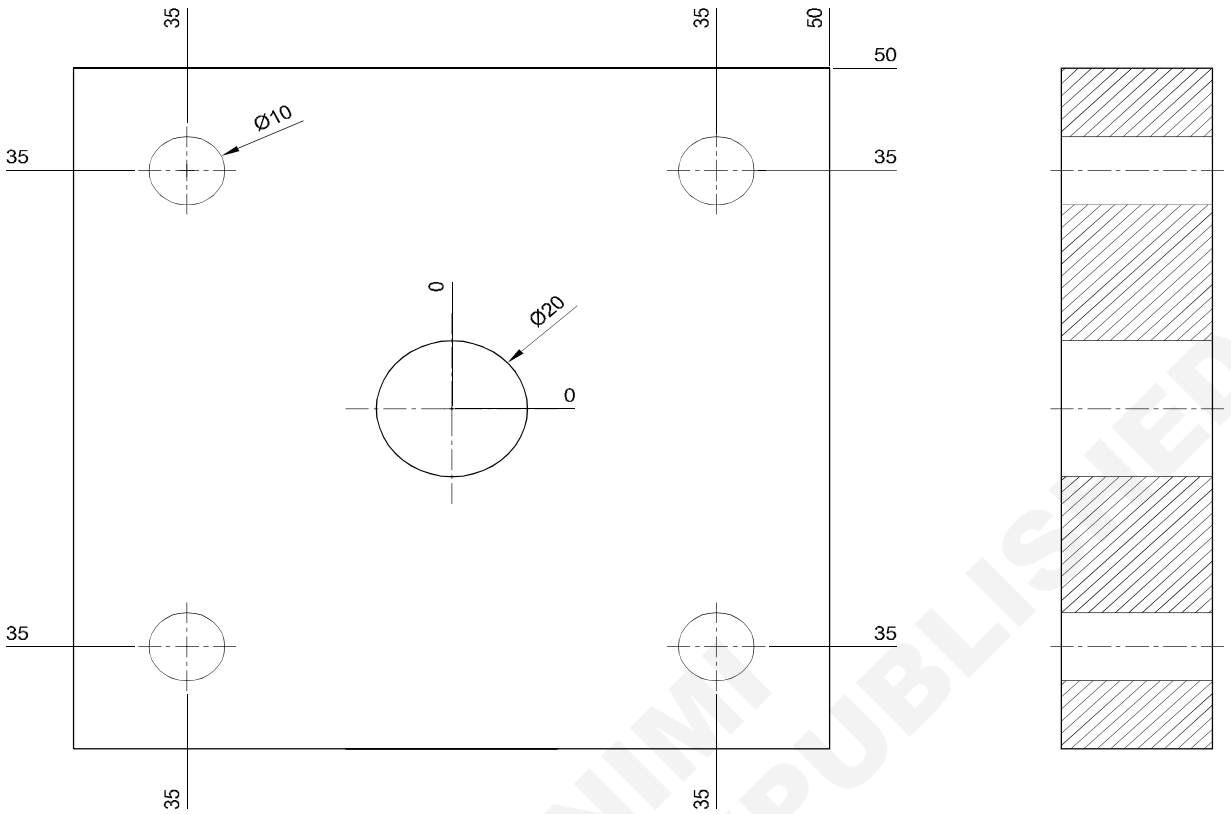
Fig 1



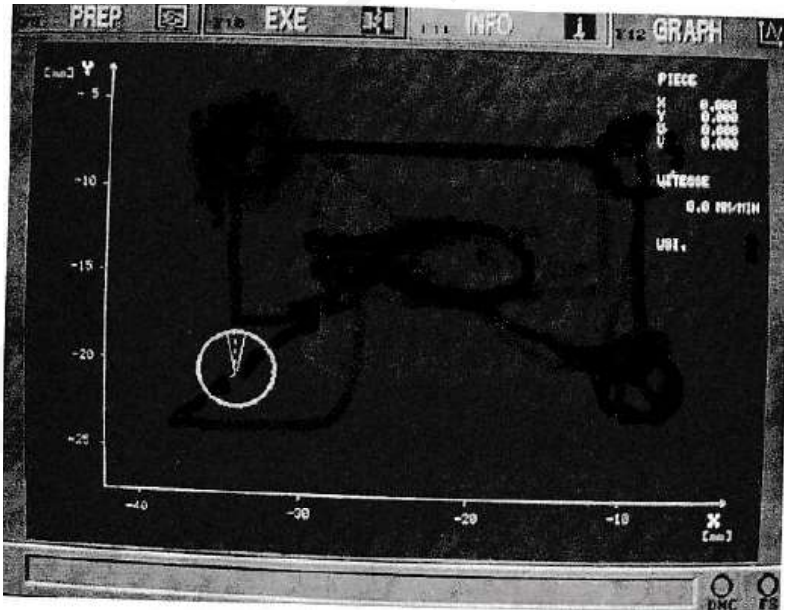
TASK 2: **Wire cut machining**

1 Final drawing (Fig 1)

Fig 1



2 Simulation can be seen in graph mode (Fig 2)

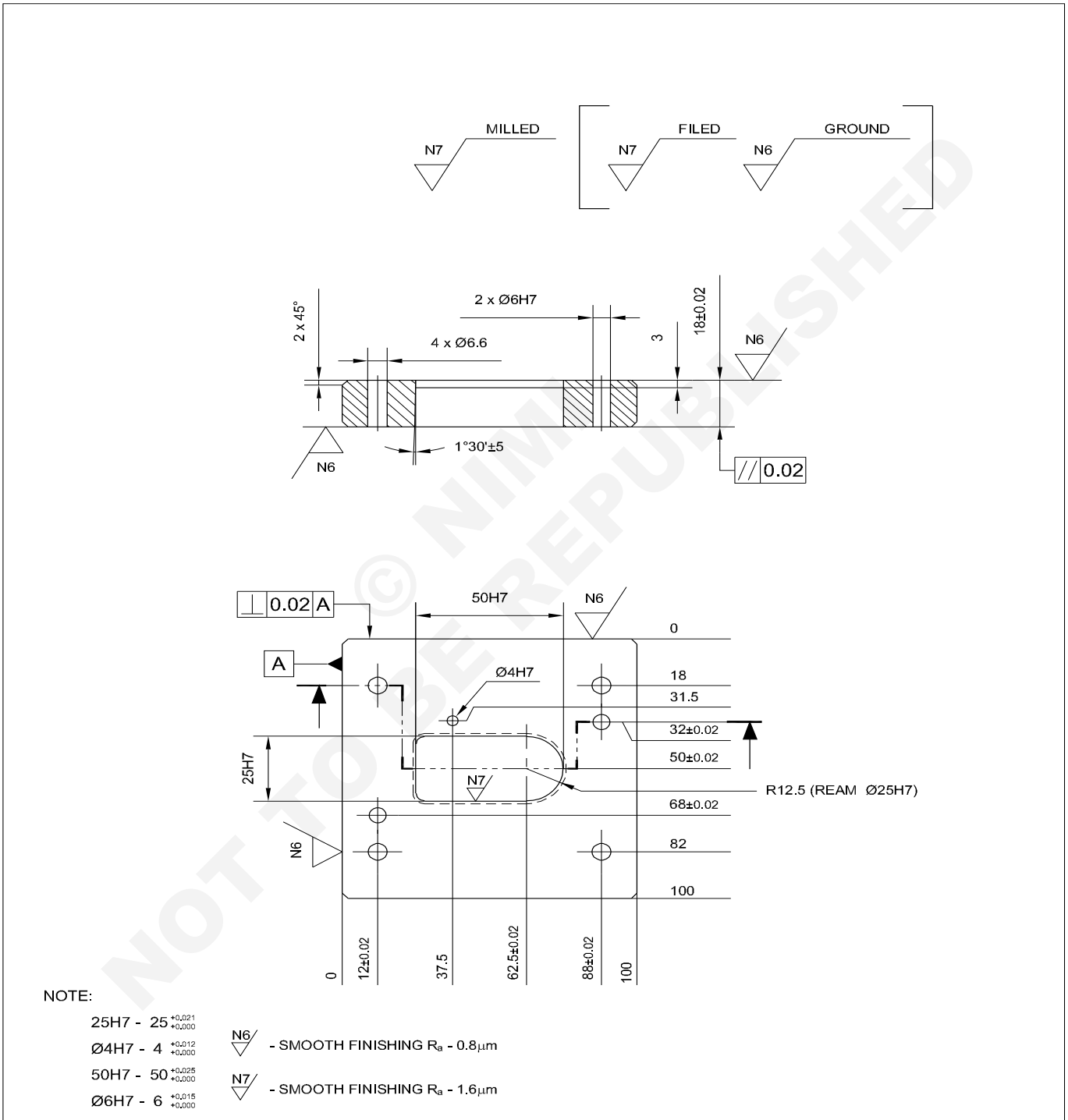


3 Follow the procedure as in the theory

4 As the job in progress see that it follows the path drawn in the simulation. Before finishing check for all dimension expected.

Manufacturing die as per drawing dimension and maintain die clearance and die land, provide angular clearance after die land

Objective: At the end of this exercise you shall be able to
- **prepare a die plate for a blanking tool.**



NOTE:

25H7 - $25^{+0.021}_{+0.000}$
Ø4H7 - $4^{+0.012}_{+0.000}$
50H7 - $50^{+0.025}_{+0.000}$
Ø6H7 - $6^{+0.015}_{+0.000}$

N6 - SMOOTH FINISHING R_a - 0.8μm
N7 - SMOOTH FINISHING R_a - 1.6μm

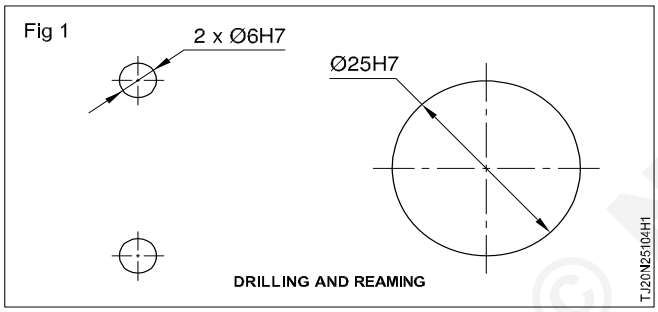
1	105 ISF 20-105	-	Fe310	-	-	2.5.104
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**DIE PLATE**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25104E1	

Job sequence

Blanking tool – die plate

- Check the raw material 125 ISF 20-105mm, mill block to 18.5 ± 0.1*100.5 ± 0.1 parallel with in 0.1 and perpendicular within 0.1mm.
- Grind thickness to 18 ±0.02 parallel within 0.02mm.
- Grind the reference sides (adj. sides) perpendicular within 0.02mm.
- Mark and punch the coordinates for the hole centers.
- Mark the profile.
- Drill and ream hole dia. 4H7.
- Drill holes dia 6.6 * 4 Nos.
- Set the block on milling machine
- Obtain the datum using the centre finder (Refer SS attached).
- Move the machine table to locate the hole centre.
- Drill and ream holes dia. 6H7 * 2 Nos and dia. 25H7 (Fig 1) hole as per drawing.

Fig 1



- Mark and punch for chain drilling the profile by keeping 0.5mm undersize for filling (Fig 2)
- Chain drill and part off the profile off the profile (Fig 3)

Fig 2

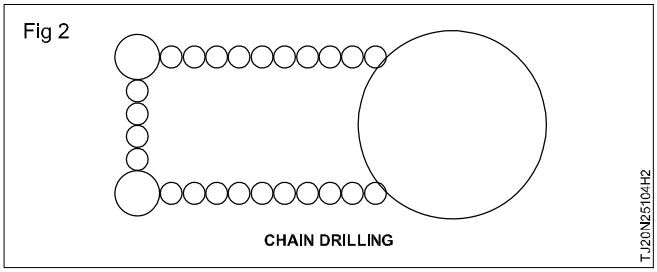
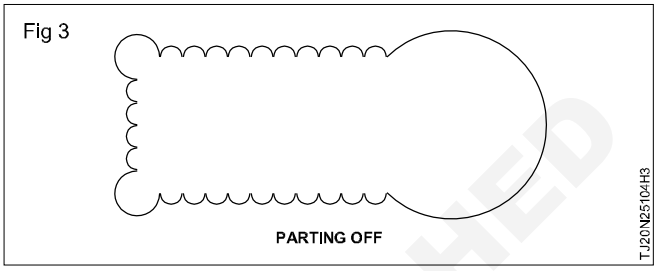
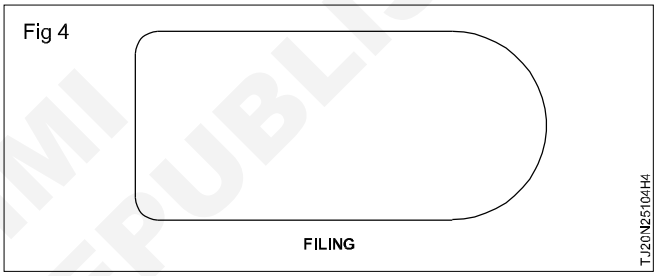


Fig 3



- File the profile as per drawing (Fig 4)

Fig 4



- File angle 1° 30 minutes as per a drawing chamfer as per drawing

Note: Dia.6H7 dowel holes to be drilled and reamed in assembly with bottom plate and shill per plate exercises 2-5-106 for dowelling.

Skill sequence

Obtaining datum using centre finder

Objective: This shall help you to
- **prepare a die plate for a blanking tool.**

Clamp the job using parallel blocks and flat clamps on the machine bed

Set the reference sides by dialing.

Clamp the centre finder in the collet adopter

Switch on the machine

Move the bed of the machine such that any one reference side of the job touches the bottom half of the center finder.

The bottom half of the centre finder will rotate eccentric to its axis.

Move the bed till the bottom half of the centre finder rotates concentric.

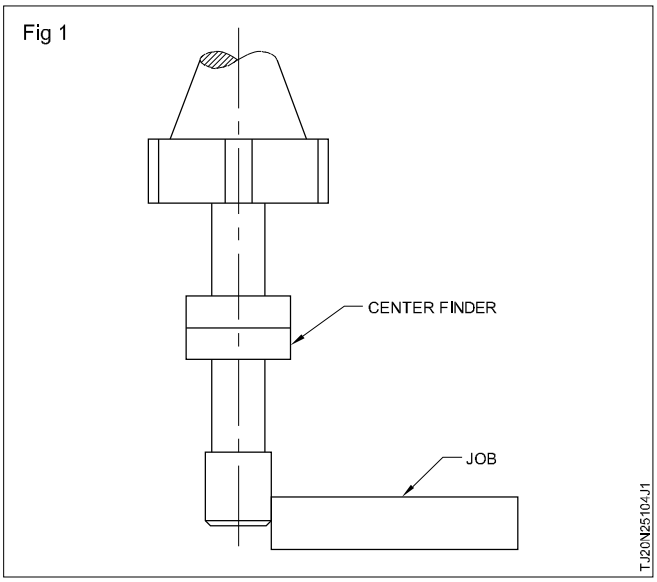
Note down the reading on the dial of the machine in that position.

Move the bed towards the machine spindle through a distance equal to half the diameter of the centre finder.

Set zero on the dial of the machine in this position.

This is the datum position.

Fig 1

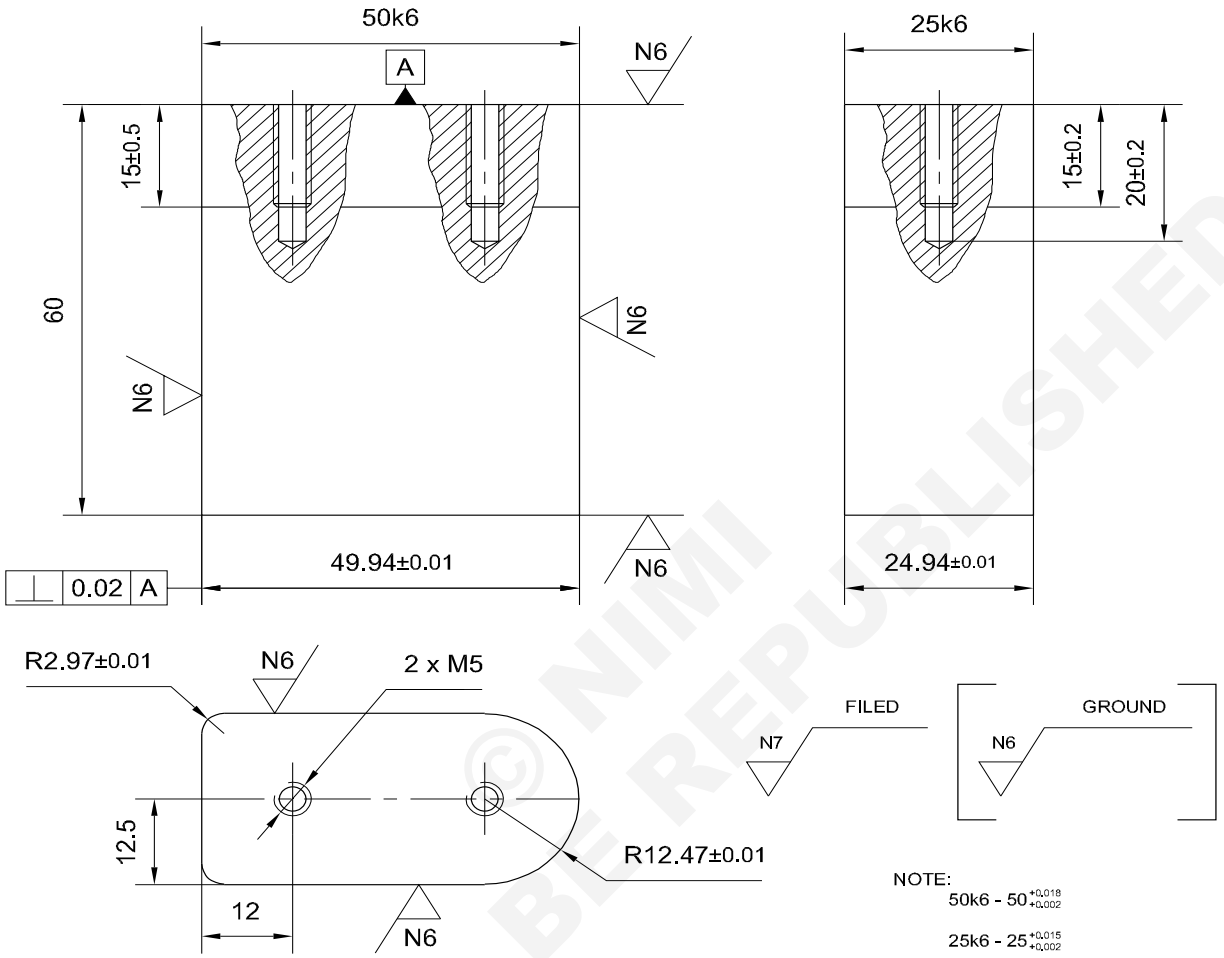


Repeat the same procedure to set the datum on the other axis.

Move the bed to locate centres of holes.

Manufacturing of Punch as per drawing dimension.

Objective: At the end of this exercise you shall be able to
- **prepare a punch for a blanking tool.**



Job sequence

Blanking tool – punch

- Check the raw material 65 ISF 32 – 55mm.
- Mill the block to 25.5 ± 0.1*50.5±0.1*60.5±0.1mm. parallel within 0.1 and perpendicular within 0.1mm.
- Grind the thickness to 25 k6 parallel within 0.01mm.
- Grind the width to 50 k6 parallel within 0.01 and perpendicular within 0.01mm.
- Grind the thickness 24.94 ± 0.01 to length 45± 0.5mm. (Grind equal material 0.03 from both the sides.)
- Grind the width to 49.94 ± 0.01 to length 45±0.5mm. (Grind equal material from both sides)
- Mark and punch the coordinates for the hole centres.
- Drill holes 4.2*2 Nos to a depth of 20mm.
- Tap M5 *2 Nos to a depth of 15mm.
- File the radius as per the drawing. Check the punch radius using a template.
- Grind both the faces to a length 60 ± 0.1mm.

1	65 ISF 32-55	-	-	-	-	2.5.105
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

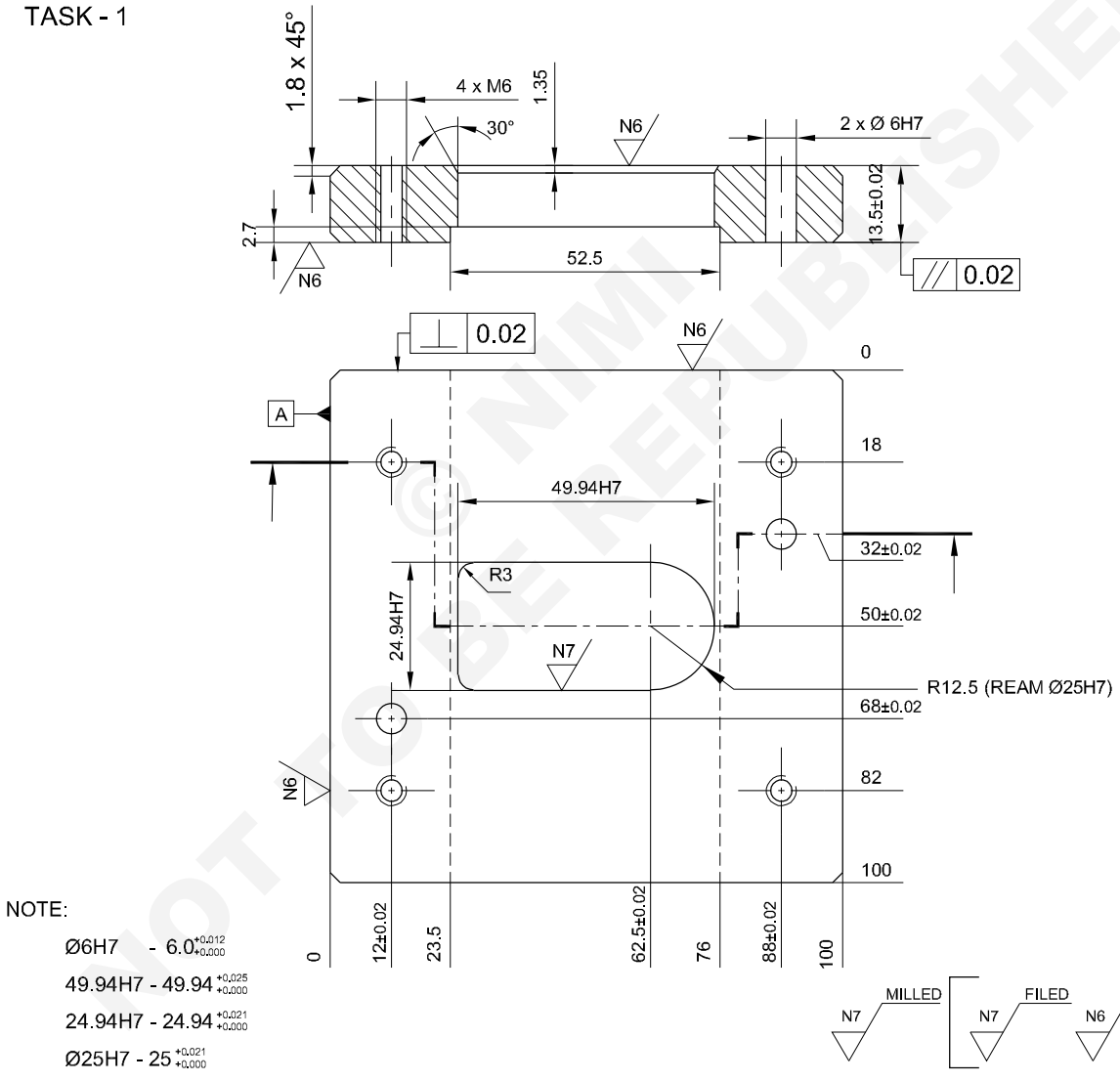
SCALE 1:1	PUNCH	DEVIATIONS ±0.1	TIME
		CODE NO. TJ20N25105E1	

Manufacturing stripper plate, bottom plate, top plate, punch holder, gauges and shank, thrust plate, stop pin

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

- **prepare a bottom plate for a blanking tool**
- **prepare a top plate for a blanking tool**
- **prepare a punch holder for a blanking tool**
- **prepare a shank for a blanking tool**
- **prepare a thrust plate for a blanking tool**
- **prepare a stopper for a blanking tool**

TASK - 1



NOTE:

Ø6H7 - $6.0^{+0.012}_{+0.000}$

49.94H7 - $49.94^{+0.025}_{+0.000}$

24.94H7 - $24.94^{+0.021}_{+0.000}$

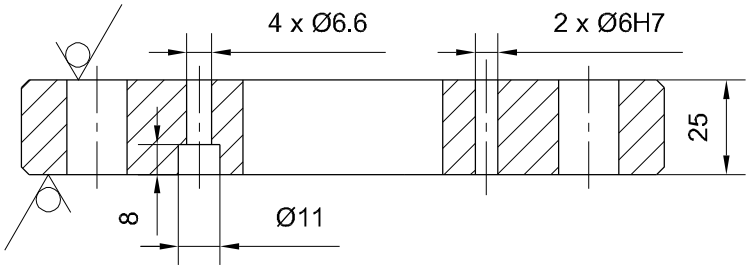
Ø25H7 - $25^{+0.021}_{+0.000}$

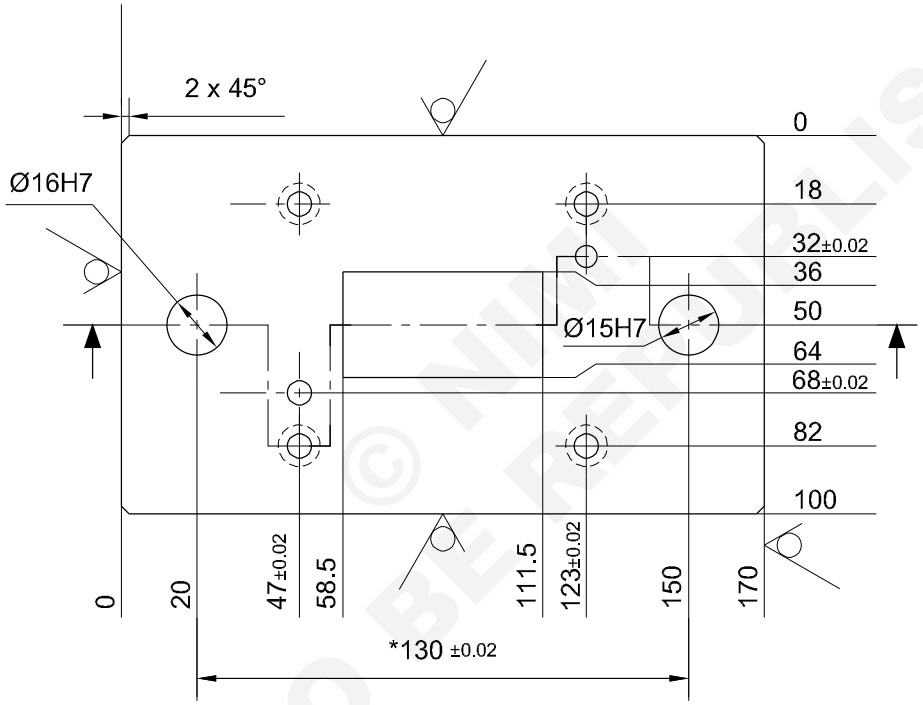
1	120 ISF 20-105	-	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**STRIPPER PLATE / GAUGE**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25106E1	

TASK - 2

FILED

N7





NOTE:

Ø6H7 - 6.0 $^{+0.015}_{+0.000}$

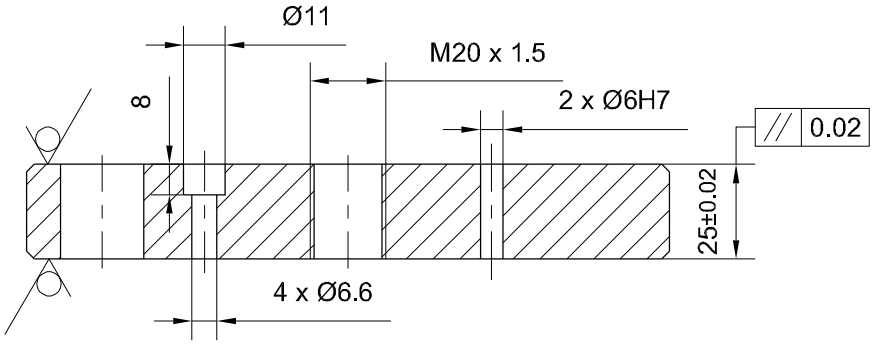
Ø16H7 - 16 $^{+0.018}_{+0.000}$

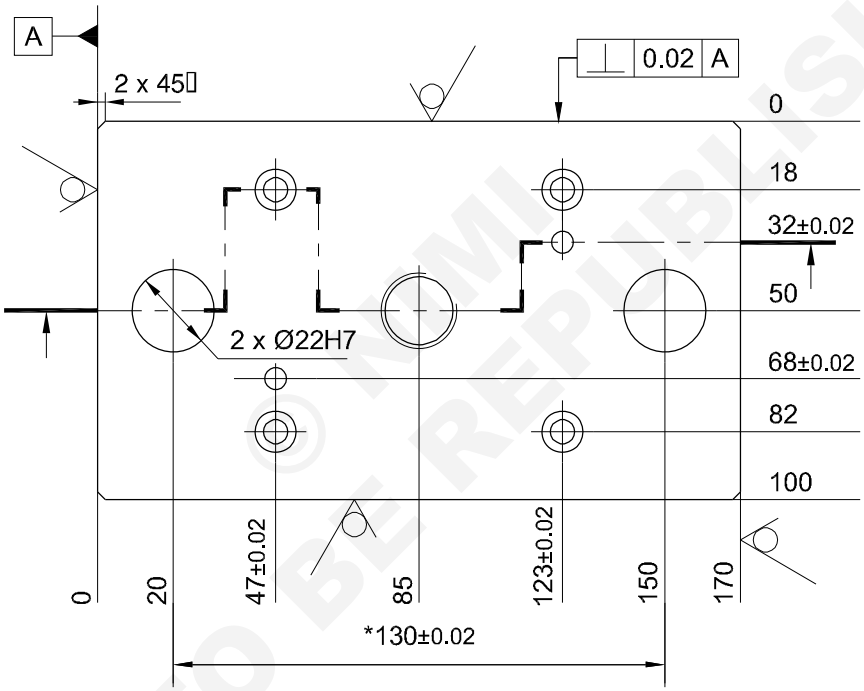
Ø15H7 - 15 $^{+0.018}_{+0.000}$

*Ø16H7 & Ø15H7 TO BE DRILLED & REAMED IN ASSEMBLY WITH GUIDE PILLAR

1	120ISF 32-175	-	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**BOTTOM PLATE**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25106E2	

TASK - 3





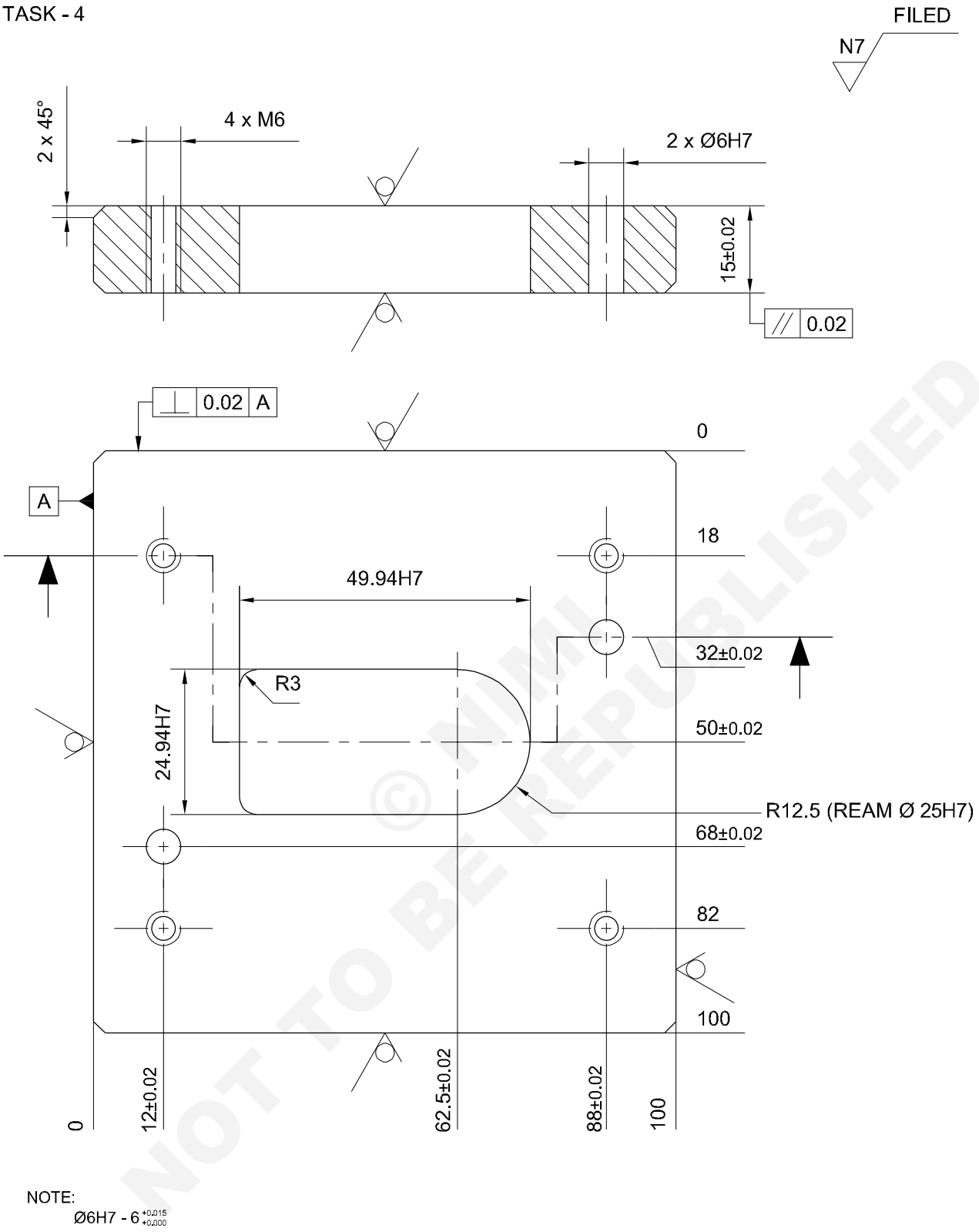
NOTE:

Ø6H7 - $6^{+0.015}_{+0.000}$

Ø22H7 - $22^{+0.021}_{+0.000}$

1	120ISF 32-175	-	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**TOP PLATE**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25106E3	

TASK - 4



NOTE:
Ø6H7 - 6 $^{+0.015}_{+0.000}$

1	120ISF 10-105	-	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**PUNCH HOLDER**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25106E4	

PROCEDURE

TASK 1: **Stripper plate**

Blanking tool – Stripper plate

1 Check the raw material 120 ISF 20 – 105 mm.

2 Mill the block to 15.5 ± 0.1*100.5 ± 0.1* 100.5 ± 0.1 parallel within 0.1 and perpendicular within 0.1mm.

3 Grind the thickness to 15+/-0.02 parallel within 0.02mm.

4 Grind the reference sides (adj sides) perpendicular within 0.02mm.

5 Mark the channel to be milled as per drawing.

6 Mark and punch the coordinates for the screw hole centres

7 Mark the profile.

8 Follow the same procedure for opening the profile as in Ex.No.2 refer to the drawing for dimensions.

9 Drill holes dia. 5*4 Nos.

10 Tap M6* 4 Nos

11 Set the job on the milling machine.

12 Mill channel to width 52.5± 0.1 to depth 3 ± 0.1mm

13 Chamfer as per drawing.

— — — — — — — —

TASK 2: **Bottom plate**

Blanking tool – bottom plate

1 Check the raw material

2 Mark and punch the coordinates for screw hole centres.

3 Mark profile.

4 Mark and punch for chain drilling the profile by keeping 0.5 under-size for filling.

5 Chain drill and part off the profile.

6 File the profile as per drawing.

7 Drill holes dia. 6.6.'4 Nos.

8 Counter bore holes dia. 11 to depth 8mm.

9 Chamfer as per drawing.

— — — — — — — —

TASK 3: **Top plate**

1 Blanking tool – top plate

2 Check the raw material.

3 Mark and punch the coordinates for the hole centres

4 Drill holes dia.6.6*4 Nos.

5 Counter bore to dia. 11*4 Nos to depth 8mm.

6 Drill holes dia. 18.5mm for m20 tap

7 Tap M20* 1.5 as per drawing

8 Chamfer as per drawing.

— — — — — — — —

TASK 4: **punch holder**

1 Blanking tool – punch holder

2 Check the raw material

3 Mark and punch the coordinates for the screw hole centers.

4 Follow the same procedure for opening the profile as in die plate and refer to the drawing for dimensions.

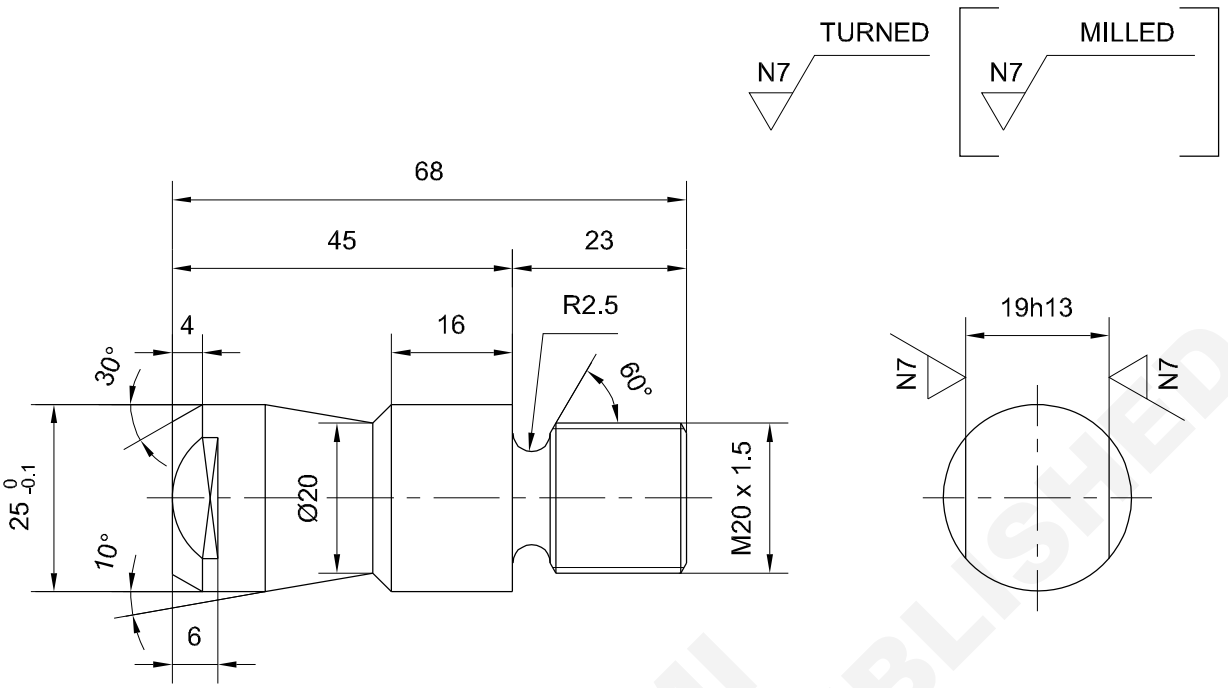
5 Drill holes dia. 5x4 Nos

6 Tap M6 x 4 Nos

7 Chamfer as per drawing.

— — — — — — — —

TASK - 5



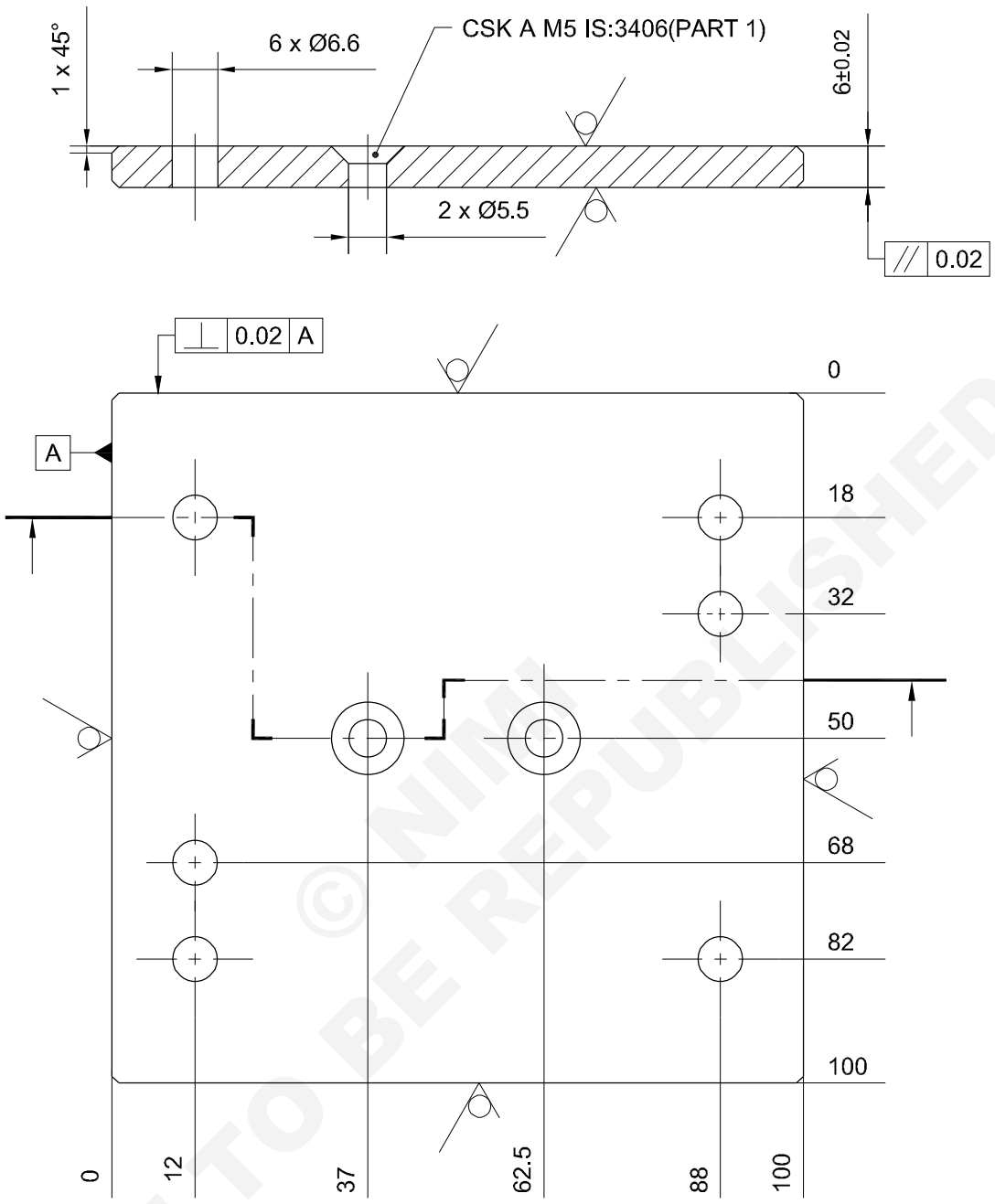
NOTE:
19h13 - 19 +0.000 -0.052

TASK 5: **Shank**

1 Blanking tool – shank
2 Check the raw material dia 32*75mm
3 Hold the job in 3 a jaw chuck
4 Face to get perpendicularity.
5 Centre drill.
6 Reverse the job and hold in the chuck.
7 Face to a total length 68+/0.1mm
8 Centre drill.
9 Hold the job in between centres.
10 Turn dia 25-0,1 to a length 48± 1mm
11 Turn taper 10 degree as per drawing by swiveling the compound slide.
12 Turn chamfer 30° as per drawing.
13 Reverse the job and hold in between centres.
14 Turn dia 20-0.2 to length 23±0.1mm.
15 Turn the groove as per drawing.
16 Turn 60-degree chamfer as per drawing.
17 Thread cut M20 * 1.5mm
18 Mill the flats as per drawing chamfer as per drawing

1	ISR Ø32 x 75	PRE MACHINED	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**SHANK**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25106E5	

TASK - 6



TASK 6: **Thrust plate**

1 Blanking tool-thrust plate

2 Check the raw material.

3 Mark and punch the coordinates for the hole centres.

4 Drill holes dia.6.6*6Nos

5 Drill holes dia 5.5.*2 Nos

6 Counter-sink the holes.

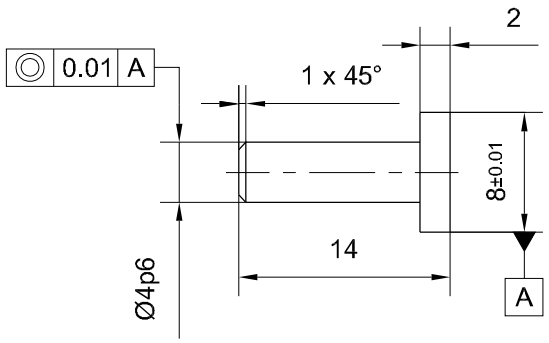
7 Chamfer as per drawing.

1	105 ISF 7 X 105	-	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		**THRUST PLATE**			DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N25106E6	

TASK - 7

GROUND

N6



NOTE:

Ø4p6 - $4^{+0.020}_{+0.012}$

TASK 7: **Stopper**

Blanking Tool-Stopper

1 Check the raw material dia. 10*20mm

2 Hold the job in a 3-jaw chuck such that the job length 10mm projects out.

3 Face to get perpendicularity

4 Turn dia.8.5 ± 0.1 to length 9 ± 0.5mm.

5 Reverse the job and hold dia.8.5 in the chuck such that the job length 13 ± 0.5mm projects out.

6 Turn dia.4.5 ± 0.1 to length 11.5mm ± .02mm.

7 Chamfer as per drawing.

8 Reverse the job and hold dia. 4.5 in the chuck such that dia. 8.5mm projects out.

9 Face dia. 8.5 to a length 4mm.

10 Hold dia. 8.5 in 4-jaw chuck on cylindrical grinder, such that the job length 12.5mm projects out

11 Grind dia.4.5 to dia.4 p6 to length 12±0.1mm.

12 Hold dia.4 p6 in a collet and grind dia.8.5 to dia.8±0.01mm.

13 Grind dia.8 face to a total length 14±0.01mm.

1	ISR Ø10 x 20	-	Fe310	-	-	2.5.106
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

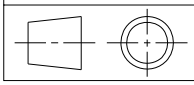
SCALE 2:1	**STOPPER**	DEVIATIONS ±0.1	TIME
		CODE NO. TJ20N25106E7	

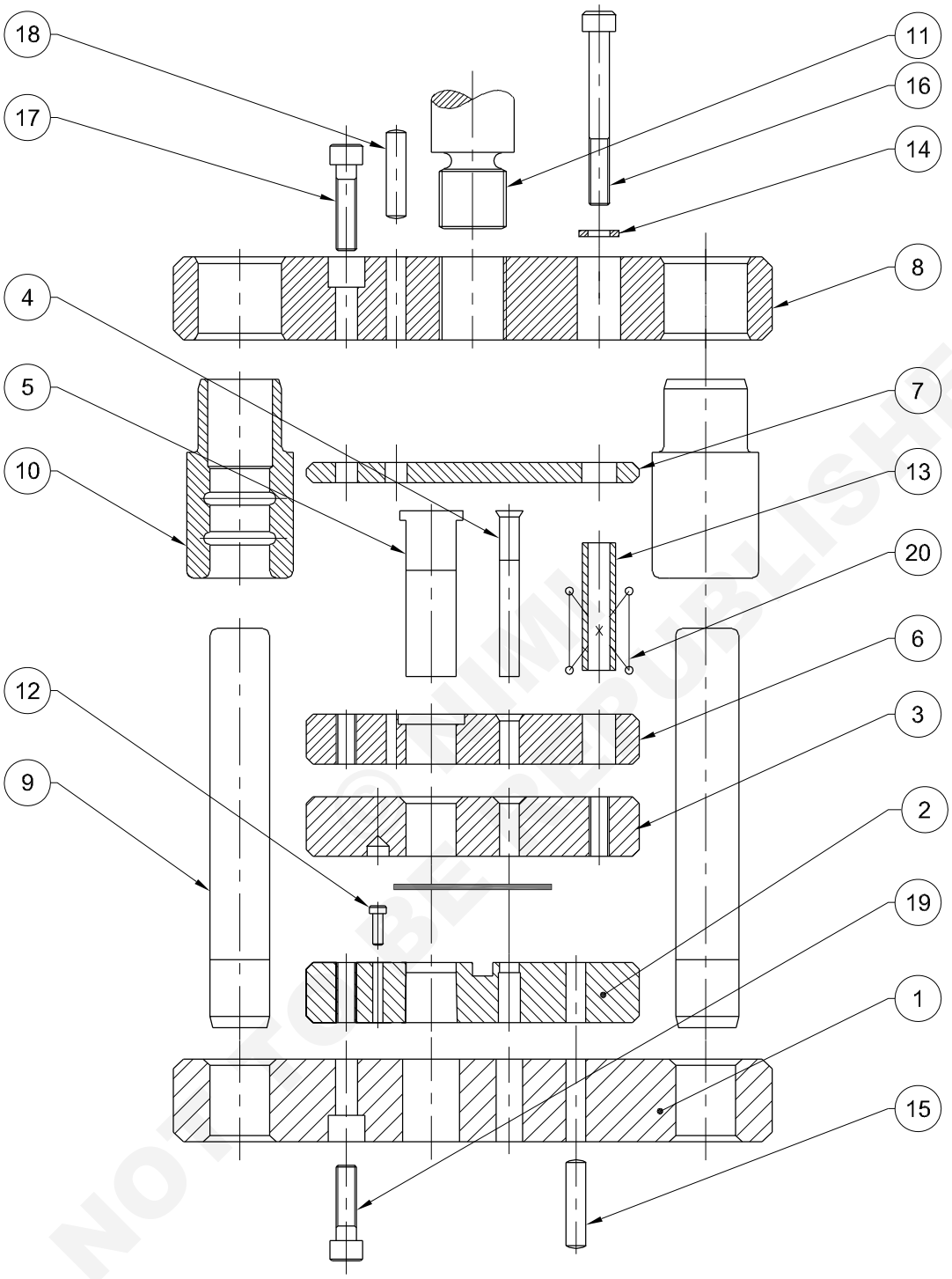
Construct a piercing and blanking tool as per the design given (all components of tool to be the exercises of other machines)

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

- **press fit bushes perpendicularly**
- **press fit pillars perpendicularly**
- **align punch and die with equal clearance**
- **check the clearance using a feeler gauge**
- **assemble a piercing tool as per drawing.**

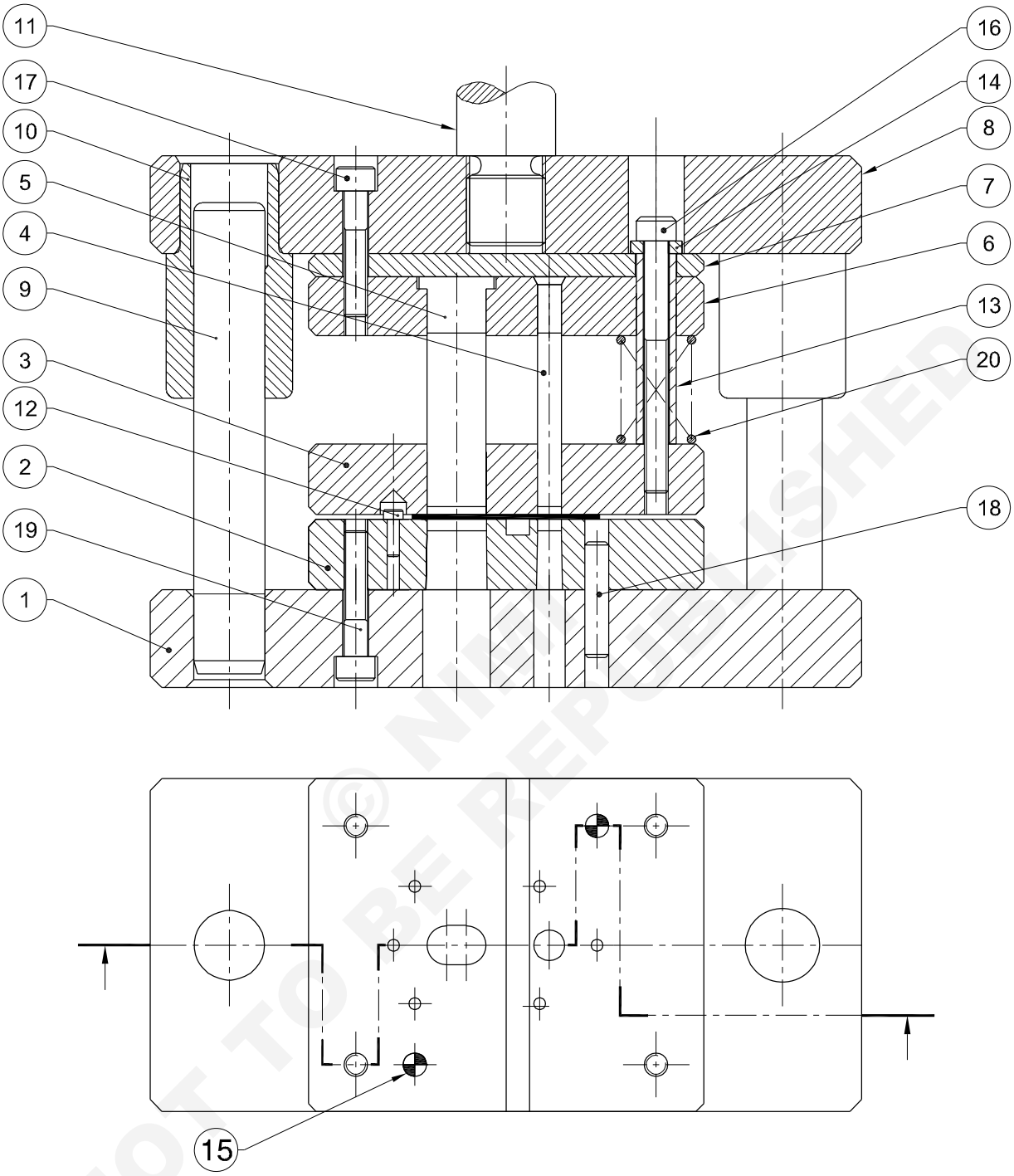
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO.
2	COMPRESSION SPRING		STD		20	
4	SHCS		STD		19	
2	DOWEL		STD		18	
4	SHCS		STD		17	
2	SHCS		STD		16	
2	DOWEL		STD		15	
2	WASHER		Fe310		14	
2	DISTANCE BUSH		Fe310		13	
6	LOCATING PIN		Fe310		12	
1	SHANK		Fe310		11	
2	GUIDE BUSH		Fe310		10	
2	GUIDE PILLAR		Fe310		09	
1	TOP PLATE		Fe310		08	
1	THRUST PLATE		Fe310		07	
1	PUNCH HOLDER		Fe310		06	
1	PIERCING PUNCH		Fe310		05	
1	ROUND PIERCING PUNCH		Fe310		04	
1	STRIPPER PLATE		Fe310		03	
1	DIE PLATE		Fe310		02	
1	BOTTOM PLATE		Fe310		01	

SCALE	PIERCING TOOL	DEVIATIONS	TIME
		CODE NO. TJ20N25107E1	



-	-	-	-	2P3	-	2.5.107
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 2:1	**PIERCING TOOL ASSEMBLY**	DEVIATIONS	TIME
		CODE NO. TJ20N25107E2	



-	-	-	-	-	-	2.5.107
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PIERCING TOOL ASSEMBLY	DEVIATIONS	TIME
		CODE NO. TJ20N25107E3	

Job sequence

Piercing tool

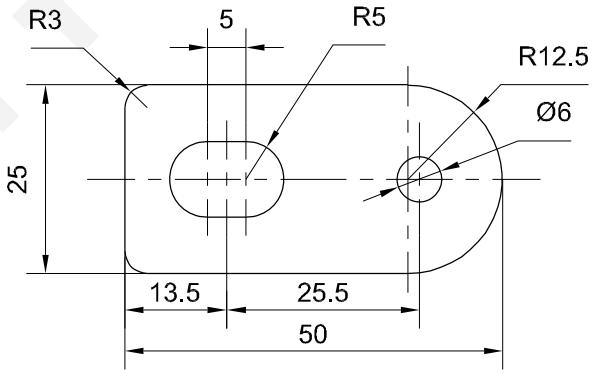
- Clean all the parts 1 to 20
- Deburr sharp edges, if any, except punch and die cutting edges.
- Clean all screw holes.
- Press fit bushes part -10 to the top plate part-8.

Note: While selecting the bush, consider the pillar size.

- Press fit the pillars Part-9 to the bottom plate part-1
- Slide the bushes along with top plate part-7 over the pillars part 9 which are already fitted to bottom plate part 1
- Remove top plate part 8 along with the bushes part-10 from the assembly.
- Press fit locating pin-6 Nos. part-12 to the die plate in the 3H7 holes.
- Fix the die plate part-2 to the bottom plate part-1 using SHCS M6 x 30-4 Nos.
- Press fit the punches (Part-4 and 5) to the punch holder part-6
- Take care that the punch part 4 and 5 should have perpendicularity with punch holder Part-6
- Fix the punch holder assembly and the thrust plate Part-7 to top plate Part-8 using SHCS M6 x 35-4 Nos.
- Drill and ream holes dia.6H7 x 2 Nos in top assembly.
- Drive dowels dia 6 x 35 – 2 Nos using a hammer in the top assembly.
- Unscrew SCHS of the bottom assembly by one pitch.
- Slide the top assembly over the pillar part-9 which are fitted to the bottom plate part 1 till be punches enter the die.
- Keep the shim equal to the cutting clearance between punch and the die profile to adjust the cutting clearance.
- Tighten the SHCS of the bottom assembly.
- Remove the top assembly.
- Drill and ream holes dia. 6H7 x 2 Nos in the bottom assembly.
- Drive dowels dia.6x30 -2 Nos using a hammer in the bottom assembly.
- Insert the stripper plate part-3 through the punches (Part 4 and 5)
- Keep springs -2 Nos in between the punch holder part 1 and the stripper plate part-3 to align the hole dia. 10H7 which is in the punch holder.
- Insert the distance bush-2 Nos Part 13 through the top plate part 8 to sit on the stripper plate part 3
- Keep washer-2Nos part 14 on the distance bush -2 Nos part 13
- Clamp SHCS M6 x 55 – 2Nos though the washer part 14 and the distance bush part 13 to the stripper plate part 3 from the top plate part 8.
- Slide the top assembly over the pillars part-9 of the bottom assembly.
- Slide the top half up and down for free movement.
- Clamp the shank part 11 to top plate of the assembled tool.

Note the tool is ready for trial.

- Piercing tool



NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	-	-	-	-	-	2.5.107

SCALE 1:1	PIERCING TOOL COMPONENT	DEVIATIONS	TIME
		CODE NO. TJ20N25107E4	

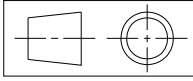
- Set the tool on the fly press.
- Lift the press ram.
- Locate the component between the locator pins in the piercing tool.
- Lower the press ram to pierce the component.
- Repeat the same procedure to pierce 2nd components.
- Check the pierced hole locations with a Vernier caliper.
- If the locations are within 0.1mm then the tool is acceptable.
- Remove the tool from the press.

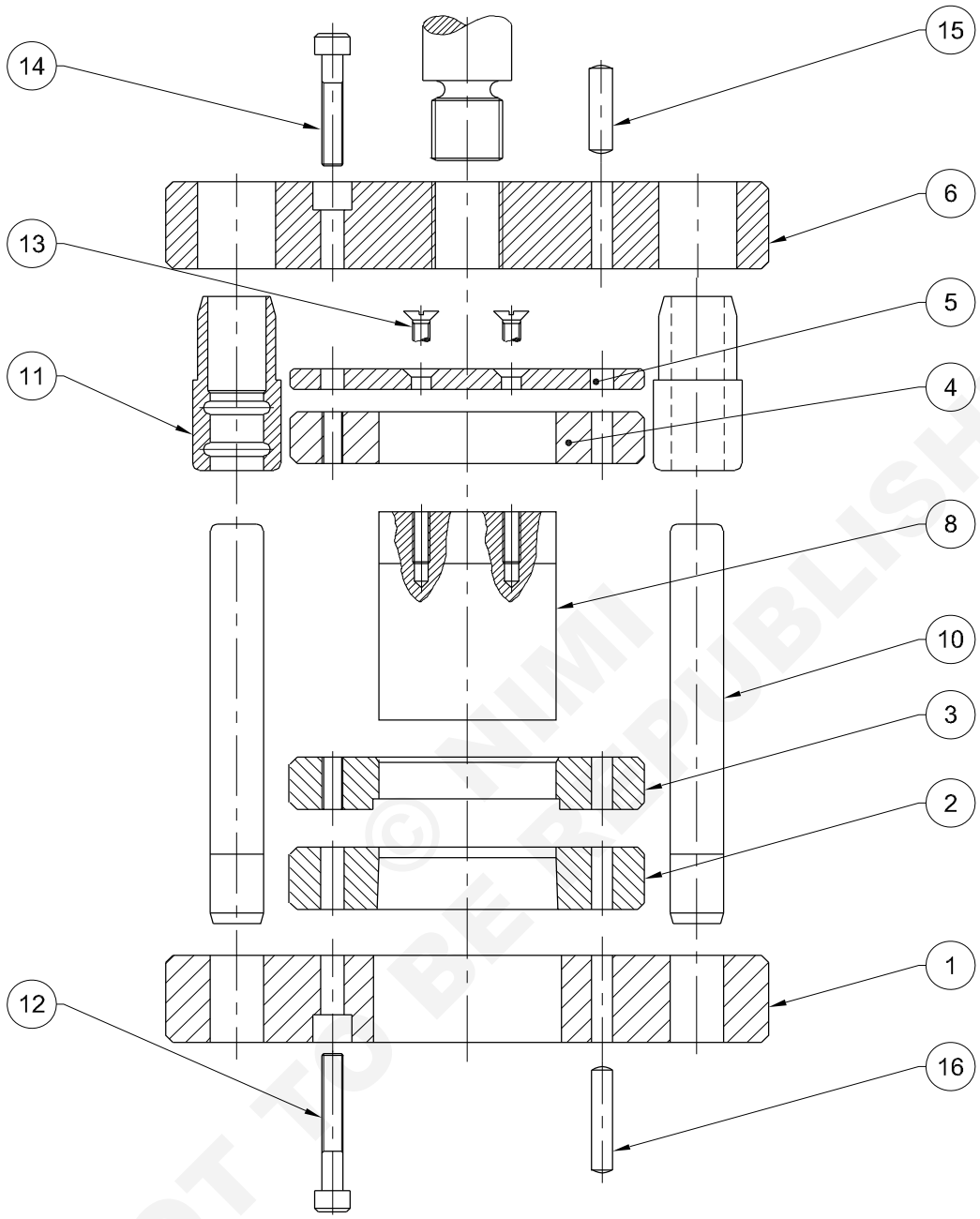
Blanking tool

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

- **drill and bore two plates in assembly**
- **press fit bushes perpendicular within ± 0.02mm**
- **Press fit pillars perpendicular within ± 0.02mm**
- **clamp plates together as per drawing**
- **align punch and die with equal clearance**
- **check the clearance using a feeler gauges**
- **set the tool on the fly press.**

NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO.
2	DOWEL		STD		16	
4	SHCS		STD		15	
2	DOWEL		STD		14	
2	COUNTER SUNK SCREW		STD		13	
4	SHCS		STD		12	
2	GUIDE BUSH		Fe310		11	
2	GUIDE PILLAR		Fe310		10	
1	STOPPER		Fe310		09	
1	BLANKING PUNCH		Fe310		08	
1	SHANK		Fe310		07	
1	TOP PLATE		Fe310		06	
1	THRUST PLATE		Fe310		05	
1	PUNCH HOLDER		Fe310		04	
1	STRIPPER PLATE		Fe310		03	
1	DIE PLATE		Fe310		02	
1	BOTTOM PLATE		Fe310		01	

SCALE	BLANKING TOOL	DEVIATIONS	TIME
		CODE NO. TJ20N25107E5	



-	-	-	-	-	-	2.5.107
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE	BLANKING TOOL ASSEMBLY	DEVIATIONS ±0.1	TIME
		CODE NO. TJ20N25107E6	

Job sequence

- Clean all the parts and standard items No 1 to No:16
- Deburr sharp edges. If any except punch and die cutting edges.
- Clean all the screw holes.
- Drill and bore the top and bottom plates part-6
- Press fit bushes part-11 to the top plate part-6

Note: While selecting the bush consider the pillar size.

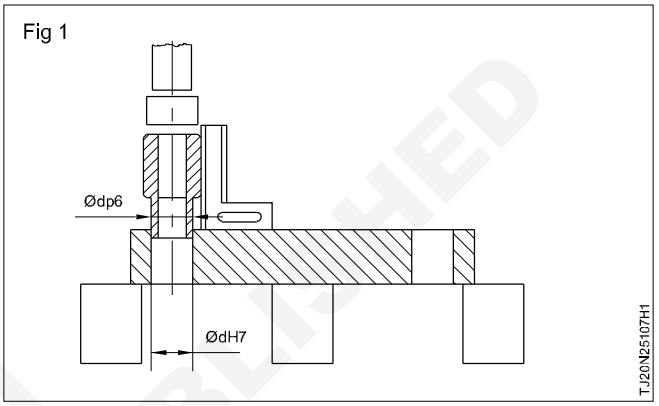
- Press fit pillars part-10 to the bottom plate part-1
- Slide the bushes part 11 along with the top plate part-6 over the pillars which are already fitted to the bottom plate part 1
- Fit the stopper part-9 to the die plate part-2 dia.4H7 hole using a soft hammer.
- Clamp the die plate (Part 2) and stripper plate (Part 3) to the bottom plate with socket head cap screws M6 x 45 – 4 No's fit the punch part 8 in the punch holder part 4
- Clamp the thrust plate part 5 on the punch part-8 with counter sunk screws M5 x 15 -2 Nos.
- Clamp the punch holder Part 4 and the thrust plate part 5 to the top plate part 5 with socket head cap screws M6 x 35 – 4 Nos
- Loosen the socket head cap screws in the bottom plate part-1 and part-6 by 1 pitch.
- Align the punch part 6 in the die plate part-2 with equal clearance by keeping 0.03shim between the punch and die profile.
- Tighten the socket head cap screws of the top plate part-6 and bottom plate part 1
- Check for uniform clearance 0.03mm using feeler gauge 0.03mm
- Remove the top half of the assembly drill and ream dia.6H7 x 2 Nos in the top assembly.
- Drill and ream holes dia. 6H7 2 Nos. in bottom assembly.
- Drive dowels dia. 6 x 35 - 2 Nos using the hammer, in a top assembly.
- Drive dowels dia. 6x50 - 2 Nos using the hammer in bottom assembly.
- Slide the top half of the assembly over the pillars.
- Slide the top half up and down for free movement.

Blanking tool – die set assembly

- Clean the top plate, the bottom plate, pillar and bushes.
- Deburr the sharp edges, if any.
- Clean the pillar and bush holes.
- Keep the top plate on parallel blocks. (Fig 1)
- Apply oil to the bush holes
- Keep the chamfered side of the bush inside the hole (H7) in the top plate as shown in Fig 1.
- Check with try square for perpendicularity. (Fig 1)

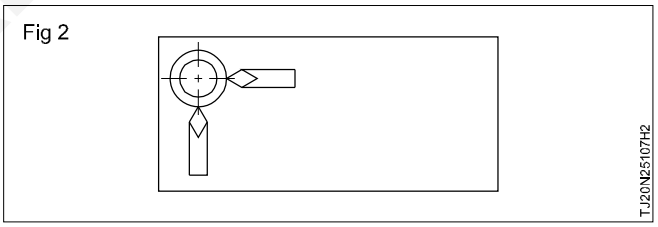
Note: While selecting the bush, consider the pillar size.

Fig 1



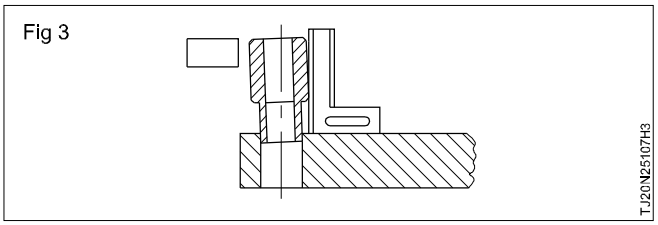
- Keep a dia.25x70mm brass rod over the bush and knock down with a knocking rod.
- After the bush enters about 5mm inside the hole of the top plate check the perpendicularity
- Check again in two opposite directions. (Fig 2)

Fig 2



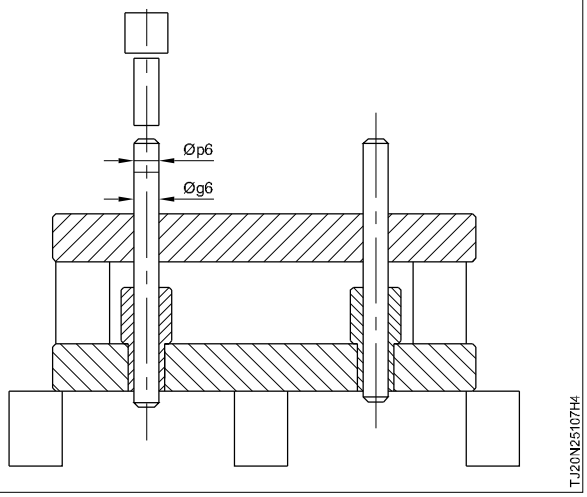
- If not perpendicular, knock the bush with brass rod from the opposite side to obtain the perpendicularity. (Fig 3)

Fig 3



- Keep a dia.25 x 70mm brass rod over the bush and knock with the knocking rod till bush shoulder touches the top plate.
- Repeat the same procedure and press fit another bush.
- Keep top plate over parallel blocks. (Fig 4)
- Keep parallel blocks over the top plate. (Fig 4)
- Keep the bottom plate over parallel blocks.

Fig 4



- Apply oil to the pillars.
- Enter the g6 dimension of pillars through the bottom plate such that it enters into the bush in this condition. Top and bottom plate can be clamped using clamp.
- Keep the dia. 25 x 70mm brass rod over the pillar and knock with a knocking rod such that the p6 dimension of the pillar enters into the bottom plate for about 5mm.
- Knock down the pillars alternatively (Fig 5 to 7) into the bottom plate till p6 dimension of the pillar is inside the bottom plate by about 1mm (Fig 8).

Fig 5

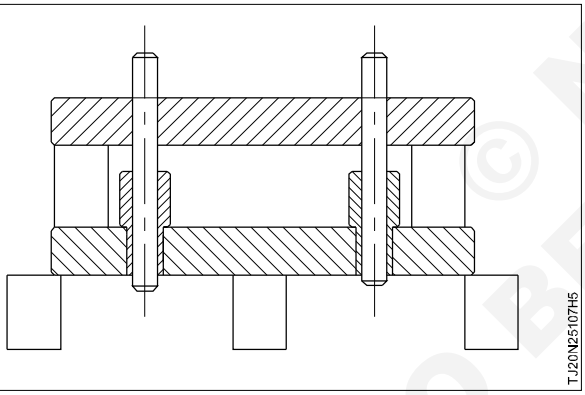
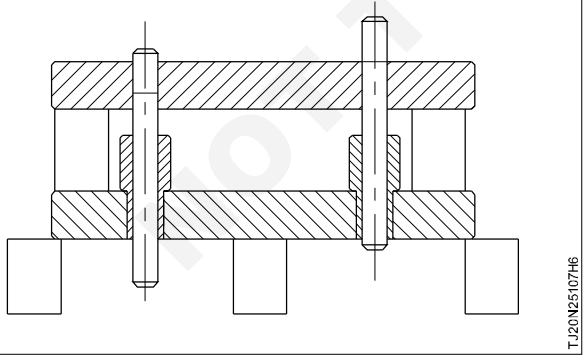


Fig 6



- Remove the parallel blocks and reverse the assembly.
- Apply oil in the bush.
- Slide the top plate up and down. The movement should be smooth.

Fig 7

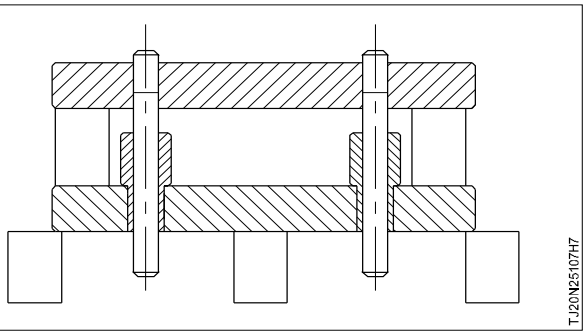
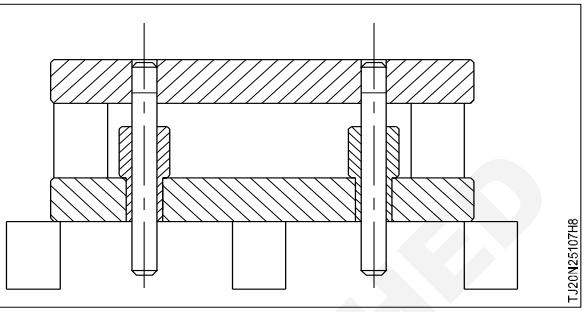


Fig 8

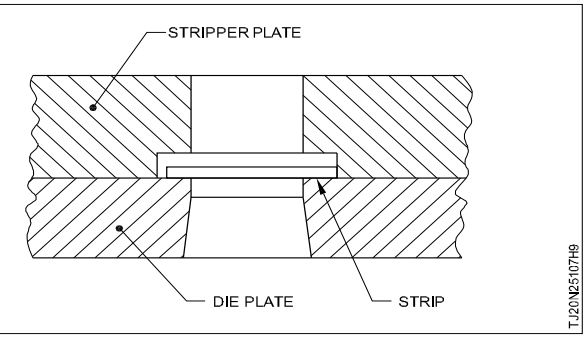


Blanking Tool – trial

- Set the tool on the press
- Lift the press ram.
- Feed 0.5* 52 mm CRCA strip through the stripper plate channel and stop against the stopper.
- Lower the press ram to blank the sheet.
- After the cutting action, lift the ram (Punch should not come out of stripper)
- Lift and feed the strip forward though one pitch and stop against the stopper.
- Lower the press ram to blank the component.
- Repeat the same procedure to get five blanked components.

Note: During feeding of the sheet, but it against the back side wall of the channel in the stripper plate (Fig 9)

Fig 9



- While aligning the punch and die maintain 0.03mm clearance per side and confirm this with the feeler gauge.
- Fasten the socket head screws.
- Take the first trial

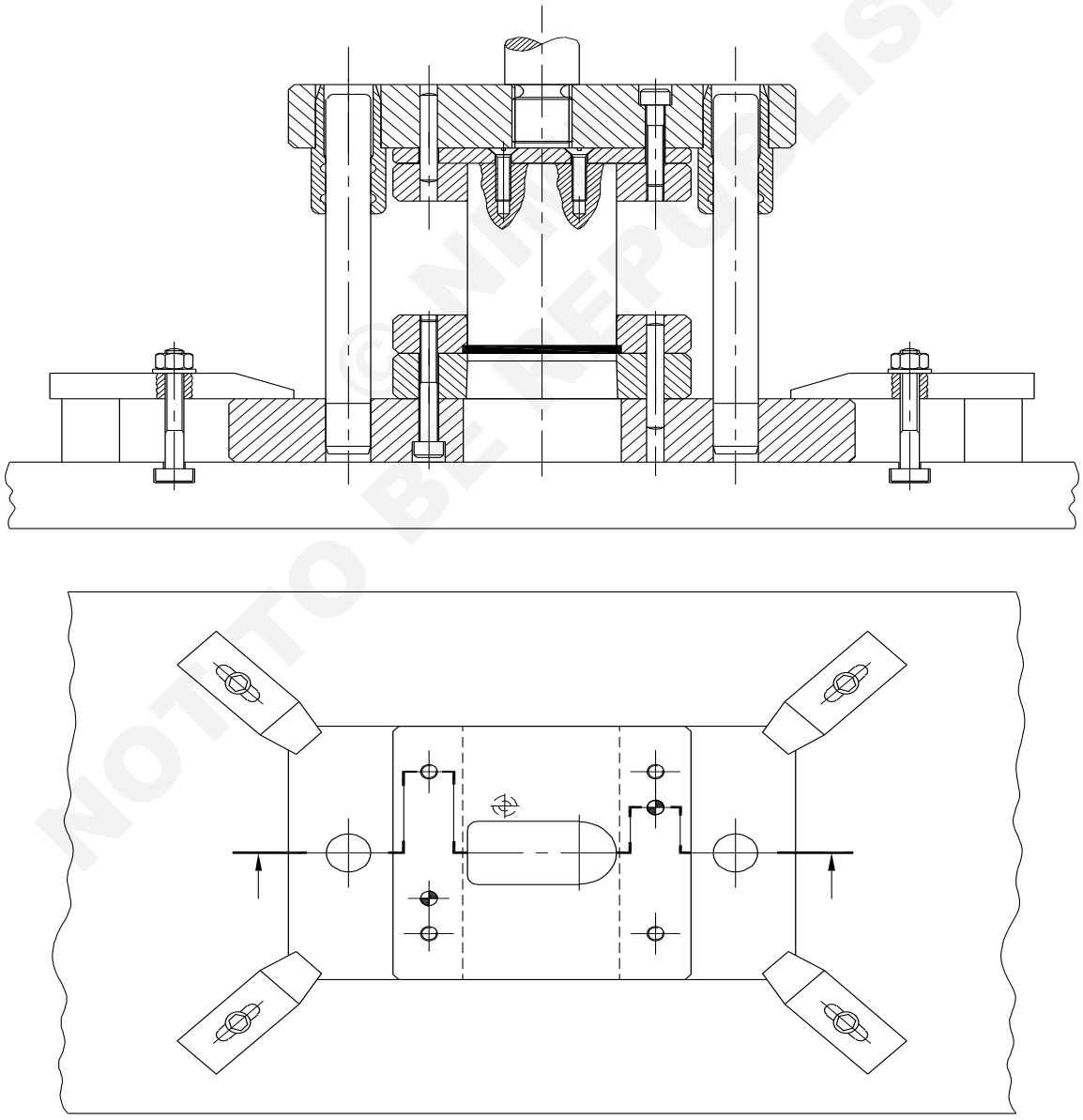
- Inspect the component and check for the uniform cut hand and burr.
- If the alignment is not achieved, it should be readjusted using feeler gauges.
- Drill ream and dowel the assembly.

Blanking tool – setting the tool on the fly press

- Lift the press ram to provide space to keep the assembled tool on the press bed.
- Keep parallel blocks between the punch holder and stripper such that the punch exists only in the stripper and not in the die plate.
- Keep the assembled tool in the centre of the pressed bed.
- Lower the press ram such that the shank enters the bore in the press ram and the press ram touches the top plate of the tool.
- Adjust the lock-nut on the press to stop the ram in that position.
- Clamp the shank to the press ram by tightening the hexagonal bolt provided on the press ram.
- Clamp the bottom half of the assembly to the press bed using four flat clamps. Take care when you lower the press ram to punch the components bushes should not touch the flat clamps.
- Lift the press ram and remove the parallel blocks.
- Loosen the lock-nut
- Lower the press ram such that the punch is on the side the die plate by about 0.5mm (pass the 0.5thickness of CRCA (Cold rolled close annealed strip) strip through the stripper channel. Lower the press ram to touch the punch face on the strip. Remove the strip from that position and lower the press ram about 1mm)
- Adjust the lock-nut and the clamp to stop the press ram in that position

Note: Take care when the press ram is lifted the punch should not come out of the stripper plate.

Fig 10



T120N25107HA

Skill sequence

Shut height of press tool

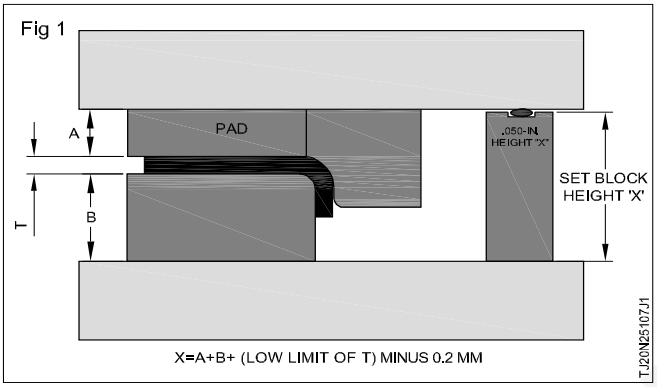
Objectives : This shall help you to

- **Set the Shut height of press tool**

The shut height of an upright press is the distance from the top of the bed to the bottom of the slide with stroke down and adjustment up. The shut height must always be either from the top of the bed or from the top of the bolster plate

The shut height can be calculated by multiplying the die cavity depth of the die with the ram stroke. However, when calculating shut height, it is important to be aware of the difference between the die cavity depth and the ram stroke. (Fig 1)

Fig 1



1 Put the tool press, and open the tool.

2 Put a small piece of material which thickness is same to the part into the tool, the material should be smaller than area of die plate so the tool does not bend the part,

3 Move the slide upwards to the upmost point, then lower the slide to the down point.

4 There is an adjustment of the slide, adjust it until the upper and lower die closed totally.

5 Check the reading of the shut height. it might be smaller than the shut height we offered as we read your description.

6 Use the shut height you just got to stamp the part.

Shut height needs to be found out every time you use a new tool since the supplier's press is different. The shut height we offered should be used as a reference data when you set up the tool.

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

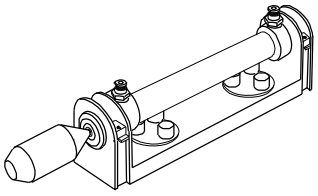
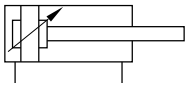
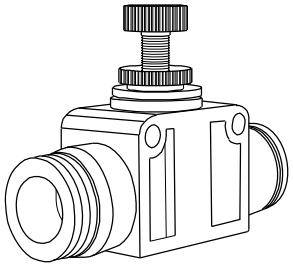
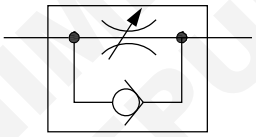
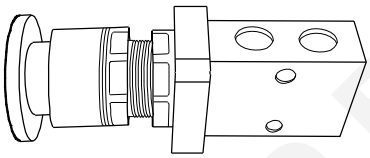
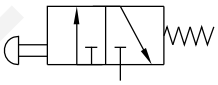
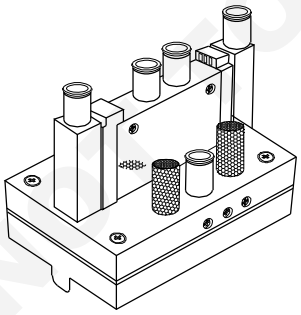
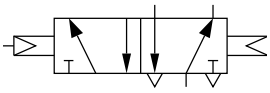
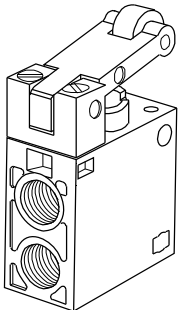
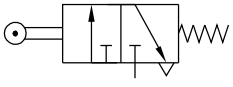
Objectives: At the end of this lesson you shall be able to
- **identify the basic pneumatic components and their symbols**
- **identify the basic hydraulic components and their symbols.**

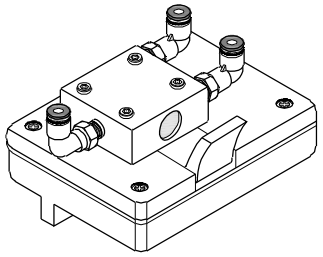
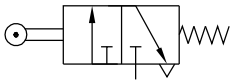
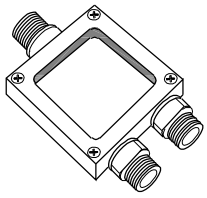
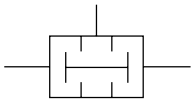
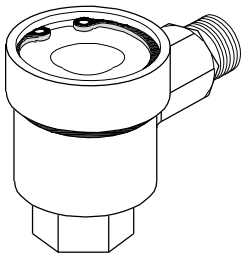
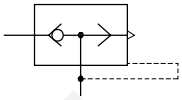
PROCEDURE

TASK 1: **Identify the basic pneumatic components and their symbols**

1 Display all the pneumatic components on the work table.

2 Identify the components and name them

S.No.	Component	Symbol	Name	Remarks
1				
2				
3				
4				
5				

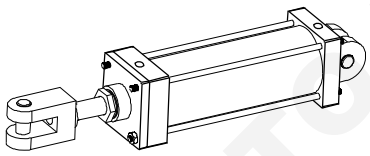
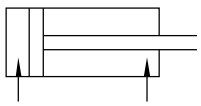
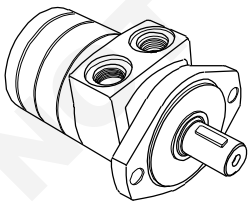
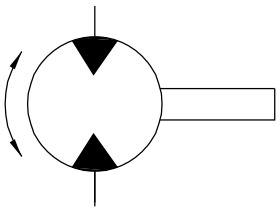
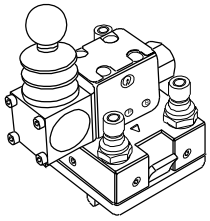
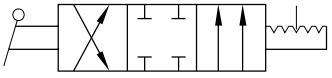
S.No.	Component	Symbol	Name	Remarks
6				
7				
8				

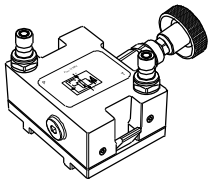
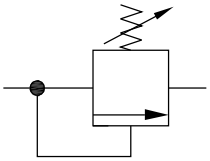
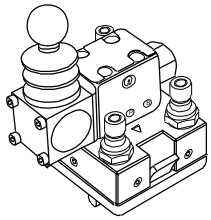
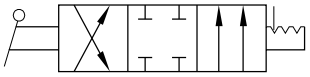
— — — — — — —

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

1 Display all the hydraulic components on the work table.

2 Identify the components and name them.

S.No.	Component	Symbol	Name	Remarks
1				
2				
3				

S.No.	Component	Symbol	Name	Remarks
4				
5				
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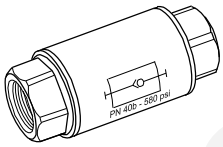
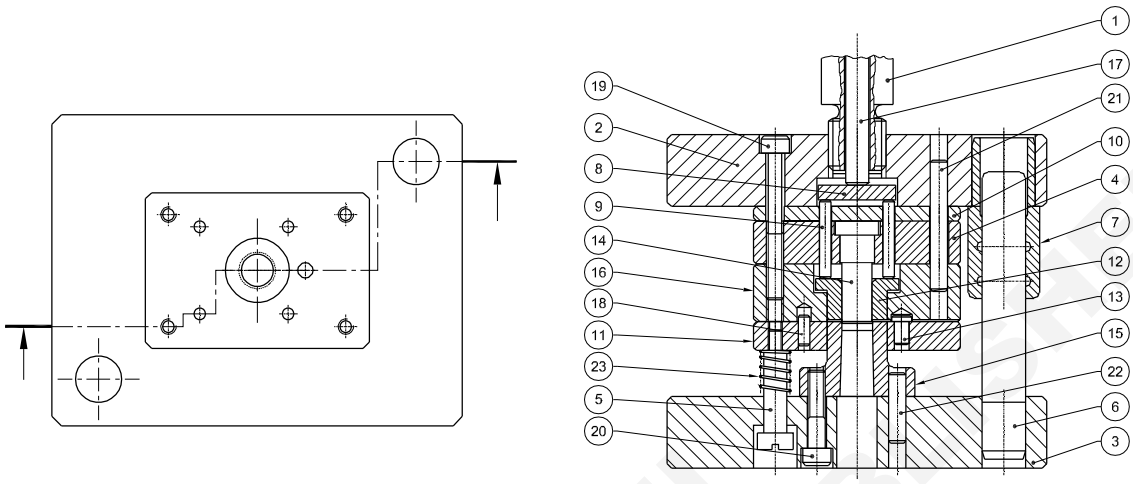
7				

Construct a compound tool as per the drawing using various tool room machines and equipment's

Objectives: At the end of this lesson you shall be able to
- **prepare all the parts of compound tools**
- **assemble a compound tools as per drawing.**



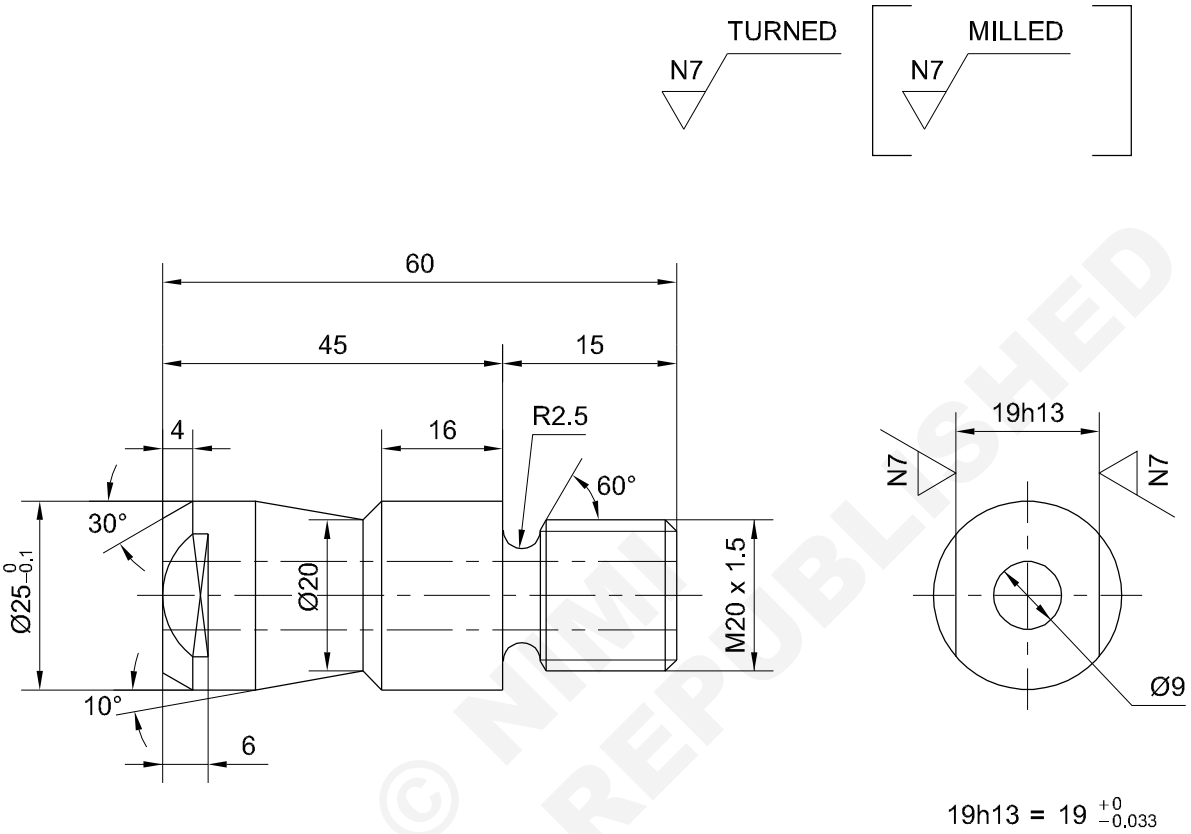
4	COMPRESSION SPRING	I.D=15,WØ=1.2,P=4,L=25	SPRING STEEL		23	-
2	DOWEL	Ø6 x 25	Fe310	STD	22	-
2	DOWEL	Ø6 x 50	Fe310		21	-
3	HEX. SOCKET HEAD CAP SCREW	M6 x 30 IS 2269-12.9	Fe310		20	-
4	HEX. SOCKET HEAD CAP SCREW	M6 x 60 IS 2269-12.9	Fe310		19	-
4	DOWEL	Ø4 x 10	Fe310	STD	18	-
1	KNOCKOUT ROD	ISRO 10-110	Fe310	STD	17	17
1	BLANKING DIE	75 ISF 25-55	OHNS		16	16
1	BLANKING PUNCH	ISRO 45-40	HCHC		15	15
1	PIERCING PUNCH	ISRO 18-45	HCHC		14	14
1	STOPPER	ISRO 10-20	Fe310		13	13
1	SHEDDER	ISRO 36-25	Fe310		12	12
1	STRIPPER	60 ISF 15-77	Fe310		11	11
1	BACK PLATE	60 ISF 10-77	Fe310		10	10
2	TRANSFER PIN	ISRO 6-40	Fe310	STD	09	09
1	TRANSFER PLATE	ISRO 32-20	Fe310		08	08
2	GUIDE BUSH	ISRO 28-55	Fe310		07	07
2	GUIDE PILLAR	ISRO 20-115	Fe310		06	06
4	SHOULDER SCREW	ISRO 16-50	Fe310		05	05
1	PUNCH HOLDER	60 ISF 20-77	Fe310		04	04
1	BOTTOM PLATE	140 ISF 30-105	Fe310		03	03
1	TOP PLATE	140 ISF 30-105	Fe310		02	02
1	SHANK	ISRO 28-65	Fe310		01	01
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO. 2.7.109

SCALE 1:1	COMPOUND TOOL	DEVIATIONS	TIME
		CODE NO. TJ20N27109E1	

Job Sequence

Refer the Exercise 2.5.125

Compound tool - Shank



Compound tool - Top plate and bottom plate

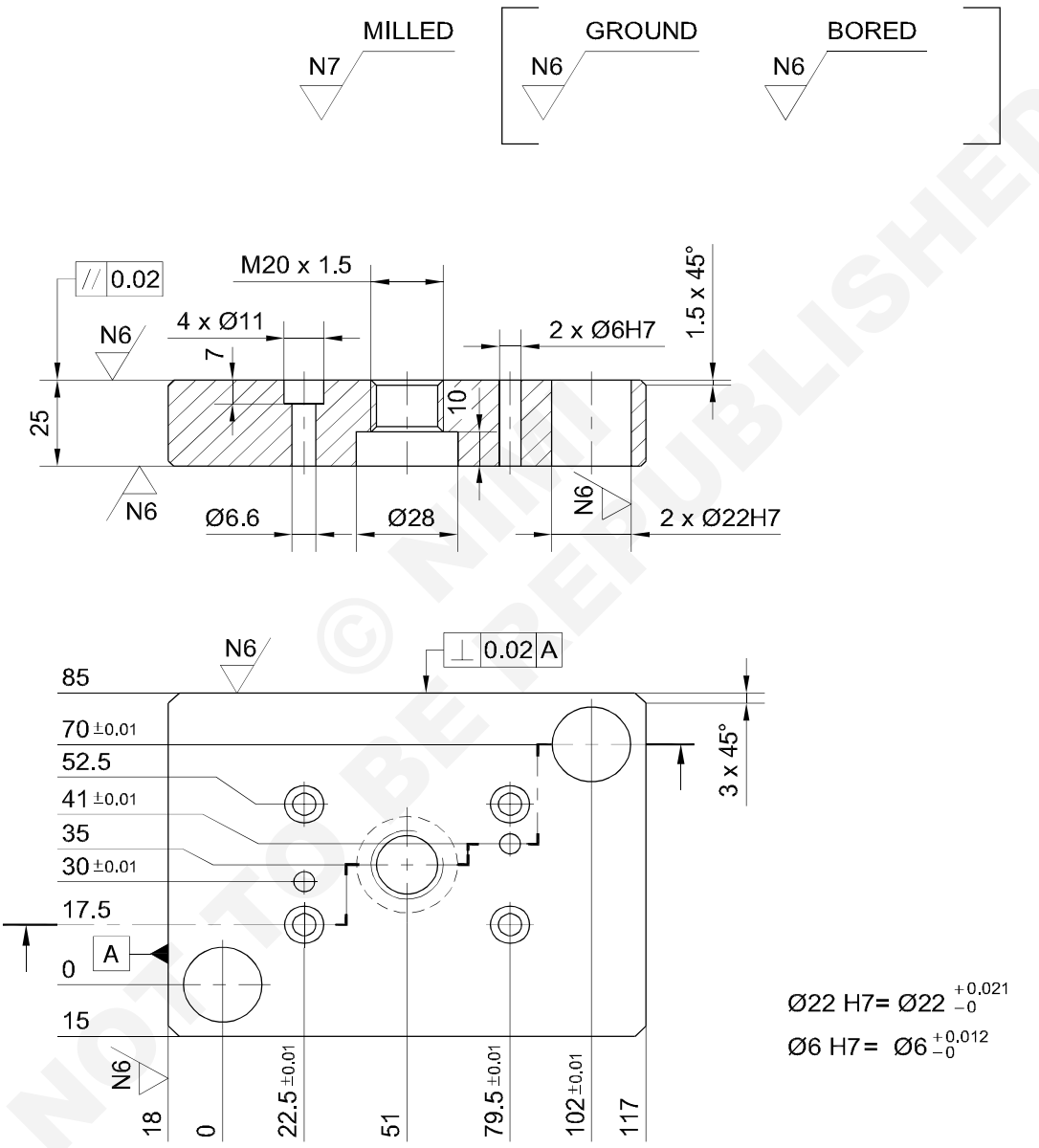
- Check the raw material 140 ISF 30 + 105
- Set the job in the vice
- Mill block to - 135 x 100 x 25mm perpendicular within 0.1 and parallel within 0.1mm.
- Repeat the same procedure for milling the second plate.

1	ISRO 28 x 65	-	Fe310	-	01	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**SHANK**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E2	

Top plate

- Check the raw material.
- Mark and punch the co-ordinates for the hole centres.
- Drill holes dia 6.6 x 4 Nos
- Counter bore to dia 11 x 4 nos to depth 7mm.
- Drill holes dia 18.5mm.
- Tap M 20 x 1.5 as per drawing.
- Chamber as per drawing.

Compound tool - Top plate

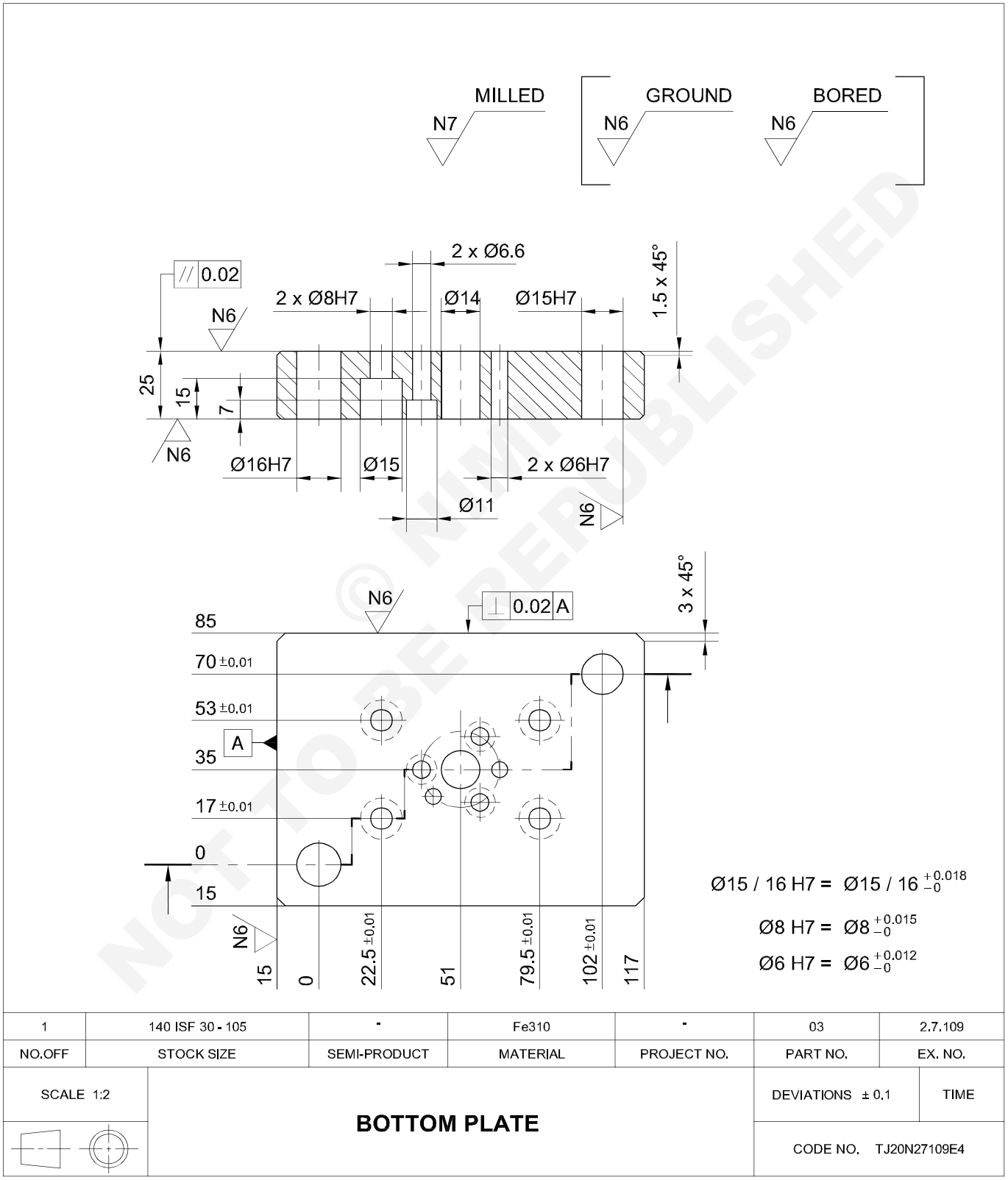


1	140 ISF 30 - 105	-	Fe310	-	02	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**TOP PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E3	

Bottom plate

- Check the raw material.
- Mark and punch the co-ordinates for screw hole centres.
- 0.5 under-size for filling.
- Drill holes dia 6.6 x 4 Nos.
- Counter bore holes dia 11 to depth 7mm.
- Chamfer as per drawing.

Compound tool - Bottom plate



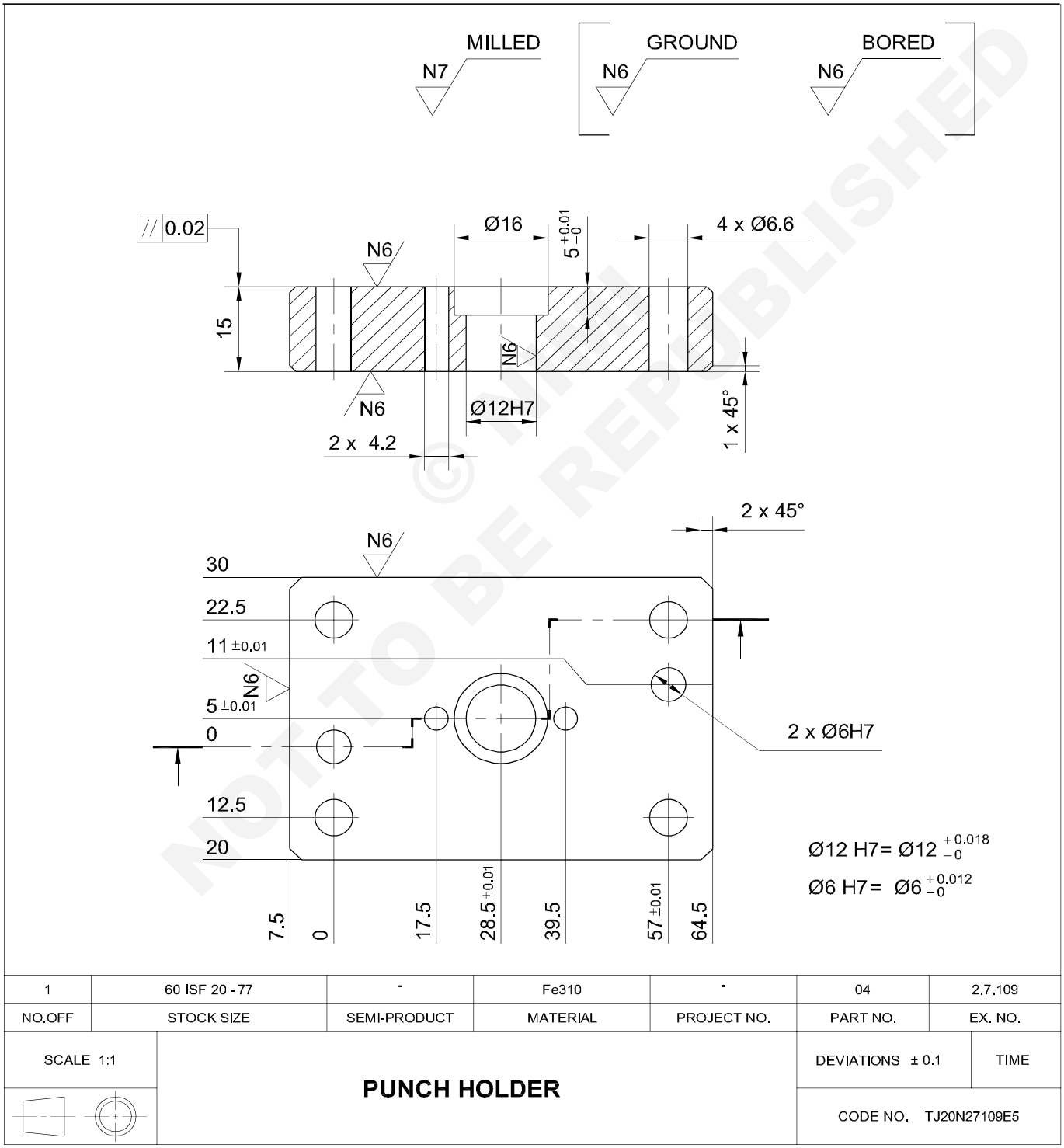
1	140 ISF 30 - 105	-	Fe310	-	03	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:2	**BOTTOM PLATE**	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N27109E4	

Punch holder

- Check the raw material.
- Mill block to 15.5 ±0.1 x 50 x 72mm perpendicular within 0.1 and parallel within 0.1mm.
- Grind the thickness to 15 ±0.02mm parallel within 0.02mm.
- Grind reference sides (adjacent sides) perpendicular within 0.02mm.
- Mark and punch the co-ordinates for the screw hole centers.
- Mark the punch hole to insert punch.
- Drill dia 6.6 x 4 holes.
- Drill dia 4.2 x 2 holes
- Drill and ream hole dia 6.H7 x 2 Nos.
- Drill and ream hole dia 4.2 x 2 Nos.
- Counter bore dia 12.H7 to a depth of 5mm.
- Chamfer as per drawing.

Compound tool - Punch holder



1	60 ISF 20 - 77	-	Fe310	-	04	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PUNCH HOLDER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E5	

Shoulder screw

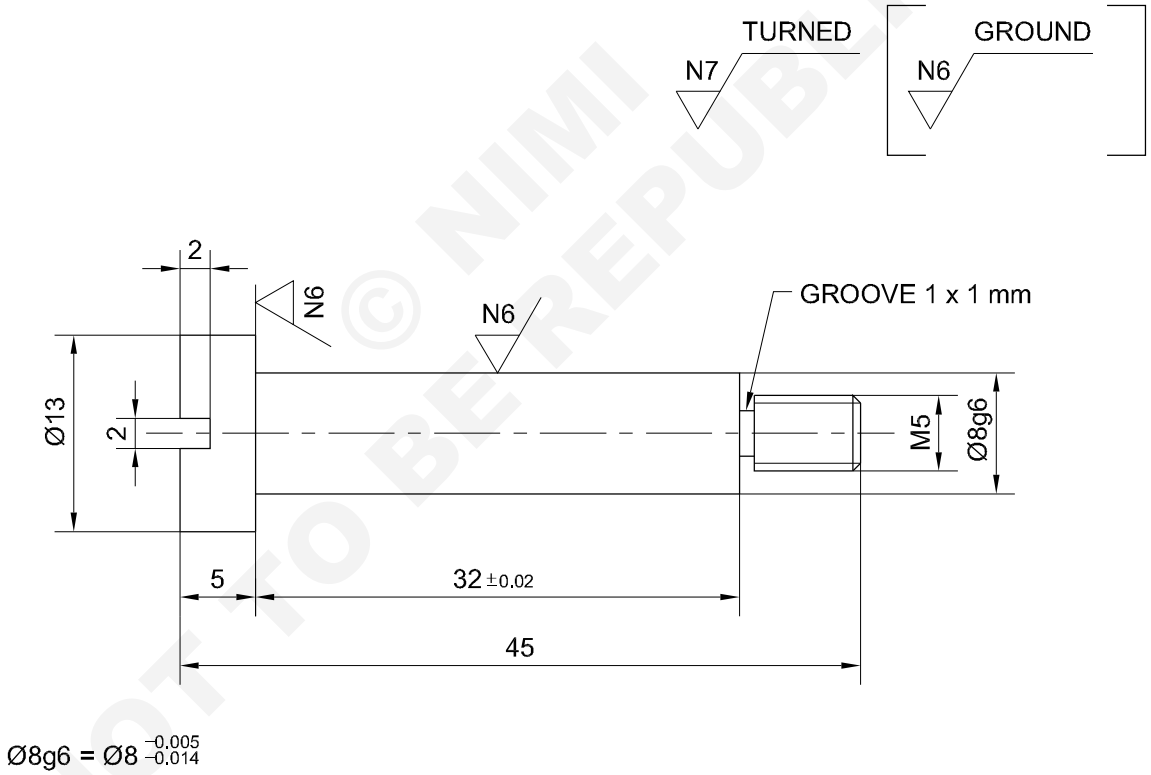
Turning

- Check the raw material ISRO dia 16 x 200mm.
- Hold the job in 3-jaw chuck such that the length 70mm projects out.
- Face to get perpendicularity.
- Turn dia 13 ±0.1 to length of 65mm.
- Turn dia 8.5 to a length of 39.5mm.
- Turn dia 4.9 to a length of 8mm.
- Turn the groove as per drawing.
- Cut external thread using M5 die on lathe to a length of 8mm.
- Part the job to a length of 47mm.
- Reverse the job and hold dia 8.5
- Face the job to a length of 45mm.
- Chamfer as per drawing.
- Repeat the same for other 3 jobs.

Grinding

- Set the job on perpendicular in grinder.
- Grind the shoulder for step length 5mm.
- Grind dia 8.5mm to dia 8g6 as per drawing.
- Repeat the same procedure and grind other shoulder screws.

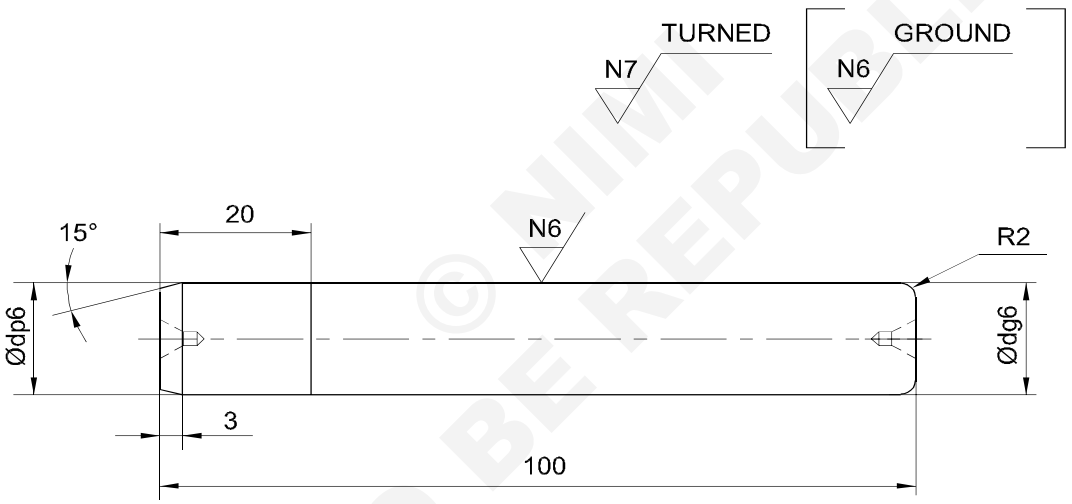
Compound tool - Shoulder screw (4 Nos)



4	ISRO 16 x 50	-	Fe310	-	05	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**SHOULDER SCREW**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E6	

Compound tool - Guide pillar (2 Nos)

- Check raw material dia. 20 - 120.
- Hold the job in a 3 jaw chuck.
- Face and centre drill.
- Reverse the job and hold in the 3 jaw chuck.
- Face to get total length 100±0.1.
- Centre drill.
- Hold the job in between centres.
- Turn dia. parallel 15.5±0.1 mm to maximum length.
- Turn taper 8 degrees ±5 minutes' length 3±0.2 by swiveling the compound slides.
- Reverse the job and hold in between centres.
- Turn dia. 15.5±0.1 mm to remaining length.
- Turn radius R2 using form tool.
- Repeat the same procedure and turn dia 16.5 pillar.
- Check the dimensions of the turned pillars.
- Set the job in between centres on the cylindrical grinder.
- Grind dia. 15.5 to dia. 15 p6 to length of 27±mm.
- Reverse and hold the job in between centres.
- Grind 15g6 to a length of 80±0.1.
- Repeat the same procedure and grind dia. 16 pillar



Ø15 / 16 p6 = Ø15 / 16 $^{+0.029}_{+0.018}$

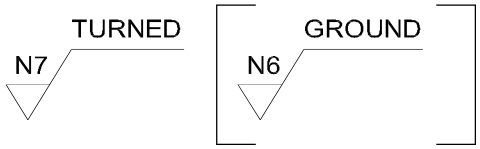
Ø15 / 16 g6 = Ø15 / 16 $^{-0.006}_{-0.017}$

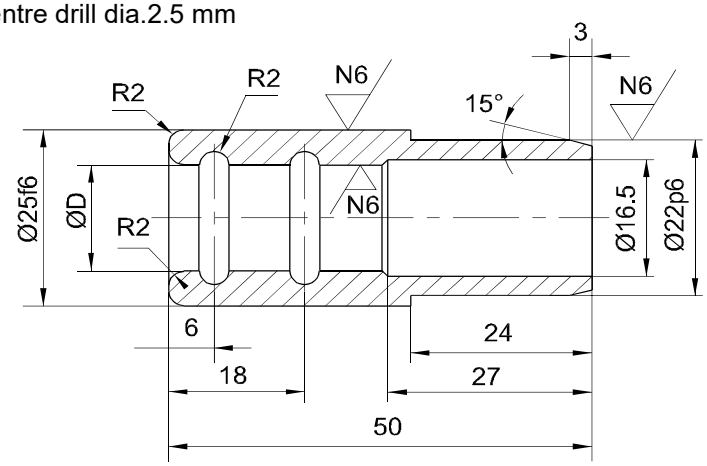
	1	2
Ød	15	16

1 + 1	ISRO 20 - 115	-	Fe310	*	06	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**GUIDE PILLAR**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E7	

Compound tool - Guide bush (2 Nos)

- Check the raw material dia.28 *55 mm.
- Hold the dia. in a 4 jaw chuck such that the job length 30 mm projects out.
- Face to get perpendicularity.
- Turn dia. 27±0.1 mm to a length of 28 mm.
- Centre drill dia.2.5 mm





$Ø25\ f6 = Ø25\ ^{-0.033}_{-0.020}$

$Ø22\ p6 = Ø22\ ^{-0.035}_{-0.022}$

$Ø15 / 16\ H7 = Ø15 / 16\ ^{+0.018}_{-0}$

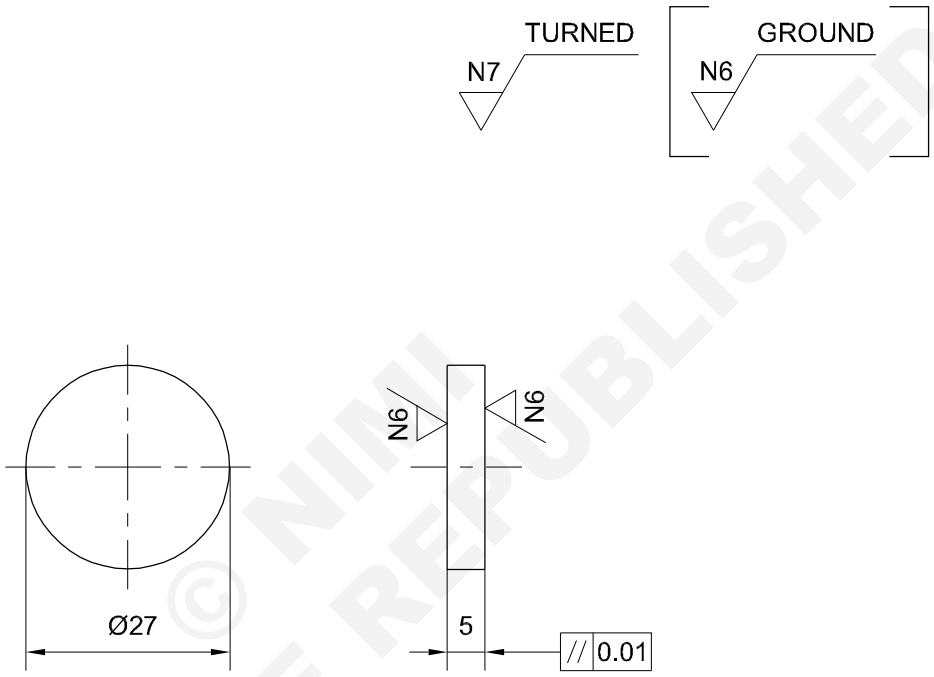
	1	2
ØD	15H7	16H7

1 + 1	ISRO 28 - 55	-	Fe310	-	07	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		**GUIDE BUSH**			DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E8	

- Drill and enlarge the hole to dia. 13.5 mm.
- Bore dia. 14.5±0.1 mm.
- Bore step dia. 16.5±0.1 mm to length 27 mm.
- Turn all grooves using a form tool.
- Turn dia. 25.5 ± 0.1 to length 28 mm.
- Turn step dia. 22.5 ± 0.1 to length 24±0.1 mm.
- Chamfer as per drawing.
- Reverse the job and set in a 4 jaw chuck.
- Face to total length 50±0.1 mm.
- Turn radius R2 mm using a form tool
- Repeat the same procedure and turn to Ø15.5 mm guide bush.
- Check the dimensions of the turned bush.
- Set the job dia. 22.5 on cylindrical grinder in a 4 jaw chuck.
- Grind external diameters as per drawing. (Ø25 p6)
- Reverse the job and hold dia 25mm with soft jaw grind dia 22.P6
- Repeat the same procedure and the grind other bush. Refer to the drawing for dimensions.

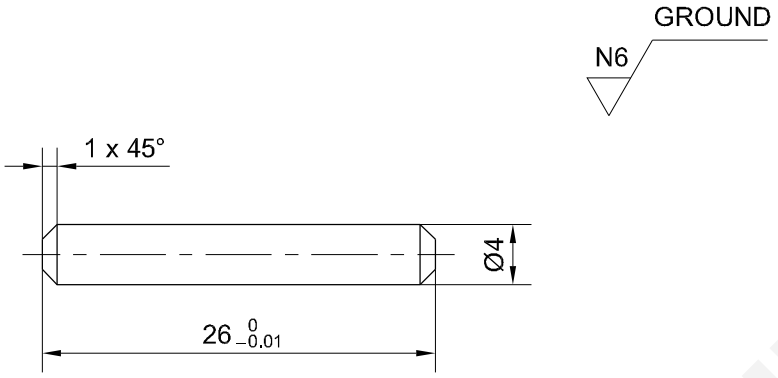
Transfer plate

- Check the raw material size
- Hold the job in 3-jaw check such that 20mm projects outside.



1 + 1	ISRO 32 - 20	-	Fe310	-	08	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**TRANSFER PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109E9	

- Face to get perpendicularity.
- Turn dia 27mm to required length.
- Part the job to a length of 5.5mm 2 Nos.
- Set the job on surface grinding machine.
- Grinding the job 5mm thickness both sides.



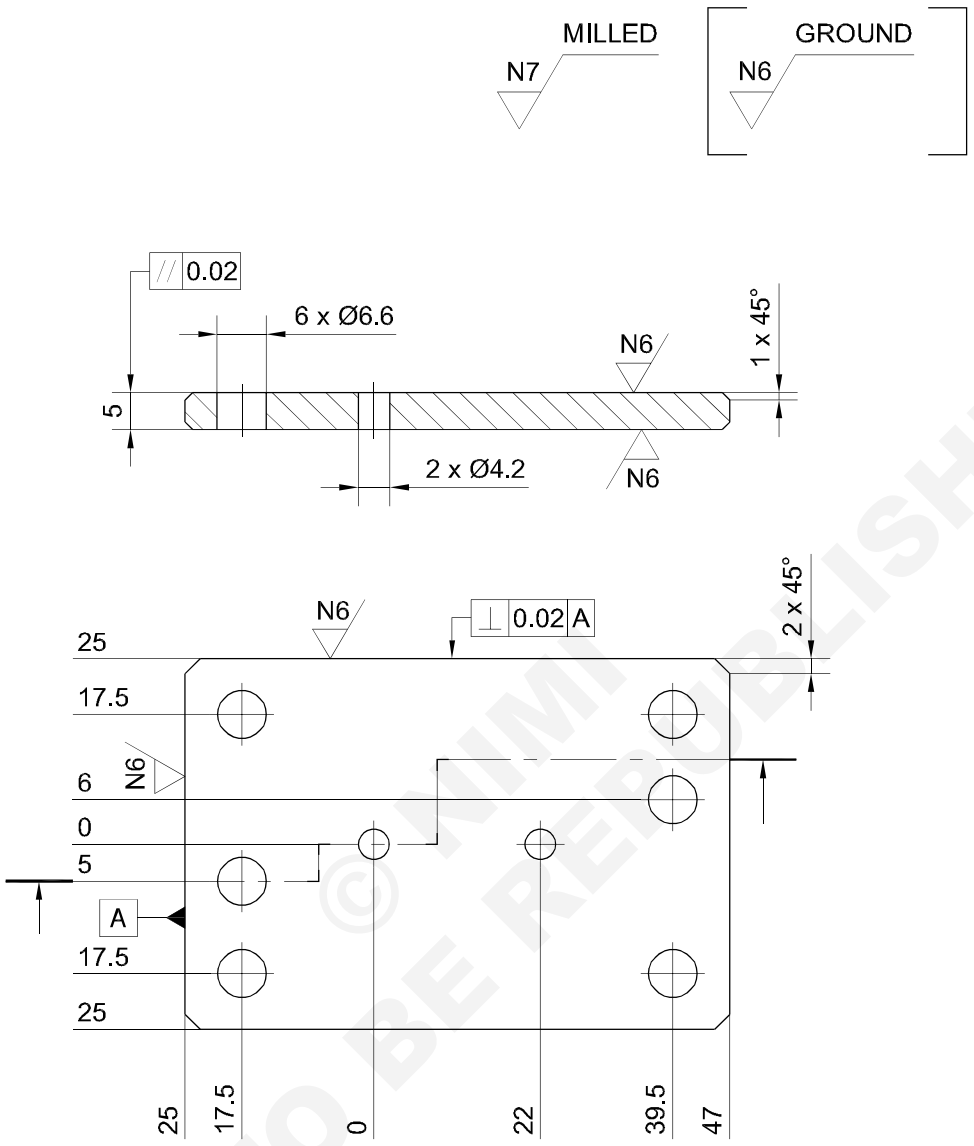
Job sequence

Standard dowel pin dia 4 x 26mm

Back plate

- Check the raw material 60 ISF 10-77.
- Mill the flat 72.5 x 50.5 x 5.5mm ±0.1mm perpendicular within 0.1 and parallel within 0.1mm.
- Grind thickness to 5mm parallel within ±0.02mm.
- Grind reference sizes (adjacent sides) perpendicular within 0.02mm.
- Mark and punch the hole centre.
- Drill holes dia 6.6 + 6 Nos.
- Drill holes dia 4.2 x 2 Nos.

2	STD	-	-	-	09	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**TRANSFER PIN**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109EA	

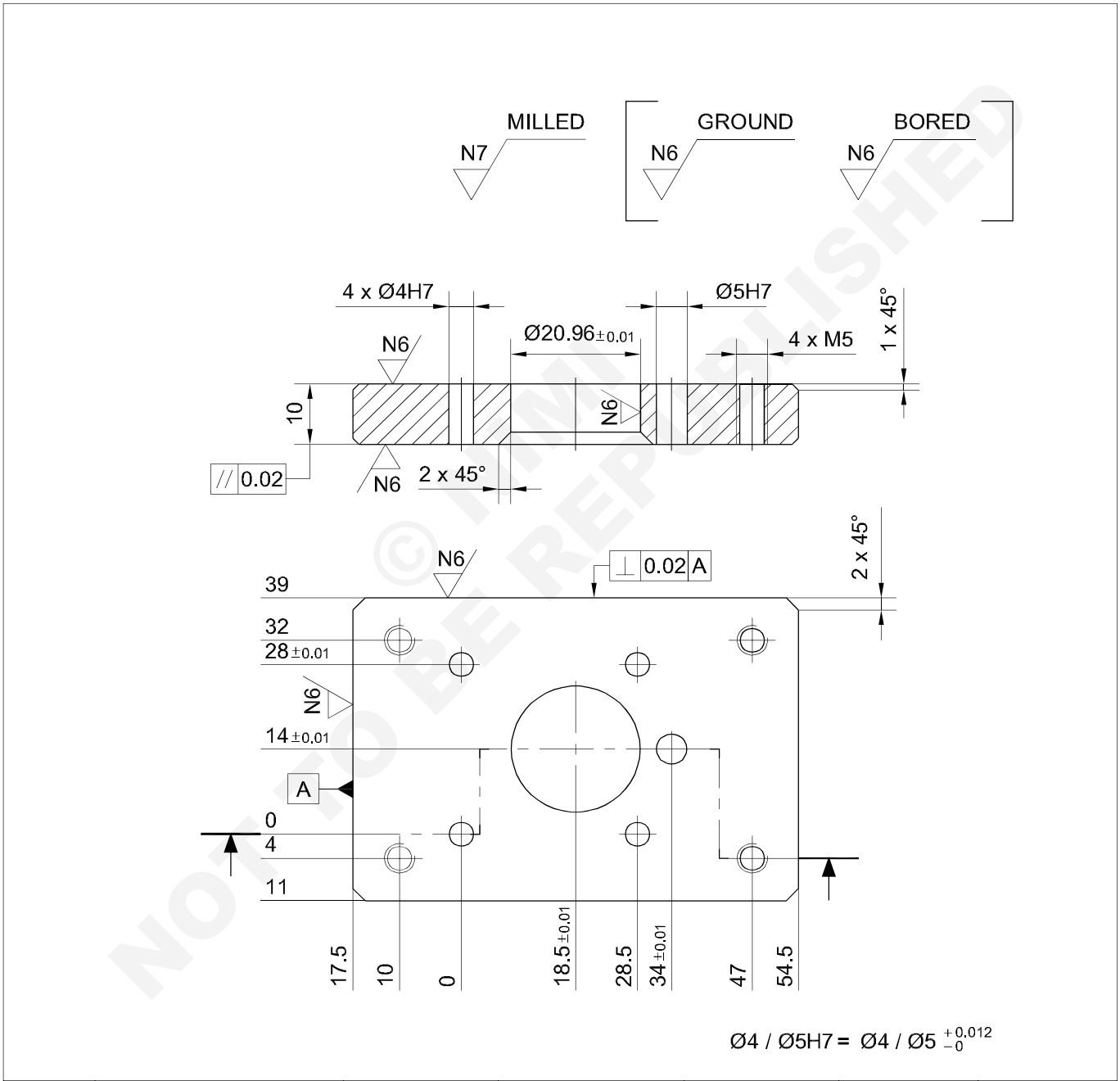


1	60 ISF 10 - 77	-	Fe310	-	10	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**BACK PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109EB	

Stripper

- Check the raw material size 60 ISF 15-77.
- Mill block 72.5 x 50.5 x 10.5mm ±0.1mm.
- Grind the thickness to 10 ± 0.02mm parallel within ±0.02mm.
- Grind the reference sides (adjacent sides) perpendicular within ± 0.02mm.
- Mark the holes and punch.
- Drill dia 4x4 Nos for M5 tap.
- Drill dia 3.9 for 4mm ream holes 4 Nos.
- Drill dia 4.8mm for 5mm ream hole.
- Set the job material milling machine.
- Drill and bore dia 20.96 ±0.01mm.
- Chamfer as per drawing.

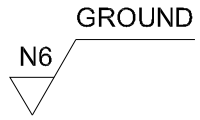
Compound tool - Stripper

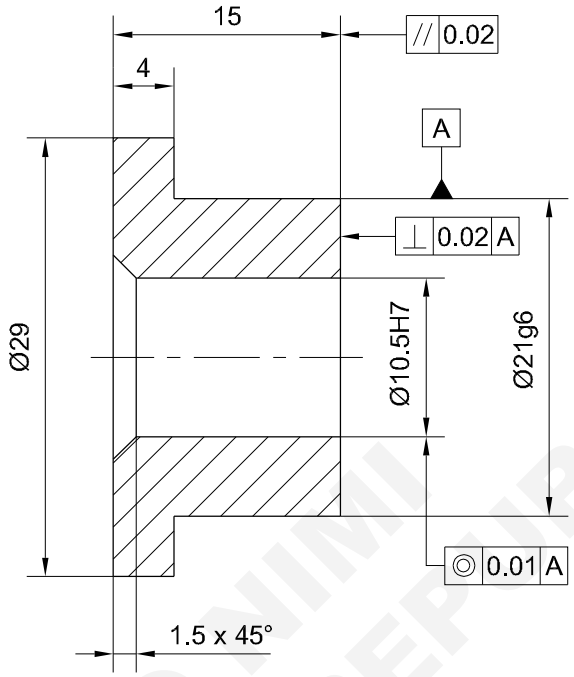


1	60 ISF 15 - 77	-	Fe310	-	11	11
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		STRIPPER			DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109EC	

Shedder

- Check the raw material ISRO 36-25.
- Hold the job in 3-jaw chuck.
- Face the job to get perpendicularity.
- Turn dia 29 ±0.02mm



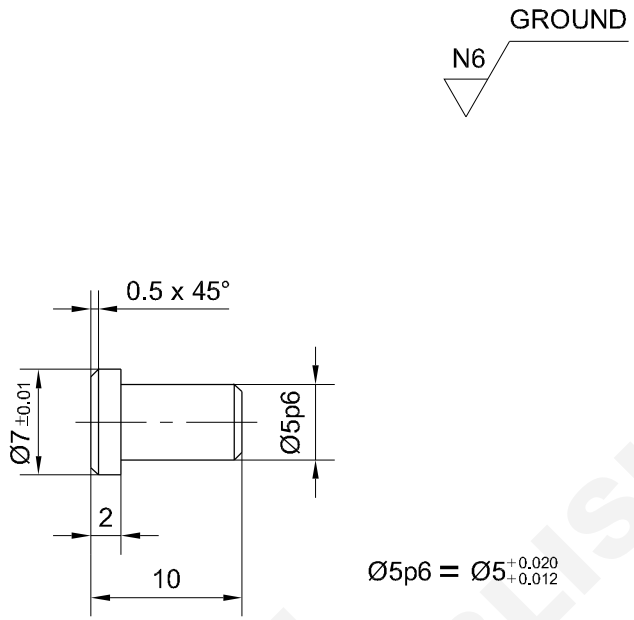


$Ø10.5H7 = Ø10.5\ ^{+0.018}_{0}$

$Ø21g6 = Ø21g6\ ^{-0.007}_{-0.020}$

1	ISRO 36 - 25	-	Fe310	-	12	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**SHEDDER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109ED	

- Turn dia 21 to a length of 11mm.
- Drill and ream to size of dia 10.5H7.
- Part the job to length of 15.5mm.
- Reverse the job hold dia 21mm.
- Face the job to the length of 15mm.
- Chamber the job as per drawing.



Stopper

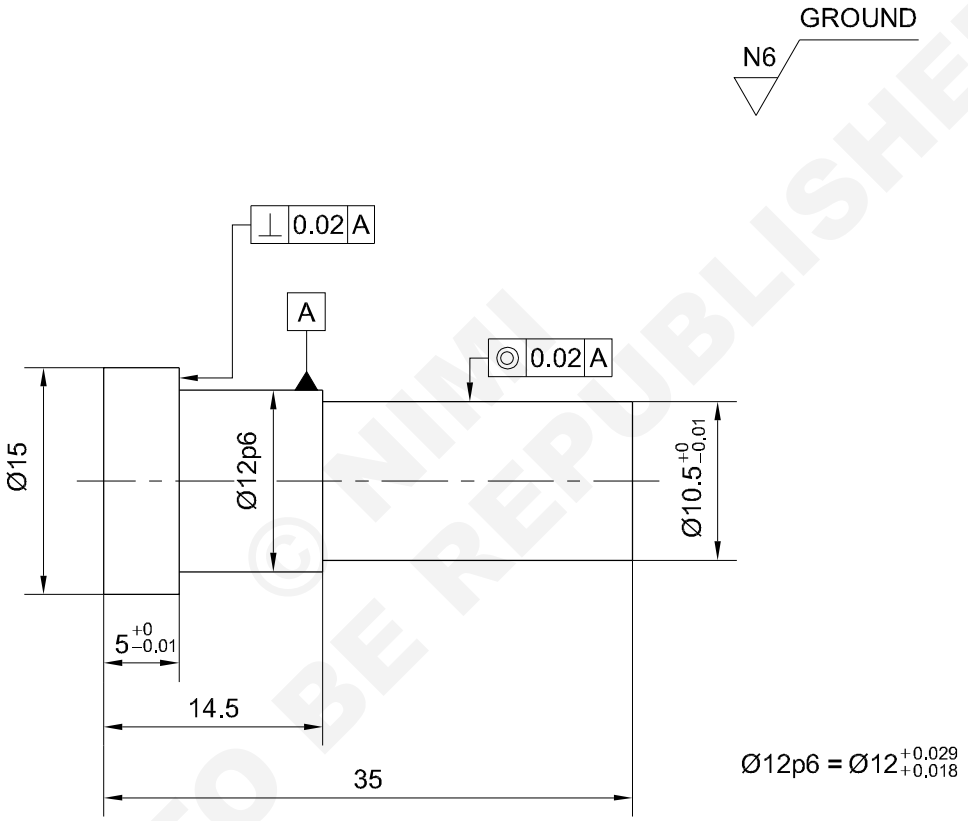
- Check the raw material ISRO 10-20.
- Hold the job in 3-jaw chuck.
- Face the job to get perpendicularity.
- Turn dia 7.5mm.
- Reverse the job and hold dia 7.5mm in the chuck.
- Turn dia 5.5 to the length of 8mm and chamfer the end.
- Reverse the job and hold dia 5.5 in the chuck.
- Face dia 7.5 to a length 2mm.
- Hold the job in cylindrical grinding.
- Grinding job dia 5.5 to dia 5mm.
- Reverse the job grind dia 7.5mm to 7mm.
- Grind dia 7mm face to a total length of 10mm.

1	ISRO 10 - 20	-	Fe310	-	13	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**STOPPER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109EE	

Piercing punch

- Check the raw material ISRO 18-45.
- Hold the job in 3-jaw chuck.
- Face to get perpendicularity.
- Turn dia 15mm.
- Turn dia 12.5mm to a length of 29.5mm
- Turn dia 11mm to a length of 20.5mm.
- Reverse the job face and maintain length 35mm.
- Hold th job in cylindrical grinding machine.
- Grind the shoulder to maintain 30mm from the face.
- Grind dia 12.5mm to 12mm.
- Grind dia 11mm to 10.5mm accuracy of +0.00-0.01mm.

Compound tool - Piercing punch



Blanking punch

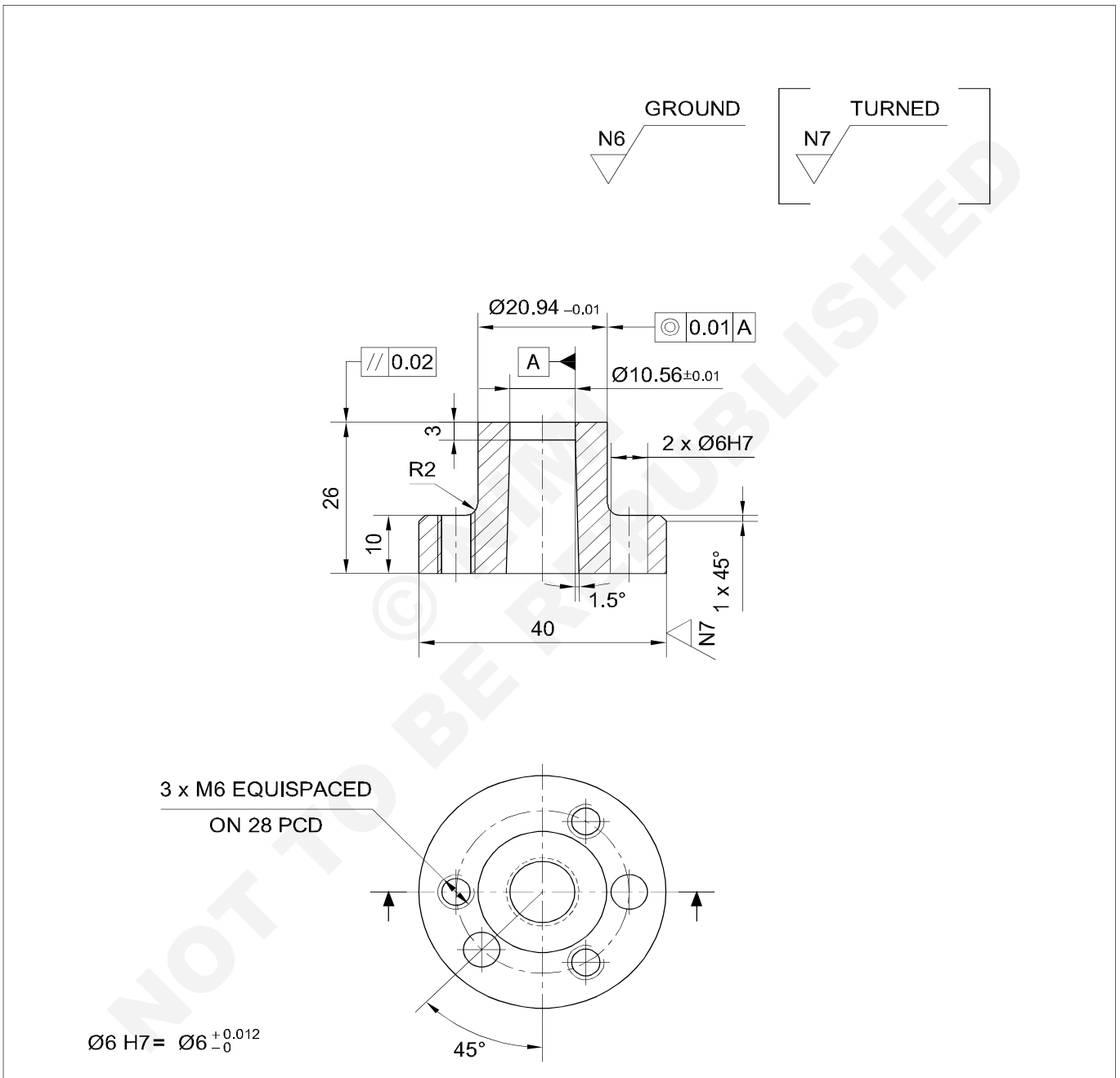
- Check the raw material ISRO 45-40.
- Hold the job in 3-jaw chuck.
- Face for perpendicularity.
- Turn dia 40 to a length of 28mm.
- Turn dia 20.94mm to a length of 16mm.
- Mark radius 2mm at corner of joining dia 40 and dia 20.94mm.
- Reverse the job and face to a length of 26 mm.
- Drill through hole 10.4mm.

1	ISRO 18 - 45	-	HCHC	-	14	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 2:1	PIERCING PUNCH	DEVIATIONS ± 0.01	TIME
		CODE NO. TJ20N27109EF	

- Ream the hole to 10.56mm using adjustable reamer.
- Set the 1.5° taper in compound slide.
- Taper turn the hole to a depth of 23mm.
- Mark 28mm PCD using single point tool.
- According to the drawing mark and punch the centers of holes.
- Drill dia 5mm for M6 tap 3 Nos.
- Drill dia 5.8 for 6mm reamer.
- Make thread using tap.
- Ream the 2 holes 5.8 with 6mm reamer.

Compound tool - Blanking punch

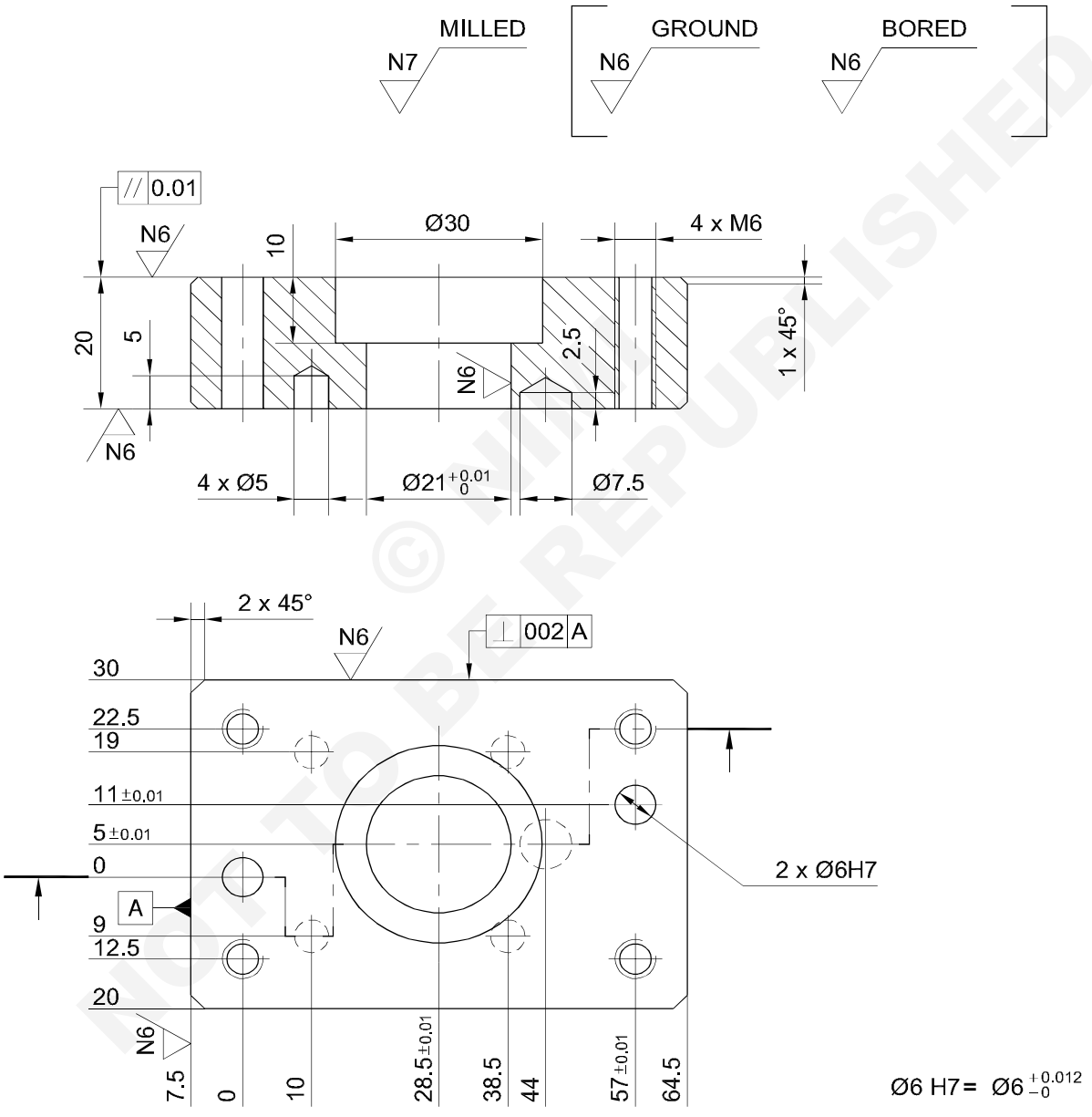


1	ISRO 45 - 40	-	HCHC	-	15	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**BLANKING PUNCH**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109EG	

Blanking die

- Check the raw material 75 ISF 25-55mm.
- Mill block 20.5 x 50.5 x 72.5 ±0.1mm.
- Grind the thickness 20.5mm to 20mm ±0.01 parallel within ±0.01mm.
- Grind the reference sides (adjacent sides) perpendicularity within 0.02mm.
- Mark the holes and punch.
- Drill dia 5mm for M6 tap 4 Nos.
- Drill dia 5mm 4 Nos to a depth of 5mm blind hole.
- Drill dia 7.5 blind hole for a depth of 2.5mm.
- Set the job on vertical milling machine.
- Drill and bore dia 21 to an accuracy of +0.01mm.
- Step bore to dia 30mm to depth of 10mm.
- Chamfer as per drawing.

Compound tool - Blanking die

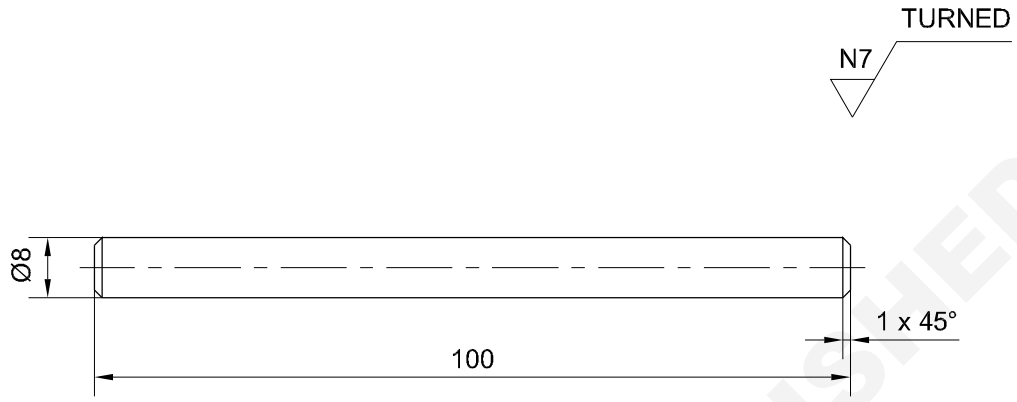


1	75 ISF 25 - 55	-	OHNS	-	16	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

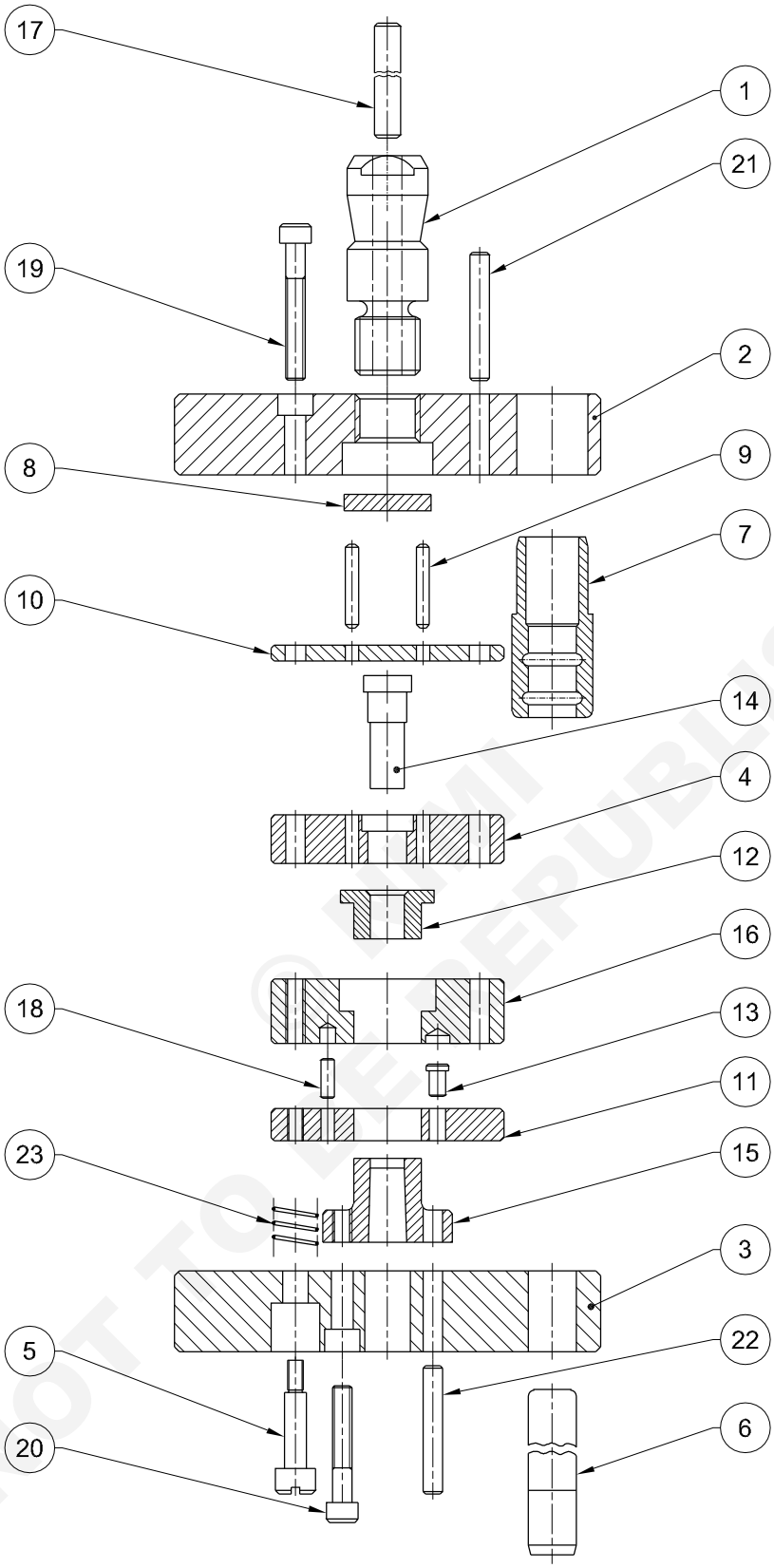
SCALE 1:1	BLANKING DIE	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N27109EH	

Compound tool - Knock out rod

Use standard dowel pin dia 8 x 100mm

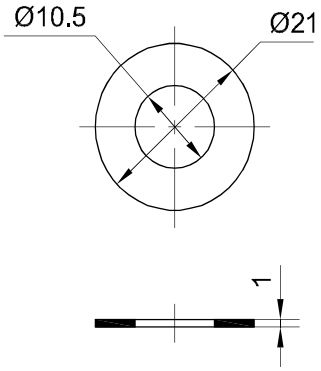


1	STD	-	Fe310	-	17	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**KNOCK OUT ROD**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N27109EI	



	50 ISF 10-60	-		-	-	2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**ASSEMBLY**				DEVIATIONS	TIME
					CODE NO. TJ20N27109EJ	

Compound trial



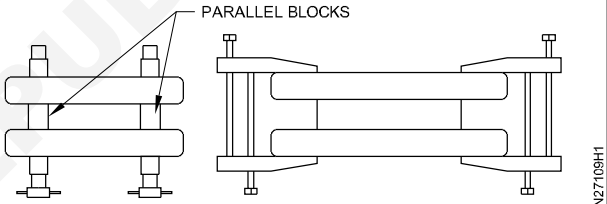
MATERIAL : CRCA

1	24 ISSH 1 - 300	-	CRCA	3P2		2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**COMPONENT**				DEVIATIONS	TIME
					CODE NO. TJ20N27109EK	

Assembling

- Collect all the parts as per drawing.
- Clean thoroughly and deburr all parts except punch and cutting edge.
- Assemble piercing punch (14) and blanking punch (15) with punch holder (4) and back plate (10).
- Apply marking media on top plate (2) butt against angle plate and mark holes centre as per drawing.
- Set the bottom plate (3) and top plate (2) together by introducing 10x20x125 parallel blocks and clamp by parallel clamp.
- Clamp the above set up on a drilling machine table.
- Drill centre hole dia 18.5 for tapping M20x1.5.
- Drill and ream dia 22 H7 at the same centre on top plate (2). The bottom plate (part 3) to be left for drill and ream dia 6 H7 only in trial assembly.
- Remove the setup and apply marking media on bottom plate (part 3) face (kep dia 14 H7 hole on up side) mark centres of dowel pin and centre punch.
- Set on drilling machine drill dia 14mm at the centre.
- Clamp the bottom plate (part 3) and stripper plate (part 11) set on drilling.
- Drilling dia 4 holes for M5 tap on stripper plate 4 Nos.
- Separate the bottom plate and stripper (part 3&11)
- Make thread on stripper using M5 tap.
- Drill dia 7.8mm 4 holes on bottom plate ream 8H7.

Fig 1



SETTING BOTTOM AND TOP PLATE

- Counter bore the 4 holes to a depth of 15mm.
- Clamp the piercing punch (part 15) with bottom plate (part 3)
- Drill dia 5mm for M6 tap on piecing punch 3 Nos equally spaced on 28 PCD.
- Separate bottom plate and drill 6.6mm 3 Nos counter bore dia 11mm to a length of 7mm.

Top assembly

- Clamp the parts top plates (2) back plate (part - 10) punch holder (part - 4) blanking die (part - 16) using 'C' clamp.
- Set the job on drilling machine.
- Mark on the top plate and punch the hole centres.
- Drill through holes of dia 5mm for M6 tap on blanking die (part - 16)
- Separate the blanking die (part - 16)
- Make threads using M6 tap 4 Nos.

- Drill dia 6.6 hole in top plate (Part - 2) back plate (part - 10) and punch holder (Part - 4) in same centre.
- Drill the counter bore of dia 11mm to a depth of 7mm.
- Clamp the back plate (Part - 10) and punch holder (Part - 4)
- Mark and punch the centre of 2 dowel holes.
- Drill dia 4.2, 2 holes.
- Assemble the top portion top plate (Part - 2), shank (Part - 1), back plate (Part 10) in between the top plate (2) and back plate insert transfer plate (Part - 8) insert of piercing punch (Part - 14) in punch holder (Part 4).
- Insert the transfer in (Part - 9) between back plate and punch holder.
- Fix the shedder (Part - 12) in blanking die cavity.
- All top parts are screwed by 4 hexagonal.

Socket head screw M6 x 60 IS 229 - 12.9 (Part 19).

Bottom assembling

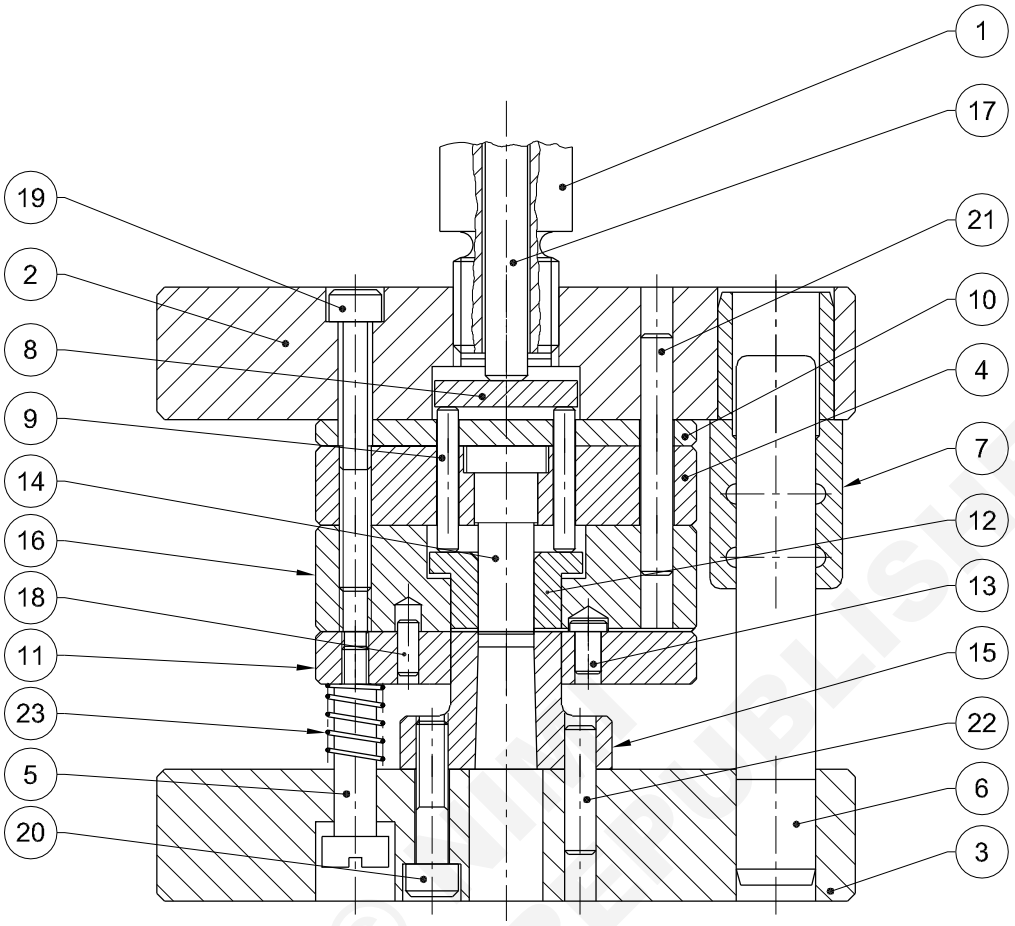
- Assemble top plate, bottom plate, pillar and bushes.
- Fix the blanking punch and bottom plate using hex socket head cap screw M6 x 30 IS 2269 - 12.9 (Part - 20).
- Fix the stripper plate (part - 11) using shoulder screw (Part - 5) insert required compression spring (Part - 23).
- Insert stopper (Part - 13) in perpendicular and insert dowel pin (Part - 18).

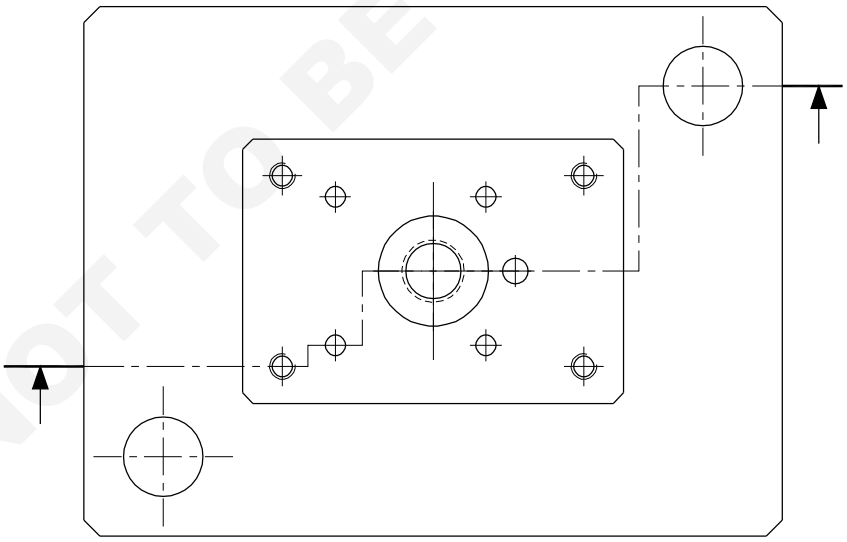
Setting the compound die in a fly press

- Adjust the ram position such that the gap in fly press approximately equal to the height of the compound die assembly.
- Lock the lock nut of the fly press.
- Lift the ram of fly press.
- Insert the sheet on stripping plate move the ram slowly bring down towards stripper such that punches and die is self-aligned.
- Tighten the bottom plate rigidly with base.
- Lift the ram upwards, remove the sheet from the stripper position the strip to accommodate on the stripping.
- Slowly bring down the ram until die reaches to the stripper and lock the nut of the ram.
- Lift the ram up.
- The compound is up on the stripping plate.
- Move the strap for next compound.
- The either component come out.
- Check the component for shape, size and finish.
- Any defect found rectify.

Trial - Compound tool

The trainees may be asked to write the job sequence. The tool is ready for trial.



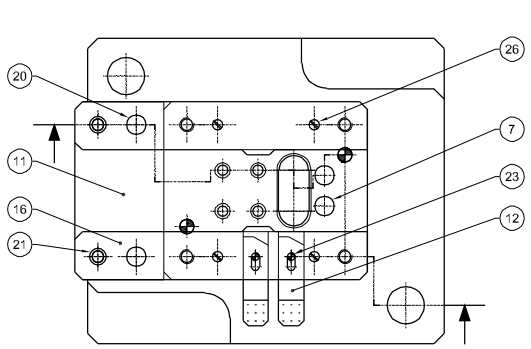


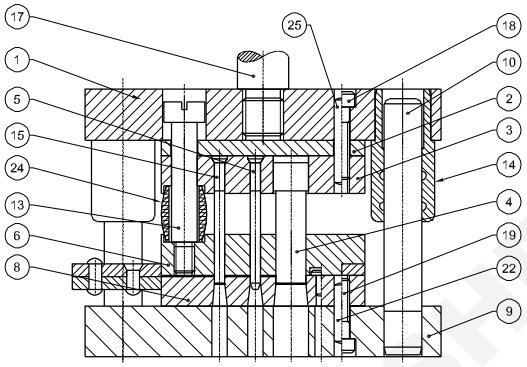
				3P2		2.7.109
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	COMPOUND TOOL TRIAL				DEVIATIONS	TIME
					CODE NO. TJ20N27109EL	

Construct a progressive tool as per the drawing

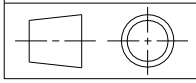
Objectives: At the end of this lesson you shall be able to

- **prepare all the parts of progressing tools**
- **assemble a progressive tools as per drawing.**





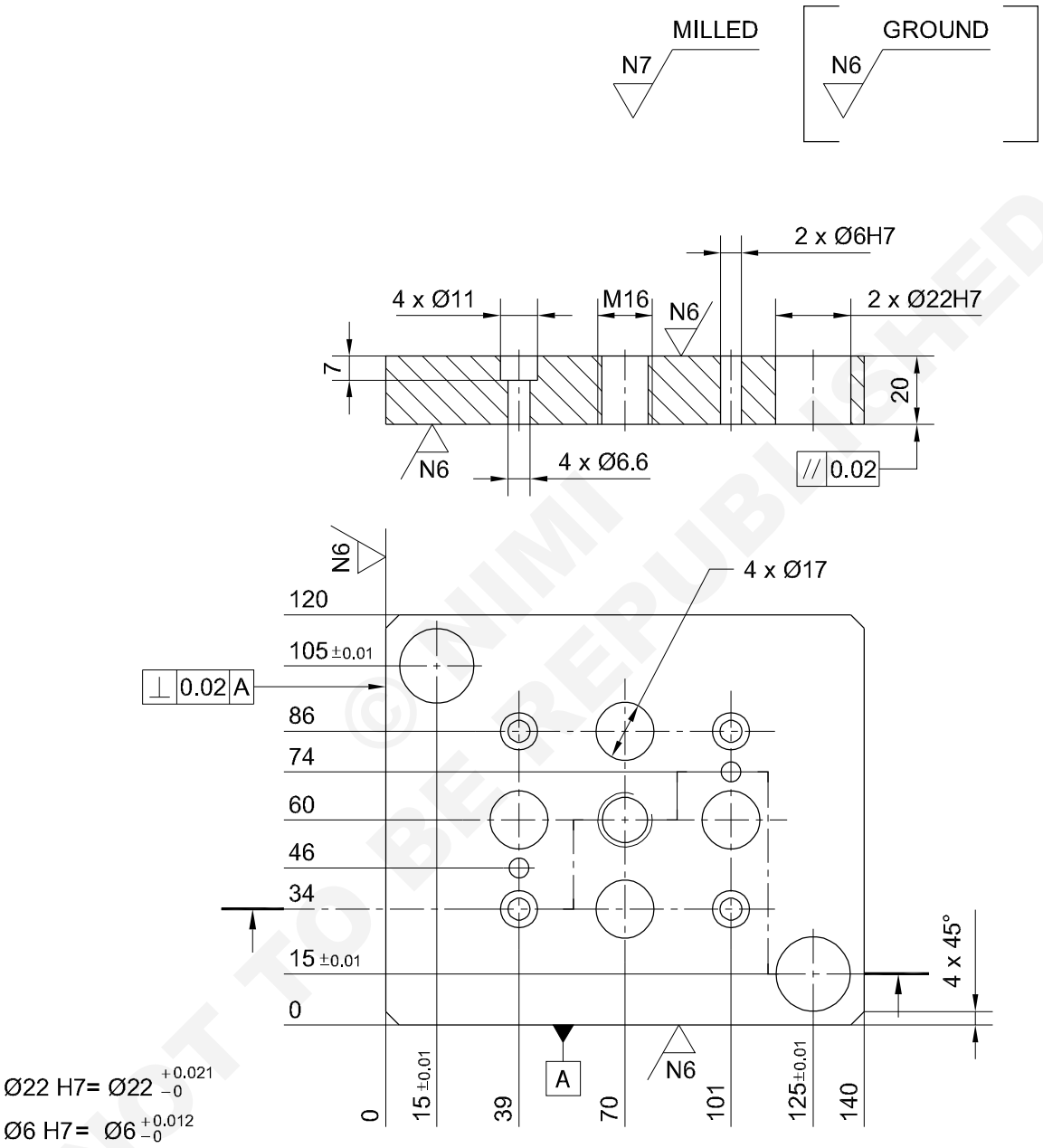
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO. 2.8.110
4	COUNTER SUNK HEAD SCREW	M4 x 12	Fe310	STD	26	
2	DOWEL	Ø6 x 25	Fe310	STD	25	
4	COMPRESSION SPRING	I.D=18, WØ=2,P=4,L=20	SPRING STEEL	STD	24	
2	DOWEL	Ø3 x 15	Fe310	STD	23	
4	DOWEL	Ø6 x 25	Fe310	STD	22	
2	SNAP HEAD RIVET	Ø5 x 15	Fe310	STD	21	
2	COUNTER SUNK HEAD RIVET	Ø5 x 15	Fe310	STD	20	
4	HEX. SOCKET HEAD CAP SCREW	M6 x 25 IS 2269-12,9	Fe310	STD	19	
4	HEX. SOCKET HEAD CAP SCREW	M6 x 30 IS 2269-12,9	Fe310	STD	18	
1	SHANK	ISRO 25-65	Fe310		17	
1	SPACERS	25 ISF 8-120	Fe310		16	
2	PIERCING PUNCH	ISRO 10-50	HCHC		15	
2	GUIDE BUSH	ISRO 32-55	Fe310		14	
4	GUIDE SCREW	ISRO 20-60	Fe310		13	
2	FINGER STOPPER	16 ISF 3-40	Fe310		12	
1	EXTENSION TABLE	40 ISF 8-75	Fe310		11	
2	GUIDE PILLAR	ISRO 20-120	Fe310		10	
1	BOTTOM PLATE	130 ISF 25-145	Fe310		09	
1	DIE PLATE	75 ISF 15-85	OHNS		08	
2	FIXED STOPPER	ISRO 10 - 20	Fe310		07	
1	STRIPPER PLATE	75 ISF 20-85	Fe310		06	
2	PILOT	ISRO 8 - 60	Fe310		05	
1	BLANKING PUNCH	40 ISF 20-46	HCHC		04	
1	PUNCH HOLDER	75 ISF 20-85	Fe310		03	
1	BOTTOM PLATE	75 ISF 8-85	Fe310		02	
1	TOP PLATE	130 ISF 25-145	Fe310		01	

SCALE 1:1	PROGRESSIVE TOOL	DEVIATIONS	TIME
		CODE NO. TJ20N28110E1	

Job Sequence

Progressive tool - Top plate

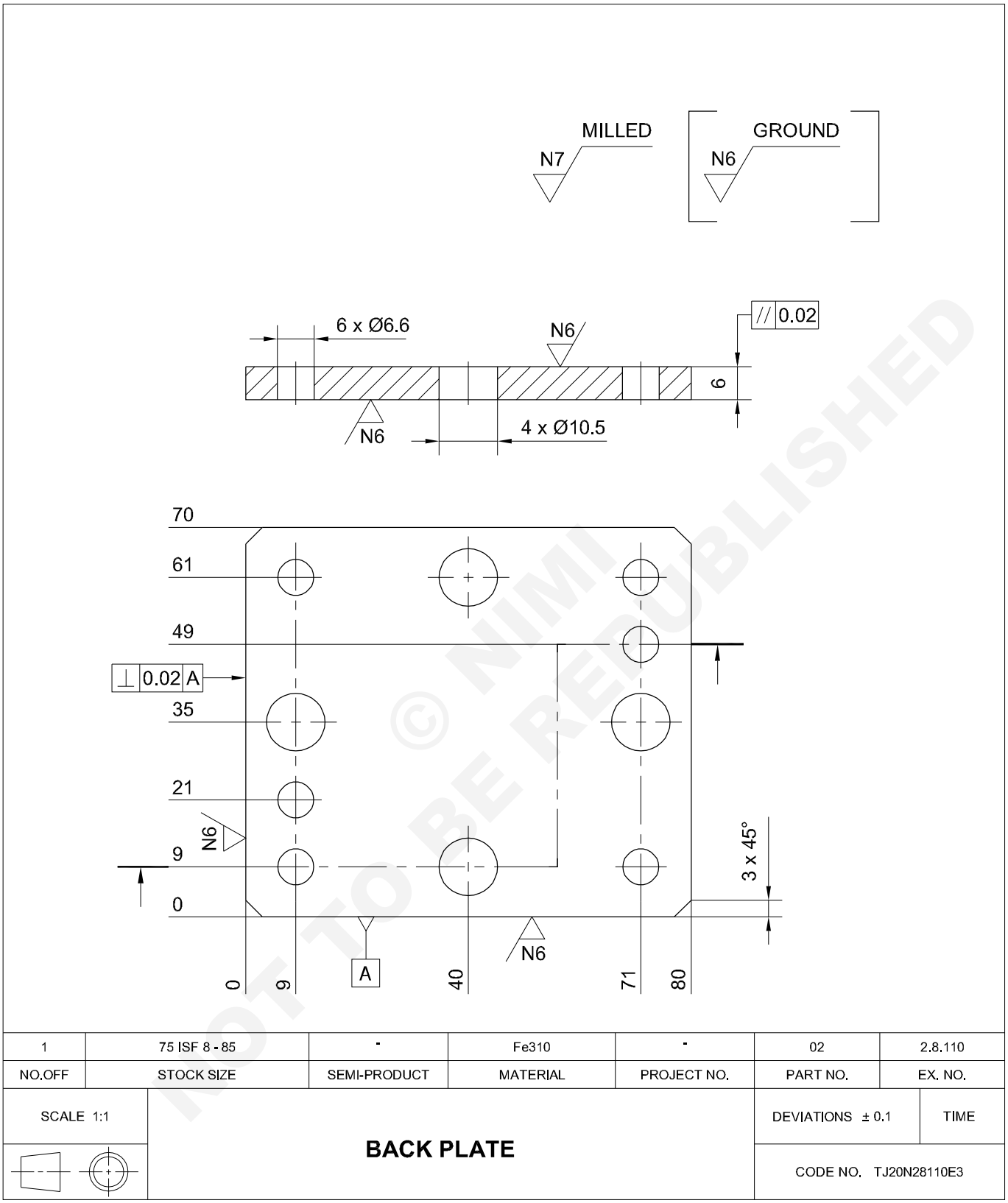
The trainees may be asked to write the job sequence.



1	130 ISF 25 - 145	-	Fe310	-	01	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**TOP PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E2	

Progressive tool - Back plate

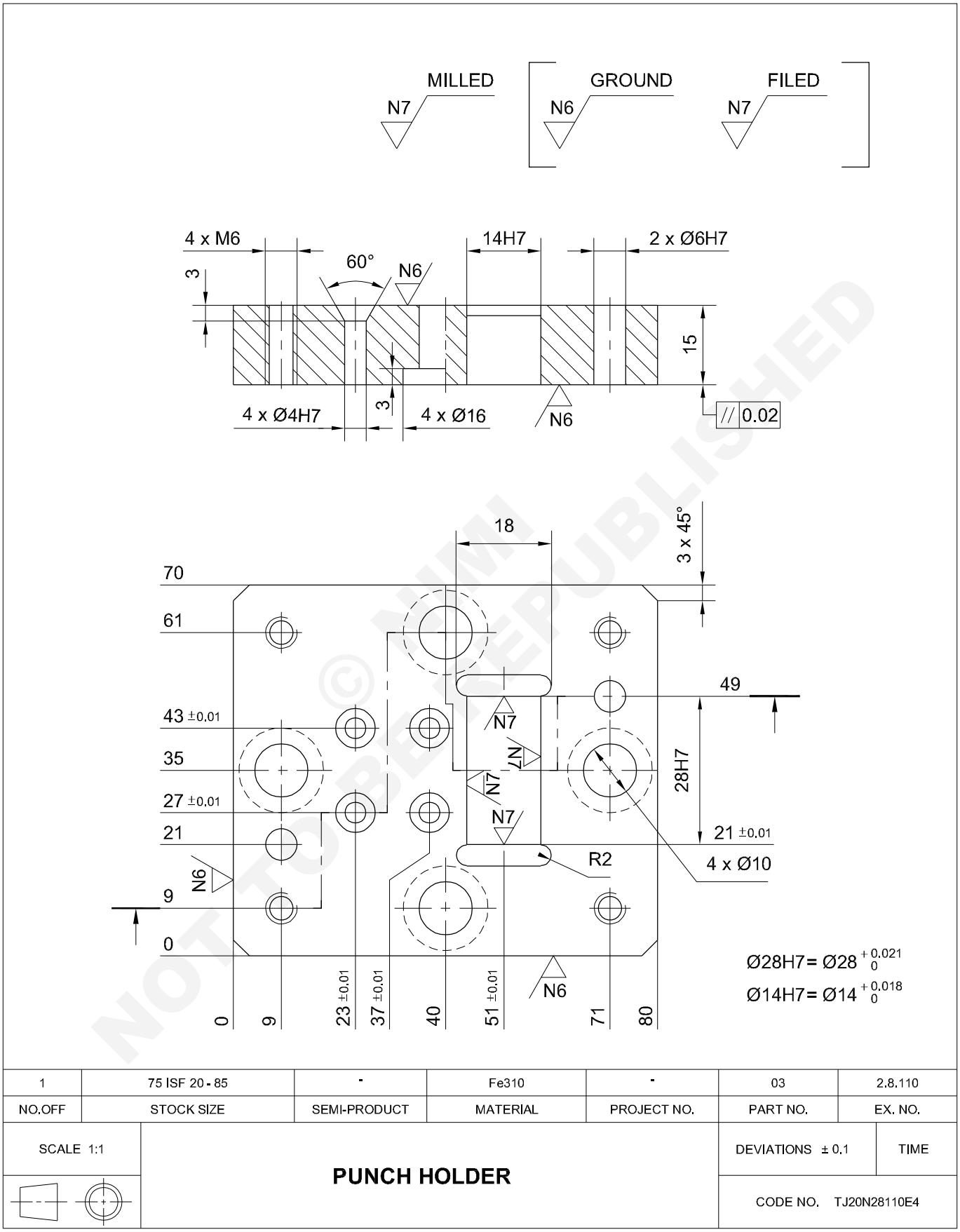
The trainees may be asked to write the job sequence.



1	75 ISF 8 - 85	-	Fe310	-	02	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**BACK PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E3	

Progressive tool - Punch holder

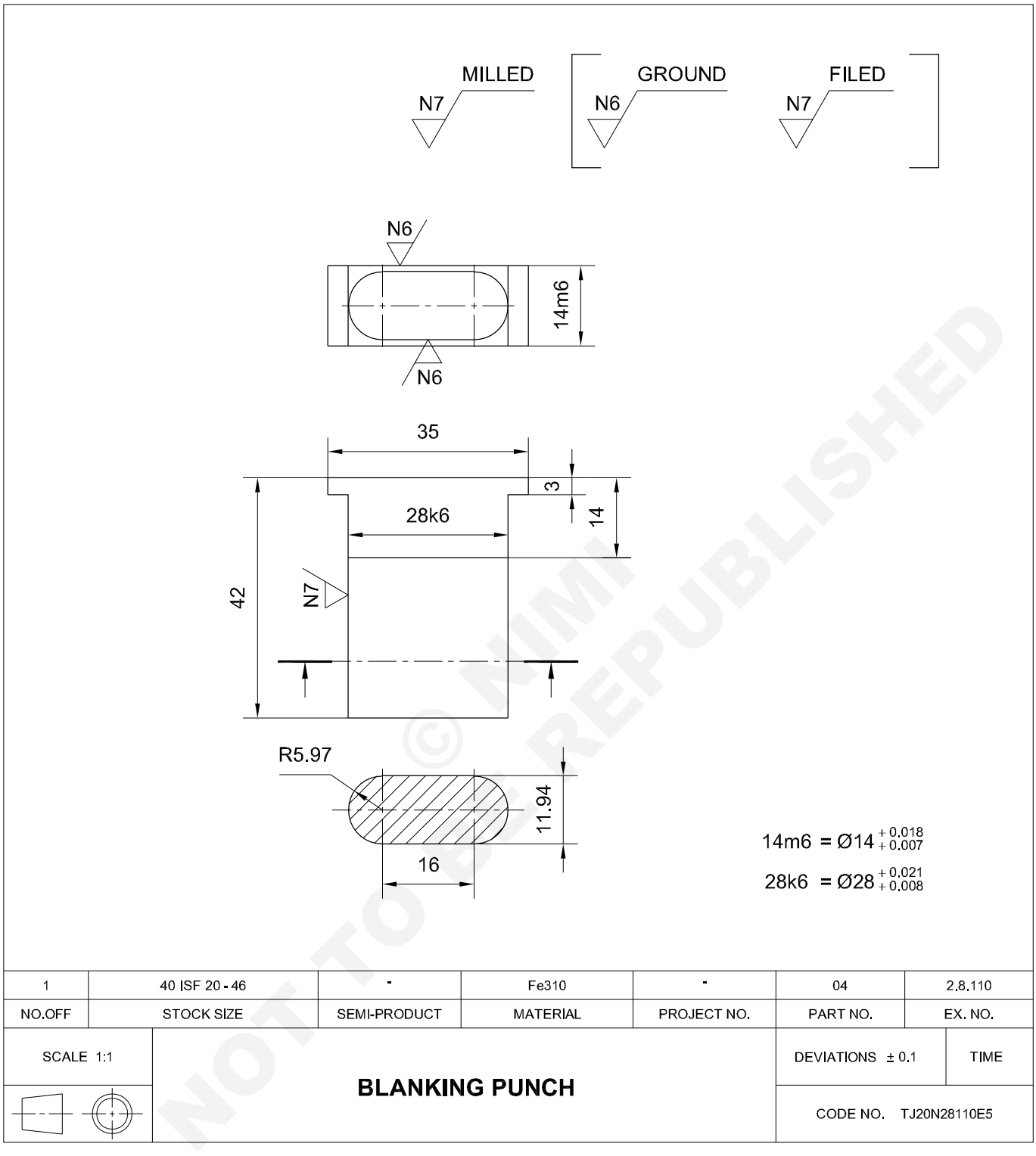
The trainees may be asked to write the job sequence.



1	75 ISF 20 - 85	-	Fe310	-	03	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PUNCH HOLDER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E4	

Progressive tool - Blanking Punch

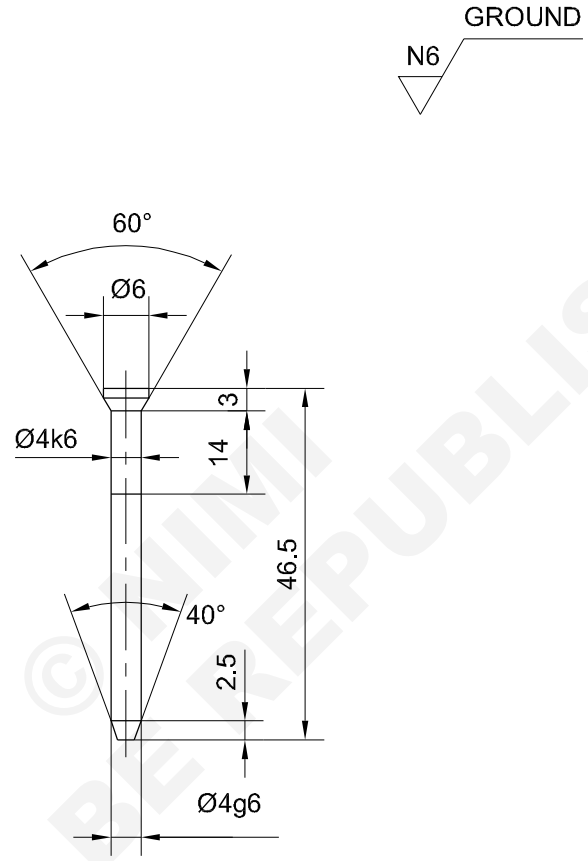
The trainees may be asked to write the job sequence.



1	40 ISF 20 - 46	-	Fe310	-	04	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**BLANKING PUNCH**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E5	

Progressive tool - Pilot

The trainees may be asked to write the job sequence.



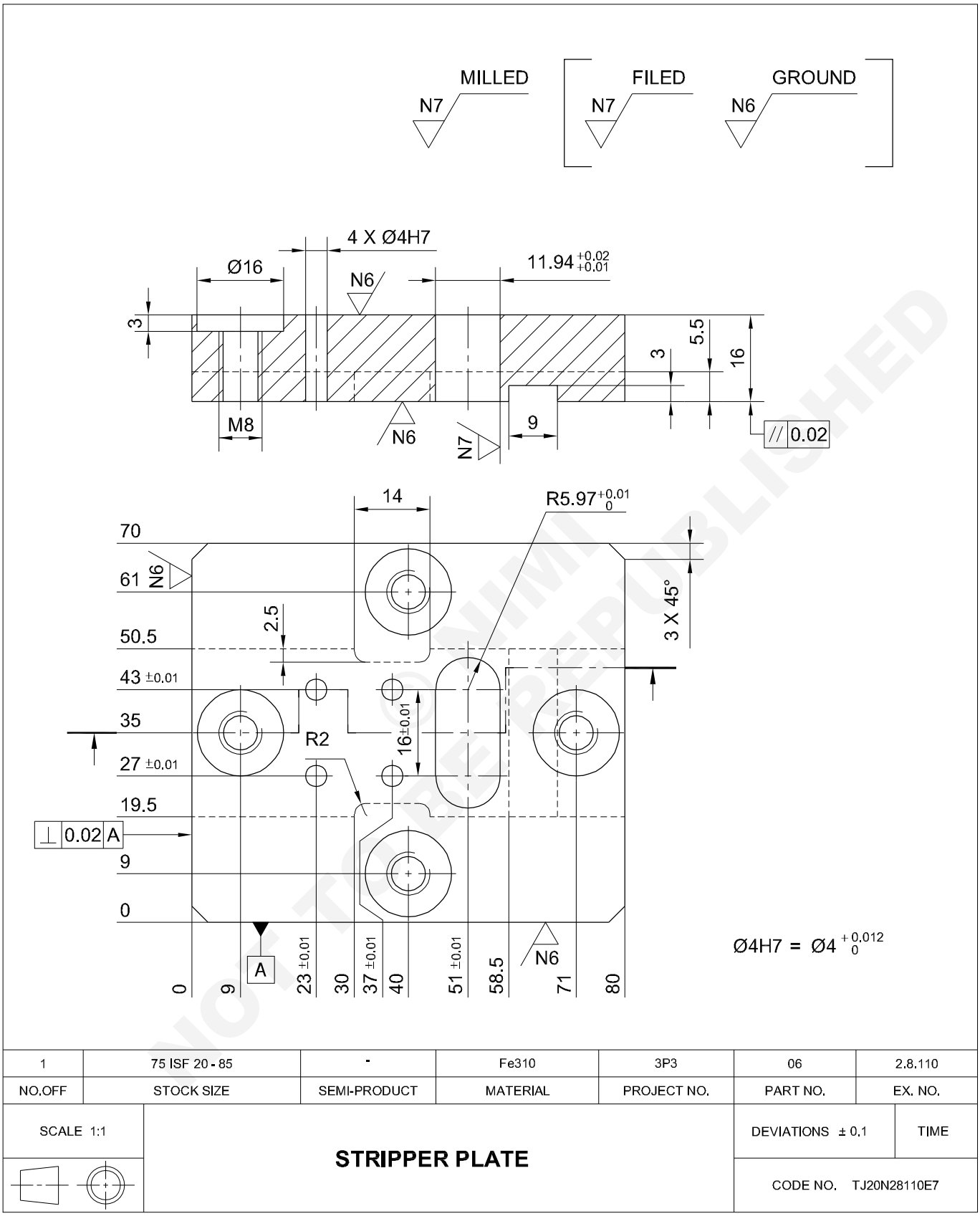
$Ø4k6 = Ø4^{+0.009}_{+0.001}$

$Ø4g6 = Ø4^{-0.004}_{-0.012}$

2	ISRO 8 - 60	-	Fe310	-	05	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PILOT**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E6	

Progressive tool - Stripper plate

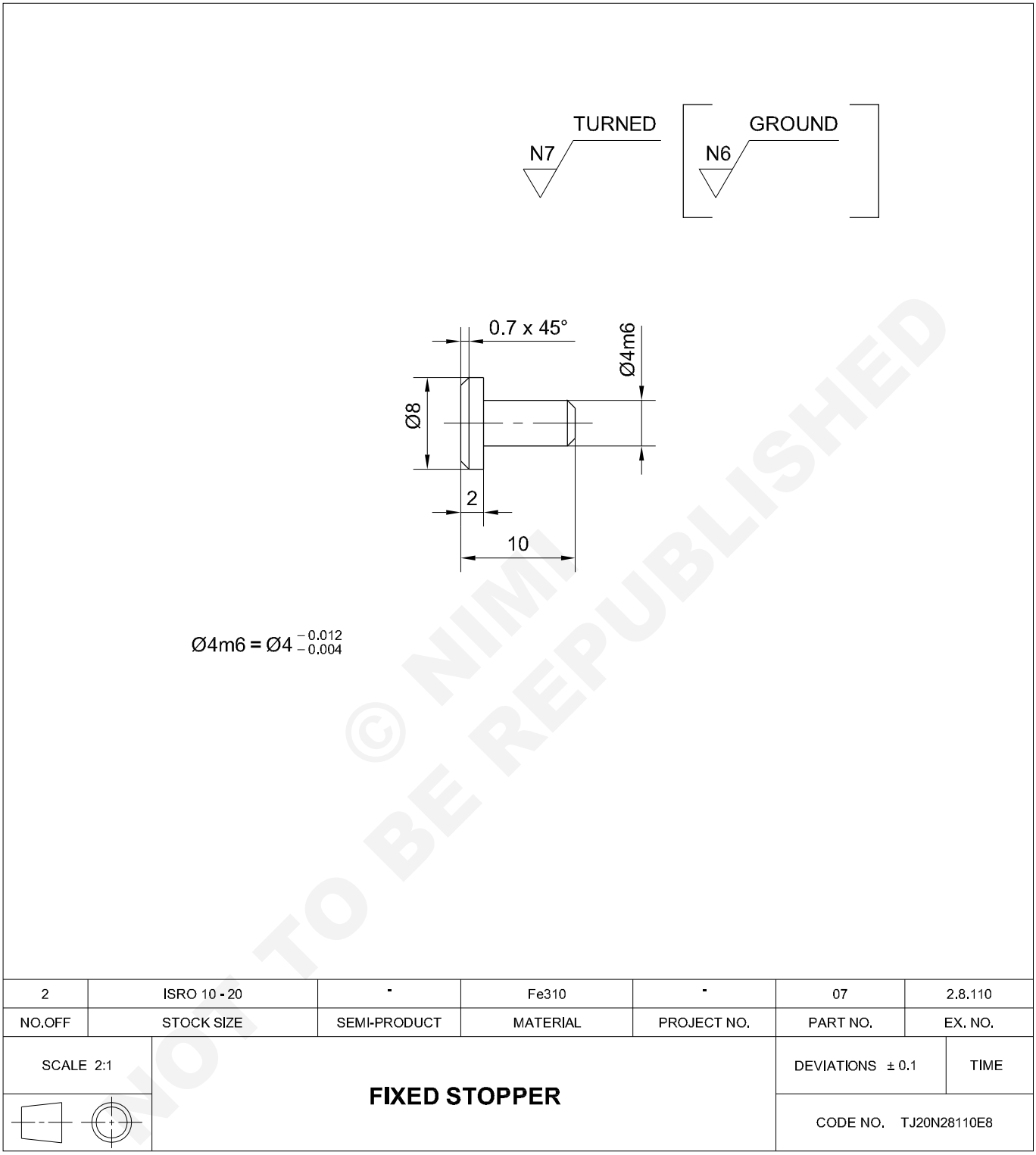
The trainees may be asked to write the job sequence.



1	75 ISF 20 - 85	-	Fe310	3P3	06	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**STRIPPER PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E7	

Progressive tool - Fixed stopper (2 Nos)

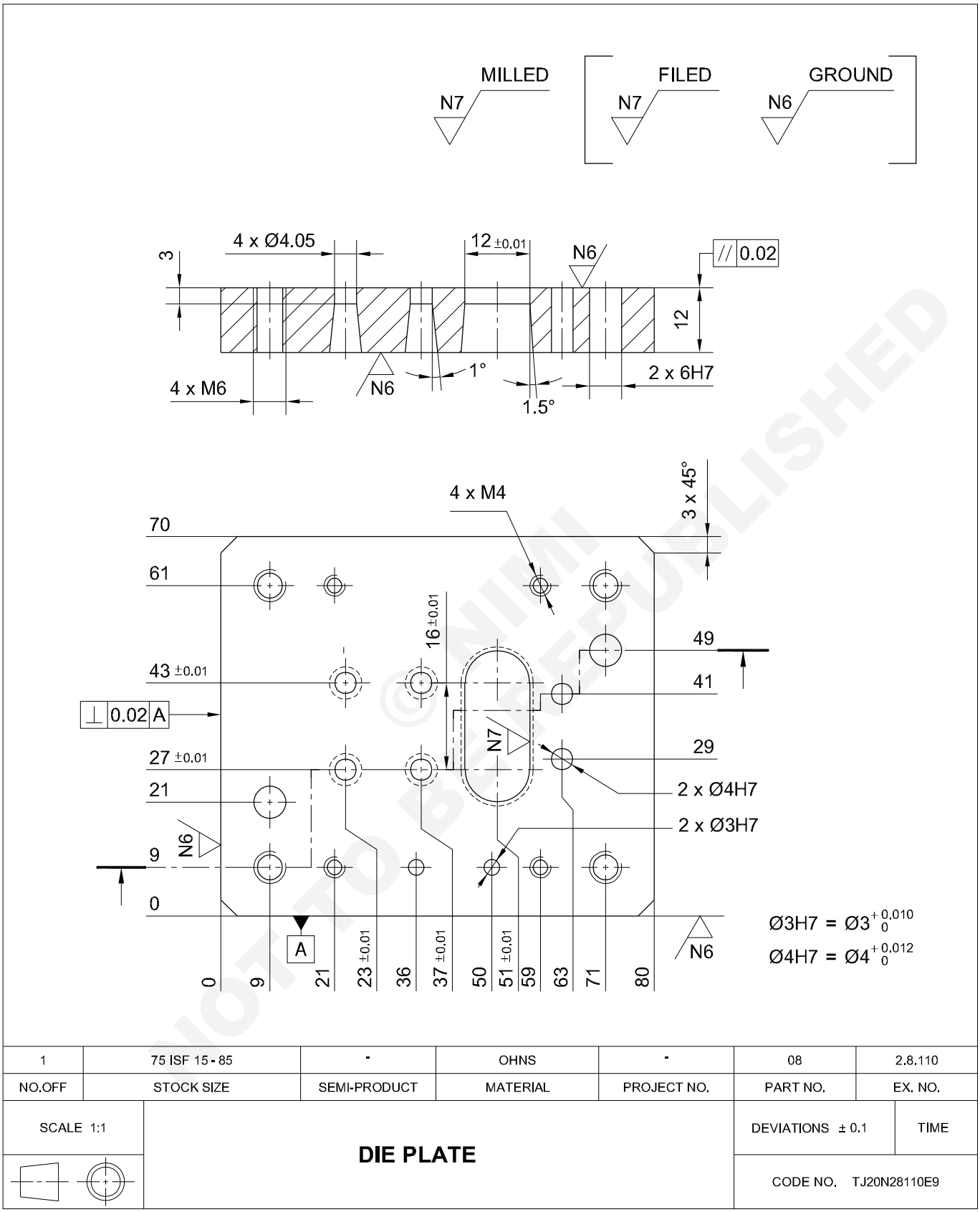
The trainees may be asked to write the job sequence.



2	ISRO 10 - 20	-	Fe310	-	07	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**FIXED STOPPER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E8	

Progressive tool - Die plate

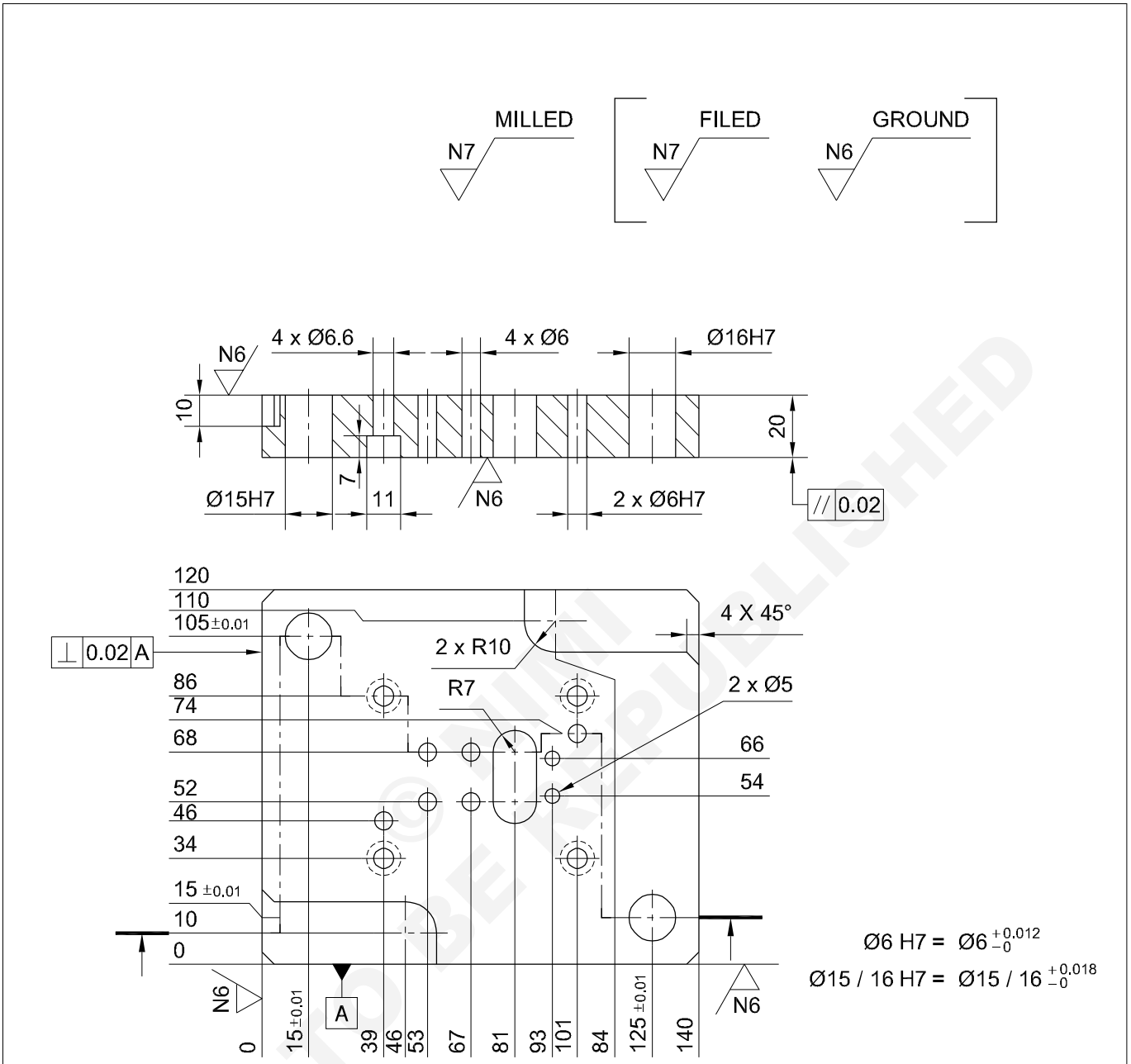
The trainees may be asked to write the job sequence.



1	75 ISF 15 - 85	-	OHNS	-	08	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DIE PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110E9	

Progressive tool - Bottom plate

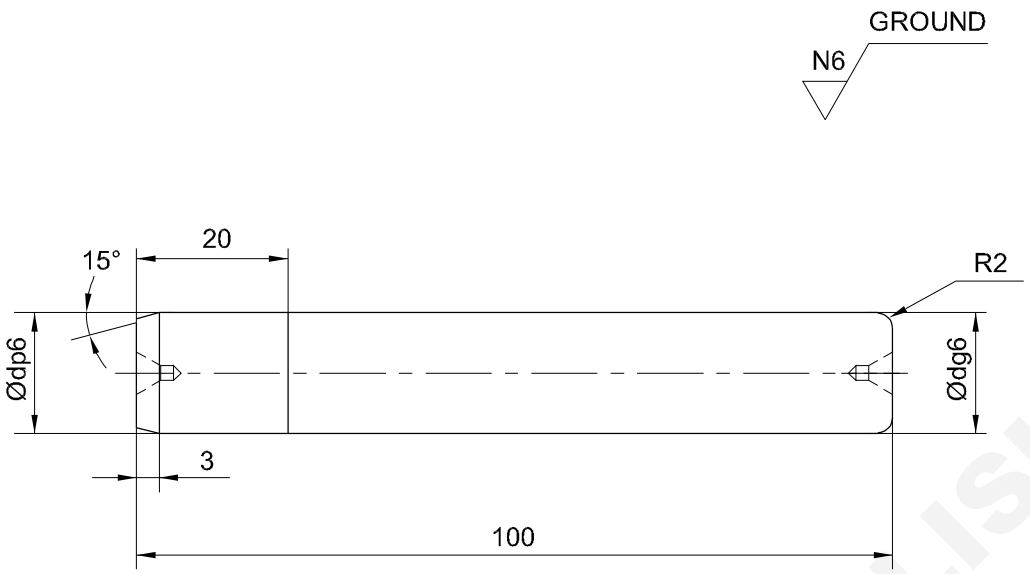
The trainees may be asked to write the job sequence.



1	130 ISF 25 - 145	-	Fe310	3P3	9	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**BOTTOM PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EA	

Progressive tool - Guide pillar (2 Nos)

The trainees may be asked to write the job sequence.



$Ø15 / 16\ p6 = Ø15 / 16\ ^{+0.029}_{+0.018}$

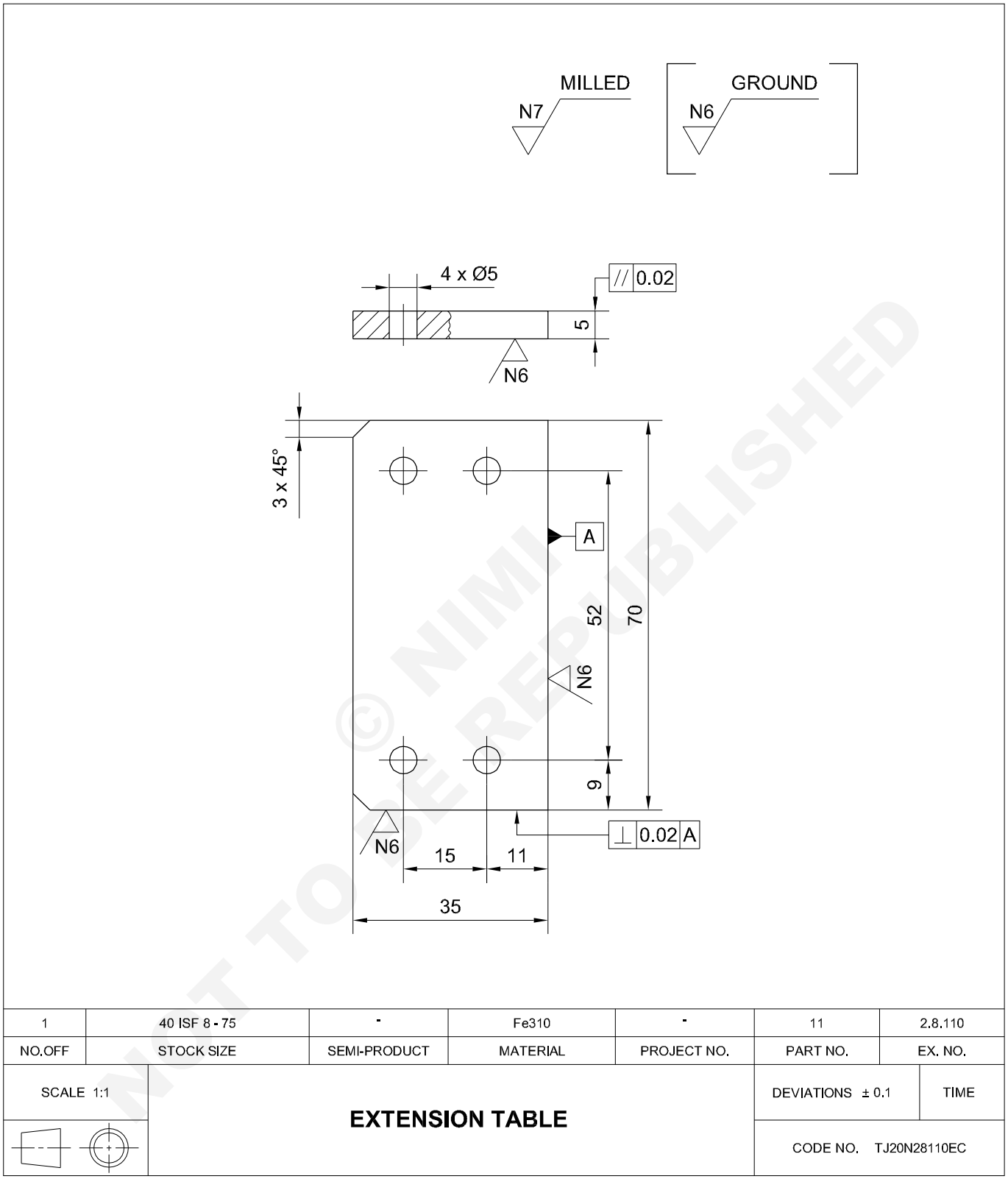
$Ø15 / 16\ g6 = Ø15 / 16\ ^{-0.006}_{-0.017}$

	1	2
Ød	15	16

1 + 1	ISRO 20 - 120	-	Fe310	-	10	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**GUIDE PILLAR**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EB	

Progressive tool - Extension table

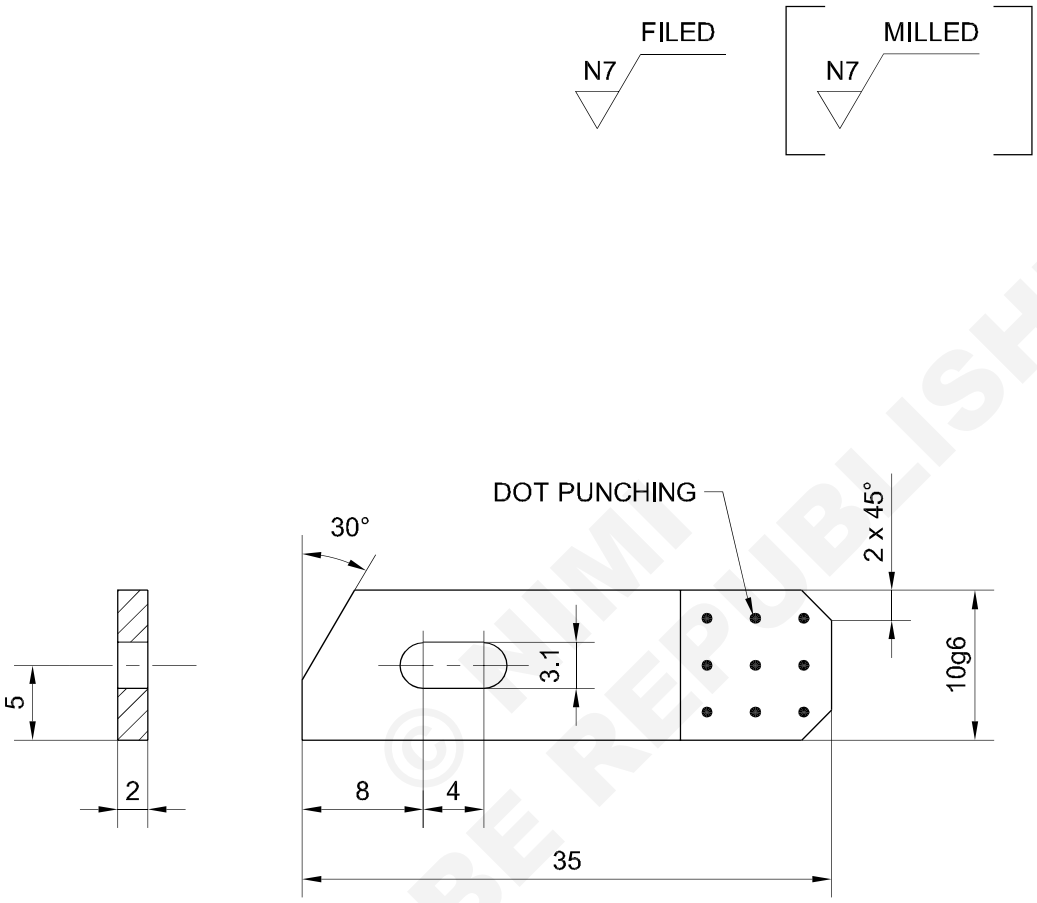
The trainees may be asked to write the job sequence.



1	40 ISF 8 - 75	-	Fe310	-	11	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		**EXTENSION TABLE**			DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EC	

Progressive tool - Finger stopper (2 Nos)

The trainees may be asked to write the job sequence.

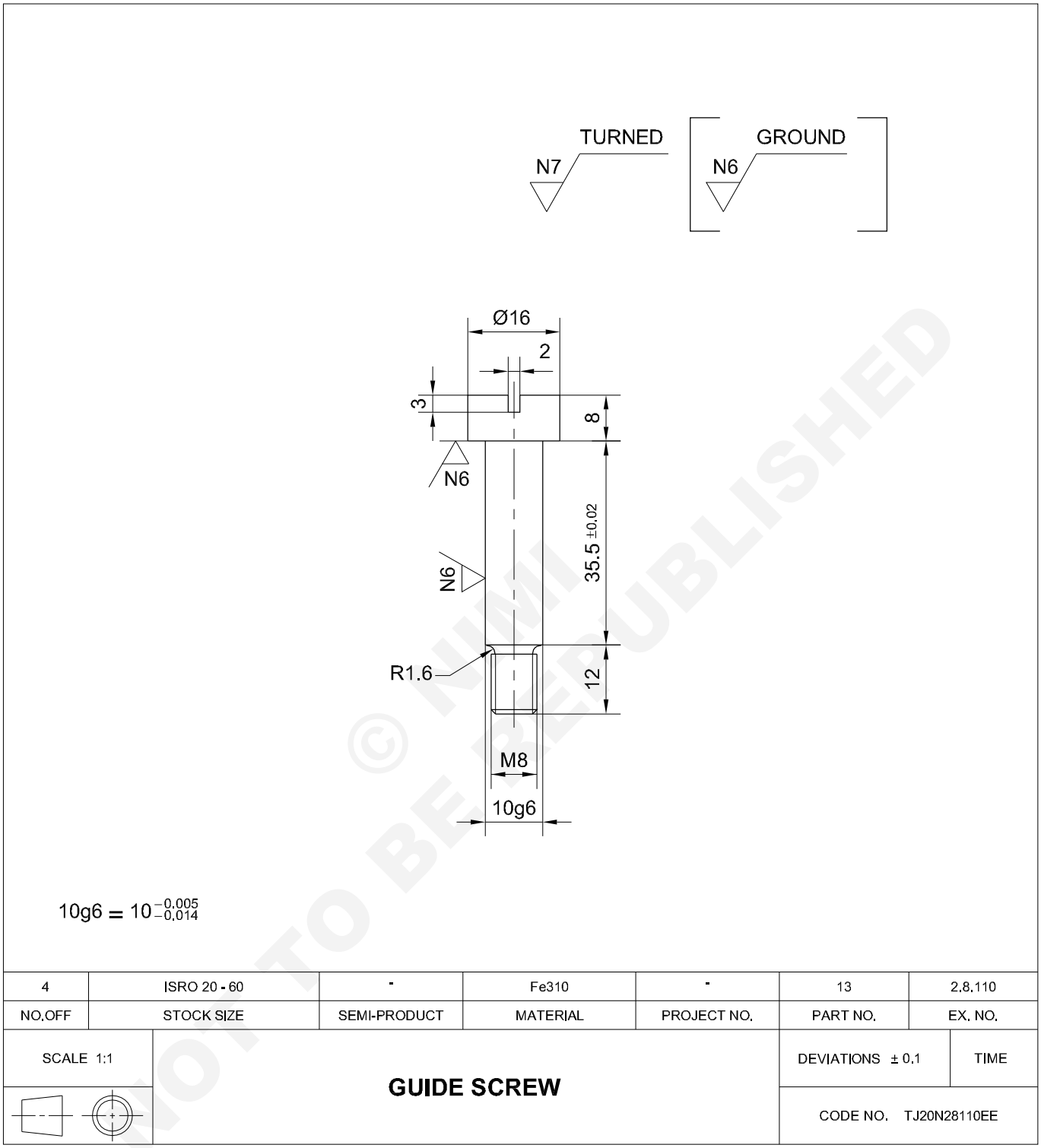


$10g6 = 10^{-0.005}_{-0.014}$

2	16 ISF 3 - 40	-	Fe310	-	12	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**FINGER STOPPER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110ED	

Progressive tool - Guide screw (4 Nos)

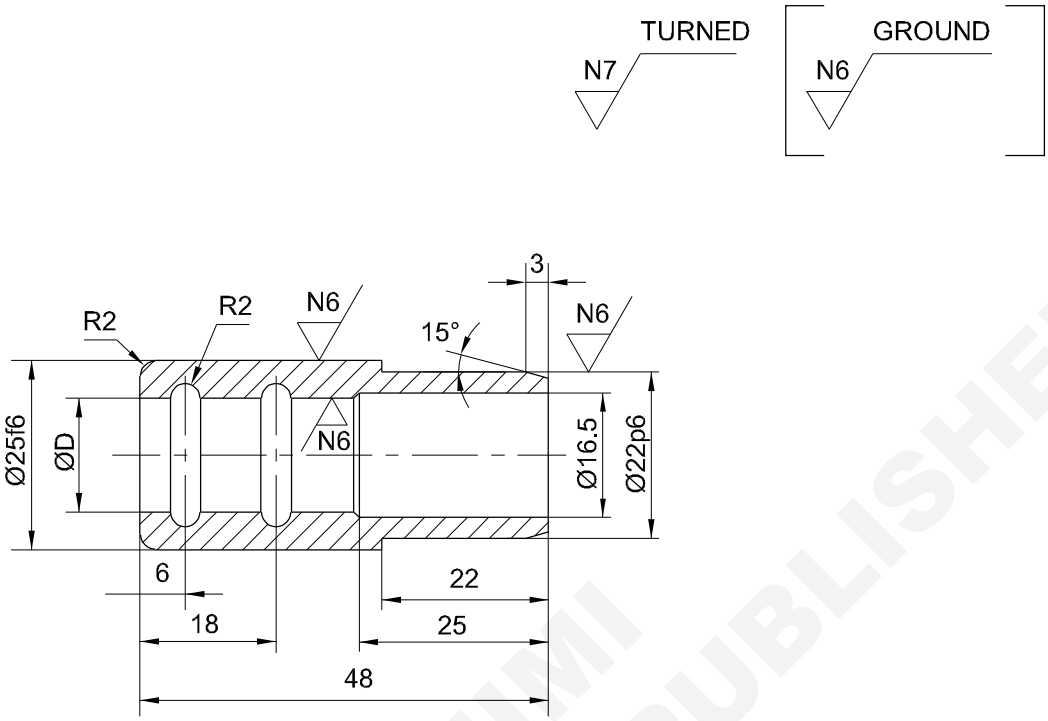
The trainees may be asked to write the job sequence.



4	ISRO 20 - 60	-	Fe310	-	13	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	GUIDE SCREW				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EE	

Progressive tool - Guide bush (2 Nos)

The trainees may be asked to write the job sequence.



	1	2
ØD	15H7	16H7

Ø25 f6 = $Ø25\ ^{-0.033}_{-0.020}$

Ø22 p6 = $Ø22\ ^{-0.035}_{-0.022}$

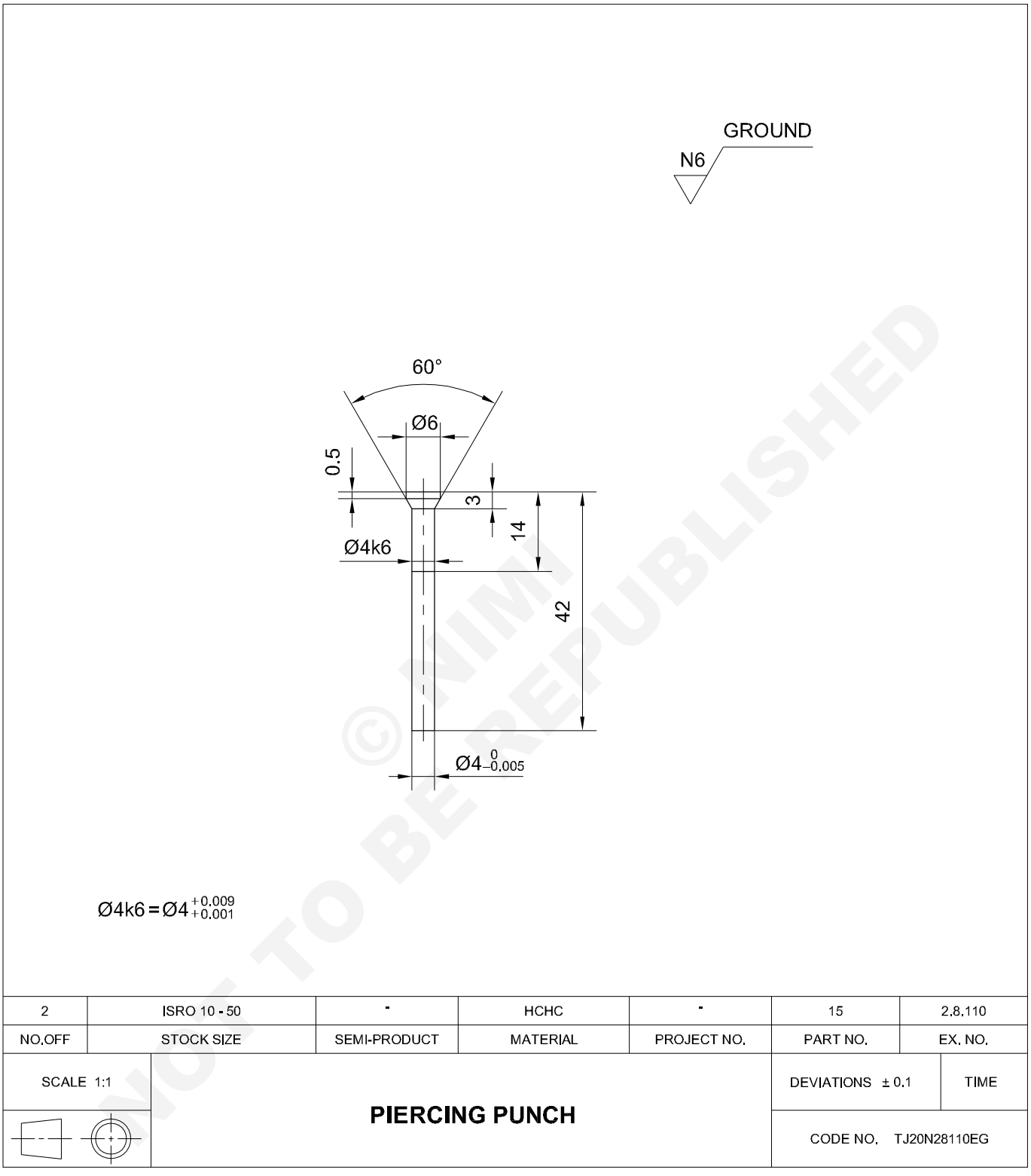
Ø15 / 16 H7 = $Ø15 / 16\ ^{+0.018}_{-0}$

2	ISRO 32 - 55	-	Fe310	-	14	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GUIDE BUSH	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N28110EF	

Progressive tool - Piercing punch (2 Nos)

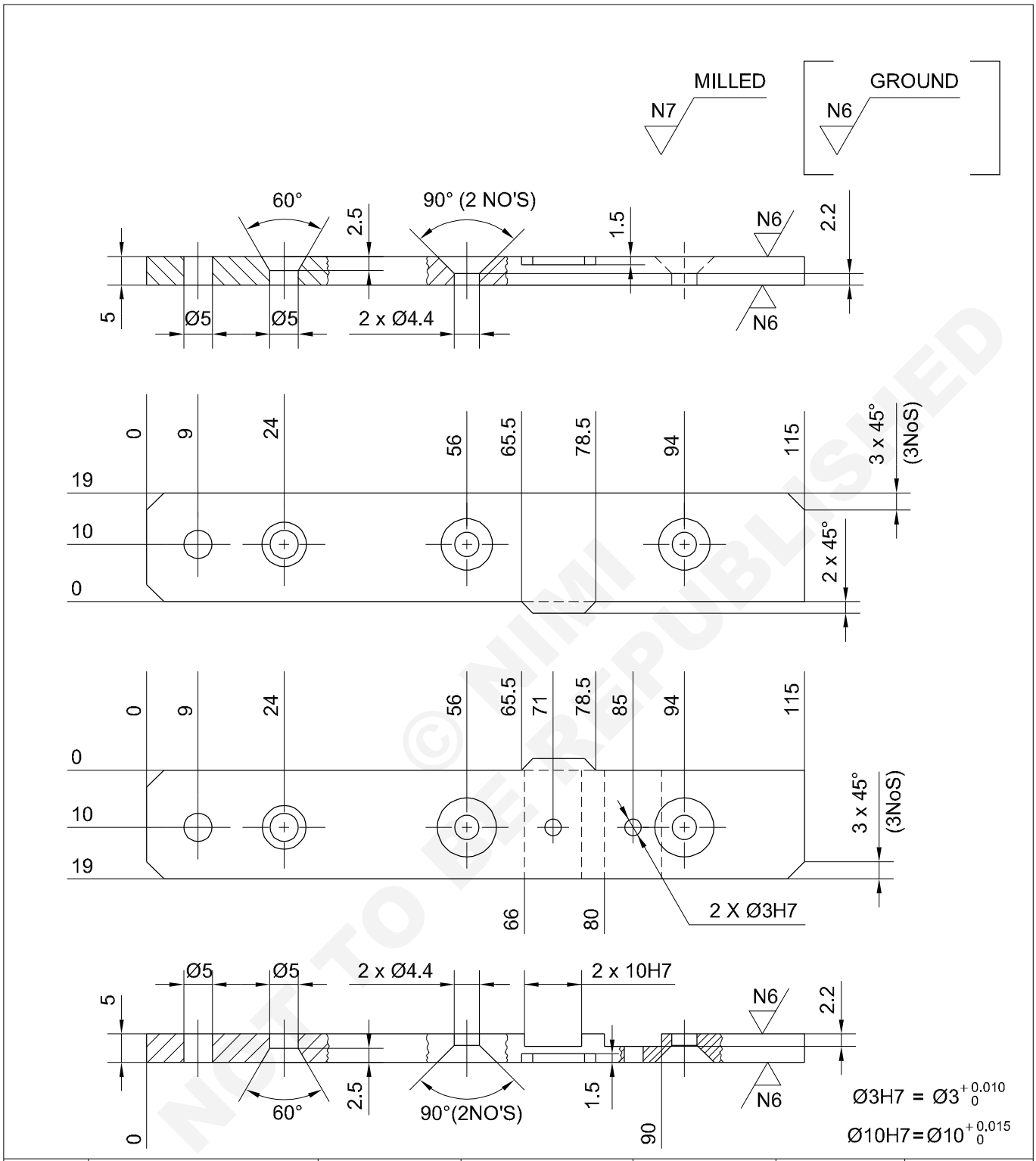
The trainees may be asked to write the job sequence.



2	ISRO 10 - 50	-	HCHC	-	15	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PIERCING PUNCH**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EG	

Progressive tool - Spacers (2 Nos)

The trainees may be asked to write the job sequence.

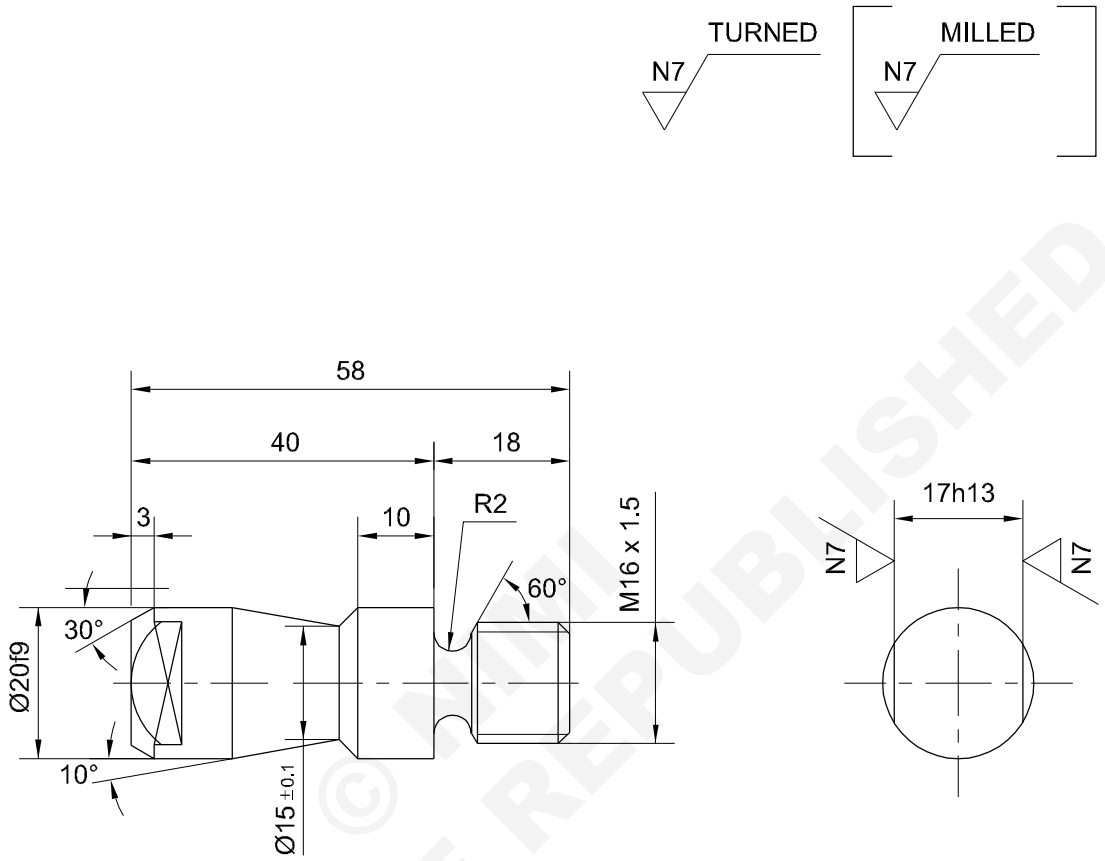


2	25 ISF 8 - 120	-	Fe310	-	16	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	SPACERS	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N28110EH	

Progressive tool - Shank

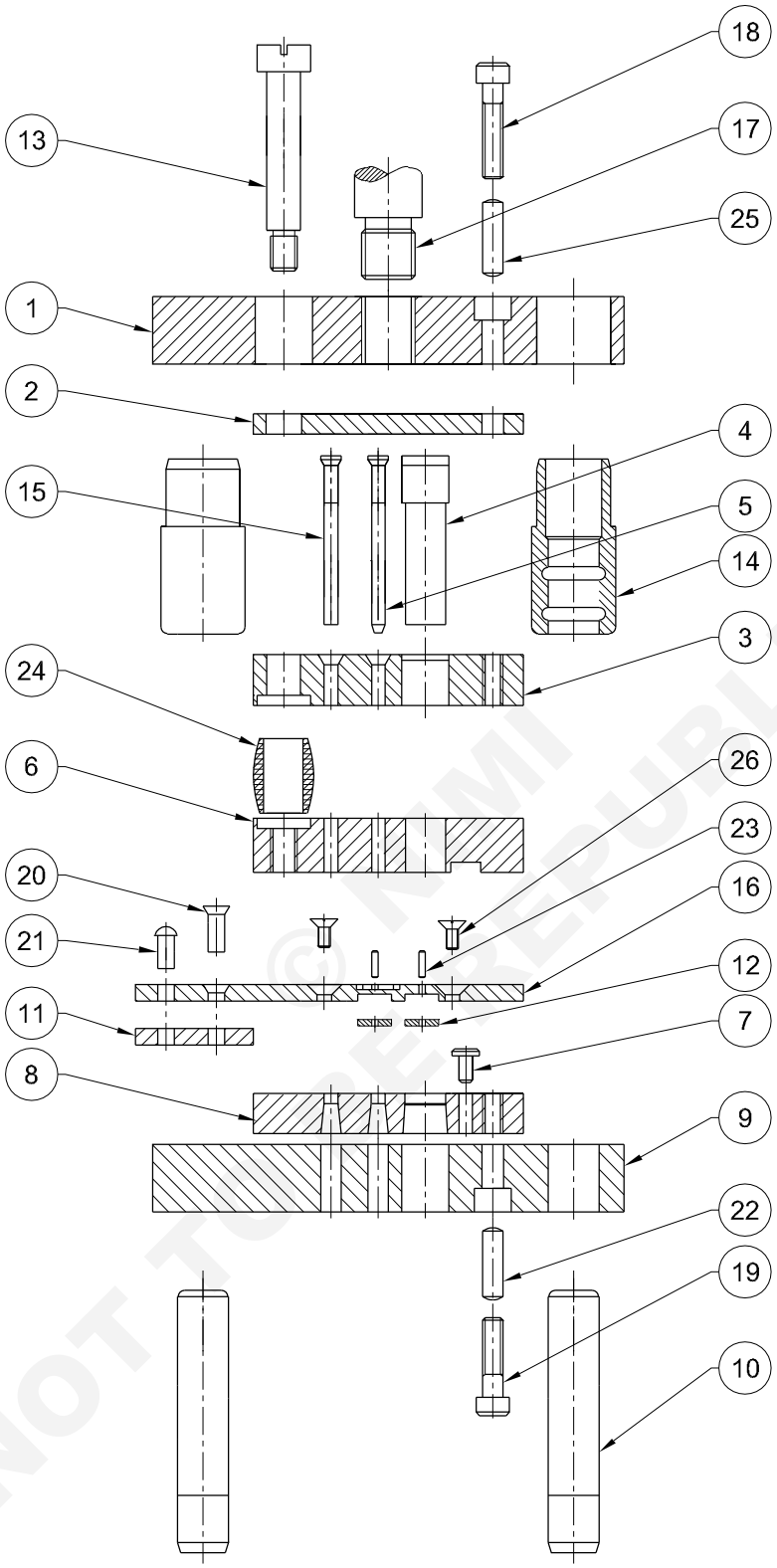
The trainees may be asked to write the job sequence.



$17h13 = 17\ ^{+0}_{-0.270}$

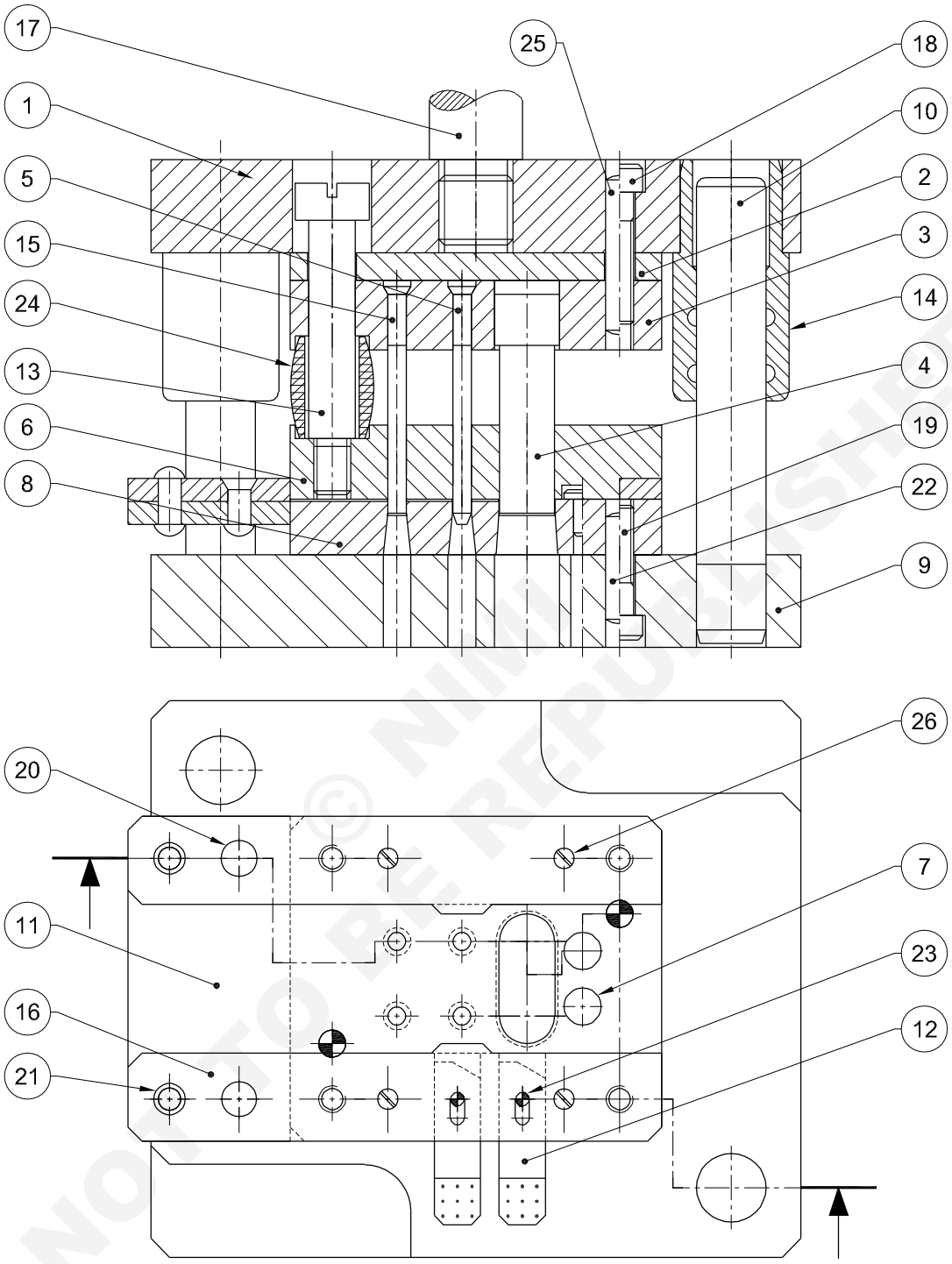
$Ø20\ f\ 9 = Ø20\ ^{+0.020}_{-0.072}$

1	ISRO 25 - 60	-	Fe310	3P3	17	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		**SHANK**			DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EI	

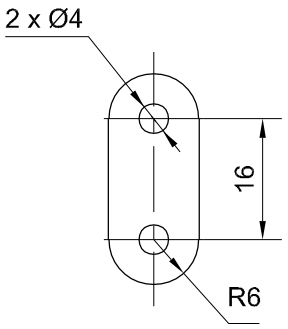


-	-	-	Fe310	3P3	-	2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

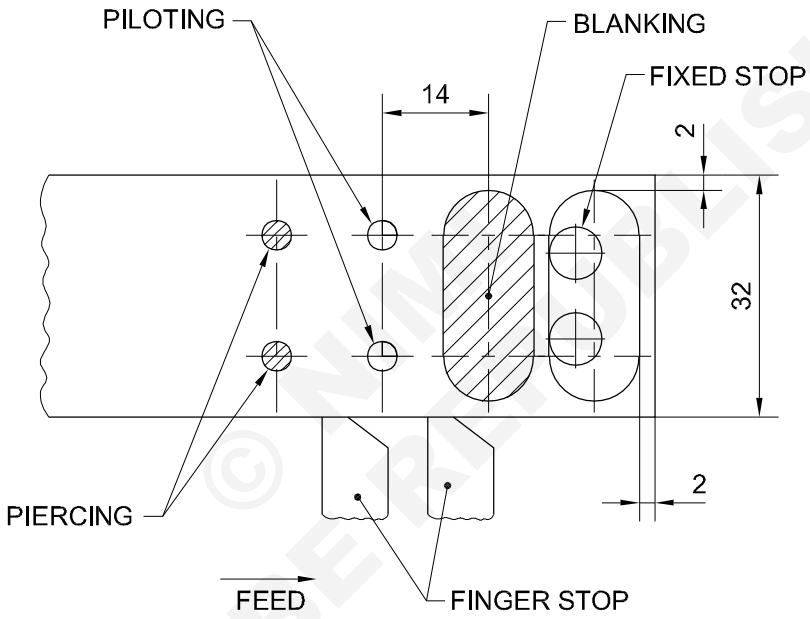
SCALE NTS	PROGRESSIVE TOOL ASSEMBLY	DEVIATIONS	TIME
		CODE NO. TJ20N28110EJ	



		-		-		2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE .		PROGRESSIVE TOOL TRIAL			DEVIATIONS	TIME
					CODE NO. TJ20N28110EK	



MATERIAL : CRCA
SHEET THICKNESS : 0.5 mm



1	321SSH 0.5 - 300	-	CRCA	-		2.8.110
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**COMPONENT**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N28110EL	

Prepare different types of documentation - 1

Objectives: At the end of this lesson 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.**

Note

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

PROCEDURE

1 Study the different types of documentation provided (format).

2 Visit to industry and collect the input/ information from industry and fill it up of all the format.

3 Prepare the required format with the knowledge gained during the industrial visit.

4 Record relevant information in the format.

5 Get it checked by your instructor/ Training offices.

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 Organization :		
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:

Place: In charge

PRODUCTION CYCLE TIME - FORMAT-3

Organization Name: **Department / Section:**	**Process:**								**Line In charge:**		**Date/Time:**
Operator:										**Machine Cycle Time**	**Notes**
Operations Sequence	**Observed Times**								**Lowest Repeatable**		

DAILY PRODUCTION REPORT - FORMAT- 4

			Daily Production Report									
Date:			**Department:** **Section:**				**Organization 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 In charge

MANUFACTURING STAGE INSPECTION REPORT - FORMAT-5

Organization 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 lesson 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.**

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

PROCEDURE

1 Study the different types of documentation provided (format).

2 Visit to industry and collect the input/ information from industry and fill it up of all the format.

3 Prepare the required format with the knowledge gained during the industrial visit.

4 Record relevant information in the format.

5 Get it checked by your instructor/ Training Officer.

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

Organization 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 Organization 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

Organization 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

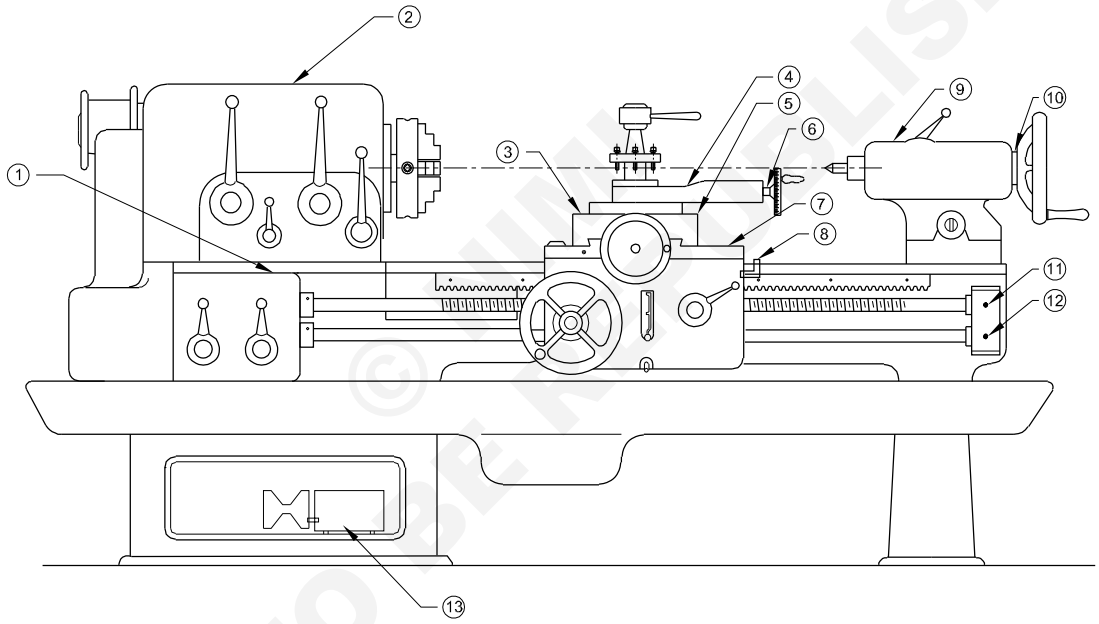
Organization Name :	
Department :	
Section :	
History sheet of machinery & Equipment	
Description of equipment	
Manufacturer's address	
Supplier's address	
Order No. and date	
Date on which received	
Date on which installed and placed	
Date of commissioning	
Size: Length x Width x Height	
Weight	
Cost	
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

Organization 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

Perform periodic lubrication system on machine

Objectives: At the end of this exercise you shall be able to
- **check the oil level in gear box of machine**
- **carryout lubrication as per the chart.**



NOTE
INSTRUCTOR DEMO THE LUBRICATION POINTS USING DIFFERENT GRADE OF OILS
GENERAL PURPOSE MACHINERY OILS - LUBREX 68
SPINDLE OILS - SERVO SPIN 12
GEAR OILS - SERVO MESH 68

-	-	-	-	-	-	2.9.112
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	PERFORM PERIODIC LUBRICATION SYSTEM ON MACHINE				TIME	
					CODE NO. TJ20N29112E1	

Identify the daily lubrication points of the lathe machine, record in table 1

TABLE - 1

Indicate number and part name													Specification of oil
Number - 3 Cross slide slide way													

- Identify the monthly lubrication filling of the lathe machine
- Record in table 2

TABLE - 2

Indicate number & part name			Specification of oil

- Identify the half yearly lubrication filling in a lathe machine
- Record in table 3

TABLE - 3

Indicate number & part name			Specification of oil

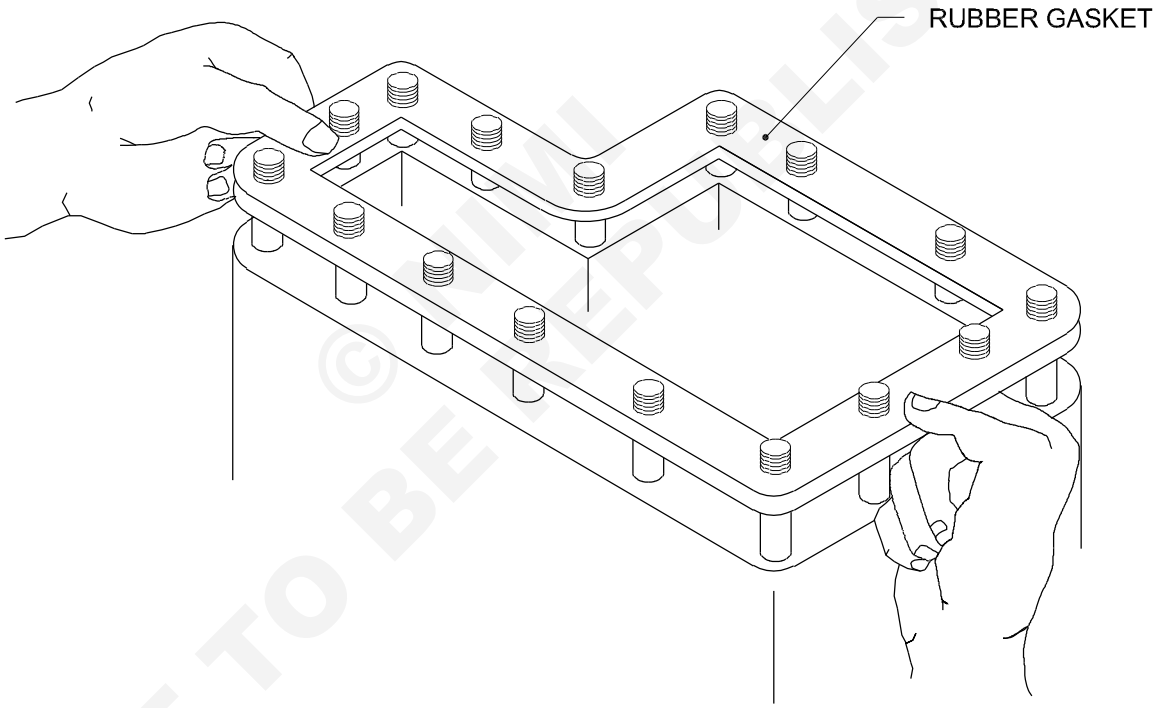
- Identify the weekly lubrication filling in a lathe machine
- Record in table 3

TABLE - 4

Indicate number & part name			Specification of oil

Simple repair work

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



1	100X75X2mm	-	RUBBER GASKET	-	-	2.9.113
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PERFORM SIMPLE REPAIR WORK**				RTOLERANCE: ±1	TIME :
					CODE NO. TJ20N29113E1	

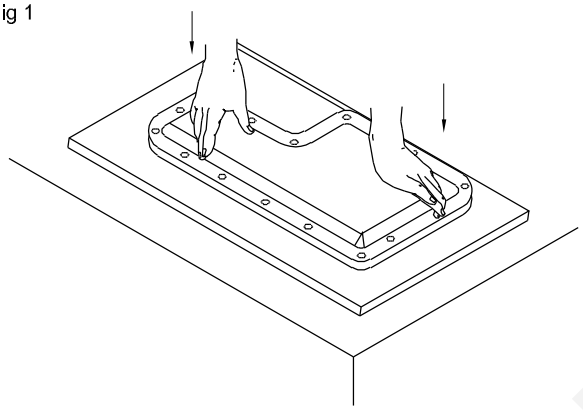
Job sequence

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

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

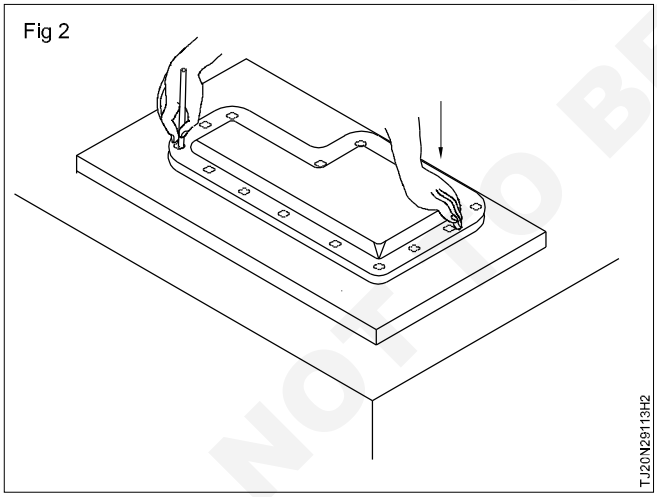
- Clean the surface of the base and the cover plate thoroughly.
- In the case of glue-bonded gaskets, surfaces should be cleaned thoroughly using a blunt scraper.
- Smear marking medium or grease on the cover plate's base surface.
- Place the gasket on to the base of the cover plate and press firmly.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

Fig 1



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

Fig 2



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

- Punch out the holes using a hollow punch and a hammer or a little over- size steel ball and a hammer. (Figs 3 and 4).
- Cut out the unwanted portion of the gasket using scissors. (Fig 5)

Fig 3

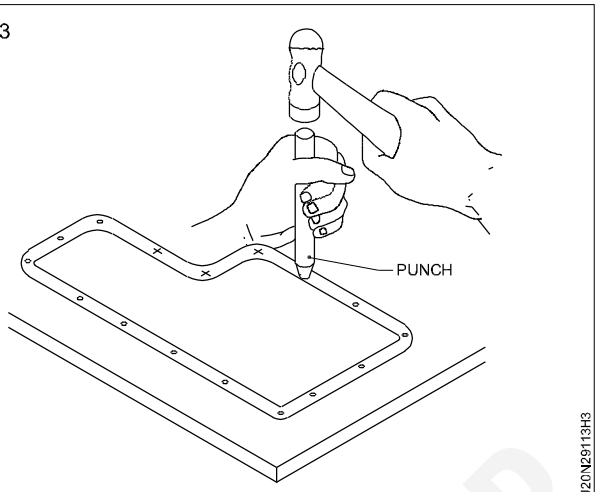


Fig 4

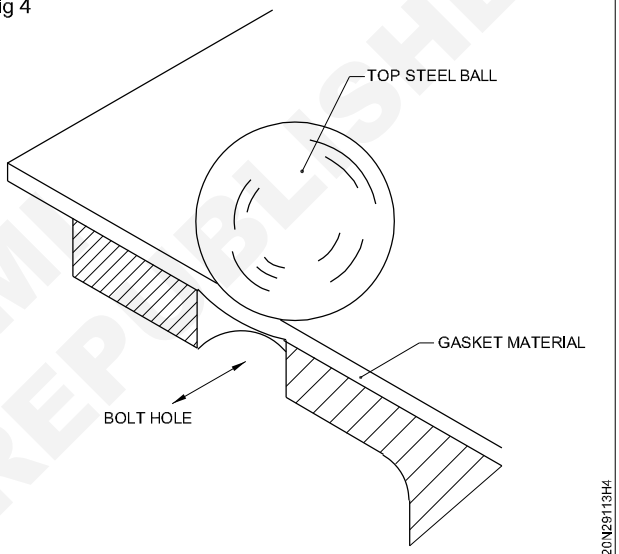
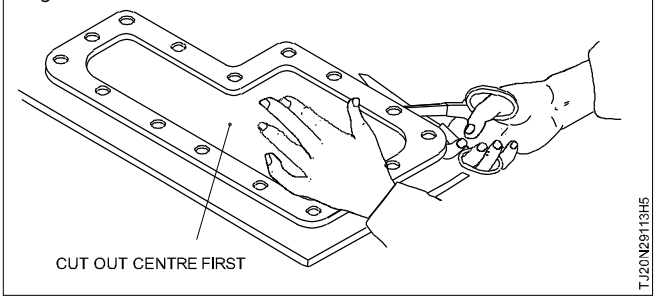


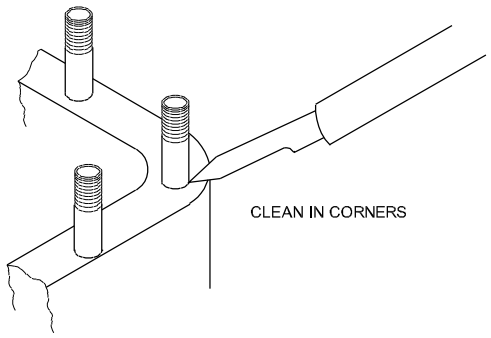
Fig 5



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

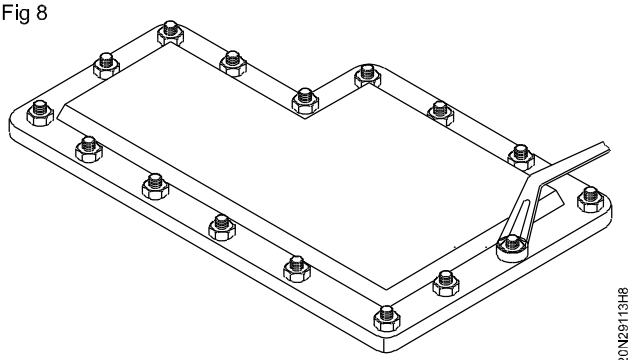
- Clean the corners of the studs. (Fig 6)
- Fit the gasket in position. (Fig 7)
- Replace the cover plate on to the gasket and tighten the screws evenly. (Fig 8)
- Test the sealed joint for leaks and functional aspects.

Fig 6



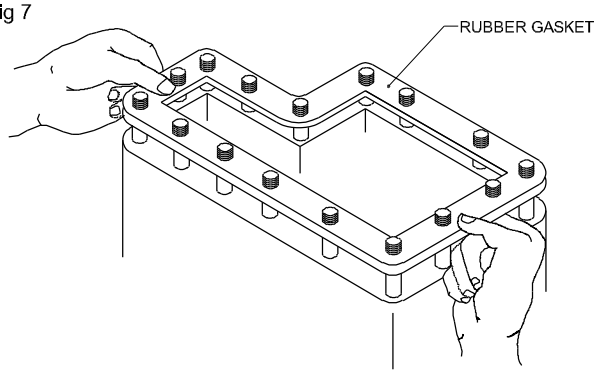
T-J20N29113H6

Fig 8



T-J20N29113H8

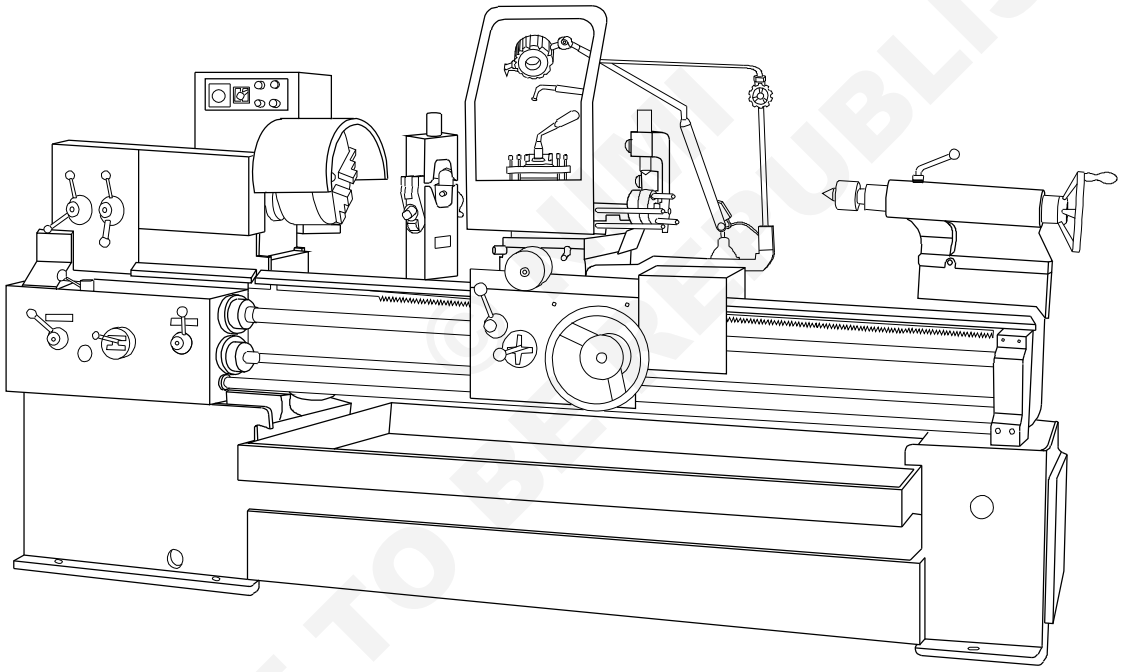
Fig 7



T-J20N29113H7

Perform routine maintenance check list

Objectives: At the end of this exercise you shall be able to
- **check the machine running condition**
- **check the lubricant level and fill the lubricant as per schedule**
- **check the sliding movement.**



–	–	–	–	–	–	2.9.114
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PERFORM THE ROUTINE MAINTENANCE WITH CHECK LIST**				TOLERANCE	TIME
					CODE NO. TJ20N29114E1	

Job sequence

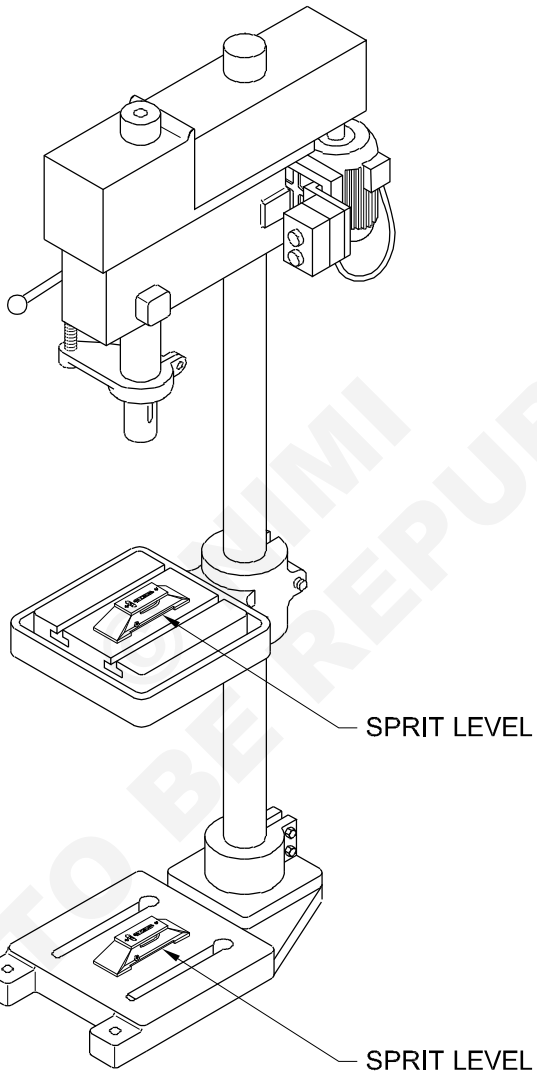
- Turn the machine off from the main power point and fit your tag, out of order, to avoid someone can try to use the machine during your maintenance procedure.
- **Open side cover and check:**
  - Driving belts, if the belts are damaged, excessive cracks, or an excessive wear, they must be replaced.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

Maintenance check list

Items to be checked	Good working/Satisfactory	Defective	Remedial measures carried out
Level of the machine			
Belt and its tension			
Bearing sound			
Working in all the speeds			
Working in all feeds			
Lubrication system			
Coolant system			
Electrical controls			
Safety guards			
Sliding surface			

Inspection of machine tools such as alignment, levelling etc

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



1	-	-	-	-	-	2.9.115
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**INSPECTION OF MACHINE TOOLS SUCH AS ALIGNMENT,LEVELING,ETC.**				DEVIATIONS	TIME:
					CODE NO. TJ20N29115E1	

Job sequence

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

Skill sequence

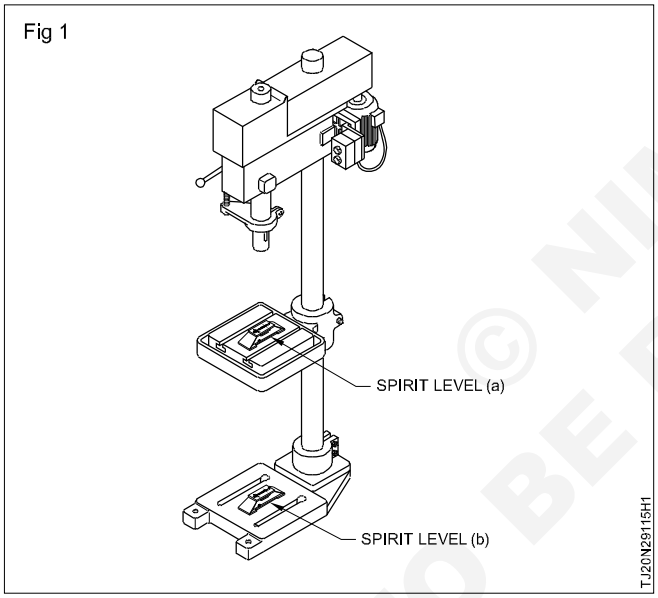
Geometrical test for pillar type drilling machine

Objective: This shall help you to

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

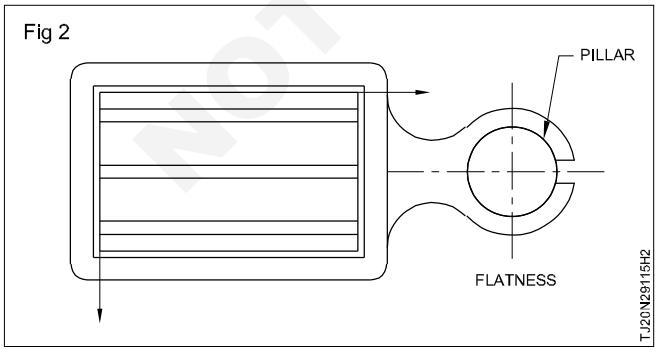
Levelling of the machine at two different positions (a) and (b) should be done before conducting the geometrical test. The permissible deviation is 0.03 per 300 mm. (Fig 1)

Fig 1



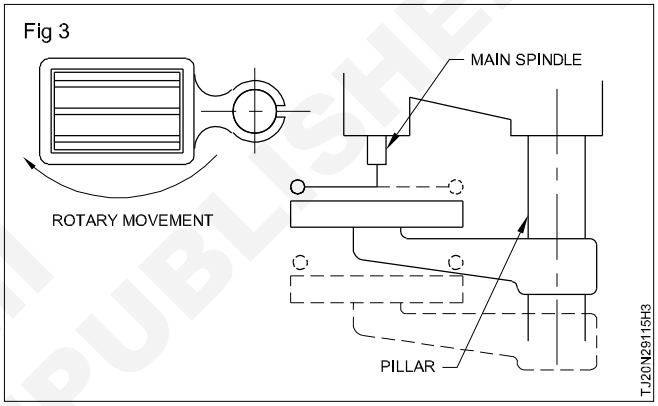
Check the flatness of the work table surface and the base plate if it is machined. (Fig 2)

Fig 2



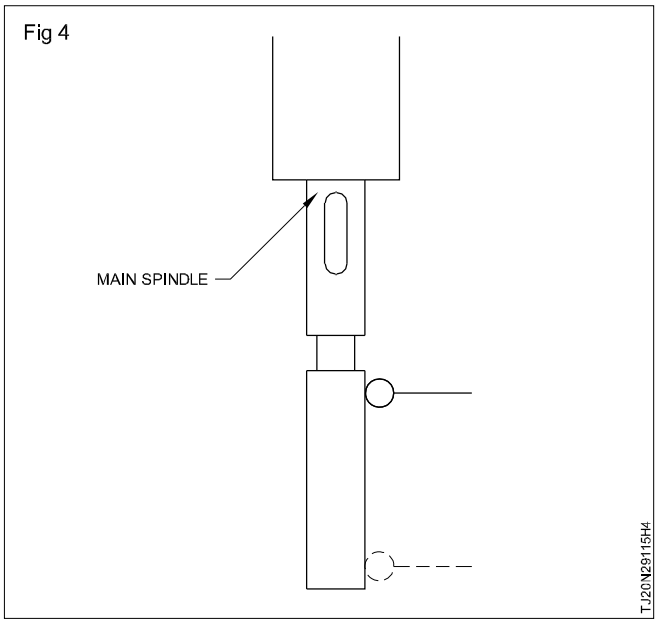
Check the camming of the rotating table, if the machine is provided with rotary movement. (Fig 3)

Fig 3



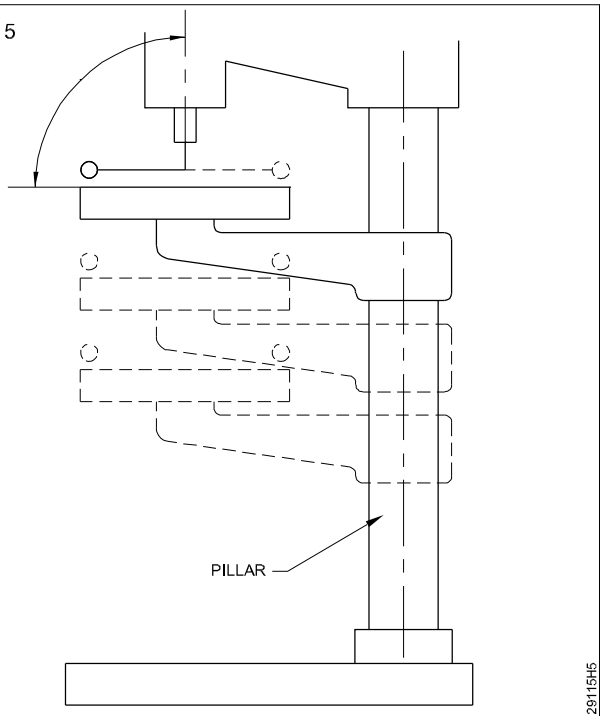
Check the run out of the spindle internal taper at two positions.(Fig 4)

Fig 4



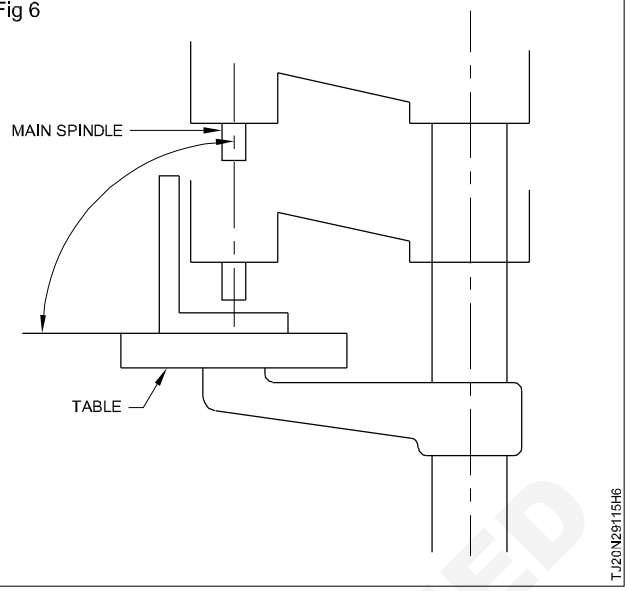
Check the straightness of the pillar and squareness of the spindle axis to the table surface (Fig 5) in two different planes.

Fig 5



STRAGHTNESS

Fig 6



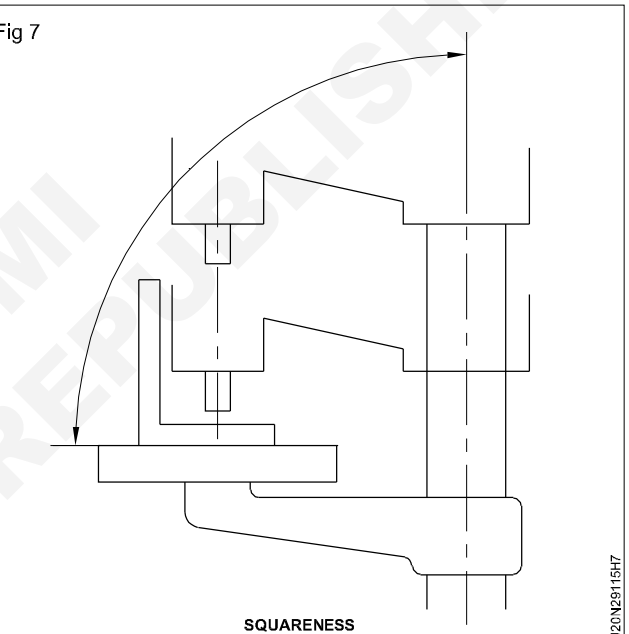
Check the squareness of the table surface to the vertical movement of the spindle housing in two planes. (Fig 6)

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

Lubricating the parts

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

Fig 7



SQUARENESS

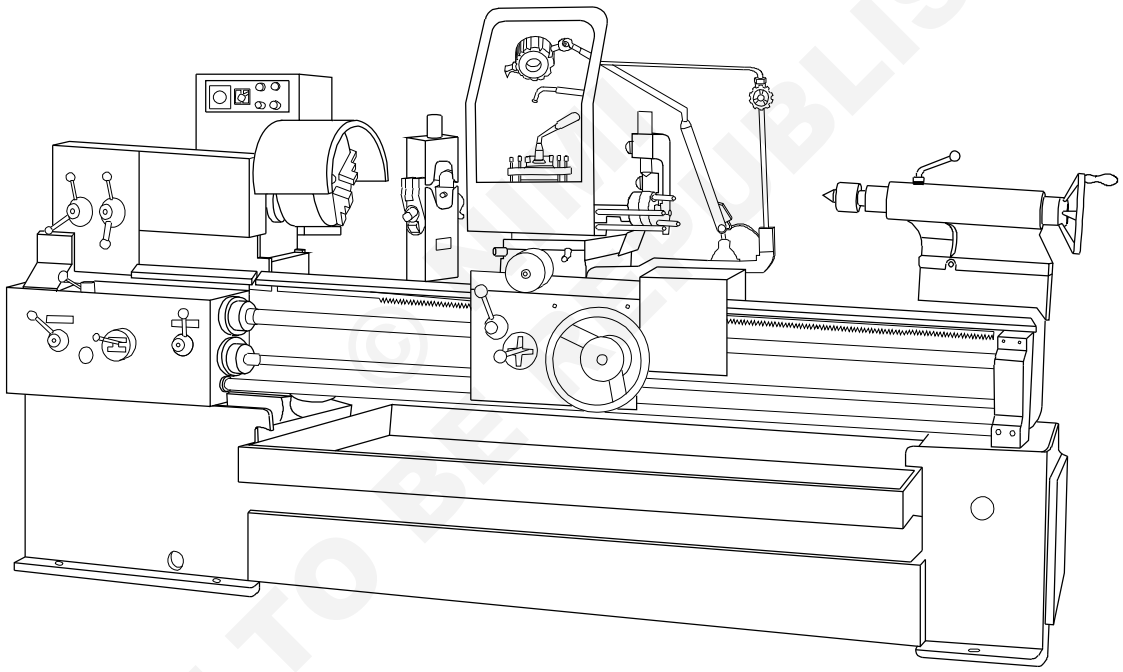
Inspect the following items and tick in the appropriate column and list the remedial measures for the defective items.

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

Accuracy testing of machine tools such as geometrical parameters

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

- **check the level of a centre lathe**
- **check the true running of a lathe spindle**
- **check the alignment of the main spindle and the tailstock spindle of a lathe**
- **check the parallelism of the tailstock sleeve with respect to bed ways.**
- **perform practical test on turned component.**

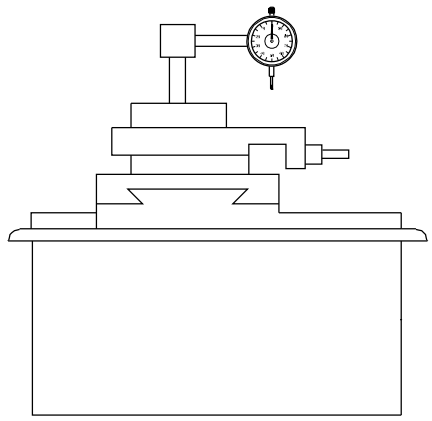


–	–	–	–	–	–	2.9.116
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**ACCURACY TESTING OF MACHINE TOOLS SUCH AS GEOMETRICAL PARAMETERS**				TOLERANCE	TIME:
					CODE NO. TJ20N29116E1	

Job sequence

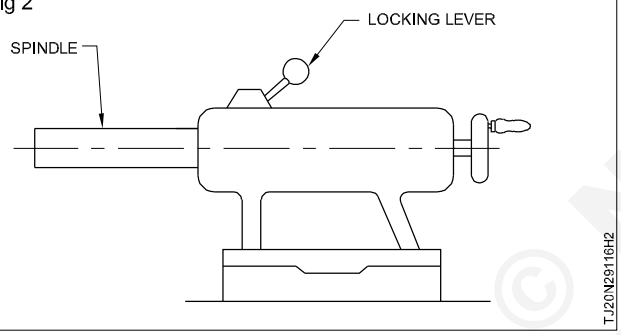
- Fix the dial gauge on the carriage. (Fig 1)

Fig 1



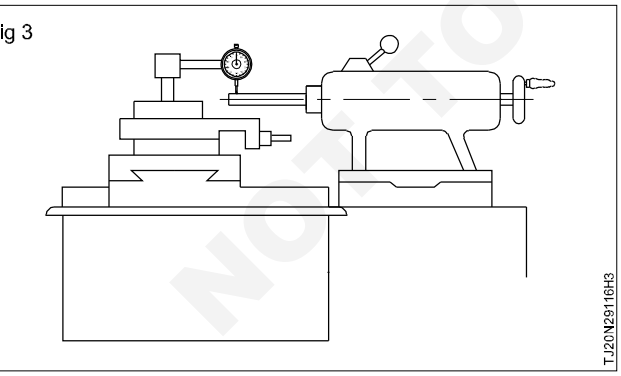
- Project the spindle of the tailstock to the maximum extent possible and lock it. (Fig 2) Check the spindle in the vertical and horizontal positions by a dial test indicator.

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 spindle in the vertical plane. (Fig 3)

Fig 3



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

- Set the dial at the zero position. (Fig 4)
- Move the carriage slowly towards the entire length of the spindle. (Fig 5)
- Note the dial reading at the extreme end of the spindle.

Fig 4

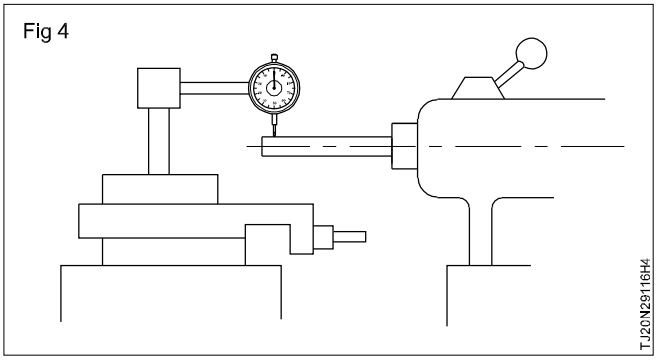
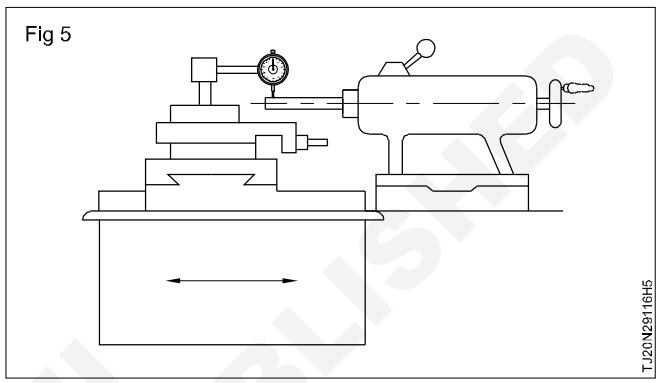


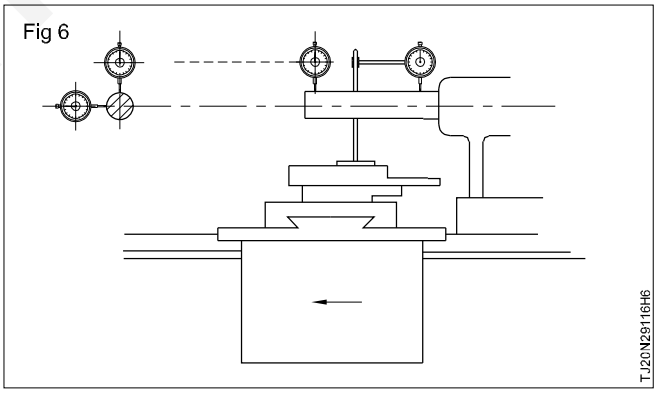
Fig 5



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

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

Fig 6



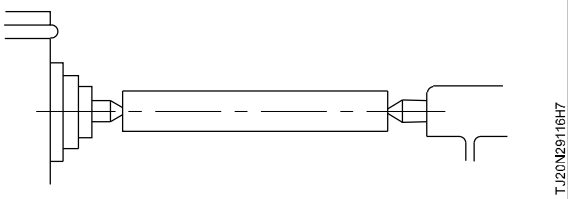
- Fix the test mandrel into the tailstock spindle. Repeat the same procedure to test the accuracy of the tailstock spindle bore in the vertical and horizontal positions as shown in the figure.

Checking the tail stock

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

Ensure that the spindle bearing is at its working temperature.

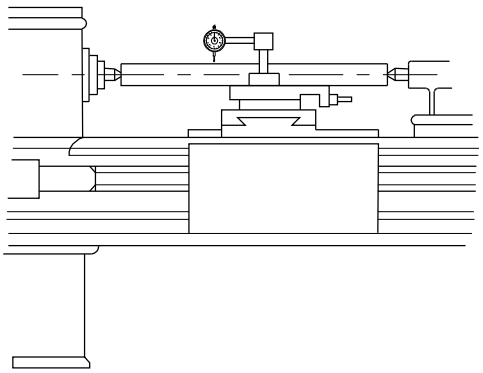
Fig 7



T-J20N29116H7

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

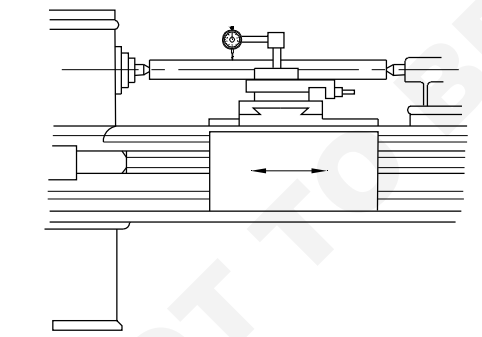
Fig 8



T-J20N29116H8

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

Fig 9



T-J20N29116H9

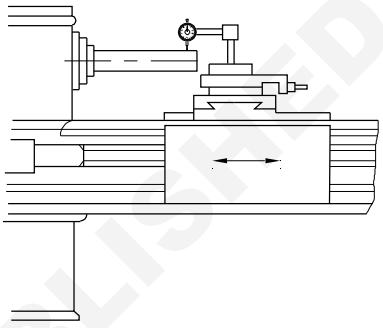
- Observe the reading of the dial as the saddle moves along the beds and note for variation, if any.

  The tailstock centre must be higher than the spindle centre within the permissible limit.
- Verify the deflection of the dial gauge reading and compare the value with the test chart. (IS: 6040)

Checking the true running of a spindle

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

Fig 10



TJ20N29116HA

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

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

Skill sequence

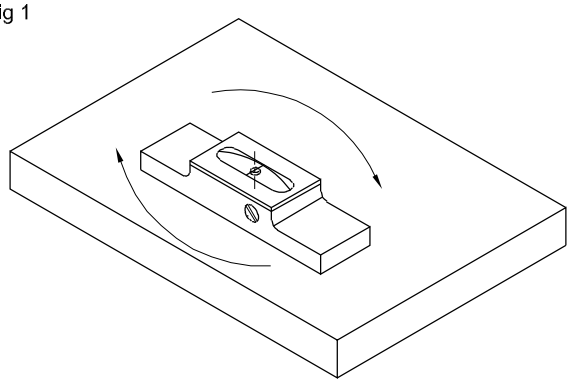
Adjustment of the spirit level with the plane surface

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

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

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

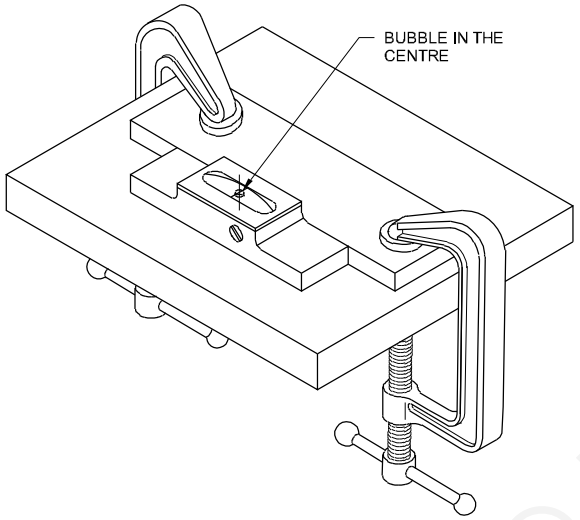
Fig 1



SPIRIT LEVEL

T.J20N29116J1

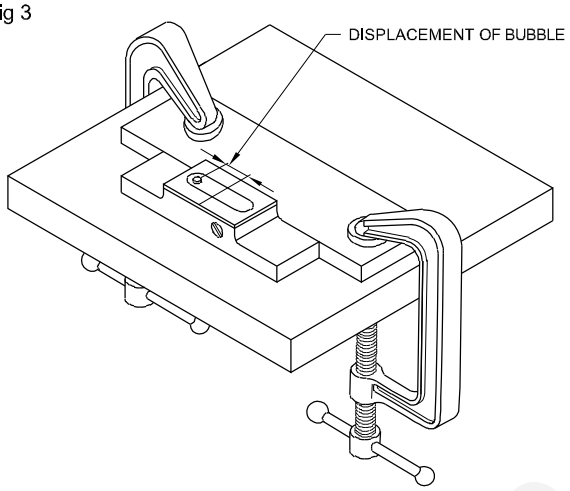
Fig 2



T.J20N29116J2

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

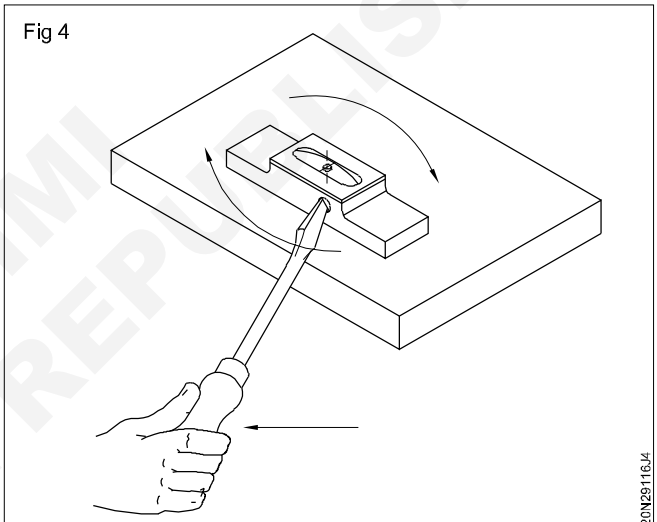


T.J20N29116J3

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

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

Fig 4



T.J20N29116J4

Level the lathe bed

Objective: 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 slide way (i.e. the slide way opposite the operator's side) longitudinally at the position 'A'.(Fig 1)

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

Take the readings of both the spirit levels.

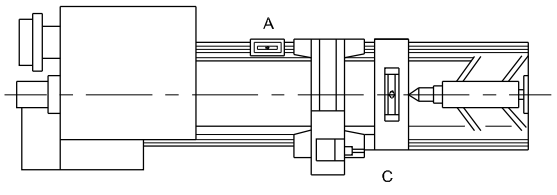
Adjust the level of the bed till both the spirit levels show the same readings.

Keep the spirit levels longitudinally and transversally at positions 'b' and 'd'. (Fig 2)

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

Repeat the sequence of operation till both the spirit levels show the same reading in all the positions a, b, c & d. (Fig 3)

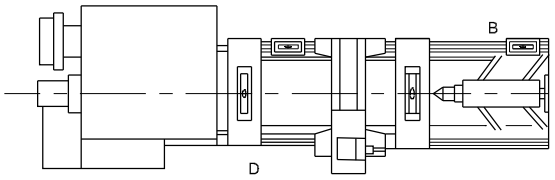
Fig 1



LEVELLING A LATHE BED

T.J20N29116X1

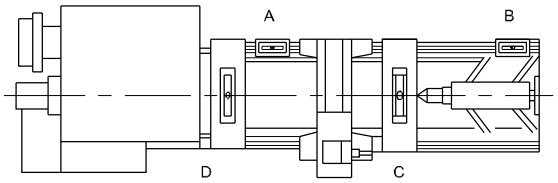
Fig 2



LEVELLING A LATHEBED

T.J20N29116X2

Fig 3

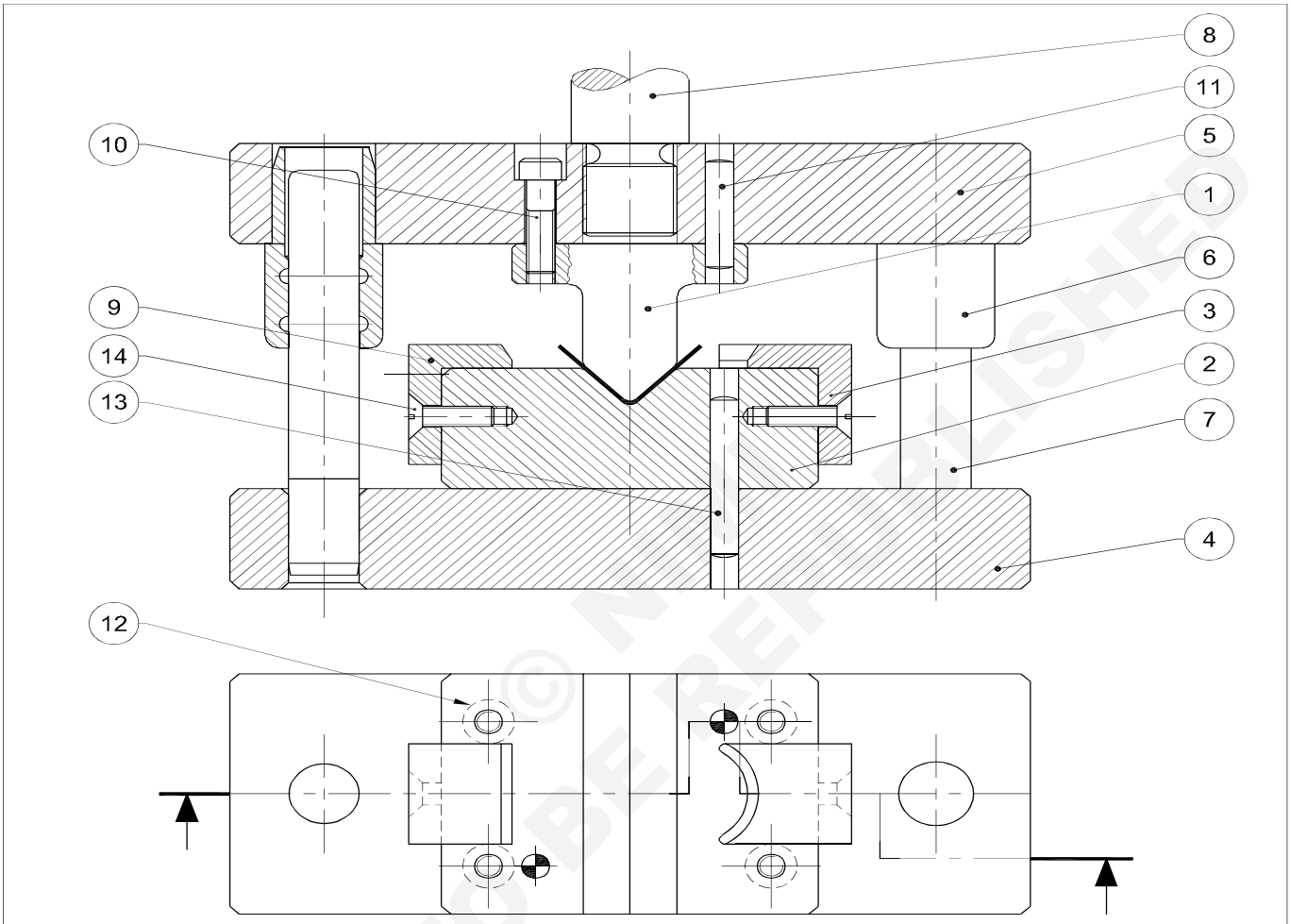


LEVELLING A LATHE BED

T.J20N29116X3

Construct a "V" bending tool as per the drawing

Objectives: At the end of this exercise you shall be able to
- **make all the parts "V" bending tool**
- **assemble the "V" bending tool**
- **take trial in "V" bending tool.**



NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO.
2	COUNTER SUNK SCREW	M5 x 10	STD		14	2.10.117
2	DOWELS	DIA 6 x 35	STD		13	2.10.117
4	SHCS	M6 x 30	STD		12	2.10.117
2	DOWELS	DIA 6 x 25	STD		11	2.10.117
4	SHCS	M6 x 25	STD		10	2.10.117
1	LOCATING BLOCK (2)	SQUARE. 32 - 35	Fe310		09	2.10.117
1	SHANK	DIA 30 x 75	Fe310		08	2.10.117
2	GUIDE PILLARS	Ex. No. 2 - 32	Fe310		07	2.10.117
2	GUIDE BUSHS	Ex. No. 2 - 31	Fe310		06	2.10.117
1	TOP PLATE	Ex. No. 2 - 43	Fe310		05	2.10.117
1	BOTTOM PLATE	Ex. No. 2 - 43	Fe310		04	2.10.117
1	LOCATING BLOCK (1)	SQUARE. 32 - 30	Fe310		03	2.10.117
1	DIE BLOCK	Ex. No. 2 - 24	Fe310		02	2.10.117
1	PUNCH	Ex. No. 2 - 23	Fe310		01	2.10.117

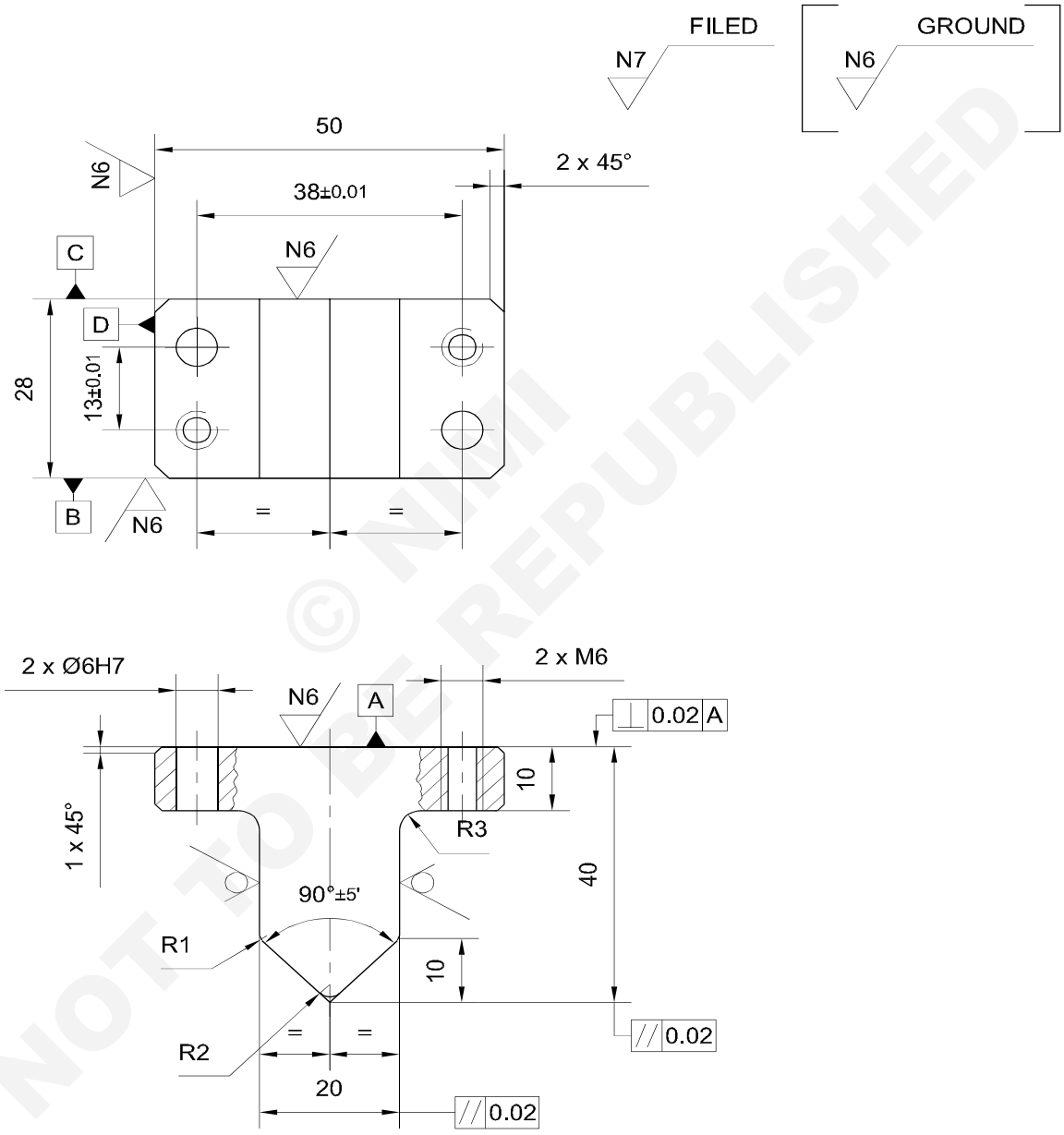
SCALE	V - BENDING TOOL	DEVIATIONS	TIME
		CODE NO. TJ20N210117E1	

Job Sequence

V - Bending tool - punch

- Check the raw material grind surface ‘B’ and ‘C’ to 28 ±0.1 parallel within 0.02mm.
- Grind surface ‘D’ to remove 0.2mm material.
- Grind base surface ‘A’ perpendicular within 0.02mm to surface ‘B’ and ‘D’.
- Mark and punch the co-ordinates for hole centres as per drawing. A for Tap M6x2 Nos.
- File radius R2 and R1 as per drawing.
- Chamfer as per drawing.

Note: Dia 6H7 dowel holes to be drilled and reamed in assembly with part 5.

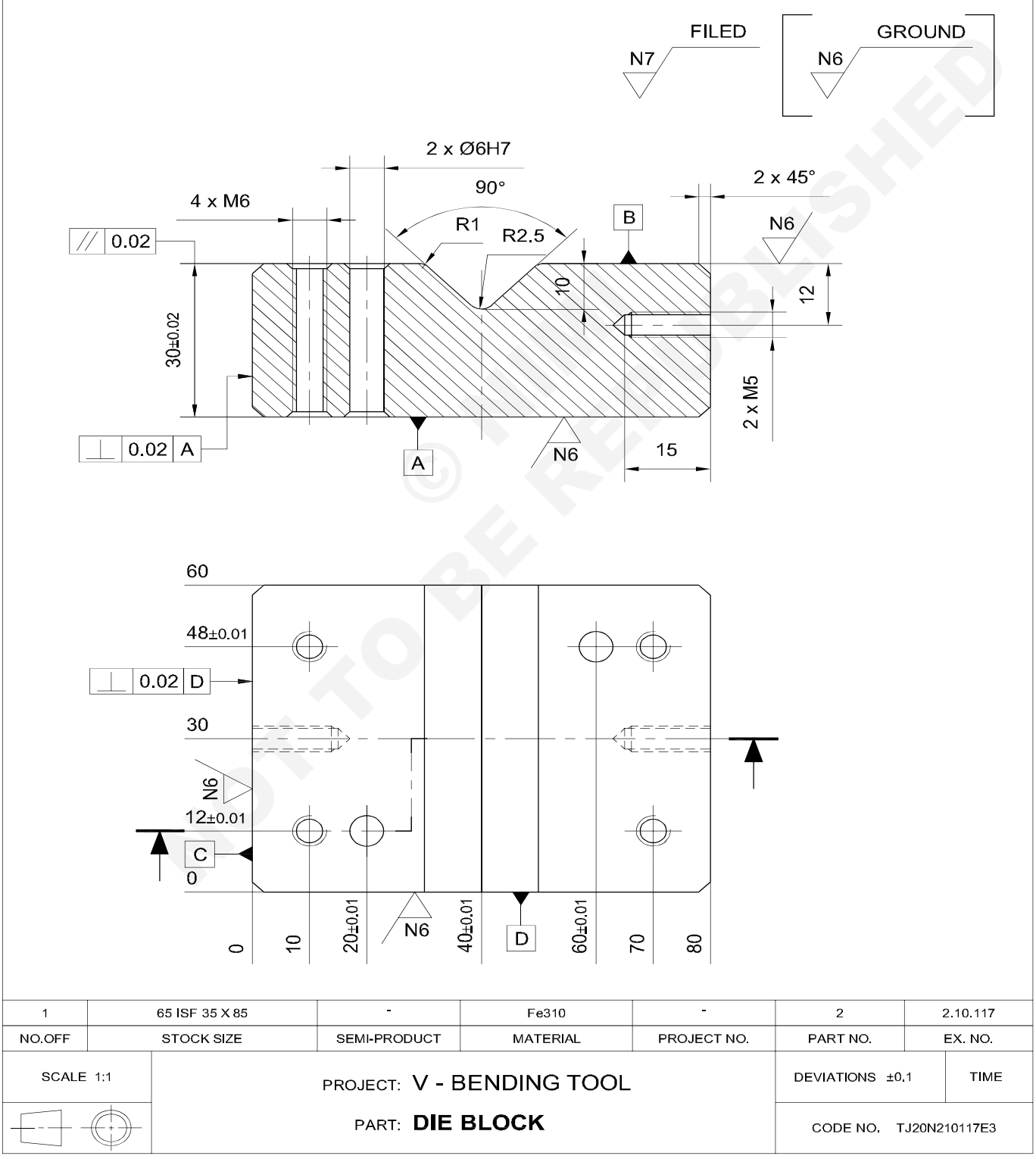


1	45 ISF 30 X 55	-	Fe310	-	1	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PUNCH**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N210117E1	

V - Bending tool - die block

- Check the raw material.
- Grind surface 'A' to remove 0.2mm material.
- Grind surface 'B' thickness 30 ±0.02mm parallel within 0.02mm.
- Grind surface 'C' to remove 0.2mm material perpendicular to surface 'D' within 0.02mm.
- Grind the reference side surface 'D' perpendicular within 0.02mm to surface 'C'.
- Mark and punch with co-ordinates for hole centres.
- Drill holes dia 5x4 Nos. for M6 tap and dia 4.2x2 Nos. for M5 tap as per drawing.
- Tap holes M6x4Nos.
- Tap holes M5 x 2Nos to a depth of 15 mm..
- File radius R1 as per drawing.
- Chamfer as per drawing.

Note: Dia 6H7 dowel holes to be drilled and reamed in assembly with part 4.

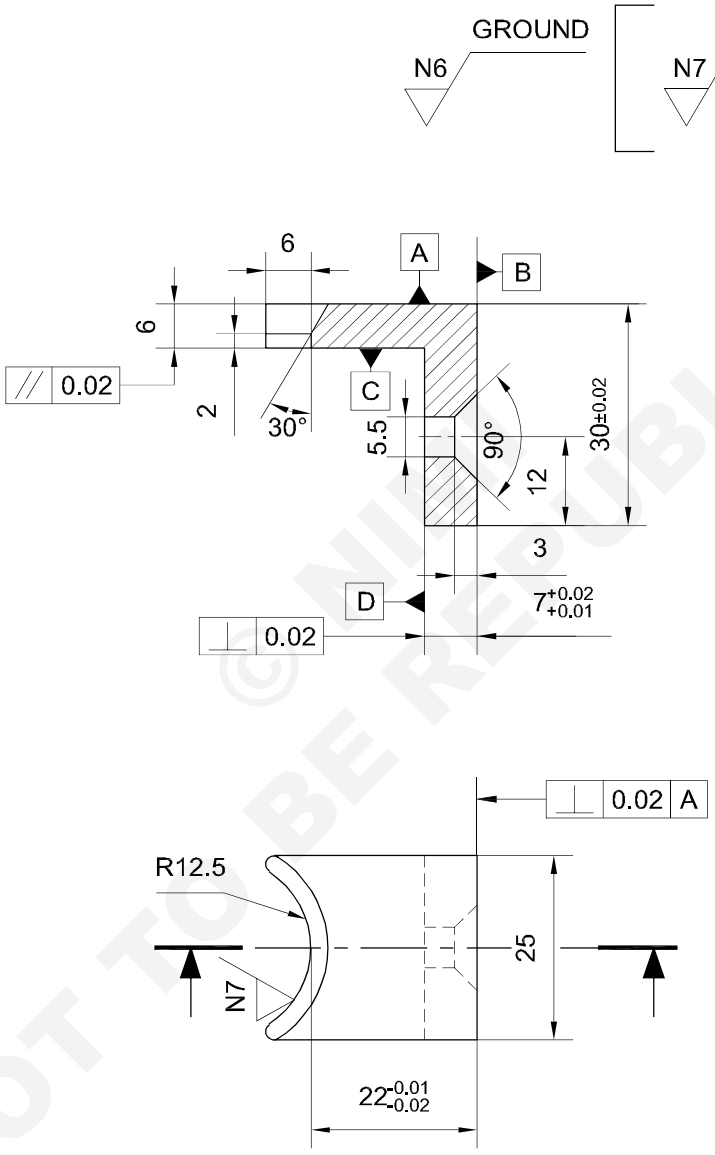


1	65 ISF 35 X 85	-	Fe310	-	2	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	PROJECT: V - BENDING TOOL	DEVIATIONS ±0.1	TIME
	PART: **DIE BLOCK**	CODE NO. TJ20N210117E3	

V - Bending tool - locating block

- Check the raw material square 32-30mm.
- Mill the block to 25.5 ±0.1x28.5 ±0.1x30.5 ±0.1 parallel within 0.1 and perpendicular within 0.1mm.
- Grind the block to 25 ±0.1x28 ±.02x30 ±0.02 parallel within 0.02 and perpendicular within 0.02mm.
- Mark step as per drawing, keeping 0.5 ±0.1mm over size for grinding mill step as per marking. Grind surface 'C' parallel to surface 'A' and surface 'D' parallel to surface 'B' as per drawing.
- Mark and punch for hole centre, drill and countersink as per drawing.
- Bore R12.5 as per drawing.
- Chamfer as per drawing.



1	□32 - 30	-	Fe310	-	3	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**LOCATING BLOCK - 1**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N210117E3	

V - Bending tool - bottom plate

- Check the raw material.
- Mark and punch the co-ordinates for the hole centres.
- Drill holes dia 6.6x4 Nos.
- Counter bore holes dia 11 to depth 9mm 4 Nos.
- Chamfer as per drawing.

Note: 1.0 dia 15 H7 holes to be drilled and reamed in assembly with part 5.

2.0 dia 6H7 dowel holes to be drilled and reamed in assembly with part 2.

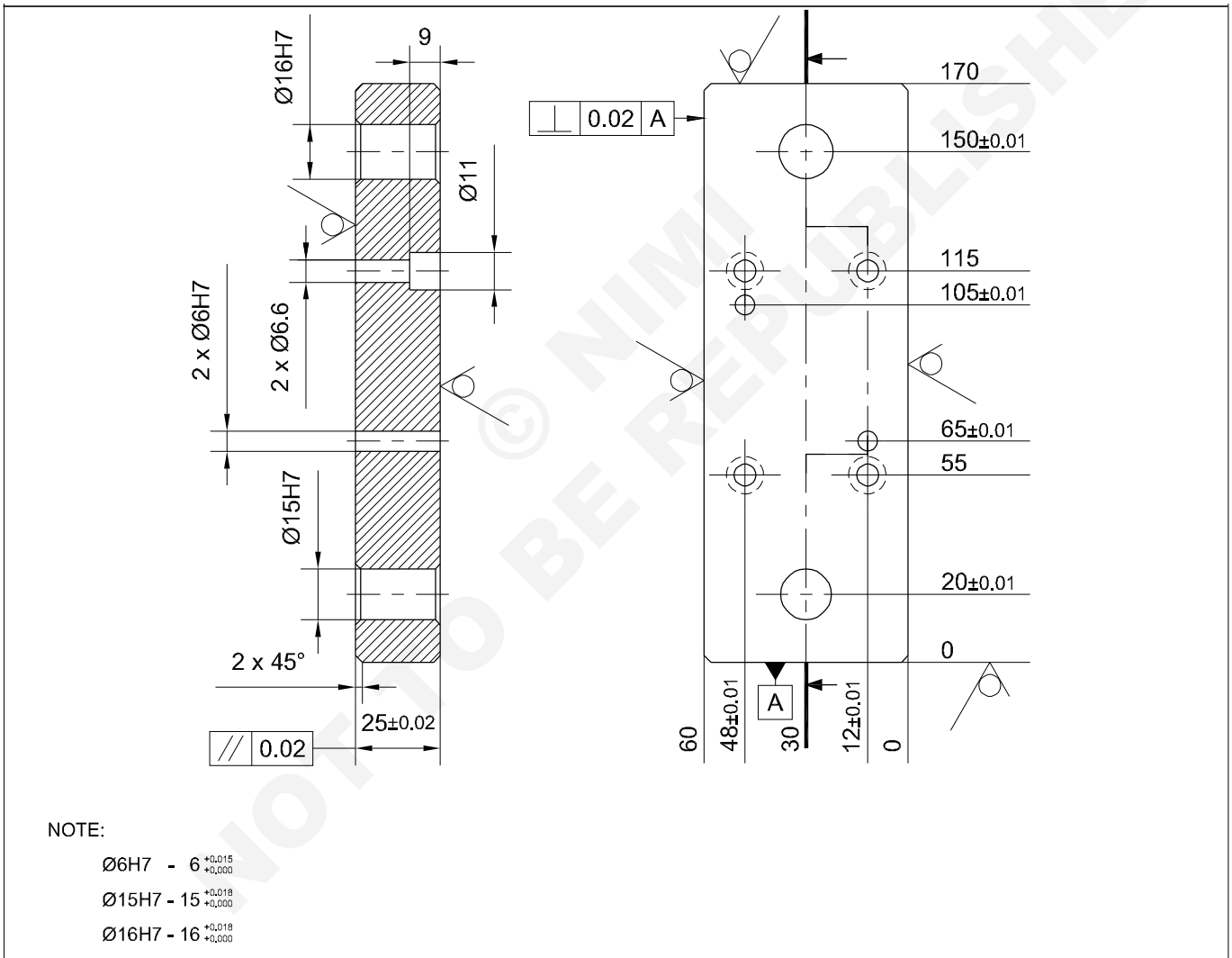
- Mark and punch the co-ordinates for hole centres.
- Drill holes dia 6.6x2 Nos.
- Counter bore holes dia 11 to depth 9mm2Nos.
- Drill and enlarge the hole to dia 18.5mm.
- Tap M20.
- Chamfer as per drawing.

Note: 22H7 holes to be drilled and bored in assembly with part 6.

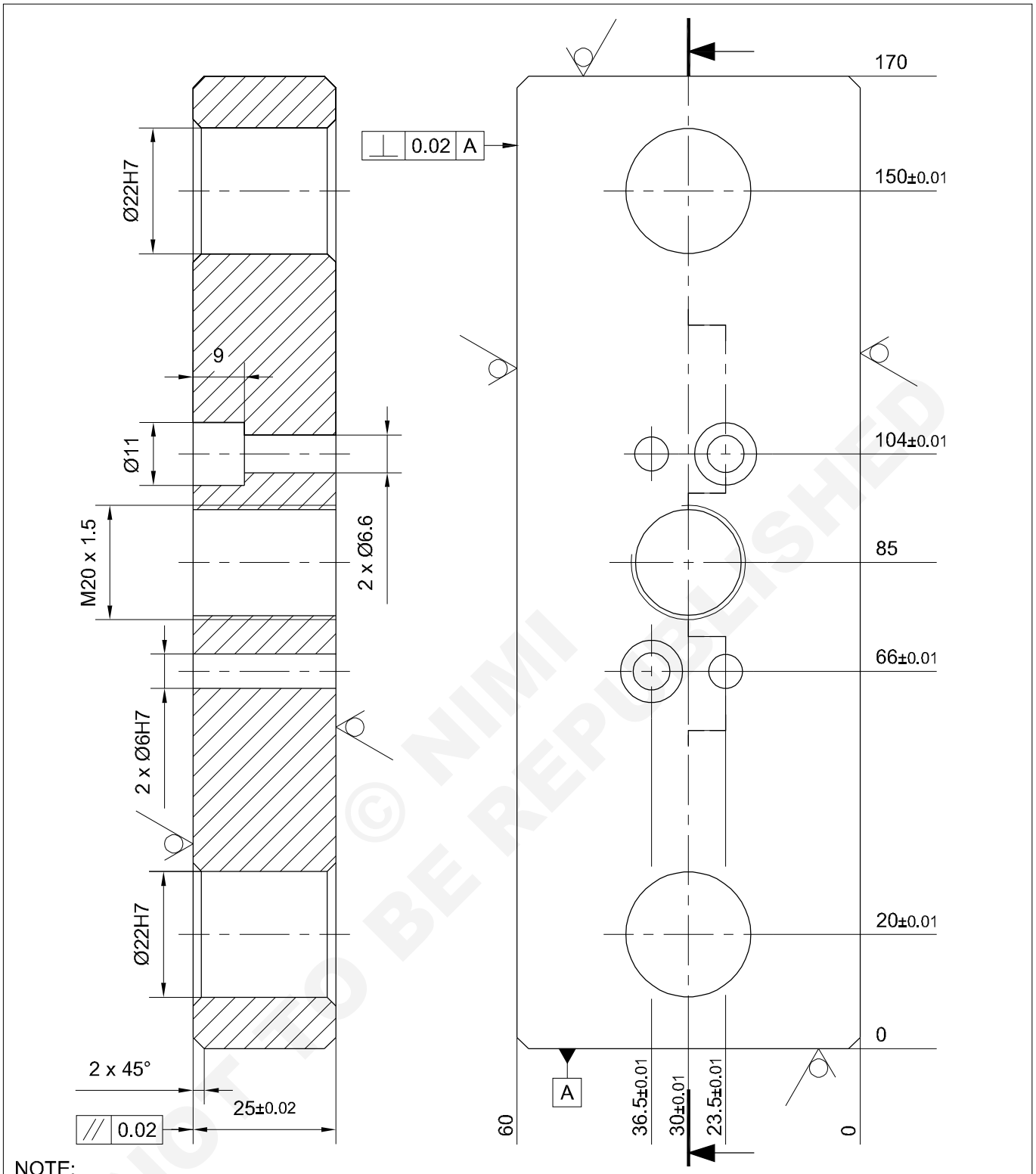
Dia 6H7 holes to be drilled and reamed in assembly with part 7.

V - Bending tool - top plate

- Check the raw material.



1	65 ISF 30 X 175	-	Fe310	-	4	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:2	**BOTTOM PLATE**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N210117E5	

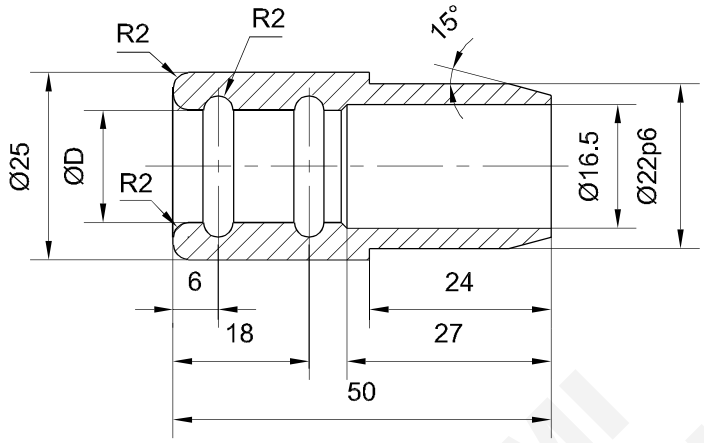


NOTE:

Ø6H7 - $6^{+0.018}_{+0.000}$

Ø22H7 - $22^{+0.021}_{+0.000}$

1	-	-	Fe310	-	5	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**TOP PLATE**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N210117E6	



Nos	ØD
1	15H7
2	16H7

NOTE:

Ø22p6 - $22^{+0.035}_{+0.022}$

Ø15/16H7 - 15/16 $^{+0.018}_{+0.000}$

1 + 1	-	-	Fe310	-	6	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GUIDE BUSH	DEVIATIONS ±0.1	TIME
		CODE NO. TJ20N210117E7	

V - Bending tool - Guide bush - 2 Nos

Turning

- Check the raw material dia 32x55mm.
- Hold the job in a 4-jaw chuck such that the job length 30mm projects out.
- Face to get perpendicularity.
- Tum dia 27 ±0.1mm to a length of 28mm.
- Centre drill.
- Drill and enlarge the hole to dia 13.5mm.
- Bore dia 14.5 ±0.1mm.
- Bore step dia 16.5 ±0.1mm to length 27mm.
- Turn oil groooves using a form tool.
- Turn dia 25.5 ±0.1 to length 28mm.
- Turn step dia 22.5 ±0.1 to length 24 ±0.1mm.
- Chamfer as per drawing.
- Reverse the job and set in a 4-jaw chuck.
- Face to total length 50 ±0.1mm.
- Turn the remaining length to dia 25.5 ±0.1mm.
- Repeat the same procedure and turn to dia 15.5mm guide bush.

Grinding

- Check the dimensions of the turned bush.
- Set the job dia 22.5 on cylindrical grinder in a 4-jaw chuck.
- Grind internal diameter to 15H7.
- Set the job on mandrel.
- Grind external diameters as per drawing.
- Repeat the same procedure and the grind dia 16 piller remaining three bushes. Refer to the drawing for dimensions.

V - Bending tool - Guide pillar - 2 Nos

Turning

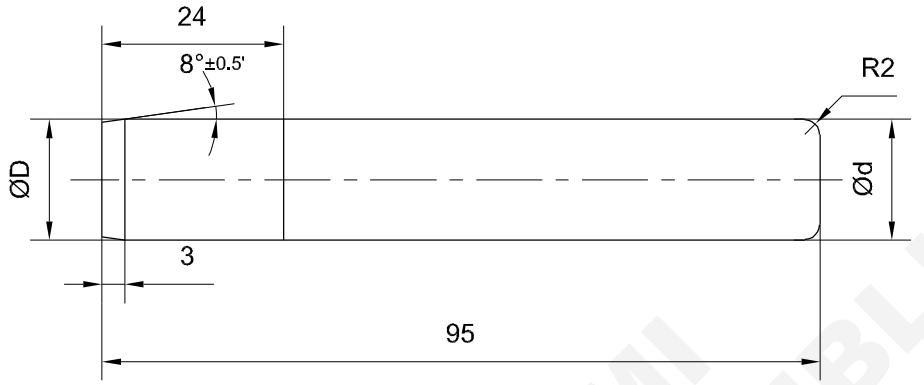
- Check the raw material dia 20x120.
- Hold the job in a 3-jaw chuck.
- Face and centre drill.
- Reverse the job and hold in the 3-jaw chuck.
- Face to get total length 115 ±0.1.
- Centre drill.
- Hold the job in between centres.
- Turn dia parallel 15.5 ±0.1mm to maximum length.
- Turn taper 8 degrees ±5 minutes length 3 ±0.2 by swiveling the compound slide.
- Reverse the job and hold in between centres.
- Turn dia 15.5 ±0.1mm to remaining length.
- Turn radius R2 using form tool.
- Repeat the same procedure and turn dia 16.5 pillar.

Grinding

- Check the dimensions of the turned pillar.
- Set the job in between centres on the cylindrical grinder.
- Grind dia 15.5 to dia 15 p6 to a length of 27 ±1mm.
- Reverse and hold the in between centres.
- Grind 15g6 to a length of 91 ±0.1.
- Repeat the same procedure dia 16 pillar.

V - Bending tool - Shank

- Check the raw material dia 32x75mm.
- Hold the job in 3 a jaw chuck.
- Face to get perpendicularity.
- Centre drill.
- Reverse the job and hold the chuck.
- Face to a total length 68 ±0.1mm.
- Centre drill.
- Hold the job in between centres.
- Turn dia 25 -0.1 to a length 48 ±1mm.
- Turn taper 10° as per drawing by swivelling the compound slide.
- Turn chamfer 30° as per drawing.
- Reverse the job and hold in between centres.
- Turn dia 20-0.2 to length 23 ±0.1mm.
- Turn the groove as per drawing.
- Turn 60° chamfer as per drawing.
- Thread cut M20x1.5mm.
- Mill the flats as per drawing.
- Chamfer as per drawing.



NOS	Ød	ØD
1	15g6	15p6
2	16g6	16p6

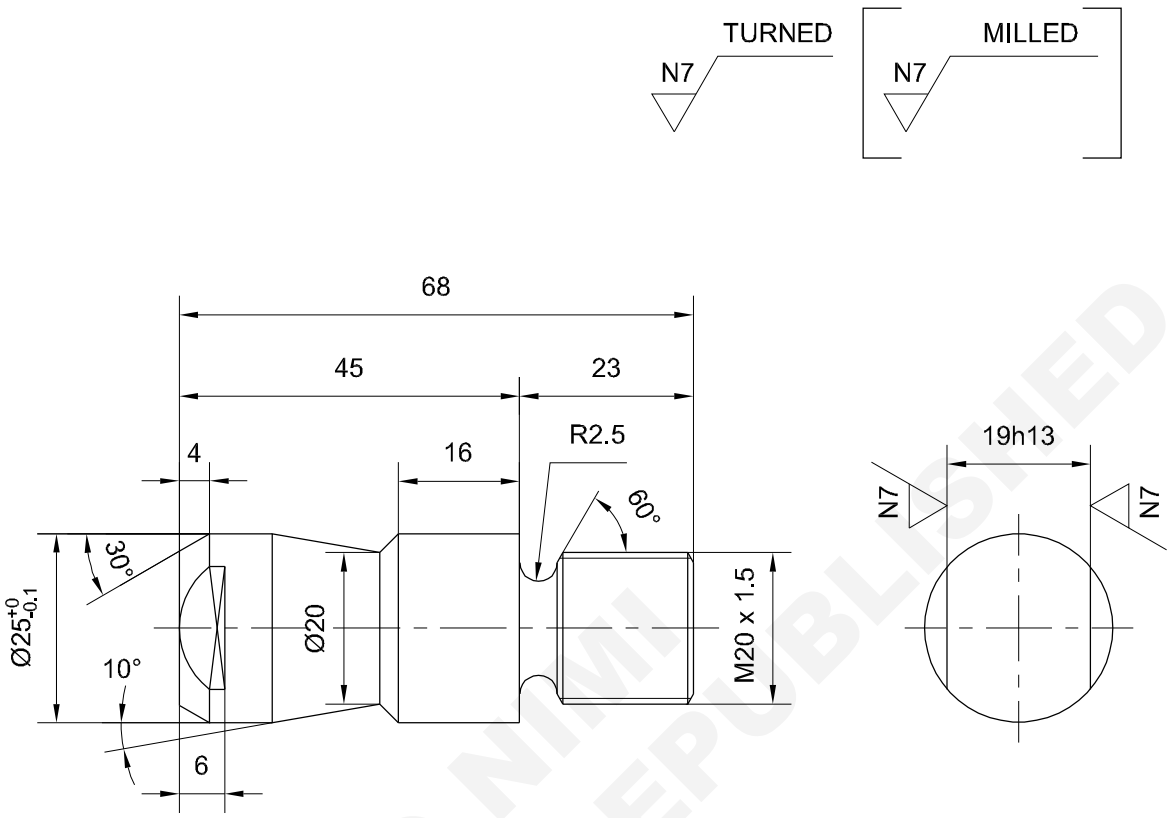
NOTE:

Ø15/16g6 - 15/16 $^{-0.006}_{-0.017}$

Ø15/16p6 - 15/16 $^{+0.029}_{+0.018}$

1 + 1	-	-	Fe310	-	7	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	GUIDE PILLAR	DEVIATIONS ±0.1	TIME
		CODE NO. TJ20N210117E8	

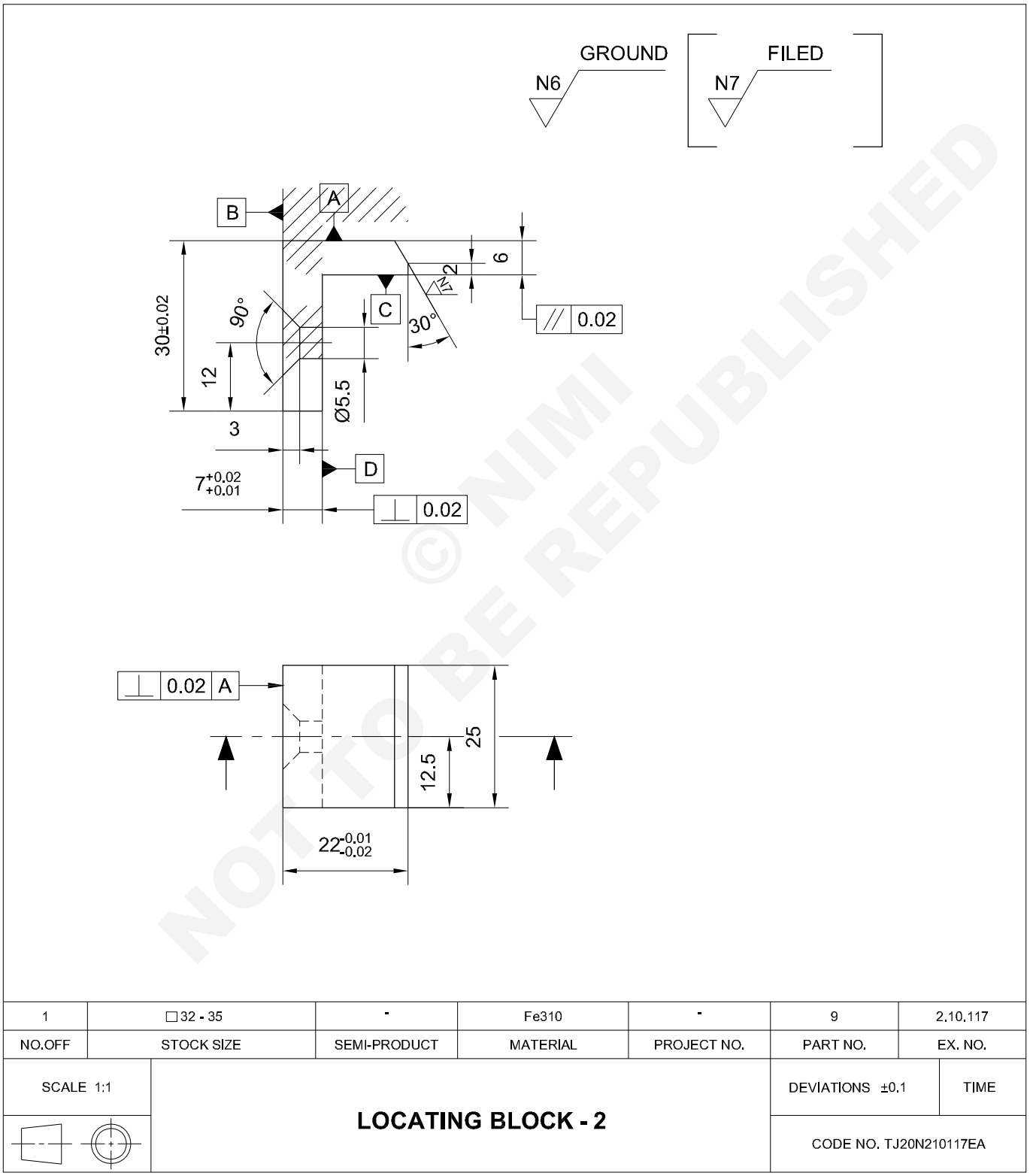


NOTE:
19h13 - $19^{+0.000}_{-0.033}$

1	Ø32 x 75	-	Fe310	-	8	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**SHANK**				DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N210117E9	

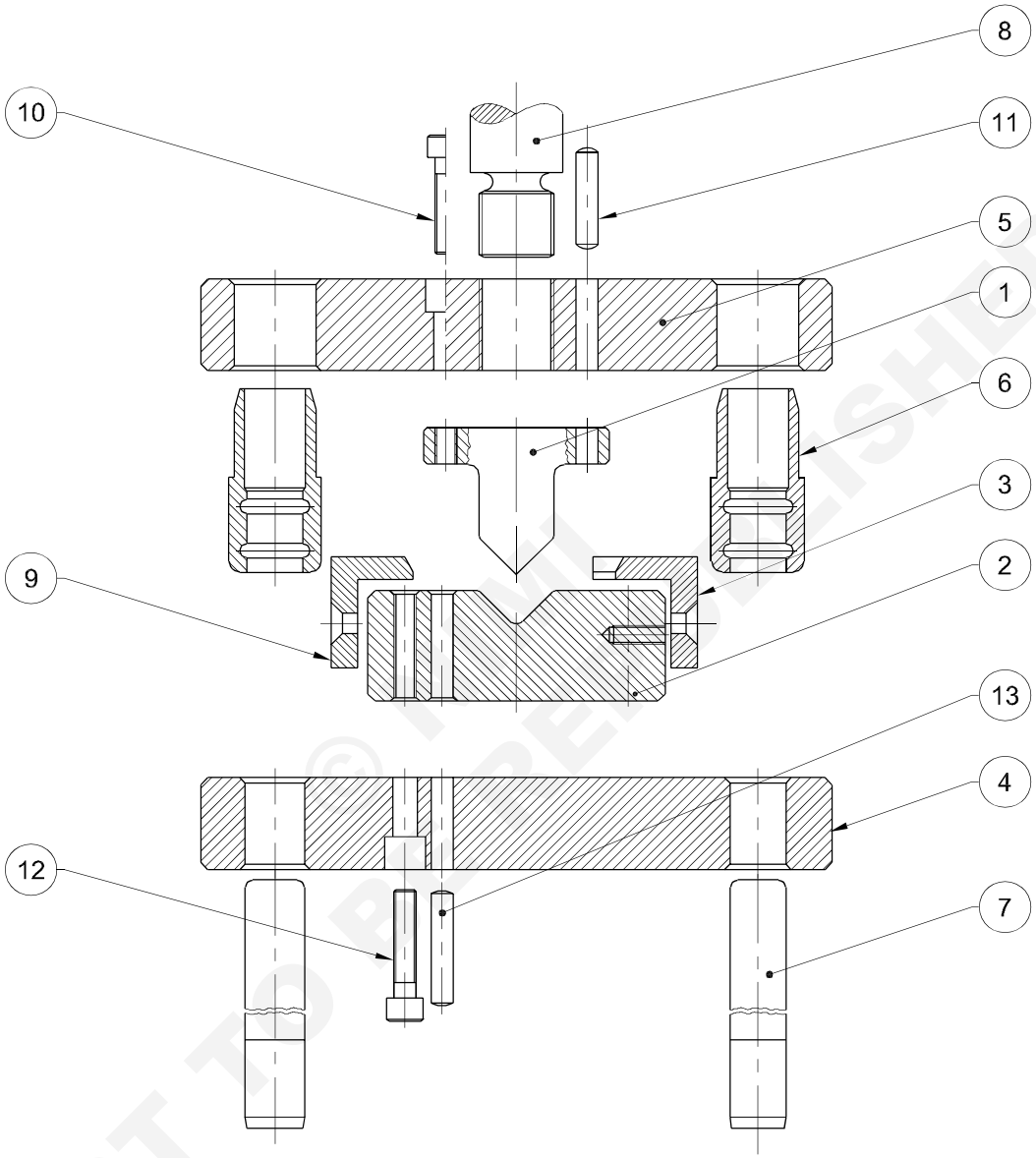
V - Bending tool - Locating block

- Check the raw material square 32-35mm.
- Mill the block to 22.5 ±0.1x25.5 ±0.1x30.5 ±0.1 parallel within 0.1 and perpendicular within 0.1mm.
- Grind the block to 22 -0.01 -0.02x25 ±0.1x30 ±0.02 parallel within 0.02mm and perpendicular within 0.02mm.
- Mark steps keeping 0.5 ±0.1 oversize for grinding.
- Mill the step as per drawing.
- Grind surface 'C' parallel to surface 'A' and surface 'D' parallel to surface 'B' within 0.02 as per drawing.
- Mark and punch as per drawing.
- Drill dia 5.5 and countersink.
- Chamfer as per drawing.



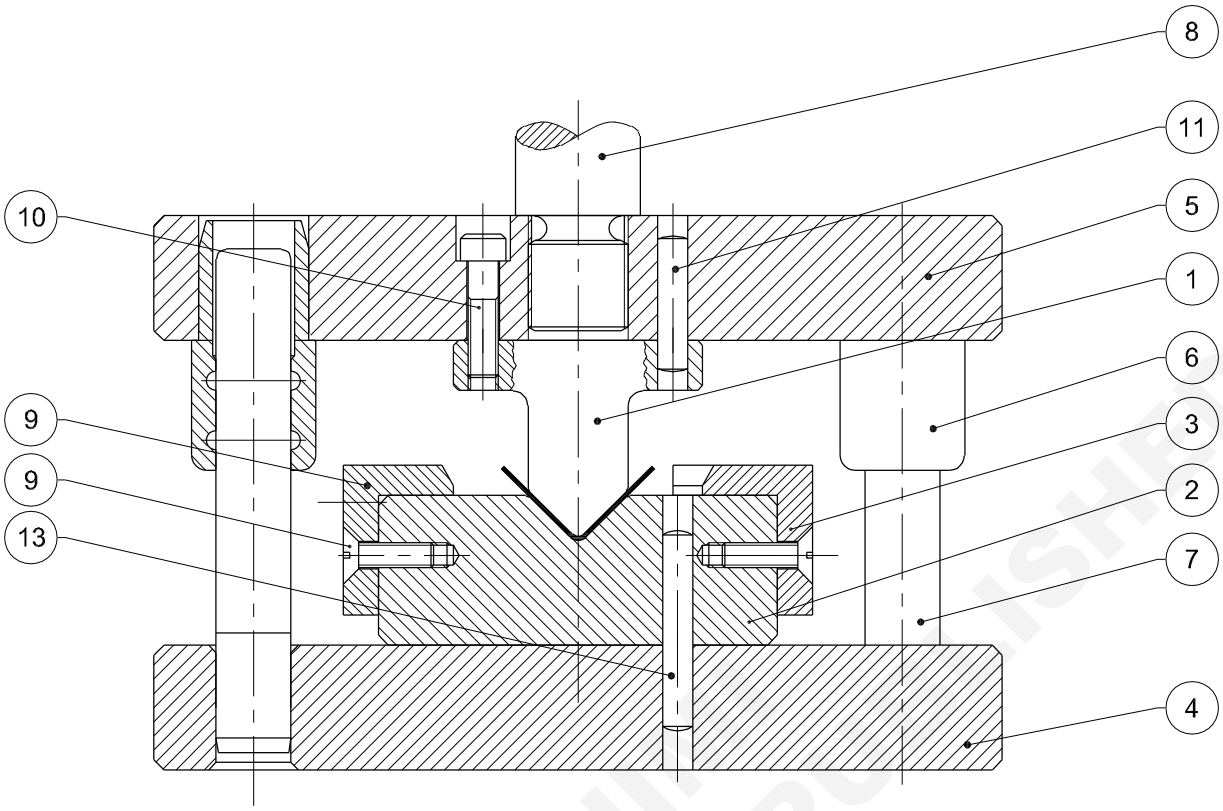
1	□32 - 35	-	Fe310	-	9	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

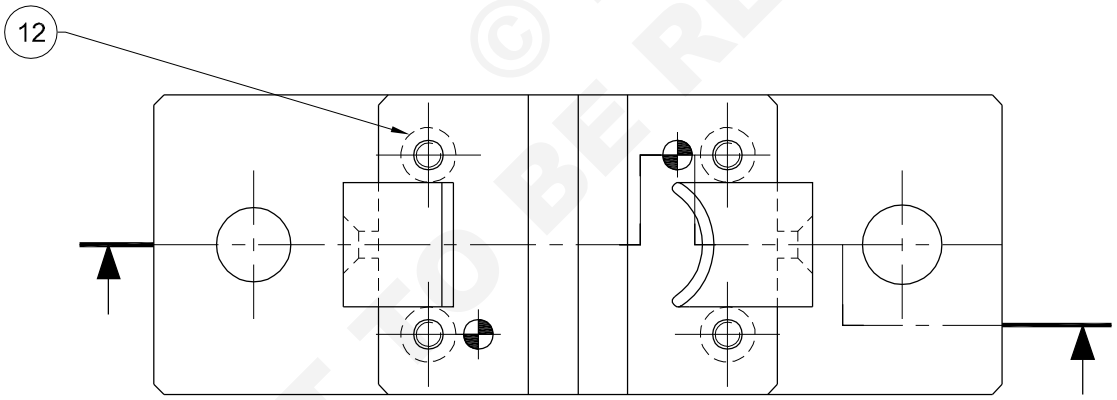
SCALE 1:1	LOCATING BLOCK - 2	DEVIATIONS ±0.1	TIME
		CODE NO. TJ20N210117EA	



-	-	-	-	2P4	-	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE	V - BENDING TOOL ASSEMBLY	DEVIATIONS	TIME
		CODE NO. TJ20N210117EB	



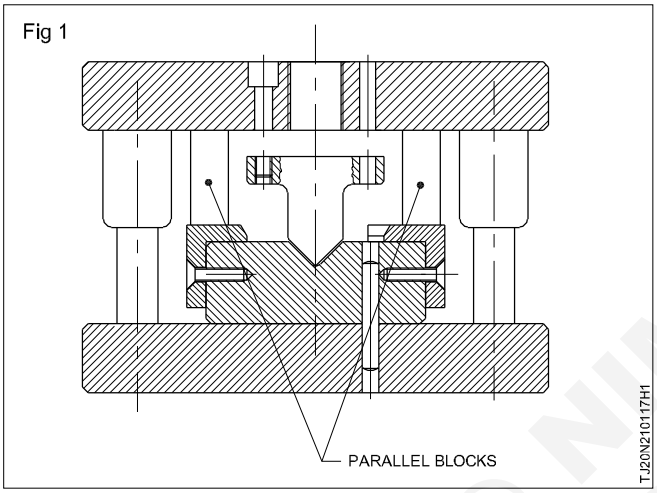


-	-	-	-	-	-	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE	**V - BENDING TOOL ASSEMBLY**				DEVIATIONS	TIME
					CODE NO. TJ20N210117EC	

V - Bending tool - Assembly

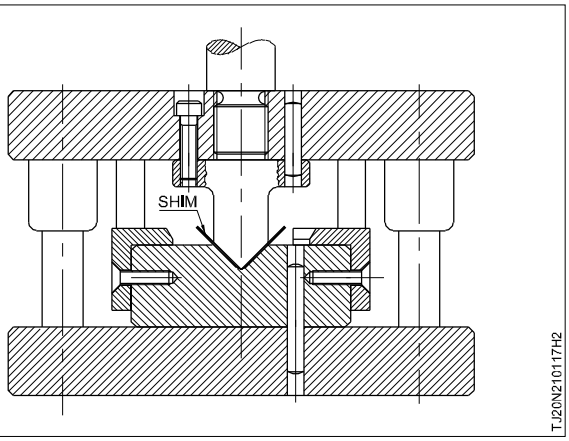
- Clean all the parts in 1 to 14.
- Deburr the sharp edges if any.
- Clean all the screw, pillar and bush holes.
- Fit the bushes (part 6) to the top plate (part 5)
- Fit the pillars (part 7) to bottom plate (part 4)
- Slide the bushes (part 6) along with the top plate (part 5) over the pillars (part 7) which are already fitted to the bottom plate (part 4).
- Remove the top plate (part 5) along with bushes (part 6) from the assembly.
- Fix the locating plates (part 3 and 9) to the die block (part 2) (Fig 1) with M5x10 countersunk screw - 2Nos.

Fig 1



- Fix the die block (part 2) to the bottom plate (part 4) with SHCS M6x30-4 Nos.
- Keep 20x40x100 parallel blocks (2 Nos) on the die block (part 2) (Fig 1).
- Slide the top plate assembly over the pillar such that the top plate rests on the parallel blocks.
- Keep the shim of 0.5 thickness on the die profile.
- Mount the punch (part 1) on the die block (part 2).
- Remove the parallel blocks and slide down the top plate assembly to touch the shoulder of th punch (part 1) (Fig 2).
- Fit the punch (part 1) to top plate (part 5) with allen screws M5x25 - 2 Nos.
- Remove the top half of assembly.
- Remove shim.
- Drill and ream holes dia 6 H7-2 Nos in top assembly.
- Drive dowels dia 6x25 - 2 Nos. Using soft hammer.
- Drill and ream th holes dia 6H7 - 2 Nos. in bottom assembly.

Fig 2



- Drive dowels dia 6x35 - 2 Nos using soft hammer.
- Slide the top half assembly over the pillars (part 7).
- Clamp the shank (part 8) to the top plate (part 5) of assembly.

Note: The tool is ready for trial.

V - Bending tool - setting the V-bending tool on fly press

Lift the press ram to provide space to keep the assembled tool on the press bed.

Adjust the lock-nut to stop the press ram in that position.

Slide up the top half of the assembly.

Keep 0.5 shim on the die profile.

Slide down the top half to seat the punch on the shim.

Keep the assembled tool on the centre of the press bed.

Loosen the lock-nut.

Lower the press than such that the shank enters the bore on the press ram and the ram touches the top plate of the tool.

Clamp the shank to the press ram by tightening the hexagonal bolt provided in the ram.

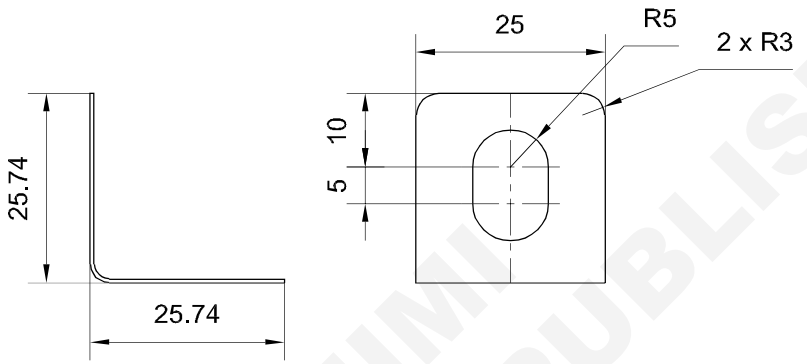
Adjust the lock-nut stop the press ram in that position.

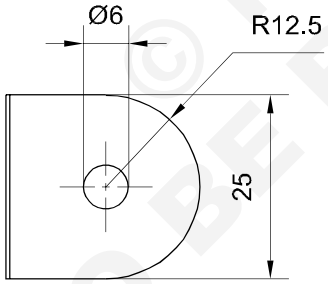
V - Bending tool - Trail

- Set the tool on fly press (Refer SS attached 2.5.126).
- Lift the press ram.
- Locate the component in between locating blocks in V-bending tool. (Part 3 & 9)
- Lower the press ram till the press ram stops by lock nut.
- Lift the press ram.
- Check the component dimensions.
- If the component dimensions are within 0.1mm then the tool is acceptable.

Note: If there is difference in the component dimensions correct the locating blocks (Part 3 and 9) respectively.

Try another component and check the dimensions.





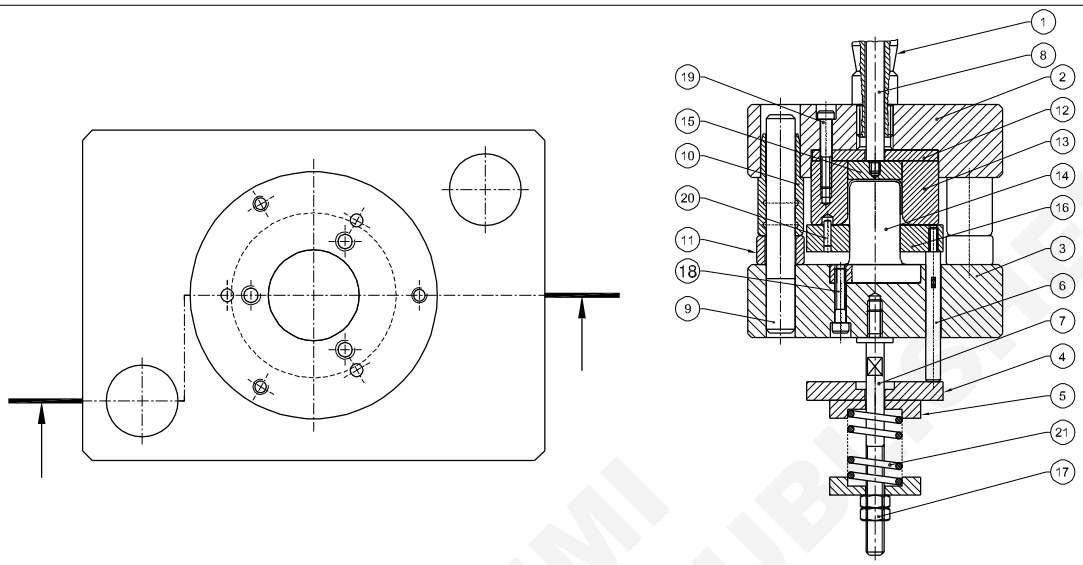
MATERIAL = CRCA

THICKNESS = 0.5mm

-	-	-	-	-	-	2.10.117
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE		**COMPONENT**			DEVIATIONS ±0.1	TIME
					CODE NO. TJ20N210117ED	

Construct a draw tool (single stage) as per the drawing given using various machine tools and equipment's

Objectives: At the end of this exercise you shall be able to
- **prepare all the parts of drawing tool using various machines**
- **assemble the draw tool as per drawing.**



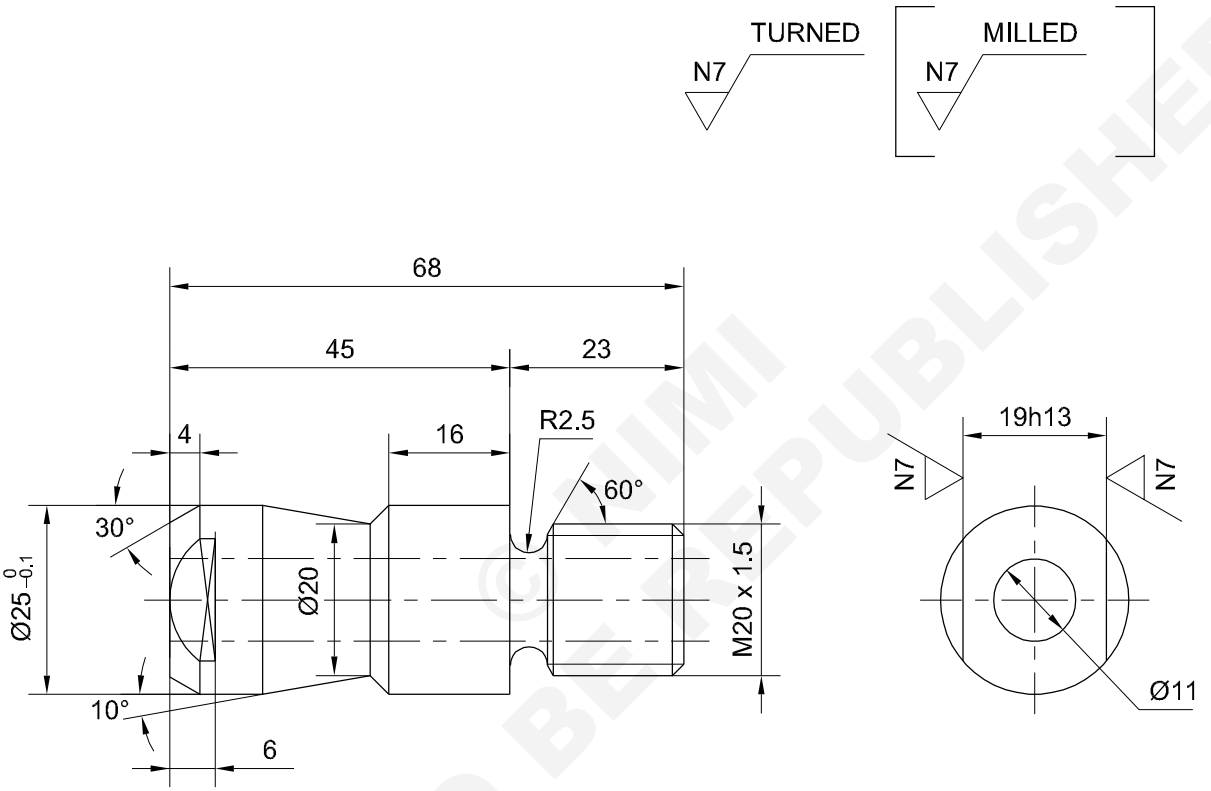
1	COMPRESSION SPRING	O.D=28, WØ=4,P=10,L=70	SPRING STEEL		21	2.10.148
3	DOWEL	Ø4 x 10	Fe310	STD	20	2.10.148
3	HEX. SOCKET HEAD CAP SCREW	M6 x 40 IS 2269-12,9	Fe310	STD	19	2.10.148
3	HEX. SOCKET HEAD CAP SCREW	M6 x 30 IS 2269-12,9	Fe310	STD	18	2.10.148
2	NUT	M10	Fe310	STD	17	2.10.148
1	PRESSURE PAD	ISRO 80-25	Fe310		16	2.10.148
1	SHEDDER	ISRO 36-20	Fe310		15	2.10.148
1	DRAW PUNCH	ISRO 56-60	Fe310		14	2.10.148
1	DRAW DIE	ISRO 80-40	Fe310		13	2.10.148
1	BACK PLATE	ISRO 80-15	Fe310		12	2.10.148
2	STOPPER	ISRO 32-25	Fe310		11	2.10.148
2	GUIDE BUSH	ISRO 32-65	Fe310		10	2.10.148
2	GUIDE PILLAR	ISRO 20-125	Fe310		09	2.10.148
1	KNOCK OUT ROD	ISRO 16-137	Fe310		08	2.10.148
1	DIE CUSHION ROD	ISRO 25-140	Fe310		07	2.10.148
3	TRANSFER PIN	ISRO 14-90	Fe310		06	2.10.148
2	DIE CUSHION DISC	ISRO 56-20	Fe310		05	2.10.148
1	BUFFER PLATE	ISRO 80-20	Fe310		04	2.10.148
1	BOTTOM PLATE	150 ISF 50-105	Fe310		03	2.10.148
1	TOP PLATE	150 ISF 50-105	Fe310		02	2.10.148
1	SHANK	ISRO 28-75	Fe310		01	2.10.148
NO.OFF	DESCRIPTION	STOCK SIZE	MATERIAL	REMARKS	PART NO.	EX. NO.

SCALE 1:1	DRAW TOOL	DEVIATIONS	TIME
		CODE NO. TJ20N210118E1	

Job Sequence

Draw tool - Shank

The trainees may be asked to write the job sequence.



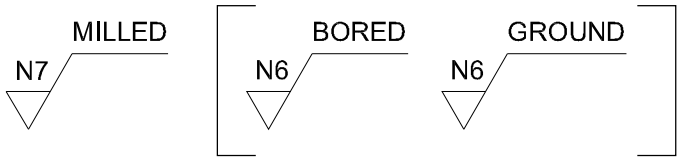
19h13 = 19 $^{+0}_{-0.330}$

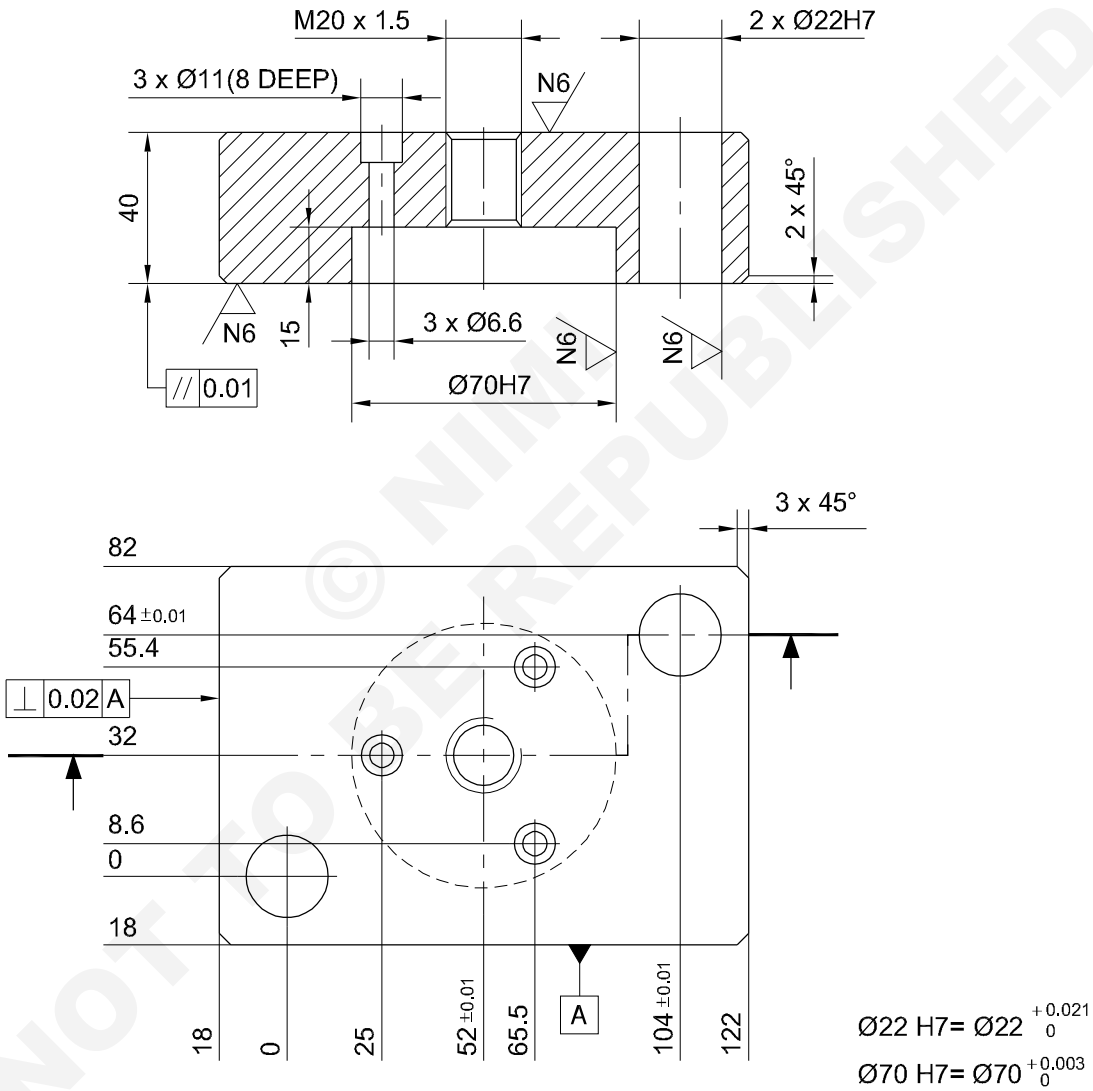
1	32 x 75	-	Fe310	-	01	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	SHANK	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N210118E2	

Draw tool - Top plate

The trainees may be asked to write the job sequence.

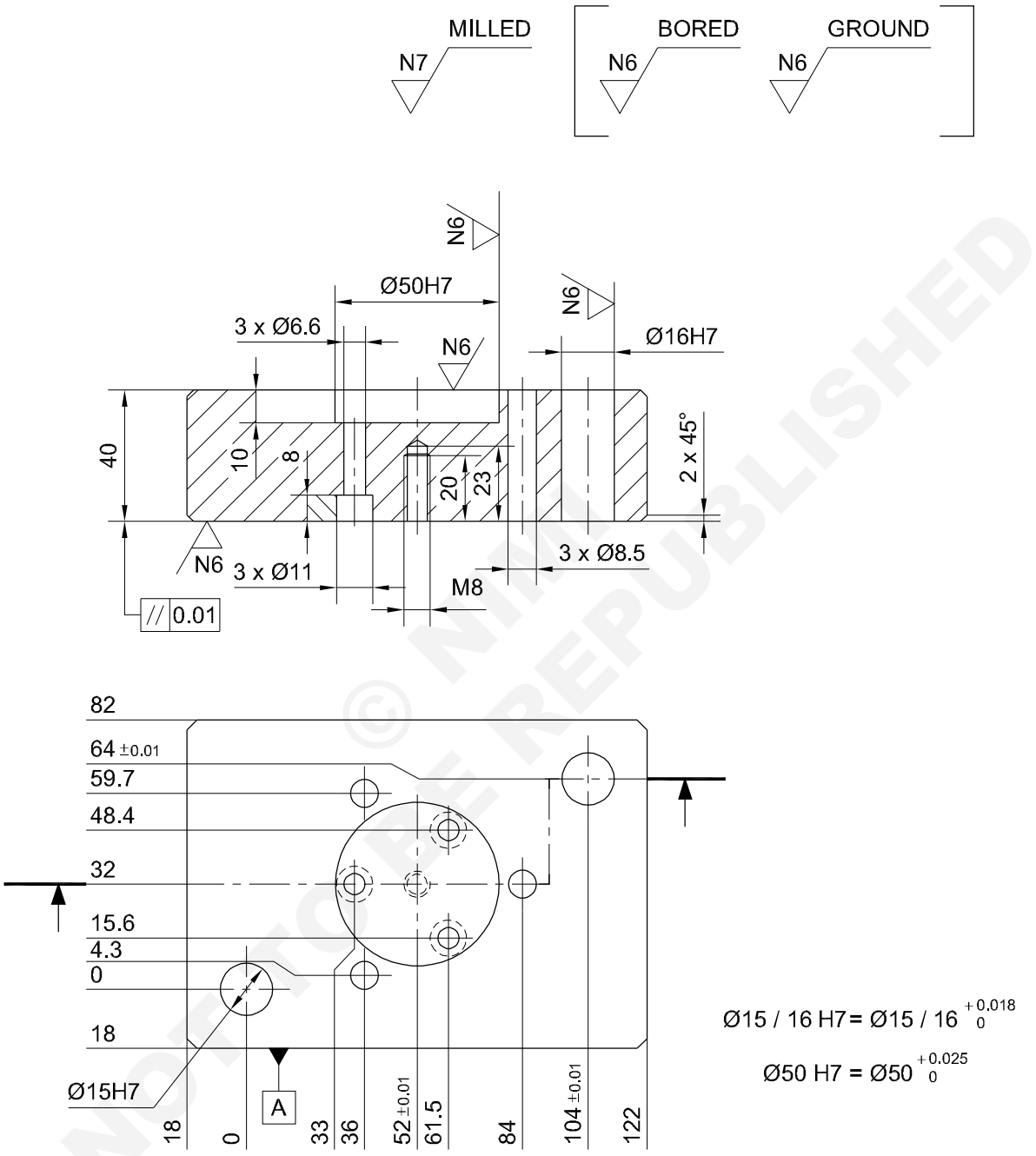




1	150 ISF 50-105	-	Fe310	-	02	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1: 2	**TOP PLATE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118E3	

Draw tool - Bottom plate

The trainees may be asked to write the job sequence.



1	150 ISF 50-105	-	Fe310	-	03	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:2	**BOTTOM PLATE**	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N210118E4	

Draw tool - Buffer plate

The trainees may be asked to write the job sequence.

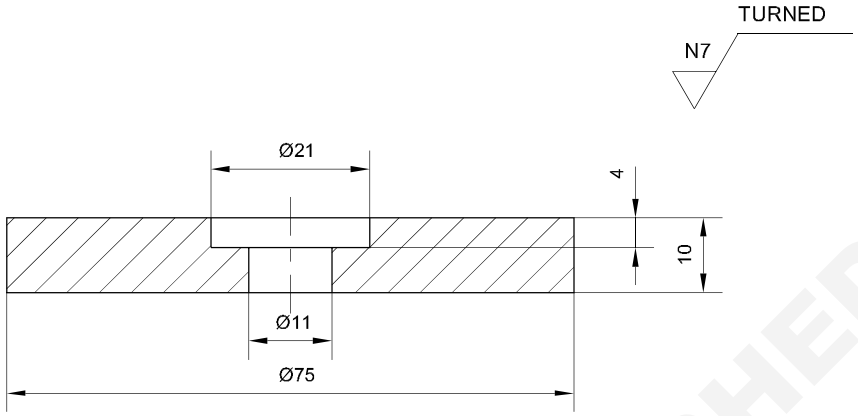
Draw tool - Die cushion disc (2 Nos)

The trainees may be asked to write the job sequence.

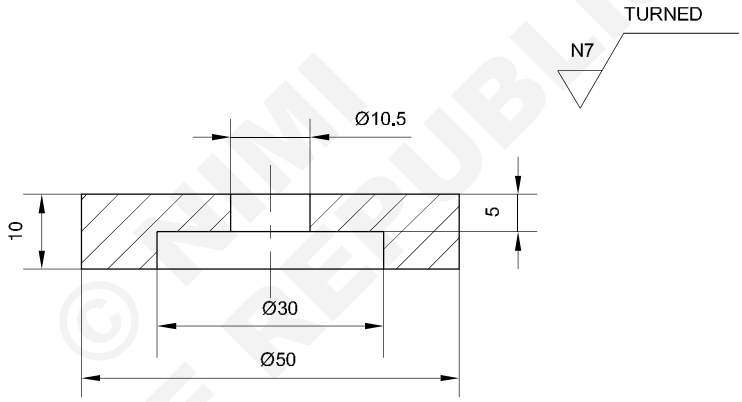
Draw tool - Transfer pin (3 Nos)

The trainees may be asked to write the job sequence.

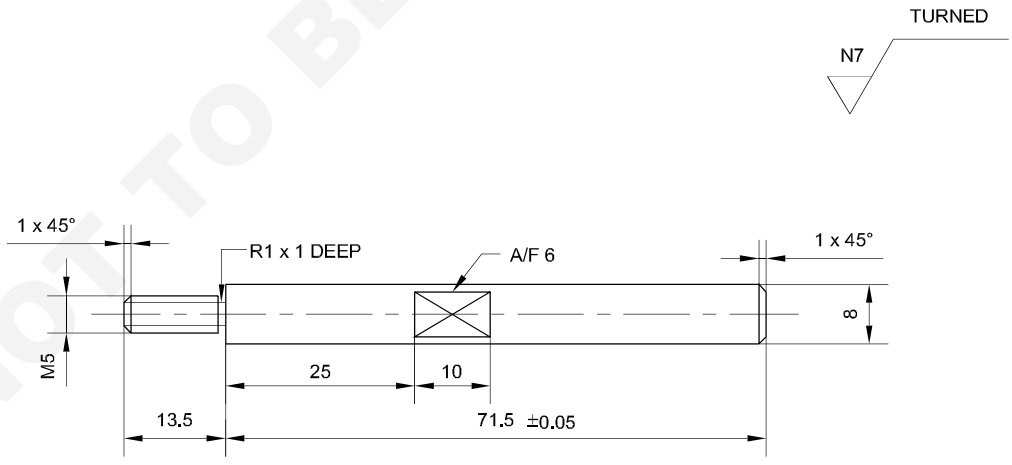
PART: 04



PART: 05



PART: 06



3	ISRO 80 - 20	-	Fe310	-	06	2.10.148
2	ISRO 56 - 20	-	Fe310	-	05	2.10.148
1	ISRO 80 - 20	-	Fe310	-	04	2.10.148
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

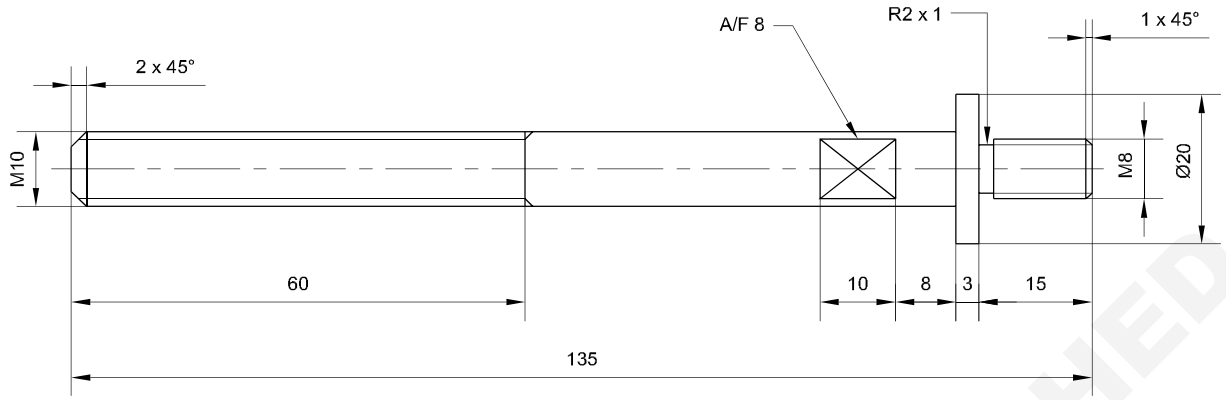
SCALE 1:1	**BUFFER PLATE, DIE CUSHON DISC & TRANSFER PIN**	DEVIATIONS ± 0.1	TIME
		CODE NO. TJN210148E5	

PART-07

TURNED
N7

Draw tool - Die cushion rod

The trainees may be asked to write the job sequence.

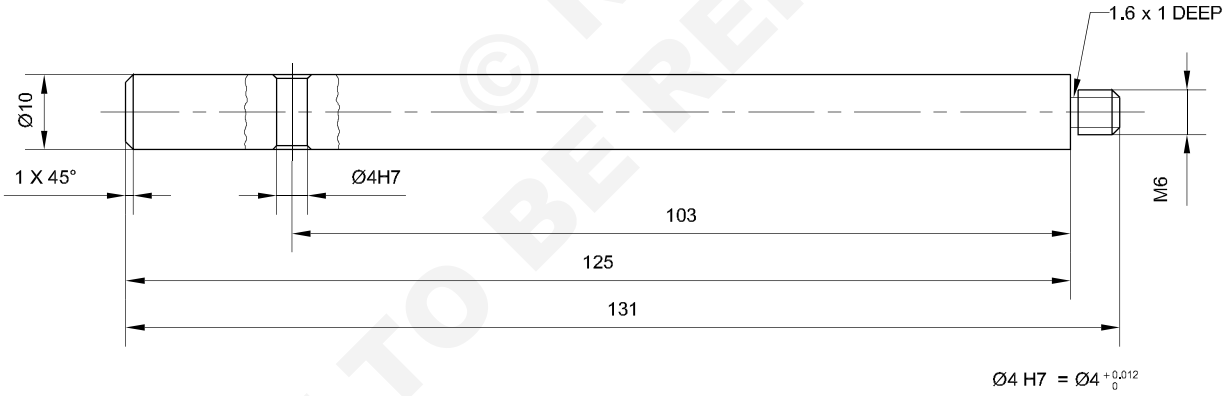


PART-08

TURNED
N7

Draw tool - Knock out rod

The trainees may be asked to write the job sequence.



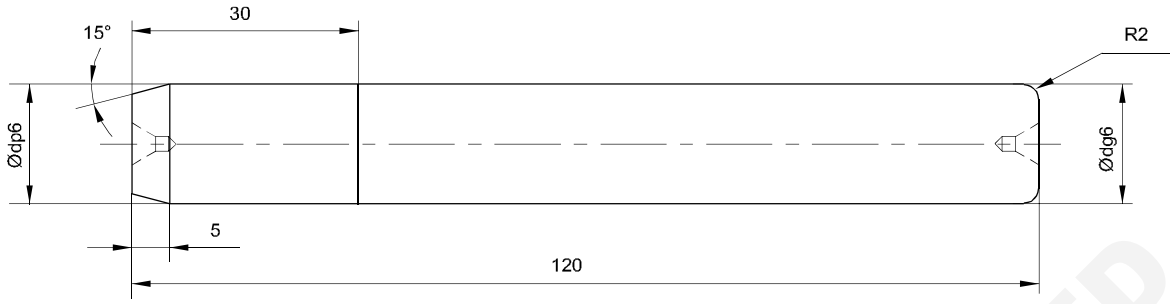
1	ISRO 16 - 137	-	Fe310	-	08	2.10.118
1	ISRO 25 - 140	-	Fe310	-	07	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DIE CUSHION ROD & KNOCK OUT ROD**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118E8	

PART-09

Draw tool - Guide pillar (2 Nos)

The trainees may be asked to write the job sequence.

GROUND N6 TURNED N7



Ø15 / 16 p6 = Ø15 / 16 $^{+0.029}_{+0.018}$

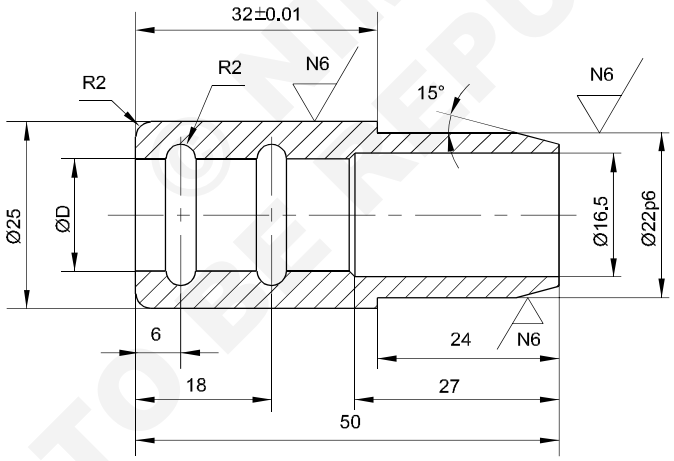
Ø15 / 16 g6 = Ø15 / 16 $^{-0.006}_{-0.017}$

	1	2
Ød	15	16

PART-10

Draw tool - Guide bush (2 Nos)

The trainees may be asked to write the job sequence.



Ø22 p6 = Ø22 $^{-0.035}_{-0.022}$

Ø15 / 16 H7 = Ø15 / 16 $^{+0.018}_{0}$

	1	2
ØD	15H7	16H7

2	ISRO 30 - 65	-	Fe310	-	10	2.10.118
2	ISRO 20 - 125	-	Fe310	-	09	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**GUIDE PILLAR & GUIDE BUSH**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118E7	

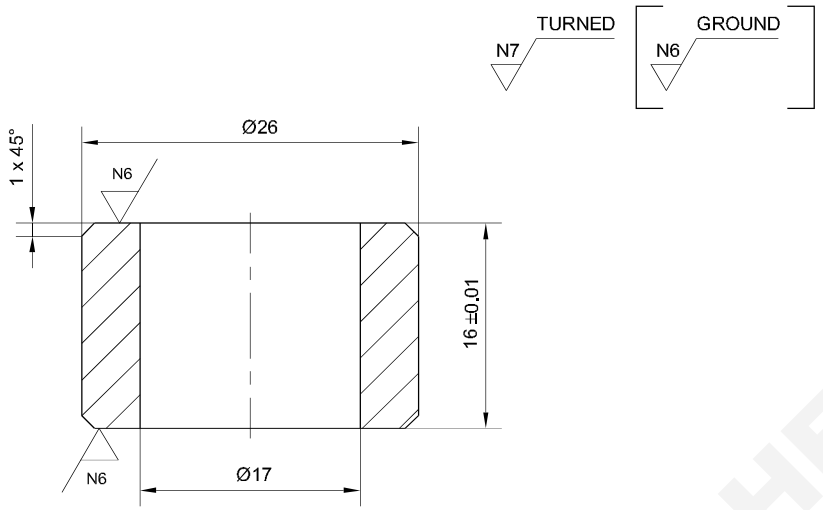
Draw tool - Stopper (2 Nos)

The trainees may be asked to write the job sequence.

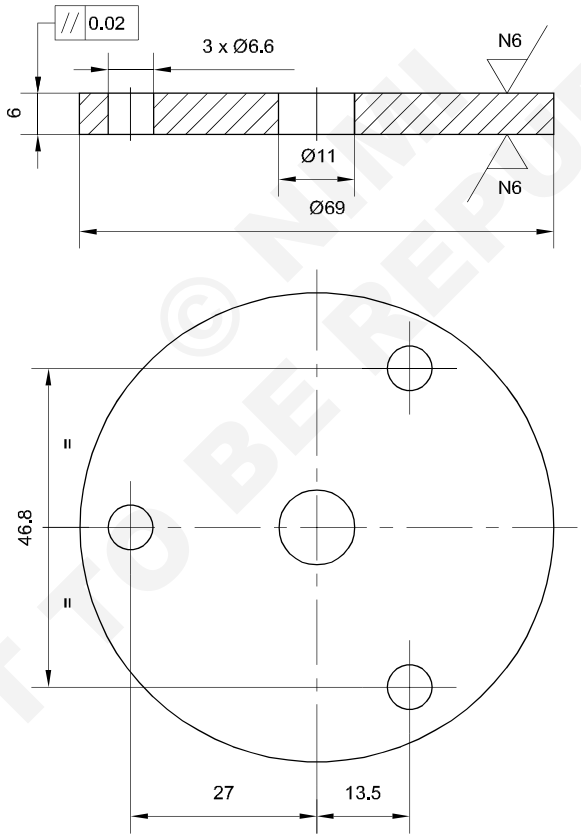
Draw tool - Back plate

The trainees may be asked to write the job sequence.

PART-11



PART-12

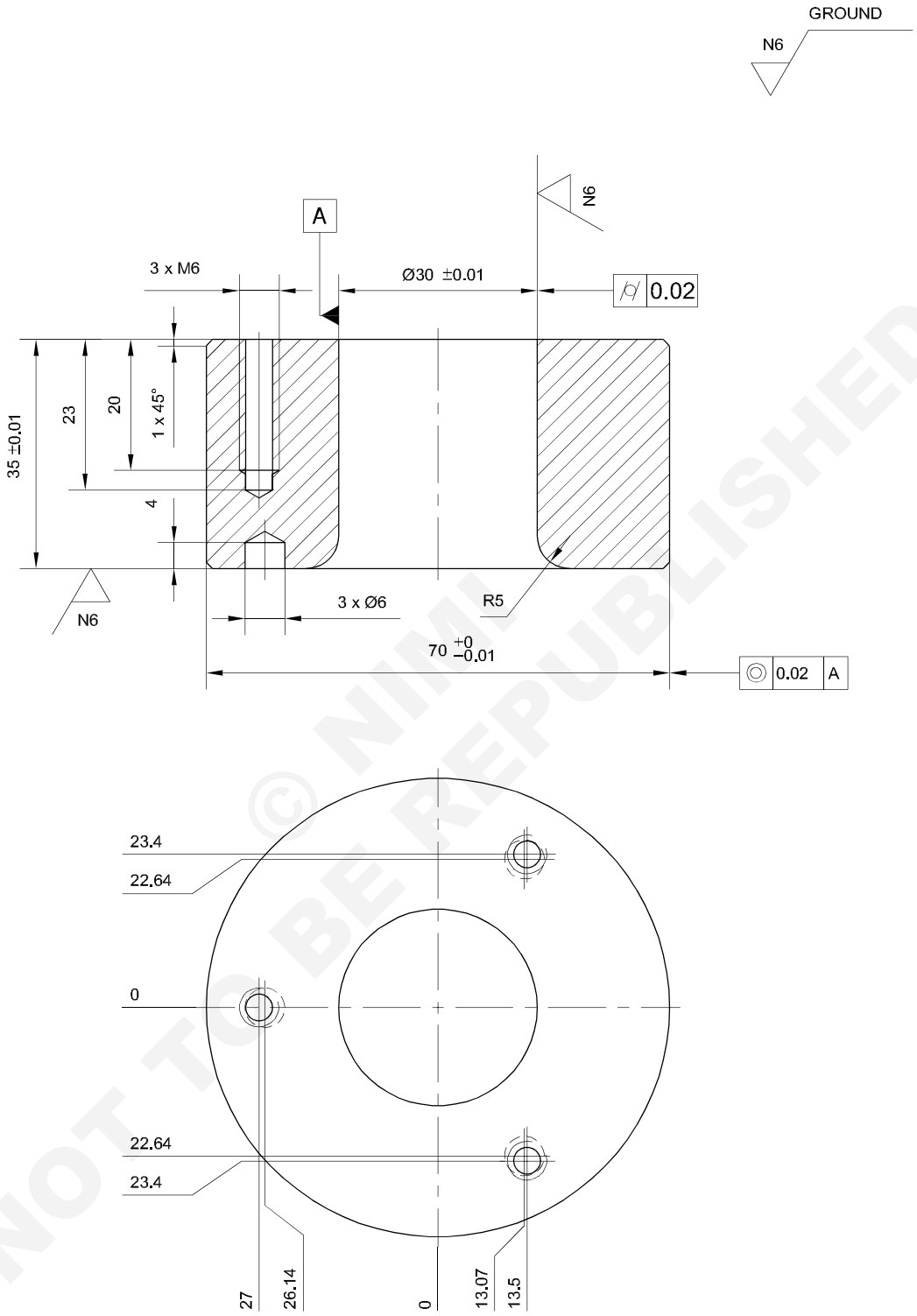


1	ISRO 80 - 15	-	Fe310	-	12	2.10.118
2	ISRO 32 - 25	-	Fe310	-	11	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 2:1	**STOPPER & BACK PLATE**	DEVIATIONS ± 0.1	TIME
		CODE NO. TJ20N210118E8	

Draw tool - Draw die

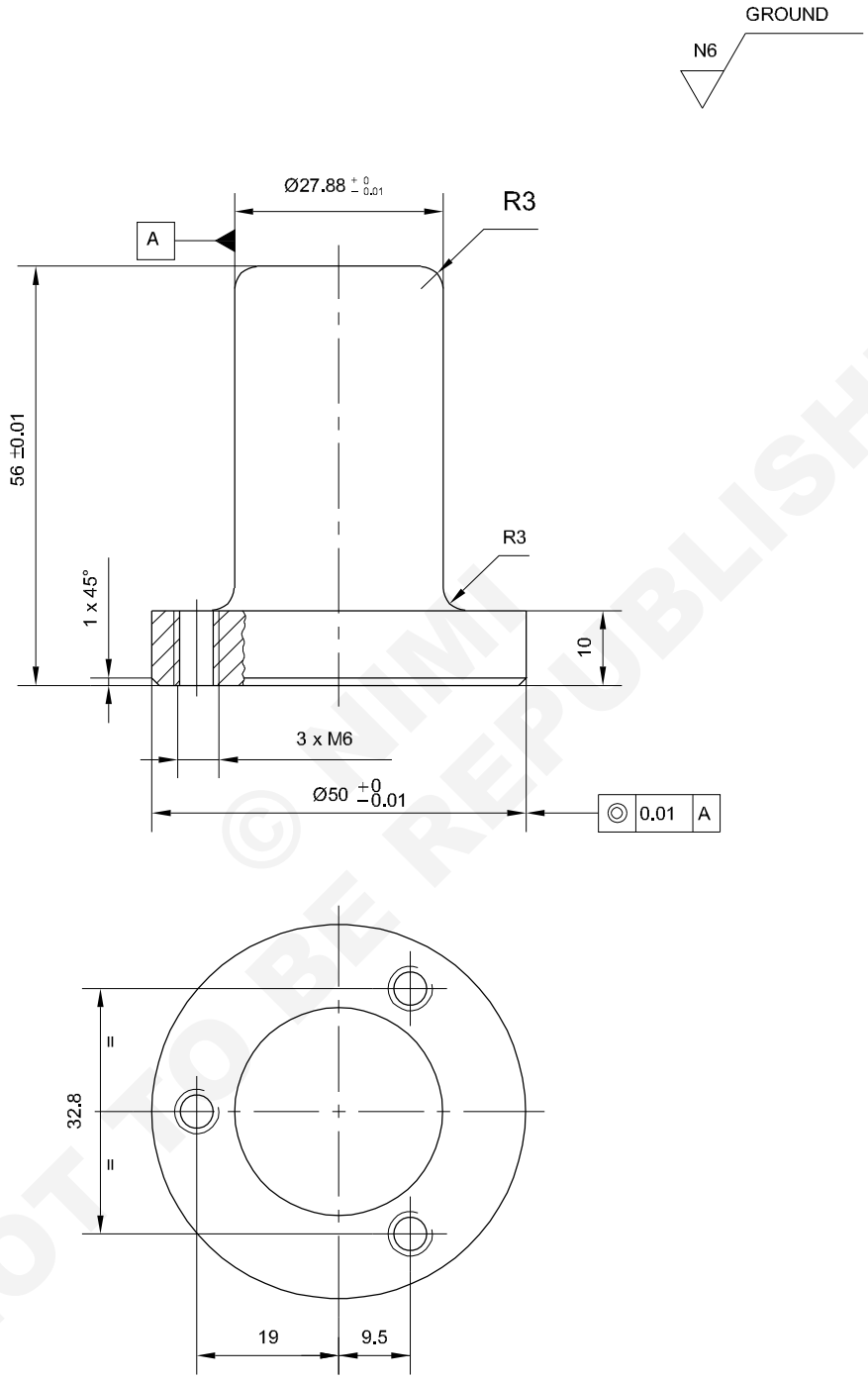
The trainees may be asked to write the job sequence.



1	ISRO 80 - 40	-	Fe310	-	13	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DRAW DIE**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118E9	

Draw tool - Draw punch

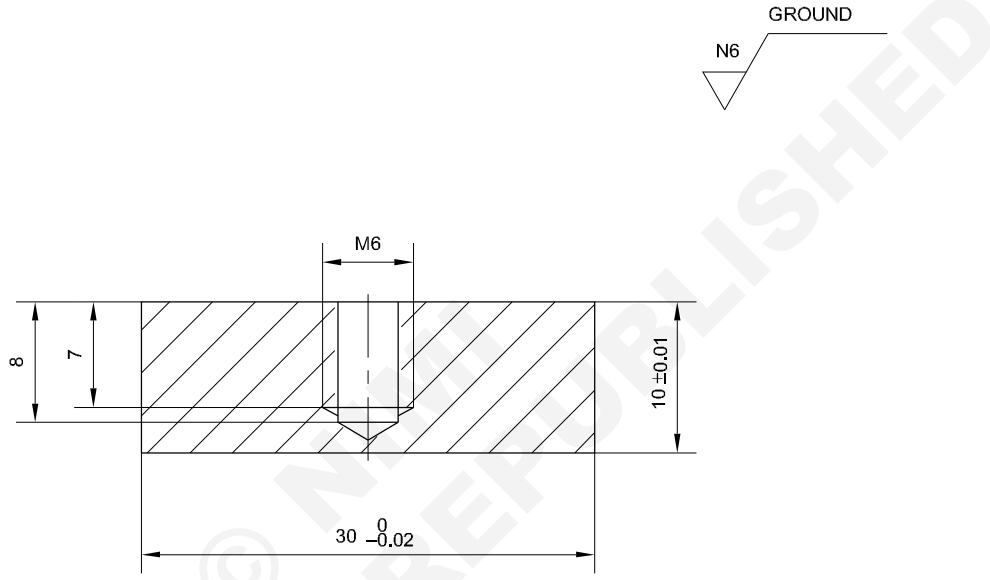
The trainees may be asked to write the job sequence.



1	ISRO 56 - 60	-	Fe310	3P4	14	2.10.118
NO.OFF	STOCK SİZE	SEMI-PRODUCT	MATERİAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DRAW PUNCH**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118EA	

Draw tool - Shedder

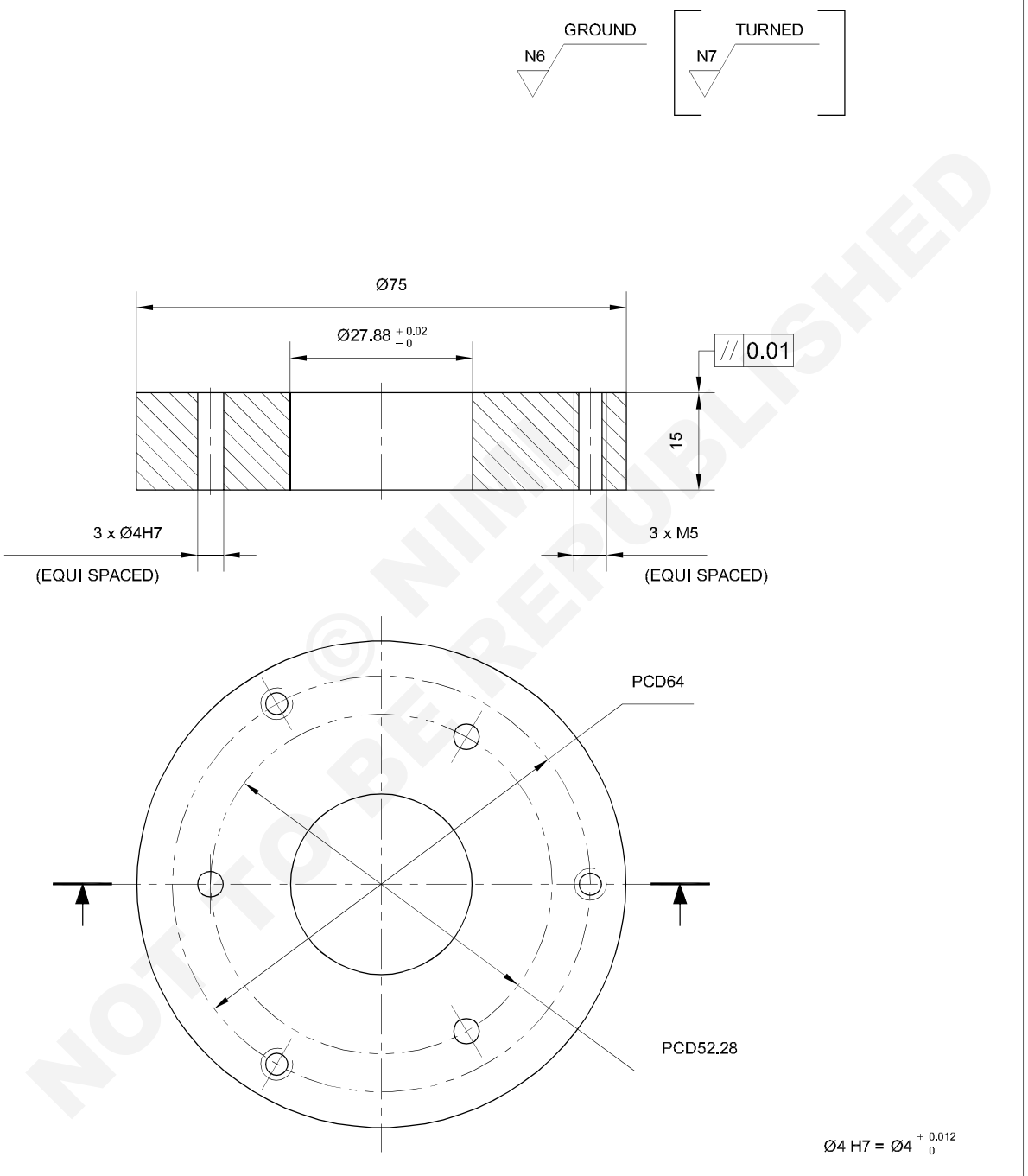
The trainees may be asked to write the job sequence.



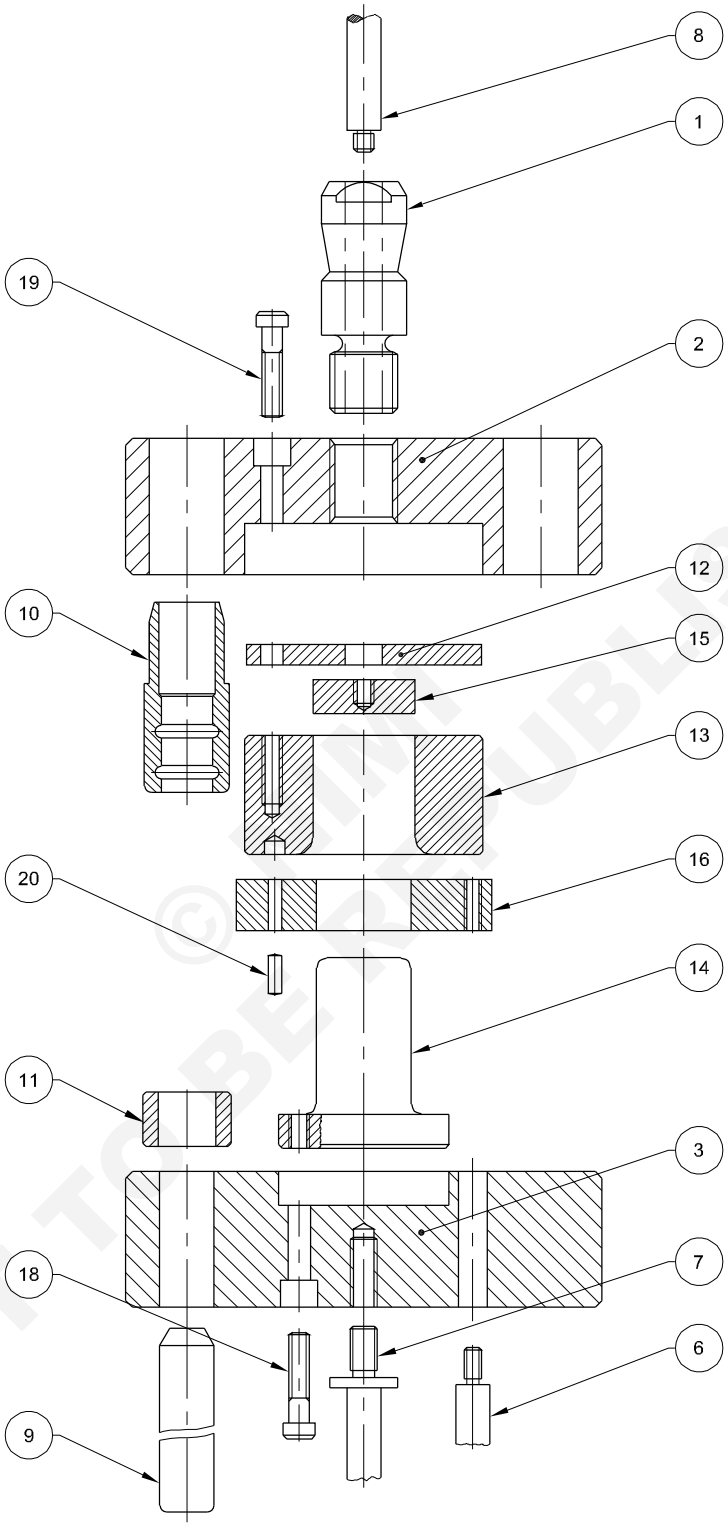
1	ISRO 36 - 20	-	Fe310	-	15	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 2:1	**SHEDDER**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJN210118EB	

Draw tool - Pressure pad

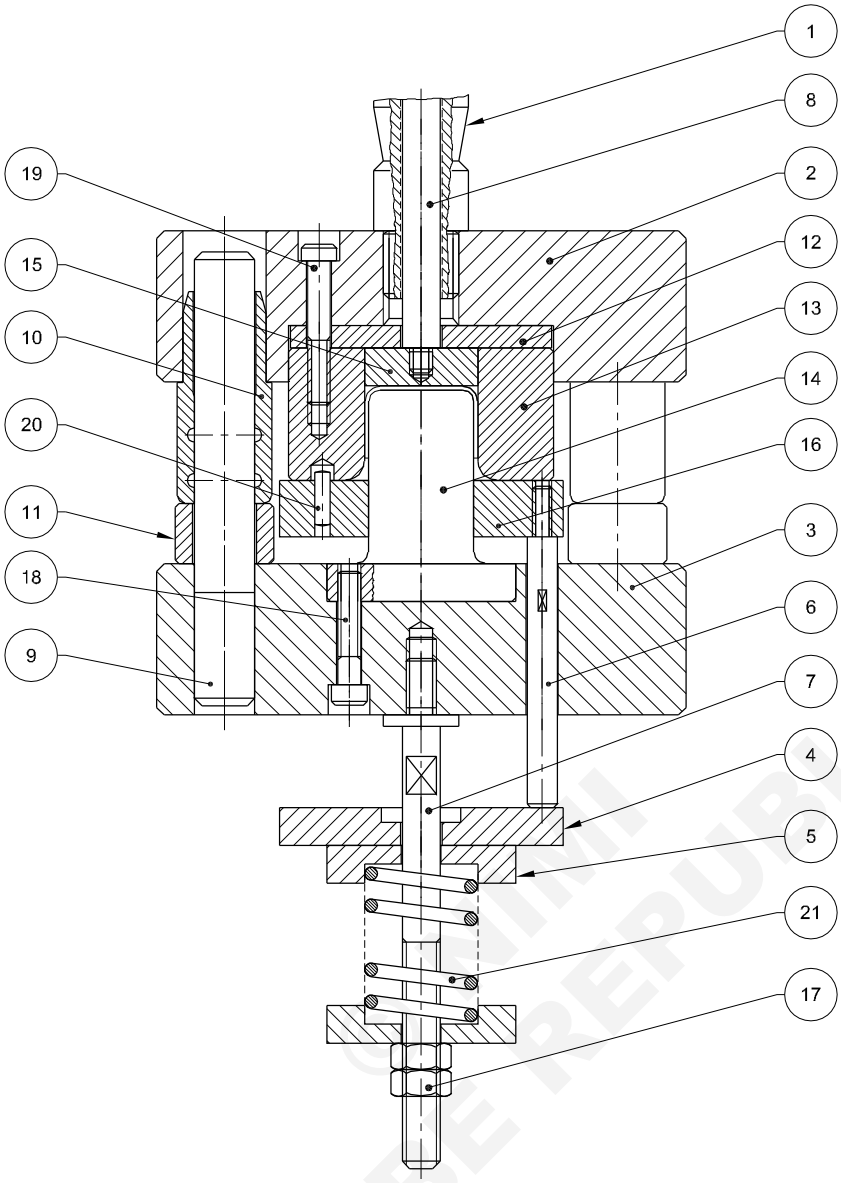
The trainees may be asked to write the job sequence.

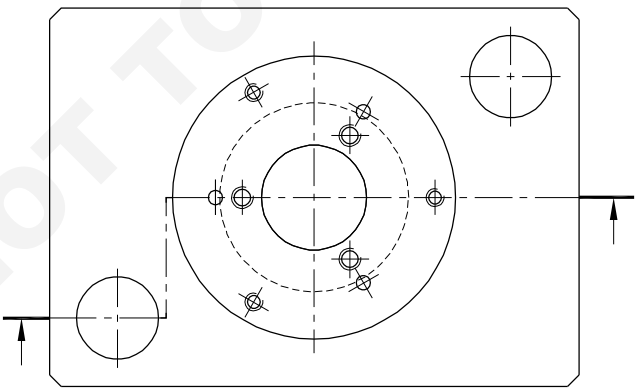


1	ISRO 80 - 25	-	Fe310	-	16	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**PRESSURE PAD**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118EC	



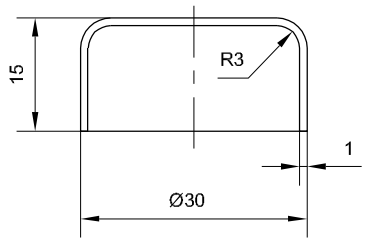
		-		-		2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE		DRAW TOOL ASSEMBLY			DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118ED	





-	-	-	-	-	-	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					DEVIATIONS ± 0.1	TIME
	DRAW TOOL ASSEMBLY				CODE NO. TJ20N210118EE	

Component trial



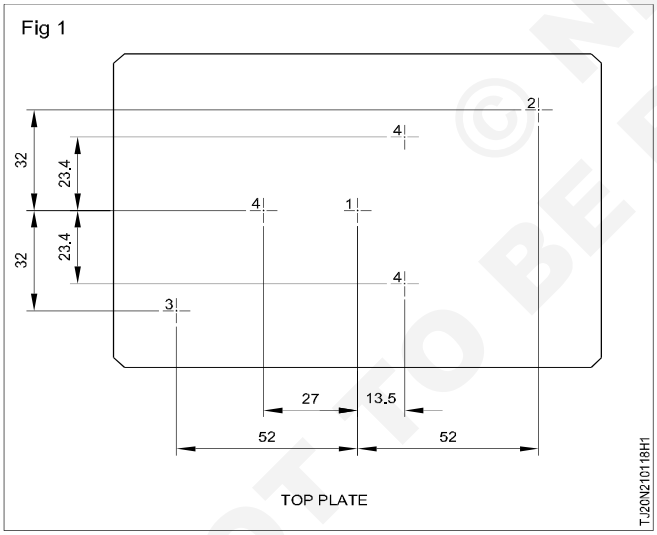
1	1 x Ø50	-	ALUMINIUM	-	-	2.10.118
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	**DRAW TOOL COMPONENT**				DEVIATIONS ± 0.1	TIME
					CODE NO. TJ20N210118EF	

Job sequence

Praparation for drawing die for assembly

- Clean all parts, deburr
- Apply marking media and mark on top plate (part 2) as per drawing and centre punch it on pressure pad
- Similarly mark and punch on pressure pad (part 16) and bottom plate (part 3)
- Make a mock plug as per drawing. (Fig 1)

Fig 1



- Set part as per drawing aligning bottom and top plate datum are same level/line and clamp by parallel clamps as shown in Fig 2.
- Clamp the above set up on drilling machine table over a parallel block as shown in Fig 3.
- Drill and ream at position ‘2’ to 2 dia 2H7.
- Similarly at position ‘3’ drill & ream to dia 15 H7 through upto bottom plate and then enlarge the hole on top plate to dia 22 H7.
- Drill 3-holes at position ‘4’ to dia 5.2mm upto draw die to 54mm deep from top plate (25+6+23) and then enlarge hole to dia 6.6 on top plate and back plate to 3mm/deep (25+6). Then C’ bore - 3 holes at position ‘4’ to dia 11x8 deep on top plate.

Fig 2

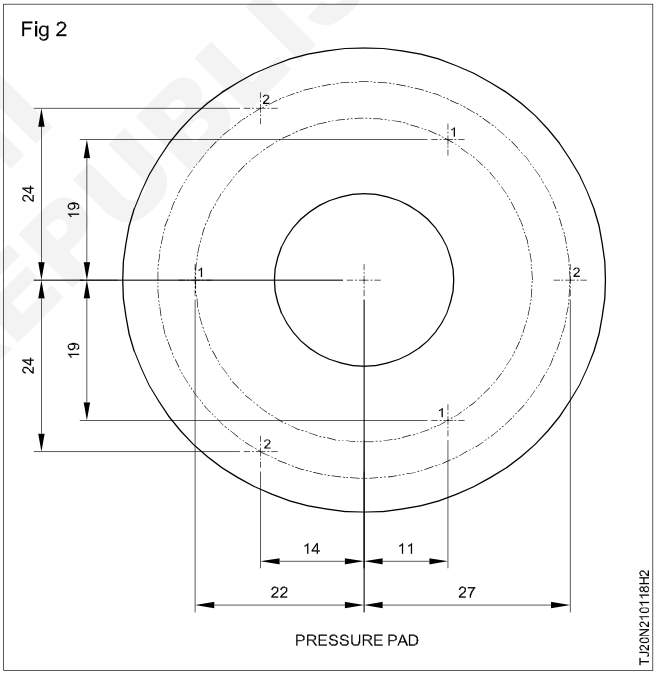


Fig 3

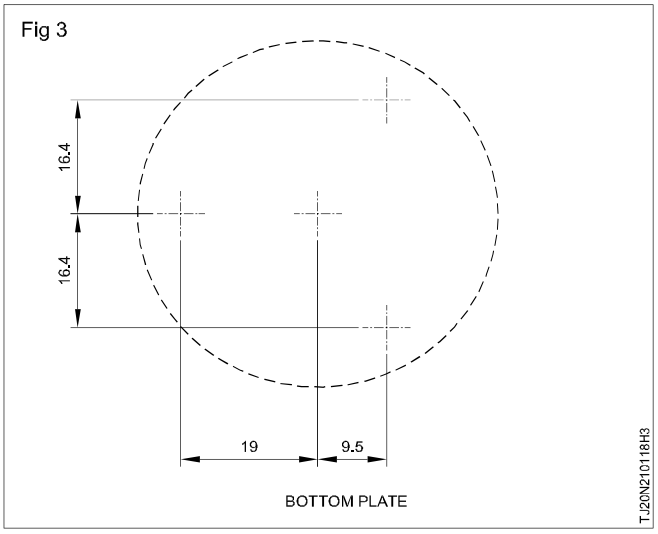


Fig 4

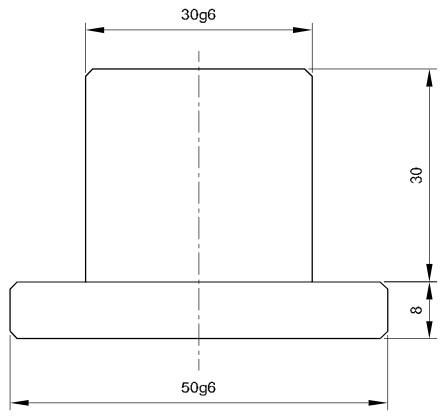


Fig 5

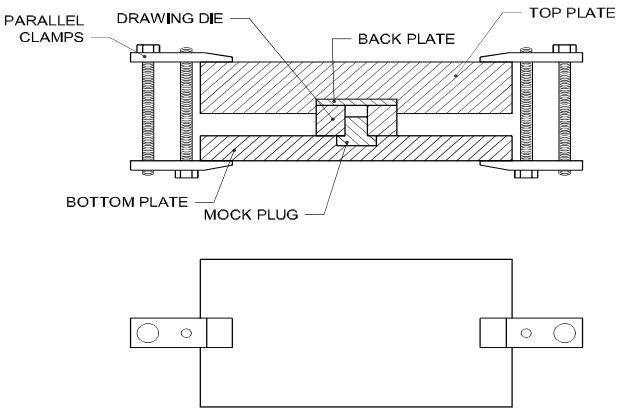
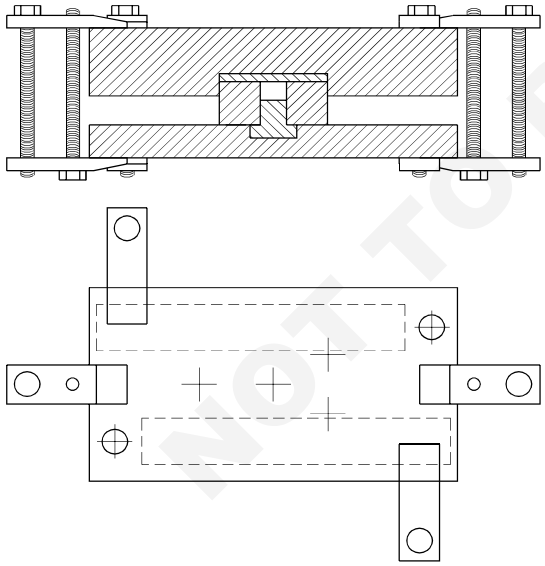
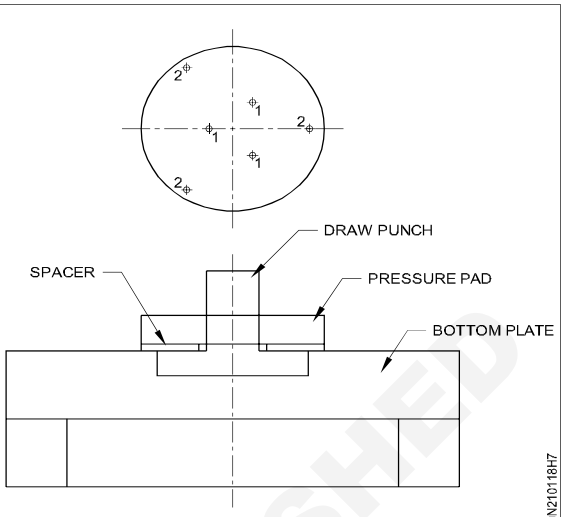


Fig 6



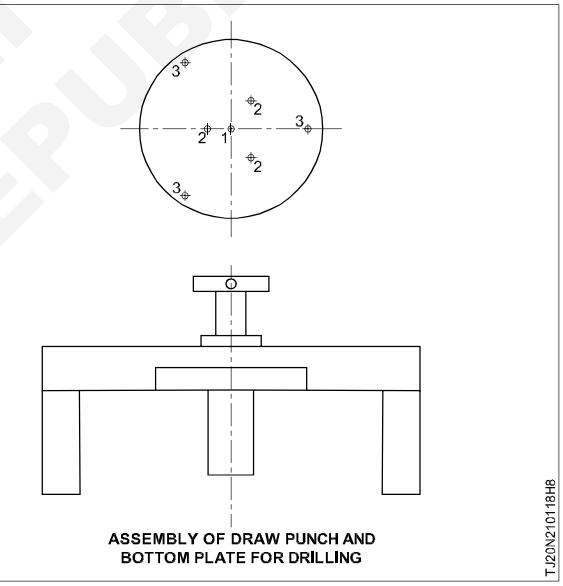
- Remove top plate back plate and draw die.
- Set bottom plate and draw punch at a spacer and pressure pad and clamp with parallel clamp as shown in Fig 7.
- Fix the above arrangement for drilling.
- Drill and ream 3 holes dia 4H7 upto pressure pad only.
- Drill 3 holes dia 4.5 (for M5 tapping) through upto bottom plate.
- Remove pressure pad and spacer.

Fig 7



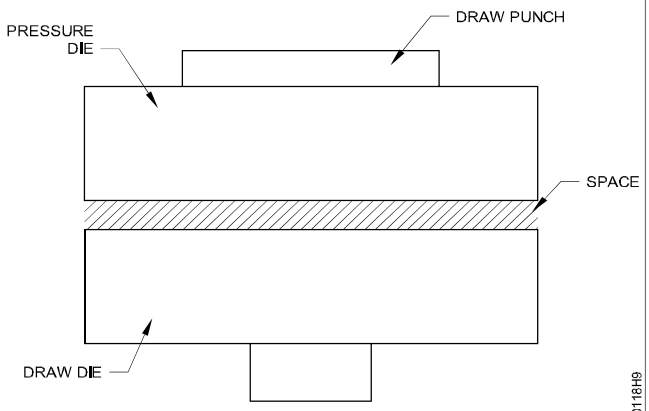
- Set bottom plate and draw punch together by parallel clamp.

Fig 8



- Fix bottom pad and draw punch and clamp for drilling as shown in Fig 8.
- Drill one hole dia 7.2x23 deep and chamfer it (for M8 tapping).
- Drill 3 holes dia 5.2 through.
- Enlarge 3 holes to dia 6.6 upto bottom plate only, then C' bore to dia 11x8mm deep.
- Drill 3 holes on predrilled holes of dia 4.5 to dia 8.5.
- Cut 0.5 thick aluminium sheet 20mm width to 180 length bend around draw punch in circular shape.
- Deburr, clean all parts for assembly.
- Set draw die and pressure pad with parallel clamp using draw punch by inserting circular shaped 1mm thick and 20mm width between draw punch and draw die for alignment and clamp for drilling.

Fig 9



ASSEMBLY OF PRESSURE PAD AND DRIVING DIE FOR DRILLING

- Drill dia 4x4 deep by tracing the prereamed 3 holes of dia 4mm.
- Remove and clamp draw die and clamp for drilling dia 6.3 holes to 4mm deep on predrilled holes of dia 4mm.
- Tap - M20x1.5 on top plate.
- Tap - M8x20 deep on bottom plate.
- Tap - M6x20 deep on draw die (3 holes).
- Tap - M6 on draw punch (3 holes).
- Tap - M6 on shedder.
- Tap - M5 on pressure pad (3 holes).

Skill sequence

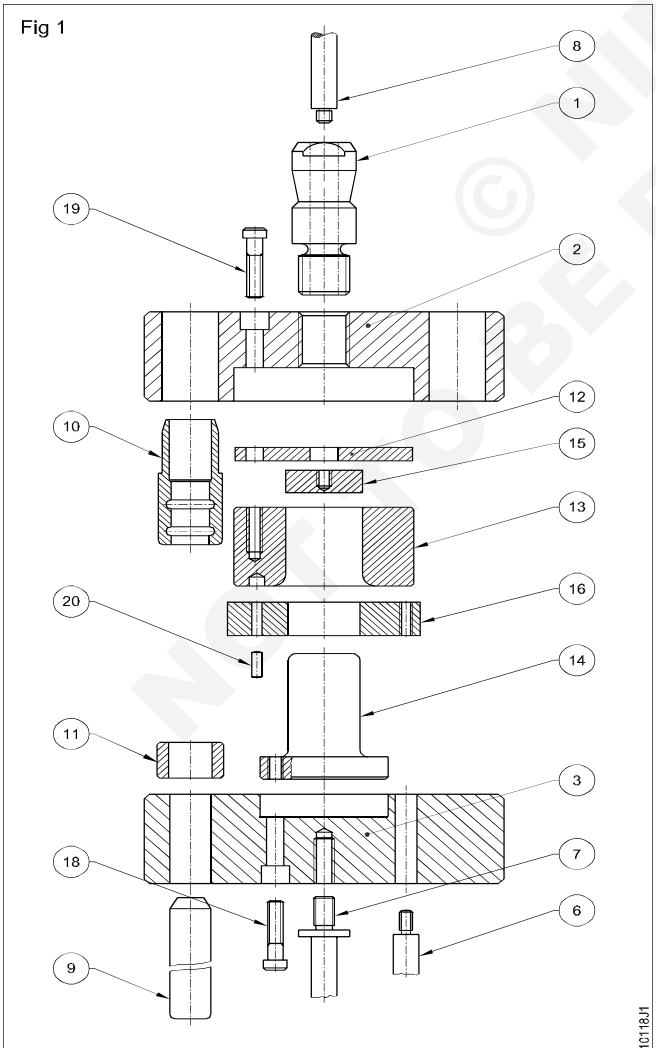
Assembling of drawing die

Objectives: This shall help you to

- **collect and check all the parts for its dimensions**
- **assemble the parts as per drawing**
- **mount the die on fly press**
- **take a trial cut and inspect the component for its shape and size.**

Assemble the drawing die

Fig 1



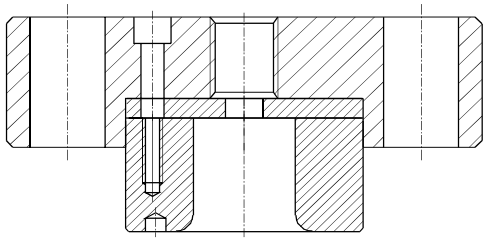
PARTS OF DRAWING DIE FOR ASSEMBLING

Collect all parts of drawing die, clean and check.

Assemble back plate (part 12) in top plate positioning the taped holes aligning with screw clearance holes in same axis.

Insert the draw die (part 13) in top plate positioning taped hole aligning with screw clearance axis as shown in (Fig 2)

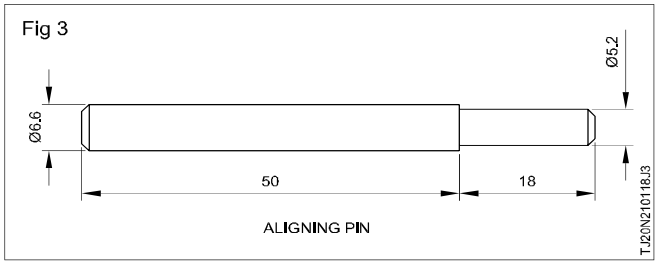
Fig 2



ASSEMBLY OF TOP PLATE

For aligning purpose use a stepped pin made to dia 6.6 - 0.05mm and dia 5.2mm - 0.05 to a length of 50mm with dia 5.2mm x 18mm step (Fig 3)

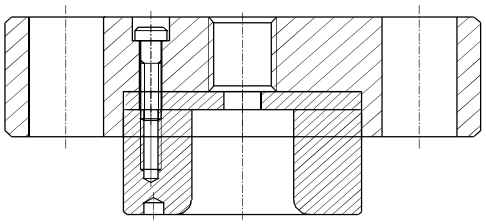
Fig 3



ALIGNING PIN

By hex.soc.hd.cap screws (part 19) tighten three parts gently. Do not overtight as shown in (Fig 4)

Fig 4



ASSEMBLY OF TOP PLATE

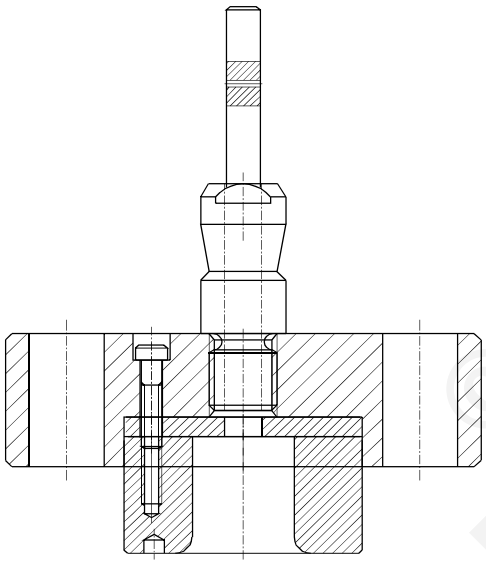
T.J20N210118.J4

Fix shank (part 01) to top plate (part 2) screwing and tight firmly using spanner.

Insert knock out rod (part 08) through shank (part 01) and screw on shedder.

Insert knock out rod (part 08) through shank (part 01) and screw on shedder (part 15), which is inserted through draw die (part 13) (Fig 5)

Fig 5



FIXING THE SHANK

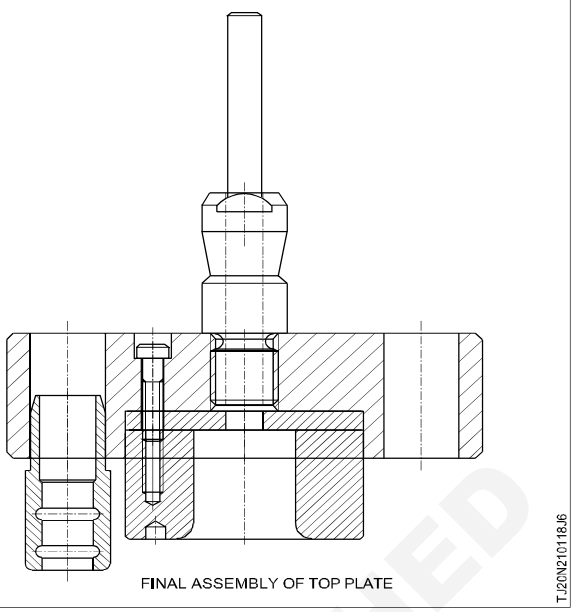
T.J20N210118.J5

13 Press guide bushes (part 10) in top plate (part 02) as shown in Fig 5

Assembly of draw punch assembly

- Insert the draw punch (part 14) in bottom plate (part 03) and fix by hex.soc.Head cap screw (part 18) and tight gently, not full tight.
- Insert dowel pin (part 20) in pressure pad, maintaining 3mm projecting out.
- Insert pressure pad (part 16) in draw punch.
- Insert transfer pin (part 06) through bottom plate (part 03) and screw it to pressure pad (part 16).
- Insert guide pillar (part 09) in bottom plate (part 03) and insert stopper (part 11) in pillars as shown in (Fig 6 & 7)

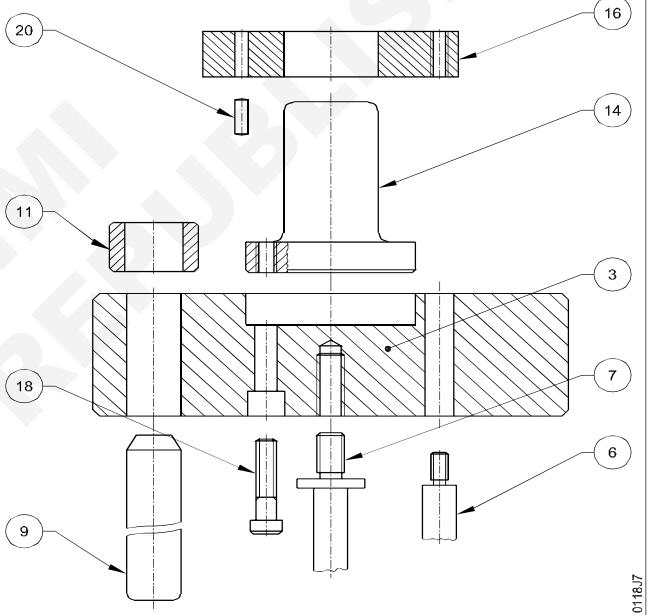
Fig 6



FINAL ASSEMBLY OF TOP PLATE

T.J20N210118.J6

Fig 7



ASSEMBLY OF DRAW PUNCH

T.J20N210118.J7

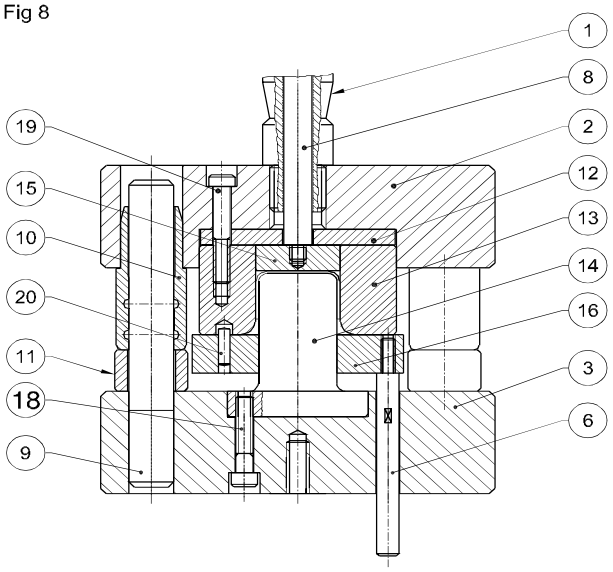
Assembly of bottom plate assembly with top plate assembly

- Place the cylindrical form of sheet around draw punch (part 14).
- Insert the top plate assembly over the bottom plate assembly guided by guide pillars through guide bush and positioning the dowels co-inside with drawing die, as well as the draw punch enters along with cylindrical sleeve into the drawing die. Now tight firmly on top plate with draw die.

Assembly of buffer plate (Fig 8 to 10)

- Position the nut (part 17) in die cushion rod (part 07) at certain distance with lock nut (part 17).

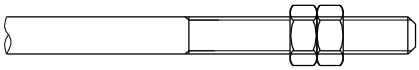
Fig 8



BOTTOM PLATE ASSEMBLY

T.J20N210118.J8

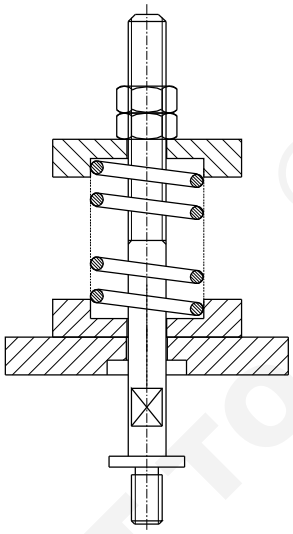
Fig 9



ASSEMBLY OF UNIT AND DIE CUSION ROD

T.J20N210118.J9

Fig 10

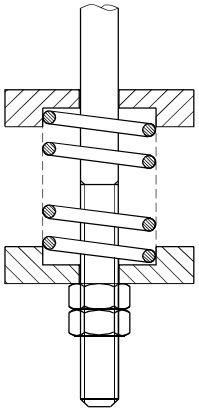


ASSEMBLY OF DIE CUSION DISC

T.J20N210118.JA

- Assemble die cushion discs (part 05) placing compression spring (part 21) in between the disc and insert in the cusion rod (part 07).
- Insert buffer plate (part 04) in die cushion rod (part 07) and rest over die cushion disc (part 05).
- Screw the above assembly to bottom plate (part 03) maintaining transfer pins (part 06) are resting over buffer plate. (part 04)

Fig 11

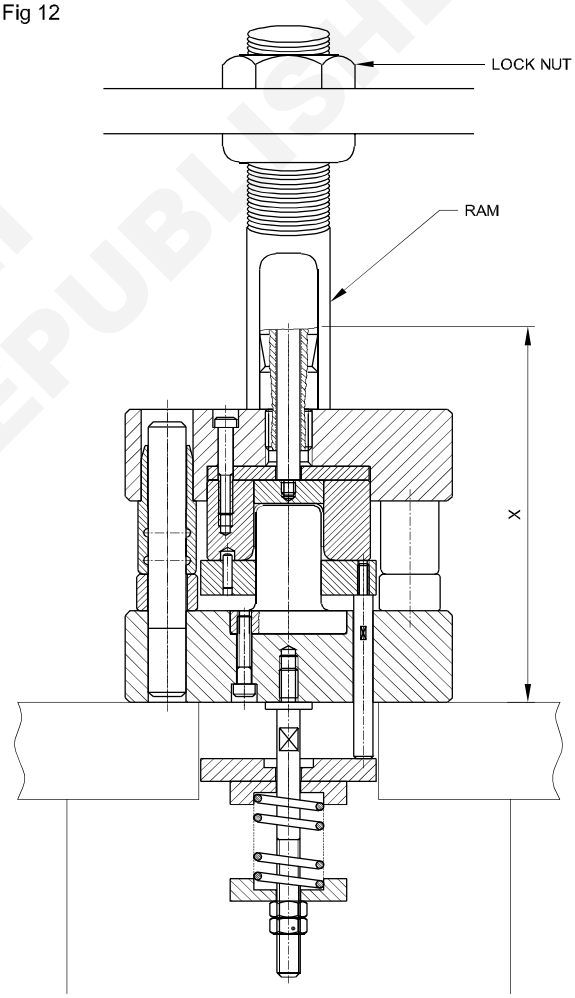


ASSEMBLY OF BUFFER PLATE

T.J20N210118.JB

Setting the drawing die assembly in a fly press (Fig 12 to 14)

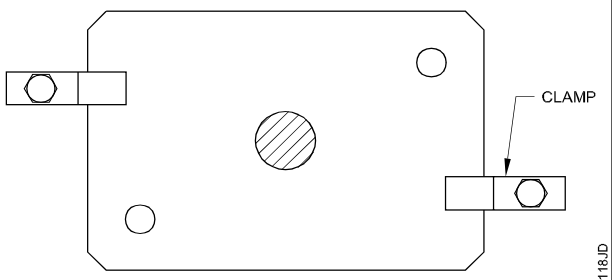
Fig 12



SETTING OF DRAWING DIE IN FLY PRESS

T.J20N210118.JC

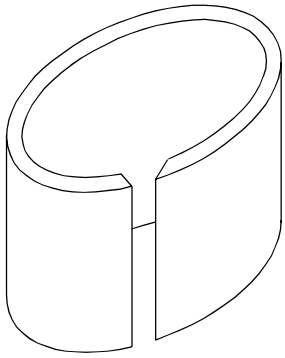
Fig 13



CLAMPING IN FLY PRESS

T.J20N210118.JD

Fig 14



SHIM

T.J20N210118.JE

- Adjust the ram position such that the gap in fly press approx. equal to height of the drawing die assembly.

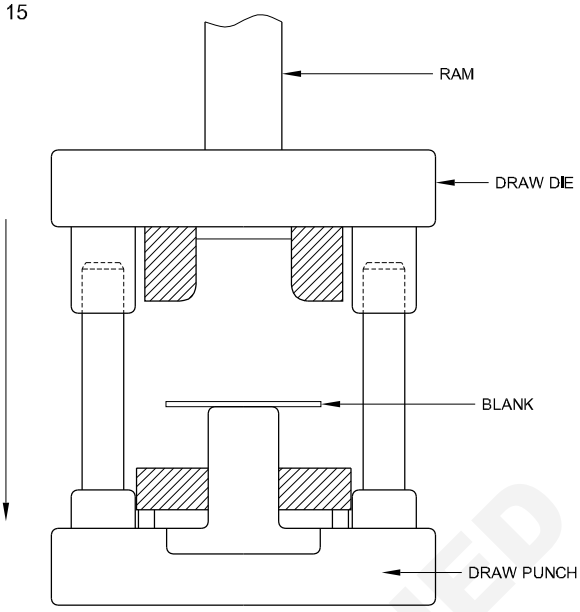
Note: Use die stop block

- Lock the lock nut of the fly press.
- Lift the ram of the fly press.
- Insert cylindrical form of sheet (made during drilling operation) into the drawing die.
- Move the ram slowly bring up, down towards drawing punch with shim (made during drilling open) such that the punch and draw die is self-aligned
- Tighten the bottom plate rigidly with base.
- Lift the ram upwards, remove shim from drawing punch, position the blank to accommodate on the pressure pad between the three pins. (Fig 15)

Note: Ensure all adjustment bolt are tightened

- Slowly bring down the ram until the punch reached to the shedder and lock nut of the ram.
- Lift the ram up, press down knock out rod such that the component is ejected out by knockout rod.

Fig 15



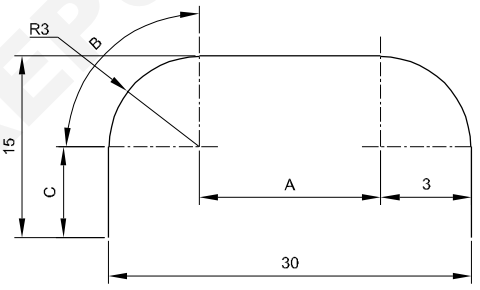
POSITIONING BLANK IN DRAWING DIE

T.J20N210118.JF

Note: Never attempt to punch more than one part at a time

- Check the component for shape, size and finish.
- Any defect found rectify. (Fig 16)

Fig 16



LAYOUT FOR CUP BLANK PROFILE

T.J20N210118.JG

The size of the blank required to draw out a cup

Dia of blank = A + 2B + 2c

A = 30 - 6 =24mm

$$B = \frac{2\pi r}{2} = \frac{2 \times 3.143 \times 3}{2}$$

= 9.429mm

C = 12 + 12 = 24mm

The size of the blank diameter

= 24 + 9.429 + 24

= 57.429 mm