

CNC MACHINING TECHNICIAN

NSQF LEVEL - 4

1st Year

TRADE PRACTICAL

SECTOR: CAPITAL GOODS & MANUFACTURING

(As per revised syllabus 2023 - 1200 Hrs)



Directorate General of Training

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



**NATIONAL INSTRUCTIONAL
MEDIA INSTITUTE, CHENNAI**

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

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Duration : 2 - Years

Trade : CNC Machining Technician - 1st Year - Trade Practical - NSQF Level - 4 (Revised 2023)

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, an autonomous body under Ministry of Skill Development & Entrepreneurship is entrusted with developing producing and disseminating Instructional Media Packages (IMPs) required for ITIs and other related institutions.

The institute has now come up with instructional material to suit the revised curriculum for **CNC Machining Technician 1st Year Trade Practical NSQF Level - 4 (Revised 2023) in Capital Goods & Manufacturing Sector under Annual Pattern**. The NSQF Level - 4 (Revised 2023) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 4 (Revised 2023) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 4 (Revised 2023) 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.,
Secretary
Director General (Training)
Ministry of Skill Development & Entrepreneurship,
Government of India.

February 2025
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 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 (NSQF) under the Craftsman and Apprenticeship Training Schemes.

The instructional materials are created keeping in mind, the main objective of Vocational Training under NCVET/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 **CNC Machining Technician NSQF Level -4 (Revised 2023)** under **Capital Goods and Manufacturing** Sector for ITIs.

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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 1st Year Course of **CNC Machining Technician under Capital Goods and Manufacturing Sector**. Trade supplemented and supported by instructions/informations to assist in performing the exercises. These exercises are designed to ensure that all the skills in compliance with NSQF LEVEL - 4 (Revised 2023) syllabus are covered. The manual is divided into Ten modules.

Module 1	-	Safety and House Keeping
Module 2	-	Basic Turning and Milling
Module 3	-	Industrial Drawing and Specification
Module 4	-	Product Inspection
Module 5	-	CNC Tooling's and Work Holding Devices
Module 6	-	CNC Turning - Basic
Module 7	-	CAM - Basic
Module 8	-	CNC Turning - Advanced
Module 9	-	CAM - Advanced
Module 10	-	CNC Maintenance

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 **CNC Machining Technician Trade**. The contents are sequenced according to the practical exercise contained in NSQF LEVEL - 4 (Revised 2023) syllabus on Trade Practical. Attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptual 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.

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

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16	Create, simulate, execute an external Grooving, parting -off & threading operation using Canned cycles (NOS: CSC/N9561)	1.6.73 & 1.6.74
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19	Create, simulate, execute an internal profile turning operation using stock removal cycles. (NOS: CSC/N9561)	1.6.79 & 1.6.80

LEARNING / ASSESSABLE OUTCOME

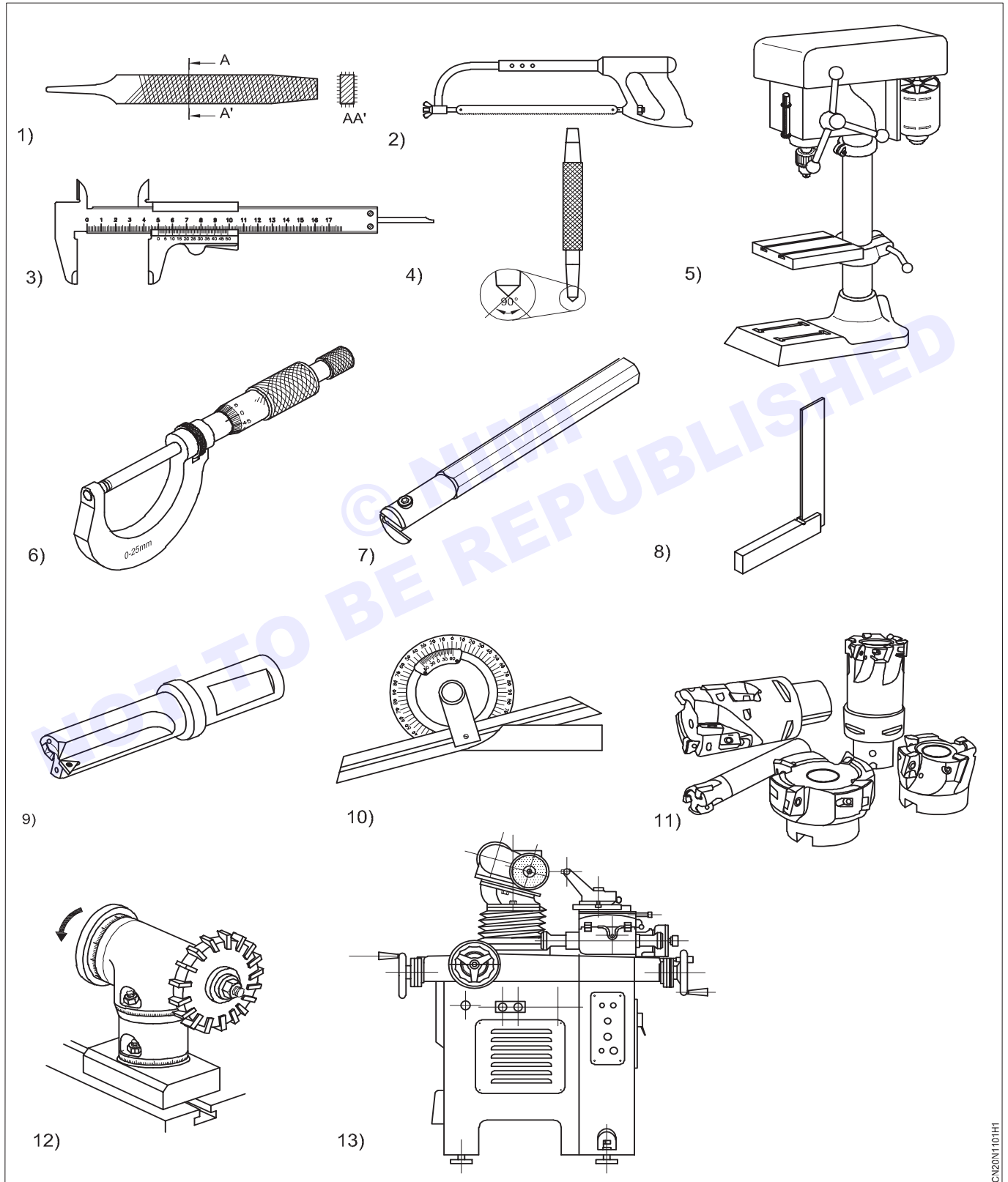
On completion of this book you shall be able to

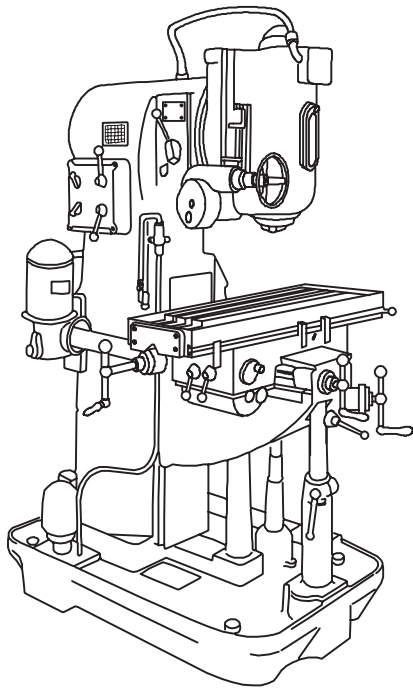
Sl. No.	Learning Outcome	Exercise No.
20	Create, simulate, execute an internal Grooving, parting -off & threading operation using Canned cycles (NOS: CSC/N9561)	1.7.81 - 1.7.85
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Importance of safety training, list of tools & machinery used in the trade

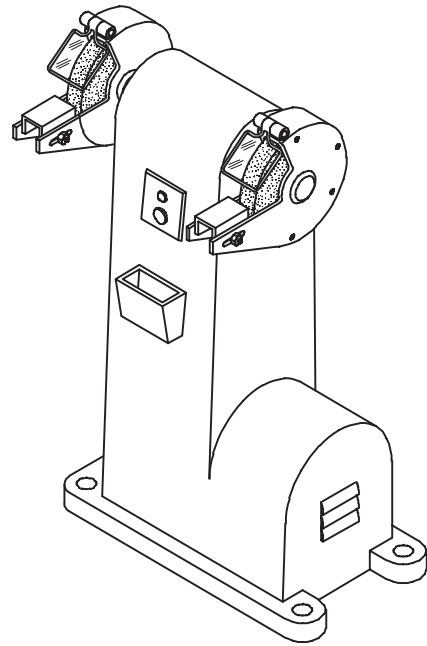
Objectives: At the end of this exercise you shall be able to

- identify the tools and equipments used in CNC machining trade
- record the name of tools, do's and dont's of each tool.

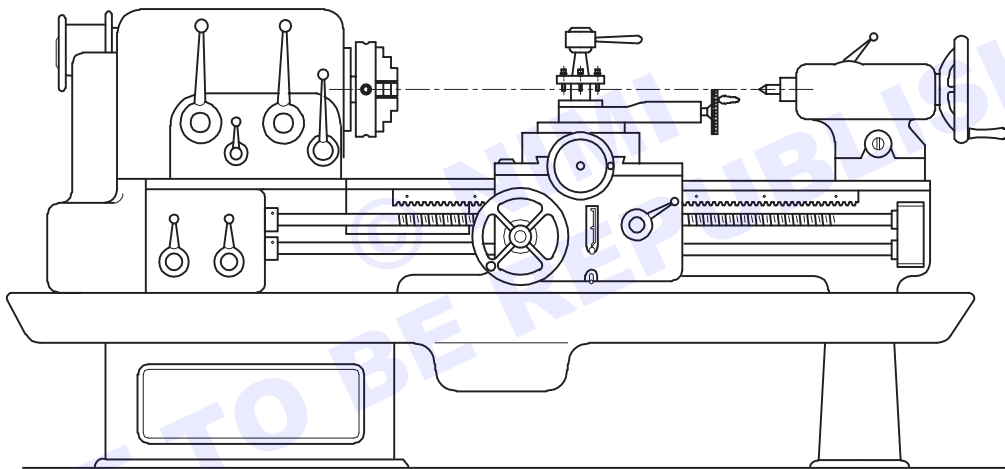




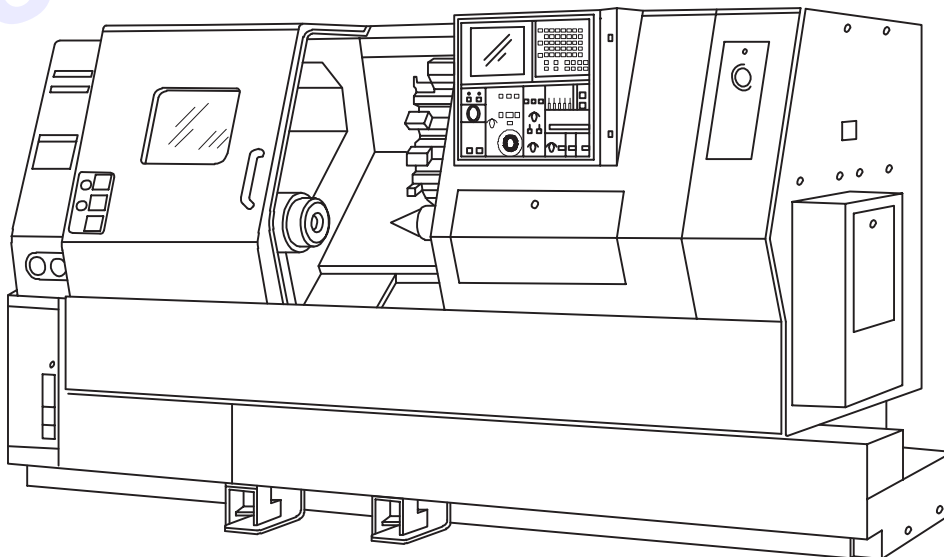
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15)



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Job Sequence

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

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

Table 1

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

- Get it checked by the instructor.

— — — — —

Basic needs of Personal Protective Equipment (PPE)

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

- identify personal protective devices
- interpret the different types of personal protective devices.

Fig 1



(1)



(2)



(3)



(4)



(5)



(6)



(7)



(8)



(9)

Job Sequence

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

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

Ask the trainees to practice it.

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

Table 1

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

- Get it checked by your instructor.

— — — — —

First aid method and basic training

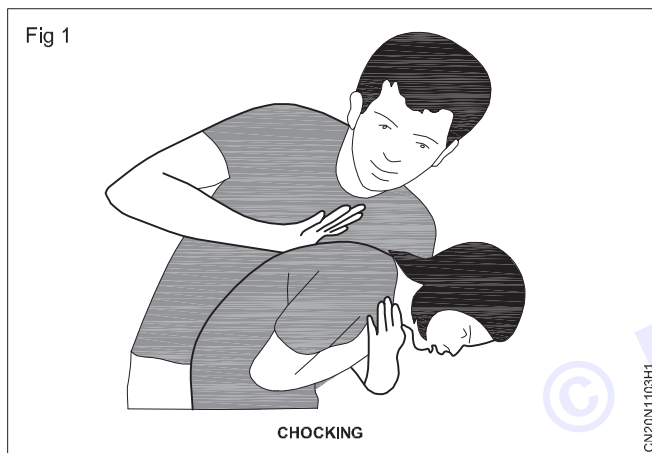
Objectives: At the end of this exercise you shall be able to

- provide first aid for choking, wound, burn, bites and sting on human
- take care a person with, eye injury, nose bleeding, diabetes, heat exhaustion first aid treatment
- give first aid treatment to person with heat stroke.

Job Sequence

TASK 1: Chocking

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



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

TASK 2: Wound (Figs 1 & 2)

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

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



- Dress the wound with cotton bandage (Fig 2)



TASK 3: Burns (Figs 1, 2 & 3)



Treating minor burns

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

TASK 4: Bites and Stings (Figs 1, 2 & 3)



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

TASK 5: Eye Injury (Figs 1 & 2)

Fig 1



- Ask patient to look up.
- Draw lower eyelid down. If object visible, remove with corner of moist cloth.
- If not visible, pull upper lid down.

- If unsuccessful, wash eye with sterile saline or clean water.
- If still unsuccessful, cover injured eye only and seek medical aid.

Fig 2



TASK 6: Nose Bleedings (Figs 1 & 2)

Fig 1



- Make a patient to sit straight and bend forward the head portion only (This will reduce blood pressure in the Veins of your nose)
- Ask the patient to breathe out from the nose.
- Pinch the nose to take out the blood in the nose.

- To prevent re-bleeding, don't pick or blow your nose and don't bend down for several hours.
- If re-bleeding occurs, go through these steps again.

Fig 2



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

- Follow the Basic First Aid Plan to assess the casualty.
- Give high-energy foods or sugar.
- Only give food if the casualty is conscious.

- If medical aid is delayed give sugar every 15 minutes.
- The casualty will recover quickly if low blood sugar level is the cause.

Fig 1



Fig 2



TASK 8: Heat exhaustion (Figs 1 & 2)

Heat exhaustion

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

Fig 1



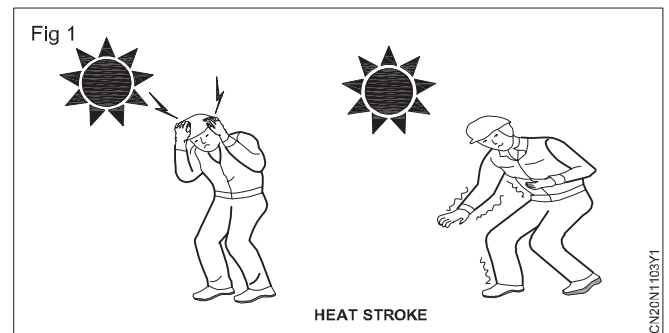
Fig 2



TASK 9: Heat stroke

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

Fig 1



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

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

- Check quickly whether the victim is under cardiac arrest.

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

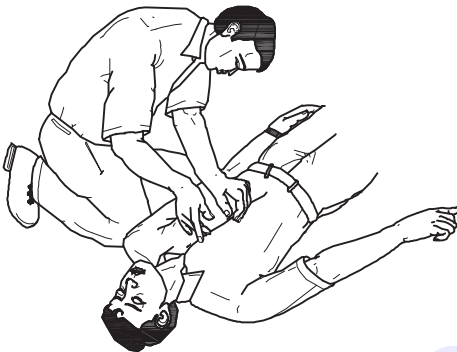
Fig 1



CN20N1103Z1

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

Fig 2



CN20N1103Z2

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

Fig 3



CN20N1103Z3

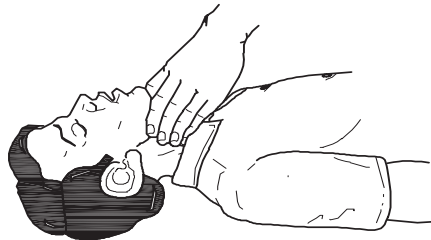
- Keeping your arms straight, press sharply down on the lower part of the breastbone; then release the pressure. (Fig 4)
- Repeat step above, fifteen times at the rate of at least once per second.
- Check the cardiac pulse. (Fig 5)
- Move back to the victim's mouth to give two breaths (mouth-to-mouth resuscitation). (Fig 6)
- Continue with another 15 compressions of the heart followed by a further two breaths of mouth-to-mouth resuscitation, and so on, check the pulse at frequent intervals.

Fig 4



CN20N1103Z4

Fig 5



CN20N1103Z5

Fig 6



CN20N1103Z6

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

Fig 7



CN20N1103Z7

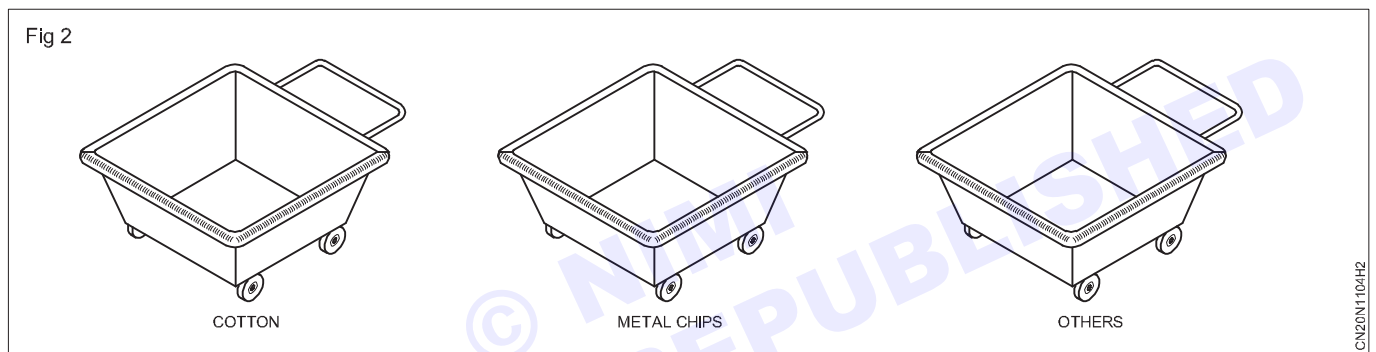
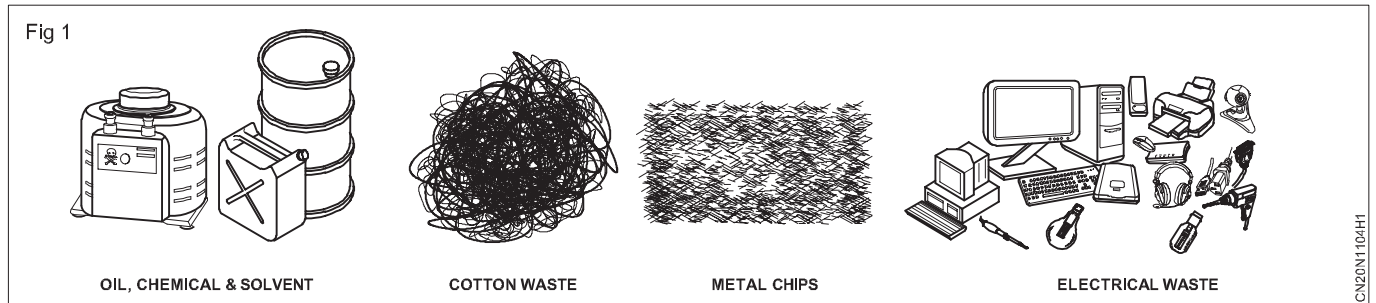
Other steps

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

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

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

- identify and segregate the waste material in workshop
- arrange the waste material in different bins.



Job Sequence

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

Do not handle the chip by bare hand
There may be different metal chips. So separate the chip according to metal.

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

Each bin should have name of the material.

Identify the material given in Fig 1 and fill in Table 1

Table 1

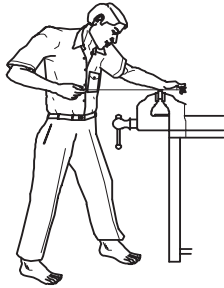
Sl. No.	Name of the material
1	
2	
3	
4	

Hazard identification and avoidance

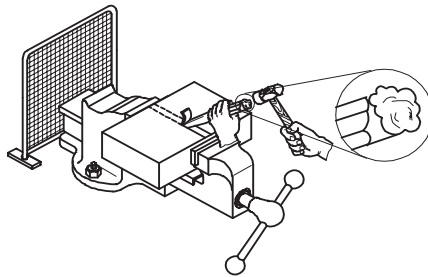
Objectives: At the end of this exercise you shall be able to

- identify the occupational hazards
- suggest suitable methods to avoid occupational hazards.

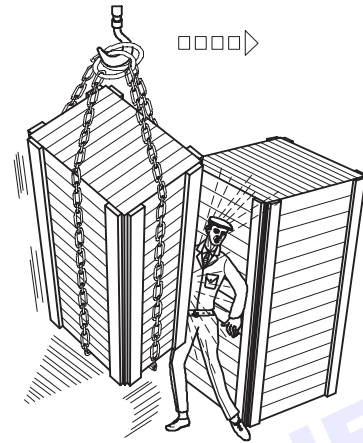
Fig 1



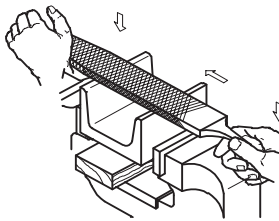
1 WORKING BARE FOOT IN SHOP FLOOR



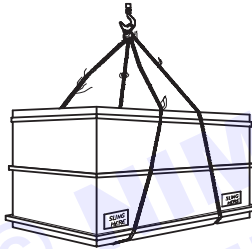
5 CHIPPING METAL SURFACE WITH MUSHROOM HEAD CHISEL



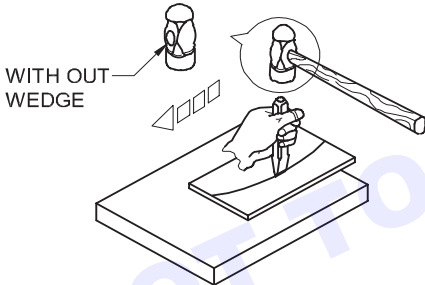
8 LIFTING A LOAD WHILE PEOPLE WORKING NEARBY



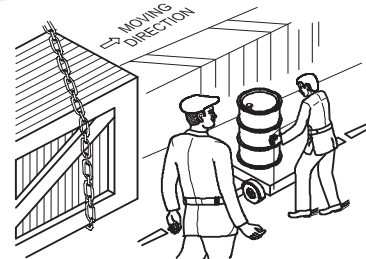
2 USING FILE WITHOUT HANDLE



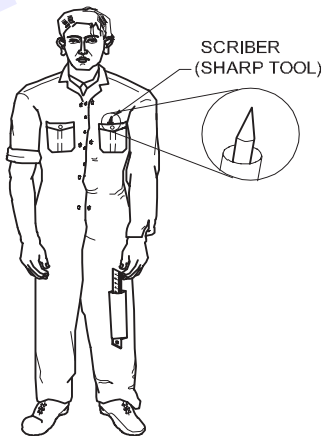
6 LIFTING LOAD WITH DAMAGED SLINGS



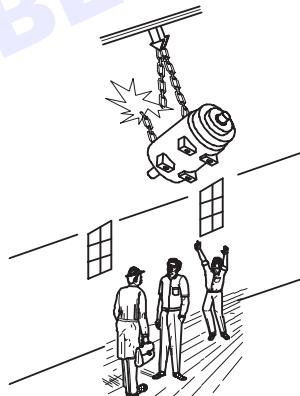
3 STRIKING ON CHISEL HEAD WITH BALL PEIN HAMMER WITHOUT WEDGE



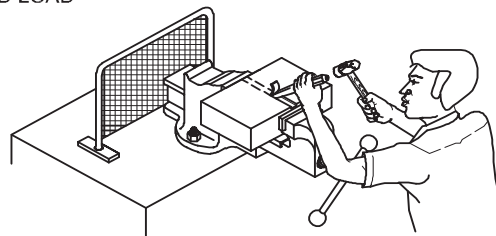
9 NO OBSTACLE WHILE MOVING THE LOAD



4 KEEPING SCRIBER SHARP EDGE OPEN IN POCKET



7 STANDING BELOW A SUSPENDED LOAD



10 CHIPPING ON METAL SURFACE WITHOUT SAFETY GOGGLES

Job Sequence

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

- Study the drawing of industrial hazards.

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

Table 1

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

- Get it checked by your instructor.

— — — — —

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

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

- identify the basic categories of safety sign
- record the meaning of safety sign in the table given.

Fig 1



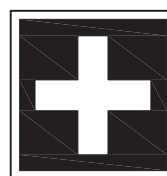
(1)



(2)



(3)



(4)



(5)



(6)



(7)



(8)



(9)



(10)



(11)



(12)



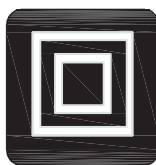
(13)



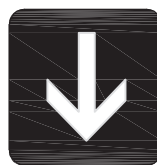
(14)



(15)



(16)



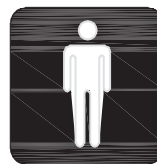
(17)



(18)



(19)



(20)

Job Sequence

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

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

Table 1

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

- Get it checked by your Instructor.

— — — — —

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

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

- adopt preventive measures to avoid electrical accidents
- take care of a person with electrical accident.

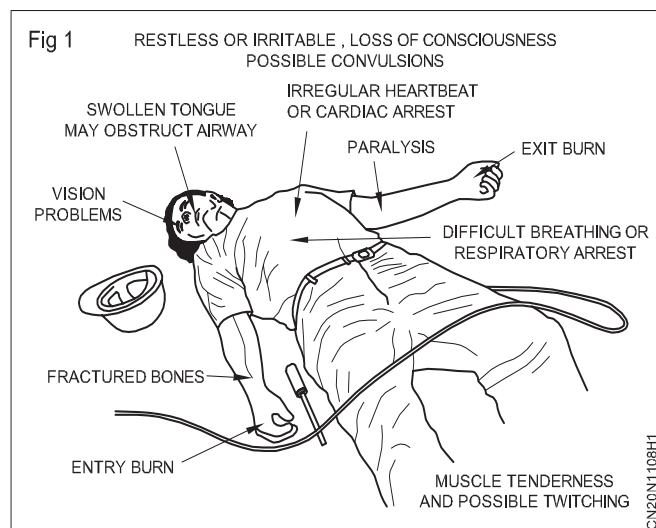
Note: The instructor shall arrange suitable electrical safety poster/chart/slogan appropriate to this exercise.

Preventive measures for electrical accidents

- Never touch any electrical apparatus /machinery with wet hands or while standing in water.
- If you get a tingle or shock when touching any electrical item, a sink, tub, or other wet area, turn off the power at the main panel and immediately call an electrician.
- Don't use damaged or broken cords/ wires or plug in anything with a missing prong.
- When unplugging, don't pull the cord; pull it by the plug.
- Don't overload sockets; use a power extension board with a safety switch.
- Know the location and how to operate shut-off switches and/or circuit breaker panels. Use these devices to shut off equipment in the event of a fire or electrocution.
- Avoid for water or chemical spills on or near electrical equipment. Wear rubber shoes in wet areas.
- Cover unused outlets and keep metal objects away from outlets. you should always take extra care to ensure that you do not come into contact with the exposed live wires as this runs the risk of shock and burns.
- Put a notice nearby to the appliance to inform others of the danger and to ensure that it is protected until you are able to schedule repairs.
- Use safe work practices every time electrical equipment is used.
- All electrical installations regardless of whether at home or in the workplace, must be grounded, which is otherwise known as earthing to track down any excess electricity, the most effective route to return to the ground without posing any safety risks.
- It is safe to work on the electrical equipment that is plugged in with only dry hand and wear non-conductive gloves and insulated-soles shoes.
- Disconnect the device from the source in the period of service or maintenance of the device.
- Disconnect the power source before servicing or repairing electrical equipment.

- All electrical cords should have sufficient insulation to prevent direct contact with wires.
- In a laboratory/workshop it is particularly important to check all cords before each use, since corrosive chemicals or solvents may erode the insulation.
- Damaged cords should be repaired or taken out of service immediately, especially in wet environments such as cold rooms and near water baths.
- Keep away from the energized or loaded circuits Arcing, sparking, or smoking from the equipment.
- If the device interacts with water or other liquid chemicals, equipment must be shut off power at the main switch or circuit breaker and unplugged.
- If any individual comes in contact with a live electric line, do not touch the individual or equipment / source/ cord; disconnect the power source from the circuit breaker or pull out the plug using a leather belt.
- Always stay at least ten feet away from the overhead power lines, carry highest voltage, which means that should anyone come into contact with them, there is a significant risk of not only electrocution but also severe burns.

First Aid for accidental electric shock victims (Fig 1)



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

First aid for accidental electrical burn victims

Electrical burns vary in severity depending upon the following conditions

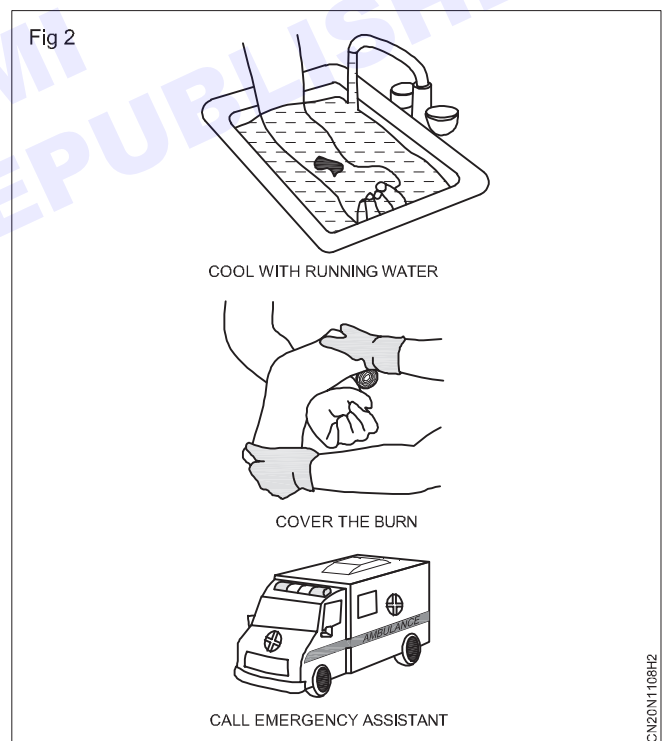
- How long the victim is in contact with the electric current;
- The strength of the current flow;
- The type of current AC or DC; and
- The direction of the current takes through the body.
- Observe the person, if the person is conscious and there are no signs of shock (such as being cold, clammy, pale and having a rapid pulse)
- Do not apply grease or oil to the burn.
- Cover the burn with a dry, sterile dressing.

- There may be more than one area burned.
- If the person has electrical burn, check for shock and follow the outlined points shown in Fig 2.
- Keep the victim from getting chilled; Seek medical attention as soon as possible.

Accidental electrical fire

- Keep flammable materials away: Electrical appliances or outlets that come into contact with flammable materials that may trigger a fire.
- Inspect electrical wiring: Have your electric wiring checked to prevent electrical fires. Wiring does not last forever, so it is a good idea to have your wiring checked
- Be wary of certain appliances: If an appliance blows a fuse, trips a circuit, or sparks while being used, unplug the appliance immediately, and check to see if it needs to be repaired or replaced.
- Check Switches or outlets that are hot to touch and/or emit an acid odour; Inspect and repair outlets and switches.
- In case of electrical fire, use only CO₂ type of Fire extinguisher.

Fig 2



Identifying different types of fire extinguishers and their use in case of fire

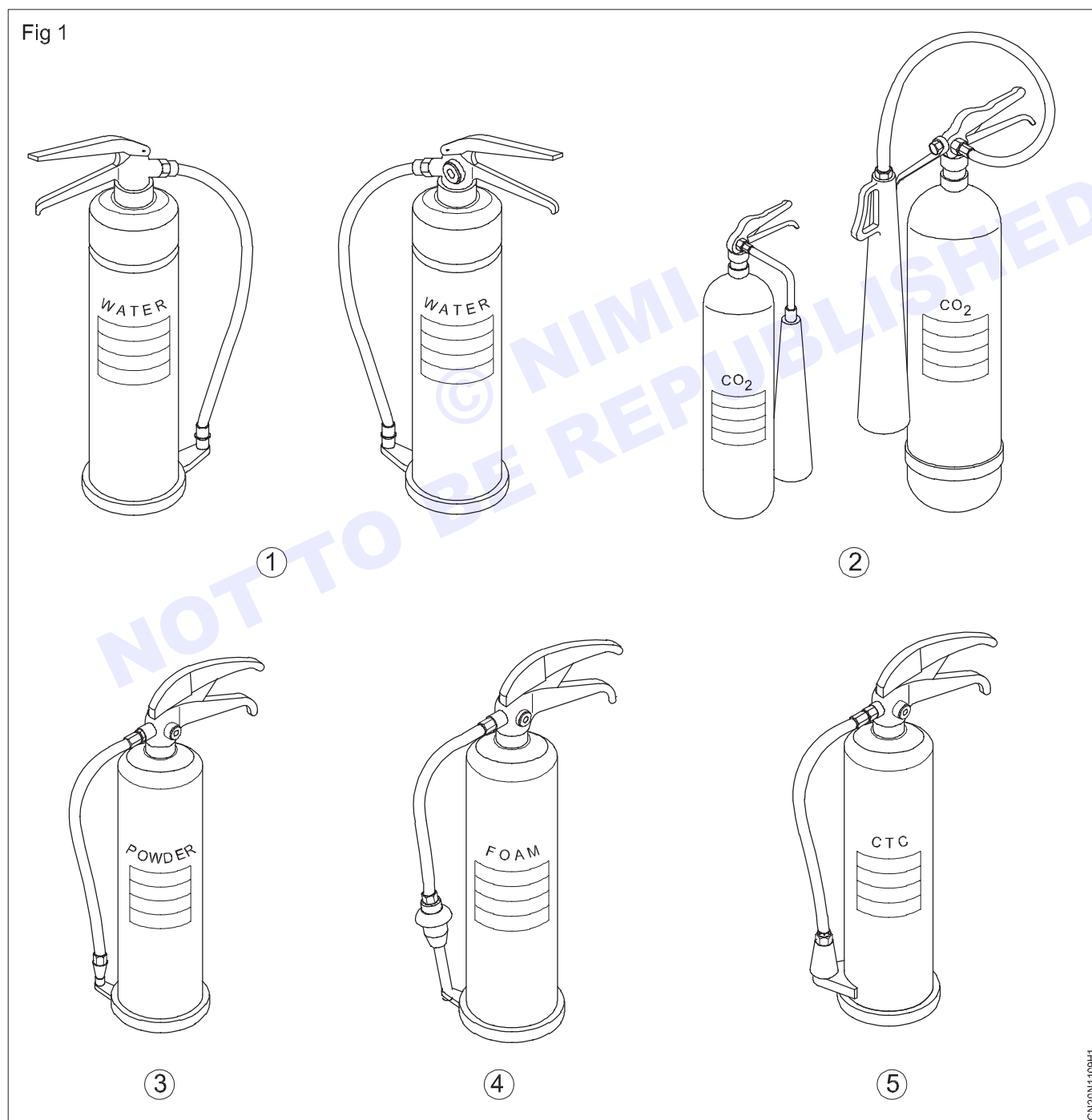
Objectives: At the end of this exercise you shall be able to

- identify the types of fire extinguishers
- record the use of each fire extinguishers
- operate the fire extinguisher.

PROCEDURE

TASK 1: Types of fire extinguishers

Fig 1



CN20N1109H1

Instructor shall provide all the types of extinguishers by physically or by chart and explain the use of each type extinguishers. Ask the trainees to identify the name and uses of each record in Table 1.

- 1 Identify the types of extinguisher.
- 2 Record the name and uses in Table 1.

Table 1

Sl. No.	Name of the extinguisher	Uses

- Get it checked by the Instructor.

TASK 2: Using fire extinguishers

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

- Select CO₂ (carbon dioxide) fire extinguisher
- Locate and pick up CO₂ fire extinguisher. Check for its expiry date.
- Break the seal.

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

Operator: Operate the fire extinguisher

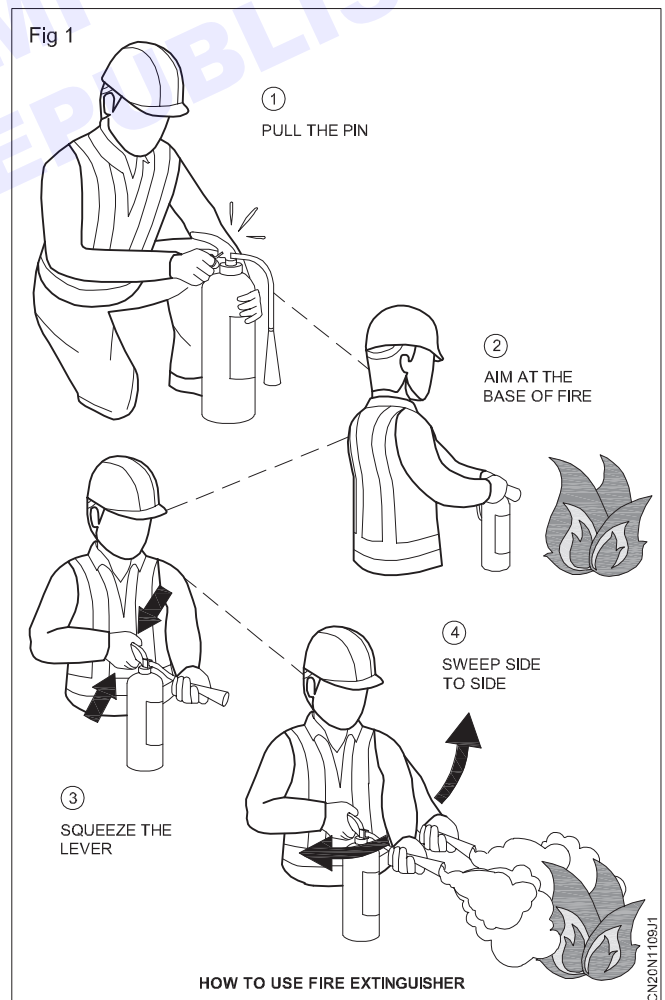
Most of the fire extinguisher operator the same basic way stands six to eight feet away from the fire and remember to **PASS - PULL - AIM - SQUEEZE - SWEEP.**

PULL the pin: This will allow you to discharge the extinguisher. (Fig 1.1)

AIM at the base of fire: If you aim at the flames (Which is frequently the temptation). The extinguishing agent will fly right through and do no good. (Fig 1.2)

Squeeze the top handle or lever: This depress a button that releases the pressurised extinguishing agent in the extinguisher. (Fig 1.3)

Sweep from side to side until the fire is completely put off. Start using the extinguisher from distance away. Then move forward. Once the fire is put off keep an eye on the area incase re-ignite. (Fig 1.4)

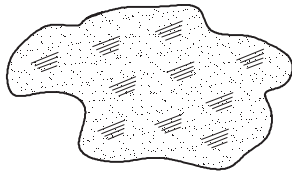


Practice and understand precautions to be followed while working in fitting jobs

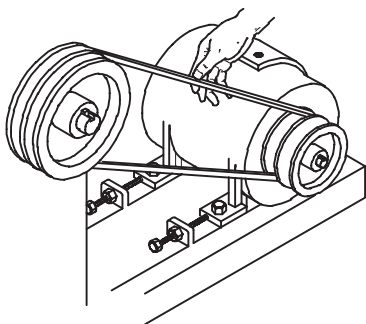
Objectives: At the end of this exercise you shall be able to

- record the precaution to be followed while working in fitting jobs.

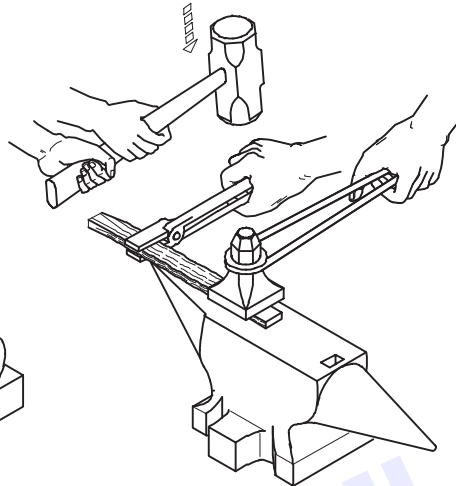
Fig 1



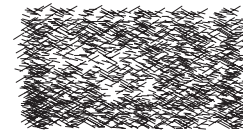
1 OIL SPILLS ON SHOP FLOOR AND WORK TABLE



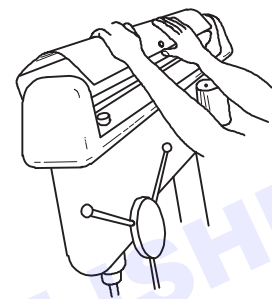
2 MACHINE RUNNING WITHOUT BELT GUARD



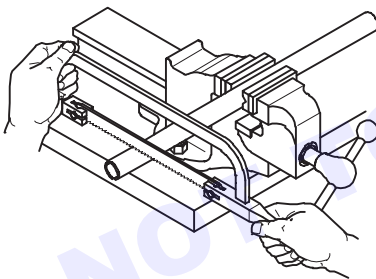
5 HANDLING HOT JOBS WITHOUT GLOVES



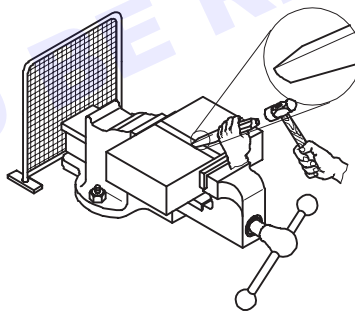
8 METAL CHIPS SPREAD ON SHOP FLOOR NEAR DRILLING MACHINE



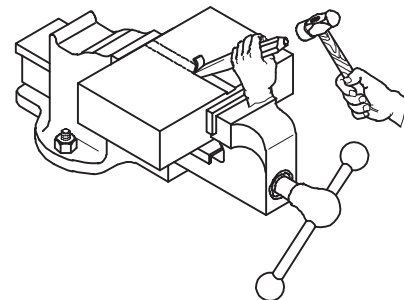
9 CHANGING THE BELT WHEN THE SPINDLE IS ROTATING



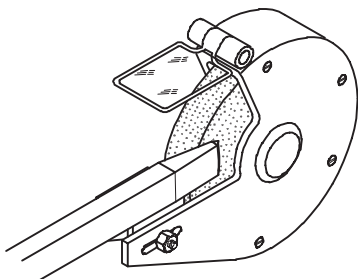
3 HACKSAWING WITHOUT HANDLE



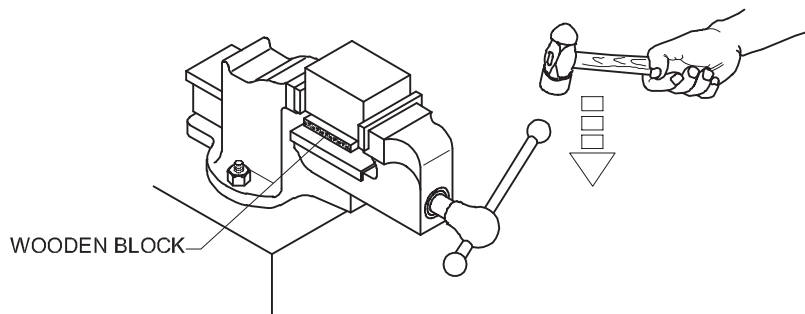
6 CHIPPING WITH BLUNT CHISEL ON METAL SURFACE



10 CHIPPING ON METAL WITHOUT CHIPPING SCREEN



4 GRINDING A FLAT CHISEL IN SIDE WAYS OF GRINDING WHEEL



7 STRIKING ON VICE HANDLE WITH HAMMER TO GRIP THE WORK PIECE

CN20N110F1

Job Sequence

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

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

Table 1

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

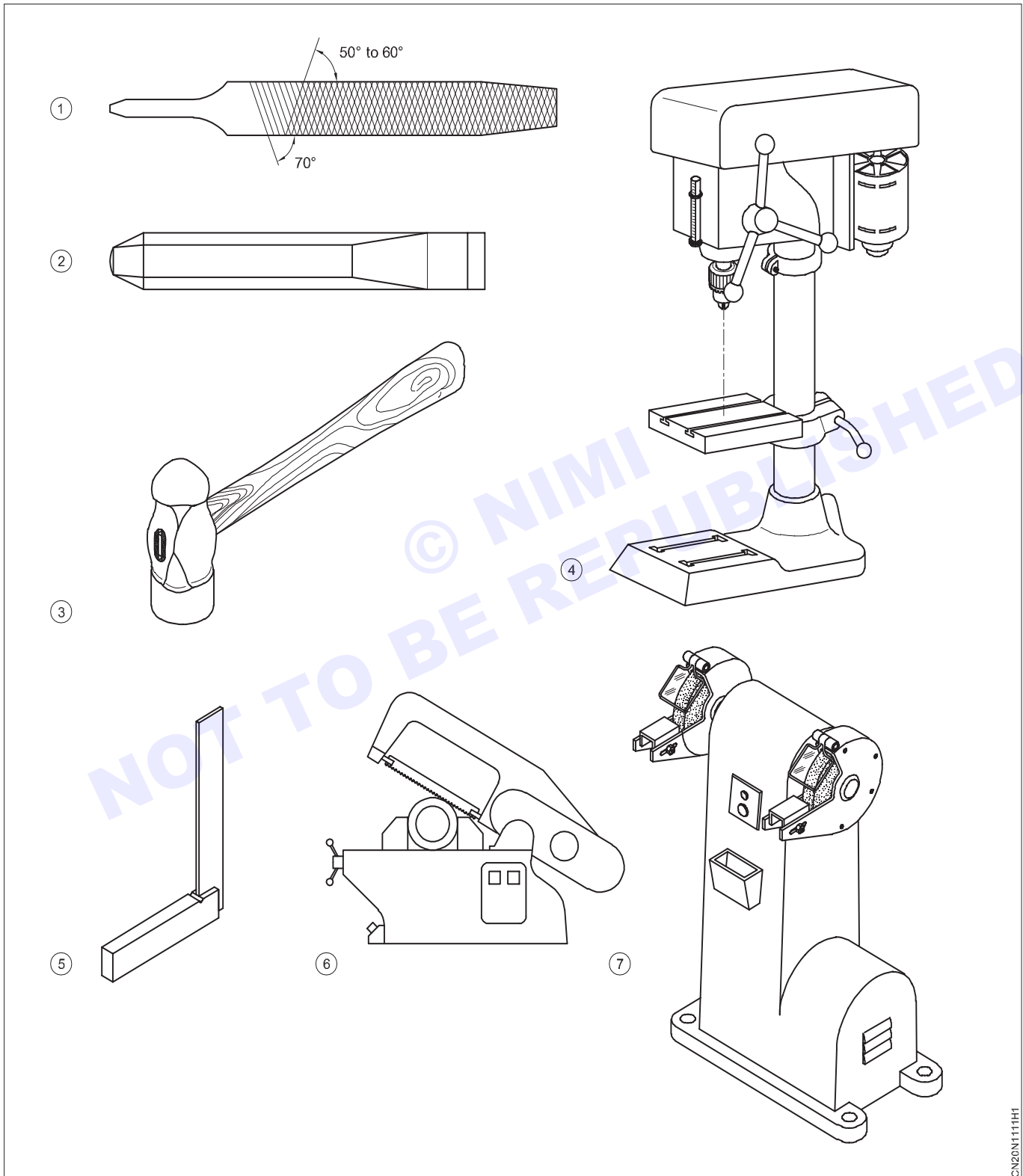
- Fill up and get it checked by your instructor.

— — — — —

Safe use of tools and requirements used in the trade

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

- record the safety joints while using tools and requirements in the trade.



Job Sequence

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

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

Table 1

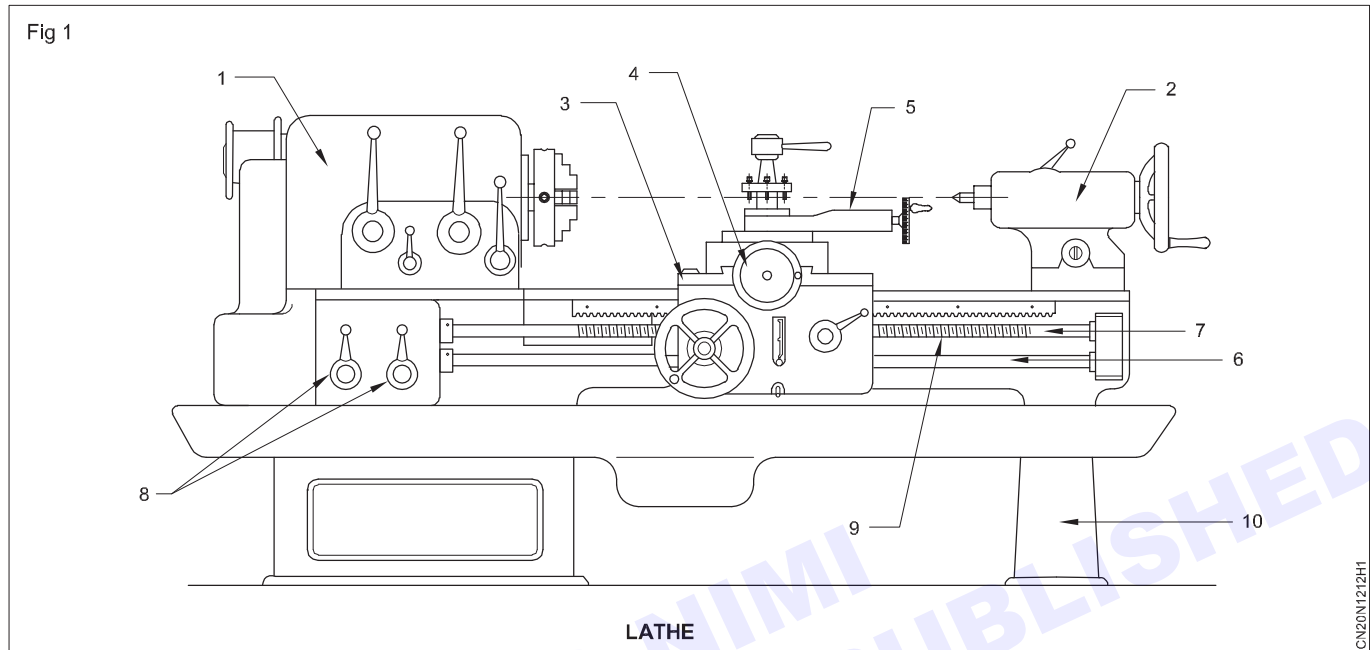
Fig No.	Description	Record precautions to be followed while working
1		
2		
3		
4		
5		
6		
7		

- Fill up and get it checked by your instructor.

Demonstrate the different parts of the lathe

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

- identify the different parts of lathe
- record the part name in the given table.



Job Sequence

The Instructor shall explain the main parts of the lathe to the trainees and ask them to record in Table.

- Identify the parts of lathe.
- Record in Table.

Table

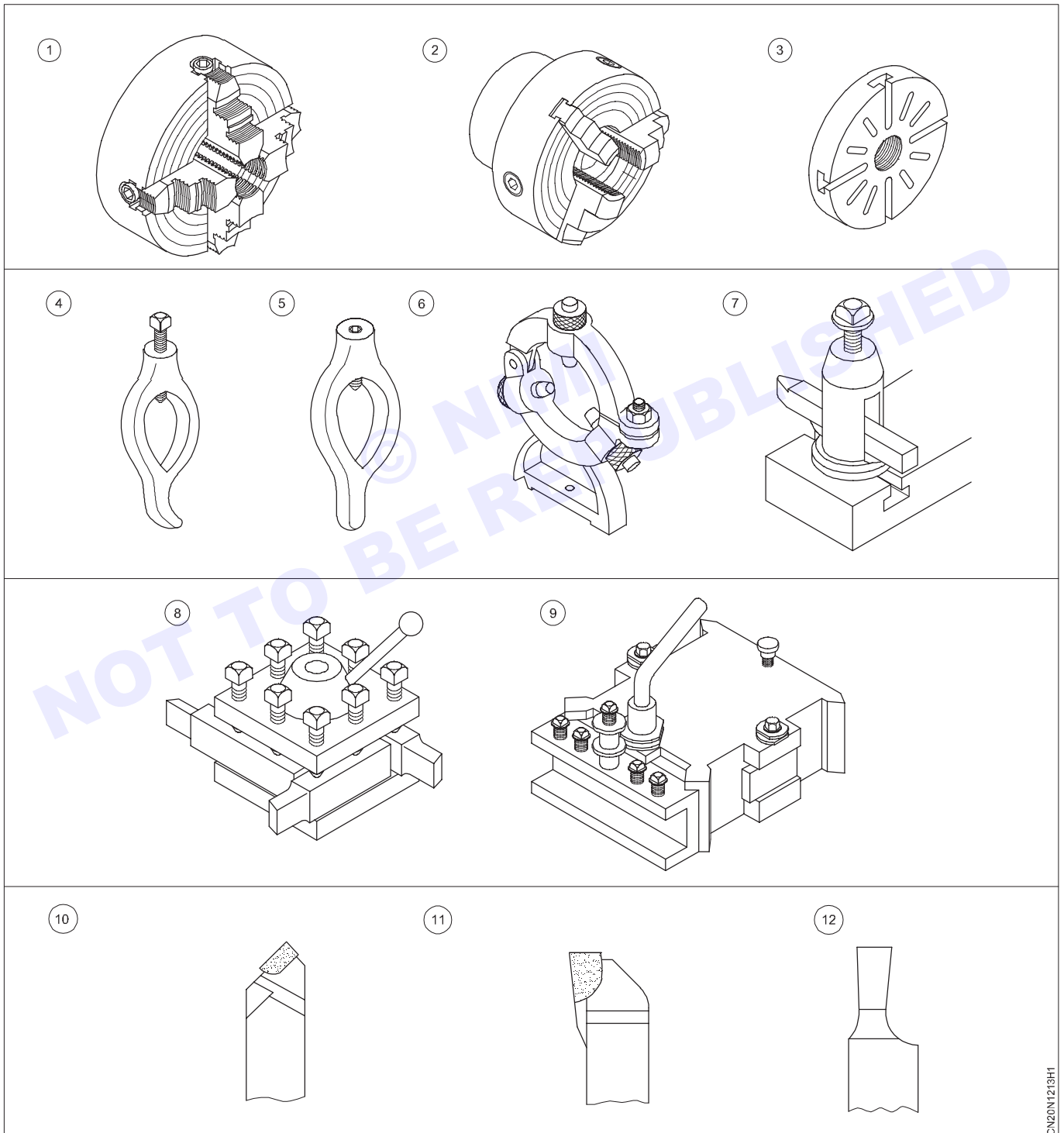
SI.No.	Part name	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

- Get it checked by the instructor.

Demonstrate different work holding devices, accessories, tool holders and cutting tools used for different operations

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

- identify work holding devices and accessories
- identify tool holders and cutting tools
- record the names in the given table.



CN20N1213H1

Job Sequence

The Instructor shall explain the holding devices, accessories, tool holders and types of tools to the trainees and ask them to record in the Table.

- Identify the lathe, accessories, tool holders and tools.
- Record in the Table 1.

Table 1

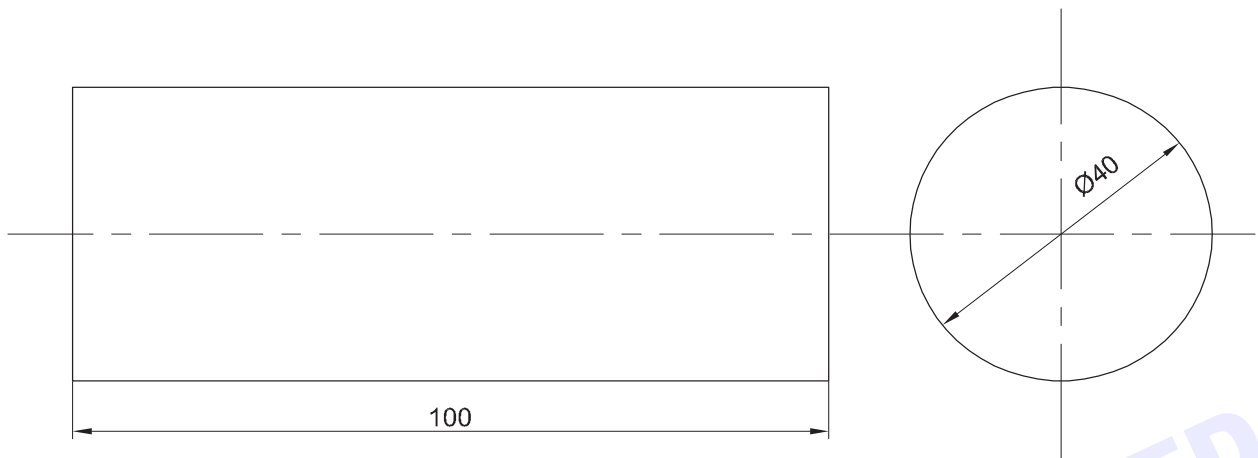
Sl. No.	Description (Names)	Remarks
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

- Get it checked by the instructor.
- — — — —

Hold workpiece in chuck and true it

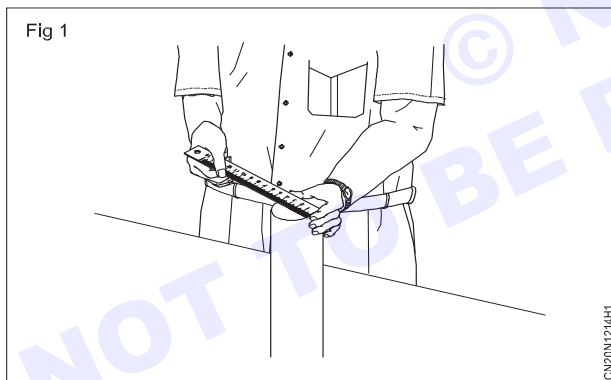
Objectives: At the end of this exercise you shall be able to

- true the round bar on four jaw chuck.

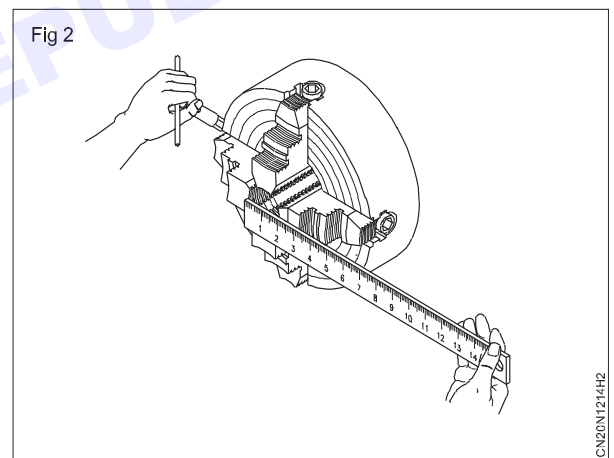


Job Sequence

- Measure the job size with an outside caliper or with a steel rule. (Fig 1)




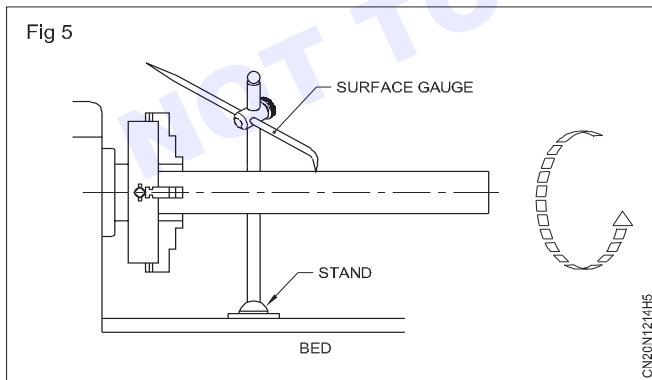
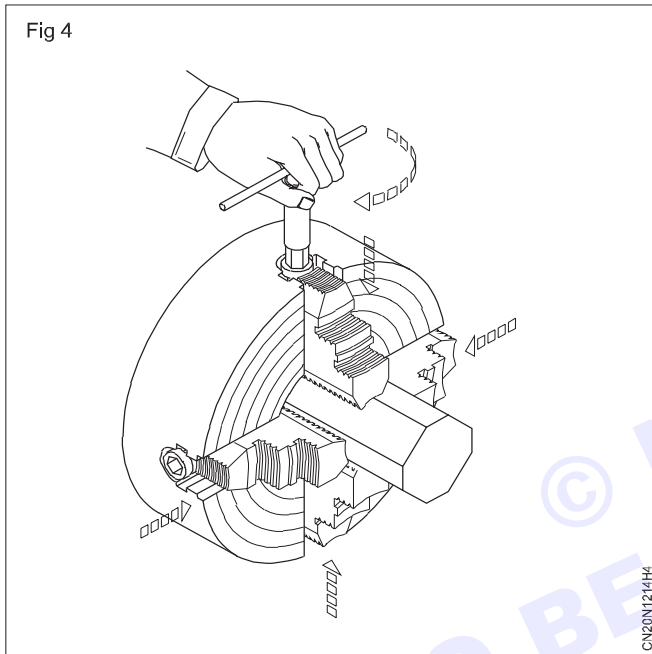
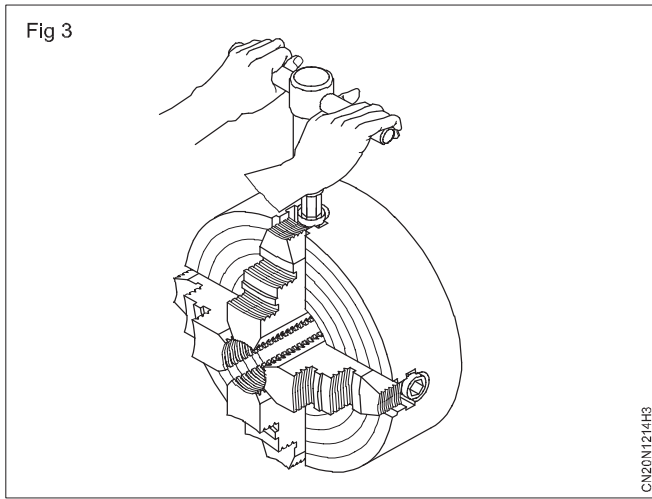
the two adjacent jaws, enough to grip the work. (Fig 4)



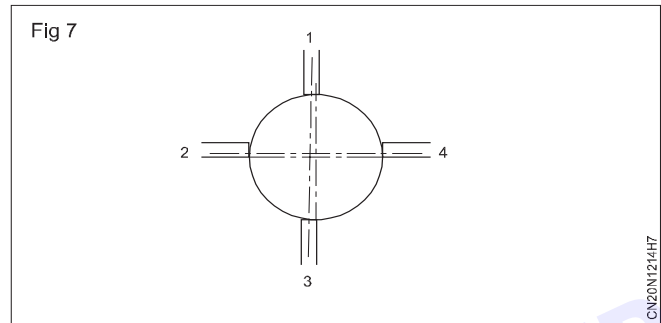
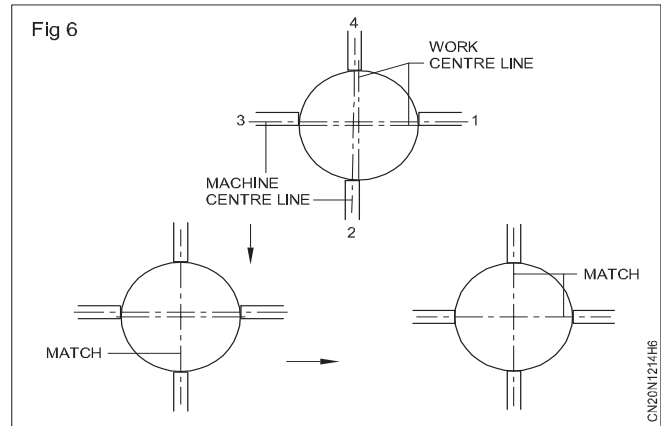
- Position the four jaws of the independent chuck, equidistant from the centre. The distance between the inner face of the opposite jaws is equal to the diameter of the work. (Fig 2)
- Open the adjacent jaws sufficiently enough to insert the work. (Fig 3)
- Place the work inside the chuck, keeping sufficient portion outside the chuck for truing and tighten

- Place the surface gauge on the bed-ways close to the chuck. (Fig 5)
- Adjust the pointer to make its tip move close to the top or side portion of the work with a minimum gap. (Fig 6)

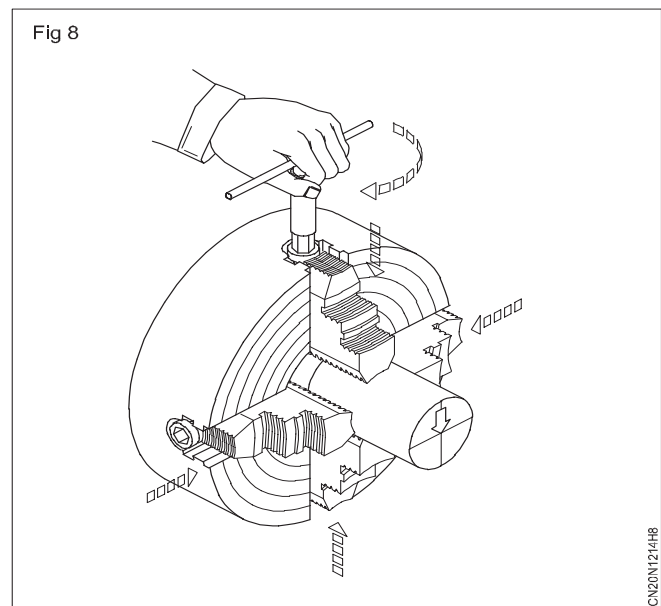
	Ø40X100	-	Fe 310	-	-	1.2.14
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	TURUING ROUND BAR ON FOUR JAW CHUCK				DEVIATIONS ±0.04	TIME :
					CODE NO. CN20N1214E1	



- Rotate the chuck by hand and observe the gap between the pointer and work surface for the position of the two opposite jaws.
- Open the jaw slightly where the gap is more, and tighten the opposite jaw.
- Repeat until the gap is the same. (Fig 7)
- Repeat the above sequences for the other set of opposite jaws.
- Bring the pointer tip closer to the work surface.



- Rotate the chuck by hand and observe the gap.
- Engage the spindle levers at about 250 rpm and run the machine.
- Give slight pressure on the top of the pointer to make the tip to touch the work, and feel.
- If the feel of contacting the pointer tip is uniform, it indicates that the work is trued.
- If the 'feel' is not uniform tighten the jaw where the feel is high.
- Repeat till a uniform feel is felt.
- Finally, tighten the opposite jaws with the same amount of pressure. (Fig 8)

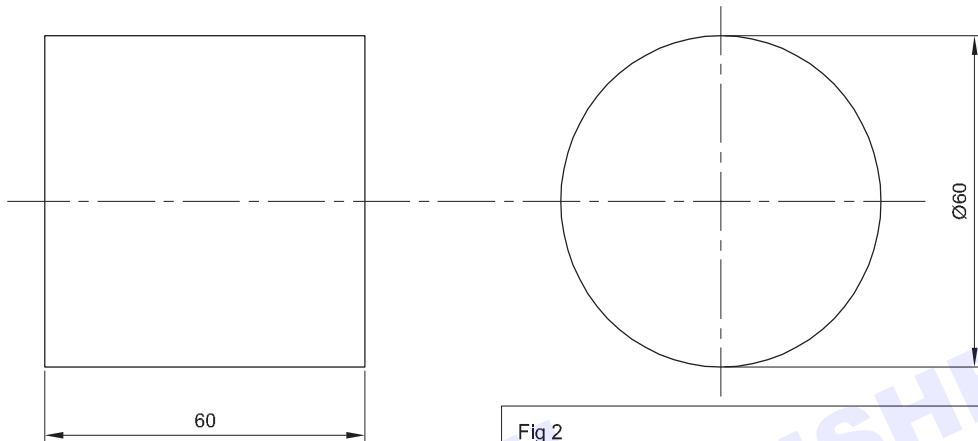


- Check once again for the true running of the work.

Performing for turning operations and measure

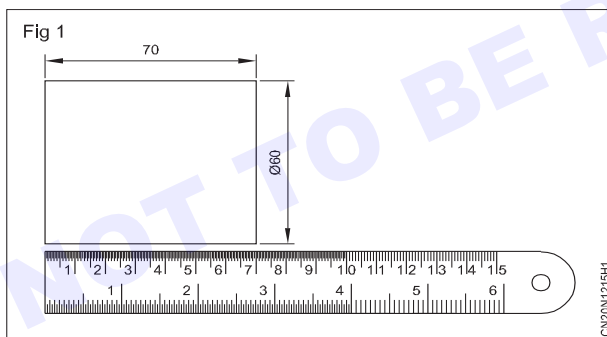
Objectives: At the end of this exercise you shall be able to

- set the tool to the correct height
- face the workpiece with an accuracy of ± 0.1 mm.

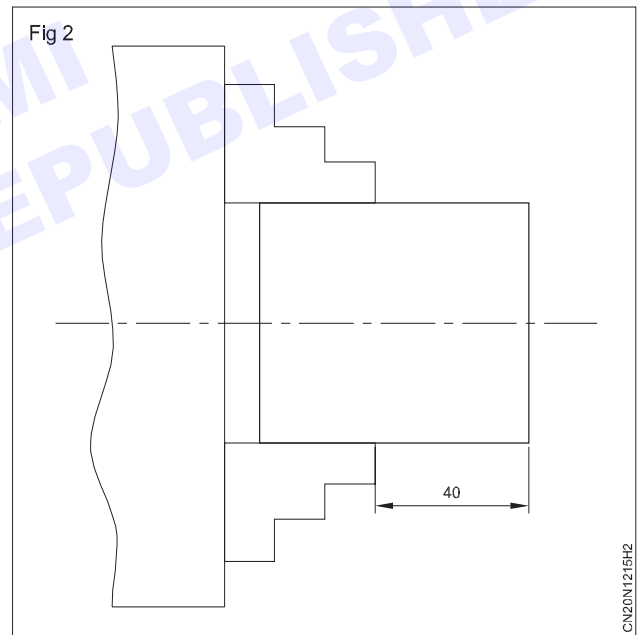


Job Sequence

- Check the raw material size and clean outer surface. (Fig 1)

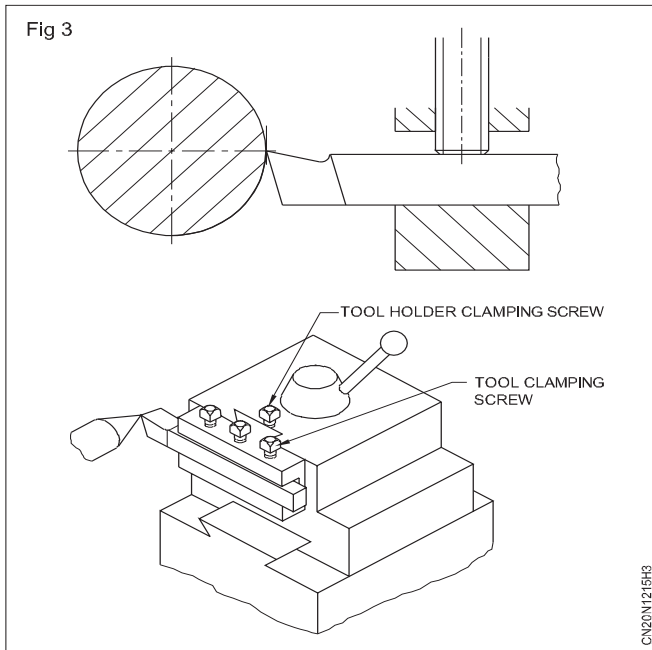


- Mount four jaw chuck.
- Fix the job 40 mm outside from jaw face and true it to lathe axis. (Fig 2)
- Fix the facing tool on tool post and align to the cutting edge to lathe axis. (Fig 3)
- Select rpm, switch on the spindle. Touch the face of the job and with draw, move the tool perpendicular to lathe axis, lock the carriage. (Fig 4a)



- Face by moving cross slide smoothly till the centre. (Fig 4b & 4c)
- Notice for pip formation if so adjust the tool height accordingly. (Fig 4d)

1	ISR Ø60 X 70	-	Fe310	-	-	1.2.15
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	Ex. NO.
<p>SCALE NTS</p> <p style="text-align: center;">FACE TURNING AND MEASURING</p>					TOLERANCE : ± 0.04	TIME :
					CODE NO : CN20N1215E1	



- Give feed, face turn to smooth surface and outside.
- Reverse and hold the job and true it.

Skill Sequence

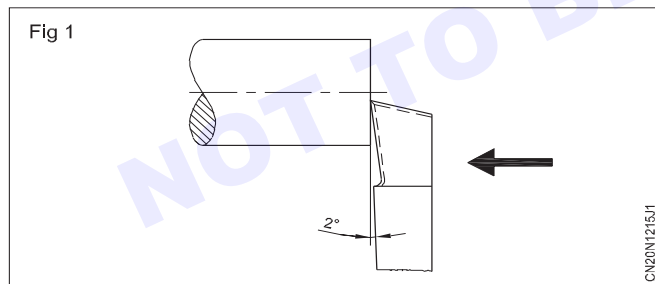
Facing work by hand feed method

Objectives: This shall help you to

- face work by the hand feed method using right hand facing tool.

Hold the tool in the tool post to the correct centre height with a minimum overhang.

Touch the tool-point with the workface at about 4 to 10 mm from the centre. (Fig 1)



Set the top slide graduate collar to zero mark and also eliminate backlash.

Lock the carriage.

Feed the tool about 0.5 mm by the compound slide inside the face of the work. (Fig 2)

Feed the tool towards the centre of the work by the cross-slide till the tool tip crosses the centre. (Fig 3)

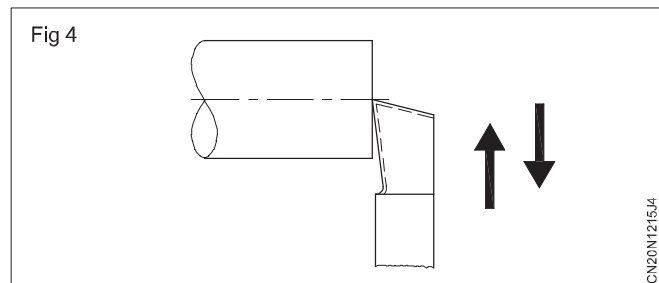
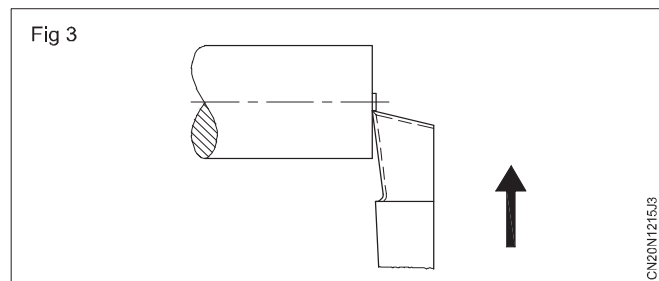
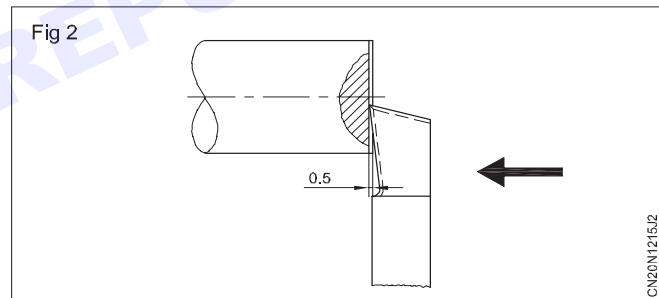
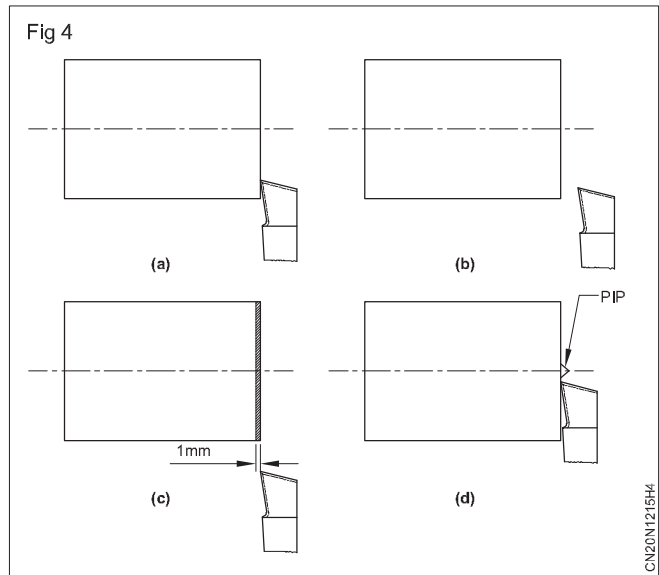
Feed the tool towards the edge of the work using the cross-slide till the tool clears the work. (Fig 4)

Measure the length of the job.

Refix the job to face the other end to size.

Repeat the sequence till the required amount of material is removed.

- Face turn to size 60 mm length.
- Check the length by vernier caliper.

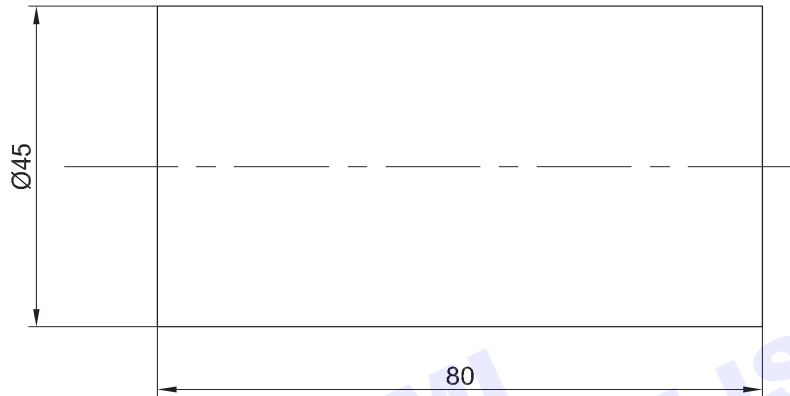


Performing OD turning (plain & step) operations

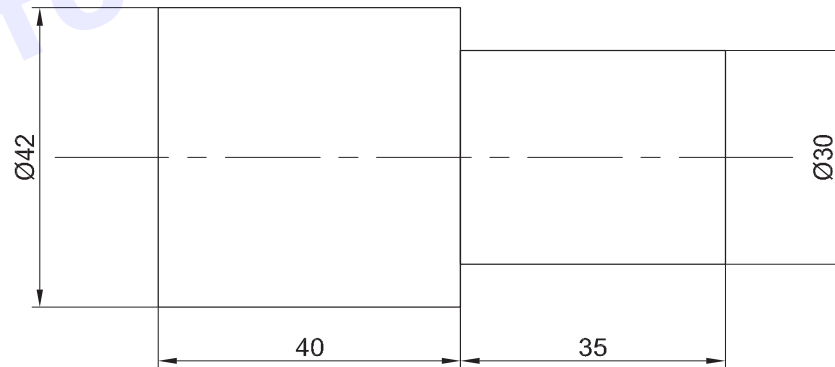
Objectives: At the end of this exercise you shall be able to

- plain turn the work by hand feed method
- turn step to the required diameter and length.

TASK 1



TASK 2

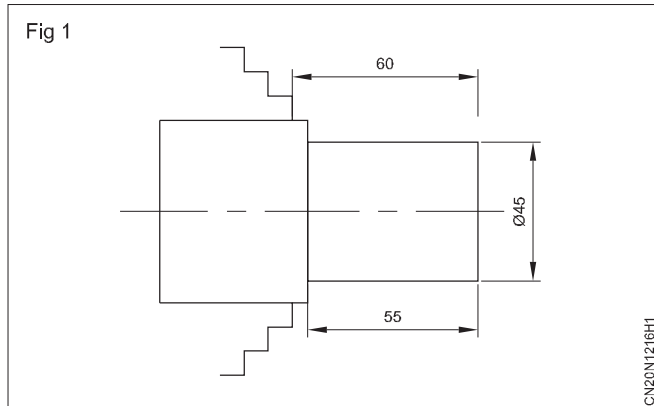


2	Ø55 x 90mm	-	Fe 310	-	-	1.2.16
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	PLAIN AND STEP TURNING				DEVIATIONS ±0.04	TIME :
					CODE NO. CN20N1216E1	

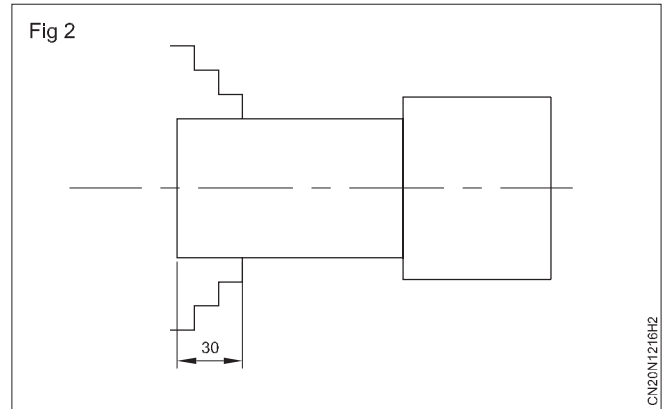
PROCEDURE

TASK 1: Plain OD turning

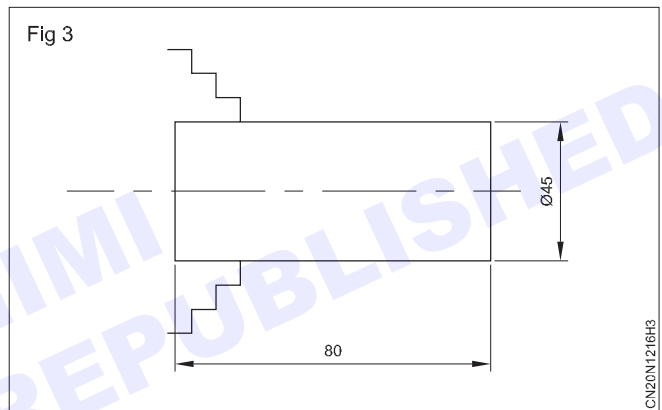
- 1 Check the raw material size and clean.
- 2 Hold the job in 4 jaw chuck leaving 60 mm outside from jaw face and true it.
- 3 Fix facing tool and align to axis.
- 4 Face the end to till irregular surface clears.
- 5 Fix turning tool and align to axis.
- 6 Plain turn to $\text{Ø}45$ in steps to maximum length (55). (Fig 1)



- 7 Remove the job and hold on dia 45, 30 mm inside jaw and true it. (Fig 2)
- 8 Plain turn to $\text{Ø}45$ in steps for rest of the length.
- 9 Fix facing tool and align to axis.

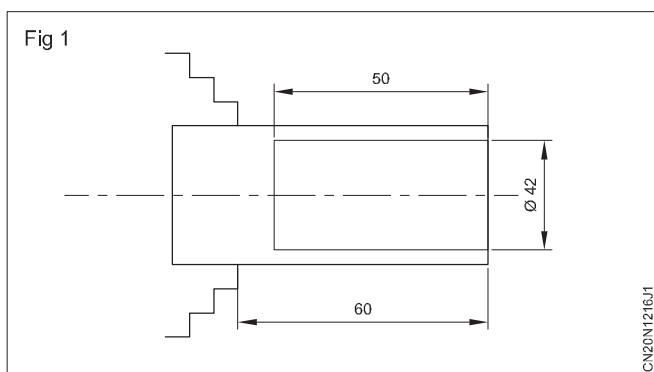


- 10 Face the end to maintain 80 mm length. (Fig 3)
- 11 Remove job, oil it to preserve and submit.

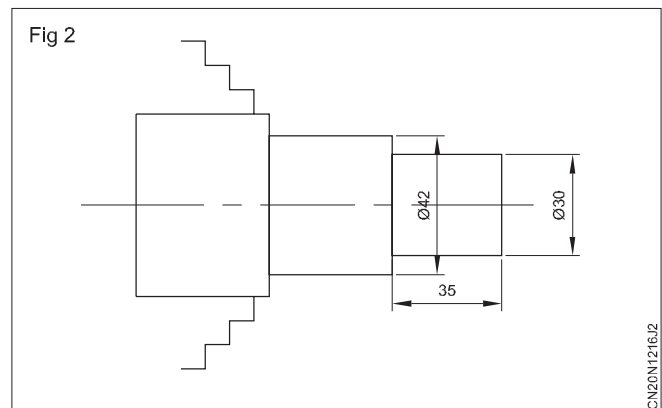


TASK 2: Step turning

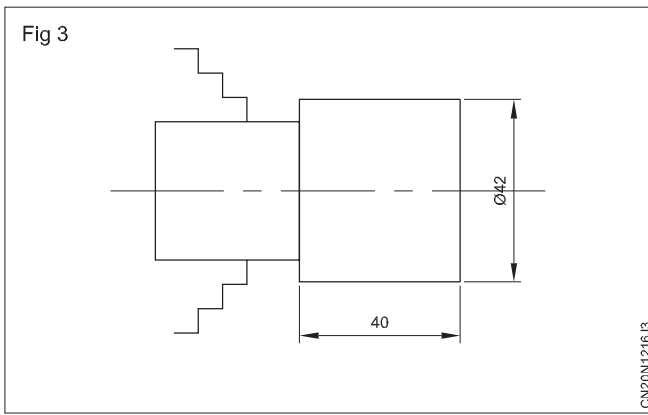
- 1 Fix turning tool and align to axis.
- 2 Plain turn to dia 42 mm steps to 50 mm length.



- 3 Step turn to dia 30 to 35 mm length and finish turn and form step. (Fig 2)



- 4 Remove job, reversed and hold on $\text{Ø}30$ butting the stepped end to jaw face and true it.
- 5 Turn to $\text{Ø}42$ to match with turned dia. (Fig 3)



- 6 Fix facing tool and face the end to maintain total length 40 mm up to the step.
- 7 Remove job oil it to preserve and submit.

Skill Sequence

Square shoulder

Objectives: This shall help you to

- machine a square shoulder.

Matching a square shoulder

Rough and finish turn the diameter to within about 1 mm of the required length.

Mount a facing tool bit in the tool-holder and set it to lathe axis.

Make sure that the tool bit is set up with the point close to the work, and with a slight space along the side cutting edge.

Note the reading on the graduated collar of the cross-slide screw.

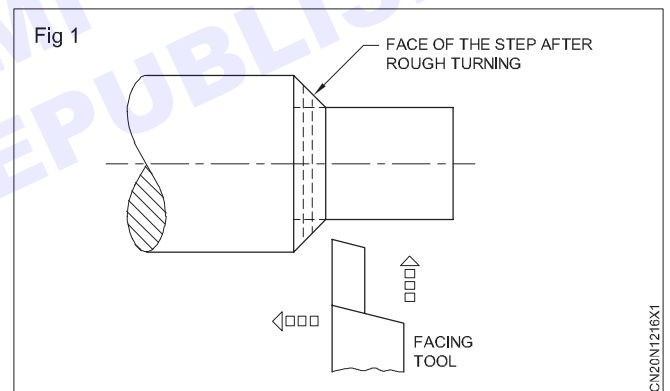
Bring the tool bit towards the shoulder with the carriage hand wheel until a cut is started. (Fig 1)

Face the shoulder by turning the cross-slide handle anti-clockwise thus, cutting from the centre to the outside.

For successive cuts, return the cross-slide screw to the same graduated collar setting. Repeat the above

procedure until the shoulder is machined to the correct length.

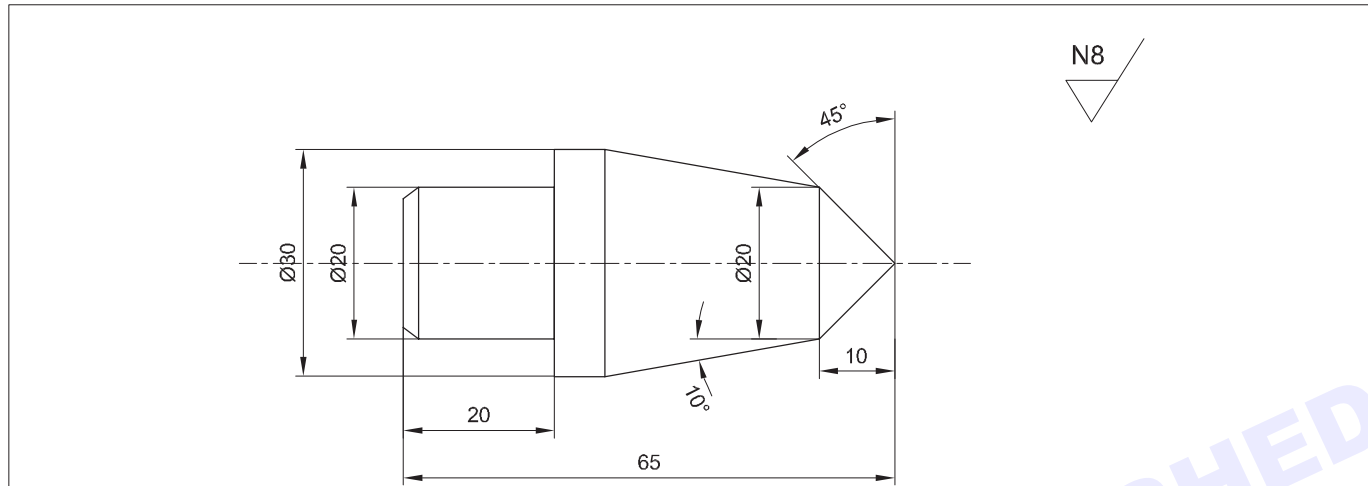
Rough and finish turn small dia meter to size.



Performing taper turning operation and measure

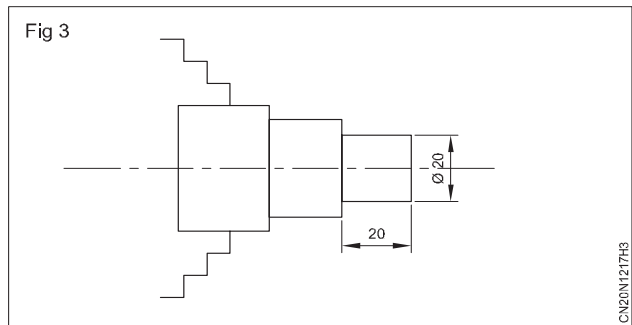
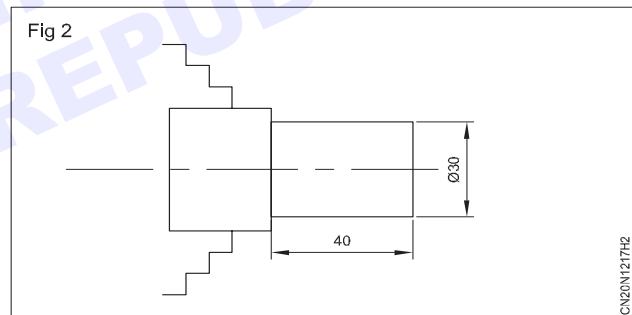
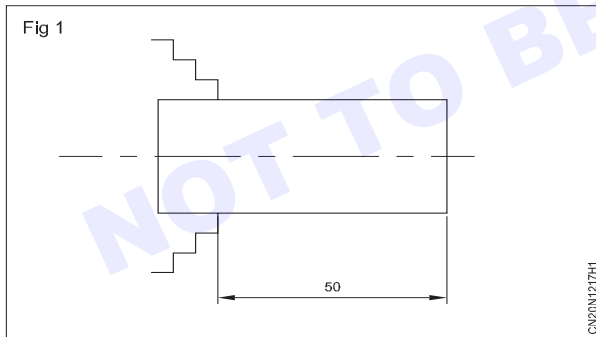
Objectives: At the end of this exercise you shall be able to

- taper turning by compound rest
- form tool grinding
- taper turning by form tool.



Job Sequence

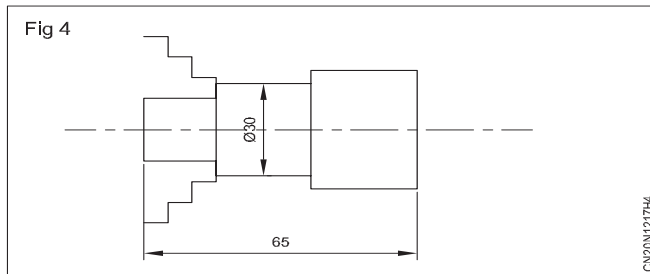
- Check raw material size and clean.
- Hold the job in 3 jaw chuck leaving 50 mm outside from jaw face. (Fig 1)



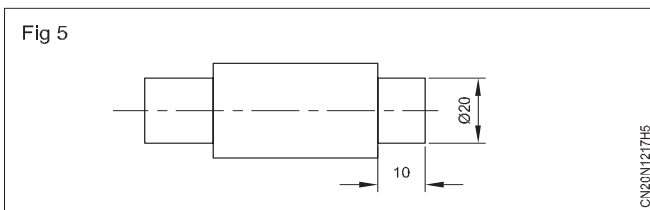
- Fix facing tool and face turn the end surface.
- Fix turning tool and turn to Ø30 to 40 mm long. (Fig 2)
- Step turn Ø20 to 20 mm long and chamfer the end. (Fig 3)

1	Ø40X100	-	Fe 310	-	-	1.2.17
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		TAPER TURNING (COMPOUND REST & FORM TOOL METHOD)			DEVIATIONS ±0.04	TIME :
					CODE NO. CN20N1217E1	

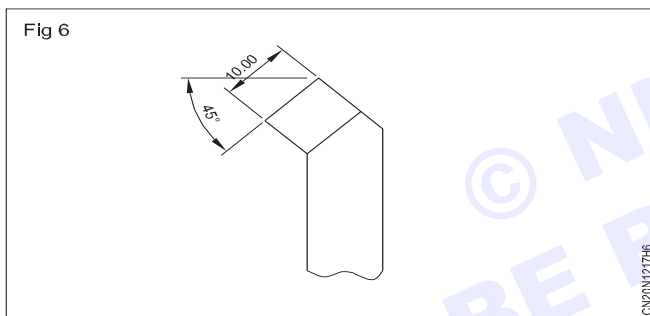
- Remove job, reverse and hold on $\text{Ø}20$ butting stepped face.
- Fix facing tool and face to total length 65 mm. (Fig 4)



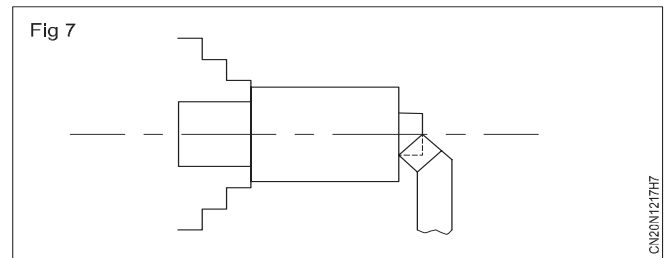
- Fix turning tool turn step dia 20 mm to 10 mm long. (Fig 5)



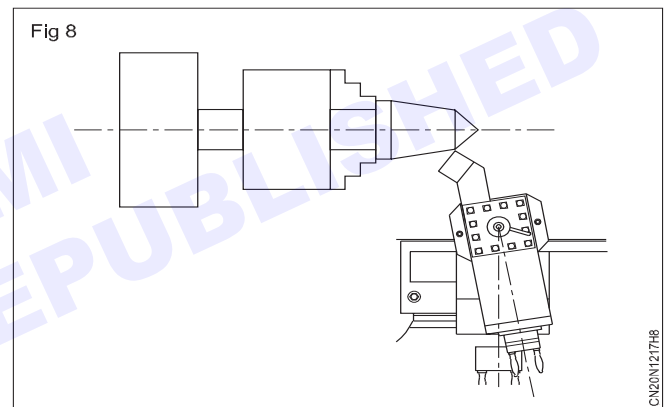
- Turn 30 to entire length.
- Grind form tool to 45° angle. (Fig 6)



- Fix form and align to lathe axis.
- Plunge to form 45° taper to 10 mm length. (Fig 7)



- Fix turning tool for taper turning.
- Set compound slide to 10° angle to lathe.
- Move carriage at suitable distance for taper turning and lock.
- Start taper turning by feeding the tool by compound slide. (Fig 8)
- Check angle and reset compound slide if required
- Complete taper turning remove job, oil to preserve and submit.



Skill Sequence

Turning taper by compound slide swivelling

Objectives: This shall help you to

- set and swivel the top slide of the compound rest to the required taper angle
- set the tool in the tool post
- turn the taper
- check the taper with a vernier bevel protractor.

The procedure in sequence is as follows: Set and true the job turned to the bigger diameter of taper.

Set the machine to the required rpm.

Loosen the top slide clamping nuts.

Swivel the top slide to half the included angle of the taper away or towards the operator as required.

Tighten the clamping nuts firmly. (Fig 2)

Ensure that equal pressure is exerted by the spanner for both the nuts.

Fix the turning tool in the tool post to the correct centre height.

Keep a minimum overhang of the tool.

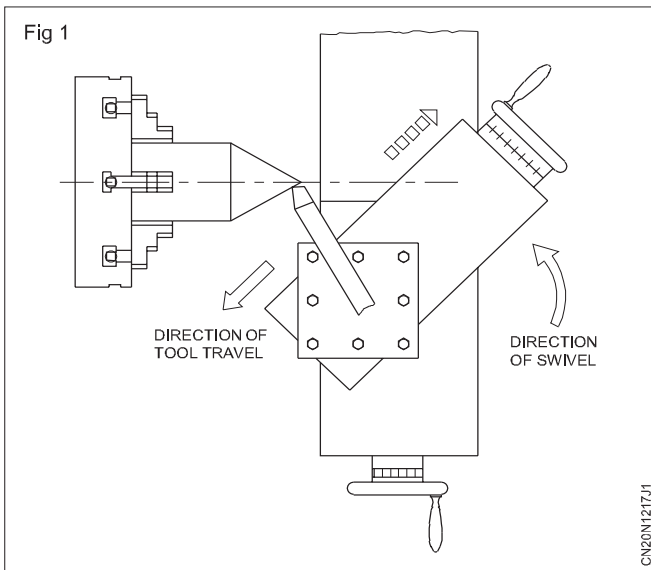
Position the top slide to cover the length of the taper turning.

As far as possible ensure that the top slide do not go beyond the edge of the base.

Lock the carriage in position.

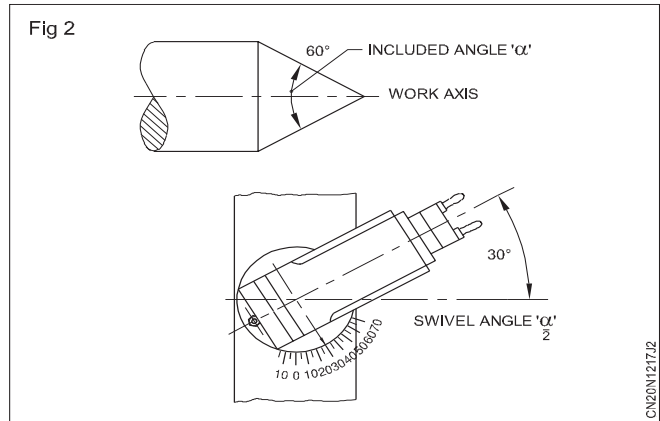
Touch the tool to the work surface during running and set the cross - slide graduated collar to zero.

Bring the tool clear off the work by the top slide hand wheel movement.



Give a depth of cut by the cross - slide and feed the tool by the top slide hand wheel till the tool clears from the work.

Feeding by the top slide must be uniform and continuous.



Give successive cuts by the cross - slide, feeding by the top slide each time.

Check the angle of the turned job with a vernier bevel protractor.

Adjust the swivel if there is any difference.

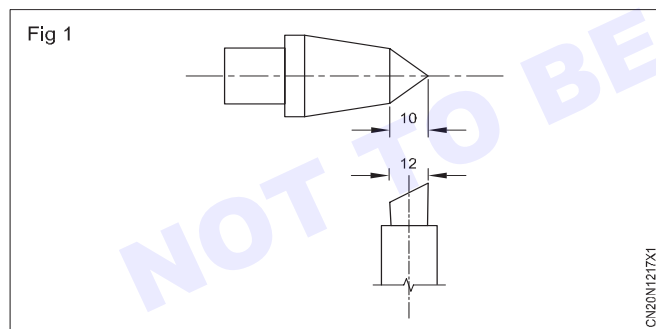
Continue the taper turning and finish the taper.

Tape turning by form tool

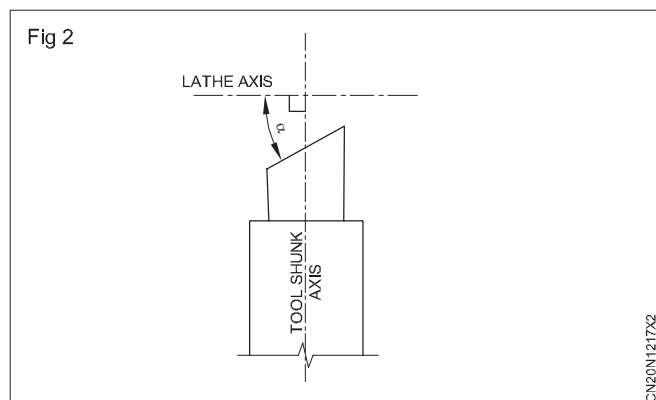
Objectives: This shall help you to

- grind form tool to required angle
- align and set the tool to lathe axis
- plunge to form taper.

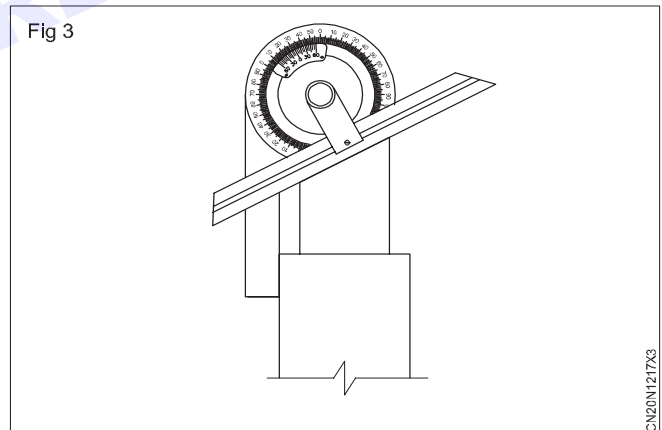
Select the tool width as required/above the taper length of the job. (Fig 1)



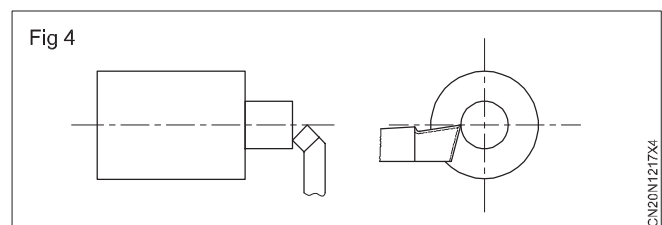
Grind required taper ' α ' angle with respect tool shank axis considering perpendicular to lathe axis. (Fig 2)



Check the angle by vernier bevel protractor keeping shank side face as datum. (Fig 3)



Set tool on tool post, align shank perpendicular and cutting edge inline to lathe axis. (Fig 4)



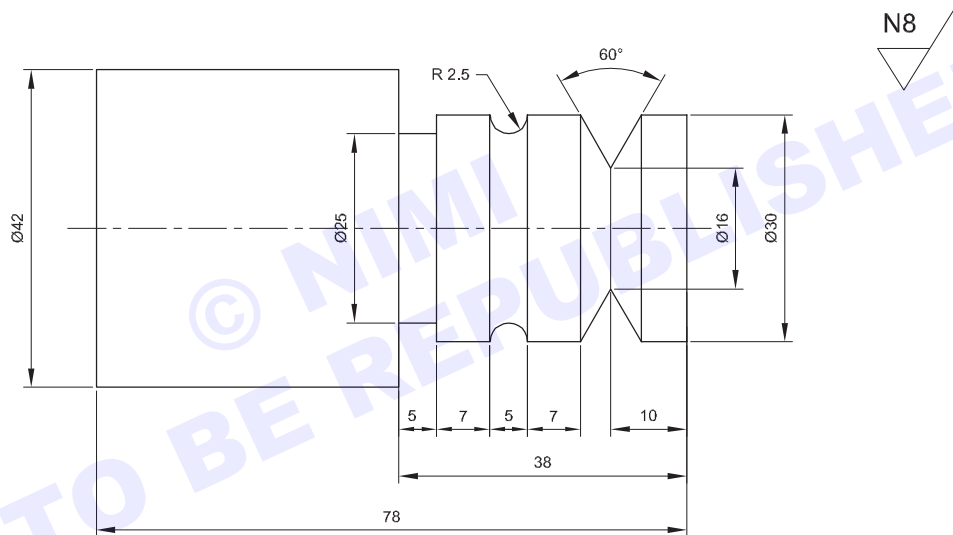
Lock carriage with reference to job taper position.

Plunge gradually by moving cross slide and form tape to the required length.

Perform grooving operations and measure

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

- grinding form tools
- forming square, radius and 'V' groove.



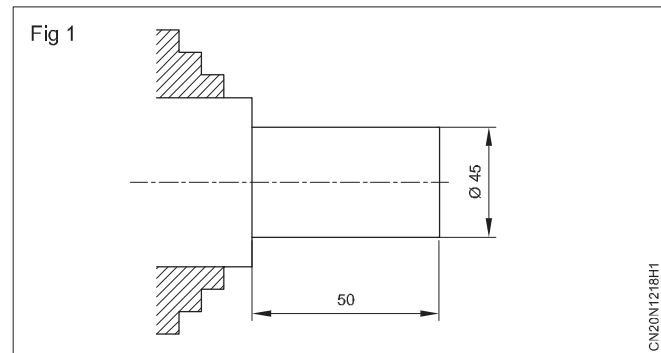
1	Ø 50 X 80	-	FE310	-	-	1.2.18
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SQUARE,RADIUS AND 'V' GROOVE OPERATION				TOLERANCE	-
					CODE NO : - CN20N1218E1	

PROCEDURE

TASK 1: Parallel turning

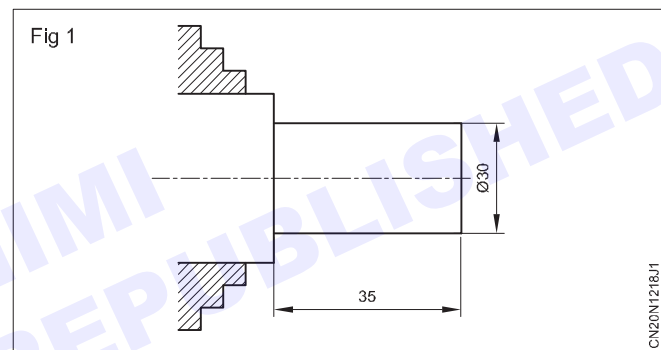
- 1 Check the raw material size and clean.
- 2 Hold the job in a 4 jaw chuck and true it keeping about 50mm outside chuck. (Fig 1)
- 3 Set the tool to the correct centre height.
- 4 Select and set the correct spindle rpm.
- 5 Face one side first and turn the outer diameter to $\text{Ø}45\text{mm}$ for the maximum possible length.
- 6 Reverse and hold the job.
- 7 Face the other end to a total length of 78mm.
- 8 Turn $\text{Ø}42\text{mm}$ to remaining length.

- 9 Remove the sharp edge.



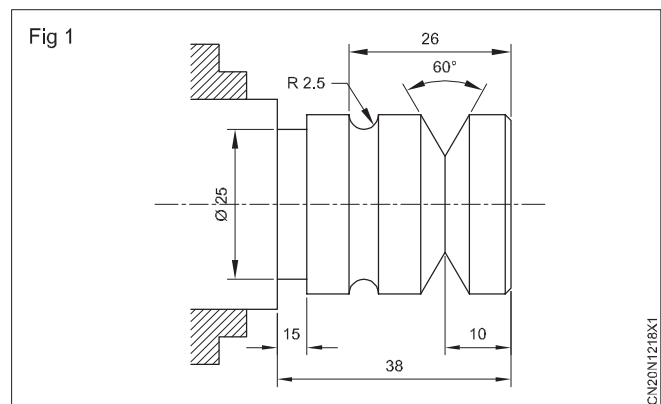
TASK 2: Step turning

- 1 Hold the job in a 4 jaw chuck $\text{Ø}42\text{mm}$ keeping about 45mm outside and true it.
- 2 Face one end.
- 3 Turn $\text{Ø}30\text{mm} \times 35\text{mm}$ length. (Fig 1)
- 4 Mark square mm, radial groove R 2 X 5 and V groove distance on job.
- 5 Turn $\text{Ø}42\text{mm} \times 40\text{mm}$ length.
- 6 Remove the sharp corners.



TASK 3: Grooving

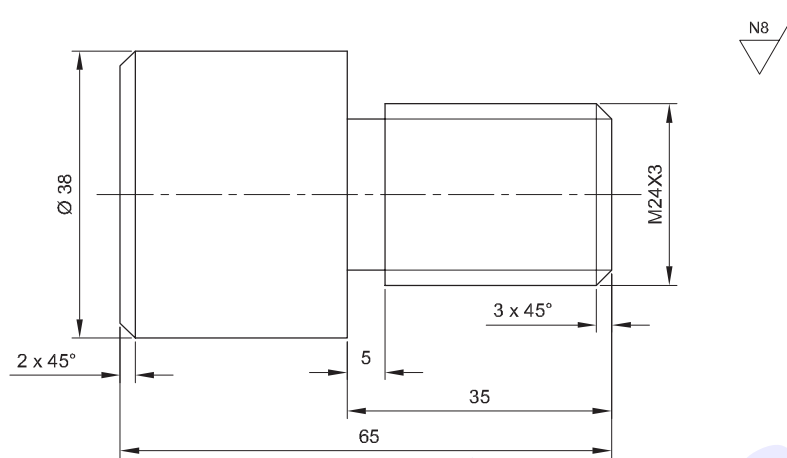
- 1 Set the u/c tool, radius tool, 'V' groove tool to the correct centre height and hold it rigidly.
- 2 Form a square groove 2.5mm depth x 5mm width at 30mm from the end face.
- 3 Form a radius groove 2.5mm depth x 5mm width at 18mm from the end face.
- 4 Plunge the 'V' groove tool to form a 'V' groove 5mm width at 6mm from the end face.
- 5 Remove the burrs.
- 6 Check the dimensions.



Perform threading operation - External

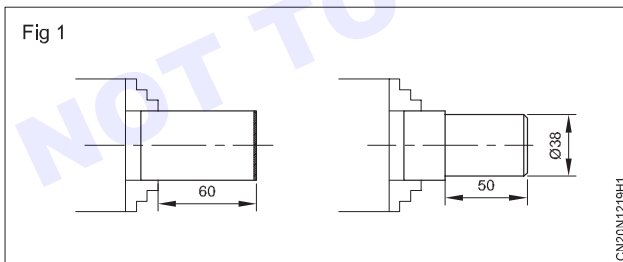
Objectives: At the end of this exercise you shall be able to

- form undercut on work held in chuck
- cut external metric thread
- check the thread profile using metric pitch gauge.

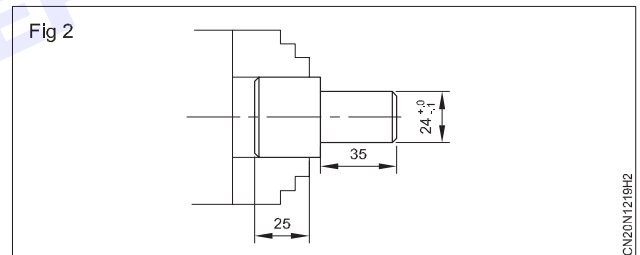


Job Sequence

- Check raw material size and clean.
- Hold on 3 jaw chuck leaving 60 mm out from jaws face, face the end. Turn to dia 38 to max length and chamfer corner. (Fig 1)

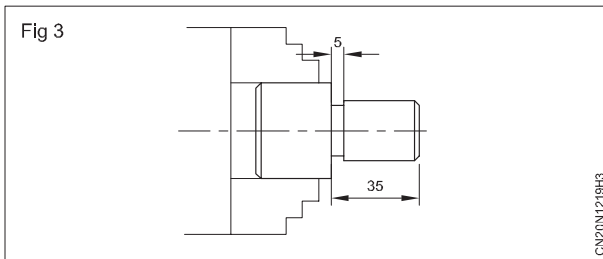


- Remove, reverse and hold 25 mm inside the jaw and rest outside -0.1.
- Turn to Ø24.0 dia to 35 mm length. (Fig 2)

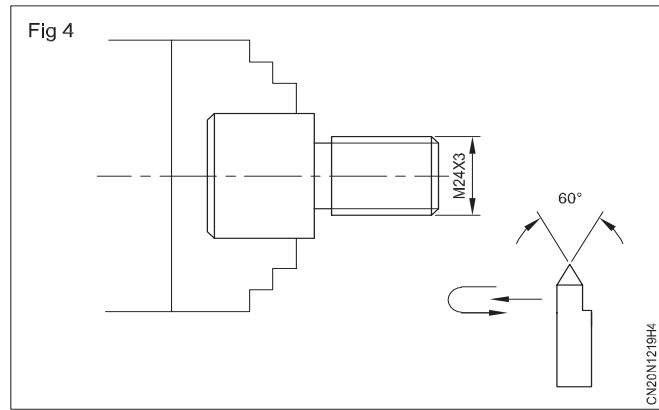


- By square grooving tool of 5 mm width, plunge to form groove. (Fig 3)
- Fix threading tool for metric thread and align.
- Change gear for M24 x 3 thread by manually lever positions.
- Cut thread M24 x 3 to 30mm length.

1	Ø60 x 75mm	-	FE310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					TOLERANCE ±	TIME :
<p style="text-align: center;">EXTERNAL THREAD CUTTING</p>					CODE NO. CN20N1219E1	



- Check with thread ring gauge or thread pitch gauge.
- Remove job oil to preserve and submit. (Fig 4)



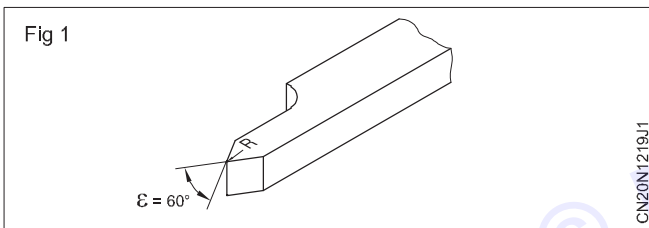
Skill Sequence

Cutting 'V' thread by plunge cut method

Objectives: This shall help you to

- cut 'V' thread using a single point tool on a lathe by the plunge cut method.

Grind a 'V' thread tool for the required thread angle. (Fig 1)

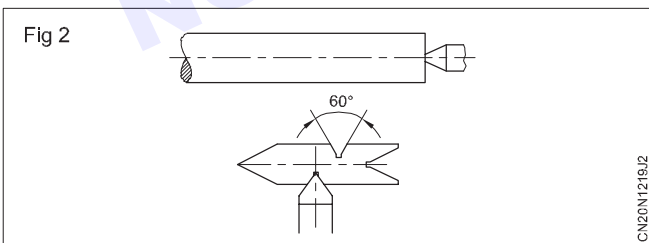


Ensure that the thread angle ground is symmetrical with respect to the axis of the tool.

Arrange the change gear train and set the quick change gearbox levers for the required pitch and hand of thread.

Clamp the tool in the tool-post and set the tool to centre height.

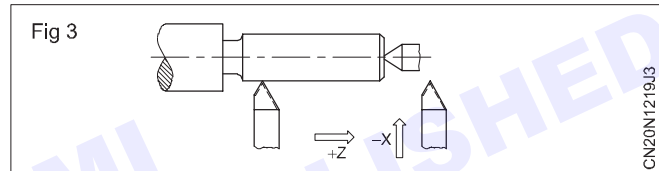
Set the tool perpendicular to the lathe axis by using centre gauge. (Fig 2)



Ensure that the top slide is set at 0° , and slackness is removed by gab adjustment.

Change gear manually/lever position Set the machine to about 1/3rd of the rough turning r.p.m.

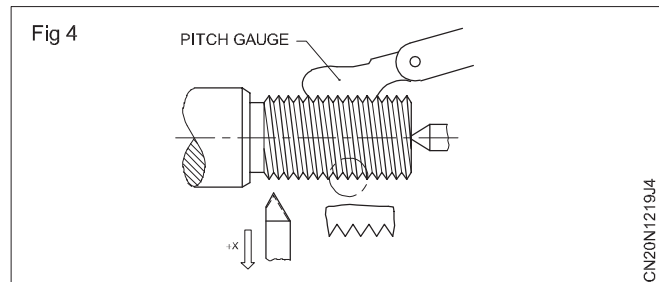
Start the machine and touch the tip to work. (Fig 3) set the cross-slide and the compound slide graduated collars to zero, eliminating backlash.



Bring the tool to the starting point and engage the half nut.

Allow the tool to take the trial cut, the depth being given 0.05 mm divisions of the cross-slide graduated collar.

Withdraw the tool at the end of the cut and stop the machine. (Fig 4)



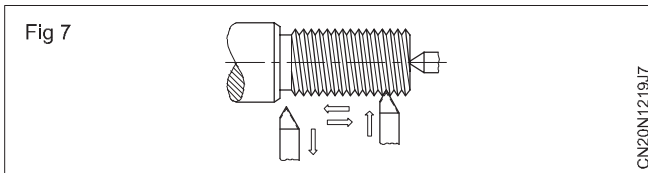
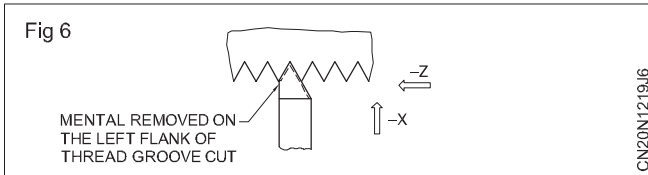
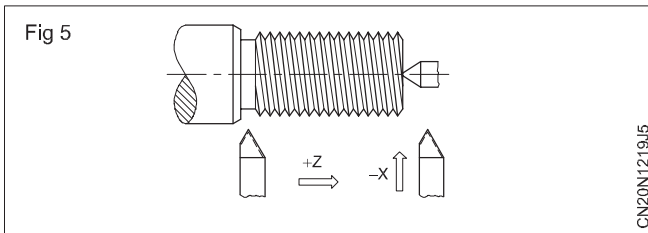
Check with the screw pitch gauge to confirm the gear box setting. (Fig 4)

Reverse the machine to bring the carriage to the starting point. (Fig 5)

Give successive cuts.

For every 3 depths of cuts by the cross-slide, give one axial cut by feeding the tool axially by half division of the compound slide. This relieves the load on the tool. (Fig 6)

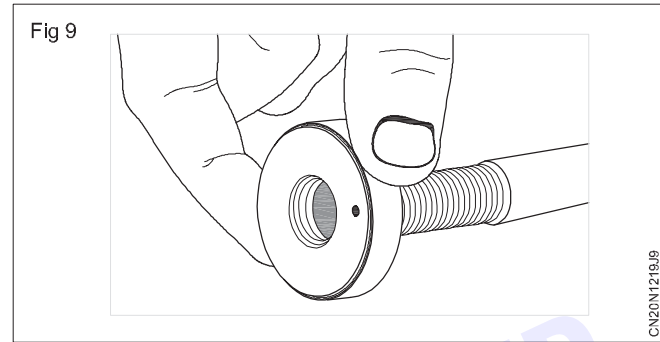
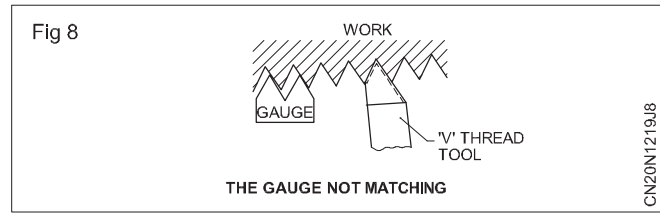
Continue the sequence till the thread profile is formed. (Fig 7)



Check with the screw pitch gauge for the thread form.
Match the mating component to ensure the class of fit.

If the tool is not set square to the axis of the work, the gauge will not match with the thread. (Fig 8)

Use thread ring gauge to check external thread (Fig 9)



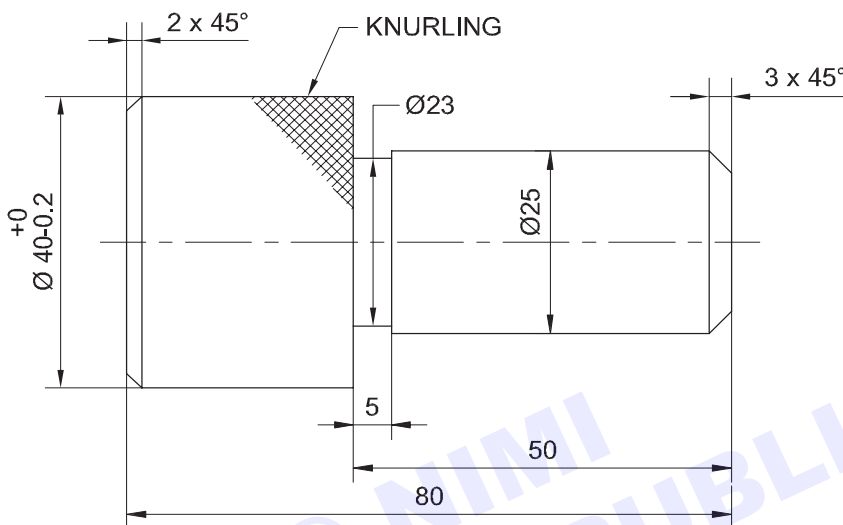
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Perform knurling operation

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

- mount a 4 jaw chuck
- true the job in the 4 jaw chuck with a surface gauge
- turn the component as per drawing and maintain the dimensions within $\pm 0.2\text{mm}$
- knurl the job as per drawing.



Job Sequence

- Check the raw material size and clean.
- Hold the material secured in a 4 jaw chuck projecting 50 mm outside the chuck.
- True the job with a surface gauge and face the end.
- Turn the job to $\text{Ø}40.00 - 0.2$ for more than the required length for knurling.
- Hold the diamond knurling tool securely and set it to the centre height.
- Select the suitable speed for the knurling operation.
- Knurl the surface till a diamond shape is formed.
- Chamfer $2 \times 45^\circ$ at the end.
- Reverse and hold the job in the chuck and true the job.
- Face the end and maintain the length of 80 mm.
- Turn the job to $\text{Ø}25 \times 50$ with a side knife tool. (Use a vernier caliper for measuring dimensions.)
- Chamfer to $3 \times 45^\circ$ at the end with a 45° chamfering tool.
- Undercut and maintain $\text{Ø}23$ and groove with a 5 mm width grooving tool.
- Deburr all sharp edges.

1	Ø45 - 85	-	Fe 310	-	-	1.2.20
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		KNURLING			TOLERANCE ± 0.2	TIME
					CODE NO. CN20N1220E1	

Remember

- Avoid overhanging of the tool.
- Use aluminium pieces for packing, to avoid marks on the knurled surface.

Safety precautions

- Never operate a lever when the machine is in motion.
- Do not keep any tools on the moving parts of the machine.
- Use a suitable coolant.

Skill Sequence

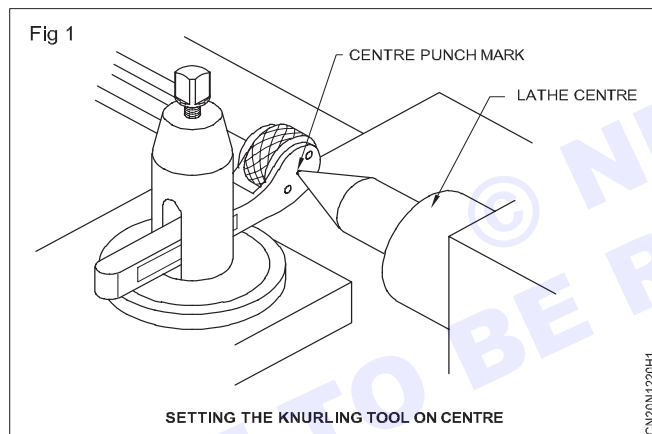
Perform threading operation - External

Objectives: This shall help you to

- prepare the work for knurling
- set the speed for knurling
- set the knurling tool in the tool post
- knurl the job using the required grade of knurl.

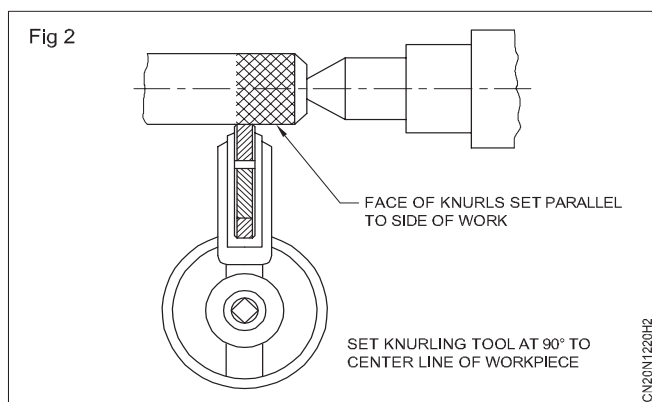
Reduce the diameter of the portion to be knurled depending upon the grade of knurl and material of the job. Reduce 0.1 mm for fine knurling, 0.2 mm for medium knurling and 0.3 mm for coarse knurling approximately.

Set the knurling tool in the tool post and align with the centre or tail stock. (Fig 1)



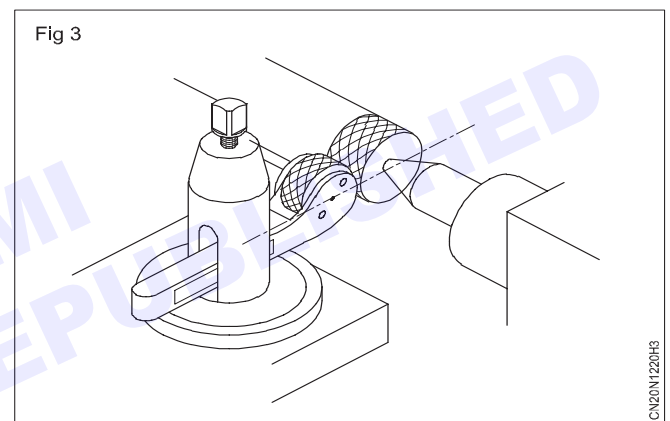
Set the machine for a low speed, preferably 1/3 to 1/4 of the turning speed. Mark off the length to be knurled.

Adjust the knurling tool so that it is at right angles to the axis of the work; tighten it firmly. (Fig 2)



Feed the knurl and make the knurls to contact the work periphery by the cross-slide hand wheel.

Move the carriage until about the face of the knurling roll overlaps the end of the workpiece which helps to produce a true pattern. (Fig 3)



Start the lathe and feed the knurling tool into the work by the cross-slide.

Stop the lathe and reset the knurling tool, if necessary.

Feeding the knurl into the workpiece, before it is rotated, may damage the knurl.

Move the knurling tool longitudinally with a uniform movement by the carriage hand wheel up to the required length of the work to be knurled.

Give the depth by the cross-slide without drawing the tool back. Feed the knurling tool to the other end.

Until the correct pattern is obtained, do not withdraw the knurling tool back.

Ample coolant is to be applied to the workpiece being knurled. This washes away any metal particles, and provides lubrication for the knurling rolls.

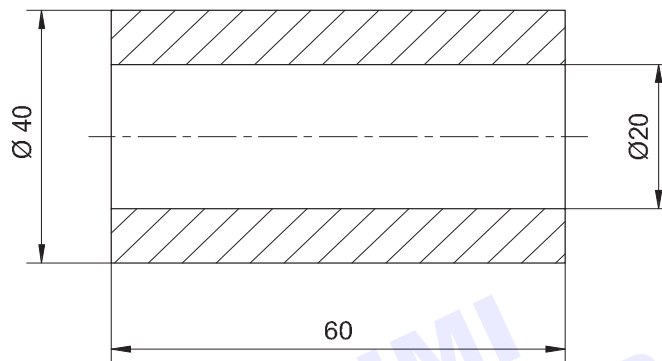
Use a fine feed for knurling hard metals and a coarse feed for knurling soft metals.

Clean the knurl with a brush for subsequent cuts.

Perform drilling operation

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

- drill through hole
- re-sharpen a twist drill
- check the twist drill for its performance.



Job Sequence

- Check the raw material for its size.
- Hold the job in a 4 jaw chuck and true it, keeping about 45mm outside the chuck.
- Set the facing tool to the correct centre height.
- Select and set the correct spindle speed, for facing.
- Face one side first, and turn the outer diameter to $\phi 40$ mm for the maximum possible length.
- Centre drill.
- Select the required size of drills including the pilot drill.
- Hold the drill in the tailstock spindle with the help of suitable sleeves after cleaning.
- Select the spindle speed for drilling the pilot hole of 12mm dia.
- Bring the tailstock to a convenient position for drilling, and lock the tailstock on the bed.
- Run the lathe and advance the drill, so that it does the drilling operation on the job held in the chuck.
- Use coolant while drilling and advance the drill slowly.
- Enlarge $\phi 12$ mm hole to $\phi 20$ mm hole by drilling at a reduced spindle speed.
- After completion of drilling throughout the job reverse and true the job; face to the required length as per drawing, and turn outer dia $\phi 40$ mm.

1	Ø45x65	→ 1.2.22	Fe 310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		DRILLING			TOLERANCE : ± 0.04mm	TIME :
					CODE NO. CN20N1221E1	

Skill Sequence

Re-sharpening a twist drill

Objectives: This shall help you to

- re-sharpen a twist drill.

A twist drill can be successfully sharpened on a bench or pedestal grinder by adopting the following procedure.

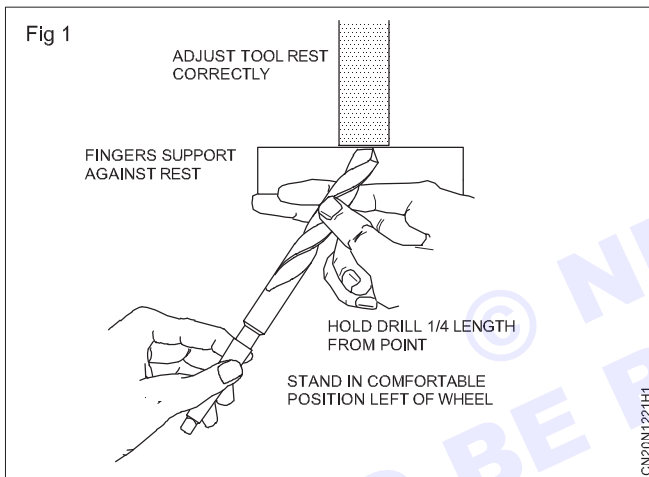
Check that the surface of each wheel is running true and that the wheels are dressed clean.

Ensure that the tool-rest are adjusted correctly and tightened

Wear safety goggles.

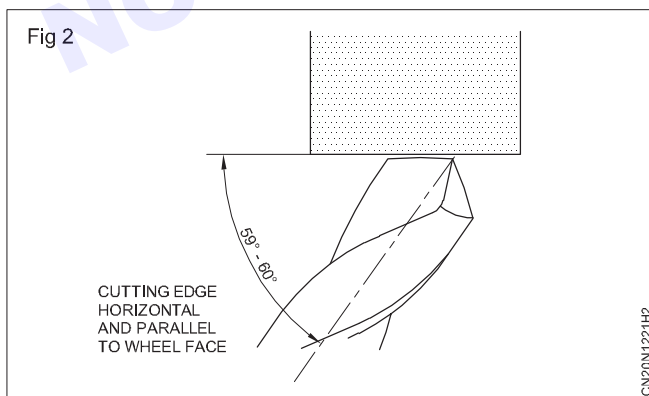
Stand in a comfortable position in front the machine.

Hold the drill at about one quarter of its length from the point, between the thumb and the first finger of the right hand. (Fig 1)



Keep both elbows against the side.

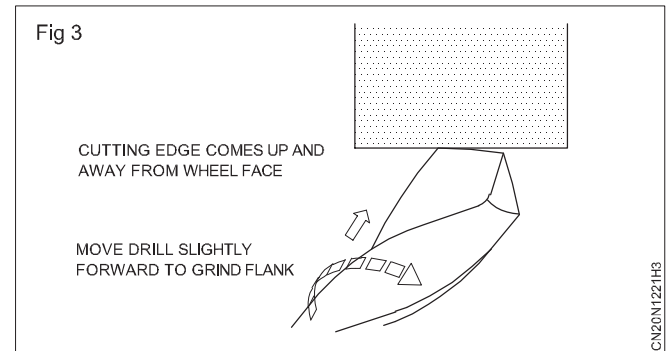
Position in such a way that the drill makes an angle of 59° to 60° to the wheel face. (Fig 2)



Hold the drill level. Twist it until one cutting edge is horizontal and parallel to the wheel face.

Swing the shank of the drill slightly downwards and to the left with the left hand. The right hand is on the tool-rest.

Match the cutting edge against the wheel. Note that, as the shank, swings down, the cutting edge comes slightly upwards and away from the wheel face. (Fig 3)



Apply a slight forward motion to your hands

This will bring the flank of the point against the wheel to produce a lip clearance.

Coordinate the three movements of swinging down, twisting clockwise and forward movement. These movements should not be heavy movements. If they are performed correctly, they will produce a cutting edge that has the correct lip clearance and cutting angle.

Practice these movements against a stationary wheel, using a new or correctly sharpened drill.

Notice how only a small movement is required to produce the required clearance.

Also note that, if the drill is twisted too far, the other cutting edge will swing down to contact the wheel face.

Proceed now to sharpen one edge, removing as little metal as possible.

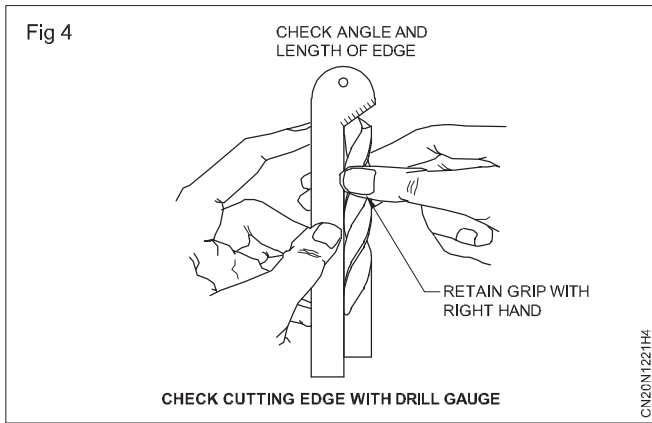
Procedure to obtain equal angles

Move the drill back, clear of the Wheel face.

Turn the drill over without moving the position. This makes the second edge to the wheel face at the same angle as the first cutting edge.

Proceed to sharpen the second cutting edge, using the same amount of drill movement as before. When these actions are carried out carefully, the drill will be sharpened with equal cutting angles. The lip clearance will be correct and equal.

Use a drill angle gauge to check that the cutting angle is correct (118° for mild steel), the cutting edges are of equal length and the lip clearances are equal and correct (about 12°). (Fig 4)



Lift the drill off the wheel face. Retain the grip on the drill with the right hand.

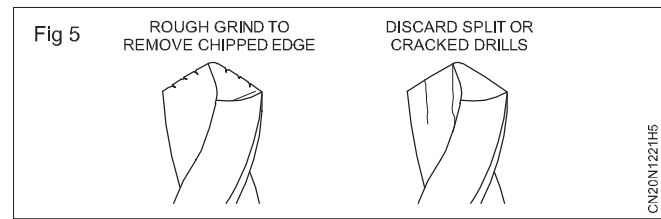
Make such inspection or checks as are necessary. Move the right hand back on-the tool-rest in the same position as before.

Hold the drill shank again in the left hand with the elbows against the side. The drill will swing back against the wheel face in the same position and at the same angle as before.

Points to be considered when sharpening drills

Grind as little as possible from the drill. Remove only enough to sharpen the cutting edges.

Rough grind the drill point with a coarse grit wheel when the edges are badly chipped. (Fig 5)



Never re-sharpen a cracked or split drill.

Avoid overheating the drill.

Apply light pressure against the wheel face. Lift the edge clears of the wheel face frequently. This allows the air stream produced by the wheel to cool the drill point.

Cooling a drill rapidly by quenching in cold water may cause cracking of the cutting edge

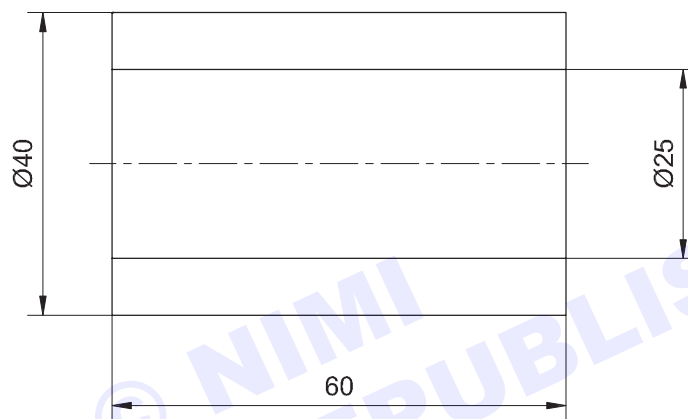
Re-sharpening of very small drills requires great skill. They require proportionally less movement to produce the cutting angles.

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Perform boring operation

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

- set the job on lathe
- set the boring tool
- bore a hole with boring tool
- measure the bore by using vernier caliper.



Job Sequence

- Hold the job (Ex.1.2.21) in 3 jaw chuck.
- Set the boring tool in tool post and align the lathe axis.
- Bore the drilled hole $\phi 20$ to $\phi 25$ mm.
- Check the bore by vernier caliper and inside caliper with outside micrometer.
- Remove the job from the chuck.
- Apply thin film oil for preserving.
- Submit the job for evaluation.

1	-	← 1.2.21	Fe 310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		BORING			TOLERANCE : ± 0.04mm	TIME :
					CODE NO. CN20N1222E1	

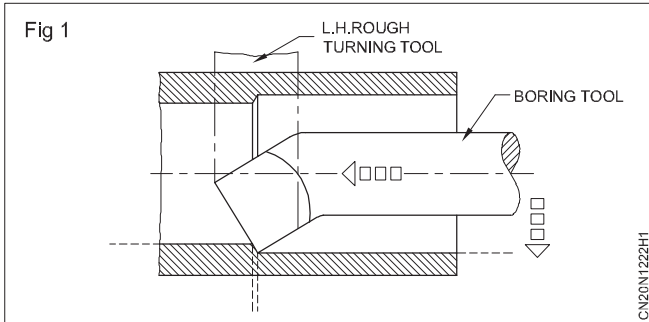
Skill Sequence

Boring a drilled hole

Objectives: This shall help you to

- set the boring tool in the tool post
- bore the drilled hole to the required size
- check the hole with the help of a vernier caliper.

Boring is an internal operation of enlarging a hole with the help of a single point cutting tool. (Fig 1)



To bore the hole, the following procedure is to be followed. Mount the workpiece in a four jaw chuck. True the face of the work and the outer diameter.

Set the lathe to the proper spindle speed for boring.

Mount the boring tool on the tool post of the compound rest.

Fix the boring tool, level and parallel to the centre line of the lathe.

Grip the boring tool as short as possible to reduce chatter.

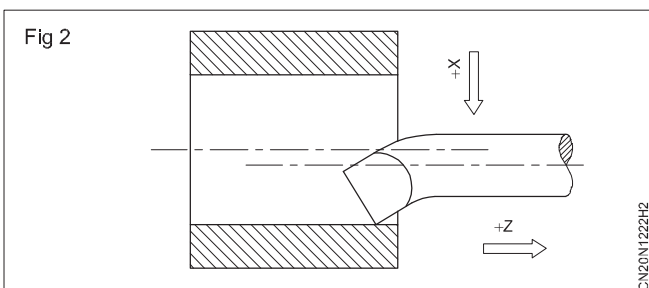
Use the largest diameter boring tool which can be accommodated in the drilled hole. (Approximately 2/3rd size of the bore)

Set the cutting edge of the cutting tool just slightly above the centre line, since there is tendency for the tool to spring downwards when cutting.

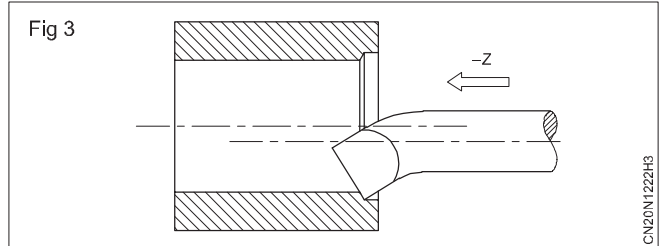
Choose a proper feed for rough boring.

The speed for boring is the same as that for turning and is calculated for the diameter of the bore.

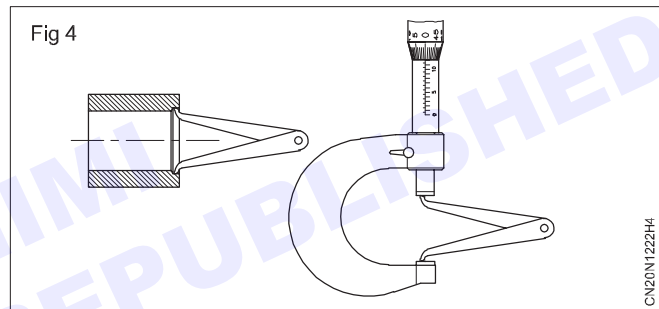
Start the machine and turn the cross-slide handle anticlockwise until the cutting tool touches the inside surface of the hole. (Fig 2)



Take a light trail cut about 0.2 mm deep and about 8 mm long at the right hand end of the work. (Fig 3)



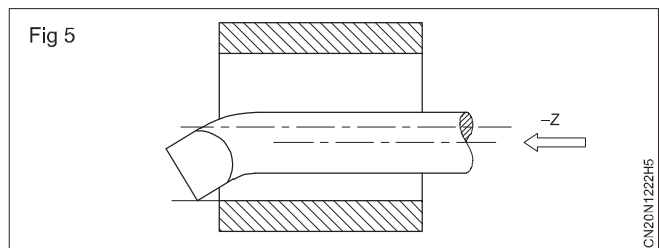
Stop the machine and measure the diameter using a telescopic gauge or inside caliper. (Fig.4)



Calculate the amount of material to be removed from the hole for the roughing cut.

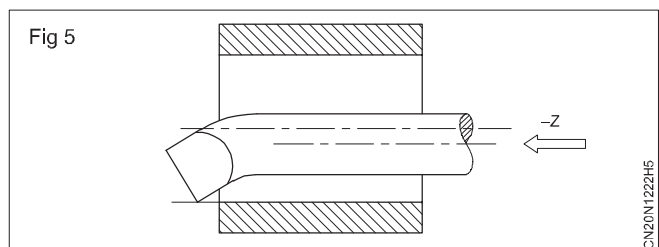
Leave about 0.5 mm undersize for a finish cut.

Take a roughing cut for the required length. (Fig 5)



Keep the machine and move the carriage to the right until the boring tool clears the hole. (Fig 6)

Set a fine feed of about 0.1 mm for the finish cut.



Set the cutting tool for the required depth to get the finished bore size.

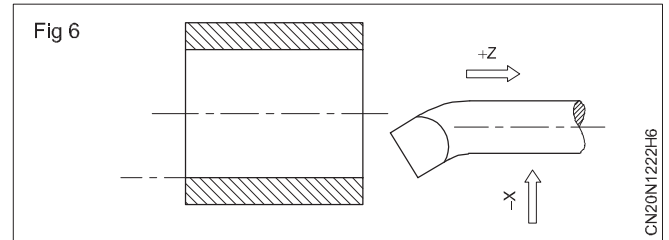
Use the cross-slide graduated collar.

Finish the boring operation and measure with a vernier caliper.

To avoid bell mouth, repeat the same cut.

Several cuts taken without adjusting the depth of cut would correct bell mounting.

Remove the sharp corners.



Inside caliper & outside micrometer used for bore measurement

Objectives: This shall help you to

- take the measurement of a bored hole with an inside caliper, transfer it to an outside micrometer and read the measurement.

Bores are checked for their dimensional accuracy by using:

- Inside micrometers.
- Universal vernier calipers.
- Inside calipers and outside micrometers (transfer measurement).
- Telescopic gauges and outside micrometers (transfer measurement).

The first two methods give direct reading whereas the 3rd and 4th are by transfer measurement.

For checking the bore diameters using inside calipers and outside micrometers the following sequence is to be followed.

Select the inside caliper according to the size of the bore to be measured.

Select an outside micrometer of suitable range for the size of the hole.

Open the legs of the inside caliper approximately permitting its entrance into the hole.

Position one leg in contact with the bottom of the bore.

Keeping this as the fulcrum, oscillate the other leg in the bore.

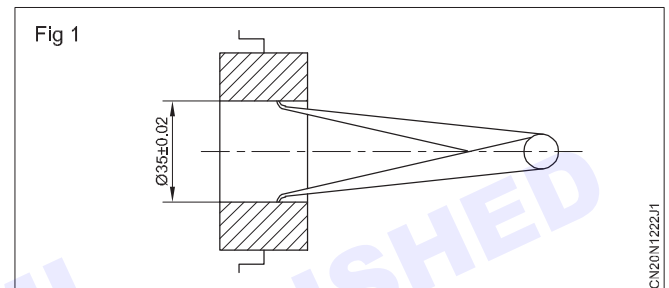
Adjust the distance between the legs by gentle tapping to increase or to decrease so as to enable the leg to enter.

Rock the inside caliper with respect to the axis of the work so as to make the leg of the inside caliper contact the bore top surface. (Fig 1)

If the 'feel' is hard, reduce the distance between the leg tips and if the feel is less or if there is no feel, increase the distance between the leg tips slightly.

Check once again and repeat till you get the correct feel.

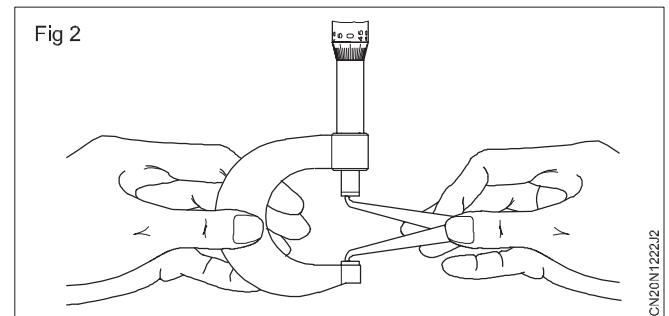
Ensure that the position of the legs is not disturbed, once the correct feel is obtained.



Hold the outside micrometer in one hand, and the spindle away from the anvil face, a little more than the distance between the two legs of the inside caliper.

Hold the inside caliper with the other hand, contacting the tip of one leg with the anvil face of the micrometer.

Oscillate the other leg and rotate the thimble of the outside micrometer to contact the tip of the oscillating leg of the inside caliper. (Fig 2)



Ensure you get the same 'feel' as before.

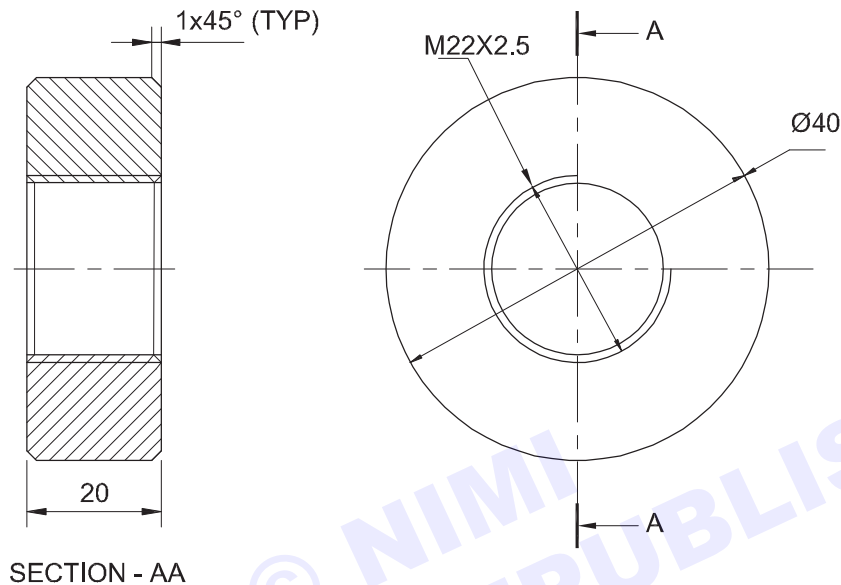
Note the readings on the barrel and thimble of the outside micrometer, and determine the size of the measurement.

The accuracy depends on the skill. Practice to get the correct feel for the measurement.

Perform threading operation - Internal

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

- cut internal 'V' thread by single point threading tool
- check the metric thread using thread plug gauge
- match the nut and bolt.



Job Sequence

- Check the given material for its size by steel rule.
- Hold the work in a three jaw chuck about 10 mm inside the chuck.
- Turn the outer dia to 40 mm to possible length.
- Chamfer the edge 1x45° by chamfering tool.
- Centre drill, and drill a pilot of $\phi 10$ mm through hole.
- Enlarge the drilled hole dia 10 mm $\phi 18$ mm by drilling.
- Bore the drilled hole to the core (root) diameter of the thread i.e. 19.2 mm.
- Set the machine to cut 2.5 mm pitch internal thread.
- Cut the internal thread.
- Check the thread with screw pitch gauge.
- Reverse and hold the work on AE 40 mm and true it.
- Face the end of the work, and maintain a total length of 20 mm.
- Chamfer 1x45° on the outer edge.
- Remove the sharp edges and have a final check.

1	Ø45 - 25	-	Fe310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		INTERNAL THREADING			ACCURACY $\pm 0.04\text{mm}$	TIME:
					CODE NO. CN20N1223E1	

Skill Sequence

Cutting an internal thread

Objectives: This shall help you to

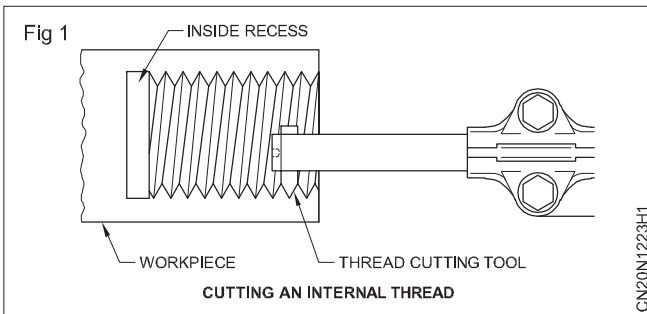
- cut an internal thread on a centre lathe.

Mount the job on four jaw chuck / three jaw chuck/ collet.

Drill and bore the job to the core diameter of the thread to required length/ through hole.

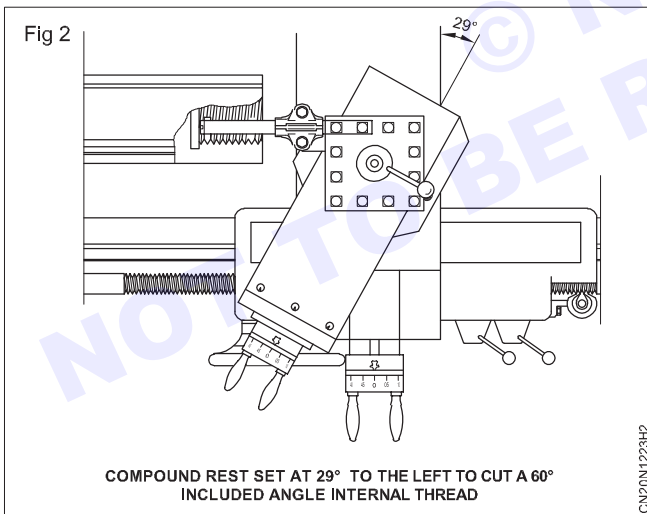
For a blind hole, cut a recess at the end of the bore enough to permit the cutting tool to clear thread.

The recess must be larger than the major diameter of the thread. (Fig 1)



Chamfer the front end to $2 \times 45^\circ$.

Set the compound rest at 29° to cut 60° included angle as shown in Fig 2.

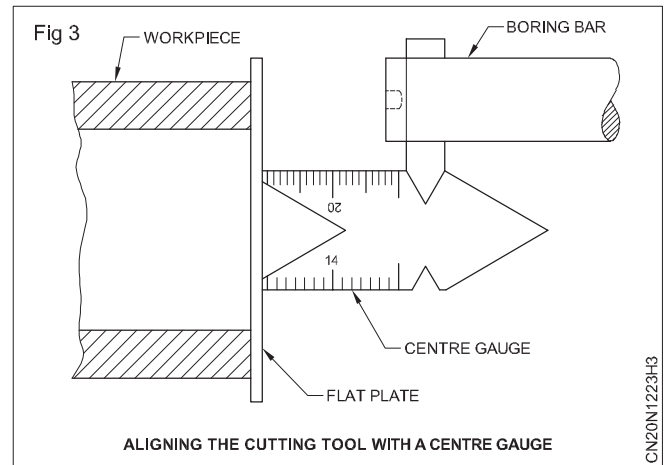


Set the gear box levers to the required pitch.

Fix the correctly ground threading tool in a boring bar.

Fix the boring bar parallel to the lathe centre line and set the point of the cutting tool to lie on the centre.

Align the cutting tool with a help of centre gauge as shown in Fig 3.



Mark the boring bar to indicate the required depth of entry into the bore.

Ensure that the boring bar does not foul anywhere on the job.

Reverse the cross slide until the tool point just touches the bore.

Set the cross-slide and compound slide graduated collars to zero.

Withdraw the cutting tool from the bore.

Set the spindle speed to $1/3$ of the calculated r.p.m.

Start the machine.

Adjust the depth of cut to 0.1 mm.

Engage the half nut.

At the end of the cut, simultaneously reverse the chuck and clear the tool just away from the thread.

Ensure that the tool should not touch the thread in both side of the bore.

When cutting tool comes out of the bore stop the machine.

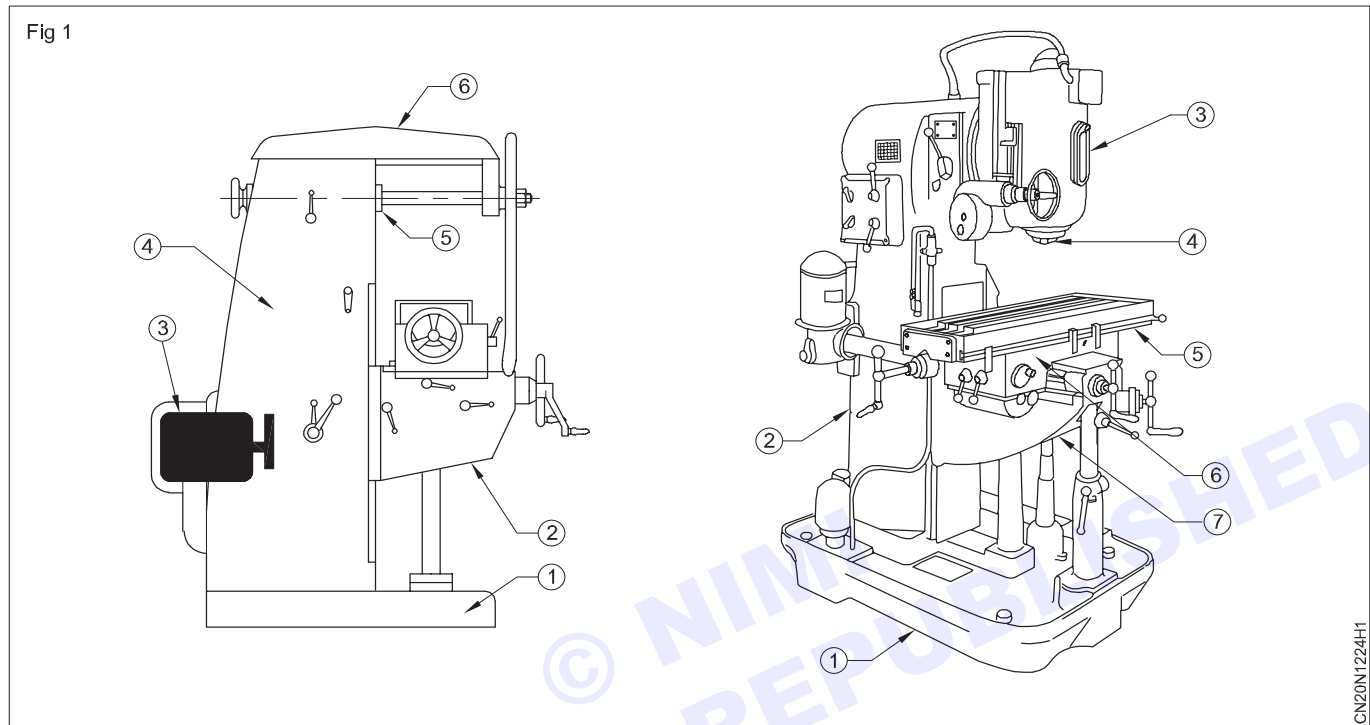
Give the depth of cut and run the machine in forward direction. Similarly finish the thread until final depth is achieved.

Check the finished thread with a thread plug gauge or a threaded bolt.

Identification of milling machine

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

- identify and record the type of milling machine
- identify the parts of milling machine
- record the parts name in table.



Job Sequence

Instructor shall show the horizontal and vertical milling machines. Brief each part of milling machines, ask the trainees to note the parts name in Table 1 for horizontal milling machine and Table 2 for vertical milling machine.

- Trainees to note down the part names of both milling machines
- Record the parts name in Table 1 for horizontal and Table 2 for vertical milling machine.

Table 1 - Horizontal milling machine

S. No.	Name of the parts
1	
2	
3	
4	
5	
6	

Table 2 - Vertical milling machine

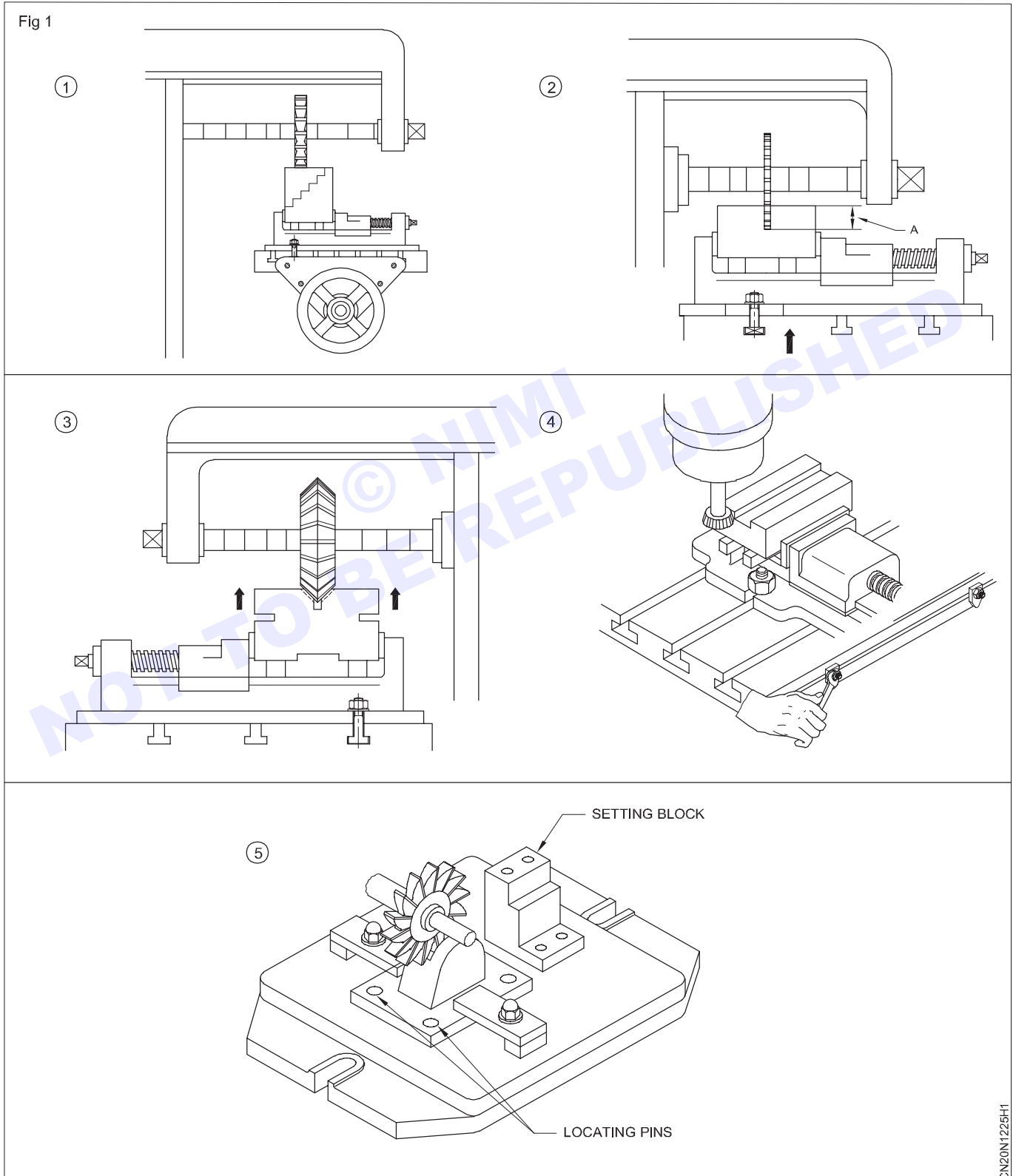
S. No.	Name of the parts
1	
2	
3	
4	
5	
6	
7	

- Get it checked by instructor.

Identify the process, tools and accessories used for the operations

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

- identify type of operation
- identify work holding device and accessory
- identify tool holders and cutting tools.



Job Sequence

Instructor shall brief each operations, tools, holding device and accessories used for each operation.

- Trainees note down the names of each.
- Record the names in Table 1.

Table 1

S. No.	Name of the operation	Work holding device	Accessories	Tool holders	Cutting tools
1					
2					
3					
4					
5					

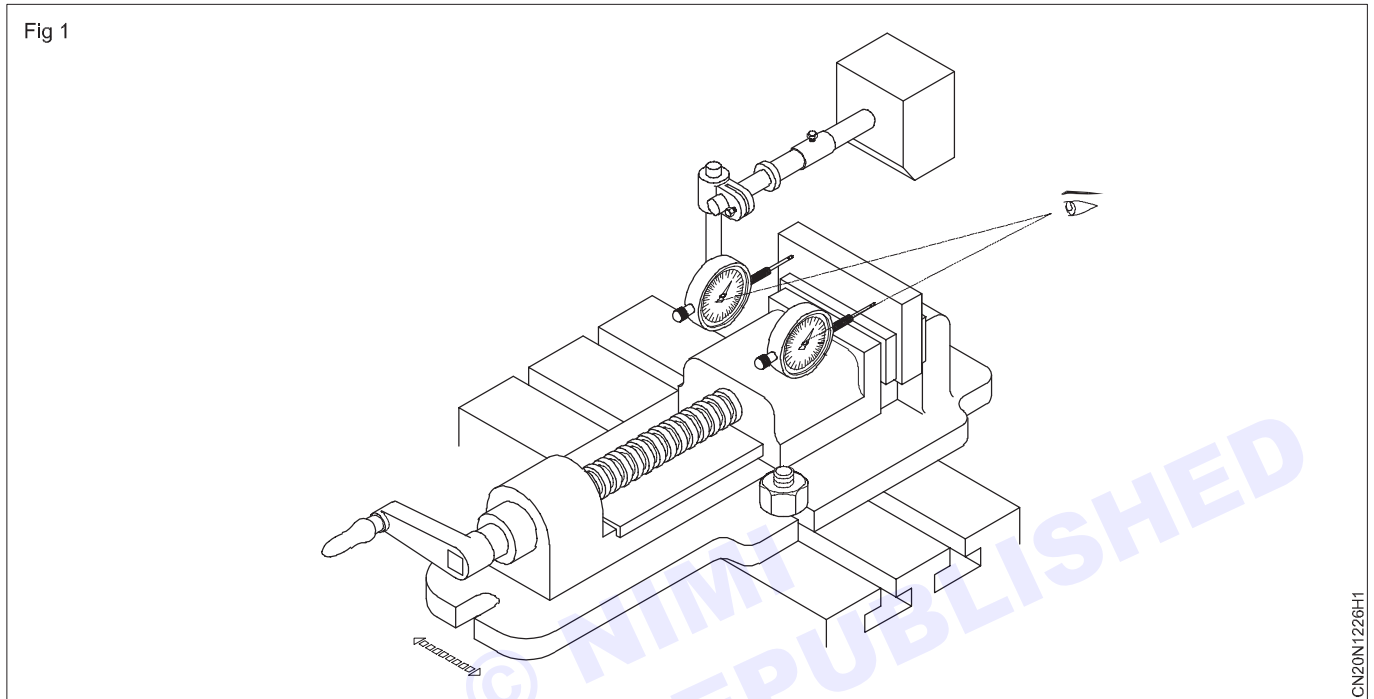
- Get it checked by the instructor.

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Aligning workpiece on milling machine

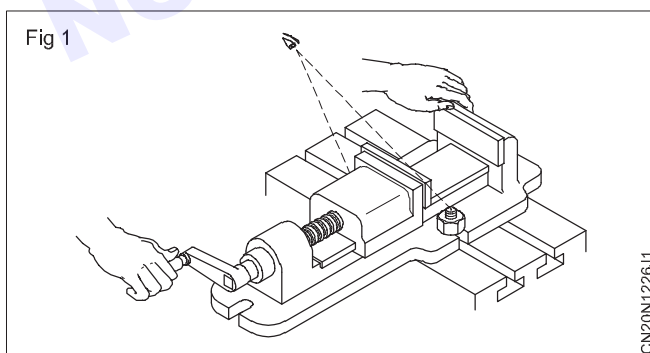
Objectives: At the end of this exercise you shall be able to

- align a machine vice on the table of the milling machine
- fix the workpiece in machine vice.

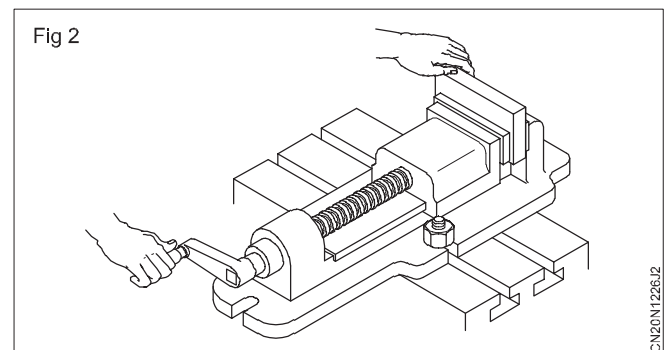


Job Sequence

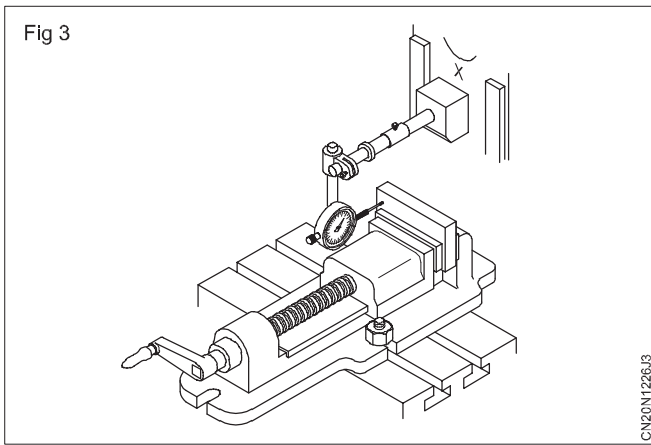
- Clean the vice base and the machine table top, free from dust for seating.
- Place the vice at the middle of the table with maximum support to avoid falling off of the vice. (Fig 1)
- Clamp the parallel block in the vice. (Fig 2) Set the vice such that the jaws are at right angle to the direction of cut.



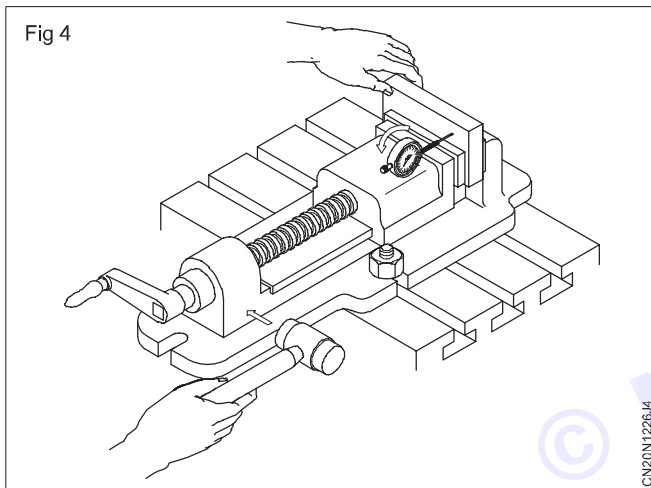
- Position the 'T' bolts into the 'T' slot. (Fig 1) While shifting the vice towards the slots ensure that there is 1mm to 2mm clearance between the 'T' bolt and the vice slot to allow for adjustment.
- Tighten all the 'T' bolt nuts by hand.



- Position the dial indicator with the magnetic base firmly on the reference surface (X). (Fig 3)
- Engage the dial indicator stylus on one end of the parallel. (Fig 3) Ensure that the dial indicator and stand do not foul anywhere.
- Adjust the position of the dial pressure and set the reading to zero on one end of the parallel.

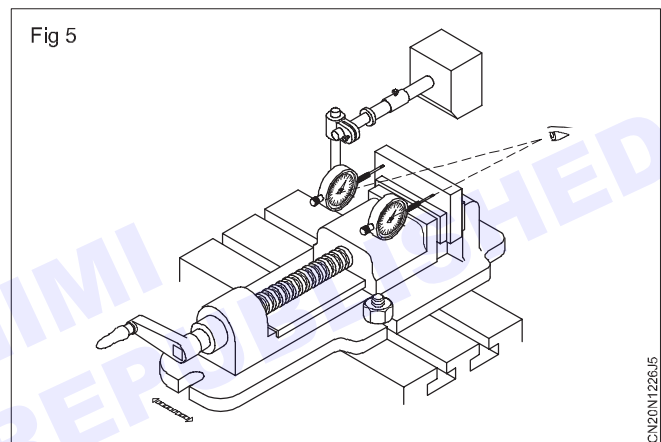


- Move the table so that the dial indicator is at the other end of the parallel. (Fig 4) observe the pointer movement.



- If the pointer deviates from zero, adjust the vice by gentle tapping in the direction as needed. (Fig 4) Ensure that the plunger is not lifted while tapping.
- Repeat the step until the dial indicator reads zero along the length.

- Tighten the vice clamping nuts without disturbing the setting.
- Check the alignment after clamping, and adjust, if necessary.
- Lubricate the vice screw and the slide ways.
- Place one of the larger surfaces of the workpiece on the parallel to prevent its downward movement while machine.
- Ensure that the workpiece is projecting the vice jaws by about 3 to 5 mm more than the total depth of cut. This avoids resetting of the job now and then also it prevents the vice jaws, tools and workpiece from damage.
- Place a rod of diameter 6 to 15mm between the middle of the unfinished side and the movable jaw. This gives line contact between the job and prevents lifting off the workpiece. (Fig 5)



- Tighten the workpiece.
- Tap the workpiece gently with a soft hammer for seating on the parallel. Ensure that the parallel block does not shake.

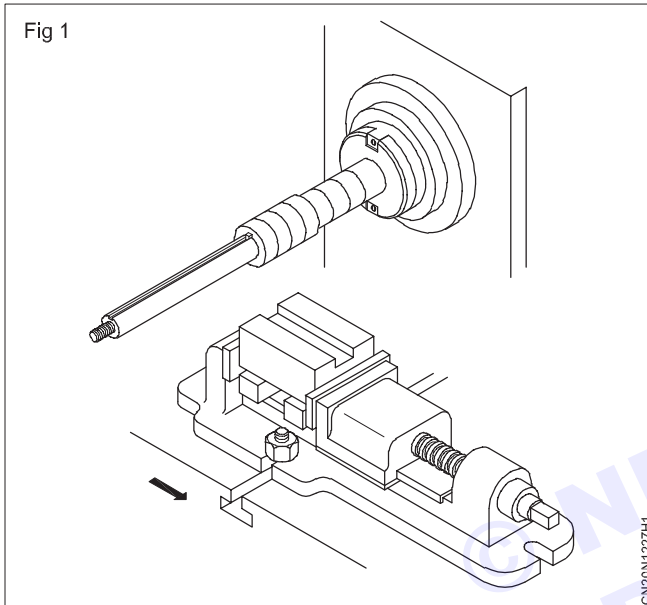
Loading, unloading of the cutter on arbor

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

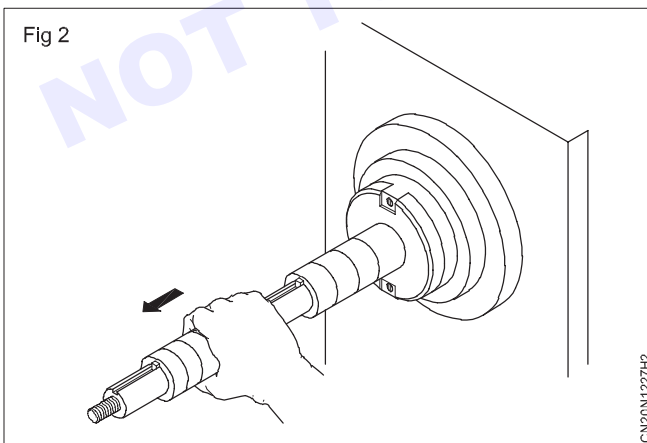
- mount and position the cutter on milling machine arbor.

Job Sequence

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

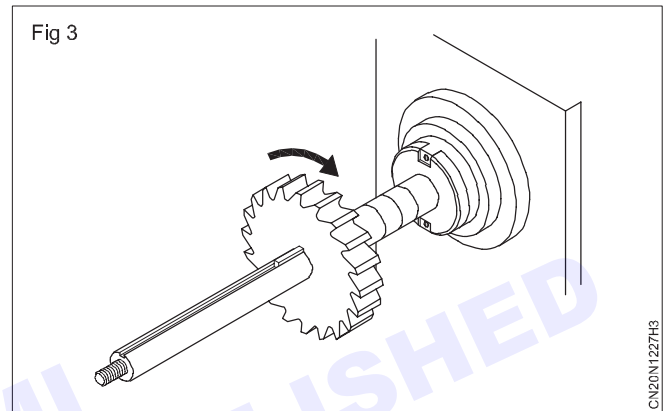


- Insert enough spacers on to the arbor so that the last spacer extends over the rear edge of the workpiece. This will enable you to fix the cutter in the middle of the workpiece for milling. (Fig 2)

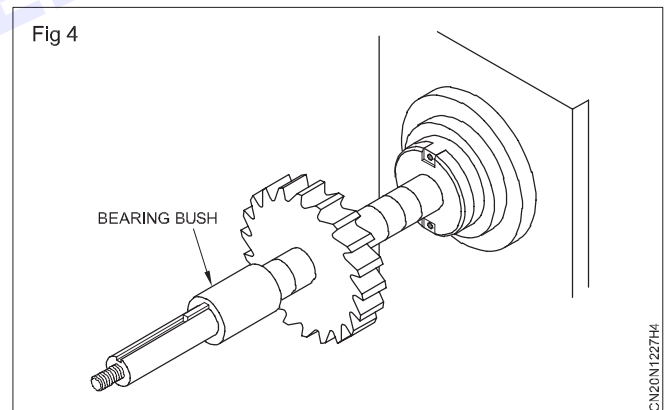


- Clean the side and face the cutter and the bore of the - cutter.
- Select the key to suit the cutter keyway.
- Place the cutter on the arbor such that the direction of rotation of the cutter is in the opposite direction of the

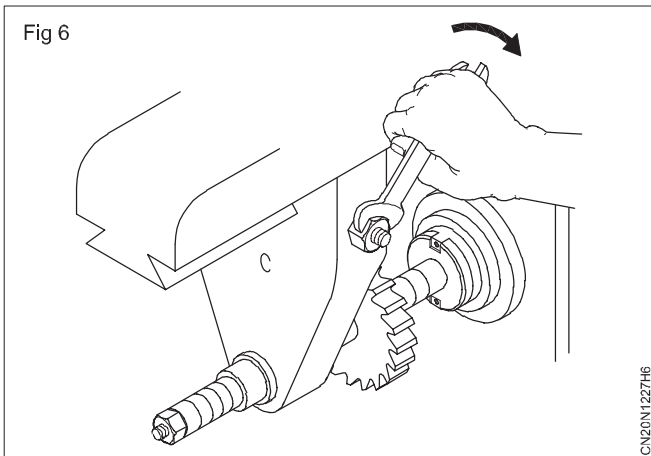
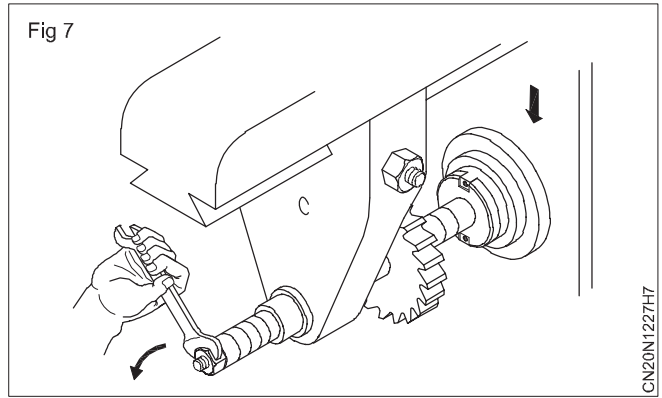
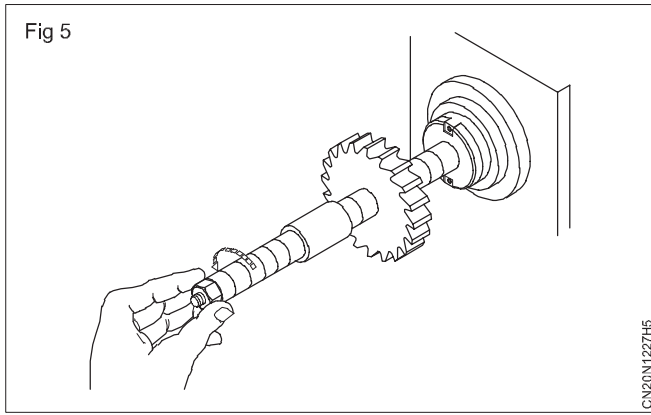
job feed for up-milling at the initial stage. Depending upon the condition of the machine, down-milling may be performed at a later stage of practice. (Fig 3)



- Ensure that the key is placed into the keyway, and milling cutter.
- Slide the bearing bush on to the arbor. (Fig 4)



- Slide on more spacers until one or two threads on the arbor screw are covered so that the spacers are pressed while tightening. If not, the cutter may not be tightened sufficiently.
- Tighten the arbor nut by hand. (Fig 5)
- Carefully slide the arbor support. (Fig 6)
- Ensure that the bearing bush extends equally on both sides of the arbor for uniform support.
- Tighten the arbor nut and switch on the machine and check visually that the cutter runs true. (Fig 7)



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

- Remove the cutter by reverse order.

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Selecting the proper feed and speed

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

- calculate speed and feed with respect material to be machined
- positioning gear levers according to the calculated speed and feed.

PROCEDURE

TASK 1: Calculate the speed and feed for the material list in Table

Table

Material	Speed rev/min	Feed/rev
Mild steel		
Cast iron		
Brass		

Data for calculation

Tool material : High speed steel
Cutting speed m/min : 20 m/min for mild steel
: 25 m/min for cast iron
: 40 m/min for brass
Feed mm/min : 40 for mild steel
: 60 for cast iron
: 100 for brass
Diameter of cutter : 100 mm

Note: Instructor should teach how to do calculation.

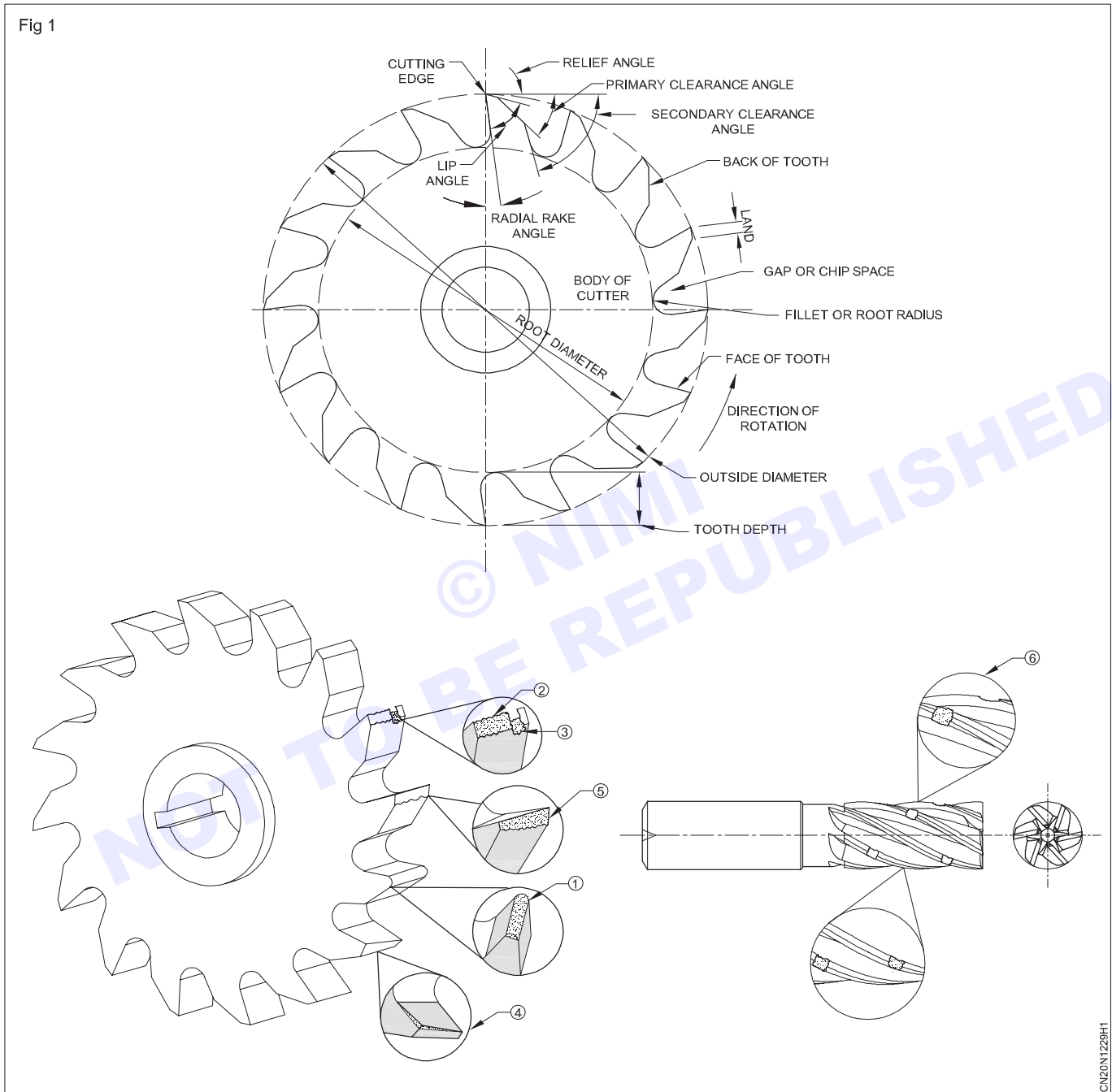
TASK 2: Perform the gear of the milling machine

The instructor may guide the trainees to position the gear to the calculated speed & feed & verify the results.

Segregate 'OK' and worn-out cutting tools

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

- identify various defects by visually.



Defectives

- 1 Tooth wear
- 2 Tooth breakage
- 3 Tooth chipping
- 4 Rake angle error
- 5 Relief angle error

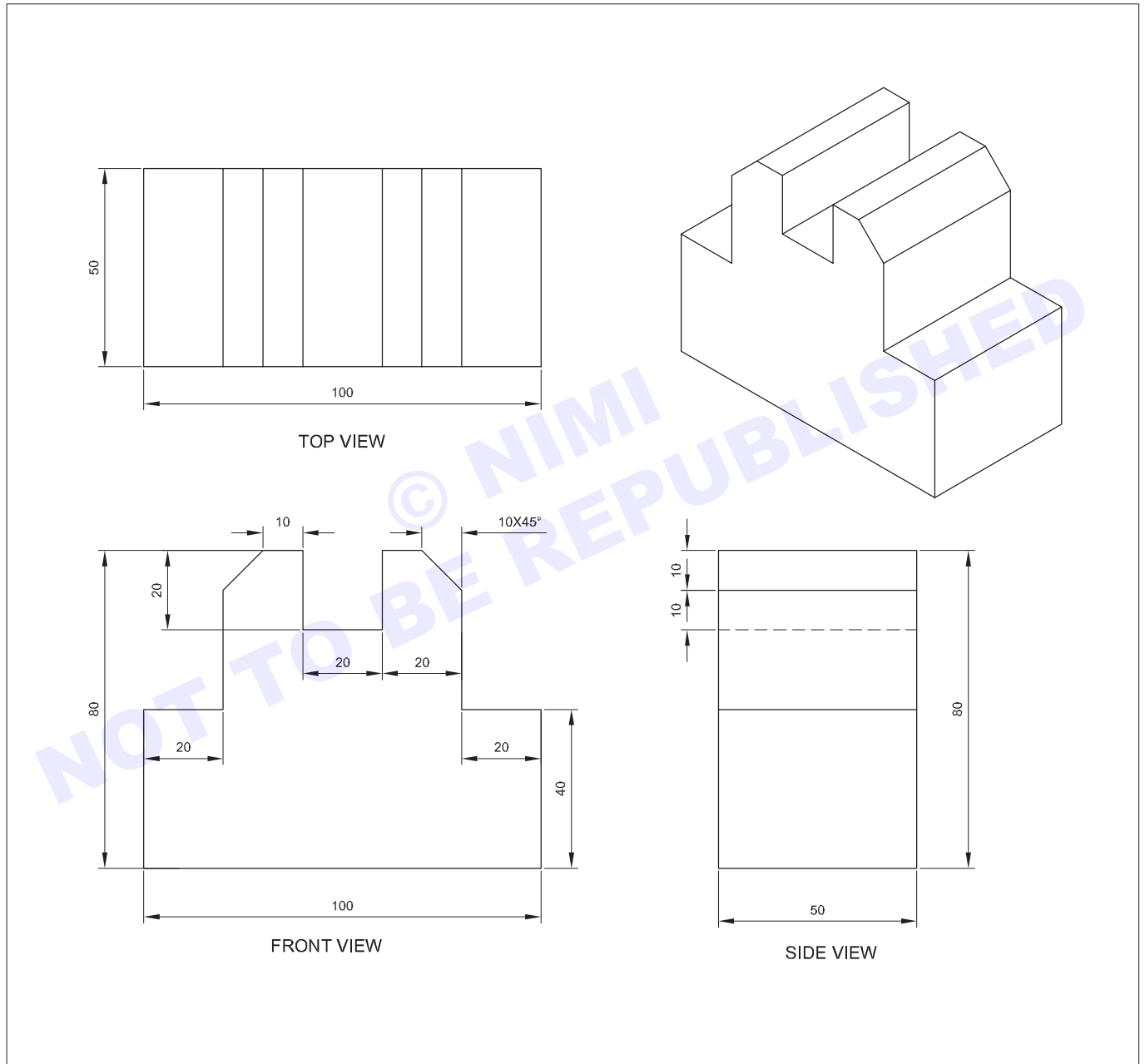
- 6 Cutter body damage

Note: Instructor has to explain the defective and defect less cutter of each elements to be compared and illustrate the difference between them.

Step milling, slot milling and angle milling

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

- set the job on machine vice for machining
- mill steps on the job
- mill the slot
- mill the angular surface
- measure the dimensions using vernier caliper, depth gauge and vernier bevel protractor.

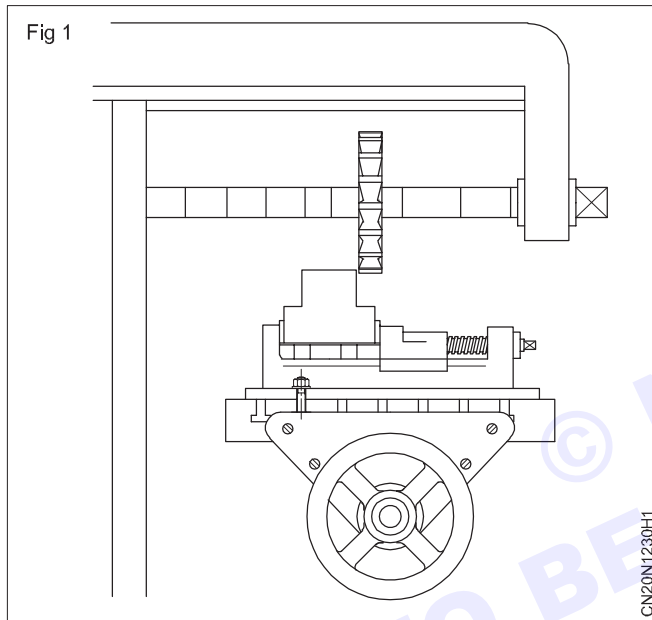


1	Ø 100 x 80 x 50 mm	PRE MACHINED	FE310	-	-	1.2.30
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	STEP MILLING, SLOT MILLING AND ANGLE MILLING				TOLERANCE ±	TIME :
					CODE NO. CN20N1230E1	

Job Sequence

Step milling

- Check the material given.
- Clamp the machine vice securely on the machine table and align jaw parallel to the column.
- Hold the job on the machine vice on the parallel block. Ensure that the parallel block does not move.
- Mount the side and take cutter on arbor.
- Set the r.p.m. of the cutting.
- Align the cutter and the job for milling steps.
- Mill the steps in sequence and check with a depth micrometer. (Fig 1)

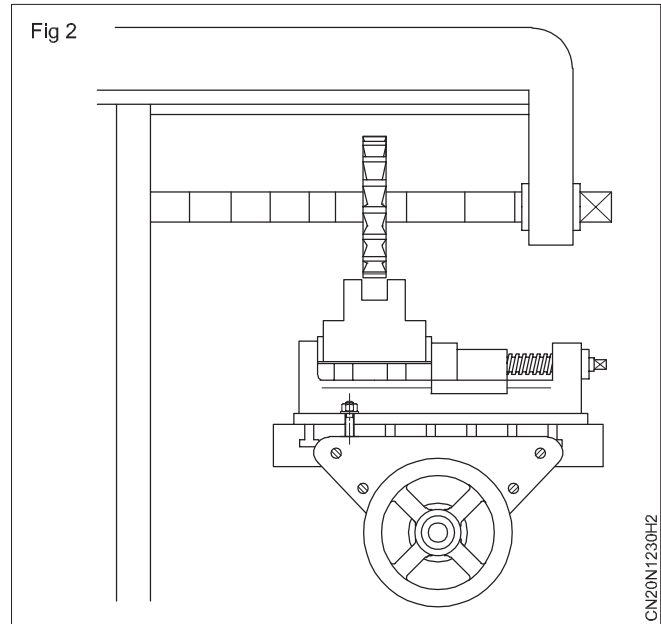


Slot milling

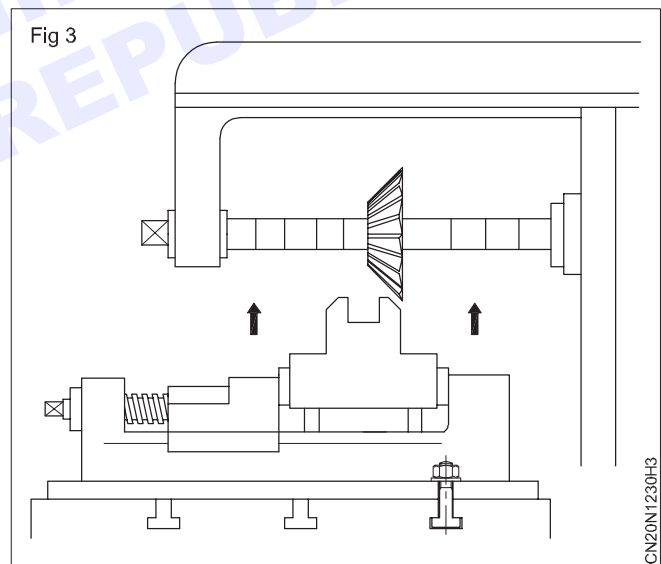
- Align the cutter and the job for milling slot.
- Mill the slot in sequence and check with a depth micrometer. (Fig 2)

Angle milling

- Hold the single angle 45° cutter on arbor.
- Align the cutter on end mill the angular surface of 10 x 45°.



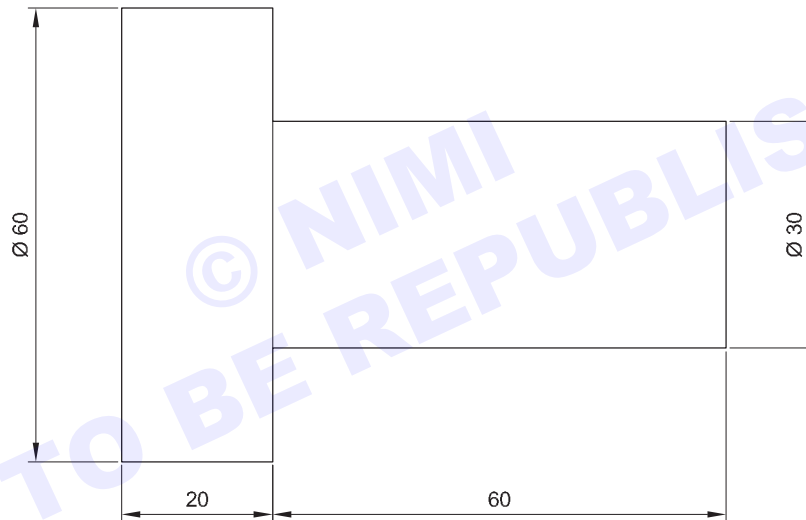
- Align the cutter on other end mill the angular surface. (Fig 3)
- Remove the job from the machine.
- Remove burrs if any.
- Check the angle using vernier bevel protector.

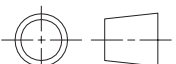


Prepare checklist of customer needs

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

- interpret technical drawings and specifications provided by customers
- identify the tools and setup required for specific machining operations
- prepare a detailed checklist for rough and finish turning processes.



1	Ø 62 x 85 mm	-	Fe 310	-	-	1.3.31
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	CREATION OF CHECKLIST				TOLERANCE ± 0.05	TIME :
					CODE NO. CN20N1331E1	

PROCEDURE

Customer needs analysis is a crucial step in CNC machining. It ensures that all product specifications, quality requirements and delivery expectations are met accurately. By preparing a detailed checklist, machinists can systematically plan and execute machining operations, reducing errors and improving efficiency.

Overview of the checklist preparation process

1 Understand the drawing: Analyze technical drawings or CAD models to extract key details like dimensions and tolerances.

2 Identify tools and materials: Select the appropriate cutting tools and materials based on the customer's specifications.

3 Plan machining operations: Sequence the steps, including roughing, finishing and inspection.

4 Ensure quality control: List inspection tools and techniques to verify final product accuracy,

5 Document and validate: Create a checklist and validate it with the customer.

Category	Task/Question	Status (✓/x)	Remarks
Design requirements	Are dimensions and tolerances clear?	✓	Critical dimension verified
Material specifications	Is the material type specified and available?	✓	Mild steel (IS 2062)
Machining requirements	Is machining sequence and tool parameter defined	✓	Feed = 0.12 mm/rev. Spindle speed = 1200 rpm.
Quality control	Are all tolerances verified post-machining?	✓	Final inspection report
Packaging & Delivery	Is the part packed securely for delivery?	✓	Bubble wrap used

Analyze the drawing and prepare checklist

Identify material type, raw material dimensions, final dimensions and tolerances.

Determine tools and setup.

Prepare a checklist for machining.

Pre-Machining checklist

Item	Status (✓/x)	Remarks
Raw material size verified		
Workpiece mounted securely		
Roughing tool inspected		
Finishing tool inspected		

Machining steps

Operation	Tool	Parameter (Feed)	Remarks
Rough turning			
Finish turning			

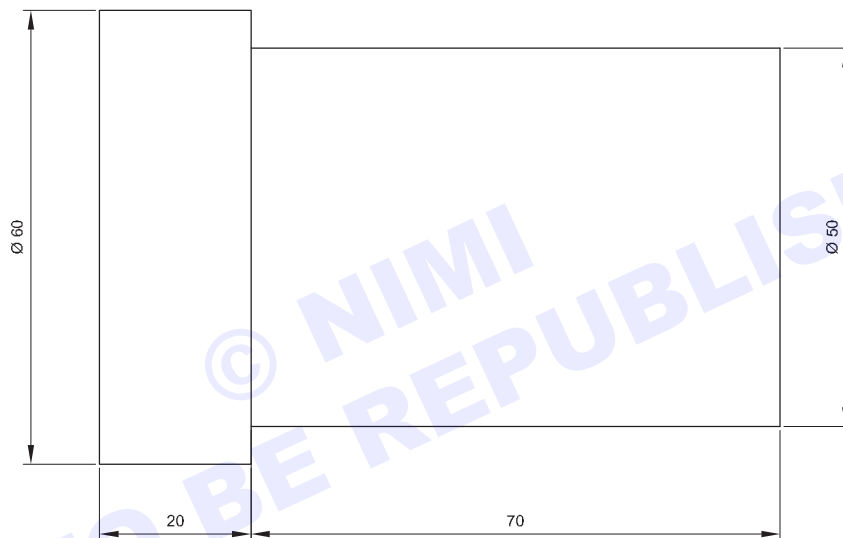
Post machining checks

Item	Status (✓/x)	Remarks
Final dimension verified		
Part cleaned and deburred		
Oiling		

Refinement in customer needs & select optimum requirement & develop product specification report

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

- refine and select the optimum cutting parameters
- perform cost analysis
- understand the products core specifications
- ensure quality and compliance with industry standards.



Job Sequence

- Study the different types of documentation provided (format).
- Record relevant information in the format.
- Get it checked by your instructor/ Training officer.

1	Ø 62 x 100 mm	-	Fe 310	-	-	1.3.32
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	REFINE CUSTOMER SPECIFICATION				TOLERANCE ± 0.05	TIME :
					CODE NO. CN20N1332E1	

Step 1: Examine the provided part drawing

Part specifications	
Final dimensions	
Material	
Tolerance	
Quantity	

Step 2: Refine cutting parameters (Feed Rate, Speed, Depth of Cut)

Rough turning parameters	
Spindle speed	
Feed rate	
Depth of cut	
Finishing parameters	
Spindle speed	
Feed rate	
Depth of cut	

Step 3: Tool selection & optimization

- Select tools based on material and part specifications (e.g., WNMG for roughing, VNMG for finishing)

Tool selection	
Operation	Tool used

Step 4: Calculate the total cost

Cost Factors to Consider

- 1 **Machine Hourly Rate (MHR):** The cost to operate the CNC machine per hour (e.g., Rs300 /hour).
- 2 Raw material cost

- 3 Overload cost

Total cost per part = Machine hour rate + Raw material cost + Overload cost

Reading of industrial drawing

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

- list out the details in title block of the given drawing
- list out the types of lines in the given drawing
- list out the standards used in the given drawing
- list out the sectional view & cut sectional view in the given drawing.









Job Sequence

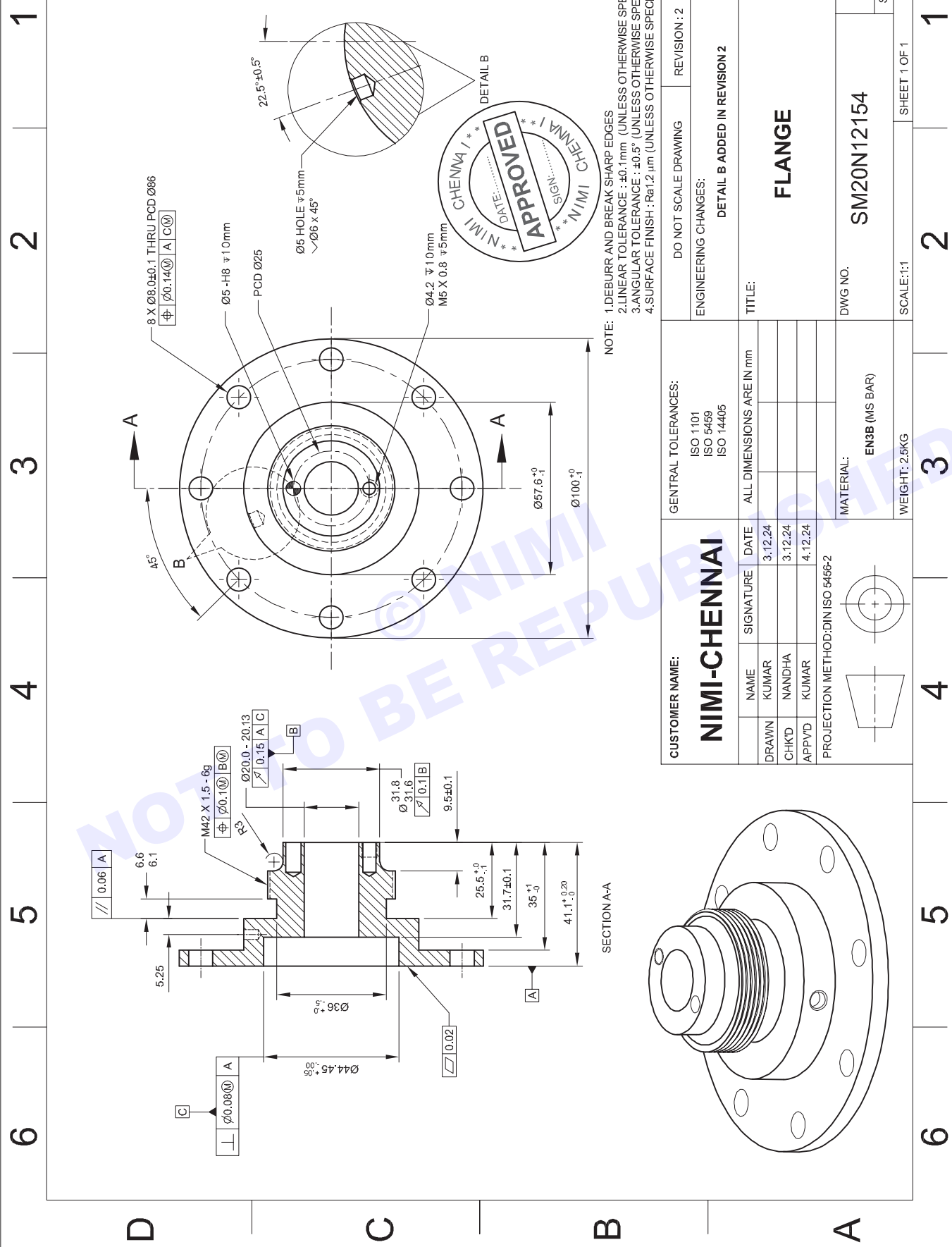
- Study the drawing.
- List out the details in the title block.
- Identify the types of lines and record in the Table 1.
- List out the general tolerances used in the drawing.
- List out the sectional views & cut sections in the given drawing.
- Get it checked by your trainer.

TASK 1: List out the details in title block

CUSTOMER NAME: _____	WEIGHT OF THE _____
PART NAME: _____	MATERIAL: _____
PART NUMBER OR _____	SCALE: _____
DRAWING NUMBER: _____	UNITS: _____
DRAWING REVISION _____	PREPARED BY: _____
NUMBER: _____	CHECKED BY: _____
ENGINEERING _____	RELEASED BY: _____
CHANGES: _____	STANDARDS: _____
PROJECTION ANGLE: _____	IN DRAWING: _____
MATERIAL: _____	STATUS OF _____
	DRAWING: _____

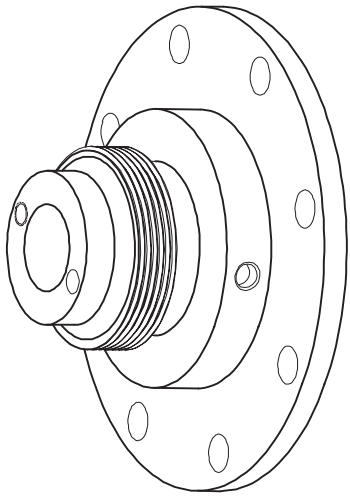
TASK 2: List out the details in title block

Sl. No.	Type of lines	Description
1		
2		
3		
4		
5		
6		
7		
8		



NOTE: 1. DEBURR AND BREAK SHARP EDGES
 2. LINEAR TOLERANCE : ±0.1mm (UNLESS OTHERWISE SPECIFIED)
 3. ANGULAR TOLERANCE : ±0.5° (UNLESS OTHERWISE SPECIFIED)
 4. SURFACE FINISH : Ra1.2, µm (UNLESS OTHERWISE SPECIFIED)

CUSTOMER NAME: NIMI-CHENNAI		GENERAL TOLERANCES: ISO 1101 ISO 5459 ISO 14405		DO NOT SCALE DRAWING		REVISION: 2	
DRAWN: KUMAR		SIGNATURE: [Signature]		DATE: 3.12.24		ENGINEERING CHANGES: DETAIL B ADDED IN REVISION 2	
CHK'D: NANDHA		DATE: 3.12.24		TITLE: FLANGE		DWG NO. SM20N12154	
APP'VD: KUMAR		DATE: 4.12.24		MATERIAL: EN3B (MS BAR)		SCALE: 1:1	
PROJECTION METHOD: DIN ISO 5456-2		WEIGHT: 2.5KG		SHEET 1 OF 1		A4 SHEET	



TASK 3: List out the general tolerances used in the drawing

- A _____
- B _____
- C _____

TASK4: List out the sectional views & cut sections in the given drawing.

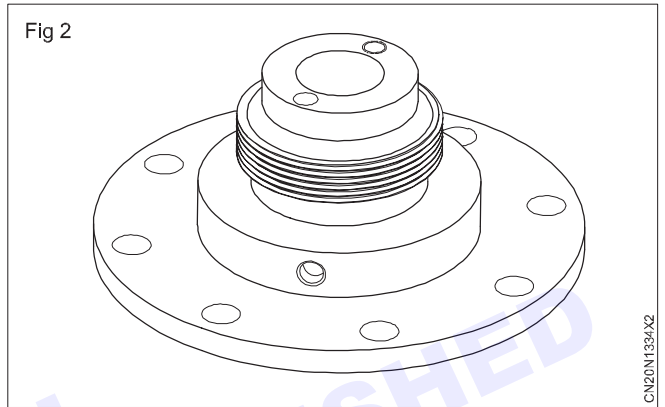
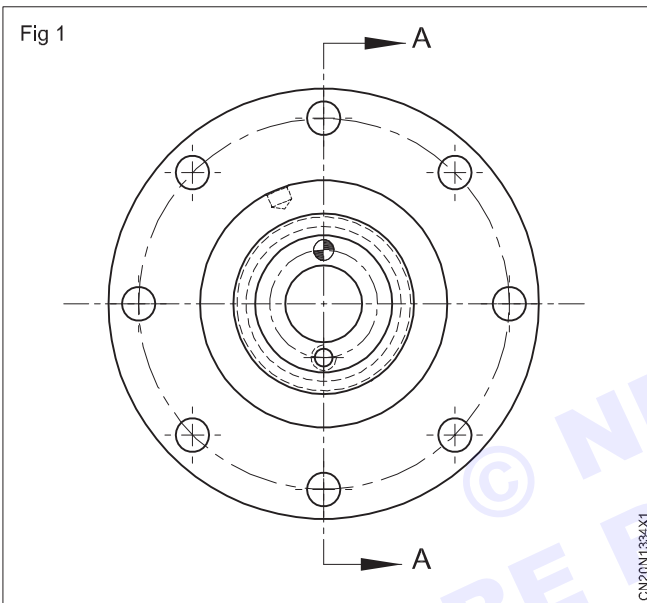
Name the view of the drawing shown in Fig 1 with respect to A-A.

Views: _____

Type of section: _____

Name the view of the drawing shown in Fig 2.

Views: _____

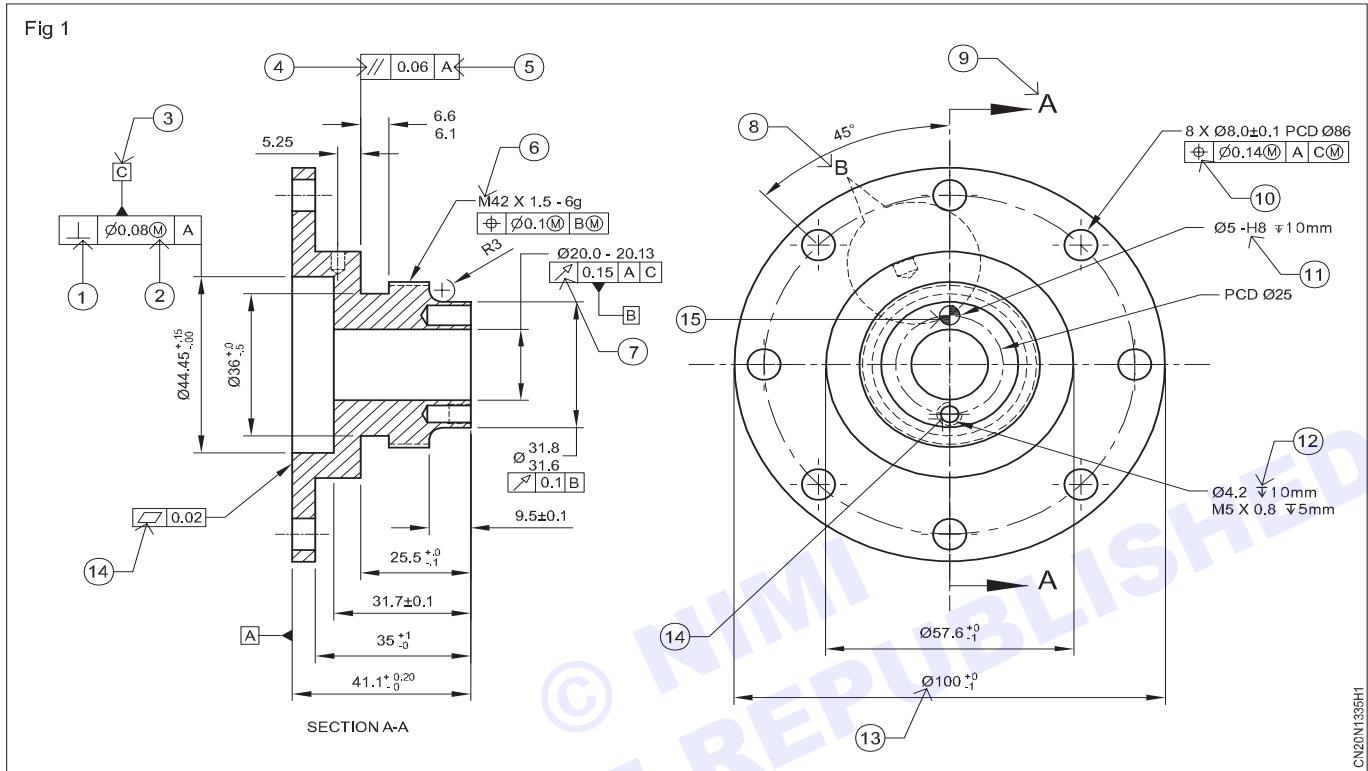


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List out the symbols used in industrial drawing

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

- identify the symbols used in the given drawing
- list the types of symbols used in the given drawing and record it in the Table 1.



Job Sequence

- Draw the symbol in the Table 1.
- Write the description of the symbol in the Table 1.

Table 1

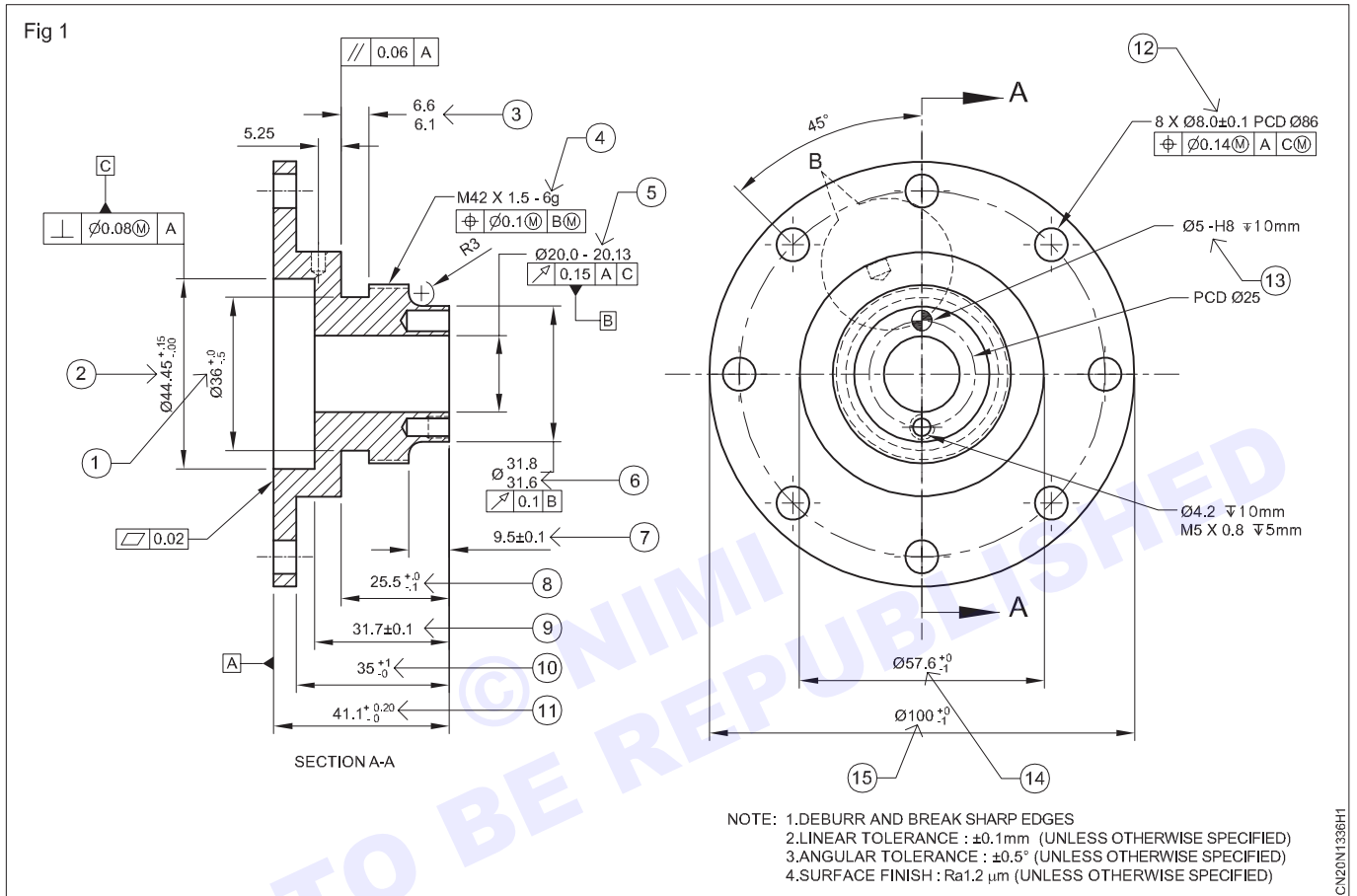
Sl. No.	Draw the symbol	Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

- Get it checked by the trainer.

Create a check list of dimensions & customer specific requirements

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

- list all the limit dimensioning as per the serial number in the given drawing
- list the dimensions with tolerances as per the serial number in the given drawing.



Job Sequence

- Study the drawing.
- Identify the types of dimensions used in the drawing.
- Record the limit dimensions in Table 1.
- Record the dimensions with tolerances in Table 2.
- Get it checked by your trainer.

Table 1 - Limit dimensioning

Sl. No.	Description	Upper limit	Lower limit
1			
2			
3			

Table 2 - Dimensions with tolerance

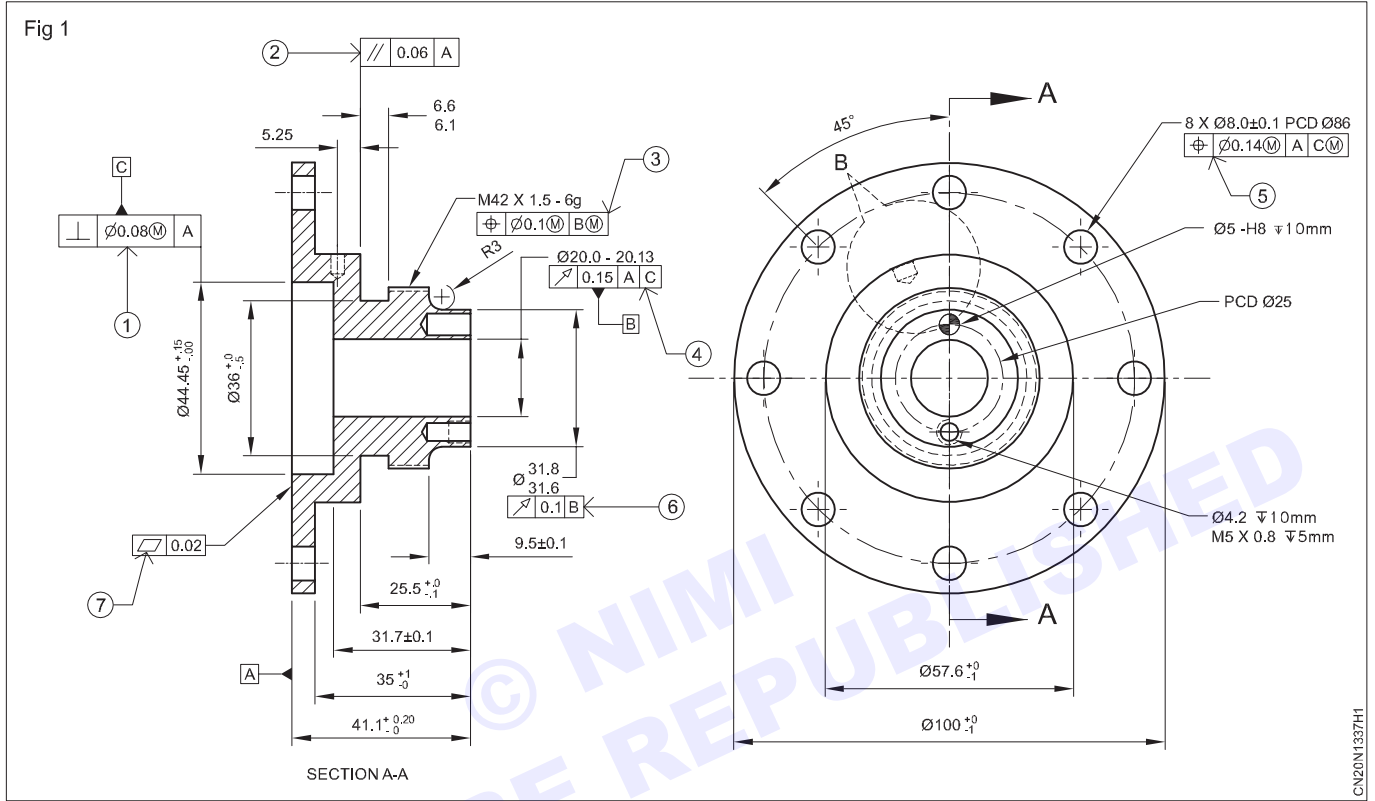
Sl. No.	Description	Size	Upper limit	Lower limit
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

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Apply the geometrical dimensioning & tolerance symbols

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

- identify all the ballooning dimensions as per the given drawing
- list the GD & T features as per the ballooning in the given Table.



Job Sequence

- Study the drawing.
- Identify the geometrical dimensioning & tolerance symbols used in the drawing.
- Draw & record the symbols with details in Table 1.
- Get it checked by your trainer.

Table 1

Sl. No.	Draw the symbol	Description	Tolerances	Modifier	Datums
1					
2					
3					
4					
5					
6					
7					

Create the machining operation process flow diagram

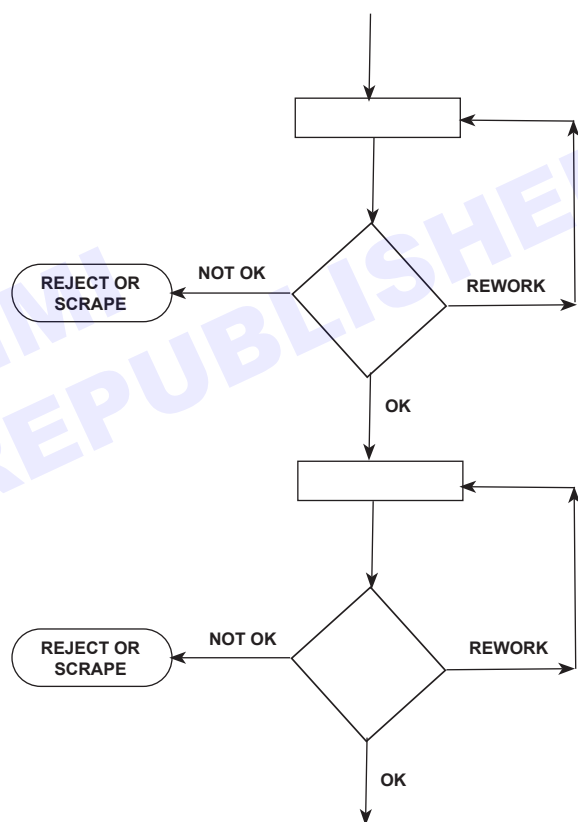
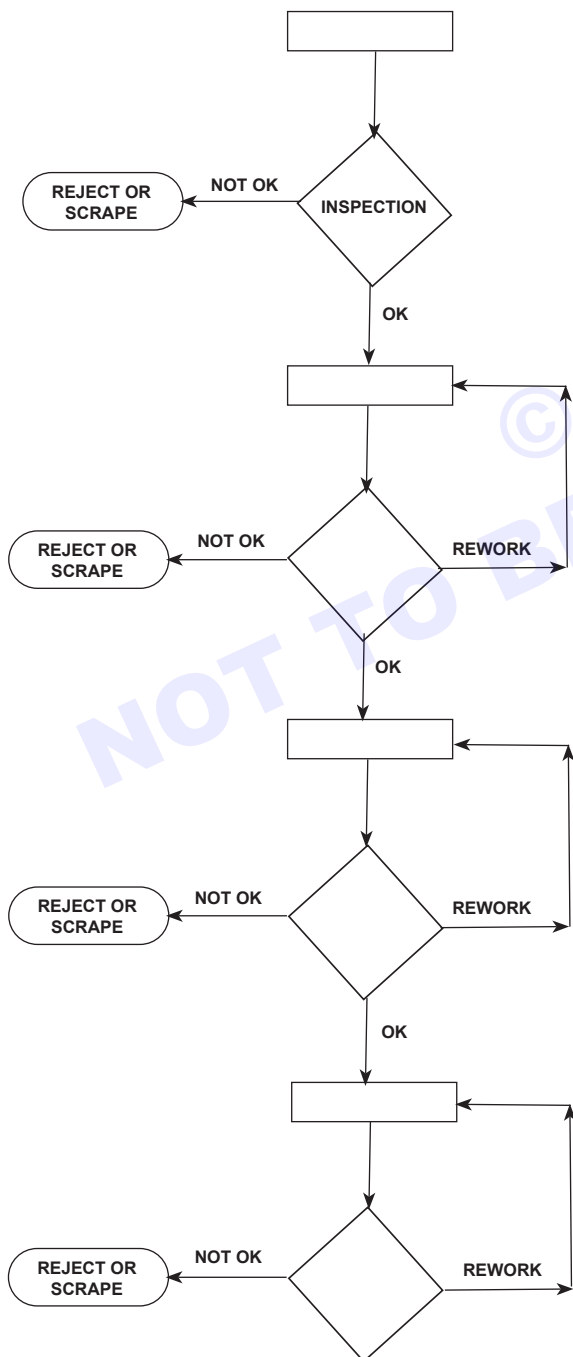
Objectives: At the end of this exercise you shall be able to

- list the types of machining process involved in the given drawing
- list the No. of machining process as per the given drawing
- prepare the process flow diagram as per the machining processes involved.

Job Sequence

- Study the given part drawing.
- List the No. of each machining process in sequence as per the given part drawing.
- Prepare the process flow diagram as per the sequence from raw material to finished part in the given format.
- Get it checked by your trainer.

Complete the given process flow diagram format



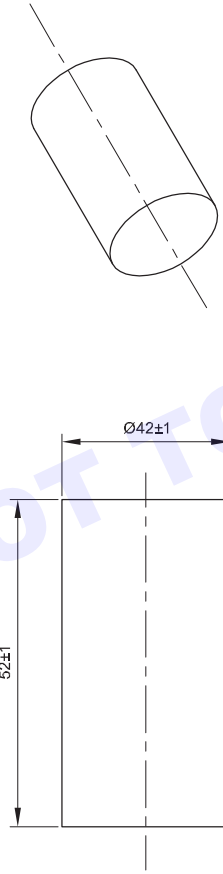
SYMBOLS USED FOR PROCESS FLOW



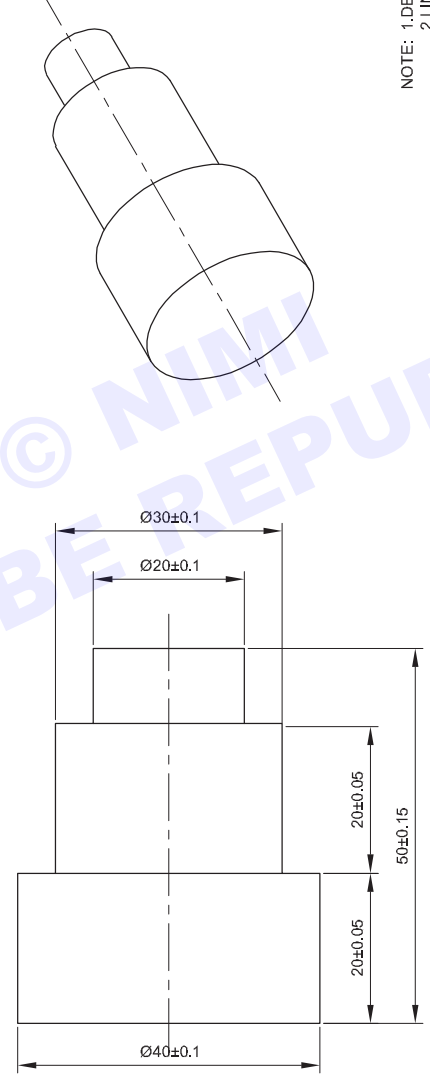
6 5 4 3 2 1

D C B A

RAW MATERIAL



FINISHED PART



- NOTE: 1. DEBURR AND BREAK SHARP EDGES
 2. LINEAR TOLERANCE : ±0.1mm (UNLESS OTHERWISE SPECIFIED)
 3. CORNER RADIUS 0.8MIN (UNLESS OTHERWISE SPECIFIED)
 4. SURFACE FINISH : Ra1.2 µm (UNLESS OTHERWISE SPECIFIED)

CUSTOMER NAME: NIMI-CHENNAI		GENERAL TOLERANCES: ISO 1101 ISO 5469 ISO 14405		DO NOT SCALE DRAWING		REVISION : -	
ENGINEERING CHANGES:		ALL DIMENSIONS ARE IN mm		TITLE: STEPPED SHAFT		DWG NO. CN20N1338H1	
NAME	SIGNATURE	DATE	MATERIAL: EN3B (MS BAR)				
DRAWN KUMAR		3.12.24	WEIGHT: 1.0KG				
CHK'D NANDHA		3.12.24	SCALE: 1:1				
APP'VD KUMAR		4.12.24	SHEET 1 OF 1				
PROJECTION METHOD: DIN ISO 5456-2			A4 SHEET				

Create the stage drawing for step turning operation

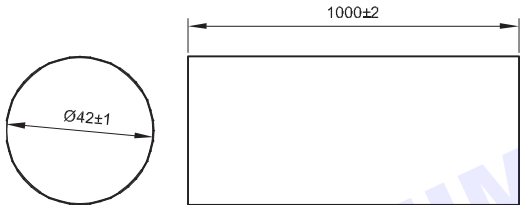
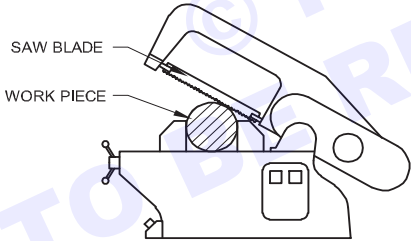
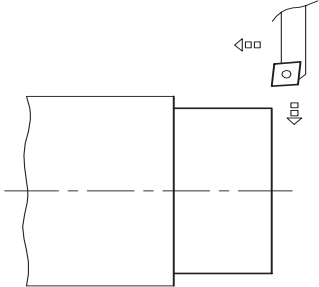
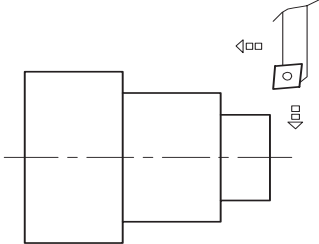
Objectives: At the end of this exercise you shall be able to

- study the process flow from raw material to finished product
- identify the number of operations to be performed in each process
- prepare the stage drawing for the step turning operation from raw material to finished product.

Job Sequence

- Study the process flow diagram as per the exercise 1.3.38.
- Identify the number of operations to be performed in each process.
- Draw the free hand sketch of a stage drawing for the step turning operation from raw material to finished product.
- Get it checked by your trainer.

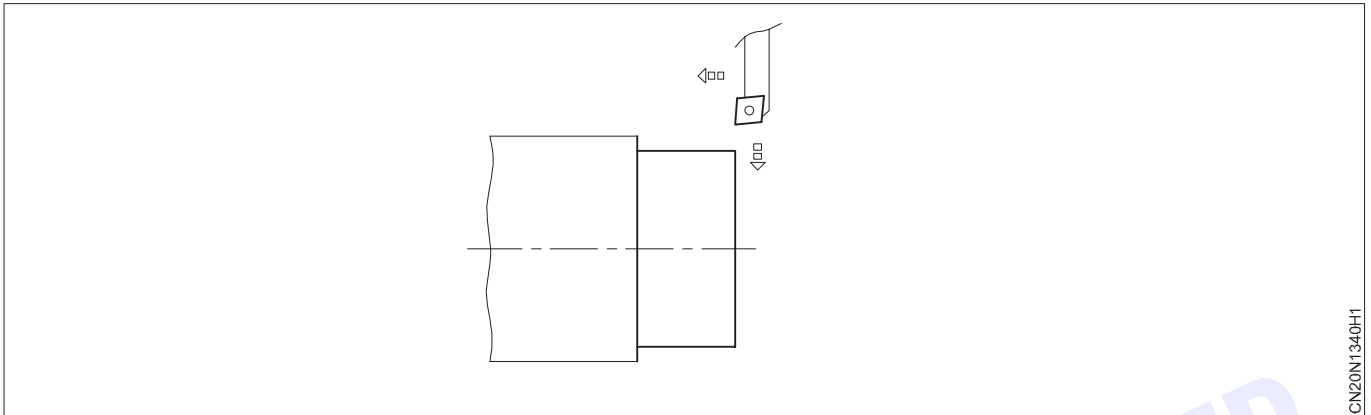
Table 1

Sl. No.	Picture process wise	Operations in each process
1		
2		
3		
4		

Create CNC lathe 1st setup stage detailed drawing for step turning

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

- identify the number of operations to be performed in turning 1st setup
- identify the clamping diameter & butting face to perform the turning 1st setup
- prepare the stage drawing for the turning 1st setup.



CN20N1340H1

© NIMI
 NOT TO BE REPUBLISHED

ORIENTATION	☐
BUTTING	➔
RESTING	▨▨▨▨▨▨▨▨
LOCATE	☑
CLAMPING	▼
WORK OFFSET	— · — ☒

PART NAME	
PART NUMBER	
REVISION	
CUSTOMER NAME	
STAGE	

NOTE/ SPECIAL INSTRUCTION :

CN20N1340H2

Job Sequence

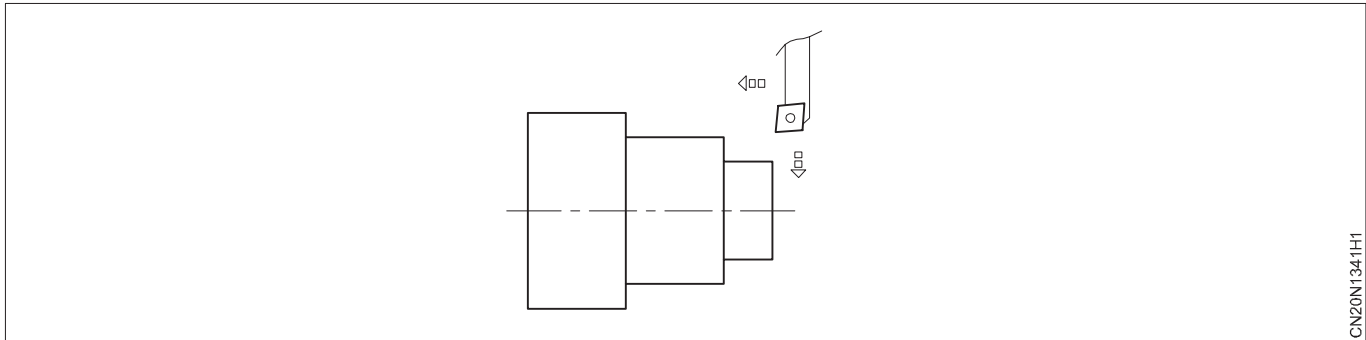
- Study the stage drawing as per the Exercise 1.3.39
- Identify the number of operations involved in Turning 1st Setup from the Table1 of Exercise 1.3.39.
- Identify the type of clamping, clamping diameter and butting face for the turning 1st setup.
- Draw the detailed drawing with dimensions, appropriate symbols for work holding provided in the Tabular & Special Instructions for Turning 1st setup.
- Get it checked by your trainer.

— — — — —

Create CNC lathe 2nd setup stage detailed drawing for step turning

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

- identify the number of operations to be performed in turning 2nd setup
- identify the clamping diameter & butting face to perform the turning 2nd setup
- prepare the stage drawing for the turning 2nd setup.



CN20N1341H1

© NIMI
 NOT TO BE REPRODUCED

ORIENTATION	
BUTTING	
RESTING	
LOCATE	
CLAMPING	
WORK OFFSET	

PART NAME	
PART NUMBER	
REVISION	
CUSTOMER NAME	
STAGE	

NOTE/ SPECIAL INSTRUCTION :

CN20N1341H2

Job Sequence

- Study the stage drawing as per the exercise 1.3.39
- Identify the number of operations involved in turning 2nd setup from the Table1 of Exercise 1.3.39.
- Identify the type of clamping, clamping diameter and butting face for the turning 2nd setup.
- Draw the detailed drawing with dimension, appropriate symbols for work holding & special instructions for turning 2nd setup.
- Get it checked by your trainer.

List out the importance of surface finish

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

- answer the question on importance of surface finish.

Answer the question on important of surface finish

1 What is surface finish?

2 What is a purpose of lay in surface finish?

3 Why surface finish is important?

4 What are the benefits of a high-quality surface finish?

5 What factors affect surface finish?

6 How can you improve surface finish quality?

7 How do you measure surface finish?

— — — — —

Identification of surface finish requirements




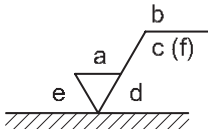
Objectives: At the end of this exercise you shall be able to

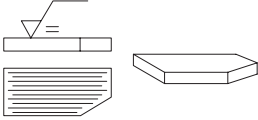
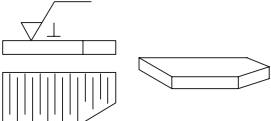
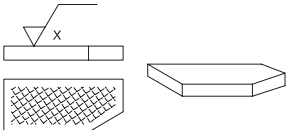
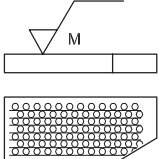
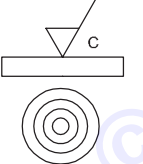
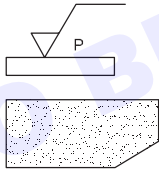


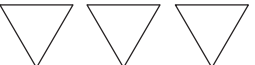

- identify the surface finish symbols
- identify the parameters related to the surface finish symbols
- list out the surface finish parameters
- list out the requirements for the surface finish parameters.

Job Sequence

- Identify the surface finish symbols.
- List the surface finish symbols in Table 1
- Identify the parameters related to the surface finish symbols.
- List out the surface finish parameters in Table 1.
- List out the requirements for the surface finish parameters in Table 1.

Table 1

Sl. No.	Surface finish symbols	Description
1		
2		
3		
4		In the given figure does 'a' indicate
		In the given figure what does 'b' Indicate:
		In the given figure what does c(f) Indicate:
		In the given figure what does 'd' Indicate:
		In the given figure what does 'e' Indicate:

Sl.No.	Direction of tool marks	Interpretation
5		
5a		
5b		
5c		
5d		
5e		
	Roughness symbol	Roughness grade number
6		
6a		
6b		
6c		

Apply surface finish symbol on machining parameter

Objectives: At the end of this exercise you shall be able to
 • interpret the details of the surface finish parameter.

V-BLOCK

ADJUSTING SCREW

CLAMP

Technical drawing showing the details of a V-block with a clamp. The V-block is shown in front, end, and top views. The clamp is shown in front and top views. An adjusting screw is also shown. Dimensions are provided for all parts.

1	-	-	-	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	DETAILS OF V-BLOCK WITH CLAMP				TOLERANCE ±	TIME :
					CODE NO. CN20N1444E1	

PROCEDURE

TASK 1: Identification of surface parameter

- 1 Read the given information in the Table.
- 2 Identify the machining processes involved.
- 3 List the machining process.
- 4 Identify the surface finish Ra and Rz values.
- 5 List the surface finish Ra and Rz values.
- 6 Identify the surface finish parameters.
- 7 List the surface finish parameters.
- 8 Draw the surface finish symbols in the Table 1.

Table 1

Sl. No.	Details	Machining Process	Surface finish values	Surface finish parameters	Surface finish symbol applicable
1	Material removal by machining process with Rz value 3 μ m				
2	Material removal by turning process With Rz value 1 μ m and circular lay				
3	Material removal by milling process with Ra value 0.9 μ m and perpendicular lay				
4	Material removal by drilling process with Ra value 2 μ m and circular lay				
5	Material removal by filing process with Ra value 1 μ m and parallel lay				
6	Material removal by turning with Rz value 2.5 μ m and circular lay with 3mm machining allowance for all surface				

— — — — —

TASK 2: Add surface finish symbols to the given job drawings

— — — — —

Improve surface finish quality by using post process manufacturing operation

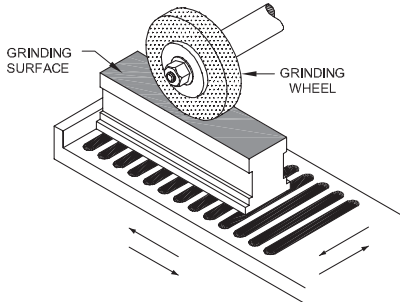
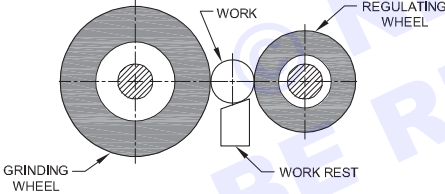
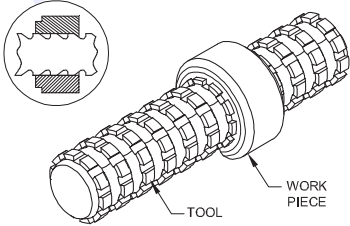
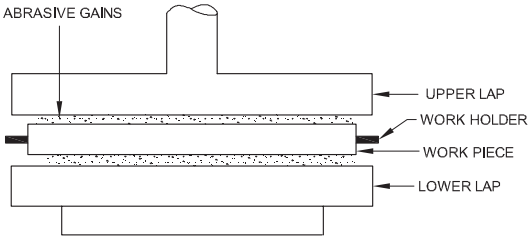
Objectives: At the end of this exercise you shall be able to

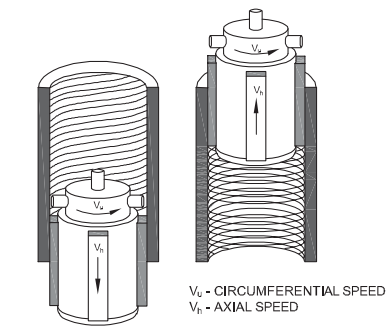
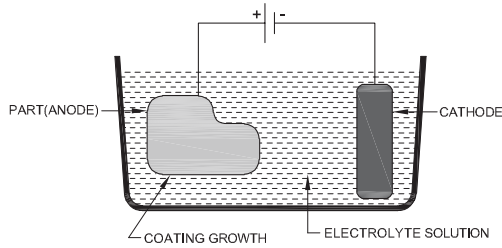
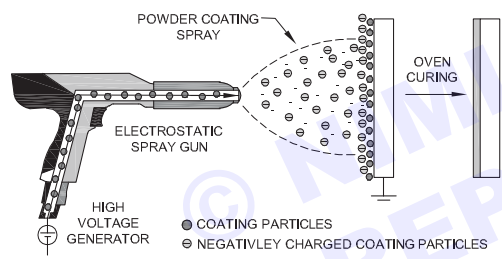
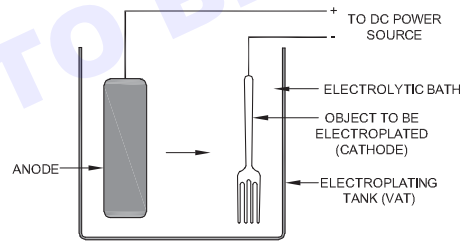
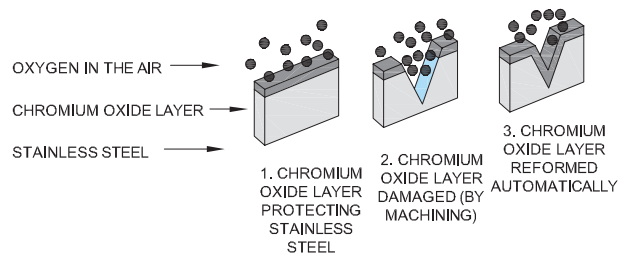
- recommend the next process to improve the surface finish.

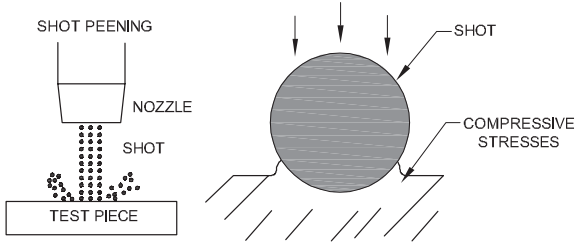
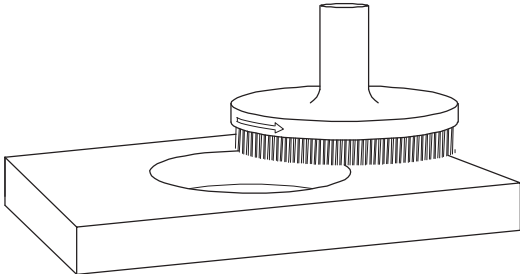
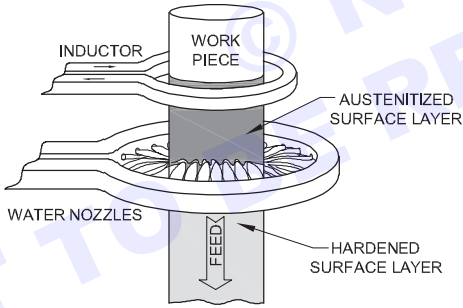
Job Sequence

- Read the content provide in Table 1.
- Recommend the next process to improve the surface finish.

Table 1

SI. No.	Post process manufacturing process figures	Next process
1		
2		
3		
4		

5	 <p>V_c - CIRCUMFERENTIAL SPEED V_a - AXIAL SPEED</p>	
6	 <p>PART (ANODE) CATHODE COATING GROWTH ELECTROLYTE SOLUTION</p>	
7	 <p>POWDER COATING SPRAY ELECTROSTATIC SPRAY GUN HIGH VOLTAGE GENERATOR ● COATING PARTICLES ⊖ NEGATIVELY CHARGED COATING PARTICLES OVEN CURING</p>	<p style="text-align: center; color: lightblue; opacity: 0.5; font-size: 2em;">NOT TO BE REPRODUCED</p>
8	 <p>ANODE TO DC POWER SOURCE ELECTROLYTIC BATH OBJECT TO BE ELECTROPLATED (CATHODE) ELECTROPLATING TANK (VAT)</p>	
9	 <p>OXYGEN IN THE AIR CHROMIUM OXIDE LAYER STAINLESS STEEL</p> <p>1. CHROMIUM OXIDE LAYER PROTECTING STAINLESS STEEL 2. CHROMIUM OXIDE LAYER DAMAGED (BY MACHINING) 3. CHROMIUM OXIDE LAYER REFORMED AUTOMATICALLY</p>	

10	 <p>The diagram illustrates the shot peening process. On the left, a container labeled 'SHOT PEENING' contains 'SHOT'. A 'NOZZLE' is positioned to spray the 'SHOT' onto a 'TEST PIECE'. On the right, a circular 'TEST PIECE' is shown with 'SHOT' particles striking its surface from above, indicated by downward arrows. This impact creates 'COMPRESSIVE STRESSES' within the surface layer of the test piece.</p>	
11	 <p>The diagram shows a brush peening tool. It consists of a cylindrical brush head with bristles, mounted on a horizontal shaft. This tool is used to apply mechanical stress to a workpiece by brushing against its surface.</p>	
12	 <p>The diagram illustrates the induction hardening process. A 'WORK PIECE' is positioned between an 'INDUCTOR' and 'WATER NOZZLES'. The inductor heats the surface of the workpiece, creating an 'AUSTENITIZED SURFACE LAYER'. Simultaneously, water is sprayed from the 'WATER NOZZLES' onto the heated surface, which rapidly cools and forms a 'HARDENED SURFACE LAYER'. A 'FEED' arrow indicates the direction of movement of the workpiece through the process.</p>	

- Get it checked by your trainer.

Selection of appropriate instruments to measure the component

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

- list out the dimensions serially in the table as per the given drawing
- identify the instruments required to measure each specific dimension as per the given drawing
- list out the measuring instruments and its range required to measure each dimension in the given table
- list out the least count of each instruments used to measure the specific dimensions.

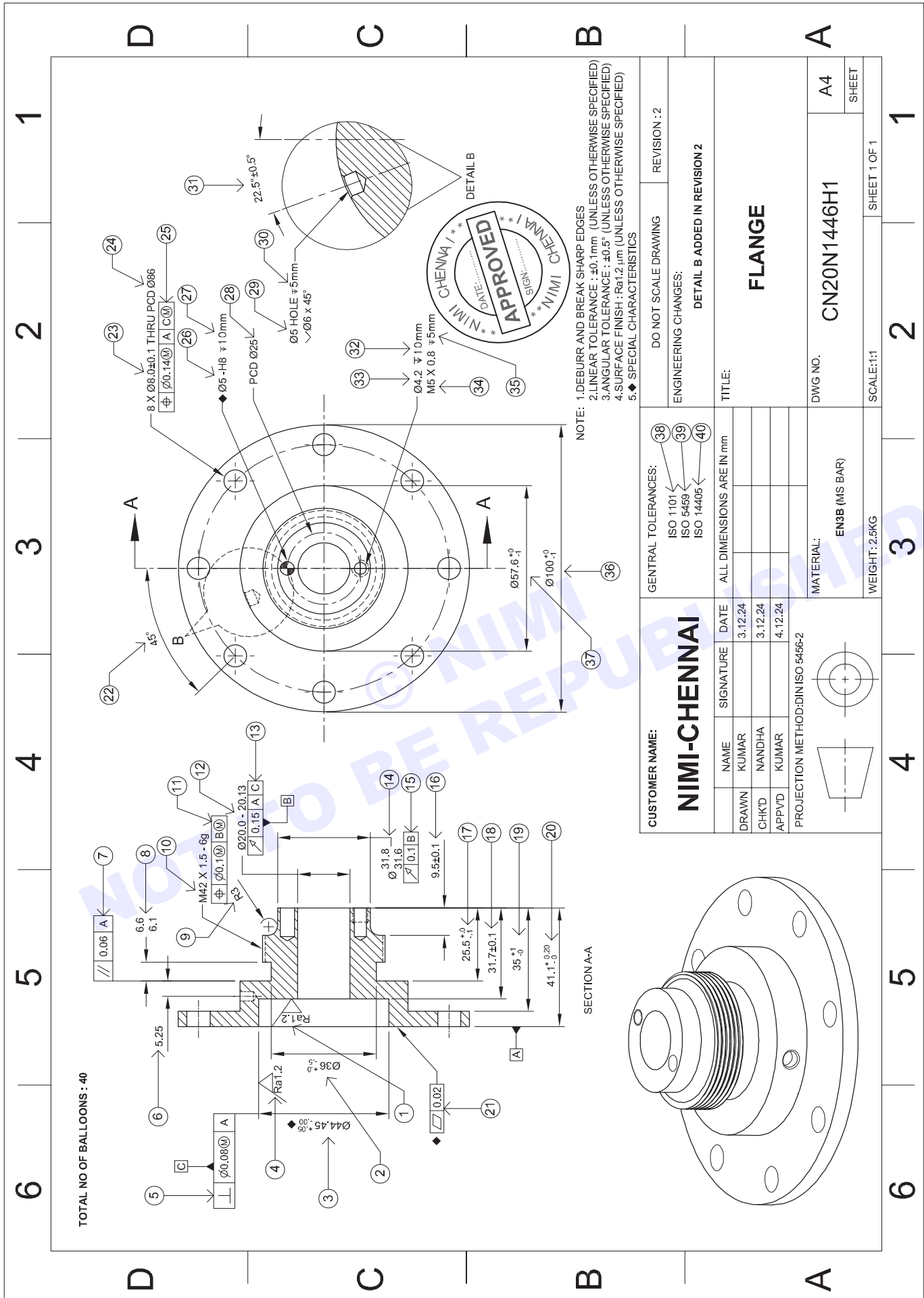
Job Sequence

- Study the drawing
- List out the dimensions and its details in the given table 1 serially.
- Identify the type of instrument required to measure each dimension mentioned serially in the given drawing.
- List out the measuring instruments and its range required to measure each dimension in the given Table1.
- List out the least count of each instruments used to measure the specific dimensions in the Table 1.

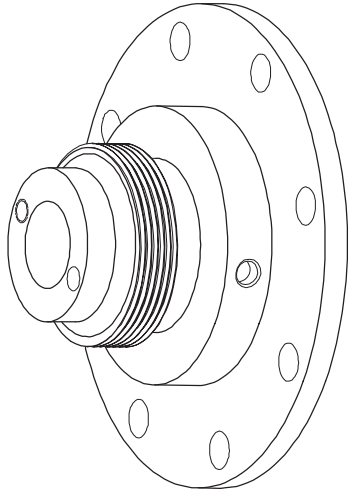
Table 1

Sl. No.	Characteristics	Specification in mm	Tolerance	Upper limit	Lower limit	Instruments and its range	Least count
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

- Get it checked by your trainer.



CUSTOMER NAME: NIMI-CHENNAI		DO NOT SCALE DRAWING		REVISION : 2
GENERAL TOLERANCES: ISO 1101 ISO 5459 ISO 14405		ENGINEERING CHANGES: DETAIL B ADDED IN REVISION 2		
TITLE: FLANGE		DO NOT SCALE DRAWING		
ALL DIMENSIONS ARE IN mm		DO NOT SCALE DRAWING		
NAME KUMAR	SIGNATURE	DATE 3.12.24		
CHK'D NANDHA		3.12.24		
APP'VD KUMAR		4.12.24		
PROJECTION METHOD: DIN ISO 5456-2		MATERIAL: EN3B (MS BAR)		DWG NO. CN20N1446H1
WEIGHT: 2.5KG		SCALE: 1:1		SHEET 1 OF 1



Prepare quality/inspection check list for confirming the product quality

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

- list out the dimensions serially in the table as per the given drawing
- identify the dimensions with special characteristics mentioned in the drawing
- mark all the special characteristics dimensions, GD & T and close tolerance dimensions as critical to quality dimensions.

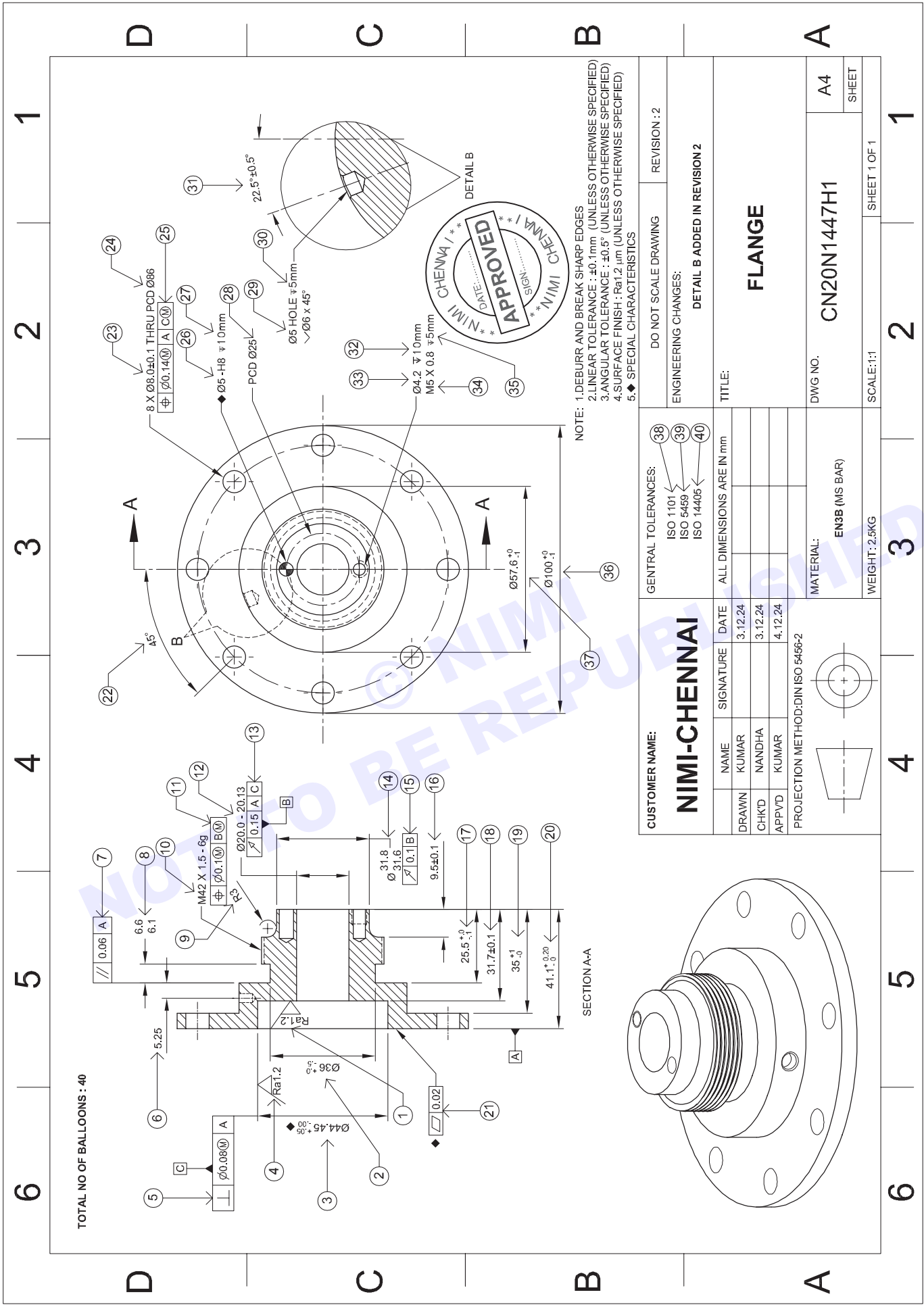
Job Sequence

- Study the drawing
- List out the dimensions and its details in the given table 1 serially.
- Identify the dimensions with special characteristics mentioned in the drawing.
- Mark these dimensions as critical to quality
- Identify the dimensions with GD & T features as mentioned in the drawing.
- Mark these GD & T features as critical to quality
- Identify the dimensions with close tolerance in the listed table1.
- Mark all the dimensions with close tolerance as critical to quality dimensions.
- The table confirms the inspection check list for confirming the product quality.

Table 1

Sl. No.	Characteristics	Specification in mm	Tolerance	Upper limit	Lower limit	Special characteristics	Critical to quality mark (Yes/No)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

- Get it checked by your trainer.



TOTAL NO OF BALLOONS : 40

SECTION A-A

NOTE: 1. DEBURR AND BREAK SHARP EDGES
 2. LINEAR TOLERANCE : ±0.1mm (UNLESS OTHERWISE SPECIFIED)
 3. ANGULAR TOLERANCE : ±0.5° (UNLESS OTHERWISE SPECIFIED)
 4. SURFACE FINISH : Ra1.2 µm (UNLESS OTHERWISE SPECIFIED)
 5. ♦ SPECIAL CHARACTERISTICS

CUSTOMER NAME: NIMI-CHENNAI		DO NOT SCALE DRAWING		REVISION : 2
GENERAL TOLERANCES: ISO 1101 ISO 5469 ISO 14405		ENGINEERING CHANGES: DETAIL B ADDED IN REVISION 2		
ALL DIMENSIONS ARE IN mm		TITLE: FLANGE		
NAME KUMAR	SIGNATURE	DATE 3.12.24		
CHK'D NANDHA		3.12.24		
APP'VD KUMAR		4.12.24		
PROJECTION METHOD: DIN ISO 5456-2		MATERIAL: EN3B (MS BAR)		DWG NO. CN20N1447H1
		WEIGHT: 2.5KG		SHEET 1 OF 1

1 2 3 4 5 6

6 5 4 3 2 1

Create incoming inspection report

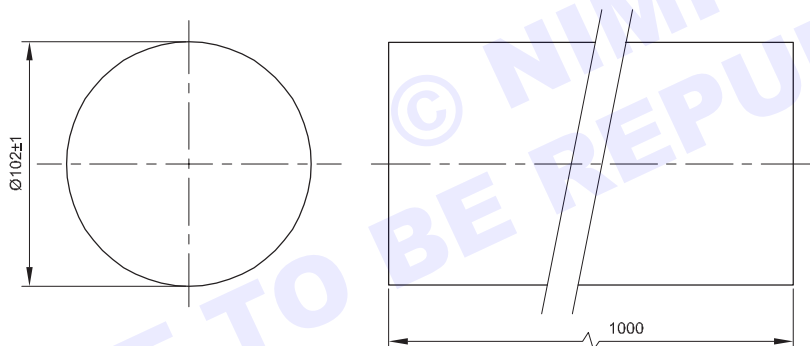
Objectives: At the end of this exercise you shall be able to

- make a table with column to list out the dimensions serially as per the given drawing
- make a table with column to the instruments required to measure each specific dimension as per the given drawing
- make a table with column to list out the range of the measuring instruments required to measure each dimension in the given table
- make a table with column to list out the least count of each instruments used to measure the specific dimensions
- make the table with 5 columns for noting the measured readings for 5 samples.

Fig 1

PART NAME	FLANGE
PART NUMBER	123456
REVISION	2
CUSTOMER NAME	NIMI CHENNAI
STAGE	RAW MATERIAL INSP

NOTE: VISUAL INSPECT FOR THE DEFECTS



CN12CN1448H1

Job Sequence

- Study the drawing.
- Make a table with column to list the dimensions and its details serially as per the given drawing.
- Identify the type of instrument required to measure each dimension mentioned serially in the given drawing.
- Make a table with column to list out the measuring Instruments and its range required to measure each dimension.
- Make a table with column to list out the least count of each instruments used to measure the specific dimensions.
- Make 5 columns to note down the measured reading for samples from 1 to 5
- Create a table with title as incoming inspection report.
- Get it checked by your trainer.

Create in-process inspection report

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

- make a table with column to list out the dimensions serially as per the given stage drawings
- identify the instruments required to measure each specific dimension as per the given stage drawing
- make a table with column to list out the measuring Instruments and its range required to measure each dimension as per the given stage drawings
- make a table with column to list out the least count of each instruments used to measure the specific dimensions
- make the tabulations for noting the measured readings for one sample.

Job Sequence

- Study the drawing.
- Make a table with column to list the dimensions and its details serially as per the given drawing.
- Identify the type of instrument required to measure each dimension mentioned serially in the given drawing.
- Make a column to list out the measuring Instruments and its range required to measure each dimension.
- Make a column to list out the least count of each instruments used to measure the specific dimensions.
- Make 1 column to note down the measured reading for one sample.
- Create a table with title as In-process inspection report.
- Perform same steps for each stage drawing.
- Get it checked by your Trainer.

Fig 1

PART NAME	FLANGE
PART NUMBER	123456
REVISION	2
CUSTOMER NAME	NIMI CHENNAI
STAGE	RAW MATERIAL INSP

TOTAL NO OF BALLOONS : 2

NOTE: VISUAL INSPECT FOR THE DEFECTS

CN20N1449H1

Fig 2

TOTAL NO OF BALLOONS : 11

NOTE/SPECIAL INSTRUCTION :

1. DEBURR ALL THE SHARP CORNER
2. MAINTAIN 0.8 MIN CORNER RADIUS IF NOT SPECIFIED
3. USE HARD JAWS FOR HOLDING THE RAW MATERIAL IN CHUCK
4. ♦ SPECIAL CHARACTERISTICS

ORIENTATION	
BUTTING	
RESTING	
LOCATE	
CLAMPING	
WORK OFFSET	

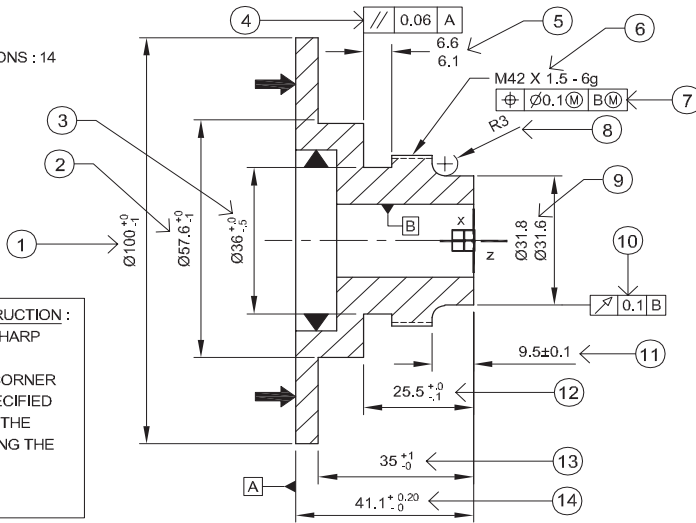
PART NAME	FLANGE
PART NUMBER	123456
REVISION	2
CUSTOMER NAME	NIMI CHENNAI
STAGE	10-TURNING 1 st SETUP

CN20N1449H2

Fig 3

TOTAL NO OF BALLOONS : 14

NOTE/SPECIAL INSTRUCTION :
 1.DEBURR ALL THE SHARP CORNER
 2.MAINTAIN 0.8 MIN CORNER RADIUS IF NOT SPECIFIED
 3.USE SOFT JAWS IN THE CHUCK FOR HOLDING THE MACHINED AREA



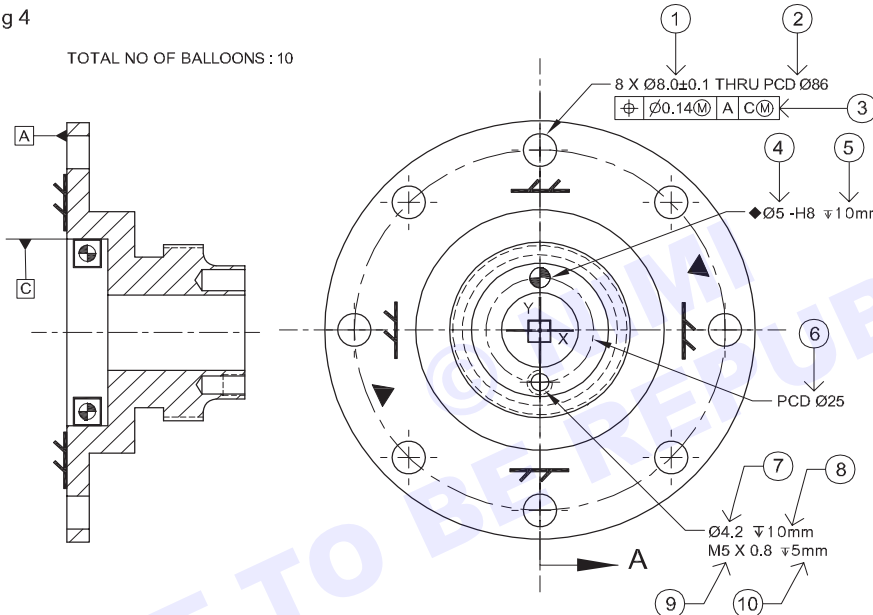
ORIENTATION	
BUTTING	
RESTING	
LOCATE	
CLAMPING	
WORK OFFSET	

PART NAME	FLANGE
PART NUMBER	123456
REVISION	2
CUSTOMER NAME	NIMI CHENNAI
STAGE	10-TURNING 2 nd SETUP

CN20N1449H3

Fig 4

TOTAL NO OF BALLOONS : 10



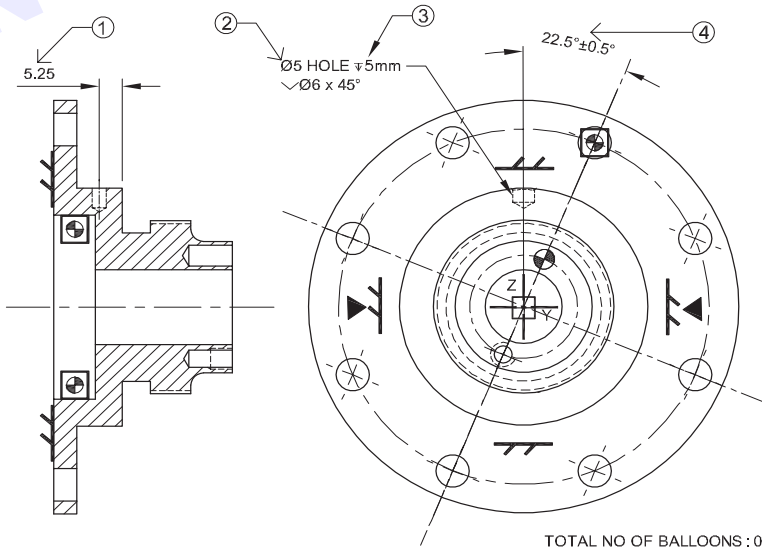
ORIENTATION	
BUTTING	
RESTING	
LOCATE	
CLAMPING	
WORK OFFSET	

PART NAME	FLANGE
PART NUMBER	123456
REVISION	2
CUSTOMER NAME	NIMI CHENNAI
STAGE	20 -MILLING 1 st SETUP

NOTE/SPECIAL INSTRUCTION :
 1.DEBURR ALL THE SHARP CORNER
 2.◆SPECIAL CHARACTERISTICS

CN20N1449H4

Fig 5



ORIENTATION	
BUTTING	
RESTING	
LOCATE	
CLAMPING	
WORK OFFSET	

PART NAME	FLANGE
PART NUMBER	123456
REVISION	2
CUSTOMER NAME	NIMI CHENNAI
STAGE	20 -MILLING 2 nd SETUP

NOTE/SPECIAL INSTRUCTION :
 1.DEBURR ALL THE SHARP CORNER

CN20N1449H5

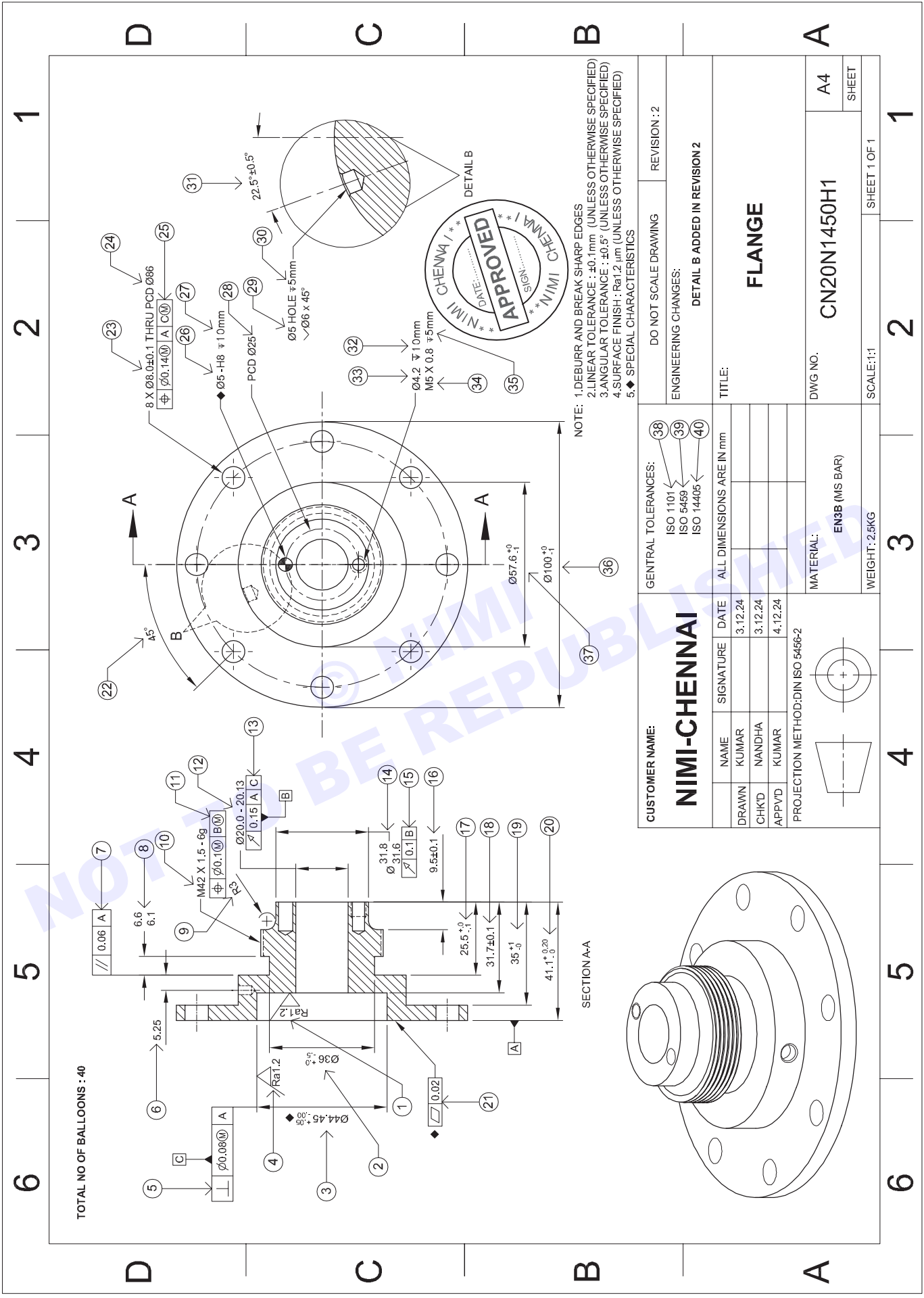
Create final pre-dispatch inspection report

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

- **make a table with column to list out the dimensions serially as per the given part drawing**
 - **list out the dimensions serially in the table as per the given drawing**
 - **identify the dimensions with special characteristics mentioned in the drawing**
 - **mark all the special characteristics dimensions, GD & T and close tolerance dimensions as critical to quality dimensions**
 - **identify the instruments required to measure each specific dimension as per the given critical to quality dimensions**
 - **make a table with column to list out the measuring instruments and its range required to measure each critical dimension**
 - **make a table with column to list out the least count of each instruments used to measure the specific dimensions**
 - **make the tabulations for noting the measured readings for 3 samples for all critical to quality dimensions.**
-

Job Sequence

- Make a table with column to list out the dimensions serially as per the given part drawing.
- List out the dimensions serially in the table as per the given drawing.
- Identify the dimensions with special characteristics mentioned in the drawing.
- Mark all the special characteristics dimensions, GD & T and close tolerance dimensions as critical to quality dimensions
- Identify the instruments required to measure each specific dimension as per the given critical to quality dimensions.
- Make a table with column to list out the measuring instruments and its range required to measure each critical dimension.
- Make a table with column to list out the least count of each instruments used to measure the specific dimensions.
- Make the tabulations for noting the measured readings for 3 samples for all critical to quality dimensions
- Get it checked by your Trainer.

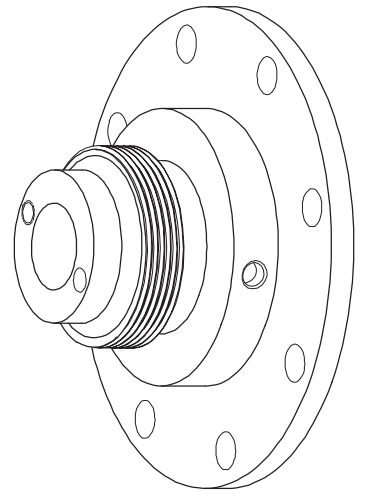


TOTAL NO OF BALLOONS : 40

SECTION A-A

NOTE: 1. DEBURR AND BREAK SHARP EDGES
 2. LINEAR TOLERANCE : $\pm 0.1\text{mm}$ (UNLESS OTHERWISE SPECIFIED)
 3. ANGULAR TOLERANCE : $\pm 0.5^\circ$ (UNLESS OTHERWISE SPECIFIED)
 4. SURFACE FINISH : $Ra1.2\text{ }\mu\text{m}$ (UNLESS OTHERWISE SPECIFIED)
 5. SPECIAL CHARACTERISTICS

CUSTOMER NAME: NIMI-CHENNAI		DO NOT SCALE DRAWING		REVISION : 2
GENERAL TOLERANCES: ISO 1101 ISO 5459 ISO 14405		ENGINEERING CHANGES: DETAIL B ADDED IN REVISION 2		
TITLE: FLANGE		DWG NO. CN20N1450H1		
MATERIAL: EN3B (MS BAR)		SCALE: 1:1		
WEIGHT: 2.5KG		SHEET 1 OF 1		



Make a check sheet report to confirming product quality before dispatch

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

- make a table with column and check box to list out the part number and part name & quantity of supply in the batch and batch number
- make a table with column and check box to confirm the inspection reports attached and number of samples for which the reports attached
- make a table with column and check box to confirm the oiling & packing details
- make a table with column and check box to confirm the transit details.

Job Sequence

- Make a table with column and check box to list out the part no and part name & quantity of supply in the batch and batch number.
- Make a table with column and check box to confirm the final inspection reports, In process Inspection report, other Inspection reports etc., attached and No. of samples for which the reports attached.
- Make a table with column and check box to confirm the oiling details.
- Make a table with column and check box to confirm the packing details like type of packing, number of parts in each packing box.
- Make a table with column to note the weight and volume of the package details.
- Make a table with column and check box to confirm the date & mode of transit details like the parcel reaches the customer by road, by sea, by air etc.,
- Get it checked by your trainer.

Note: Trainer shall provide the necessary details for preparing the "check sheet report to confirming product quality before dispatch."

Identification of multi point cutting tools and its names

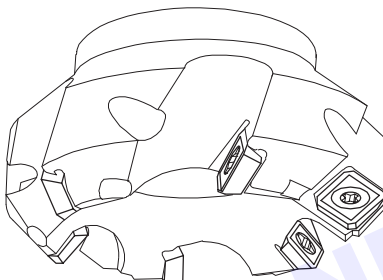
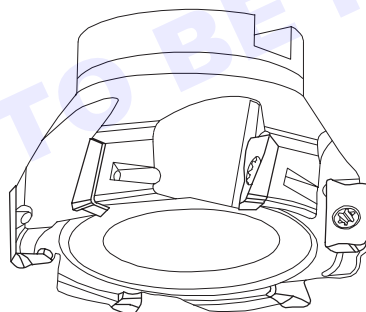
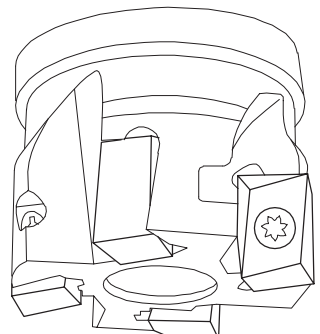
Objectives: At the end of this exercise you shall be able to

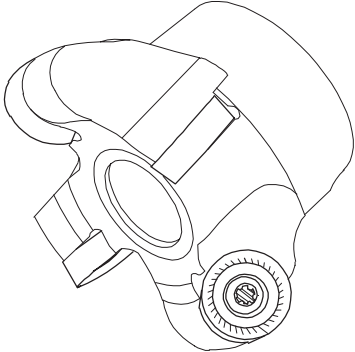
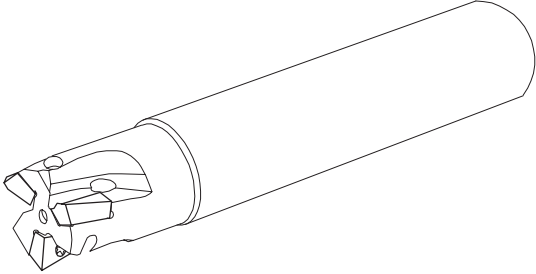
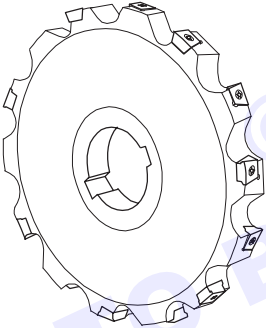
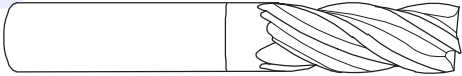
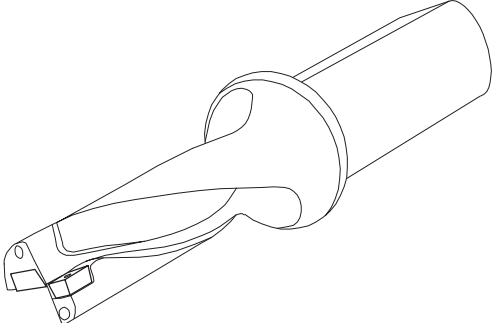
- identify the multi point cutting tools
- fill names in Table 1.

Job Sequence

- Observe the cutting tools listed in Table 1 and write the name of the cutting tool in Table 1.

Table 1

S. No.	Fig	Name of the milling cutter
1		
2		
3		

S. No.	Fig	Name of the milling cutter
4		
5		
6		
7		
8		

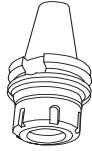

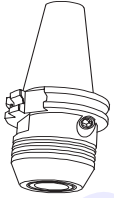

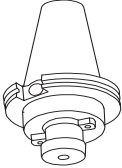
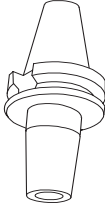
Identify the tool holders

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

- identify the tool holders.

Job Sequence

- Observe the tool holders listed in Table 1 and write the names and purpose in Table 1.

S. No.	Fig	Name of the holder	Purpose
1			
2			
3			
4			
5			
6			

Hold a single point cutting tool to perform a operation

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

- select suitable insert and its holder
- fix the insert on the tool holder
- clamp the tool assembly to turret.

Requirements

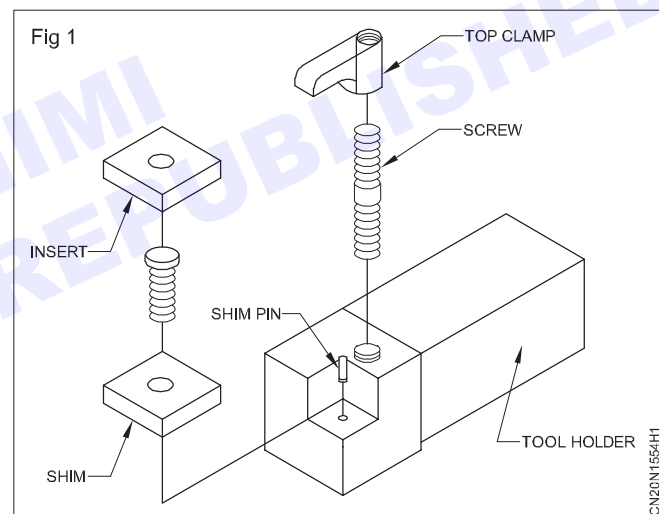
Tools/Equipments/Instruments

- OD Turning tool holder - 1 No.
- Insert - 1 No.

PROCEDURE

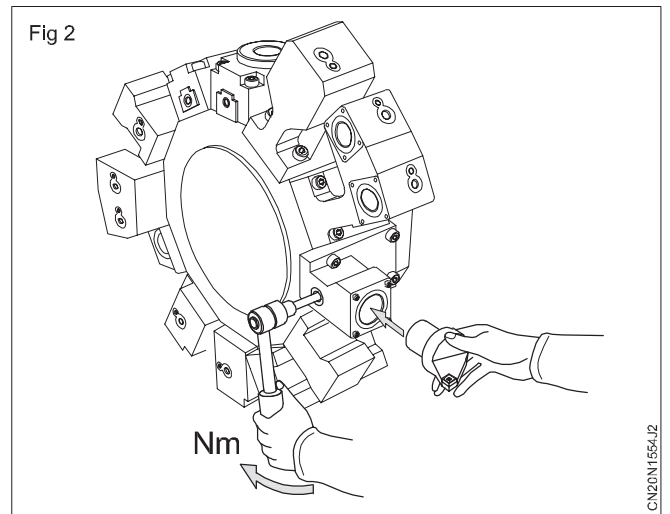
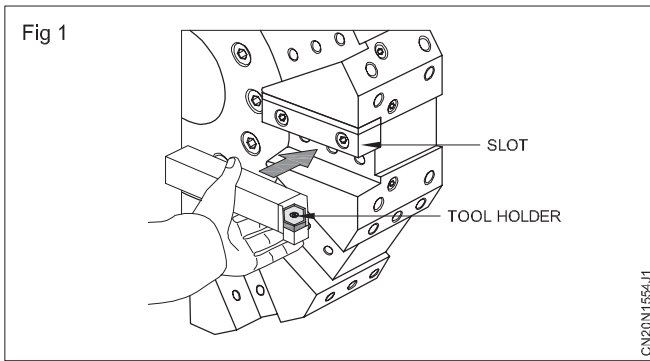
TASK 1: Fixing insert on single point tool holder

- Clean the insert and tool holder.
- Clean the seat of shim.
- Place shim in proper location.
- Clean the insert with proper allen key.



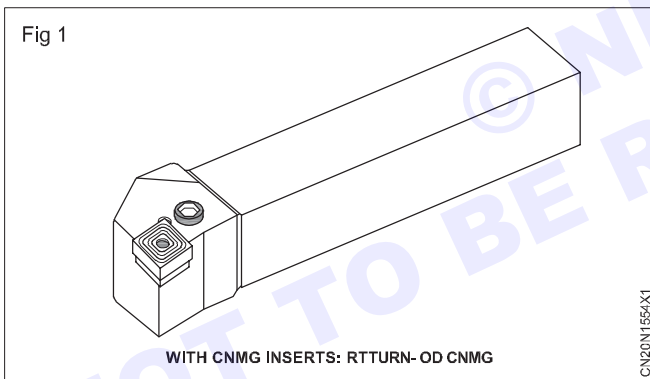
TASK 2: Clamp tool holder adaptor in the turret

- Position the turret to the required station number
- Insert the turret tool holder adaptor in the turret aligning rack matching with internal rack in turret and butting against the turret face and clamp.
- Clean the pocket.
- Clamp the assembly with suitable allen key and wrench. (Figs 2 & 3)



TASK 3: Mount the tool holder in turret

- Fix tool holder shank in the tool holder adaptor. (Figs 1 & 2)
- Clamp tool holder with suitable spanner.
- Check the clamping.
- Now ready for operation.



Prepare coolant using soluble oil

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

- prepare coolant using soluble oil
 - check the coolant concentration.
-

PROCEDURE

TASK 1: Prepare coolant

- Clean the container or coolant tank properly.
- Fill the water, in the container approximately 3/4 capacity of the coolant tank.
- Add soluble oil to water approximately in the ratio of 1:20, by string the water while fourth the soluble oil.
- Check the concentration of the coolant.
- Pour the coolant in the coolant tank.

Take care not to spin the coolant on the floor.

TASK 2: Check the coolant concentration

1 Foam and lubricity test (Simple check)

Assume the coolant during machining

- If excessive foam forms the coolant may be too diluted.
- If the tools or workpieces feel dry or dilute lubrication, the concentrating likely too low.
- A properly mixed coolant should feel lightly slippery when rubbed between your fingers.

2 Coolant colour and classify

- Check the coolant tank for signs of oil separation, discoloration or bacterial growth. (Pour small)

- Properly mixed coolant will appear uniformly coloured without floating oil layers or debris.

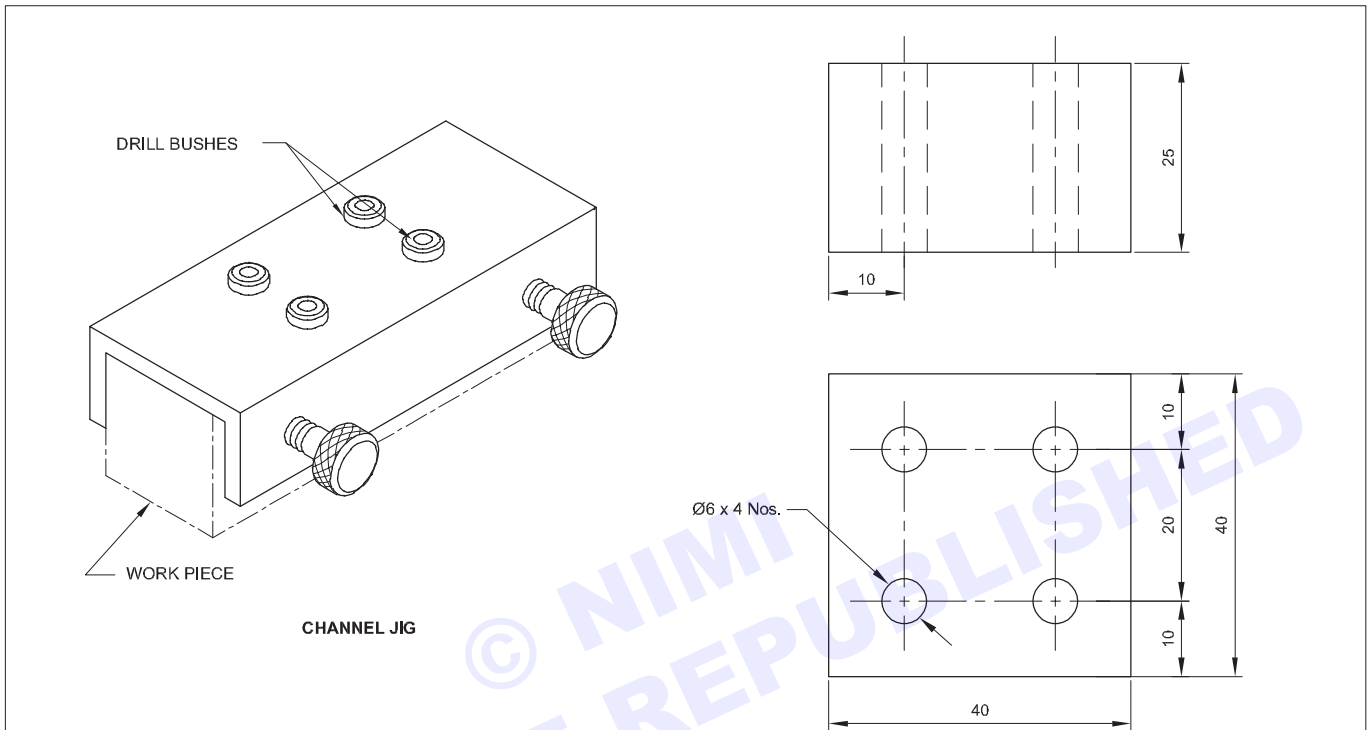
Note: It is important to follow the manufactures recommendations for specific coolant brands and machining operations.

Regular monitoring ensures the coolant effectiveness and prevents tool wear or workpeice damage.

Mount a drilling jig to hold square block to perform operation

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

- mount a drill jig
- locate the workpiece in a jig
- check for the accuracy.



Job Sequence

- Locate the jig in the drilling.
- Ensure the component located in the jig.
- Clamp the job with the screws.
- Drill dia 6mm.
- Remove the top plate.

- Take out the component from the jig.
- Check the component with a vernier caliper according to the drawing.

Note: Trainer shall arrange drilling for practice.

1	15F 60X40X25mm	-	FE 310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					TOLERANCE ±	
A DRILLING JIG TO HOLD SQUARE BLOCK					TIME :	
					CODE NO. CN20N1556E1	

Identify the 'G' codes

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

- recognize the purpose of G-codes
- identify and record function in table
- identify the 'G' codes in the program and mention its function.

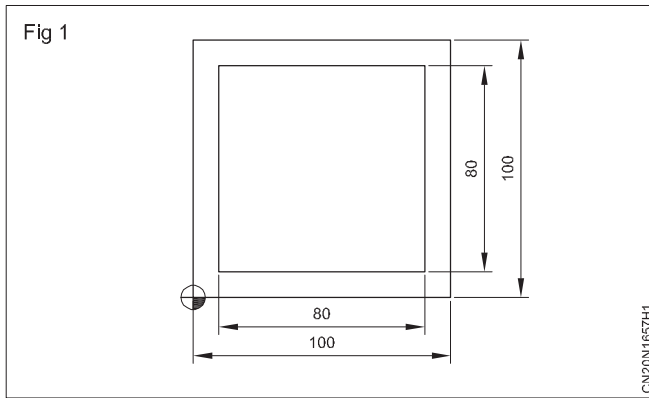
PROCEDURE

TASK 1: Identify the 'G' codes & record in Table 1

Table 1

'G' CODE	Function of the code
G00	
G01	
G02	
G03	
G04	
G20	
G21	
G28	
G40	
G41	
G42	
G50	
G90	
G91	
G92	
G94	
G95	
G96	
G97	
G98	
G99	

TASK 2: Use 'G' codes for milling operation (Fig 1)

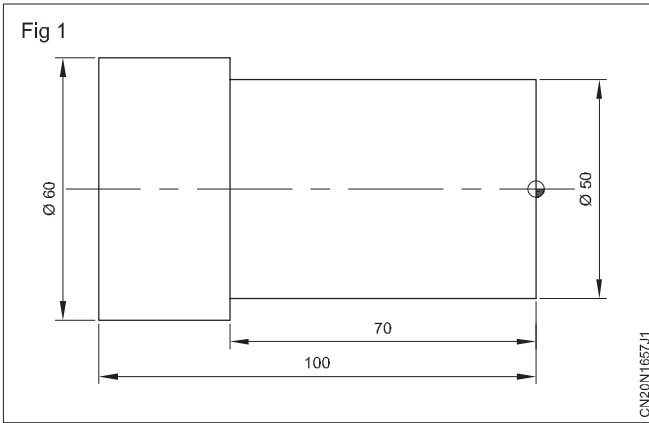


- 1 Identify the 'G' code in the given program and mention its purpose in Table 2.

Table 2

Program	Function
G__ G__;	
G28 G91 Z0.0;	
G__ X0.0 Y0.0;	
M06 T01 H1;	
M03 S1500;	
M08;	
G00 G__ X10.0 Y0.0 Z5.0;	
G__ X10 Y10 Z-0.5 F100;	
G__ X90 Y10;	
G__ X90 Y90;	
G__ X10 Y90;	
G__ X10 Y10.0;	
G__ Z50.0;	
M09;	
M05;	
M30;	

TASK 3: Use 'G' codes for turning operation (Fig 1)



- 1 Identify the 'G' codes in the given program and mention its purpose in Table 3.

Table 3

Program	Function
G18 G90 G21;	
G0U0.0 W0.0;	
T0101;	
G96M03 S1200 ;	
M08;	
G01X60.0 Z2.0	
G01X50.0 F0.12;	
G01 Z-70.0;	
G02 X60.0 Z2.0;	
M09;	
G00U0.0 W0.0;	
M05;	
M30;	

Identify the 'M' codes

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

- read and record the function of 'M' code in table
- identify the 'M' codes in the program and mention its function.

PROCEDURE

TASK 1: Identify the 'M' codes & record in Table 1

Table 1

M-code	Function of M-code
M00	
M01	
M02	
M03	
M05	
M06	
M08	
M09	
M30	
M98	
M99	

TASK 2: List out M-codes using in a part program Table 2

- 1 Record M codes used CNC program in Table 1.
- | | |
|------------------|--------------------|
| O0001; | N70G00Z-0.5; |
| N10G21G90; | N80G01X-1.0 F0.10; |
| N20G28U0.0W0.0; | N90G00Z2.0; |
| N30T0101; | N100G00X62.0; |
| N40G97M03S1200; | N110M09; |
| N50G00X62.0Z2.0; | N120G28U0.0W0.0; |
| N60M08; | N130M05; |
| | N140M30; |

**Table 2
Identify M-codes**

S. No.	M-code used	Function of M-code
1		
2		
3		
4		
5		

- Get it checked by the trainer.

Identify various canned cycle end codes

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

- identify different types of canned cycles and their applications
- write the syntax of CNC canned cycles.

- Identify CNC canned cycles

Table 1

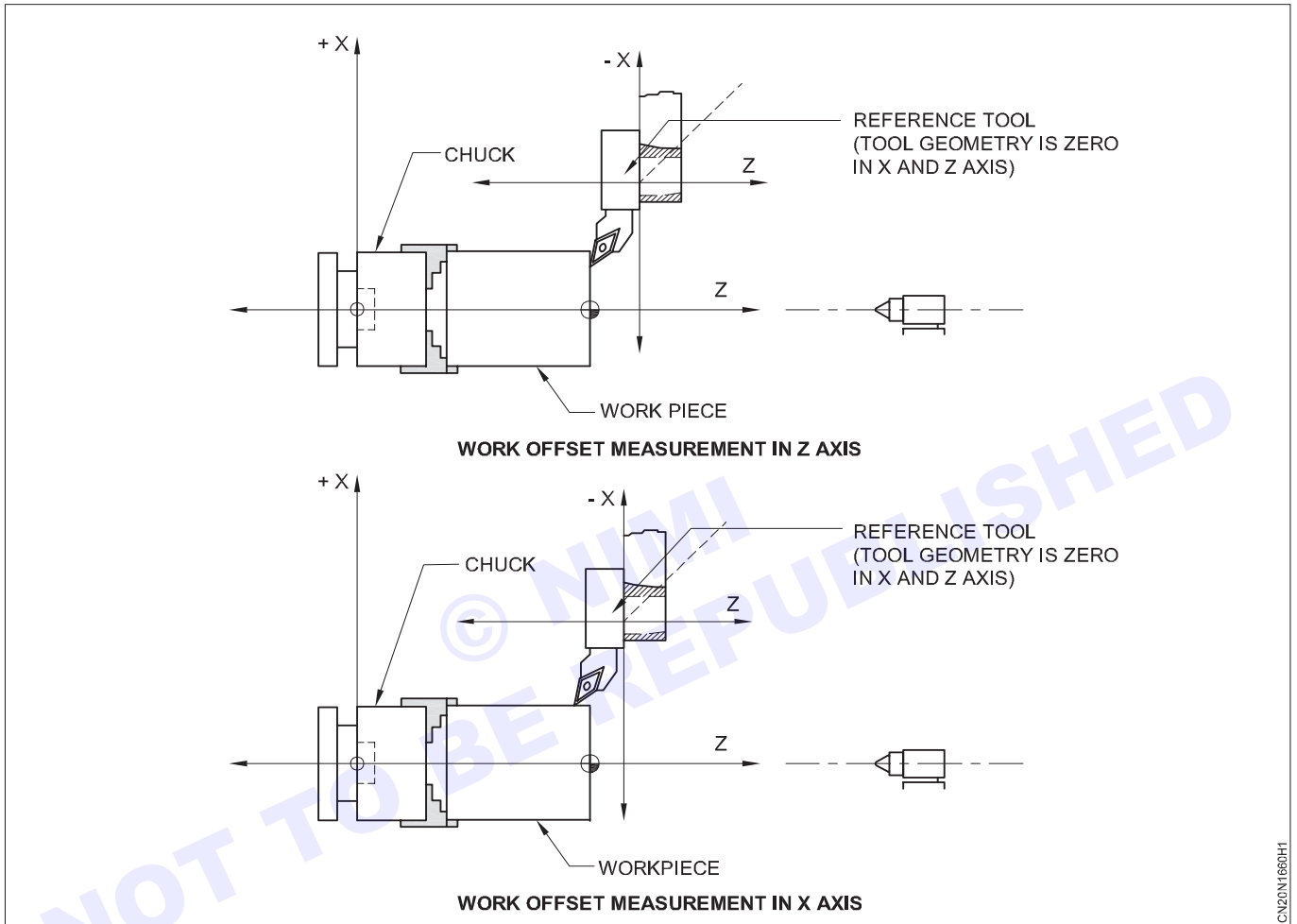
S. No.	Canned cycle	Purpose	Syntax/format
1	G70		
2	G71		
3	G72		
4	G73		
5	G74		
6	G75		
7	G76		

- Get it checked by the trainer.

Taking tool offset with the help of jog mode

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

- measure and enter tool offset in X & Z axis
- understand the purpose of tool offsets
- operate the CNC machine in jog mode.



PROCEDURE

TASK 1: Machine reference

- Offset method - Fanuc
- Select tool no 1: T0101

Step 1: First of all, you have to reference the machine. (Fig 1)



- Select "ZRN" mode. (Reference)
- Press "+x:" key.
- Press "+z" key
(Tool reach at reference position)

Step 2: Select MDI mode. (Fig 2)

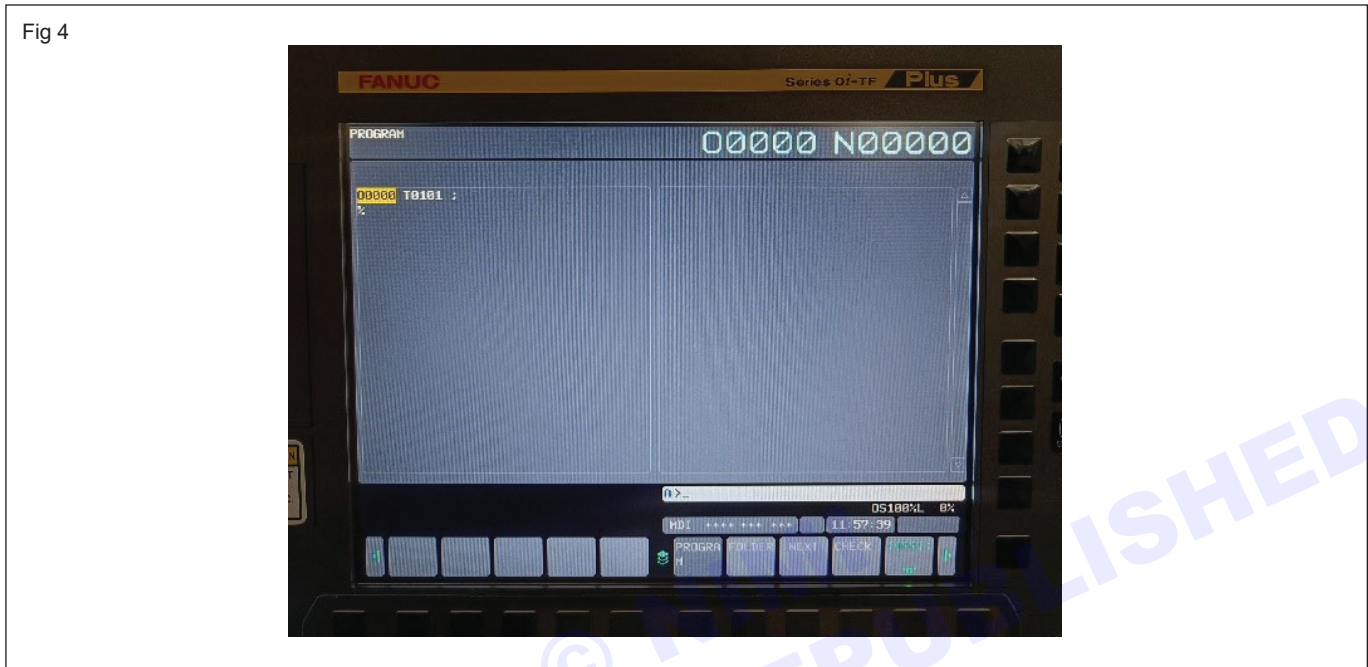


Step 3: Press "PROG" key. (Fig 3)



(In program mode we give the command for tool T0101)

- Type command T0101; in the system
- Press "EOB" key (to complete block)
- Press "INSERT" key. (Fig 4)



Step 4: Press "CYCLE START" key. (Fig 5)



(If your tool No.1 is not on work position it will become on working position)

Step 5: Now we have to touch the edge of the tool by touching the face and diameter of the workpiece for set offset. But here we take offset of z-axis.

- Press "z or x-axis" key (as you need)
- Press "100 - micron" key
- Then move the tool turret by hand wheel for touch the tool edge to workpiece face.

Note: Fanuc CNC have many models there are more changes in MDI panel. Some model there is no hand wheel at time u can use an alternative method to move tool turret

Step 6: After touching tool we move on the system screen.

Press "OFFSET" KEY. (Fig 6)



- Offset page screen will open

Step 7: For entering an offset data. (Fig 7)

- Select "GEOM" (geometry) option which is on screen by using just below soft key horizontal.
- Set the cursor on a tool no G001 (Tool no 1)
- The take cursor on z-axis in front of tool no G001 by pressing arrow key.

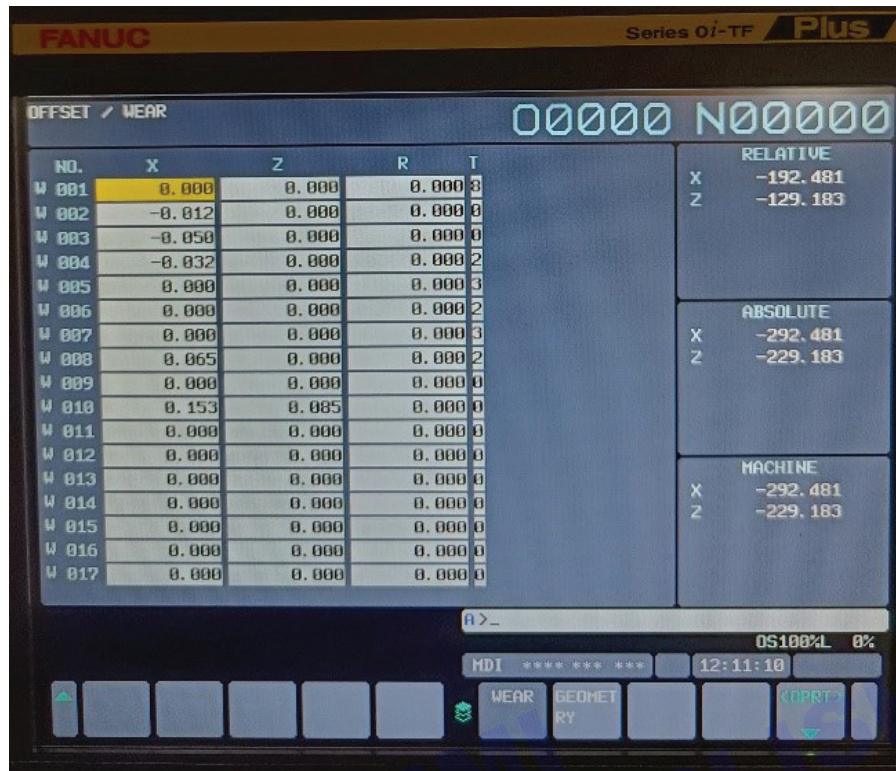
Step 8

- Type code Z0.0 by using keys. Then

b Select "MEASUR" option which is on screen by using just below soft key.

(here we saw the z-axis offset value save in z column)

Fig 7



Step 9: Now we want to take the offset of the x-axis. We want to do the same here as we did in the z-axis.

- Press "X or Z-axis" key. (as you need touch the tool at the workpiece diameter).
- Then move the tool turret by hand wheel for touch the tool edge to workpiece diameter.

Step 10: Go on screen.

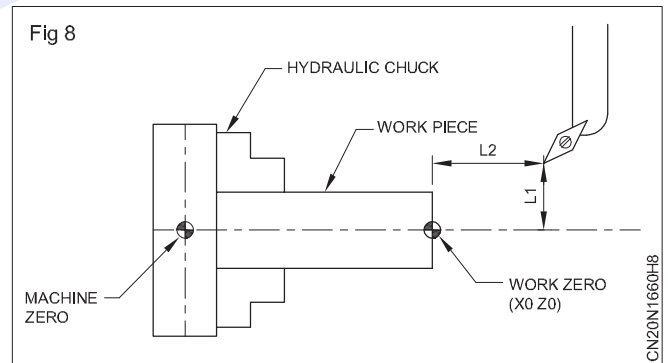
- Set cursor on x-axis column front of tool no G001.
- Type code X50 (actual diameter of the workpiece) by using keys. Then
- Select "MEASUR" option which is on screen by using just below soft key.

(here we saw the X-axis offset value save in X column)

Step 11: For tool take home position by using "ref" mode.

Offset Setting (Hass)

Fig 8



TASK 2: Tool offset (Hass)

- Select tool no 1: T0202

Step 1: First of all you have to reference the machine. (Fig 1)

- Press handle jog soft key
- Press X Diameter measure soft key
- Press Z Face Measure soft key

(Tool reach at reference position)

Fig 1



Step 2: Press "MDI" key. (Fig 2)

Fig 2



Step 3: (In program mode we give the command for tool T0202)

- 1 Type command T0202 in the system
- 2 Press "EOB" key (to complete block)
- 3 Press "ENTER" key.
- 4 Press "CYCLE START" key.

(If your tool no.1 is not on work position it will become on working position)

Step 4: Set Tool Offset (X-Axis):

Position the Tool: Move the tool axis in jog mode. (Fig 3)

Fig 3



- 1 Manual move the Axis in Jog mode on the diameter of workpiece.

Step 5: Enter the workpiece diameter in offset X Axis geometry

- 1 Measure the diameter of the workpiece and input this value into the CNC control.
- 2 Press OFFSET soft key. As shown in picture. (Fig 4)
- 3 Press soft key X DIAMETER MEASURE (Fig 5)
- 4 Put a diameter value of workpiece & press ENTER key. (Fig 6)

Step 6: Set Tool Length Offset (Z-Axis) (Fig 7)

Fig 4



Fig 5

Offsets				
Tool	Work			
Active Tool: 2				
Tool Offset	X Geometry	Y Geometry	Z Geometry	Radius Geometry(D)
2 Spindle	0.	0.	0.	0.
3	0.	0.	0.	0.
4	0.	0.	0.	0.
5	0.	0.	0.	0.
6	0.	0.	0.	0.
7	0.	0.	0.	0.
8	0.	0.	0.	0.
9	0.	0.	0.	0.
10	0.	0.	0.	0.
11	0.	0.	0.	0.

Fig 6



Fig 7

Offsets				
Tool	Work			
Active Tool: 2				
Tool Offset	X Geometry	Y Geometry	Z Geometry	Radius Geometry
2 Spindle	-8.7200	0.	0.	0.
3	0.	0.	0.	0.
4	0.	0.	0.	0.
5	0.	0.	0.	0.
6	0.	0.	0.	0.
7	0.	0.	0.	0.
8	0.	0.	0.	0.
9	0.	0.	0.	0.
10	0.	0.	0.	0.
11	0.	0.	0.	0.
12	0.	0.	0.	0.
13	0.	0.	0.	0.
14	0.	0.	0.	0.

Position the Tool: Use the jog mode to bring the tool on the face of a workpiece.

- 1 **Manual touch-off:** Slowly move the tool towards the workpiece surface until it makes contact.
- 2 Put the cursor in ZAxis Block Press Z FACE MEASURE

Step 7: Referencing the machine.

Find out maximum bed travel limits in JOG mode

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

- identify the over travel limit switches and x and z axis in CNC turning center.

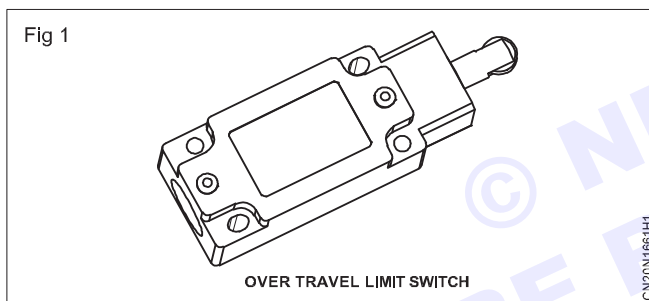
Job Sequence

- Identification of machine bed travel limit switches in x and z axis

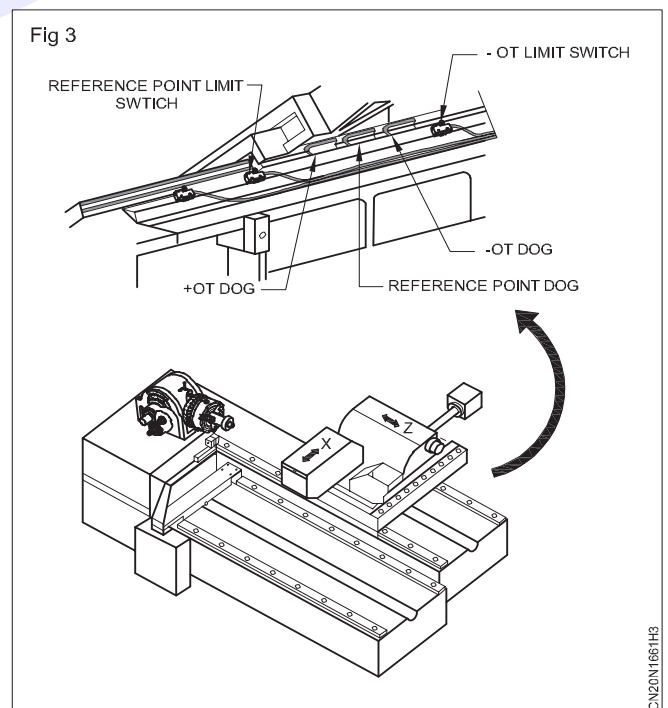
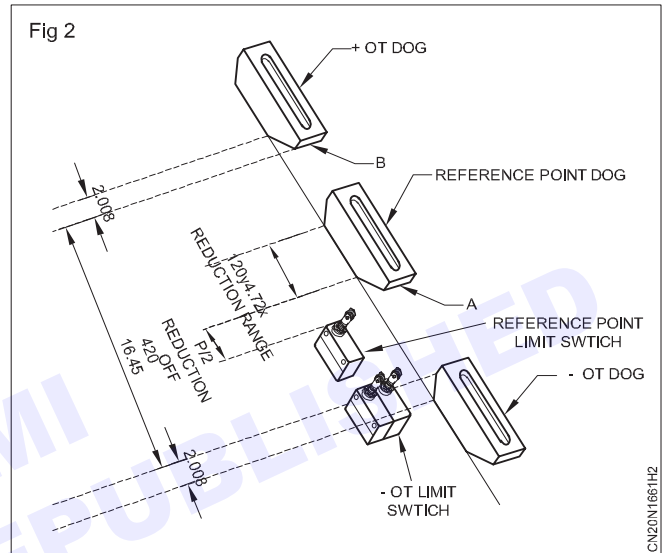
- Figs 2 & 3 shows x axis and z axis dog and limit switch respectively.

There are two types of over travel limit
 1 Soft 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.

Identification of hardware over travel switch (Fig 1)



- Switch ON the machine.
- Position the X axis in the middle of the x movement.
- Remove the telescopic cover at both ends.
- Observe the over travel limit switches in both direction that is x -" and x +".
- Similarly position the z axis movement in the middle of the lathe bed.
- Open the telescopic cover at both the ends and observe the over travel limit switches in Z- and Z+.
- Move the x axis or z axis till it touch limit switch and observe limit over travel in 'ALARM' message.
- Disconnect limit switch or take away from the movement.
- Reset the 'RESET' button and move away from limit switch.
- Refix the limit switch, telescope cover.
- In the recent version of CNC machines are having over travel switch to overcome the above process.

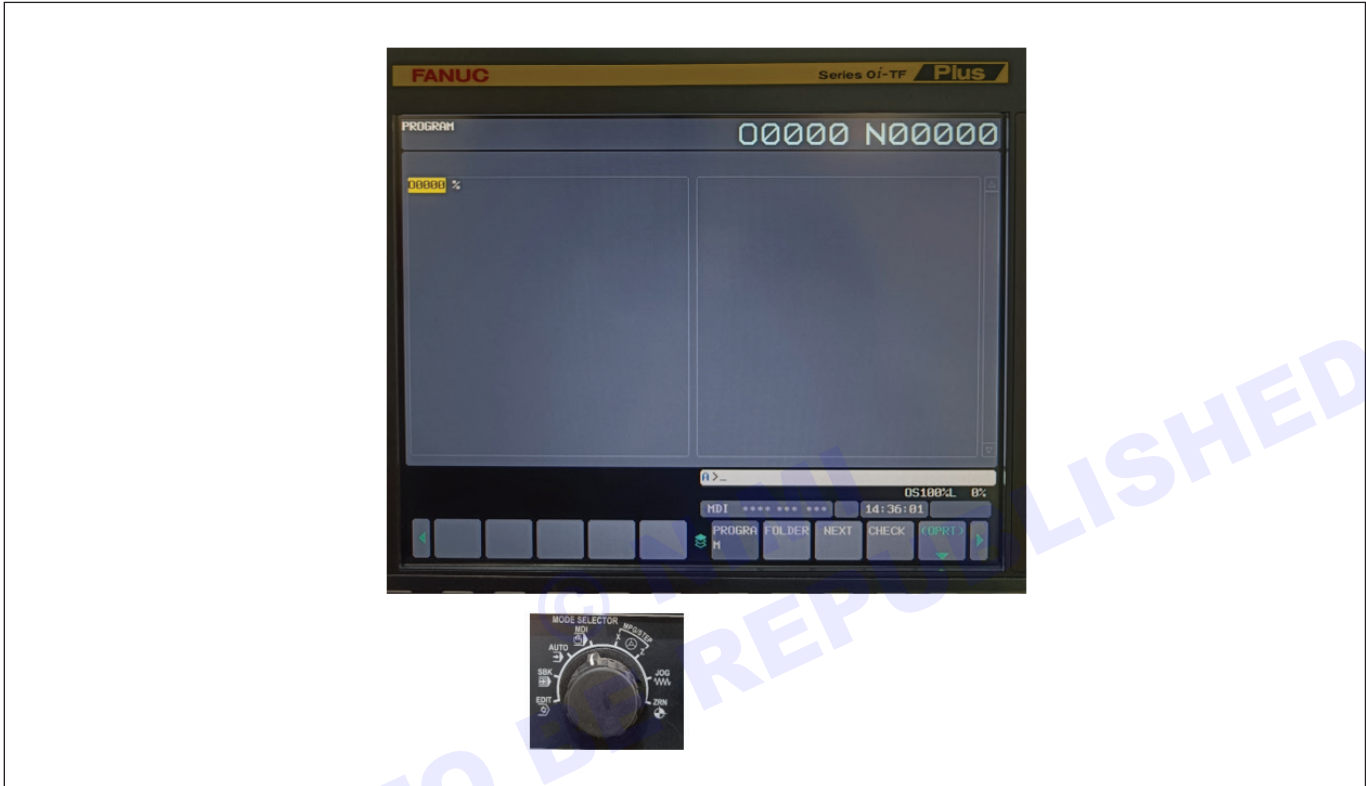


Create a program in MDI mode

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

- write the program
- enter the program
- operate with MDI mode.

MDI operation - list



PROCEDURE

TASK 1: Perform on MDI Mode

MDI mode for home position (Fig 1)

Fig 1



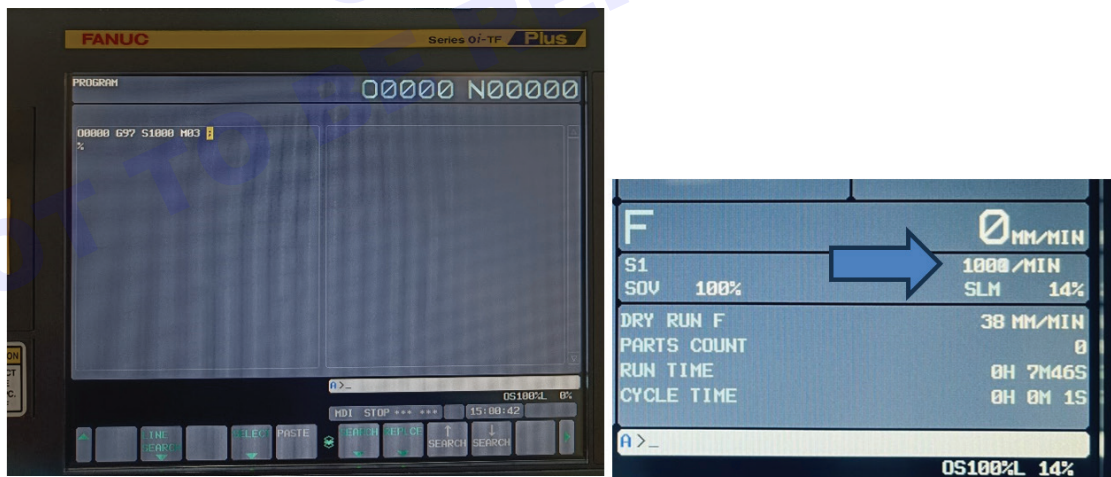
- 1 Select "MDI" mode.
 - 2 Press "PROG" key. Keep pressing that key constantly until the "Program MDI" appeared on screen.
 - 3 Type code "G28 U0.00 W0.00;"
 - 4 Press "INSERT" key
 - 5 Press "CYCLE START" key.
- For tool indexing (Fig 2)**

Fig 2



- 6 Press "MDI" key.
 - 7 Long press "PROG" key until the "Program MDI" appears on the screen
 - 8 Type code "T0101".
 - 9 Press "INSERT" key.
 - 10 Press "CYCLE START" key
- For spindle rotation (Fig 3)**

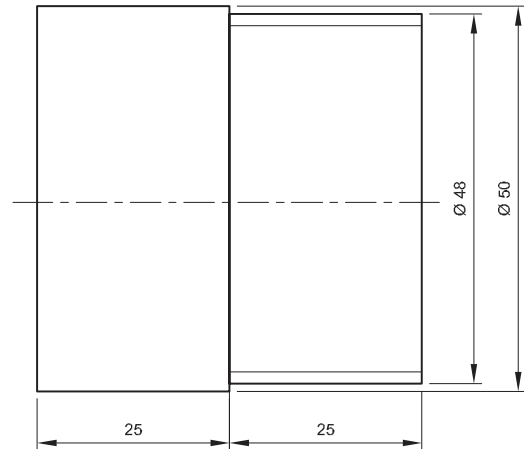
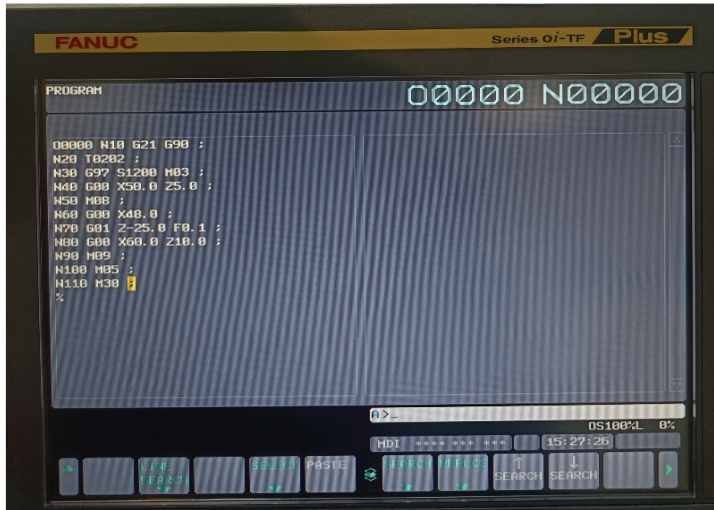
Fig 3



- 11 Press "MDI" key
- 12 Long press "PROG" key, until the "Program MDI" appears on the screen.
- 13 Type code "G97 S2000 M03;"
- 14 Press "INSERT" key.
- 15 Press "CYCLE START" key

TASK 2: Ask the trainees to enter the program and execute in MDI mode

Fig 1



N10 G21 G90;
 N20 T0202;
 N30 G97 S1200M03;
 N40 G00 X50.0 Z5.0;
 N50 M08;
 N60 G00 X48.0;
 N70 G01 Z-25.0 F0.1;
 N80 G00 X60.0 Z10.0;
 N90 M09;
 N100 M05;
 N110 M30;

- Reference the Axis & setup the workpiece.
- Perform offset for X & Z Axis.
- Press the MDI button on the control panel.
- The MDI prompt will appear on the display.
- Enter your commands one at a time.
- To execute a command, press the CYCLE START button.
- To move the machine manually, use the JOG buttons on the control panel.

Note: Ask trainees to verify the program by trainer.

MDI operation

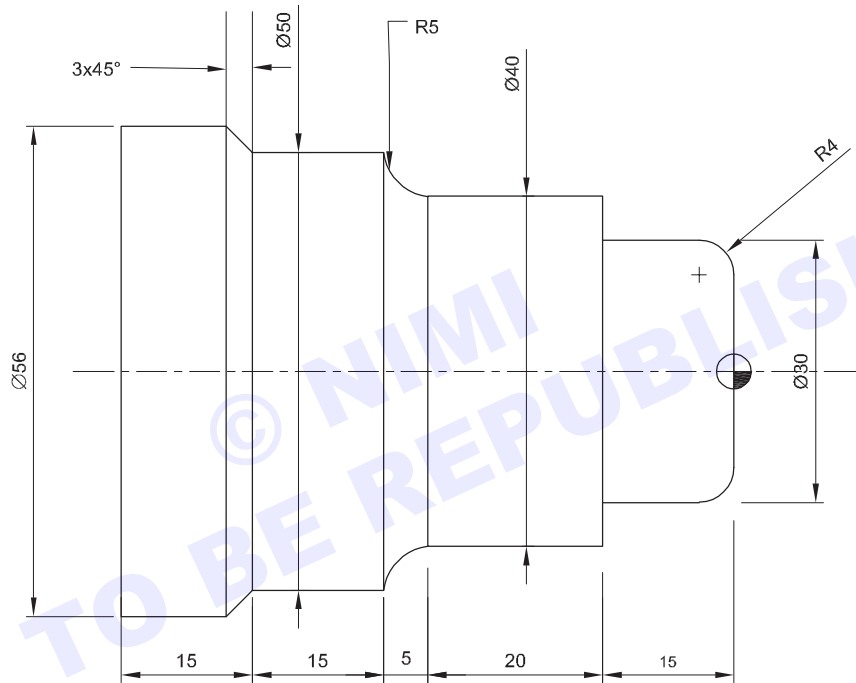
Steps

- Switch ON the machine.

Run the program in single block mode

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

- write the part program
- understand function of SBK mode
- run the part program in single block / auto block.



1	Ø 60 x 75 mm	-	Fe310	-	-	1.6.63
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		SINGLE BLOCK MODE			TOLERANCE ± 0.1	TIME :
					CODE NO. CN20N1663E1	

Job Sequence

• Switch ON simulator	G00 X65.0 Z5.0 M08;
• Select the machine.	G01 Z2.0 F0.1;
• Enter the program in edit mode.	G71 U1.0 R1.0;
• Select required tool and clamping device.	G71 P10 Q20 U0.0 W0.0 F0.1;
• Write a part program.	N10 G01 X0.0 F0.1;
• Run the simulation in single block mode	G01 Z0.0 F0.1;
• Transfer the program to the machine.	G01 x 22.0 F0.1;
Take the tool offset.	G03 X30.0 Z- 4.0 R4 F0.1;
Execute the program in single block mode.	G01 Z-15.0 F0.1;
Press the cycle start button to execute the next block.	X40.0;
Run the program in auto continues mode.	Z-35.0;
Check the dimension and remove the job.	G02 X50.0 Z - 40 R5 F0.1;
Switch off the machine.	G01 Z-55.0 F0.1;
O0002;	X56.0 Z-58.0 ;
G21 G90 G95;	N20 G01 Z-70.0 F0.1;
G28 U0.0 W0.0 ;	G00 X65.0 Z5.0 M09;
T0101;	G28 U0 W0;
G50 S1500 M03;	M05;
G96 S180;	M30;

Search an existing program and edit


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

- inserting, altering, and deleting a word
- replacing words and addresses
- deleting blocks.


Job Sequence

- Switch ON Switch ON CNC machine.
- Reference the Machine.
- Select edit mode.
- Search the program name in program library.
- Open the Existing Program & start editing.


Editing → search for part program to be edited

- Select EDIT mode
- Press function  key and display the program screen.
- Select a program to be edited
- If a program to be edited is selected, perform the operation
- Search for a word to be modified
 - Scan method
 - Word search method
- Perform an operation such as altering, inserting, or deleting a word

Word search

- Press the cursor key 







The cursor moves forward word by word on the screen; the cursor is displayed at a selected word. The cursor is positioned to the address of the selected word.

- Press the cursor key 

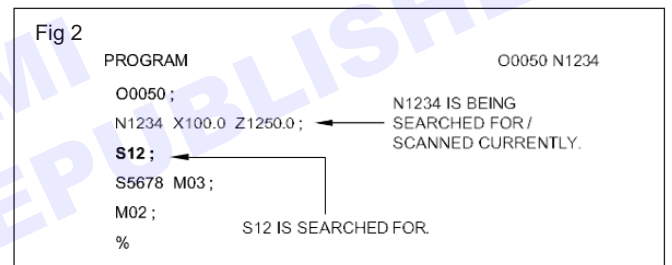
The cursor moves backward word by word on the screen; the cursor is displayed at a selected word.







Example: When Z1250.0 is scanned (Fig 1)



- Holding down the cursor  key or  scans words continuously.
- Pressing the page key  displays the next page and searches for the first word of the page
- Pressing the page key  displays the previous page and searches for the first word of the page.
- Holding down the page key  or  displays one page after another

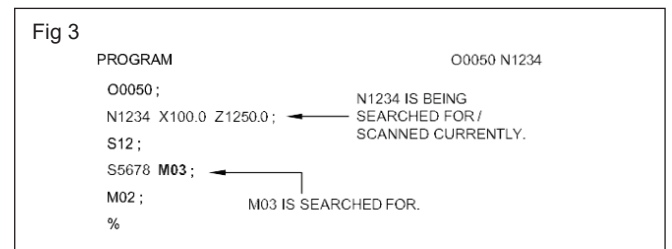
Example of searching for S12 (Fig 2)







- Key in address 
- Key in  
 - S12 cannot be searched for if only S1 is keyed in.
 - S09 cannot be searched for by keying in only S9.
 - To search for S09, be sure to key in S09.
- Pressing the cursor key  starts search operation.
- Upon completion of search operation, the cursor is displayed at "S" of S12. Pressing the cursor key  rather the cursor  key performs search operation in the reverse direction.

Searching an address

Example of searching for M03 (Fig 3)



Key in address

- Press the cursor key ... 
- Upon completion of search  operation, the cursor is displayed at "M" M03. Pressing the  key rather than the  key performs search operation in the reverse direction

Heading a program



Method 1

- 1 Press  when the program screen is selected


in EDIT mode.

When the cursor has returned to the start of the program, the contents of the program are displayed from its start on the screen.

Method 2

- 1 Select AUTO or **EDIT** mode.
- 2 Press function **PROG** key and display the program
- 3 Press the address key 
- 4 Press the cursor key... 

Inserting a word

- Search for or scan the word immediately before a word to be inserted
- Key in an address to be inserted.
- Key in data
- Press the  key.

Example of inserting T15

- Search for or scan Z1250.0 (Fig 4)


```
Fig 4
PROGRAM                                O0050 N1234
O0050;
N1234 X100.0 Z1250.0; ← Z1250.0 IS BEING SEARCHED FOR / SCANNED.
S12;
S5678 M03;
M02;
%
```

- Key in   

- Press the  key (Fig 5)

```
Fig 5
PROGRAM                                O0050 N1234
O0050;
N1234 X100.0 Z1250.0 T15; ← T15 IS INSERTED.
S12;
S5678 M03;
M02;
%
```

Altering a word

- Search for or scan a word to be altered
- Key in an address to be inserted
- Key in data.
- Press  key

Example of changing T15 to M15


- Search for or scan T15 (Fig 6)

```
Fig 6
PROGRAM                                O0050 N1234
O0050;
N1234 X100.0 Z1250.0 T15; ← T15 IS SEARCHED FOR, SCANNED.
S12;
S5678 M03;
M02;
%
```

- Key in   
- Press the  key. (Fig 7)

```
Fig 7
PROGRAM                                O0050 N1234
O0050;
N1234 X100.0 Z1250.0 M15; ← T15 IS CHANGED TO M15.
S12;
S5678 M03;
M02;
%
```

Deleting a word

- Search for or scan a word to be deleted
- Press the  key

Example of deleting a word

- Search for or scan X100.0 (Fig 8)

```
Fig 8
PROGRAM                                O0050 N1234
O0050;
N1234 X100.0 Z1250.0 M15; ← X100.0 IS SEARCHED FOR / SCANNED.
S12;
S5678 M03;
M02;
%
```

- Press the  key (Fig 9)

```
Fig 9
PROGRAM                                O0050 N1234
O0050;
N1234 Z1250.0 M15; ← X100.0 IS DELETED.
S12;
S5678 M03;
M02;
%
```


- Search for or scan N1234 (Fig 10)
- Key in 

Fig 10

```

PROGRAM                                O0050 N1234
O0050 ;
N1234 Z1250.0 M15 ; ← N1234 IS SEARCHED FOR /
S12 ;                                  SCANNED.
S5678 M03 ;
M02 ;
%
```

- Press the  key (Fig 11)

Fig 11

```

PROGRAM                                O0050 N1234
O0050 ;
S12 ; ← BLOCK CONTAINING
S5678 M03 ;                             N1234 HAS BEEN
M02 ;                                     DELETED.
%
```

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Importance of G00 - Rapid traverse

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

- understand the function of G00 - code.

G00 - Rapid traverse / positioning

G00 X.... Y...; (CNC milling)

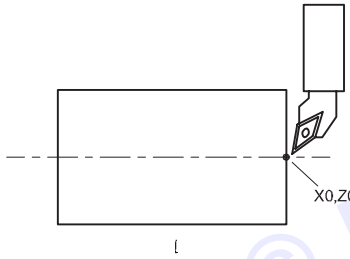
Format - G00 X... Z ; (CNC lathe)

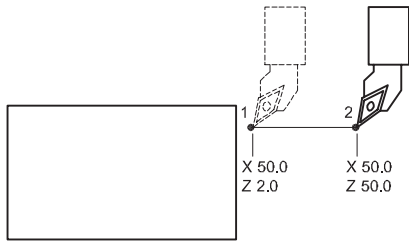
G00 Z....;(CNC milling)

Job Sequence

- Trainer shall demonstrate the importance and use of G00 Code.
- Ask the trainees to observe, understand, and record it in table 1.

Table 1

S. No.	Operation	Observation
1	 <p>Initially Tool position at X0, Z0 When we execute the command. G00 X 150.00 Z100.0; where the tool tip will position?</p>	
2	How will it move to the position?	
3	What is the feed rate of the G00 command?	
3	How to stop the movement while using the G00 command?	

S. No.	Operation	Observation
4	How to stop the movement while using the G00 command?	
5	What precautions should be taken while using the G00 command?	
6	What is the rapid traverse rate when the knob is at 25%?	
7	How will the rapid traverse rate be decreased or increased?	
8	<p>Write the block required for moving from position 1 to 2?</p> 	

- Get it checked by the trainer.

Importance of G01 - linear interpolation

Objectives: At the end of this exercise you shall be able to
 • understand the function of G01 - code.

G01- Linear interpolation

G01 Z ... F....;

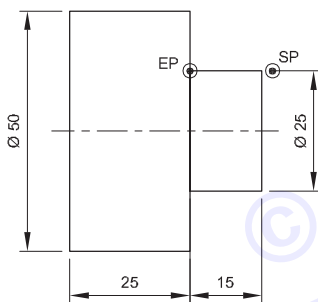
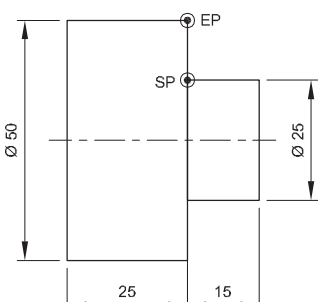
Format - G01 X...F...;

G01 X...Z...F;

Job Sequence

- Trainer shall demonstrate the importance and use of G01 Code.
- Ask the trainees to observe, understand, and record it in Table 1.

Table 1

S. No.	Operation	Observation
1	 <p>SP- Starting Point EP- Ending Point Write the block required for moving from SP to EP?</p>	
2	 <p>Write the block Required for Moving SP to EP?</p>	

S. No,	Operation	Observation
3	How to Stop the movement while execute G01 command?	
4	What precautions should be taken while using the G01?	
5	How will the linear interpolation rate decrease or increase?	
6	Name the operations G01 command used?	1 2 3
7	Write the unit of the G01 command that is used?	

- Get it checked by the trainer.

— — — — —

Rapid traverse and linear interpolation (G00 & G01)

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

- prepare the CNC part program for facing
- prepare the CNC part program for turning.

TASK 1

CHUCK

Ø43

G00

G01

TOLERANCE ± 0.02

TASK 2

CHUCK

Ø50

Ø48

30

TOLERANCE : ± 0.02

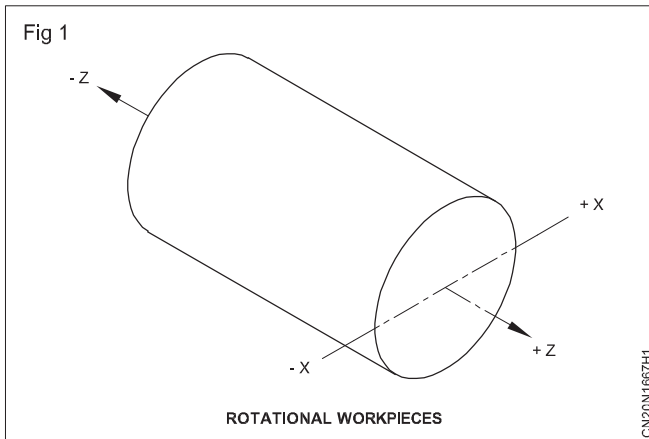
ALL DIMENSIONS ARE IN mm

-	Ø50 x 100	-	Fe310	-	TASK 2	-
-	Ø43 x 100	-	Fe310	-	TASK 1	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
<p>SCALE 1:1</p> <p>PROGRAM FOR FACING AND TURNING OPERATION</p>					DEVIATIONS ± 0.1	TIME :
					CODE NO. CN20N1667E1	

PROCEDURE

TASK 1: Facing

- 1 Study the drawing dimension.
- 2 Check the raw material for the required size.
- 3 List out the G code & M code needed for the programme.
- 4 Fix the axes for turning operation (Fig 1)



- 5 Prepare & write down the part program.
- 6 Ensure the tool in place.
- 7 Hold the job on machine chuck & clamp securely
- 8 Get the program checked for its correctness (Avail instructor's help)

- 9 Try to make few similar program for some other components made earlier.

Axis movement

Part program for facing in Fanuc (Task 1)

```
:0001
N5 G28 U0 W0;
N10 G50 S1500 T0101;
N15 G96 S900 M03;
N20 G00 X50.0 Z5.0;
N25 Z-0.5;
N30 G01 X-1.0 F0.1;
N35 G00 Z2.0 X50.0;
N40 Z-1.5;
N45 G01 X-1.0 F0.1;
N50 G00 Z2.0 Z50.0;
N55 G28 U0 W0;
N60 M05;
N65 M30;
```

TASK 2: Part program for turning in Fanuc

```
0000;
N1;
G28 U0 W0;
G50 S1500 T0101;
G96 S900 M03;
G00 X50.0 Z2.0;
X49.0;
G01 Z-30.0 F0.1;
G00 X50.0 Z5.0;
X48.0;
F01 Z-30.0 F0.1;
X50.0;
G00 X52.0 Z5.0;
G28 U0 W0;
M05;
M30;
```

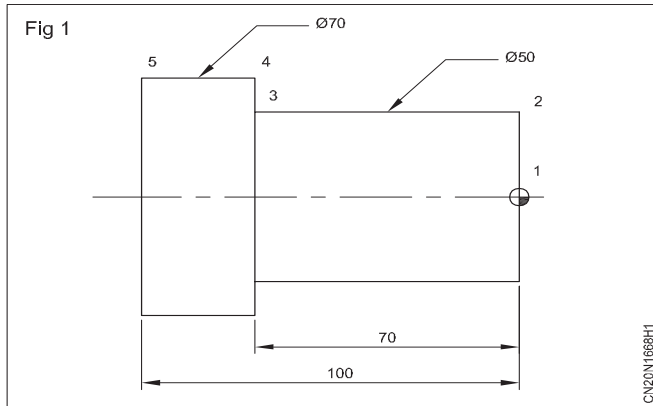
Create and execute program to verify absolute & incremental programming

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

- practice on absolute and incremental co-ordinates
- perform linear and circular interpolations.

PROCEDURE

TASK 1: Absolute and Incremental program (Fig 1)



Absolute program in Table 1.

Table 1

Absolute		
Position	X	Z
1	0.0	0.0
2	50.0	0.0
3	50.0	-70.0
4	70.0	-70.0
5	70.0	-100.0

Incremental program in Table 2.

Table 2

Absolute		
Position	X	Z
1	0.0	0.0
2	50.0	0.0
3	50.0	-70.0
4	70.0	-70.0
5	70.0	-100.0

Method of programming

There are two methods of dimensioning.

- 1 Absolute system of programming (or) fixed point zero, system of dimensioning.
- 2 Incremental system of programming (or) floating zero system of dimensioning. (or) previous point zero system of dimensioning.

Absolute programming

In Absolute dimensions programming all the point of the tools is coming from the datum point (or) zero point.

Incremental programming

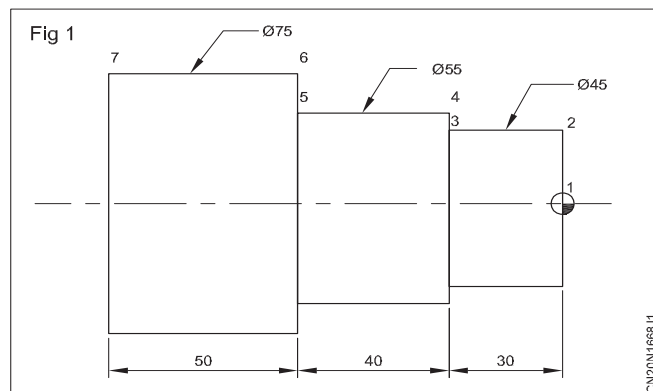
In this system, tool move from the previous point.

Example 1: The points 1 to 5 in the drawing indicates the absolute in Table 1 and incremental in Table 2

Exercise for absolute & incremental methods

Write the points for the following figures in absolute & incremental programming.

TASK 2: Programming method (Fig 1)



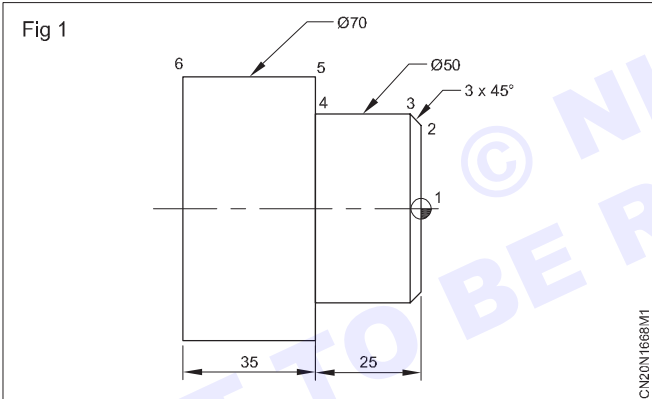
Absolute		
Position	X	Z
1		
2		
3		
4		
5		
6		
7		

Incremental		
Position	U	W
1		
2		
3		
4		
5		
6		
7		

— — — — —

TASK 3: Absolute and Incremental co-ordinates (Fig 1)

Trainees to indicate the co-ordinate values in the given tables.



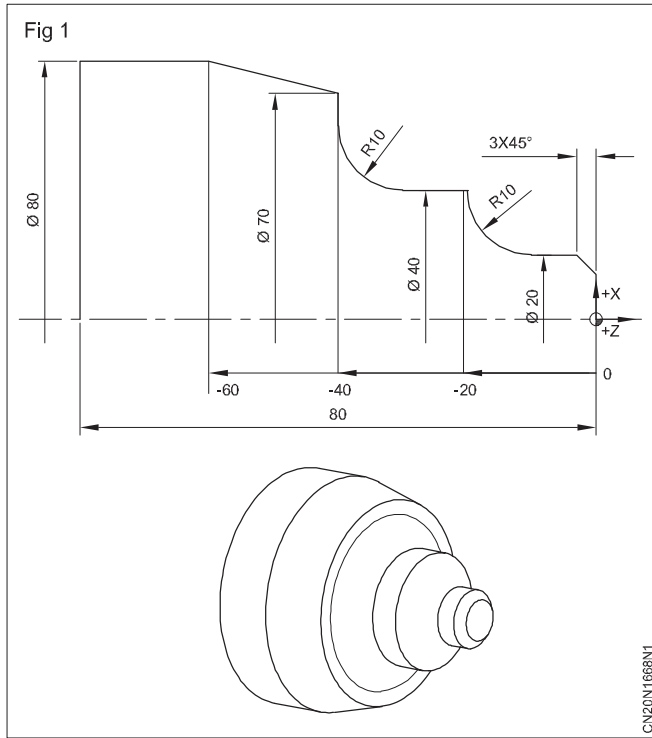
Absolute		
Position	X	Z
1		
2		
3		
4		
5		
6		

Incremental		
Position	U	W
1		
2		
3		
4		
5		
6		

— — — — —

TASK 4: Write the tool path (Fig 1)

Write the tool path using G01, G02 & G03 with G90/G91

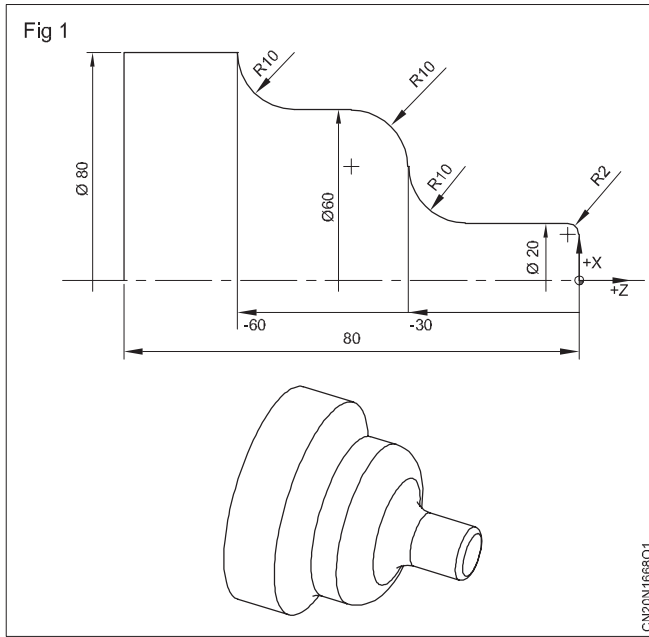


G90					
N	G	X	Z	I	K
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					

G91					
N	G	X	Z	I	K
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					

TASK 5: Write the tool path (Fig 1)

Write the tool path using G01, G02, G03 with G90/G91

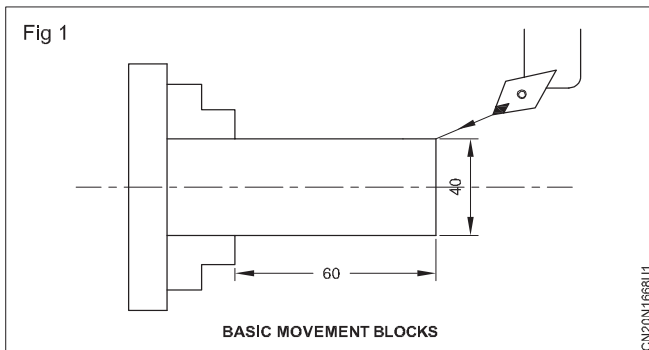


G90					
N	G	X	Z	I	K
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					
N13					

G91					
N	G	X	Z	I	K
N1					
N2					
N3					
N4					
N5					
N6					
N7					
N8					
N9					
N10					
N11					
N12					

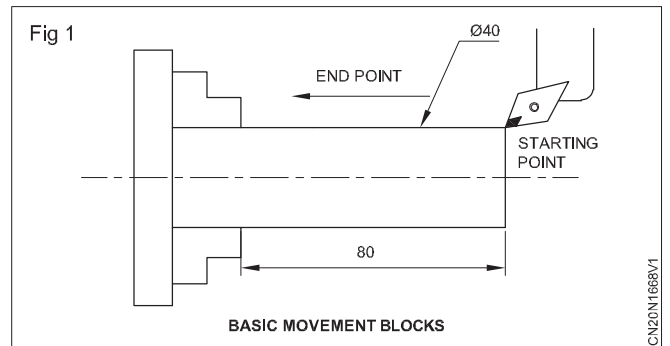
TASK 6: Rapid positioning (Fig 1)

Rapid positioning G00X.....Z



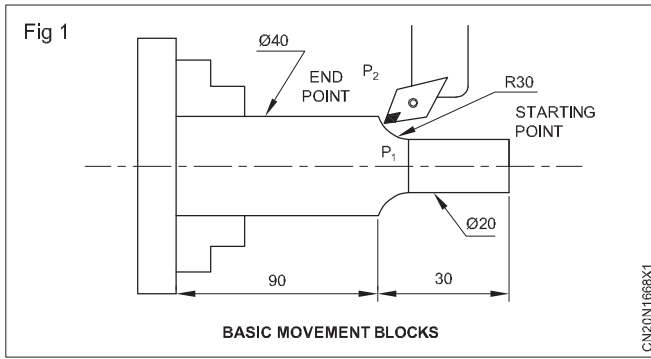
TASK 7: Linear interpolation (Fig 1)

Linear interpolation G01X.....Z



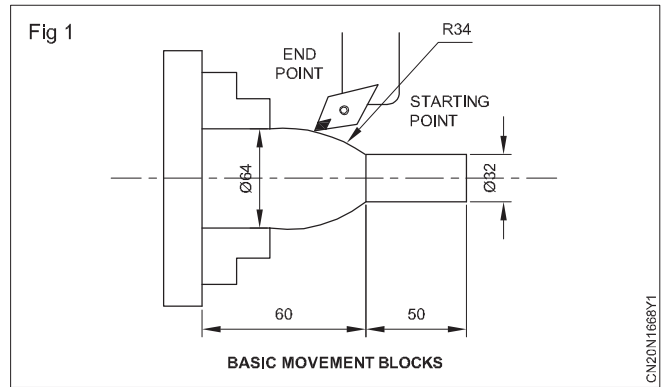
TASK 8: Circular interpolation (Fig 1)

Circular interpolation (CW) G02 G90X.....Z...



TASK 9: Circular interpolation (Fig 1)

Circular interpolation (CCW) G03 G90X....Z...



Rapid positioning

Circular interpolation (CW)

Write and simulate the program
TASK 6

Linear interpolation

Circular interpolation (CCW)

Write and simulate the program
TASK 7

Write and simulate the program
TASK 8

Write and simulate the program
TASK 9

Get it verified by the trainer.

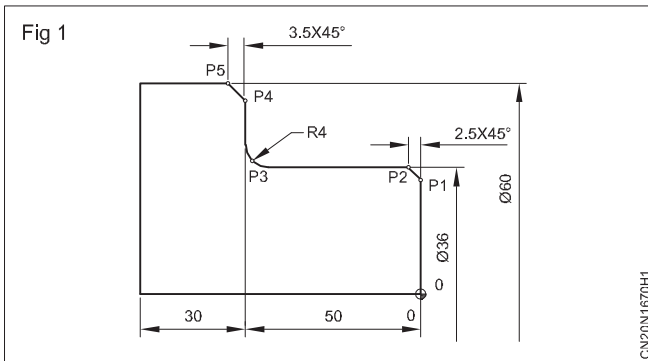
Create and execute program in (G02)/(G03) circular interpolation CW/CCW

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

- prepare the program with G02 & G03
- simulate the program.

PROCEDURE

TASK 1: Programming with G01, G02, G03



```
G00 Z1.0 M08;
G00 X65.0;
G71 P10 Q20 U0 W0 F0.15;
N10 G01Z0.0;
X31.0;
G01X36.0A135;
G01Z-46.0;
G02X44.0Z-50.0 R4;
G01X53.0;
G01X60.0Z-53.0;
N20G01Z-80.0;
G0X65.0Z2.0;
G28U0.0W0.0;
M05;
M30
```

Programming with G01, G02

```
O0012;
G28 U0.0 W0.0;
T0101;
G50 M03 S1500;
G96 M03 S200;
```

TASK 2: Write a program with G01, G02, G03 in Table 1

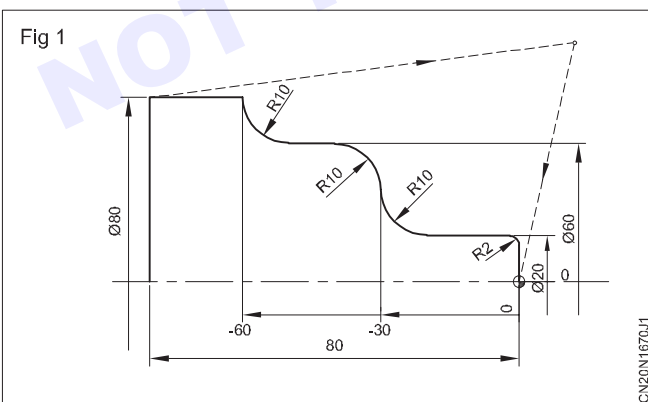


Table 1

Write a program with G01, G02, G03

TASK 3: Write a program with G01, G02, G03 in Table 2

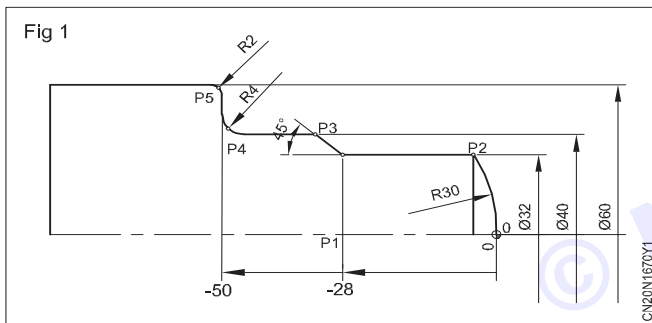


Table 2

Write a program with G01, G02, G03

- Study the drawing dimension
- Check the raw material for the required size.
- List out the G code & M code needed for the program.
- Fix the axes for turning operation (Fig 1)
- Prepare the part program.
- Simulate the part program.
- Ask the trainees to understand the part program.
- Record the program in Table 1 & 2.
- Verified by the trainer.

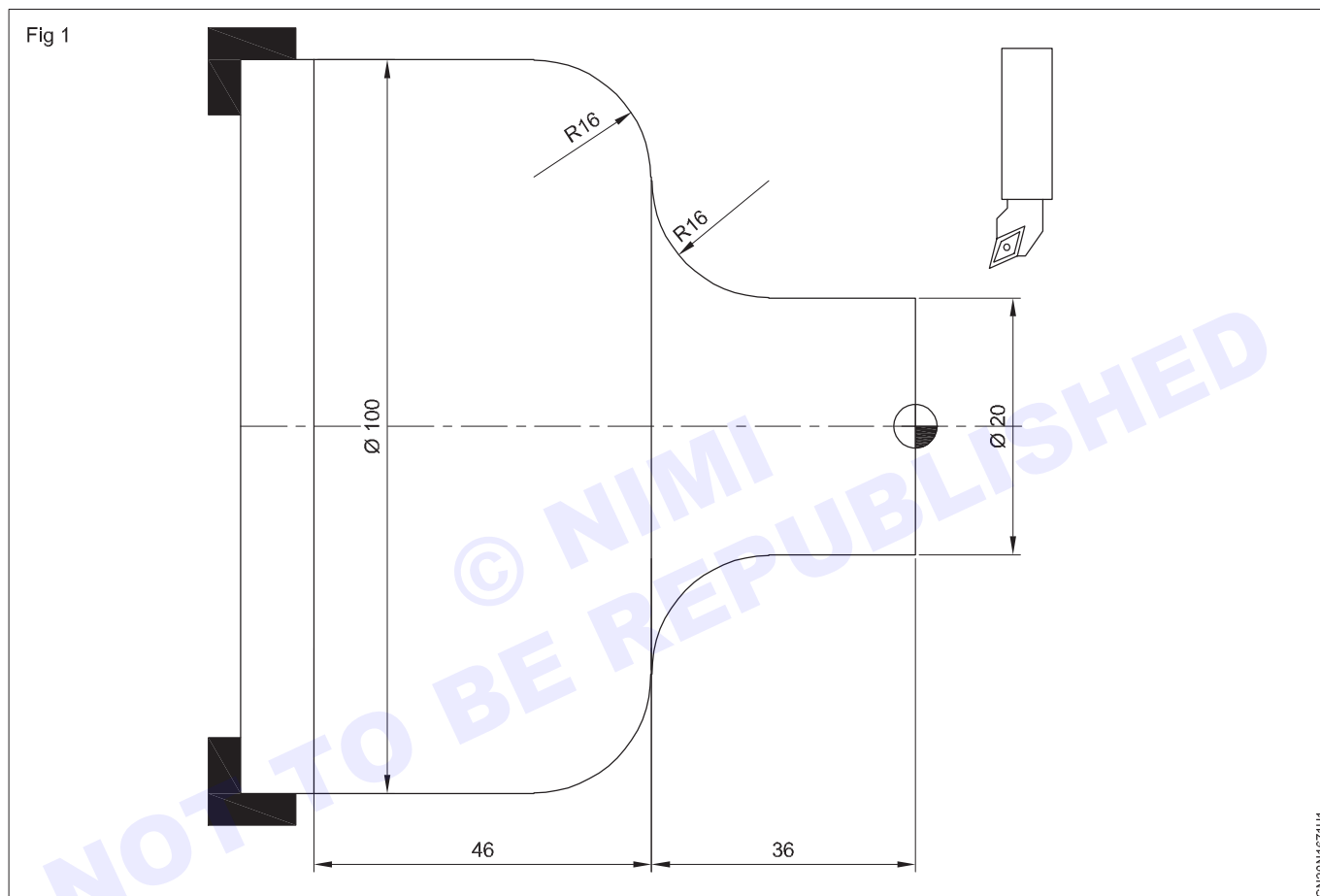
Circular interpolation by using I,K code

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

- prepare the program using I,K code in G02 & G03
- simulate the program.

PROCEDURE

TASK 1: Programming with G02, G03 by using I,K



O3131;

G28 U0.0 W0.0;

T0303;

G50 S2000;

G96 S200 M03;

G00 X102.0 Z2.0 M08;

G71 U1.0 R2.0;

G71 P80 Q90 U0 W0 F0.25;

N80 G00 X35.0 Z1.0;

G01 Z-20.0 F0.2;

G02 X67.0 Z-36.0 I16.0 K0.0;

G01 X68.0;

G03 X100.0 Z-52.0 I0.0 K-16.0;

N90 G01 Z-82.0;

G00 X200.0 Z200.0;

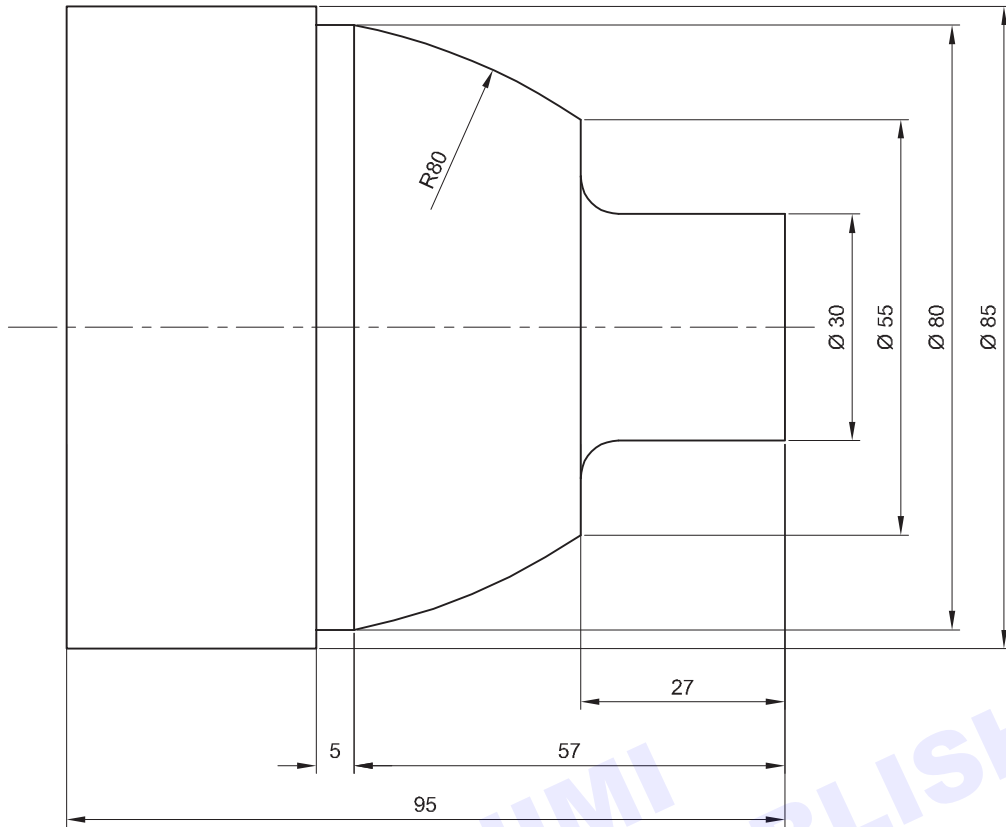
M09;

M05;

M30;

TASK 2: Programming with G02, G03 by using I,K

Fig 1



CN20N1671J1

Table 1

Write a program with G02, G03

- Study the drawing dimension
- Check the raw material for the required size.
- List out the G code & M code needed for the program.
- Fix the axes for turning operation.
- Prepare & write down the part program.

- Ensure the tool in place.
- Simulate the program.

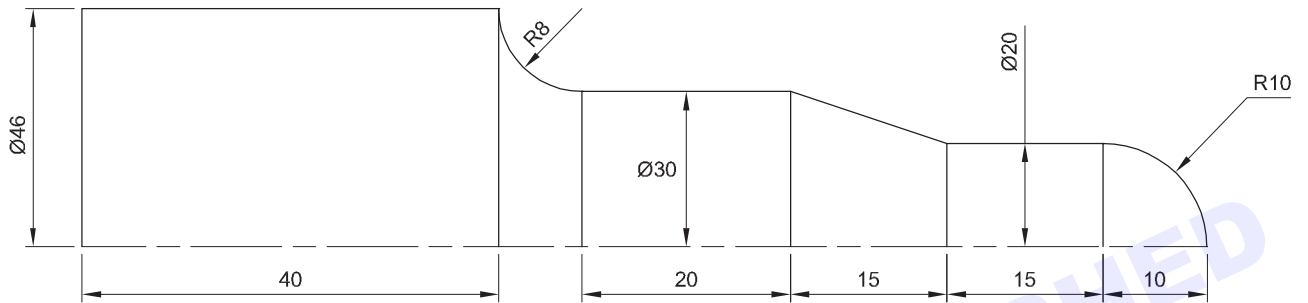
Ask trainees to fill the Table 1. Get it verified by the trainer.

External profile using turning, facing & pattern repeat cycle

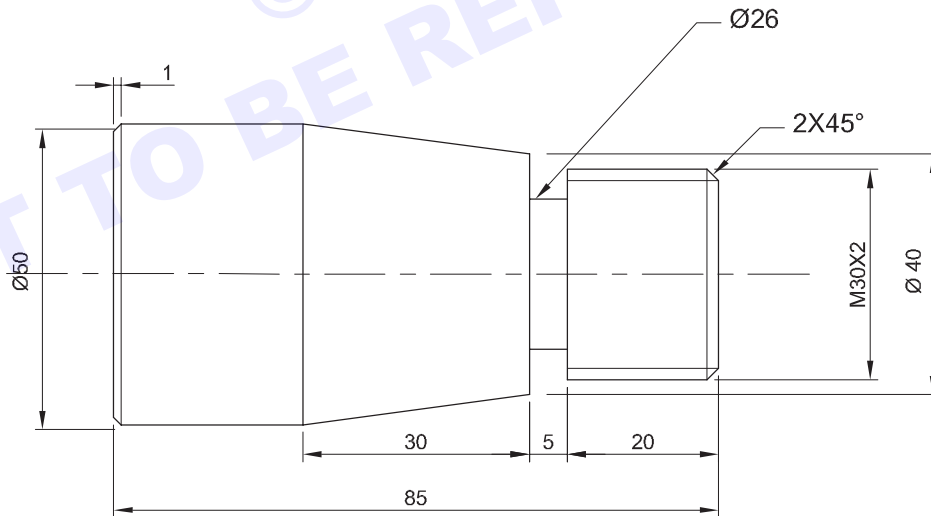
Objectives: At the end of this exercise you shall be able to

- prepare a part programme for given sketch
- simulate the program
- input the part programme into the machine
- run the program in SBL/AUTO mode.

TASK : 1



TASK : 2



2	Ø55 x 90	-	MS ROD	-	-	-
1	Ø100 x 110	-	MS ROD	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					DEVIATIONS	
					TIME :	
					CODE NO. CN20N1672E1	
PROFILE TURNING						

Job Sequence

Program

%

O4133

N10 G21 G40 G90;

N15 G28 U0 W0;

N20 G50 S1500T0101;

N25 G96 S400 M03;

N30 G00 G42 X52 Z5;

N35 G71 U1 R2;

N40 G71 P45 Q75 U1 W1 F0.1;

N45 G01 X0;

N50 Z0.0;

N55 G03 X20 Z-10 R10;

N60 G01 Z-25;

N65 G01 X30 Z-40;

N70 Z-60;

N75 G02 X46 Z-68 R8;

N80 G01 Z-108;

N85 G70 P45 Q80 F0.05;

N90 T0100 M09

N95 G28 U0 W0;

N100 M05;

N105 M30;

- Study the part drawing and list the tools required

- Prepare the CNC program.

- Get it checked by the instructor.
- Check the raw material size and conform with the part drawing,
- Hold the job on chuck by projection 55 mm length for turning.
- Enter the part programme in CNC machine (or) transfer the programme by simulator to CNC machine.
- Set the tool to the required turret station.
- Measure work offset in X and Z direction and enter the work offset page say G54/G55.
- Measure the tool offset in all tools in X and Z direction and enter the tool geometry offset page.
- Enter the tool type and tool nose radius
- Check the work offset and tool offset.

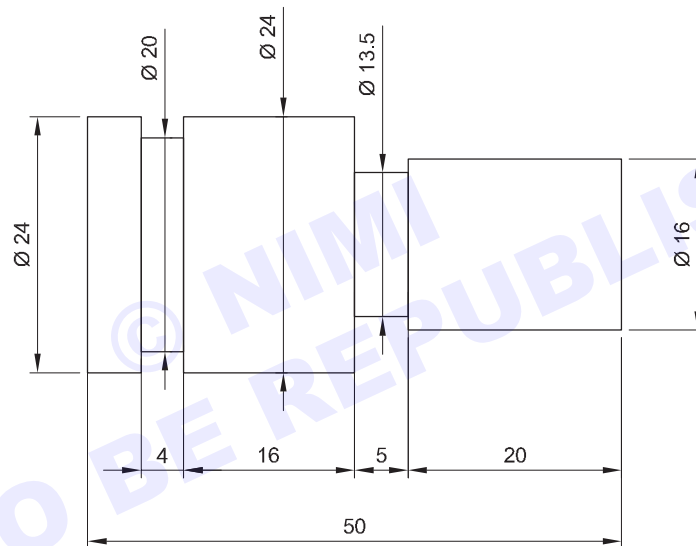
If there is any mistake correct the programme ask your instructor for guidance

- Run the programme in single block by setting the offset away from the work zero
- Observe the spindle direction speed tool position carefully.
- Run the programme in auto mode in original tool and work set.
- Check the dimension. If any correction changes the wear offset and run the programme.
- Check the dimension and surface finish.
- Remove the job from the machine. Check all the dimension once again.
- Switch off the machine.

External grooving and parting off operation

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

- write the part program for OD grooving using canned cycle
- write the part program for parting off using canned cycle
- simulate the program and run the program in CNC turning centre.



1	Ø 25 x 55 mm	-	FE 310	-	-	1.6.73
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		GROOVING AND PARTING OFF			TOLERANCE ± 0.5	TIME :
					CODE NO. CN20N1673E1	

PROCEDURE

TASK 1: Grooving

- Study the part drawing
- Prepare the CNC program
- Hold the job on chuck by projection 60 mm length
- Enter the program
- Take the tool offset
- Simulate the program and check.
- Run the program in AUTO mode
- Take out the work piece and check the dimensions
- Switch OFF the machine.

Program

1st operation

O6325

N1; (TURNING)

G28 U0 W0;

G97 S1200 M03;

T0101;

G00 X30.0 Z5.0 M08;

Z0.0;

G01 X-1 F0.2;

G00 Z5;

X24;

G01 Z-50 F0.2;

G00 X26, Z5;

X20;

G01 Z-25 F0.1;

G00 X26;

G00 Z5

G00X16;

G01 Z-25 F0.1;

G01 X26

G00 Z5 M09

G28 U0 W0;

M05;

M01;

N2 (OD GROOVING with 3mm tool)

G28 U0 W0;

G97 S700 M03;

T0202;

G00 X17.0 Z5.0 M08;

G01 Z-23 F0.1;

G75 R1.0;

G75 X13.5 Z-45 P500 Q2000 F0.08;

G00 X25;

G00 Z5;

G01 Z-44 F0.1

G75 R1.0;

G75 X20 Z-45 P500 Q1000 F0.08;

G00 X50;

Z10 M09;

G28 U0 W0;

M05;

M30;

TASK 2: Parting OFF operation

- Study the part drawing
- Prepare the CNC program
- Hold the job on chuck by projection 60mm length
- Enter the program.
- Take the tool offset
- Simulate the program
- Run the program in AUTO mode.
- Take the part off piece and check the dimension.
- Remove the job and switch off the machine.

Program

2nd operation

N1; (Parting off with 3mm tool)

G28 U0 W0;

G97 S600 M03;

T0303;

G00 X23 Z-5 M08;

G00 Z-53 F0.1;

G75 R1.0;

G75 X-1 Z-53 P500 Q0 F0.08;

G00 X30;

Z10.0 M09;

G28 U0 W0;

M05;

M01;

N3; (Facing)

G28 U0 W0;

G97 S600 M03

T0101;

G00 X30 Z0 M08;

G00 Z-1;

G01 X-1 F0.2;

G00 Z5;

G28 U0 W0;

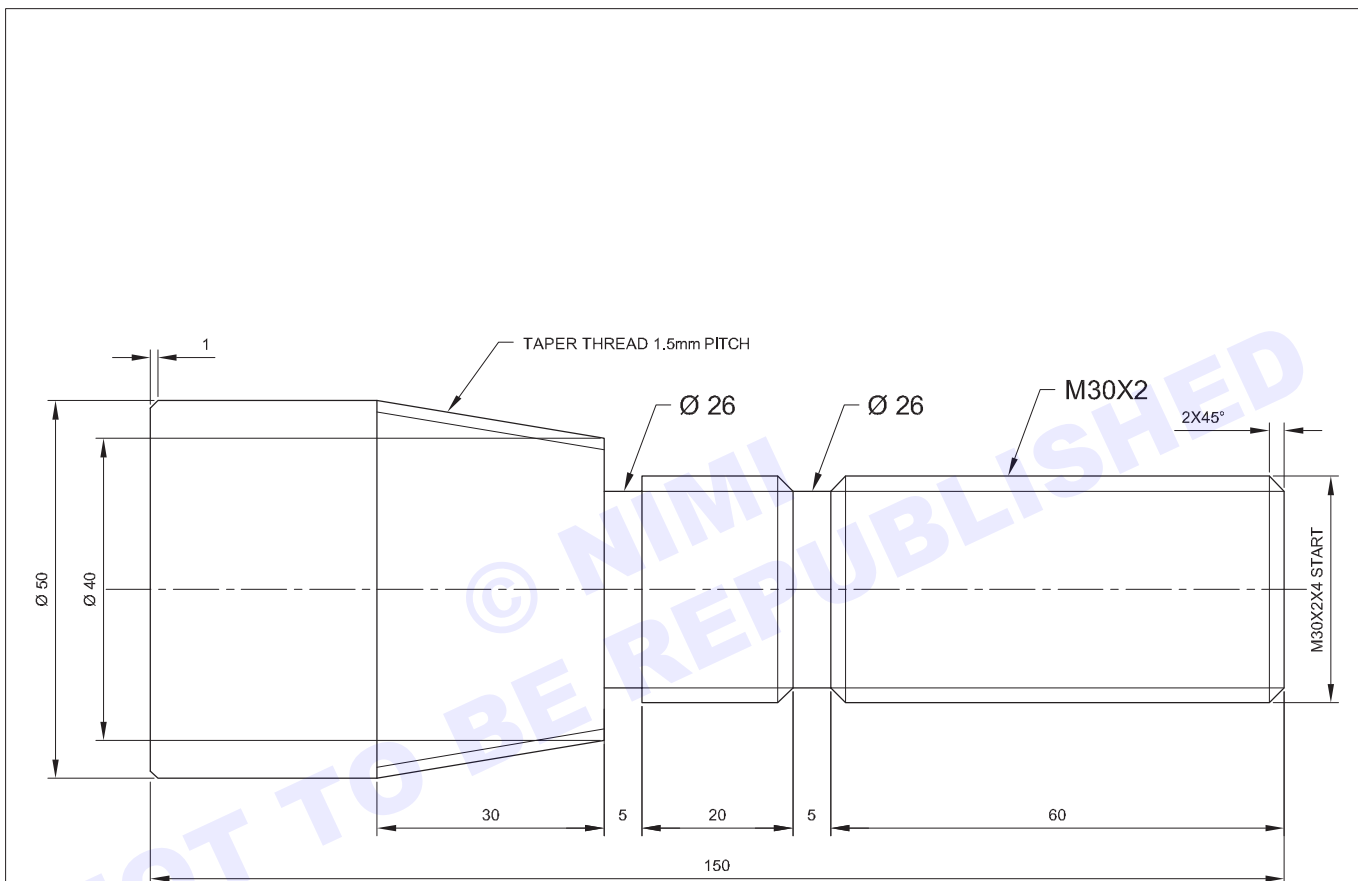
M05;

M30;

Create, simulate, execute external threading (straight, taper and multistart) using canned cycles

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

- prepare a part program
- input the part program into the machine
- simulate the program
- produce the job in SBL/AUTO mode.



1	$\varnothing 55 \times 155\text{mm}$	-	FE 310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		EXTERNAL THREADING (STRAIGHT TAPER AND MULTI START) USING CANNED CYCLE			TOLERANCE \pm	TIME :
					CODE NO. CN20N1674E1	

Job Sequence

- Study the part drawing and list the tools required.
- Prepare the CNC program.
- Get it checked by the instructor.
- Check the raw material size and confirm with part drawing.
- Hold the job on chuck by projection 120mm length in turning.
- Enter the part programme in CNC machine (or) transfer the programme by simulator to CNC machine.
- Set the tool to the required turret station.
- Measure work offset in X and Z direction and enter the work offset page say G54/G55.
- Measure the tool offset in all tools in X and z direction and enter the tool geometry offset page.
- Enter the tool type and tool nose radius.
- Check the work offset and tool offset.
- Run the program in single block by setting the offset away from the work zero.
- Observe spindle direction speed, tool position carefully.
- Run the programme in AUTO mode in original tool and work set.
- Check the dimension and surface finish.
- Remove the job from the machine. Check all dimensions
- Switch OFF the machine.

Program

% (1st operation) facing

O0078

N1;

G28 U0 W0;

G96 S250 M03;

G50 S1500;

T0101;

G00 X65 Z5 M08;

G71 U1 R1;

G71 P10 Q20 U0 W0 F0.1;

N10 G01 X0 F0.1;

Z0;

X58.0;

X60.0 Z-1.0;

N20 G01 Z-120 F0.1;

M09;

G28 U0 W0;

M05;

M01;

M30;

Programme for grooving, threading & taper threading and multi start threading

IInd operation (Step turning)

O126

N1;

G28 U0 W0;

G97 S1200 M03;

T0101

G00 X55 Z5 M08;

G71 U10 R1;

G71 P10 Q20 U0 W0 F0.1;

N10 G01 X0 F0.1;

Z0;

X26.0

X30 Z-2;

Z-90;

X40.0;

X50.0 Z-120;

N20 G01 Z-125 F0.1;

G00 X60 Z5 M09;

G28 U0 W0;

M05;

M01;

N2; (Grooving 3mm)

G28 U0 W0

G27 S600 M03

T0303

G00 X31.0 Z5 M08;

G01 Z-63 M08

G75 R1.0;

G75 X26 Z-65 P600 Q2000 F0.08;

G00 X60;

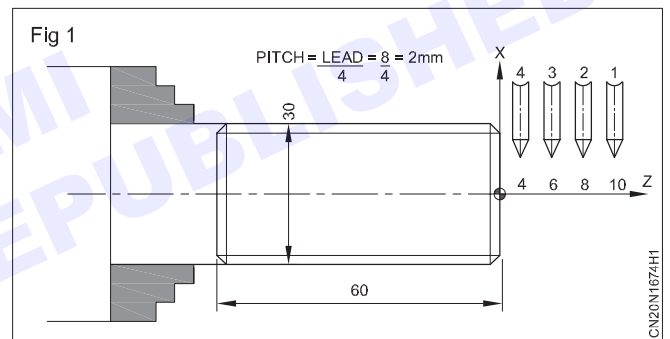
G00 Z-88;

G75 R1.0;

G75 X26.0 Z-90 P600 Q2000 F0.08;

G00 X60;
 Z10 M09;
 G28 U0 W0;
 M05;
 M01;
 N3 : (External threading)
 G28 U0 W0;
 G97 S600 M04;
 T0505;
 G00 X31.0 Z-65 M08;
 G01 Z-61 F0.1;
 G76 P030060 Q20 R0.02;
 G76 X27.42 Z-85 P13000 Q300 F2.0;
 G00 X60.0;
 G01 Z-81 F0.1;
 G76 P030060 Q20 R0.02;
 G76 X38.58 Z-123 P097 Q200 R-5.5 F1.5;
 G00 X60 Z5 M09;
 G28 U0 W0;
 M05;
 M01;
 N4; (multi start thread)
 G28 U0 W0
 G97 S600 M04;
 T0505;

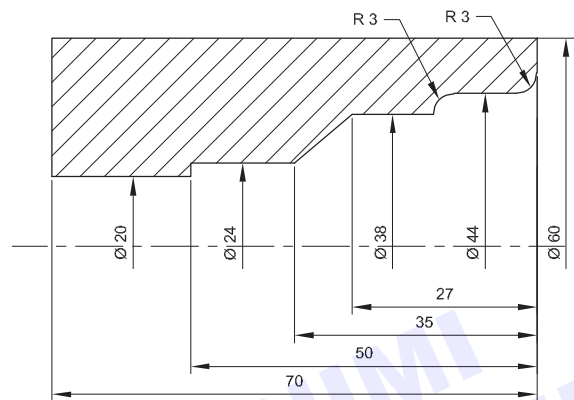
G00 X32 Z10;
 G76 P020060 Q150 R50;
 G76 X27.44 Z-60 P1280 Q400 F8.0;
 G00 X32.Z8;
 G76 P020060 Q150 R50;
 G76 X27.44 Z-60 P1280 Q400 F8.0;
 G00 X32 Z6;
 G76 P020060 Q150 R50;
 G76 X27.44 Z-60 P1280 Q400 F8.0;
 G00 X32 Z4;
 G76 P020060 Q150 R50;
 G76 X27.44 Z-60 P1280 Q400 F8.0;
 G00 X60 Z5 M09;
 G28 U0 W0
 M05
 M01
 M30;



Prepare the part program using TNRC G41 (left)

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

- write the part program for the given drawing
- execute the program in CNC turning centre.



Job Sequence

- Study the drawing.
- Prepare a part program
- Edit the program in CNC turning centre.
- Simulate the program and check.
- Select the required tools and fix in the turret
- Take tool offset for all tools and enter the values.
- Execute the program in automode
- Verify the dimensions if any variation in dimension correct it by wear offset method.
- Remove the workpiece and clean it.
- Switch off the machine.

1	Ø60 x 75mm	-	FE310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	PREPARE THE PART PROGRAM USING TNRC LEFT				TOLERANCE ±	TIME :
					CODE NO. CN20N1675E1	

Program

0716;
G40;
G18 G90 G21 G99 G97 G54;
T0101 S1000 M04; (Turning tool)
G42;
G00 X70 Z0;
G01 X-1 Z0 F0.1;
G00 Z5;
G00 X60 Z5
G01 X60 Z-70.F0.2;
G00 X65;
M05;
M01;
G28 U0 W0;
T0303 S800 M03; (DRILL DIA 18mm)
G40;
G00 X0 Z50;
G90 G98;
G74 R1000;
G74 Z-75 Q 20000 F0.2
G00 Z50;
M05;
M01;
T0606 S800 M04; (BORING TOOL)

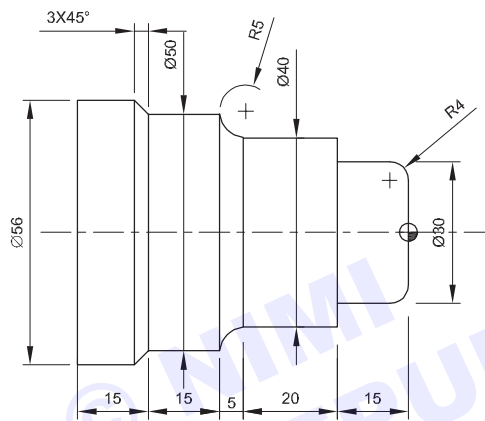
G41;
G00 X16 Z50;
G71 U1 R1;
G71 P20 Q30 U-0.5 W 0.5 F 0.1;
N20 G01 X51 Z0;
G02 X44 Z-3 I10 K-3;
G01 X44 Z-12;
G03 X38 Z-15 I-3 K0;
G01 X38 Z-33;
G01 X24 Z-35;
G01 Z-50;
G01 X20 Z-50;
N30 G01 X20 Z-70;
G00 X100 Z100 M05;
G28 U0 W0
T0505; (Finishing tool)
S 1500 M04;
G70 P20 Q28 F0.5
G00 X100 Z100 M05;
G40;
G28 U0 W0;
M05
M30

— — — — —

Programming using TNRC right & cancel

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

- write the part program for given job
- simulate the program
- execute the program in auto mode.



1	Ø60 x 75mm	-	FE310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	TOOL NOSE RADIUS COMPENSATION RIGHT & CANCEL				TOLERANCE ±	TIME :
					CODE NO. CN20N1676E1	

Job Sequence

- Study the given drawing.
- Write the part program using tool nose radius compensation
- Select the suitable tool.
- Take tool offset and input the values.
- Simulate the program.
- Run the program in AUTO mode.
- Remove the workpiece and check the dimensions
- Switch OFF the machine.

Program

O0284

G21 G90 G95 G55

G28 U0 W0

T0101;

G97 S1500 M03;

G40;

G00 X65.0 Z5.0 M08;

G01 Z2.0 F0.1;

G71 U1.0 R1.0;

G71 P10 Q20 U0.0 W0.0 F0.1;

N10 G01 X0.0 F0.1;

G01 Z0.0;

G01 G42 x 22.0 ;

G03 X30.0 Z- 4.0 R4 F0.1;

G01 Z-15.0 F0.1;

X40.0;

Z-35.0;

G02 X50.0 Z - 40 R5 F0.1;

G01 Z-55.0 F0.1;

X56.0 Z-58.0 ;

N20 G01 G40 Z-70.0 F0.1;

G40;

G00 X65.0 Z5.0 M09;

G28 U0 W0;

M05;

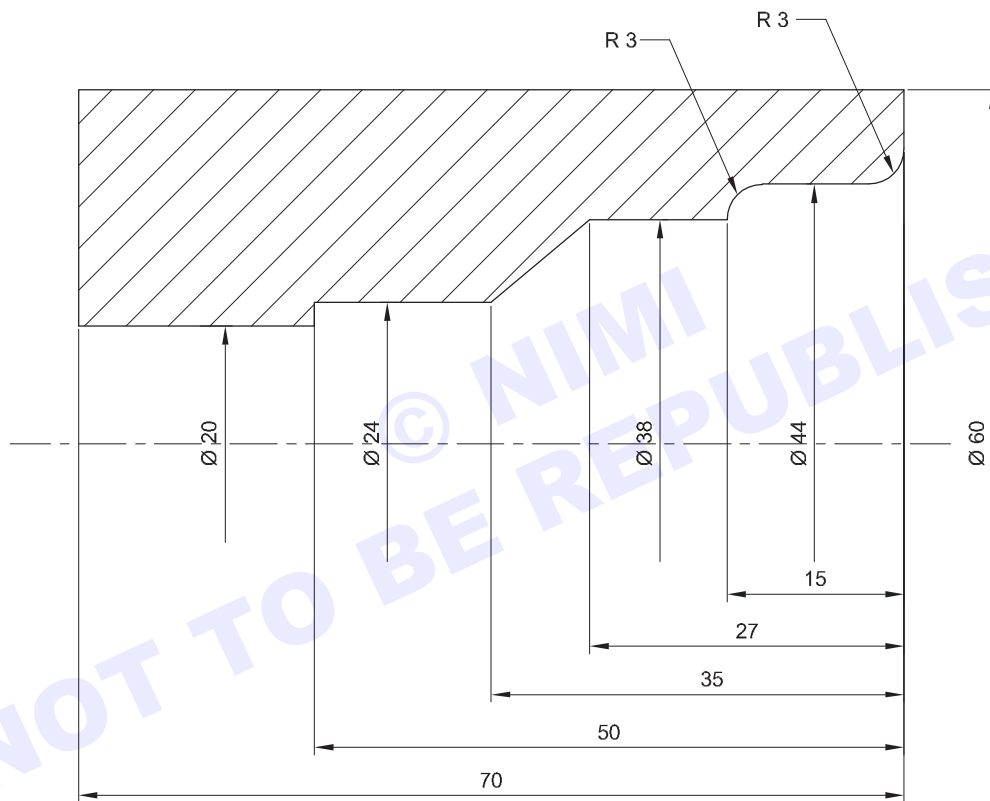
M30;

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Internal profile turning using canned cycle

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

- prepare the CNC program using drilling cycle
- prepare the program using boring operation with stock removal cycles
- verify the program
- execute the program in auto mode check the dimensions.



1	PRE MACHINED Ø 60 X 70	-	Fe310	-	--	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		INTERNAL OPERATION			DEVIATIONS	TIME :
					CODE NO. CN20N1678E1	

Job Sequence

Prepare the CNC program in FANUC control

- Write program for facing and turning to a diameter 60 mm to a length of 70mm
- Write program for drilling (slot drill/ U drill) dia18mm to a length of 70 mm using G83 cycle
- Write the program for roughing internal stock removal using cycle G71
- Write the program for finishing internal stock removal using cycle G71
- Verify the program in simulator
- Transfer the program to machine/enter the program manually and verify by machine simulation
- Set the tool in turret as per the program
- Set the work piece in chuck projecting 75 mm
- Measure work offset and tool offset enter in relevant area
- Verify the tool offset and work offset
- Verify the program on machine by shifting work offset in single block mode
- Reset the work offset
- Execute the program in auto mode
- Verify the dimensions, if any variation in dimension correct it by wear offset method
- Remove the work piece and clean the machine
- Sample Fanuc program is provided

Note: Trainees should develop the same part program in siemens control and get it verified by your instructor.

Program in Fanuc

01234; (FANUC -B -G CODE)

N1 G80 G40;

N2 G18 G90 G21 GS4 G99 G97;

N3 T0101 S1000 M04; (TURNING TOOL)

N4 G00 X70.00 Z0.0;

N5 G01 X-0.1 Z0.0 F0.1;

N6 G00 X-1.0 ZS.0;

N7 G00 X60 ZS.0;

N8 G01 X60 Z-70.0;

N9 G01 X65 Z-70.0;

N10 M05

N11 G28 U0.0 W0.0 T0100;

N12 T0303 S800 M03; (SLOT DRILL DIA 18mm)

N13 G00 X0.0 Z50.0;

N14 G90 G98 G83 X0.0 Z-75.0 R5.0 Q10.0 P100 F0.1;

N15 G28 U0.0 W0.0 M05 T0300;

N16 T0606 S800 M04; (BORING TOOL)

N17 G00 X16.0 Z50.0;

N18 G71 U1.0 R1.0;

N19 P20 Q28 U-0.5 W0.5 F0.1;

N20 G01 X51.0 Z0.0;

N21 G02 X44.0 Z-3.0 10.0 K-3.0;

N22 G01 X44.0 Z-12.0;

N23 G03 X38.0 Z-15.0 R3.0;

N24 G01 X38.0 Z-33.0;

N25 G01 X24.0 Z-35.0;

N26 G01 X24.0 Z-50;

N27 G01 X20.0 Z-50.0;

N28 G00 X20.0 Z-70.0;

N29 G00 X100 Z100 M05

N30 G28 U0.0 W0.0 T0600;

N31 T0505; (FINISHING TOOL)

N32 S1500 M04;

N33 G70 P20 Q 28 F0.5;

N34 G00 X100 Z100 M05;

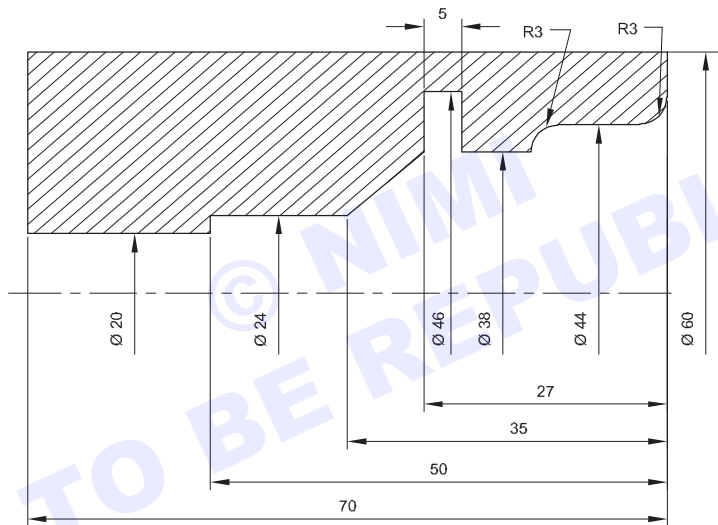
N35 G28 U0.0 W0.0 T0500;

N36 M30;

Create, simulate and execute operations of internal groove using a canned cycle

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

- write a program for internal grooving
- set the necessary tools
- produce the job in SBL/AUTO mode.



1	EX NO: 1.6.78	--	Fe310	-	--	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	INTERNAL OPERATION				TOLERANCE	TIME :
					CODE NO. CN20N1679E1	

Job Sequence

- Study the part drawing G92 S2000 M03
- Prepare the CNC part program G96 S150 M08;
- Get it checked by the trainer G41;
- check the material size and confirm with part drawing G00 X65 Z10;
- Enter the part program G00 X33
- Set the internal grooving tool Z0;
- Take tool offset and enter the values. G01 Z-20 F0.5;
- Simulate the programme and check. G01 Z-22 F0.1;
- Run the program in SBL/AUTO mode. G75 R1.0
- Check the dimensions G75 X46 Z-27 P400 F0.08;
- Switch OFF the machine. G00 X33;

Program

% G28 U0 W0;
O9448 (3mm Grooving tool) M05
G21 G40 G90; M01
G40; M30
G28 U0 W0;
T0101;

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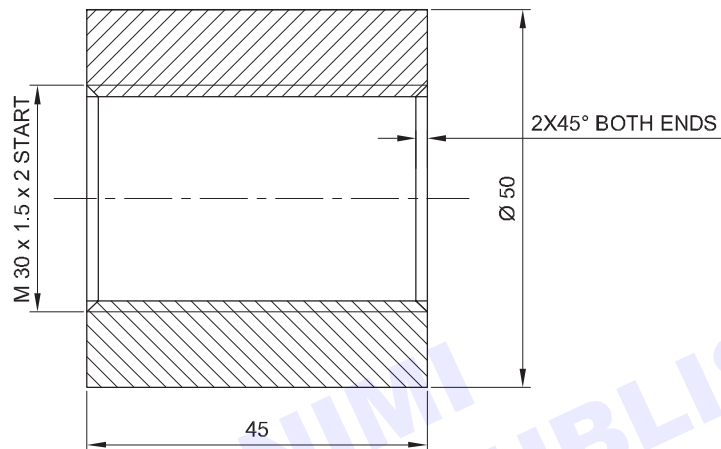
Internal threading (straight, taper and multistart) using canned cycles

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

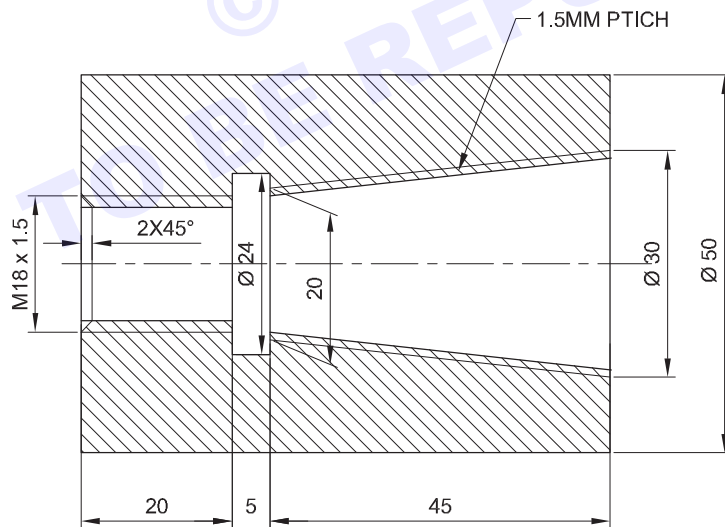
- create the part program
- simulate the program
- run the machine in SBL/AUTO mode.

PROCEDURE

TASK -1



TASK -2



2	Ø 55 x 75 mm	-	FE 310	-	TASK - 2	
1	Ø 55 x 50 mm	-	FE 310	-	TASK - 1	1.6.80
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		INTERNAL THREADING			TOLERANCE : ±0.02mm	TIME :
					CODE NO. CN20N1671E1	

TASK 1: Internal (Multistart) threading

- Study the given drawing.
- Prepare part program for facing, OD turning, center drilling, drilling, boring and multi start threading.
- Input the program in CNC turning centre.
- Take the tool offsets.
- Simulate the program and check.
- Run the program in SBL/AUTO mode.
- Clean and check the workpiece.
- Switch OFF the machine

Program

```
O4260;
N1; (facing & OD turning I OPN)
G28 U.0 W0.0;
G97 S1000 M04;
T0101;
M08;
G00 X60 Z10.0;
G00 Z0.0;
G01 X-2.0 F0.20;
G00 Z5.0;
G00 X58.0;
G00 Z2.0;
G01 Z-30.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X56.0;
G01 Z-30.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X55.0;
G01 Z-30.0 F0.20;
G00 X60.0;
G00 Z5.0;
G28 U0.0 W0.0;
M09;
M05;
M01;
N2; (facing & OD turning II OPN)
G28 U0.0 W0.0;
G97 S1000 M04;
T01 01;
M08;
G00 X60.0 Z10.0;
G00 Z3.0;
G01 X-2.0 F0.15;
G00 Z5.0;
G00 X60.0;
G00 Z1.0;
G01 X-2.0 F0.15;
G00 Z2.0;
G00 X60.0;
G00 Z0.0;
G01 X-2.0 F0.20;
G00 Z5.0;
G00 X58.0;
G00 Z2.0;
G01 Z-25.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X56.0;
G01 Z-25.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X55.0;
G01 Z-25.0 F0.20;
G00 X60.0;
G00 Z5.0;
G28 U0.0 W0.0;
M05;
M09;
M01;
N3; (center drilling)
G28 U0.0 W0.0;
T0202;
G97 S1000 M04;
G00 X0.0 Z5.0;
M08;
G01 Z-8.0 F0.1;
G00 Z5.0;
M09;
```

M05;
 G28 U.0 W0.0;
 M01;
 N4; (drilling with 25mm drill)
 G28 U.0 W0.0;
 T0303;
 G97 S1500 M04;
 G00 X0.0 Z5.0;
 M08;
 G74 R5.0;
 G74 Z-45.0 Q5000 F0.08;
 G01 Z2.0 F2.0;
 G00 Z20.0;
 G28 U.0 W0.0;
 M05;
 M09;
 M01;
 N5; (Boring)
 G28 U.0 W0.0;
 T0404;
 G97 S1200 M04;
 M08;
 G00 X32.0 Z5.0;
 G00 Z1.0;
 G01 Z0.0 F0.15;
 G01 X28.158 Z-2.0 F0.15;
 G01 Z-45.0 F0.15;
 G01 X26.0 F0.20;
 G01 Z2.0 F2.0;
 G00 Z10.0;
 G00 X60.0;
 G28 U.0 W0.0;
 M05;
 M09;

M01;
 N6; (Double start thread cutting)
 G28 U0.0 W0.0;
 T0505;
 G97 S1000 M04;
 M08;
 G00 X26.0 Z3.0; 1st start position
 G76 P030060 Q100 R0.1;
 G76 X30.0 Z-45.0 P921 Q200 F3.0;
 G00 X26.0;
 G01 Z4.5 F0.5; 2nd start position
 G76 P030060 Q100 R0.1;
 G76 X30.0 Z-45.0 P921 Q200 F3.0; LEAD = F=3.0
 G00 X26.0;
 G01 Z5.0 F0.5;
 M09;
 M05;
 G28 U.0 W0.0;
 M30;
Calculation
 $M30 \times 1.5 \times 2\text{START}$
 Pitch = 1.5 mm
 Single start = Lead = pitch
 Two start = Lead = pitch x No.of start
 $= 1.5 \times 2$
 $F = 3.0$
 Thread depth = $0.6143 \times \text{pitch}$
 $= 0.6143 \times 1.5$
 $= 0.921$
 Minor $\phi = \text{Major } \phi - 2 \times \text{thread depth}$
 $= 30 - 2(0.921)$
 $= 30 - 1.842$
 Minor $\phi = 28.158$
 Bore ϕ size = $\phi 28.158$

TASK 2: Internal taper threading (STRAIGHT, TAPER THREADING)

- Study the given drawing.
- Prepare part program for facing, OD turning, center drilling, drilling, boring, grooving, taper boring and taper threading.
- Input the programme in CNC turning centre.
- Simulate the program and check.
- Set the tool offsets.
- Run the program in SBL/AUTO mode.
- Clean and check the workpiece.
- Switch OFF the machine

Program

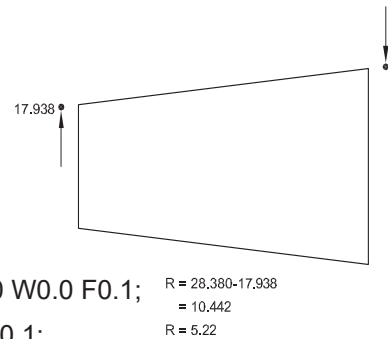
O04261;
N1; (facing & OD turning) (setup I)
G28 U0.0 W0.0;
G97 S1000 M04;
M08;
T0101;
G00 X60.0 Z10.0;
G00 Z0.0;
G01 X-2.0 F0.20;
G00 Z5.0;
G00 X58.0;
G00 Z2.0;
G01 Z-30.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X56.0;
G01 Z-30.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X55.0;
G01 Z-30.0 F0.20;
G00 X60.0;
G00 Z5.0;
G28 U0.0 W0.0;
M05;
M09;
M01;
N2; (facing & OD turning) (setup II)
G28 U0.0 W0.0;
G97 S1000 M04;
T0101;
M08;
G00 X60.0 Z10.0;
G00 Z3.0;
G01 X-2.0 F0.15;
G00 Z5.0;
G00 X60.0;
G00 Z1.0;
G01 X-2.0 F0.15;
G00 Z2.0;
G00 X60.0;
G00 Z0.0;

G01 X-2.0 F0.20;
G00 Z5.0;
G00 X58.0;
G00 Z2.0;
G01 Z-45.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X56.0;
G01 Z-45.0 F0.20;
G00 X60.0;
G00 Z2.0;
G00 X55.0;
G00 Z-45.0 F0.20;
G00 X60.0;
G00 Z5.0;
G28 U0.0 W0.0;
M05;
M09;
M01;
N3 (center drilling)
G28 U0.0 W0.0;
T0202;
G97 S1000 M04;
G00 X100.0 Z50.0;
G00 X0.0 Z5.0;
M08;
G01 Z-8.0 F0.1;
G00 Z5.0;
M09;
M05;
G28 U0.0 W0.0;
M01;
N4; (drilling ϕ 15)
G28 U0.0 W0.0;
T0303;
G97 S1500 M04;
G00 X100.0 Z50.0;
G00 X0.0 Z5.0;
M08;
G74 R5.0;
G74 Z-75.0 Q5000 F0.08;
G01 Z2.0 F1.0;
G00 Z20.0;

G28 U0.0 W0.0;
 M05;
 M09;
 M01;
 N5; (boring opn)
 G28 U0.0 W0.0;
 T0404;
 G97 S1300 M04;
 M08;
 G00 X18.0 Z5.0;
 G00 Z2.0;
 G01 Z0.0 F0.20;
 G01 X16.158 Z-2.0 F0.20;
 G01 Z-72.0 F0.10;
 G01 X14.0 F0.25;
 G00 Z2.0;
 G00 X60.0 Z10.0;
 G28 U0.0 W0.0;
 M05;
 M09;
 M01;
 N6; (ID Grooving) (5mm WIDTH TOOL)
 G28 U0.0 W0.0;
 T0505;
 G97 S800 M04;
 M08;
 G00 X15.0 Z10.0;
 G00 Z2.0;
 G75 R1.0;
 G75 X24.0 Z-25.0 P400 F0.05;
 G00 X15.0;
 G00 Z2.0;
 M05;
 M09;
 G28 U0.0 W0.0;
 M01;
 N7; (M18 X 1.5 STRAIGHT Threading)
 G28 U0.0 W0.0;
 T0606;
 G97 S1000 M04;
 M08;
 G00 X20.0 Z10.0;
 G00 Z2.0;

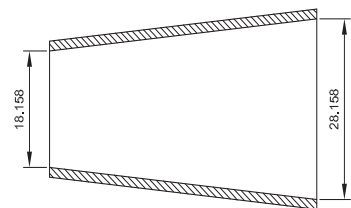
G01 X15.0 Z2.0 F0.20;
 G76 P030060 Q100 R0.05;
 G76 X18.0 Z-22.0 P921 Q200 F1.5;
 G01 X15.0 Z2.0;
 G28 U0.0 W0.0;
 M05;
 M09;
 M01;
 N8; (Taper boring) - III operation setup

G28 U0.0 W0.0;
 T0808;
 G97 S1000 M04;
 M08;
 G00 X17.0 Z2.0;
 G71 U1.0 R0.5;
 G71 P100 Q200 U0.0 W0.0 F0.1;
 N100 G01 X28.158 F0.1;
 G01 Z0.0 F0.1;
 G01 X18.158 Z-45.0 F0.1;



G00 X17.0;
 N200 G00 Z2.0;
 G28 U0.0 W0.0;
 M09;
 M05;
 M01;
 N9; (Taper threading) - III operation (setup)

G28 U0.0 W0.0;
 T0707;
 G97 S1200 M04;
 M08;
 G00 X28.38 Z2.0;
 G76 P030060 Q100 R0.05;
 G76 X17.939 Z-47.0 P921 Q200 R5.22 F1.5;
 G01 Z2.0;
 G28 U0.0 W0.0;



M05;
 M09;
 M30;

Format

G76 P Q R;

G76 X_Z_P_R_F_;

R - Taper value = R(-) External taper thread

= R(+) Internal taper thread

Computer aided manufacturing software and its industrial application

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

- record the computer aided manufacturing software's used in industries
- record the computer aided manufacturing software application in various industries.

S. No.	CAM software names	CAM software application
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Job Sequence

The instructor shall demonstrate the trainers to recognize the CAM software and its application in various industries and ask them to record in Table 1.

- Trainees will note down the application of CAM software.
- Record it in Table 1
- Get it checked by the instructor.

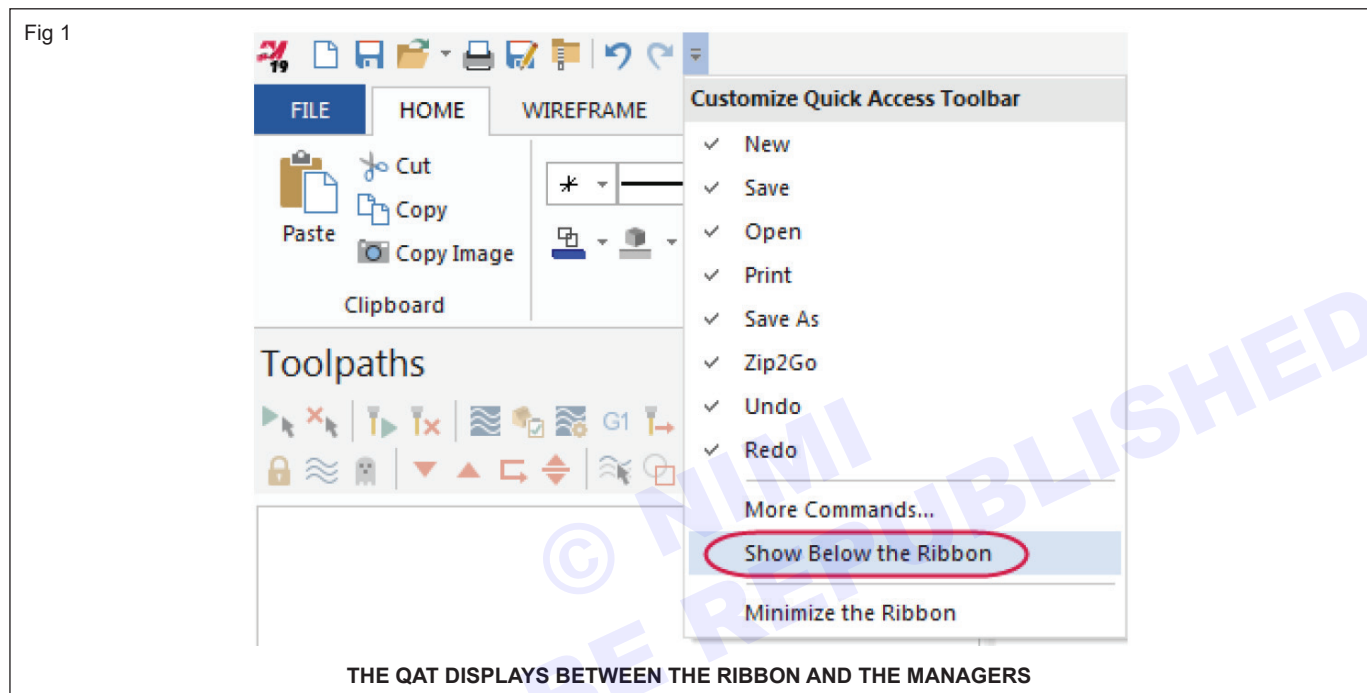
Customize the quick access tool bar

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

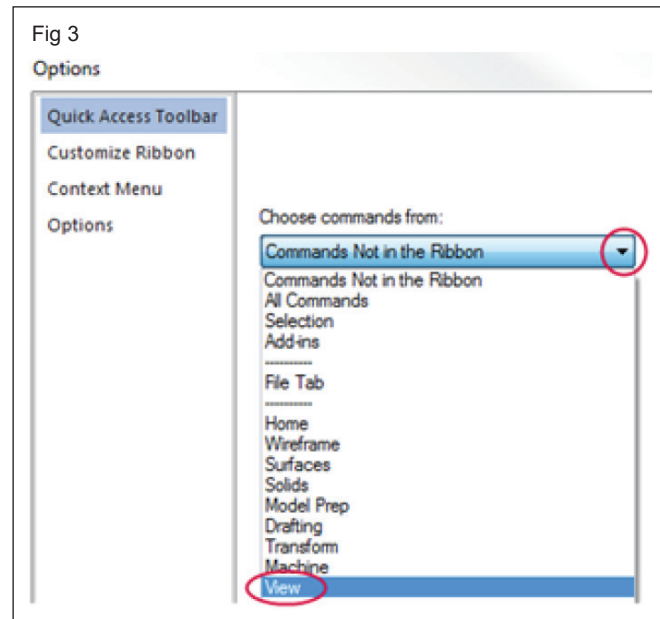
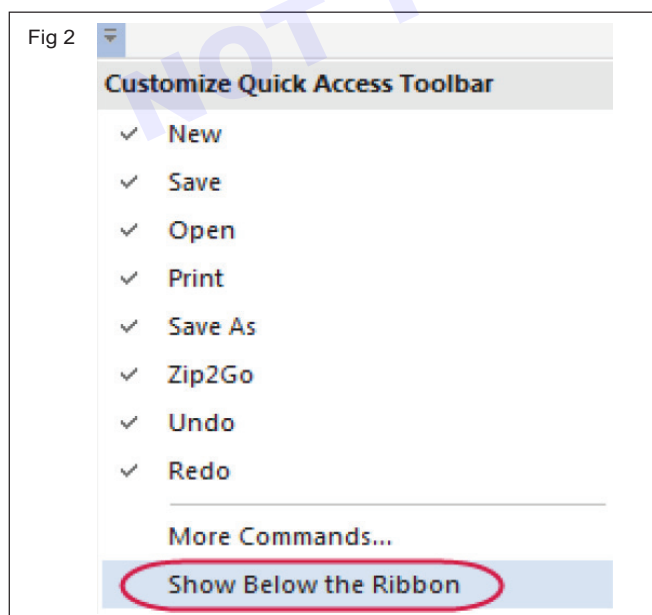
- customize the quick access tool bar in CAM software.

PROCEDURE

- 1 Switch on the computer and wait few seconds.
- 2 Double-clicking mastercam's desktop icon.
- 3 Take a few moments to explore mastercam's interface
- 4 Click the QAT drop-down, and select show in (Fig 1) below the ribbon.



- 5 Click the QAT drop-down again, and select more Command (Fig 2)
- 6 On the quick access toolbar page, select view from the Choose commands from drop-down. (Fig 3)

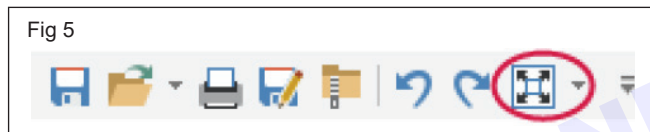
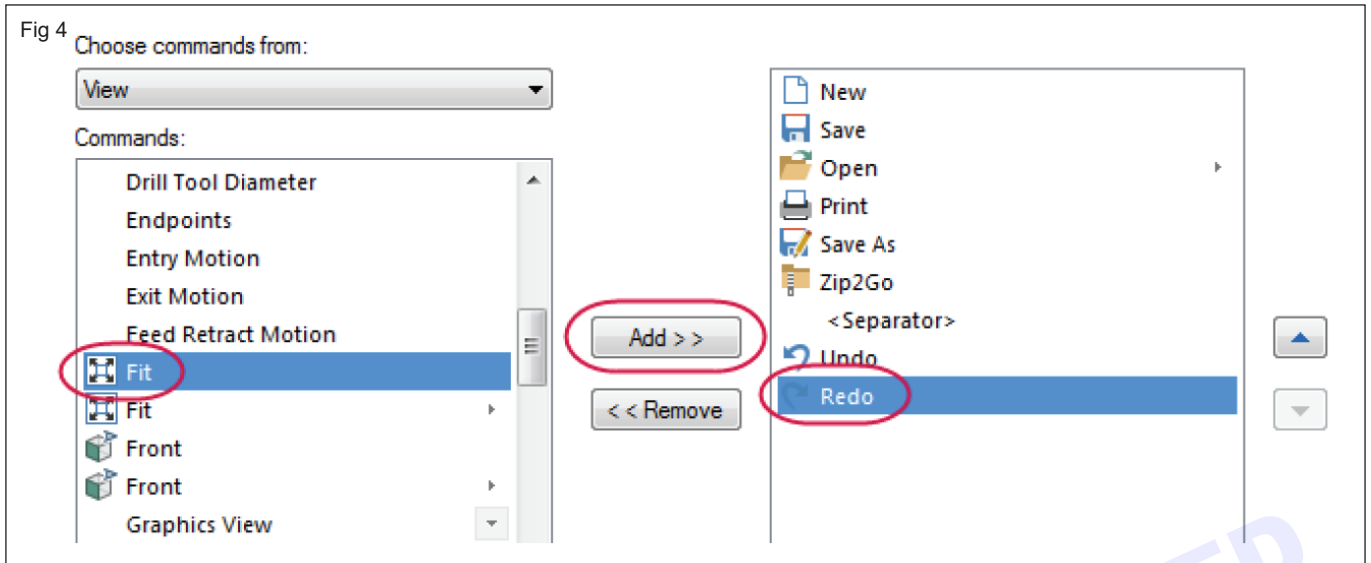


The options dialog box opens

7 Select Fit in the commands list, and then click Add. The command appears at or below the selected command in the right-hand pane. (Fig 4)

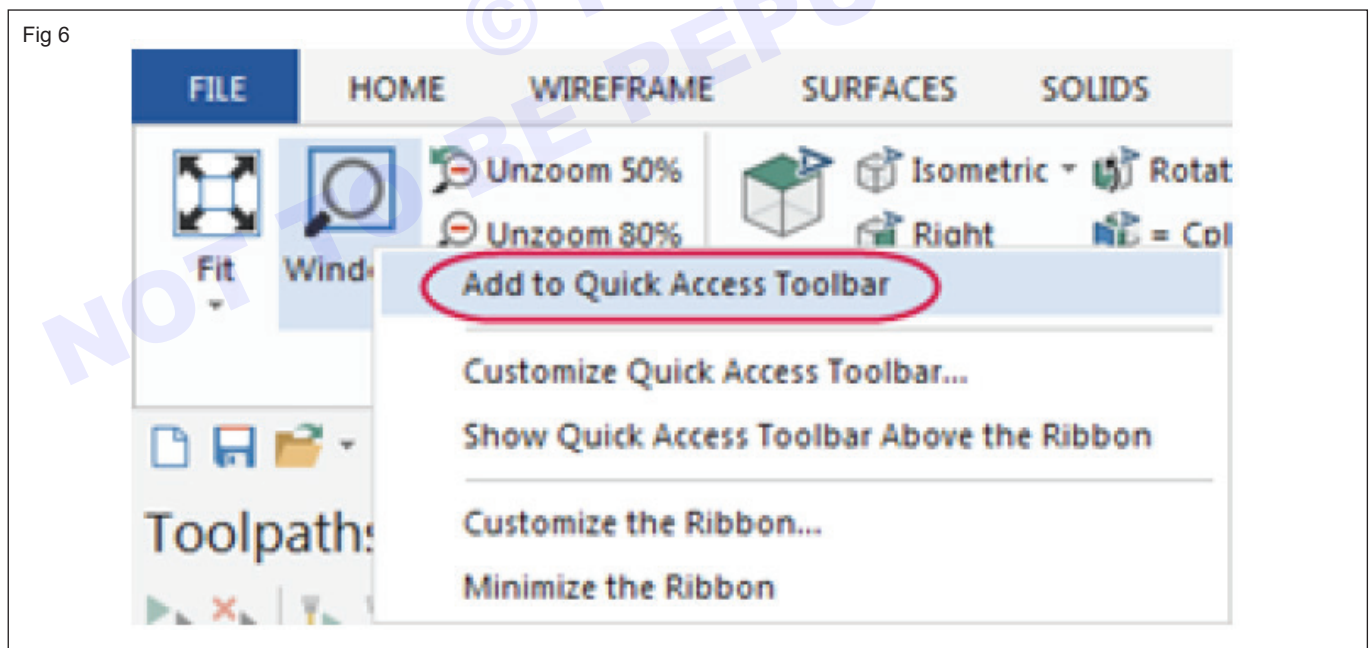
8 Click OK, and the Fit command shows in the QAT. (Fig 5)

Note: That to make items easier to find, the commands list is in alphabetical order.



9 Alternatively, you can add any command in the ribbon to the QAT by right-clicking the command in the ribbon and selecting Add to Quick Access toolbar. (Fig 6)

10 Return the QAT to its placement above the ribbon.



Customize the ribbon

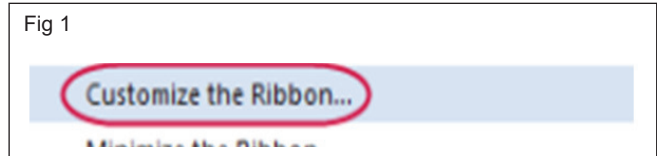
Objectives: At the end of this exercise you shall be able to

- create a new tab
- add several functions, and change the tab's position on the ribbon.

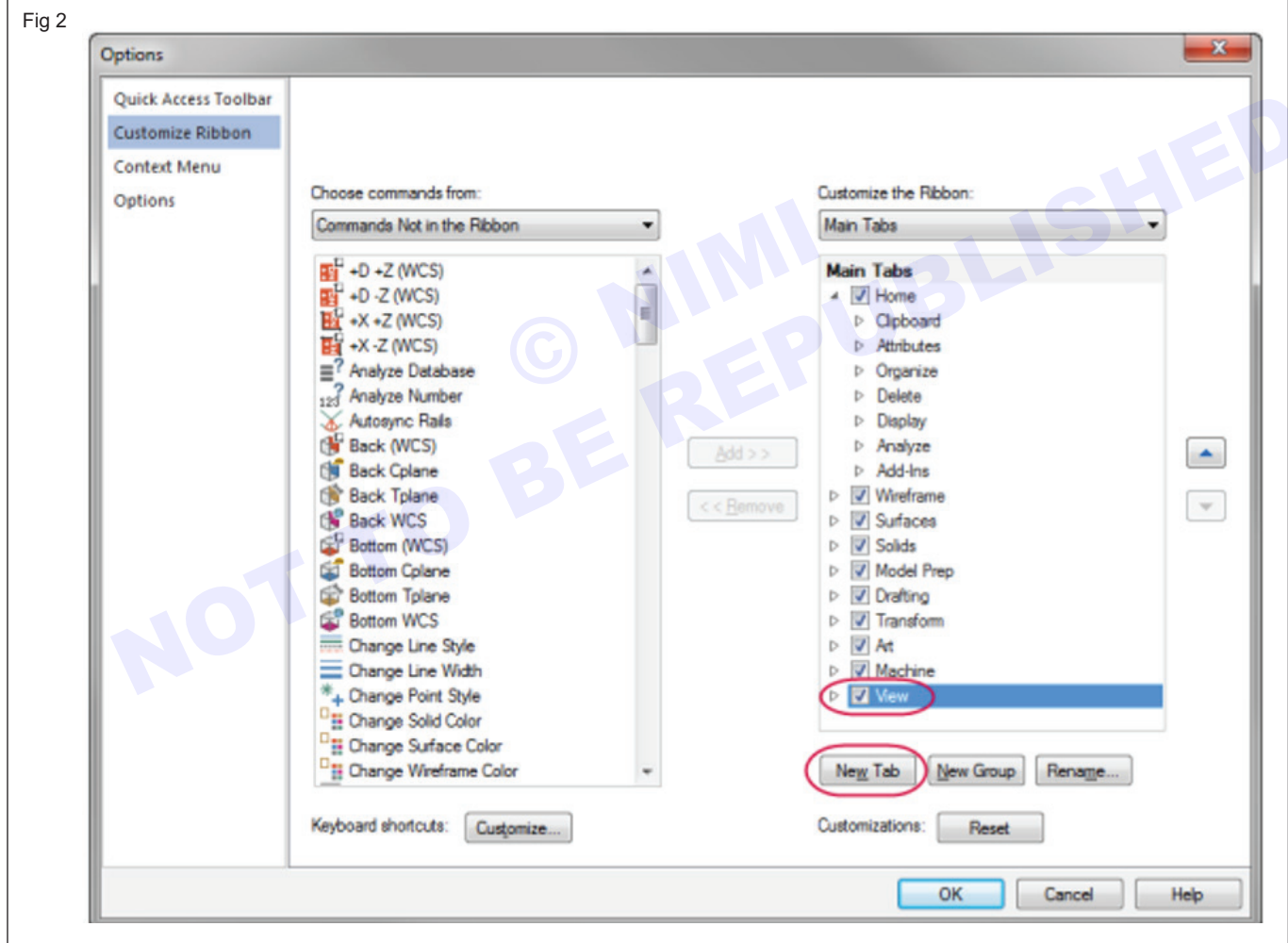
PROCEDURE

- 1 Switch on the computer, and wait few seconds
- 2 Double-clicking Mastercam's desktop icon
- 3 Take a few moments to explore mastercam's interface
- 4 Right-click the ribbon, and select Customize the Ribbon. (Fig 1)

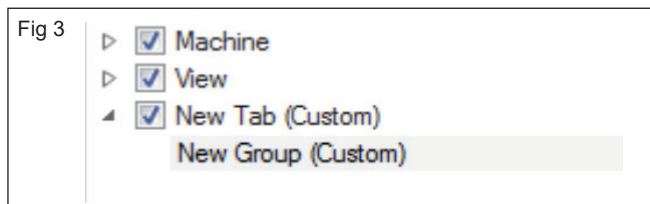
The options dialog box opens.



- 5 Select the view tab in the customize the ribbon list, following illustration. (Fig 2)

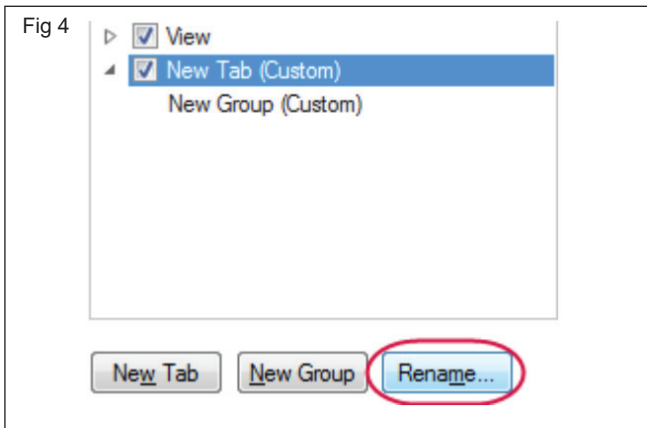


- 6 Click New Tab. The New Tab (Custom) and New Group (Custom) appear in the main tabs list. (Fig 3)



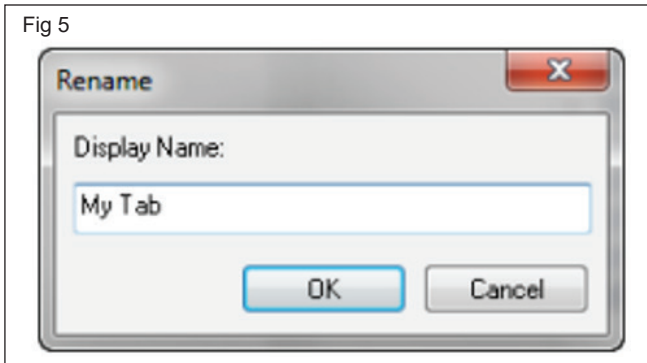
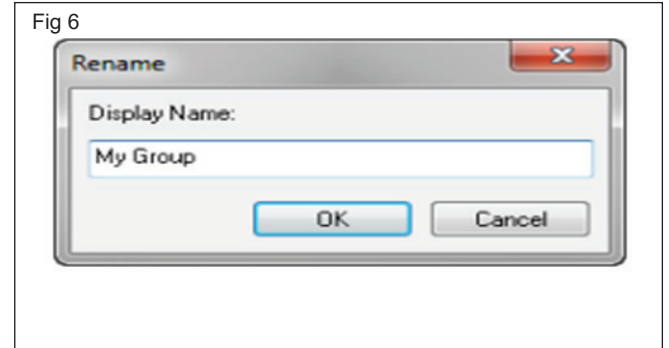
- 7 Select New Tab (Custom) and then click Rename. alternatively, you can right-click New Tab (Custom) and select Rename from the context menu. (Fig 4)

- 8 Enter my tab for the display name and click OK. (Fig 5)



9 Select new group (Custom) in the list of tabs and click Rename.

10 Enter my group for the display name and click OK. (Fig 6)



11 Select Pan from the Commands not in the Ribbon list, and then click Add. (Fig 7)

12 The command is added to My group (Custom). (Fig 8)

13 Select zoom target from the Commands not in the Ribbon list, and then click Add. (Fig 9)

14 Select My Tab (Custom), and use the up arrow button to position the tab below the Home tab. (Fig 10)

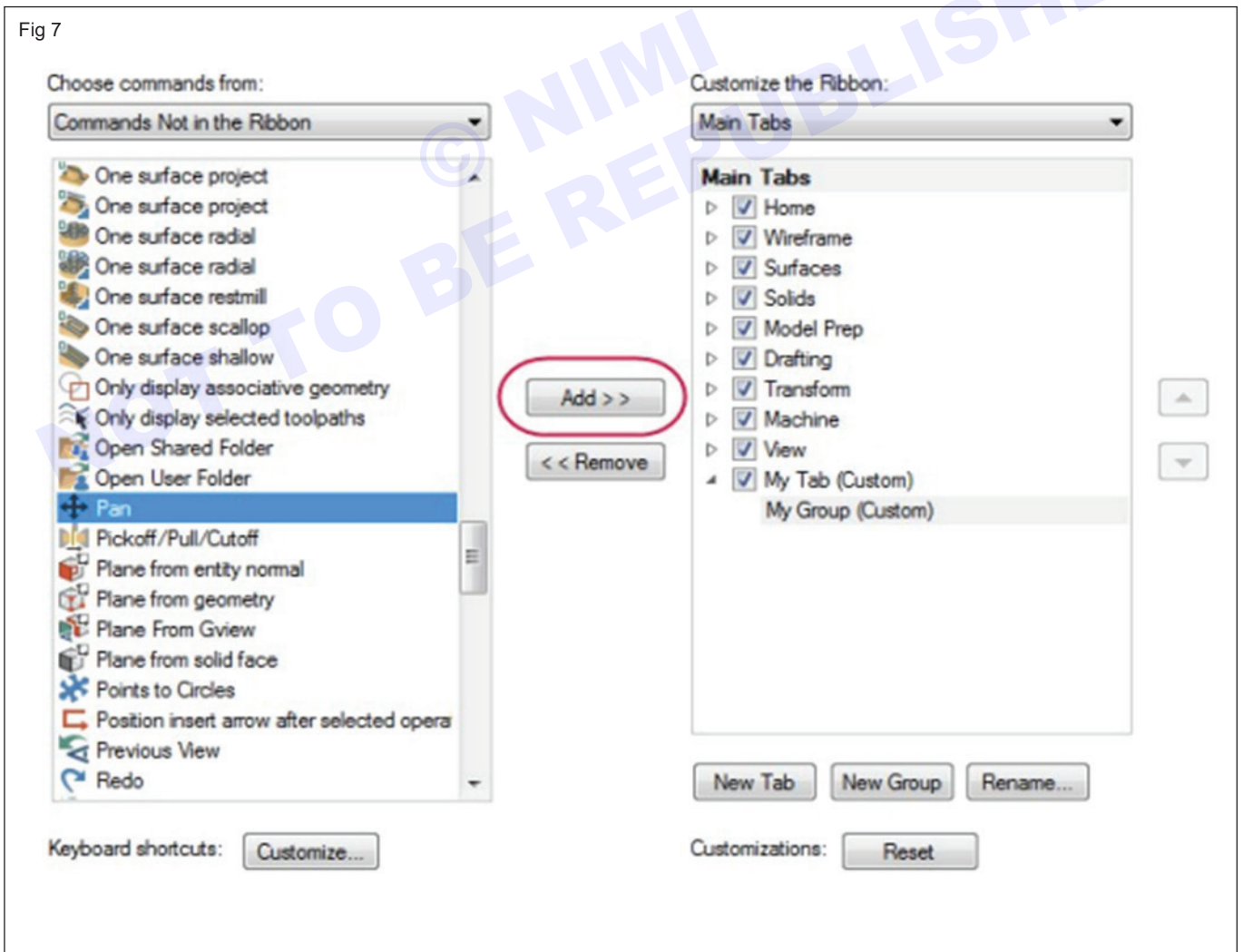


Fig 8

The command is added to My Group (Custom).

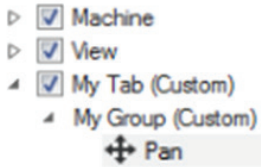
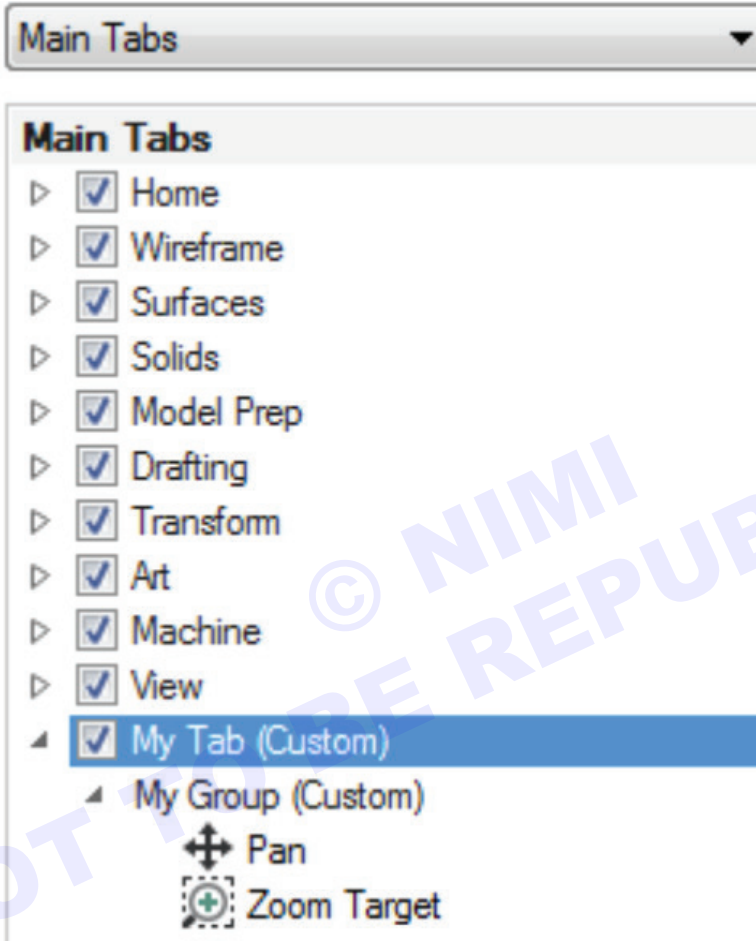


Fig 9



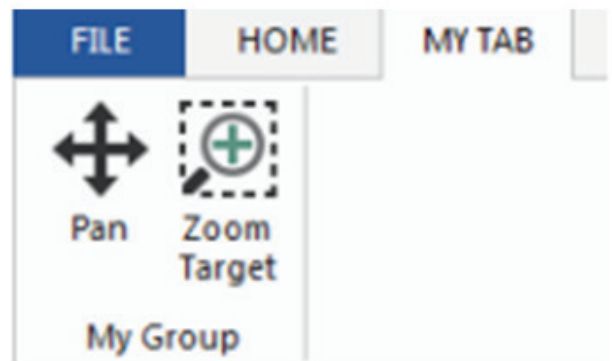
Fig 10

Customize the Ribbon:



- 15 Click OK to close the options dialog box.
- 16 Choose My Tab to view your customized tab with the Pan and Zoom Target commands. (Fig 11)
- 17 On your own, return to the options dialog box to add more commands to your tab, or rearrange the order of the ribbon tabs

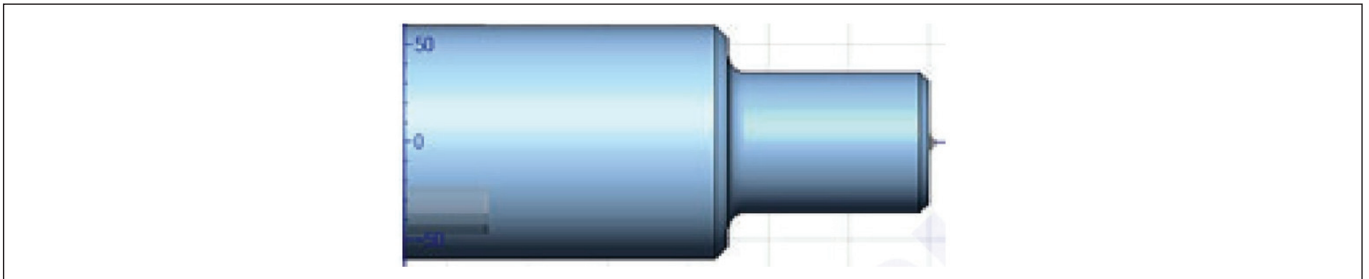
Fig 11



Importing and exporting of sample library file

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

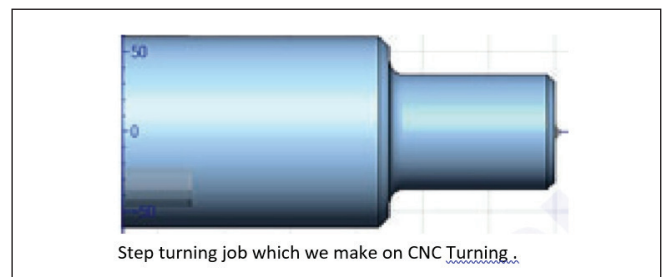
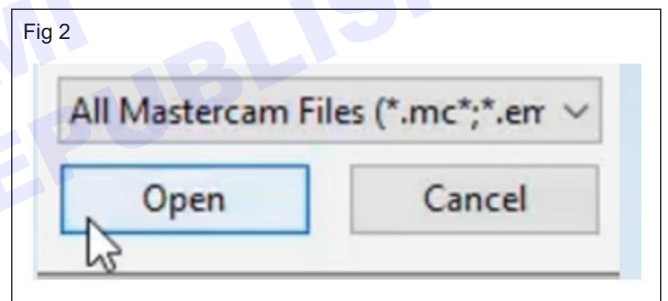
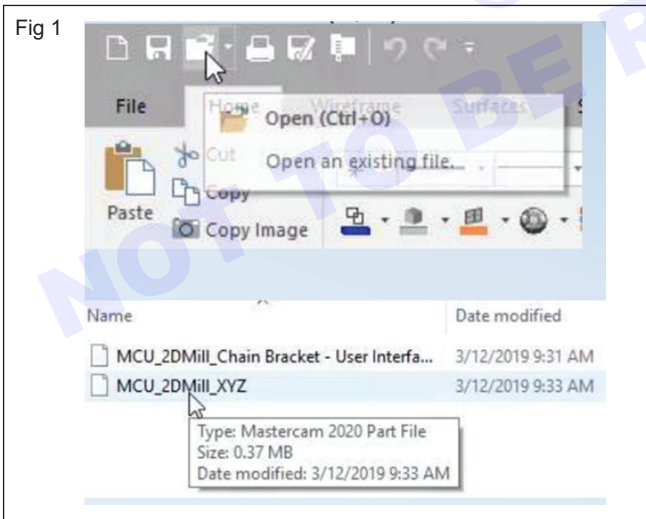
- open in-mastercam part files
- import multiple files
- save files in export folder
- export one or more files.



PROCEDURE

TASK 1: Opening of part file for mastercam

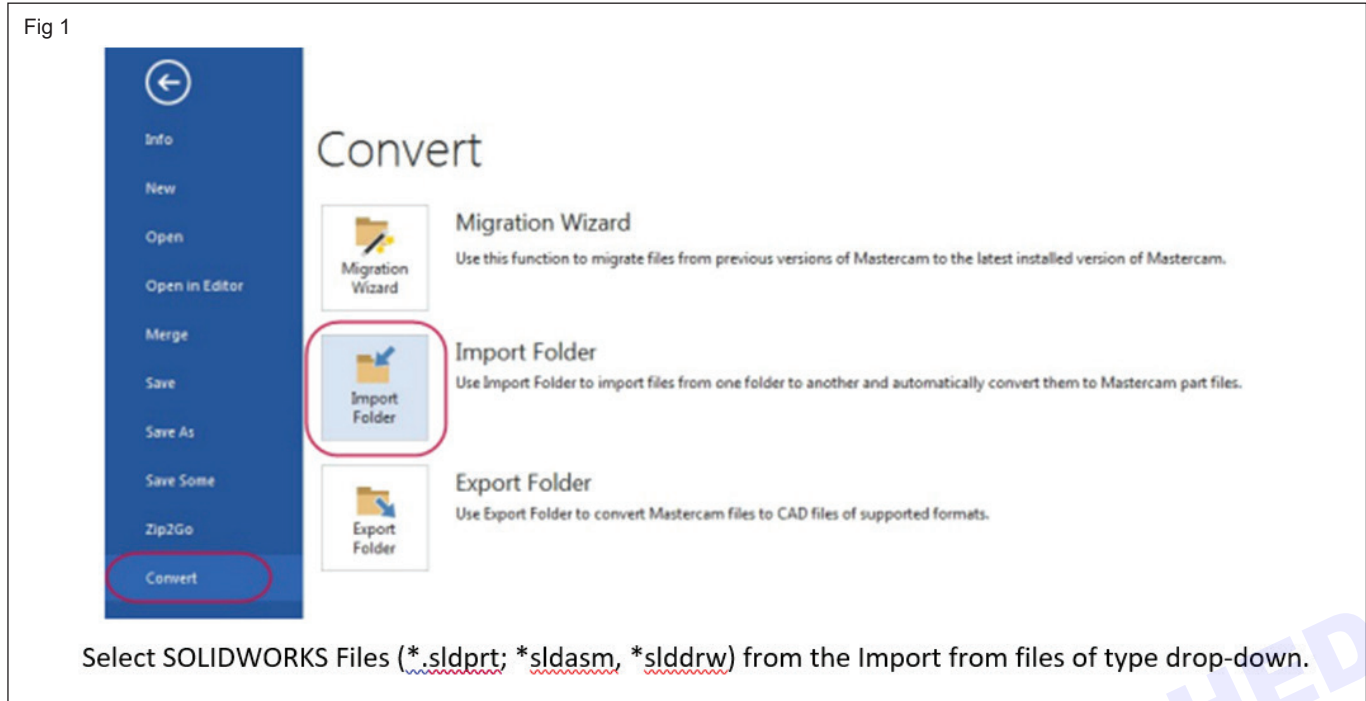
- 1 Switch on the computer and wait few munite.
- 2 Double-clicking Mastercam's desktop icon. Or Launching Mastercam from the windows start menu.
- 3 Take a few moments to explore Mastercam's interface
- 4 Click the open button in the Quick Access toolbar (QAT) (Fig 1)
- 5 Click the open button in the open window to open the file. (Fig 2)



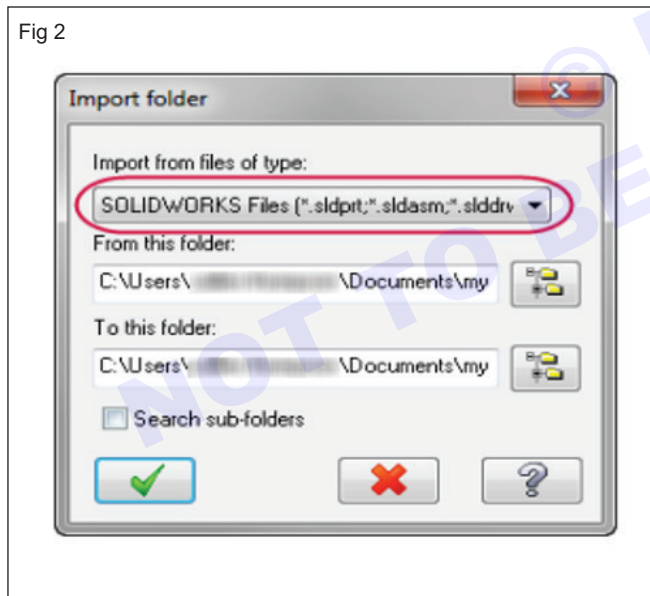
- 6 Step turning job which we make on CNC turning.

TASK 2: Importing of multiple files

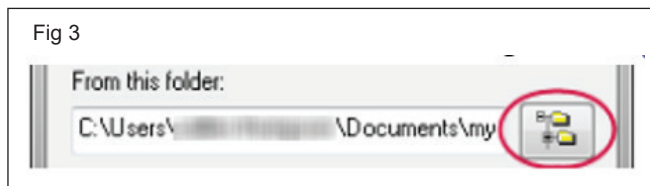
- 1 Import multiple files.
- 2 Select File, convert and then click Import Folder
- 3 The Import folder dialog box opens. (Fig 1)



Select SolidWorks Files (*.sldprt; *.sldasm, *.slddrw) from the Import from files of type drop-down. (Fig 2)

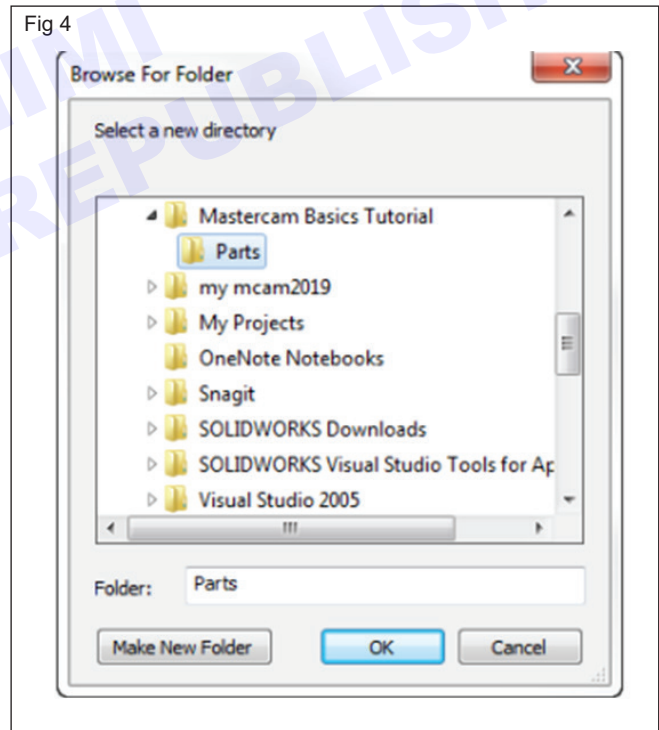


- 3 Click the browse button on the right of the from this folder box.(Fig 3)

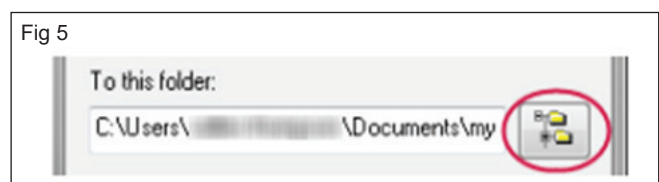


The Browse for folder dialog box opens.

- 4 Select the location where you stored the tutorial files, and then click OK. (Fig 4)

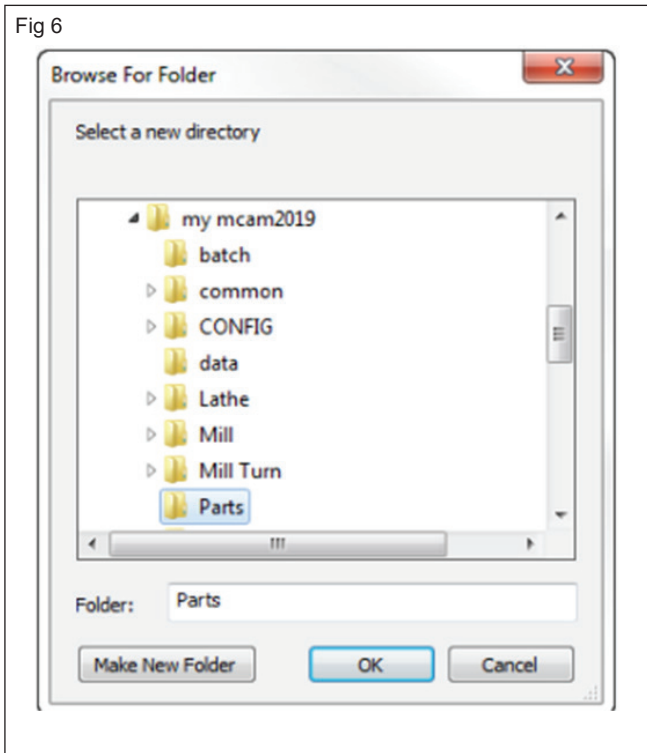


- 5 Click the browse button to the right of the to this folder box.(Fig 5)



- 6 Browse to \documents\my mcam\parts and then click OK. (Fig 6)

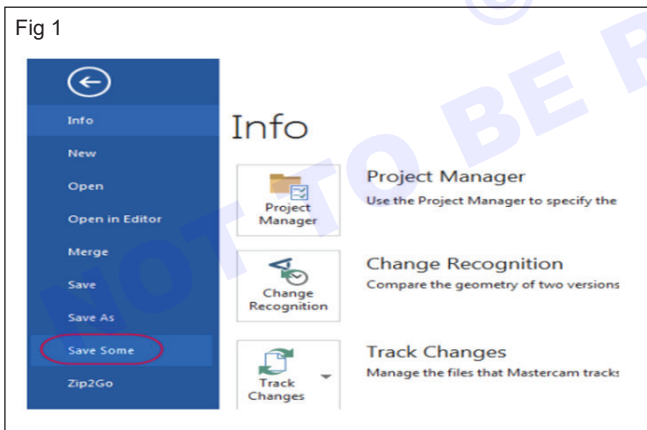
Fig 6



TASK 3: Change 2D to mastercam file

- 1 Open 2D turn_MM, which was provided with this practical. In the open dialog box, you might need to change your file type to Mastercam Files (*.mcam). (Fig 1)
- 4 Select the five arcs shown in the picture below. The arcs change colour when they are selected. (Fig 3)

Fig 1

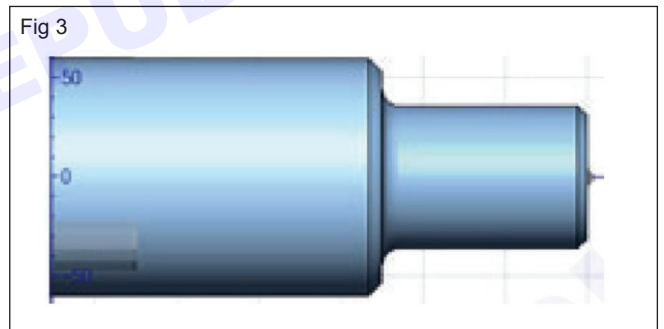


- 2 Select File, Save some.
- 3 Choose wireframe on the status bar to show the wireframe of the solid body making it easier to select the arcs. (Fig 2)

Fig 2



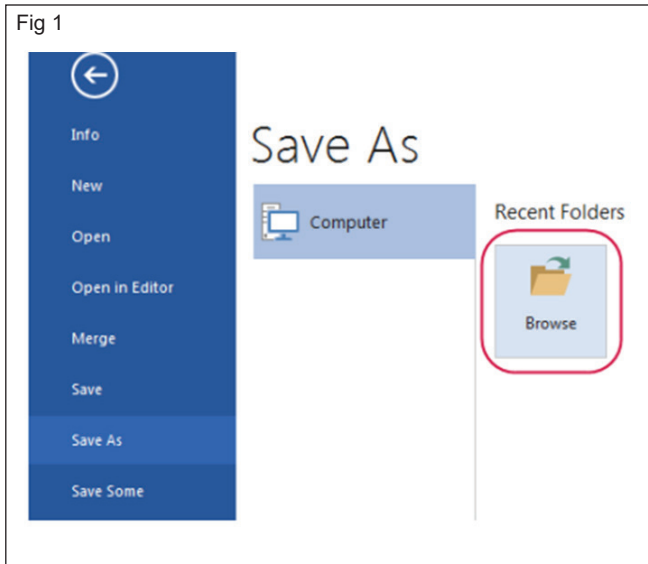
Fig 3



- 5 Press [Enter] to accept the selection. The Save As dialog box opens.
- 6 Type 2D_turn_ARCS for the File name.
- 7 Click Save or press [Enter] to save the file. Mastercam saves only the selected arcs.
- 8 Open 2D_turn_ARCS_ARCS, and notice that it contains only the arcs that you selected.

TASK 4: Save mastercam file into ASCII format

- 1 Open 2D_turn arcs_MM, which was provided with this tutorial.
- 2 Select file, Save As, and then click browse. (Fig 1)

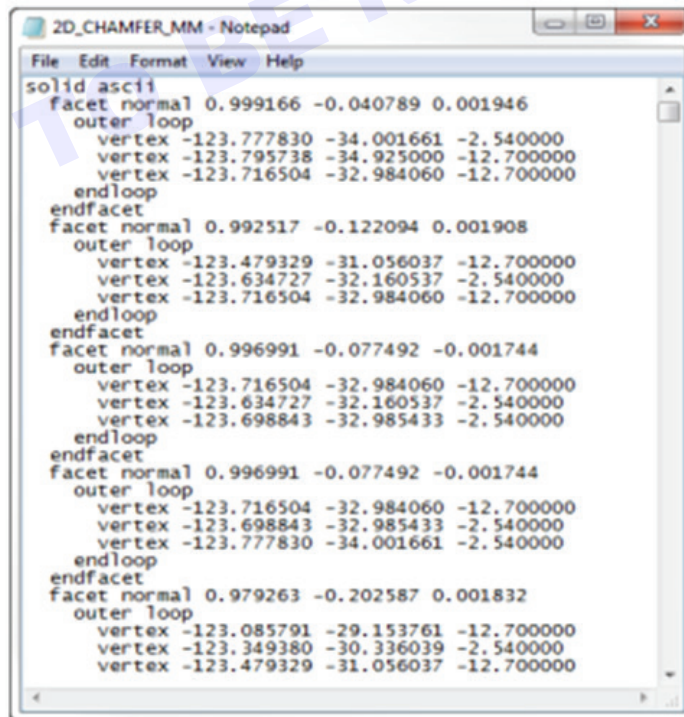


The Save As dialog box opens.

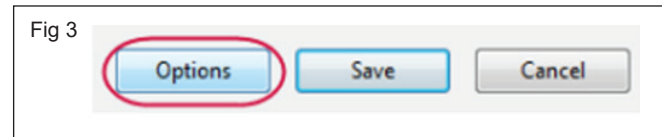
- 3 Select Stereolithography Files (*.stl) in the Save As type drop-down list. (Fig 2)



Fig 5

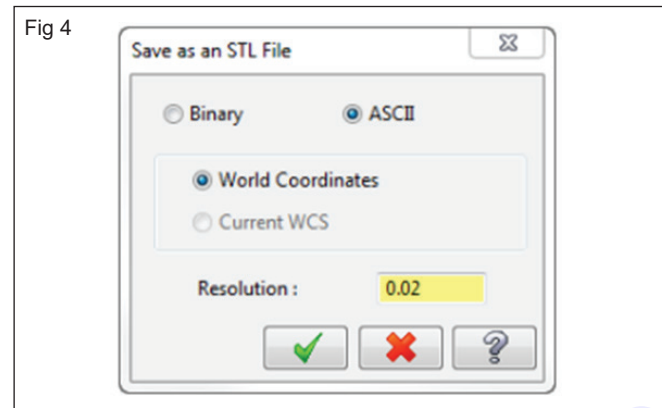


- 4 Click options. (Fig 3)



The Save as an STL File dialog box opens.

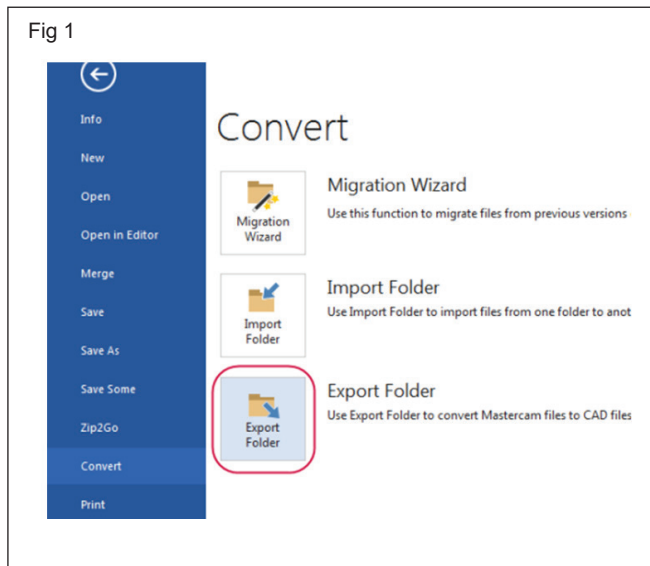
- 5 Select the ASCII option. (Fig 4)



- 6 Click OK to close the Save as an STL File dialog box.
- 7 Click Save in the Save As dialog box. Mastercam saves the file in ASCII Stereolithography format. Note: Because the Stereolithography file is ASCII, you can view it with any text editor, such as Notepad, as shown below. (Fig 5)

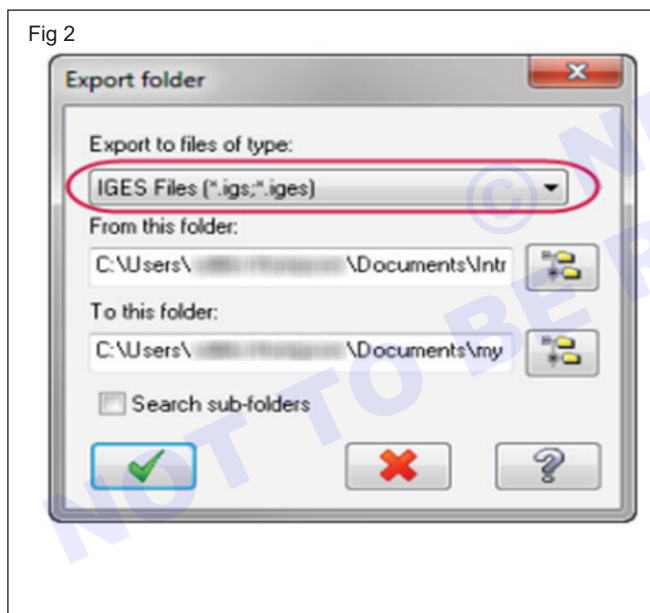
TASK 5: Saving file in export folder

- 1 Select File, Convert, and then click Export Folder. (Fig 1)

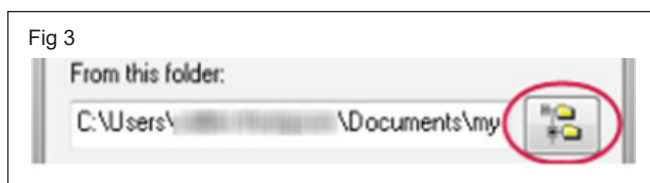


The Export folder dialog box opens.

- 2 Select IGES Files (*.igs;*.iges) from the Export to files of type drop-down. (Fig 2)

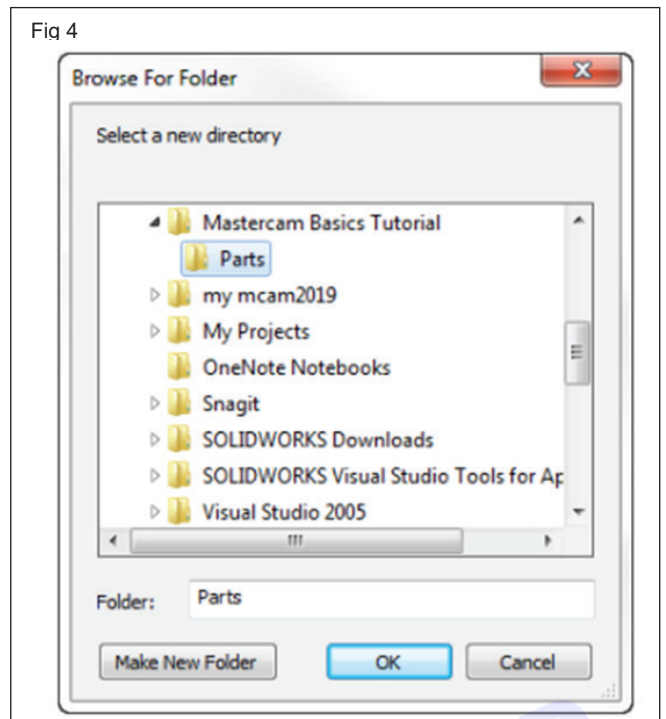


Click the Browse button to the right of the from this folder box. (Fig 3)

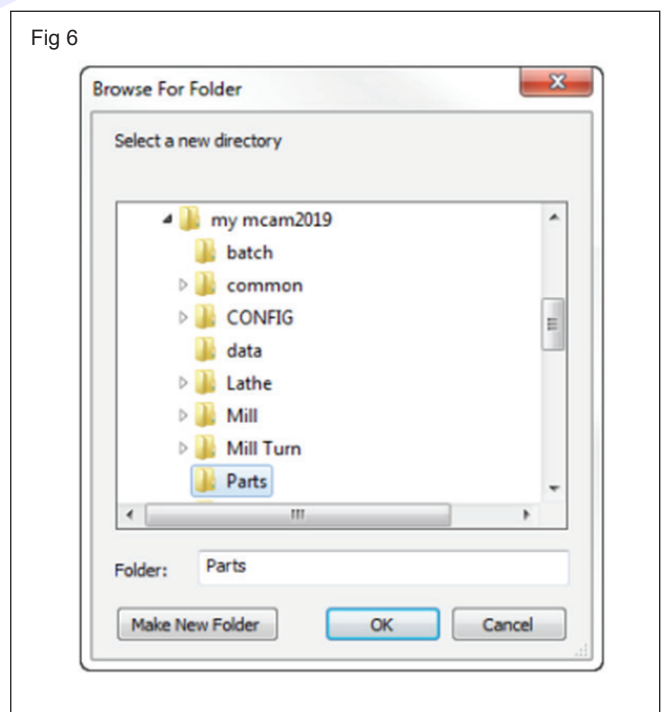


The Browse For Folder dialog box opens.

- 4 Select the directory where you stored the tutorial parts, and then click OK. (Fig 4)
- 5 Click the Browse button to the right of this folder box. (Fig 5)



- 6 Browse to \Documents\my mcam\parts, and click OK. (Fig 6)

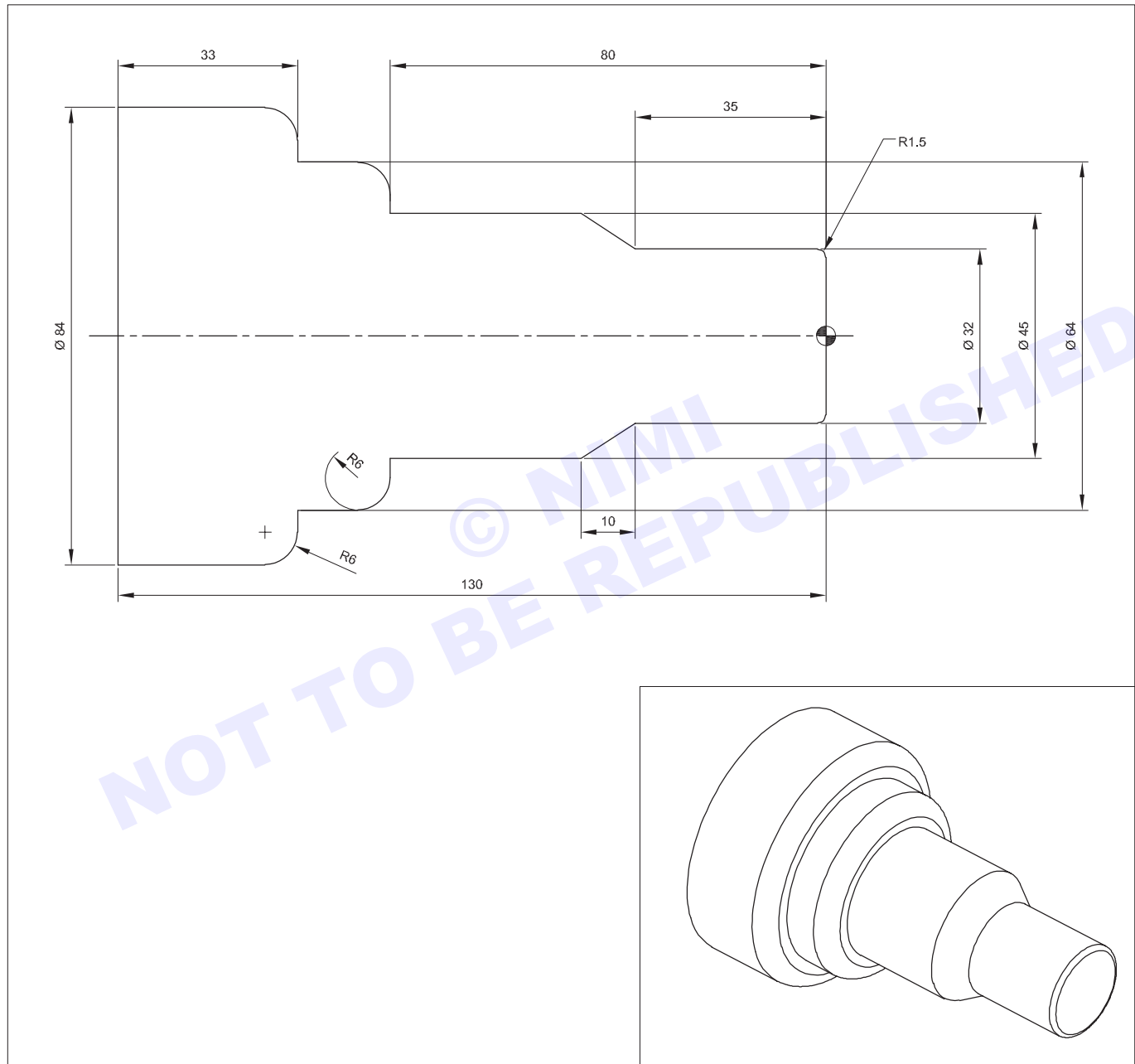


- 7 Click OK in the Export folder dialog box.

Creation of 3d solid modeling geometry

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

- change the units
- set up the graphical user Interface
- draw a 2D sketch of the given drawing
- revolve solids to create a 3D Model.



1	$\varnothing 60 \times 105\text{mm}$	-	-	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		CREATE 3D SOLID MODELING			TOLERANCE \pm	TIME :
					CODE NO. CN20N1785E1	

TASK 1: Change the units to metric

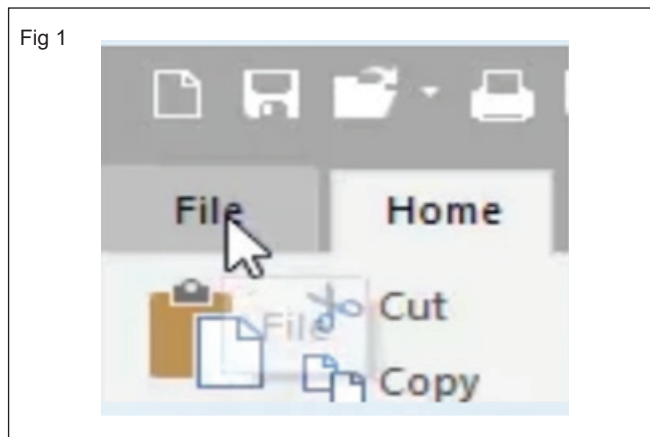
Switch on the computer and wait few minute.

Double-clicking Mastercam's desktop icon. or

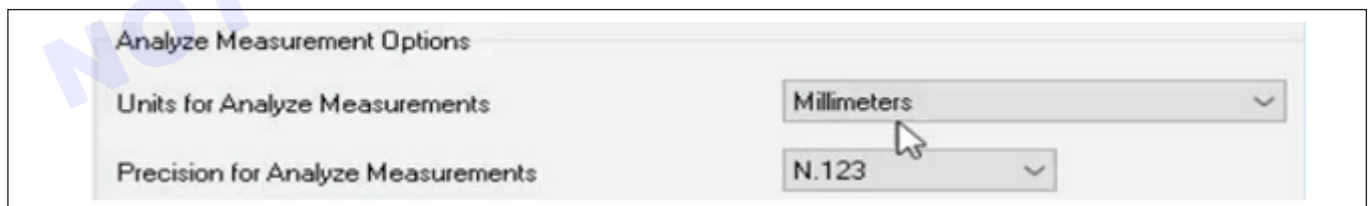
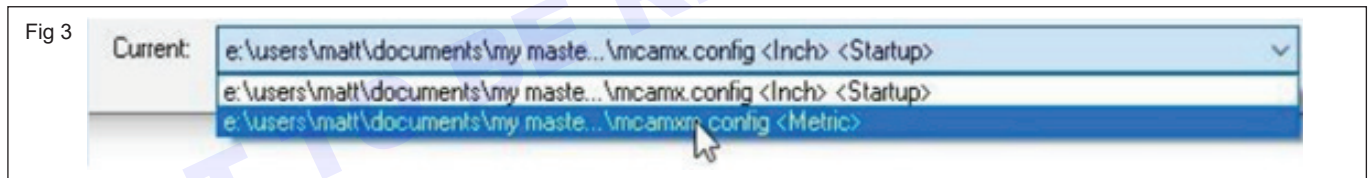
Launching mastercam from the windows start menu.

Take a few moments to explore Mastercam's interface

- 1 To change the units of the file, click the File tab in the upper left corner of the screen. (Fig 1)

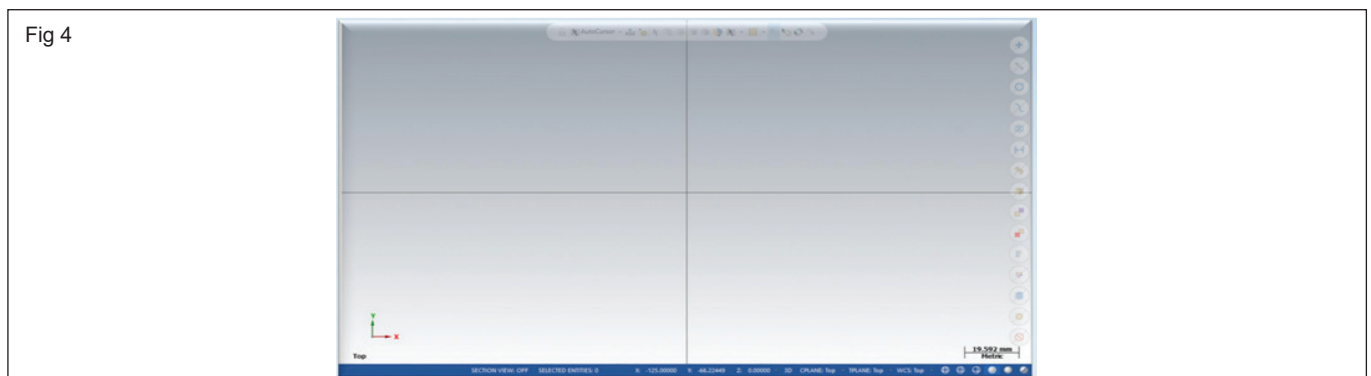


- 2 In the left column of the file screen, choose the Configuration option. (Fig 2)
- 3 At the bottom of the system configuration window, use the current field's drop-down menu to select. (Fig 3)
- 4 After changing this option, notice that the units for Analyze measurements changes to millimeters. (Fig 4)



- 5 Click the green OK button in the system configuration window

After setting metric scale press F9 to show coordinate system. (Fig 4)



TASK 2: Setting up the Graphical user Interface

1 Click on the View option.

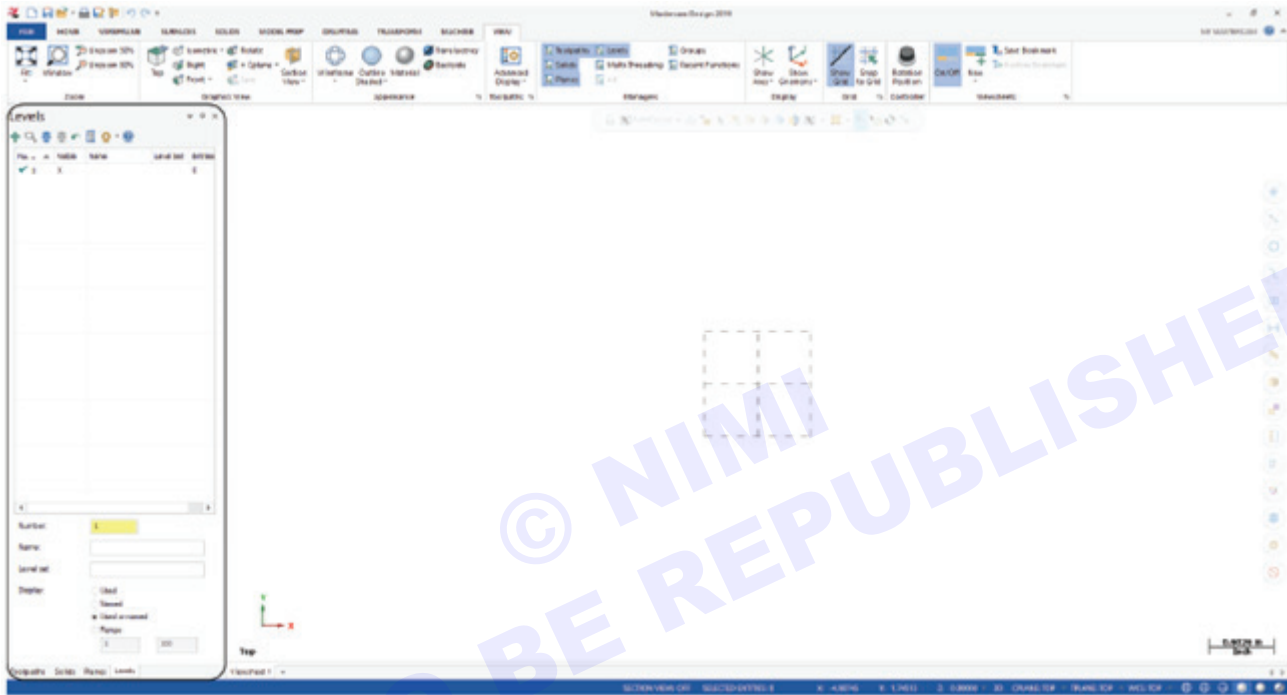
2 From the managers group, enable all four managers. (Fig 1)

Fig 1



3 The panels should be on the left side of the graphics window. (Fig 2)

Fig 2



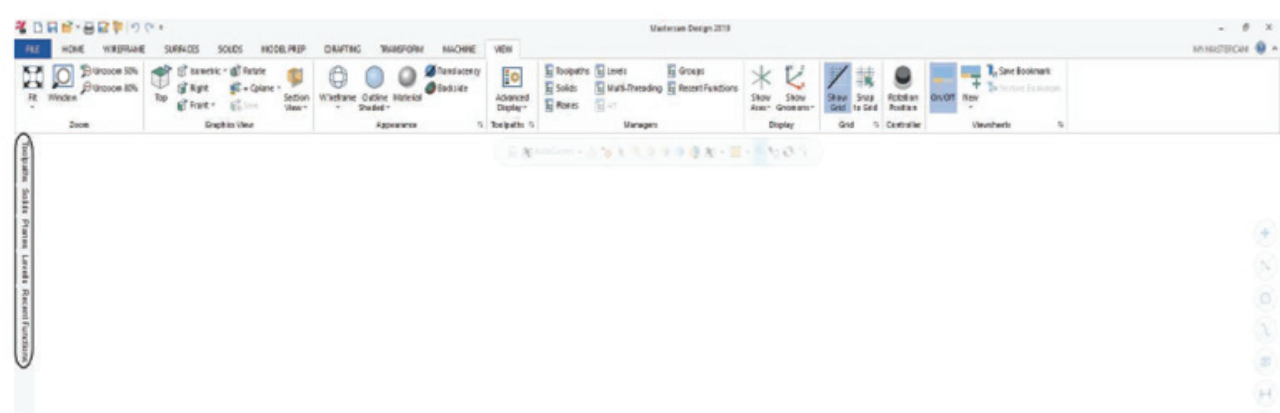
4 To hide all panels, click on the Auto Hide icon. (Fig 3)

Fig 3



5 The panels will be hidden to the left of the graphics window. (Fig 4)

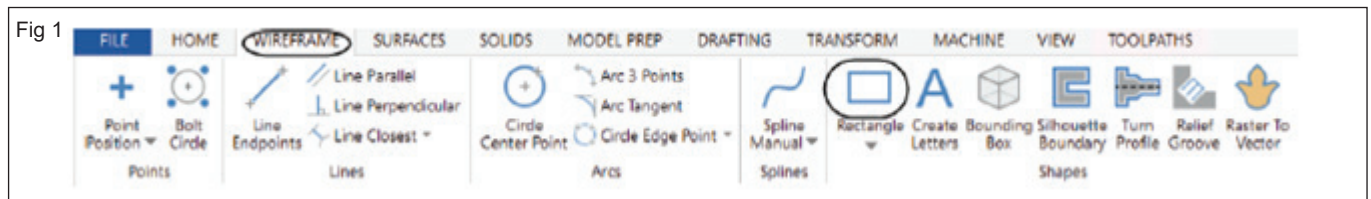
Fig 4



TASK 3: Draw a 2D sketch of the given drawing

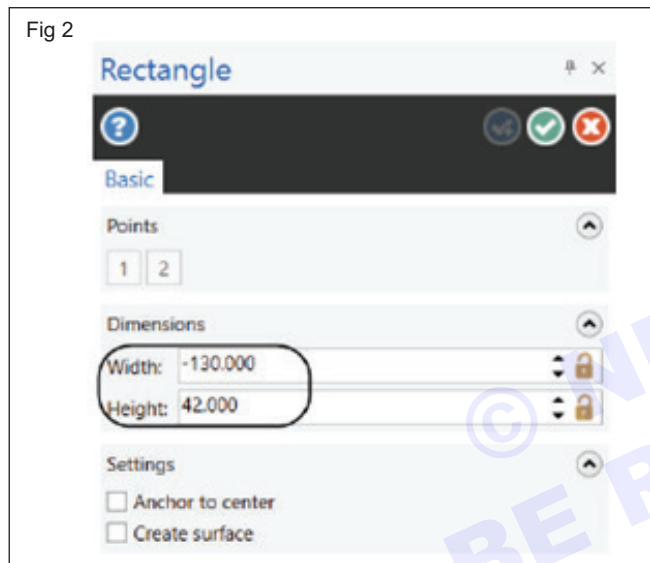
Wireframe

- From the shapes group, select rectangle. (Fig 1)



Note: Select the rectangle icon as shown. If you click too close to the drop down arrow, a fly-out list commands appear and you can select the top rectangle command.

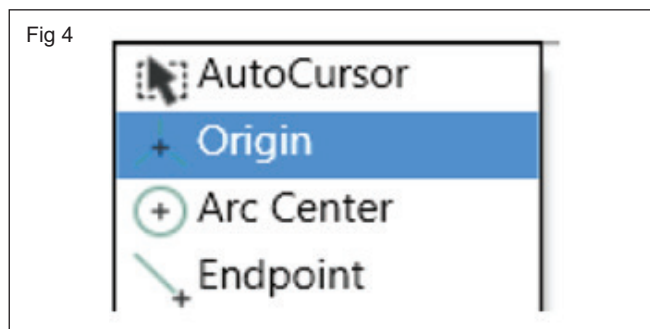
- Enter the width and the height and press enter. (Fig 2)



- To select the position of the base point, from the general selection toolbar, click on the drop down arrow next to Autocursor. (Fig 3)



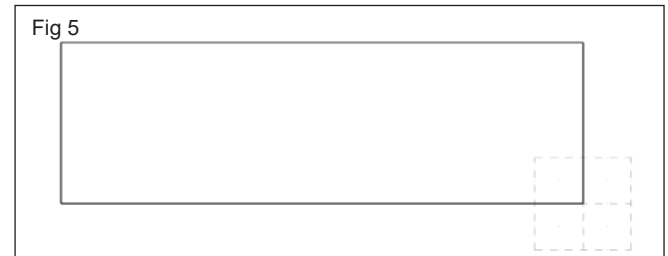
- From the fly-out menu select origin. (Fig 4)



- To see the entire rectangle, right mouse click in the graphics window and select fit.

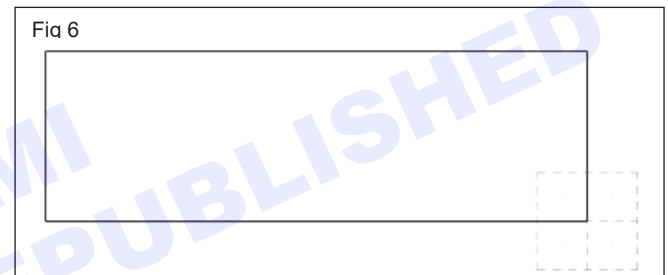
Note: To fit the geometry to the screen you can also press Alt + F1.

- A preview of the geometry should look. (Fig 5)

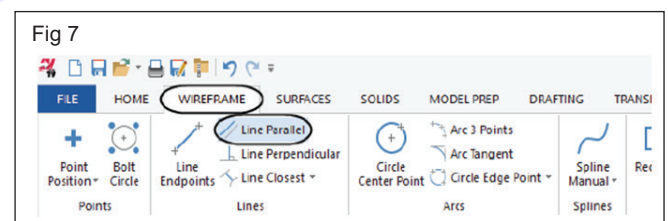


Select the OK button to exit the rectangle command.

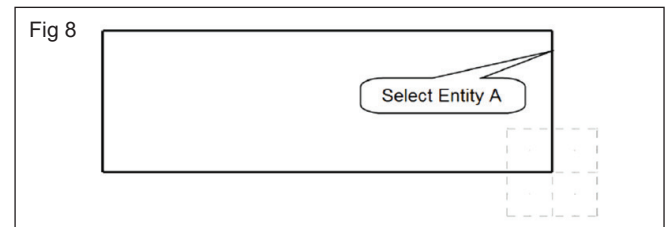
- The geometry should look. (Fig 6)



- From the lines group, select line parallel. (Fig 7)



Select a line]: select **Entity A**. (Fig 8)

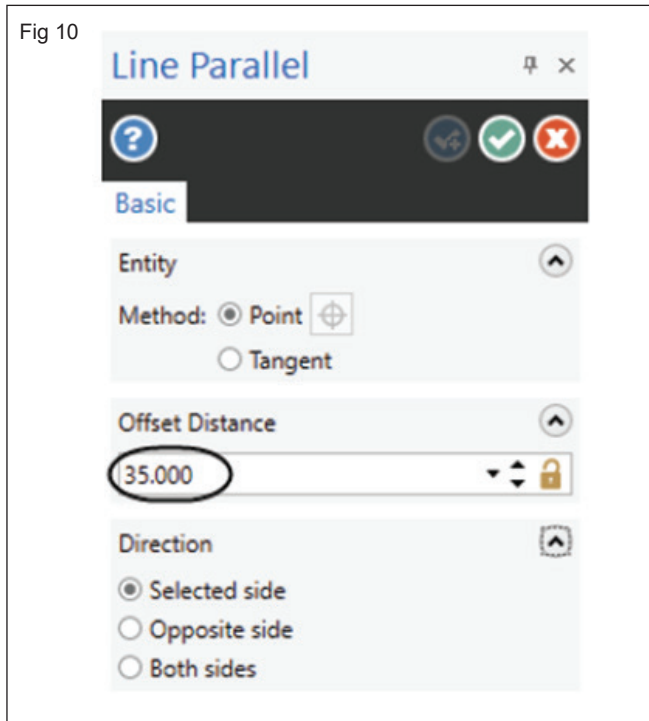


- [Select the point to place a parallel line through]: Pick a point to the left of the selected line.(Fig 9)



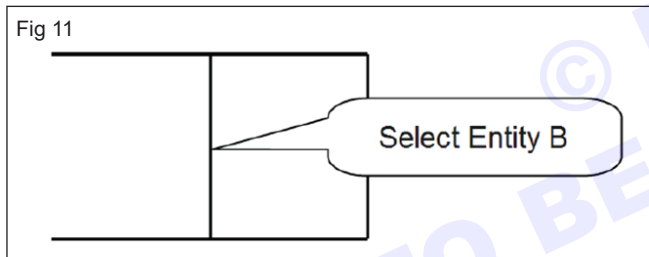
10 In the Line Parallel panel, enter the Distance 35.0.

11 Press Enter to move the line to the proper distance.
(Fig 10)



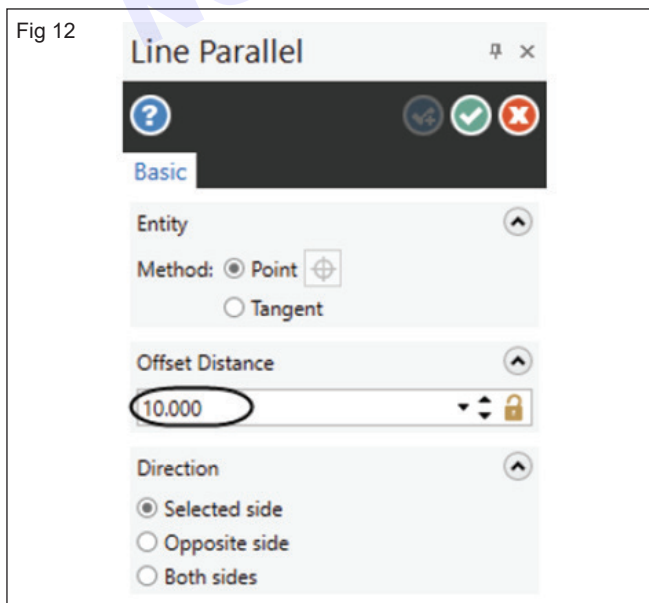
12 Press Enter to continue.

13 [Select a line]: Select Entity B. (Fig 11)



[Select the point to place a parallel line through]: Pick a point to the left of the selected line.

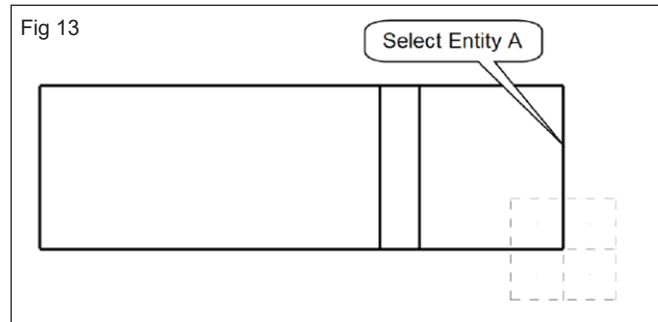
14 Enter the Distance 10.0. (Fig 12)



15 Press Enter to move the line to the proper distance.

16 Press Enter to continue.

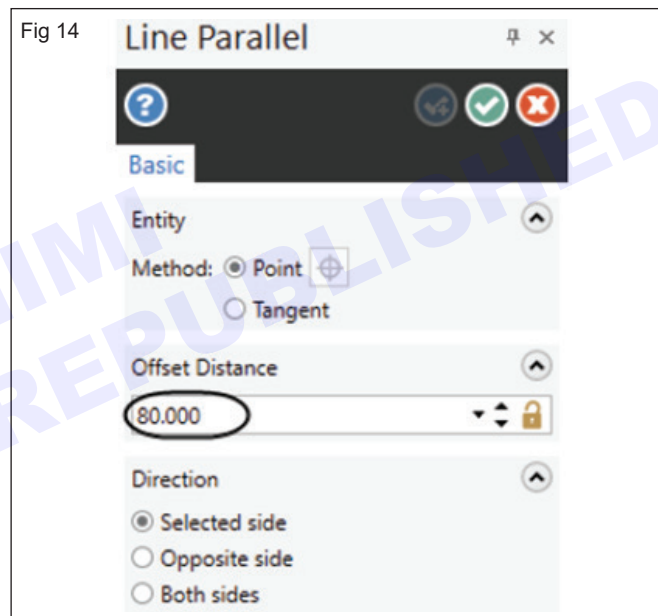
17 [Select a line]: Select Entity A again. (Fig 13)



18 [Select the point to place a parallel line through]: Pick a point to the left of the selected line.

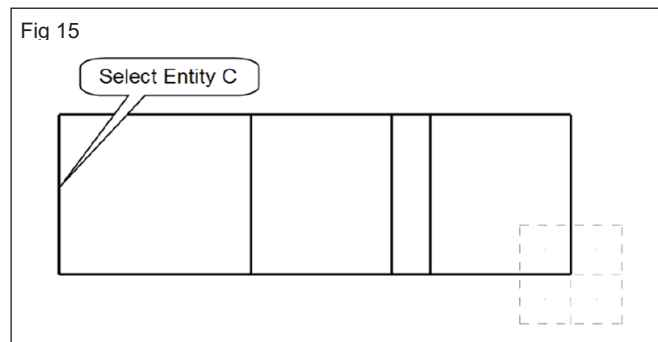
19 Enter the Distance 80.0.

20 Press Enter to move the line to the proper distance.
(Fig 14)



21 Press Enter to continue.

22 [Select a line]: Select Entity C. (Fig 15)

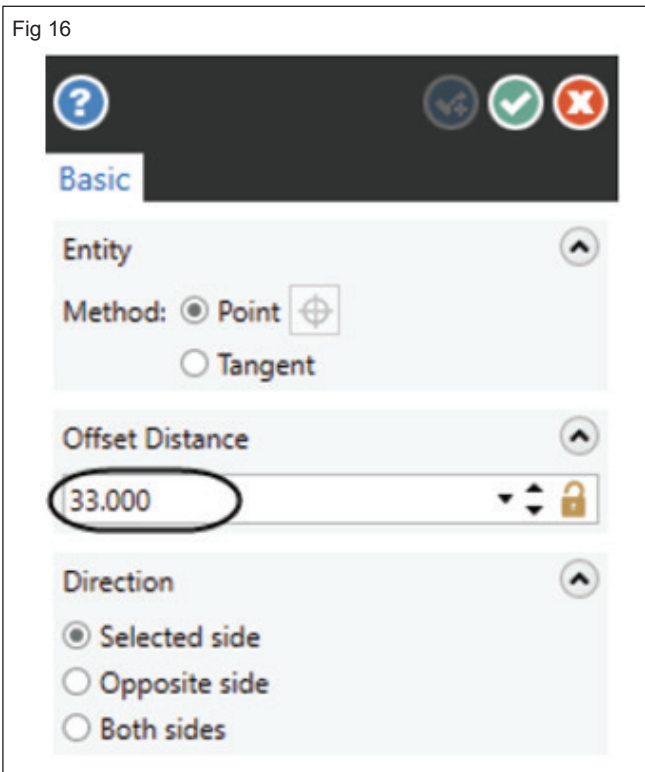


23 [Select the point to place a parallel line through]: Pick a point to the right of the selected line.

24 Enter the Distance 33.0.

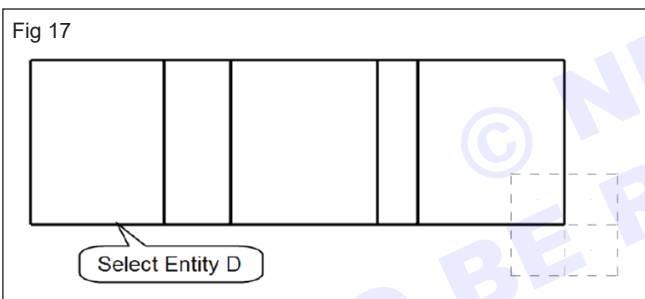
25 Press Enter to move the line to the proper distance.
(Fig 16)

Fig 16



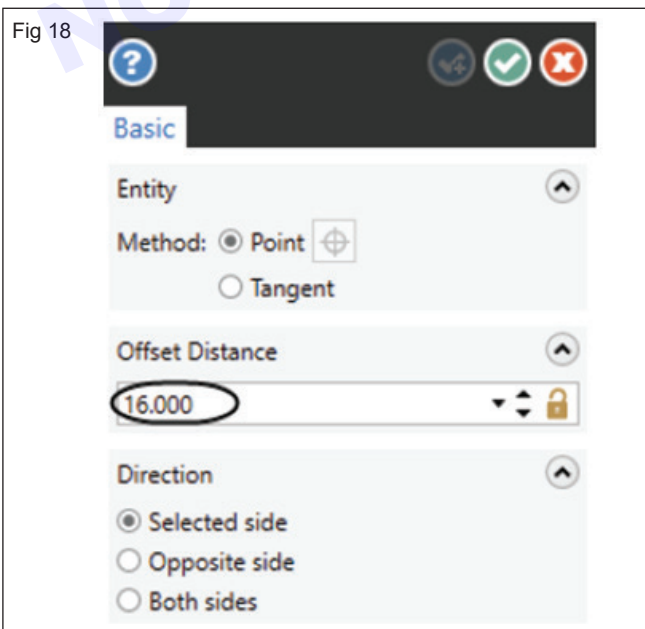
Press **Enter** to continue.

26 [Select a line]: Select Entity D. (Fig 17)



27 [Select the point to place a parallel line through]: Pick a point above the selected line.

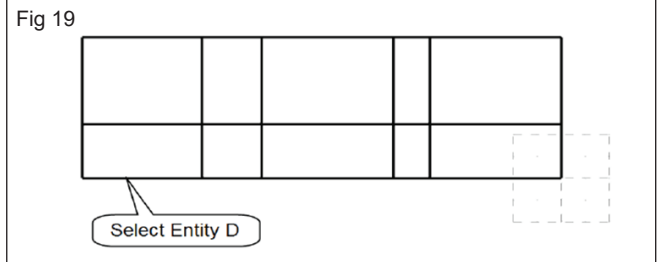
28 Enter the Distance 16.0. (Fig 18)



29 Press **Enter** to move the line to the proper distance.

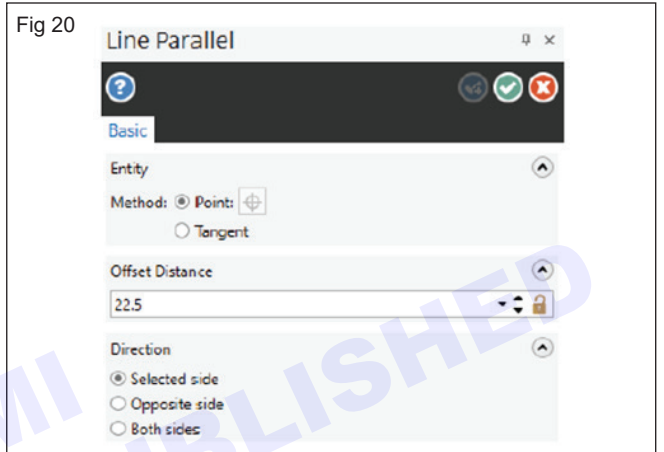
30 Press **Enter** to continue.

31 [Select a line]: Select Entity D. (Fig 19)



32 [Select the point to place a parallel line through]: Pick a point above the selected line.

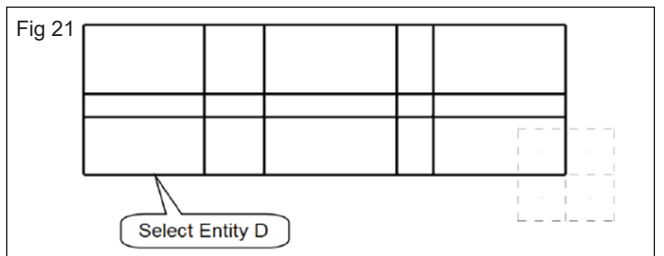
33 Enter the **Distance** 22.5. (Fig 20)



34 Press **Enter** to move the line to the proper distance.

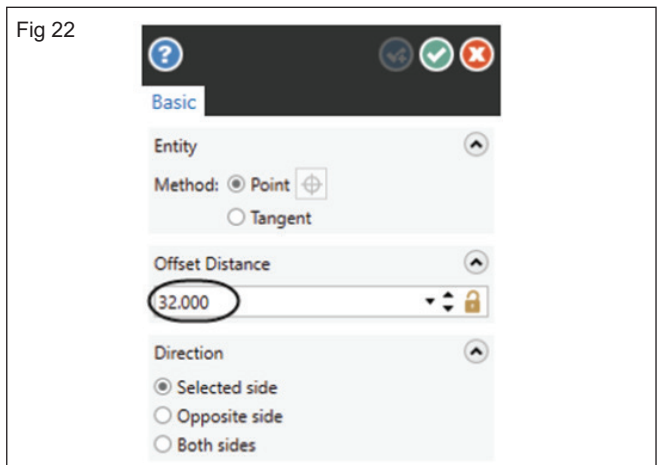
35 Press **Enter** to continue.


36 [Select a line]: Select Entity D. (Fig 21)



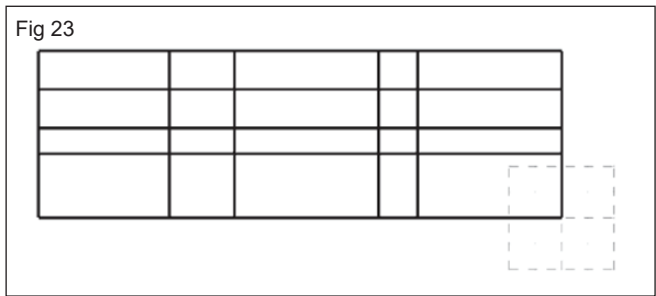
[Select the point to place a parallel line through]: Pick a point above the selected line.

37 Enter the Distance 32.0. (Fig 22)



38 Select the OK button to exit the command. 

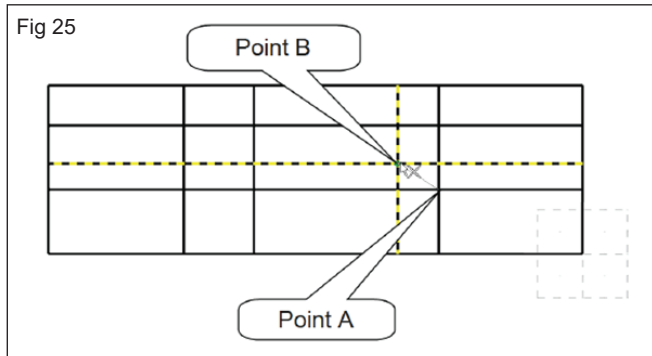
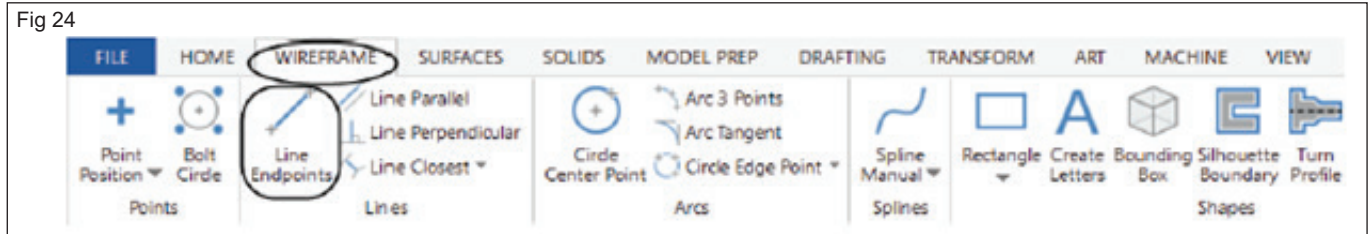
39 The part should appear as shown. (Fig 23)



Wireframe

From the Lines group, select Line Endpoints. (Fig 24)

- [Specify the first endpoint]: Click the intersection between the two lines at Point A. (Fig 25)

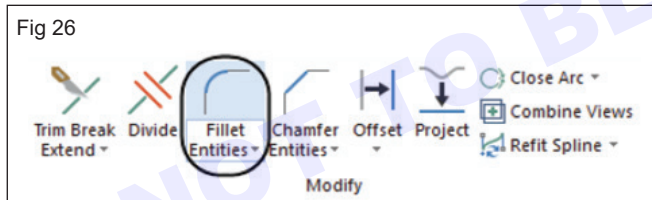


- [Specify the second endpoint]: Click the intersection between the two lines at Point B as shown.

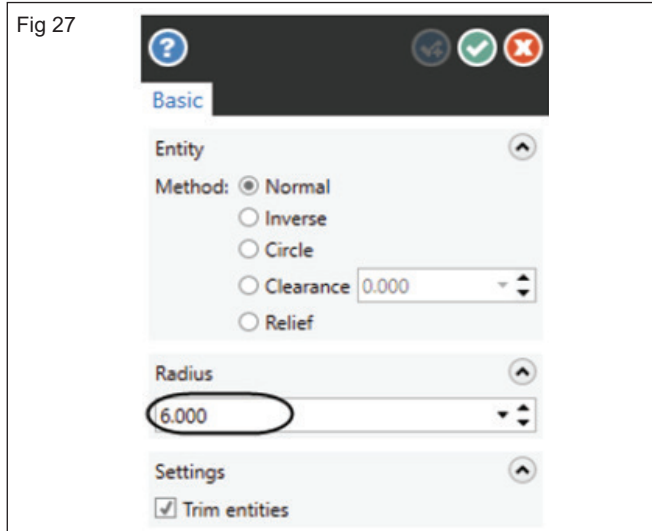
Select the OK button to exit the command. 

Wireframe

From the Modify group, select Fillet Entities. (Fig 26)

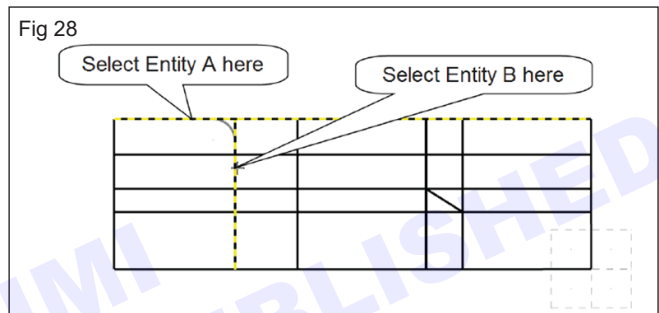


Enter the Radius 6.0 and make sure that the rest of the parameters in the window are set, (Fig 27)



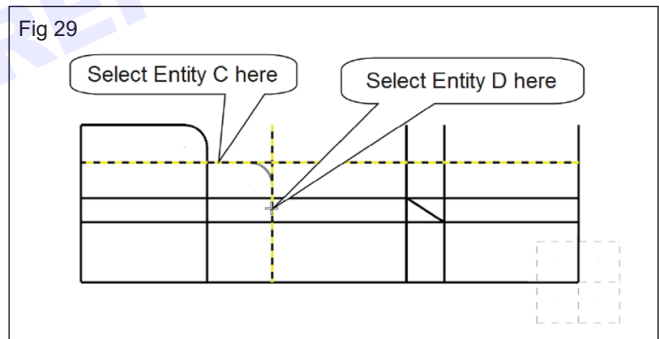
[Select an entity]: Select Entity A. (Fig 28)

[Select another entity]: Select Entity B. (Fig 28)



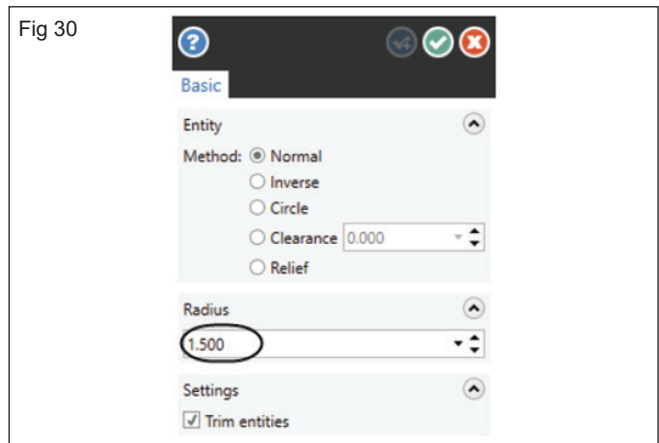
[Select an entity]: Select Entity C. (Fig 29)

[Select another entity]: Select Entity D. (Fig 29)

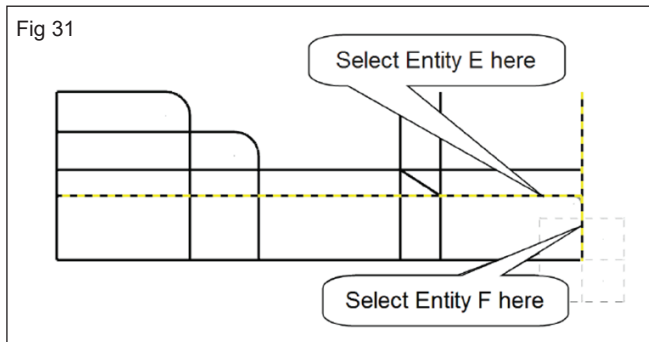


Press Enter to finish the fillet.

- Change the radius to 1.5 and make sure that the rest of the parameters in the window are set. (Fig 30)

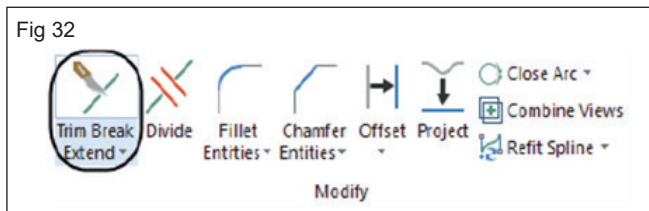


- [Select an entity]: Select Entity E. (Fig 31)
- [Select another entity]: Select Entity F. (Fig 31)



Select the OK button to exit the command. 

From the Modify group, select Trim **Break Extend**. (Fig 32)

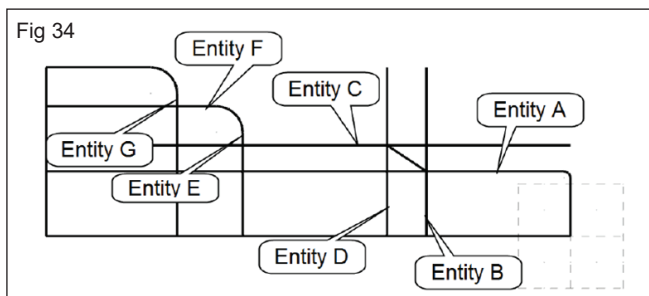


Enable the Trim 2 entities button. (Fig 33)



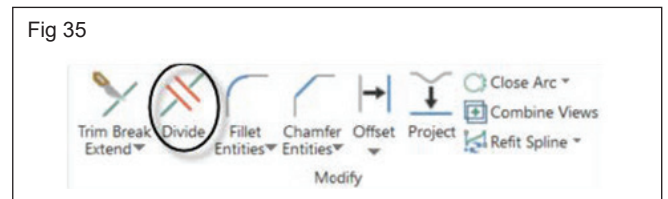
[Select the entity to trim/extend]: Click on Entity A. (Fig 34)

[Select the entity to trim/extend to]: Click on Entity B. (Fig 34)



- [Select the entity to trim/extend]: Click on Entity C (Fig 34)
- [Select the entity to trim/extend to]: Click on Entity D (Fig 34)
- [Select the entity to trim/extend]: Click on Entity E. (Fig 34)
- [Select the entity to trim/extend to]: Click on Entity C (Fig 34)
- [Select the entity to trim/extend]: Click on Entity G.
- [Select the entity to trim/extend to]: Click on Entity F.

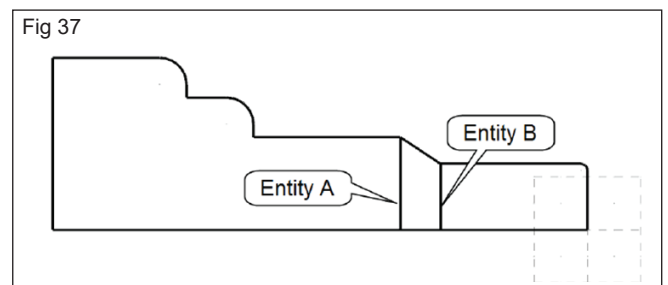
From the Modify group, select Divide. (Fig 35)



In the Divide panel, enable Trim. (Fig 36)

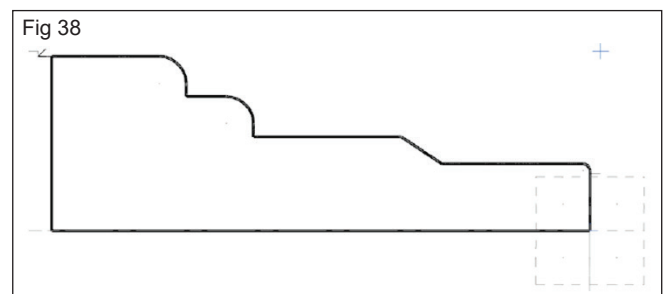


[Select the curve to divide / delete]: Select Entity A and Entity B. (Fig 37)



Select the OK button from the toolbar. 

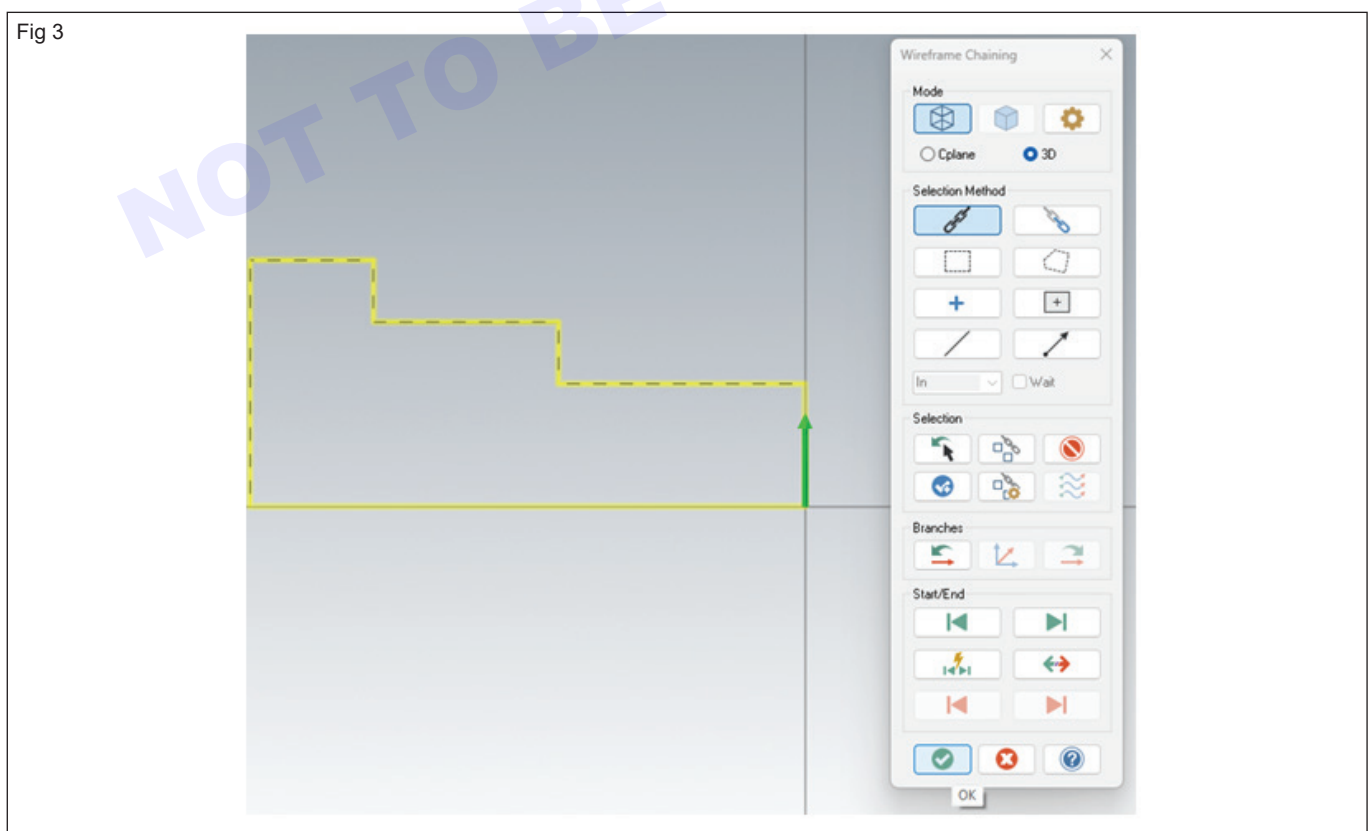
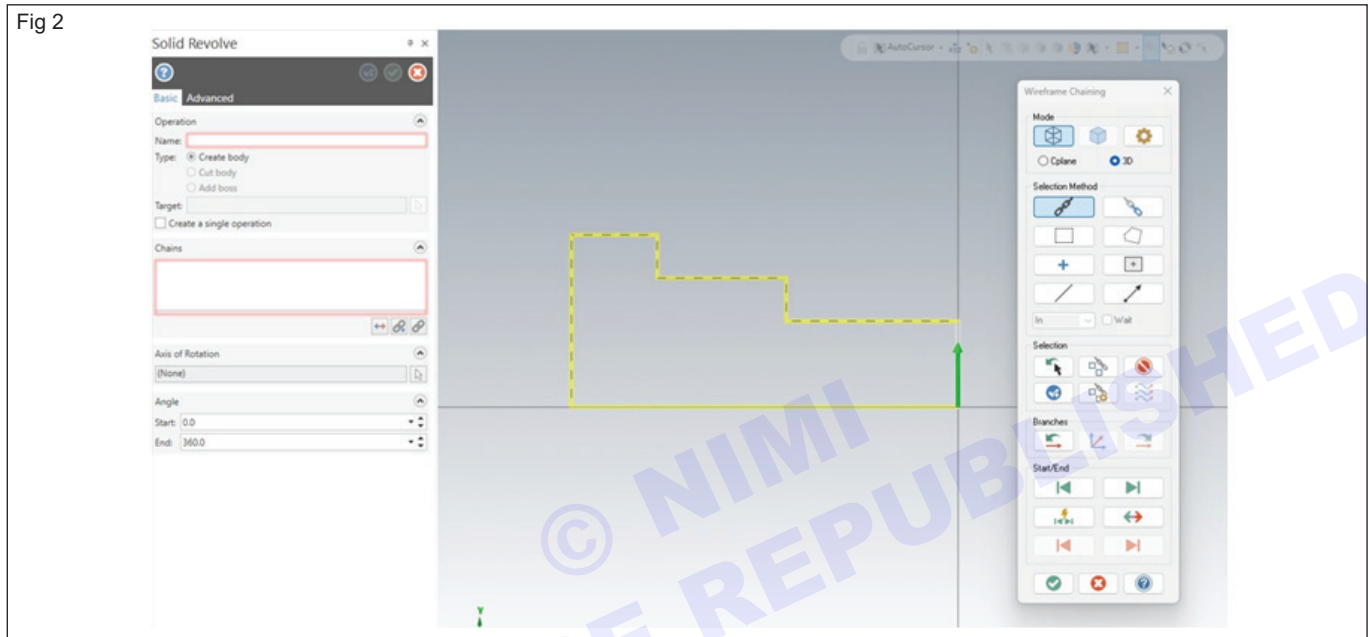
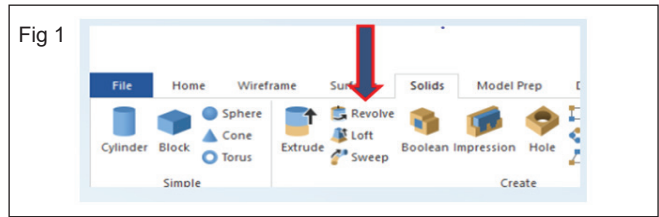
The part should appear. (Fig 38)



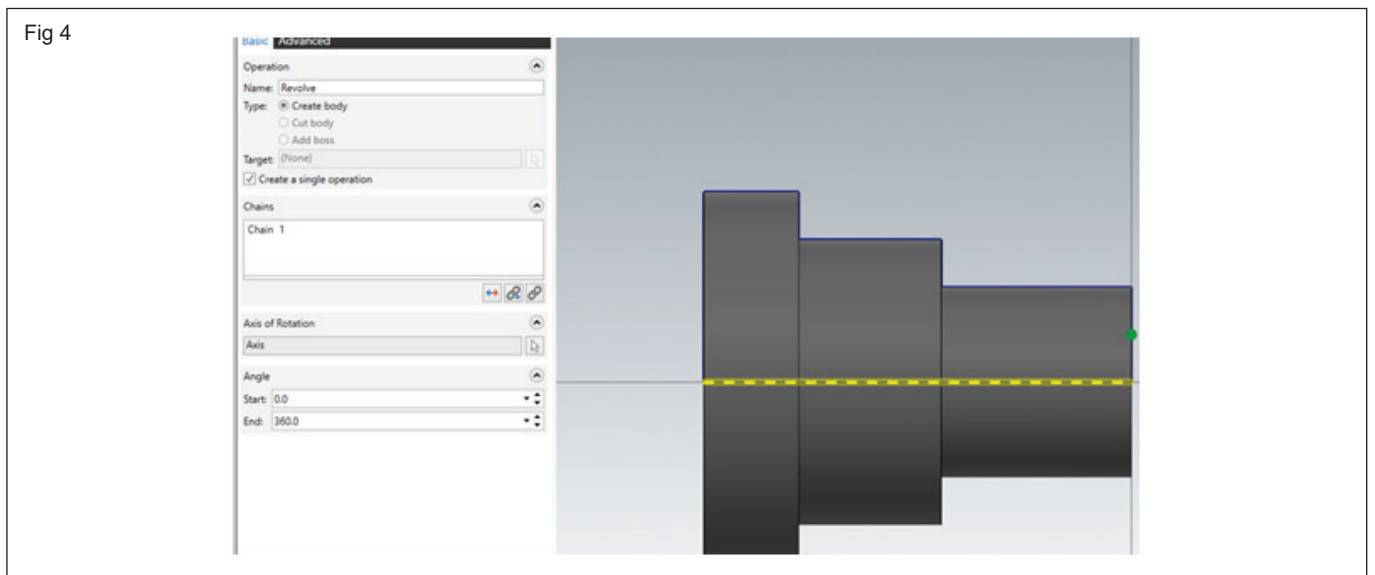
File find a location on the computer to save your file.
Save As. File name: "Your name 1".
click on the browse icon. 

Task 4: Revolve solids to create a 3D Model

- 1 Select revolve option in solids. (Fig 1)
- 2 Select body chain which revolve and press enter. (Fig 2 & 3)



- 3 Select a line to be used as the axis of rotation & press enter. (Fig 4)



- 4 3D Model is ready for machining

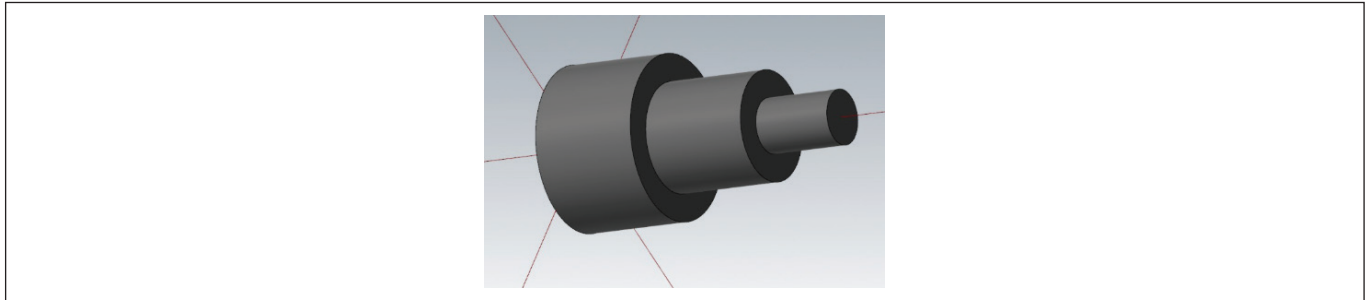
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Import 3D model

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

- access quick access toolbar
- configure the file
- select the 3D model File in CAM software
- import 3D model and open in the software.

Job Sequence



- Switch on the computer and wait few minutes.
 - Double-clicking Mastercam's desktop icon.
 - or
 - Launching Mastercam from the Windows Start menu.
- (Fig 1)

Fig 1



Fig 2

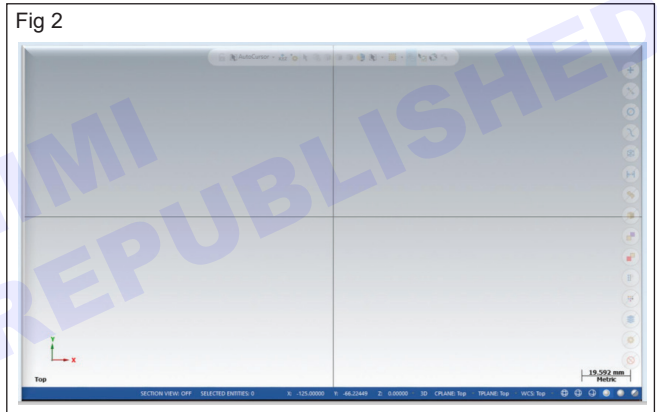
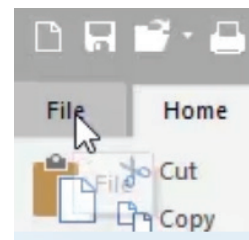


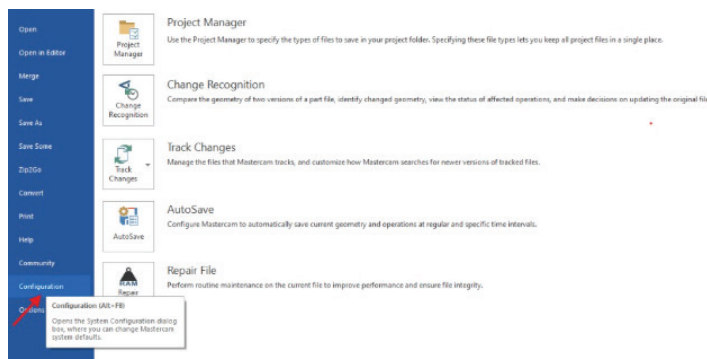
Fig 3



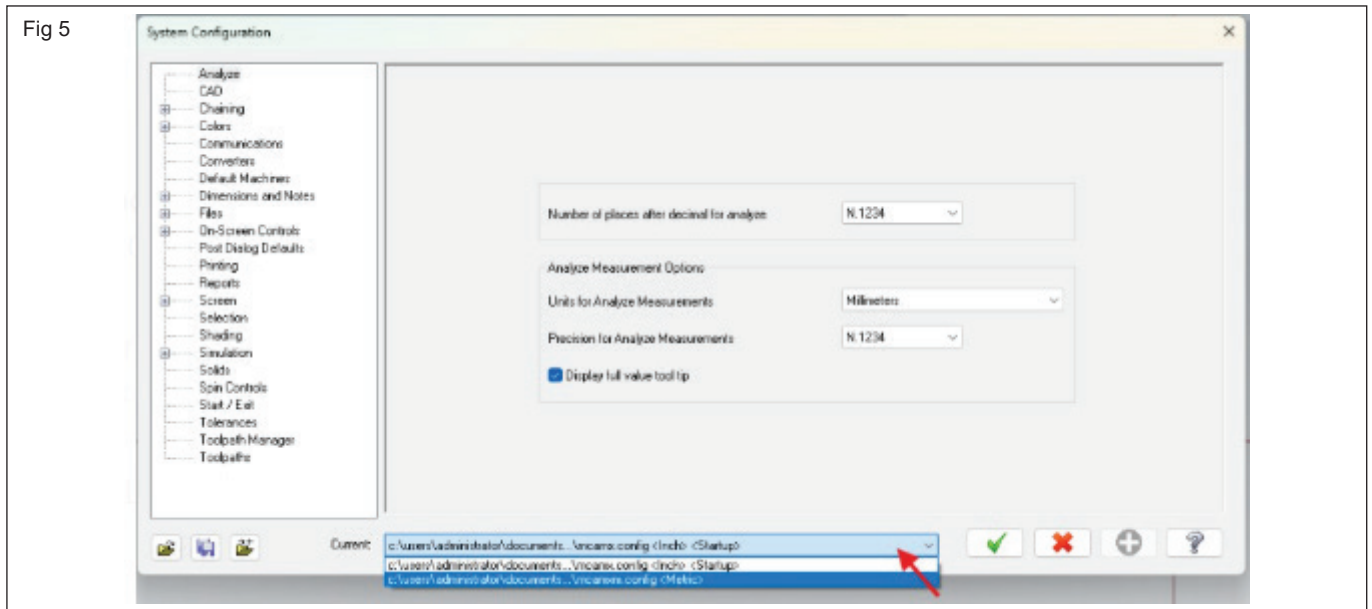
- Take a few moments to explore Mastercam's interface.
- (Fig 2)
- Click the Open button in the Quick Access Toolbar (QAT). (Fig 3)

- To change the units of the file, click the File tab in the upper left corner of the screen. (Fig 4)

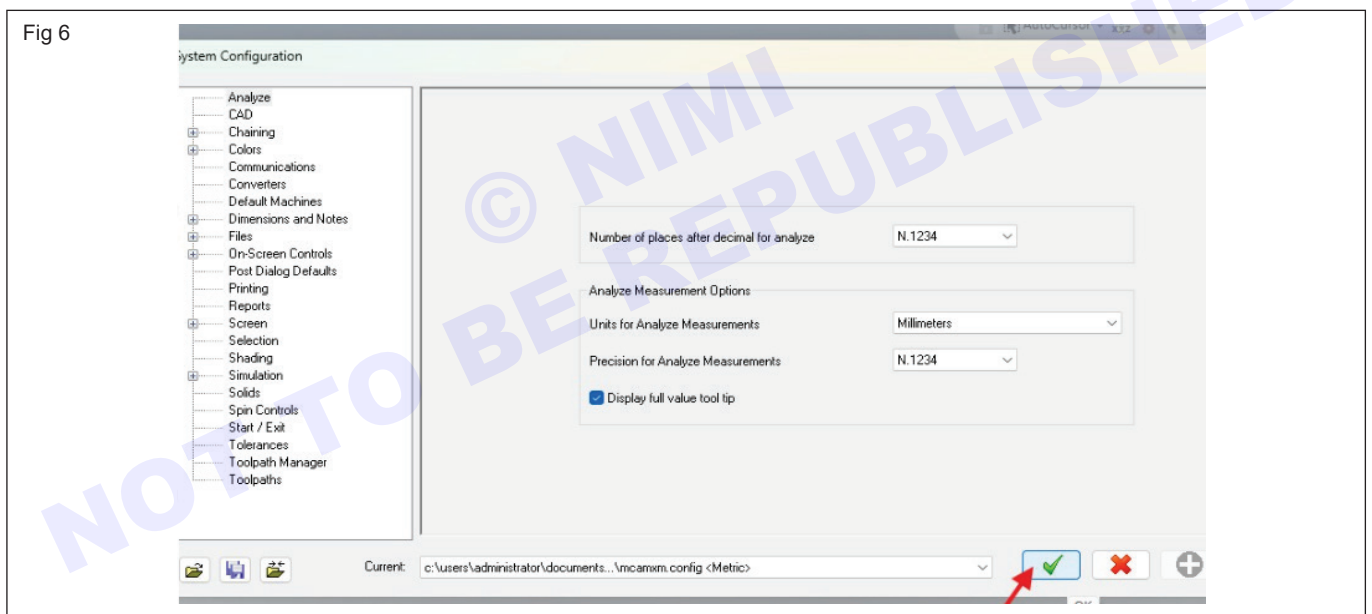
Fig 4



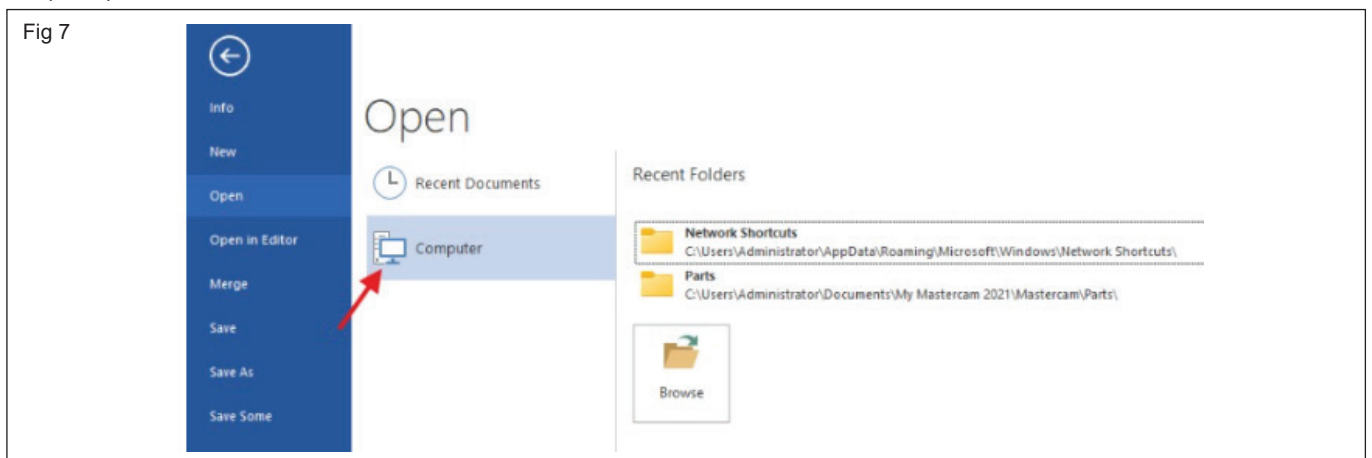
- In the left column of the File screen, choose the Configuration option.
- At the bottom of the System Configuration window, use the Current field's drop-down menu to select the option. (Fig 5)



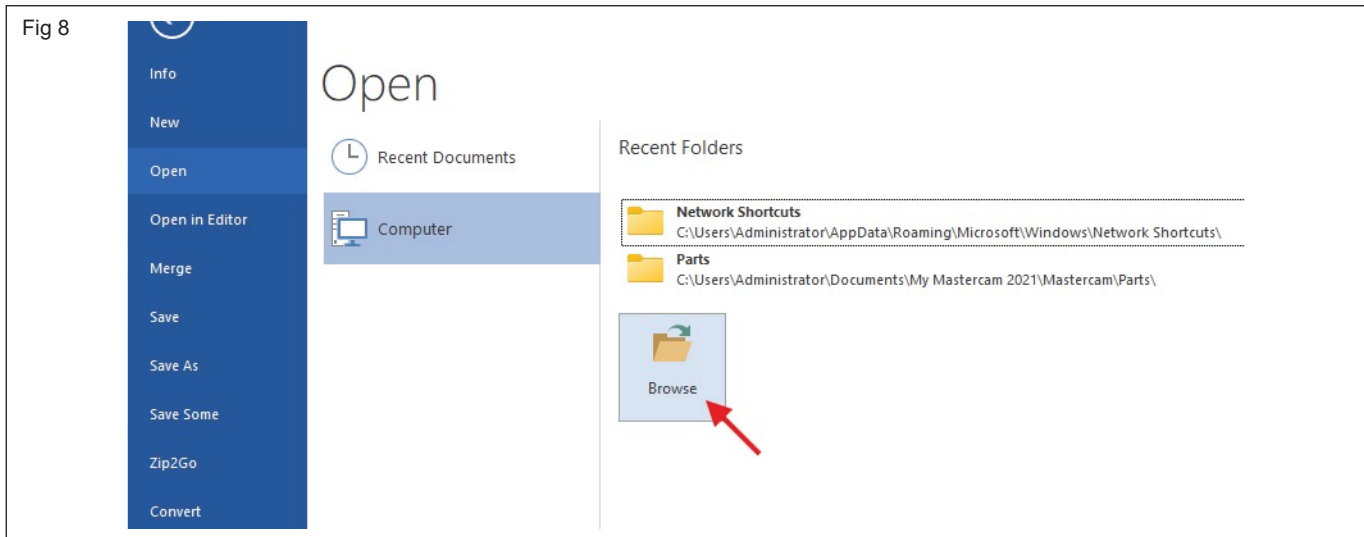
- After changing this option, notice that the Units for Analyze Measurements changes to Millimeters.
- Click the Green OK button in the System Configuration window. (Fig 6)



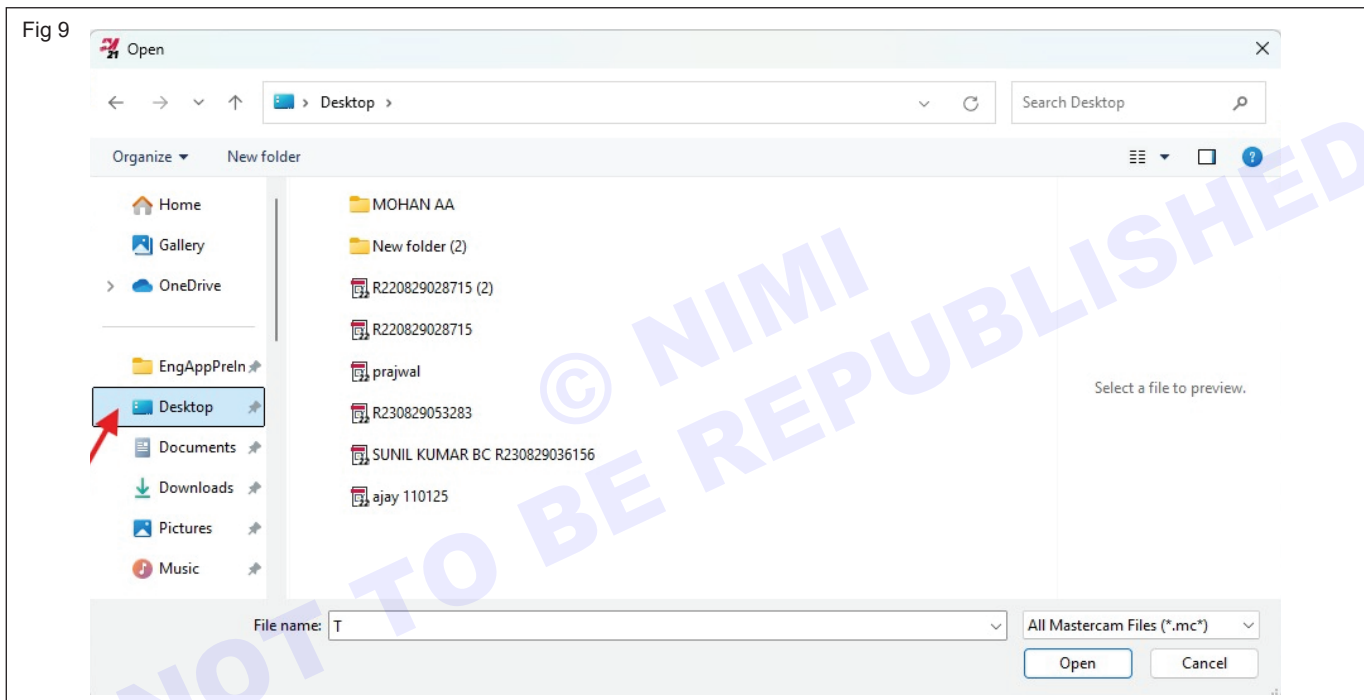
- Click the Open button in the Quick Access Toolbar (QAT).
- click "OPEN" option. (Fig 7)



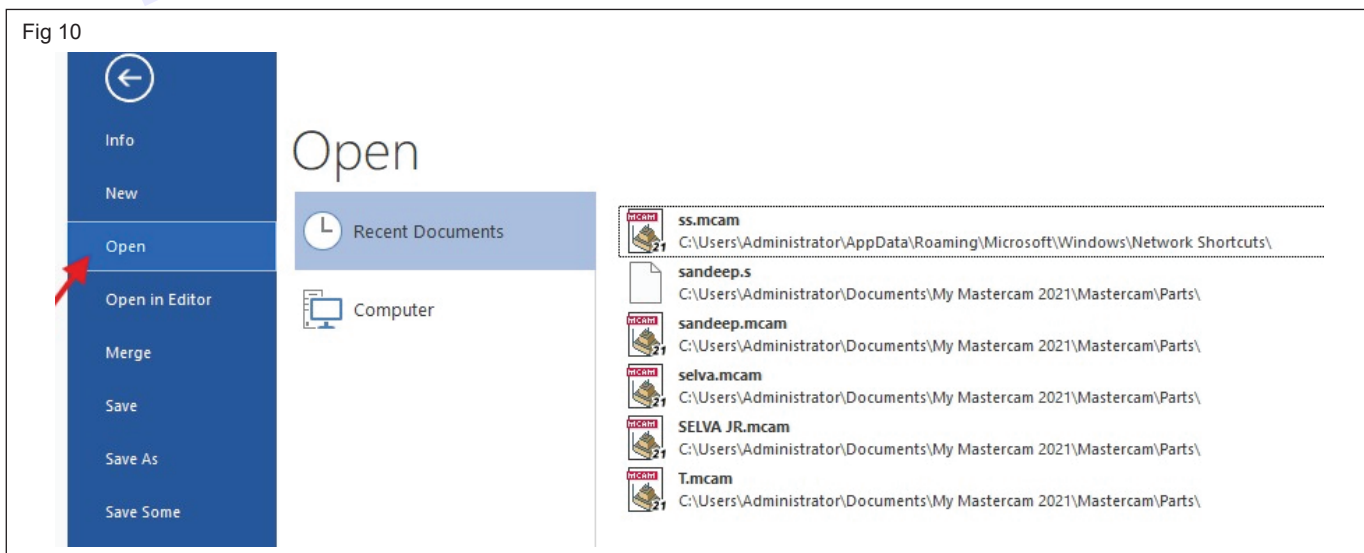
- Select “COMPUTER”. (Fig 8)



- Open “BROWSER”. (Fig 9)

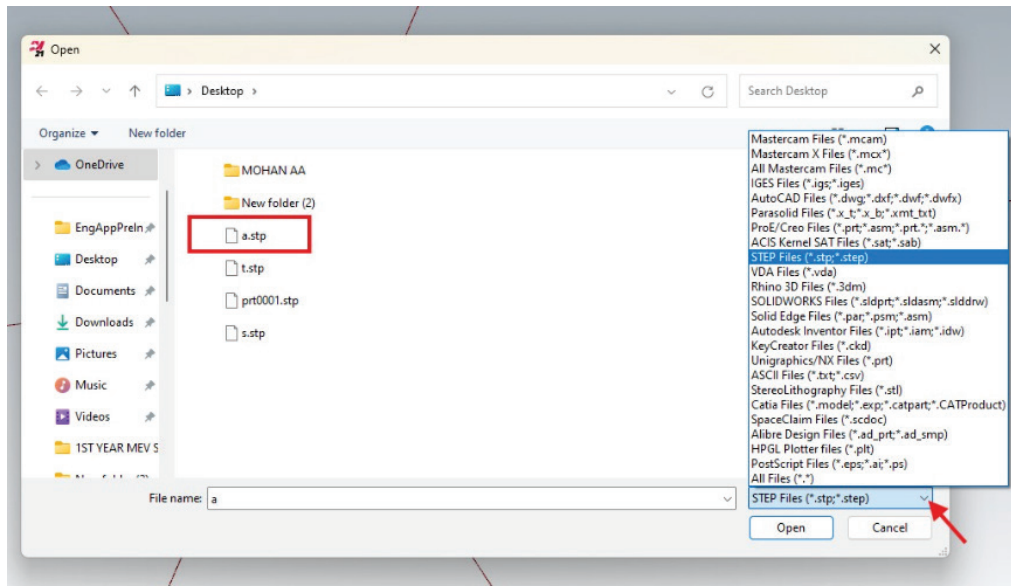


- Open “BROWSER”. (Fig 10)



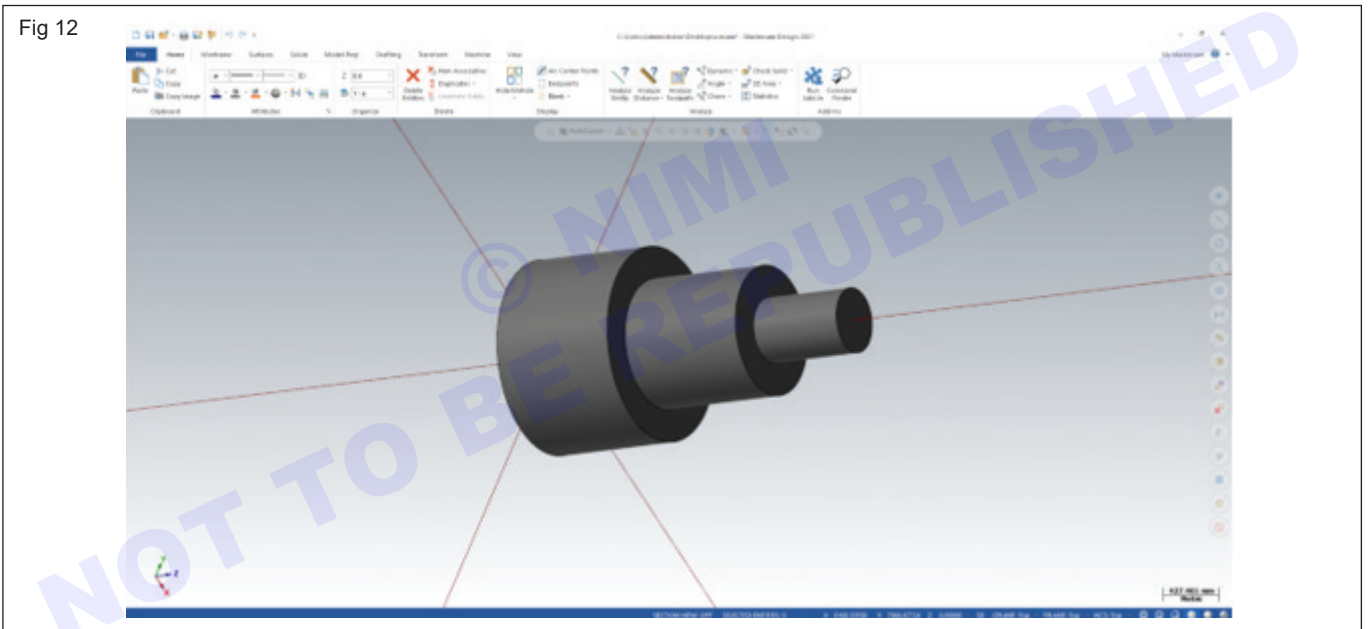
- Click“DESTOP”option. (Fig 11)

Fig 11



- Filter the required “STEP FILE” and double click the required file. (Fig 12)

Fig 12



- Required 3D MODEL is IMPORTED into the software

List out the importance of tool path generation

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

- identify the lathe general tool paths, symbols
- identify the lathe manual tool paths
- list out the lathe finishing tool paths
- list out the lathe canned tool paths.

Job Sequence

- Identify the lathe general tool path symbols
- Record the importance of tool path in table
- Record the tool path name in Table.

Sl. No.	General tool paths symbols	Tool path name	Importance
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

11			
12			
Sl. No.	Manual tool paths	Tool path name	Importance
1			
2			
Sl. No.	Canned tool paths	Tool path name	Importance
1			
2			
3			
4			

Get it checked by the instructor.

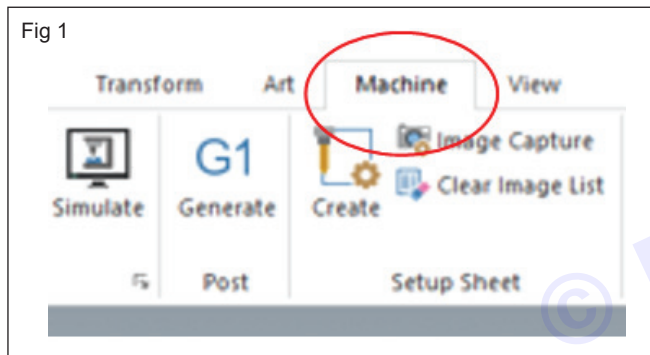
Select and upload cutting tool library in cam software

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

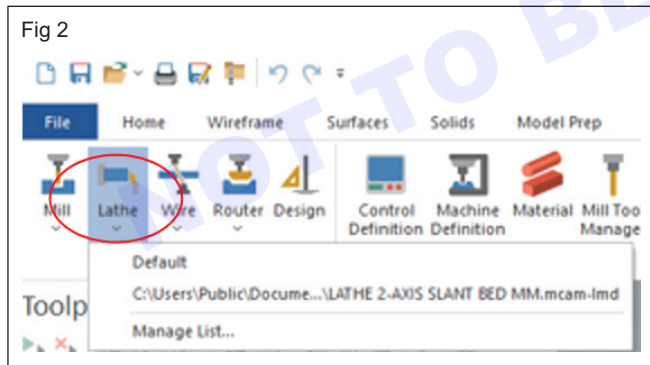
- select lathe in machine option in mastercam.
- select tool manager in mastercam
- identify tool library
- select appropriate tool library for the tool manufacturers or make
- change the tool details and parameters
- upload the tool library.

PROCEDURE

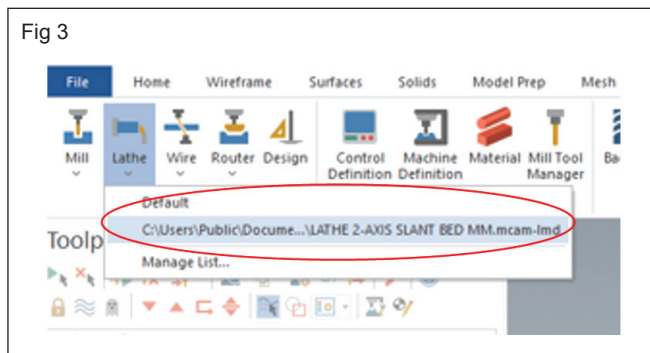
- 1 Switch on the computer and wait few minute.
- 2 Double-clicking Mastercam's desktop icon. Or Launching Mastercam from the Windows Start menu.
- 3 Take a few moments to explore Mastercam's interface.
- 4 Select 'Machine' option. (Fig 1)



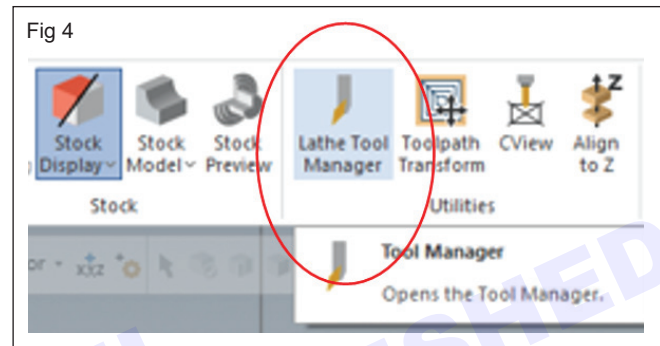
- 5 Select 'Lathe ' option. (Fig 2)



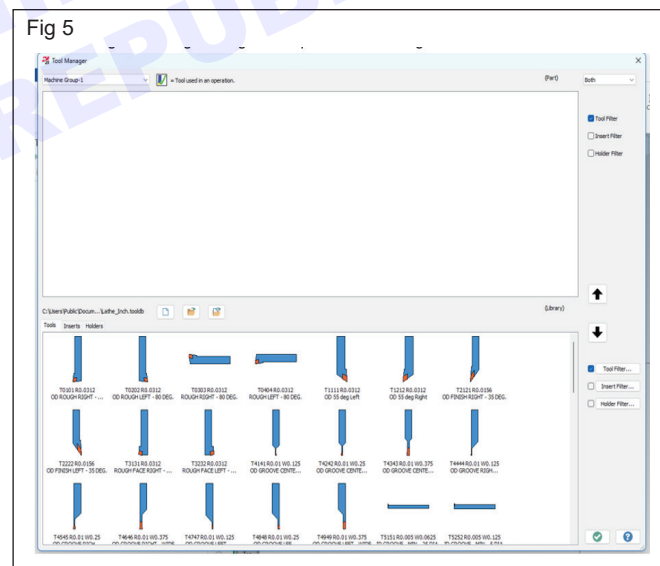
- 6 Select the Controller from the drop down under 'Lathe' option. (Fig 3)



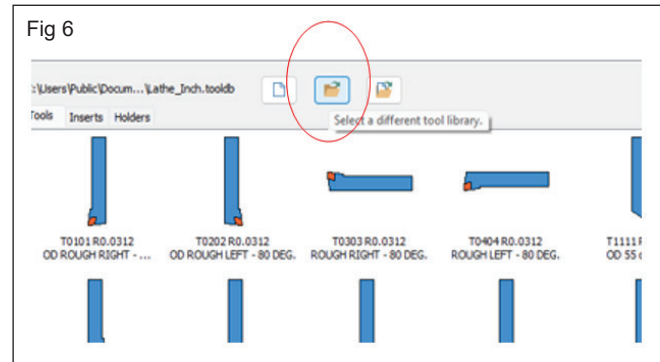
- 7 Select 'Tool Manager'. (Fig 4)



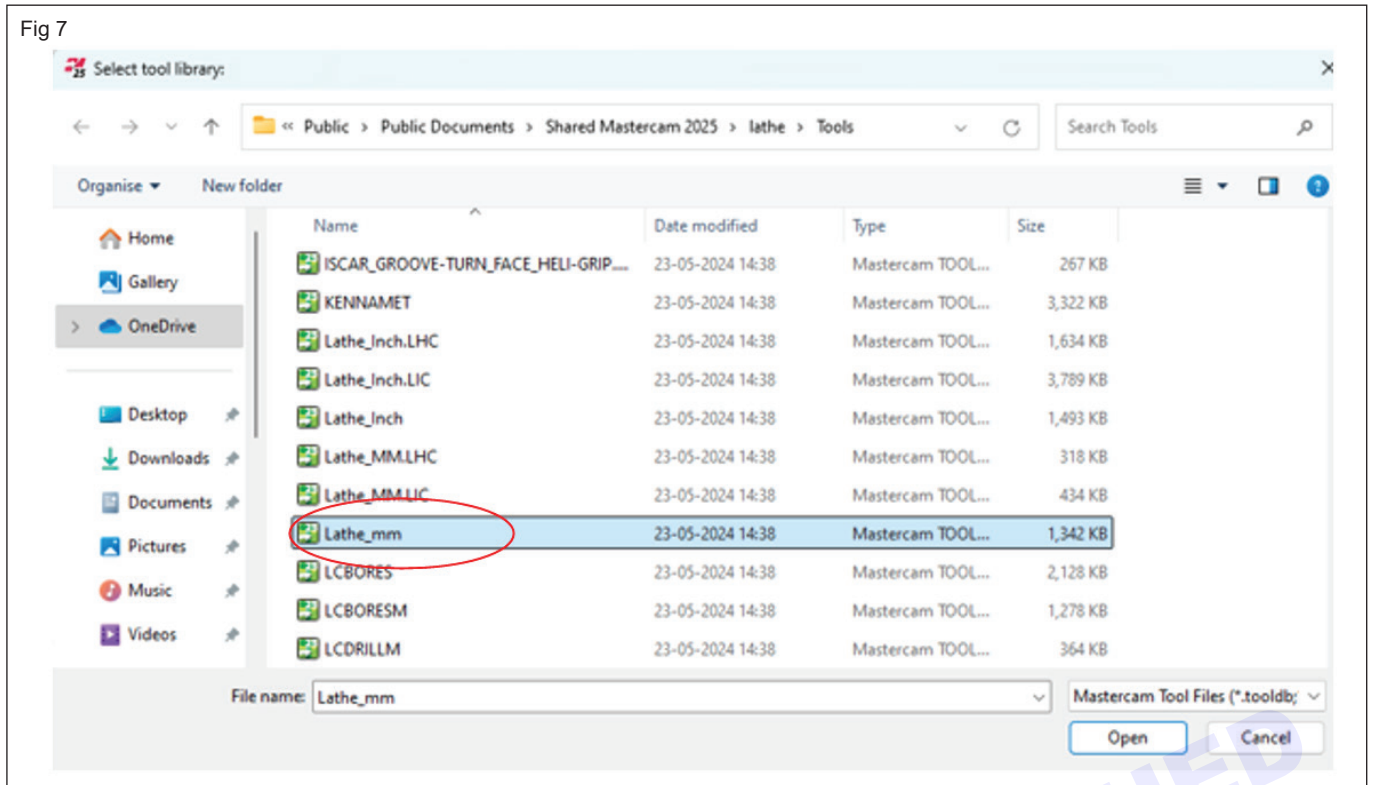
- 8 The following Tool Manager Dialogue Box Opens. (Fig 5)



- 9 Select 'Select a different Tool Library ' Option. (Fig 6)

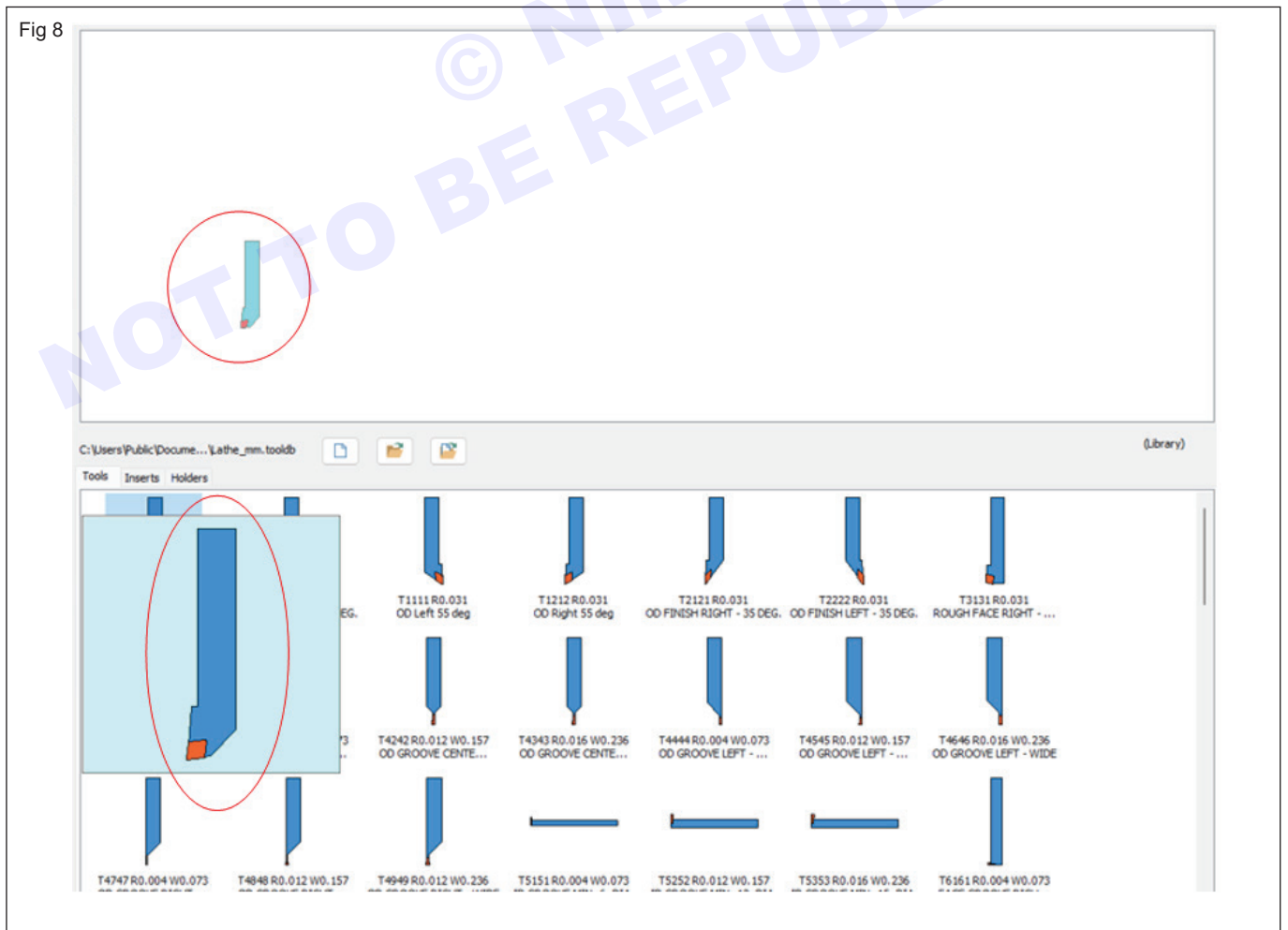


10 The below Dialogue Box opens. (Fig 7)

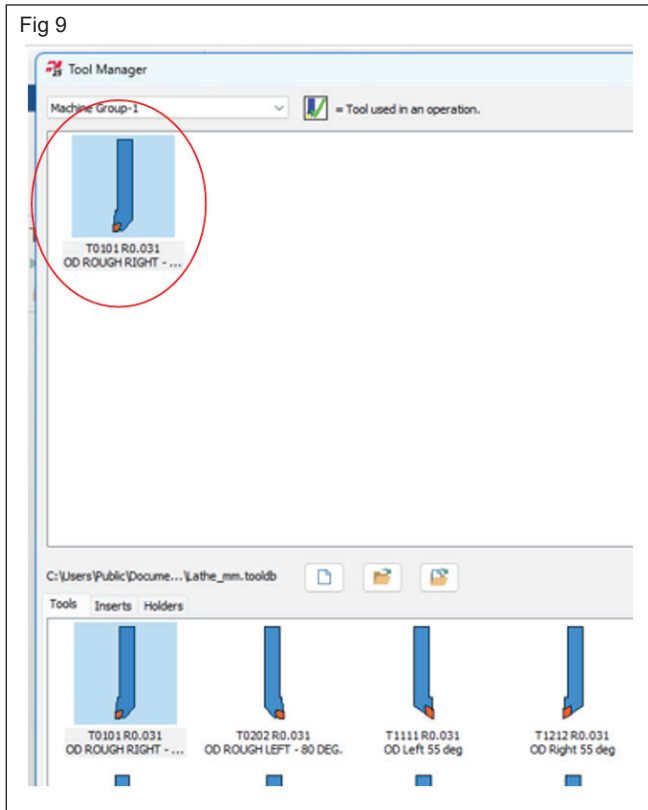


11 From the options we can select the Tool Library for the respective Tool Make or Company of Tool Manufacturers.

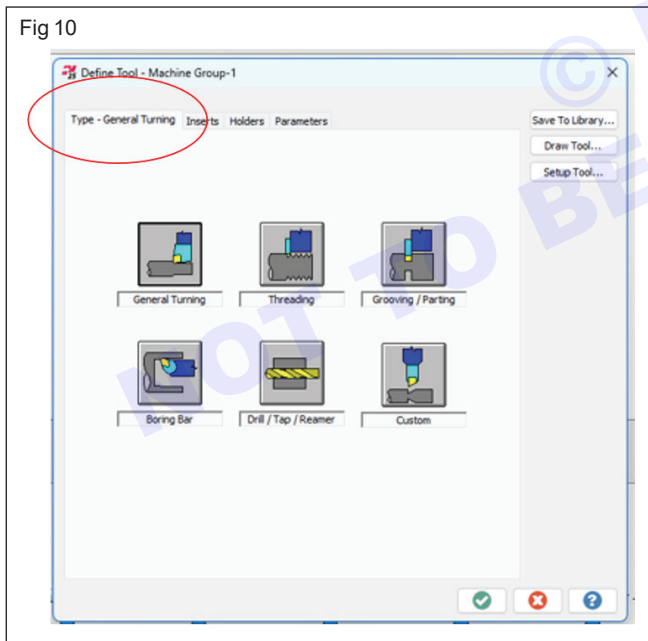
12 Select the tool using left mouse button. Drag and drop in the Upper Window. (Fig 8)



13 Double click on the Tool icon dropped in the above window. (Fig 9)

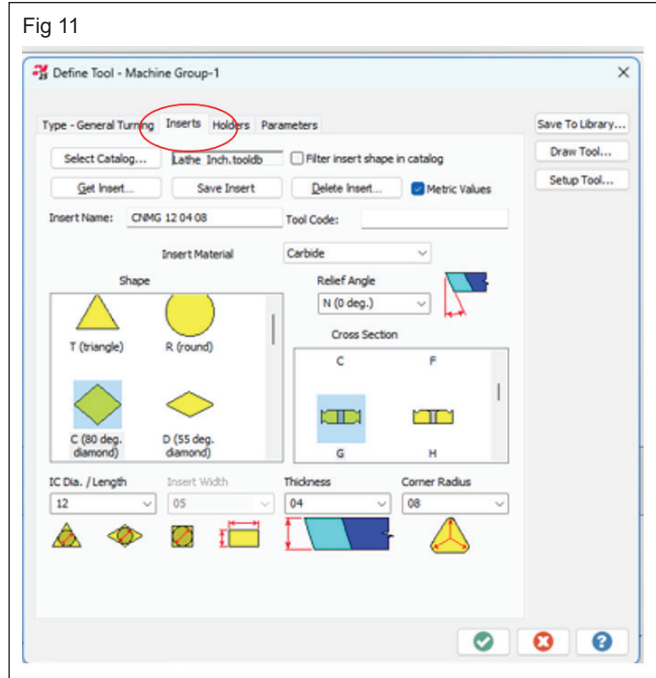


14 The following window appears. (Fig 10)



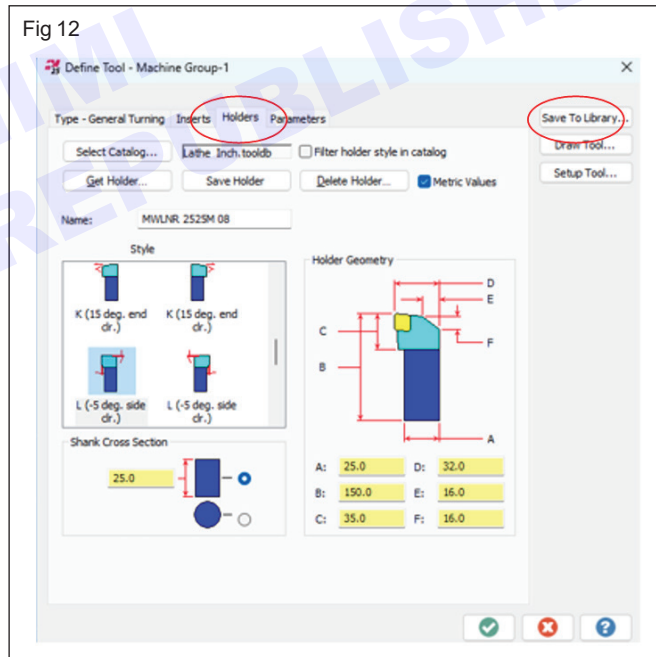
15 Using the above window, we can modify the Type of Tool and select 'Save to Library' option.

16 Select 'Inserts' Option the following window appears. (Fig 11)



17 In the above window the Tool Insert data can be modified.

18 Select the Holders option in the window the Following Dialogue box appears. (Fig 12)



19 In the above window the Tool Holders details can be modified as per the available toolings.

20 Click 'Save to Library' option

21 The selected tool data is uploaded into the library of the turning machine group.

Run the simulation tool on 3d model for virtual verification of tool path

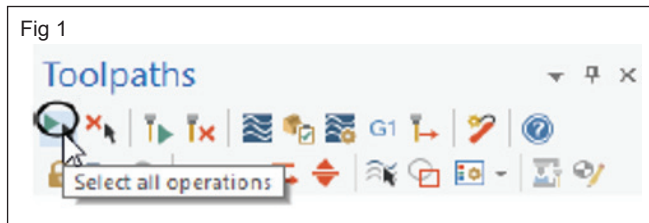
Objectives: At the end of this exercise you shall be able to

- back plot the tool path
- simulate the tool path in verify for a selected operation
- simulate the tool paths in verify for all the operations.

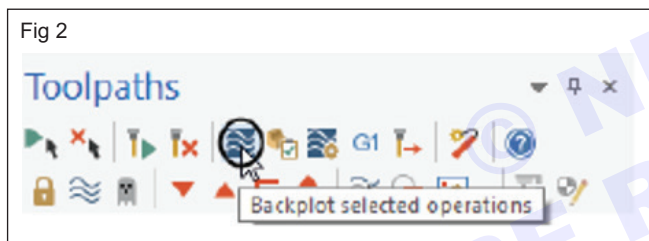
PROCEDURE

TASK1: Back plot the toolpath 1

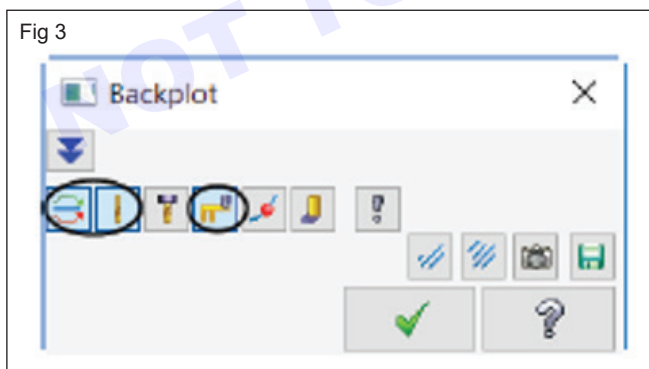
- 1 Make sure that the toolpath is selected (signified by the green check mark on the folder icon). If the operation is not selected, choose the **Select all operations** icon. (Fig 1)



- 2 Select the **Backplot selected operations** icon. (Fig 2)



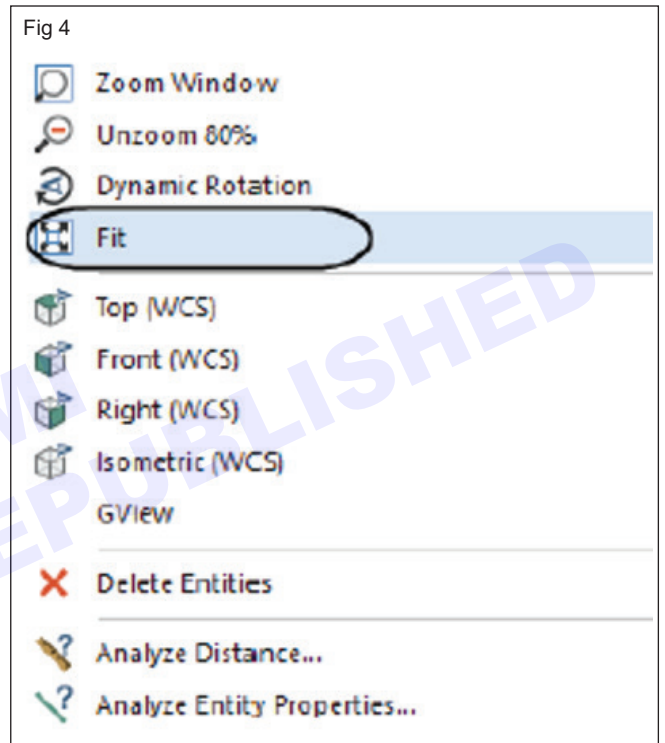
- 3 In the Backplot dialog box enable the Display with color codes, Display tool, Display holder and Display rapid moves icons. (Fig 3)



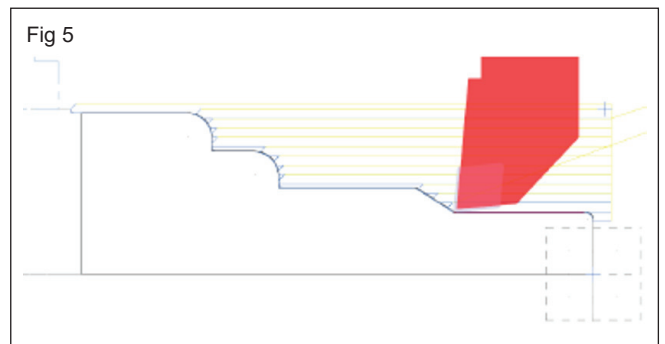
- 4 To fit the workpiece to the screen, if needed, right mouse click in the graphics window again and select **Fit** or press **Alt + F1**. (Fig 4)

- You can step through the Backplot by using the Step forward or Step back buttons.
- You can adjust the speed of the backplot with the Rin speed slider.

- Select the Play button to run Backplot.



- 5 The toolpath should look. (Fig 5)



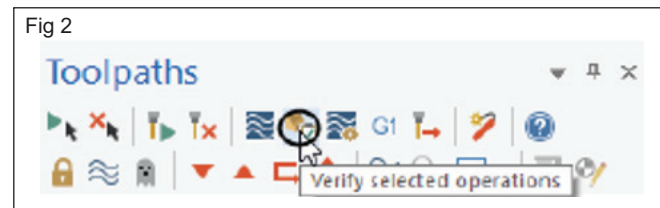
- Select the OK button to exit Backplot.

TASK 2 : Verify the tool paths

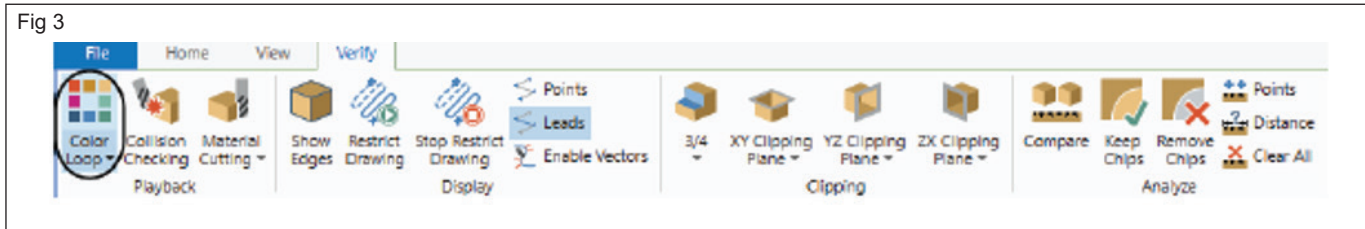
1 To verify all toolpaths, from the Toolpaths Manager, choose the Select all operations icon. (Fig 1)



2 Select the verify selected operations icon. (Fig 2)

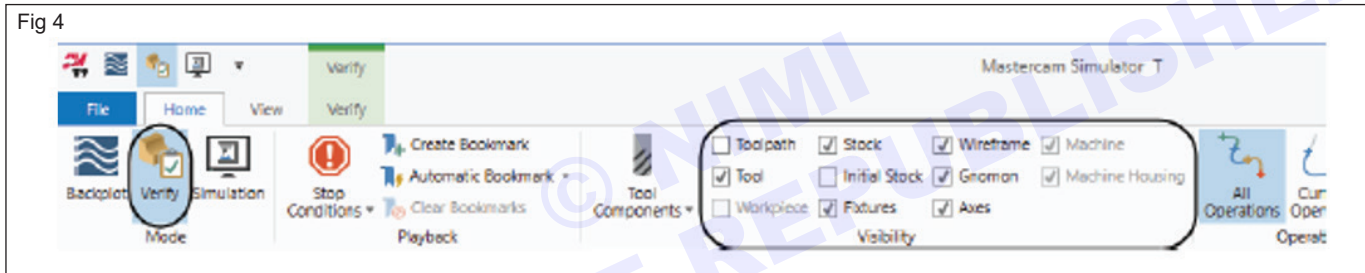


3 Select the verify tab, and enable color loops. (Fig 3)

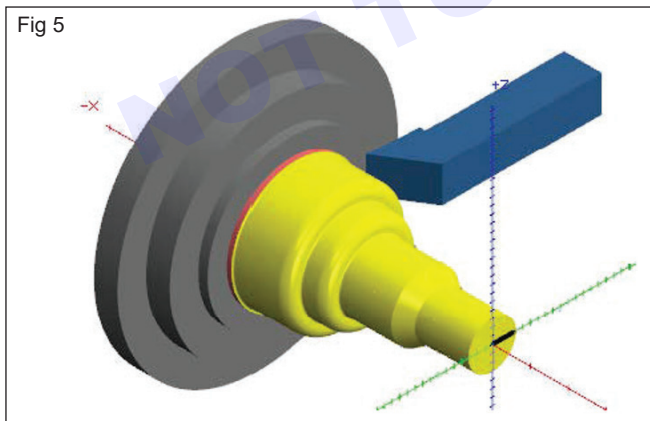


4 This option will change the material removal color. This can be set based on the operation or on the tool number used to machine the part. This makes it easier to spot if you forgot to leave the stock on in the finish operations.

- In Mastercam Simulator, verify should be enabled and change the settings. (Fig 4)
- Select the **Play** button to run **verify**.



• To see the part from an **Isometric** view right mouse click in the graphics **window** and select Isometric. The part should look. (Fig 5)



- To check the part step by step, click first on the Start button.
- Click on **Step Forward** to see the tool moving one step at a time.



- Click on **Step Forward** until the toolpath is completed.
- To go back to the Mastercam window, minimize the **Mastercam Simulator window**.
- Press **Alt + T** to remove the toolpath display.



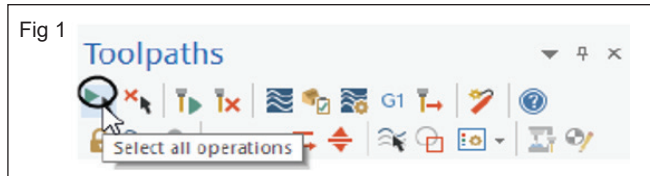
Generate a NC program by using CAM software

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

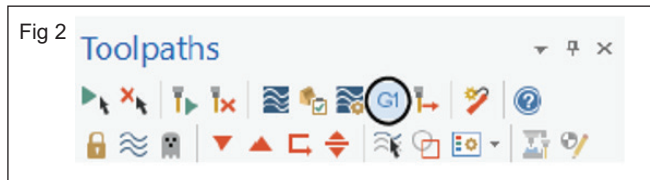
- post process and generate the program.
- save the generated program.

PROCEDURE

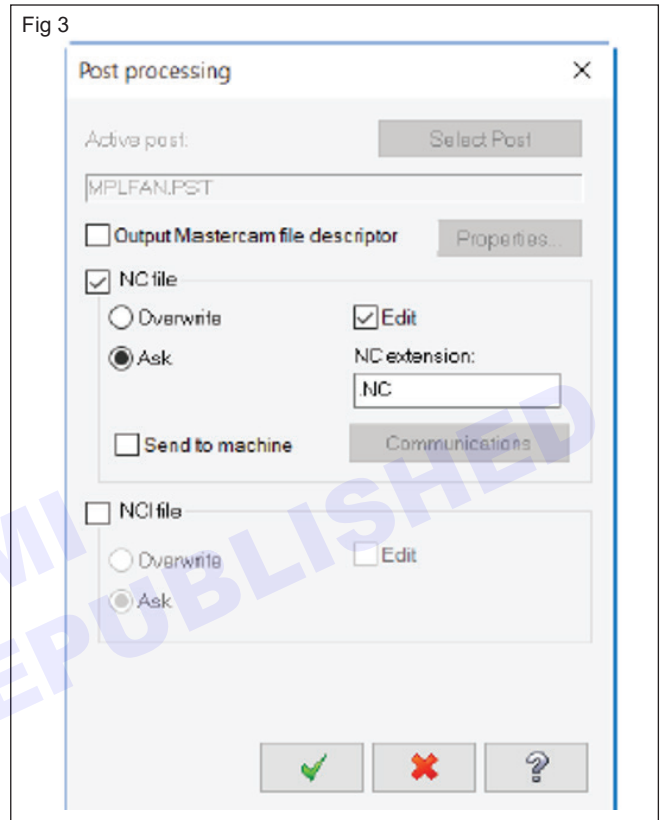
- 1 Ensure all operations are selected. If they are not, use the **Select all operations** icon in the **Toolpaths Manager**. (Fig 1)



- 2 Select the **Post selected operations** icon from the **Toolpaths Manager**. (Fig 2)



- 3 In the **Post processing** dialog box, make the necessary changes. (Fig 3)

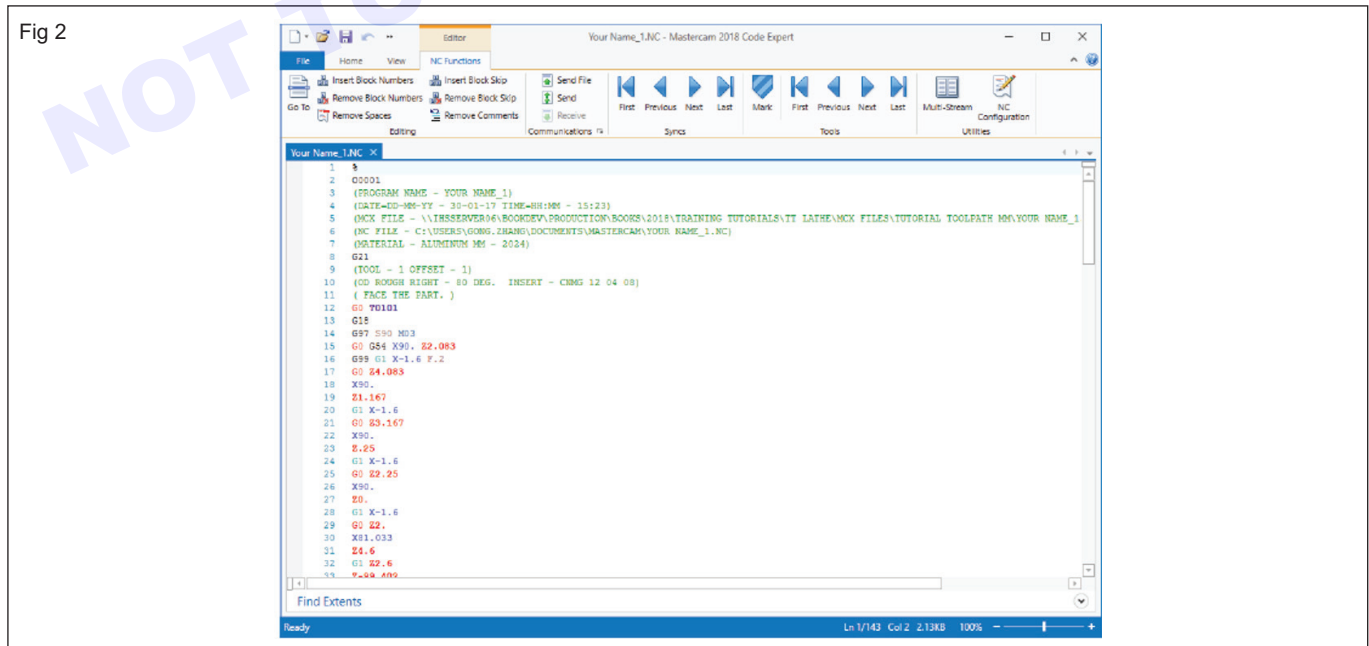


Select the OK button to continue.



Save the NC file.

The Mastercam Code Expert window will be launched and the NC program will appear. (Fig 4)



- 4 Select the "X" box at the upper right corner to exit the editor.

- 5 Save the updated Mastercam File

Export the generated NC program for machining process

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

- exporting the CAM program through memory card
- exporting the CAM program from PC to CNC memory via LAN
- exporting the CAM program from USB devices.

PROCEDURE

TASK 1: Exporting the CAM program through memory card

- 1 Connect the card reader to the PC.
- 2 Fix the memory card in the card reader.
- 3 Copy the CAM program to be run into the memory Card.
- 4 Remove the memory card.
- 5 Fix the memory card in the machine using the below procedures.

TASK 2: Procedure for fixing the memory card

- 1 Take a memory card (Fig 1) & Compact flash adopter (Fig 2) as shown in the below Figs.
- 2 Insert the memory card into adopter flash card slot as shown in Figs 3 & 4.

Fig 1



Fig 3



Fig 2



Fig 4



3 Open the PCMCIA or Adopter Slot in the Machine as shown in Figs 5 & 6.

Fig 5



Fig 6



4 Insert the adopter with memory card as shown in Figs 7 & 8.

Fig 7

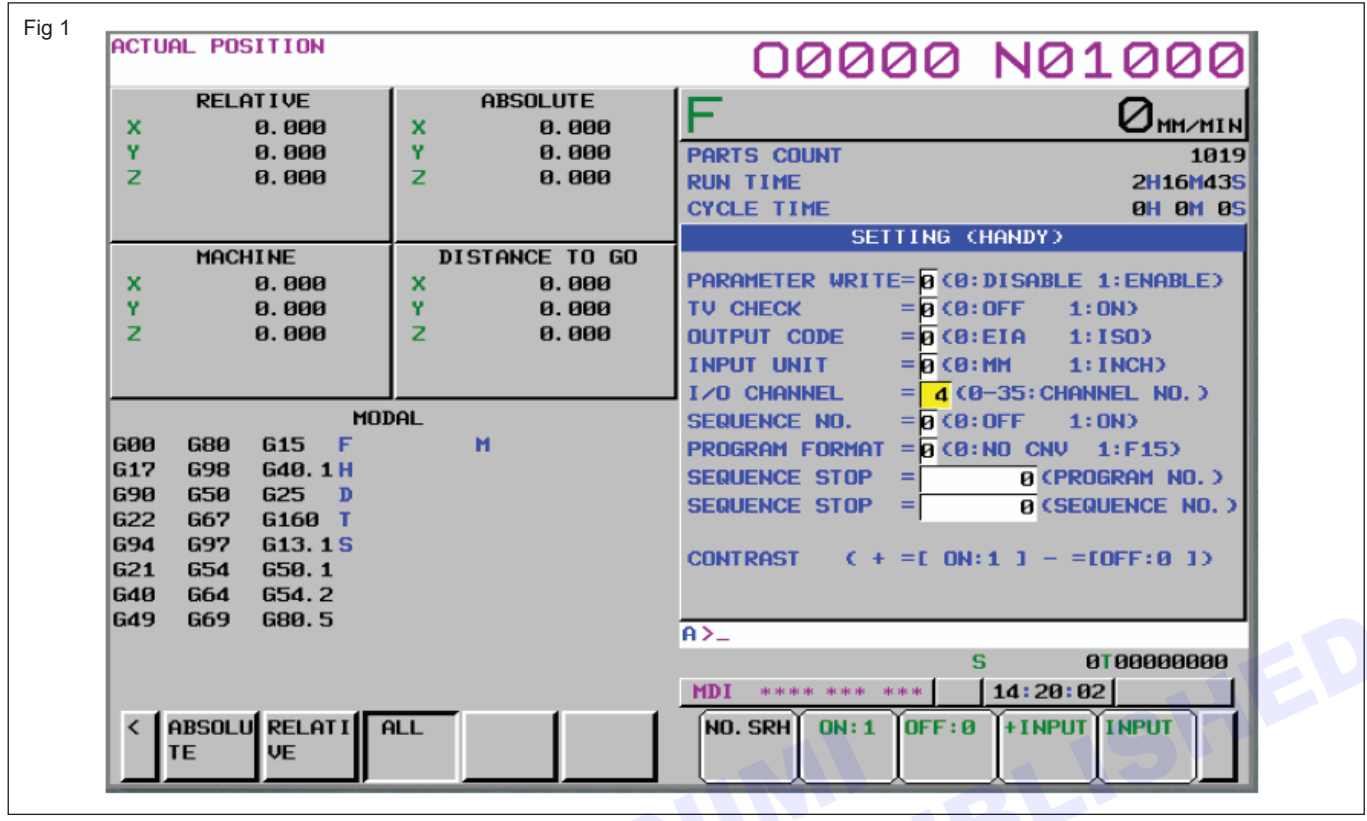


Fig 8

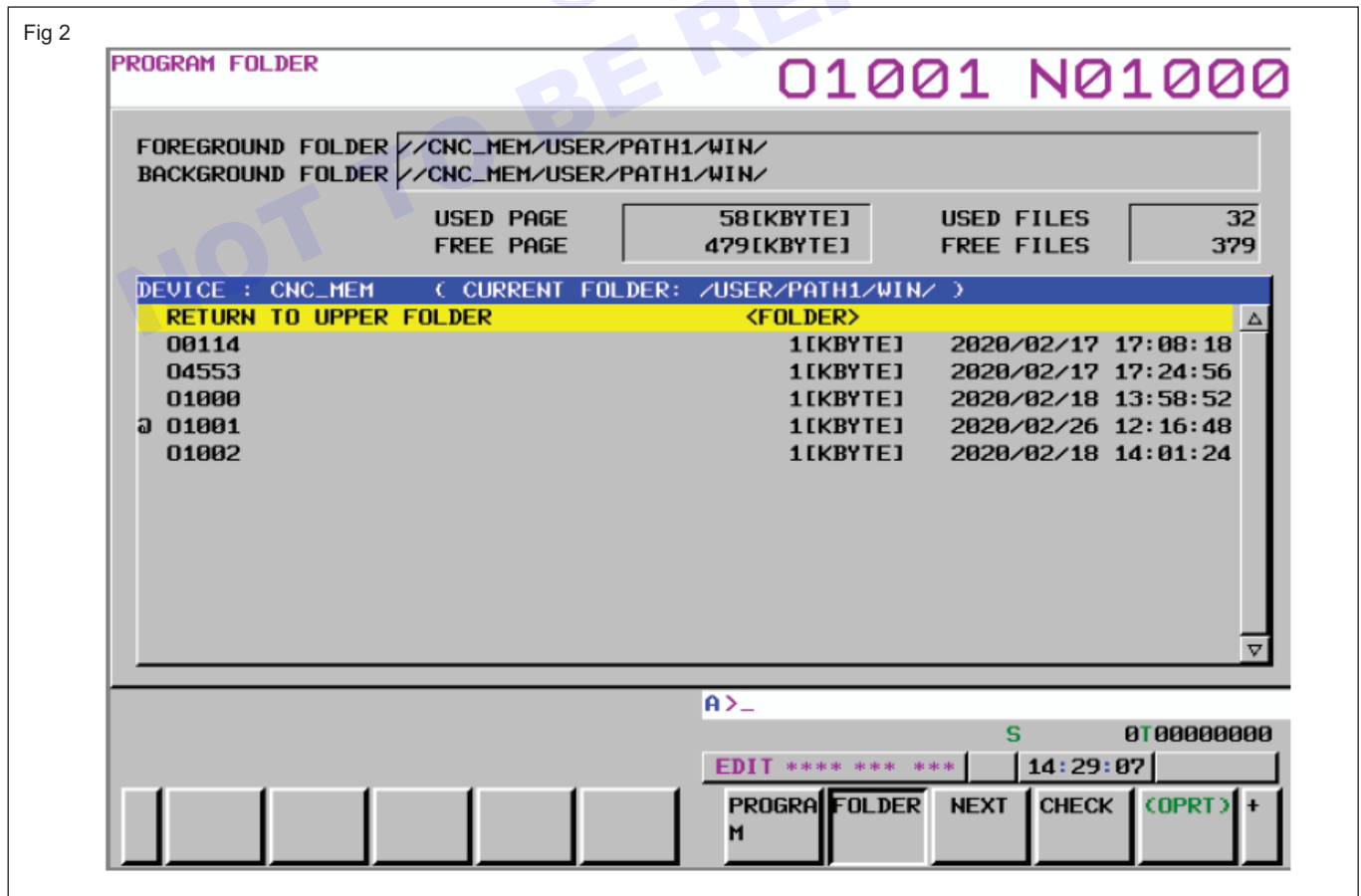


TASK 3: Procedure for executing the program in CNC Machine by using DNC mode & memory card

- 1 Press "OFS/SET" function key and select "SETTING".
Set I/O CHANNEL as 4 for memory card. (Fig 1)

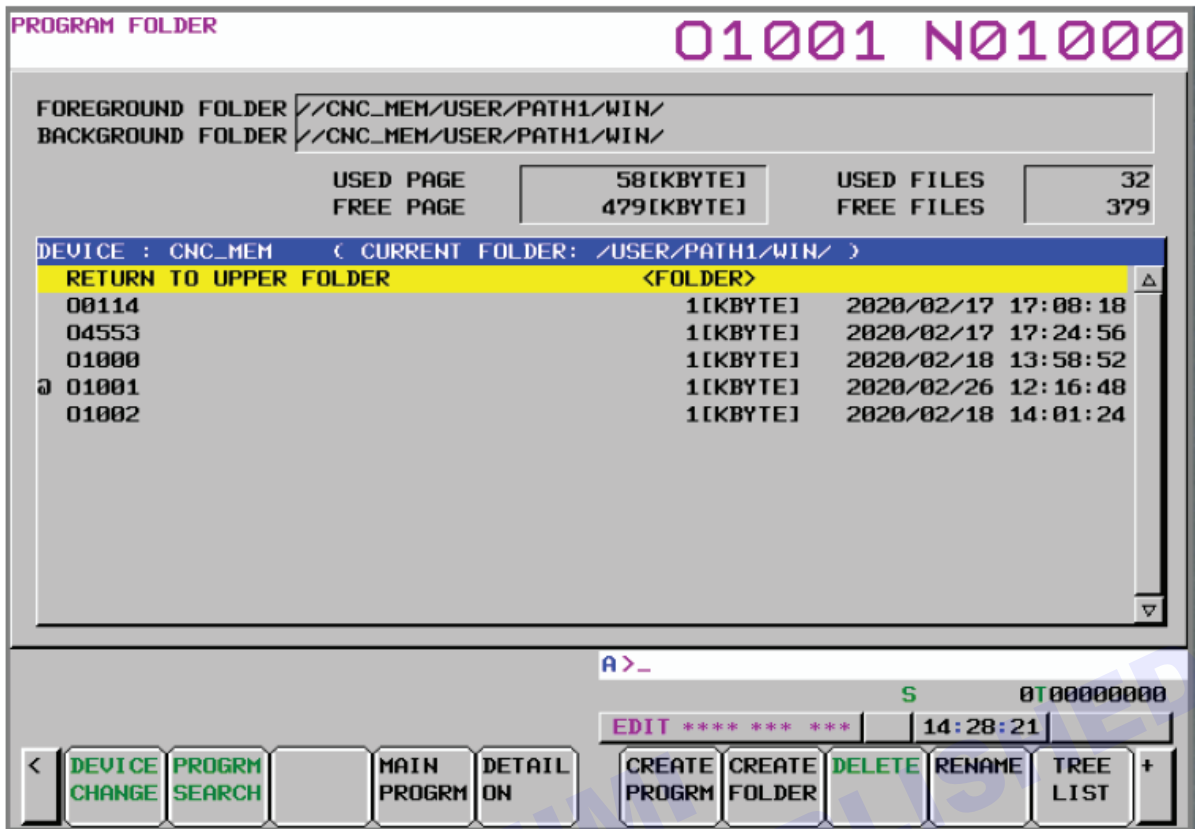


- 2 Press "PROG" function key and select "FOLDER" (Fig 2)



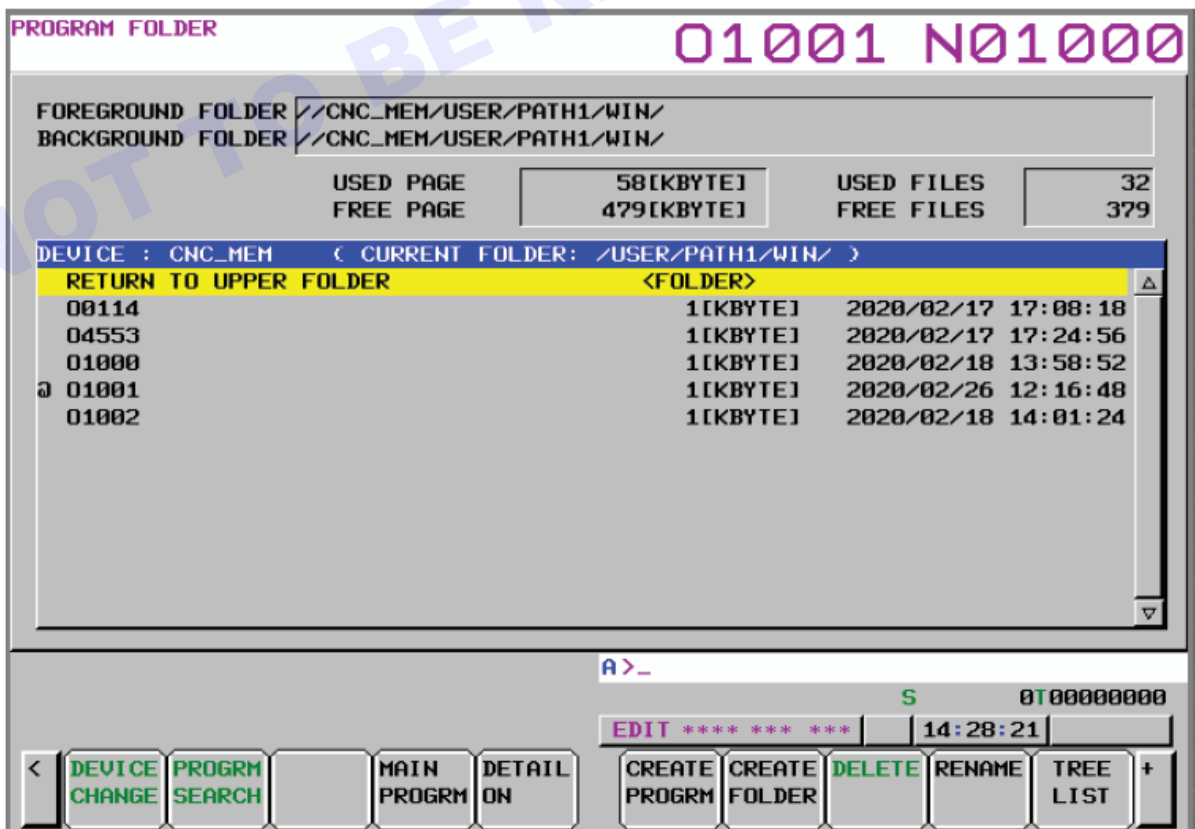
- 3 Select "OPRT" and select "DEVICECHANGE".
(Fig 3)

Fig 3



- 4 Select "MEMORY CARD". All files in memory card will be displayed. (Fig 4)

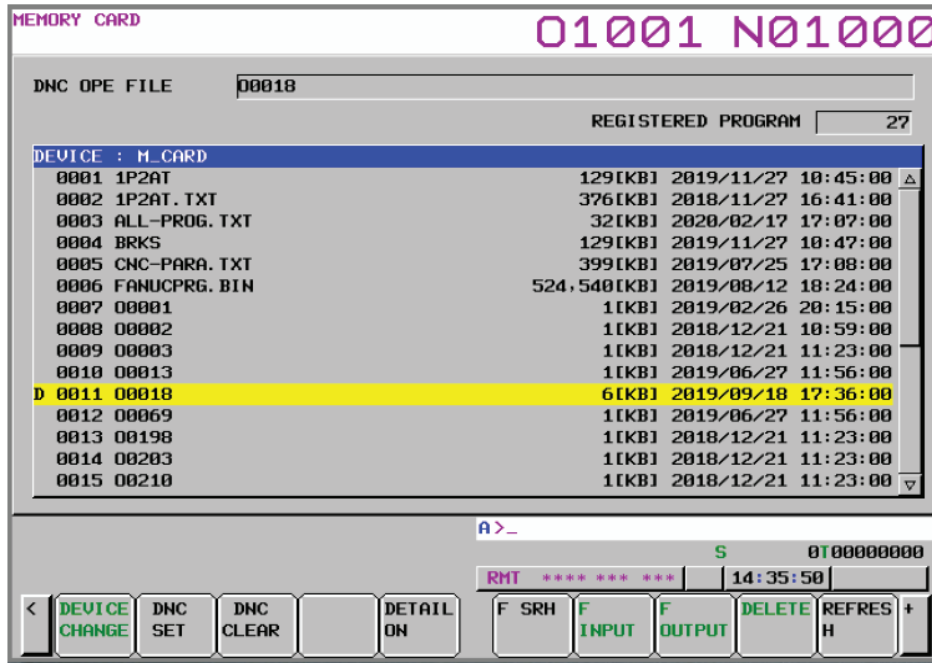
Fig 4



5 Set "REMOTE mode" and move the cursor to target program and select "DNC SET". Then press cycle start to run the program through memory card.

6 DNC operation file name will be displayed on top of the screen (DNC OPE FILE) and also "D" is displayed in front of file name. (Fig 5)

Fig 5



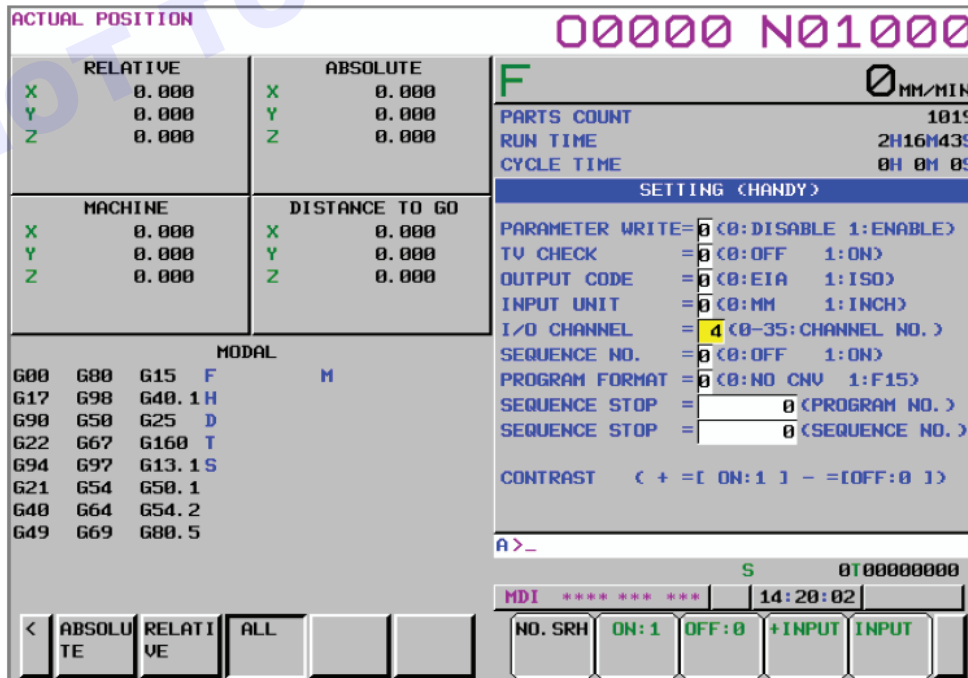
TASK 4: Procedure to execute the program in the memory card by sub program call (M198)

The subprogram call function is provided to call and execute subprogram files stored in an external input / output devices like USB drives (Pen drives), memory cards during memory operation.

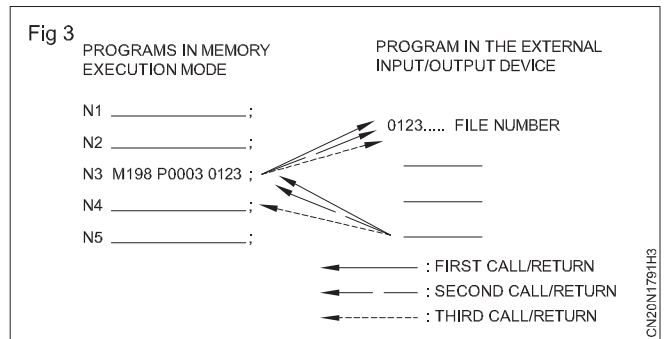
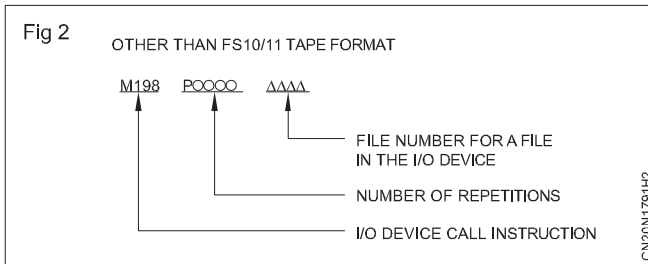
- 1 Insert the memory card to CNC machine.
- 2 Press "OFS/SET" function key and select "SETTING". Set I/O CHANNEL as 4 for memory card. (Fig 1)

When the following block in a program in CNC memory is executed, a sub program file in the memory card is called

Fig 1



- 3 In CNC memory make a main program and in a block link the program number in a memory card by calling a sub program call using M code M198 and end the SUBPROGRAM using M99. This returns to the main program. Example of a format is shown (Figs 2 &3)

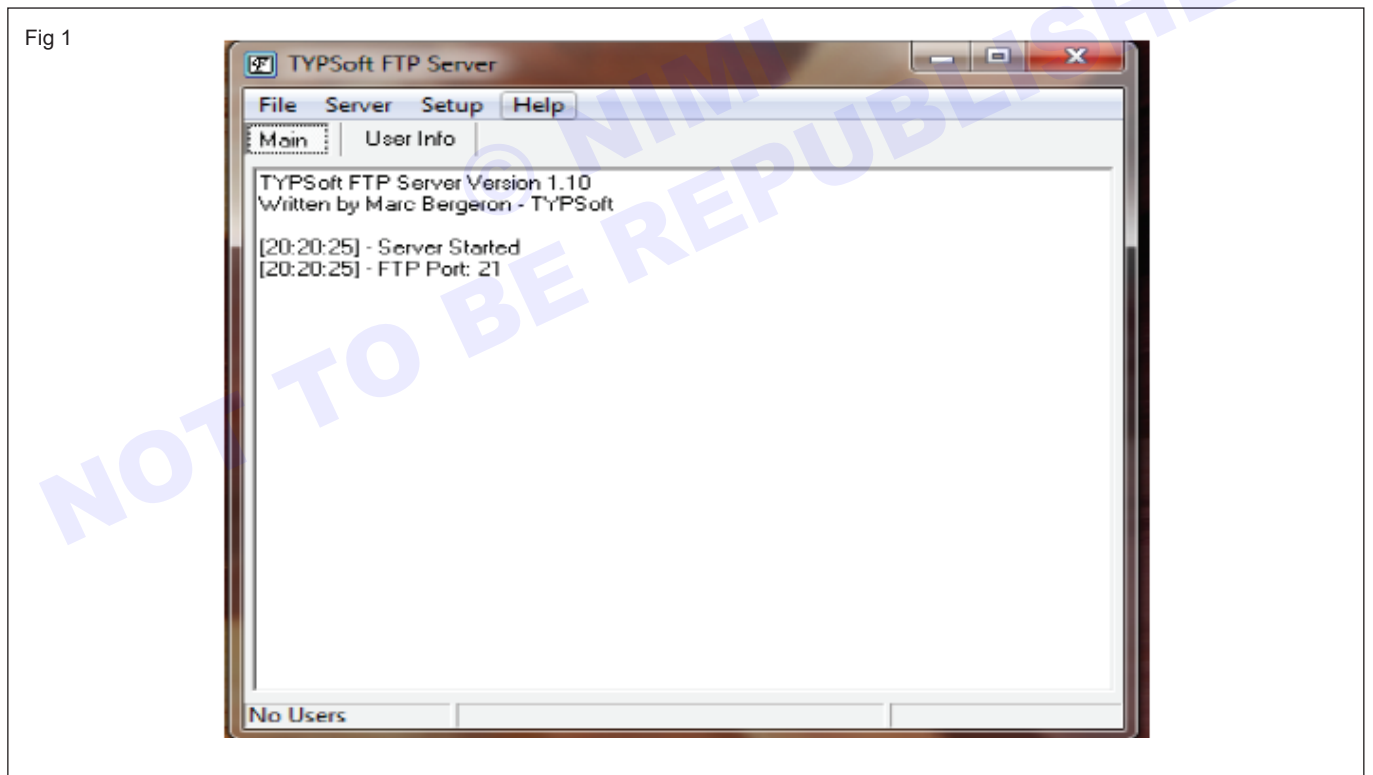


Note: These procedures may change depending on the control system in your CNC machine. Kindly refer your machine manual or your machine control supplier for any settings.

TASK 5: Exporting the CAM program from PC to CNC memory via LAN

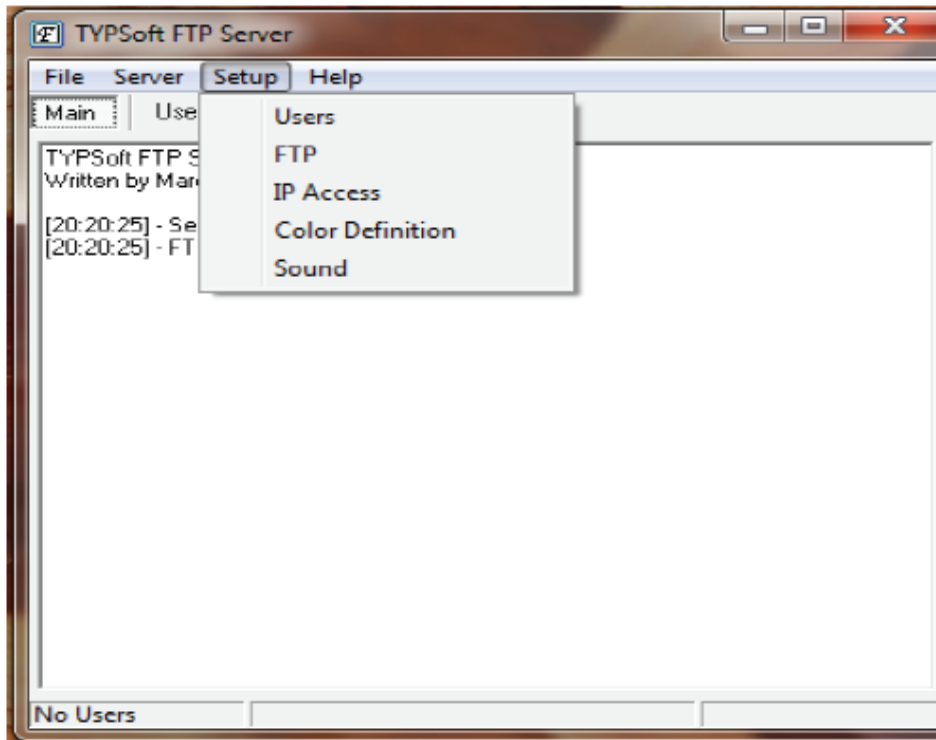
Settings required in PC

- 1 Prepare Ethernet cross cable and connect cable between PC to embedded Ethernet Port. Install FTP server software in PC.
- 2 Set PC IP address (example:192.168.0.25) and subnet mask as 255.255.255.0
- 3 Open the “TYPSoft FTP server” software. (Fig 1)



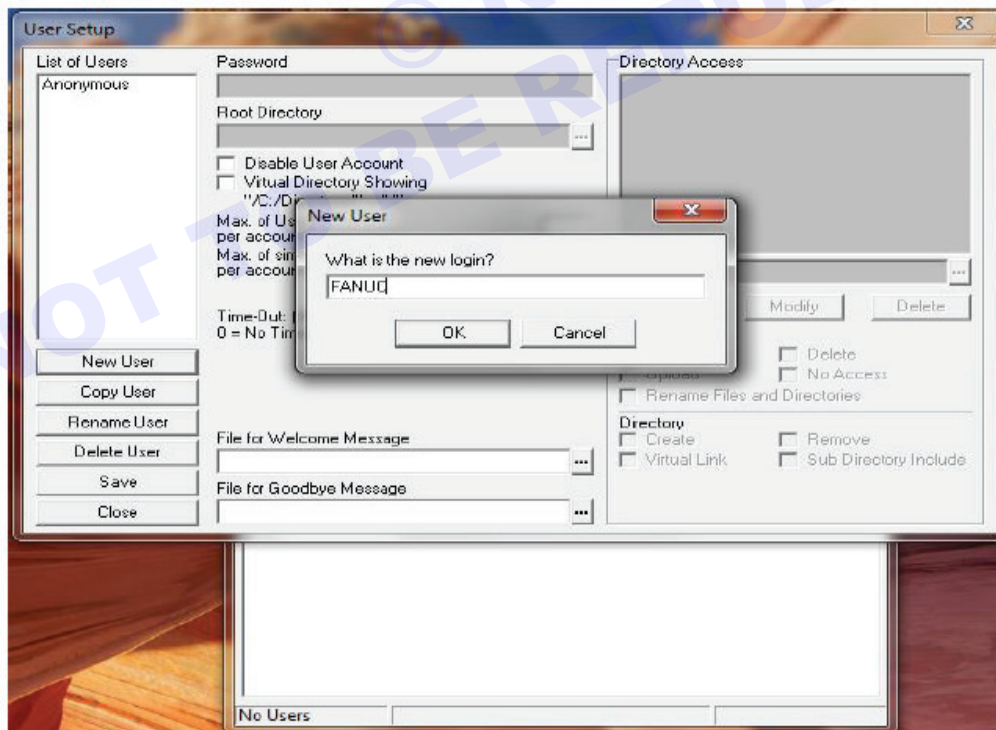
4 Select 'Setup' and select 'Users'. (Fig 2)

Fig 2



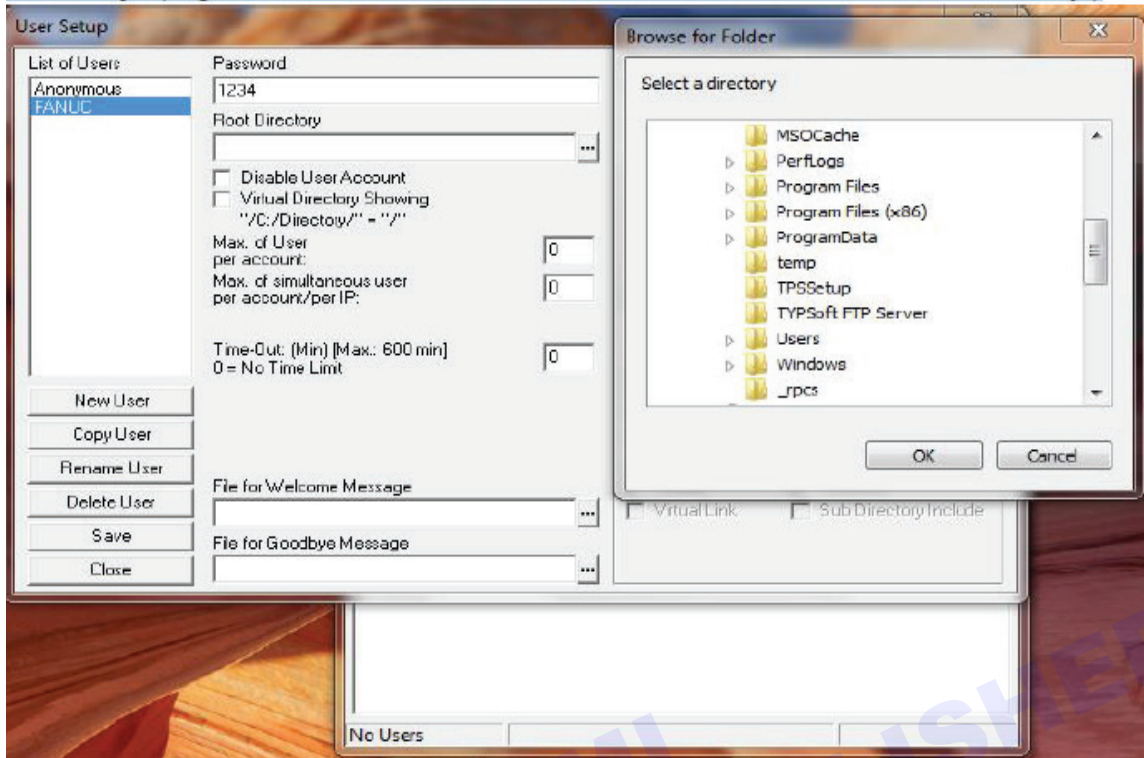
5 Select "New User" and enter the new login name press "OK". (Fig 3)

Fig 3



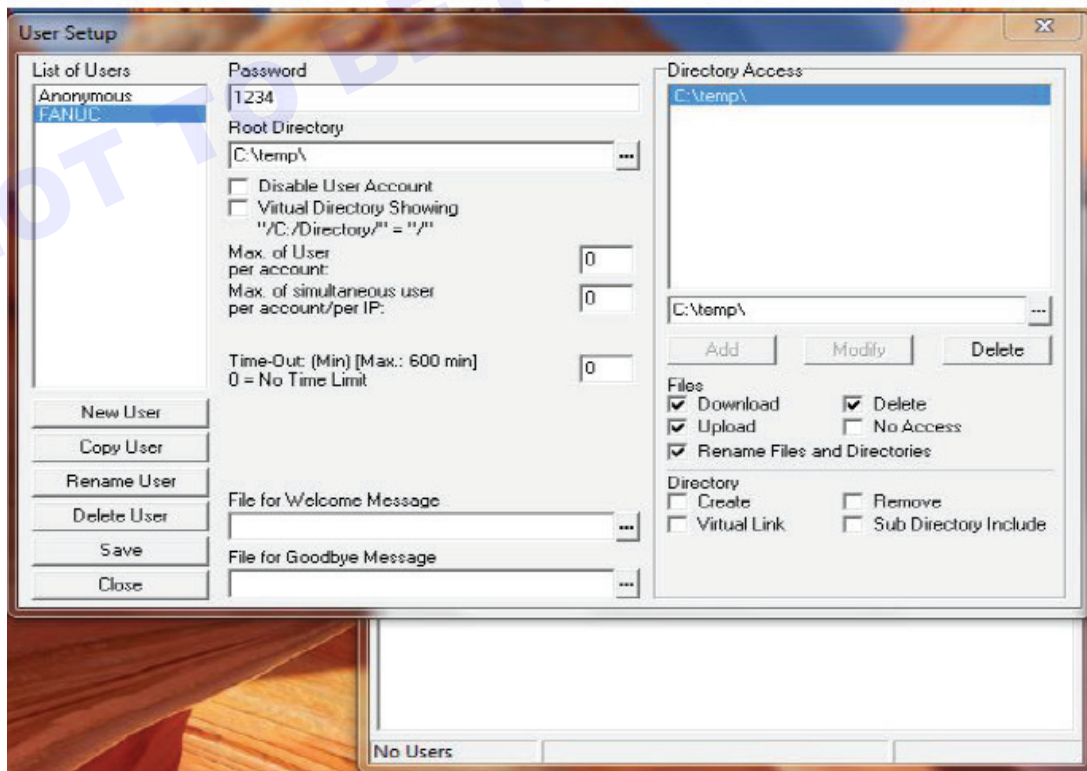
- Select the newly created user, then enter the password and select the root directory. (e.g. here we selected TEMP folder in C: drive as root directory) (Fig 4)

Fig 4



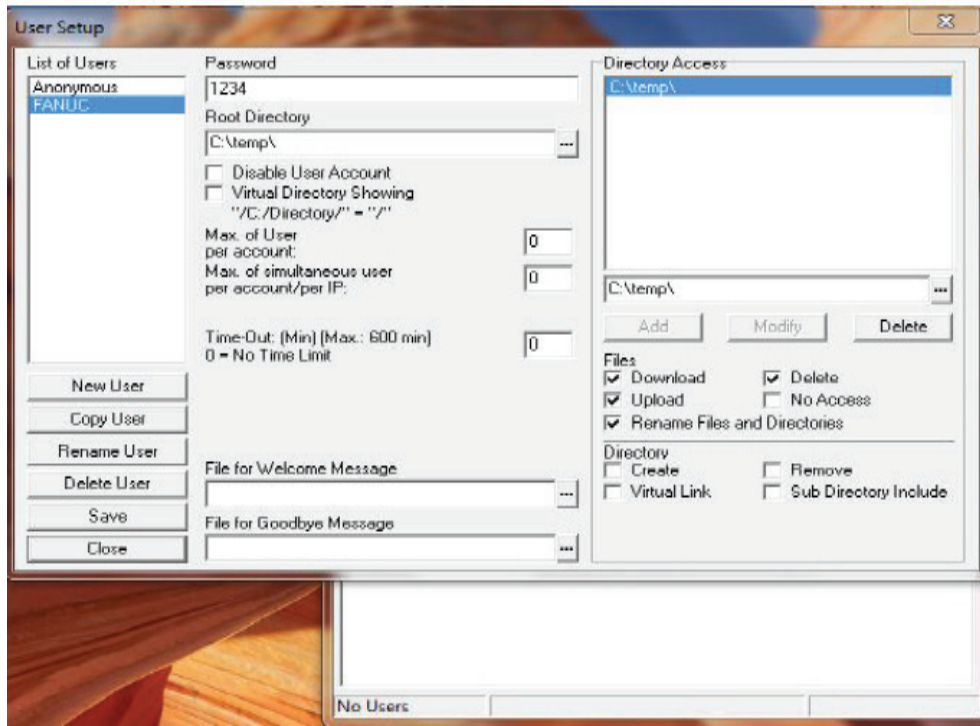
- Select "C:\temp\" from directory access and select the file operation download, upload, delete and rename files and directories. (Fig 5)

Fig 5



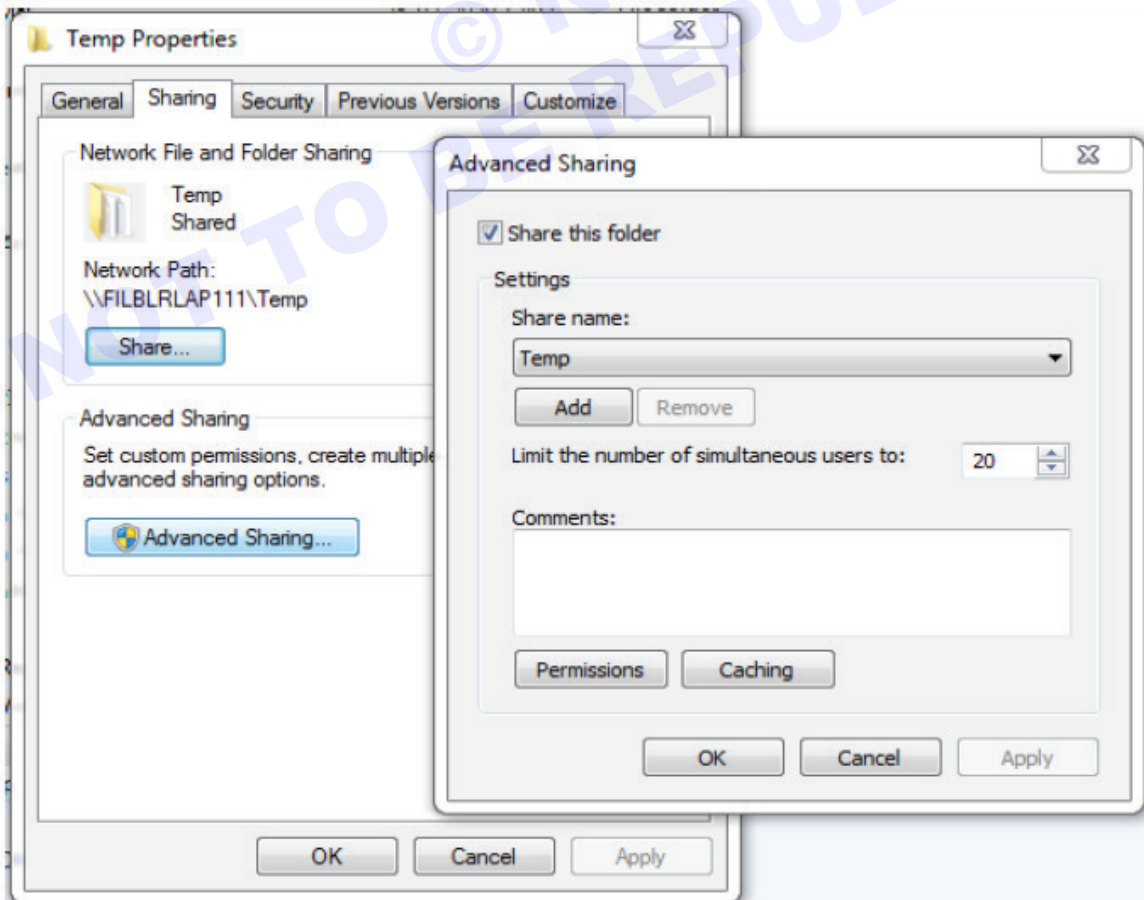
- Click on “Save”, then close ‘FTP’. (Fig 6)

Fig 6



- Folder sharing should be enabled for selected folder (Here TEMP folder). (Fig 7)

Fig 7



Settings required in CNC

- Press SYSTEM function key then set parameter 14885#1(EDE)=1 in PARAMETER menu.
- Press SYSTEM function key then press right arrow. Select EMBED then select COMMON. Enter IP Address for CNC (Ex: 192.168.0.1) and subnet mask (255.255.255.0).
- Select FOCAS2 in EMBED menu. Set port number TCP as 8193, Time out as 10. Ensure AVAILABLE DEVICE is selected as EMBEDDED.
- Select "FTPTRANS" in EMBED. Set PC IP address in HOST NAME.
- Set PORT NUMBER as 21. Set same USER NAME and PASSWORD set in FTP server software. (Fig 8)

Fig 8

ETHERNET SETTING 00000 N00000

FTP TRANS: SETTING [EMBEDDED]

CONNECT 1 1 / 6

HOST NAME (IP ADDRESS)
192.168.0.25

PORT NUMBER 21

USER NAME
FANUC

PASSWORD

AVAILABLE DEVICE EMBEDDED

A) ^

MDI ***** ** 00:13:30

< COMMON FOCAS2 FTPTRN RMTDAG (OPRT) +

- Press page down and enter /TEMP in login folder. (Fig 9)

Fig 9

ETHERNET SETTING 00000 N00000

FTP TRANS: SETTING [EMBEDDED]

CONNECT 1 2 / 6

LOGIN FOLDER
/TEMP

AVAILABLE DEVICE EMBEDDED

A) ^

MDI ***** ** 00:15:04

< COMMON FOCAS2 FTPTRN RMTDAG (OPRT) +

- Press “OFS/SET” function key and select setting.
Set 9 in I/O channel for DNC operation in embedded Ethernet. (Fig 10)

Fig 10

SETTING (HANDY)		00000 N01000	
PARAMETER WRITE	=	0	(0:DISABLE 1:ENABLE)
TV CHECK	=	0	(0:OFF 1:ON)
OUTPUT CODE	=	0	(0:EIA 1:ISO)
INPUT UNIT	=	0	(0:MM 1:INCH)
I/O CHANNEL	=	9	(0-35:CHANNEL NO.)
SEQUENCE NO.	=	0	(0:OFF 1:ON)
PROGRAM FORMAT	=	0	(0:NO CNV 1:F15)
SEQUENCE STOP	=	0	(PROGRAM NO.)
SEQUENCE STOP	=	0	(SEQUENCE NO.)
CONTRAST (+ = [ON:1] - = [OFF:0])			
A) _			
S		0T00000000	
MDI ***** **		17:05:30	
{ NO. SRH	ON:1	OFF:0	+INPUT INPUT

Execute the program in DNC mode of CNC via PC & Ethernet

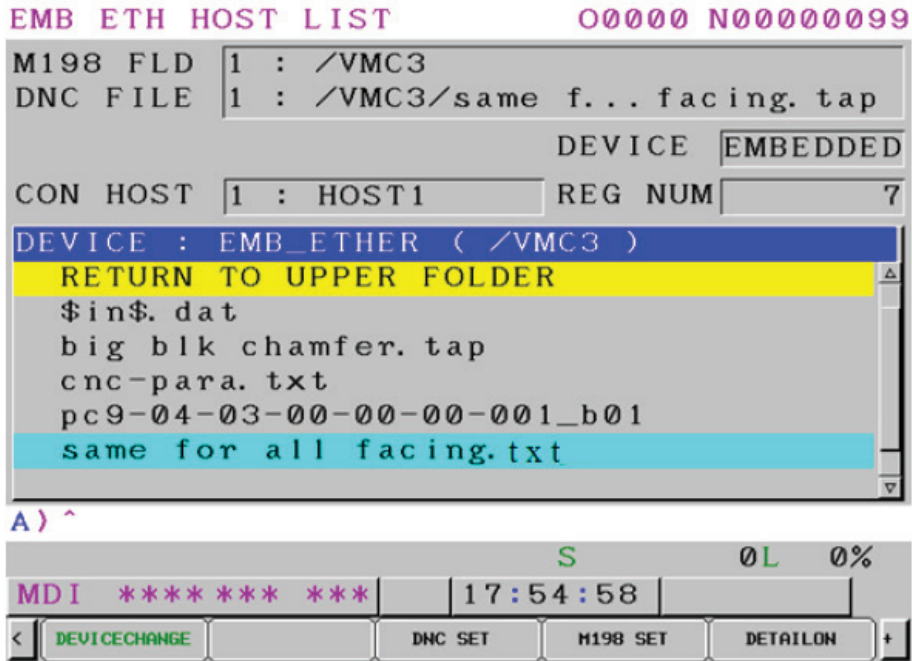
- Press “PROG” function key and select “FOLDER” (Fig 11)

Fig 11

PROGRAM FOLDER		02158 N00000	
F. G. FLD	//CNC_MEM/USER/PATH1/		
B. G. FLD	//CNC_MEM/USER/PATH1/		
USED PG	7 [KBYTE]	USED FL	24
FREE PG	530 [KBYTE]	FREE FL	987
DEVICE : CNC_MEM (/USER/PATH1/)			
RETURN TO UPPER FOLDER			
1	1 [KBYTE]		
00001	1 [KBYTE]		
05000	1 [KBYTE]		
00030	1 [KBYTE]		
00031	1 [KBYTE]		
00010	1 [KBYTE]		
A) ^			
EDIT ***** **		15:03:16	
PRGRM	FOLDER	NEXT	CHECK (OPRT) +

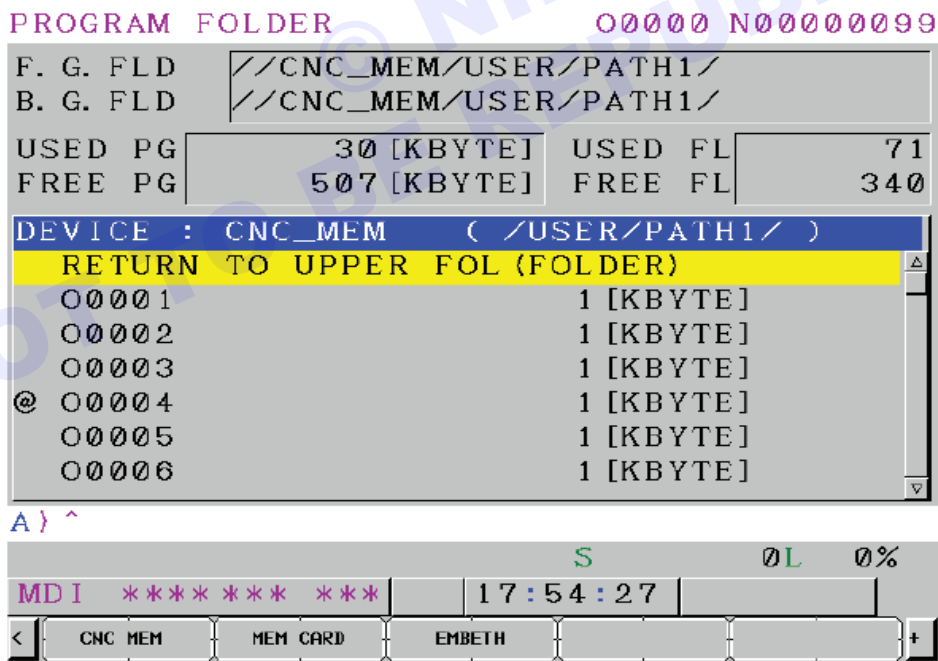
- Select “OPRT” and select “DEVICECHANGE” (Fig 12)

Fig 12



- Select “EMBED ETHER” for embedded Ethernet port (Fig 13).

Fig 13

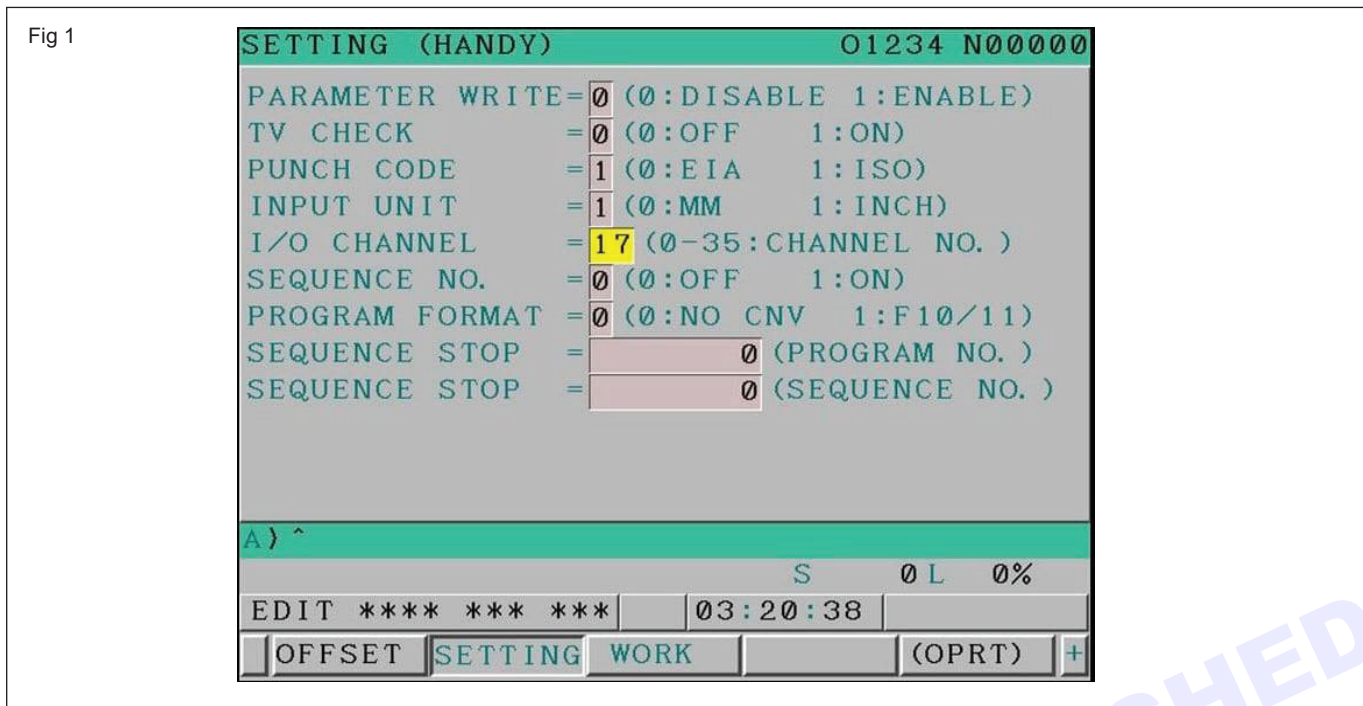


- Set REMOTE mode and select target program by moving cursor then press “DNCSET”.
- Press CYCLE START to execute the program.

Note: The above procedure is for FANUC series. These procedure changes for different controls of CNC machines. For making these ethernet settings can refer machine manual also can contact machine control builder for the support.

TASK 6: Exporting the CAM program from USB devices

- 1 Select MDI mode.
- 2 Press the OFFSET/SETTING button.
- 3 Change the I/O Channel to 17 and you should be ready to go. (Fig 1)




- 4 Go to "edit" mode
- 5 Press "Folder"
- 6 Look near the bottom and you'll see "Device Change" Press it
- 7 Then select "USB" from the choices.
- 8 You will now notice that the directory has changed from the CNC internal memory to the USB drive.
- 9 Highlight the file you want to read into the memory for Example O1234.NC
- 10 Setting a file number. Enter the number of the desired file example: 1234 and then press soft key
- 11 Press "FSet"
- 12 Setting a program number in CNC Memory. Enter the number of the desired program example: 5550. Then Press soft key "OSET"
- 13 Press "EXEC"
- 14 The file will now be read into the CNC memory.
- 15 MAKE SURE you press "DEVICE CHANGE" again and select "CNC" from the choices to go back to the machine's internal memory.

TASK 7: Program input through USB/Flash drive

Fanuc I series control

(Latest control have the facility to use USB/Flash drive)

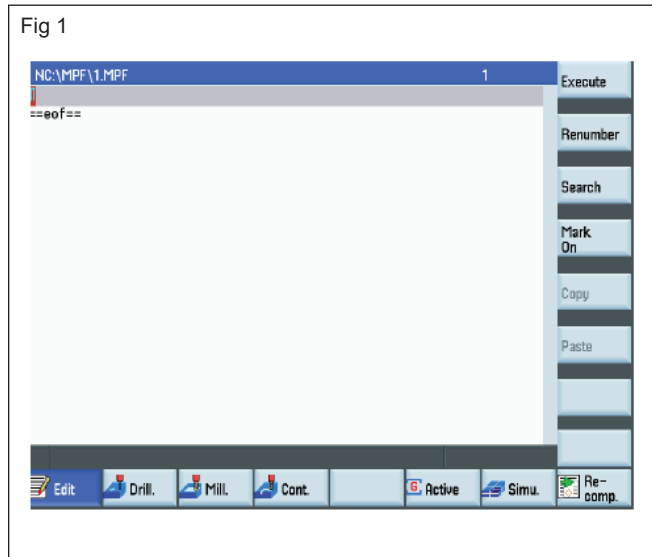
- 1 Make sure that you are in edit mode.
- 2 Press MDI mode
- 3 Press offset and setting page on the soft key to collect the setting page.
- 4 In setting page i/o channel set to use the USB channel.
- 5 Insert the USB stick then select the edit mode
- 6 Click on program - that display the program directory screen
- 7 Click directory and operation then > (arrow key) then notice it says devise USB
- 8 Select USB memory and it automatically reads what's on the card
- 9 Now by pressing  down words arrow select the program that you want to load it into your CNC control.
- 10 Click on the right arrow key until you see the file input file/output file.
- 11 Click on input now.

Notice the program numbers, type the exact name of the program on to the field and then select a program number O1 and click on set and then press execute and then it will load that program under number one and can see it's active at the top of the screen.

TASK 7: Program transfer from USB/flash drive to CNC machine (Siemens control)

Soft key functions

Pressing this key on PPU allows you to open the following window Fig 1



- 1 Stores the NC programs for subsequent operations
- 2 Manages and transfers the manufacturer cycles
- 3 Reads in/out files via the USB drive and executes part programs from the external storage media
- 4 This soft key is valid on the PPU160.2 only and displays as follows
- 5 Reads in/out files via Ethernet interface and executes part programs from a computer
- 6 Backs up manufacturer files
- 7 Backs up user files
- 8 Shows the recently accessed files
- 9 Executes the selected file. No editing is allowed in the execution process.
- 10 Creates new files or directions
- 11 Searches for files
- 12 Selects all files for the subsequent operations
- 13 Copies the selected files(s) to the clipboard
- 14 Pastes the selected files(s) from the clipboard to the current directory
- 15 Restores the deleted file(s)
- 16 Opens the lower-level meant for more options
 - Rename the part programs
 - Cut the part programs

Note: Soft keys 2 and 6 are visible only with the manufacturer password

Searching for programs

- 1 Select the program management operating area
- 2 Select the storage directory in which you wish to perform the search

Note: The following two folders are visible only with the manufacturer password:



- 3 Press this vertical soft key to open the search window.
- 4 Enter the complete name with extension of the program file to be searched in the first input field in the search window. To narrow your search, you can enter the desired text in the second field
- 5 Use this key to choose whether to include subordinate folders or observe upper/lower case.
- 6 Press this soft key to start the search

Transferring from external (through USB interface)

Prerequisite: A USB memory stick (which includes the part program to be transferred) is inserted in the front USB interface of the PPU

Proceed as follows to transfer a part program from external through the USB interface

- 1 Select the program management operating area
- 2 Press this soft key to enter the USB directory
- 3 Select the program file you desire to transfer
- 4 Press this soft key to copy the file to the buffer memory on the control system
- 5 Enter the program directory
- 6 Press this soft key to past the copied file into the program directory

Identify the manufacturing process

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

- identify the manufacturing process.

PROCEDURE

TASK 1: Industrial visit

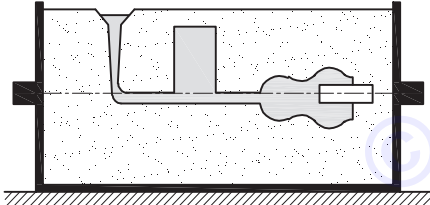
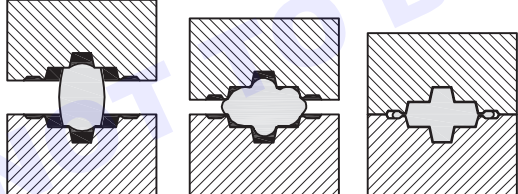
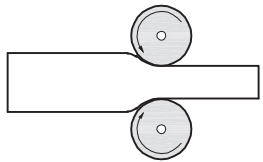
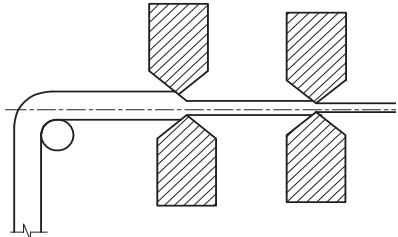
- Trainees visit the industries & know the manufacturing process.

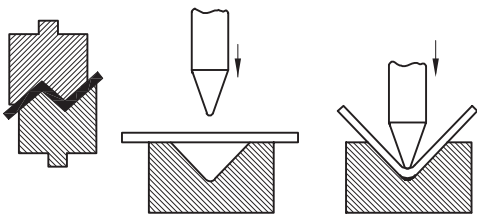
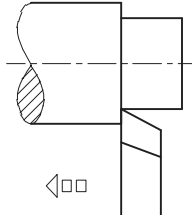
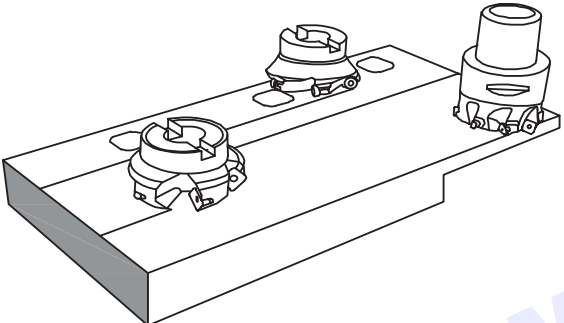
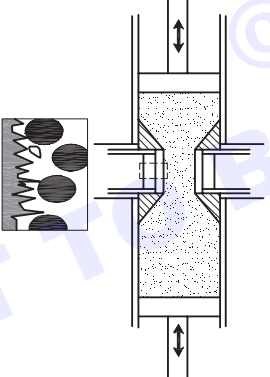
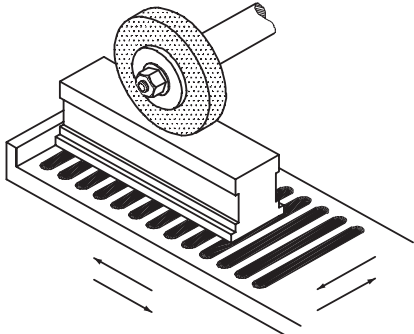
Trainer shall arrange industrial visit to know the different manufacturing process.

TASK 2: Identification of manufacturing process

- Trainee will identify the various manufacturing process and record in Table 1.

Table 1

SI.No	Manufacturing process	Name of the process	Remarks
1			
2			
3			
4			

5			
6			
7			
8			
9			

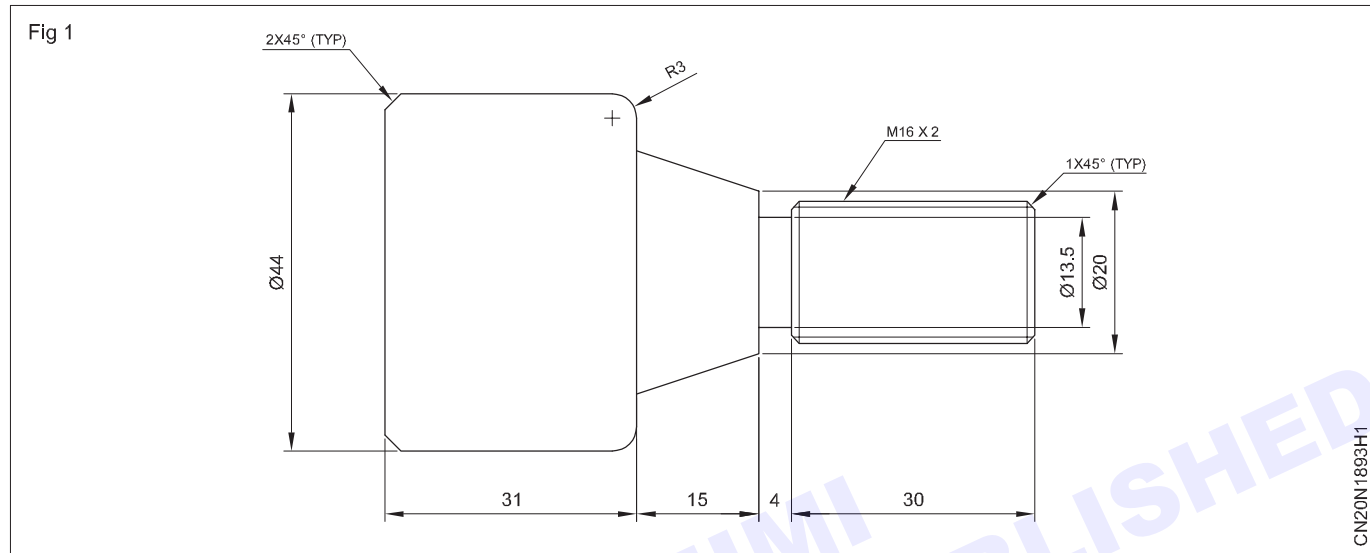
- Get it checked by the trainer

Machining sequence for part program

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

- read the drawing
- identify the machining sequence.

PROCEDURE



- Study the drawing.
- Write the sequence of operations involved in the part.
- Trainer shall demonstrate the machining sequence of the job.
- Ask the trainees to record it in Table 1.
- Get it verified by the trainer.

Table 1

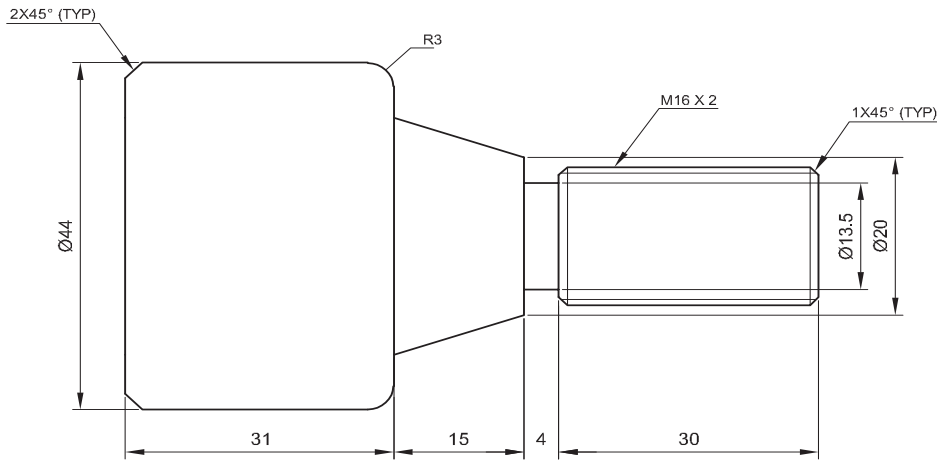
Sl. No.	Sequence of operation	Remarks

Select the machine (CNC&VMC) to achieve designed shape

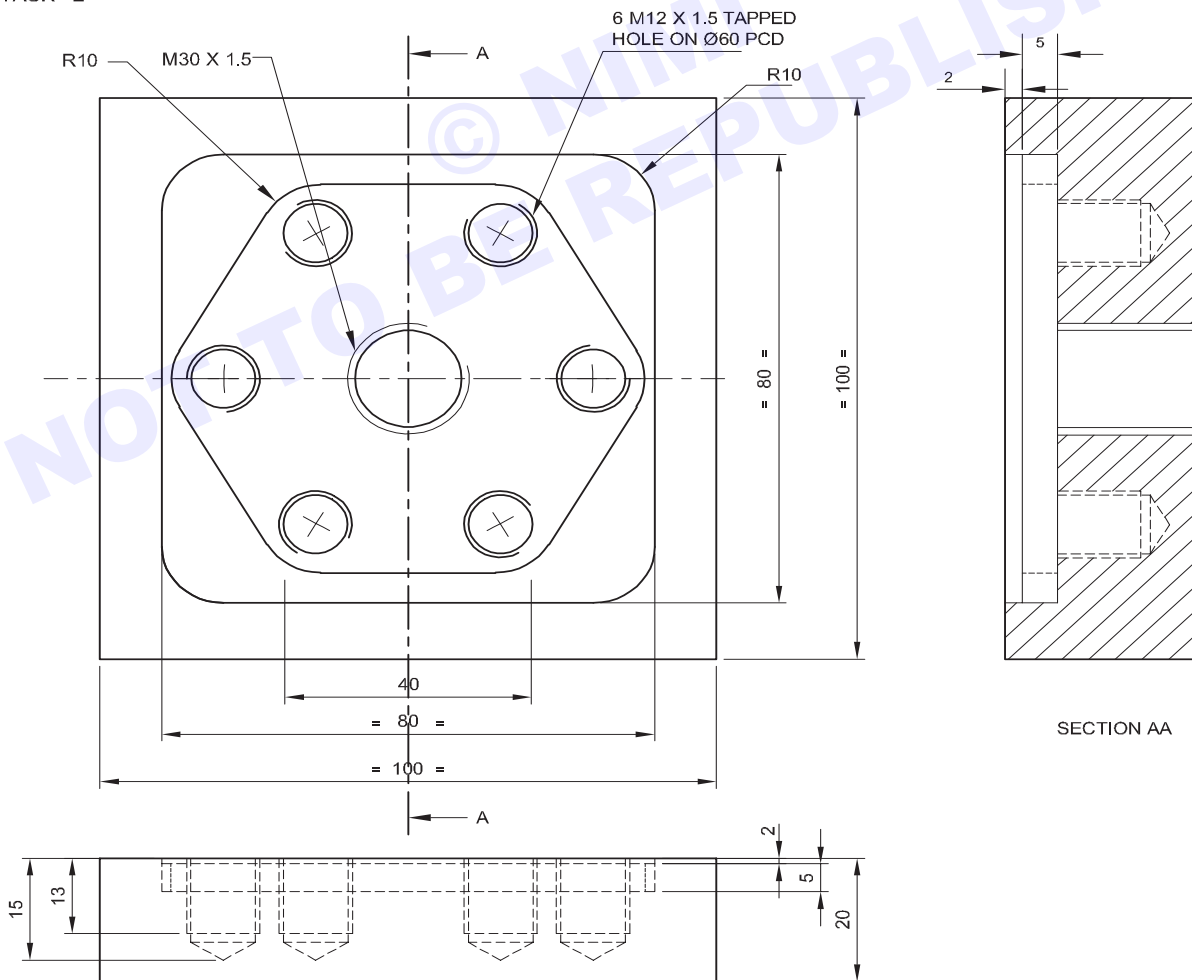
Objectives: At the end of this exercise you shall be able to

- study the drawing and list out the operations involved
- select the machine to perform operations.

TASK - 1



TASK - 2



PROCEDURE

TASK 1: Reading the drawing

- Read the drawing.
- Fill the sequence of operation simple to complex in the Table 1.
- Name the machine used to perform operations in Table 1.

Table 1

Sl. No.	Operation	Machine
1		
2		
3		
4		
5		
6		
7		
8		

TASK 2: Name of the machines

- Read the drawing.
- Fill the sequence of operation simple to complex in the Table 2.
- Name the machine used to perform operations in Table 2.

Table 2

Sl. No.	Operation	Machine
1		
2		
3		
4		
5		
6		
7		
8		

- Get it verified by trainer.

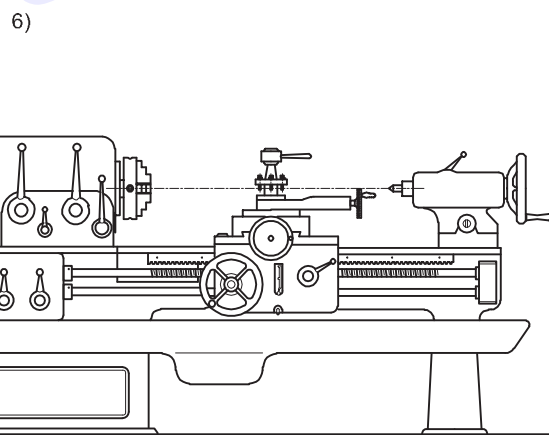
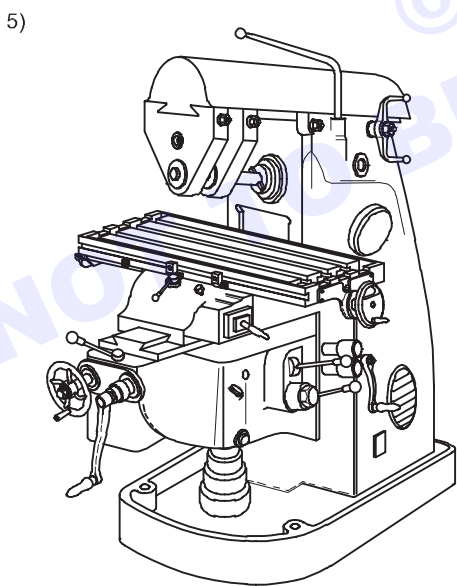
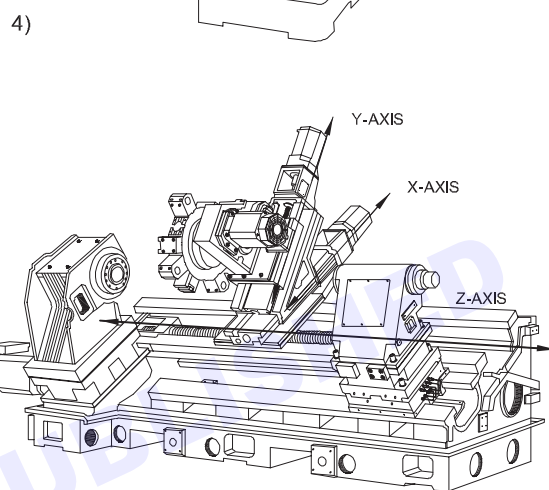
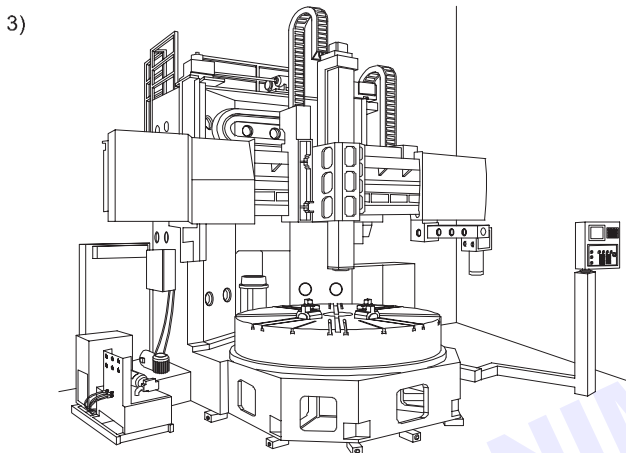
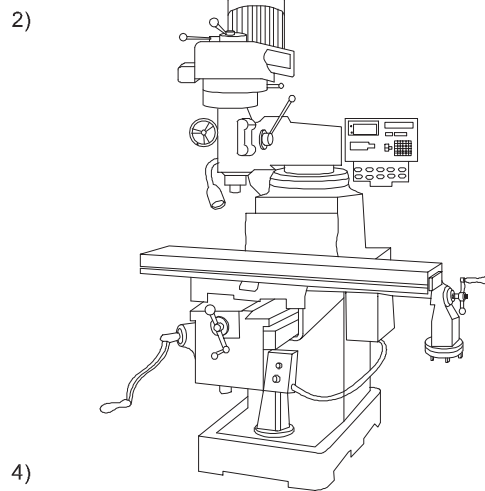
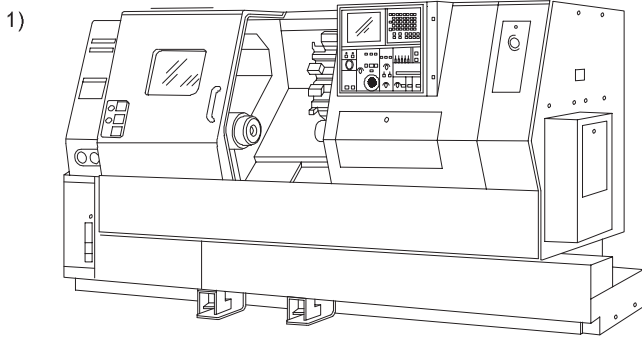


Table 1

Sl. No.	Name of the parts	Function of the part
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

- Get it checked by the instructor.

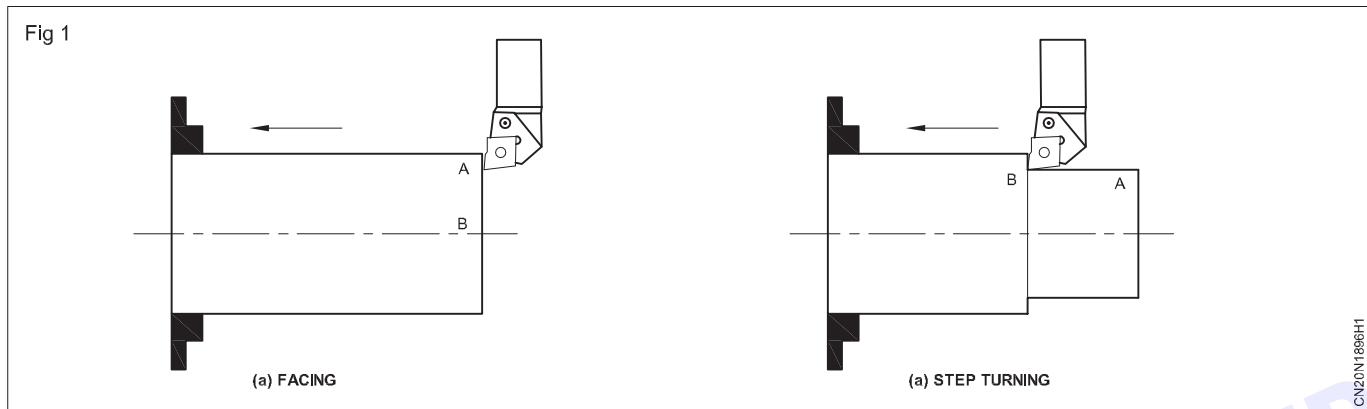
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Select the cutting tools and tool holders for step turning

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

- select suitable insert for step turning operation for machining alloy steel
- select the corresponding tool holders for the operation.

PROCEDURE



Note: trainer shall provide required catalogue and guide the trainee in selecting inserts and its tool holders.

- Identify the operation from the drawing and select the shape of the insert.
- Select insert material, insert specification and tool holder from the catalogue.

- Determine the machining condition.
- Select the clamping system.
- Select the corresponding tool holder.
- Record the specifications of inserts and tool holders in Table 1.

Table 1

SI. No.	Operations	Insert specification	Tool holder specification	Remarks
1	Facing			
2	Step turning			

Selection turning tool from tool catalogues

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

- select turning insert and its tool holder for particular operation.

First step

- Define material and type of operation
- Define material according to ISO 'P', 'M' and 'K' and identify the operation from the contents.

Second step

- Define application and machining conditions.

- Locate first choice of insert geometry and grade by application.
F-Finishing
M-Medium
R-Rough

Conditions

- - Good
- ◐ - Normal
- - difficult

Third step

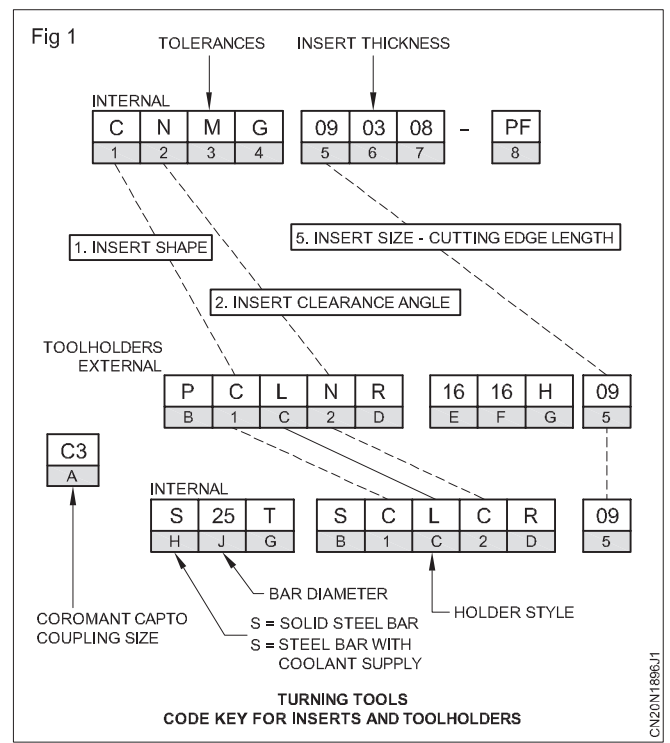
Choose insert with recommended cutting data

Select the insert from the ordering page and note down the speed, feed and depth of cut recommended.

Fourth step

Choose tool holder

Select the tool holder using the insert shape and size

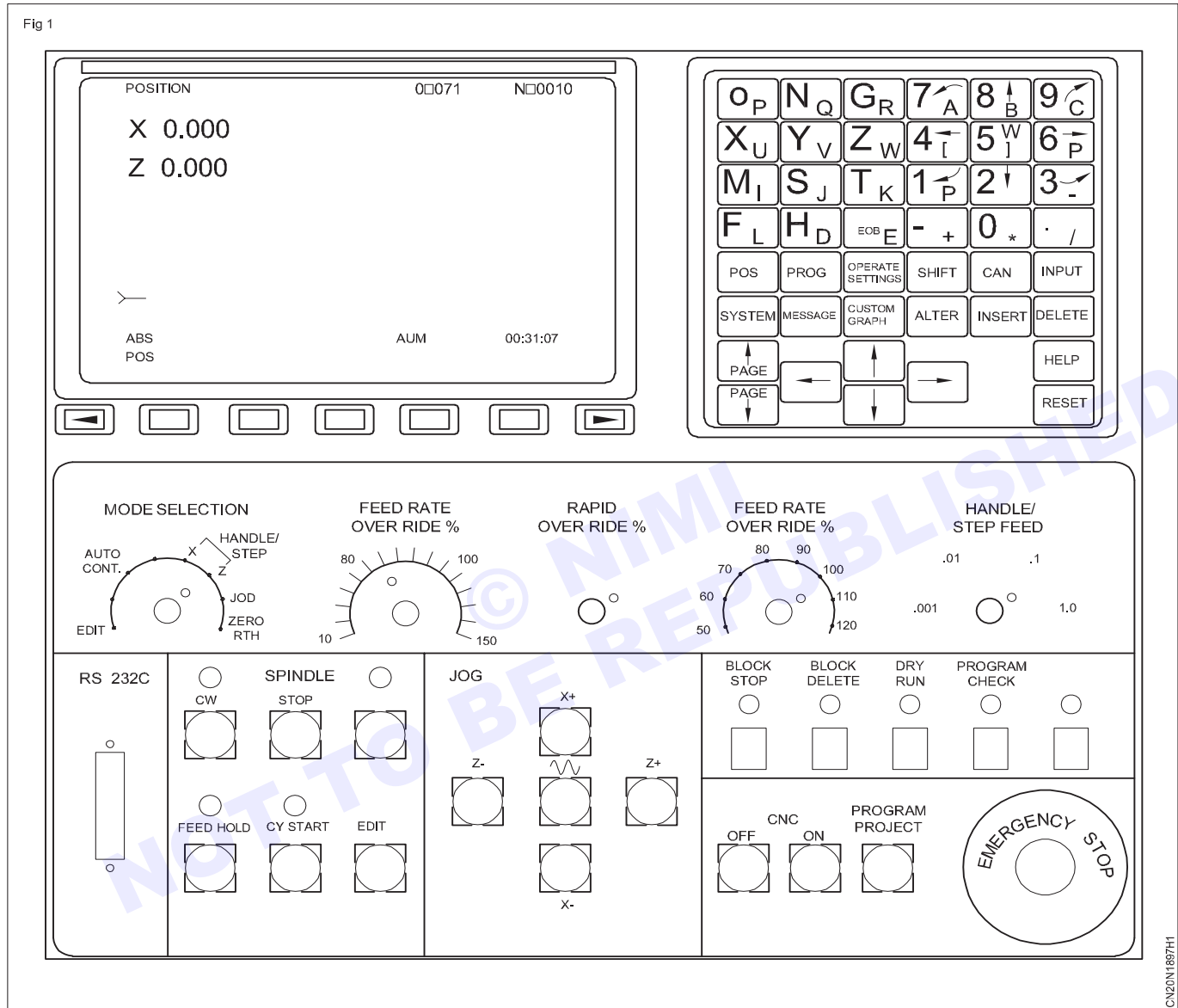


Starting and referencing CNC machines

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

- start the machine with standard operating procedure.

PROCEDURE



- Wear appropriate PPE (safety glass, gloves and steel-toe boots if required).
- Ensure the area around the machine is clean and free of debris or obstruction.
- Confirm that the machine is connected to the correct power source.
- Check for any signs of damage, leaks or loose components.
- Ensure the coolant reservoir is filled to the recommended level.
- Verify that the lubrication system is functioning and has adequate oil.
- Check the recommended hydraulic oil level of hydraulic pump oil reservoir.
- Inspect the tool turret or tool post for correct tool placement.
- Switch ON the voltage stabilizer check the voltage values.
- Switch ON the isolation switch.
- Press "NC ON" push button.
- Wait for the screen to indicate module setting status.
- Display of software configuration.
- Release "EMG" switch.

- Now press 'CONTROL ON or MACHINE ON'.
- The machine will be in 'MDI' mode by default.
- Press 'Reset' button for refreshing.
- Press 'jog' mode switch.
- Press X - or X+.
- Press Z - or Z +.
- Screen showing X0.000 20.000.

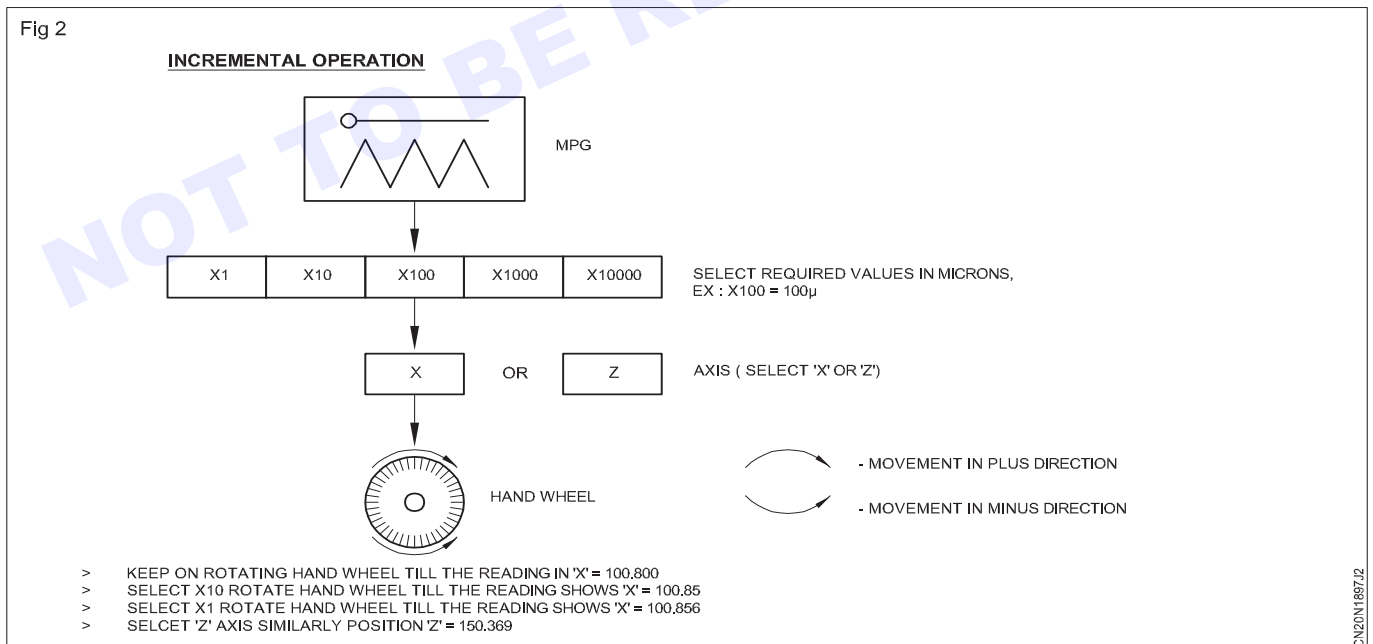
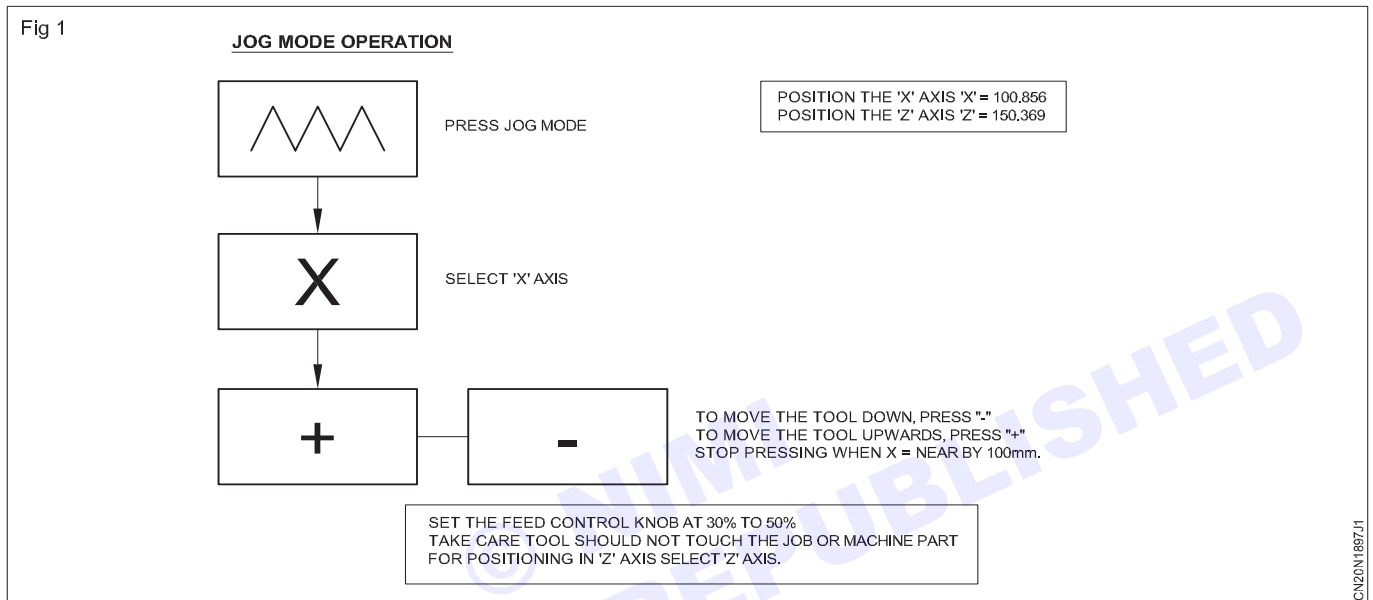
JOG incremental and MDI mode operation

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

- operate in JOG mode and operate in (manual puls generator)
- operate in manual data input mode.

MDI MODE operation

- Pictorial representation of JOG mode operation is shown in Fig 1.
- Pictorial representation of incremental mode operation is shown in Fig 2.



- Set mode switch to MDI selection
- Select program softkey 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 100mm in (+) direction from the previous tool position.
- Repeat the step and give X-100.0 then
- The axis X will move 100mm in (-) direction.
- Now the tool will reach the programmed position.

Referencing of tool holder/turret

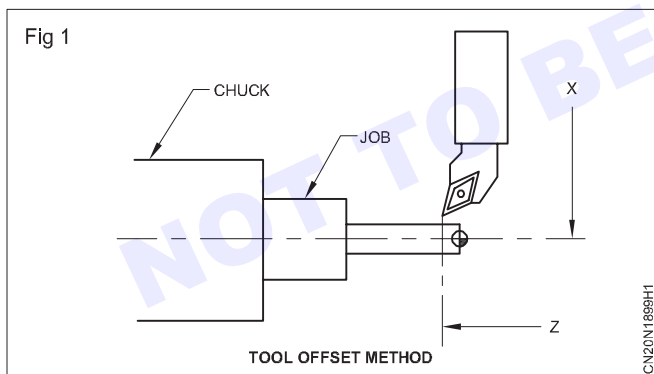
Objectives: At the end of this exercise you shall be able to

- measure the tool offset values in X and Z axis
- measure the work offset values in X and Z axis.

PROCEDURE

TASK 1: Tool offset measurement (Fig 1) in Fanuc control

- 1 X axis tool offset method
- 2 Reference tool is T01 and offset is zero in X and Z axis.
- 3 Clamp job in chuck.
- 4 Select MDI mode. Press in MDI prog-screen.
- 5 Enter tool number: T0200 (Turning tool).
- 6 Press insert button, Press cycle start button.
- 7 Tool cutting edge position with spindle ON CW or CCW in MDI mode.
- 8 Enter MO3 SI500 Press reset button, Press cycle start button.
- 9 To select jog mode or MPG mode to move x and z axis.
- 10 Touch the job in x axis just clean OD turning to ensure no disturbance in x axis. (Fig 1)



- 11 Measure the outside diameter.
- 12 Using cursor in geometry screen select Tool No.2 x axis select.
- 13 Enter job diameter
- 14 Press measure button in softkey
- 15 Now tool cutting edge in job centre is OK.
- 16 Tool offset in X axis is saved

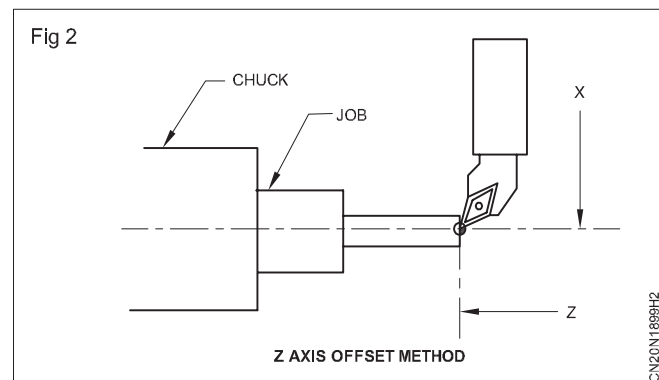
OFFSET / GEOMETRY		00002 N00200		
NO.	X	Z	R	T
G 001	1.638	-0.342	0.800	3
G 002	0.000	0.000	0.000	0
G 003	4.073	-0.029	0.400	3
G 004	0.000	0.000	0.000	0
G 005	5.133	-7.719	0.000	0
G 006	0.000	0.000	0.000	0
G 007	0.000	0.000	0.000	0
G 008	0.000	0.000	0.000	0

RELATIVE	U	-566.528
	W	-562.380

A) ~		S	0L 0%
MEM *****	***	11:43:13	
<	NO. SRH	MEASUR	INP. C. +INPUT INPUT +

Z axis offset method

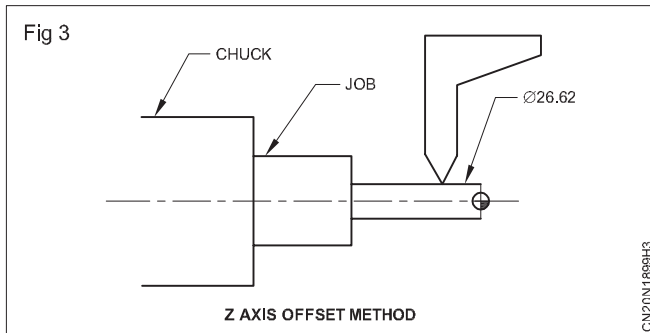
- Spindle ON rotate the job.
- Select jog mode or MPG mode to move axis. Manually turning job facing position no disturbance Z axis. (Fig 2).



- Select offset button press in geometry mode.
- Use cursor select tool no 2 and z axis.
- Enter Z0.
- Enter Z0 press Measure in softkey
- Now z axis tool offset OK.
- Tool offset in Z axis is saved

Second tool offset

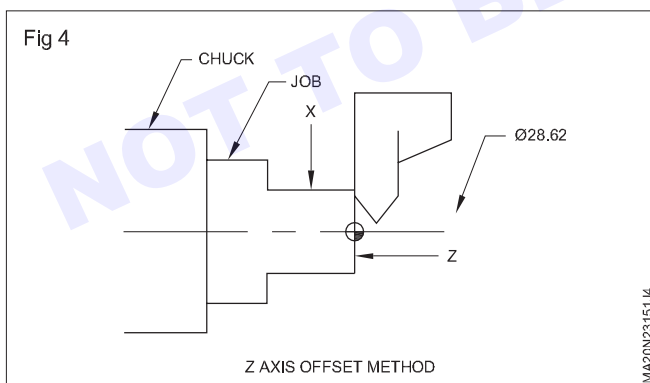
- Select MDI mode Press MDI Prog Screen.
- Enter tool no (Threading tool) T0300 Press Reset button Press Cycle start.
- Select jog mode or MPG mode then move axis.
- Same procedure MPG mode incremental touch job in x axis with piece of paper Do not disturb X axis (Fig 3).



- Select offset button press in geometry mode.
- Use cursor to select tool no 3 and x axis.
- Enter constant same dia.
- Press measure button in softkey

Threading tool offset measurement

- Z axis offset
- Select MPG mode in incremental variation. To move axis z position.
- To check by inserting a piece of paper between tool and the job ensuring that there is no disturbance in Z axis (Fig 4).

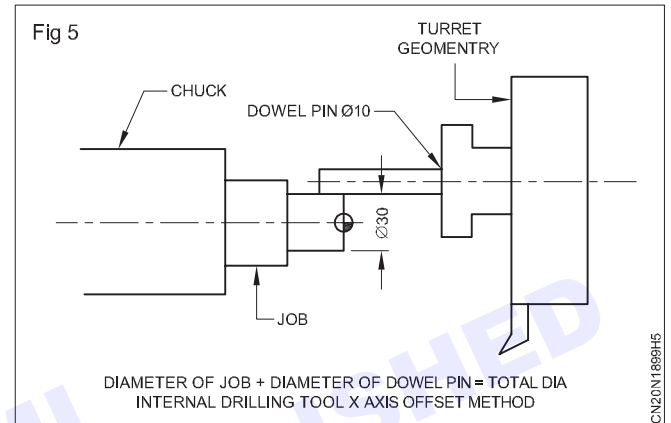


- Select offset button in geometry mode.
- To use cursor, select tool no 3 and z axis.

- Enter Z0.
- Ex: Z0 Press Measure in softkey
- Now second tool z axis offset saved.

Internal drilling tool x axis offset method

- Fix the turned job in chuck
- Select MDI mode press enter tool no T0400 and cycle start.
- Select jog or MPG mode to move axis on the job of top side.
- Check with piece of paper whether contact of dowel pin with the job is proper. (Fig 5)

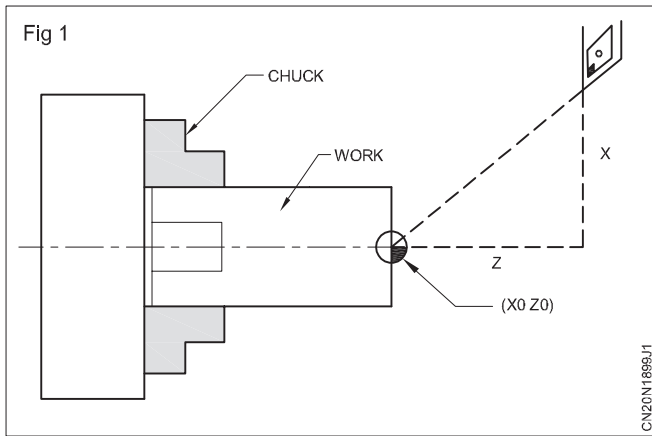


- Select offset screen in geometry mode.
- Use cursor to select x mode and tool number.
- Enter dia.
- Ex: Job dia + Dowel pin dia = Total dia $30 + 10 = 40$
- Enter dia x40 Press Measure button in softkey
- Drill cutting point in job centre point.
- Then fix the drill.
- Touch the job face a piece of paper whether contact of drill with the job in proper.
- Enter Z0 Press Measure in softkey
- Drilling tool off set is saved

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

TASK 2: Measurement of work offset (Fig 1)

- 1 Ensure the work secured firmly in chuck
- 2 Index the tool in MDI mode with tool offset cancel and set tool offset X0,Z0, and tool type
- 3 Switch 'ON' spindle
- 4 Carry out slight facing of the job
- 5 After the finish cut move the tool back in X direction only
- 6 Now switch off spindle



- 7 Go to Tool off set mode
- 8 Press GEOM softkey and position the cursor using cursor movement button and select the offset number G54
- 9 Enter the Z-axis value Z0.0

- 10 Press softkey
- 11 Now rotate the spindle in appropriate direction and machine the outside diameter ('OD')
- 12 Do not disturb X-axis
- 13 Take tool away in Z-direction only
- 14 Stop the spindle
- 15 Measure the outer diameter of the job using micrometer
- 16 Go to OFFSET softkey
- 17 Press GEOM softkey
- 18 Position the cursor to the required work offset number and enter the measured value. (eg: X32.62)
- 19 Press softkey

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

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Identify the axes of machine '+' & '-' travel of axes & travel range of tool holder turret

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

- identify the axes of machine
- identify the '+' & '-' of axes
- identify the travel range of the tool holder turret.

PROCEDURE

TASK 1: Axes of machine

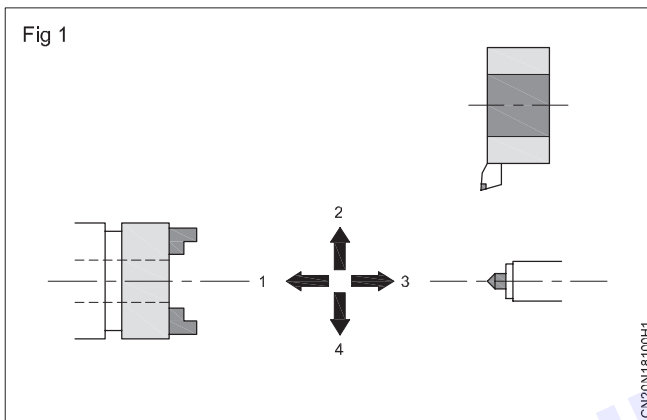


Table 1

Sl. N.o	Name of the axis	Travelled direction
1		
2		
3		
4		

Trainer shall demonstrate the axis and movements, travel range. Ask the trainees to record in Table 1, 2 & 3.

TASK 2: Travel of axes '+' & '-'

Table 2

Sl. No.	Activity	Button selection
1	To move the z axis toward & spindle	
2	To move the z axis toward & tailstock	
3	To move the x axis toward & job centre	
4	To move the x axis toward & home position	
5	Position of mode selection	

TASK 3: Measure the travel range of axes

Table 3

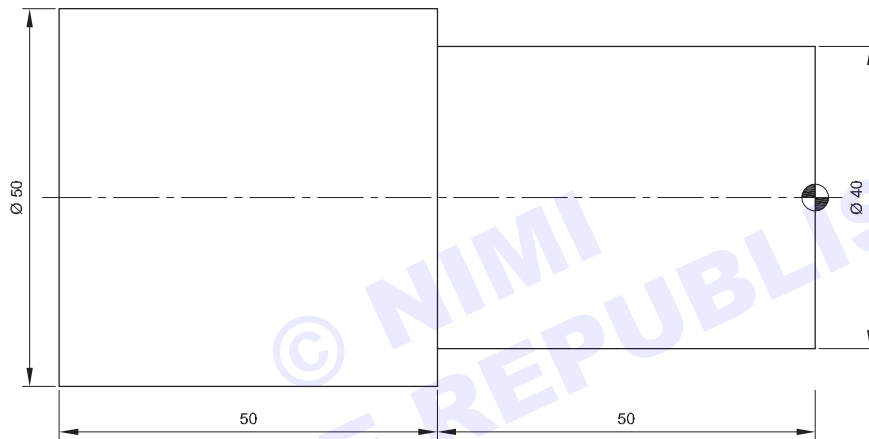
Sl. No.	Activity	Button selection
1	'z' axis is moved from home position to machine zero position	
2	'x' axis is moved from home position to spindle center	

- Get it verified by the trainer.

Run the program in single block set up by adjusting speed, feed and depth of cut

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

- prepare CNC program for given drawing on machine
- run the program in single block and adjusting speed, feed.



Job Sequence

- Prepare the part program for given job.
- Check the program in simulator
- Start the machine
- Press the edit mode.
- Press the directory button on function buttons.
- Press the program button.
- Press the program number eg. '0'1234.
- Press the program edit button.
- Enter the simulated part program.

1	Ø55 x 105mm	-	MS ROD	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	SINGLE BLOCK SET UP BY ADJUSTING SPEED,FEED & DEPTH OF CUT				TOLERANCE ±	TIME :
					CODE NO. CN20N18101E1	

TASK 1: Program preparing

01234	G01 X 42.5 F0.2;
T0000	G01 Z-49.5 F0.2;
G91 G28 X0;	G01 X43.0;
G91 G28 Z0;	G00 Z1.0;
T0101;	G01 X41.0 F0.2
M04 S1500;	G01 Z-49.5 F0.2
G90 G00 x 51.0 Z5;	G01 X 41.5
G01 Z0 F0.2;	G00 Z1.0;
G01 X-1 F0.2; (facing at 0.5mm stock)	G01 X40.0 F0.2
G00 Z5;	G01 Z-50.0 F0.2
G00 X 49.0;	G01 X50.0
G01 Z-49.5 F0.2	G00 Z5
G01 X50;	G91 G25 X0
G00 Z1.0	G28 Z0;
G01 X45 F0.2	M05;
G01 Z-49.5 F0.2	M30;
G01 X46.5;	
G00 Z1.0;	

After completion of program writing save the program

TASK 2: Hold the job in chuck

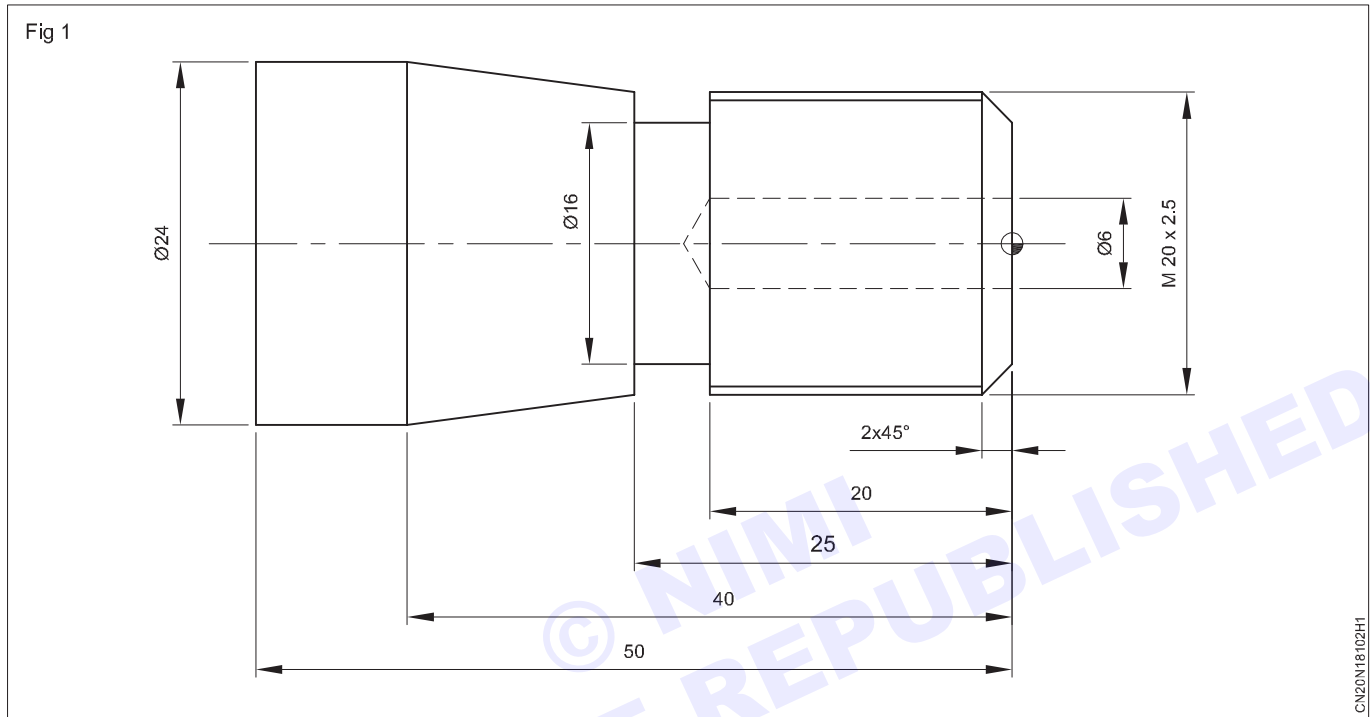
- 1 Set the suitable tool, for operation in turret tool holder
- 2 Make the work offset and enter measurements in work offset option.
- 3 make a tool offset and enter measurement in tool offset option.
- 4 Go to the directory and call the program number 01234
- 5 Press the single block button.
- 6 Set the rapid speed at 0-25%.
- 7 Select the auto cycle mode.
- 8 Set the speed over ride at 50%
- 9 Set the feed over ride at 0%
- 10 Press the cycle start button
- 11 The program run by block by block (single block)
- 12 When spindle is ON. Set the spindle speed 100%.
- 13 Increase the feed override gradually 0-30%
- 14 Press the cycle ON button the execution of the program is stopped the current block is executed.
- 15 Press cycle start button to executive next block.
- 16 Similarly continued until the end of program that is M30.

Inspect the operating parameter defined in machining control plan

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

- understand the part drawing
- select the cutting parameter for the operation.

PROCEDURE



- Trainer shall demonstrate the operating parameters for the drawing given.
- Ask Trainees to fill the table 1.

Table 1

SI.No	Operation	Cutting speed	Feed	Depth of cut	RPM	Remarks

- Get it verified by the trainer.

Run the program in auto mode in single block

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

- load the program to run in auto mode operation
- check the program using single block mode in auto.

Job Sequence

- Load the program to run in auto mode operation
- Keep the feed rate and rapid knobs to zero position
- Press cycle start
- Open the rapid switch to 30%
- Press cycle start button, the execution of the program is stopped after the current block is executed.
- Press cycle start button to execute next block.
- Similarly continued until the end of program that is M30;

Skill Sequence

Running program in auto mode/memory operation

Objectives: This shall help you to

- load the program to run in auto mode
- execute the program in auto mode.

Memory operation

Programs are registered in memory in advance. When one of these programs is selected and the cycle start switch on the machine operator's panel is pressed, automatic operation starts, and the cycle start LED goes on.

Steps in memory operation

Press the MEMORY mode selection switch.

Select a program from the registered programs. To do this, follow the steps below.

Press **PROG** to display the program screen.

Press address **○**

Enter a program number using the numeric keys.

Press the [O SRH] softkey.

Press the cycle start switch on the machine operator's panel. Automatic operation starts, and the cycle start LED goes on. When automatic operation terminates, the cycle start LED goes off.

To stop or cancel memory operation midway through, follow the steps below.

Stopping memory operation

Press the feed hold switch on the machine operator's panel. The feed hold LED goes on and the cycle start LED goes off. The machine responds as follows.

When the machine was moving, feed operation decelerates and stops.

When dwell was being performed, dwell is stopped.

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

When the cycle start switch on the machine operator's panel is pressed while the feed hold LED is on, machine operation restarts.

Terminating memory operation

Press the **RESET** key on the MDI panel.

Automatic operation is terminated and the reset state is entered.

When a reset is applied during movement, movement decelerated the stops.

Identify the wear out cutting tools & replace the cutting tool

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

- identify the wear out cutting tools
- replace the cutting tool.

PROCEDURE

TASK 1: Identify the wear out cutting tool

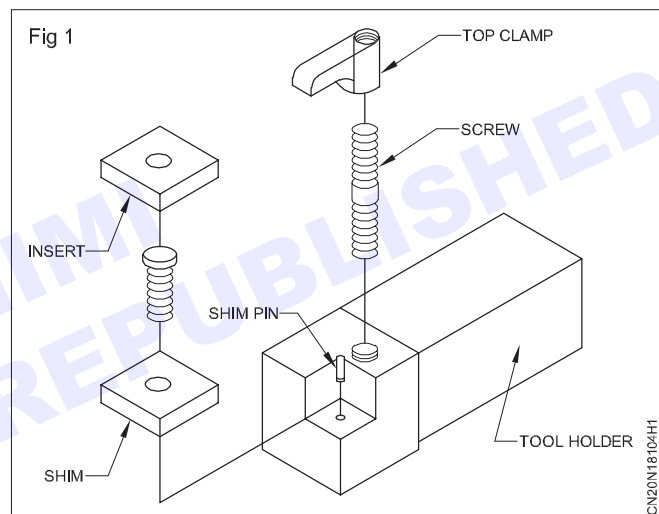
- 1 Visually inspect the tool.
- 2 Verify any chip off / broken at the cutting edge.
- 3 Any colour change at the cutting edge.

Note: Verify with trainer and replace the tool

TASK 2: Replace the cutting tool

- 1 Replace the insert. (Fig 1)
- 2 Clean the insert and tool holder.
- 3 Check the condition of the insert and shim.
- 4 If damaged remove the insert from the tool holder with proper allen key.
- 5 Check the shim for damage. If it is damaged replace or index to next corner.
- 6 Clean the seat of insert and shim.
- 7 Place the shim in proper location.
- 8 Place the insert with sharp cutting edge or new one against the supporting points.
- 9 Clamp the insert with proper allenkey.

Note: Pay full attention while removing or tightening - otherwise you may damage the screw.



Tool wear offset

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

- determine the amount of wear in x and z direction
- input/change the wear offset values in x and z axes.

PROCEDURE

Determine the wear offset

Adjusting the tool wear offset is necessary because, as the cutting tool wear, the dimension they are machining may increase or decrease. The tool wear offset process allows you to change the position of the cutting tool compensate for the tool wear.

- All 'X' setting will normally have diameter value and 'z' axis setting will be length.
- If the machined diameter is larger than the programed dimension, the wear offset is in minus direction and vice versa.
- Measure the size of the work and compare with the programed values. Tool number is 3

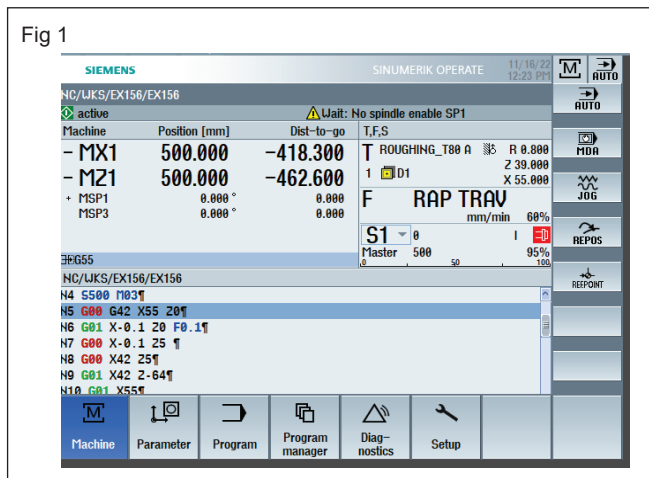
Example programed value in x 30.00

z 15.00

- The measured value is diameter 30.05
- The measured value in length 15.04
- The difference in diameter is 0.05
- The different in length is 0.04
- Since the both the values are positive
- Enter these values x -0.05 and Z-0.04

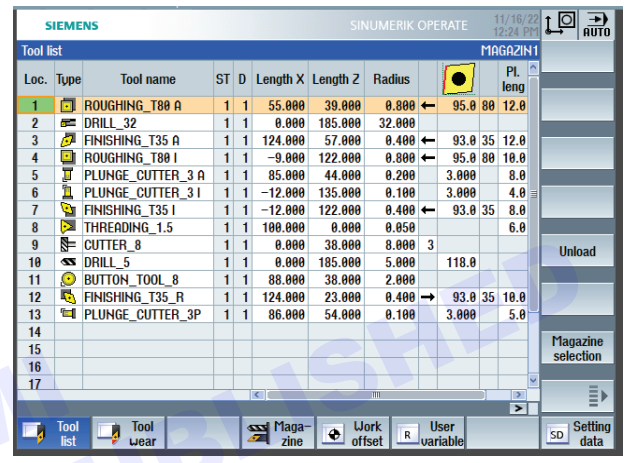
Changing the wear offset value in system in siemens control

- Press machine key the screen will display as in Fig 1



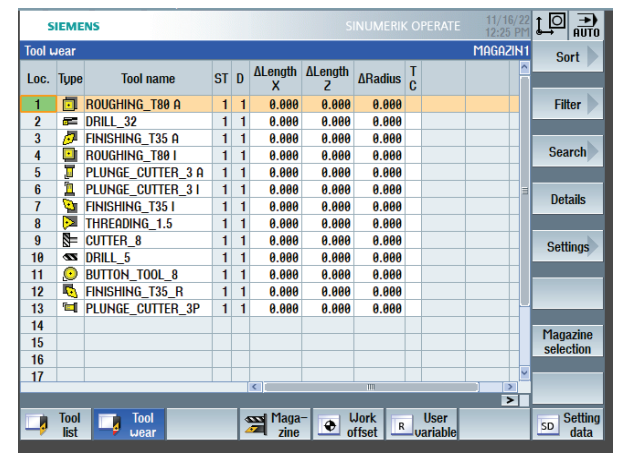
- Press parameter. The screen will display as in Fig 2. will display the tool list.

Fig 2



- Press tool wear key and it leads to wear offset screen as shown in Fig 3.

Fig 3



- Position the cursor at tool number 3 and input the determined values in x as negative, and z as negative (x -0.005,z-0.04)

The system will automatically add or subtract the from existing wear offset values. It is zero values then x -0.05 and z-0.04 will be active.

Fanuc control

The word offset with two adjectives

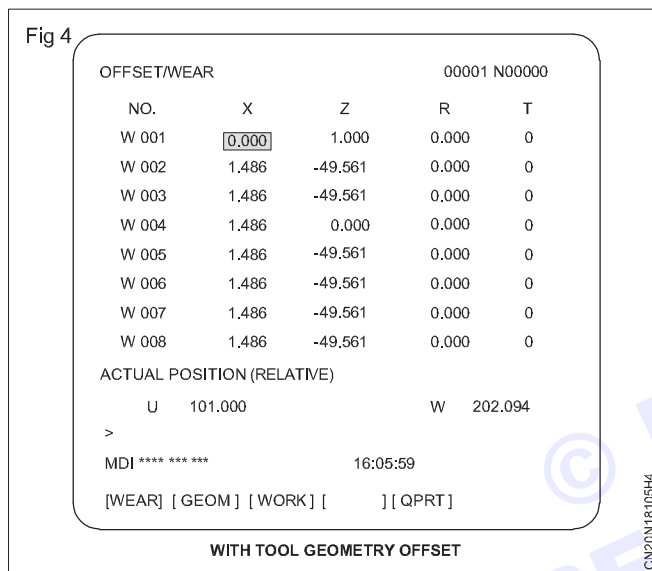
1 OFFSET -GEOMETRY

2 OFFSET -WEAR

- Geometry offset is the tool offset matches with turret station number.

To enter the tool offset/geometry

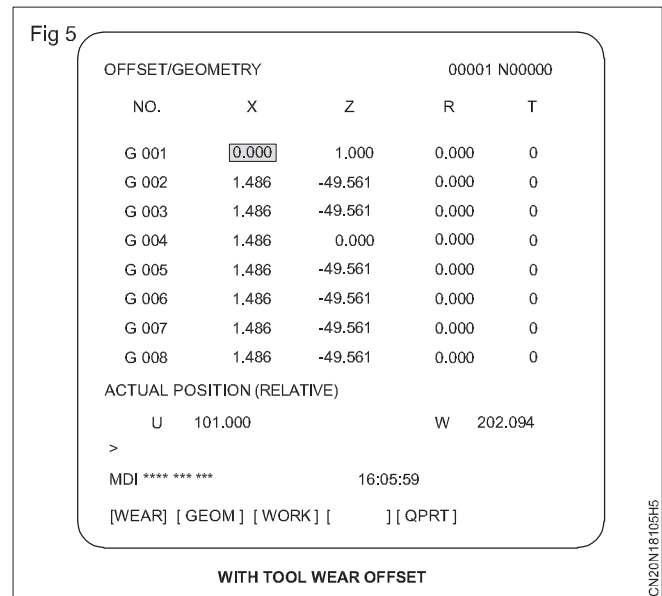
- Press function key.
- Press chapter selection softkey [OFFSET] or press several times until the tool compensation screen is displayed.
- Pressing softkey [GEOM] displays tool geometry compensation values. (Fig 4)



- Place the cursor at the required number example tool number 7 means G007.
- Enter the determined wear value and input the value for X and Z.

For wear input

- Pressing softkey [WEAR] displays tool wear compensation values. (Fig 5)

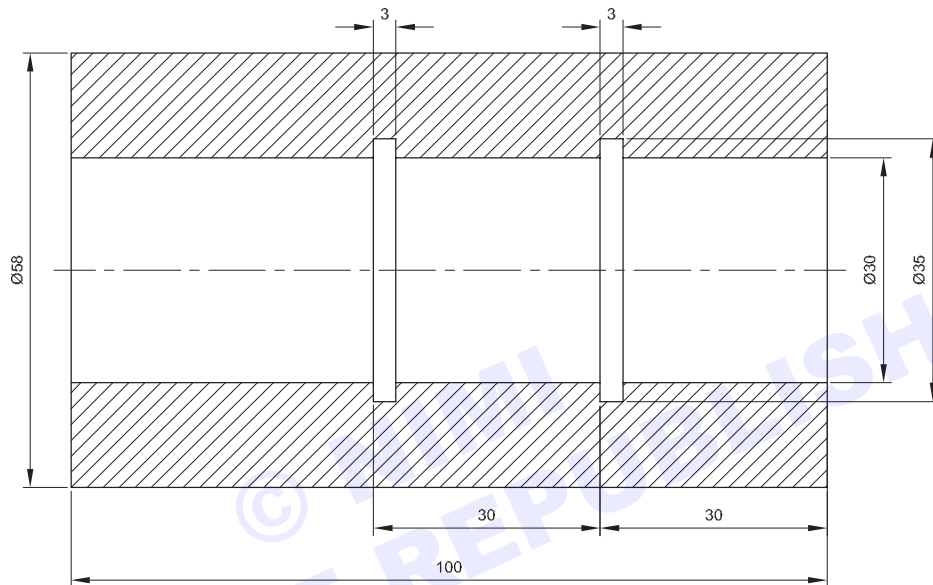


- Move the cursor to the compensation value to be set or changed using page keys and cursor keys, or enter the compensation number and press softkey [NO.SRH].
- To set a compensation value, enter a value and press softkey [INPUT].
- To change the compensation value, enter a value to add to the current value (a negative value to reduce the current value) and press softkey [INPUT]. or, enter a new value and press softkey [INPUT].
- TIP is the number of the virtual tool tip (see programming).
- TIP may be specified on the geometry compensation screen or on the wear compensation screen.

Create a program using subroutine codes

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

- prepare the CNC program for the given sub drawing
- link the program using sub routine technique
- verify the program by simulator.



Job Sequence

- Write the CNC program.
- Enter the CNC program in CNC simulator using edit mode.
- Verify the program in simulator.
- Transfer the program to the machine.
- Take the tool offset.
- Run the main program and subprogram
- Check dimensions and remove the job.

1	Ø60 x 105mm	-	FE310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					TOLERANCE ±	
					TIME :	
					CODE NO. CN20N18106E1	

PROGRAM USING SUBROUTINE CODE

Program using subroutine code

O0010; (MAIN PRORAM)
T0101;(FACING & OD TURNING)
G97M03S1200;
G0X62.0Z0.0 M08;
G01X-0.5F0.1;
G0Z2.0;
G0X62.0
G0X60.0;
G01Z-100.0F0.15;
G0X62.0 Z1.0;
G0X58.0;
G01Z-100.0 F0.15;
G0X62.0 Z1.0
G0X100.0;
G28 U0.0 W0.0;
M05;
T0202; (CENTER DRILL)
G97S1000 M03;
G0X0.0 Z2.0
G01Z-8.0F0.1;
G01Z5.0;
G0X100.0;
G28 U0.0 W0.0;
T0303; (DRILL 28 mm)
G97S800M03;
G0X0.0Z2.0;
G01Z0.0 F0.1;
M98 P1244 L10; (SUBPROGRAM CALL)
G0Z5.0;
X100.0;
G28 U0.0 W0.0;
M05;
T0404; (BORING)
G97 S1100 M03;
G0Z3.0;
X30.0;

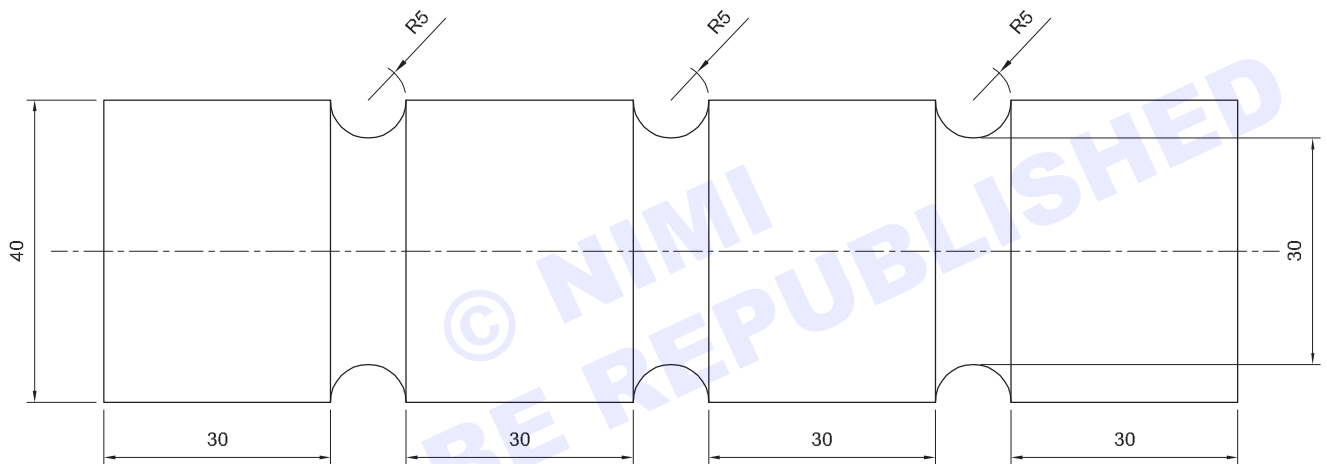
G01 Z-100 F0.1;
G0X29.0;
Z5.0;
X100.0;
G28 U0.0 W0.0;
M05;
T0505; (GROOVING)
G97 S1000 M03;
G0Z5.0;
X29.0;
Z-30.0;
M98 P1234 L4; (SUBPROGRAM CALL)
G01 Z-60.0;
M98 P1234 L4; (SUBPROGRAM CALL)
G0X29.0;
Z5.0;
G0X100.0;
G28 U0.0 W0.0;
M05;
M09;
M30;
O01244 (SUB PROGRAM DRILL)
G01 W-10.0 F0.1;
G0 W10.0;
G01 W-10.0F0.5;
M99;

SUBPROGRAM
O1234; (GROOVING)
G01 U 1.0F 0.08;
G01X30.0;
G01 U2.0;
G01X30.0;
G01U2.5;
G01X29.0;
M99;

Select & run sub program from the main program by controlling speed & feed

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

- select & execute a sub program
- control speed and feed in auto mode.



1	Ø42 x 150mm	-	FE310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1	USE OF SUB PROGRAM				TOLERANCE ±	TIME :
					CODE NO. CN20N18107E1	

Job Sequence

- Write the CNC program for turning operation.
- Enter the CNC program in CNC simulator using edit mode.
- Verify the program in simulator.
- Transfer the program to the machine.
- Take the offset.
- Run the main program and subprogram by controlling speed & feed
- Check the dimension and remove the job.
- Switch off the machine.

Main program

Code	Description
O1212;	Program
N5 G21 G18 G90;	Metric units, XZ plane, absolute positioning
T0101;	Selection of tool
G97 M03 S1200;	Spindle ON with 1200 RPM, feed rate 0.2mm/rev
N10 G00 X40 Z0;	Rapid traverse to X40, Z0(safe position)
N20 M98 P1234 L3;	Call subprogram O1234 for 3 repetitions
N30 G01 W-30 F0.2	Linear interpolation to Z-30
N40 G28 U0 W0;	Return to machine home (X and Z offsets 0)
N50 M05;	Spindle OFF
N60 M30;	Program end and rewind

Subprogram: (To be loaded separately in controller)

Code	Description
O1234;	Subprogram number O1234
G01 U0 W-30;	Linear interpolation to Z-30
G02 U0 W-10 R5;	Circular interpolation (clockwise) to Z-10, radius 5mm
N60 M99;	End of subroutine, return to main program

Identify and select tooling as per machining material

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

- **decide cutting tool material for various applications.**

PROCEDURE

Write the suitable tool material for the job material mentioned in the table 1.

Table 1

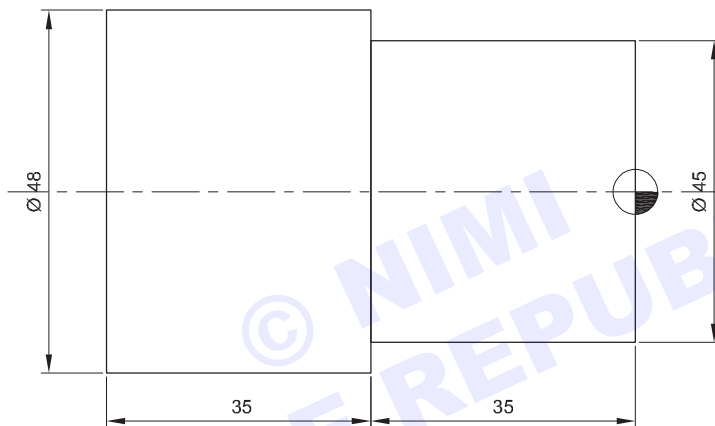
Sl. No.	Job material	Tool material
1	Low carbon steel	
2	High carbon steel	
3	Stainless steel	
4	Grey cast iron	
5	Brass & Bronze	
6	Aluminium	
7	Aluminium casting	
8	Copper	
9	Gun metal	
10	Tool steel	

Note : Trainer shall provide any tool catalogue for the selection of cutting tool material in accordance with ISO.

Step turning and facing

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

- prepare CNC programme for the given drawing
- enter the programme in CNC simulator using edit mode
- verify the programme by simulation on CNC simulator
- execute the program in auto mode.



01	Ø50x75MM	-	FE 310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1		FACING AND TURNING PROGRAM			TOLERANCE ±	TIME :
					CODE NO. CN20N18109E1	

Job Sequence

- Read the drawing
- Switch ON the computer
- Open the mastercam software (Fig 1)

Fig 1



- Press F (for wireframe setup. (Fig 2)

- Draw 2D sketch as per drawing (Fig 3)

Fig 2

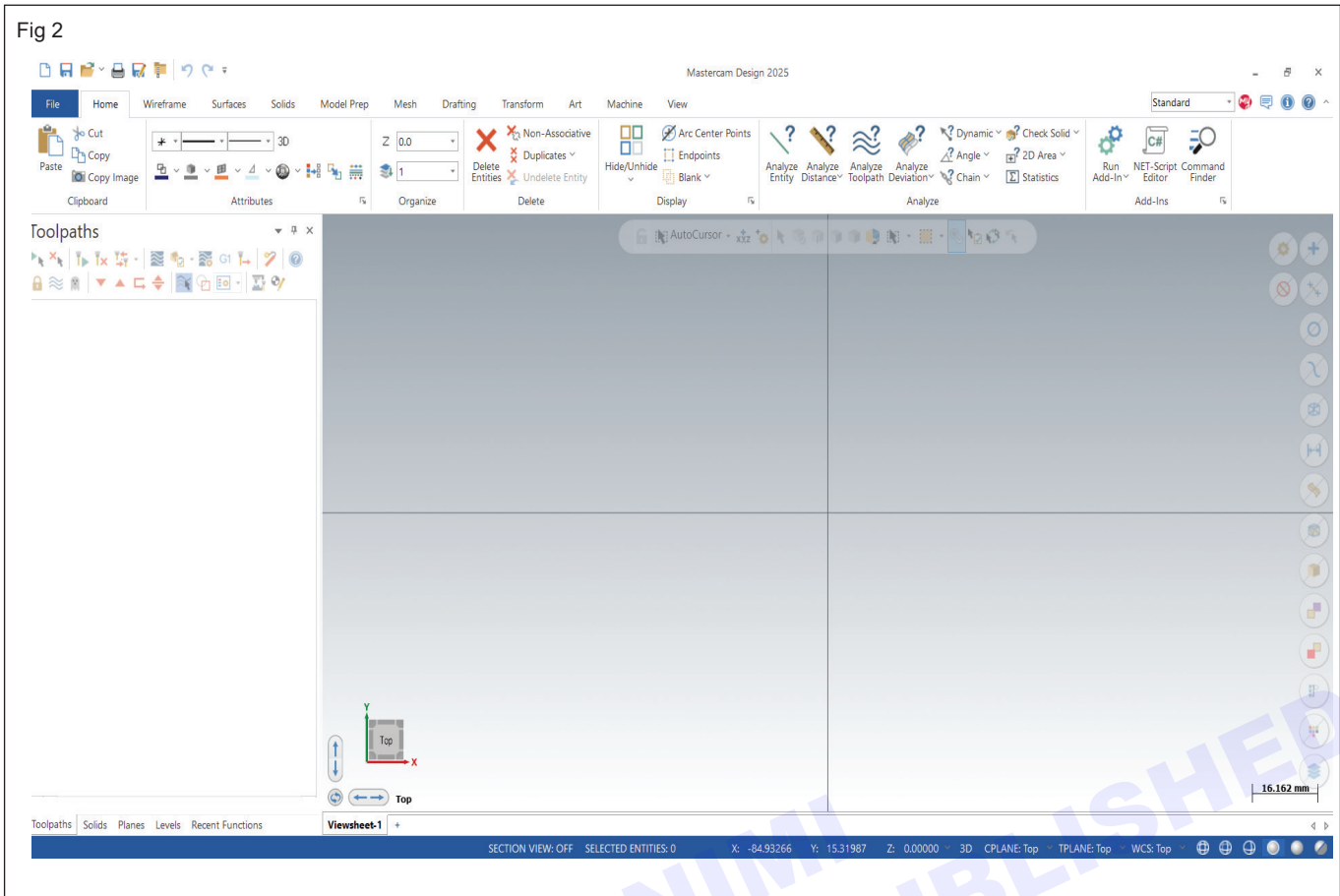
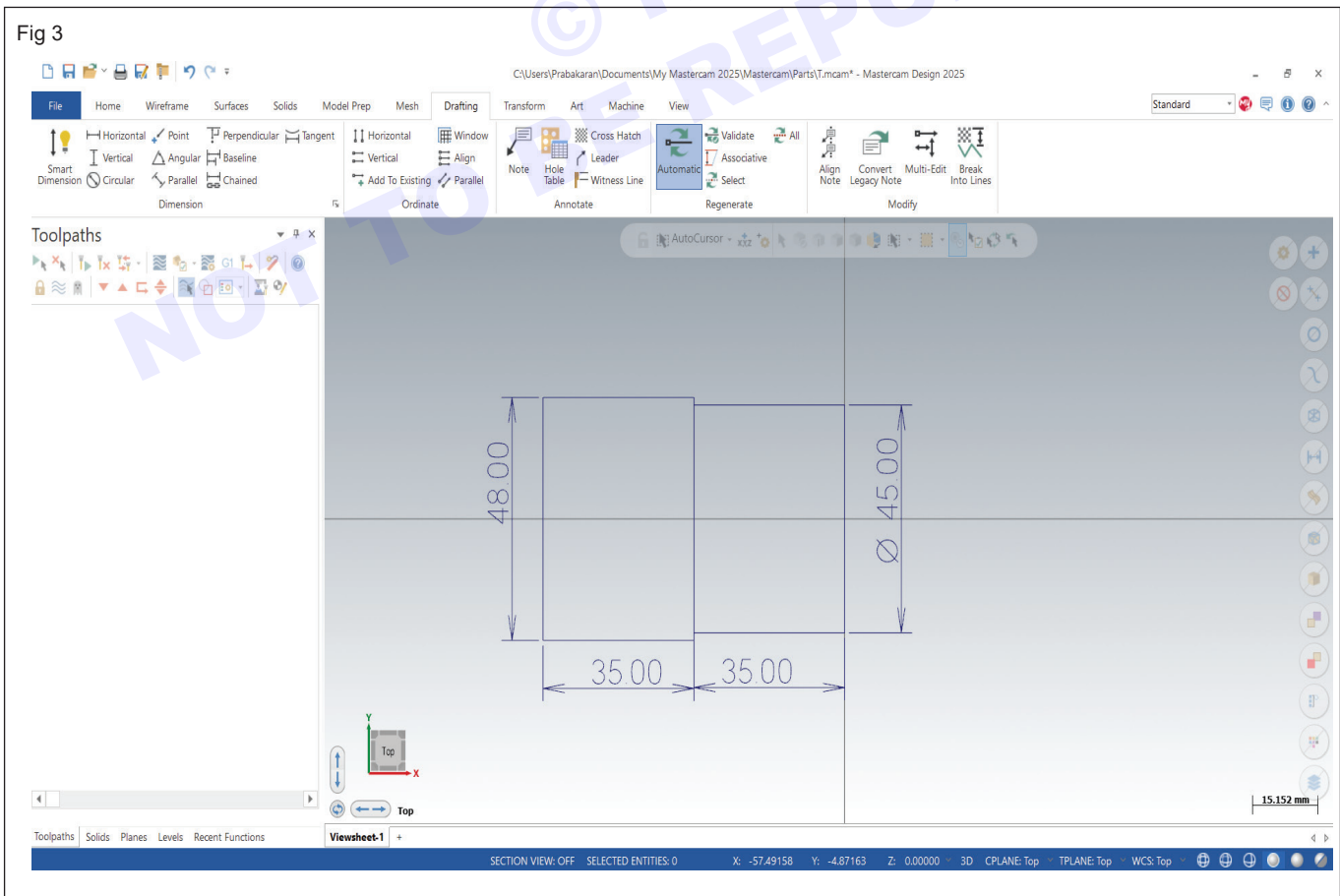
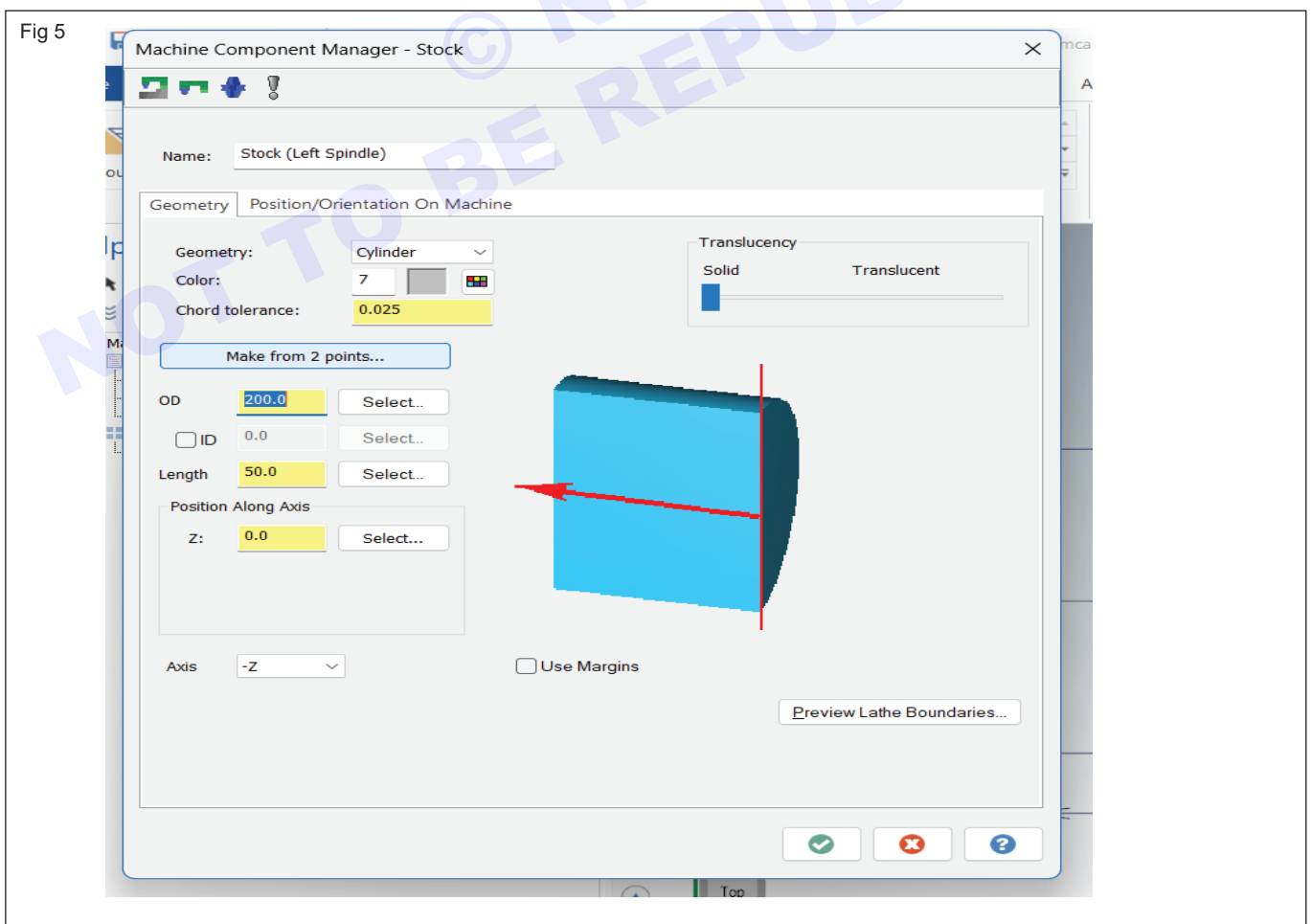
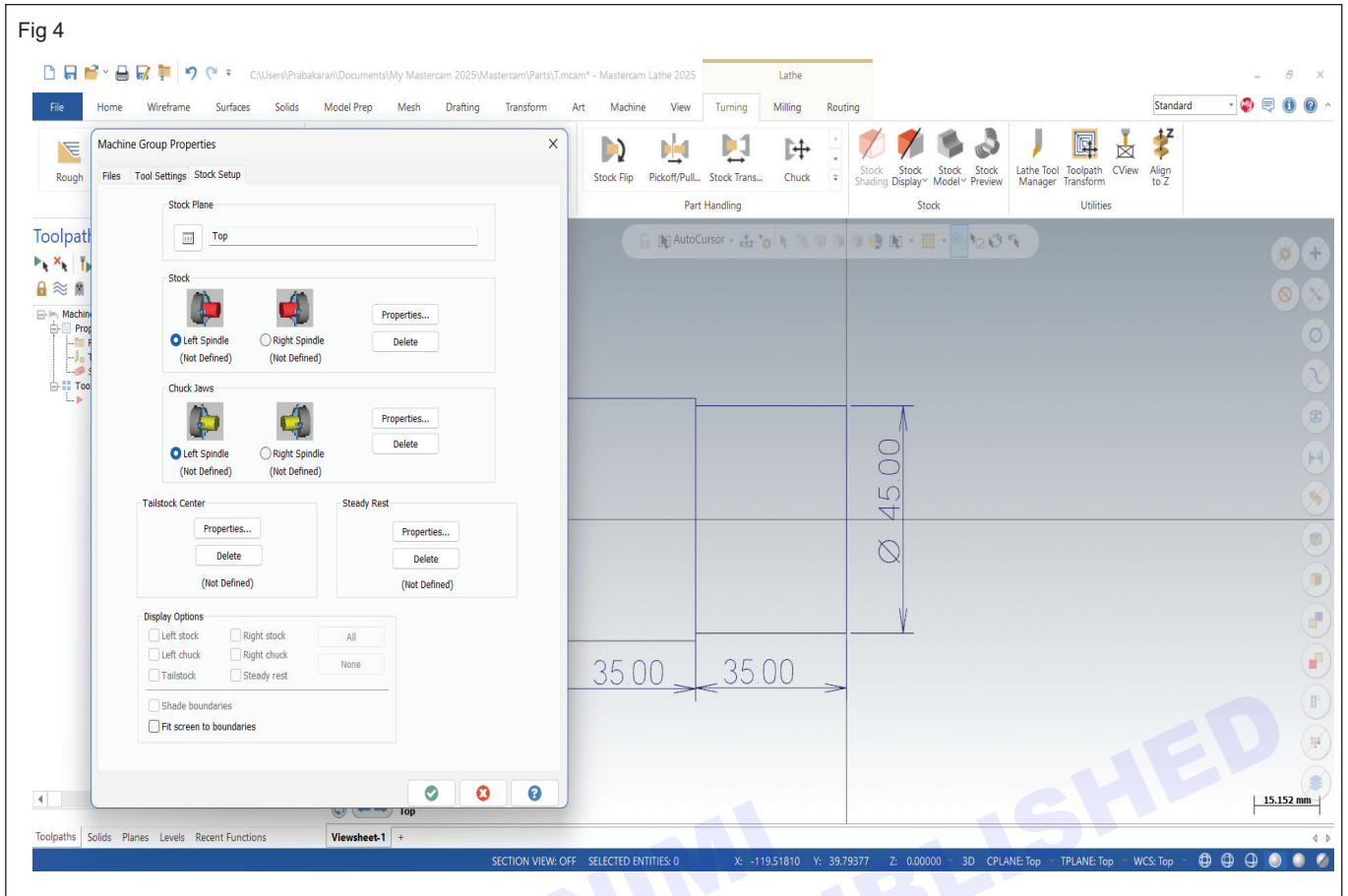


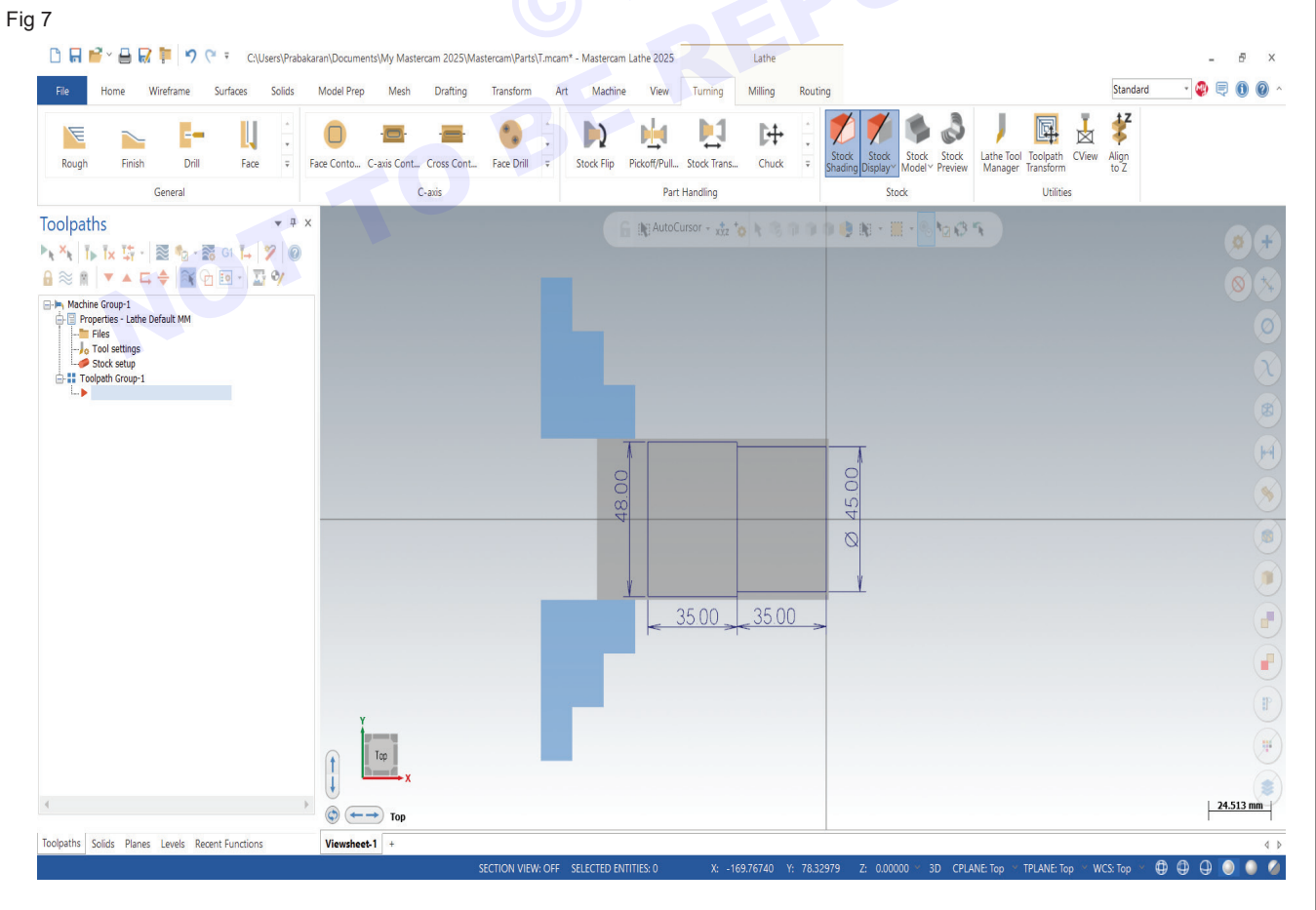
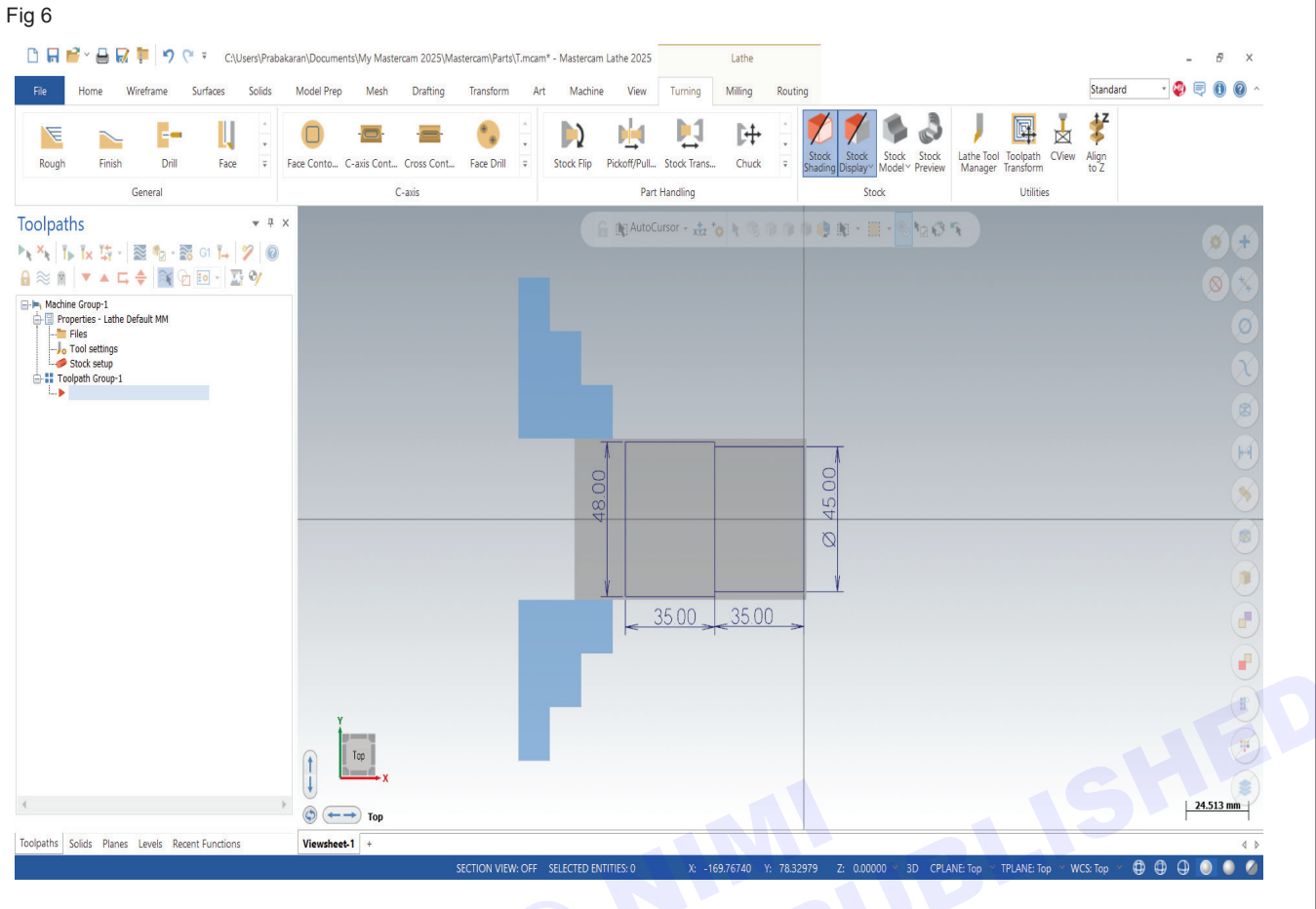
Fig 3



- Select machine definition with lathe option.
- Perform the stock setup (Fig 4&5)



- Figs 6 & 7 shows jaws setup with stock



- Select appropriate toolpath for the desired operation.
- Select appropriate tool, tool path parameter as shown in Figs 8, 9 & 10.

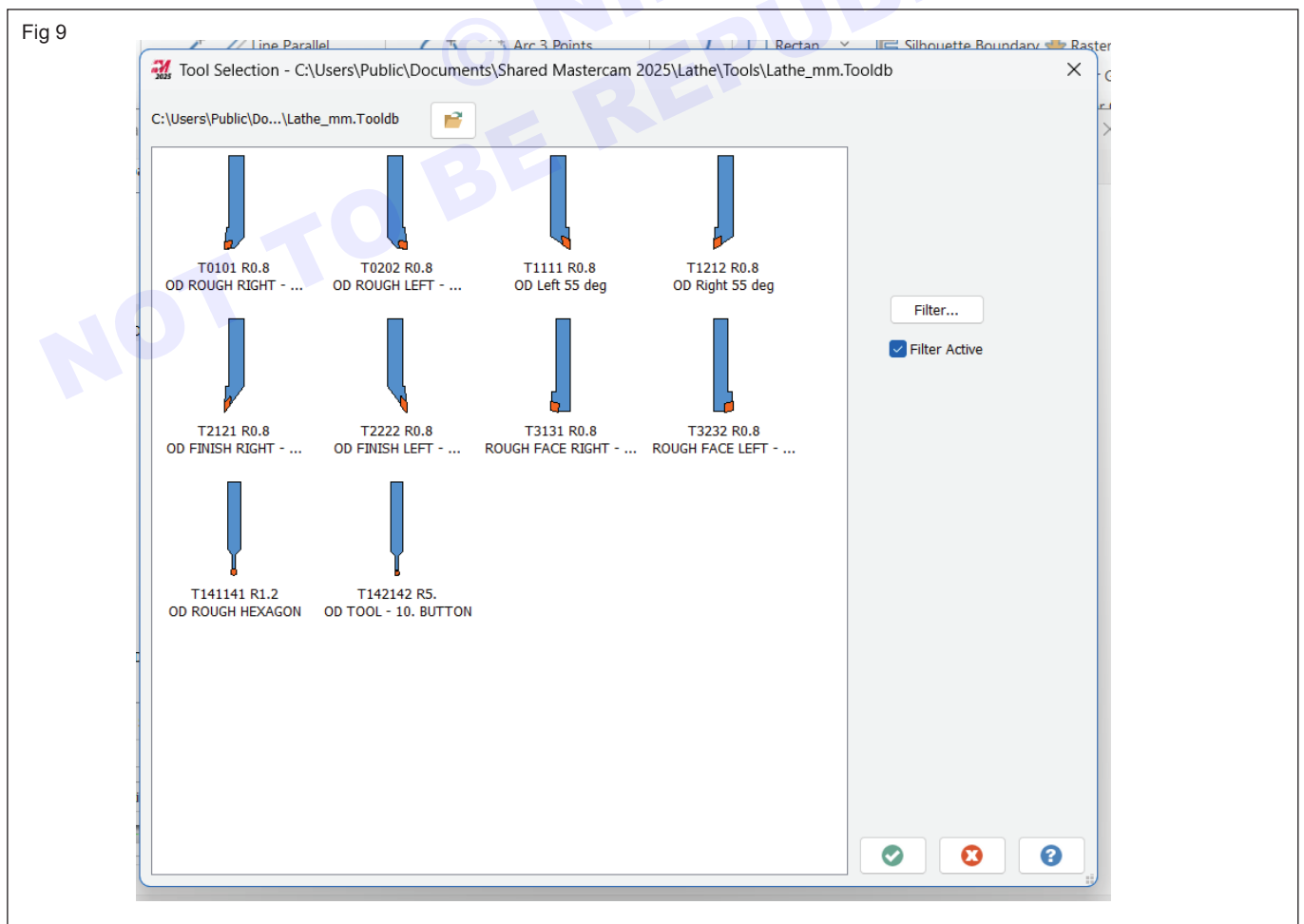
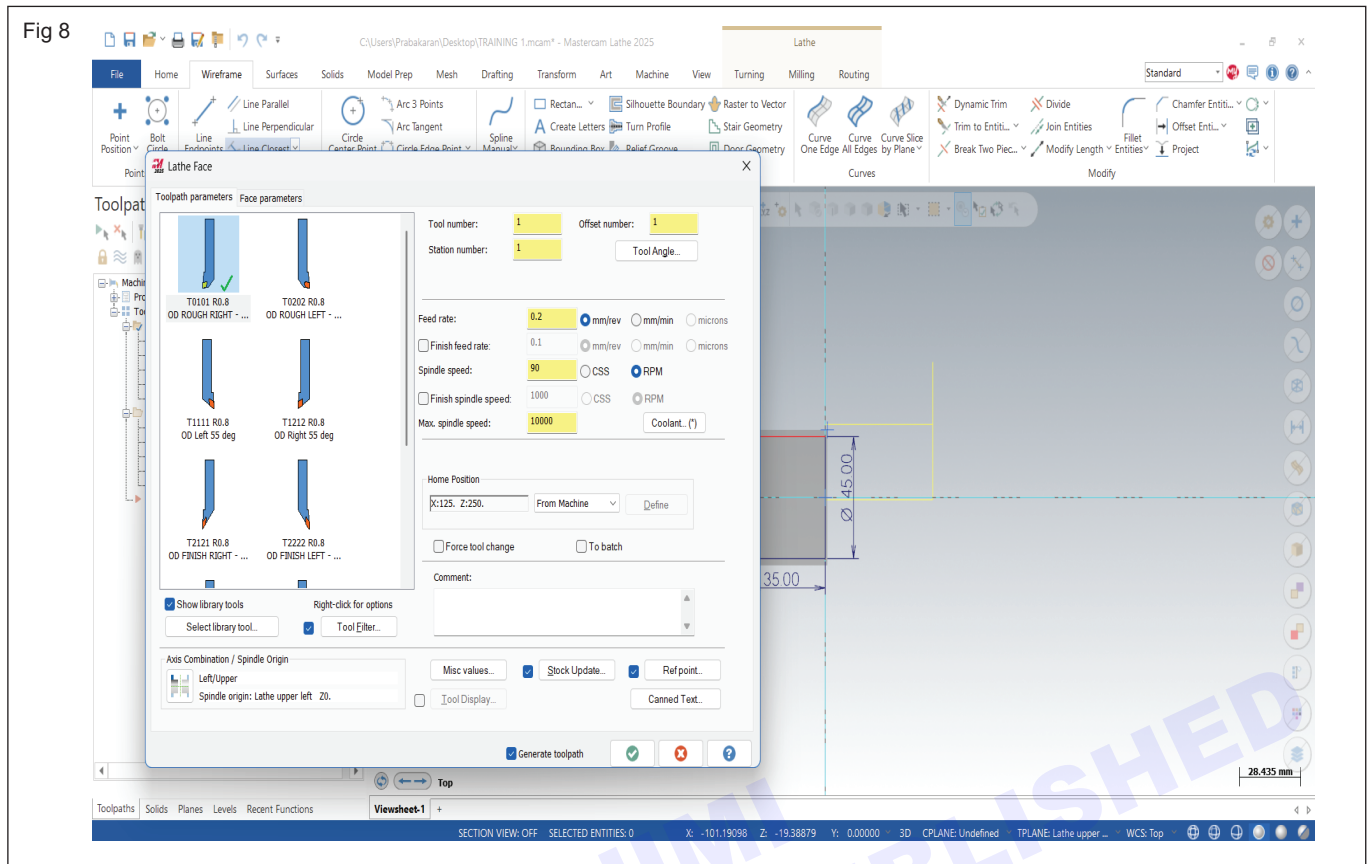
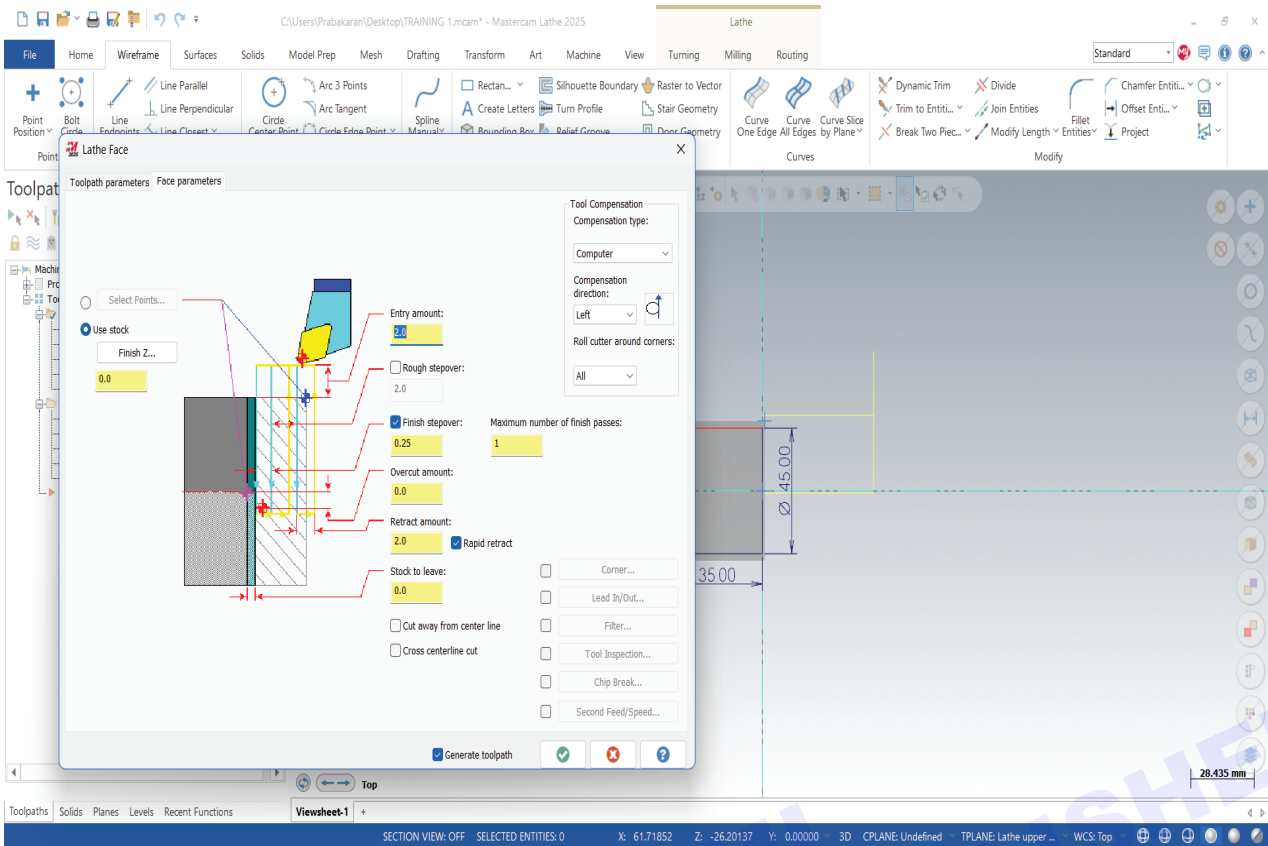
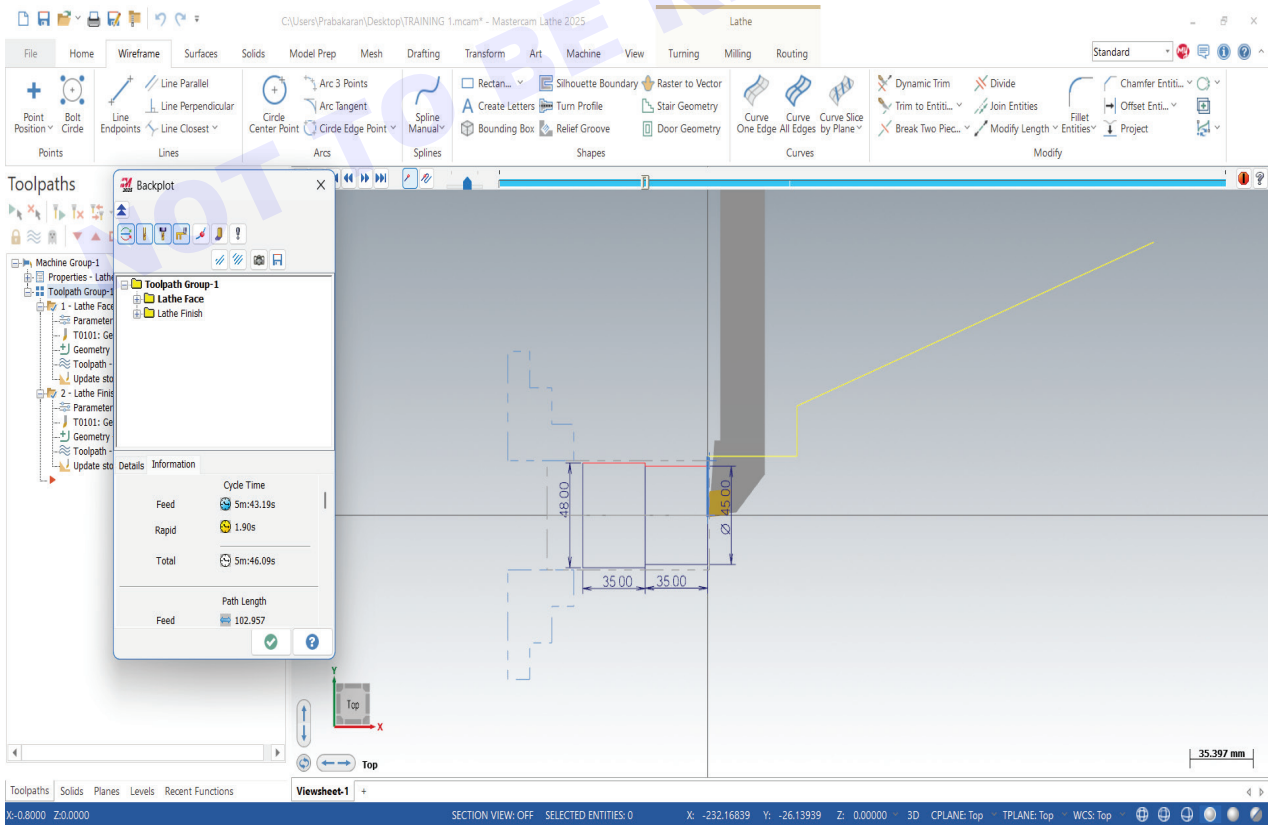


Fig 10



- Select back plot option to simulate the toolpath for facing operation. (Fig 11)

Fig 11



- Select backplot option to simulate the toolpath for OD turning operation (Fig 12)
- Verify the toolpath. (Fig 13)

Fig 12

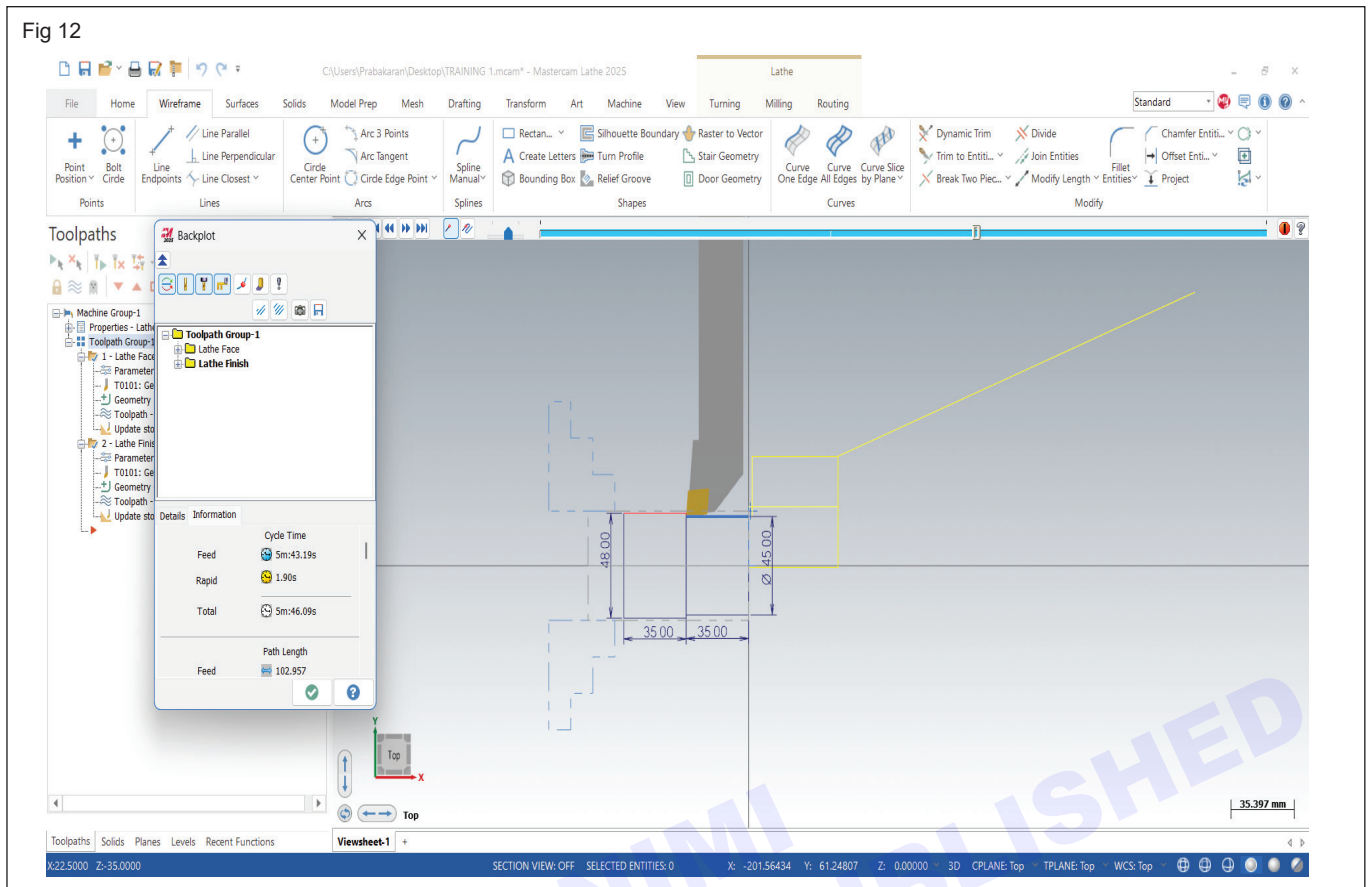
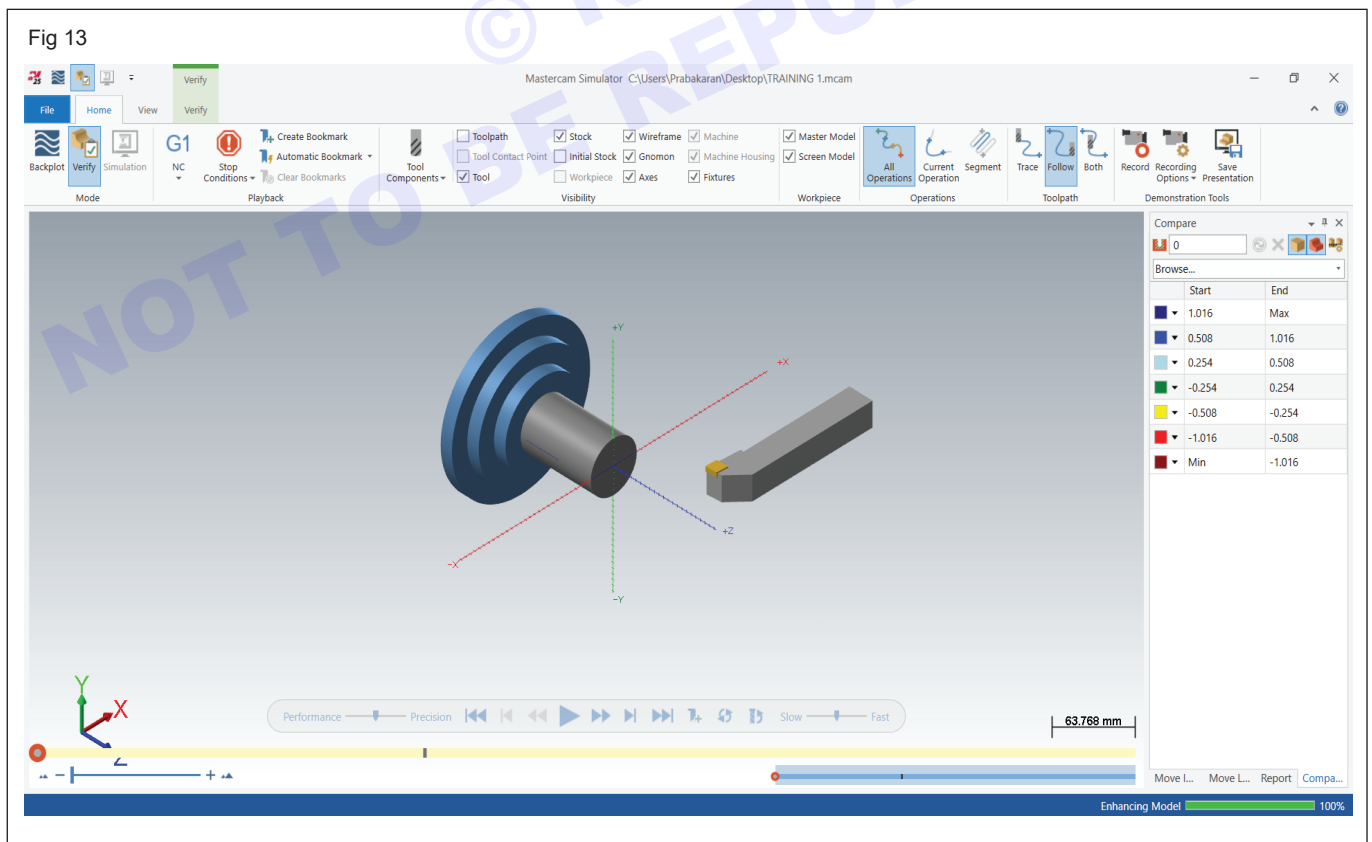
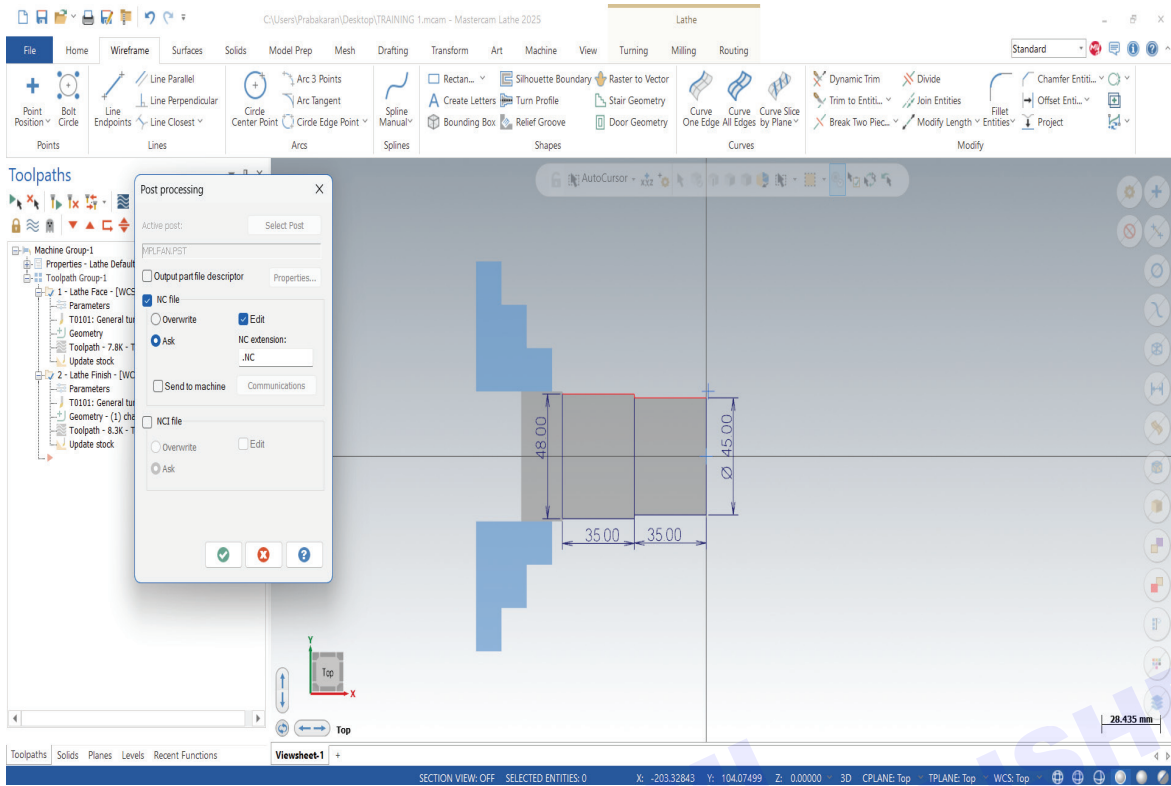


Fig 13



- Select G1 option to perform post processing to generate NC file. (Fig 14).

Fig 14



- NC program generated (Fig 15)

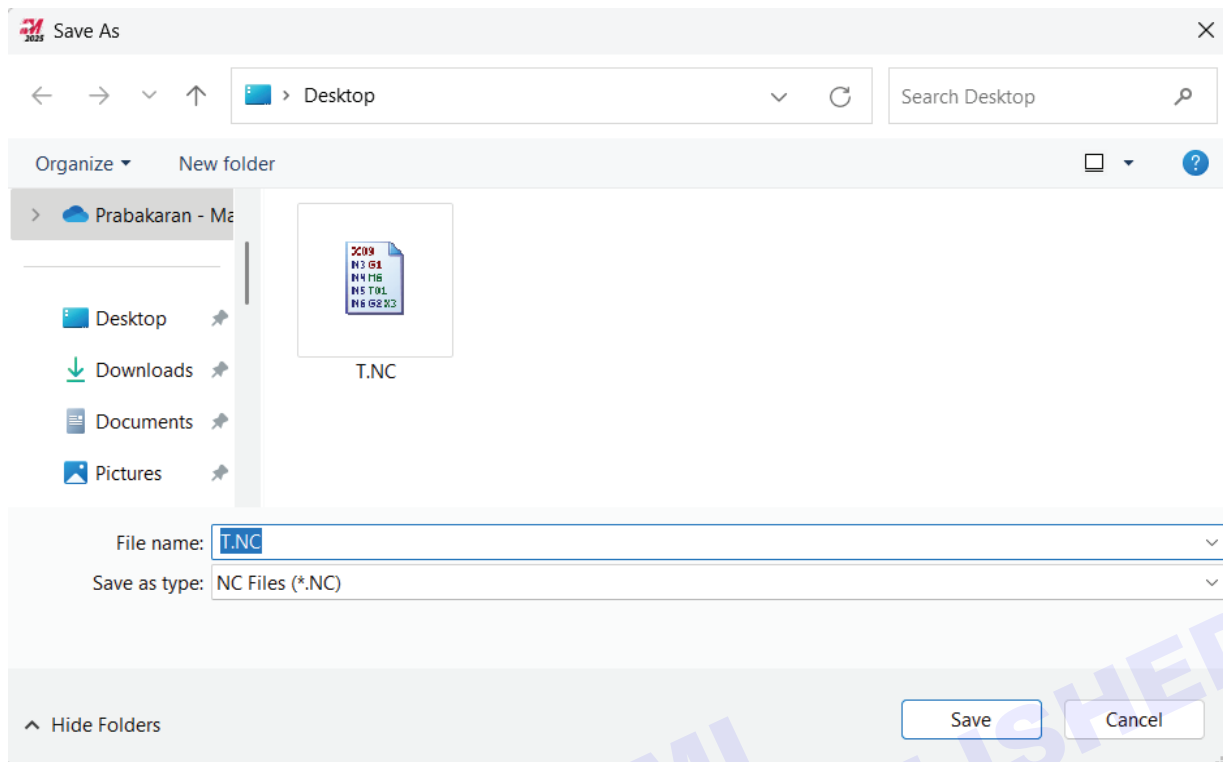
Fig 15

```

%
O0001 (FACING AND STEP TURNING)
G21
G0 T0101
G18
G97 S90 M04
G0 G54 X100. Z50. M8
X54.
Z0.
G99 G1 X-1.6 F.2
G0 Z2.
Z50.
X100.
Z2.
X45.
G1 Z0. F.2
Z-35.
X46.4
G18 G3 X48. Z-35.8 K-.8
G1 Z-70.
X50.828 Z-68.586
G0 X100.
Z50.
G28 U0. V0. W0. M05
T0100
M30
%
```

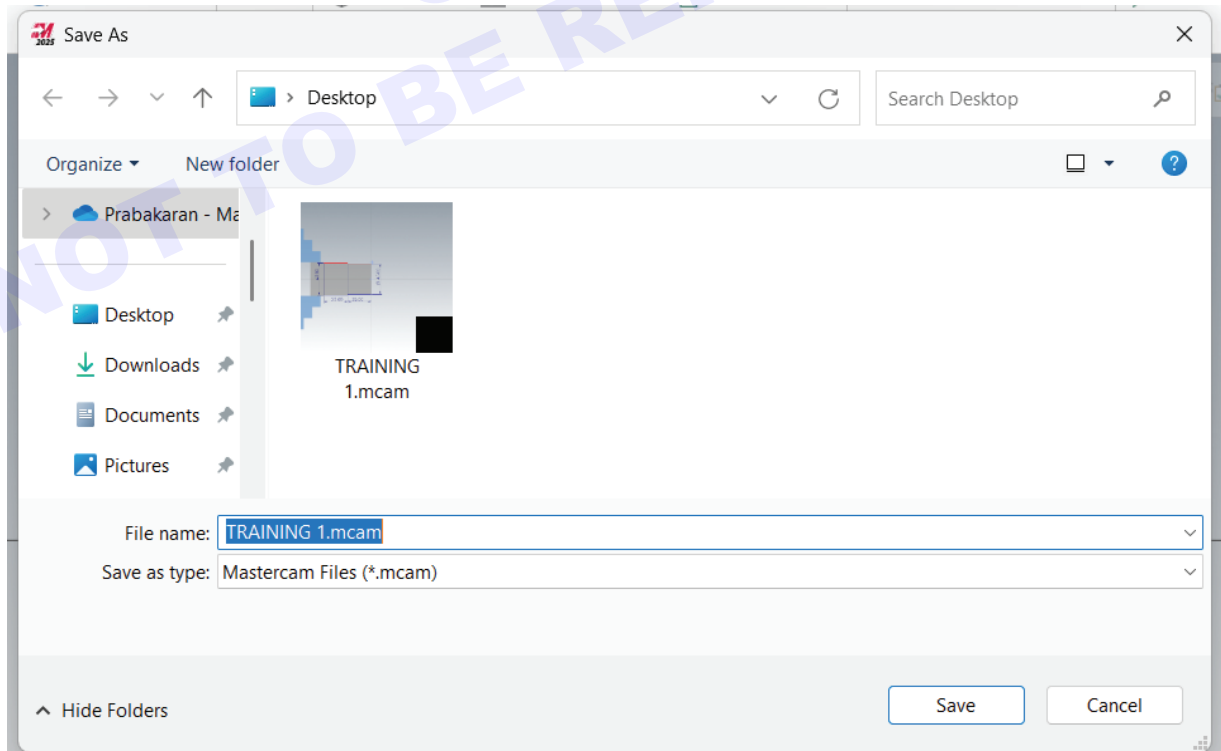
- Save the NC file in the desired location in PC.
(Fig 16)

Fig 16



- Save the mastercam file in the desired location.
(Fig 17)

Fig 17



- Transfer the program to CNC lathe.
- Execute program on the machine.

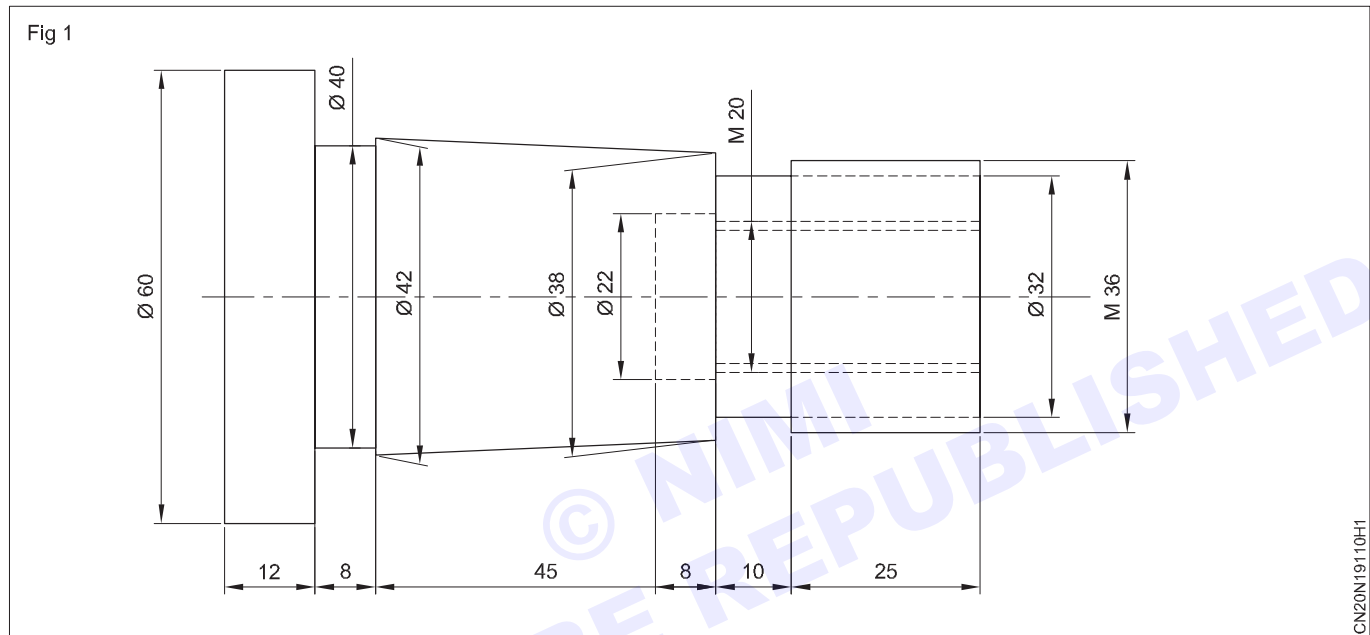
Note: To prepare the program refer previous exercises on CAM

Create a complex machining part program with the help of CAM

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

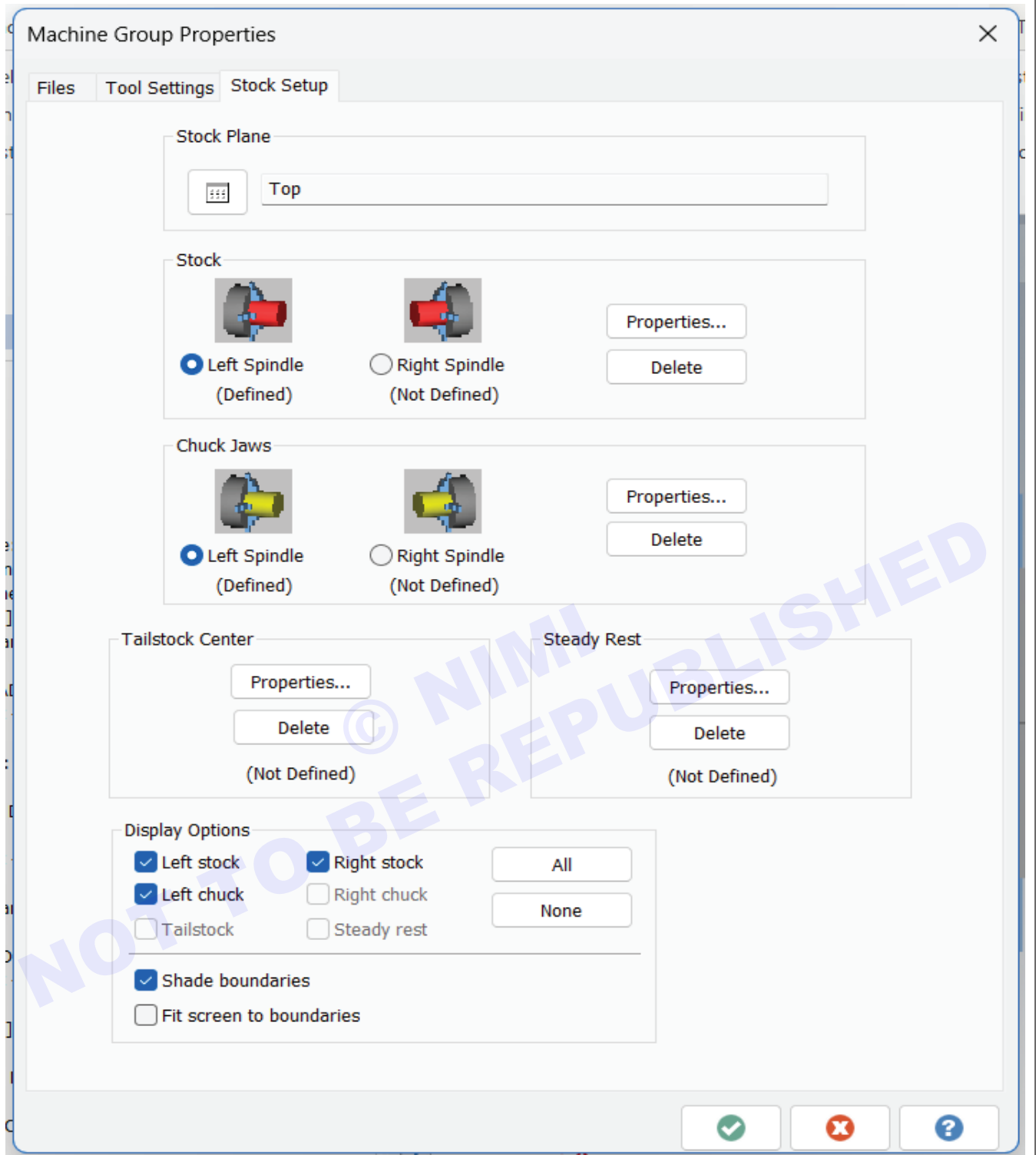
- study the drawing
- open the master cam software
- draw 2D sketch using CAM software
- perform the tool paths by selecting appropriate tools and verify
- create a NC program using post processing.

Study the drawing (Fig 1)



- Switch on the computer
- Open the mastercam software
- Press F9 for lineframe setup
- Draw 2D sketch as per drawing
- Select machine definition with lathe option
- Perform stock setup. (Fig 2)

Fig 2



- Setup stock and jaws. (Figs 3&4)

Fig 3

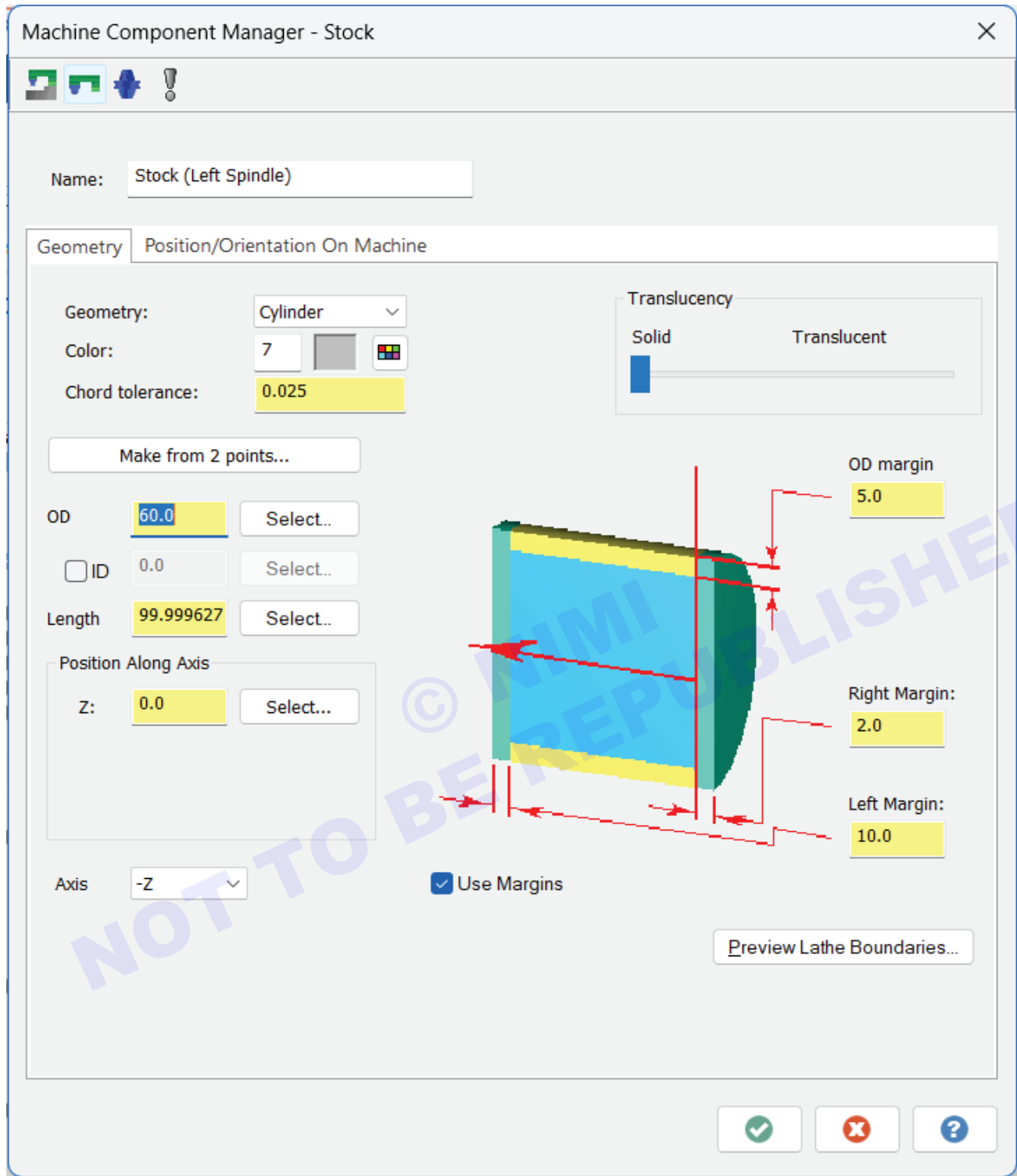
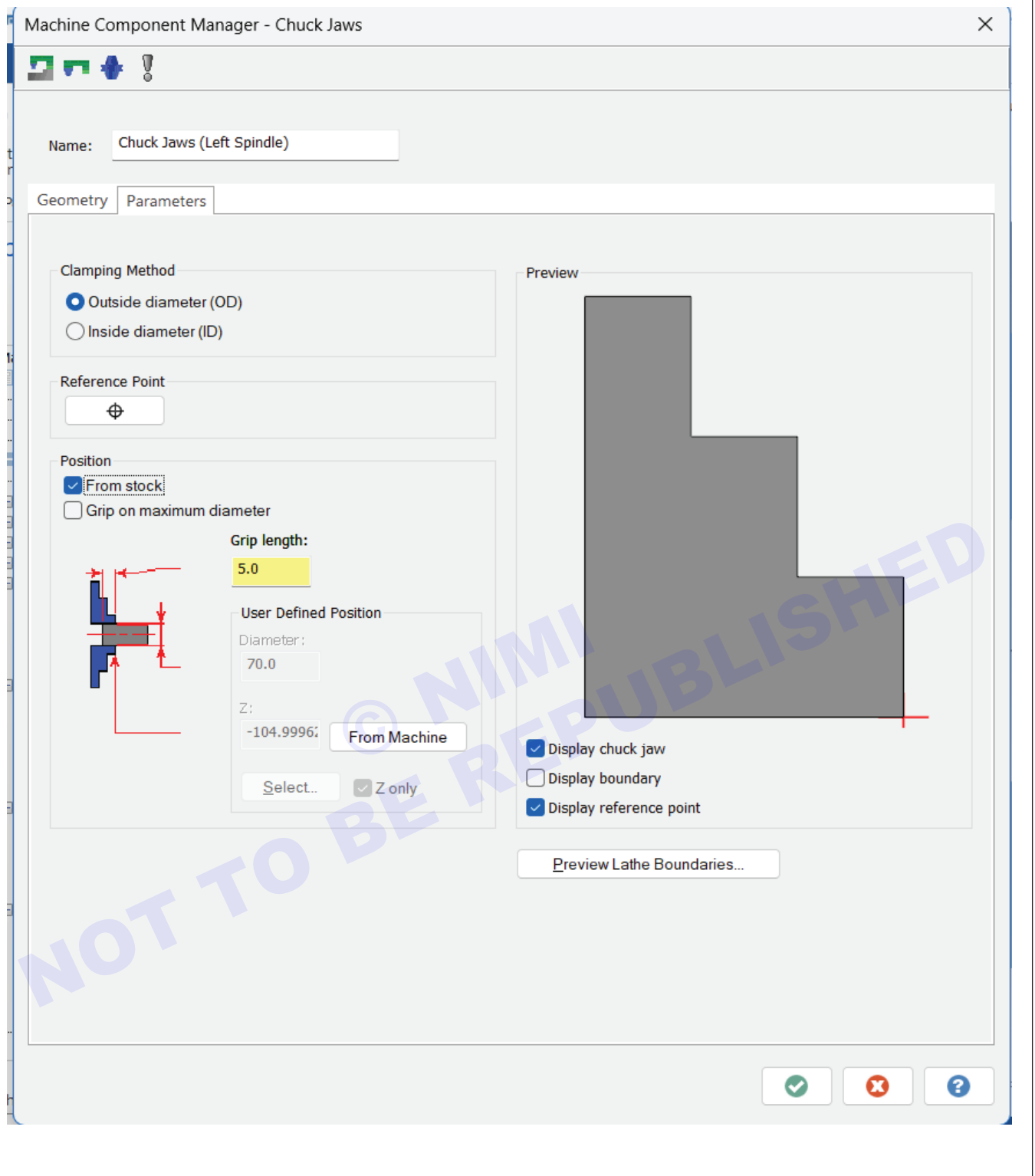
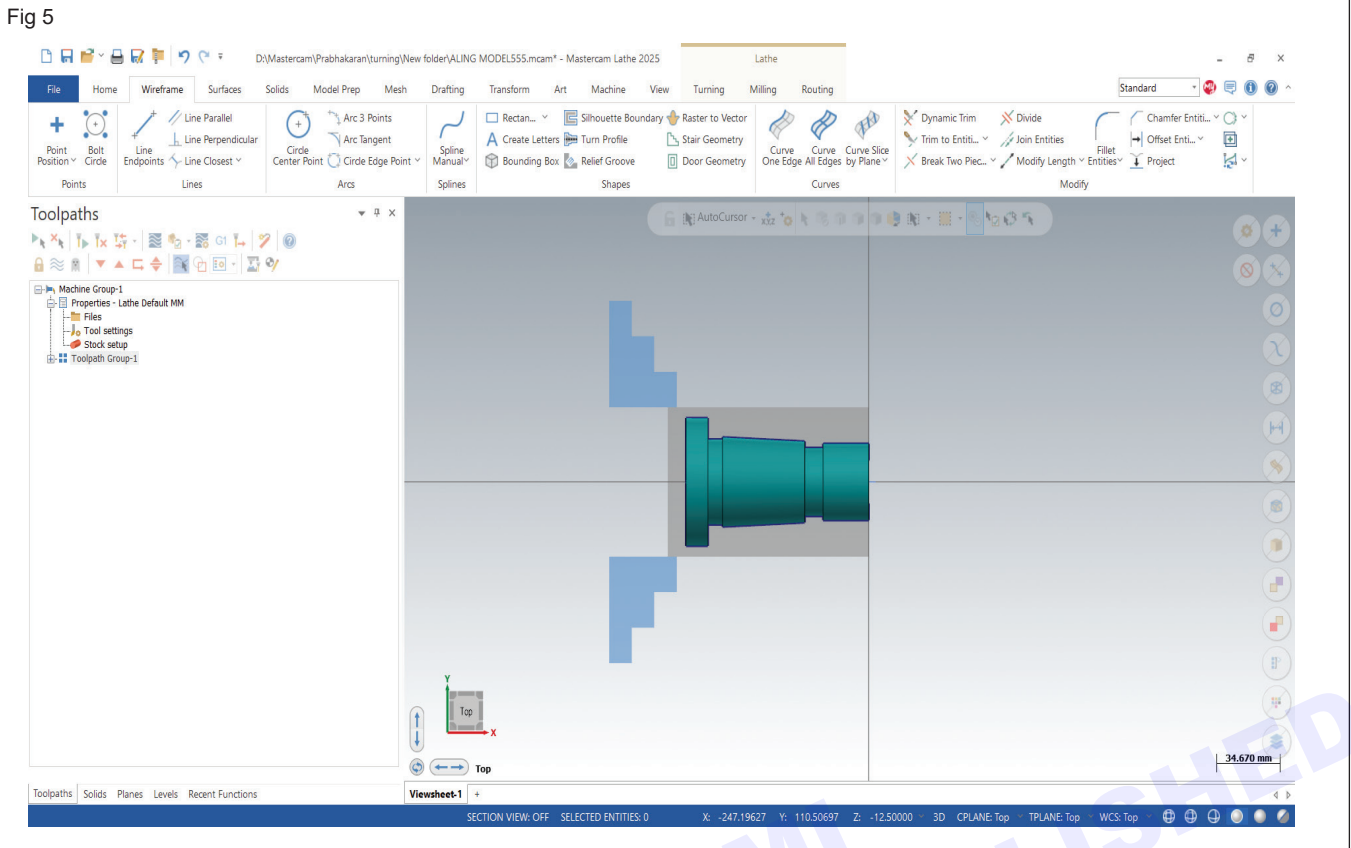


Fig 4



- Setup workpiece is as shown in Fig 5.



- Lathe face toolpath (Figs 6 & 7)

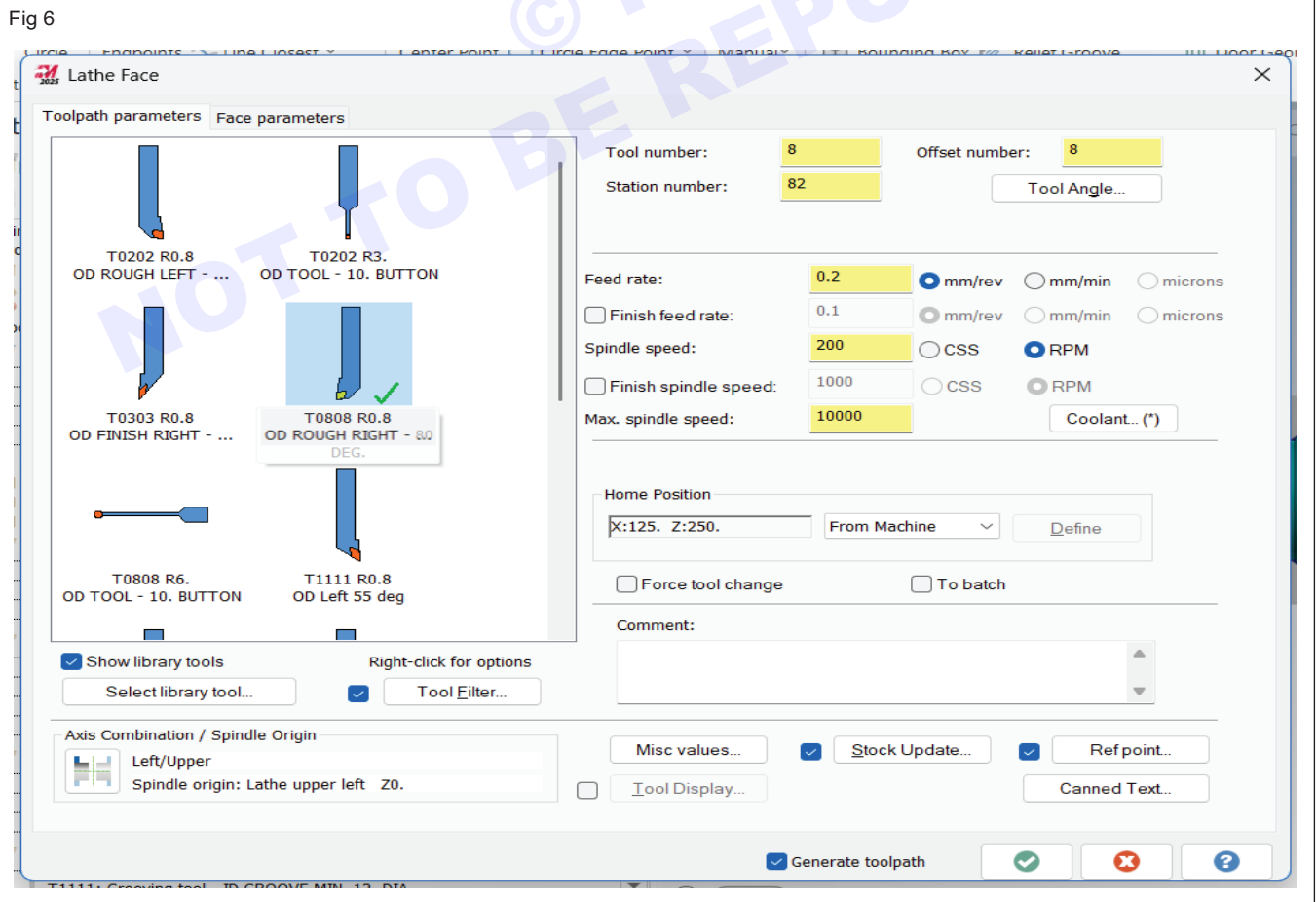
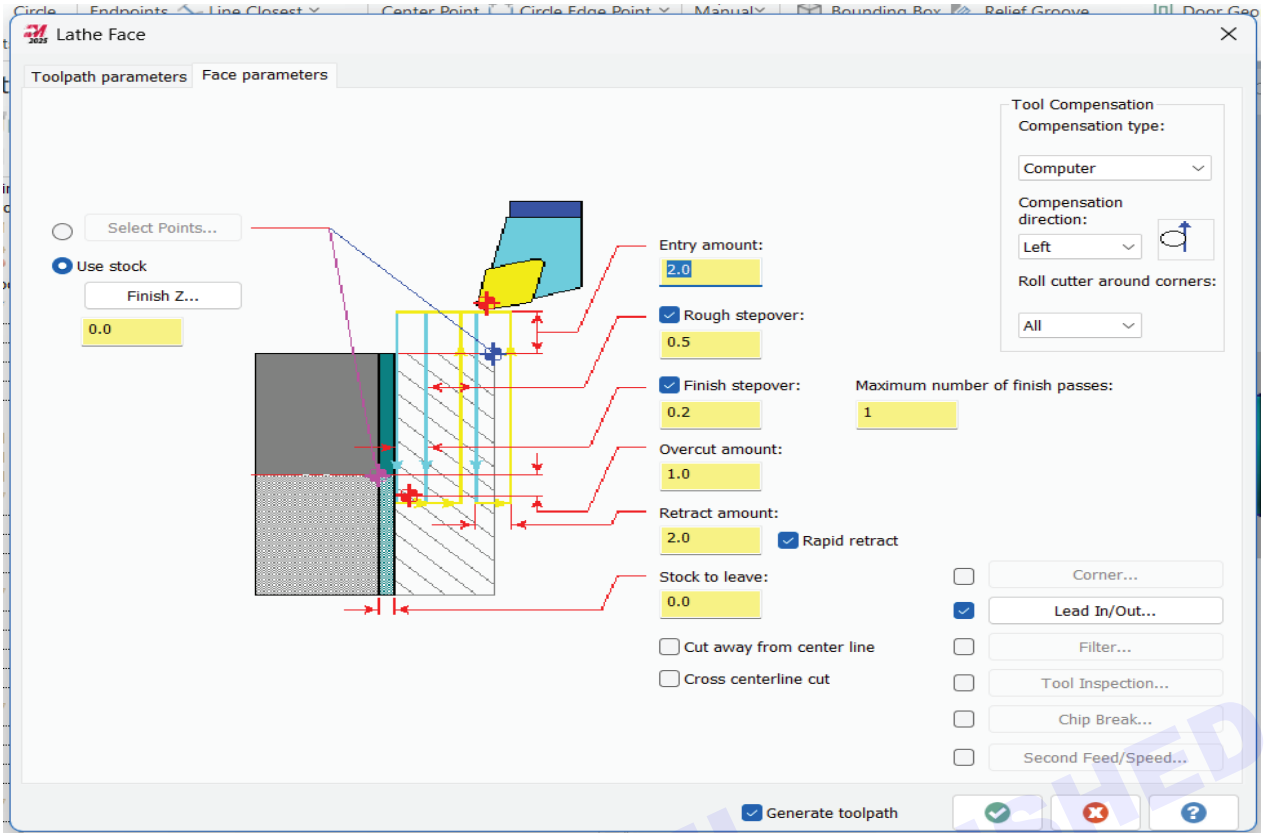


Fig 7



- Lathe rough toolpath (Figs 8 & 9)

Fig 8

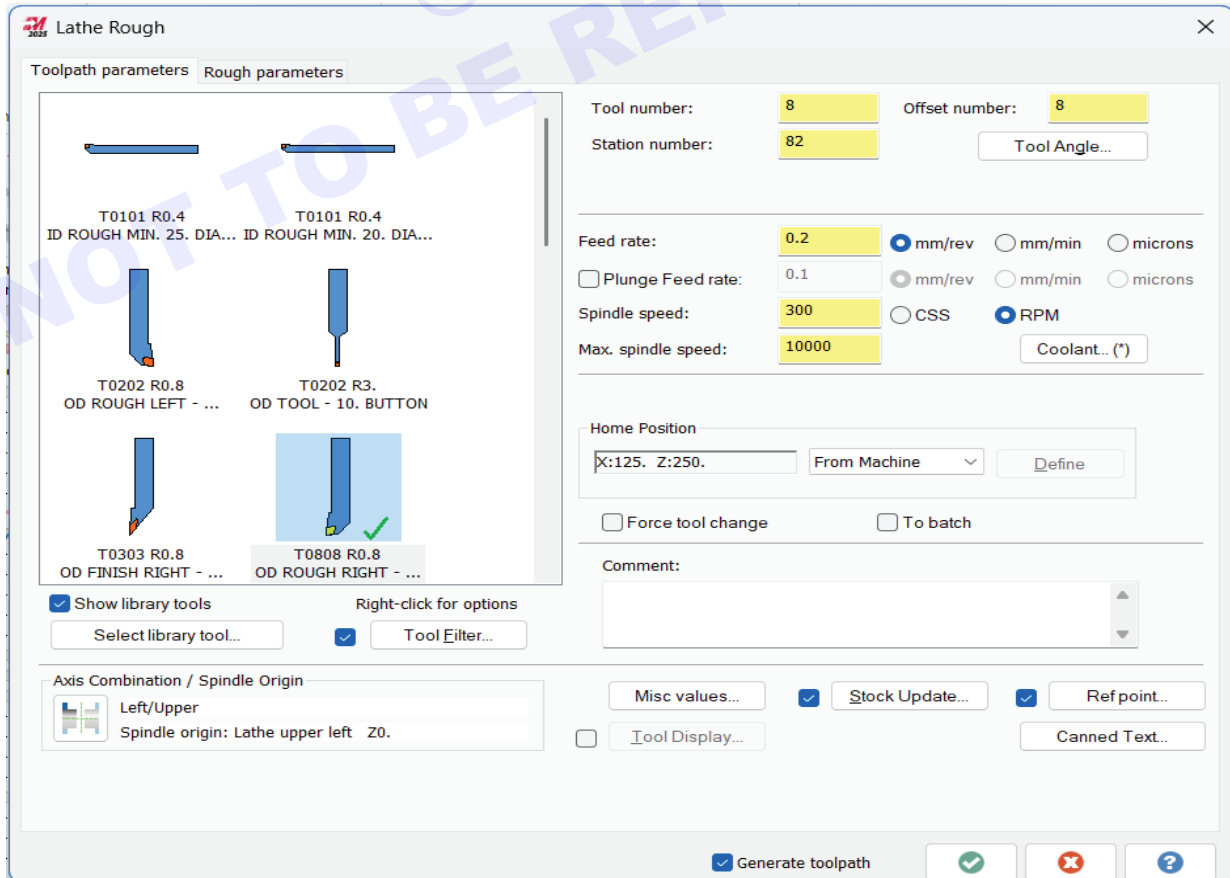
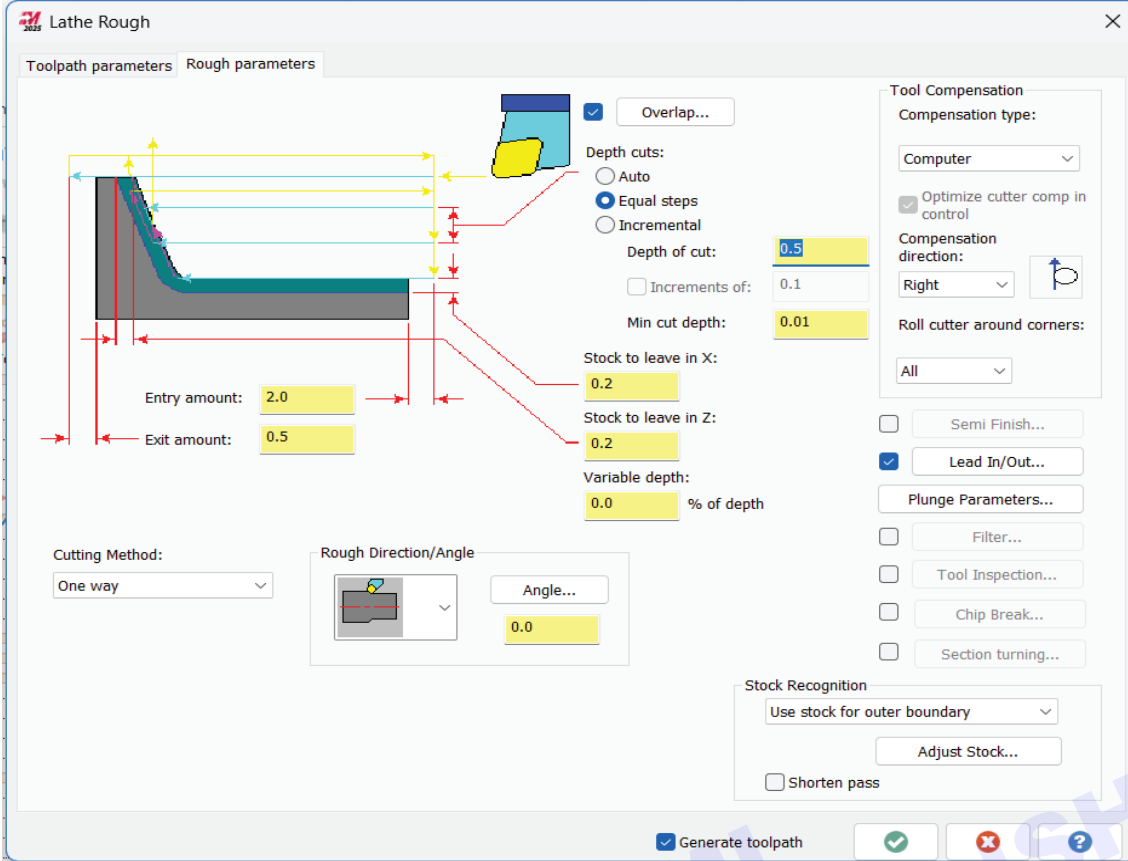


Fig 9



- Lathe finish toolpath (Figs 10 & 11)

Fig 10

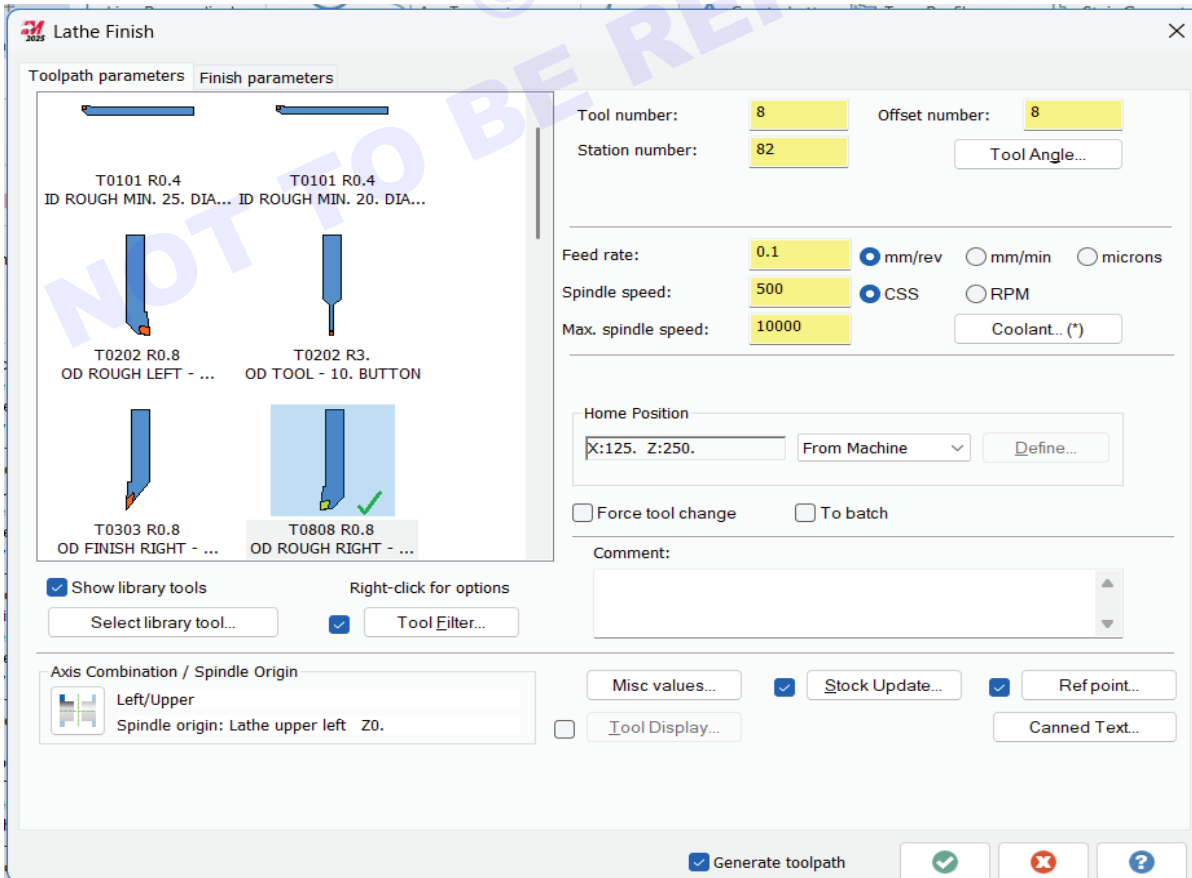
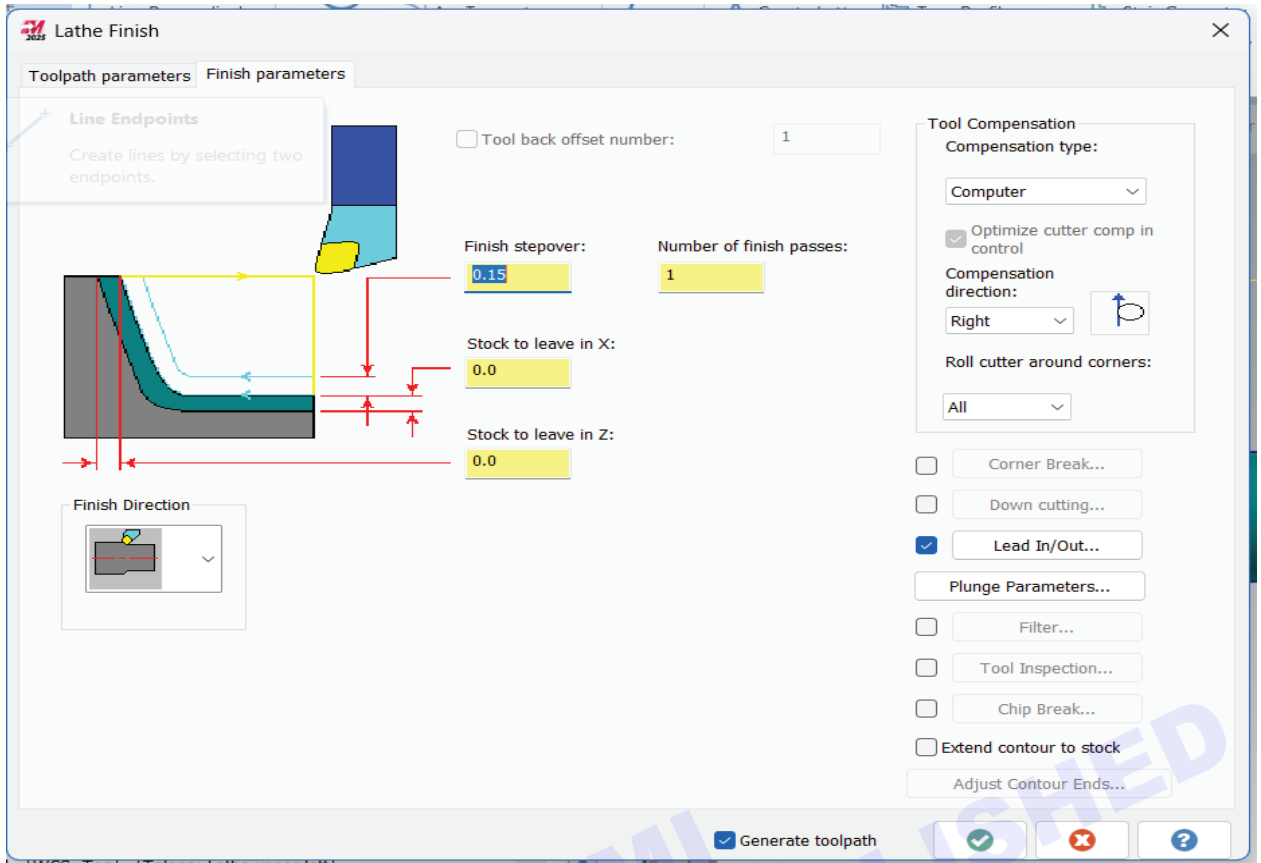


Fig 11



- Lathe groove toolpath (Figs 12, 13 & 14)

Fig 12

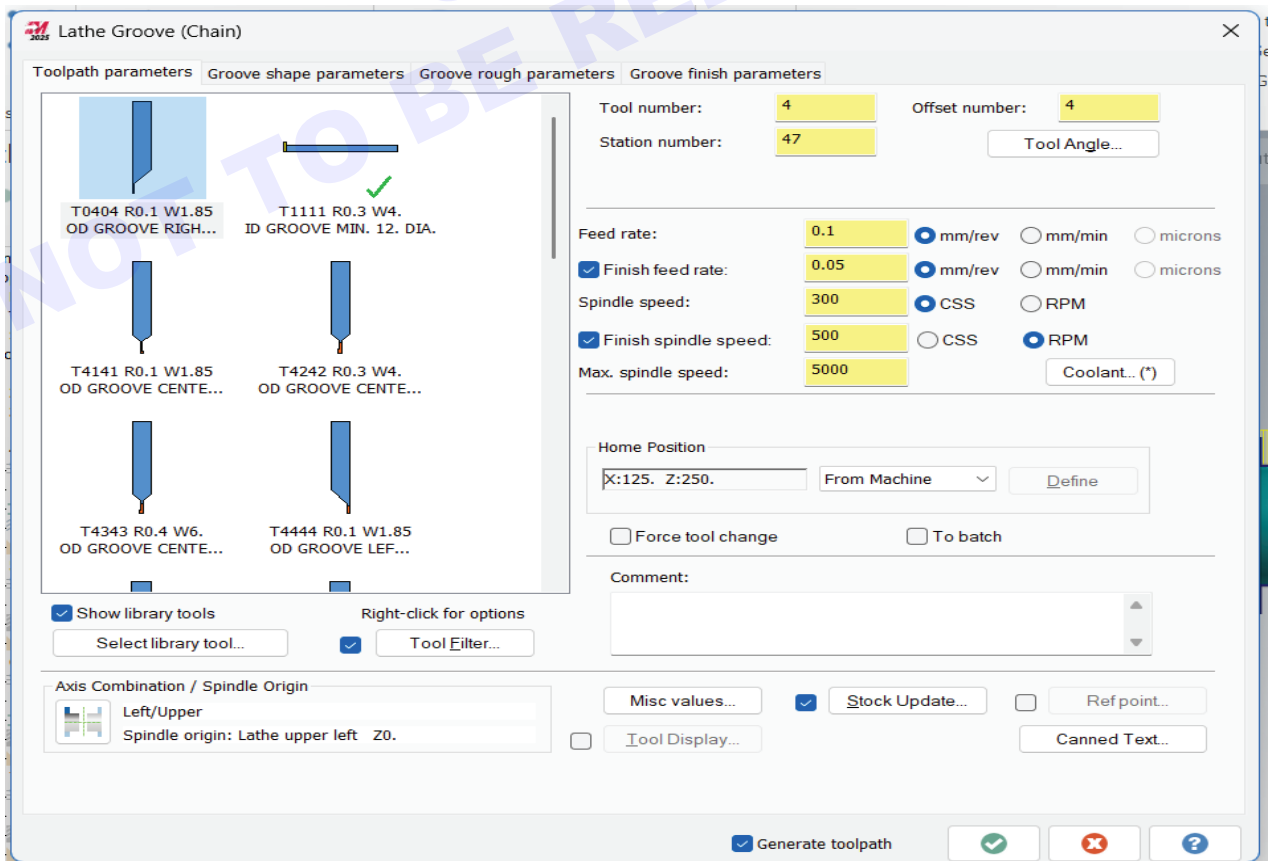


Fig 13

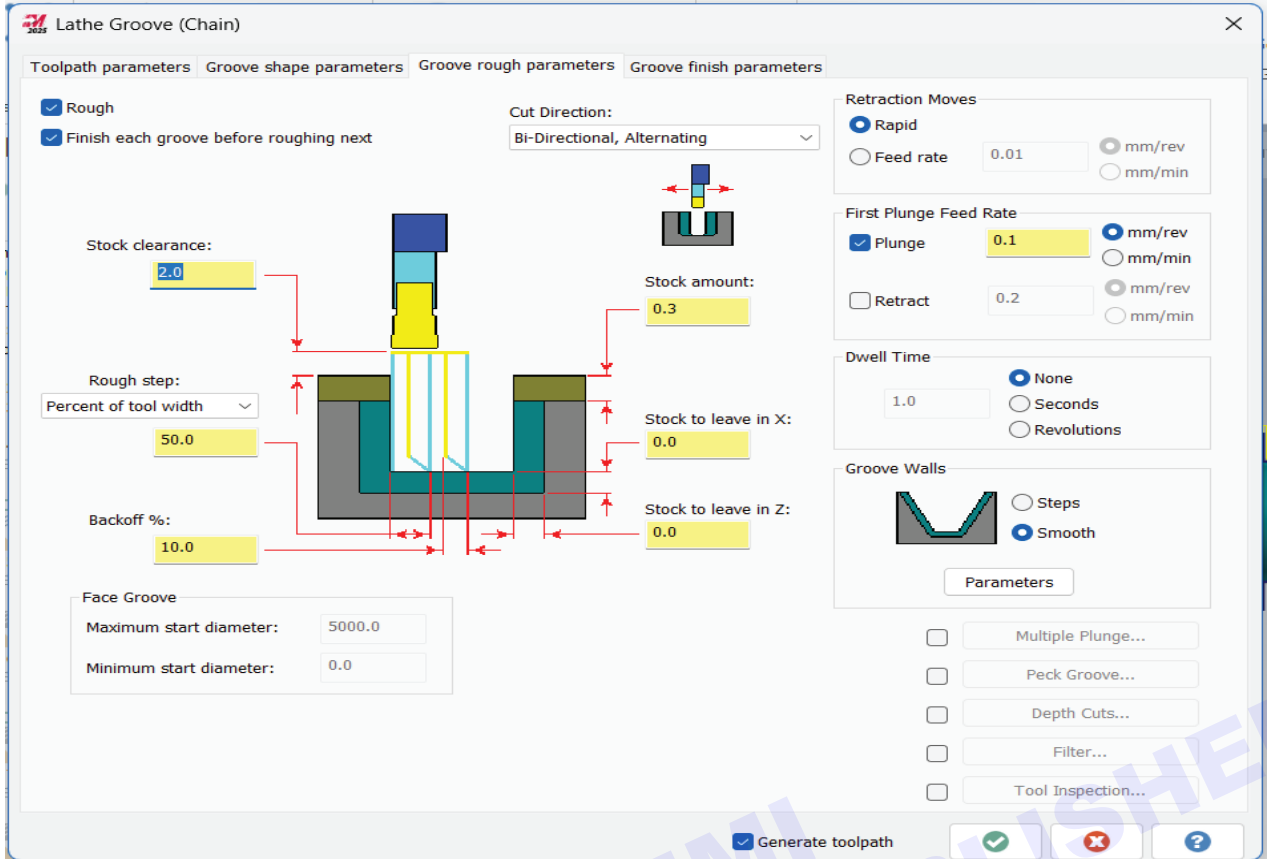
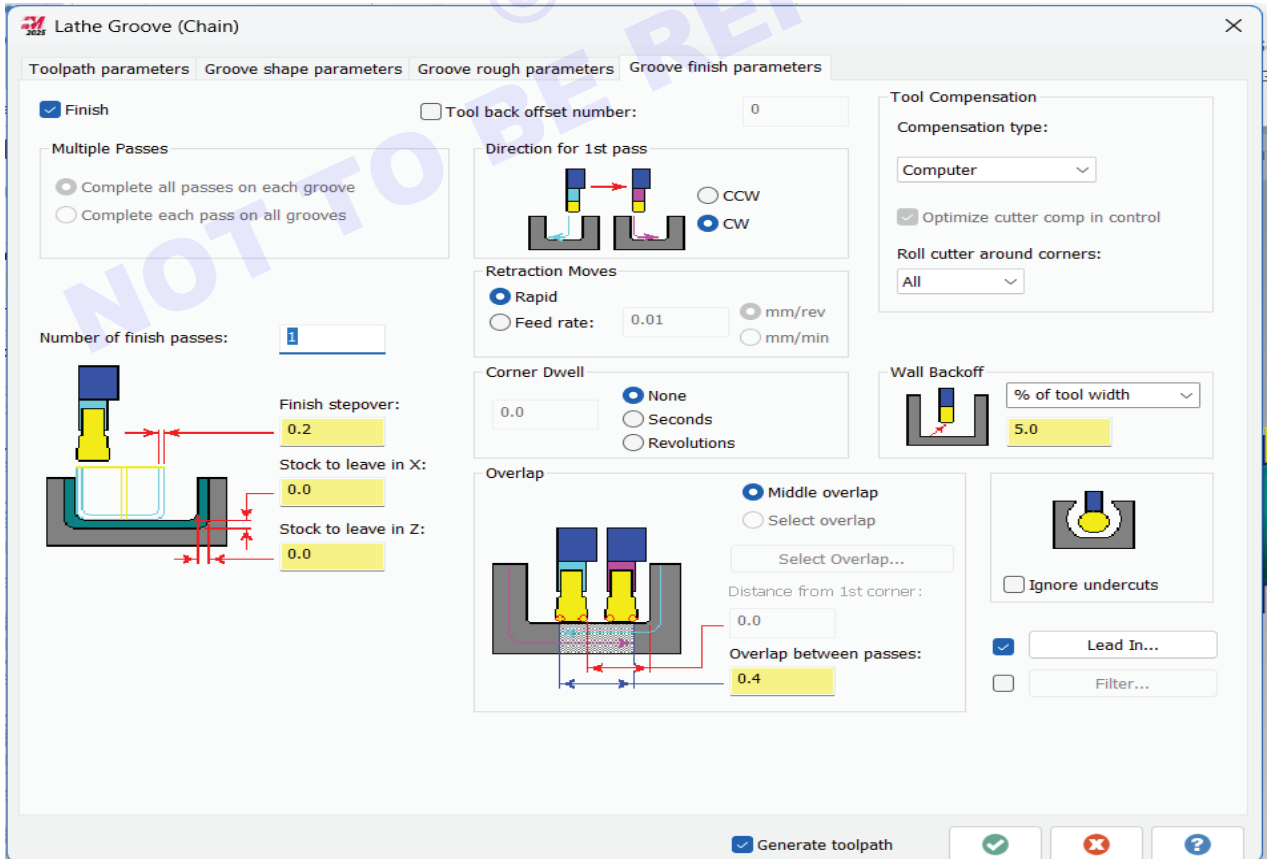


Fig 14



- Lathe thread toolpath (Figs 15,16 & 17)

Fig 15

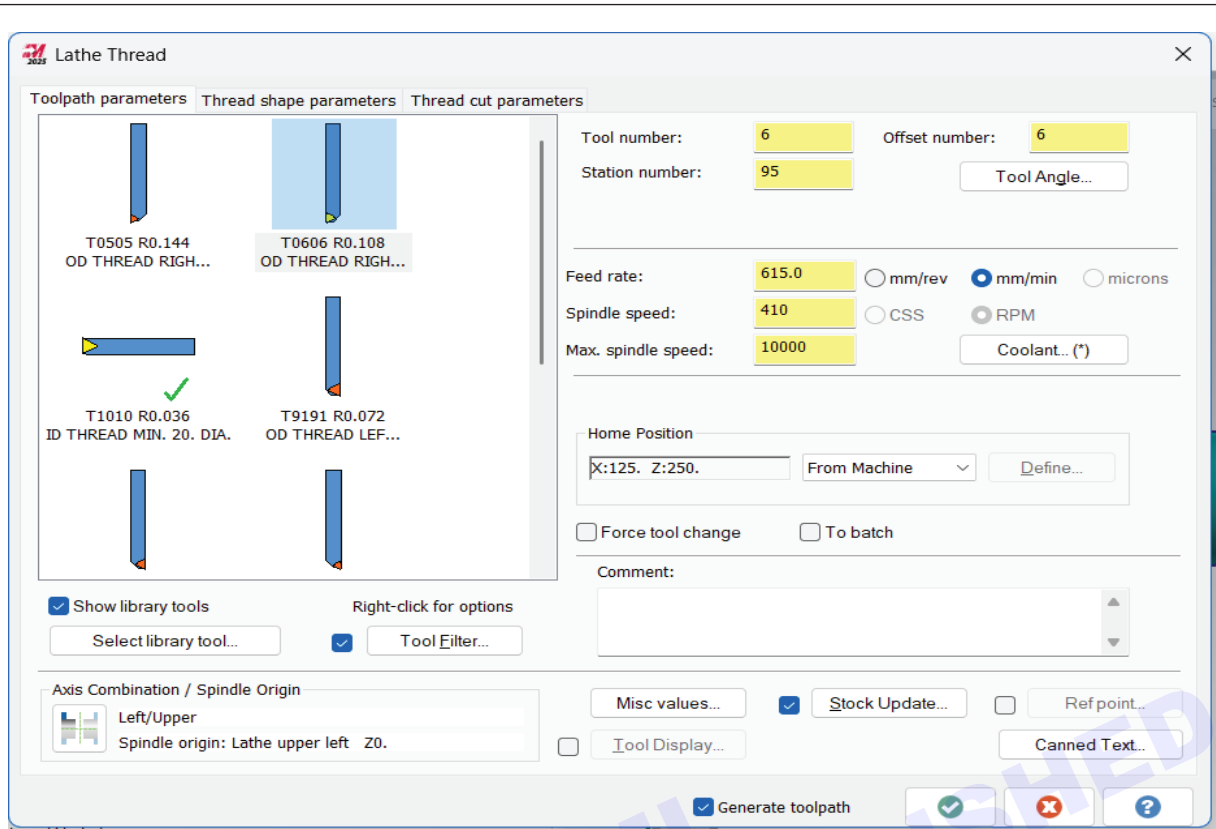


Fig 16

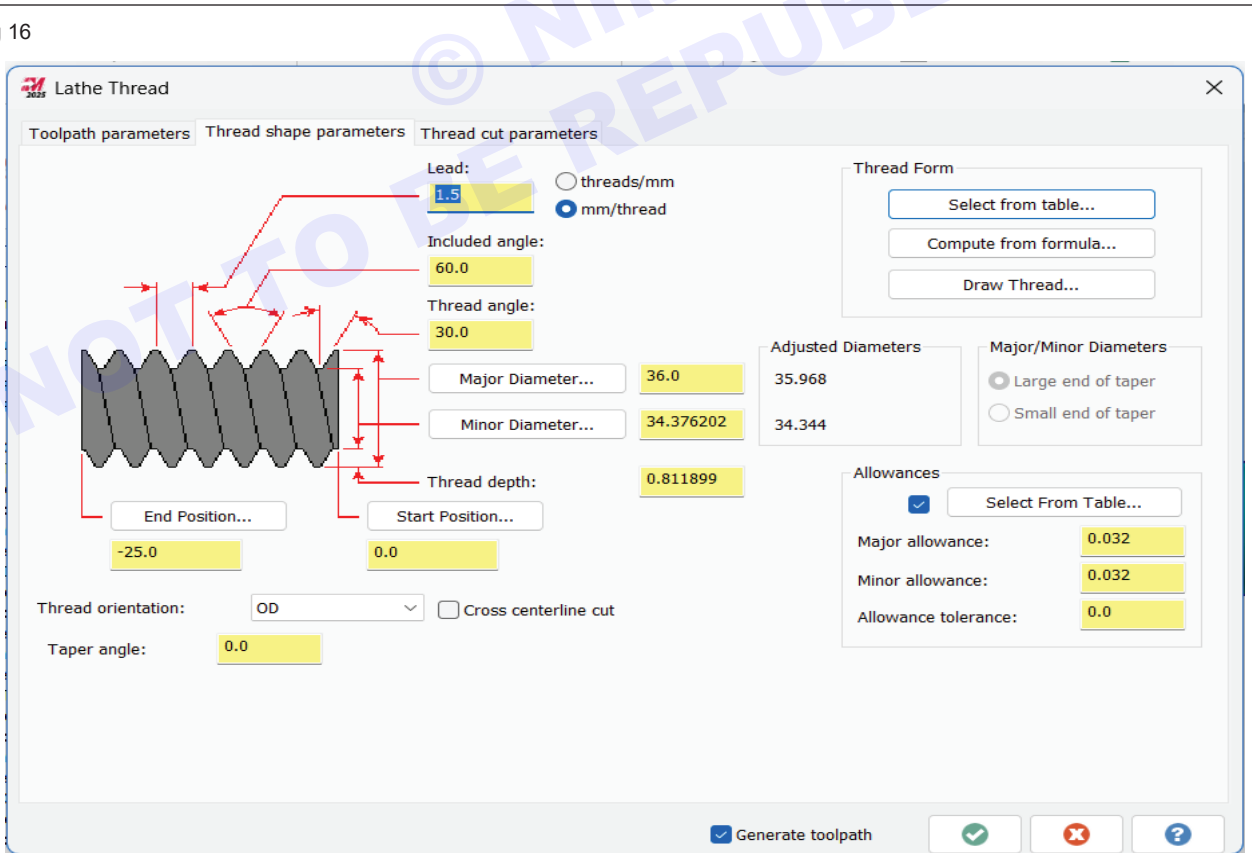
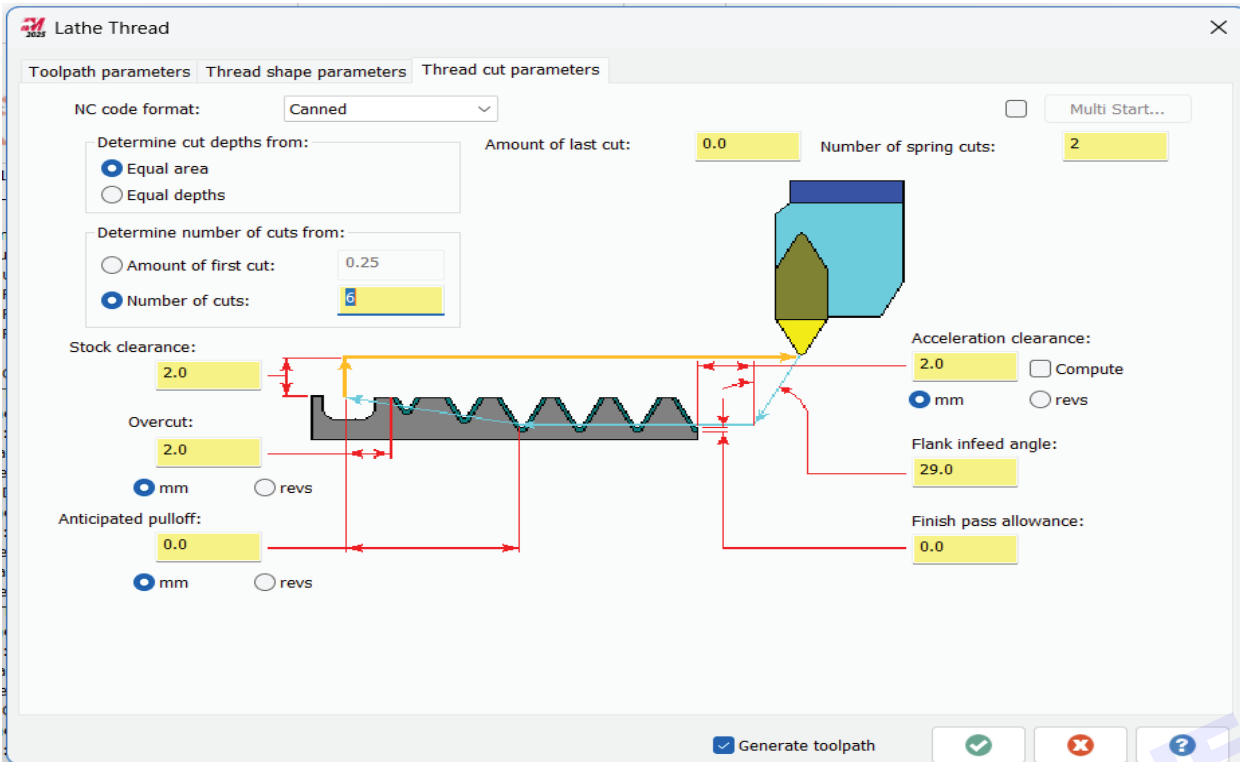


Fig 17



- Lathe drill toolpath (Figs 18 & 19)

Fig 18

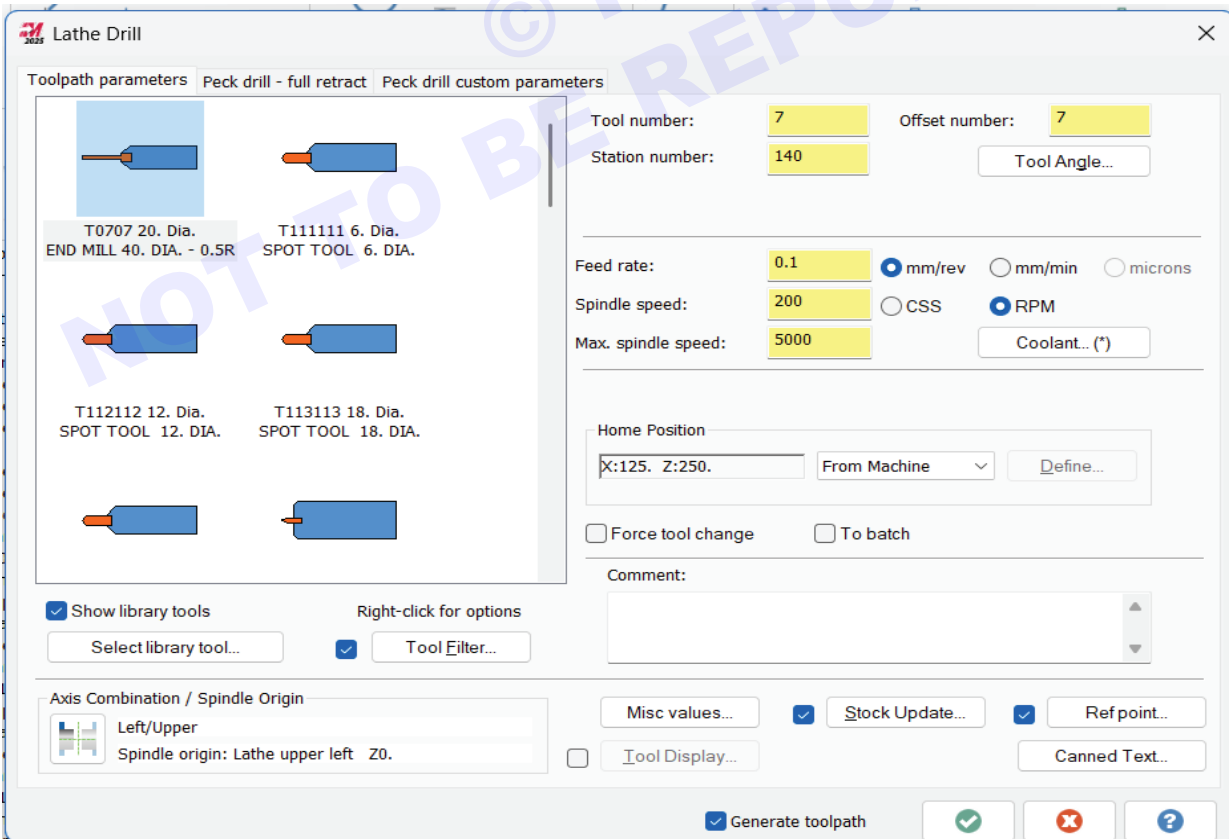
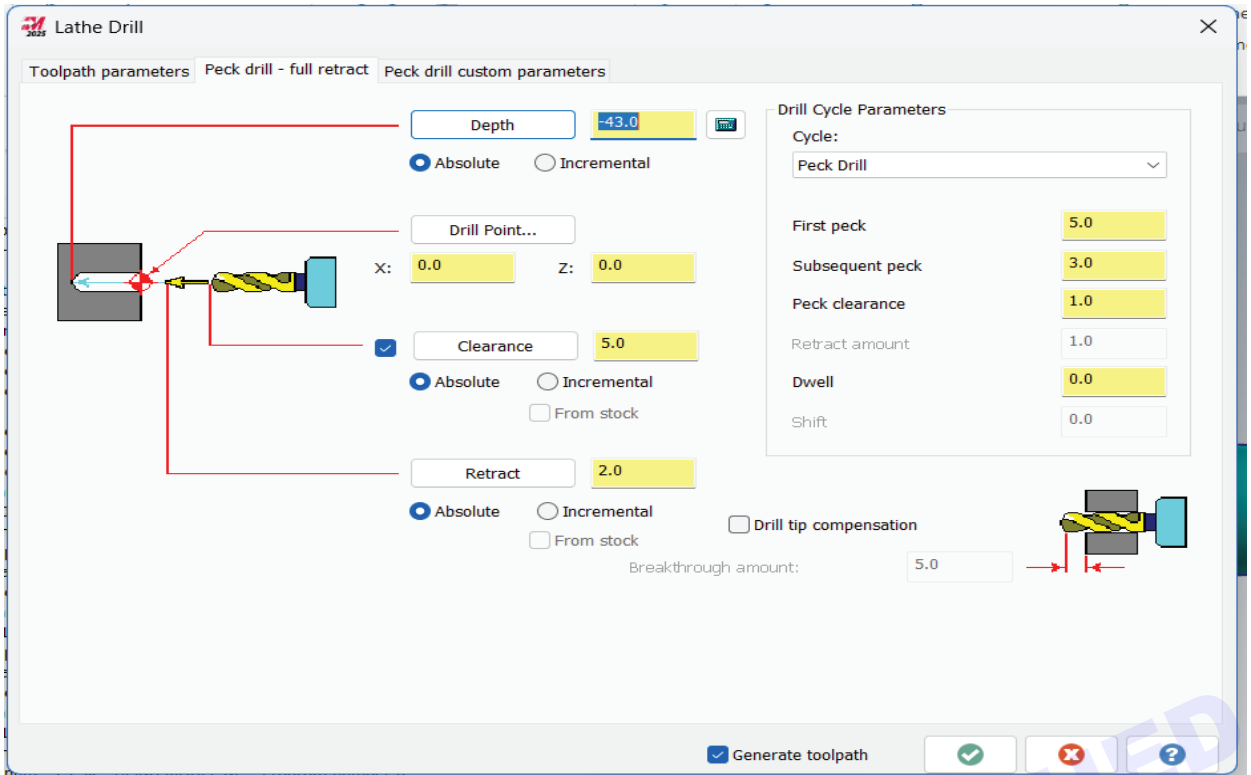


Fig 19



- Lathe groove (ID) toolpath (Figs 20, 21 & 22)

Fig 20

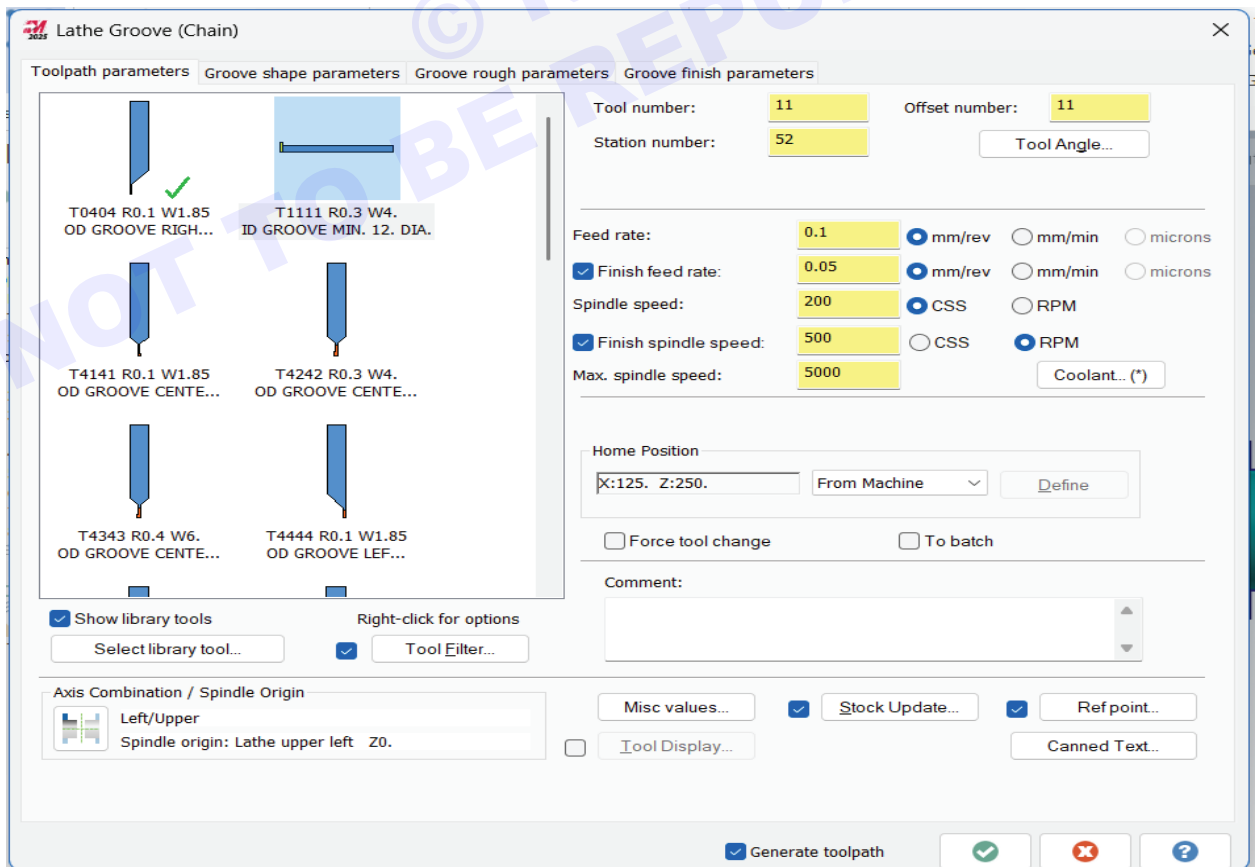


Fig 21

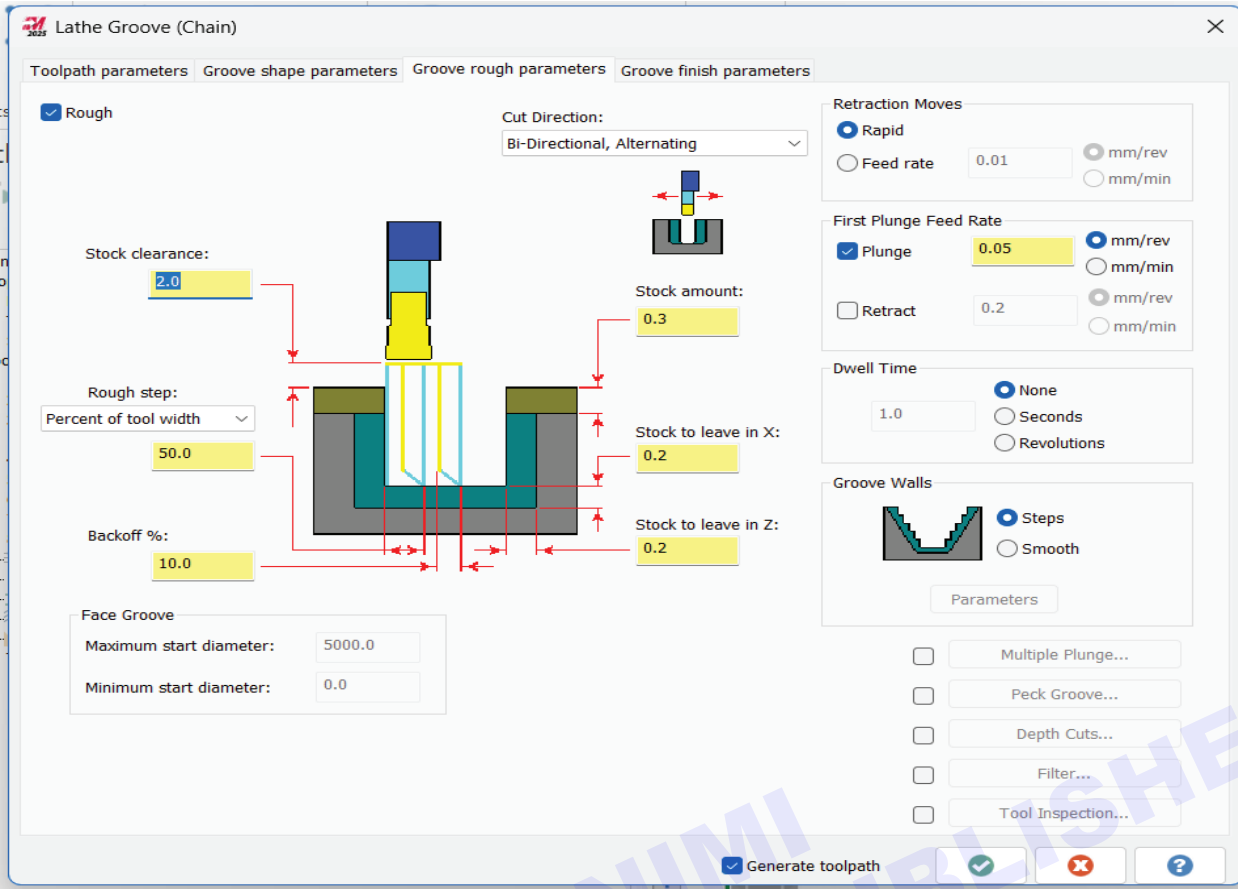
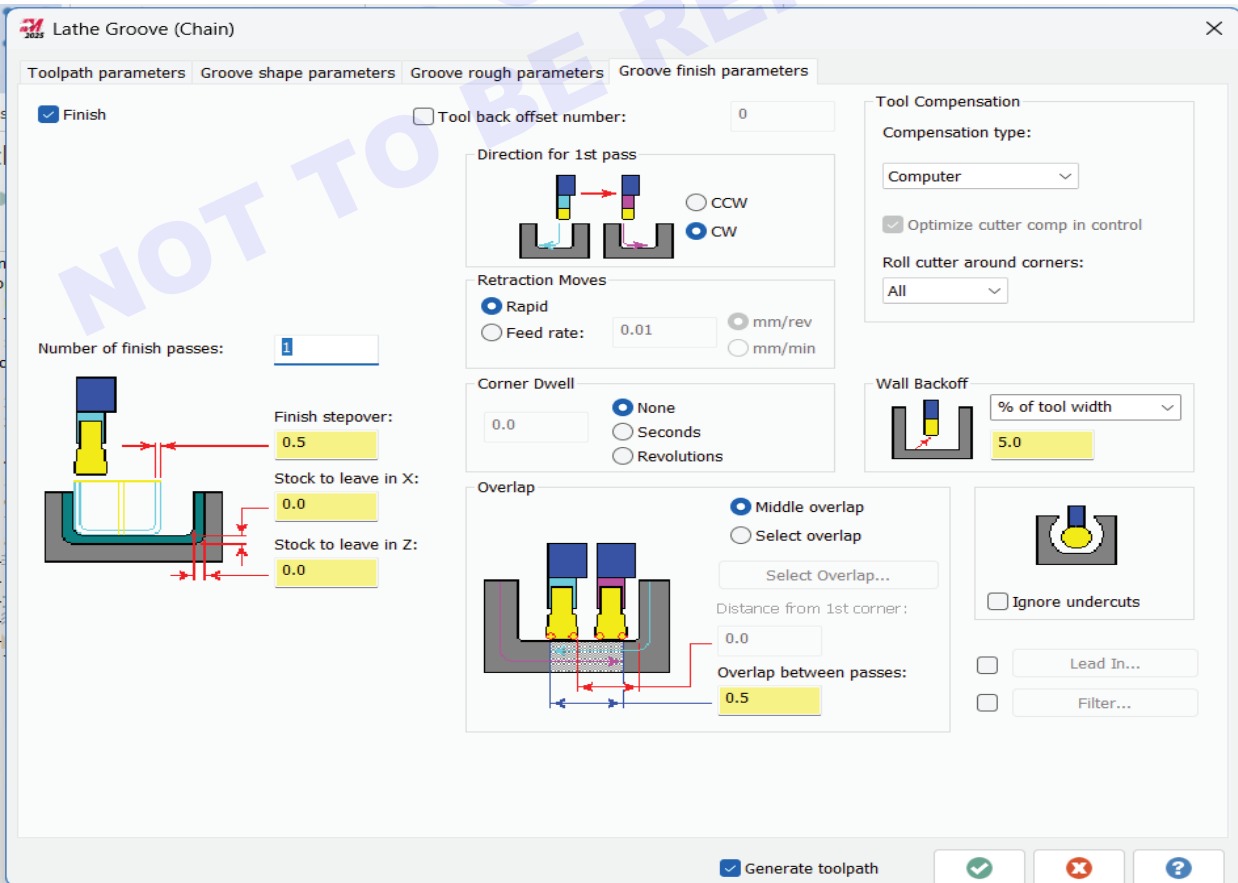


Fig 22



- Lathe thread (ID) toolpath (Figs 23, 24 & 25)

Fig 23

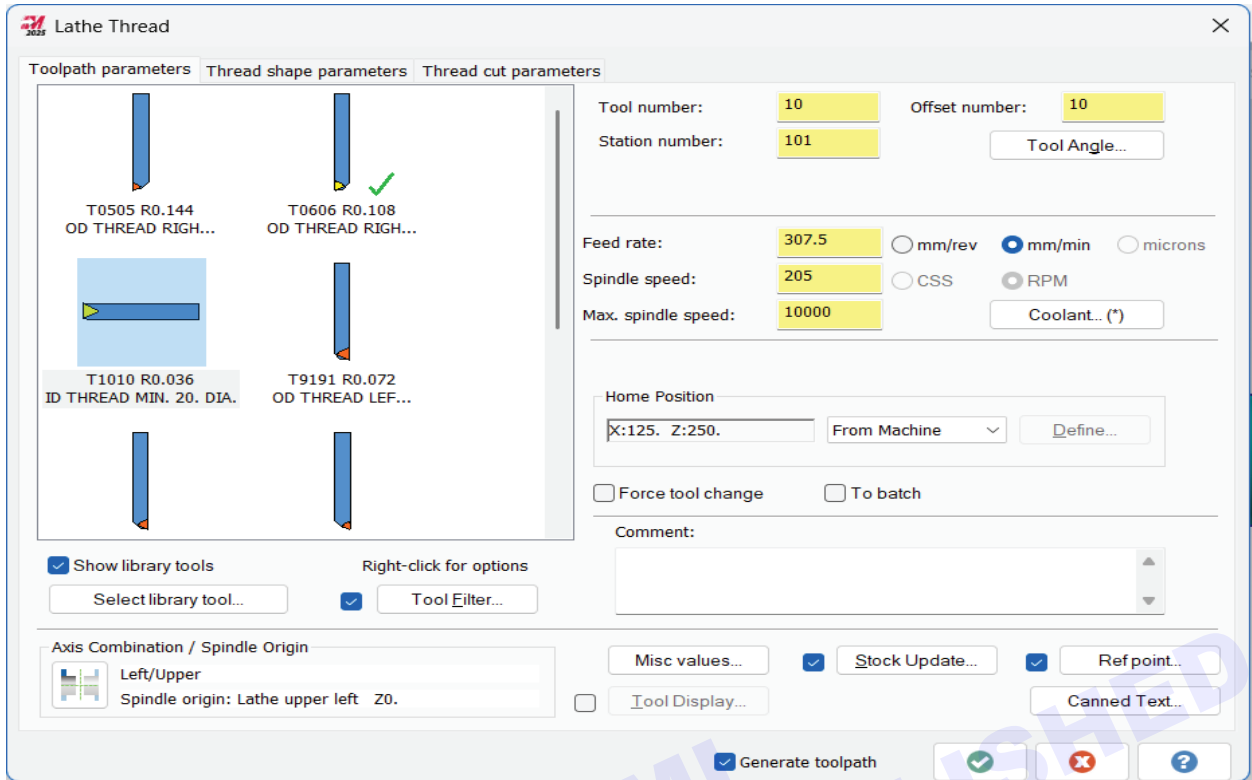


Fig 24

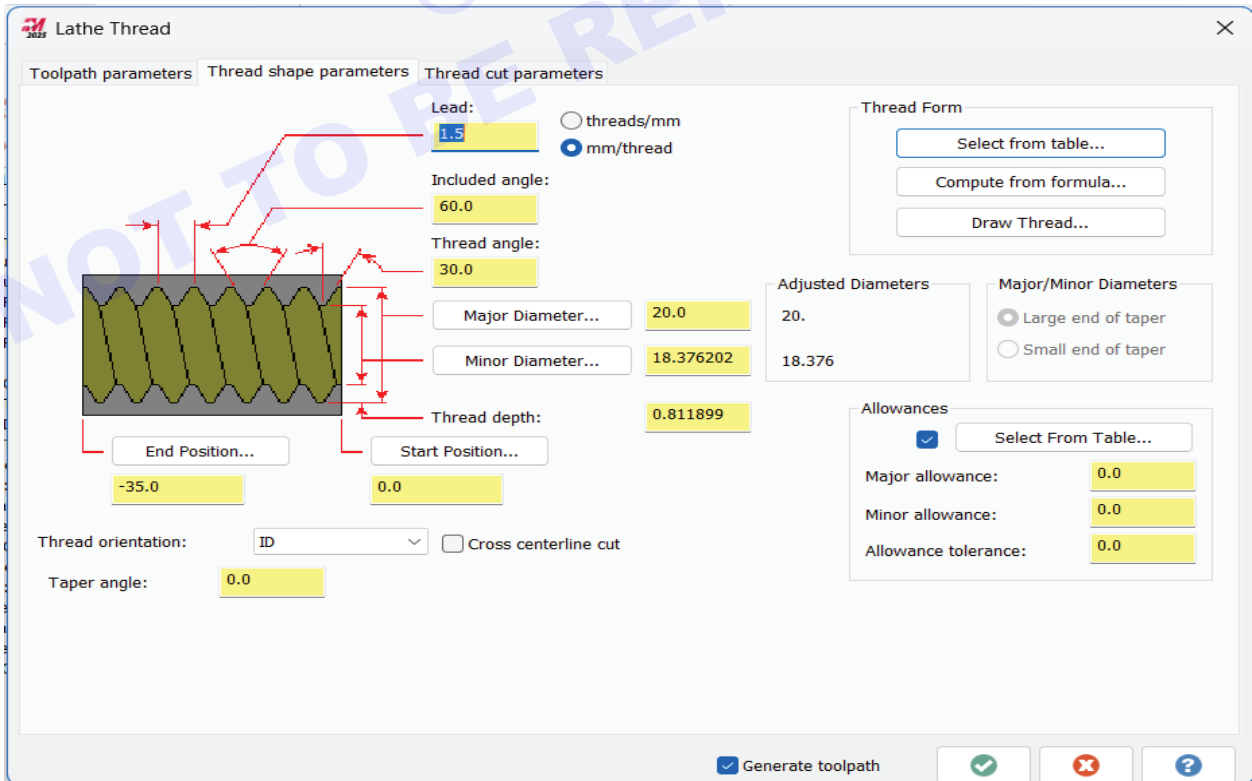
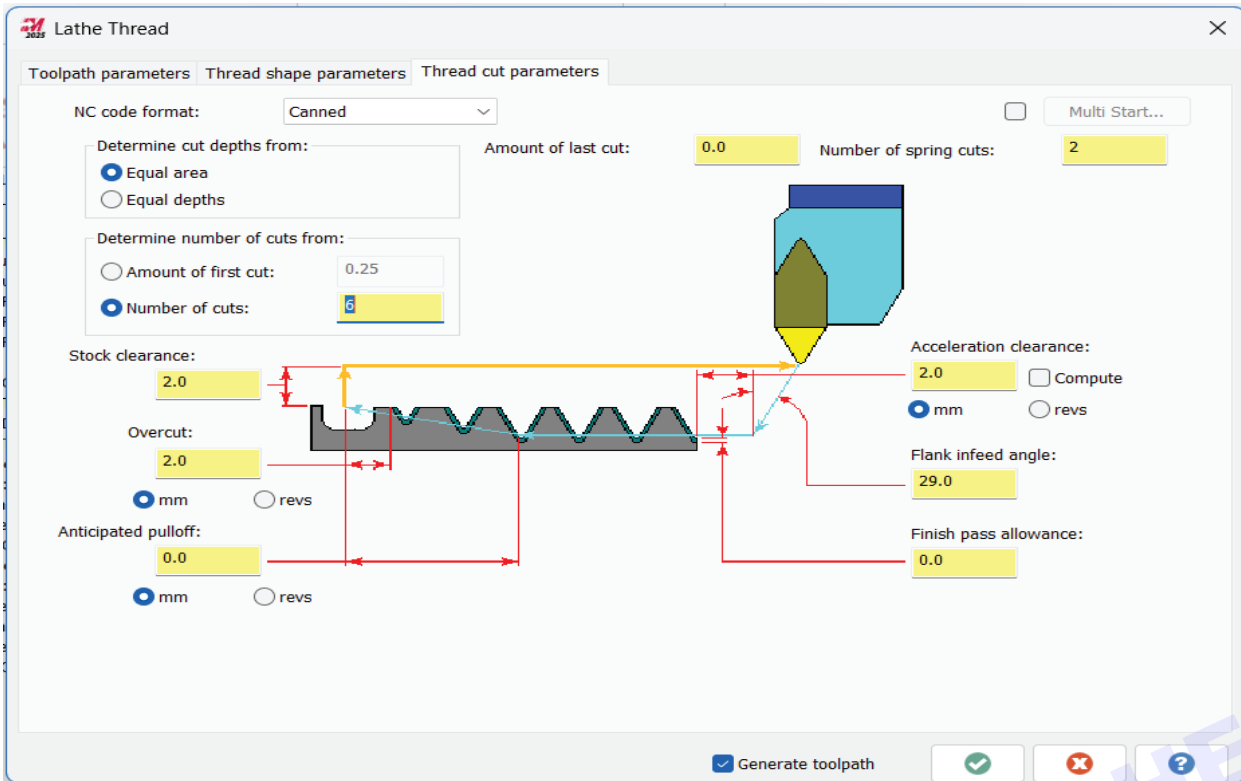


Fig 25



- Select appropriate toolpath parameter for the desired operation.
- Select back plot option to simulate the toolpath for OD turning operation.
- Select back plot option to simulate the toolpath for facing operation.
- Verify the toolpath. (Figs 26&27)

Fig 26

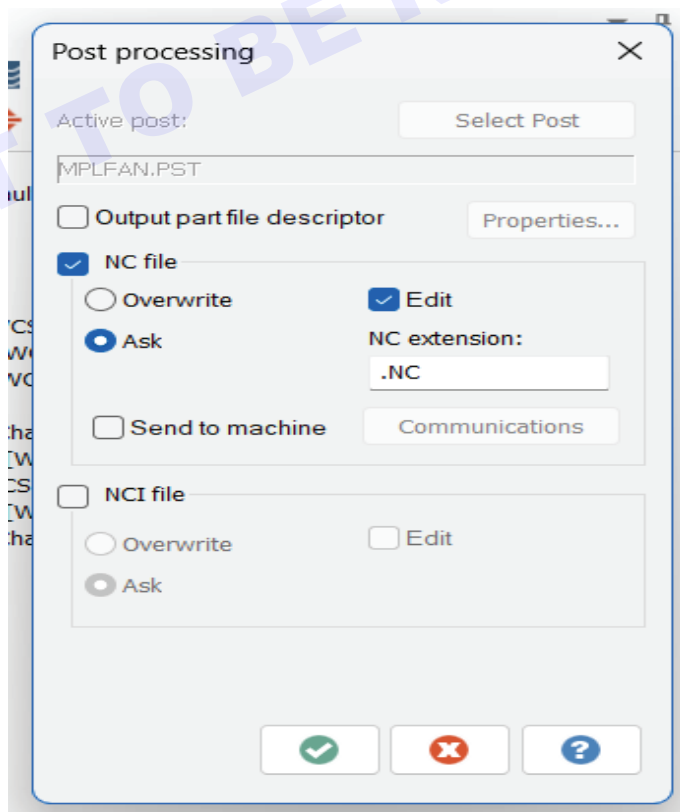
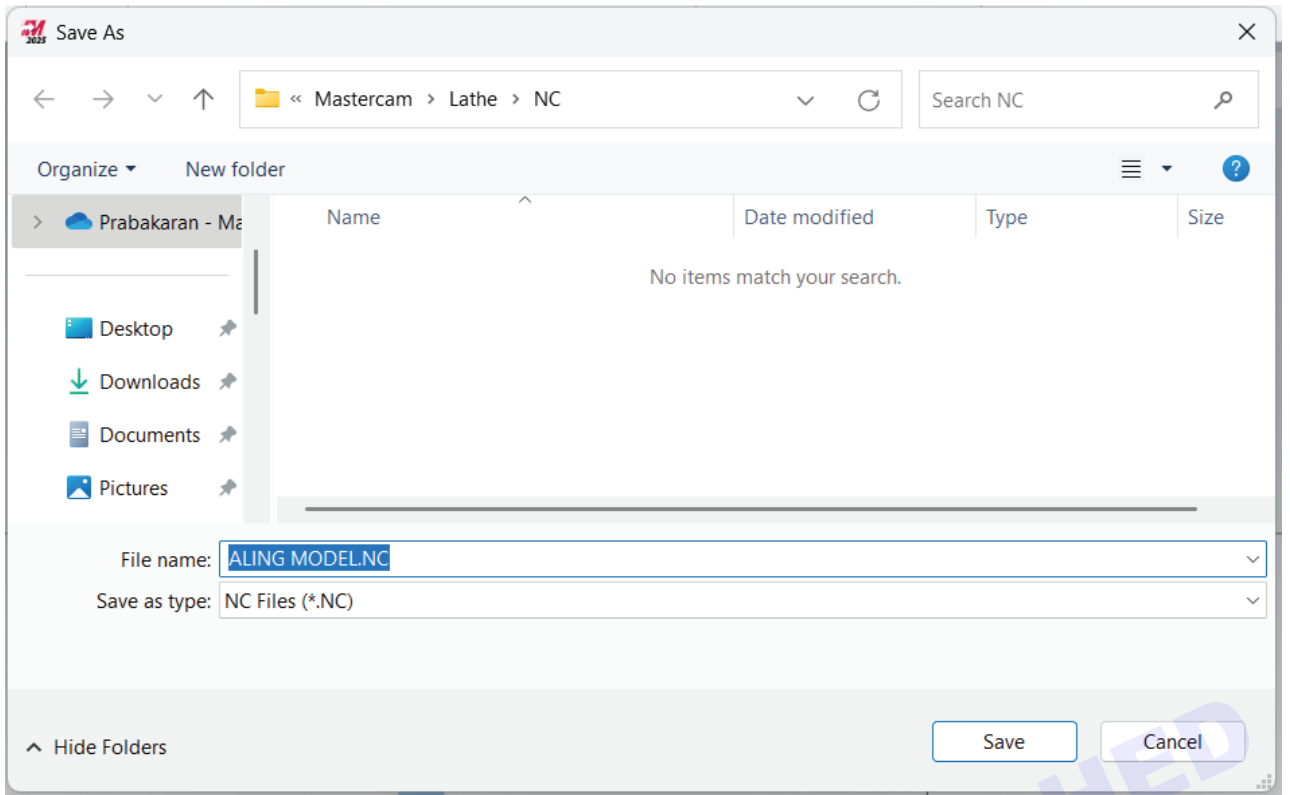


Fig 27



```

00000 C:\Users\Prabakaran\Desktop\ALING MODEL - Copy.NC
(PROG
(DATE=DD-MM-YY - 02-01-25 TIME=HH:MM - 22:47)
(MCAM FILE - D:\MASTERCAM\PRABHAKARAN\TURNING\NEW FOLDER\ALING MODEL555.MCAM)
(NC FILE - C:\USERS\PRABAKARAN\DESKTOP\ALING MODEL.NC)
(MATERIAL - ALUMINUM MM - 2024)

```

G21	G0 Z5.1
(TOOL – 8 OFFSET – 8)	X78.
(OD ROUGH RIGHT – 80 DEG. INSERT – CNMG 12	Z.65
04 08)	G1 X74. F.2
G0 T0808	X-3.6
G18	Z2.65
G97 S200 M04	G0 Z4.65
G0 G54 X170.672 Z110.111 M8	X78.
X78.	Z.2
Z1.55	G1 X74. F.2
G99 G1 X74. F.2	X-3.6
X-3.6	Z2.2
Z3.55	G0 Z4.2
G0 Z5.55	X78.
X78.	Z0.
Z1.1	G1 X74. F.2
G1 X74. F.2	X-3.6
X-3.6	Z2.
Z3.1	G0 Z4.

Z110.111		91	X66.899 Z-99.385
X170.672		92	G0 Z4.2
G97 S300		93	X62.094
Z50.		94	G1 Z2.2 F.2
X0.		95	Z-100.8
X69.012		96	X63.082
Z4.152		97	X65.911 Z-99.385
50	X69.012	98	G0 Z4.2
51	Z4.152	99	X61.106
52	G1 Z2.152 F.2	100	G1 Z2.2 F.2
53	Z-100.8	101	Z-100.8
54	X71.	102	X62.094
55	X73.828 Z-99.385	103	X64.923 Z-99.385
56	G0 Z4.2	104	G0 Z4.2
57	X68.024	105	X60.118
58	G1 Z2.2 F.2	106	G1 Z2.2 F.2
59	Z-100.8	107	Z-88.288
60	X69.012	108	G18 G3 X60.4 Z-88.8 I - .859 K - .512
61	X71.84 Z-99.385	109	G1 Z-100.8
62	G0 Z4.2	110	X61.106
63	X67.035	111	X63.934 Z-99.385
64	G1 Z2.2 F.2	112	G0 Z4.2
65	Z-100.8	113	X59.129
66	X68.024	114	G1 Z2.2 F.2
67	X70.852 Z-99.385	115	Z-87.869
68	G0 Z4.2	116	G3 X60.118 Z-88.288 I - .364 K - .931
69	X66.047	117	G1 X62.946 Z-86.874
70	G1 Z2.2 F.2	118	G0 Z4.2
71	Z-100.8	119	X58.141
72	X67.035	120	G1 Z2.2 F.2
73	X69.864 Z-99.385	121	Z-87.8
74	G0 Z4.2	122	X58.4
75	X65.059	123	G3 X59.129 Z-87.869 K-1.
76	G1 Z2.2 F.2	124	G1 X61.958 Z-86.455
77	Z-100.8	125	G0 Z4.2
78	X66.047	126	X57.153
79	X68.875 Z-99.385	127	G1 Z2.2 F.2
80	G0 Z4.2	128	Z-87.8
81	X64.071	129	X58.141
82	G1 Z2.2 F.2	130	X60.97 Z-86.386
83	Z-100.8	131	G0 Z4.2
84	X65.059	132	X56.165
85	X67.887 Z-99.385	133	G1 Z2.2 F.2
86	G0 Z4.2	134	Z-87.8
87	X63.082	135	X57.153
88	G1 Z2.2 F.2	136	X59.981 Z-86.386
89	Z-100.8	137	G0 Z4.2
90	X64.071	138	X55.176

139	G1 Z2.2 F.2	187	G1 Z2.2 F.2
140	Z-87.8	188	Z-87.8
141	X56.165	189	X48.259
142	X58.993 Z-86.386	190	X51.087 Z-86.386
143	G0 Z4.2	191	G0 Z4.2
144	X54.188	192	X46.282
145	G1 Z2.2 F.2	193	G1 Z2.2 F.2
146	Z-87.8	194	Z-87.8
147	X55.176	195	X47.271
148	X58.005 Z-86.386	196	X50.099 Z-86.386
149	G0 Z4.2	197	G0 Z4.2
150	X53.2	198	X45.294
151	G1 Z2.2 F.2	199	G1 Z2.2 F.2
152	Z-87.8	200	Z-87.8
153	X54.188	201	X46.282
154	X57.017 Z-86.386	202	X49.111 Z-86.386
155	G0 Z4.2	203	G0 Z4.2
156	X52.212	204	X44.306
157	G1 Z2.2 F.2	205	G1 Z2.2 F.2
158	Z-87.8	206	Z-87.8
159	X53.2	207	X45.294
160	X56.028 Z-86.386	208	X48.123 Z-86.386
161	G0 Z4.2	209	G0 Z4.2
162	X51.224	210	X43.318
163	G1 Z2.2 F.2	211	G1 Z2.2 F.2
164	Z-87.8	212	Z-87.8
165	X52.212	213	X44.306
166	X55.04 Z-86.386	214	X47.134 Z-86.386
167	G0 Z4.2	215	G0 Z4.2
168	X50.235	216	X42.329
169	G1 Z2.2 F.2	217	G1 Z2.2 F.2
170	Z-87.8	218	Z-79.976
171	X51.224	219	X42.398 Z-80.756
172	X54.052 Z-86.386	220	G3 X42.4 Z-80.8 I - .999 K - .044
173	G0 Z4.2	221	G1 Z-87.8
174	X49.247	222	X43.318
175	G1 Z2.2 F.2	223	X46.146 Z-86.386
176	Z-87.8	224	G0 Z4.2
177	X50.235	225	X41.341
178	X53.064 Z-86.386	226	G1 Z2.2 F.2
179	G0 Z4.2	227	Z-68.749
180	X48.259	228	X42.329 Z-79.976
181	G1 Z2.2 F.2	229	X45.158 Z-78.562
182	Z-87.8	230	G0 Z4.2
183	X49.247	231	X40.353
184	X52.075 Z-86.386	232	G1 Z2.2 F.2
185	G0 Z4.2	233	Z-57.521
186	X47.271	234	X41.341 Z-68.749

235	X44.17 Z-67.334	283	G1 Z-101.
236	G0 Z4.2	284	X62.828 Z-99.585
237	X39.365	285	G0 X150.677
238	G1 Z2.2 F.2	286	Z61.074
239	Z-46.294	287	G28 U0. V0. W0. M05
240	X40.353 Z-57.521	288	T0800
241	X43.181 Z-56.107	289	M01
242	G0 Z4.2	290	(TOOL – 4 OFFSET – 4)
243	X38.376	291	(OD GROOVE RIGHT – NARROW INSERT – N151.2-182-205G)
244	G1 Z2.2 F.2	292	G0 T0404
245	Z-35.552	293	G18
246	G3 X38.437 Z-35.756 I - .968 K - .248	294	G97 S1478 M03
247	G1 X39.365 Z-46.294	295	G0 G54 X64.6 Z-85.364
248	X42.193 Z-44.88	296	G60 S3600
249	G0 Z4.2	297	G96 S300
250	X37.388	298	G1 X40. F.1
251	G1 Z2.2 F.2	299	G0 X64.6
252	Z-34.92	300	Z-84.486
253	G3 X38.376 Z-35.552 I - .474 K - .88	301	G1 X40. F.1
254	G1 X41.205 Z-34.138	302	X40.176 Z-84.574
255	G0 Z4.2	303	G0 X64.6
256	X36.4	304	Z-86.243
257	G1 Z2.2 F.2	305	G1 X40. F.1
258	Z0.	306	X40.176 Z-86.155
259	Z-25.8	307	G0 X64.6
260	Z-34.8	308	Z-83.607
261	X36.439	309	G1 X40. F.1
262	G3 X37.388 Z-34.92 K-1	310	X40.176 Z-83.695
263	G1 X40.217 Z-33.506	311	G0 X64.6
264	G0 Z50.	312	Z-87.122
265	X0.	313	G1 X40. F.1
266	G18	314	X40.176 Z-87.034
267	G97 S1056	315	G0 X64.6
268	G50 S3600	316	Z-82.728
269	G96 S500	317	G1 X40. F.1
270	X150.677	318	X40.176 Z-82.816
271	Z61.074	319	G0 X64.6
272	Z2.	320	Z-88.
273	X36.	321	G1 X40. F.1
274	G1 Z0. F.1	322	X40.176 Z-87.912
275	Z-25.8	323	G0 X64.6
276	Z-35.	324	Z-81.85
277	X36.439	325	G1 X40. F.1
278	G18 G3 X38.038 Z-35.765 K -.8	326	X40.176 Z-81.938
279	G1 X42. Z-80.782	327	G0 X64.6
280	Z-88.	328	G97 S600
281	X58.4	329	Z-80.436
282	G3 X60. Z-88.8 K- .8		

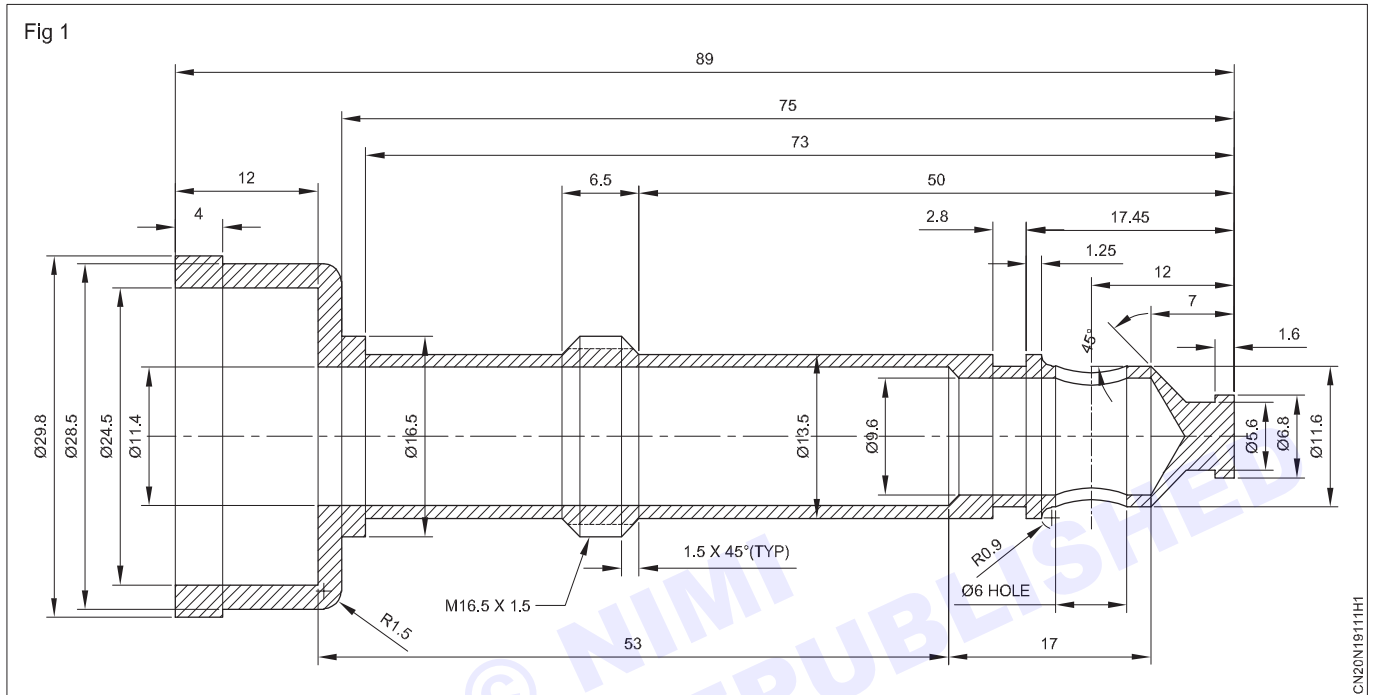
330	X44.828	378	Z-26.85
331	G1 X42. Z-81.85 F.05	379	G1 X32. F.1
332	X40.	380	X32.181 Z-26.941
333	Z-84.925	381	G0 X42.639
334	G0 X62.828	382	G97 S500
335	Z-89.414	383	Z-25.436
336	G1 X60. Z-88. F.05	384	X38.828
337	X40.	385	G1 X36. Z-26.85 F.05
338	Z-84.525	386	X32.
339	G0 X60.	387	Z-30.925
340	G97 S1592	388	G0 X40.867
341	G96 S300	389	Z-36.414
342	Z-31.378	390	G1 X38.039 Z-35. F.05
343	X42.639	391	X32.
344	G1 X32. F.1	392	Z-30.525
345	G0 X42.639	393	G0 X38.828
346	Z-30.472	394	G28 U0. V0. W0. M05
347	G1 X32. F.1	395	T0400
348	X32.181 Z-30.563	396	M01
349	G0 X42.639	397	(TOOL – 6 OFFSET – 6)
350	Z-32.283	398	(OD THREAD RIGHT – MEDIUM INSERT – R166.0G-16mm 01-150)
351	G1 X32. F.1	399	G0 T0606
352	X32.181 Z-32.193	400	G18
353	G0 X42.639	401	G97 S410 M04
354	Z-29.567	402	G0 G54 X39.968 Z2.313
355	G1 X32. F.1	403	G76 P020029 Q0 R0
356	X32.181 Z-29.657	404	G76 X34.344 Z-27. P8119 Q2802 R0. F1.5
357	G0 X42.639	405	G28 U0. V0. W0. M05
358	Z-33.189	406	T0600
359	G1 X32. F.1	407	M01
360	X32.181 Z-33.098	408	(TOOL – 7 OFFSET – 7)
361	G0 X42.639	409	(END MILL 40. DIA. – 0.5R)
362	Z-28.661	410	G0 T0707
363	G1 X32. F.1	411	G18
364	X32.181 Z-28.752	412	G97 S200 M03
365	G0 X42.639	413	G0 G54 X0. Z50.
366	Z-34.094	414	Z5.
367	G1 X32. F.1	415	Z2.
368	X32.181 Z-34.004	416	G1 Z-3. F.1
369	G0 X42.639	417	G0 Z2.
370	Z-27.756	418	Z-2.
371	G1 X32. F.1	419	G1 Z-6. F.1
372	X32.181 Z-27.846	420	G0 Z2.
373	G0 X42.639	421	Z-5
374	Z-35.	422	G1 Z-9. F.1
375	G1 X32. F.1	423	G0 Z2.
376	X32.181 Z-34.909	424	Z-8.
377	G0 X42.639		

425	G1 Z-12. F.1	471	X14.376
426	G0 Z2.	472	G76 P020029 Q0 R0
427	Z-11.	473	G76 X20. Z-37. P8119 Q2475 R0. F1.5
428	G1 Z-15. F.1	474	X0.
429	G0 Z2.	475	Z50.
430	Z-14	476	G28 U0. V0. W0. M05
431	G1 Z-18. F.1	477	T1000
432	G0 Z2.	478	M01
433	Z-17.	479	(TOOL – 11 OFFSET – 11)
434	G1 Z-21. F.1	480	(ID GROOVE MIN. 12. DIA. INSERT –
435	G0 Z2.		N151.2-400-40-5G)
436	Z-20.	481	G0 T1111
437	G1 Z-24. F.1	482	G18
438	G0 Z2.	483	G97 S3600 M04
439	Z-23.	484	G0 G54 X0. Z50.
440	G1 Z-27. F.1	485	G50 S3600
441	G0 Z2.	486	G96 S200
442	Z-26.	487	X14.691
443	G1 Z-30. F.1	488	Z-41.
444	G0 Z2.	489	G1 X21.6 F.05
445	Z-29.	490	G0 X14.691
446	G1 Z-33. F.1	491	Z-39.2
447	G0 Z2.	492	G1 X21.6 F.1
448	Z-32.	493	X21.24 Z-39.38
449	G1 Z-36. F.1	494	G0 X14.691
450	G0 Z2.	495	Z-42.8
451	Z-35.	496	G1 X21.6 F.1
452	G1 Z-39. F.1	497	X21.24 Z-42.62
453	G0 Z2.	498	G0 X14.691
454	Z-38.	499	G97 S500
455	G1 Z-42. F.1	500	Z-43.
456	G0 Z2.	501	X19.291
457	Z-41.	502	G1 X22. F.05
458	G1 Z-43. F.1	503	Z-41.
459	G0 Z5.	504	G0 X19.291
460	Z50.	505	Z-39.
461	G28 U0. V0. W0. M05	506	X20.
462	T0700	507	G1 X22. F.05
463	M01	508	Z-41.5
464	(TOOL – 10 OFFSET – 10)	509	G0 X19.291
465	(ID THREAD MIN. 20. DIA. INSERT –	510	Z50.
	R166.0L-16MM01-050)	511	X0.
466	G0 T1010	512	G28 U0 V0 W0 M05
467	G18	513	T1100
468	G97 S205 M04	514	M30
469	G0 G54 X0. Z50.	515	%
470	Z2.295	516	

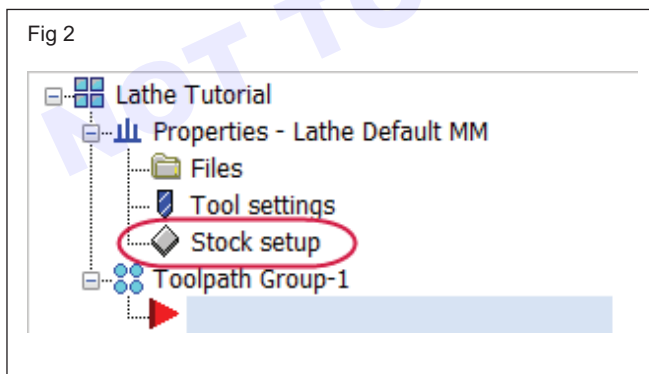
Setup work-piece

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

- create a 2D sketch
- setup workpiece.



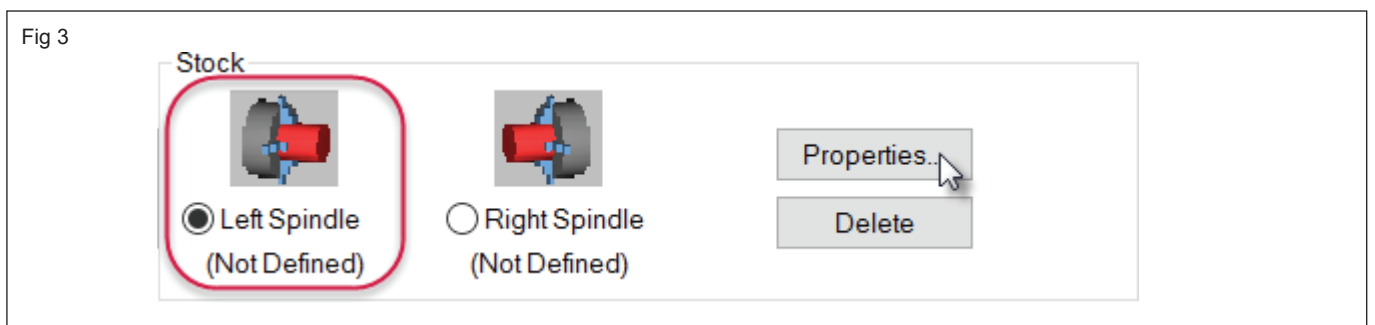
Step 1: Open the toolpaths manager. Expand the properties group and click Stock setup to open the stock setup tab of the machine group properties dialog box. (Fig 2)

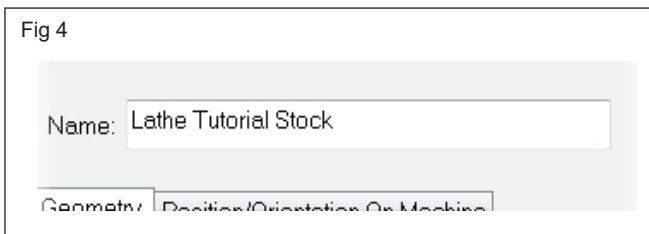


- Open the CAM Software
- Create a 2D sketch
- Select the Machine
- Go to stock setup
- Set the stock size for the given drawing
- Set the grip length for Jaws.

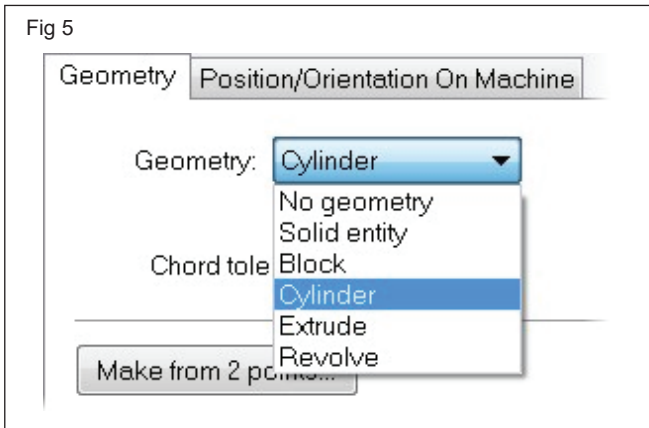
Step 2: In the stock section, select left spindle and click properties. The machine component manager - stock dialog box opens. (Fig 3)

Step 3: In the name field, type lathe tutorial stock to name the stock setup for the left spindle. (Fig 4)



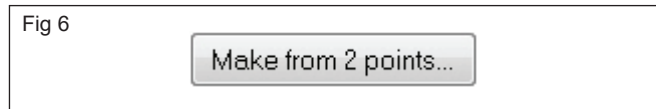


Step 4: Choose cylinder from the geometry drop-down selections. (Fig 5)



Cylinder lets you create 3D bar stock. This is suitable for most turning operations.

Step 5: Click the make from 2 points button. (Fig 6)



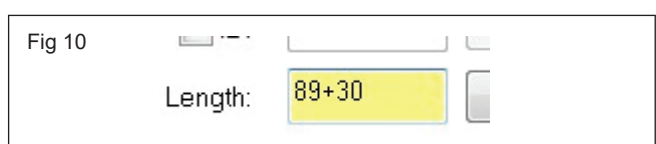
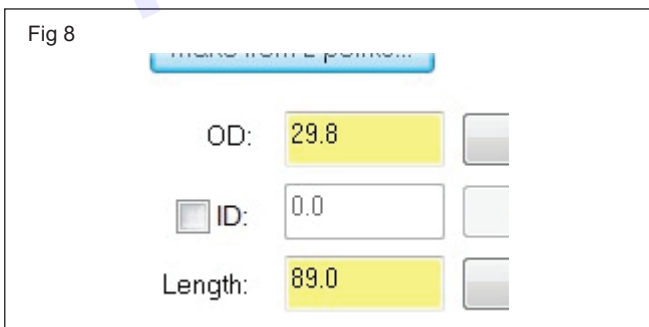
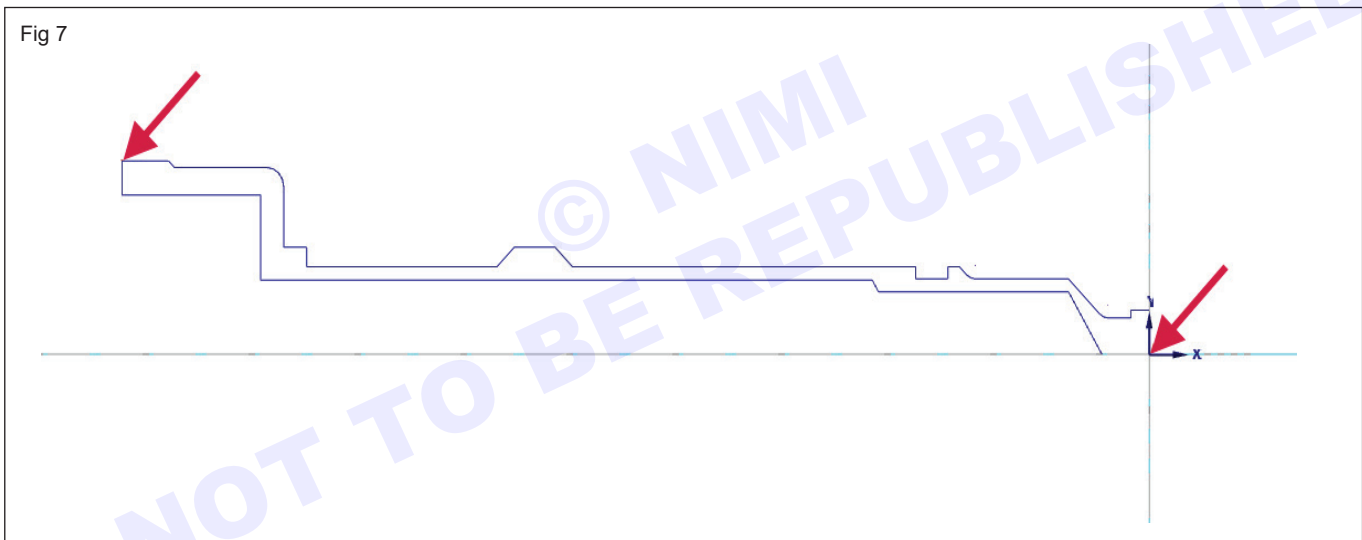
Step 6: In the graphics window, select the origin and the top of the part's back face. If you have not already done so, change the G View to TOP. (Figs 7 & 8)

Mastercam calculates the distance between the points and enters the values of the part's outer diameter (OD) and length directly into the fields

Step 7: Add an additional 30 mm to the length field. (Figs 9 & 10)

The additional stock (about 30 percent) provides enough material for the left spindle chuck to hold the stock in place during machining

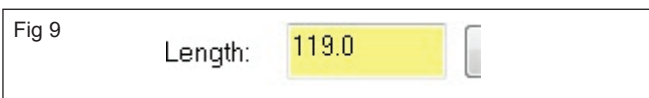
Fields that take number values have a built-in calculator that let you enter simple formulas directly into the field

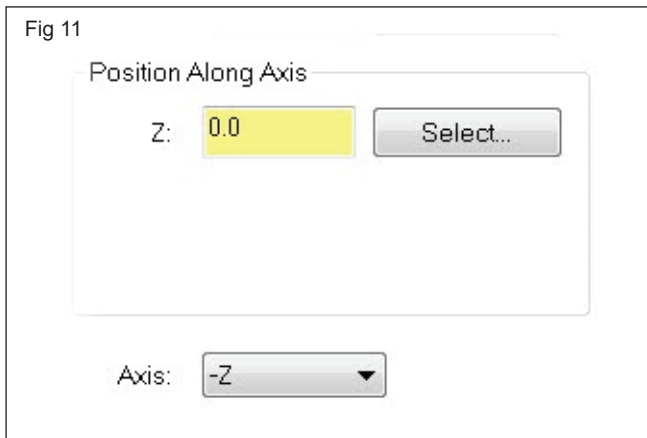


Step 8: Confirm that the position along axis is set to 0.0 & the axis field has -Z for the stock direction. (Fig 11) These two values determine the location and orientation of the cylinder. The center of the part's face lies on the origin, and the part is positioned along -Z.

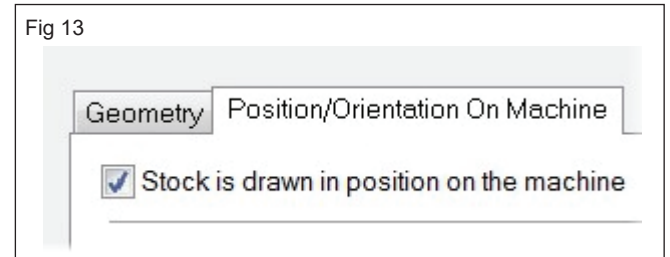
Step 9: Select the use margins option to activate the stock margin fields.

Enter 4.2 mm in the OD margin field and 1.0 mm in the Right Margin field. Mastercam adds the margin to the stock boundary. (Fig 12)





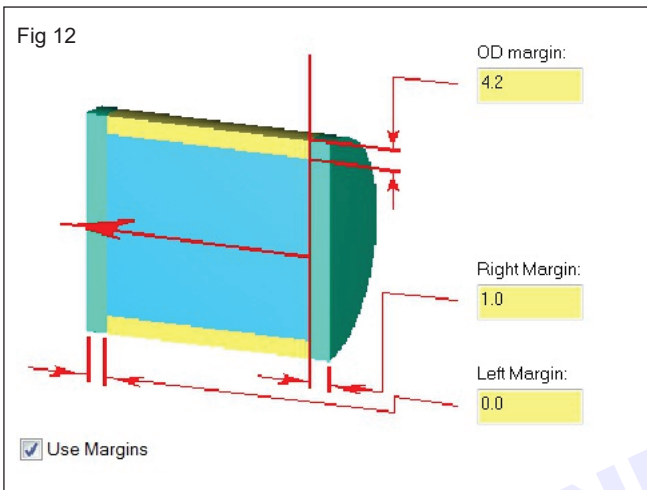
Step 10: Click the position/orientation on machine tab and make sure the option, stock is drawn in position on the machine is selected. (Fig 13)



Step 11: Return to the geometry tab and click the preview lathe boundaries button to view your results. (Fig 14)

Step 12: Press [Enter] to return to the machine component manager - Stock dialog box

Step 13: Click OK to accept your lathe stock setup settings. The left spindle stock is defined. (Fig 15)

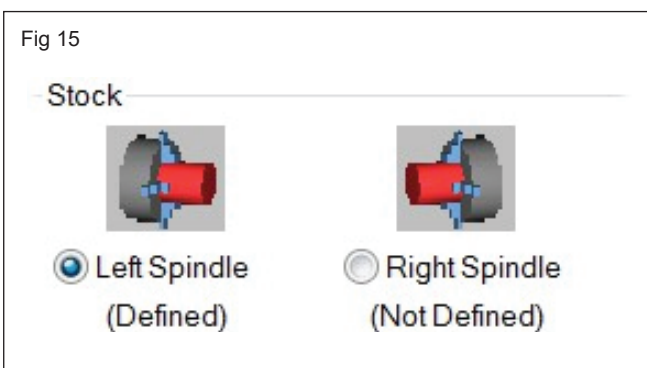
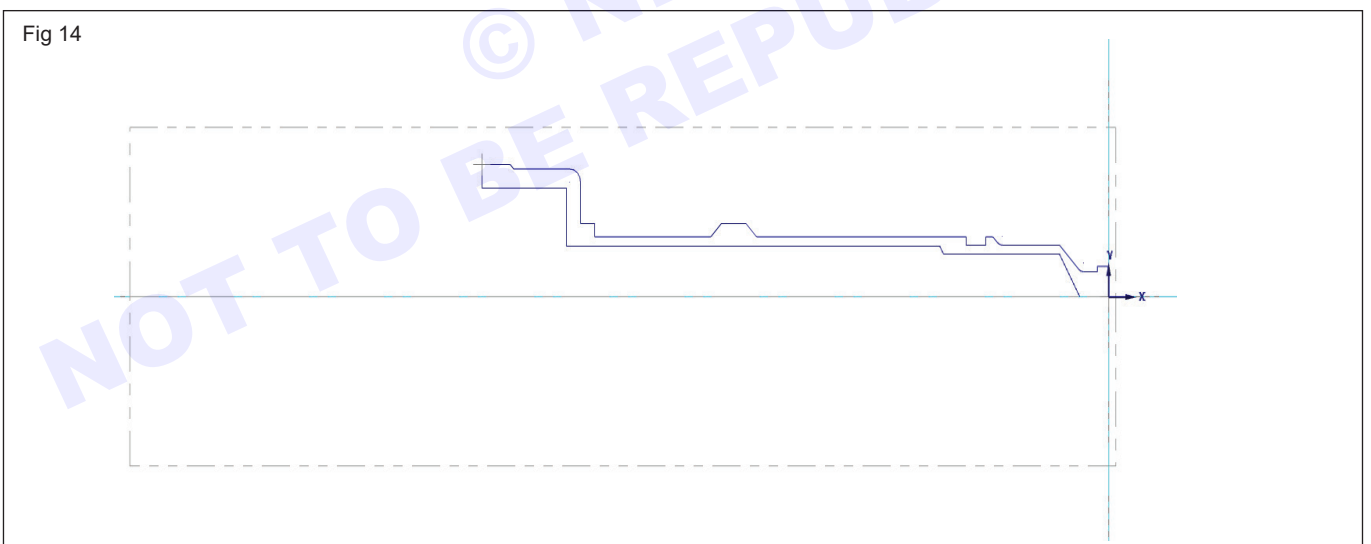


Defining the Chuck Jaws

In this exercise you will define the position and grip length for the chuck jaws. You can only use the method described below after the stock has been set up.

Step 14: In the chuck jaws section, select left spindle and click properties. (Figs 16 & 17)

The Machine Component Manager - Chuck Jaws dialog box opens to the Geometry tab.



Confirm that your settings match those in the picture above. Although, we use a simple definition for this tutorial, Mastercam allows you to define your chuck jaws by selecting a solid model or a chained profile. See Mastercam Help for more information about enhanced support for modeling chucks and chuck jaws.

Step 15: Click the parameters tab. (Fig 18)

Fig 16



Fig 17

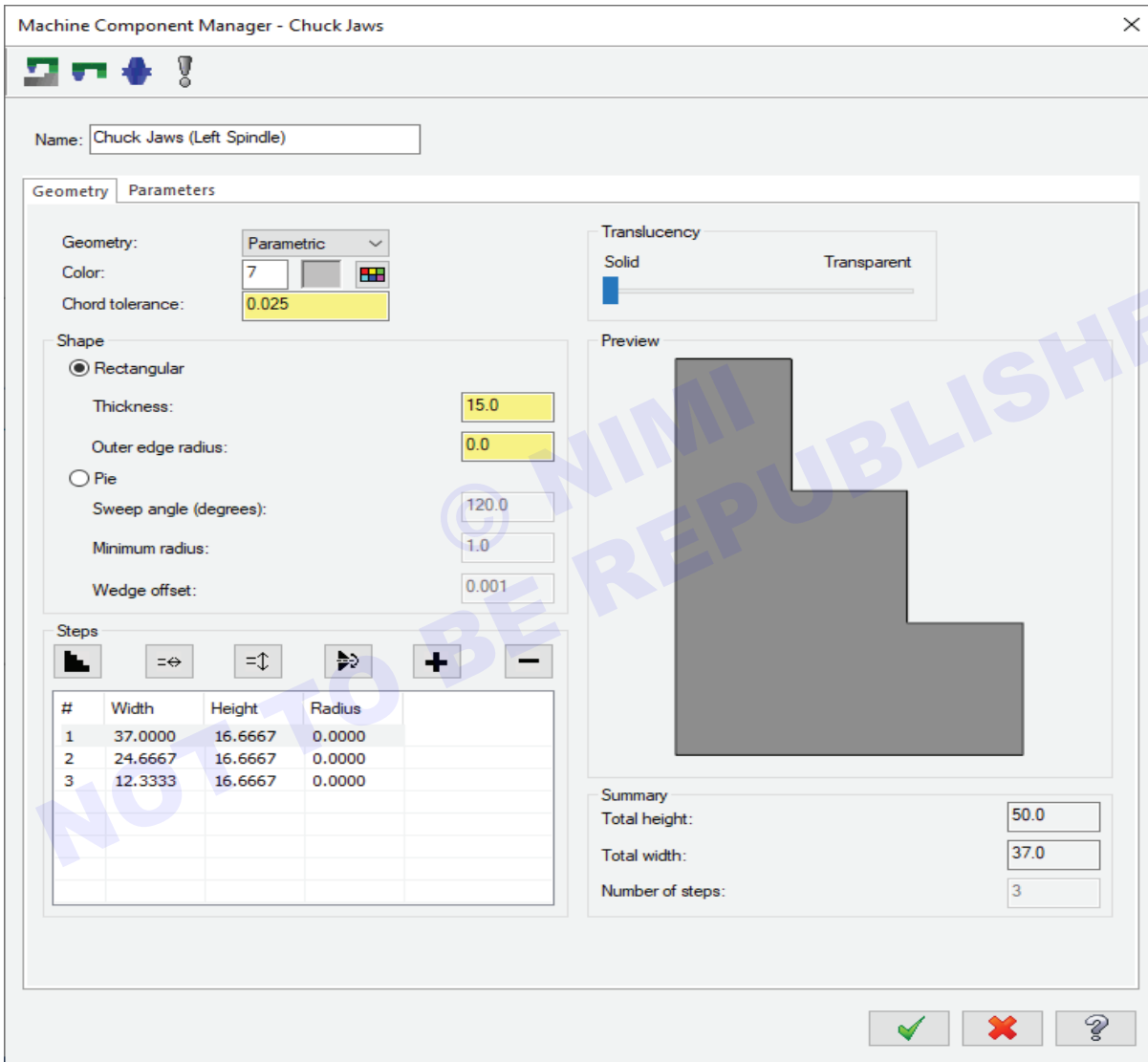
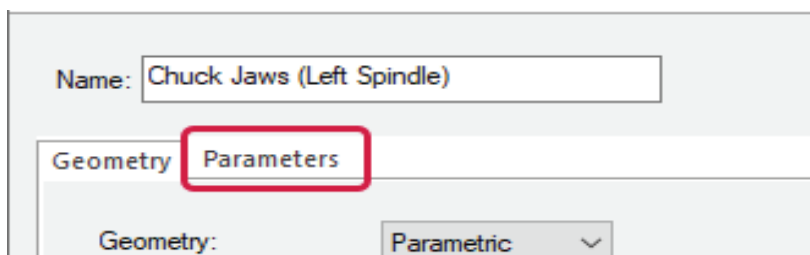
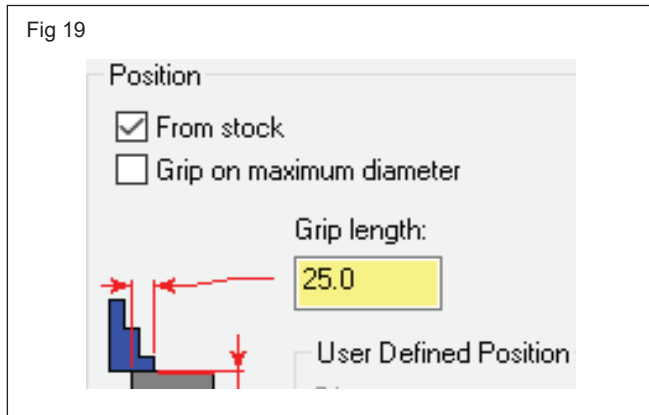


Fig 18



Step 16: In the position section. (Fig 19)



- Select from stock.
- Enter 25 mm in the Grip length field.

Mastercam uses these settings to calculate the position of the chuck jaws relative to the stock, and to determine how much stock is being held by the chuck jaws. Since you added 30 mm of extra stock in Task 6 & 7, a grip length of 25 mm gives enough clearance to cut off the part.

Step 17: Confirm that the other values on the parameters tab match those in the graphic below. (Fig 20)

Step 18: Click OK to accept these settings. (Fig 21)

The Stock Setup tab displays with the left spindle's chuck jaws defined.

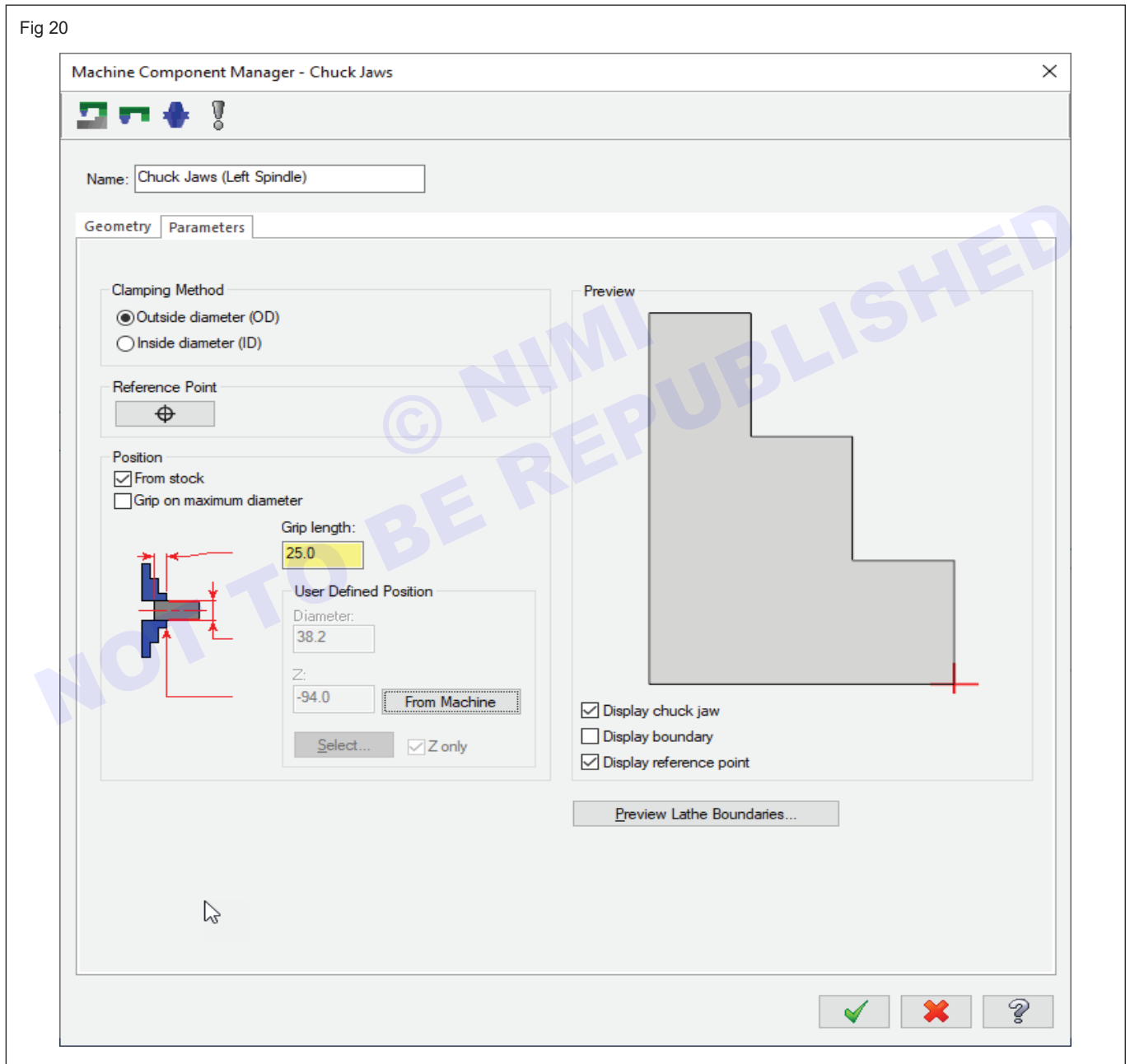
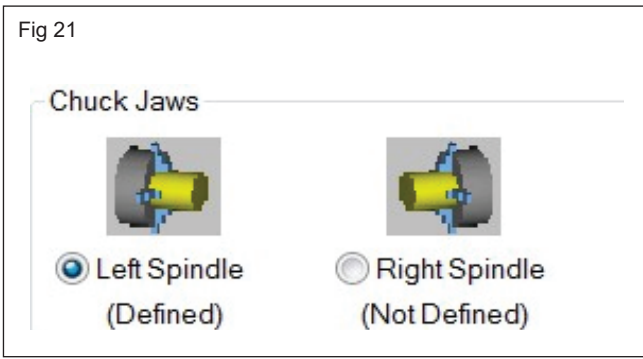
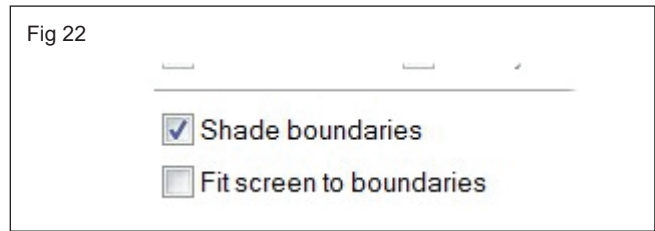


Fig 21



Step 19: Select the shade boundaries option to more easily see the stock boundaries and chuck jaws you have created. (Fig 22)

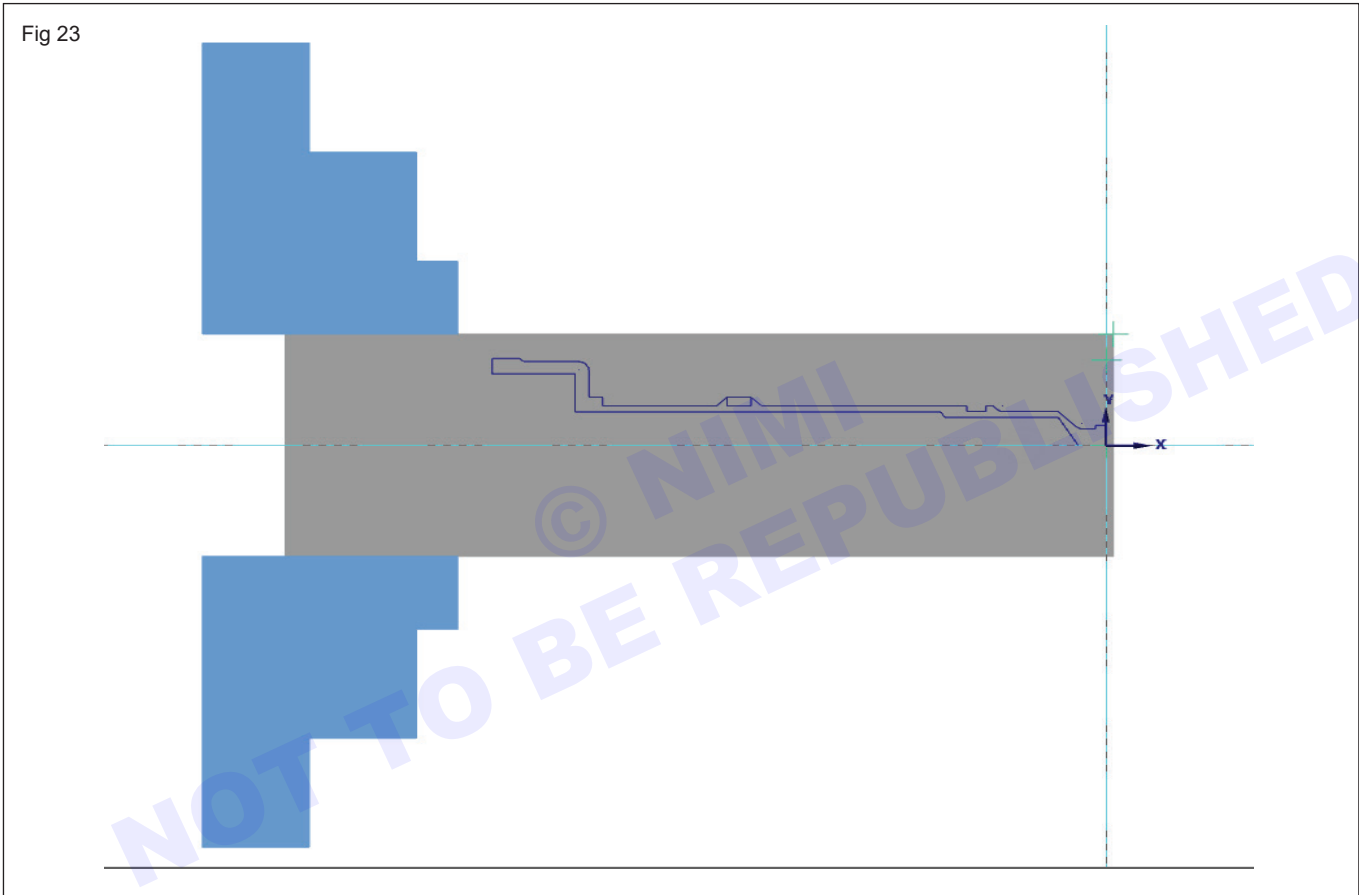
Fig 22



Step 20: Click OK to close the machine group properties dialog box

Step 21: Save the file. (Fig 23)

Fig 23



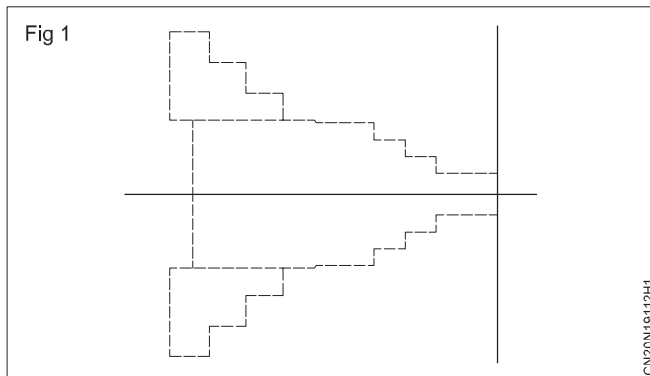
Calculate machine operation efficiency with the help of cycle time

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

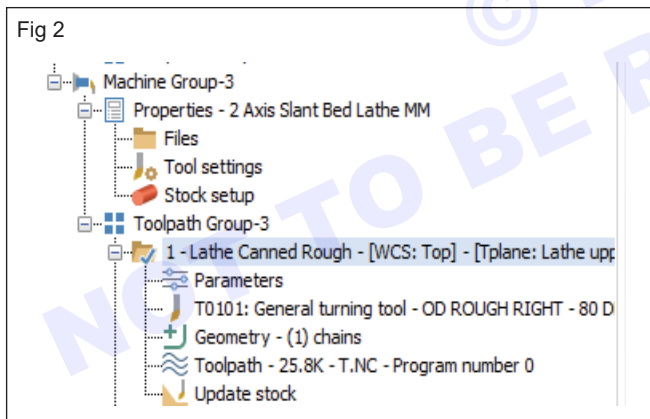
- check cycle time for same operation with different tool paths
- develop a setup sheet for all the operations
- select the efficient tool path with the help of cycle time.

PROCEDURE

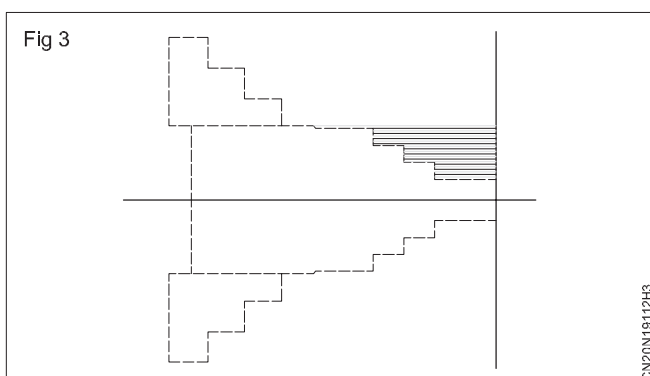
- Consider a Step Turned Job as shown in Fig 1.



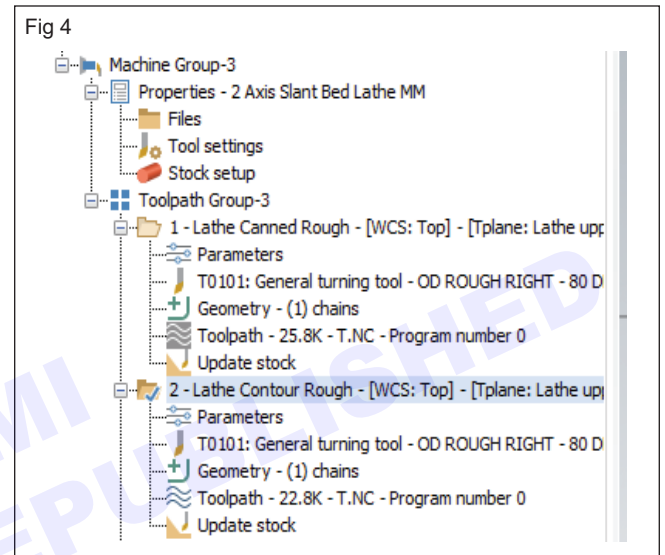
- Perform Rough Turning using different CAM Cycles.
- Perform Canned Rough Cycle Toolpath for the given Job as shown in Fig 2.



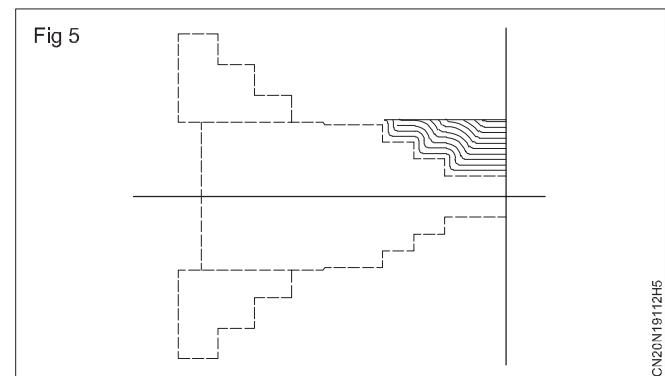
- The Tool Path looks as shown in Fig 3.



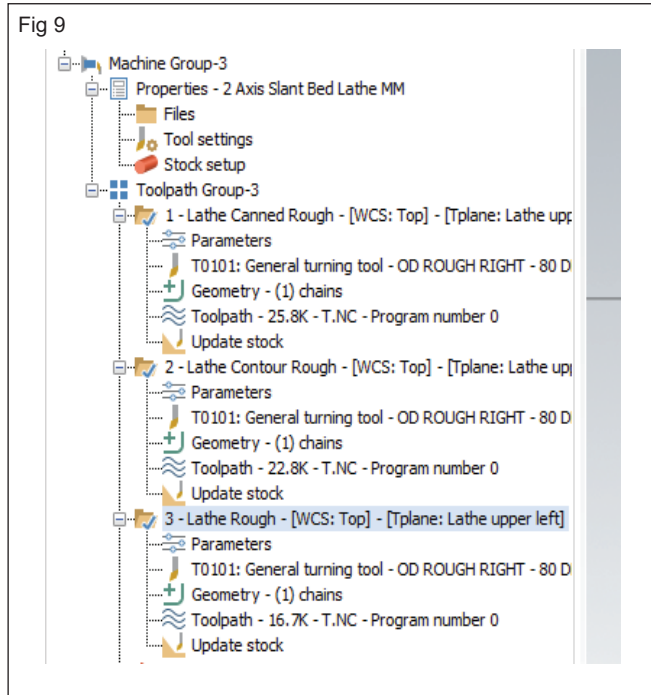
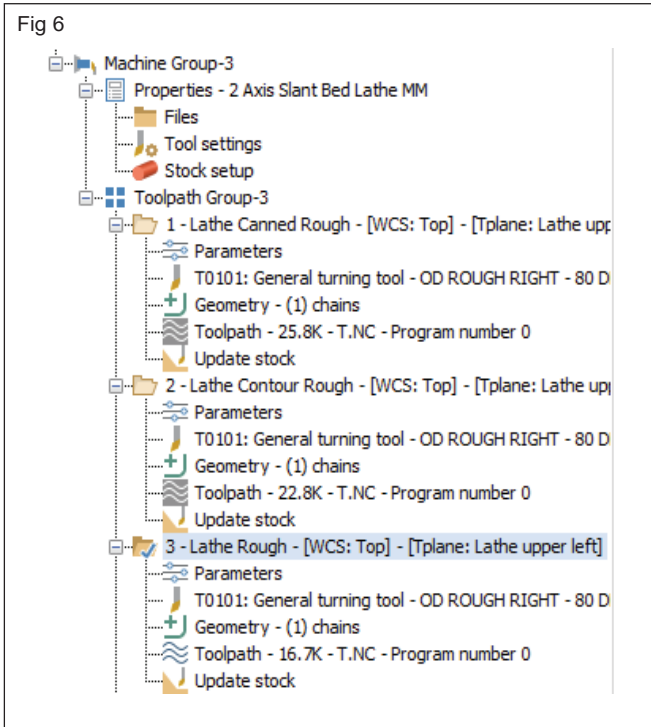
- Perform Contour Rough cycle Toolpath for the same Job as shown in Fig 4.



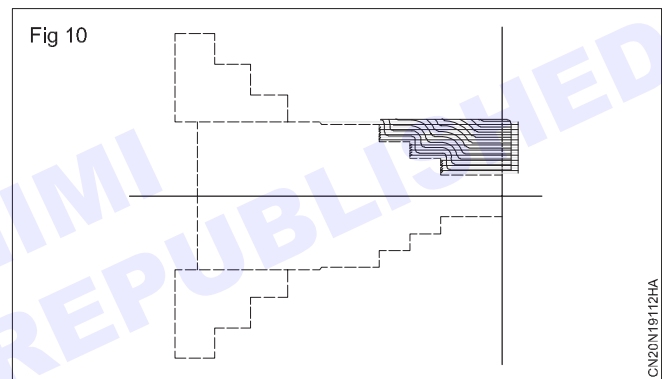
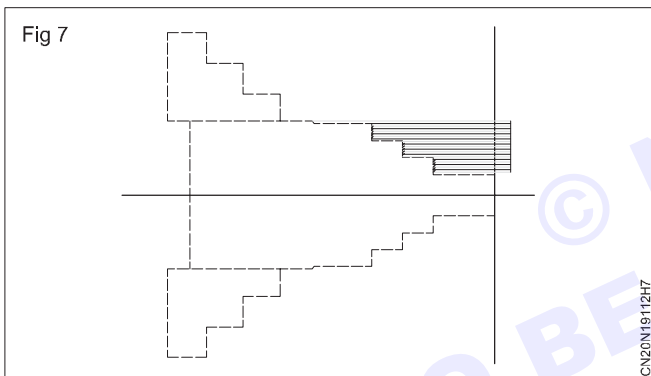
- The Tool path looks as shown in Fig 5.



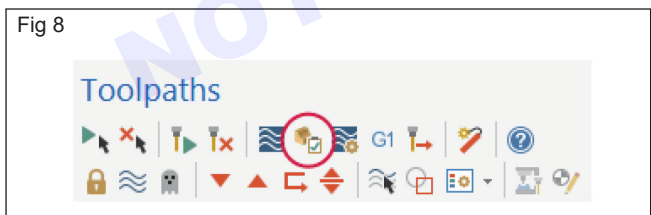
- Perform Rough Cycle Toolpath for the same Job as shown in Fig 6.



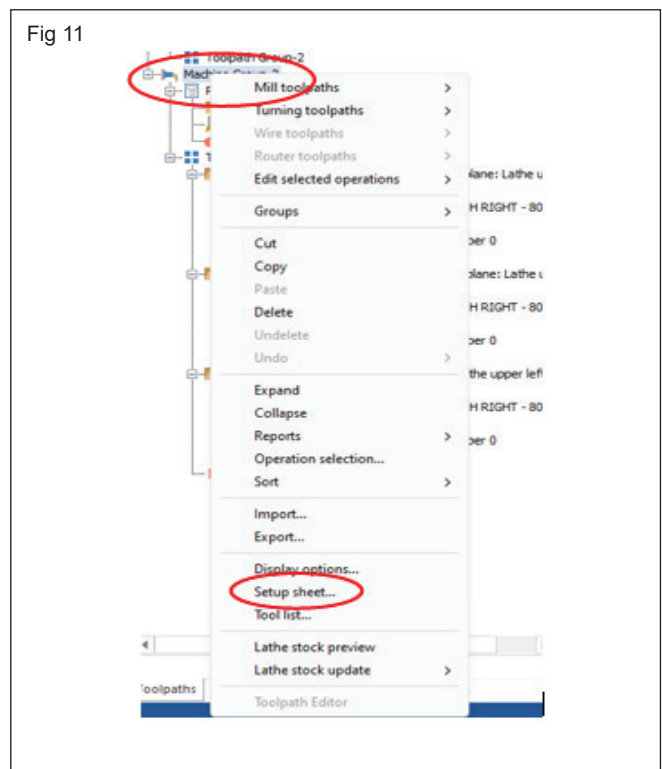
- The Tool path looks as shown in Fig 7.



- Select the Option “Select all dirty Operations” as shown in Fig 8.



- All the Tool paths selected is as shown in Fig 9.
- All the Selected Tool path Operations looks as shown in Fig 10.
- Right Click on the Machine Group and select setup Sheet as shown in Fig 11.



- Enter the details of General Information for developing the Spread Sheet as shown in Fig 12. And click ok.
- The Setup sheet with the details for each Operation and cycle time is developed as shown in Fig 13.

Fig 12

Setup Sheet

General Information

Project: MACHINE OPERATION EFFICIENCY

Customer: NIMI

Programmer: MANU KUMAR H A

Drawing: STEP TURNING

Revision: 01

Note 1:

Note 2:

Note 3:

Images

Use color

Format: BMP

The current screen image will be captured as a reference when you select OK.

Clean...

View of Operation

Operation's WCS

Operation's Tplane

Isometric relative to operation's WCS

Isometric (WORLD)

Graphics view

Tool Sorting

Default Ascending Descending None

Report Templates (Press F2 to reassign)

2 AXIS SLANT BED LATHE MM | setup sheet (lathe)

Buttons: [Camera] [OK] [Cancel] [Help]

Fig 13

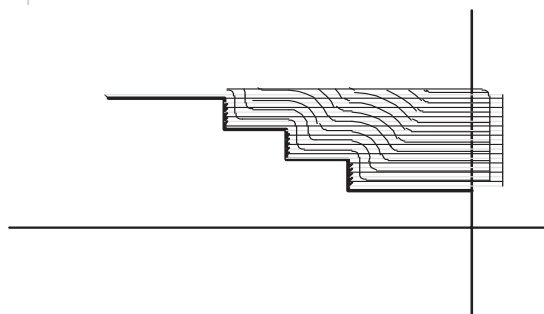
Mastercam Setup Sheet Report

2 Axis Slant Bed Lathe MM

GENERAL INFORMATION

PROJECT NAME:	MACHINE OPERATION EFFICIENCY
CUSTOMER NAME:	NIMI
PROGRAMMER:	MANU KUMAR H A
DRAWING:	STEP TURNING
DATE:	06 January 2025
TIME:	17:20
REVISION:	01

E:\ACER DESKTOP BACK UP\ID DRIVE\NIMI DEVELOPMENT CNC MCING TECHNICIAN\OPERATION EFFICIENCY EXERCISE.EMCAM



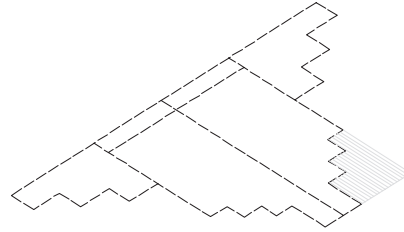
OPERATIONLIST

OPERATION INFO 1 - Lathe Canned Rough

CYCLE TIME: 0 HOURS, 3 MINUTES, 31 SECONDS

COMMENT:

SPINDLE SPEED: 120 CSS
FAST FEED: 0.2 mm/rev
SLOW FEED: 0.1 mm/rev
STOCK TO LEAVE (X): 0.2
STOCK TO LEAVE (Z): 0.2
RETRACT ACTIVE: NO
ENTRY ACTIVE: NO
COOLANT: Flood



TOOL INFO T0101: General turning tool - OD ROUGH RIGHT - 80 DEG.

TOP TURRET: YES
ACTIVE SPINDLE: Left
SPINDLE DIRECTION: CCW
SPINDLE SPEED: 120 CSS
FAST FEED: 0.2 mm/rev
SLOW FEED: 0.1 mm/rev
OFFSET: 1
OFFSET (BACK):
INSERT UP: NO
COOLANT: Flood
TIME: 00:03:31



HOLDER: MWLNR 2525M 08
LENGTH: 150.0
WIDTH: 32.0
ORIENTATION: Vertical **ANGLE:** 0.0
HAND: Right

INSERT: CNMG 12 04 08
SHAPE: C (80 deg. diamond)
RADIUS: 0.8
MATERIAL: Carbide

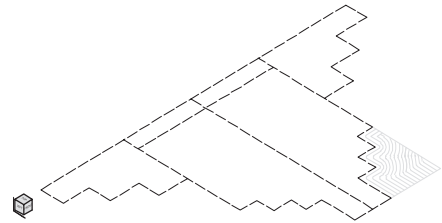


OPERATION INFO

2 - Lathe Contour Rough

CYCLE TIME:	0 HOURS, 3 MINUTES, 36 SECONDS
COMMENT:	

SPINDLE SPEED:	120 CSS
FAST FEED:	0.2 mm/rev
SLOW FEED:	0.1 mm/rev
STOCK TO LEAVE (X):	0.2
STOCK TO LEAVE (Z):	0.2
RETRACT ACTIVE:	NO
ENTRY ACTIVE:	NO
COOLANT:	Flood



TOOL INFO

T0101: General turning tool - OD ROUGH RIGHT - 80 DEG.

TOP TURRET:	YES
ACTIVE SPINDLE:	Left
SPINDLE DIRECTION:	CCW
SPINDLE SPEED:	120 CSS
FAST FEED:	0.2 mm/rev
SLOW FEED:	0.1 mm/rev
OFFSET:	1
OFFSET (BACK):	
INSERT UP:	NO
COOLANT:	Flood
TIME:	00:03:36

HOLDER:	MWLNR 2525M 08
LENGTH:	150.0
WIDTH:	32.0
ORIENTATION:	Vertical ANGLE: 0.0
HAND:	Right

INSERT:	CNMG 12 04 08
SHAPE:	C (80 deg. diamond)
RADIUS:	0.8
MATERIAL:	Carbide

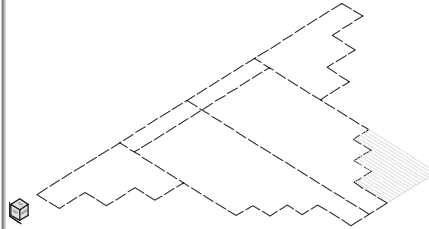


NOT TO BE REPUBLISHED

OPERATION INFO 3 - Lathe Rough

CYCLE TIME: 0 HOURS, 3 MINUTES, 50 SECONDS
COMMENT:

SPINDLE SPEED: 120 CSS
FAST FEED: 0.2 mm/rev
SLOW FEED: 0.1 mm/rev
STOCK TO LEAVE (X): 0.2
STOCK TO LEAVE (Z): 0.2
RETRACT ACTIVE: NO
ENTRY ACTIVE: NO
COOLANT: Flood



TOOL INFO T0101: General turning tool - OD ROUGH RIGHT - 80 DEG.

TOP TURRET: YES
ACTIVE SPINDLE: Left
SPINDLE DIRECTION: CCW
SPINDLE SPEED: 120 CSS
FAST FEED: 0.2 mm/rev
SLOW FEED: 0.1 mm/rev
OFFSET: 1
OFFSET (BACK):
INSERT UP: NO
COOLANT: Flood
TIME: 00:03:50

HOLDER: MWLNR 2525M 08
LENGTH: 150.0
WIDTH: 32.0
ORIENTATION: Vertical ANGLE: 0.0
HAND: Right

INSERT: CNMG 12 04 08
SHAPE: C (80 deg. diamond)
RADIUS: 0.8
MATERIAL: Carbide

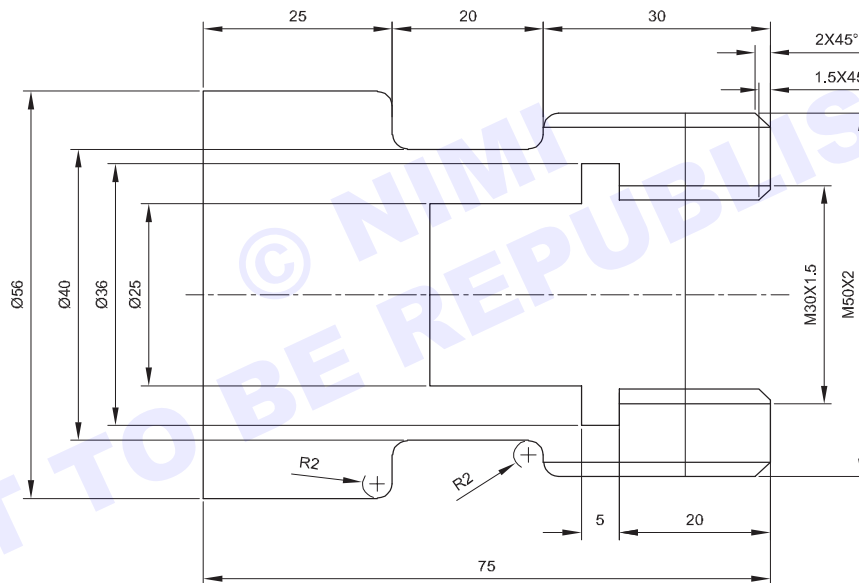


- Compare the Cycle Times of all the Three Tool paths
- The Cycle Time taken for the simple step Turning Operation by Canned Rough Tool path has the cycle time of 3Minutes and 31Seconds.
- This shows that the Canned Rough Tool path has taken less Cycle time and has Optimum Efficiency compared to Lathe Contour Rough and Lathe Rough Tool paths.

Create a program of grooving/threading on OD/ID in CNC turning

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

- create the program for OD turning operation using CAM
- create the program for ID boring operation using CAM
- create the program for OD grooving & threading operation using CAM
- create the program for ID grooving & threading operation using CAM
- check the program by simulation
- export the program to CNC lathe
- run the program auto/single auto mode.

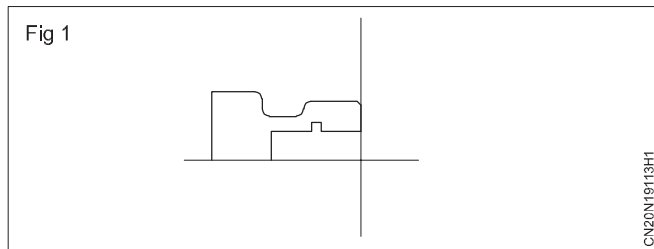


1	$\varnothing 60 \times 75 \text{ mm}$	-	FE310	-	-	-
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE 1:1					TOLERANCE \pm	
					TIME :	
					CODE NO: CN20N19113E1	

GROOVING / THREADING ON OD/ID

Job Sequence

- Read the drawing.
- Switch ON the computer.
- Open the mastercam software
- Select the default metric configuration file
- Load a machine definition
- From machine tab, choose the lathe machine type and select default.
- Press F9 to display axes and wireframe setup
- Select the lathe plane from the planes manager toolbar and select +D +Z from the drop down menu.
- Create the 2D geometry. (Fig 1)



- Select solid and revolve and do right click to get 3D view
- Save the file. (Figs 2 & 3)
- Perform the stock setup (Fig 4) & Jaw setup (Fig 5)

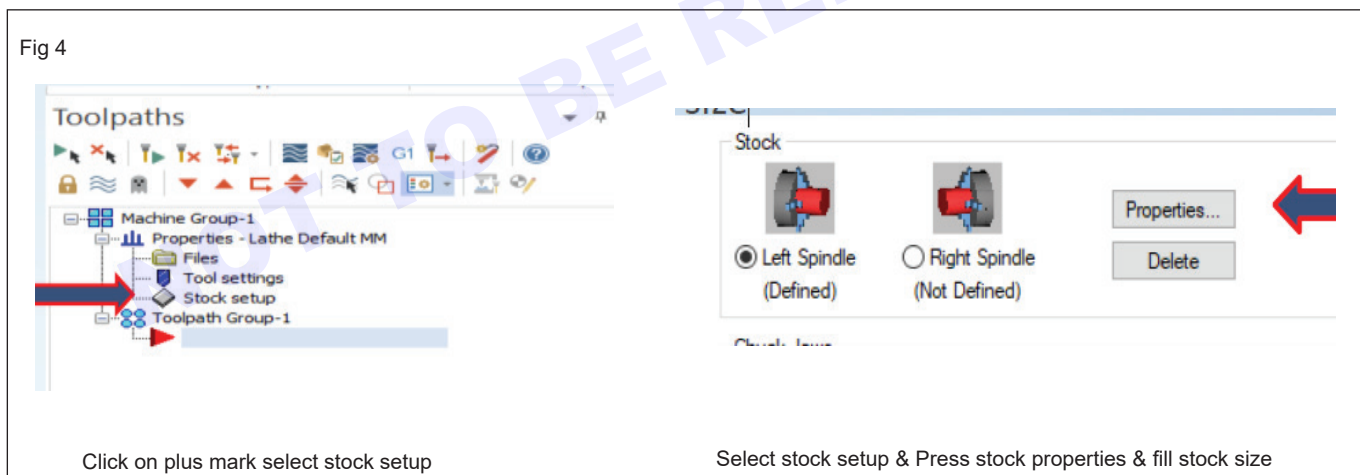
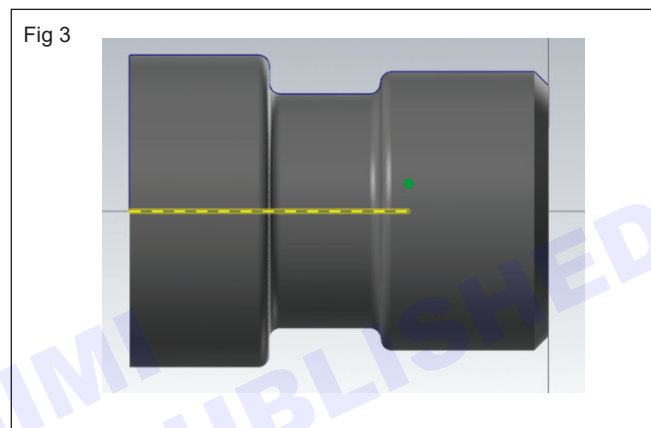
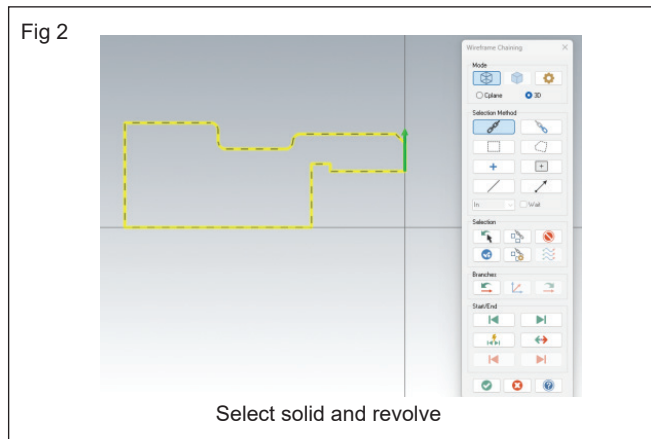
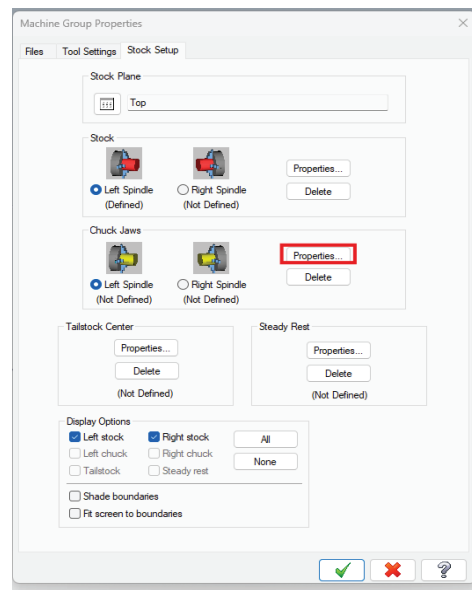
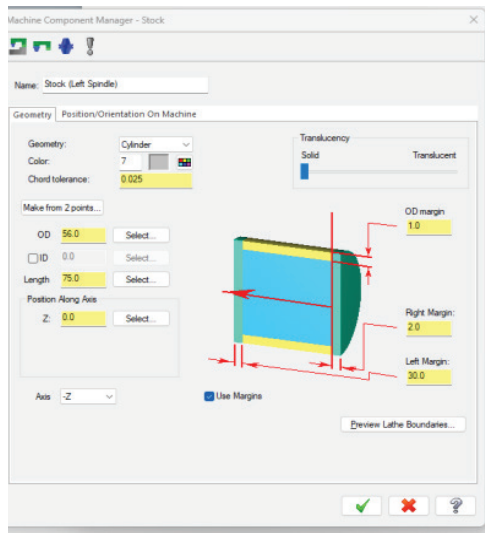
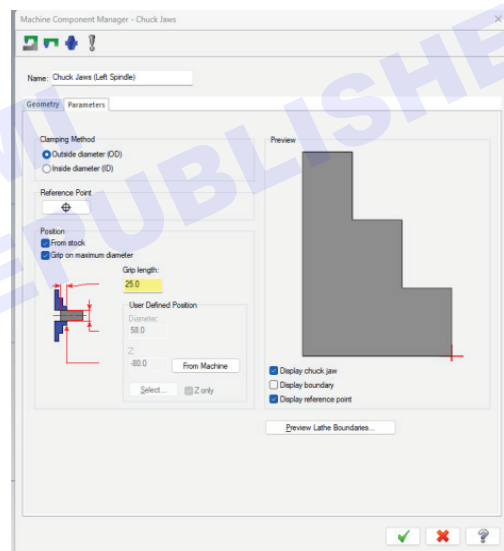
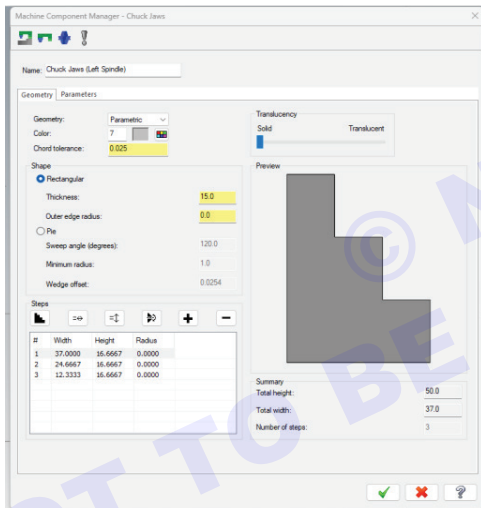


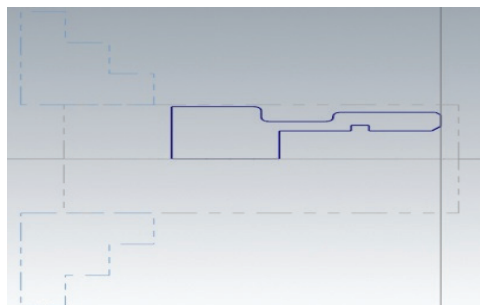
Fig 5



Select chuck Jaws properties & fill Jaws size



Click "ok" green right mark

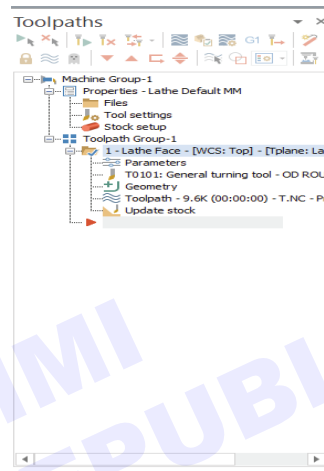
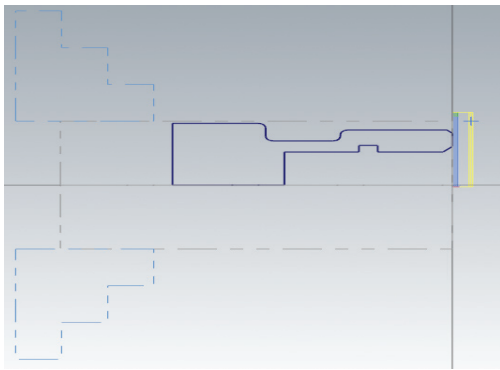
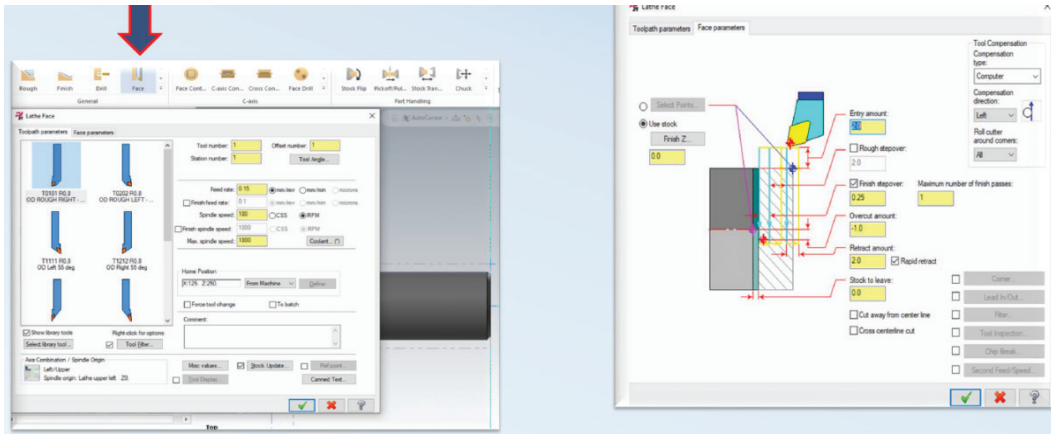


Select lathe and turning

- Select appropriate toolpath for the desired operations
- Lathe face toolpath (Fig 6)

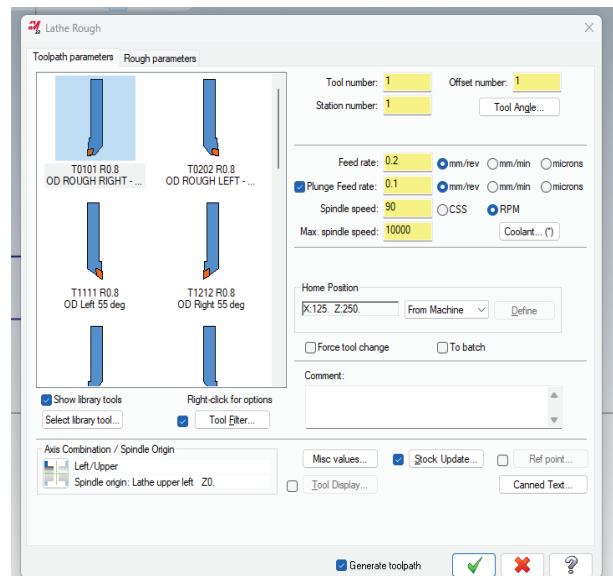
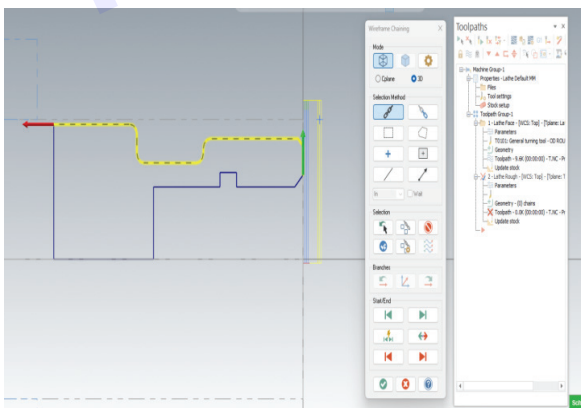
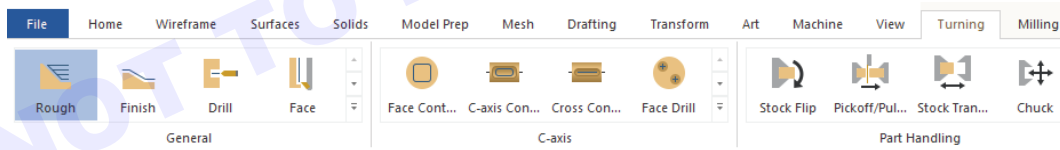
Fig 6

Select face operation choose a tool & fill parameters



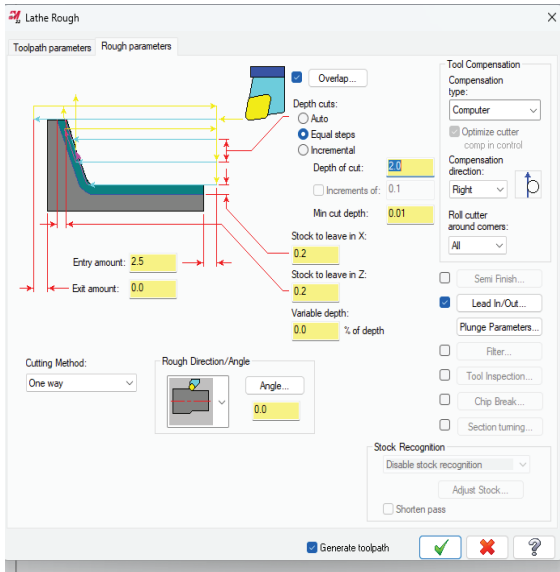
- Lathe rough toolpath & lathe finish toolpath (Figs 7 & 8)

Fig 7

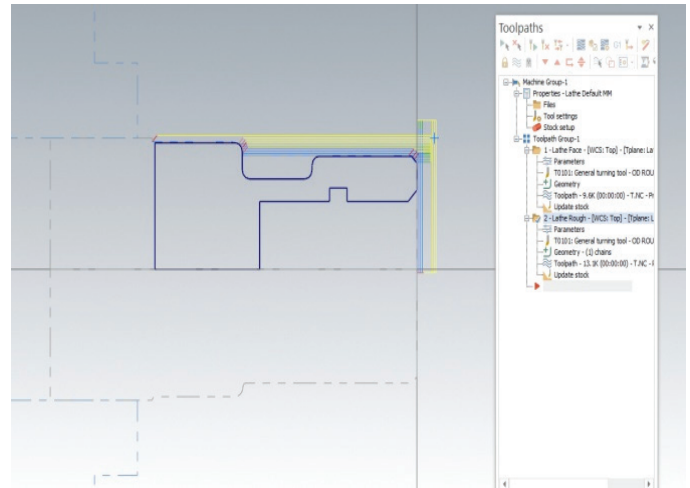


Select tool and fill parameters

Fig 8



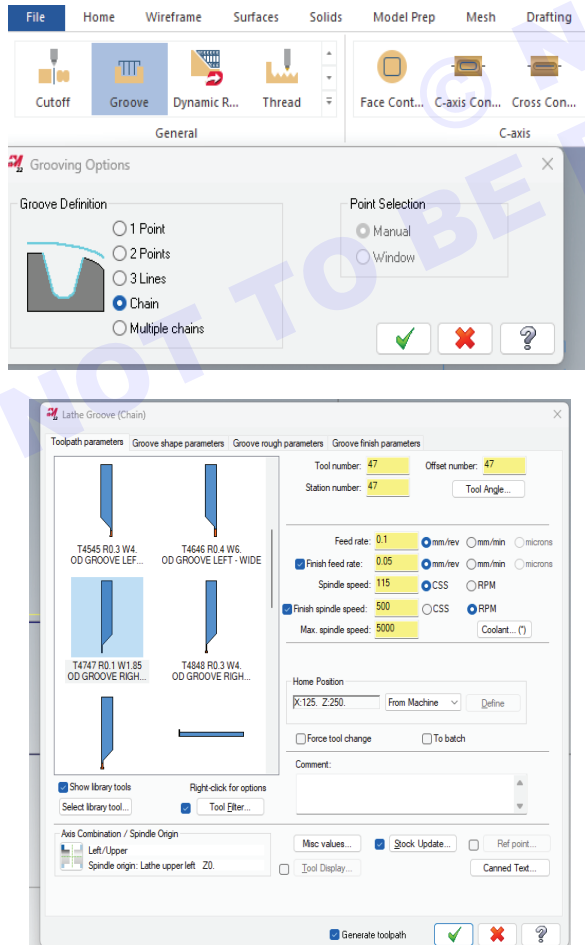
Click "ok" green right mark



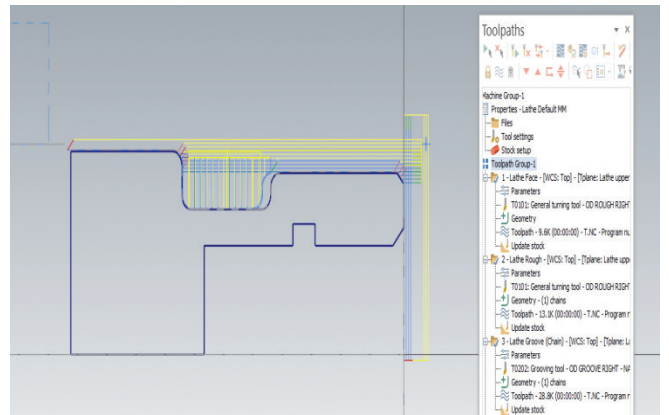
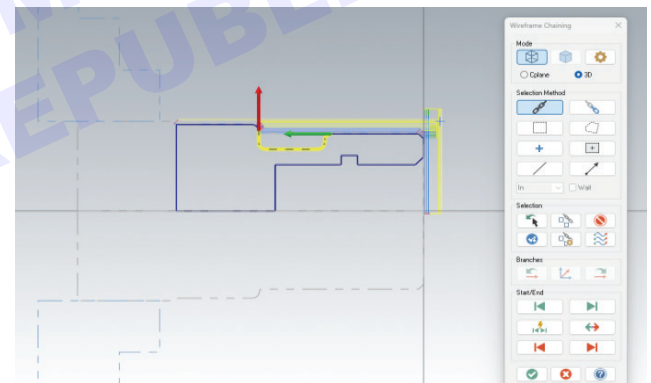
- Lathe groove toolpath (Fig 9)

Fig 9

Select Groove operation choose a tool & fill parameters

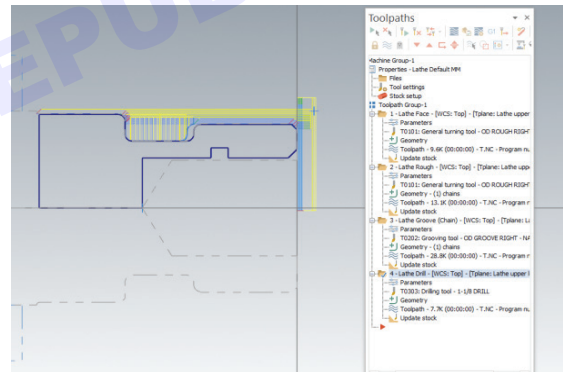
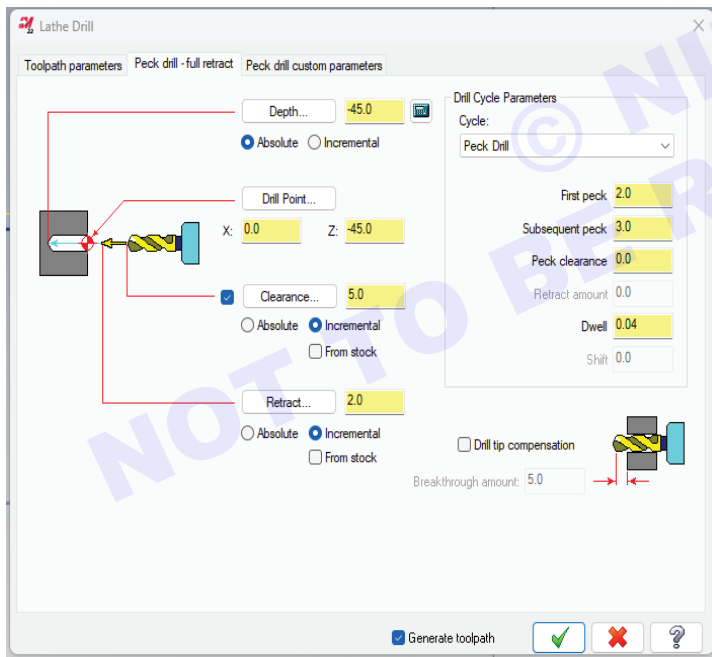
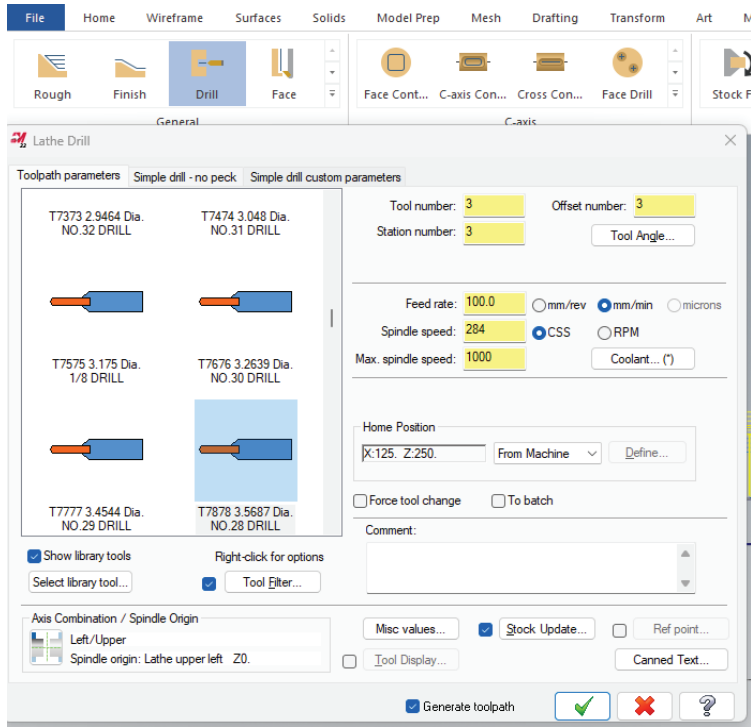


Click "ok" green right mark



- Lathe drill toolpath (Fig 10)

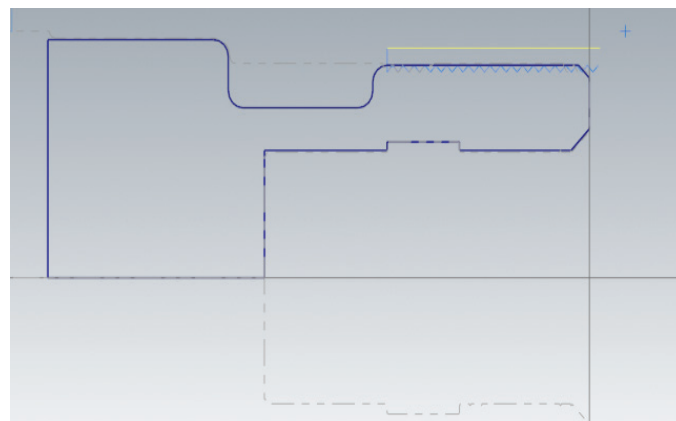
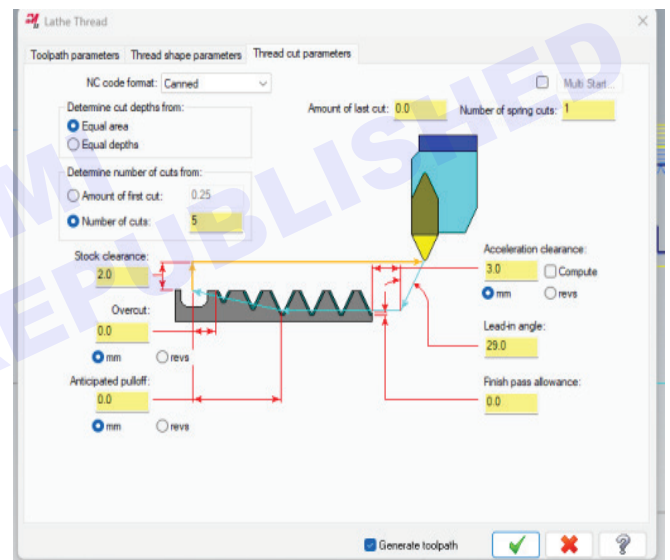
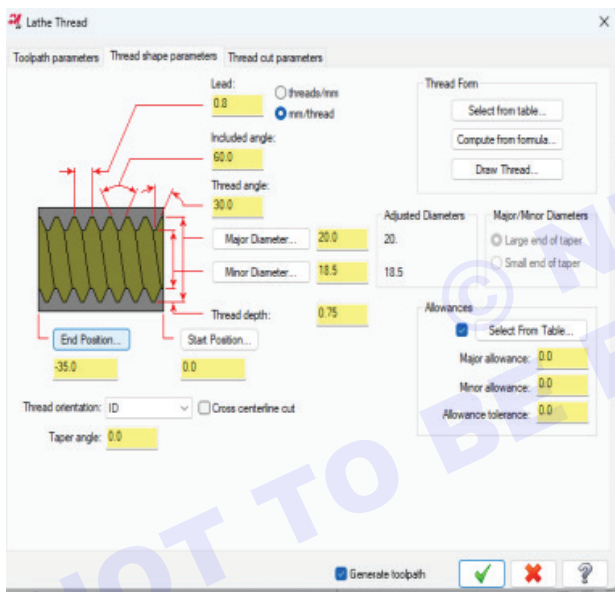
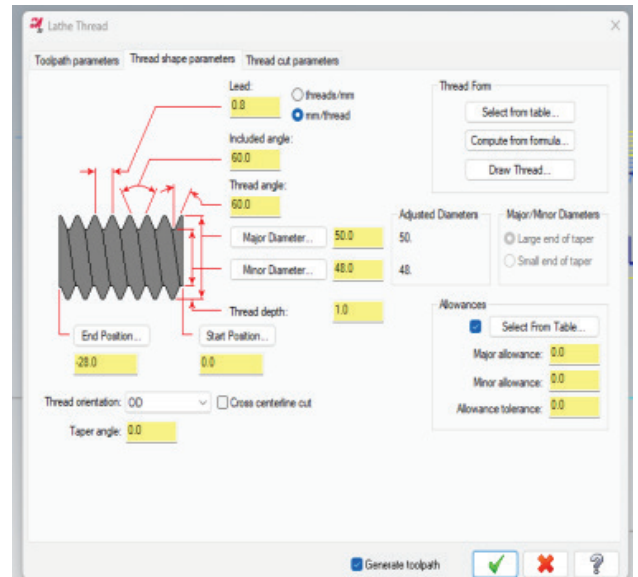
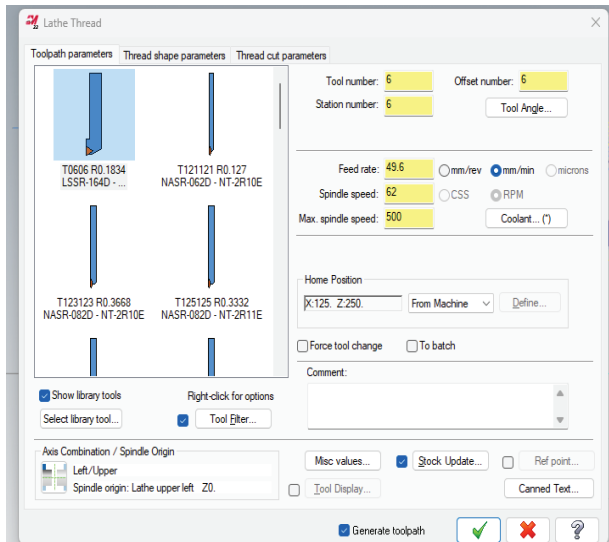
Fig 10



Select Drill operation choose a tool & fill parameters

- Lathe thread toolpath (Fig 11)

Fig 11 Select threading operation and fill all parameters, Select start point & end point



Select thread cut parameters and fill it, Click "ok" green right mark

- Lathe bore toolpath (Fig 12)

Fig 12

The image displays the 'Lathe Rough' software interface. At the top, there is a 'General' toolbar with icons for 'Rough', 'Finish', 'Drill', and 'Face'. The main window is divided into 'Toolpath parameters' and 'Rough parameters' tabs. The 'Toolpath parameters' tab shows a 3D model of a lathe part with various toolpaths highlighted in red and yellow. The 'Rough parameters' tab contains various settings for tool compensation, feed rates, and spindle speed. A large watermark 'NOT TO BE RE-PUBLISHED' is overlaid on the image.

General

Lathe Rough

Toolpath parameters

Rough parameters

Tool number: 5
Station number: 5
Offset number: 5
Tool Angle...

Feed rate: 0.0762 mm/rev
Plunge Feed rate: 0.0508 mm/rev
Spindle speed: 61 CSS
Max. spindle speed: 3000
Coolant... (?)

Home Position: X:125. Z:250. From Machine Define

Force tool change To batch

Comment:

Generate toolpath

Tool Compensation

Compensation type: Computer
Optimize cutter comp in control
Compensation direction: Left
Roll cutter around corners: All

Semi Finish...
Lead In/Out...
Plunge Parameters...
Filter...
Tool Inspection...
Chip Break...
Section turning...

Stock Recognition

Use stock for outer boundary
Adjust Stock...
Shorten pass

Stock to leave in X: 0.2
Stock to leave in Z: 0.2
Variable depth: 0.0 % of depth

Depth cuts:
Auto
Equal steps
Incremental
Depth of cut: 0.5
Increments of: 0.1
Min cut depth: 0.01
Entry amount: 2.0
Exit amount: 0.0

Cutting Method: One way
Rough Direction/Angle: Angle... 0.0

3D Model: T0404 R0.7937 NDLPR-164D - DPGR-432 DTANLS-164 - TNMG-432K
T0505 R0.7937 DTANRS-164 - TNMG-432K CSKNRP-164D - SNMG-432
T0505 R0.7937 DTANRS-164 - TNMG-432K CSKNRP-164D - SNMG-432
T0505 R0.7937 MWLNL-164D - WINMG-432 A10-SVQBR2 - VBMT-221

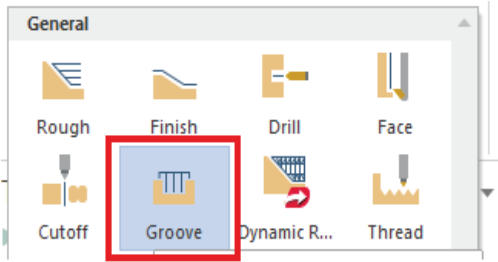
Axis Combination / Spindle Origin
Left/Upper
Spindle origin: Lathe upper left Z0.

Misc values... Stock Update... Ref point...
Tool Display... Canned Text...

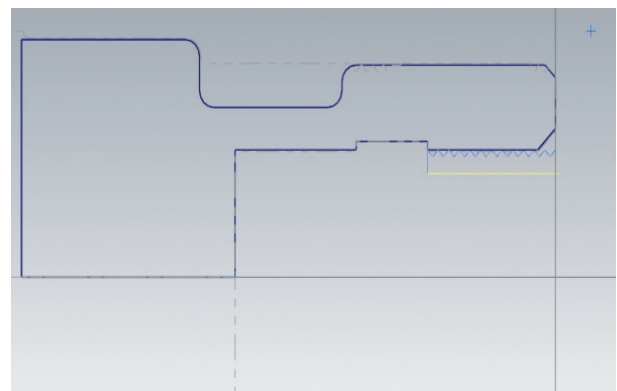
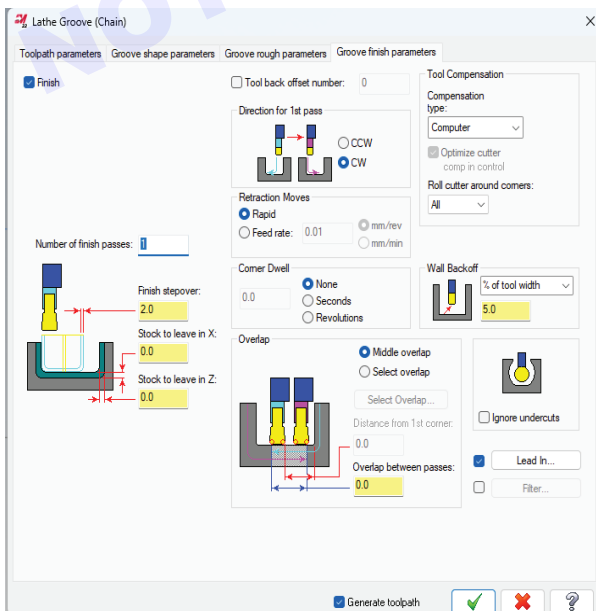
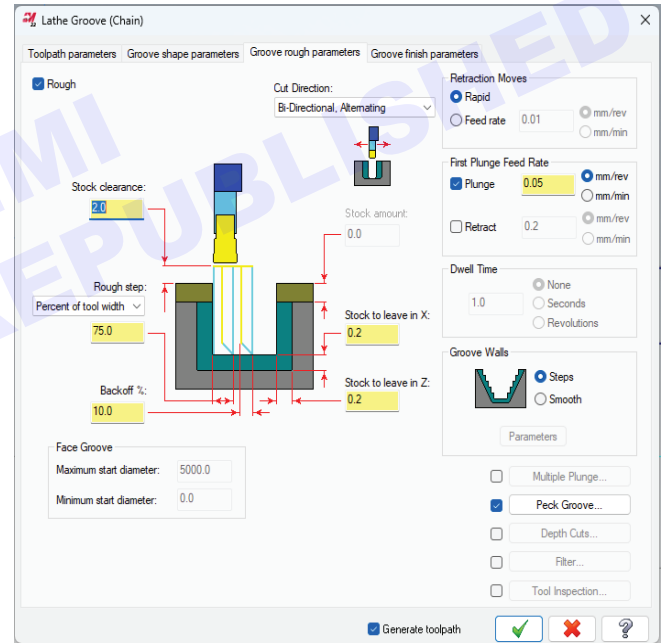
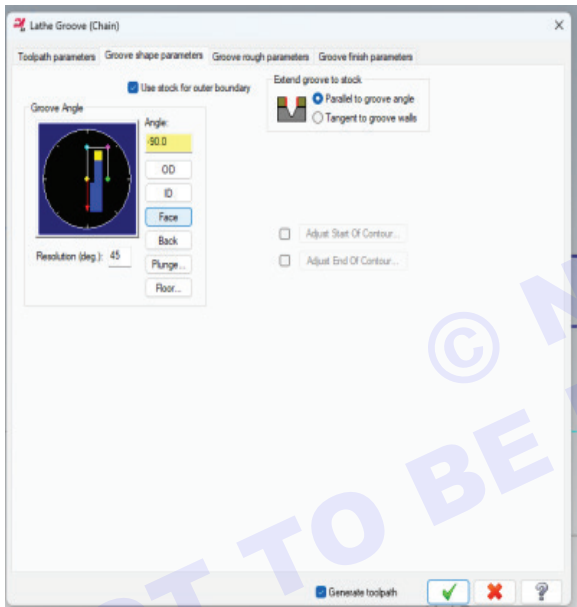
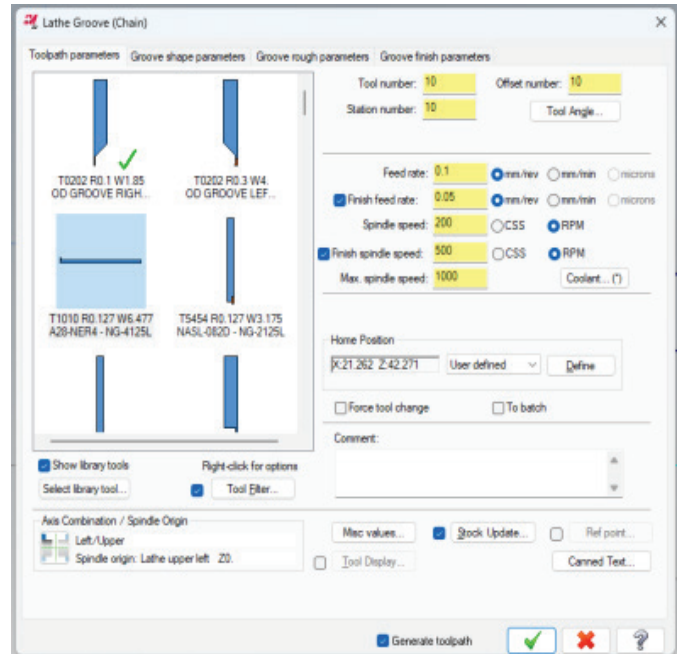
Select rough for boring & select body chain
Click "ok" green right mark

- Lathe groove toolpath (Fig 13)

Fig 13



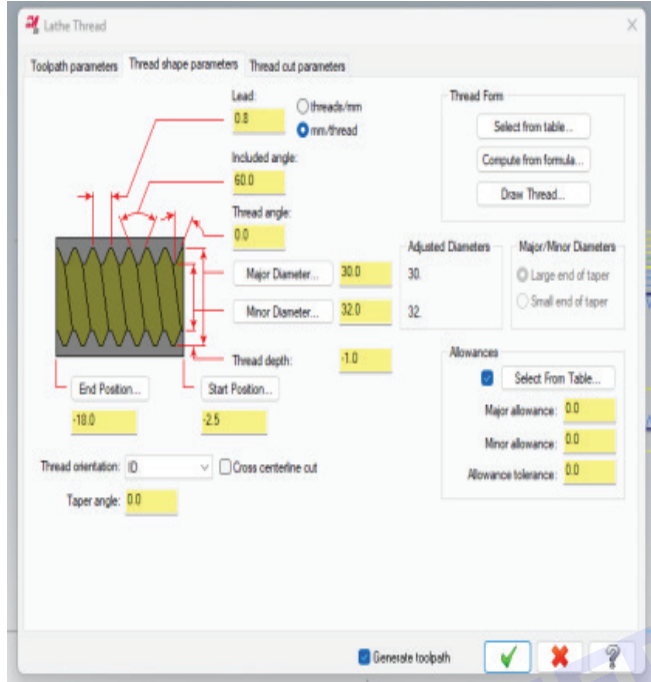
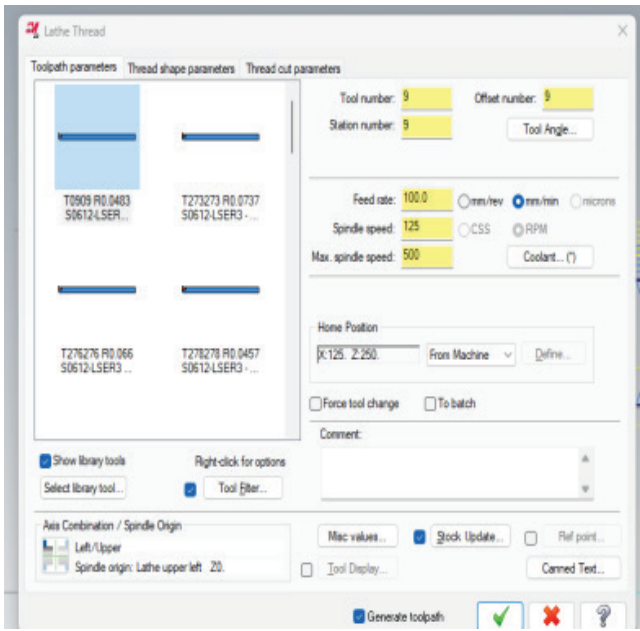
Select grooving operation and fill all the parameter in toolpath parameters, groove shape parameters, groove rough parameters, groove finish parameters.



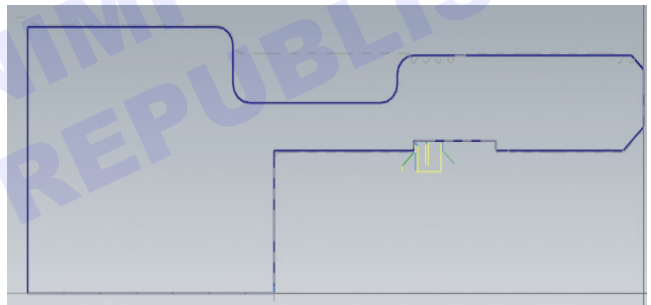
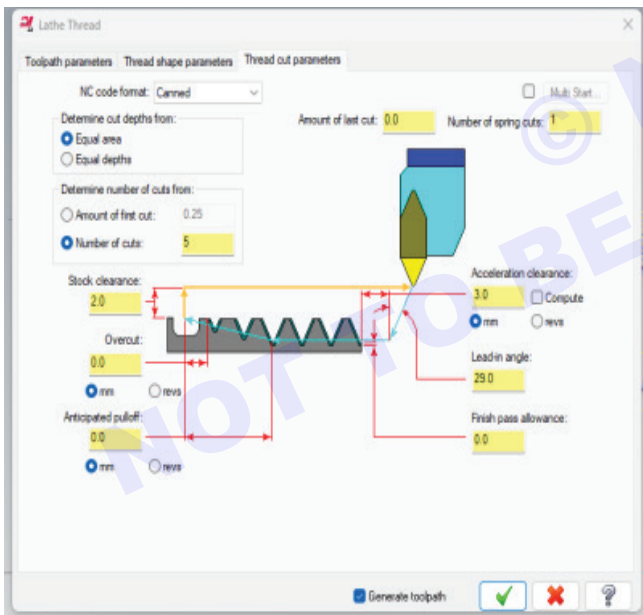
Click "ok" green right mark

- Lathe thread toolpath (Fig 14)

Fig 14



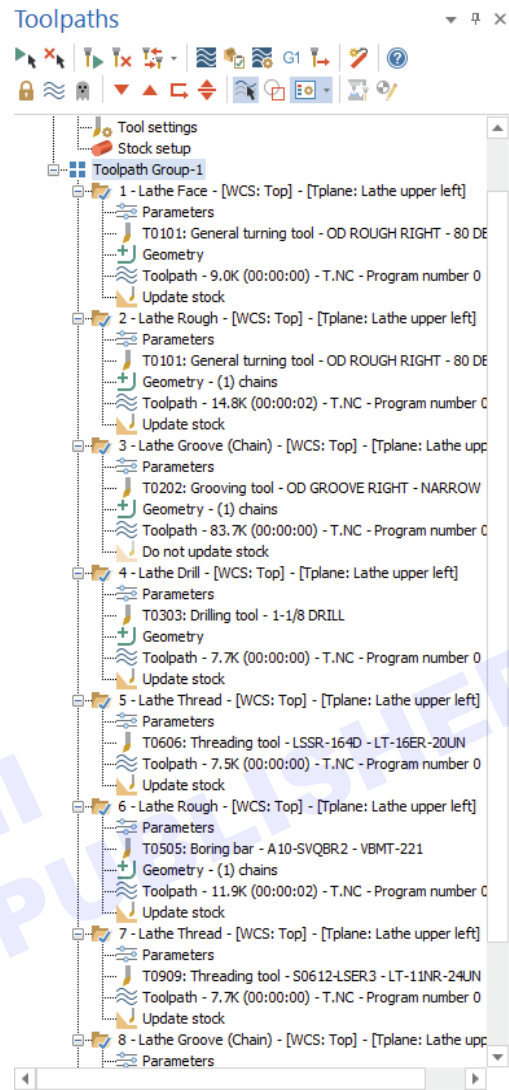
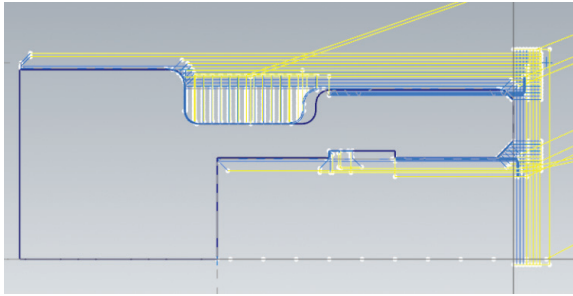
Select threading operation and fill all parameters



Click "ok" green right mark

- Select back plot option to simulate the toolpaths for simulation (Fig 15)

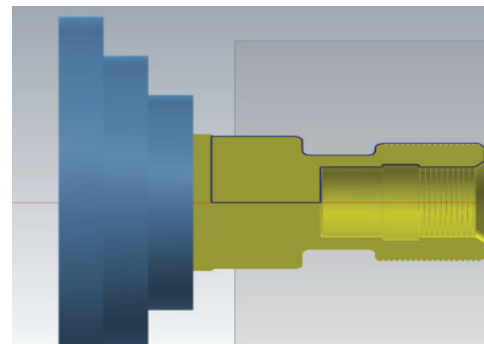
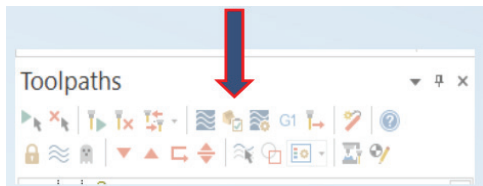
Fig 15



Select all operation press 1st below button from TOOLPATHS for simulation

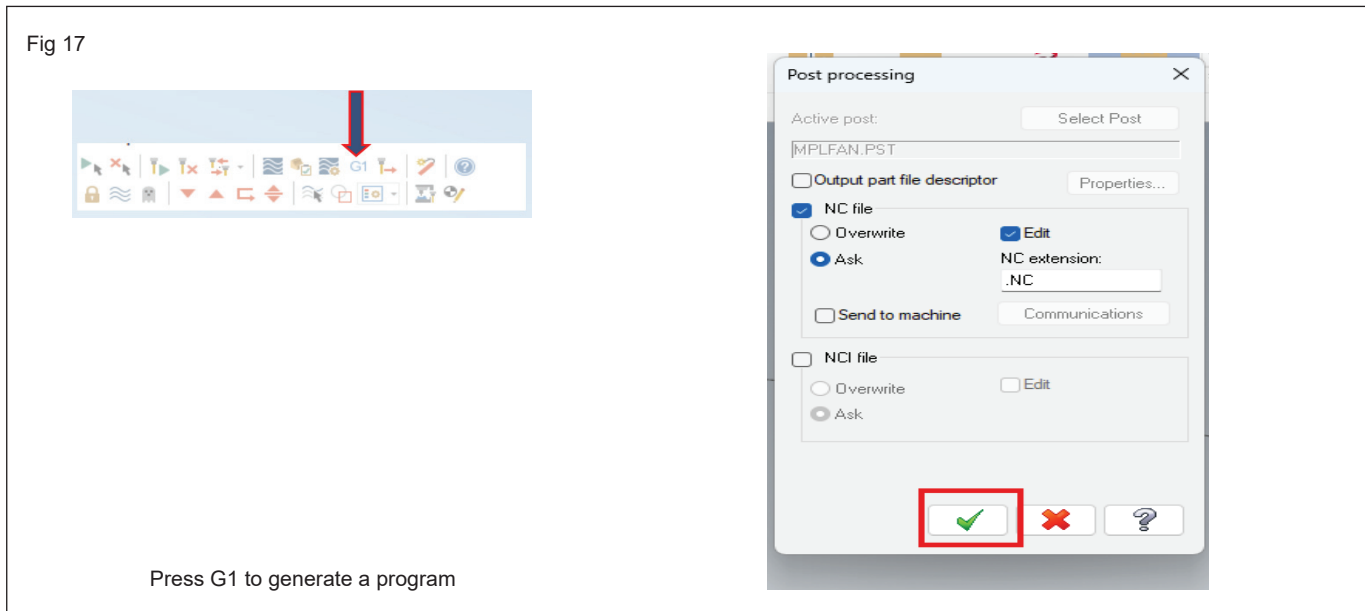
- Verify the toolpath (Fig 16)

Fig 16



Verify selected operation, Press indicate button for simulation

- Select G1 option to generate the program (Fig 17)



- NC program generated

O0000	G1 X-1.6 F.15
(PROGRAM NAME - EX .1)	G0 Z3.
(DATE=DD-MM-YY - 08-01-25 TIME=HH:MM - 14:28)	X62.
(MCAM FILE - C:\USERS\ADMINISTRATOR\DESKTOP\EX 1.8.00.MCAM)	Z.5
(NC FILE - C:\USERS\ADMINISTRATOR\DESKTOP\EX .1.8)	G1 X-1.6 F.15
(MATERIAL - ALUMINUM MM - 2024)	G0 Z2.5
G21	X62.
(TOOL - 1 OFFSET - 1)	Z0.
(OD ROUGH RIGHT - 80 DEG. INSERT - CNMG 12 04 08)	G1 X-1.6 F.15
G0 T0101	G0 Z2.
G18	X57.016
G97 S1500 M03	Z4.151
G0 G54 X62. Z3.5 M8	G1 Z2.151 F.15
G99 G1 X-1.6 F.15	Z-74.8
G0 Z5.5	X58.
X62.	X60.828 Z-73.386
Z2.	G0 Z4.2
G1 X-1.6 F.15	X56.032
G0 Z4.	G1 Z2.2 F.15
X62.	Z-51.766
Z1.5	G18 G3 X56.4 Z-52.8 I-2.816 K-1.034
G1 X-1.6 F.15	G1 Z-74.8
G0 Z3.5	X57.016
X62.	X59.844 Z-73.386
Z1.	G0 Z4.2
	X55.048
	G1 Z2.2 F.15
	Z-50.903

G3 X56.032 Z-51.766 I-2.324 K-1.897
G1 X58.86 Z-50.351
G0 Z4.2
X54.064
G1 Z2.2 F.15
Z-50.424
G3 X55.048 Z-50.903 I-1.832 K-2.375
G1 X57.876 Z-49.489
G0 Z4.2
X53.08
G1 Z2.2 F.15
Z-50.116
G3 X54.064 Z-50.425 I-1.34 K-2.684
G1 X56.892 Z-49.01
G0 Z4.2
X52.096
G1 Z2.2 F.15
Z-49.922
G3 X53.08 Z-50.116 I-.848 K-2.877
G1 X55.908 Z-48.702
G0 Z4.2
X51.112
G1 Z2.2 F.15
Z-49.821
G3 X52.096 Z-49.922 I-.356 K-2.979
G1 X54.924 Z-48.508
G0 Z4.2
X50.128
G1 Z2.2 F.15
Z-1.797
G3 X50.4 Z-2.3 I-.864 K-.503
G1 Z-28.8
Z-49.8
G3 X51.112 Z-49.821 K-3.
G1 X53.94 Z-48.407
G0 Z4.2
X49.144
G1 Z2.2 F.15
Z-1.258
X49.814 Z-1.593
G3 X50.128 Z-1.796 I-.707 K-.707
G1 X52.956 Z-.382
G0 Z4.2
X48.16
G1 Z2.2 F.15

Z-.766
X49.144 Z-1.258
X51.972 Z.156
G0 Z4.2
X47.176
G1 Z2.2 F.15
Z-.274
X48.16 Z-.766
X50.988 Z.648
G28 U0. V0. W0. M05
T0100
M01
(TOOL - 2 OFFSET - 2)
(OD GROOVE RIGHT - NARROW INSERT - N151.2-185-20-5G)
G0 T0202
G18
G97 S115 M03
G0 G54 X54.4 Z-40.583
G1 X50. F.05
G0 X50.4
G1 X49.6 F.05
G0 X50.
G1 X49.2 F.05
G0 X49.6
G1 X48.8 F.05
G0 X49.2
G1 X48.4 F.05
G0 X48.8
G1 X48. F.05
G0 X48.4
G1 X47.6 F.05
G0 X48.
G1 X47.2 F.05
G0 X47.6
G1 X46.8 F.05
G0 X47.2
G1 X46.4 F.05
G0 X46.8
G1 X46. F.05
G0 X46.4
G1 X45.6 F.05
G0 X46.
G1 X45.2 F.05
G0 X45.6
G1 X44.8 F.05

G0 X45.2
G1 X44.4 F.05
G0 X44.8
G1 X44. F.05
G0 X44.4
G1 X43.6 F.05
G0 X44.
G1 X43.2 F.05
G0 X43.6
G1 X42.8 F.05
G0 X43.2
G1 X42.4 F.05
G0 X42.8
G1 X42. F.05
G0 X42.4
G1 X41.6 F.05
G0 X42.
G1 X41.2 F.05
G0 X41.6
G1 X40.8 F.05
G0 X41.2
G1 X40.4 F.05
G0 X54.4
Z-39.267
G1 X50. F.1
G0 X50.4
G1 X49.6 F.1
G0 X50.
G1 X49.2 F.1
G0 X49.6
G1 X48.8 F.1
G0 X49.2
G1 X48.4 F.1
G0 X48.8
G1 X48. F.1
G0 X48.4
G1 X47.6 F.1
G0 X48.
G1 X47.2 F.1
G0 X47.6
G1 X46.8 F.1
G0 X47.2
G1 X46.4 F.1
G0 X46.8
G1 X46. F.1
G0 X46.4

G1 X45.6 F.1
G0 X46.
G1 X45.2 F.1
G0 X45.6
G1 X44.8 F.1
G0 X45.2
G1 X44.4 F.1
G0 X44.8
G1 X44. F.1
G0 X44.4
G1 X43.6 F.1
G0 X44.
G1 X43.2 F.1
G0 X43.6
G1 X42.8 F.1
G0 X43.2
G1 X42.4 F.1
G0 X42.8
G1 X42. F.1
G0 X42.4
G1 X41.6 F.1
G0 X42.
G1 X41.2 F.1
G0 X41.6
G1 X40.8 F.1
G0 X41.6
G1 X40.8 F.1
G0 X41.2
G1 X40.4 F.1
X40.663 Z-41.768
G0 X54.4
Z-37.95
G1 X50. F.1
G0 X50.4
G1 X49.6 F.1
G0 X50.
G1 X49.2 F.1
G0 X49.6
G1 X48.8 F.1
G0 X49.2
G1 X48.4 F.1
G0 X48.8
G1 X48. F.1
G0 X48.4
G1 X47.6 F.1
G0 X48.
G1 X47.2 F.1
G0 X48.
G1 X47.2 F.1
G0 X47.6

G1 X46.8 F.1	G0 X48.8
G0 X47.2	G1 X48. F.1
G1 X46.4 F.1	G0 X48.4
G0 X46.8	G1 X47.6 F.1
G1 X46. F.1	G0 X48.
G0 X46.4	G1 X47.2 F.1
G1 X45.6 F.1	G0 X47.6
G0 X46.	G1 X46.8 F.1
G1 X45.2 F.1	G0 X47.2
G0 X45.6	G1 X46.4 F.1
G1 X44.8 F.1	G0 X46.8
G0 X45.2	G1 X46. F.1
G1 X44.4 F.1	G0 X46.4
G0 X44.8	G1 X45.6 F.1
G1 X44. F.1	G0 X46.
G0 X44.4	G1 X45.2 F.1
G1 X43.6 F.1	G0 X45.6
G0 X44.	G1 X44.8 F.1
G1 X43.2 F.1	G0 X45.2
G0 X43.6	G1 X44.4 F.1
G1 X42.8 F.1	G0 X44.8
G0 X43.2	G1 X44. F.1
G1 X42.4 F.1	G0 X44.4
G0 X42.8	G1 X43.6 F.1
G1 X42. F.1	G0 X44.
G0 X42.4	G1 X43.2 F.1
G1 X41.6 F.1	G0 X43.6
G0 X42.	G1 X42.8 F.1
G1 X41.2 F.1	G0 X43.2
G0 X41.6	G1 X42.4 F.1
G1 X40.8 F.1	G0 X42.8
G0 X41.2	G1 X42. F.1
G1 X40.4 F.1	G0 X42.4
X40.663 Z-38.082	G1 X41.6 F.1
G0 X54.4	G0 X42.
Z-43.217	G1 X41.2 F.1
G1 X50. F.1	G0 X41.6
G0 X50.4	G1 X40.8 F.1
G1 X49.6 F.1	G0 X41.2
G0 X50.	G1 X40.4 F.1
G1 X49.2 F.1	X40.663 Z-43.085
G0 X49.6	G0 X54.4
G1 X48.8 F.1	Z-36.633
G0 X49.2	G1 X50. F.1
G1 X48.4 F.1	G0 X50.4

G1 X49.6 F.1
G0 X50.
G1 X49.2 F.1
G0 X49.6
G1 X48.8 F.1
G0 X49.2
G1 X48.4 F.1
G0 X48.8
G1 X48. F.1
G0 X48.4
G1 X47.6 F.1
G0 X48.
G1 X47.2 F.1
G0 X47.6
G1 X46.8 F.1
G0 X47.2
G1 X46.4 F.1
G0 X46.8
G1 X46. F.1
G0 X46.4
G1 X45.6 F.1
G0 X46.
G1 X45.2 F.1
G0 X45.6
G1 X44.8 F.1
G0 X45.2
G1 X44.4 F.1
G0 X44.8
G1 X44. F.1
G0 X44.4
G1 X43.6 F.1
G0 X44.
G1 X43.2 F.1
G0 X43.6
G1 X42.8 F.1
G0 X43.2
G1 X42.4 F.1
G0 X42.8
G1 X42. F.1
G0 X42.4
G1 X41.6 F.1
G0 X42.
G1 X41.2 F.1
G0 X41.6
G1 X40.8 F.1

G0 X41.2
G1 X40.4 F.1
X40.663 Z-36.765
G0 X54.4
Z-44.533
G1 X50. F.1
G0 X50.4
G1 X49.6 F.1
G0 X50.
G1 X49.2 F.1
G0 X49.6
G1 X48.8 F.1
G0 X49.2
G1 X48.4 F.1
G0 X48.8
G1 X48. F.1
G0 X48.4
G1 X47.6 F.1
G0 X48.
G1 X47.2 F.1
G0 X47.6
G1 X46.8 F.1
G0 X47.2
G1 X46.4 F.1
G0 X46.8
G1 X46. F.1
G0 X46.4
G1 X45.6 F.1
G0 X46.
G1 X45.2 F.1
G0 X46.
G1 X44.8 F.1
G0 X46.4
G1 X45.6 F.1
G0 X46.
G1 X45.2 F.1
G0 X45.6
G1 X44.8 F.1
G0 X45.2
G1 X44.4 F.1
G0 X44.8
G1 X44. F.1
G0 X44.4
G1 X43.6 F.1
G0 X44.
G1 X43.2 F.1
G0 X43.6
G1 X42.8 F.1
G0 X44.8
G1 X44. F.1
G0 X44.4
G1 X43.6 F.1
G0 X44.
G1 X43.2 F.1
G0 X43.6
G1 X42.8 F.1
G0 X43.2
G1 X42.4 F.1
G0 X42.8

G1 X42. F.1	G0 X44.
G0 X42.4	G1 X43.2 F.1
G1 X41.6 F.1	G0 X43.6
G0 X42.	G1 X42.8 F.1
G1 X41.2 F.1	G0 X43.2
G0 X41.6	G1 X42.4 F.1
G1 X40.8 F.1	G0 X42.8
G0 X41.2	G1 X42. F.1
G1 X40.4 F.1	G0 X42.4
X40.663 Z-44.402	G1 X41.6 F.1
G0 X54.4	G0 X42.
Z-35.317	G1 X41.2 F.1
G1 X50. F.1	G0 X41.6
G0 X50.4	G1 X40.8 F.1
G1 X49.6 F.1	G0 X41.2
G0 X50.	G1 X40.4 F.1
G1 X49.2 F.1	X40.663 Z-35.448
G0 X49.6	G0 X54.4
G1 X48.8 F.1	Z-45.85
G0 X49.2	G1 X50. F.1
G1 X48.4 F.1	G0 X50.4
G0 X48.8	G1 X49.6 F.1
G1 X48. F.1	G0 X50.
G0 X48.4	G1 X49.2 F.1
G1 X47.6 F.1	G0 X49.6
G0 X48.	G1 X48.8 F.1
G1 X47.2 F.1	G0 X49.2
G0 X47.6	G1 X48.4 F.1
G1 X46.8 F.1	G0 X48.8
G0 X47.2	G1 X48. F.1
G1 X46.4 F.1	G0 X48.4
G0 X46.8	G1 X47.6 F.1
G1 X46. F.1	G0 X48.
G0 X46.4	G1 X47.2 F.1
G1 X45.6 F.1	G0 X47.6
G0 X46.	G1 X46.8 F.1
G1 X45.2 F.1	G0 X47.2
G0 X45.6	G1 X46.4 F.1
G1 X44.8 F.1	G0 X46.8
G0 X45.2	G1 X46. F.1
G1 X44.4 F.1	G0 X46.4
G0 X44.8	G1 X45.6 F.1
G1 X44. F.1	G0 X46.
G0 X44.4	G1 X45.2 F.1
G1 X43.6 F.1	G0 X45.6

G1 X44.8 F.1
G0 X45.2
G1 X44.4 F.1
G0 X44.8
G1 X44. F.1
G0 X44.4
G1 X43.6 F.1
G0 X44.
G1 X43.2 F.1
G0 X43.6
G1 X42.8 F.1
G0 X43.2
G1 X42.4 F.1
G0 X42.8
G1 X42. F.1
G0 X42.4
G1 X41.6 F.1
G0 X42.
G1 X41.2 F.1
G0 X41.6
G1 X40.8 F.1
G0 X41.2
G1 X40.4 F.1
X40.663 Z-45.718
G0 X54.4
Z-34
G1 X50. F.1
G0 X50.4
G1 X49.6 F.1
G0 X50.
G1 X49.2 F.1
G0 X49.6
G1 X48.8 F.1
G0 X49.2
G1 X48.4 F.1
G0 X48.8
G1 X48. F.1
G0 X48.4
G1 X47.6 F.1
G0 X48.
G1 X47.2 F.1
G0 X47.6
G1 X46.8 F.1
G0 X47.2
G1 X46.4 F.1

G0 X46.8
G1 X46. F.1
G0 X46.4
G1 X45.6 F.1
G0 X46.
G1 X45.2 F.1
G0 X45.6
G1 X44.8 F.1
G0 X45.2
G1 X44.4 F.1
G0 X44.8
G1 X44. F.1
G0 X44.4
G1 X43.6 F.1
G0 X44.
G1 X43.2 F.1
G0 X43.6
G1 X42.8 F.1
G0 X43.2
G1 X42.4 F.1
G0 X42.8
G1 X41.6 F.1
G0 X42.
G1 X41.2 F.1
G0 X41.6
G1 X40.8 F.1
G0 X41.2
G1 X40.4 F.1
X40.663 Z-34.132
G0 X54.4
Z-47.167.
G1 X50. F.1
G0 X50.4
G1 X49.6 F.1
G0 X50.
G1 X49.2 F.1
G0 X49.6
G1 X48.8 F.1
G0 X49.2
G1 X48.4 F.1
G0 X48.8
G1 X48. F.1
G0 X48.4

G1 X47.6 F.1	G1 X48.792 F.1
G0 X48.	G0 X49.192
G1 X47.2 F.1	G1 X48.39 F.1
G0 X47.6	G0 X48.79
G1 X46.8 F.1	G1 X47.988. F.1
G0 X47.2	G0 X48.388
G1 X46.4 F.1	G1 X47.586 F.1
G0 X46.8	G0 X47.986.
G1 X46. F.1	G1 X47.184 F.1
G0 X46.4	G0 X47.584
G1 X45.6 F.1	G1 X46.781 F.1
G0 X46.	G0 X47.181
G1 X45.2 F.1	G1 X46.379 F.1
G0 X45.6	G0 X46.779
G1 X44.8 F.1	G1 X45.977. F.1
G0 X45.2	G0 X46.377
G1 X44.4 F.1	G1 X45.575 F.1
G0 X44.8	G0 X45.975.
G1 X44. F.1	G1 X45.173 F.1
G0 X44.4	G0 X45.573
G1 X43.6 F.1	G1 X44.771 F.1
G0 X44.	G0 X45.171
G1 X43.2 F.1	G1 X44.369 F.1
G0 X43.6	G0 X44.769
G1 X42.8 F.1	G1 X43.967. F.1
G0 X43.2	G0 X44.367
G1 X42.4 F.1	G1 X43.565 F.1
G0 X42.8	G0 X43965.
G1 X42. F.1	G1 X43.163 F.1
G0 X42.4	G0 X43.563
G1 X41.6 F.1	G1 X42.761 F.1
G0 X42.	G0 X43.161
G1 X41.2 F.1	G1 X42.359 F.1
G0 X41.6	G0 X42.759
G1 X40.8 F.1	G1 X41.957 F.1
G0 X41.2	G0 X42.357
G1 X40.4 F.1	G1 X41.555 F.1
X40.663 Z-47.035	G0 X41.955
G0 X54.4	G1 X41.153 F.1
Z-32.683	G18 G2 X40.4 Z-33.75 I-.323 K-1.066
G1 X49.998. F.1	G0 X41.6
G0 X50.398	G0 X41.2
G1 X49.596 F.1	G1 X40.4 F.1
G0 X49.996	X40.663 Z-47.035
G1 X49.194 F.1	G0 X54.4
G0 X49.594	Z-32.683

G1 X49.998 F.1
G0 X50.398
G1 X49.596 F.1
G0 X49.996
G1 X49.194 F.1
G0 X49.594
G1 X48.792 F.1
G0 X49.192
G1 X48.39 F.1
G0 X48.79
G1 X47.988 F.1
G0 X48.388
G1 X47.586 F.1
G0 X47.986
G1 X47.184 F.1
G0 X47.584
G1 X46.781 F.1
G0 X47.181
G1 X46.379 F.1
G0 X46.779
G1 X45.977 F.1
G0 X46.377
G1 X45.575 F.1
G0 X45.975
G1 X45.173 F.1
G0 X45.573
G1 X44.771 F.1
G0 X45.171
G1 X44.369 F.1
G0 X44.769
G1 X43.967 F.1
G0 X44.367
G1 X43.565 F.1
G0 X43.965
G1 X43.163 F.1
G0 X43.563
G1 X42.761 F.1
G0 X43.161
G1 X42.359 F.1
G0 X42.759
G1 X41.957 F.1
G0 X42.357
G1 X41.555 F.1
G0 X41.955
G1 X41.153 F.1

G18 G2 X40.4 Z-33.75 I1.323 K-1.066
G1 Z-34.
G0 X54.4
Z-32.05
G1 X49.987 F.1
G0 X50.388
G1 X49.575 F.1
G0 X49.975
G1 X49.163 F.1
G0 X49.563
G1 X48.75 F.1
G0 X49.15
G1 X48.337 F.1
G0 X48.737
G1 X47.925 F.1
G0 X48.325
G1 X47.513 F.1
G0 X47.913
G1 X47.1 F.1
G0 X47.5
G1 X46.688 F.1
G0 X47.087
G1 X46.275 F.1
G0 X46.675
G1 X45.862 F.1
G0 X46.263
G1 X45.45 F.1
G0 X45.85
G1 X45.038 F.1
G0 X45.438
G1 X44.625 F.1
G0 X45.025
G1 X44.212 F.1
G0 X44.612
G1 X43.8 F.1
G2 X41.153 Z-32.684 K-1.7
G0 X54.4 Z-32.683
Z-48.483
G1 X50.004 F.1
G0 X50.404
G1 X49.607 F.1
G0 X50.007
G1 X49.211 F.1
G0 X49.611
G1 X48.814 F.1

G0 X49.214	G1 X49.957 F.1
G1 X48.418 F.1	G0 X50.357
G0 X48.818	G1 X49.515 F.1
G1 X48.021 F.1	G0 X49.915
G0 X48.421	G1 X49.072 F.1
G1 X47.625 F.1	G3 X45.8 Z-32.05 I-1.636 K1.616
G0 X48.025	G1 X43.8
G1 X47.228 F.1	G0 X54.4
G0 X47.628	X55.8
G1 X46.832 F.1	Z-49.8
G0 X47.232	G1 X51.4 F.1
G1 X46.435 F.1	G0 X51.8
G0 X46.835	G1 X51. F.1
G1 X46.039 F.1	G0 X51.4
G0 X46.439	G1 X50.6 F.1
G1 X45.642 F.1	G0 X51.
G0 X46.042	G1 X50.2 F.1
G1 X45.246 F.1	G0 X50.6
G0 X45.646	G1 X49.8 F.1
G1 X44.849 F.1	G0 X50.2
G0 X45.249	G1 X49.4 F.1
G1 X44.453 F.1	G0 X49.8
G0 X44.853	G1 X49. F.1
G1 X44.056 F.1	G0 X49.4
G0 X44.456	G1 X48.6 F.1
G1 X43.66 F.1	G0 X49.
G0 X44.06	G1 X48.2 F.1
G1 X43.263 F.1	G0 X48.6
G0 X43.663	G1 X47.8 F.1
G1 X42.867 F.1	G0 X48.2
G0 X43.267	G1 X47.4 F.1
G1 X42.47 F.1	G0 X47.8
G0 X42.87	G1 X47. F.1
G1 X42.074 F.1	G0 X47.4
G0 X42.474	G1 X46.6 F.1
G1 X41.677 F.1	G0 X47.
G0 X42.077	G1 X46.2 F.1
G1 X41.281 F.1	G0 X46.6
G0 X41.681	G1 X45.8 F.1
G1 X40.884 F.1	G0 X46.2
G0 X41.284	G1 X45.4 F.1
G1 X40.488 F.1	G0 X45.8
X40.751 Z-48.352	G1 X45. F.1
G0 X54.4	G0 X45.4
Z-31.367	G1 X44.6 F.1

G0 X45.
G1 X44.2 F.1
G0 X44.6
G1 X43.8 F.1
G3 X40.488 Z-48.483 K1.7
G0 X54.4
Z-30.05
G1 X50.361 F.1
G3 X49.072 Z-31.366 I-2.28 K.3
G0 X54.4 Z-31.367
G18
G97 S500
Z-29.85
X50.4
G1 X49.995 F.05
G18 G3 X45.8 Z-31.85 I-2.098 K.1
G1 X43.8
G2 X40. Z-33.75 K-1.9
G1 Z-39.925
G0 X53.835
G18
Z-50.
G1 X43.8 F.05
G18 G3 X40. Z-48.1 K1.9
G1 Z-39.925
G0 X53.835
G28 U0. V0. W0. M05
T0200
M01
(TOOL - 3 OFFSET - 3)
(1-1/8 DRILL)
G0 T0303
G18
G97 S1000 M03
G0 G54 X0. Z5.
Z2.
G98 G1 Z-3. F100.
G4 P.04
G0 Z2.
Z-3.
G1 Z-6. F100.
G4 P.04
G0 Z2.
Z-6.
G1 Z-9. F100.

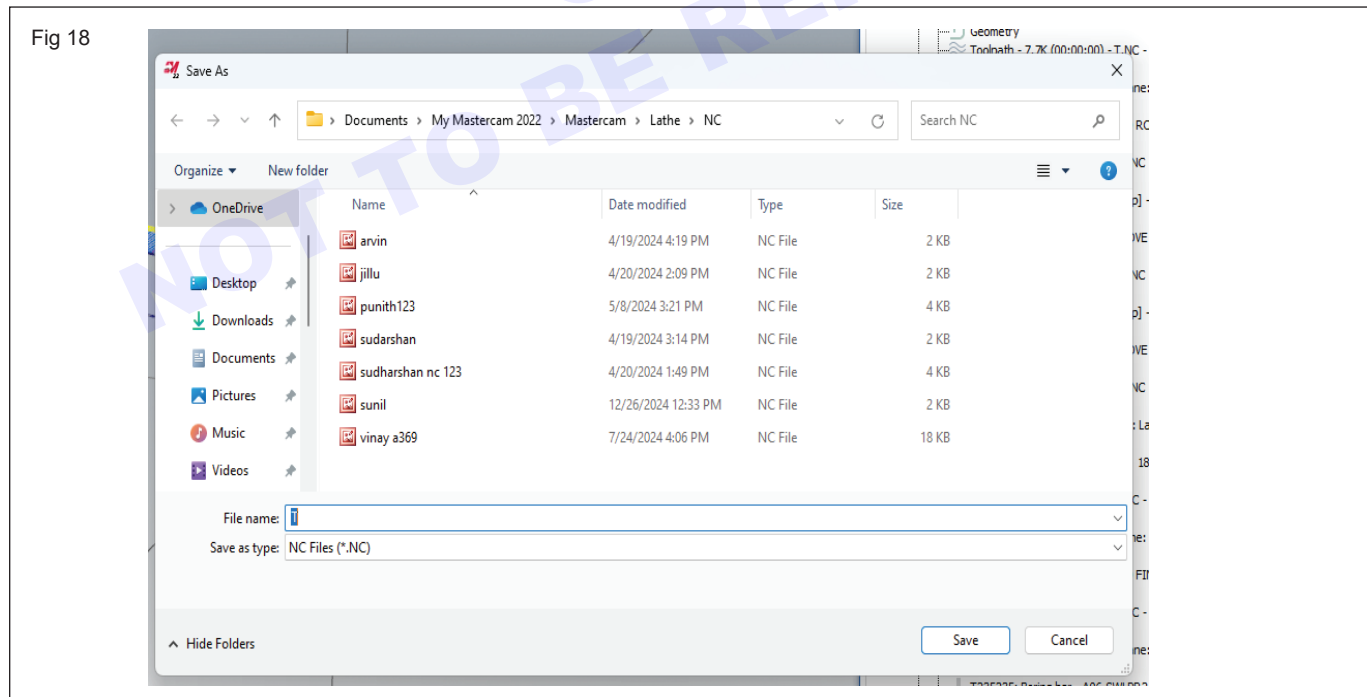
G4 P.04
G0 Z2.
Z-9.
G1 Z-12. F100.
G4 P.04
G0 Z2.
Z-12.
G1 Z-15. F100.
G4 P.04
G0 Z2.
Z-15.
G1 Z-18. F100.
G4 P.04
G0 Z2.
Z-18.
G1 Z-21. F100.
G4 P.04
G0 Z2.
Z-21.
G1 Z-24. F100.
G4 P.04
G0 Z2.
Z-24.
G1 Z-27. F100.
G4 P.04
G0 Z2.
Z-27.
G1 Z-30. F100.
G4 P.04
G0 Z2.
Z-30.
G1 Z-33. F100.
G4 P.04
G0 Z2.
Z-33.
G1 Z-36. F100.
G4 P.04
G0 Z2.
Z-36.
G1 Z-39. F100.
G4 P.04
G0 Z2.
Z-39.
G1 Z-42. F100.
G4 P.04

G0 Z2.	X29.957 Z-2.471
Z-42.	X27.128 Z-1.057
G1 Z-45. F100.	G0 Z4.2
G4 P.04	X31.954
G0 Z5.	G1 Z2.2 F.076
G28 U0. V0. W0. M05	Z-1.473
T0300	X30.955 Z-1.972
M01	X28.127 Z-.558
(TOOL - 6 OFFSET - 6)	G0 Z4.2
(LSSR-164D - LT-16ER-20UN INSERT - LT-16ER-20UN)	X32.953
G0 T0606	G1 Z2.2 F.076
G18	Z-.973
G97 S62 M03	X31.954 Z-1.473
G0 G54 X54. Z1.793	X29.126 Z-.058
G76 P010029 Q0 R0	G0 Z4.2
G76 X48.376 Z-28. P8120 Q3145 R0. F1.5	X33.951
G28 U0. V0. W0. M05	G1 Z2.2 F.076
T0600	Z-.474
M01	X32.953 Z-.973
(TOOL - 5 OFFSET - 5)	X30.124 Z.441
(A10-SVQBR2 - VBMT-221 INSERT - VBMT-221)	G0 Z4.2
G0 T0505	X34.95
G18	G1 Z2.2 F.076
G97 S671 M03	Z.025
G0 G54 X28.958 Z4.164	X33.951 Z-.474
G50 S3000	X31.123 Z.94
G96 S61	G0 Z1.25
G99 G1 Z2.164 F.076	G28 U0. V0. W0. M05
Z-44.8	T0500
X26.13 Z-43.386	M01
G0 Z4.2	(TOOL - 9 OFFSET - 9)
X29.957	(S0612-LSER3 - LT-11NR-24UN INSERT - LT-11NR-24UN)
G1 Z2.2 F.076	G0 T0909
Z-2.471	G18
X29.95 Z-2.475	G97 S125 M03
G18 G2 X29.6 Z-2.897 I.422 K-.422	G0 G54 X24.376 Z2.037
G1 Z-18.397	Z.776
Z-28.397	G76 P010029 Q0 R0
Z-44.8	G76 X30. Z-18. P8120 Q2826 R0. F1.5
X28.958	Z2.037
X26.13 Z-43.386	G28 U0. V0. W0. M05
G0 Z4.2	T0900
X30.955	M01
G1 Z2.2 F.076	(TOOL - 10 OFFSET - 10)
Z-1.972	(A28-NER4 - NG-4125L INSERT - NG-4125L)

G0 T1010
 G18
 G97 S200 M03
 G0 G54 X25.6 Z1.25
 Z-24.677
 G1 X30. F.05
 G0 X29.6
 G1 X30.4 F.05
 G0 X30.
 G1 X30.8 F.05
 G0 X30.4
 G1 X31.2 F.05
 G0 X30.8
 G1 X31.6 F.05
 G0 X25.6
 Z-27.8
 G1 X30. F.1
 G0 X29.6
 G1 X30.4 F.1
 G0 X30.
 G1 X30.8 F.1
 G0 X30.4
 G1 X31.2 F.1

G0 X30.8
 G1 X31.6 F.1
 X30.975 Z-27.488
 G0 X25.6
 G97 S500
 Z-29.414
 X26.772
 G1 X29.6 Z-28. F.05
 X32.
 Z-26.238
 X31.352 Z-26.562
 G0 X27.172
 Z-23.063
 G1 X30. Z-24.477 F.05
 X32.
 Z-25.127
 Z-26.238
 G0 X26.772
 Z1.25
 G28 U0. V0. W0. M05
 T1000
 M30
 %

- Save the NC file in the desired location in PC (Fig 18)



- Save the mastercam file in the desired location.
- Export the program to CNC lathe
- Execute the program on CNC lathe

Note : To perform this exercise refer previous exercises on CAM

File/folder transfer between workstation and CNC

- Objectives:** At the end of this exercise you shall be able to
- check cycle time for same operation with different tool paths
 - develop a setup sheet for all the operations
 - select the efficient tool path with the help of cycle time.

PROCEDURE

TASK 1: Configuration of RS232 communication settings

RS232 communication settings

Proceed as follows to configure the communication settings for the RS232 interface



- Connect the control system with the PC/PG using an RS232 cable.



- Select the desired operating area on the PPU



- Press this softkey to go to the RS232 directory

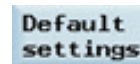


- Press this softkey to open the window for RS232 communication settings

- Use this key to set the values in the following window as required (Fig 1).



- Press this softkey to save your settings. If desired, you can press the following softkey to reset the setting to defaults



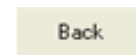
- Return to the RS232 main screen
- Open the SinuComPCIN on your PC/PG



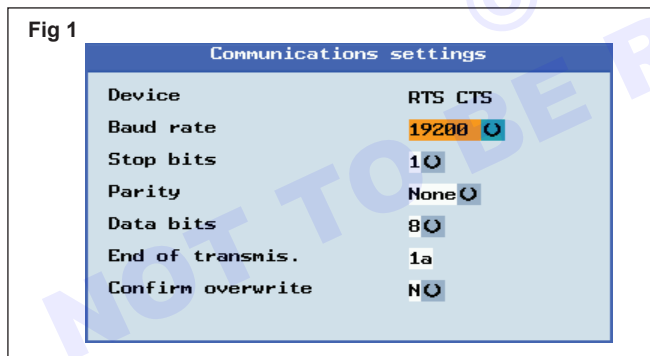
- Press this button on the main screen and then select the desired baudrate from the list. Note that this baudrate must be the same as that you have selected on the NC side.



- Save the settings with this button



- Return to the main screen of SinuComPCIN



TASK 2 : Executing from external (through RS232 interface)

Prerequisites

- The tool SinuComPCIN has been installed on your PC/PG
- The RS232 communication has been successfully established between the control system and the PC/PG.

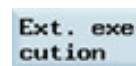
Proceed as follows to execute a part program from external through the RS232 interface



- Select the desired operating area on the PPU



- Press this softkey to go to the RS232 directory.

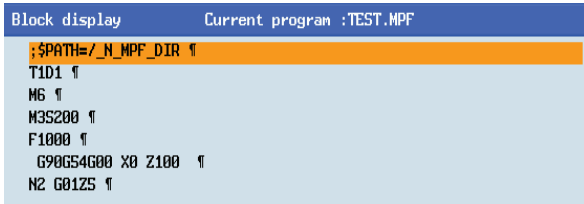


- Press this vertical softkey, and the system automatically changes to "AUTO" mode in the machining operating area.



- Press this button on the main screen of SinuComPCIN and select the desired program for execution, for example, Test.mpf. The program is transferred to the buffer memory on the control system and then displayed in the following window. (Fig 1)

Fig 1



- If desired, you can use this softkey to specify how you want the program to be executed (for more information of the program control, refer to section “Program control”)



- Press this key to execute the program. The program is reloaded continuously.

Either at the end of the program or after pressing the following key, the program is automatically removed from the control system.



Note: When using the external execution via RS232, the RS232 interface must not be active for another application. This means, for example, the Rs232 interface must not be active through the following operation



> “PLC” > STEP 7 connect



TASK 3 : Transferring from external (through RS232 interface)

Prerequisites

- The tool SinuComPCIN has been installed on your PC/PG
- The RS232 communication has been successfully established between the control system and the PC/PG (Fig 1).

Note: The program files can be transferred only to the system drive N:\MPF or N:\CMA; therefore, before transfer make sure the drive identifier contained in the first line in the program file is “N” and the target directory in the second line is “N_MPF” or “N-CMC”. If not, you must change manually, for example



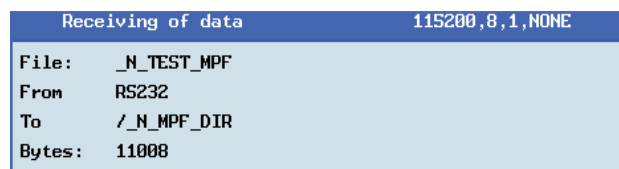
- Press this vertical softkey in the RS232 window



- Press this button on the main screen of SinuComPCIN and select the desired program for execution, for example, Test.mpf. The data transferring starts (Fig 2).

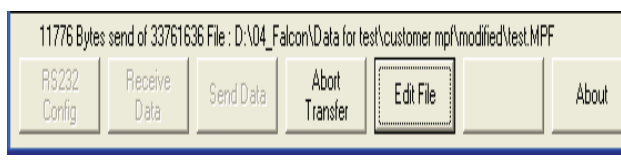
On the NC side

Fig 2



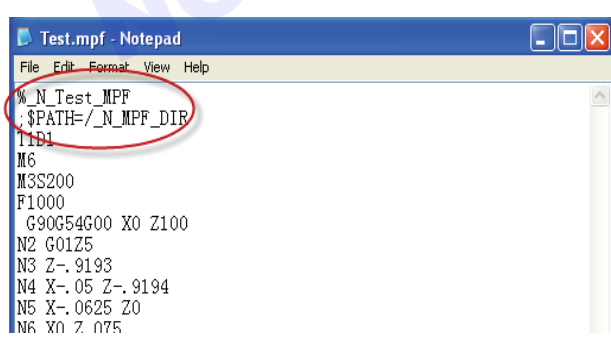
On the SinuComPCIN side (Fig 3)

Fig 3



- Wait until SinuCom PCIN has finished data transfer, and click this button.

Fig 1



Proceed as follows to transfer a part program from external through the RS232 interface



- Select the desired operating area on the PPU



- Press this softkey to go to the RS232 directory

Creation of directory folders as per operator, job, customer etc.,

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

- create customer based directory folders
- create operator based directory folders.

PROCEDURE

Customer-based directory folders

Step 1: Switch on the CNC machine

Step 2: Perform reference point

Step 3: Select Edit Mode (Fig 1)



Step 4: Press program softkey (Fig 2)

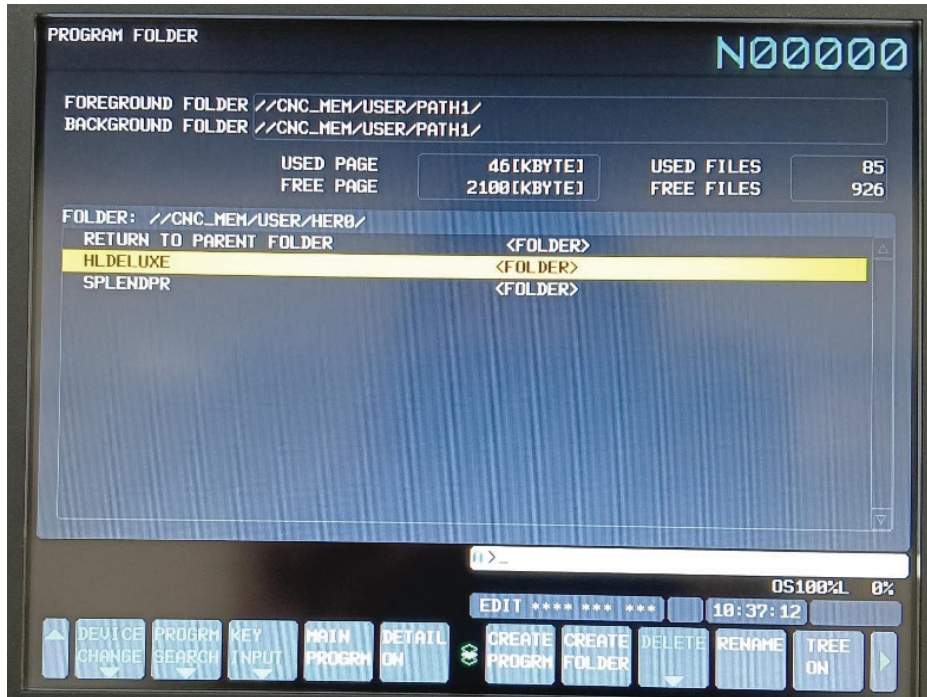


Step 3: Type a customer name "HERO" & press softkey "CREATE FOLDER" in program directory. (Fig 3)



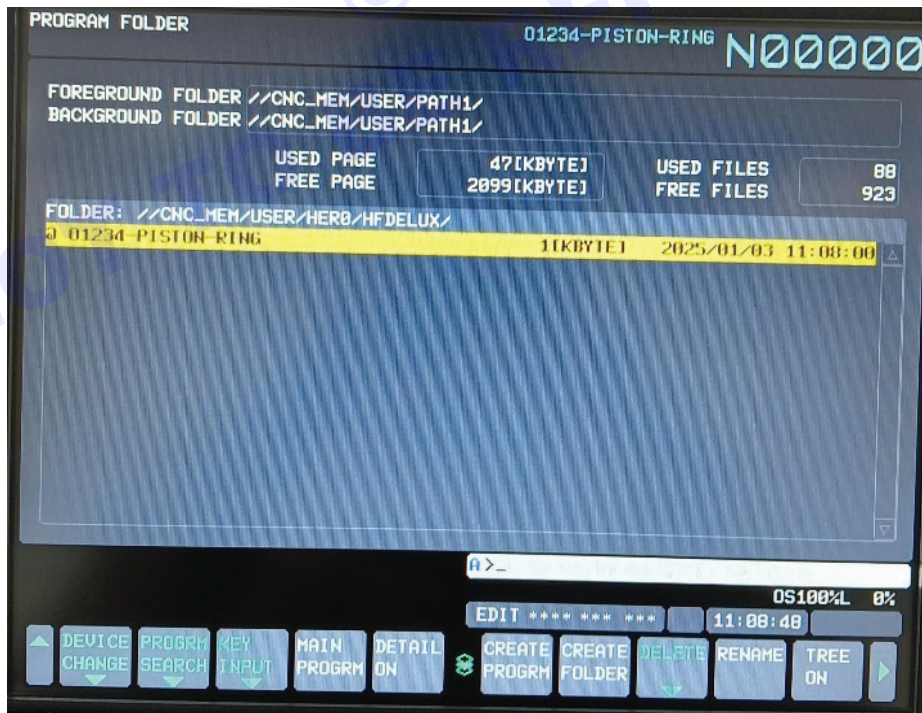
Step 4: Create sub folder “HL DELUX” in CNC_MEM / USER / HERO (Fig 4)

Fig 4



Step 5: Insert a program name “O1234-Piston-RING” in CNC_MEM / USER / HERO (Fig 5)

Fig 5



Operator - Based directory folders

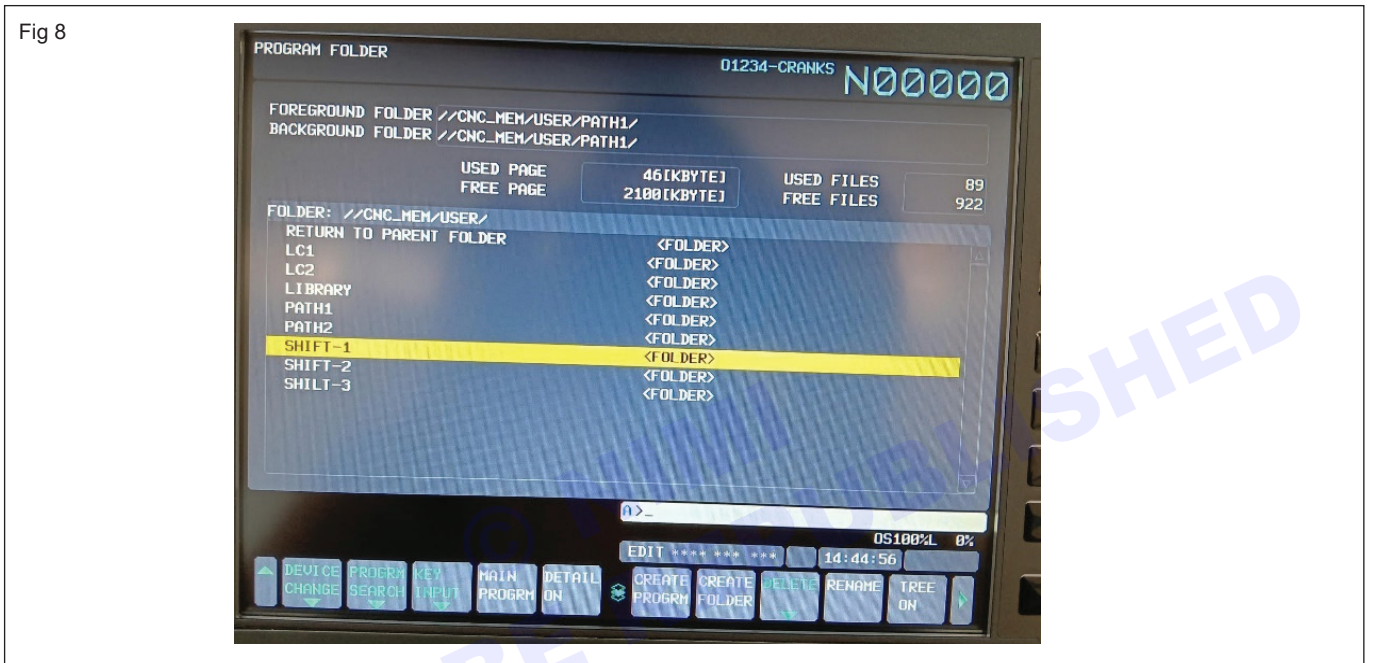
Step 1: Select edit mode (Fig 6)



Step 2: Press program softkey (Fig 7)



Step 3: Type a shift number "shift - 1" & press softkey "CREATE FOLDER" in program directory. (Fig 8)

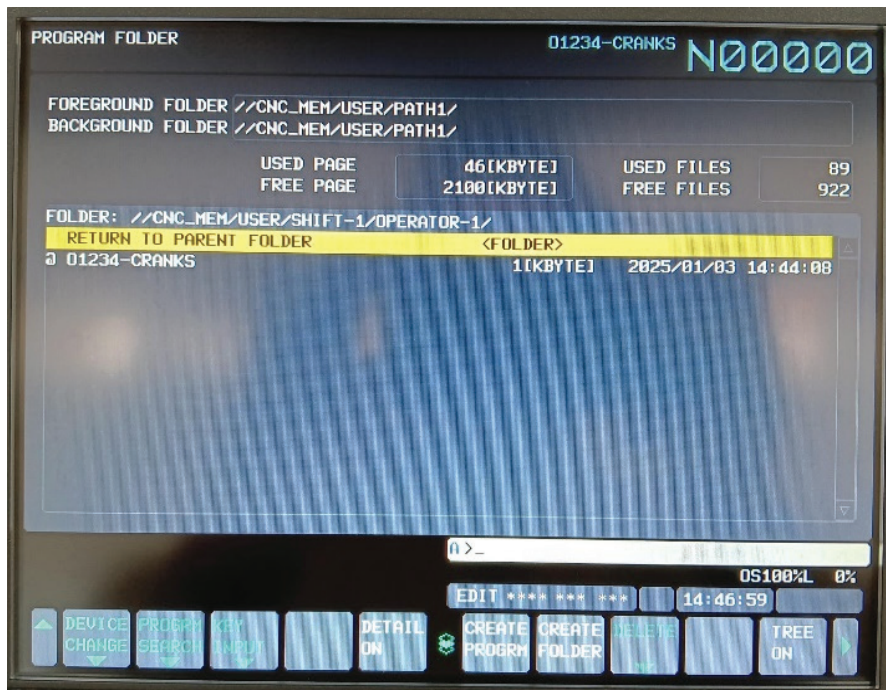


Step 4: Create sub folder with operator name "OPERATOER - 1" in CNC_MEM / USER / SHIFT - 1/ (Fig 9)



Step 5: Insert a program name “O1234-Piston-CRANKS” in CNC_MEM / USER / SHIFT -1 / OPERATOR - 1 (Fig 10)

Fig 10



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Import and export of external CNC machining program

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

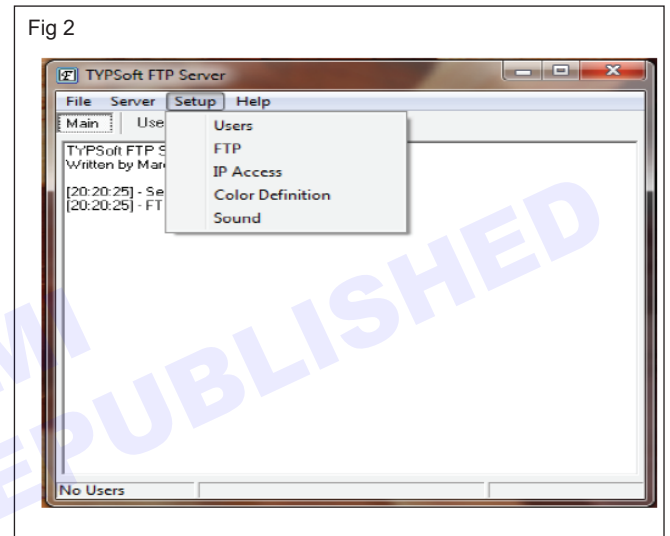
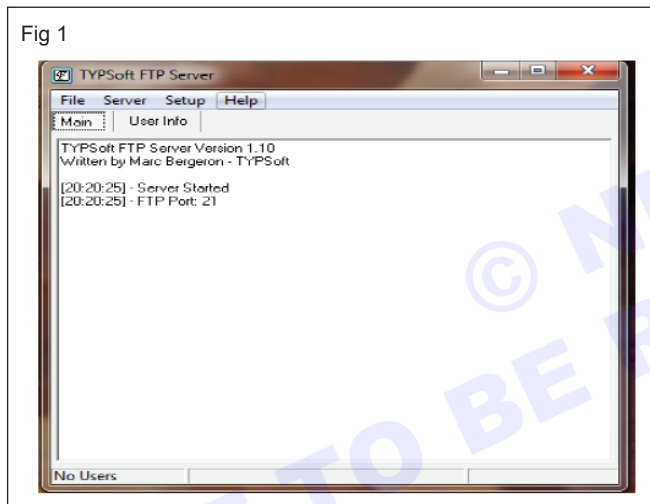
- export and import the program from PC to CNC memory via LAN
- import the program from USB devices to CNC
- export the program from CNC to USB devices.

PROCEDURE

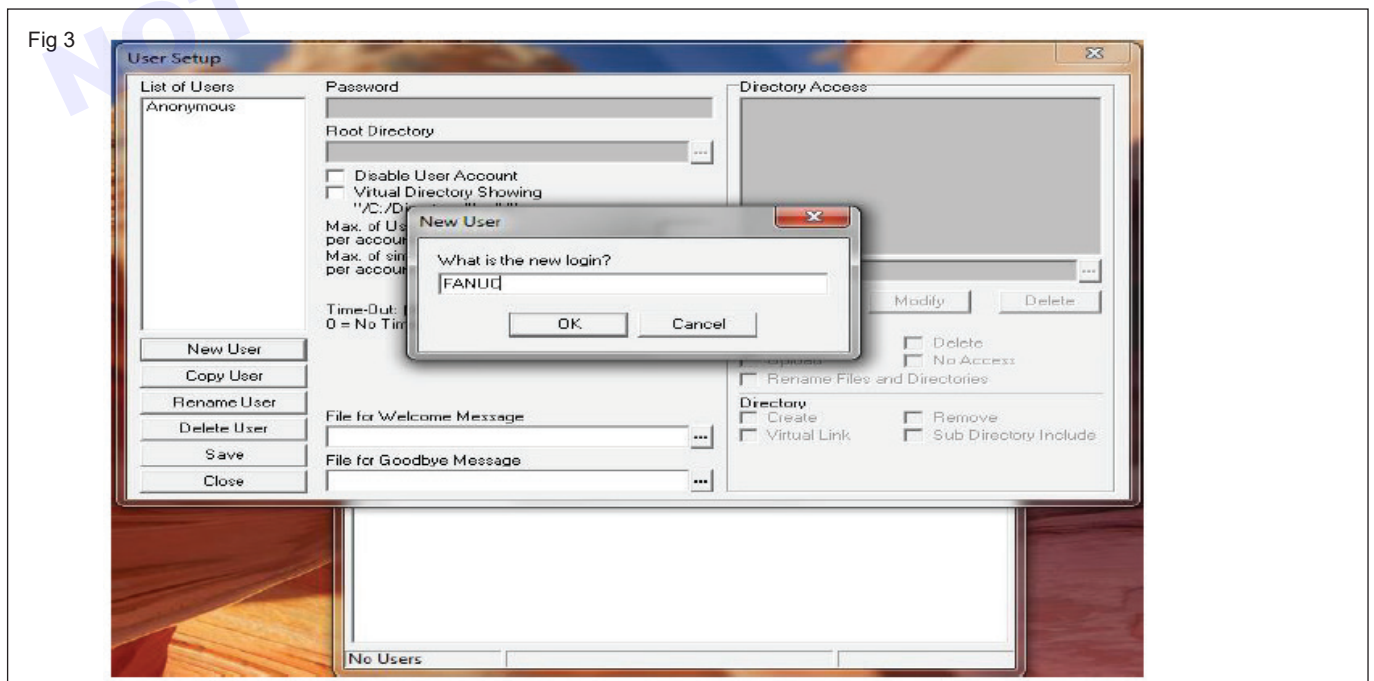
Exporting and Importing the program from PC to CNC memory via LAN

TASK 1: Settings required in PC

- 1 Prepare Ethernet cross cable and connect cable between PC to Embedded Ethernet Port. Install FTP server software in PC.
- 2 Set PC IP address(example:192.168.0.25) and subnet mask as 255.255.255.0
- 3 Open the "TYPSoft FTP server" software. (Fig 1)
- 4 Select 'Setup' and select 'Users' (Fig 2)

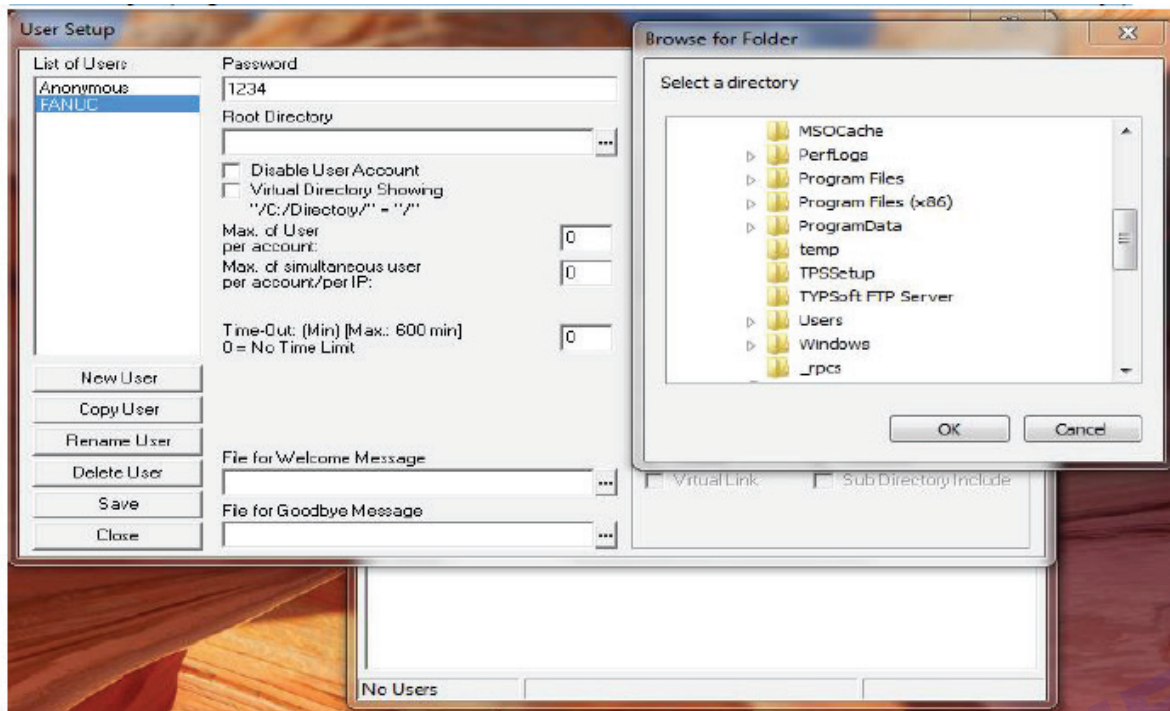


- 5 Select "New User" and enter the new login name press "OK". (Fig 3)



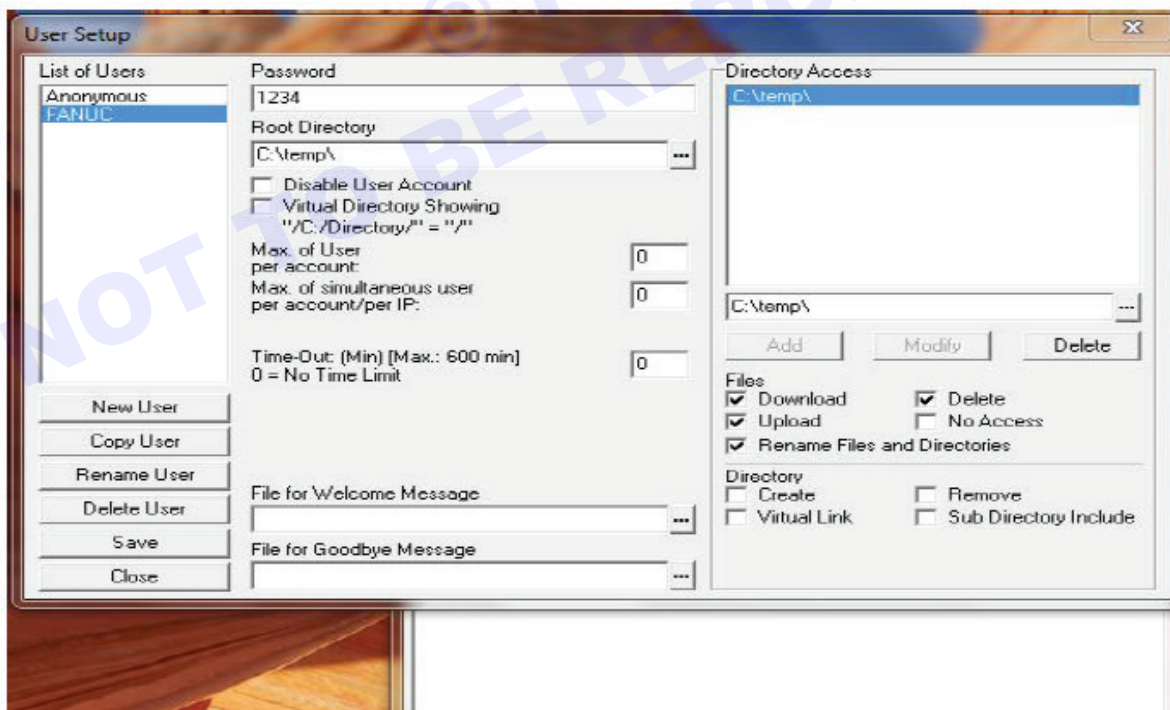
- 6 Select the newly created user, then enter the password and select the Root directory. (E.g. here we selected TEMP folder in C: drive as root directory.) (Fig 4)

Fig 4



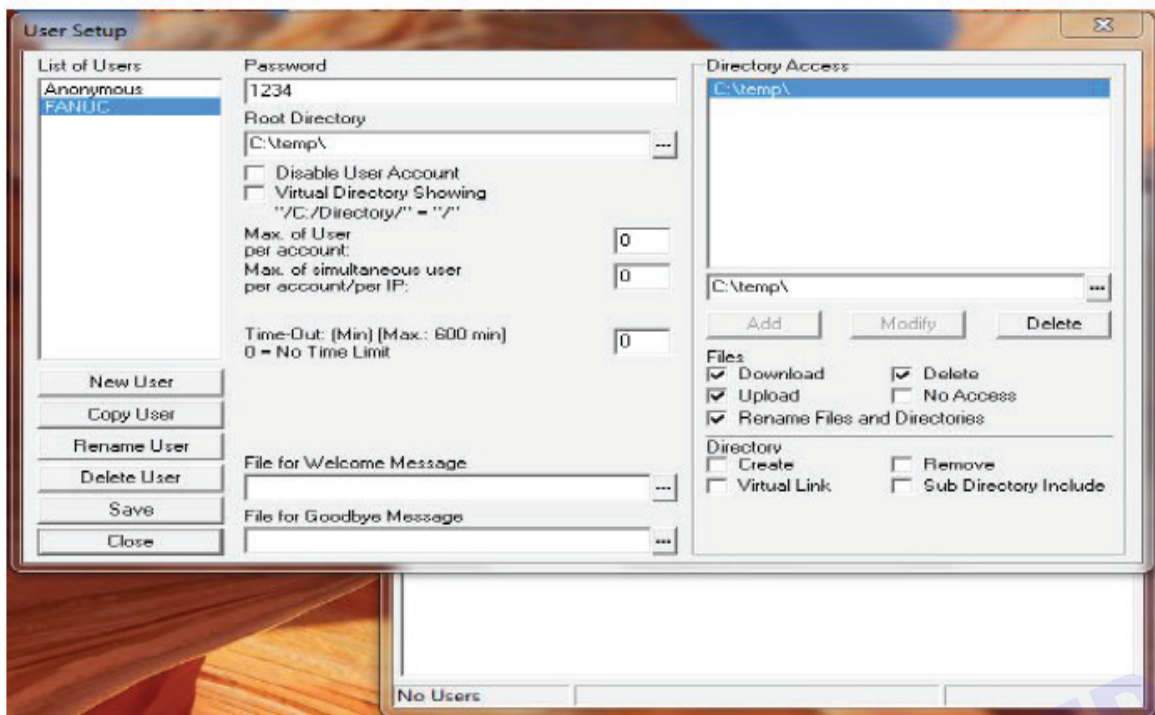
- 7 Select "C:\temp\" from Directory access user and select the file operation Download, upload, delete and Rename Files and Directories. (Fig 5)

Fig 5



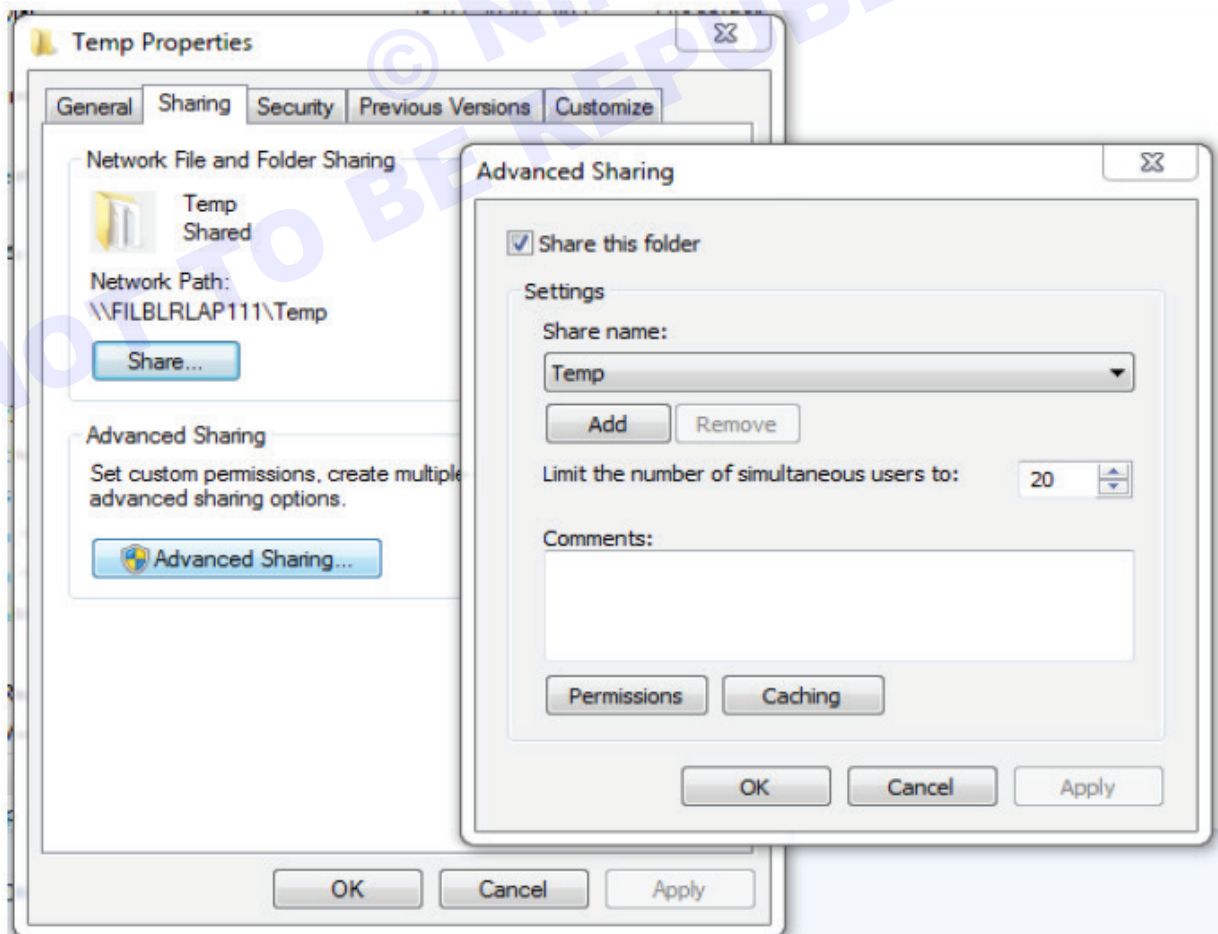
8 Click on "Save", then Close 'FTP'. (Fig 6)

Fig 6



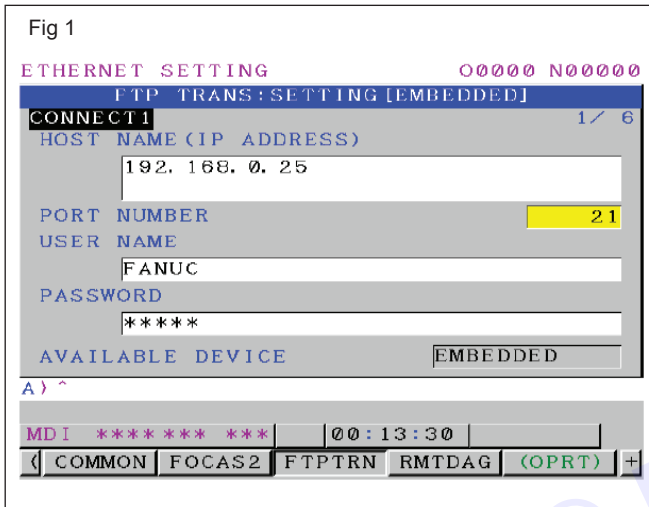
9 Folder sharing should be enabled for selected folder (Here TEMP folder). (Fig 7)

Fig 7

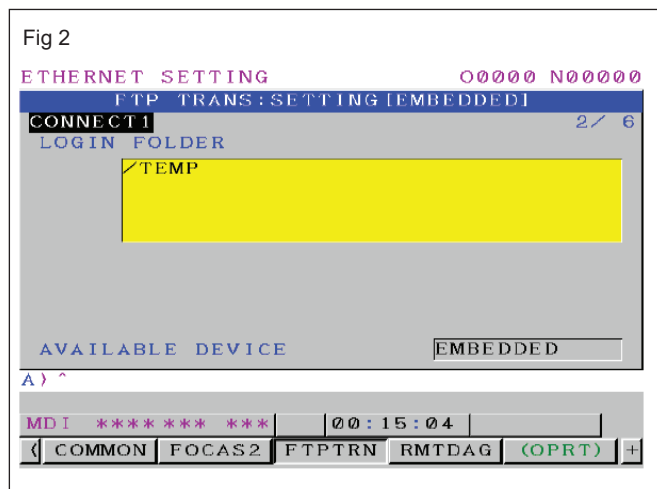


TASK 2: Settings required in CNC

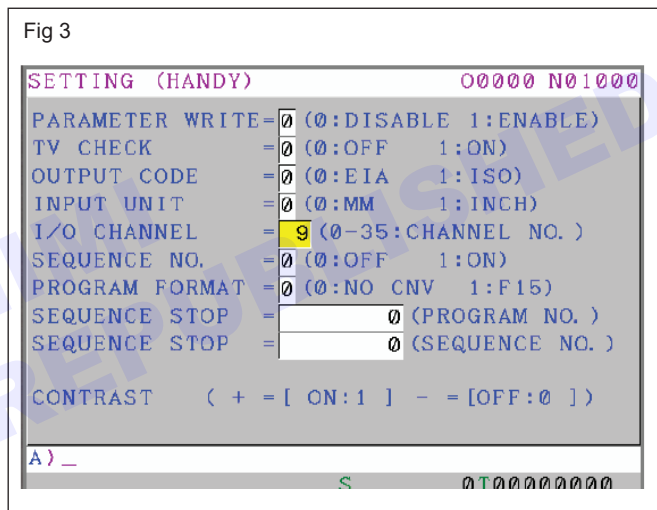
- 1 Press SYSTEM function key then set parameter 14885#1(EDE)=1 in PARAMETER menu.
- 2 Press SYSTEM function key then press right arrow. Select EMBED then select COMMON. Enter IP Address for CNC (Ex: 192.168.0.1) and Subnet mask (255.255.255.0).
- 3 Select FOCAS2 in EMBED menu. Set Port number TCP as 8193, Time out as 10. Ensure AVAILABLE DEVICE is selected as EMBEDDED.
- 4 Select "FTPTRANS" in EMBED. Set PC IP address in HOST NAME. (Fig 1&2)



- 5 Set PORT NUMBER as 21. Set same UESR NAME and PASSWORD set in FTP Server software.
- 6 Press Page down and enter /TEMP in login folder.

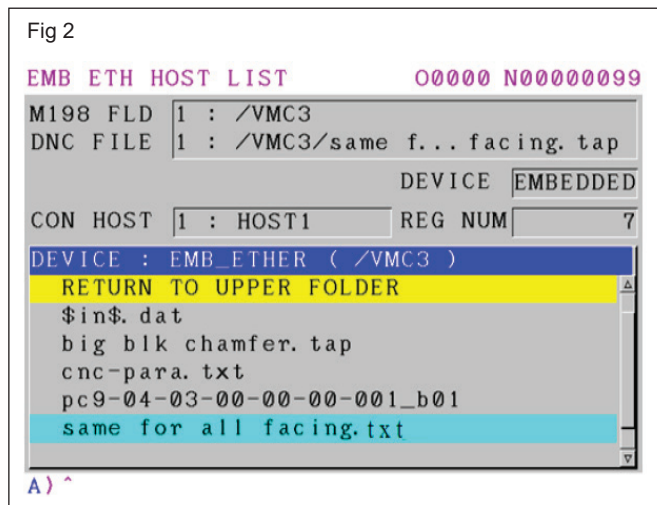
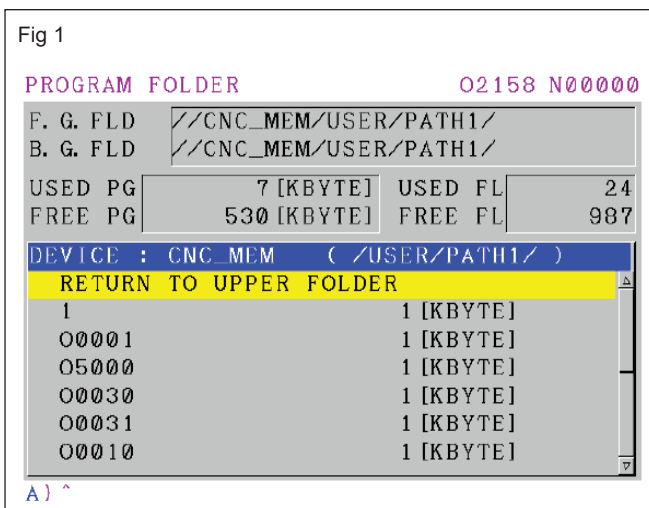


- 7 Press "OFS/SET" function key and select Setting. Set 9 in I/O channel for DNC operation in Embedded Ethernet. (Fig 3)

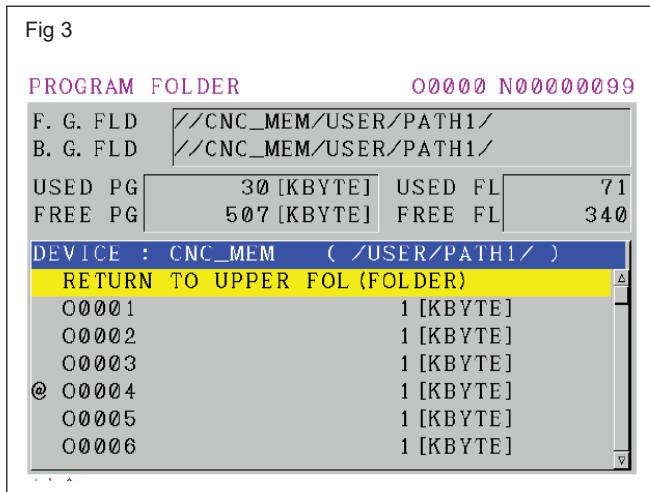


TASK 3: Execute the program in DNC ode of CNC Via PC & Ethernet

- 1 Press "PROG" function key and select "FOLDER". (Fig 1)
- 2 Select "OPRT" & select "DEVICECHANGE". (Fig 2)



- 3 Select "EMBED ETHER" for Embedded Ethernet Port. (Fig 3)

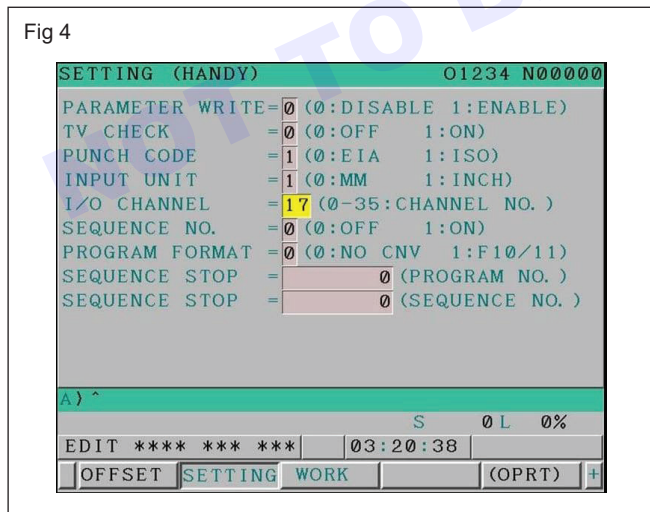


- 11 Set REMOTE mode and Select Target Program by moving cursor then press "DNCSET".
- 12 Press CYCLE START to execute the program.

NOTE: The Above procedure is for FANUC series. These Procedure changes for different Controls of CNC Machines. For making these Ethernet Settings can Refer Machine Manual also can contact Machine Control Builder for the support.

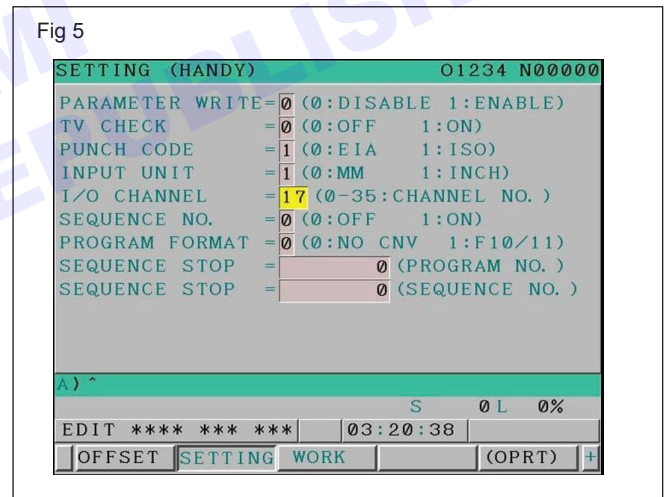
Import the Program from USB devices to CNC

- Select MDI Mode. (Fig 4)
- Press the OFFSET/SETTING button.
- Change the I/O Channel to 17 and you should be ready to go.



- Go to "edit" mode
- Press "Folder"
- Look near the bottom and you'll see "Device Change" Press it

- Then select "USB" from the choices.
- You will now notice that the directory has changed from the CNC internal memory to the USB drive.
- Highlight the file you want to read into the memory for Example O1234.NC
- Setting a file number. Enter the number of the desired file example: 1234 and then press softkey
- Press "FSet"
- Setting a program number in CNC Memory. Enter the number of the desired program example: 5550. Then Press softkey "OSet"
- Press "EXEC"
- The file will now be read into the CNC memory.
- MAKE SURE you press "DEVICE CHANGE" again and select "CNC" from the choices to go back to the machine's internal memory.
- Export the Program from CNC to USB Devices.
- Select MDI Mode.
- Press the OFFSET/SETTING button.
- Change the I/O Channel to 17 and you should be ready to go. (Fig 5)



- Go to "edit" mode
- Press "Folder"
- Highlight the file you want to read into the memory for Example O1234.NC
- Setting a file number. Enter the number of the desired file example: 1234 and then press softkey
- Press "OSet"
- Setting a program number in USB. Enter the number of the desired program example: 5550. Then Press softkey "FSET"
- Press "EXEC"
- The file will now be read into the USB.

Perform routine maintenance as per the OEM recommendations

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

- **prepare the routine maintenance format**
- **perform the routine maintenance**
- **record the routine maintenance in the respective formats.**

PROCEDURE

- Refer OEM (Original Equipment Manufacturer) manual or catalogue.
- Prepare a Preventive Maintenance Record in a defined format.
- Record the maintenance activities in the respective format daily, weekly, quarterly, half-yearly & yearly.
- Enter the machinery and equipment details.

- Maintain the maintenance log format.
- Get it checked by your trainer.

Note: Trainer shall arrange for a industrial visit and guide the trainees

- Ask trainees to fill the formats as per OEM recommendation.

Machinery and Equipment record - Format

Organization Name :	
Department :	
Section :	
History sheet 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	

Routine maintenance - Format

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
1 Daily mechanical			
Chuck greasing			
Lub.pump oil level			
Hyd.pressure			
Lub unit pressure			
Front door rail clean			
Chuck pressure switch			
Coolant tank / Filter			
Electrical/A/C functioning			
Exhaust Fan			
Inspected by			
Signature			
Name :			
Date :			
			Signature of in-charge

Maintenance log - Format

Organization Name :
Department :
Section :
Name of the Machine :

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

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Guidelines for performing routine maintenance

Weekly check details

- 1 Lubricator oil level in FRL unit (option)
- 2 Cleaning of air filter in AC unit
- 3 Air filter and fan of electrical cabinet cleaning
- 4 Coolant tank / Filter cleaning
- 5 Functioning of spindle motor blower fan.
- 6 Cleaning of spindle belt.

Quarterly check details

- 1 Temperature inside the control panel - less than 35°C
- 2 Lubrication pump suction / inlet filter cleaning
- 3 Hydraulic oil temperature - less than 60°C.
- 4 Checking of runout / noise in spindle, tailstock
- 5 Spindle front cover cleaning.
- 6 Chuck (Jaw stroke)
- 7 Chuck / cylinder (Run out)
- 8 Hydraulic power pack / Transmission box oil level
- 9 Cleaning of panel inside
- 10 Cleaning of machine lamp

Half yearly check details

- 1 Check for any cable breakage / damaged shielding
- 2 Positioning coder connector / coupling tightness.
- 3 Relay terminal screw tightness
- 4 Coolant motor, chip conveyor tightness
- 5 Servo motor, chip conveyor connector tightness
- 6 Check if any abnormal noise / vibration / heat generation in powerpack & ballscrew
- 7 Hydraulic power pack / Transmission box oil replacement.
- 8 Axes, spindle drive belts tension.
- 9 Hydraulic power pack suction, inlet filter cleaning.
- 10 Electrical control panel cleaning.
- 11 Proper functioning of gear change
- 12 Turret (center, height, pocket reading).
- 13 Slide seals adjustment
- 14 Disassemble and cleaning of the chuck
- 15 Cracks in hydraulic hoses.
- 16 Hollow cylinder coolant drain port cleaning.
- 17 Lubrication distributor oil flow checking.

Yearly check details

- 1 Check battery (system) voltage
 - 2 Cleaning of PCB's
 - 3 Cleaning of all proximity / Limit switches
 - 4 Cable routing check
 - 5 Fan filters replacement
 - 6 Electrical loose connections
 - 7 Back lash check
 - 8 Chuck cylinder disassemble and clean.
 - 9 Check for smooth movement of axes.
 - 10 Solenoid valve / power pack over heading
 - 11 Machine level.
- — — — —

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