FITTER

TRADE PRACTICAL

NSQF LEVEL - 4.5

VOLUME - 1

HANDBOOK FOR CRAFTS INSTRUCTOR TRAINING SCHEME

Directorate General of Training

DIRECTORATE GENERAL OF TRAINING
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
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A Comprehensive Training Program
under Crafts Instructor Training Scheme (CITS)
for Instructors

HANDBOOK ON TECHNICAL INSTRUCTOR TRAINING MODULES

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सत्यमेव जयते

भारत सरकार
कौशल विकास एवं उद्यमिता मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
AND ENTREPRENEURSHIP

Foreword

In today's rapidly evolving world, the role of skilled craftsmen and women is more crucial than ever. The Craft Instructor Training Scheme (CITS) stands at the forefront of this transformation, shaping the educators who will train the next generation of artisans and technicians. This book aims to provide an in-depth understanding of the subject, exploring its significance, methodologies, and impact on vocational training.

The Craft Instructor Training Scheme was established with the objective of enhancing the quality of instruction in industrial training institutes and other vocational training institutions. By equipping instructors with advanced skills and knowledge, the scheme ensures that they are well-prepared to impart high-quality training to their students. This, in turn, contributes to the creation of a highly skilled workforce capable of meeting the demands of modern industry.

The initial chapters provide the importance of specialized instructor training. Following this, detailed chapters delve into the curriculum covering advanced techniques, safety protocols, and instructional strategies. Each section is designed to offer both theoretical insights and practical applications, ensuring a well-rounded understanding of the subject.

The book offers recommendations for overcoming obstacles and enhancing the effectiveness of the program, with the ultimate goal of producing highly skilled instructors capable of shaping the future workforce.

This book is intended for a diverse audience, including current and aspiring instructors, vocational training administrators, policymakers, and industry stakeholders. It serves as a valuable resource for understanding the intricacies of the subject and its pivotal role in vocational education.

I extend my heartfelt gratitude to all contributors who have shared their experiences and expertise, enriching this book with their valuable insights. Special thanks to the contribution of the development team, reviewers and NIMI that have supported this endeavor, providing essential data and resources.

It is my sincere hope that this book will inspire and guide readers in their efforts to enhance vocational training, ultimately contributing to the development of a skilled and competent workforce.

ATUL KUMAR TIWARI, I.A.S.
Secretary, MSDE

त्रिशलजीत सेठी
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कौशल विकास एवं उद्यमशीलता मंत्रालय
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GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

FOREWORD

The Craftsmen Training Scheme (CTS) implemented by the Directorate General of Training (DGT) provides skill training to the youth and ensures a steady flow of skilled manpower for the industry. It aims to raise quantitatively and qualitatively the industrial production by systematic training, and to reduce unemployment among the youth by providing them with employable skills.

The Craft Instructor Training Scheme (CITS) is an indispensable part of the Craftsmen Training Scheme (CTS). It offers comprehensive training both in 'skills' and in 'training methodology' to the instructor trainees to make them conversant with techniques of transferring hands-on skills.

I congratulate NIMI for taking the initiative of preparation of the course content for CITS. This will help institutionalize the mechanism for imparting training to the trainers all across the ecosystem. I also extend my gratitude to the Instructors and Officials of National Skill Training Institutes (NSTIs) and the DGT for their invaluable contribution in preparation of the CITS course content.

As we navigate the complexities of a rapidly changing world and the technological disruptions, the significance of CTS and CITS has increased manifold. It not only empowers individuals with practical skills but also lays the foundation for a prosperous future. I am confident that this book will serve as a guiding light to all instructor trainees for skill development and nation-building.

Trishaljit

(Trishaljit Sethi)

PREFACE

The Craft Instructor Training Scheme is an indispensable module of the Craftsmen Training Scheme, which has been an integral part of the Indian skill development industry since its inception. This program aims to equip instructors with the necessary skills and teaching methodology to effectively transfer hands-on skills to trainees and promote a holistic learning experience. The first Craft Instructor Training Institute was established in 1948, followed by six more institutes across India in 1960. Today, these institutes, including the National Skill Training Institute (formerly Central Training Institute for Instructors), offer the CITS course, which is mandated by the Directorate General of Training (DGT).

The Craft Instructor training program is designed to develop skilled manpower for industries. The course aims to offer instructors an opportunity to improve their instructional skills, engage learners effectively, offer impactful mentoring, and make efficient use of resources, leading to a more skilled workforce in various industries. The program emphasizes collaborative and innovative approaches to teaching, resulting in high-quality course delivery. Overall, the Craft Instructor Training Scheme is a pivotal program that helps instructors grow in their careers and make a significant contribution to society. This program is essential for developing skilled manpower and promoting a robust learning environment that benefits both trainees and instructors alike.

ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following experts to bring out this Instructional material **(Trade Practical)** for **CITS Fitter (NSQF Level - 4.5) (Volume - I of II)** under the **CG&M** Sector for **Instructors**.

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

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

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

ABOUT THE TEXT BOOK

The Vocational Instructor Training Program is a comprehensive initiative designed to equip aspiring students with the necessary skills and knowledge to effectively teach in vocational education settings. This program encompasses a range of pedagogical strategies, instructional techniques, and subject-specific content tailored to the diverse vocational fields. Participants engage in coursework that covers curriculum development, assessment methods, classroom management, and the integration of industry-relevant technologies. Practical experience and hands-on training are emphasized, allowing participants to apply theoretical concepts in real-world teaching environments. Through collaborative learning experiences and mentorship opportunities, aspiring vocational instructors develop the confidence and competence to facilitate engaging and impactful learning experiences for their students. This training program aims to cultivate a new generation of educators who are not only proficient in their respective vocational fields but also adept at fostering the success and employability of their students in today's competitive workforce.

This text book covers communication, self-management, information and communication technology, entrepreneurial and green skills. It has been developed as per the learning outcome-based curriculum.

G C Rama Murthy,
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CONTENT

EXERCISE 1: Introduction of Occupational Safety and health

Objectives

At the end of this exercise you shall be able to

- identify the occupational safety devices.
- interpret the different types of safety devices.

Procedure

Job Sequence

Note: Trainer shall display all the pictures & wall chart of safety devices in the section and brief their names, uses and the safety point to be observed for each safety devices.

- Trainees will note down names of all the occupational safety devices and their uses.
- Record it in Table 1.

Table 1

S. No.	Name of housekeeping	Importance	Precaution to be observed (Do and Don't)
1			
2			
3			
4			
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16			
17			
18			

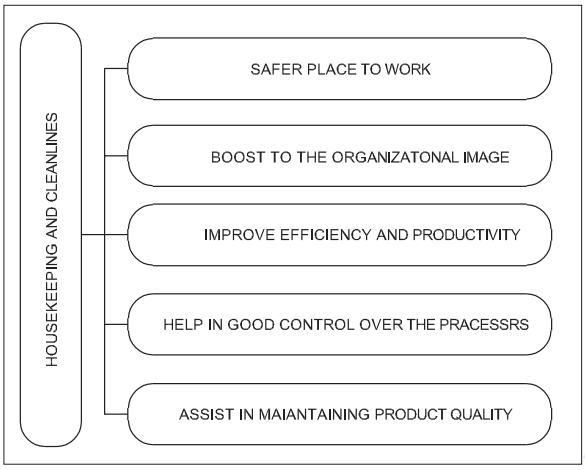
EXERCISE 2: Importance of house keeping & good shop floor practices

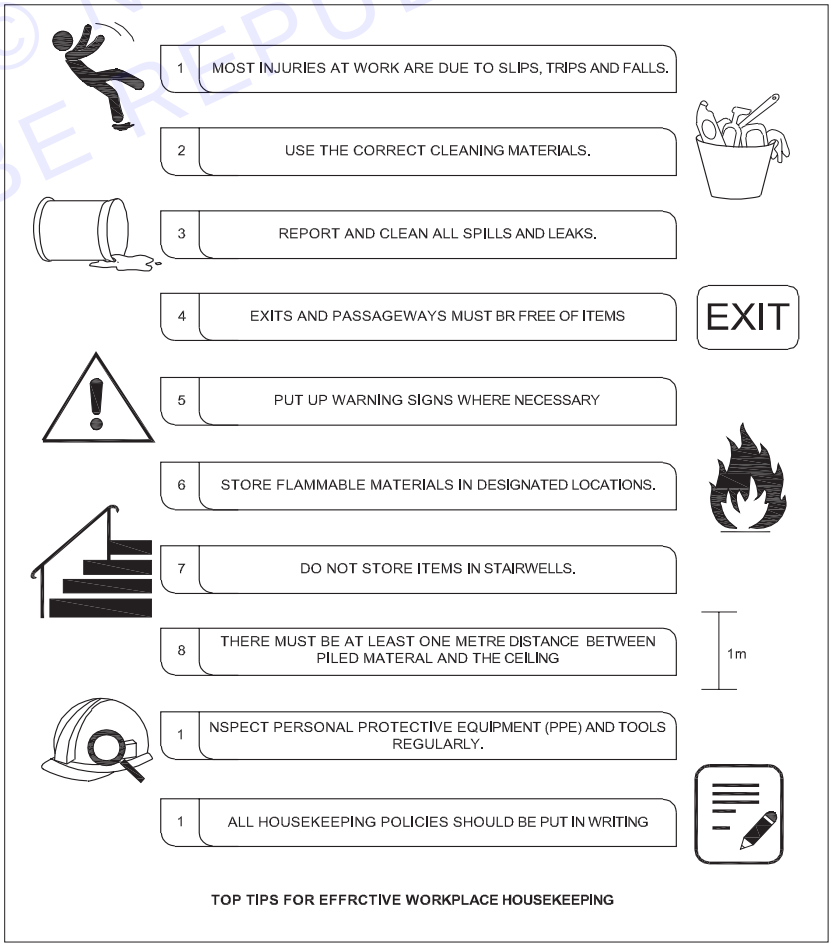
Objectives

At the end of this exercise you shall be able to

- identify the effective House Keeping tips
- identify Good Shop floor practice followed in Industry.

Procedure





Job Sequence

Note : Trainer shall display all the pictures & chart related to housekeeping and good shop floor practice in the section and brief their uses.

- Trainees will note down all the tips and importance of House keeping
- Record it in Table 1.

Table 1

S. No.	Name of housekeeping	Importance	Precaution to be observed (Do and Don't)
1			
2			
3			
4			
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18			

Get it checked by trainer.

EXERCISE 3: Introduction of healthy , safety and environment guidelines legislation & regulation as applicable

Objectives

At the end of this exercise you shall be able to

- Identify the healthy, safety and its importance at work place to prevent unsafe act and conditions in work related activities
- Identify the environment guidelines, legislation & regulation in India.

Procedure

Safety, Health and Environment guidelines as per Rules & requlations followed in india are listed as follows:

1 The Enivironment (Protection) Act, 1986.
2 The Environment (Protection) Rules, 1986.
3 Enivironmental Impact Assessment of Development Projects 1994.
4 The Prevention and control of pollution (uniform consent procedure) Rules,1999.
5 Manufacture, Storage and Import of Hazardous chemicals Rules, 1989.
6 Manufacture, Storage and Import of Hazardous chemical (Amendment) Rules, 2000.
7 Hazardous Wastes (Management and Handling) Rules, 1989.
8 Bio-Medical Waste (Management and Handling) Rules, 1998.
9 Batteries (Management & Handling) Rules, 2000.
10 Ozone Depleting Substances (Regulation) Rules, 2000.
11 The Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987.
12 The Air (Prevention and Control of Pollution) Act, 1982.
13 The Air (Prevention and Control of Pollution) Rules, 1982.
14 The Tamil Nadu Air (Prevention and Control of Pollution) Rules, 1983.
15 Noise Pollution (Regulation and Control) Rules, 2000.
16 The Water (Prevention and Control of Pollution) Act, 1974 as amended in 1978 & 1988.
17 The Tamil Nadu Water (Prevention and Control of Pollution) Rules,1983.
18 The Water (Prevention and Control of Pollution) Cess Act, 1977 as amended by Amendment Act, 1991.
19 The Water (Prevention and Control of Pollution) Cess Rules, 1978.
20 Factories Act, 1948.
21 Tamilnadu Factories Rules, 1950.
22 The Gas Cylinders Rules, 1981.
23 The Indian Electricity Act, 1910.
24 The Indian Electricity Rules, 1956.
25 The Petroleum Act, 1934.
26 The Petroleum Rules,1976.
27 The Public Liability Insurance Act, 1991.
28 The Public Libility Insurance Rules, 1991.

29 Hazardous Wastes (Management and Handling) Rules,2000

Poor working conditions affect a worker's health and safety. Unsafe or unhealthy working conditions are not eliminated to industries and can be anywhere. Whether inside or outside, the workshop workers may face many health and safety hazards. It also affects the environment of the workers. Occupational hazards have harmful effects on workers, their families, and other people in the community, as well as on the physical environment around the workplace.

The provisions made in as applicable to the Factories Act, 1948 (Act No.63 of 1948), as amended by the Factories (Amendment) Act, 1987 (Act 20 of 1987) are as follows: Occupational safety and health various sections provided in factories act, 1948 are under the following headings:

- Fencing of machinery.
- Work on or near machinery in motion.
- Employment of young persons on dangerous machines.
- Striking gear and devices for cutting off power.
- Self-acting machines.
- Casing of new machinery.
- Prohibition of employment of women and children near cotton-openers.
- Hoist and lifts.
- Lifting machines, chains, ropes and lifting tackles.
- Revolving machinery.
- Pressure plant.
- Floors, stairs and means of access.
- Excessive weights.
- Protection of eyes .
- Precautions against dangerous fumes, gases, etc.

Job Sequence

Note: Trainer shall display the chart of safety health and environment guidelines, legislation and regulation applicable in India in the section.

- Trainees will note down all safety health and environment guidelines.
- Record it in Table 1.

Table 1

S. No.	Name of safety, health and environment guidelines	Uses	Legislation and Regulations applicable in India
1			
2			
3			
4			
5			
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11			
12			
13			
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Get it checked by trainer.

EXERCISE 4: Introduction of disposal procedure 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 materials indifferent bins.

Job Sequence

Fig 1

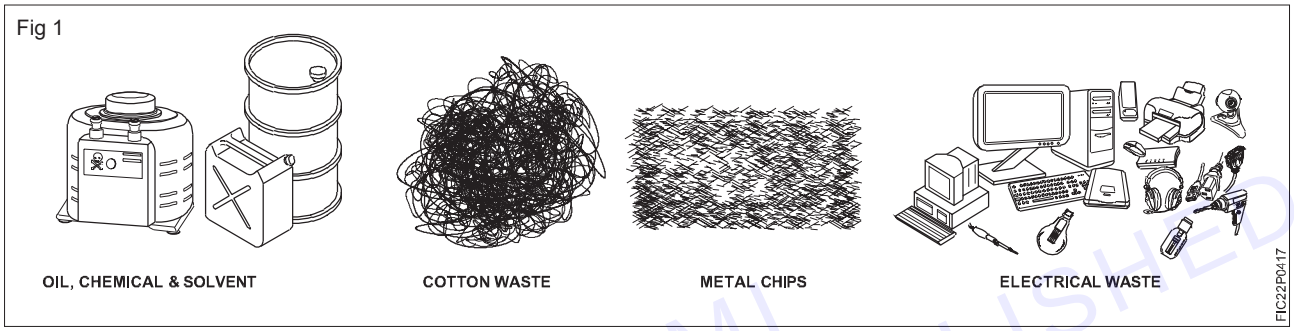
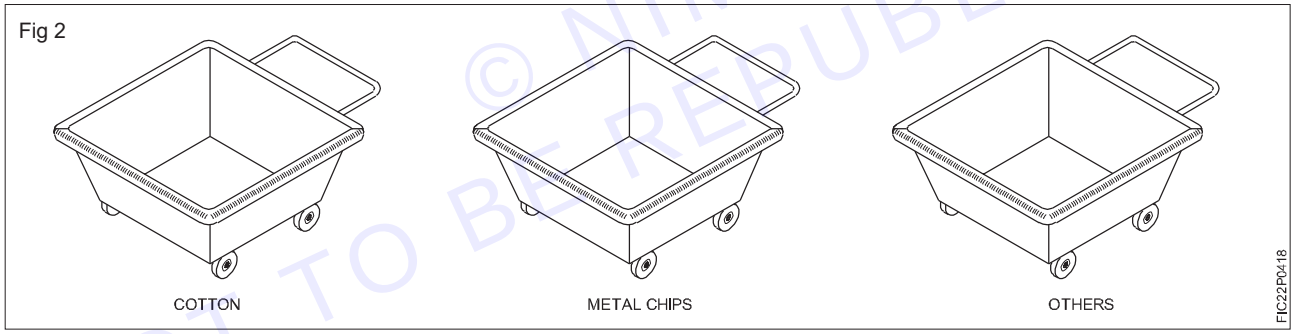


Fig 2



- Separate the cotton waste.
- Collect the chips by hand shovel with the help of brush.
- Clean the floor, if oil is spilled.
- Separate the cotton waste material and store it in the bin provided to store the waste cotton material.
- Similarly store the each category of metal chip in separate bins.

Note: Do not handle the chip by bare hand

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

Each bin should have name of the material.

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

Table 1

S. No.	Name of the material
1	
2	
3	
4	
5	
6	
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EXERCISE 5: Introduction to basic safety introduction, personal protective equipment's (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
- identify occupational hazards and the corresponding potential hazards.

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.

Note: The instructor shall display the different types of personal protective equipment's 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.

TASK 1:

Table 1

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

— — — — —

TASK 2:

Note: Instructor may brief the various types of occupational hazards and their causes.

- Identify the occupational hazard and the corresponding situation with the potential harm and record it in Table 1.

Table 1

S.No.	Source or potential harm	Type of occupational hazards
1	Noise	
2	Explosive	
3	Virus	
4	Sickness	
5	Smoking	
6	Non control device	
7	No earthing	
8	Poor house keeping	

Get it check by trainer.

— — — — —

EXERCISE 6: Importance of Basic injury prevention, basic first aid, hazard identification and avoidance, basic safety sign for danger

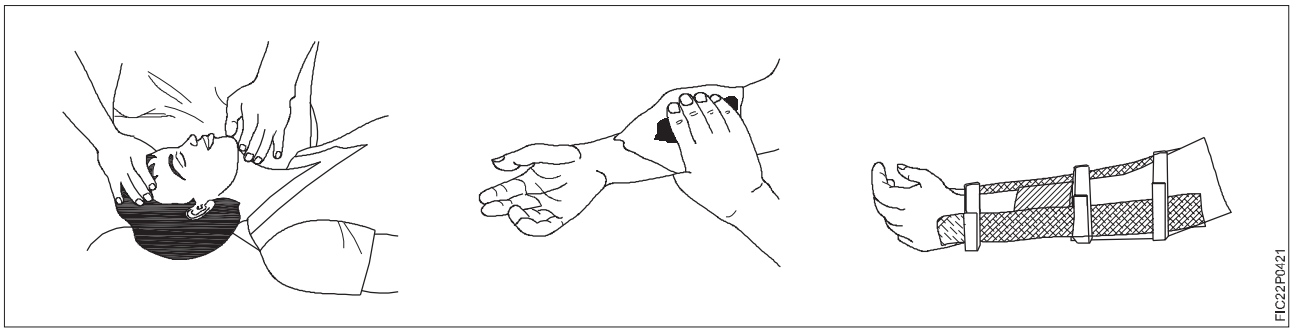
Objectives

At the end of this exercise you shall be able to

- identify basic injury prevention devices
- perform basic first aid
- indentify occupational hazards and suggest suitable methods to avoid occupational hazards
- identify basic safety sign.

Basic injury prevention devices

Basic First Aid



Procedure

Note: Assumption - For easy manageability, Instructor may arrange the trainees in group and ask each group to perform one method of resuscitation.

TASK1: **Prepare the victim to receive artificial respiration**

1 Loosen the tight clothing which may interfere with the victim's breathing.

2 Remove any foreign materials or false teeth from his mouth and keep the victim's mouth open.

3 Bring the victim safely to the level ground, taking necessary safety measures.

4 Start artificial respiration immediately without delay. Do not waste too much time in loosening the clothes or trying to open the tightly closed mouth.

5 Avoid violent operations to prevent injury to the internal parts of the victim.

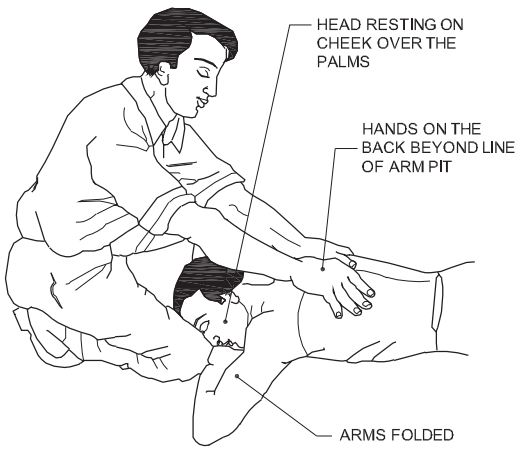
6 Send word for a doctor immediately.

TASK 2: **Resuscitate the victim by Nelson's arm - Lift back pressure method**

Note: Nelson's arm-lift back pressure method must not be used in case there are injuries to the chest and belly.

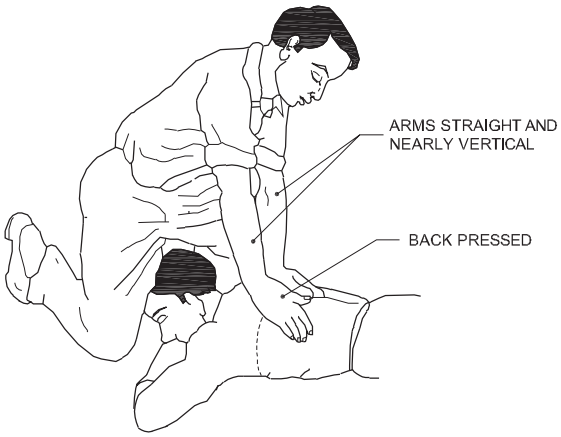
1 Place the victim prone (that is face down) with his arms folded with the palms one over the other and the head resting on his cheek over the palms. Kneel on one or both knees near the victim's hand. Place your hands on the victim's back beyond the line of the armpits, with your fingers spread outwards and downwards, thumbs just touching each other as in Fig 1.

Fig 1



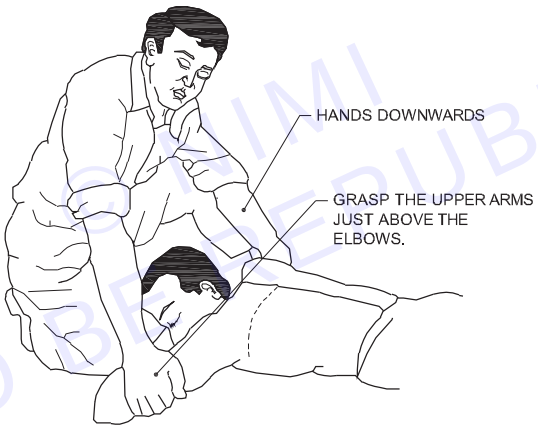
2 Gently rock forward keeping your arms straight until they are nearly vertical, and steadily pressing the victim's back as shown in Fig 2 to force the air out of the victim's lungs.

Fig 2



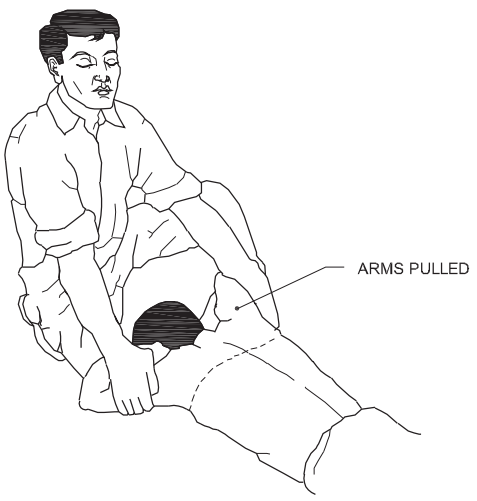
3 Synchronise the above movement of rocking backwards with your hands sliding downwards along the victim's arms, and grasp his upper arm just above the elbows as shown in Fig 3. Continue to rock backwards.

Fig 3



4 As you rock back, gently raise and pull the victim's arms towards you as shown in Fig 4 until you feel tension in his shoulders. To complete the cycle, lower the victim's arms and move your hands up to the initial position.

Fig 4



5 Continue artificial respiration till the victim begins to breathe naturally. Please note, in some cases, it may take hours.

6 When the victim revives, 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.

7 Keep him in the lying down position and do not let him exert himself.

Note: Do not give him any stimulant until he is fully conscious.

TASK 3: **Resuscitate the victim by Schafer's method**

Do not use this method in case of injuries to victim on the chest and belly.

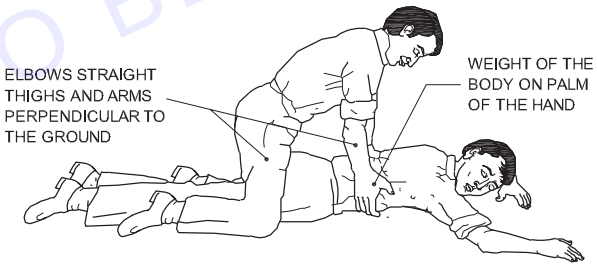
1 Lay the victim on his belly, one arm extended direct forward, the other arm bent at the elbow and with the face turned side ward and resting on the hand or forearm as shown in Fig 1.

2 Kneel astride the victim, so that his thighs are between your knees and with your fingers and thumbs positioned as in Fig 1.

Fig 1

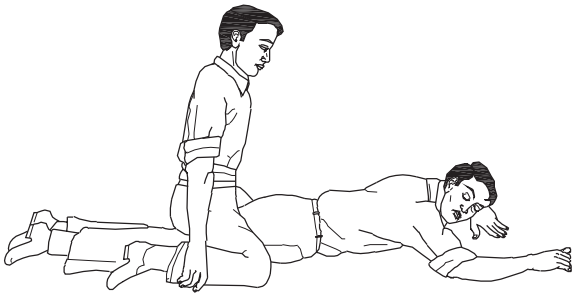
3 With the arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the lower ribs of the victim to force the air out of the victim's lungs as shown in Fig 2.

Fig 2



4 Now swing backward immediately removing all the pressure from the victim's body as shown in Fig 3, thereby, allowing the lungs to fill with air.

Fig 3



5 After two seconds, swing forward again and repeat the cycle twelve to fifteen times a minute.

6 Continue artificial respiration till the victim begins to breathe naturally.

— — — — —

TASK 4: **Resuscitate the victim by mouth-to-mouth method**

1 Lay the victim flat on his back and place a roll of clothing under his shoulders to ensure that his head is thrown well back. (Fig 1)

Fig 1

FIC22P0429

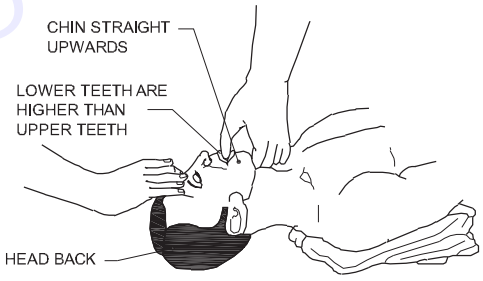
2 Tilt the victim's head back so that the chin points straight upward. (Fig 2)

Fig 2

FIC22P0430

3 Grasp the victim's jaw as shown in Fig 3, and raise it upward until the lower teeth are higher than the upper teeth; or place fingers on both sides of the jaw near the ear lobes and pull upward. Maintain the jaw position throughout the artificial respiration to prevent the tongue from blocking the air passage.

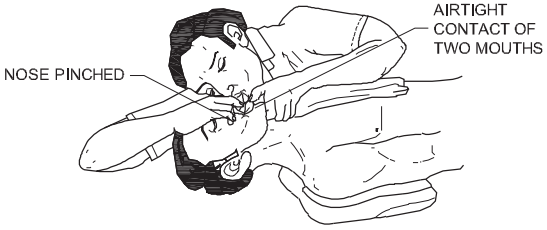
Fig 3



FIC22P0431

4 Take a deep breath and place your mouth over the victim's mouth as shown in Fig 4 making airtight contact. Pinch the victim's nose shut with the thumb and forefinger. If you dislike direct contact, place a porous cloth between your mouth and the victim's. For an infant, place your mouth over his mouth and nose.

Fig 4



FIC22P0432

5 Blow into the victim's mouth (gently in the case of an infant) until his chest rises. Remove your mouth and release the hold on the nose, to let him exhale, turning your head to hear the rushing out of air. The first 1 to 3 breathings should be as rapid as the victim responds, thereafter the rate should be slowed to about 12 times a minute (20 times for an infant).

Note: If air cannot be blown in, check the position of the victim's head and jaw and recheck the mouth for obstructions, then try again more forcefully. If the chest still does not rise, turn the victim's face down and strike his back sharply to dislodge obstructions.

Sometimes air enters the victim's stomach as evidenced by a swelling stomach. Expel the air by gently pressing the stomach during the exhalation period.

— — — — —

TASK 5: **Resuscitate the victim by Mouth-to-Nose method**

Note : Use this method when the victim's mouth will not open, or has a blockage you cannot clear.

1 Use the fingers of one hand to keep the victim's lips firmly shut, seal your lips around the victim's nostrils and breathe into him. Check to see if the victim's chest is rising and falling. (Fig 1)

Fig 1

FIC22P0433

2 Repeat this exercise at the rate of 10 - 15 times per minute till the victim responds.

3 Continue this exercise till the arrival of the doctor.

— — — — —

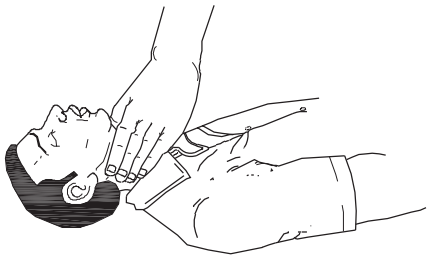
TASK 6: **Resuscitate a victim who is under cardiac arrest by (CPR) cardio pulmonary resuscitation**

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

1 Check quickly whether the victim is under cardiac arrest.

Note: 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

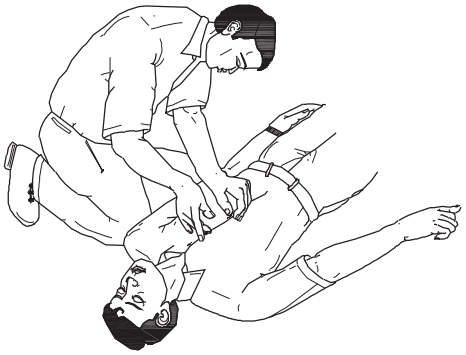


FIC22P0434

2 Lay the victim on his back on a firm surface.

3 Kneel alongside facing the chest and locate the lower part of the breastbone. (Fig 2)

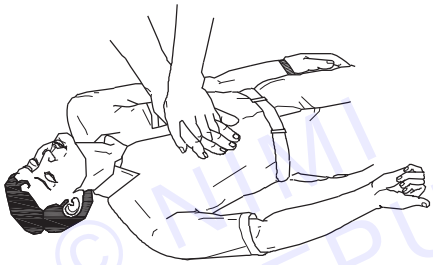
Fig 2



FIC22P0435

4 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



FIC22P0436

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

Fig 4

FIC22P0437

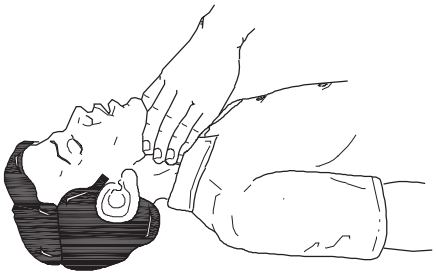
6 Repeat step 5, fifteen times at the rate of atleast once per second.

7 Check the cardiac pulse. (Fig 5)

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

9 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 5



FIC22P0438

Fig 6

FIC22P0439

10 As soon as the heartbeat returns, stop the compres- sions immediately but continue with mouth-to-mouth resuscitation until natural breathing is fully restored.

11 Place the victim in the recovery position as shown in Fig 7.

Fig 7

FIC22P0440

Note: Keep him warm and get medical help quickly.

Other steps

1 Send word/attendant for a doctor immediately.

2 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.

— — — — —

TASK 7: **Treatment for bleeding victim**

1 Determine the location of the bleeding.

2 Elevate the injuried area above the heart if possible.

3 Apply direct pressure to the bleeding area with sterile cloth.

4 Keep the pressure on for 5 seconds.

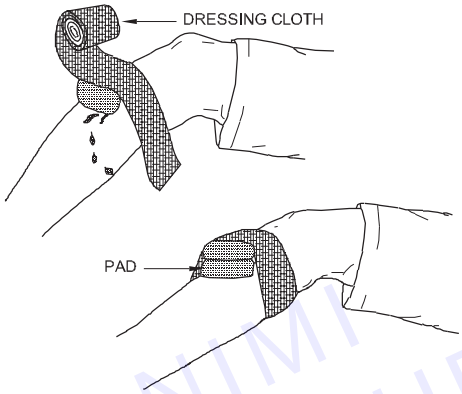
5 Check to see if the bleeding has stopped if not apply further pressure for 15 minutes.

6 Clean the wound.

7 Bandage the wound with pad of soft material. (Fig 1)

8 Advice victim to take treatment from doctor.

Fig 1

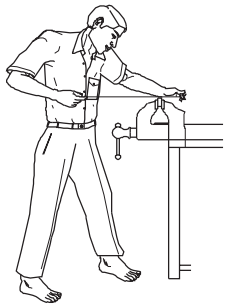


Hazard identification and avoidance

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

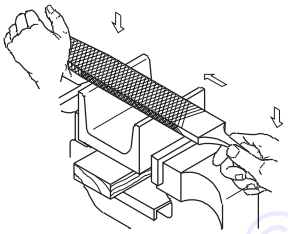
- indentify the occupational hazards.
- suggest suitable to avoid occupational hazards.

1



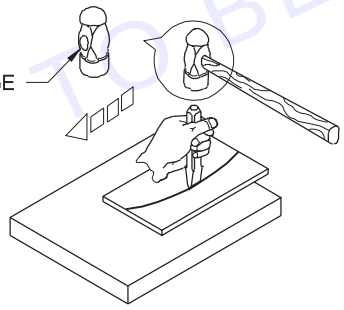
WORKING BARE FOOT IN SHOP FLOOR

2



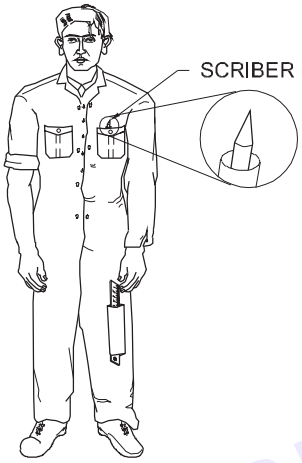
USING FILE WITHOUT HANDLE

3



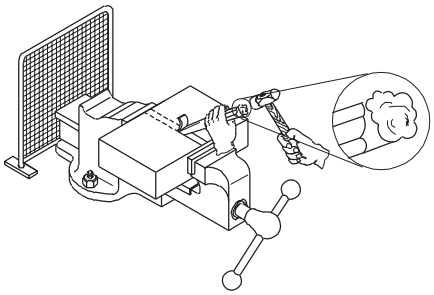
STRIKING ON CHISEL HEAD WITH BALL PEIN HAMMER WITHOUT WEDGE

4



KEEPING SCRIBER SHARP EDGE OPEN IN POCKET

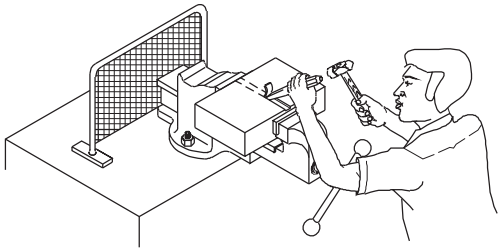
5



CHIPPING METAL SURFACE WITH MUSHROOM HEAD CHISEL

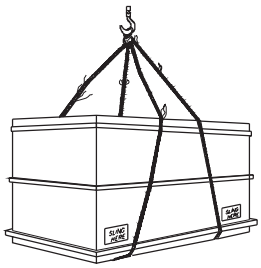
FIC22P0442

6



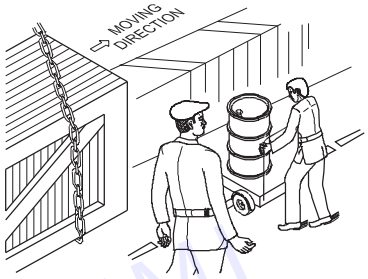
CHIPPING ON METAL SURFACE
WITHOUT SAFETY GOGGLES

7



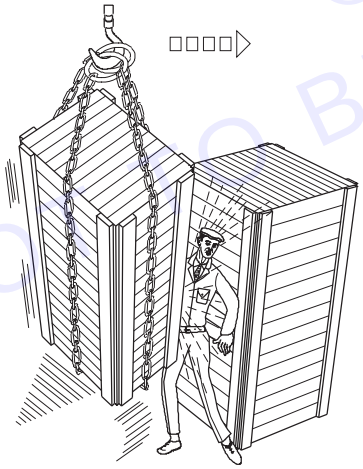
LIFTING LOAD WITH DAMAGED SLINGS

8



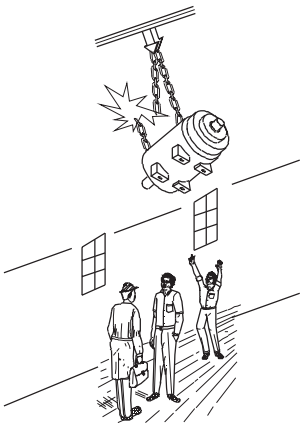
NO OBSTACLE WHILE MOVING THE LOAD

9



LIFTING A LOAD WHILE PEOPLE
WORKING NEARBY

10



STANDING BELOW A SUSPENDED LOAD

FIC22P044

Job Sequence

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

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

Table 1

S.No.	Identification of hazards	Avoidance
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

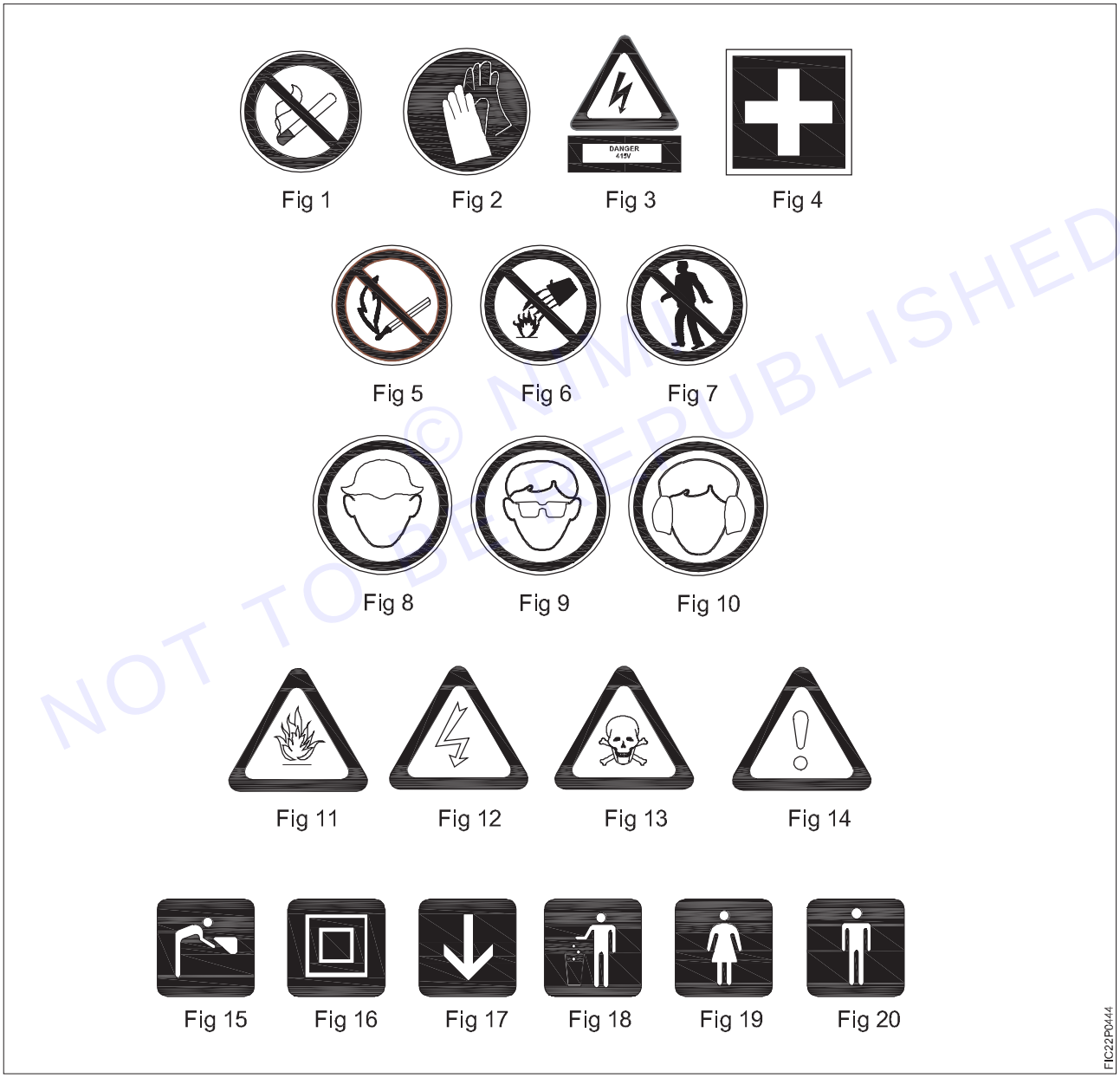
- Get it checked by trainer.

EXERCISE 7: Importance of warning, caution & 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.



Job Sequence

Note: Trainer 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.
- 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		

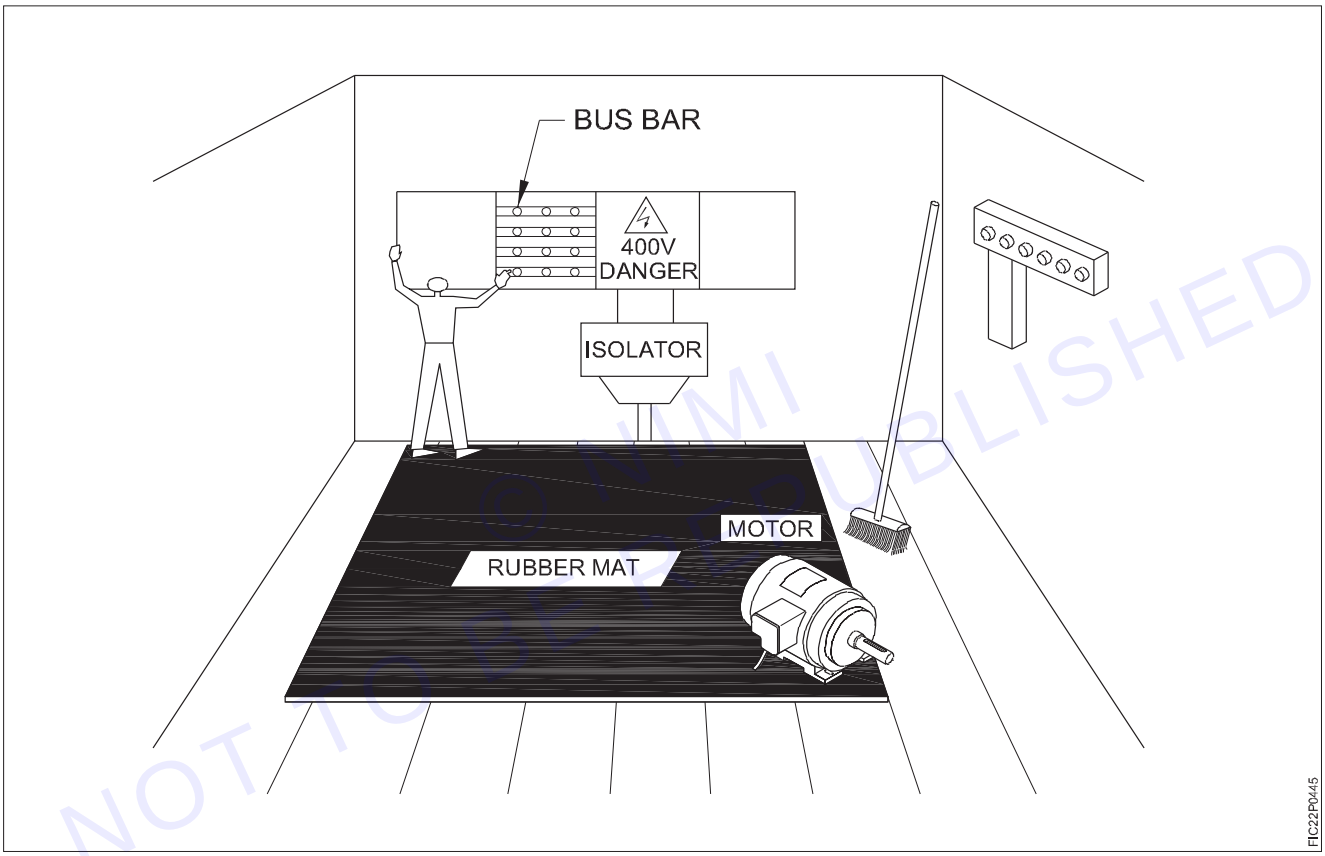
- Get it checked by trainer.

EXERCISE 8: Introduction of preventive measures for electrical accidents & steps to be taken in such accident

Objectives

At the end of this exercise you shall be able to

- rescue a person from live wire .



Job Sequence

Disconnecting a person (mock victim) from a live supply (simulated)

1 Observe the person (mock victim) receiving an electric shock. Interpret the situation quickly.

2 Remove the victim safely from the 'live' equipment by disconnecting the supply or using one of the items of insulating material.

3 Move the victim physically to a nearby place.

4 Check for the victim's natural breathing and consciousness.

5 Take steps to apply respiratory resuscitation if the victim is unconscious and not breathing.

Note: Do not run to switch off the supply that is far away.

Do not touch the victim with bare hands until the circuit is made dead or the victim is moved away from the equipment.

Push or pull the victim from the point of contact of the live equipment, without causing serious injury to the victim. (Fig 1)

Fig 1

EXERCISE 9: To use of fire extinguishers

Objectives

At the end of this exercise you shall be able to

- select the fire extinguisher according to the type of fire
- operate the fire extinguisher
- extinguish the fire.

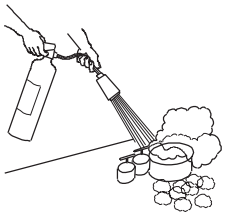
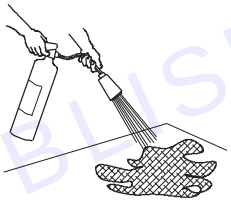
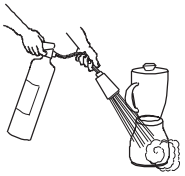
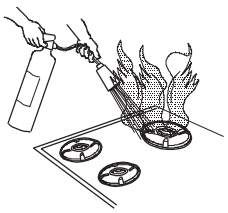
Job Sequence

- Alert people surrounding by shouting fire, fire, fire when observe fire.
- Inform fire service or arrange to inform immediately.
- Open emergency exist and ask them to go away.
- Put “Off” electrical power supply.

Note: Do not allow people to go nearer to the fire.

- Analyze and identify the type of fire. Refer Table1

Table 1

Class ‘A’	Wood, paper, cloth, solid material	
Class ‘B’	Oil based fire (grease, gasoline, oil) & liquefiable solids	
Class ‘C’	Gas and liquefied gases	
Class ‘D’	Metals and electrical equipment	

Note: Assume the fire is ‘B’ type (flammable liquefiable solids)

- Select CO_2 (carbon dioxide) fire extinguisher
- Locate and pick up CO_2 fire extinguisher. Check for its expiry date.
- Break the seal. (Fig 1)
- Pull the safety pin from the handle (Fig 2) (Pin located at the top of the fire extinguisher). (Fig 2)

Fig 1

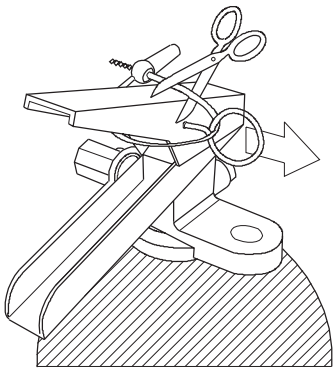
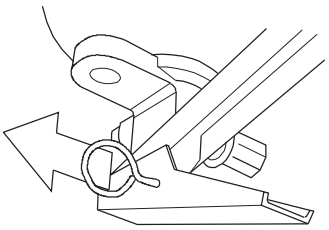


Fig 2



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- Aim the extinguisher nozzle or hose at the base of the fire (this will remove the source of fuel fire) (Fig 3)
- Squeeze the handle lever slowly to discharge the agent (Fig 4)
- Sweep side to side approximately 15 cm over the fuel fire until the fire is put off. (Fig 4)

Fig 3

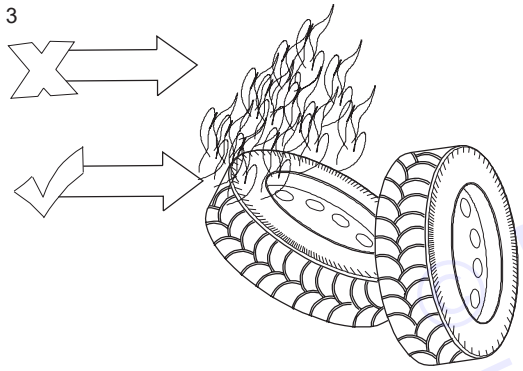
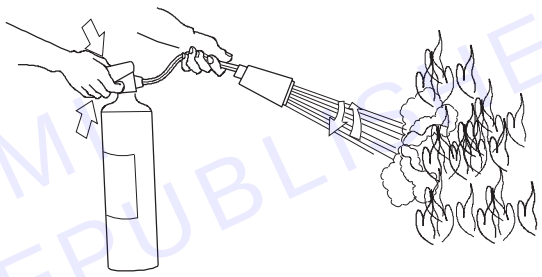


Fig 4



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Caution

- While putting off fire, the fire may flare up.
- Do not be panic so long as it is put off promptly
- If the fire doesn't respond well after you have used up the fire extinguisher move yourself away from the fire point.
- Do not attempt to put out a fire where it is emitting toxic smoke, leave it to the professionals.
- Remember that your life is more important than property. So don't place yourself or other at risk.

Note: In order to remember the simple operation of fire extinguisher

Remember

P.A.S.S. This will help to use fire extinguisher.

P for pull

A for aim

S for squeeze

S for sweep

EXERCISE 10: Importance of Technical English

Objectives

At the end of this exercise you shall be able to

- facilitates effective communication
- understand the manuals and instructions
- ensures safety,
- enhances employability,
- promotes standardization, and fosters professional development.

Procedure

Technical English is of utmost importance for fitter instructors for several reasons:

1 **Effective Communication:** Fitter instructors need to communicate technical information clearly and effectively to their students. Technical English enables them to convey complex concepts, instructions, and safety procedures accurately, ensuring that students understand and follow them correctly.

2 **Understanding Manuals and Instructions:** Fitters often work with machinery and equipment that come with technical manuals and instructions written in English. Proficiency in technical English allows instructors to understand these documents thoroughly and pass on this knowledge to their students.

3 **Safety:** In industrial settings, safety is paramount. Fitter instructors need to effectively communicate safety protocols, hazards, and precautions to their students. Technical English skills are essential for accurately conveying this critical information to ensure the safety of students and workers.

4 **Enhancing Employability:** Many technical fields, including fitting, require employees to have a certain level of proficiency in English. By imparting technical English skills to students, fitter instructors enhance their employability prospects in industries where English is the primary language of communication.

5 **Accessing Resources:** Technical English proficiency enables fitter instructors to access a wide range of technical resources such as research papers, articles, and online tutorials. This allows them to stay updated with the latest advancements in their field and incorporate relevant information into their teaching.

6 **Globalization:** In today's globalized world, many industries operate on an international scale, and English is often the common language used for communication. Fitter instructors with strong technical English skills are better equipped to collaborate with professionals from different parts of the world and access global job opportunities.

7 **Standardization:** Technical English provides a standardized terminology for describing technical concepts and components. This standardization ensures consistency in communication within the field of fitting, reducing the chances of misunderstandings and errors.

8 **Professional Development:** Proficiency in technical English opens up avenues for fitter instructors to engage in professional development activities such as attending workshops, conferences, and seminars conducted in English. This exposure allows them to broaden their knowledge base and exchange ideas with professionals from diverse backgrounds.

EXERCISE 11: Prepare different types of documentation as per Industries need by different methods of recording information

Objectives

At the end of this exercise you shall be able to

- prepare and fill up batch processing record in format
- prepare and fill up bill of materials (BOM)
- prepare and fill up production cycle time in format
- prepare and fill up daily production report in format
- prepare and fill up manufacturing stage inspection report format.

Procedure

TASK 1: **Documentation 1**

Note:

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

Job Sequence

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

BATCH PROCESSING RECORD - FORMAT - 1

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

BILL OF MATERIAL (BOM) - FORMAT - 2
as per IS: 11666-1985

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

Date

Place

Trainer

PRODUCTION CYCLE TIME - FORMAT - 3

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

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

DAILY PRODUCTION REPORT - FORMAT- 4

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

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

Signature of section Incharge

MANUFACTURING STAGE INSPECTION REPORT - FORMAT - 5

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

Documentations 2

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

- prepare and fill job card in format
- prepare and fill work activity log in format
- prepare and fill batch production record
- prepare and fill estimation sheet in format
- prepare and fill maintenance log in format
- prepare and fill the history sheet of machinery and equipment in format.

TASK 2: **Documentation 2**

Note:

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

Job Sequence

- Study the different types of documentation provided in (Format).
- Prepare the required format with the knowledge Gained during the industrial visit.
- Visit to the industry and collect the input/ information from industry and fill it up in the format

JOB CARD - FORMAT-1

Job Card	Doc No.	
	Rev No.	
	Date	

Order Starting Date	
Customer	
Work Order No.	

Details

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

EXERCISE 12: Introduction of basic life support training and be able to perform DRSABCD (D: check for danger, R: check for response, S: send for help, A: open the air way)

Objectives

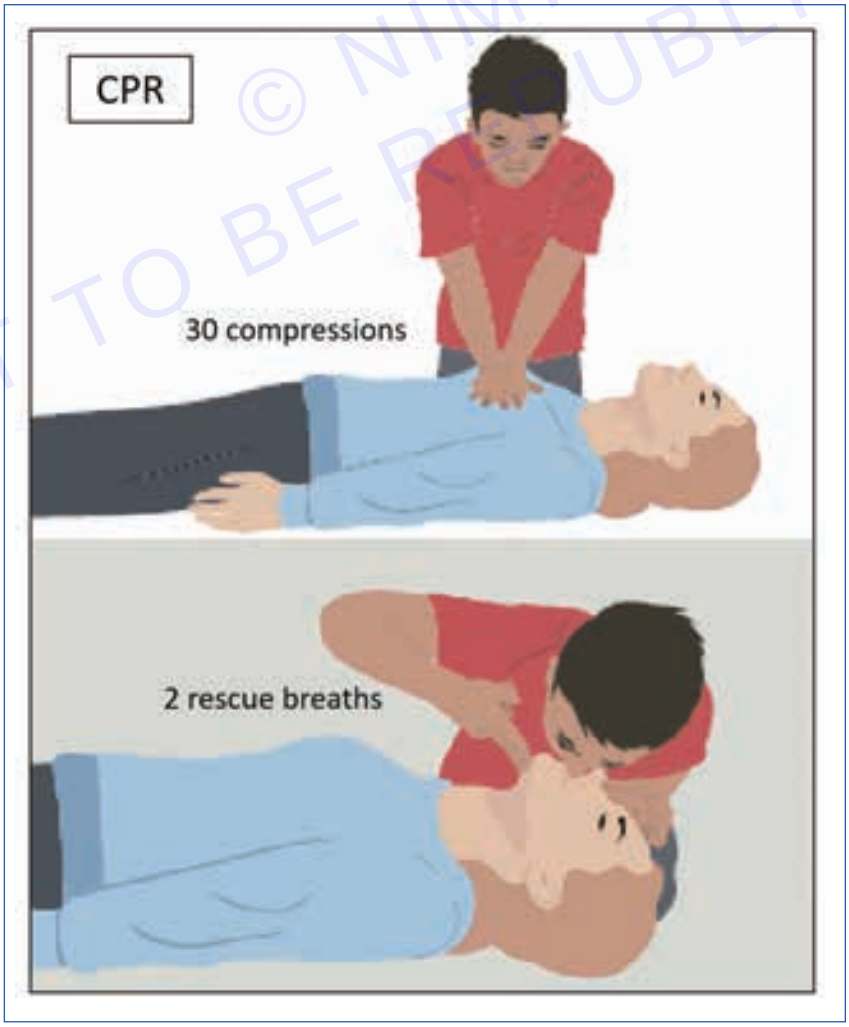
At the end of this exercise you shall be able to

- understanding emergency situations
- initiating rapid response
- performing cpr (cardiopulmonary resuscitation)
- maintaining a safe environment
- using automated external defibrillator.

Procedure

- Record relevant information in the format.
- Get it checked by your instructor/ Training Officer.

Basic Life Support Training



Basic Life Support (BLS) defines

Sequences of procedures performed to restore the circulation of oxygenated blood after a sudden pulmonary or cardiac arrest until the can be given full medical care at a hospital. BLS does not include the use of drugs or invasive skill.

Essential steps for initiating rapid response under BLS

1 **Check for Safety:** Ensure your safety and the safety of others at the scene. If there are any hazards, address them immediately.

2 **Assess Responsiveness**

- Gently tap the person and shout, “Are you okay?”
- If there is no response, proceed to the next step.

3 **Activate Emergency Medical Services (EMS)**

- Call for help or ask someone nearby to call 1013 (or the local emergency number).
- Provide clear information about the situation and location.

4 **Open the Airway**

- Place the person on their back.
- Tilt their head back slightly to open the airway.
- Check for breathing.

5 **Check Breathing**

- Look, listen, and feel for normal breathing.
- If the person is not breathing or only gasping, begin chest compressions.

6 **Start Chest Compressions**

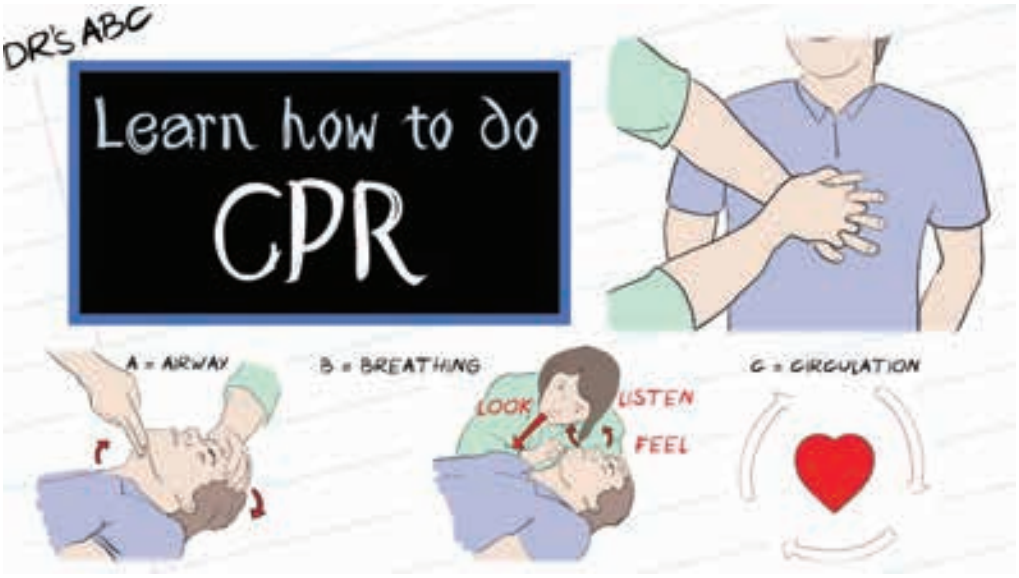
- Position your hands on the center of the person’s chest (lower half of the sternum).
- Use your body weight to compress the chest at least 2 inches deep.
- Perform compressions at a rate of 100-120 per minute.

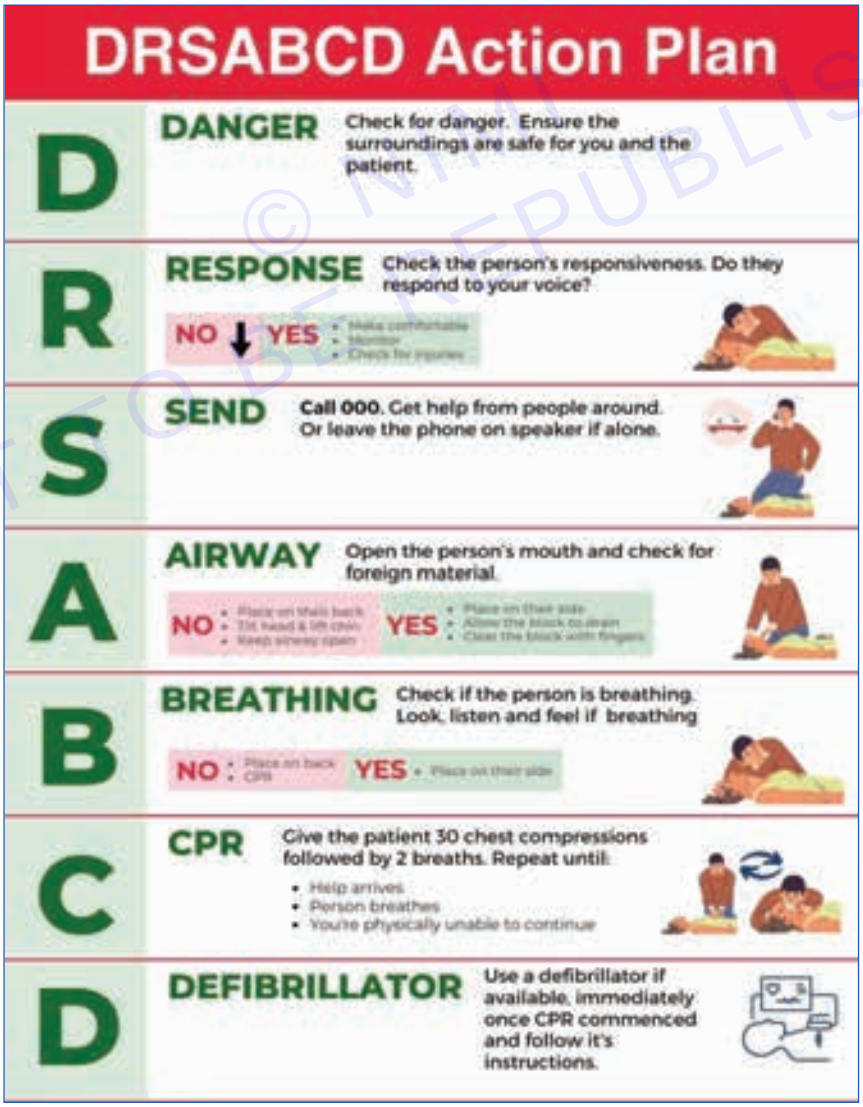
7 **Provide Rescue Breaths**

- After 30 compressions, give 2 rescue breaths.
- Pinch the person’s nose shut and create an airtight seal over their mouth.
- Give a breath that makes the chest rise visibly.

8 **Continue CPR:**

- Alternate between 30 compressions and 2 rescue breaths.
- Continue until professional help arrives or the person starts breathing on their own.





Job Sequence

Note: Trainer shall display all the chart and poster related to basic life support training, CPR, DRSABCD names, uses and the safety point to be observed for each tool and equipment.

- Trainees will note down all the displayed posters and chart names, uses and the precaution to be observewhile performing .
- Record it in Table 1.
- Get it checked by the Trainer.

Table 1

S.No.	Name of BLS training	Uses	Precaution to be observed (Do's and Don't)
1			
2			
3			
4			
5			

EXERCISE 13 : Importance of Skill Grading Chart

Objectives

At the end of this exercise you shall be able to

- assessing the proficiency and competency of trainees in various operations.
- identification of strengths and weaknesses
- self-assessment and motivation
- structuring training pathway.

Procedure

Skill Grading Chart

A skill grading chart is a tool used to assess and track the progress of trainees as they develop their skills and proficiency in various aspects of the fitter trade. This chart typically outlines specific skills, tasks, or competencies relevant to the fitter trade operations such as filling hacksawing, drilling, scrapping, tapping, reaming, external threading, tool grinding, turning and other skills with in accuracy.

Importance of Skill Grading Chart

A skill grading chart for can play a crucial role in their development and progression of skill. Here are some key reasons highlighting its importance.

1 **Objective Assessment:** A skill grading chart provides an objective framework for assessing the proficiency and competency in various areas related to trade. It helps both trainees and trainers understand their strengths and areas needing improvement.

2 **Progress Tracking:** It allows trainees to track their progress over time, providing motivation and a sense of accomplishment as they advance through different skill levels. This can help them stay focused and committed to their training.

3 **Identification of Strengths and Weaknesses:** By clearly outlining different skills and competencies, the grading chart helps identify both strengths and weaknesses in trainees' abilities. This enables targeted training interventions to address areas needing improvement and further develop strengths.

4 **Structured Training Pathway:** The chart establishes a structured pathway for skill development, guiding trainees through progressive levels of proficiency. This structured approach ensures that trainees build a solid foundation of knowledge and skills before advancing to more complex tasks.

5 **Standardization:** A skill grading chart helps standardize the training process across different trainees and instructors. It ensures consistency in the assessment criteria and helps maintain quality standards within the fitness industry.

6 **Feedback and Guidance:** Trainees receive valuable feedback and guidance based on their performance assessments. This feedback is essential for their learning and growth, as it helps them understand areas where they excel and areas where they need to focus on improvement.

7 **Career Advancement:** The skill grading chart serves as a roadmap for career advancement. advancing through different skill levels demonstrates competence and readiness for taking on more responsibilities and higher-level roles within the industry.

8 **Enhanced Skill:** Ultimately, a skill grading chart ensures that trainees are well-equipped to provide high-quality skill. By continuously improving their skills and knowledge, trainees can deliver better service.

9 **Quality Assurance:** For training programs and institutions, a skill grading chart serves as a quality assurance tool. It ensures that trainees are meeting the established standards and that the training program is adequately preparing them for their roles as fitters.

10 **Communication Tool:** The skill grading chart also facilitates communication between trainers, trainees, and employers. It provides a common language for discussing trainees' progress and proficiency levels, enabling transparent communication about expectations and performance.

EXERCISE 14 : Designing the grade exercise covering a list of skills

Objectives

At the end of this exercise you shall be able to

- assessing the various skill and proficiency
- ability to use of cutting tools and precision measuring tools
- understanding to safety protocols and procedures .
- accuracy and precision in task performance.

Procedure

Designing a graded exercise covering a list of skills for trainees involves creating a practical assessment that evaluates trainees' abilities to perform tasks related to the fitter trade. Below is an example of how can design such an exercise

Exercise Title: Fitter Trade Skills Assessment

Objective:

The objective of this exercise is to assess trainees' proficiency in various skills essential to the fitter trade.

Skills to be assessed:

1 **Mechanical Skills:** Ability to use hand and power tools, performs measurements, and interpret technical drawing.

Fig 1

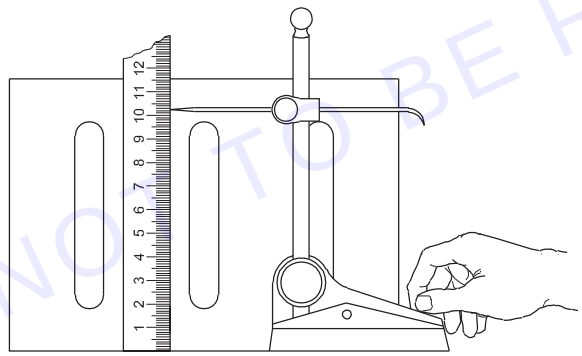


Fig 2

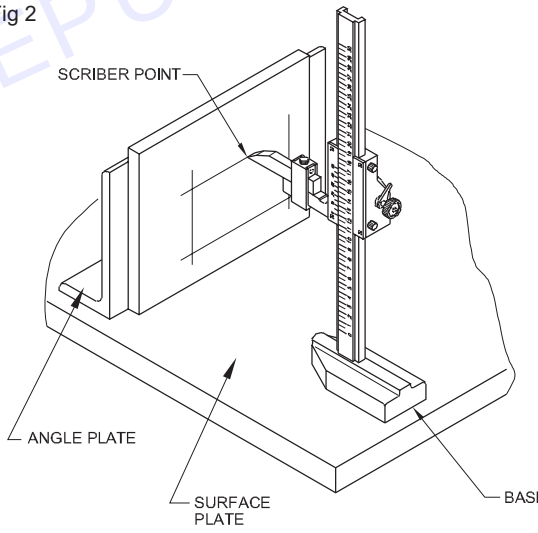


Fig 3

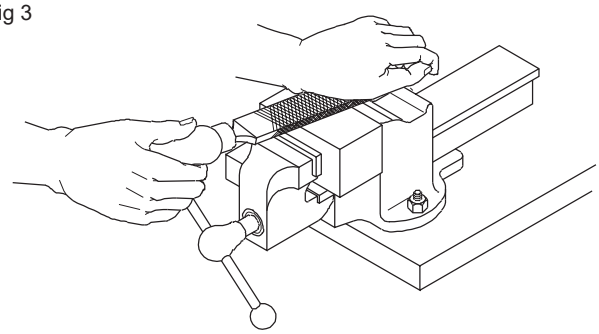
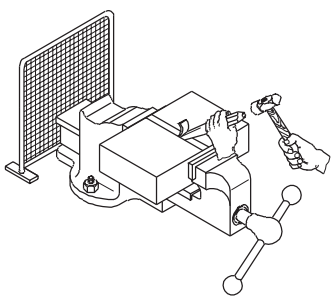


Fig 4



2 **Safety Practices:** Understanding and adherence to safety protocols and procedures.

Fig 5

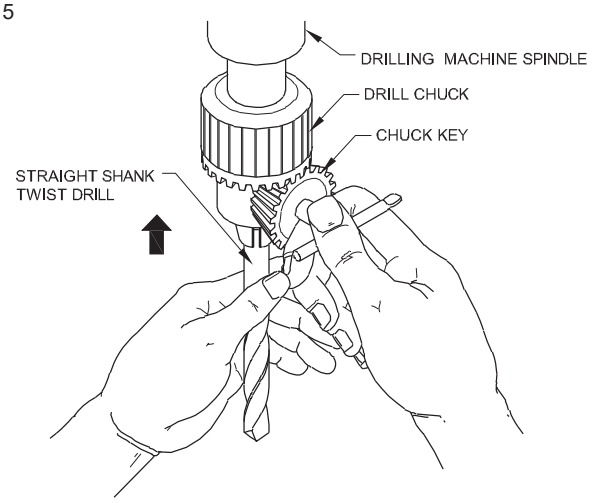
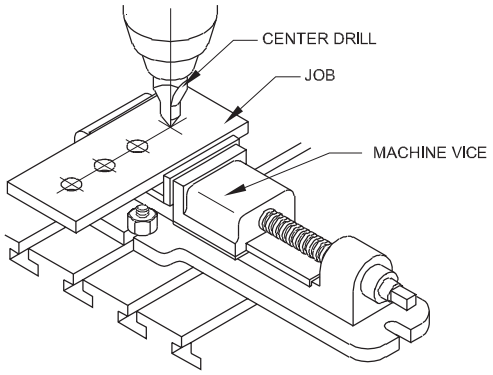


Fig 6



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3 **Equipment Operation:** Competence in operating machinery and equipment commonly used in the trade.

4 **Technical Knowledge:** Understanding of basic principles and concepts related to the trade.

5 **Communication Skills:** Ability to effectively communicate with team members and follow instructions.

Exercise Format

The exercise will consist of a series of stations, each representing a different skill category. Trainees will rotate through the stations and perform tasks or respond to scenarios related to each skill.

Station 1: Mechanical Skills

- TASK 1: Properly measure and mark a piece of metal according to provided specifications.
- TASK 2: Use a power drill to create holes in the marked metal piece, ensuring accuracy and safety.

Station 2: Safety Practices

- Scenario: Respond to a simulated workplace scenario involving a safety hazard (e.g., spilled oil, exposed wiring). Demonstrate the correct procedure for addressing the hazard and ensuring the safety of oneself and others.

Station 3: Equipment Operation

- TASK: Operate a lathe machine to perform a turning operation on a metal workpiece. Follow instructions provided by the examiner and adhere to safety precautions.

Station 4: Technical Knowledge

- Written Assessment: Answer a series of multiple-choice and short-answer questions related to basic principles of the fitter trade, such as types of joints, materials, and fastening techniques.

Station 5: Communication Skills

- Role-play: Engage in a simulated communication scenario with another trainee or examiner. This could involve giving or receiving instructions, clarifying information, or providing feedback on a task.

Grading Criteria:

Trainees will be evaluated based on the following criteria:

- Accuracy and precision in task performance.
- Adherence to safety protocols and procedures.
- Competence in equipment operation and technical knowledge.
- Clarity and effectiveness of communication.

Grading Scale

Each station will be graded on a scale of 1 to 5, with 1 being unsatisfactory and 5 being exceptional. Trainees' overall performance will be determined based on their cumulative scores across all stations.

Skill Grading Scale

Skill Grade	Competency
1	No Competence
2	Low Competence
3	Some Competence
4	High Competence
5	Expert

Format of Skill Grading Chart

S. No.	Name of Trainee	Roll No.	Exercise No.											
			1	2	3	4	5	6	7	8	9	10	11	12
1	A	F-01												
2	B	F-02												
3	C	F-03												
4	D	F-04												
5	E	F-05												
6	F	F-06												
7	G	F-07												
8	H	F-08												
9	I	F-09												
10	J	F-10												
11	K	F-11												
12	L	F-12												
13	M	F-13												
14	N	F-14												
15	O	F-15												
16	P	F-16												
17	Q	F-17												
18	R	F-18												
19	S	F-19												
20	T	F-20												
21	U	F-21												
22	V	F-22												
23	W	F-23												
24	X	F-24												
25	Y	F-25												

EXERCISE 15: Introduction of concept of conservation of raw material

Objectives

At the end of this exercise you shall be able to

- identify corrosion of raw material
- preventing corrosion of raw material
- maintaining structural integrity of raw material
- enhancing durability of raw material.

Procedure

The concept of conservation of raw material such as mild steel flat, mild steel rods, M.S and C.I blocks involves strategies to prolong the life span and maintain the quality of products while minimizing waste and environmental impact. Mild steel flat, commonly used in various industries for structural purposes, fabrication, and construction, requires proper conservation practices to prevent corrosion, degradation and premature failure.

1 **Preventive Maintenance:** Regular inspection and maintenance help identify early signs of corrosion, damage, or wear on raw materials. Applying protective coatings such as paint, primer, or galvanization can shield the surface from moisture, chemicals, and environmental factors, prolonging its lifespan.

2 **Proper Handling and Storage:** Handling raw materials with care during transportation, storage, and installation prevents surface damage and deformation. Storing the flats in a dry, well-ventilated area away from corrosive substances and moisture helps maintain their integrity and prevents rust formation.

3 **Efficient Fabrication Techniques:** Employing precision cutting, drilling, and welding techniques minimizes material wastage during fabrication processes. Utilizing computer-aided design (CAD) software and automated machinery ensures accurate measurements and efficient use of mild steel flats, reducing scrap generation and conserving raw materials.

4 **Recycling and Reuse:** Repurposing scrap or leftover mild steel flats in other projects reduces waste and conserves resources. Recycling metal shavings, offcuts, and obsolete components through scrap metal recycling programs minimizes environmental impact and promotes sustainability in the manufacturing industry.

5 **Corrosion Protection:** Implementing corrosion protection measures such as cathodic protection, sacrificial anodes, or corrosion-resistant coatings helps mitigate the effects of rust and corrosion on mild steel flats. Regular inspection and maintenance of protective coatings ensure long-term corrosion resistance and structural integrity.

6 **Environmentally Friendly Practices:** Choosing environmentally friendly coatings and treatments for mild steel flats minimizes the use of harmful chemicals and reduces environmental pollution. Opting for water-based paints, eco-friendly primers, and low VOC (volatile organic compound) coatings promotes sustainability and reduces the carbon footprint of manufacturing processes.

7 **Life cycle Assessment:** Conducting a lifecycle assessment of mild steel flat products helps evaluate their environmental impact from raw material extraction to disposal. Assessing energy consumption, emissions, and resource usage throughout the product lifecycle enables manufacturers to identify areas for improvement and implement sustainable practices.

EXERCISE 16 : Demonstration on the concept of conservation of raw material

Objectives

At the end of this exercise, you will be able to

- understanding conservation principles
- promoting sustainability awareness
- illustrating physical changes.

Procedure

Practical steps for conserving raw materials like mild steel flats using preventive measures and maintenance techniques

Materials needed for conserving of raw materials

1 Raw materials like Mild steel flat (can be a small piece or sample)
2 Protective coatings (such as paint, primer, or anti-corrosion spray)
3 Cleaning materials (degreaser, wire brush, sandpaper)
4 Rust converter or inhibitor.
5 Lubricants (such as WD-40 or grease)
6 Protective equipment (gloves, safety glasses)

Demonstration Steps

1 **Assessment:** Begin by examining the raw materials for any signs of corrosion, rust, or damage. Note the current condition to determine the appropriate conservation measures needed.

2 **Cleaning:** Use a degreaser and wire brush to remove any dirt, grease, or loose rust from the surface of the mild steel flat. Ensure the surface is clean and free from contaminants that may interfere with subsequent conservation steps.

3 **Rust Removal:** If there are areas of significant rust or corrosion, use sandpaper or a wire brush to gently remove the rust until you reach bare metal. Be careful not to damage the surface of the mild steel flat during this process.

4 **Application of Protective Coatings**

- Apply a primer specifically designed for metal surfaces to enhance adhesion and corrosion resistance.
- Once the primer has dried, apply a layer of protective paint suitable for mild steel. Choose a paint that offers good adhesion, durability, and resistance to environmental factors.
- Alternatively, use an anti-corrosion spray or coating designed to protect metal surfaces from rust and corrosion. Follow the manufacturer's instructions for application.

5 **Rust Conversion:** If there are areas where complete rust removal is not feasible, apply a rust converter or inhibitor to convert the rust into a stable compound. This helps prevent further corrosion and stabilizes the affected areas.

6 **Regular Maintenance**

- Implement a maintenance schedule to inspect the raw material regularly for signs of corrosion, damage, or wear.
- Clean the surface periodically to remove dirt, debris, and contaminants that can promote corrosion.
- Apply lubricants to moving parts or areas prone to friction to prevent corrosion and ensure smooth operation.

7 **Protection from Environmental Factors:** Store or install the mild steel flat in a location protected from exposure to moisture, humidity, and corrosive chemicals whenever possible. Consider using protective covers or enclosures to shield the steel from harsh environmental conditions.

8 **Documentation:** Keep records of the conservation activities performed, including dates of inspections, maintenance procedures, and any repairs or treatments applied. This documentation helps track the effectiveness of conservation efforts over time and informs future maintenance decisions.

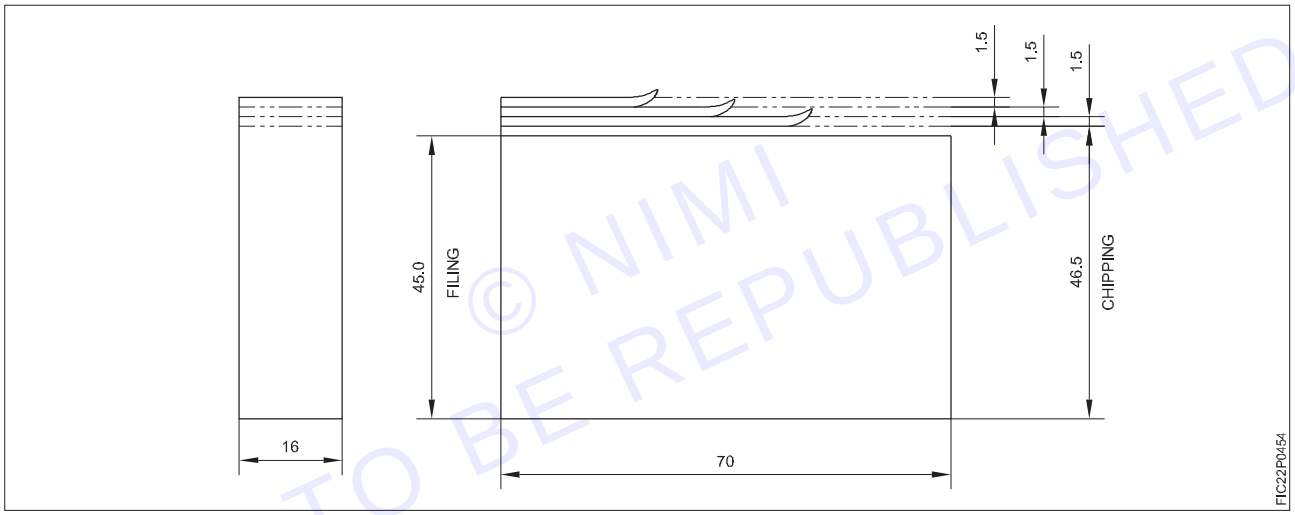
EXERCISE 17 : Exercise on chipping a flat surface on mild steel & cast Iron blocks, with a flat & cross cut chisel

Objectives

At the end of this exercise you will be able to

- chip surfaces evenly using a flat chisel.
- chip curve on flat bearing surface with uniform round nose chisel
- chisel/half round chisel.
- chip keyways at various angles with cross cut and diamond point chisel.

Note: Each trainee should practice chipping of 3 layers of 1.5 mm deep.



Job Sequence

- Apply marking media and mark the depth of metal to be removed by chipping.
- Punch the marked line with a dot punch.
- Hold the job firmly in the vice.
- Support the job with wooden block while chipping.

If necessary give a wooden support below the work piece so that the marked line should be above the vice jaw face.

- Select a flat chisel 20 mm width with proper cutting edge.
- Select a ball pein hammer of 1 kg.
- Hold the chisel at approximately 35° angle of inclination in chipping position.
- Hold the hammer at the end of the handle to get more leverage.

Caution: Chisel should be free from mushroom head.

Hammer handle should be securely fixed with eye hole with a wedge.

Use goggles while chipping.

Skill Sequence

Chipping using flat chisel

Before commencing chipping: Select a mushroom-free chisel and choose a hammer with a well secured handle. (Fig 1)

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

Wear safety goggles.

Install the chipping screen. (Fig 2)

Fig 1

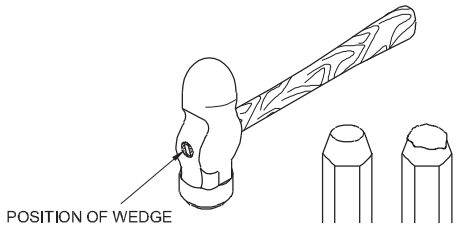
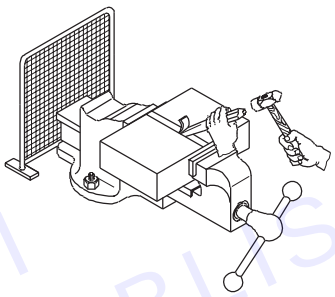


Fig 2



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

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

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

Fig 3

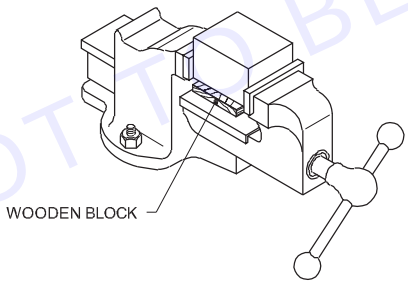
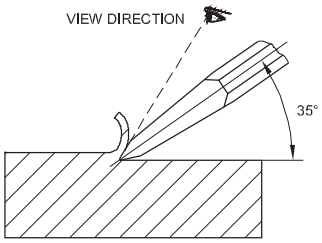


Fig 4



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

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

Fig 5

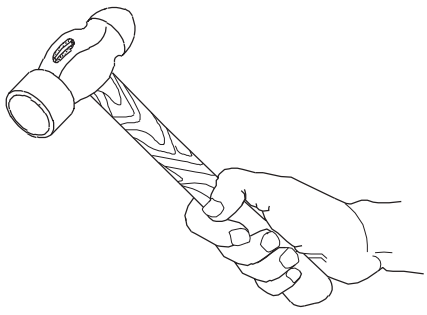
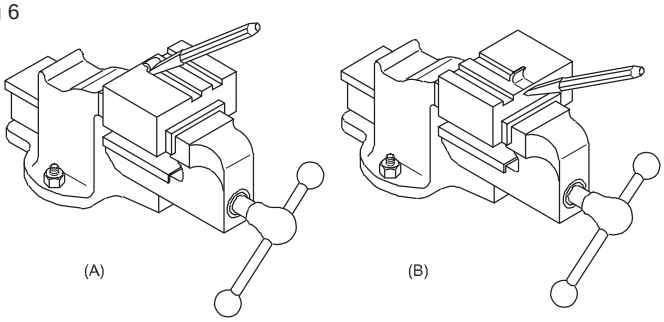
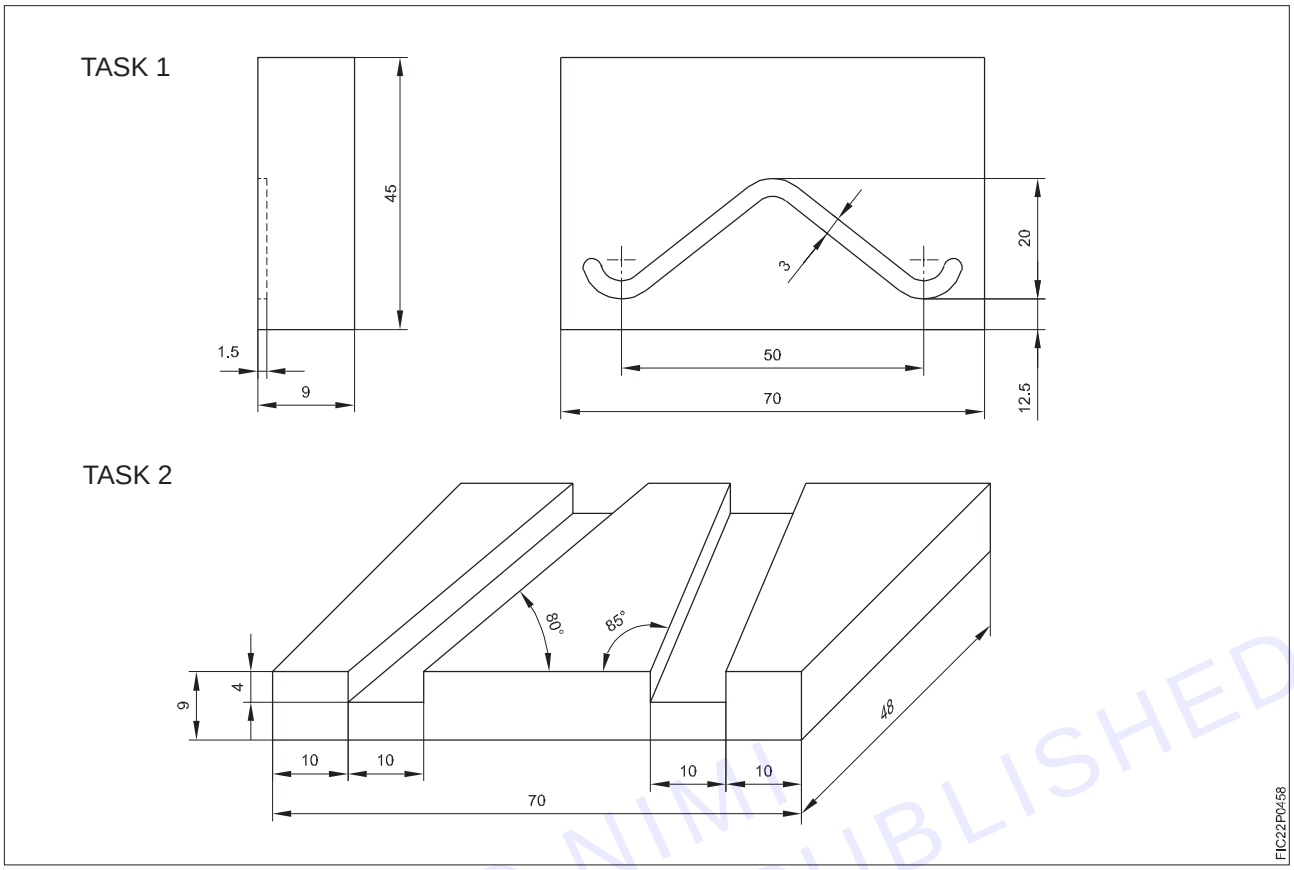


Fig 6



Chipping on mild steel with cross cut chisel



Job Sequence

TASK 1: **Chipping oil groove**

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

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

- Check the raw metal for its size.
- File to size 70x48x9 mm.
- Check the size with vernier caliper.
- Check the squareness with try square.
- Apply marking media and mark keyways using Vernier height gauge and keyway angles using vernier bevel protractor.
- Punch witness marks.
- Hold the job in bench vice.
- Chip keyways with cross cut chisel to the required depth.
- Chip keyways sharp corners with a dimond point chisel.
- Check the job size with vernier caliper.
- Check the anlges with vernier bevel protractor.
- Finish the job and deburr it.
- Apply thin coating of oil and preserve it for evalvation.

Grind the chisels well

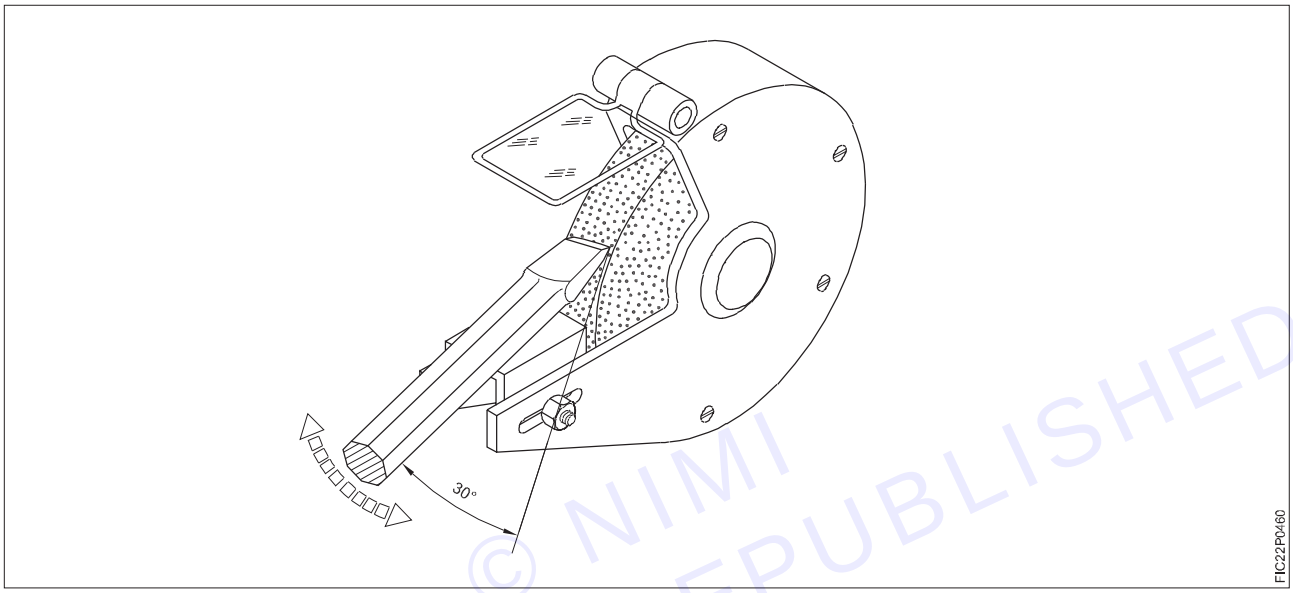
- **Look always at the cutting edge.**
- **Cool the cutting edge from time to time.**

EXERCISE 18: Exercise to make the flat chisel by grinding

Objectives

At the end of this exercise, you will be able to

- re-sharpen the flat chisel using pedestal/bench grinder
- operate safely the pedestal or bench grinding machine.



Note: Instructor shall provide chisels for re-sharpening.

Skill Sequence

Grinding of flat chisel

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

- grind a flat chisel when they become blunt.

Before grinding: Check the grinding wheel by,

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

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

– visually check for cracks.

Switch on the grinder, stand by the side of the wheel for safety, and see whether the wheel runs 'true' and has no excessive vibration. In case of excessive vibration, truing is necessary. Ask the instructor for advice.

Ensure that there is enough coolant in the container.

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

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

Fig 1

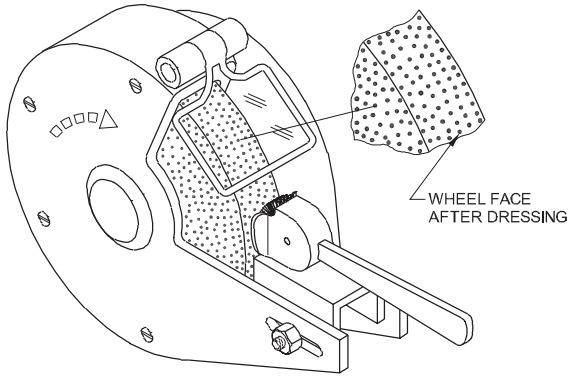
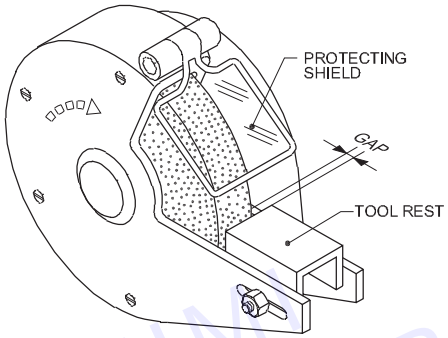


Fig 2

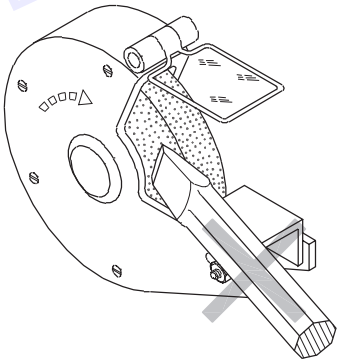


During grinding: Take a blunt chisel for re-grinding. Chisels will become blunt due to use. For efficient chipping, chisels are to be re-sharpened regularly.

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

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

Fig 3



Switch on the grinder.

Hold the chisel edge parallel to the wheel surface; the body of the chisel must be at an angle of 30° in such a way as to get 60° wedge angle. (Fig 5)

Rest the body of the chisel on the tool rest (A) (Fig 5) and allow the point to touch the wheel. (Figs 4 & 5)

Keep the pressure as minimum as possible to prevent excessive heating of the cutting edge, (avoid blue colour i.e. annealing effect).

Fig 4

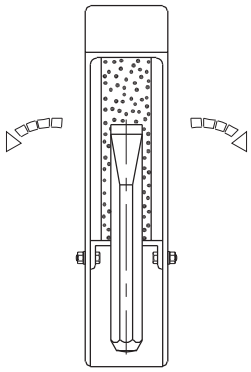


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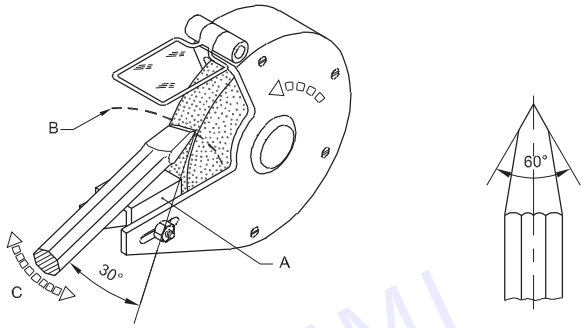
Fig 5



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Rock the point on both sides in an arc to provide convexity at the cutting edge. (Fig 5) See the arrows ‘C’.

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

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

Check the wedge angle with a bevel protractor.

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

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

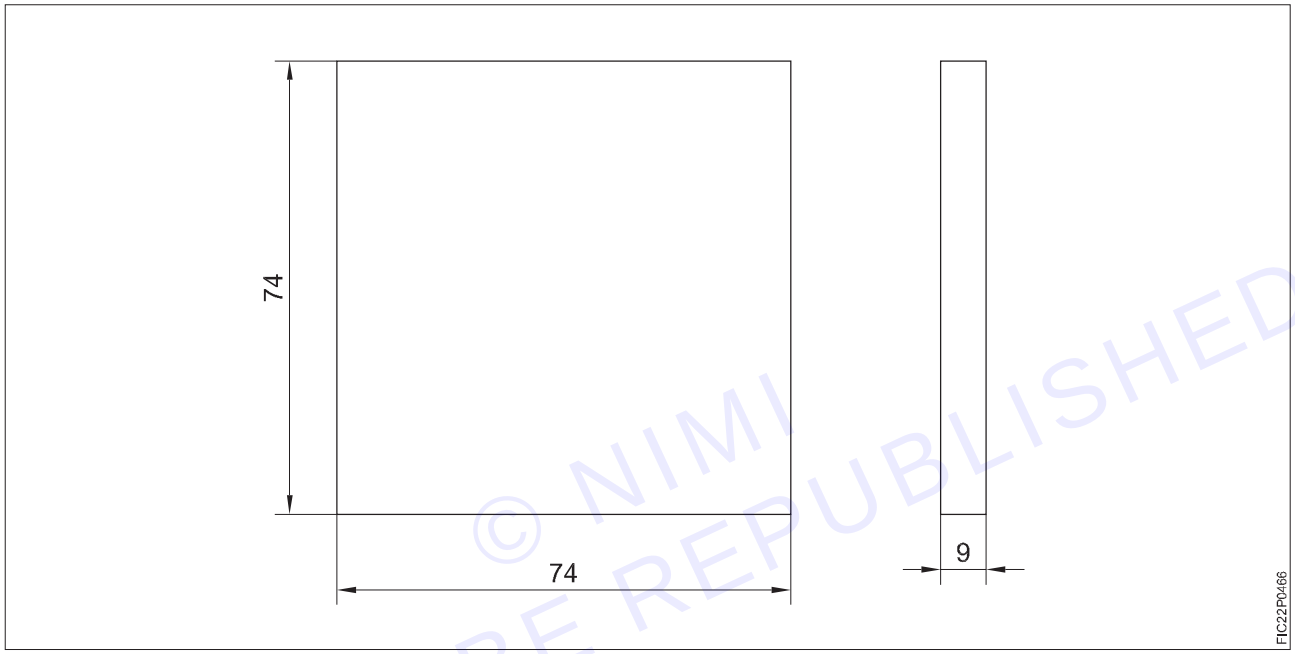
Check the wedge angle with a bevel protractor.

EXERCISE 19: Exercise on filing flat surface to right angle

Objectives

At the end of this exercise, you will be able to

- file flat, parallel surfaces within an accuracy of 0.02mm
- check parallelism with an try square
- check right angle with try square.



Bill of Metal: Mild steel flat 75 x 75 x 10 mm

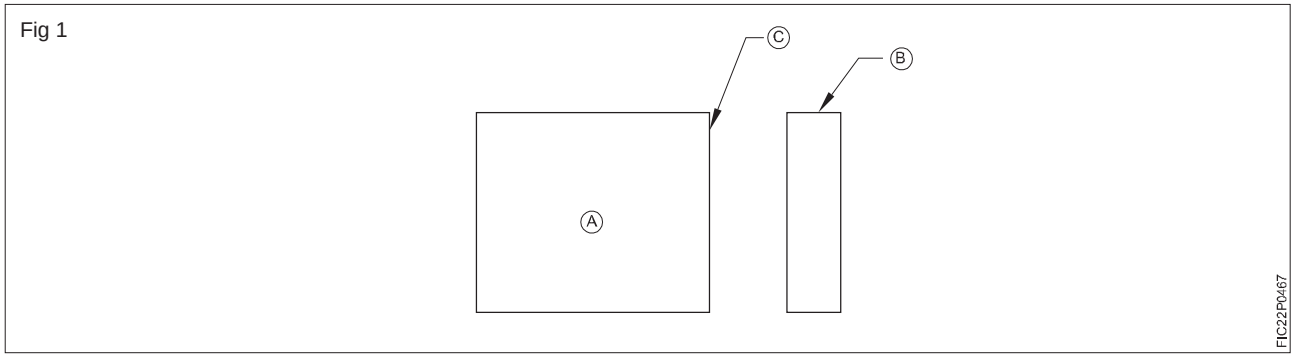
Job Sequence

TASK 1: **Chipping oil groove.**

- Check the raw material size using steel rule.
- Remove the scaling by flat rough file.
- File side (A) with flat bastard file (Fig 1)

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

Fig 1



- Check the flatness by blade of a try square.
- File side (B) and maintain the squareness with respect to side (A).
- Check the squareness with a try square.

Fig 2

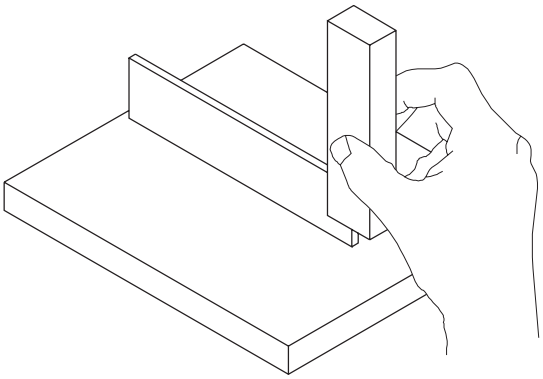
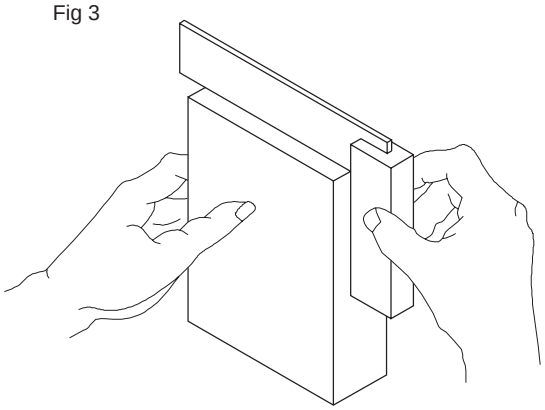


Fig 3



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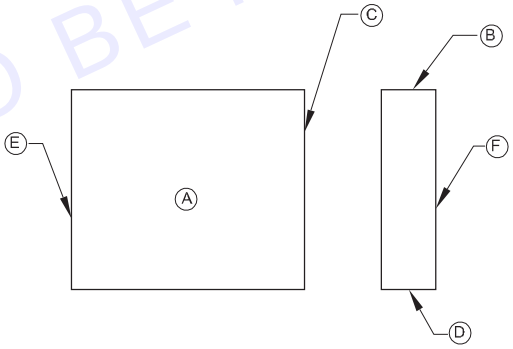
- Set Jenny caliper to 74 mm using steel rule.
- Draw parallel lines of 74 mm to side (B) and (C)
- Punch the marked line using dot punch and ball pein hammer.
- Set and file sides (D) and (E) to 74mm and maintain squareness to all other sides.
- Maintain (D) and (E) parallel to side (B) and (C) (Fig 4)
- Check the dimensions with a steel rule and squareness with a try square.
- File surface (F) and maintain the thickness of 9 mm parallelism to side A.
- Remove sharp edges. Apply little amount of oil and preserve it for evaluation.

Fig 4



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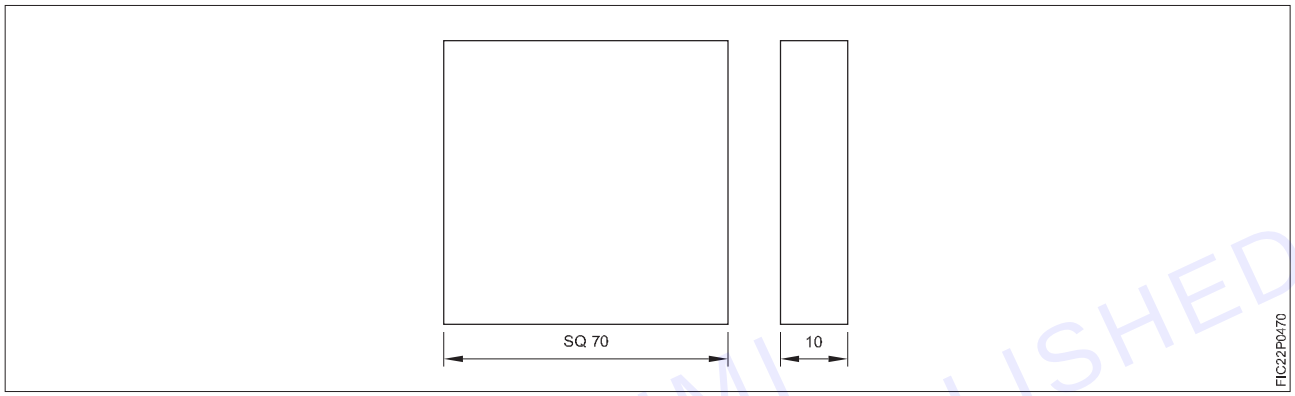
EXERCISE 20: Exercise on scraping practice on cast iron surface plate

Objectives

At the end of this exercise, you will be able to

- file surfaces flat and square to the accuracy of ± 0.04 mm
- find high spot on flat surfaces using prussion blue
- scrap on the flat surfaces and test.

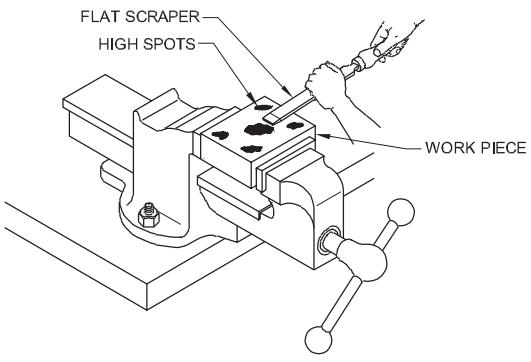


Job Sequence

Scraping on Flat Surface

- Check the raw material for its size.
- File metal to size 72x72x10 mm maintaining flatness and squareness..
- Check the size with vernier caliper.
- Clean the surface plate with soft cloth.
- Apply prussion blue evenly on the surface plate.
- Place the job on surface plate and move slightly forward and backward.
- Take the job from surface plate and notice the blue spotted marks on the flat surface.
- Hold the job in bench vice.
- Scrap and remove the high spots on the flat surface of the job using flat scraper Fig 1.

Fig 1



- Wipe off the scraped surface with soft cloth to remove burrs.

  Again, place the scraped surface on prussion blue applied surface and move forward and backward and notice the high spot marks.

- Repeat the scraping process untill the prussion blue spotted marks spread over the entire surface of the job.

Precautions

- Ensure that the workpiece is securely clamped or held in bench vice to prevent it from moving or shifting during scraping.
- Wipe off the scraped surface with soft cloth.
- Apply thin coat of oil and pressure it for evaluation.
- Make sure scraper is sharp and properly maintained. Dull tools can slip or cause uneven scraping,

.

EXERCISE 21: Scraping of flat bearing surface and their fitting

Objectives

At the end of this exercise you shall be able to

- find high spots on curved surfaces using prussion blue
- scrap curved surfaces and test.

Skill Sequence

A half round scraper is the most suitable scraper for scraping curved surfaces. This method of scraping differs from that of flat scraping.

Method

For scraping curved surfaces the handle is held by hand in such a way as to facilitate the movement of the scraper in the required direction. (Fig 1)

Pressure is exerted with the other hand on the shank for cutting.

Rough scraping will need excessive pressure with longer strokes.

For fine scraping, pressure is reduced and the stroke length also becomes shorter.

Cutting action takes place both on forward and return strokes. (Fig 2)

Fig 1

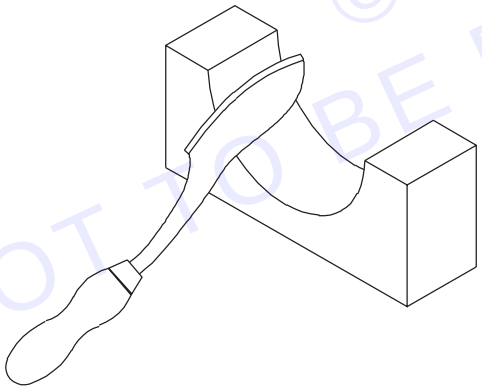
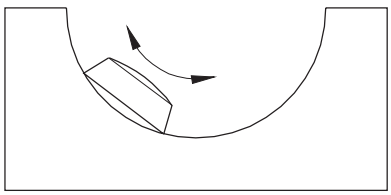


Fig 2



FIC22P0472

During the forward movement one cutting edge acts, and on the return stroke, the other cutting edge acts.

After each pass, change the direction of cutting. This ensures a uniform surface. (Figs 3 & 4)

Fig 3

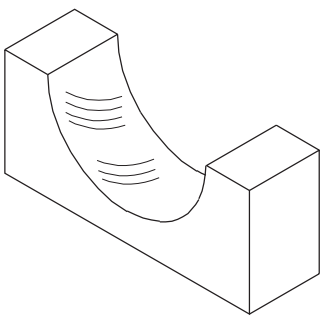
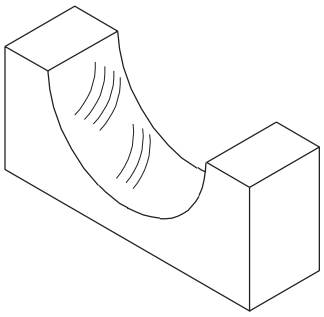


Fig 4

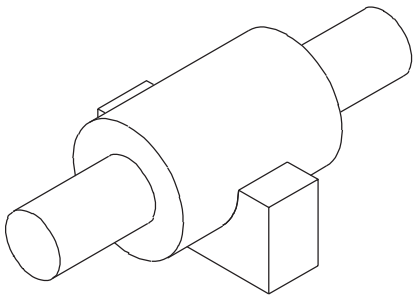


FIC22P0473

Use a master bar to check the correctness of the surface being scraped. (Fig 5)

Note: Apply a thin coating of Prussion blue on the master bar to locate the high spots.

Fig 5



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Sharpening a flat scraper

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

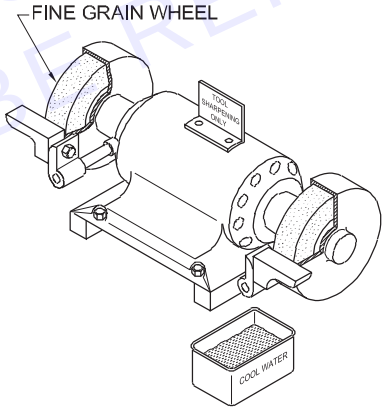
- sharpen a flat scraper by grinding and honing.

Flat scrapers are sharpened by grinding the cutting edge and honing both faces.

To avoid overheating while grinding, use wet wheel grinding or ensure that there is a cooling arrangement for the pedestal/bench grinder.

Select a grinding wheel with fine grain. (Fig 1)

Fig 1



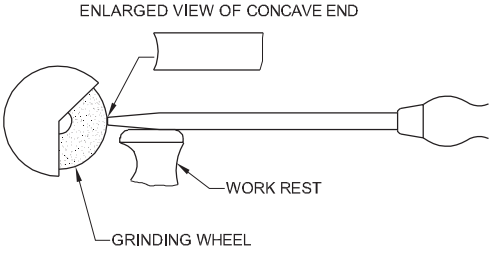
FIC22P0475

Soft grade aluminium oxide grinding wheel with large diameter gives best results

Note: Check for gap between the work-rest and the grinding wheel, and adjust, if neessary.

For grinding the cutting edges, hold the scraper horizontal and flat on the tool rest. (Fig 2)

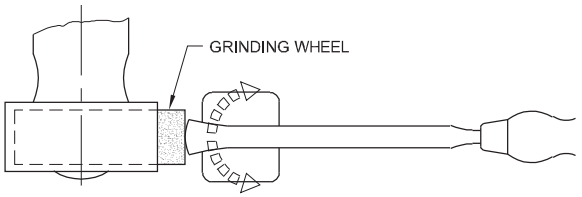
Fig 2



FIC22P0476

Move the scraper in an arc to provide a slightly concave surface on the cutting edge. (Fig 3)

Fig 3



Note: If the scraper is carbide-tipped use silicon carbide or diamond wheels. (Fig 4)

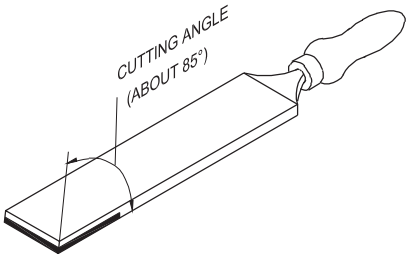
The cutting edges sharpened by grinding should be honed. Honing removes grinding marks and provides keen cutting edges.

Use a fine grade aluminium oxide oilstone for honing. While honing use a lubricant.

Mix light mineral oil with kerosene for preparing the lubricant.

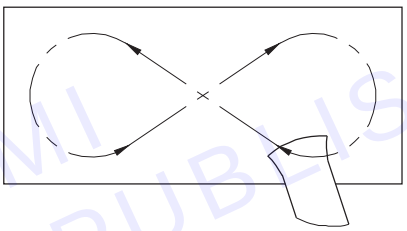
Hone the faces first with a movement as shown in Fig 5.

Fig 4



CEMENTED CARBIDE TIP SCRAPER

Fig 5



Then hone the cutting end by placing the scraper in an upright position on the oilstone with a rocking movement. (Figs 6 & 7)

Fig 6

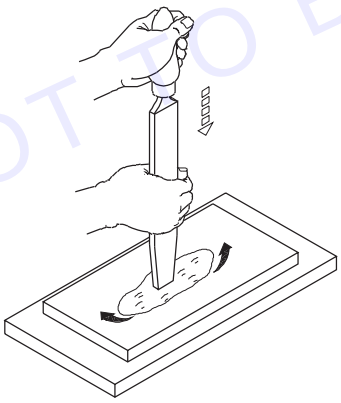
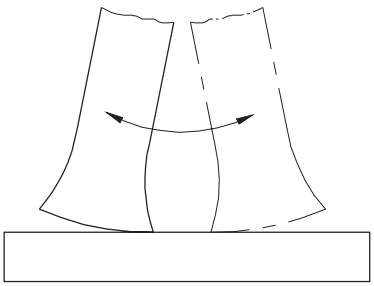


Fig 7



What should be the cutting angle? It should be

- for rough scraping - 60°
- for final scraping - 90°

Sharpening half round scrapers

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

- sharpen a half round scraper.

Scrapers are usually re-sharpened on oilstones. When cutting edges are badly damaged, they are ground on pedestal grinders.

Sharpening half round scrapers

Half round scrapers have two cutting edges on the rounded back. (Fig 1)

The cutting edges are formed by the bottom surface, and the flat surfaces are ground on the rounded back of the scraper. (Fig 2)

Fig 1

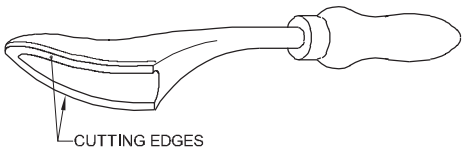
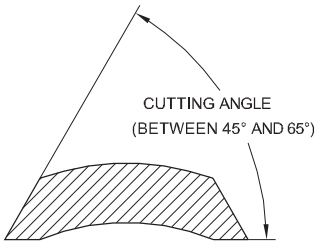


Fig 2



SECTION OF HALF - ROUND SCRAPER

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Grind the bottom surfaces with a slight curve. This helps the cutting edges to make point contact on the surfaces being scraped. (Fig 3)

Rub the bottom surface with a rocking motion on the oli stone for re-sharpening. (Fig 4)

Fig 3

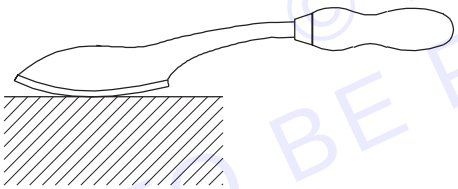
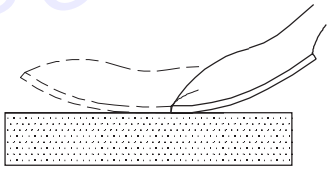


Fig 4



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When the cutting edge is blunt it can be re-sharpened by grinding the bottom surface.

Note: As far as possible avoid grinding of the edges. (Flat surface ground on the rounded back)

EXERCISE 22: Evaluation scheme & procedure how to check the job/exercise as per the marking scheme with tolerance ±0.02mm

Objectives

At the end of this exercise you shall be able to

- assessing the various skill and proficiency
- ability to use of cutting tools and precision measuring tools
- develop the required skill
- understanding and adhering to safety protocols and procedures
- develop problem-solving skills.

Evaluation Scheme

Objective Features (Requirement of tools, sequence of operation etc.)

S.No.	Objective Features	Marks	Score marks	Remarks
1				
2				
3				
4				
5				
6				
	Total marks			

Subjective Features (Handling of tools and instruments, Checking etc.)

S.No.	Subjective Features	Marks	Score marks	Remarks
1				
2				
3				
4				
5				
6				
	Total marks			

Attitude

S.No.	Attitude	Marks	Score marks	Remarks
1	Safety and cleanness			
2	Co-operation, Initiative and communication			
	Total marks			

Observations

S.No.	Observations	Marks	Score marks	Remarks
1	Observations			
2	Viva			
	Total marks			

Marking Scheme

S. No.	Name of the Trainee	Roll No.	Process	Accuracy	Finish	Time	Soft Skill	House Keeping	Total	Remarks
Marks			**25**	**25**	**15**	**15**	**10**	**10**	**100**	
1										
2										
3										
4										
5										
6										
7										
8										
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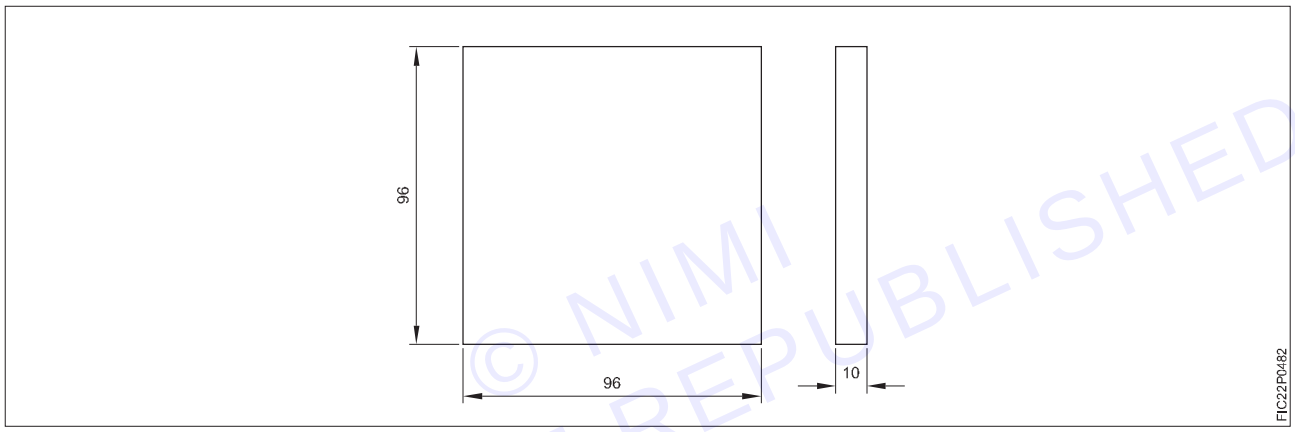
20										

EXERCISE 23: Right the sequence operations of the job / exercise with procedure to complete the job along with safety precautions

Objectives

At the end of this exercise you shall be able to

- prepare tool list for an exercise
- make Parallel surface
- making squareness of job
- application of marking tools
- cheking with precision measuring tools.



Sequence of Operations

1 Read the drawing thoroughly

2 Prepare required tools list as per drawing.

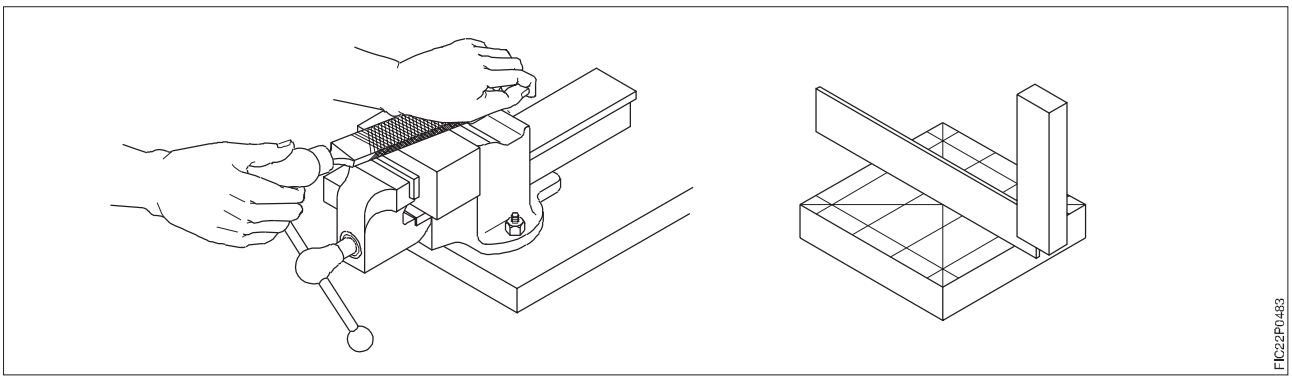
3 Check the raw material size using steel rule.

4 Remove scaling surface by flat rough file.

5 File the surface using flat bastard file.

6 Check the flatness by the blade of try square or using surface plate.

7 File the longer side surface of the job using flat bastard file.



8 Check flatness of longer side using try square or surface plate

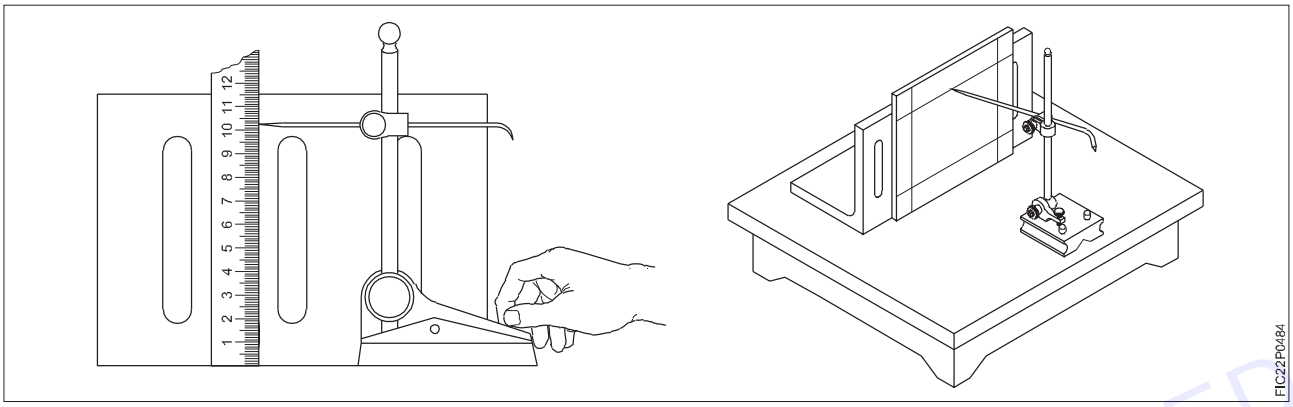
9 File shorter side using bastard file

10 Check squareness with the help of try square.

11 Remove the sharp edge by using flat bastard second cut file.

12 Apply a thin layer a marking media on the job surface.

13 Draw marking lines as per drawing.



14 Punch / Witness marks as per drawing using dot punch and marking hammer.

15 Remove the extra material from the job using chisel/ hacksaw frame with blade.

16 File the job up to marking lines using flat second cut file.

17 Check all the dimensions as per drawing using vernier caliper / micro meter.

18 Insure all the dimensions with in tolerance using flat second cut file.

19 Maintain thickness as per drawing.

20 Finish the job with in tolerance using smooth file.

21 Remove all the burrs/sharp edge of the job using second cut file / emery paper / oil stone.

22 Use oil on finish job surface.

23 Pack job using oil paper.

Safety precautions

1 Hold the work piece rigidly in the holding device.

2 Use the file with Wooden / plastic handle.

3 Remove sharp edge / burrs of the job using flat file.

4 Don't use the oil / grease on the file or job surface.

5 Handle carefully precision measuring instruments.

6 Don't mix precision measuring instruments with cutting tools.

7 Use filing speed as per material of the job.

8 Select correct pitch of the blade as per raw material in hacksawing.

9 Check squareness properly.

10 Don't touch filed surface.

MODULE 2

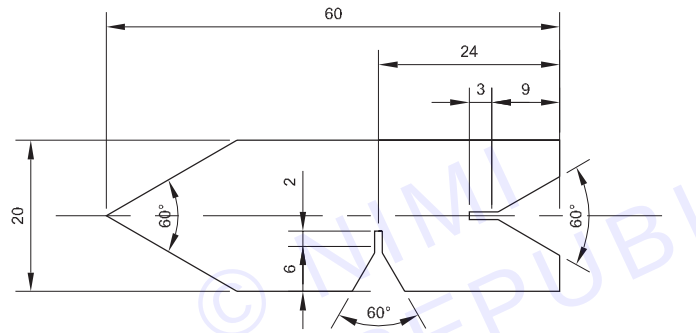
EXERCISE 24: Making scheme and evaluation of intricate profile of exercise

Objectives

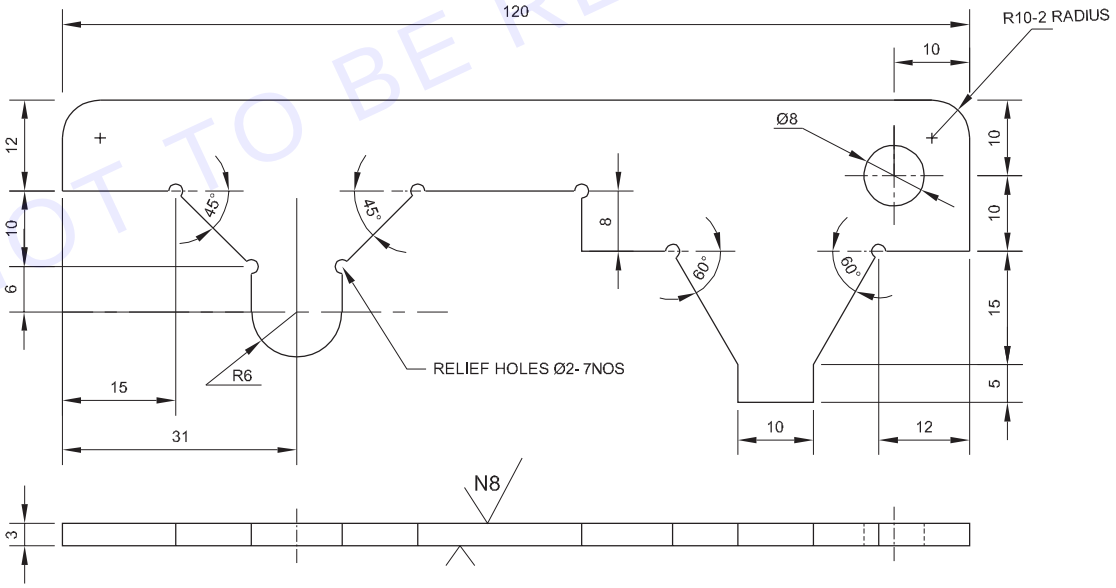
At the end of this exercise you shall be able to

- mark dimension with Vernier height gauge for Task 1 and 2
- mark angle with Vernier bevel protractor for Task 1 and 2
- make relief by hacksawing
- file external and internal V groove
- evaluation of intricate profile.

TASK 1



TASK 2



Job Sequence

TASK 1: **Angle gauge**

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

— — — — —

TASK 2: **Template of different profiles**

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

Marking scheme and Evaluation of intricate profile

S.No.	Name of the Trainee	Roll No.	Process	Accuracy	Finish	Time	Soft Skill	House Keeping	Total	Remarks
Marks			25	25	15	15	10	10	100	
1										
2										
3										
4										
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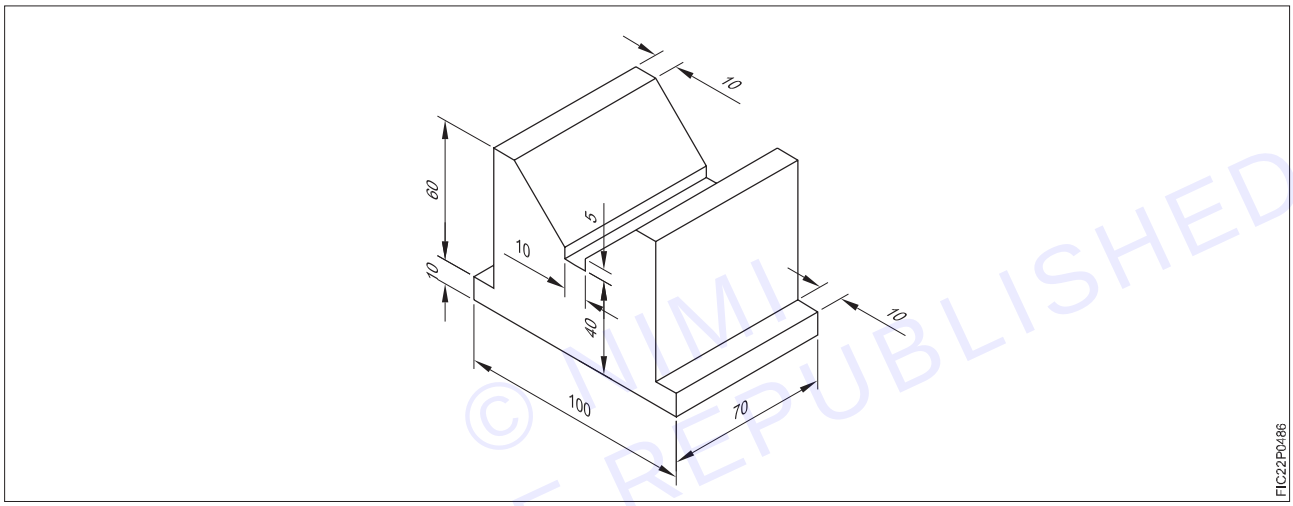
EXERCISE 25: Making a V-block from cast Iron as per drawing

Objectives

At the end of this exercise you shall be able to

- hold and concentric job in four jaw chuck of Lathe Machine
- operate and carry out plain turning operation on the lathe machine
- making Block in Lathe Machine using single point cutting tool
- slant hacksawing.



Job Sequence

1 Hold the Cast Iron Block in 4 jaw chuck of the Lathe Machine for removing the scaling (casted) surface.
2 True (concentric) the job using marking block.
3 Hold and set the turning tool in the tool post of lathe machine.
4 Turn & finish the surface of a block.
5 Dismantling the C.I Block from 4 jaw chuck of centre lathe.
6 Hold & true the block in 4 jaw chuck of centre lathe for turning adjacent surface of block.
7 Check perpendicularity (right angle) of the machined surface of block.
8 Turn and maintain all the 6 surfaces of cast iron block.
9 Maintain the size of cast iron block 102x72x72 mm.
10 Use a thin layer of marking media.
11 Mark and punch as per drawing.
12 Cut extra material using Hacksaw.
13 Cut and maintain side slot 70x60x10 mm.
14 Check and maintain right angle of side slot 70x60x10mm
15 Cut V groove using slant hacksawing on both sides.

16 Maintain V groove using flat second cut file.

17 Check V groove 90 degree angle using protractor head or Vernier bevel protractor.

18 Maintain depth of v groove 25mm.

19 Prepare square slot 10mm breadth and 5mm depth using square file.

20 Check and maintain square slot 10mm breadth, 70 length and 5mm depth.

21 Cut other side slot 70x60x10 mm using hacksaw.

22 Finish and check side slot 70x60x10 mm.

23 Maintain v block size 100x70x70mm as per drawing using second cut file.

24 Check the size using Vernier caliper with accuracy 0.02mm.

25 Remove sharp edge/ burrs of surfaces.

26 Oil and pack with oil paper.

Bill of Metal

Cast Iron Block 105x75x75 mm

Safety precautions

1 Handle lathe machine under guidance of trainer.

2 Hold the job in 4 jaw chuck properly.

3 True (concentric) the job carefully using marking block.

4 Set proper height of turning tool in the tool post.

5 Check perpendicularity of machined surface.

6 Remove burrs/sharp edge after machining.

7 Grind turning tool carefully.

8 Clean and oiling to the sliding surface of lathe machine after working.

9 Cut the v groove with slant hacksawing carefully.

10 Don't use file without handle.

11 Handle carefully to precision measuring tools.

12 Check zero error of Vernier caliper before using.

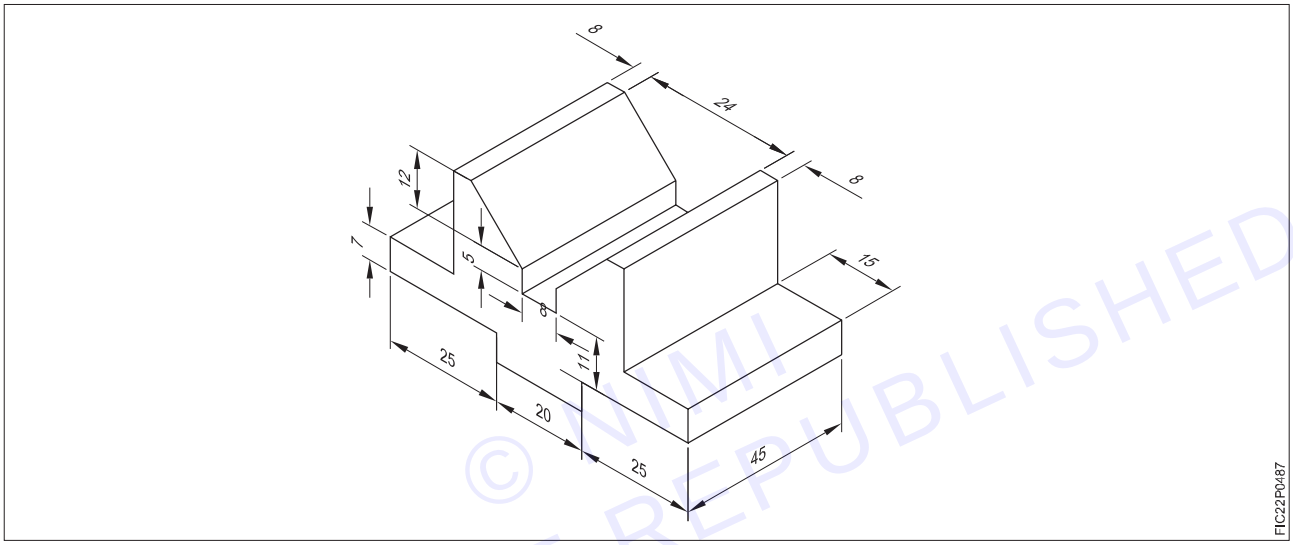
13 Clean all the tools such as marking, cutting and measuring tools after work.

EXERCISE 26: Making a V-block from mild steel as per drawing

Objectives

At the end of this exercise you shall be able to

- layout identical components for economical use of raw material
- slant hacksawing
- file square and step
- taper filling & finish.



Procedure

1 Check the raw material as per drawing.
2 Cut the block as per bill of metal.
3 Rough and finish fill to size 75 X50X40 mm Block
4 Study the drawing and mark the block as per dimensions with reference to centre line on both surfaces.
5 Punch the block
6 Cut the extra material using hacksaw.
7 Cut the v groove by slant hacksawing using hacksaw.
8 Cut a v template for checking v groove at 90°
9 Maintain V groove 90° and check.
10 Fill and finish template at 90°.
11 Check template accurately at 90° using vernier bevel protractor.
12 File V groove and finish.
13 Check v groove using template.
14 Mountain v groove at 90°.
15 File square and finish 10 X 5 X 70 mm slot.

16 Check square slot.

17 File & finish template 90° and check accurately.

18 Check the v groove using template.

19 File & finish all dimension of v block.

20 Checking dimensions using vernier coliper .

21 Finish all the dimensions as per drawing using finish file.

22 Remove sharp edge / burrs of the side.

23 Use oil and packing in oil paper

Bill of Metal

M.S.block 75 X 50 X 40mm

Safety Precautions

1 Read the drawing thoroughly.

2 Don't use file without handle.

3 Remove the sharp edge / burrs of the job using files.

4 Don't use the oil / grease on the file or job surface.

5 Handle carefully precision measuring instruments.

6 Don't mix precision measuring instruments with cutting tools.

7 Use filing speed as per material of the job.

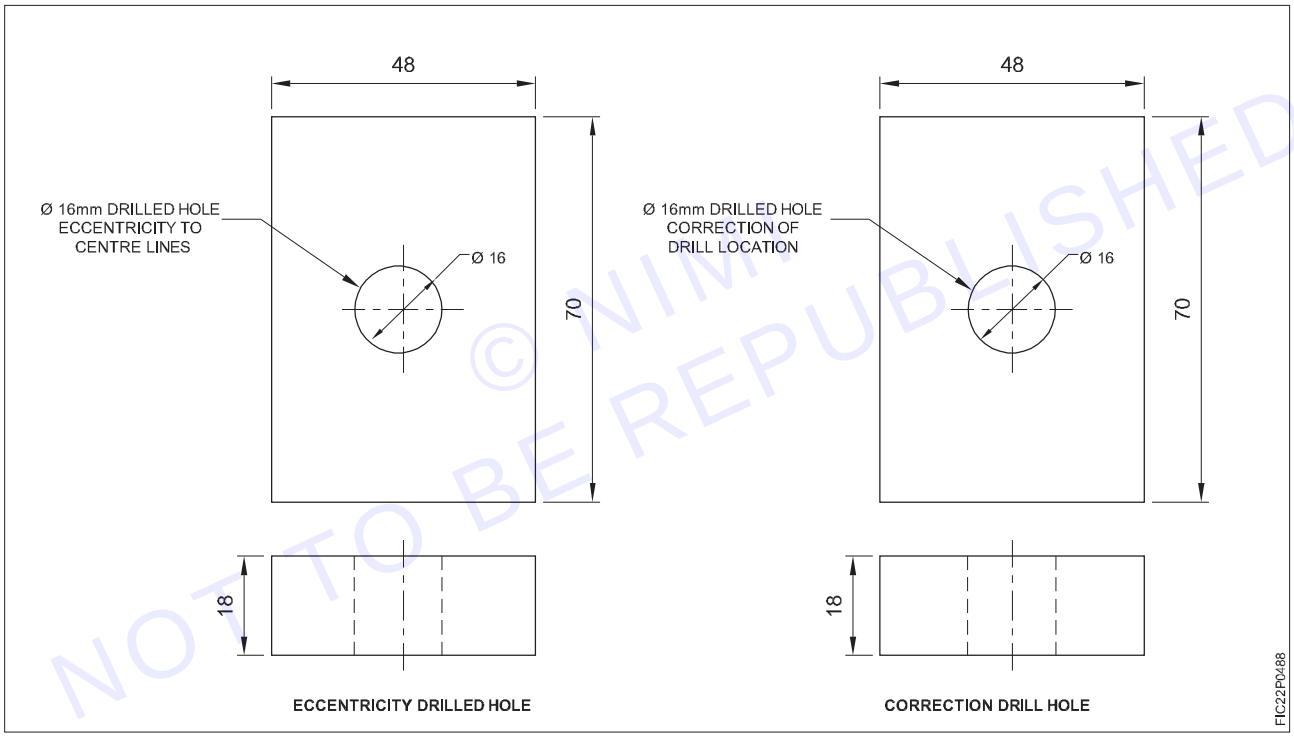
8 Select correct pitch of the blade as per raw material in hacksawing

EXERCISE 27: Relocating a wrongly positional drilled hole & checking concentricity & dimension for true drilling

Objectives

At the end of this exercise you shall be able to

- prepare round rod more than the hole size
- plug the hole as tight fit
- file the plugged surface on both sides flat and square
- mark the hole location concentricity to centre lines
- drill pilot and correct drill hole concentricity to the centre lines.



Job Sequence

- Check the given material hole size Fig 1.
- Punch on the drill hole centre mark with centre punch 90°.
- Fix centre drill in drill chuck and make centre drill hole.
- Fix Ø 6 mm drill and drill hole as a pilot hole
- Similarly fix Ø 9 mm, Ø 13 mm drill and enlarge the previously drilled holes.
- Prepare round rod more than 0.050 mm actual size of drilled hole (16.000 + 0.050 = 16.050 mm)
- Plug the hole as tight fit with prepared round rod using ball pein hammer (Fig 2).
- File the plug surface on both sides to flat and square.
- Apply marking media on surface.

Fig 1

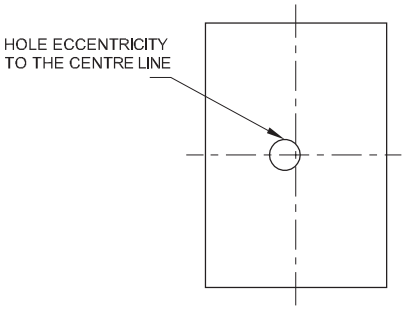
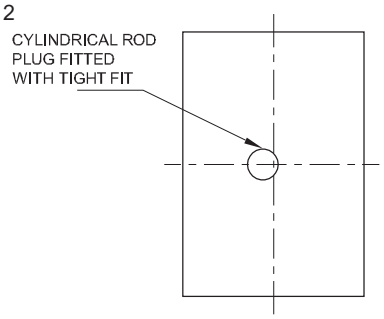


Fig 2



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- Mark correct centre for drill hole with vernier height gauge (Fig 3)
- Finally, fix Ø 16 mm drill and enlarge the previously drilled hole Fig 4.
- Check concentricity of drilled hole Ø 16 mm using dial test indicator DTI.

Fig 3

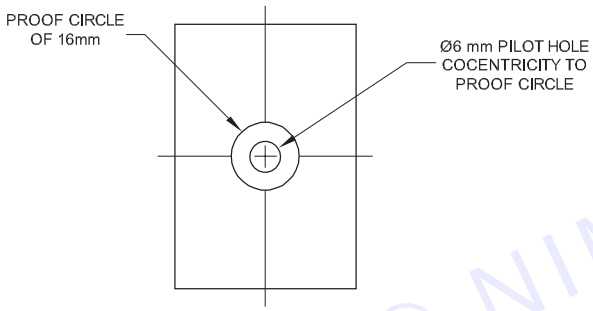
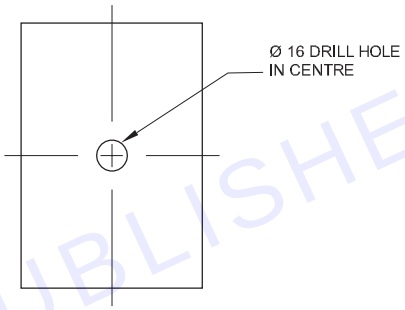


Fig 4



FIC22P0490

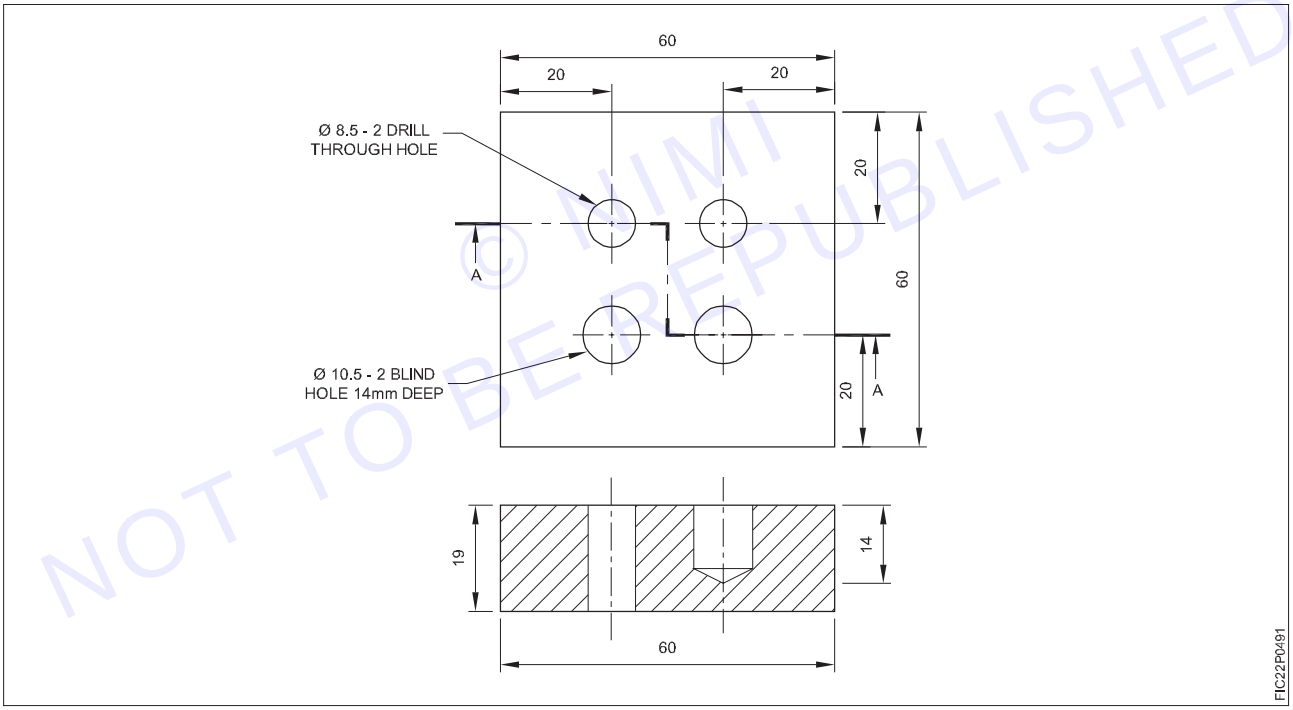
- Finish file, de-burr, clean and check dimensions with vernier caliper
- Apply a little oil and preserve it for evaluation.

EXERCISE 28: Practice on drilling through and blind holes on ferrous & non-ferrous metals to a positional accuracy of ±0.10mm

Objectives

At the end of this exercise you shall be able to

- mark drill hole centres using vernier height gauge
- set the correct spindle speed in drilling machine
- drill through hole as per drawing
- set the depth bar to drill blind hole
- drill blind hole to the required depth size.
- drill on ferrous and non- ferrous metal.



Job Sequence

- Check the raw material size.
- File and finish the metal to size 60 x 60 x 19 mm maintaining parallelism and perpendicularity.
- Check the flatness and squareness with try square and size with vernier caliper.
- Apply marking media and mark drill holes centres using vernier height gauge as per drawing.
- Punch on drill holes centres using centre punch 90°
- Hold the job in drilling machine table.
- Make centre drill in drill holes centres.

- Fix Ø 6mm drill in drilling machine spindle through drill chuck and drill pilot holes for both through and blind holes.
- Use soluble oil as coolants for drilling Mild steel workpiece .
- Fix Ø 8.5 mm drill and drill through hole as per drawing.
- Fix Ø 10.5 mm drill and drill blind hole to the required depth of 14 mm using depth stop of drilling machine.
- Use kerosene oil for drilling in Aluminum flat.
- File and de - burr in all the surfaces of the job.
- Apply a thin coat of oil and preserve it for evaluation.

Skill Sequence

Drilling blind holes

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

- drill blind holes to the required depth using the depth stops.

Method of controlling depth of blind holes

While drilling blind holes, it is necessary to control the feed of the drill. Most machines are provided with a depth stop arrangement by which the downward movement of the spindle can be controlled. (Fig 1)

Most depth stop arrangements will have graduations by which the advancement of the spindle can be observed.

Generally the blind hole depth tolerances are given up to 0.5 mm accuracy.

Setting for drilling blind holes

For blind hole - depth setting, first the work is held on the machine and the hole is located correctly.

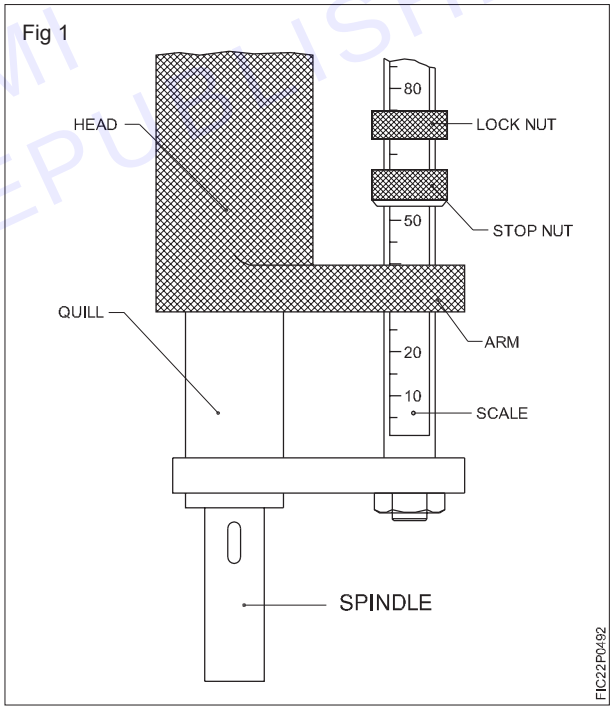
The drill is started, and it drills until the full diameter is formed. Note down the initial reading at this point. (Fig 2)

Add the initial reading to the depth of the blind hole to be drilled.

Initial reading + Depth of hole = Setting.

Adjust the stop next to the required setting, using the scale.

Fig 1



Tighten the lock nut to prevent the setting from being disturbed.

Start the machine and feed the drill. When the stop nut reaches the arm, the blind hole is drilled to the required depth. (Fig 3)

While drilling, release the drill frequently from the hole for the chips to be flushed out by the cutting fluid.

Fig 2

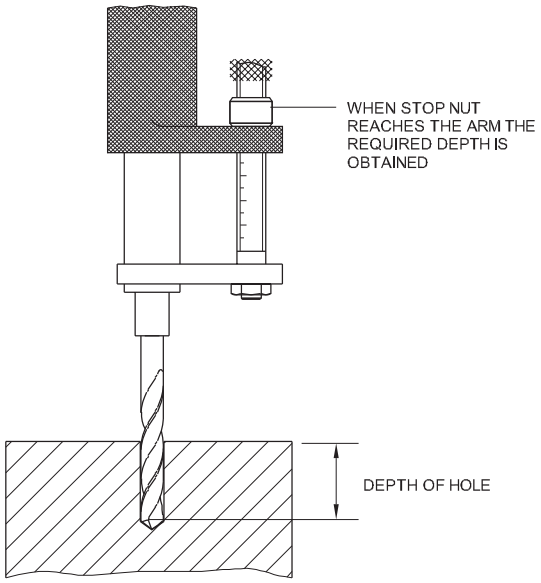
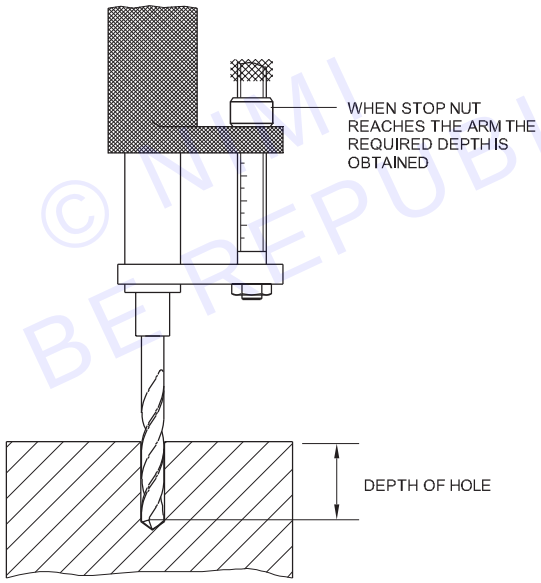


Fig 3



Bill of Metal: Mild steel flat: 62x62x20 mm

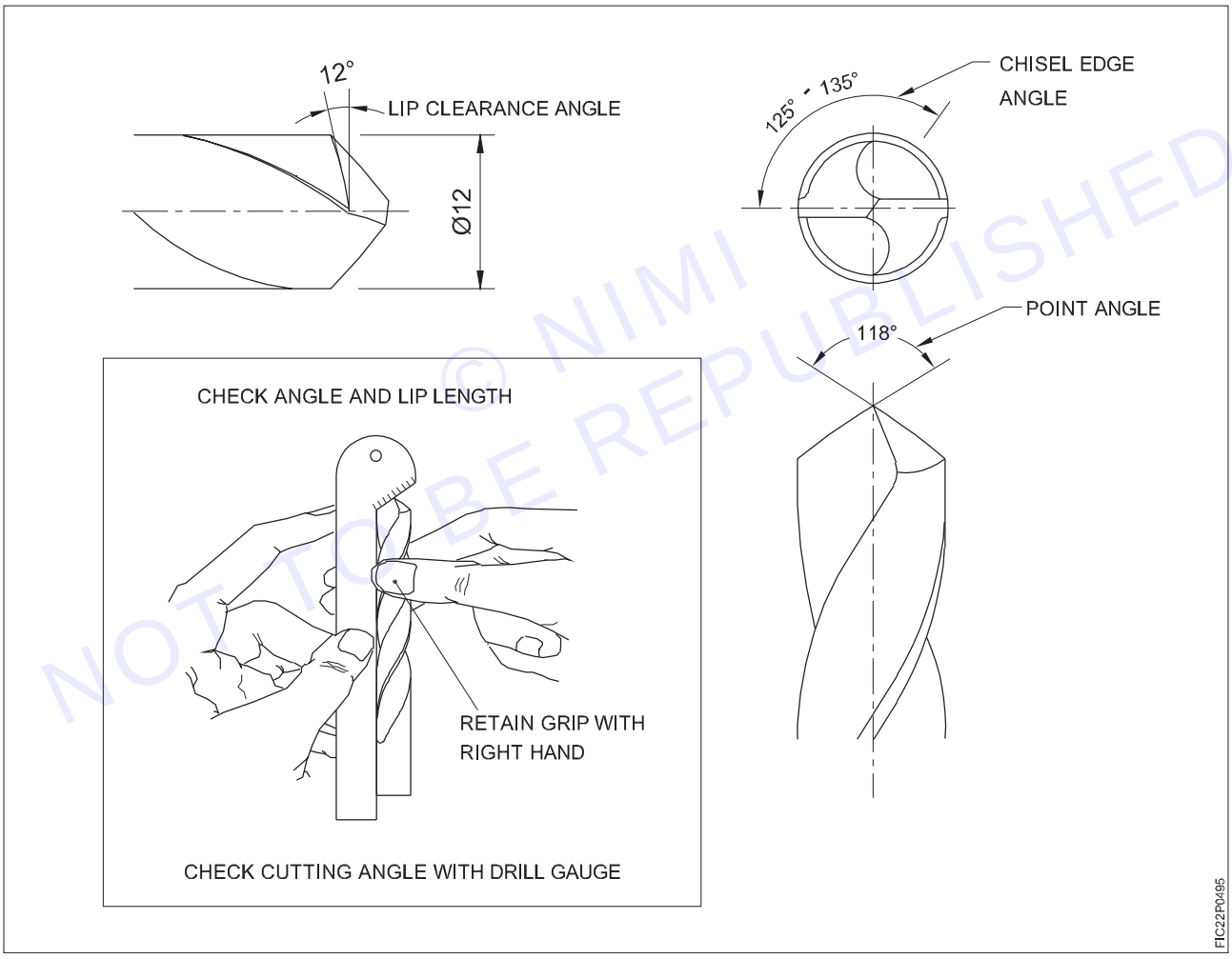
Aluminium flat: 62x62x10mm (for Non ferrous metal)

EXERCISE 29: Practical/exercise on grinding twist drill and without attachment and checking angle with gauge

Objectives

At the end of this exercise you shall be able to

- dress the grinding wheel.
- identify the grinding machine and parts
- re-sharpen the drill in pedestal grinder
- check the drill angle using drill gauge.



Job Sequence

- Hold the blunt twist drill properly in both hands.
- Place the drill on tool rest.
- Touch the cutting edge of a twist drill in grinding wheel face maintaining 31°angle from grinding stone.
- Twist the drill slightly on wheel face and grind one cutting edge the required angle to get 59°.
- Similarly, grind the other cutting edge to the required angle to get 59° maintaining the cutting edges length equal.

Swing the shank of the drill slightly down wards while grinding.

While sharpening drill, the cutting edges length and angles should be equal.

- Check the cutting angle and cutting edge length in to drill grinding gauge.
- Switch off the grinding machine and clean properly.

Wear safety goggles while sharpening twist drills.

Skill Sequence

Off - Hand grinding with bench and pedestal grinders

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

- state off hand grinding with bench and pedestal grinders.

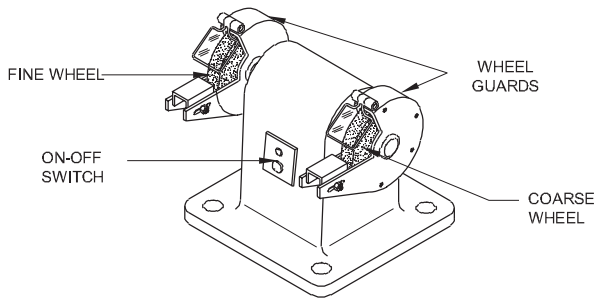
Off - hand grinding is the operation of removing material which does not require great accuracy in size or shape. This is carried out by pressing the workpiece by hand against a grinding wheel.

Off - hand grinding is performed for rough grinding of jobs and re -sharpening wheel.

scribers punches chisels twist drills, single point cutting tools etc.

off - hand grinding is performed with a bench or pedestal grinder. (Fig 1)

Fig 1



BENCH TYPE GRINDER

Bench grinders

Bench grinders are fitted to a bench or table, and are useful for light duty work.

Pedestal grinders

Pedestal grinders are mounted on a base (pedestal), which is fastened to the floor. They are used for heavy duty work.

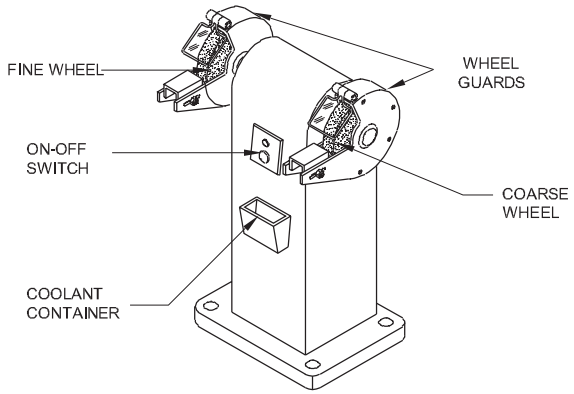
These grinders consist of an electric motor and two spindles for mounting grinding wheels. On one spindle a coarse - grained wheel is fitted, and on the other, a fine grained wheel. For safety, while working, wheel guards are provided. (Fig 2)

A coolant container is provided for frequent cooling of the work. (Fig 2)

Adjustable work - rests are provided for both wheels to support the work while grinding. These work - rests must be set very close to the wheels.

Extra eye - shields are also provided for the protection of the eyes. (Fig 2)

Fig 2



PEDESTAL TYPE GRINDER

Re-sharpening a twist drill

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

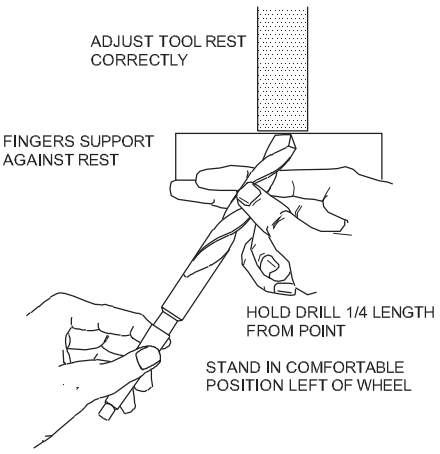
- state about resharpening a twist drill.

- A twist drill can be successfully sharpened on a bench or pedestal grinder by adopting the following preocedure.
- Check that the surface of each wheel is running true and that the wheels are dressed clean.

Ensure that the tool-rest are adjusted correctly and tightened.

- Wear safety goggles.
- Stand in a comfortable position in front of the machine.
- Hold the drill at about one quarter of its length from the point, between the thumb and the first finger of the right hand. (Fig 1)

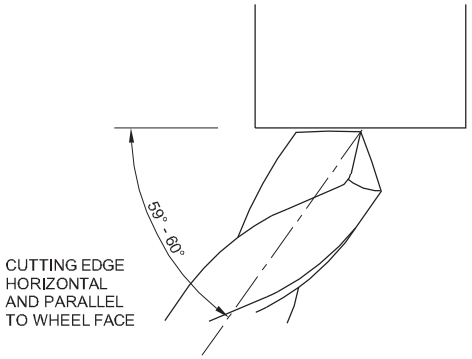
Fig 1



Keep both elbows against the side.

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

Fig 2



Hold the drill level. Twist it until one cutting edge is horizontal and parallel to the wheel face. (Fig 3)

Swing the shank of the drill slightly downwards and to the left with the left hand. The right hand is on the tool-rest. (Fig 4)

Fig 3

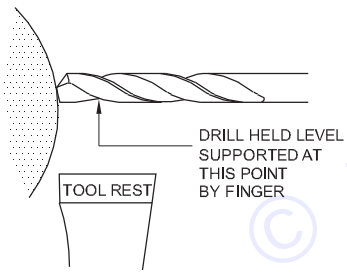
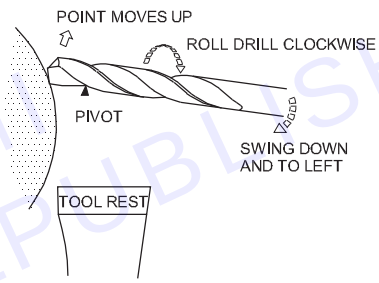
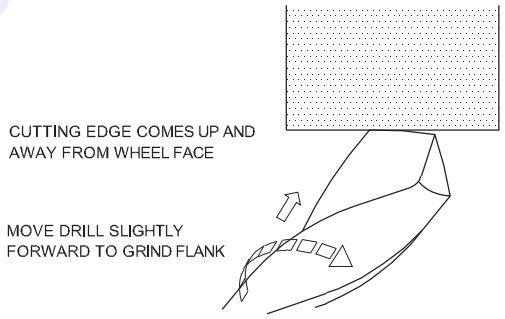


Fig 4



Watch the cutting edge against the wheel. Note that, as the shank, swings down, the cutting edge comes slightly upwards and away from the wheel face. (Fig 5)

Fig 5



Apply a slight foward 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

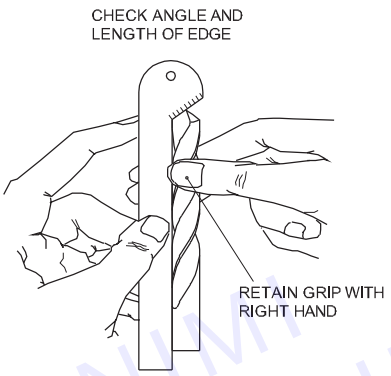
Move the drill back, clear of the wheel face.

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

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

Use a drill angle gauge to check that the cutting angle is correct (118° for mild steel), the cutting edges are of equal length and the lip clearances are equal and correct (about 12°). (Fig 6)

Fig 6



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

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

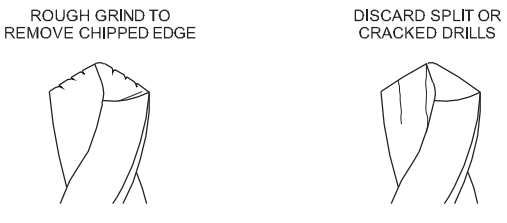
Hold the drill shank again in the left hand with the elbows against the side. The drill will locate back against the wheel face in the same position and at the same angle as before.

Points to be considered when sharpening drills

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

Rough down the drill point with a coarse grit wheel when the edges are badly chipped.(Fig 7)

Fig 7



Never re-sharpen a cracked or split drill. Avoid overheating the drill.

Apply light pressure against the wheel face. Lift the edge clear of the wheel face frequently. This allows the air stream produced by the wheel to cool the drill point.(Fig 8)

Fig 8

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

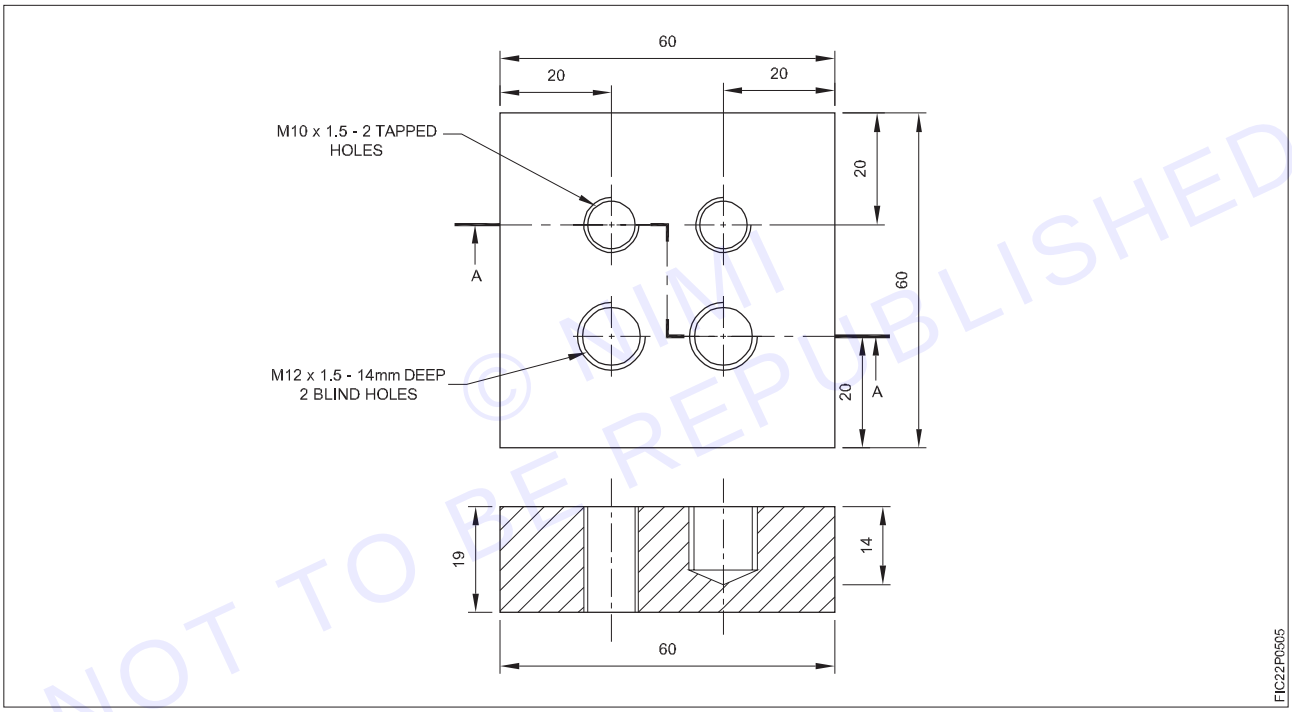
Re-sharpening of very small drills requires great skill. They require proportionally less movement to produce the cutting angles.

EXERCISE 30: Exercise on tapping through and blind holes to suit stud & bolt

Objectives

At the end of this exercise you shall be able to

- determine the hole size for tapping
- chamfer the holes for tapping
- set the tap in the hole
- set the height for blind hole
- drilling blind hole
- cut internal threads in through and blind holes using hand tap and tap wrench.



Job Sequence

Cut internal thread in through hole

- Use old finished job for this excercise.
- Make throughout hole (8.5mm dia) for making M10 thread.
- Fix the job in bench vice.
- Fix M 10 first tap in tap wrench and cut internal thread in through hole.
- Similarly, fix M 10 second tap and third tap in tap wrench one by one and cut the internal thread to form full thread.
- Repeat the above process to cut internal thread in other drilled through hole.

Cut internal thread in blind hole

- Remove metal chips if any from the blind hole by turning it upside down and slightly tapping it on a wooden surface.

- Fix the M 12 first tap in tap wrench.
- Screw a matching nut on the first tap to the required distance for 14 mm to act as a depth stop.
- Cut internal thread in blind hole to the required depth 14 mm.
- Remove the metal chips, if any from the threaded blind hole.
- Similarly, fix M 12 second tap and third tap in tap wrench one by one and cut the thread to form full thread.
- Clean the threaded hole without burrs.
- Repeat the above process to cut internal thread in other drilled blind hole.
- Check the threaded hole using the M10, and M12 matching bolts by screwing.
- Apply thin coat of oil and pressure it for evaluation

Use cutting fluid while cutting the thread.

Internal threading of through holes using hand taps

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

- practice internal threading of through holes using hand taps

Determining the tap drill size

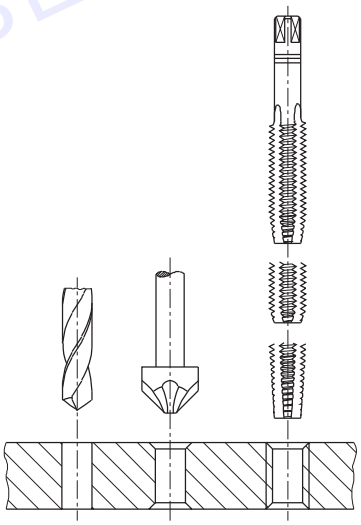
For cutting internal threads, it is necessary to determine the size of the hole (tap drill size). This can be calculated using the formula or can be chosen from the table of the tap drill sizes.

Procedure

Drill the hole to the required tap drill size.

Do not forget to give the chamfer required for aligning and starting the tap. (Fig 1)

Fig 1



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

Use soft jaws while holding the finished surface on the vice.

Fix the first tap (taper tap) in the wrench.

Too small a wrench will need a greater force to turn tap. Very large and heavy tap wrenches will not give the feel required to turn the tap slowly as it cuts.

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

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

Fig 2

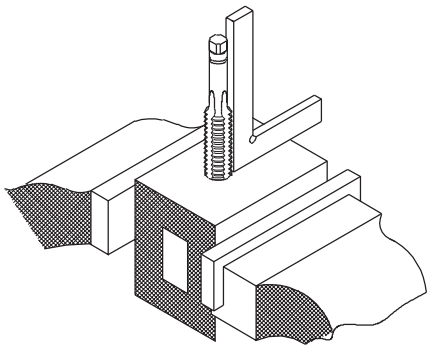
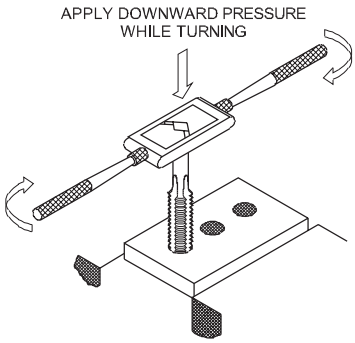


Fig 3



STARTING THE TAP

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When you are sure of starting of the thread, remove the tap wrench without disturbing the tap alignment.

Check and make sure the tap is vertical. Use a small try square for help. (Fig 4)

Place the try square in two positions, 90° to each other. (Fig 5)

Fig 4

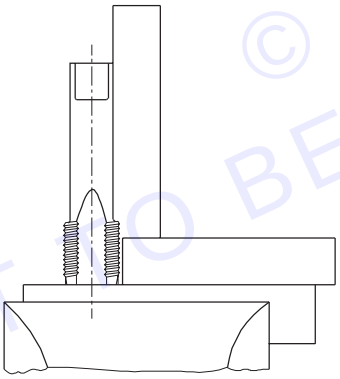
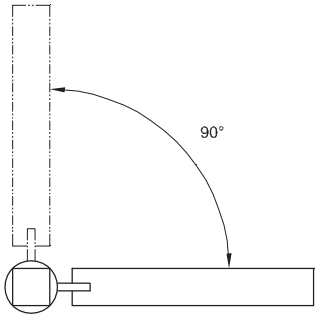


Fig 5



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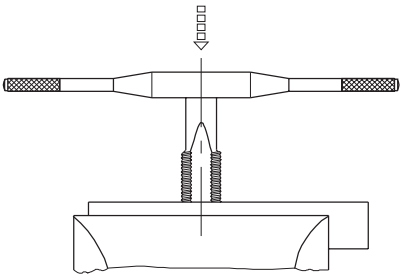
Make corrections, if necessary. This is done by exerting slightly more pressure on the opposite side of the tap inclination. (Fig 6)

Fig 6



SQUARING UP THE TAP

FIC22P0509

Never apply side pressure without giving a turning motion to the tap.

Check the tap alignment again with a try square.

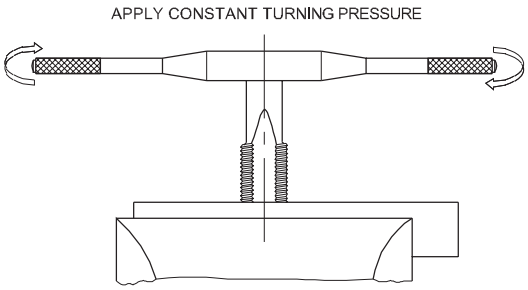
Fit the tap wrench, and tighten without disturbing the tap alignment.

Make one or two turns and check the alignment.

The tap alignment should be corrected within the first few turns. Afterwards this cannot be done for the threads will break.

After the tap is positioned vertically, turn the wrench lightly by holding the ends of the wrench handles without exerting any downward pressure. (Fig 7)

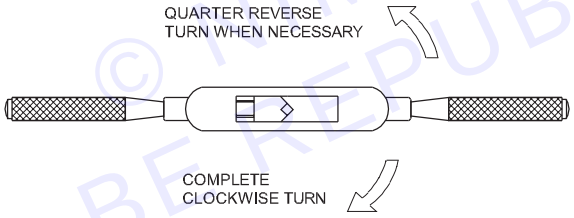
Fig 7



While turning the wrench, the movement should be well balanced. Any extra pressure on one side will spoil the tap alignment and can also cause breakage of the tap.

Continue cutting the thread. Turn backwards frequently, about quarter turn, to break the chip. (Fig 8) Stop and turn backwards also when some obstruction to movement is felt.

Fig 8



Cut the thread until the tap is fully inside the hole being threaded.

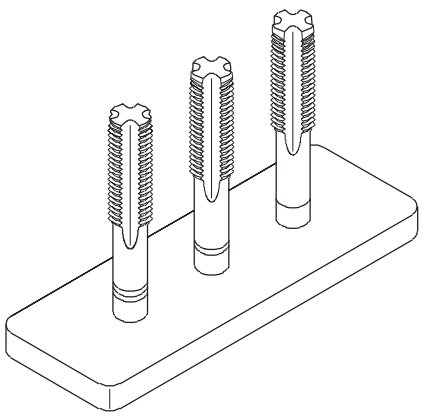
Use a cutting fluid while cutting the thread.

Finish and clean up using intermediate and plug tap. The intermediate and plug tap will not cut any thread if the tap has entered the hole fully.

Remove the chips from the work with a brush. Check the threaded hole with a matching screw.

Clean the tap with a brush, and place it back on the stand (Fig 9)

Fig 9



Internal threading blind holes using hand taps

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

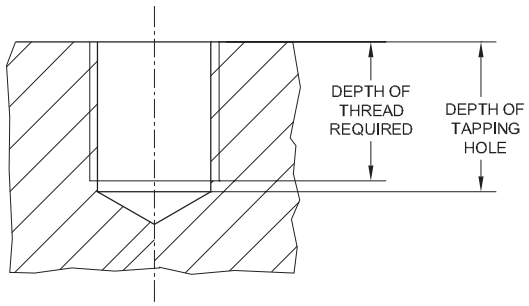
- practice Internal threading blind holes using hand taps.

Drilling a blind hole

Determine the tapping drill size using the table for tapping drill sizes.

Drill a blind hole using the depth stop arrangement. The depth of the tapping hole should be slightly more than the depth of the required thread. (Fig 1)

Fig 1



Procedure for threading

Remove metal chips, if any, from the blind hole by turning it upside down and slightly tapping it on a wooden surface.

Do not clear the chips by blowing as it can cause injury to your eyes.

Screw a matching nut on the first tap to act as a depth stop. (Fig 2)

Thread the blind hole until the nut touches the plate surface.

Remove the chips from the hole frequently, using a flattened and bend wire. (Fig 3)

Fig 2

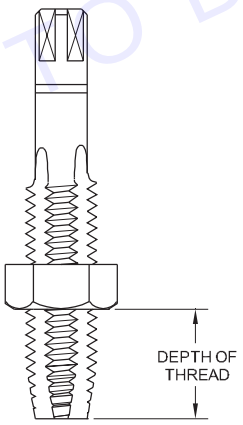
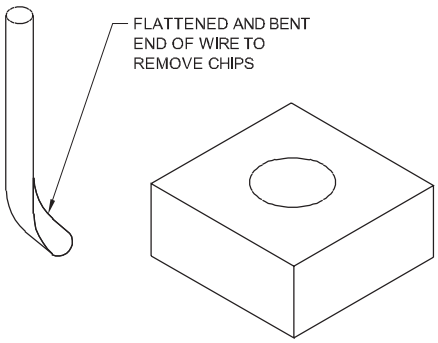
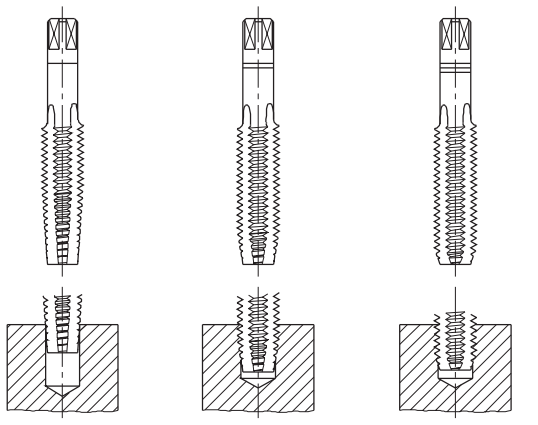


Fig 3



Finish tapping the hole with intermediate and bottoming tap. Set the nut to control the depth of the thread. (Fig 4)

Fig 4

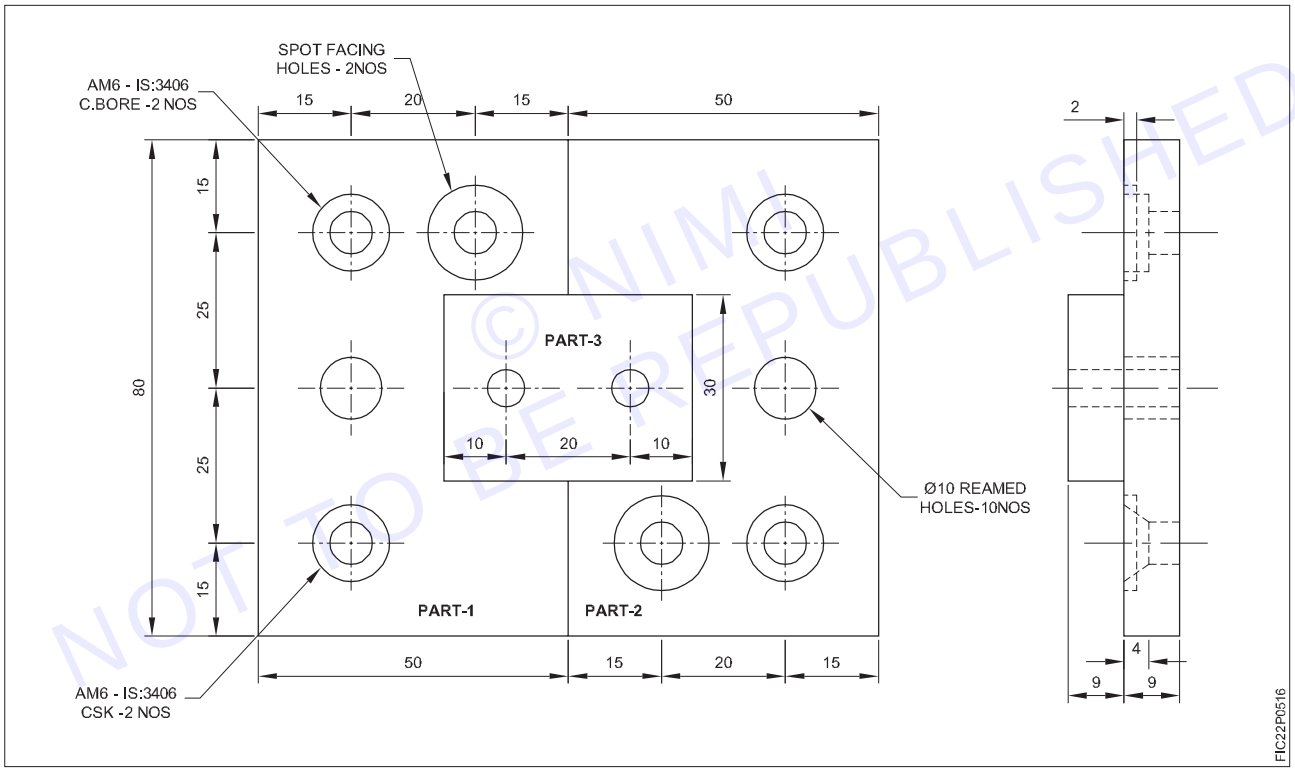


EXERCISE 31: Demonstration and exercise on counter bore, counter sink, spot facing reaming holes - three pieces fitting with dowel pins

Objectives

At the end of this exercise you shall be able to

- mark the lines as per job drawing
- drill, counter sink, counter bore and ream the holes as per drawing
- drill, spot face as per drawing .
- cut and remove excess metal in part 1, 2 and 3.
- file and finish to size and shape,
- make and fit using dowel pins as per drawing.



Job Sequence

- Check the raw material for its size.
- File and finish to over all size of part 1 and 2 to 80x50x9 mm, part 3 to the size of 40x30x9 mm maintaining parallelism and perpendicularity.
- Mark the hole centres using centre punch and punching in part 1, 2 and 3 as per drawing..
- Mark the hole centres using centre drill .
- Fix the job in drilling machine table with suitable clamps.
- Fix centre drill in drilling machine spindle through drill chuck and drill centre drilling in all drill holes centres.
- Fix Ø 6 mm drill in drill chuck and drill through holes a sper drawing in all centre in drilled holes.

- Similarly, fix Ø 9.8 mm drill in drill chuck and drill through holes in ream hole locations.
- Fix counter sink tool in drilling machine and counter sink two holes to the required depth.
- Similarly, fix counter bore tool in drilling machine and counter bore two holes to the required depth.
- Ream in Ø 9.8 mm two drilled holes using Ø 10 mm hand reamer with wrench.
- Hold spot facing tool in drilling machine and spot face two holes to required depth .
- Fix drill Ø 5.8mm and drilled 01 hole in part 1 & 2 .
- Reamed 01 hole part 1 and 2 using Reamer Ø 6mm for dowel pins.
- Check all the dimensions using Vernier caliper.
- Hold part 1 in bench vice.
- Cut and remove excess metal by hacksawing.
- File to size and shape as per job drawing.
- Similarly, repeat the above process in part 2 and complete the job.

PART - 3

- Mark the dimension lines as per drawing and punch witness marks in part 3.
- Cut and remove excess metal by sawing and file to size and shape as per drawing.
- Mark the hole centres using centre punch.
- Fix drill Ø 5.8mm and drilled 02 holes .
- Reamed 02 holes using Reamer Ø 6mm for dowel pins.
- Check all the dimensions using Vernier caliper.
- Match part 1, 2 ,3 and fit dowel pins Ø 6mm.
- De - burr in all the surfaces and corners of the jobs.
- Apply oil and preserve it for evaluation.

Skill Sequence

Counter sink

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

- state counter sink.

Fix the job in the machine vice (if necessary, use parallel blocks) and set it square.

Align the machine spindle with the drilled hole to be countersunk. (Fig 1)

Remove the drill and fix the countersink tool on the machine without disturbing the alignment. (Fig 2)

Fig 1

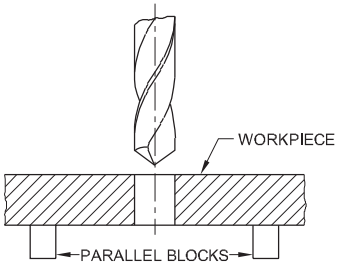
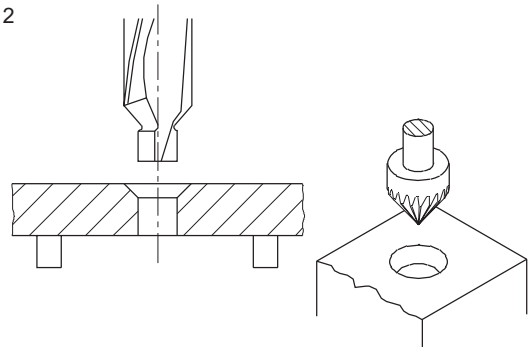


Fig 2



Set the spindle speed of the drilling machine RPM. Use the formula

Substitute the recommended speed of the countersink. (V = 1/3rd of the cutting speed for drilling)

Countersink hole to a depth equal to the head length of the screw head. (Fig 3)

Check the countersink hole with a suitable countersink head screw for proper seating. (Fig 4)

Fig 3

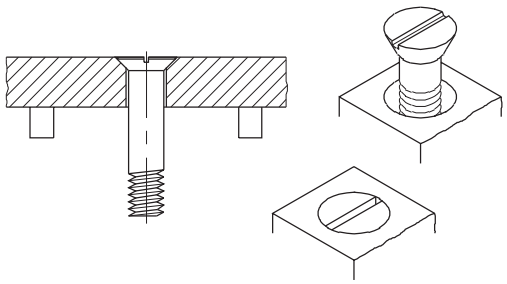
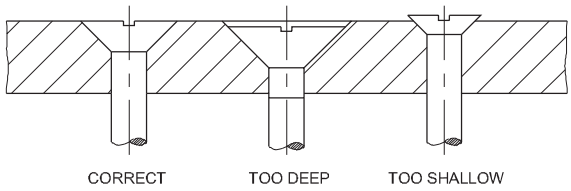


Fig 4



Counter boring

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

- state counter boring.

Selection of counter bore sizes

- B.I.S. recommends different sizes of counter bores based on the sizes of the clearance holes.
- Select the counter bore according to the screw size.
- Fix the job in the machine vice, square to the axis of the machine spindle. Use parallel blocks. (Fig 1)

Set the location of the drilled hole position using the correct diameter drills.

Align the spindle axis with the drilled hole. For accurate work, drill and counter bore in one setting.

Mount and fix the counter bore tool on the drilling machine spindle. (Fig 2)

Fig 1

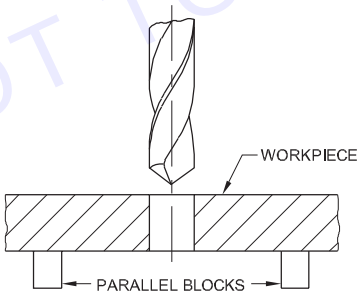
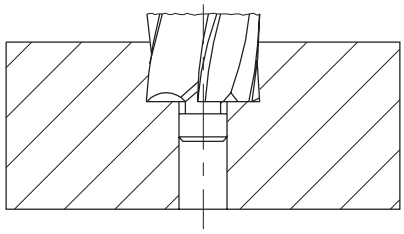


Fig 2



Set the spindle speed of the drilling machine to the nearest calculated RPM. Use the formula

$$V = \frac{\pi \times d \times n}{1000}$$

(Consider the value of `V` as 1/3rd of the cutting speed for drilling)

Counter bore the hole to a depth slightly more than the thickness of the screw head (Figs 3 & 4)

Use the depth stop arrangement for controlling the depth of the counter bore hole.

Check the depth of the counter bored hole. (Use the correct screw for checking the depth and seating).

Fig 3

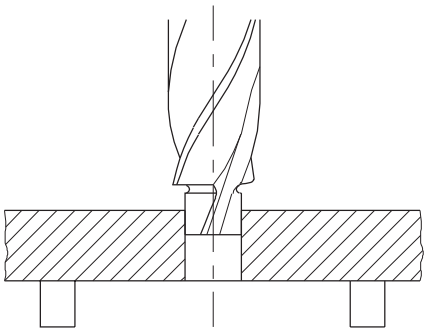
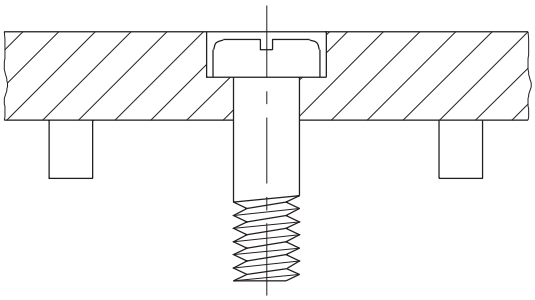


Fig 4



FIC22P0520

Reaming drilled holes using hand reamers

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

- state Reaming drilled holes using hand reamers.

Reaming drilled holes using hand reamers

Determining the drill size for reaming

Use the formula,

Drill diameter = Reamed hole size - (Undersize + Oversize)

Refer to the table for the recommended undersizes in Related Theory on DRILL SIZES FOR REAMING.

Hand reaming

Drill holes for reaming as per the sizes determined.

Place the work on parallels while setting on the machine vice. (Fig 1)

Chamfer the hole ends slightly. This removes burrs, and will also help to align the reamer vertically (Fig 2). Fix the work in the bench vice. Use vice clamps to protect the finished surfaces. Ensure that the job is horizontal.

Fig 1

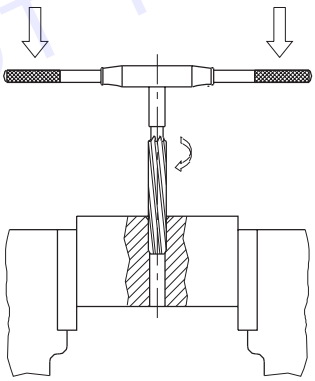
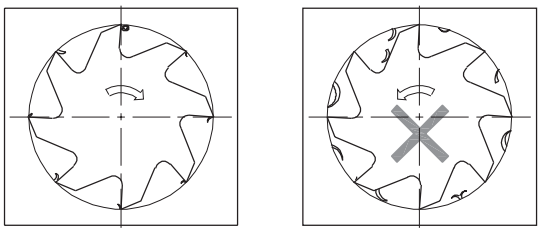


Fig 2



FIC22P0522

Fix the tap wrench on the square end and place the reamer vertically in the hole. Check the alignment with a try square. Make corrections, if necessary. Turn the tap wrench in a clockwise direction applying a slight downward pressure at the same time (Fig 3). Apply pressure evenly at both ends of the tap wrench.

Apply cutting fluid.

Turn the tap wrench steadily and slowly, maintaining the downward pressure.

Do not turn in the reverse direction it will scratch the reamed hole. (Fig 4)

Fig 3

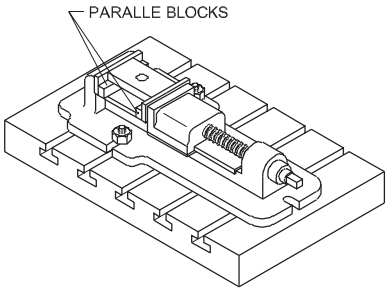
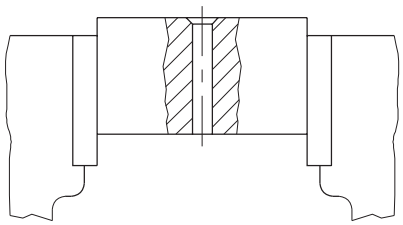


Fig 4

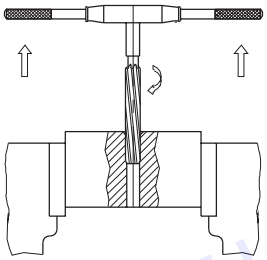


FIC22P0521

Ream the hole through. Ensure that the taper lead length of the reamer comes out well and clear from the bottom of the work. Do not allow the end of the reamer to strike on the vice.

Remove the reamer with an upward pull until the reamer is clear of the hole. (Fig 5)

Fig 5



FIC22P0523

Remove the burrs from the bottom of the reamed hole.

Clean the hole. Check the accuracy with the cylindrical pins supplied.

EXERCISE 32: Revision & Internal Assessment

Objectives

At the end of this exercise you shall be able to

- giving text to the trainees.

Trainer shall give test exercise for revision and internal assessment.

EXERCISE 33: Demonstration on removal of broken Taps or Studs from through hole and blind hole

Objectives

At the end of this exercise you shall be able to

- different methods of removing broken taps.
- causes for breakage of stud.
- different methods for removing broken stud.

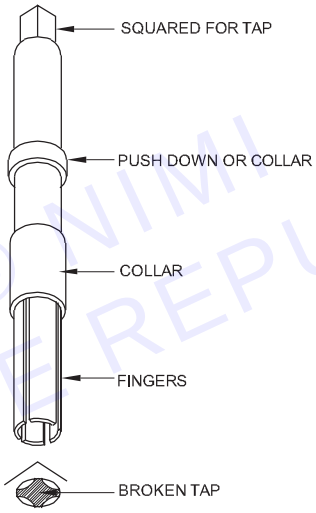
Job Sequence

Following methods can apply to removal of broken taps or studs from through or blind hole.

Taps broken below the surface pose a problem for removing. Any one of the several methods can be used.

Use of tap extractor (Fig 1)

Fig 1



This is a very delicate tool and need very careful handling. This extractor has fingers which can be inserted on the flutes of the broken tap. The sliding collar is then brought to the surface of the work and the extractor turned anticlockwise to take out the broken tap.

A light blow on the broken tap with a punch will help to relieve the tap if it is jammed inside the hole.

Use of punch (Fig 2)

In this method the point of the punch is placed in the flute of the broken tap in an

Inclination and struck with a hammer the positioning of the punch should be such that the broken tap is rotated anticlockwise when struck.

Annealing and Drilling the Tap (Fig 3)

This is a method adopted when other method fail. In the process the broken tap is heated by flame or by other methods for annealing. A hole is then drilled on the annealed tap. The remaining piece can be removed either by using a drift or using an EZY - OUT (extractor). This method is not suitable for workpieces with low melting temperatures such as aluminium, copper etc. (Fig 3)

Fig 2

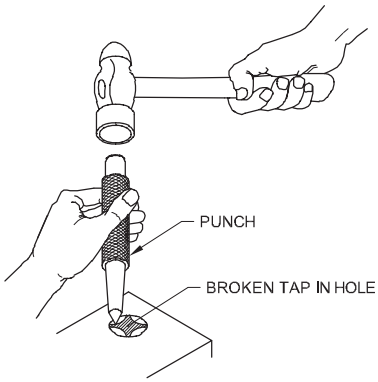
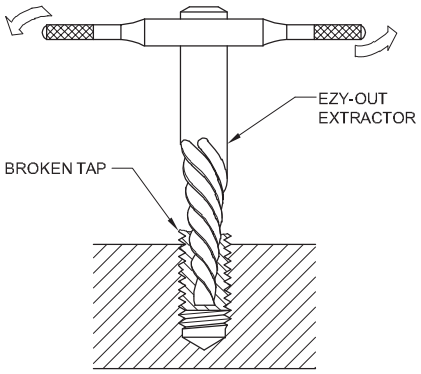


Fig 3



FIC22P0525

Use of nitric acid

In this method nitric acid is diluted in a proportion of about one part acid to five parts of water is injected inside. The action of the acid loosens the tap and then it is removed with an extractor or with a nose plier. The workpiece should be thoroughly cleaned for preventing further action of the acid.

While diluting acid mix acid to water.

Use of spark erosion

For salvaging certain precision components damaged due to breakage of taps, spark erosion can be used. In this process, the metal (broken tap) is removed by means of repetitive spark discharges. The electrical discharge occurs between an electrode and the electro - conductive workpiece (tap) and the minute particles are eroded both from the electrode and the workpiece. In many cases it may not be necessary to remove the broken tap completely. (After a small portion has been eroded, a screw- driver or punch can be used to remove the remaining portion of the tap.) The shape of the electrode also need not be round. It can be for assisting the tools for rotating the broken tap.

Removing broken stud

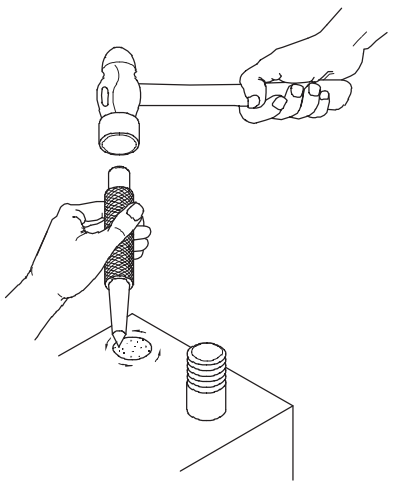
The stud is used in place of a bolt ,when there is insufficient space to accomodate the bolt head or to avoid use of an unnecessarily long bolt. Studs are generally used to fix up cover plates or to connect cylinder covers to engine cylinders.

Methods of removing broken studs

1 Prick punch method

If the stud is broken very near to the surface, drive it in an anticlockwise direction, using a prick punch and hammer to remove it. (Fig 1)

Fig 1

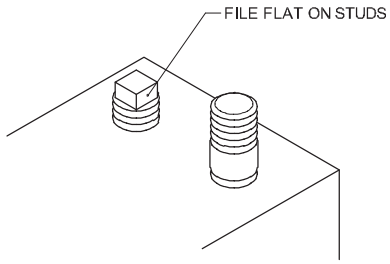


FIC22P0526

2 Filling Square Form

When the stud is broken a lilttle above the surface form a square on the projecting portion to suit a standard spanner. Then turn it anticlockwise using a spanner to remove it. (Fig 2)

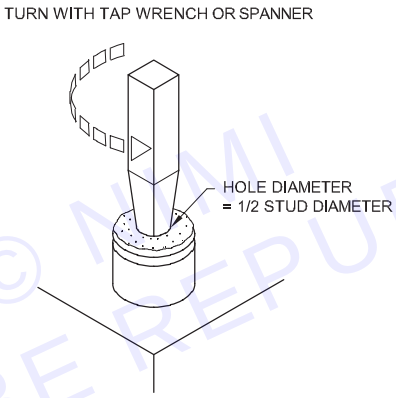
Fig 2



3 Using square taper punch

Broken stud can also be removed by drilling a blind hole (hole diameter equals to half of stud diameter) and driving a square taper punch into the hole as shown in Fig 3. Turn the punch using a suitable spanner in an anti - clock- wise direction to unscrew the stud.

Fig 3

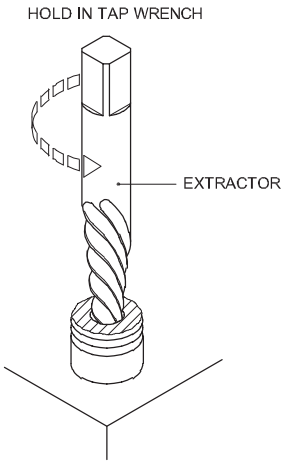


4 EZY - out method (Fig 4)

Ezy - out or a stud extactor is a hand tool, somewhat similar to the form of a taper reamer but has left hand spiral. It is available in a set of 5 pieces. The recommended drill size is punched on each ezy - out .

After drilling the hole recommended ezy - out is set on it and turned in an anti - clockwise direction by a tap wrench. As it is rotated it penetrates into the hole increasing its grip and in the process the broken stud gets unscrewed. (Fig 4)

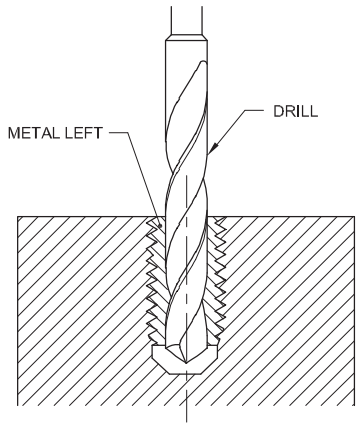
Fig 4



5 Making drill hole

Correctly find out the centre of the broken stud and drill hole nearly equal to the core diameter of the stud down the centre so that the threads only remain. Remove the thread portion by the point of a scriber in the form of broken chips. Re - tap the drill the hole to clear the threads. (Fig 5)

Fig 5



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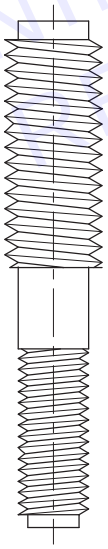
6 Making Oversize hole

If all other method fail, drill a hole equal to the size of the stud size or a little over and tap the hole with an oversize tap. Now a special over size stud as shown in Fig 6 is to be made and fitted in position

Fig 6



OVERSIZE SPECIAL STUD TO SUIT THE TAPPED HOLE

FIC22P0531

EXERCISE 34: Exercise on external threading by using dies & lubricant

Objectives

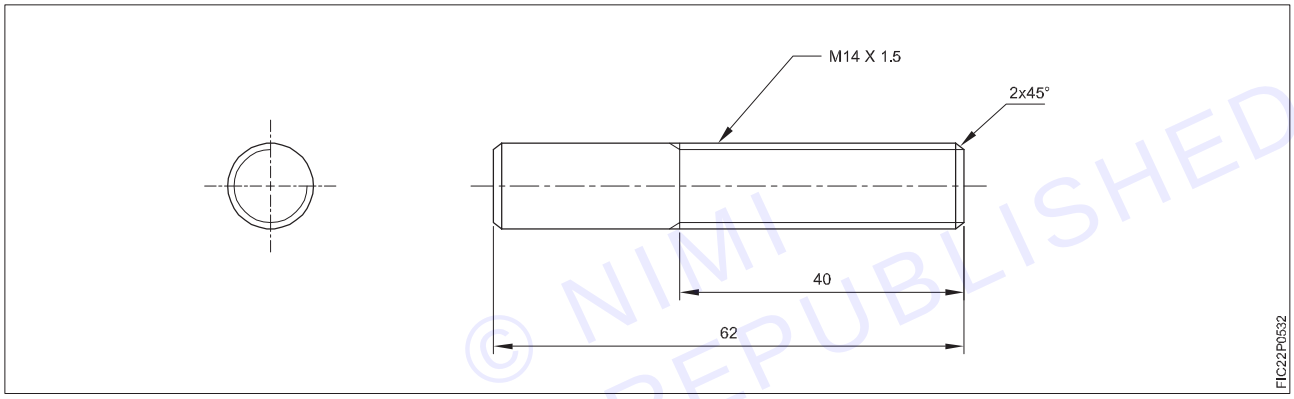
At the end of this exercise you shall be able to

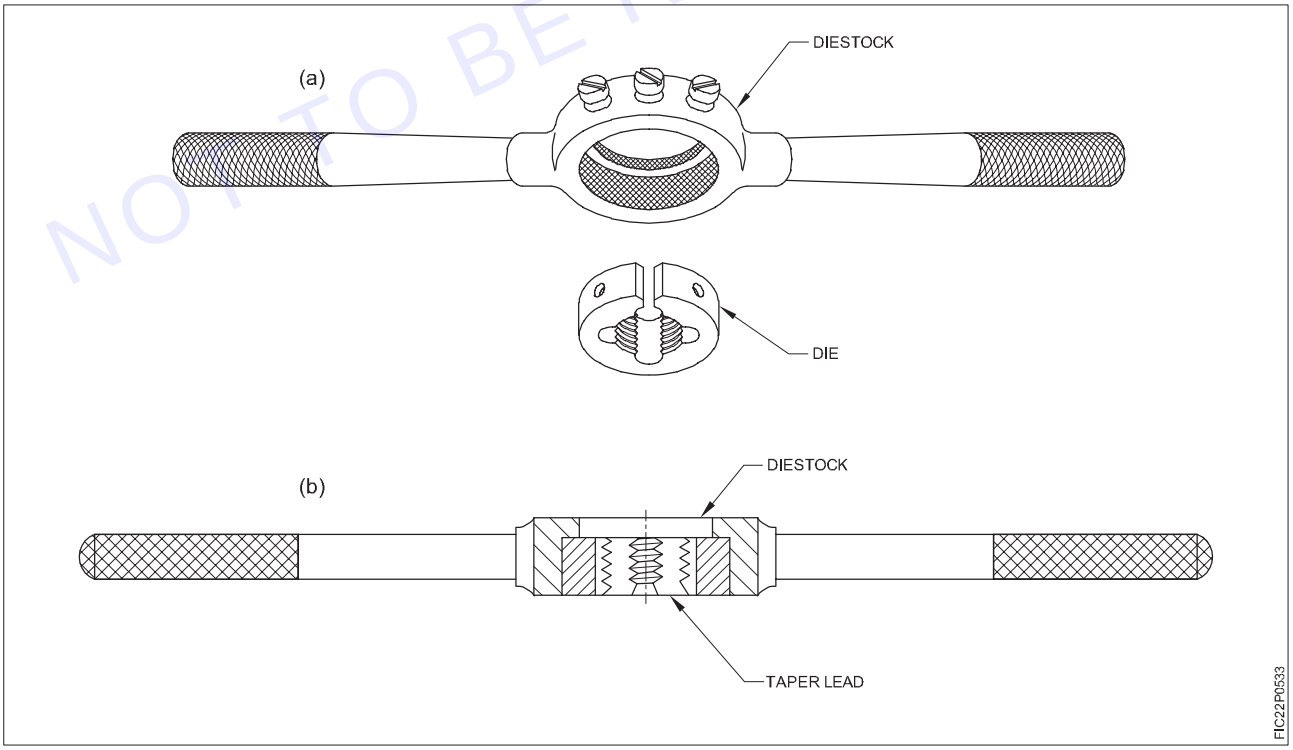
- file blank size in round rod to cut external thread
- cut M14 external thread using split die and die stock to the required length
- check the thread with screw pitch gauge and matching nut.

Check blank size.

Blank size = Thread size - 0.1 x pitch of thread

Fix the die in the diestock and place the leading side of the die opposite to the step of the diestock.



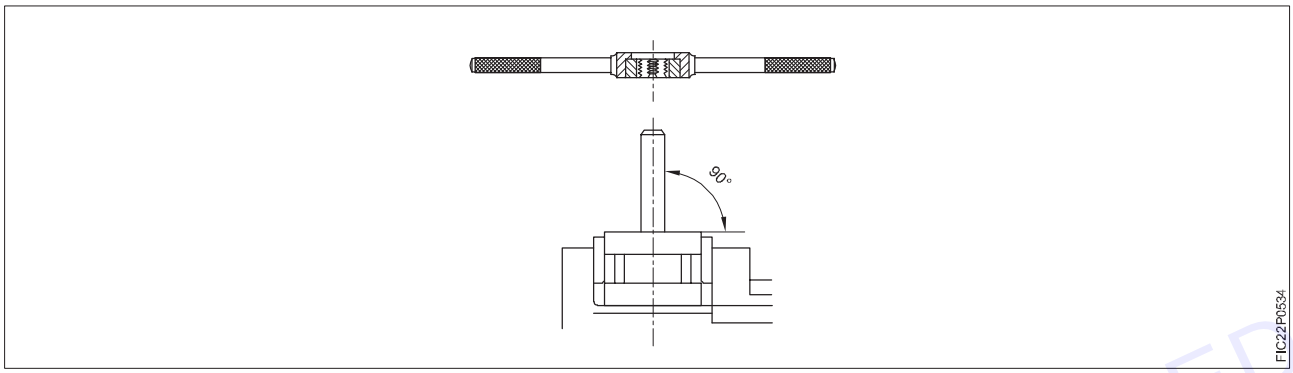


Job Sequence

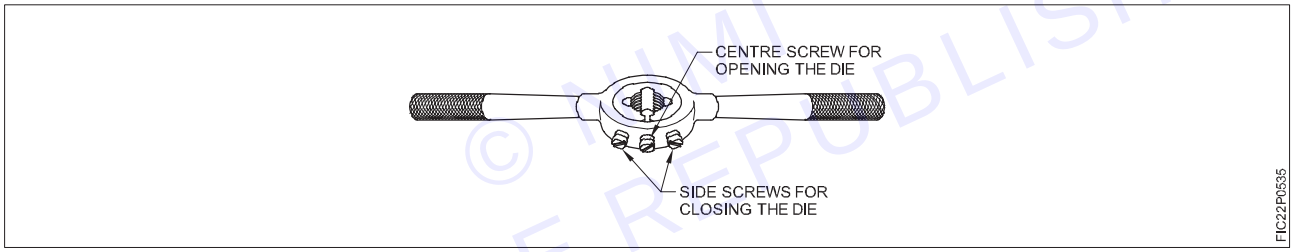
- Check the raw material for its size.
- File blank size to Ø 13.9 mm x 40 mm length as per drawing.
- File chamfer in both ends to 2 mm x 45°
- Hold the job at 90° in bench vice.

Use vice clamp for ensuring a good grip in the vice.

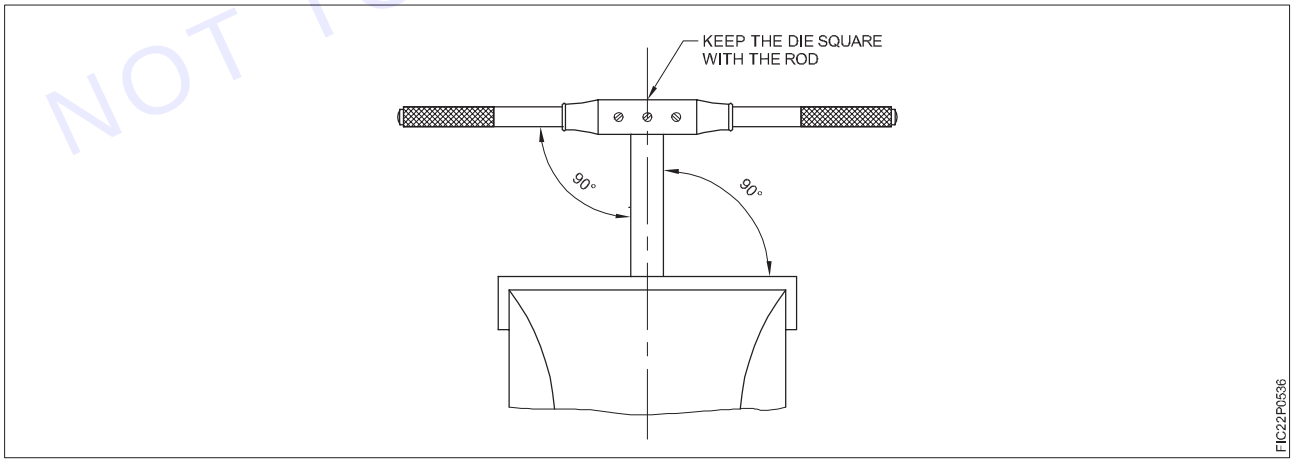
Project the blank above the vice - just the required thread length only.



- Set M14 split die in die stock.



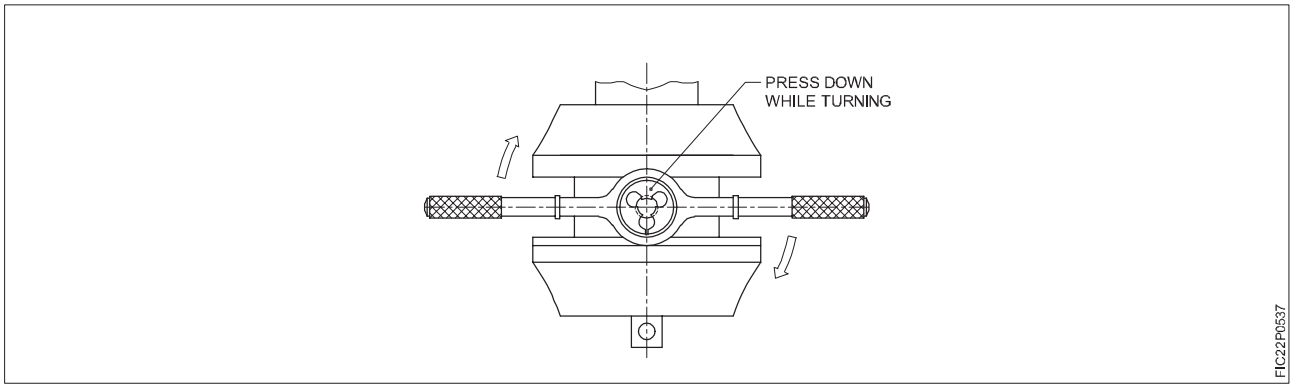
- Set the die on the blank end and press down evenly and turn in clockwise direction slowly to cut thread.
- Check the die 90° to the cylindrical rod.



- Apply pressure evenly on the die stock and turn in a clock wise direction to advance the die in cylindrical blank.
- Cut external thread slowly and reverse the die for short distance in order to break the chips.
- Increase depth of cut gradually by adjusting the screws and cut the thread to correct pitch of the thread.
- Check the thread with screw pitch gauge.
- Repeat the thread cutting process until the nut matches.

- Apply a little oil and preserve it for evaluation.

Use cutting lubricant while cutting thread.



EXERCISE 35: Care & Maintenance while using Taps and Dies

Objectives

At the end of this exercise you shall be able to

- identify correct method of tapping.
- perform proper procedure while using die.
- understand causes of broken tap during tapping
- achieve high quality external and internal thread.

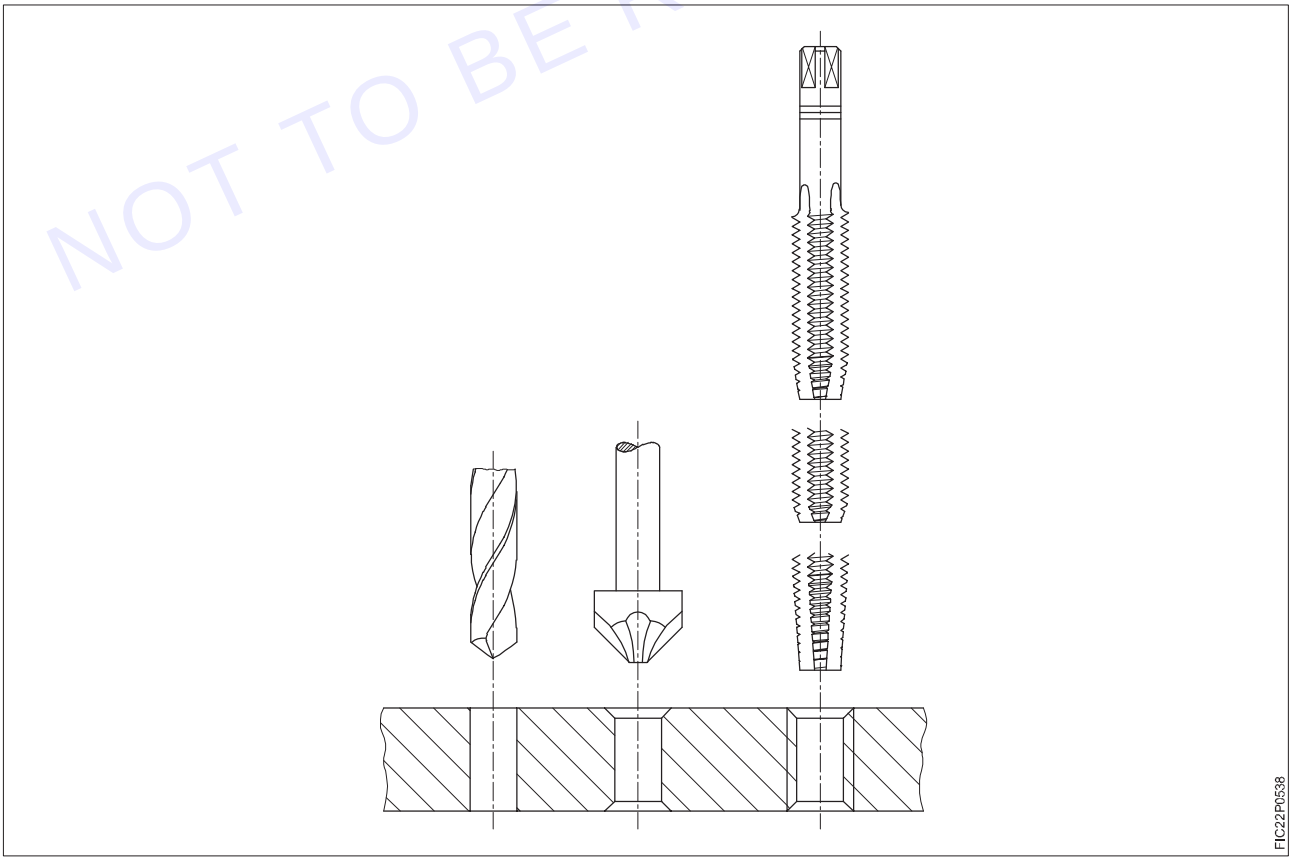
Following key points are covered while using tap and die for making internal and external thread.

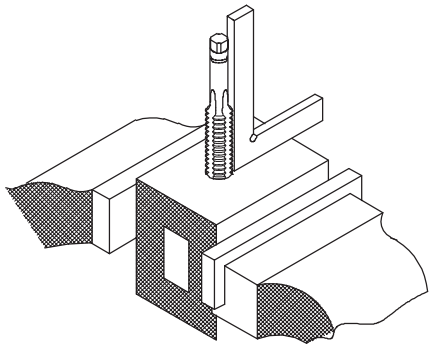
- Hole size for tapping is very crucial, it must be correct in size and chamfered.
- Hole size may be find as

Hole size = Tap size - 2 x depth of thread

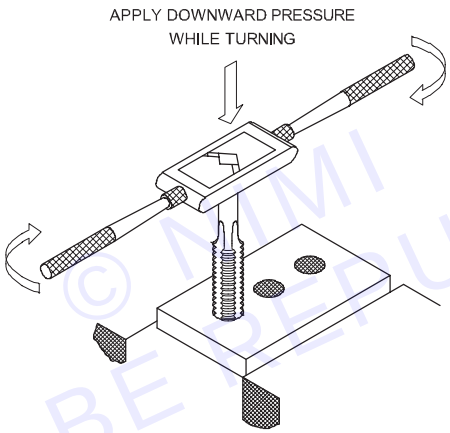
- Do not forget to give the chamfer required for aligning and starting the tap
- Hold the work firmly and horizontally in the vice. The top surface should be slightly above the level of the vice jaws . this help in using try square without any obstruction while aligning the tap.
- Fix the taper tap in Tap wrench.

Too small wrench will need a greater force to turn the tap . very large and heavy tap wrenches will not give the feel required to turn the tap slowly as it cuts.



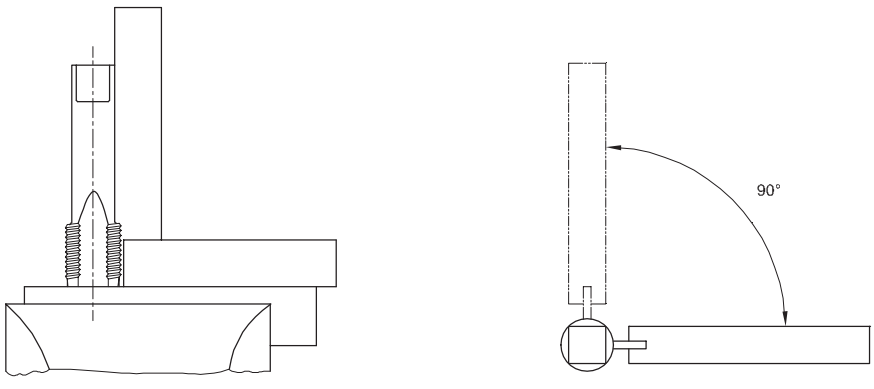


- Position the tap in the chamfered hole vertically by ensuring the tap wrench in horizontal plane.
- Exert steady downward pressure and turn the tap wrench slowly in a clockwise direction to start the thread . Hold the tap wrench close to the centre.

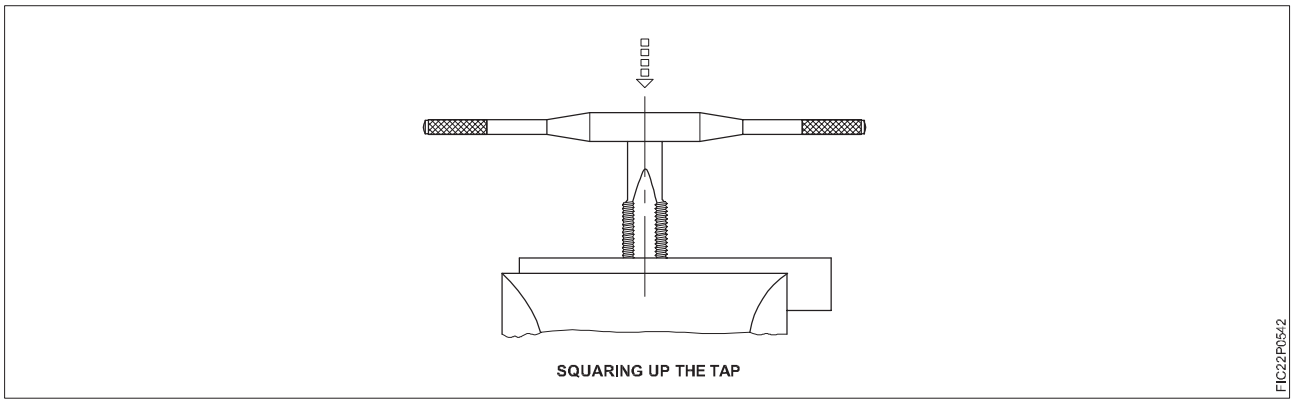


STARTING THE TAP

- When sure of starting of the thread , remove the tap wrench without disturbing the tap alignment.
- Check and make sure the tap is vertical. Use small try square for help.place the try square in two position, 90 to each other.

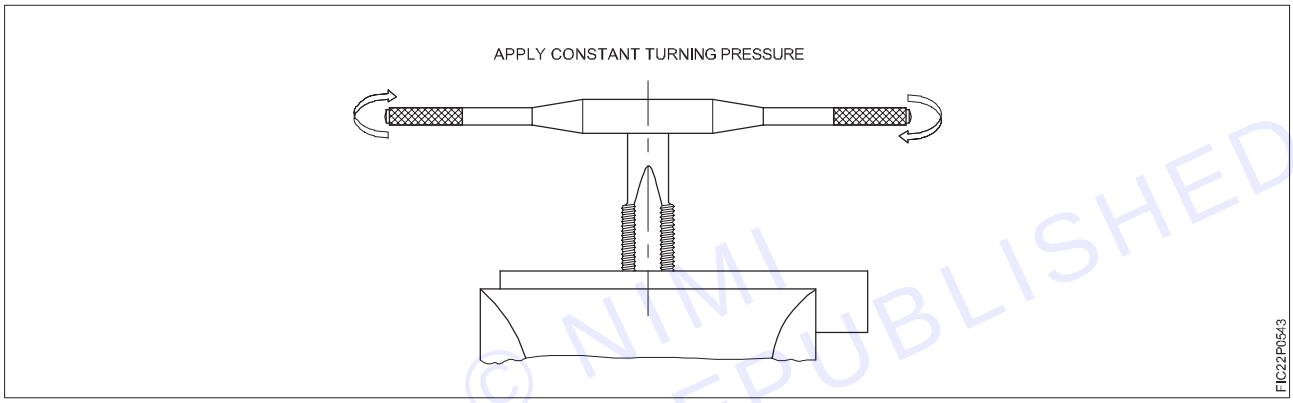


- Make corrections, if necessary, This is done by exerting slightly more pressure on the opposite side of the tap inclination.

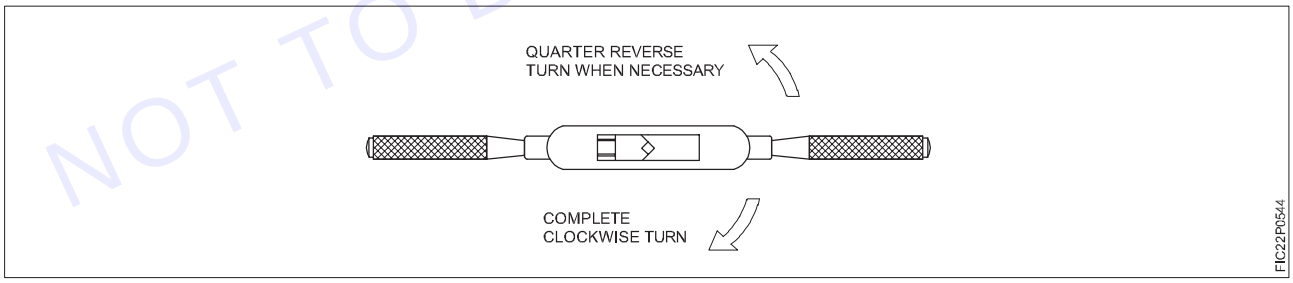


SQUARING UP THE TAP

- Never apply side pressure without giving a turning motion to the tap.
- After tap is positioned vertically, turn the wrench lightly by holding the ends of wrench handles without exerting any downward pressure.



- While turning the wrench, the movement should be well balanced. Any extra pressure on one side will spoil the alignment and can also cause the breakage of the tap.
- Continue cutting the thread, Turn backward frequently about quarter turn, to break the chip.



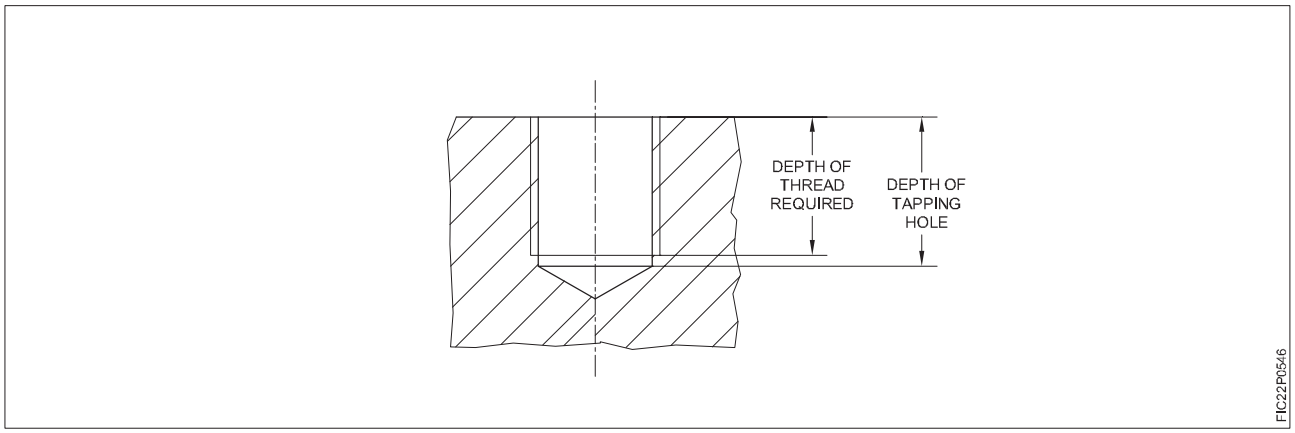
- Stop and turn backward also when some obstruction to movement is felt.
- Use suitable lubricant specific to the material to avoid friction and overheating during tapping.

  Cut the thread until the tap is fully inside the hole being threaded.
- Finish and clean up using intermediate and plug tap .
- The intermediate and bottoming tap will not cut any thread only finish the thread if the tap entered the hole fully,
- Remove the chips from the work with a brush; check the threaded hole with a matching screw.
- Clean the tap with a brush and place it back on the stand.

Drilling a blind hole

Determine the tapping drill size using formula or table for tapping drill size.

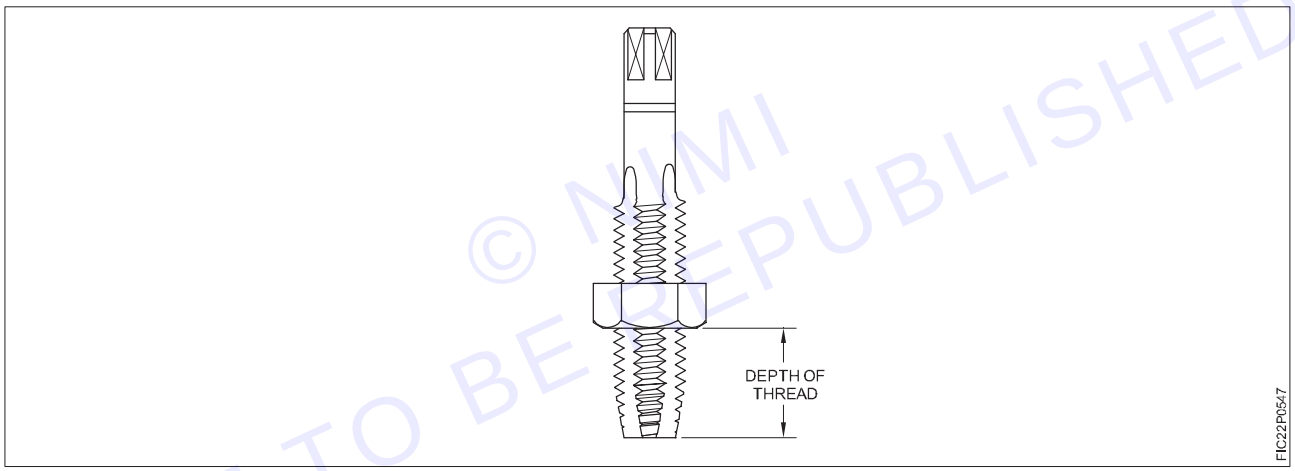
Drill a blind hole using the depth stop arrangement. The depth of the tapping hole should be slightly more than the depth of the required thread.



Remove the metal chips if any, from the blind hole by turning it upside down and slightly tapping it on a wooden surface.

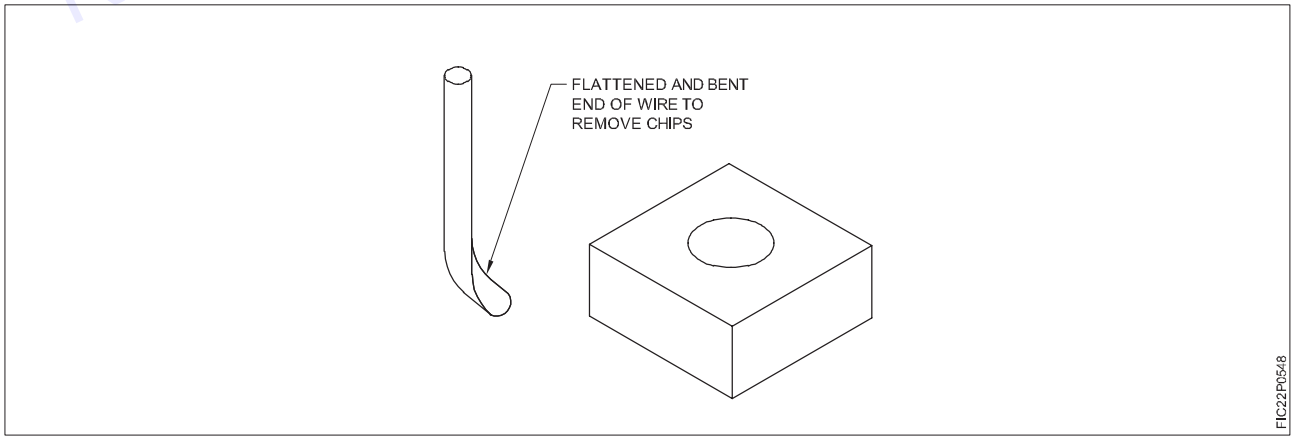
Do not clear the chips by blowing as it can cause injury to your eyes.

- Screw a matching nut on the taper tap to act as a depth stop.

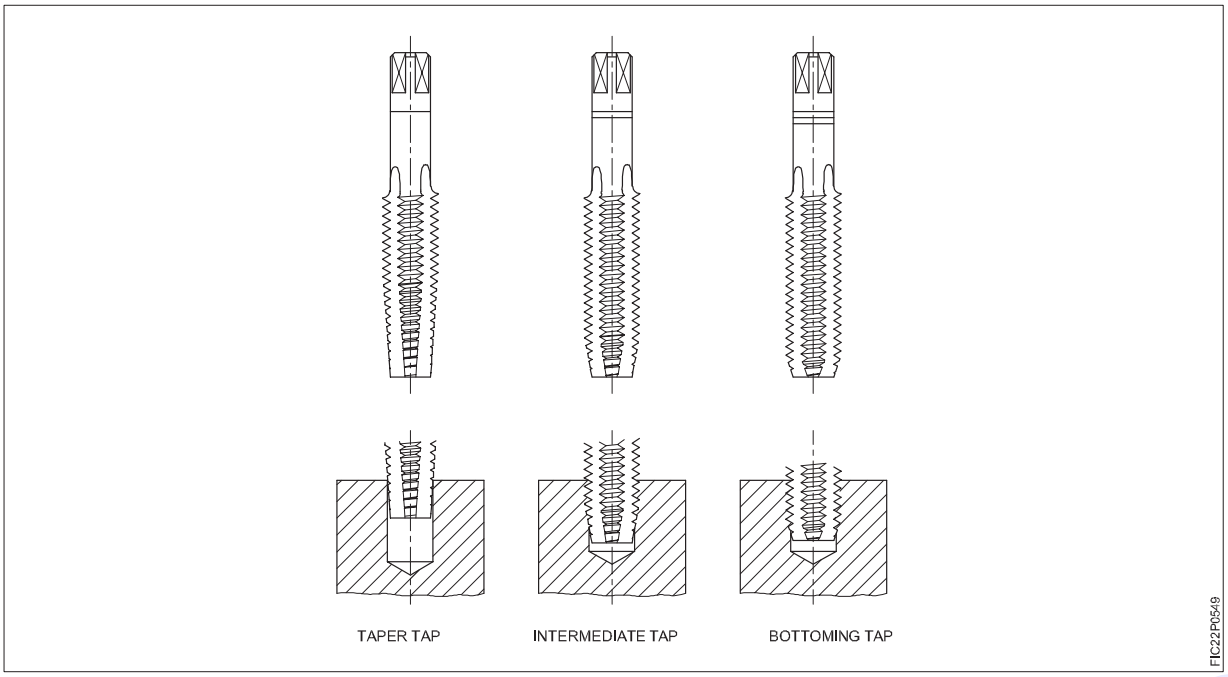


Thread the blind hole until the nut touches the plate surface.

- Remove the chips from the hole frequently , using a flattened and bent wire.



- Finish tapping the blind hole with intermediate and bottoming tap. Set the nut to control the depth of the thread.

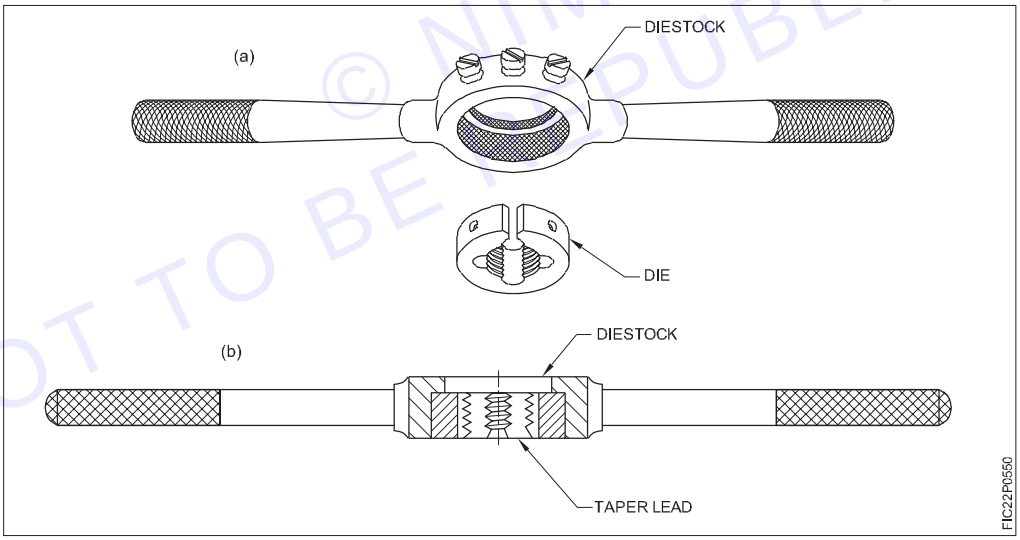


Cut the external thread using die

- Check blank size

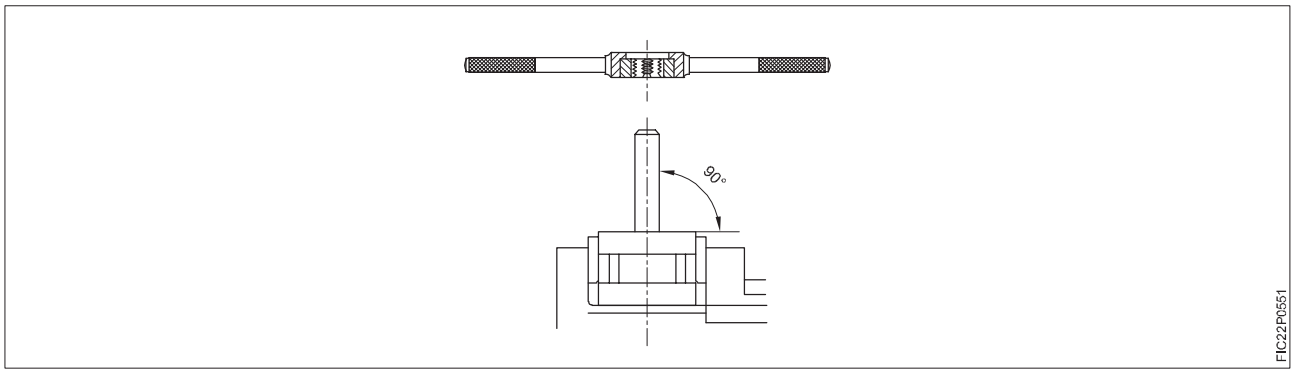
Blank size = Thread size - 0.1 x Pitch of thread

- Fix the die in the die stock and place the leading side of the die opposite to the step of the die stock.

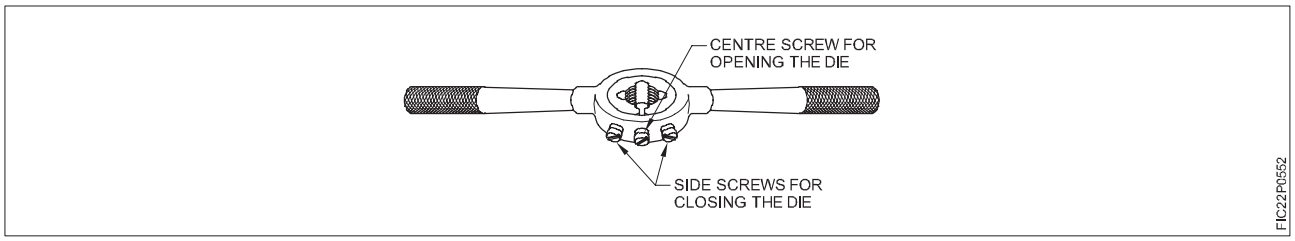


Use false jaws for ensuring good grip in the vice.

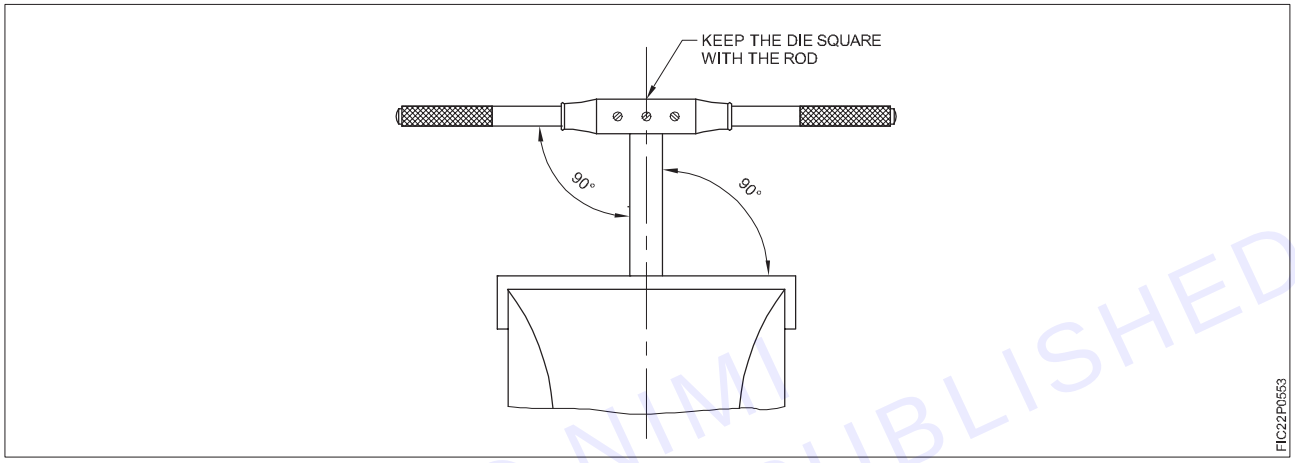
- Project the blank above the vice just required thread length only.



- Place the leading side of the die on the chamfer of the work.
- Make sure that the die is fully open by tightening the centre screw of the die stock.



- Start the die, square to the bolt centre line.



- Apply pressure on the die stock evenly and turn in a clockwise direction to advance the die on the bolt blank. Cut slowly and reverse the die for a short distance in order to break the chips.

After Use:

- **Cleaning:** Thoroughly clean your taps and dies after each use. Wipe them down with a soft cloth to remove any metal shavings or debris. You can also use a brush to clean the flutes of the taps.
- **Degreasing:** If you're using a lubricant, you may need to degrease your taps and dies before storing them. This will help prevent rust and corrosion.
- Inspection: Regularly inspect your taps and dies for any signs of wear or damage. Look for chipped teeth, worn threads, or excessive dulling. Damaged tools can produce poor-quality threads and should be replaced to avoid further issues.
- **Storage:** Store your taps and dies in a clean, dry place. A tool box or cabinet with compartments will help keep them organized and prevent them from banging around and getting damaged. You can also apply a light coat of oil to the tools before storing them to further protect them from rust and corrosion.

EXERCISE 36: Measuring the thread Dimension by various methods by thread Micrometer

Objectives

At the end of this exercise you shall be able to

- Identify elements of thread
- Describe the feature of thread micrometer
- Measuring effective diameter of thread using thread micrometer
- Measuring effective diameter of thread by three wire method.

Following thread elements considered in thread measurement.

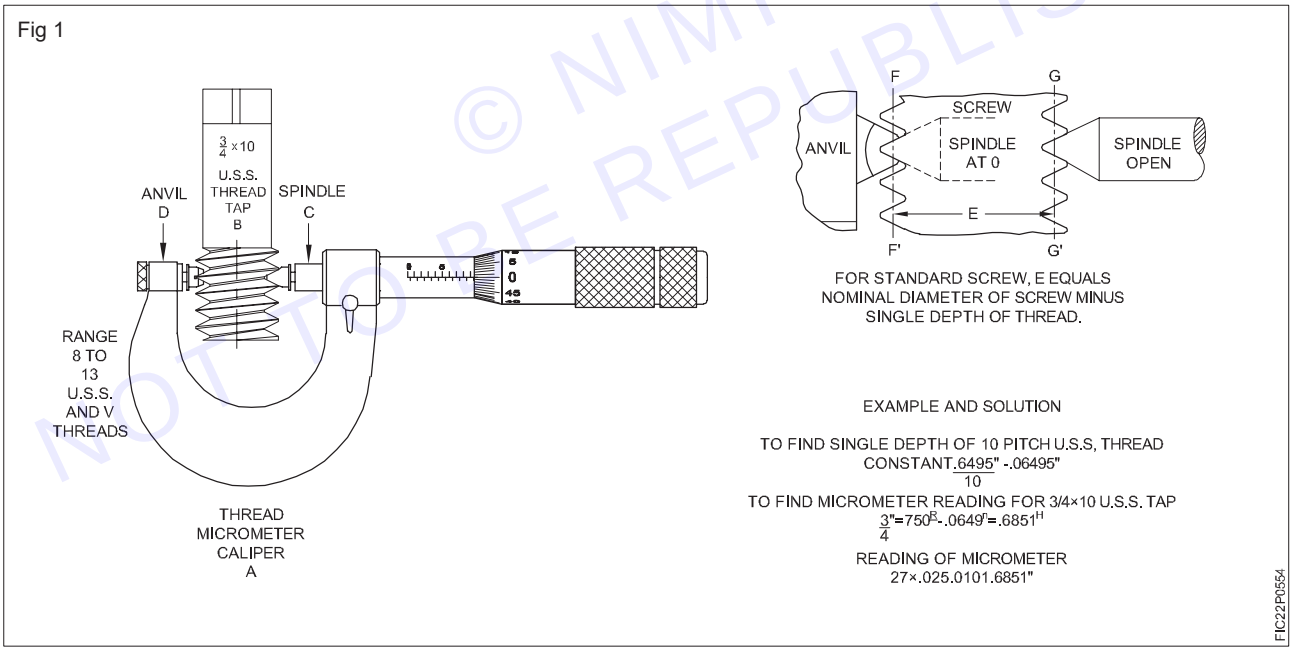
1 Pitch of Screw Thread

2 Angle of thread

3 Effective (Pitch) diameter of thread

Screw thread Micrometer: This micrometer is used to measure the effective diameter (pitch diameter) of screw threads . This dimension is important because the area of the thread flanks in the vicinity of the pitch line is where the greatest transmission of force occurs between mating parts.

Fig 1



This is very similar to the ordinary micrometer in construction but has facilities to change the anvils.

The anvils are replaceable and are changed according to the profile and pitch of the different systems of threads. (Figs 2 & 3)

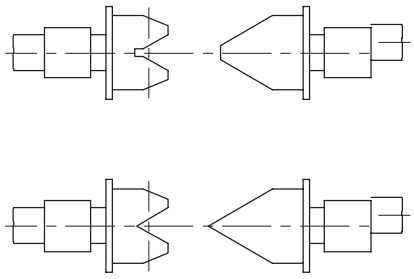
The three-wire method: This method uses three wires of the same diameter for checking the effective diameter and the flank form. The wires are finished with a high degree of accuracy.

The size of the wires used depends on the pitch of the thread to be measured.

For measuring the effective diameter, three wires are suitable placed between the threads. (Fig 4)

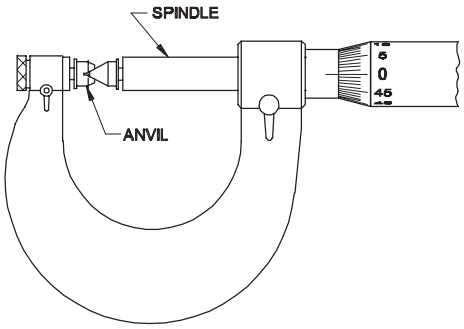
e measuring wires are fitted in wire-holders which are supplied in pairs. One holder has provisions to fix one wire and the other for two wires. (Fig 5)

Fig 2



INTERCHANGEABLE ANVILS

Fig 3



SPINDLE AND ANVIL OF MICROMETER AT ZERO SETTING

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Fig 4

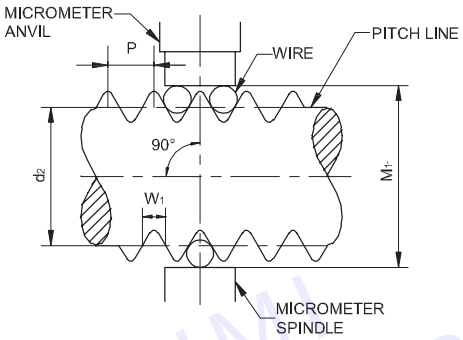

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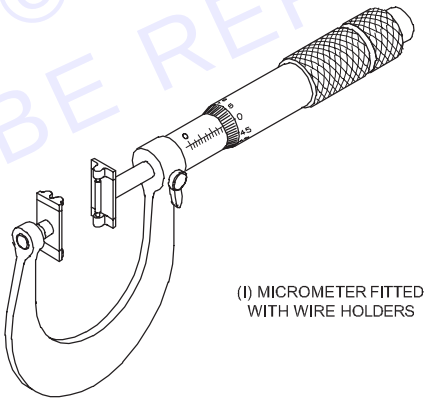
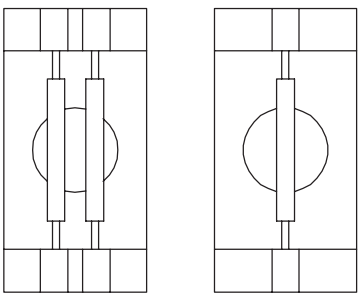
Fig 5



(I) MICROMETER FITTED WITH WIRE HOLDERS



DOUBLE WIRE SINGLE WIRE

(II) WIRE HOLDERS

FIC22P0557

While measuring the screw thread, the holder with the one wire is placed on the spindle of the micrometer and the other holder with two wires is fixed on the anvil.

Selection of 'best wire' (Fig 6): The best wire is the one which, when placed in the thread groove, will make contact at the nearest to the effective diameter. The selection of the wire is based on the type of thread and pitch to be measured. The selection of the wire can be calculated and determined but readymade charts are available from which the selection can be made.

Fig 6

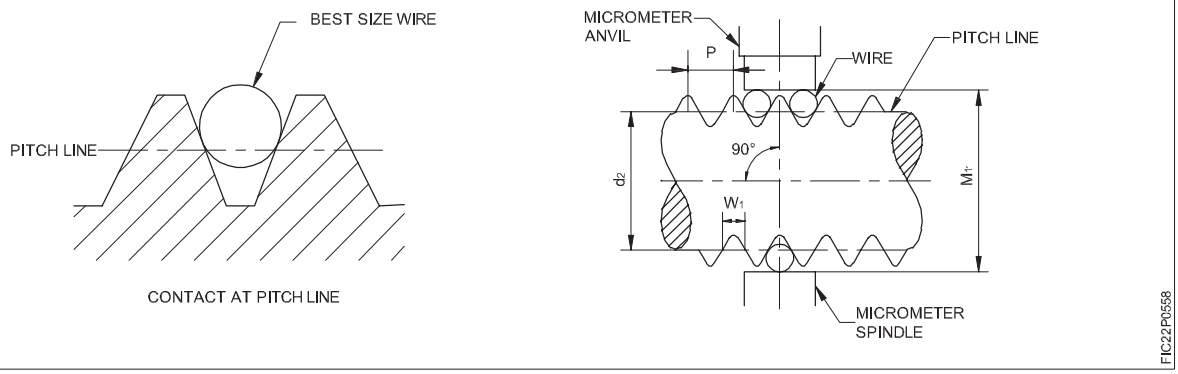


Table 1

Measurement with measuring wires. Metric threads with coarse pitch (M)

Thread designation	Pitch P (mm)	Basic measurement mean d_2 (mm)	Measuring wire dia. W_1 (mm)	Dimension over wire M_1 (mm)
M1	0.25	0.838	0.15	1.072
M 1.2	0.25	1.038	0.15	1.272
M 1.4	0.3	1.205	0.17	1.456
M 1.6	0.35	1.373	0.2	1.671
M 1.8	0.35	1.573	0.2	1.870
M 2	0.4	1.740	0.22	2.055
M 2.2	0.45	1.908	0.25	2.270
M 2.5	0.45	2.208	0.25	2.569
M 3	0.5	2.675	0.3	3.143
M 3.5	0.6	3.110	0.35	3.642
M 4	0.7	3.545	0.4	4.140
M 4.5	0.75	4.013	0.45	4.715
M 5	0.8	4.480	0.45	5.139
M 6	1	5.350	0.6	6.285
M 8	1.25	7.188	0.7	8.207
M 10	1.5	9.026	0.85	10.279
M 12	1.75	10.863	1.0	12.350
M 14	2	12.701	1.15	14.421
M 16	2	14.701	1.15	16.420
M 18	2.5	16.376	1.45	18.464
M 20	2.5	18.376	1.45	20.563
M 22	2.5	20.376	1.45	22.563
M 24	3	22.051	1.75	24.706
M 27	3	25.051	1.75	27.705
M 30	3.5	27.727	2.05	30.848

Table 2

Measurement with measuring wires. Metric threads with fine pitch (M)

Thread designation	Basic measurement mean d_2 (mm)	Measuring wire dia. W_1 (mm)	Dimension over wire M_1 (mm)
M 1 x 0.2	0.870	0.12	1.057
M 1.2 x 0.2	1.070	0.12	1.257
M 1.6 x 0.2	1.470	0.12	1.557
M 2 x 0.25	1.838	0.15	2.072
M 2.5 x 0.35	2.273	0.2	2.570
M 3 x 0.35	2.773	0.2	3.070
M 4 x 0.5	3.675	0.3	4.142
M 5 x 0.5	4.675	0.3	5.142
M 6 x 0.75	5.513	0.45	6.214
M 8 x 1	7.350	0.6	8.285
M 10 x 1.25	9.188	0.7	10.207
M 12 x 1.25	11.188	0.7	12.206
M 14 x 1.5	13.026	0.85	14.278
M 16 x 1.5	15.026	0.85	16.278
M 18 x 1.5	17.026	0.85	18.277
M 20 x 1.5	19.026	0.85	20.277
M 22 x 1.5	21.026	0.85	22.277
M 24 x 2	22.701	1.15	24.420
M 27 x 2	25.701	1.15	27.420
M 30 x 2	28.701	1.15	30.419

EXERCISE 37 : Demo on Thread Micrometer and its applications

Objectives

At the end of this exercise you shall be able to

- use screw thread micrometer.
- measurement pitch diameter of V thread
- measuring effective diameter of thread using three wire method.

A screw thread micrometer, unlike a regular micrometer, is specifically designed to measure the key dimensions of screw threads. These dimensions include the:

- **Pitch diameter:** This is the diameter measured between the flanks of the thread, essentially the average diameter of the screw.
- **Major diameter:** This is the diameter measured at the peaks of the threads.
- **Minor diameter:** This is the diameter measured at the roots of the threads.

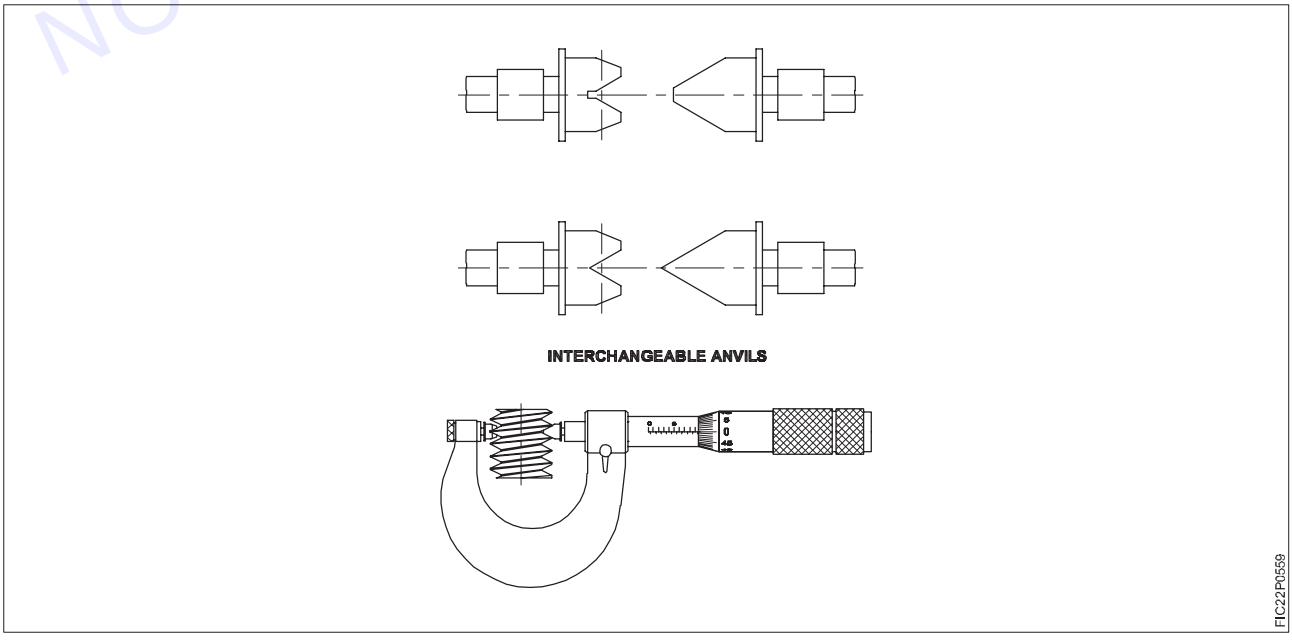
Here's a demonstration of how to use a screw thread micrometer:

1 Setting the anvils:

- Most screw thread micrometers have two sets of anvils: a fixed anvil and a movable spindle with a measuring anvil.
- Some micrometers may have interchangeable anvil tips for different thread sizes.
- Consult the micrometer's manual for specific instructions on setting the anvils for the desired thread type (e.g., metric, Unified Coarse Thread - UNC, etc.).
- There might be setting standards or gage blocks included to ensure accurate anvil positioning.

2 Measuring the thread:

- Place the screw thread between the anvils, with the flanks of the thread fitting into the V-shaped grooves on the anvils.
- Gently rotate the ratchet thimble until the anvils make contact with the screw thread, but avoid overtightening. A ratchet stop mechanism is usually present to provide a consistent measuring force.
- Read the measurement on the micrometer's sleeve and thimble scales. The reading will typically be the pitch diameter of the thread



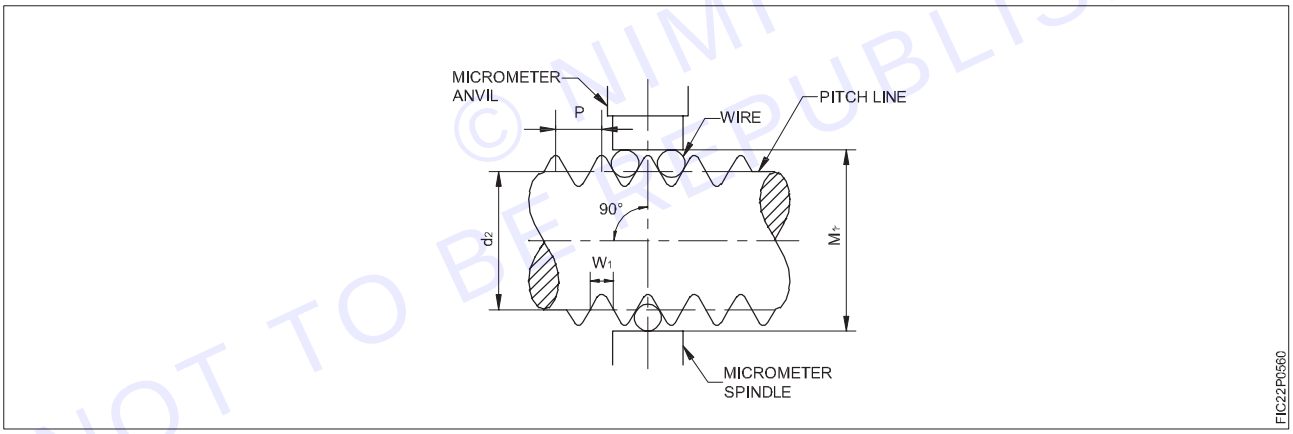
Applications of Thread Micrometer

Measurement of Pitch Diameter:

The three-wire method: This method uses three wires of the same diameter for checking the effective diameter and the flank form. The wires are finished with a high degree of accuracy.

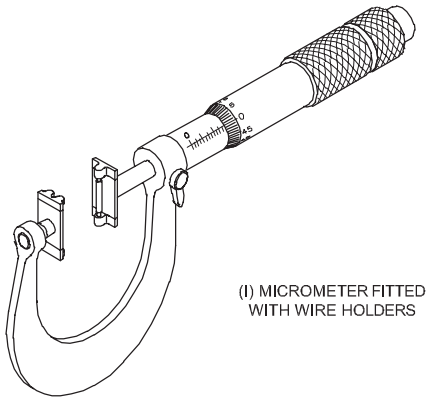
The size of the wires used depends on the pitch of the thread to be measured.

For measuring the effective diameter, three wires are suitable placed between the threads.

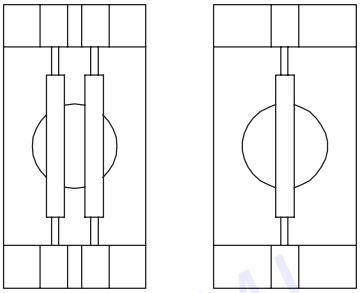


The measuring wires are fitted in wire-holders which are supplied in pairs. One holder has provisions to fix one wire and the other for two wires.

While measuring the screw thread, the holder with the one wire is placed on the spindle of the micrometer and the other holder with two wires is fixed on the anvil.



(I) MICROMETER FITTED WITH WIRE HOLDERS



DOUBLE WIRE SINGLE WIRE

(II) WIRE HOLDERS

FIC22P0561

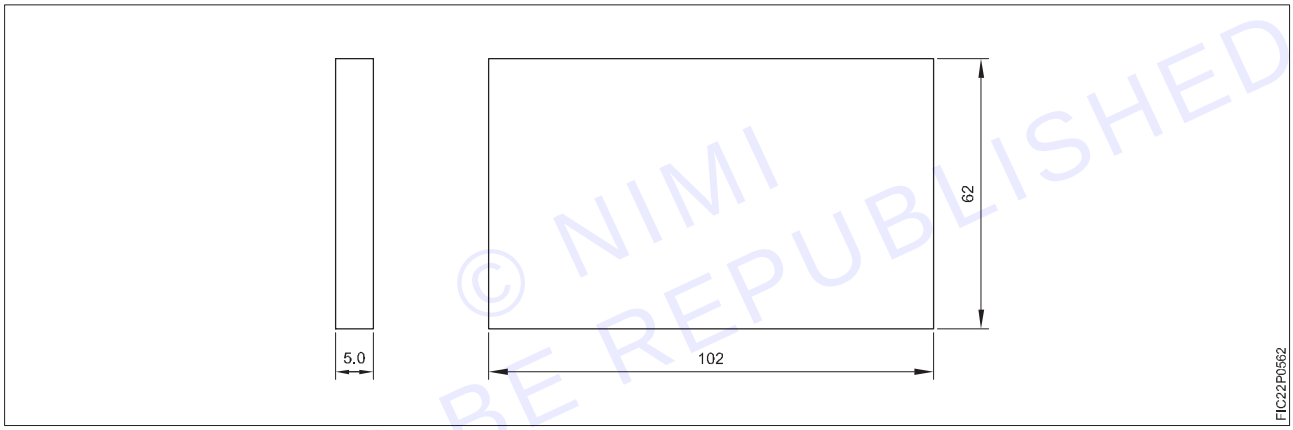
EXERCISE 38: Exercise involving preparation of one of the flat surface as master and two of the adjoining sides square by filing flat and square

Objectives

At the end of this exercise you shall be able to

- file surfaces flat and square within ±0.02mm using flat bastard and second cut file.
- scribe lines parallel to reference surfaces using a scriber.
- punch witness marks on scribed lines with a dot punch.
- check flatness and squareness using a try-square.
- check thickness using an outside caliper.

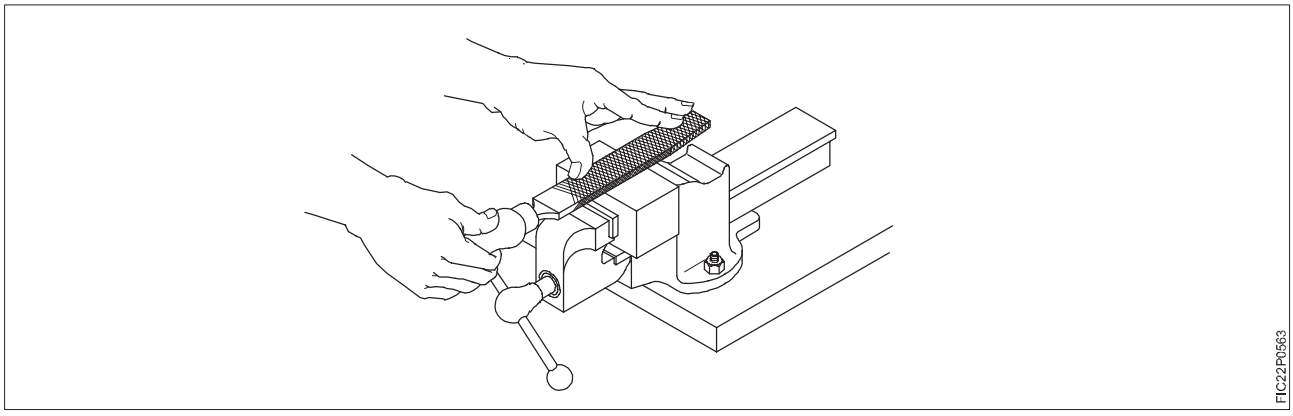
Job Sequence



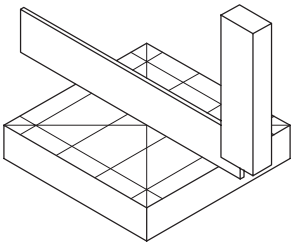
- Remove burrs, if any, using a flat second cut file and ensure the metal surface is free from oil or grease.
- Check the raw material for its size with a steel rule 300mm.
- Hold the workpiece in a 125mm jaw bench vice on its ends.
- Ensure the work is held horizontally.

Do not over-tighten the workpiece.

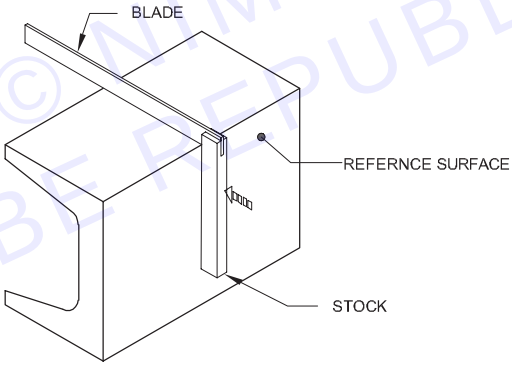
- Remove the scaling surface using Rough file
- File the top surface with a flat bastard file 250mm.



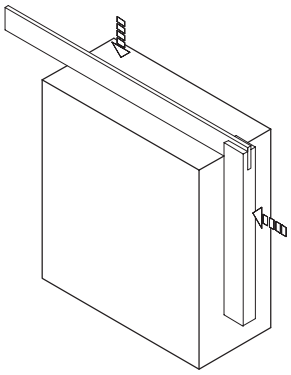
- Check flatness with a try-square.
- File to medium finish using a flat second cut file 250mm.
- Check the flatness of surface using try square.
- Remove high spot using second cut file 250mm and check flatness again.
- Repeat this activity until surface make parallel as master surface.
- Check flatness using try square.



- Hold the job in bench vice properly to file the longer side.
- File straight this longer side using second cut file
- Check straightness of side using try square.
- File and check flatness and squareness with previously finished surfaces using a try-square 150mm.



- File the adjacent shorter side flat and square to both the finished sides.
- Check squareness (right angle) between both sides.



- Remove burrs and mark sizes as per job drawing, using a steel rule, try-square and scriber.
- Punch witness marks on scribed lines with scribing block.
- File the other two sides flat and square, maintaining the dimensions.

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

- File the other flat surface parallel and check the thickness using vernier caliper/micrometer.

EXERCISE 39: Demo on application of various types of lubricants & coolants

Objectives

At the end of this exercise you shall be able to

- identify types of lubricants and coolants
- types of lubrication method
- properties of lubicants
- importance of lubricants and coolants.

PROCEDURE

Lubricants are substances that reduce friction between moving surfaces, wear and tear between moving parts, as well as to dissipate heat and prevent corrosion.

- **Function:** Their primary role is to minimize the resistance between contacting parts, preventing them from grinding together and causing wear and tear.

Advantages:

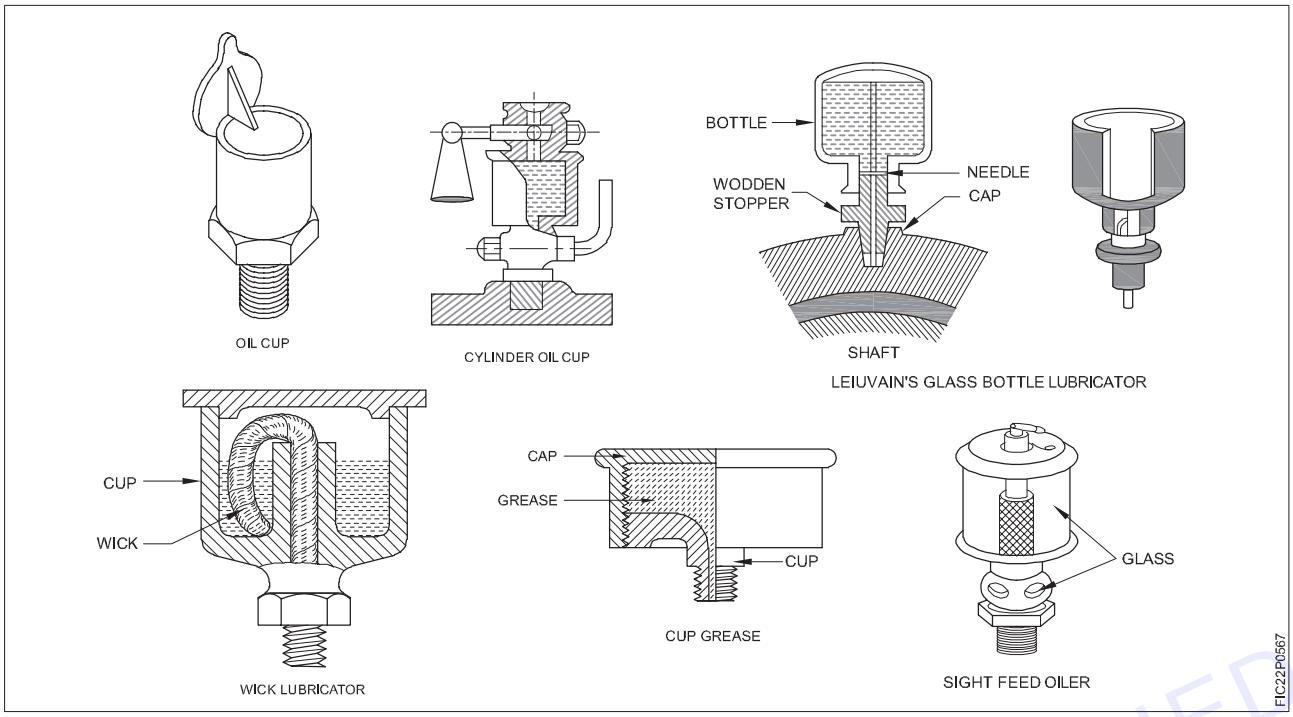
- **Reduced friction:** This leads to smoother operation, less energy loss, and extended lifespan of machinery.
- **Heat dissipation:** Friction generates heat, and lubricants help absorb and carry it away, preventing overheating and protecting components.
- **Protection from wear:** By creating a thin film between surfaces, lubricants minimize direct contact, reducing wear.
- **Corrosion prevention:** Some lubricants contain additives that form a protective barrier on metal surfaces, preventing rust and other forms of corrosion.
- **Sealing and cleaning:** Lubricants can act as a seal against dust and dirt, keeping contaminants out of delicate mechanisms.

Application methods

- Gravity Feed system
- Force Feed System
- Splash System

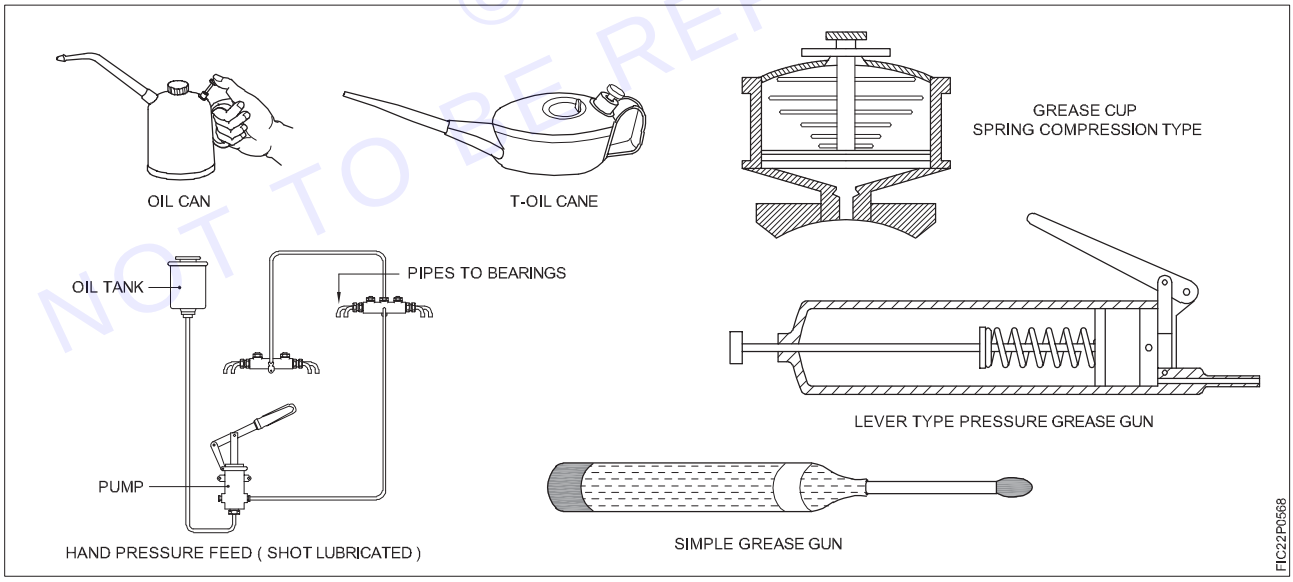
Gravity feed system:

In a gravity feed lubrication system, The lubricant slowly feeds due to gravity and may include a metering mechanism to control the flow rate.



Force feed system

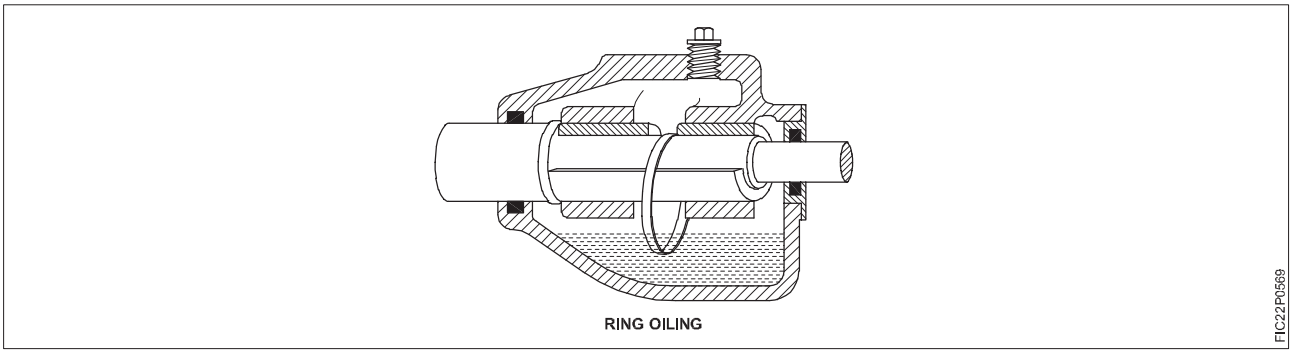
Force feed system lubrication is a method used to supply lubricants under pressure to various parts of a machine or equipment, ensuring adequate lubrication even under high loads or speeds. This method is commonly employed in heavy machinery, industrial equipment, and engines where proper lubrication is critical for smooth operation and longevity.



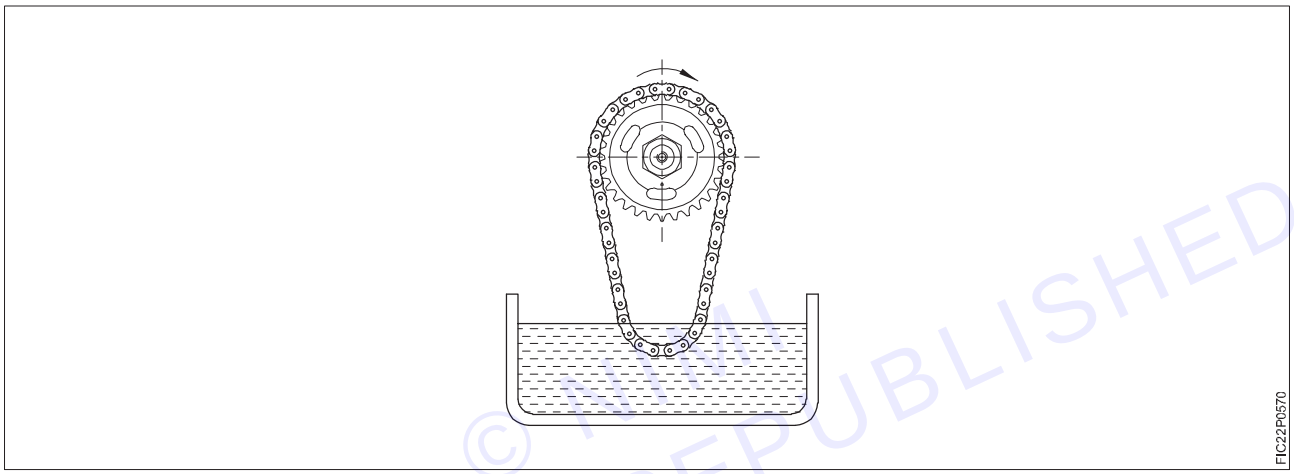
Splash Lubrication

Splash lubrication is a method used to lubricate moving parts within an engine or machinery by allowing the lubricant to splash or flow over the components as they rotate. This method is commonly used in engines, gearboxes, and some types of industrial machinery.

Ring Oiler



Chain Oiler



Coolants

coolants play a crucial role in various machining processes to ensure efficient cutting, cooling, and lubrication of metal workpieces and cutting tools.

Coolants, also known as cutting fluids or lubricants, play a crucial role in machining operations within a fitter workshop. They are used for various purposes to enhance the machining process, prolong tool life, improve surface finish, and reduce heat generation. Here's a demonstration of the various applications of coolants in a fitter workshop:

Water-Based Coolant:

- Setup: Prepare a machining operation such as milling or turning.
- Demonstration: Use a water-based coolant mixed with water according to the manufacturer's instructions. Apply it during the machining process.

Characteristics:

- Water-based coolants are economical and environmentally friendly.
- They provide good cooling properties and are effective in chip removal.
- Water-based coolants are suitable for general machining operations on ferrous and non-ferrous metals.

Synthetic Coolant:

- Setup: Set up a machining operation like drilling or grinding.
- Demonstration: Utilize a synthetic coolant mixed with water at the recommended concentration.
- Apply it during the machining process.

Characteristics:

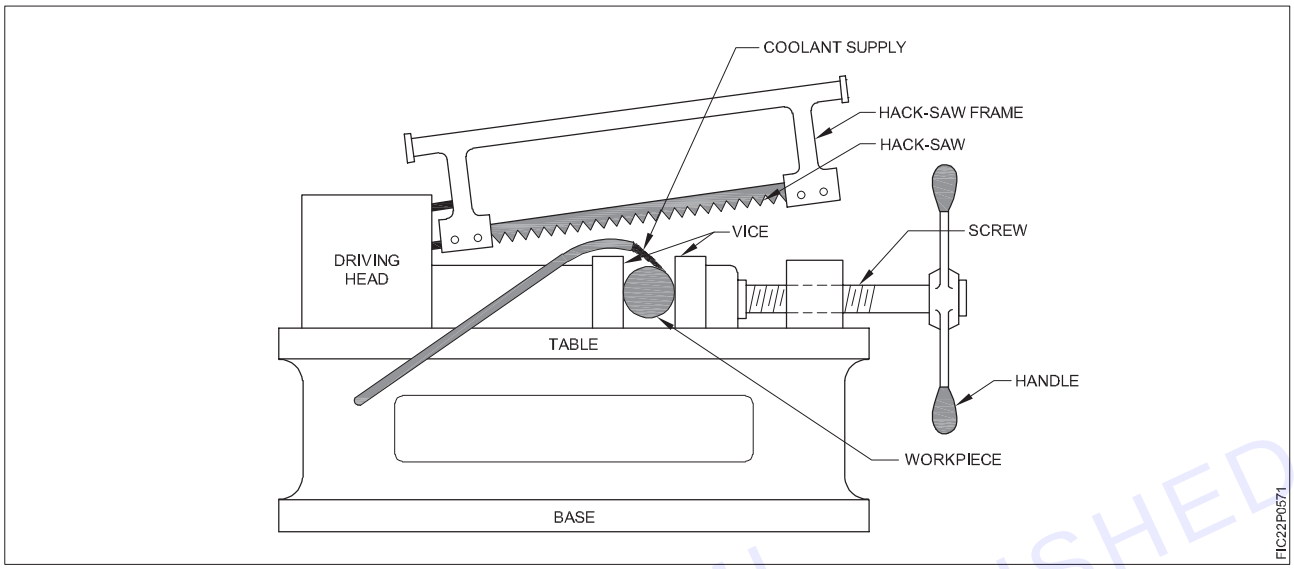
- Synthetic coolants offer excellent lubrication properties, reducing friction and extending tool life.
- They are often used for high-speed machining operations and on difficult-to-machine materials.
- Synthetic coolants resist bacterial growth and provide long sump life.

Oil-Based Coolant:

- **Setup :** Prepare a threading or sawing operation.
- **Demonstration :** Employ an oil-based coolant, either straight or diluted, as recommended by the manufacturer. Apply it during the machining process.

Characteristics:

- Oil-based coolants provide superior lubrication, especially for heavy-duty machining applications.
- They offer excellent surface finish and are suitable for operations requiring high heat dissipation.
- Oil-based coolants are commonly used for machining tough alloys and stainless steels.



Semi-Synthetic Coolant:

- **Setup :** Set up a machining operation such as milling or turning.
- **Demonstration :** Use a semi-synthetic coolant, which is a blend of synthetic and oil-based coolants, mixed with water. Apply it during the machining process.

Characteristics:

- Semi-synthetic coolants combine the benefits of synthetic and oil-based coolants, offering good lubrication and cooling properties.
- They are versatile and can be used for a wide range of machining operations on various materials.
- Semi-synthetic coolants provide stability and extended tool life while being cost-effective.

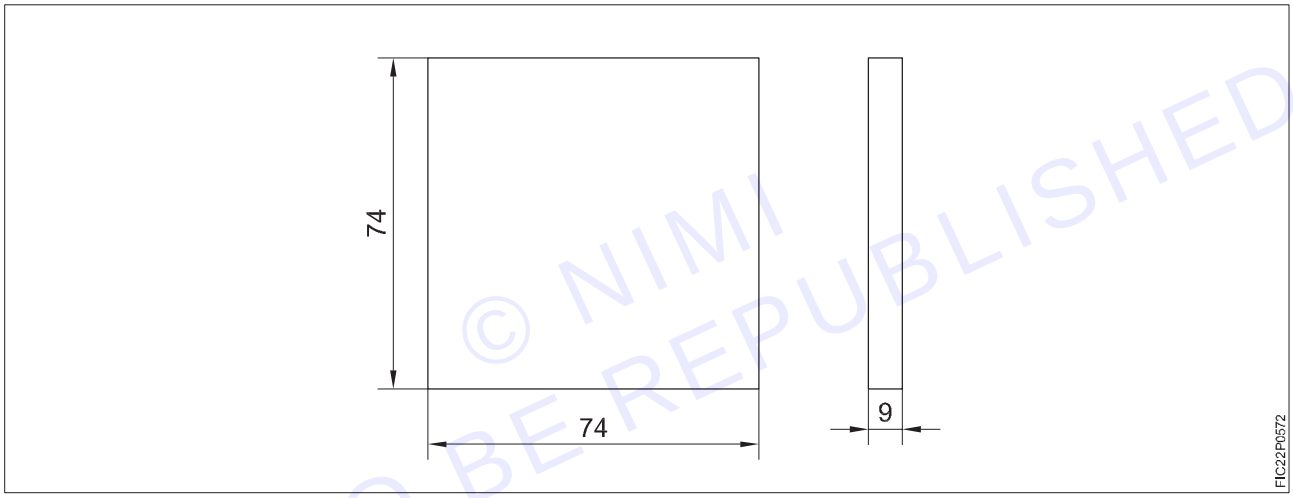
EXERCISE 40: Practice on filing to make sides square and the surface flat with minimum basic practical skills involvement

Objectives

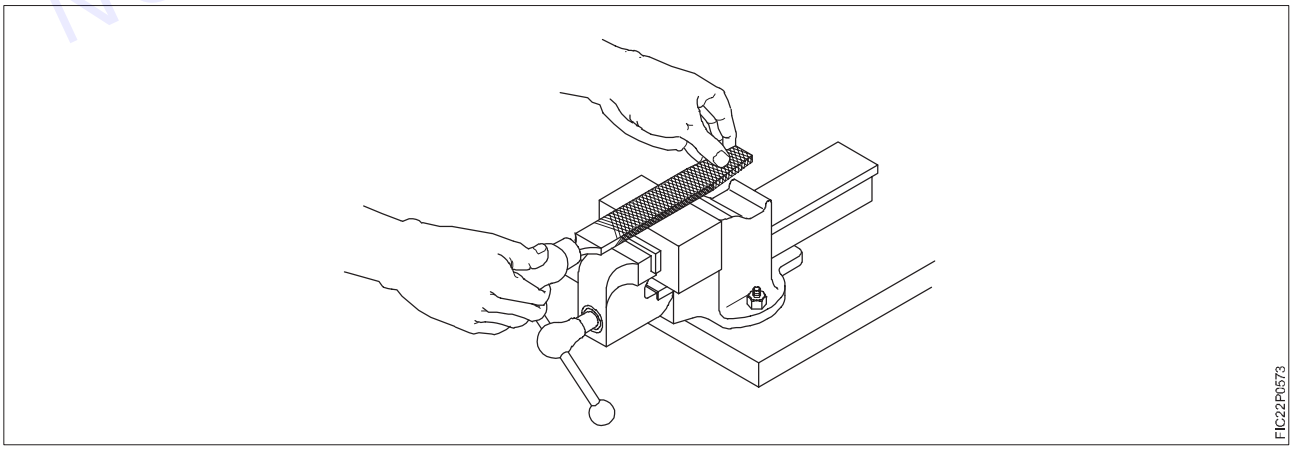
At the end of this exercise you shall be able to

- make flat surface using file
- check flatness using try square
- make squareness.
- check squareness of the job with try square.

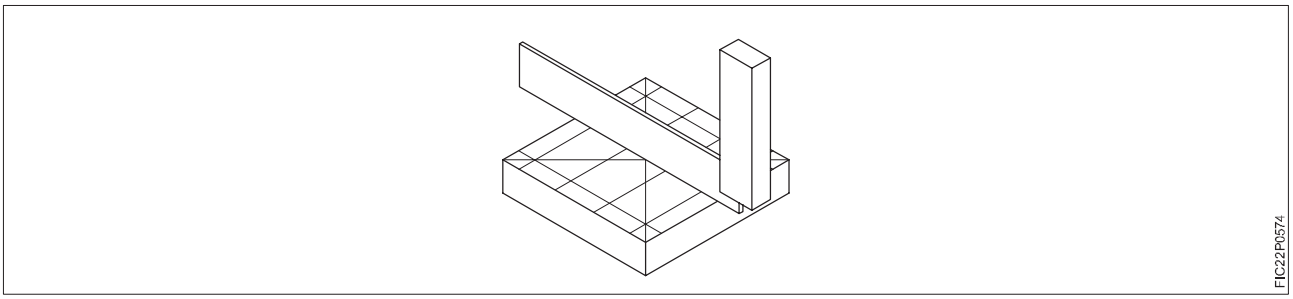
Job Sequence



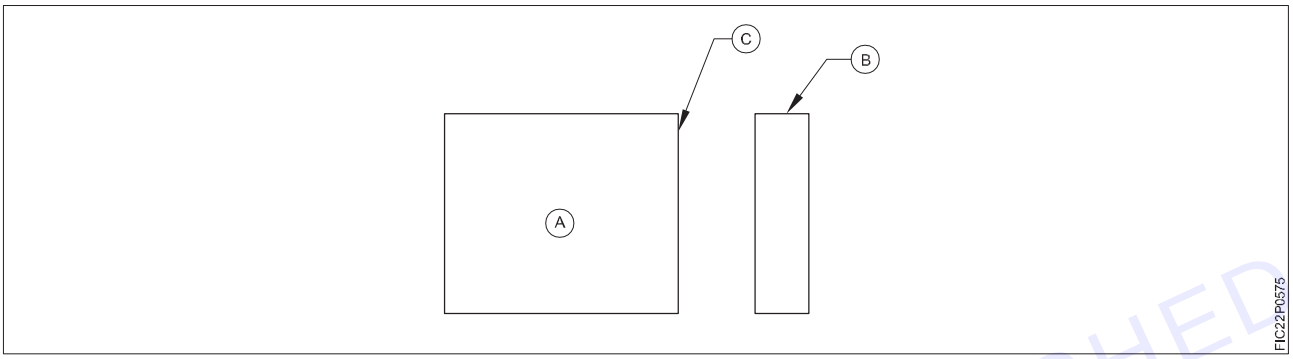
- Check the raw material size using steel rule.
- Remove the scaling by flat rough file.
- File surface (A) with flat bastard file



- Check the flatness by blade of a try square

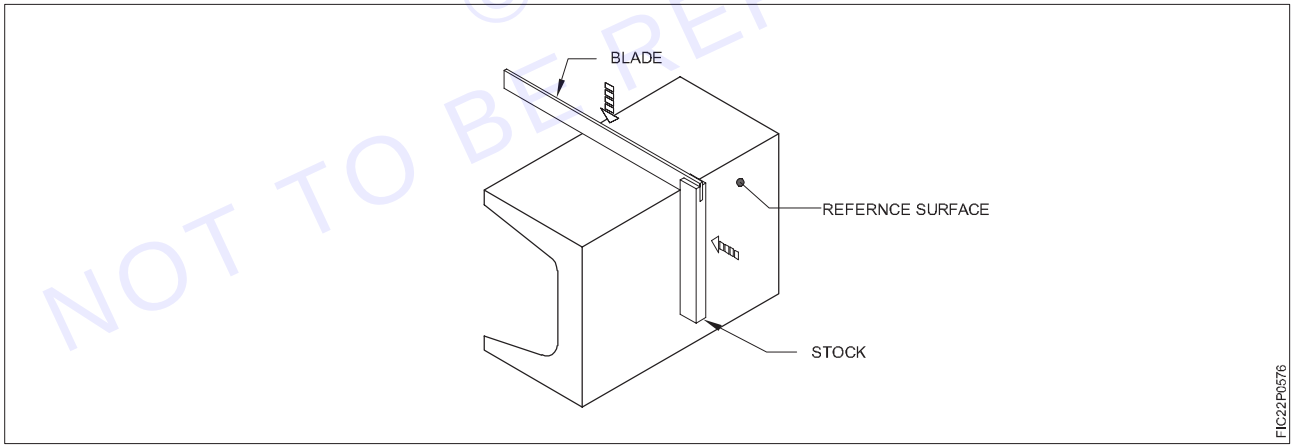


- File side (B) and maintain the squareness with respect to side (A).

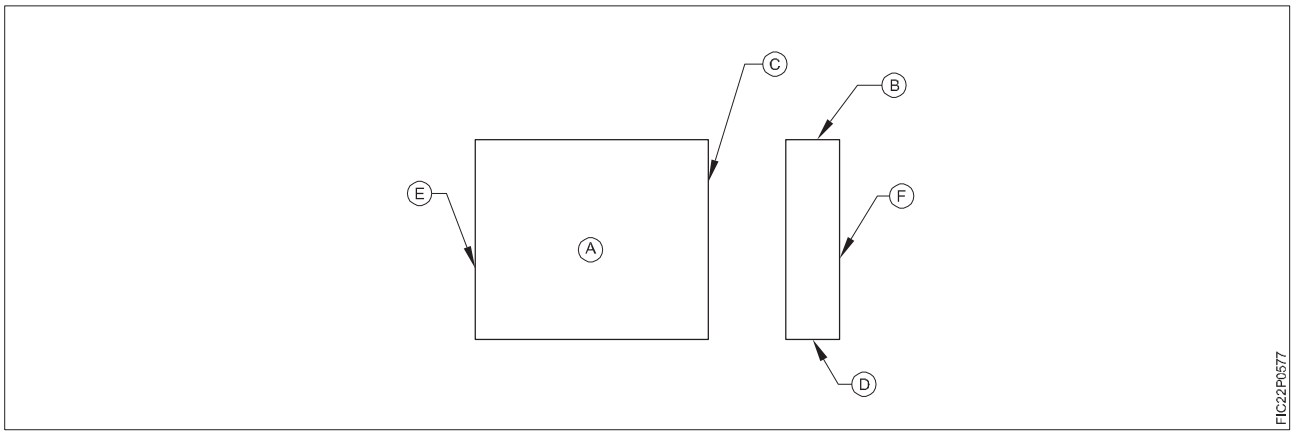


The side A,B and C are mutually perpendicular to each other

- Check the squareness with flat surface using a try square.



- Set marking block to 74 mm using steel rule
- Draw parallel lines of 74 mm to side (B) and (C)
- Punch the marked line using dot punch and ball pein hammer
- Set and file sides (D) and (E) to 74mm and maintain squareness to all other sides.
- Maintain (D) and (E) parallel to side (B) and (C)
- Check the dimensions with a steel rule and squareness with a try square
- File surface (F) and maintain the thickness of 9mm parallelism to side A.
- Remove sharp edges. Apply little amount of oil and preserve it for evaluation.



EXERCISE 41: Demo on usages of Digital height gauge and applications

Objectives

At the end of this exercise you shall be able to

- identify parts of digital height gauge
- working of digital height gauge
- applications of digital height gauge.

Procedure

A digital height gauge is an electronic measuring tool used for precise determination of heights in machining, metalworking, woodworking, and various other precision applications. It offers several advantages over traditional vernier height gauges, making it a popular choice.

- **Construction:** Digital height gauge typically consist of a sturdy base, a vertical column with a sliding mechanism, and a measuring foot. The column houses a linear encoder that translates the movement of the slide into a digital reading displayed on a LCD screen.
- **Measurement Range:** Digital height gauge come in various ranges, commonly from 0-150mm up to 0-1000mm or more.
- **Resolution:** Digital height gauges offer high resolution, typically ranging from 0.01mm (0.0005 inches) to 0.005mm (0.0002 inches), allowing for very precise measurements.

Setting Up:

1 **Turn it on and zero the display:** Most digital height gauges will have a power button and a zero/set button. Turn it on, then with the measuring foot (the foot that touches the object you're measuring) raised, press the zero/set button. This sets the current position as the zero point for your measurements.

2 **Attaching probes (optional):** Some gauges allow attaching different probes for specific applications. If your gauge uses probes and you need one for your measurement, consult the manual for proper attachment.

Taking Measurements:

1 **Lower the measuring foot:** Use the slide mechanism, a rack and pinion system with a fine adjustment knob, to lower the measuring foot towards the object you want to measure.

2 **Reaching the reference point:** Gently bring the measuring foot down until it just barely touches the surface referencing from (e.g., a flat surface on workpiece). Often hear a beep or see a change on the display to indicate contact.

3 **Reading the measurement:** The current display value represents the distance between the measuring foot and the reference point established when zeroed the gauge.

Advantages over Vernier Height Gauges:

- **Easier to read:** Digital display provides clear and unambiguous readings, eliminating the need to interpret vernier scales.
- **Faster measurements:** Digital readout allows for quicker measurements compared to vernier gauges.
- **Data output:** Some models can transmit data to computers for recording or analysis.
- **Error reduction:** Less prone to human error in reading vernier scales.

Uses of digital height gauge:

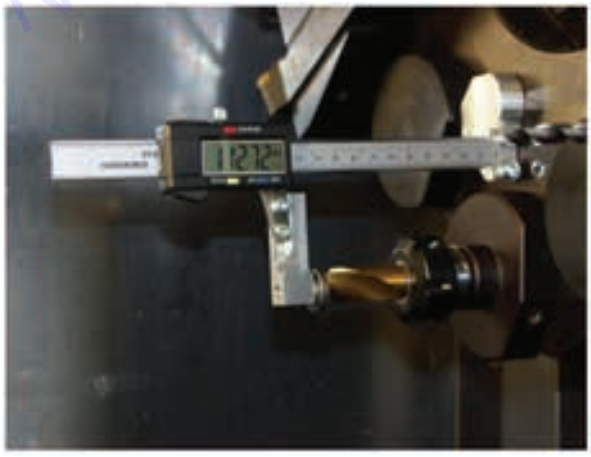
- Measuring workpiece heights, thicknesses, and depths.
- Transferring reference heights for marking or machining operations.
- Checking parallelism and perpendicularity.
- Setting tool heights on machines like milling machines or drill presses.

Measuring workpiece heights,

Transferring reference heights for marking or machining operations

Checking parallelism and perpendicularity

Setting tool heights on machines like milling machines or drill presses



EXERCISE 42: Demo on digital indicator& bore gauge and their application

Objectives

At the end of this exercise you shall be able to

- identify elements of digital indicator and bore gauge
- working of digital indicator and bore gauge
- checking parallelism, flatness, ovaliness, concentricity of job using digital indicator
- checking internal diameter of bore using bore gauge
- precaution while handling of digital indicator and bore gauge.

Procedure

Digital indicators are a modern variation of the classic dial test indicator (DTI) commonly used to measure minute deviations in alignment, runout, and flatness of machined surfaces.

Digital vs. Dial:

- Traditional DTIs have a circular dial with a needle that shows the movement.
- Digital indicators display the measurement as a numerical value on a screen, making them easier to read and record.

Advantages of Digital Indicators:

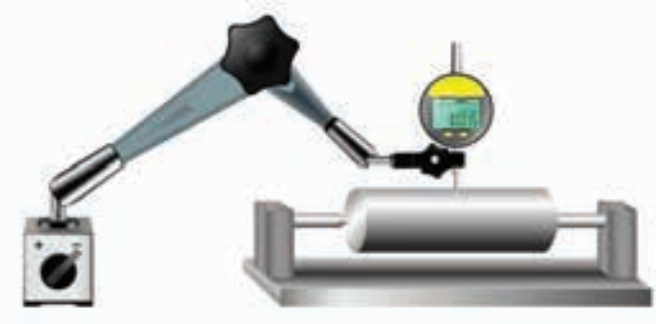
- **Improved Readability:** The digital display eliminates the possibility of misinterpreting needle positions on a dial.
- **Data Recording:** Some models allow data output for easy documentation and analysis.
- **Additional Features:** Certain digital indicators offer functionalities like tolerance settings, data transfer, and multiple measurement units.

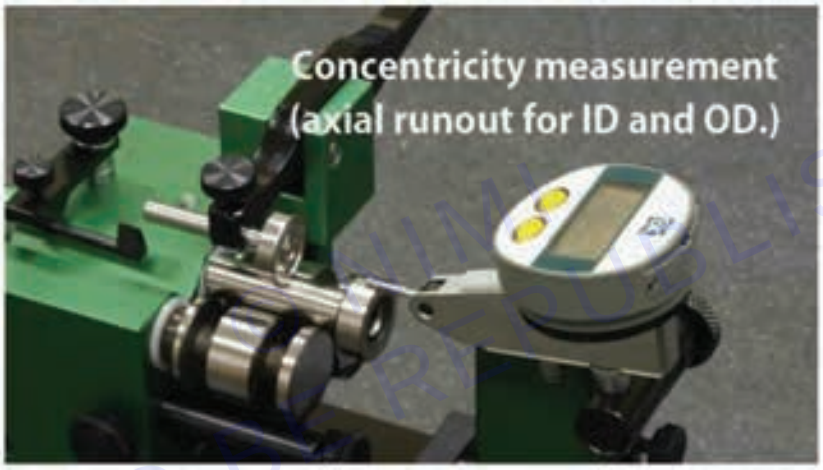
Uses of Digital indicator

- Checking runout of rotating parts

- Measuring flatness of surfaces like surface plate.
- Ensuring straightness of machined components.
- Aligning shafts and bearings during assembly.

Checking run out of rotating parts





Measuring flatness of surfaces like machine tables

Ensuring straightness of machined components

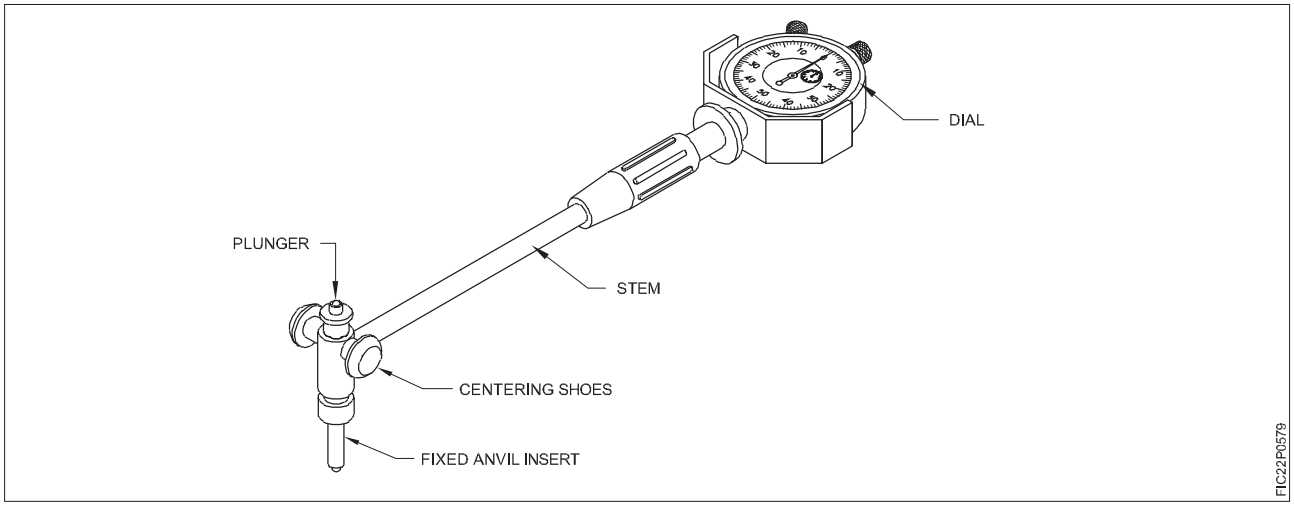
Aligning shafts and bearings during assembly

Bore Gauge

The bore gauge is a handy tool to measure the internal diameter of holes or bore.

- A bore gauge, typically a dial bore gauge, consists of a base unit with a moveable measuring head on one end.
- The head has spring-loaded contacts that expand to fit the bore's diameter.
- A dial gauge on the base unit displays the difference between the head's size and the actual bore diameter.

How to use a bore gauge for basic measurements.



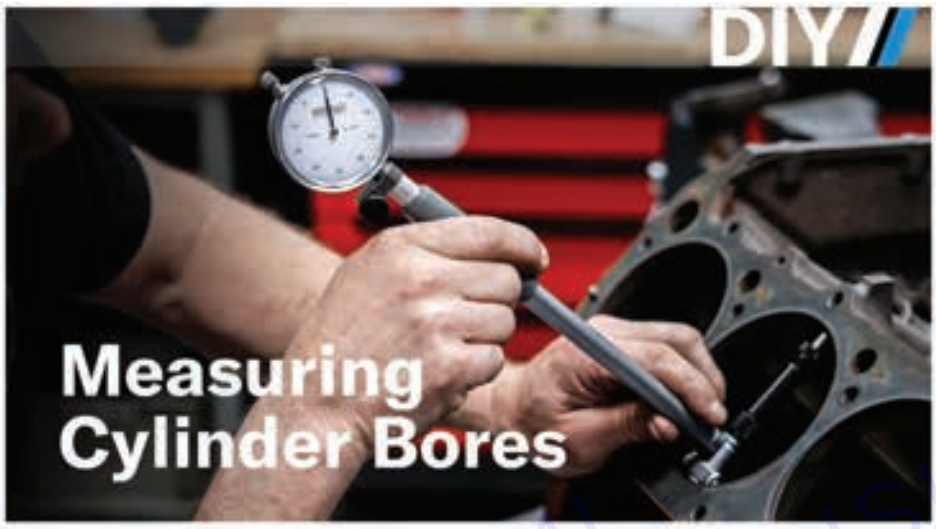
50-160mm Dial bore gauge, Accuracy -0.01mm

Case 1: Machining a Component

- We've machined a hole in a metal block. need to ensure it's within tolerance for a tight-fitting shaft.
- **Demo:** Use the bore gauge to measure the diameter at various depths and locations within the hole. This ensures the bore isn't tapered or out-of-round.
- **Key Point:** Bore gauges allow for quick and precise confirmation that machined parts meet dimensional specifications.

Case 2 : Checking Engine Cylinder Wear

- We suspect wear in an engine cylinder. Need to measure the diameter to determine if it's beyond the service limit.
- **Demo:** Choose a small measuring head to enter the cylinder. Gently rotate the gauge to get a minimum diameter reading.
- **Key Point:** Bore gauges help diagnose engine wear by revealing changes in cylinder diameter.



Case 3 : Inspecting Valve Seats

- We 're repairing a cylinder head and need to ensure the valve seats are within the correct diameter.
- **Demo:** Use a specialized measuring head designed for valve seats. This head might have ball contacts or other features to reach specific areas.
- **Key Point:** Bore gauges with special attachments allow for measurements in hard-to-reach or oddly shaped bores, like valve seats.

Some safety precautions to follow while using a digital indicator and bore gauge:

Before beginning:

- **Inspect the tools:** Don't use a damaged bore gauge or digital indicator. Cracks, loose parts, or a malfunctioning gauge can lead to inaccurate measurements and potential hazards.
- **Cleanliness is key:** Maintain the gauge and the workpiece in good condition. Dirt or debris can affect the accuracy of the measurement.
- **Work area prep:** Ensure your workspace is clean, free of clutter, and well-lit. Adequate lighting will help you see the gauge readings clearly and avoid mistakes.
- **Stable footing:** Make sure the work area floor isn't slippery and wear non-slip shoes to prevent accidents.

While using the bore gauge:

- **Be gentle:** Avoid dropping the bore gauge. These instruments are precision tools and can be damaged by rough handling.
- **Squared away:** When using the bore gauge, ensure the anvils are square to the bore for an accurate measurement.

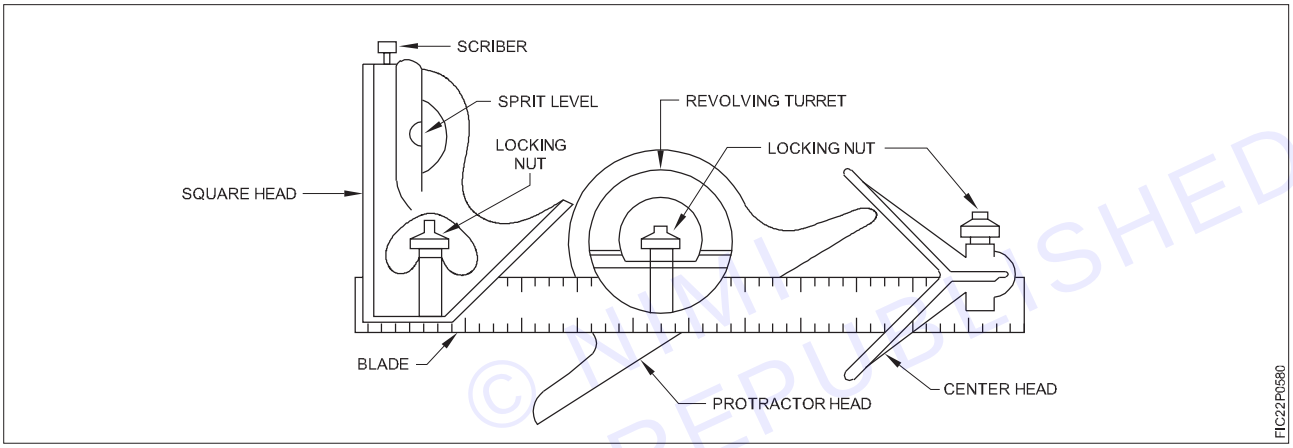
EXERCISE 43: Demo on combination set and parts and its functions

Objectives

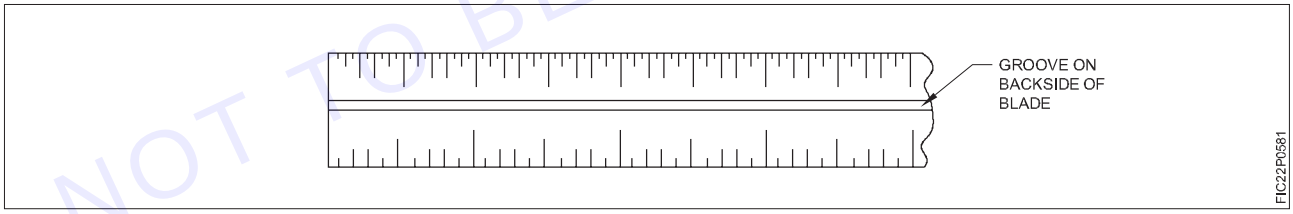
At the end of this exercise you shall be able to

- identify parts of combination set
- check job with help of square head
- marks off the line with square head
- checking & marking by Protractor head
- find the centre of round job by centre head.

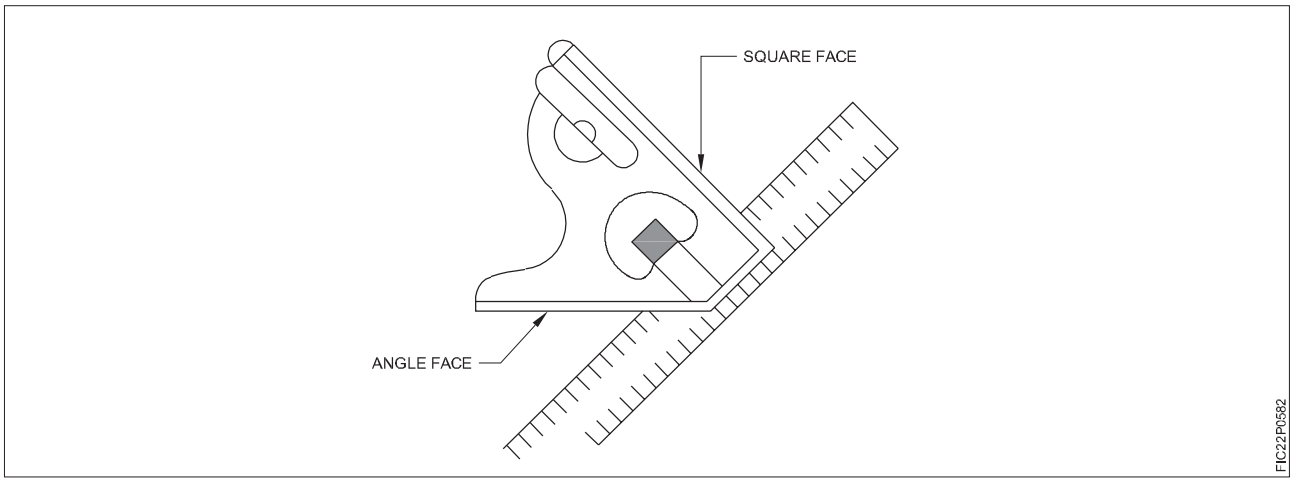
Procedure



Blade

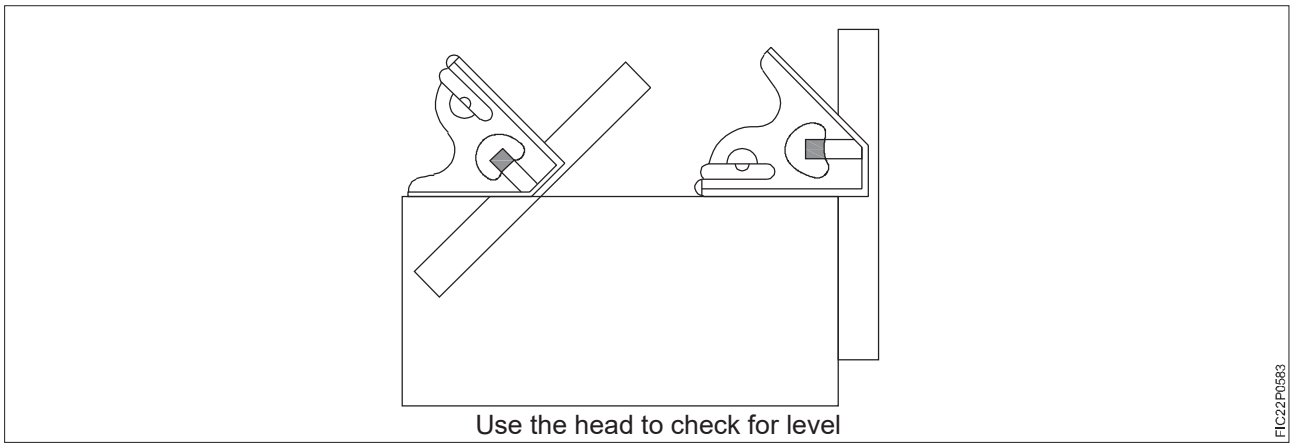


Square Head



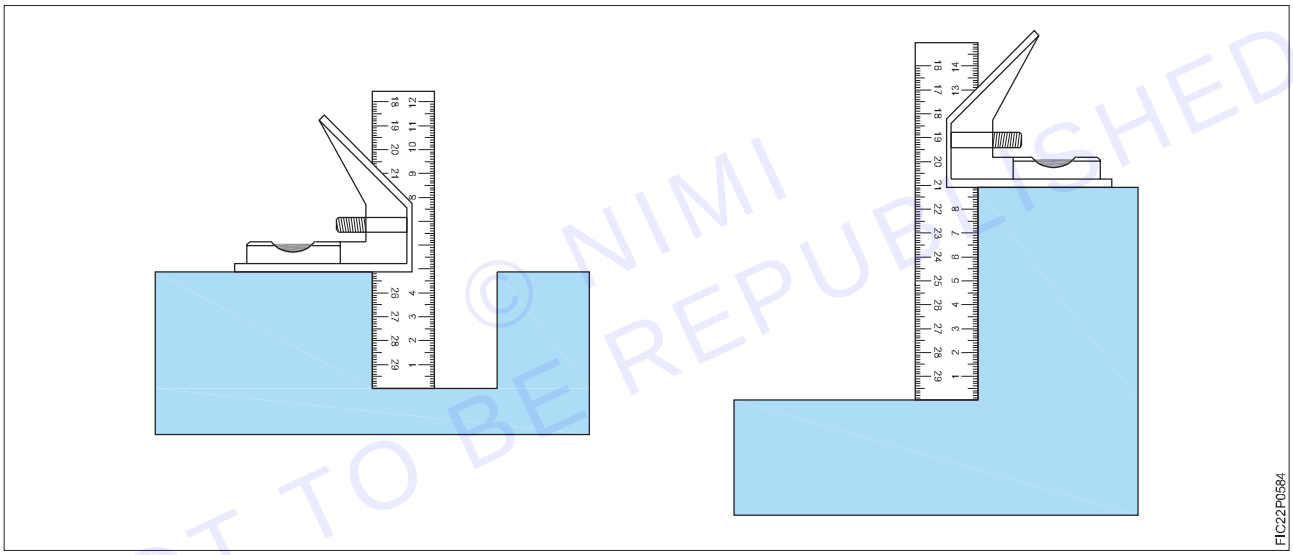
Using square head

1 For checking angles, rest the head on its square face to check a 90° angle and on its angled face to check 45°.

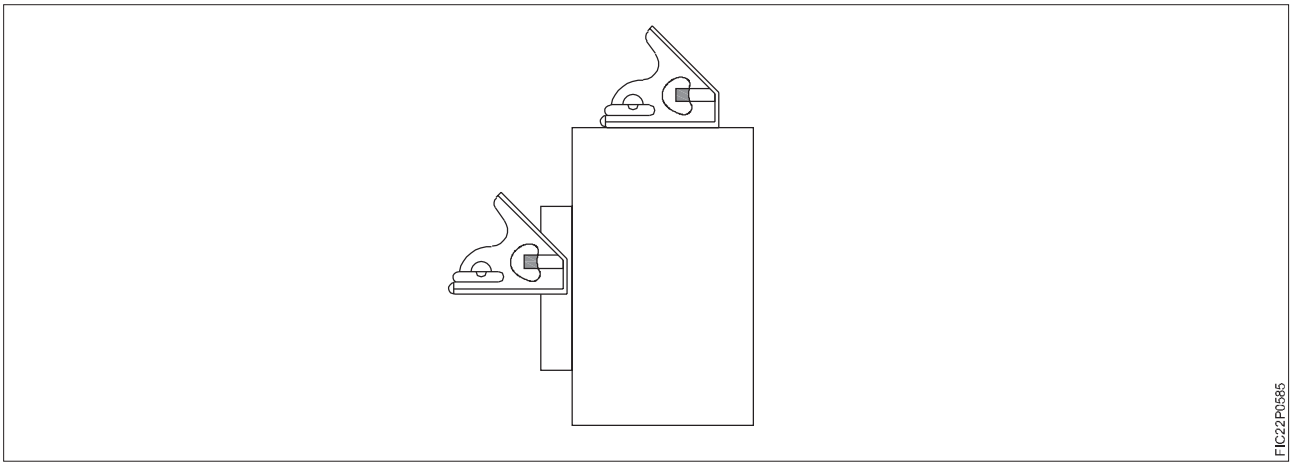


Use the head to check for level

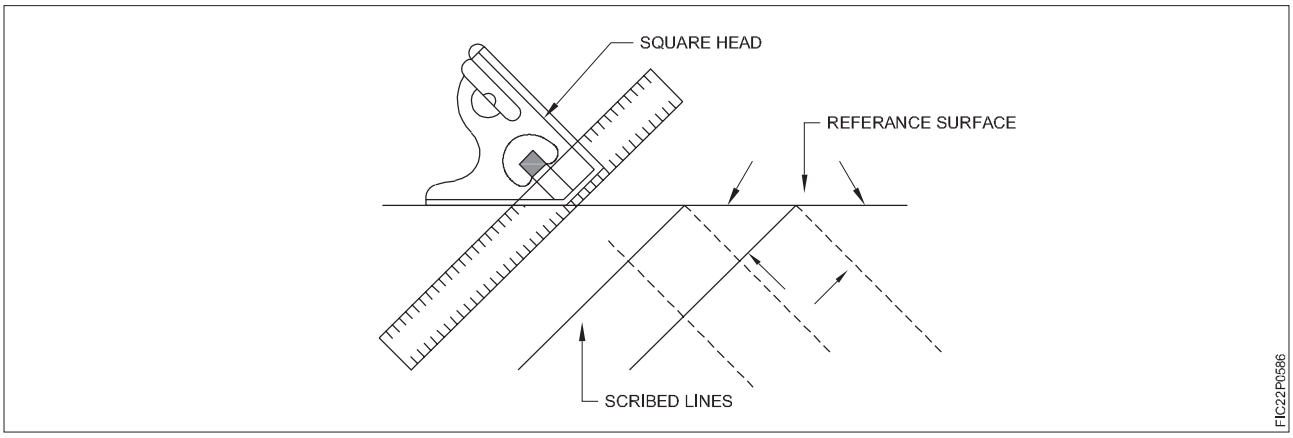
2 For measuring depth, loosen the locking nut, rest the square face flat on the reference surface and push the rule into the depth. Tighten the locking nut, remove the rule and read the depth.



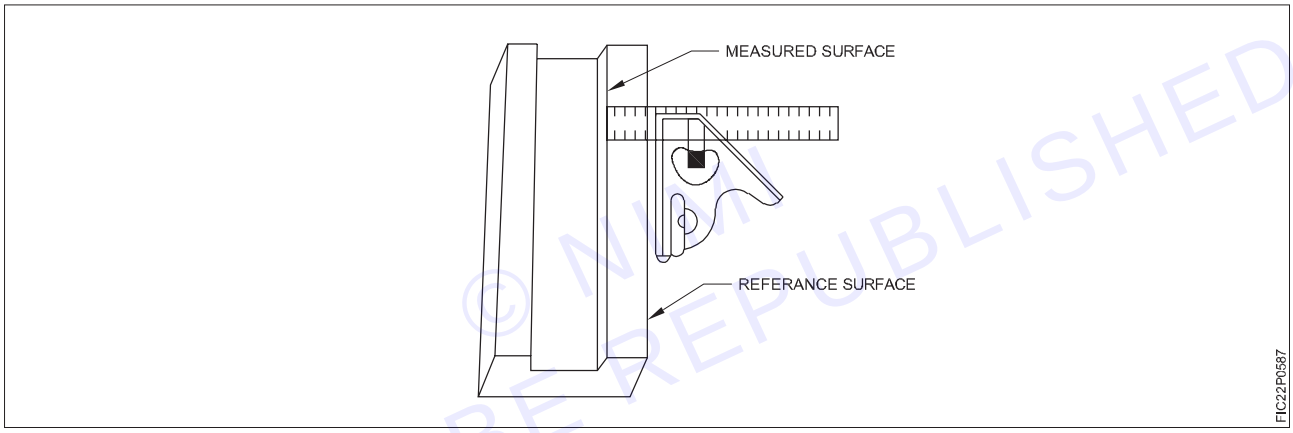
3 For checking horizontal surface, rest the square face of the head on the surface with blade removed and reinstall the blade and check vertical surfaces by holding the blade against the vertical member to see that it is plumb.



4 For laying out a line, move the blade until it extends the required distance from the head. This measurement is read on the scale of the blade. Lock the blade and the square head using locking nut and position the head firmly against the reference surface. Scribe the required line.



5 For measuring length hold the head firmly against the reference surface. Move the blade until it exactly splits the measured point. Read the dimension on the blade of the square head.



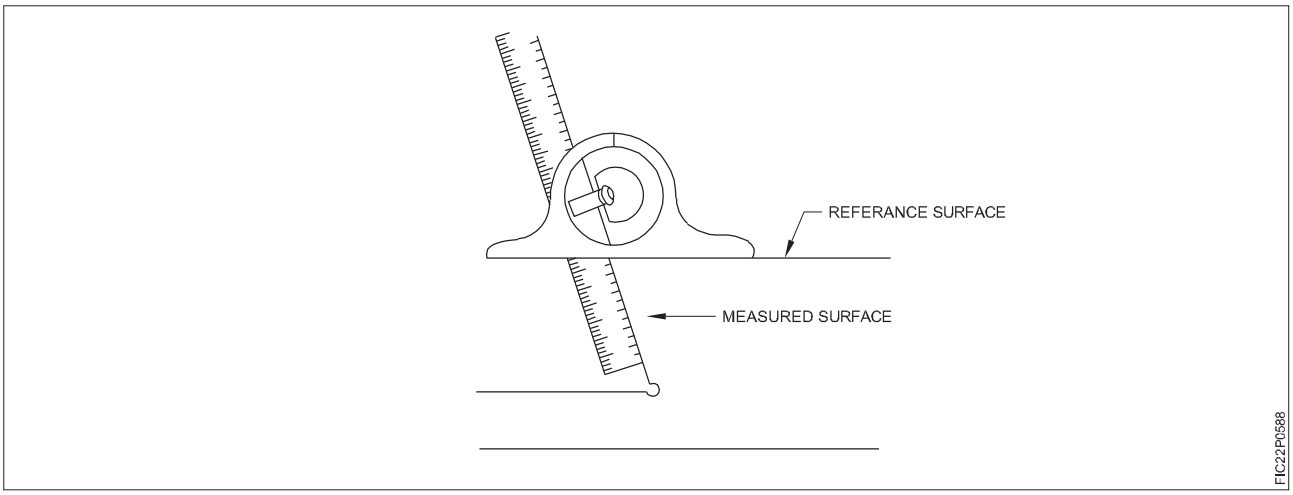
Protractor Head

Using protractor head for measuring and marking an angle

1 Loosen the revolving turret locking nut to allow the turret (disc) to be rotated when a slight force is applied.

2 Press the flat face of the protractor head against the reference surface.

3 Position the protractor head so that the blade and turret may be moved to the desired angle and mark off the angle.



4 For measuring an angle bring the blade down gently to the work piece and adjust it. The desired angle is reached when there is no light showing between the measured surface of the work and the blade.

Tighten the locking nut. Read the graduation on the turret that coincides with the reference mark on the protractor head.

Center Head

The center head, when inserted on the blade, is used to locate and lay out the center of cylindrical workpieces.

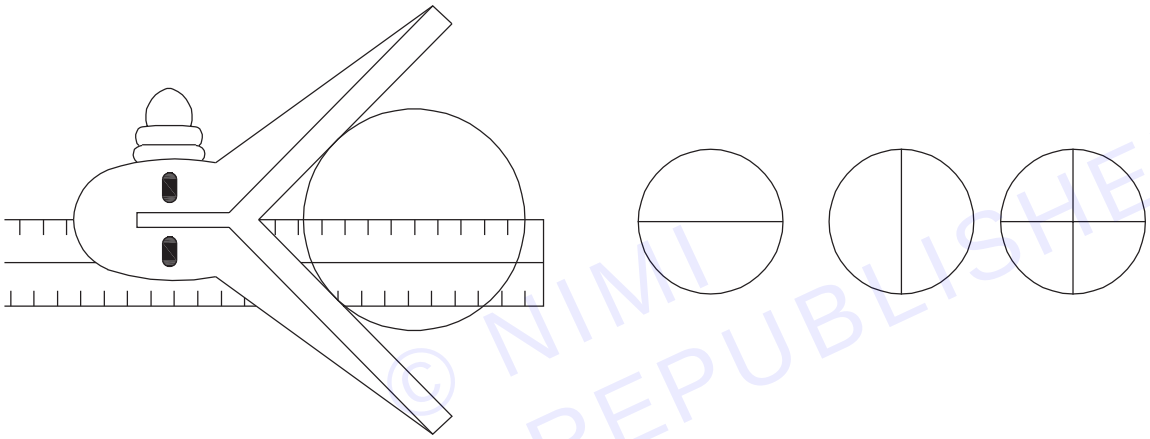
Using the center head.

1 Place the "V" legs of the center head against the outer Surface of the cylindrical workpiece. Hold it in this position.

2 Scribe the centerline with a sharp scriber along the blade.

3 Turn either the round base 900 or the center head over. Hold the center head firmly against the bar.

4 Scribe the second centerline along the blade.



LAYING OUT CENTER ON CYLINDRICAL WORKPIECE USING CENTER HEAD

FIC22P0589

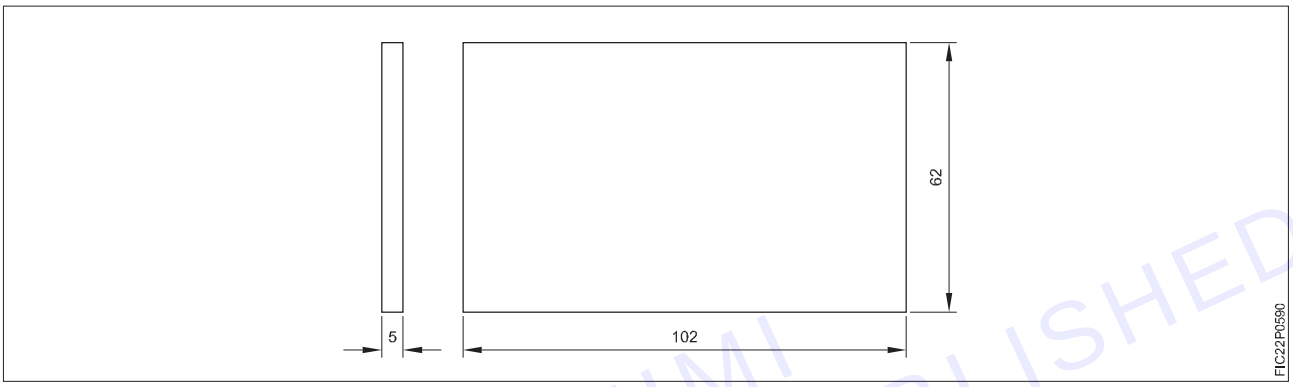
EXERCISE 44: Exercise on advanced practice on making filing etc

Objectives

At the end of this exercise you shall be able to

- make right angle surface
- make accurate surface
- make close dimension with accuracy 0.02mm.

Procedure



1 Check the raw material for its size with a steel rule 300mm.
2 Hold the workpiece in a 125mm jaw bench vice on its ends.
3 Ensure the work is held horizontally.
4 File the top surface with a flat bastard file 250mm.
5 Check flatness with a try-square.
6 File to medium finish using a flat second cut file 250mm.
7 Hold the workpiece to file the longer side.
8 File and check flatness and squareness with previously finished surfaces using a try-square 150mm.
9 File the adjacent shorter side flat and square to both the finished surface.
10 Remove burrs and mark sizes as per job drawing, using a steel rule, try-square and scriber.
11 File the other two sides flat and square, maintaining the dimensions.
12 File the other flat surface parallel and check the thickness using an Vernier caliper.
13 Remove burrs, using a flat second cut file.

Safety Precautions

1 Read the drawing thoroughly.
2 Don't use file without handle.
3 Remove the sharp edge / burrs of the job using second cut files.
4 Don't use the oil / grease on the file or job surface.
5 Handle carefully precision measuring instruments.
6 Don't mix precision measuring instruments with cutting tools.
7 Use filing speed as per material of the job.
8 Select correct pitch of the blade as per raw material in hacksawing.
9 check squareness carefully
10 Take high spot using Prussian blue on surface plate.

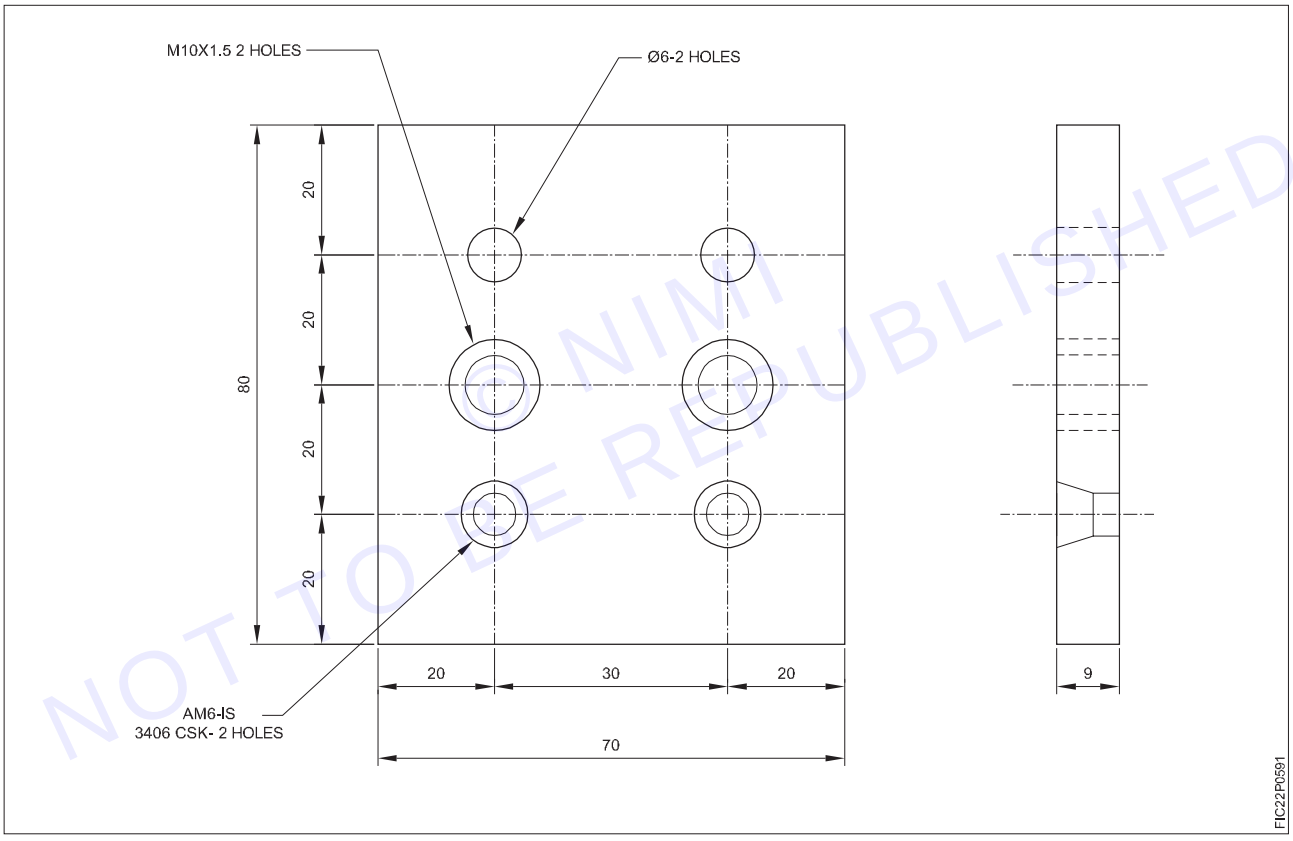
EXERCISE 45: Exercise on advance practice on drilling, counter sinking, tapping etc

Objectives

At the end of this exercise you shall be able to

- file and finish flat surfaces within an accuracy of ± 0.02 mm
- mark and drill holes as per drawing
- calculate Tap drill size
- cut internal thread to assemble countersink screws
- use counter sunk drill.

Procedure



- Check the raw material for its size.
- Remove scaling surface using rough file.
- File the top surface with a flat bastard file 250mm.
- Check flatness with a try-square.
- File to medium finish using a flat second cut file 250mm.
- Check the flatness of surface using try square.
- Remove high spot using second cut file 250mm and check flatness again.
- Repeat this activity until surface make parallel .
- Check flatness using try square.
- file longer side using second cut file 250mm.

- Check straightness of side using try square.
- File the adjacent shorter side flat and square to both the finished sides.
- Check squareness (right angle) between both sides using try square.
- Remove burrs/ sharp edge.
- Apply marking media on job surfaces
- Mark lines as per drawing.
- Punch witness marks.
- Mark centre drill for drilling.
- Find hole size for M10X1.5 tapping using formula

TDS=Tap size-2xdepth of thread.

- Drill Ø 6mm in six places.
- Enlarge Ø 8.5mm and chamfered for tapping.
- Hold C'SK drill AM6 for counter sinking
- Use counter sunk drill AM-6
- Set taper tap in Ø 8.5mm hole.
- Check straightness using try square.
- Use medium and bottoming tap.
- Check thread using Bolt Ø 10mm.
- De-burrs and remove sharp edge.
- Apply a little oil and preserve it for evaluation.

EXERCISE 46: Assemble of parts and checking and preparation a parallel clamp

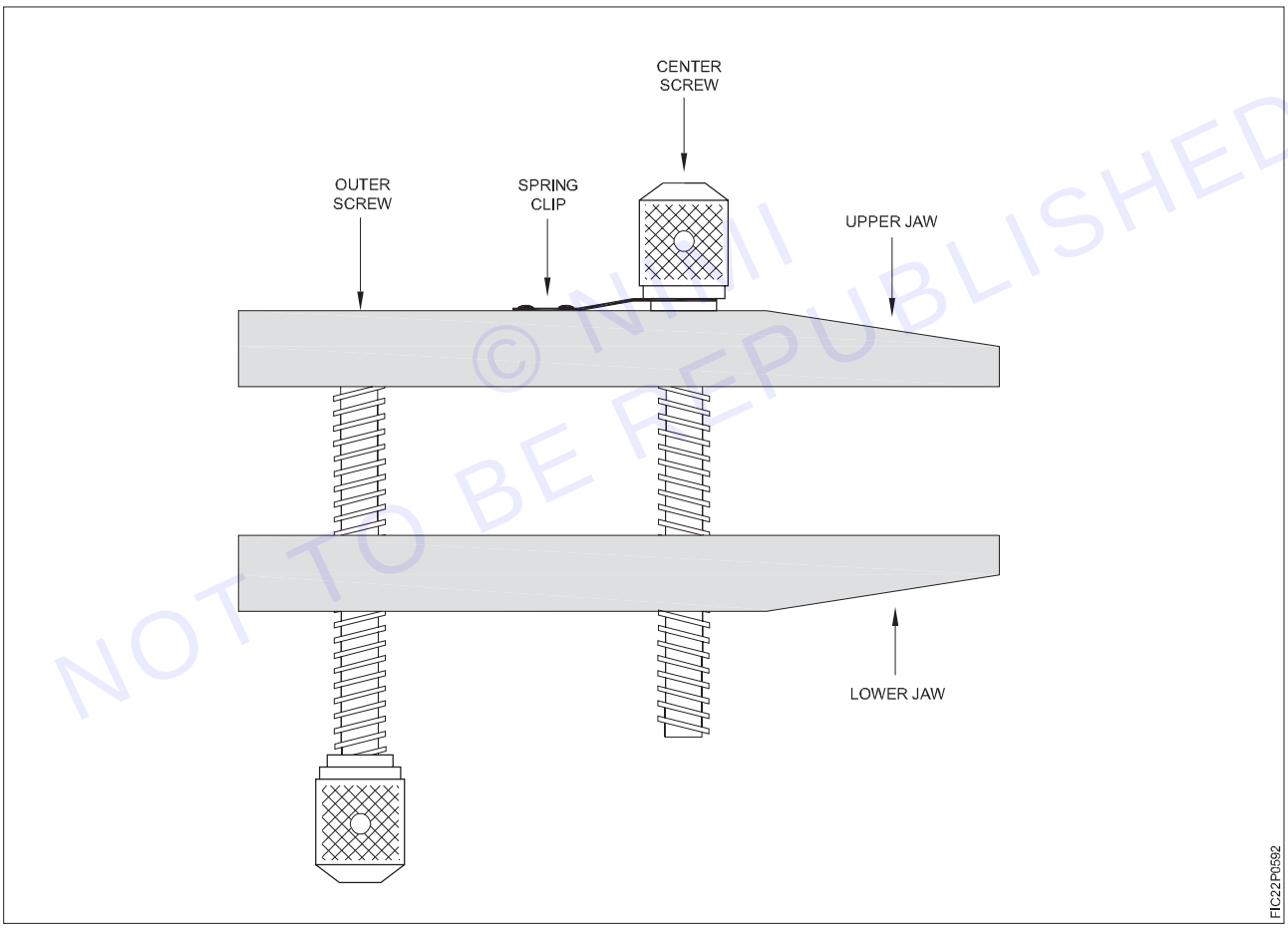
Objectives

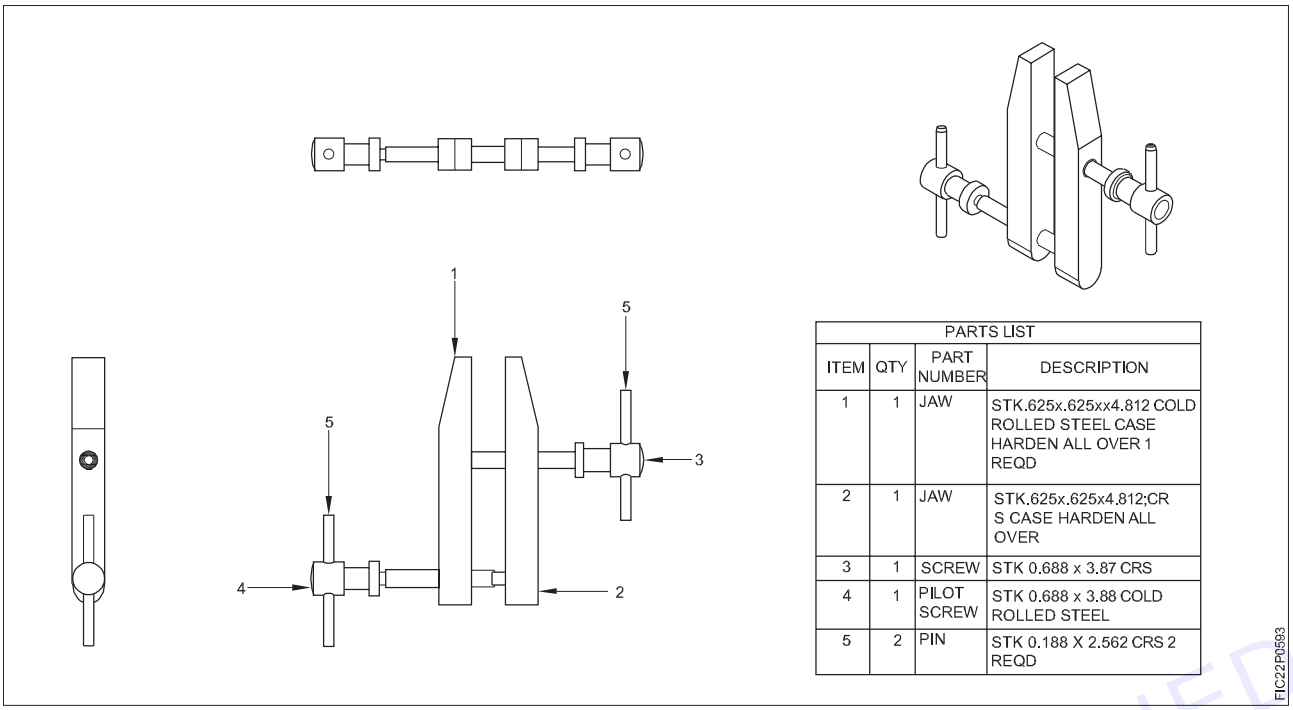
At the end of this exercise you shall be able to

- fine uses of Vernier caliper and micrometer
- use proper assembly tools
- perform assembling procedure
- use proper safety precaution in assembly.

Procedure

Parallel clamp is holding device which used to hold finished small job for further marking and machining process. This is known as tool makers vice also.





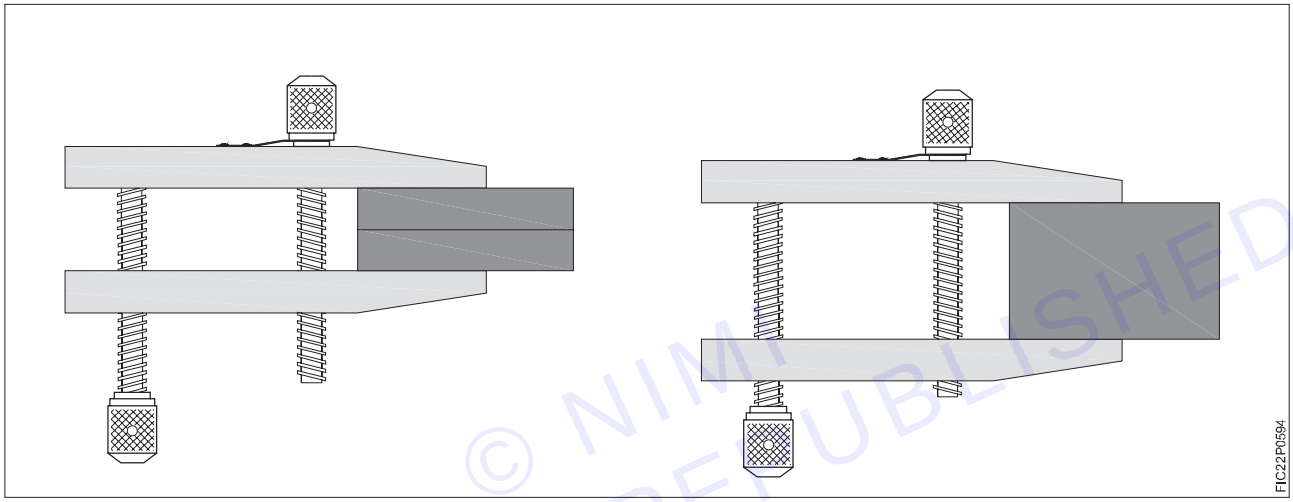
Details parts of parallel clamp

Part No	Name of part	Qty	Size(mm)	Material
1	Lower Jaw	01	125x16x16	M.S
2	Upper Jaw	01	125x16x16	M.S
3	Screw(centre)	01	M10x100	M.S
4	Screw(outer)	01	M10x100	M.S
5	Pin	02	ϕ5X65	M.S

Job Sequence

- Insure that work area is clean, well-lit and free from any obstructions.
- Collect all the necessary parts required for assembly of parallel clamp including jaws, screws, pin, handles etc.
- Ensure that all the required tools such as wrenches, screw drivers, Allen keys depending on the types of fasteners are available.
- Inspect each parts using Vernier caliper and micrometer and ensure each parts dimensions are in the limit of tolerance.
- Inspect each parts for any defects, damage or irregularities that may ef affect the assembly or functionality of the parallel clamp.
- If any parts are found to be defective, set them aside for repair or replacement.
- Positioned the jaws onto the bar at desired distance apart, ensuring they are aligned parallel to each other.
- Use the screw to assemble the jaws , ensuring they are tightened securely but not excessively.
- If necessary, apply lubricant to the screw mechanism to facilitate smooth operation.
- Attach the handle (s) to screw mechanism , ensuring they are securely fastened.
- Depending on the designed we may need to insert pin or screw to the handle(s) in place.

- Check the alignment of the jaws to ensure they are parallel and properly aligned with each other.
- Test the functionality of the clamp by turning the handle (s) to open and close the jaws , checking for smooth operation and proper clamping action.
- If any adjustment are needed, such as tightening or loosening fasteners or realigning parts, make them at this stage to ensure the clamp functions correctly.
- Conduct a final inspection of the assembled clamp to ensure all parts are securely fastened and aligned properly.
- Check for any defects or abnormalities that may affect the performance of the clamp.
- If clamp requires any finishing touches such as paiting or coating apply them according to the drawing .
- If the clamp is to be packed for storage, use oil and packed properly ensuring to prevent damage during storage or transpotations.



Safety Precautions

During the assembly of a parallel clamp, it's important to observe safety precautions to prevent accidents and injuries. Here are some safety precautions to follow:

1 **Wear Personal Protective Equipment (PPE):** Wear appropriate PPE such as safety glasses or goggles to protect your eyes from flying debris or particles during assembly.

2 **Handle Tools Safely:** Use tools properly and handle them with care to avoid accidents. Ensure that tools are in good condition and free from defects before use.

3 **Avoid Pinch Points:** Be cautious of pinch points between moving parts of the clamp during assembly, especially when tightening screws or adjusting handles.

4 **Secure Workpiece:** Secure the workpiece firmly in place before starting the assembly process to prevent it from slipping or moving unexpectedly.

5 **Beware of Sharp Edges:** Be mindful of sharp edges or protrusions on clamp components that could cause cuts or abrasions. Handle parts with care and wear gloves if necessary.

6 **Work in a Well-Ventilated Area:** If working with lubricants or adhesives during assembly, ensure adequate ventilation to prevent inhalation of fumes or vapors.

7 **Inspect Tools and Equipment:** Regularly inspect tools and equipment for any defects or damage. Replace or repair any faulty equipment to prevent accidents.

8 **Work Mindfully:** Focus on the task at hand and avoid distractions while assembling the clamp to prevent accidents due to inattention.

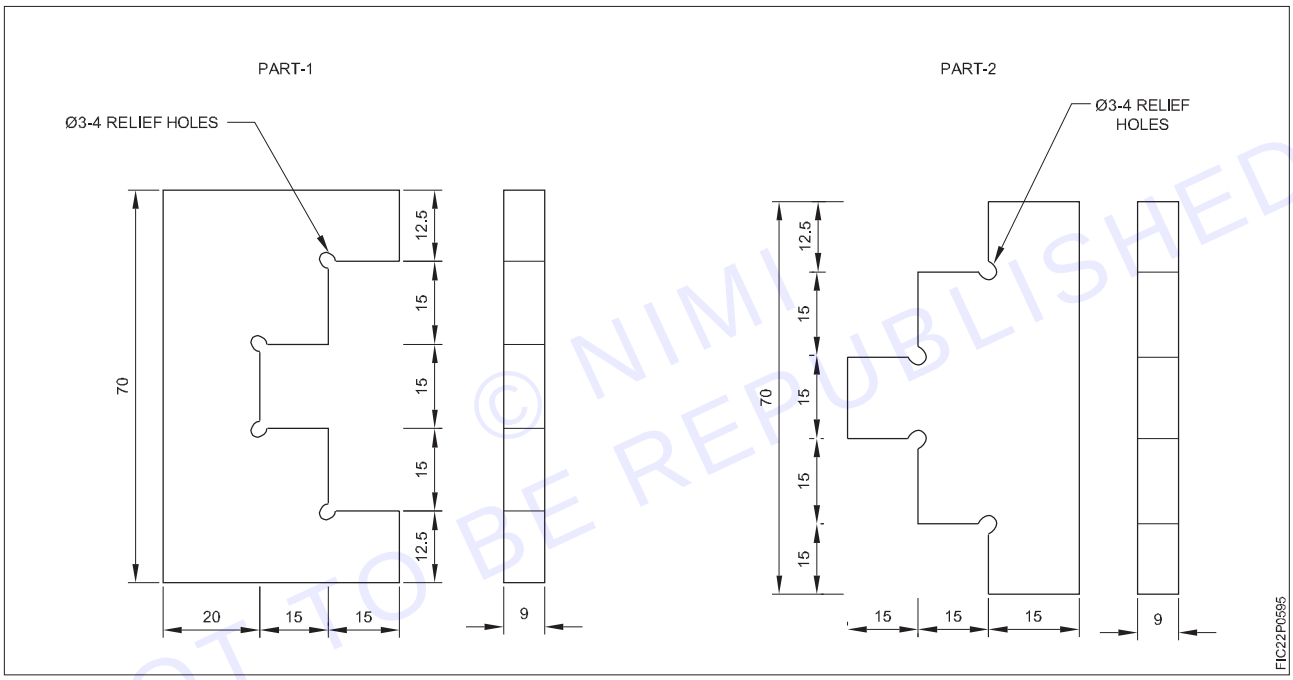
EXERCISE 47: Practice on square fitting, step fitting etc. as per given drawing

Objectives

At the end of this exercise you shall be able to

- mark off lines using vernier height gauge
- file steps maintaining accuracy ± 0.02 mm
- maintain squareness using safe edge file
- drill relief hole
- match male & female parts with accuracy 0.02mm.

Procedure



PART - 1

- Check the raw material for its size.
- File and finish to size 70 x 50 x 9.5 mm maintaining parallelism and perpendicularity.
- Mark and punch in part '1' .
- Drill Ø 3 relief holes as shown job drawing.
- Chain drill holes for parting off excess material from part '1' .
- Cut and remove excess material using web chisel and ball pein hammer.
- File steps to size maintaining accuracy ± 0.02 mm and squareness using safe edge file different grades
- Check the size with Vernier caliper .
- Maintain thickness 9mm.
- Remove burrs/sharp edge.

PART- 2

- File and finish to size 70 x 50 x 9.5 mm maintaining parallelism and perpendicularity.
- Mark and punch in part -2 as per drawing.

- Drill Ø 3 relief holes as shown in drawing.
- Chain drill holes for parting off excess material from part - 2 .
- Cut and remove excess material using web chisel and ball pein hammer.
- File steps to size and squareness using safe edge file different grades .
- Check the size with vernier caliper .
- Match part 1 and 2 .
- Finish file on part 1, 2 and de - burr in all the surfaces.
- Maintain thickness 9mm.
- Use oil in all surfaces and presrve for evaluations.

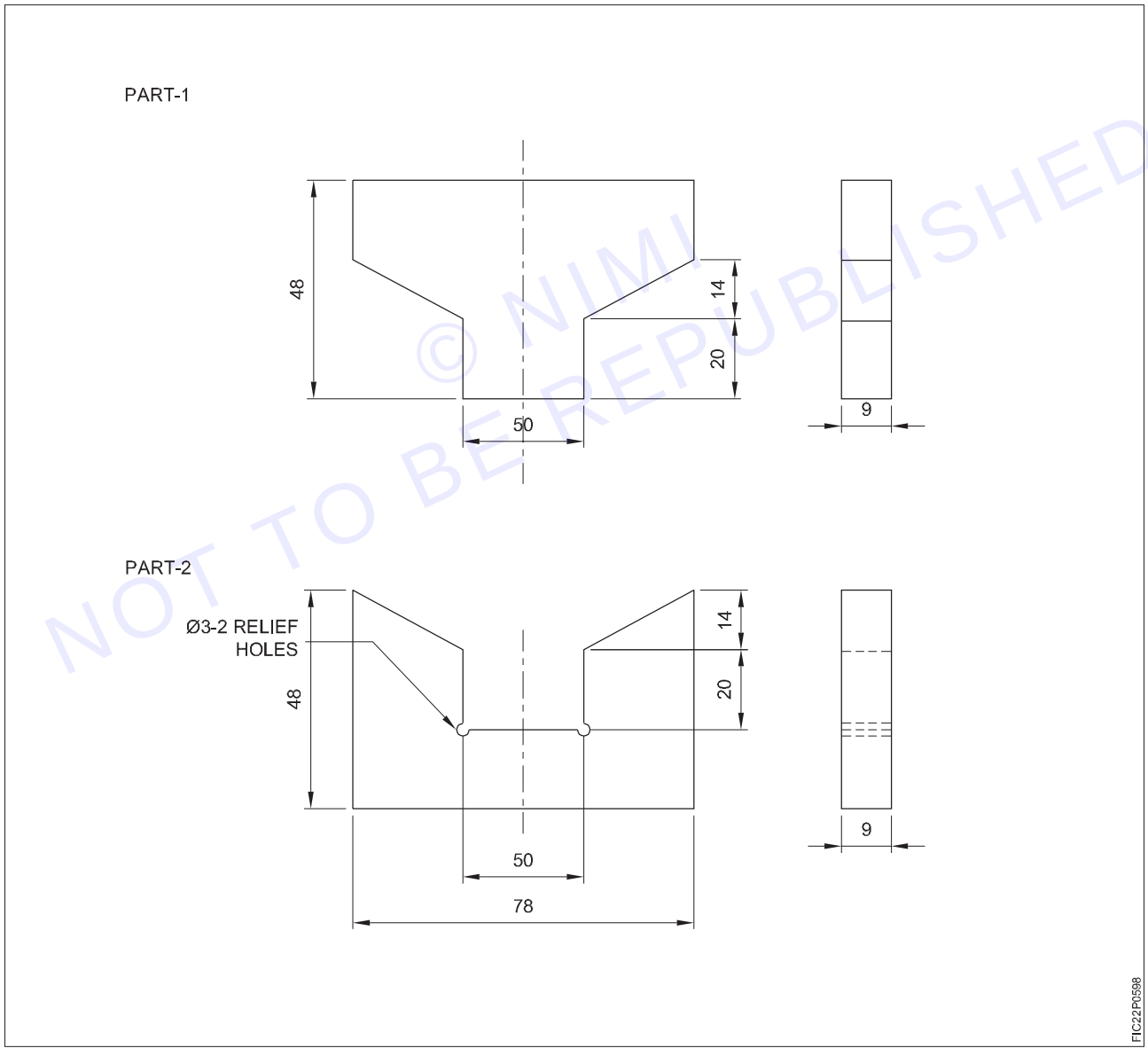
EXERCISE 48: Practice on sliding and angle fitting, within accuracy of ±5 minutes and their evaluation

Objectives

At the end of this exercise you shall be able to

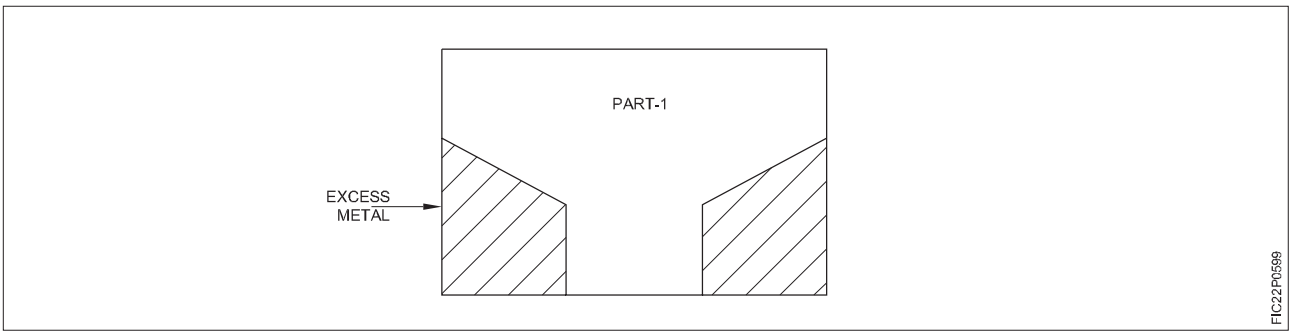
- file surfaces flat and square to the accuracy of ± 0.04 mm
- mark dimension lines as per drawing
- file flat and angular surfaces as per drawing
- measure the angle using vernier bevel protractor
- fit combined open, angular sliding sides, finish and de-burr.

Procedure

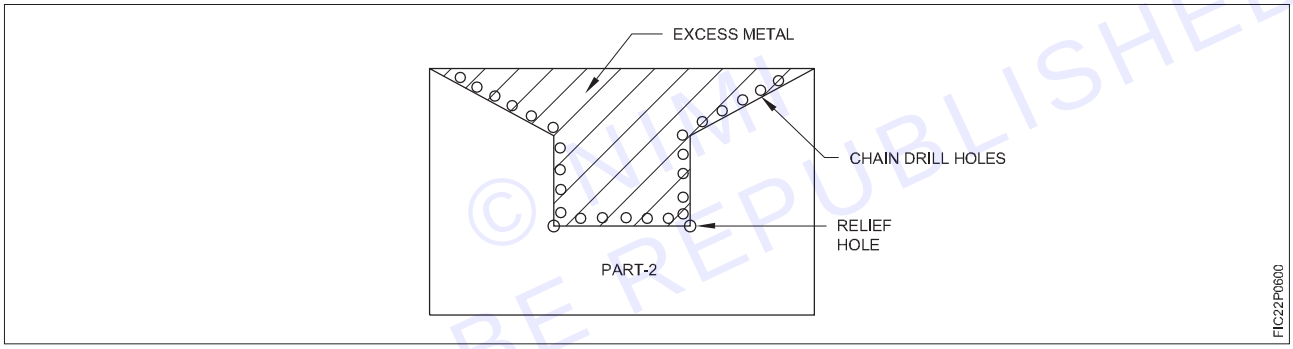


- Check the raw material for its size.
- File part 1 and 2 to over all size 78 x 48 x 9 mm maintaining parallelism and perpendicularity.

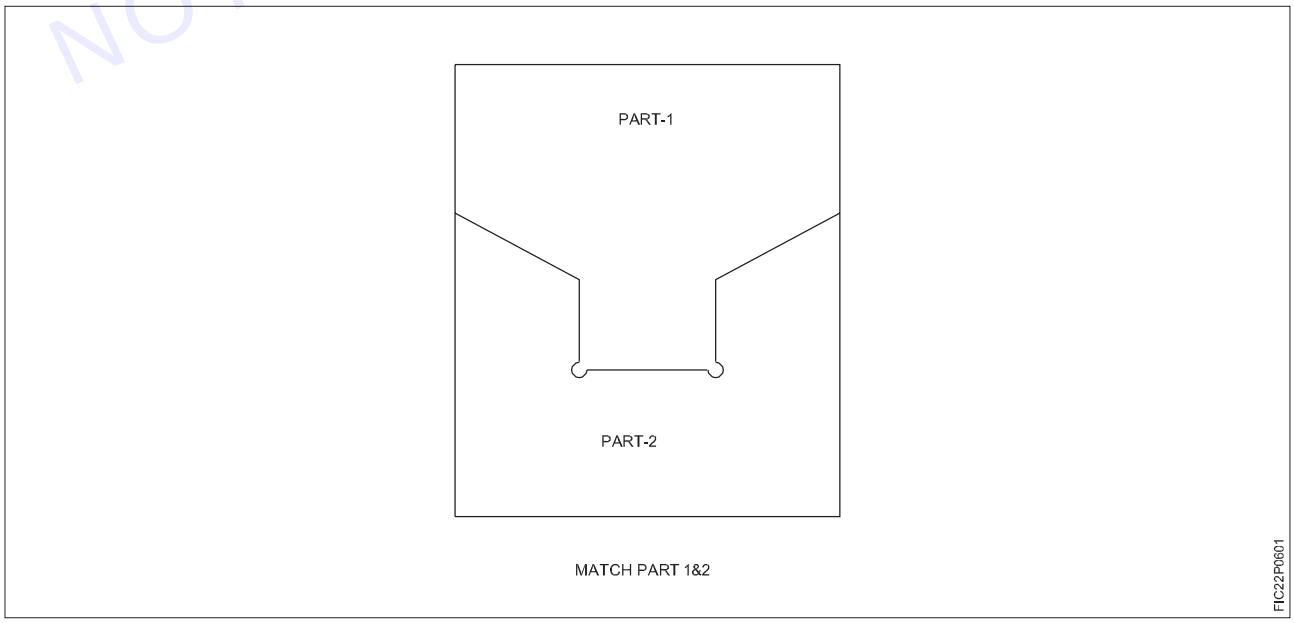
- Check the size with vernier caliper.
- Apply marking media and mark dimension lines on part 1 and 2 as per job drawing.
- Punch witness marks on part 1 and 2.
- Hacksaw and remove the excess metal in part 1 and file to size and shape maintaining accuracy ± 0.04 mm and angle 30 minutes as shown in Fig 1.



- Drill Ø 3 mm relief hole in part 'B'
- Chain drill, chip, remove the excess metal in part 'B' and file to size and shape as shown in Fig 2.
- Check the size with vernier caliper and angles with vernier bevel protector.



- Finish file on part 1 and 2 and de-burr in all corners.
- Match part 1 and 2 as shown Fig 3.
- Apply a little oil and perserve it for evaluation



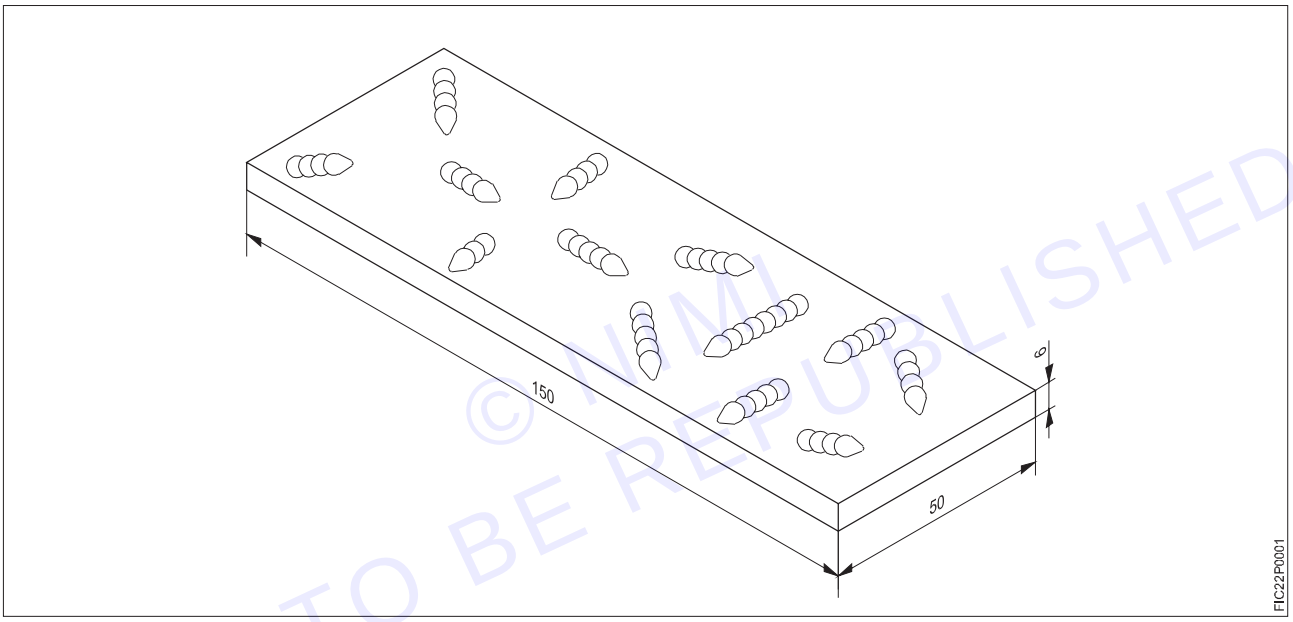
MODULE 4

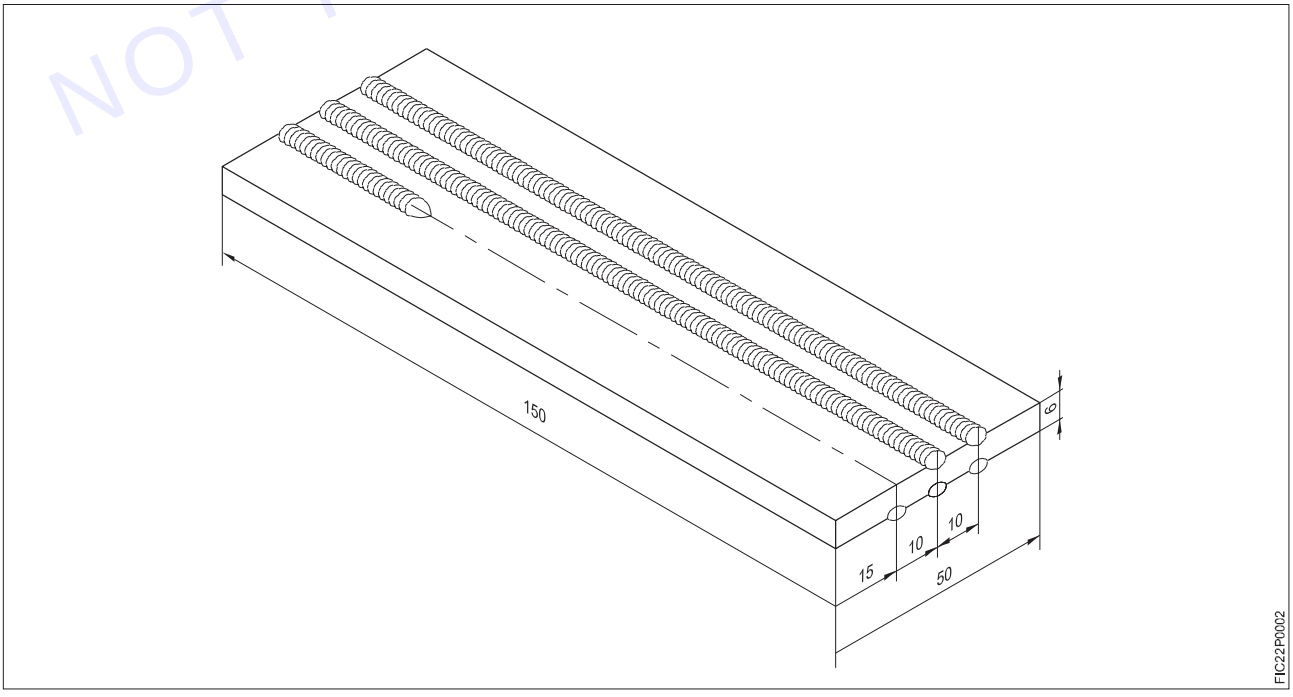
EXERCISE 49: Striking and maintaining arc, laying straight - line bead

Objectives

At the end of this exercise you shall be able to

- set and operate an AC and DC arc welding plant
- set the welding current for the different sizes of electrodes
- strike and maintain the arc by scratching and tapping method
- deposit uniform straight weld beads and inspect for faults.





Demonstration on Importance of arc welding in Industry & uses

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

- explain about the importance of Arc Welding in Industry.
- illustrate different uses of Arc Welding.

Arc welding is a welding process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals, when cool, result in a binding of the metals.

Arc welding can deliver extremely strong bonds even between thin metals. The construction industry uses arc welding to guarantee strong, sustainable connections within buildings, bridges, and other infrastructures. Other industries that use arc welding are the oil and gas industry and the power industry.

Advantages

- Cost – equipment for arc welding is well-priced and affordable, and the process often requires less equipment in the first place because of the lack of gas.
- Portability – these materials are very easy to transport.
- Works on dirty metal.

Disadvantages

There are a few reasons why some people look to other options beyond arc welding for certain kinds of projects. These downsides can include:

- Lower efficiency – more waste is generally produced during arc welding than many other types, which can increase project costs in some cases
- High skill level – operators of arc welding projects need a high level of skill and training, and not all professionals have this
- Thin materials – it can be tough to use arc welding on certain thin metals

Job Sequence

TASK 1 : **Striking and maintaining arc**

- Check the size of the raw material.
- Mark and file to size.
- Clean the metal surface with a steel wire brush and wipe off the oil and grease if any.

Dirt or rust makes poor connections.

- Wear safety apparel (Protective clothing)
- Connect the welding cables with the machine and the job.

Check the cables for damage and loose connections. Check whether the earth-clamp is properly attached.

- Fix a Ø 4mm M.S. electrode in the holder.

Ensure the electrode is firmly held in the holder from the bare end.

- Set the welding current (amperage) 140-150 amps.

If the welding machine is a D.C. one, connect the electrode to the negative.

- Start the welding machine.
- Strike and maintain the arc by the scratching method.

Use a welding screen fitted with proper coloured glasses while arc-welding.

- Hold a correct arc for a short distance and break by quickly withdrawing the electrode up.

The correct arc burning will give steady, sharp, crackling sound.

Repeat this exercise until the arc can be struck every time without the electrode freezing.

If the electrode freezes (sticks) to the plate, it should be freed immediately by a quick twist of the wrist motion to avoid overheating or spoiling.

— — — — —

TASK 2 : **Laying straight line beads by arc welding**

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Set the work piece on the welding Table in a flat position
- Set the arc-welding plant and connect the welding cables.
- Select and fix M.S. Electrode Æ4mm in the holder.

Ensure that the electrode-holder JAWS are clean.

- Set a welding current 140-150 amps on a AC or DC machine.

If the power source is D.C. connect the electrode with the negative straight polarity.

- Wear the complete safety apparel and check the filter lens of the welding screen.
- Strike the arc on a scrap piece for trial and observe the current setting.

Ensure that the burning of the electrode is normal.

- Strike the arc on the job-piece at one edge and maintain a uniform normal short arc.
- Move the electrode in a straight line and complete the bead at the other edge of the plate.
- During welding maintain a correct angle of the electrode at 70o - 80o.
- Arc length producing a steady sharp crackling sound.
- Travel speed approx. at the rate of 150mm per minute.
- Remove the slag from the weld bead and inspect for:
  - Uniform width and height - slag inclusion.
  - Normal depth of fusion.
  - Straightness.
- Repeat the exercise till you achieve good results.

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EXERCISE 50 : Setting of arc welding machine for welding

Objectives

At the end of this exercise you shall be able to

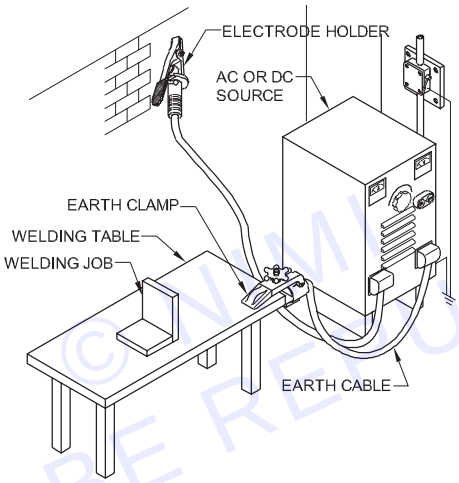
- set the arc-welding plant
- set the current according to the size of electrode
- strike and maintain the arc by the scratching and tapping method.

Striking an arc is a basic operation in arc welding. It will occur every time the welding is to be started.

It is an essential basic skill to learn in arc welding.

Setting of arc-welding plant (Fig 1)

Fig 1



Check the working of power source for the welding machine.

Remember electricity is a good servant but a bad master.

Call an electrician for solving any electrical problems.

Connect the welding cables with the welding machines.

Ensure that the cable connections are clean, dry, tight and are attached to the proper terminals of the machine.

Attach tightly the earth cable with the welding table at the proper place.

Keep the electrode-holder at a safe place.

If the machine is on DC power, connect the cables in correct POLARITY.

Setting a welding current

Set the welding current as per the diameter of the electrode to be used. (Table 1)

Select the electrode as per the thickness of the metal to be welded or as recommended. (Table 1)

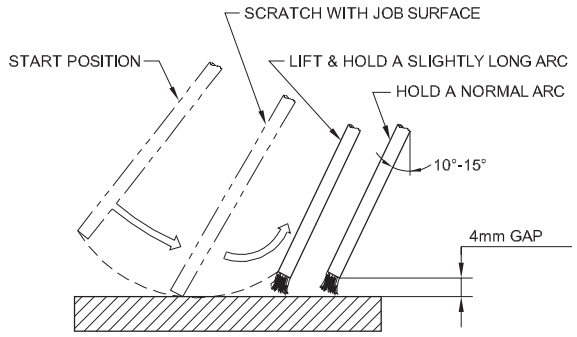
Use alternative electrodes of nearest size in the case of non availability of the exact size of electrodes.

The electrodes diameter should not be more than the thickness of the metal to be welded.

Striking and maintaining an arc

Scratching method (Fig 2)

Fig 2



SCRATCH METHOD

Hold the electrode about 25mm above the job-piece at one end, perpendicular to the surface.

Bring the welding screen in front of your eyes.

Ensure safety apparel is worn.

Table 1

Plate Thickness in mm (approx.)	Electrode Size mm	Current Range (amperes)
1.6	1.6	40-60
2.5	2.5	50-80
4.0	3.2	90-130
6.0	4.0	120-170
8.0	5.0	180-270
25.0	6.0	300-400

Strike the arc by dragging the electrode quickly and softly across the welding job, using wrist movement only.

Withdraw the electrode approximately 6mm from the surface for a few seconds, and then lower it to (approx) 4mm distance.

If the arc has been properly struck, a burst of light with a steady sharp crackling sound will be produced.

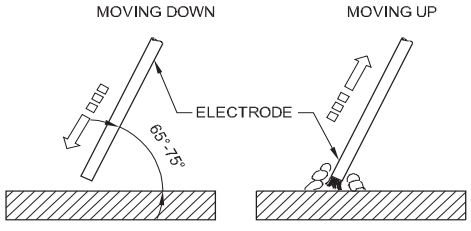
Tapping method (Fig 3)

Strike the arc by moving the electrode down to touch the job surface lightly.

Move the electrode slowly up, approximately 6mm for a few seconds, and then lower it to approx. 4mm from the surface.

The tapping method is generally recommended as it does not produce pit marks on the job surface.

Fig 3



TAP METHOD

EXERCISE 51 : Straight line beading by arc (Flat position)

Objectives

At the end of this exercise you shall be able to

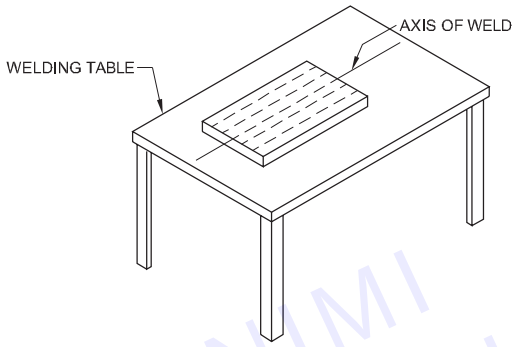
- deposit straight beads in a flat position
- clean the weldment and inspect for faults.

Job setting

Set the job in a flat position on the welding table. (Fig 1)

Ensure there is a good electrical contact between the job and the welding table.

Fig 1

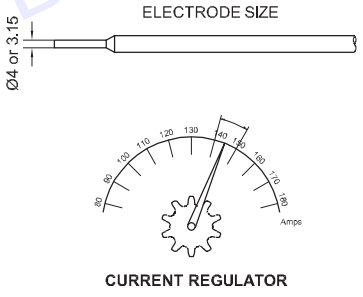


Current setting (Fig 2)

Set the current on the welding machine, 140-150 amps for Ø4mm M.S. Electrode.

Always follow the current range chart for the electrodes in use.

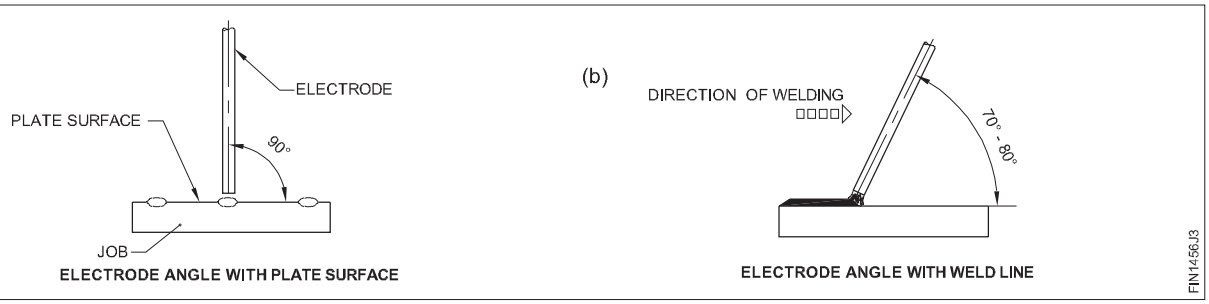
Fig 2



Electrode position (Fig 3a&b)

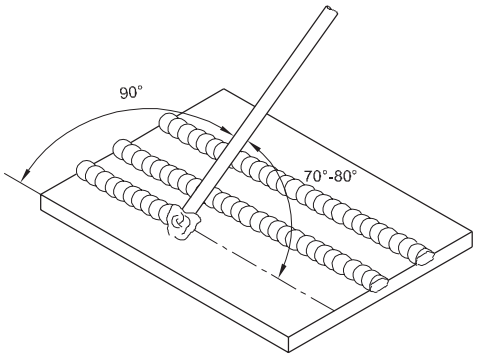
Hold the electrode at an angle of 70° - 80° with the weld line and 90o with the adjoining plate surface.

Fig 3



Depositing straight beads (Fig 4)

Fig 4



Deposit straight beads by following the punched line and maintaining arc

- Correct arc length
- Correct travel speed
- Correct angle of electrode.

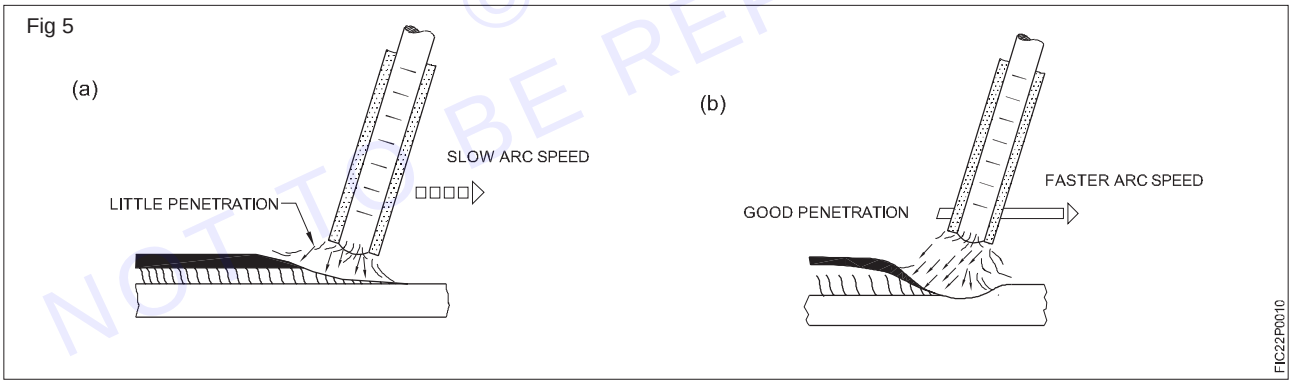
Ensure that the welding screen lens is clean so that you can see the arc and the weld line.

Replace the plain glass, if spattered.

LISTEN to the arc. It produces a steady sharp crackling SOUND.

Adjust the travel speed by watching the electrode melting and flowing through the molten pool to form a deposited metal. (Fig.5a & b)

Fig 5



Weldment Inspection (Fig 6)

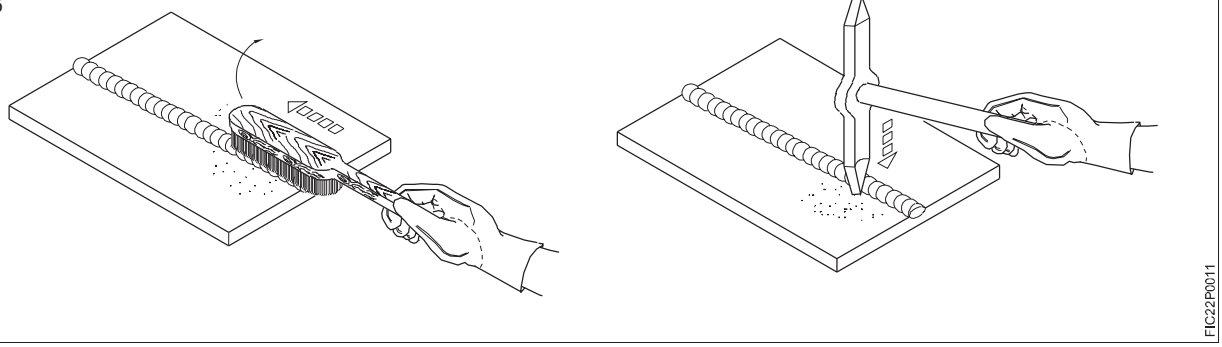
Remove the slag from the weldment using a chipping hammer and a wire brush.

Use goggles during slag removal.

Inspect the deposited beads and note any variations in the:

- Width and height
- Depth of fusion
- Length of run. (Straightness)

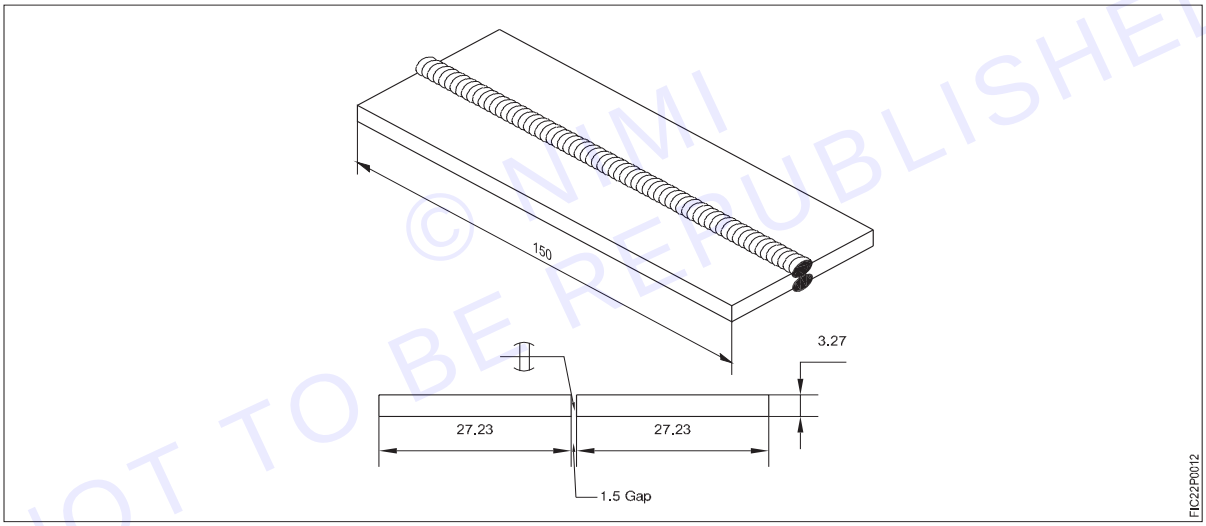
Fig 6

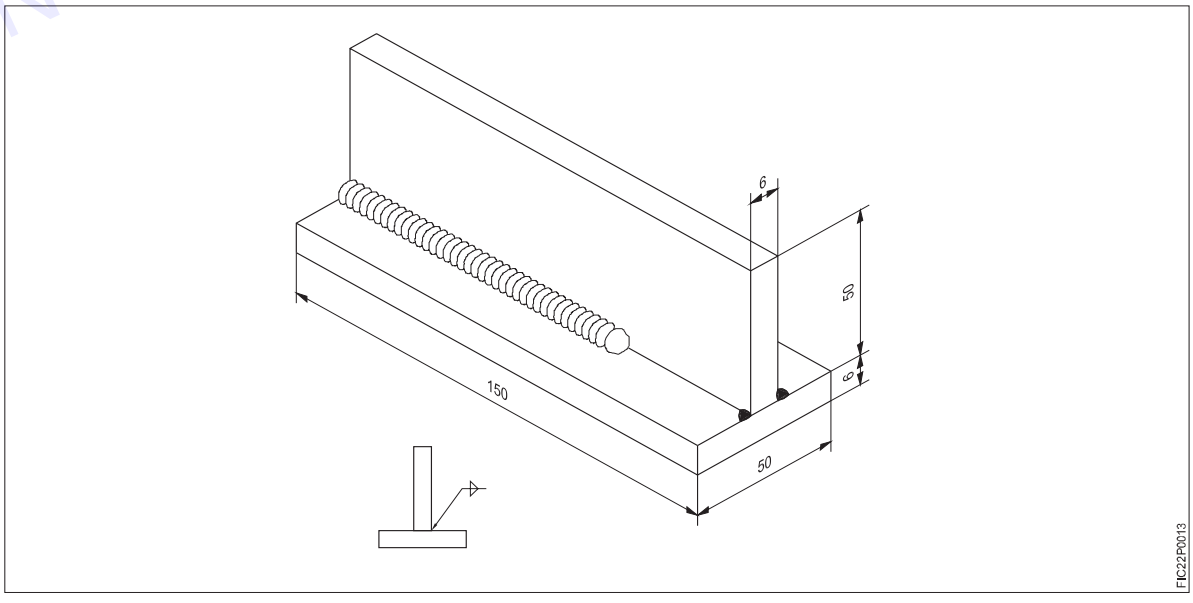


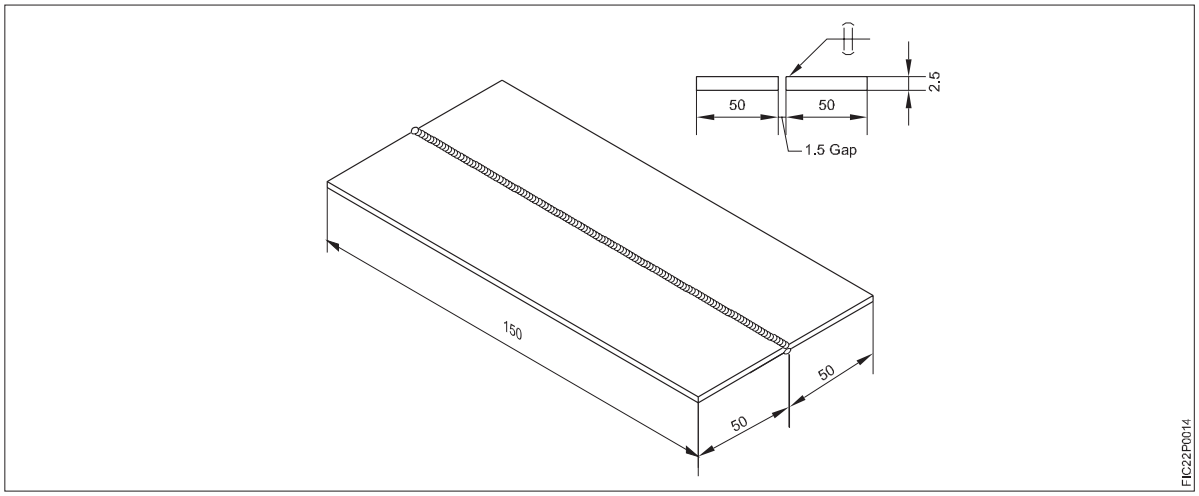
Making square, Butt joint and 'T' fillet joint - gas and arc

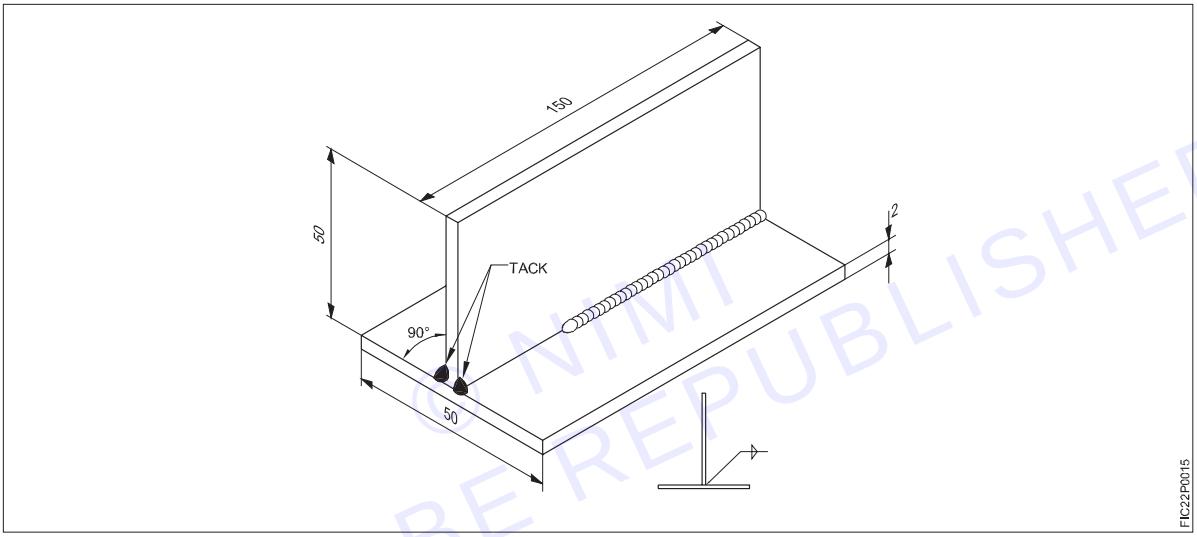
Objectives : At the end of this exercise you shall be able to

- set and weld the workpiece to form a square butt and 'T' fillet joints in correct alignment in arc
- weld a 'T' fillet and square butt joint using recommended electrode, filler rod and nozzle size
- remove distortion from the joint
- clean the weldment and inspect for the surface defects.









Job Sequence

TASK 1 : **Square butt joint in flat position by arc welding**

- Check the size of the raw material.
- Mark and file to size for square.
- Set the pieces on the welding table for square butt joint with 1.5mm gap in alignment. (Refer to drawing)
- Select a Ø 3.15mm M.S. electrode and set a 120 amps current.

Connect the electrode to negative, if the power source is D.C.

- Tack the pieces at both ends and also in the centre.

Ensure safety apparel is worn.

- Check the alignment of the tacked pieces, and reset, if necessary.
- Place the joint in a flat position on the welding table, well grounded. (Tacks side down- Refer skill sequence)
- Select a Ø 4.0mm M.S. electrode and set a 150-160 amps current.
- Deposit the first bead along the joint line with a:

- Correct arc length
- Correct electrode angle
- Correct welding speed.

- Chip the slag from the bead, brush and inspect.

Use tongs to hold the hot job, chipping hammer and wire brush for chipping and cleaning, goggles for the protection of the eyes.

- Clean the back side of the first bead thoroughly and grind tacks flush.
- Deposit the second bead on this side, using the same settings.
- Chip the slag from the bead, brush and inspect for faults.
- Practice this exercise until you can produce a sound butt weld.

  While but joint welding 1/3rd of gap to be maintained according to the thickness of plate or flat section of metal.

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TASK 2 : **T' Fillet joint in flat position by arc welding**

- Check the size of the raw material
- Mark and file to size
- Set and tack the job-pieces at both ends as 'T' fillet joint . (Refer to drawing).
- Ensure that a Ø 3.15mm electrode and a 130 amps current are used. Safety apparel should be worn.
- Clean the tacks, check alignment and reset the job, if necessary.
- Place the joint on a welding table in a flat position. (Tack side down - Refer skill sequence)
- Select a Ø 4mm M.S. electrode and set a 150-160 amps current.
- Deposit the first bead along the joint line with a correct and uniform
  - Arc length
  - Travel speed
  - Electrode angle.

Ensure the electrode angle is 45° with the corner and 70° to 80° with the welding line in the direction of travel.

Clean the weldment and inspect for faults.

- Clean the other side of the joint and grind the tacks flush.
- Set the joint in a flat position (weld side down).
- Make a second weld along the joint line with the same setting and technique as used for the first bead.

Clean the weld and inspect for the following weld characteristics.

- Smooth and close ripple appearance. Uniform width and height equal leg lengths
- Good fusion at the toe of the weld without undercut and overlap
- Leg length of the fillet weld equal to the plate thickness
- Repeat the exercise until you can produce good welds.

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TASK 3 : **Square butt joint in flat position by gas welding**

- Check the size of the raw material.
- Mark and file to size.
- Set the job pieces on a welding table to form a square butt joint (open) with a root cap 1.5 mm.
- Set a gas welding plant, attach nozzles No.5 and set a pressure of 0.15kg/cm2 for both the gases.

- Select a C.C.M.S. filler rod Æ1.5mm for tacking and Æ3.00mm for welding.
- Wear safety apparel.
- Set the neutral flame.
- Tack the pieces at both the ends and also in the centre using a Æ 1.5mm filler rod. (Keep a shrinkage allowance of 2)

Tacks should be well fused and penetrated.

- Check the alignment and gap between the pieces, and reset, if necessary.
- Clean the tacks and reset the job on the welding table in a flat position.
- Start welding, using the leftward technique with the correct angle of the blowpipe and filler rods of Æ3mm.
- Fuse the edges uniformly and add filler metal. (maintain a correct travel speed and motion of the blowpipe and filler rod, to produce a uniform weld bead)
- Stop at the left edge, fill the crater to complete the weld.
- Extinguish the flame, cool the nozzle and place the blowpipe at a safe place.

Clean the welded joint and visually inspect for

- a slight convex uniform width and height of bead.
- a slight penetrating bead on the reverse side of the ripples joint near the root.

- Repeat the exercise till you get good results.

— — — — —

TASK 4 : **Fillet weld 'T' joint in flat position by gas welding**

- Prepare job pieces as per drawing.
- Clean the surface and edges of the sheets to be welded.
- Set the sheets in the form of a 'Tee' joint on the gas welding table.
- Wear safety apparels and gas welding goggles.
- Set the gas welding plant, fix nozzle No.5 and set pressure at 0.15 kgf/cm2 for both the gases.
- Set the neutral flame, tack at both ends of the joint and also in the centre with a 1.6 mm C.C.M.S rod.
- Check the alignment of the joint with a try square and clean the tacked portion.
- Keep the job on the welding table in a flat position.
- Start welding with the leftward technique and melt the right hand end of the joint.
- Fuse the area to be welded (i.e. equally the part of the horizontal sheet and the vertical sheet) and apply the filler rod in the molten pool to form a fillet weld at the joint.
- Maintain correct travel speed, manipulate the blowpipe and filler rod to produce a uniform weld bead.
- Stop the weld at the left hand end of the joint after filling up the crater at the end of the weld.
- Extinguish the flame, cool the nozzle and place the blowpipe at its place.
- Clean the weldment and inspect for defects in the fillet weld.

Visual inspection

- Slight convexity, uniform width, uniform ripples indicate a good weld bead. A weld without undercut, overlap,porosity, etc. will ensure a good quality weld.
- Weld on the other side of the joint for more practice

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Skill Sequence

Square butt joint by arc in flat position (TASK 1)

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

- weld a square butt joint in a flat position
- inspect the completed butt weld.

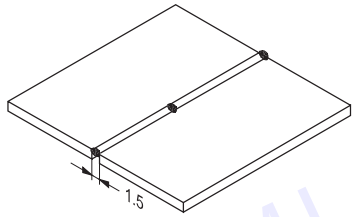
This type of joint is used very extensively in industry. If welded from both the sides (6 mm plate thickness), a sound weld can be obtained.

Setting and tacking

Set the pieces as butt joints with a 3 mm gap in a welding.

Tack at both the ends and one in the centre. (Fig 1)

Fig 1



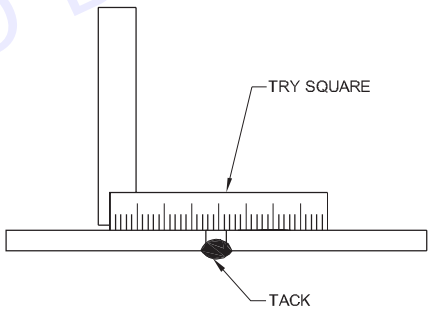
Use a Ø 3.15mm M.S electrode. Set the current

120-130 amps and length of the tack 15 mm.

Ensure the tacks are fused.

Check the alignment after tacking, and reset, if necessary (Fig 2).

Fig 2



Check the tack-welds thoroughly.

Welding butt joint

Place the joint in a flat position.

Deposit the first bead, using a Æ4mm M.S. electrode and 150-160 amps current with a correct:

- Electrode angle
- Travel speed, and
- Arc length. (Fig 3)

Fig 3

Move the electrode forward and backward along the line of the weld to

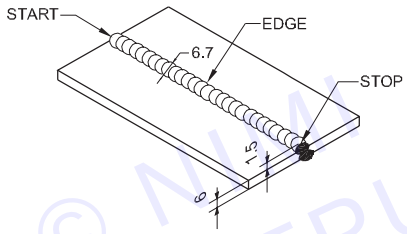
- Pre-heat the metal ahead of the weld
- Minimize the tendency to burn through
- Force the slag back over the top of the weld and control slag inclusion.

Inspection of the weld

Remove the slag from the weld and inspect for the following weld characteristics. (Fig 4)

- Width and height of bead should be uniform.
- Appearance should be smooth with close ripples.

Fig 4



- The face of the weld should be slightly convex.
- Edge of the welds should have good fusion, no overlap and undercut.
- The starting and stopping points should be free of depressions and high spots.
- The root of the weld and plate surface should have good fusion and penetration.
- The surface of the plate should be free of spatters.

'T' fillet joint by arc in flat position (TASK 2)

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

- weld 'T' fillet joint by arc in flat position free of distortion and weld defects
- inspect the fillet for weld characteristics.

The weld deposited on a 'T' or lap joint is called a fillet weld. Often the 'T'joint is called a fillet joint. (Fig 1) This joint is mostly used in industrial fabrication work.

Setting and tacking (Fig 2)

Set the pieces in alignment, forming a 90° 'T'.

Tack the pieces at both ends.

Use Ø 3.15mm M.S. electrodes.

Set current at 150-160 amps.

Fig 1

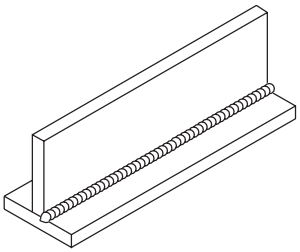


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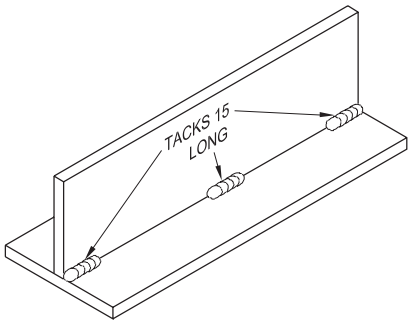
Fig 2



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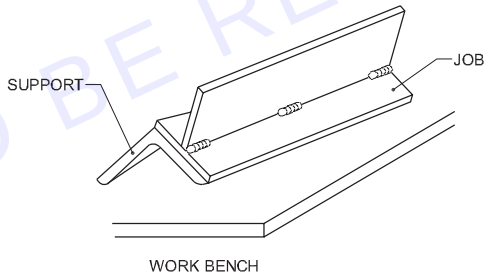
Ensure the tacks are well fused having a 15 mm length

Check the alignment after tacking.

Welding a fillet joint

Place the joint for flat position welding. (Fig 3)

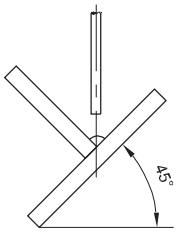
Fig 3



FIC22P0022

Hold the electrode, pointing at the corner of the joint at an angle of 45° to the plate surface. (Fig 4)

Fig 4



FIC22P0023

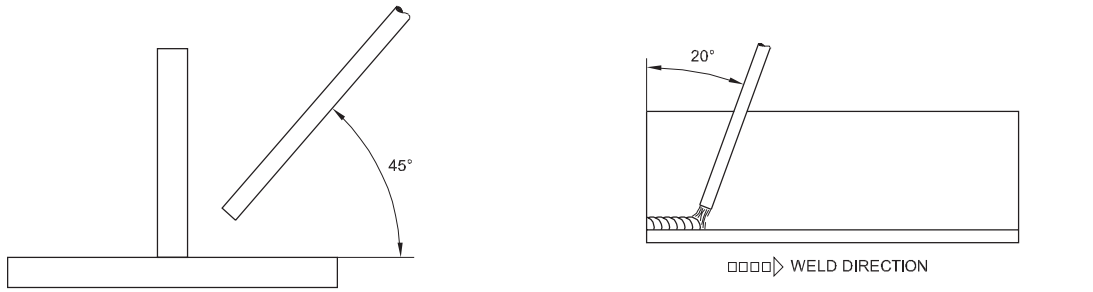
Incline the electrode 10°- 20° in the direction of travel. (Fig 5)

Proceed to weld along the joint with a uniform travel speed. (Fig 5)

Watch the molten pool and freezed bead carefully for excessive build up or undercut (faults).

Increase the speed or change the angle of the electrode to correct the above faults, if they appear.

Fig 5



Inspect the weld

Clean the weld thoroughly.

Inspect the fillet for correct shape and size.

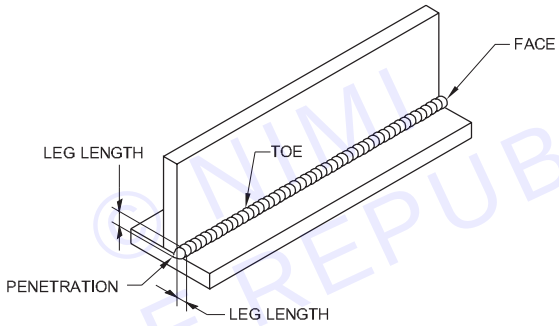
No undercut and overlap at the toe of the weld. (Fig 6)

Leg lengths of the fillet almost equal to the plate.

Penetration of the weld complete to the root.

Face of the weld slightly convex.

Fig 6

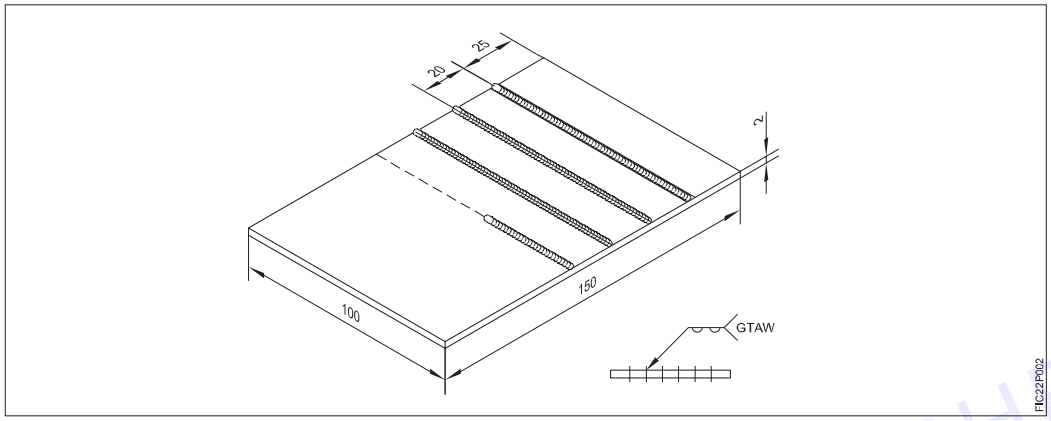


EXERCISE 52 : Depositing bead on aluminium sheet 2mm thick - position flat

Objectives

At the end of this exercise you shall be able to

- weld fusion runs with filler wire on aluminimum by TIG welding process in flat position.



Job Sequence

1 Prepare the aluminimum sheet as per dimensions.

2 Clean the surface with the stainless steel wire brush.

3 Also do the chemical cleaning with acetone/alcohol to remove the grease and surface oxide.

4 Draw parallel lines and punch the lines as per dimensions.

5 Set the job in flat position.

6 Select the power supply as follows:

- In case of helium as shielding gas use DCEN.
- In case of Argon as shielding gas and use AC power source. Majority of welding is done using argon gas.

7 Set up the GTA welding plant as per the Fig.1.

8 Select the type and size of tungsten electrode, current, gas flow rate and set them on the machine.

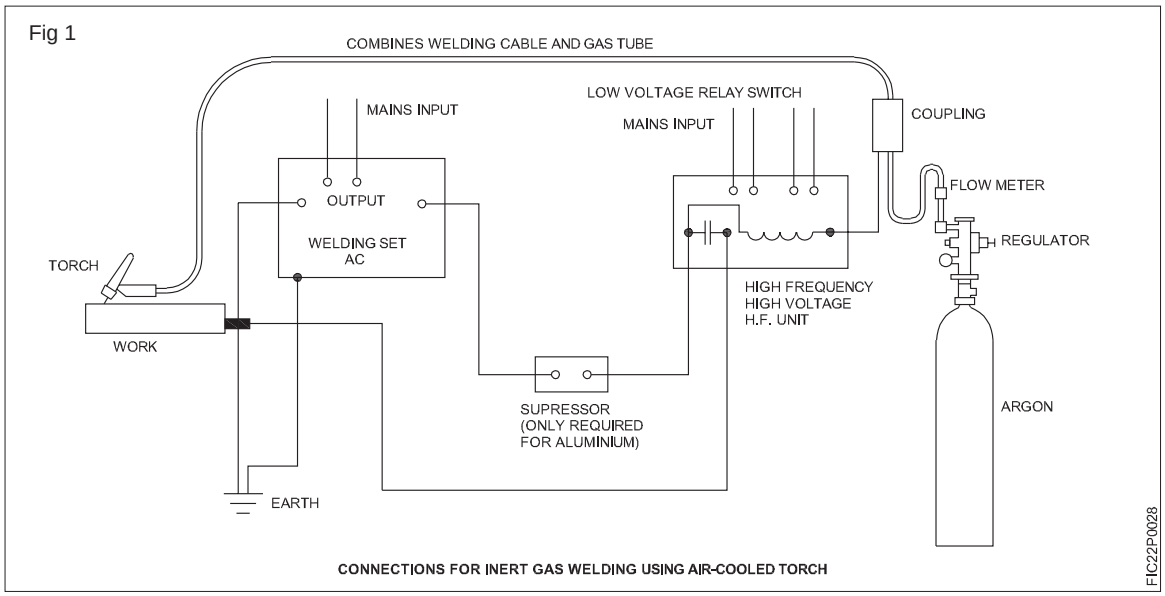
9 Select aluminium filler wire. 1.6mmf with 5% silicon.

10 Switch on the machine and strike the arc.

11 Deposit fusion run with filler wire using leftward welding technique.

12 Clean and inspect the weld job.

Fig 1



CONNECTIONS FOR INERT GAS WELDING USING AIR-COOLED TORCH

Skill Sequence

Ensure to use correct size of the sheet for welding.

Select aluminimum (95% AL and 5% Si) filler wire 1.6mmf.

Set the current and other parameters as per the Table given below.

Open the gas cylinder valve slowly.

Follow leftward technique.

The filler rod and torch are held at an angle of 10 to 150 and 70 to 800 to the line of weld.

Finish welding and ensure to fill the crater.

Brush the weld using SS wire brush and check for defects if any.

A table-I of the variables used when manually welding aluminium with the gas tungsten arc using AC and high frequency.

Table 1

Metal thickness	Joint type	Diameter of tungs ten alloy electrode with 1 to 27 zirconium	Filler rod diameter (if required)	Amperage	Gas	
					Type	L/min
2 mm	Butt & Corner	1.6 mm	1.6 mm	60 - 85	Argon	7
	Fillet	1.6 mm	1.6 mm	75 - 100	Argon	7
3.15	Butt & Corner	3.15 mm	2.4 mm	120 - 150	Argon	9.5
	Fillet	3.15 mm	2.4 mm	130 - 160	Argon	9.5
5 mm	Butt & Corner	3.15 mm or 4mm	3.15 mm	120 - 150	Argon	12
	Fillet	3.15 mm or 4mm	3.15 mm	130 - 160	Argon	12
6.3 mm	Butt & Corner	4 or 5 mm		240 - 280	Argon	14
	Fillet	4 or 5 mm		250 - 320	Argon	14

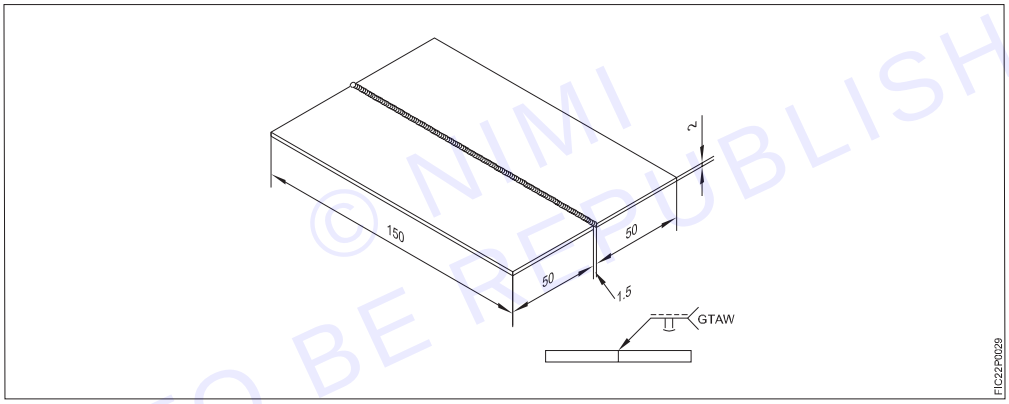
Butt weld square butt joint on aluminium sheet 2mm - position flat

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

- weld square butt joint on Aluminium sheet 3mm thick using TIG welding process.

Job Sequence

1 Prepare aluminium sheets as per dimensions.
2 Use Tungsten (zirconium) 2.4mm dia electrode.
3 Clean the edges of the sheets.
4 Use the stainless steel wire brush for surface cleaning.
5 Set the square butt joint.
6 Select the various parameters as given in the Table 1 and set them accordingly.
7 Weld the joint in flat position using leftward technique.
8 Fill the crater.
9 Clean the weld area thoroughly.
10 Inspect the job for free from defects.



Skill Sequence

Ensure setting of Butt joint as per drawing.
Tungsten electrode tip to be ground for AC welding-Aluminium as shown in Fig 1.
Tack weld at equal intervals-keeping the uniform root gap of 1.5mm between the samples along the welding length.
Adjust the current as per guide line given in Table 1.

Fig 1

ROUND TIP OF TUNGSTEN
ELECTRODE IN AC TIG WELDING

TABLE 1

Guideline for Manual AC GTA welding of aluminium

Plate thickness (mm)	Welding position	Joint type	Current AC (Amp)	Electrode Dia.(mm)	Nozzle size (10) mm (mm)	Argon flow Rate LPM	Filler rod Dia. mm	Number of runs
2 mm	F	Square butt	70 - 100	2.4	8.0	10	2.4	1
	H, V	Square butt	70 - 100	2.4	8.0	10	2.4	1
	O	Square butt	60 - 90	2.4	8.0	13	2.4	1
3.2	F	Square butt	120 - 150	3.2	9.5	10	3.2	1
	H, V	Square butt	110 - 140	3.2	9.5	10	3.2	1
	O	Square butt	110 - 140	3.2	9.5	13	3.2	1
4.8	F	60^0 Single Vee	180 - 220	4.0	11	12	4.0	2
	H, V	60^0 Single Vee	160 - 200	4.0	11	12	4.0	2
	O	60^0 Single Vee	170 - 200	4.0	11	12	4.0	2
6.35	F	60^0 Single Vee	220 - 240	4.8	12.7	15	4.0	2
	H, V	60^0 Single Vee	220 - 240	4.8	12.7	15	4.0	2
	O	60^0 Single Vee	210 - 250	4.8	12.7	18	4.0	2

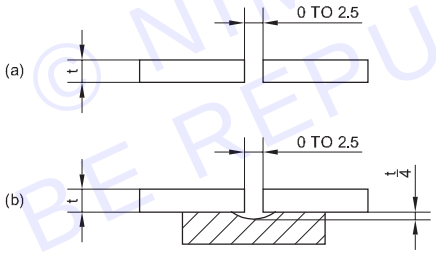
F - Flat, H - Horizontal, V - Vertical, O - Overhead

Maintain uniform short arc throughtout the welding.

Care to be taken to avoid end crater.

During welding a temporary backing is to be given on the underside to support the penetration bead.

Fig 2



Fillet weld - Tee joint on aluminium sheet 2mm - position flat (1F)

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

- weld a Tee fillet joint using 5% Silicon Aluminium Filler wire in flat position by TIG welding process.

Job Sequence

1 Prepare aluminium sheets as per dimensions.

2 Clean the edges of the sheets by the chemical cleaning method and deburr. Use the stainless steel wire brush for surface cleaning.

3 Set the “Tee” joint for aluminium welding.

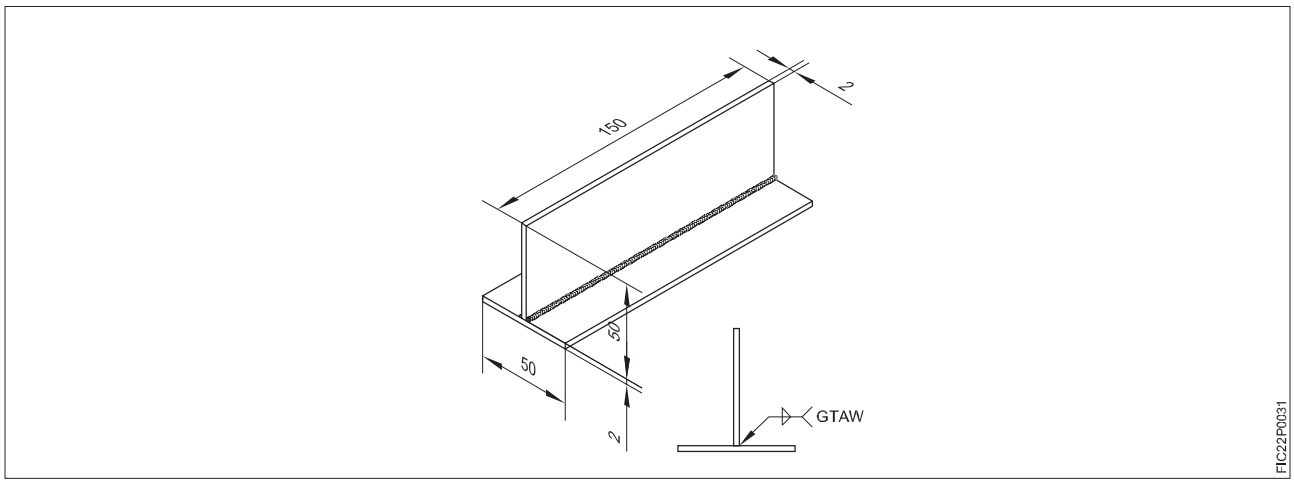
4 Use 2.4mm size tungsten (zirconium) electrode.

5 Select 95% aluminium 5% silicon filler wire 1.6mmf.

6 Weld Tee joint in flat position using leftward technique.

7 Clean the weld area thoroughly.

8 Inspect the job.



Skill Sequence

Ensure setting of the Tee joint as per drawing.

Tack weld at equal intervals (50mm spacing) so that the plates are set to form 900 equal Tee.

Take adequate care in selection of Tungsten Electrode Tip for alternating current power. (Fig 3)

Lack of penetration is avoided by judicially following the position of the Arc with respect to the joint. See Fig 1 and Fig 2.

Fig 1

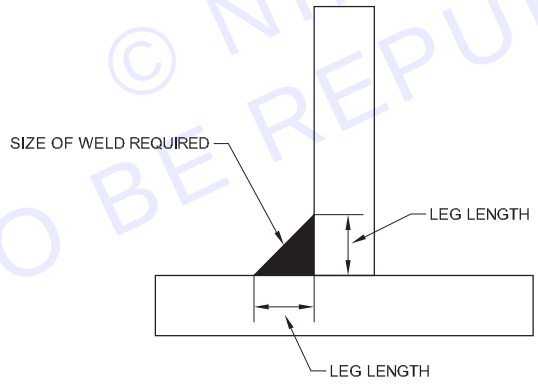


Fig 2

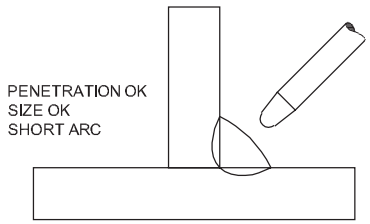


Fig 3

ROUND TIP OF TUNGSTEN
ELECTRODE IN AC TIG WELDING

Fillet weld outside corner joint on aluminium sheet 2mm - thick in postion flat (1F)

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

- weld outside corner joint in aluminium sheet 2 mm thickness using TIG welding process.

Job Sequence

1 Use pure aluminium filler wire/alluminium +5% silicon of 2.4mmj.

2 Use 2.4jmm (Zirconium) tungsten electrode.

3 AC power source with DC suppressor and high frequency units.

4 Shielding gas argon.

5 Prepare aluminium sheet as per dimensions.

6 Clean the edges of the sheets.

7 Use stainless steel wire brush for surface cleaning.

8 Tack the set pieces at correct intervals and in correct alignment for an outside corner joint (Fig 1).

9 Weld the joint in flat position.

10 Make uniform size bead with correct penetration at the root in the outside corner joint.

11 Clean the weld area thoroughly.

12 Inspect the completed outside corner weld for weldment quality.

Fig 1

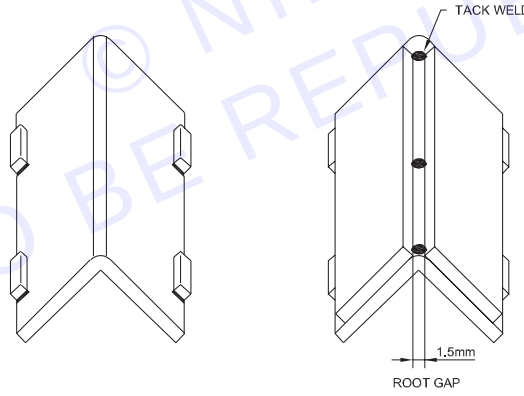
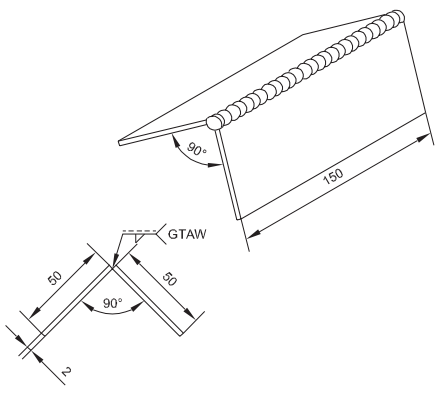


Fig 2



Skill Sequence

Ensure the setting of an outside corner joint as per drawing.

Adjust current 60- 90 Amp in AC.(Refer Table 1 of fabrication - welder Ex.No. 2.2.02)

Use a backing bar made from a piece of steel angle with its apex bevelled or radi used to accommodate the penetration bead.

Hold the sheet on to the backing bar with steel strap. (Fig 1)

– correct alignment and uniformity of bead with correct penetration after cleaning the welded joint thoroughly.

– uniform ripples with equal width and height of bead (Fig.2).

Fig 1

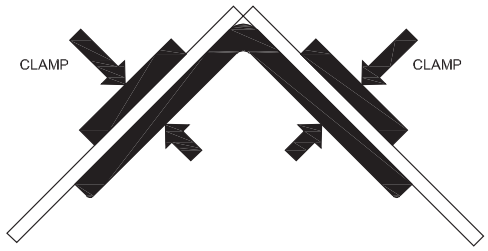
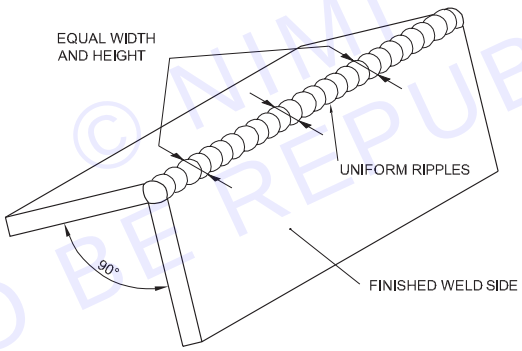


Fig 2



EXERCISE 53 : Setting up OXY-Acetylene plant

Objectives

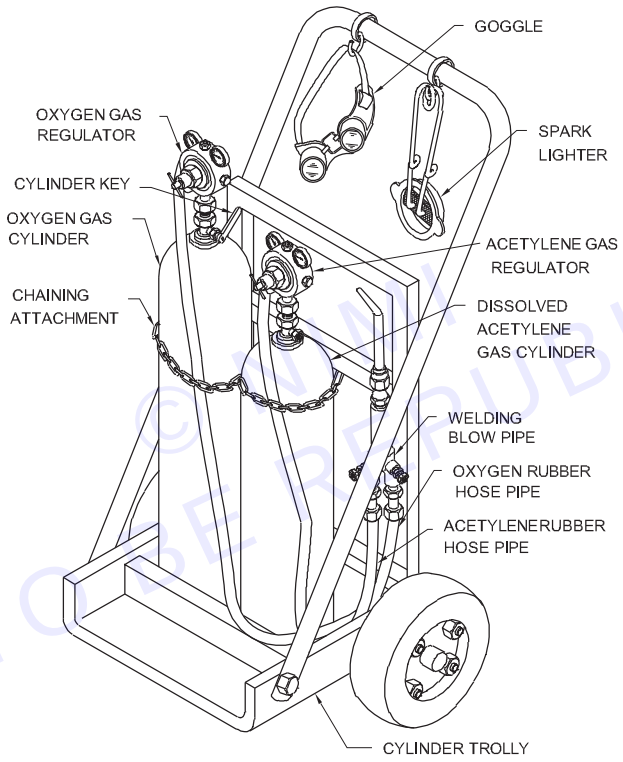
At the end of this exercise you shall be able to

- set up the oxy-acetylene plant.

Objectives

- Move oxygen and acetylene cylinders with the caps from the store to the gas welding area. An oxygen cylinder is identified by the black colour painted on it. An acetylene cylinder is identified by the maroon colour painted on it. Also the oxygen cylinder will be taller than an acetylene cylinder and the diameter of oxygen cylinder will be less than the diameter of an acetylene cylinder.

Fig 1



SETTING OF OXY-ACETYLENE PLANT

- Ensure cylinders are kept separately from the empty cylinders.
- Position the gas cylinders in a trolley and secure them with a chain.
- Always keep the cylinders upright/vertically in the cylinder stand/on the floor (Fig 2)
- While moving, the gas cylinders should be kept slightly inclined to the vertical position and the protector cap used to avoid damage to the cylinder valves. (Fig 3)
- Do not roll the cylinders horizontally on the ground.
- Remove the cylinder caps. Crack the gas cylinder valves by qucikly opening and closing them using the cylinder key. Fig 4
- Dirt dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.
- Always stand opposite to the valve outlet while cracking the cylinders. (Fig 5)

Fig 2

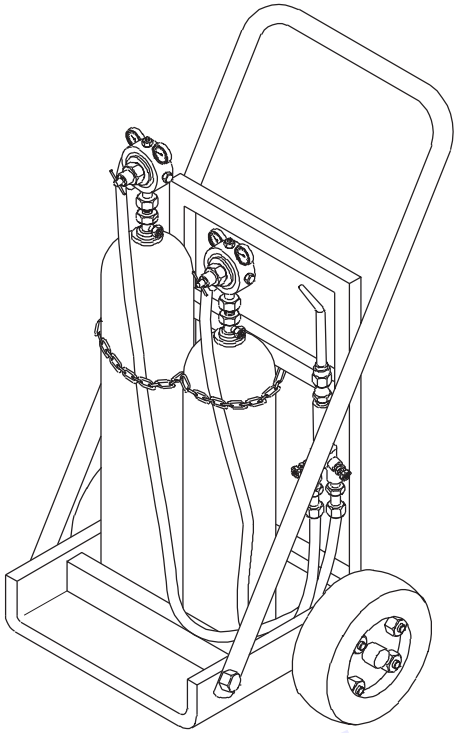


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Fig 3

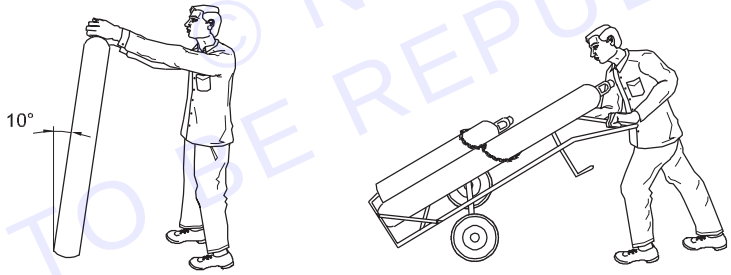

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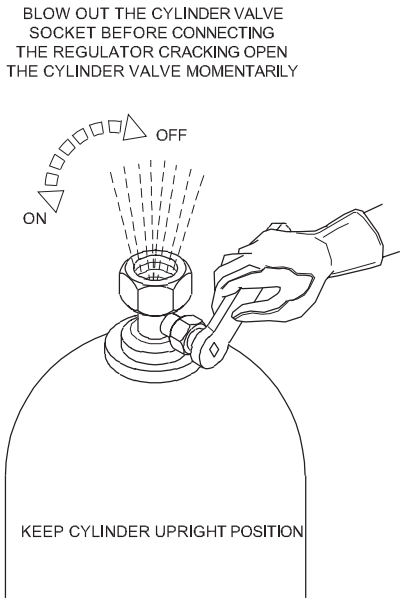
Fig 4

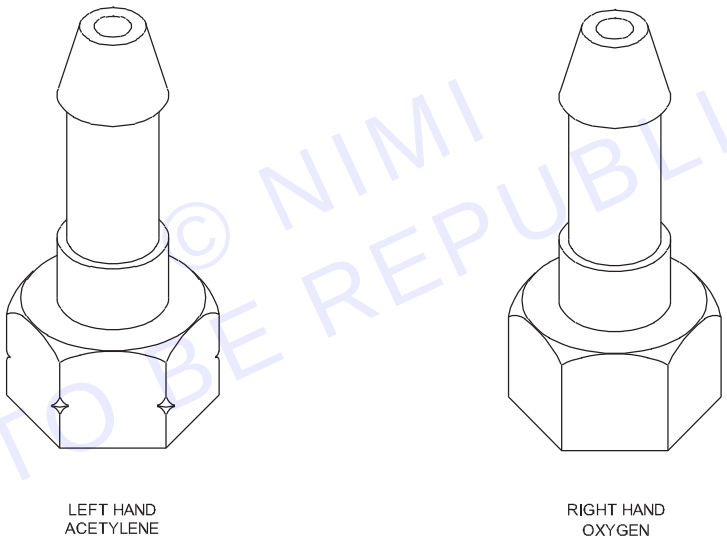


FIC22P0038

Fig 5

- Ensure that your hands are free from grease or oil.
- Connect the oxygen regulator to the oxygen gas cylinder (righthand threads).
- Connect the acetylene regulator to the acetylene gas cylinder (lefthand threads)
- Ensure the pressure adjusting screws of both regulators are in a released condition.
- Be sure to connect the correct regulator on cylinders, Acetylene connections have left hand thread and oxygen has right hand thread.
- The acetylene regulator connecting nut will have a groove cut on it (Fig 6) and the pressure gauge dial will be of maroon colour.

Fig 6



- All threaded connections should be fixed intially by tightening by hands and then only a spanner should be used. This will help to avoid assembly with cross thread leading to damage to threads.
- Always use the correct size spanner to prevent damage to the threads (Fig 7)
- It is dangerous to apply lubrications in the threaded assemblies of gas welding equipment as it can cause fire (Fig 8)
- While tightening avoid undue force. The connections should be just tight.
- Connect the hose connector at the regulator end and the hose-protectors at the blowpipe end.

  (use black hose for oxygen line and maroon hose for acetylene line.)
- Acetylene connections have left hand threads with a cut on the corners of the nut while oxygen connections have right hand thread without a cut.
- Attach one end of the black hose-pipe to the oxygen regulator outlet and the maroon coloured hose-pipe to the acetylene regulator outlet (Fig 9)
- Secure the joints using hose-clips to ensure good grip and to avoid gas leakage (Fig 10)

Fig 7

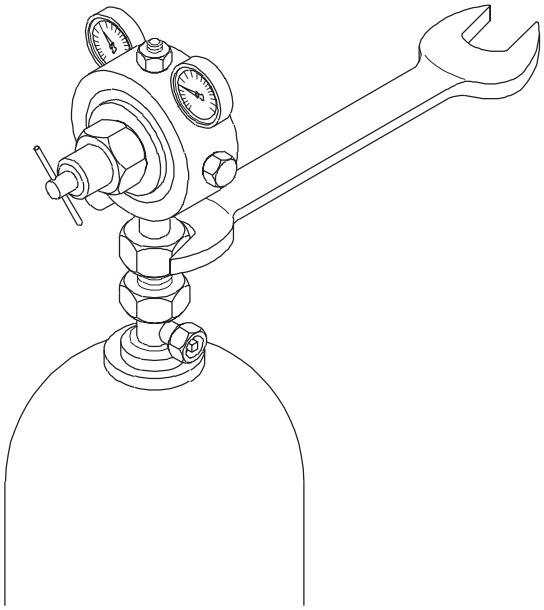


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Fig 8

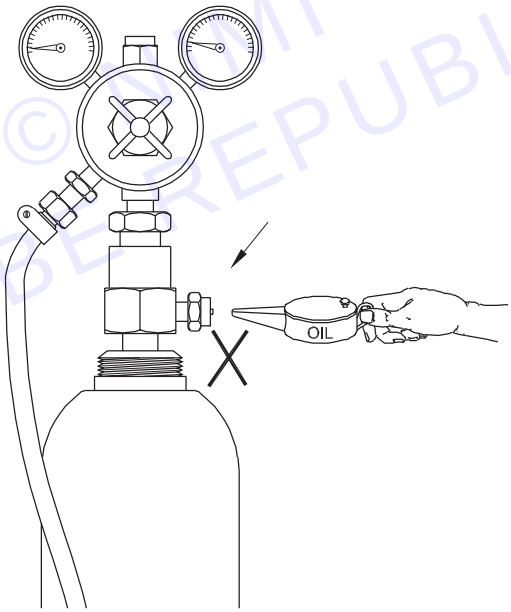

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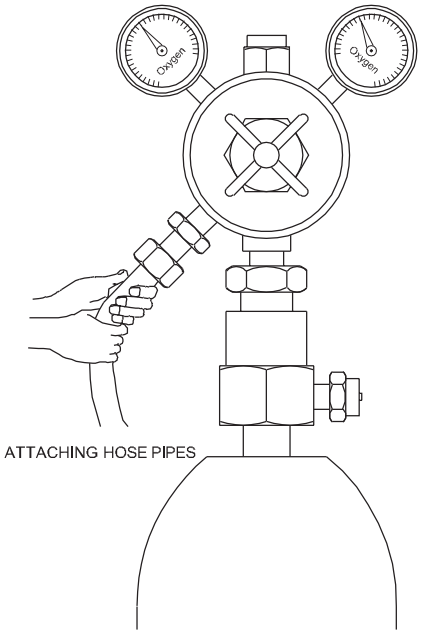
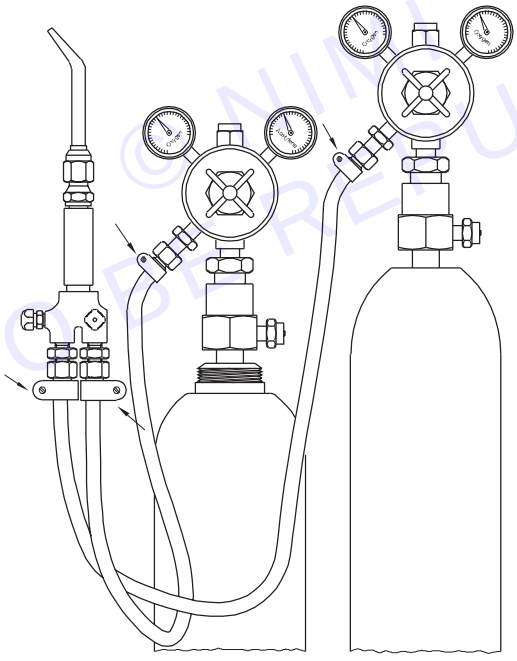
Fig 9



ATTACHING HOSE PIPES

FIC22P0043

Fig 10

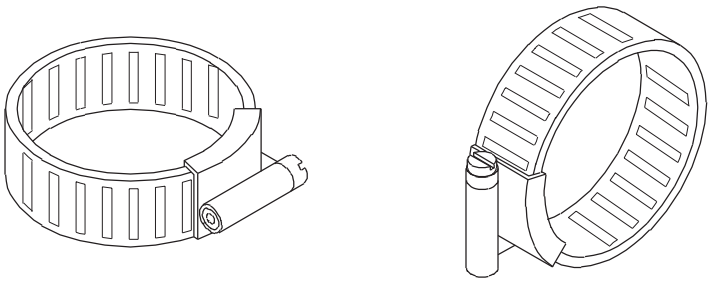


USE HOSE CLIPS BEFORE
CONNECTING TO REGULATOR
AND BLOW PIPE

FIC22P0044

- Use a screwdriver to tighten the hose- clips.
- Always use the correct size hose-clips (Fig 11)
- Turn on the pressure adjusting screw of the regulator to which the oxygen hose pipe is connected (Fig 12)
- Exert sufficient pressure to blow out dust or dirt particles if any are tapped inside the hose-pipe and then release the pressure adjusting screw.
- Repeat the same for the acetylene hose also.

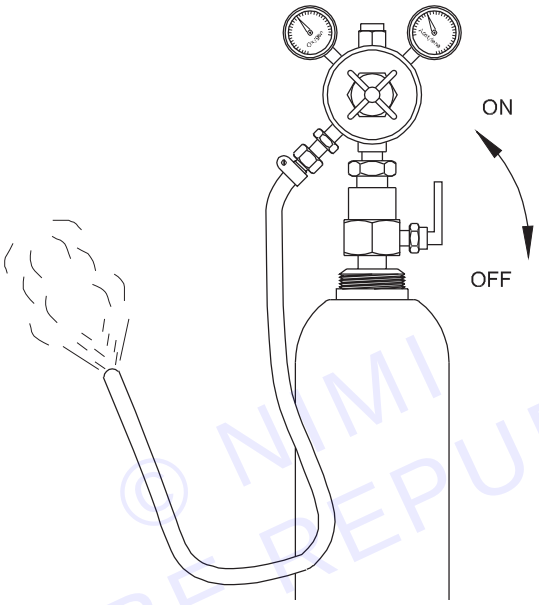
Fig 11



HOSE CLIPS

FIC22P0045

Fig 12



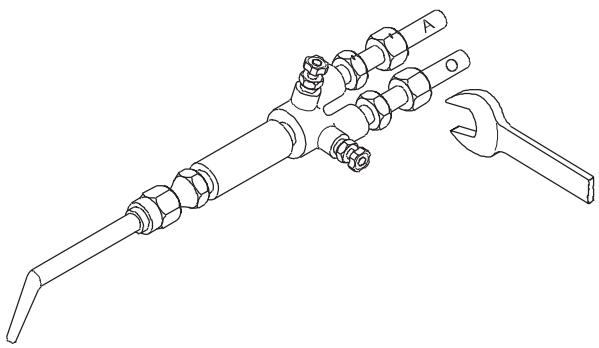
ATTACH NEW HOSES TO REGULATORS
AND TO DISPEL DUST ETC., QUICKLY
PASS PRESSURISED GAS TO ATMOSPHERE
MOMENTARILY.
NOTE: THIS SHOULD BE DONE BEFORE
FITTING HOSE PROTECTORS

FIC22P0046

Attaching blowpipe

The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig 13)

Fig 13

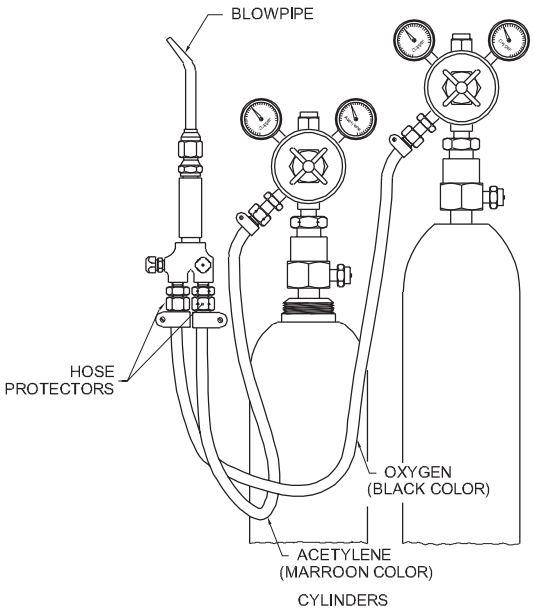


ATTACHING BLOW PIPES

FIC22P0047

Fix the hose-protectors at the blowpipe ends. The hose- protectors with a groove at the corners are fixed on the acetylene hose-pipe and connected to the acetylene inlet of the blowpipe. The hose-protectors without cutting marks are fixed on the oxygen hose-pipe and connected to the oxygen inlet of the blowpipe. (Fig 14)

Fig 14



The hose-protectors protect against the return flow of gas from the blowpipe to the rubber hoses. They act as non-return valves.

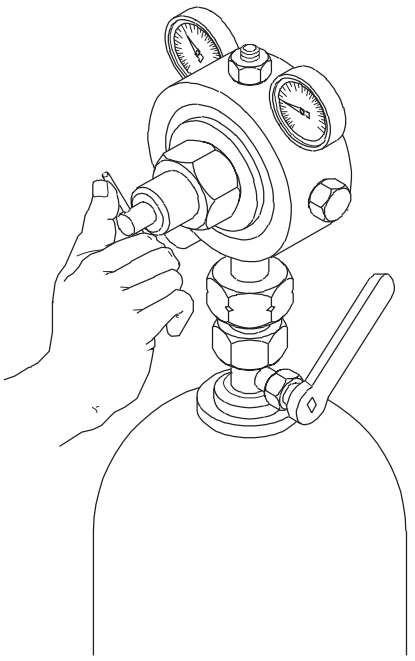
Adjusting the gas pressure

The gas pressure for both oxygen and acetylene has to be adjusted at regulators according to the size of the nozzle.

The size of the nozzle is selected according to the job material and thickness.

For adjusting the gas pressure, open the valves of both the cylinders slowly by one turn and set the pressure on both regulators as 0.15 kg /cm2 for small size nozzles, by tightening the pressure adjusting screws. (Fig 15) Ensure the blow pipe control valves are kept open while setting the gas pressure.

Fig 15



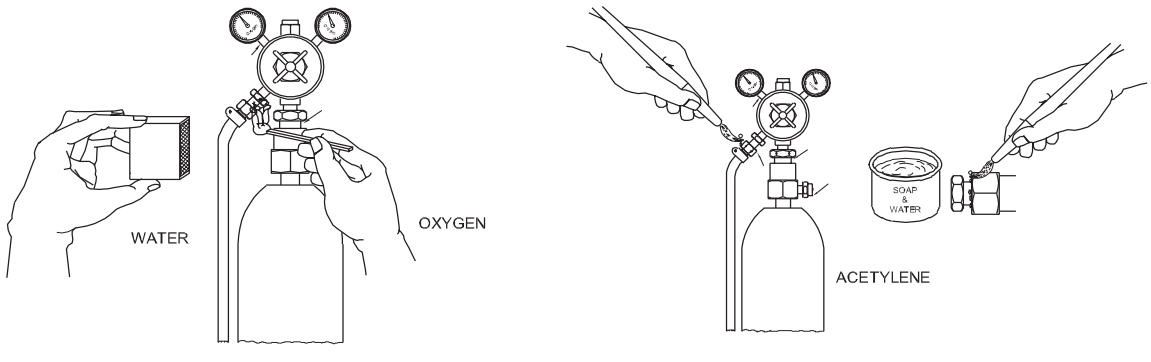
The pressure can be read on the working pressure gauge of gas regulators

Testing for leakage

All connections must be tested for leakage.

Apply soap water solution for acetylene connections and fresh water for oxygen connections (Fig 16).

Fig 16



Use of soap water on oxygen connections may lead to fire hazards.

Never use matches or flame light during leakage test.

Lighting the flame

Attach the recommended size of nozzle to the neck of the welding blowpipe i.e nozzle No.3.

Open the gas cylinders and adjust the recommended gas pressures on the regulators.

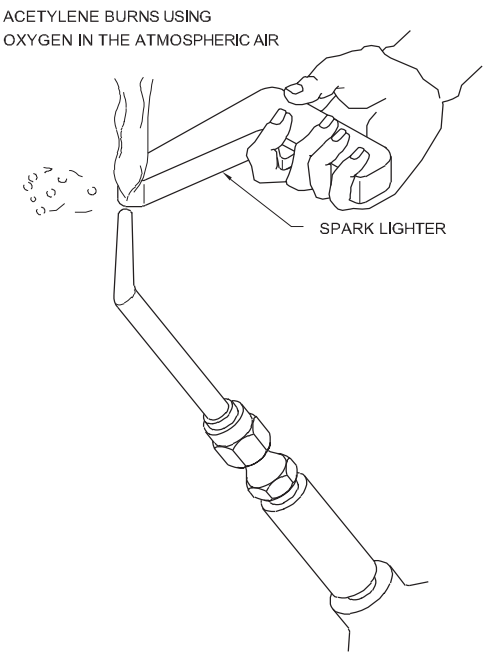
The pressure of oxygen and acetylene is 0.15 kg/cm2 for nozzle no.3

Open cylinder valves very slowly.

While setting pressure on the regulator, keep the blowpipe control valve open for accurate setting.

Open the acetylene control valve 1/4 turn on the blowpipe and ignite with a spark lighter. (Fig 17) Acetylene burns using the oxygen in the atmospheric air with a black smoke.

Fig 17

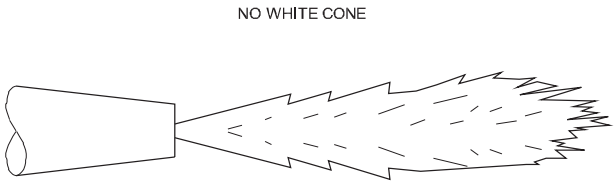


Avoid using any other source of fire other than the spark lighter.

Point the blowpipe in a safe direction in the open space, away from you and others.

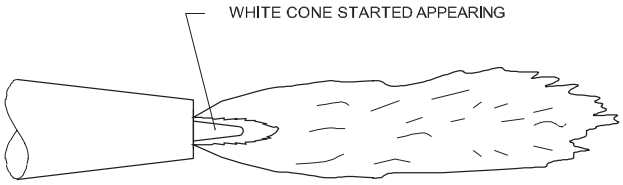
Increase the acetylene till the black smoke disappears. (Fig 18)

Fig 18



Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle (Fig 19)

Fig 19



Square butt joint in flat position by gas (TASK 4)

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

- set and tack the workpieces in alignment for a square butt joint
- produce a uniform and well penetrated bead on an open square butt joint in a flat position
- visually inspect the completed joint.

The requirements of a good welded joints are:

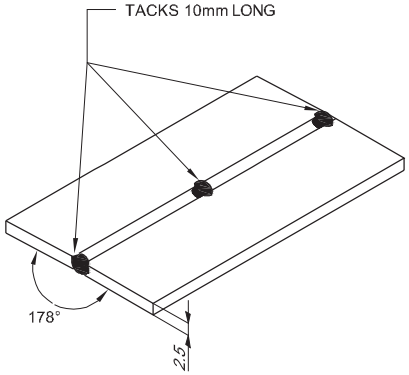
The joint must be in correct alignment (distortion free)

The weld must be well fused, well penetrated, uniform in width and height, of correct size and free from internal or external faults.

Setting and tacking

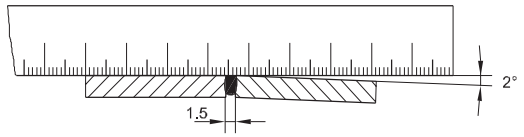
Set and tack the job-pieces in correct alignment with a proper gap and for distortion allowance. (Fig 1)

Fig 1



Check the alignment after tacking, and reset, if necessary. (Fig 2)

Fig 2

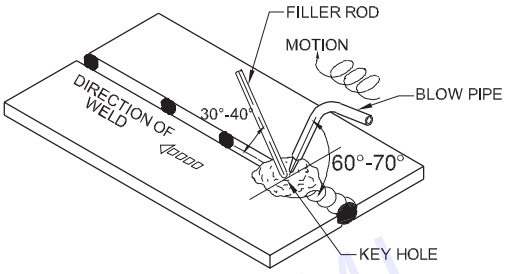


Welding

Produce a well-fused uniform bead with complete penetration using a leftward technique (Fig 3) by;

- Holding and manipulating the blowpipe and filler rod in the recommended angles.
- Maintain a uniform travel speed and feed.
- Forming a correct size keyhole.

Fig 3

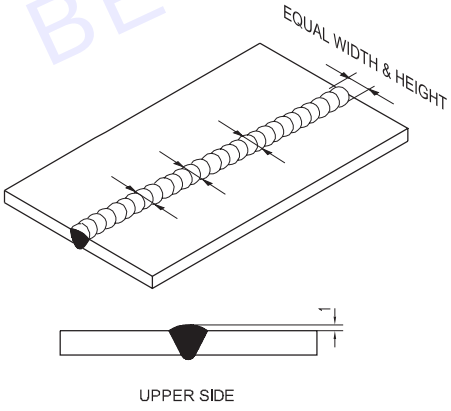


Finish the job

Check alignment - remove distortion, if required, and inspect for:

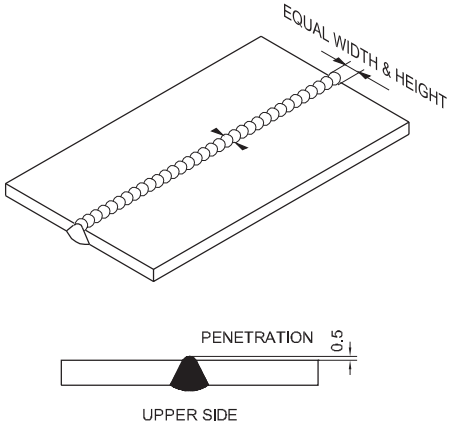
Uniform width and height of weld bead in size. (Fig 4)

Fig 4



- Uniform ripples and fusion, complete penetration. (Fig 5)
- Absence of faults such as undercut, lack of fusion, unfilled crater etc.

Fig 5



Fillet weld 'T' joint in flat position by gas welding (TASK 5)

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

- set and tack the workpiece in alignment for a fillet weld tee joint
- weld a tee fillet joint using recommended filler rod and nozzle size
- visually inspect the completed joint.

'T' fillet joints are used extensively in industry i.e., fabrication of underframes, vertical supporters for oil and water containers and other similar structural work.

It is an economical joint with very little edge preparation but difficult to weld without defects (i.e. unequal leg length, undercut, etc.) unless the operator gets proper practice.

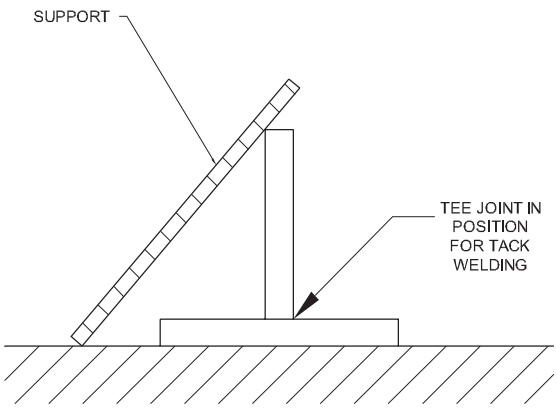
Root penetration must be obtained completely and undercut is to be avoided.

Setting and tacking the job pieces

Place the pieces on the welding table for Tee joint.

Hold the pieces in position using support. (Fig 1)

Fig 1

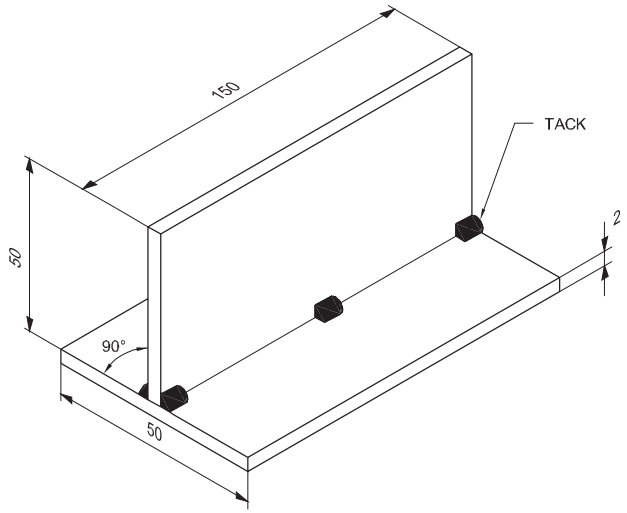


Ensure the vertical piece is perpendicular to the horizontal piece without gap of the joint.

Check with a try square for perpendicularity.

Tack-weld the joint at both ends (Fig 2) on one side of the joint.

Fig 2



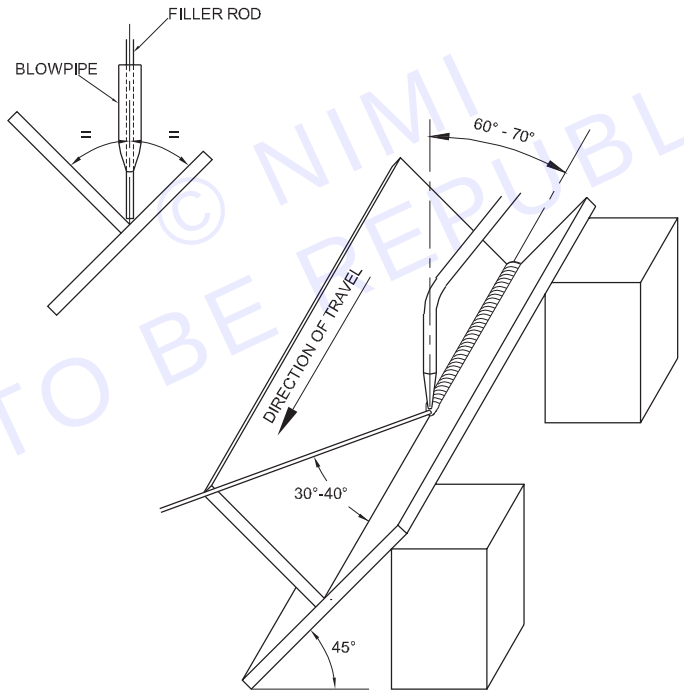
TACK WELDING A TEE JOINT

FIC22O0060

Welding of fillet 'T' joint in flat position (Fig 3)

Place the tacked joint in flat position by tilting and supporting it. (Fig 3)

Fig 3



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Start welding at the right hand end of the joint by fusing the tack-weld and the parent metal to form a molten pool. Keep the blowpipe in the leftward direction at an angle of 60° to 70° and the filler rod at an angle of 30° to 40° to the line of travel. The blow pipe and filler rod should be held at 45° between the 2 surfaces of the joint. This will ensure root penetration. Watch the molten metal closely to make sure that both pieces melt uniformly. Change the angle of the blow pipe if the pieces do not melt uniformly. When the molten pool is formed add the filler rod in the centre of molten pool. Give slight side-to-side movement to the flame (blowpipe) and a piston like motion to the filler rod.

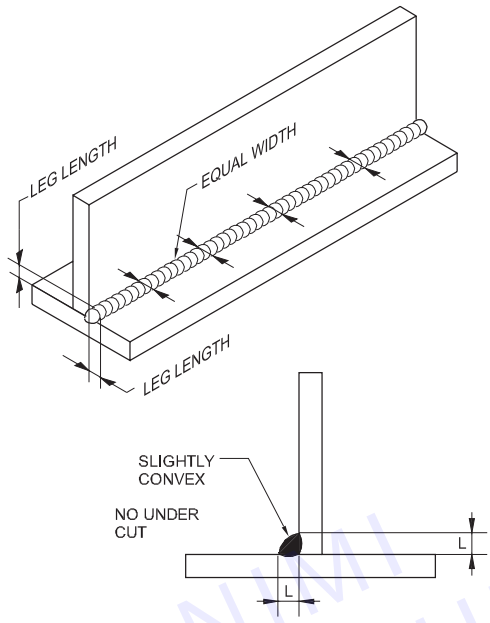
Adust the rate of travel of the blowpipe and the filler rod to secure even penetration at the root and into both sheets and to produce a fillet weld of equal leg length.

Visual inspection (Fig 4)

Clean the weldment and inspect for:

- Uniform weld size and shape of bead (reinforcement and contour slightly convex)
- Equal leg length, no undercut at the toes of the weld
- no porosity, overlap

Fig 4

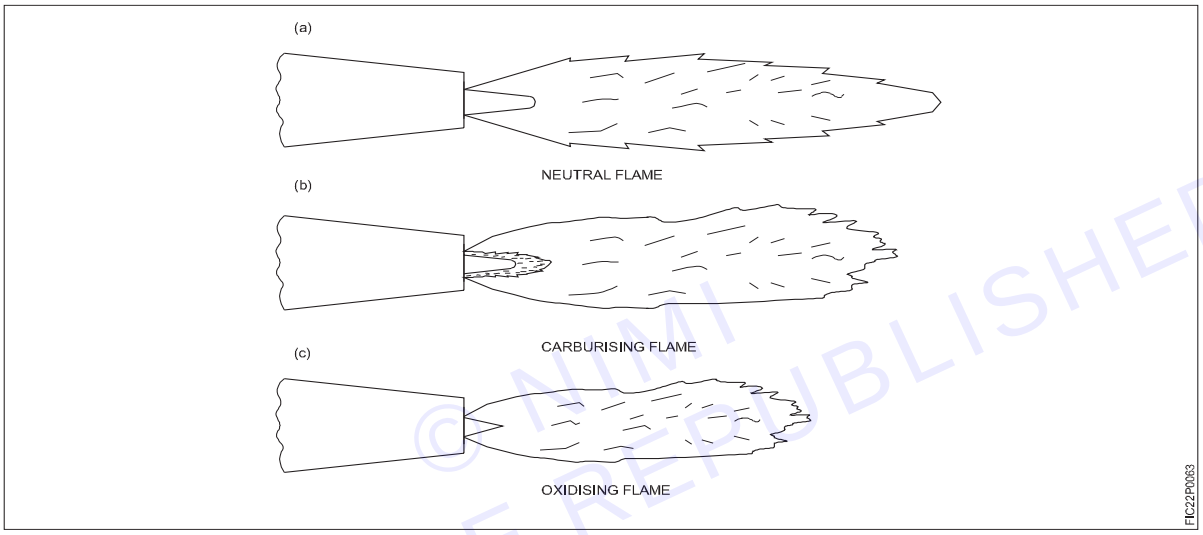


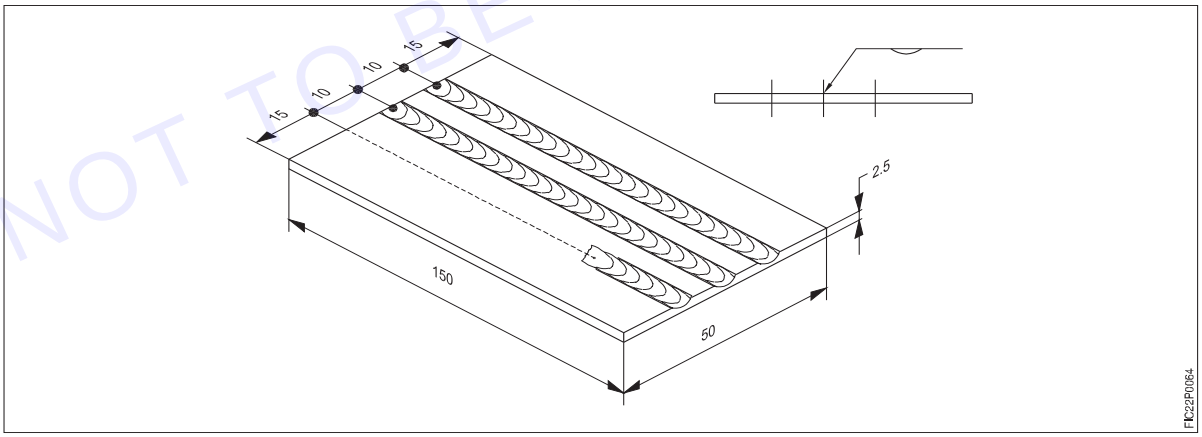
EXERCISE 54 : Setting up of flames, fusion runs with and without filler rsod and gas

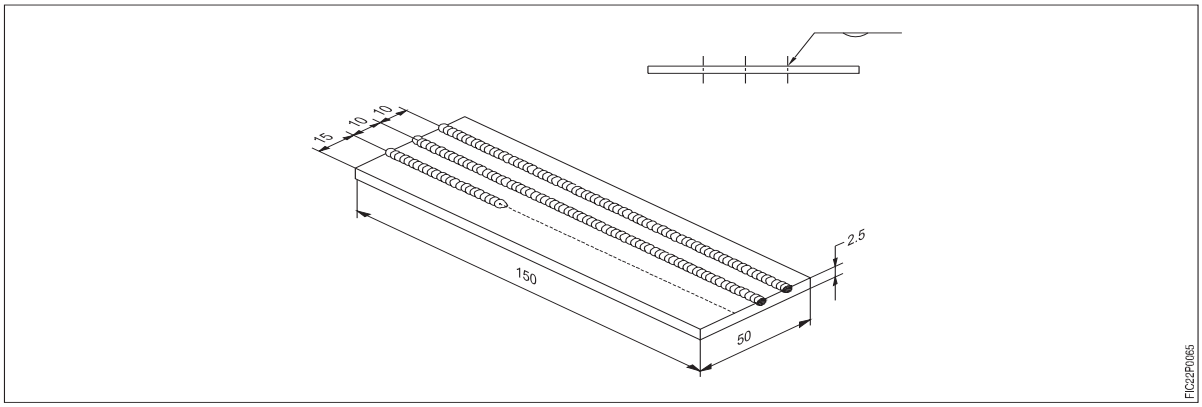
Objectives

At the end of this exercise you shall be able to

- set gas pressure according to the nozzle size
- select and fit the correct size nozzle according to the job thickness
- set job for flat position, weld fusion run with and without filler rod using leftward technique
- ignite, adjust and extinguish oxy-acetylene flame
- shut the oxy acetylene plant for stopping work
- clean the weldment and visually inspect for weld defects.







Job Sequence

TASK 1 : **Oxy - acetylene flame setting**

- Wear safety apparel
- Open the gas cylinders and adjust the gas pressures on the regulators
- Open the control valve of the acetylene gas in the blowpipe
- Ignite the flame by using a spark lighter.

Avoid using any other source of fire

- Adjust the acetylene flow till the black smoke goes away
- Open the oxygen gas till a proper round inner cone is established without any sound in the flame. This is known as a neutral flame.
- Adust the oxidizing flame by increasing the oxygen gas (with sharp inner cone and little hissing sound)
- Set the neutral flame again and adust the carburizing flame by increasing the acetylene gas with the soft inner cone covered with an outer feather without any sound
- Repeat the setting of the flames till you manage to set the flame without any backfire or flash-back

Flame extinguishing and stopping work

- Extinguish the flame by closing the acetylene valve first and then the oxygen valve
- Dip the blowpipe nozzle in water to cool down by opening a little oxygen gas
- Close the cylinder valves and release all the pressure from the line

— — — — —

TASK 2 : **Fusion runs without filler rod in flat position by gas**

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Clean the surface
- Set the job piece on the welding table with the left edge raised about 15mm.
- Select and attach nozzle size 5 with a blowpipe (Indian Oxygen make)
- Set the acetylene and oxygen pressure at 0.15kg/cm2 on the regulators.
- Wear safety apparel and set the NEUTRAL flame.
- Hold the blowpipe in position with the job at the right edge with the nozzle angle 60° - 70° with the welding line (marked with punches) nozzles angle 90° with the adjoining surface distance of the flame cone 1.5mm to 3.0mm from the surface, pointing leftward.
- Start heating and fusing the surface with a slight circular motion of the blowpipe.
- Move the blowpipe in a leftward direction keeping a uniform speed as you get local fusion (small round pool of molten metal).

Avoid excessive concentration of heat. If the metal becomes too hot, lift the blowpipe momentarily away from the molten pool.

Keep the molten pool in correct size by adjusting the rate of travel and the circular motion of the blowpipe.

- Stop at the left edge and lift the blowpipe quickly.
- Extinguish the flame and cool the blowpipe in water.
- Clean the fused surface with a steel-wire brush and inspect the uniformity of fusion runs.

If the speed of travel and the blowpipe motion are correct, the FUSION RUNS will appear in uniform width and even ripples.

- Repeat the exercise till you achieve uniform FUSION.

— — — — —

TASK 3 : **Fusion run with filler rod in flat position by gas**

- Check the size of the raw material.
- Mark and file to size.
- Mark the bead position as per drawing.
- Set the workpiece on the welding table with the left edge raised about 15mm.
- Select the nozzles size 5 (IOL make-saffire type) and set the acetylene/oxygen pressure at 0-15 kg/cm2.
- Select a mild steel copper coated (C.C.M.S) filler rod of Ø1.6mm.
- Wear safety apparel and set a neutral flame.
- Hold the blowpipe at an angle of 60° - 70° on a punched line of sheet and make a small molten pool at the right hand edge.

Keep a flame cone distance of 2.0 to 3.0mm from the job surface.

- Hold the filler rod in the left hand, pointing near the molten pool with an angle of 30°- 40° with the line of weld.
- Dip the end of the filler rod into the molten pool and add the filler metal on the job surface to form a weld bead.
- Move towards the left with a uniform speed along the punched line with a slight circular motion of the blowpipe and piston-like motion of the filler rod.

Add enough rod into the molten pool to build up the bead evenly in height and width.

Coordinate the rate of travel with the filler rod to control the size of the bead and the required penetration.

- Stop at the left edge, extinguish the flame and cool the nozzle.
- Clean the weld surface. Inspect for even ripples and uniform width/height of the weld bead.
- Repeat the exercise till you get good results.

Skill Sequence

Ignite,setup and extinguish oxy-acetylene flame for gas welding (TASK 1)

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

- ignite, set and extinguish an oxy-acetylene flame for gas welding correctly
- shut the oxy-acetylene plant for stopping work.

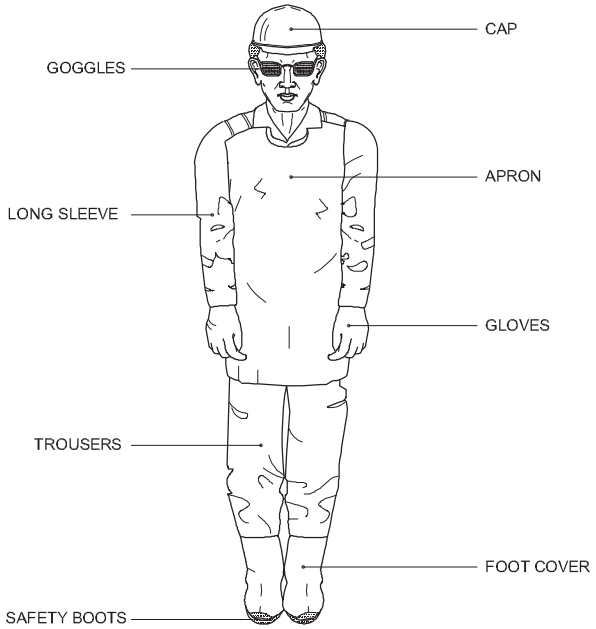
Flame lighting

The safety apron, gloves and goggles are worn as shown in (Fig 1).

Set the pressure of oxygen and acetylene at 0.2kgf/cm2 for a small size nozzle. (No.3)

While setting the pressure on the regulator, keep the blowpipe control valve open for accurate setting.

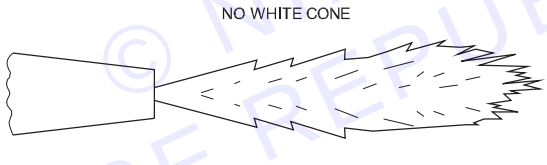
Fig 1



Open the acetylene control valve ¼ turn of the blowpipe and ignite with the help of the spark-lighter. Adjust the acetylene flow till the black smoke goes away. (Fig 2)

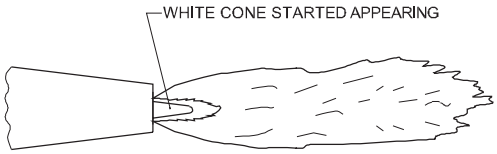
Avoid back fire or flash-back of blow pipe.

Fig 2



Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. (Fig 3)

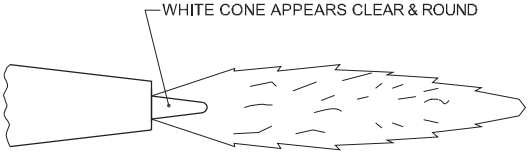
Fig 3



Flame adjustment

To adjust the neutral flame, add sufficient oxygen to make the white cone clear and round. (Fig 4)

Fig 4



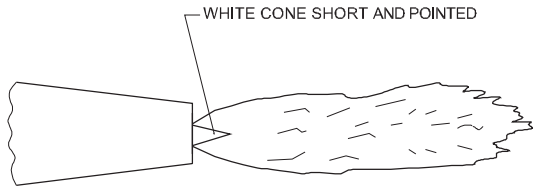
The gas mixture from the blowpipe consists of oxygen and acetylene in equal volumes.

To adjust the oxidising flame, add more oxygen.

The white cone will become short and sharp.

The flame will produce a hissing sound and will have a short length. (Fig 5)

Fig 5

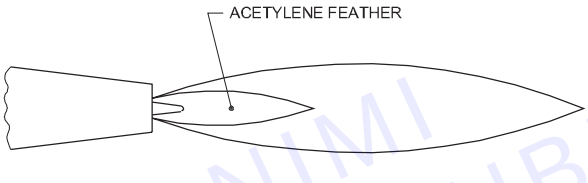


To adjust a carburising flame, adjust the flame to neutral and then add acetylene.

The white cone will become long, surrounded by a feather-like portion.

The flame will burn quietly and have more length. (Fig 6)

Fig 6



Extinguishing the flame

To extinguish the flame, close the acetylene valve (blowpipe) first and then the oxygen valve.

Shutting off the plant

At the end of the work, shut off the plant as stated below.

Close the acetylene cylinder valve.

Open the blowpipe acetylene valve and release all pressure.

Release the acetylene regulator pressure adjusting screw.

Close the blowpipe acetylene valve.

Repeat the above four steps for shutting off oxygen also.

Fusion runs without filler rod in flat position by gas (TASK 2)

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

- hold the blowpipe and flame in correct position to obtain proper fusion of metal
- make fusion runs without filler rod to produce uniform beeds
- visually examine the quality of fusion beeds.

Fusion runs

Homogeneous joints are produced in gas welding by melting and fusing the metal edges with the help of a gas flame.

The beginner in gas welding must practice the following steps correctly.

Fusing of a metal using a proper gas flame.

Holding the blowpipe in a correct position.

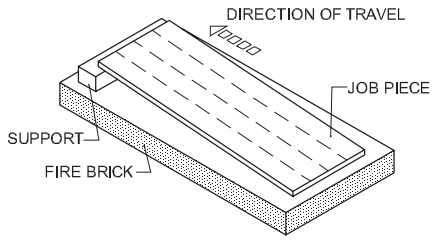
Fusion run in a straight line using the leftward technique.

Cleaning and setting the job-piece

Clean the job-piece surface with a steel-wire brush and emery paper.

Set the job-piece on a fire-brick welding table, raising the left edge app. 15mm. (Fig 1)

Fig 1



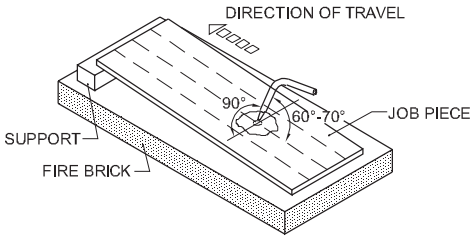
Holding the blowpipe and flame in correct position for proper fusion.

Hold the blowpipe and flame in such a position that the axis of the joint is parallel to the operator's body (Fig 2)

Fig 2

The angle of the nozzle with welding line 60°-70° (Fig.3) the fuse metal forms a small puddle on the molten pool on the job surface at the right edge (Fig 3) give a slight circular motion to the blowpipe.

Fig 3

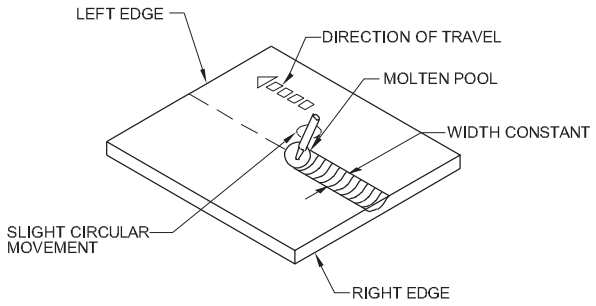


Making fusion run without a rod

Move the blow pipe in a leftward direction as you get local fusion.

Keep the molten pool on the punch line. (Fig 4)

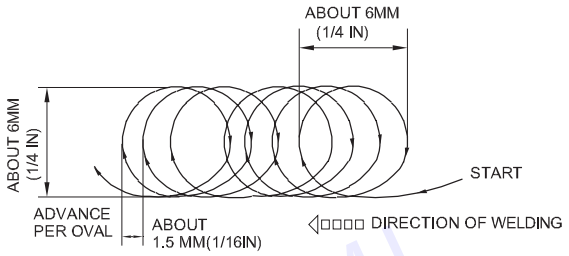
Fig 4



Maintain a constant speed of travel with a slight circular motion to the blowpipe. (Fig 5)

Maintain a constant 2-3mm of distance between the white cone of the flame and the sheet surface for a proper HEAT INPUT and avoidance of BACKFIRE.

Fig 5

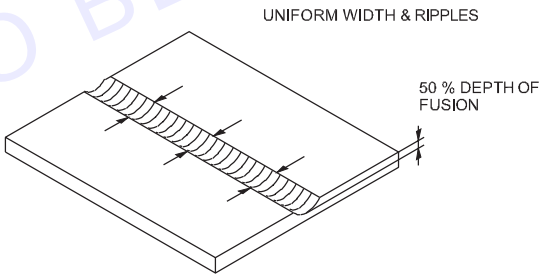


Visual examination of fusion run

Clean the fusion run with a steel-wire brush at the end of the weld.

Inspect visually for uniform width, and ripples with the uniform depth of fusion in job thickness. (Fig 6)

Fig 6



Fusion runs with filler rod on steel plate in flat position by gas (TASK 3)

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

- make fusion runs with filler rod in a straight line using leftward technique
- clean and inspect the weldment for faults.

During gas welding, most of the joints require filler metal to obtain a proper, strong weld.

The feeding of the filler metal in the molten pool requires special skill, which is outlined here.

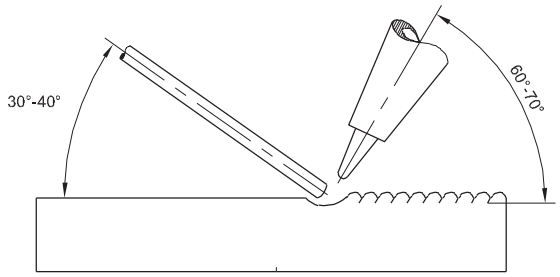
Correct position of the blowpipe and filler rod.

Hold the blowpipe and the filler rod in the correct position in respect of the job.

The blowpipe angle should be 60° - 70° with the weld line (towards right).

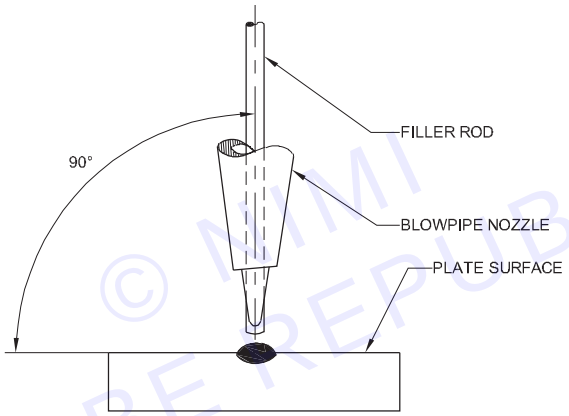
The filler rod angle should be 30° - 40° with the weld line (towards left). (Fig 1)

Fig 1



Keep the blowpipe and the filler rod at 90° to the plate surface. (Fig 2)

Fig 2

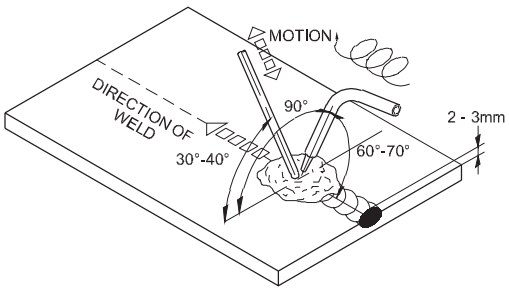


Surface fusion and filler rod addition

Fuse the metal surface and add the filler metal with proper motions; circular motion for the blowpipe, and piston-like motion for the filler rod. (Fig 3)

Maintain a flame cone distance from 2 to 3mm from the metal surface.

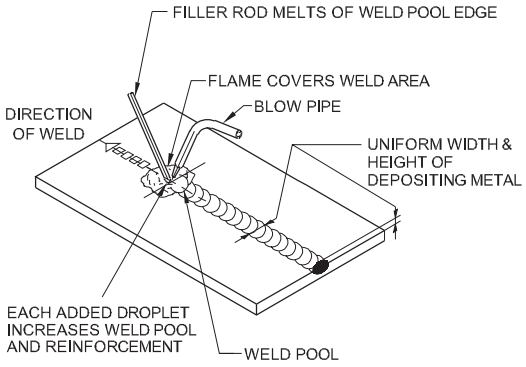
Fig 3



Direction of welding

Move the blow pipe in a leftward direction along as straight line to complete the weld. (Fig 4)

Fig 4

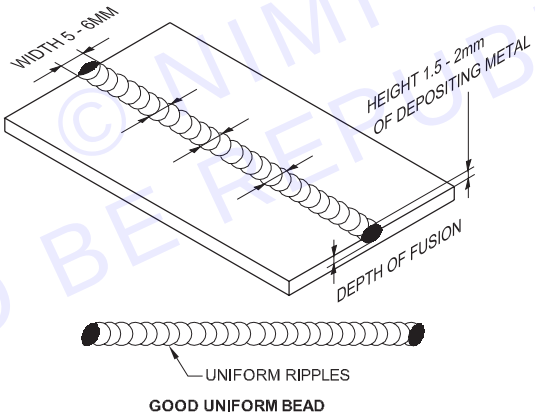


Maintain a constant 2-3mm of distance between the white cone of the flame and the sheet surface for a proper HEAT INPUT and avoidance of BACKFIRE.

Inspection of weld

Inspect the weld bead after cleaning properly with a wire brush, for a uniform width and height of the bead, uniform ripples, and proper depth of fusion. (Fig 5)

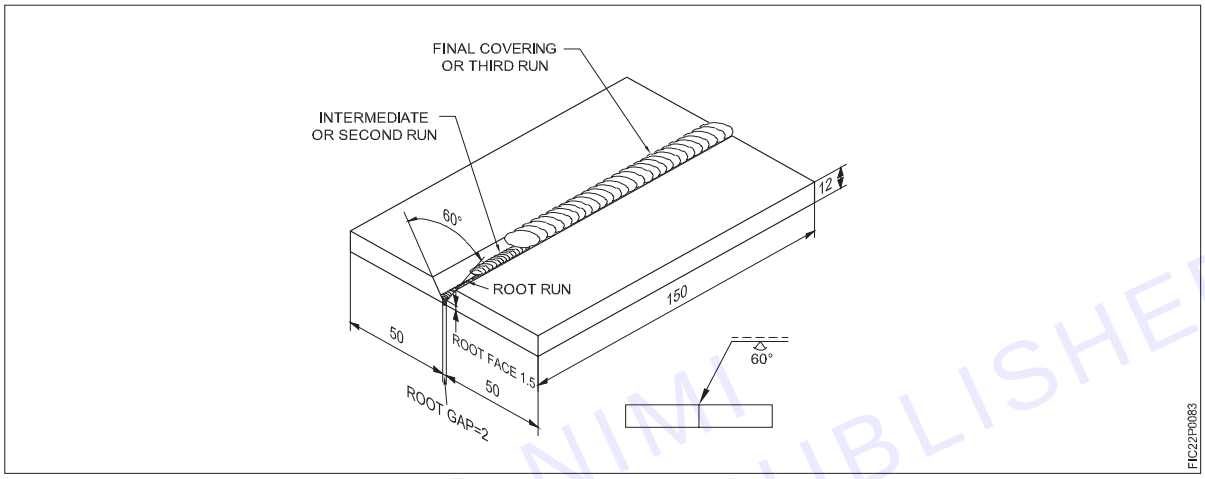
Fig 5

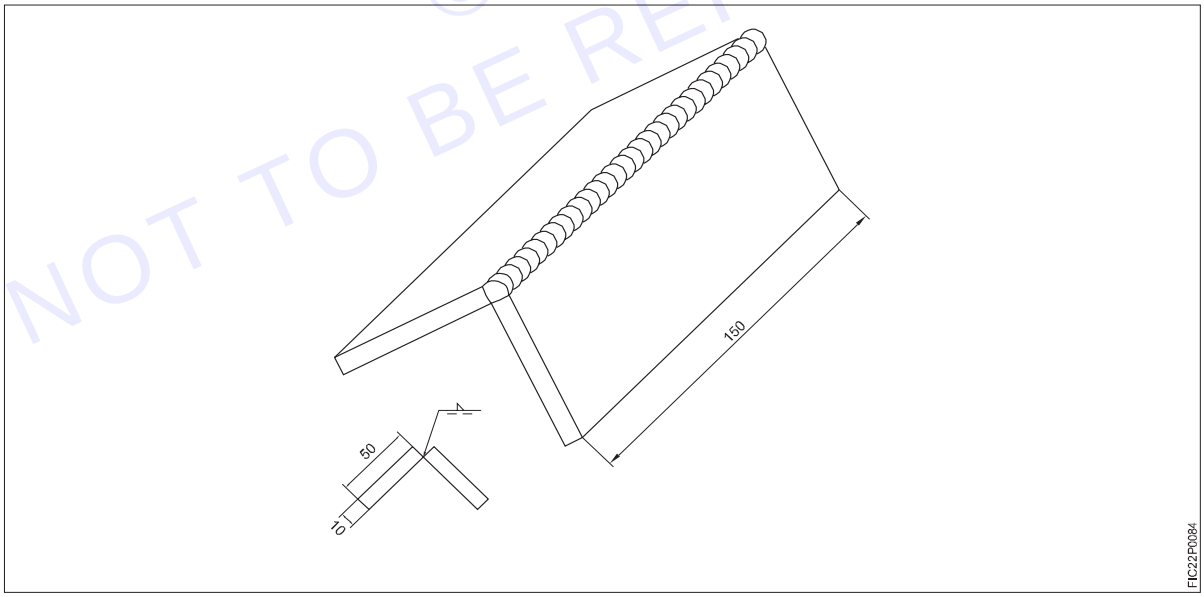


Butt weld and corner, fillet in arc welding

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

- bevel the plate edges by gas cutting for single vee butt joint
- grind the gas-cut bevel edges with proper root face for single Vee butt joint
- set the plates with a root gap of 2mm and proper distortion allowance for single Vee butt joint
- control arc blow
- deposit root run in single Vee butt joint to ensure complete penetration
- deposit intermediate and final covering runs in single Vee butt joint to obtain proper fusion and reinforcement
- clean and inspect the groove weld for surface defects and uniform root penetration.



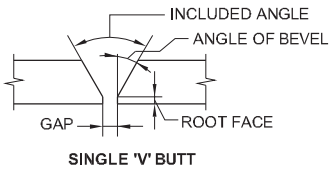


Job Sequence

TASK 1 : **Single 'V' butt joint in flat position by arc welding**

- Straight cut two 12mm thick plates by gas cutting as per drawing and grind them to size.
- Mark the bevel to 30o angle using bevel protractor in two plates.
- Punch witness marks
- Bevel the edges of each plate to 300 angle by gas cutting and file the root face as per drawing for edge preparation single 'V' Butt of joint. (Fig 1)

Fig 1



- Clean the plates from dirt, water, oil grease, paint etc.
- Keep the plates inverted in the form of a butt joint with proper root gap.
- Maintain a distortion allowance of 1.5o on each side of the joint.
- Wear all protective clothings.
- Use a 3.15mm medium coated MS electrode and set 110 amperes current. In case of DC welding machine connect the electrode cable to the negative terminal of the machine.
- Tack weld on the back side of the plates at the ends. The length of tack should be 20mm.
- De-slag the tack weld and clean.
- De-slag and clean the root run and inspect root penetration.
- Position the tack welded job on the table in flat position (the single V portion facing up)
- Deposit the root run and fill the crater as done for welding square butt joint.
- Take special care to maintain key hole to ensure proper melting of root face and root pentration.
- Deposit the second run/intermittent run using 4mm medium coated electrode and 150-160 ampere current, short arc and proper weaving of the electrode. Avoid excessive weaving and ensure normal travel speed.
- Fill the crater wherever necessary.
- De-slag.
- Deposit the third run/covering run using the same parameter and technique used for 2nd run. Ensure a proper reinforcement of 1 to 1.5mm and avoid undercut.
- Inspect for any surface weld defect.

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TASK 2 : **Fillet weld in open corner joint in flat position by arc welding**

- Prepare job plates to size as per drawing.
- Clean the joining edges and surfaces of plates.
- Set the plates as an open corner joint with a root gap of 2.5 mm using an angle iron jig.
- Select correct polarity, if a DC generator is used.
- Tack the joint pieces at both ends using Ø 3.15 mm medium coated MS electrode and 100-110 amps current from inside of the joint.
- Ensure safety apparels are worn. Use a proper method to control distortion.
- Clean the tacks, check alignment and reset the joint, if required.

- Set the joint on the welding table in a flat position.
- Deposit root run in the joint by forming a keyhole and obtain complete penetration.
- De-slag and clean the root run and inspect root penetration.

Ensure the crown of penetration is not more than 1.6 mm in height.

- Grind and dress the face of the root run, if required.
- Set the welding current 160 amps for Æ 4mm medium coated M.S. electrode.
- Deposit an intermediate layer i.e. second run over the root run with slight weaving motion using Æ4mm electrode.
- Clean the intermediate layer thoroughly and inspect for faults. Rectify the defects, if any.
- Deposit the final layer to the weld size using the same current setting, electrode and weaving motion as used for the second layer.
- Clean the final layer for inspection.
- Inspect the corner fillet weld:
  - to ensure uniform and correct reinforcement
  - to ensure that the weld face is free from porosity, slag inclusion, unfilled crater, overlap and edge of plate melted off/insufficient throat thickness.

Skill Sequence

Single 'Vee' butt joint in flat position by arc (TASK 1)

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

- single 'vee' butt joint in flat position by welding
- prepare the plate edges for single vee butt joint
- set the plates with a root gap of 2mm and proper destortion allowance for single 'vee' butt joint
- deposit root bead in termediate and final covering runs in single 'vee' butt joint
- clean and inspect the weld for surface defects.

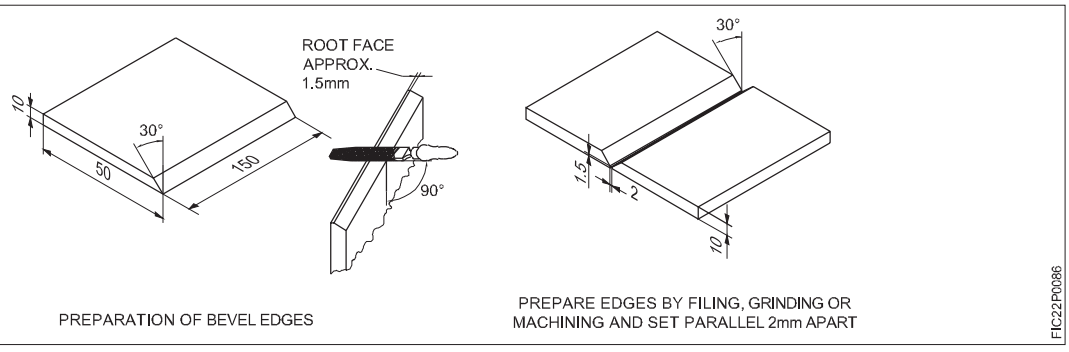
Preparation of the pieces (Fig 1)

Cut a 300 bevel on each pieces using oxy-acetylene cutting.

Grind the edges to remove oxide deposits on the bevel.

Prepare a uniform root faces of 1.5mm by filing on both the bevelled edges.

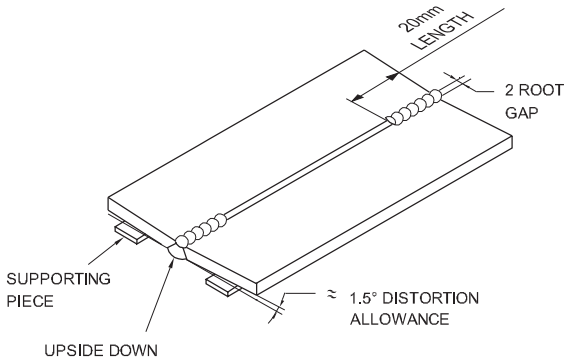
Fig 1



Setting the single Vee butt joint and tacking

Keep the bevel edges upside down with a root gap of 2mm, and 30 distotion allowance. (Fig 2) using suitable support i.e. 1.50 on each side of the joint.

Fig 2



SETTING THE SINGLE VEE BUTT JOINT AND TACKING

Tack-well on both ends. (20mm long)

Ensure safety apparels are worn.

Place the joint in flat position after tacking.

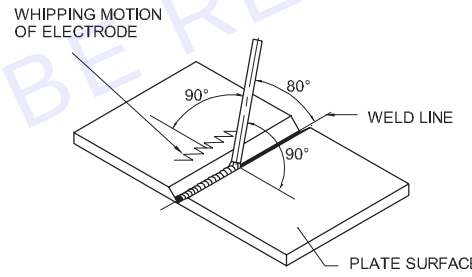
Deposition of root bead (Fig 3)

Deposit root bead using a Ø3.15 M.S. electrode and 110 amps welding current.

Proceed with a uniform normal speed holding a short arc.

Keep the electrode angle (as shown in Fig 3) at 800 to the line of weld.

Fig 3



ELECTRODE ANGLE AND MOTION FOR SINGLE VEE BUTT JOINT IN LAYING ROOT BEAD

Give a whipping motion to the electrode to maintain the size of the KEYHOLE for correct penetration.

Clean the root bead, and observe penetration.

Deposition of hot pass & caping beads (Fig 4)

Deposit the 1st covering bead using a 4.00mm dia medium coated M.S.electrode and 160 amps welding current.

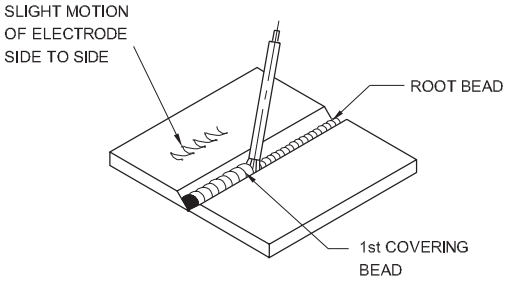
Proceed with a uniform speed, holding a normal short arc and a side-to side weaving motion to the electrode.

Ensure the electrode angle is the same as it was for the root bead.

Clean the bead thoroughy and grind the humps in beads (if present).

Rectify possible defects, if any.

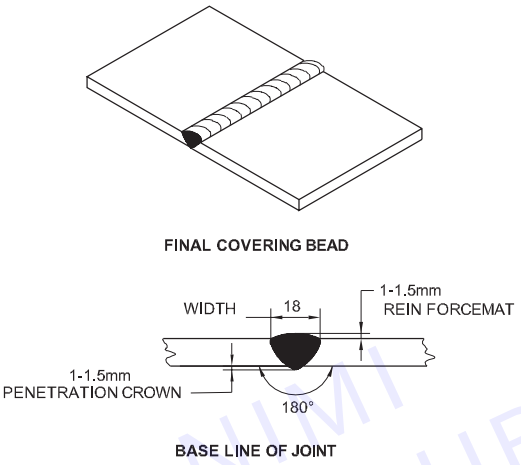
Fig 4



ELECTRODE MOTION IN DEPOSITING 1st COVERING BEAD

Depostion of final/caping bead (Fig 5)

Fig 5



Deposit the final covering bead using a Ø5.mm M.S. electrode, 220 amps welding current, and imparting a wider side-to-side weaving motion to the electrodes. Pause (stop) the electrode weaving at the toes of the weld so that undercut defect will get eliminated.

Cleaning and inspection

Clean the welded jont thoroughly from both sides.

Inspect the weld size, surface defects, root penetration and distortion.

Edge preparation

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

- types of edge preparation.

The preparation of edges are necessary prior to welding in order to obtain the required strength to the joint.

Joining edges are prepared for welding by one of the methods mensioned below

Flame cutting

Machine tool cutting

Machine grinding or hand grinding

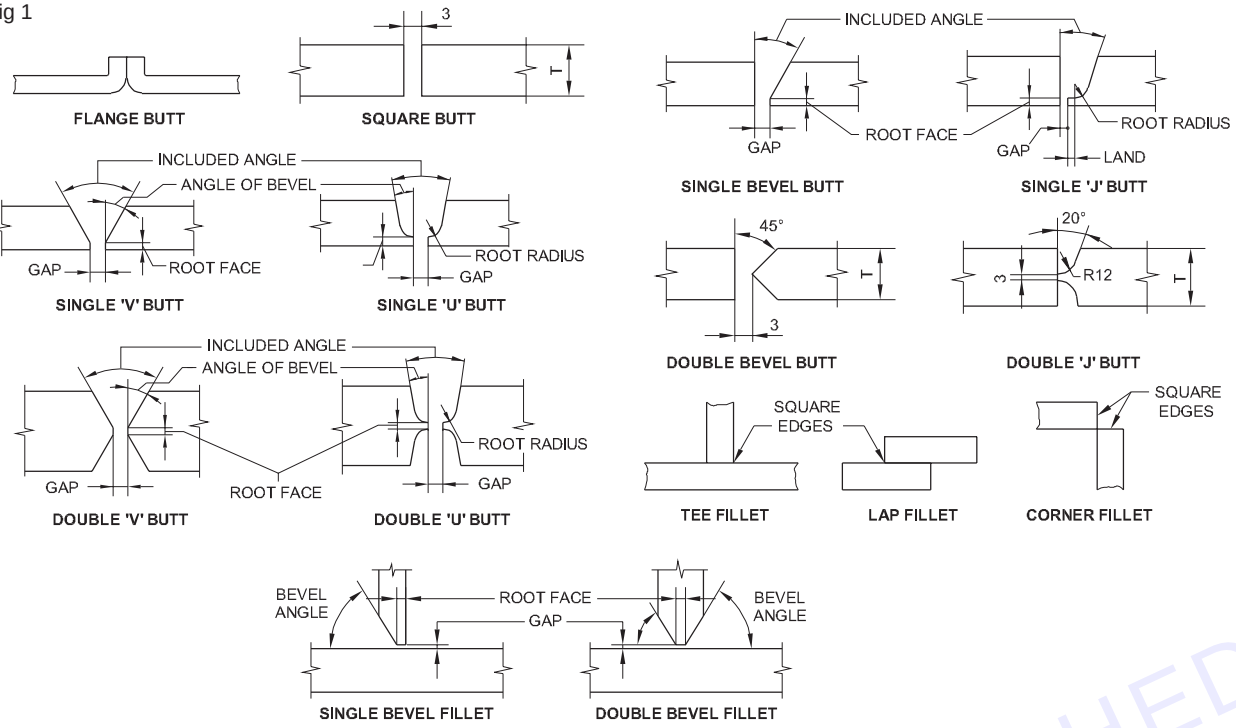
Filing

Chipping

Types of edge preparation and setup

Different edge preparations generally using in arc welding are shown in Fig 1

Fig 1



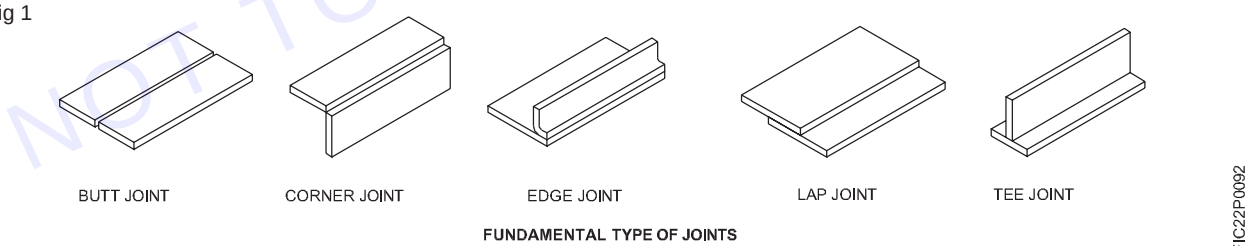
Basic welding joints and position

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

- types of welding joints and position.

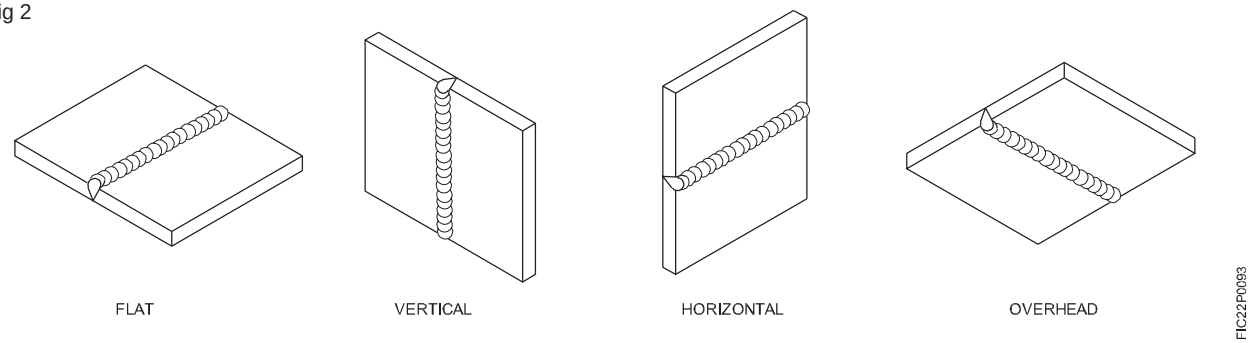
The various basic welding joints are shown in Fig 1

Fig 1



The following are the important basic welding positions. (Fig 2)

Fig 2



Fillet weld in open corner joint in flat position by arc welding (TASK 2)

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

- set and weld open corner joint.

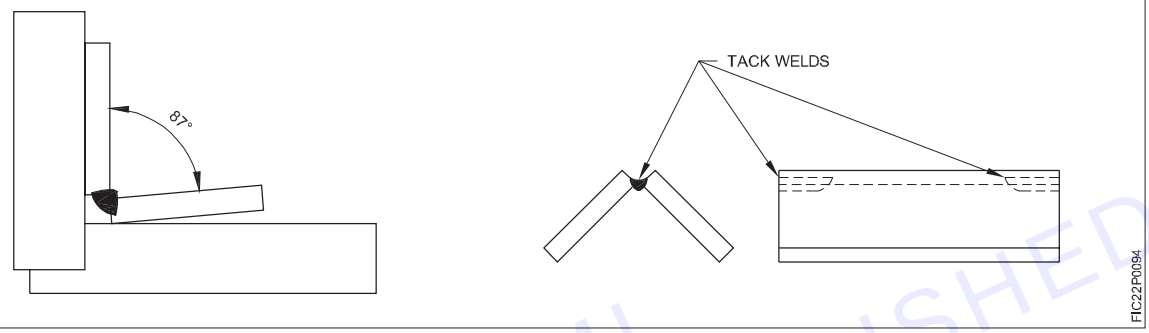
Setting and tacking plate pieces for open corner joint (Fig 1)

Set the plates as an open corner joint on the table with parallel root gap of 2.5mm throughout the joint. The angle between the plates is kept at 870 to control the distortion.

The angular distortion is normally taken as 1° per run.

Check the alignment of the joint with a try square. (Fig 1)

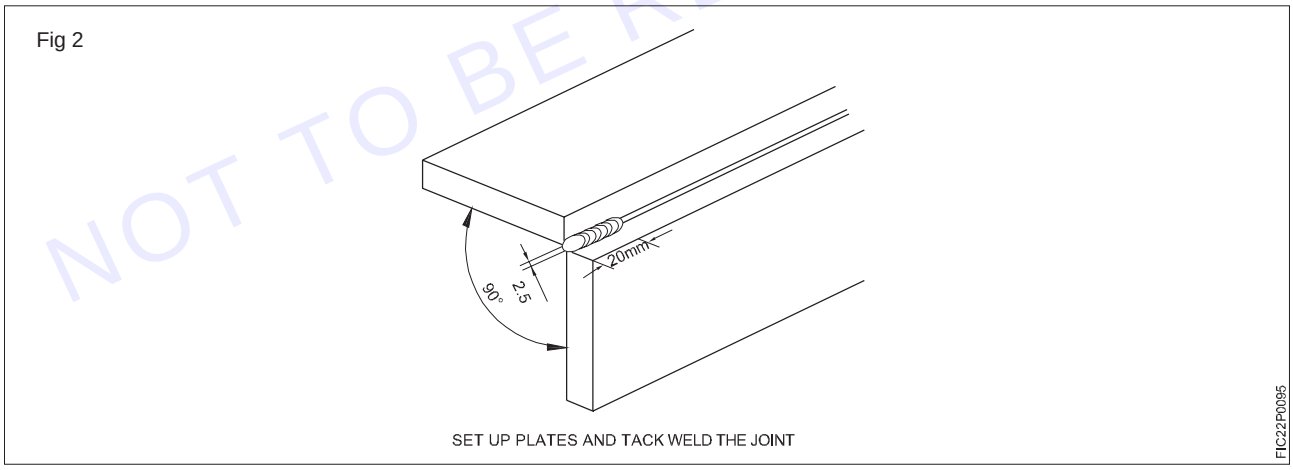
Fig 1



Another method to control distortion is, set the angle at 900 and use a right angled iron fixture to minimise the distortion.

Tack weld the corner joint from inside using a MS electrode Ø 3.15mm and 100 - 110 amps current range. Tack weld at both ends with max tack length of 20mm each. (Fig.2)

Fig 2



Ensure that the joining edges are perfectly clean and safety apparels are worn.

Deslag and clean the tacks using chipping hammer and wire brush. (Fig 3)

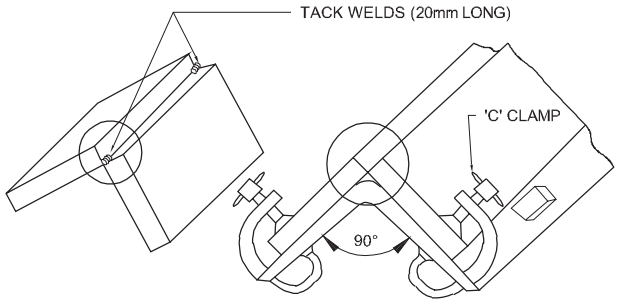
Deposition of root run

Set the joint in a flat position.

Deposit root run in the bottom of the corner by

- using a M.S. electrode Ø 3.15 and welding current 110 to 120 amps.
- maintaining a slightly short arc
- positioning the electrode vertically between the edge and 60° - 70° with the weld line. (Fig 4)

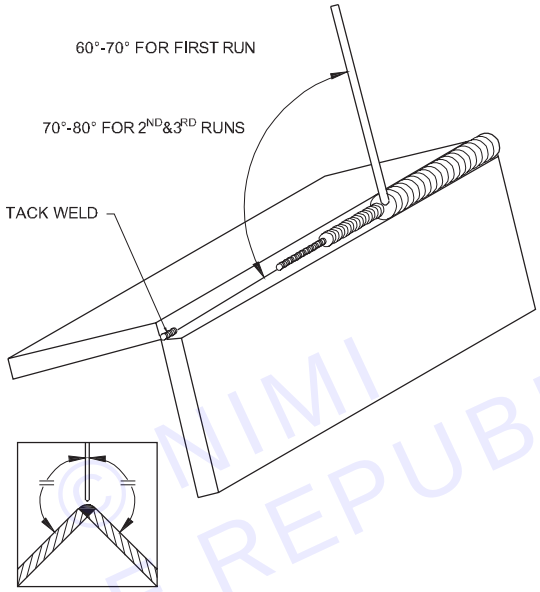
Fig 3



OUTSIDE - CORNER JOINT SETUP, FLAT POSITION

FIC22P0096

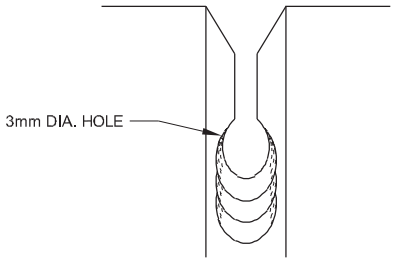
Fig 4



FIC22P0097

- forming a keyhole near the weld crater of the tack weld to ensure complete penetration. (Fig 5)
- maintaining travel speed similar to the speed used for straight beading. Clean the root run thoroughly and observe penetration.

Fig 5



THE KEYHOLE.

FIC22P0098

Ensure no slag particles are adhering on the root run.

The crater is to be properly filled in each run.

Deposition of covering layers

Deposit 1st covering layer i.e., the second run using a ø 4.00 mm medium coated MS electrode and 160 amps welding current. A weaving motion for the electrode has to be given to ensure enough metal is deposited in the groove and both edges of the plates are fused.

Ensure that the electrode angles are as shown in Fig 4. Uniform medium arc length, uniform normal travel speed should be maintained.

Clean the slag from the 1st covering layer thoroughly.

Ensure all the surface defects are rectified.

Deposit 2nd (final) covering layer i.e. the third run using:

- Ø 4 mm M.S. electrode and 160 amps welding current
- wider weaving motion to the sides of corner joint
- a slower rate of travel that was done for the 1st covering layer.
- Use the same angle of electrode and arc length as used in 1st covering layer.

Each movement of the weave from one side to the other will deposit more metal, and that takes more time.

Ensure restarting and stopping of the beads correctly.

The usual defect on the final layer of weld is 'edge plate melted off'. This can be eliminated if care is taken to weave the electrode to the required extent so that the edges are just fused. The arc should not be focussed on the edges at all.

Inspection of fillet weld in corner joint (Fig 6)

Clean the weldment thoroughly.

Check the angle between the plates for 900.

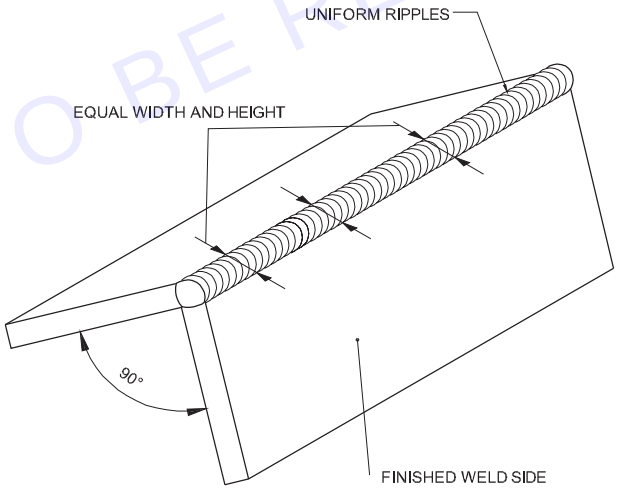
Check each run/layer for the following weld characteristics.

Width and height: Uniform

Appearance: Smooth with close ripples.

Size: Full fillet without excessive reinforcement .

Fig 6



Face of welds: Root run and 1st covering layer flat, final layer slightly convex.

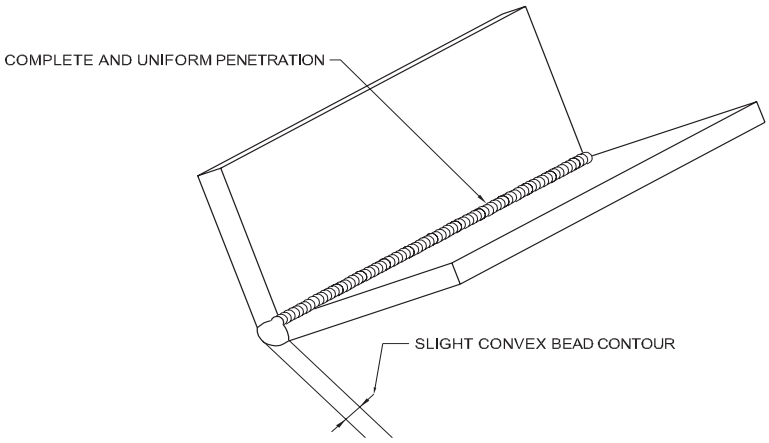
Edges of welds: Good fusion, no undercut, no overlap.

Starts and stops: Free of depression and high spots, craters filled.

Back side: Complete and uniform penetration. (Fig 7)

Surrounding plate surface: Free of spatter.

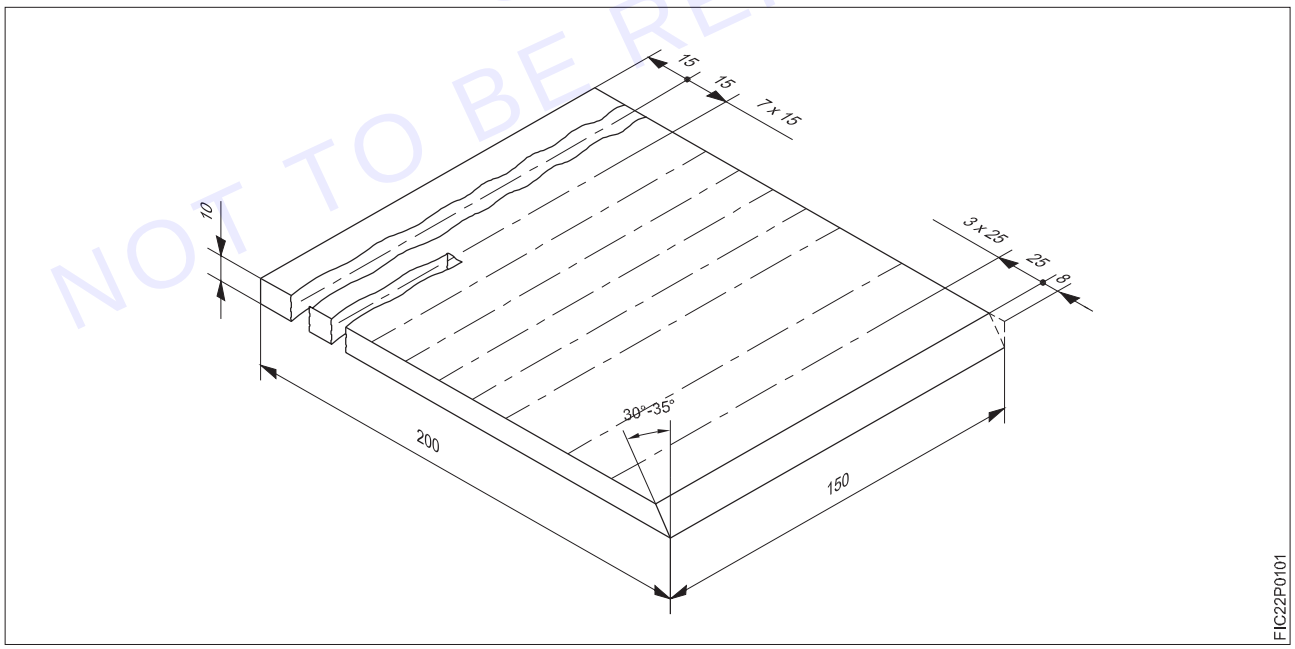
Fig 7

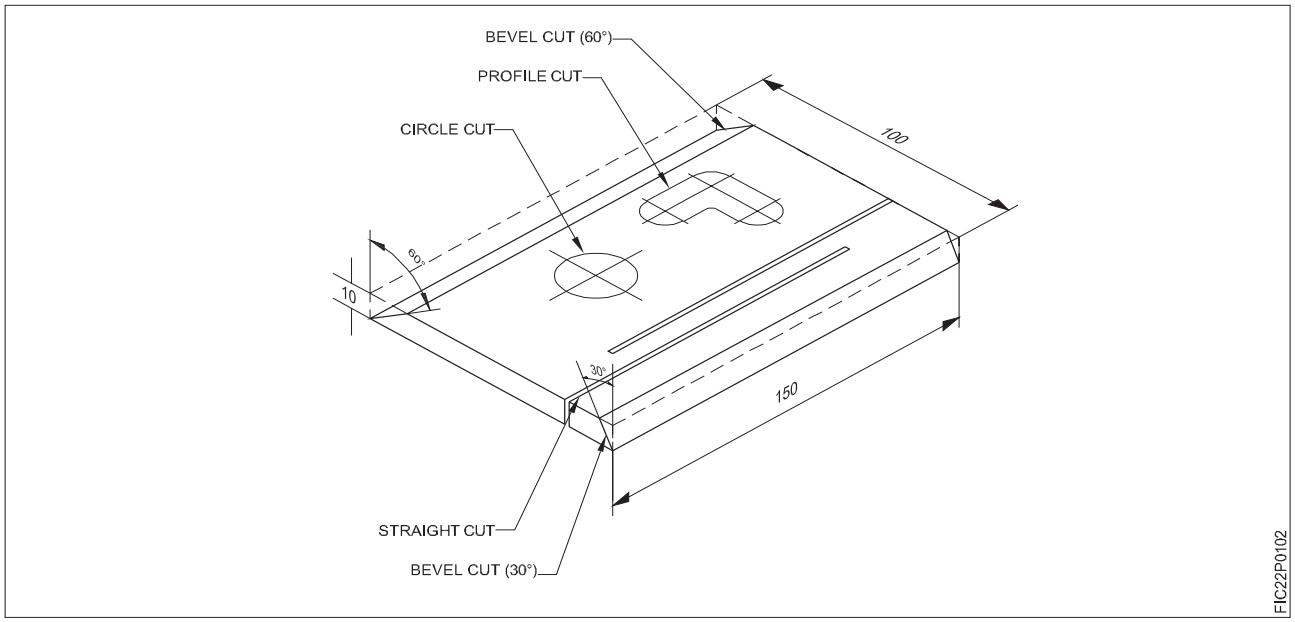


Gas cutting of MS plates

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

- mark cutting lines on the plate by keeping proper cutting allowance
- set the job for straight, bevel, circle and profile cutting
- select the cutting nozzle No. and the cutting oxygen pressure for different plate thickness
- adjust the preheating flame and preheat the metals
- cut straight line bevel, circle and profile by hand and machine
- clean the gas cut edges and inspect for defects.





Job Sequence

TASK 1 : **Oxy - acetylene hand cutting straight and bevel cut**

- Wear all safety clothing.
- Set the gas welding plant with a cutting blowpipe, and cutting oxygen regulator.
- Fit the correct cutting nozzle according to the thickness of the metal to be cut (for M.S. plate 10mm thickness use 1.2mm dia. orifice cutting nozzle)
- Adjust both oxygen and acetylene gas pressure according to the cutting nozzle size. (Oxygen 1.6 kgf/sq.cm and acetylene 0.15 kgf/sq.cm)

While adjusting the pressure keep the cutting blow pipe walls open

- Check the size of the raw material
- Mark and file to size 200x150x10
- Clean the plate from dirt, oil, grease paint, water etc.
- Mark gas cutting lines as per drawing.
- Punch witness marks on cutting lines
- Set the job on cutting table.
- Set the neutral flame.
- Wear the gas welding goggles.
- Hold the blowpipe at an angle of 900 between the line of cut and the cutting nozzle axis is between the nozzle and the surface of the plate.
- Heat one end of the punched line up to cherry red hot condition.
- Keep the distance between the workpiece and the tip of the nozzle about 5mm.
- Place the preheat cone approximate 1.6mm above the plate.
- Move the flame in circle a little larger than the tip size. When metal is heated to Cherry red, move the tip to the edge of the plate.
- Operate the cutting oxygen lever immediately and move the torch slowly along cutting direction.
- Maintain correct torch speed and distance between the plate surface and the nozzle up to the end of the cut.
- If long plates are to be cut, to get a good straight gas cut surface, clamp a straight edged flat parallel to the line of cut and use a spade guide attached to the cutting torch. Move the torch uniformly along the clamped flat and pressing the spade guide against the flat.
- On completion of the cut release the cutting oxygen lever and shut off the flame.

- Clean the cut surface by wire brush after chipping off any slag sticking to the cut edge.

Making bevel cuts

- The best method for obtaining a good bevel with a minimum slag is to cut and bevel at the same time.
- Mark and punch straight lines 25mm apart.
- For cutting a bevel keep one or two flats on the plates to be bevelled and angle the cutting nozzle by resting the nozzle over the flats.
- Hold the torch in left hand, light it, tilt it to 30-350 of the perpendicular.
- Preheat and start the cut holding the torch on both hands as done in straight line-cutting. Avoid kerf filling by increasing travel speed.
- On reaching the end, cutting should continue for another 6mm or more to get a complete cut.
- Shut off the torch at the end and dip it in water and chip off the slag.
- Repeat the exercise till a good and smooth cut is achieved.
- To bevel the edge of a long plate with a clean and good gas cut surface, use a bevelling attachment to the torch and tilt the nozzle of the torch to the required angle of bevel.

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TASK 2 : **Oxy - acetylene machine cutting**

- Check the size of the raw material.
- Mark and file to size
- Mark the gas cutting lines atraight bevel, circle and profile as per drawing.
- Punch witness marks on the gas cutting marked line.
- Set the cutting machine and connect the oxygen and acetylene cylinders, regulators to the hoses of the machine and fix a suitable cutting nozzle.
- Fit the circular and profile template on the cutting machine table.
- Clean the surface of the metal plate to be cut.
- Select and fix the nozzle as per the thickness of the plate to be cut.
- Clean the track on which the cutting torch assembly unit is mounted and the circular and profile templates and make sure that there is no dirt on them.
- Check the starting lever and ensure that it is in neutral position.
- Set the required pressure of oxygen and acetylene according to the size of the nozzle.
- Set the required speed in the speed control dial according to the thickness of the metal to be cut.
- Adjust the nozzle to a height such that the inner cone of the preheating flame is 3 mm from the surface of the metal to be cut.
- Place the cutting machine at the starting point.
- Ignite and set the neutral flame.
- Allow for sufficient preheating, and then switch ‘on’ the jet of oxygen.
- Simultaneously switch ‘on’ the machine to move the cutting unit forward with the correct speed on the rails to make a straight line cut.
- Stop the machine and turn the switch to neutral position at the end of the cut.
- Set the cutting nozzle to 300 angle and cut the bevel similar to the straight line cut.
- Turn the job plate by 1800 and cut the 600 bevel angle by setting the cutting nozzle to 600.
- Arrest the linear movement of the cutting unit of the machine with the rails using a clamp and attach it to the pivot block used for cutting circle and profiles.
- Set the pivot block to get the required diameter and fix it on the machine table.
- Set the cutting nozzle perpendicular to the job plate and ignite it and set the preheating flame.
- When the plate becomes red hot, open the stream of cutting oxygen and cut the circle.
- For profile cutting, attach the template of the profile to the machine table and make the cutting head unit to follow the profile.
- After the cut is over stop all machine movements and remove the slag from all the gas cut surfaces.
- Use tongs while handling the gas cut job.
- Ensure that the molten slag during cutting, and solidified hot slag chipped after cutting, fall into a collecting trough kept below the table.
- Clean the cutting edges from slag and inspect the cut for gas cutting defects.

Skill Sequence

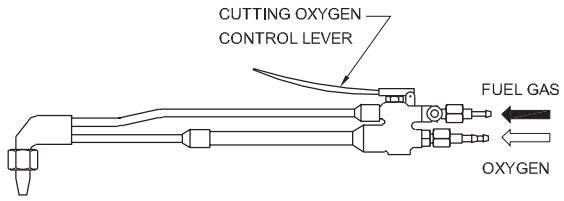
Oxy-acetylene hand cutting straight and bevel cut (TASK 1)

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

- set the gas cutting plant
- set the job for cutting
- adjust the cutting flame for gas cutting.

Setting the gas cutting plant: Set the oxy-acetylene gas cutting plant in the same way as was done for welding and connect the cutting blowpipe in the place of the welding blowpipe. (Fig 1) Also change the oxygen welding regulator with oxygen cutting regulator.

Fig 1

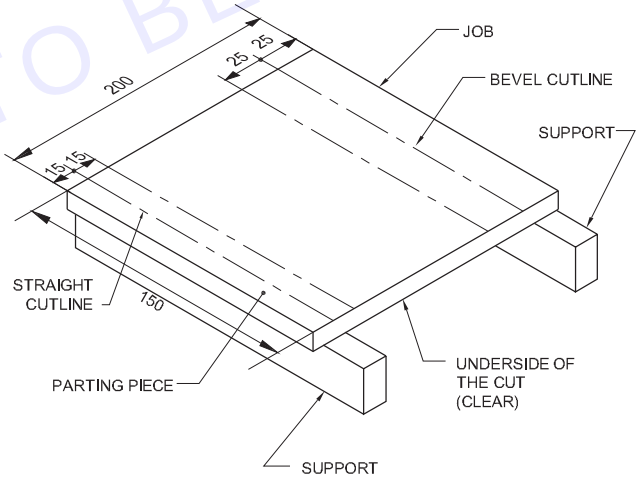


Setting the job for straight line cutting (Fig 2): Mark and punch 7 straight lines on the plate 15 mm apart for a straight line cut and 3 lines 25mm apart for bevel cutting on other edge.

Set the job on the cutting table so that the parting piece is free to fall.

Ensure that the underside of the cutting line is clear and no combustible materials are lying nearby.

Fig 2



CUTTING JOB SET ON SUPPORTS

Adjusting cutting flame: Select the cutting nozzle and set the gas pressure as per the cutting job thickness. (Table 1)

The bevel thickness will be more for bevel cut, when compared with a square cut for same thickness.

Table 1

Data for cutting

Diameter of cutting oxygen orifice nozzle	Thickness of steel plate	Cutting oxygen pressure
(1) mm	(2) mm	(3) kgf/cm2
0.8	3.6	1.0 - 1.4
1.2	6.19	1.4 - 2.1
1.6	19 - 100	2.1 - 4.2
2.0	100 - 150	4.2 - 4.6
2.4	150 - 200	4.6 - 4.9
2.8	200 - 250	4.9 - 5.5
3.2	250 - 300	5.5 - 5.6

Acetylene pressure should be 0.15 kgf/cm2 for all thickness of plates.

Select ø1.2 mm (orifice) cutting nozzle for cutting a 10 mm thick plate.

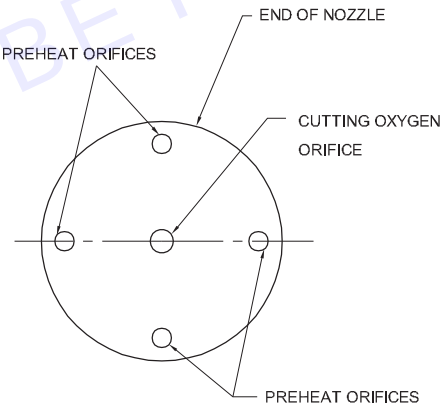
Set 1.6 kgf/sq.cm pressure for the cutting oxygen and

0.15 kgf/sq.cm pressure for the acetylene gas.

Ensure safety apparel is worn.

Fix the cutting nozzle into the cutting blowpipe correctly. (Fig 3)

Fig 3



PREHEATING ORIFICES (HOLES) ON CUT LINE

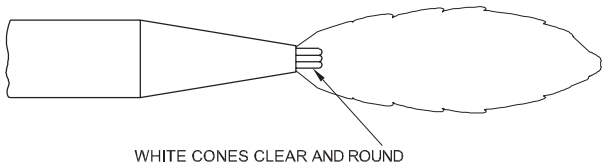
SETTING OF CUTTING NOZZLE

Check for leakage in the blowpipe connections of oxygen and actylene gas lines.

Adjust the neutral flame for preheating. (Fig 4)

Ensure that the flame adjustment is not disturbed while operating the cutting oxygen lever.

Fig 4

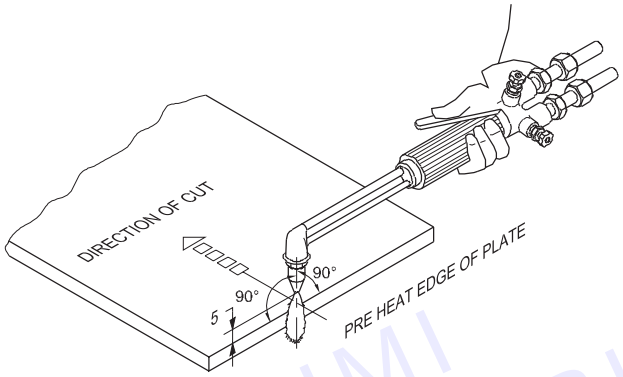


Straight line cutting: Keep the hand cutting blowpipe at 90° angle with the plate surface and start cutting a straight line. (Fig 5)

Preheat the starting point to red heat before pressing the cutting oxygen lever. (Fig 5)

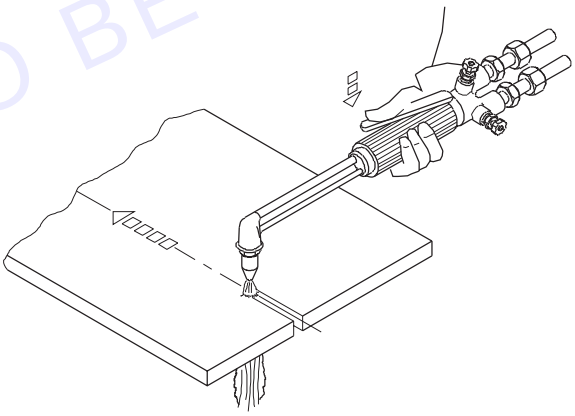
Keep the distance between the workpiece and the nozzle about 5 mm to avoid backfire. (Fig 5)

Fig 5



Release the cutting oxygen by pressing the cutting oxygen control lever and start the cutting action and move the blowpipe along the punched line with uniform speed. (Fig 6)

Fig 6



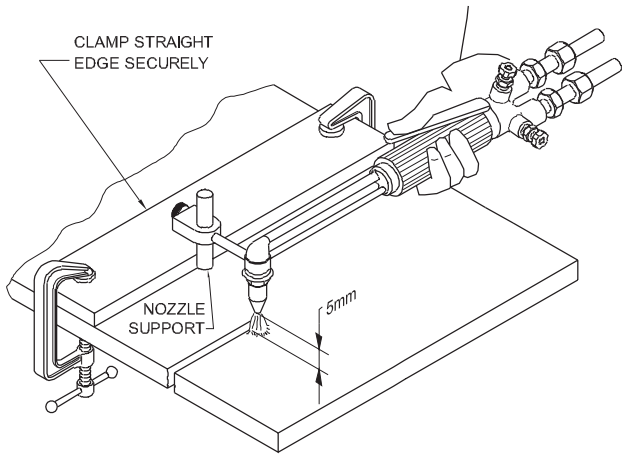
Ensure straight travel without any side-to-side movement.

The nozzle angle is 90° with the plate surface till the completion of cut.

Open the cutting oxygen valve fully.

If possible fix a straight edge or template to the plate and fix a support to the cutting nozzle so as to ensure constant distance between the tip of the nozzle and the plate surface and maintain a uniform straight cut. (Fig 7)

Fig 7



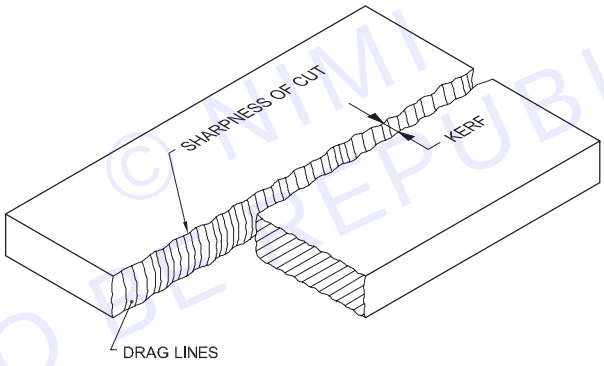
Inspect the cutting for

– uniform and smooth cut or drag line

– straightness, sharpness.

– width of the cut (Kerf) Fig 8

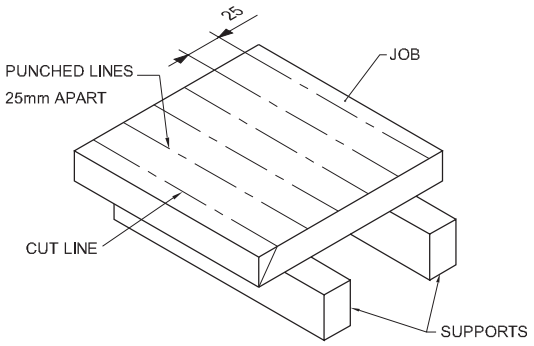
Fig 8



Bevel cutting: Set the job as shown in Fig 9. Hold the cutting blowpipe (nozzle) at (required) 60 - 55° angle so that the bevel angle on the plate will be 30 - 350. (Fig 9)

There should not be any obstruction at the underside of the cutline and the parting piece from the job should be free to fall.

Fig 9

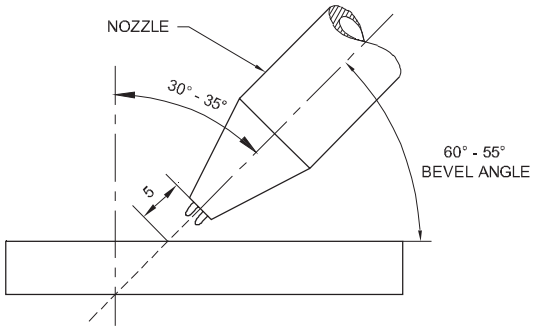


CUTTING JOB SET ON SUPPORTS

Preheat the starting point to cherry red colour.

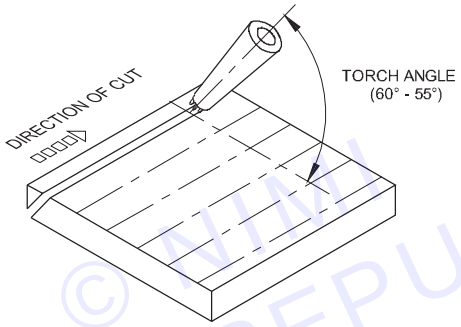
Keep the distance between the workpiece and the nozzle about 5mm to avoid backfire. (Fig 10)

Fig 10



Release extra oxygen by pressing the cutting oxygen lever, observe the cutting action and start moving along the punched line with uniform speed. (Fig 11)

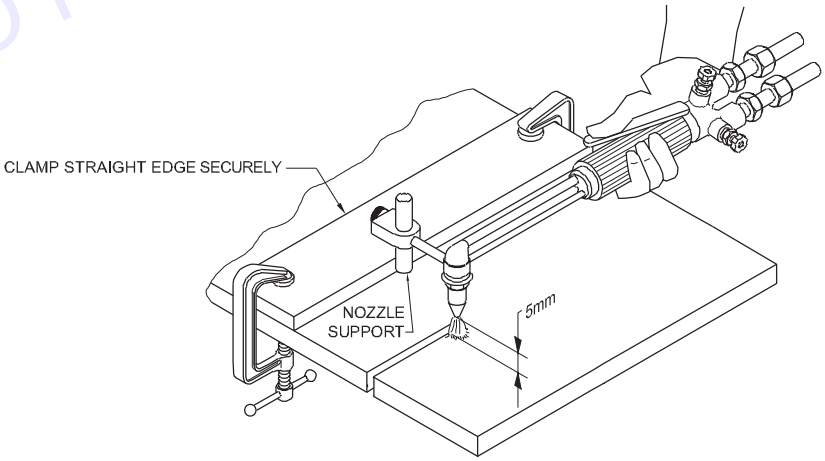
Fig 11



Keep less cutting speed than you would use for a straight cut for the same thickness.

Fix one or more straight bar to the cutting job to ensure the cut is along the straight line and also able to maintain the correct angle. (Fig 12)

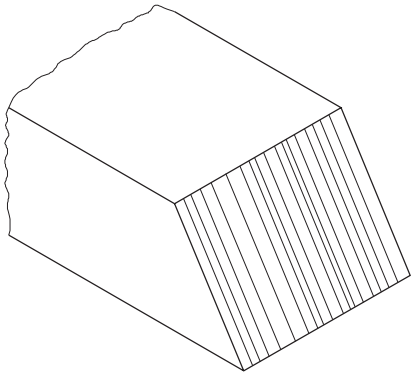
Fig 12



Inspection of bevel cut: Clean the slag if sticking to the cut surface by a chipping hammer and wire brush and inspect for any gas cutting defects.

GOOD QUALITY is shown by excellent top edge and extremely smooth cut face. The cut part is dimensionally accurate. (Fig 13)

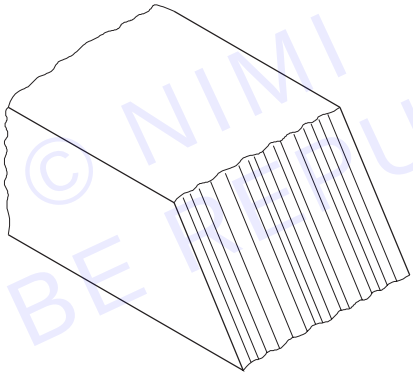
Fig 13



FIC22P0115

POOR QUALITY results in gouging which is a most common fault. This is caused either by excess speed or too low a preheat flame. (Fig 14)

Fig 14



FIC22P0116

Oxy-acetylene machine cutting (straight, bevel, circle and profile) (TASK 2)

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

- assembly of the portable cutting machine
- set the gas pressure to the size of nozzle
- cut the profiles by portable cutting machine.

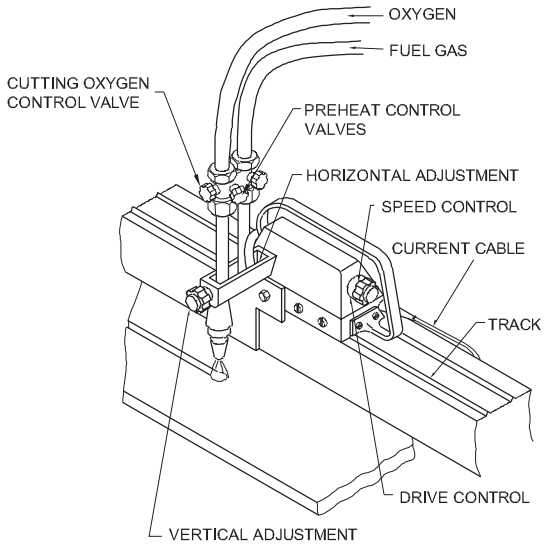
The assembly of the machine, the use of templates or systems of reproduction, the position of the work, the speed range and cutting nozzles vary according to the type of the machines.

Assemble the accessorises like cutting head for straight and bevel cutting with the cutting machine. (Fig 1)

Select the 1.2mm size of the cutting nozzle for 10mm thick plate.

Set the correct gas pressure of 0.15kgf/cm2 for acetylene and 1.4 to 2 kgf/cm2 for oxygen for 1.2mm size nozzle.

Fig 1



PORTABLE CUTTING MACHINE

Set the machine to run freely as per the regulated speed i.e 50cm/min for 10mm thick plate.

Ignite the flame and adjust the neutral flame.

Set the nozzle tip to a correct distance from the surface of the plate to be cut i.e. about 7 to 8mm.

Start the machine and run to the required distance to cut the metal.

Switch 'off' the machine and extinguish the flame at the end of the cut.

Remove the plate, clean the iron oxide slag and inspect the cut surface.

For cutting a bevel edge tilt the cutting torch nozzle to the required angle and follow the same skill sequence followed for straight line cutting. (Fig.2)

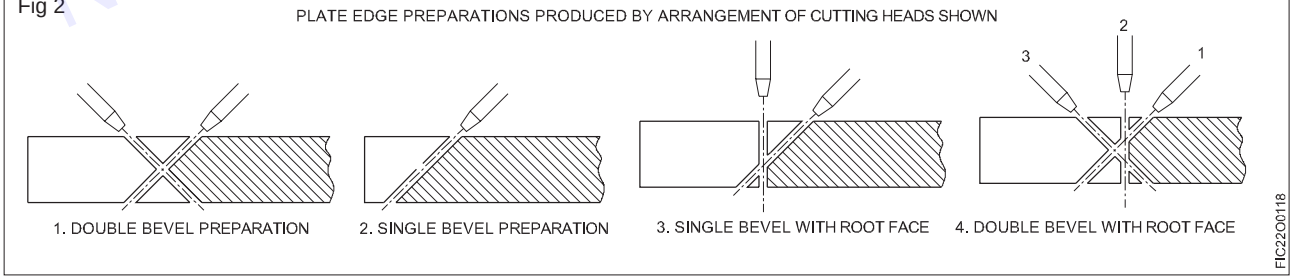
Start the machine and run to the required distance to cut the metal.

Switch 'off' the machine and extinguish the flame at the end of the cut.

Remove the plate, clean the iron oxide slag and inspect the cut surface.

For cutting a bevel edge tilt the cutting torch nozzle to the required angle and follow the same skill sequence followed for straight line cutting. (Fig 2).

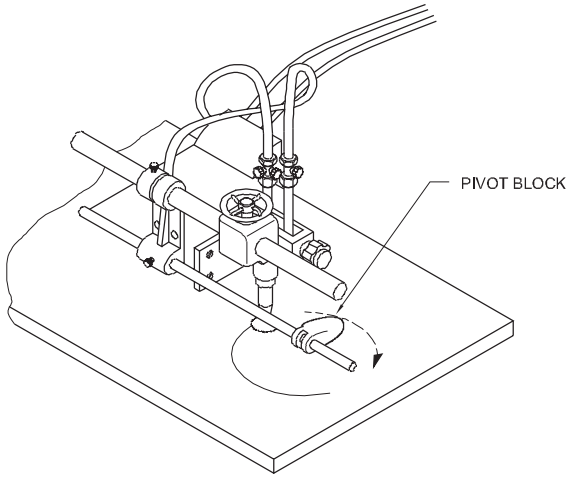
Fig 2



For cutting a circle, attach cutting torch nozzle to the pivot block (Fig 3) and follow the same method used to cut straight line and bevel. It is important to pierce a small hole inside the circumference of the circle to be cut and then move the torch to the nearest point on the circumference. Then use the pivot block to move the flame along the circumference of the circle.

To cut a profile the same sequence used for circle cutting is followed except that a template similar to the profile to be cut is mounted on the table and a tracer attached to the cutting head will follow the template profile. The torch flame will cut the profile on the job.

Fig 3



SMALL CIRCLE CUTTING

FIC22P0119

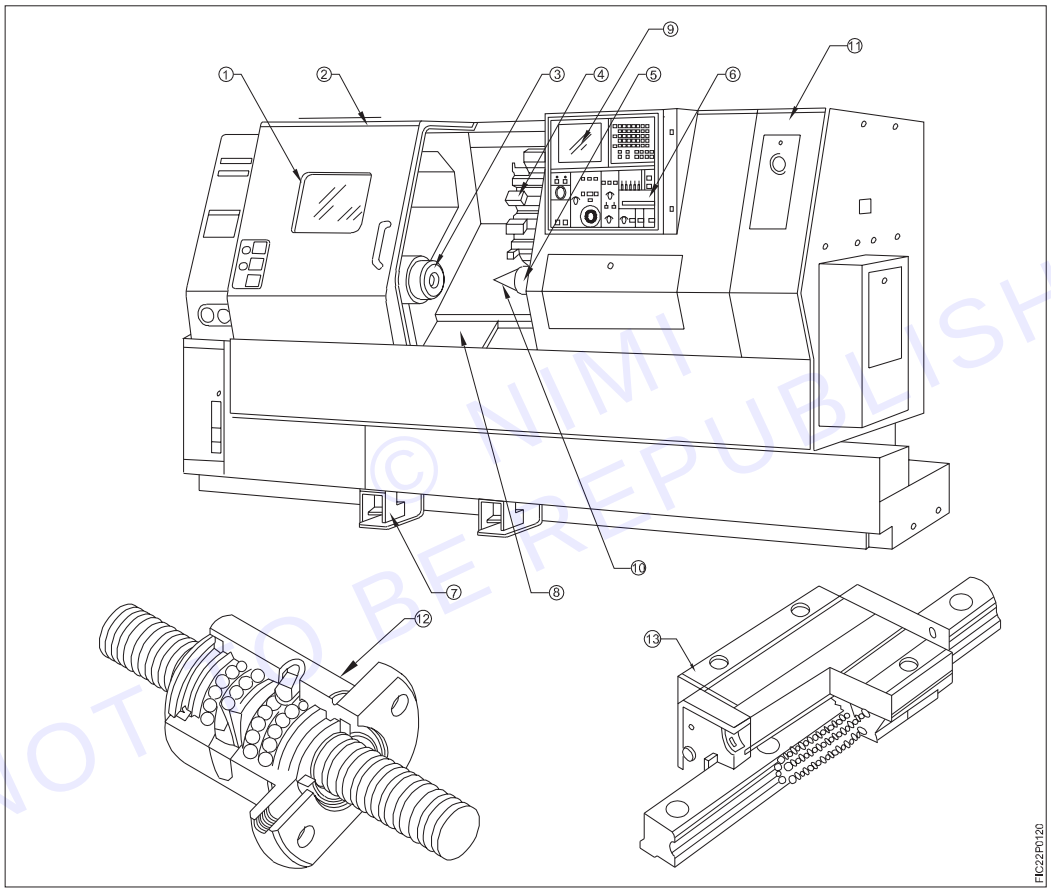
MODULE 5

EXERCISE 55 : Demonstration of CNC lathe machine, its parts an d function

Objectives

At the end of this exercise you shall be able to

- identify the parts of CNC lathe machine
- list out the functions of each part of the CNC lathe machine.



Job Sequence

- Identify the parts of CNC lathe machine and its function.
- List out the name of the parts in the given table 1
- Instructor will demonstrate the parts and its functions.

Note : Instructor to guide to identy CNC machine parts and axis control.

Table 1

Part No.	Name of the parts	Function of the part
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		

Note :Get it checked by the instructor.

Working of CNC machine parts by using multimedia based simulator

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

- operate the multimedia based simulator
- identify the CNC machine parts on simulator

- **Instructor will show the C.N.C Machine parts by using multimedia basd simulator Trainees should identify and understand the working parts and write in the parts given below table - 1**
- **Instructor to refer the previous exercise.**

Table - 1

Sl No.	CNC parts Identified by trainee in simulator
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	

Identify machine over travel limits and emergency stop on the machine

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

- identify the over travel limit switches and x and z axes in CNC turning center
- identify emergency stop and operate it.

Job Sequence

TASK 1 : **Indentification of machine over travel limit switches in x and y axis**

There are two types of over travel limit

1 Soft over travel

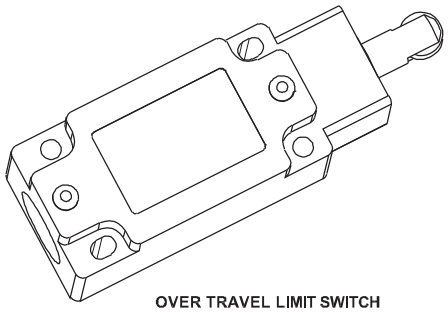
2 Hardware over travel

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)

Fig 1



OVER TRAVEL LIMIT SWITCH

FIC22P0121

- Position the X axis in the middle of the x axis movement
- Remove the telescopic cover at both ends.
- Observe the over travel limit switched 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 observer travel limit switches.
- Refix the telescopic cover , take care no dust practical should enter into the remove slide.
- Fig 2 shows the x axis dog and limit switch
- Fig 3 shows the z axis dog and limit switch

Fig 2

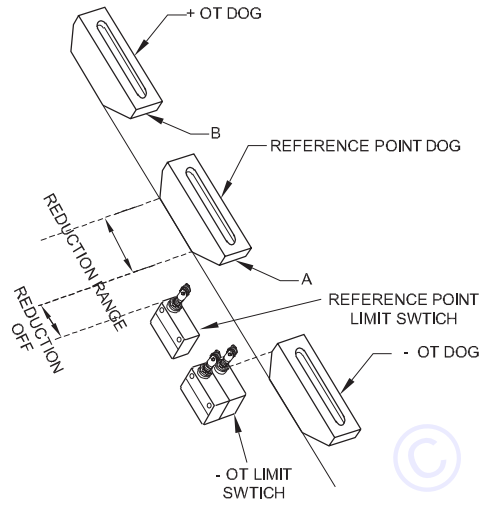
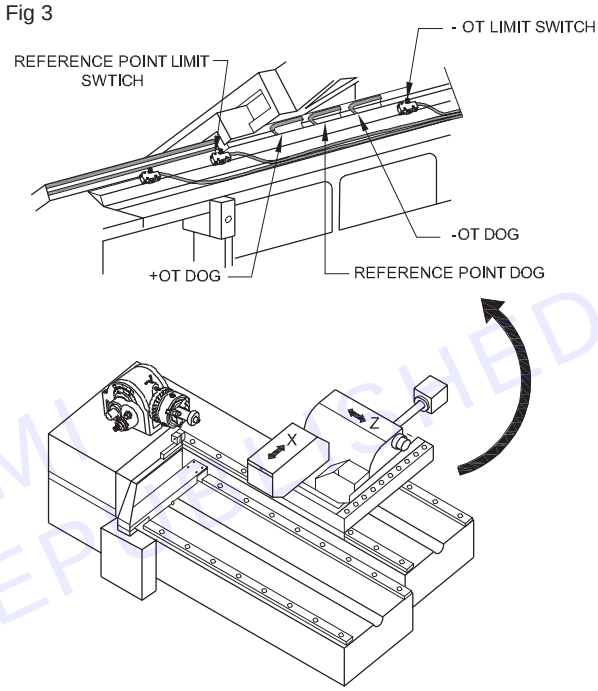


Fig 3



TASK 2 : **Identification emergency stop bush button**

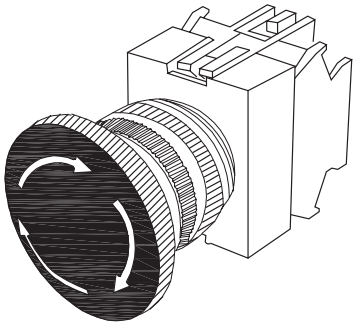
Emergency stop button are designed in such a manner in which their role is more physical, such as interrupting a power supply to the machine control system. It is a basic big red pushbuttons fixed on machine control panel.

Emergency stop pushbutton that has mechanical plastic or metal tabs and grooves internally such that when you push it (interrupting the circuit), it is held in that position until you twist it. They are designed to be large, hard to miss, and easy to push sample is given Fig 1.

Note : Pratice to put off and relace the emergency switch.

Caution: Do not try to rotate in anticlockwise direction.

Fig 1

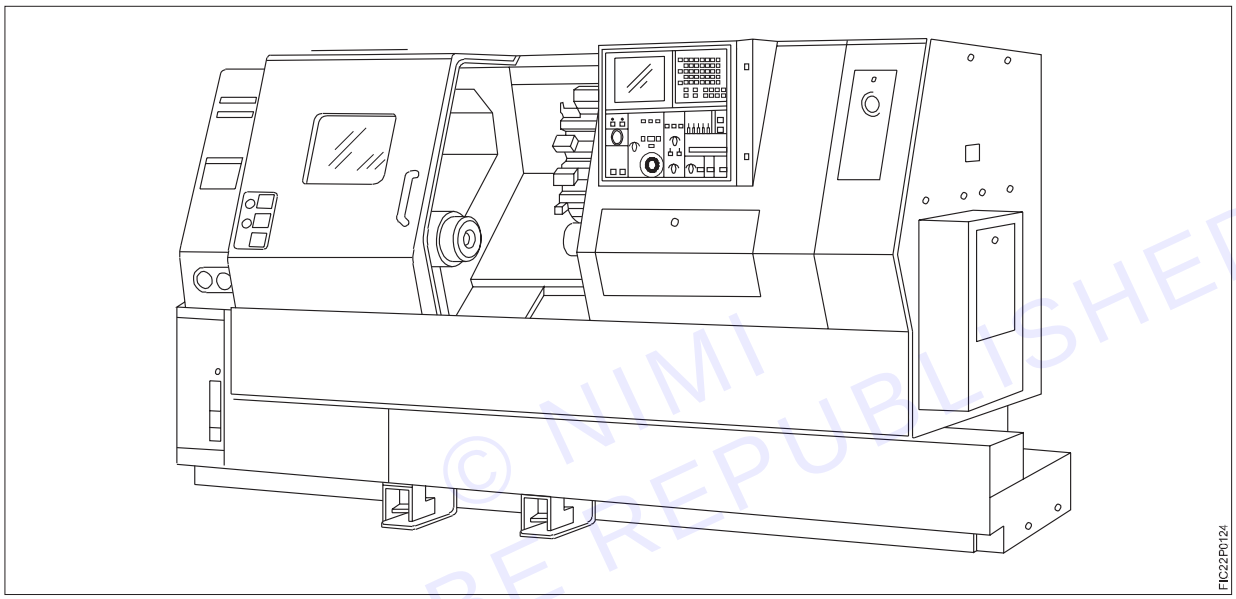


EXERCISE 56 : Conduct a preliminary check of readiness of the CNC turning centre

Objectives

At the end of this exercise you shall be able to

- check cleanliness of the machine
- check oil levels
- check correct working of lubrication system
- send the turret to machine reference point.



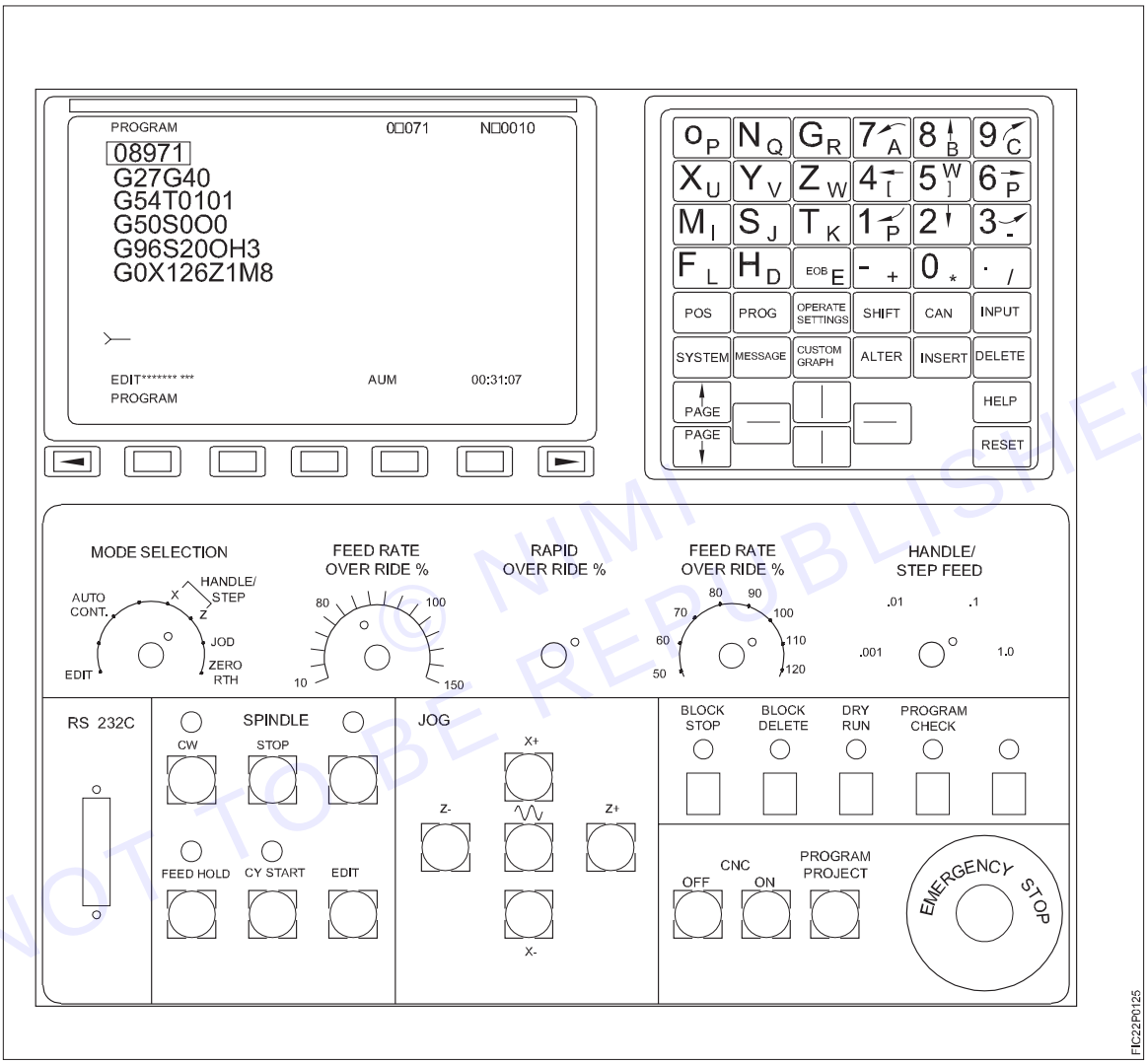
Job Sequence

- Ensure the cleanliness of machine.
- Use banian waste to clean.
- Ensure there is no oil spill around the machine.
- Switch 'ON' the Machine.
- Move the tool in JOG mode to a safe place.
- Send the turret to machine Reference point.
- Check the lubrication oil level and ensure it is within the acceptable level.
- Check hydraulic oil level.
- Check coolant oil level.
- Check correct working of lubrication system by manual operation.

Starting the machine, do homing on CNC simulator and machine

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

- perform homing in CNC simulator
- perform homing on CNC machine using JOG and MPG modes.



Job Sequence

TASK 1: **"Machine ON" and Homing on simulator**

Switch ON (System)

↓

Select the simulator software for turning

↓

Select the fanuc oit CNC system

↓

Release emergency button

↓

Unlock the edit key using cursor

↓

Give little movement by pressing X -, Z -

↓

Pres reference switch

↓

Press 'X' button to move X axis to the origin

↓

Press 'Y' button to move 'Y' axis to the origin

↓

CNC machine simulator 'Zero Ref' homing reached

— — — — —

TASK 2: **"Machine ON" and Homing on machine**

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

- Switch on the main power connection to the machine.
- Switch on the voltage stabilizer.
- Switch on the isolation switch.
- Press "NC ON" push button.
- Wait for the screen to indicate module setting status. (Fig 1)
- Display of software configuration (Fig 2)

Fig 1

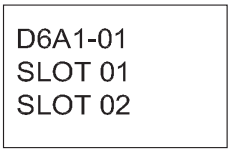
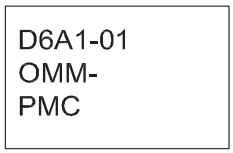


Fig 2



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

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

Skill Sequence

Jog incremental and MDI mode operation

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

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

Fig 1

JOG MODE OPERATION

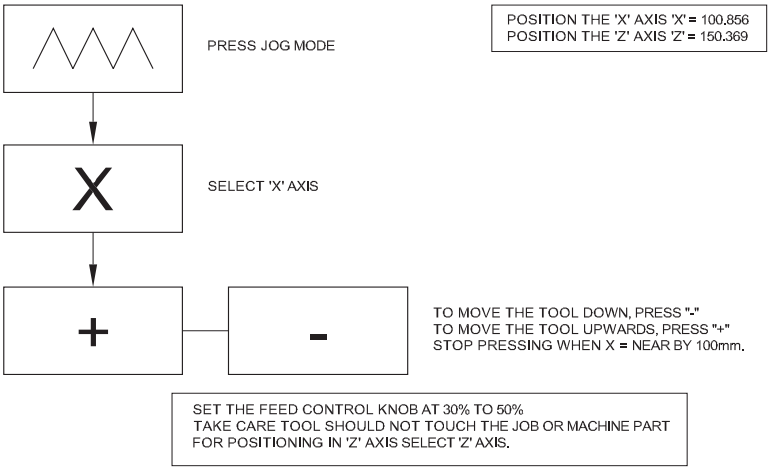
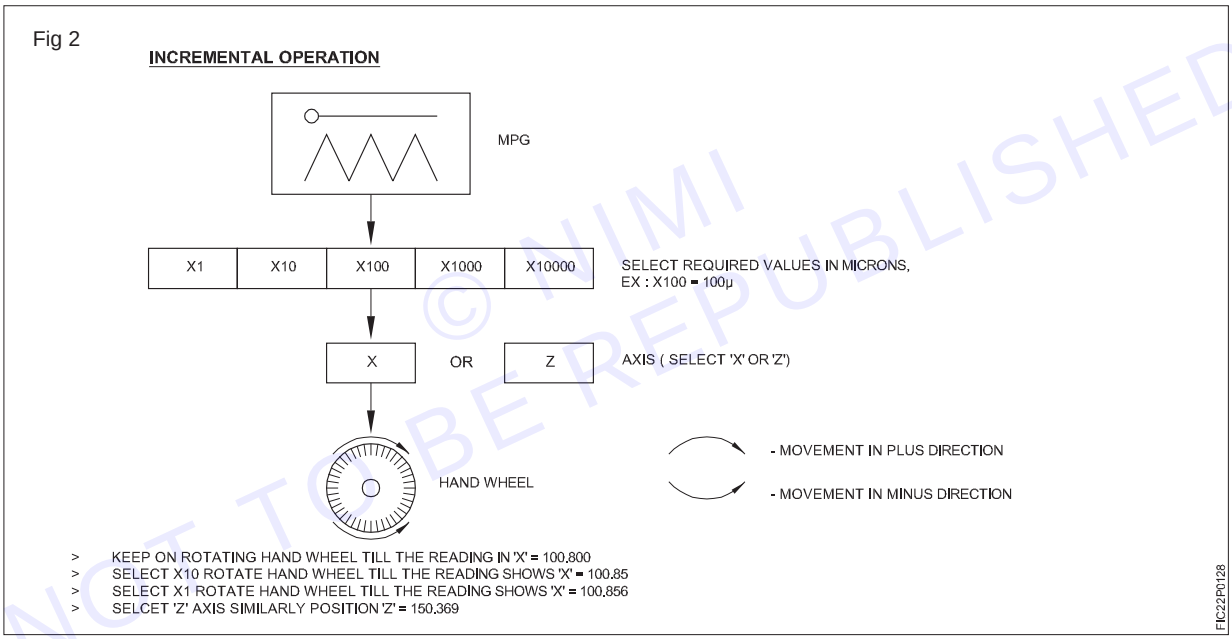


Fig 2

INCREMENTAL OPERATION

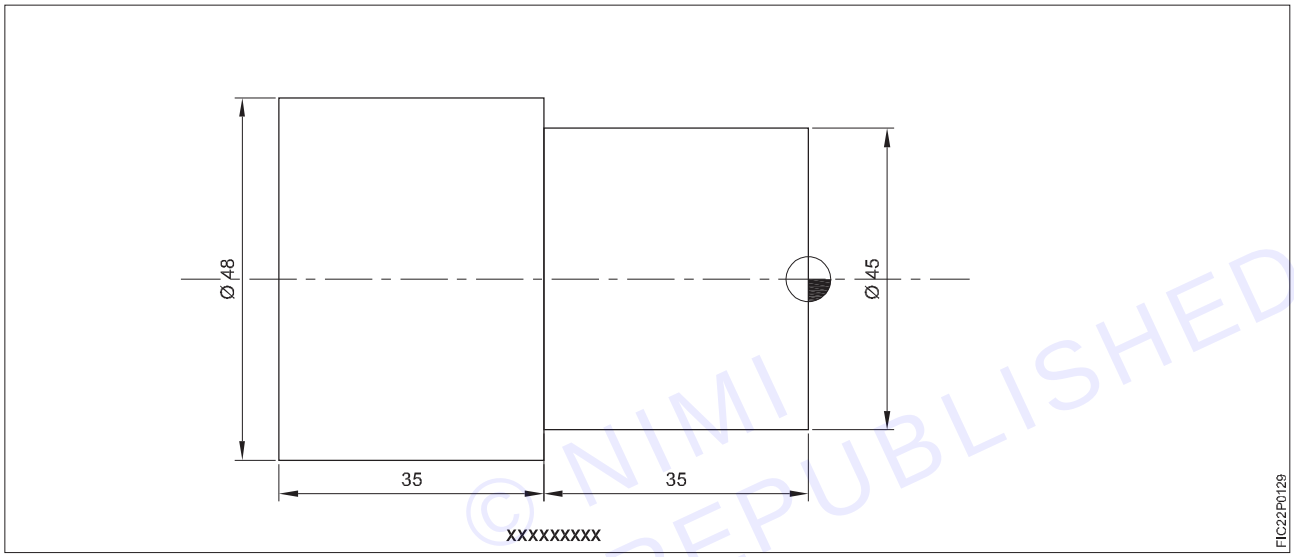


EXERCISE 57 : Facing and turning program

Objectives

At the end of this exercise you shall be able to

- prepare CNC program for the given drawing
- enter the program in CNC simulator using edit mode
- verify the program by simulation on CNC simulator.



Job Sequence

- Write the CNC program for facing operation
- Write the CNC program for plain turning operation.
- Write the CNC program for step turning
- Enter the program in CNC simulator using edit mode
- Verify the program by simulation in simulator

Program (facing and turning)

03001 - program number

N5 G90 G55 G95; - preparatory functions

N10 T0505 M04; - Tool change with spindle on ccw

N15 G00 X52.00 Z0.00; - Positioning for facing

N20 G01 X-0.1 Z0.00 F0.1;

M25 G00 X48.00 Z5.00;

N30 G01 X48.00 Z -70.00;

N35 G01 X52.00 Z-70.00;

N40 G00 X52.00 Z2.00;

N45 G00 X45.00 Z2.00;

N50 G01 X45.00 Z - 35.00;

N55 G01 X49.00 Z 35.00

N60 G00 X100 Z100;

N65 G28 G91 X0.00 Y0.00 T0500 M05;

N70 M90;

N75 M30;

Tool path shown in Fig 1.

SIEMENS CNC SIMILATION PROGRAM,

N10 G54 G90 G95

N15 WORKPIECE(,,, “SYLINDER”, 0,0,-100,-80,50)

N20 T= “FINISHING_T35A”

N25 M04 S500

N30 G00 X52.0 Z0.0

N35 G01 X-0.1 Z0.0 F0.1

N40 G00 X48.0 Z2.0

N45 G01 X48 Z-70

N50 G01 X52 Z-70

N55 G00 X52 Z2.0

N60 G00X45 Z2.0

N65 G01X45.0Z-35.0

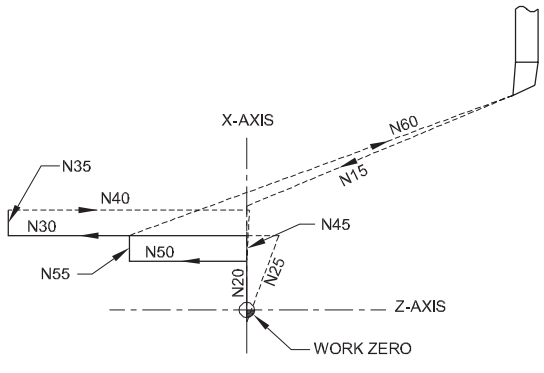
N70 G01 X49.0 Z -35.0

N75 G00 X100 Z100

N80 M05

N85 M30

Fig 1



Skill Sequence

Enter CNC program in edit mode

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

- enter the programme in fanue control.

Fanuc control
Go to JOG mode
↓
Press part program
↓
Press edit
↓
Enter % and new program number of job
↓
Press Select program
↓
(blank space open for entry of program)
↓
Write program using numerical key and edit key

Mounting Jaws to suit the part holding area on CNC machine

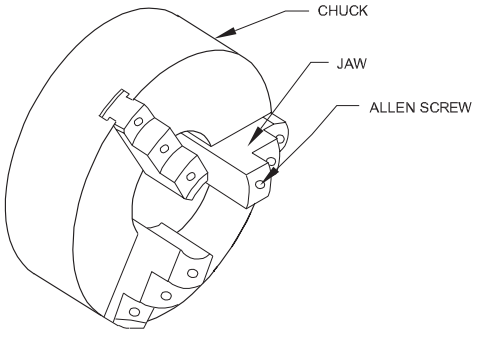
Objectives : At the end of this exercise you shall be able to

- remove the jaw and reload it
- check the concentricity with dial test indicator.

Job Sequence

- Loosen allen screws of all the three jaws
- Count the number of serration radially outwards
- Leave equal number of serration (rack) outwards and hold jaws firmly
- Ensure the space slightly higher than the diameter of job
- Tighten the allen screw using suitable allen key.
- Check the clamping of job.

Fig 1

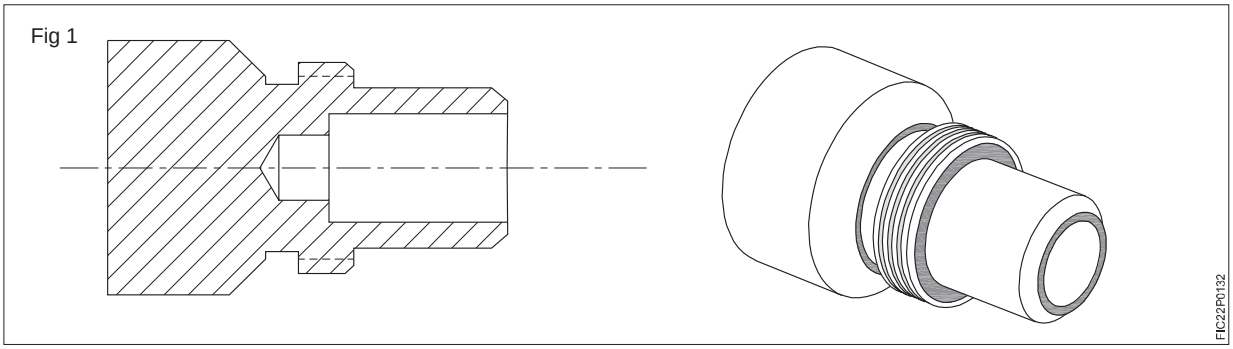


Mounting tools on the turret according to part & process required

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

- prepare tooling sheet as per part drawing
- select suitable insert and its holder
- assemble the tool assembly in turret.

Fig 1



Job Sequence

- Read the job drawing and list out the turning operation and arrange the operation simple to complex
- Prepare the tooling sheet as per the operation including insert and tool holder example as in chart 1

CHART 1

PART NO		DATE	
PART NAME		PROGRAMMER:	
MACHINE: CNC LATHE		MATERIAL / ALUMINUM	
SEQ	**OPERATION**	**TOOL**	**STATION**
1	FACING (ROUGH)	CNMG-432 INSERT, 30 GRADE DCLN HOLDER, -5°, RH, 1" X 1"X6" LONG	1
2	O.D TURNING (ROUGH)	CNMG-432 INSERT, 30 GRADE DCLN HOLDER, -5°, RH, 1"X1"X6" LONG	1
3	O.D TURNING (FINISH)	VNMG -432 INSERT DVJN HOLDER,-3°, RH, 1"X1"X6" LONG	2
4	O.D GROOVING	GROOVING INSERT, SEAT SIZE 3, CUTTING WIDTH 0.125" MIN TO 0.187" MAX CUTOFF/GROOVING HOLDER, SEAT SIZE 3 75"X. 75"X 5" LONG	3
5	O.D THREADING	TRIANGLE LAY DOWN INSERT , 60° 8 TPI EXTERNAL THREAD HOLDER, RH , 75" x75" X4" L	4
6	DRILLING	5/8 DIAMETER HSS TWIST DRILL NUMBER 35 DOVETAIL CHUCH HOLDER	5
7	BORING (ROUGH)	DPGT-211 55° INSERT SDUP HOLDER, STEEL, RH, ∅3/8" SHANK X 6" LONG, 0.6" MIN BORE DIAMETER	6
8	BORING (FINISH)	DPGT-211 55° INSERT SDUP HOLDER, CARBIDE, RH, ∅3/8 SHANK X6" LONG, 0.6" MIN BORE DIAMETER	7

Fix insert in the appropriate tool holder (Fig 1)

- Fix tool holder shank in respective tool holder for turret supplied along with the machine. (Fig 2)
- Insert the turret tool holder assemble in the turret, alining rack matching with internal rack in turret and butting against the turret.
- Clamp the tool holder assembly with suitable allenkey.
- Simillary assemble and mount the external turning tool in turret as shown in Fig 3, asper tooling sheet.
- For internal boring operation
- Select appropriate boring insert and it box bar (Fig 4)
- Select suitable sleeve(Fig 5) and tighten it
- Insert the boring bar in Fig 6 and tighten it
- Mount the assembly in the tu`rret
- For centre drilling and drilling operation select correct size tool asper drawing assemble Fig 7 in turret and Fig 8 in holder and Fig 9 in drill chuck.

Fig 1

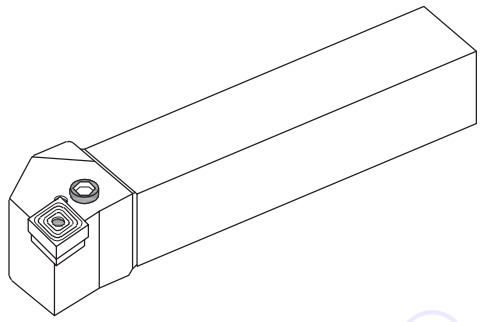


Fig 2

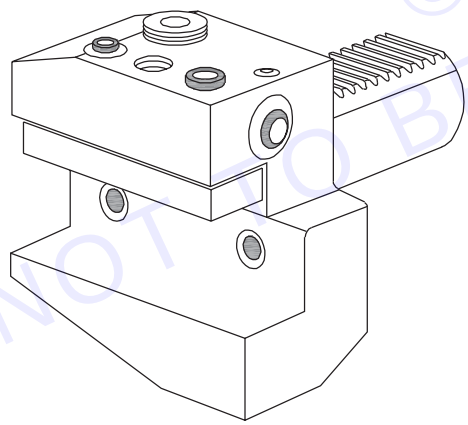


Fig 3

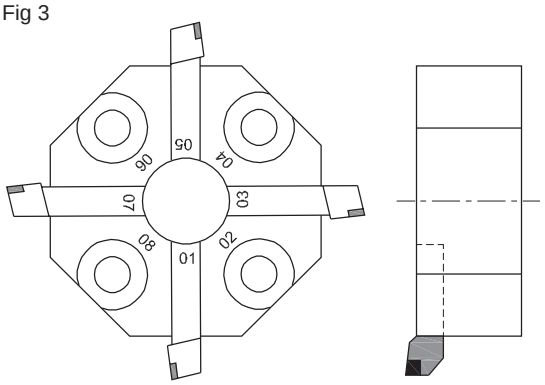


Fig 4

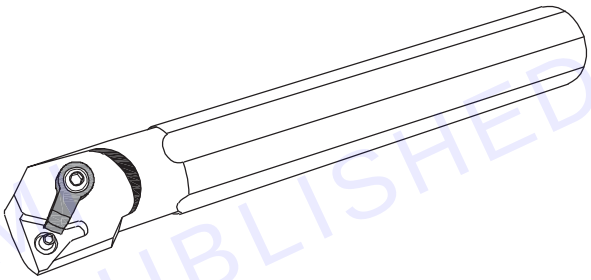


Fig 5

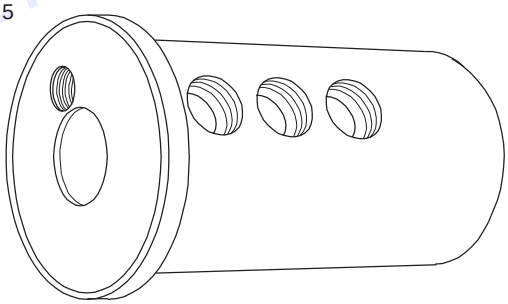


Fig 6

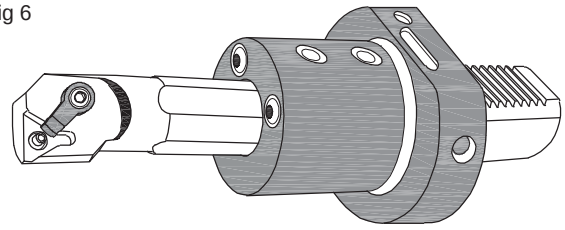


Fig 7

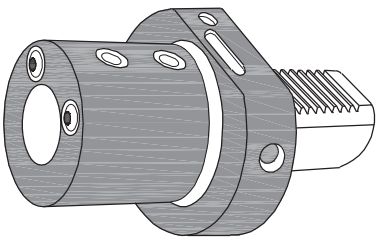


Fig 8

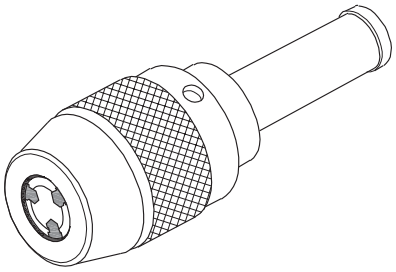
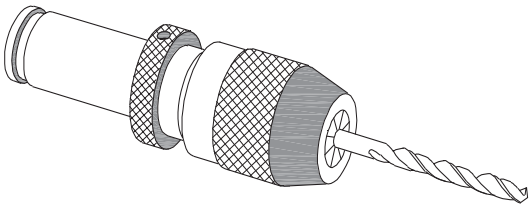


Fig 9



Perform work and tool setting

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

- set the work co-ordinate system
- set the tool with respect to the work co-ordinate system
- set the live tool datum.

Procedure

TASK 1: **Work co-ordinate setting on the face of chuck (Fig1)**

- Set the work piece zero at the chuck face

The work piece will be in 1st quardrant that is z and x values in positive. Generally fixtures are fitted on the face of the jaw.

- Work co-ordinate on face of jaw (Fig 2)
- Set the work piece on the face of the jaw as shown in Fig 2.
- In this case the x zero and z zero is work piece seating side is/or in the face of jaw
- Work piece coordinate on front face (Fig 3)
- Set the work piece zero as shown in Fig 3
- In this case the work piece in second quardrant, that is x is positive z axis is negative

Fig 1

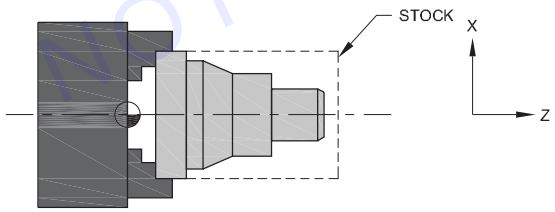


Fig 2

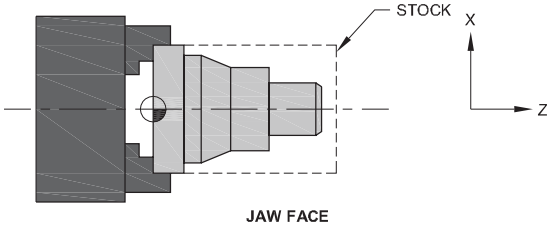
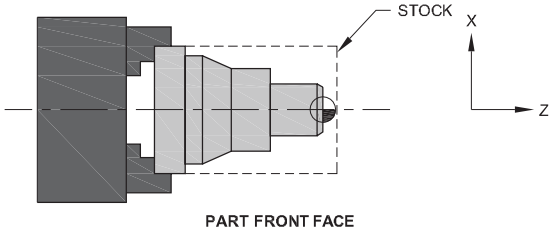


Fig 3



TASK 2 : **Tool reference point and commanding point**

- Turret reference point in relation to the work co-ordinate system is shown in Fig 1
- Tool reference point in relation to the turret reference point is shown in Fig 2
- X=tool length in x axis from reference point.
- Z=tool length in z axis from reference point.
- P =commanding point on tool in relation to the work coordinate system
- Measure x and z distance and enter in tool offset page, then 'p' will become commanding point

Measurement of tool offset differ control to control, the above if methods is sinumeric control.

- For various tool the commanding point are shown in Fig 3
- For tools such as drill and other point to point tool used in milling or turning the reference point is always the extreme tip of the tool measured along z axis . x will always zero (Fig 4)
- Measure the tool centre distance from the machine centre in x axis and that will be x axis tool offset.
- Measure the distance from the reference point and the tool tip in z and that is tool offset in z axis
- For boring tool measure the distance from machine centre to the boring to tool tip that is x axis tool offset
- Similarly measure the length from the reference point to tool the in z direction. That is the tool offset in z direction as shown in Fig 5

Fig 1

M = MACHINE ZERO POINT. (UNCHANGEABLE REF. POINT DETERMINED BY MACHINE MANUFACTURER)
N = TOOL MOUNTING REFERNCE POINT.
W = WORK PIECE ZERO POINT. (CAN BE FREELY DETERMINED BY THE PROGRAMMER AND CAN BE MOVED WITHIN PROGRAM

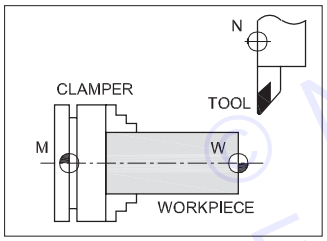


Fig 2

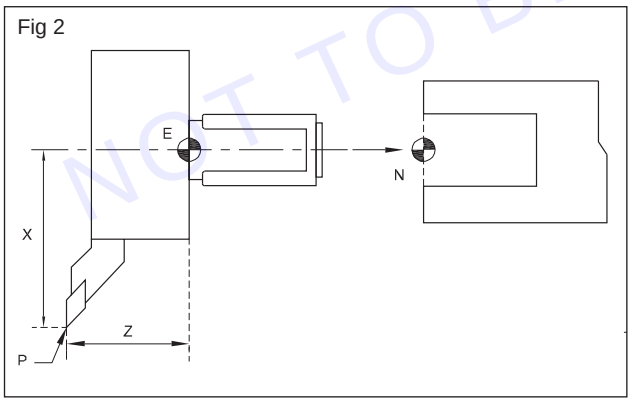


Fig 3

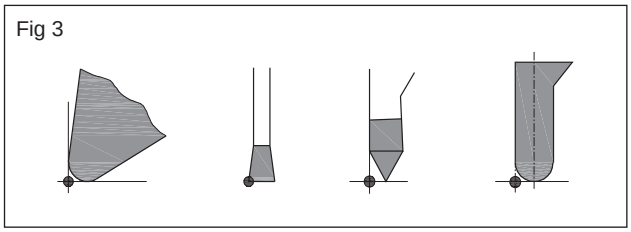


Fig 4

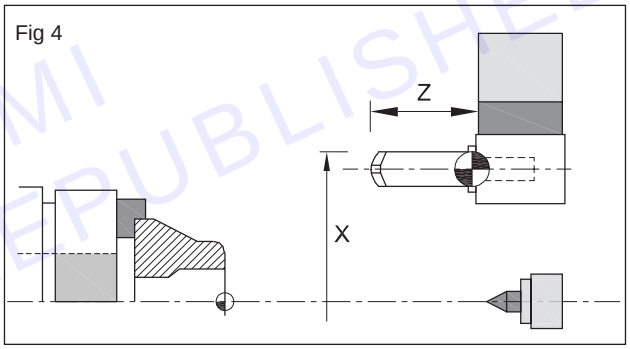
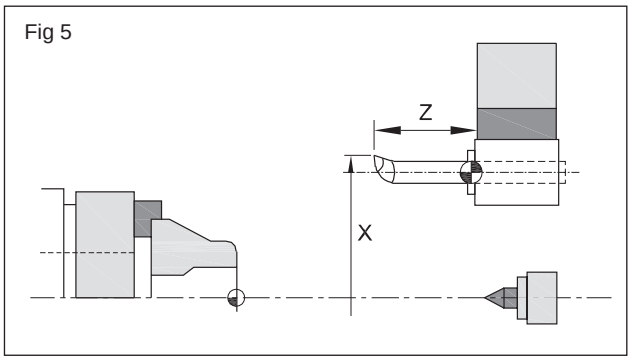


Fig 5



CNC turning centre operation in various modes (JOG, MDI, MPG & AUTO Mode)

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

- measurement work offset values in z and x axis
- measure the tool offset values in x and z axis.

Job Sequence

TASK 1: **Measurement of work offset (Fig1)**

Ensure the work secured firmly in chuck

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

Switch 'ON' spindle

Carry out slight facing of the job

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

Now switch off spindle

Go to Tool off set mode

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

Enter the Z-axis valveZ0.0

Press soft key

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

Do not disturb X-axis

Take tool away in Z-direction only

Stop the spindle

Measure the outer diameter of the job using micrometer

Go to OFFSET soft key

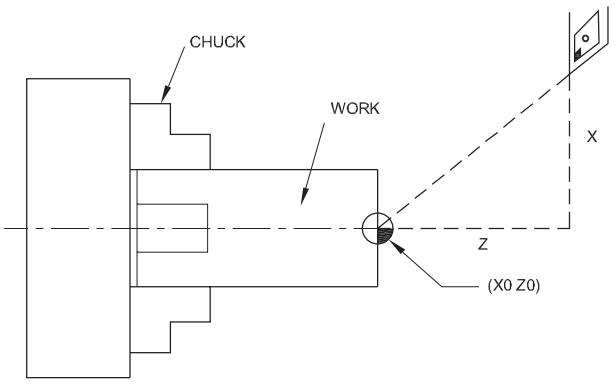
Press GEOM soft key

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

Press soft key

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

Fig 1



TASK 2 : **Tool offset measurement (Fig 1) in fanuc control**

X axis tool offset method

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

Clamp job in chuck.

Select MDI mode. Press in MDI prog-screen.

Enter tool number: T0200 (Turning tool).

Press insert button, Press cycle start button.

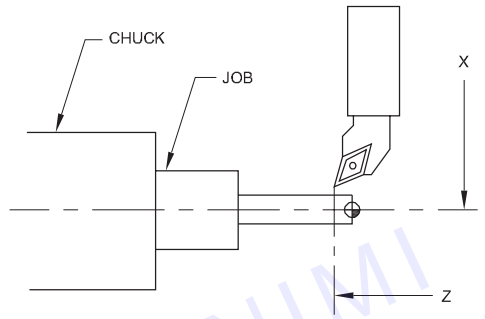
Tool cutting edge position with spindle ON CW or CCW in MDI mode.

Enter MO3 SI500 Press reset button, Press cycle start button.

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

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

Fig 1



TOOL OFFSET METHOD

FIC22P0141

Measure the outside diameter.

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

Enter job diameter

Ex: x28.62 Press measure button in soft key

Now tool cutting edge in job centre is OK.

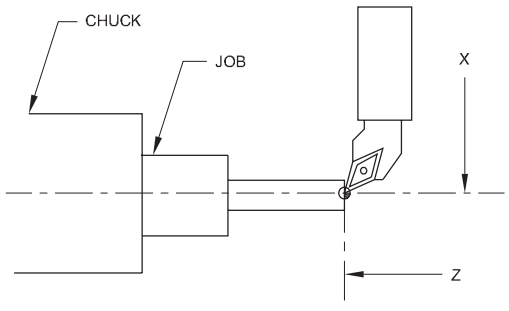
Tool offset in X axis is saved

Z axis offset method

Spindle ON rotate the job.

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

Fig 2



Z AXIS OFFSET METHOD

FIC22P0142

Select offset button press in geomentry mode.

Use cursor select tool no 2 and z axis.

Enter Z0.

Enter Z0 press Measure in soft key

Now z axis tool offset OK.

Tool offset is Z axis is saved

Second tool offset

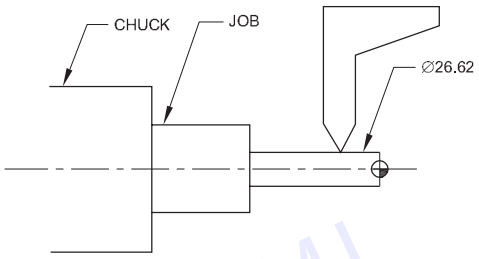
Select MDI mode Press MDI Prog Screen.

Enter tool no (Threading tool) T0300 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 distrub X axis (Fig 3).

Fig 3



Z AXIS OFFSET METHOD

Select offset button press in geomentry mode.

Use cursor to select tool no 3 and x axis.

Enter constant same dia.

Ex: x28.62 Press Measure button in soft key

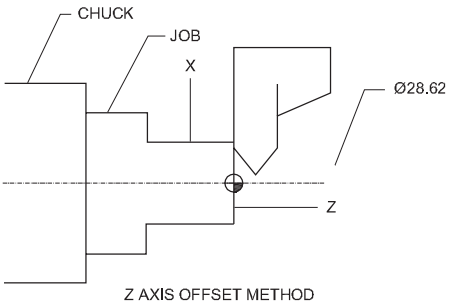
Threading tool offset measurement

Z axis offset

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

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

Fig 4



Z AXIS OFFSET METHOD

Select offset button in geomentry mode.

To use cursor select tool no 3 and z axis.

Enter Z0.

Ex : Z0 Press Measure in soft key

Now second tool z axis offset saved.

Internal drilling tool x axis offset method

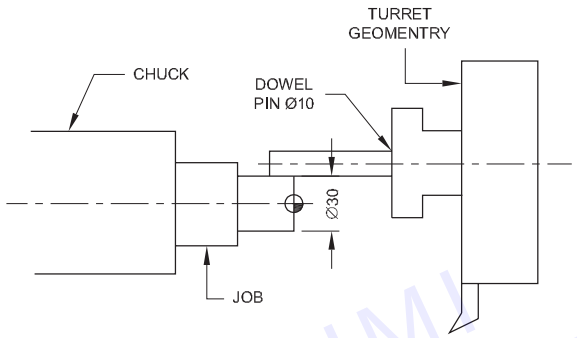
Fix the turned job in chuck

Select MDI mode press enter tool no T0400 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)

Fig 5



DIAMETER OF JOB + DIAMETER OF DOWEL PIN = TOTAL DIA
INTERNAL DRILLING TOOL X AXIS OFFSET METHOD

Select offset screen in geomentry mode.

Use cursor to select x mode and tool number.

Enter dia.

Ex : Job dia + Dowel pin dia = Total dia

30 + 10 = 40

Enter dia x40 Press Measure button in soft key

Drill cutting point in job centre point.

Then fix the drill.

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

Enter Z0 Press Measure in soft key

Drilling tool off set is saved

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

Entering the tool offset, tool nose radius and orientation for TNRC in offset page on CNC simulator

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

- identify the tool offset page
- enter tool data in offset page.

Job Sequence

- Press function key OFFSET SETTING.
- Press chapter selection soft key [OFFSET] or press OFFSET SETTING several times until the tool compensation screen is displayed.
- Pressing soft key [GEOM] displays tool geometry compensation values as in Fig 1.
- Pressing soft key [WEAR] displays tool wear compensation values. (Fig 2)

Fig 1

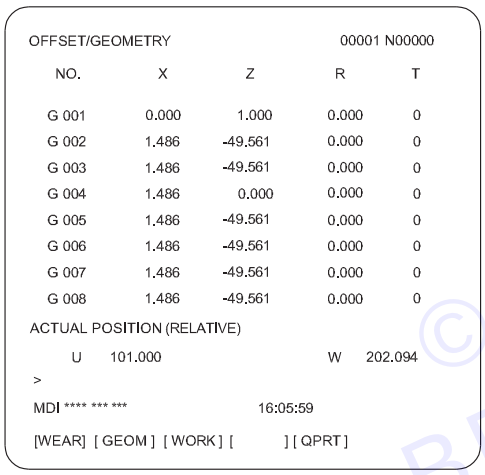
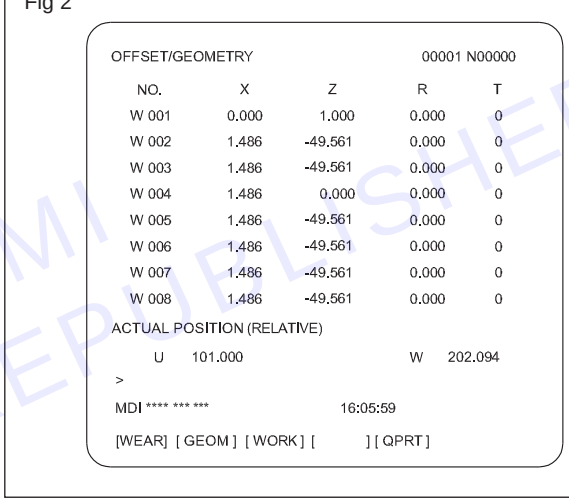


Fig 2



- Move the cursor to the compensation value to be set or changed using page keys and cursor keys, or enter the compensation number for the compensation value to be set or changed and press soft key [NO.SRH].
- To set a compensation value, enter a value and press soft key [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 soft key [+INPUT]. Or, enter a new value and press soft key [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.

Note:A decimal point can be used when entering a compensation value.

Procedure for entering tool offset data in CNC simulator and on machine will be same.

- Dimensions and annotations (2 methods): Select the import (Show model annotations) dimensions used to create the model
- Create (New reference) dimentsions (Note: reference dimensions cannot be changed) (Fig 3)
- When importing dimensions try using the feature/view option versus inserting all the dimesnions for the mode as it will cluster all them togerther. Feature helps reduce the cluster and yet the dimensions are editable, providing the benfit to edit the actual parts and assemblies in a bi-directional fashion from the drawing.
- Editing the sheet: Use the “Note” tool to enter your name and part number. (Fig 4)

Fig 3

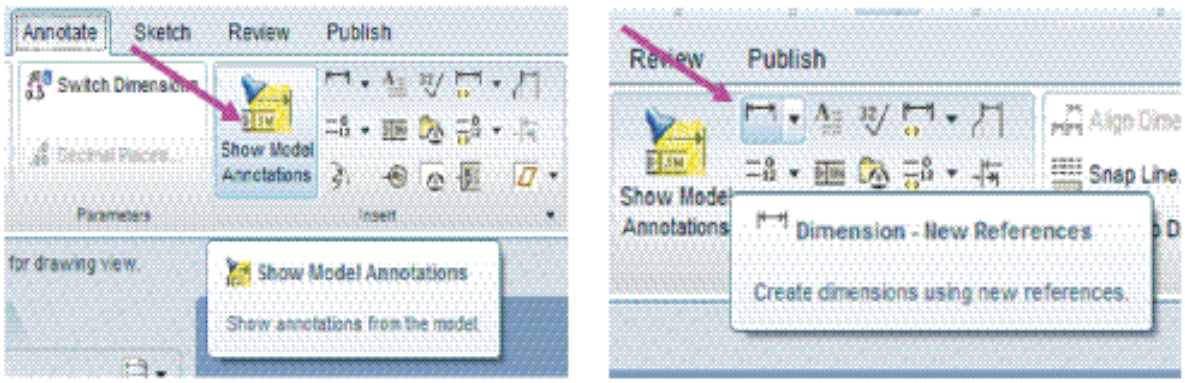
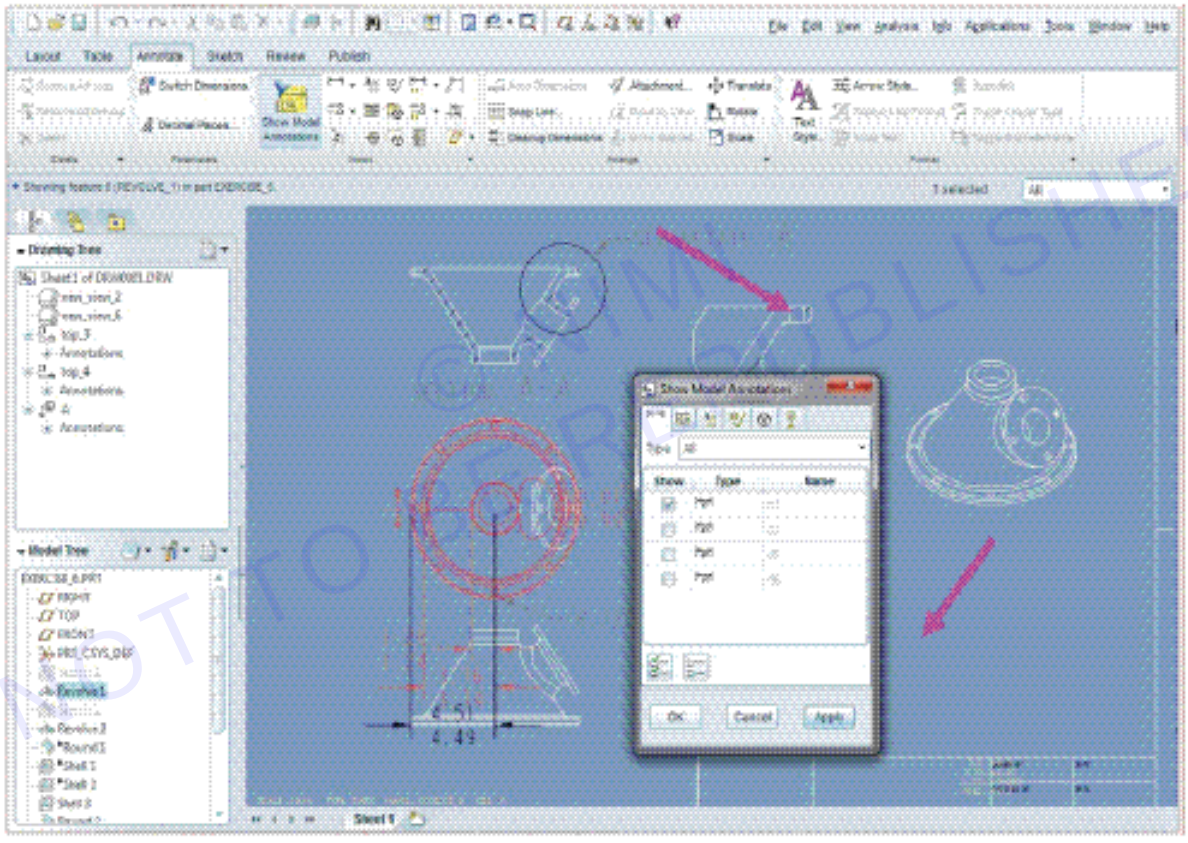


Fig 4



Skill Sequence

Direct input of tool offset value

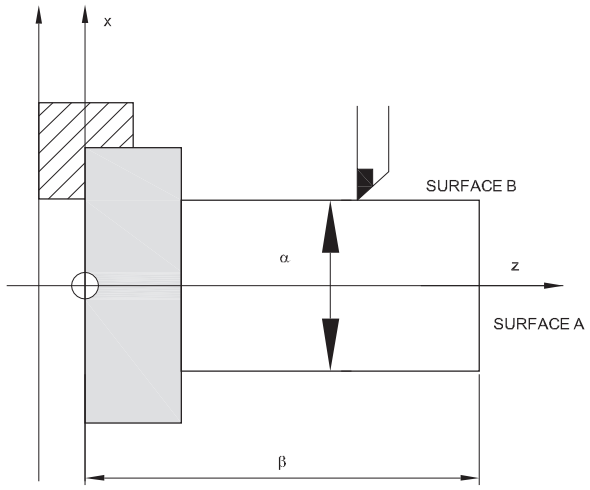
Objectives : At the end of this exercise you shall be able to

- measure and direct input tool datas.

Setting of Z axis offset value

- Cut surface A in manual mode with an actual tool. Suppose that a workpiece coordinate system has been set. (Fig 1)

Fig 1



- Release the tool in X axis direction only, without moving Z axis and stop the spindle.
- Measure distance B from the zero point in the workpiece coordinate system to surface A.
- Set this value as the measured value along the Z–axis for the desired offset number, using the following procedure. (Fig 2)

Fig 2

OFFSET/GEOMETRY 00001 N00000

NO.	X	Z	R	T
G 001	0.000	1.000	0.000	0
G 002	1.486	-49.561	0.000	0
G 003	1.486	-49.561	0.000	0
G 004	1.486	0.000	0.000	0
G 005	1.486	-49.561	0.000	0
G 006	1.486	-49.561	0.000	0
G 007	1.486	-49.561	0.000	0
G 008	1.486	-49.561	0.000	0

ACTUAL POSITION (RELATIVE)

U 0.000 W 0.000

V 0.000 H 0.000

>MZ120.

MDI **** *** *** 16:05:59

[NO,SRH] [MEASUR] [INP.C.] [+INPUT] [INPUT]

- Press the function key OFFSET SETTING or the soft key [OFFSET] to display the tool compensation screen. If geometry compensation values and wear compensation values are separately specified, display the screen for either of them.
- Move the cursor to the set offset number using cursor keys.
- Press the address key Z to be set.
- Key in the measured value (b).
- Press the soft key [MESURE].
- The difference between measured value â and the coordinate is set as the offset value.

Setting of X axis offset value.

- Cut surface B in manual mode.

- Release the tool in the Z–axis direction without moving the X–axis and stop the spindle.
- Measure the diameter á of surface B. Set this value as the measured value along the X–axis for the desired offset number in the same way as when setting the value along the Z–axis.
- Repeat above procedure for other necessary tools. The offset value is automatically calculated and set.
- For example, in case a=69.0 when the coordinate value of surface B in the diagram above is 70.0, set 69.0 [MEASURE] at offset No.2.
- In this case, 1.0 is set as the X–axis offset value to offset No.2.

Compensation values for a program created in diameter programming

Enter diameter values for the compensation values for axes for which diameter programming is used.

Tool geometry offset value and tool wear offset value.

If measured values are set on the tool geometry compensation screen, all compensation values become geometry compensation values and all wear compensation values are set to 0. If measured values are set on the tool wear compensation screen, the differences between the measured compensation values and the current wear compensation values become the new compensation values.

Program checking in dry run single block mode

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

- load the program to run in auto mode operation
- check the program in dry run using single block mode.

Job Sequence

- Load the program to run in auto mode operation
- Keep the feed rate and rapid knobs to zero position.
- Press cycle start
- Press dry run and single block mode
- 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 executeive next block.
- Similarly continued until the end of program that is M30;

Skill Sequence

Running program in auto mode/memory operation

Objectives : At the end of this exercise you shall be able 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 O
- Enter a program number using the numeric keys.
- Press the [O SRH] soft key.
- 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.

Dry run and single block mode

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

- run the program in dry run mode and single block mode.

Dry run

The tools is moved at the federate specified by a parameter regardless of the federate specified in the program. This function is used for checking the movement of the tool under the state that the workpiece is removed from the table.

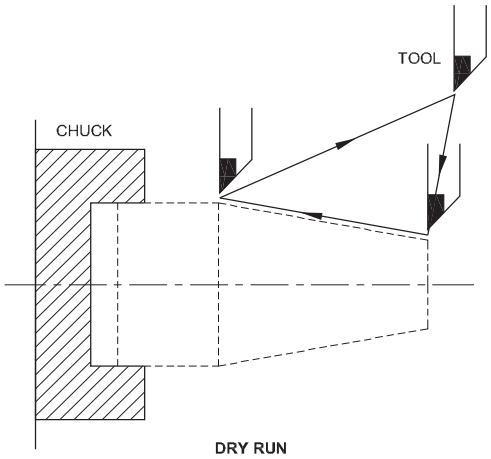
Steps for dry run operation (Fig 1)

- Load the program
- Select auto mode operation
- Press the dry run switch on the machine operator's panel during automatic/memory operation.
- Press cycle start. The tool moves at the feed rate specified in a parameter.
- Rapid traverse switch can also be used for changing the feed rate.

Single block operation

Pressing the single block switch, starts the single block mode. When the cycle start button is pressed in the single block mode, the tool stops after a single block in the program is executed. Check the program in the single block mode by executing the program block by block.

Fig 1



Steps for single block (Fig 2)

Press the single block switch on the machine operator's panel. The execution of the program is stopped after the current block is executed.

Press the cycle start button to execute the next block. The tool stops after the block is executed.

Refer to the appropriate manual provided by the machine tool builder for single block execution.

Fig 2