WELDER
(GMAW & GTAW)

NSQF LEVEL - 3

TRADE PRACTICAL

SECTOR: CAPITAL GOODS AND MANUFACTURING

(As per revised syllabus July 2022 - 1200 Hrs)

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Directorate General of Training

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

NATIONAL INSTRUCTIONAL MEDIA INSTITUTE, CHENNAI

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

Sector : Capital Goods and Manufacturing

Duration : 1 Year

Trades : Welder (GMAW & GTAW) - Trade Practical - NSQF Level - 3 (Revised 2022)

Developed & Published by

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FOREWORD

The Government of India has set an ambitious target of imparting skills to 30 crores people, one out of every four Indians, to help them secure jobs as part of the National Skills Development Policy. Industrial Training Institutes (ITIs) play a vital role in this process especially in terms of providing skilled manpower. Keeping this in mind, and for providing the current industry relevant skill training to Trainees, ITI syllabus has been recently updated with the help of Media Development Committee members of various stakeholders viz. Industries, Entrepreneurs, Academicians and representatives from ITIs.

The National Instructional Media Institute (NIMI), Chennai, has now come up with instructional material to suit the revised curriculum for **Welder (GMAW & GTAW) - Trade Practical** in **CG & M Sector** under **Yearly Pattern.** The NSQF Level - 3 (Revised 2022) Trade Practical will help the trainees to get an international equivalency standard where their skill proficiency and competency will be duly recognized across the globe and this will also increase the scope of recognition of prior learning. NSQF Level - 3 (Revised 2022) trainees will also get the opportunities to promote life long learning and skill development. I have no doubt that with NSQF Level - 3 (Revised 2022) the trainers and trainees of ITIs, and all stakeholders will derive maximum benefits from these Instructional Media Packages IMPs and that NIMI's effort will go a long way in improving the quality of Vocational training in the country.

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

Jai Hind

Director General (Training)
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PREFACE

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

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

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

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

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

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

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

Chennai - 600 032 **EXECUTIVE DIRECTOR**

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ACKNOWLEDGEMENT

National Instructional Media Institute (NIMI) sincerely acknowledges with thanks for the co-operation and contribution extended by the following Media Developers and their sponsoring organisation to bring out this IMP for the trade of **Welder (GMAW & GTAW) - Trade Practical - NSQF Level - 3 (Revised 2022)** under the **CG & M** Sector for ITIs.

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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.

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INTRODUCTION

TRADE PRACTICAL

The trade practical manual is intended to be used in practical workshop. It consists of a series of practical exercises to be completed by the trainees during the course. These exercises are designed to ensure that all the skills in compliance with NSQF Level - 3 (Revised 2022) syllabus are covered.

The manual is divided into Six modules.

Module 1	-	**Induction Training & Welding Process**
Module 2	-	**Welding Techniques**
Module 3	-	**Weldability of Steel**
Module 4	-	**Gas Metal Arc Welding**
Module 5	-	**Gas Tungsten Arc Welding**
Module 6	-	**Pipe Joints & Inspection**

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

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

TRADE THEORY

The manual of trade theory consists of theoretical information for the Course of the **Welder (GMAW & GTAW)** - Trade Theory - NSQF Level - 3 (Revised 2022) in **CG & M**. The contents are sequenced according to the practical exercise contained in NSQF Level - 3 (Revised 2022) syllabus on Trade Theory attempt has been made to relate the theoretical aspects with the skill covered in each exercise to the extent possible. This correlation is maintained to help the trainees to develop the perceptional capabilities for performing the skills.

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

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

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

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CONTENTS

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LEARNING / ASSESSABLE OUTCOME

On completion of this book you shall be able to

S.No.	Learning Outcome	Ref. Ex.No.
1	Perform joining of MS sheet by Gas welding in different positions following safety precautions. (NOS: CSC/N0204)	1.1.01 - 1.1.06
2	Join MS plates by SMAW in different positions. (Mapped NOS: CSC/N0204)	1.1.07 - 1.1.09
3	Perform straight, bevel & circular cutting on MS plate by Oxy-acetylene cutting process. (Mapped NOS: CSC/N0201)	1.2.10 - 1.2.32
4	Perform different types of MS pipe joints by Gas welding (OAW). (NOS: CSC/N0204)	1.3.33 - 1.3.38
5	Weld different types of MS pipe joints by SMAW. (Mapped NOS: CSC/N0204)	1.3.39 - 1.3.46
6	Setup GMAW / GTAW plant and weld M.S, S.S and Aluminium sheets in all positions. (Mapped NOS: CSC/N0212)	1.3.47 - 1.3.49
7	Perform Arc gauging on MS plate. (NOS: CSC/N0204)	1.3.50 - 1.3.52
8	Join MS/ Aluminium /SS sheets/plates by GMAW in various positions using different modes of metal transfer. (Mapped NOS: CSC/N0209)	1.3.53 - 1.3.54
9	Using of mixed shielding gas for GMAW welding. (NOS: CSC/N0204)	1.4.55 - 1.4.66
10	Welding of metals by FCAW process. (Mapped NOS: CSC/N0205)	1.4.67 - 1.4.70
11	Join Aluminum & Stainless-Steel sheets by GTAW in different position. (Mapped NOS: CSC/N0212)	1.5.71- 1.5.90
12	Weld pipe joints by GTAW. (Mapped NOS: CSC/N0212)	1.6.91 - 1.6.94
13	Cut ferrous and nonferrous metal using plasma Arc cutting. (Mapped NOS: CSC/N0207)	1.6.95 - 1.6.97
14	Test welded joint by visual inspection Dye penetrant & Magnetic particle testing methods. (Mapped NOS: CSC/N0204)	1.6.98 - 1.6.99

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SYLLABUS

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
Professional Skill 43Hrs; Professional Knowledge 08 Hrs	Perform joining of MS sheet by Gas welding in different positions following safety precautions. (NOS: CSC/N0204)	**Induction training:** 1. Familiarization with the Institute. 2. Importance of trade Training. 3. Machinery used in the trade. Introduction to safety equipment and their use etc. 4. Hack sawing, filing square to dimensions. Markin	- General discipline in the Institute - Elementary First Aid. - Importance of Welding in Industry - Safety precautions in Shielded Metal Arc Welding, and Oxy- Acetylene Welding and Cutting.
		5. Setting up of Arc welding machine & accessories and striking an arc. 6. Setting of oxy-acetylene welding equipment, Lighting and setting of flame.	- Introduction and definition of welding. - Arc and Gas Welding Equipments, tools and accessories. - Various Welding Processes and its applications. - Arc and Gas Welding terms and definitions.
Professional Skill 23Hrs; Professional Knowledge 04 Hrs	Join MS plates by SMAW in different positions. (Mapped NOS: CSC/N0204)	7. Fusion run without and with filler rod on M.S. sheet 2 mm thick in flat position. 8. Edge joint on MS sheet 2 mm thick in flat position without filler rod. 9. Marking and straight line cutting of MS plate. 10 mm thick by gas.	- Different process of metal joining methods: Bolting, riveting, soldering, brazing, seaming etc. - Types of welding joints and its applications. Edge preparation and fit up for different thickness. - Surface Cleaning
Professional Skill 164Hrs; Professional Knowledge 32 Hrs	Perform straight, bevel & circular cutting on MS plate by Oxy-acetylene cutting process.(Mapped NOS: CSC/N0201)	10. Straight line beads on M.S. plate 10 mm thick in flat position. 11. Weaved bead on M. S plate 10mm thick in flat position.	- Basic electricity applicable to arc welding and related electrical terms & definitions. - Heat and temperature and its terms related to welding - Principle of arc welding. And characteristics of arc.
		12. Square butt joint on M.S. sheet 2 mm thick in flat Position. 13. Fillet "T" joint on M. S. Plate 10 mm thick in flat position.	- Common gases used for welding & cutting, flame temperatures and uses. - Types of oxy-acetylene flames and uses. - Oxy-Acetylene Cutting Equipment principle, parameters and application.
		14. Beveling of MS plates 10 mm thick. By gas cutting. 15. Open corner joint on MS sheet 2 mm thick in flat Position. 16. Fillet lap joint on M.S. plate 10 mm thick in flat position.	- Arc welding power sources: Transformer, Rectifier and Inverter type welding machines and its care & maintenance. - Advantages and disadvantages of A.C. and D.C. welding machines.
		17. Chair fabrication without hand rest, with square pipe of 25mm width 1 mm (GMAW/GTAW welding machine)	- Welding positions as per EN & ASME: flat, horizontal, vertical and over head position. - Weld slope and rotation. - Welding symbols as per BIS & AWS.

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Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
		18. Fillet "T" joint on M S she et 2 mm thick in flat position. 19. Open Corner joint on MS plate 10 mm thick in flat position. 20. Fillet Lap joint on MS sheet 2 mm thick in flat position. 21. Single "V" Butt joint on M S plate 12 mm thick in flat position (1G).	- Arc length - types - effects of arc length. - Polarity: Types and applications.
		22. Square Butt joint on M.S. sheet. 2 mm thick in Horizontal position. 23. Straight line beads and multi layer practice on M.S. Plate 10 mm thick in Horizontal position. 24. Fillet "T" 10 mm thick in Horizontal position.	- Calcium carbide uses and hazards. - Acetylene gas properties. - Acetylene gas Flash back arrestor
		25. Fillet Lap joint on M.S. sheet 2 mm thick in horizontal position. 26. Fillet Lap joint on M.S. plate 10 mm thick in horizontal position.	- Oxygen gas and its properties - Charging process of oxygen and acetylene gases - Oxygen and Dissolved Acetylene gas cylinders and Color coding for different gas cylinders. - Uses of Single stage and double stage Gas regulators.
		27. Fusion run with filler rod in vertical position on 2mm thick M.S. sheet. 28. Square Butt joint on M.S. sheet. 2 mm thick in vertical position. 29. Single Vee Butt joint on M.S. plate 12 mm thick in horizontal position (2G).	- Oxy acetylene gas welding Systems (Low pressure and High pressure). Difference between gas welding blow pipe(LP & HP) and gas cutting blow pipe - Gas welding techniques. Rightward and Leftward techniques.
		30. Small tool fabrication with 25mm square pipe of Width iMM& dimension 12*9*9 inch. (G M A W / GTAW process). 31. Fillet "T" joint on M.S sheet 2 mm thick in vertical position. 32. Fillet "T" 10 mm thick invertical position.	- Arc blow - causes and methods of controlling. - Distortion in arc & gas welding and methods employed to minimize distortion - Arc Welding defects, causes and Remedies.
Professional Skill 54Hrs; Professional Knowledge 12 Hrs	Perform different types of MS pipe joints by Gas welding (OAW). (NOS: CSC/N0204)	33. Structural pipe welding butt joint on MS pipe 0 50 and 3mm WT in 1G position. 34. Fillet Lap joint on M.S. Plate 10 mm in vertical position.	- Specification of pipes, various types of pipe joints, pipe welding positions, and procedure. - Difference between pipe welding and plate welding.
		35. Open Corner joint on MS plate 10 mm thick in vertical position. 36. Pipe welding - Elbow joint on MS pipe 0-50 and 3mm WT. 37. Pipe welding "T" joint on MS pipe 0 - 50 and 3mm WT. 38. Single "V" Butt joint on M S plate 12 mm thick in vertical position (3G).	- Pipe development for Elbow joint, "T" joint, Y joint and branch joint - Uses of Manifold system - Gas welding filler rods, specifications and sizes. - Gas welding fluxes - types and functions. - Gas Brazing &Soldering : principles, types fluxes & uses

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Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
			- Gas welding defects, causes and remedies.
Professional Skill 61Hrs; Professional Knowledge 11 Hrs	Weld different types of MS pipe joints by SMAW. (Mapped NOS: CSC/N0204)	39. Pipe welding 45 ° angle joint on MS pipe 0 - 50 and 3mm WT. 40. Straight line beads on M.S. plate 10mm thick in over head position.	- Electrode : types, functions of flux, coating factor, sizes of electrode. - Effects of moisture pick up. - Storage and baking of electrodes.
		41. Pipe Flange joint on M.S plate with MS pipe 0 - 50 mm X 3mm WT. 42. Fillet "T" 10 mm thick in over head position. 43. Pipe welding butt joint on MS pipe 0 - 50 and 5 mm WT. in 1G position. 44. Fillet Lap joint on M.S. plate 10 mm thick in over head position.	- Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature. - Welding of low, medium and high carbon steel and alloy steels.
		45. Single "V" Butt joint on MS plate 10mm thick in over head position(4G). 46. Pipe butt joint on M. S. pipe 0 - 50mm WT 6mm (1G Rolled).	- Effectsof alloying elements on steel - Stainless steel: types- weld decay and weldability.
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	Setup GMAW / GTAW plant and weld M.S, S.S and Aluminium sheets in all positions. (Mapped NOS: CSC/N0212)	47. Square Butt joint on S.S. sheet. 2 mm thick in flat position. 48. Square Butt joint on S.S. Sheet 2 mm thick in flat position. 49. Square Butt joint on Brass sheet 2 mm thick in flat position.	- Brass - types - properties and welding methods. - Copper - types - properties and welding methods.
Professional Skill 23Hrs; Professional Knowledge 04 Hrs	Perform Arc gauging on MS plate. (NOS: CSC/N0204)	50. Square Butt & Lap joint on M.S. sheet 2 mm thick by brazing. 51. Single "V" butt joint C.I. plate 6mm thick in flat position. 52. Arc gouging on MS plate 10 mm thick.	- Aluminium, properties and weldability, Welding methods - Arc cutting & gouging,
Professional Skill 20Hrs; Professional Knowledge 04 Hrs	Join MS/ Aluminium /SS sheets/plates by GMAW in various positions using different modes of metal transfer. (Mapped NOS: CSC/N0209)	53. Square Butt joint on Aluminium sheet. 3 mm thick in flat position. 54. Bronze welding of cast iron (Single "V" butt joint) 6mm thick plate.	- Cast iron and its properties types. - Welding methods of cast iron.
Professional Skill 107Hrs; Professional Knowledge 22 Hrs	Using of mixed shielding gas for GMAW welding. (NOS: CSC/N0204)	55. Familiarization with the machinery used in the trade. 56. Introduction to safety equipment and their use etc. 57. Setting up of GMAW/GTAW welding machine & accessories.	- Outline of the subjects to be covered. - Safety precautions pertaining to GTAW & GMAW.
		58. Straight line beads on MS plate by GMAW welding. 59. Lap joint on MS plate by GMAW welding in down hand position.	- Introduction to GMAW - equipment - accessories. - Various names of the process.(MIG-MAG/ C O 2 WELDING, FCAW). - Advantages & Limitations.

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Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
		60. Open corner joint on MS plate in down hand position. 61. "T" joint on MS sheet in flat position.	- Power source & accessories Wire Feed unit. - Types of shielding gases &advantages.
		62. "T" joint on MS sheet in horizontal position. 63. "T" joint on MS sheet in vertical position. 64. "T" joint on MS sheet in overhead position.	- Welding Gun & its parts. - Modes of metal transfer - Dip, Globular, spray &pulsed transfer and its significance.
		65. Single "V' butt joint by C02 welding in down hand position. 66. Single "V' butt joint by Argo shield welding in flat position (Gas: Argon and CO_2 mixture).	- Flux cored arc welding. - Welding wire types and specification.
Professional Skill 41Hrs; Professional Knowledge 09 Hrs	Welding of metals by FCAW process. (Mapped NOS: CSC/ N0205)	67. Straight line beads on MS plate by Flux cored Arc welding (FCAW). 68. Single "V' joint by Flux cored Arc welding.	- Trouble shooting in MIG welding. - Data and Tables related to CO2 welding.
		69. Straight line beads on S.S plate by GMAW welding. 70. Lap & Square butt and T joint on S.S. sheet.	- Reading of Welding procedure specifications (WPS). - Reading of Procedure qualification Record (PQR)
Professional Skill 171Hrs; Professional Knowledge 31 Hrs	Join Aluminum & Stainless-Steel sheets by GTAW i n different position. (Mapped N O S : CSC/N0212)	71. Straight line beads on Aluminum plate by GMAW welding. 72. Single "V' and fillet joint on Aluminum plate. 73. Setting up GTAW welding plant and establishing the arc. 74. Beading practice on MS sheet by GTAW. 75. Square butt joint on MS in down hand position.	- Types of weld defects, causes and remedy in GMAW process. - Introduction to GTAW welding - Equipment& accessories. - Advantages & Limitations.
		76. Open corner joint on MS sheet in down hand position. 77. Lap joint on MS sheet in down hand position.)	- Power source - Types, polarity and application -
		78. Tee joint on MS sheet in down hand position.) 79. Lap joint on MS sheet in Horizontal position.	- Tungsten electrode, Types, sizes, and uses. - Type of shielding gases- Types & properties.
		80. Square butt joint on MS sheet in Horizontal position. 81. Square butt joint on MS sheet in Vertical position.	- GTAW Welding consumables - Types & Specifications as per BIS & AWS
		82. Lap & Tee joint on MS sheet in Vertical position. 83. Square butt joint on MS sheet in overhead position.	- Tables & data relating to TIG welding. - Different type of weld joints- plates & pipes.

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Duration	Reference Learning Outcome	Professional Skills (Trade Practical) with Indicative hours	Professional Knowledge (Trade Theory)
		84. Beading practice on SS sheet. 85. Square butt joint on SS sheet by TIG in flat position. 86. Open corner joint on SS sheet by TIG in flat position.	- Edge preparation of plates & pipes. - Fitting of joint plates for TIG Welding.
		87. Square butt joint on SS sheet in Vertical position. 88. Lap joint on SS sheet in vertical position.	- Advantages of root pass welding of pipes by TIG welding
		89. Tee joint on SS sheet in Vertical position. 90. Square butt joint welding of SS sheet with back purging Technique.	- Types of weld defects, causes and remedy in GTAW process.
Professional Skill 64Hrs; Professional Knowledge 12 Hrs	Weld pipe joints by GTAW. (Mapped NOS: CSC/N0212)	91. Beading practice on Aluminium sheet by GTAW. 92. Square butt joint on Aluminium sheet by GTAW in flat position.Open corner joint on Aluminium sheet in flat position.	- Purging: Importance, Method of giving.
		93. Square butt joint on Aluminium sheet in Vertical position.Single V butt joint on Aluminum sheet by TIG.	- Weldability of metals.
		94. Square butt joint on Tube welding practice on M.S. & S.S tube metals in rolled position.Square butt joint on Tube welding practice on Aluminium in rolled position.	- Preheating and Post heating - Distortion and methods of control. - Submerged Arc welding - Principles, application- Types of fluxes, welding head, power source and Parameter setting.
Professional Skill 23Hrs; Professional Knowledge 04 Hrs	Cut ferrous and nonferrous metal using plasma Arc cutting. (Mapped NOS: CSC/N0207)	95. Plasma cutting of SS sheets & Aluminum plates.Dimensional inspection of weldments. 96. Weld test specimen preparation. 97. Visual inspection of weldments.	- Plasma welding principles, Equipment, power source, parameter settings, Advantages & limitations - Plasma cutting principles and advantages.
Professional Skill 21Hrs; Professional Knowledge 04 Hrs	Test welded joint by visual inspection Dye penetrant & Magnetic particle testing methods. (Mapped NOS: CSC/N0204)	98. Dye penetrant. 99. Magnetic particle testing.	- Inspection & testing of weldments - Visual inspection methods - Inspection kits - universal gauge, Fillet gauge, etc. - Non-destructive Testing methods, PT, MPT, UT & RT - Destructive testing - Bend test & tensile test.

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Familiarization with the Institute

Objectives: At the end of this exercise you shall be able to
- **explain the familiarization of institute.**

PROCEDURE

Familiarization with institute.

Instructor brief the function of institute.

1 Introduce the instructor to the trainees

2 Introduce the trainees to the instructor.

3 Instructor introduce the trainees himself to the trainee's.

4 Instructor give brief details about the function of the institute and organisational structure.

5 Visit to all the section of the institute.

6 Introduce the staffs and their designation.

7 Visit to smart classroom and show the video regarding organisation structure and importance welder trade.

8 Explain the job opportunity in industrial sector.

9 Ask the trainees to write the name and designation of the key post staffs in the institute in Table 1.

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Importance of trade training

Objectives: At the end of this exercise you shall be able to
- **state the importance of welder trade**
- **describe the learning path ways of craftsman training scheme**
- **explain the employment opportunities of welder trade.**

This trade is meant for the candidates who aspire to become a professional WELDER. The duration of the trade is two semesters under craftsman training scheme.

Competencies achieved

After successful completion of this trade trainee shall be able to perform the following skills with proper sequence.

1 Welding of M.S. sheet and M.S. pipe by Gas welding process.

2 Welding of M.S. plate in all position by SMAW process.

3 Straight, bevel & circular cutting on MS. plate by Oxyacetylene cutting process.

4 Repair & Maintenance works

5 GMAW welding on M.S sheet & M.S plate.

6 Operating skills of spot welding machine, PUG cutting machine,

7 Welding C.I using SMAW process.

Further learning pathways

Also on successful completion of the trade the candidate can pursue apprenticeship training in Registered Industries/ Organization, further for a period of one year under Apprenticeship Training scheme to acquire practical skills and knowledge.

Employment Opportunities

On successful completion of this trade, the candidates shall gain to be fully employed in the following industries:

1 Structural CG & M like bridges, Roof structures, Building & construction.

2 Automobile and allied industries.

3 Site construction activities for power stations, process industries and mining.

4 Service industries like road transportation and railways.

5 Ship building and repair.

6 Infrastructure and defense organizations.

7 In public sector industries like BHEL, NTPC, etc and private industries in India & Abroad.

8 Petrochemical industries like ONGC, LOCL, and HPCL etc.

9 Self employment.

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Machinery used in welding trades and introduction to safety equipment and their use etc.

Objectives: At the end of this exercise you shall be able to
- **name the machinery used in welding shop**
- **record the name and its uses of each machine in given table.**

- Name the welding machine used in welding trade
- Explain the machinery used in welding shop
- Recommend the name and its uses of each machine in given table

Fig 1

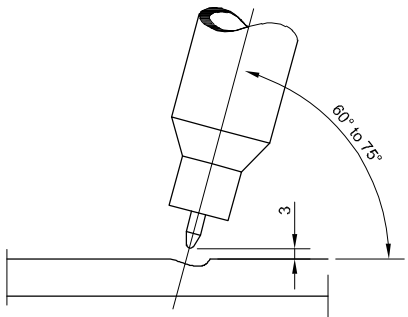

Fig 2

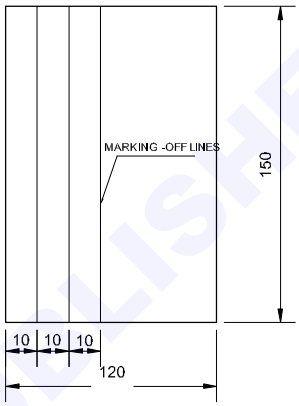

Fig 3

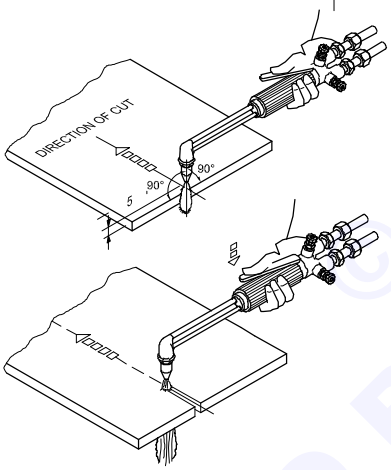

Fig 4

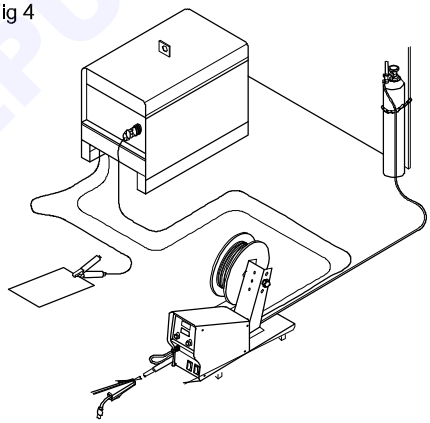

Fig 5

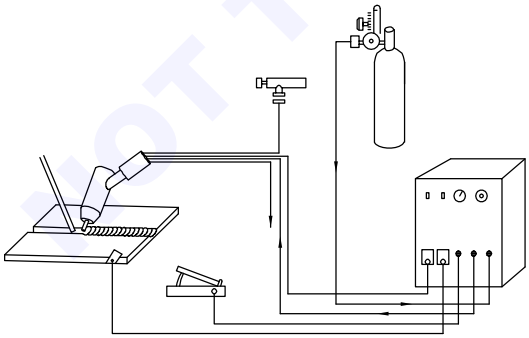

Fig 6

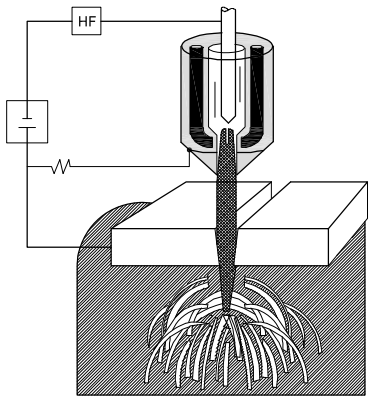

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Fig 7

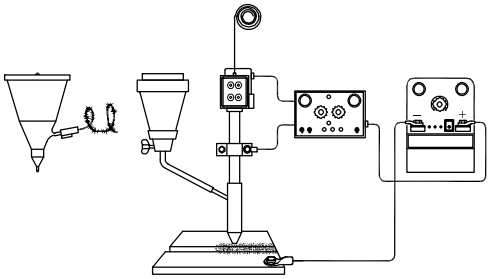

Fig 8

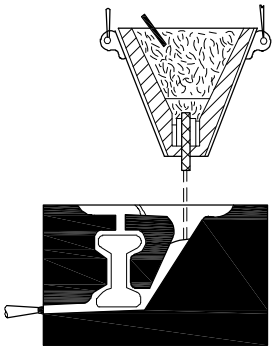

Fig 9

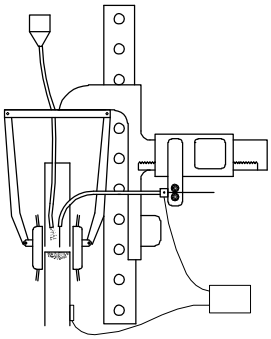

Fig 10

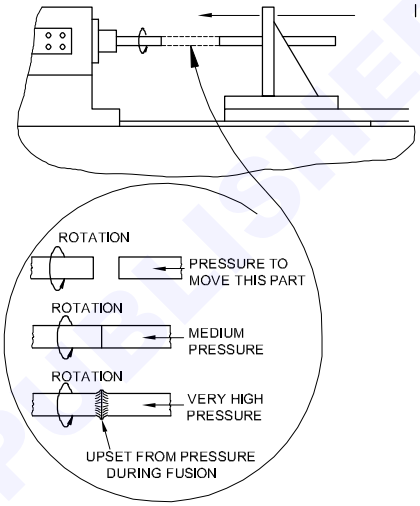

Fig 11

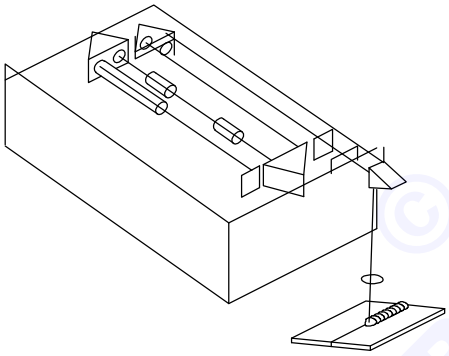

Fig 12

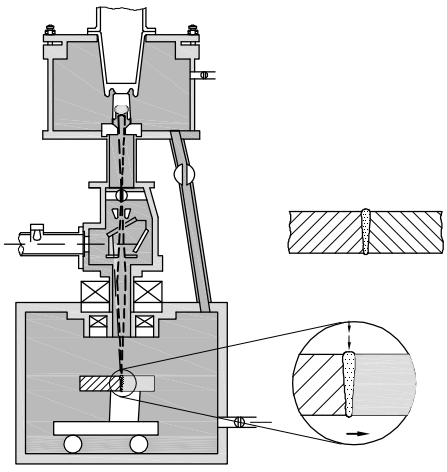

Fig 13

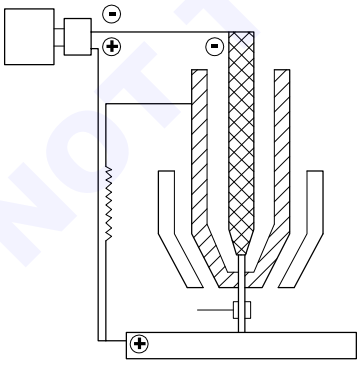

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Fig 14

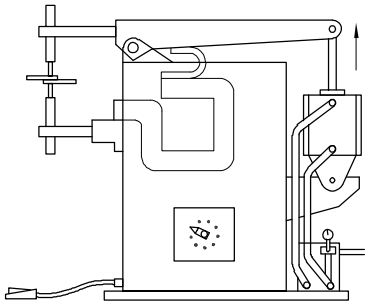
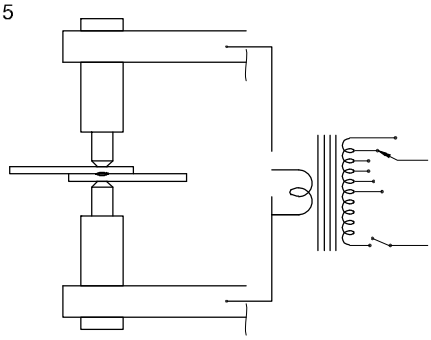


Fig 15

a



b

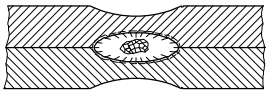


Fig 16

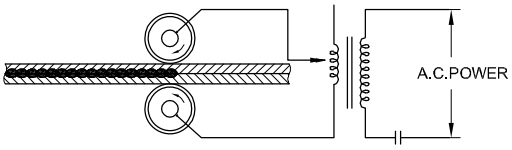


Fig 17

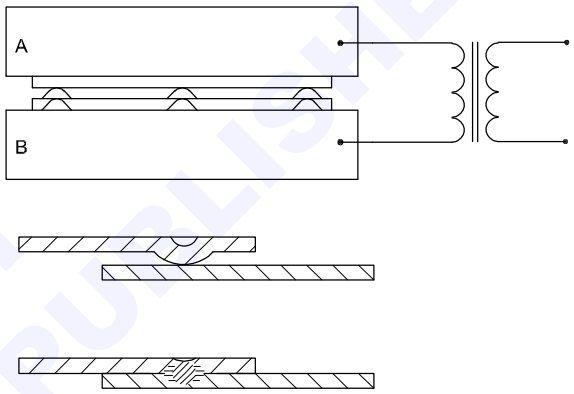


Fig 18

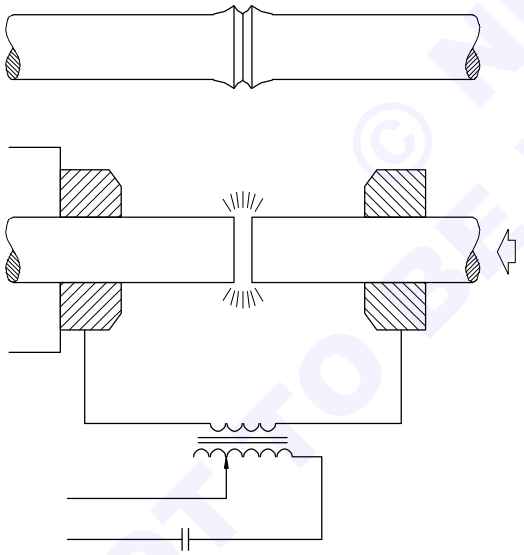
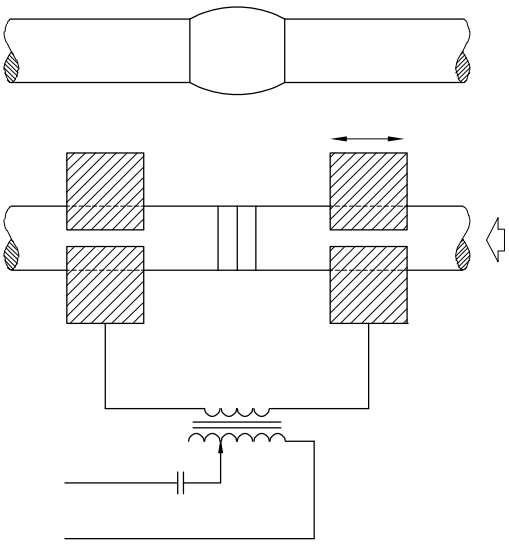


Fig 19



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WG20N1103H3

Job Sequence

- Identify the machinery in your work shop.
- Name the machine and their uses.
- Record it in table 1.

TABLE 1

S. No.	Name of the machine	Uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Get it checked by the instructor.

Table 1: Referring the machine and use the machine name with help of instructor

Introduction to safety equipment and their uses

Objectives: At the end of this exercise you shall be able to
- **identity the safety equipment listed in the drawing**
- **record the uses of respective safety equipment in the table.**

Note: The instructor may provide or arrange the different types of personal protection equipment or chart and explain how to identify and select the PPE devices suitable for the work and ask the trainees to write names and its uses in the given table.

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Fig 1

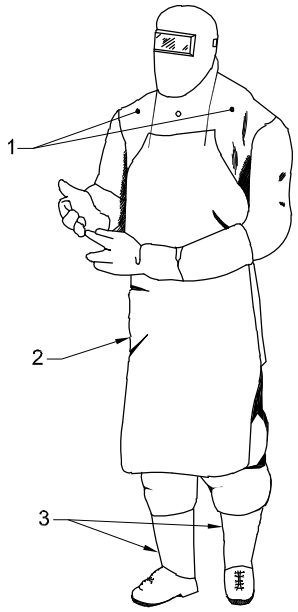

Fig 6

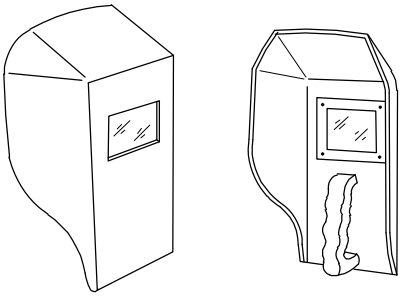

Fig 7

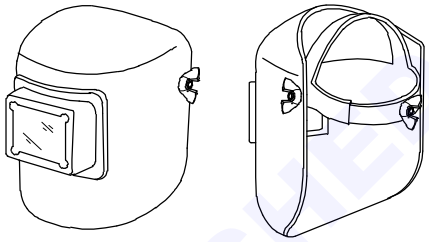

Fig 4

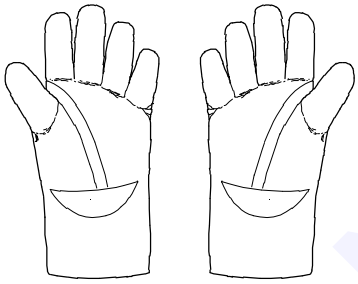

Fig 8

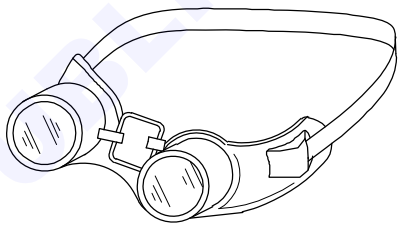

Fig 5

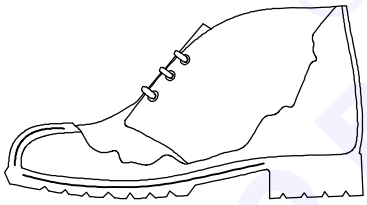

Fig 9

Fig 10

WG20N1103J1

Job Sequence

- Read and interpret the personal protection equipment by visually on real devices or from the charts.
- Identify and select the personal protection equipment used for suitable type of protection.
- Write the name of the PPE to the corresponding type of protection in table 1.
- Get it checked by your instructor.

TABLE 1

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

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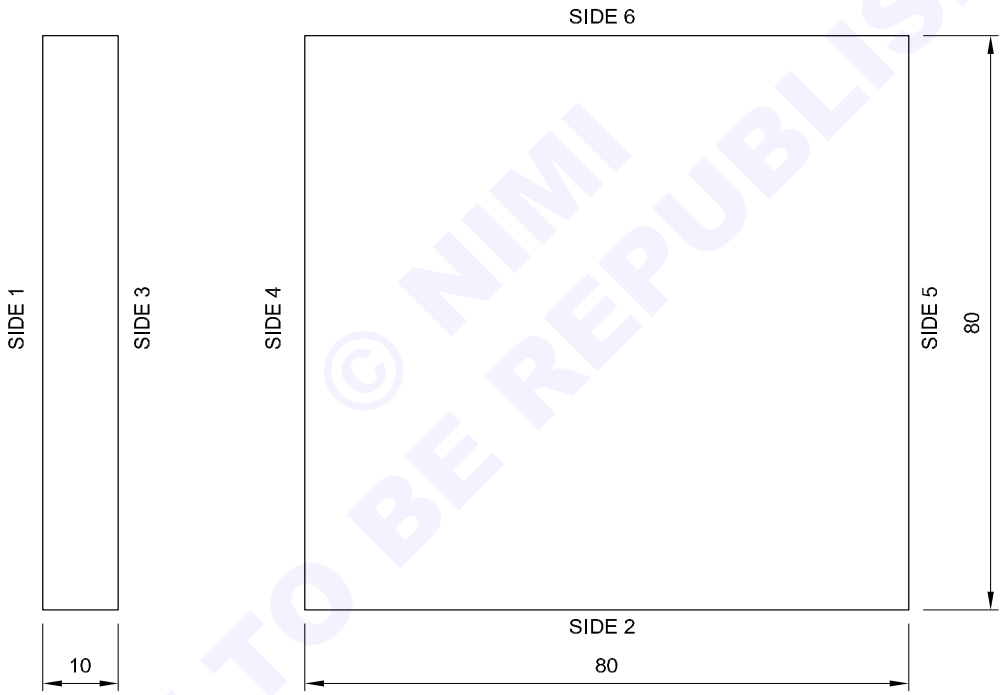
Hack sawing, filing square to dimension

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

- **file the surface to 90°**
- **mark the overall size using try square**
- **cut excess metal by hack saw**
- **file to square and maintain the dimension ±0.5 mm check the dimensions with steel rule.**



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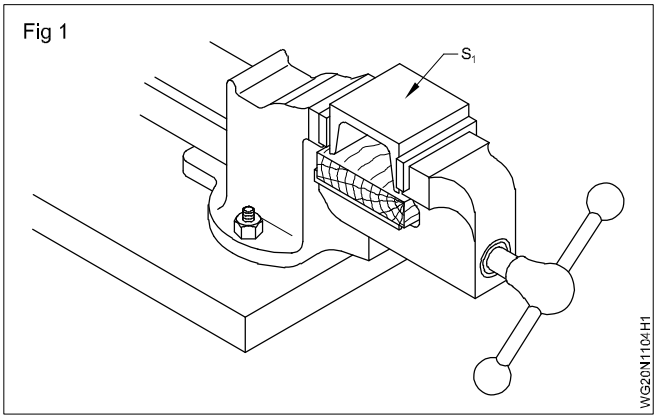
1	100ISF x 10-100	-	Fe310	-	-	1.1.04
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:1	HACKSAWING,FILING SQUARE TO DIMENSION	DEVIATIONS ±0.5	TIME 7h
		CODE NO. WG20N1104E1	

Job Sequence

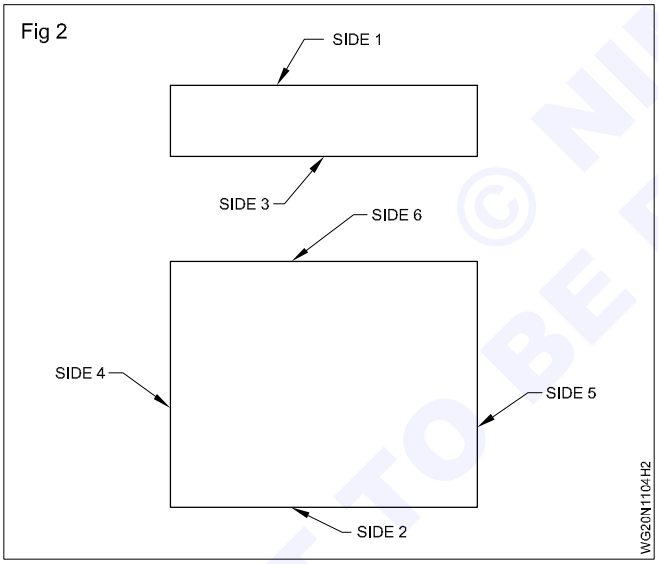
- Check the stock size material using steel rule.
- Remove burrs, if any.
- Hold the job in vice, so that surface side 1 comes on top (Fig 1).

Fig 1



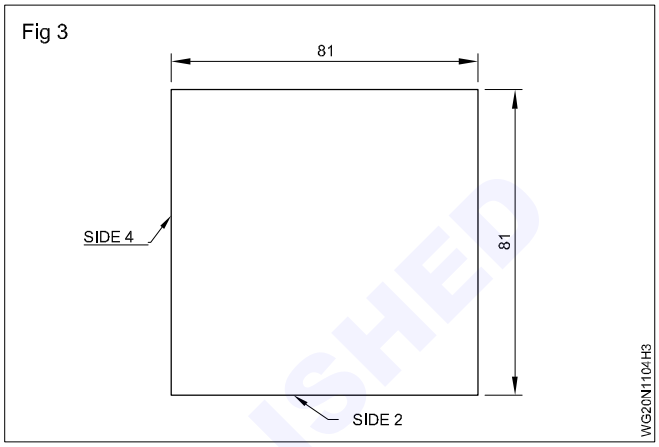
- File the surface side 1 with a flat bastard file.
- Check the surface level with straight edge (blade of a try square).
- File one edge (side 2) flat and 90°, to side 1 (Fig 2).

Fig 2



- File side 3 flat and parallel to side 1.
- File side 4 to 90° to side 2.
- Check the 90° angle with try square.
- Apply marking media on side 1.
- Mark 81 mm keeping side 2 on surface plate (Fig 3).

Fig 3



- Similarly mark 81 mm on side 5 keeping side 4 on surface plate.
- Punch the marked line.
- Hold the job in the bench-vice keeping 10 mm away from the marked line.
- Make a notch on the line to start hack sawing.
- Cut along the marked line.
- Similarly cut on the other side.
- File sides 5 and 6 and check the squares and maintain the dimension of 80.00 mm ±0.5 mm.
- Deburr the job and apply oil and preserve it for evaluation.

Skill Sequence

Filing flat surface

Objective: This shall be help you to
- **file flat surface**

Check the height of the bench vice. (Fig 1) If the height is more, use a platform and if it less, select and use another workbench.

Hold the job in the bench vice with a projection of 5 to 10 mm from the top of the vice jaw.

Select the files of various grades and length according to the

– size of the job

– quantity of metal to be removed

– material of the job.

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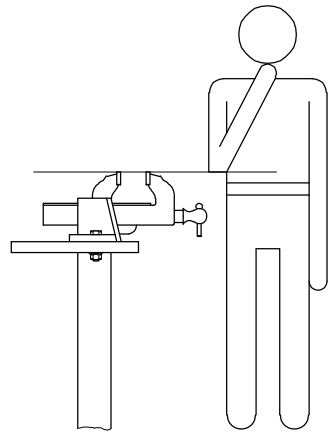
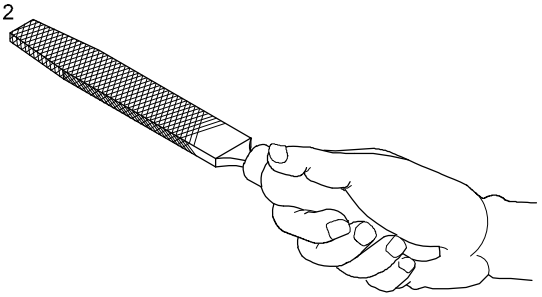
Fig 1



WG20N1104-J1

Check whether the handle of the file fits tightly. Hold the handle of the file (Fig 2) and push the file forward using your right hand palm.

Fig 2



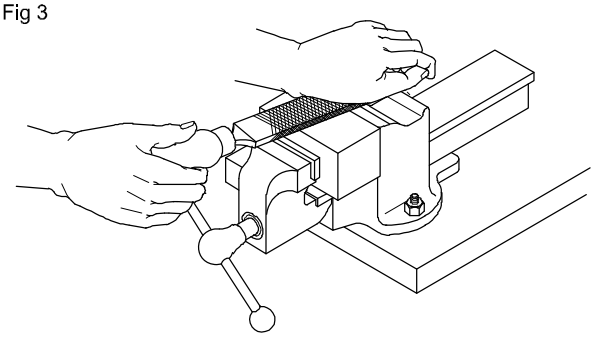
WG20N1104-J2

Hold the tip of the file according to the quantity of the metal to be removed.

For heavy filing. (Fig 3)

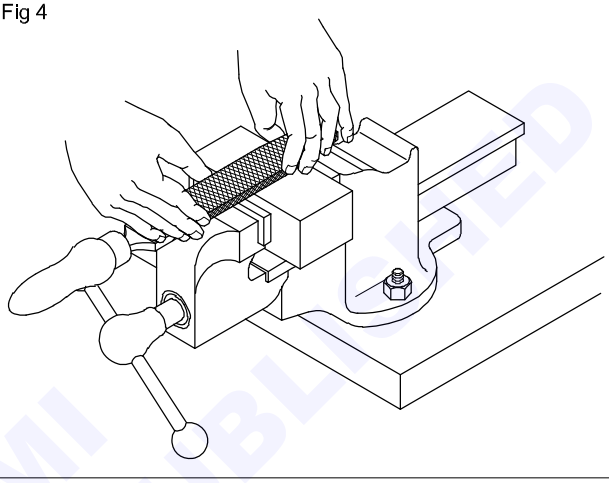
For removing the local unevenness draw filing can also be done. (Fig 4) The same filing can also be done for fine finishing.

Fig 3



WG20N1104-J3

Fig 4



WG20N1104-J4

Start filing by pushing the file uniformly during the forward stroke and release the pressure during the return stroke.

Continue giving strokes. Balance the pressure of the file in such a way that the file always remains flat and straight over the surface to be filed.

Checking flatness and squares

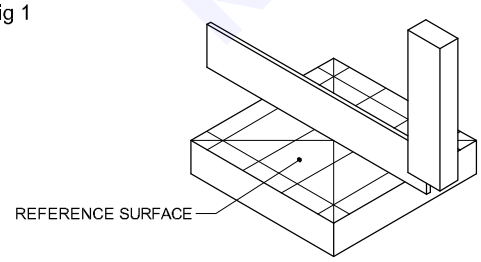
Objectives: This shall help you to

- **check flatness**
- **check squares.**

Checking flatness (Fig 1)

Use the blade of the try square as a straight edge for checking flatness.

Fig 1



WG20N1104-X1

Place the blade of the try square on the surface to be checked in all directions so as to cover the entire surface.

Do the checking facing the light. Light gap will indicate high and low spots.

Checking squares: Consider the large finished surface as the reference surface. Ensure that the reference surface is filed perfectly and is free from burrs.

Butt and press the stock against the reference surface. (Fig 2)

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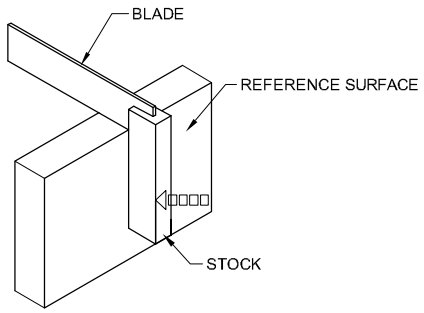
Fig 2



Bring down slowly and make the blade touch the second surface with which the squares is to be checked.

Light gap will indicate the high and low spots.

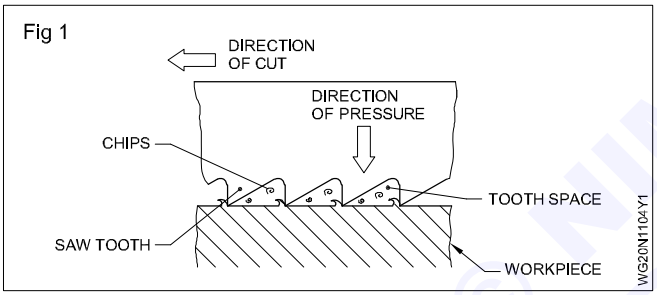
Hacksawing

Objectives: This shall help you to
- **fix hacksaw blades maintaining correct tension and direction**
- **cut metal pieces with a hacksaw.**

Insert the hacksaw blade pin holes in the blade holder pins (fixed and adjustable) of the hacksaw frame.

Ensure that the teeth of the hacksaw blade is pointed in the direction of the cut and away from the handle. (Fig 1)

Fig 1



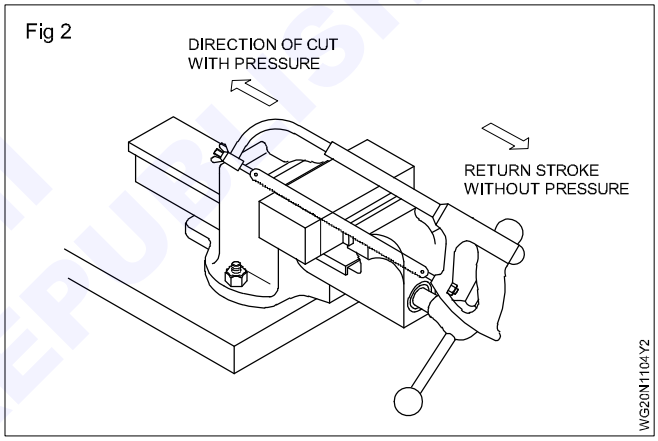
Ensure that the blade is held vertical and correctly tensioned before starting.

While starting the cut, make a small notch.

The cutting movement should be steady, and the full length of the blade must be used.

Apply pressure only during the forward stroke. (Fig 2)

Fig 2



While cutting, make sure that at least two to three teeth are in contact with the work.

Normally, a coolant is not necessary while hacksawing.

Do not move the blade too fast. While finishing a cut slow down to avoid breakage of blade or injury to yourself and others.

Marking out on MS plate and punching

Objectives: At the end of this exercise you shall be able to
- **draw lines on metallic surfaces by scribers**
- **draw parallel lines by try squer**
- **register the profile by dot punching.**

Job Sequence

- Check the size of the given MS plate as per drawing.
- Apply copper sulphate/chalk powder solution and allow it to dry.
- Keep the plate or flat on the work bench and mark points A, B, C, D, E & F and A_1, B_1, C_1, D_1, E_1 & F_1 as per dimensions given on the job drawing.
- Draw the 6 lines joining the points A and A_1, B and B_1 etc upto F and F_1.
- Check the marked lines for the correctness and parallelism visually.
- Using a dot punch and a hammer make punch marks on all the lines with a pitch of 4mm.

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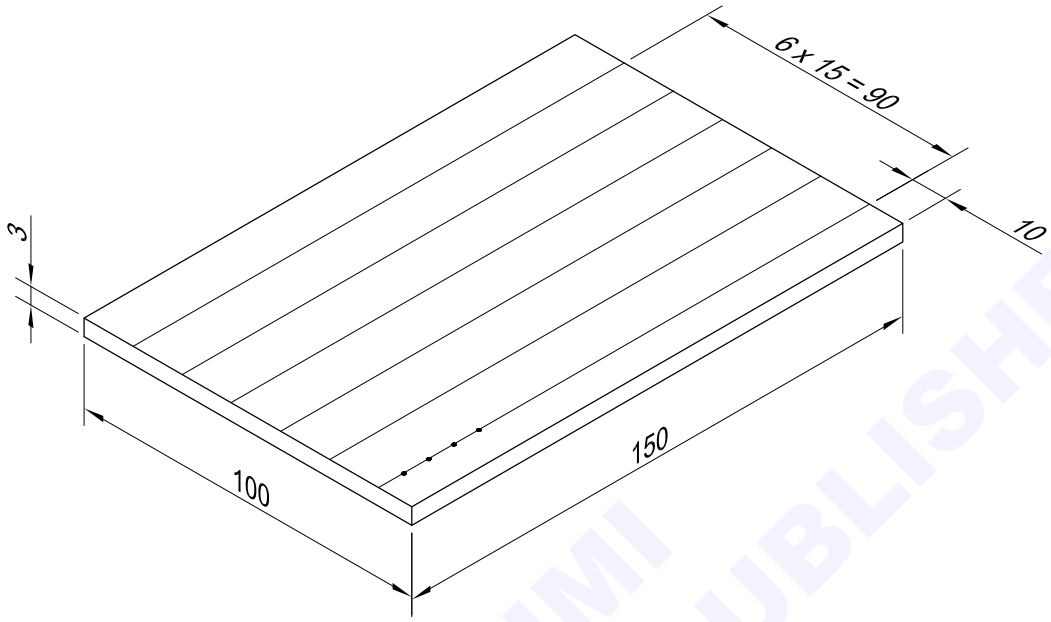

1	100 ISF 3x150	-	Fe 310	-	-	1.1.04
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**MARKING OUT ON M.S. PLATE AND PUNCHING**				TOLERANCE ±1	TIME
					CODE NO. WG20N1104E2	

Skill Sequence

The marking media, copper sulphate or chalk powder solution, is applied on the job surface and dried so that the lines scribed on it will be clearly visible.

Apply the marking media uniformly with a 15mm painting brush.

Using steel rule and scriber point mark points A, B,C,D,E & F from the 150mm long edge of job at 10, 25, 40, 55, 70 and 85mm distances. Similarly mark points A_1,B_1,C_1,D_1,E_1 & F_1 (Fig 1) The edge of the steel rule may have damaged.

To avoid wrong measurement coincide or set the 1st or 2nd cm graduation mark of the steel rule against the 150mm long edge of the job for taking measurements and marking of points A to F and A_1 to F_1. Ensure that there is no parallax error (observation error) while using the scale to mark the points A to F and A_1 to F_1 (Fig 2)

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Fig 1

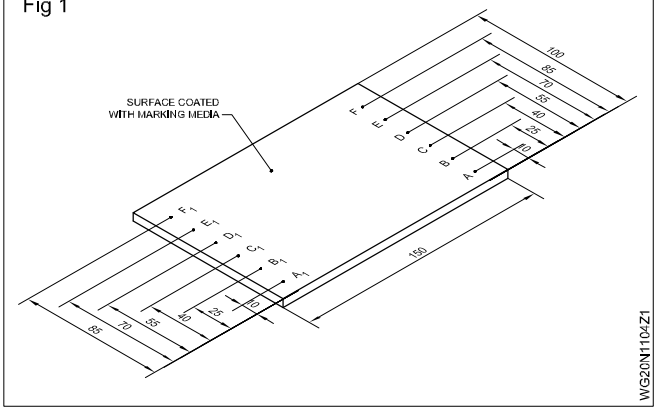
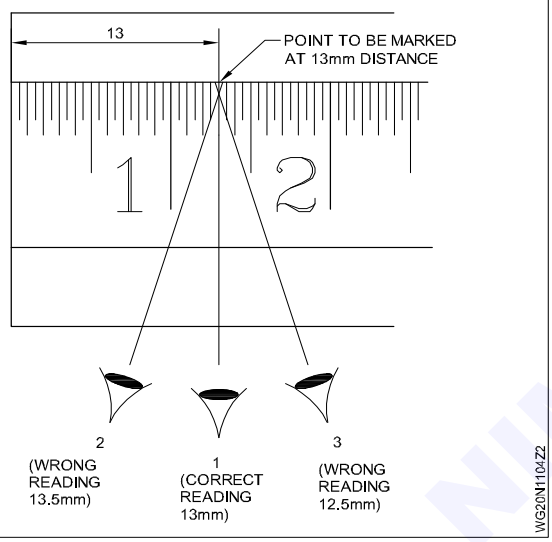


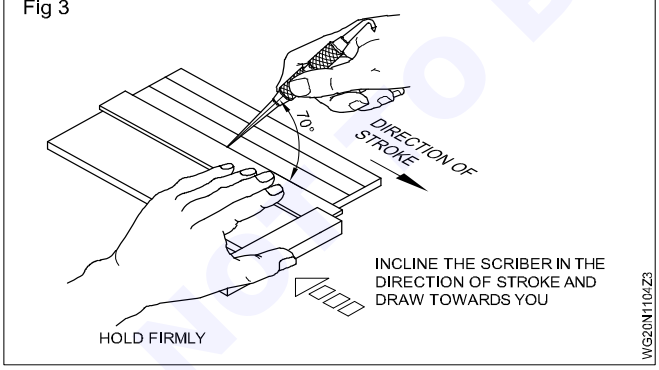
Fig 2



Using the steel rule and scriber, draw the lines AA_1, BB_1, CC_1, DD_1, EE_1 & FF_1.

Incline the scriber in the direction of stroke and draw towards you (Fig 3)

Fig 3



Using the dot punch and the hammer, punch small dots on the 6 lines. (Fig 4 and Fig 5) While hammering hold at the extreme end of the handle.

Fig 4

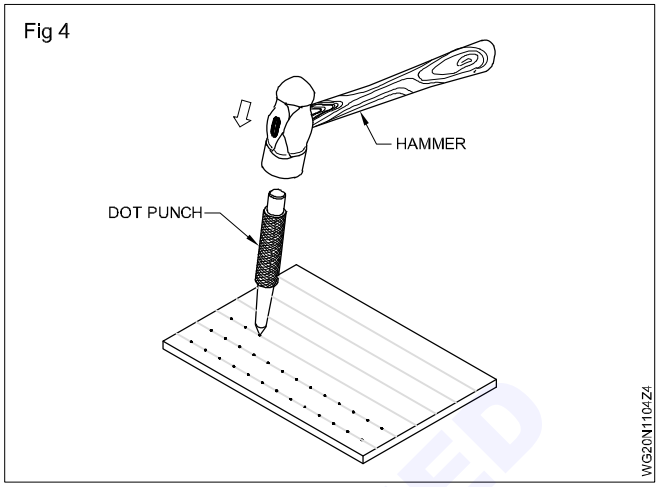
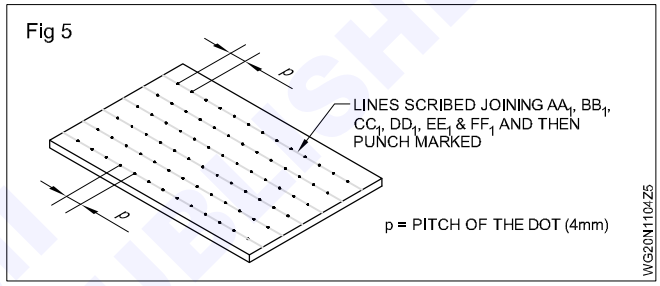


Fig 5



Maintain a pitch of 4mm approximately between the dots. Pitch is the distance between two consecutive dots.

Check whether the lines are straight and parallel using steel rule and the punch marks are clear and visible.

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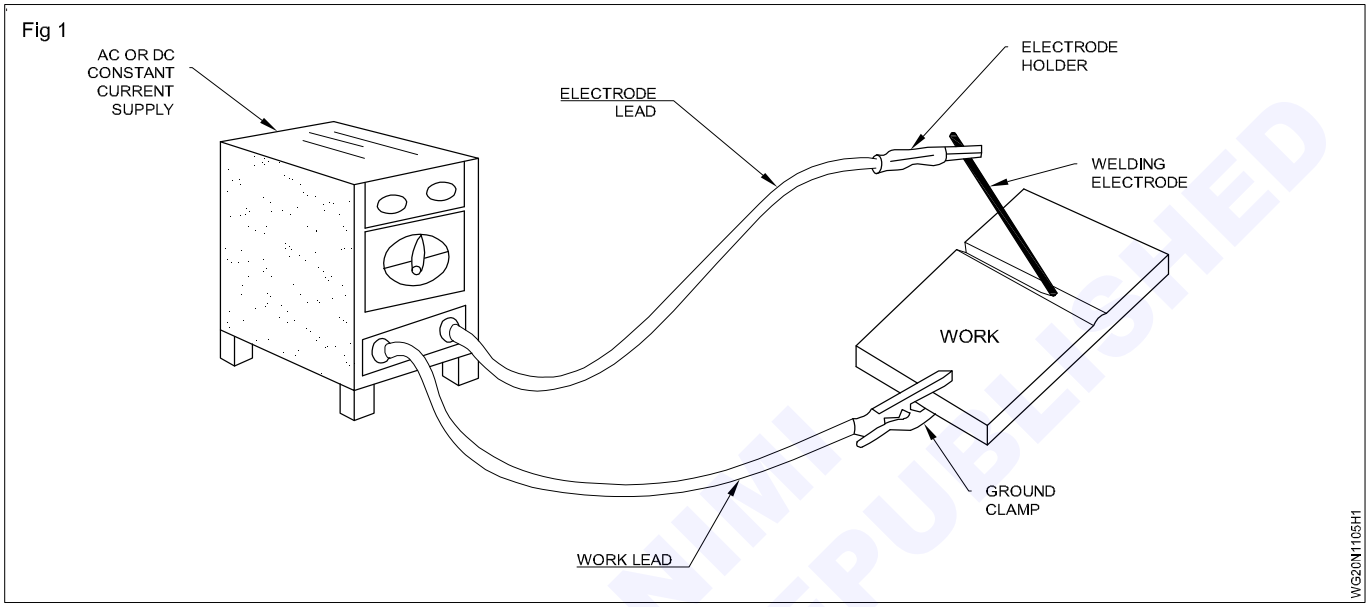
Setting up of arc welding machine & accessories and striking an arc (SMAW-01)

Objectives: At the end of this exercise you shall be able to
- **connect the welding cables between the welding machine, electrode holder and the job**
- **start and operate the controls and stop are welding machine in sequence**
- **set welding current and strike and maintain the arc.**

Fig 1



Job Sequence

- Set up the equipment in a safe place
- Organize the tools that you are using.
- Obtain the piece for welding and connect the ground clamp to one of them.
- Turn on the welding transformer.
- Set the amperage as per the suggested list on the machine.
- Insert the electrode in to the electrode holder into angled groove.
- Position the rod tip 25 to 50mm away from the welding position.
- Lower the helmet and now it is ready to strike the arc.

Skill Sequence

Setting of oxy-acetylene welding machine& accessories and striking an arc

Objective: This shall help you to
- **assist in setting up arc welding plant.**

Setting up Arc Welding plant (Fig 1)

Check the welding machine and other accessories as per sketch. A welding generator (Fig 2) or a welding rectifier (Fig 3) gives a direct current for welding and a welding transformer (Fig 4) gives an alternating current for welding.

Connect the welding machine to the power supply.

Be sure that the main supply switch and the welding machine are properly earthed. This will avoid any electric shock to the welder. Fig 1

Switch on the starter.

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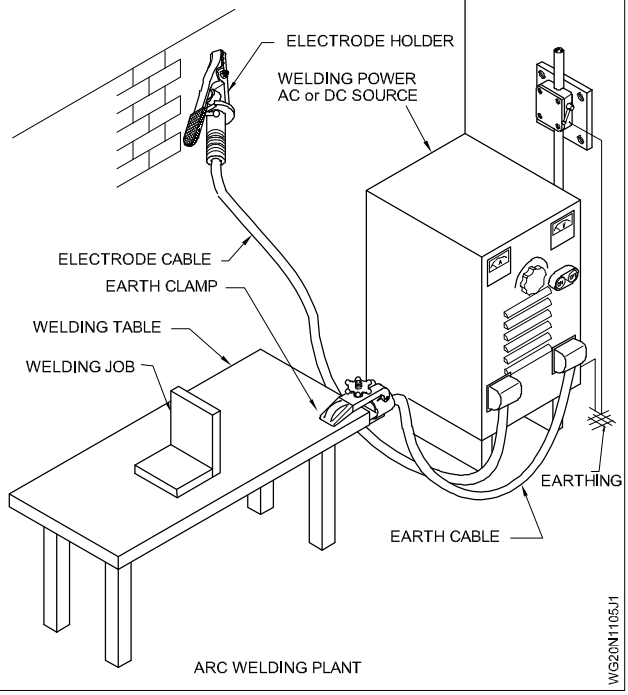
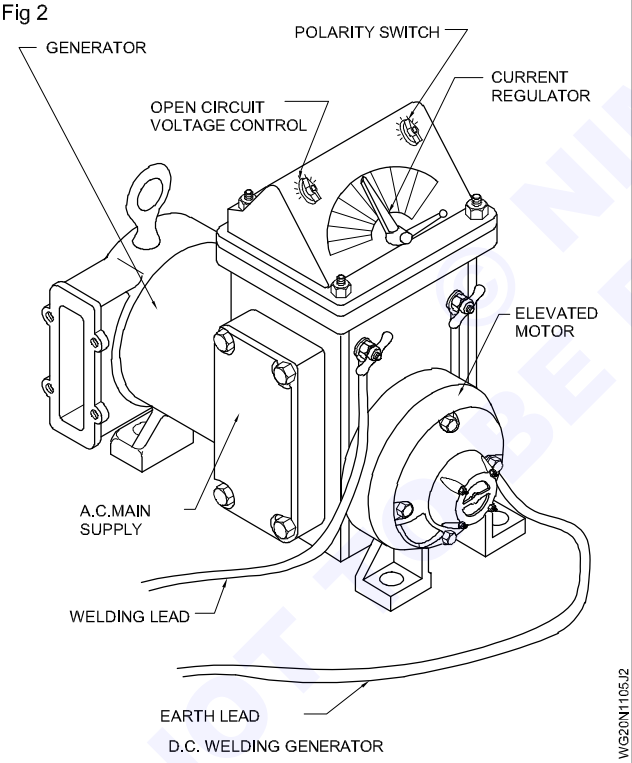
Fig 1



ARC WELDING PLANT

Fig 2



D.C. WELDING GENERATOR

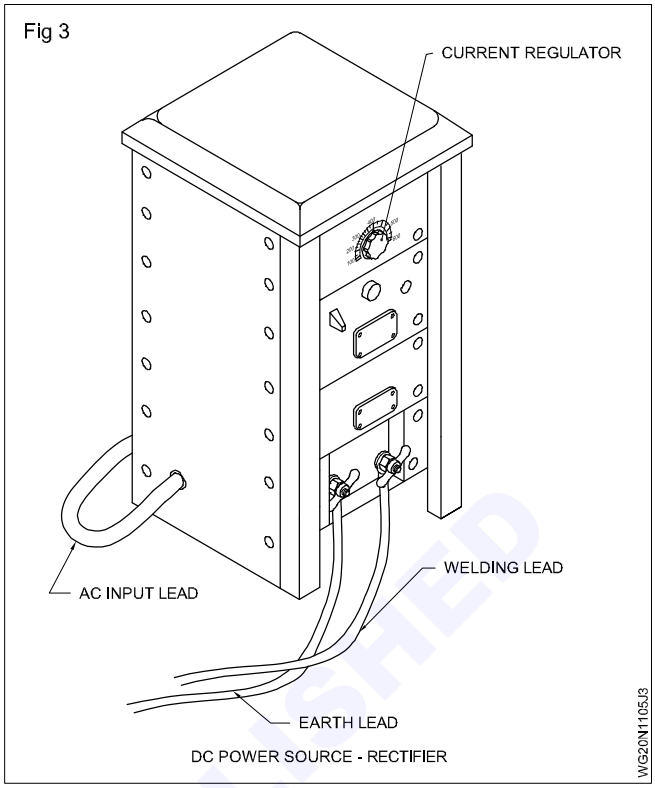
Check and ensure the electrode holder and earth cable are without any loose connection or damage.

Loose cable connections cause spark, heat and unstable arc.

Connect tightly the earth cable to the welding table or work using the earth clamp and the electrode cable with the electrode holder.

Hang the electrode-holder on an insulated hook provided near the welding table whenever it is not in use.

Fig 3

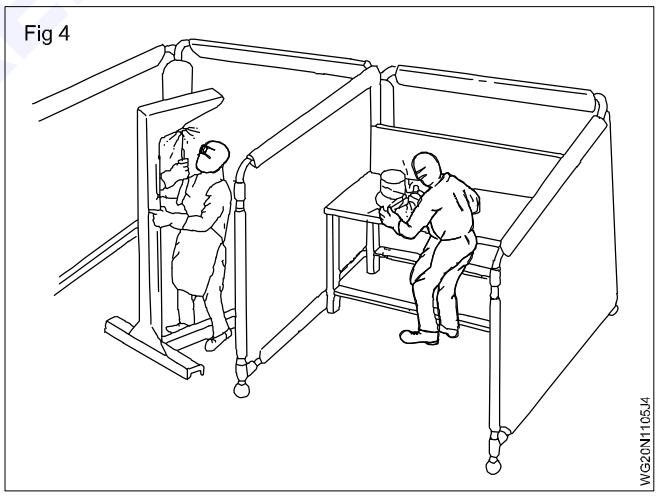


DC POWER SOURCE - RECTIFIER

Place portable screens around the welding table for the safety of others. (Fig 4)

Check that the welding accessories such as chipping hammer, carbon steel wire brush, tongs and chipping goggles are in working condition.

Fig 4



Keep ready safety apparels (such as leather apron, gloves, sleeves, leggings, jacket, shoes and cap) to ensure personal safety.

Operating the controls of arc welding machines.

Arc welding machines are used to get suitable current for welding purposes.

Connect the welding machine to the main supply as follows.

– Install the welding machine near the 3 phase main supply, keeping the mains supply cables as short as possible to avoid electrical power losses.

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– Call a skilled electrician for permanent connections to the main supply since it carries dangerously high voltage.

Ensure that the main switch, fuses and power cables electrode holder, earth clamp and cable lugs are of the required ampere capacity.

If the main supply connection is of the plug type, the welder can himself connect the main supply.

Check the proper operation of the main switch.

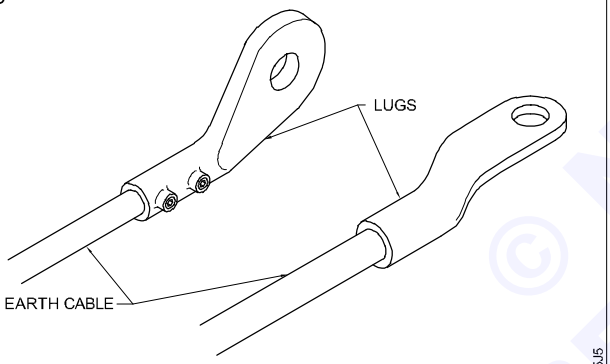
Check the proper operation of the on/off switch of the machine.

Check the proper operation of the current regulator of the welding machine and set the current at 90 -110 ampere for a 3.15mm diameter electrode.

Check the operation of the polarity switch, if it is a DC welding generator or a rectifier.

Welding cables are used to carry the welding current from the welding machine to the electrode-holder and the job and suitable lugs are attached to the earth cable ends (Fig 5).

Fig 5

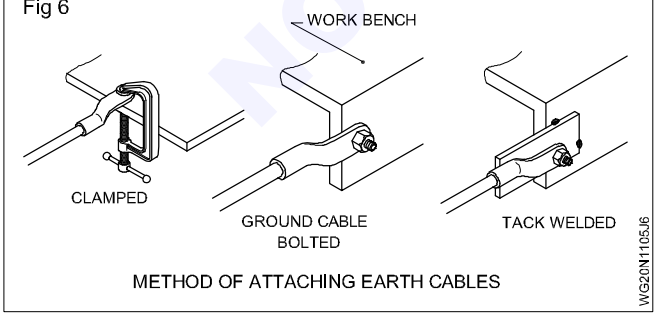


CABLE ATTACHMENTS

Connect one end of the earth cable to one of the output terminal of the machine tightly.

Connect the other end of the earth cable with the welding table or work tightly using the earth clamp as shown in Fig 6. Other methods are shown in Fig 6.

Fig 6



METHOD OF ATTACHING EARTH CABLES

Connect one end of the electrode cable to the second terminal of the machine and the other end to the electrode holder.

Starting and stopping of arc welding machines

Welding transformer

Switch 'on' the main supply of the welding transformer.

Start and stop the welding transformer (2-3 times) using the on/off switch provided on the machine.

Welding generator

Switch 'on' the main supply of the welding generator.

Start and stop the welding generator (2-3 times) using start-delta-starter provided on the machine.

Put the starter in star position, wait for a few seconds and then put the switch in delta position to avoid damage to the machine.

Welding rectifier

Switch 'on' the main supply of the welding rectifier.

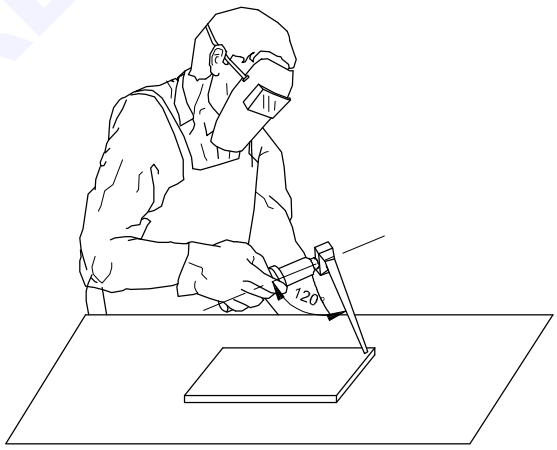
Start and stop the welding rectifier 2-3 times using the 'on' - 'off' switch provided with the machine.

In some of the rectifiers, a transfer switch is provided. By operating this switch the machine can be used as DC welding machine or as AC welding machine.

Striking of arc on mild steel (M.S.) plate in flat position

Fix a 3.15 mm dia medium coated mild steel electrode between the jaws of the electrode holder. (Fig 7).

Fig 7



WELDER ABOUT TO STRIKE AN ARC

Ensure the bare wire end of the flux coated electrode is firmly held in the slot/groove provided in the electrode holder.

Set 90-110 ampere for the 3.15 ø electrode. All electrode manufacturers indicate the current values for different size electrodes which can be used as a guide while setting currents.

Striking the arc is a basic action whenever a welder has to start welding or an electrode is changed or an arc is put-off during welding.

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Connect the electrode to negative if the machine is a DC welding machine.

Clean the given scrap iron plate (work piece) surface with a steel wire brush, and clean the oil or grease, water and paint, if any.

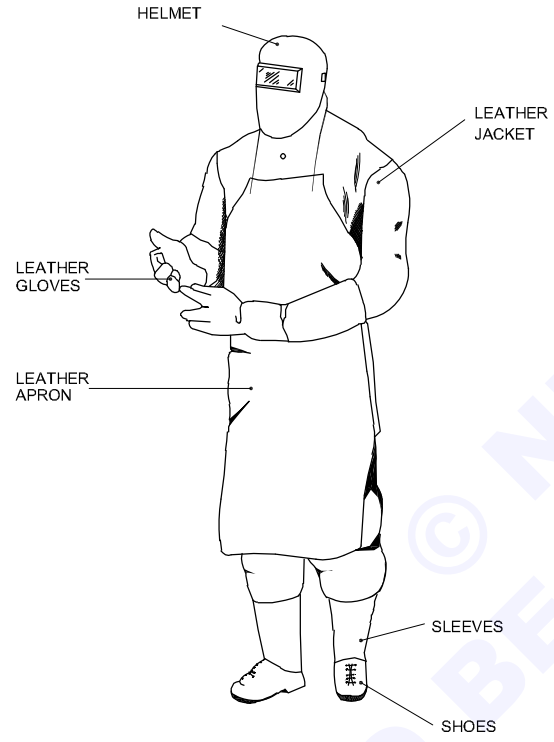
Improper cleaning makes poor electrical contacts and weak welds due to weld defects.

Set the work piece on the welding table in a flat position.

Switch 'on' the input supply and start the welding machine.

Ensure safety apparels are worn. Fig 8

Fig 8



Hold the electrode about 5 mm above the job piece at one end at 75° angle to the line of weld and at 90° to the plate surface. (Fig 9)

Scratching method (Fig 10)

Put on the welding helmet or bring the welding shield in front of your eyes.

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

Withdraw the electrode approximately 6 mm from the surface for a few seconds and then lower it to approximately 3 mm distance to maintain the arc.

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

To break the arc quickly withdraw the electrode up.

Fig 9

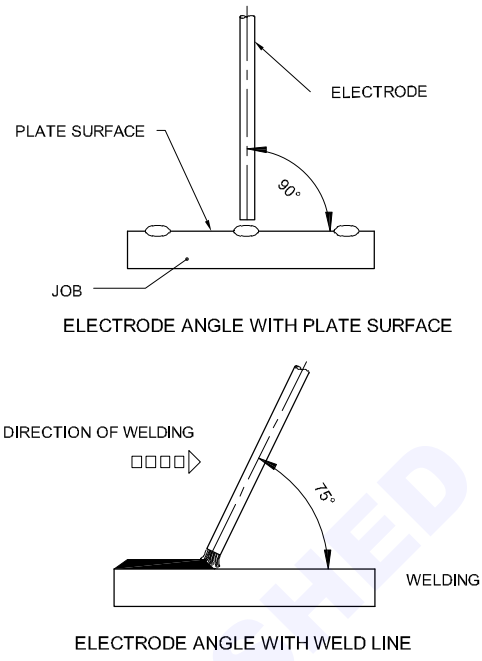
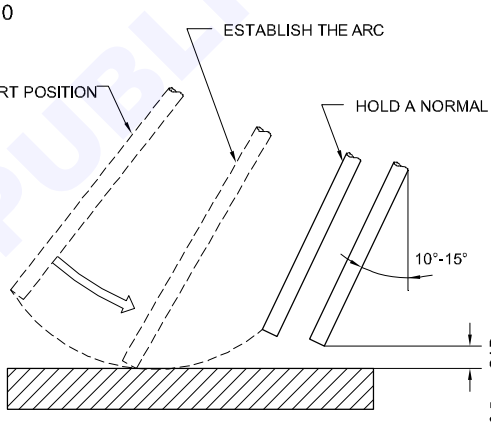


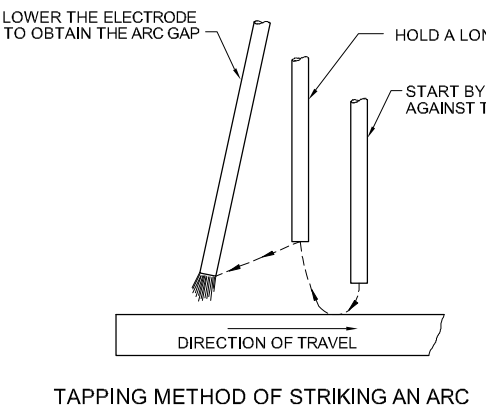
Fig 10



Tapping method (Fig 11)

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

Fig 11



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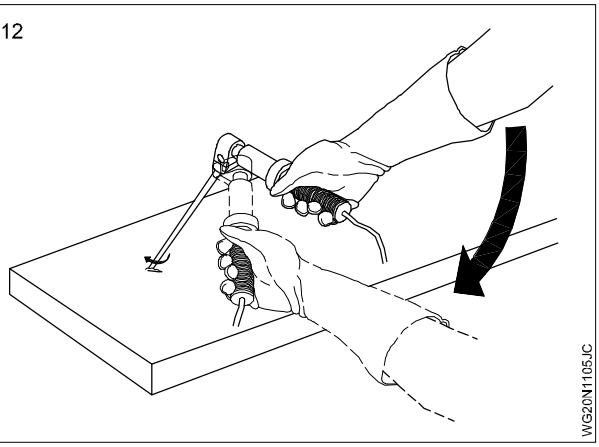
Lift the electrode up slowly approximately 6 mm for a few seconds and then lower it to approximately 3 mm from the surface to maintain a correct arc.

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

If the electrode freezes (sticks) to the plate, it should be immediately freed by a quick twist of the wrist to avoid its overheating or spoiling. (Fig 12)

Fig 12



Strike the arc by the scratching method.

Look at the arc through the filter glass only fitted in the welding screen/shield or helmet.

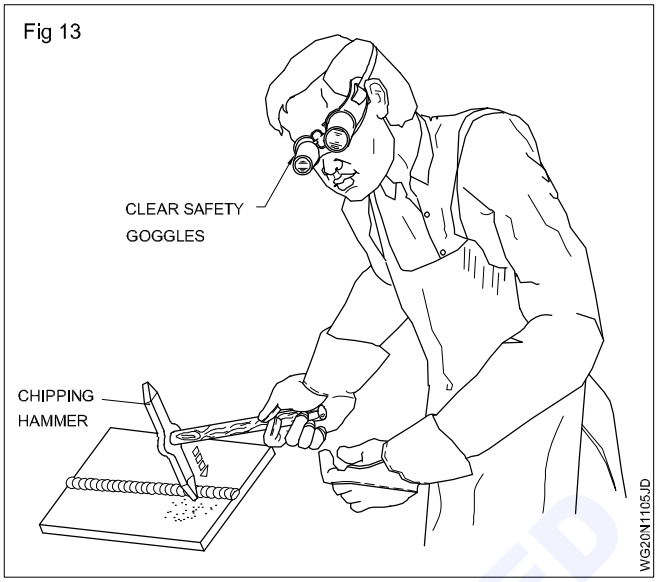
Remove the slag covering from the top of the short weld deposits by using a chipping hammer, and clean with a wire brush. Fig 13.

Use chipping goggle or chipping screen, while DE slagging welds. Fig 13

If the welded job is small in size use tongs to hold a hot job.

Repeat striking the arc on the scrap MS plate until the arc can be struck every time without the electrode freezing.

Fig 13



Safety precautions during arc welding

During metal arc welding, the metal is heated and fused by the heating source - electric arc. The following are the common dangers involved.

– Electric shock
– Sparks and spatters
– Smoke and fumes
– Heat radiation
– Chipped and hot slag particles
– Hot jobs and the hot stub ends.

To protect the welder from the above dangers, he has to follow certain safety precautions which are explained in the Related Theory on Induction Training.

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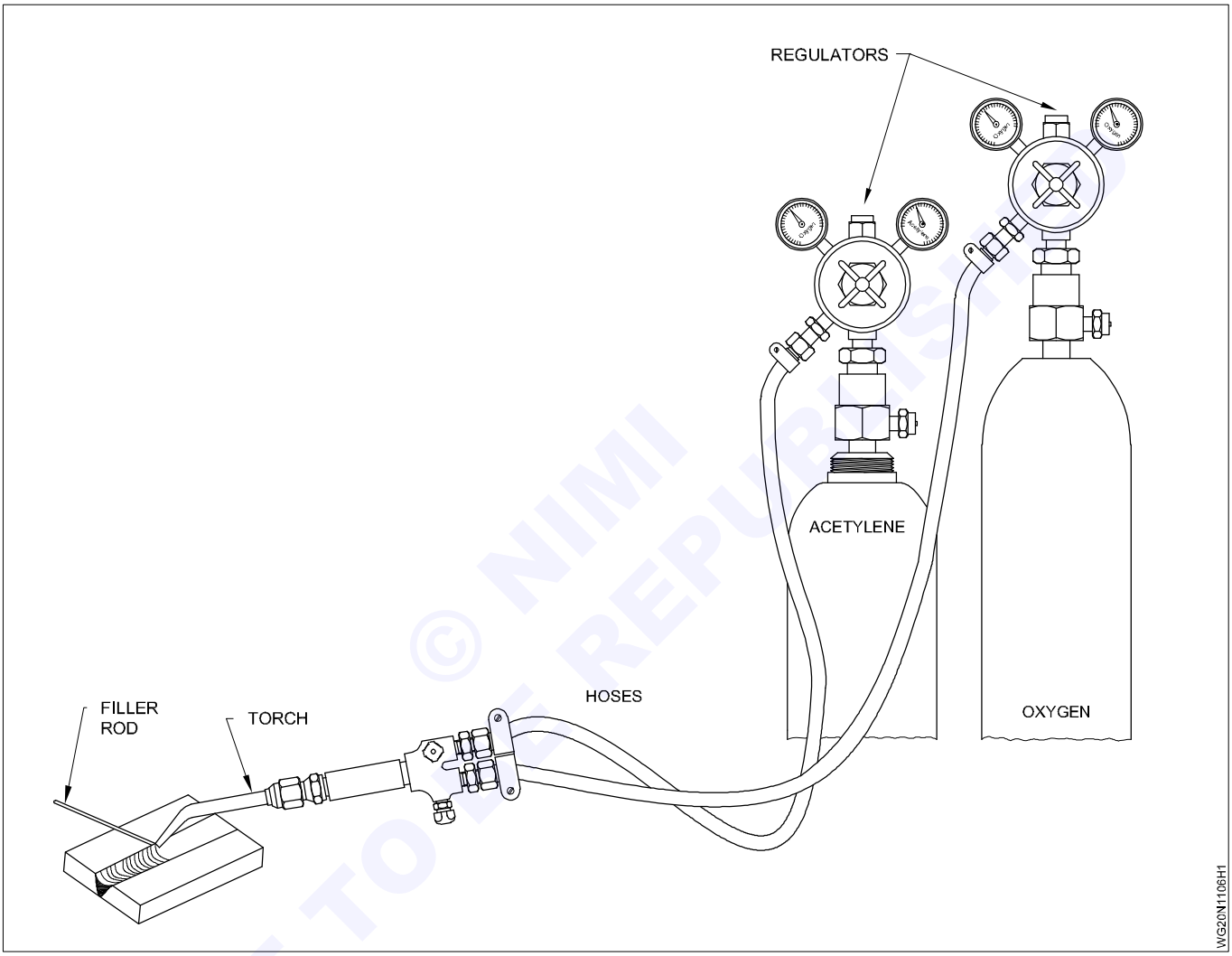
Setting of oxy-acetylene welding equipment, Lighting and setting of flame

Objectives: At the end of this exercise you shall be able to
- **name of the equipments of OAW**
- **set the types of flames**
- **explain the welding procedure of OAW.**



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Job Sequence

- Inspect all inlet and outlet valves, threads and seats on both cylinders and regulators.
- Crack the valves.
- Install the regulator.
- Inspect hose fittings for damage and attach it.
- Open the gas cylinders, oxygen and Acetylene.
- Purge both hoses by opening the regulator valve correctly as per gas, one at a time.
- Inspect torch handle.
- Assemble the torch handle.
- Attach the hose correctly.
- Leak check and purging.
- Light the flame.
- Adjust the flame to get neutral flame.
- Observe the flame pattern.
- Adjust the flame to get oxidizing flame.
- Observe the flame pattern.

- Adjust the flame to get carburizing flame.
- Observe the flame pattern.
- Shut down the torch flame.
- Shut down and bleed the pressure from the system.

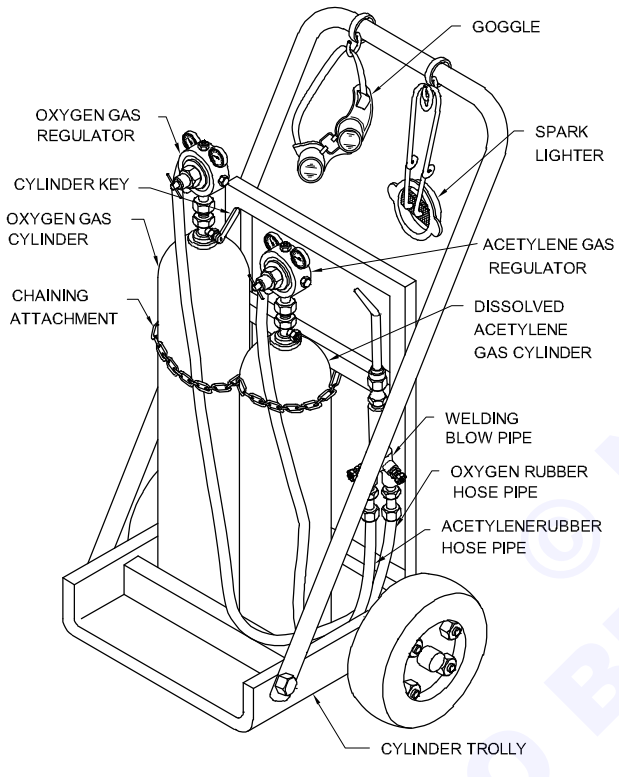
Skill Sequence

Setting of oxy-acetylene welding equipment, lighting and setting of flame

Objectives: This shall help you to
- **set up oxy-acetylene plant**
- **set up the flames neutral oxidizing and carburizing**
- **close down the gas welding plans.**

Setting up oxy-acetylene plant Fig 1

Fig 1



SETTING OF OXY-ACETYLENE PLANT

Move oxygen and acetylene cylinders with the caps from the store to the gas welding area.

An oxygen cylinder is identified by the black color painted on it. An acetylene cylinder is identified by the maroon color painted on it. Also the oxygen cylinder will be taller than an acetylene cylinder and the diameter of oxy-gen cylinder will be less than the diameter of an acetylene cylinder.

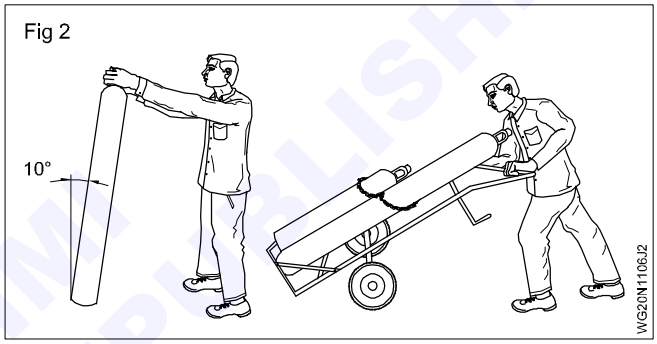
Ensure full cylinders are kept separately from the empty cylinders.

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.

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 2)

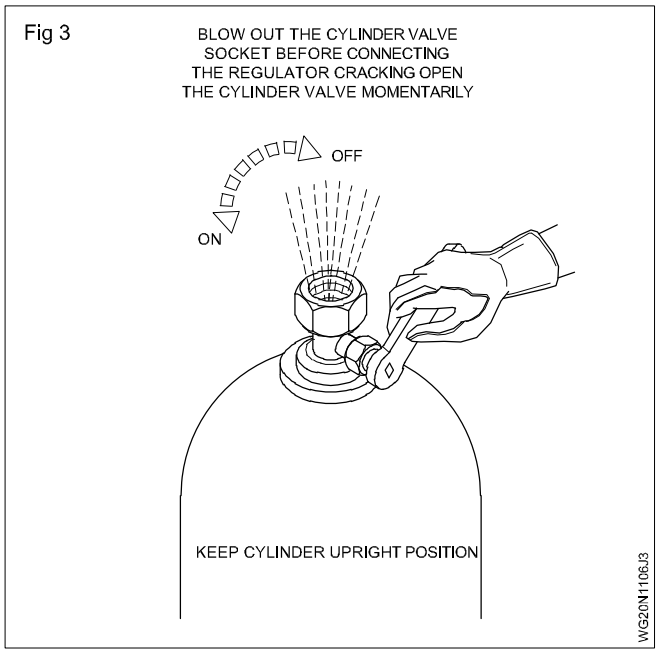
Fig 2



Do not roll the cylinders horizontally on the ground.

Remove the cylinder caps. Crack the gas cylinder valves by quickly opening and closing them using the cylinder key. Fig 3.

Fig 3



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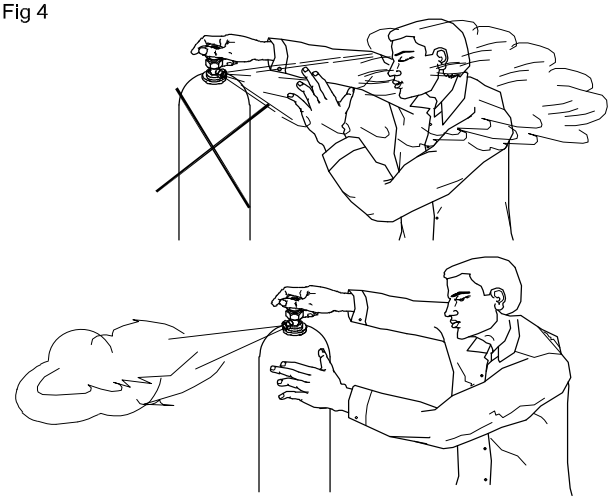
Dirt and dust particles from the cylinder valve sockets are cleaned by cracking the cylinder valve. This will avoid leakage of gas due to improper seating of the cylinder valve and also to prevent the dust particles from entering into the regulators which may cause damage to the regulators.

Always stand opposite to the valve outlet while cracking the cylinders. (Fig 4)

Fig 4



Ensure that your hands are free from grease or oil.

Connect the oxygen regulator to the oxygen gas cylinder (right hand threads).

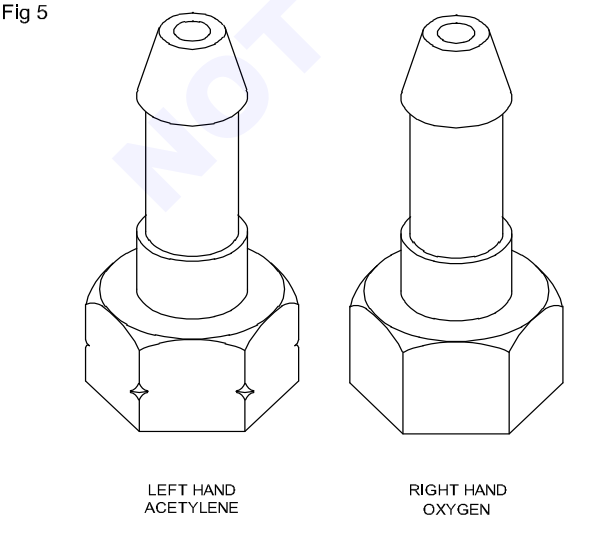
Connect the acetylene regulator to the acetylene gas cylinder (left hand threads).

Ensure the pressure adjusting screws of both regulators are in a released condition.

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 5) and the pressure gauge dial will be of maroon color.

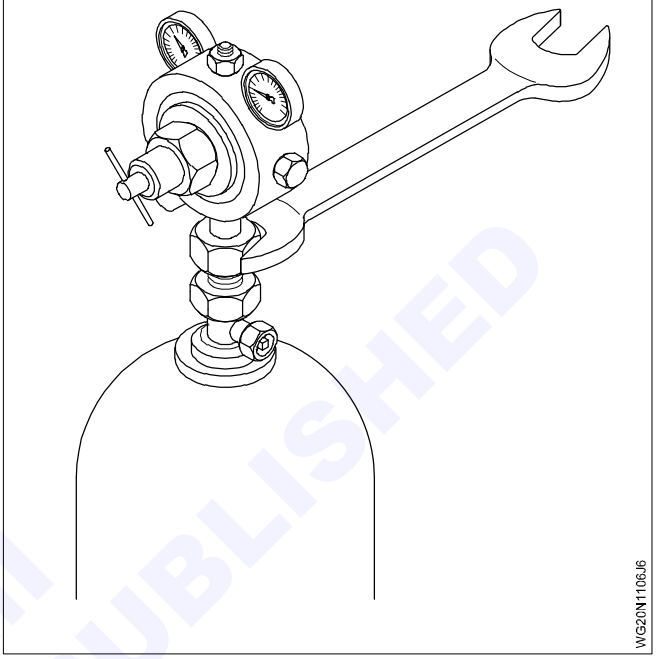
Fig 5



All threaded connections should be fixed initially 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 6)

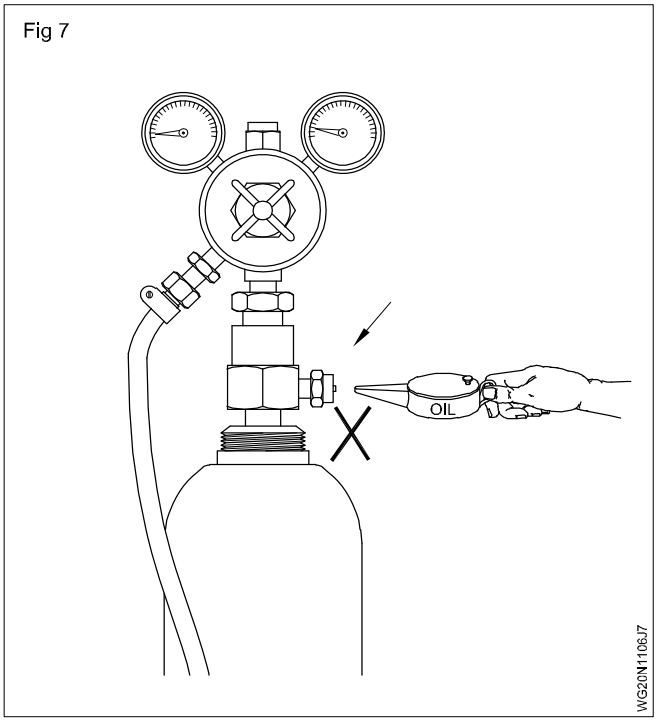
Fig 6



It is dangerous to apply lubricants in the threaded assemblies of gas welding equipment as it can cause fire. (Fig 7)

While tightening avoid undue force. The connections should be just tight.

Fig 7



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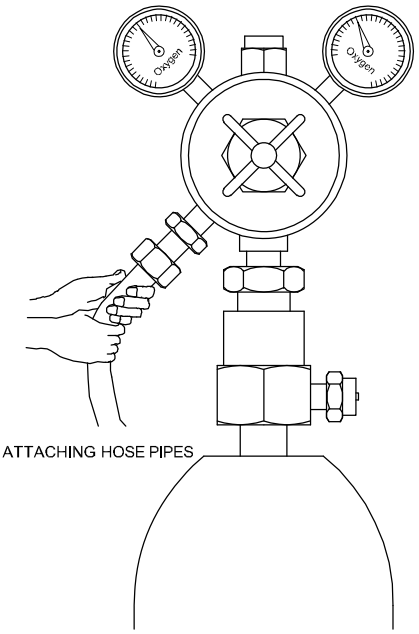
Connect the hose connector at the regulator end and the hose-protectors at the blowpipe end.

(Use black hose for oxygen line and maroon hose for acetylene line.)

Acetylene connections have left hand threads with a cut on the comers 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 colored hose-pipe to the acetylene regulator outlet. (Fig 8)

Fig 8



ATTACHING HOSE PIPES

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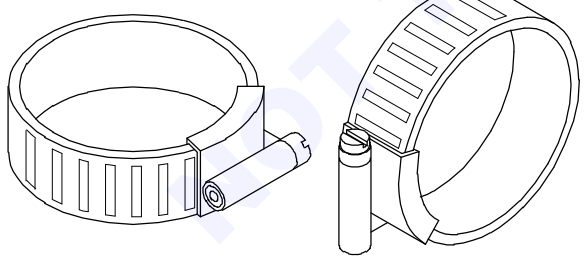
Secure the joints using hose-clips to ensure good grip and to avoid gas leakage.

Use a screwdriver to tighten the hose-clips.

Always use the correct size hose-clips. (Fig 9)

Fig 9



HOSE CLIPS

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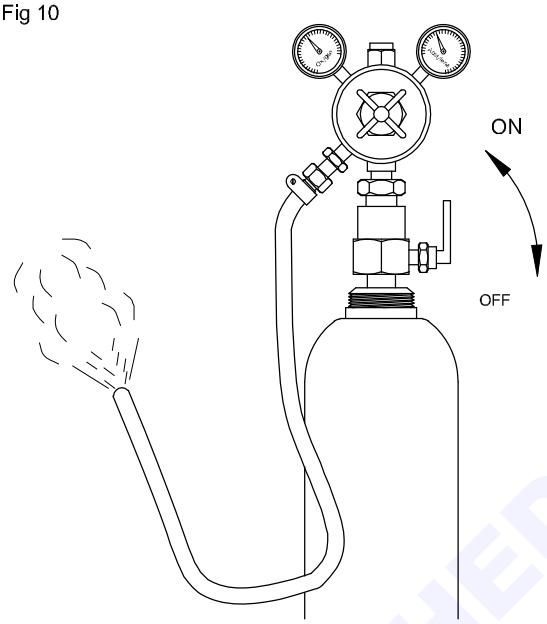
Turn on the pressure adjusting screw of the regulator to which the oxygen hose pipe is connected. (Fig 10)

Exert sufficient pressure to blow out dust or dirt particles if any are trapped inside the hose-pipe and then release the pressure adjusting screw.

Repeat the same for the acetylene hose also.

Fig 10



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

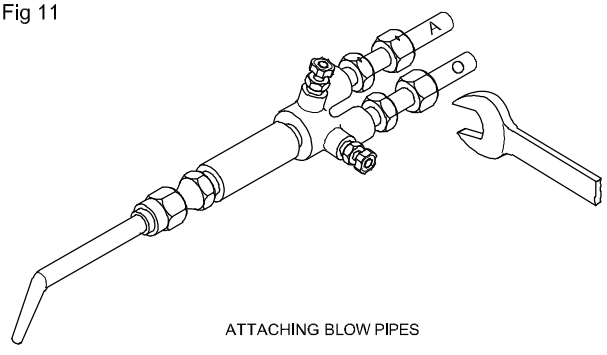
WG20N1106JA

Attaching blowpipe

The other end of the hose-pipe is to be attached to the blowpipe inlets. (Fig 11)

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 11



ATTACHING BLOW PIPES

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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.

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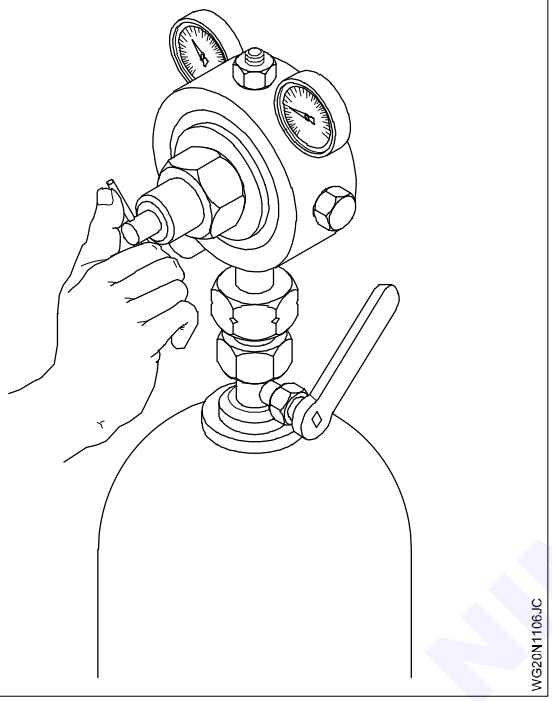
For adjusting the gas pressure, open the valves of both the cylinders slowly by one turn and set the pressure on both regulators as 0.15 kg/cm^2 for small size nozzles, by tightening the pressure adjusting screws. (Fig 12) Ensure the blow pipe control valves are kept open while setting the gas pressure.

The pressure can be read on the working pressure gauge of gas regulators.

Fig 12



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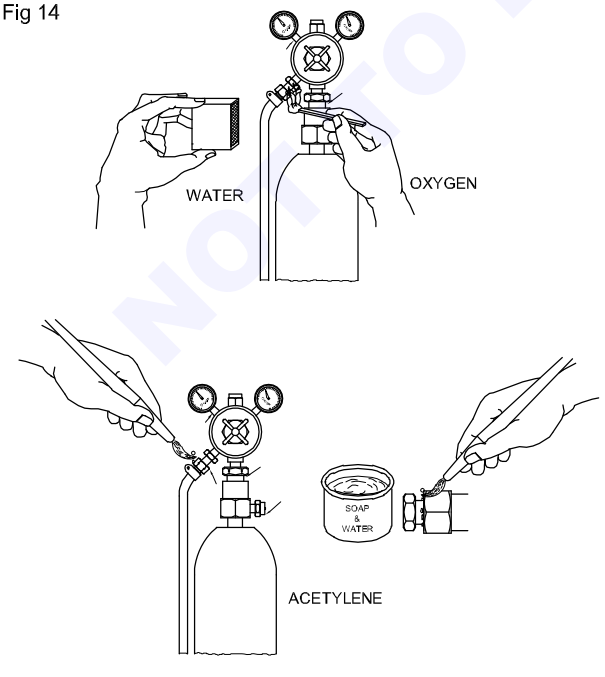
Testing for leakage

All connections must be tested for leakage.

Apply soap water solution for acetylene connections and fresh water for oxygen connections. (Fig 13)

Fig 14



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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.

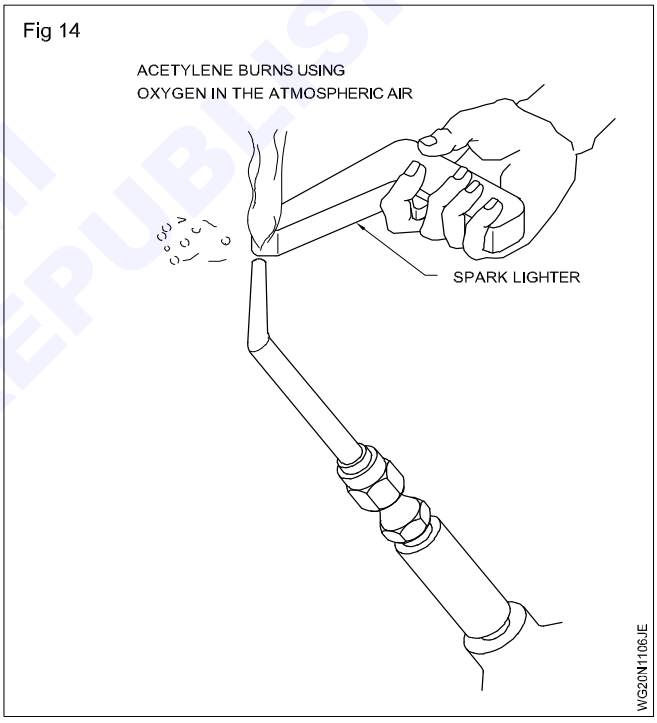
The pressure of oxygen and acetylene is 0.15 kgs/cm^2 for nozzle No. 3.

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 14) Acetylene burns using the oxygen in the atmospheric air with a black smoke.

Fig 14



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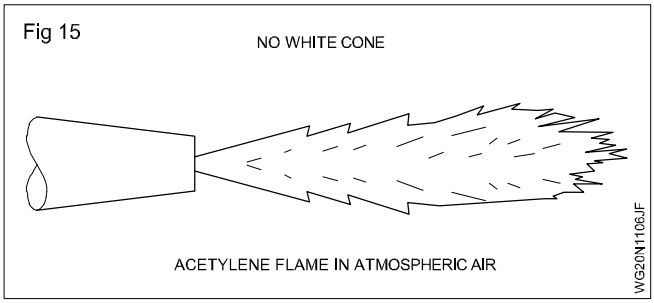
Avoid using any other source of fire other than the spark lighter. Point the blowpipe in a safe direction in the open space, away from you and others.

Increase the acetylene till the black smoke disappears. (Fig 15)

Fig 15



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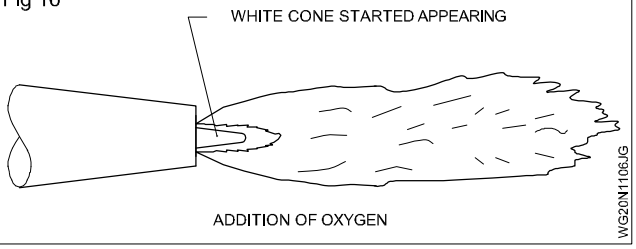
Observe the flame and add oxygen by opening the oxygen control valve of the blowpipe. Now a bright white cone starts appearing at the tip of the nozzle. (Fig 16)

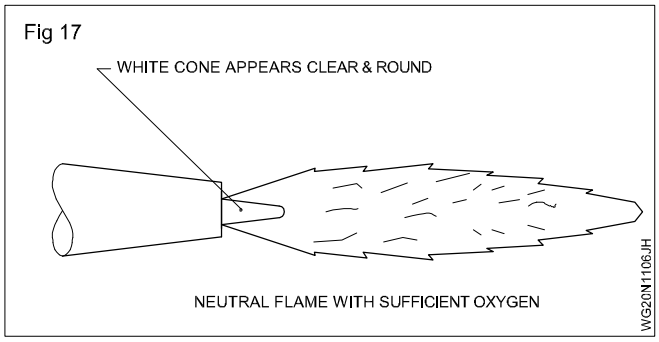
Fig 16



Flame adjusting to set different types of oxy-acetylene flames.

To adjust the neutral flame, add sufficient oxygen to make the white cone clear and round. (Fig 17)

Fig 17



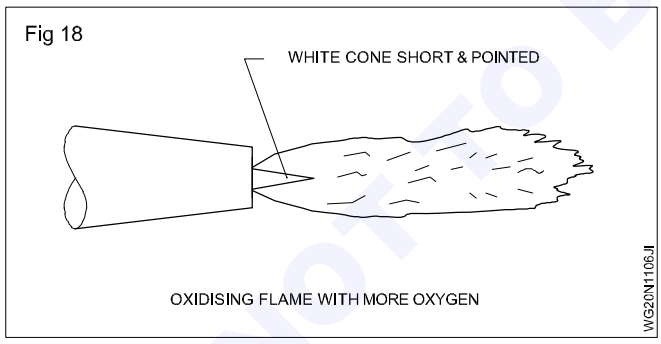
The gas mixture from the blowpipe has equal volume of oxygen and acetylene.

To adjust the oxidizing flame, from neutral flame decrease acetylene flow.

The white cone will become short and sharp.

The flame will produce a hissing sound and will have a short length. (Fig 18)

Fig 18



The gas mixture from the blowpipe has more volume of oxygen than acetylene.

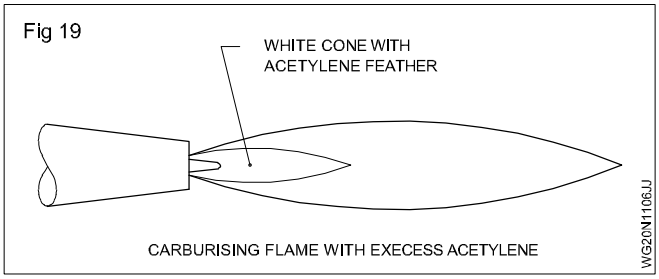
To adjust the carburizing flame, adjust the flame to neutral and then add acetylene.

The white cone will become long surrounded by a feather like portion.

The flame will burn quietly having more length. (Fig 19)

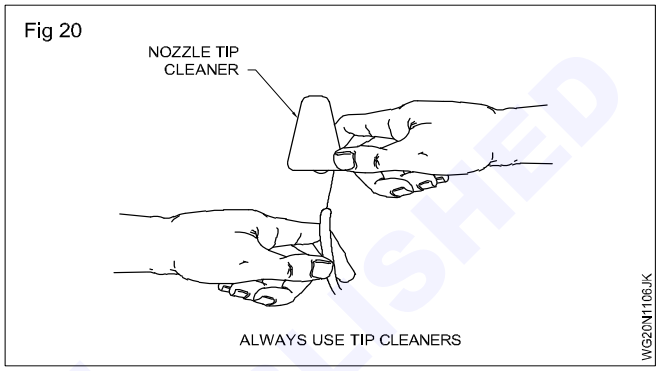
The gas mixture from the blowpipe has more volume of acetylene than oxygen.

Fig 19



After continuous use of the blow pipe during welding the nozzle may get blocked by metal particles or spatters. This blockage has to be removed to get continuous flow of gases by using a nozzle cleaner. (Fig 20)

Fig 20



Repeat the setting of flames till you manage to set the flame without any backfire or flash back.

Extinguishing the flame

To extinguish the flame close the acetylene control valve (blowpipe) first and then the oxygen control valve.

Closing down the plant

At the close of work, shut off the plant in the sequence given below.

Close the acetylene cylinder valve.

Close the oxygen cylinder valve.

Open the blowpipe acetylene valve and release all the gas pressure.

Open the blowpipe oxygen valve and release all the gas pressure.

Both the pressure gauges on the regulators should read zero.

Release the acetylene regulator pressure adjusting screw.

Release the oxygen regulator pressure adjusting screw.

Close the blowpipe acetylene valve.

Close the blowpipe oxygen valve.

Ensure

– there is no fire around the equipment

– the gas is completely exhausted by dipping the nozzle in water.

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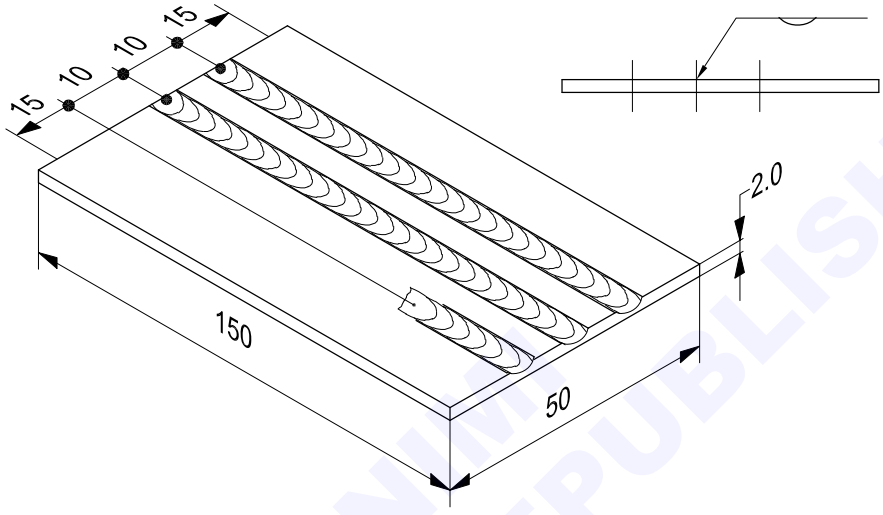
Fusion run without and with filler rod on M.S. sheet 2 mm thick in flat position.

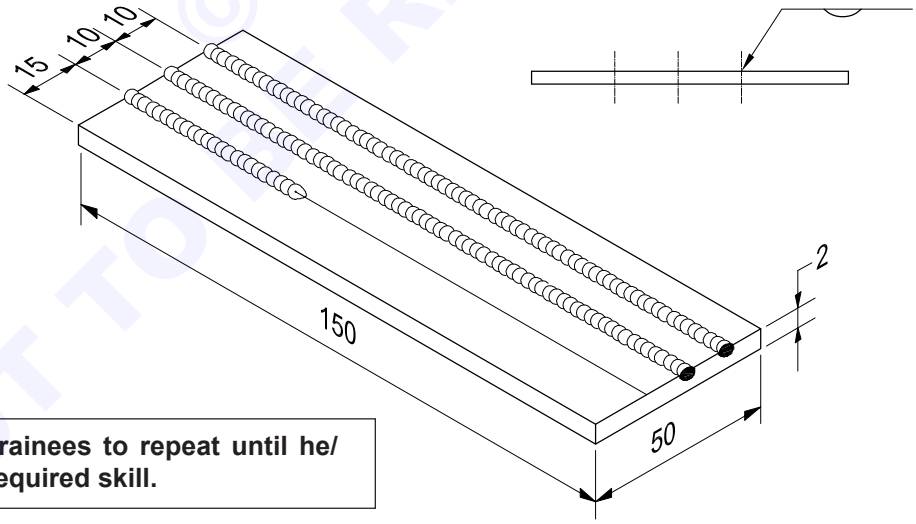
Objectives: At the end of this exercise you shall be able to

- **set job for flat position welding**
- **select and fit the correct size nozzle according to the job thickness**
- **set gas pressure according to nozzle size**
- **fusion run without the filler rod in flat position using leftward technique**
- **clean the weldment and visually inspect for weld defects.**

TASK 1



TASK 2



Note: Permit the trainees to repeat until he/ she acquired the required skill.

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01	ISST 150 x 2.0-50	-	Fe310-W	-	-	1.1.07
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	**FUSION RUNS WITHOUT AND WITH FILLER ROD ON MS SHEET 2mm THICK IN FLAT POSITION (QAW-01)**	DEVIATIONS	TIME : 8Hrs
		CODE NO. WL20N1107E1	

Job Sequence

TASK 1: **Fusion runs without filler rod in flat position**

- Mark and cut the M.S. sheet pieces of size 152 × 122 × 2.5mm using a hand lever shear.

Care should be taken to keep the fingers off from the shearing blades. Wear gloves to avoid injury.

- Straighten the cut pieces by hammering on an anvil.
- File and finish the sheet to dimensions as per drawing.
- Mark and punch parallel lines on the sheet surface as per sketch and set the job piece on the welding table in that position with fire brick support.
- Select and attach nozzle size 5 to the blowpipe.

Wear safety apparels and gas welding goggles.

- Set acetylene and oxygen pressure 0.15 kg/cm^2 on the regulators.
- Ignite the oxy-acetylene gases and adjust the neutral flame.
- Hold the blowpipe on the job at its right hand end at the required angle.
- Start heating the surface on the right end of the sheet with slight circular motion to the blowpipe and produce a molten pool on the marked line.
- Move the blowpipe from right to left direction maintaining a uniform speed and blow pipe angle.
- Avoid excessive concentration of heat at any one point.

If the metal becomes too hot, lift the blowpipe momentarily away from the molten pool.

Do not touch the inner cone with the molten pool, to avoid backfire and flashback.

- Keep the molten pool in correct size by adjusting the rate of travel and giving slight circular motion to the blowpipe.
- Stop at the left end and lift and blowpipe quickly.
- Extinguish the flame and cool the blowpipe in water.
- Clean the fused surface with a steel wire brush and inspect for the uniformity of fusion runs.

If the speed of travel and blowpipe motion are correct, the fusion runs will appear with uniform width and even ripples.

Repeat the above 4 more times to achieve uniform fusion and better manipulation of blowpipe.

— — — — — — — —

TASK 2: **Fusion run with filler rod in flat position**

- Select and fix the nozzle size 5 and set acetylene / oxygen pressure 0.15 kg/cm^2.
- Select copper-coated mild steel (CCMS) filler rod of ø1.6 mm.
- Wear safety apparels and gas welding goggles.
- Ignite the oxy-acetylene gases and set the neutral flame.
- Hold the blowpipe on the right hand at an angle of 60° - 70° with the punched line of the job and make a small molten pool at the right hand edge of the line.
- Keep the flame cone distance 2.0 to 3.0 mm above 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.
- Melt the base metal at the right end of a punched line and create a molten pool.
- Fuse the end of the filler rod by dipping at the center of the molten pool and add filler metal on the job surface to form a weld bead.
- Move both the blow pipe and the filler rod towards left with uniform speed along the punched line with a slight circular motion to the blowpipe.
- Move the filler rod up and down (piston like motion) at a constant speed.
- Add enough rod into the molten pool to build up the bead evenly in height and width.
- Adjust the rate of travel of the blowpipe with the filler rod to control the size of the bead and the required penetration/depth of fusion.
- Keep the filler rod end within the flame outer flame to avoid oxidation.
- Stop at the left hand end of the punched line by filling the crater properly.

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- Extinguish the flame and cool the nozzle.
- Clean the weld surface. Inspect for even ripples and uniform width/height of weld bead.
- Repeat this for the remaining 4 more punched lines to achieve better manipulation of blow pipe and filler rod.

Skill Sequence

Fusion run with and without filler rod

Objective: This shall help you to
- **set and carry out fusion run with and without filler rod.**

The beginner for gas welding must practice:

– holding the blowpipe in the correct position

– fusing of the metal by using a proper blow pipe manipulation

– getting proper coordination of both hands to manipulate the blow pipe and filler rod together

– deposit fusion run in a straight line from the right end to the left end of the job.

Preparation of sheet for welding

Use gloves while handling sheets.

2 mm is the shearing allowance so that the finished size after filling will be 150 × 50mm.

Remove buckling of sheet due to shearing by hammer on the anvil.

File the irregular edges of the job to remove burrs and unevenness on the edge to get a sheet size of 150 × 50mm.

Cleaning and setting job piece

Remove rust if any using a wire brush and emery paper.

Do not rub with heavy pressure on the wire brush.

Use the emery paper rolled on a piece of wood while cleaning.

Remove paint, oil or grease by dipping the M.S. sheet in a solvent of dilute hydrochloric acid.

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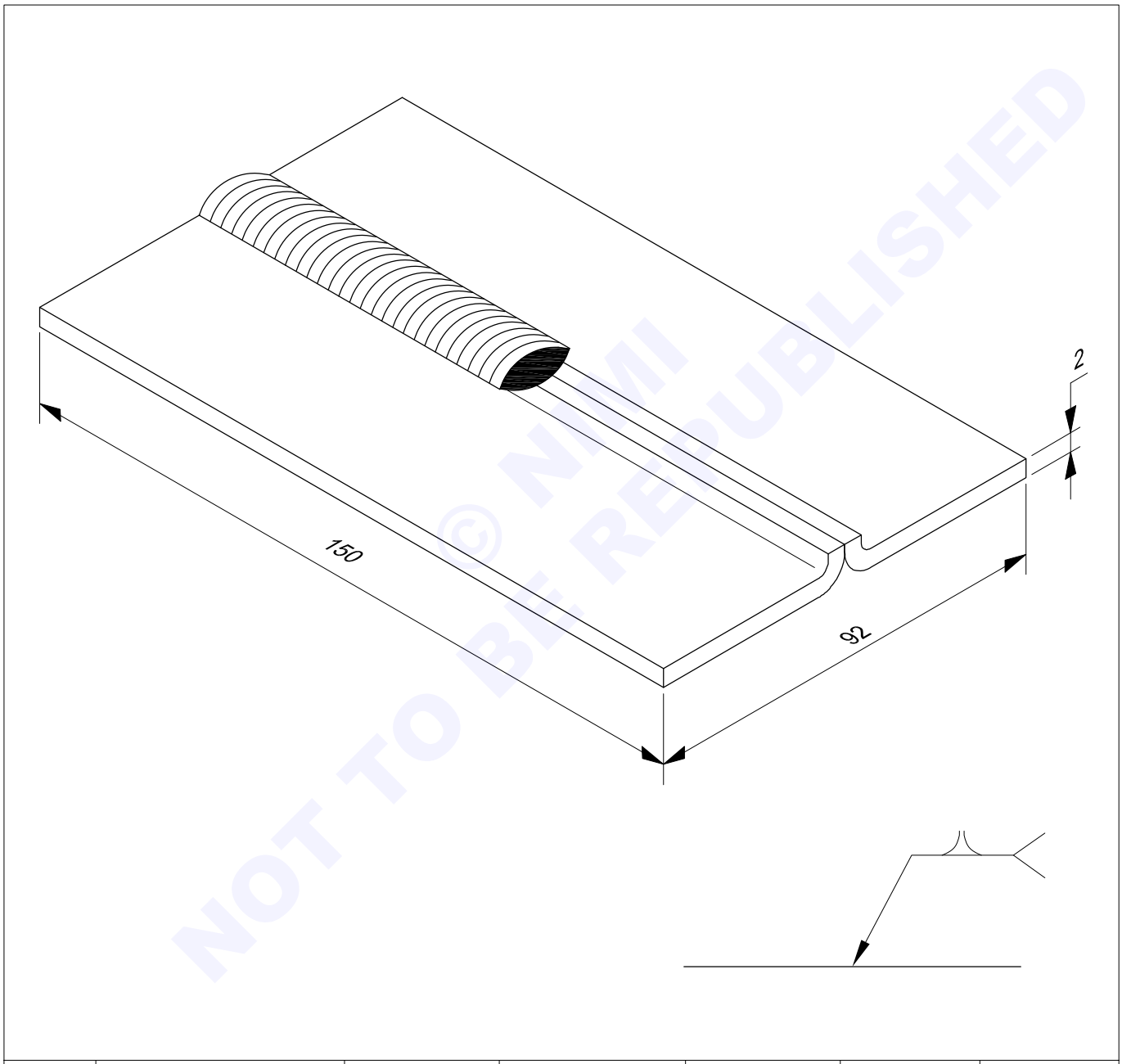
Edge joint on MS sheet 2mm thick in flat position without filler rod (OAW-03)

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

- **prepare the job to the given size as per drawing**
- **bend the edges of the plate as per drawing**
- **set the job as a edge joint and tack weld them**
- **weld the edge joint in flat position using leftward technique**
- **clean and inspect the edge weld for surface uniformity.**



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2	ISST 50 x 2 - 150		Fe 310 - W			1.1.08
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	EDGE JOINT ON M.S.SHEET 2mm IN FLAT POSITION WITHOUT FILLER ROD (QAW-03)				TOLERANCE ±1	TIME 7Hrs
					CODE NO. WG20N1108E1	

Job Sequence

- Prepare the job pieces as per drawing.
- File the edges of square and ensure through cleaning of the edges.
- Bend the edges of the plates to be joined at 90° to the surface.

The length of the bent portion should be twice of the thickness of the plate.

- Set the gas welding plant, fix nozzle No. 5 and set the gas pressure of 0.15 kg/cm^2 for both gases.
- Select CCMS filler rod 2mm ø for tacking and welding. (If necessary)
- Set neutral flame.
- Clean the tacks and set the job on the welding table in a flat position, over fire brick supports.
- Start the weld at right end of the job.
- Keep the blowpipe at 60° - 70°.
- Fuse the edges uniformly and proceed towards left.

Fuse the bent edges up to the entire surface of the plate.

- Stop at the left end, fill the crater and complete the weld.
- Extinguish the flame, cool the nozzle in water.
- Clean the welded joint and inspect for
  - Uniform width and height of bead.
  - Uniform ripples.

Skill Sequence

Edge joining on MS plate

Objective: This shall help you to
• join the edge of the MS plate.

Preparation: Prepare the job pieces of size 150×50×2mm by shearing and then filing.

Setting and bending:

- Bend the edges of the plates.
- Set the prepared job pieces on the welding table and tack at both ends.
- Length of the tack weld is 5 mm approximately.
- Check the alignment after tacking.

Welding

- Start the weld at the right end of the joint.
- Use leftward technique.
- Maintain uniform travel speed and feed to the flame.
- Clean the deposited bead using wire brush.

Use all the safety apparels and gas welding goggles.

Inspection

Inspect the quality of weld by

- Checking the finish of the job.
- Checking the uniformity of width and height of the weld bead in size.
- Checking the uniformity of ripples, fusion and complete penetration.
- Checking that the weld is free from faults such as porosity, undercut, lack of fusion etc.

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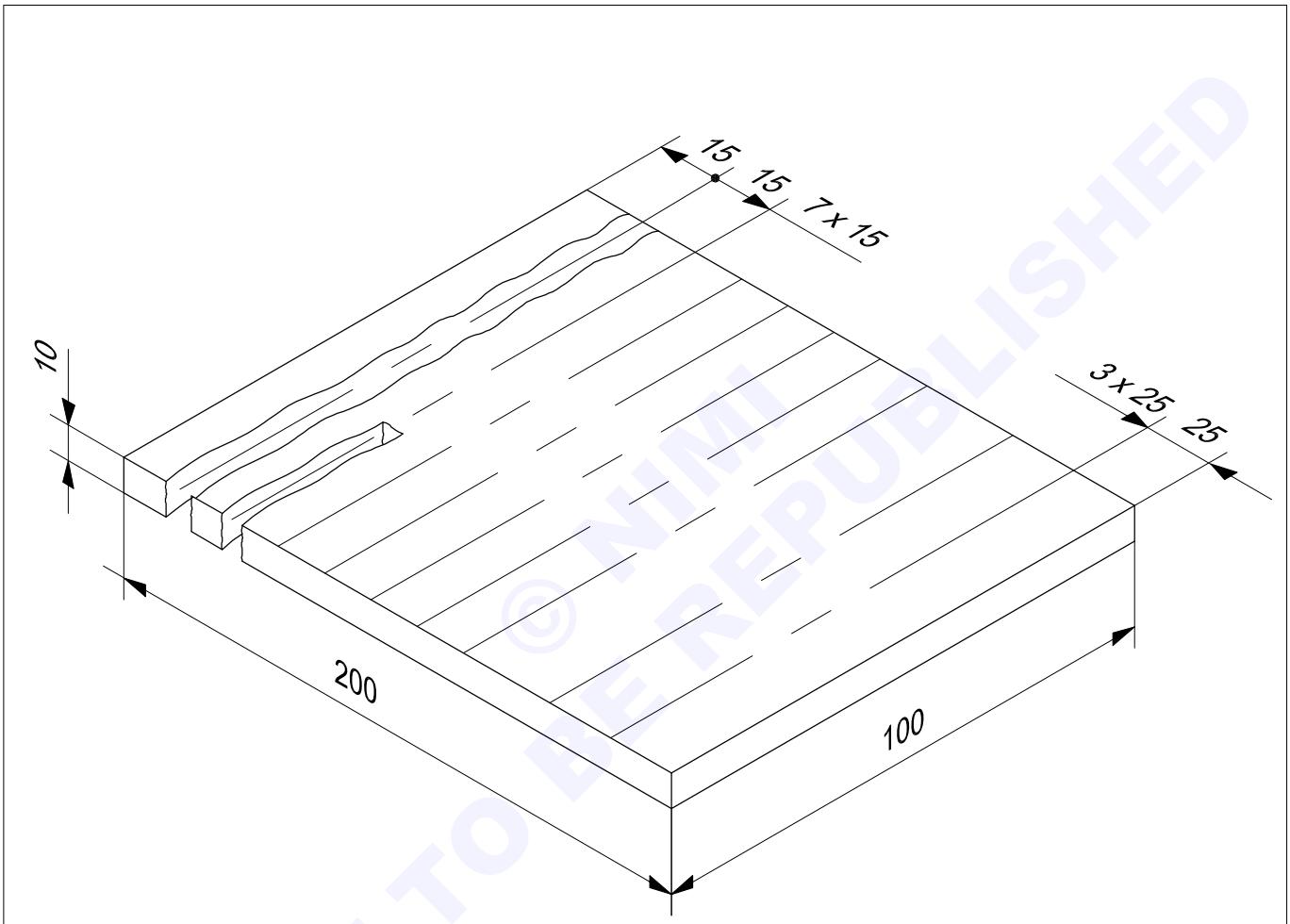
Marking and straight line cutting of MS plate. 10 mm thick by gas

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

- **set the work piece for a straight cutting**
- **adjust the gas cutting flame**
- **gas cut along a straight line by hand**
- **observe safety while cutting with gas**
- **clean and inspect the gas cut surface.**



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1	100 ISF x10 x 200	-	Fe310-W	-	-	1.1.09
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE 1:2	MARKING AND STRAIGHT LINE CUTTING OF M.S.PLATE 10mm THICK BY GAS	DEVIATIONS	TIME 2hrs
		CODE NO. WG20N1109E1	

Job Sequence

- Wear complete safety apparel.
- Set the gas welding plant with a cutting blowpipe.
- Attach the correct nozzle according to the thickness of the metal.
- Adjust the gas pressure of acetylene and cutting oxygen according to the thickness of the metal and the cutting nozzle.
- Clean the surface to be cut.
- Punch a straight line.
- Adjust proper cutting flame.
- Hold the cutting blowpipe at 90^0 to the cut line and plate surface.
- Hold at one end of the plate on the punch line up to cherry red hot.

Keep a distance of about 5mm between the work piece and the nozzle.

- Release the cutting oxygen and observe the cutting action.
- Move the cutting blowpipe towards the other end, following the procedure line.

Maintain a correct speed and distance of the nozzle.

- Close the cutting oxygen and shut off the flame on the completion of the cut.
- Clean the cut and inspect for its accuracy.

Skill Sequence

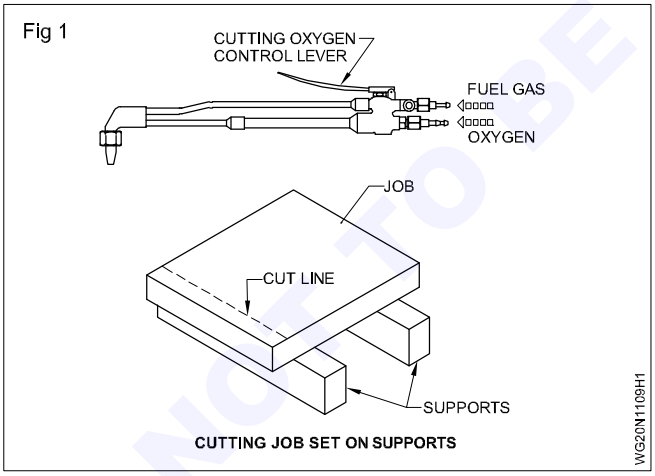
Straight cutting along by hand

Objectives: This shall help you to
- **set an oxy-acetylene plant for gas cutting**
- **gas cut in a straight line by hand**
- **inspect the faults in a gas cut.**

Setting the gas cutting plant: Set the oxy-acetylene plant and connect the cutting blowpipe.

Setting the job for cutting (Fig 1)

Fig 1



CUTTING JOB SET ON SUPPORTS

Set the job for cutting on a rigid surface.

Provide overhang so that the parting piece is free to fall.

Ensure the underside of the cut line is free from any obstruction.

Wear safety apparel while gas cutting.

Adjusting the cutting flame

Select the cutting nozzle and set the gas pressure as per the cutting job thickness. (Table 1)

Set the cutting nozzle in the blowpipe correctly.

TABLE 1

Data for cutting

Diameter of cutting oxygen orifice nozzle	Thickness of steel plate	Cutting oxygen Pressure
(1) mm	(2) mm	(3) kg/cm^2
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

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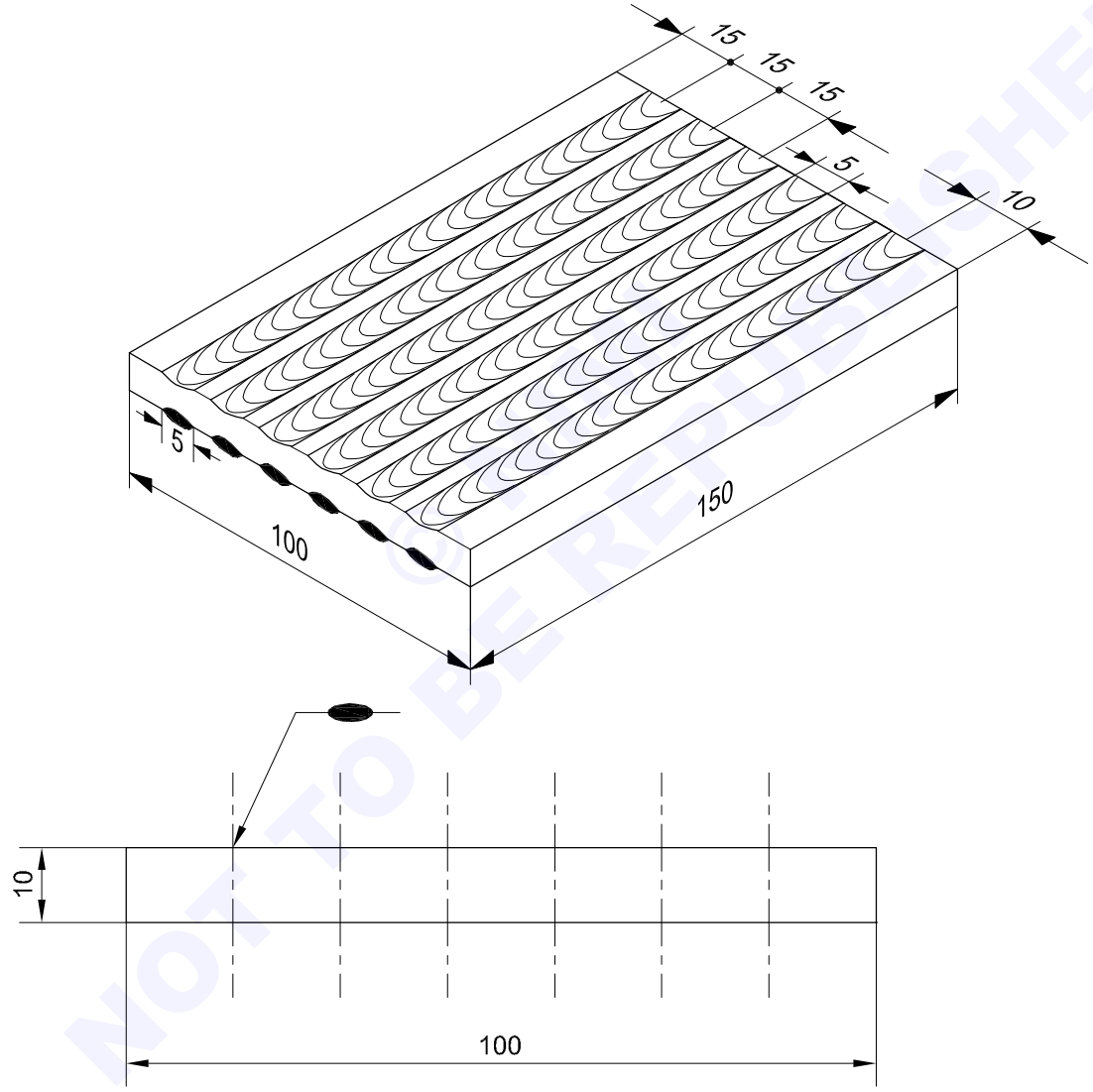
Straight line beads on MS plate 10mm thick in flat position (SMAW - 02)

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

- **prepare and set job pieces for straight line beading**
- **select the electrode, current and polarity for depositing the weld beads**
- **deposit uniform straight bead in flat position by arc welding**
- **maintain constant arc length, electrode angle and travel speed**
- **restart a broken arc and fill the crater properly**
- **remove and clean the slag and spatter from the weld bead using a chipping hammer and wire brush**
- **inspect deposited beads for any surface defects.**



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1	100 ISF 10 - 150		Fe 310 - W			1.1.10
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**STRAIGHT LINE BEADS ON M.S.PLATE10mm THICK IN FLAT POSITION (SMAW-02)**				TOLERANCE ±1	TIME
					CODE NO. WG20N1210E1	

Job Sequence

- Prepare the plates to size (as per drawing) by Hack-saw cutting and grinding.
- Clean the plate surface (job) with a stainless steel wire brush and remove the burrs by filing.
- Lay out parallel lines on both sides of the job surface as per sketch and mark with a center punch.
- Set the plate on the welding table in a flat position.
- Ensure the plate is contacting well with the welding table and the earth clamp is not loosely connected with the work table.
- Wear protective clothing (safety apparels).
- Use welding goggles.
- Ensure the filter glass of the welding shield is in good condition.
- Fix a 3.15 mm ø M.S. electrode in the holder.
- Set the welding current to 90 to 110 amps approximately.
- Connect the electrode cable with the transformer welding machine. In case of a DC welding generator or rectifier, connect it to the negative terminal.
- Connect the earth clamp on the right extreme end of the job/work table.
- Start the welding machine.
- Strike the arc on a scrap piece for trial and observe the current setting.
- Ensure the burning of the electrode is normal and the arc is smooth.
- Readjust the welding current if necessary.
- Use a short arc.
- Deposit straight line beads on the work piece along the punched line from the left hand end to the other end.
- Hold the electrode at 60° to 70° to the line of weld. Move it along the line of weld and towards the job at uniform speed.
- Restart the bead whenever the arc is broken and ensure to fill the crater.
- Fill the crater at the end of the bead without fail.
- Remove slag from the weld bead using a chipping hammer and clean with steel wire brush.
- Use a chipping screen while Deslagging.
- Inspect deposited beads for:
  - uniform width and height
  - straightness
  - uniform ripples
  - slag inclusion
  - unfilled crater
  - porosity
  - undercut
- Repeat the exercise on the other side of the plate.

Skill Sequence

Straight line bead on MS plate in flat position

Objective: This shall help you to
- **set and weld the straight line beads on MS plate in flat position.**

Prepare a M.S. plate piece 100×150×10 using a hacksaw and file.

Mark straight line, punch the line keeping 15mm distance in between. (Fig 1)

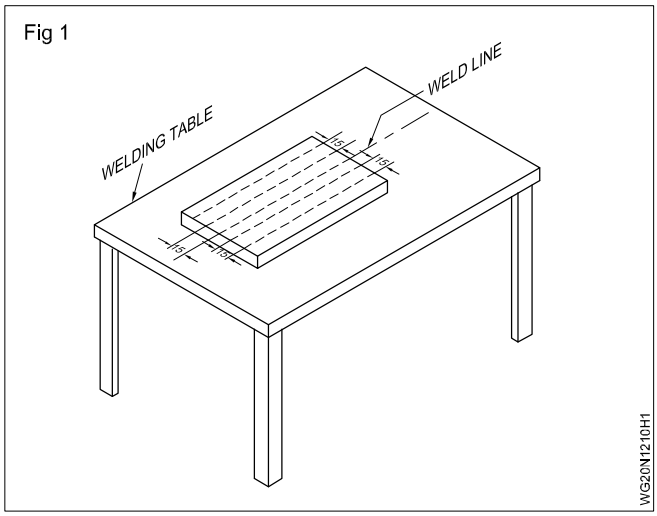
Set the job on the welding table in a flat position with the punched surface facing up. (Fig 1)

The bottom surface of the job should be perfectly clean to get good electrical contact between the job and the welding table.

Always follow the current range according to the diameter of the electrode, as given in the electrode packet by the electrode manufacturer.

Check for proper melting of the job and electrode on a scrap metal piece.

Fig 1



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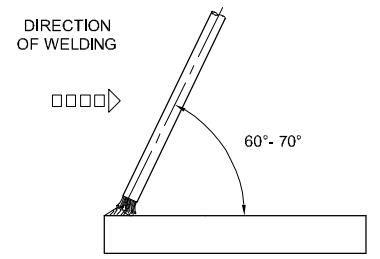
Hold the electrode at an angle of 70° to 80° with weld line/ punched line. (Fig 2)

Fig 2



ELECTRODE ANGLE WITH WELD LINE

When a DC welding machine is used connecting the earth cable at the right end of the job or work table will help to deposit the weld metal at the correct place in the joint.

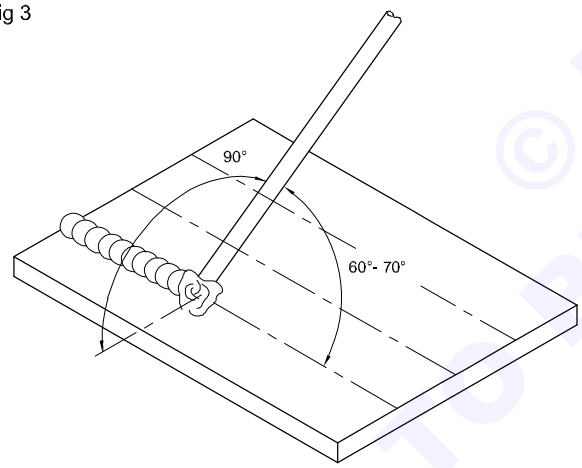
Deposit straight line beads taking the punched lines as a guide maintaining:

– the medium arc length (L) (i.e. equal to dia. of electrode used (d). If a DC welding machine is used then use of a short arc length will help to reduce the deviation of the molten metal from its intended path.

– correct travel speed (approximately 150 mm per minute)

– correct electrode position/angles. Fig 2 and 3

Fig 3



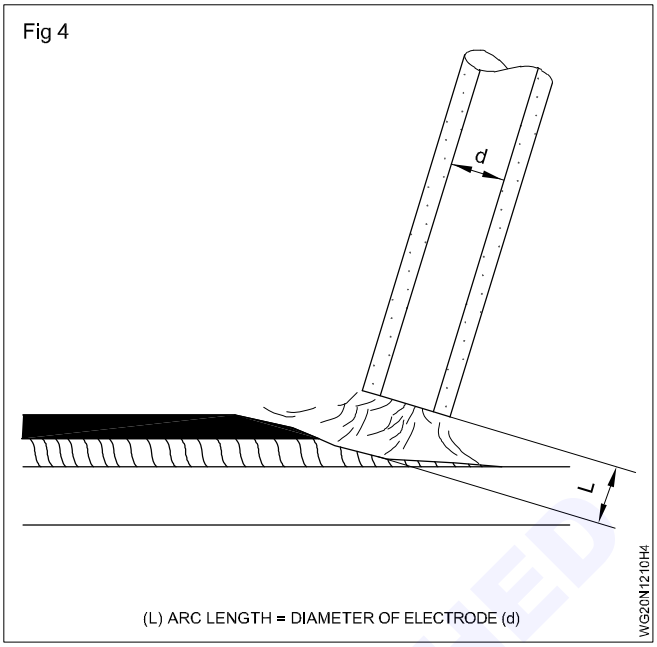
The electrode should be moved towards the job to maintain a gap between the tip of the electrode and the molten pool. (Fig 4)

Welding screen glasses should be clean enough to see the arc action on the molten pool and punched line mark.

Listen to the arc's steady sharp crackling sound while welding. It indicates uniform burning of the electrode.

Adjust the travel speed by watching the electrode melting rate and flowing through the molten pool to form the deposited metal. The uniform travel speed of the electrode along and towards the line of the weld gives a uniform bead.

Fig 4

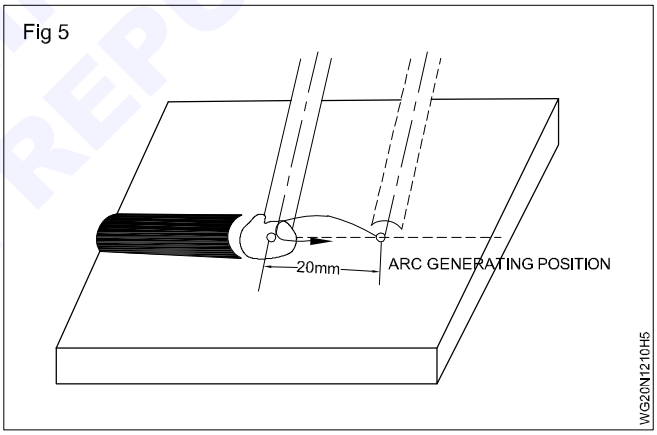


(L) ARC LENGTH = DIAMETER OF ELECTRODE (d)

Whenever the arc is broken a depression called crater is formed at the breaking point and this crater has to be filled first while restarting the arc. So clean the crater and generate an arc at about 20mm ahead of the crater and return to the crater at a faster rate.

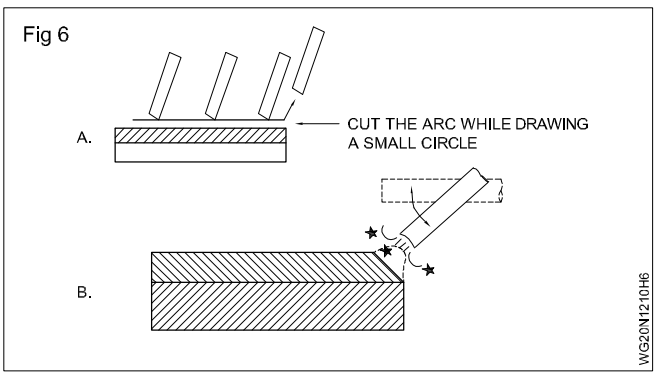
Build the deposit so that it fills the crater, then move the electrode ahead. Fig 5.

Fig 5



Also after completion of each bead fill the crater as follows. Fig 6

Fig 6



Build the deposit on the crater so that it is the same level as the welding bead.

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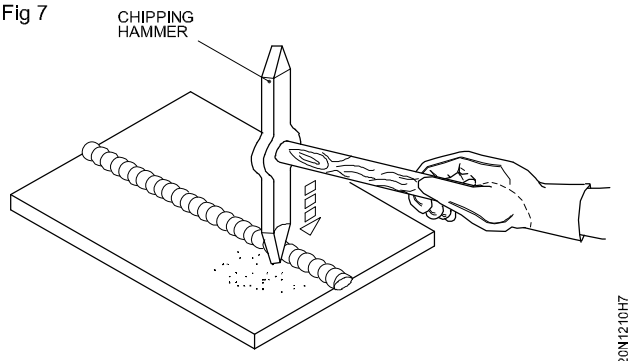
– Let the arc length be shorter at the end of the run and draw a small circle 2 to 3 times.

– Repeat Off and On the arc at the end.

Fill the crater. Fig 6

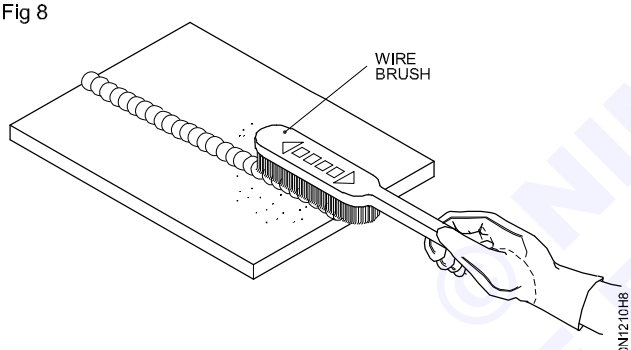
Remove the slag and spatters from the weldment using a chipping hammer and wire brush, so that the metal surface of the bead is exposed for checking for any defects. (Figs 7 and 8)

Fig 7



CHIP OFF THE SLAG

Fig 8



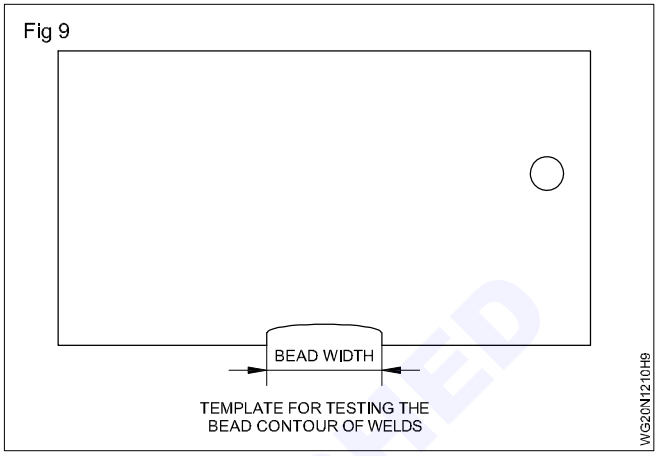
REMOVE ALL SLAG AND SPATTER

Determine the causes for the above weld defects and use the remedial/prevention methods in further deposits.

Check the deposited beads and note any variation in the:

– width and height using a template Fig 9.

Fig 9

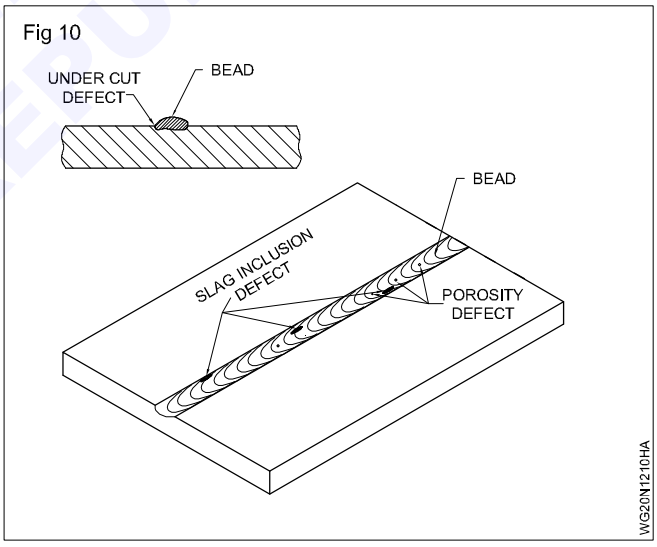


– depth of fusion

– straightness of the run

– check for surface defects such as slag inclusion, surface porosity, undercut, improper bead profile etc. Fig 10

Fig 10



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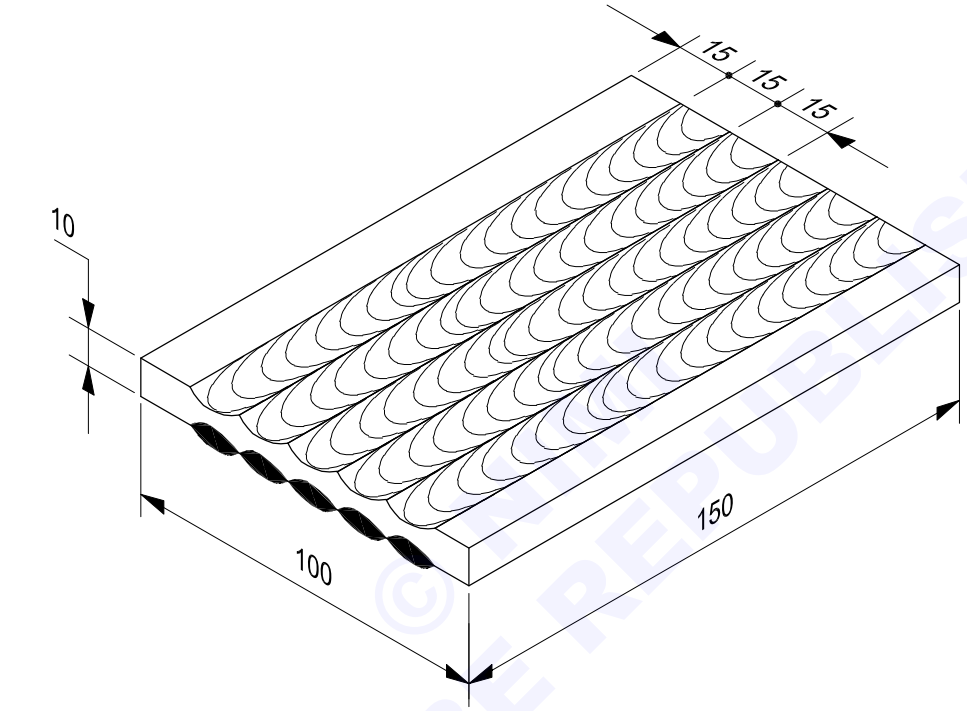
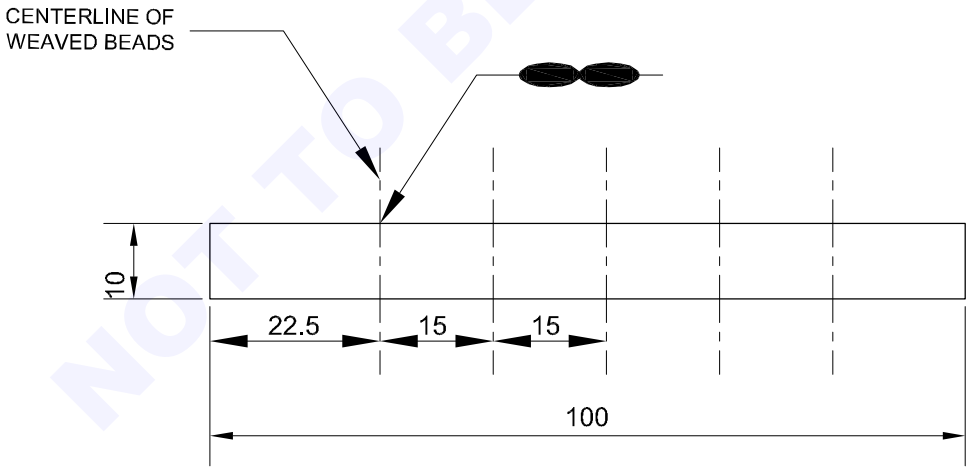
Weaved beads on MS plate 10mm thick in flat position (SMAW-03)

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

- **prepare and set the plate pieces for depositing weaved beads**
- **select and set the electrode, current, polarity**
- **deposit uniform beads by weaving the electrode in flat position**
- **maintain the required arc length, electrode travel speed and angle**
- **restart and end the bead properly without crater defect**
- **inspect to ensure the welds are free from defects and of specified size.**





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1	100 ISF 10 - 150		Fe 310 - W			1.1.11
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**WEAVED BEADS ON M.S PLATE10mm THICK IN FLAT POSITION (SMAW-03)**				TOLERANCE ±1	TIME
					CODE NO. WG20N1211E1	

Job Sequence

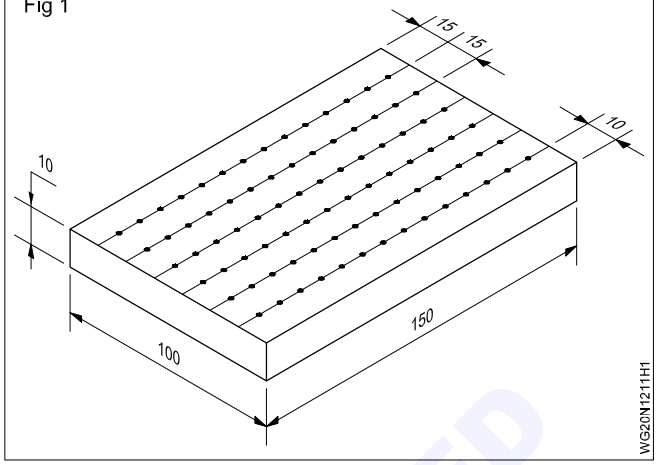
- Prepare the job to size as per the given drawing.
- Ensure the job piece is free from oil, grease, paint, dirt etc.
- Clean the job surface with a steel wire brush and by grinding the edges.
- Mark parallel lines on the job surface as per drawing for depositing weave beads and punch.
- Set the work piece (job) on the welding table in a flat position.

Wear protective clothing (safety apparels).

- Inspect the welding screen glasses for spatters and for suitable shade number.
- Select 4mm ø medium coated M.S. electrode. (BIS Code:ER4211)
- Set the welding current between 150 - 160 amps.
- Observe the electrode burning rate on a scrap piece and re-adjust the current, if necessary.
- Deposit the weaved beads on the work piece between the punched lines from one end to the other.
- Restart the weld whenever the arc is put off or when changing electrode or otherwise.
- Stop weld in the end and fill up the crater.
- Deslag the weld bead using a chipping hammer and clean with a steel wire brush.

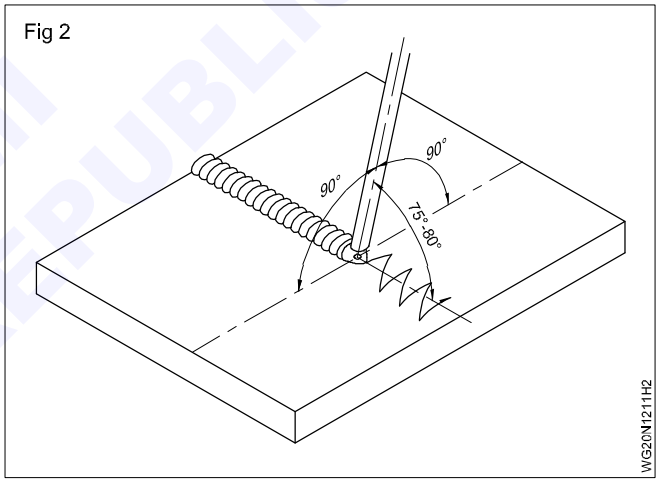
  Use chipping goggles and tongs during Deslagging.
- Inspect the deposited weaved beads for:
  - uniform width and height
  - straightness of beads
  - uniform ripples
  - overlap on sides of weld
  - external weld defects like undercut, porosity, slag inclusion etc.
  - unfilled crater
  - restarting defects.
- Repeat the exercise till you produce uniform weaved beads, with correct restarts and stops.
- Position the electrode with the weld line at an angle of 75° - 80° Fig 1
- position the electrode with the adjoining plate surface at an angle of 90° giving side-to -side weaving motion using the arm movement. avoid using wrist movement for electrode weaving.

Fig 1



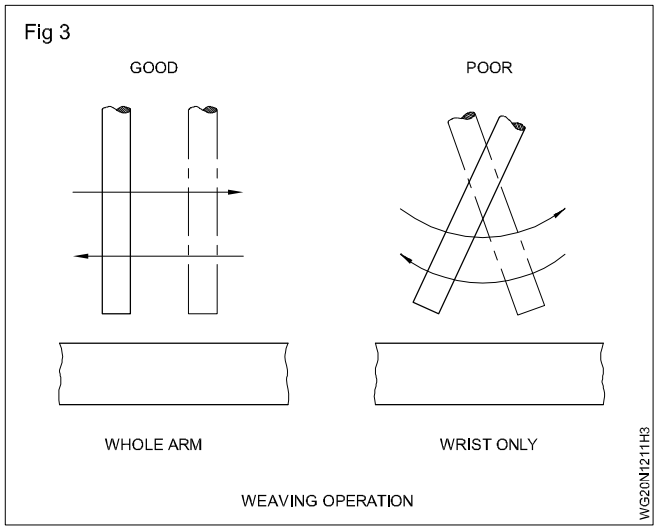
- Deposit the weaved beads between the punched lines by:
- Positioning the electrode correctly (as shown in the Fig 2)

Fig 2



- Weaving the electrode side-to-side. (Fig 3)
- Restrict the weaving motion to three times the electrode diameter i.e. 10 to 12mm for 4mmø electrode.

Fig 3



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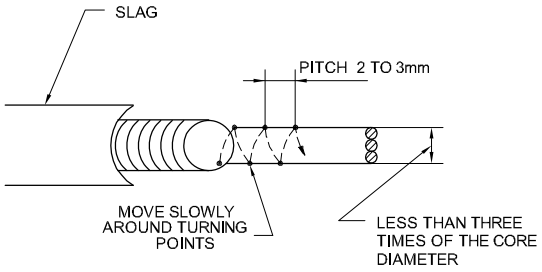
- Advance the bead on each weave by not more than 2 to 3 mm, so that the light, thin, molten slag will always be kept away from the molten pool of metal. Fig 4.
- Advancing the bead too far ahead will result in slag inclusion and poor appearance.

Fig 4



1) KEEP THE ELECTRODE AT 90° AGAINST THE BASE METAL AND 75 TO 80° AGAINST THE WELDING DIRECTION.

2) MOVE THE ELECTRODE FROM SIDE TO SIDE AND STOP FOR A SHORT MOMENT AT EACH SIDE.

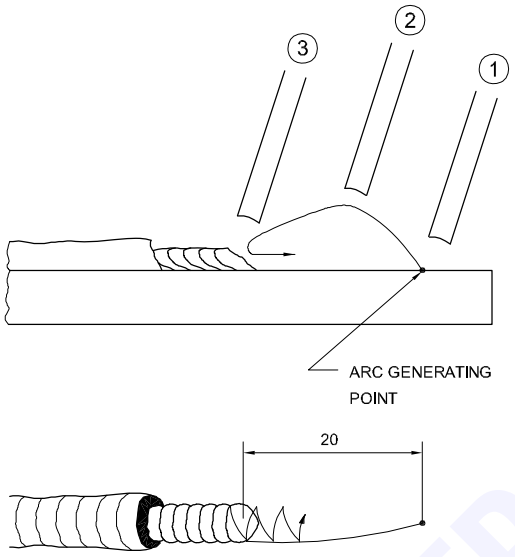
a.THE WEAVING WIDTH SHOULD BE WITH IN THREE TIMES OF THE CORE WIRE DIAMETER.
b.MOVE THE ELECTRODE AT A CONSTANT PITCH BY USING THE WHOLE ARM

WG20N1211H4

Restarting of bead

- To ensure a good restart, proper fusion and fill up at the crater, proceed as follows.
- Remove the slag about 25 mm from the end of the crater.
- Restart with a long arc at the forward edge of the crater. (Fig 5)

Fig 5



1) CLEAN THE CRATER
2) INITIATE AN ARC AT ABOUT 20mm AHEAD OF THE CRATER AND RETURN TO THE CRATER
3) BUILD THE DEPOSIT SO THAT IT NEARLY FILLS THE CRATER, THEN PROGRESS

WG20N1211H5

- Move the arc slowly across the crater reducing the arc length and fill the crater.
- Start forward travel at the normal rate with medium arc length.

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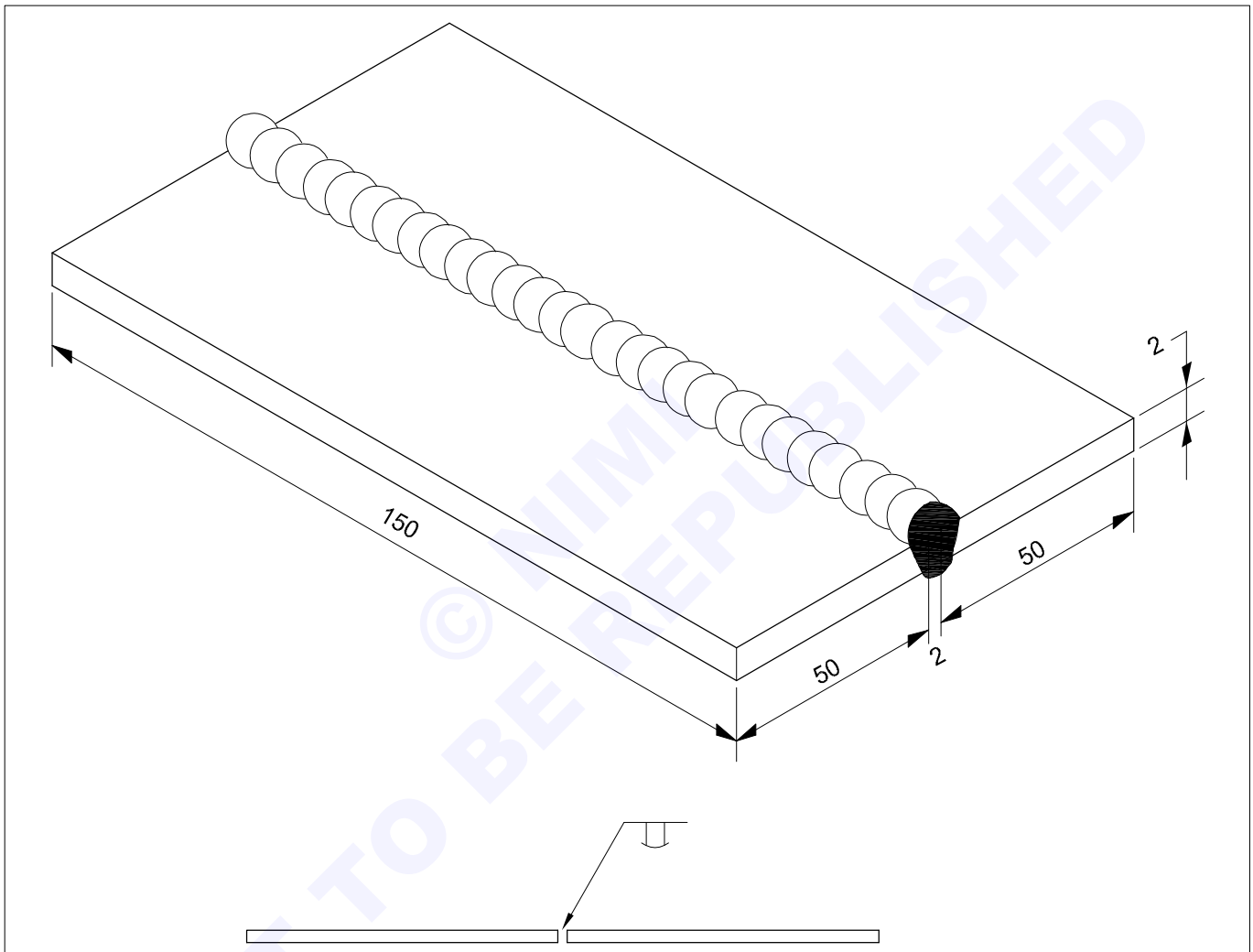
Square butt joint on MS sheet 2 mm thick in flat position

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

- **prepare the job as per drawing**
- **set the root gap and tack weld them**
- **weld the square butt joint in flat position using leftward technique**
- **clean and inspect the weld defects.**



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2	ISST 150 X 50 X 2		Fe 310 - W			1.2.12
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	BUTT WELD - SQUARE BUTT JOINT ON M.S SHEET 2mm IN FLAT POSITION (1G)				TOLERANCE ±1	TIME
					CODE NO. WG20N1212E1	

Job Sequence

- Prepare the job pieces as per drawing.
- File the edges to square and ensure thorough cleaning of the joining edges.
- Set the job pieces on the welding table to form a square butt joint with a root gap of 1mm.
- Set the gas welding plant, fix nozzle No. 5 and set the gas pressure of 0.15 kg/cm^2 for both gases.
- Select C.C.M.S. filler rod 1.6 mm ø for tacking and welding.

Wear safety apparels and gas welding goggles.

- Set neutral flame.
- Tack the pieces at both ends and at center, using 1.6 mm ø filler rod with 1mm root gap at right end and 3mm root gap at the left end.

Tacks should be well fused and penetrated and done on the bottom side of the joint.

- Check the alignment and root gap and reset if necessary.
- Clean the tacks and set the job on the welding table in a flat position, over fire brick supports.

Turn the tack weld side down.

- Start the weld at the right end of the job.
- Direct the flame at the beginning of the seam (welding line) with the blowpipe nozzle at an angle of 60° - 70° towards right.
- Hold the filler rod at an angle of 30° - 40° with the seam towards left.
- Fuse the edges uniformly and add filler metal by up and down (piston like) motion and proceed to weld towards left.
- Maintain a uniform speed of the blowpipe with slight circular motion.
- Stop at the left end, fill the crater and complete the weld.
- Extinguish the flame, cool the nozzle in water and keep it on the cylinder trolley.
- Clean the welded joint and remove distortion.
- Inspect the joint by visual inspection for:
  - slight convexity with uniform width and height of bead without undercut.
  - uniform ripples without porosity.
  - uniform root penetration.
- Repeat the exercise till you get good results.

Skill Sequence

Square butt joint

Objective: This shall help you to
- **prepare and gas weld the square butt joint.**

Preparation: Prepare the job pieces of size 150×50×2.0 mm by shearing and then by filing.

Setting and tacking: Set the prepared job pieces on the welding table with a root gap of 1mm at the right end and 3mm at the left end and in alignment. (Fig 1)

The root gap is increasing from right end to the left end because the gap will get closed as the weld proceeds towards the left end, due to expansion of the base metal.

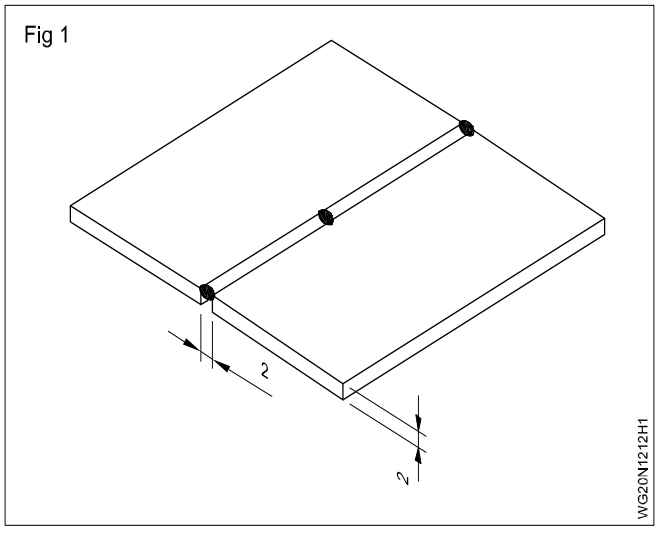
Tack-weld the joint at equal intervals to hold them together, maintaining the alignment. (Fig 1)

Ensure that the

– distance between the tack-welds is 75 mm.

– length of the tack-weld is 6 mm.

Fig 1



Tack welds should be on the back side of the joint to be welded and in line with the joint.

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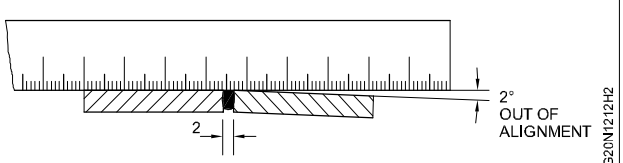
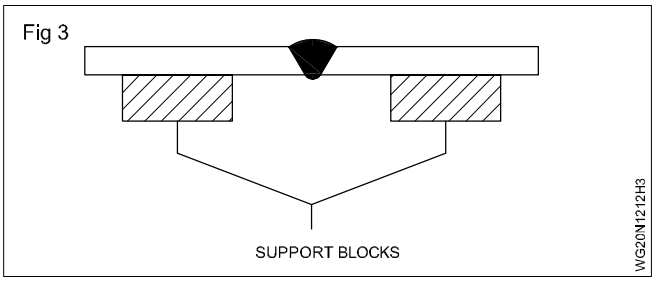
Check the alignment after tacking, and reset, if the sheets are out of alignment. (Fig 2)

Fig 2



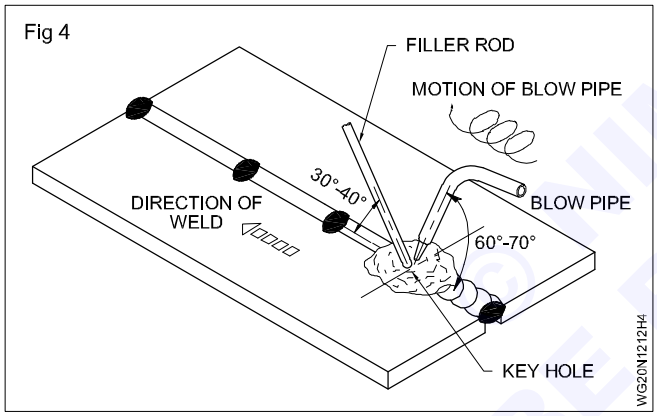
Welding: Keep free space under the joint for complete penetration. (Fig 3)

Fig 3



Start the weld at the right end of the joint. (Fig 4)

Fig 4



Weld a well fused uniform bead with complete penetration using leftward technique. (Fig 4)

Manipulate the blowpipe to maintain necessary motion to the blow pipe and the filler rod and the recommended angle of blowpipe and the filler rod.

Maintain uniform travel speed and feed to the flame and the filler rod.

Maintain a keyhole which is a clear indication that the melting is taking place up to the bottom of the root of the joint ensuring better root penetration. (Fig 5)

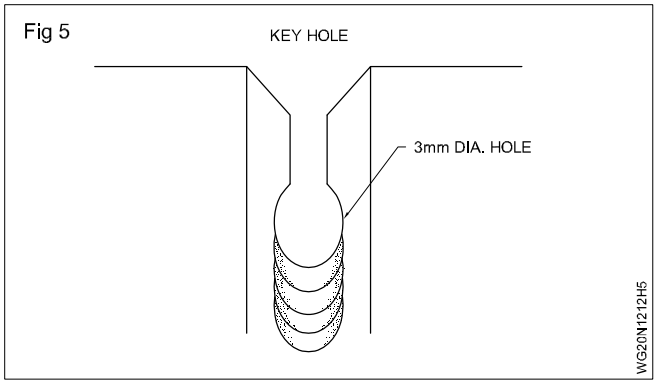
Clean the deposited bead using wire brush.

Inspect the quality of weld by:

– checking the finish of the job

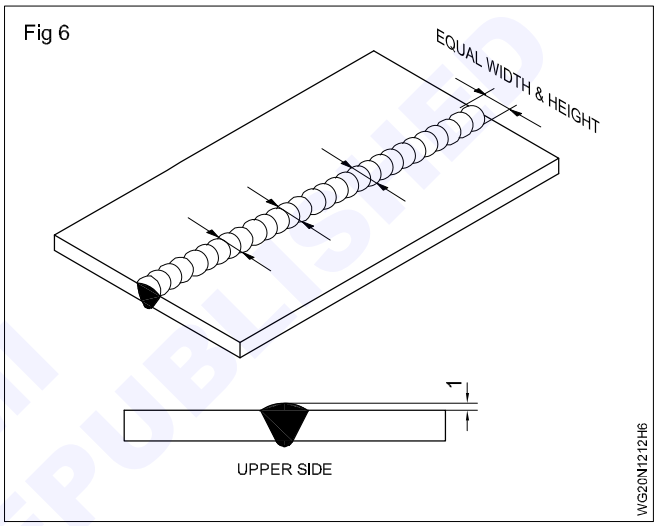
– checking the alignment (remove distortion if required)

Fig 5



– checking the uniformity of width and height of the weld bead in size (Fig 6)

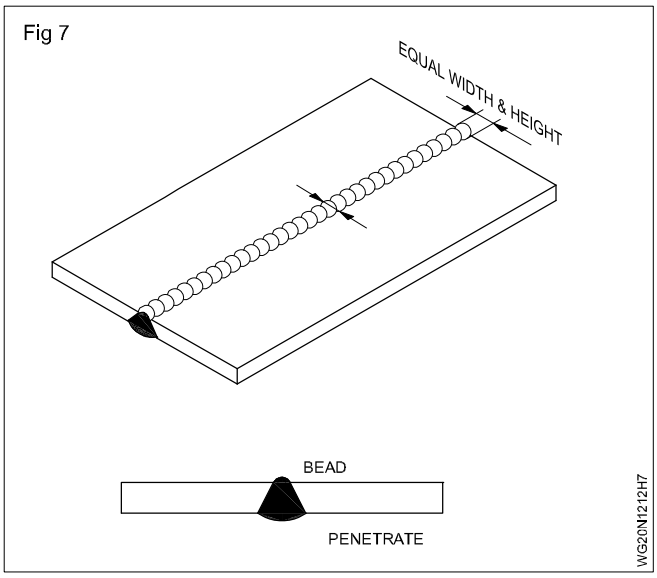
Fig 6



– checking the uniformity of the ripples, fusion and complete penetration (Fig 7)

– checking that the weld is free from faults such as porosity, undercut, lack of fusion, unfilled crater etc.

Fig 7



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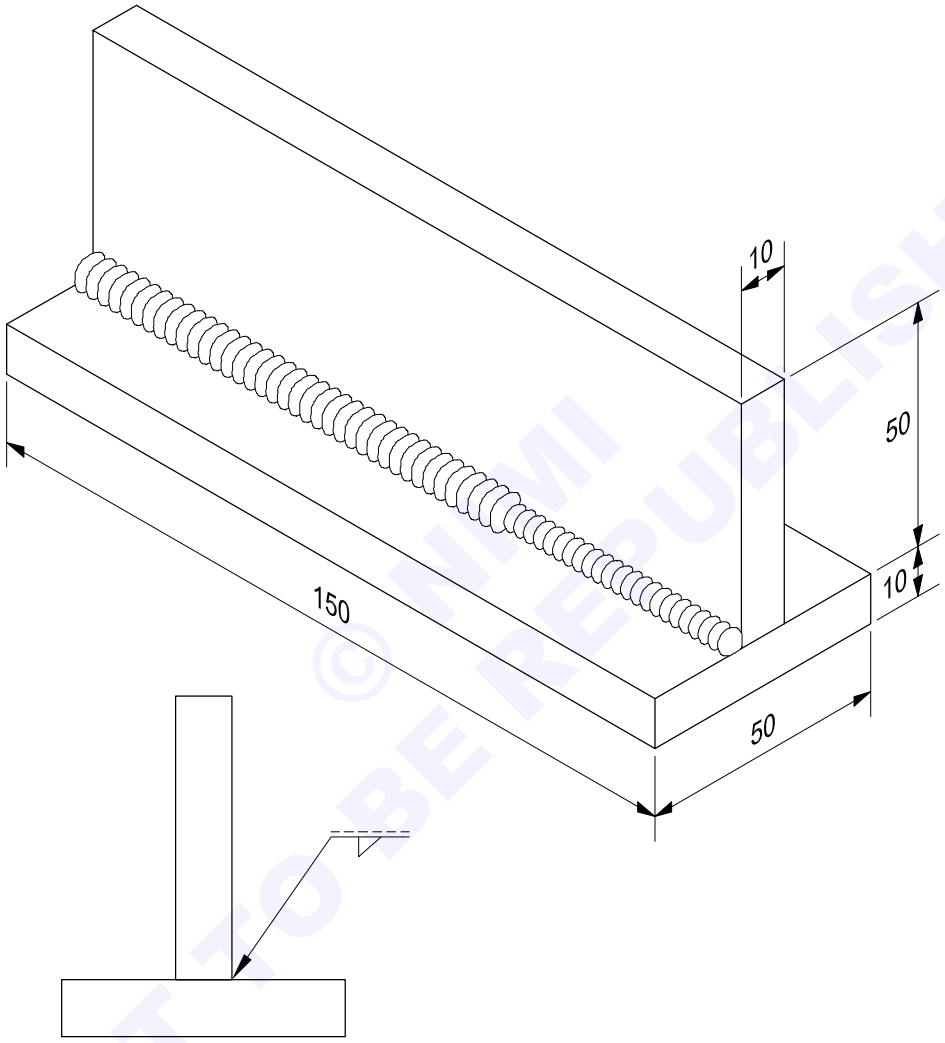
Fillet "T" joint on MS plate 10mm thick in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **set the 'T' joint and tack weld**
- **deposit root and covering run in flat position**
- **clean and inspect the weld defects.**



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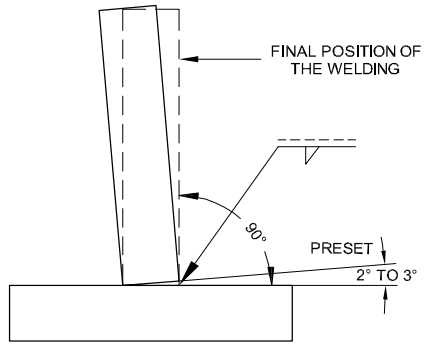
2	50 ISF 10 - 150	-	Fe 310 - W	-	-	1.2.13
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	FILLET 'T' JOINT ON M.S PLATE 10mm THICK IN FLAT POSITION. (1F)	TOLERANCE ±1	TIME
		CODE NO. WG20N1213H7	

Job Sequence

- Cut the plate by gas cutting/hacksaw cutting as per drawing.
- Grind the edges square.
- Use goggles while grinding.
- Clean the joining edges and surface of the plates.
- Wear protective clothing.
- Set the pieces in the form of Tee as per drawing and Tack-weld on both ends.
- Preset the pieces to have 92° to 93° angle between the plate surfaces. (Fig 1) i.e. give a distortion allowance of 2 to 3°.
- Set the Tee joint in a flat position.
- Connect the electrode cable to the negative terminal, if a DC machine is used.
- Deposit root run using a 3.15mm dia. medium coated M.S. electrode and 90-110 amps welding current.
- Ensure uniform root penetration and an electrode angle of 45° between the plates and 80° with the weld line.
- Wear chipping goggles.

Fig 1



- Remove the slag from the root run with a chipping hammer and clean with a wire brush.
- Deposit covering run with a weave motion using a 4mm dia. medium coated M.S. electrode and 120-140 amps welding current.
- Remove the slag from the final bead and clean the weld.
- Use weld gauge for checking the leg size of the weld. If you do not get the required 10mm leg length in 2 runs of weld deposit then deposit a third run using the same technique adopted for the second run.
- Inspect the Tee fillet weld for defects.

Skill Sequence

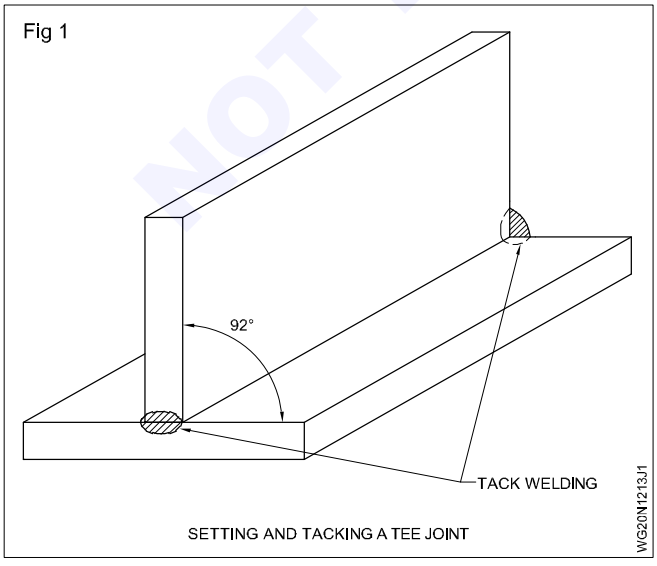
Fillet 'T' joint in flat position (1F)

Objective: This shall help you to
- **prepare and make 'T' joint in flat position.**

Setting and tacking of a Tee joint (Fig 1)

Set the pieces in alignment forming 92° between the plates Fig 1. This presetting to 92° is done to compensate the effect of shrinkage forces when weld deposit cools down.

Fig 1



SETTING AND TACKING A TEE JOINT

Tack-weld the pieces at both ends of the Tee joint by using a 3.15mm dia. medium coated M.S. electrode and 90-110 amps welding current.

Ensure the tacks are well fused at the root.

Check the alignment of the Tee joint after tacking.

Welding a tee fillet joint

Use a channel to place the joint in a flat position. (Fig 2)

The electrode angle of 45° will help to fuse both plates equally and the 80° angle will help to get a good root penetration.

Proceed along the welding line with uniform travel speed and short arc to get uniform fusion and root penetration.

The slag has to be removed thoroughly from the root run so that the slag inclusion defect can be avoided in the next run.

Use a slightly side-to-side weaving motion. (Fig 3) The width of weave should give a leg size of 10mm.

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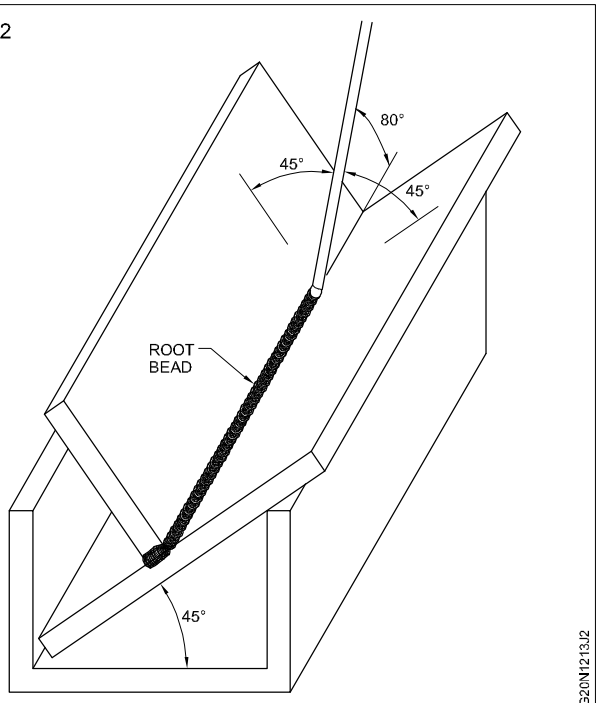
Fig 2

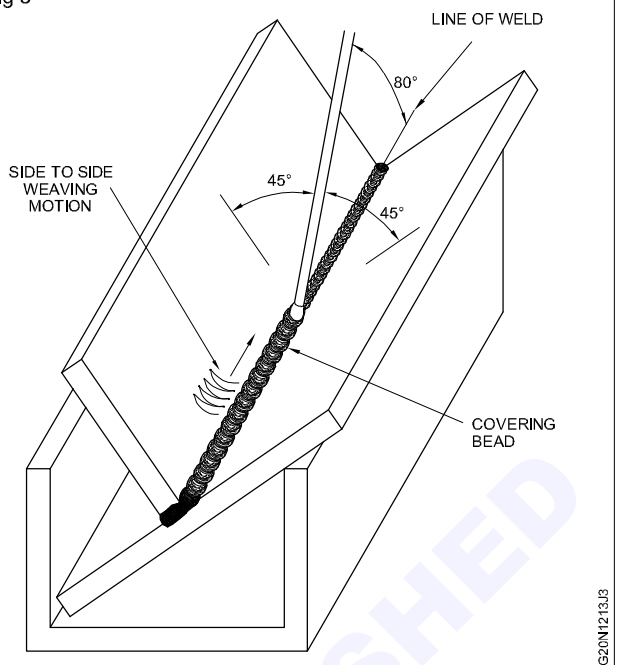


Maintain the same electrode angle as in the root bead.

If the leg size is less than 10mm then deposit a third run using the same technique used for the second run.

Clean the final covering bead thoroughly.

Fig 3



Stop the electrode weaving for a moment at the toes of the weld to avoid undercut. Fill the crater at the end of the bead.

Inspection of fillet weld

Inspect the fillet welds for defects, correct shape and size of fillet and equal leg length on either side of the weld.

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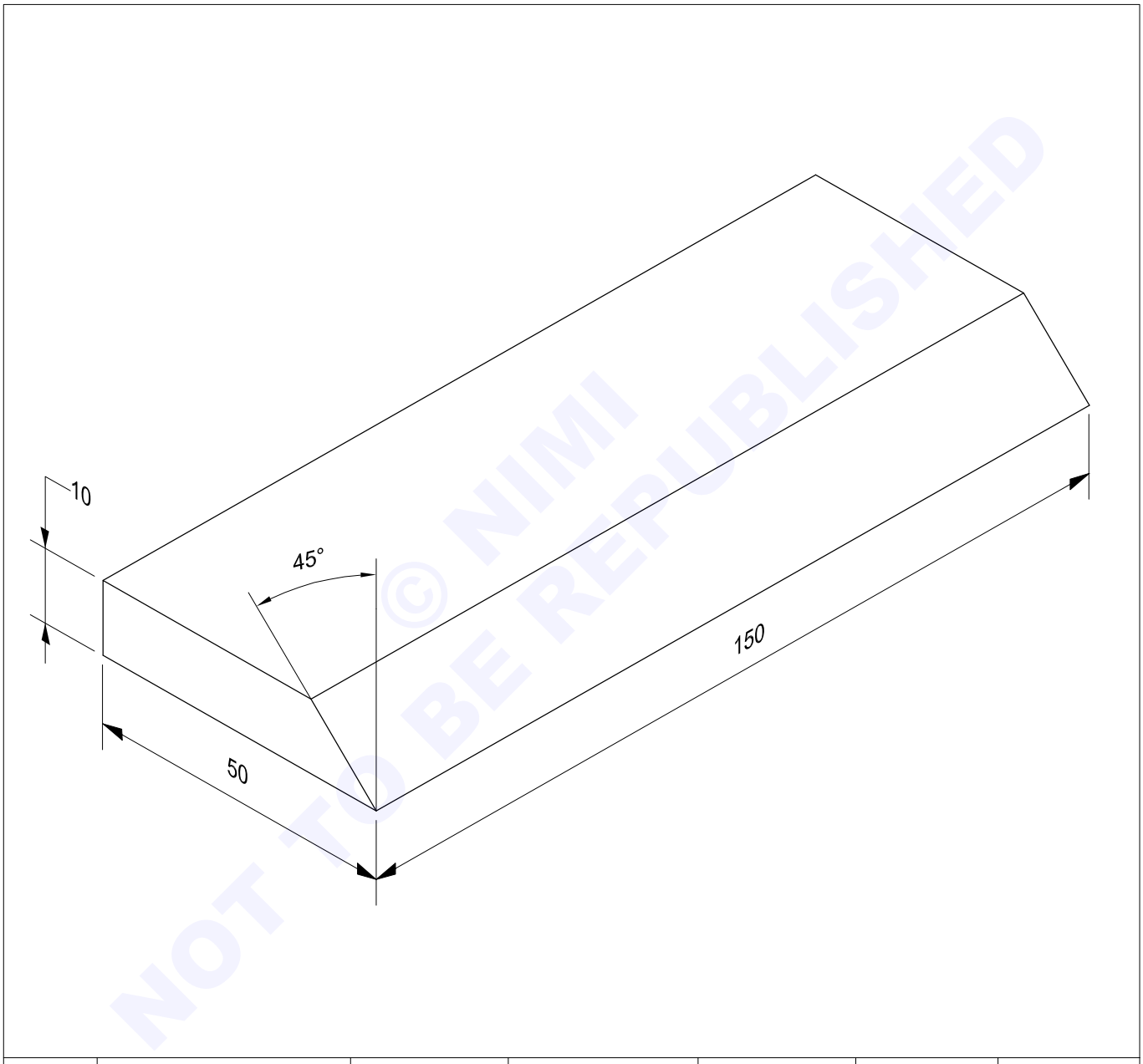
Beveling of MS plates 10mm thick by gas cutting

Objectives: At the end of this exercise you shall be able to
- **prepare and set the work piece as per drawing**
- **cut bevel by using hand gas cutter**
- **clean and inspect the gas cut.**



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1	50 ISF 10-150	-	Fe310-W	-	-	1.1.14
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE : NTS	BEVELING OF M.S PLATE 10mm THICK BY GAS CUTTING	DEVIATIONS	TIME 7h
		CODE NO. WG20N1214E1	

Job Sequence

- Wear safety apparel.
- Clean the surface to be cut.
- Set the gas welding plant and fix the cutting blowpipe.

Ensure the cutting nozzle is according to the thickness of the metal.

- Adjust the gas pressure of acetylene and the cutting oxygen.

Ensure the pressure setting as per the metal thickness and size of the cutting nozzle.

- Mark and punch the plate at the required bevel angle.
- Adjust a proper cutting flame.
- Hold the cutting blowpipe at the proper bevel angle to be cut.
- Heat at one end of the plate on the punch line up to cherry red hot.
- Release the cutting oxygen, and observe the cutting action.
- Move the cutting blowpipe towards the other end, following the punched line slowly and steadily at the required angle.

Maintain a correct speed and distance of the nozzle.

- Close the cutting oxygen and extinguish the flame on the completion of the cut.
- Clean the cut, and inspect for its accuracy.
- Repeat the exercise till you achieve a good and smooth cut.

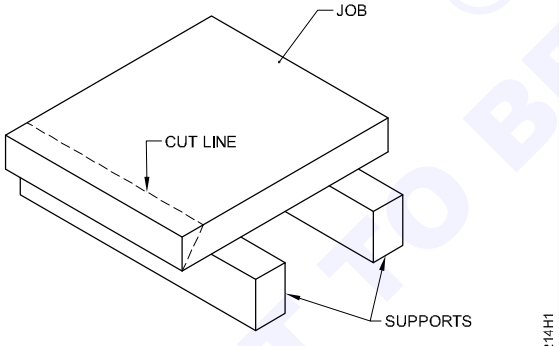
Skill Sequence

Bevel cutting by hand (Oxy-acetylene)

Objectives: This shall help you to
- **set the work piece for bevel cutting**
- **gas cut bevel surfaces by hand**
- **inspect the bevel cut.**

Setting the job (Fig 1)

Fig 1



SETTING JOB ON SUPPORTS

Set the job on a rigid table.

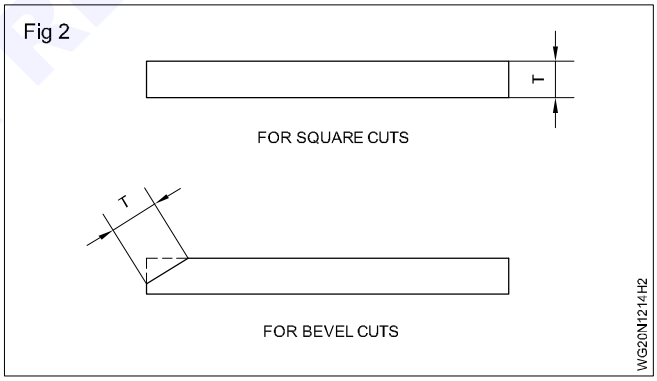
Ensure the underside of the cut line is clear.

Adjustment of the cutting flame.

Select a cutting nozzle as per the length of the bevel. (Fig2)

Set the cutting nozzle in the blowpipe and adjust the neutral flame for pre-heating.

Fig 2



Ensure that the flame adjustment is not disturbed while operating the cutting oxygen lever.

Bevel cutting

Hold the cutting blowpipe (nozzle) at the required bevel angle. (Fig 3)

Preheat the starting point to a cherry red color.

Distance between the work piece and the nozzle tip should be about 5mm to avoid backfire. (Fig 3)

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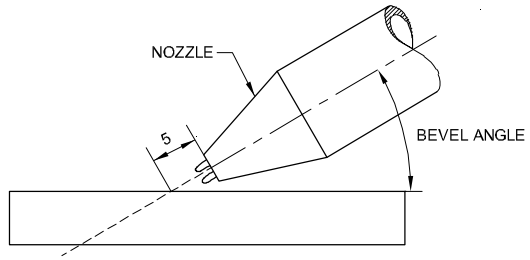
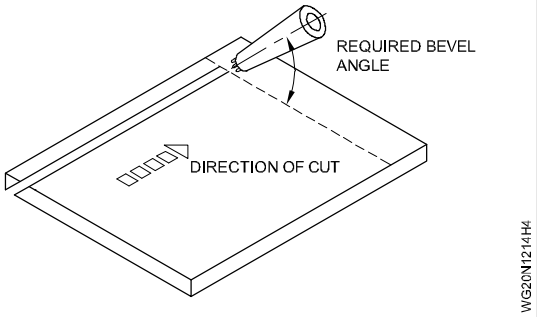
Fig 3



Release extra oxygen, observe the cutting action and start travelling along the punched line with a uniform speed (Fig 4) and steady hand.

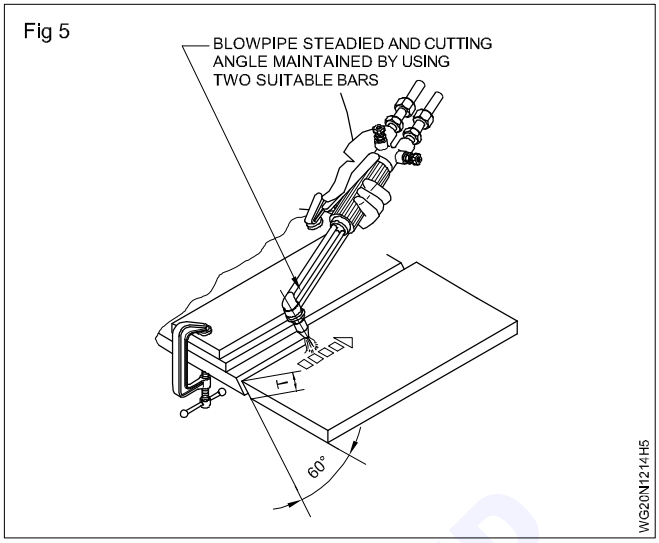
Fig 4



The cutting speed should be less than required for the straight cut for the same thickness.

If possible, fix suitable straight bars to the cutting job to ensure a straight cut and angle maintenance. (Fig 5)

Fig 5

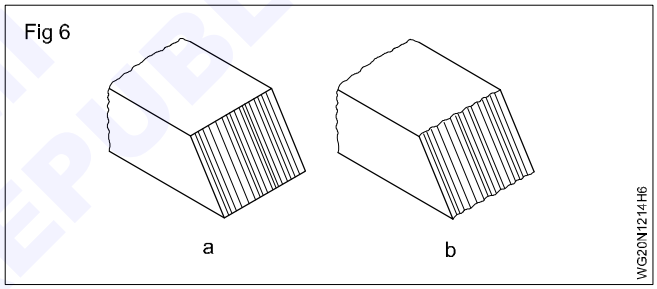


Inspection of bevel cut

Clean the cut and inspect the cutting quality

A good quality cut is indicated by a straight top edge and extremely smooth-cut face. (Fig 6a) Poor quality gouging is a common defect in gas cutting. (Fig 6b) This is caused by excess speed or too mild a heating flame.

Fig 6



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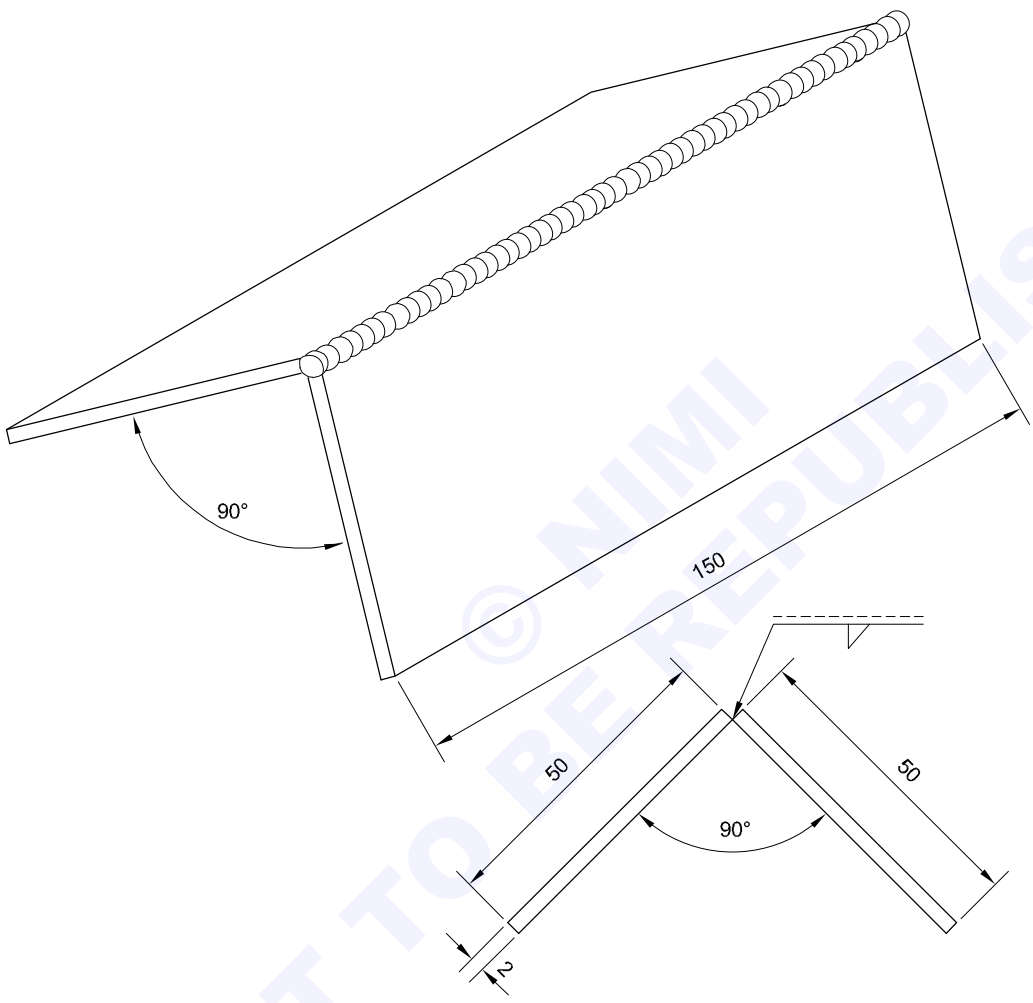
Open corner joint on M.S. sheet 2 mm thick in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **set the root gap and tack weld**
- **weld the open corner joint by leftward technique**
- **clean and inspect the weld defects.**



2	ISST 50 x 2 - 150	-	Fe 310 - W	-	-	1.2.15
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	OPEN CORNER JOINT ON M.S. SHEET 2mm IN FLAT POSITION				TOLERANCE ±0.5	TIME
					CODE NO. WG20N1215E1	

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Job Sequence

- Prepare the edges of the sheets to be joined by filling.
- Set the sheets as outside corner joint by keeping at 90° angle between the members with a uniform root gap of 1.5mm between the edges.
- Fix nozzle No. 5 and adjust the gas pressure to 0.15kg/sq.cm. for both gases.
- Select C.C.M.S. filler rod 1.6 mm dia.

- Wear all safety clothing and use the gas welding goggle.
- Set natural flame, tack at both ends of the joint and at the center by fusing the edges adding filler rod.
- Check the correct alignment of the joint pieces with a try square, clean the tacks, and reset if needed.

Use tongs for holding hot pieces.

- Keep the tacked joint on the welding table in a flat position.
- Hold the blowpipe and filler rod at an angle of 60° to 70° and 30° to 40° respectively with the weld line, start welding from the right hand edge of the joint, move towards the left hand side using the leftward technique.
- Keep the flame at the root of the joint, fuse both the edges uniformly, then dip the filler rod in the molten pool, like a 'piston like' motion, steadily move and give slight circular motion to the blowpipe.

Maintain 1 to 1.5 mm distance between the flame cone and the molten pool to avoid backfire, and to obtain good fusion of the root, use the key-hole technique.

Add filler metal at the top edge of the molten pool as required to build up the weld.

Synchronize the rate of travel and addition of filler metal to obtain a slightly convex bead with proper root penetration.

- Stop welding at the left hand edge of the joint, after filling up the crater.
- Extinguish the flame, cool the nozzle and keep the blowpipe at a safe place.
- Clean the welded joint and inspect for:
  - uniform ripples with slightly convex bead with correct throat thickness.
  - uniform width and height of bead
  - uniform penetration of bead on the reverse side of the joint near the root (indication of root fusion).

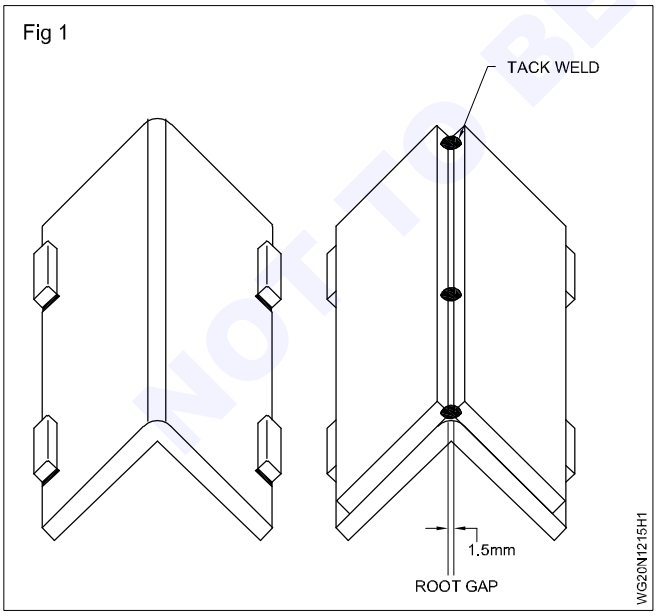
Skill Sequence

Open corner joint in flat position

Objective: This shall help you to
- **prepare and weld open corner joint in flat position.**

Set the job pieces prepared with square edges in correct position using angle iron support. (Fig 1)

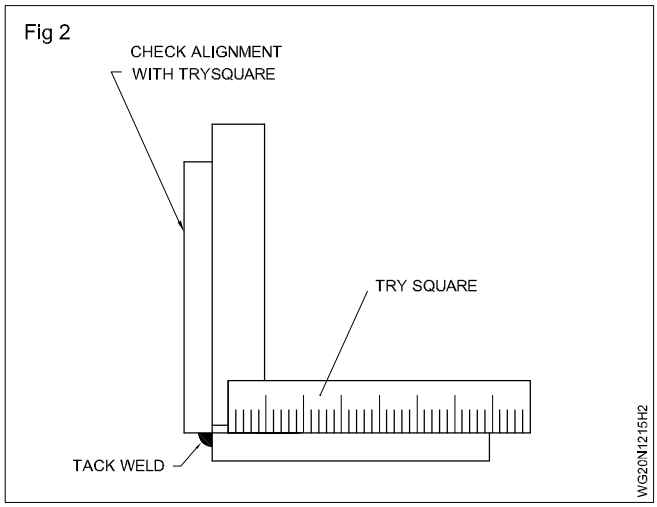
Fig 1



Tack-weld the pieces at correct intervals in correct sequence, with 1.0 mm root gap.

Check the alignment of the tacked pieces and reset, if required. Use a try square. (Fig 2)

Fig 2



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Fusion welding on open corner joint

Make uniform bead with correct penetration by:

– holding the blowpipe and filler rod in correct position (Figs 3 and 4)

Fig 3

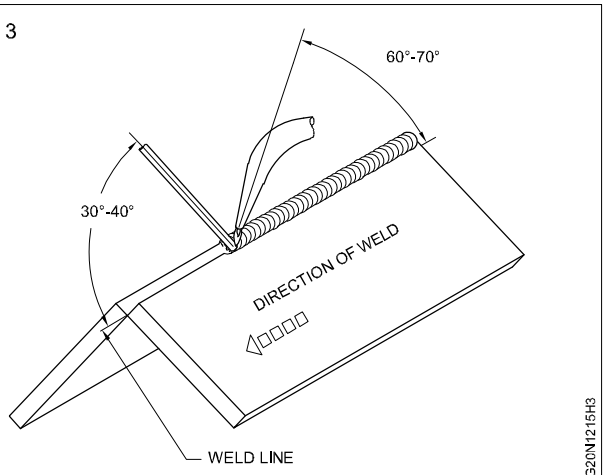
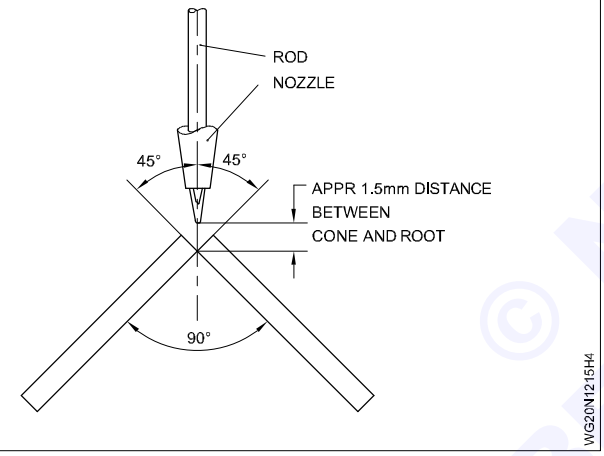


Fig 4



– maintaining uniform travelling speed

– fusing the edges with the keyhole formation to get full penetration. (Fig 5)

– ensuring the top edges of the sheets do not melt excessively.

Inspect the open corner welded joint for:

– 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 6)

Fig 5

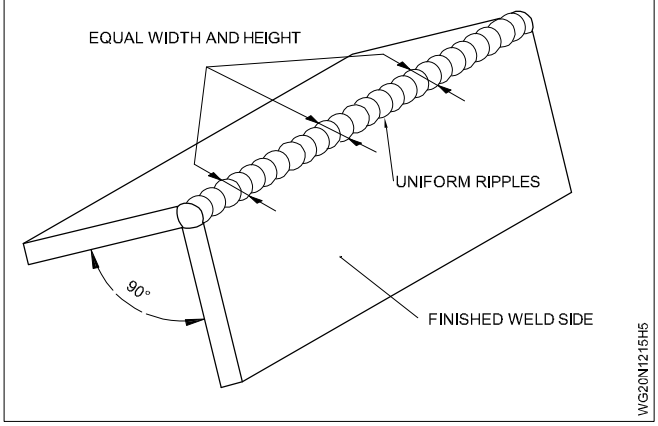
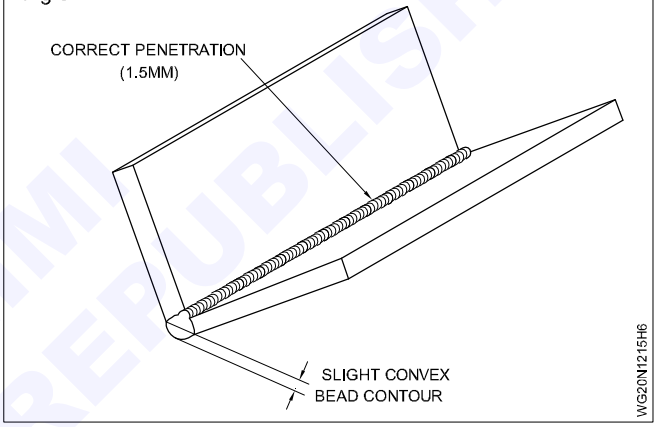
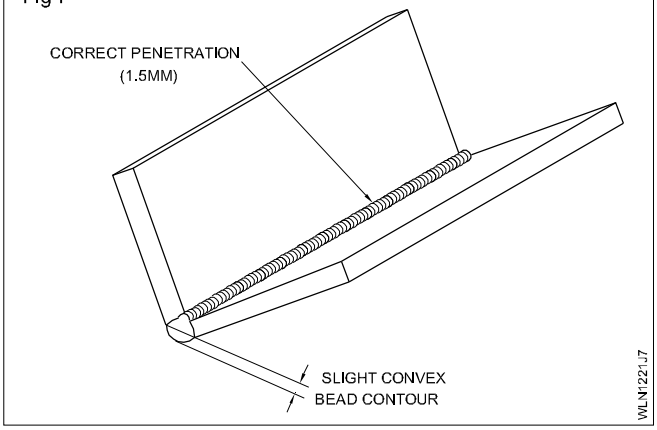


Fig 6



– slight convex bead with weld penetration at the root of the joint. (Fig 7)

Fig 7



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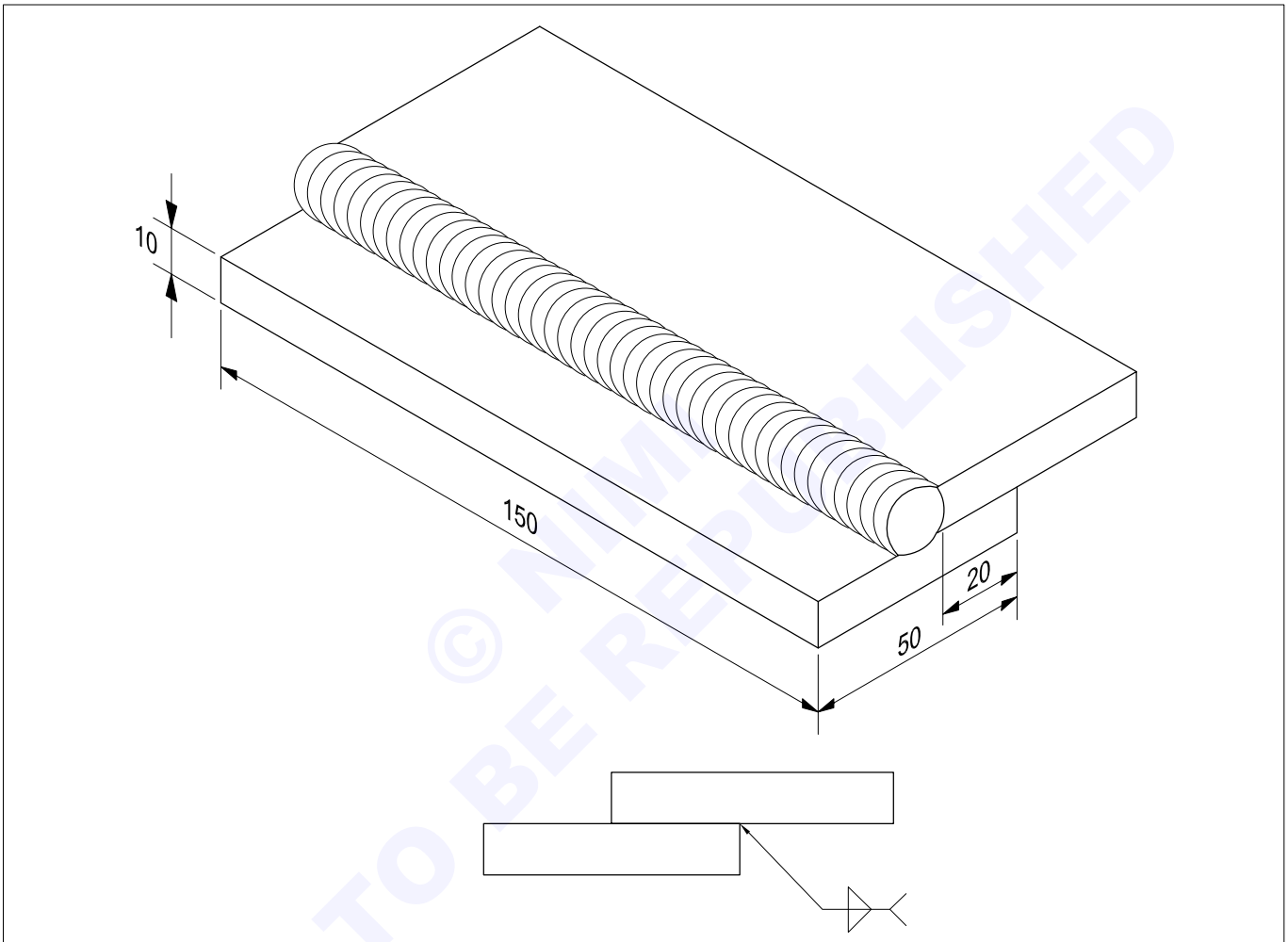
Fillet lap joint on MS plate 10mm thick in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing by gas cutting**
- **set plates as a lap joint and tack weld**
- **deposit root and covering run in flat position**
- **clean and inspect the weld defects.**



2	50 ISF 10 - 150		Fe 310 - W			1.2.16
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	FILLET LAP JOINT ON M.S PLATE 10mm THICK IN FLAT POSITION.				TOLERANCE ±1	TIME
					CODE NO. WG20N1216E1	

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Job Sequence

- Cut the plate pieces by gas cutting as per drawing.
- Grind the gas-cut edges to square.
- Remove the grinding burrs and clean the surfaces by wire brush.
- Set the pieces in the form of a lap joint as per drawing.
- Select DCEN polarity, in case of a DC machine.

Wear protective clothing.

- Tack-weld on both ends.
- Set the lap joint in a flat position.

- Deposit root run by using a 3.15mm dia. medium coated M.S. electrode with 90 -110 amps current.

Ensure an electrode angle of 45° with the fillet corner and 80° with the welding line.

- Remove the slag with a chipping hammer and clean with a wire brush.
- Use tongs to hold the job.
- Wear chipping goggle for the protection of eyes.

Skill Sequence

Lap fillet joint in flat position

Objective: This shall help you to
- **prepare and weld lap fillet joint in flat position.**

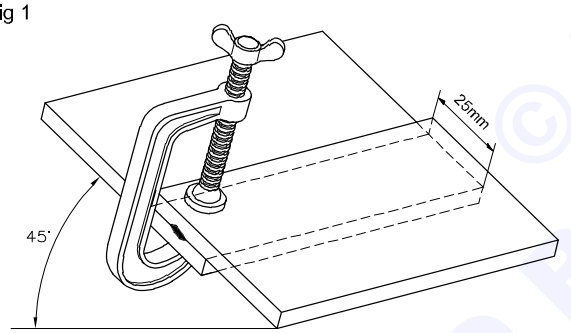
Setting and tacking the lap joint (Fig 1)

Set the lap joint with an overlap of 25mm.

The overlap may vary based on the plate thickness.

Tack-weld on both ends. (Fig 1) Ensure the 2 lapping surfaces are perfectly cleaned and they contact each other properly. Use a 3.15mmø MS electrode with 90-120 amp current for tacking.

Fig 1



SETTING TACKING A LAP JOINT.

Set the joint in a flat position using angle iron (Fig 2).

Welding the lap fillet joint in flat position

Deposit root run with a 3.15mmø medium coated MS electrode with 100-110 amp. current.

Maintain 80° angle to the line of the weld and 45° between the weld faces. (Fig 2)

Maintain a short arc to get uniform fusion and root penetration.

Avoid side-to-side movement of the electrode.

Deslag and clean the root bead thoroughly.

Deposit the final covering run with a 4mmø medium coated MS electrode and 160 amp current.

Give side-to-side movement to the electrode not more than 2.5 times its dia.

- Deposit the final covering run with a weave motion using a 4.00 mm dia. medium coated M.S. electrode with 120 -140 amps welding current.

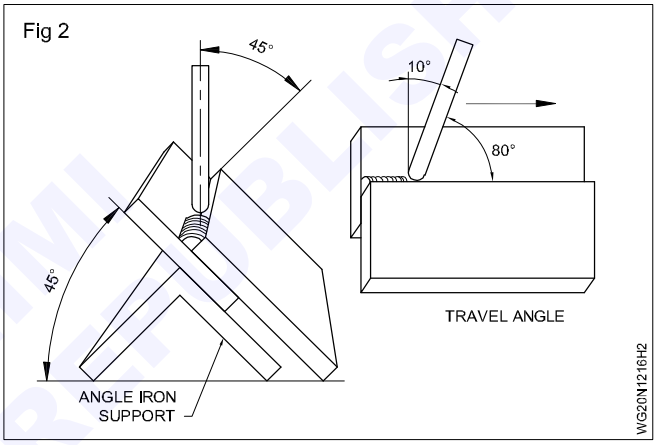
Prevent the upper edge of the plate from melting off.

- Remove the slag from the final weld and clean thoroughly.

Use a weld gauge to check the fillet size.

- Inspect the lap fillet weld for surface defects and size.

Fig 2



Use the same electrode angle as was used for the root bead.

Prevent the upper edge of the plate from melting off by not allowing the arc to concentrate more on the upper edge.

Remove the slag with a chipping hammer.

Clean the weld with a steel wire brush.

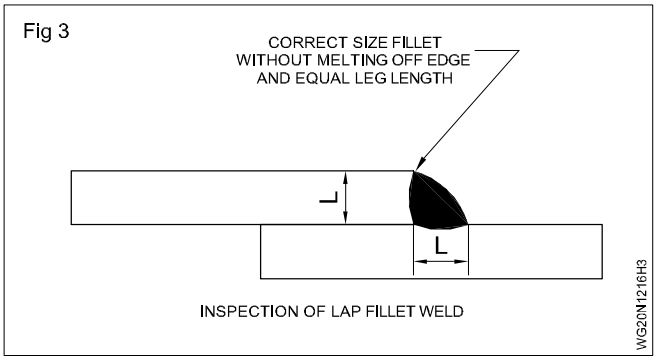
Inspect the lap fillet weld (Fig 3) and ensure:

– it has equal leg length with slight convexity

– the upper edge of the plate has not melted off

– it is free from surface defects.

Fig 3



INSPECTION OF LAP FILLET WELD

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Chair fabrication without hand rest with square pipe of 25mm width 1mm (GMAW/GTAW) welding machine

Objectives: At the end of this exercise you shall be able to
- **prepare the square pieces as per drawing**
- **set the joint and tack weld**
- **weld the joint by using GMAW/GTAW.**

Requirements

Tools/ Equipment/ Instruments

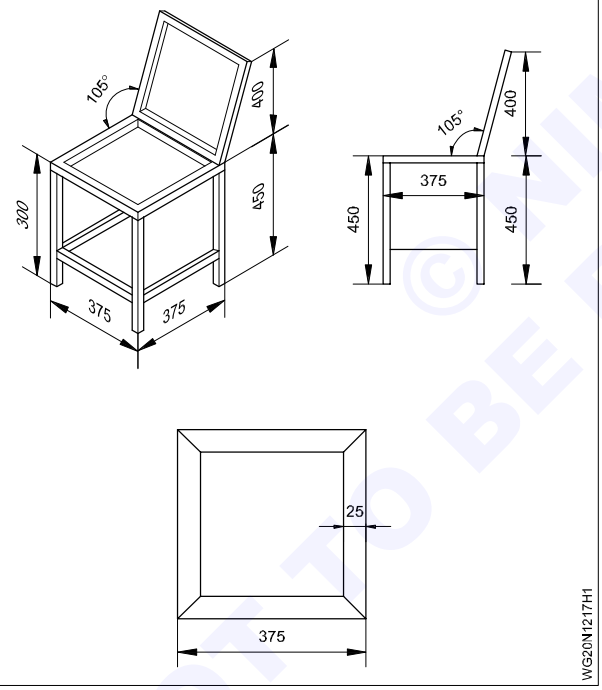
25mm sq tube (1mm)

- GMAW/GTAW welding mk, with set up accessories
- Steel rule, trysquar, hack saw frame with blade, flat file, tongs, wire brush etc.,

Materials

- 25 x 1 x 450 mm length sq tube M.S - 4 Nos.
- 25 x 1 x 450 mm length sq tube M.S - 4 Nos.
- 25 x 1 x 450 mm length sq tube M.S - 4 Nos.

Fig 1



Job Sequence

- Marking and cutting as to be done as per the dimensions.(Hacksawing /mic cutting)
- Remove the burrs by filing
- Set the pattern as per the drawing.
- Choose the tungsten electrode GMAW or GTAW.
- Choose the ccms filler wire.
- Select approprite (current) amps and voltage.
- Weld the setting by sequence operation.
- Weld the four legs as per drawing.
- Weld the back rest as per drawing
- Throughly clean and finish the job.
- Wear safety precaution while welding (GMAW/GTAW)

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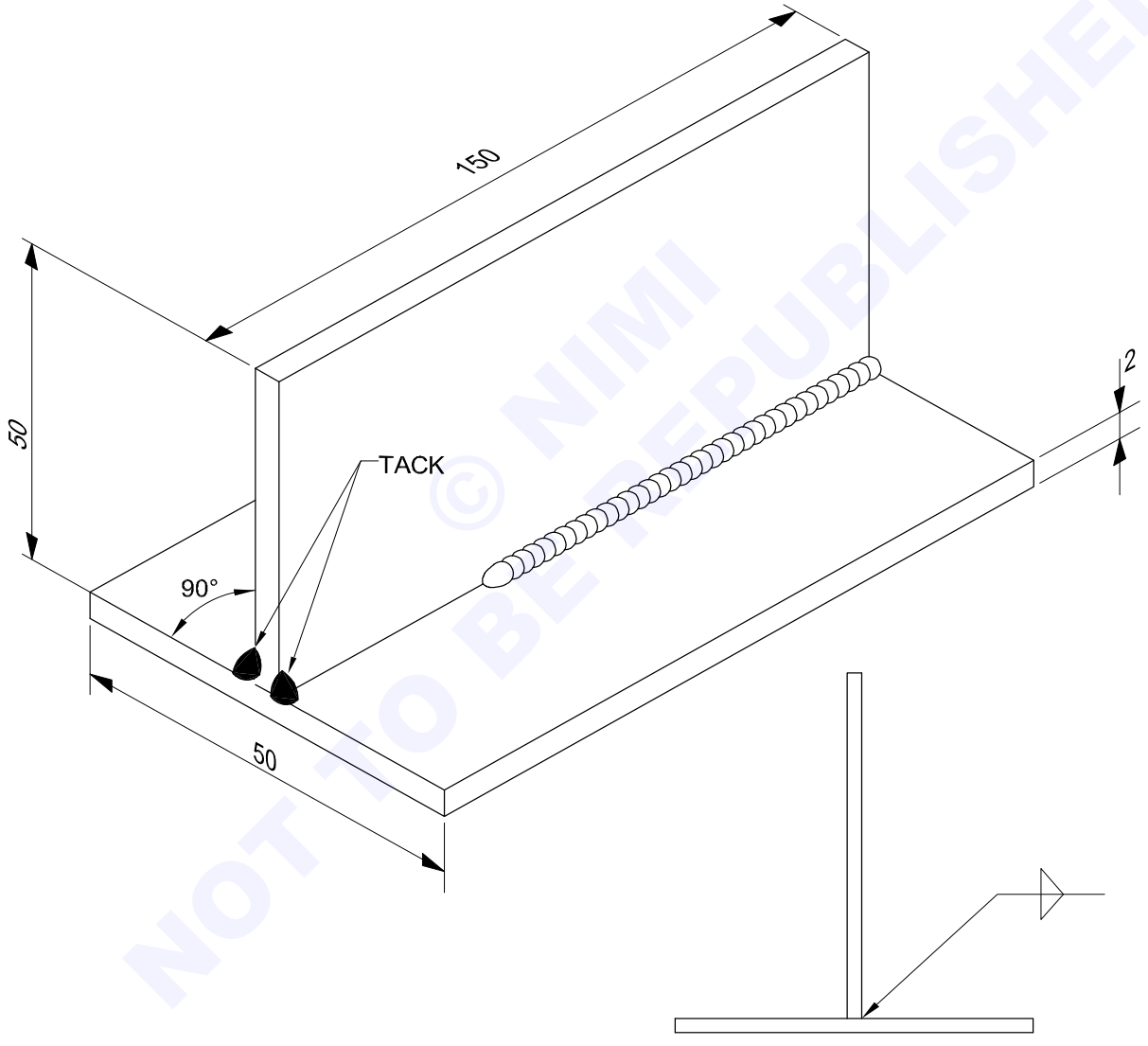
Fillet 'T' joint on M.S. sheet 2mm thick in flat position

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

- **prepare the job as per drawing**
- **select nozzle filler and flame**
- **set the tack weld the job**
- **weld the 'T' joint in flat position**
- **set and tack the job to form 'T' fillet joint and manipulate the blow pipe and the filler rod properly**
- **weld a 'T' fillet joint using recommended filler rod and nozzle size**
- **clean and inspect the weldments for defects.**



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2	ISST 50 x 2 - 150		Fe 310 - W			1.2.18
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**FILLET "T" JOINT ON M.S. SHEET 2mm THICK IN FLAT POSITION (1F)-(OAW-06)**				TOLERANCE ±0.5	TIME
					CODE NO. WG20N1218E1	

Job Sequence

- 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 'T' joint on the welding table.
- Wear safety apparels and gas welding goggles.
- Set the gas welding plant, fix nozzle No. 5 and set pressure at 0.15 kg/cm for both gases.
- Set the neutral flame, tack at both ends of the joint also in the center 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.

Skill Sequence

Fillet weld 'T' joint on MS sheet 2.00mm in flat position

Objective: This shall help you to
- **prepare and fillet weld 'T' joint on MS 2.00mm in flat position.**

'T' fillet joints are used extensively in industry i.e., Capital Goods & Manufacturing of underframes, vertical supporters for oil and water containers and other similar structural work.

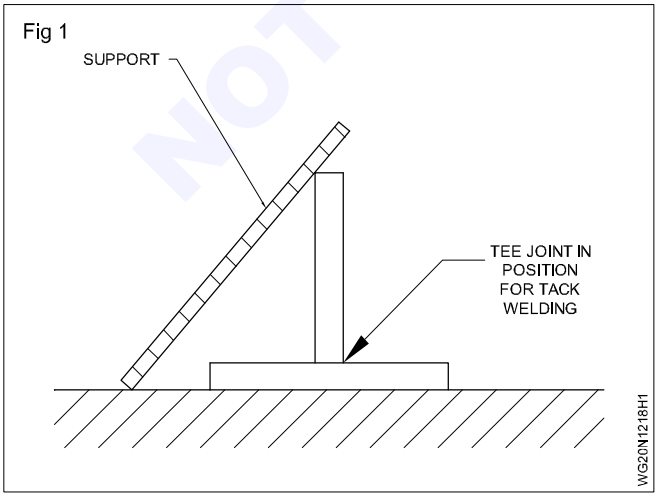
It is an economical joint with very little edge preparation but difficult to weld without defects (i.e. unequal leg length, undercut, etc.) unless the operator gets proper practice.

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 as 'T' joint.

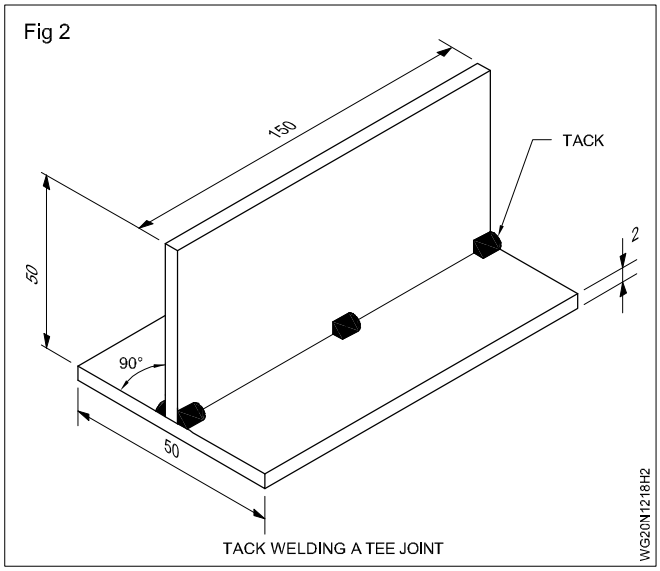
Hold the pieces in position using support. (Fig 1)



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.



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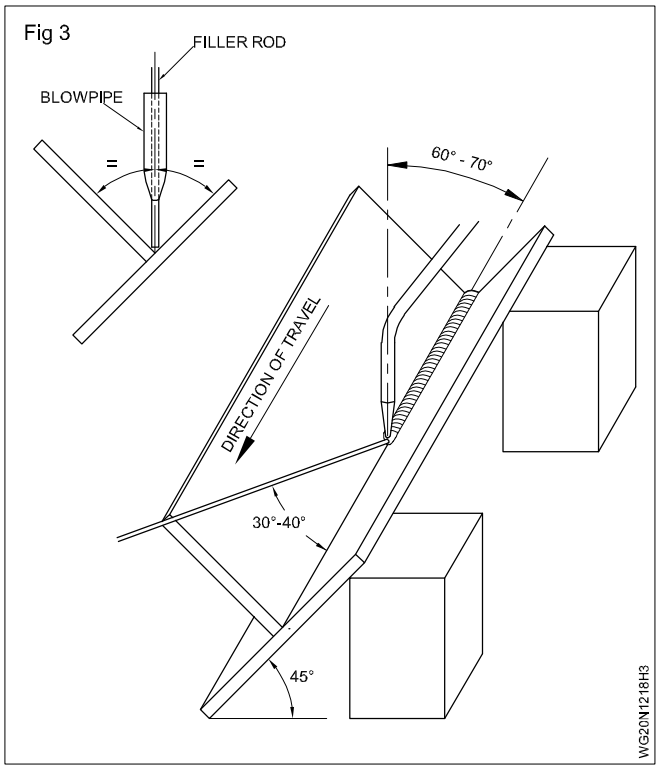
Welding of fillet 'T' joint in flat position (Fig 3)

Place the tack welded in flat position by tilting and supporting it. Fig 3.



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 blowpipe if the pieces do not melt uniformly. When the molten pool is formed add the filler rod in the center of molten pool. Give slight side-to-side movement to the flame (blowpipe) and a piston like motion to the filler rod.

Adjust 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.

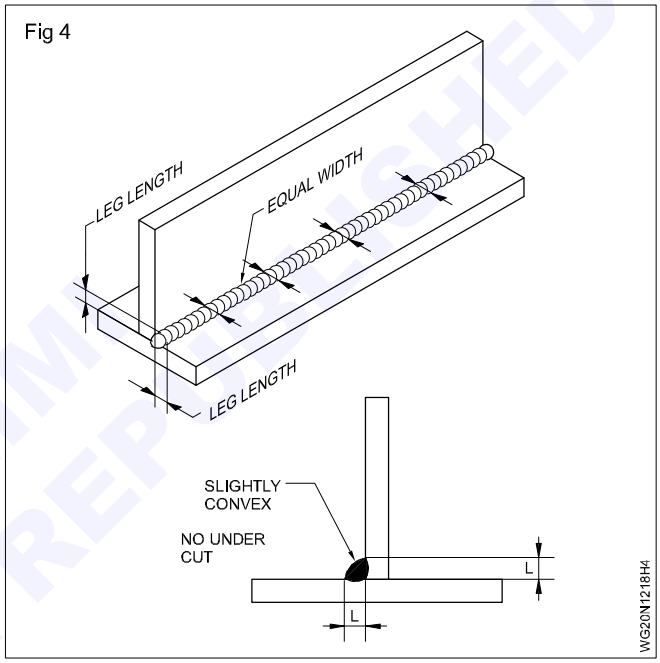
Visual inspection (Fig 4)

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.



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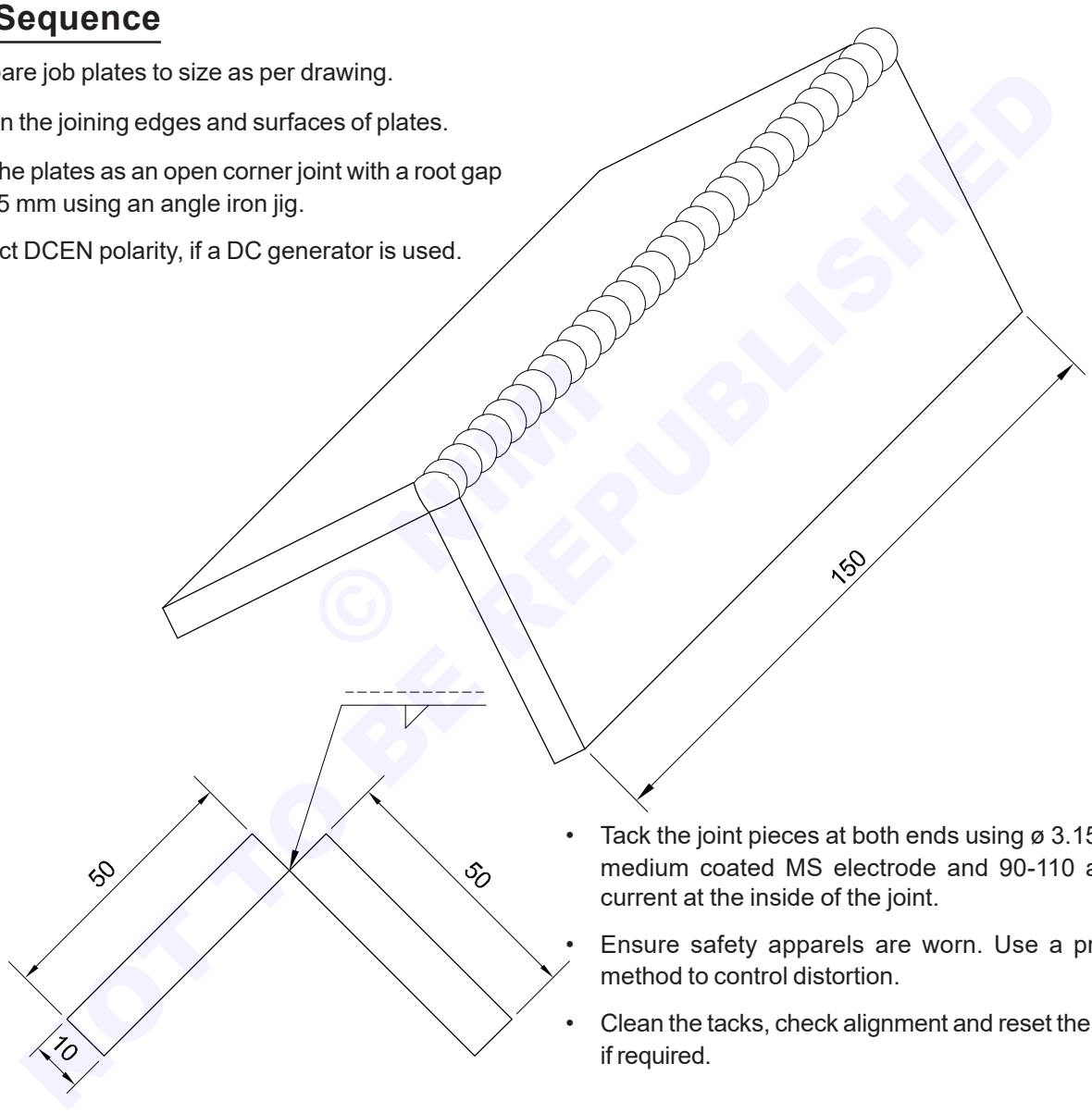
Open corner joint on MS plate 10mm thick in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare and set the job as drawing**
- **set the root gap and tack weld**
- **deposit root and weaving bead in flat position**
- **clean and inspect the weld defects.**

Job Sequence

- 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 DCEN polarity, if a DC generator is used.



- Tack the joint pieces at both ends using ø 3.15 mm medium coated MS electrode and 90-110 amps current at the 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.

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2	50ISF10 - 150	-	Fe 310 - W	-	-	1.2.19
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	OPEN CORNER JOINT ON M.S PLATE 10mm THICK IN FLAT POSITION (1F)-(SMAW-06)	TOLERANCE ±1	TIME
		CODE NO. WG20N1219E1	

- 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.
- Deslag 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 120-140 amps for 4mm ø medium coated M.S. electrode.
- Deposit an intermediate layer i.e. second run over the root run with slight weaving motion using 4mmø 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.

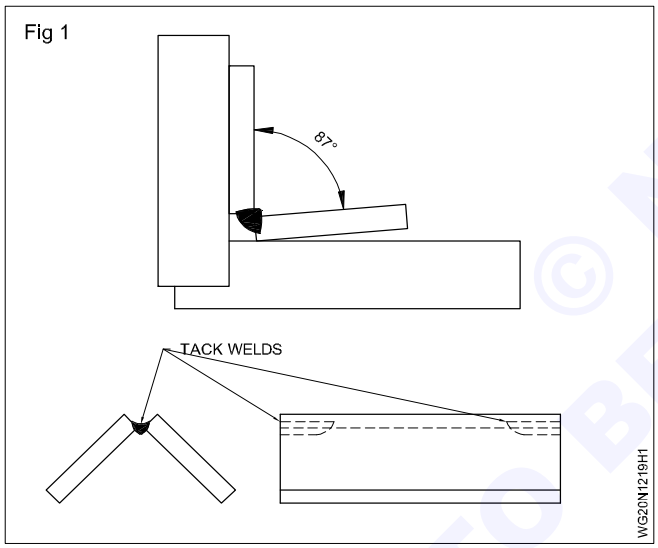
Skill Sequence

Open corner joint on MS plate 10mm thick in flat position (1F)

Objective: This shall help you to
- **prepare and weld corner joint on MS plate 10mm thick in flat position.**

Setting and tacking plate pieces for open corner joint (Fig 1)

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 87° to control the distortion.

The angular distortion is normally taken as 1° per run.

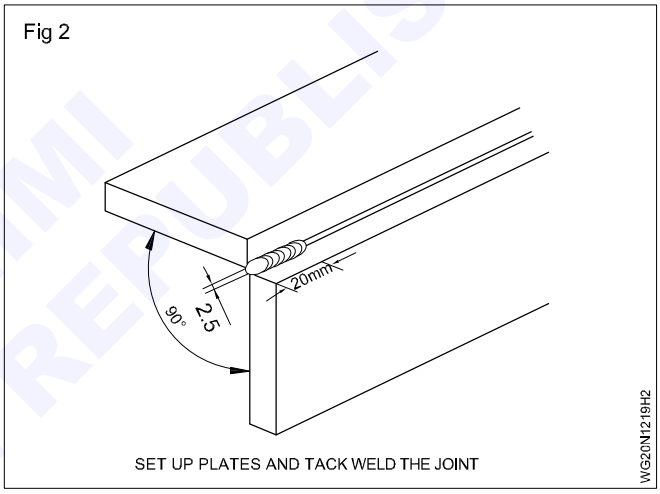
Check the alignment of the joint with a try square. (Fig 1)

Another method to control distortion is, set the angle at 90° and use a right angled iron fixture to minimize the distortion. Fig 3.

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)

Ensure that the joining edges are perfectly clean and safety apparels are worn.

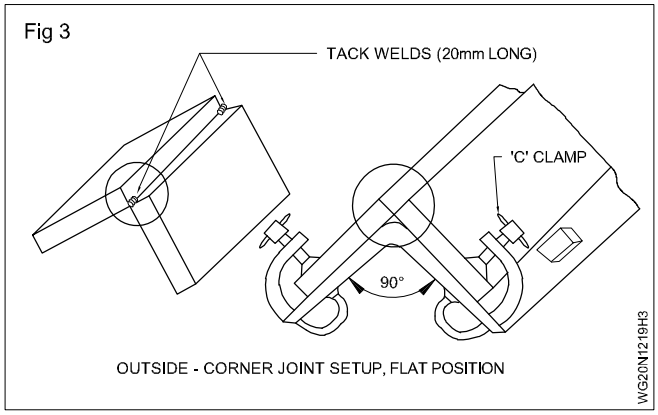
Fig 2



SET UP PLATES AND TACK WELD THE JOINT

Deslag and clean the tacks using chipping hammer and wire brush.

Fig 3



OUTSIDE - CORNER JOINT SETUP, FLAT POSITION

Deposition of root run

Se the joint in a flat position.

Deposit root run in the bottom of the corner by

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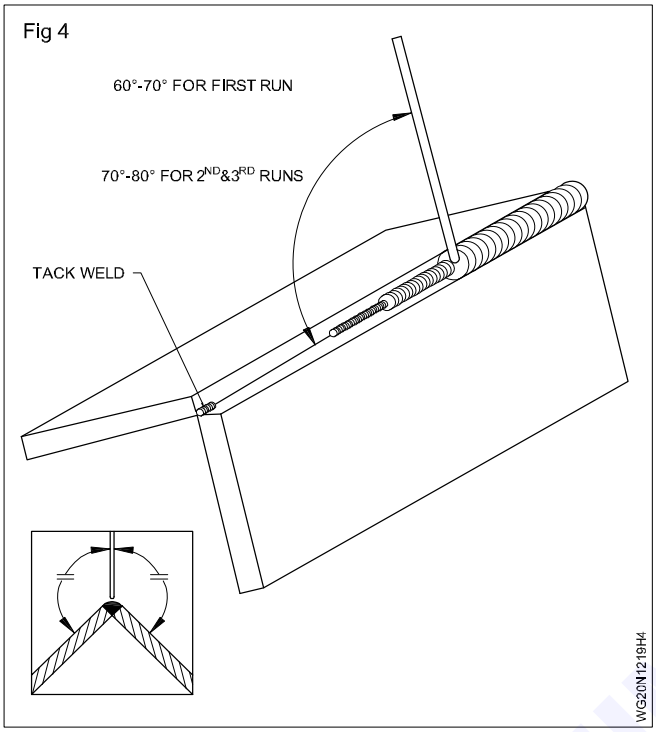
– using a M.S. electrode ø3.15 and welding current 110 to 120 amps.

– maintaining a slightly short arc

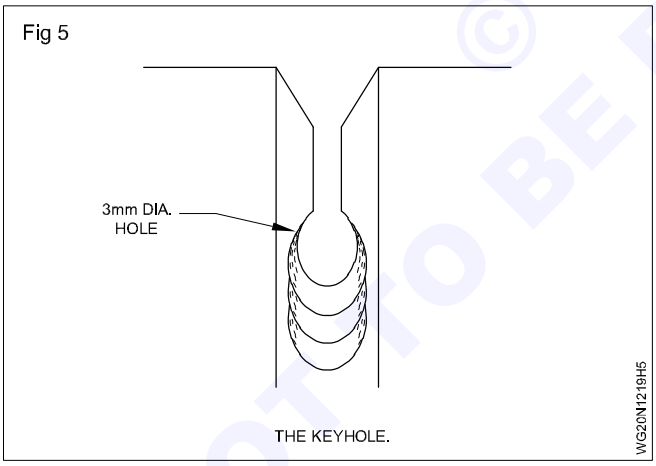
– positioning the electrode vertically between the edge and 60° - 70° with the weld line. Fig 4

Fig 4



– forming a keyhole near the weld crater of the tack weld to ensure complete penetration. Fig 5

Fig 5



– maintaining travel speed similar to the speed used for straight beading. Clean the root run thoroughly and observe penetration.

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 120-140amps 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 6. 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:

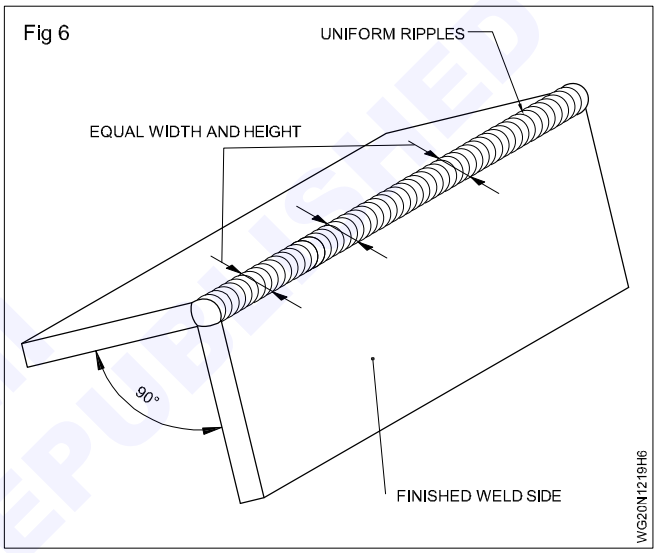
– ø 4 mm M.S. electrode and 120-140 amps welding current

– wider weaving motion to the sides of corner joint

– a slower rate of travel that the 1st covering layer.

– Use the same angle of electrode and arc length as used in 1st covering layer. Fig 6.

Fig 6



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 focused on the edges at all.

Inspection of fillet weld in corner joint (Fig 7)

Clean the weldment thoroughly.

Check the angle between the plates for 90°.

Check each run/layer for the following weld characteristics.

Width and height: Uniform.

Appearance: Smooth with close ripples.

Size: Full fillet without excessive reinforcement.

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.

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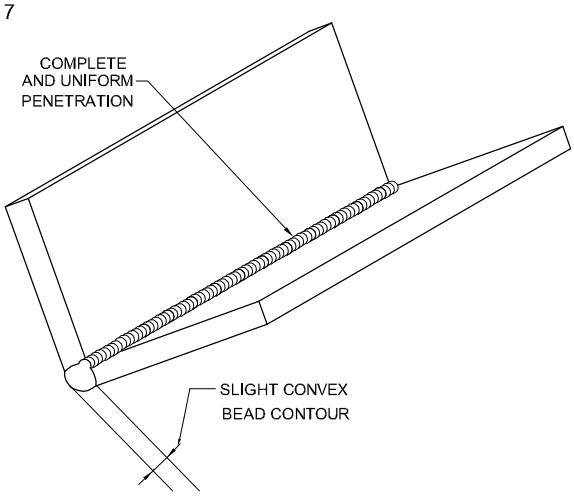
Fig 7



Back side: Complete and uniform penetration. (Fig 7)

Surrounding plate surfaces: Free of spatter.

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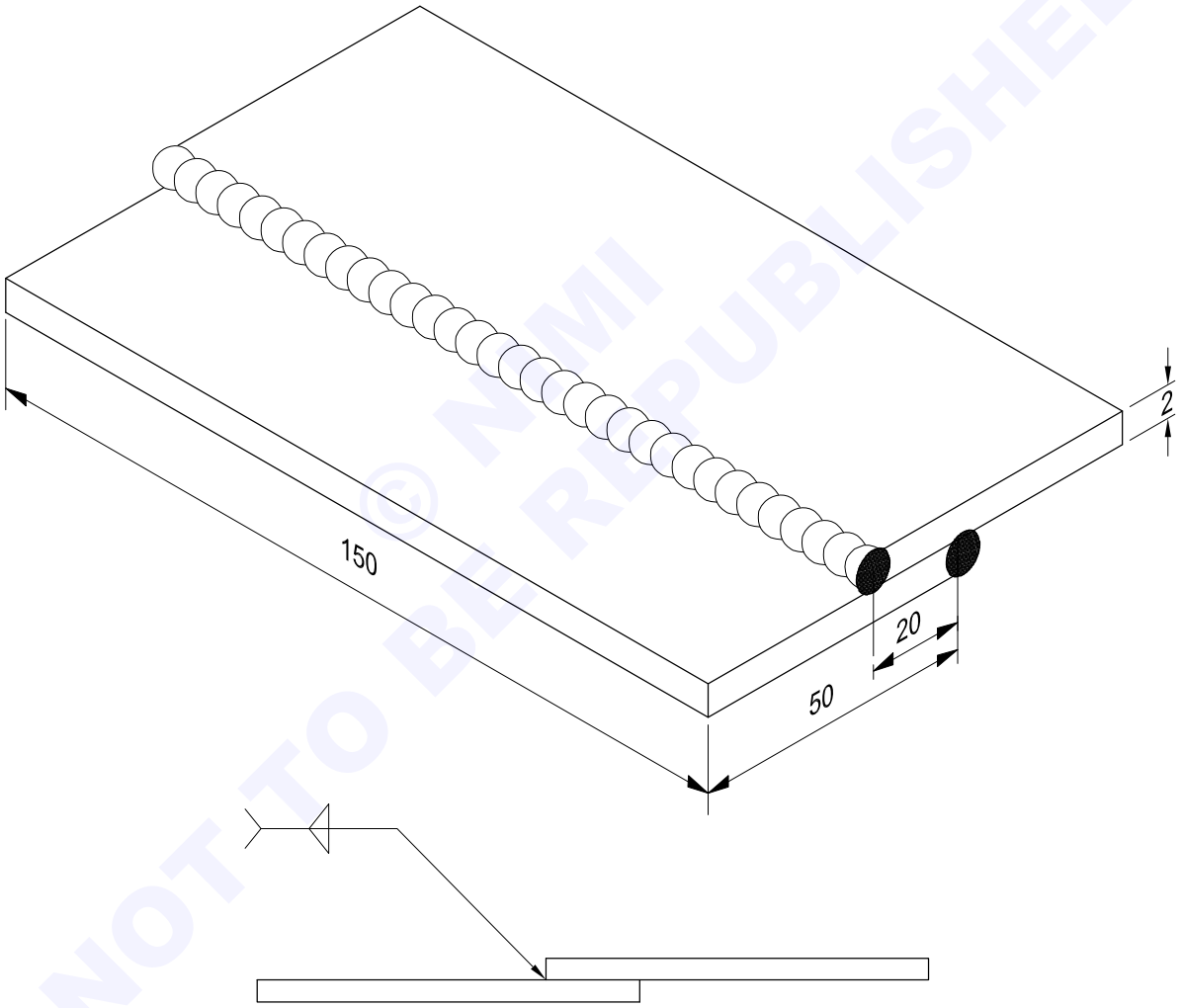
Fillet lap joint on MS sheet 2mm thick in flat position (1F)

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

- **prepare and set the job as per drawing**
- **select nozzle, filler rod**
- **set the flame (neutral) and tack weld**
- **weld the lap joint in flat position**
- **clean and inspect the weld defects.**



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2	ISST 50 x 2 - 150		Fe 310 - W			1.2.20
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**FILLET LAP JOINT ON M.S.SHEET 2mm THICK IN FLAT POSITION (1F)-(OAW-07)**				TOLERANCE ±1	TIME 10Hrs
					CODE NO. WG20N1220E1	

Job Sequence

- Prepare the job as per drawing and clean the edges.
- Set the job on the welding table to form a lap joint.
- Set the gas welding plant, fix nozzle No. 5 and set a pressure of 0.15 kg/cm for both gases.
- Select a C.C.M.S. filler rod 1.6 mm ø for tacking and welding.

Wear safety apparels and use gas welding goggles.

- Set the neutral flame.
- Tack the pieces at both ends and also in the center using a 1.6 mm ø filler rod.
- Check the alignment of pieces, clean the tacks, and place on the welding table in a flat position.
- Start welding, using leftward technique with the correct angle of the blowpipe and (3mm ø) filler rod.
- Fuse the edges uniformly, add filler metal to obtain correct root fusion and reinforcement, and proceed towards left. Don't concentrate the flame on the top member in the lap joint.
- Maintain correct travel speed, manipulation of blowpipe and filler rod to produce uniform weld bead.
- Stop at the left end, after filling the crater and complete the weld.
- Extinguish the flame, cool the nozzle in water and place the blowpipe at its place on the cylinder trolley.
- Clean the welded joint with a wire brush.

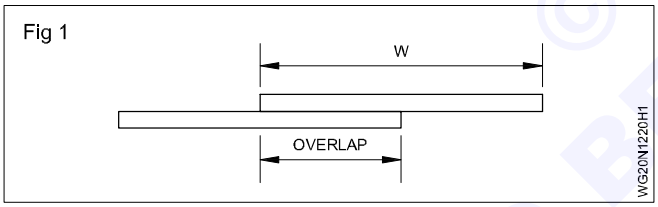
Skill Sequence

Lap weld joint on MS sheet 2.00 mm in flat position

Objective: This shall help you to
- **prepare and lap weld joint on MS plate 2.00mm in flat position.**

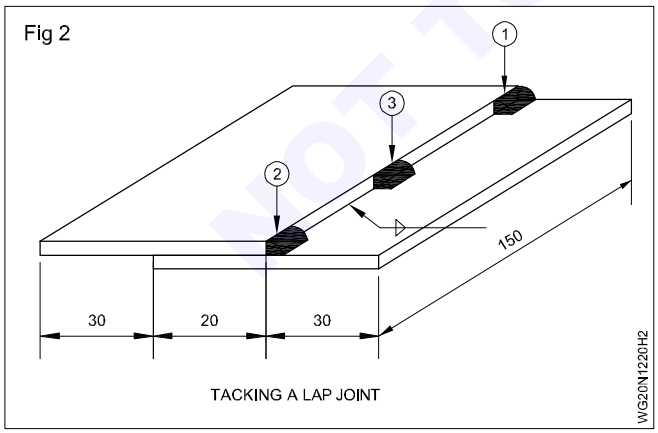
Set and tack the job pieces in correct alignment with proper overlapping of pieces. (Fig 1)

Fig 1



Place the tack welds at correct locations. (Fig 2)

Fig 2

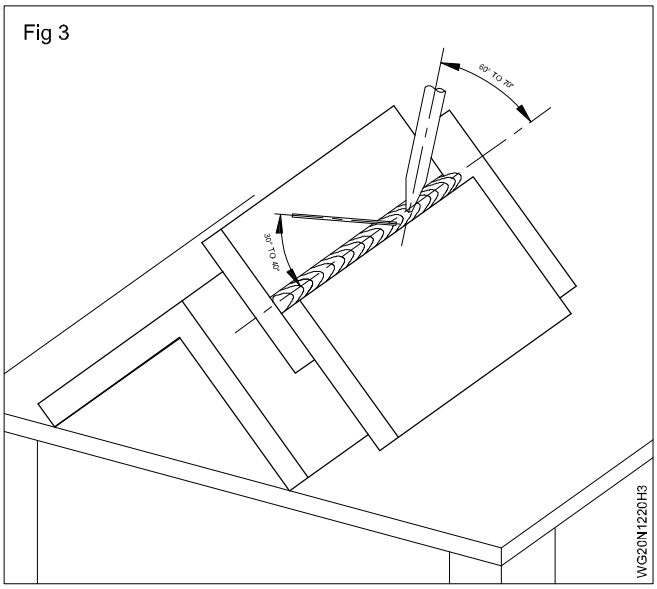


TACKING A LAP JOINT

Weld a uniform, well penetrated, correct size fillet lap weld in flat position by

– proper positioning of the joint (Fig 2)
– proper angle of the blowpipe and filler rod (Figs 3 & 4)

Fig 3



– proper manipulation of the blowpipe and filler rod.
– using leftward welding technique.

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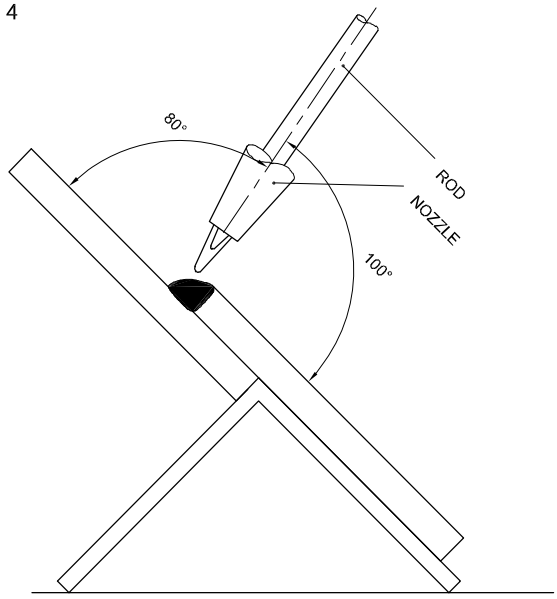
Fig 4



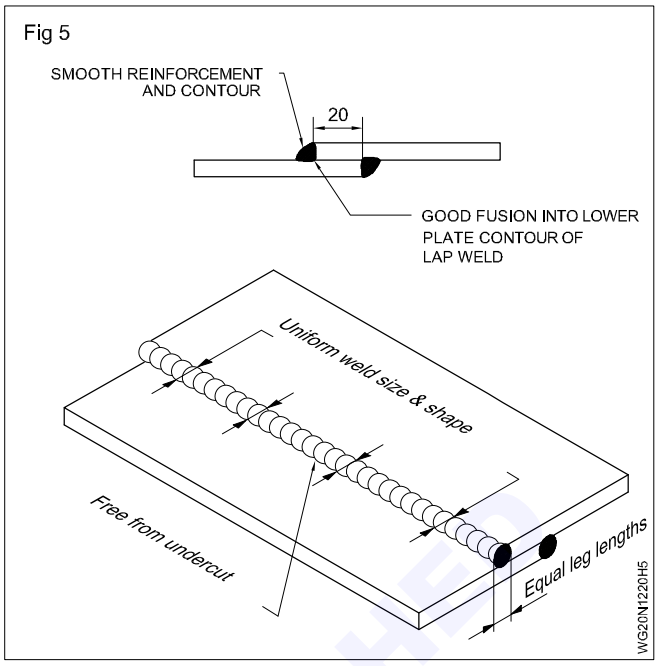
Avoid movement of blow pipe flame nearer to the edge of the top plate. This will avoid edge of the plate melted off defect.

– maintaining uniform travel speed and feed.

– Clean the weldment and inspect for: (Fig 5)

– uniform weld size and shape of whole length (reinforcement and contour) of the joint.

Fig 5



– equal leg length

– no undercut at the toe of weld

– no fusing of the top plate edge to undersize

– smooth ripple appearance

– proper crater filling.

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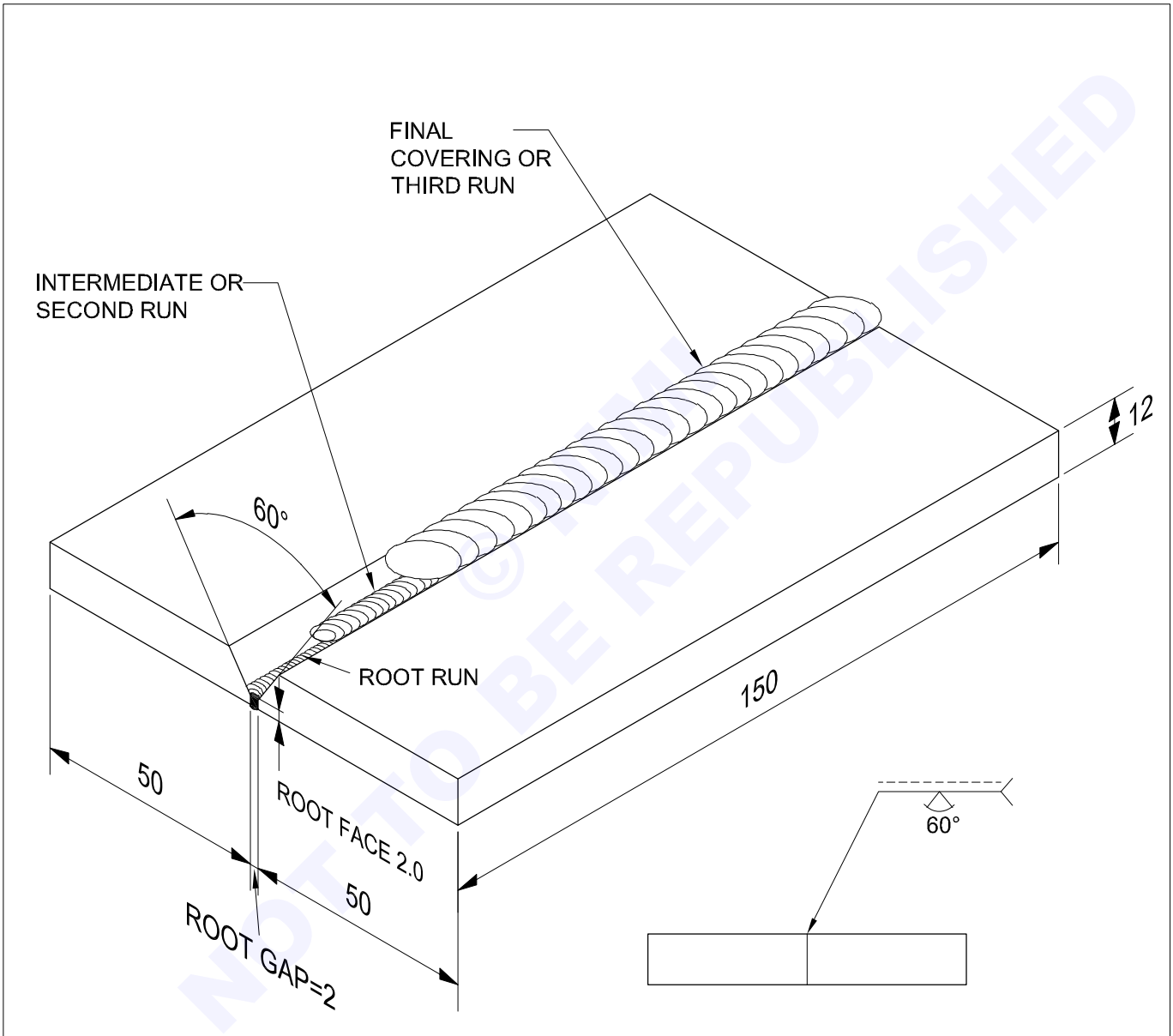
Single "V" butt joint on MS plate 12mm thick in flat position (1G)

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

- **prepare the job as per drawing**
- **make the bevel by gas cutting**
- **set the root gap and tack weld**
- **deposit root, second and weaving bead in flat position**
- **clean and inspect the weld defects.**



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2	50 ISF 12 - 150		Fe 310 - W			1.2.21
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	SINGLE "V" BUTT JOINT M.S. PLATE 12mmTHICK IN POSITION FLAT POSITION (1G)-(SMAW-07)				TOLERANCE ±1	TIME
					CODE NO. WG20N1221E1	

Job Sequence

- Straight cut two 12mm thick plates by gas cutting as per drawing and grind them to size.
- Bevel the edges of each plate to 30° angle by gas cutting and file the root face as per drawing.
- 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 2° on each side of the joint.
- Wear all protective clothing.
- Use a 3.15mm medium coated MS electrode and set 90-110 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 25mm.
- Deslag the tack weld and clean.
- 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 penetration.
- Deposit the second run/intermittent run using 4mm ø medium coated electrode and 125-140 ampere current, short arc and proper weaving of the electrode. Avoid excessive weaving and ensure normal travel speed.
- Fill the crater wherever necessary.
- Deslag.
- 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.

Skill Sequence

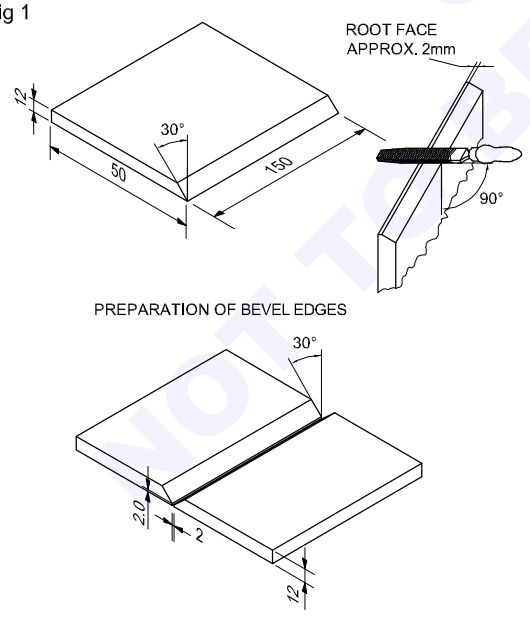
Welding of single 'V' butt joint MS plate 12mm thickness in flat position

Objective: This shall help you to

- **weld single V butt joint MS plate 12mm in flat position (1G).**

Preparation of the pieces (Fig 1)

Fig 1



Cut a 30° bevel on each piece using oxy-acetylene cutting.

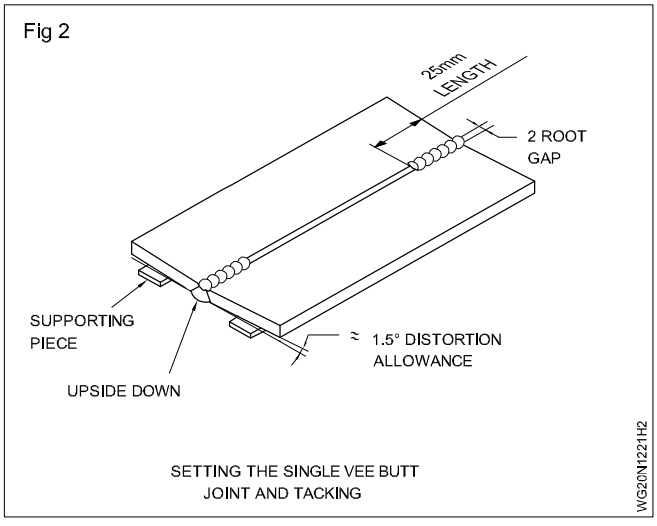
Grind the bevel edges to remove oxide deposits on the bevel.

Prepare a uniform root faces 1.5 mm by filing on both the beveled edges.

Setting the single V butt joint and tacking

Keep the bevel edges upside down with a root gap of 2mm, and 3° distortion allowance. (Fig 2) using suitable support. i.e. 1.5° on each side of the joint.

Fig 2



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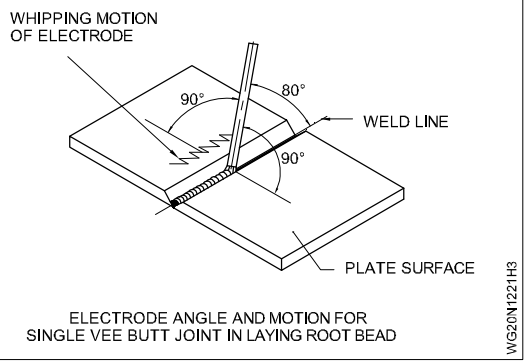
Tack-weld on both ends. (20mm long)

Ensure safety apparels are worn.

Place the joint in flat position after tacking.

Deposition of root bead (Fig 3)

Fig 3



ELECTRODE ANGLE AND MOTION FOR
SINGLE VEE BUTT JOINT IN LAYING ROOT BEAD

Deposit root bead using a 3.15 dia. 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 80° to the line of weld.

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 & covering beads

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 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 thoroughly and grind the humps in beads (if present).

Rectify possible defects, if any.

Deposit the final covering bead using a 5.00mm 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.

Follow the other steps as done for the 1st covering bead.

Cleaning and inspection

Clean the welded joint thoroughly from both sides.

Inspect the weld size, surface defects, root penetration and distortion.

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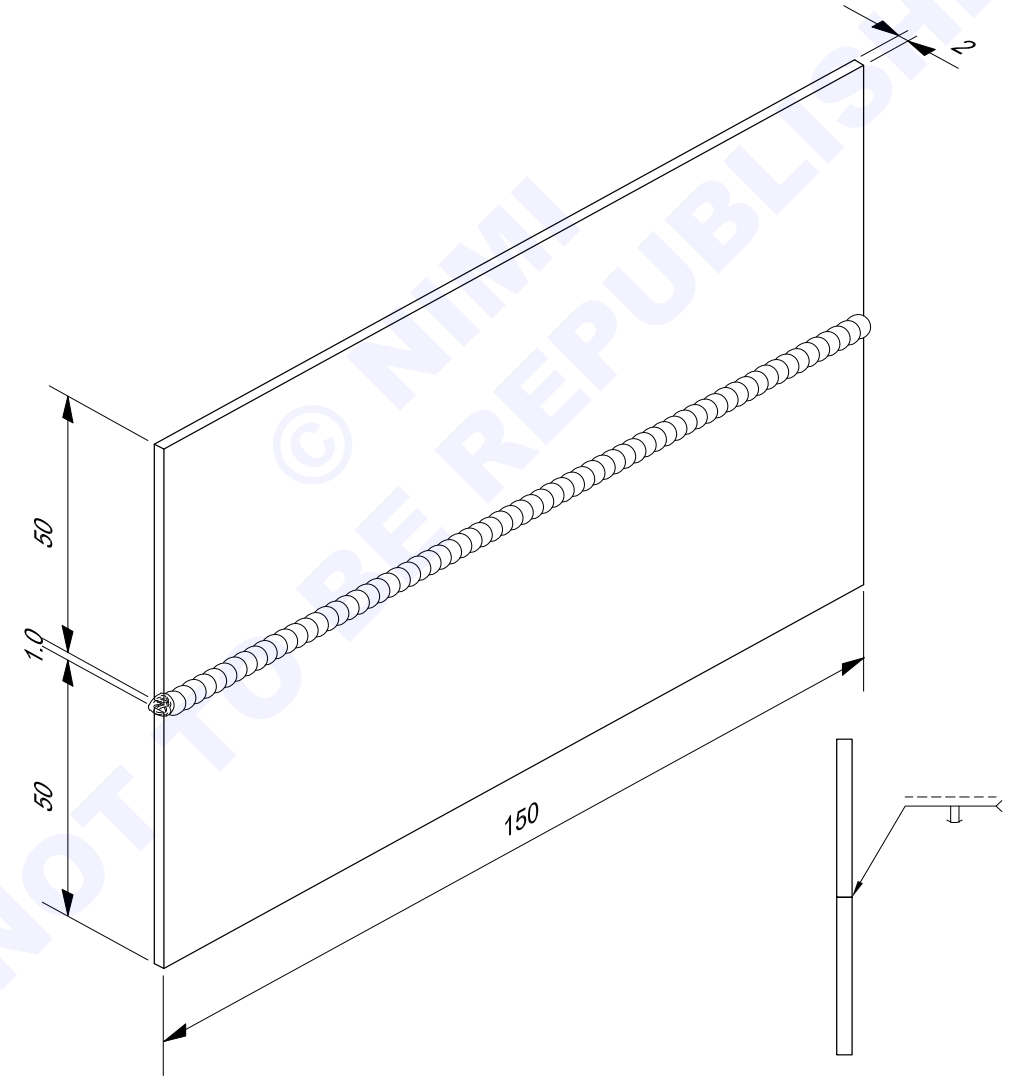
Square butt joint on MS sheet 2mm thick in horizontal position(2G)-(OAW-08)

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

- **prepare the job as per drawing**
- **set the root gap and tack weld**
- **deposit weld bead in horizontal position**
- **clean and inspect the weld defects**
- **set and tack the job pieces to form a square butt joint with proper root gap**
- **fix the job in the positioner in horizontal position**
- **weld square butt joint by proper manipulation of the blowpipe and filler rod using leftward technique**
- **ensure good root penetration weld reinforcement and bead profile**
- **clean and inspect the welded joint for weld defects.**



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2	ISST 50 x 2 - 150	-	Fe 310 - W	-	-	1.3.22
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	BUTT WELD - SQUARE BUTT JOINT ON M.S SHEET 2mm IN HORIZONTAL POSITION.				TOLERANCE ±0.5	TIME
					CODE NO. WG20N1222E1	

Job Sequence

- Prepare the job pieces as per drawing.
- Clean the edges and surfaces of the metal pieces.
- Set the job pieces as square butt joint with a root gap of 1.0 mm.
- Select the nozzle No. 5 and C.C.MS. filler rod dia. 1.6 mm.
- Set a gas pressure of 0.15 kg/cm^2.
- Follow necessary safety precautions.
- Tack weld the sheets and check for uniform root gap and alignment.
- Weld the joint with a single run in horizontal position.
- Clean the welded area and inspect the weld for defects.

Skill Sequence

Weld square butt joint 2mm horizontal position (2G)

Objective: This shall help you to
- **prepare and weld square butt joint MS plate 2mm in horizontal position.**

Position the crossbar of the positioner to the eye level. (Fig 1)

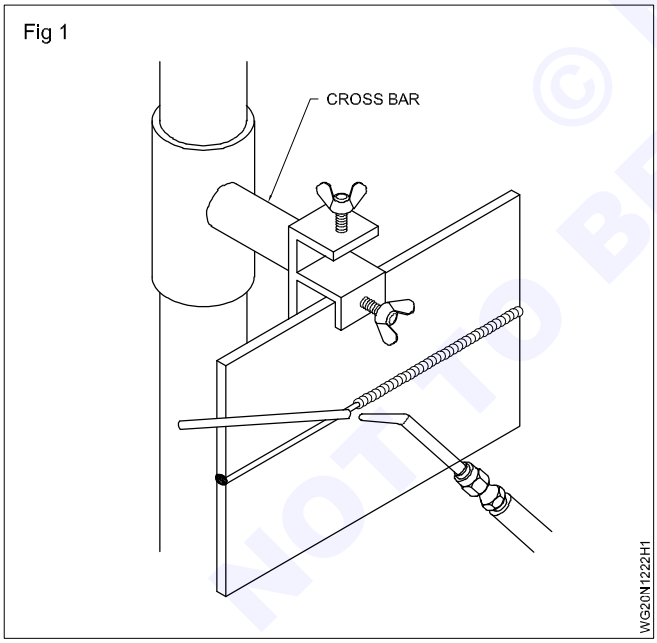
Adjust the pressure of oxygen and that of acetylene at 0.15 kg/cm^2.

Set a soft neutral flame.

Tack-weld the job at both ends and at the center with a root gap of 1.0 mm.

Fix the job on the crossbar of the positioner in horizontal position. (Fig 1)

Fig 1



Ensure the job is in horizontal position at a convenient height.

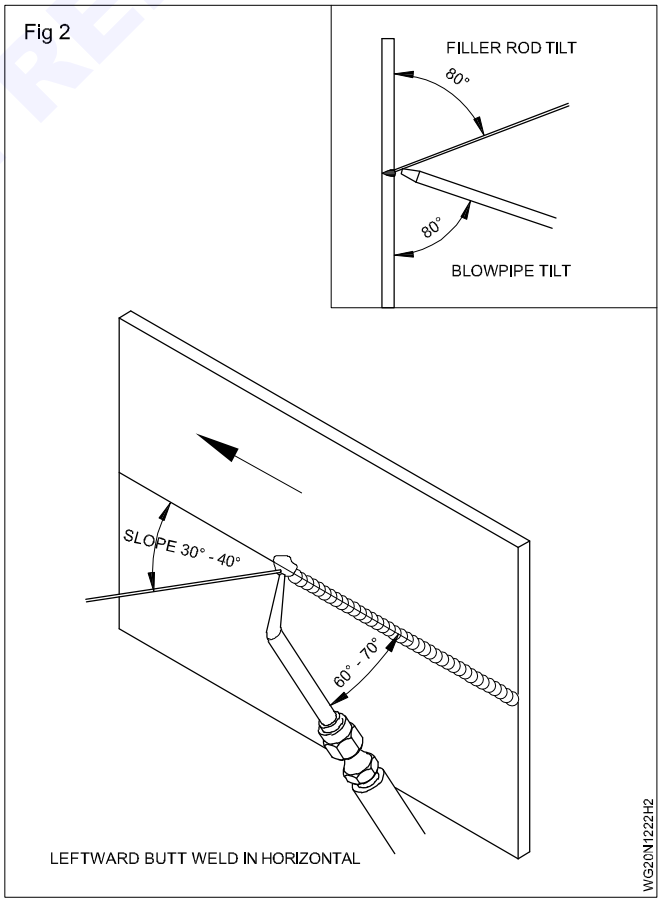
Hold the blowpipe at 60° to 70° and the filler rod at 30° to 40° to the line of weld. Deposit the bead from the right end of the joint by giving a circular motion to the blowpipe and proceed towards the left end.

Ensure both edges melt equally and up to the root of the joint.

Check the weldment for correct profile with complete penetration.

Proper angle between the blow pipe, filler rod and the sheet surface is to be maintained (Fig 2). The filler rod is added when the inner cone of the flame reaches the top edge of the joint. This will help in avoiding the excessive melting of the bottom edge of the joint and will avoid sagging of weld metal.

Fig 2



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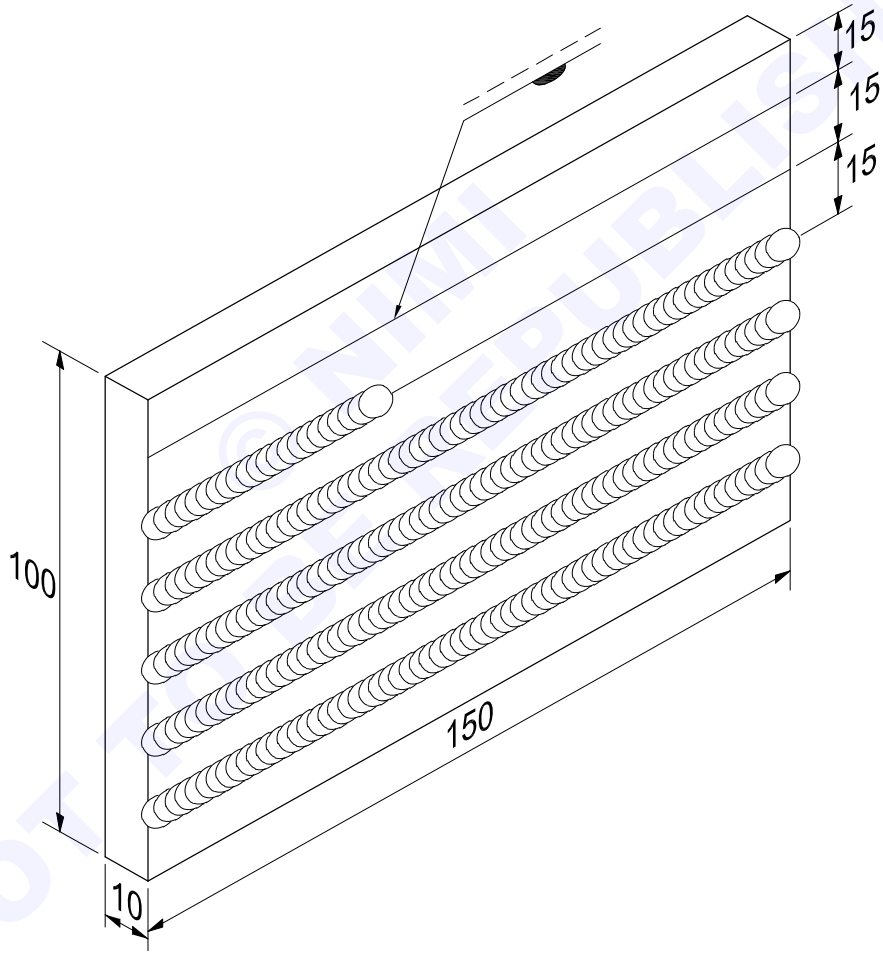
Straight line beads and multi-layer practice on M.S. plate 10mm thick in horizontal position

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

- **prepare job as per drawing**
- **select the electrode, current, polarity and arc length suitable for welding in horizontal position**
- **deposit uniform straight line beads in horizontal position**
- **control the molten metal and slag by the manipulation of the electrode angle**
- **prevent sagging of weld metal**
- **clean and inspect the weld defects.**



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1	100 ISF x 10 - 150	-	Fe 310 - W	-	-	1.3.23
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**STRAIGHT LINE BEADS ON M.S PLATE 10mm THICK AND MULTIPASS PRACTICE IN HORIZONTAL POSITION (SMAW-08)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1223E1	

Job Sequence

Preparation

- Mark and cut the plate as per drawing. Clean the surface and file the edges before punching the lines.
- Scribe lines and make punch marks as per job drawing.
- Select a 3.15mm electrode and set 90-110 amps and use DCEN. Set the job in a horizontal position.
- To avoid sagging molten metal, use a short etc.
- Convex bead will trap slag.
- Start at left hand side of the plate hold the electrode pointing upward at angle of 70° to 80° to the surface of base metal. Use a travel angle 70° to 80° to weld direction.
- Remove the slag with a chipping hammer and clean the bead with a wire brush.

Inspection of bead

- Inspect the bead weld for surface defects like undercut, slag inclusions, overlap etc.

Skill Sequence

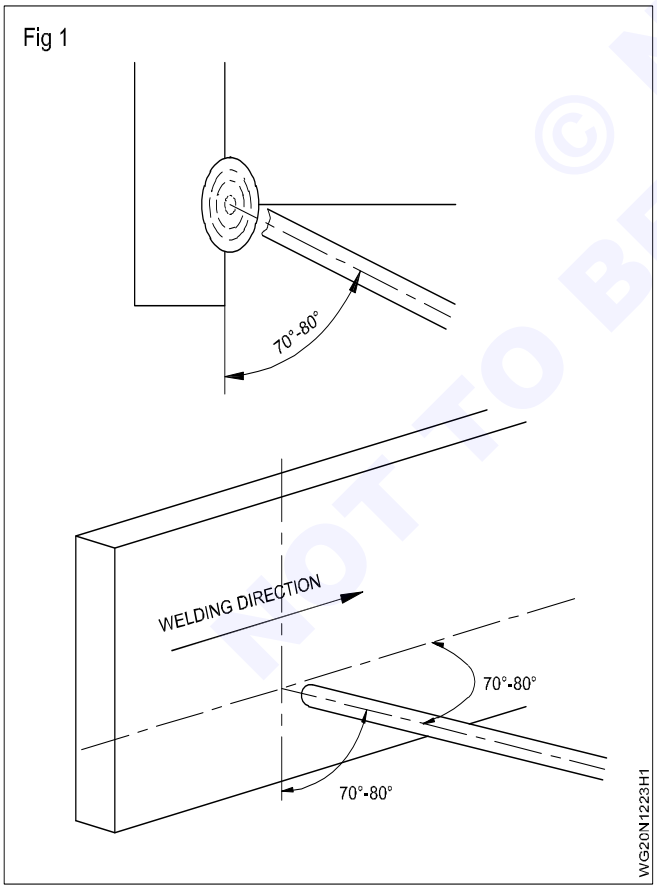
Weld straight line bead on MS plate 10mm in horizontal position

Objective: This shall help you to
- **prepare and weld straight line bead on MS plate 10mm in horizontal position.**

Making a bead on plate weld in the horizontal position is very much like making it in a flat position.

But the angle of electrode should be held at an angle to the surface and inclined to the line of travelling as shown in the Fig 1.

Fig 1

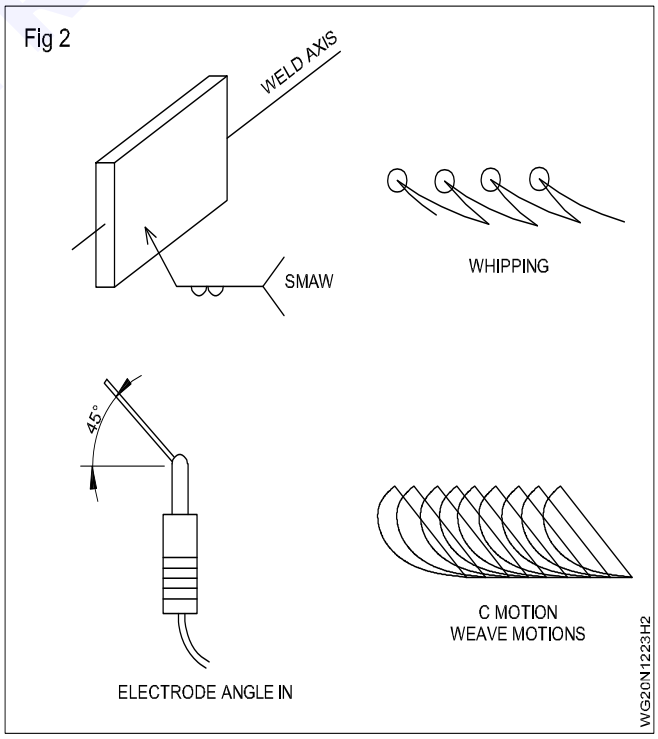


Reduce the current to get faster cooling. This helps to avoid overhanging of weld puddle at the bottom side of the plate.

Use a faster travel speed and maintain weld puddle size not larger than the coating diameter of the electrode.

Move the electrode to the right with a slight whipping motion or a "C" motion as shown in Fig 2. This helps to cool the puddle slightly, solidify faster and avoid sagging of bead. While using "C" motion pause at the upper left of the "C".

Fig 2



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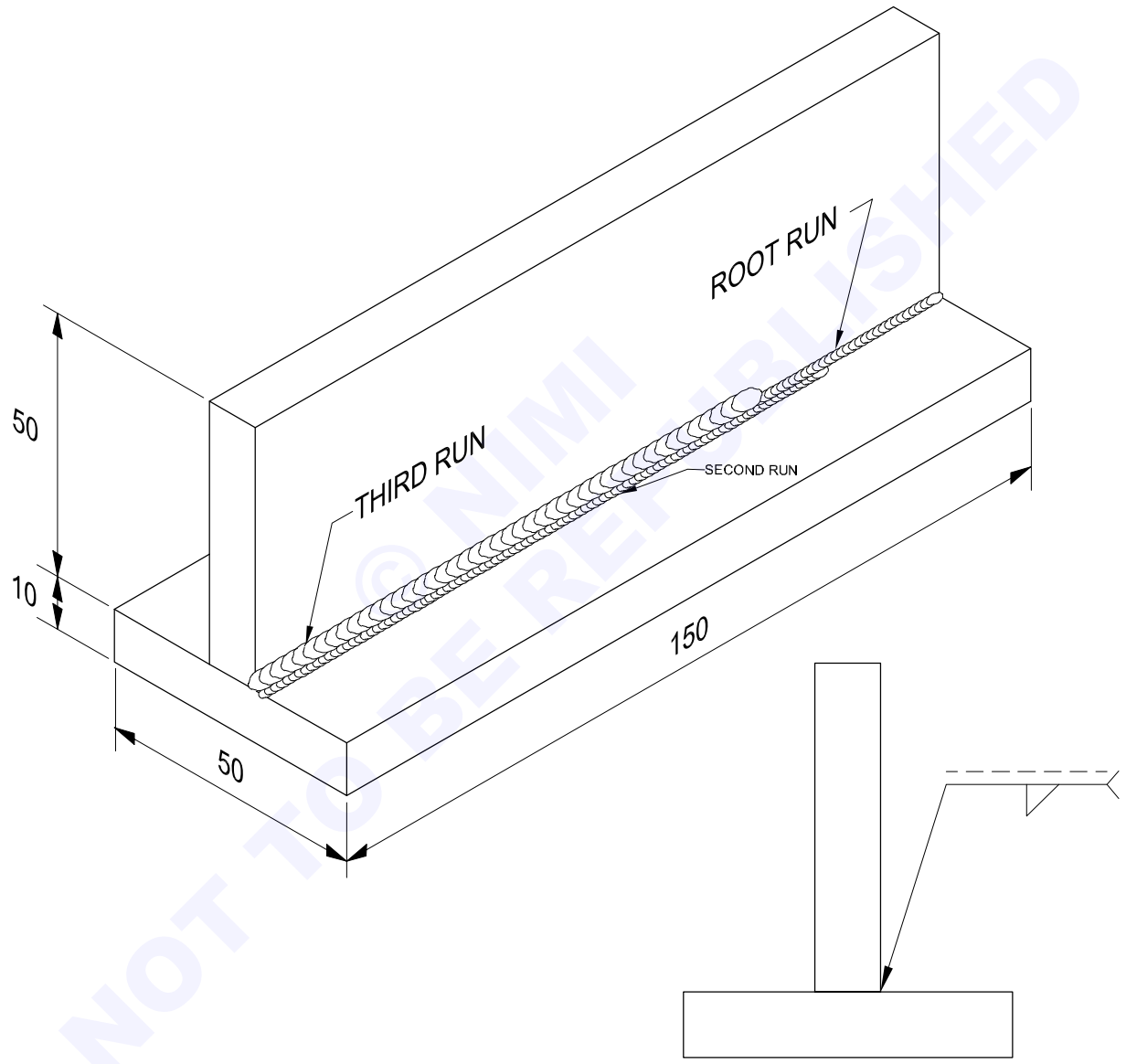
Fillet - 'T' joint on MS plate 10mm thick in horizontal position

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

- **select electrode, current, polarity and arc length**
- **use distortion control and arc blow control methods**
- **deposit to weld 'T' joint with a short arc and uniform travel speed**
- **inspect the weldments for external defects.**



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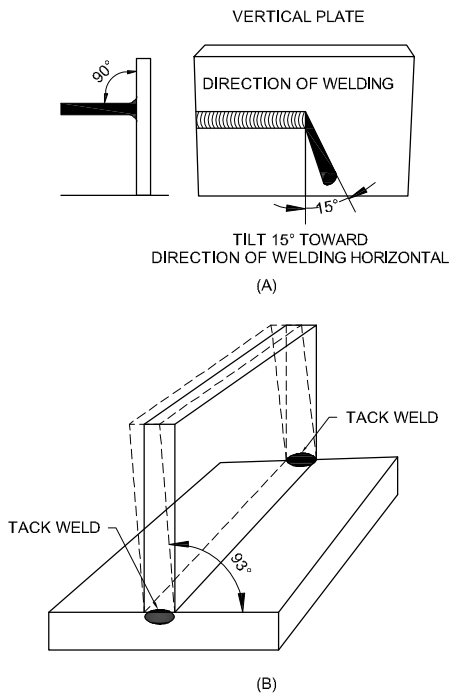
2	50 ISF x 10 - 150		Fe 310 - W			1.3.24
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FILLET 'T'- JOINT ON M.S PLATE 10mm THICK IN HORIZONTAL POSITION (2F)-(SMAW-09)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1224E1	

Job Sequence

- Prepare and clean the plates as given in Ex. No. E-8/ 3.04.

Fig 1



(A) HOW TO HOLD AN ELECTRODE WHILE MAKING A HORIZONTAL WELD BEAD ON A VERTICAL PLATE
(B) HOW TACK WELDS CAN BE USED TO HOLD A T JOINT IN PLACE UNTIL IT IS FULLY WELDED

- Set the Tee joint as per drawing and tack weld (Fig 1)
- Fix the joint in horizontal position.
- If DC machine is used, connect the electrode to the negative and use short arc to control arc blow.
- To avoid distortion due to contraction preset the plates such a way that the angle of the tack welded joint is increased to 92° to 93° on the welding side.
- Deposit the root run without weaving.
- Hold the electrode at the center of the joint and start from leftward and use proper technique to avoid excessive metal deposition at the bottom of the plate.
- Deslag and clean the root run.
- Deposit the second and third run using stringer bead technique covering the previously laid bead partially and the plate surface.
- Ensure to fill the crater and to clean the bead.
- Check for the size of fillet, bead profile, weld defects and rectify them.

Skill Sequence

'T' joint weld on MS plate 10mm in horizontal position

Objective: This shall help you to
- **set and weld 'T' joint on MS plate 10mm thick in horizontal position.**

Fix the joint in a horizontal position. For this the bottom plate should be kept parallel to the ground and the other plate perpendicular. Fig 1.

Welding Tee joint (fillet) in horizontal position: Deposit root run with 3.15 mm dia. electrode and 90-110 amps welding current, maintaining the electrode angle 70° to 80° to the line of weld and 40° to 50° between the vertical plate and electrode (as in Fig 1).

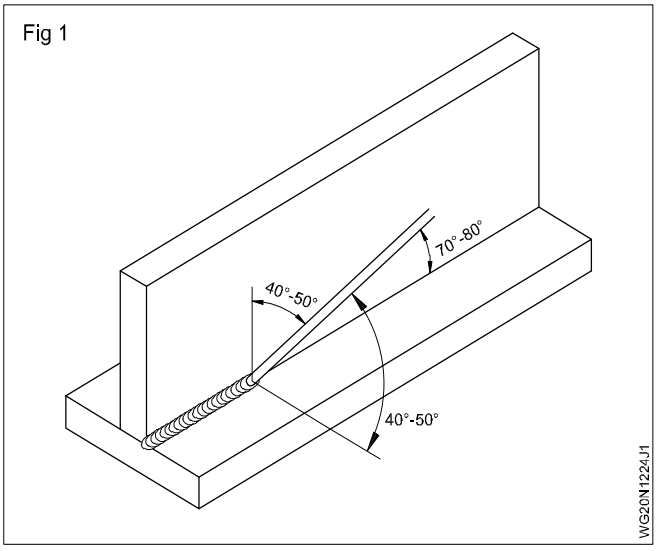
Maintain a short arc to get uniform fusion and proper root penetration.

Deslag and clean the root bead thoroughly. Use safety goggles while deslagging to protect the eyes from flying slag particles.

Deposit second run with a 4 mm electrode and 120-140 amps welding current, the angle of electrode to the bottom plate to be 55° - 65° and 25° - 35° to the vertical plate and 70° to 80° to the line of weld. (As in Fig 2.)

This second run has to be deposited partly covering the root run and partly on the bottom plate. Fig 4

Fig 1



Give a steady movement to the electrode using a short arc.

Deslag and clean the weld bead.

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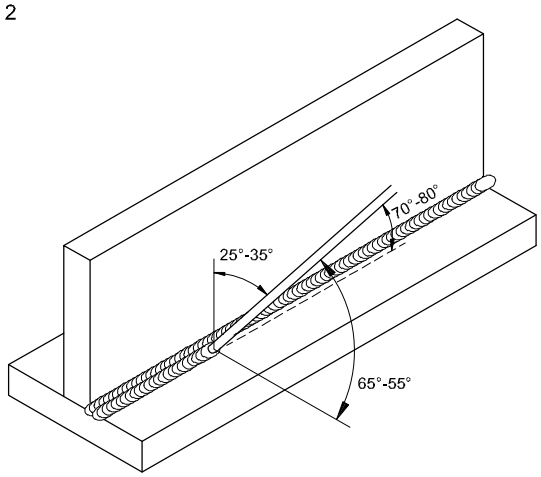
Fig 2



Deposit the third and final run with a 4 mm dia. Electrode and 160 amps welding current. Angle of the electrode to the line of weld is 70° to 80° and 40° - 50° on both plates. (Fig 3) The third run has to be deposited in such a way that the bead covers partly the root run and the second run and partly the vertical plate (Fig 4). Also there should not be a valley at the bottom toe line of the third run in order to maintain necessary throat thickness. If two pass technique is adopted second run should be done in a weaving motion. (Fig 5)

Deslag and clean the weld bead.

Fig 3

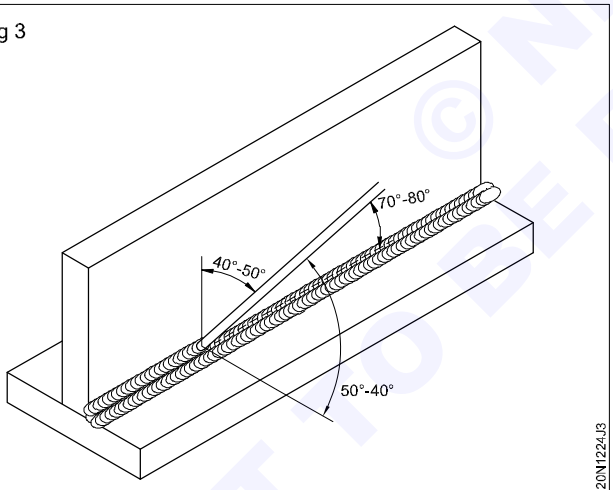
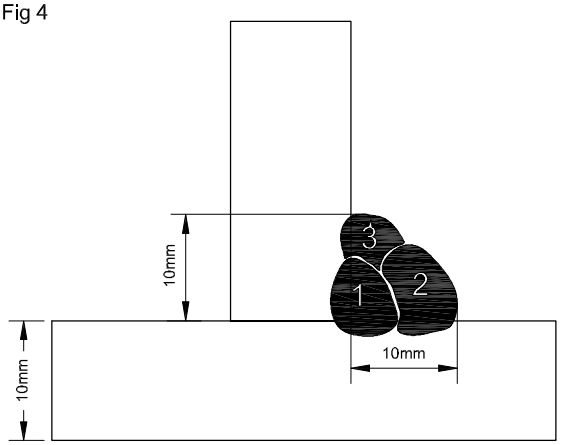
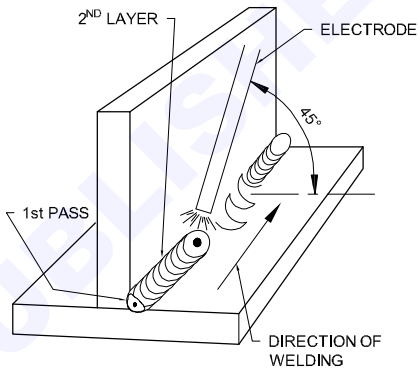


Fig 4



OREDER OF MAKING STRINGER BEADS FOR A " T " JOINT IN HEAVY PLATE

Fig 5



WEAVING MOTION USED FOR 2ND RUN OF FILLET WELDS (HORIZONTAL POSITION)

Avoid over-deposition and side undercut by using a proper angle and travel speed of the electrode.

Inspection of T joint

Inspect the fillet weld for equal leg length and correct size.

Inspect to ensure the fillet weld is free from undercut and excessive lapping on bottom plate.

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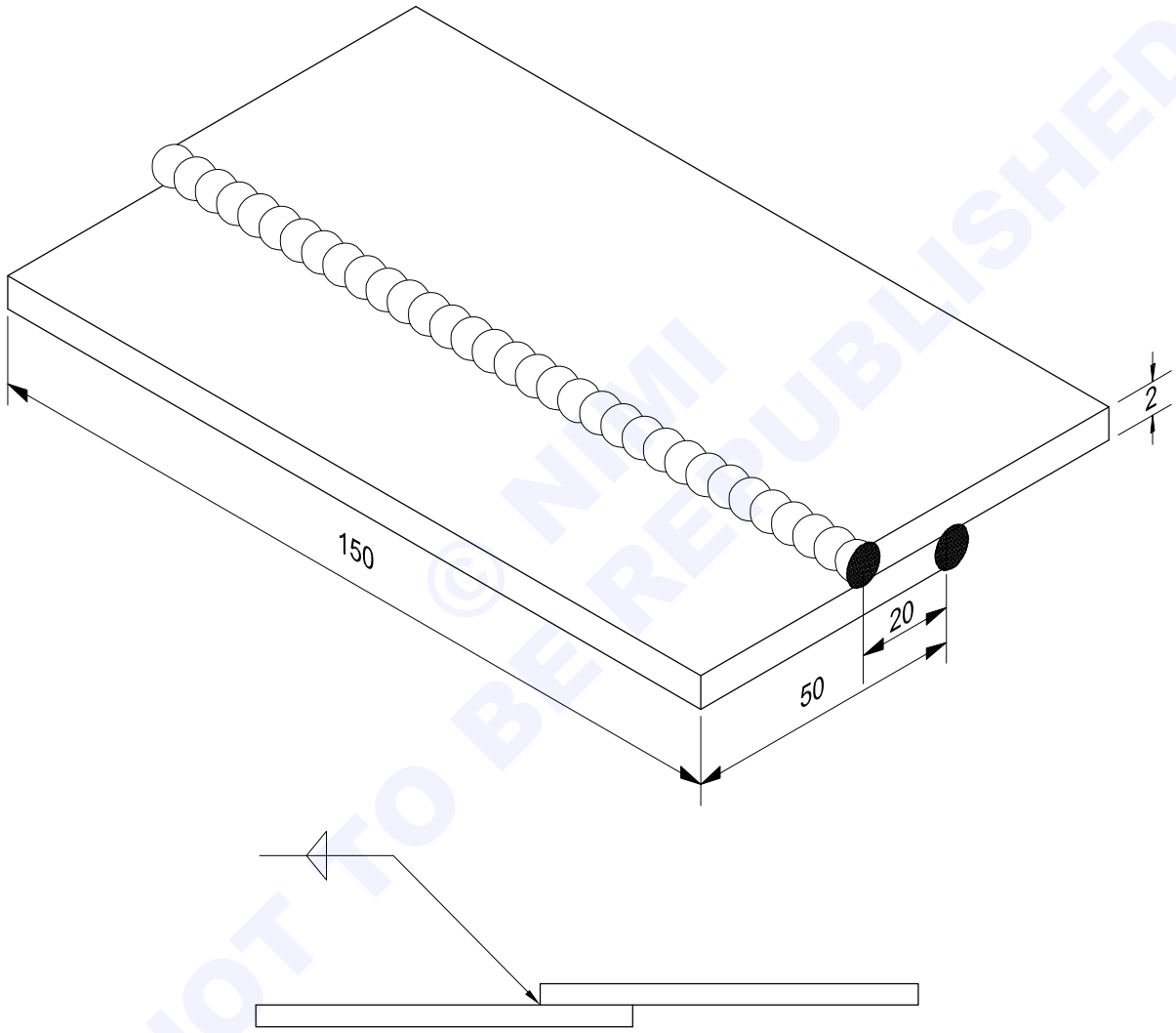
Fillet - lap joint on MS sheet 2mm thick in horizontal position

Objectives: At the end of this exercise you shall be able to
- **prepare,set and tack the job as per drawing**
- **weld the joint in horizontal position**
- **clean and inspect the weld defects.**



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2	ISST 50 x 2 - 150	-	Fe 310 - W	-	-	1.3.25
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	FILLET - LAP JOINT ON M.S.SHEET 2mm THICK IN HORIZONTAL POSITION (2F)-(OAW-09)	TOLERANCE ±1	TIME
		CODE NO. WG20N1225E1	

Job Sequence

- Prepare the job pieces as per drawing.
- Clean the edges and surfaces of the metal pieces.
- Set the job pieces as lap joint.
- Select the nozzle No. 5 and C.C.M.S. filler rod 1.6mmø.
- Set a gas pressure of 0.15 kg/m^2.
- Follow necessary safety precautions.
- Tack weld the sheets and check for alignment
- Weld the joint with a single run in horizontal position.
- Clean the welded area and inspect the weld for defects.

Skill Sequence

Lap joint on MS sheet 2.00mm in horizontal position (2F)

Objective: This shall help you to
- **prepare and weld lap joint on MS sheet 2.00mm in horizontal position.**

- Position the cross bar of the positioner to the eye level.
- Set and tack the job pieces in correct alignment with proper overlapping of pieces.
- Place the tack welds at correct locations.
- Fix the job on the cross bar of the positioner in horizontal position.
- Hold the blowpipe at 60 to 70° and the filler rod at 30 to 40° to the line of weld. Deposit the bead from the right end of the joint by giving a circular motion to the blowpipe and proceed towards the left end.
- Maintain correct travel speed, manipulation of blowpipe and filler rod to produce uniform weld bead.

Clean the weldment and inspect for:

– Uniform weld size and shape of whole length (reinforcement and contour) of the joint.

– Equal leg length.

– No undercut at the toe of weld.

– Smooth ripple appearance.

– Proper crater filling.

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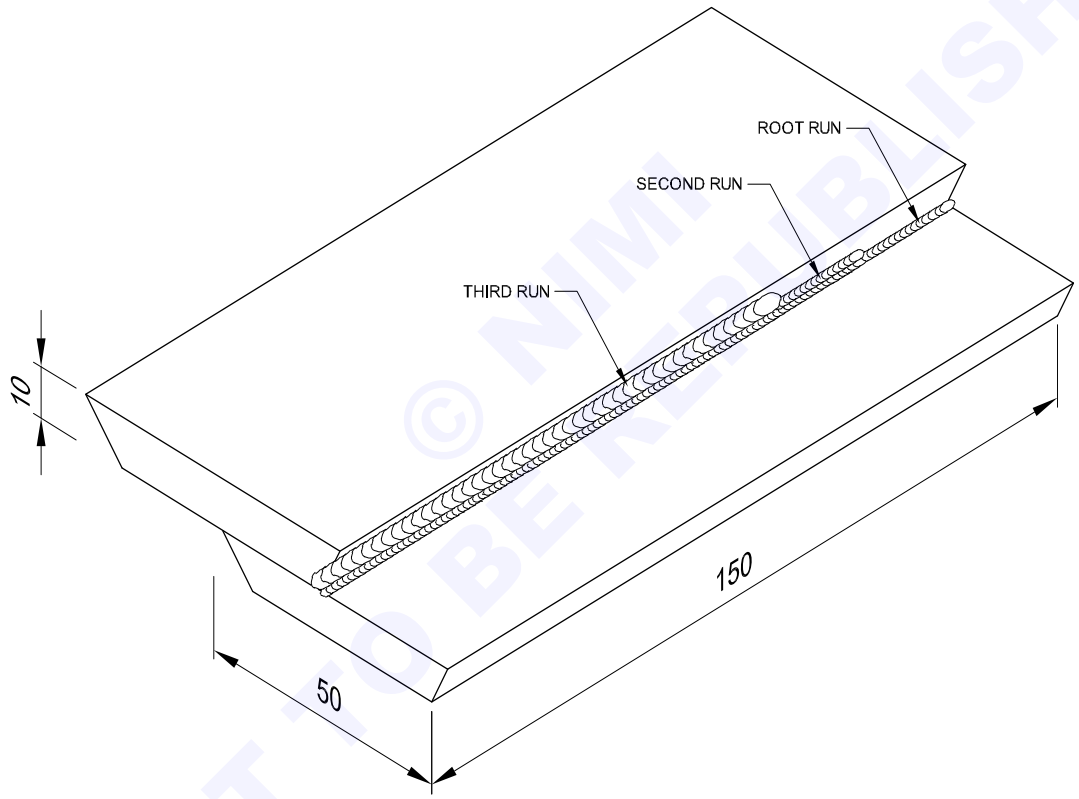
Fillet lap joint on MS plate 10mm thick in horizontal position (2F)-(SMAW-10)

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

- **prepare the job as per drawing**
- **select electrode, current, polarity and are length**
- **deposit root, second and third bead in horizontal position**
- **clean and inspect the weldments for external defects.**



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2	50 ISF x 10 - 150	-	Fe 310 - W	-	-	1.3.26
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FILLET LAP JOINT ON M.S PLATE 10mm THICK HORIZONTAL POSITION (2F)-(SMAW-10)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1226E1	

Job Sequence

- Prepare and clean the plates as per given dimensions.
- Set the Lap joint as per drawing and tack weld.
- Fix the joint in horizontal position.
- If DC machine is used, connect the electrode to the negative and use short arc to control arc blow.
- To avoid distortion due to contraction preset the plates such a way that the angle of the tack welded joint is decreased to 87° on the Back side.
- Deposit the root run without weaving.
- Hold the electrode at the center of the joint and start from leftward and use proper technique to avoid excessive metal deposition at the bottom of the plate.
- Deslag and clean the root run.
- Deposit the second and third run using stringer bead technique covering the previously laid bead partially and the plate surface.
- Ensure to fill the crater and to clean the bead.
- Check for the size of fillet, bead profile, weld defects and rectify them.

Skill Sequence

Fillet weld lap joint MS plate 10mm horizontal position (2F)

Objective: This shall help you to
- **prepare and weld lap joint on MS plate 10mm in horizontal position.**

Fix the joint in a horizontal position. For this the bottom plate should be kept parallel to the ground and the other plate perpendicular.

Welding Lap joint (fillet) in horizontal position: Deposit root run with 3.15 mm dia. electrode and 90-110 amps welding current, maintaining the electrode angle 70° to 80° to the line of weld and 40° to 50° between the vertical plate and electrode.

Deslag and clean the root bead thoroughly. Use safety goggles while deslagging to protect the eyes from flying slag particles.

Deposit second run with a 4mm electrode and 160 amps welding current, the angle of electrode to the bottom plate to be 55° - 65° and 25° - 35° to the vertical plate and 70° to 80° to the line of weld.

This second run has to be deposited partly covering the root run and partly on the bottom plate.

Give a steady movement to the electrode using a short arc.

Deslag and clean the weld bead.

Deposit the third and final run with a 4 mm dia. electrode and 160 amps welding current. Angle of the electrode to the line of weld is 70° to 80° and 40° - 50° on both plates. The third run has to be deposited in such a way that the bead covers partly the root run and the second run and partly the vertical plate. Also there should not be a valley at the bottom toe line of the third run in order to maintain necessary throat thickness. If two pass technique is adopted second run should be done in a weaving motion. Deslag and clean the weld bead.

Avoid over-deposition and side undercut by using a proper angle and travel speed of the electrode.

Inspection of Tee joint

Inspect the fillet weld for equal leg length and correct size.

Inspect to ensure the fillet weld is free from undercut and excessive lapping on bottom plate.

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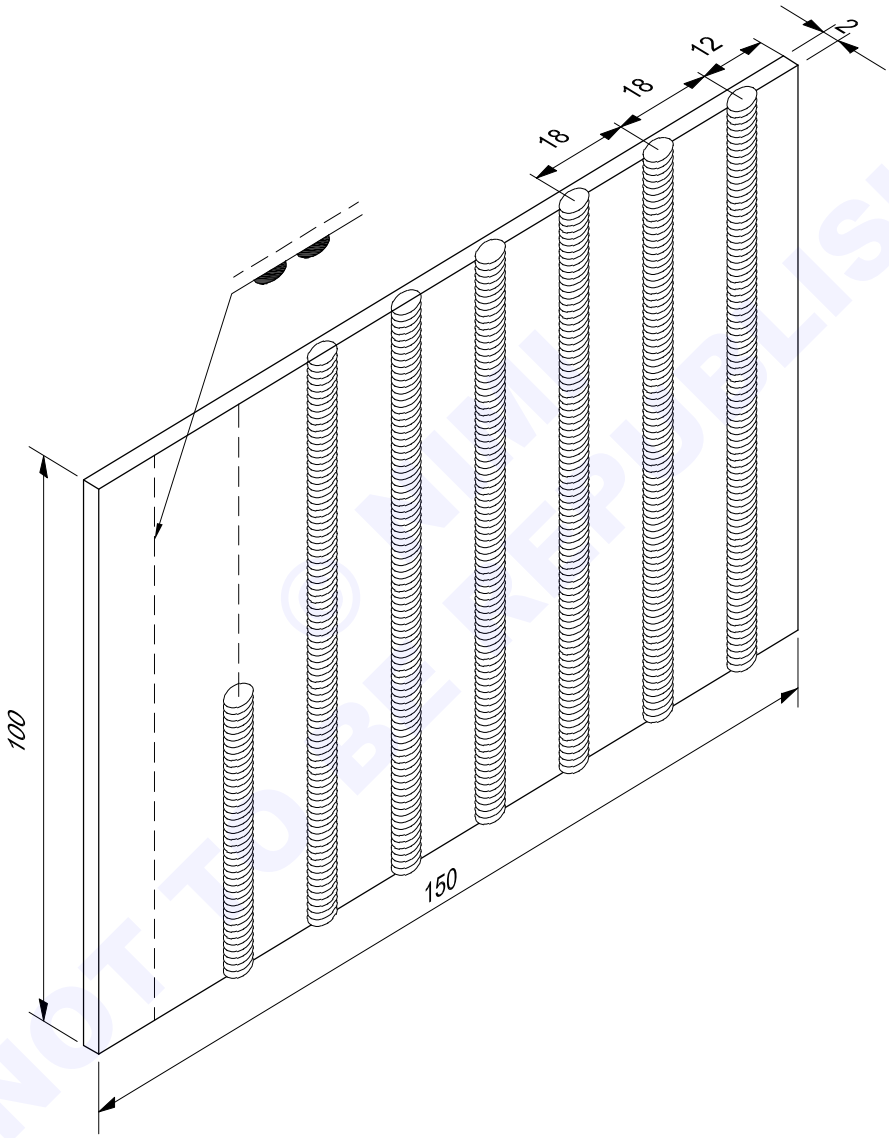
Fusion run with filler rod in vertical position on 2mm thick MS sheet

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

- **prepare the job as per drawing**
- **fix the job in vertical position in the weld positioner**
- **select the nozzle and filler rod size and the gas pressure**
- **manipulate the blowpipe and filler rod maintaining proper angle**
- **deposit bead in vertical position in upward direction along a straight line**
- **clean and inspect the bead visually and identify the defects.**



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1	ISST 100 x 2 - 150	-	Fe 310 - W	-	-	1.3.27
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FUSION RUN WITH FILLER ROD IN VERTICAL POSITION ON 2mm THICK M.S SHEET (OAW-10)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1227E1	

Job Sequence

- Prepare the sheet as per drawing and scribe straight lines and punch mark them as per the sketch.
- Clean the surface of the sheet.
- Fix the marked sheet on the weld positioner or vertical welding jig in vertical position at a convenient height.
- Select No. 5 size nozzle and fix it to the blow pipe.
- Select 1.6mm dia. CCMS rod and set 0.15 kg/sq.cm pressure for the gases.
- Follow necessary safety precautions.
- Light the blowpipe and set neutral flame.
- Hold the blow pipe at 75° and the filler rod at 30 - 40° to the line of weld. The angle between the blow pipe nozzle and filler rod and the sheet surfaces should be at 90°.
- Deposit the weld bead starting from the bottom most point of a punched line and moving upwards along the line.
- Ensure the melting of the base metal and the filler rod are kept as minimum as possible.
- Maintain proper angles for the blow pipe and filler rod.
- Move the blow pipe and filler rod without any side to side movements along the marked line at a uniform speed in upward direction.
- Do not allow the inner cone of the flame to come in contact with the molten metal (puddle) to avoid back fire.
- Complete depositing the weld bead up to the top end of the line and ensure to fill the crater.
- Ensure to avoid undercut defect by proper manipulation of the blow pipe and the filler rod.
- Clean the bead and visually inspect for any surface / external defect.
- Repeat the exercise on the other punch marked lines for more practice.

Skill Sequence

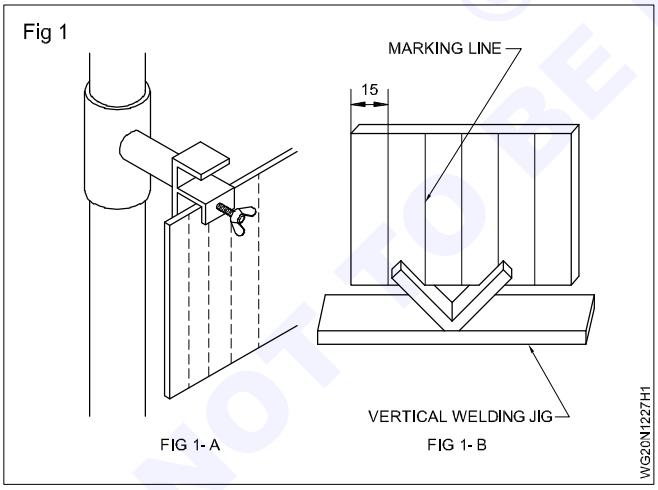
Fusion run with filler rod, 2mm MS sheet in vertical position

Objective: This shall help you to

- **prepare and carry out fusion run with filler rod in 2mm MS sheet in vertical position.**

Job setting: Fix the job in vertical position. (Figs 1A or B) at a level from the ground based on your height.

Fig 1

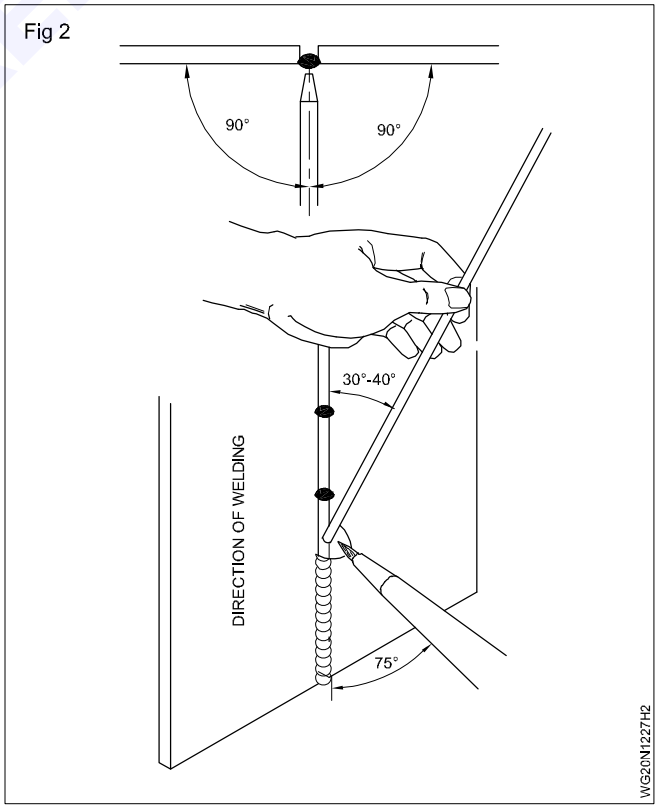


Fix nozzle No. 5 and select a CCMS rod 1.6mmø.

Welding technique: Deposit the weld in vertical upward position.

Maintain the angle of the blowpipe at 75° and the filler rod at 30° - 40°. (Fig 2)

Fig 2



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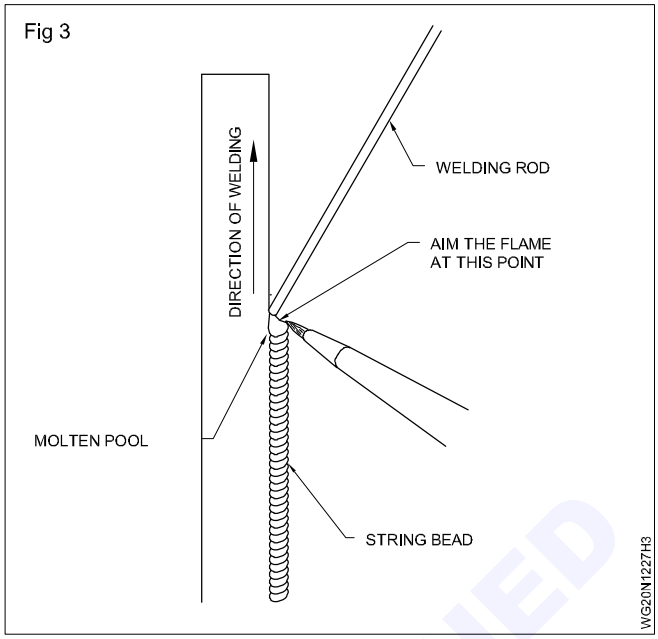
Control the molten pool without giving any circular motion to the blowpipe. (Fig 3)

Take due care that the weight of the blow pipe and hoses do not pull your hand downwards while the deposition of weld metal progresses upwards.

Inspect the weld bead for surface defects like undercut, poor bead appearance due to sagging of weld metal, excessive reinforcement, wavy weld deposit etc.

Fig 3



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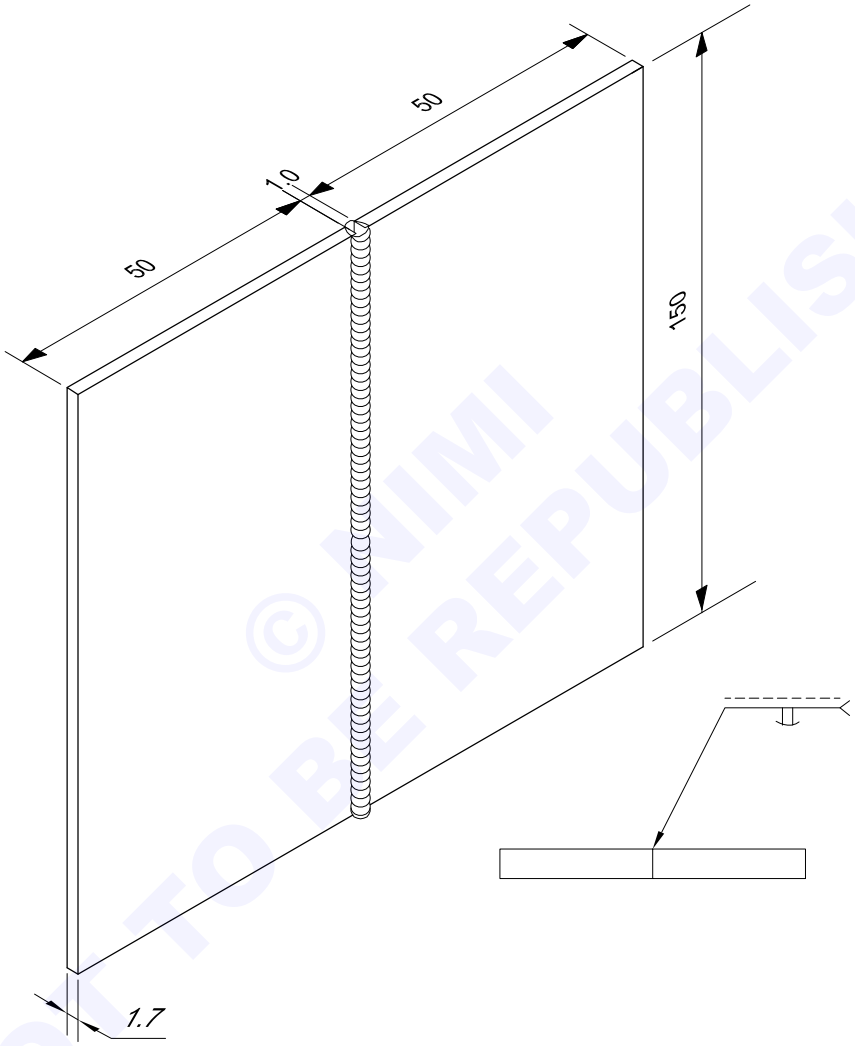
Square butt joint on MS sheet 2mm thick in vertical position (3G)-(OAW-11)

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

- **prepare and set the job as per drawing**
- **select filler rod nozzle and tack weld**
- **weld the job in vertical position**
- **clean and inspect the weld defects.**



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2	ISST 50 x 2 - 150	-	Fe 310 - W	-	-	1.3.28
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SQUARE BUTT JOINT ON M.S.SHEET 2mm THICK IN VERTICAL POSITION (3G)-(OAW-11)**				TOLERANCE ±0.5	TIME 8 Hrs
					CODE NO. WG20N1228E1	

Job Sequence

- Shear the plate and file the edges. Clean the surface with a wire brush. Set the plate as a square butt with a 1.5 mm root gap.
- Fix nozzle No. 5 and adjust the gas pressure of oxygen and acetylene at 0.15 kg/cm^2.
- Ignite the torch and set the neutral flame.
- Select a C.C.M.S. filler rod of 1.6 mm ø.
- Tack-weld the two pieces with a 1.5 mm uniform root gap on both ends and in center.
- Check for correct alignment.
- Fix the sheet in vertical in the 'C' clamp with the bottom edge of the sheet at welder's chest height.
- Melt the tack weld and establish a weld pool at the bottom edge of the joint.
- Keep the blowpipe angle 75° - 80° to the line of travel and the filler rod angle 30° to 40° to the same plane and proceed to weld upwards.
- Continuously dip the filler rod tip in the molten pool and move upwards. Weld the joint with a single run.
- Ensure the edges of both the metals melt equally so as to achieve complete penetration.
- At the end of the joint add sufficient filler metal and fill up the crater. Use a pair of tongs to remove the job from the fixture.
- Clean the weld and inspect for surface defects and root penetration.

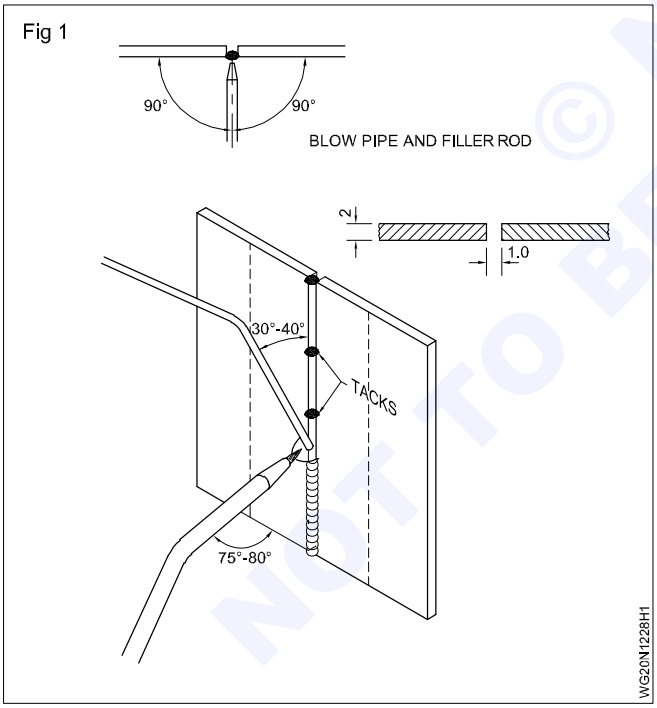
Skill Sequence

Square butt joint on MS sheet 2mm in vertical position

Objective: This shall help you to
- **prepare and weld square butt joint on MS sheet 2mm in vertical position.**

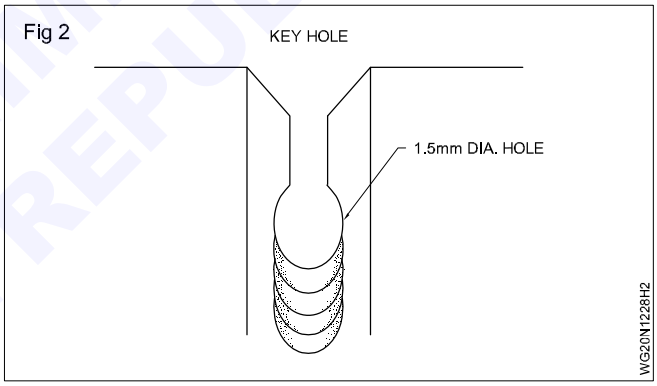
Tack the two sheets together as a square butt joint and fix the job in vertical position. (Fig 1)

Fig 1



Move the torch to the bottom of the square groove and establish a weld puddle. Continue to develop the puddle until you see the keyhole (Fig 2) that indicates complete penetration.

Fig 2



When you achieve the desired penetration, begin adding filler metal and proceed welding upwards. (Fig 1)

Use a slight side to side weaving to the blow pipe to ensure fusion of both the edges of the joint.

Progress upward at a uniform rate of travel and add filler metal to get a bead of even width with good profile and appearance.

End the weld at the top of the joint and ensure to fill the crater.

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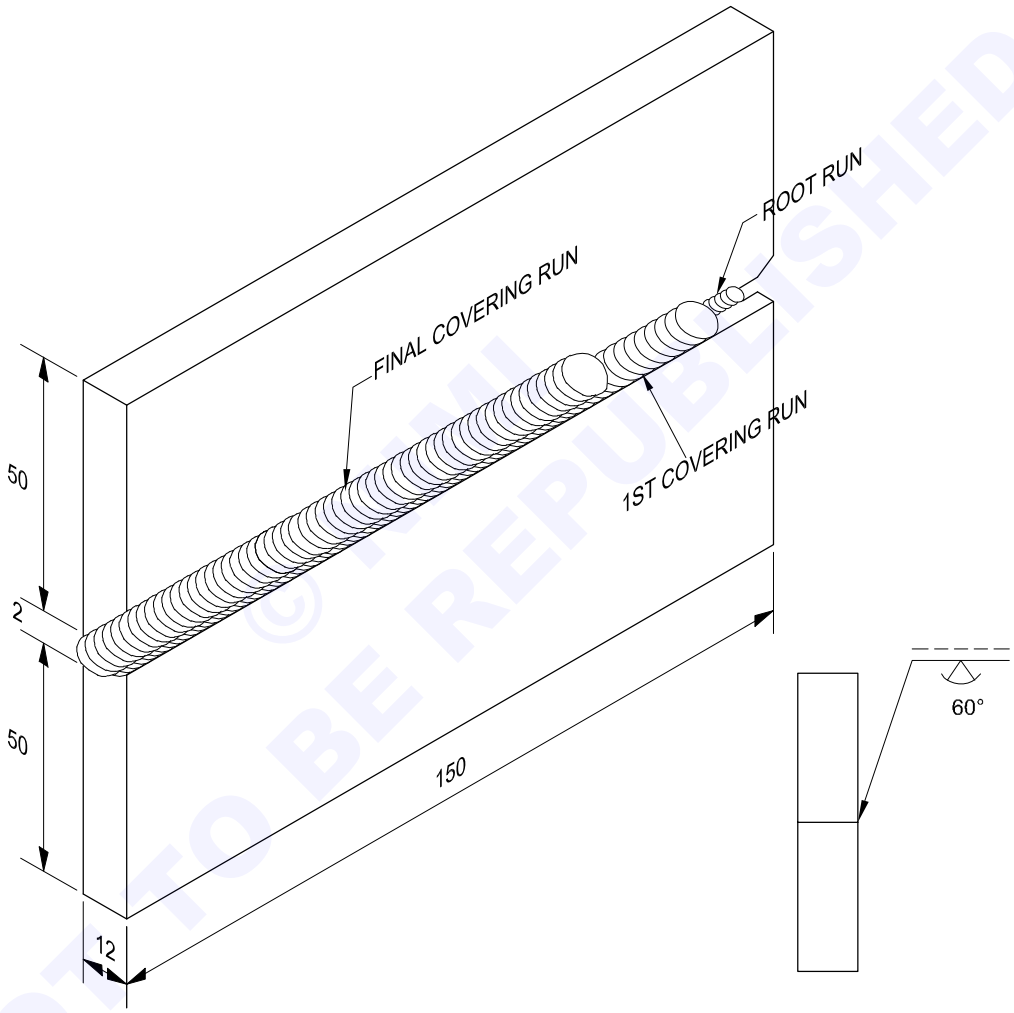
Single "V" butt joint on MS plate 12mm thick in horizontal position

Objectives: At the end of this exercise you shall be able to
- **prepare the plate edges beveling by gas cutting**
- **set tghe gap and tack weld**
- **deposit root, second and third bead in horizontal**
- **clean and inspect the weld defects.**



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2	50 ISF 12 - 150	-	Fe 310 - W	-	-	1.3.29
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SINGLE "V" BUTT JOINT ON M.S PLATE 12mm THICK IN HORIZONTAL POSITION (2G) -(SMAW-11)**				TOLERANCE ±1	TIME
					CODE NO. WG20N1229E1	

Job Sequence

- Cut the MS plates 150x50x12mm thick to size.
- Bevel the edges.
- One of the plates is beveled to 45° by gas cutting.
- The second plate is beveled to 15° by gas cutting.
- Clean the edges and remove all the burrs.
- Preset the single 'V' for controlling the distortion.

Wear safety clothing.

- Tack the beveled plates with a root gap of 2 mm.
- Fix the joint in horizontal position such that the member with 45° bevel as the top member with 15° beveled members as the bottom member.
- Deposit the root run starting from top plate and fuse the bottom plate also. Maintain uniform penetration throughout.
- Deposit 2nd and final 3rd run to complete the joint in horizontal position.
- Deslag each run and clean the bead.
- Inspect the welded joint for defects.

Skill Sequence

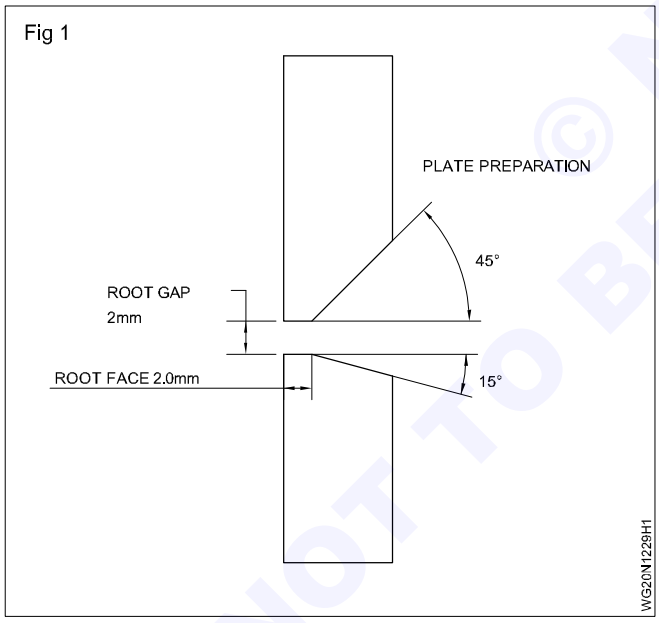
Single 'V' butt joint on MS plate 12mm thick in horizontal position

Objective: This shall help you to
- **prepare and weld single V butt joint on MS plate 12mm thick in horizontal position.**

Prepare the beveling by gas cutting and filling.

Prepare the plate and make 45° bevel for the top member and 15° bevel for the bottom member with a root face of 1.5 mm by filling. Fig 1

Fig 1



Then file the bevel and keep the root face 1.5 mm. (Fig 1) Set the job with a 2 mm root gap and tack weld on both ends.

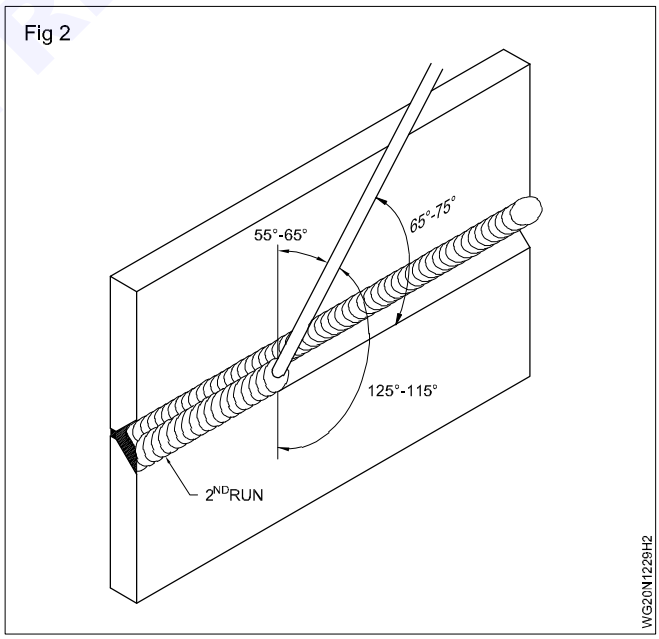
This type of beveling is used specially for welding single 'V' butt joint in horizontal position to deposit the metal against the effect of gravity.

Deposit a root run without weaving motion and hold the electrode angle 90° to the vertical plate and 65° to 75° to the line of the joint.

Maintain the keyhole to obtain uniform penetration.

Deposit the 2nd run by reducing the electrode angle to the upper vertical plate 55° to 65° using slight weaving motion. (Fig 2)

Fig 2



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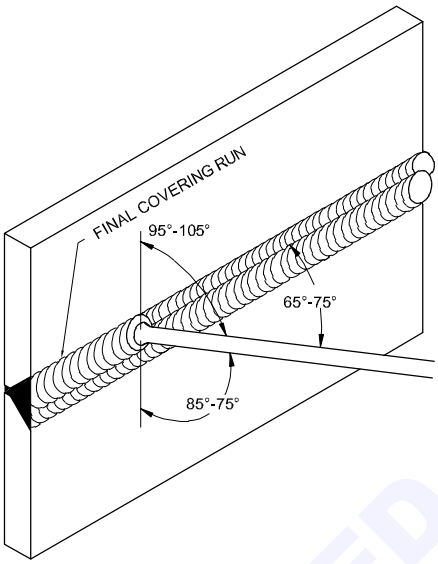
Deposit the 3rd run by increasing the electrode angle 95° to 105° to the upper vertical plate using slight weaving motion. (Fig 3) Deposit the outer edge of the upper fusion face and the junction of the 2nd run.

Fig 3



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Small tool fabrication of square pipe of 25x25x1mm width 25mm pipe of thickness 1mm and dimension 12”x9”x9” (GMAW & GTAW) process

Objectives: At the end of this exercise you shall be able to
- **prepare the plate edges beveling by gas cutting**
- **set tghe gap and tack weld**
- **deposit root, second and third bead in horizontal**
- **clean and inspect the weld defects.**

Requirements

Tools/ Equipment/ Instruments

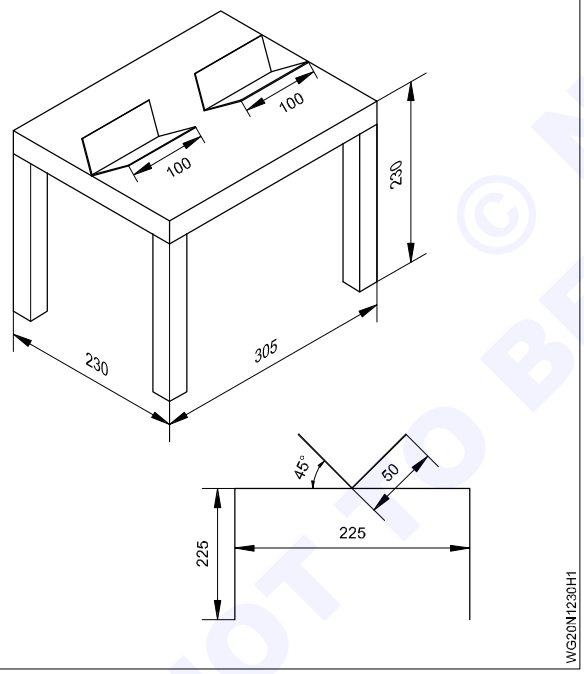
25mm sq tube (1mm)

- GMAW/GTAW welding mk, with set up accessories
- Steel rule, trysquar, hack saw frame with black, flat file, tong, wire brush etc.,

Materials

- 25mm square tube 25 x 25 x 225mm - 6 Nos.
- 25mm square tube 25 x 25 x 300mm - 2 Nos.
- M.S angle 50 x 50 x 6 - 100mm lenp 15 - 2 Nos.

Fig 1



Job Sequence

- Marking the square tube and per diagram
- Cut the raw material by hacksaw as per the dimension in the diagram
- Remove the burrs by filing on gridding
- Choose the tungsten electrode ø24mm thorium 2% with related filler rod. (C.C.M 1.6mm)
- Choose the CCMS filler wire GMAW.
- Select appropriate current and voltage.
- Weld the square tube as per the diagram by systematic approach
- Weld pieces mid plane of the square tube.
- Thoroughly clean weld joint and finish job accordingly
- Observe safety precaution whole welding (GMAW/ GTAW)

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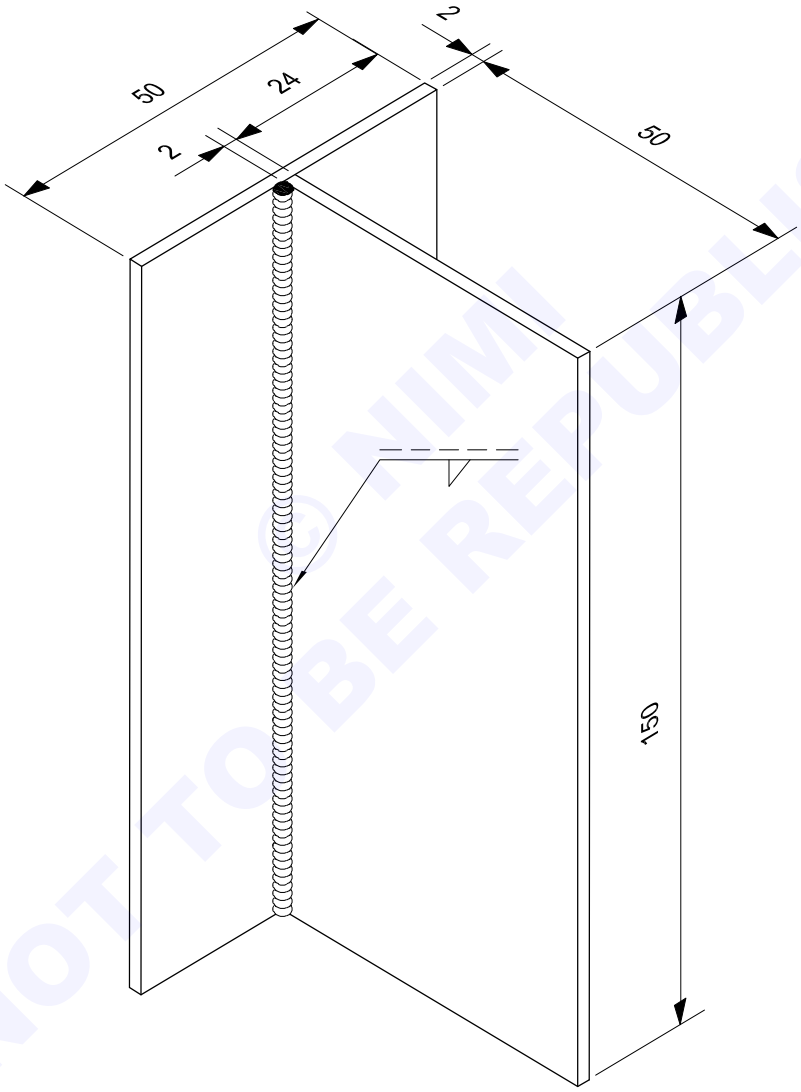
Fillet 'T' joint on MS sheet 2mm thick in vertical position (3F)-(OAW-12)

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

- **set the job pieces and tack as fillet tee joint**
- **select nozzle size, filler rod and set gas pressure for welding**
- **manipulate the blow pipe and filler rod to deposit weld metal in vertical upward direction**
- **deposit the weld bead in vertical position**
- **ensure the root penetration**
- **clean the joint and inspect for weld defects.**



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2	ISST 50 x 2 - 150	-	Fe 310 - W	-	-	1.3.31
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	FILLET 'T' JOINT ON M.S SHEET 2mm THICK IN VERTICAL POSITION (3F)-(OAW-12)				TOLERANCE ±0.5	TIME
					CODE NO. WG20N1231E1	

Job Sequence

- Prepare the material as per drawing and file the edges to square. Clean the surface with a wire brush.
- Select nozzle No. 5 and a 1.6mmø C.C.M.S. rod. Set the neutral flame.
- Set gas pressure at 0.15 kg/cm^2.
- Wear protective leather clothing and welding goggles.
- Tack the work piece as a 'T' joint.
- Ensure the joint is clamped properly in the fixture in the vertical position and the line of weld becomes perpendicular to the ground.
- Start welding the joint from the bottom in the upward direction manipulating the blow pipe and filler rod properly.
- Maintain proper angles for the blow pipe and filler rod between the sheet surfaces and to the line of weld so that the root and the surfaces joined will melt properly.
- Ensure the molten puddle does not sag too much due to gravity.
- At the end of the joint fill up the crater and complete the weld.
- Remove the work piece from the fixture and clean the weld bead.
- Inspect the weld bead for equal leg length, uniform ripple and ensure it is free from surface defects.

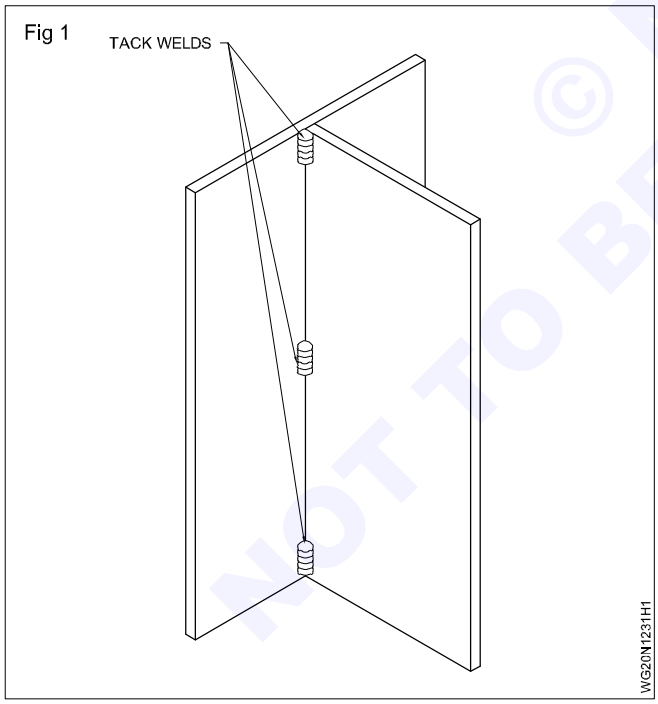
Skill Sequence

Fillet 'T' weld in MS sheet 2mm in vertical position

Objective: This shall help you to
- **prepare and weld fillet 'T' weld in MS sheet 2mm in vertical position.**

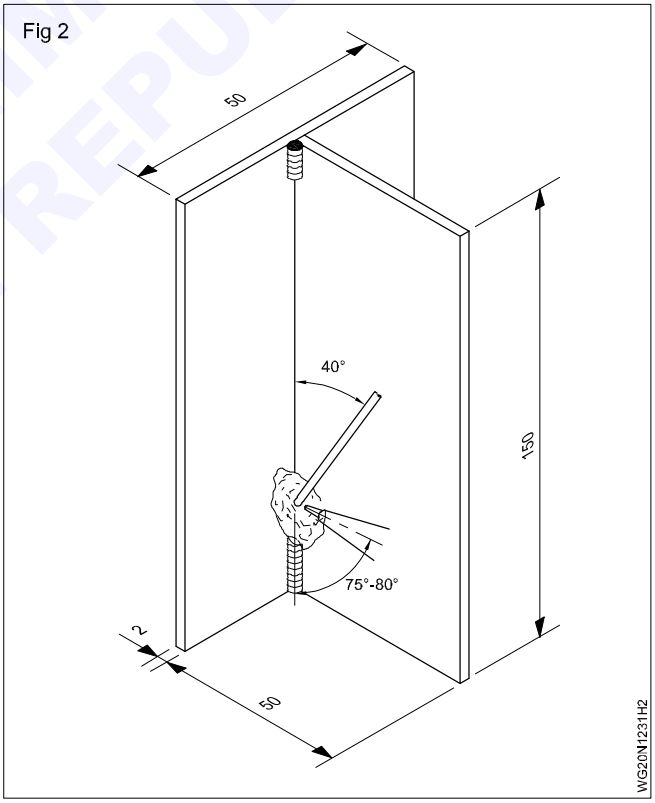
Keep one of the sheets vertically at 90° to the bottom sheet (Fig 1) and tack weld using neutral flame at the ends of the joint in proper alignment and at the center.

Fig 1



Maintain the angle of the blowpipe at 75-80° and filler rod at 40° respectively to the line of weld in vertical upward direction. (Fig 2) Also maintain a blowpipe angle of 45° between the sheet surfaces. (Fig 3)

Fig 2



Control the molten pool steadily and weld the fillet joint on the root by melting both the surfaces to be joined equally.

Dip the end of the filler rod continuously in the molten pool and proceed welding upward.

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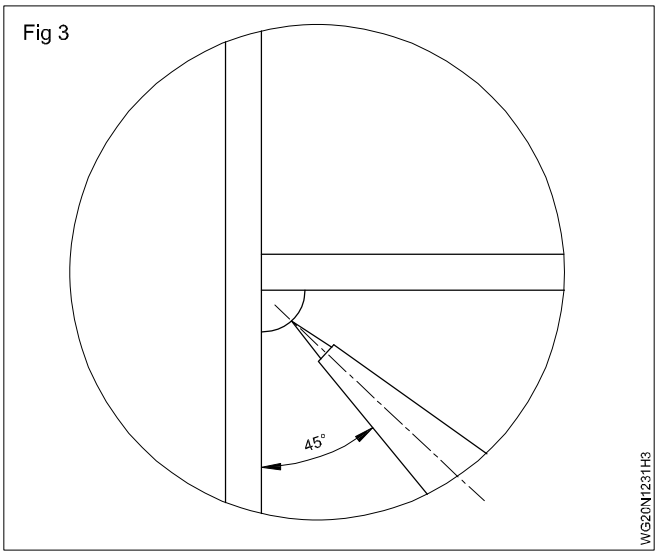
Fig 3



The above mentioned procedure will help to fuse the root and both the sheet surfaces of the joint uniformly as well as control sagging of molten metal deposited into the joint.

Ensure uniform speed of torch travel against the gravitation pull of the hand due to the weight of blowpipe, hose etc.

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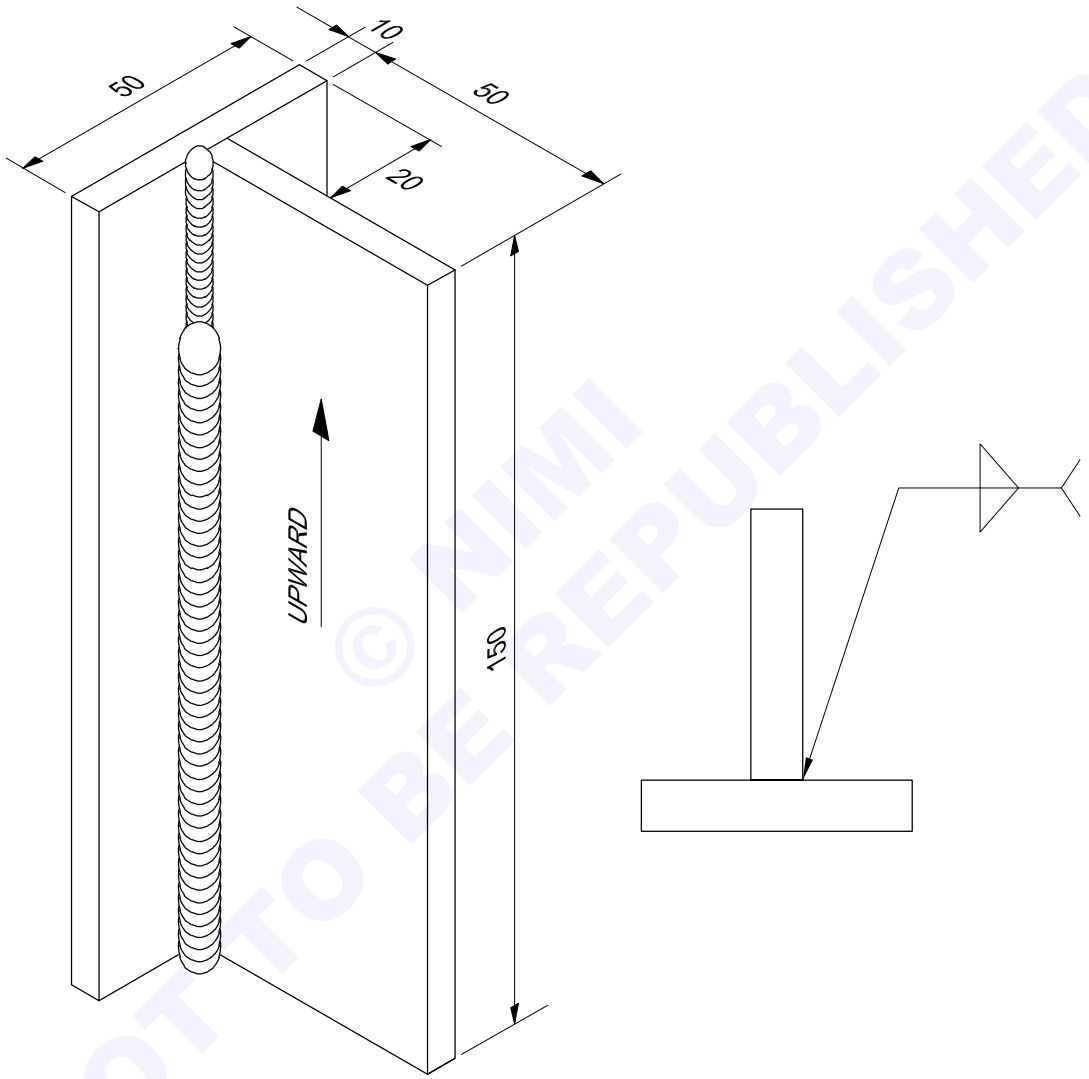
Fillet - "T" joint on MS plate 10mm thick in vertical position (3F)-(SMAW-13)

Objectives: At the end of this exercise you shall be able to
- **prepare and set the joint in vertical position**
- **deposit root and covering run by using short arc**
- **clean and inspect the surface defects.**



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2	50 ISF 10 - 150	TO EX.NO.28	Fe 310 - W			1.3.32
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**FILLET - "T" JOINT ON M.S PLATE 10mm THICK IN VERTICAL POSITION (3F)-(SMAW-13)**				TOLERANCE ±1	TIME
					code no. WG20N1232E1	

Job Sequence

- Mark the plate to size and cut as per drawing.
- Prepare square edges.
- Set the work piece as a 'T' joint.
- Select a 3.15 mm electrode and set 90-110 amps current.
- Connect electrode cable to -ve terminal.
- Tack-weld the work pieces at the ends.

Preset the plates to 2° to take care of distortion.

- Position the joint in vertical in the welding positioner.
- Deposit the root run with short arc length and by a slight weaving up and down motion to the electrode.
- Use whipping action for the electrode.
- Deslag and clean thoroughly with a wire brush.

Use goggles while Deslagging.

- Select a 4 mm ø electrode and set 120-140 amps current.
- Deposit 2nd run with short arc using a weaving motion and uniform speed of metal deposition.
- Avoid undercut.
- Ensure proper crater filling.
- Remove the welded joint from the positioner, clean and inspect for defects.

Follow the necessary safety precautions during welding.

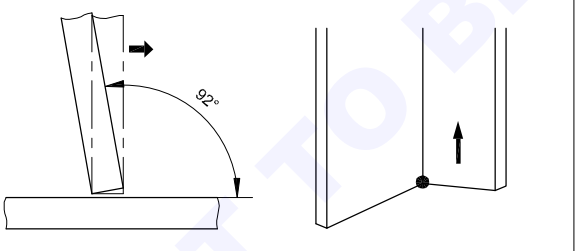
Skill Sequence

Fillet weld 'T' joint on MS plate 10mm thick in vertical position

Objective: This shall help you to
- **prepare and fillet weld 'T' on MS plate 10mm thick in vertical position.**

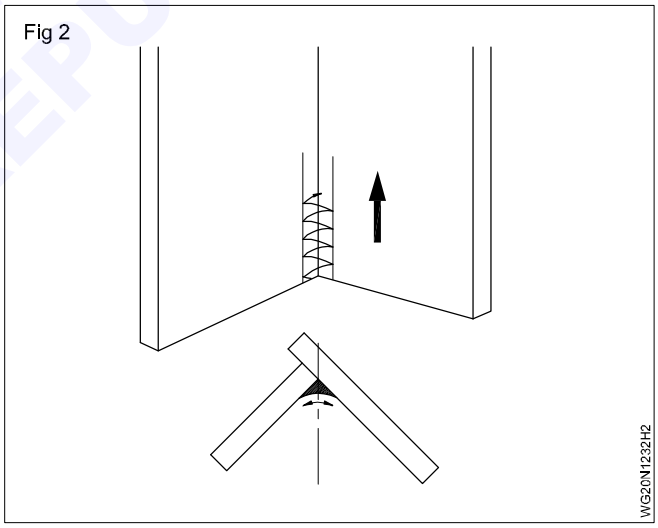
In vertical welding the difficulty to be overcome is the inclusion of slag in the weld metal, undercut and control of molten metal from sagging. These are avoided by using a short arc and proper weaving technique with a correct electrode angle. Preset the plate at 1° per run as shown in Fig 1 to take care of angular distortion. While depositing the root run start from the lowest part of the work piece. (Fig 2)

Fig 1



Depositing root run: Ensure equal deposit of weld metal on both the plates by giving a slight weaving motion.

Fig 2



Use whipping action for the electrode (Fig 3). During whipping action, the electrode is raised away from the molten pool a little with a long arc and again brought back closer to the molten pool with a short arc. When the electrode is raised from the molten pool, the weld metal cools a little and partly solidifies which helps in reducing the sagging effect of the molten weld metal.

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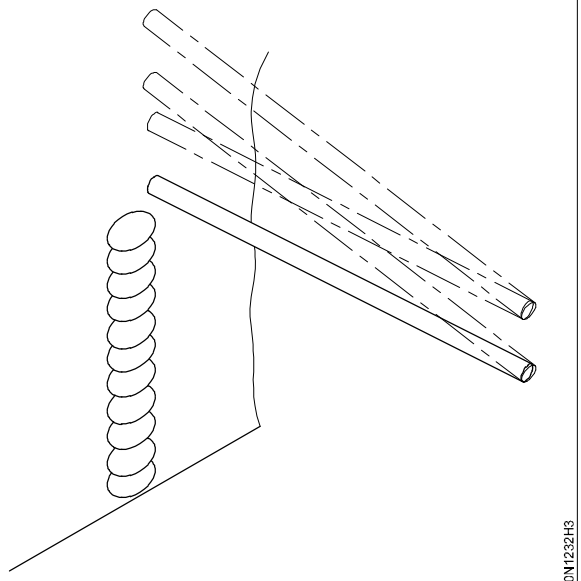
Fig 3

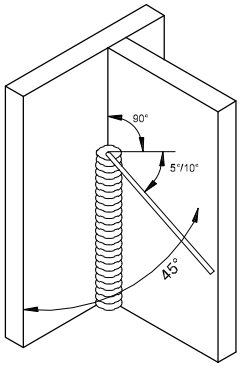


WHIPPING ACTIONS

WG20N1232H3

Move the electrode from side to side and stop for a short moment at each side to avoid undercut. Keep the angle of the electrode as shown in Fig 4 to deposit the metal at proper place in the joint without sagging.

Fig 4



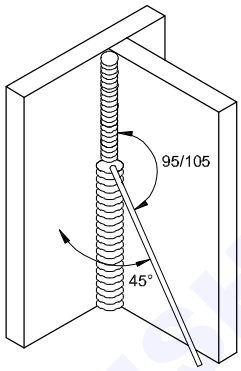
VERTICAL 'T' FILLET ELECTRODE ANGLES

WG20N1232H4

Clean thoroughly the root run, and specially any slag at toes should be removed.

Weld the second run to get a uniform bead of required size. Use a zigzag or triangular movement of the electrode as shown in Fig 6. Use short arc length and stop a while at the sides to fill the weld at the toes. The electrode tip pointing upwards due to the electrode angle Fig 4 and the use of short arc and the weaving technique will control the sagging of the weld metal and the slag inclusion. The stoppage of the electrode at the toes of the weld for a moment in the weaving motion will help to avoid undercuts.

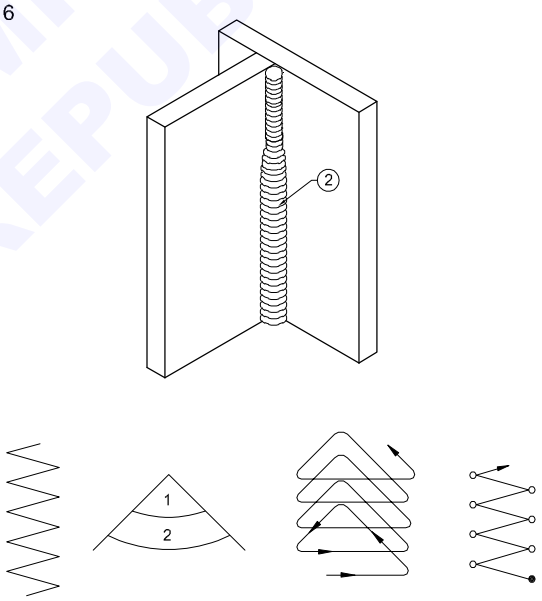
Fig 5



VERTICAL ' T ' FILLET

WG20N1232H5

Fig 6



WG20N1232H6

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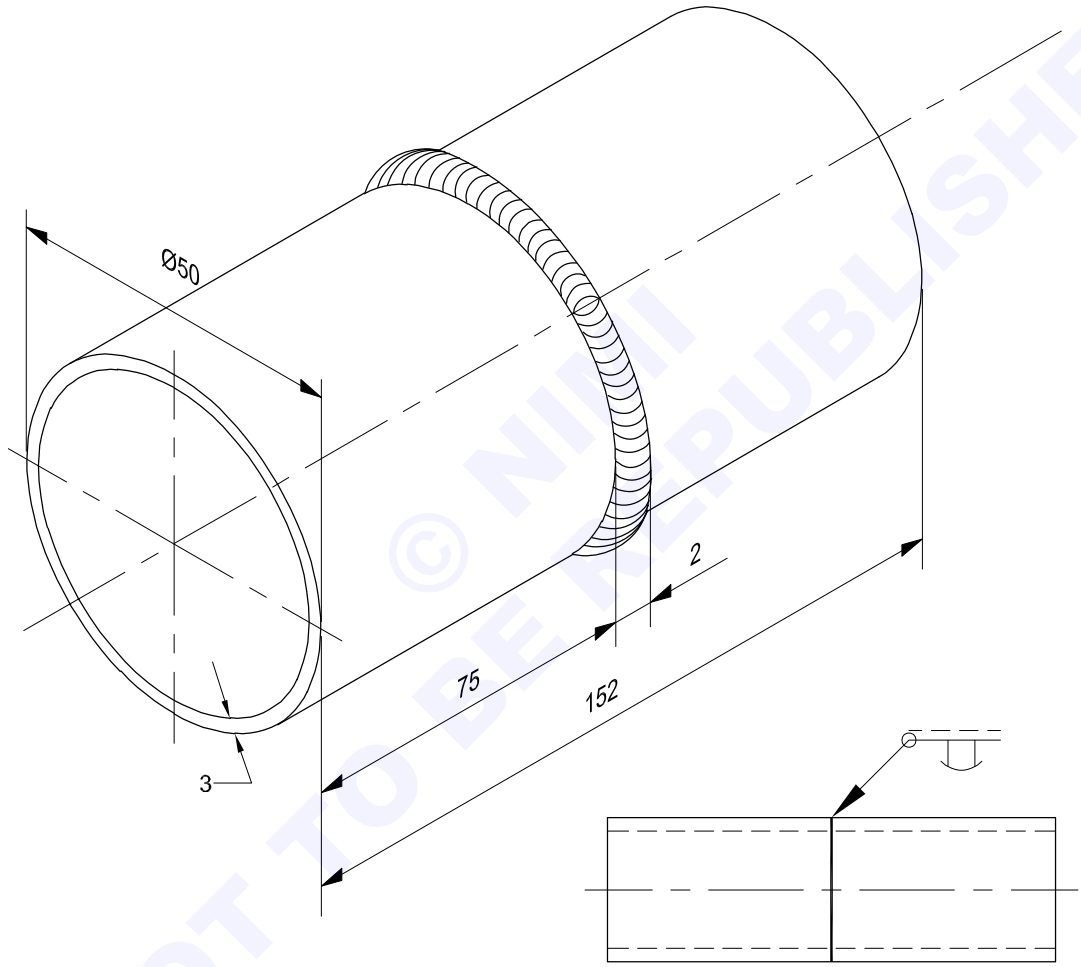
Structural pipe welding butt joint on MS pipe ø50mm × 3mm wall thickness in 1G (Roller) position (OAW -13)

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

- **cut and prepare the MS pipe as per drawing**
- **select nozzle, filler rod sizes, gas pressures and flame**
- **set the root gap and tack weld the pipes**
- **weld the butt joint in IG position**
- **clean and inspect for surface defects.**



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2	Ø50 x 3 x 75	-	Fe 310 - W	-	-	1.3.33
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**STRUCTURAL PIPE WELDING.PIPE BUTT JOINT ON M.S.PIPE Ø50 x 3mm WALL THICKNESS IN 1G (ROLLING)POSITION (OAW-13)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1333E1	

Job Sequence

- Cut the pipes to 75mm length by hacksaw and file its end square to 75mm length. Root gap 1mm
- Clean the inside and outside surfaces of the cut pipes after deburring.
- Fix No. 5 size nozzle, select 1.6mmø CCMS filler rod and set 0.15 kg/cm^2 pressure for both gases.
- Set the 2 pipes on an angle or channel fixture to form a coaxial pipe butt joint with proper root gap.
- Follow necessary safety precautions.
- Set neutral flame.
- Tack weld in 3 places (120° apart) keeping 1.5mm root gap between the pipes.
- Divide the pipe circumference into four segments. Keep the pipe horizontally on the fixture.
- Deposit the root run starting from 3 o'clock position to 12 o'clock position using proper blowpipe and filler rod angles. (I segment)
- Turn the pipe joint in the clockwise direction so that the end of the root run already made in I segment comes to the 3 o'clock position.
- Continue to weld the root run for the second quarter segment as done for the first segment.
- Similarly, complete root run of 3rd and 4th segments.
- Ensure the root penetration by maintaining a keyhole at the root throughout the root run.
- Clean the root run by steel wire brush.
- Fix No. 5 size nozzle, select 1.6mmø CCMS filler rod and set 0.15 kg/cm^2 gas pressure.
- Set neutral flame and fill the V groove by depositing the 2nd run using slight weaving to the blowpipe so that both the faces of the V and the root run will fuse properly.
- Ensure proper bead size, profile and weld reinforcement as well as avoid undercut and other weld defects.
- Clean the joint and inspect for external defects.

Skill Sequence

Structural pipe welding butt joint on MS plate ø 50 × 3 mm wall thickness in 1G (Rolling) position

Objective: This shall help you to

- **prepare and weld structural pipe welding butt joint on MS plate ø 50 × 3 mm wall thickness in 1G (Rolling) position.**

Pipe welding is a highly skilled welding operation, which involves correct alignment and good penetration by equally melted edges of the pipes. As the welding is to be done on a curved surface, the position of the blow pipe and filler rod will continuously change as the welding progresses along the joint. To do this you have to put some extra efforts to get the special skill of welding a pipe joint.

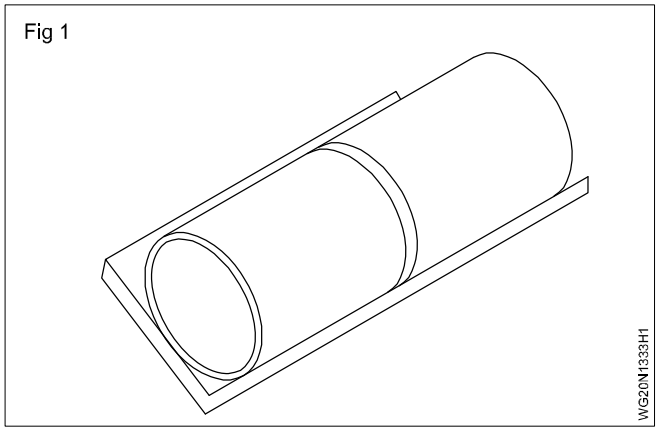
Preparation and setting: Check and ensure correct size of pipes. Prepare two M.S. pipes 50 mm ø and 75 mm long by hacksaw cutting. As the end faces of a pipe cut by a hacksaw may not be at 90° to the pipe axis, file the end faces of the pipe to get the 90° angle. Bevel the ends of the pipes by filing.

Clean the pipes and remove burrs, if any. Align the pipes in flat position as shown in Fig 1. Tack the weld joint by inserting 1.5 mm wire to maintain a uniform root gap. (Fig 2a and 2b) Ensure the tack welded pipes are coaxial. (i.e., the axis of both the pipes are the same.)

Select the angle iron or channel fixture according to the diameter of the pipe.

Place the tacked pipes on the fixture.

Fig 1



To ensure proper root penetration select nozzle No. 5 and a 1.6 mm C.C.M.S. rod for the root run.

Start welding as shown in the figure and complete the first segment. (Figs 3 and 4) The blowpipe and the filler rod angles are as shown in Fig 4 at the "start of the weld" and have to be changed to those angles shown at the "stop weld" continuously and gradually. i.e. weld from 3 o'clock position to 12 o'clock position.

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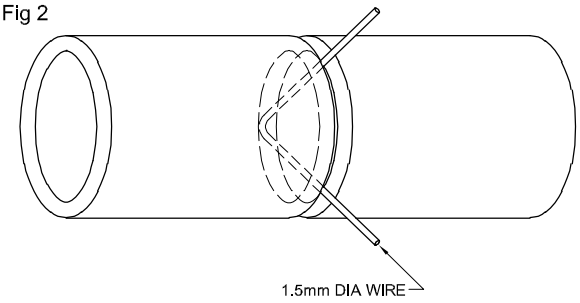
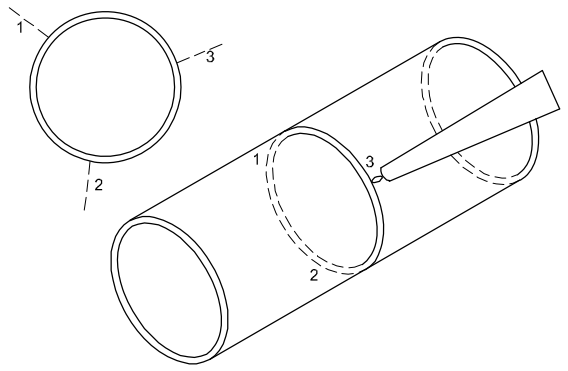
Fig 2



USE OF BENT WIRE OR SUITABLE SPACER TO SET ROOT GAP

(A)

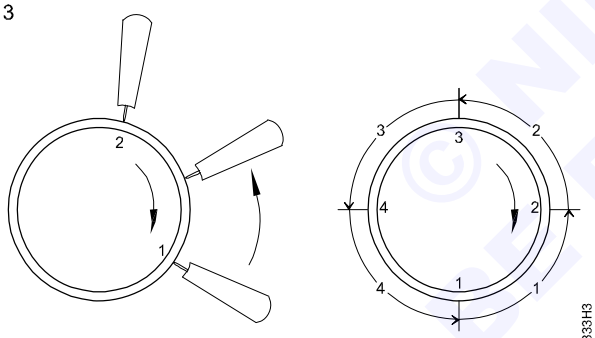


(B)

TACK WELDS AT POINTS 1, 2, AND 3

WG20N1333H2

Fig 3



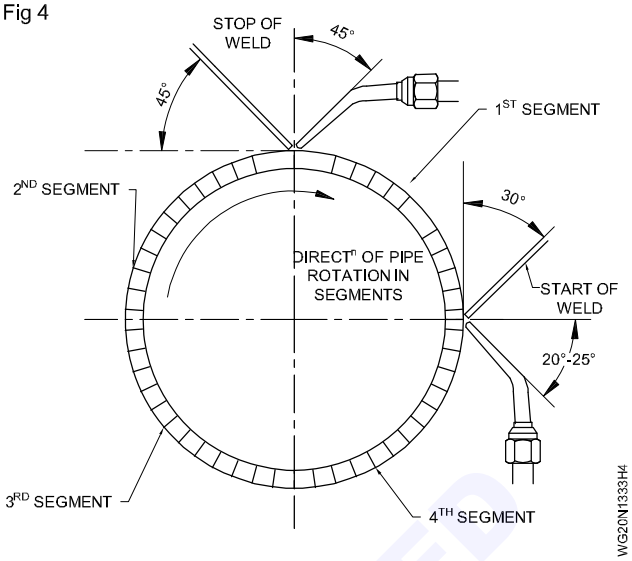
TORCH POSITION AND TURNING THE PIPE

WG20N1333H3

After completion of I segment welded, rotate the pipe joint in clockwise direction until the II segment will come to the position of I segment.

Deposit the root run on the II segment similar to the I segment.

Fig 4



WG20N1333H4

Further welding is done by rotating the pipe to the III and IV segment.

Ensure proper melting of tacks for good penetration and surface appearance.

It is very important to maintain a keyhole ahead of the molten pool at the root of the joint which will ensure root penetration.

Remove the work piece from the rotating fixture.

Clean the weld bead and inspect the root run for root penetration and weld defects.

Keep the pipe joint on the rotating fixture and fix no. 2 nozzle, set 0.15 kg/cm^2 pressure for the gases and use 1.6mmø CCMS filler rod.

Deposit the final run over the root run using neutral flame.

Follow the same welding technique used for the root run except maintaining a keyhole. Ensure proper fusion of the root run and the side walls of the V groove by proper movement of blow pipe and filler rod.

Ensure undercuts are avoided and proper bead profile, size and reinforcement is maintained. Clean the joint and inspect for weld defects.

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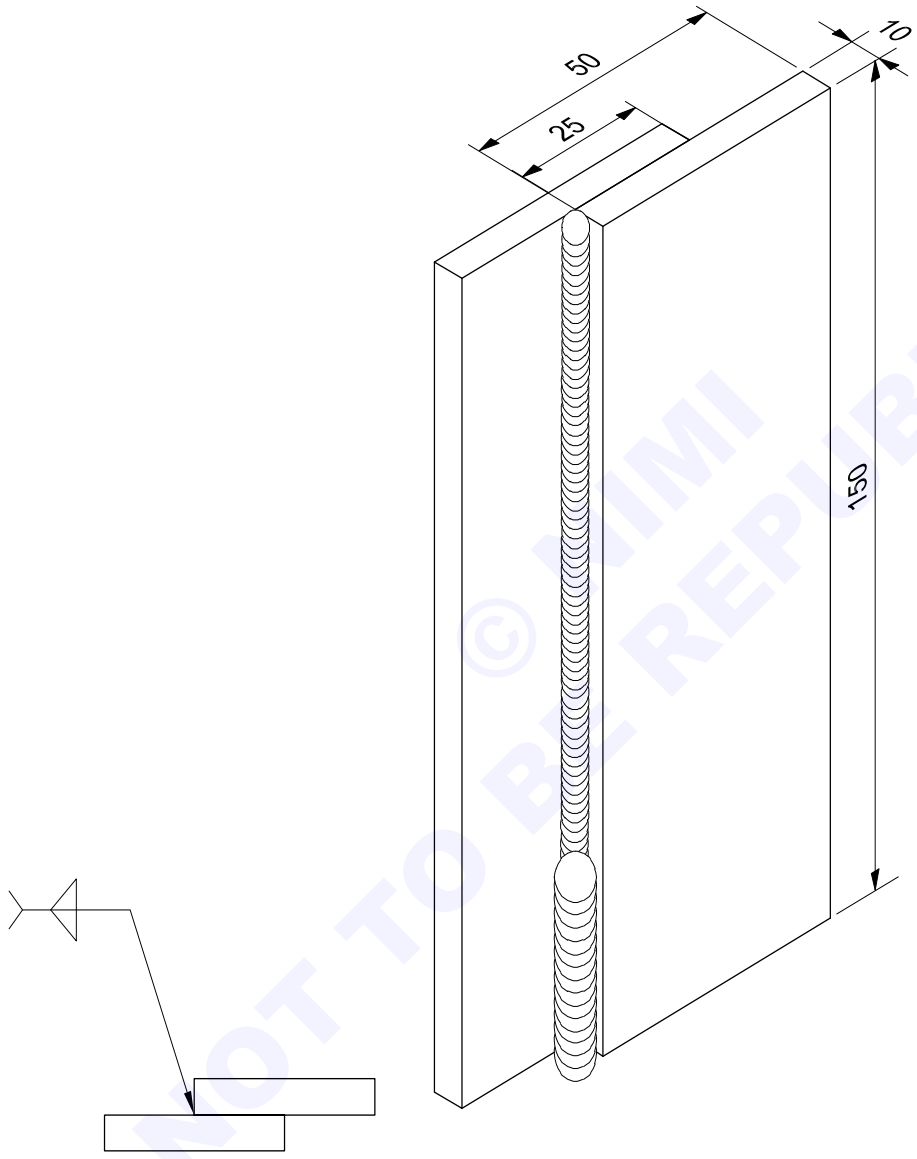
Fillet - lap joint on MS plate 10mm in vertical position (3G)-(SMAW-14)

Objectives: At the end of this exercise you shall be able to
- **prepare and set the job as per drawing**
- **deposit root and covering bead in vertical position**
- **clean and inspect the weld defects.**



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2	50 ISF 10 - 150	-	Fe 310 - W	-	-	1.3.34
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	FILLET LAP JOINT ON M.S PLATE 10mm IN VERTICAL POSITION (UPWARD)	TOLERANCE ±0.5	TIME
		CODE NO. WG20N1334E1	

Job Sequence

- Gas cut the plate to size as per drawing.
- Prepare square edges.
- Clean the flat surface and the edges of plate.
- Take the T fillet joint already welded under exercise No.
- Assemble/clamp the plate with the bottom side of plate of the T fillet joint to form a lap joint as shown in the job drawing. The lapping distance should be 25mm.
- Select a 3.15mm dia. medium coated MS electrode and set 90-110 amp current.
- Use electrode negative polarity if a DC machine is used for welding.
- Set the assembled job on the welding table and tack weld the plate C with plate at their ends.
- Ensure that the surfaces of plates are parallel to each other and that there is no gap between them after tacking.
- Remove slag and fix the job on the welding positioner in vertical position.
- Deposit the root run with short arc length and by a very slight weaving motion to the electrode.
- Give whipping action to the electrode to prevent sagging of molten metal and slag.
- Deslag with a chipping hammer and clean the joint and bead thoroughly with a wire brush, particularly at the toes of the weld.

Use goggles while deslagging.

- Select a 4mm dia. medium coated MS electrode and set 120 to 140 amp. current.
- Deposit the 2nd run with short arc and weaving motion.
- The weaving motion and the movement of the arc in the upward direction should be at uniform speed.
- Ensure the correct fillet size with proper bead profile is obtained and the edge of the plate is not melted off. Also ensure that there is no undercut at the toe of the weld on the bottom plate.
- Remove the welded joint from the positioner after filling the crater.
- Clean the joint using a wire brush and inspect for any external defect.

Follow the necessary safety precautions during welding.

Skill Sequence

Fillet lap joint on MS plate 10mm thick in vertical position

Objective: This shall help you to
- **prepare and weld fillet lap joint on MS plate 10mm thick in vertical position.**

Welding a lap joint in vertical position has always been a problem - one of the upper edge of the plate being burnt (edge melted off). This can be overcome by using proper electrode manipulation.

Method of depositing bead in vertical on lap joint

Set a minimum current so as to maintain a small molten pool.

Use a short arc for depositing root run with whipping motion so as to prevent sagging of the weld metal. (Fig 1 and 2) Deposit the 2nd run with weaving motion and this will avoid sagging of the molten metal. The angle of the electrode should be 75° - 80°. (Fig 3)

Any one of the weaving motion shown in Fig 2 can be used.

Do not break the arc while moving in the upward direction.

The motion of the electrode should be a weaving motion.

Fig 1

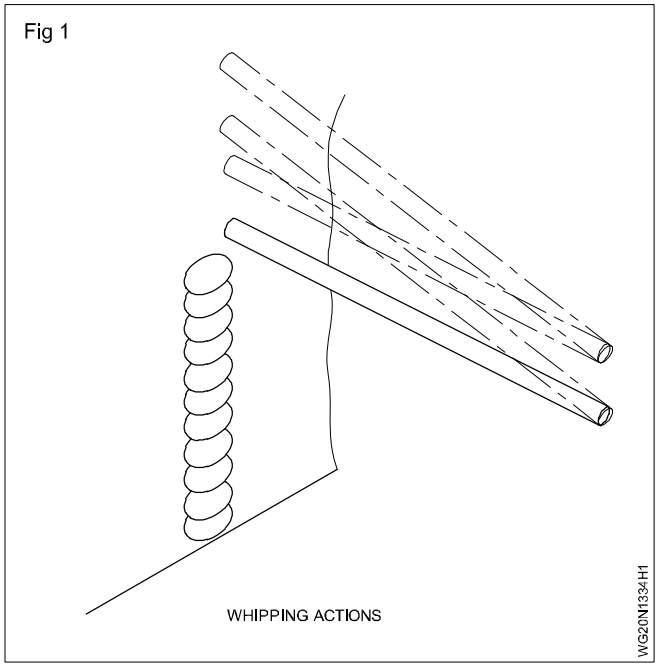

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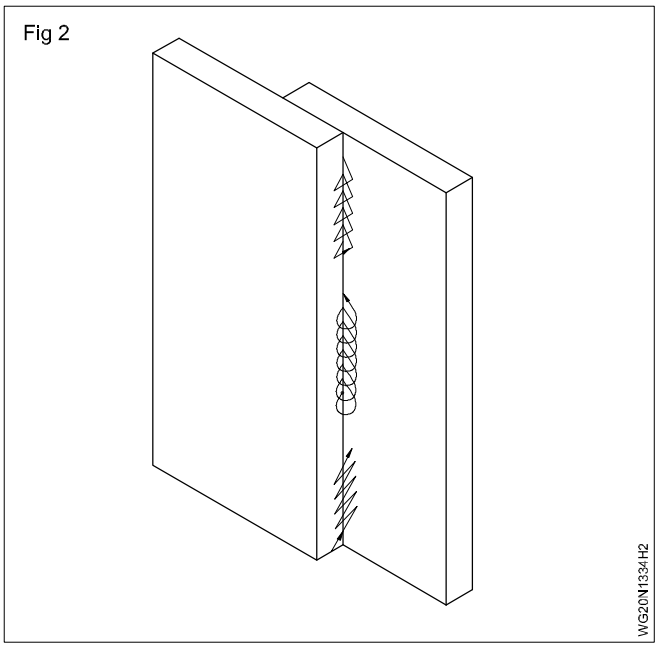
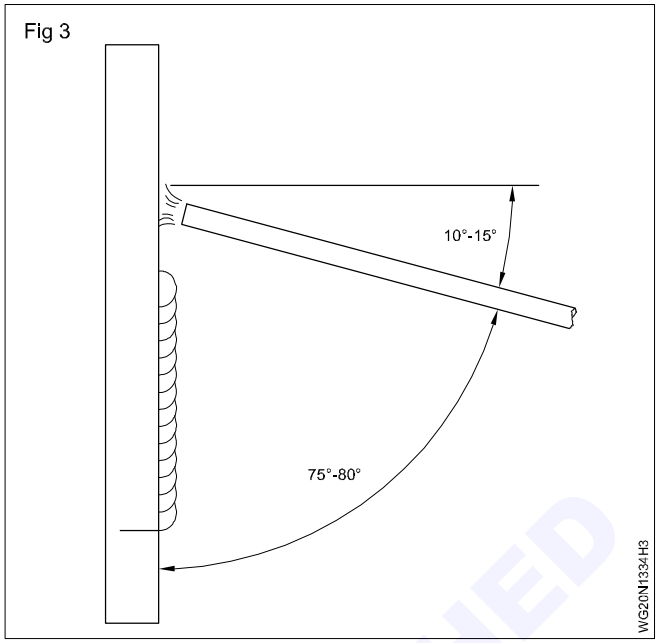
Fig 2



Keep the electrode motion confined to the weld width so that the edge of the upper plate is not melted off.

The rate of travel should be even for obtaining a uniform bead with a good appearance.

Fig 3



Overlapping distance should not be more than 3 times the thickness of the base metal.

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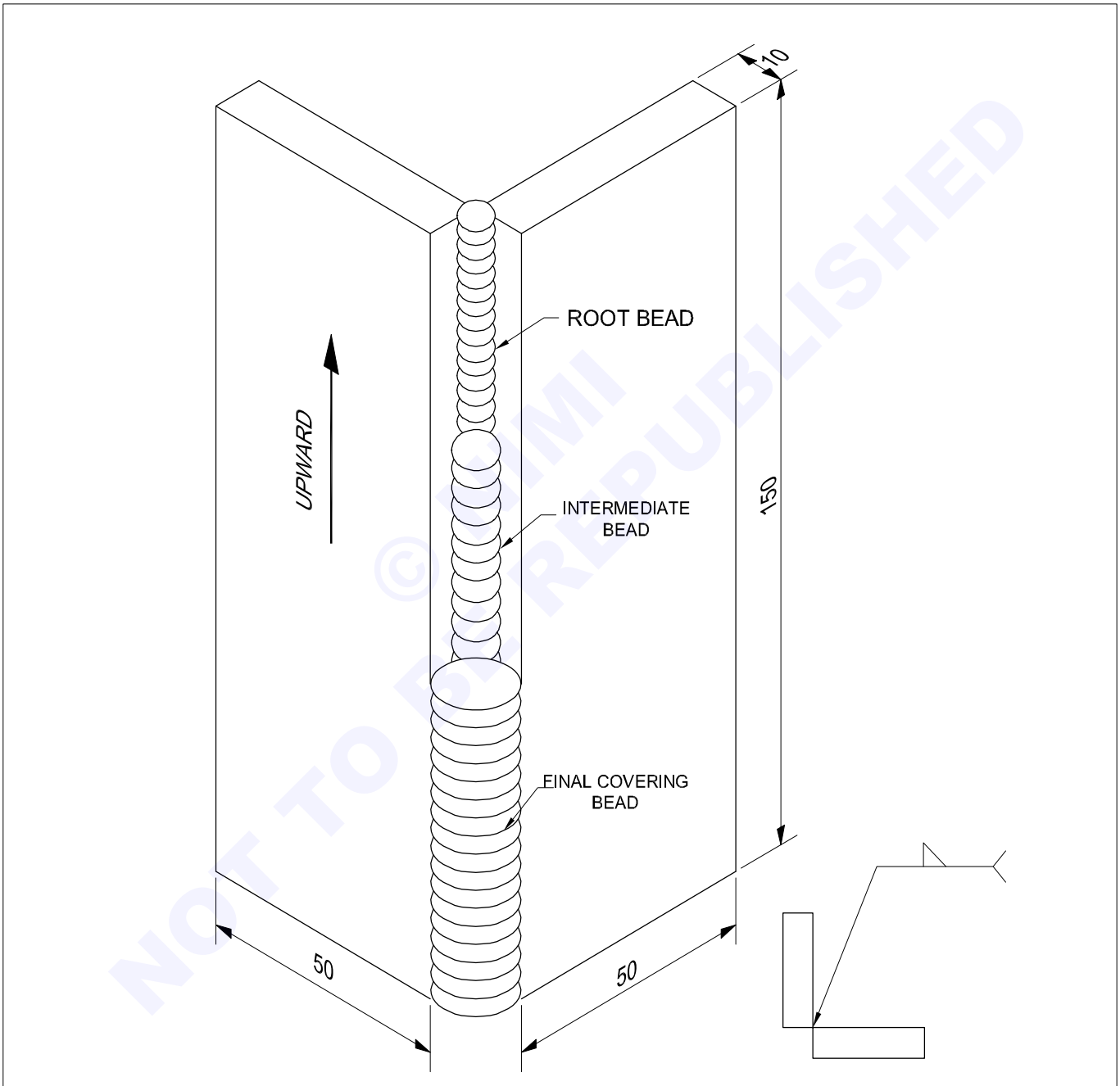
Open corner joint on MS plate 10mm thick in vertical position (3F)-(SMAW-15)

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

- **weld root run on open corner joint in vertical upward**
- **prepare,set and tack weld**
- **deposit root run 2nd and 3rd layer by weaving motion on open corner joint in vertical upward**
- **clean and inspect for surface defects and angle between the members.**



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2	50 ISF 10 - 150	-	Fe 310 - W	-	-	1.3.35
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	OPEN CORNER JOINT ON MS PLATE 10mm THICK IN VERTICAL POSITION (3F)-(SMAW-15)	TOLERANCE ±1	TIME
		CODE NO. WG20N1335E1	

Job Sequence

- Mark the plate to size and gas cut as per drawing.
- Prepare square edges and clean the parts to be welded.
- Set the 2 pieces as an open corner joint and use spacers to maintain a uniform root gap of 2mm. Then tack weld the two pieces together to form a 87° angle between the inner faces of the plates.
- Remove the spacers and set or fix the weldment in vertical position on the weld positioner.
- Select 3.15ø electrode and set 90-110 Amps DCEP.
- Deposit root run with short arc length.
- Deslag and clean thoroughly with a wire brush.

Use goggle while deslagging.

- Select 4mmø electrode and set 120-140 amps.
- Deposit 2nd run using short arc and slight weaving motion.
- Deslag and deposit third and final run with 4mm dia. electrode.
- Avoid undercut.
- Clean the joint and inspect for defects.

Skill Sequence

Open corner joint on MS plate of 10mm thick in vertical position

Objective: This shall help you to
• prepare and weld open corner joint on MS plate of 10mm thick in vertical position.

Setting and tacking of the fillet open corner joint

Mark and punch the plates, to cut square by gas cutting.

Grind or file the gas-cut edges to square.

Remove the grinding burrs and clean the surfaces by filing and with a wire brush.

Wear goggles while cutting, grinding.

Set the fillet open corner joint with a 2mm root gap and an angle of 87° between the inside surfaces of the plates to control the distortion. Fig1.

Tack-weld on the root side of the joint on both ends.

Use a 3.15 mm dia. M.S. electrode and 90-110 amps current.

Position the joint in vertical and the angle of the line of weld with the top of the table should be 90°. (Fig 1)

Welding fillet open corner joint in vertical position

Deposit root run with a 3.15 mm dia. electrode and 90-110 amps welding current. (Fig 2)

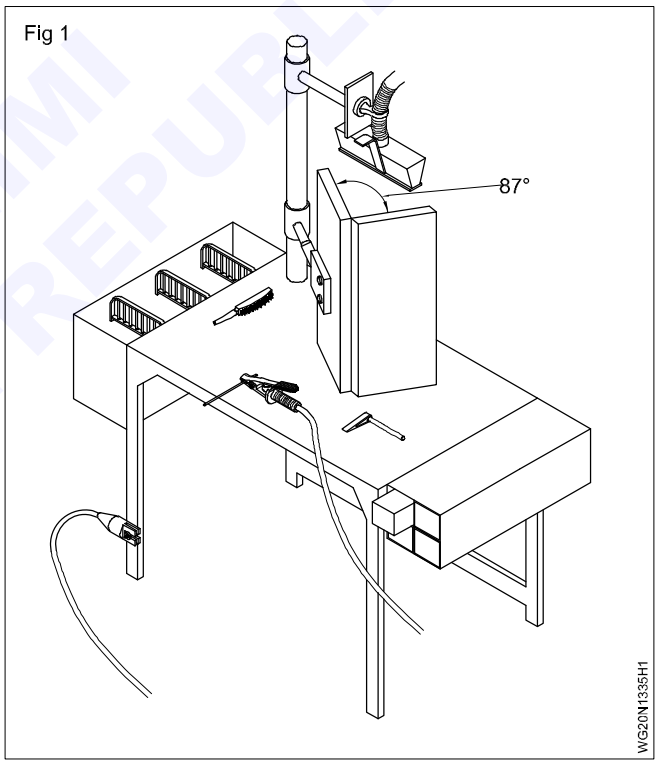
Maintain an electrode angle of 80° to the line of weld and the electrode movement slightly sideways, and deposit weld bead from the bottom to the top. Give whipping motion to the electrode.

Maintain a short arc to get uniform fusion and a keyhole to ensure proper root penetration.

Keep 1.6 mm root penetration depth.

Deslag and clean the root bead at the toes thoroughly; also Deslag and clean the weld bead.

Fig 1



Wear safety goggles.

Deposit the second run with a 4 mm dia. electrode and 120-140 amps welding current. The angle of electrode should be 80° to the line of weld and the arc length should be short.

Move the electrode steadily upwards and sideways as one.

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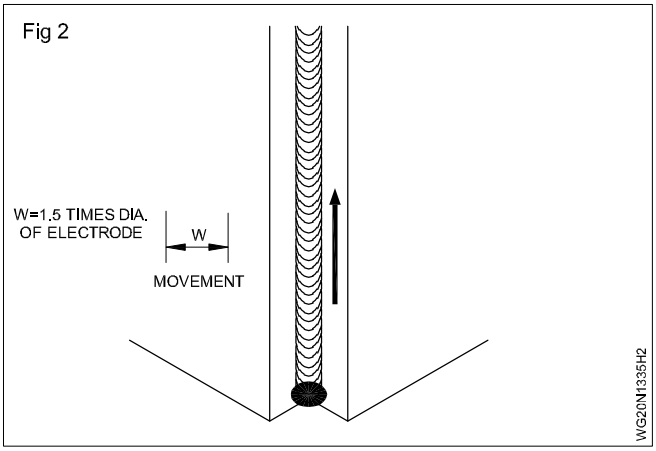
Fig 2



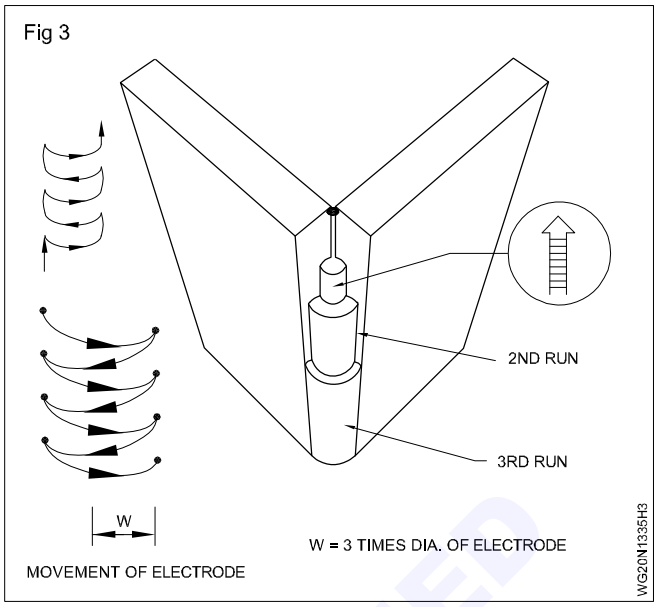
Deslag and clean the weld bead.

Deposit the third and final run with a 4 mm dia. electrode and 120-140 amps welding current with short arc length and sideways movement. (Fig 3)

Deslag and clean the weld bead.

Avoid over-reinforcement height and edge burning.

Fig 3



Inspect the open corner fillet weld for:

– external weld defects
– edge burning and reinforcement height
– depth of root penetration.

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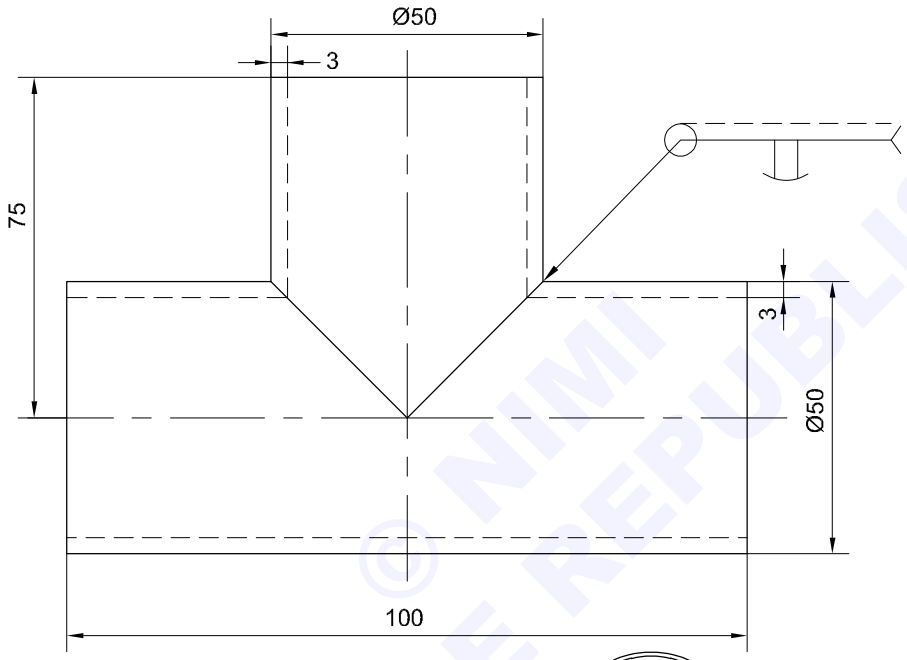
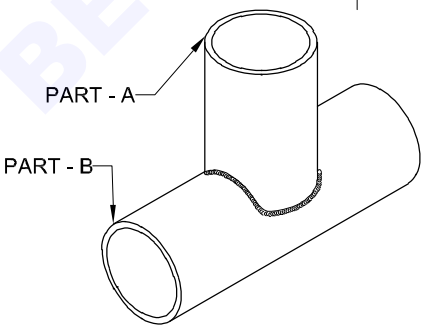
Pipe welding - Elbow joint on MS pipe ø50mm and 3mm wall thickness (OAW)

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

- **draw the development for "ELBOW" pipe joint**
- **cut and prepare the pipe as per the dimensions**
- **set the pipes to form a 90° pipe elbow joint**
- **tack weld the pipe with a root gap of 1.6mm**
- **deposit weld bead by following pipe welding procedure**
- **clean and inspect for weld defects.**





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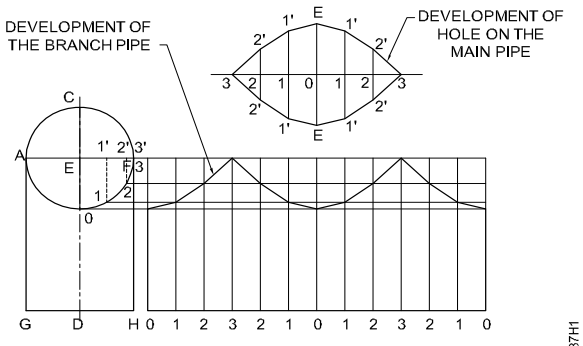
1	Ø50 x 3 - 100	-	Fe 310 - W	-	B	1.3.44
1	Ø50 x 3 - 75	-	Fe 310 - W	-	A	1.3.37
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**PIPE WELDING - 'T' JOINT ON MS PIPE Ø50mm AND 3mm WALL THICKNESS IN FLAT POSITION (1G)-(OAW-15)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1337E1	

Job Sequence

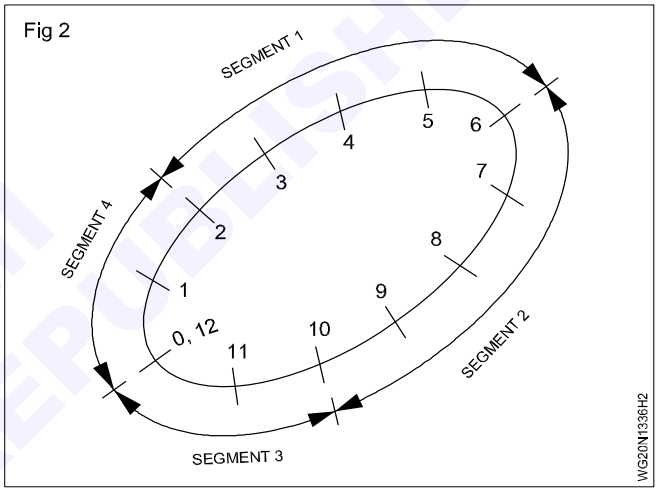
- Ensure the correct size of the pipes are used.
- Draw development for an "elbow" joint. Fig 1 on a drawing sheet scale full size.

Fig 1



- Cut the development of the pipe elbow from the drawing sheet and paste it on one end of both the 100mm long pipes.
- Make punch marks along the profile of the development on the pipes and cut the pipe along the punch marks using a hacksaw.
- Deburr the cut edges and file it to correct any irregularity on the cut edges.
- Clean the surface of the pipe of any oxide and other contaminants.
- Set and align the pipe to on angle of 90°.
- Select nozzle No. 5 and ø1.6mm CCMS filler rod with 0.15 kg/cm^2 pressure for both gases.
- Set neutral flame.
- Follow necessary safety precautions.
- Tack weld the joints at 4 places with 1.6mm root gap and keep the joint in alignment. Check the 90° angle between the pipe axes using try square.
- Use leftward and vertical welding technique.
- Weld the joints by manipulating the blowpipe and filler rod in one run using 3mmø CCMS rod dividing the weld into 4 segments.
- The joint which will be in the form of an ellipse has to be welded in 4 segments. Fig 2 The order of sequence of welding is 2 to 6 (segment 1). 10 to 12 (segment 3) 10 to 6 (segment 2) and 2 to 0 (segment 4). This order of welding sequence will help to keep the tacked joint such that the welding is partially done in vertically upwards and partially in flat position.

Fig 2



- Ensure maintaining keyhole and ending the weld of each segment properly to get the root penetration without fail.
- Avoid excessive penetration.
- Clean the welded joint and inspect for weld defects.

Skill Sequence

(ELBOW) Joint on MS pipe ø50×3mm wall thickness in flat position

Objective: This shall help you to

- **prepare and weld (ELBOW) joint on MS pipe ø50×3mm wall thickness in flat position.**

Fix no. 5 nozzle to the blowpipe to help in fusing both the edges of the joint (which is 3mm thick) to the full depth and get good root penetration.

Also the joint which is elliptical in shape can be welded properly with good fusion and root penetration only if the tack welded pipes are welded in 4 segments.

The segments are divided on the tacked pipe elbow joint as shown in Fig 2 under job sequence.

This division into 4 segments will help to keep the job in the required position so that the welding is done partially by vertical welding technique and partially by flat position.

In addition, the distortion in the pipe joint due to welding can be controlled by welding the segment in the sequence 1,3,2 and 4.

Maintaining a continuous keyhole as done in pipe square butt joint will help in getting good root penetration.

During welding fuse the tacks fully and also ensure proper fusion of edges and root of the joint of each segment.

Use the blow pipe and filler rod angles of 60 - 70° and 30 - 40° to the tangent at the point of welding. Give a very slight side to side motion to the blowpipe.

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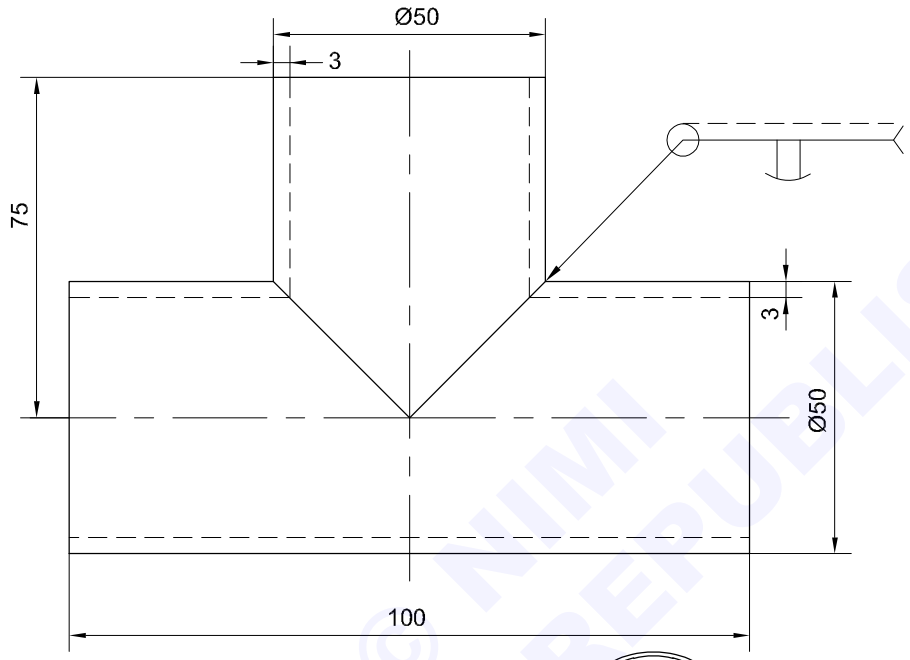
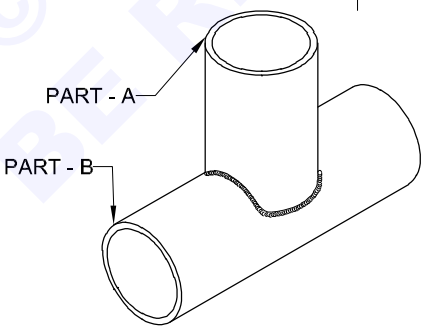
Pipe welding 'T' joint on MS pipe ø50mm and 3mm wall thickness

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

- **set the pipe and tack weld**
- **weld the pipe T joint using welding techniques**
- **clean and inspect for external weld defects.**





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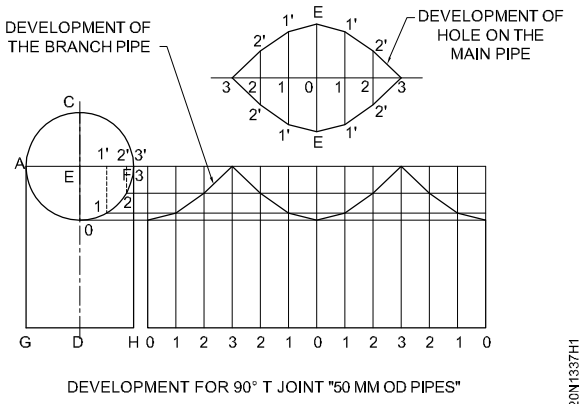
1	Ø50 x 3 - 100	-	Fe 310 - W	-	B	1.3.44
1	Ø50 x 3 - 75	-	Fe 310 - W	-	A	1.3.37
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE WELDING - 'T' JOINT ON MS PIPE Ø50mm AND 3mm WALL THICKNESS IN FLAT POSITION (1G)-(OAW-15)	TOLERANCE ±1	TIME
		CODE NO. WG20N1337E1	

Job Sequence

- Ensure the correct size of pipes are used.
- Prepare development for 90° branch. (Fig 1) on a drawing sheet.

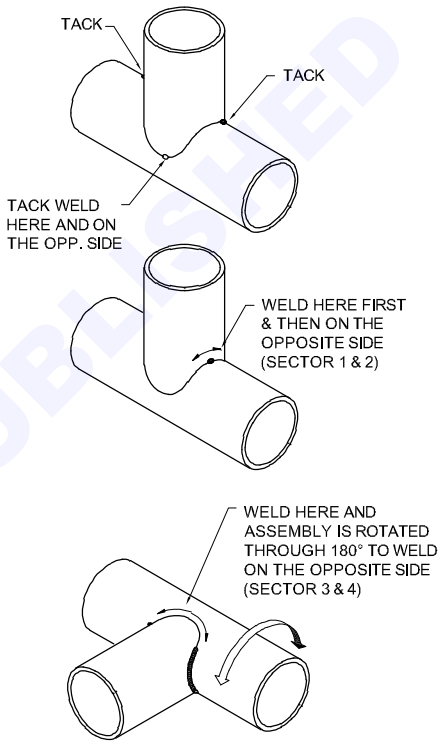
Fig 1



DEVELOPMENT FOR 90° T JOINT "50 MM OD PIPES"

- Cut and paste it on the pipes.
- Punch mark the profile of the development on both pipes. Cut the branch pipe along the punch marked profile and file it. Cut the profile marked on the main pipe by gas cutting and file it.
- Deburr the gas cut edges and file the edges.
- Clean the surface of the pipe to remove any oxide and other contaminants.
- Set and align the branch pipe with the main pipe at an angle of 90°. (Fig 2)
- Select no. 5 nozzle, ø3mm CCMS rod and use neutral flame with 0.15 kg/cm^2 pressure for both gases.
- Follow necessary safety precautions.
- Tack-weld the joint at 4 place with 90° intervals and with a 2 mm root gap to ensure root penetration.
- Ensure the tacked pipe "T" joint is positioned properly to make it convenient to manipulate the blow pipe and filler rod without any obstruction.
- Weld the joint by manipulating the blow pipe and filler rod without rotation of the pipe.
- Maintain keyhole throughout the welding and give side to side motion to the blow pipe to ensure good root penetration and fusion of both the edges of the joint.
- Take care to properly fuse the crater of the previous sector welded with the starting of the new sector.
- Complete the weld in 4 sectors 1, 2, 3 and 4 along the curved joint using leftward technique. Fig 2

Fig 2



Avoid excess penetration.

- Clean the weld and inspect the weldment for defects.

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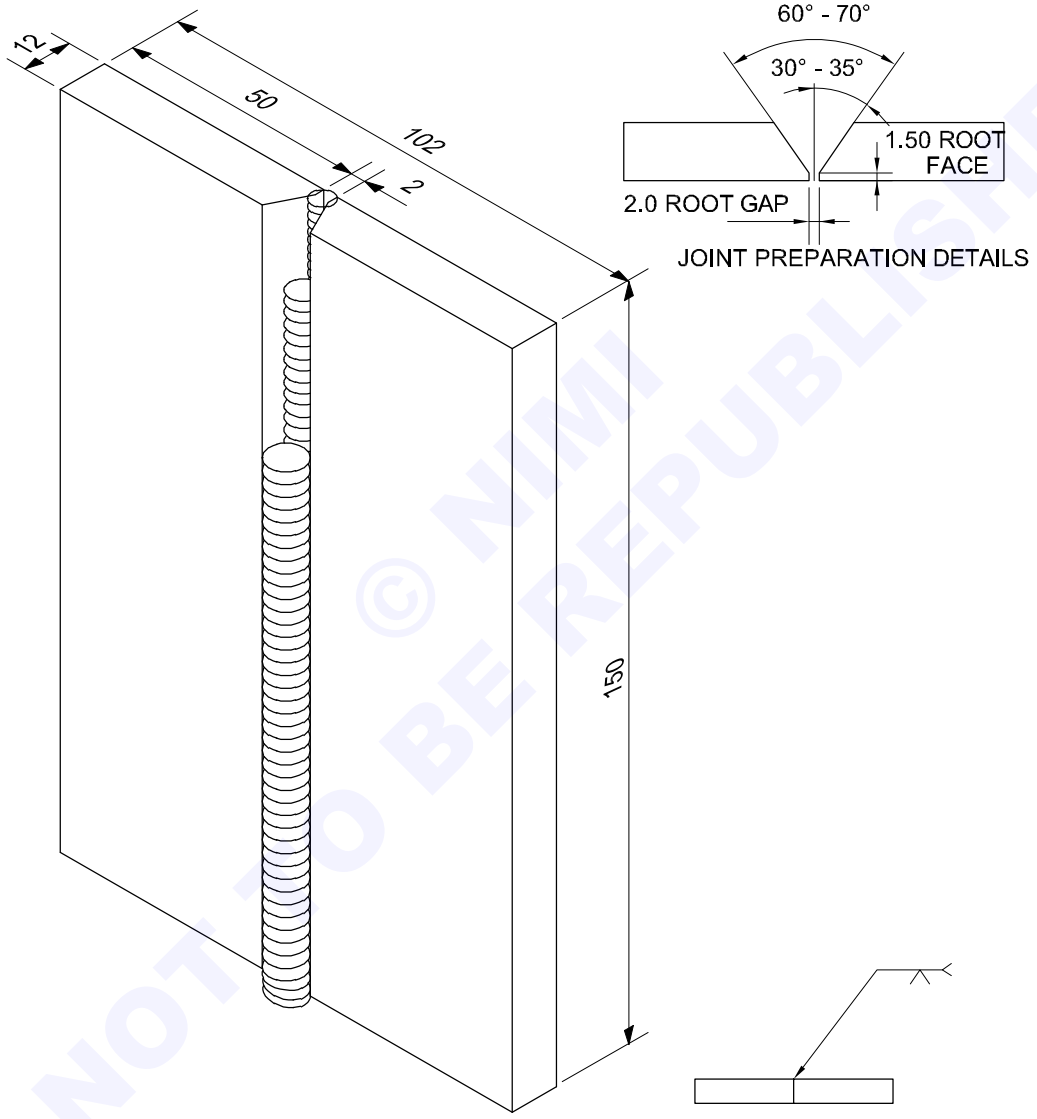
Single "V" butt joint on MS plate 12mm thick in vertical position (3G)

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

- **prepare the bevel edges by gas welding**
- **set the root gap and tack weld the job**
- **deposit root,2nd and 3rd bead in vertical position**
- **clean and inspect the weld defects.**



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2	50 ISF 12 x 150	-	Fe 310 - W	-	-	1.3.38
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SINGLE "V" BUTT JOINT ON MS PLATE 12mm THICK IN VERTICAL POSITION (3G)-(SMAW-16)	TOLERANCE ±1	TIME
		CODE NO. WG20N1338E1	

Job Sequence

- Cut the MS plate 12mm thick to size (2 Nos.).
- Bevel the edges as per drawing.
- Both plates will have 30 to 35° bevel angle and 1.5mm root face and with no burr at the edges.
- Using spacers maintain a uniform gap of 2mm throughout and tack weld the plates.
- Preset the plates to 177° on the root side of the joint.
- Set the tack welded joint in vertical position
- Use ø3.15mm MS electrode and DCEN polarity for DC welding.
- Deposit the root run starting from bottom of the plate upward and maintain a uniform root penetration.
- Use short arc.
- Remove slag etc. and clean the weld with wire brush.
- Use ø4mm MS electrode and 150-amp current.
- Deposit 2nd, 3rd run using proper weaving technique and complete the weld in vertical position.
- Check the proper root penetration and other external weld defects.
- Rectify the defects whenever possible.

Skill Sequence

Single 'V' butt joint on MS plate of 10mm thick in vertical position

Objective: This shall help you to
- **prepare and weld single 'V' butt joint on MS plate of 10mm thick in vertical position.**

Preparation of pieces

Cut and bevel the edges to an angle of 30 to 35° by using oxy-acetylene cutting.

Grind the bevel edges to remove oxides, and get smoothness.

Use goggles while cutting and grinding.

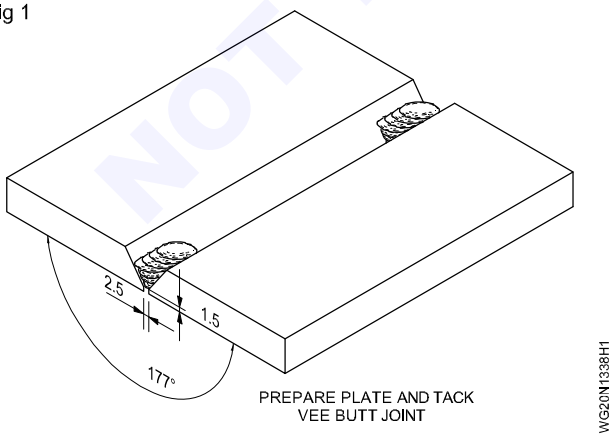
Prepare a 1.5mm root face throughout the length by filing.

Setting and tacking of single 'V' butt joint

Keep the bevel edges parallel with the 2.0mm root gap. The 2.5mm thick spacers are used to get a uniform and parallel root gap.

Tack-weld on both ends with correct alignment and presetting of 3° to control distortion. (Fig 1) i.e. on the root side the angle between the plates should be 177°.

Fig 1

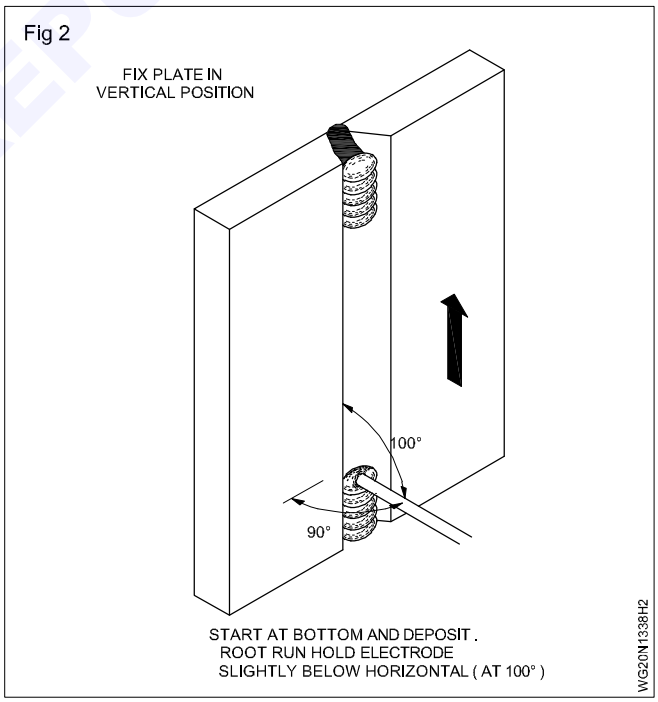


Position the joint in vertical using the weld positioner.

Deposition of weld beads

Deposit the root run using a 3.15 mm dia. M.S. electrode and 110 amps current with a slight sideways movement of the electrode. (Fig 2)

Fig 2



Ensure a keyhole throughout the root run.

The angle of the electrode in the holder should be 120° so that it is convenient to hold the electrode at 80° to the line of weld.

The arc length should be short.

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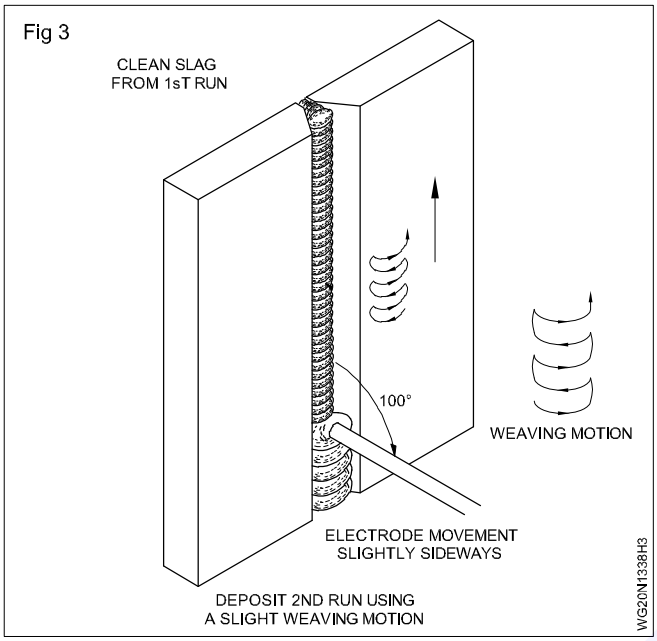
The root penetration depth should not exceed 1.6 mm.

Remove the slag and clean the root run by using a chipping hammer and wire brush.

Deposit the second run using a 4 mm dia. M.S. electrode over the root layer with 160 amps current and an electrode movement slightly sideways. (Fig 3)

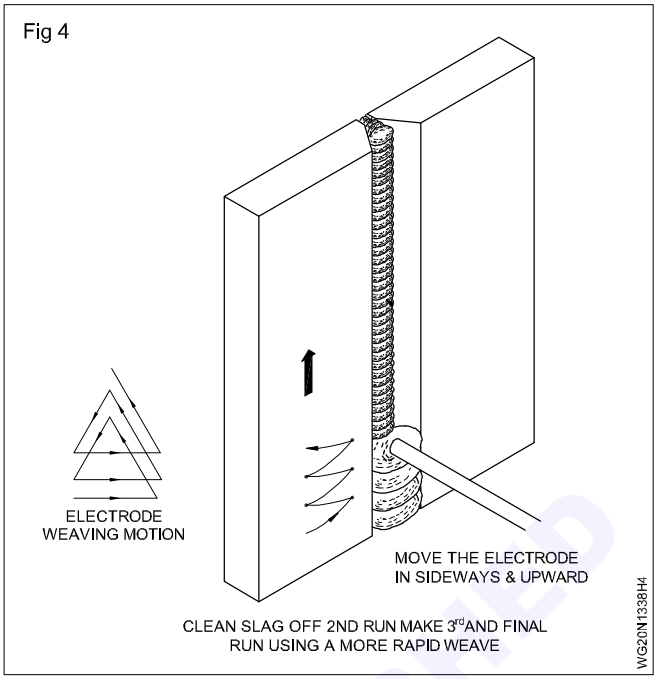
Fig 3



Remove the slag and clean the weld bead thoroughly.

Deposit the third layer using a 4 mm dia. M.S. electrode and 160 amps current (Fig 4) pausing regularly at the toes of the weld.

Fig 4



The weaving motion of electrodes can be anyone of the three patterns shown in Fig 3 and Fig 4.

The arc length should be short which helps to control sagging of weld metal.

Avoid undercut and excessive convexity, concavity.

Remove slags with a chipping hammer and clean the weld bead thoroughly with a wire brush.

Inspect for root penetration, undercut, blow holes and excess reinforcement.

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Pipe welding 45° angle joint on M.S. pipe ø50mm and 3mm wall thickness (SMAW)

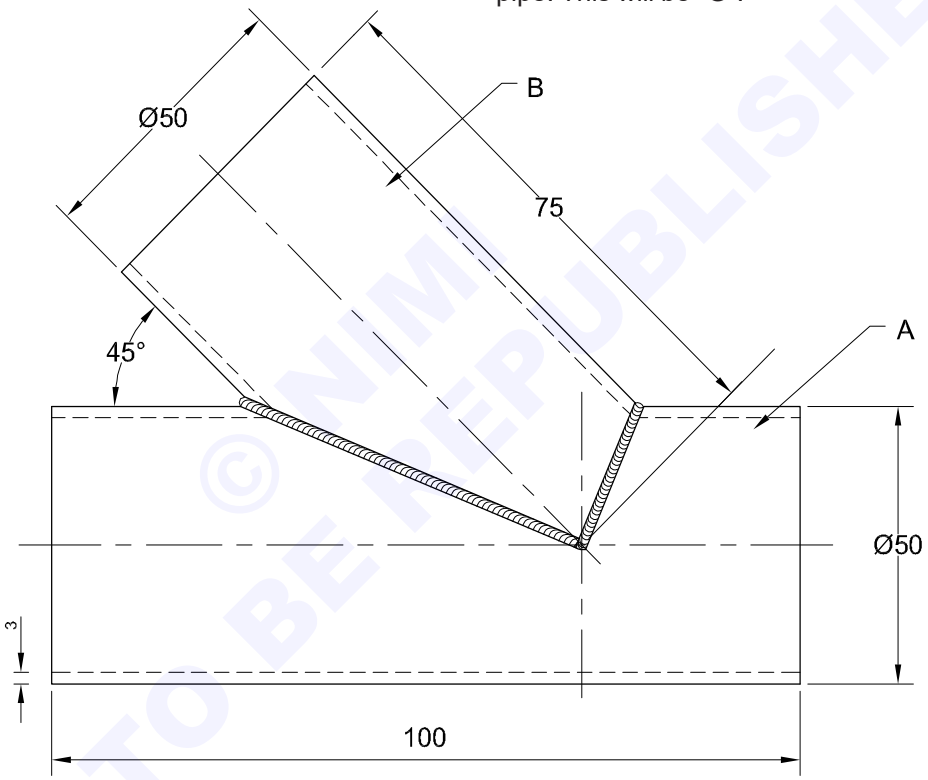
Objectives: At the end of this exercise you shall be able to
- **prepare the development of pipe for 45° branch joint**
- **cut and prepare the pipes as per dimensions**
- **tack and complete the welding by manipulating the torch and filler rod.**

PROCEDURE

Procedure for development of 45° branch pipe: Refer Fig 1. Draw a center line AB.

1 Mark the points C, D, E and F taking the radius and the length of the given pipe with the center line AB as reference line.

2 On the line "CD" locate the position of the 45° branch pipe. This will be "G".



3 Draw a 45° angle at the point "G".

4 Choose a suitable height and mark the height of the branch pipe (GI) in 45° line from point G.

5 From I, draw a horizontal line on both sides (XX'). This XX' will be the base line for drawing development.

6 From I, plot the outside diameter of the branch pipe IJ on the line XX'.

7 Draw a center line for the branch pipe. This line will cut the main pipe's center line AB at K.

1	Ø 50 x 3 x 100	-	Fe310 - W	-	A	1.3.39
1	Ø 50 x 3 - 75	-	Fe310 - W	-	B	1.3.39
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE WELDING 45° ANGLE JOINT ON M.S. PIPE Ø50mm AND 3mm WALL THICKNESS (1G)-(SMAW)	TOLERANCE ±1	TIME
		CODE NO. WG20N1339E1	

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8 Join GK. Draw a perpendicular line to GK at K which meets CD at H. Join KH. Now IGKHJ will be the shape (outline) of the branch pipe.

9 Draw a semicircle equal to the branch pipe outside diameter.

10 Divide the semicircle into 6 equal parts as 0-1; 1-2; 2-3; 3-4; 4-5 & 5-6.

11 Draw vertical lines from these points 1,2,3,4,5. Already there will be two vertical lines IG from the point 6 and JH from point 0. These vertical lines will cut the branch pipe lines 'GK' and 'KH' at points 6', 5', 4', 3', 2', 1' & 0'. Note that points 6' and G as well as points 0' and H are the same points. In the base line XX' plot 13 points equal to the distance of '0-1' as 0, 1,2,3,4,5,6,5,4,3,2,1,0.

12 Draw vertical lines to XX' from these 13 points.

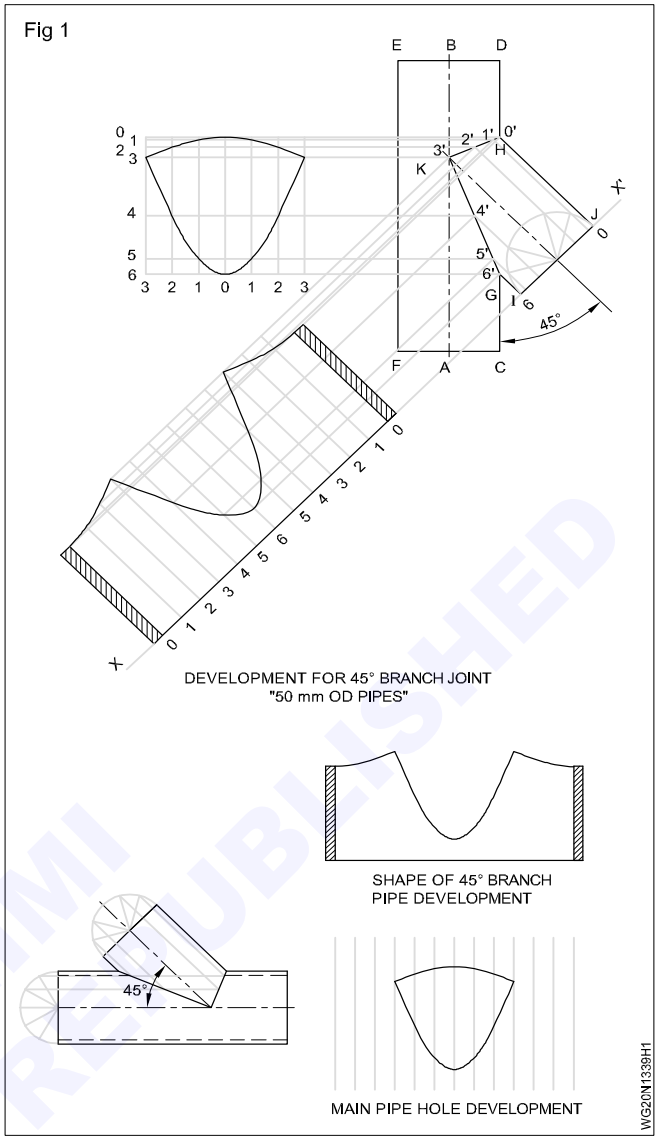
13 Draw horizontal lines parallel to XX' from points 6', 5', 4', 3', 2', 1', 0'. These 7 horizontal lines will cut the 13 vertical lines from the base line at 13 points.

14 Join the 13 cutting points with a regular smooth curve. Now the required development for the 45° branch pipe will be ready. Give allowance of 3 to 5mm at the edges of the development. (Fig 1)

15 For developing a hole in the base pipe: Above the main pipe, draw 7 lines parallel to AB namely 3,2,1,0,1,2,3 equal to the distance of 0-1 on the semi circle.

16 Draw vertical lines from 0', 1', 2', 3', 4', 5', 6'. These vertical lines will intercept the 7 horizontal lines. Join the intercepting points with a smooth curve. The required development for hole is now ready.

Fig 1



Job Sequence

- Ensure the correct size of pipes are used.
- Prepare development for 45° branch on a drawing sheet.
- Cut and paste it on the pipes.
- Punch mark the profile of the development on both pipes. Cut the branch pipe along the punch marked profile and file it. Cut the profile marked on the main pipe by gas cutting and file it.
- Deburr the gas cut edges and file the edges.
- Clean the surface of the pipe to remove any oxide and other contaminants.
- Set and align the branch pipe with the main pipe at an angle of 45°. (Fig 2)
- Select no. 5 nozzle, ø1.6mm CCMS rod and use neutral flame with 0.15 kg/cm^2 pressure for both gases.
- Follow necessary safety precautions.
- Tack-weld the joint at 4 place with 45° intervals and with a 2 mm root gap to ensure root penetration.
- Ensure the tacked pipe "Branch" joint is positioned properly to make it convenient to manipulate the blow pipe and filler rod without any obstruction.
- Weld the joint by manipulating the blow pipe and filler rod without rotation of the pipe.
- Maintain keyhole throughout the welding and give side to side motion to the blow pipe to ensure good root penetration and fusion of both the edges of the joint.
- Complete the weld in 4 sectors 1, 2, 3 and 4 along the curved joint using leftward technique.
- Take care to properly fuse the crater of the previous sector welded with the starting of the new sector.

Avoid excess penetration.

- Clean the weld and inspect the weldment for defects.

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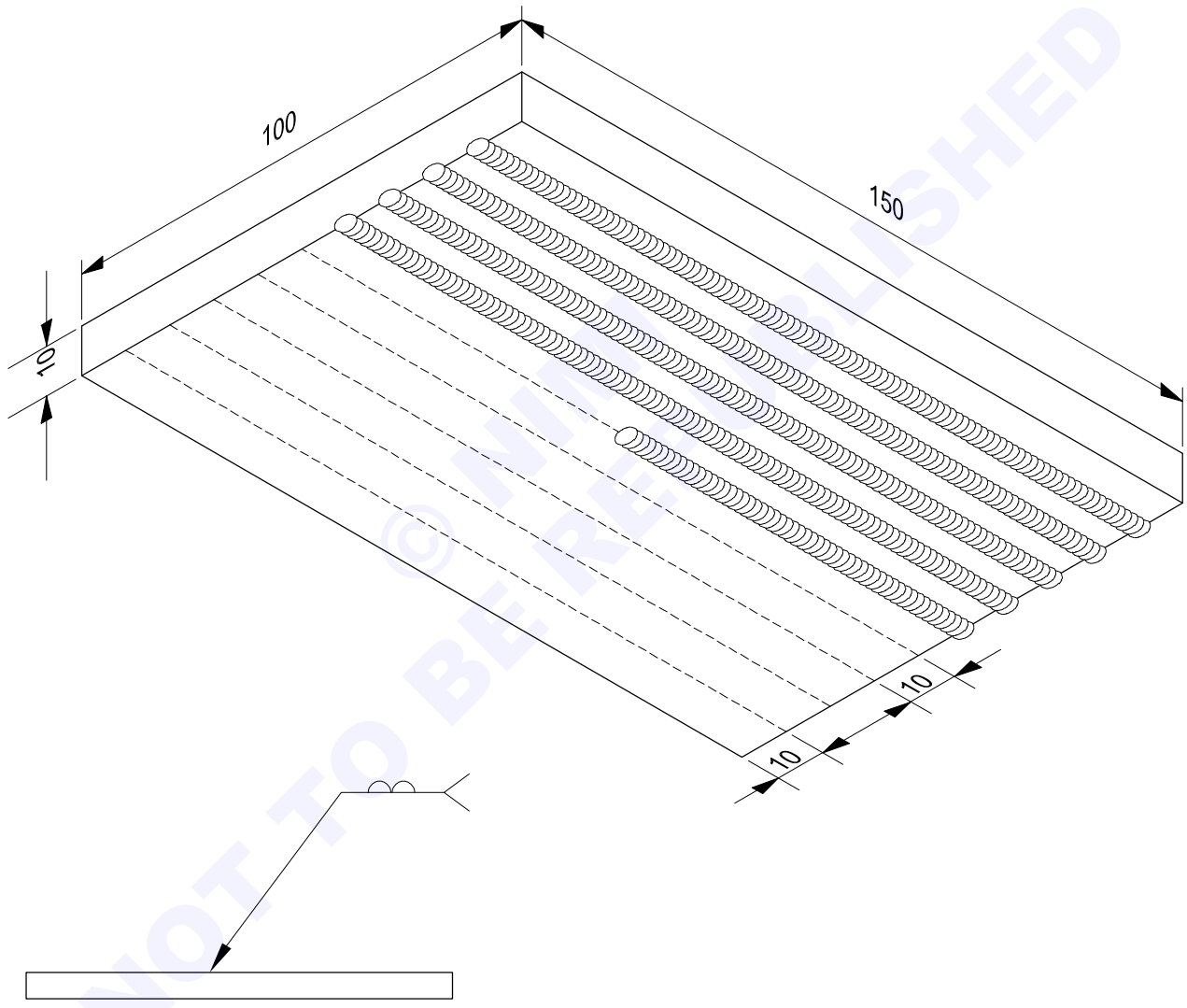
Straight line beads on MS plate 10mm thick in over head position

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

- **prepare the job as per drawing**
- **select the electrode, current polarity and arc length**
- **deposit weld beads in overhead welding**
- **clean and inspect the job.**



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1	150 ISF 10 - 100	-	Fe 310 - W	-	-	1.3.40
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	STRAIGHT LINE BEADS ON MS PLATE 10mm THICK IN OVER HEAD POSITION (SMAW-17)	TOLERANCE ±1	TIME
		CODE NO. WG20N1340E1	

Job Sequence

- Prepare and clean the plate.
- Lay out parallel lines as per drawing.
- Mark and punch lines with a center punch.
- Fix the plate in overhead position in the positioner. Adjust the job to suit your height.
- Select and fix a 3.15 mm dia. M.S. electrode and set 90-110 amperes current.

Use a helmet specially when welding in over-head position.

Run and support the electrode-holder cable over your shoulder.

Use hand sleeves and leg guards in addition to other protective clothing.

- Deposit the first bead along the punched line with short arc at normal speed.

Control the molten pool and slag using proper technique.

- Deslag, clean the bead and inspect for defects.
- Deposit the other beads along the punched line as done in the case of the first bead.
- Inspect the weld beads for defects.

Practice until you are able to deposit uniform straight beads without defects.

Skill Sequence

Straight line bead on MS plate 10mm thick in over head position

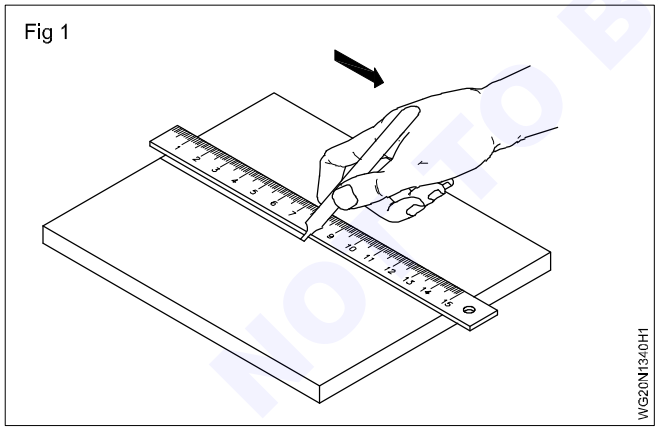
Objective: This shall help you to
- **prepare and practice straight line bead on MS plate 10mm thick in over head position.**

Introduction

Though overhead welding is the most difficult one, it can be made easy by following proper welding techniques. Welding in overhead position is done in piping work, ship building and in structural Capital Goods & Manufacturing.

Mark parallel lines with a scriber (Fig 1) and punch the line with a center punch.

Fig 1

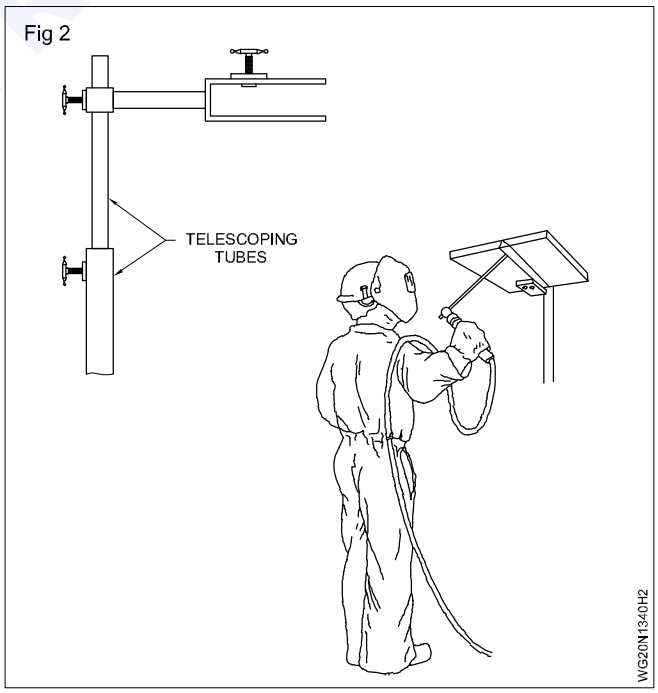


When setting the job in overhead position, the job with the punched line should be facing the ground. (Fig 2)

The height of the job is to be adjusted depending on your height using the telescoping tubes of the jig or positioner. (Fig 2) Small particles of molten metal and spatters will fall down from the joint during welding in overhead position and to protect yourself from these hot particles it is very important to use a helmet, hand sleeves, leg guards, gloves, apron and shoes.

In this position, the hand will be pulled down due to the weight of the cable. Due to this it is difficult to maintain a short arc constantly. This can be reduced by placing the cable over the shoulder as shown in Fig 2.

Fig 2



Use 3.15 mm ø MS electrode and set 90 - 110 amperes current. The current is set around 10amp less than that used for flat position, because maintaining a small molten pool is very important to reduce the pulling effect of gravity.

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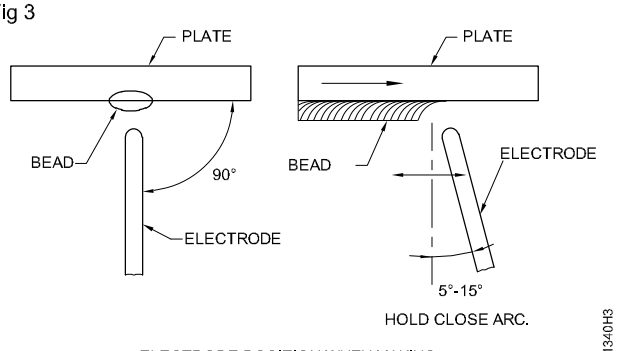
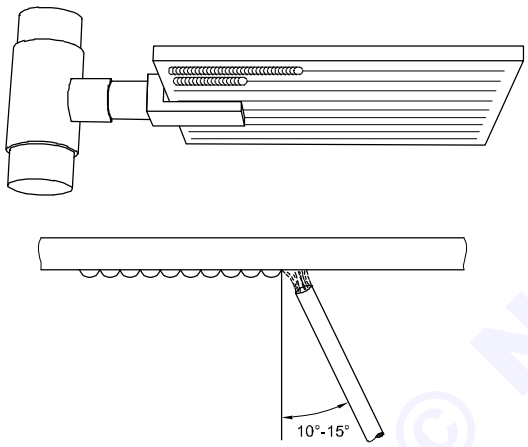
The electrode should be held at 90° to the base metal surface and at 5° to 15° to the direction of the weld. (Fig 3 & 4)

Fig 3



ELECTRODE POSITION WHEN MAKING BEADS IN OVERHEAD POSITION

Fig 4



POSITION OF THE ELECTRODE FOR OVERHEAD WELDING

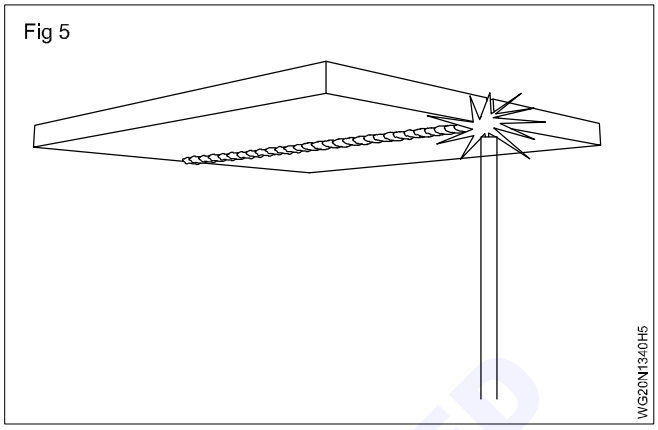
You can successfully overcome the force of gravity by using a short arc.

Deposit the first bead along the punched line. Care should be taken to maintain a very small molten pool to reduce the gravitational effect.

This will also help to control the molten slag from entering the molten metal.

Deposit the run up to the end of the work piece. (Fig 5)

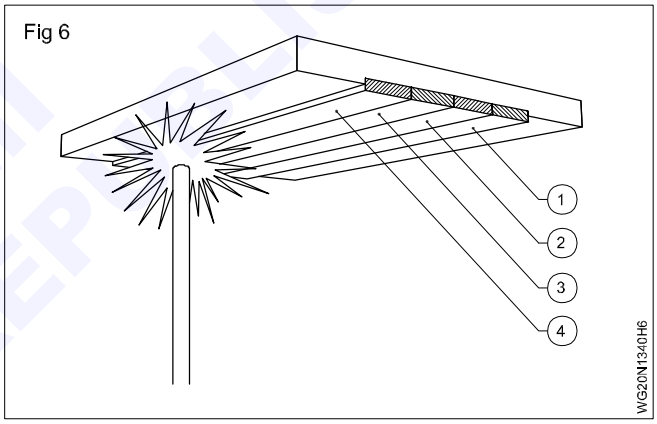
Fig 5



Repeat the same procedure to weld the second and subsequent beads. (Fig 6)

Inspect the weld for surface defects like uniformity of beads, undercuts, slag inclusions, blow holes etc.

Fig 6



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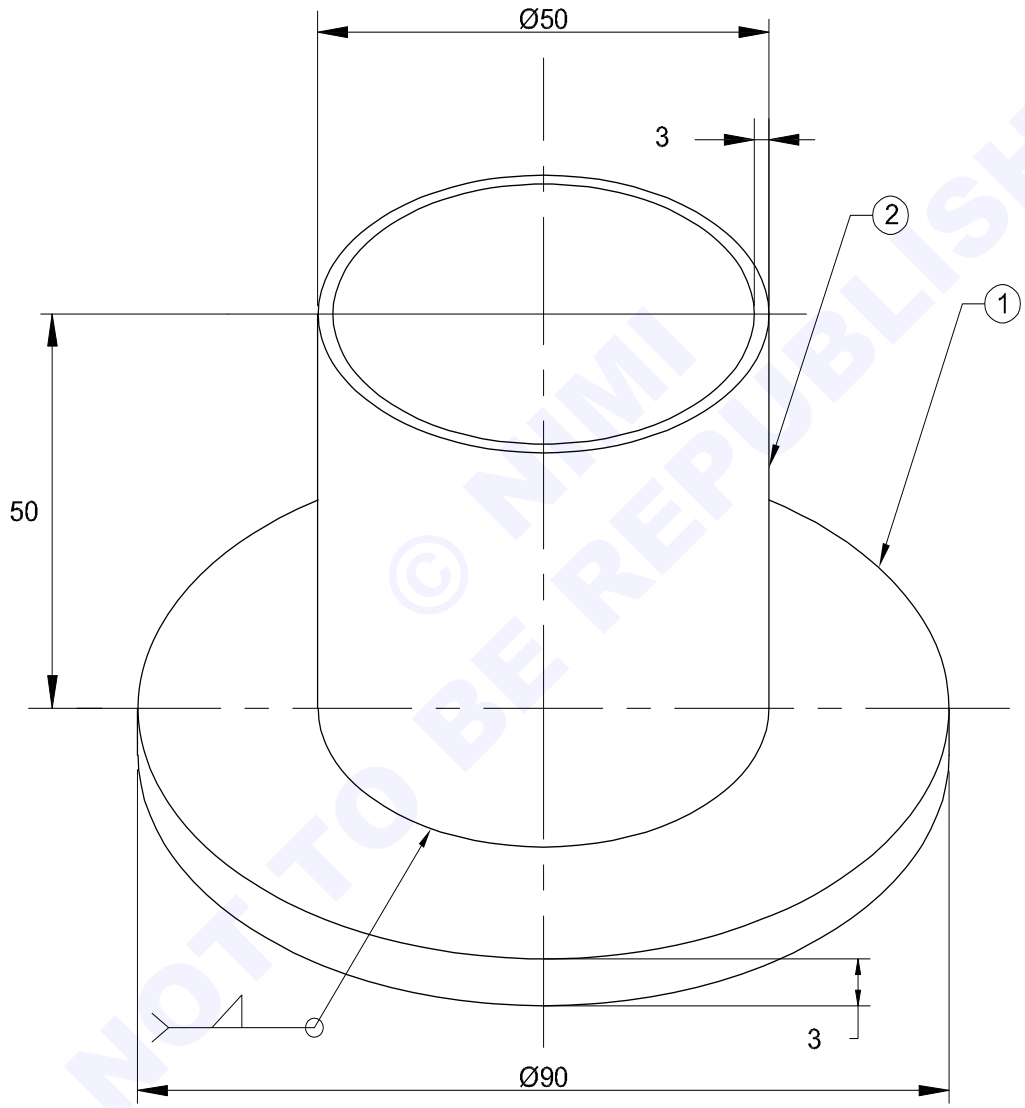
Pipe flange joint on MS plate with MS pipe ø50mm × 3mm wall thickness

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

- **mark an internal and external circle on a square plate**
- **cut the internal and the external circles by oxy-acetylene gas cutting**
- **insert an MS pipe and tack weld**
- **weld the pipe with the flange in 1G position (rolling)**
- **clean the joint and inspect for any external weld defect.**



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1	Ø50 x 3 - 50	-	Fe 310 - W	-	2	1.3.41
1	100 ISF 3 - 100	-	Fe 310 - W	-	1	1.3.41
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE FLANGE JOINT ON MS PLATE WITH MS PIPE Ø50mm x 3mm WALL THICKNESS (iF)-(SMAW-18)	TOLERANCE ±1	TIME 15 Hrs
		CODE NO. WG20N1341E1	

Job Sequence

- Find the center of the given 3mm thick square plate by joining the 2 diagonals of the square plate using a scriber and mark a dot on the meeting joint of the diagonals using a dot punch.
- Using a spring divider scribe/draw a circle of radius 25mm at the center of the square plate and another larger circle with a radius of 45mm and punch mark both the circumference of the circles.
- Select 5 No. size cutting nozzle and fit it with the cutting torch.
- Set a pressure of 0.15 kg/cm^2 for acetylene gas and 1.5 kg/cm^2 for oxygen gas for cutting 3mm MS plate.
- Set neutral flame and preheat at the center point of one of the edges of the square plate until it reaches bright red hot condition/kindling temperature.
- Press the oxygen cutting lever and move the torch by hand from the edge of the plate until the punch marked circumference of the larger circle is reached.
- Now using a roller guide and circle cutting attachment start cutting the larger external circle of 90mm diameter.

Ensure necessary safety precautions to be used for gas cutting is followed.

- To cut the internal circle, first pierce a small hole at about 10mm inside the circumference of the 50mm dia. circle.
- Move the torch towards the circumference from the pierced hole and complete the 50mmø hole cutting using a small circle cutting attachment.
- Clean the cut edges and trim the inside face of the cut edges using a half round file.
- Insert the given pipe of 50mm outside diameter in the cut hole of the plate such that the end of the pipe is flush with the flat surface on the other side of the 6mm plate to form a pipe flange joint.
- Select a 3.15mm medium coated MS electrode and set 90-110 amperes current and DCEN if a DC welding is used.
- Tack weld at four places at 90° intervals on the other side of the joint.

Ensure that the pipe is at 90° to the plate surface while tacking.

- Position the joint on a suitable weld fixture so that welding can be done by 1G rolling method.
- Complete the welding of the joint in one run using segment welding method.
- Deslag and clean the joint with a wire brush.
- Inspect visually for any external weld defects.

Ensure proper crater filling at the end of each segment welding.

Use appropriate safety precaution during arc welding and deslagging.

Skill Sequence

Pipe flange joint on MS pipe in flat position

Objective: This shall help you to
• weld pipe flange joint on MS plate with MS pipe ø50 mm × 3mm wall thickness.

For external circle cutting to get a 90mm dia. circular plate from the given 100mm square plate, the cut can be started from the free edge of the plate Fig 1. After the cut reaches the punch marked circumference line, fix the circle cutting attachment (Fig 4) at a distance of 45mm from the center of the cutting nozzle and keeping the conical point of the circle cutting attachment at the center of the plate and cut the external circle of radius 45mm.

To cut an internal circle, a small hole called pilot hole is to be drilled or pierced by gas cutting inside the circumference of the circle/profile before starting to cut the required circle/profile. The procedure to pierce a pilot hole is as follows. Refer Fig 2.

Fig 1

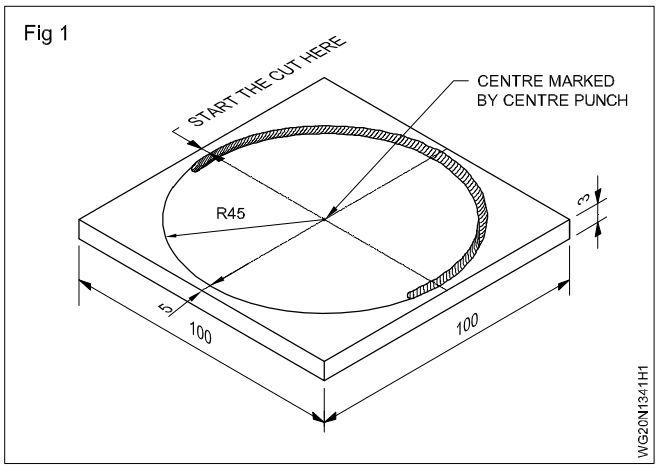

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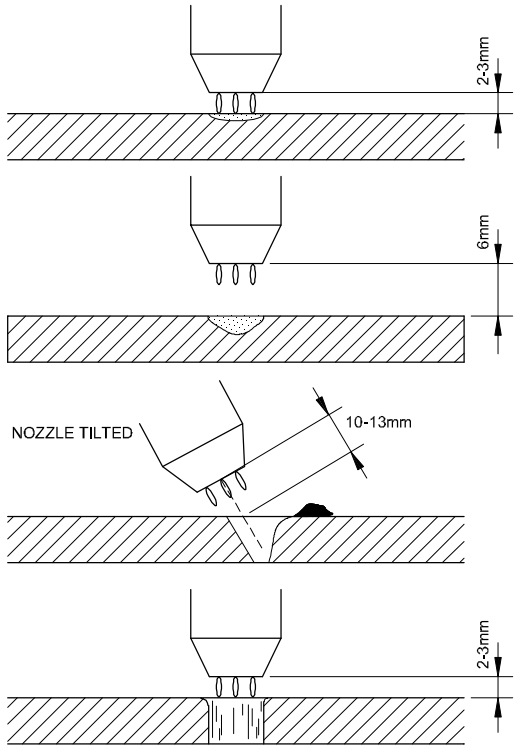
Fig 2



PIERCING A PILOT HOLE

Set the flame in the usual manner then:

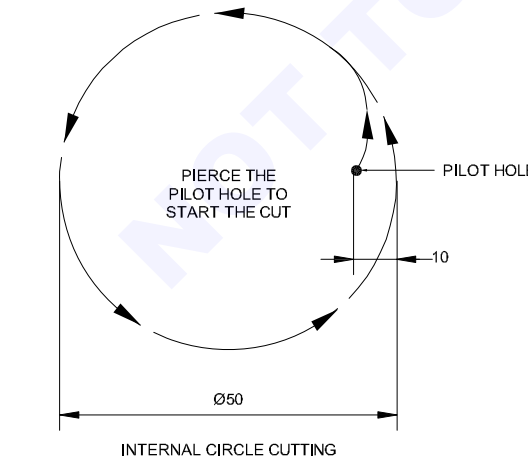
– Preheat the spot with the torch about 6mm from the plate, so that inner cones almost touch the plate.

– When the spot is bright red, lift the torch to about 13mm above the plate until the metal nearly melts and tilt the torch to the side a little.

– Press the cutting oxygen lever slowly and move the torch around slightly until the cut is through the plate.

After piercing the pilot hole move the torch as shown in Fig 3 until it reaches the circumference of the 50mmø circle.

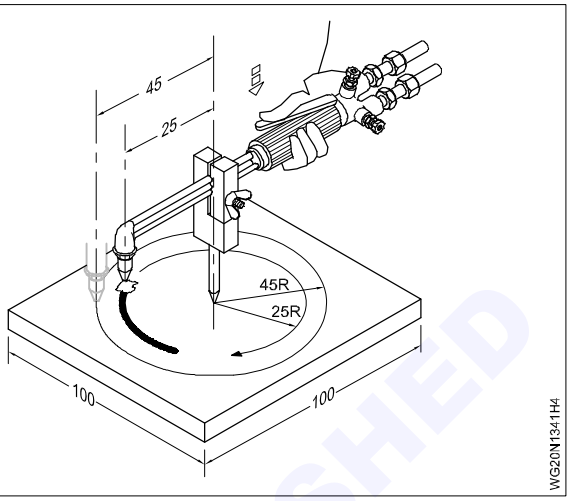
Fig 3



INTERNAL CIRCLE CUTTING

To cut a circle, it can be done by free hand movement along the circumference or a circle cutting attachment as shown in Fig 4 can be used which will give an accurate cut surface very close to 50mm diameter. To get a fine and uniform cut surface the torch has to be moved steadily with a uniform speed along the circumference.

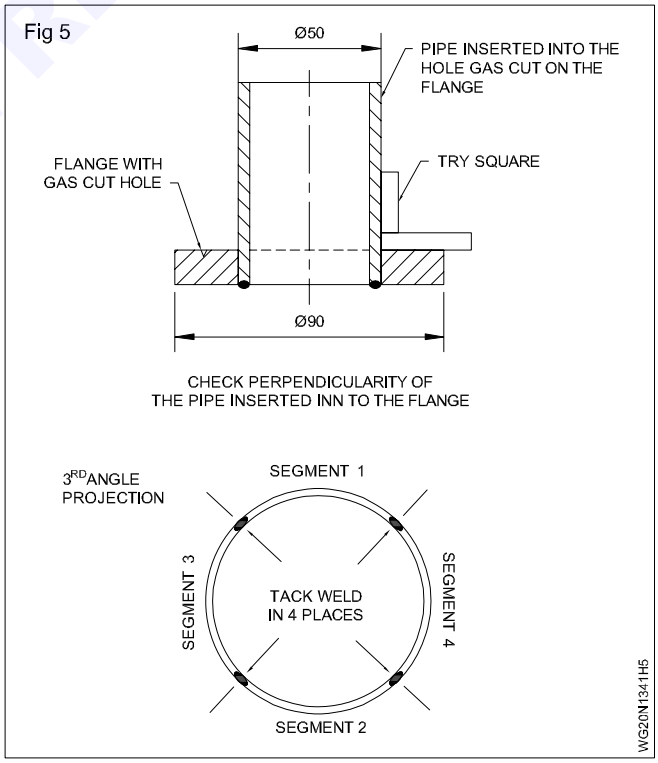
Fig 4



While tacking the pipe with the gas cut flange ensure that perpendicularly is maintained. Refer Fig 5 Tacking is done at 4 places on the other side of the flange joint. Fig 5. Use 4mm dia. electrode so that the required fillet size of 3 to 3.5mm can be maintained.

To weld the joint in 1G (rolling) position, use a weld fixture as shown in Fig 6 to make it convenient to weld in 1G position and complete the weld in 4 segments. 1, 2, 3 and 4 (Fig 5)

Fig 5



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Maintain as short an arc as possible and an electrode angle of 45° between the plate and pipe surfaces.

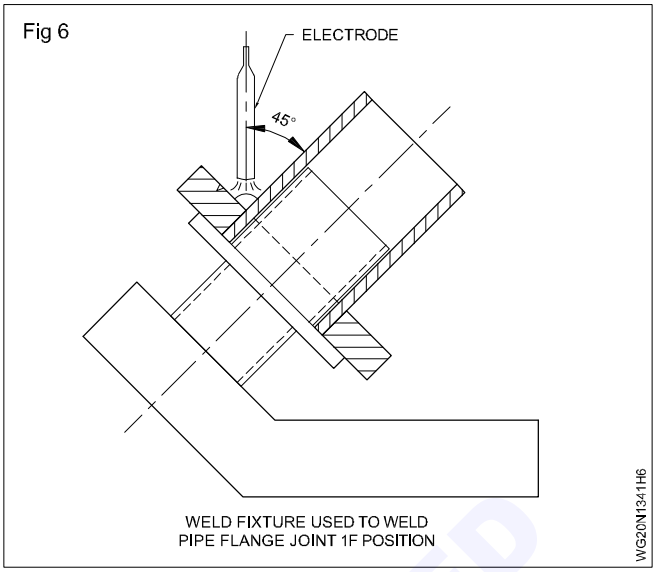
Follow the weld sequence as shown in the Fig 5 which will help to control distortion i.e. First weld segment (1) in down hand position. Then rotate the joint by 180° and weld segment (2) in down hand position. Similarly, weld segment (3) and segment (4) by rotating the joint on the fixture to bring the segments for welding in down hand position. Fig 5.

While welding segments 3 and 4 the weld deposit should cover about 10mm distance over the previous deposit to ensure crater filling and continuity in the root penetration.

Deslag after welding each segment and avoid undercut by proper current setting and speed of welding.

Clean the weld using wire brush. Check the fillet size with a weld gauge.

Fig 6



WELD FIXTURE USED TO WELD
PIPE FLANGE JOINT 1F POSITION

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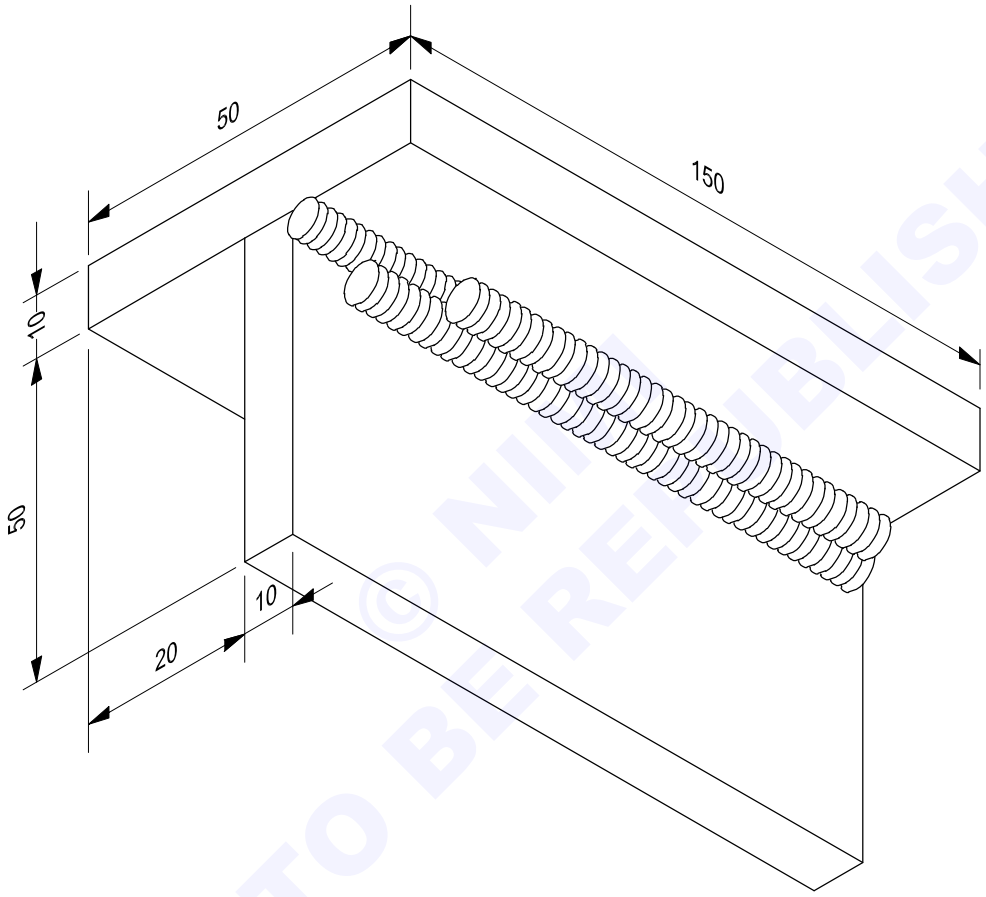
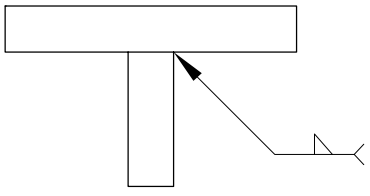
Fillet - "T" joint on MS plate 10mm thick in over head position (4F)-(SMAW-19)

Objectives: At the end of this exercise you shall be able to
- **prepare and set the job as per drawing**
- **deposit root 2nd and 3rd bead in over head position**
- **clean and inspect the weld defects.**





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2	150 ISF 10 - 50	-	Fe 310 - W	-	-	1.3.42
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**FILLET - "T" JOINT ON MS PLATE 10mm THICK IN OVER HEAD POSITION (4F)-(SMAW-19)**	TOLERANCE ±1	TIME
		CODE NO. WG20N1342E1	

Job Sequence

- Prepare and clean the job pieces.
- Set and tack the job pieces at both ends of the Tee joint in flat positions.

Tack the work pieces in outside edges so as to avoid starting defect.

- Set the job in overhead position and adjust its height.

Wear protective clothing i.e. helmet, hand sleeves, apron etc.

- Set a current of 90-110 amps for a 3.15mmø M.S. electrode.
- Connect the electrode holder in positive pole in the case of a DC machine.
- Deposit root run (first bead) deep in the root of the joint using a 3.15 mm ø electrode.
- Remove the slag and deposit second and third run with a 3.15 mm electrode.
- Remove the hot job by using a pair of tongs.
- Clean the weldments and inspect the surface defects.
- Repeat the exercise until you are able to weld the joint without defect.

Skill Sequence

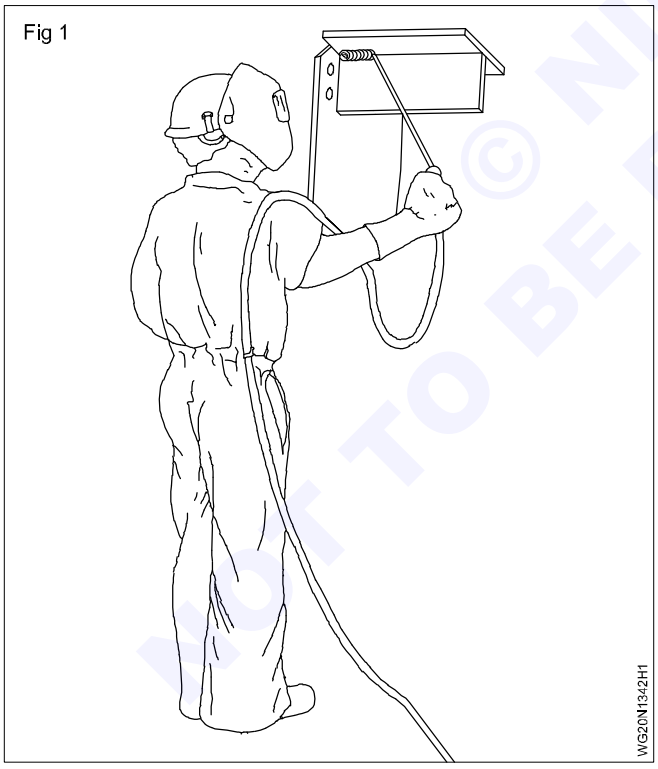
Fillet 'T' joint on MS plate 10mm thick in over head position

Objective: This shall help you to
- **prepare and weld fillet 'T' joint on MS plate 10mm thick in over head position.**

Job setting

Set the job in overhead position on the positioner. (Fig 1)

Fig 1

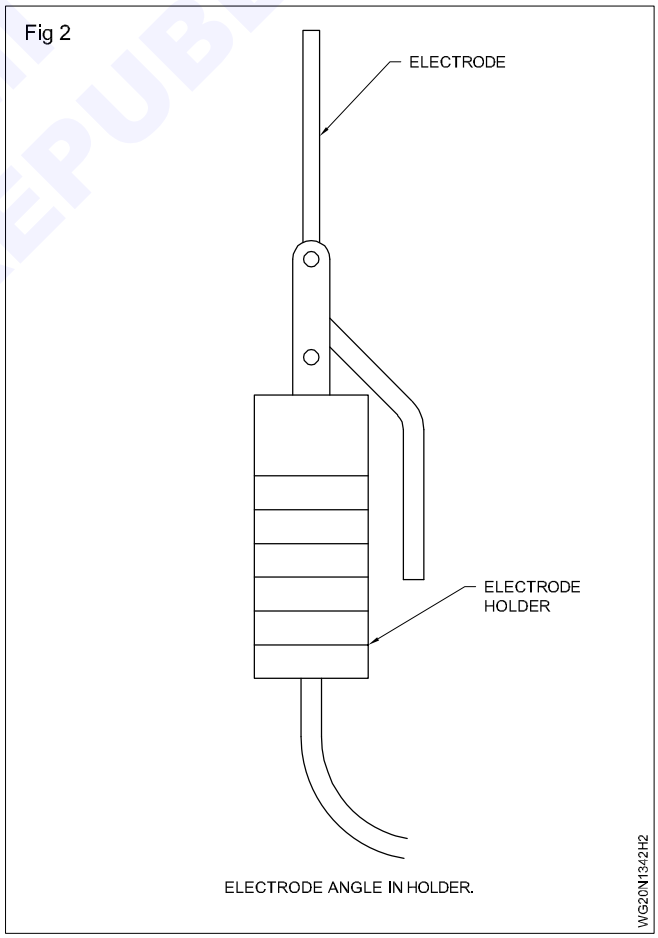


Fix the electrode as shown in Fig 2.

Start the bead at the left side. (Fig 1)

Use a 30° work angle off the vertical plate as shown in Fig 3.

Fig 2



Work angle is the angle between the electrode and the job surface.

Use a drag angle of approximately 10-15° to the direction of the weld.

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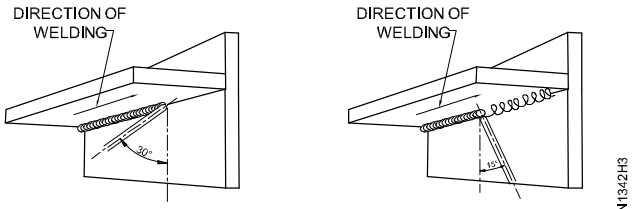
Fig 3



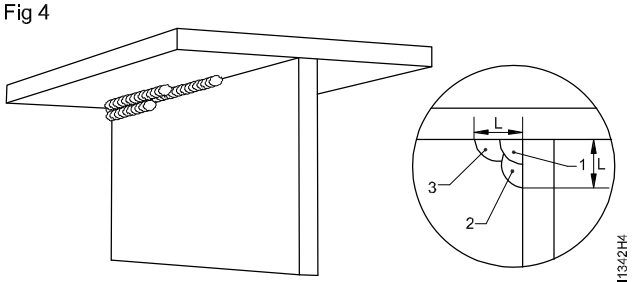
FILLET WELD IN THE OVERHEAD POSITION

Drag angle is the angle between the electrode and the line of weld.

Maintain a short arc all the time.

When multi-passes are used the second pass should be placed between the first pass and the vertical plate so that the second bead overlaps the first pass, (Fig 4) by about 2/3rd of its width.

Fig 4



T-JOINT IN AN OVERHEAD POSITION

The third bead should cover the top horizontal plate and about two-third of bead two. The leg lengths "L" of the weld should be equal. (Fig 4)

Welding in the overhead position is not difficult if you remember to keep the puddle flat and small.

If the molten metal becomes too fluid and tends to sag, whip your electrode away quickly from the crater and allow the metal to solidify.

Do not attempt to deposit too much weld metal at one time.

All the slag must be removed before you deposit the next run.

The process is quite hazardous because of flying spatters and the possibility of molten metal from the puddle dropping on to the operator. By maintaining a short arc length and rapid electrode manipulation this difficulty may be overcome to a great extent.

The discomfort of the cable can be minimized by dropping it over the shoulder if you are welding in a standing position as shown in Fig 1 or over the knees if in a sitting position.

Inspection: Remove the slag from the weld and inspect the joint for surface and external defects.

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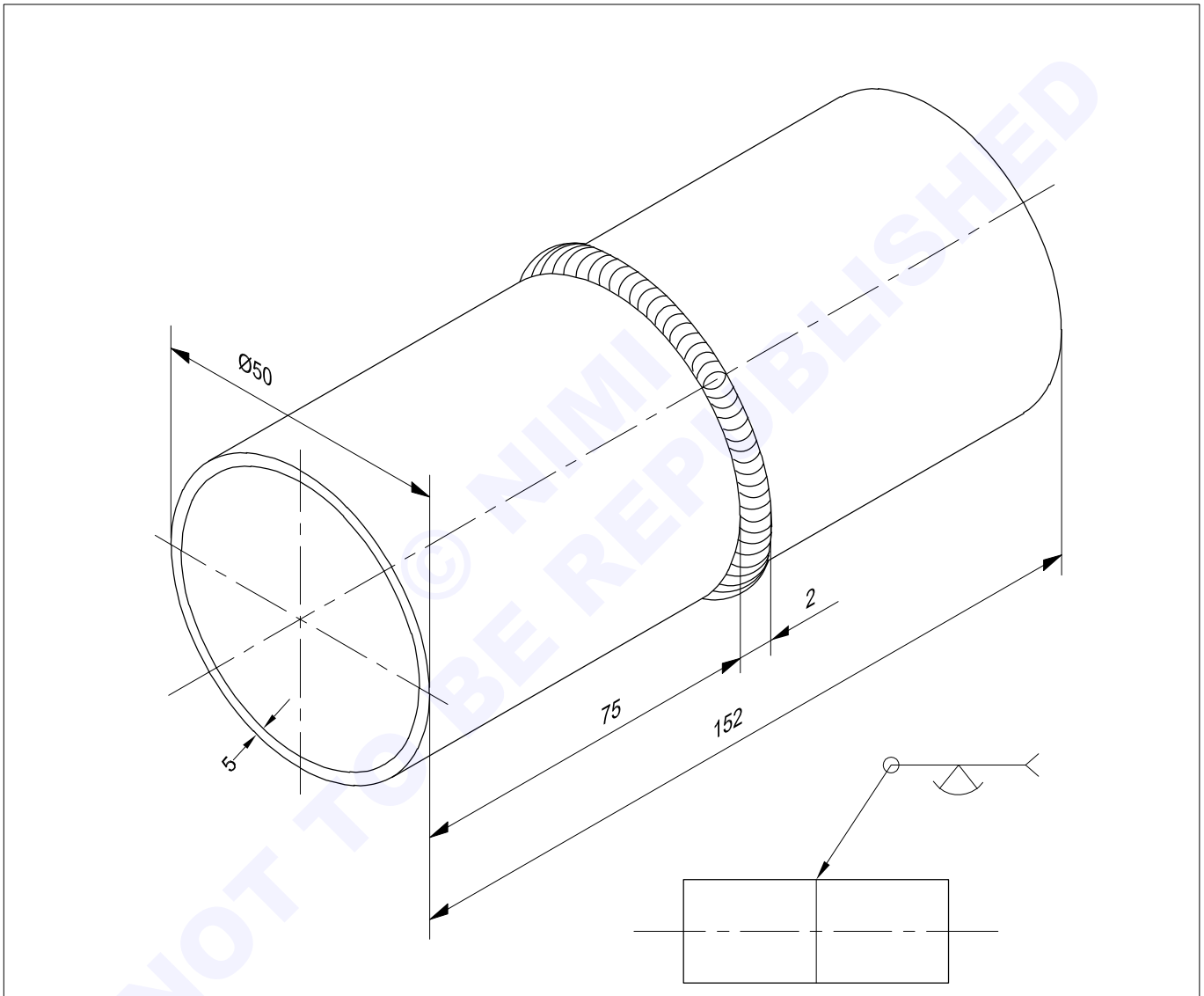
Pipe welding butt joint on MS pipe ø50mm and 5mm wall thickness in 1G (SMAW)

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

- **cut and bevel the pipe for weld**
- **set the root gap and tack weld**
- **deposit weld bead by rotation method**
- **clean and inspect the weld defects.**



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2	Ø50 x 5 - 75	-	Fe 310 - W	-	-	1.3.43
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**PIPE WELDING BUTT JOINT ON MS PIPE Ø50mm AND 5mm WALL THICKNESS IN 1G POSITION (SMAW-20)**	TOLERANCE ±1	TIME 15 Hrs
		CODE NO. WG20N1343E1	

Job Sequence

- Cut the pipes to the given size.
- File pipe ends to be at right angle to the pipe axis.
- Grind the edges to 30 to 35° bevel maintaining 2 mm root face.
- Remove the burrs and rust from the pipe ends.
- Arrange the 2 pipes to form as a butt joint.
- Use a fixture or V profile of an angle iron to align pipes.

Wear protective clothing.

- Switch 'on' the machine and select a 3.15 mm ø electrode for tacking and the root run and set an 90-110 amps current.
- Put 4 tacks at regular intervals adjusting 2 mm root gap between the pipes using spacers.
- Ensure that each tack ends with a key hole.
- Check and ensure that the pipes are in line after tacking.
- Set 90-110 amp for a 3.15mmø electrode for root run.
- Deposit the root run in flat position by without rotating the pipe.
- Welding using the keyhole technique ensures root penetration.
- Remove slag from the root thoroughly.
- Deposit the second and third run using a 3.15 mm ø electrodes i.e. the same as for the root run.
- Clean and inspect the joint.

Skill Sequence

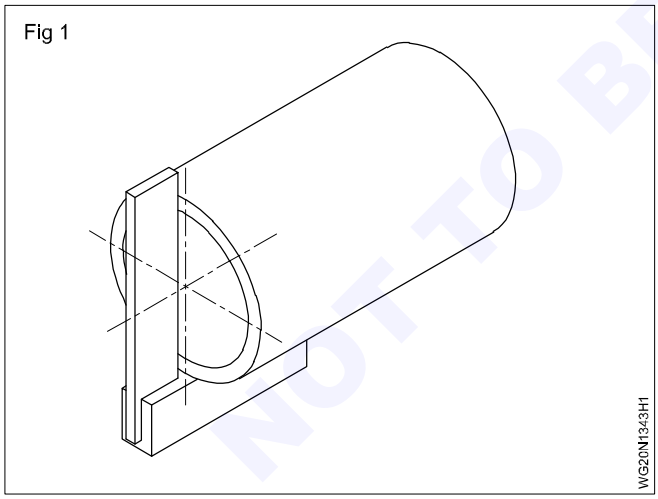
Pipe welding butt joint on MS pipe ø50mm and 5mm wall thickness in 1G (SMAW)

Objectives: At the end of this exercise you shall be able to
- **cut and bevel the pipe for weld.**

Cut the pipes to the given size by a hacksaw.

Check the squares of the pipe end by using a try square. (Fig 1) and file the pipe end so that it is square with the pipe axis.

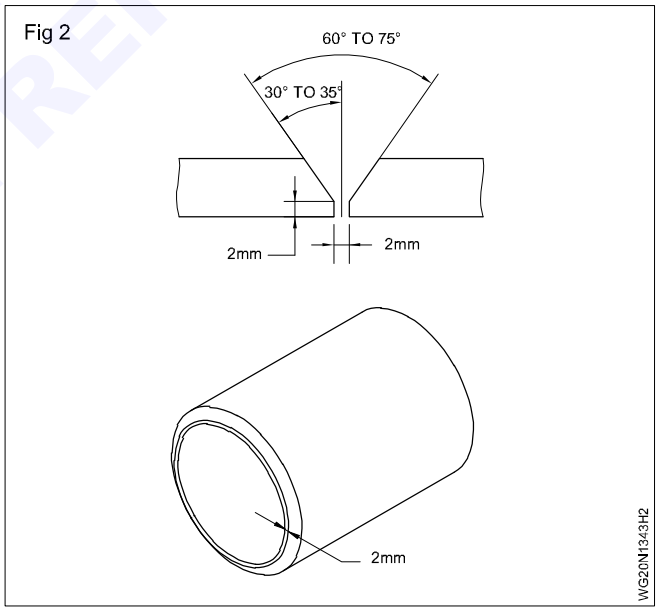
Fig 1



Prepare 30 to 35° bevel on one end of each pipe, leaving 1.5 to 1.75 mm root face by grinding or by filing. (Fig 2)

Switch 'on' the machine and adjust 110 amp current for 3.15 mm ø medium coated M.S. electrode (B.I.S code ER4211). Use DCEN polarity.

Fig 2



Before tacking, align the pipes on V profile of an angle iron with 2 mm root gap (Fig 3) and tack them as shown in Fig 4. Check the gap using a 2 mm rod.

Place the electrode in the holder, as in Fig 6. Use a 90 degree angle or a 45 degree angle away from the end of the holder.

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Fig 3

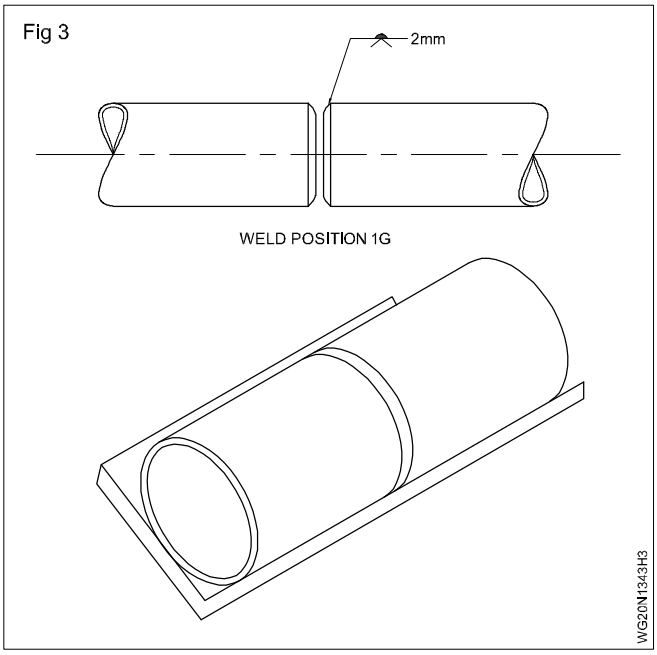
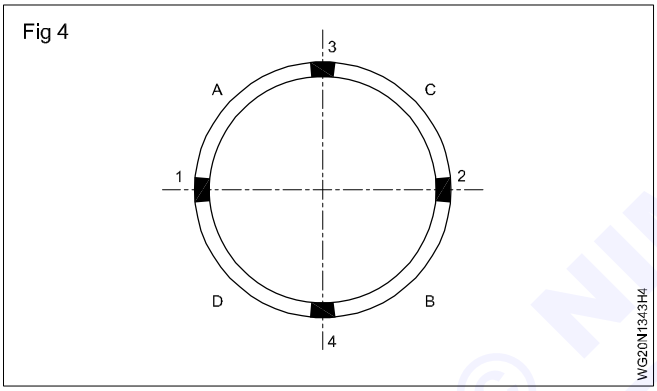


Fig 4



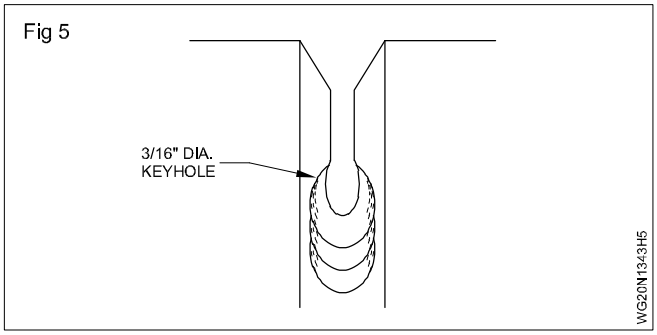
Position yourself so that you are at a 90 degree angle to the pipe. Be sure you are comfortable.

Strike the arc, on the bevel, at approximately 3 o'clock. Carry it down to 4 o'clock. Pause long enough for the root faces to melt away and for a keyhole to form Fig 5. Then reverse your electrode direction.

To run the first pass uphill, utilize the whipping method, as in welding plate in the vertical position. Use an electrode at a push angle of 5 to 15 degrees upward, as in Fig 6. Whip upward, taking care not to damage the surface of the pipe on either side of the V groove. Stop when you reach 1 o'clock, as shown in Fig 6. Clean thoroughly.

Turn the pipe toward you one quarter of a turn. Then proceed in the same manner until the first pass is completed. Be sure to start the next electrode slightly below the crater.

Fig 5



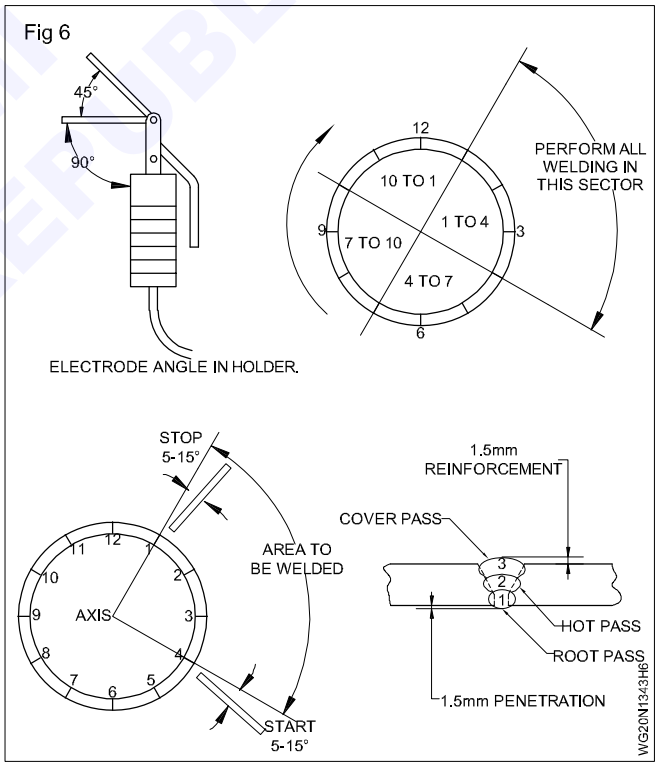
The second pass (hot pass) and third pass (cover pass) can be welded using 3.15mm electrode with either the triangle motion or the alternate weave, as in vertical plate welding. Take care to pause at the sides of the joint. Burn out any entrapped slag and fill in any undesirable undercut.

The sequence of beads is shown in Fig 6. Adhere to the maximum root and face reinforcement shown.

When you make the connection on completing the pass, be sure to overlap slightly. Break the arc by slowly drawing it away from the puddle.

Clean and inspect the joint for surface defects.

Fig 6



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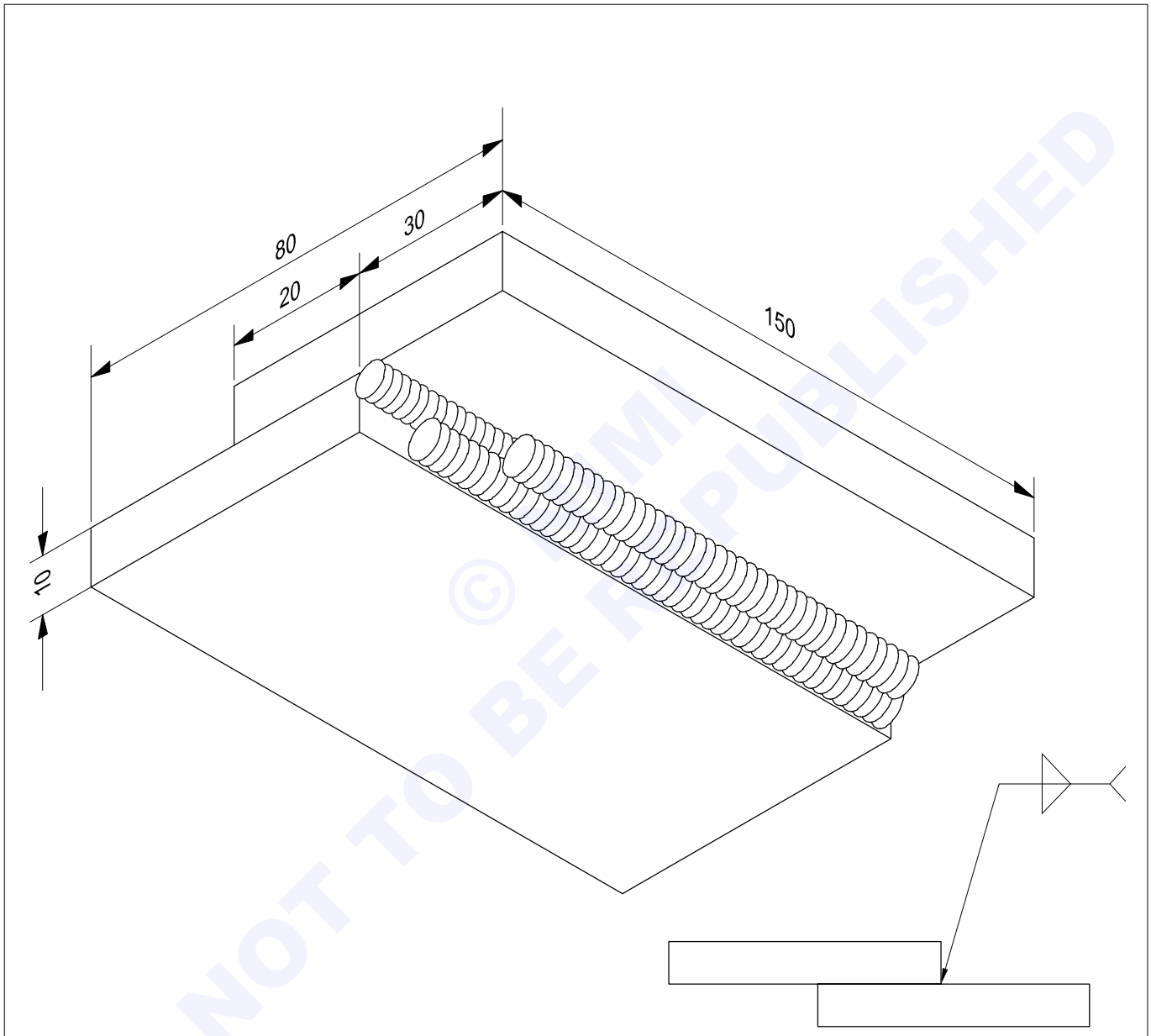
Fillet - lap joint on MS plate 10mm thick in over head position (4G)-(SMAW-21)

Objectives: At the end of this exercise you shall be able to
- **weld fillet lap joint in overhead position**
- **clean and inspect the job for surface defects.**



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2	50 ISF 10 - 150	-	Fe 310 - W	-	-	1.3.44
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	FILLET LAP JOINT ON M.S. PLATE 10mm THICK IN OVERHEAD POSITION.	TOLERANCE ±1	TIME
		CODE NO. WG20N1344E1	

Job Sequence

- Mark the plate and cut to given size.
- Prepare the square edges.
- Set the lap joint without gap and tack the plate on both ends.
- Clamp the job for overhead lap welding.
- Select 3.15ø electrode and set the current.
- Hold the electrode at an angle of 45° to the plate surface and an angle of 15° to the perpendicular to the line of weld.
- Lay the first bead at the root without weaving the electrode.
- Clean the slag using a chipping hammer.
- Deposit 2nd and 3rd run using stringer beads.
- Deslag, clean and inspect the joint.

Skill Sequence

Fillet lap joint on MS plate 10mm thickness in over head position

Objective: This shall help you to
- **prepare and weld fillet lap joint on MS plate 10mm thickness in over head position.**

Preparation and job setting

Mark and cut the plate to the given size by gas cutting.

Clean the surfaces of the plates and file to square edge.

Set lap fillet without gap and tack the plates at both ends.

Keep the lapping distance as 20mm.

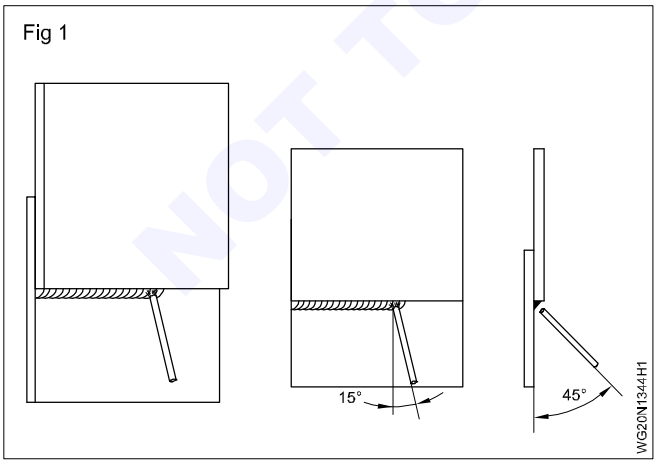
Wear leather gloves, hand sleeves, apron, leg guard, helmet etc.

Clamp the job for overhead welding.

Select a M.S. electrode 3.15 mm ø and set 90-110 amps current.

Hold the electrode so that it bisects the angle between the edge of the top plate and the surface of the bottom plate, and is inclined slightly away from the crater, say 15°. (Fig 1)

Fig 1



Lay the first bead at the root of the joint with a short arc without electrode weaving.

Remove the slag from the bead using a chipping hammer and clean with a wire brush.

Use a M.S. electrode 3.15 mm ø and deposit the 2nd run with 90-110 amps. current, between the 1st bead and the surface of the plate, maintaining a short arc. The electrode angle is the same as the one mentioned for root run.

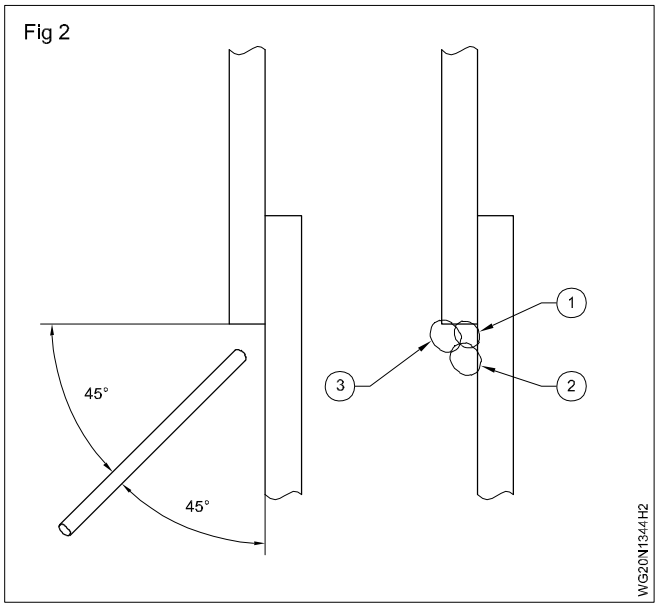
Deslag the second bead thoroughly.

Use a 3.15 mm electrode and set 90-110 amps current.

Deposit the 3rd bead in between the first bead and the bottom edge of the top plate (Fig 2) with a short arc and with an electrode angle of 45° to the surface of the plate to avoid the edge melting off the top plate.

Clean the weld thoroughly and inspect for defects, like undercut, porosity, uneven ripples and the melting off of the edge plate.

Fig 2



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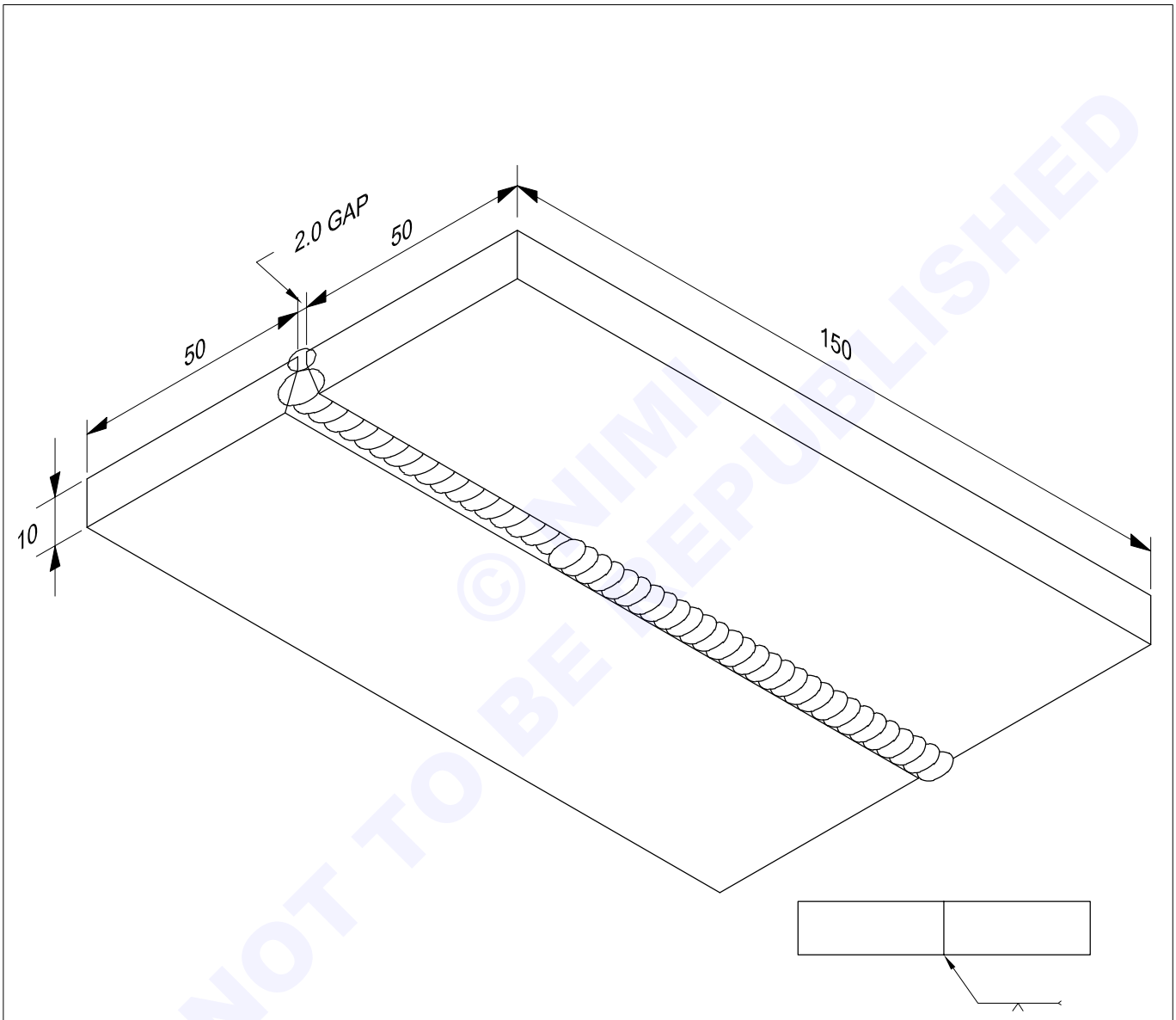
Single "V" butt joint on MS plate 10mm thick in over head position (4G)-(SMAW-22)

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

- **prepare the bevel edges as per drawing**
- **set the root gap and tack weld**
- **deposit root run, 2nd run, 3rd run in overhead position**
- **Clean and inspect the weld defects.**



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2	50 ISF x 10 - 150	-	Fe 310 - W	-	-	1.3.45
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	SINGLE 'V' BUTT JOINT ON M.S. PLATE 10mm THICK IN OVERHEAD POSITION.				TOLERANCE ±1	TIME
					CODE NO. WG20N1345E1	

Job Sequence

- Prepare the plates to size as per drawing.
- Clean the beveled plate.
- Use spacers, maintain 2.0 mm root gap, tack one end and adjust the gap and tack the other end.
- Preset the plates 3° to take care of distortion as done in Ex.No.E32/3. 16.

Ensure safety apparels are worn.

- Arrange the work piece in overhead position.
- Select a 3.15 mm M.S. electrode and set 90-110 amps current.
- Weld the root run with short arc with uniform welding speed, so that a uniform root penetration can be obtained.
- Chip the slag and inspect the weld.

Use a pair of tongs to hold hot jobs.

Use a chipping hammer and wire brush for cleaning.

Use chipping goggles for protection of eyes.

- Deposit second covering run with a weaving motion.
- Use a 3.15 mm electrode with 90-110 amps current.
- Deposit the third covering run similar to the second run.

Skill Sequence

Single 'V' butt joint on MS plate 10mm thick in over head position

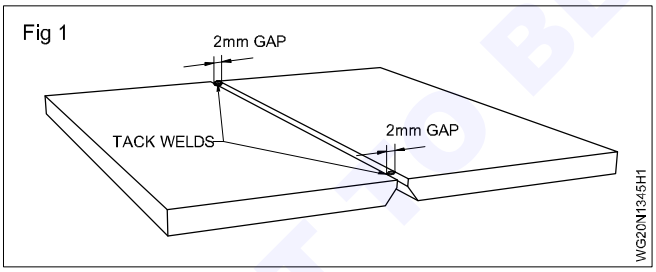
Objective: This shall help you to
- **prepare and weld single 'V' butt joint on MS plate 10mm thick in over head position.**

This type of joint is used very extensively for welding huge structures as in rail coach, ship building industries and earth moving equipment manufacture and for welding big structures and huge pipes at side.

Setting and tacking

Set the pieces as single V butt joint with 2.5 mm root gap. (Fig 1) Tack at both ends.

Fig 1



Use a 3.15 mm ø M.S. electrode and set a current of 90-110 amps.

Preset the plates

Fix the work piece in the overhead position. (Fig 2)

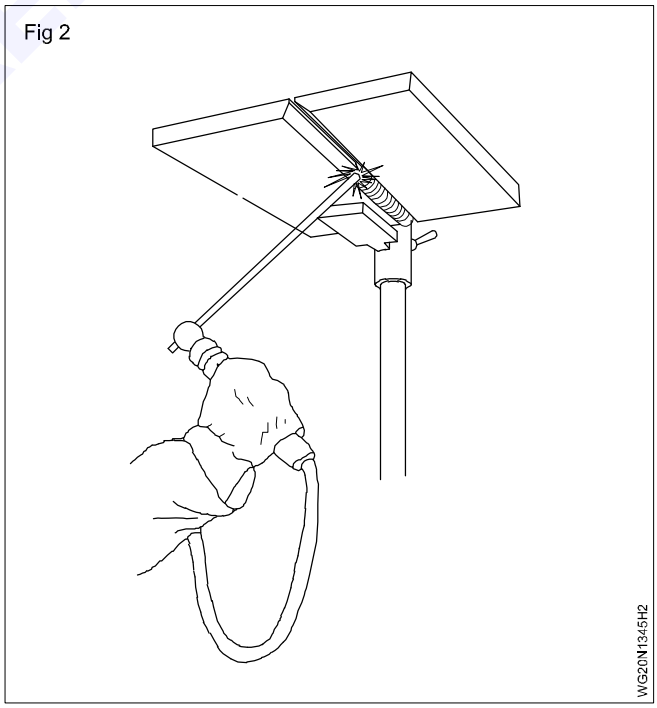
Adjust it to a suitable height.

Use a light welding cable to reduce the load on your arms.

Weld root run

The electrode should be kept as near as possible and square to the surface of the plate and at a small angle to the direction of the weld. (Fig 3) Keep the electrode well up in the gap and control the 'keyhole' to get a small reinforcement on the weld on the root side. (Figs 3 and 4)

Fig 2



Keep a short arc length. (Fig 4)

Control the slag. The slag must not drop into or flood the weld pool.

Weld up to the end of the work piece, chip off the slag after cooling and inspect the weld.

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Fig 3

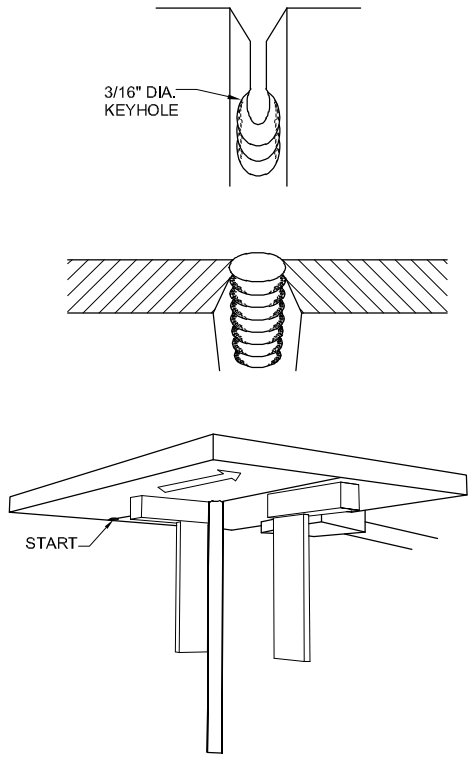
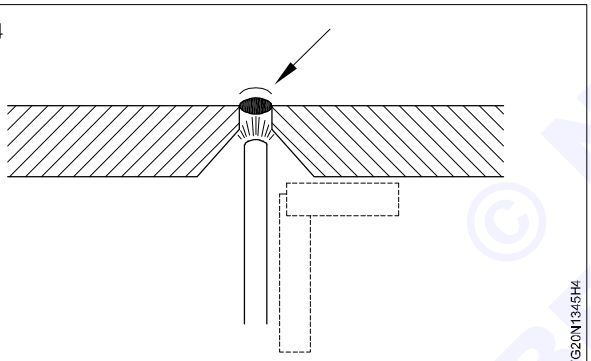


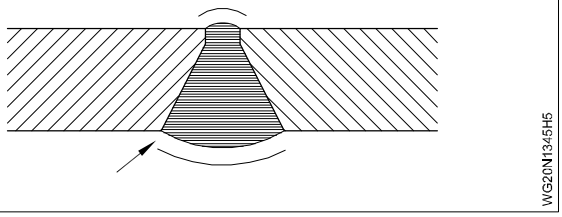
Fig 4



Weld second and third passes

Select a 3.15 electrode and set 100 amps current. Use weaved beading technique. The electrode should be moved across the face of the weld. (Fig 5)

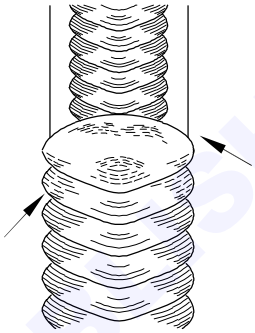
Fig 5



Do not deposit too much metal in the center of the bead causing it to sag in the center.

The side-to-side movement should be kept within the required weld size. (Fig 6)

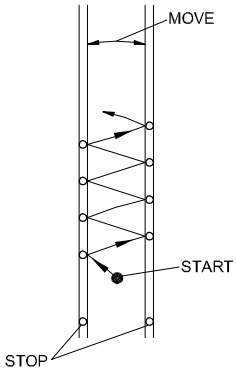
Fig 6



Stop a while at the sides of the weld to prevent undercut. (Fig 7)

Chip off the slag and inspect the weld.

Fig 7



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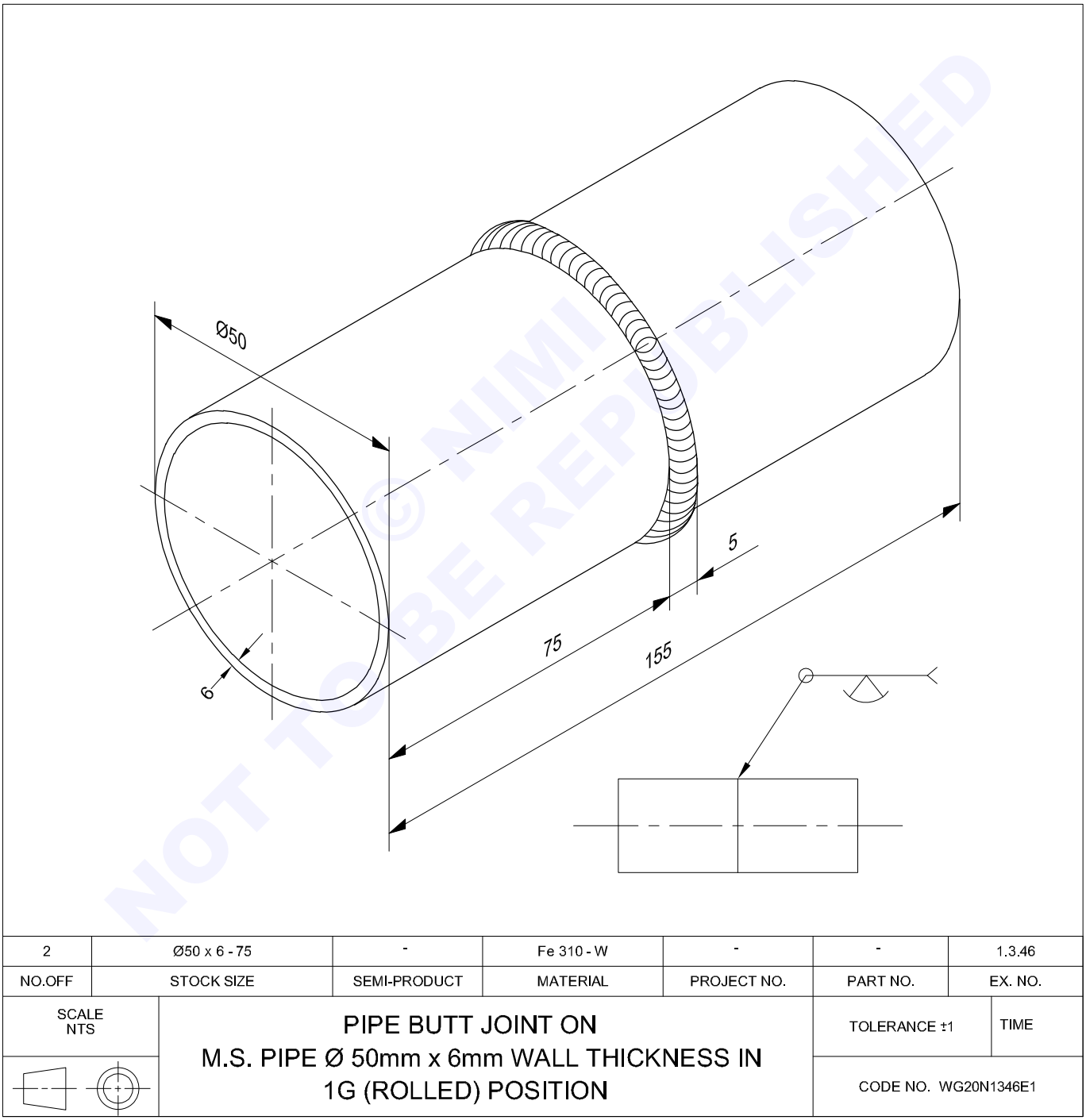
Pipe butt joint on MS pipe ø50mm wall thickness 6mm (1G Rolled) position (SMAW-23)

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

- **cut and bevel the pipe for welding**
- **set the root gap and tack weld**
- **make root run and covering run by rotation**
- **clean the job and inspect for defects.**



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2	Ø50 x 6 - 75	-	Fe 310 - W	-	-	1.3.46
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	PIPE BUTT JOINT ON M.S. PIPE Ø 50mm x 6mm WALL THICKNESS IN 1G (ROLLED) POSITION	TOLERANCE ±1	TIME
		CODE NO. WG20N1346E1	

Job Sequence

- Cut the pipes to the given size.
- File pipe ends to be at right angle to the pipe axis.
- Grind the edges to 30 to 35° bevel maintaining 1.5 to 1.75 mm root face.
- Remove the burrs and rust from the pipe ends.
- Arrange the 2 pipes to form as a butt joint.
- Use a fixture or V profile of an angle iron to align pipes.

Wear protective clothing.

- Switch 'on' the machine and select a 3.15 mm ø electrode for tacking and the root run and set an 100 amps current.
- Put 4 tacks at regular interval adjusting 2 mm root gap between the pipes using spacers.
- Ensure that each tack ends with a key hole.
- Check and ensure that the pipes are in line after tacking.
- Set 110 amp for a 3.15mmø electrode for root run.
- Deposit the root run in flat position by rotating the pipe.
- Welding using the keyhole technique ensures root penetration.
- Remove slag from the root thoroughly.
- Deposit the second and third run using a 3.15 mm ø electrodes i.e. the same as for the root run.
- Clean and inspect the joint.

Skill Sequence

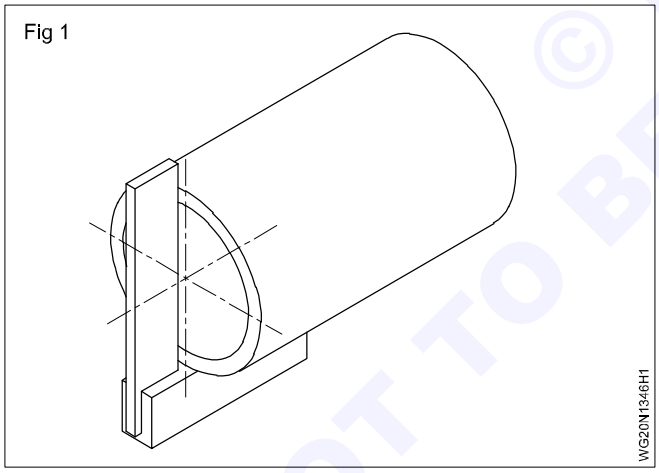
Pipe joint on MS pipe ø50mm×6mm wall thick in over head rolled position

Objective: This shall help you to
- **prepare and weld pipe joint on MS pipe ø50mm×6mm wall thick in over head rolled position.**

Cut the pipes to the given size by a hacksaw.

Check the squares of the pipe end by using a try square. (Fig 1) and file the pipe end so that it is square with the pipe axis.

Fig 1



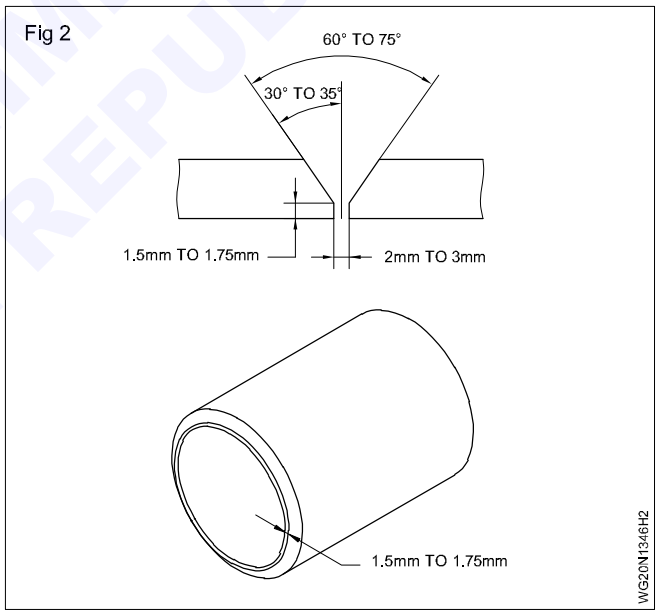
Prepare 30 to 35° bevel on one end of each pipe, leaving 1.5 to 1.75 mm root face by grinding or by filing. (Fig 2)

Switch 'on' the machine and adjust 110 amp current for 3.15 mm ø medium coated M.S. electrode (B.I.S code ER4211). Use DCEN polarity.

Before tacking, align the pipes on V profile of an angle iron with 2 mm root gap (Fig 3) and tack them as shown in Fig 4. Check the gap using a 2 mm rod.

Place the electrode in the holder, as in Fig 6. Use a 90 degree angle or a 45 degree angle away from the end of the holder.

Fig 2



Position yourself so that you are at a 90 degree angle to the pipe. Be sure you are comfortable.

Strike the arc, on the bevel, at approximately 3 o'clock. Carry it down to 4 o'clock. Pause long enough for the root faces to melt away and for a keyhole to form Fig 5. Then reverse your electrode direction.

To run the first pass uphill, utilize the whipping method, as in welding plate in the vertical position. Use an electrode at a push angle of 5 to 15 degrees upward, as in Fig 6. Whip upward, taking care not to damage the surface of the pipe on either side of the V groove. Stop when you reach 1 o'clock, as shown in Fig 6. Clean thoroughly.

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Fig 3

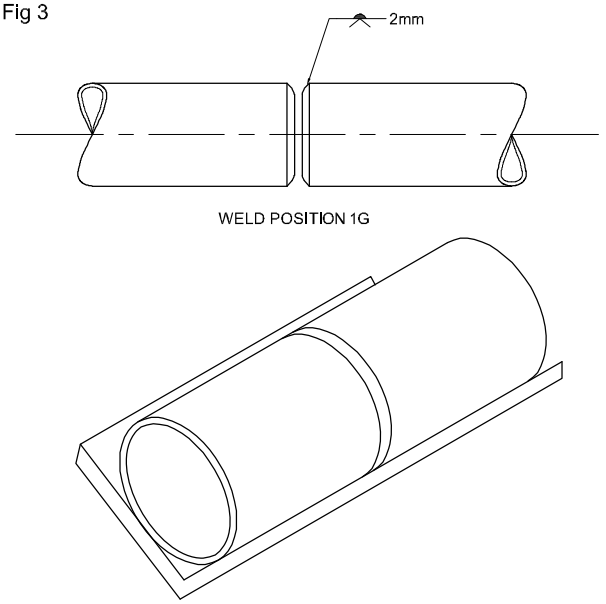


Fig 4

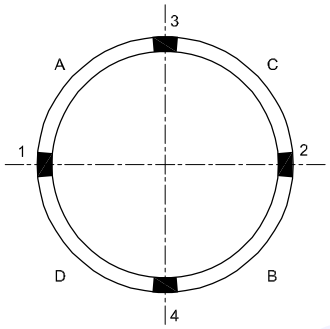
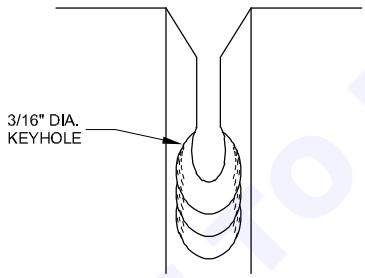


Fig 5

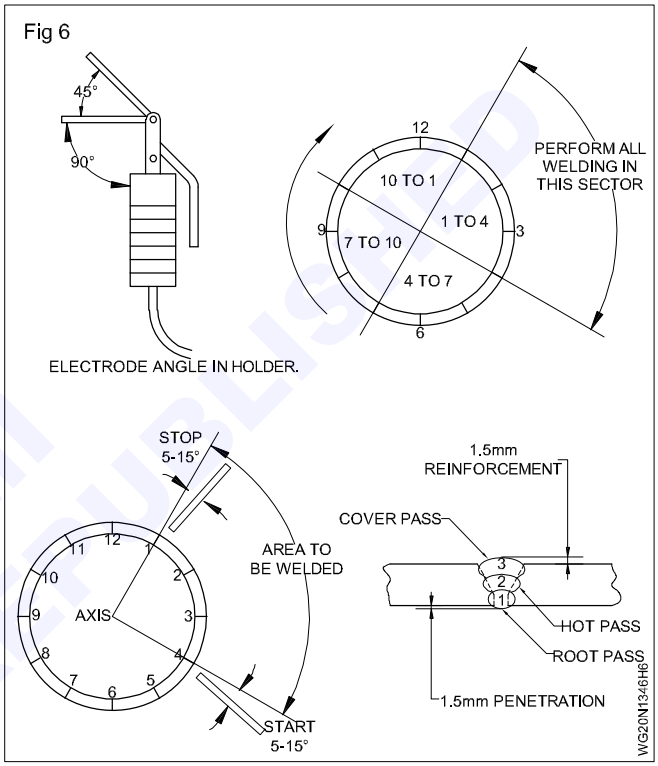


Turn the pipe toward you one quarter of a turn. Then proceed in the same manner until the first pass is completed. Be sure to start the next electrode slightly below the crater.

The second pass (hot pass) and third pass (cover pass) can be welded using 3.15mm electrode with either the triangle motion or the alternate weave, as in vertical plate welding. Take care to pause at the sides of the joint. Burn out any entrapped slag and fill in any undesirable undercut.

The sequence of beads is shown in Fig 6. Adhere to the maximum root and face reinforcement shown.

Fig 6



When you make the connection on completing the pass, be sure to overlap slightly. Break the arc by slowly drawing it away from the puddle.

Clean and inspect the joint for surface defects.

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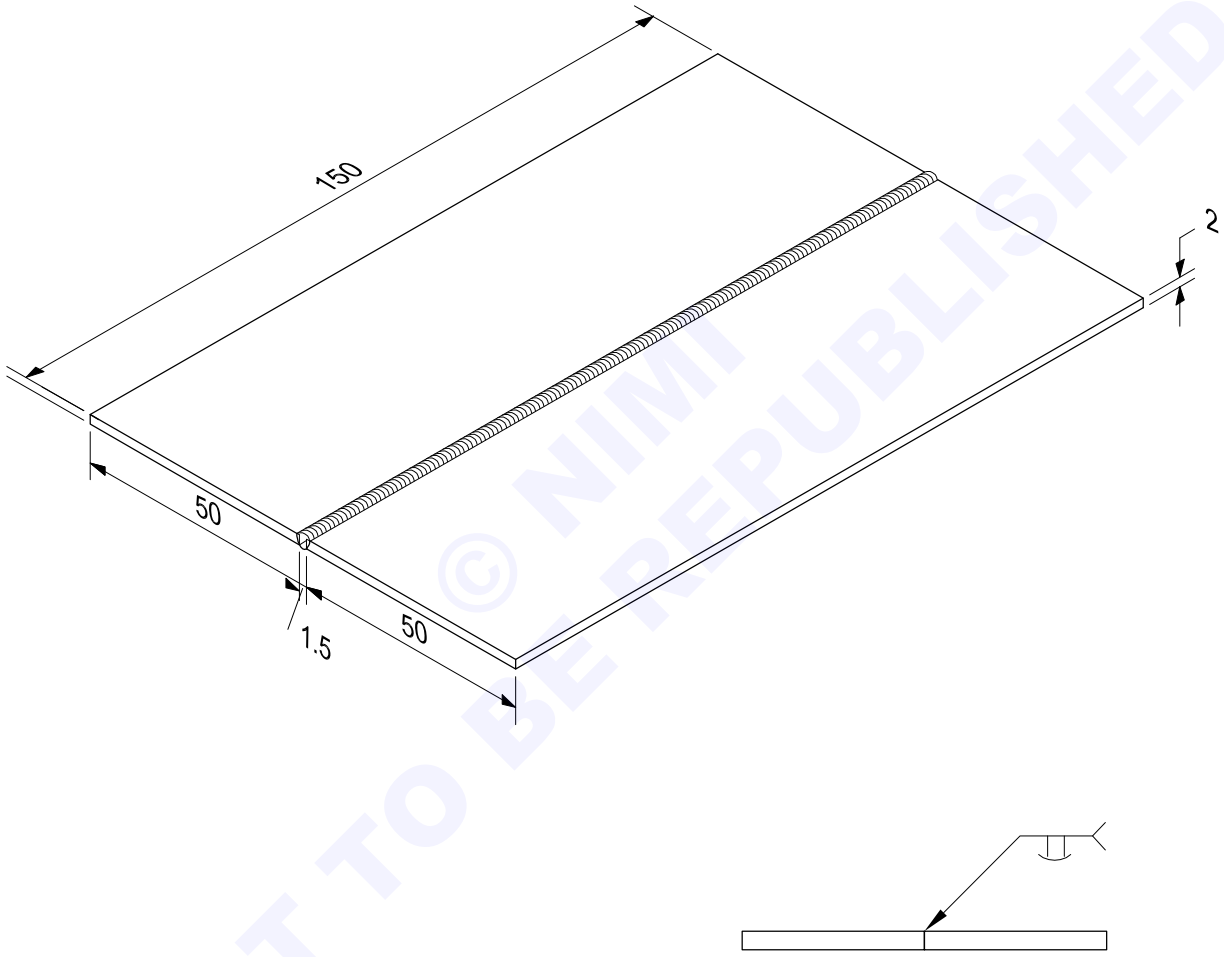
Square butt joint on stainless steel sheet 2mm thick in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **select filler rod, flux and flame**
- **weld the square butt joint by using leftward technique**
- **clean and inspect the weld defects.**



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2	150 x 50 x 2	-	X 04 Cr19 Ni9	-	-	1.3.47
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTTJOINT ON STAINLESS STEEL SHEET 2mm THICK IN FLAT POSITION.	TOLERANCE ±1	TIME
		CODE NO. WG20N1347E1	

Job Sequence

- Prepare the stainless steel sheet as per dimensions.
- Clean the edges of the sheets.
- Select the nozzle No. 5 for 3.15 mm thickness.
- Select the stainless steel flux and apply on both sides of the edges of the joint by using a 12mm paint brush and apply on filler rod.
- Set and align the stainless steel sheet as square butt joint.
- Set perfect neutral flame.
- Tack-weld at every 50mm length of the butt joint.
- Weld the joint using leftward technique.
- Clean the joint and inspect the weld for defects.

Skill Sequence

Square butt joint on stainless steel sheet 2mm thick in flat position

Objective: This shall help you to
- **prepare and weld square butt joint on stainless steel sheet 2mm thick in flat position.**

Prepare the stainless steel sheet as per dimensions given in the sketch.

Use a stainless steel wire brush to clean the edges of the sheets and remove any chromium oxide and other impurities from the edges.

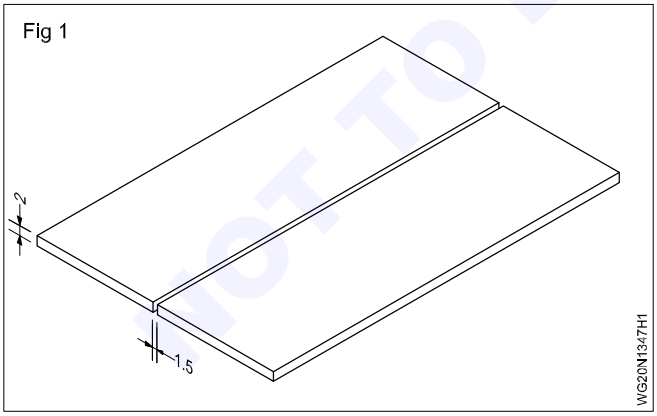
Select nozzle No. 5 and fix on the blowpipe.

Select a 1.6 mm ø specially treated columbium bearing 18/8 type stainless steel filler rod, or cut strips from the base metal to use as filler rod. 18/8 stainless steel means the alloy steel contains 18% chromium, 8% nickel and the balance % is iron, carbon % etc.

Select good quality flux which contains zinc chloride and potassium dichromate; make powdered flux in a pasty form by adding water. Apply the flux on both sides of the plate and filler rod.

Set the sheets as butt joint on a thick metal plate with 1.5 mm gap as shown in Fig 1.

Fig 1

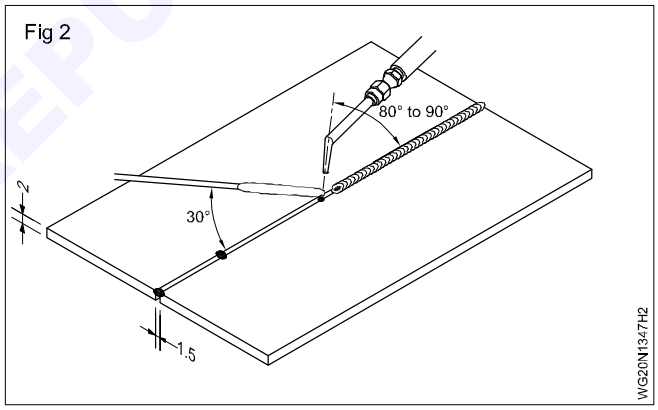


Set a strict neutral flame or slightly carburizing flame so as to prevent the formation of oxidizing flame which is harmful.

Tack-weld on both ends of the joints and for every 50 mm in between them.

Start welding from the right hand side by holding the blow-pipe at an angle of 80° to 90° and the filler rod at 20° to 30°. (Fig 2)

Fig 2



Ensure uniform penetration at the root of the joint.

Finish the weld by filling up the crater at the end of the bead.

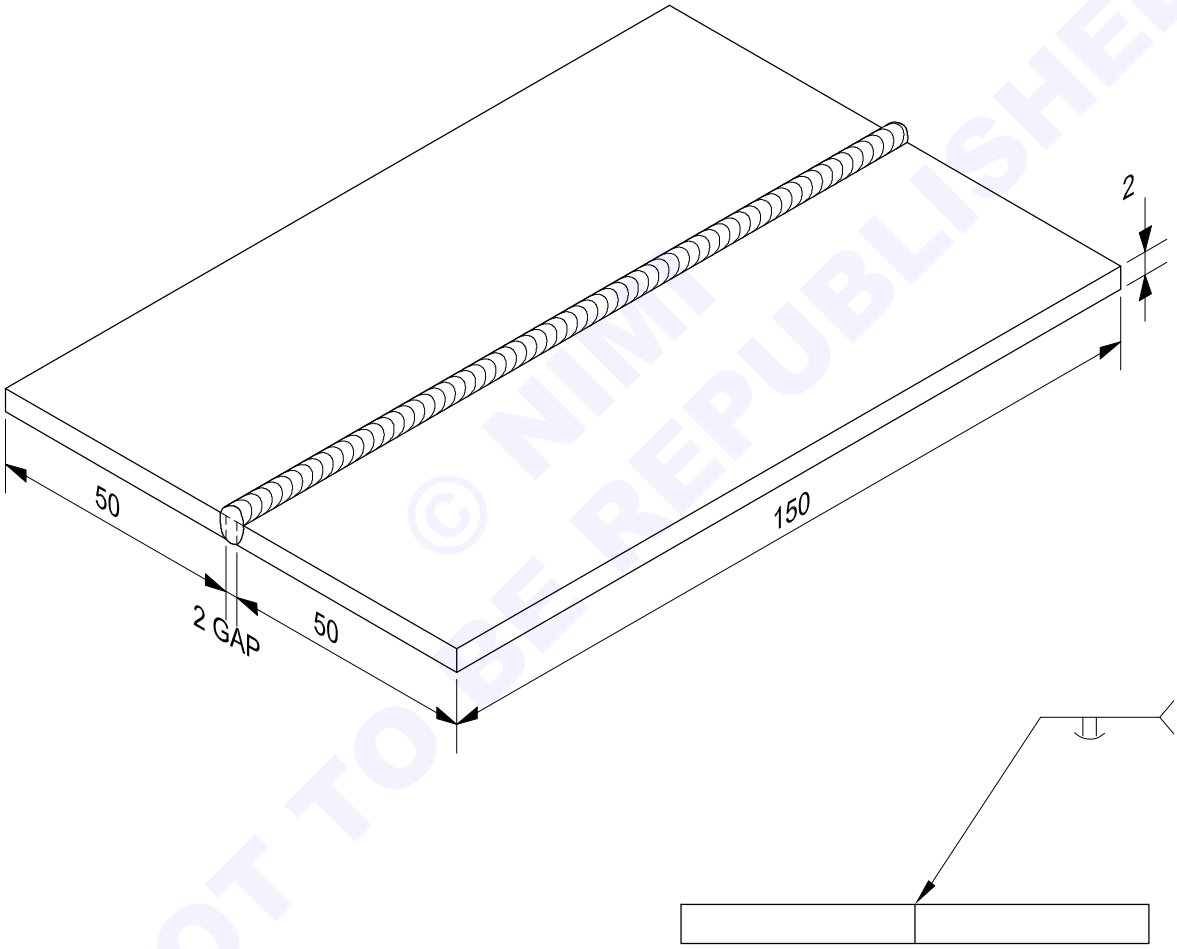
Clean the weld bead and inspect.

Ensure the complete removal of the flux residues.

NOT TO BE REPUBLISHED

Square but joint on stainless steel sheet 2mm thick in flat position (SMAW-24)

Objectives: At the end of this exercise you shall be able to
- **set and tack the stainless steel sheets**
- **select the electrode, polarity and set the current**
- **finish the weld in a single pass**
- **clean and inspect the weld.**



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2	ISST 50 x 2 - 150	-	X 04 Cr 19 Ni 9	-	-	1.3.48
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT JOINT ON STAINLESS STEEL SHEET 2 mm THICK IN FLAT POSITION.	TOLERANCE ±1	TIME
		CODED NO. WG20N1348E1	

Job Sequence

- Prepare square edges.
- Clean the prepared edges.
- Select a 3.15 mm ø stabilized electrode and set 100 amps current.
- Follow necessary safety precautions.
- Set and tack the pieces.
- Place copper chill plates on the job by the side of the joint.
- Keep the current low to reduce over heating of the electrode and job.
- Complete the weld in a single pass without weaving.
- Clean the weld and inspect the bead for surface defects.
- Use stainless steel wire brush and separate hand gloves for stainless steel welding. This helps to avoid ferrous contamination and corrosion.

Skill Sequence

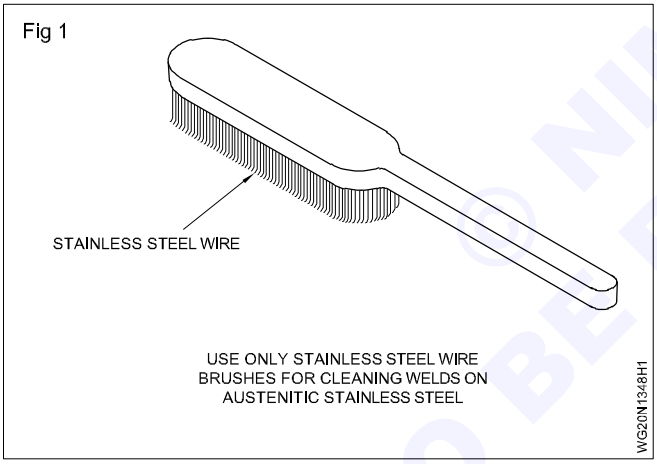
Square butt joint on Stainless steel sheet 2mm thick in flat position

Objective: This shall help you to
- **prepare and weld square butt joint on stainless steel sheet 2mm thick in flat position.**

Prepare square edges by filing.

Remove burrs from the edges, and clean the edges with a stainless steel wire brush and remove the surface impurities. (Fig 1)

Fig 1



Take a 3.15 mm ø stainless steel electrode and connect it to the positive side of the DC machine.

Columbium based electrodes (called stabilized stainless steel electrode) are used to avoid the welded joint getting corroded/rusted after welding.

Set the cleaned stainless steel plates on the work table with a uniform root gap of 2 mm as shown in Fig 2 and tack them at every 50 mm.

Clean the joint thoroughly to remove slag from the tacks.

Clamp chill plates adjacent to the joint to minimize distortion and buckling. (Fig 3)

To prevent damaging the metal surface, the polished side of a sheet should be placed down.

Fig 2

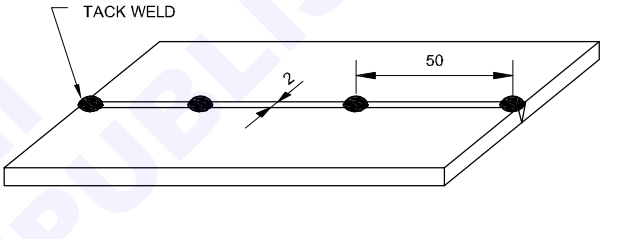
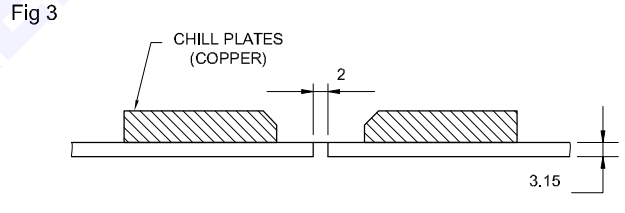


Fig 3



Keep the current as low as possible to reduce overheating of the job.

Start welding at the left hand side of the joint and maintain a short arc.

Do not weave the electrode.

The electrode angle must be 70° to 80° in the direction of the weld.

Maintain a high welding speed to avoid over-heating of the plate edges.

Finish the welding at the right end of the plate.

Deslag and clean thoroughly with a stainless steel wire brush.

Inspect for surface defects.

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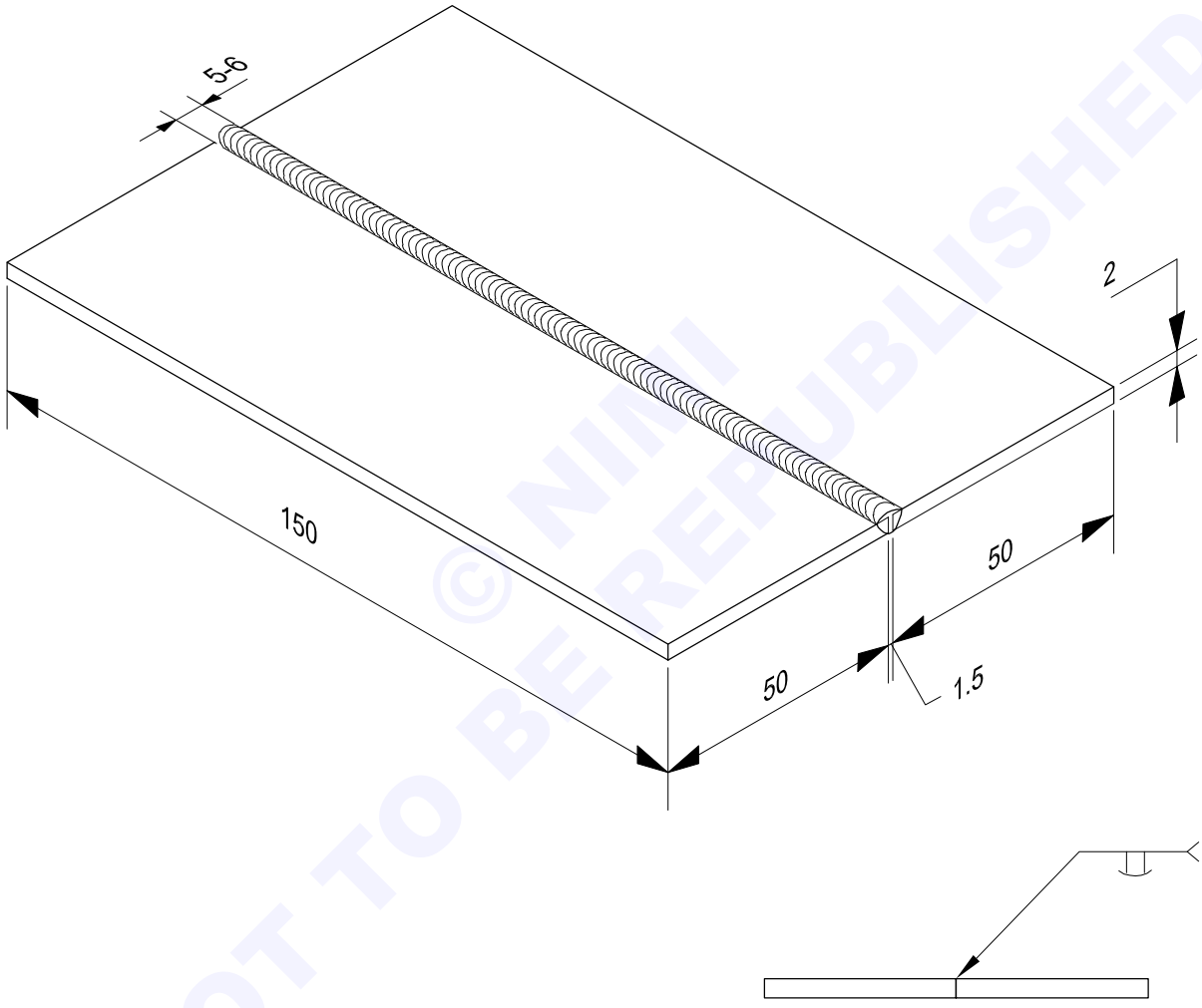
Square butt joint on brass sheet 2mm thick in flat position (OAW-18)

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **select filler rod nozzle gas pressure and flux**
- **set the oxidizing flame and tack weld**
- **weld the joint in flat position**
- **clean and inspect the weld defects.**



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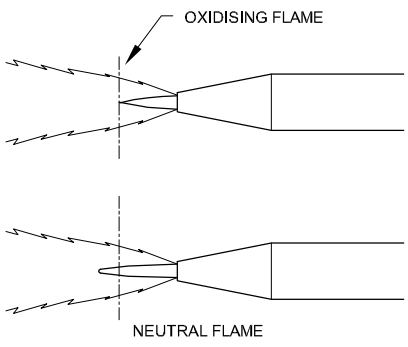
2	150 x 50 x 2	-	CuZn30-O IS:2378	-	-	1.3.49
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT JOINT ON BRASS SHEET 2 mm THICK IN FLAT POSITION.	TOLERANCE ±1	TIME
		CODE NO. WG20N1349E1	

Job Sequence

- Prepare the brass sheets as per dimension given in the sketch.
- Deburr the edges of the sheet.
- Clean the surfaces of the sheet and remove oxides if any.
- Select nozzle No. 5 and set 0.15 kg/cm^2 pressure for both the gases.
- Select a silicon-bronze rod of 1.5 mm ø.
- Select brass flux (borax type). Apply the flux by dipping the hot end of the filler rod in the powdered flux from time to time.
- Set and align the plates with a root gap of 1.5 mm.
- Set a soft oxidizing flame. (Fig 1)
- Slightly preheat the plates before tacking and tack weld using 1.5mmø filler rod. The pitch of tacks should be 50mm.
- Adopt leftward technique.

Fig 1



OXIDISING FLAME FOR BRASS

- Add the filler rod more rapidly as welding approaches the end of the seam. Fill the crater.
- Ensure complete removal of all flux residue.
- Clean the weld bead and inspect.
- Avoid inhaling zinc oxide fumes using a respirator.

Skill Sequence

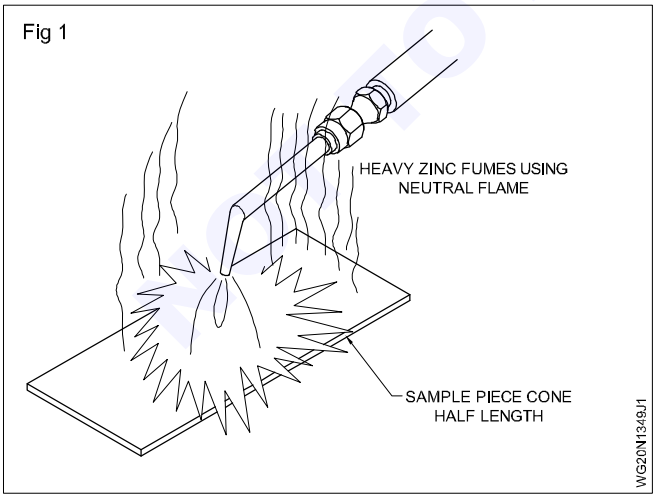
Square butt joint on brass plate 2mm thick in flat position

Objective: This shall help you to

- **prepare and weld square butt joint on brass plate 2mm thick in flat position.**

Set a neutral flame and play over the sample brass piece. White zinc fumes will be seen. Then reduce the acetylene gas by operating the acetylene control valve in the blowpipe until the white fumes disappear. This is the required oxidizing flame for the particular brass sheet to be welded. (Fig 1)

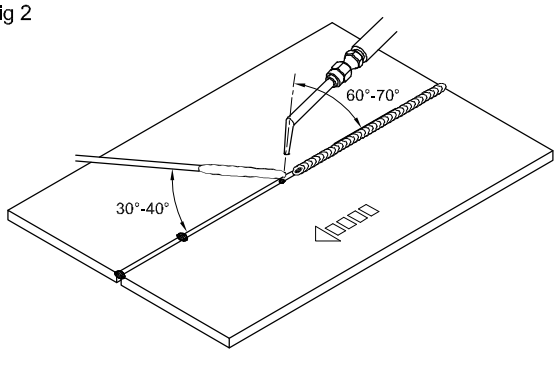
Fig 1



Commence welding at right side end and continue until the joint is completed. The filler rod is fed into the pool as the surface sinks, indicating that penetration is being achieved.

The inner cone of the flame is held fairly close to the surface of the weld. Keep the angle of the blowpipe at 60°-70° and filler rod at 30°-40°. (Fig 2)

Fig 2



Reduce the blowpipe angle or withdraw entirely to reduce heat input at the crater.

A respirator is to be used to avoid inhaling of toxic zinc fume coming out of the brass sheet.

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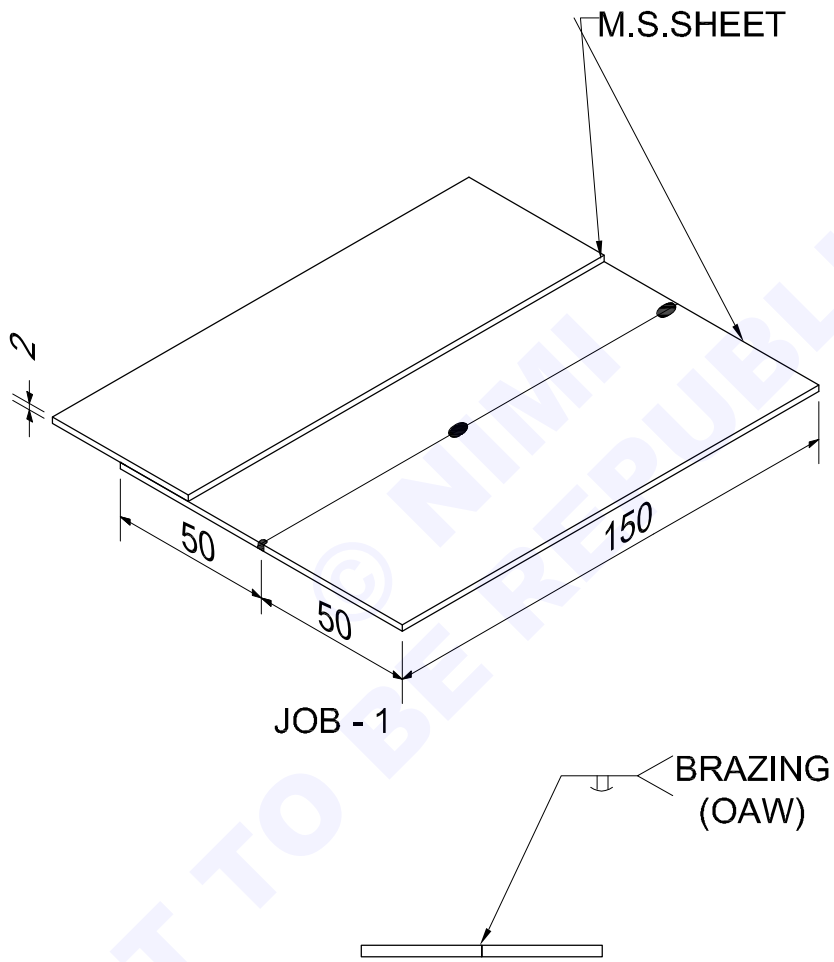
Square butt and lap joint on M.S. sheet 2mm thick by brazing in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **select filler rod,flux and oxidizing flame**
- **braze the butt and lap joint in flat position**
- **clean and inspect the weld defects.**



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3	ISST 50 x 2 - 150	-	Fe310 - W	-	-	1.3.50
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT AND LAP JOINT ON M.S SHEET 2MM THICK BY BRAZING	TOLERANCE ±1	TIME
		CODE NO. WG20N1350E1	

Job Sequence

- Cut the sheets as per drawing and file the edges to be joined square.
- Clean the joint area.
- Set the sheets as a square butt joint without root gap
- Select nozzle, filler rod, gas pressures, flux.
- Set oxidizing flame.
- Use leftward technique.
- Preheat the sheets and joint area to about 800°C.
- Dip the hot filler rod in flux and melt the filler rod into the joint ensuring proper wetting conditions.
- Avoid application of too much heat into the joint.
- Finish the joint in one run only.
- Clean the joint and inspect for weld defects like porosity etc, and for slight root penetration and proper bonding.
- Prepare a copper and a brass tube as per dimension.
- Clean and remove the surface oxides by wire wool.
- Select the nozzle No. 5 and 1.6mmø silicon bronze filler rod.
- Apply flux to the filler rod.
- Set the oxidizing flame.
- Manipulate the blowpipe and filler rod with flux applied on it using proper angles to fill the bell mouthed groove.
- Clean and remove the flux residue.
- Inspect for external weld defects.

Skill Sequence

Brazing of square and lap joint on MS sheet of 2mm thick

Objective: This shall help you to
- **prepare and brazing of square and lap joint on MS sheet of 2mm thick.**

Brazing of MS sheet (Job-1)

Oxidizing flame is used to avoid evaporation of zinc while brazing. Fig 1

The blow pipe and filler rod is held at angles as shown in Fig 1.

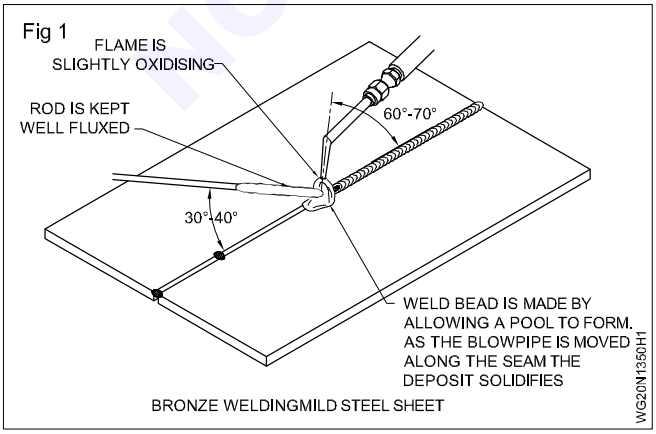
A No. 3 size nozzle with 0.15 kg/cm^2 pressure for both gases is used as the base metal is not melted, but heated to around 800°C.

A 1.6mmø silicon bronze filler rod is used which helps free flow of molten filler metal.

Direct the flame to the joint edges and tack weld at the ends and center of the joint. Fig 1.

Preheating the sheets to the correct temperature helps in proper wetting/spreading of the filler metal into the joint to get good bonding. Fig 1

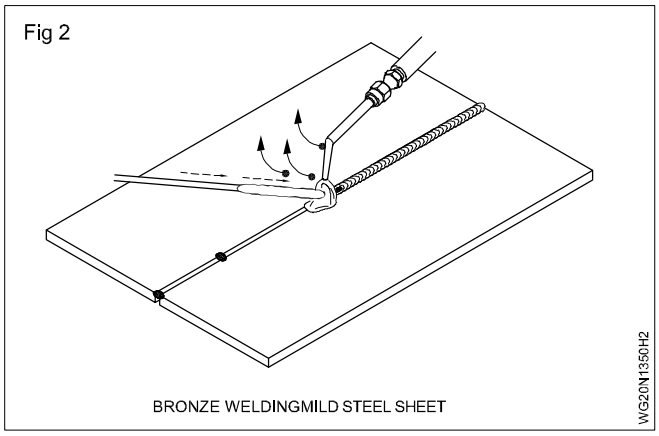
Fig 1



The flame has to be directed only on the melting filler rod or the weld deposit in order to prevent oxidation or over-heating of MS sheet.

After establishing the molten pool, the flame is withdrawn slightly (Fig 2) to permit the deposited metal freeze partially. Again reintroduce the filler rod to melt further deposit. Observe the brazed area carefully to ensure proper bonding is obtained and a uniform weld size is achieved.

Fig 2



To avoid crater at the end of the weld the filler rod is continued to be added into the molten pool at the finishing point and the flame is withdrawn.

It is essential to remove any unused and residual flux on the finished weld to avoid corrosion later on.

Check the joint for proper bonding of filler metal with the base metal and proper root penetration by the filler metal. Check for weld defects like surface porosity, etc.

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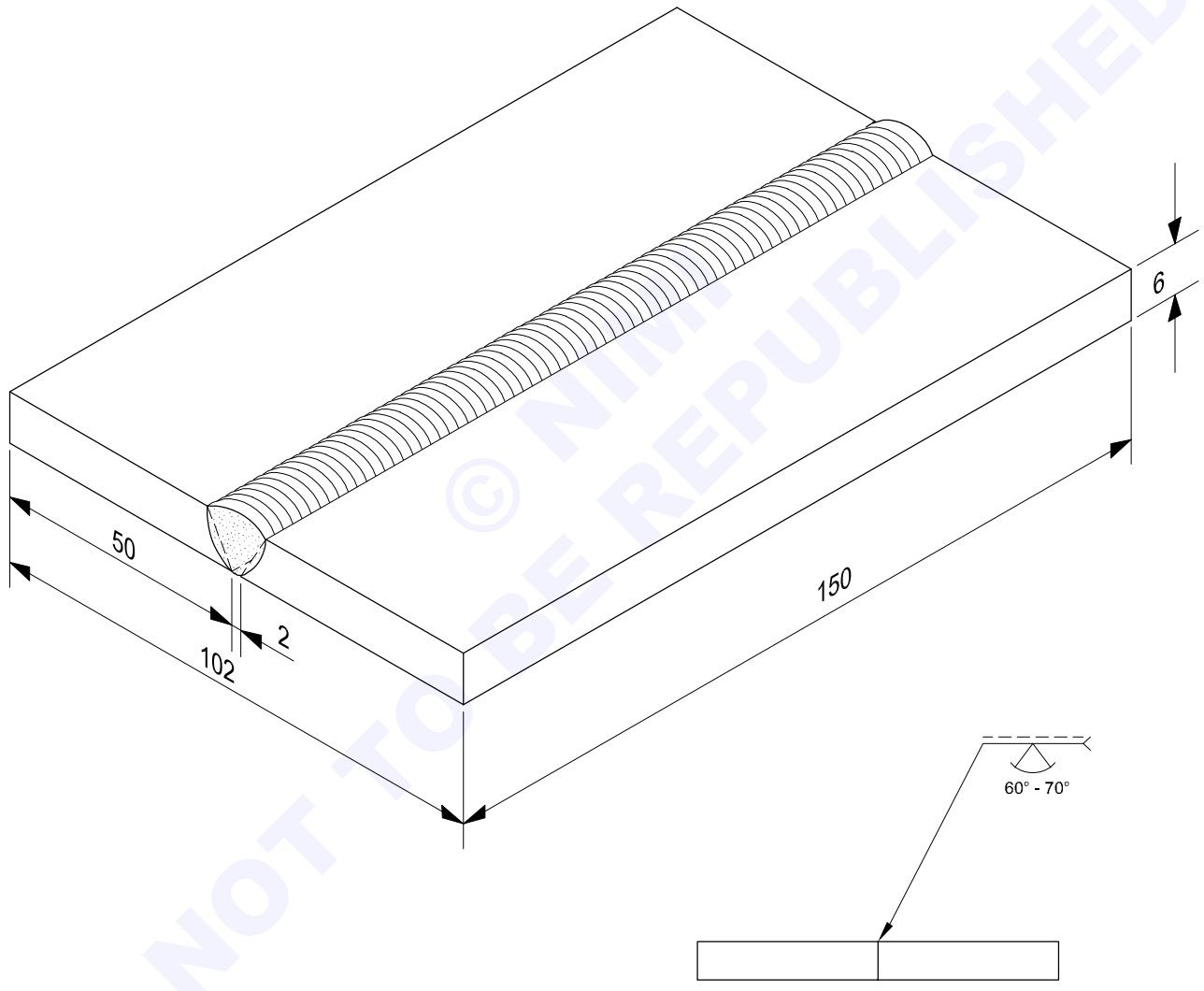
Single "V" butt joint on cast iron plate 6mm thick in flat position

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

- **prepare the edges, set the cast iron plates and tack weld**
- **preheat and post heat the joint**
- **select the electrode and set the current**
- **deposit root run, second and third runs**
- **inspect the joint for defects.**



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2	150 x 50 x 6	-	FG 15	-	-	1.3.51
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SINGLE "V" BUTT JOINT ON CAST IRON PLATE 6mm THICK IN FLAT POSITION (1G)-(SMAW-25)	TOLERANCE ±1	TIME
		CODE NO. WG20N1351E1	

Job Sequence

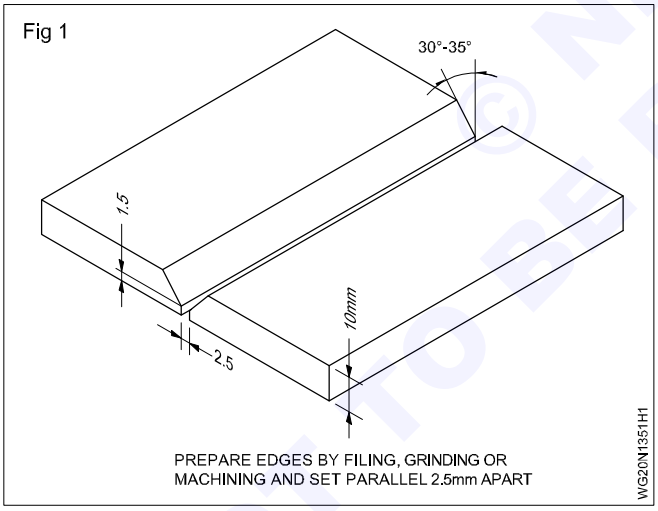
- Bevel the edges to 30° angle by grinding (or) filing maintain root face to 1.5mm.
- Keep the plates in alignment in flat position maintain a root gap of 2.50mm.
- Select low hydrogen type E7016 (or) E7018 electrode 3.15mm size and use DCEP polarity i.e., connect the electrode cable to the +ve terminal of the machine.
- Follow necessary safety precautions.
- Preheat the job to 300°C using a oxy-acetylene torch and check the temperature using a thermo chalk and tack weld on both ends using low hydrogen electrode.
- Keep the tack welded joint in flat position.
- Deposit the root run using ø3.15mm low hydrogen M.S. electrode ensuring root penetration.
- Clean the root run. Deposit 2nd and 3rd run using slight weaving and digging motion.
- Maintain minimum interpass temp 200°C throughout and also peen the weld bead by ball pein hammer to remove internal stress concentration for every run.
- Post heat the job if required and cover it in dry sand or ash to allow to cool slowly.
- Clean the weld and inspect it for cracks, proper fusion and other surface defects.

Skill Sequence

Single 'V' butt joint on cast iron plate

Objective: This shall help you to
- **prepare and weld single 'V' butt joint on cast iron plate.**

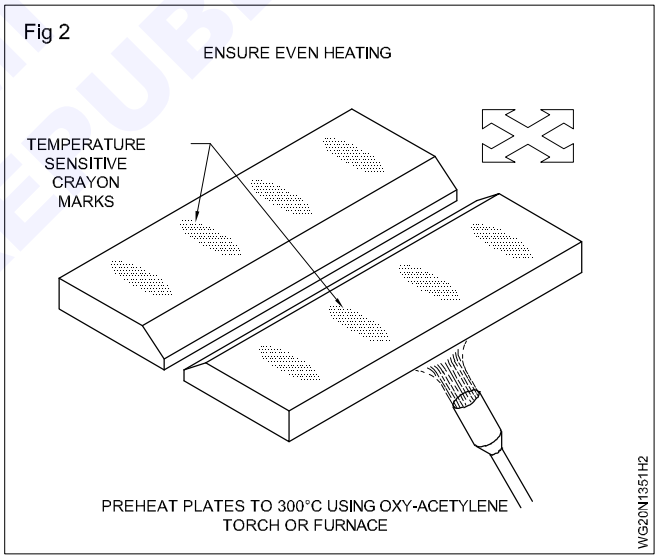
Bevel the edges: Bevel the edges to 30° angle by machining or filling. Maintain the root face 1.5 mm (Fig 1) avoid sharp edges as it may get chipped off if not handled properly.



Set and tack weld: Keep the job parallel in flat position and maintain the root gap 2.5 mm.

Preheat the job: Preheat the job at 300°C by using an oxy-acetylene flame. (Fig 2) Check the temperature by using a thermo chalk. (Figs 3a & 3b) Tack weld on both ends. (Fig 4)

Deposition of runs: Select a M.S. electrode (low hydrogen) 3.15 mm dia. and set the current at 130-140 amps with DCEP. (Electrode +ve) Deposit root run with electrode angle of 80° to the line of weld with medium arc length. AVOID SHORT ARC.



Clean the root run by a wire brush. Deposit the second the by using a 3.15 mm dia. electrode with slightly weaving motion and keep the electrode angle 80° to the line of weld. Move the electrode with a digging action. Since fluidity of cast iron is less, to make the molten metal to flow into the joint easily the electrode has to be given a digging action.

Clean the second run by a wire brush.

Deposit the third run by using a 3.15 mm dia. electrode with a slight weaving motion. Keep the electrode angle at 80° to the line of weld. Peen the welded bead by a ball pein hammer to remove internal stresses. Post heat the job to preheating temperature. Keep the job under dry sand or ash and allow to COOL SLOWLY. Clean the weldment by using a wire brush.

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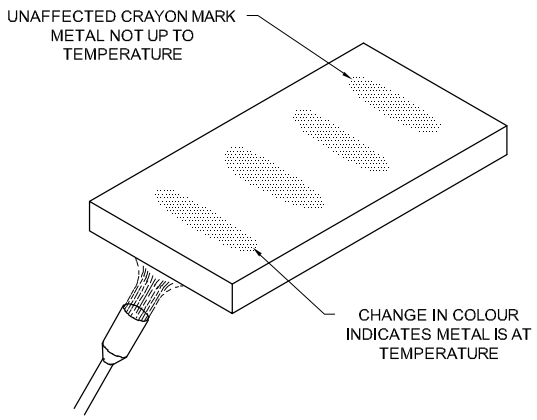
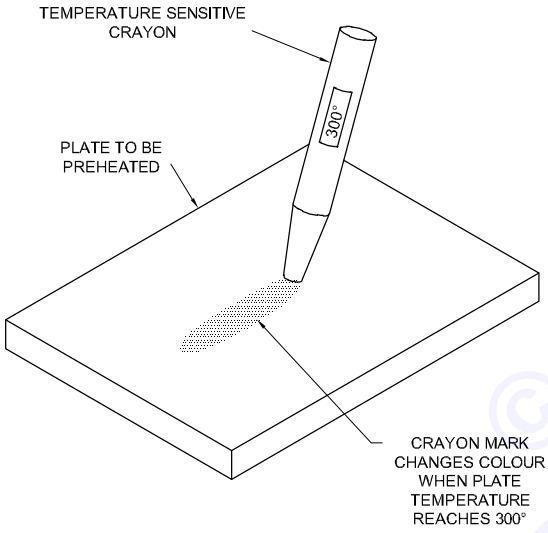
Fig 3



USE OF TEMPERATURE SENSITIVE CRAYON
FOR TEMPERATURE MEASUREMENT

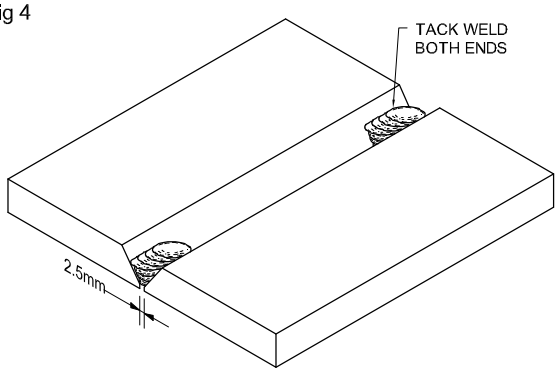
(3a)



TEMPERATURE SENSITIVE CRAYON

(3b)

Fig 4



PREPARED PLATES SET UP FOR A SINGLE-V BUTT JOINT

The use of low hydrogen electrode and the preheating, post heating, peening and slow cooling are essential to avoid cracks in the cast iron joint.

Inspect the welds: Inspect the welds for proper fusion, cracks and other surface defects.

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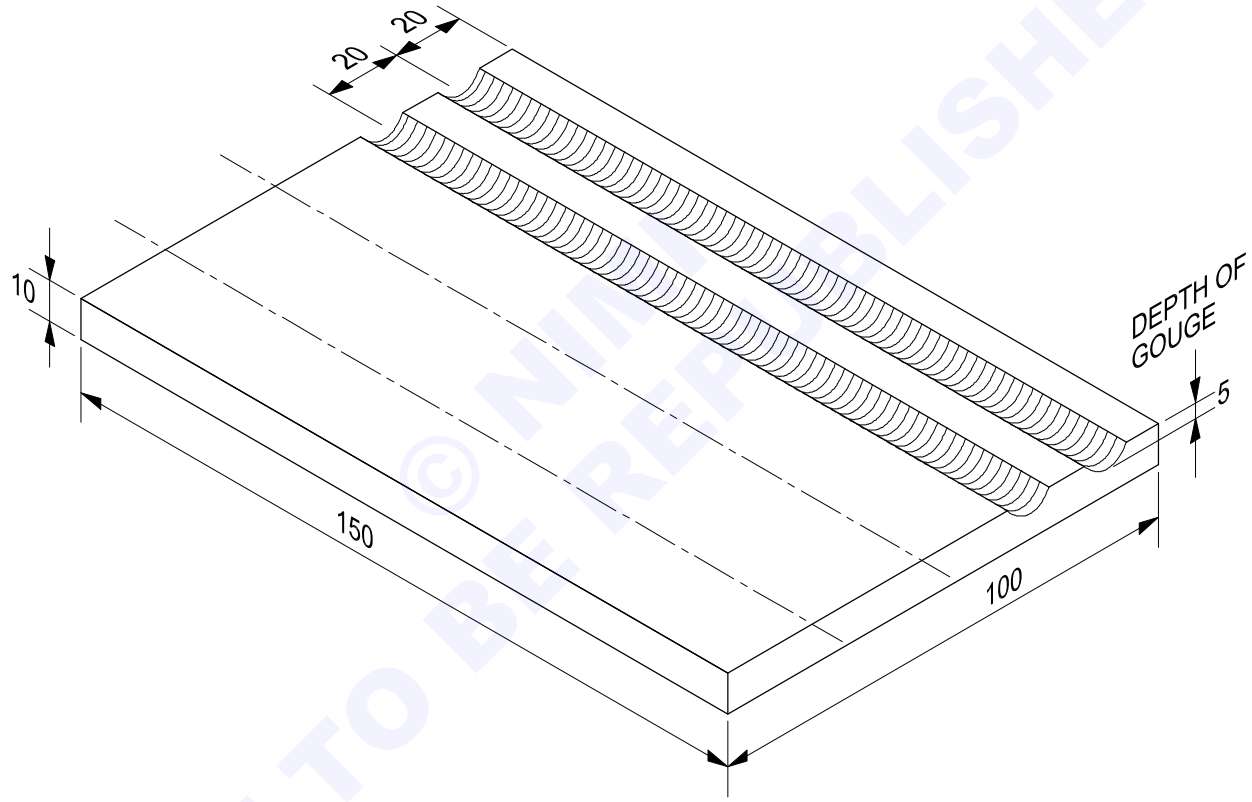
Arc gouging on MS plate 10mm thick

Objectives: At the end of this exercise you shall be able to
- **select the electrode and set the current as per requirements**
- **start and maintain gouging action**
- **clean and inspect the gouging.**



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1	100 ISF 10 - 150	-	Fe310 - W	-	-	1.3.52
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	ARC GOUGING ON M.S.PLATE 10mm THICK IN FLAT POSITION.	TOLERANCE ±1	TIME
		CODE NO. WG20N1352E1	

Job Sequence

- Mark and cut the pieces as per the given size.
- Mark and punch the straight line.
- Keep the plate in down hand position.
- Use 4mm dia electrode for 10mm thick plate and select DC electrode negative (DCEN).
- Set 300 amps current for both AC or DC machines and select DCEN if DC is used.
- Start from edge of the plate keeping a slant angle.
- When molten metal is established reduce the angle further to gouge and remove surface metal.
- While gouging is in progress remove molten metal and slag away from the arc and gouged groove.
- Move the electrode fast and control the gouging action.
- Complete the operation and clean the gouging surface.
- Inspect the groove for smoothness, even depth and uniformity.

Skill Sequence

Arc gouging on MS plate 10mm thick in flat position

Objective: This shall help you to
- **prepare and do the arc gouging on MS plate 10mm thick in flat position.**

Prepare the pieces: Mark and cut the pieces as per given sizes by gas cutting. Clean the surfaces. Mark and punch a straight line.

Position the plate down hand or flat.

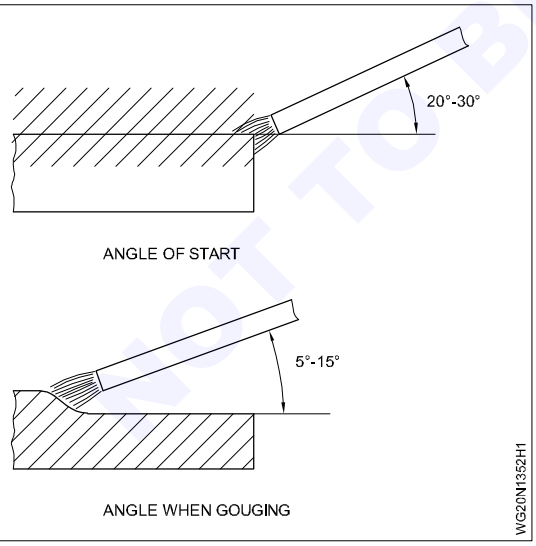
Select the electrode and set the current.

Select a 4 mm dia. gouging electrode for a 10 mm thick plate.

Set 300 amps current in AC or DC m/c and if DC is used set the (straight polarity) electrode negative (DCEN).

Gouging the plate: Point the electrode towards one end of the edge with an angle of 20°-30° and 90° to the rear surface of the plate. (Fig 1)

Fig 1



Strike the arc.

Wear a respirator while gouging.

As the molten pool is established, lower the electrode holder and reduce the angle between 5°-15° from 20°-30°.

Move the electrode along the line of marking from the right to the left side of the plate without side movement.

While gouging is in progress push the molten pool and slag away from the arc and the gouged groove.

Due to rapid fusion because of the arc, heat, move the electrode fast and control the gouging operation.

Ensure that the angle of slope is not too steep, and avoid grooving too deeply.

Use safety boots and leg guards to protect the legs.

Maintain the angle and travel of electrode constant so as to obtain a groove of uniform width and depth.

Clean the gouging surfaces.

Inspect the gouging.

Check the smoothness, depth and uniformity of gouging.

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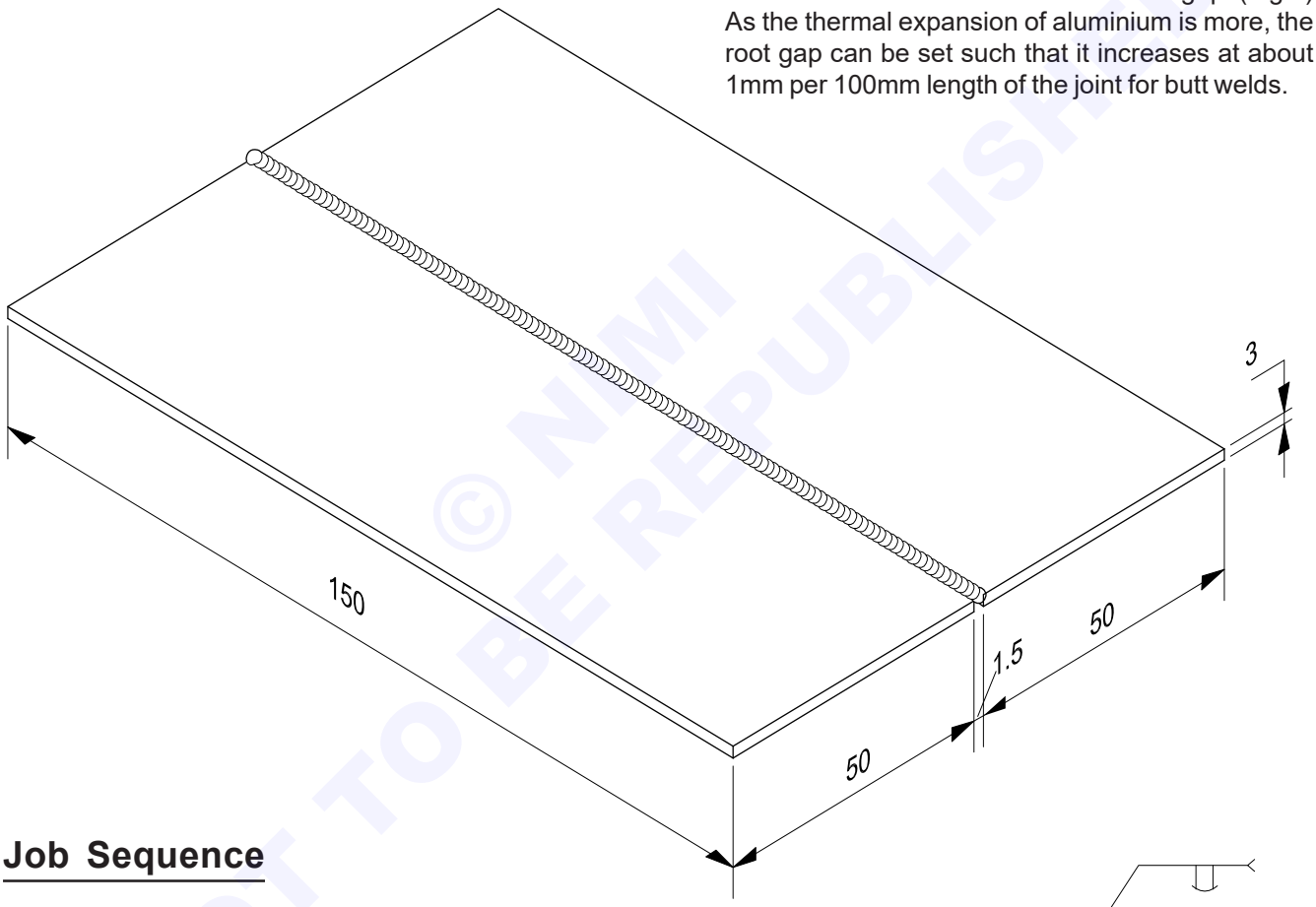
Square butt joint on aluminium sheet 3mm thick in flat position

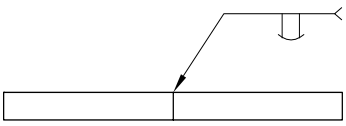
Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **select filler rod, nozzle, gas, pressure and flux**
- **set the flame and tack weld**
- **deposit aluminium bead in flat position**
- **clean and inspect the weld defects.**

- Don't grind aluminium sheets in a grinding machine.
- Apply the pasty flux on the butting edges.
- Set the sheets with 1.5 mm - 2 mm root gap. (Fig 1) As the thermal expansion of aluminium is more, the root gap can be set such that it increases at about 1mm per 100mm length of the joint for butt welds.



Job Sequence

- Prepare aluminium sheet as per dimension with square edges.
- Clean the surface and edges of the sheets to remove the surface oxide and other impurities using stainless steel wire brush/solvent.



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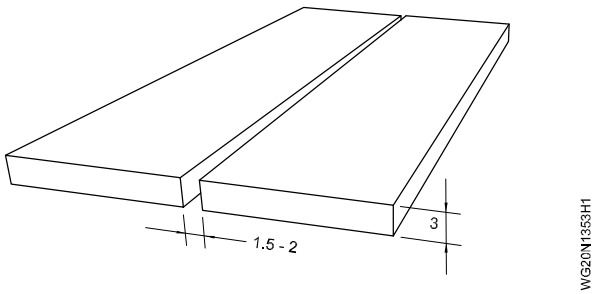
2	150 x 50 x 3	-	AL.199990-IS:737	-	-	1.3.53
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

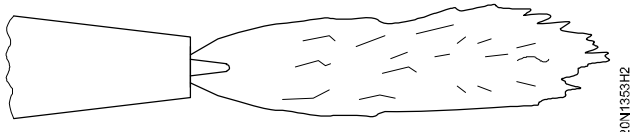
SCALE NTS	SQUARE BUTT JOINT ON ALUMINIUM SHEET 3mm IN FLAT POSITION.	TOLERANCE ±0.5	TIME
		CODE NO. WG20N1353E1	

Fig 1



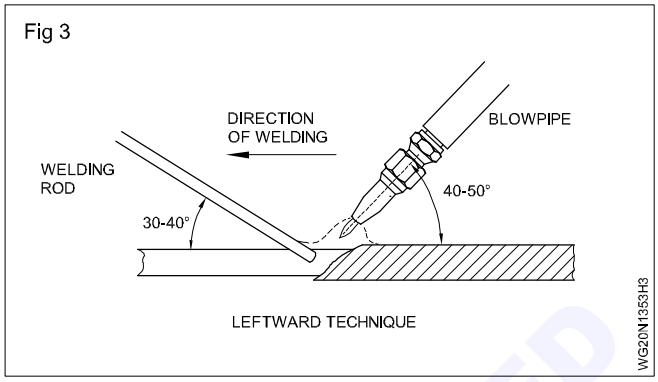
- Fix nozzle No. 5 on the blow pipe and adjust gas pressure of 0.15 kg/sq.cm^2 for both gases.
- Adjust a strict neutral flame. (Fig 2)

Fig 2



- Use silicon aluminium filler rod 3 mm ø and apply the pasty flux on the filler rod.
- Tack-weld at both ends of the joint and at the center.
- Preheat the job to a temperature of 150° - 180°C to reduce the effect of expansion during welding using the blow pipe flame itself.
- Start welding by the leftward technique by holding the blowpipe at an angle of 40° to 50° and the filler rod at an angle of 30° - 40°. (Fig 3)
- Do not remove the filler rod end from the outer envelope of the flame till the welding is over.

Fig 3



- Clean the weld by washing in a 10% sulphuric acid solution.
- Again wash the weld by rinsing in hot or cold water.
- No traces of flux should remain on the weld. It will cause corrosion, after completion of the weld.
- Inspect for weld defects.
- As the end of the joint is approached, reduce the blow pipe and filler rod angle and raise the inner cone. This is done to avoid burn through of the joint.

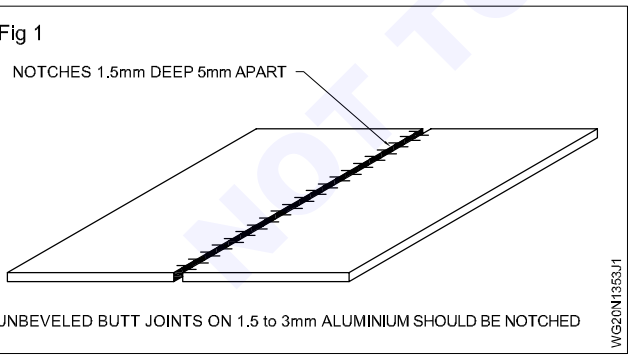
Skill Sequence

Square butt joint on aluminium sheet of 3mm thick

Objective: This shall help you to
- **prepare and weld square butt joint on aluminium sheet of 3mm thick.**

While preparing square edges make notches on the edges to be joined. Fig 1

Fig 1

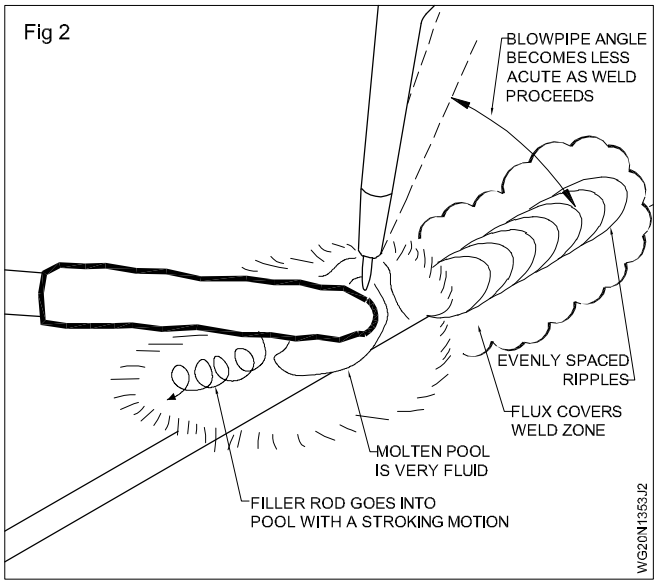


Since setting a strict neutral flame is difficult a very slight carburizing flame is set for welding aluminium.

While using leftward technique, the blow pipe angle will be reduced gradually as the welding progresses. Fig 2.

As there is no colour change when aluminium melts, watch carefully for any shrinking of oxide film on the surfaces of the base metal which indicates the starting of base metal melting.

Fig 2



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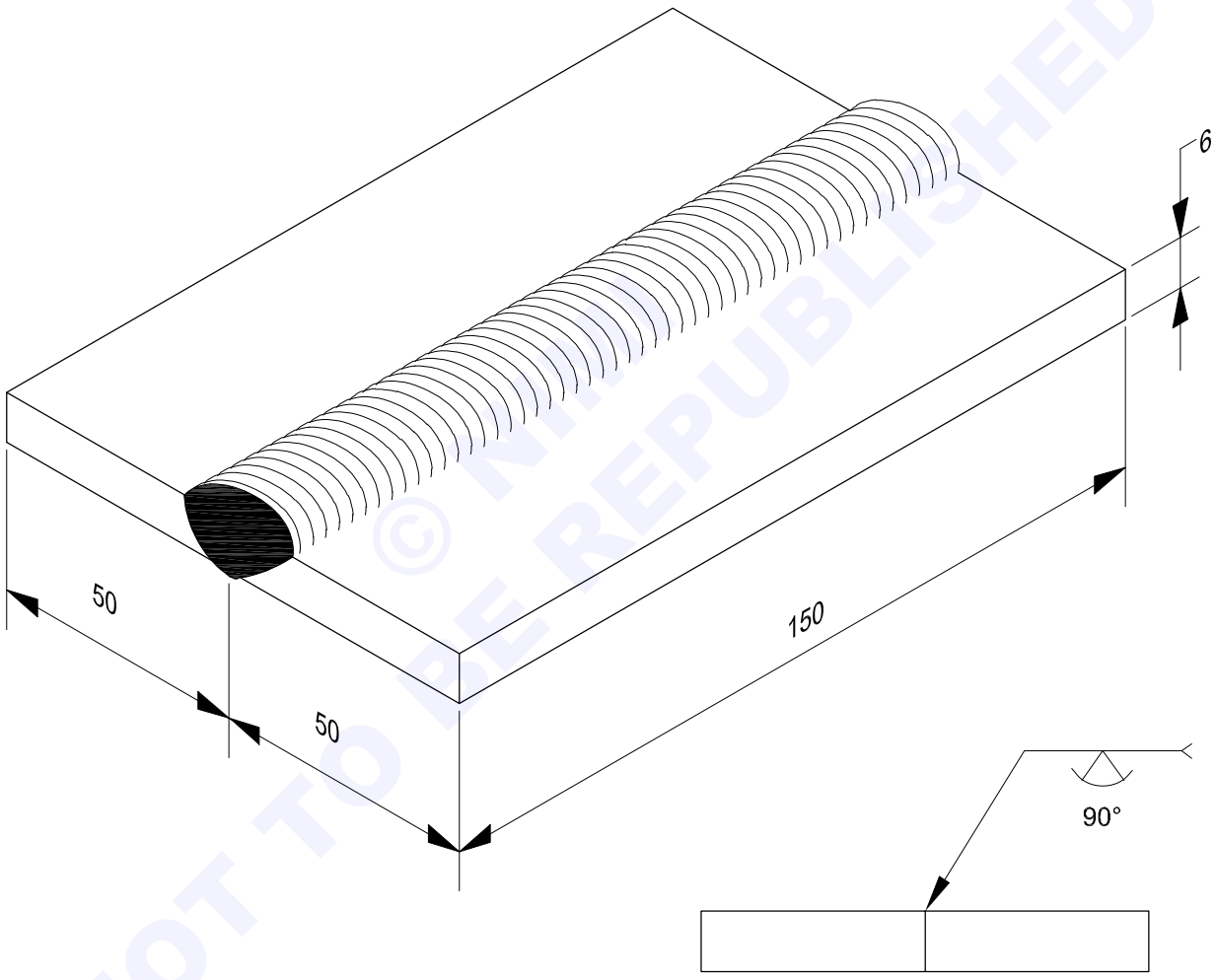
Bronze welding of single "V" butt joint on cast iron plate 6mm thick plate

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

- **prepare the job as per drawing**
- **select the correct nozzle size and filler rod (composition and size)**
- **set a slightly oxidized flame**
- **deposit weld bead by following welding procedure**
- **clean and check for defects on the weldment.**



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2	150 x 50 x 6	-	FG15	-	-	1.3.54
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	BRONZE WELDING OF SINGLE 'V' BUTT JOINTON 6 mm THICK CAST IRON PLATE IN FLAT POSITION.	TOLERANCE ±1	TIME
		CODE NO. WG20N1354E1	

Job Sequence

- Clean the surface of the work piece from oil, grease, dirt and remove oxides if any by filing/grinding.
- Grind the edges of the plate to (no feather edge) form a single V of included angle of 90°. Round off all sharp edges.
- Select nozzle No.10.
- Select a silicon bronze filler rod of 3mmø for the root run and 5mmø for the 2nd run.
- Select bronze flux and 0.15 kg/cm^2 pressure for both gases.
- Ensure all safety precautions before lighting the torch.
- Set a soft oxidizing flame.
- Apply flux in powder form by dipping hot filler rod. Then tack weld on both ends of the joint with a uniform root gap of 2.5mm.
- Weld the root run using leftward technique and 3mmø filler rod keeping the job at 30° slope.
- Ensure wetting of weld faces by the filler metal before building up the bead.
- Heat the weld faces only to dull red color by giving circular motion to the blow pipe.

It is not necessary to melt the base metal for bronze welding of cast iron.

- Clean the root run and deposit the 2nd run using 5mm filler rod after applying flux.
- Fill the joint by filler metal to get a maximum of 1.5mm reinforcement, good ripple formation.
- Clean the joint removing any flux residue and inspect for defects.
- Heat control is important. If the heat is insufficient the bronze metal will not wet the surface or flow properly.
- Excess heat will cause the bronze metal to flow more freely and not allow it to build up.

Skill Sequence

Bronze welding of single 'V' butt joint on cast iron plate of 6mm thick

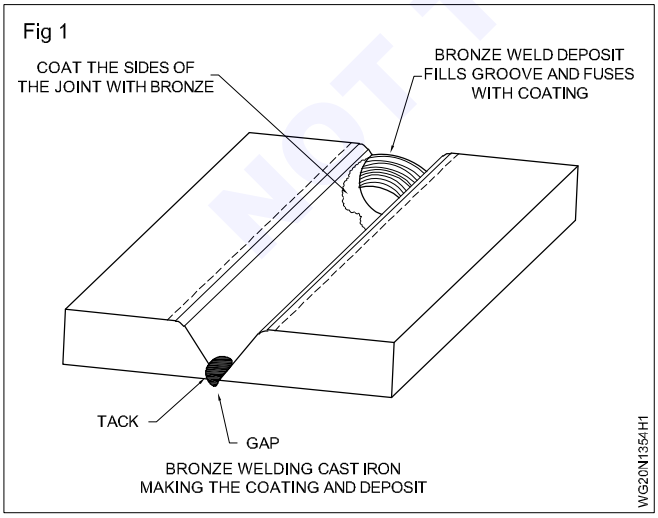
Objective: This shall help you to
- **prepare and bronze welding of single 'V' butt joint on cast iron plate of 6mm thick.**

Set the job with 30° inclinations. Keep the angle of the filler rod at 30° to 40° and give a rubbing action to the filler rod on the V.

Maintain the angle of the blowpipe at 60° to 70° and give a circular motion to the blowpipe. (Fig 2)

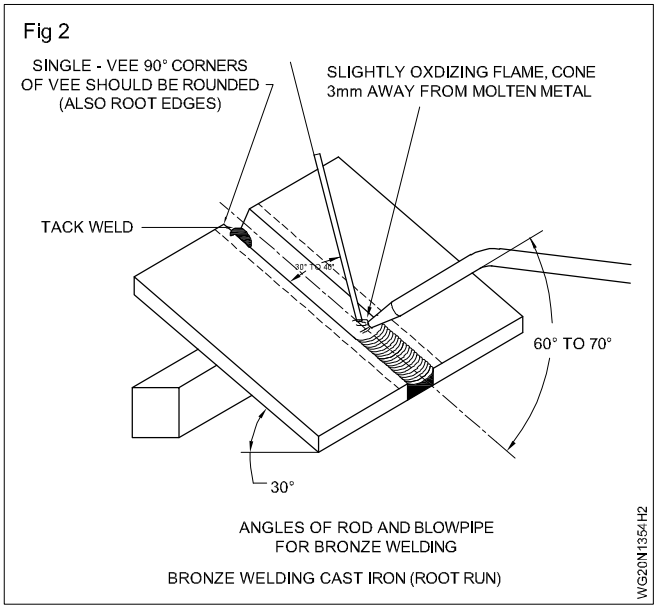
Deposit a root run with a 3mmø filler rod and the finishing run with a 5mmø filler rod. Dip the hot filler rod end into the powdered bronze flux frequently.

Fig 1



In bronze welding of cast iron the base is only heated to 650°C and it is not melted. So while depositing the root run the surfaces of the joint is coated with a layer of filler metal for about 20mm along the joint, ensuring that it is correctly bonded. Fig 1.

Fig 2



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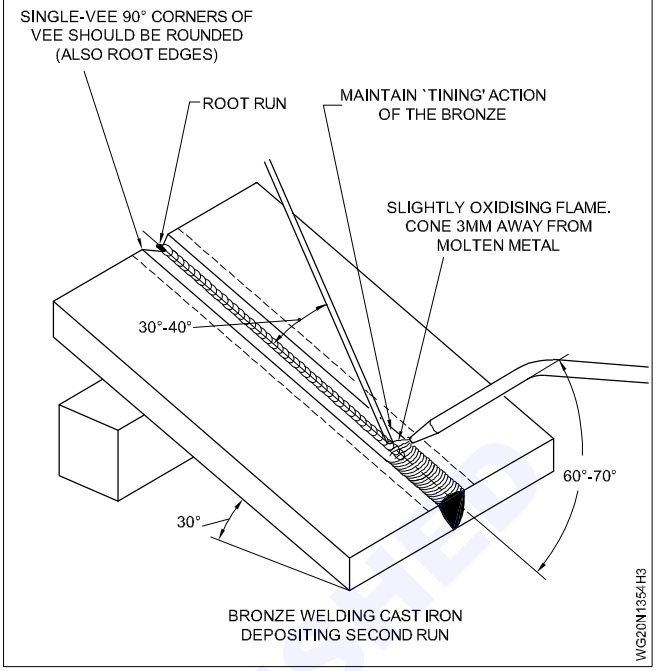
Then return to the starting point and add sufficient filler metal to produce a satisfactory weld. This method is repeated continuously until the root run is completed. Fig 2 Ensure root penetration by the filler metal and fusion between consecutive bronze filler metal deposits.

Weld similarly the 2nd run by using 5mmø filler rod dipped in flux with a soft oxidizing flame and get 1.5mm reinforcement and good bead up to the end of the joint. Fig 3.

Clean the bead and remove the flux residue on both sides of the joint.

Inspect the joint for weld defects like porosity, incomplete penetration etc.

Fig 3



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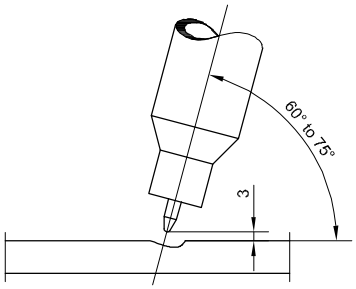
Familiarisation with the machinery used in trades

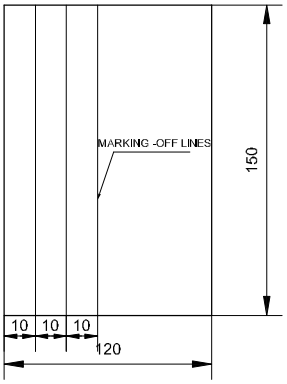
Objectives: At the end of this exercise you shall be able to
- **name the machinery used in welding shop**
- **record the name and its uses of each machine in given table.**

Fig 1

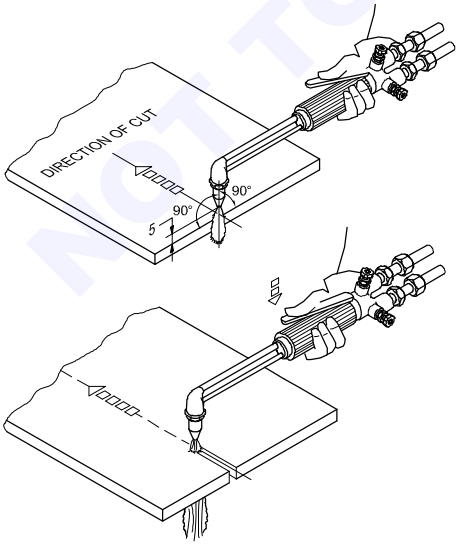
(1)



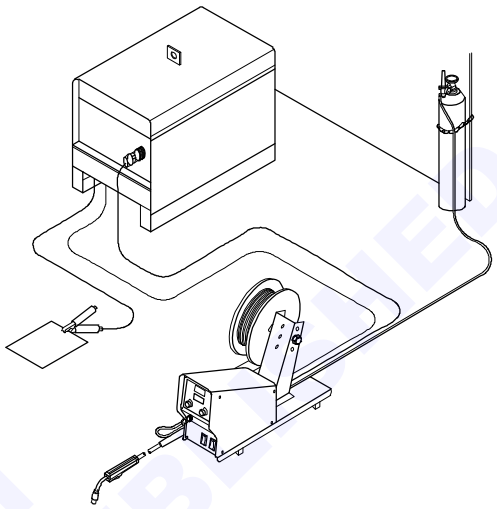
(2)



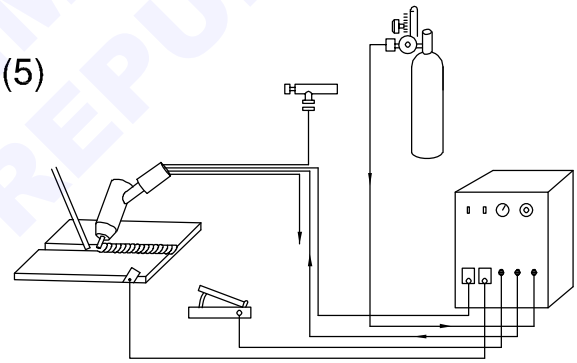
(3)



(4)



(5)



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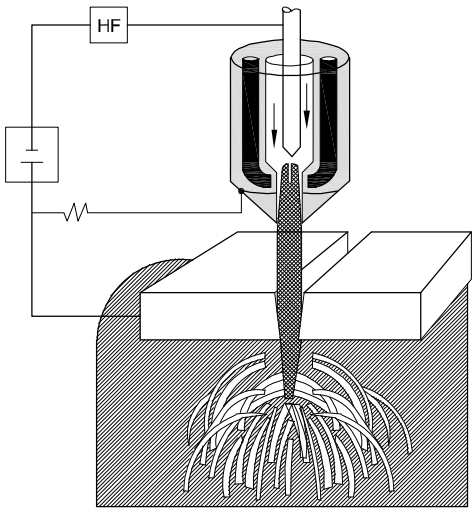

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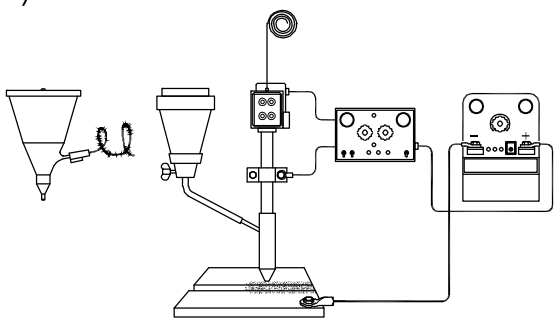
Fig 2

(7)



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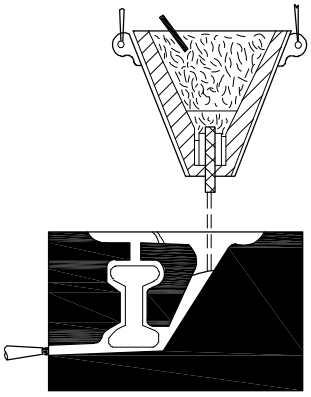

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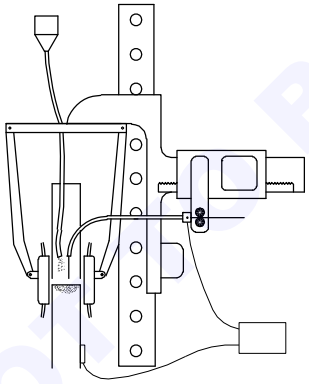
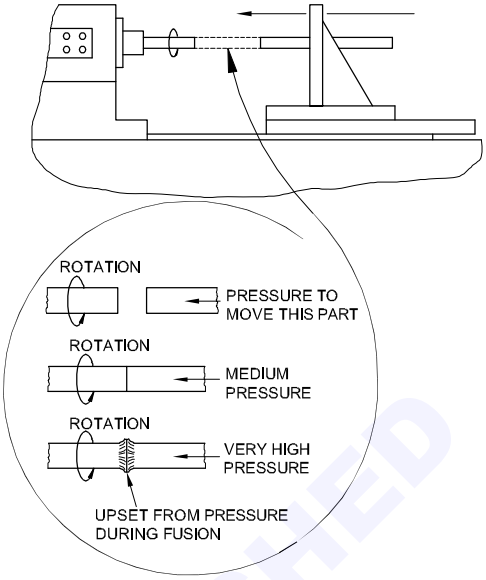


(10)



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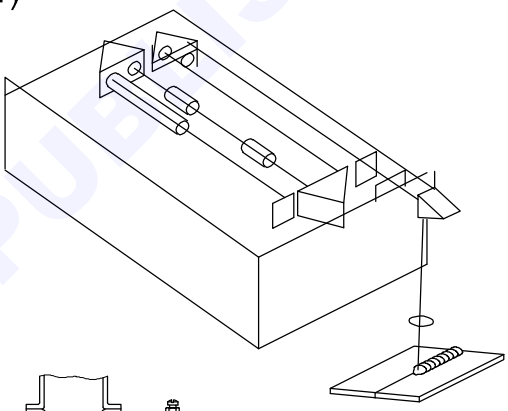

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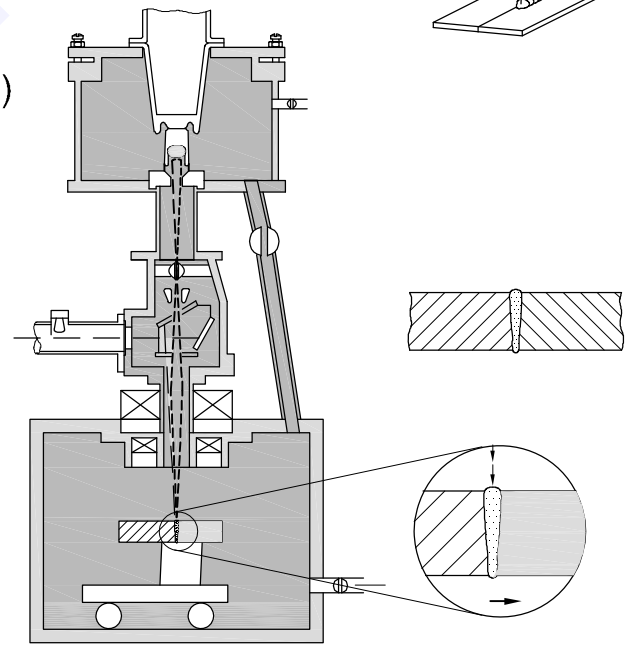

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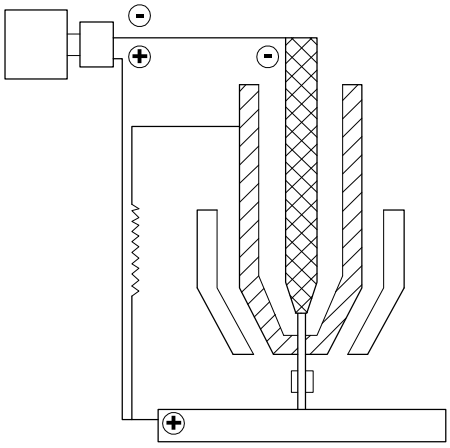
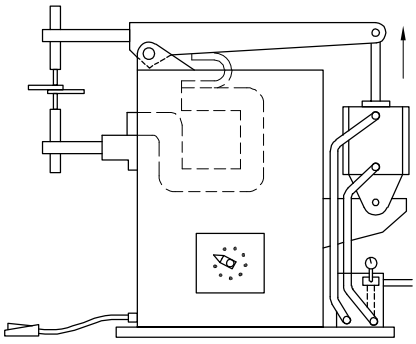
Fig 3

(13)



(14)



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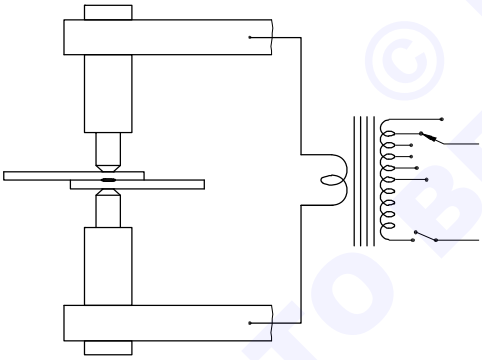

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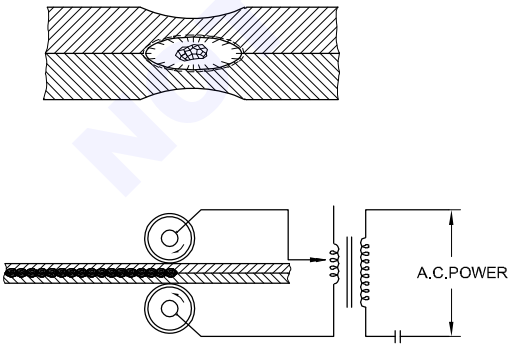

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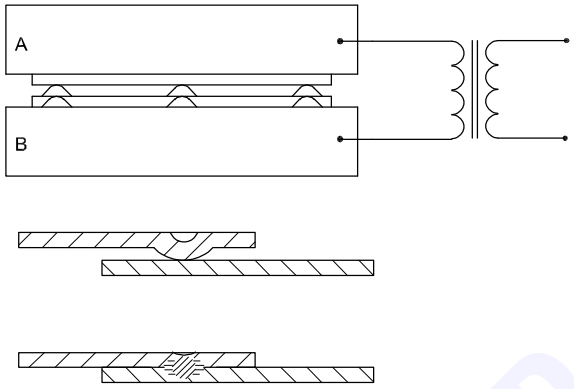

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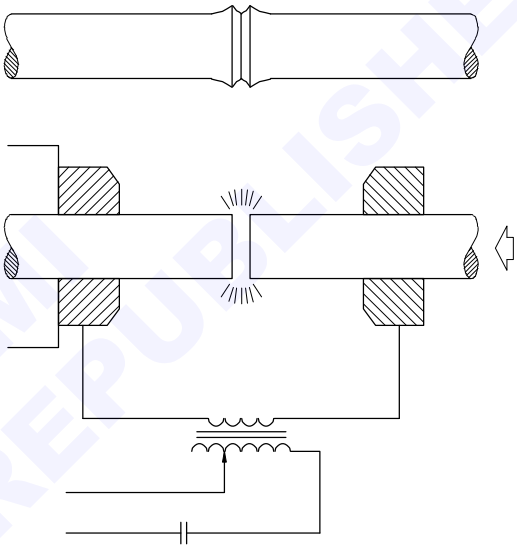
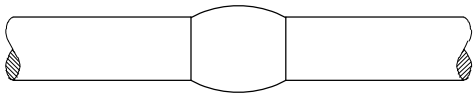
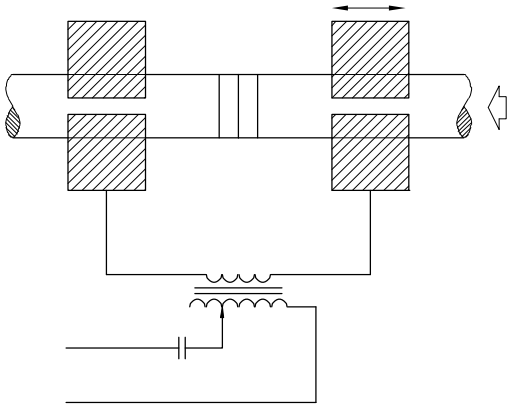




(19)



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WG20N1455H3

Job Sequence

- Machinery in your work shop.
- Machine and their uses.
- Record it in table 1.

TABLE 1 : Referring the machine and use the machine name with help of instructor

TABLE 1

S. No.	Name of the machine	Uses
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Get it checked by the instructor.

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Introduction to safety equipment and their use etc

Objectives: At the end of this exercise you shall be able to
- **identity the safety equipment listed in the drawing**
- **record the uses of respective safety equipment in the table.**

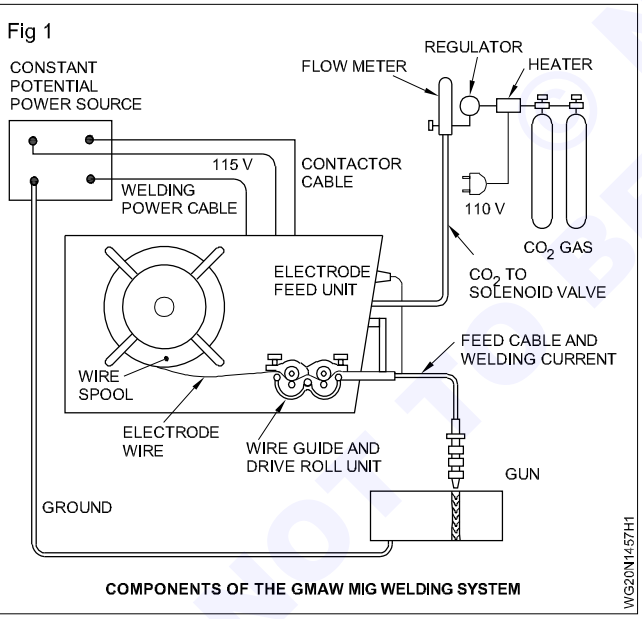
Refer the Exercise 1.1.03

Setting up of GMAW welding machine GMAW/GTAW welding machine and accessories

Objectives: At the end of this exercise you shall be able to
- **identify the GMAW welding machine and accessories**
- **describe the welding techinies of GMAW.**

Setting up of the CO_2 machine: Fix the wire spool and take the wire through the guide tube, rollers, spiral and contact tip at the end of the torch/gun. (Fig 1)

Fig 1



COMPONENTS OF THE GMAW MIG WELDING SYSTEM

Draw the wire from the spool, pass it on through the inlet wire guide, driver rollers and outlet wire guide. (Fig 2 & 3).

Fig 2

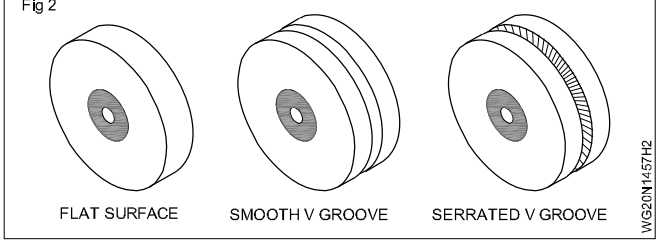
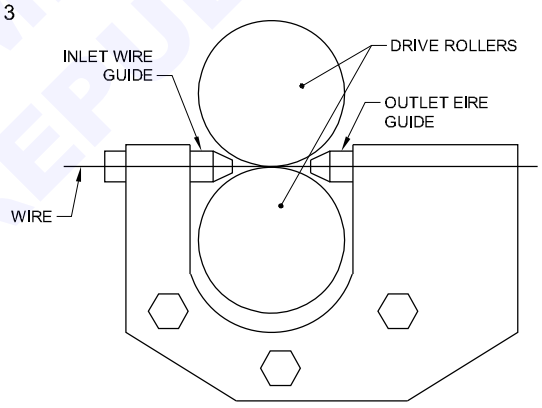


Fig 3



DRIVE ROLLS AND WIRE GUIDES PROPERLY ALIGNED

The roller should not be over tightned to avoid flattening and peeling of copper coating on the wire. The wire is further passed through the conduit liners with spring liners called spiral Fig.4 to the welding torch outlet through the contact tip. (Fig 5)

The wire should not develop any bends (or) kinks while inserting.

The contact tip should be removed to facilitate easy flow of the wire from the Spiral and put in position into the Torch later.

Start the welding machine after the machine is connected to the 3 phase supply mains.

Connect the welding torch to the positive terminal. The positive terminal influences deeper, wider weld penetration with a good ripple formation.

NOT TO BE REPUBLISHED

Fig 4

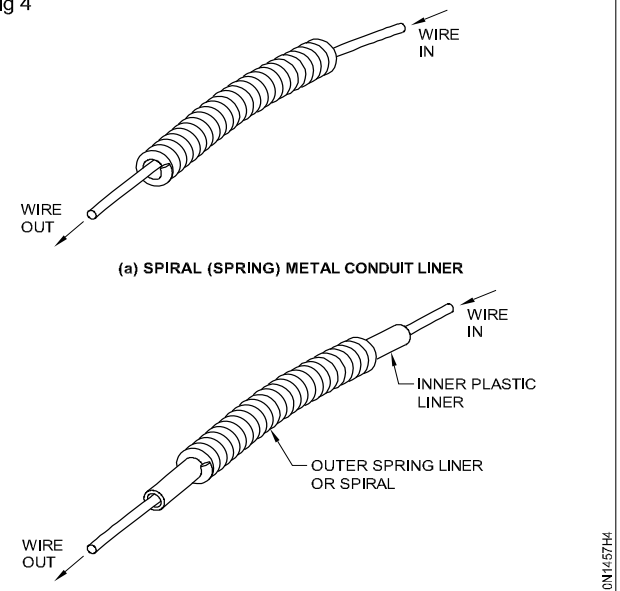
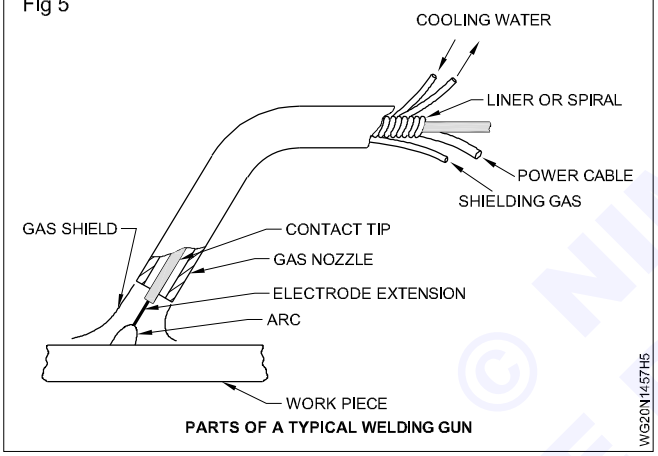


Fig 5



Connecting the heater, regulator and flow meter: The inlet end of the CO_2 gas heater is connected to the CO_2 cylinder. (Fig.1) The heater should be connected to either 110V supply from the welding machine (or) 230V supply from the mains.

This will help to avoid ice-forming (freezing) of the CO_2 gas at regulator and flow meter. Fix a two stage regulator using a flat spanner to the outlet end of the gas heater and ensure proper functioning of the dial gauges. Connect finally the Flow meter, Gas hose to the welding torch/gun. Set an outflow pressure for CO_2 gas to get a gas flow of 8 to 10 LPM as required for the Dip Transfer mode.

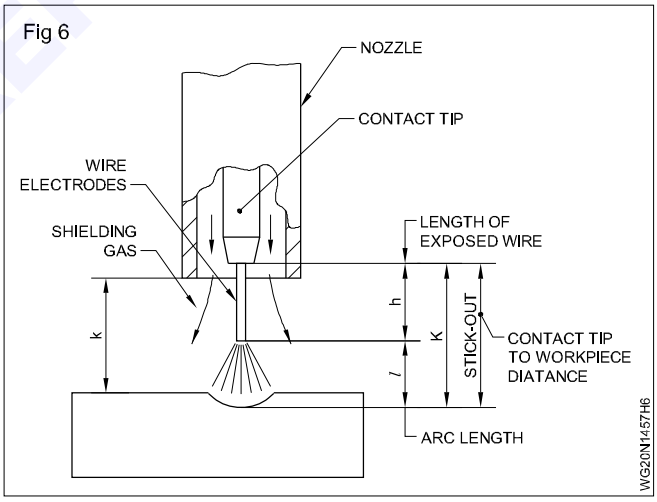
Ensure to avoid leakage at all connections so as to get correct pressure at the nozzle end. This could be checked by using soap-water solution. When used with correct gas flow rate a rapid cracking and hissing sound shall be heard. Too little flow results in porosity and too high flow rate creates turbulances and in turn contaminates weld.

Setting up arc voltage, stickout and wire feed rate for dip transfer

Setting the current level by selecting proper wire feed rate: For this exercise of depositing straightline beads it is desirable to select a smaller diameter wire i.e. 0.8mm dia wire and dip transfer method. Accordingly a current range of 80-100A is to be set for the 0.8mm dia wire. The current to be set has a direct relationship with the wire feed rate in Co_2 welding/GMAW process. So the correct wire feed rate corresponding to the 80-100A current is set on the Electrode Feed unit of the machine.

Setting appropriate arc voltage for the corresponding current used: The Arc Voltage to be set depends on the filler wire diameter, the type of metal transfer and the current selected. The thumb rule to select arc voltage for DIP transfer mode in GMAW process is calculated by using an imperical formula i.e. Arc voltage = 14 + 0.05 (I) ±2 where I is the current selected for the diameter of the wire. This can be up further by +2 volts for globular and spray transfer mode and depending upon bead finish. For laying straight line beads on 10mm thick mild steel plate set an voltage of 23 to 24 volts using set voltage control knob of Co_2 welding machine. This set voltage will drop down and settle at 19-21 volts after arc initiation. The reduction in voltage from set to Arc voltage is due to length of the cable and other factors. The welder should select 19 to 21 volts, strike the arc without changing the current; The right arc voltage is selected by Trial and Error method to get a uniform bead profile.

Fig 6



Setting the stick-out: This is the distance between the end of the contact tip and the outer tip of the electrode till it touches the base metal [refer (k) in the Fig.6. The stickout recommended is 5 to 10 mm for Dip Transfer. If the stickout is too short then excessive spatters will get deposited at the end of the nozzle which in turn restricts the shielding gas flow and may cause porosity. If the stickout is too large, arc voltage will shoot up, current diminishes, the arc will tend to become weaker and the metal deposition will become irregular.

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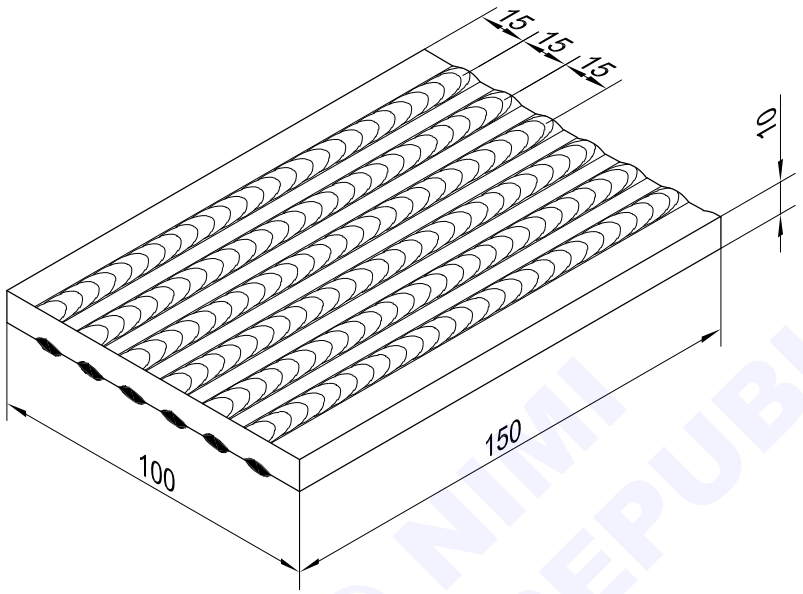
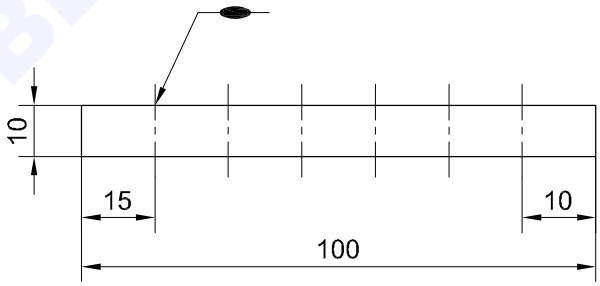
Straight line beads on MS plate in flat position by GMAW welding

Objectives: At the end of this exercise you shall be able to
- **set up the GMAW welding machine and parameters**
- **deposit uniform straight bead in flat position**
- **clean inspect the weld defects.**





Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.

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1	100 ISF 10 - 150		Fe 310			1.4.58
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	STRAIGHT LINE BEADS ON M.S. PLATE GMAW WELDING	TOLERANCE ±1	TIME :
		CODE NO. WG20N1458E1	

Job Sequence

- Prepare the job to size as per drawing.
- Clean the job surface with carbon steel wire brush.
- Mark parallel lines on the job surface as per drawing and punch the lines.
- Set the workpiece (job) on the work table in Flat position.
- Fix the 0.8mm diameter wire spool in position, lock it up and pull the wire through the guide tube, rollers, spiral and contact tip of the torch.
- Start the welding machine. Connect the torch to the positive (DC +ve) terminal (DCRP) of the machine.
- Connect the CO_2 gas heater to the electrical supply 5-10 minutes before starting of the weld.
- Set the arc voltage at 19-21 volt as required for Dip Transfer mode.
- Set the Gas Flow Rate at 8-10 LPM (Litres Per Minute).
- Set the wire feed rate so as to get 90-100 amp by striking the arc on a scrap plate.
- Use DIN 11 or 12 black/green filter glass on Hand Shield/Helmet for above current setting.
- Wear the protective clothing as required.
- Switch over to weld mode as indicated in the machine.
- Strike the arc, maintain a filler wire stick out of 8-10mm from the end of the contact tip to the job as required for dip transfer mode.
- Deposit the bead on punched lines of the job from one end to other.
- Remove spatters with chipping hammer and clean the joint using carbon steel wire brush.
- Self inspect the weld bead for finish and defects.

Skill Sequence

Straight line beads on MS plate in flat position by GMAW welding

Objective: This shall help you to
- **set up the GMAW welding machine and parameters.**

Preparation and setting of the job: Prepare a M.S plate piece of size 150 x 100 x 10mm thick.

Mark striaght lines with punch marks spaced at 15mm.

Set the job on the welding table in a Flat position as done in earlier exercises.

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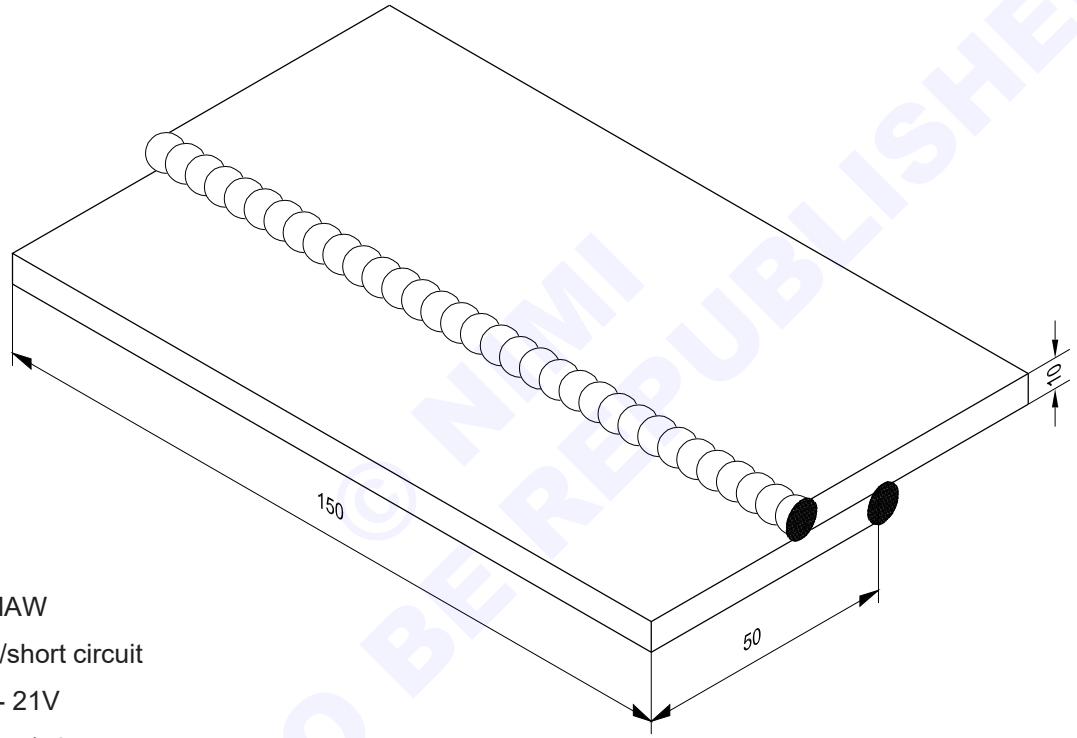
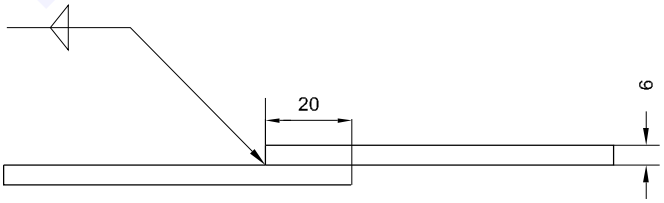
Lap joint on MS plate by GMAW welding in downhand position

Objectives: At the end of this exercise you shall be able to
- **prepare plate pieces to size as per drawing**
- **set and tack weld the plates as per drawing**
- **deposit the bead**
- **clean and inspect for surface defects on the weld and bead appearance.**



Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.



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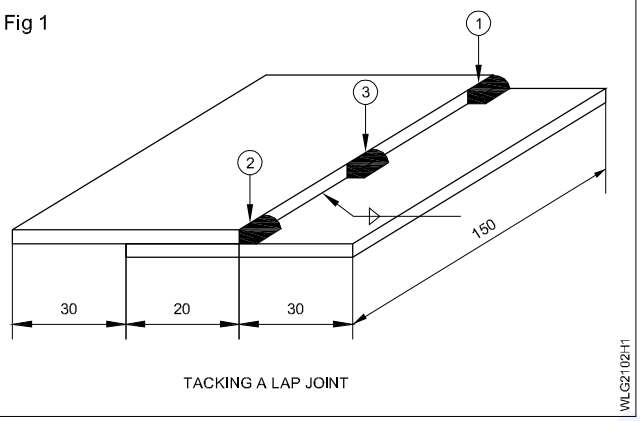
2	ISF 50 x 10 - 150		Fe 310 - W			1.4.59
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	LAP JOINT ON MS PLATE BY GMAW WELDING IN DOWN HAND POSITION	TOLERANCE±1	TIME :
		CODE NO . WG20N1459E1	

Job Sequence

- Cut the sheet by shearing machine as per drawing.
- Grind and file the edges of plates to square.
- Deburr and clean the surface of the plates by carbon steel wire brush and filling.
- Set the plate A on the plate B in the form of lap as per drawing.
- Wear protective clothing's.
- Connect the torch to the positive terminal of the machine.

Fig 1



TACKING A LAP JOINT

- Set 90-100A current/corresponding wire feed rate, 19 to 20 arc voltage and deposit the run using Dip transfer mode.
- Tack weld (min. 10mm length) on both ends of the lap joint as dhown in Fig 1.
- Keep the tack welded jib in the channel at 45 degree from the horizontal plane so that the welding can be done in flat / down hand position.
- Weld the lap joint by using 0.8mm dia. Mild steel filler wire and using stringer bead welding technique.
- Ensure good leg length and even fusion of plates.
- Avoid under cut
- Ensure the edges of the plate is not melted off due to excessive weaving
- Ensure there is no undercut at the other toe of the lap weld on plate
- Clean the bead by wire brush
- Inspect the welded joint for undercut, porosity, uneven bead formation, edge of the plate melted off, distortion and good bead profile.

Skill Sequence

Lap joint on MS plate by GMAW welding in downhand position

Objective: This shall help you to

- **clean and inspect for surface defects on the weld and bead appearance.**

For the lap fillet joints no distortion allowance is recommended

Since the GMAW welding process does not have the ability to remove many impurities, it is very important to clean the mill scale, rust, paint, oil or grease from the plate surface.

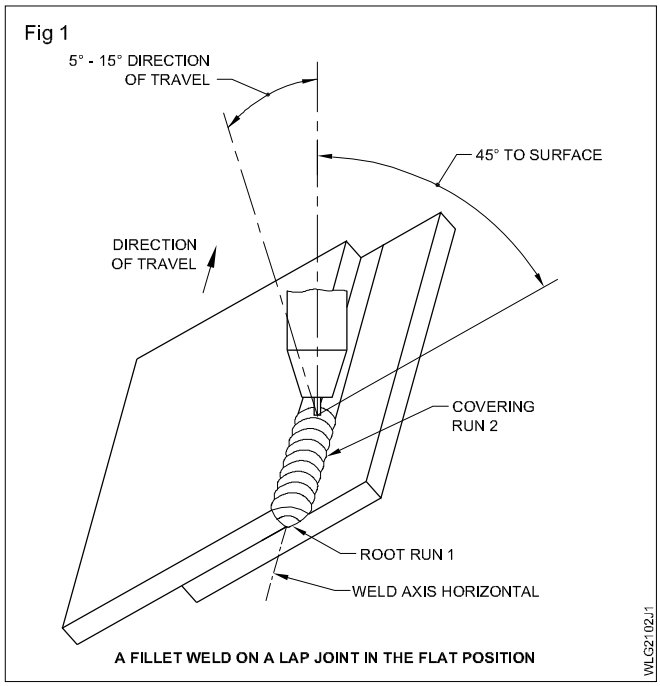
For welding the joints in flat position it is convenient to use the channel to position the joints. This weld permits the tack welded job to be kept at 45^0 angle with the horizontal plane.

The gun is held perpendicular to the joint at angle of 5 to 15 degree forward to the direction of travel as shown in Fig.2.

The torch movement at the edge of the top plate of the Lap joint should be so controlled that the edge is not melted off. Also the torch has to be paused when reaching the bottom toe of the weld for a short period so that the undercut, if developed, at toe is properly filled with filler metal.

Maintain a uniform travel speed for the torch to get the required bead reinforcement, height and appearance. Use the anti spatter spray as and when the torch nozzle gets clogged with weld spatters. Note that if this is not done, the wire feed may be irregular causing unstabilised arc and the Carbon-di-oxide gas flow will not be uniform causing atmospheric contamination of the weld and porosity.

Fig 1



A FILLET WELD ON A LAP JOINT IN THE FLAT POSITION

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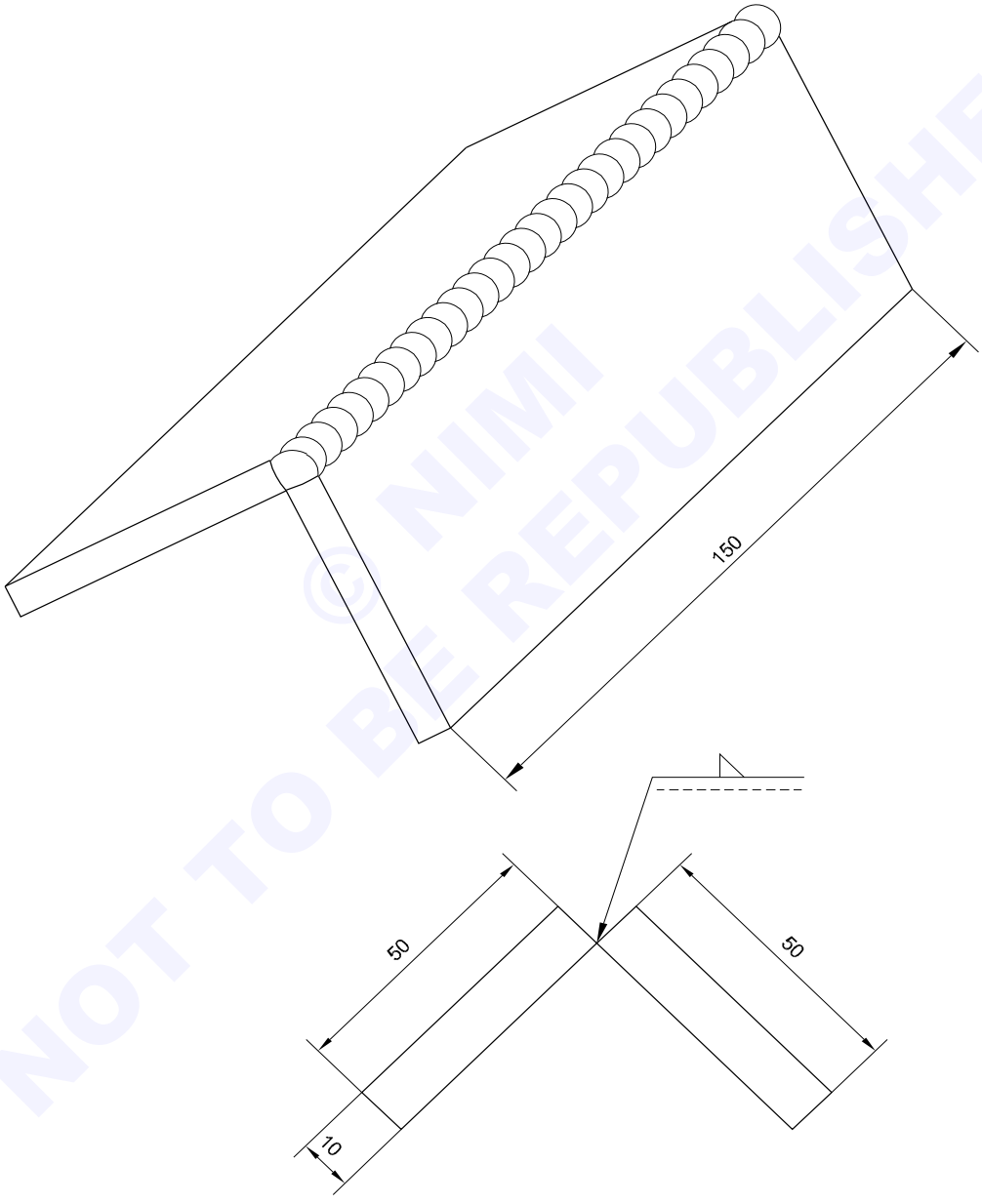
Open-corner joint on M.S. plate in down hand position

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

- **prepare plate pieces to size as per drawing**
- **set and tack weld the plates**
- **set the corner joint in plat position for welding**
- **deposit the bead in downhand position**
- **clean and inspect for surface defects.**



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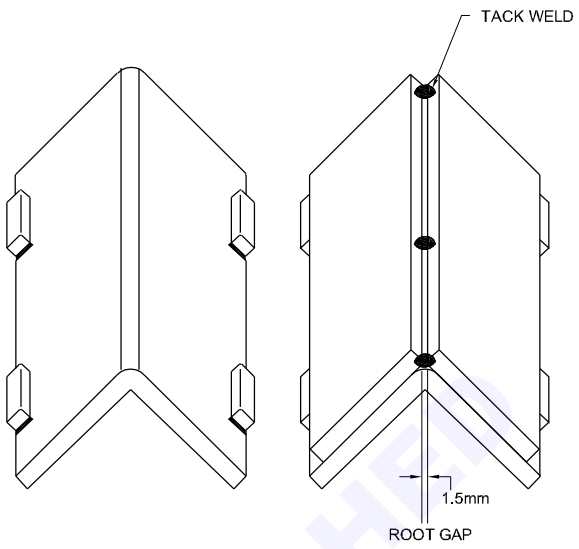
2	50ISF10 - 150		Fe 310 - W			1.4.60
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	OPEN CORNER JOINT ON MS PLATE IN DOWN HAND POSITION				TOLERANCE ±1	TIME :
					CODE NO . WG20N1460E1	

Job Sequence

- Cut the plate by shearing machine as per drawing.
- Grind and file the edges of plates to square.
- Deburr and clean the surface of the plates by carbon steel wire brush and filling.
- Set the plate on the plate in the form of corner joint at 90º with specified root gap in flat position as per drawing.
- Wear protective clothing's.
- Connect the torch to the positive terminal of the machine.
- Set 90-100A current/corresponding wire feed rate, 19 to 21 arc voltage and deposit the run using Dip transfer mode.
- Tack weld (min. 10mm length) on both ends of the lap joint as shown in Fig 1.
- Keep the tack welded job on the welding table in flat/ down hand position.
- Deposit run in the joint by forming a key hole and obtain complete penetration and even fusion of plates.
- Ensure good leg length and even fusion of plates.
- Avoid under cut.
- Ensure the edges of the plate is not melted off due to excessive weaving.

Fig 1



- Ensure there is no undercut at the other toe of the corner weld on plate
- Clean the bead by wire brush
- Inspect the welded joint for undercut, porosity, uneven bead formation, edge of the plate melted off, distortion and good bead profile.

Skill Sequence

Open-corner joint on M.S. plate in down hand position

Objective: This shall help you to
- **clean and inspect for surface defects.**

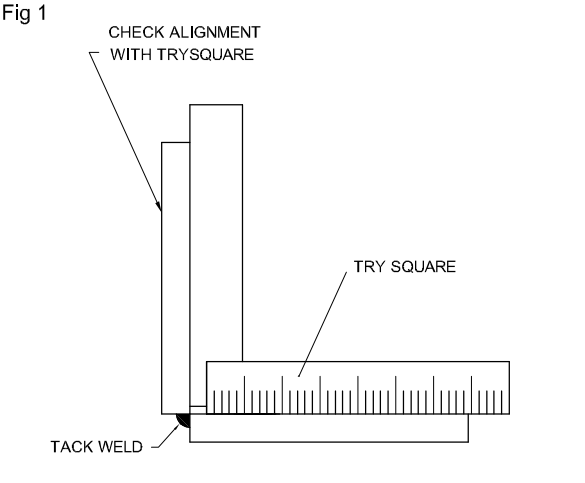
While tack welding, plates A and B for the corner joint the angle between them is to be at 90 degree.

Since the GMAW welding process does not have the ability to remove many impurities, it is very important to clean the mill scale, rust, paint, oil or grease from the plate surface.

Maintain a uniform travel speed for the torch to get the required bead appearance, reinforcement, penetration and height.

Use the anti spatter spray as and when the torch nozzle gets clogged with weld spatters. Note that if this is not done, the wire feed may be irregular causing unstabilised arc and the Carbon-di-oxide gas flow will not be uniform causing atmospheric contamination of the weld and porosity.

Fig 1



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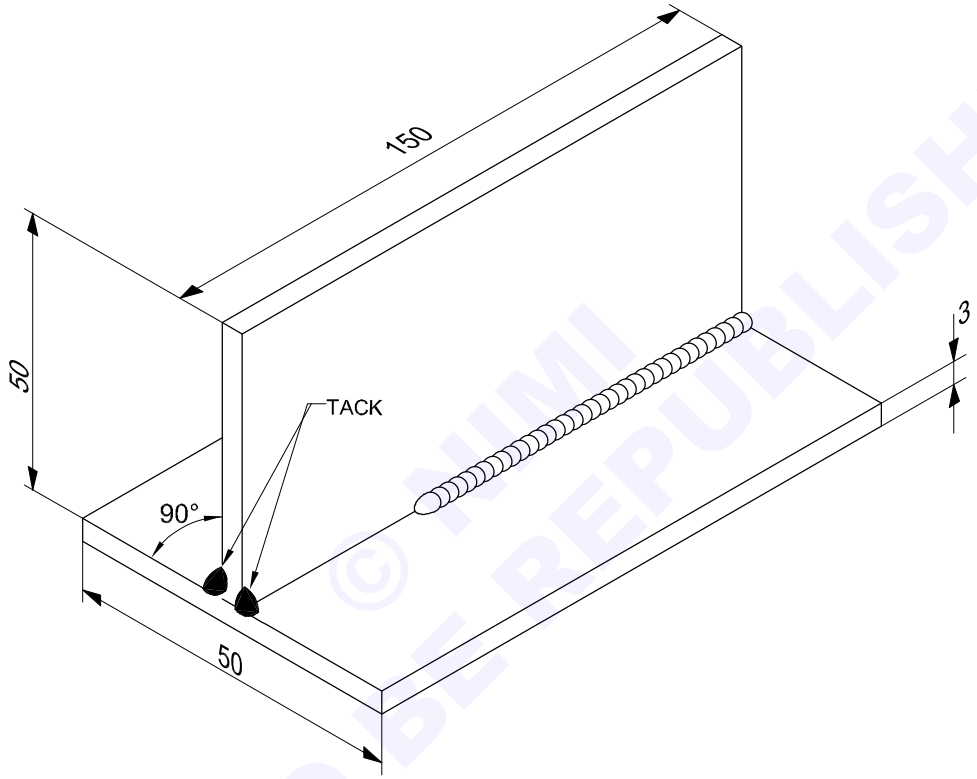
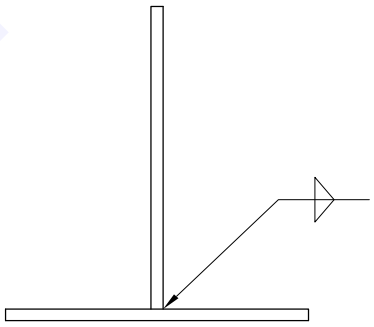
Tee joint on M.S in flat position

Objectives: At the end of this exercise you shall be able to
- **prepare plate pieces to size as per drawing**
- **set and tack weld**
- **set the 'T' joint in flat position for welding**
- **deposit the bead with appropriate amount of filler metal**
- **clean and inspect for surface defects on the weld.**



Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.



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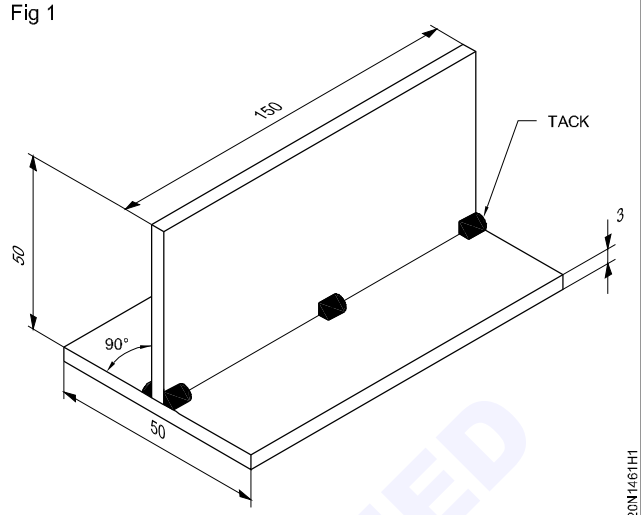
2	ISST 50 x 3 - 150		Fe 310 - W			1.4.61
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**FILLET TEE JOINT M.S. SHEET IN FLAT POSITION**				TOLERANCE ±0.5	TIME : 9 Hrs
					CODE NO . WG20N1461E1	

Job Sequence

- Cut the plate by shearing machine as per drawing.
- Grind and file the edges of plates to square.
- Deburr and clean the surface of the plates by carbon steel wire brush and filling.
- Set the plate on the plate in the form of Tee as per drawing.
- Wear protective clothing's.
- Connect the torch to the positive terminal of the machine.
- Set 90-100A current/corresponding wire feed rate, 19 to 20 arc voltage and deposit the run using Dip transfer mode.
- Tack weld (min. 10mm length) on both ends of the Tee joint as shown in Fig 1.
- Keep the tack welded job in the channel at 45 degree from the horizontal plane so that the welding can be done in flat / down hand position.
- Weld the Tee joint by using 0.8mm dia. Mild steel filler wire and using stringer bead welding technique.
- Ensure good leg length and even fusion of plates.
- Avoid under cut.
- Ensure the edges of the plate is not melted off due to excessive weaving.

Fig 1



TACK WELDING A TEE JOINT

- Ensure there is no undercut at the other toe of the lap weld on plate
- Clean the bead by wire brush
- Inspect the welded joint for undercut, porosity, uneven bead formation, edge of the plate melted off, distortion and good bead profile.

Skill Sequence

Tee joint on M.S in flat position

Objectives: This shall help you to

- **set the 'T' joint in flat position for welding**
- **clean and inspect for surface defects on the weld.**

For the lap fillet joints no distortion allowance is recommended.

Since the GMAW welding process does not have the ability to remove many impurities, it is very important to clean the mill scale, rust, paint, oil or grease from the plate surface.

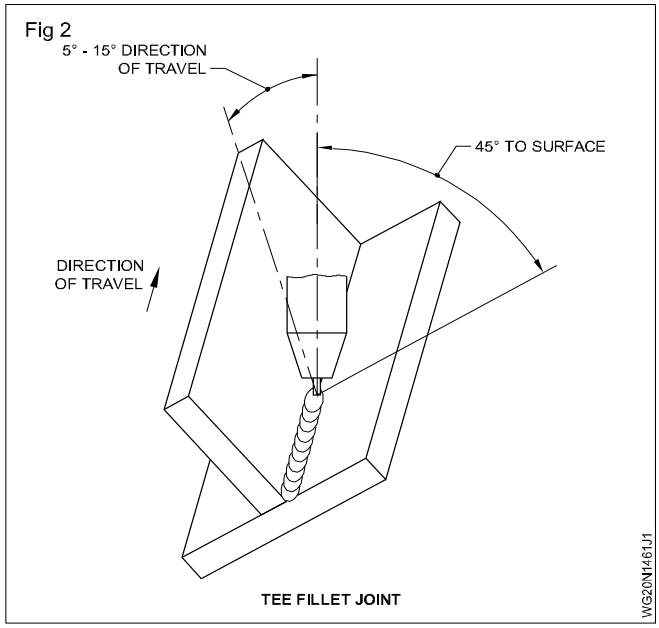
For welding the joints in flat position it is convenient to use the channel to position the joints. This weld permits the tack welded job to be kept at 45^0 angle with the horizontal plane.

The gun is held perpendicular to the joint at angle of 5 to 15 degree forward to the direction of travel as shown in Fig 1.

The torch movement at the edge of the top plate of the Lap joint should be so controlled that the edge is not melted off. Also the torch has to be paused when reaching the bottom toe of the weld for a short period so that the undercut, if developed, at toe is properly filled with filler metal.

Maintain a uniform travel speed for the torch to get the required bead reinforcement, height and appearance. Use the anti spatter spray as and when the torch nozzle gets clogged with weld spatters. Note that if this is not done, the wire feed may be irregular causing unstabilised arc and the Carbon-di-oxide gas flow will not be uniform causing atmospheric contamination of the weld and porosity.

Fig 2



TEE FILLET JOINT

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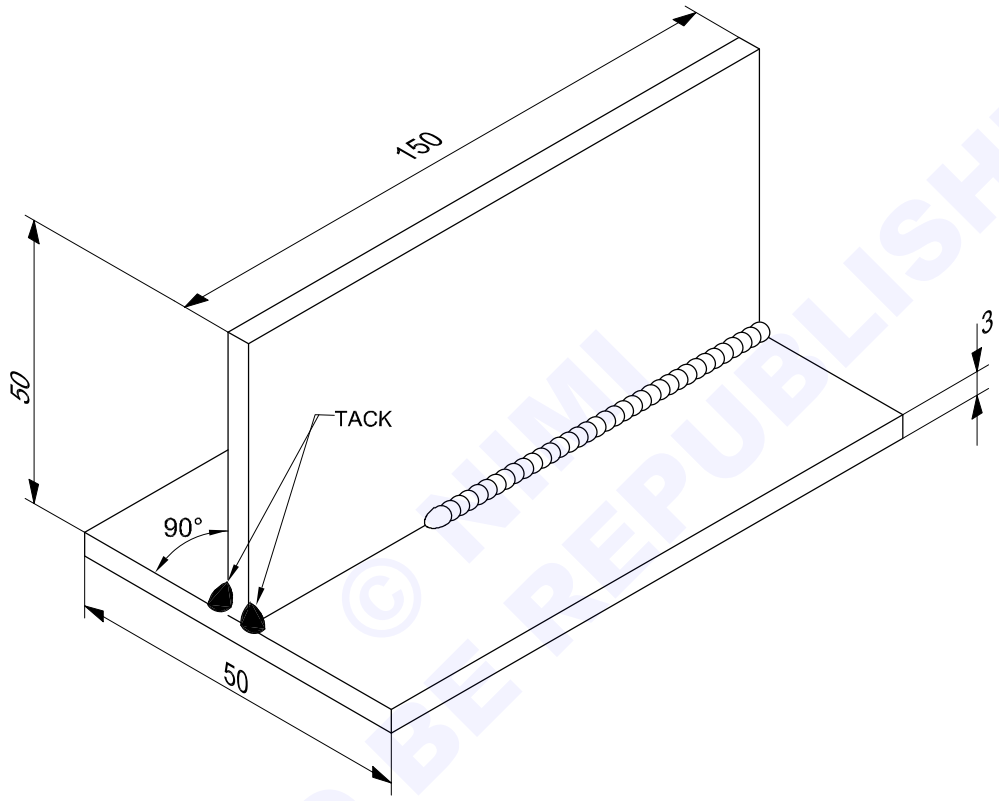
Tee joint on M.S sheet in horizontal position

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

- **prepare plate pieces to size as per drawing**
- **set and tack weld the plates**
- **set the 'T' joint in Horizontal position**
- **deposit the bead with appropriate amount of filler metal**
- **clean and inspect for surface defects.**



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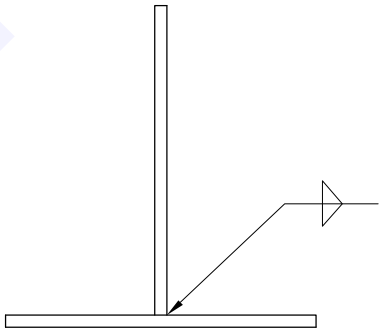
Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.

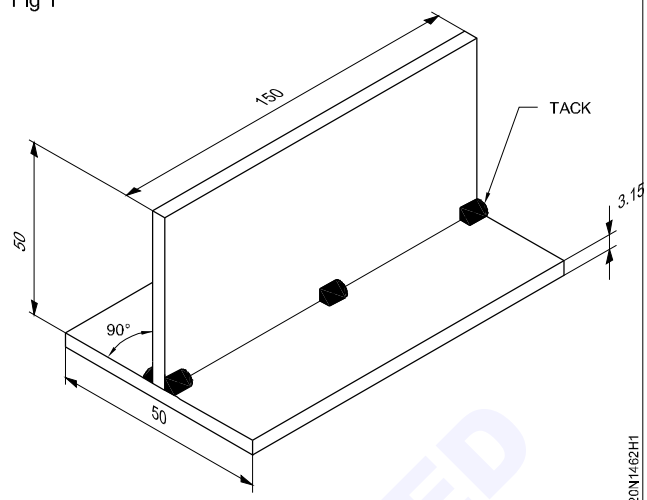


2	ISST 50 x 3 - 150		Fe 310 - W			1.4.62
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	"T" JOINT ON MS SHEET IN HORIZONTAL POSITION				TOLERANCE ±0.5	TIME : 9 Hrs
					CODE NO . WG20N1462E1	

Job sequence

- Cut the sheet by shearing machine as per drawing.
- Grind and file the edges of sheet to square
- Deburr and clean the surface of the sheets by carbon steel wire brush and filing.
- Set the plate in the form of Tee as per drawing.
- Wear protective clothings.
- Connect the torch to positive terminal of the machine.
- Tack weld(min. 10mm length) on both ends of the tee joint as shown in the Fig 1.
- Keep the tack welded job in horizontal position.
- Set current to 90 - 100 ampheres / corresponding wire feeding rate (3 to 4 m/min), 19 to 21 Arc voltage and deposit the root run using dip transfer mode.
- Weld the Tee joint by using 0.8mm dia. Mild steel filler wire and using stringer bead welding technique.
- Ensure good leg length and even fusion of plates.
- Avoid under cut.
- Ensure the edges of the plate is not melted off due to excessive weaving.

Fig 1



TACK WELDING A TEE JOINT

- Ensure there is no undercut at the other toe of the lap weld on plate.
- Clean the bead by wire brush.
- Inspect the welded joint for undercut, porosity, uneven bead formation, edge of the plate melted off, distortion and good bead profile.

Skill Sequence

Tee joint on M.S sheet in horizontal position

Objective: This shall help you to
- **clean and inspect for surface defects.**

While tack Tee joint the angle between them is to be kept at 91º initially as shown in Fig 1(i.e a distortion allowance of 1º per run) or Tee fillet joints distortion allowance is recommended.

Since GMAW welding process does not have the ability to remove many impurities, it is very important to clean the mill scale, rust, paint, oil or grease from the plate surface.

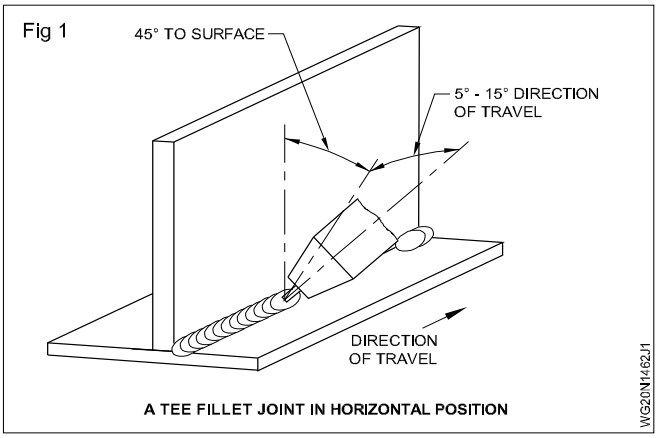
For welding the joints in flat (downhand) position it is convenient to use the channel to position the joints. This will permit the tack welded job to be kept at 45º angle with the horizontal plane.

The gun is held perpendicular to the joint at angle of 5 to 15 degree forward to the direction of travel as shown in Fig.2.

The torch movement at the edge of the top plate of the Tee joint should be so controlled that the edge is not melted off. Also the torch has to be paused when reaching the bottom toe of the weld for a short period so that the undercut, if developed, at toe is properly filled with filler metal.

Maintain a uniform travel speed for the torch to get the required bead reinforcement, height and appearance.Use the anti spatter spray as and when the torch nozzle gets clogged with weld spatters. Note that if this is not done, the wire feed may be irregular causing unstabilised arc and the Carbon-di-oxide gas flow will not be uniform causing atmospheric contamination of the weld and porosity.

Fig 1



A TEE FILLET JOINT IN HORIZONTAL POSITION

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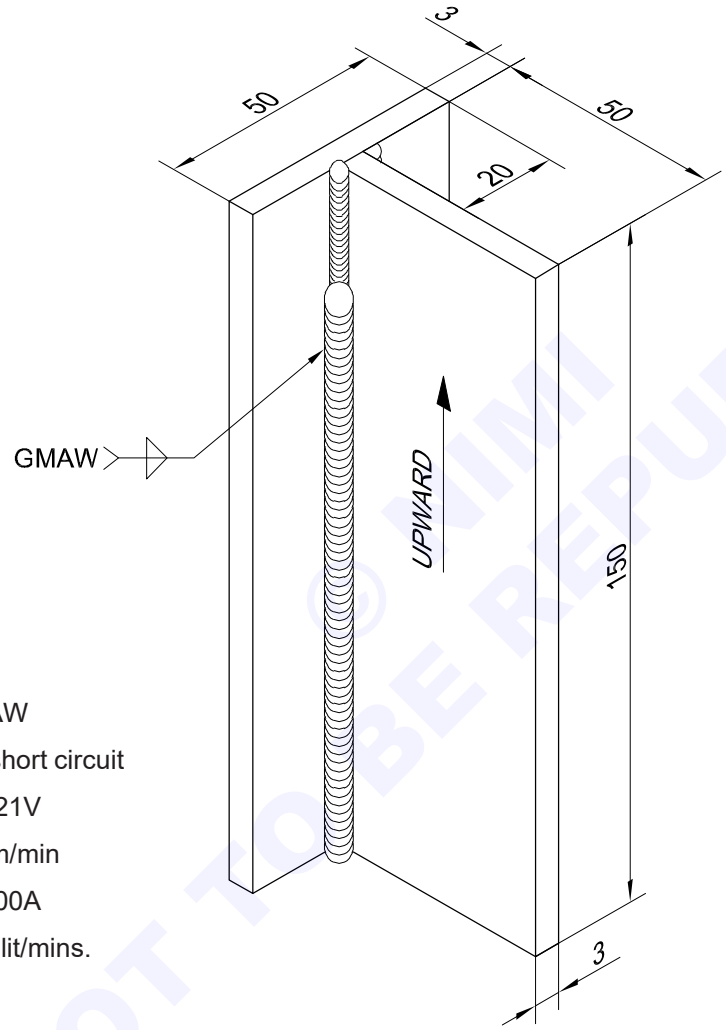
Tee joint on MS in vertical position

Objectives: At the end of this exercise you shall be able to
- **prepare the plates and tack weld**
- **prepare, set and tackweld the plates as per drawing**
- **deposit root, 2nd by using bottom to top**
- **clean and inspect the defects.**



Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.

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2	ISST 3 x 50 x 150		Fe 310 - W			1.4.63
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	'T' JOINT ON M.S. SHEET IN VERTICAL POSITION GMAW				TOLERANCE ±1	TIME : 9 Hrs
					CODE NO. WG20N1463E1	

Job sequence

- Prepare the sheet to size (i.e 150 x 50 x 3mm) using gas cutting, grinding and filing.
- Clean the base metal surface along the welding line with a carbon steel wire brush.
- Set the plates in the form of an inverted "T".
- Wear all protective devices.
- Tack weld the 2 plates, keeping the T joint in vertical position.
- Set the welding parameters as done in earlier exercises.
- Strike the arc keeping proper angles for the torch.
- Deposit the run without weaving and ensure proper penetration and fill the crater.
- Clean the weld bead.
- Check for defects like overlap, undercut, porosity and check for correct leg size and throat thickness.

Skill Sequence

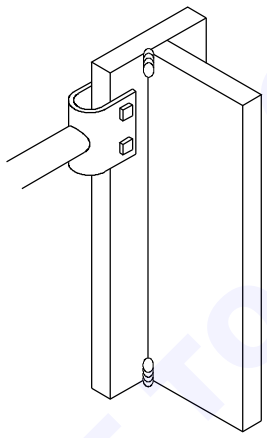
Tee joint on MS in vertical position

Objectives: This shall help you to
- **deposit root, 2nd by using bottom to top**
- **clean and inspect the defects.**

Adjust the power source and wire feeder to obtain 18 to 19 volts and 90 - 100 amperes, gas flow of 8 - 10LPM (Litre per minute). Select the lower side of the range for vertical welding.

Thoroughly clean the pieces to be joined, tack them together and position them as shown in Fig 1.

Fig 1



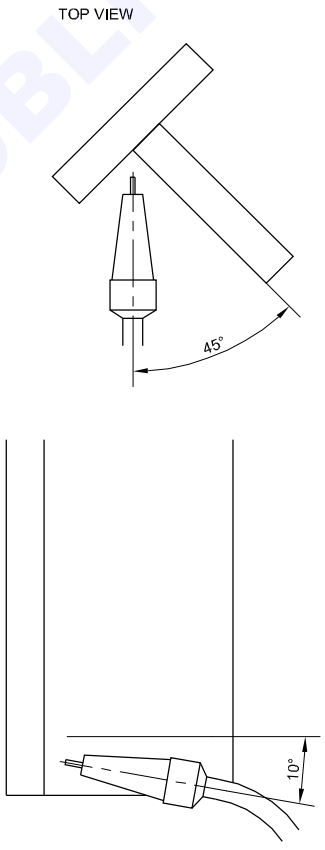
WELD POSITION FOR A VERTICAL UP TEE JOINT FILLET

WLG2106H1

Beginning at the bottom of the joint, use the gun angles shown in Fig 2. Begin to weld using a weaving motion similar to that given in Fig.3.

The weld will deposit a shelf at the bottom of the joint on which you can build. Be certain when you weave the gun that the arc reaches the root of the joint to ensure good root penetration. Pause on the sides to fill in the weld and prevent undercut. Increase the travel speed of the gun when moving from side to side to prevent excessive buildup, which would make a very convex bead.

Fig 2



GUN ANGLES

WLG2106H2

Complete the joint, keeping the fillet size as close to 2 mm as possible.

Weld the other side of the T assembly, using the same technique as for the first side.

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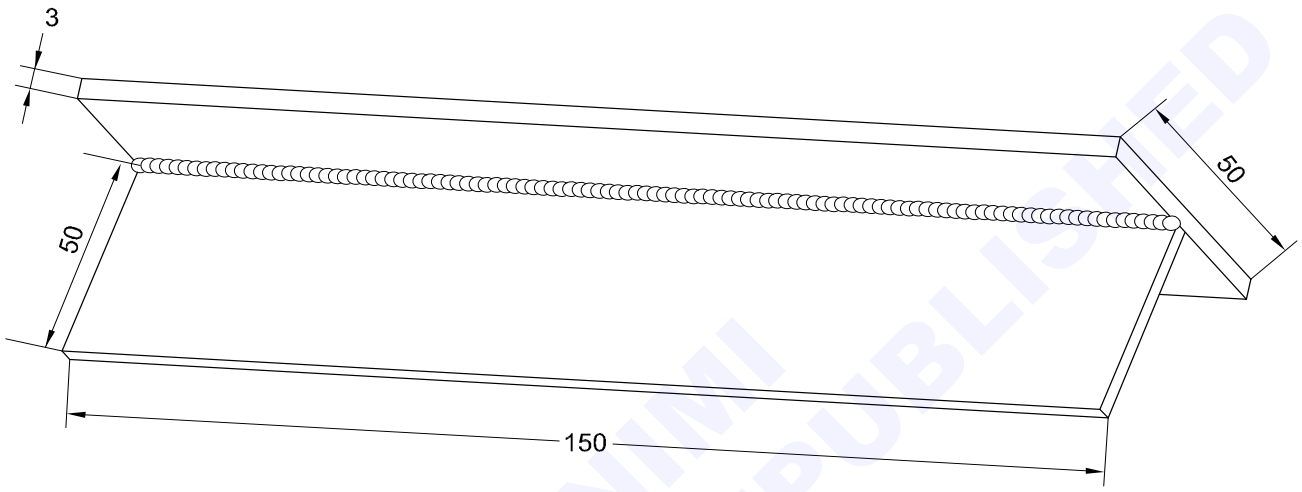
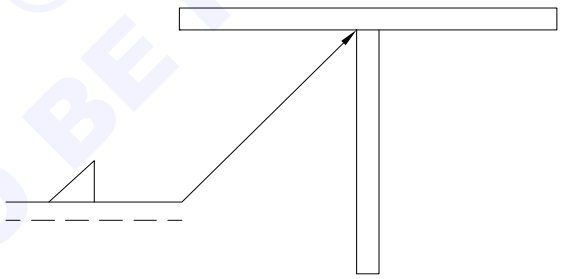
Tee joint on MS sheet in overhead position

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

- **set and tack weld the sheets as Tee joint**
- **fix the tack welded job in overhead position**
- **select filler rod and set the gas pressures**
- **manipulate the torch to deposit the weld runs in overhead position without excessive sagging**
- **ensure proper fusion at the root of the joint and the weld faces**
- **clean and inspect for defects.**



Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.



2	ISST 50 x 3 x 150		Fe 310 - W			1.4.64
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	TEE JOINT M.S. SHEET IN OVER HEAD POSITION				TOLERANCE ±1	TIME : 9 Hrs
					CODE NO . WG20N1464E1	

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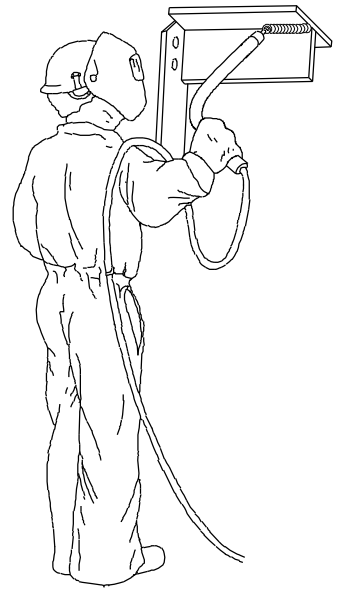
Job Sequence

- Prepare the plates as per drawing using gas cutting, grinding.
- Set the plates as "inverted T" and tack weld as done in earlier exercise.
- Clamp the job in overhead position using weld positioner (Fig.1) at a convenient height to you and in normal T.position.
- Wear all protective clothing as shown in Fig.1.

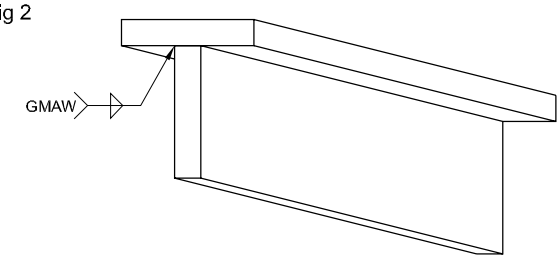
Fig 1



WG20N1464H1

- Adjust the power supply and wire feeder to obtain 19 to 20 volts and 90 to 100 amperes and a gas flow 8 to 10 LPM.
- Clean the pieces to be welded, tack weld them together and position them as shown in Fig.2.

Fig 2

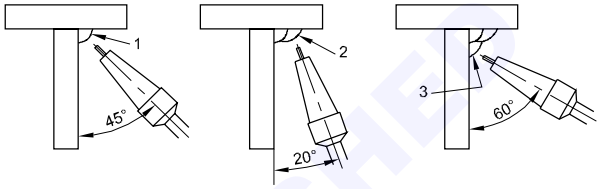


WELD POSITION FOR AN OVERHEAD TEE JOINT FILLET

WG20N1464H2

- Use the gun angle shown in Fig.3 and use back hand technique to put in the first pass. Weave the gun slighly to ensure fusion along the toe of the weld.

Fig 3



GUN ANGLES

WG20N1464H3

Skill Sequence

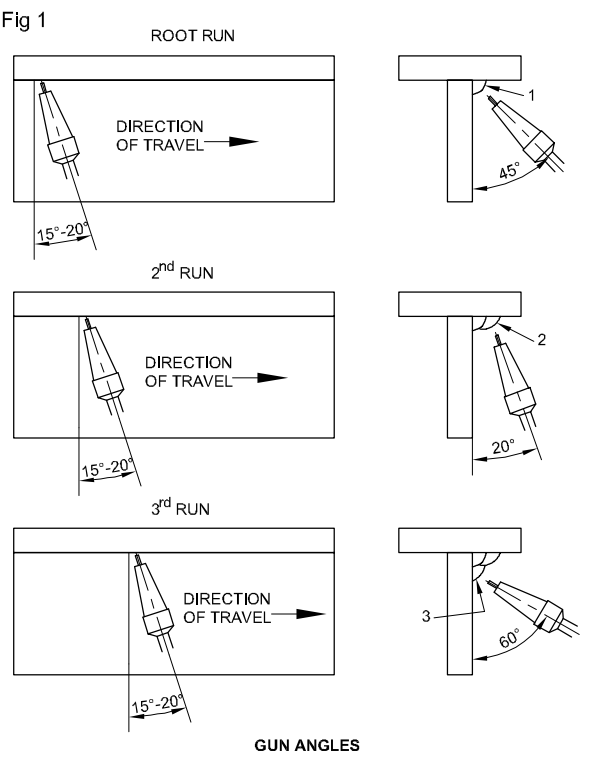
Tee joint on MS sheet in overhead position

Objectives: This shall help you to
- **ensure proper fusion at the root of the joint and the weld faces**
- **clean and inspect for defects.**

It is important to ensure that the T joint is held in the weld positioner firmly. The line of weld of the joint should be parallel to the ground and is in such a height from the ground that it is easily accessible to the welder depending on the height of the welder. Ensure that the torch assembly hose, containing the spiral, filler wire, gas hose etc is long enough so that it can be carried over your shoulder while welding in overhead position (refer Fig.1).

This will help in maintaining the constant distance between the torch and the Joint (base metal) to be welded. Using a welding helmet and wearing a welder's overall is very essential to protect the whole body from the weld spatters in overhead welding position. Use back hand welding technique and stringer bead technique.

Fig 1



GUN ANGLES

WG20N1464J1

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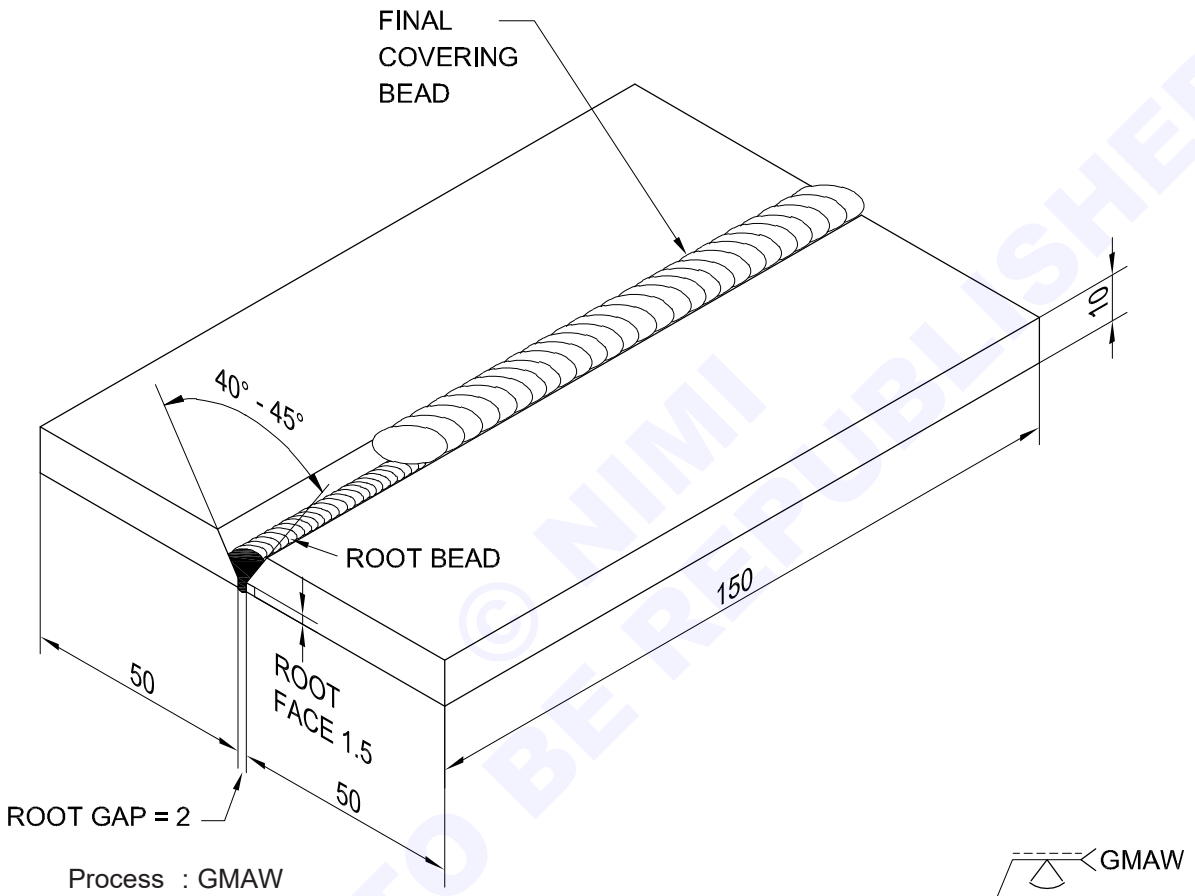
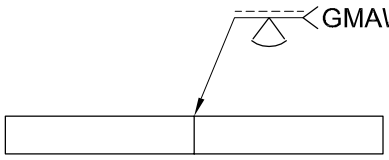
Single V butt joint by CO_2 welding in downhand position

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

- **prepare the plates with bevelling by using gas cutting and grinding**
- **prepare the plates with bevelling as per drawing**
- **set root gap and tack weld**
- **deposit the 2nd and 3rd run using weaving technique**
- **clean and inspect the weld defects.**



Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.



2	50 ISF 10 - 150		Fe 310 - W			1.4.65
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SINGLE 'V' BUTT JOINT BY CO_2 WELDING IN DOWN HAND POSITION	TOLERANCE ±1	TIME :
		CODE NO. WG20N1465E1	

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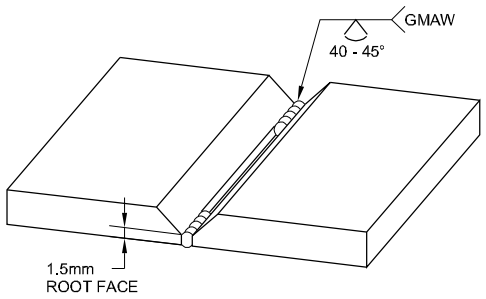
Job Sequence

- Adjust the power source and wire feeder to obtain 18 to 19 volts and 90 and 100 amperes, gas flow 8-10 LPM.
- Thoroughly clean the pieces to be joined. Pay particular attention to the top of the plate, the sidewalls of the groove and the underside of the joint. Grind or file a 1.5mm root face on each beveled edge as shown in Fig.1.
- Tack the pieces together and position as shown in Fig.1. Put spacers under the plate so that you don't weld the plate to your table.

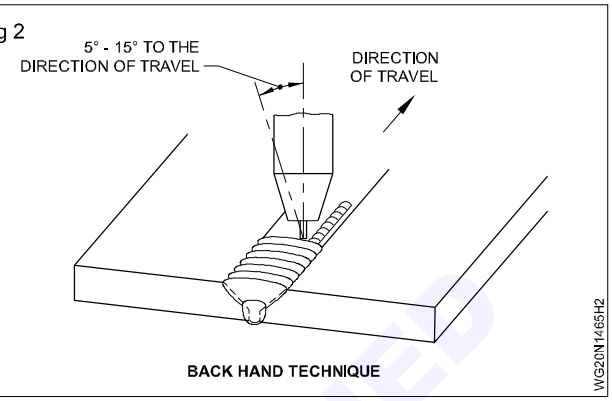
Fig 1



TACK WELDED AND WELD POSITION FOR A FLAT V - GROOVE BUTT JOINT

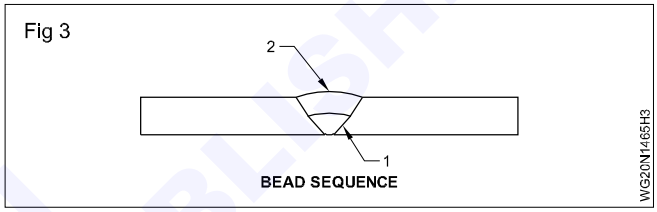
- Hold the gun perpendicular to the joint and strike the arc at the tack. Move the torch from left to right end of the joint i.e use backhand technique.(Fig.2) Weave the gun from side to side. When the gun is in the center of the joint, watch the arc very closely. By concentrating the arc on the leading edge of the puddle, you can cause the bead to penetrate through the joint and fuse both root faces. If you bring the arc too far down in the puddle, the wire will go through the joint and the arc will become very erratic. If you allow the arc to go too far up on the puddle, your penetration will decrease and you will not penetrate the joint. Practice will help you use the arc to control the flow of the weld puddle.
- Complete the joint using the bead sequence shown in Fig 3. Use a slight weave to help the weld flow and to fuse to the sidewalls of the groove and the previous beads.

Fig 2



BACK HAND TECHNIQUE

Fig 3



BEAD SEQUENCE

- When you have completed the weld, cool it and examine it. The root should show full penetration along the entire length. The root reinforcement should protrude beyond the joint from 0.5 to 1mm. The face of the weld should merge smoothly with the base metal. The reinforcement should be atleast 1mm above the surface of the base metal and also should not exceed beyond 1.5.

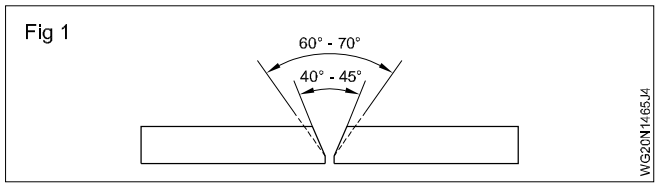
Skill Sequence

Single V butt joint by CO_2 welding in downhand position

Objectives: This shall help you to
- **deposit the 2nd and 3rd run using weaving technique**
- **clean and inspect the weld defects.**

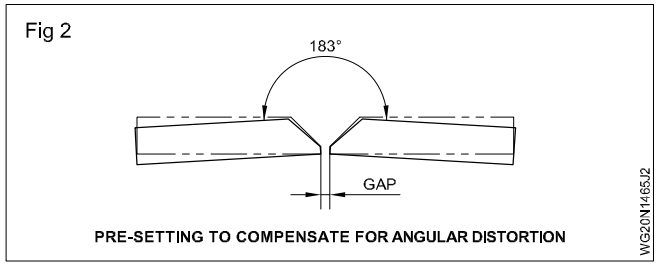
For GMAW process the plates are bevelled so that the included angle (groove angle) of the single Vee butt joint is 40 to 45^0 as shown in the Fig.1. This is less compared to MMAW groove angle which is kept at 60 - 70^0.

Fig 1



To control the transverse distortion it is advisable to preset the joint to 183^0 for 10mm thick plates as shown in Fig.2.

Fig 2



PRE-SETTING TO COMPENSATE FOR ANGULAR DISTORTION

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Distortion may be allowed for by pre-setting the plates in the opposite way so that the weld pulls them to the desired shape. When the weld shrinks it will pull the plate to its correct position shown by dotted line in Fig.2.

Maintaining the angle of the torch 5 to 15^0 towards the direction of travel as shown in Fig.2 in Job Sequence will help to get better root penetration.

Maintain a stick-out of 5 to 8mm (maximum 10mm)

Set a current of 80-90A for 0.8mm dia wire with a corresponding arc voltage of 18 to 19V.

Set a gas flow rate to 8-10LPM so as to protect the weld metal from atmospheric contamination.

Maintain a faster travel speed of 3 to 4m/min. to avoid burn throughs during the root run. At the same time ensure to get full and even root penetration throughout.

It is very important to clean the root run by Carbon Steel wire brush to avoid any non-metallic inclusions during the 2^{nd} pass/run.

Set the current to 90 to 100A and an arc voltage of 19 to 20V for the 2^{nd} run.

Maintain a slower travel speed compared to the root run for the 2^{nd} run. Use semicircular side to side weaving movement (crescent motion) to achieve full side wall fusion without any undercuts at either end of the bead.

Maintain a dwell time (pause) of 1 to 2 seconds to get a proper, even filling at the end of the toes on either side of the bead.

Maintain a proper and even bead profile and a face reinforcement of 1 to 1.5mm.

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Capital Goods & Manufacturing — Exercise 1.4.66
Welder (GMAW & GTAW) - Gas Metal Arc Welding

Single V Butt joint (ARGO shield) in flat position (Gas : Arson &Co2 mixture)

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

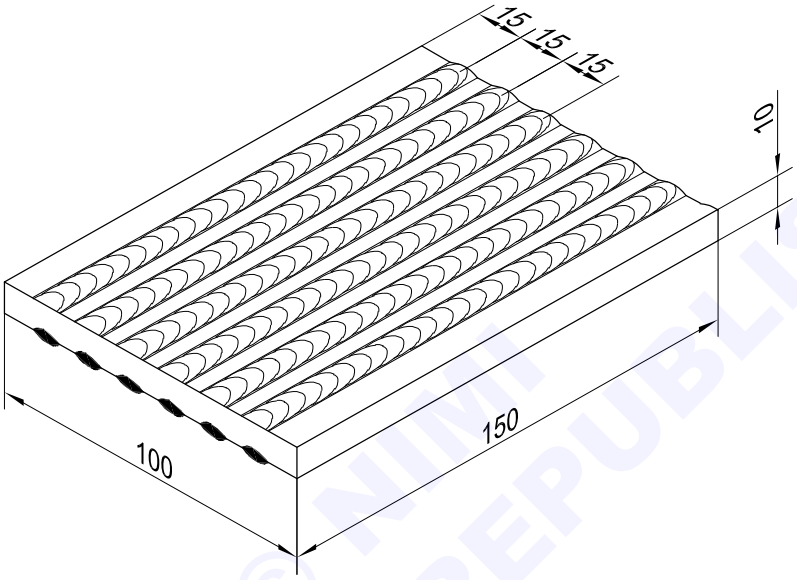
- **prepare the plates with bevelling by using gas cutting and grinding**
- **prepare the plates with bevelling as per drawing**
- **set root gap and tack weld**
- **deposit the 2^{nd} and 3^{rd} run using weaving technique**
- **clean and inspect the weld defects.**

Refer the Exercise 1.4.65

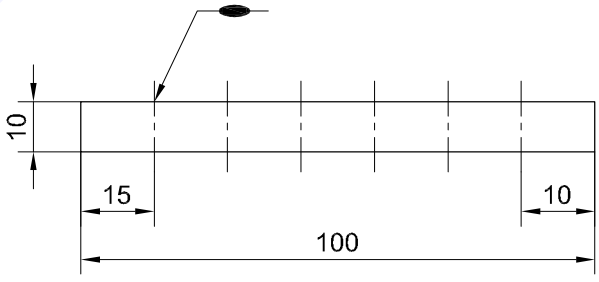
Straight line beads on MS plate in flat position by flux cored arc welding

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

- **set up the GMAW welding machine and set welding parameters.**
- **strike and maintain the electric arc**
- **deposit uniform straight bead in flat position**
- **inspect weld bead for weld defects.**



Process : FCAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.



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1	100 ISF 10 - 150		Fe 310			1.4.67
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**DEPOSING STRAIGHT LINE BEADS ON M.S.PLATE IN FLAT POSITION BY GMAW**				TOLERANCE ±1	TIME :
					CODE NO. WG20N1467E1	

Job Sequence

- Prepare the job to size as per drawing.
- Clean the job surface with carbon steel wire brush.
- Mark parallel lines on the job surface as per drawing and punch the lines.
- Set the workpiece (job) on the work table in Flat position.
- Fix the flux cored wire spool in position, lock it up and pull the wire through the guide tube, rollers, spiral and contact tip of the torch.
- Start the welding machine. Connect the torch to the positive (DC +ve) terminal (DCRP) of the machine.
- Connect the CO_2 gas heater to the electrical supply 5-10 minutes before starting of the weld.
- Set the arc voltage at 19-21 volt as required for Dip Transfer mode.
- Set the Gas Flow Rate at 5-10 LPM (Litres Per Minute).
- Set the wire feed rate so as to get 90-100 amp by striking the arc on a scrap plate.
- Use DIN 11 or 12 black/green filter glass on Hand Shield/Helmet for above current setting.
- Wear the protective clothing as required.
- Switch over to weld mode as indicated in the machine.
- Strike the arc, maintain a filler wire stick out of 8-10mm from the end of the contact tip to the job as required for dip transfer mode.
- Deposit the bead on punched lines of the job from one end to other.
- Remove spatters and slag with chipping hammer and clean the joint using carbon steel wire brush.
- Self inspect the weld bead for finish and defects.
- Compare the weld bead quality with other SMAW welding.
- If possible test the welded job by different tests.

Skill Sequence

Straight line beads on MS plate in flat position by flux cored arc welding

Objective: This shall help you to
- **inspect weld bead for weld defects.**

Prepre the plate as per drawing i.e. 150 x 100 x 10 mm.

Mark the parallel lines on the metal with the help of scriber, and try square.

Set gas pressure, current, voltage and wire feed as required.

Deposit the straight line beads on the marked lines with uniform speed.

Clean the slag & spatters and inspect the joint.

Compare the welding beads with other GMAW weld beads.

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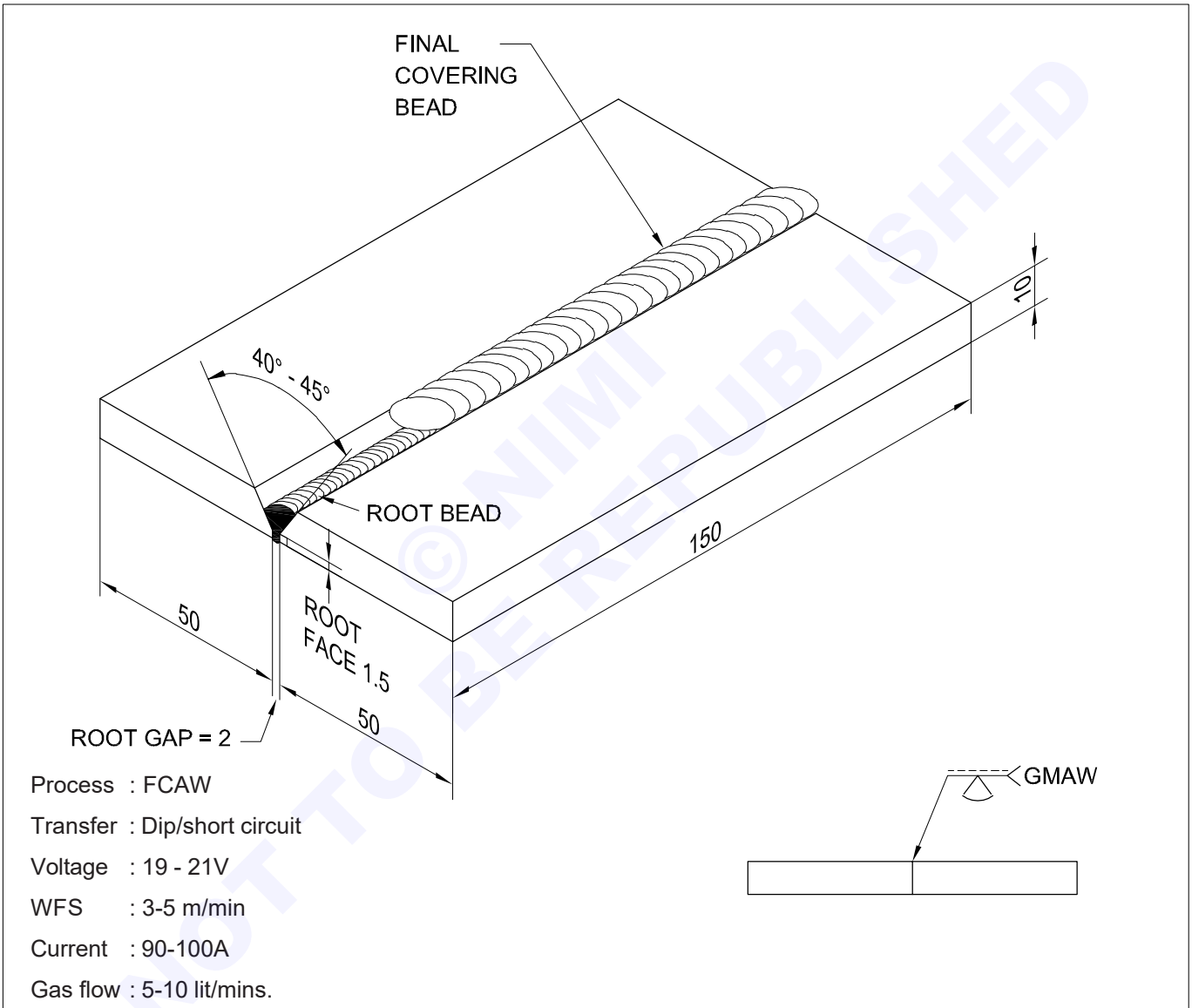
Single “V” joint by flux cored arc welding

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

- **prepare the plates with bevelling by using gas cutting and grinding**
- **prepare the plates with bevelling as per drawing**
- **set root gap and tack weld**
- **deposit the 2nd and 3rd run using weaving technique**
- **clean and inspect the weld defects.**



Process : FCAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.

2	50 ISF 10 - 150		Fe 310 - W			1.4.68
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SINGLE 'V' JOINT BY FLUX CORED ARC WELDING**				TOLERANCE ±1	TIME :
					CODE NO. WG20N1468E1	

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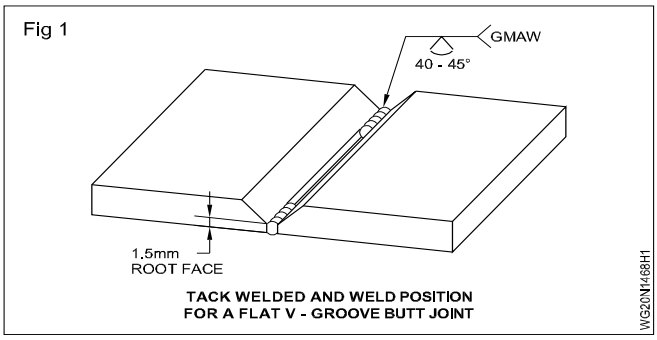
Job Sequence

1 Adjust the power source and wire feeder to obtain 18 to 19 volts and 90 and 100 amperes, gas flow 8-10 LPM.

2 Use flux cored wire spool.

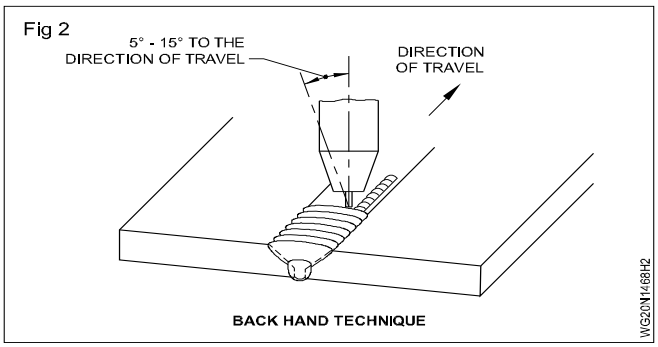
3 Thoroughly clean the pieces to be joined. Pay particular attention to the top of the plate, the sidewalls of the groove and the underside of the joint. Grind or file a 1.5mm root face on each beveled edge as shown in Fig.1.

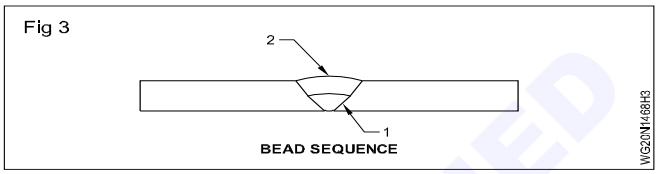


4 Tack the pieces together and position as shown in Fig.1. Put spacers under the plate so that you don't weld the plate to your table.

5 Deslag and clean the root run.

6 Complete the joint using the bead sequence shown in Fig 3. Use a slight weave to help the weld flow and to fuse to the sidewalls of the groove and the previous beads.

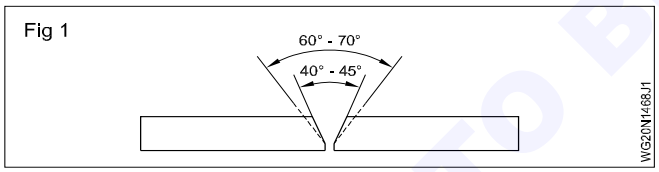




7 When you have completed the weld, cool it and examine it. The root should show full penetration along the entire length. The root reinforcement should protrude beyond the joint from 0.5 to 1mm. The face of the weld should merge smoothly with the base metal. The reinforcement should be atleast 1mm above the surface of the base metal and also should not exceed beyond 1.5.

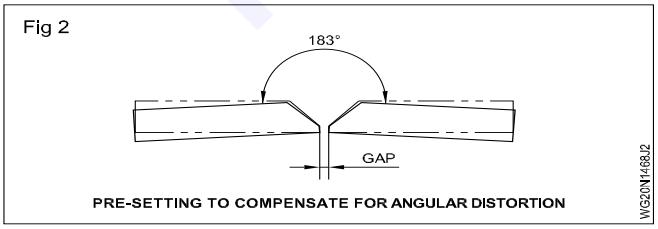
Skill Sequence

For GMAW process the plates are bevelled so that the included angle (groove angle) of the single Vee butt joint is 40 to 45^0 as shown in the Fig.4. This is less compared to MMAW groove angle which is kept at 60 - 70^0.



To control the transverse distortion it is advisable to preset the joint to 183^0 for 10mm thick plates as shown in Fig.5.

Distortion may be allowed for by pre-setting the plates in the opposite way so that the weld pulls them to the desired shape. When the weld shrinks it will pull the plate to its correct position shown by dotted line in Fig.5.



Maintaining the angle of the torch 5 to 15^0 towards the direction of travel as shown in Fig.2 in Job Sequence will help to get better root penetration.

Maintain a stick-out of 5 to 8mm (maximum 10mm)

Set a current of 80-90A for 0.8mm dia wire with a corresponding arc voltage of 18 to 19V.

Set a gas flow rate to 8-10LPM so as to protect the weld metal from atmospheric contamination.

Maintain a faster travel speed of 3 to 4m/min. to avoid burn throughs during the root run. At the same time ensure to get full and even root penetration throughout.

It is very important to clean the root run by Carbon Steel wire brush to avoid any non-metallic inclusions(slag) during the 2nd pass/run.

Set the current to 90 to 100A and an arc voltage of 19 to 20V for the 2nd run.

Maintain a slower travel speed compared to the root run for the 2nd run. Use semicircular side to side weaving movement (crescent motion) to achieve full side wall fusion without any undercuts at either end of the bead.

Maintain a dwell time (pause) of 1 to 2 seconds to get a proper, even filling at the end of the toes on either side of the bead.

Maintain a proper and even bead profile and a face reinforcement of 1 to 1.5mm.

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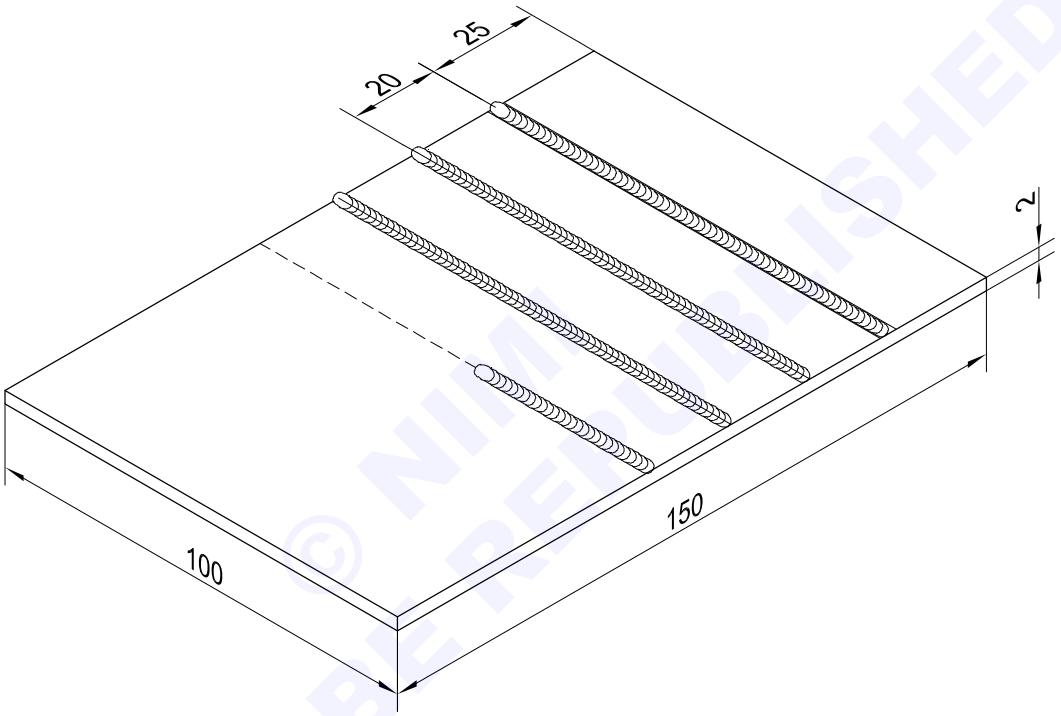
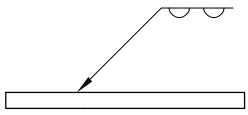
Straight line beads on S.S plate by GMAW welding

Objectives: At the end of this exercise you shall be able to
- **mark and set the plate as per drawing**
- **select filler wire and set the gas flow and current**
- **deposite the bead with are without weaving**
- **clean and inspect the weld.**



Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.



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1	100 x 150 x 2	--	X04Cr19I9	--	--	1.4.69
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**STRAIGHT LINE BEADS ON S.S PLATE BY GMAW WELDING**				TOLERANCE ±1	TIME : 10Hrs
					CODE NO. WG20N1469E1	

Job Sequence

- Prepare the job to size as per drawing.
- Clean the job surface with stainless steel wire brush.
- Mark parallel lines on the job surface as per drawing and punch the lines.
- Set the workpiece (job) on the work table in Flat position.
- Fix the 0.8mm diameter wire spool in position, lock it up and pull the wire through the guide tube, rollers, spiral and contact tip of the torch.
- Start the welding machine. Connect the Torch to the positive (DC +ve) terminal (DCRP) of the machine.
- Open the Argon gas flow before striking the arc.
- Select the mixed gas Argon 98% + Oxygen 2% or Argon 99% + Oxygen 1% for S.S.Welding by GMAW process
- Set the arc voltage at 19-21 volt as required for Dip Transfer mode.
- Set the Gas Flow Rate at 8-10 LPM (Litres Per Minute).
- Set the wire feed rate so as to get 60-80 Amp by striking the arc on a scrap plate.
- Use DIN 11 or 12 black/green filter glass on Hand Shield/Helmet for above current setting.
- Wear the protective clothing as required.
- Switch over to weld mode as indicated in the machine.
- Strike the arc, maintain a filler wire stick out of 8-10mm from the end of the contact tip to the job as required for Dip Transfer Mode.
- Deposit the bead on punched lines of the job from one end to other.
- Clean the joint using Stainless Steel Wire Brush.
- Self inspect the weld bead for finish and defects.

Skill Sequence

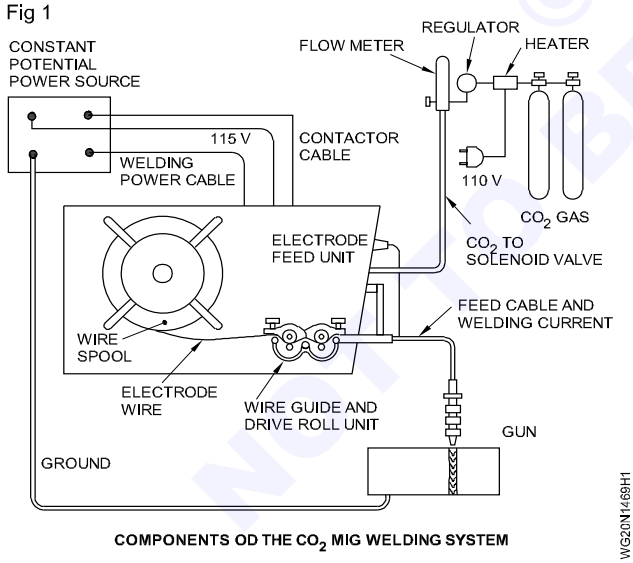
Straight line beads on S.S plate by GMAW welding

Objective: This shall help you to
- **clean and inspect the weld.**

1 **Preparation and setting of the job:** Prepare a S.S plate piece of size 150 x 100 x 3mm thick.

2 **Setting up of the GMA welding machine**

Fig 1



COMPONENTS OD THE CO_2 MIG WELDING SYSTEM

Fig 2

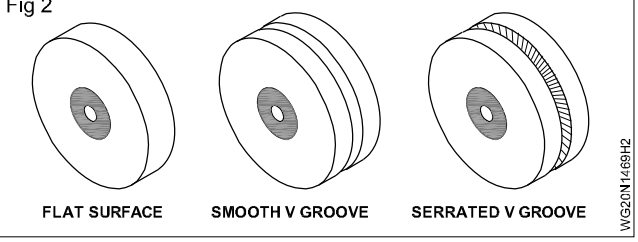
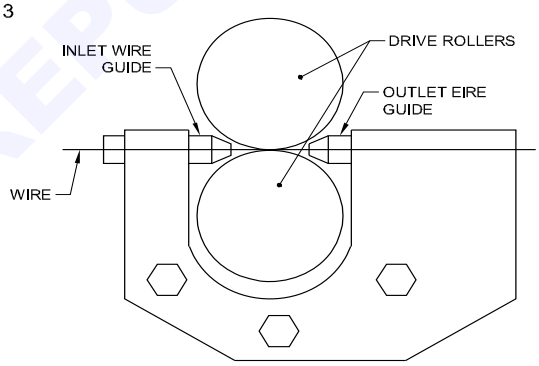
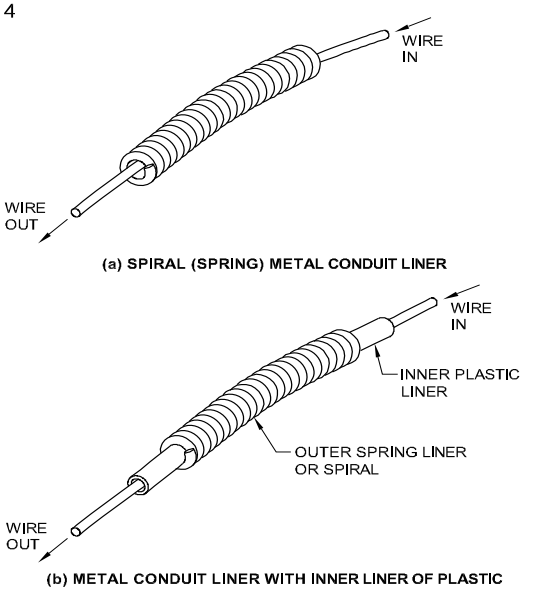


Fig 3



DRIVE ROLLS AND WIRE GUIDES PROPERLY ALIGNED

Fig 4



(a) SPIRAL (SPRING) METAL CONDUIT LINER

(b) METAL CONDUIT LINER WITH INNER LINER OF PLASTIC

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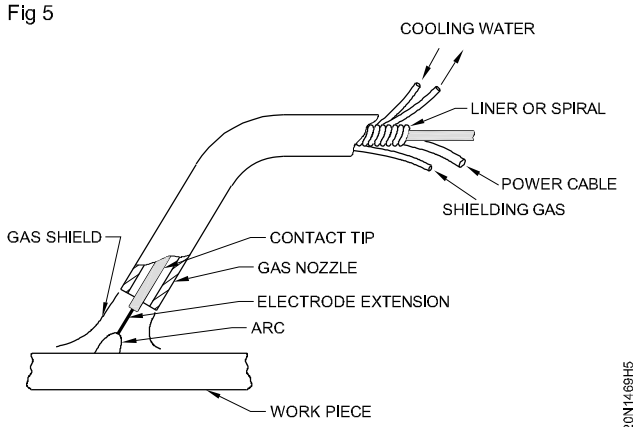
Fig 5



PARTS OF A TYPICAL WELDING GUN

The wire is further passed through the conduit liners with spring liners called spiral Fig 4 to the welding torch outlet through the contact tip. (Fig 5)

The wire should not develop any bends (or) kinks while inserting.

The contact tip should be removed to facilitate easy flow of the wire from the spiral and put in position into the Torch later.

Start the MIG welding machine after the machine is connected to the 3 phase supply mains.

Connect the welding torch to the positive terminal.

The positive terminal influences deeper, wider weld penetration with a good ripple formation.

Fix a two stage regulator using a flat spanner to the outlet end of the gas heater and ensure proper functioning of the dialgauges.

Connect finally the flow meter, gas hose to the welding torch/gun.

Set an outflow pressure for argon gas to get a gas flow of 8 to 10 LPM as required for the dip transfer mode.

Ensure to avoid leakage at all connections so as to get correct pressure at the nozzle end. This could be checked by using soap-water solution. When used with correct gas flow rate a rapid cracking and hissing sound shall be heard. Too little flow results in porosity and too high flow rate creates turbulances and in turn contaminates weld.

3 Setting up arc voltage, stickout and wire feed rate of dip transfer

Setting the current level by selecting proper wire feed rate: For this exercise of depositing straightline beads it is desirable to select a smaller diameter wire i.e. 0.8mm dia wire and Dip Transfer method. Accordingly a current range of 80-100A is to be set for the 0.8mm dia wire. The current to be set has a direct relationship with the wire feed rate in Co_2 welding/GMAW process. So the correct wire feed rate corresponding to the 80-100A current is set on the Electrode Feed unit of the machine.

4 Setting appropriate arc voltage for the corresponding current used:

5 Setting the stick-out:

6 Welding procedure (depositing the beads):

Fig 6

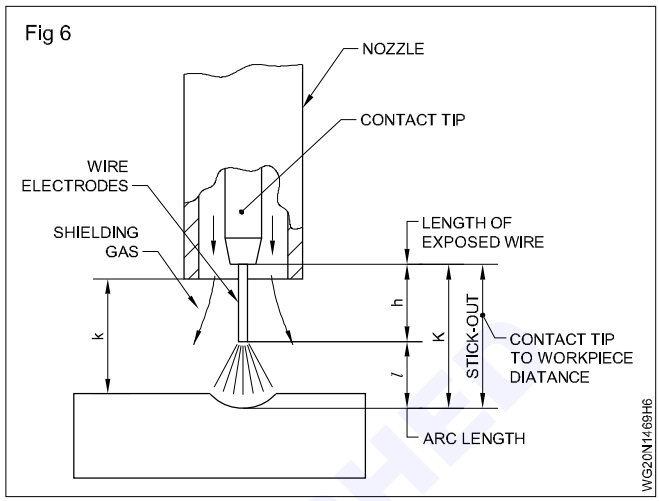


Fig 7

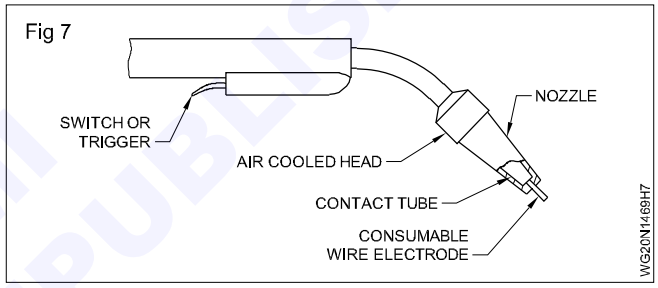
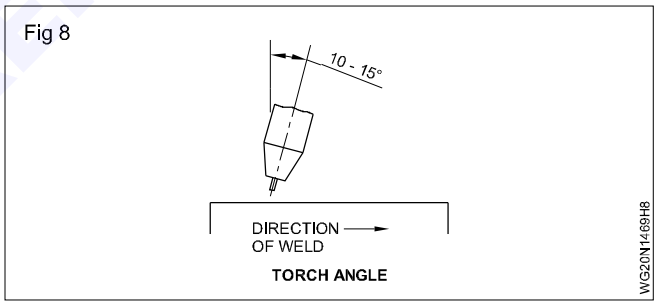


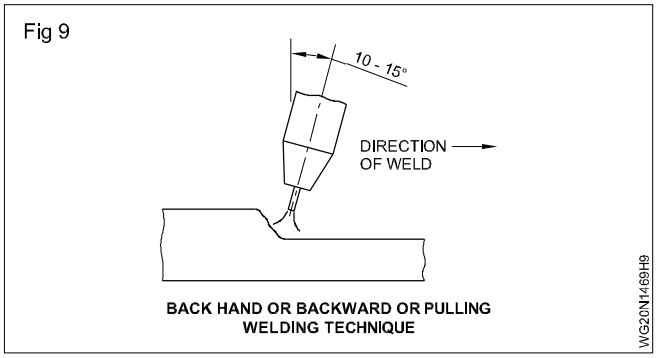
Fig 8



TORCH ANGLE

Move the torch uniformly starting from the left end of the job towards the right end or from the right end to the left end of the job Fig.9 and 10. Based on the welding direction, the welding technique is called as Backhand or Backward or Pulling technique Fig.9 and Forehands or Forward or Pushing technique (Fig.10).

Fig 9



BACK HAND OR BACKWARD OR PULLING WELDING TECHNIQUE

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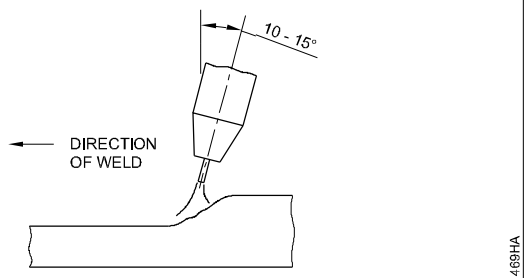
Fig 10



FORE HAND OR FORWARD OR PUSHING
WELDING TECHNIQUE

WG20N1469HA

Use anti spatter spray or Gel periodically to avoid the sticking of the spatter at the mouth of the torch nozzle.

Ensure the crater is filled properly at the end of the bead as done in shielded metal arc welding.

Avoid excessive travel speeds for the torch to get correct bead width, height and ripple formation and to avoid undercut.

Cleaning the weld bead: The spatters, if present, on the surface of the bead and base metal are to be removed by using a chipping hammer. Also use protective goggles for safety. Further the bead has to be cleaned by carbon steel wire brush to remove any non-metallic deposits on the bead.

Repeat the above procedure for other runs done alternately by both Forehand and Backhand techinques (push and pull welding).

Inspecting the finished welded job: Use visual inspection method to verify whether any weld defects such as undercut, uneven bead width, height, ripple formation and wavy line of bead are there.

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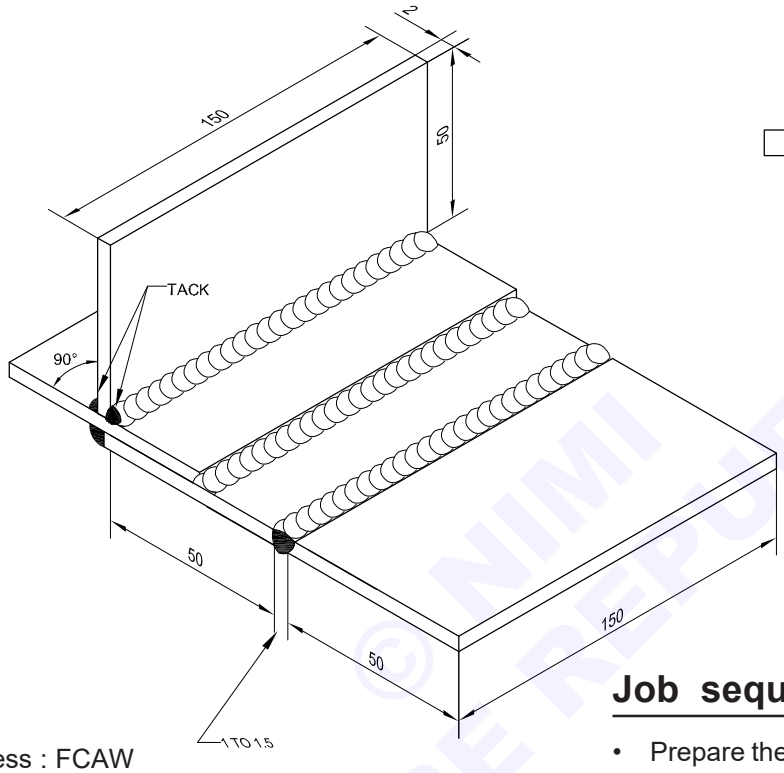
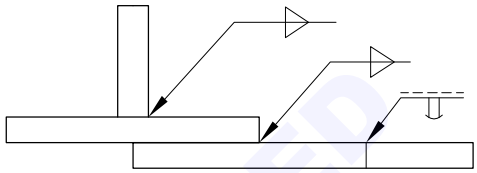
Exercise 1.4.70

Lap & square butt and Tee joint on S.S sheet

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

- **prepare the sheets as per drawing**
- **set and tack the sheets to correct alignment**
- **deposit the weld metal**
- **clean and post treat the job.**





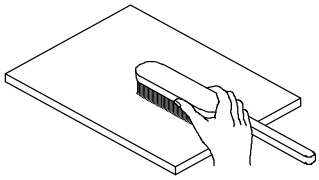
Process : FCAW
Transfer : Dip/Short circuit
Voltage : 19-21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins

Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.

Job sequence

- Prepare the sheets as per drawing and remove the burrs by filing.
- Clean the surface of the plates by using S.S wire brush as per Fig 1.

Fig 1



- Set the sheets in the form of lap, square butt and tee joint on the welding table use clamps to avoid distortion as per Fig 2,3 &4.
- Set the GMA welding plant

4	ISST 50 x 2 - 150		X04Cr1919			1.4.70
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	LAP,SQUARE BUTT AND TEE JOINT ON S.S SHEET IN FLAT POSITION BY GMAW				TOLERANCE ±0.5	TIME :
					CODE NO . WG20N1470E1	

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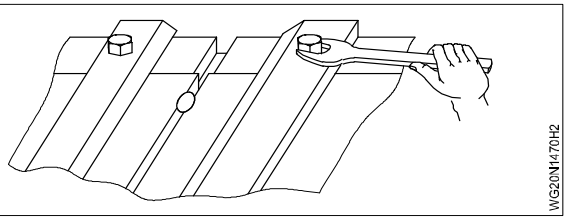
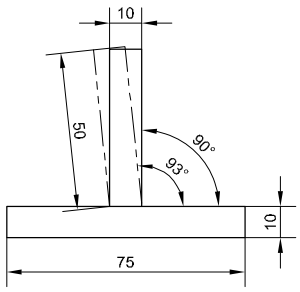
Fig 2



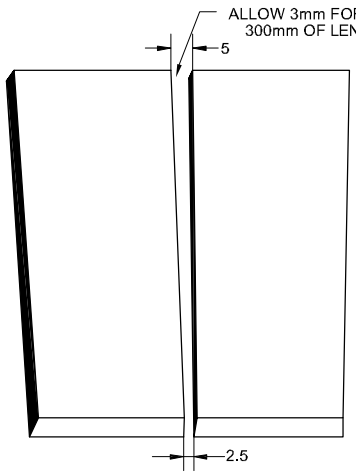
WG20N1470H2

Fig 3



WG20N1470H3

Fig 4



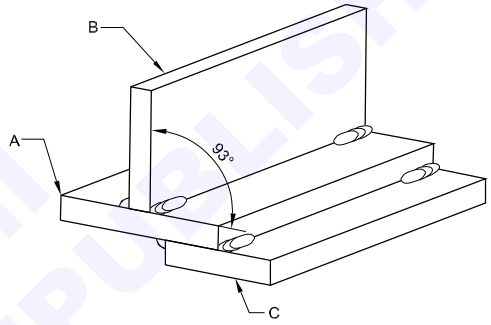
PROVIDE A SPACE BETWEEN THE EDGES TO BE WELDED

WG20N1470H4

Wear safety Gadgeds

- Fix ϕ 0.8mm S.S wire spool in the wire feeder unit and pull the wire through the guide tube, rollers, spiral and contact tip of the torch.
- Connect the torch with positive terminal (DCRP) of the machine and start the welding machine.
- Open the Argon gas flow before striking the arc and set 8 to 10 LPM gas flow.
- Set the arc voltage to 19 to 20 volts as required for dip transfer mode.
- Set the wire feed rate so as to get 90-100 Amp by striking the arc on a scrap plate.
- Tack the plate as per Fig 5 & 6.
- Deposit the metal on lap, tee and square butt joint with appropriate penetration, reinforcement, leg length along with defect free welding.
- Avoid under cut and ensure the edges of sheets is not melted of due to excess weaving.
- Clean the beads throughly by Stainless steel wire brush and remove the spatters.
- Inspect the weld joint for under cut, uneven bead, edge of the plate melted off, distortion and good bead profile.
- Heat the welded job to 900ºC - 1100ºC and quench in the water to avoid weld decay.

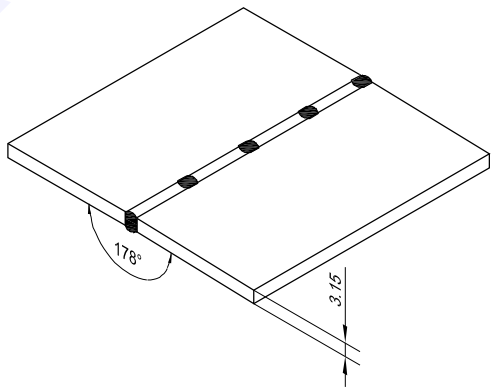
Fig 5



SETTING AND TACKING A TEE JOINT AND LAP JOINT

WG20N1470H5

Fig 6



WG20N1470H6

Skill Sequence

Lap & square butt and Tee joint on S.S sheet

Objective: This shall help you to
- **clean and post treat the job.**

Ensure setting of the tee, lap and square butt joint as per drawing.

Tack weld at regular intervals so that the plates are set to form in the correct alignment.

Lack of penetration is avoided by using correct arc length, root gap and travels speed.

Post treat the welded job to avoid weld decay.

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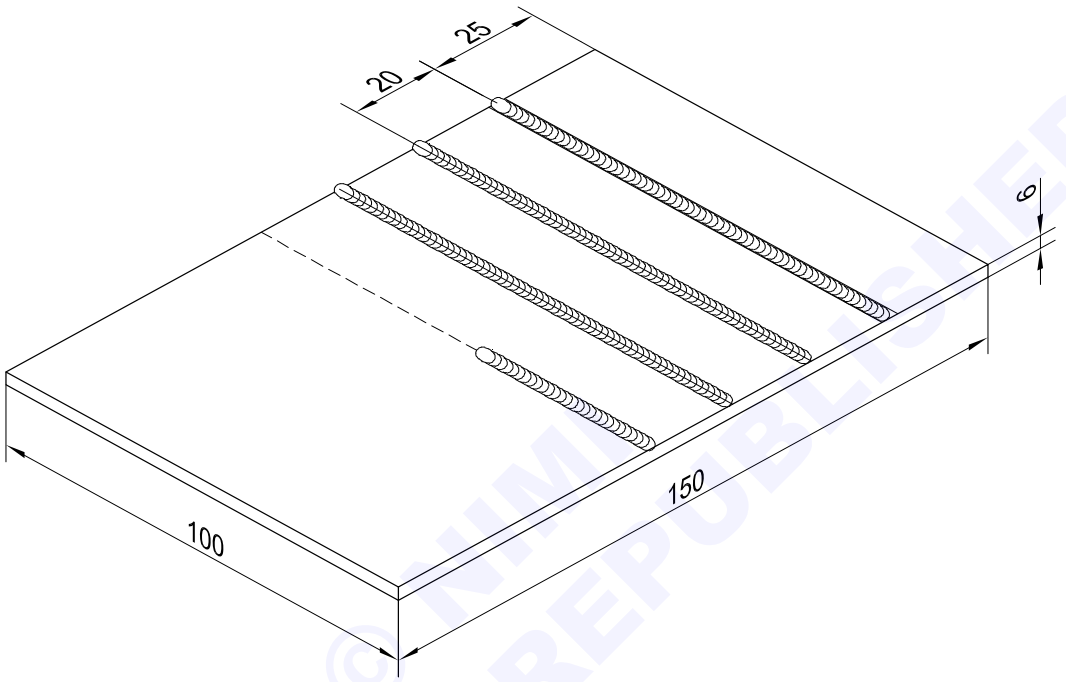
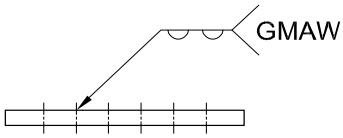
Straight line bead on aluminium plate by GMAW Welding

Objectives: At the end of this exercise you shall be able to
- **prepare the plate as per drawing**
- **deposit weld bead by using.**





Process : GMAW
Transfer : Dip/short circuit
Voltage : 19 - 21V
WFS : 3-5 m/min
Current : 90-100A
Gas flow : 5-10 lit/mins.

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1	100 x 3 x 150	--	AL.199990 - IS 737	--	--	1.5.71
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	**STRAIGHT LINE BEADS ON ALUMINUM PLATE BY GMAW WELDING**	TOLERANCE ±1	TIME : 9Hrs
		CODE NO. WG20N1571E1	

Job Sequence

- Prepare the aluminium sheet as per drawing
- Clean the surface with S.S wire brush
- If need, do the chemical cleaning with acetone / alcohal to remove the grease and surface oxide.
- Draw the parallel lines and punch mark them as per dimensions.
- Set the job in flat position.
- Select ø1.6mm aluminium filler wire (5% silicon).
- Switch on the welding machine.
- Set the wire feed rate to 3 - 4m/min.
- Set the arc voltage 19 to 21v and 90 to 100amps current.
- Fix argon gas cylinder and gas flow is 8 - 10litres/min.
- Strike the arc, maintain a filler wire stick out to 8 - 10mm from the end of the contact tip to the job as required.
- Deposit the bead on punched lines of the job from one end to other.
- Remove spatters with chipping hammer and clean the joint using S.S wire brush.
- Self inspect the weld bead for defects.

Skill Sequence

Straight line bead on aluminium plate by GMAW Welding

Objectives: At the end of this exercise you shall be able to
- **deposit weld bead by using.**

Prepare a aluminium plate of size 150 x 100 x 2mm

Mark Straight line with punch marks.

Set the job on the welding table in flat position as done in the earlier exercises.

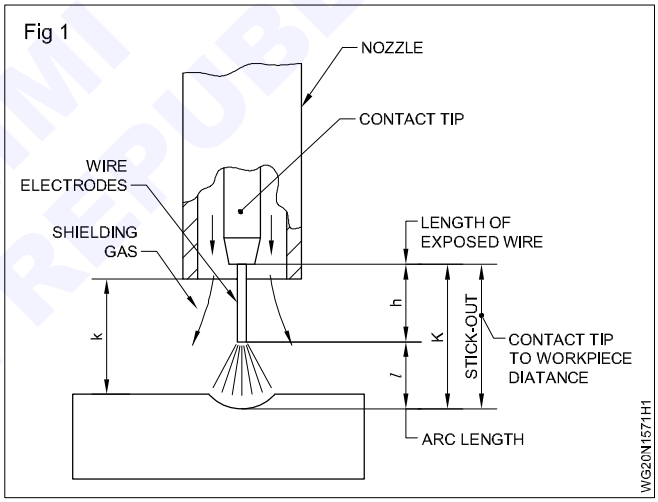
Set the GMA welding machine and gas assembly.

Setting up arc voltage stick out and wire feed rate.

Deposit the straight line beads on the sheet.

Clean the weld bead and inspect the joint.

Fig 1



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Single 'V' and Tee fillet joint on aluminium plate

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

- **prepare the plates as per drawing and bevelled**
- **set the joint and tack weld**
- **tack weld in both ends**
- **select parameter and deposit weld beed**
- **process and check the defects.**

Process : GMAW

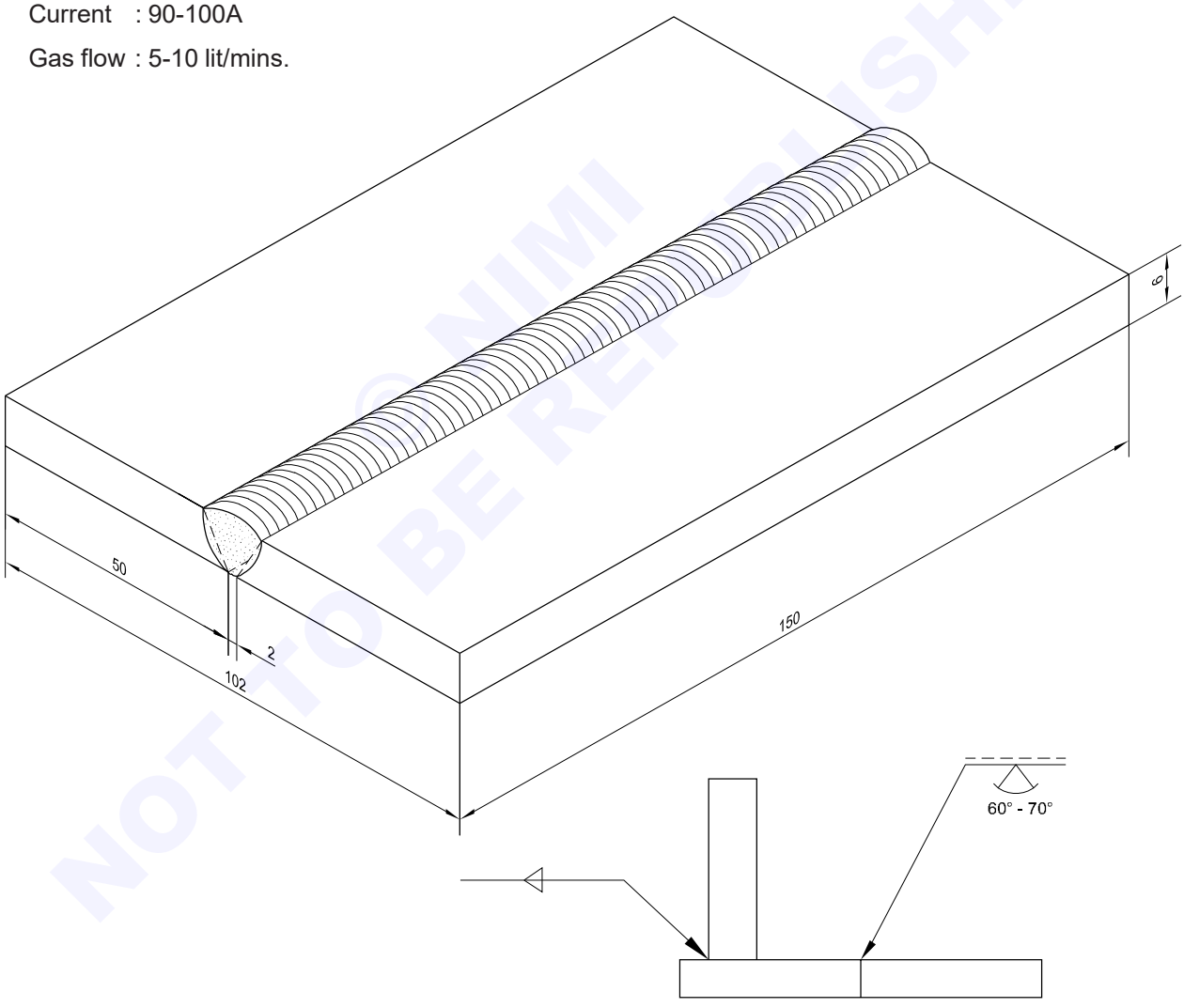
Transfer : Dip/short circuit

Voltage : 19 - 21V

WFS : 3-5 m/min

Current : 90-100A

Gas flow : 5-10 lit/mins.



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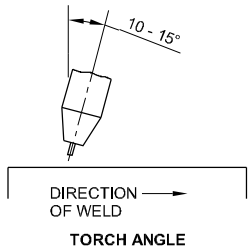
3	ISF 150 x 50 x 6					1.5.72
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	SINGLE VEE AND FILLET TEE JOINT ON ALUMINIUM PLATE IN FLAT POSITION BY GMAW				TOLERANCE ±1	TIME : 25Hrs
					CODE NO . WG20N1572E1	

Job Sequence

- Prepare the aluminium plates as per drawing and prepare the edges for bevelling
- Sheet edges clean throughly to used steel wire brush
- Process the straight line bead and punch.
- Workpiece set the welding table in down hand position.
- Select ø1.6mm aluminium filler wire with 5% silicon.
- Turn on the machine.
- Select the amps 90-100; arc voltage 18-21v.
- Select argon cylinder and filler wire stick our 8-10mm.
- Process the weld bead straight

Fig 1



- Clean the spatter to use chipping hammer.
- Visual inspect.

Skill Sequence

Single 'V' and Tee fillet joint on aluminium plate

Objectives: At the end of this exercise you shall be able to
- **process and check the defects.**

Prepare the aluminium plates of size 150 x 50x 6mm

Set the edges without sharp.

Process the line straight line.

Parameter setting Amps and volts.

Check the single Vee bevelling and process the root face.

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Setting up of GTA welding plant and establishing the arc

Objectives: At the end of this exercise you shall be able to
- **identify the equipment and accessories of GTAW**
- **operate the GTAW machineries**
- **set the parameters of GTAW**
- **select and prepare the electrode.**

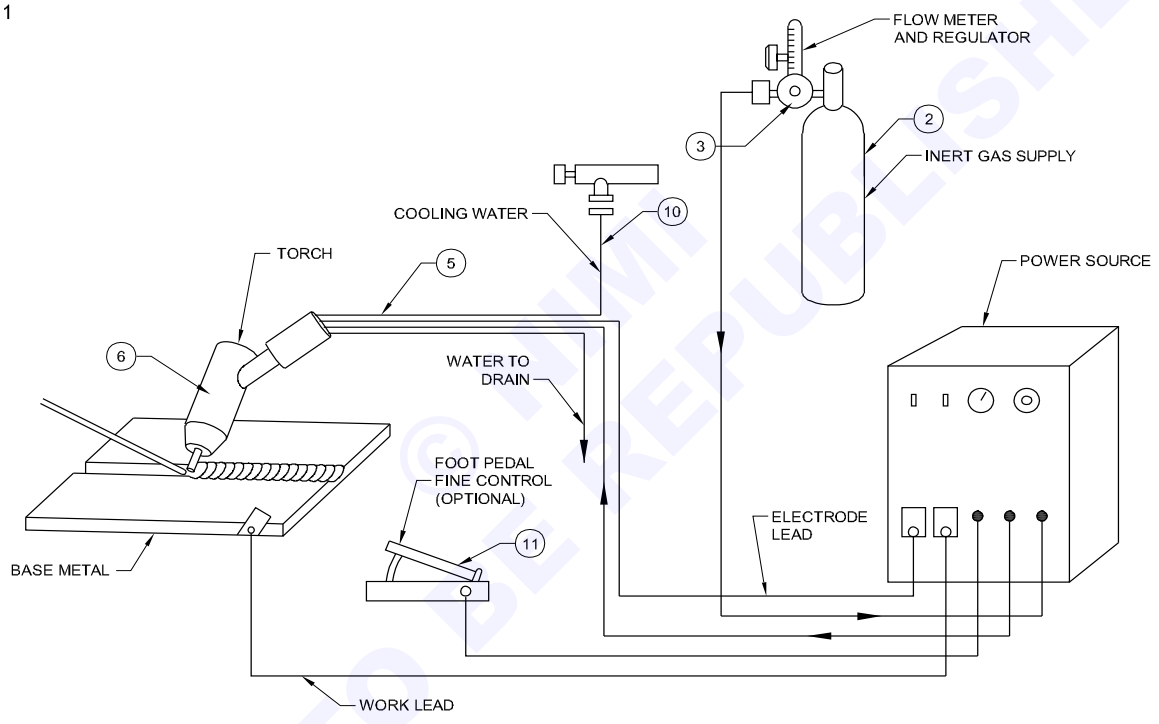
Process : GTAW

Tungsten electrode = 2.4 mm(Thoriated/ceriated)

Current - Argon = 80-100Amps (DCEN)

Gas flow - Argon : 3-4 LPM

Fig 1



A DIAGRAMMATIC DRAWING OF A COMPLETE GAS TUNGSTEN ARC WELDING

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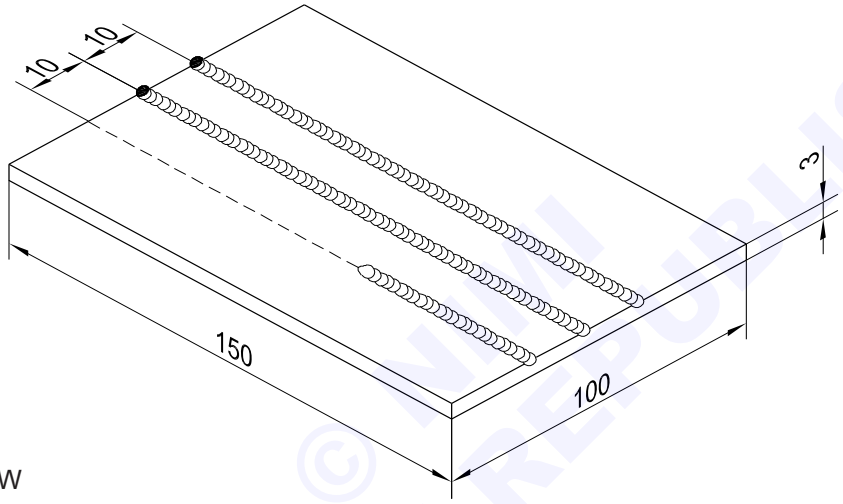
Tig Welding

1 Welding Machine
2 Argon Gas cylinder with flow meter and
3 Gas cylinder
4 Gas flow meter
5 Gashoses and attachment
6 Tig welding torch
7 Tig welding tungsten electrode
8 Filler rod
9 Extra needed tig welding tools
10 Water bucket
11 Foot Switch

Beading practice in MS sheet by GTAW

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **deposit weld bead with filler rod in flat position**
- **clean and inspect the surface defects.**

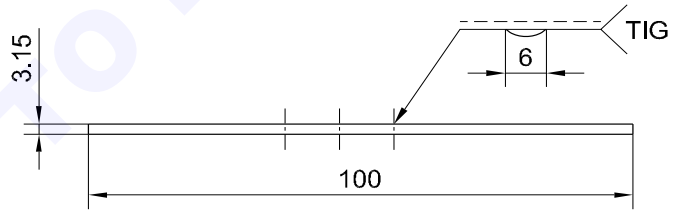


Process = GTAW

Tungsten electrode = 2.4 mm (Thoriated/ ceriated)

Current = 80-100 amps (DCEN)

Gas flow - Argon = 3-4 LPM



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1	ISST 100 x 3-150	--	Fe 310	--	--	1.5.74
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	BEADING PRACTICE ON MS SHEET BY GTAW	TOLERANCE ±1	TIME : 8Hrs
		CODE NO. WG20N1574E1	

Job Sequence

- Prepare the job as per drawing.
- Clean the sheet without rust formation.
- Weld process line marking and punching.
- Set the piece to welding table.
- Use ϕ2.mm tungsten rod 2.0mm arc (2% thorium mided)
- Select the polaring to electrode negative.
- Select 1.6ϕ ccms filler rod .
- Current setting 80 - 90 amps.
- Turn "ON" the machine.
- Beforte welding open the gas value.
- Fix argon gas flow rate.
- Torch 6° 60°- 70° process to start left to right.
- Electrode tip at 3 mm distance to the base metal.
- Slow speed to narrow line maintain travel speed.
- Correct filler size maintain.
- Torch 6° and hand speed should maintained.

Skill sequence

Beading practice in MS sheet by GTAW

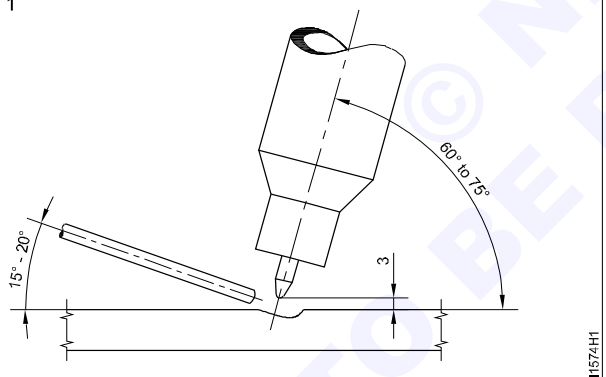
Objectives: At the end of this exercise you shall be able to
- **clean and inspect the surface defects.**

Feed the filler rod carefuly maintained.

Torch 6° speed of travel even maintain.

Hold the torch 6°- 90° setting up of are voltage, current and sustions .

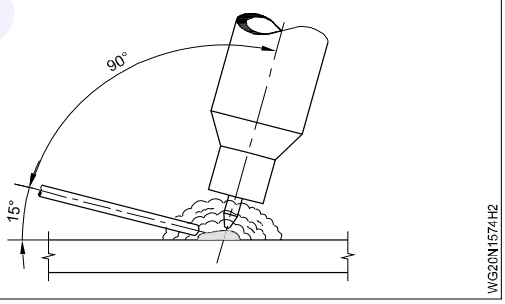
Fig 1



THE RELATIVE POSITIONS OF THE ELECTRODE AND FILLER ROD FOR GTAW

Not proper clean the sheet and rust filler rod to form the under cut carefully.

Fig 2



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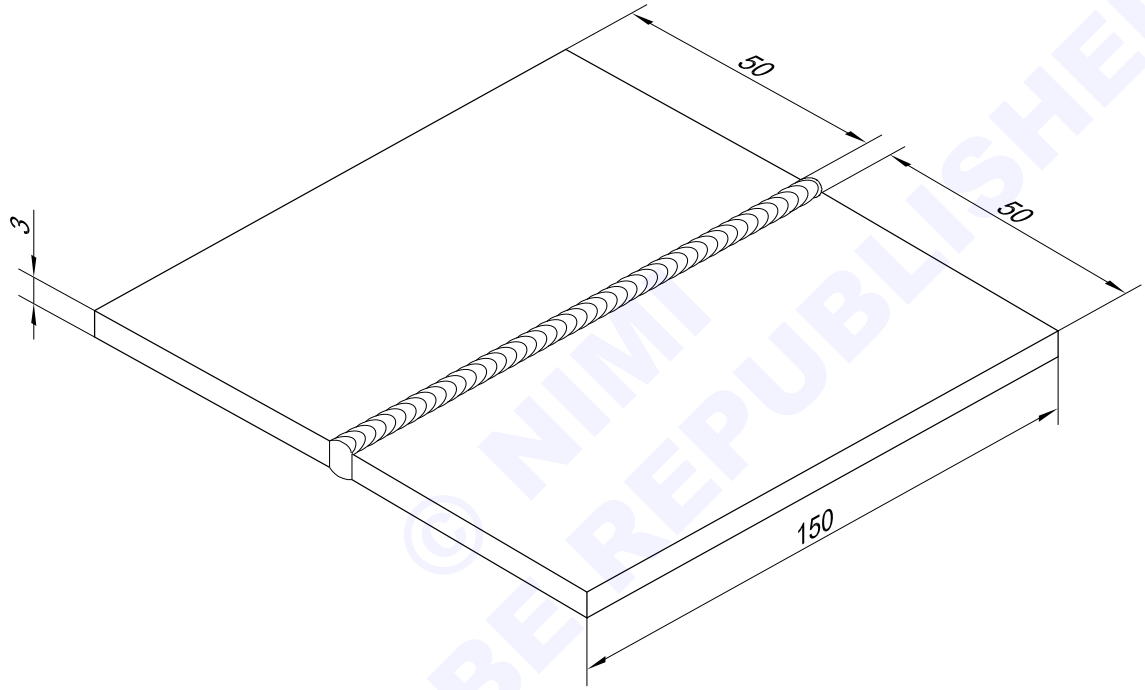
Square butt joint on MS in downhand position

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

- **select and set the electrode size, filler rod, current, gas flow rate and polarity**
- **weld the joint using proper torch angle and filler rod**
- **weld the joint without distortion, weld defects.**

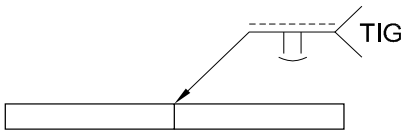


Process : GTAW

Tungsten electrode = 2.4 mm(Thoriated/ceriated)

Current - Argon = 80-100Amps (DCEN)

Gas flow - Argon : 3-4 LPM



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2	ISST 50x3 - 150	--	Fe 310	--	--	1.5.75
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT JOINT ON MS IN DOWN HAND POSITION	TOLERANCE ±1	TIME :
		CODE NO. WG20N1575E1	

Job Sequence

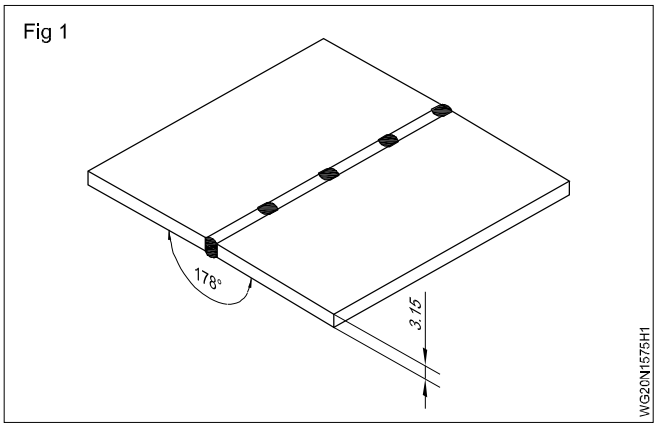
- Prepare the job pieces of size 150 x 50 x 3mm - 2 Nos.

Setting and tacking

- Set the prepared job pieces on the welding table with a uniform root gap and in alignment. (Fig.1)

Ensure that there is a uniform gap of 2mm. Preset the sheets; give an allowance of 2^0.

Fig 1



- Tack-weld the joint at equal intervals of 50mm to hold them together, maintaining the alignment. (Fig.1)
- Ensure that the
  - distance between the tack-welds is 50mm.
  - length of the tack-weld is 6mm and with full penetration.

Tack welds should be on the side to be welded and in line with the joint.

- Weld the tack welded job from right to left holding the torch and filler rod at proper angle and using uniform travel speed.
- Ensure root penetration using keyhole technique.
- Fill the crater properly.

Skill Sequence

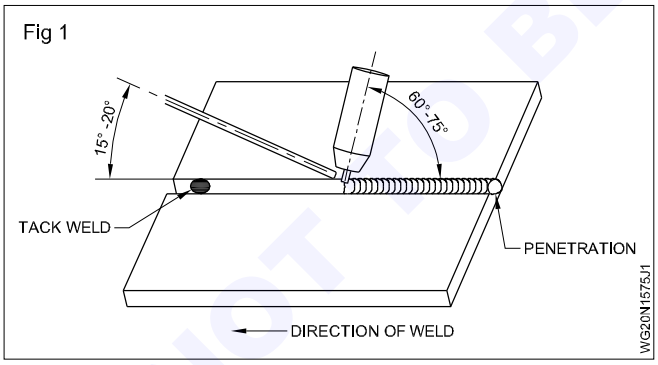
Square butt joint on MS in downhand position

Objectives: At the end of this exercise you shall be able to
- **weld the joint without distortion, weld defects.**

Welding : Keep free space under the joint for complete penetration.

Start the weld from the right end of the joint. (Fig 1)

Fig 1



Manipulate and hold the torch and filler wire as shown in Fig 1.

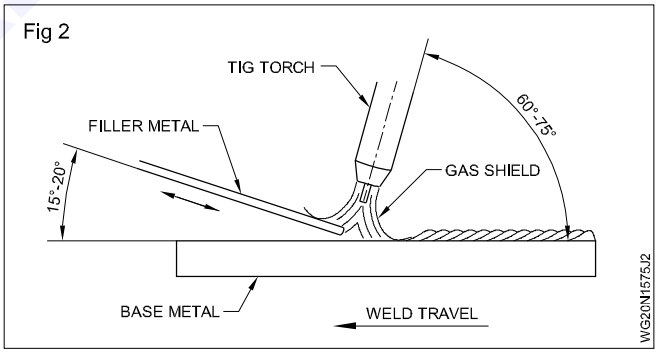
Weld a well fused uniform bead with complete penetration using leftward technique. (Fig 1)

Maintain uniform travel speed of 15cm/min. for the torch and piston like motion to the filler rod (Fig 2).

Maintain a keyhole for better root penetration.

Clean the deposited bead.

Fig 2



Inspect the quality of weld by:

- checking the finish of the job
- checking the alignment (remove distortion if any)
- checking the uniformity of width and height of the weld bead in size.
- checking the uniformity of the ripples, fusion and complete penetration. (Fig 3)
- checking that the weld is free from faults such as undercut, lack of fusion, unfilled crater, porosity etc.

Checking that the weld is free from faults such as undercut, lack of fusion unfilled crater, porosity etc,

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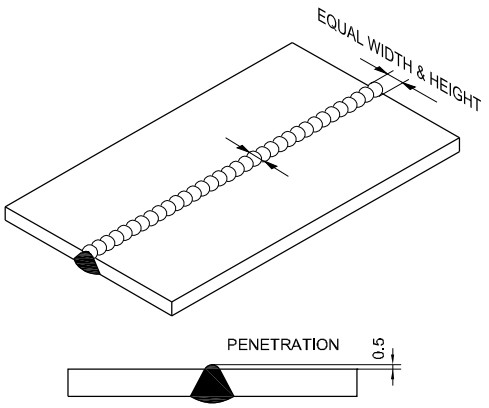
Fig 3



Cut the welded joint into specimen pieces with a hacksaw (Fig 4)

Test the specimen piece for 'free root bend test using a bench vice and hammer (Fig 5)

Fig 4

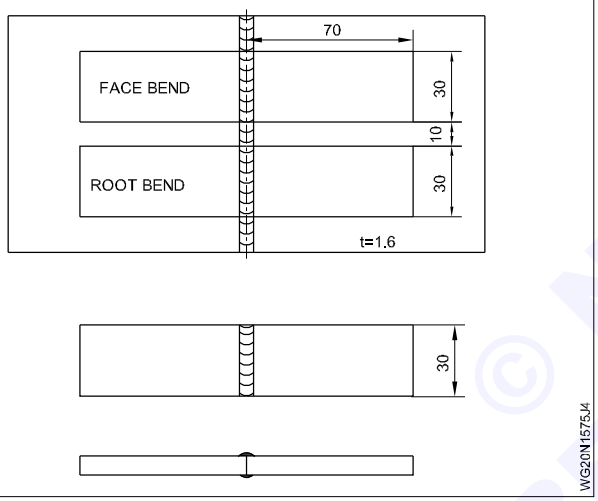
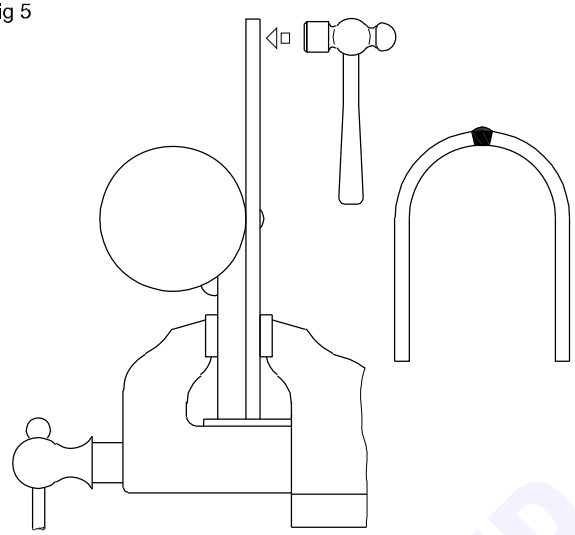


Fig 5



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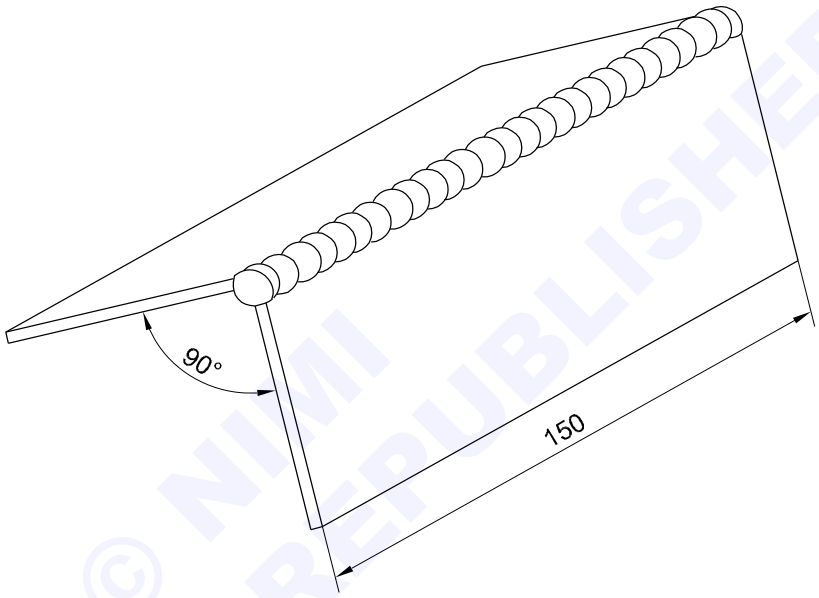
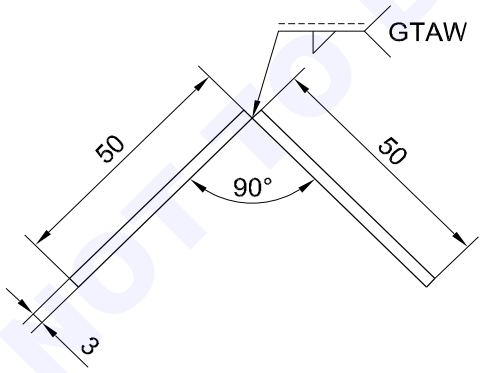
Open corner joint on M.S in flat position by GTAW

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

- **weld outside corner joint in M.S sheet 2mm thickness using TIG welding process.**





Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM

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2	ISST 50 x 3 - 150	--	Fe310	--	--	1.5.76
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

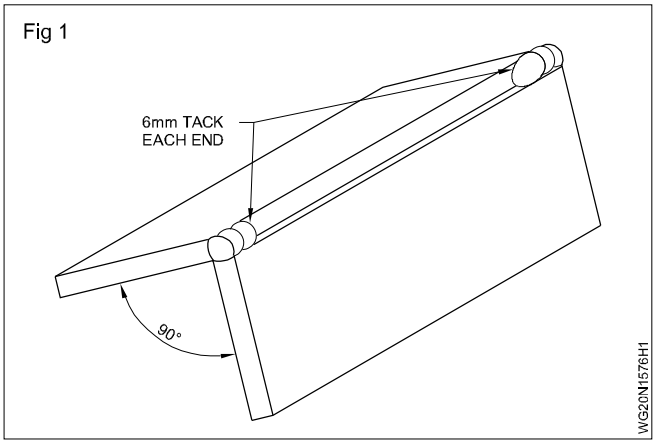
SCALE NTS	OPEN CORNER JOINT ON MS SHEET IN DOWN HAND POSITION.	TOLERANCE ±1	TIME :
		CODE NO. WG20N1576E1	

Job Sequence

- Prepare the job pieces of size 150 x 50 x 2mm.
- Set the prepared job pieces on the welding table with a proper root gap and in alignment.
- Tack-weld the joint at equal intervals of 50mm to hold them together, maintaining the alignment.

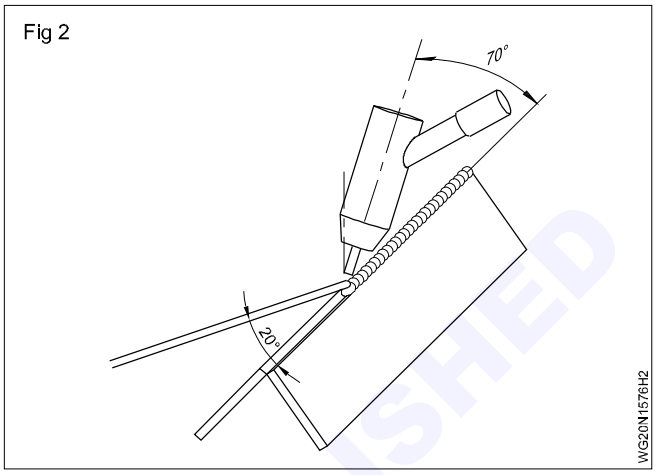
Length of the tack-weld should be 6mm with full penetration Fig 1.

Fig 1



- Weld the tack welded job from right to left holding the torch and filler rod at proper angle and using uniform travel speed Fig 2.
- Ensure root penetration using key hole technique.
- Fill the crater properly.

Fig 2



Skill Sequence

Open corner joint on M.S in flat position by GTAW

Objectives: At the end of this exercise you shall be able to
- **weld outside corner joint in M.S sheet 2mm thickness using TIG welding process.**

Start the weld from the right end of the joint and keep free space under the joint for complete penetration.

Manipulate and hold the torch and filler wire.

Maintain uniform travel speed of 15cm/min. for the torch and piston like motion to the filler rod.

Clean the deposited beads.

Check the unformity of ribbles, fusion and complete penetration.

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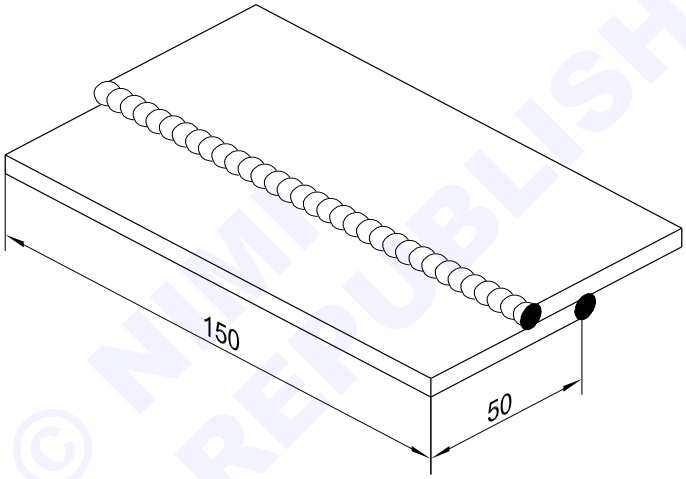
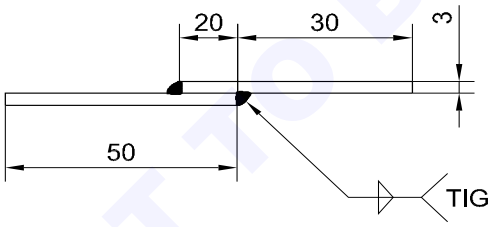
Lap joint on M.S sheet in downhand position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **set and tack weld**
- **deposit weld bead by using filler rod**
- **clean and inspect the weld defects.**





Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM

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2	50 x 3-150	--	Fe310	--	--	1.5.77
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	LAP JOINT ON MS SHEET IN DOWN HAND POSITION				TOLERANCE ±1	TIME :
					CODE NO. WG20N1577E1	

Job Sequence

- Prepare the job as per drawing and clean the edges.
- Set the job on the welding table to form a lap joint with the recommended overlapping (refer to drawing).
- Set the GTAW plant.
- Select the appropriate ϕ of electrode.
- Tack the pieces at both ends and also in the centre using 3mmϕ filler rod.
- Manipulate the torch and filler rod with recommended angle.
- Weld and complete the job.
- Clean thoroughly using the stainless steel wire brush.
- Inspect the correct size of fillet weld, slight convexity, uniform width and height, uniform ripples without any surface defects.
- Repeat the exercise till you get good results.

Skill Sequence

Lap joint on M.S sheet in downhand position

Objectives: At the end of this exercise you shall be able to
• clean and inspect the weld defects.

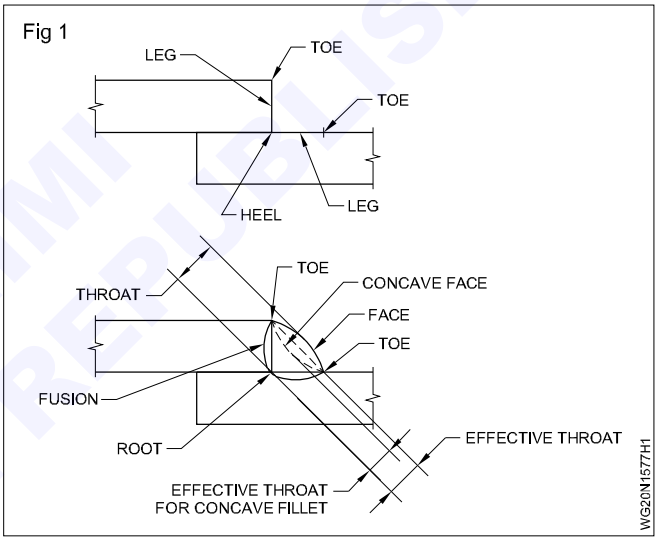
Penetration must be obtained completely without undercut and melting off of the edge of the upper plate.

Equal leg length and smooth ripple appearance to be maintained.

In this lap joint, legs, toes, effect throat and other condition should full fill. Refer Fig.1.

Ensure the edge of the top sheet is not melted away. Avoid concentrating the arc for longer time at the top edge of the top sheet.

Fig 1



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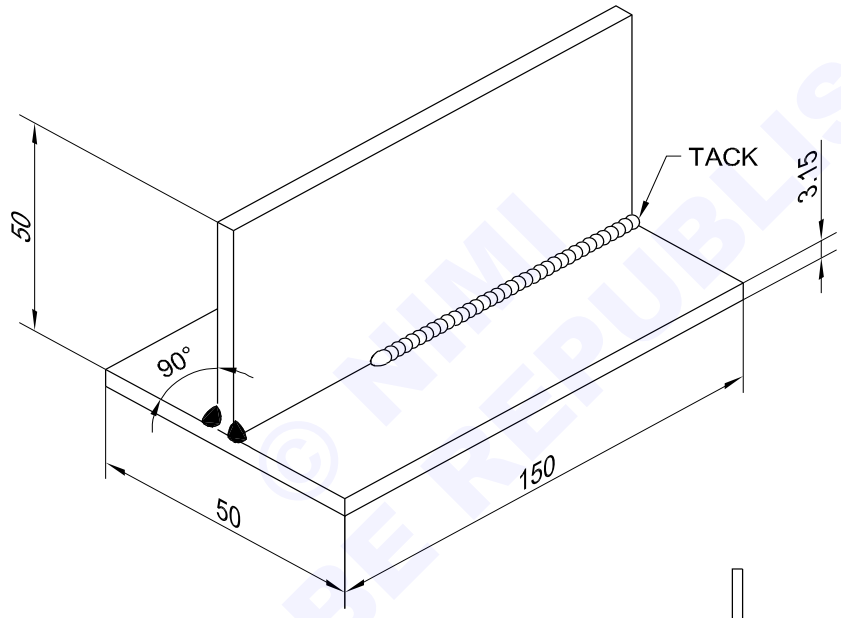
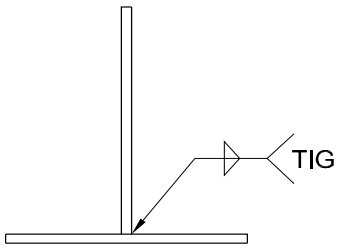
Tee joint on MS sheet in downhand position

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

- **set and tack plate pieces as per drawing**
- **set the current, gas flow rate, polarity**
- **select a proper filler rod, shielding gas and electrode size for welding**
- **weld the Tee joint in flat position**
- **clean and inspect weldment for weld defects.**





Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM

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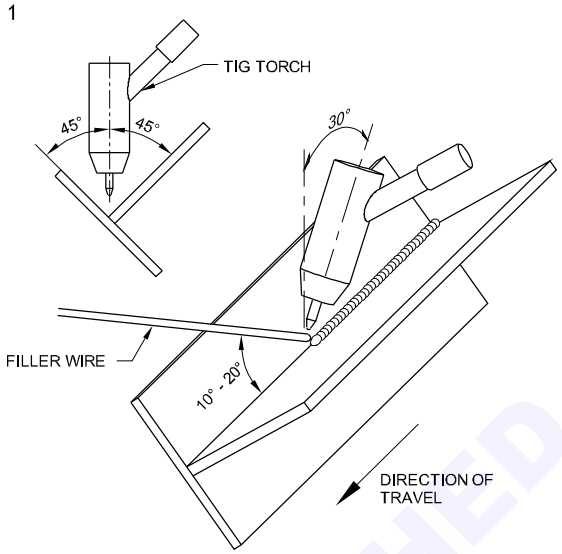
2	ISST 50x3 - 150	--	Fe 310	--	--	1.5.78
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	TEE JOINT ON MS SHEET IN DOWN HAND POSITION	TOLERANCE ±1	TIME :
		CODE NO . WG20N1578E1	

Job Sequence

- Prepare job pieces as per drawing.
- Clean the surfaces and edges of the sheets to be welded.
- Wear safety apparels.
- Select the dia of electrode, filler rod, current and electrode polarity (DCEN), argon gas flow rate and the rate of travel of the torch and filler rod as given in Table 1
- Set the sheets and tack weld in the form of a 'Tee' joint on the welding table in flat position as in Fig.1.
- Ensure the torch and filler rod are held at the required angle and moved as in Fig.1.
- Fill the crater.

Fig 1



Skill Sequence

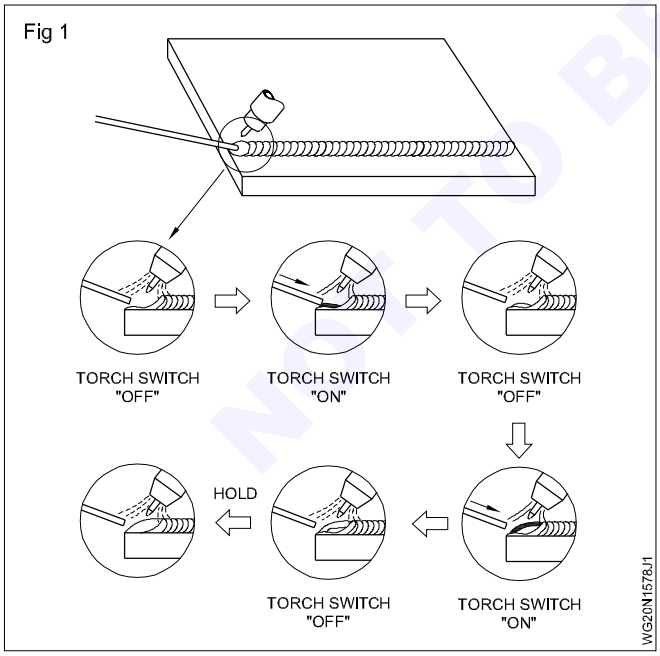
Tee joint on MS sheet in downhand position

Objectives: At the end of this exercise you shall be able to
- **clean and inspect weldment for weld defects.**

Manipulate the torch and filler rod in correct position with respect to the job. Stop the weld at the left hand edge of the joint after filling up in the crater at the end of the weld.

At the end of welding, perform the crater filler treatment by repeating the torch switch "ON-OFF".Fig.1.

Fig 1



Cut the arc and hold at the finishing point until molten metal solidifies.

Visual inspection: Slight convexity, uniform width, uniform ripples and free from undercut at the toes of the weld indicate a smooth job.Fig.2.

Fig 2

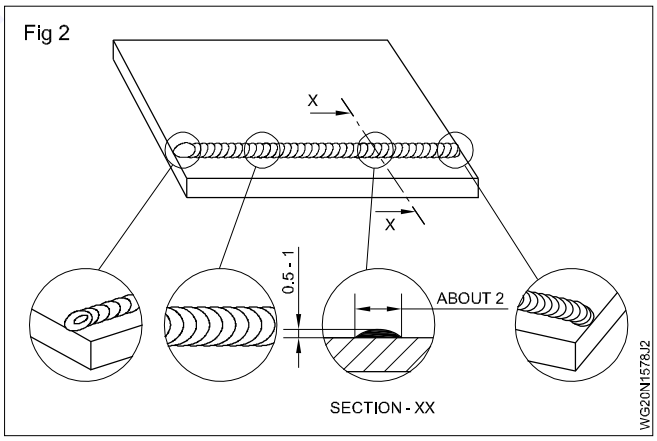


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Table 1

Variables for TIG welding mild steel using DCEN

Metal thickness in mm	Joint type	Tungsten electrode diameter in mm	Filler rod diameter (if reqd) in mm	Amperage	Argon gas flow rate in litres/min.	Arc travel speed in cm/min.
1.6	Butt & Corner	1.6	1.6	60 – 70	7.0	22.5
1.6	Fillet	1.6	1.6	70 – 90	7.0	22.5
3.15	Butt & Corner	2.4	2.4	80 – 100	7.0	15.0
3.15	Fillet	2.4	2.4	90 – 115	7.0	22.5
5	Butt & Corner	2.4	3.15	115 – 135	9.5	12.5
5	Fillet	2.4	3.15	140 – 165	9.5	17.5
6.3	Butt & Corner	3.2	4.0	160 – 175	9.5	10.0
6.3	Fillet	3.2	4.0	170 – 200	9.5	12.5

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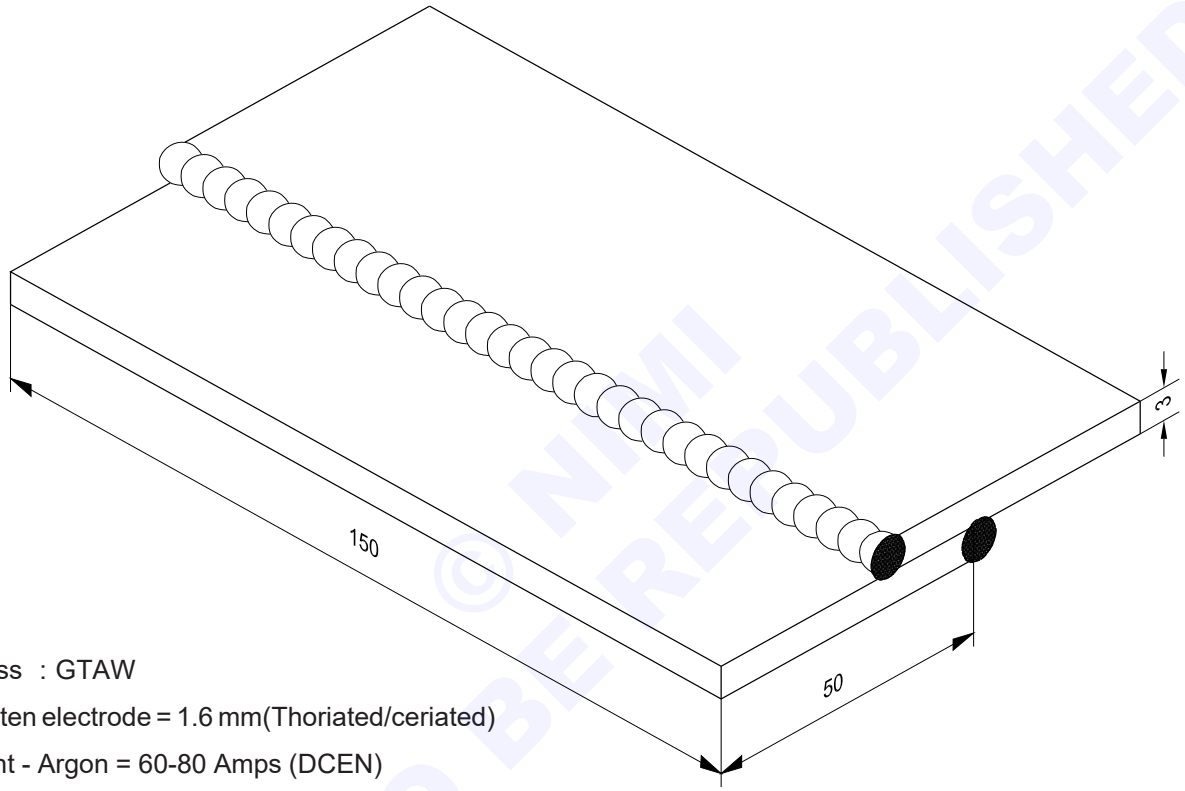
Lap joint on MS sheet in horizontal position GTAW

Objectives: At the end of this exercise you shall be able to
- **set and tack the job as per drawing**
- **weld lap fillet joint using correct size filler rod**
- **clean and inspect the weldments for weld defects.**

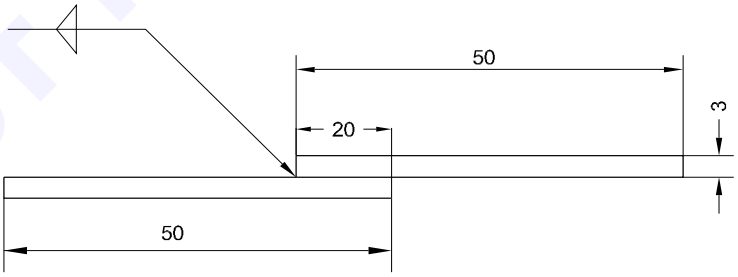


Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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2	ISST 50 x 3 - 150		Fe 310 - W			1.5.79
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**LAP JOINT ON MS SHEET IN HORIZONTAL POSITION**				TOLERANCE ±1	TIME : 8Hrs
					CODE NO . WG20N1579E1	

Job Sequence

- Prepare the job as per drawing and clean the edges.
- Set the job on the welding table to form a lap joint.
- Select a C.C.M.S filler rod 1.6 mm ø for tacking and 3.00 mm ø for welding.

Wear safety apparels and use helmet with filter glass.

- Tack the pieces at both ends and also in the centre using a 1.6 mm ø filler rod.
- Check the alignment of pieces, clean the tacks, and place on the welding table in a flat position.
- Start welding, using leftward technique with the correct angle of the torch and (3mm ø) filler rod.
- Fuse the edges uniformly, add filler metal to obtain correct root fusion and reinforcement, and proceed towards left. Don't concentrate the torch on the top member in the lap joint.
- Maintain correct travel speed, manipulation of torch and filler rod to produce uniform weld bead.
- Stop at the left end, after filling the crater and complete the weld.
- Extinguish the Arc by switch off the torch.
- Clean the welded joint with a wire brush.

Visual inspection: Inspect for correct size of fillet weld, slight convexity, uniform width and height, uniform ripples without edge of plate melted off defect and other surface defects.

Weld the job from the other side also following the same steps.

Repeat the exercise till you get good results.

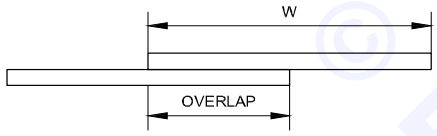
Skill Sequence

Lap joint on MS sheet in horizontal position GTAW

Objectives: At the end of this exercise you shall be able to
• clean and inspect the weldments for weld defects.

Set and tack the job pieces in correct alignment with proper overlapping of pieces. (Fig.1)

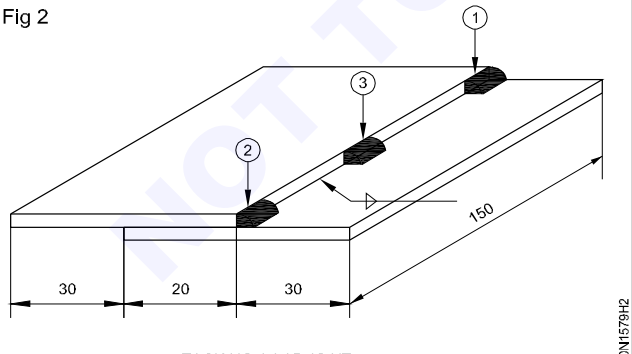
Fig 1



Place the tack welds at correct locations. (Fig.2)

Weld a uniform, well penetrated, correct size fillet lap weld in flat position by

Fig 2



– proper positioning of the joint (Fig.2)
– proper angle of the torch and filler rod.
– proper manipulation of the torch and filler rod (Fig 3&4).

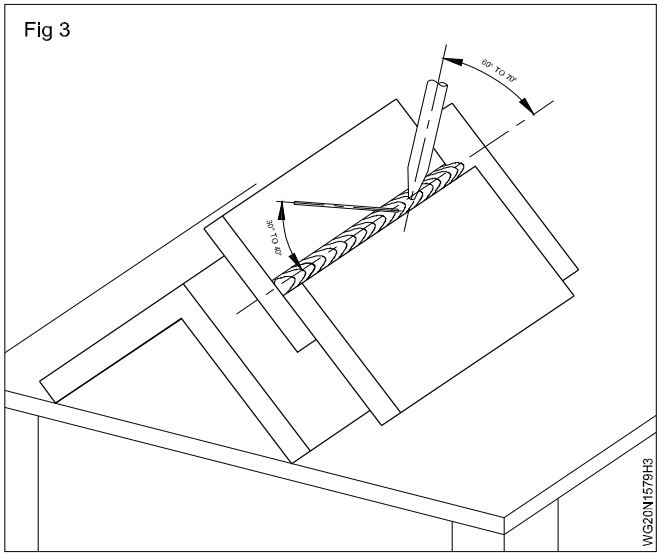
Avoid movement of torch nearer to the edge of the top plate. This will avoid edge of the plate melted off defect.

– maintaining uniform travel speed and feed.

Clean the weldment and inspect for: (Fig 5)

– uniform weld size and shape of whole length (reinforcement and contour) of the joint.
– equal leg length
– no undercut at the toe of weld
– no fusing of the top plate edge to undersize
– smooth ripple appearance
– proper crater filling.

Fig 3



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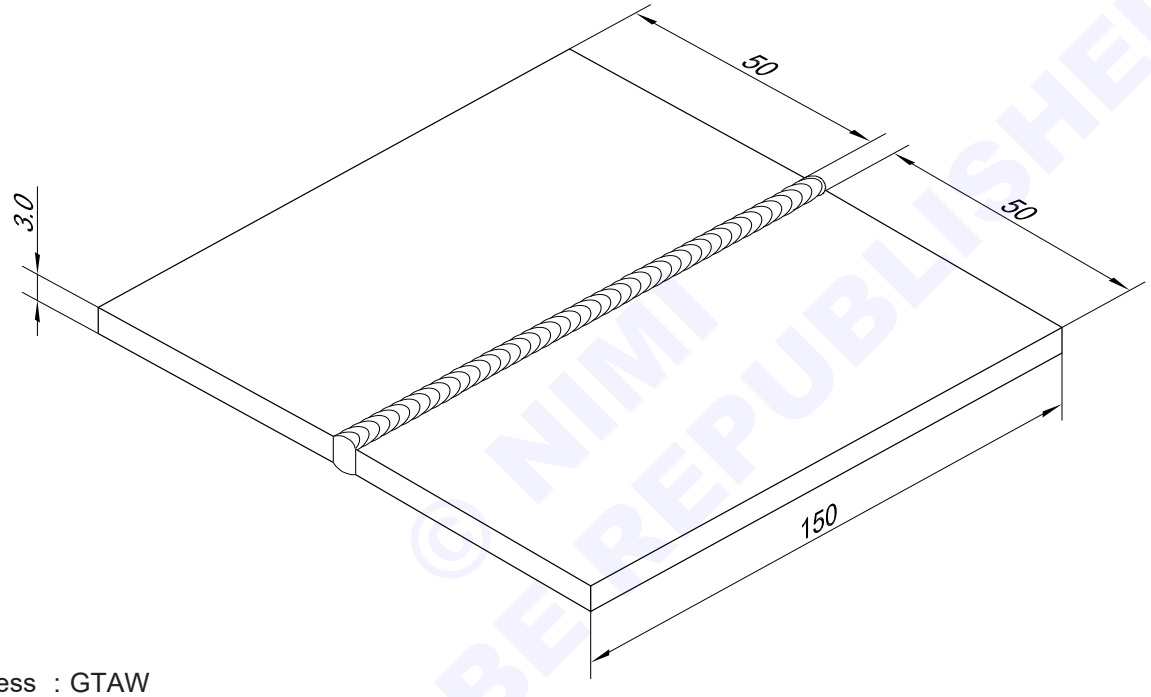
Square butt joint on M.S sheets in horizontal position by GTAW

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

- **select and set the electrode size, filler rod, current, gas flow rate and polarity**
- **weld the joint using proper manipulation and angles for the torch and filler rod**
- **weld the joint without distortion, weld defects.**

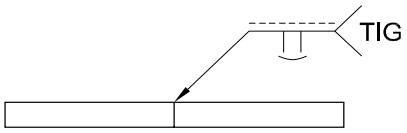


Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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2	ISST 50 x 3 - 150	--	Fe 310	--	--	1.5.80
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SQUARE BUTT JOINT ON M.S. SHEET IN HORIZONTAL POSITION**				TOLERANCE ±1	TIME : 9Hrs
					CODE NO. WG20N1580E1	

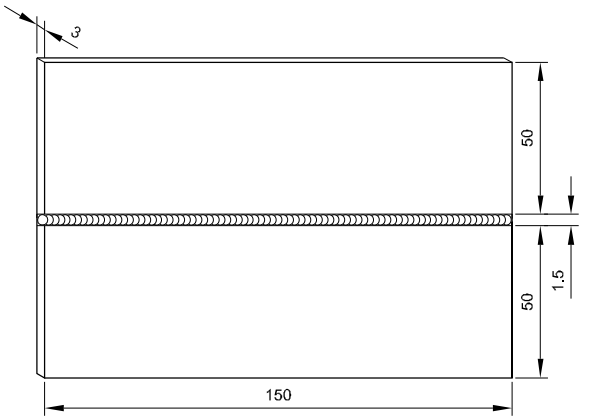
Job Sequence

- Prepare the job pieces of size 150 x 50 x 3mm - 2 Nos.

Setting and tacking

- Set the prepared job pieces on the welding table with a uniform root gap and in alignment. (Fig.1)

Fig 1



Ensure that there is a uniform gap of 2mm. Preset the sheets; give an allowance of 2^0.

- Tack-weld the joint at equal intervals of 50mm to hold them together, maintaining the alignment. (Fig.1)
- Ensure that the
  - distance between the tack-welds is 50mm.
  - length of the tack-weld is 6mm and with full penetration.

Tack welds should be on the side to be welded and in line with the joint.

- Weld the tack welded job from right to left holding the torch and filler rod at proper angle and using uniform travel speed.
- Ensure root penetration using keyhole technique.
- Fill the crater as done in earlier exercises.

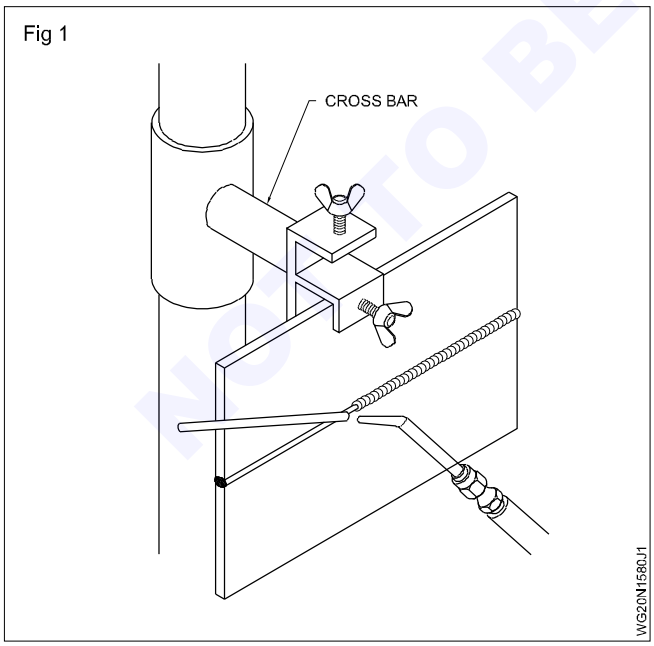
Skill Sequence

Square butt joint on M.S sheets in horizontal position by GTAW

Objectives: At the end of this exercise you shall be able to
- **weld the joint without distortion, weld defects.**

Welding : Keep free space under the joint for complete penetration. Start the weld from the right end of the joint. (Fig 1)

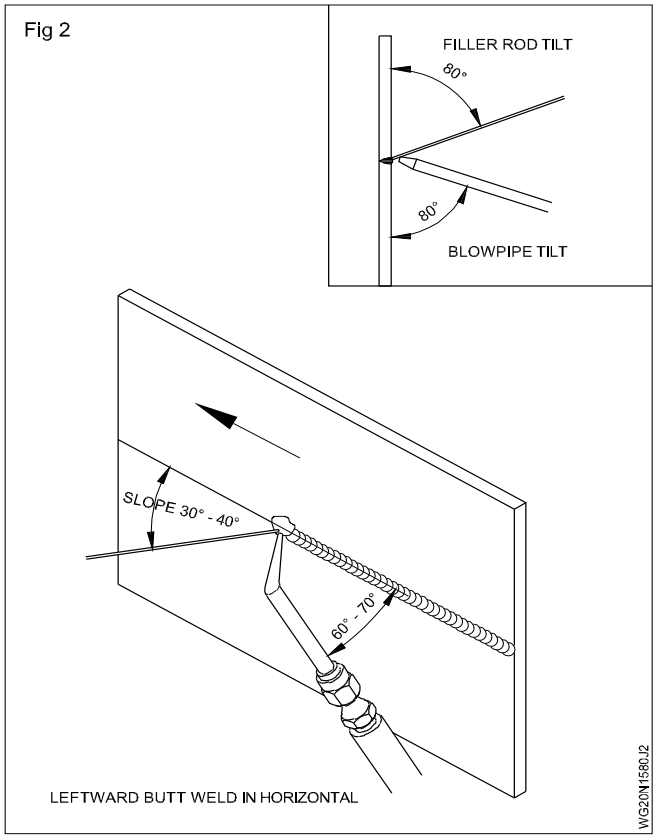
Fig 1



Manipulate and hold the torch and filler wire as shown in Fig.1. Weld a well fused uniform bead with complete penetration using leftward technique. (Fig 1)

Maintain uniform travel speed of 15cm/min. for the torch and piston like motion to the filler rod (Fig 2).

Fig 2



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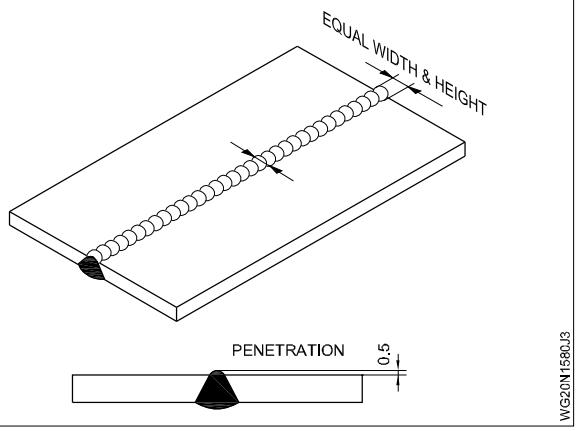
Maintain a keyhole for better root penetration.

Clean the deposited bead.

Inspect the quality of weld by:

– checking the finish of the job
– checking the alignment (remove distortion if any)
– checking the uniformity of width and height of the weld bead in size.
– checking the uniformity of the ripples, fusion and complete penetration. (Fig 3)

Fig 3



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Square butt joint MS sheet in vertical position by GTAW

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

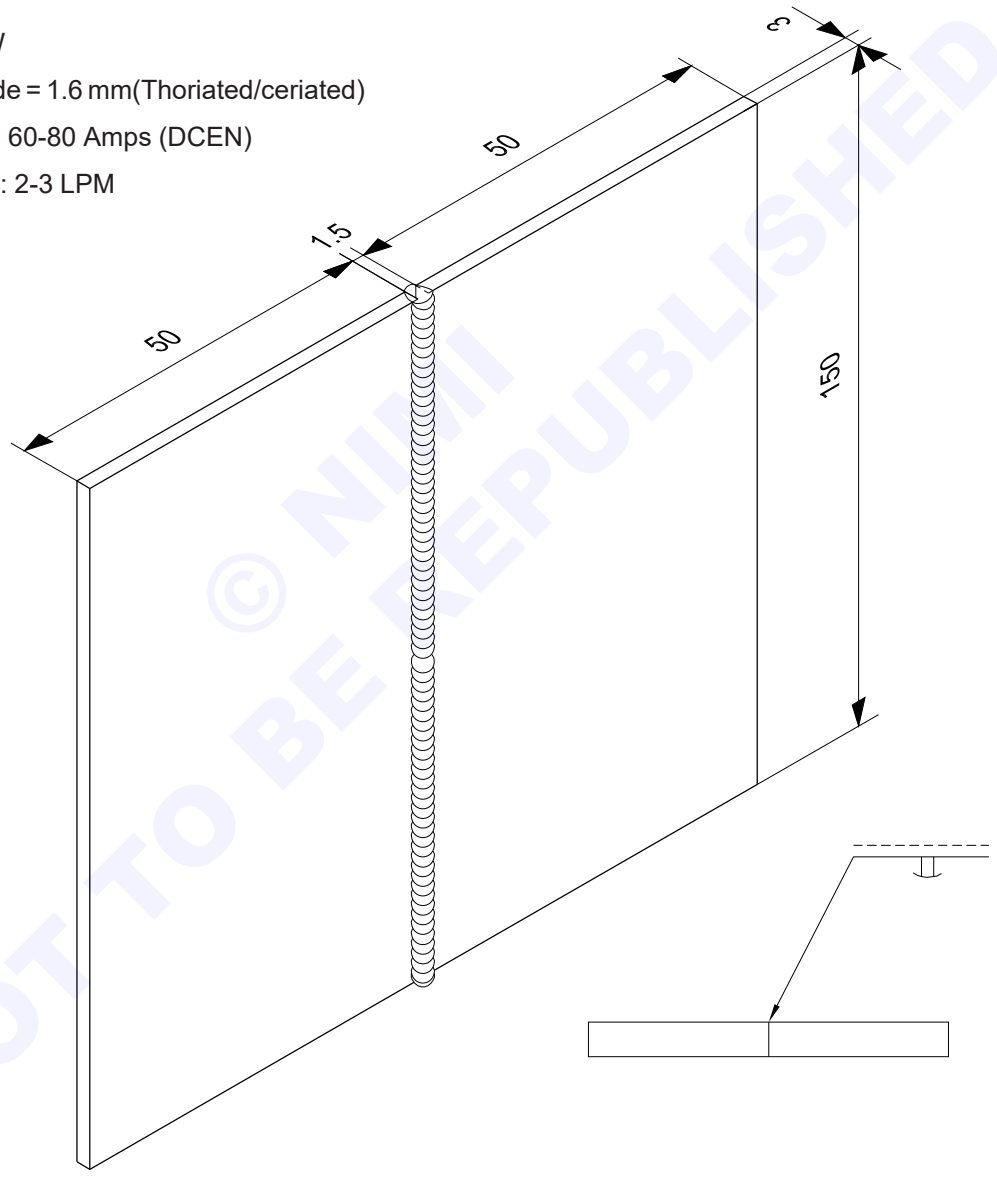
- **prepare and assemble the joint as square butt joint**
- **set the job in the vertical position with a root gap of 2mm**
- **select proper filler rod and set the gas pressures**
- **manipulate the torch and filler rod and weld in vertical position by upward method**
- **ensure proper fusion and root penetration**
- **clean the job and inspect for weld defects.**

Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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2	ISST 50 x 3 - 150		Fe 310 - W			1.5.81
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SQUARE BUTT JOINT ON M.S. SHEET IN VERTICAL POSITION.**				TOLERANCE ±0.5	TIME :
					CODE NO . WG20N1581E1	

Job Sequence

- Prepare the job pieces of size 150 x 50 x 3mm - 2 Nos.

Setting and tacking

- Set the prepared job pieces on the welding table with a uniform root gap and in alignment.

Ensure that there is a uniform gap of 2mm. Preset the sheets; give an allowance of 2^0.

- Tack-weld the joint at equal intervals of 50mm to hold them together, maintaining the alignment.
- Ensure that the
  - distance between the tack-welds is 50mm.
  - length of the tack-weld is 6mm and with full penetration.

Tack welds should be on the side to be welded and in line with the joint.

- Weld the tack welded job from bottom to top holding the torch and filler rod at proper angle and using uniform travel speed.
- Ensure root penetration using keyhole technique.
- Fill the crater properly

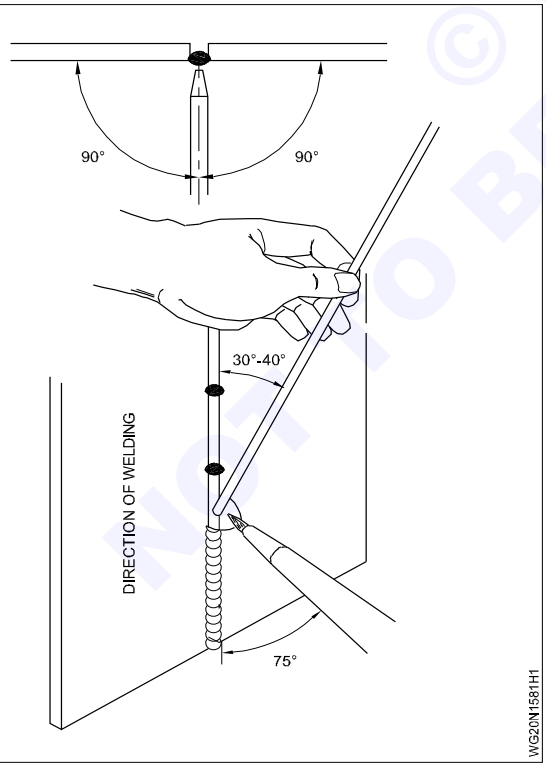
Skill Sequence

Square butt joint MS sheet in vertical position by GTAW

Objectives: At the end of this exercise you shall be able to
- **select proper filler rod and set the gas pressures.**

Welding : Keep free space under the joint for complete penetration. Start the weld from the bottom of the joint. (Fig.1) Manipulate and hold the torch and filler wire as shown in Fig.1. Weld a well fused uniform bead with complete penetration using leftward technique. (Fig.1)

Fig 1



Maintain uniform travel speed of 15cm/min. for the torch and piston like motion to the filler rod (Fig.2).

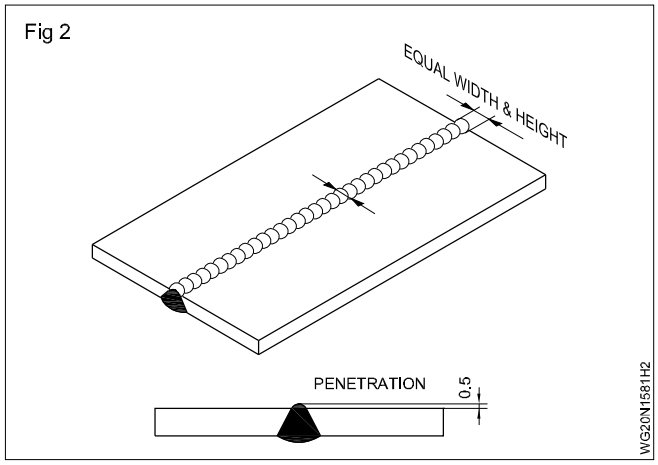
Maintain a keyhole for better root penetration.

Clean the deposited bead.

Inspect the quality of weld by:

- checking the finish of the job
- checking the alignment (remove distortion if any)
- checking the uniformity of width and height of the weld bead in size.
- checking the uniformity of the ripples, fusion and complete penetration. (Fig.2)

Fig 2



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Lap & tee joint on MS sheet in vertical position by GTAW

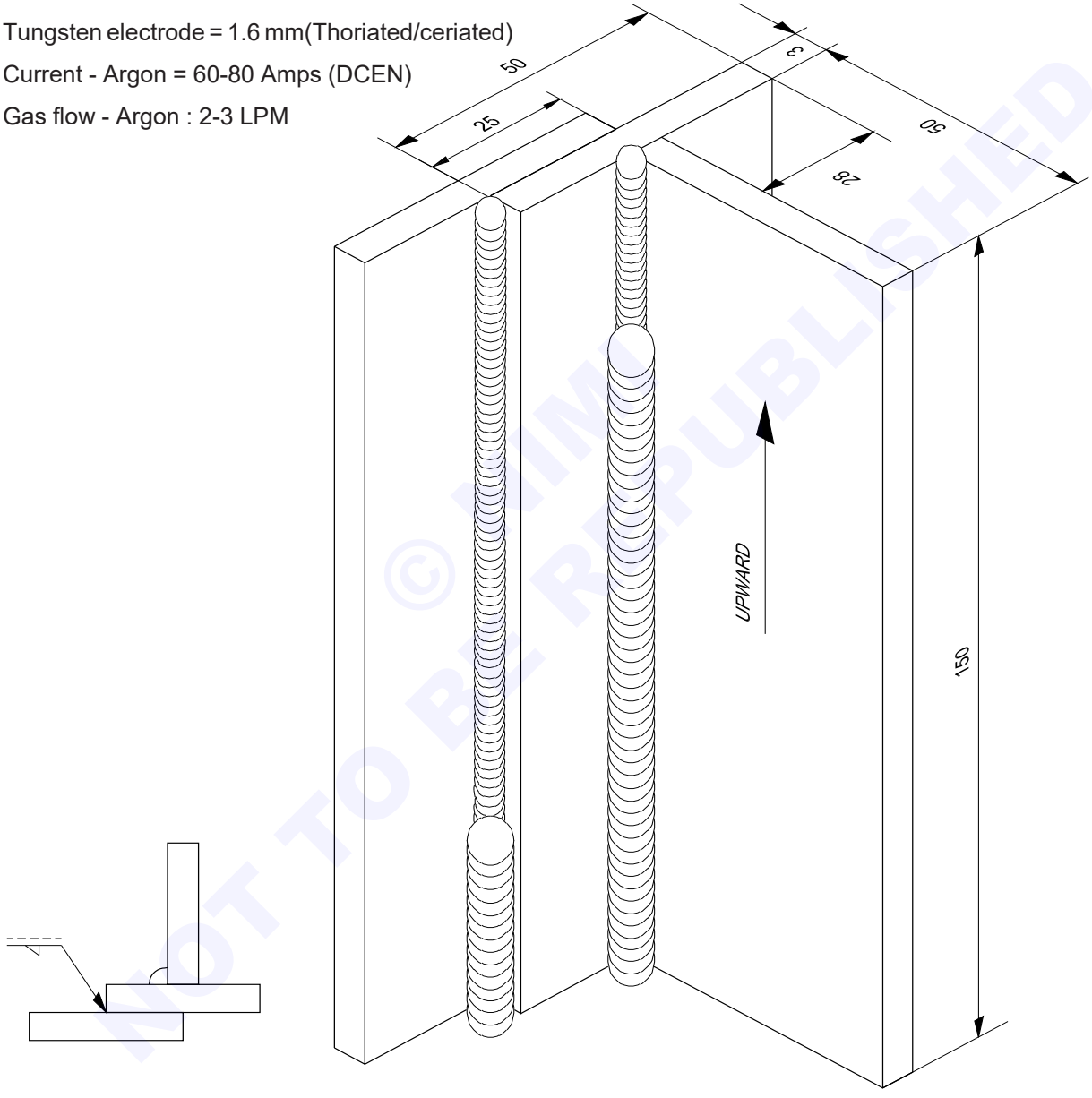
Objectives: At the end of this exercise you shall be able to
- **prepare,set and tack weld as per drawing**
- **deposit weld bead by using upward direction**
- **clean and inspect the weld defects.**

Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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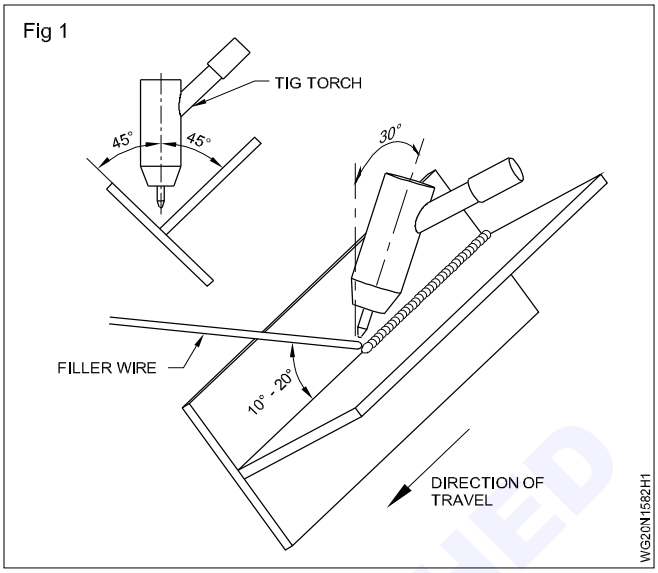
3	ISST 3 - 50 x 150		Fe 310 - W			1.5.82
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**LAP & TEE JOINT ON MS SHEET IN VERTICAL POSITION**				TOLERANCE	TIME : 9Hrs
					CODE NO . WG20N1582E1	

Job Sequence

- Prepare job pieces as per drawing.
- Clean the surfaces and edges of the sheets to be welded.
- Wear safety apparels.
- Select the dia of electrode, filler rod, current and electrode polarity (DCEN), argon gas flow rate and the rate of travel of the torch and filler rod .
- Set the sheets and tack weld in the form of a 'Tee' & Lap joint on the welding table.
- Ensure the torch and filler rod are held at the required angle and moved as in Fig.3 for tee as well as lap joint.
- Fill the crater.

Fig 1



Skill Sequence

Lap & tee joint on MS sheet in vertical position by GTAW

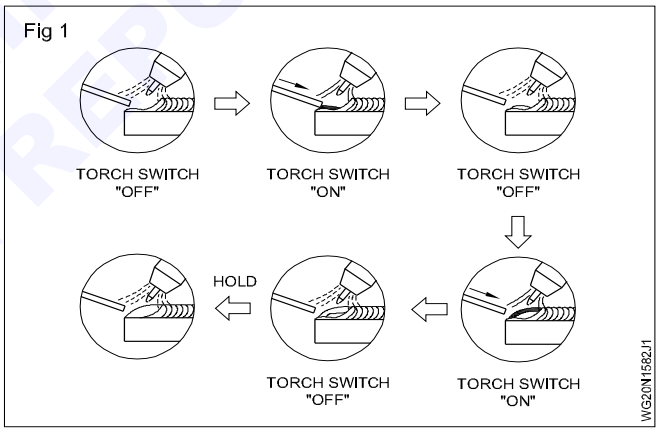
Objectives: At the end of this exercise you shall be able to
- **deposit weld bead by using upward direction.**

Manipulate the torch and filler rod in correct position with respect to the job. Stop the weld at the left hand edge of the joint after filling up in the crater at the end of the weld.

Since welding is done on both sides of the joint, the angular distortion between the vertical and horizontal sheet of the Tee joint is automatically controlled. So no presetting is required. The current set is 10 to 15 ampere more than that of butt joint to get proper fusion of the root and fusion faces of the joint. At the end of welding, perform the crater filler treatment by repeating the torch switch "ON-OFF".Fig.1. Cut the arc and hold at the finishing point until molten metal solidifies.

Visual inspection: Slight convexity, leg length uniform width, uniform ripples and free from undercut at the toes of the weld indicate a smooth job.

Fig 1



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Square butt joint on MS sheet in overhead position by GTAW

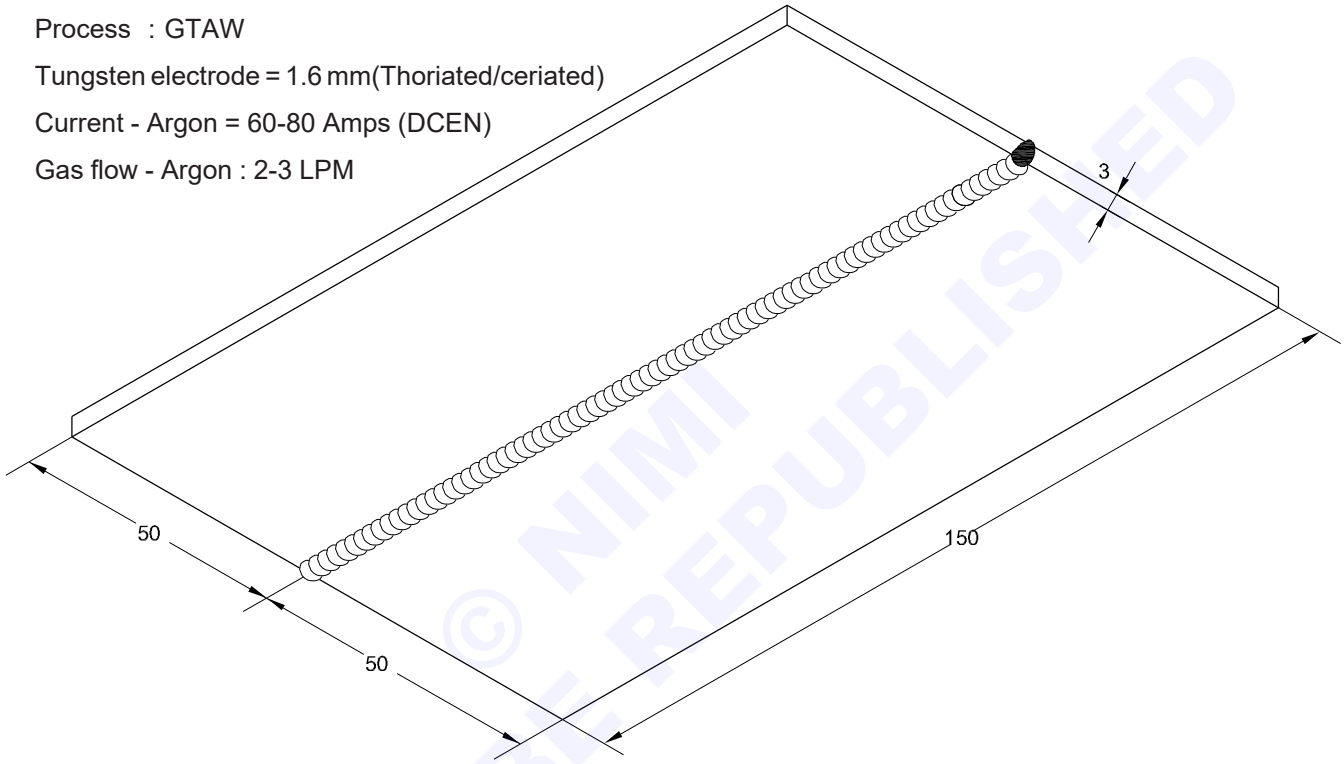
Objectives: At the end of this exercise you shall be able to
- **prepare the sheet for welding as per drawing**
- **clean, set and tack weld the sheets as a square butt joint**
- **deposit the metal into the joint in overhead position**
- **clean the joint and profile and weld defects.**

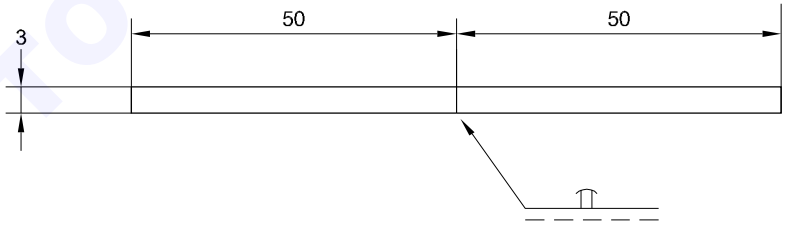
Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM





2	ISST 50 x 3 x 150		Fe 310 - W			1.5.83
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SQUARE BUTT JOINT ON M.S. SHEET IN OVERHEAD POSITION**				TOLERANCE ±1	TIME :
					CODE NO . WG20N1583E1	

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Job Sequence

- Cut, prepare and clean the sheets as per drawing.
- Set the tack welded joint in overhead position select 1.6mmø filler rod for tacking and welding.
- Follow necessary safety precautions.
- Bring the torch to the plate and establish a puddle and create the keyhole.
- Hold the torch and filler rod at appropriate angle and use leftward technique.
- Add filler metal paying attention to bead width and surface contour. Note that the flame can be used to aid in controlling the puddle.
- Ensure proper root penetration is obtained.
- Fill the crater.
- Complete the weld, clean it, examine it for proper bead size, profile and weld defects.

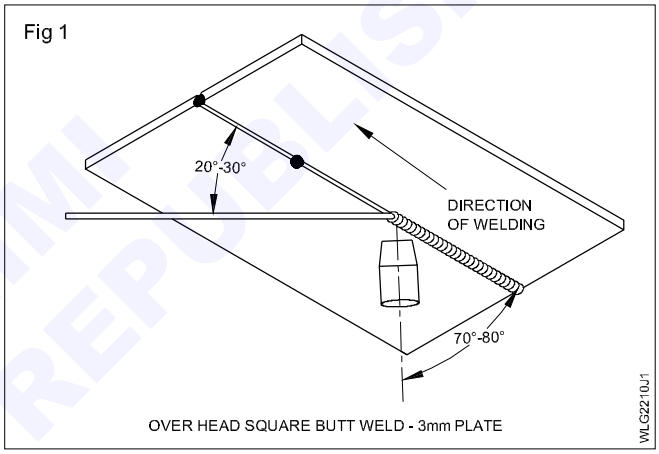
Skill Sequence

Square butt joint on MS sheet in overhead position by GTAW

Objectives: At the end of this exercise you shall be able to
- **deposit the metal into the joint in overhead position.**

At the right hand end of the joint, fuse the tack weld and parent metal to form the weld pool. When the molten pool is established, commence the weld by using a suitable blowpipe and filler rod movement. The torch is travelled in a leftward direction, in a circular looping movement, to maintain control of the molten metal. Add the filler rod by piston movement as the torch is returned to its starting point. Hold the torch an angle of 70^0 - 80^0 and the filler rod at an angle of 20^0 - 30^0 from the horizontal as shown in the Fig. 1

Fig 1



OVER HEAD SQUARE BUTT WELD - 3mm PLATE

At the end of the seam the weld is terminated by adding sufficient filler rod to obtain adequate build-up at the end of the joint. Speed of deposition must be increased and the angle of the blowpipe changed as metal is quickly added to complete the joint.

Visual examination/inspection : The reinforcement is likely to be more pronounced than a joint made in the flat position. Although this is acceptable, it should be uniform and not excessive. The pentration must be sufficient to have fused the sheet edges uniformly through the joint.

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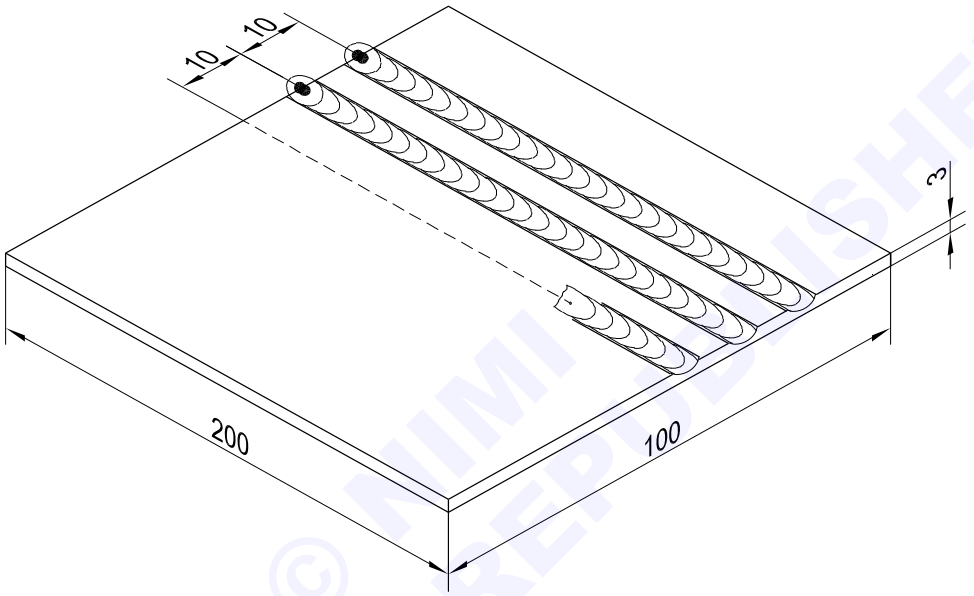
Beading practice on stainless steel sheet

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **deposit fusion run with filler rod**

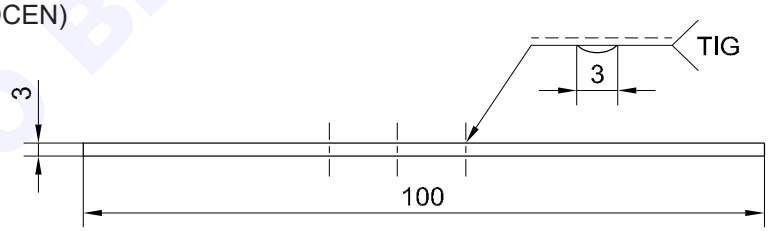


Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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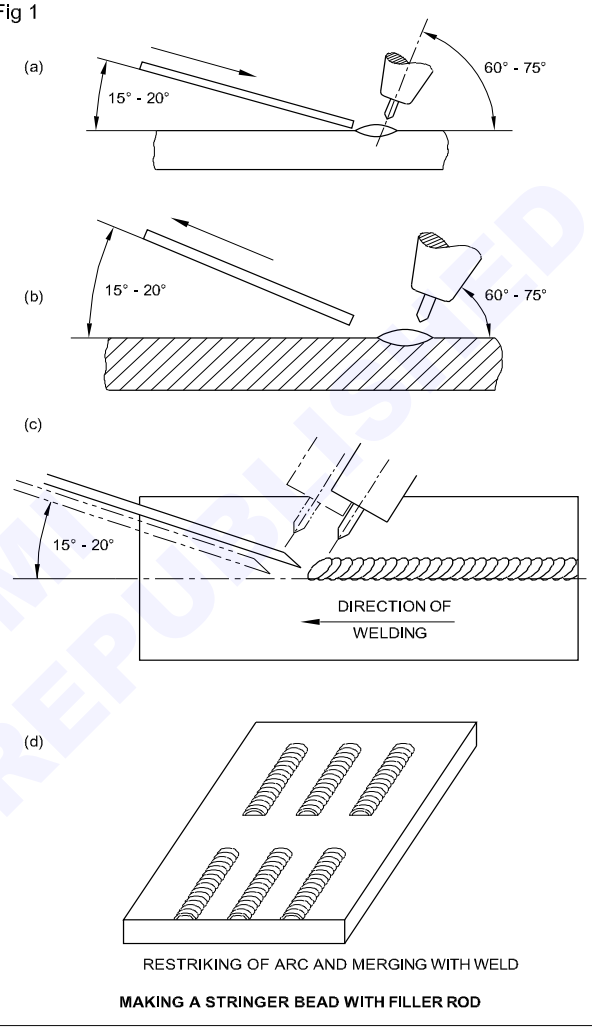
1	100 x 3 - 200	--	X 04 Cr 19 Ni 9	--	--	1.5.84
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**BEADING PRACTICE ON SS SHEET**				TOLERANCE ±1	TIME : 8Hrs
					CODE NO. WG20N1584E1	

Job Sequence

- Making stringer bead in flat position with filler wire
- Take a piece of a plate of size 150 x 100 x 2mm and mark a few straight lines. Hold the torch in the right hand and above the right hand end of the plate, start the arc and establish a puddle holding the torch perpendicular to the plate.
- Maintain a proper arc length until a proper size and shape of the puddle is achieved. Rotate the torch in the clockwise direction slanting the torch to 60^0 - 75^0 to the vertical.
- Now bring the filler rod to the puddle. Keep the filler rod at an angle of 15 to 20^0 from the base plane of the plate. Add the filler rod to the front edge of the molten puddle. (Fig 1a)
- Allow the filler rod to melt off in the molten puddle. Do not melt the filler rod in the head of the arc.
- Add the filler rod-a drop at a time to the leading edge of the puddle. Move the filler rod back and move the torch forward to advance the puddle. Always keep the end of the filler metal within the protective gas shielding.
- Progressing at an even travel speed of the torch and regularly adding the filler rod to produce a uniform bead, move the torch and wire along the straight line always maintaining the size of the molten pool. Do not support and rest your hands and your body on the table or the job.
- Withdraw the filler rod, but within the gas shielding keeping it at an angle of 15 to 20^0 of the plate surface. (Fig 1b)
- Move the torch a little ahead in the left hand direction which will not allow to melt the newly added filler rod. It will melt into the existing puddle. Now move the torch to the leading edge of the molten puddle. (Fig 1c)
- Manipulate the torch in small semicircular contours, finally while stopping the welding at the left edge of the plate.
- Practise this bead on plate welding on the lines marked on the plate using the torch movements at different speeds. Faster movements will produce smaller beads and slower movement will produce larger beads.
- This procedure can be repeated holding the torch in the left hand and feeding the filler by the right hand.

Fig 1



MAKING A STRINGER BEAD WITH FILLER ROD

WG20N1584H1

Skill Sequence

Beading practice on stainless steel sheet

Objectives: At the end of this exercise you shall be able to
- **deposit fusion run with filler rod**

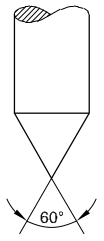
Select a tungsten electrode of a properϕ and give a proper angle to its tip 60^0 normally.

Manipulate the torch and filler rod 60^0 - 75^0 and 15^0 and 20^0 respectively.

Electrodes are normally ground to a vertex angle of 60^0 Fig.1.

For DC EN polarity welding recommended.

Fig 1



RECOMMENDED ELECTRODE TIP

WG20N1584J1

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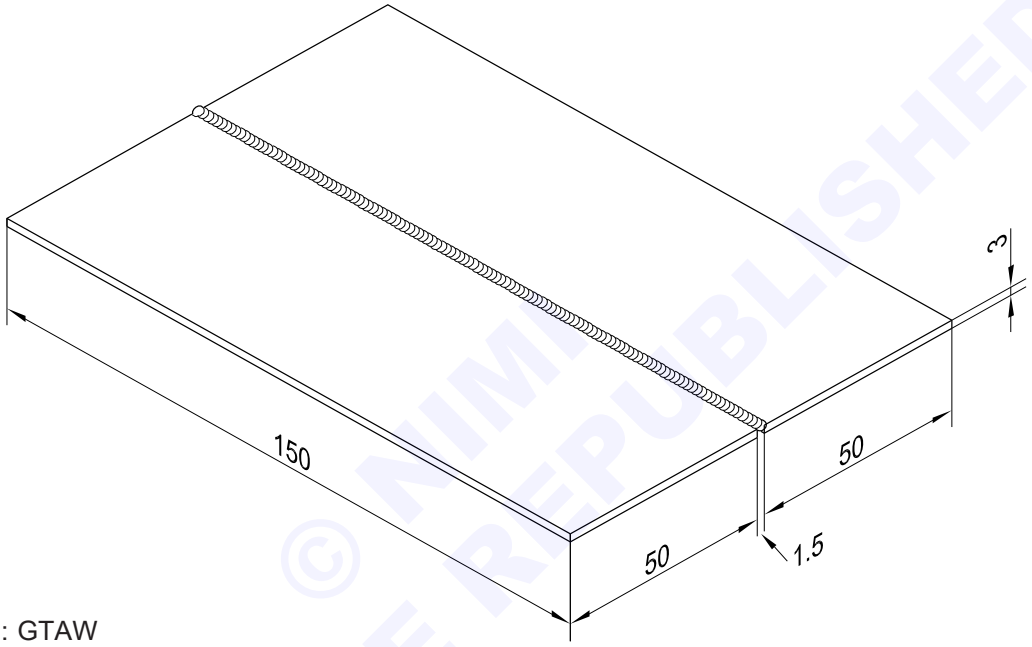
Square butt joint on S.S sheet by TIG in flat position

Objectives: At the end of this exercise you shall be able to
- **weld Square Butt joint on stainless steel sheet in flat position.**

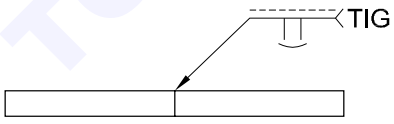


Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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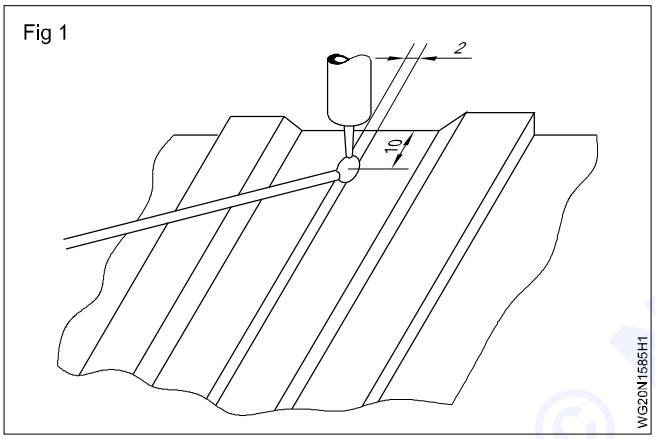
2	ISST - 50 x 3 - 150	--	X 04 Cr 19 Ni 9	--	--	1.5.85
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT JOINT ON SS SHEET BY TIG IN FLAT POSITION	TOLERANCE ±1	TIME : 9Hrs
		CODE NO . WG20N1585E1	

Job Sequence

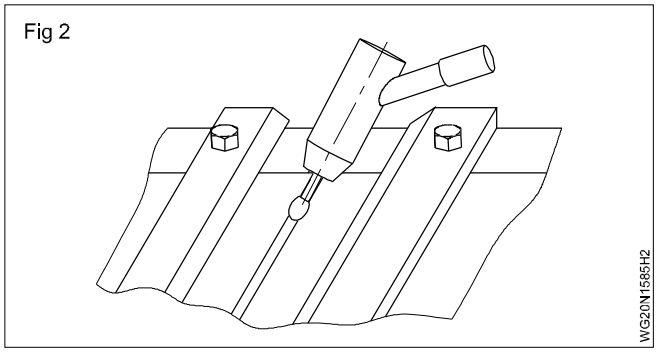
- Clean the base metal surface with the S.S wire brush.
- Clean the base metal surface with alcohol.
- Adjust the current to about 80 to 90A.
- Adjust the gas flow rate to 6-8LPM.
- Set the root gap to 1.6mm.
- Fix the base metal with the jig.
- Flow the back shielding gas by 4LPM.
- Tack weld at 10mm inside from both ends of the joint.
- Stop the back shielding gas.
- Remove the base metal from the jig.
- Check if the joint has good alignment.
- Fasten the base metal securely to the jig.

Fig 1



- Polish the base metal with the S.S wire brush.
- Adjust the current to about 80 to 90A.
- Adjust the shielding gas to 6.8LPM.
- Generate an arc at the tack welding position.
- Return to the start end.
- Hold the torch to about 70 to 80^0 against the welding direction and 90^0 against the base metal surface.

Fig 2



- Keep the arc length about 3 to 5mm.
- Set the filler wire about 10 to 15^0 against the base metal surface.
- Make a molten pool.
- Apply the filler wire when both sides of the pool sink a little.
- Insert the filler wire into the pool leading end.
- Apply the filler wire of optimum length while monitoring the bead forming state.
- Weld along the joint line.
- Cut the arc.
- Generate the arc again and deposit the crater a little.
- Fill the crater up to the bead level.
- Stop the back shielding gas.
- Check the bead wave profile and uniformity.
- Check the bead width and reinforcement are optimum.
- Check if there is an undercut or overlap.
- Check if there is lack of penetration.
- Check the crater filling state.
- Check if the bead surface is oxidized.

Skill Sequence

Square butt joint on S.S sheet by TIG in flat position

Objectives: At the end of this exercise you shall be able to
- **weld Square Butt joint on stainless steel sheet in flat position.**

While adding the filler wire to the leading edge of the puddle, be careful not to get the wire too close to the tungsten electrode tip or it will melt onto and contaminate the tungsten. A contaminated electrode will require dressing before further use.

Manipulation of the torch and filler wire.

Improper fastening of the base metal to the jig causes poor alignment as in the Fig 1 and causes excessive offset at the joint area owing to high thermal expansion characteristics of stainless steel.

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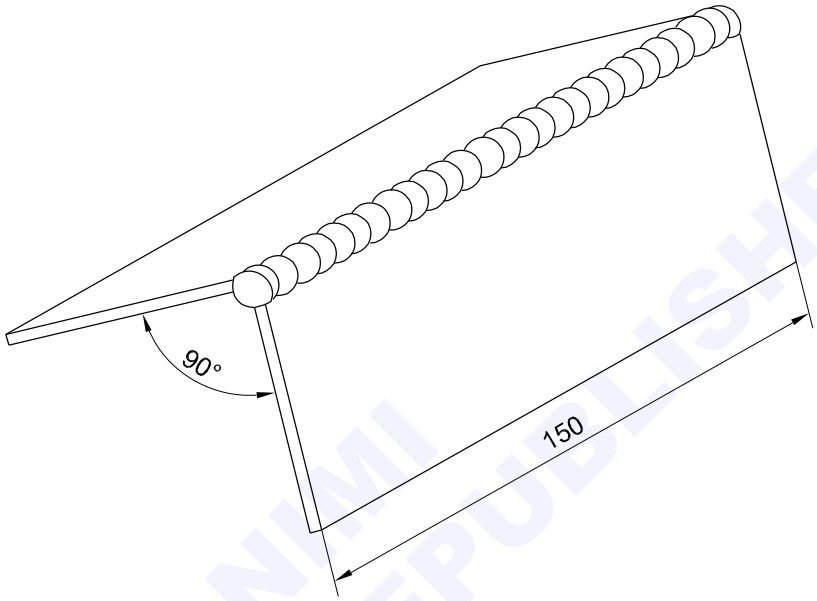
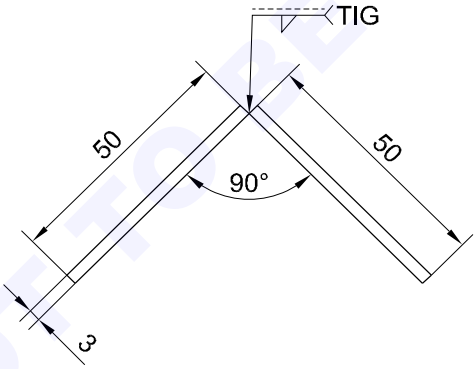
Open corner joint on S.S.Sheet by TIG in flat position

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

- **weld-fillet weld open corner joint on stainless steel sheet 1.6mm (t) flat position.**





Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM

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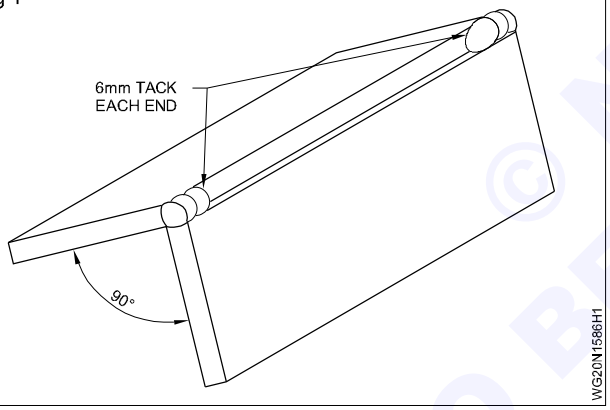
2	50 x 3 - 150	--	X 04 Cr 19 Ni 9	--	--	1.5.86
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	OPEN CORNER JOINT ON SS SHEET BY TIG IN FLAT POSITION	TOLERANCE ±1	TIME :
		CODE NO. WG20N1586E1	

Job Sequence

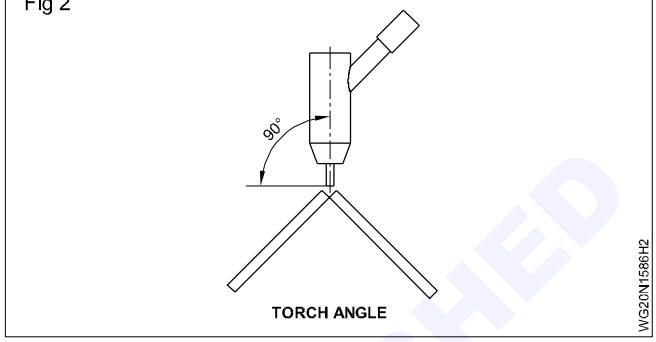
- Prepare the sheets as per drawing.
- Clean the metal surface with stainless steel wire brush.
- Clean the base metal surface with alcohol.
- Adjust the current to about 40 - 60 Amps.
- Adjust the gas flow rate to 6-8 LPM (Litres per minute).
- Select ϕ1.6mm the tungsten electrode and S.S filler wire.
- Insert the electrode into the collet of the torch.
- Make certain that it is firmly held and extends the required distance beyond the end of the nozzle.
- Lay the torch down away from the welding cables.
- Move the polarity switch to the correct setting DC- electrode negative.
- Turn the power switch on.
- Set the job as outside corner joint by keeping at 90^0 angle between the members.
- Tack weld the job at both ends of the joint and position them as shown in Fig.1.

Fig 1



- Extend the wire again 10 to 12 in., (250 to 300mm) strike an arc, establish a puddle and begin adding the wire to the lead edge of the puddle.
- Remember to dab the wire into the puddle. Do not continuously feed it. Doing so can lead to porosity lack of fusion and slag entrapment.
- Check the bead wave profile and uniformity.

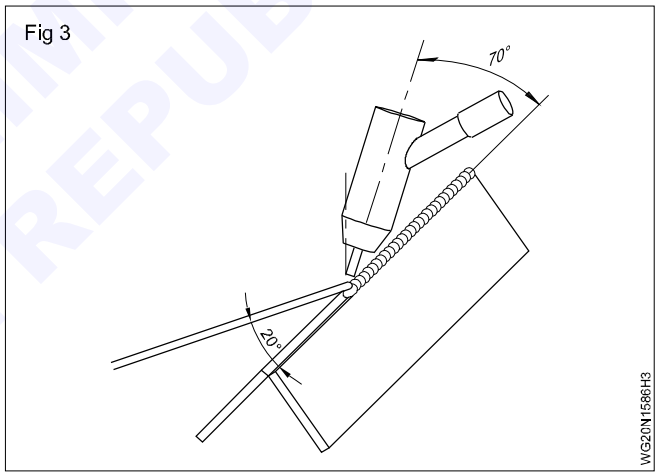
Fig 2



- Check the bead width and reinforcement are optimum.
- Check for the defects.

19 Check if the bead surface is oxidised.

Fig 3



Skill Sequence

Open corner joint on S.S.Sheet by TIG in flat position

Objectives: At the end of this exercise you shall be able to
- **weld-fillet weld open corner joint on stainless steel sheet 1.6mm (t) flat position.**

Set the job to form an outside corner joint 90^0 with correct alignment.

Tack the job on both ends in appropriate position.

Manipulate the torch and filler wire 70^0 and 20^0 to the line of weld respectively.

Both edges of the bead should blend smoothly with the metal surfaces.

There should be no overlapping or undercutting.

The bead must be straight and have a uniform width and contour.

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Square butt joint on S.S sheet in vertical position

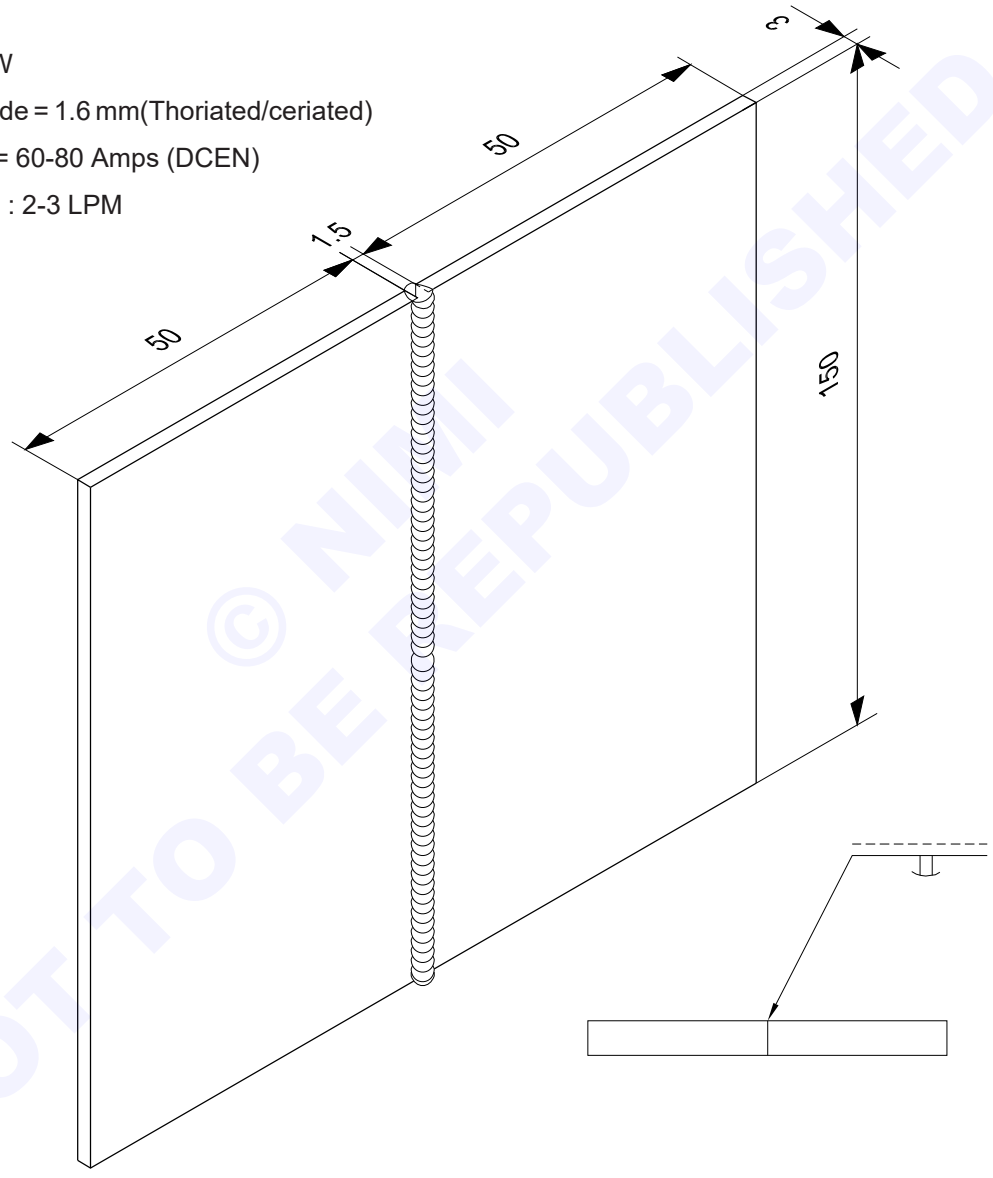
Objectives: At the end of this exercise you shall be able to
- **prepare and assemble the joint as per drawing**
- **set the job in the vertical position with a root gap**
- **select proper filler rod and set the gas pressures**
- **deposit weld bead in vertical by upward position**
- **clean the job and inspect for weld defects.**

Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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2	ISST 50 x 3 - 150		X 04 Cr 19 NI9			1.5.87
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SQUARE BUTT JOINT ON SS SHEET IN VERTICAL POSITION**				TOLERANCE ±0.5	TIME : 9Hrs
					CODE NO . WG20N1587E1	

Job Sequence

- Clean the base metal surface with the S.S wire brush.
- Clean the base metal surface with alcohol.
- Adjust the current to about 80 to 90A.
- Adjust the gas flow rate to 6-8LPM.
- Set the root gap to 1.5mm.
- Fix the base metal with the jig.
- Flow the back shielding gas by 4LPM.
- Tack weld at 10mm inside from both ends of the joint.
- Stop the back shielding gas.
- Remove the base metal from the jig.
- Check if the joint has good alignment.
- Fasten the base metal securely to the jig.
- Polish the base metal with the S.S wire brush.
- Adjust the current to about 80 to 90A.
- Adjust the shielding gas to 6.8LPM.
- Adjust the back shielding gas to 4 LPM.
- Generate an arc at the tack welding position.
- Return to the start end.
- Hold the torch to about 70 to 80^0 against the welding direction and 90^0 against the base metal surface.
- Keep the arc length about 3 to 5mm.
- Set the filler wire about 30 to 40^0 against the base metal surface.
- Make a molten pool.
- Apply the filler wire when both sides of the pool sink a little.
- Insert the filler wire in to the pool leading end.
- Apply the filler wire of optimum length while monitoring the bead forming state.
- Weld along the joint line.
- Cut the arc.
- Generate the arc again and deposit the crater a little.
- Fill the crater up to the bead level.
- Stop the back shielding gas.
- Check the bead wave profile and uniformity.
- Check the bead width and reinforcement are optimum.
- Check if there is an undercut or overlap.
- Check if there is lack of penetration.
- Check the crater filling state.
- Check if the bead surface is oxidized.

Skill Sequence

Square butt joint on S.S sheet in vertical position

Objectives: At the end of this exercise you shall be able to
- **select proper filler rod and set the gas pressures.**

While adding the filler wire to the leading edge of the puddle, be careful not to get the wire too close to the tungsten electrode tip or it will melt onto and contaminate the tungsten. A contaminated electrode will require dressing before further use.

Manipulation of the torch and filler wire.

Improper fastening of the base metal to the jig causes poor alignment as in the Fig 1 and causes excessive offset at the joint area owing to high thermal expansion characteristics of stainless steel.

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Lap joint on S.S sheet in vertical position

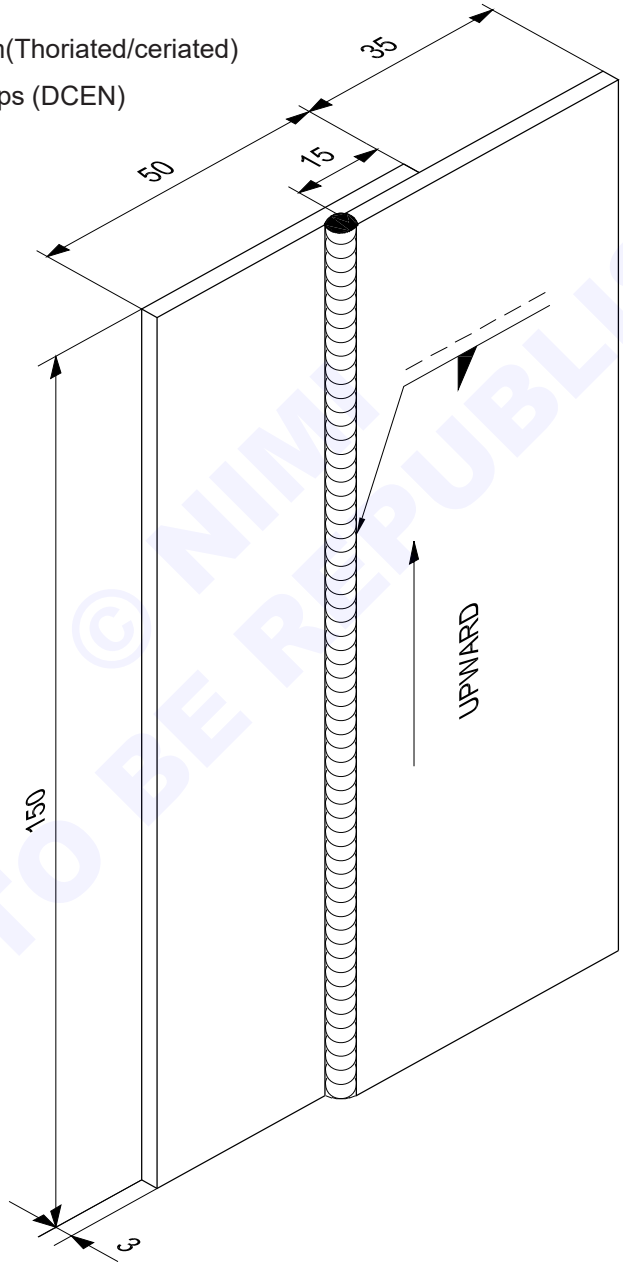
Objectives: At the end of this exercise you shall be able to
- **prepare and assemble plates as per drawing**
- **fix the job in the fixture for vertical welding**
- **deposit weld bead in upward position**
- **clean and inspect the weldment for weld defects.**

Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM



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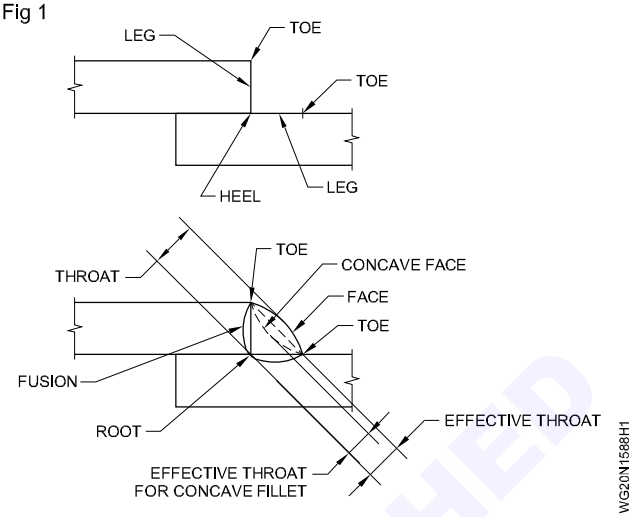
2	ISST 50 x 3 - 150		X 04 Cn 19 N19			1.5.88
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**LAP JOINT ON SS SHEET IN VERTICAL POSITION**				TOLERANCE ±0.5	TIME : 9Hrs
					CODE NO . WG20N1588E1	

Job Sequence

- Prepare the job as per drawing and clean the edges.
- Set the job on the welding table to form a lap joint with the recommended overlapping (refer to drawing).
- Set the GTA welding plant.
- Select the appropriate ϕ of electrode.
- Tack the pieces at both ends and also in the centre using 3mmϕ filler rod.
- Manipulate the torch and filler rod with recommended angle.
- Weld and complete the job.
- Clean thoroughly using the stainless steel wire brush.
- Inspect the correct size of fillet weld, slight convexity, uniform width and height, uniform ripples without any surface defects.
- Repeat the exercise till you get good results.

Fig 1



Skill Sequence

Lap joint on S.S sheet in vertical position

Objectives: At the end of this exercise you shall be able to
- **deposit weld bead in upward position.**

Penetration must be obtained completely without undercut and melting off of the edge of the upper plate.

Equal leg length and smooth ripple appearance to be maintained.

In this lap joint, legs, toes, effect throat and other condition should full fill. Refer Fig.1.

Ensure the edge of the top sheet is not melted away. Avoid concentrating the arc for longer time at the top edge of the top sheet.

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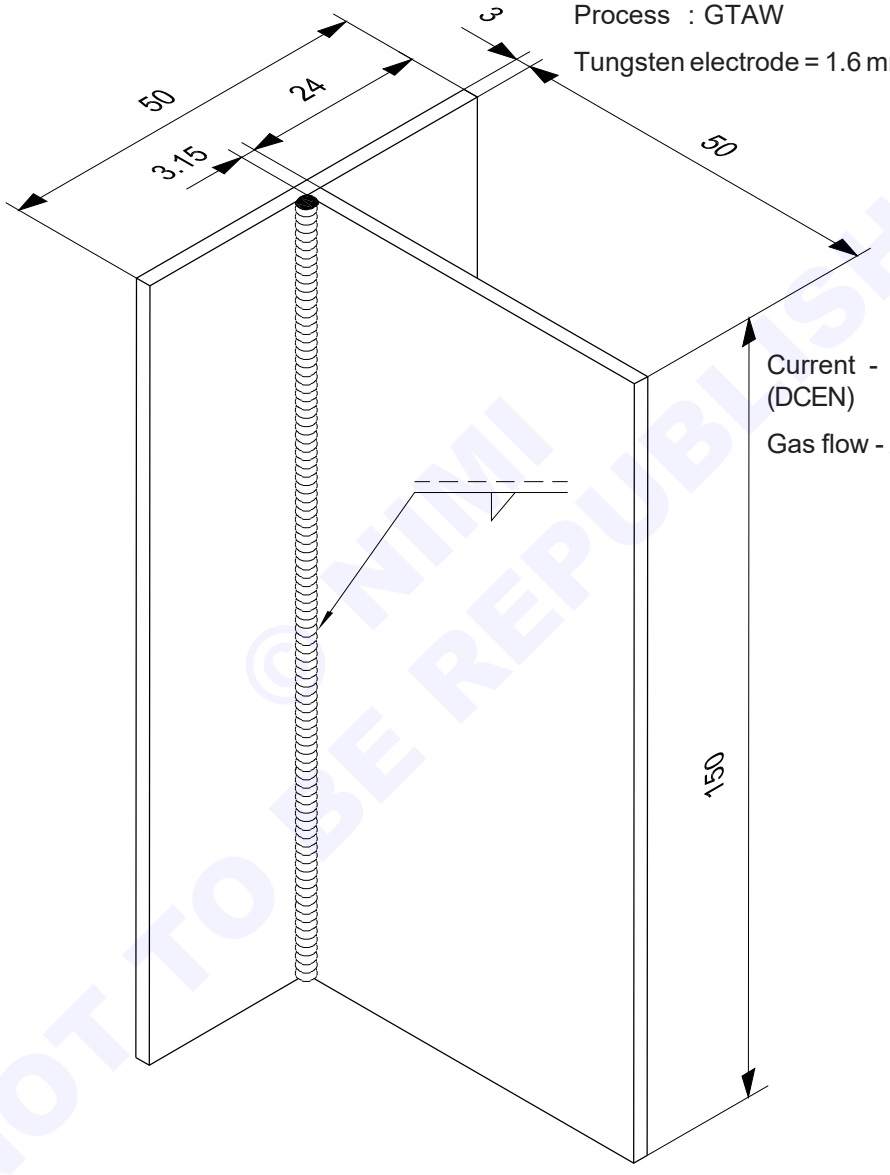
Tee joint on S.S sheet in vertical position

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

- **set the job pieces and tack**
- **select filler rod and set gas pressure for welding**
- **deposit the weld bead in vertical position**
- **clean the joint and inspect for weld defects.**



Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM

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2	ISST 50 x 3 - 150		OX4Cn19N19			1.5.89
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**TEE JOINT ON SS SHEET IN VERTICAL POSITION.**				TOLERANCE ±0.5	TIME : 9Hrs
					CODE NO . WG20N1589E1	

Job Sequence

- Prepare the material as per drawing and file the edges to square. Clean the surface with a wire brush.
- Select a 3mmø S.S filler rod.
- Wear protective clothings and helmet.
- Tack the workpiece as a Tee joint.
- Ensure the joint is clamped properly in the fixture in the vertical position and the line of weld becomes perpendicular to the ground.
- Start welding the joint from the bottom in the upward direction manipulating the torch and filler rod properly.
- Maintain proper angles for the torch and filler rod between the sheet surfaces and to the line of weld so that the root and the surfaces joined will melt properly.
- Ensure the molten puddle does not sag too much due to gravity.
- At the end of the joint fill up the crater and complete the weld.
- Remove the workpiece from the fixture and clean the weld bead.
- Heat the welded job 900 to 1100ºC and quench in water to avoid weld decay.
- Inspect the weld bead for equal leg length, uniform ripple and ensure it is free from surface defects.

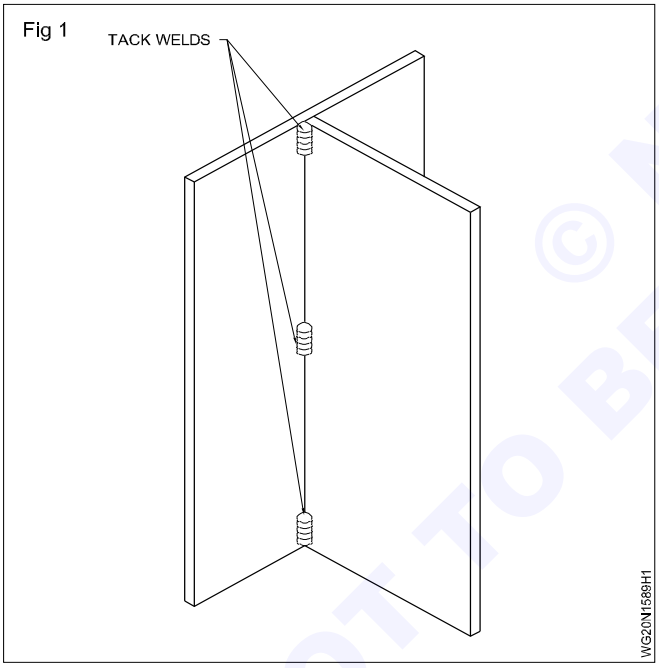
Skill Sequence

Tee joint on S.S sheet in vertical position

Objectives: At the end of this exercise you shall be able to
- **deposit the weld bead in vertical position.**

Keep one of the sheets vertically at 90^0 to the bottom sheet (Fig.1) and tack weld using neutral flame at the ends of the joint in proper alignment and at the centre.

Fig 1



Maintain the angle of the torch at $75 - 80^0$ and filler rod at 40^0 respectively to the line of weld in vertical upward direction. (Fig.2) Also maintain a torch angle of 45^0 between the sheet surfaces. (Fig.3) Control the molten pool steadily and weld the fillet joint on the root by melting both the surfaces to be joined equally. Dip the end of the filler rod continuously in the molten pool and proceed welding upward.

The above mentioned procedure will help to fuse the root and both the sheet surfaces of the joint uniformly as well as control sagging of molten metal deposited into the joint.

Ensure uniform speed of torch travel against the gravitation pull of the hand due to the weight of torch, hose etc.

Fig 2

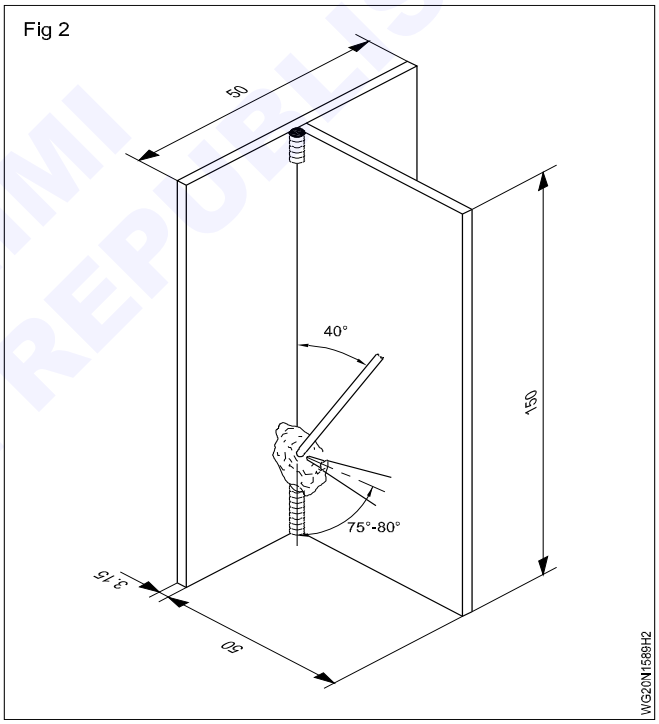
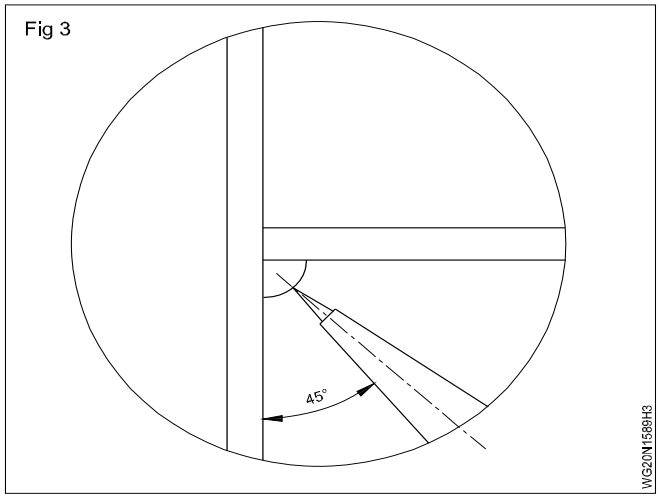


Fig 3



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Square butt joint welding of S.S sheet with back purging technique

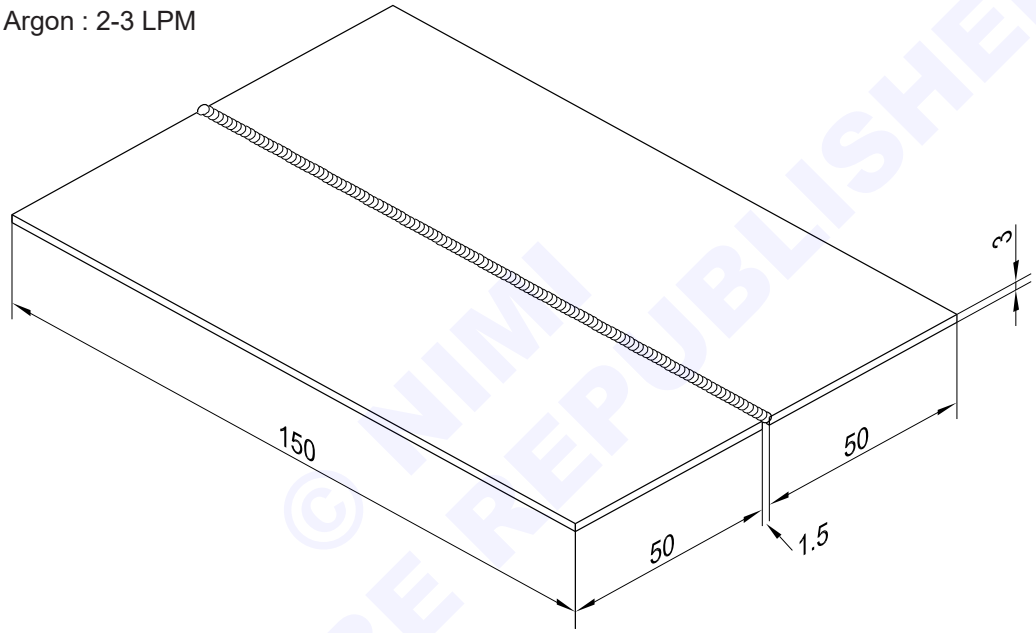
Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **deposit weld bead with back purge technique**
- **clean and inspect the welding defects.**

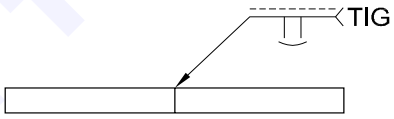
Process : GTAW

Tungsten electrode = 1.6 mm(Thoriated/ceriated)

Current - Argon = 60-80 Amps (DCEN)

Gas flow - Argon : 2-3 LPM





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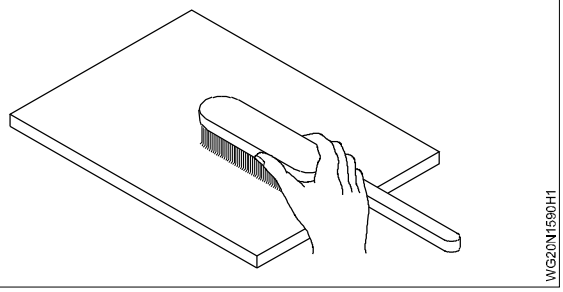
2	50 x 3.0 x 150mm	--	X 04 Cr 19 NI 9	--	--	1.5.90
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT JOINT WELDING OF SS SHEET WITH BACK PURGING TECHNIQUE	TOLERANCE ±1	TIME : 9Hrs
		CODE NO. WG20N1590E1	

Job Sequence

- Select low-carbon grades of base metal SA 240 type stainless steel.
- Cut the materials to be welded to the required size and shaped for welding by arc appropriate method 50 x 2 x 150mm - 2 pcs.
- Clean the surfaces to be joined prior to welding, to obtain high quality welds.(Fig 1).
- Select the filler wire ER 308L, ϕ 2.0mm x 1000mm long and welding procedures.

Fig 1



- Select the tungsten electrode EWTh-2, ϕ 2.0mm.
- Select the shielding gas for stainless steel welding and purging (i.e. Argon).
- Prepare the welding power sourcs for GTAW.
- Stainless steel sheet layout must be done perfectly.
- Prepare and temporarily assemble the back purging arrangements (Fig 2).
- Adjust suitable gas flow rate in the flow meter (refer Table-1) 10-12 lpm (litres per minute).

Fig 2

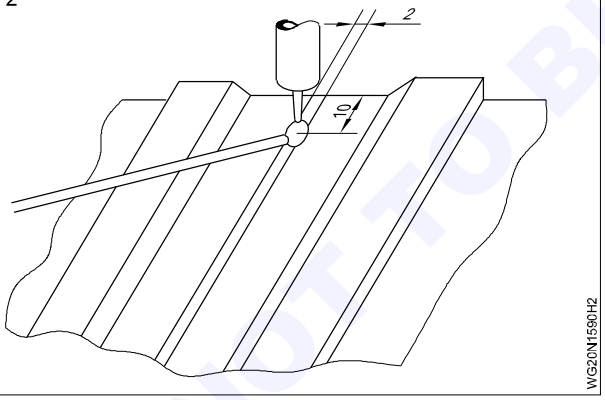


Fig 3

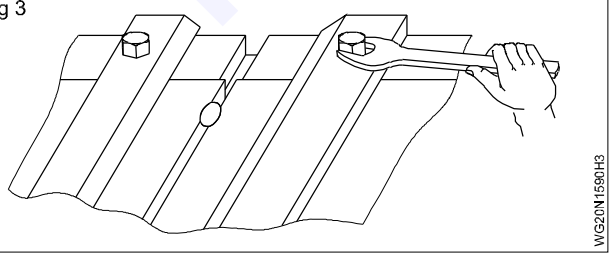


Fig 4

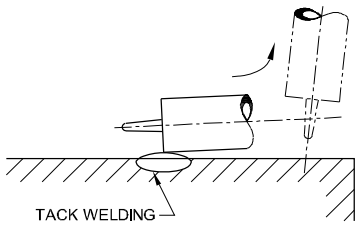


Fig 5

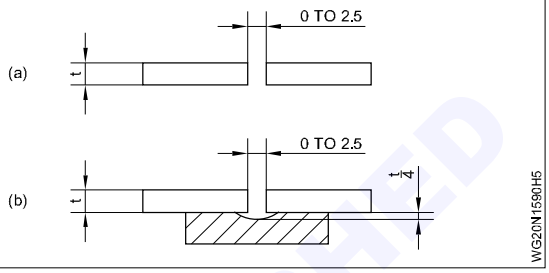


Fig 6

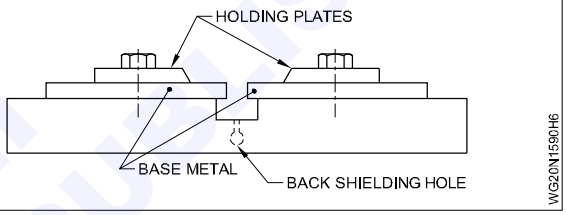


Fig 7

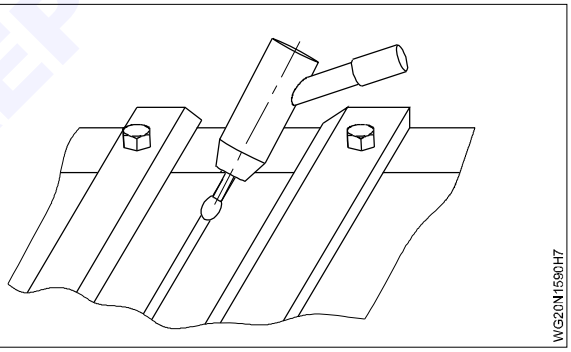
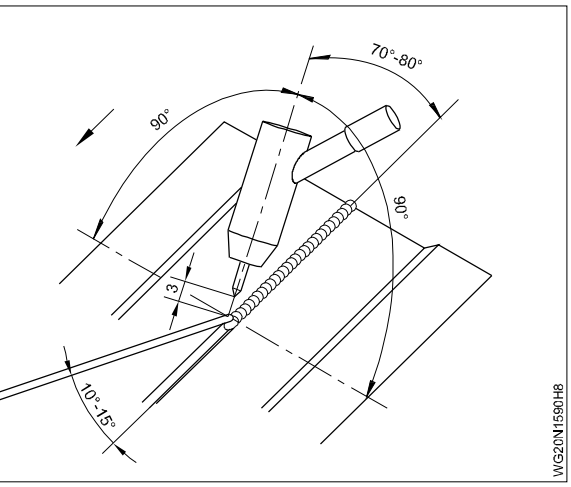


Fig 8



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- Strike the arc by switching on the torch and the electrode should be directed to be beading edge of the weld pool.

Shield the welding area from direct exposure to fans, open doors or the wind by providing plywood or temporary shed.

- Weld the root pass with the stringer bead technique. When the root pass is welded, the tackweld must be completely removed.
- Maintain low heat input to avoid too high an interpass temperature and overheating of the weld area.

The backing gas purge shall be maintain until atleast two layers of weld deposit have been made. After completion of cover passes, the purging dams (arrangements) shall be removed.

- Visual inspection shall be performed before during and after welding.
- Any temporary welded attachments shall be ground off and inspected by suitable nondestructive test such as penetrant test.

It is general practice to protect the roots of S.S welds with argon purging to prevent root oxidation

Skill Sequence

Square butt joint welding of S.S sheet with back purging technique

Objectives: At the end of this exercise you shall be able to
- **deposit weld bead with back purge technique.**

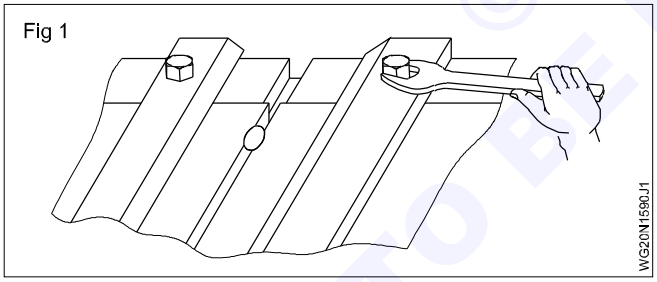
This will help you to successful welding of S.S requires the following considerations when selecting welding consumables and procedures to assure satisfactory weld properties.

i Joint Design

ii Joint Cleanliness

iii Joint Fit-up (Distortion control)

Fig 1



iv Filler Wire

v Tungsten Electrode preparation

vi Shielding Gas

vii Purging Gas

viii Welding power source

ix Purging Arrangements

x Oxygen level measurement

xi Welding sequence

xii Post weld cleaning

xiii Pickling and Passivationss

xiv Visual Inspection

xv Ferrite content in S.S weld metal

xvi Safety

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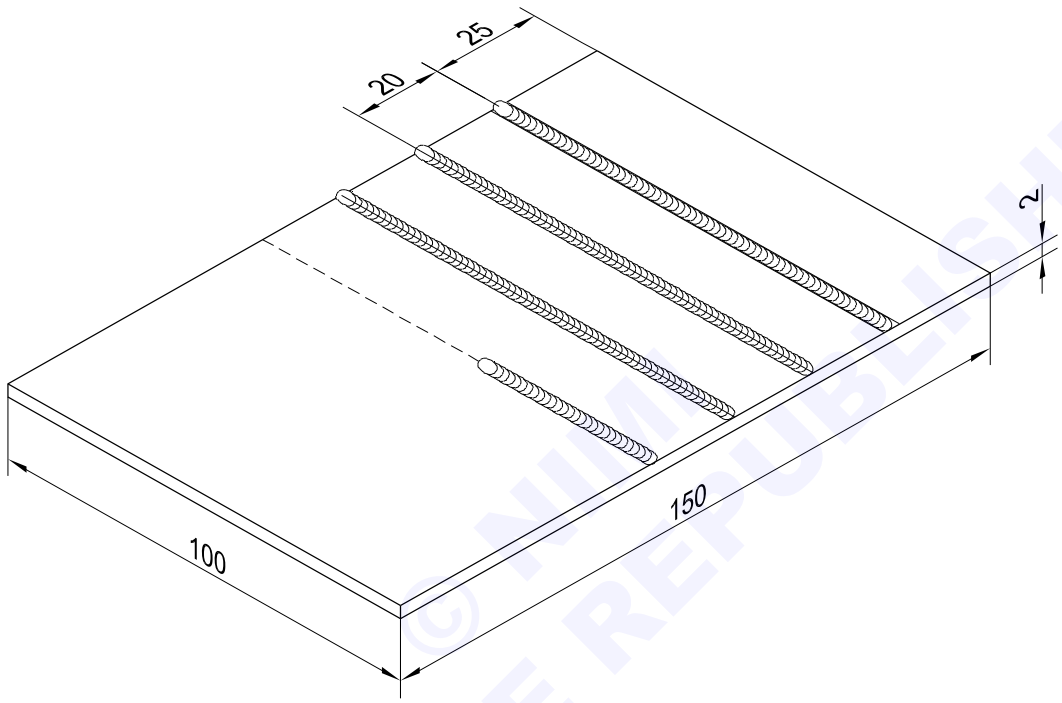
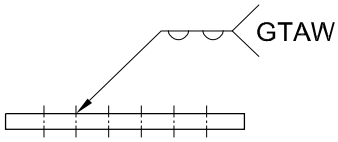
Beading practice on aluminium sheet by GTAW

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.**





Process : GTAW

Tungsten electrode = 3.15 mm(Zirconeted/ceriated)

Current - Argon = 100-120 Amps (AC)

Gas flow - Argon : 4-5 LPM

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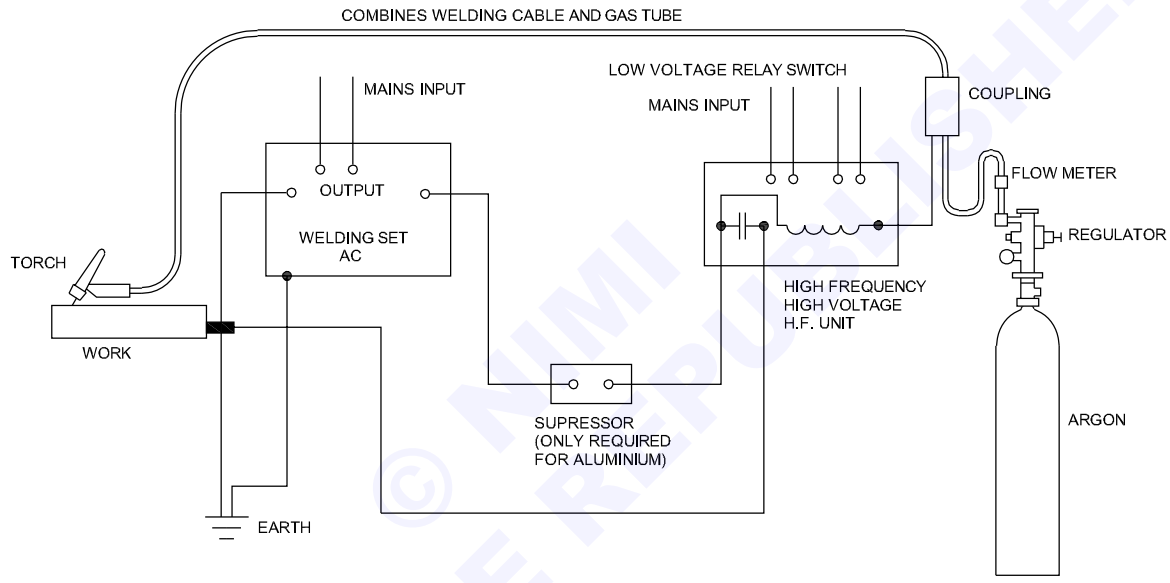
1	100 x 2 x 150	--	AL.199990 - IS 737	--	--	1.6.91
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**DEPOSITING BEAD ON ALUMINIUM SHEET 2mm ON POSITION FLAT**				TOLERANCE ±1	TIME : 9Hrs
					CODE NO. WG20N1691E1	

Job Sequence

- Prepare the aluminimum sheet as per dimensions.
- Clean the surface with the stainless steel wire brush.
- Also do the chemical cleaning with acetone/alcohol to remove the grease and surface oxide.
- Draw parallel lines and punch mark them as per dimensions.
- Set the job in flat position.
- Select the power supply as follows:
  - Use Argon as shielding gas and use AC power source. Majority of welding is done using argon gas.
- Set up the GTA welding plant as per the Fig.1.
- Select the type and size of tungsten electrode, current, gas flow rate and set them in filler wire. 1.6mmϕ with 5% silicon.
- Switch on the machine and strike the arc.
- Deposit fusion run with filler wire.
- Clean and inspect the weld job.

Fig 1



CONNECTIONS FOR INERT GAS WELDING USING AIR-COOLED TORCH

Skill Sequence

Beading practice on aluminium sheet by GTAW

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.**

Ensure to use correct size of the sheet for welding.

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

Set the current and other parameters.

Open the gas cylinder valve slowly.

Follow leftward technique.

The filler rod and torch are held at an angle as given in the earlier GTA welding exercises.

Finish welding and ensure to fill the crater.

Wire 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.

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TABLE 1

Guideline for Manual AC GTAwelding 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
1.6	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

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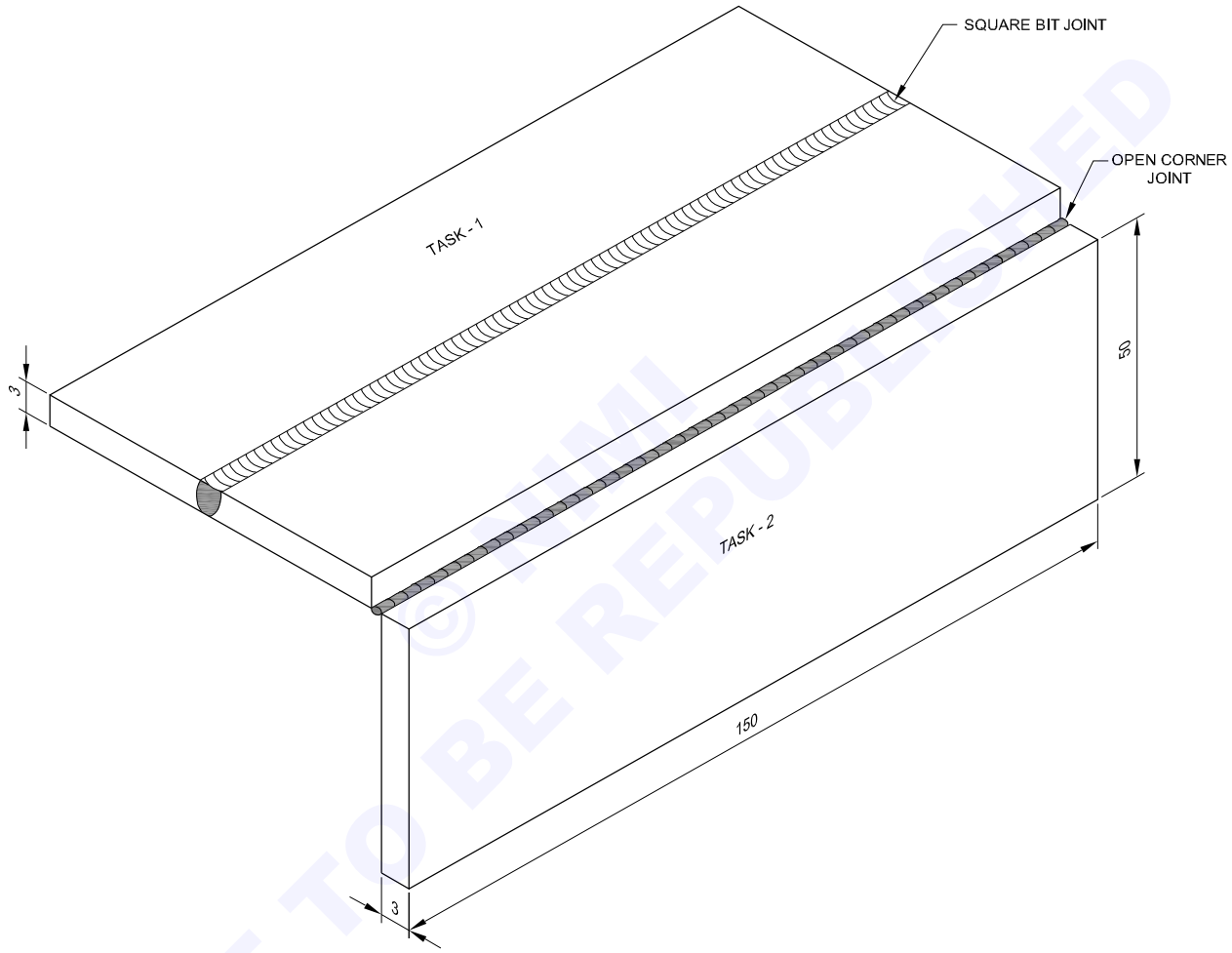
Square butt joint on aluminium sheet by GTAW in flat position, open corner joint on aluminium sheet in flat position.

Objectives: At the end of this exercise you shall be able to
- **weld square butt joint in Aluminium sheet 3mm thick using TIG welding process.**



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3	ISST 50 x 3 -150	--	AI 199990 - IS737	--	--	1.6.92
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**SQUARE BUTT JOINT ON ALUMINIUM SHEET BY GTAW IN FLAT POSITION & OPEN CORNER JOINT ON ALUMINIUM SHEET IN FLAT POSITION**				TOLERANCE ±1	TIME :
					CODE NO. WG20N1692E1	

Job Sequence

Task 1

1 Prepare aluminium sheets as per dimensions.
2 Use Tungsten (zirconium) 2.0mm 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.

— — — — — — — — —

Task 2

1 Prepare the job as per drawing
2 Clear the job file the edges to use flat file.
3 To set the butt joint tack weld technique with united root gap
4 Process the weld welding with narrow line with uniform penetration.
5 Another aluminum sheet to set the open corner joint with 1.0mm root gap included 90°
6 Process the weld without excess flow and uniformly penetration maintain key hole

Skill Sequence

Open corner joint on aluminium sheet in flat position

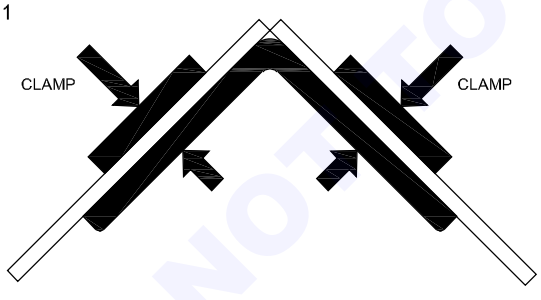
Objectives: At the end of this exercise you shall be able to
- **weld square butt joint in aluminium sheet 3mm thick using TIG welding process.**

Ensure the setting of an outside corner joint as per drawing.

Adjust current 60 - 90 Amp in AC.(Refer Table 1.)

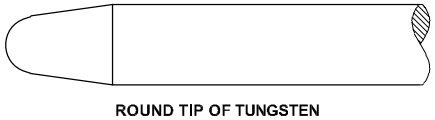
Use a backing bar made from a piece of steel angle with its apex bevelled or radious used to accommodate the penetration bead.

Fig 1



Hold the sheet onto the backing bar with steel strap. Fig.2

Fig 2



– 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.3).

Fig 3

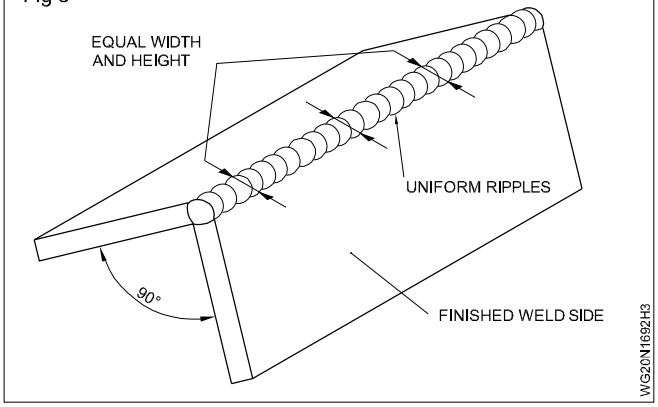


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TABLE 1

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
1.6	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

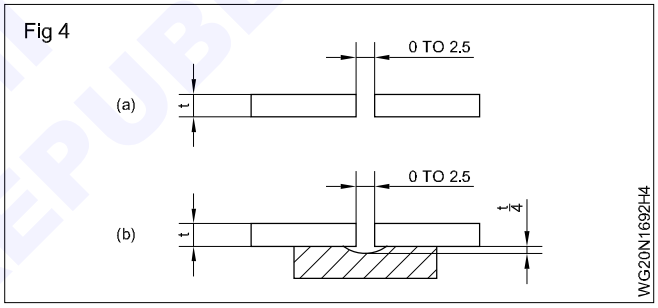
F - Flat, H - Horizontal, V - Vertical, O - Overhead

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 4



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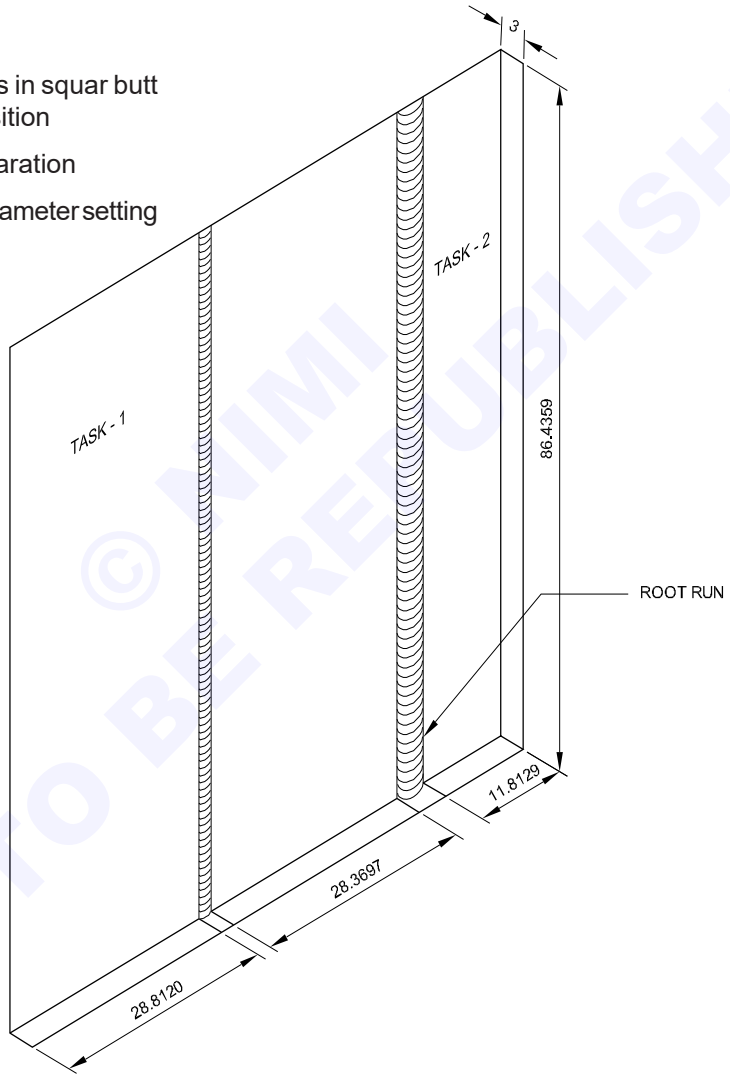
Square butt joint on aluminium sheet in vertical position, single V butt joint on aluminium sheet by TIG

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **set and tack weld the job**
- **deposit weld bead in vertical position**
- **clean and inspect the defects.**

Job Sequence

TASK 1

- Prepare the job as per dimensions in squar butt and single Vcc butt in vertical position
- Prepare sq butt square edge preparation
- Set root gap 2.0mm with correct parameter setting (BMP stroll)
- Process the root run with correct parameter setting (Ampstrolr)
- Clean and inspect both runs.
- Prepare second job single vee butt joint bevel L° and roof face
- Set vertical 2mm roof gap and roof run process.
- Process second run clean and inspect both runs.



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3	ISST 50 x 6 -150	--	AI 199990 - IS737	--	--	1.6.93
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.

SCALE NTS	SQUARE BUTT JOINT ON ALUMINIUM SHEET IN VERTICAL POSITION.SINGLE V BUTT JOINT ON ALUMINUM SHEET BY TIG	TOLERANCE ±1	TIME : 15Hrs
		CODE NO. WG20N1693E1	

TASK 2

- Prepare por ex job as per drawing
- Set bur with narrow line process welding
- Select parameter torch & filler rod L° elen
- Second job single U grooving angle and roof face check jack weld and setting.
- Roof run process penetranon check in both runs
- Final covering run process correct filler size use length without weld defects.

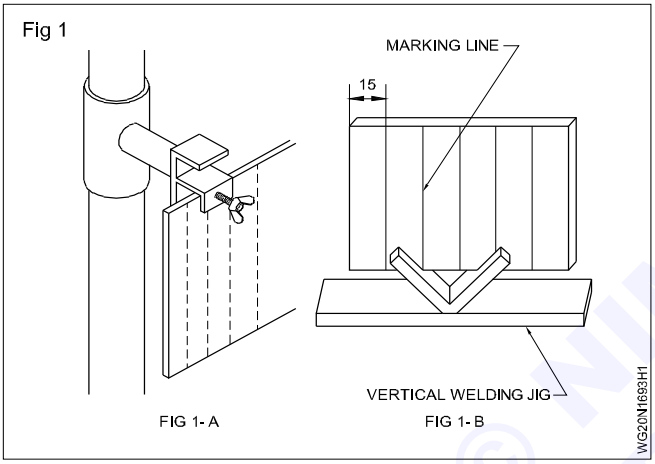
Skill Sequence

single V butt joint on aluminium sheet by TIG

Objectives: At the end of this exercise you shall be able to
• deposit weld bead in vertical position.

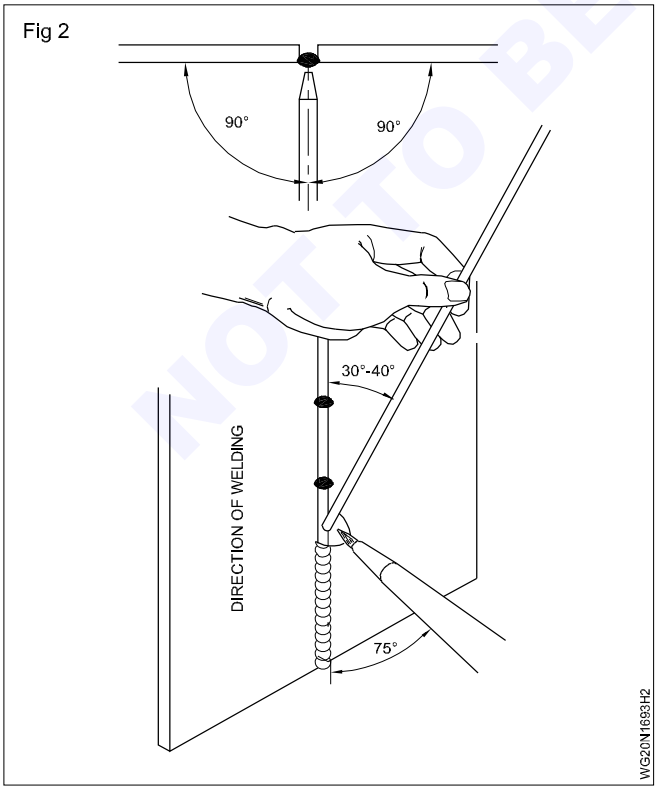
Job setting: fix the job in in vertical position a level from the ground based on your height. (Fig 1)

Fig 1



welding technique: Deposit the weld in vertical upward position

Fig 2



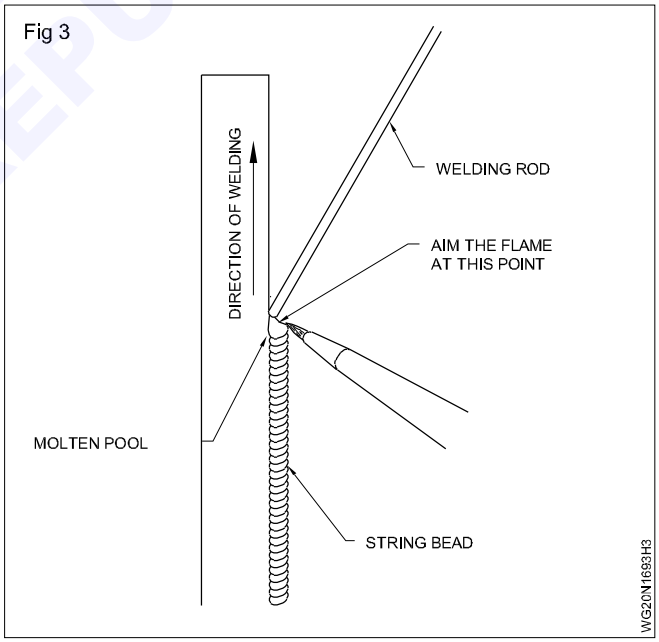
mainitain the angle of the blowpipe at 75° and the filler rod at 30°-40° (Fig 2)

Control the molten pool without giving any circular motion to the blowpipe. (Fig 3)

take due care that the weight of the blow pipe and hoses do not pull your hand downwards while the deposition of weld metal progresses upwards.

inspect the weld bead for surface degects like undercut, door bead appearance due to saggiing of weld metal, excessive reinforcement, wacy weld deposit etc.,

Fig 3



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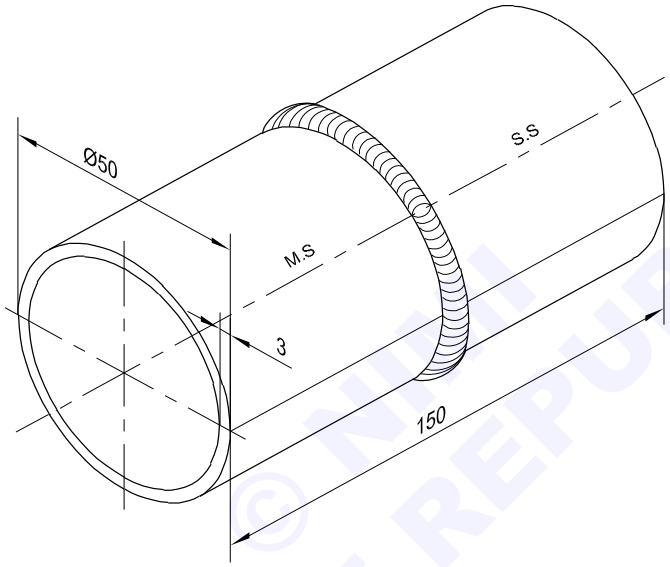
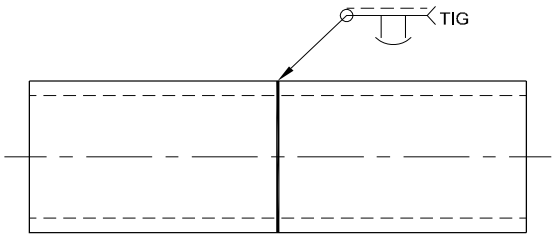
Square butt joint on tube welding practice on M.S.tube metals in rolled position

Objectives: At the end of this exercise you shall be able to
- **prepare the job as per drawing**
- **deposit the weld beads by rolled position.**

TASK : 1





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NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
1	Ø50 x 3 - 75	--	Fe 310	--	--	1.6.94
1	Ø50 x 3 - 75	--	X04Cr19N19	--	--	1.6.94

SCALE NTS	SQUARE BUTT JOINT ON TUBE WELDING PRACTICE ON M.S. & S.S TUBE METALS IN ROLLED POSITION	TOLERANCE ±1	TIME : 10Hrs
		CODE NO. WG20N1694E1	

Job Sequence

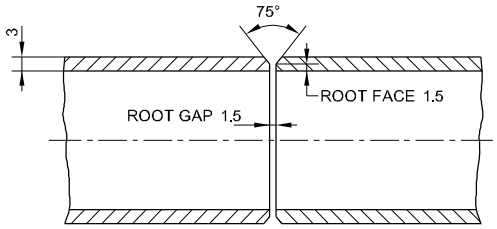
Task 1

1 Cut and prepare the aluminium pipe as per the dimensions given.

2 Align the pipes in flat position (butt) for tack weld with the help of a Vee Block-angle iron.

3 Tack the joints at 120^0 by rotation and complete the tacking.

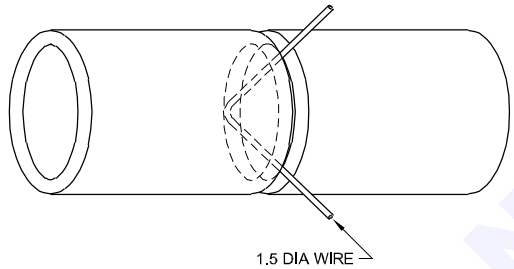
Fig 1



EDGE PREPARATION AND SETTING PIPE FOR BUTT WELD

WG20N1694 H1

Fig 2



USE OF BENT WIRE OR SUITABLE SPACER TO SET ROOT GAP

WG20N1694 H2

4 Use the roller stand to maintain the downward welding position.

5 Rotate the pipe at uniform speed for good weld result. Fig.3.

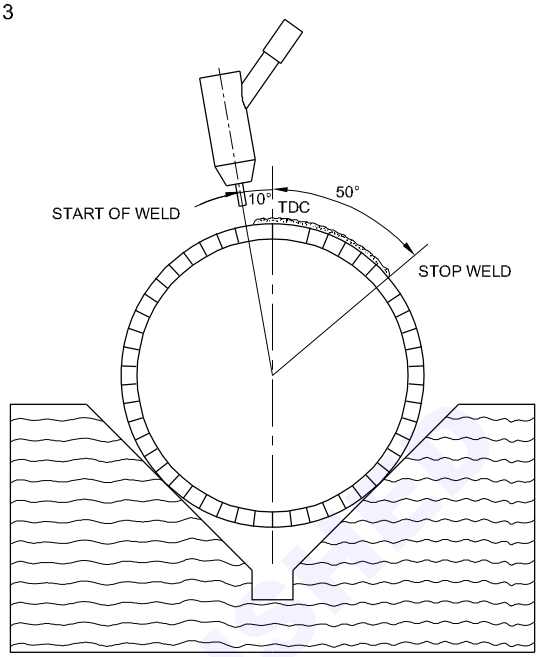
6 Further welding is done by rotating the pipe as shown in Fig.4 to the next segment and completed.

7 Repeat the above procedure till the joint is completely welded.

8 Remove the workpiece from the rotating fixture.

9 Clean the weld bead and inspect.

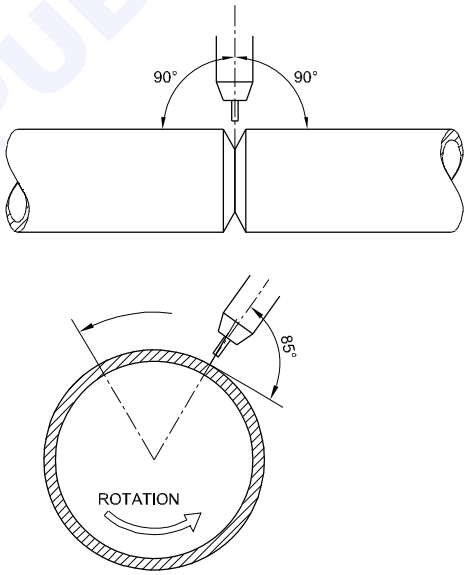
Fig 3



WELDING FIRST SEGMENT

WG20N1694 H3

Fig 4



WG20N1694 H4

Skill Sequence

Square butt joint on tube welding practice on M.S.tube metals in rolled position

Objectives: At the end of this exercise you shall be able to
- **deposit the weld beads by rolled position.**

Pipe welding is a highly skilled welding operation, which involves correct alignment and good penetration by equally melted edges of the pipes.

Select the rotating fixture according to the diameter of the pipe.

Place the tacked pipes on the rotating fixture and check the freeness of rotation.

Ensure proper melting of tacks for good penetration and surface appearance.

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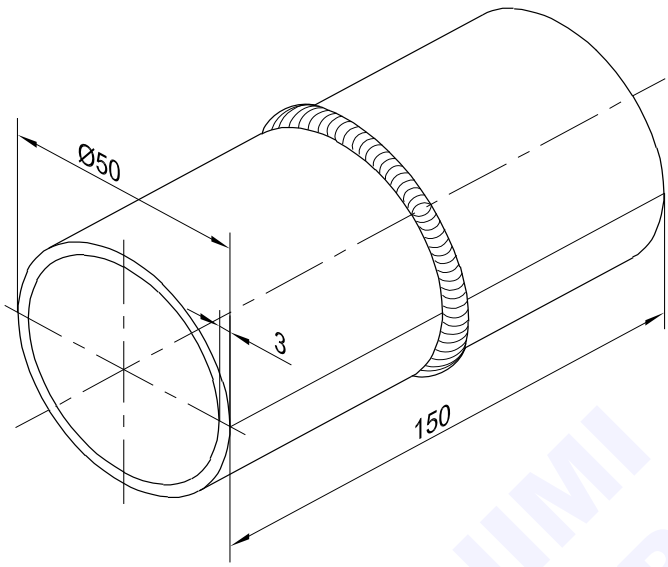
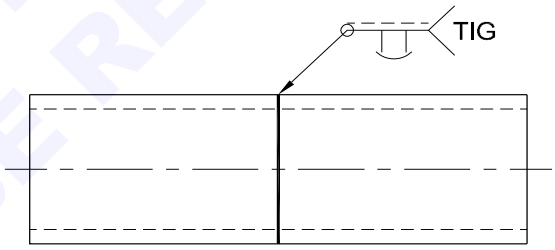
Square butt joint on tube welding practice on aluminium in rolled position

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

- **weld square butt joint in aluminium pipe wall thickness 3mm and 50mmϕ in flat position using TIG welding process.**

TASK : 2





2	Ø50 x 3 - 76	- -	A1199990 - IS737	- -	- -	1.6.94
NO.OFF	STOCK SIZE	SEMI PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**N.SQUARE BUTT JOINT ON TUBE WELDING PRACTICE ON ALUMINIUM IN ROLLED POSITION.**				TOLERANCE ±1	TIME : 10Hrs
					CODE NO . WG20N1694E2	

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Job Sequence

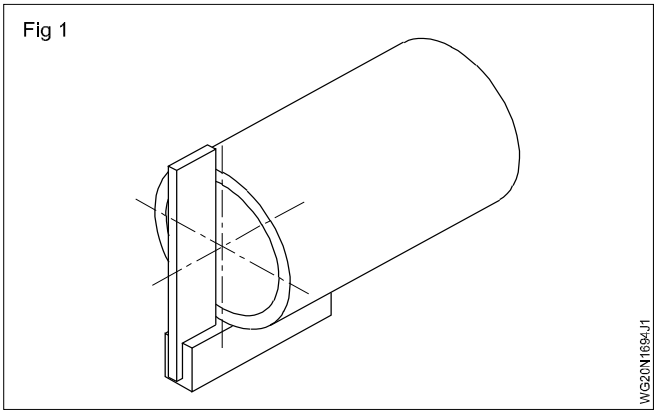
Task 2

1 Prepare the MS pipe as per the drawing 2 Nos.

2 Prepare the pipe ends and clean with machining followed by degreasing and pickling.

3 Check the squareness of the pipe edge by using a try square. (Fig.1)

Fig 1



4 Select the filler wire - C.C.M.S 2.4mmϕ.

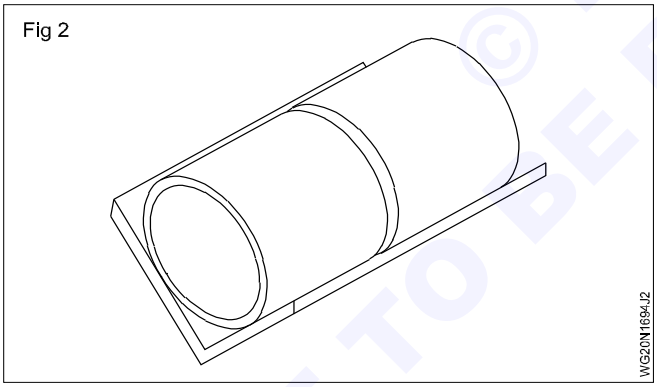
5 Select suitable tungsten electrode size 2.5mmϕ.

6 Set the current 85-110 Amps.

7 Set the argon flow 6-8LPM.

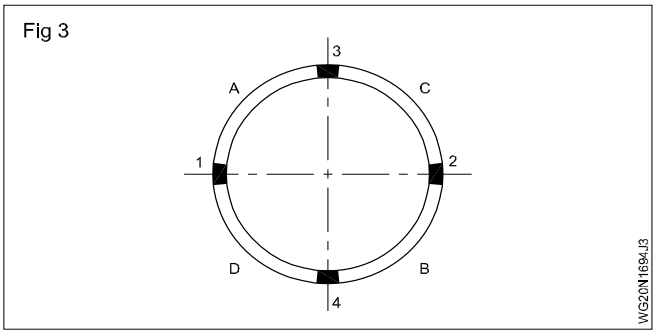
8 Before tacking align the pipes on "V" block on Vee profile with 2mm root gap. [Fig.2] and then tack them as shown in Fig.3.

Fig 2



9 Start the welding plant and tack the job as shown in Fig.3 with equal intervals.

Fig 3



10 Complete the weld as per sequence given below and clean the job inspect the weld for surface defects.

11 Turn the pipe to place section 'A' in a convenient position. (Fig.4A)

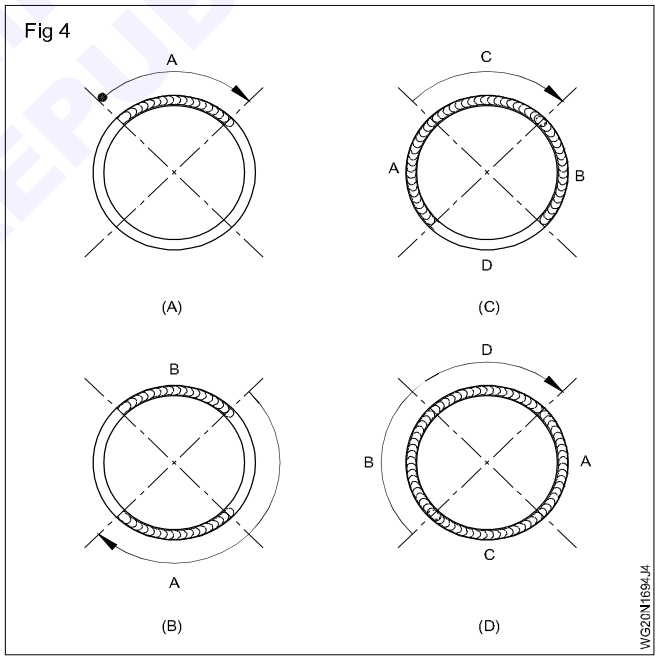
12 Weld section A (in clockwise direction).

13 Next position section 'B' opposite to section 'A' and weld it. (Fig.4B)

14 Turn the pipe and weld section 'C'. The run must melt completely into the other welds. (Fig.4C)

15 Turn the pipe and weld the last section (Section D). The run must melt into the other welds. (Fig.4D)

Fig 4



Skill Sequence

Square butt joint on tube welding practice on aluminium in rolled position

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

- **weld square butt joint in aluminium pipe wall thickness 3mm and 50mmϕ in flat position using TIG welding process.**

GTA welding of MS pipes and plates are frequently used to perform the single pass for 3mm and less thickness and root pass for the multi pass for welding on thicker plates.

A typical filler wire composition for GTA welding is as follows:

C - 0.15%
Si - 0.50%
Mn - 1.2%
S = 0.03%
P = 0.03%

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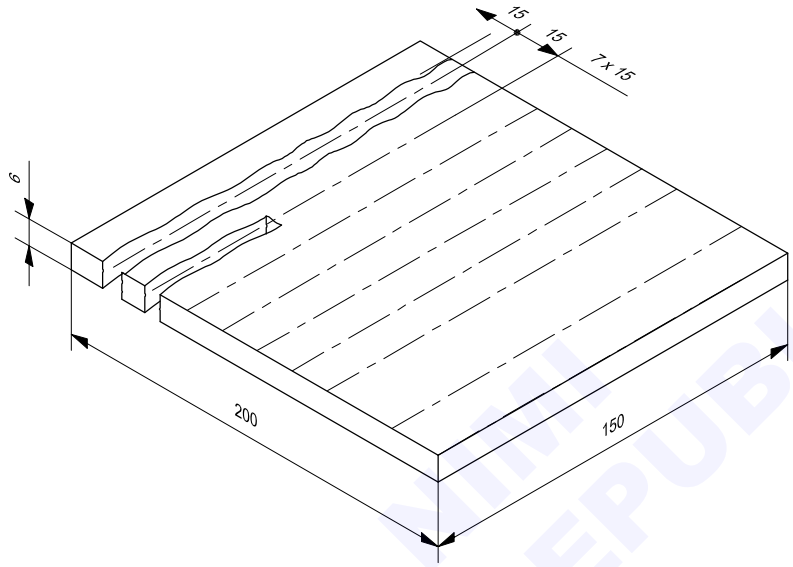
Plasma cutting of S.S.Sheet and aluminium plates

Objectives: At the end of this exercise you shall be able to
- **prepare the plate as per dimensionplasma**
- **make straight line cutting**
- **clean and inspect the weldments.**

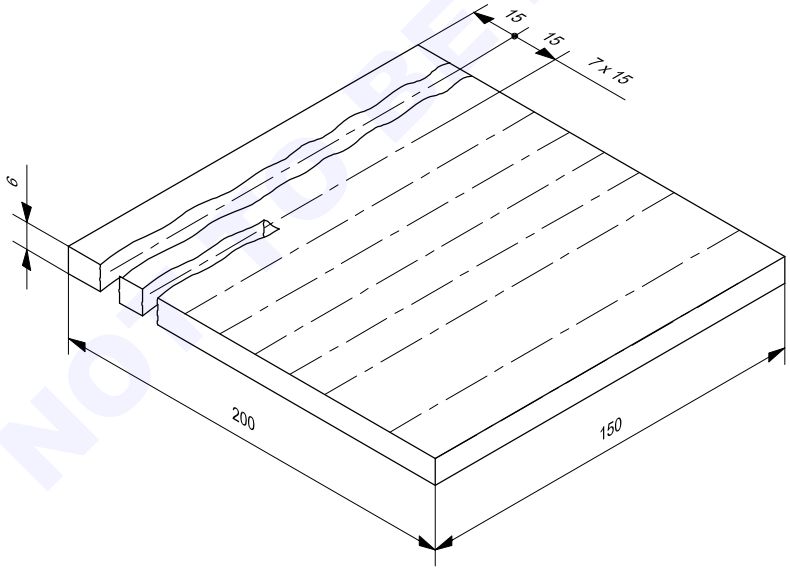
TASK : 1

S.S SHEETS



TASK : 2

ALUMINUM PLATES



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1	150 ISF 6 - 200		X O4 Cr 19N19			1.6.95
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	**PLASMA CUTTING OF SS SHEETS & ALUMINUM PLATES**				TOLERANCE	TIME : 8Hrs
					CODE NO . WG20N1695E1	

Job Sequence

- Begin cutting by placing the torch as close as possible to the edge of the base metal.
- Pull the trigger to initiate the pilot arc.
- Move the torch near the workpiece to initiate the cutting arc
- Wait for the arc to penetrate through the bottom of the workpiece.
- Start moving the torch slowly, perpendicular to the workpiece. Watch sparks leaving the bottom of the workpiece to judge your speed. If the sparks are not visible at the bottom of the plate, you have not penetrated the metal. This is because your travel speed is too fast or you have insufficient output amperage.
- At the end of a cut, angle the torch slightly or pause briefly to competely finish the cut systems
- Provide a post-flow circuit, the post-flow air will continue for a short period of time after the trigger is releases to cool the torch and consumable parts. However, cutting can be resumed immediately.
- To maximize cutting speeds, it is recommended to turn your power source to full output for all material thicknesses.

Proper Safety Procedures

Safety procedures must be closely followed in any application of a plasma cutter.

- Be aware of potential hazards involved with the process, including high voltages, noise, temperatures, flammable materials, fumes, ultravioltradiation, and molten metal.
- Proper welding clothing should be worn, as well as shaded eye protection, as specified by the manufacturer.
- As with all industrial products, read the owner's manual for proper safety procedures.

Skill Sequence

Plasma cutting of S.S.Sheet and aluminium plates

Objectives: At the end of this exercise you shall be able to
- **prepare the plate as per dimensionplasma.**

Plasma cutters use either "high frequency start" or "contact start" technology to initiate the pilot arc. If you plan to use a plasma cutter near telephones, computers, CNC machines or other electronic equipment, be aware that high frequency (HF) often interferes with electronic controls.

To avoid potential HF problems, all machines feature contact start design that does not cause interference. Even better the contact start method creates a visible pilot arc that helps you better position the torch.

Pre-Cut Checklist

A few final words of advice before cutting:

Follow proper safety procedures and wear personal safety equipment - read the Owner's Manual!

Inspect the torch tip, electrode and shield cup and replace worn items. The expence is well worth avoiding the poor cutting performance (and operator frustration) caused by worn parts.

Check gas/air pressure at the compressor or bottle gauge.

Turn on the plasma machine.

Set the amperage control (generally to maximum) and check the air pressure.

Grind off rust or paint where you plan to secure the ground clamp. This step is critical with 12-amp machines; they just don't have the power to drive through rust and paint like larger units do.

Place the ground clamp as close to the cut as possible, and place the clamp on the work piece itself when possible. Check for any loose connections between the work cable and the clamp.

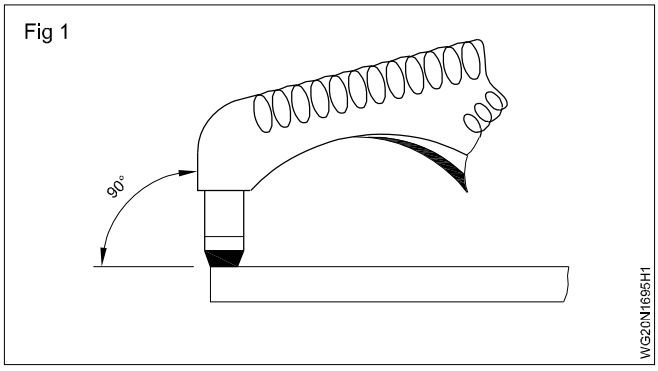
Relax-don't hold the torch too firmly or your hand will shake more

Begin cutting.

Cutting Technique

Step 1 : Place the drag shield on the edge of the base metal, or hold the correct standoff distance (typically 1/8 in.). Dircet the arc straight down. (Dragging the tip will reduce tip life).

Fig 1



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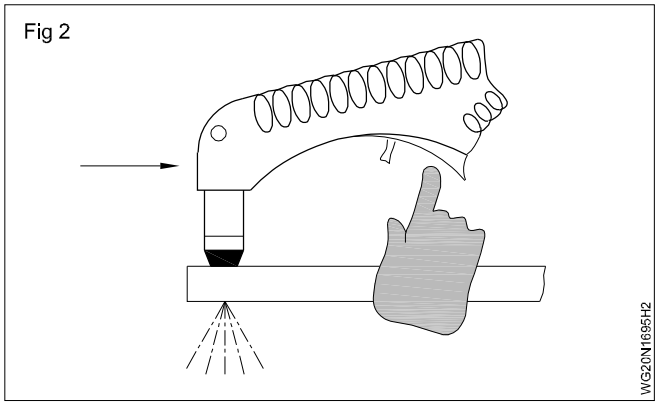
The arc starts immediately when trigger is pressed.

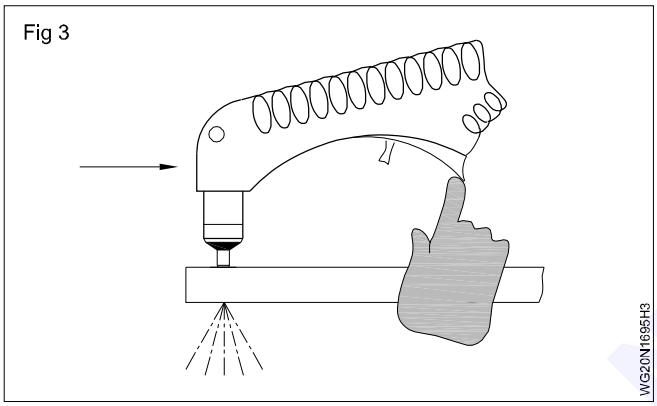
Step 2: Raise the trigger lock, press the trigger and the pilot arc starts immediately.

Fig 2



Step 3: Once the cutting arc starts, begin to slowly move the torch across the metal.

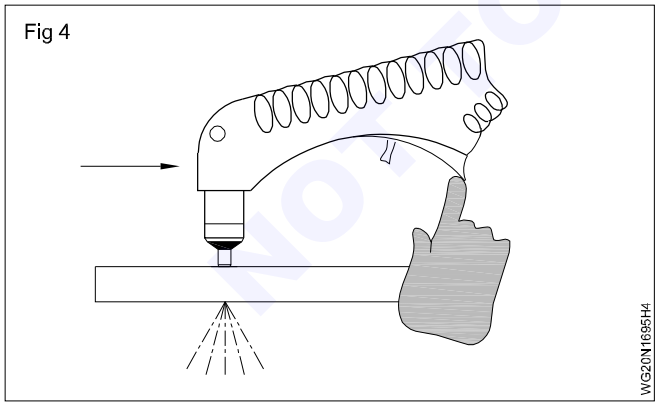
Fig 3



Step 4: Adjust your speed so sparks go through metal and out bottom of cut.

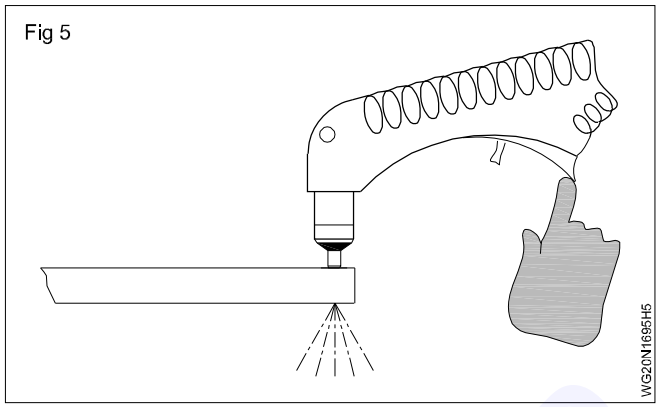
If the sparks are not visible at the bottom of the plate, the arc is not penetrating the metal. This can be caused by moving the torch too quickly, insufficient amperage or directing the plasma steam at an angle (not straight down). Insignificant grounding can also cause this problem.

Fig 4



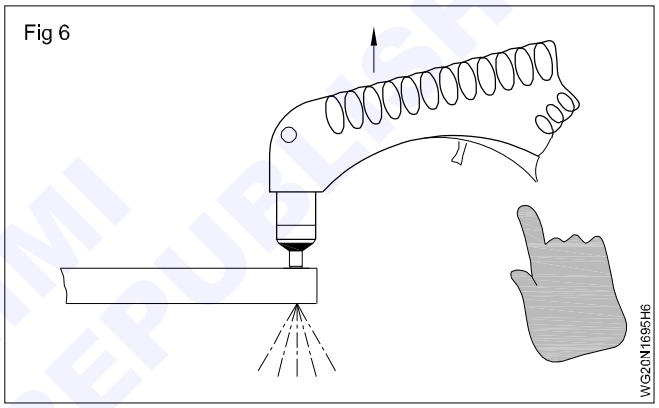
Step 5: At the end of a cut, angle the torch slightly towards the final edge or pause briefly before releasing trigger to completely sever the metal.

Fig 5



Step 6: To cool torch, post-flow air continues for 20-30 seconds after releasing the trigger; pressing the trigger during post-flow instantly restart the arc.

Fig 6



Travelling at the right speed produces a very clean cut with less dross on the bottom of the cut, as well as little or no distortion to the metal. If the travel speed is too slow, the material you are cutting may become hot and accumulate more dross. To minimize dross, increase travel speed or reduce amperage (for a rated cut). Dross also accumulates when you push a machine to its maximum thickness. The only cure for this is a bigger machine.

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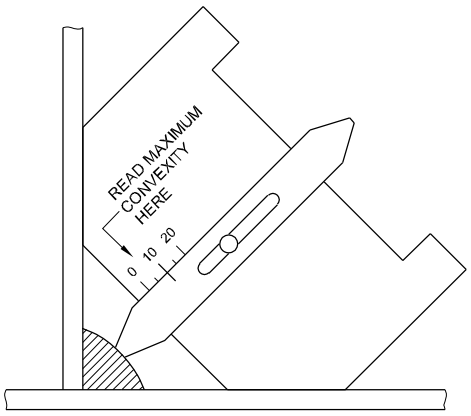
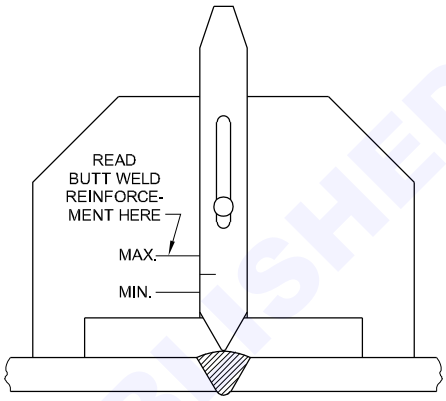
Dimensional inspection of weldments

Objectives: At the end of this exercise you shall be able to
- **use weld gauges**
- **identify concave / convex**
- **identify the leg length / weld thickness.**

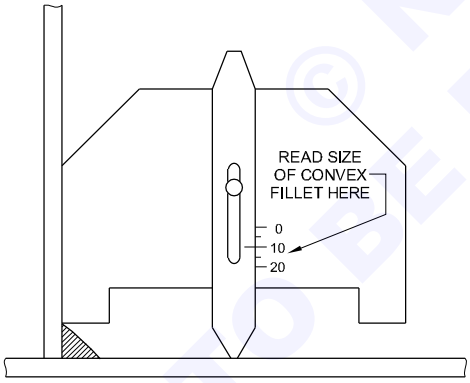
Fig 1



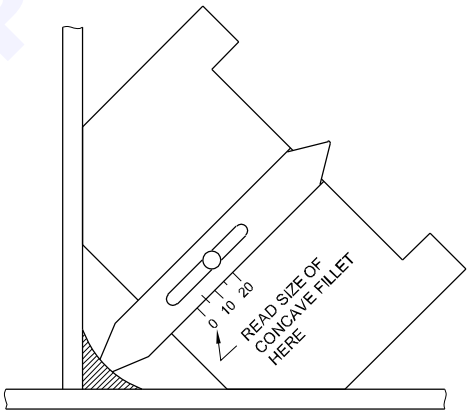
TO CHECK THE MAXIMUM PERMISSIBLE CONVEXITY



CHECKING BUTT WELD FOR MAXIMUM AND MINIMUM CONVEXITY



TO MEASURE THE SIZE OF A FILLET WELD



TO DETERMINE THE SIZE OF A CONCAVE FILLET

WG20N1695J1

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Fig 2

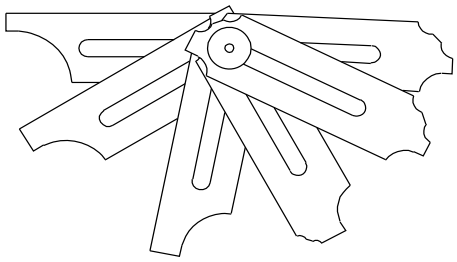

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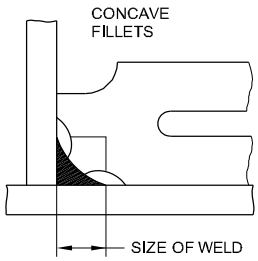
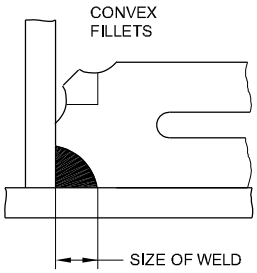
Fig 3



WG20N1695J3

Fig 4



WG20N1695J4

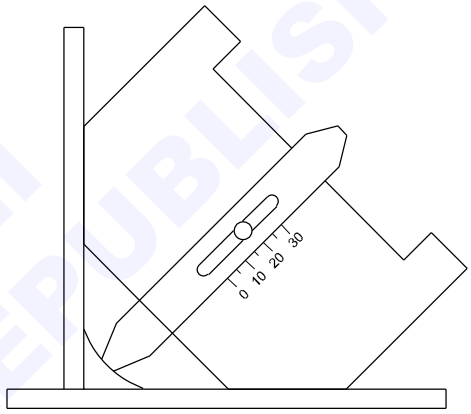
Weld gauge:

The weld gauge is used to measure the convexity & concavity, size and reinforcement of a weld.

Job Sequence

- Take the angle plate and welded job for testing.
- Place the work piece on the inspection table.
- Take the weld gauge and check its error deviation.
- Butt the weld gauge parallel to one side of the angle plate to measure the size of concave fillet.
- Measure the coincides of the main scale & vernier scale in the weld gauge.
- Change the position of the weld gauge such that the vernier scale touch the concave shape of the weld to measure the maximum permissible concavity.
- Measure the concedes of the main scale & vernier scale reading.

Fig 1



TO DETERMINE THE MAXIMUM A PERMISSIBLE CONCAVE FILLET

WG20N1695K1

- Note the reading for observation.

Skill Sequence

Dimensional inspection of weldments

Objectives: At the end of this exercise you shall be able to
- **identify the leg length / weld thickness.**

Select the welded job with concave

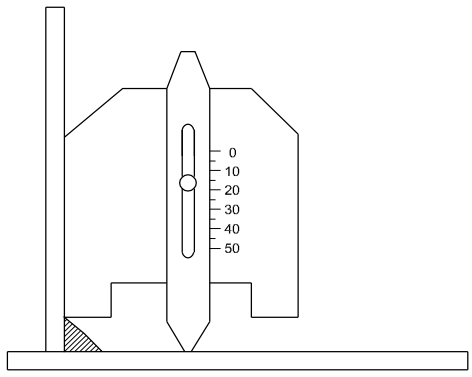
Check and correct the error deviation in the weld gauge

Measure the size of concavity

Change the position of weld gauge and check the maximum permisseable concavity

Note the reading for observation.

Fig 2



TO MEASURE THE SIZE OF A CONVEX FILLET WELD

WG20N1695K2

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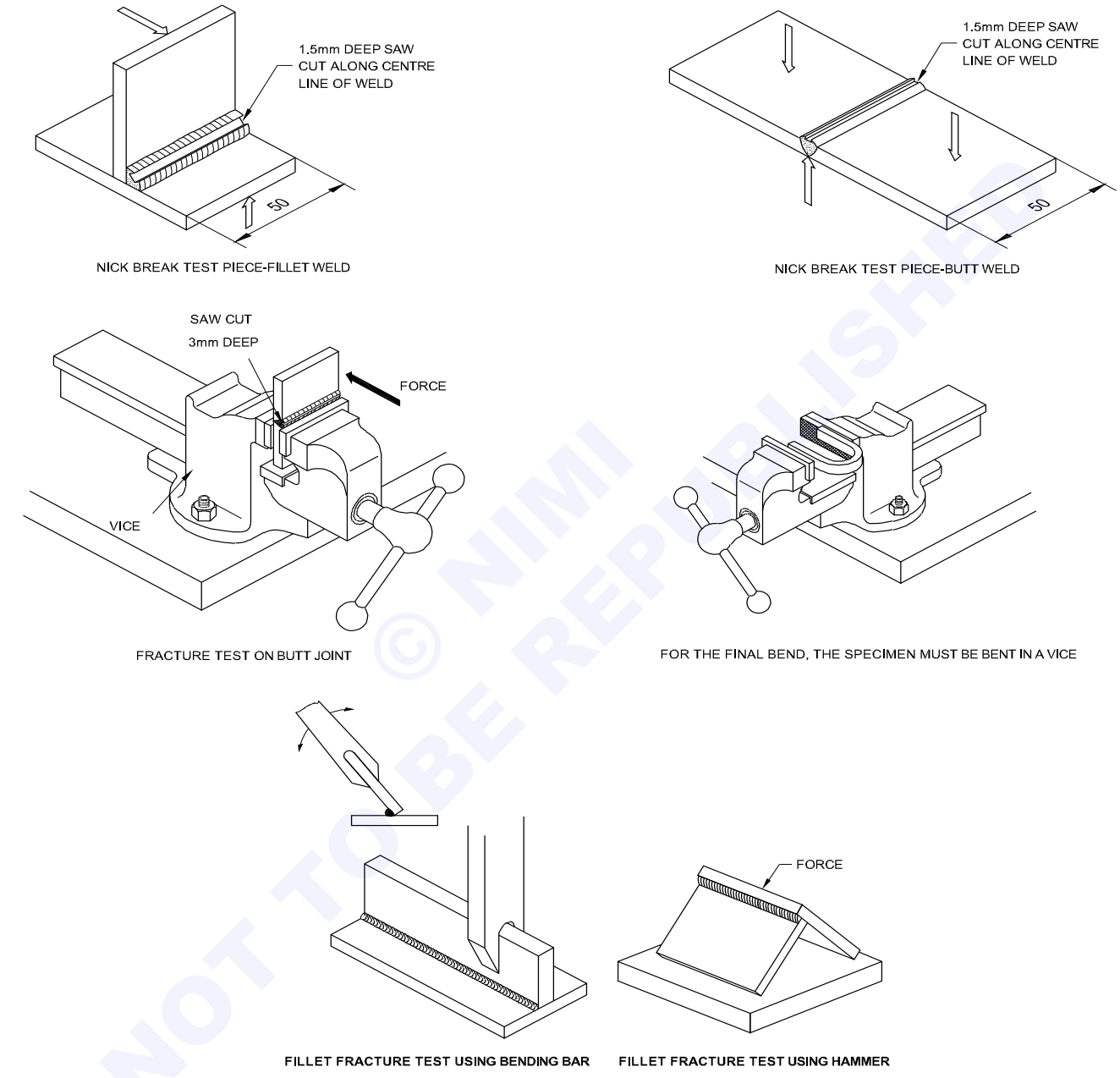
Weld test specimen preparation

Objectives: At the end of this exercise you shall be able to
- **prepare the specimen depends the inspection.**

Fig 1



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Job Sequence

- Prepare flat butt welding specimen and T first fillet weld 2 specimen unit plate even of 10mm
- Remove the slag using clipping hammer
- Cut the welder part using hammer and bend the plate for nice break test to find out the weld defect
- Hold the butt welded one part in the bench vice and hammering the top portion then find out the weld defect
- Hold butt welded specimen length and input vice lamb till the specimen becomes u-shaped then final the weld defect tabulates the defect seen in the specimen.
- Hold the T fillet specimen wire the bending bar and bend the vertical part and not down the weld defects.
- Lay the t weld specimen on flat surface and hammer the specimen shown in figure then find out the fillet weld defect
- These best are belong to destructive test method to find out the weld defect in the specimen

Visual inspection of weldments

Objectives: At the end of this exercise you shall able to:
- **observe the given sample of weld joint visually**
- **study the weld joint and identify the defects**
- **prepare the inspection repor.**

Task 1: **Inspection of weld bead**

WELD SAMPLE - BEAD	OBSERVATIONS ON WELD BEAD
TASK - 1  SAMPLE-1	
 SAMPLE-2	
 SAMPLE-3	

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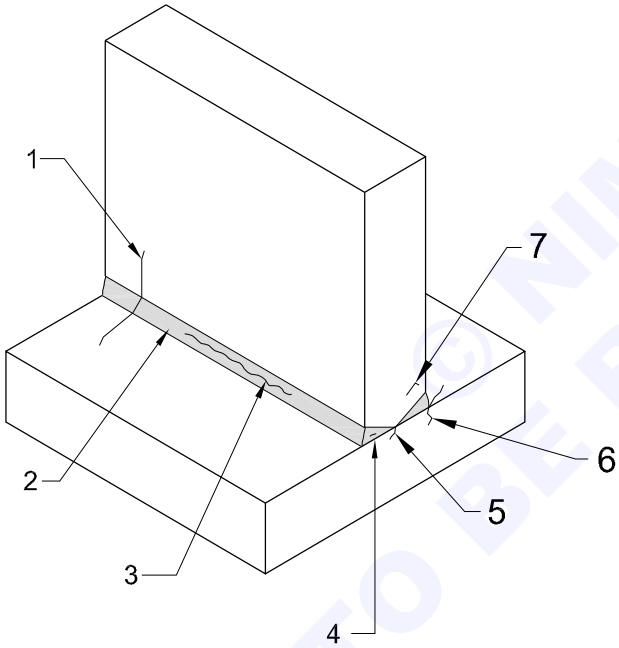
Task 2 : **Inspection of weld sample fillet joints**

1 Observe the given sample of weldment.

2 Study the weld joint and identify the defect.

3 Record the name of defect in weld against each sample.

WELD SAMPLE - FILLET JOINT	NAME OF DEFECT
TASK - 2  **Note: Actual samples to be given by instructor for further study.**	1 Spatters 2 Crack 3 Parent metal 4 Crater 5 Penetration 6 Undercut 7 Fusion Penetration 8 Parent Metal 9 Chamfering Area

WG20N1698J1

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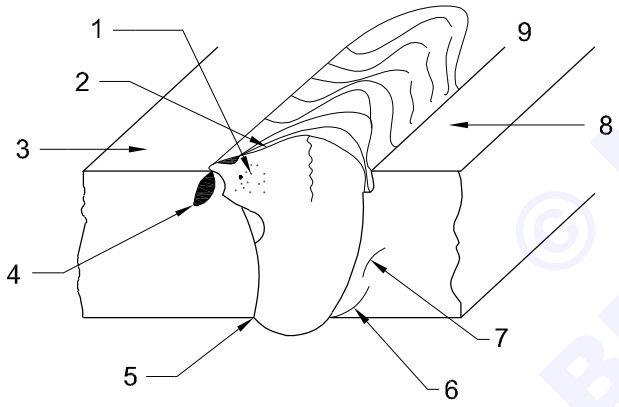
Task 3: **Inspection of weld sample butt joint**

1 Observe the given sample of weld joint.

2 Study the weld joint and identify the defect.

3 Record the name of defect in weld joint against each sample.

WELD SAMPLE - FILLET JOINT	NAME OF DEFECT
TASK - 3  	1 Spatters 2 Crack 3 Parent metal 4 Crater 5 Penetration 6 Undercut 7 Fusion Penetration 8 Parent Metal 9 Chamfering Area

WG20N1698J2

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Job Sequence

Task 1: **Inspection of weld bead**

1 Study the given weld sample for inspecting the bead under proper lighting.

2 Observe the weld bead using magnifying glass for (2-2.5) any deviation on straight and uniform welding.

3 Record the deviations by visually observed in this welded sample 1 as slag inclusion and discontinuity on the weld bead.

4 Record the observations in the register with details.

5 On sample 2, it is observed that porosity along the length of bead, with spatters, along the bead of weld.

6 On sample 3, it is observed that non uniformity along the bead with pin holes defective.

If instructor provides actual welded samples, to trainees it may be cleaned the weld joints with wire brush used be free from dirt, dust, slag which may affect the quality of appearances for visual examination.

— — — — — — —

Task 2**: Inspection of weld sample fillet joints**

1 Study the given weld sample for fillet joint for inspecting the type of defects.

2 Observe the fillet weld joint and prepare ably cleaned lee force visual inspection using with wire brush.

3 Ensure that the cleaned surface is free from dirt, dust, slag etc. which may affect the quality of appearance for visual examination.

4 Record the name of the defects each mentioned is welded sample fillet joint.

5 Record the observations in the register with details.

— — — — — — —

Task 3: **Inspection of weld sample butt joint**

1 Study the given weld sample for butt joint for inspecting the type of defects.

2 Observe the butt joint and prepare ably cleaned lee force visual inspection using with wire brush.

3 Ensure that the cleaned surface is free from dirt, dust, slag etc., which may affect the quality of appearance for visual examination.

4 Record the name of the defects each mentioned in welded sample butt joint.

5 Record the observations in the register with details.

— — — — — — —

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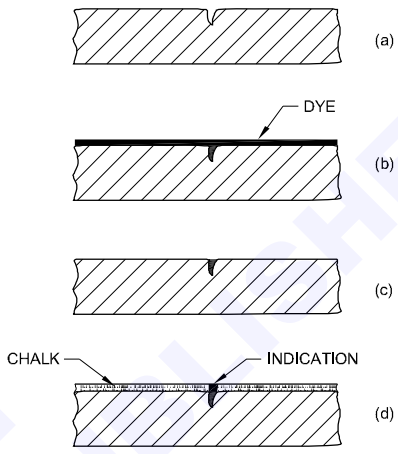
Evaluation of welding defects using dye penetrant testing mehtod on plate & pipe

Objectives: At the end of this exercise you shall be able to
- **inspect a welder steel component for surface defects using dye penetrant method**
- **identify the defect.**

PROCEDURE

- Clean the surface of the test piece welded steel components.
- Spray the coloured dye on the surface(B)
- Allow the dye to soak for about 2 to 3 minutes.
- Wash the surface with cleaner (C)
- Dry the surface using a soft cloth.
- Spray the liquid developer on the surface (D)
- Observe the coloured dye coming out in the shape of the defect in to the white liquid developer.
- Analyse the defect.

Fig 1



LIQUID PENETRANT TEST

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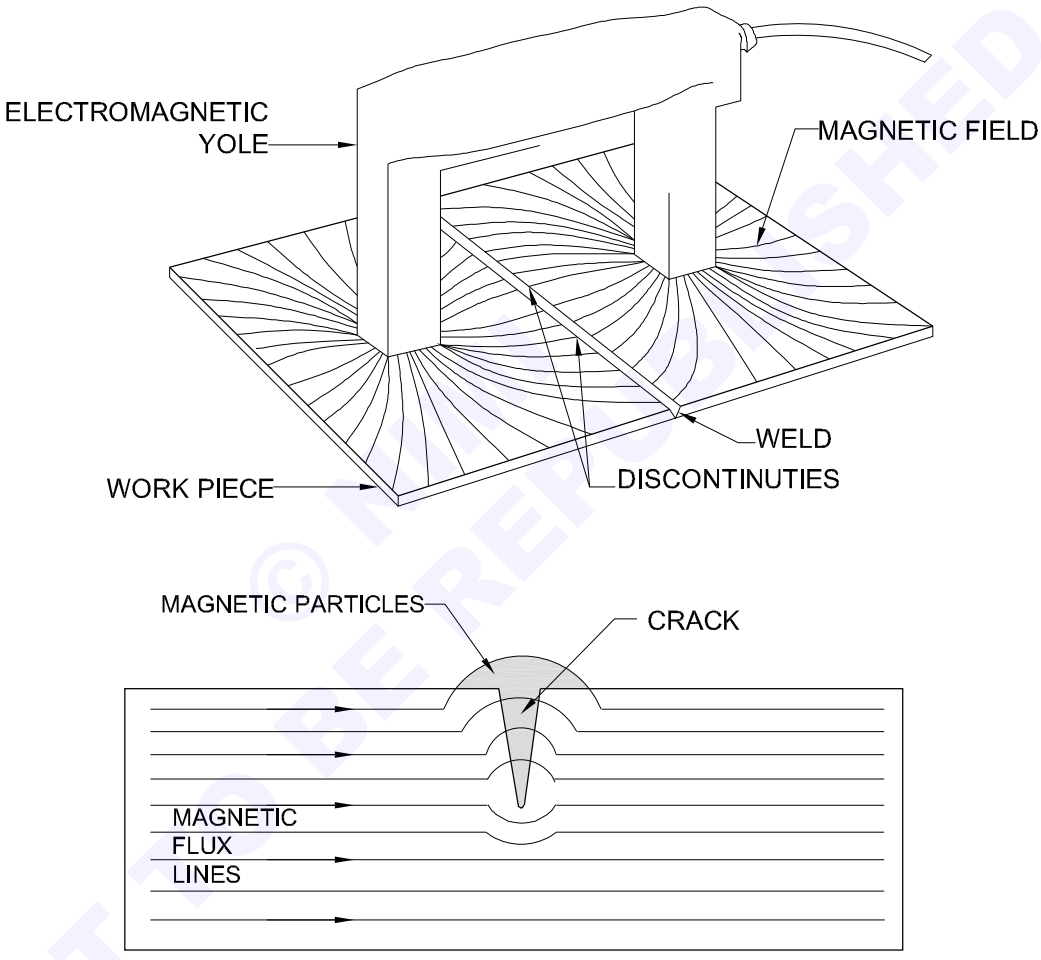
Magnetic particle test

Objectives: At the end of this exercise you shall be able to
- **inspect of welded component for surface defect using magnetic practical test.**
- **locate and mark the place of defect.**



MAGNETIC PARTICLE INSPECTION

1	WELDED JOB		Fe 310 - W			1.6.99
NO.OFF	STOCK SIZE	SEMI-PRODUCT	MATERIAL	PROJECT NO.	PART NO.	EX. NO.
SCALE NTS	MAGNETIC PARTICAL TEST				TOLERANCE ±0.5	TIME :
					CODE NO . WG20N1699E1	

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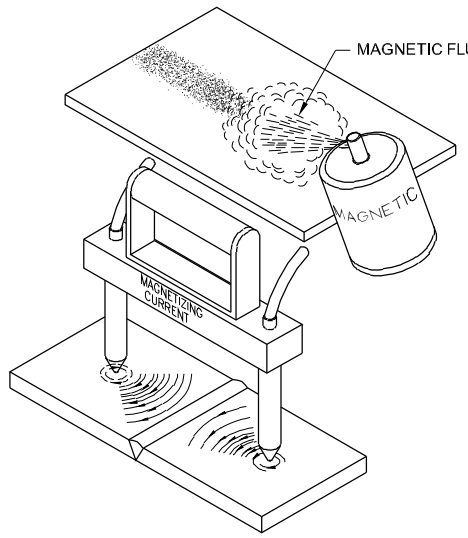
Job Sequence

- Familiarize with the working of magnetic particle test unit
- Set the test piece in the MPT unit
- Spray the iron particle liquid on the surface of the component
- Switch on the power to magnetic the test piece

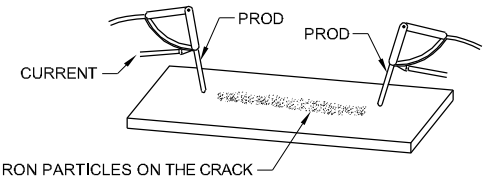
Fig 1



MAGNETIC PARTICLE TEST

- Observe the iron particles which gather at the edges of crack (or) flaw
- Locate the crack or flaw and make the area.

Fig 2



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