

58

SYLLABUS FOR
WELDER (GAS AND ELECTRIC)
UNDER
CRAFTSMEN TRAINING SCHEME
&
APPRENTICESHIP TRAINING SCHEME

As approved by
GOVERNMENT OF INDIA

In consultation with
THE NATIONAL COUNCIL FOR
VOCATIONAL TRAINING
&
CENTRAL APPRENTICESHIP COUNCIL

Issued by
GOVERNMENT OF INDIA
MINISTRY OF LABOUR
DIRECTORATE GENERAL OF
EMPLOYMENT & TRAINING
NEW DELHI

2007

GENERAL INFORMATION

1. Name of the trade : WELDER (Gas & Electric)
2. N.C.O. Code No. : 872.10, 872.20
3. Entry Qualification : Passed in 8th Class Examination
(7th Class Pass where Terminus Examination is in 7th Class)
4. Duration of Craftsman Training : One Year
5. Unit Size : 12 Trainees
6. Space Requirement : 80 Sq. Metre
7. Duration of Apprenticeship Training : 02 Year including one year Basic Training
8. Rebate to Ex-ITI/ITC Trainees : One Year for Ex-ITI/ITC Passed out Trainees in the Trade of Welder (Gas & Electric) / Welder
9. Ratio of Apprentice to Workers : 1 : 4

Note for Apprenticeship Training :

At the end of shop floor training, an apprentice shall appear a final examination to be conducted at establishment level based on actual shop floor training received by the apprentice. This examination shall comprise of assesment of work dairies maintained by the apprentices and Viva-Voce to be conducted by the external examiner (other than the official directly responsible for shop floor training).

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New & recommendation

Practical	Theory	Engg. Drw.	W/Shop Calculation & Sciences
<p>Induction Training: Familiarization with the Institute's Importance of Trade Training - machinery used in the trade. Introduction to safety equipment and their uses etc. Setting up of Arc and as Apparatus. Lighting and adjustment of flame. Striking and arc.</p>	<p>3</p> <p>General discipline in the Institute Elementary First Aid importance of Welding in Industry- Safety in Manual Metal Arc Welding-Safety in Oxy-Acetylene Welding and Cutting- Marking and measuring tools Materials preparation method. Gas Welding hand tools — Uses - Care and Maintenance Various Welding Processes- Their Classification and their applications.</p>	<p>4</p> <p>Importance of Engineering Drawing and its knowledge.</p>	<p>5</p> <p>Importance of Science and Calculation to the Trade skill and Fundamental Arithmetical Operations Addition, Subtraction, Multiplication and Division.</p>
<p>Fusion Run with and without filler rod. M.S. Plate 2 mm position.</p>	<p>Uses - Care and Maintenance Various Welding Processes- Their Classification and their applications.</p>	<p>Use of Drawing Instruments. T-Square Drawing Board etc.</p>	<p>Properties and uses of cast iron, wrought iron, plain carbon steels and alloy steels.</p>
<p>Straight line Beads on M.S. Plate M.S. 10 mm position F.</p>	<p>Different Process of metal joining - Bolting-Riveting-Soldering-Brazing etc.</p>	<p>Letters, Numbers and Alphabets as per IS 696/1972.</p>	<p>Properties and uses of cast iron, plain carbon steels and alloy steels.</p>
<p>Butt weld square Butt joint on M.S. sheet. M.S. sheet 3 mm Position F.</p>	<p>Oxy-Acetylene Cutting Equipment- Principle and Application — their care and maintenance.</p>	<p>Letters, Numbers and Alphabets as per IS 696/1972</p>	<p>Properties and uses of Copper, Zinc, Lead, Tin and Aluminium.</p>

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<p>Weaved bead on M. S. Plate. M.S. Plate 10 mm Position F.</p>	<p>Simple Electrical terms and their definitions- Uses of Electricity as applied to welding-Electricity-AC-DC-Types of Electric Welding and Applications.</p>	<p>Freehand Sketching of straight lines, rectangles, Circles, Polygons etc.</p>	<p>Properties and uses of Brass, Bronze, Bearing Metal, Solder, Rubber and Timber.</p>
<p>Oxy-Acetylene, hand cutting on M.S. Plate Straight and bevel.</p>	<p>Common Gases used for Welding- Oxygen Acetylene. LPG types of Oxy-Acetylene flames-Their setting- uses- Various Gas combinations - Flame Temperatures and their uses- States of matter.</p>	<p>Use of different types of line and symbols for drawing. Importance of putting dimension on the drawing as per IS 696/1972.</p>	<p>Fraction-Addition, Subtraction, multiplication and Division-Problems.</p>
<p>Fillet weld lap joint on MS Plate. Plate 5 mm Position F. Butt weld in Open Square Butt Joint. MS plate 5 mm Position F. Butt Weld-Single V-Butt Joint. M.S. Plate 10 mm Position F.</p>	<p>Nomenclature of welding joints- Terms applied to each joint- Explanation with simple sketches — Welding symbols- Description and uses. Edge preparation - application.</p>	<p>Freehand sketching with dimension, scale and proportionate sketching.</p>	<p>Fraction-Addition, Subtraction, Multiplication and Division-Problems.</p>
<p>Fillet Weld Tee joint M.S. Sheet 2 mm Position F. Fillet weld Outside Corner joint. MS sheet 2 mm Position F.</p>	<p>Chemistry and structure of Oxy-Acetylene Flame. Manufacture of Calcium Carbide-Quality control Properties-Its impurities. Effect of each element on metals.</p>	<p>Reading of simple blue print.</p>	<p>Decimal-Addition, Subtraction, Multiplication, and Division-Problems.</p>

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<p>Fillet Weld Tee joint M.S. Sheet 2 mm Position F. Fillet weld Outside Corner joint. MS sheet 2 mm Position F.</p> <p>Straight line Beads on M.S. Plate M.S. Plate 10 mm position H.</p> <p>Butt weld single butt joint. MS plate 12 mm Right hand welding Technique Position H. Fusion Run with filler rod on MS sheet. MS Sheet 8.15 mm Position H.</p> <p>Butt Weld Single Vee Butt joint on MS plate. MS plate 10 mm Position H. Straight Line Bead Vertical Upward. MS Plate 10 mm.</p>	<p>Chemistry and structure of Oxy-Acetylene Flame. Manufacture of Calcium Carbide-Quality control Properties-Its impurities. Effect of each element on metals.</p> <p>Principle of Arc Welding-Necessity of Welding Machines-types of Machine - Construction - Advantages and disadvantages of each machine-Care and maintenance.</p> <p>Acetylene-its properties-Acetylene Generators, Carbide to water type - Working Principle - Care and Maintenance - Water to Carbide type- working principle-care and maintenance. Comparison of two types of generators. Acetylene purifier-Hydraulic Back Pressure valve.</p> <p>Arc and its characteristics-Arc length-types. Uses-Advantages and disadvantages.</p>	<p>Reading of simple blue print.</p> <p>Isometric views and Oblique views with dimensions of such as Cube, Rectangular, Block, Cylinder etc.</p> <p>Explanation of simple Orthographic Projection 1st angle, as per IS 696/1972</p> <p>Explanation of simple Orthographic Projection 3rd angle, as per IS 696/1972</p>	<p>Decimal-Addition, Subtraction, Multiplication, and Division-Problems.</p> <p>Decimal-Addition, Subtraction, Multiplication, and Division-Problems.</p> <p>Fraction and Decimals Conversion - Fraction to Decimal and vice-versa.</p> <p>System of Units-British, Metric and S.I. Units for Length, Mass, Area, Volume, Capacity, time.</p>

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<p>Achievement: Should be able to weld joints uniformly to a length of not less than 15 cm by Gas and Arc Welding respectively.</p> <p>1. Marking out on MS plate or Flat. 2. Filing square to Dimensions.</p> <p>3. An edge chipping and cutting. 4. Hacksawing.</p> <p>Fillet Weld Inside Corner Joint. MS Sheet 2 mm Position H.</p> <p>Laying Weaved Beads Vertical Upward MS Plate 10 mm Position V.</p>	<p>Polarity-types - Method of identification-Uses of each type - Importance and indication of wrong polarity</p> <p>Safety precaution in Fitter Shop - Steel Rule types and its uses- Punches-types and its uses, Try square-Scriber-its functions.</p> <p>Chisel-types and construction-Hacksaw Frame Hacksaw Blades- its types. Files-Parts. Types and uses- Hammer types-Parts and its uses. Vices and Clamps-their types.</p> <p>Oxygen-its properties-Manufacturing methods Oxygen Cylinder-D.A. Cylinder-Description-Method of Charging-Care and Maintenance.</p> <p>Welding positions-Flat-Horizontal- Vertical and overhead-Slope</p>	<p>Sketching the views solid bodies when viewed perpendicular to their surfaces and axes.</p> <p>Sketching the views solid bodies when viewed perpendicular to their surfaces and axes.</p> <p>Freehand Sketching of plan and elevation of simple objects like Hexagonal bar, square bar, Circular bar, tapered bar and Hollow bar etc.</p> <p>Reading of simple Blue Print.</p>	<p>Conversions between British and Metric Systems.</p> <p>The square root- The Square and Square root of a Whole Number and Decimal.</p> <p>The Square root-Shop Problems.</p> <p>Heat and Temperature - Effects of Heat, Thermometric Scales</p>

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	and Rotation. Electrodes-types – Objects of Flux coating- Characteristic of Flux- I.S.-B.S.-AWS.- Specification. Criteria for choice of Electrodes.		such as a Celsius, Farahrenheit and Kelvin- Temperature measuring Instru-ments.
Butt-weld Square Butt Joint. MS Sheet 2 mm Position H.	Regulators-Types-Construction and uses. Care and Maintenance. Welding Blow Pipes-Types-Description-Operation-Construction-Uses-Care and Maintenance-Difference between H.P & L.P. System.	Views of simple Hollow and solid Bodies with dimensions.	Conversions between the above Scales of Temperature.
Fillet Weld Lap Joint. MS Plate 10 mm Position V. Upward. Fillet Weld Outside Corner Joint. MS Plate 10 mm Position V Upward.	Effect of Moisture on Electrodes- Necessity and importance of baking the electrodes before use-storage conditions and handling of electrodes for better welding quality.	Views of simple Hollow and Solid Bodies with dimensions.	Units of Heat-Calorie, B. Th.U., C.H. U.- Specific Heat, Latent Heat, Heat Loss and Heat Gain-Simple problems.
Fillet Weld Lap Joint. MS Sheet 2 mm Position V. Filled Weld Tee Joint. MS Sheet 2 mm Position. Fillet Weld Outside Corner Joint. MS sheet 2 mm Position V.	Faults in gas welding-definition of faults, their effects- Causes- Corrections. Manifold system- Necessity-Operations- Limitation-Care and maintenance.	Construction of Orthographic Projection from the given Isometric view of shaped Blocks in first angle method.	Percentage-Changing Percent to Decimal and Fraction and vice versa- Problems on Percentages related to the Trade..

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Butt Weld/Single Vee Butt Joint. MS Plate 10 mm position V Upward. Straight Line beads on MS Plate, MS Plate 10 mm Position OH.	Arc Blow-Definition-Its causes and effects-Methods to overcome in practice-Faults in Arc Welding-Definition-Effects, Causes and Correction of each fault.	Construct a Orthographic Projection from the given Isometric view of shaped Blocks in first angle method.	Percentage-Changing Percent to Decimal and Fraction and vice versa- Problems on Percentages related to the Trade.
Butt Weld-Square Butt Joint. MS Sheet 2 mm Position V. Fusion run with filler rod. MS Sheet. MS sheet 2 mm Position OH.	Welding Technique-Right Hand-Left Hand Explanation Method- application-Lined Welding- Application.	Construct an Orthographic Projection from the given Isometric view of shaped Blocks in 3 rd angle method.	Definition of speed, Velocity, Acceleration, Mass, Weight and difference between Mass and Weight.
Fillet Lap Joint. MS Plate 10 mm Position OH. Butt Weld-Single Vee Butt Joint. MS plate 2 mm Position OH	Distortion in Arc Welding - Causes and effects. Methods employed to minimise its effects.	Construct an Orthographic Projection from the given Isometric view of shaped Blocks in 3 rd angle method.	Newton's Laws of Motion-Definite of Force-Units of Force in M.K.S. Systems and S.I. Unit of force.
Marking Cutting. Different angles, shapes (Geometrical) on Cutting notches, metal sheets. Making a cylinder, square, rectangular shapes. Different sheet metal joints and soldering practice	Sheet Metal Shop Safety rules- Measuring tools-Marking tools- Sheet Metal Hammers-Pullers- Mallets, pun ches. Grooves- River set and uses- Types of sheets and uses-soft solder and soldering process.	Exercise on Blue Print Reading related to missing lines and missing views.	Ratio-Simple Problems in Ratios.

1	2	3	4	5
3.	Taper tray Butt joint-Soldering Practice Elbow Joints Pipe joints- Tee Pipes-Equal and unequal pipes.	Development of parallel line method- Examples Taper tray and different elbow and T Pipes- Hand lever shears- Guillotine shearing machine- Circular Cutting-Machine parts. Description uses Nibbling shearing parts and uses.	Simple Isometric Drawing- from the given Orthographic views of simple Objects.	Proportion-Direct and Inverse Proportion- Shop Problems.
4.	Fillet Weld TEE Joint. MS sheet 2 mm Position O.H.	Methods employed to control distortion in Gas Welding-Stress relieving-Outdoor methods-Edge preparations-Methods-Applications.	Welding Symbols as per I.S.I. employed on Drawings.	Work-Units of work in M.K.S. System and S.I. Unit of Work-Simple Problems.
5.	Fillet Weld Pipe Flange Joint (Circular cutting) on MS Plate 6 mm MS Pipe 50 mm dia. wall thickness 3 mm Position. IG (Rolling) Pipe Butt Weld - Butt Joint on MS pipe 75 mm OD- 6 mm wall thickness.	Welding of M.S. Pipe-Difference between pipe and plate welding-pipe development 90 degree and 45 degree branch pipe. Pipe Welding-Position 16, 26, 56, 66. Procedure of pipe welding.	Freehand Sketching on rivets and washers with dimensions from samples as per I.S.I.	Power-Practical Units of Power such as Watt and Horse Power; Definition of I.H.P., B.H.P. and efficiency.
6.	Pipe Butt Joint on MS Pipe. MS Pipe 50 mm dia. 3 mm wall thickness. Position. IG (Rolling)	Specifications for filler rods and wires for Gas Welding. Effect of Atmosphere on	Freehand Sketching of Riveted joints.	Definition of Energy, Potential Energy, Kinetic Energy, Law

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2.	Pipe L Joint. MS Pipe 50 mm dia 3 mm WT Position F. Pipe 90 Degree TEE Joint MS Pipe 25 mm dia 2 mm WT position F.	metals. Use of Gas Welding flux and roots for different methods-Effect of alloying elements on Weldability.	Freehand Sketching of Riveted joints.	Conservation of Energy- S.I. Unit of Energy- Simple Problems in P.E. and K.E.
3.	Fusion Welding of Cast Iron- Maintenance work (only demonstration) Position F. Bronze Welding of Cast Iron- Broken Parts Position F.	Cast Iron-determination of weldability-Preheating methods- Choice of Methods of welding (Arc.) Bronze Welding of Cast Iron - its limitation.	Exercise on Blue Print. Reading related to missing Dimensions and missing section.	Pythagoras Theorem- Shop Problems.
4.	Fusion Welding of Cast Iron- Butt Weld. Cast Iron Block 150 x 50 x 10 or Position F. Bronze Welding of Cast Iron Butt Weld. Cast Iron Block 150 x 50 x 10 or Position F.	Fusion Welding of Cast Iron- Bronze welding of Cast Iron- Determination of weldability.	Algebraic Symbols and Fundamentals- Addition, Subtraction, Multiplication and Division-Problems.	Algebraic Symbols and Fundamentals- Addition, Subtraction and Division-Problems.
5.	Butt Weld Copper Square Butt Joint. Copper sheet 150 x 50 x 3.15 mm Bronze Electrode Position F.	Welding of Copper-Properties- Weldability Methods-Preheat and post heat-Finishing of Weld- Effect of alloying elements.	Freehand sketching of nuts and bolts with dimensions from samples.	Algebraic Symbols and Fundamentals- Addition, Subtraction and Division-Problems.
6.	Fusion Welding of Copper-Butt Joint Copper Sheet 150 x 50 x 3.15 mm Position F. Bronze Welding of Copper-Butt Joint Copper Sheet 150 x 50 x 3.15 mm Position F.	Welding of copper by gas-procedure-Finishing of weld. Welding of copper, Bronze welding process-Finishing of Welding.	Freehand sketching of hand tools of the trade.	Algebra-Simple Equations- Problems.

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1.	<p>Hard Facing on MS Round Rod. Micro flow metal spraying – Cold and Hot Process. MS Round 150 × 50 × 3 mm dia. position F.</p> <p>Repairing of Broken Machine Parts. By using Low Heat Input Electrodes.</p>	<p>Conservation of metallic resources- Welding repairing need of the hour- Advantage of low heat input alloys in weld repair- Powder Welding- Iridology (wear and tear) - Hard surfacing electrodes - uses.</p>	<p>Freehand sketching of hand tools of the trade.</p>	<p>Algebra- Simultaneous Equations- Problems.</p>
2.	<p>Fusion Welding of Brass Butt Weld. Brass sheet 3.15 mm Position F.</p> <p>Butt Weld of Stainless Steel Square Butt Joint. Stainless steel sheer 2 or 3 mm Position F.</p>	<p>Classification of steel- Welding of High carbon steel- Low and Medium alloy steels- Limitations preheating and interposes Temperature of plate for such alloys during welding. Welding of stainless steel- Grades- Edge preparation- Method of welding.</p>	<p>Freehand sketching of hand tools of the trade.</p>	<p>Algebra- Quadratic equations- Problems.</p>
3.	<p>Welding of Stainless self. Butt Weld Square Butt Joint. Stainless steel sheet 3.15 mm Position F. Arc Gouging with Electrodes. MS Plate above 12 mm Position F. Carbon Arc gouging on MS Plate 12 mm. By using Carbon Electrodes.</p>	<p>Welding of aluminium – Edge preparation- Flame and angle of blow pipe and filler rod- preheating- Welding of Cast Aluminium – Preheating- Determination of preheating- Technique of welding.</p>	<p>Freehand sketching of keys and cotters with their dimensions from samples as per I.S.I.</p>	<p>Lever- Types of Levers with their examples.</p>

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1.	<p>Butt Weld- Square Butt Joint on Aluminium. Aluminium Sheet 3.15 mm Position F.</p> <p>Brazing of Copper to Brass tube. (Bell Mouth Joint). Copper Tube and Brass Tube 2.5 mm Od × 2 mm WT. Position F.</p> <p>ACHIEVEMENT: The trainees should be able to weld Ferrous and Non-ferrous metals to a reasonable standard.</p>	<p>Arc cutting of mild steel- Selection methods. Arc Cutting Equipment- Arc Gouging and its application- Types of Arc Cutting Electrodes. Air Arc Cutting and its application.</p>	<p>Freehand sketching of screw threads with their dimensions from samples as per I.S.I.</p>	<p>Simple problems on straight and bell cranked levers.</p>
2.	<p>Producing jobs as per Drawings. (Jobs involving all position welding)</p>	<p>Welding of dissimilar metals- Choice of methods. Application of each method - Limitations. Different Flame cutting machines and cutting of quality- care and maintenance.</p>	<p>Geometrical Development of Prism. Pyramid and Isometrics.</p>	<p>Logarithms- Use of Logarithmic Tables- Problems on Multiplication and Division by using Logarithmic tables.</p>

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Silver Brazing of Copper To Stainless Steel Tube- 12 mm dia. Oxy Acetylene Machine Cutting. Oxy-Acetylene Flame Gouging- Removing Welds.	Resistance Welding-Principle of resistance welding- Types, Applications, Advantages-Laser Beam. Welding and Cutting-Principle of Laser Beam- Description of equipments.	Exercise on Blue Print reading related identification of surface symbols.	Logarithms-Problems on Power and roots by using Logarithmic tables.
Production jobs as per drawing such as Furniture items, Windows, Grills.	Modern Welding Process- submerged Arc Welding Principle of the process- Equip-ment used Weld Procedure- advantages-Limitations. Electro Slag Welding- Weld Procedure- advantages Limitations.	Triangular Prism and Hexagonal Prism-Projection and Development.	Further practice in the use of Log Table.
Production jobs as per drawing such as Furniture items, Windows, Grills.	Inspection and testing of Weld- Destructive Non-destructive Test- Semi-Destructive Test Explanation of each method. Termitic Welding. Economy in Welding Simple Weld Estimation.	Triangular Prism and Hexagonal Prism-Projection and Development.	Meaning of Stress, Strain- Simple problems.

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Production jobs as per drawing such as Furniture items, Windows, Grills.	Introduction to TIG Welding- TIG Welding. Equipments- Advantages of TIG Welding Process over Manual Metal Arc Welding and Oxy-Acetylene Welding Process.	Cylinder Projection and Development, Cone Projection and Development. Examples based on right cones.	Mensuration-Areas- Square, Rectangle, Equilateral Triangle, Isosceles Triangle, Right Angled Triangle, Scalene Triangle-Problems.
Fusion Runs without filler rod on Aluminium. Aluminium Sheet 3 mm. Position F. Fusion Runs with Filler Rod on Aluminium Sheet 3 mm. position F.	Power Sources for TIG Welding- types-Applications- Care and maintenance-High frequency unit- parts, construction and uses D.C. Suppressor Unit Construction application- Care and Maintenance. Tungsten Electrodes. Types sizes, uses.	Cylinder Projection and Development, Cone Projection and Development. Examples based on right cones.	Mensuration-Areas- Square, Rectangle, Equilateral Triangle, Isosceles Triangle, Right Angled Triangle, Scalene Triangle-Problems.
Fillet weld lap joint on Aluminium. Aluminium Sheet 3 mm- Position F. Fillet Weld TEE joint on Aluminium. Aluminium sheet 3 mm - position F. Butt Weld Square Butt joint on Aluminium. Aluminium sheets 3 mm-Position F.	Argon Gas-Properties-Uses- Ceramic shield Defects-Causes and correction in TIG Welding Types of polarity and its application.	Views of simple solid bodies cut by section plane on drawing standard methods.(Full and Half Sections) I.S. 696/1972.	Areas-Hexagon, Circle, Circular ring, Sector Ellipse-Problems.

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<p>Fillet Weld Outside Corner Joint on Aluminium. Aluminium Sheet 3 mm- Position F. Butt Weld-Square Butt Joint on Aluminium Pipe. Aluminium pipe 50 mm dia × 3 mm WT. Position F. Fusion Run without Filler Rod on Stainless steel sheet. Stainless steel sheet-2 mm Position F.</p>	<p>Data/ Tables for TIG Welding.</p>	<p>Views of simple solid bodies cut by section plane on drawing standard methods (Full and Half Sections) I.S. 696/1972.</p>	<p>Areas-Hexagon, Circle, Circular ring, Sector Ellipse-Problems.</p>
<p>Fusion Run with filler rod on Stainless steel sheet. Stainless steel sheet-2 mm Position F. Fillet weld-Lap joint on Stainless steel sheet. Stainless steel sheet 2 mm Position F. Fillet weld TEE joint on Stainless steel sheet. Stainless steel sheet-2 mm Position F.</p>	<p>Introduction to CO₂ Welding, CO₂ Welding Equipment and Accessories- Description of CO₂ Welding set with diagram.</p>	<p>Exercise on Blue Print Reading.</p>	<p>Mensuration-Volume and Weight of Simple Solid bodies such as Cube, Square Prism, Rectangular Prism, Hexagonal Prism, Triangular Prism, Cone, Cylinder, Hollow Cylinder-Shop Problems.</p>

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<p>Fillet Weld-Outside Corner Joint. Stainless Steel Sheet 2 mm Position F. Steel weld square Butt Joint. Stainless steel sheet 2 mm Position F. Butt weld-square Butt joint on Stainless steel tube. Stainless steel tube 30 or 40 mm O.D × 3 mm WT. Position F.</p>	<p>Mode of metal transfer in CO₂ welding. Dip Transfer or Short circuiting transfer Spray Transfer (Free Flight) Globular Transfer (intermittent).</p>	<p>Sketching of finished articles from drawing and preparation of sequence of operations.</p>	<p>Mensuration-Volume and Weight of Simple Solid bodies such as Cube, Square Prism, Rectangular Prism, Hexagonal Prism, Triangular Prism, Cone, Cylinder, Hollow Cylinder-Shop Problems.</p>
<p>Butt Weld on M.S. Pipe. MS Pipe 50 mm OD × 3 mm WT. Position IG (Rolling) Fillet TEE Joint on MS Pipe, MS Pipe 50 mm OD × 3 mm WT.</p>	<p>Welding Wires used in CO₂ welding, its composition, diameters, applications. Various Gas mixtures and its applications in CO₂ Welding. Wire feed system-Types-applications-Limitations-Care and maintenance.</p>	<p>Sketching of finished articles from drawing and preparation of sequence of operations.</p>	<p>Mensuration-Volume and Weight of Simple Solid bodies such as Cube, Square Prism, Rectangular Prism, Hexagonal Prism, Triangular Prism, Cone, Cylinder, Hollow Cylinder-Shop Problems.</p>

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Pipe Elbow Joints on MS Pipe. MS Pipe 50 mm OD x 3 WT. Position F.	Tables/Data related to CO ₂ Welding. Information on solid flux Cored Wires.	Free sketching of simple objects related to the trade and preparation of simple working drawing from the sketches.	Finding the capacity in Litres of Square, Rectangular, Hexagon, Cone and Cylinder Shaped Vessels.
Straightline Beads on MS Plate 10 mm Position F. Fillet Weld TEE Joint on MS Flat 50 x 12 mm Position F. Fillet Weld TEE Joint MS Flat 50 x 12 mm Position F.	Electron Beam Welding- Principle of the Process- Description of equipment- application of the process- Advantages over the metallic Arc Welding Limitations.	Free sketching of simple objects related to the trade and preparation of simple working drawing from the sketches.	Finding the lateral Surface Area and Total Surface Area of Square, Rectangular, Hexagon, Cone and Cylinder Shaped Solids and Vessels.
Fillet weld Lap Joint. MS Flat 50 x 12 mm Position F.	Friction Welding-Principle of the process Description of the Equipment. Application of the process-Advantages over the Metallic Arc Welding- Limitations.	Conventional representation of materials by I.S.I.	Finding the lateral Surface Area and Total Surface area of Square, Rectangle, Hexagon, Cone and Cylinder shaped Solids and Vessels.

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Straight Line Beads in Horizontal Position MS Plate 10 mm.	Arc Brazer-Principle of the process-Description of the Equipment-Application of the process- Advantages.	Conventional representation of materials by I.S.I.	Further practice of Mensuration Problems by using the Logarithm.
Fillet Weld TEE Joint. MS Flat 50 x 10 mm Position H.	Do	Method of indicating surface roughness by I.S.	Revision
Preparation for Trade Test		Revision	Revision
Trade Test		Test	Test

LIST OF TOOLS AND EQUIPMENT

For the trade of WELDER (GAS AND ELECTRIC)
(For a batch of Unit of 12 trainees)

S.No.	Trainee's Kit	For Instructor	For Instructor
1	2	3	4
1.	Gloves pair leather	1	12
2.	Apron leather	1	12
3.	Screen welding helmet type	1	12
4.	Screen welding hand	1	12
5.	Goggles pair welder	1	12
6.	Hammer scaling 0.25 kg with handle	1	12
7.	Chisel cold flat 19 mm	1	12
8.	Centre punch 9 mm × 127 mm	1	12
9.	Dividers 20 cm	1	12
10.	Calliper outside 15 cm	1	12
11.	Rule 60 cm two fold brass topped read inches and mm	1	12
12.	Wire brush 15 cm × 3.7 cm	1	12
13.	Spark lighter	1	12
14.	Chipping screen hand	1	12
15.	Safety boots for welders	1 pair	12 pairs
16.	Safety goggles	1 pair	12 pairs
17.	Square blade 15 cm		12
18.	Scriber 15 cm		12
19.	Tongs holding 30 cm		12

SHOP OUTFIT

20.	Brass Rule 30 cm or nickel chrome steel rule 30 cm	4
21.	Hammer ball pen 1 kg with handle	4
22.	Chissel cold cross 9 mm	8
23.	Screw Driver 25 cm blade and 20 cm blade	1 each

25.	Number bunch 6 mm and letter punch 6 mm	1 set
26.	Hacksaw frame adjustable 30 cm	4
27.	Hammering blocks 5 cm thick 60 sq.	2
28.	Magnifying glass 15 cm	4
29.	Weld measuring gauge fillet and butt	2
30.	File half round bastard 30 cm	6
31.	File flat 35 cm rough	6
32.	Spanner 12 mm and 15 mm double ended	4
33.	Spanner D.E. 6 mm to 15 mm 1.5 mm set of Nos.	1 set
34.	Clamps 10 cm, 15 cm, 20 cm, 30 cm	2 each
35.	Hammer sledge double faced 3 kg	1 no.
36.	Pipe wrench 25 cm and 35 cm	1 each
37.	Steel tape 182 cm flexible in case	3
38.	Tinman's square 60 cm × 30 cm	1
39.	Welding torches with 10 nozzles 2 to 45 Low pressure with Nozzle	6 sets 2 sets
40.	Metal Powder Spray Equipment for metalizing & hard facing kit "Oxy-Acetylene Manual process"	1 kit
41.	Earth clamps	12 nos.
42.	Pipe cutter (cap. 50 mm dia)	1 set
43.	Cutting troth Oxy-Acetylene with nozzle 3/64	2 sets
44.	Heavy duty cutting and squouging blow pipe with cutting and squouging nozzles	1 set
45.	Electrodes holder 400 amps	6 nos.
46.	Welding rubber hose, oxygen and acetylene 8 mm each	65 metres
47.	Rubber hose clips	50 nos.
48.	Spindle key (for opening cylinder valve)	8 nos.
49.	Pressure regulator oxygen double stage	8 nos.
50.	Pressure regulator acetylene Regulators	8 nos.
51.	Tip cleaner	8 nos.
52.	Glasses coloured 108 mm × 82 mm × 3 mm	16 nos.

53. Glass white 108 mm × 82 mm	32 nos.
54. Outfit spanner	8 nos.
55. Rubber hose pipe black and red 5 mm	30 mt.
56. Leather sleeves	12 pairs

GENERAL INSTALLATION

57. Transformer welding continuous welding current with all accessories	300 A 400 A	2 sets 2 sets
58. Arc welding set rectifier type 300 - 450 amps continuous welding current with all accessories		1 set
59. Welding Generator DC rotary set 200-300 amps with all accessories		
60. CO ₂ Welding Machine complete.400 amps		1 set
61. TIG Welding set complete 300 amps AC/DC		1 set
62. Welding cables to carry 350 amps with flexible rubber		45 meter
63. Lugs for cables		24 nos.
64. Oxygen cutting machine (Line & circle)		1
65. Gas welding table 822 cm × 92 cm + 60 cm fire bricks on stand with positioner		6 for one each trainee
66. Arc welding table all metal with positioner 122 cm × 92 cm × 60 cm		6
67. Trolley for cylinder (H.P. Unit)		2
68. Bench shear capacity up to 5 mm		1
69. D.E. grinder 30 cm wheel motorised Pedestal type		1
70. Vice bench 10 cm		6
71. Power hacksaw		1
72. Electrode Drying Oven thermostatically controlled temperature 0-250 C 10 kg Cap.		1 no.
73. AG 7 Grinder		1 no.
74. Portable drilling machine (Cap. 6 mm)		1 no.
75. Braze weld equipment Brazier which can be used with existing welding transformer		1 no.

77. Metal rack 182 cm × 152 cm × 45 cm	1
78. Instructor's table (Steel)	1
79. Blackboard with easel	1
80. Instructor's chair (Steel)	1
81. First Aid box	1
82. Welding helmets	6 nos.
83. Fire buckets with stand	3 nos.
84. Steel lockers with 8 Pigeon holes	2 nos.

- NOTE :**
1. No additional items are required to be provided for unit or batch working in the Second shift except the items under trainee's tool kit lockers.
 2. Provision of cleaning of periodically welding helmets and goggles with antiseptic solution should be made, as these are likely to be used by more than one trainee.

**SYLLABUS FOR THE TRADE OF WELDER
(GAS & ELECTRIC)
Under
APPRENTICESHIP TRAINING SCHEME**

Period of Training : 2 Years

The period of training for this trade is 2 years consisting of Basic Training for a period of one year and shop training for the remaining period.

(The syllabus for this trade should be considered as a guide for imparting Apprenticeship Training according to the facilities available in industry).

List of operations/skills to be learnt during Practical Training which includes Basic Training.

NOTE :

All freshers should undergo one year Basic Training followed by one year training on the Shop Floor. The remaining operations/skills given in the list should be learnt on the shop floor. The apprentices should have more practice on the shop floor on these operations/skills, which have been already learnt during basic training and additional operations/skills during the shop floor training and development methods of work, speed, accuracy and finish in jobs.

1. The content of one year in Industrial Training Institutes in this trade is exactly same as mentioned in 1 above. The trainees of Industrial Training Institutes who may be engaged for one year for shop floor training after one year training in Industrial Training Institute should follow the same course of apprenticeship as in 1 above.

S. No. List of Operations / Skills to be learnt during Apprenticeship

1	2

BASIC TRAINING : 1 YEAR

1. Instructions in safety precautions as applicable to the trade.
2. Use of Hammer and cold chisel
3. Fitting as applicable to the trade welder

6. Use of Chisels
7. Use of clamps
8. Use of jigs and fixtures
9. Use & importance of flash back Arrestor
10. Use of Hand Tool for oxy-acetylene welding
11. Use of Welding torch, Acetylene generators and Oxygen Cylinder
12. Use of high pressure dissolved acetylene cylinder
13. Preparation of surfaces of welding
14. Use of heavy duty nozzles for welding
15. Oxy-Acetylene cutting
16. Use of light duty nozzles for welding
17. Use of hand tools in electric welding
18. Use of different types of filler rods
19. Use of different types of electrodes
20. Minimising distortion by weld sequence
21. Minimising distortion by control of heat spread
22. Welding of cast iron
23. Reclamation of worn parts by welding
24. Introduction to pipe, copper Bronze and Brass Welding
25. Introduction of hard facing and aluminium brazing
26. Preheating and post heating for welding
27. Inspection and testing of welds
28. Welding of objects according to drawing
29. Use of protective appliances

SHOP FLOOR TRAINING : 1 YEAR

1. Instruction in safety precautions on the shop floor
Reading blue prints & welding symbols
2. Cutting of sheet metal to size
3. Position Welding e.g., Horizontal, Vertical, Oblique and overhead
4. Use of Weld Gauges
5. Use of Fixtures to minimise distortion
6. Welding of Stainless Steel
7. Pipe Welding
8. Copper Welding
9. Bronze Welding
10. Welding of Aluminium

13. Aluminium brazing
14. Welding by submerged Arc. TIG, MIG, MAG, eliding and cutting
CO₂ welding process, Tremite welding, Function welding
15. Use of Resistance, Welding Machines, spot, butt and seam
16. Gouging and grinding
17. Welding with low heat input electrodes wires and fluxes.
18. Powder spray by torch method (Arc & gas)
19. Testing of welds — Destructive and Non-destructive methods
20. Preparing simple Fixtures for production welding
21. Setting of welding machine for production work
22. Use of profile cutting machines
23. Observation of machinery used in fabrication shops
24. Stress relieving operations of weldments

Note : The operations/skills marked * are desirable. They must be carried where facilities are available in the establishment.

SOCIAL STUDIES

The syllabus has already been approved and is same for all trades.