WELDER (PIPE AND PRESSURE VESSELS)

COMPETENCY BASED CURRICULUM

(Duration: 1 Year 3 Months)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 4

SECTOR – FABRICATION

सत्यमेव जयते

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

Directorate General of Training

Skill India
कौशल भारत-कुशल भारत

WELDER (PIPE AND PRESSURE VESSELS)

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
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1. BACKGROUND

1.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

1.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

1.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.
- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

Welder (pipe and pressure vessels) trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of 01 year 03 months (01 Block of 15 months including basic training) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

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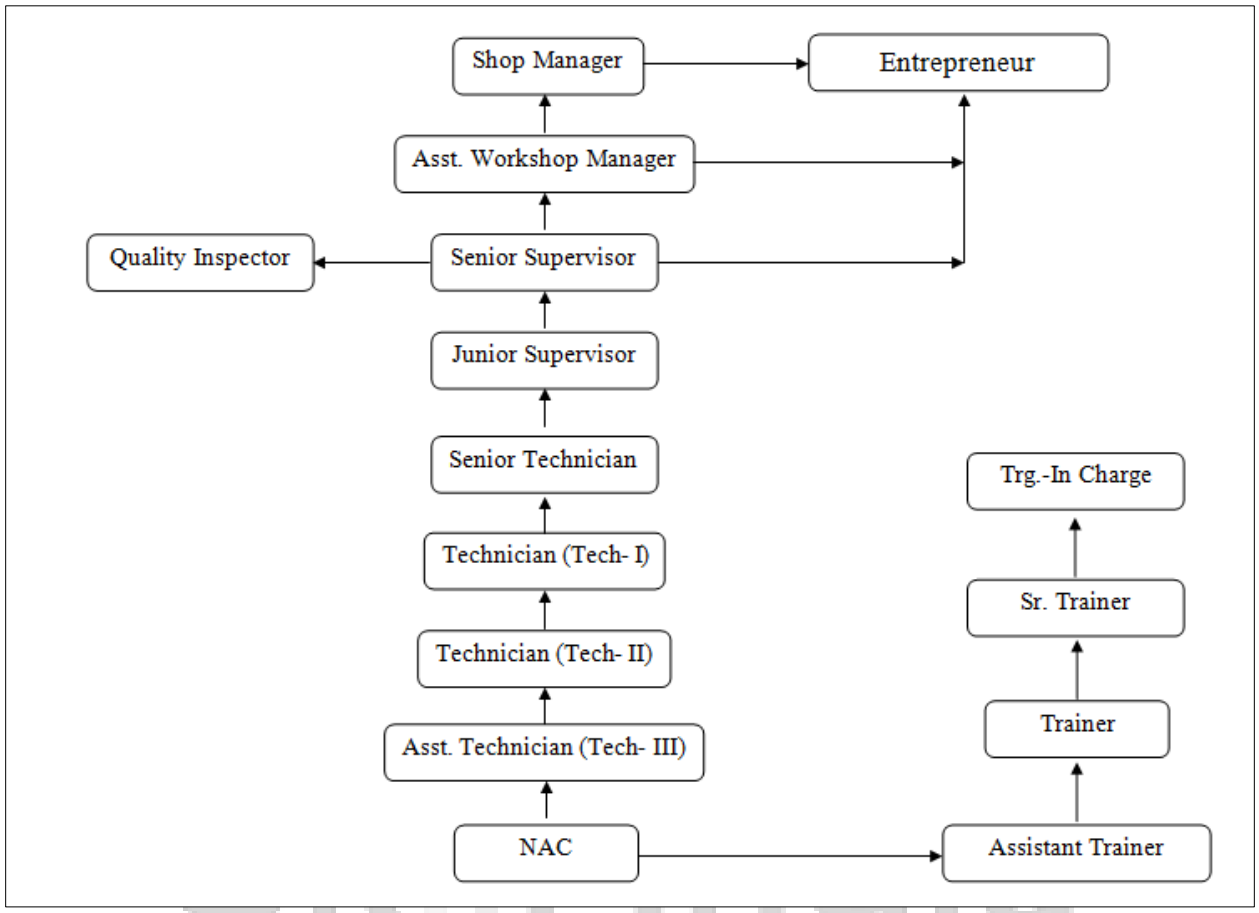
2.2 CAREER PROGRESSION PATHWAYS:

- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of one year (*Basic Training and On-Job Training*) : -

Total training duration details: -

Time (in months)	**1-3**	**4 - 15**
Basic Training	**Block– I**	**-----**
Practical Training (On - job training)	**----**	**Block – I**

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A. Basic Training

For 02 yrs. course (Engg.) :-(**Total 06 months:** 03 months in 1st yr. + 03 months in 2nd yr.)
For 01 yr. course (Engg.) :-(**Total 03 months:** 03 months in 1st yr.)

S No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	**For 01 Yr. course**
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	**1000**	**500**

B. On-Job Training:-

For 02 yrs. Course (Engg.) :-(**Total 18 months:** 09 months in 1st yr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. course (Engg.) :-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course (Engg.)	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training

institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by NCVT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the	• Demonstration of good skill in the use of

candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Weightage in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Brief description of Job roles:

Welder (Gas & Electric) while doing gas welding fuses metal parts together using welding rod and oxygen acetylene flame. Examines parts to be welded, cleans portion to be joined, holds them together by some suitable device and if necessary makes narrow groove to direct flow of molten metal to strengthen joint. Selects correct type and size of welding rod, nozzle etc. and tests welding, torch. Wears dark glasses and other protective devices while welding. Releases and regulates valves of oxygen and acetylene cylinders to control their flow into torch. Ignites torch and regulates flame gradually. Guides flame along joint and heat it to melting point, simultaneously melting welding rod and spreading molten metal along joint shape, size etc. and rectifies defects if any.

Welder (Gas & Electric) while doing Arc welding**,** fuses metals using arc-welding power source and electrodes. Examines parts to be welded, cleans them and sets joints together with clamps or any other suitable device. Starts welding power source and regulates current according to material and thickness of welding. Connect one lead to part to be welded, selects required type of electrode and clamps other lead to electrode holder. May join parts first at various points for holding at specified angles, shape, form and dimension by tack welding. Establish arc between electrode and joint and maintain it throughout the length of the joint.

Welder, Machine operates gas or electric welding machine to joint metal parts by fusion. Sets machine for operation by igniting burners and adjusting flames or by switching on current. Regulates flow of gas or current and adjusts machine according to material to be welded. Checks cooling system and adjusts movement of conveyor, if any. Feeds material to be welded with either one by one or in batch according to type of machine and welds them by pressing paddle, or by automatic arrangements. May use fixtures or other suitable devices for mass production work.Is designated as SPOT WELDER, FLASH WELDER, etc. according to machine and type of work done.

Welder (Pipe & Pressure vessel) Welds M.S Sheet and M.S pipe by GAS welding process. Welds M.S. Plate in all position by SMAW process. Cuts Straight, Bevel & Circular on MS plate by Oxy-Acetylene cutting process. Undertakes repair & maintenance works. Gouging, Gas and Plasma cutting on M.S plates. Groove welding on M.S. plate in 1G, 2G, 3G & 4G positions. Prepares and weld pipes in1G, 2G, 5G & 6G positions by SMAW & GTAW. Prepare and fit pipes for T, Y, K joints and weld by SMAW. Welds pipe by GMAW. Inspects and test welds by using Non-destructive Testing method – PT.

Plan and organize assigned work and detect & resolve issues during execution in his own work area within defined limit. Demonstrate possible solutions and agree tasks within the team.

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Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO 2015:

i) 7212.0100 - Welder (Gas & Electric)
ii) 7212.0200 - Welder, Machine operates
iii) 7212.0300 - Welder (Pipe & Pressure vessel)

4. NSQF LEVEL COMPLIANCE

NSQF level for Welder (pipe and pressure vessels) trade under ATS: **Level 4**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

a. Process
b. professional knowledge,
c. professional skill,
d. core skill and
e. Responsibility.

The Broad Learning outcome of Welder (pipe and pressure vessels) trade under ATS mostly matches with the Level descriptor at Level- 4.

The NSQF level-4 descriptor is given below:

Level	Process required	Professional knowledge	Professional skill	Core skill	Responsibility
Level 4	Work in familiar, predictable, routine, situation of clear choice.	Factual knowledge of field of knowledge or study	Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	Language to communicate written or oral, with required clarity, skill to basic Arithmetic and algebraic principles, basic understanding of social political and natural environment.	Responsibility for own work and learning.

5. GENERAL INFORMATION

Name of the Trade	**Welder (Pipe & Pressure Vessels)**
NCO - 2015	**7212.0100, 7212.0200, 7212.0300**
NSQF Level	Level – 4
Duration of Apprenticeship Training (Basic Training + On-Job Training)	3 months + 1 year (01 Block of 15 months duration including basic training)
Duration of Basic Training	a) Block –I : 3 months **Total duration of Basic Training: 3 months**
Duration of On-Job Training	a) Block–I: 12 months **Total duration of Practical Training: 12 months**
Entry Qualification	Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Selection of Apprenticeship	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	03 months
CTS trades eligible for Welder (pipe and pressure vessels) Apprenticeship	**Three months (**Basic training) in the trade of **Welder** ii) **Three months (**Basic training) for Fabrication sector with advance module in **Pipe and Pressure vessels** under CoE.

Note:

- *Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.*
- *For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.*

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Welder (pipe and pressure vessels) course of 01 years duration under ATS.

Block I:-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

Block-1

The candidate should be competent to execute following operation/ skills after completion of the industrial training: -

1. Practice to use machinery in shop with safety equipments.
2. Perform Pipe and plate flange joint welding T & Y pipe joint welding

3. Perform Groove welding on plate in 1G & 2G positions, Inspection and clearance using LPI testing during Root pass and cover pass
4. Practice to Grove welding 3G & 4G position and root pass and cover pass welding and LPI testing.
5. Perform Welding of pipes (schedule 40) in 1G& 2G position, Inspection and clearance using LPI testing during Root pass and cover pass
6. Perform Root welding of pipes (schedule 40) in 5G position - Intermediate and cover pass welding in 5G points, Inspection and clearance using LPI testing
7. Perform Root pass welding of pipes(schedule 40) 1G & 2G positions by TIG, Square butt joint on M.S. plate in 4G position, Inspection and clearance using LPI testing
8. Perform Root pass welding of pipes (schedule 60) 5G & 6G positions by TIG, Inspection and clearance using LPI testing
9. Perform Pipe welding dia 50mm in 2G position by GTAW, Inspection and clearance using LPI testing
10. Perform Root pass welding of pipes (schedule 80) 6G positions by SMAW (by pipe welding electrode), Inspection and clearance using LPI testing
11. Perform Pipe (schedule 40/60/80) welding by GMAW in 1G position.
12. Perform dissimilar welding like SS and MS by SMAW/TIG.
13. Perform setting of CO_2 plant for welding and practice on submerged arc welding.
14. Perform dimensional inspection of weldments, Visual inspection of weldments, Non-destructive testing of weldments, Bend Testing of specimen according to codes and standards
15. Perform testing of specimen with codes and standards, weld test on plates and pipe, Preparation of WPS and PQR, Welding inspection and test, Perform Ultrasonic Testing, Radiographic film reviewing.

Abbreviations:
SMAW - Shielded Metal Arc welding, GTAW- Gas Tungsten Arc Welding, GMAW - Gas Metal Arc Welding, OAW- Oxy-Acetylene Welding, OAGC- Oxy-Acetylene Gas Cutting
LPI- Liquid Penetrant Inspection, Schedule 40 Pipe = Min. Dia 100mm & Wall thickness 4mm to 6mm, Schedule 60 Pipe = Min. Dia 100mm & Wall thickness 6mm to 8mm,
Schedule80 Pipe = Min. Dia 150mm & Wall thickness 10mm to 13mm

Note: *Learning outcomes are reflection of total competencies of a trainee and assessment will be carried out as per assessment criteria.*

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	**ASSESSMENT CRITERIA**
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1. 1. Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1. 2. Recognize and report all unsafe situations according to site policy.
	1. 3. Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1. 4. Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1. 5. Identify and observe site policies and procedures in regard to illness or accident.
	1. 6. Identify safety alarms accurately.
	1. 7. Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1. 8. Identify and observe site evacuation procedures according to site policy.
	1. 9. Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1. 10. Identify basic first aid and use them under different circumstances.
	1. 11. Identify different fire extinguisher and use the same as per requirement.
	1. 12. Identify environmental pollution & contribute to avoidance of same.
	1. 13. Take opportunities to use energy and materials in an environmentally friendly manner
	1. 14. Avoid waste and dispose waste as per procedure
	1. 15. Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.

including basic electrical and apply in day to day work.*[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. 3Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*	3. 1. Read & interpret the information on drawings and apply in executing practical work.
	3. 2. Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3. 3. Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments as per tool list.
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality	5.1 Explain the concept of productivity and quality tools and apply during execution of job.

tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws. 5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution. 6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7. 1. Explain personnel finance and entrepreneurship. 7. 2. Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme. 7. 3. Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8. 1. Use documents, drawings and recognize hazards in the work site. 8. 2. Plan workplace/ assembly location with due consideration to operational stipulation 8. 3. Communicate effectively with others and plan project tasks 8. 4. Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
Block-I	
*Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under **Block – I** (section: 10) must ensure that the trainee works in familiar, predictable, routine, situation of clear choice. Assessment criteria should broadly cover the aspect of **Planning** (Identify, ascertain, etc.); **Execution** apply factual knowledge of field of knowledge, recall and demonstrate practical skill during performing the work in routine and repetitive in narrow range of application, using appropriate rule and tool, complying with basic arithmetic and algebraic principles and language to communicate in written or oral with required clarity; **Checking/ Testing** to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for his/her own work and learning.*	

8. SYLLABUS

BASIC TRAINING (Block – I)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	- Introduction to safety equipment and their use etc. - Setting of welding plant, Arc, Gas and plasma cutting. - Hack sawing, filing square to dimensions. - Marking out on MS plate and punching.	- Elementary First Aid. - Different process of metal joining methods: Bolting, riveting, soldering, brazing, seaming etc. - Introduction and definition of welding. - Importance of Welding in Industry. - Arc and Gas Welding Equipments, tools and accessories. - Arc and Gas Welding terms and definitions.
2	- Fusion run without and with filler rod on M.S. sheet 2 mm thick in flat position by GTAW. - Edge joint on MS sheet 2 mm thick in flat position without filler rod by GTAW. - Marking and straight line cutting of MS plate Straight line and Weaved beads on M.S. plate 10 mm thick in flat position by GTAW & SMAW. 10 mm thick by OAGC	- Various Welding Processes and its applications. - Types of welding joints and its applications. - Edge preparation and fit up for different thickness. - Surface Cleaning. - Safety precautions in Shielded Metal Arc Welding, and Oxy-Acetylene Welding and Cutting.
3	- Straight line and Weaved beads on M.S. plate 10 mm thick in flat position by GTAW & SMAW.	- 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. - Recent advances in power sources which gives better penetration and better root fusion with minimum heat addition.
4	- Square butt joint on M.S. sheet 2 mm thick in flat Position by GTAW. - Beveling of MS plates 10 mm thick. By	- Common gases used for welding & cutting, flame temperatures and uses.

	gas cutting by OAGC. - Open Corner joint on MS plate 10 mm thick in flat position by SMAW	- Types of oxy-acetylene flames and uses. - Oxy-Acetylene Cutting Equipment principle, parameters and application
5	- Circular gas cutting on MS plate 10 mm thick by profile cutting machine. - Fillet "T" joint on MS sheet 2 mm thick in flat position by GTAW. - Fillet Lap joint on MS sheet 2 mm thick in flat position GTAW.	- Arc welding power sources: Transformer, Motor Generator set, Rectifier and Inverter type welding machines and its care & maintenance. - Advantages and disadvantages of A.C. and D.C. welding machines. - Role of stiffeners in controlling distortion.
6	- Single "V" Butt joint on MS plate 12 mm thick in flat position (1G) by SMAW. - Square Butt joint on M.S. sheet. 2 mm thick in Horizontal position by GTAW. - Straight line beads and multi layer practice on M.S. Plate 10 mm thick in Horizontal position by SMAW	- Welding positions as per EN & ASME: flat, horizontal, vertical and over head position. - Weld slope and rotation. - Welding symbols as per BIS & AWS.
7	- Fillet Lap joint on M.S. plate 10 mm thick in horizontal position by SMAW.	- Electrode: Types, functions of flux, coating factor, sizes of electrode Coding of electrode as per BIS, AWS, IS. - Effects of moisture pick up. - Storage and baking of electrodes. - Special purpose electrodes and their applications.
8	- Fusion run with filler rod in vertical position on 2mm thick M.S sheet by GTAW. - Square Butt joint on M.S. sheet. 2 mm thick in vertical position by GTAW. - Single Vee Butt joint on M.S. plate 12 mm thick in horizontal position (2G) by SMAW.	- Oxygen and Dissolved Acetylene gas cylinders and Color coding for different gas cylinders. - Gas regulators, types and uses. - Oxy acetylene gas welding Systems (Low pressure and High pressure). Difference between gas welding blow pipe(LP & HP) and gas cutting blow pipe
9	- Structural pipe welding butt joint on MS pipe Ø50 and 3mm WT in 1G position by GTAW. - Fillet Lap joint on M.S. Plate 10 mm in vertical position by SMAW. - Open Corner joint on MS plate 10 mm	- Gas welding filler rods, specifications and sizes. - Gas welding fluxes - types and functions. - Gas Brazing & Soldering : principles, types fluxes & uses

	thick in vertical position by SMAW. - Pipe welding - Elbow joint on MS pipe Ø 50 and 3mm WT by GTAW.	- Gas welding defects, causes and remedies.
10	- Pipe welding "T" joint on MS pipe Ø 50 and 3mm WT by GTAW. - Single "V" Butt joint on MS plate12 mm thick in vertical position (3G) by SMAW.	- Arc blow - causes and methods of controlling. - Distortion in arc & gas welding and methods employed to minimize distortion. - Arc Welding defects, causes and Remedies. - Stress Relieving or Post Welding Heat Treatment (PWHT).
11	- Pipe welding 45 ° angle joint (6G) on MS pipe Ø 50 and 3mm WT by GTAW. - Pipe Flange joint on M.S plate with MS pipe Ø 50 mm X 3mm WT by GTAW	- Classification of steel. - Welding of low, medium and high carbon steel and alloy steels. - Effects of alloying elements on steel. - Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature. - Stainless steel: types- weld decay and Weldability.
12	- Fillet "T" joint on M.S. plate 10 mm thick in Overhead position by SMAW. - Pipe welding butt joint on MS pipe Ø 50 and 5 mm WT. in 1G position by SMAW. - Fillet Lap joint on M.S. plate 10 mm thick in overhead position by SMAW. - Single "V" Butt joint on MS plate 10 mm thick in overhead position (4G) by SMAW. - Pipe butt joint on M. S. pipe Ø 50mm and WT 6mm (5G) by SMAW	- Specification of pipes, various types of pipe joints, pipe welding positions, and procedure. - Difference between pipe welding and plate welding. - Pipe development for Elbow joint, "T" joint, Y joint and branch joint. - Manifold system.
13	**Revision& Internal Assessment**	

Note: - *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration : - 30 hrs.)**
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	**Introduction to Engineering Drawing and Drawing Instruments :** - Conventions - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
2.	**Basic Mathematics -** BODMAS rule Fraction-Addition, Subtraction, multiplication and Division-Problem solving, Decimal-Addition. Simple calculation using Scientific Calculator.	**Lines :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
3.	**Conversion** of Fraction to Decimal and vice-versa.	**Free hand drawing of** - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
4.	**Percentage**: Introduction, Simple calculation. Changing percentage to fraction and decimal & vice-versa.	**Drawing of Geometrical Figures:** Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.

Welder (Pipe and Pressure Vessels)

5.	**Material Science :** Definition, properties (physical & mechanical) and uses of Metal, Non-metal, Alloy &Insulator. Types of ferrous and Non-ferrous metals. Difference between Ferrous and Non-Ferrous metals.	**Sizes and Layout of Drawing Sheets** - Selection of sizes - Title Block, its position and content - Item Reference on Drawing Sheet (Item List)
6.	**Mass, Weight and Density:** Mass, Unit of Mass, Weight, difference between mass and weight. Density, unit of density. Relation between mass, weight & density. Simple problems related to mass, weight, and density.	**Method of presentation of Engineering Drawing** - Pictorial View - Orthographic View - Isometric view
7.	**Mensuration :** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.	**Drawing of Solid figures** - (Cube, Cuboids, Cone) with dimensions.
8.	**<u>Elasticity:</u>** <u>Elastic & Plastic material. Stress & strain and their units. Young's modules. Ultimate stress and breaking stress.</u>	**Free hand Drawing of Solid figures** (Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.
9.	**Heat & Temperature:** Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, Scale of temperature, relation between different scale of temperature. Thermometer, pyrometer.	**Free Hand sketch** of hand tools and measuring tools used in respective trades.

	Transmission of heat, conduction, convection, radiation.	
10.	**Basic Electricity:** Introduction and use of Electricity. AC, DC & their comparisons. Current, Voltage, Resistance& their units. Power, Energy & their units. Insulator and conductors & their uses**.**	**Projections:** - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification.
11.		**Drawing** of Orthographic projection in 3rd angle.

9.2 EMPLOYABILITY SKILLS

(DURATION: 55 HRS.)

Topic No.	Topic	Duration (in hours)
	English Literacy	**7**
1.	Reading **Reading and understanding simple sentences about self, work and environment**	
2.	Writing **Construction of simple sentences Writing simple English**	
3.	Speaking / Spoken English **Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.**	
	I.T. Literacy	**10**
1.	Basics of Computer **Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.**	
2.	Word processing and Worksheet **Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document.** **Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.** **Use of External memory like pen drive, CD, DVD etc,**	
3.	Computer Networking and INTERNET **Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication.**	
	Communication Skill	**18**
1.	Introduction to Communication Skills **Communication and its importance** **Principles of Effective communication** **Types of communication - verbal, nonverbal, written, email, talking on phone.** **Nonverbal communication - components-Para-language** **Body - language** **Barriers to communication and dealing with barriers.**	

2.	Listening Skills **Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.**	
3.	Motivational Training **Characteristics Essential to Achieving Success** **The Power of Positive Attitude** **Self awareness** **Importance of Commitment** **Ethics and Values** **Ways to Motivate Oneself** **Personal Goal setting and Employability Planning.**	
4.	Facing Interviews **Manners, Etiquettes, Dress code for an interview** **Do's & Don'ts for an interview**	
	Entrepreneurship skill	**8**
1.	**Concept of Entrepreneurship** **Entrepreneurship- Entrepreneurship - Enterprises:-Conceptual issue.** **Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.**	
2.	Institutions Support **Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes& procedure & the available scheme.**	
	Productivity	
1.	**Productivity** Definition, Necessity.	
2.	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3.	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**6**
1.	Safety & Health **Introduction to Occupational Safety and Health importance of safety and health at workplace.**	
2.	Occupational Hazards **Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.**	

3.	Accident & safety **Basic principles for protective equipment.** **Accident Prevention techniques - control of accidents and safety measures.**	
4.	First Aid **Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person**	
	Labour Welfare Legislation	
1.	Welfare Acts **Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Employees Provident Fund Act.**	
	Quality Tools	**6**
1.	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2.	**Quality Circles :** **Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.**	
3.	**House Keeping :** **Purpose of Housekeeping, Practice of good Housekeeping.**	
4.	Quality Tools **Basic quality tools with a few examples**	

10. DETAILS OF COMPETENCIES (ON-JOBTRAINING)

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

BLOCK – I

The candidate should be competent to execute following operation/ skills after completion of the industrial training: -

1. Practice to use machinery in shop with safety equipments.
2. Perform Pipe and plate flange joint welding T & Y pipe joint welding
3. Perform Groove welding on plate in 1G & 2G positions, Inspection and clearance using LPI testing during Root pass and cover pass
4. Practice to Grove welding 3G & 4G position and root pass and cover pass welding and LPI testing.
5. Perform Welding of pipes (schedule 40) in 1G& 2G position, Inspection and clearance using LPI testing during Root pass and cover pass
6. Perform Root welding of pipes (schedule 40) in 5G position - Intermediate and cover pass welding in 5G points, Inspection and clearance using LPI testing
7. Perform Root pass welding of pipes(schedule 40) 1G & 2G positions by TIG, Square butt joint on M.S. plate in 4G position, Inspection and clearance using LPI testing
8. Perform Root pass welding of pipes (schedule 60) 5G & 6G positions by TIG, Inspection and clearance using LPI testing
9. Perform Pipe welding dia 50mm in 2G position by GTAW, Inspection and clearance using LPI testing
10. Perform Root pass welding of pipes (schedule 80) 6G positions by SMAW (by pipe welding electrode), Inspection and clearance using LPI testing
11. Perform Pipe (schedule 40/60/80) welding by GMAW in 1G position.
12. Perform dissimilar welding like SS and MS by SMAW/TIG.
13. Perform setting of CO_2 plant for welding and practice on submerged arc welding.
14. Perform dimensional inspection of weldments, Visual inspection of weldments, Non-destructive testing of weldments, Bend Testing of specimen according to codes and standards
15. Perform testing of specimen with codes and standards, weld test on plates and pipe, Preparation of WPS and PQR, Welding inspection and test, Perform Ultrasonic Testing, Radiographic film reviewing.

Abbreviations:
SMAW - Shielded Metal Arc welding, GTAW- Gas Tungsten Arc Welding, GMAW - Gas Metal Arc Welding, OAW- Oxy-Acetylene Welding, OAGC- Oxy-Acetylene Gas Cutting

Welder (Pipe and Pressure Vessels)

LPI- Liquid Penetrant Inspection, Schedule 40 Pipe = Min. Dia 100mm & Wall thickness 4mm to 6mm, Schedule 60 Pipe = Min. Dia 100mm & Wall thickness 6mm to 8mm, Schedule80 Pipe = Min. Dia 150mm & Wall thickness 10mm to 13mm

Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

ANNEXURE – I

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

Welder (pipe and pressure vessels)			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-18 is required additionally)			
Sl. no.	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1.	Welding helmet fiber		21 nos.
2.	Welding hand shield fiber		21 nos.
3.	Chipping hammer with metal handle	250 Grams	21 nos.
4.	Chisel cold flat	19 mm x 150 mm	21 nos.
5.	Centre punch	9 mm x 127 mm	21 nos.
6.	Dividers	200 mm	21 nos.
7.	Stainless steel rule	300mm	21 nos.
8.	Scriber double point	150 mm	21 nos.
9.	Flat Tongs long	350mm	21 nos.
10.	Hack saw frame fixed	300 mm	21 nos.
11.	File half round bastard	300 mm	21 nos.
12.	File flat bastard	350 mm	21 nos.
13.	Hammer ball pane with handle	1 kg	21 nos.
14.	Tip Cleaner		21 nos.
15.	Try square	6"	21 nos.
B : GENERAL MACHINERY SHOP OUTFIT			
16.	Spindle key		4
17.	Screw Driver 300mm blade and blade	250 mm	1 each
18.	Number punch	6 mm	2 set
19.	Letter punch	6 mm	2 set
20.	Magnifying glass	100 mm .dia	2 nos
21.	Universal Weld measuring gauge		2 nos
22.	Earth clamp	600A	6 nos
23.	Spanner D.E.	6 mm to 32mm	2 sets
24.	C-Clamps	10 cm and 15 cm	2 each
25.	Hammer sledge double faced 4 kg		1

26.	S.S tape 5 meters flexible in case		1
27.	Electrode holder 600 amps		6
28.	H.P. Welding torch with 5 nozzles		2 sets
29.	Oxygen Gas Pressure regulator double stage		2
30.	Acetylene Gas Pressure regulator double stage		2
31.	CO_2 Gas pressure regulator, with flow meter		1 set
32.	Argon Gas pressure regulator with flow meter		2 set
33.	Metal rack 182 cm x 152 cm x 45 cm		1
34.	First Aid box		1
35.	Steel lockers with 8 Pigeon holes		2
36.	Steel almirah / cupboard		2
37.	Black board and easel with stand		1
38.	Flash back arrester (torch mounted)		4 pairs
39.	Flash back arrester (cylinder mounted)		4 pairs
40.	Auto Darkening Welding Helmet		2 nos.
GENERAL INSTALLATION SHOP OUTFIT			
41.	Welding Transformer with all accessories (400A , OCV 60 - 100 V, 60% duty cycle)		2 sets
42.	Welding Transformer or Inverter based welding machine with all accessories (300A , OCV 60 - 100 V, 60% duty cycle)		2 sets
43.	D.C Arc welding rectifiers set with all accessories (400 A. OCV 60 -100 V, 60% duty cycle)		2 sets
44.	GMAW welding machine 400A capacity with air cooled torch, Regulator, Gas preheater, Gas hose and Standard accessories		1 set
45.	AC/DC GTAW welding machine with water cooled torch 300 A, Argon regulator, Gas hose, water circulating system and standard accessories.		2 set
46.	Air Plasma cutting equipment with all accessories, capacity to cut 25 mm clear cut		01 set
47.	Air compressor suitable for air plasma cutting system		01 no
48.	Pipe beveling machine		01 no
49.	Universal Testing machine		Optional
50.	Pug cutting machine Capable of		01 set

	cutting Straight & Circular with all accessories		
51.	Pedestal grinder fitted with coarse and medium grain size grinding wheels dia. 300 mm		1
52.	Bench grinder fitted with fine grain size silicon carbide green grinding wheel dia. 150 mm		1
53.	AG 4 Grinder		2 Nos
54.	Suitable gas welding table with fire bricks		2 Nos
55.	Suitable Arc welding table with positioner		9
56.	Trolley for cylinder (H.P. Unit)		2
57.	Hand shearing machine capacity to cut 6 mm sheets and flats		1
58.	Power saw machine 18''		1
59.	Portable drilling machine (Cap. 6 mm)		1
60.	Oven, electrode drying 0 to 350°C, 10 kg capacity		1
61.	Work bench 340x120x75 cm with 4 bench vices of 150 mm jaw opening		4 sets
62.	Oxy Acetylene Gas cutting blow pipe		2 sets
63.	Oxygen, Acetylene Cylinders		2 each*
64.	CO_2 cylinder		1 No *
65.	Argon gas cylinder		1 No *
66.	Anvil 12 sq. inches working area with stand		1 No.
67.	Swage block		1 No.
68.	Die penetrant testing kit		1 set
69.	Magnetic particle testing Kit		1 set
70.	Fire extinguishers (foam type and CO_2 type)		1
71.	Fire buckets with stand		4 nos
72.	Portable abrasive cut-off machine		1 No
73.	Centre lathe swing over dia 10"		Optional
74.	Suitable gas cutting table		1 No
75.	Welding Simulators for SMAW/GTAW/GMAW		1 each (Optional)

Note:

1. * Optionally Gas cylinders can also be hired as and when required
2. 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 and steel lockers.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: Welder (pipe and pressure vessels)

LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1.	Draughtsman drawing instrument box		20+1 set
2.	Set square celluloid 45^o	(250 X 1.5 mm)	20+1 set
3.	Set square celluloid 30^o-60^o	(250 X 1.5 mm)	20+1 set
4.	Mini drafter		20+1 set
5.	Drawing board IS: 1444	(700mm x500 mm)	20+1 set
B : Furniture Required			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1	Drawing Board		20
2	Models : Solid & cut section		as required
3	Drawing Table for trainees		as required
4	Stool for trainees		as required
5	Cupboard (big)		01
6	White Board (size: 8ft. x 4ft.)		01
7	Trainer's Table		01
8	Trainer's Chair		01

TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
Sl. No.	**Name of the Equipment**	**Quantity**
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500VA	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	20 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.		

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :			**Year of Enrollment :**
Name & Address of ITI (Govt./Pvt.) :			**Date of Assessment :**
Name & Address of the Industry :			**Assessment location: Industry / ITI**
Trade Name :	**Semester:**		**Duration of the Trade/course:**
Learning Outcome:			

Sl. No	**Candidate Name**	**Father's/Mother's Name**	Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA	**Total internal assessment Marks**	**Result (Y/N)**
Maximum Marks (Total 100 Marks)			**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**		
1														
2														