



**Skill India**  
कौशल भारत - कुशल भारत

# SHEET METAL WORKER

NSQF LEVEL - 6



SECTOR- CAPITAL GOODS & MANUFACTURING

**COMPETENCY BASED CURRICULUM**  
**CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**



GOVERNMENT OF INDIA

Ministry of Skill Development & Entrepreneurship

Directorate General of Training

**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**

EN-81, Sector-V, Salt Lake City, Kolkata – 700091



Directorate General of Training

# **SHEET METAL WORKER**

**(Engineering Trade)**

**SECTOR – CAPITAL GOODS & MANUFACTURING**

**(Revised in 2019)**

**Version 1.1**

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Developed By

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Kolkata – 700 091

[www.cstaricalcutta.gov.in](http://www.cstaricalcutta.gov.in)

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## 1. COURSE OVERVIEW

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The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructor Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960 by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (IToT). This is a competency based course for instructors of one year duration. “Sheet Metal Worker” CITS trade is applicable for Instructors of “Sheet Metal Worker” CTS Trade.

The main objective of Craft Instructor training programme is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

## 2. TRAINING SYSTEM

### 2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) & DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal <http://www.nimionlineadmission.in>. The course is of one-year duration. It consists of Trade Technology (Professional skills and Professional knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

### 2.2 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year:

S No.	Course Element	Notional Training Hours
1.	<b>Trade Technology</b>	
	Professional Skill (Trade Practical)	640
	Professional Knowledge (Trade Theory)	240
2.	<b>Engineering Technology</b>	
	Workshop Calculation & Science	80
	Engineering Drawing	120
3.	<b>Training Methodology</b>	
	TM Practical	320
	TM Theory	200
	<b>Total</b>	<b>1600</b>

### 2.3 PROGRESSION PATHWAYS

- Can join as an Instructor in a vocational training Institute/ technical Institute.
- Can join as a supervisor in Industries.

### 2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. The marks of internal assessment will be as per the formative assessment template provided on [www.bharatskills.gov.in](http://www.bharatskills.gov.in)

b) The **Final Assessment** will be in the form of **Summative Assessment Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The external examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

#### 2.4.1 PASS CRITERIA

S No.	Subject		Marks	Internal assessment	Full Marks	Pass Marks	
						Exam	Internal assessment
1.	Trade Technology	Trade Theory	100	40	140	40	24
2.		Trade Practical	200	60	260	120	36
3.	Engineering Technology	Workshop Cal. & Sc.	50	25	75	20	15
4.		Engineering Drawing	50	25	75	20	15
5.	Training Methodology	TM Practical	200	30	230	120	18
6.		TM Theory	100	20	120	40	12
<b>Total Marks</b>			<b>700</b>	<b>200</b>	<b>900</b>	<b>360</b>	<b>120</b>

The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%. There will be no Grace marks.

#### 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 the assessment. While assessing, the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

Due consideration should also be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure,

behavioral attitude, sensitivity to the 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 of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary
- Assessment Sheet
- Progress chart
- Video Recording
- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming yearly examination for audit and verification by examining 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 candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an <b>acceptable standard</b> of crafts instructorship with <b>occasional guidance</b> and engage students by demonstrating good attributes of a trainer.	<ul style="list-style-type: none"> <li>• Demonstration of <b>fairly good</b> skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Average engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.</li> <li>• Occasional support in imparting effective training.</li> </ul>
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a <b>reasonable standard</b> of crafts instructorship with <b>little guidance</b> and engage students by demonstrating good attributes of a trainer.	<ul style="list-style-type: none"> <li>• Demonstration of <b>good</b> skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Above average in engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the</li> </ul>

	<p>entire lesson.</p> <ul style="list-style-type: none"> <li>• Little support in imparting effective training.</li> </ul>
(c) Weightage in the range of more than 90% to be allotted during assessment	
<p>For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a <b>high standard</b> of crafts instructorship with <b>minimal or no support</b> and engage students by demonstrating good attributes of a trainer.</p>	<ul style="list-style-type: none"> <li>• Demonstration of <b>high</b> skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Good engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A high level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.</li> <li>• Minimal or no support in imparting effective training.</li> </ul>



### 3. GENERAL INFORMATION

<b>Name of the Trade</b>	<b>SHEET METAL WORKER-CITS</b>
<b>Trade Code</b>	<b>DGT/ 4025</b>
<b>Reference NCO 2015</b>	2356.0100, 7213.0101, 7224.0102, 7213.0200
<b>NSQF Level</b>	Level-6
<b>Duration of Craft Instructor Training</b>	One Year
<b>Unit Strength (No. of Student)</b>	25
<b>Entry Qualification</b>	<p>Degree in appropriate branches of Mechanical/Production/Metallurgy/ Mechatronics Engineering from AICTE/UGC recognized Engineering College / University.</p> <p style="text-align: center;">OR</p> <p>Diploma in appropriate branches of Mechanical/Production/Metallurgy/ Mechatronics Engineering from AICTE/ recognized board / Institution.</p> <p style="text-align: center;">OR</p> <p>National Trade Certificate in the Sheet Metal Worker or other related trades.</p> <p style="text-align: center;">OR</p> <p>National Apprenticeship Certificate in the Sheet Metal Worker or other related trades.</p>
<b>Minimum Age</b>	18 years as on first day of academic session.
<b>Space Norms</b>	120 sq. m
<b>Power Norms</b>	15 KW
<b>Instructors Qualification for</b>	
<b>1. Sheet Metal Worker -CITS Trade</b>	<p>B.Voc./Degree in appropriate branches of Mechanical/Production/Metallurgy/ Mechatronics Engineering from AICTE /UGC recognized University with two years experience in relevant field.</p> <p style="text-align: center;">OR</p> <p>03 years Diploma in appropriate branches of Mechanical/Production/Metallurgy/Mechatronics Engineering from AICTE/ recognized Board/ Institution or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field.</p> <p style="text-align: center;">OR</p> <p>NTC/ NAC passed in Sheet Metal Worker trade with seven years experience in relevant field.</p> <p><b>Essential Qualification:</b> National Craft Instructor Certificate (NCIC) in Sheet Metal Worker trade, in any of the variants under DGT.</p>

<p><b>2. Workshop Calculation &amp; Science</b></p>	<p>B.Voc/Degree in any Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>3 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any Engineering trade with seven years experience in relevant field.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;"><b>OR</b></p> <p>NCIC in RoDA or any of its variants under DGT.</p>
<p><b>3. Engineering Drawing</b></p>	<p>B.Voc/Degree in Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>03 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years' experience in the relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any one of the 'Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with seven years experience.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;"><b>OR</b></p> <p>NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.</p>
<p><b>4. Training Methodology</b></p>	<p>B.Voc/Degree in any Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>3 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any Engineering trade with seven years experience in relevant field.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;"><b>OR</b></p> <p>NCIC in RoDA or any of its variants under DGT.</p>
<p><b>5. Minimum Age for Instructor</b></p>	<p>21 years</p>

Distribution of training on Hourly basis: (Indicative only)						
Total Hrs /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	TM Practical	TM Theory
40 Hours	16 Hours	6 Hours	2 Hours	3 Hours	8 Hours	5 Hours

## 4. JOB ROLE

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### Brief description of job roles:

**Manual Training Teacher/Craft Instructor;** instructs students in ITIs/Vocational Training Institutes in respective trades as per defined job role. Imparts theoretical instructions for the use of tools & equipments of related trades and related subjects. Demonstrate process and operations related to the trade in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment and tools in stores.

**Fitter-Fabrication;** identifies metals, tools; carrying out fitting and fabrication operations like measuring, marking out, sawing, grinding, drilling, chiselling, threading, tapping, scraping, manual lapping and inspecting of components in order to fit a component as per specifications. It also involves basic oxy fuel gas cutting and basic manual arc welding as per given instructions and under supervision.

**Sheet Metal Worker, General;** makes sheet metal articles according to drawing or sample. Studies drawing or sample and records measurements if necessary. Selects sheet of required type, thickness (gauge) and size and marks it with scribe, square, divider, foot rule etc., according to drawing or sample. Shears wherever necessary by machine or hand shears and makes it to required shape and size by bending, seaming, forming, riveting, soldering etc., using mallets, hammers, formers, sets, stakes, etc., or by various machines such as shearing, bending, beading, channelling, circle cutting. Checks work at stages during operations and does soldering, brazing as necessary. May undertake pneumatic and hydraulic tests. May also undertake repair work. May specialize in different metal sheets such as tin, copper, brass.

**Sheet Metal Worker, Structural;** assembles, alters and repairs prefabricated sheet metal sections according to specifications by various mechanical processes such as drilling, riveting, trimming, soldering etc. to form body structures of motor vehicles, aircraft, water tanks etc. Studies drawings and other specifications. Selects prefabricated metal sheet of required size, shape, form and thickness, measures them and marks outline and positions to indicate joints, bends etc. Punches or drills holes in metal sheets at marked points with hand or tools and joins various parts together by riveting, soldering, welding or with nuts and bolts. Bends metal sheet to required shape and covers it by joining it with frame at suitable places with nuts and bolts. Trims ends of bent metallic sheet by filing, sawing, bending etc. as appropriate. May install assembled body structure on frames for having wooden parts fitted to it. May heat and bend metallic parts of frame. May do spot welding.

### Reference NCO-2015 with respective QPs/NOS:

- a. 2356.0100 - Manual Training Teacher/Craft Instructor
- b. 7213.0101 - Sheet Metal Worker - Hand Tools and manually operated machines
- c. 7224.0102 - Fitter Fabrication
- d. 7213.0200 - Sheet Metal Worker, Structural

## 5. LEARNING OUTCOME

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

### 5.1 TRADE TECHNOLOGY

1. Analyse sheet of required type, thickness and size and mark it with scribe, square, divider, steel rule etc. according to drawing or sample.
2. Demonstrate different types of hemming (single & double) wiring (solid & false) & sheet Metal Seams.
3. Evaluate different process of surface development like, parallel line method, radial line method, triangulation method geometrical construction etc.
4. Demonstrate different types of punches, Rivets, Riveting tools.
5. Demonstrate soldering, brazing operating on different types of sheets used in SMW section.
6. Evaluate development of square section segmental quarter bend pipe and round section segmental quarter bend pipe also demonstrate how to make various ducting work.
7. Demonstrate setting up of oxy-acetylene plant, setting different types of flame and deposit fusion run with/without filler rod in flat position square butt joint in flat position by gas.
8. Demonstrate setting up of arc welding plant and striking and maintaining of arc and laying straight line beads on MS plate in flat position.
9. Explain machines used in SMW trade, work of machines, safety of machines, Riveting on aluminium sheet with various rivets. Aluminium soldering.
10. Demonstrate making of holes in sheet metal using punching machine & drill machine, grinding a drill bit with the help of gauge & grinding machine and use of rawl bits.
11. Assess pipe bending by hand & by hydraulic pipe bending machine, external & internal threading, use of self tapping screw and works with metal spinning lathe.
12. Assess making of copper, brass, stainless steel articles by use of power press.
13. Evaluate selection of appropriate welding process and joining of different types of metals and check for its correctness.
14. Assess fabrication work of different types of windows, doors and electrical panel etc.
15. Demonstrate use of computer application for creation of 2D, 3D object on CAD software.

## 6. COURSE CONTENT

SYLLABUS FOR SHEET METAL WORKER - CITS			
TRADE TECHNOLOGY			
Duration	Reference Learning Outcome	Trade Practical	Trade Theory
Practical 32Hrs  Theory 12Hrs	Analyze sheet of required type, thickness and size and mark it with scribe, square, divider, steel rule etc. according to drawing or sample.	<ol style="list-style-type: none"> <li>1. Induction of training</li> <li>2. Familiarization with the Institute,</li> <li>3. Importance of trade in Training</li> <li>4. Machines used in the trade.</li> <li>5. Induction to safety devices used in shop floor.</li> </ol>	<p>General discipline in the institute</p> <ul style="list-style-type: none"> <li>- Elementary of First aid</li> <li>- Importance of the sheet metal work in the Industry.</li> <li>- General safety precautions</li> <li>- Safety precaution in sheet metal work &amp; protective devices</li> <li>- Terms &amp; definitions in sheet metal work.</li> </ul>
		<ol style="list-style-type: none"> <li>6. Cutting with different types of geometrical shapes by using hand snips (straight cut, right and left cut) cutting off inside and inside curves, cutting off notices and cutting profiles.</li> </ol>	<ul style="list-style-type: none"> <li>- Description and uses of sheet metal tools ,equipments and accessories (Measuring, Marking, cutting &amp; holding tools)</li> <li>- Various types of hand snips and their uses,</li> <li>- Description and uses of hand shears ,</li> </ul>
Practical 48Hrs  Theory 18Hrs	Demonstrate different types of hemming (single & double) wiring (solid & false) & sheet Metal Seams.	<ol style="list-style-type: none"> <li>7. Single &amp; double hemming &amp; wiring practice (solid &amp; false wiring).</li> <li>8. Sheet Metal seams: Grooved seam, Locked Grooved seam, Pane down seam.</li> <li>9. Bottom lock seam or Corner Fold (Knocked-up seam), Corner Clip Lock, Double Bottom Lock, Clip Lock (Cap Lock), snap Joint etc.</li> </ol>	<ul style="list-style-type: none"> <li>- Calculation of hemming &amp; wiring allowance</li> <li>- Various types of machines used in sheet metal work (guillotine shears, circle cutting machine, bending machine, folding etc.)</li> <li>- Sheet Metal Folded Joints: Description of Sheet Metal Seam, Grooved seam, Locked Grooved seam, Pane down seam. .</li> <li>- Knocked up seam inside and outside, capstrip seam, pitsburg seam etc</li> <li>- Folding &amp; joining allowances, edge stiffening, wiring allowances &amp; false wiring</li> </ul>

Practical 48Hrs  Theory 18Hrs	Evaluate different process of surface development like, parallel line method, radial line method, triangulation method geometrical construction etc.	10. Folding, Bending Sheet Metal to 90 degree using wooden mallet, 'C' clamps etc. 11. Making a radius using Wooden blocks and Hairpin Folder. 12. Making a cylindrical container with knocked- up, bottom (Bottom Locked), Grooved Joint and hemmed Top.	- Definitions of pattern, Development, stretched out pattern, Master pattern (gross pattern) and templates
		13. Forming frustum of Cone. 14. Making of Mug, scoop, measuring can 15. Hemming (single, Double) wire edge by hand process	- Development of surfaces by parallel line method, and radial line method.
		16. Make a taper chute square to rectangle transition. Make a taper chute square to round.	- Development of surfaces: Triangulation method and geometrical construction methods
Practical 32Hrs  Theory 12Hrs	Demonstrate different types of punches, Rivets, Riveting tools.	17. Making a hole with solid punches, round punches as per BIS. 18. Riveting practice using various types of rivet heads. 19. Single chain, Double chain and Zig- zag and Lap & butt riveted joints	- Description of solid and hollow punches as per BIS. Sizes of solid and hollow Punches and their uses. - Rivets and its parts, Selection of Rivet heads. Types of Rivet and their uses. - Standard sizes of Rivets and Riveting Tools. - Calculation for Riveting allowances (pitch and Lap)
		20. Making a dust pan ( Corner and handle riveted) 21. Making a fire bucket with lap riveted joint on one side and Locked Grooved Seam on the other side. Bottom Hollowing and Bottom Lock Seam.	- Fastening of Sheet Metal: - Self tapping screws, Clips and Connectors; Their uses, Types and Allowance of 'S' Clips, Government Clips, Drive Clips, Mailing Clips etc.
Practical 80Hrs  Theory 30Hrs	Demonstrate soldering, brazing operating on different types of sheets used in SMW section.	22. Solder Lap joint 23. Single plated solder butt joint	- Solder, Different types of solder and their composition. Types and uses of fluxes, their effect on different metal. Process of soft soldering
		24. Making an oil Can by hand process by soldering	- Hard soldering process(brazing).

		25. Making funnel by soldering process	- Heating appliances (Hand Forge, Blow Lamp, L.P.G.)
		26. Make by soldering 27. Elbow 90° equal dia pipe 28. T joint 90° equal dia pipe	- Development & laying out pattern of Elbow pipe, T pipe and offset pipe in equal diameter.
		29. T joint 90° unequal dia pipe by soldering 30. T Pipe 60° branch joint unequal dia pipe 31. Offset T joint equal dia pipe	- Development of T pipe joint for equal and unequal diameter pipes. - Introduction to tubes and pipes.
Practical 32Hrs	Evaluate development of square section segmental quarter bend pipe and round section segmental quarter bend pipe also demonstrate how to make various ducting work.	32. Forming square section segmental quarter bend pipe with suitable lock and forming round section segmental quarter bend pipe	- Laying out pattern of 60° off-set 'T' pipe. Pattern Development of 'Y' pipe. - Preparation of pickling solution.
Theory 12Hrs		33. Making a square duct elbow with snap block	- Protection-Coating, Cleaning and preparing of Sheet Metals Corrosion and anti corrosion treatment of sheet metal. - Method of galvanizing, tinning, anodising, sheradising and Electroplating
Practical 16 Hrs	Demonstrate setting up of oxy-acetylene plant, setting different types of flame and deposit fusion run with/without filler rod in flat position square butt joint in flat position by gas.	34. Setting up of Oxy-acetylene plant and setting different type of flames.	- Safety precaution in gas welding - Description of Oxyacetylene plant and the equipments, accessories & tools - Types of oxy-acetylene flames & its uses
Theory 06 Hrs			
Practical 16 Hrs	Demonstrate setting up of arc welding plant and striking and maintaining of arc and laying straight line beads on MS plate in flat position.	35. Setting up of arc welding plant and striking & maintaining of arc and laying short beads.	- Safety precaution in arc welding - Description of arc welding plant and the equipments, accessories & tools
Theory 06 Hrs			
Practical 16 Hrs	Demonstrate setting up of oxy-acetylene plant, setting different types of flame and deposit fusion run with/without filler	36. Fusion run with/without filler rod in flat position.	- Types and description of flux
Theory 06 Hrs		37. Square butt joint in flat position by gas.	- Types of welding blow pipes .& its functions



	rod in flat position square butt joint in flat position by gas.		
Practical 16 Hrs  Theory 06 Hrs	Demonstrate setting up of arc welding plant and striking and maintaining of arc and laying straight line beads on MS plate in flat position.	38. Straight line beads on ms plate 6mm in flat position by arc welding.	- Brief description of Arc welding machines
Practical 32Hrs  Theory 12Hrs	Explain machines used in SMW trade, work of machines, safety of machines, Riveting on aluminium sheet with various rivets. Aluminium soldering.	39. Importance of machinery used in the trade. 40. Types of job made by the trainees in trade 41. Introduction to machinery safety including firefighting equipment and their uses etc. 42. Locked groove joint on aluminum sheet	- Importance of the trade in the development of Industrial Economy of the Country. - Review of Types of sheet metal Fabrication. - Methods of developments. - Introduction to Aluminum fabrication, and its applications.
		43. Single riveted lap joint on aluminum sheet. 44. Double strap single row riveted butt joint on aluminum sheet 45. Exercise involving practical work on Aluminium Sheet, and using. Pop Rivet. 46. Aluminium Windows with. different extruded sections, Aluminium Soldering	- Ferrous and Non-Ferrous metals. Use of Copper and Alloys. - Laying out pattern of conical elbows. Pattern development of lobster back bends. - Chemical and Physical properties of Aluminium. - Use of Aluminium and its Alloys
Practical 32Hrs  Theory 12Hrs	Demonstrate making of holes in sheet metal using punching machine & drill machine, grinding a drill bit with the help of gauge & grinding machine and use of rawl bits.	47. Making holes in sheet metal using Punching Machine. 48. Making holes in sheets with a twist drill.	- Brief Description of hand punch machine. Hand and Power operated drilling Machines. Drill Bits, parts and effects of cutting angles.
		49. Tri-paning with use of hand and electric drilling machine. Grinding a drill bit 50. Practice in Drilling Holes in walls and Ceilings as applied to ducting work. Use of rawl bits and rawl plug.	- Angles for Drilling sheet metals, effect of speed, Feed Cutting Fluids, etc., on metals. - Difference between drilled and punched holes. - Description of swaging and beading machine, its parts, operating principles etc.

Practical 48Hrs  Theory 18Hrs	Assess pipe bending by hand & by hydraulic pipe bending machine, external & internal threading, use of self tapping screw and works with metal spinning lathe.	51. Practice on pipe bending by hand. Pipe bending using Hydraulic Pipe bending' machine. 52. Development of a cone: Cylinder fitted to a cone. Equal dia pipe joint with crimping and Ogee beading	- Introduction to pipe/tube bending. - Brief description of Hydraulic pipe bending machine. Operating Principles etc.
		53. Practice on external threading using "Die stock". 54. Practice on internal threading using taps. 55. Typical folding, Bending Practice, Making Steel-Racks, Reinforcement with angle iron. 56. Use of self tapping screws and other fasteners.	- Description of roll forming machine types and operating principles, description of slip roll forming machine and its function - Use of Die and Die Holder, Description of taps and tap wrench.
		57. Project work such as Steel Stool, Aluminium Ladder etc. 58. Metal Spinning: Making a cylindrical medicine container of Aluminium Sheet	- Method to operate folding/brake folder for typical folding. - Description and use of jigs and fixtures
		59. Making a Copper article by use of power press and also making brass and stainless steel articles. 60. Practice of Buffing and polishing	- Definition of Planishing and its application. Brief description of polishing machine. Various types of bobs and polishing compounds
Practical 16 Hrs  Theory 06 Hrs	Assess making of copper, brass, stainless steel articles by use of power press.	59. Making a Copper article by use of power press and also making brass and stainless steel articles. 60. Practice of Buffing and polishing	- Definition of Planishing and its application. Brief description of polishing machine. Various types of bobs and polishing compounds
		61. Pipe butt joint in down hand position 62. Butt joint on MS flat in down hand position by arc	- Principle of arc welding. Types of welding machines and their uses. Advantages and disadvantages of AC/DC welding machines. - Arc length and its importance
		63. Fillet lap and T joint on MS flat in down hand position 64. Resistance welding. Spot welding, seam welding.	- Welding defects - Principle of resistance welding. Types and applications. - Welding symbols
		65. CO <sub>2</sub> welding. Deposit bead on MS sheet in flat position.	- Introduction to CO <sub>2</sub> welding process. Welding equipments and accessories..
Practical 96Hrs  Theory 36Hrs	Evaluate selection of appropriate welding process and joining of different types of metals and check for its correctness.	66. Lap joint T joint and butt joint in down hand position by CO <sub>2</sub> welding.	- Advantages and application of CO <sub>2</sub> process

		67. TIG welding. Deposit bead on SS sheet in flat position. Making butt, Tee and corner joint by TIG welding.	- TIG welding process. Advantages. Description of equipments. Types of polarity and application
		68. Deposit bead on Aluminium sheet in flat position. Making butt, Tee and corner joint	- Types of Tungsten Electrodes, Filler rods, Shielding Gases. - Defects, causes and remedy in TIG welding process
		69. Pipe butt joint on MS/SS by TIG welding process.	- Latest sheet metal cutting techniques: Plasma cutting, Laser cutting, etc.
		70. Pipe Y joint on MS/SS by TIG welding process.	- Latest sheet metal cutting techniques: water jet cutting and punching etc
Practical 48Hrs  Theory 18Hrs	Assess fabrication work of different types of windows, doors and electrical panel etc.	71. Make models of Aluminium sliding windows and doors.	- Specification of aluminium channels angles, strips, tubes beadings, packing rubber, cardboard, glasses etc.
		72. Partitions of mini model rooms by using aluminum channels beadings etc	- Tools and equipments used in aluminium fabrication. - Assembly & Sub assembly: Gaurding assembly, Door assembly, Chassis assembly, Cabinet assembly, Power pack assembly etc.
		73. Making Electrical Panel, trunk boxes fabrication and Painting.	- Process of painting. Spray painting. Etch primer painting,
		74. Making ducts fabrication and Painting	- Powder coating, buffing, grinding, and sanding. - Selection of different grit sizes.
Practical 32Hrs  Theory 12Hrs	Demonstrate use of computer application for creation of 2D, 3D object on CAD software.	75. Installing procedure Auto CAD software. Auto CAD. Commands & use of different menus of Auto CAD.	- Auto CAD software and its uses. Installing procedure of Auto CAD. Auto CAD command & use of different menus of Auto CAD
		76. Working practice on Auto - CAD with simple sheet metal drawings.	- Familiarization with different option for creating dimension & adding text to drawing, creating drawing in different layers, line type color window format menu. - Creating sectional drawing & adding different type's pattern under hatch command in draw menu.

**SYLLABUS FOR CORE SKILLS**

- |   |
|---|
| 1. Workshop Calculation & Science (Common for all Engineering CITS trades) (80 Hrs) |
| 2. Engineering Drawing (Group I) (120Hrs)   |
| 3. Training Methodology (Common for all CITS trades) (320Hrs + 200Hrs)              |

Learning outcomes, assessment criteria, syllabus and Tool List of above Core Skills subjects which is common for a group of trades, provided separately in [www.bharatskills.gov.in](http://www.bharatskills.gov.in)

## 7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
<b>TRADE TECHNOLOGY (TT)</b>	
1. Analyse sheet of required type, thickness and size and mark it with scribe, square, divider, steel rule etc. according to drawing or sample.	Plan and select the type of sheet as per requirement.
	Prepare the piece as per drawing.
	Mark the sheet using scribe, steel rule, divider etc.
	Carry out dimensional inspection to ascertain quality.
2. Demonstrate different types of hemming (single & double) wiring (solid & false) & sheet Metal Seams.	Plan and mark the sheet.
	Learn different allowances taken for hemming wiring and seam joint.
	Select the tools required for bending, seaming, riveting etc.
	Perform the operation with safety.
3. Evaluate different process of surface development like, parallel line method, radial line method, triangulation method geometrical construction etc.	Make the development as per drawing on paper.
	Cut the pattern with necessary allowances.
	Set the pattern on metal sheet and mark.
	Cut the sheet with snip Make the job as per drawing
4. Demonstrate different types of punches, Rivets, Riveting tools.	Plan and select required tools for different operation
	Select proper size of punch, rivet, snap, dolly etc.
	Perform the operation as per drawing.
	Carry out visual inspection.
5. Demonstrate soldering, brazing operating on different types of sheets used in SMW section.	Plan and select the nozzle size, working pressure, types of flame, filler rod and flux as per requirement.
	Prepare, set the pieces as per drawing.
	Braze/solder the joint adopting proper brazing/ soldering technique and safety aspect.
	Carry out visual inspection to ascertain quality of joint.
6. Evaluate development of square section segmental quarter bend pipe and round section segmental quarter bend pipe also demonstrate how to	Plan and prepare the development for a specific type of segment
	Complete the job with proper safety
	Carry out visual inspection correctness.

make various ducting work.	
7. Demonstrate setting up of oxy-acetylene plant, setting different types of flame and deposit fusion run with/without filler rod in flat position square butt joint in flat position by gas.	Plan and prepare the metal for joint.
	Select the size of filler rod, size of nozzle & working pressure.
	Set and tack the pieces as per drawing
	Deposit the weld bead.
	Inspect the joint.
8. Demonstrate setting up of arc welding plant and striking and maintaining of arc and laying straight line beads on MS plate in flat position.	Plan and prepare the pieces for welding
	Select the type and size of electrode
	Set the welding current as per the dia. of electrode.
	Deposit the straight weld beads maintaining appropriate technique and safety aspects.
	Clean and inspect the beads.
9. Explain machines used in SMW trade, work of machines, safety of machines, Riveting on aluminium sheet with various rivets. Aluminium soldering.	Plan and discuss the work of machines.
	Discuss safety precaution to be followed.
	Demonstrate aluminium soldering.
	Clean the job and carryout visual inspection.
10. Demonstrate making of holes in sheet metal using punching machine & drill machine, grinding a drill bit with the help of gauge & grinding machine and use of rawl bits.	Locate the centre with centre punch where hole to be made
	Use proper size of punch of drill bit
	Learn how to grinding a drill bit.
	Check the angle of bit.
	Inspect the job.
11. Assess pipe bending by hand & by hydraulic pipe bending machine, external & internal threading, use of self tapping screw and works with metal spinning lathe.	Choose appropriate size of pipe and pipe bending fixture.
	Mark where bending to be done.
	Fill the pipe with dry sand.
	Heat the pipe
	Bend the pipe.
Check visually.	
12. Assess making of copper, brass, stainless steel articles by use of power press.	Choose appropriate shape and size of die and punch.
	Fit the die and punch in the machine.
	Complete the operation.
	Check visually.
13. Evaluate selection of appropriate welding	Demonstrate pipe butt joint in down hand position.
	Make butt joint on MS flat in down hand by arc.

process and joining of different types of metals and check for its correctness.	Practice Co2 welding deposit bead on MS sheet in flat position.
	Make lap joint T joint and butt joint in down hand position by Co2 welding, TIG welding.
	Deposit bead on SS sheet in flat position.
	Make butt Tee and Corner joint by TIG welding.
	Deposit bead on aluminium sheet in flat position.
	Make butt, Tee and corner joint.
	Practice butt joint on MS/SS pipe by TIG welding process.
	Practice to weld Y joint on MS/SS pipe by TIG welding process.
14. Assess fabrication work of different types of windows, doors and electrical panel etc.	Explain briefly the specification and name of various channels, angles, strips etc.
	Make the job as per dimension.
	Check the job visually.
15. Demonstrate use of computer application for creation of 2D, 3D object on CAD software.	Explain brief details of CAD 2D software.
	Create simple 2D drawing through CAD.
	Explain brief details of CAD 3D modelling.
	Illustrate simple 3D drawing through CAD.

## 8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT FOR SHEET METAL WORKER (CITS)			
For batch of 25 candidates			
S No.	Name of the Tools& Equipment	Specification	Quantity
<b>A. TRAINEES TOOL KIT</b>			
1.	Steel rule	300 mm	26 Nos.
2.	Wing divider	200 mm	26 Nos.
3.	Centre punch	100 mm	26 Nos.
4.	Spring dividers	150 mm	26 Nos.
5.	Ordinary wooden mallet		26 Nos.
6.	Soldering copper hatchet type	0.25 kg	26 Nos.
7.	Cross peen hammer	0.25 kg with handle	26 Nos.
8.	Protractor with blade	150mm	26 Nos.
9.	Steel tape	2 metres	26 Nos.
10.	Ballpen hammer	0.5kg with handle	26 Nos.
11.	Scriber (engineer's)	150 mm x 3 mm	26 Nos.
12.	Prick punch	100mm	26 Nos.
13.	Type square	6 inch	26 Nos.
<b>B. INSTRUMENT AND GENERAL SHOP OUTFIT PER UNIT</b>			
14.	Steel Square	450 mm x 600 mm	4 Nos.
15.	Sheet Metal Gauge		1 No.
16.	Hatcher Stake		4 Nos.
17.	Stake Round and Bottom		4 Nos.
18.	Half Moon Stake		4 Nos.
19.	Funnel Stake		4 Nos.
20.	Anvil Face Stake		4 Nos.
21.	Bick Iron Stake		4 Nos.
22.	Tinman's Horse		4 Nos.
23.	Hammer Peaning with handle		4 Nos.
24.	Hammer Creasing with handle		4 Nos.
25.	Hammer Planishing with handle		4 Nos.
26.	Hammer Block with handle		2 Nos.
27.	Shear Tinman	300mm	8 Nos.
28.	Snip straight		8 Nos.
29.	Right cut snips	250mm	4 Nos.
30.	Left cut snips	250mm	4 Nos.
31.	Hand Shear Universal ID	250 mm	4 Nos.
32.	Hollow Punch set Round	3 mm dia.	2 Nos.
33.	Rivet sets snap and Dolly combined	3 mm	4 Nos.
34.	Chisel cold flat	25 mm x 250 mm.	4 Nos.
35.	Punch Letter	4 mm	1 set
36.	Punch Number	4 mm	1 set



37.	File flat second cut	250 mm	2 Nos.
38.	File flat smooth	250 mm	2 Nos.
39.	File flat bastard	300 mm	2 Nos.
40.	File half round	300 mm smooth	2 Nos.
41.	Hacksaw frame adjustable (Tubular)	300 mm	4 Nos.
42.	Hand Groover	5 mm	4 Nos.
43.	Plier. Combination	150 mm	2 Nos.
44.	Grip Wrench ID	200 mm	2 Nos.
45.	Ladle	150 mm Dia.	2 Nos.
46.	Blow Lamp	1 litre.	2 Nos.
47.	H.S.S. Twist Drill (parallel Shank)	3 mm, 4 mm & 6 mm each	3 Nos.
48.	Hand Drill machine	0 to 12 mm	2 Nos.
49.	Soldering Copper Hatchet type	500 gms.	8 Nos.
50.	Pneumatic rivet gun		2 Nos.
51.	Trammel Point	(with beam 600 mm)	1 No.
52.	Vernier caliper	(0 mm - 150 mm)	1 No.
53.	Micrometer Outside	(0 to 25 mm)	1 No.
54.	File Rasp cut	250 mm	2 Nos.
55.	D.E. Spanner G.P.	(6 mm to 32 mm) (Set of 12 spanner)	2 Set
56.	Bossing Mallet		4 Nos.
57.	End tacked Mallet		4 Nos.
58.	Soft hammer (Brass, copper, Lead)		4 Nos.
59.	Steel Rule	600mm	4 Nos.
60.	Oilcan pressure feed	500ml	2 Nos.
61.	Raising hammer with handle		4 Nos.
62.	Rawl Punch holder and bits (No.8, 10, 12, 14)		2 .Sets
63.	Hollowing Hammer with handle		4 Nos.
64.	Tripaning tool	70 mm	1 No.
65.	Hand vice	50 mm	4 Nos.
66.	Tongs Flat		2 Pairs.
67.	Portable Electric drill (Single phase) -	6mm	2 Nos.
68.	Pop rivet gun		2 Nos.
69.	Lazy Tong		2 Nos.
70.	Screw Driver	250 mm	2 Nos.
71.	Round File	2nd Cut 250 mm	4 Nos.
72.	Triangular File 'Smooth	250 mm	4 Nos.
73.	Square File 2nd Cut	250 mm.	4 Nos.
74.	Needle File (Swiss File)	150 mm	1 set
75.	'C' Clamp	150 mm	2 Nos.
76.	Soft faced Hammer		4 Nos.
<b>C. GENERAL INSTALLATIONS</b>			
77.	Bench lever shears	250 mm Blade x 3mm Capacity	1 No.
78.	Air Compressor (Pressure and displacement of air) Pneumatic Pop rivet		1 No.

	Gun		
79.	Spray Gun-(painting)	500 ml.	1 No.
80.	Combination turning up and wiring machine		1 No.
81.	Guillotine. Shearing Machine foot operated		1 No.
82.	Oxy acetylene welding plant (complete set)		1 set
83.	Circle cutting machine	300 mm dia	1 set
84.	Pillar type drilling machine	12 mm	1 No.
85.	Slip roll former	1.6. mm x 1000 mm	1 No.
86.	D.E. Grinder Pedestal motorised	200 mm	1 No.
87.	Anvil with Stand	50 kgs.	1 No.
88.	Bench vice	120 mm, 150 mm	2 each
89.	Fly press Ball press No.4 single body		1 No.
90.	Power Press	20 Tons	1 No.
91.	Buffing and Polishing Machine		1 No.
92.	Nibbling Machine		1 No.
93.	Spinning Lathe		1 No.
94.	Seaming Machine.		1 No.
95.	Glass cutter - Diamond point		1 No.
96.	Work Bench	1820 x 1310 x 760 mm	4 Nos.
97.	Almirah	1820 x 1210 x 450 mm	2 Nos.
98.	Metal rack	1820 x-1520 x 450 mm	2 Nos.
99.	Steel Lockers with	8 Drawers.	2 Nos.
100.	Fire extinguisher Soda Acid and foam type		1 each
101.	Fire buckets with Stand-		4 Nos.
102.	Black Board with Easel.		1 No.
103.	Wooden Stool	450.mm.	1 No.
104.	Portable Nibbler		2 Nos.
105.	Portable Pneumatic Shear.		2 Nos.
106.	Pipe Bending Machine (Hydraulic Type)	12 mm to 30 mm	1 No.
107.	Hand Press Brake Capacity	(0.8 mm)	1 No.
108.	Beading Machine with throat clearance (with crimping rollers)	380 mm	1 No.
109.	Tin smiths bench folder	600 x 1.6 mm	1 No.
110.	Gas Welding Table	1220 mm x 760 mm	1 No.
111.	Spot & Seam Welding Machine		1 No. each
112.	Arc welding Transformer/ Rectifier/Inverter with accessories	300Amps	1 set
113.	Co <sub>2</sub> welding machine complete set	300Amps	1 set
114.	TIG welding machine complete set	200 Amps	1 set
115.	Universal cutting machine		1 No.

## ANNEXURE – I

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in revising the curriculum. Special acknowledgement is extended by DGT to the expert members who had contributed immensely in this curriculum.

<b>List of Expert members participated for finalizing the course curriculum of Sheet Metal Worker (CITS)trade.</b>			
<b>SNo.</b>	<b>Name &amp; Designation Sh/Mr/Ms</b>	<b>Organization</b>	<b>Remarks</b>
<b>Members of Sector Mentor council</b>			
1.	Dr. G. Buvanashakaran	AGM, WRI, Trichy	Chairman
2.	Dr. K. Ashokkumar	AGM, BHEL, Trichy	Member
3.	Prof. Jyothi Mukhopadhyaya	IIT, Ahmedabad	Member
4.	B. Pattabhiraman	MD, GB Engineering, Trichy	Member
5.	Dr. Rajeev Kumar	IIT, Mandi	Member
6.	Dr. Vishalchauhan	IIT, Mandi	Member
7.	D.K. Singh	ITI, Kanpur	Member
8.	Navneet Arora	IIT, Roorkee	Member
9.	R. K. Sharma	Head, SDC, JBM Group, Faridabad	Member
10.	Puneet Sinha	Deputy Director, MSME, New Delhi	Member
<b>Mentor</b>			
11.	Deepankar Mallick	Director of Training, DGE&T Hq,	Mentor
<b>Members of Core Group</b>			
12.	M Thamizharasan	JDT, CSTARI, Kolkata	Member
13.	M Kumaravel	DDT, FTI , Bangalore	Team Leader
14.	Sushil Kumar	DDT, DGE&T Hq,	Member
15.	S.P. Khatokar	T.O. ATI, Mumbai	Member
16.	V.L. Ponmozhi	TO, CTI, Chennai	Member
17.	D. Pani	TO, ATI, Howrah	Member
18.	Amar Singh	TO, ATI, Ludhiana	Member

