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

COMPETENCY BASED CURRICULUM

SHEET METAL WORKER

(Duration: One Year)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

SECTOR – CAPITAL GOODS AND MANUFACTURING

Directorate General of Training

SHEET METAL WORKER

(Engineering Trade)

(Revised in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3

Developed By

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1. COURSE INFORMATION

During the one-year duration a candidate is trained on subjects Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation and Employability Skills related to job role. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The broad components covered under Professional Skill subject are as below:

The practical part starts with selecting sheet of required type, thickness (gauge) and size and marks it with scriber, square, divider, steel rule etc., according to drawing or sample. Other activities conducted at the yearly course are like shearing or bending the sheet as per sketch by machine or hand shear, forming sheet metal to required shape and size by various operations such as shearing, bending, beading, channeling, circle cutting, seaming, forming, riveting etc., performing different type of MS pipe joints by Gas welding (OAW), performing soldering, brazing operations on sheet metal etc. The course also covers performing Arc welding, Gas welding on sheet metals, performing frame work hollowing and raising on non ferrous and ferrous sheets, bending and joining of pipes, preparing utility items with ferrous and non ferrous sheets, performing TIG Welding, MIG Welding, Spot Welding on metal sheets, fabrication work with metal sheets, undertake repair work of mudguard, Radiators etc.

Professional Knowledge subject is simultaneously taught in the same fashion to apply cognitive knowledge while executing task. In addition components like Physical properties of engineering materials, different types of iron, properties and uses, Heat & Temperature are also covered under theory part.

In addition to above components the core skills components viz., Workshop calculation & science, Engineering drawing, employability skills are also covered. These core skills are essential skills which are necessary to perform the job in any given situation.

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 Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programmes of Directorate General of Training (DGT) for propagating vocational training.

Sheet Metal Worker trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of one year duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Workshop Calculation science, Engineering Drawing and Employability Skills) imparts requisite core skills, knowledge and life skills. After passing out of the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

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.
- 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.

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 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	Professional Skill (Trade Practical)	1000
2	Professional Knowledge (Trade Theory)	280
3	Workshop Calculation & Science	80
4	Engineering Drawing	80
5	Employability Skills	160
	Total	**1600**

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by **Controller of examinations, DGT** as per the guidelines. The pattern and marking structure is being notified by DGT 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

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%. 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. Due consideration should 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 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 and records of internal (Formative) assessments are to be preserved until forthcoming 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 produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce	• Good skill levels in the use of hand

work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	tools, machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Weightage in the range of more than 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% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Sheet-metal worker; make, install and repair articles and parts of articles of sheet metal such as sheet steel, copper, tin, brass, aluminium, zinc or galvanized iron. Sheet Metal Worker, 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 scriber, 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, channeling , circle cutting. Checks work at stages during operations and does soldering, brazing, arc welding, gas welding, TIG welding & MIG welding as necessary. May undertake aluminum paneling work. May also undertake repair work. May specialize indifferent metal sheets such as tin, copper, brass.

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

Reference NCO-2015:

i) 7213.0101 – Sheet Metal Worker, General/Sheet Metal Worker – Hand Tools and Manually Operated Machines.
ii) 7212.0100 – Welder, Gas
iii) 7212.0200 – Welder, Electric
iv) 7212.0500 – Brazer
v) 7212.0700 – Welder, Resistance

4. GENERAL INFORMATION

Name of the Trade	**SHEET METAL WORKER**
Trade Code	DGT/1027
NCO – 2015	7213.0101, 7212.0100, 7212.0200, 7212.0500, 7212.0700
NSQF Level	Level-3
Duration of Craftsmen Training	One year (1600 Hours)
Entry Qualification	Passed 8th class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, DEAF, HH
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	80 sq. m
Power Norms	11 KW
Instructors Qualification for	
1. Sheet Metal Worker Trade	B.Voc/Degree in Mechanical / Metallurgy / Production Engineering/ Mechatronics from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. OR 03 years Diploma in Mechanical and allied from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. OR NTC / NAC passed in the trade of "Sheet Metal Worker" Trade with 3 years' experience in relevant field. **<u>Essential Qualification</u>:** Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT. ***Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However both of them must possess NCIC in any of its variants.***
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. OR 03 years Diploma in Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational)

	from DGT with two years' experience in the relevant field. OR NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade OR NCIC in RoDA or any of its variants under DGT.
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. OR 03 years Diploma in Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. OR NTC/ NAC in any one of the Engineering trades with three years experience. Essential Qualification: National Craft Instructor Certificate (NCIC) in relevant trade OR NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

Distribution of training on Hourly basis: (Indicative only)

Total Hrs /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employability Skills
40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Select sheet of required type, thickness (gauge) and size and mark it with scriber, square, divider, steel rule etc., according to drawing or sample following safety precautions.
2. Shears or bends the sheet wherever necessary by machine or hand shear.
3. Form sheet metal to required shape and size by bending, seaming, forming, riveting etc., using mallets, hammers, formers, sets, stakes, etc., or by various operations such as shearing, bending, beading, channelling, circle cutting.
4. Perform different type of MS pipe joints by Gas welding (OAW).
5. Perform soldering, brazing operations on sheet metal.
6. Perform Arc welding, Gas welding, TIG welding & MIG welding and spot welding on sheet metals.
7. Make sheet metal articles according to drawing or sample following safety precaution.
8. Plan & work in different sheet metals such as tin, copper, brass.
9. Undertake Aluminium frame works.
10. Make ducts, cabins & panels.
11. Undertake repair work of mudguard, Radiators etc.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Selects sheet of required type, thickness (gauge) and size and mark it with scriber, square, divider, steel rule etc., according to drawing or sample following safety precautions.	Plan and select the type of sheet metal type & thickness as per requirement.
	Prepare the pieces as per drawing.
	Setting up the sheet in specific position.
	Mark the sheet using scriber, steel rule divider etc.
	Carry out dimensional inspection to ascertain quality.
2. Shears or bends the sheets wherever necessary by machine or hand shear.	Plan and select the type machine required for shearing& bending
	Prepare, set the pieces as per drawing.
	Set up the pieces in specific position.
	Use the machine for shearing/bending or by hand.
	Carry out visual inspection correctness.
3. Form sheet metal to required shape and size by bending, seaming, forming, riveting, etc., using mallets, hammers, formers, sets, stakes, etc., or by various operations such as shearing, bending, beading, channelling, circle cutting.	Plan and mark on for forming operation.
	Select the tools required for the bending, seaming, forming, riveting operations like mallets, hammers, formers, sets, stakes, etc.
	Set the sheared plate properly on cutting table.
	Perform the bending, seaming, forming, riveting operations operation maintaining proper techniques and all safety aspects.
	Clean the job and inspect the cut surface for soundness of operation.
4. Perform different type of MS pipe joints by Gas welding (OAW).	Plan and prepare the development for a specific type of pipe joint.
	Mark and cut the MS pipe as per development.
	Select the size of filler rod, size of nozzle, working pressure etc.
	Set and tack the pieces as per drawing.
	Deposit the weld bead maintaining proper technique and safety aspects.
	Inspect the welded joint visually for poor penetration, uniformity of bead and surface defects.
5. Performs soldering, brazing operations on	Plan and select the nozzle size, working pressure, type of flame, filler rod and flux as per requirement.

sheet metal.	Prepare, set the pieces as per drawing.
	Braze/ solder the joint adapting proper brazing/soldering technique and safety aspect.
	Carry out visual inspection to ascertain quality weld joint.
6. Perform Arc welding, Gas welding TIG welding, MIG welding, spot welding on sheet metals.	Plan and prepare the pieces for welding.
	Select the type and size of filler rod and flux/electrode, size of nozzle and gas pressure/welding current, preheating method and temperature as per requirement. In case of arc welding, welding machine, electrode dis, ampere etc. In case of MIG welding select size of electrode wire, welding voltage, gas flow rate, wire feed rate as per requirement. In case of TIG welding Select power source as per material, size and type of Tungsten electrode, welding current, gas nozzle size, gas flow rate and filler rod size as per requirement.
	Set and tack sheets as per drawing.
	Deposit the weld maintaining appropriate technique and safety aspects.
	Cool the welded joint by observing appropriate cooling method. Use post heating, peening etc. as per requirement.
	Clean the joint and inspect the weld for its uniformity and different types of surface defects.
7. Makes sheet metal articles according to drawing or sample following safety precaution.	Prepare, set the pieces as per drawing.
	Selection of machine and material, marking, shearing/ bending.
	Set up the pieces in specific position.
	Perform the sheet metal joining operations operation maintaining proper techniques and all safety aspects.
	Carry out visual inspection to ensure quality of joint.
8. May work in different sheet metals such as tin, copper, brass.	Plan and select the metal and clean the surface thoroughly.
	Selection of machine and material, marking, shearing/ bending.
	Set up the pieces in specific position.
	Perform the sheet metal joining operations operation maintaining proper techniques and all safety aspects.
	Clean and inspect for quality.
9. Undertake Aluminium frame works.	Plan and select aluminium section like channels, rectangular tubes etc. specific type joint.
	Mark and cut the aluminium section as per development.
	Set up the pieces in specific position.

	Perform the Aluminium metal joining operations operation maintaining proper techniques and all safety aspects
	Carry out visual inspection to ensure quality of joint.
10. Make ducts, cabins & panels.	Prepare, set the pieces as per drawing.
	Selection of machine and material, marking, shearing/ bending.
	Set up the pieces in specific position.
	Perform the sheet metal joining operation maintaining proper techniques and all safety aspects.
	Carry out visual inspection to ensure quality of joint.
11. Undertake repair work of mudguard, Radiators etc.	Plan and mark on surface for repair work.
	Select the torch/nozzle size, current and working pressure of gas as per requirement.
	Perform the cutting operation by adapting proper techniques and safety aspects.
	Perform the proper joining operation.
	Clean and inspect for quality.

SYLLABUS FOR SHEET METAL WORKER TRADE			
DURATION: ONE YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Select sheet of required type, thickness (gauge) and size and mark it with scriber, square, divider, steel rule etc., according to drawing or sample following safety precautions.	1. Induction of training Familiarisation with the Institute, Importance of trade in Training Machines used in the trade. (12 hrs.) 2. Induction to safety devices used in shop floor. (13 hrs.)	General discipline in the institute Elementary of First aid Importance of the sheet metal work in the Industry. General safety precautions Safety precaution in sheet metal work. (07 hrs)
		3. Identification of Tools and Equipments Induction and use of marking tools. (8 hrs.) 4. Practice in Reading, Steel Rule, Scribing of straight lines, Bisecting of straight lines (on the sheet metal) using marking tools. (17 hrs.)	Metals and Non-Metals and their Characteristics, Types, Sizes and uses of Sheet Metals as per BIS. Use of reference table. Raw material information: CRCA, HRCA & MS Material Terms & definitions in sheet metal work. (07 hrs)
		5. Mark and cut through the straight lines Planishing of Sheet Metal. (6 hrs.) 6. Practice in drawing simple Geometrical shapes. (10 hrs.) 7. Practice in marking and cutting of sheets to various angles. (9 hrs.)	Marking and laying out tools and accessories Measuring Tools : steel Rule, calipers, try square, L square , Micrometer, Vernier caliper, Vernier height gauge, Combination set, screw pitch gauge, radius gauge, SWG, Bevel Protractor etc. Marking Tools: Scratch AWL, divider, Trammel point, punches etc. Cutting tools: Snips, shears, hacksaw, chisel, cutting plier, files, drills, tap & die sets etc. (07 hrs)
Professional	Shears or bends the sheet wherever	8. Practice on cutting with different types of snips. (10	Hand tools: mallets, hammer, sheet metal hammers,

Skill 25 Hrs; Professional Knowledge 07 Hrs	necessary by machine or hand shear.	hrs.) 9. Tin snips (Straight cut, Right cut and Left cut) cutting off inside and outside curve, cutting off notches and cutting off profiles. (15 hrs.)	groovers, riveting tools, screw drivers, wrench and spanners etc. Holding tools & accessories: vices, C clamps, stakes, stakes holder, hollow mandrel, wooden former, Jigs & fixtures, soldering bits etc. (07 hrs)
Professional Skill 125 Hrs; Professional Knowledge 35 Hrs)	Form sheet metal to required shape and size by bending, seaming, forming, riveting etc., using mallets, hammers, formers, sets, stakes, etc., or by various operations such as shearing, bending, beading, channelling , circle cutting.	10. Practice on Sheet Metal seams. "Grooved seam, Locked Grooved seam, Pane down seam, Bottom lock seam or Corner Fold (Knocked-up seam), Corner Clip Lock, Double Bottom Lock, Clip Lock (Cap Lock), snap Joint etc. (Folded Joints) and hemming practice. (18 hrs.)	Sheet Metal Folded Joints: Description of Sheet Metal Seam, Grooved seam, Locked Grooved seam, Paned down seam, Knocked up seam inside and outside, capstrip seam, pitsburg seam etc. (06 hrs)
		11. Forming rectangular shapes using stakes. (8 hrs.) 12. Forming Cylindrical job using various stakes such as Hollow Mandrel, Hatchet Stake; Tin Man's' Anvil stake etc. (12 hrs.)	Folding and joining allowances, edge stiffing, wiring allowances and false wiring, types of notches in sheet metal. (06 hrs)
		13. Folding, Bending Sheet Metal to 90 degree using wooden mallet, 'C' clamps etc. (4 hrs.) 14. Making a radius using Wooden blocks using Hairpin Folder. (4 hrs.) 15. Making a cylindrical container with knocked- up, bottom (Bottom Locked), Grooved Joint and hemmed Top. (5 hrs.) 16. Forming frustum of Cone. (4 hrs.) 17. Making of Mug, scoop, measuring can. (4 hrs.)	Definitions of pattern, Development, stretched out pattern, Master pattern (gross pattern) and templates Development of by parallel line method, radial line method. (06 hrs)

		18. Hemming (single, Double) wire edge by hand process. (4 hrs.)	
		19. Make a taper chute square to rectangle transition. (08 hrs.) 20. Make a taper chute square to round. (10 hrs.)	Development of surfaces: Triangulation method and geometrical construction methods. (06 hrs)
		21. Making holes with solid punches, round punches as per BIS. (08 hrs.) 22. Use of hollow punches making hole in sheet metal with help of wood block. (11 hrs.)	Solid and Hollow Punches. Description of hand punches as per BIS. Sizes of solid and hollow Punches and their uses. (06 hrs)
		23. Riveting practice using various types of rivet heads. (4 hrs.) 24. Single chain riveted joint. Double chain and Zig- zag, Lap & butt riveted joints Making a dust pan (Corner and handle riveted) (8 hrs.) 25. Making a fire bucket with lap riveted joint on one side and Locked Grooved Seam on the other side. (7 hrs.) 26. Bottom Hollowing and Bottom Lock Seam. (6 hrs.)	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) (05 hrs)
Professional Skill 150 Hrs; Professional Knowledge 42 Hrs	Perform different type of MS pipe joints by Gas welding (OAW).	27. Solder Lap joint. (12 hrs.) 28. Single plated solder butt joint.(13 hrs.)	Fastening of Sheet Metal: Self taping screws, Clips and Connectors; Their uses, Types and Allowance of 'S' Clips, Government Clips, Drive Clips, Mailing Clips etc. (07 hrs)
		29. Making oil Can by hand process by soldering. (12 hrs.) 30. Making funnel by soldering process.(13 hrs.)	Solder, Different types of solder and their composition. Types and uses of fluxes, their effect on different metal. (07 hrs)
		31. Make by soldering:- • Elbow 90° equal dia pipe.	Process of soft soldering, hard soldering (brazing).

		(7 hrs.) • T joint 90° equal dia pipe. (9 hrs.) • T joint 90° unequal dia pipe by soldering. (9 hrs.)	Heating appliances (Hand Forge, Blow Lamp, L.P.G.) (07 hrs)
		32. Make by soldering:- T Pipe 60°branch joint unequal dia pipe Offset T joint equal dia. (25 hrs.)	Development & laying out pattern of elbow pipe, T pipe and offset pipe in equal diameter. (07 hrs)
		33. Make a taper lobster back bend 90 degree from oblique cone by soldering. (25 hrs.)	Development of T pipe, round equal and unequal. Introduction to tubes and pipes. (07 hrs)
		34. Forming square section segmental quarter bend pipe with suitable lock and forming round section segmental quarter bend pipe. (25 hrs.)	Laying out pattern of 600 off-set 'T' pipe. Pattern Development of 'Y' pipe. Preparation of pickling solution. Protection-Coating, Cleaning and preparing of Sheet Metals Corrosion and anti corrosion treatment of sheet metal. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Perform soldering, brazing operations on sheet metal.	35. Making a square duct elbow with snap block. (25 hrs.)	Method of galvanizing, tinning, anodising, sheradising and Electroplating. (07 hrs)
		36. Make a conical hopper by soldering. (25 hrs.)	Development and laying out of pattern of segmental quarter bend pipe. (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Perform Arc welding, Gas welding , TIG welding & MIG welding and Spot welding on sheet metals	37. Setting up of Oxy-acetylene plant and types of flames. (25 hrs.)	Need for ducting. Places where ducting is employed and the working principle of a dust cyclone, Gutter and its use. False ceiling. (07 hrs)
		38. Setting up of Arc welding plant and striking & maintaining the arc & laying short beads. (25 hrs.)	Safety precaution in gas & arc welding Description of Oxyacetylene plant and the equipments, accessories & tools. (07 hrs)
		39. Fusion run with/without filler rod in flat position. (12 hrs.)	Types of oxy-acetylene flames & its uses. Types and description of flux. Types of

		40. Square butt joint in flat position by gas. (13 hrs.)	welding blow pipes & its functions. (07 hrs)
		41. Brazing copper sheet in lap joint in flat position. (25 hrs.)	Various types of pipe joints. Method of metal preparation & cleaning them base metal before welding. Gas welding defects causes & remedies. Arc welding defects causes & remedies. (07 hrs)
Professional Skill 175 Hrs; Professional Knowledge 49 Hrs	Make sheet metal articles according to drawing or sample following safety precaution.	42. Importance of machinery used in the trade. (5 hrs.) 43. Types of job made by the trainees in trade. (8 hrs.) 44. Introduction to machinery safety including fire fighting equipment and their uses etc. (12 hrs.)	Importance of the trade in the development of Industrial Economy of the Country. Review of Types of sheet metal Fabrication. Methods of developments. (05 hrs)
		45. Locked groove joint by aluminum sheet. (8 hrs.) 46. Single riveted lap joint by aluminum sheet. (8 hrs.) 47. Double strap single row riveted butt joint by aluminum sheet. (9 hrs.)	Introduction to Aluminum fabrication, and its applications. Ferrous and Non-Ferrous metals. Use of Copper and Alloys. Laying out pattern of conical elbows. Pattern development of lobster back bend. Chemical and Physical properties of Aluminium. Use of Aluminium and its Alloys. (07 hrs)
		48. Exercise involving practical work on Aluminium Sheet, and using Pop Rivet. (6 hrs.) 49. Aluminium Windows with different extruded sections, Aluminium Soldering. (10 hrs.)	Brief Description of hand punch machine. Hand and Power operated drilling Machines. Drill Bits, parts and effects of cutting angles. Angles for Drilling Sheet Metals, effect of speed, Feed Cutting Fluids, etc., on metals. Difference between drilled and punched holes. (07 hrs)
		50. Making holes in sheet metal using Punching Machine. (4 hrs.) 51. Making holes in sheets with	Description of swaging and beading machine, its parts, operating principles etc. Description of Fly Ball press.

		a twist drill. (5 hrs.) 52. Tri-paning with use of hand and electric drilling machine. Grinding a drill bit. (5 hrs.) 53. Practice in Drilling Holes in walls and Ceilings as applied to ducting work. (6 hrs.) 54. Use of rawl bits and rawl plug. (5 hrs.)	Operating Principles of Power Press and press brakes. Method to calculate the pressure adjustment. Clearance between Die and Punch. Introduction to "C" and "H" frame presses. (07 hrs)
		55. Practice on hollowing and rising on non-ferrous sheet as well as ferrous sheet. (08 hrs.) 56. Practice on removing dents of spherical or hemi-spherical articles using wheeling and raising machine. (Repairing mud guards etc.) (10 hrs.)	Properties of stainless steel and its uses. Properties and uses of tin, lead, zinc and silver. Description and Physical properties of Muntz Metal, Gun Metal, White Metal etc. (05 hrs)
		57. Practice on pipe bending by hand. (5 hrs.) 58. Pipe bending using Hydraulic Pipe bending' machine. (5 hrs.) 59. Development of a cone: Cylinder fitted to a cone. (8 hrs.) 60. Equal dia pipe joint with crimping and Ogee beading. (5 hrs.)	Introduction to pipe/tube bending. Brief description of Hydraulic pipe bending machine. Operating Principles etc. Description of roll forming machine types and operating principles, description of slip roll forming machine and its function. (05 hrs)
		61. Practice on external threading using "Die stock". (5 hrs.) 62. Practice on internal threading using taps. (5 hrs.) 63. Typical folding, Bending Practice, Making Steel-Racks, Reinforcement with angle iron. (10 hrs.) 64. Use of self taping screws and other fasteners. (5 hrs.)	Use of Die and Die Holder, Description of taps and tap wrench. (06 hrs)

		65. Project work such as Steel Stool, Aluminium Ladder etc. (08 hrs) 66. Metal Spinning: Making a cylindrical medicine container of Aluminium Sheet. (10 hrs.)	Method to operate folding/brake folder for typical folding. Description and use of jigs and fixtures. (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Plan & work in different sheet metals such as tin, copper, brass.	67. Making a Copper article by use of power press and also making brass and stainless steel articles. (13 hrs.) 68. Practice of Buffing and polishing. (12 hrs.)	Definition of Planishing and its application. Brief description of polishing machine. Various types of bobs and polishing compounds. (07 hrs)
		69. Angle iron bending in different angles and different radii. (13 hrs.) 70. Twisting the M.S. square rod and flats. (12 hrs.)	Operating principles of spinning lathe. Description of spinning. (07 hrs)
		71. Gas welding Square butt joint on M.S. sheet in down hand position Fillet Tee& Lap joint on M.S sheet in down hand position. (25 hrs.)	Different process of metal joining types of weld joint &weld positions. Oxy-acetylene welding equipments & application, Types of flame& their uses. (07 hrs)
		72. Pipe butt joint in down hand position. (8 hrs.) 73. Butt joint on MS flat in down hand position by arc. (8 hrs.) 74. Fillet lap and T joint on MS flat in down hand position. (9 hrs.)	Principle of arc welding. Types of welding machines and their uses. Advantages and disadvantages of AC/DC welding machines. Arc length and its importance Welding defects. (07 hrs)
Professional Skill 125 Hrs; Professional Knowledge 35 Hrs	Perform Arc welding, Gas welding , TIG welding & MIG welding and Spot welding on sheet metals	75. Resistance welding. Spot welding, seam welding. (25 hrs)	Principle of resistance welding. Types and applications. Welding symbols. (07 hrs)
		76. Co2 welding. Deposit bead on MS sheet in flat position. (12 hrs) 77. Lap joint T joint and butt joint in down hand position. (13 hrs)	Introduction to CO2 welding process. Welding equipments and accessories. Advantages and application of CO2 process. (07 hrs)

		78. TIG welding. Deposit bead on SS sheet in flat position. Making butt, Tee and corner joint. (25 hrs.)	TIG welding process. Advantages. Description of equipments. Types of polarity and application. (07 hrs)
		79. TIG welding. Deposit bead on Aluminium sheet in flat position. (12 hrs.) 80. Making butt, Tee and corner joint. (13 hrs.)	Types of Tungsten Electrodes, Filler rods, Shielding Gases. Defects, causes and remedy in TIG welding process. (07 hrs)
		81. MS/SS pipe butt and Y joint by TIG welding process. (25 hrs.)	Latest sheet metal cutting techniques: Plasma cutting, Laser cutting, water jet cutting and punching etc. (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Undertakes Aluminium frame works. Makes ducts, cabins & panels.	82. Make models of Aluminium sliding windows and doors. (13 hrs.) 83. Partitions of mini model rooms by using aluminum channels beadings etc (8 hrs.) 84. Electrical Panel, trunk boxes & ducts fabrication and Painting. (4 hrs.)	Specification of aluminium channels angles, strips, tubes beadings, packing rubber, cardboard, glasses etc. Tools and equipments used in aluminium fabrication. Assembly & Sub assembly: Gaurding assembly, Door assembly, Chassis assembly, Cabinet assembly, Power pack assembly etc. Process of painting. Spray painting. Etch primer painting, Powder coating, buffing, grinding, and sanding. Selection of different grit sizes. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Undertake repair work of mudguard, Radiators etc.	85. Special Exercises: Repairing Mudguard and Radiators and testing of Sheet metal containers. (25 hrs.)	Types of Radiators and construction of Radiators, Mufflers, Estimation of work. (07 hrs)
		86. Any Special Exercises: Repairing Blocked Silencer and fuel tank. (25 hrs.)	Material handling: handling of light, medium and heavy materials. Use of cranes and types. Estimation and costing. (07 hrs)
Industrial training / Project work			

SYLLABUS FOR CORE SKILLS
1. Workshop Calculation & Science(Common for one year course) (80Hrs)
2. Engineering Drawing (80Hrs)
3. Employability Skills(Common for all CTS trades) (160Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in.

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
SHEET METAL WORKER (For Batch of 20 Candidates)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOLS KIT			
1.	Steel Rule	300 mm	20 +1 Nos.
2.	Wing Divider	200 mm	20 +1 Nos.
3.	Centre Punch	100 mm	20 +1 Nos.
4.	Spring Dividers	150 mm	20 +1 Nos.
5.	Ordinary Wooden Mallet		20 +1 Nos.
6.	Soldering Copper Hatchet Type	0.25 kg	20 +1 Nos.
7.	Cross Peen Hammer	0.25 kg with handle	20 +1 Nos.
8.	Protractor with blade	150mm	20 +1 Nos.
9.	Steel tape	2 metres	20 +1 Nos.
10.	Ballpen hammer	0.5kg with handle	20 +1 Nos.
11.	Scriber	150 mm x 3 mm (Engineer's)	20 +1 Nos.
12.	Prick punch	100mm	20 +1 Nos.
B. GENERAL SHOP OUTFIT			
13.	Steel Square	450 mm x 600 mm	4 Nos.
14.	Sheet Metal Gauge		1 No
15.	Hatcher Stake		4 Nos.
16.	Stake Round and Bottom		4 Nos.
17.	Half Moon Stake		4 Nos.
18.	Funnel Stake		4 Nos.
19.	Anvil Face Stake		4 Nos.
20.	Bick Iron Stake		4 Nos.
21.	Tinman's Horse		2 Nos.
22.	Hammer Peaning with handle		4 Nos.
23.	Hammer Creasing with handle		4 Nos.
24.	Hammer Planishing with handle		4 Nos.
25.	Hammer Block with handle		2 Nos.
26.	Shear Tinman	300mm	8 Nos.
27.	Snip straight		8 Nos.
28.	Right cut snips	250mm	4 Nos.
29.	Left cut snips	250mm	4 Nos.
30.	Hand Shear Universal	250 mm	4 Nos.
31.	Hollow Punch set Round	3 mm Dia	2 Nos.

32.	Rivet sets snap and Dolly combined	3 mm	4 Nos.
33.	Chisel cold flat	25 mm x 250 mm.	4 Nos.
34.	Punch Letter	4 mm	1 set
35.	Punch Number	4 mm	1 set
36.	File flat	250 mm second cut	2 Nos.
37.	File flat	250 mm smooth	2 Nos.
38.	File flat	300 mm bastard	2 Nos.
39.	File half round	300 mm smooth	2 Nos.
40.	Hacksaw frame	300 mm adjustable (Tubular)	4 Nos.
41.	Hand Groover	5 mm	4 Nos.
42.	Plier. Combination	150 mm	2 Nos.
43.	Grip Wrench	200 mm	2 .Nos.
44.	Ladle	150 mm Dia.	2 Nos.
45.	Blow Lamp	1 litre.	2 Nos.
46.	H.S.S. Twist Drill	3 mm, 4 mm & 6 mm each (parallel Shank)	3 Nos.
47.	Hand Drill machine	0 to 12 mm	2 Nos.
48.	Soldering Copper Hatchet type	500 gms.	8 Nos.
49.	Pneumatic rivet gun		2 Nos.
50.	Trammel Point	with beam 600 mm	1 No.
51.	Vernier caliper	0 mm - 150 mm	1 No
52.	Micrometer Outside	0 to 25 mm	1 No.
53.	File Rasp cut	250 mm	2 Nos.
54.	D.E. Spanner G.P. (Set of 12 spanner)	6 mm to 32 mm	2 Set
55.	Bossing Mallet		4 Nos.
56.	End tacked Mallet		4 Nos.
57.	Soft hammer (Brass, copper,Lead)		4 Nos.
58.	Steel Rule	600mm	4 Nos.
59.	Oilcan pressure feed	500ml	2Nos.
60.	Raising hammer with handle		4 Nos.
61.	Rawl Punch holder and bits (No.8, 10, 12, 14)		2 Sets.
62.	Hollowing Hammer with handle		4 Nos.
63.	Tripaning tool	70 mm	1 No.
64.	Hand vice	50 mm	4 Nos.
65.	Tongs Flat		2 Pairs.
66.	Portable Electric drill (Single phase) -6mm		2 Nos.
67.	Pop rivet gun		2 Nos.
68.	Lazy Tong		2 Nos.
69.	Screw Driver	250 mm	2 Nos.
70.	Round File	2nd Cut 250 mm	4 Nos.

71.	Triangular File 'Smooth	250 mm	4 Nos.
72.	Square File	2nd Cut 250 mm.	4 Nos.
73.	Needle File (Swiss File)	150 mm	1 set
74.	C Clamp	150 mm	2 Nos.
C. GENERAL INSTALLATION			
75.	Bench leaver shears	250 mm Blade x 3mm Capacity	1 No.
76.	Air Compressor (Pressure and displacement of air) Pneumatic Pop rivet Gun		1 No.
77.	Spray Gun(painting)	500 ml.	1 No.
78.	Combination turning up and wiring machine		1 No.
79.	Guillotine. Shearing Machine foot operated		1 No.
80.	Oxy acetylene welding plant (complete set)		1 set
81.	Circle cutting machine	300 mm dia	1 set
82.	Pillar type drilling machine	12 mm	1 No.
83.	Slip roll former	1.6. mm x 1000 mm	1 No.
84.	D.E. Grinder Pedestal motorised	200 mm	1 No.
85.	Anvil	50 kgs with Stand	1 No.
86.	Bench vice	120 mm, 150 mm	2 each
87.	Fly press Ball press No.4 single body		1 No.
88.	Power Press 2 Tons		1 No.
89.	Buffing and Polishing Machine		1 No.
90.	Nibbling Machine		1 No.
91.	Spinning Lathe		1 No.
92.	Seaming Machine		1 No.
93.	Glass cutter - Diamond point		1 No.
94.	Work Bench	1820 x 1310 x 760 mm	4 Nos.
95.	Almirah	1820 x 1210 x 450 mm	2 Nos.
96.	Metal rack	1820 x-1520 x 450 mm	2 Nos.
97.	Steel Lockers with 8 Drawers.		2 Nos.
98.	Fire extinguisher Soda Acid and foam type		1 each
99.	Fire buckets with Stand-		4 Nos.
100.	Black Board with Easel.		1 No.
101.	Wooden Stool	450.mm.	1 No.
102.	Portable Nibbler		2 Nos.
103.	Portable Pneumatic Shear.		2 Nos.
104.	Pipe Bending Machine (Hydraulic Type)	12 mm to 30 mm	1 No.
105.	Hand Press Brake Capacity	0.8 mm	1 No.
106.	Beading Machine with 380 mm throat clearance (with crimping rollers)		1 No.

107.	Tin smiths bench folder	600 x 1.6 mm	1 No.
108.	Gas Welding Table	1220 mm x 760 mm	1 No.
109.	Spot & Seam Welding Machine		1 No each.
110.	Arc welding Transformer/ Rectifier/Inverter 300 Amps with accessories		1 set
111.	Co_2 welding machine complete set	300Amps	1 set
112.	TIG welding machine complete set	200 Amps	1 set
113.	Universal cutting machine		1 No.
D. CLASS ROOM FURNITURE FOR TRADE THEORY			
114.	Instructor's table and Chair (Steel)		1 Set
115.	White magnetic board	1200mm X 900 mm	1 No.
116.	Instructors lap top pre-loaded with O.S and MS Office package	With latest configuration	1 No.
117.	LCD projector with screen		1 No.

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*

ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert members participated in preparation of course curriculum of Sheet Metal Worker trade			
S No.	**Name & Designation Shri/Mr./Ms.**	**Organization**	**Remarks**
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2.	Dr.K. Ashokkumar, AGM	BHEL, Trichy	Member
3.	Prof. Jyothi Mukhopadhya	IIT, Ahmedabad	Member
4.	B. Pattabhiraman, MD	GB Engineering, Tricgy	Member
5.	Dr. Rajeev kumar	IIT, Mandi	Member
6.	Dr. Vishalchauhan	IIT, Mandi	Member
7.	D.K. Singh	IIT, 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
MENTOR			
11.	Deepankar Mallick, DDG (C&P)	DGT Hq,	Mentor
MEMBERS OF CORE GROUP			
12.	M Thamizharasan, JDT	CSTARI, Kolkata	Member
13.	M Kumaravel, DDT	FTI , Bangalore	Team Leader
14.	Sushil Kumar, DDT	DGTHq,	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, Ludhiyana	Member
19.	Gopalakrishnan, TO	NIMI, Chennai	Member
20.	Balachandranachari A.V, Principal	ITI, Kottayam, Kerala	Member
21.	Pazhanimurugan. P, JTO	GITI, K.G.F. Karnataka	Member

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprentice Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्